The Cyclecar Project

MTM Scientific, Inc. P.O. Box 522 Clinton, MI 49236 USA

Figure 1. The Cyclecar Project created this vehicle, as described here.

The Cyclecar Project was inspired by the Cyclecars of the early automotive age. Many fine examples of Cyclecars were built by amateurs between 1910 and 1930 with the desire to 'get on the road' with a simple and inexpensive vehicle. One fine example of a Cyclecar is on display at the Henry Ford Museum in Dearborn, Michigan as shown in Figure 2.

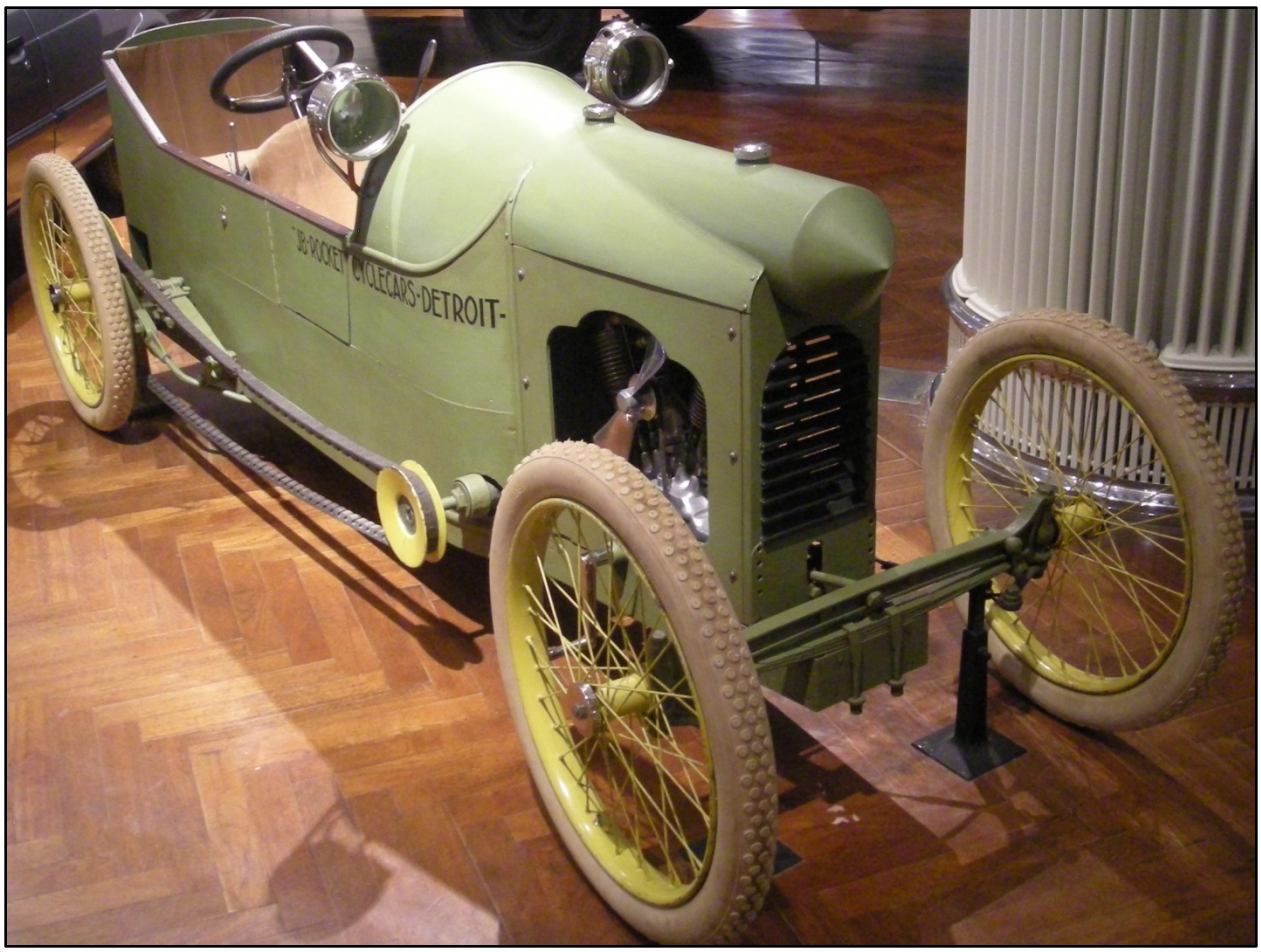


Figure 2. Cyclecar on display at the Henry Ford Museum, Dearborn MI.

Cyclecars typically have an air cooled engine, large wheels and a narrow-width profile. Many Cyclecars had a single rear wheel to reduce expenses. A single rear wheel also avoids the complication of a rear differential, but the overall rollover stability is also reduced. Our experiments with a single rear wheel showed the instability was too great for our liking.

Figure 3. Cyclecar built by a hobbyist in France with single rear wheel.

We endeavored to build a Cyclecar using commonly available off-the-shelf parts. This turned out to be surprisingly easy and inexpensive to do. Many of the components are go-kart parts, with other parts carefully selected from EBAY and other sources. For example, the main frame of the Cyclecar is a go-kart frame from Azusa Engineering. This classic frame has been around for decades. The frame is a basic weldment of steel tubing and sheet. The frame is available by mail order for less than $200, with shipping by way of regular carriers such as UPS.

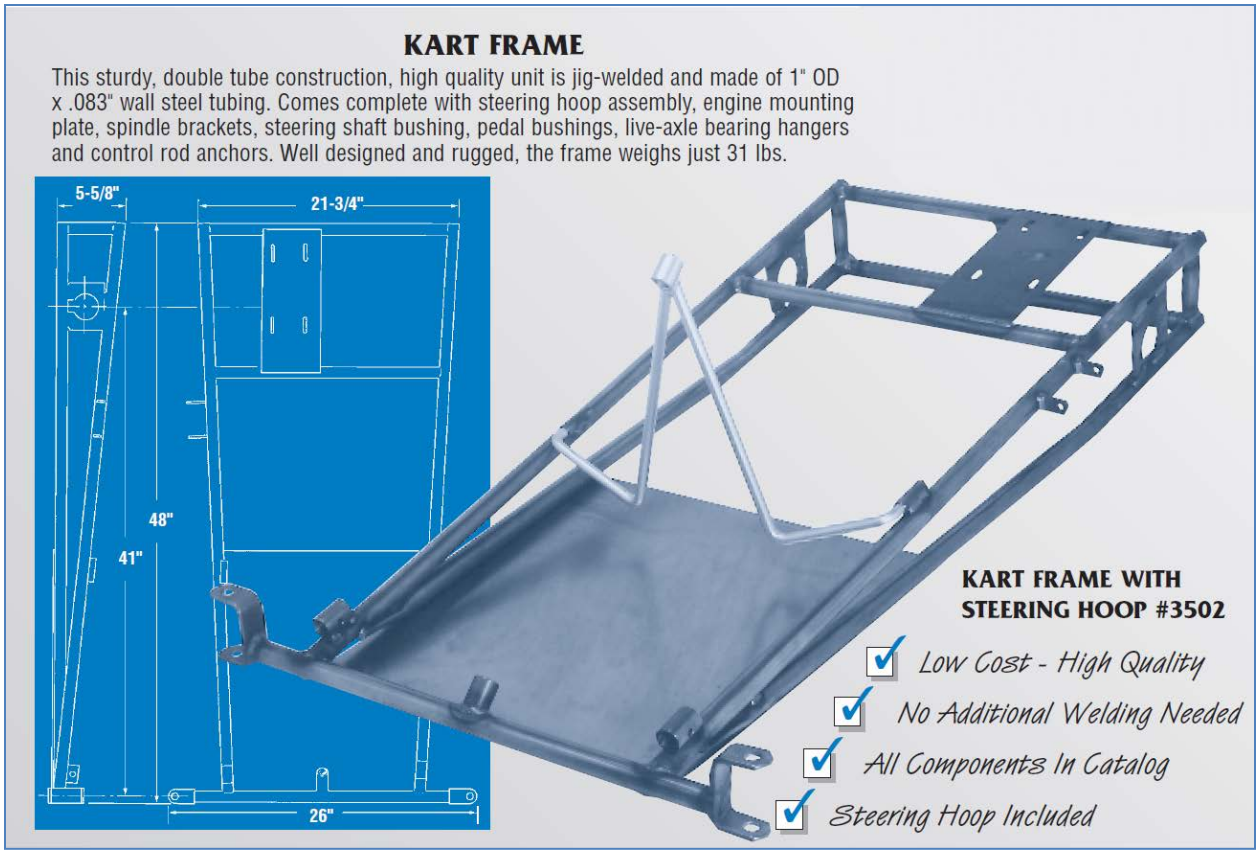


Figure 4. The main frame of the Cyclecar is from a go kart design.

Front End & Steering

The front end of the Cyclecar has large bicycle-type wheels to raise the frame off the ground and provide good rolling resistance to bumps and rough road. The front wheels are spoked with pneumatic tires and ball bearings. The front wheels were originally designed for use as part of a push-type garden cart. We found there were 2 primary issues with using these wheels and tires: 1) The bearings were not designed for high speed or rough service, and 2) the pneumatic inner tubes were prone to punctures and leaking.

Fortunately the issues with the ball bearings were easily and inexpensively solved with a simple bearing replacement, as shown in the photos. We were able to find replacement bearings of high quality which

have provided excellent service. The bearings we used are pre-packed with grease and also sealed for protection from dirt and contaminants.

