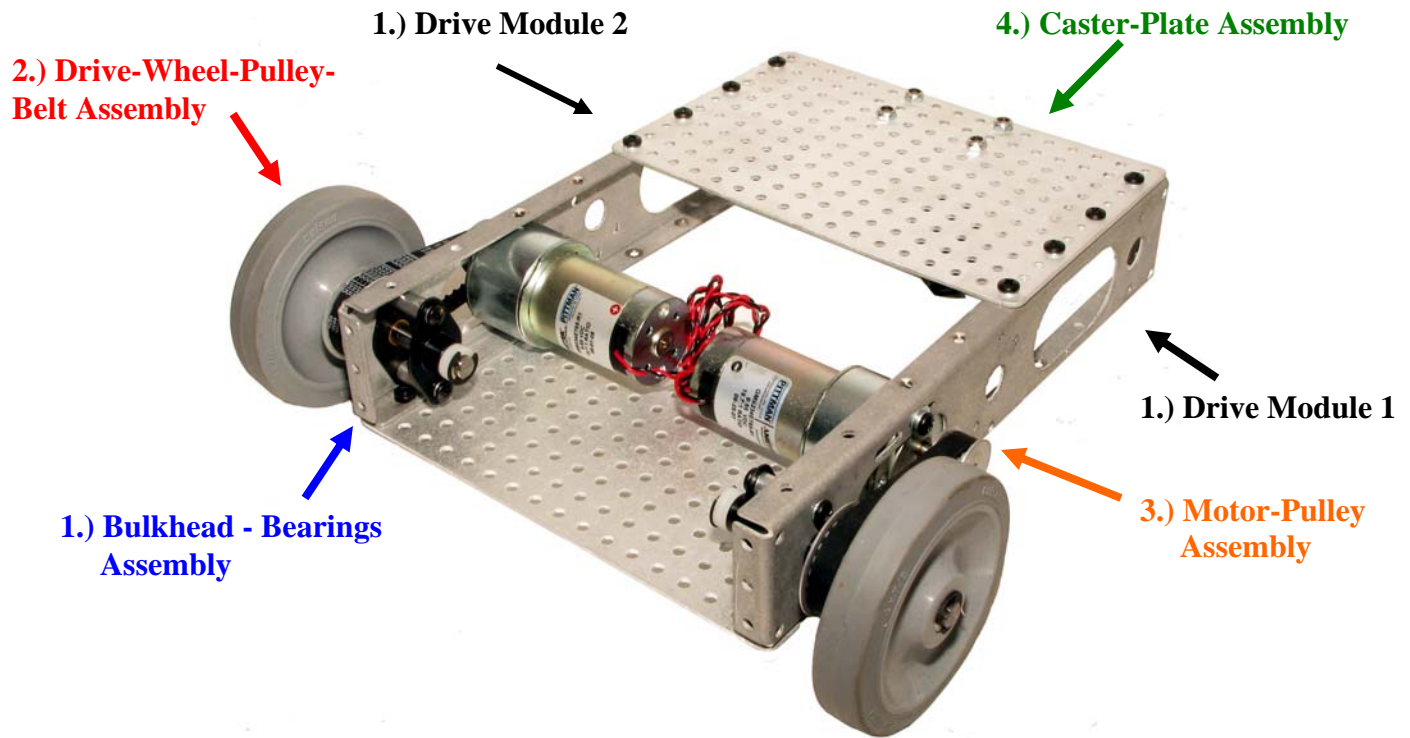


The HMC-Lite Construction Guide

The Heavy Metal-Lite Chassis is constructed using two identical drive modules. The drive modules are constructed using 3 mechanical sub-assemblies. The drive modules are easily integrated into a single chassis using the caster plate assembly and a cover plate.



Mechanical Sub-Assemblies

Drive Module: The chassis and (2) drive modules are constructed by combining the **Bulkhead and Bearings**, **Drive Wheel**, **Motor-Pulley Assembly** and **Caster-Plate assembly**.

- 1. Bulkhead-Bearings Assembly** (2 required) The two (2) bulkhead and bearing assemblies provide the basic structure for each of the two (2) drive modules. 2 students working together can construct the right and left bulkhead and bearing assemblies in about 10 - 15 minutes.
- 2. Drive-Wheel-Pulley-Belt Assembly** (2 required)
There are two (2) drive wheel assemblies. 2 students working together can construct both assemblies in about 10 - 15 minutes.
- 3. Motor-Pulley Assembly**
There are 2 motor, pulley and belt assemblies. 2 students working together can construct both assemblies in about 10 - 15 minutes.
- 4. The Caster-Plate Assembly** is constructed using a steel swivel caster and 6x9 flat plate. 2 students can integrate the two drive modules using the caster-plate assembly and an additional 6x9 plate in about 10 - 15 minutes.

Total (Mechanical) construction time for two students: 50 – 60 minutes.

Necessary Tools

Safety Glasses
Phillips Head Screwdriver #2 pt.
Allen Wrench/Hex Key (sizes 1/16, 5/64)

Wire Strippers and Crimpers

Structural/ Mechanical Materials

Qty.	
4	3/8" I.D. Self aligning Flanged Bearings
2	14 Tooth, XL Flanged Aluminum Timing Pulley w 0.250" Bore and (2) Set Screws
2	24 Tooth, XL Flanged Aluminum Timing Pulley w 0.375" Bore and (2) Set Screws
4	3/8" "E" Clip
2	3/8: wide x 48 Tooth XL Timing Belts
2	Bulkhead Plates
2	6 x 9 Plates
2	4" Wheel with Keyed Aluminum Bushing Assembly
2	3/8" Dia. x 4" Long Machined Axle with Key Slot
2	Gearhead Motor (12 Volt, 19.7:1 Standard)
1	Swivel Caster

