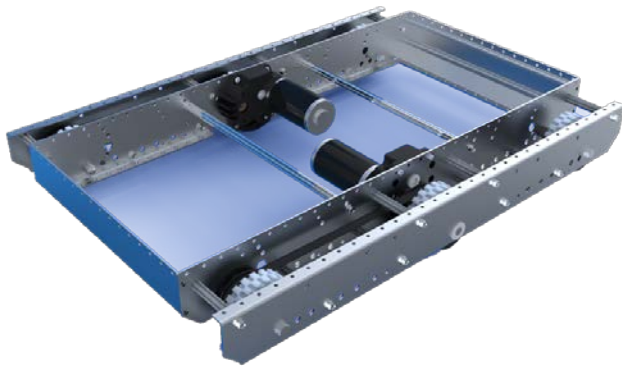




User Guide



AM14U Drive System for the 2014 FIRST Robotics Competition



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AndyMark – Your Robot Parts Experts

AndyMark, Inc. was founded in 2004 by Andy Baker and Mark Koors to design and sell unique mechanical parts for competition and educational robotics. Through their volunteer work with the *FIRST* Robotics Competition (FRC), they identified a niche market and began designing and selling robotics components for *FIRST* teams. At that time, many designs were being shared and re-created, but finding the correct fabrication resources for these parts was difficult for some FRC teams. AndyMark has been a proud supplier to the FRC program since 2005.

Andy and Mark have been mentors in the *FIRST* Robotics Competition (FRC) since 1998. Together Mark and Andy have over 60 years of engineering experience. In addition, the AndyMark team of engineers is comprised of *FRC* team alumni and mentors with many years of *FRC* experience. They are currently active *FRC* Team mentors and serve as key volunteers at Regional and off-season *FIRST* events. This team of engineers is dedicated to providing high quality products and excellent customer service.

System Overview

The 2014 AM14U Drive System is designed for use in the 2014 *FIRST* Robotics Competition (FRC). The AM14U Drive System includes standard AndyMark products:

- AM14U Drive Chassis Frame (am-2597)
- 2 - Toughbox Mini 8.45:1 Gearboxes (am-2598)
- 6 - 4" HiGrip Wheels (am-2256)

All of these parts are provided in kit form. Assembly instructions can be found in this manual and online. CAD files and more detailed layout drawings can be found on the "[AndyMark.com/KOP](http://www.andymark.com/KOP)" webpage.

Additional Instructions Available

We encourage customers to seek product information at **www.andymark.com**, contact us via e-mail at **sales@andymark.com**, or call Toll-Free **877-868-4770** with questions about any of our products. Best of luck to all the *FIRST* Teams in the 2014 *FRC* season!

Detailed assembly tips and instruction videos can be found on the [AndyMark YouTube channel](http://www.andymark.com/KOP). Additional resources are available on the "<http://www.andymark.com/KOP>" web page.

Wheel Assembly Bill of Materials

Component	Part Number	Quantity	Part Photo
4" HiGrip Wheel	am-2256	6	
500EX Hex Hub	am-2568	2	
Gates HTD 15mm wide, 131T	am-2571	4	
Gates HTD 15mm wide, 170T	am-2570	4	
Pulley Kit			
Pulley, 42 Tooth	am-2234-half	16	
Screw Kit			
10-24 x 1.25 Thread Forming Screws	am-1266 sold as pkg: am-1278	48	
Bearing Kit			
1614ZZ Bearing	am-0209	8	
FR8ZZ-Hex Bearing	am-0279	2	

Toughbox Mini Overview

Each FRC team receives two Toughbox (TB) Mini Gearboxes ([am-2598](#)) unassembled. Each TB Mini includes the parts to mount up to two 2.5" CIM motors ([am-0255](#)). Each gearbox has mounting holes for optional encoders.

Gearbox Specifications

- Gear Profile: 20 dp, 14.5 degree pressure angle
- Gear Material: Cold-formed 4140 Steel
- Gear Ratio: 8.45:1
 - CIM Gear: 14 Tooth (8mm bore w/ 2mm keyway)
 - Large Cluster Gear: 50 Tooth (3/8" Hex bore)
 - Small Cluster Gear: 19 Tooth (3/8" Hex bore)*
 - Large Output Gear: 45 Tooth (1/2" Hex bore)*
- Output Shaft: 1/2" Hex, 4140 Steel
- Housing Material: Nylon 6/6 with long fiber reinforcements






*To change the speed of the AM14U, different gear ratios can be used in the Toughbox Mini. The AM14U features a center wheel directly driven by a TB Mini Hex Output Shaft. To change the ratio and drive speed, the standard 19 tooth Small Cluster Gear and 45 tooth Large Output Gear will need to be replaced with two gears totaling 64 teeth.