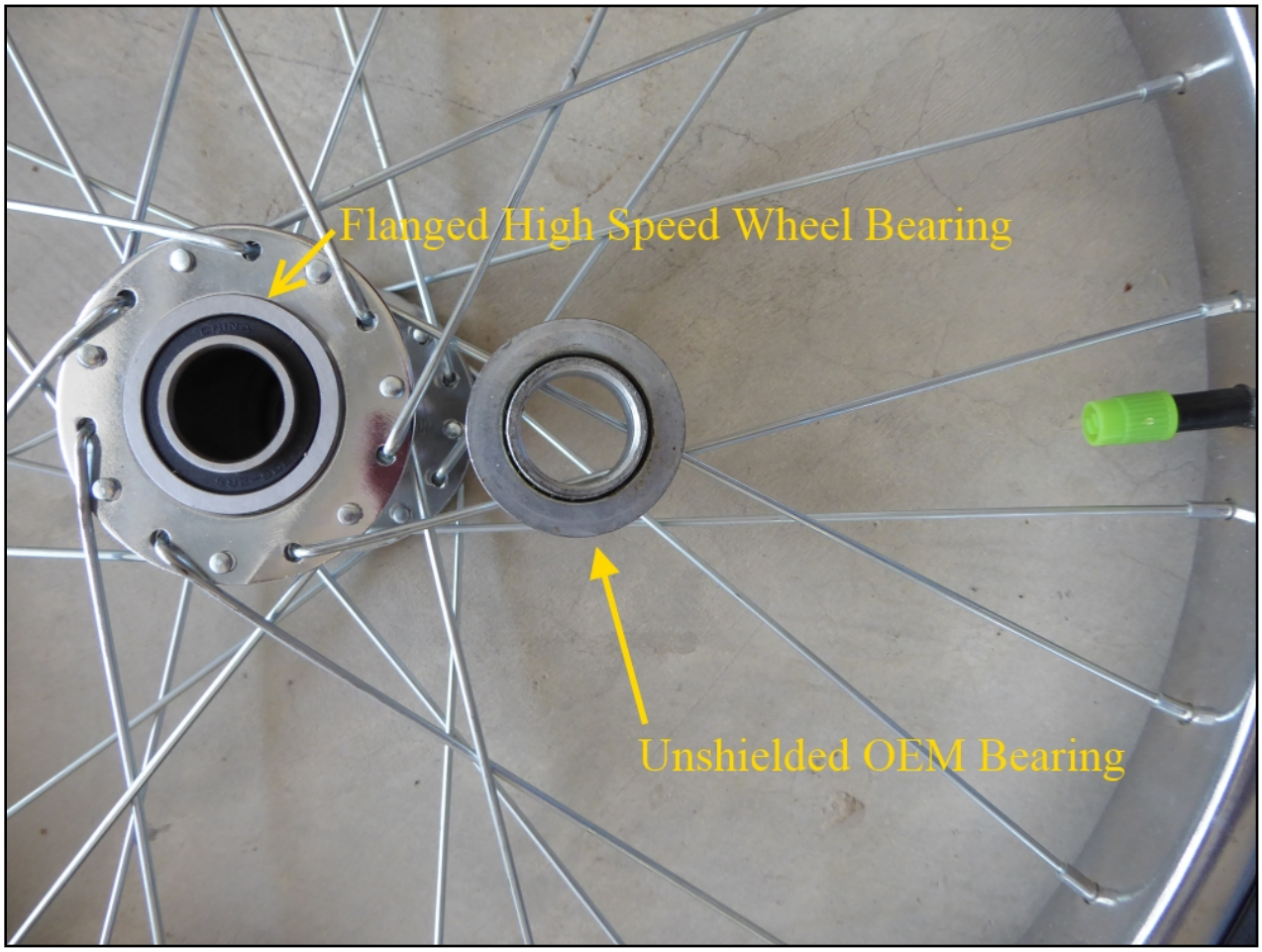


Figure 5. The original front wheel bearings were replaced.

The issues with the pneumatic tires leaking were rather surprising to us. We found that the fasteners for the spoke seats in the rims had numerous sharp edges. At first we tried to tape-over these sharp edges with vinyl electrical tape, but that did not work for long, and the tires would start leaking again. We eventually solved this problem by replacing the original inner tubes with a special 'stop-leak' type. (“Slime”) This simple and inexpensive remedy has worked quite well for us.

Using large diameter tires on the front end required increasing the width of the front wheel base to eliminate rubbing against the frame during sharp turns. We incorporated 2 design features to solve this problem: We started by choosing the largest and longest wheel spindles available. And second, we used shaft spacers to move the wheels outboard as much as possible. (Spacers were found at our local hardware, but McMaster-Carr offers parts that will also work.) The combination of these two design choices resulted in perfect placement of the front wheels, and provides the necessary turning clearance. The front and rear wheels also track together. Drill the shaft ends and install a cotter pin, safety pin or wire to prevent the nuts from coming loose. ***The nylon locknuts are not sufficient. They will eventually work their way off!***

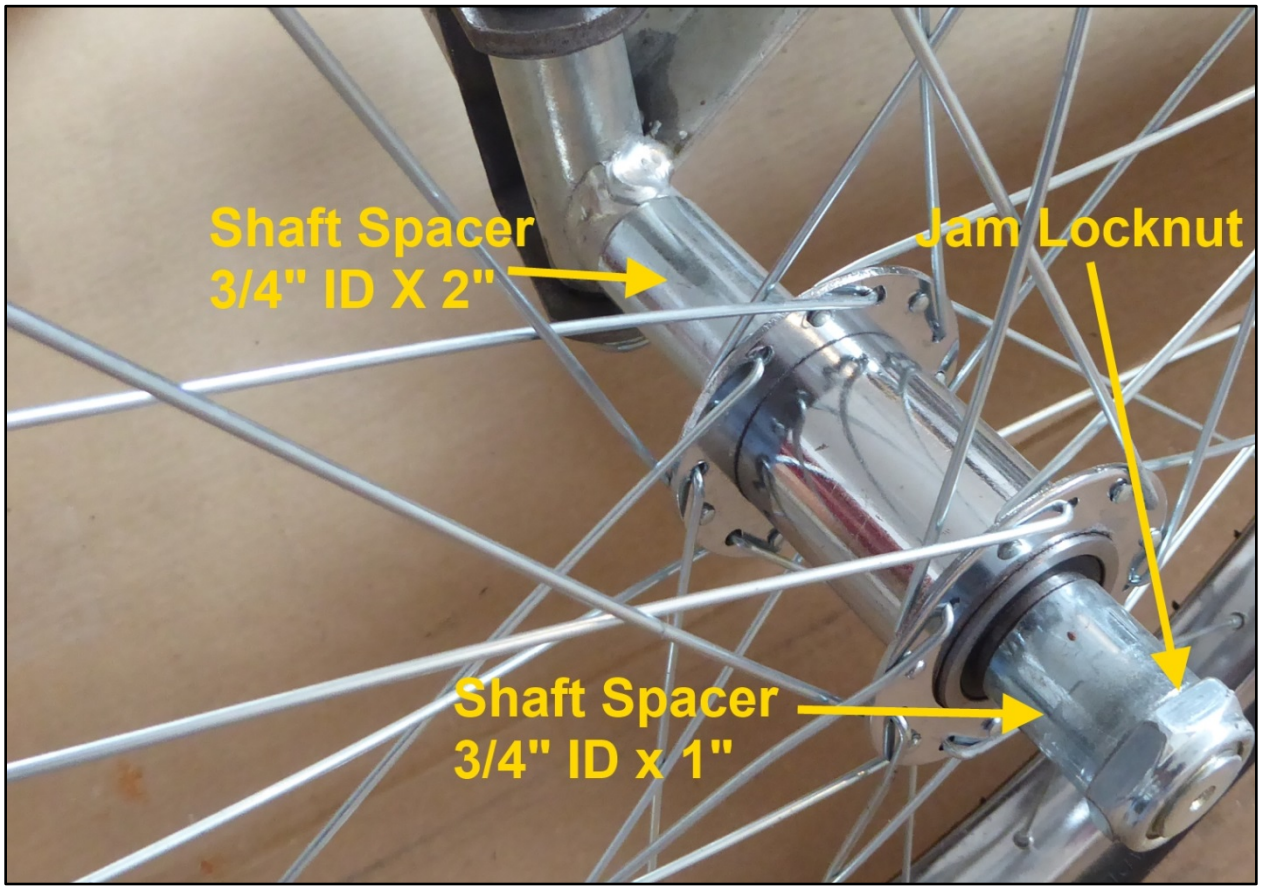


Figure 6. Details of the spacers used on both of the front wheels.

The steering linkage to the spindles is a more-or-less standard type of ball end linkages. We opted to weld our pinion arms to the steering wheel shaft for perfect placement, but we expect the pre-welded style would also be satisfactory. We chose a butterfly type steering wheel to increase the clearance underneath, which makes it much easier to enter and exit the driving seat.

Figure 7. Butterfly style steering wheel increases clearance for driver.

Rear End & Brakes

The rear wheel shaft on the Cyclecar is a live axle. That means the entire axle shaft rotates with the wheels. The rear axle is supported by two ball bearings at opposite ends. We chose to use a heavy duty 1.0 inch diameter shaft with length of 36 inches. The shaft has keyway cuts at both ends. Both ends of the shaft are also stepped-down and threaded, which is a great convenience for attaching the wheel hubs.