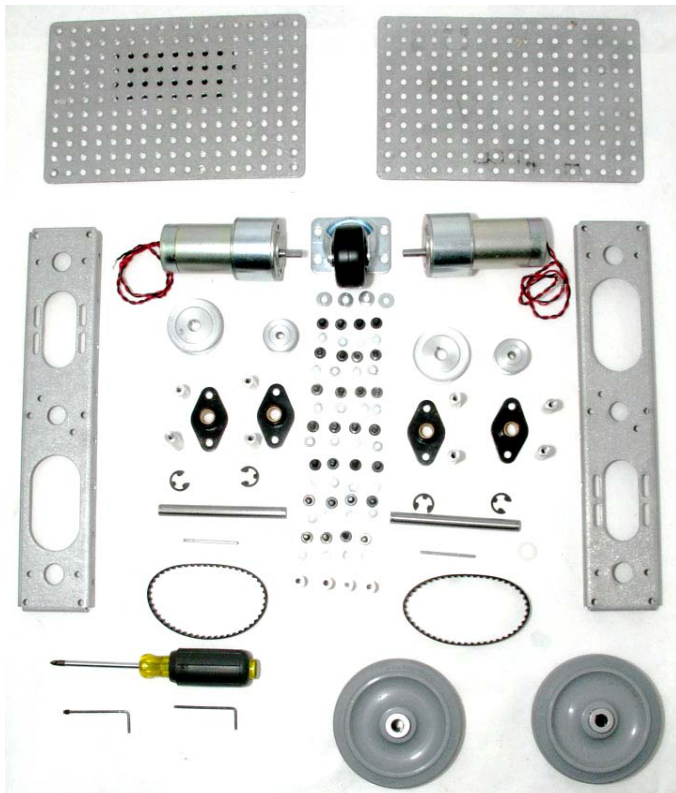
Hardware

Qty.	
34	#10-32 x 3/8" Phillip Machine Screws
8	#10 Flat Washers
34	#10 Lock Washers
4	3/8" Bore x 5/8" OD x 0.062" Nylon Spacer Washers
6	3/8" Bore x 5/8" OD x 0.125" Nylon Spacer Washers
2	3/32" x 1.75" Round Ended Key Stock
1	Loctite™ 243 .5ml ampule
4	#10-32 x 1" PH Machine Screws
2	#10-32 Hex Nuts
4	#10-32 x 1/4"dia x 5/8" L Alm, Standoffs
4	#10-32 Nylon Lock Nuts
4	#10-32 x 5/8" long x 3/8"dia. Nylon Spacers

Electrical (Optional)

1	SPST Toggle Switch
1	Switch Plate and Fasteners
1	Electronics Kit

(Includes motor controllers, wire and connectors.)



Note: In order to maximize the educational benefit to the students and minimize the time on task, it is advisable to let the students handle and identify all the HMC-Lite components and review this document before beginning the assembly of the HMC-Lite. It is especially helpful to study the illustrations at the end of this document in order to learn what the final assemblies look like and how the components, assemblies and modules are related.

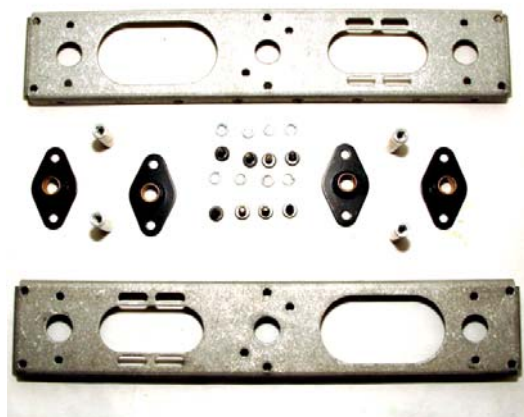
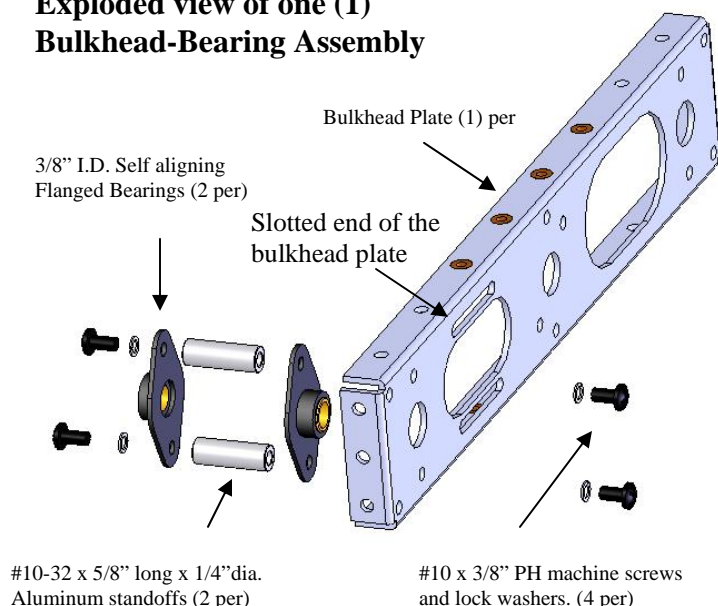
1.) Bulkhead Bearing Assembly

2 Assemblies (sets) required

Average assembly time: 2 students about 10-15 minutes

Note: Since it is necessary to assemble 2 identical modules it is helpful to assign one student to assemble a module and one student to assemble the other, identical module.