More information about these optional gears can be found at "[AndyMark.com/TBmini](#)".

Ratio	CIM Gear	Lg. Cluster	Sm. Cluster	Lg. Output	AM14U Speed**
5.95:1	14T (am-0034)	50T (am-0149)	24T (am-0177)	40T (am-0178)	12.1 ft/sec
7.31:1	14T (am-0034)	50T (am-0149)	21T (am-2564)	43T (am-2565)	9.8 ft/sec
8.45:1 (Included)	14T (am-0034)	50T (am-0149)	19T (am-0176)	45T (am-0179)	8.5 ft/sec
10.71:1	14T (am-0034)	50T (am-0149)	16T (am-0747)	48T (am-0885)	6.7 ft/sec
12.75:1	14T (am-0034)	50T (am-0149)	14T (am-0151)	50T (am-0150)	5.6 ft/sec

**AM14U speed estimation is based on calculations using 4" wheels, and one CIM motor per TB Mini running at 4100 rpm, or 75% of free speed.

Toughbox Mini Bill of Materials

Component	Part Number	Quantity	Part Photo
TB Mini Housing	am-0650	1	
TB Mini Hex Output Shaft	am-2566	1	
TB Mini Small Hex Shaft	am-0152	1	

TB Mini Kit 1 – Gears			
50 Tooth, 3/8" Hex Gear	am-0149	1	
14 Tooth, 8mm CIM Gear	am-0034	2	
19 Tooth, 3/8" Hex Gear	am-0176	1	
45 Tooth, 1/2" Hex Gear	am-0179	1	
TB Mini Kit 2 – Bearings			
R6ZZ Bearing	am-0516	2	
FR6ZZ Bearing	am-0028	1	
FR8ZZ-Hex Bearing	am-0279	1	
TB Mini Kit 3 – CIM Hardware			
2x2x10mm Machine Key	am-1121	2	
5/16" Washer	am-1009 sold as pkg: am-1279	4	
8mm Retaining Clip	am-0033	2	
10-32 x 0.625" SHCS with Yellow Patch	am-1120 sold as pkg: am-1246	4	
TB Mini Kit 4 – TB Hardware			
10-32 x 0.75" SHCS	am-1047 sold as pkg: am-1280	4	
10-32 Nylock Nut	am-1042 sold as pkg: am-1211	4	
Grease Pack	am-0908	4	
1/2" E-Clip Ring	am-0206	1	

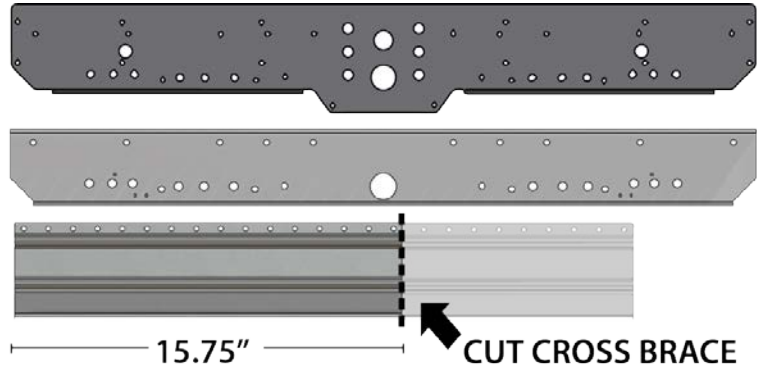
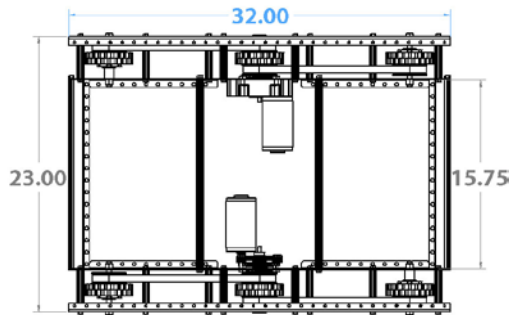
AM14U Chassis Frame Bill of Materials