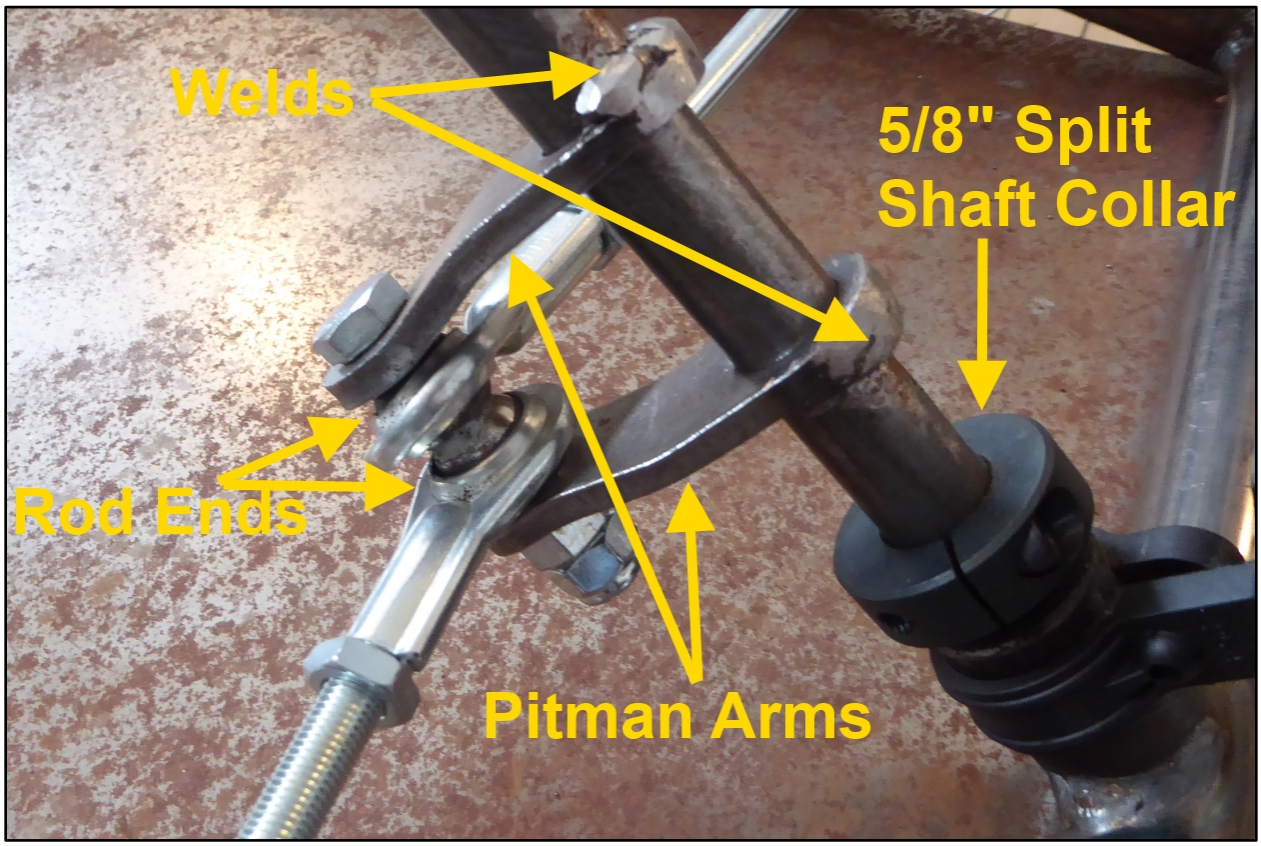


Figure 8. Details of the steering mechanism.

The rear shaft was found to have a tendency to drift right-or-left in the ball bearing supports. We implemented a simple system of spacers to precisely and rigidly position the shaft. The spacers are located at opposite ends of the shaft. The spacers ride between the inner races of the ball bearings and the inside rims of the wheel hubs. (The wheel hubs are solidly attached to the stepped-down shaft ends.) This simple system of shaft spacers positions the live rear axle in a fixed location.

The driver left side wheel is free to spin on the shaft. The wheel hubs do not have ball bearings. The bore of both wheel hubs is plain. No key is used on the freewheel. The axle is positioned off the inner race of the main axle bearing using a 1” ID bronze spacer of 2.25” length. A spacer

washer was also used to fine tune the length, as shown in the photo. The hub is held onto the shaft with a ¾" diameter steel spacer of 1.0" length. The axle bolt on the end is a Nylon insert type, which is resistant to unthreading. We advise to drill the shaft ends and use safety wire when you have the assembly finalized.

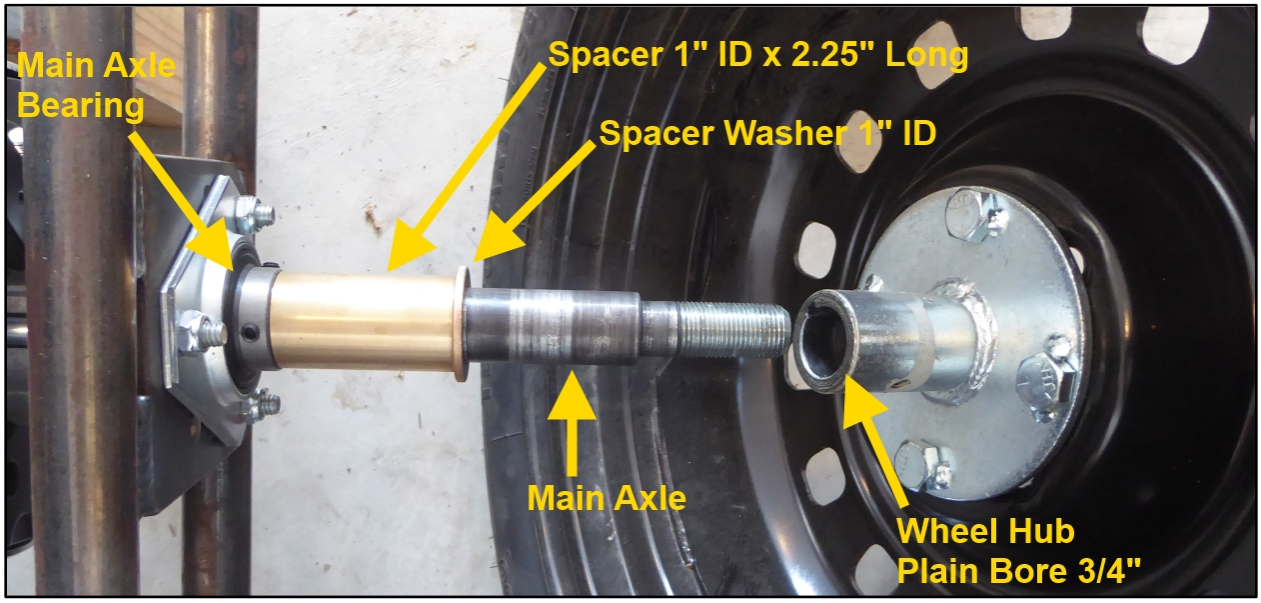


Figure 9. Drive side left rear wheel. This wheel freewheels. Not driven.

The rear wheels and tires of the Cyclecar are unusually large. The large size was chosen to facilitate ground clearance and operation over rough terrain. We searched extensively for suitable go-kart wheels, but they were generally expensive and limited in size. The Cyclecar wheels and tires are actually compact spares from a Ford Escort! We found these wheels readily available on EBAY, at reasonable prices and in like-new condition. The only modification we made to the wheels was to drill a pattern of 4 mounting holes to match the bolt stubs on the hubs.

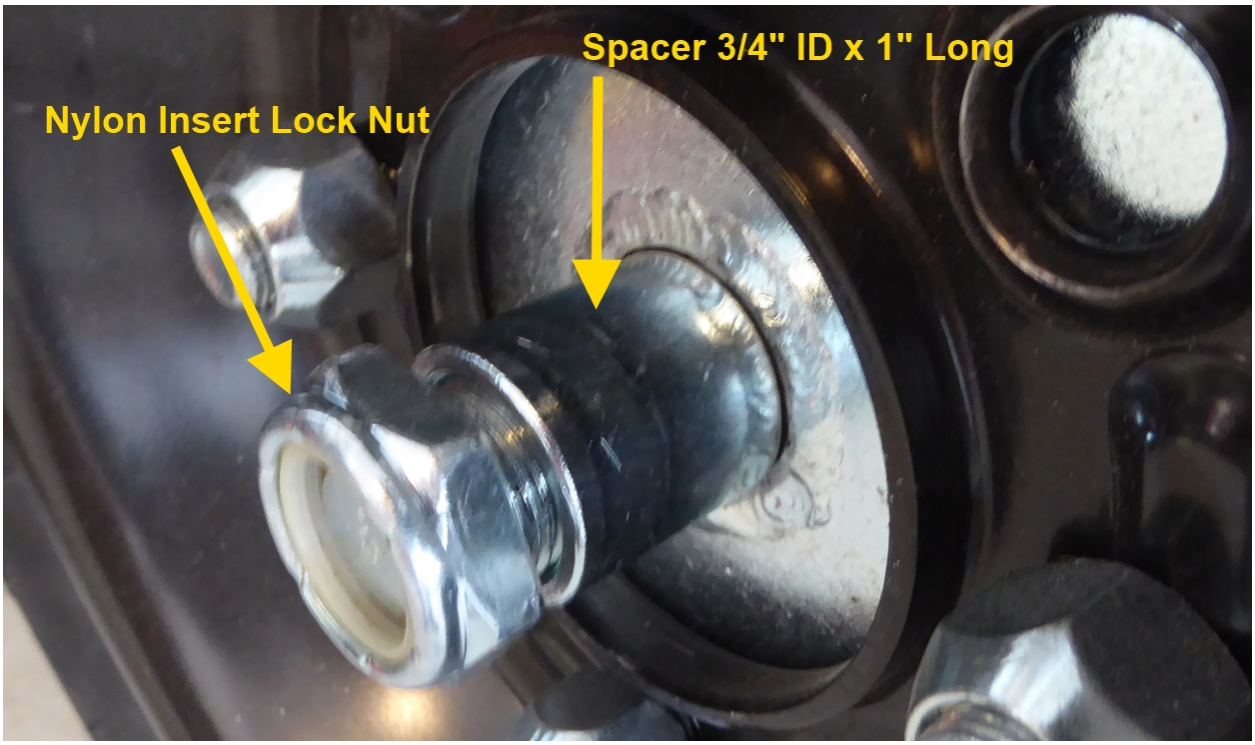


Figure 10. The wheel hubs are held to the shaft using a spacer & locknut. Drill a hole in the shaft and install a cotter pin after adjustment!