Exploded view of one (1) Bulkhead-Bearing Assembly

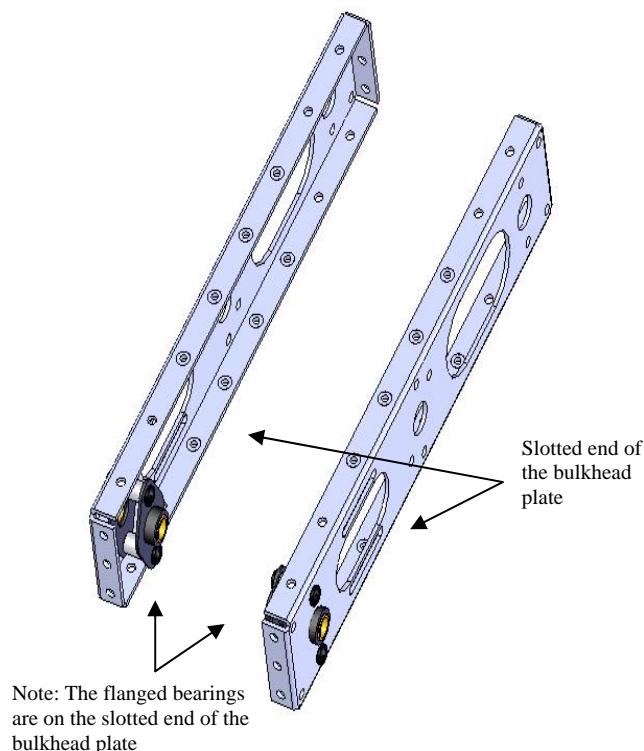


Components and Tools to Make 2 Modules:

Qty.	Description	Bag #1
16	#10-32 x 3/8" PH Machine Screws	
16	#10 Lock Washers	
2	Bulkhead Plates	
4	3/8" I.D. Flanged Bearings	
4	#10-32 x 5/8" long x 1/4" dia. Aluminum standoffs	
1	#2 Phillip Head Screwdriver (not shown)	

Procedure

1. Begin the assembly at the slotted end of the bulkhead plate. Place the 3/8" I.D. flanged bearings into the mounting holes on the bulkhead as shown in the illustration above. Place the bearings through the bulkhead plates from the inside, to the outside as illustrated.
2. Attach one flanged bearings to the aluminum standoff using (2) #10-32 x 3/8" Phillips head machine screws, and (2) #10 lock washers. Do not over-tighten the screws.
The approximate torque (Tightening) specification is about 22 -26 inch pounds. If this specification is not familiar to you then take a moment to research torque specifications online or ask someone who knows.
3. Repeat the procedure for both assemblies (2 total).