Component	Part Number	QTY	Part Photo
AM14U Inner Plate	am-2567	2	
AM14U Outer Plate	am-2572	2	
AM14U Cross Brace Extrusion, 24.75"	am-2573	2	
500 Churro, 24.75"	am-2595	2	
500 Churro, 3.375"	am-2569	16	
Chassis Kit 1 – Support Screws			
1/4-20 x 0.75" Thread Rolling Screw	am-1310 sold as pkg: am-1321	44	
Chassis Kit 2 – Axle Bolts			
3/8-16 x 4.25" HHS Bolt	am-1297	4	
3/8-16 Nylock Nut	am-1054	4	
Chassis Kit 3 - Spacers			
0.583" Hex Spacer	am-1305	2	
0.280" Plastic Spacer	am-1306	4	
0.850" Plastic Spacer	am-1307	4	

AM14U Frame Diagrams & Cut Lines:

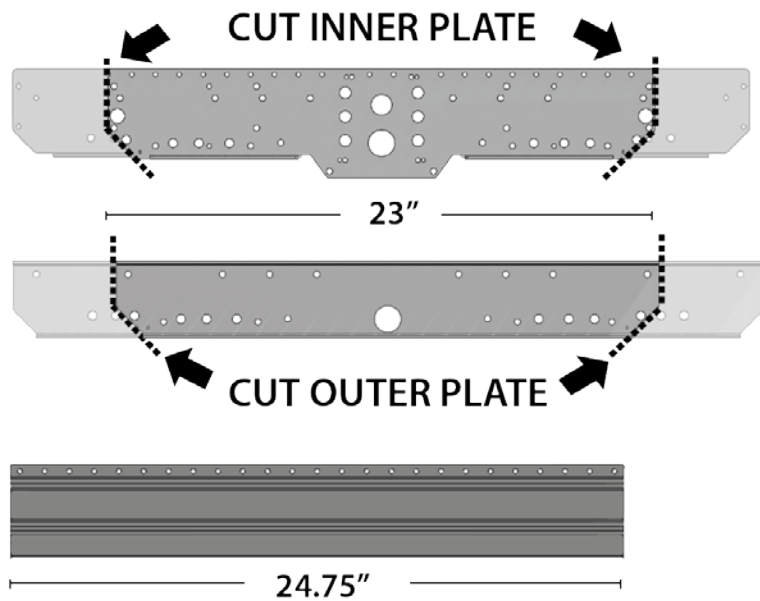
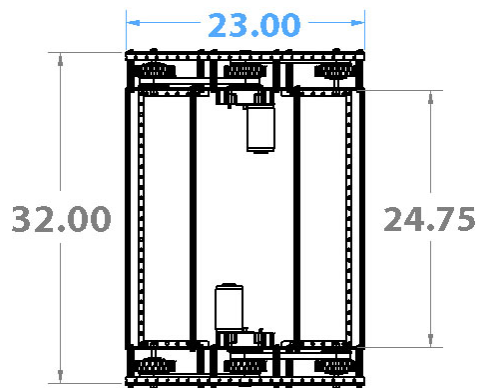
The AM14U is designed for two configurations: **Long** or **Wide**. Chassis pieces **must be measured** and cut down to size. The following shows where to cut the braces and plates for each configuration.

LONG CHASSIS

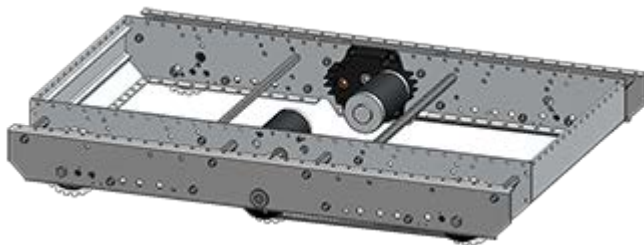


CUT CROSS BRACE

WIDE CHASSIS



Note: Small holes on Inner and Outer Plates should be used as cutting guides.



LONG CHASSIS

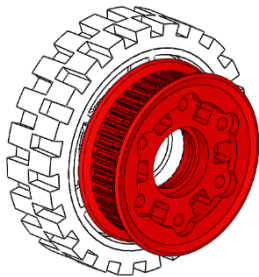


WIDE CHASSIS

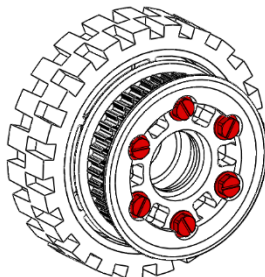
4" HiGrip Wheel and Pulley Assembly Instructions

Outer Wheels (QTY 4)

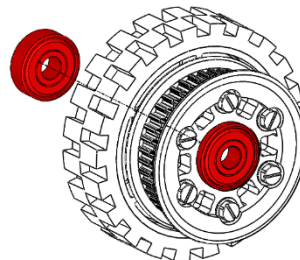
Step 1: Add two pulley halves (am-2234-half) to the wheel (am-2256).