One of the most significant design choices for the Cyclecar was the type of rear wheel drive. The rear shaft is a live axle. We initially attached both rear wheels directly to the shaft to maximize traction. Traction was indeed accomplished, but the steering was difficult for anything more than a gradual turning radius. We eventually progressed to using a single driven rear wheel drive. In this configuration the traction is still very good and the steering is exceptionally easy and sharp. Since both the wheel hubs and shaft are prepped to accept keys, selecting the drive mode on a wheel is simply a matter of including a shaft key, or not. We have chosen to drive the wheel closest to the engine on the driver's right. Drill the shaft ends and install a cotter pin, safety pin or wire to prevent the nuts from coming loose. ***The nylon locknuts are not sufficient.***

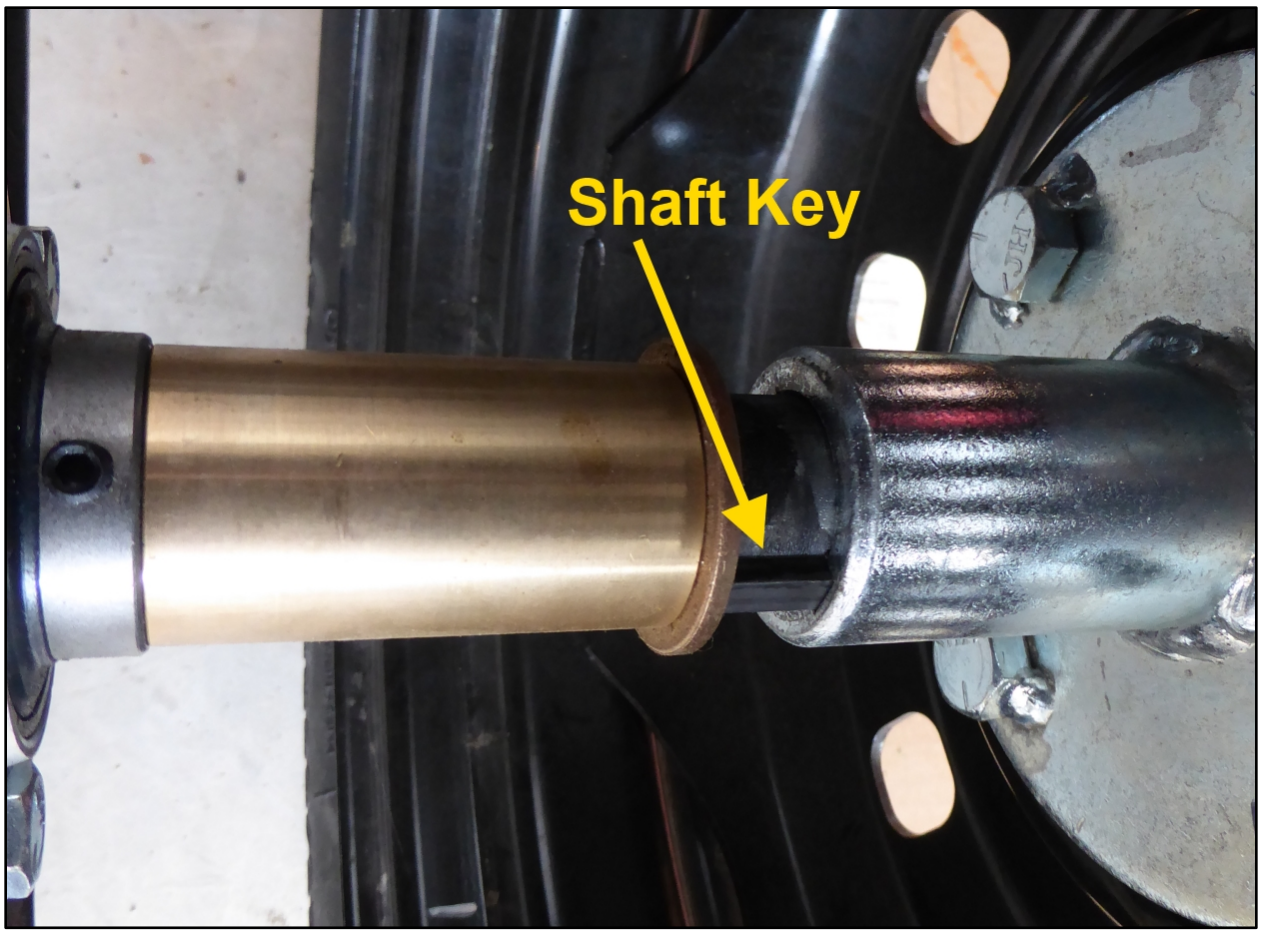


Figure 11. The driver side right wheel is keyed to the shaft. It is driven.

The Cyclecar uses a standard drum and shoe style go-kart braking system. This approach to the brakes turned out to be ideal, since the frame is designed for easy mounting of the associated components. The only challenge with the brakes was securing their axial location on the rear shaft. As supplied, the brake drum is designed to be attached using a shaft key and set screws, on the driver's left. We found this method worked at first, but eventually the set screws would loose their grip and the drum would begin to move. We solved this problem by adding split shaft collars on either side of the brake hub. The shaft collars are designed to securely grip the shaft, and they can be easily positioned to any desired location along the shaft. By using shaft collars on both sides of the brake hub, we also captured the shaft key inside the brake hub.

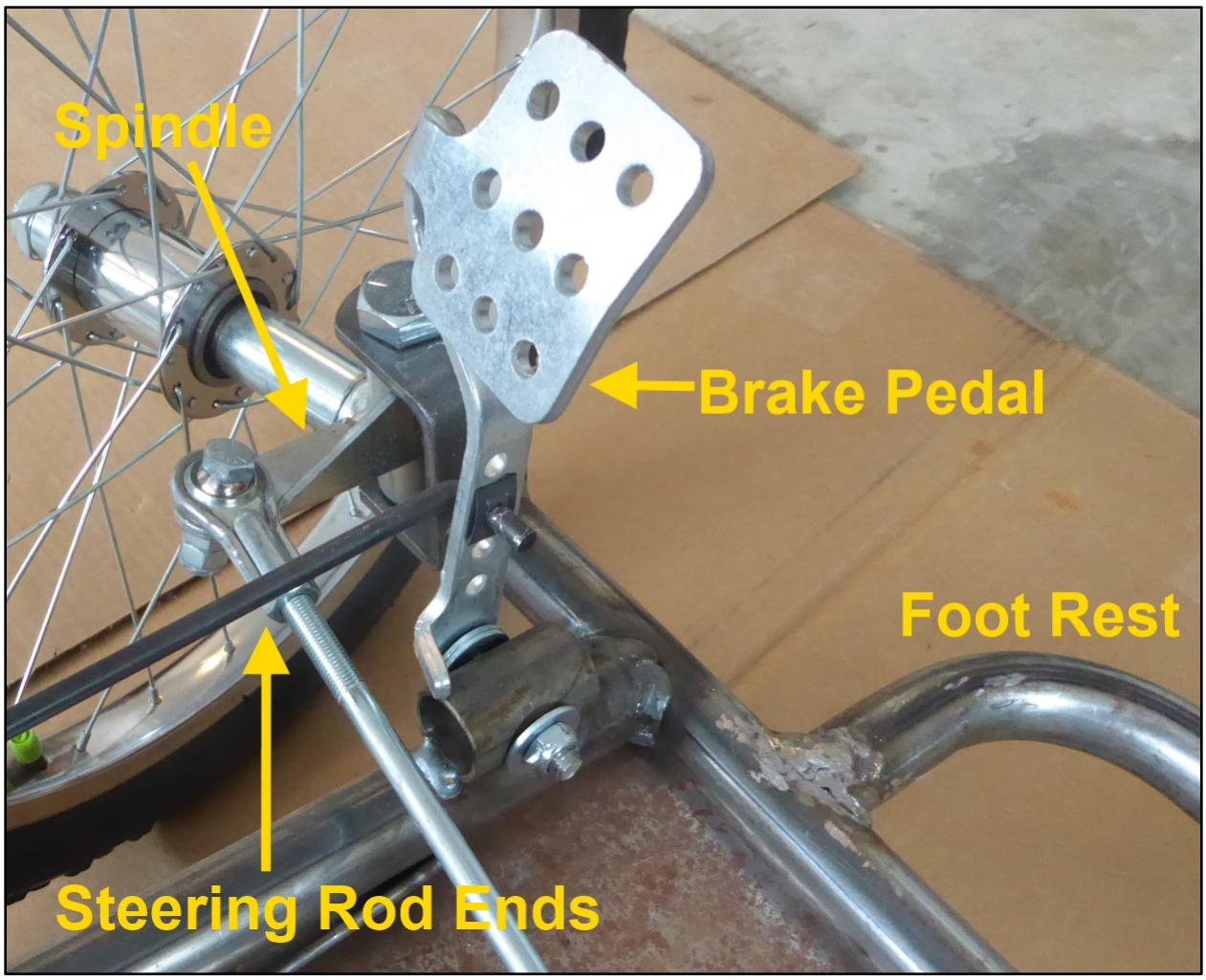


Figure 12. Detail for the brake pedal.

