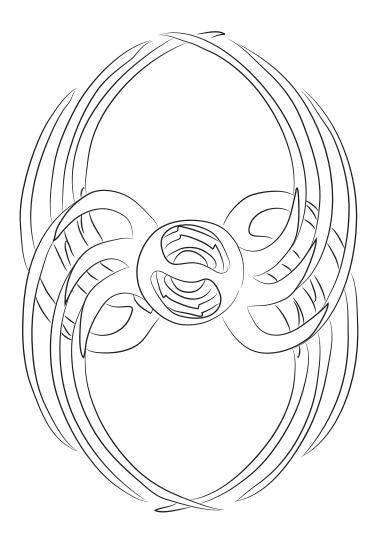


# sample

Important information:

McMaster Carr, a supplier whose part numbers are referenced throughout this document, can only ship within the United States. Builders outside of the U.S. must find an alternate supplier for the required hardware.

Hardware part numbers and availability are subject to change. Verify that all hardware or equivalents are obtainable prior to purchasing these plans.



design by Derek Hugger

# The Basics

#### Contents

These plans include all the information required to build Cepheid. They provide an outline of the build process, tips for an accurate and successful build, lists of required tools and off-the-shelf components, a complete parts list, full scale patterns for all plywood parts, and step-by-step assembly instructions.

#### Before Building

Read and understand <u>all</u> instructions before building. Failure to do so will lead to increased frustration levels, lengthened build times, wasted material, and other vexing occurrences.

#### **Build Process**

Always wear eye protection and any other necessary personal protective gear. Read, understand, and abide by all manufacturer instructions and warnings for all tools used.

- 1. Use a light duty/general purpose spray adhesive to temporarily bond the patterns to plywood. Apply the adhesive evenly and sparingly.
- 2. Drill the holes first, and then cut out the parts. Hole alignment between parts is critical to proper function, so care must be taken to drill the holes accurately. Take time to cut out the parts accurately. An accurately cut part will require less sanding and less modification later.
- 3. Remove the patterns from the cut plywood parts, and then sand the parts to remove rough edges and any residual adhesive.
- 4. Cut and tap all aluminum tubes, brass tubes, and stainless steel. See Plywood Thickness Compensation in Tips + Tactics.
- 5. Following the assembly instructions, build all subassemblies and then the Top Level Assembly.
- 6. If desired, disassemble Cepheid to finish its components. Note that stain and other finish options can affect the thickness of parts and may also effect friction levels between moving parts.

#### Notes

When printing the patterns, always print at 100% scale. Do not use the "scale to fit page" option.

Cepheid contains many moving wood parts as well as wood parts that stack onto one another. As such, using a quality, flat Baltic birch plywood is very important. Cheaper, lower quality plywood, such as types often found at home improvement stores like Home Depot, can be warped and knotted.

Changing humidity levels can cause wood parts to swell and move. Some binding or changes in performance may occur with changes in humidity. As humidity levels return to normal, so too should the system's performance.