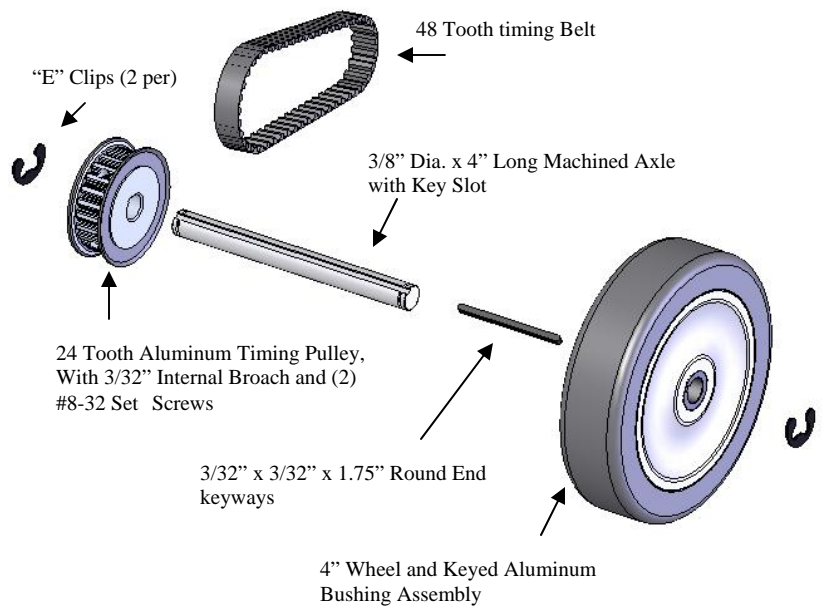
2.) Drive-Wheel-Pulley-Belt Assembly

2 Assemblies required

Average assembly time: 2 students about 10-15 minutes

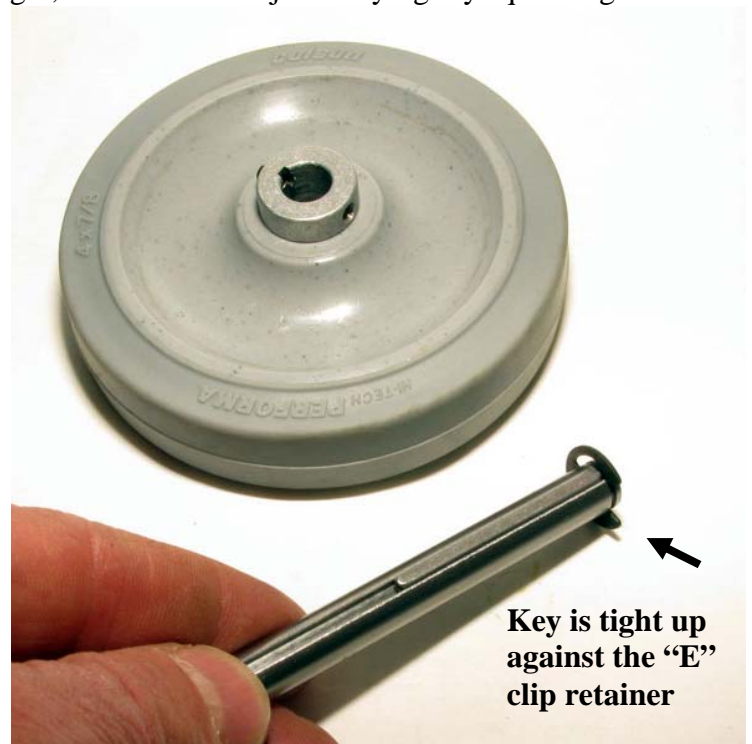
Components and Tools for 2 modules

Qty.	Description	Bag #2
2	4" Wheel and Keyed Aluminum Bushing Assembly	
2	3/8" Dia. x 4" Long Machined Axle with Key Slot	
2	24 Tooth Aluminum Timing Pulley, With 3/32" Internal Broach and (2) #8-32 Set Screws	
2	3/32" x 3/32" x 1.75" Round End Key	
2	48 Tooth timing Belt	
4	"E" Clips	
1	5/64" (0.078") Allen Wrench or Hex Key	
1	3/32" Allen Wrench or Hex Key	
1	6" Flat File (Fine)	
6	3/8"ID x 5/8"OD x 0.125" Nylon Spacer Washers	
4	3/8"ID x 5/8"OD x 0.0625" Nylon Spacer Washers	



Procedure

1. Snap one "E" clip retainer onto the slotted end of the 3/8" diameter x 4" long steel axle. If the "E" clip retainer does not snap in tight, the fit can be adjusted by lightly squeezing the "E" clip retainer ends with a pair of pliers as shown in the top picture on page 5.
2. Place the 3/32" x 3/32" x 1.75" round end key into the broached slot on the 4" axle. Position the key so that it butts up against the "E" clip retainer.
3. Slide the 4" wheel and keyed aluminum bushing assembly onto the axle, and tight against the "E" clip retainer. Tighten the #10-32 set screw on the wheel bushing using a 3/32" hex key wrench to hold the 4" wheel and keyed aluminum bushing assembly in place.
4. Slide the 24 tooth broached aluminum timing pulley onto the axle. Make certain the wheel bushing flange and timing pulley are tightly abutted. Tighten the (2) two #8-32 set screws on the pulley using a 5/64" hex key wrench.
5. Place the 48 tooth belt on the pulley.
6. Repeat the procedure to create (2) two Drive-Wheel Assemblies.

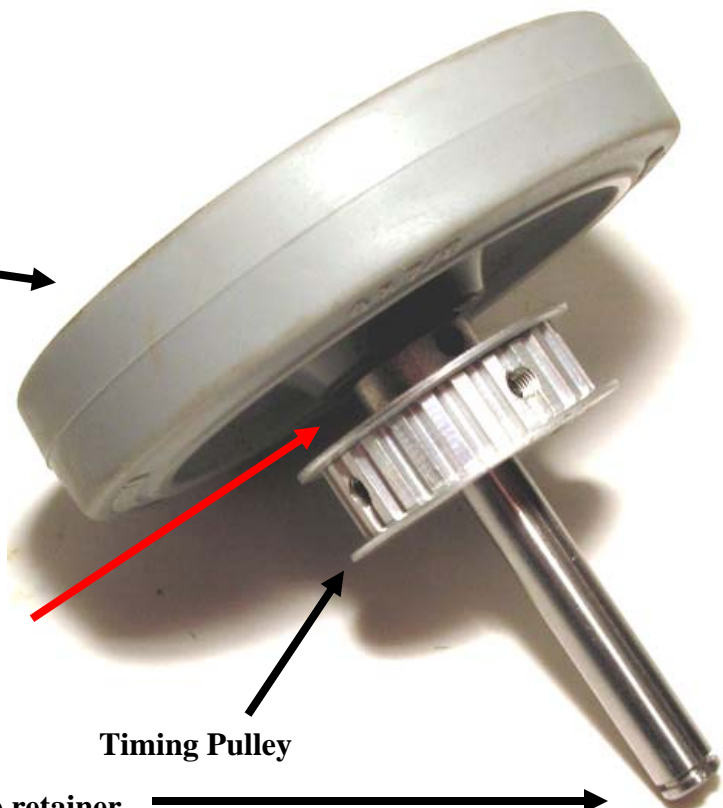


The illustration on the left shows how to adjust the “E” clip retainer. By gently squeezing the “E” clip, it is possible to slightly reduce the radius of curvature. This ensures that the “E” clip retainer will fit snugly into the machined groove at the ends of the axle.



4” wheel and keyed aluminum bushing assembly

The Boss end of the wheel bushing is tight up against the timing pulley.