The Cyclecar uses a chain drive to transmit power from the engine to the wheels. A large chain sprocket is attached to the rear axle. The sprocket is also fixed to the shaft using a key. The position of the sprocket on the shaft is fixed by using another pair of split shaft collars. (Identical to the method of locating the brake drum.) The sprockets are designed for standard Number 35 chain, cut to length, and held together with a master chain link.

Engine & Jackshaft & Clutch

The Cyclecar uses a 4 cycle internal combustion engine with 97cc displacement rated for 2.8 HP at 3600 RPM. We purposely chose to use

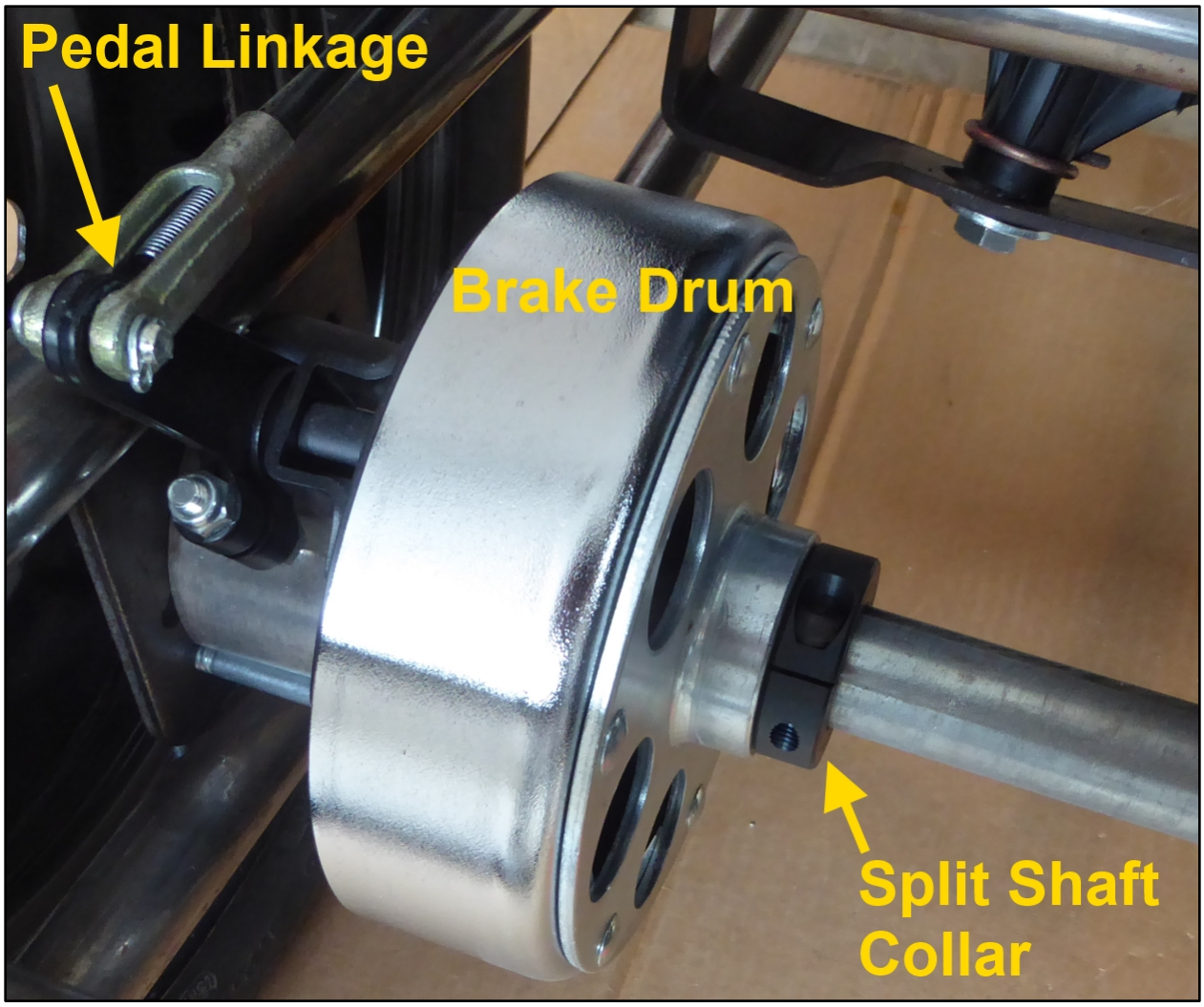


Figure 13. Details of the brake drum assembly.

a small engine for overall economy, and focused on creating a drive system with good mechanical advantage to effectively use the available power. The big rear wheels and high RPM engine requires a large ratio of speed reduction to develop good low speed torque.

The large ratio of speed reduction from the engine to the wheels is accomplished using a double-reduction chain drive system. A small sprocket on the engine drives a large sprocket on an intermediate shaft called the 'Jackshaft'. A second small sprocket on the jackshaft drives the large sprocket on the main axle shaft. The overall speed reduction ratio is the product of the two individual reduction ratios, in this case 16.

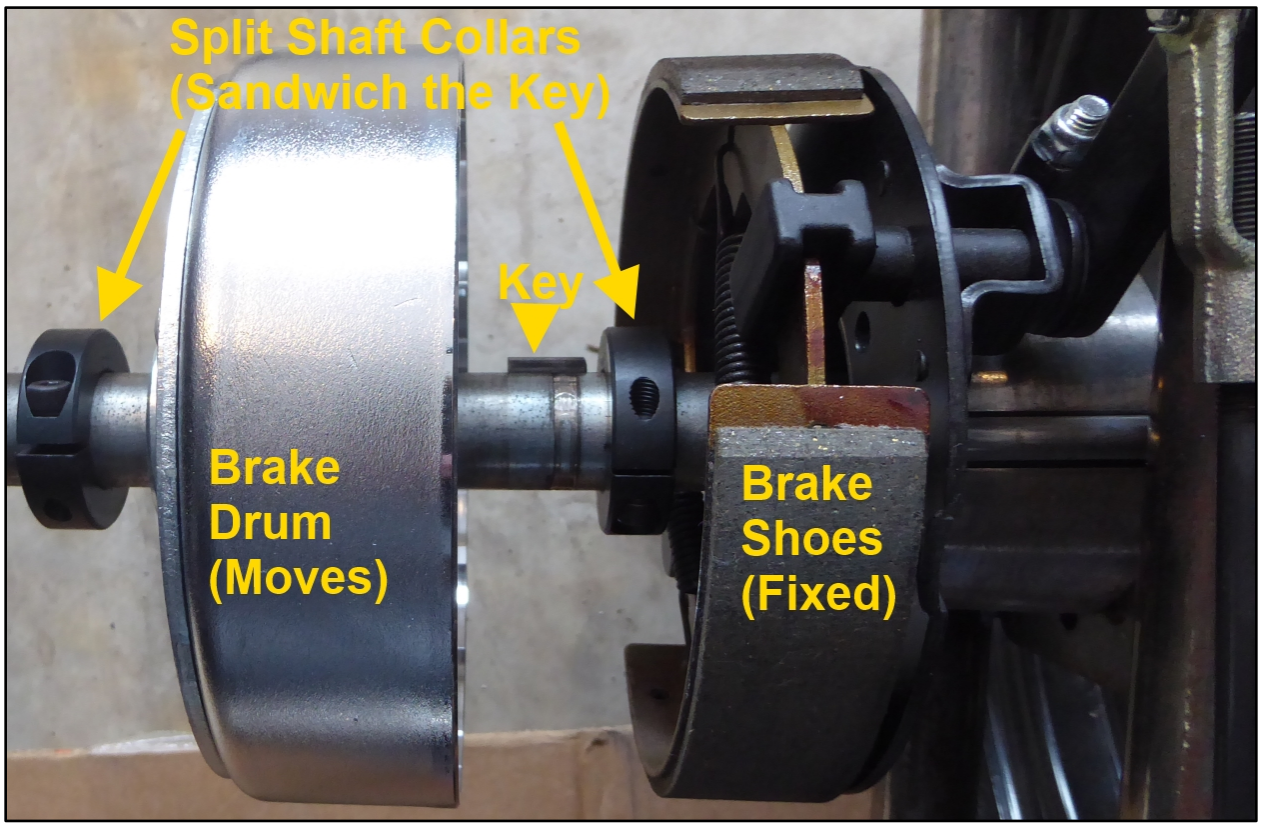


Figure 14. Detail of how brake drum is sandwiched to hold the key.

The centrifugal clutch has 11 teeth. The jackshaft large sprocket has 27 teeth. [27 / 11= 2.45] The jackshaft small sprocket has 11 teeth. The large axle shaft sprocket has 72 teeth. [72 / 11= 6.54] So, the overall reduction ratio of the entire drive is the product of the two individual ratios. [2.45 x 6.54 = 16.0]

The usual challenge with using a jackshaft is the mechanical mounting

arrangement. The jackshaft must be supported with ball bearings because it is rotating. At the same time the jackshaft position affects two center distances, and the chain lengths between them: 1) Jackshaft to engine, and 2) Jackshaft to rear axle. We found a mechanical kit on EBAY specifically designed for adding a jackshaft to a small horizontal shaft engine. The kit uses a rectangular steel channel with a heavy duty shaft supported by ball bearings mounted in pillow blocks.

The engine mounts to the top of the steel channel in the jackshaft kit. The bolt pattern on the engine we chose does not exactly match the bolt pattern on the channel. Fortunately, we found an adapter plate on EBAY that was perfect for mounting the engine. The adapter plate is supported by 4 bolts, as shown in the photos. The sandwich arrangement of nuts on the 4 bolts are used to move the engine up-and-down, thereby adjusting the chain tension. By using this arrangement the engine and jackshaft mount become an integral unit... which only needs adjustment once to obtain the proper chain length between engine and jackshaft.