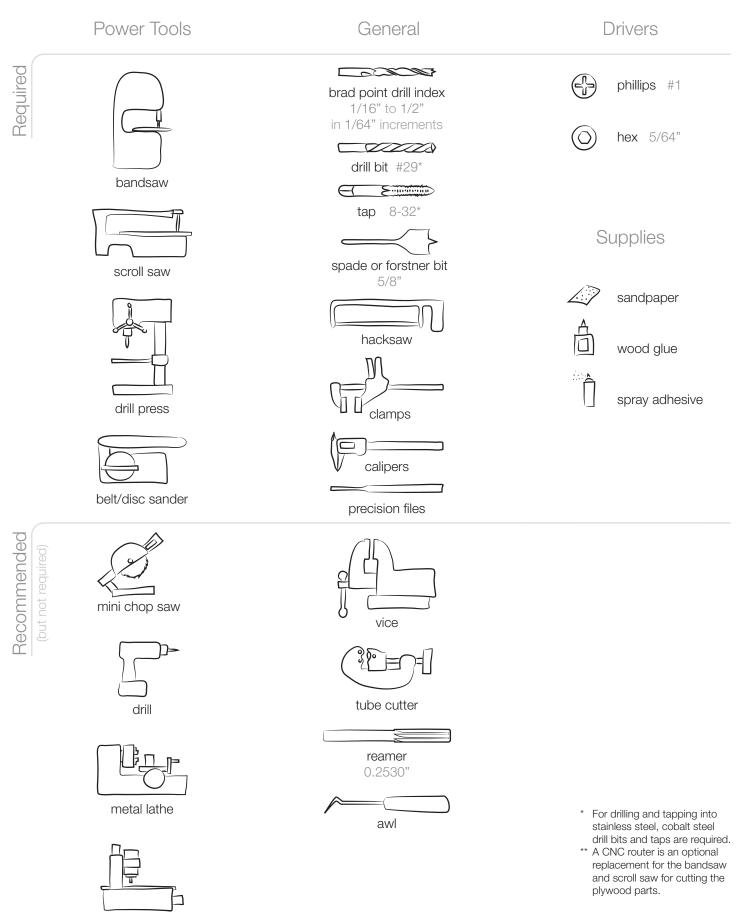
#### Terms of Use

© 2017 Derek Hugger. All Rights Reserved.

By purchasing these plans, you have agreed to the following terms and conditions:

Reproduction of part or all of this document is prohibited except by the original retail purchaser for his or her own personal use. The contents of this document and associated documents, including but not limited to instructions, designs, illustrations, diagrams, and patterns are for personal use, and may not be included in any other work or publication, nor be distributed, nor be used for commercial purposes except with explicit written consent from the author. Any apparatus or work created using the designs, patterns, or instructions in this document is for personal use only and may not be used for commercial purposes nor sold for profit. The contents of this document are presented in good faith but without warranty and without guaranteed results.

# Tools



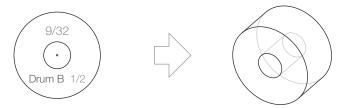
cnc router\*\*

### Tips + Tactics

### Pattern Syntax

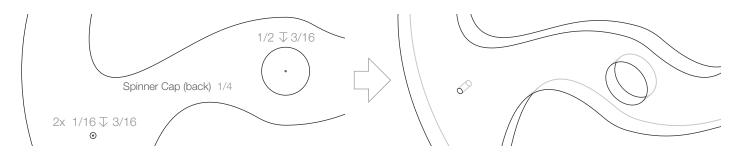
#### Patterns are labeled with a part name followed by a thickness dimension.

Example: Drum B is cut from 1/2" plywood. It also has a hole to be drilled thru with a 9/32" bit.



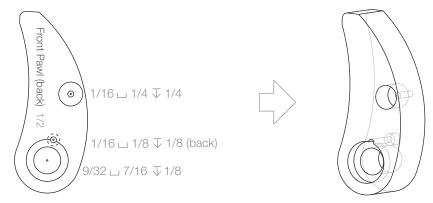
#### A $\ensuremath{\mathbb{J}}$ symbol indicates drilling to a certain depth, not thru.

Example: The Spinner Cap has two 1/16" holes drilled 3/16" deep. It also has a 1/2" hole drilled 3/16" deep. As indicated by "(back)", this pattern shows the back side of the part.



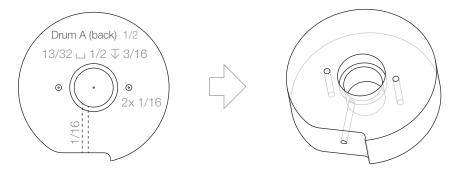
# Two concentric circles indicate a hole with a counterbore. A dashed concentric circle indicates a hole with a counterbore drilled from the back side of the part.

Example: The Front Pawl has a 1/16 thru hole with a 1/4" counterbore drilled 1/4" deep. It has a 9/32" thru hole with a 7/16" counterbore drilled 1/8" deep from the back side. As indicated by "(back)", this pattern shows the back side of the part.



#### Straight Dashed lines indicate a hole drilled from the side, centered on the thickness of the part.

Example: Drum A has a 1/16" hole drilled from the side. It also has two 1/16" thru holes and a 13/32" thru hole with a 1/2" counterbore drilled 3/16" deep. As indicated by "(back)", this pattern shows the back side of the part.



### Tips + Tactics

### Plywood Thickness Compensation

The exact thickness of plywood is typically thinner than the plywood's specification. For example, 1/4" plywood may actually measure 0.23" thick. Because of this, it may be necessary to adjust the lengths of many of Cepheid's metal parts. It is best to cut wood parts first, and then cut the metal parts to match.

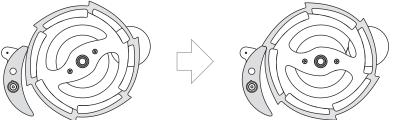
#### Wall Mounting

Use the Wall Mount Template as a guide for locating Cepheid's four mounting points on a wall. The large horizontal and vertical lines indicate the center of Cepheid. Mount into studs or use appropriate anchors to ensure that Cepheid will not fall or otherwise separate from the wall.