Step 2: Using six 10-24 x 1.25" (am-1266) thread forming screws attach the pulley halves to the wheel.



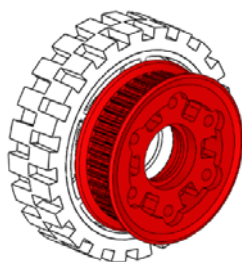
Step 3: Press two 1614ZZ Bearings (am-0209) into each side of the wheel/pulley.



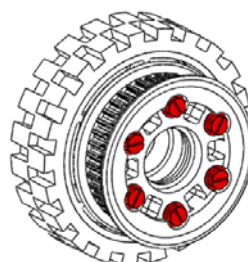
4X

Center Wheels (QTY 2)

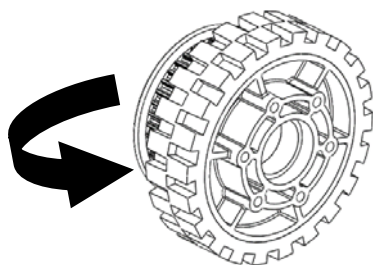
Step 1: Add two pulley halves (am-2234-half) to the wheel (am-2256).



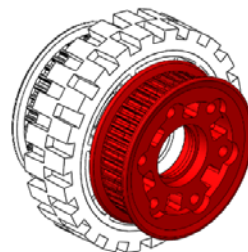
Step 2: Using six 10-24 x 1.25" (am-1266) screws attach the pulley halves to the wheel.



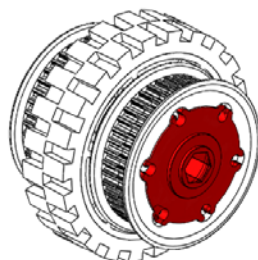
Step 3: Flip wheel over.



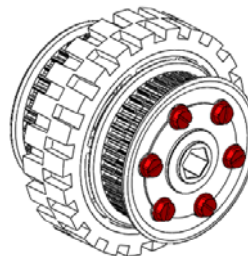
Step 4: Add two more pulley halves (am-2234-half) to the wheel.



Step 5: Insert one 500EX Hex Hub (am-2568) into the pulley on one side of the wheel.



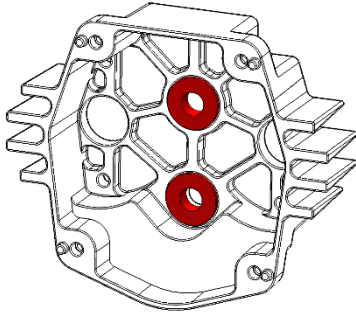
Step 6: Add six 10-24 x 1.25" (am-1266) screws to secure the pulley and hub to the wheel.



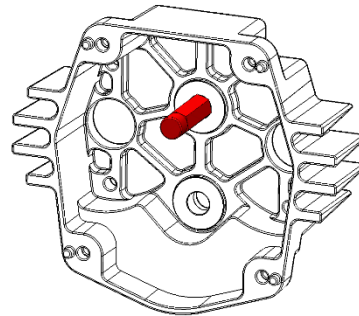
2X

Toughbox Mini & Chassis Assembly Instructions

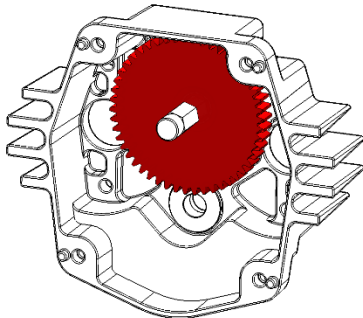
Step 1: Press two R6ZZ bearings (am-0516) into the two center holes of the TB Mini Housing (am-0650).



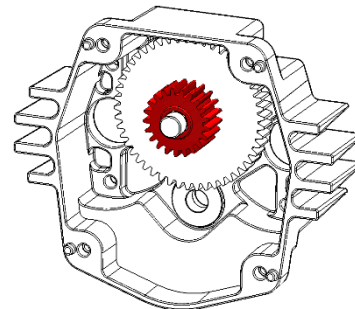
Step 2: Insert TB Small Hex Shaft (am-0152) into R6ZZ bearing closest to the flat edge of the housing.