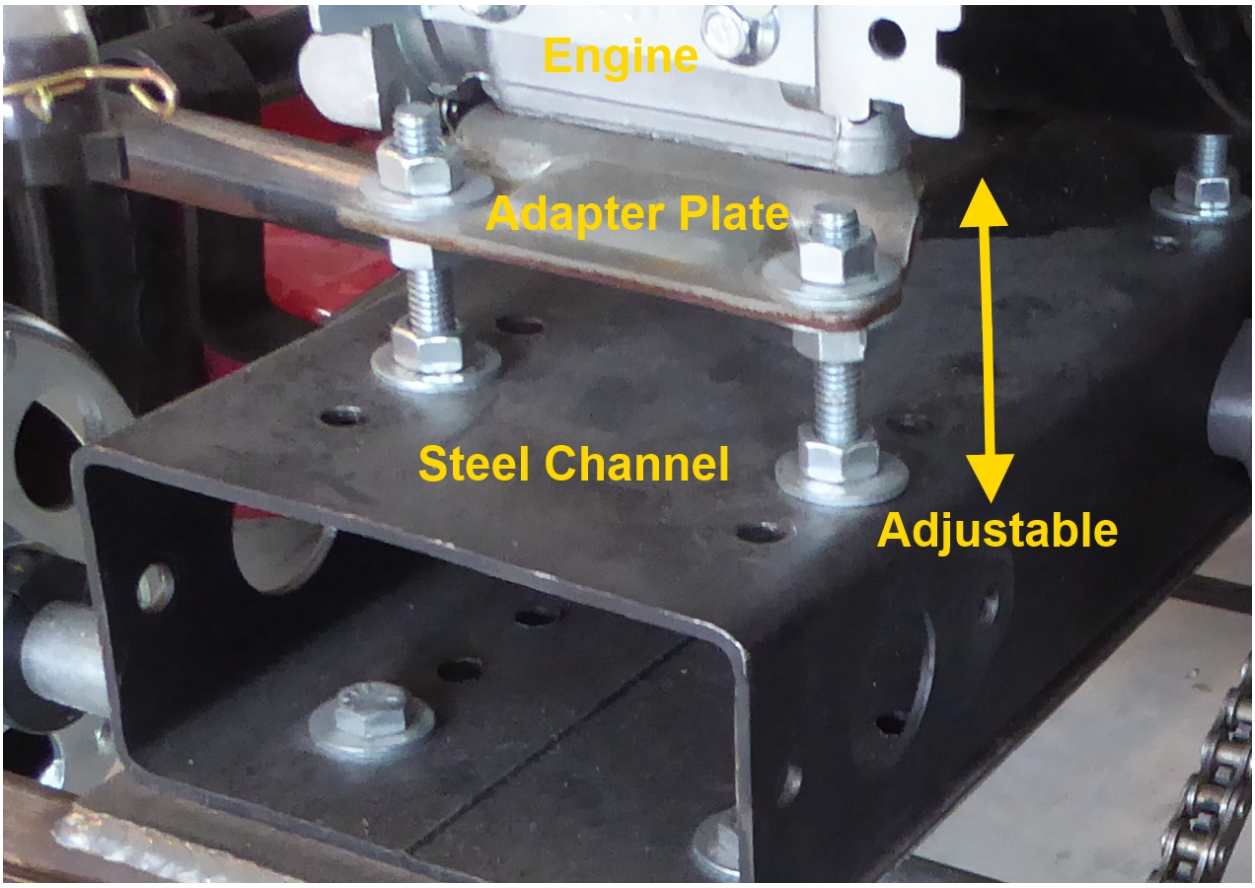


Figure 15. The engine is adjustable up and down using the 4 bolts.

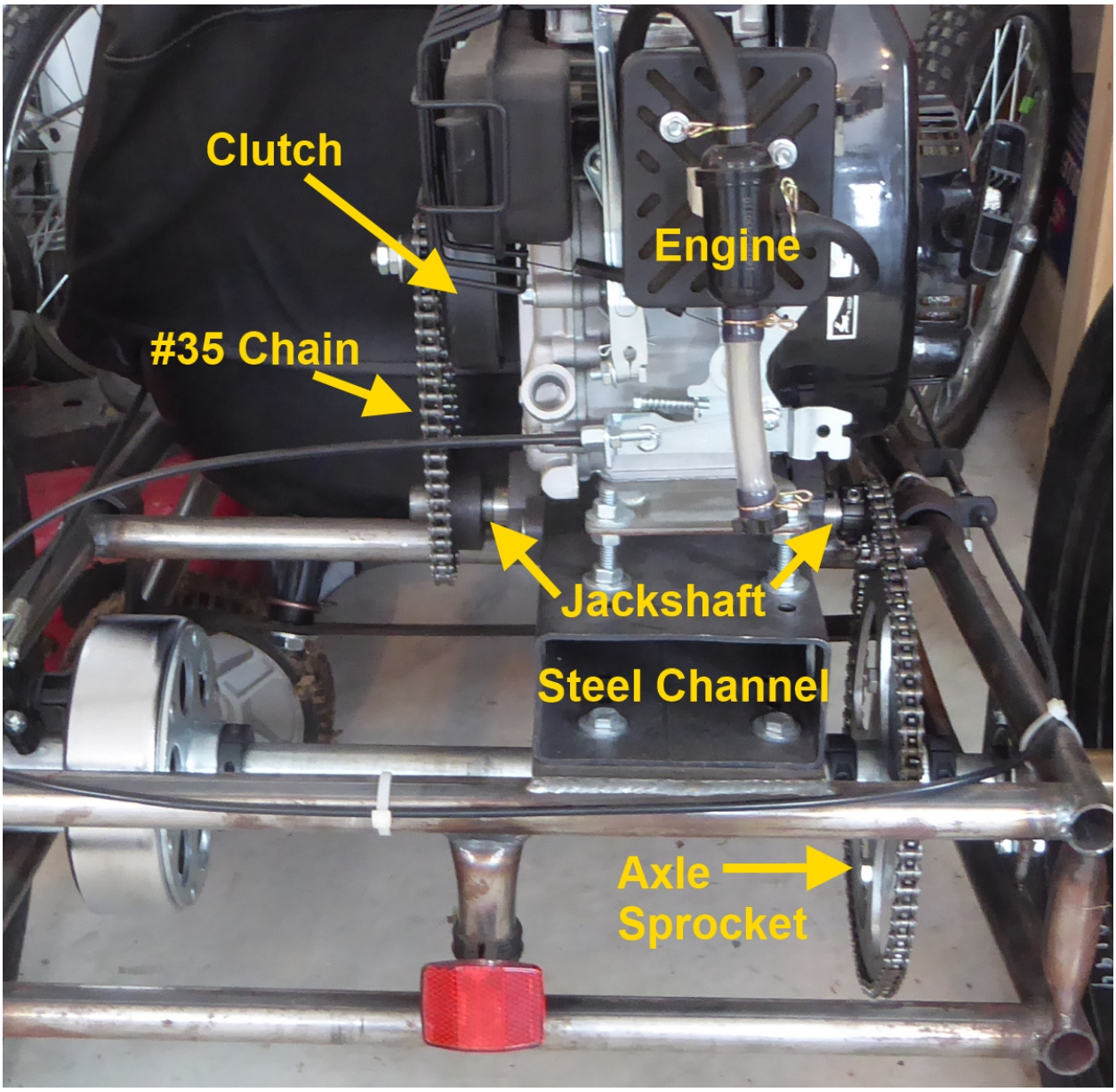


Figure 16. Overall view of the jackshaft drive system for the Cyclecar.

The modular engine-and-jackshaft assembly is mounted to the Cyclecar frame in the location where just the engine would normally be positioned. The Cyclecar frame has a mounting plate with slots designed for an adjustable center distance to the rear shaft axle. The slots are used to adjust for proper chain length between the jackshaft and the axle. We found this simple arrangement to be rugged and easy to work with.

A centrifugal clutch is part of the power train. The clutch is directly mounted on the engine's output shaft. The clutch allows the engine to reach operating RPM before power is sent to the chain drive. We used a standard go-kart centrifugal clutch for this purpose.