It is easier to examine and troubleshoot Cepheid's magnetic ratchet mechanism on a tabletop rather than on a wall. As such, it is recommended to fully assemble Cepheid and get its mechanisms working properly prior to mounting it to a wall. When the magnetic ratchet mechanism is working as intended, disassemble Cepheid by following the Top Level Assembly instructions in reverse, mount the Wall Mount Asm to the desired wall location, and then reassemble Cepheid, following the Top Level Assembly instructions.

#### Winding

If the Rear Pawl is not engaged on one of the Ratchet Wheel's teeth, rotate the Ratchet Wheel clockwise until the pawl clicks over a tooth.



Then, hold the Rear Spinner stationary and rotate the Front Spinner clockwise. Be sure not to over-wind; stop winding when the mark on the Spring is visible (see Subassembly Step 7). Release both spinners to set Cepheid into motion.



### Parts + Assemblies List

Туре	Description	Qty	Туре	Description	Qty	Туре	Description	Qty
Aluminum Tube	A Tube 1/4" x 1-1/8"	1	Plywood 1/8"	Drum A Rear Flange	1	Subassembly	Drum B Asm	1
Aluminum Tube	A Tube 1/4" x 1-1/8" NT	1	Plywood 1/8"	Drum B Front Flange	1	Subassembly	Front Pawl Asm	1
Aluminum Tube	A Tube 1/4" x 1-5/8"	1	Plywood 1/8"	Drum B Rear Flange	1	Subassembly Subassembly	Front Pawl Support Asm Front Spinner Asm	1 1
Brass Tube	B Tube 9/32" x 1/4"	2	Plywood 1/4"	Drum A Front Flange	1	Subassembly	Ratchet Wheel Asm	1
Brass Tube	B Tube 9/32" x 3/8"	3	Plywood 1/4"	Front Pawl Support	1	Subassembly	Rear Pawl Asm	1
Brass Tube	B Tube 9/32" x 5/8"	1	Plywood 1/4"	Front Ratchet Wheel	1	Subassembly	Rear Pawl Support B Asm	1
			Plywood 1/4"	Ratchet Wheel Spacer	1	Subassembly	Rear Spinner Asm	1
Stainless Steel Tube	S Tube 1/4" x 5-1/4"	1	Plywood 1/4"	Rear Pawl Support B	1	Subassembly	Wall Mount Asm	1
			Plywood 1/4"	Rear Ratchet Wheel	1			
Stainless Steel Rod	Rod 1/16" x 5/8"	4	Plywood 1/4"	Spinner Cap	1	Top Level Asm	Cepheid	1
Hardware	1/8" Magnet	4	Plywood 1/2"	Drum A	1			
Hardware	1/4" Magnet	2	Plywood 1/2"	Drum B	1			
Hardware	Bearing	6	Plywood 1/2"	Front Pawl	1			
Hardware	LSHCS 8-32 x 1/4"	4	Plywood 1/2"	Front Spinner A	1			
Hardware	PHSTS #2 x 1/2"	3	Plywood 1/2"	Front Spinner B	1			
Hardware	PHSTS #2 x 3/4"	58	Plywood 1/2"	Front Spinner C	1			
Hardware	Spring	1	Plywood 1/2"	Front Spinner Support	1			
Hardware	Washer	4	Plywood 1/2"	Rear Pawl	1			
Hardware	Weight	10	Plywood 1/2"	Rear Pawl Support A	1			
			Plywood 1/2"	Rear Spinner A	1			
			Plywood 1/2"	Rear Spinner B	1			
			Plywood 1/2"	Rear Spinner C	1			
			Plywood 1/2"	Rear Spinner Support	1			
			Plywood 1/2"	Wall Mount	1			
			Plywood 1/2"	Wall Mount Support	1			

### Hardware

Description	Qty	McMaster Carr P/N *
<ul><li>1/8" Magnet Neodymium, 0.7 lbs max pull, Ø1/8" x 1/8"</li><li>1/4" Magnet Neodymium, 2.5 lbs max pull, Ø1/4" x 1/4"</li></ul>	4 2	5862K61 58605K75
Bearing (see image below)	6	57155K376
LSHCS 8-32 x 1/4" Low Socket Head Cap Screw	4	93615A317
PHSTS #2 x 1/2" Pan Head Self Tapping Screw PHSTS #2 x 3/4" Pan Head Self Tapping Screw	3 58	92470A098 92470A103
Spring (see image below)	1	A 3X51-20007**
Washer #8 (outer Ø 3/8, inner Ø 0.174")	4	90107A010
Weight (see image below)	10	90309A315