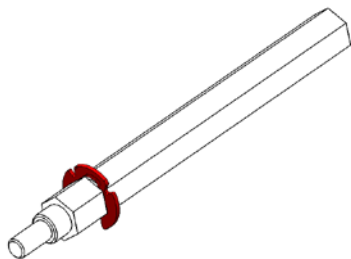
Step 3: Place 50 tooth gear (am-0149) on the TB Small Hex Shaft with **flat side up**.



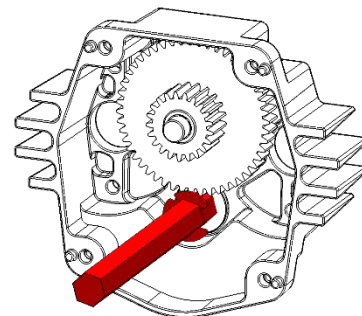
Step 4: Place 19 tooth gear (am-0176) on the TB Small Hex Shaft with **flat side down**.



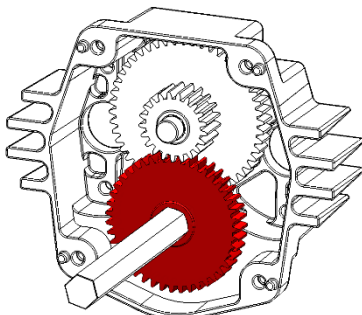
Step 5: Tap the ½" E-Clip (am-0206) onto the groove on the TB Hex Output Shaft (am-2566).



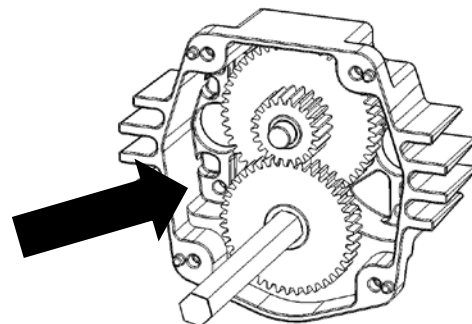
Step 6: Insert small end of the TB Hex Output Shaft (am-2566) into the other R6ZZ bearing.



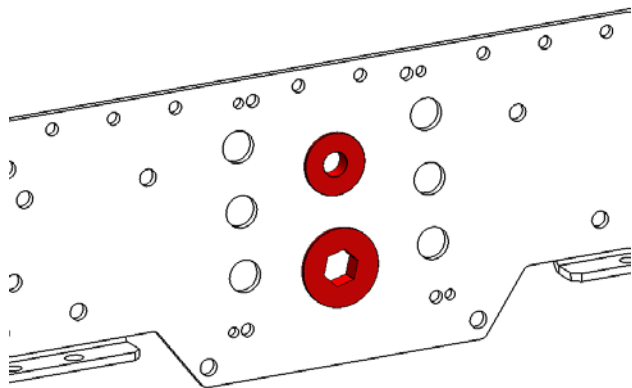
Step 7: Place 45 Tooth Gear (am-0179) on TB Hex Output Shaft **flat side down**.



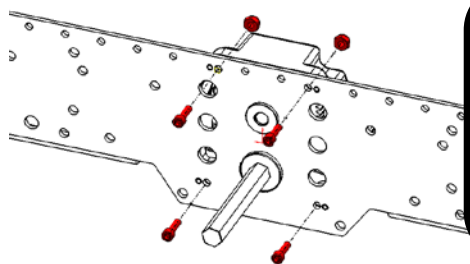
Step 8: Use all four Grease Packs (am-0908) and apply grease to all of the gear teeth.



Step 9: Press FR6ZZ (am-0028) and FR8ZZ-HEX (am-0279) bearings into center holes on the Inside Plate (am-2567) with the **bearing flanges on the same side** as the bottom flange.



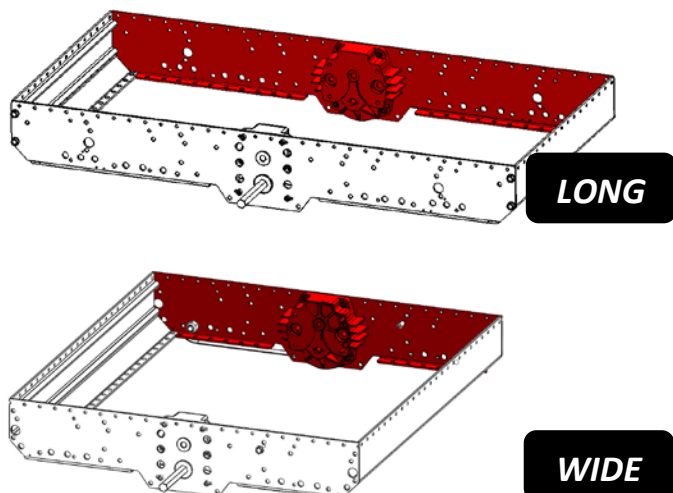
Step 11: Attach TB Mini Gearbox to Inner Plate with four 10-32 x 0.75" Bolts (am-1047) and four 10-32 NyLock nuts (am-1042). The nuts will fit into the hex pockets on the TB Mini housing.