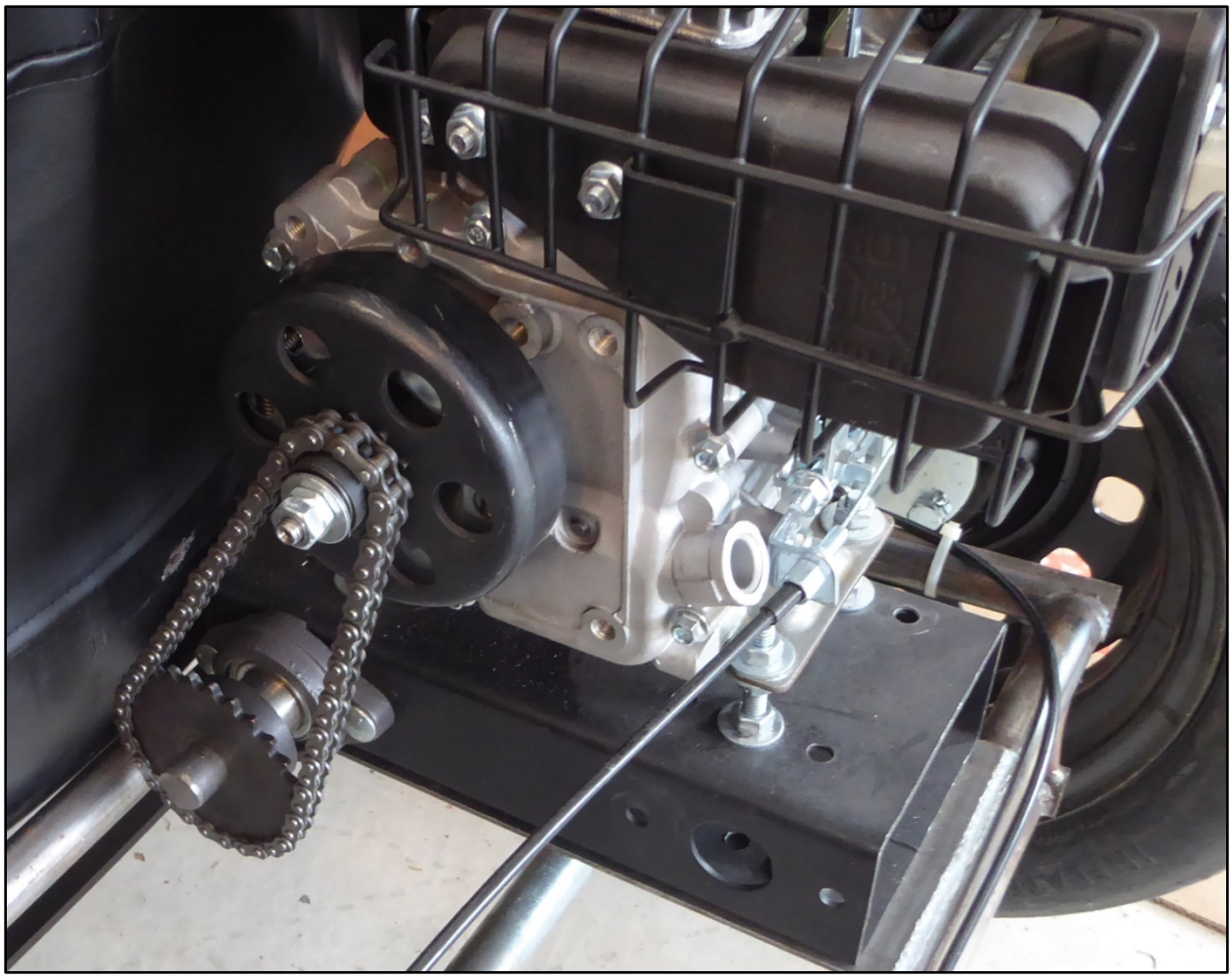


Figure 17. View of the drive train on the centrifugal clutch side.

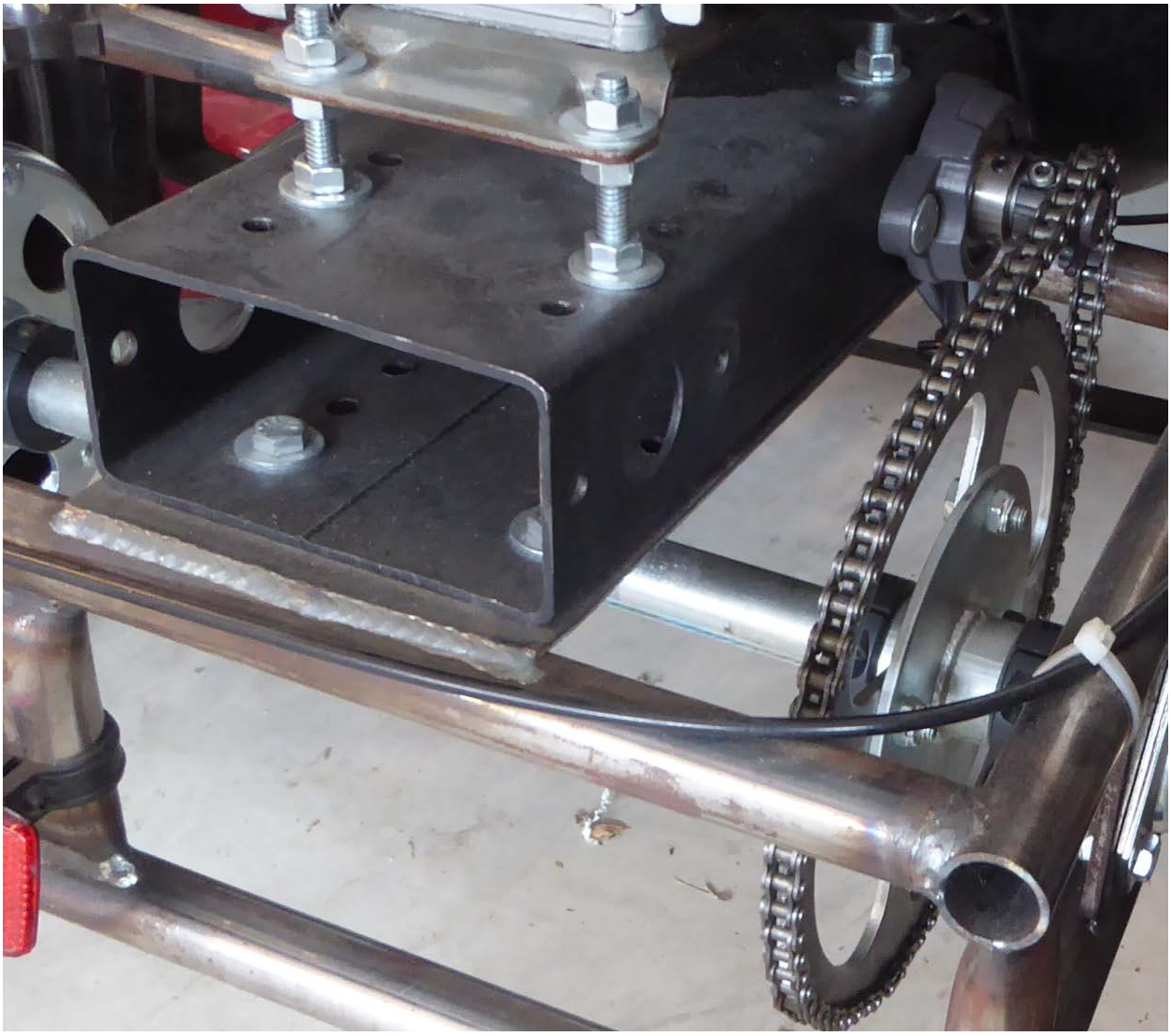


Figure 18. View of the drive train on the shaft-driven side.

Miscellaneous

The brake and throttle pedals are standard go-kart types. We included an inexpensive engine kill switch button on the frame, which the motor is designed to readily accept. The bucket seat and seat cover are also standard go-kart design, and fit the frame perfectly.

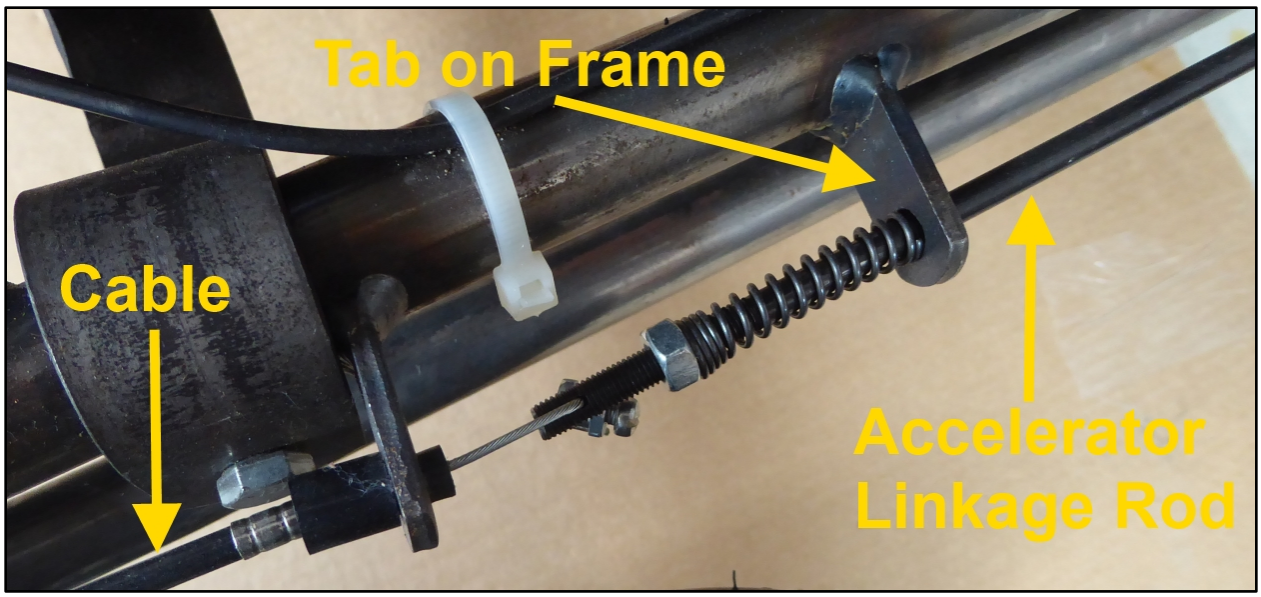


Figure 19. Detail of transition of accelerator rod to throttle cable.