Bearing Double Shielded, ABEC-5





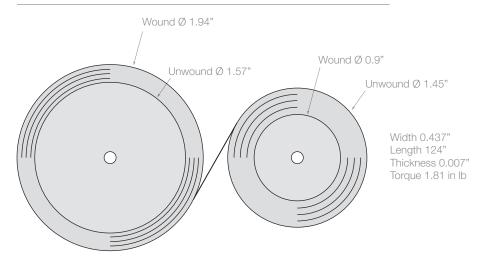
Weight Unthreaded Brass Spacers for #6 Screws



Inner Ø 0.14" Outer Ø 1/2"

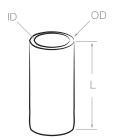
Note that although these spacers are designed for #6 screws, #2 screws may be used.

Spring NEG'ATOR Spring Motor (aka Constant Torque Spring)



### Metal

Description	Material	OD x L *	ID	Qty	Tap**	McMaster Carr P/N ***
A Tube 1/4" x 1-1/8" A Tube 1/4" x 1-1/8" NT A Tube 1/4" x 1-5/8"	Aluminum Aluminum Aluminum	1/4" x 1-1/8" 1/4" x 1-1/8" 1/4" x 1-5/8"	0.120" 0.120" 0.120"	1 1 1	one side none one side	4568T11
B Tube 9/32" x 1/4" B Tube 9/32" x 3/8" B Tube 9/32" x 5/8"	Brass Brass Brass	9/32" x 1/4" 9/32" x 3/8" 9/32" x 5/8"	0.253" 0.253" 0.253"	2 3 1	-	8859K25
S Tube 1/4" x 5-1/4"	Stainless Steel	1/4" x 5-1/4"	0.120"	1	both sides	89495K395
Rod 1/16" x 5/8"	Stainless Steel	1/16" x 5/8"	-	4	-	90145A421



OD outer diameter

ID inner diameter

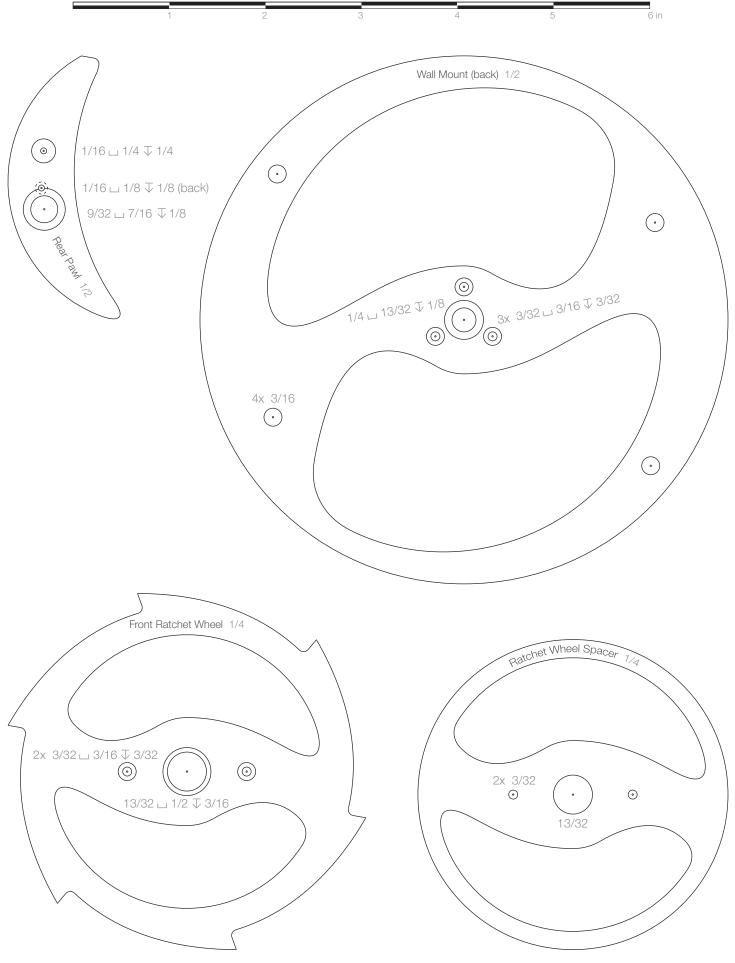
L length

\*

Due to variations in plywood thicknesses, required tube lengths may vary slightly. Expand 0.120" tube ID with a #29 drill bit and then tap for 8-32 thread. Minimum thread depth: 1/4". \*\*