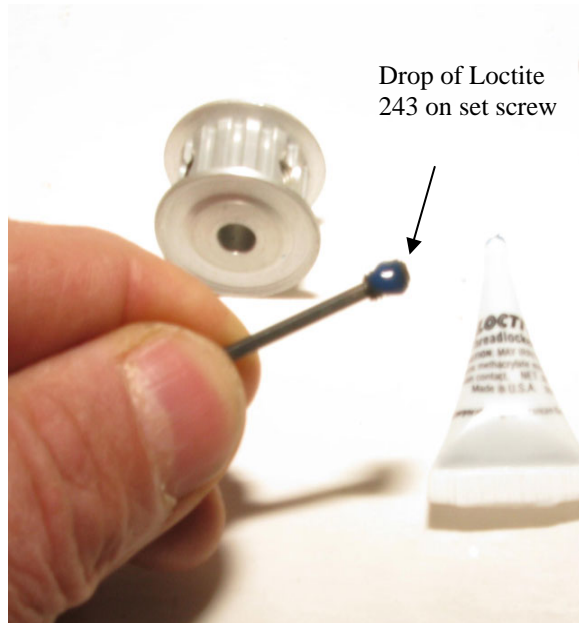
3.) Motor-Pulley Assembly

2 Assemblies required

Average assembly time: 2 students about 10-15 minutes

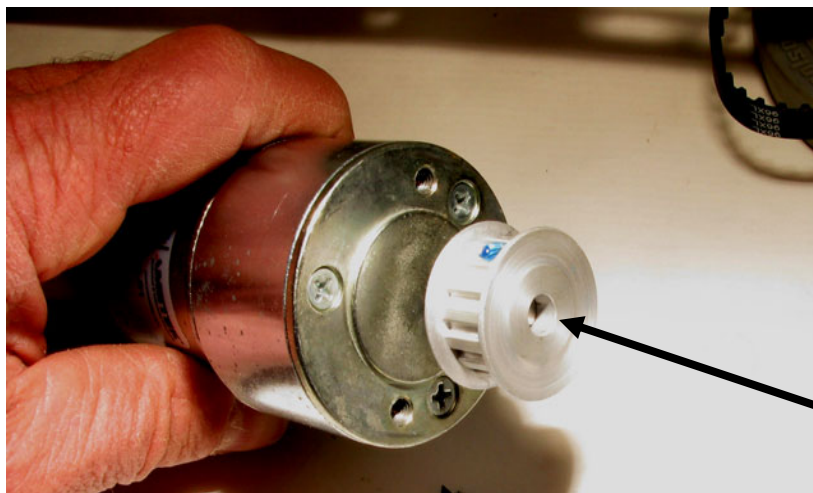
Components and Tools for 2 modules

Qty.	Bag #3 Description
2	Gear head Motors
2	14 Tooth Aluminum Pulleys
4	#10-32 x 3/8" PH Machine Screws
4	#10 Lock Washers
4	#10 Flat Washers
1	Ampule of Loctite 243
1	3/32" Allen Wrench



Procedure

1. Remove one of the set screws from the pulley.
2. Place a drop of Loctite 243 onto the set screw and thread it only part way into the pulley
3. Place the pulley onto the motor shaft and align the flat on the motor shaft with the set screw that has been coated with Loctite. (Note: This is an essential step. Be certain the set screw with the Loctite has been carefully aligned with the flat part of the motor shaft.)
4. **Adjust the pulley so that the outboard face of the pulley extends 0.170" from the end of the motor shaft. This will allow for proper belt alignment between the motor and drive pulleys.**



5. With the pulley positioned in the motor shaft as described, tighten the set screws, Place the motor and pulley assembly aside.
6. Repeat the process to create two (2) motor and pulley assemblies.

Face of the pulley extends 0.170" beyond the end of the motor shaft for proper alignment.

4.) Integrate The Drive Module Components

2 Assemblies required

Average assembly time: 2 students about 15-20 minutes

The (2) drive modules are constructed by combining the Bulkhead-Bearing, Drive-Wheel-Pulley-Belt and Motor-Pulley assemblies.

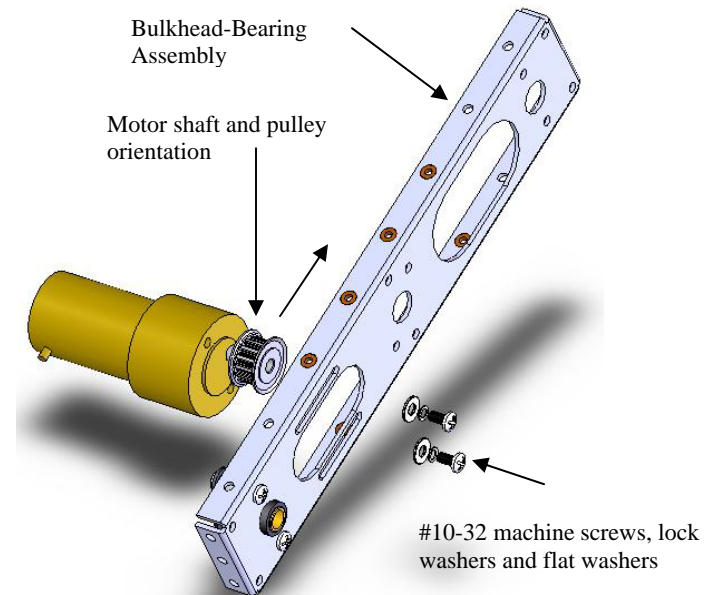
Components and Tools for 2 modules

Qty. Description

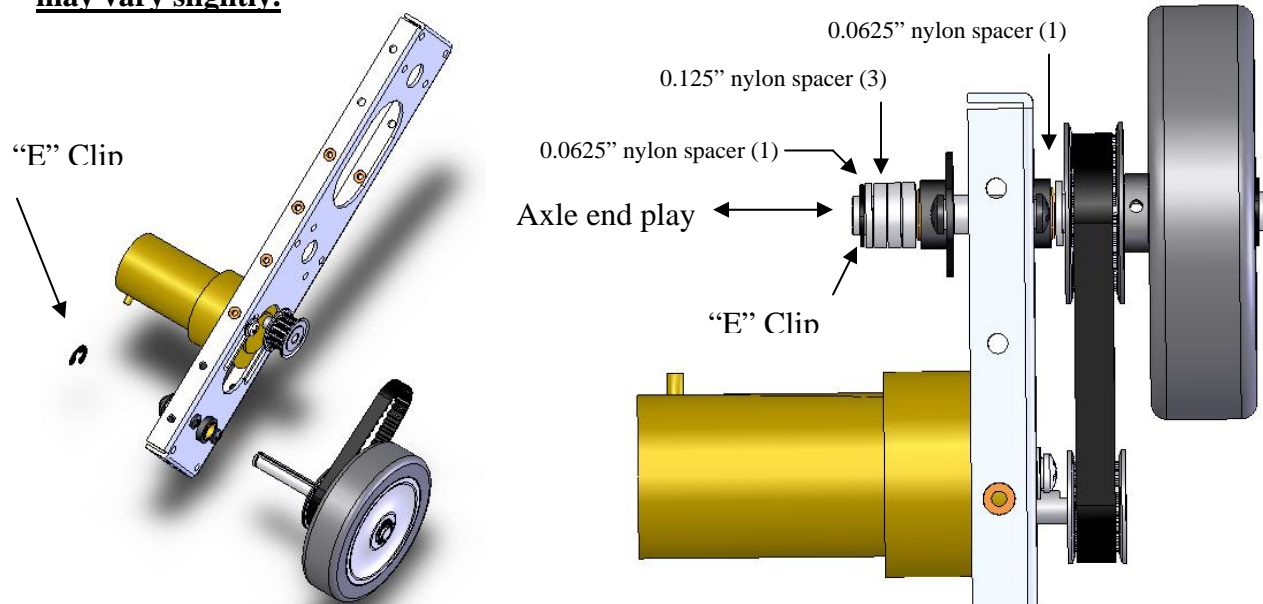
- 2 Bulkhead-Bearing Assemblies
- 2 Drive-Wheel-Pulley-Belt Assemblies
- 2 Motor-Pulley Assemblies
- 4 #10-32 x 3/8" PH Machine Screws, lock and flat washers. (from bag #3)
- 16 Nylon Spacer Washers (Bag #2)