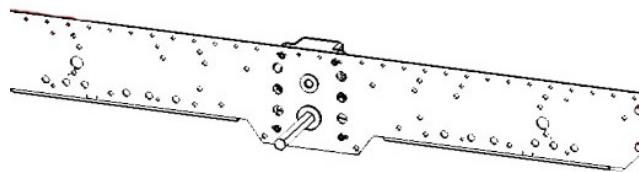
Note: The gears should spin freely when the output shaft is rotated by hand.

Repeat steps 1-11 for second gearbox

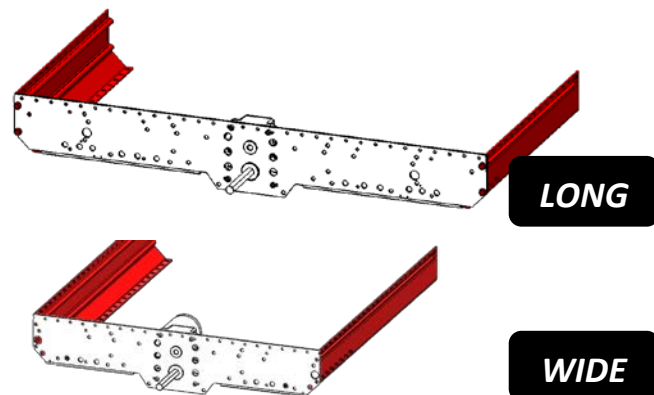
Step 13: Attach second TB Mini assembly to Cross Brace Extrusions with four 1/4-20 x 0.75" Thread Rolling Screws (am-1310).



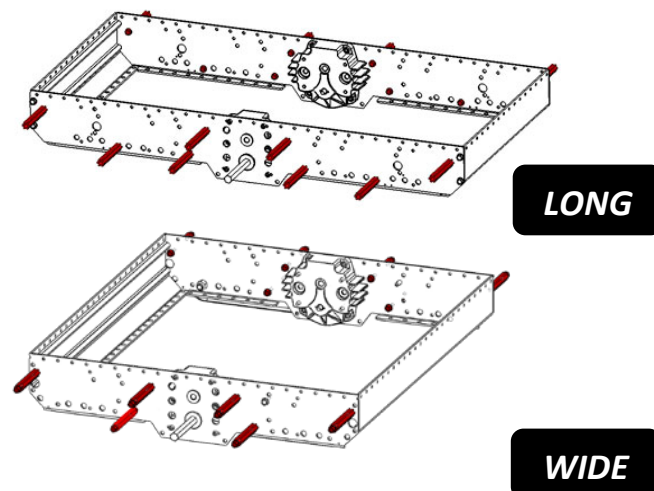
Step 10: Place Inner Plate with bearings onto the gearbox using the plastic locating studs. The flanged edge of the plate should be facing towards the gearbox housing.



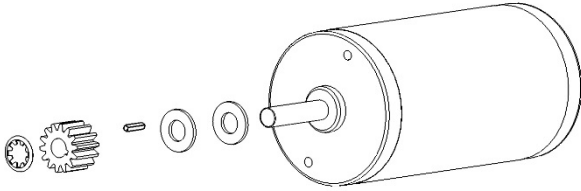
Step 12: Using four 1/4-20 x 0.75" Thread Rolling Screws (am-1310) attach the Cross Brace Extrusions (am-2573).



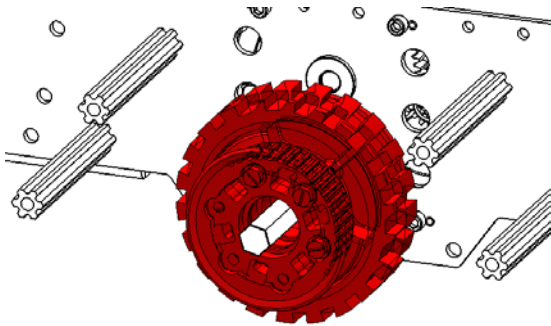
Step 14: Attach sixteen (long chassis) **OR** twelve (wide chassis) 500 Churro, 3.375" (am-2469) with 1/4-20 x 0.75" Thread Rolling Screws (am-1310). Use diagrams below for suggested locations.