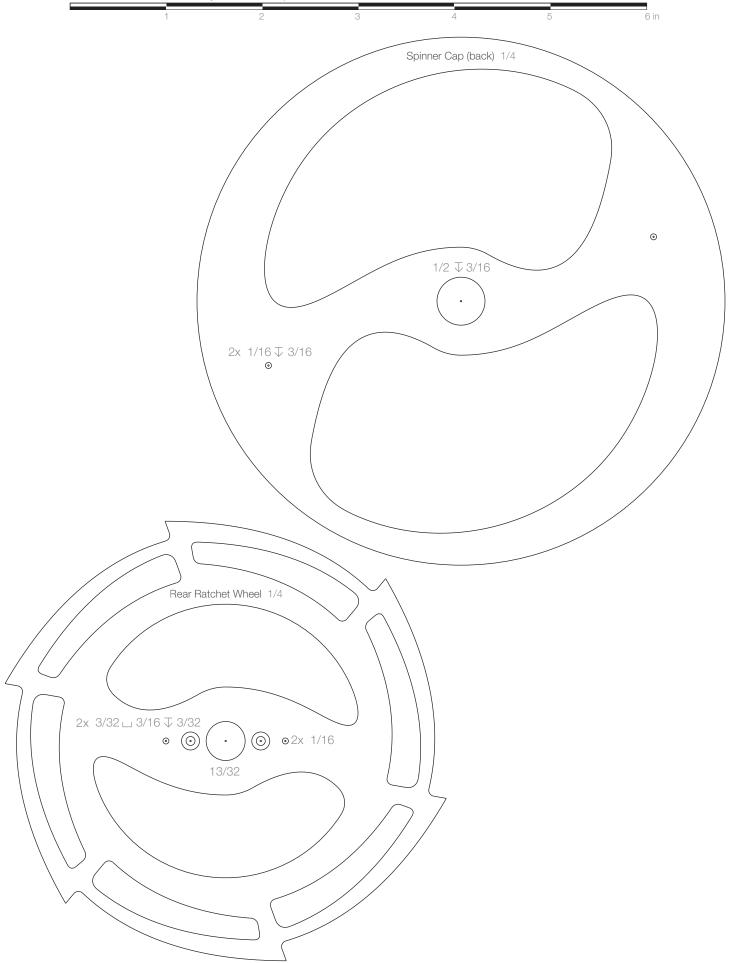
\*\*\* Part numbers referenced are from www.mcmaster.com.



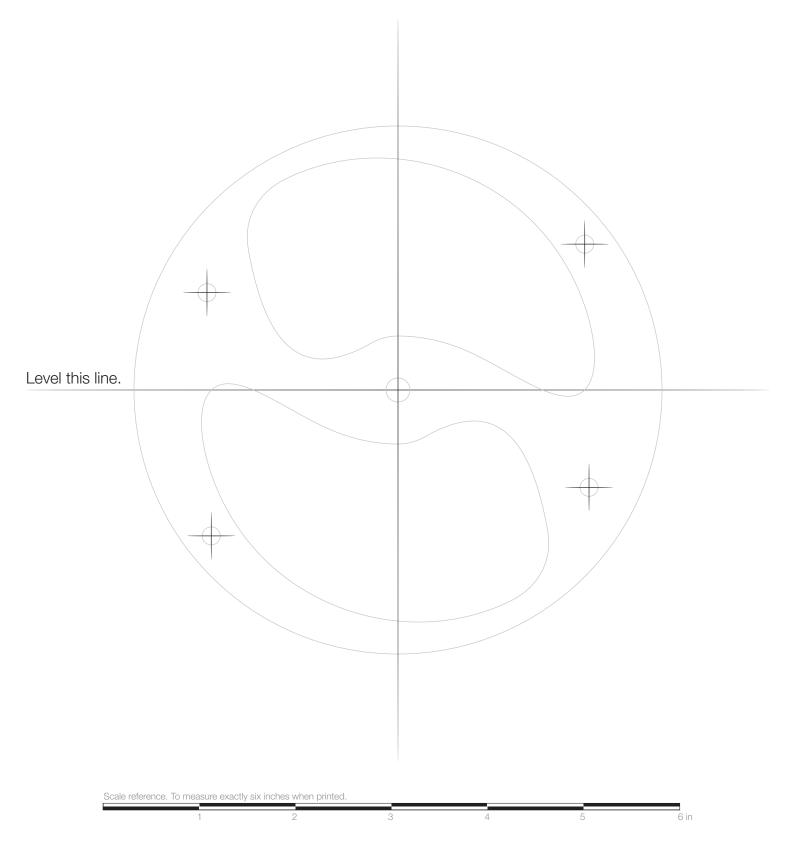


© 2017 Derek Hugger

Scale reference. To measure exactly six inches when printed.