Procedure

1. Attach the Motor-Pulley Assembly to the Bulkhead-Bearing assembly. Make certain the motor shaft and pulley are oriented as shown in the illustration (right). Do not tighten the motor mounting screws at this time, keep them loose so the motor can slide easily in the appropriate slot.
2. The HMC-Lite kit includes nylon spacers used to shim the axle in order to maintain parallel alignment between the belt and pulleys. Take the time to carefully align the belt and pulleys and to use the correct combination of 0.0625" and 0.125" thick nylon spacers. Up to 1/8" of axle end play is acceptable.
3. Attach the Drive-Wheel-Pulley-Belt assembly by sliding the axle through the bearing holes. Wrap the tooth belt around the motor pulley and observe the alignment of the belt and pulleys.



The nylon spacers do not have to be positioned exactly as shown since each assembly may vary slightly.



Assembly Note: Tight belts are inefficient, and lead to reduced run times since they drain the battery. Adjust belts so they are loose, but do not slip. Check that belts will deflect about 1/4"-3/8" when pushed in the center of the belt with light finger pressure.

5.) The Caster-Plate Assembly

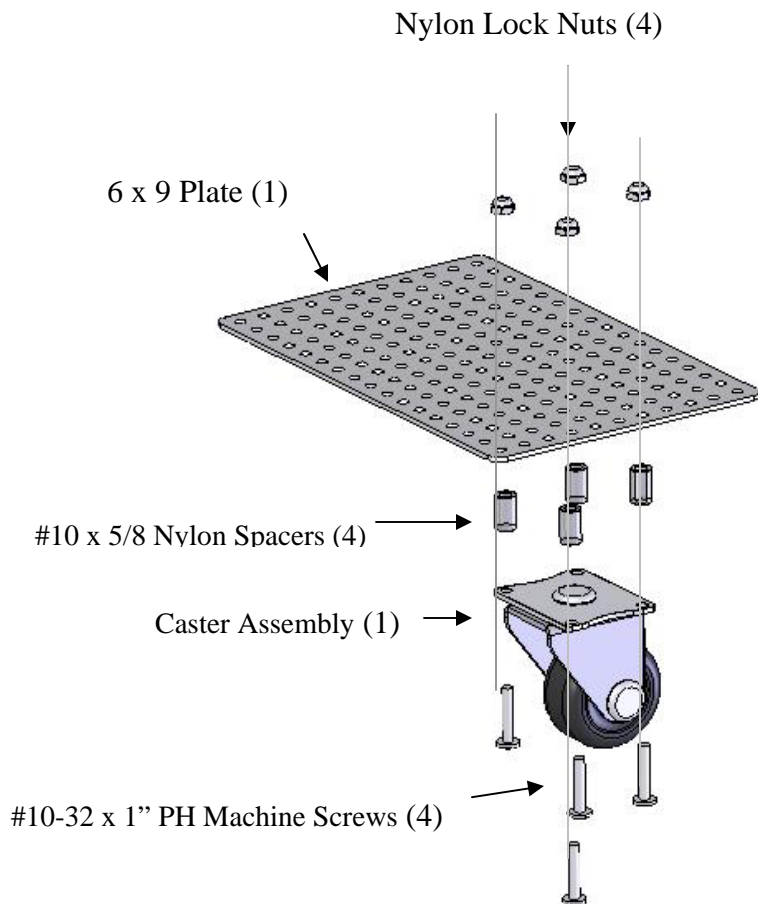
Components and Tools for 1module

One assembly required
Average assembly time: 2 students
about 10-15 minutes

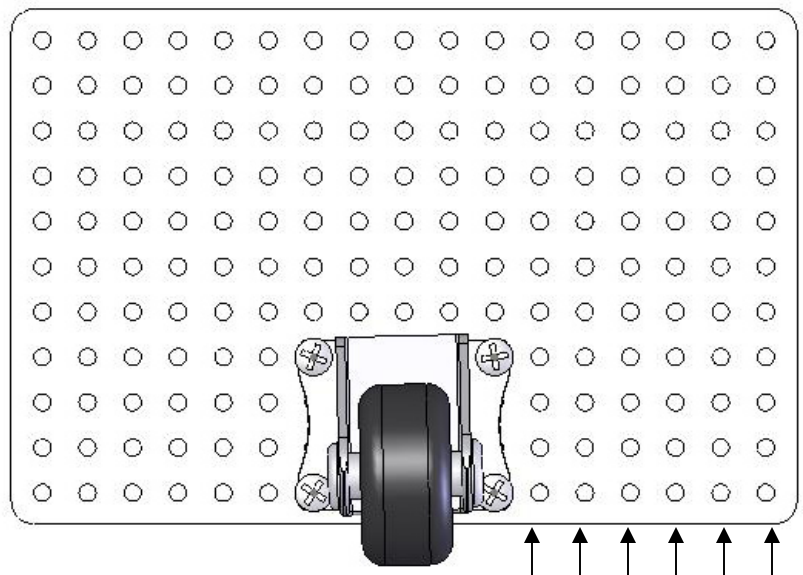
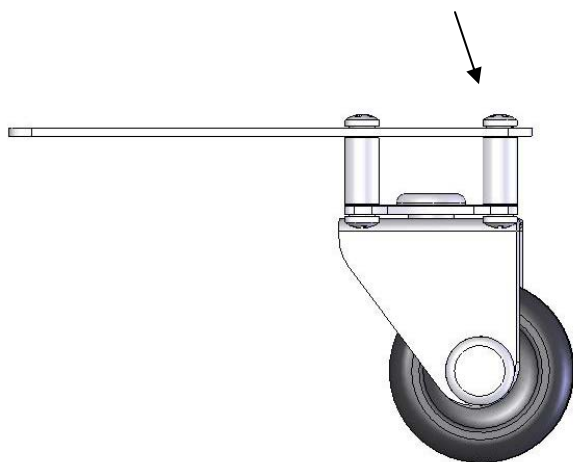
Qty.	Bag # 4 Description
1	6x9 Plate
4	#10-32 x 1" PH Machine Screws
4	#10 Nylon Lock Nuts
4	#10 x 5/8 Nylon Spacers
1	Caster Assembly
1	#2 Phillips Head Screwdriver
1	3/8" Combination wrench

Procedure

1. Position the caster assembly at the center of the 6 x 9 plate.
2. Thread the #10 x 1" PH machine screws up through the caster plate, nylon spacers and 6 x 9 plate.
3. Capture the screws using the nylon locking nuts.
4. Position the caster along the line of holes at the outside edge of the 6 x 9 plate.



Align caster along outer edge of holes



Count 6 holes on each side of the 6x9 plate to center the caster

6.) Assemble The Chassis

One assembly required

Average assembly time: 2 students about 10-15 minutes

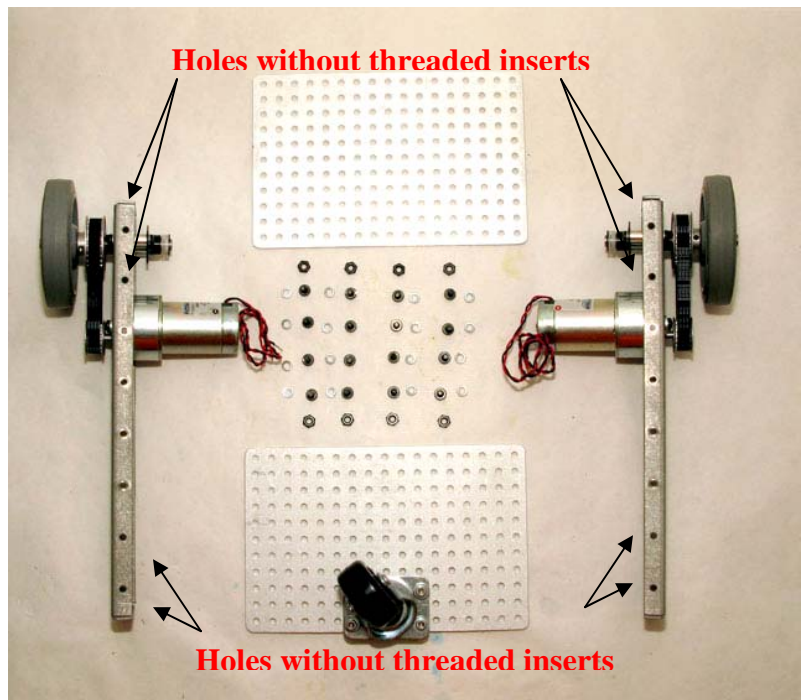
Components and Tools

Qty.	Bag # 5	Description
1		6x9 Plate
1		Caster Plate Assembly
2		Drive Modules
12		#10-32 x 3/8" PH Machine Screws
4		#10 Hex Nuts
12		#10 Lock Washers