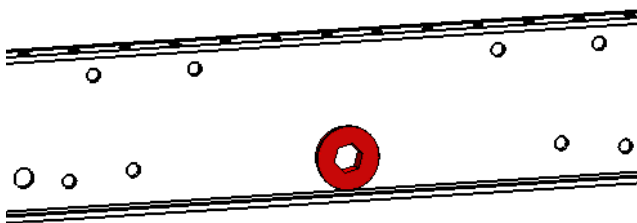
Step 15: Place the two 5/16" Washers (am-1009) onto the CIM Motor shaft. Place the 2x2x10mm Machine Key (am-1121) into the keyway. Push the 14 Tooth, 8mm CIM Gear (am-0034) onto the shaft, to the face of the washers, while aligning the keyway with the Machine Key. Use a 3/8" socket to press the 8mm Retaining Clip (am-0033) onto the shaft against the face of the gear.



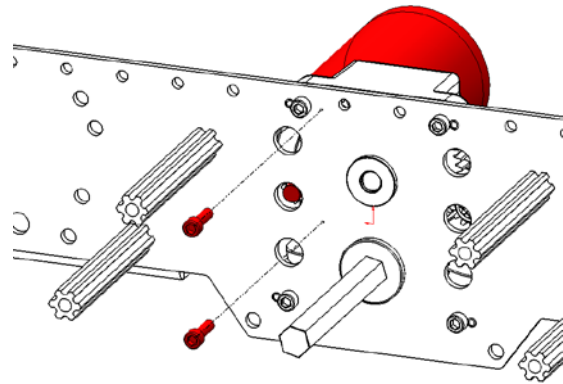
Step 17: Place a Center Wheel Assembly on to the TB Hex Output shaft with the 500EX Hex Hub side facing towards the inner plate.



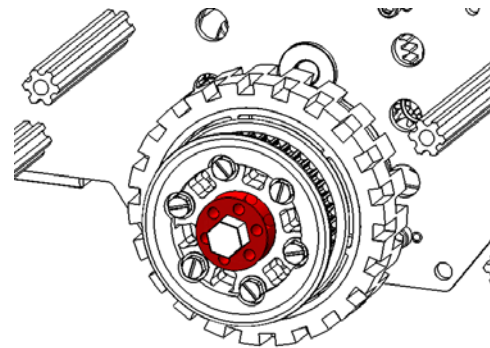
Step 19: Press the FR8ZZ-Hex Bearing (am-0279) into the center hole of the Outside Plate (am-2572) with the **bearing flanges on the same side** as the bottom flange.



Step 16: Line up the CIM motor with the two mounting holes in the TB Mini. The housing can be used to locate and center the motor. Secure the CIM motors to the TB Mini with two 10-32 x 0.625" SHCS w/ Yellow Patch (am-1120).

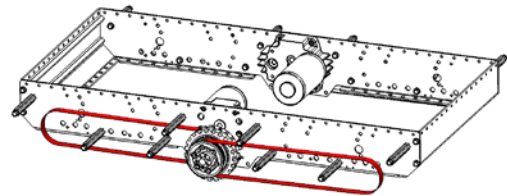


Step 18: Place the 0.583" Hex Spacer (am-1305) onto the TB Hex Output shaft into the pulley. Make sure the spacer is **fully seated in the pulley**.

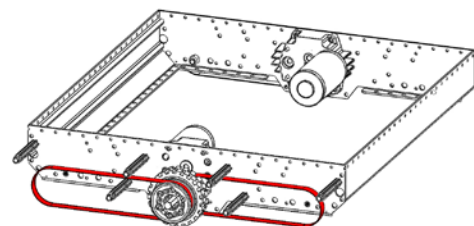


Step 20: Add two belts around the center wheel assembly.

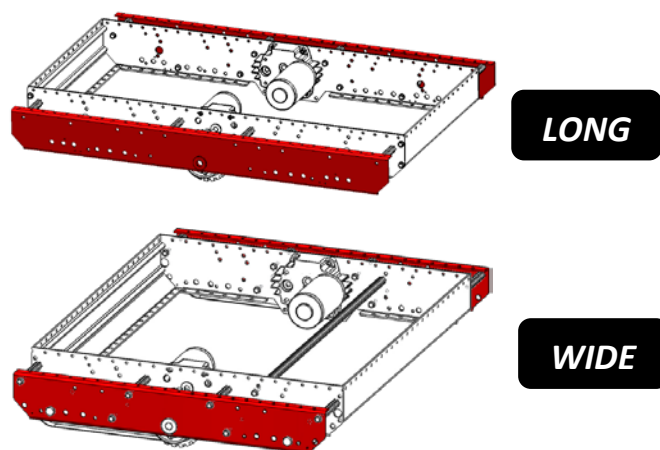
LONG CHASSIS uses 170 tooth belts (am-2570)