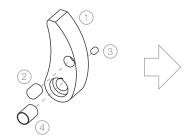


# Wall Mount Template

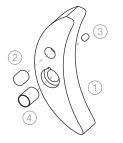


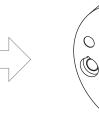
### Subassemblies

Steps 1, 2









#### Front Pawl Asm

1 Front Pawl 1>	K
-----------------	---

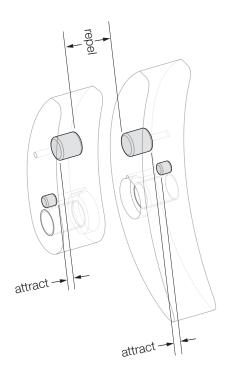
- 2 1/4" Magnet 1x
- 3 1/8" Magnet 1x
- 4 B Tube 9/32" x 3/8" 1x

The B Tube and Magnets must press firmly into place. Magnets must sit flush in the Front Pawl. Align magnet polarities such that they attract each other through the Front Pawl Asm.

#### Rear Pawl Asm

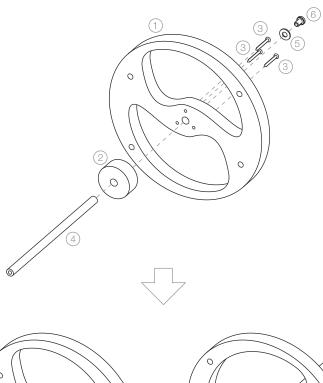
1	Rear Pawl	1x
2	1/4" Magnet	1x
3	1/8" Magnet	1x
4	B Tube 9/32" x 3/8"	1x

The B Tube and Magnets must press firmly into place. Magnets must sit flush in the Rear Pawl. Align magnet polarities such that they attract each other through the Rear Pawl Asm, but the 1/4" Magnet repels the 1/4" Magnet in Front Pawl Asm when the two assemblies are face to face. See image below.



### Subassemblies

Steps 5, 6

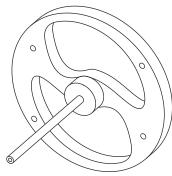


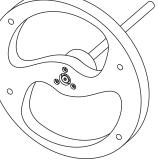
#### Wall Mount Asm

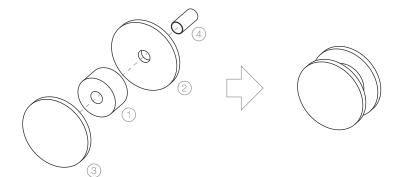
1	Wall Mount	1x
2	Wall Mount Support	1x
3	PHSTS #2 x 3/4"	Зx

- 4 S Tube 1/4" x 5-1/4" 1x
- 5 Washer 1x
  - 6 LSHCS 8-32 x 1/4" 1x

All fasteners must be sub-flush. S Tube must press firmly into place.







### Drum B Asm

- 1 Drum B 2 Drum B R
  - Drum B Rear Flange 1x
- 3 Drum B Front Flange 1x
- 4 B Tube 9/32" x 5/8" 1x

Glue Drum B to Drum B Rear Flange and to Drum B Front Flange. B Tube must press firmly into place.

1x

### Front Spinner Asm Step 2

1 2 3	Weight PHSTS #2 x 3/4" Front Spinner Support	5x 9x 1x	A	

### Top Level Assembly Step 3

1	B Tube 9/32" x 3/8"	1x
2	Front Spinner Asm	1x
З	Washer	1x
4	LSHCS 8-32 x 1/4"	1x

The length of the B tube may change. See Magnetic Ratchet Mechanism in Tips + Tactics.

(4)

To avoid putting an axial load on the bearings and to help promote smoother motion, ensure there is clearance between the S Tube and the Front Spinner Asm.

Show of the second seco

This gap is controlled by adjusting the length of the B Tube installed between the Wall Mount Asm and Rear Spinner Asm.

0.010" - 0.020"