Procedure

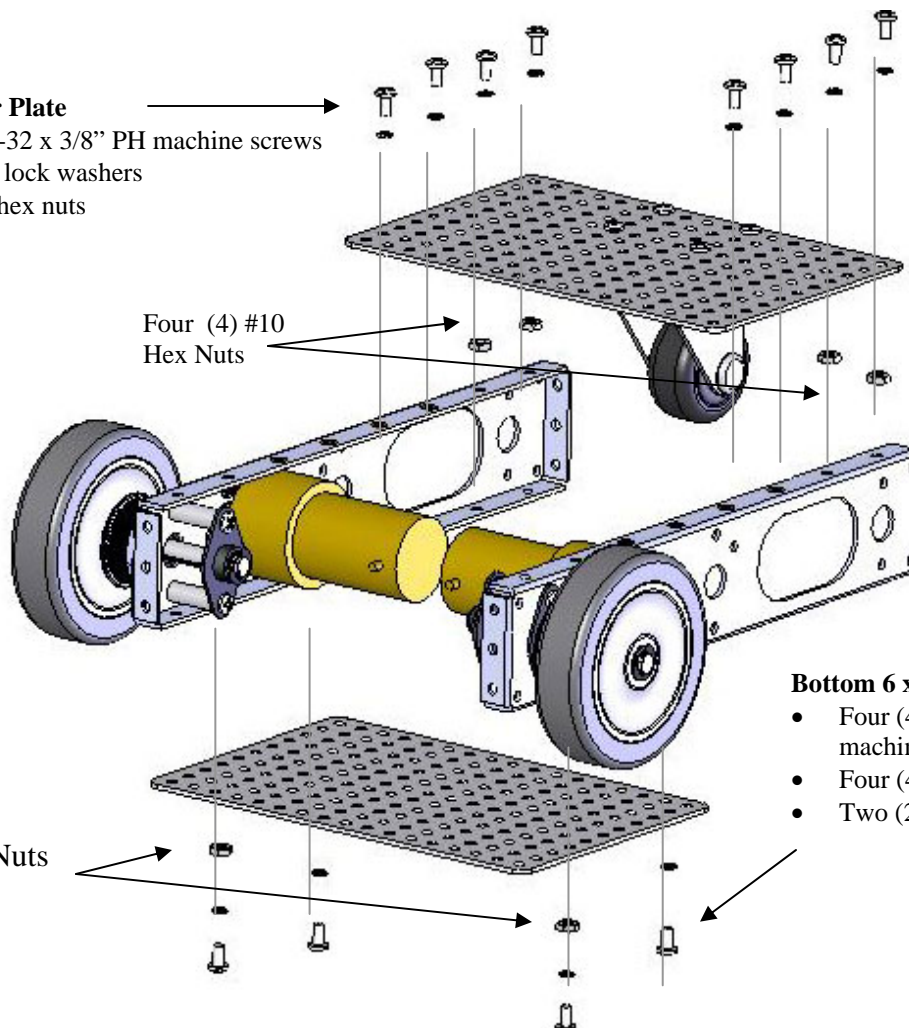
Fasten the caster plate assembly to the (2) two drive modules using six (6) #10-32 x 3/8" PH machine screws lock washers and two (2) #10 hex nuts.

Note: The #10 hex nuts and #10-32 x 3/8" PH machine screws are used to secure the caster plate to the drive modules using the holes that do not have threaded inserts. See the illustration below.



Top 6 x 9 Caster Plate

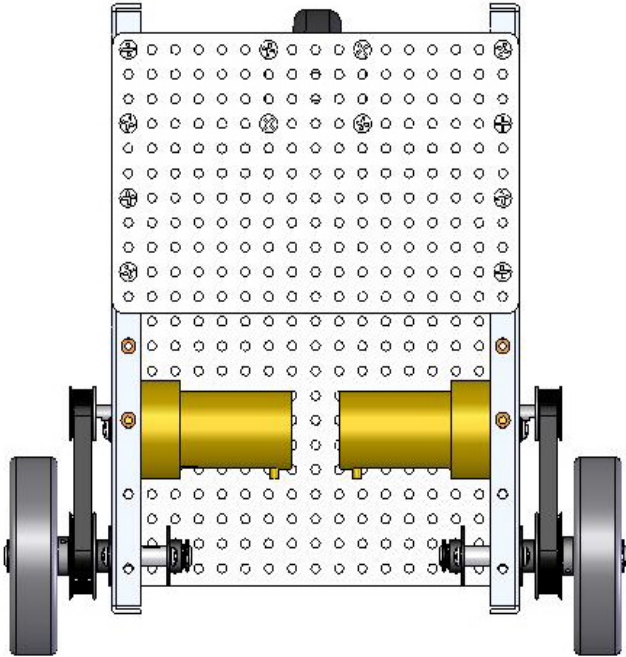
- Eight (8) #10-32 x 3/8" PH machine screws
- Eight (8) #10 lock washers
- Four (4) #10 hex nuts



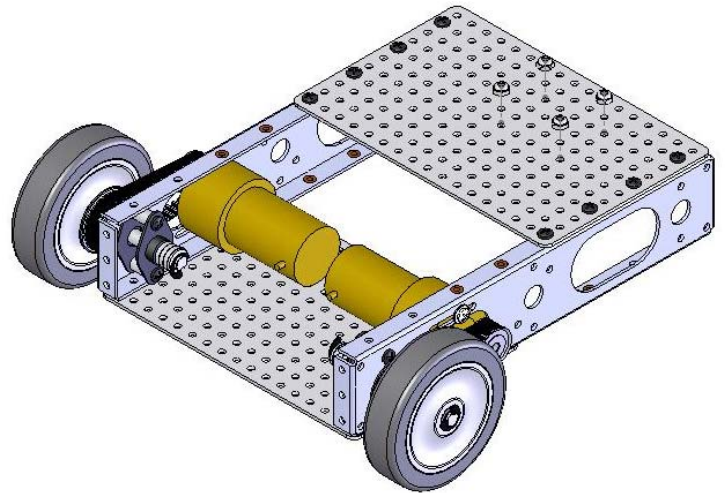
Bottom 6 x 9 Plate

- Four (4) #10-32 x 3/8" PH machine screws
- Four (4) #10 lock washers
- Two (2) #10 hex nuts

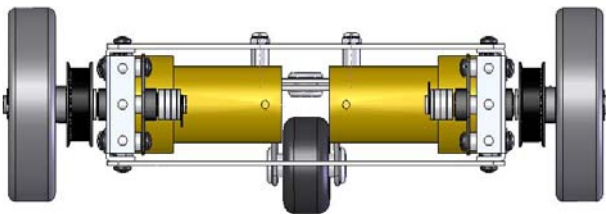
Completed Heavy Metal-Lite Chassis



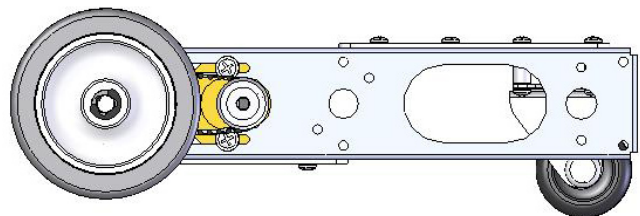
Top View



Isometric View



Front View



Right View