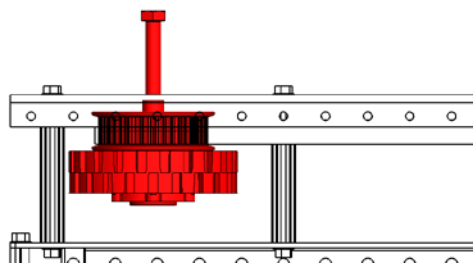
WIDE CHASSIS uses 131 tooth belts (am-2571)



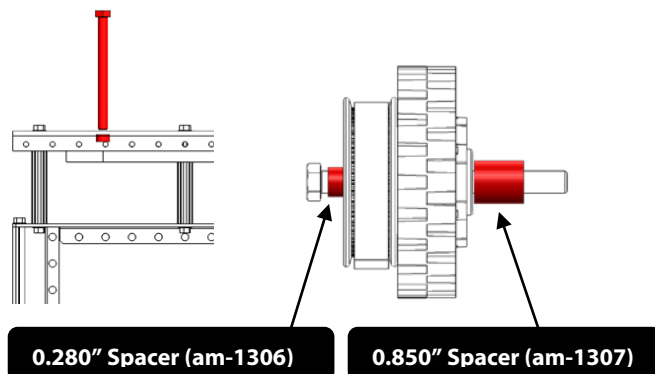
Step 21: Slide the bearing in the Outside Plate onto the TB Hex Output Shaft. The plate flanges should face towards the inner plate. Attach the plate to each 500 Churro, 3.375" with 1/4"-20 x 0.750" Thread Rolling Screws (am-1310)



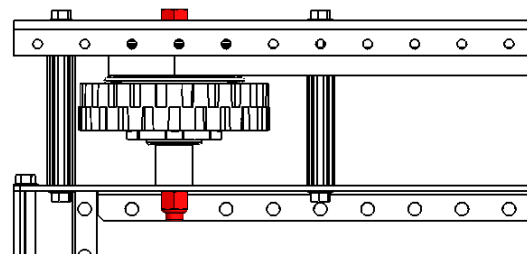
Step 23: Place the wheel in position and slide onto bolt. Make sure to put the belt onto the pulley ensuring that the belt runs parallel to the inner and outer plates. The front and back wheels will be in opposite orientations.



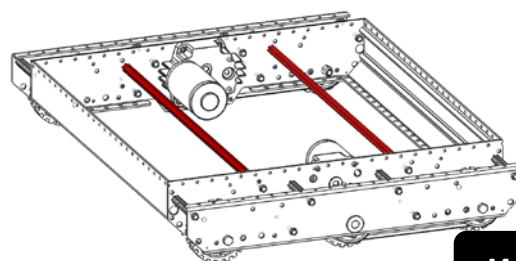
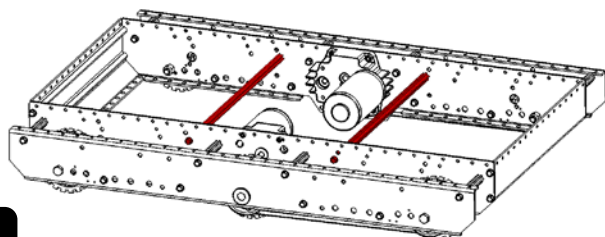
Step 22: Slide the axle 3/8-16 x 4.25 HHS Bolt (am-1297) into the axle hole and add the first spacer. The 0.280" Plastic Spacer (am-1306) is used on the pulley side of the wheel. The 0.850" Plastic Spacer (am-1307) is used on the other side of the wheel.



Step 24: Add the 0.850" spacer (am-1307) to the axle and push the axle all the way through the hole on the inside plate. Secure the axle with the NyLock Nut (am-1054). Be sure to tighten the nut so that there is no lateral motion of the wheel but not so tight that the wheel does not rotate freely.



Step 25: Add the 500 Churro, 24.75" as stiffeners across the middle of the robot (feel free to move these to other holes to accommodate electronics and/or other mechanisms.)



Congratulations, you've completed the AM14U Drive Chassis.
For more technical resources please visit our website AndyMark.com/KOP