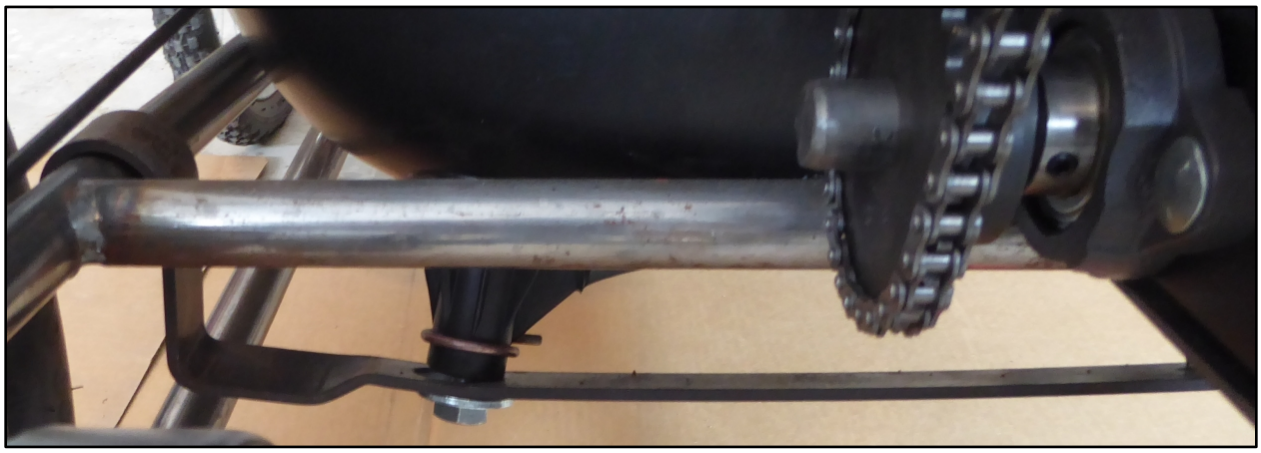


Figure 20. The plastic bucket seat mounts to rails hanging from the frame.

We did make a small optional change to the front of the frame. We welded an extension on the front to serve as an extended foot rest. We found that pre-fabricated tubular steel parts are readily available on EBAY for building dune buggies. The front extension is actually designed to be a pre-formed grip handle. We found that the small electric welder sold by Harbor Freight (which uses flux-cored welding wire) worked quite well for us.

Figure 21. Details of the flux cored welder from Harbor Freight.

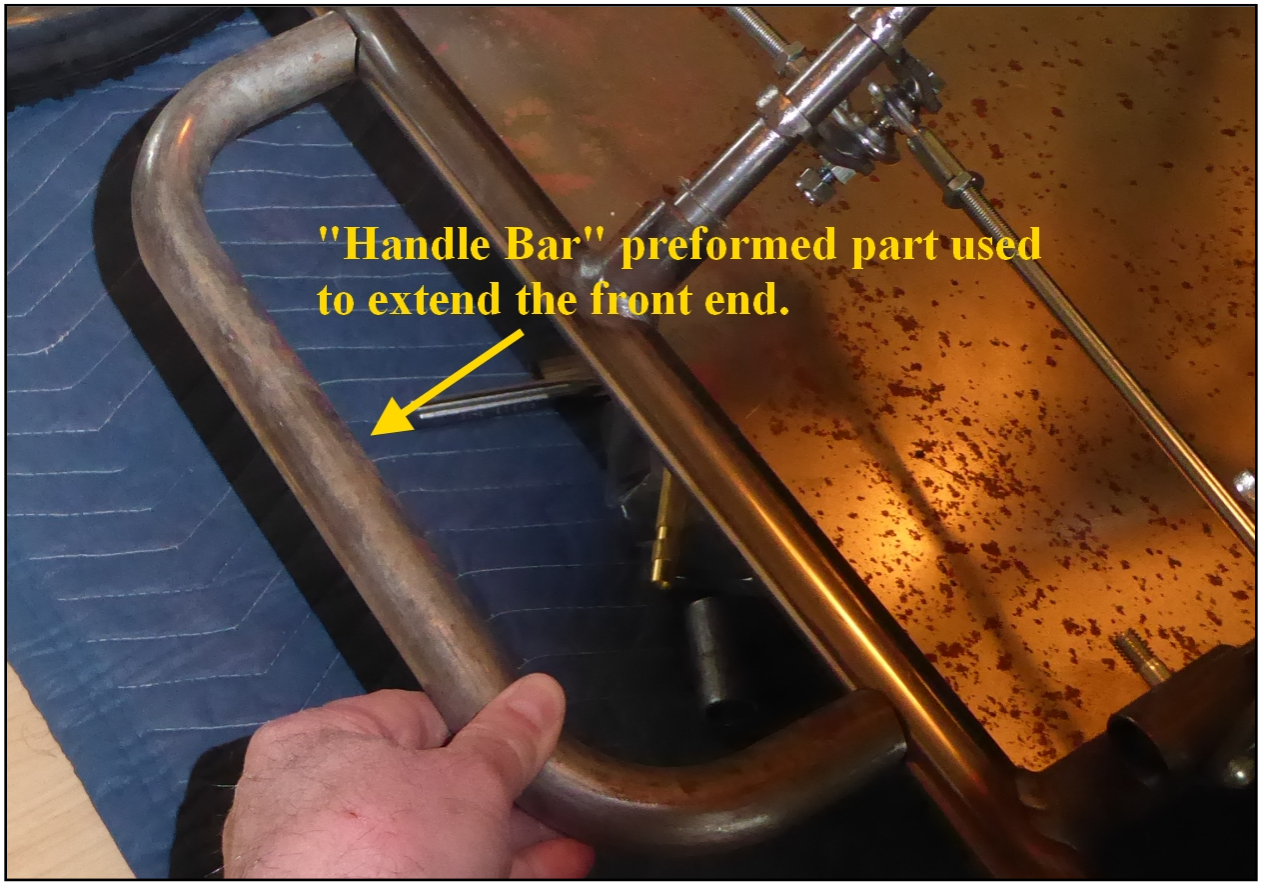


Figure 22. Details of the front foot rest frame extension.

A logical improvement to the Cyclecar design would be to add rollover protection. *We actually rolled over the Cyclecar by making a sharp turn at high speed. So be careful!* We found that the existing chain drive ratios provide a nice compromise between speed and power. For example, driving the Cyclecar on grassy turf was not a problem, even for an adult.

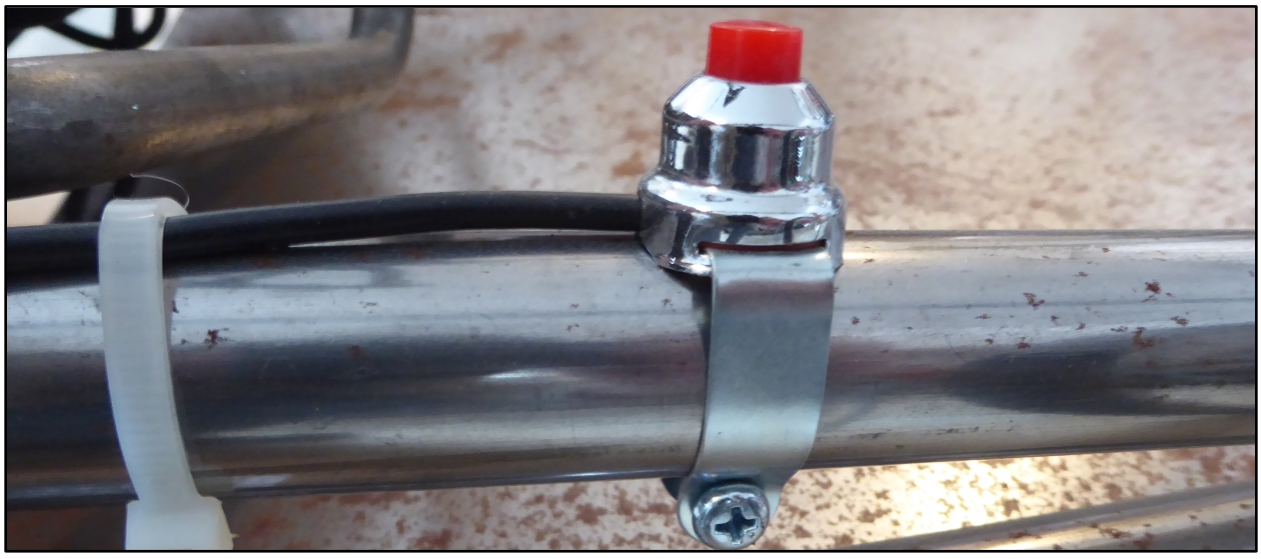


Figure 23. Details of the kill switch mounting for the engine.

The Cyclecar does not have a suspension system to reduce shock and vibration. We found that the most effective method of improving the quality of the ride was to operate with low air pressure in the rear tires. Normally, compact spares are inflated to a rock-hard pressure of 60 psi. Instead, we operate the rear tires at about 15 psi. A true suspension system would be a worthwhile project to consider for improving this design. Another improvement might be to cut the frame at the midpoint and weld extensions in place to extend the overall length for more leg room. A nice paint job, or even some fiberglass body cowlings,

would also be worthwhile project improvements.

Figure 24. View of the Cyclecar near completion. No front bumper, yet!

Ideas, Improvements & Future Projects

Roll bar protection would be the most obvious improvement for the Cyclecar. Of course, another great improvement would be a nice paint job! A fiberglass body or shell would also be a fun project, as an enclosure would certainly improve driver comfort and extend the driving season. Another idea to explore would be adding electric drive to the vehicle. Instead of simply replacing the gasoline engine, we had thought

it might be possible to replace the front bicycle tires with electrically driven wheels. (These are widely available on EBAY.) Something else to consider would be adding an electrical system in general. This could consist of a battery with an electrical DC generator for charging connected to the drive system. A system of headlights or brake lights would be the perfect companion with an onboard battery, as would other electronic devices such as a GPS navigation, solar panels, speedometers, etc.

Figure 25. Complete kits are available for electric bicycle wheels.

Another idea we have considered is replacing the front bicycle wheels with skis for operation in snow. For that purpose we have the front skis

from older style snowmobiles look very promising, and again are available on EBAY.

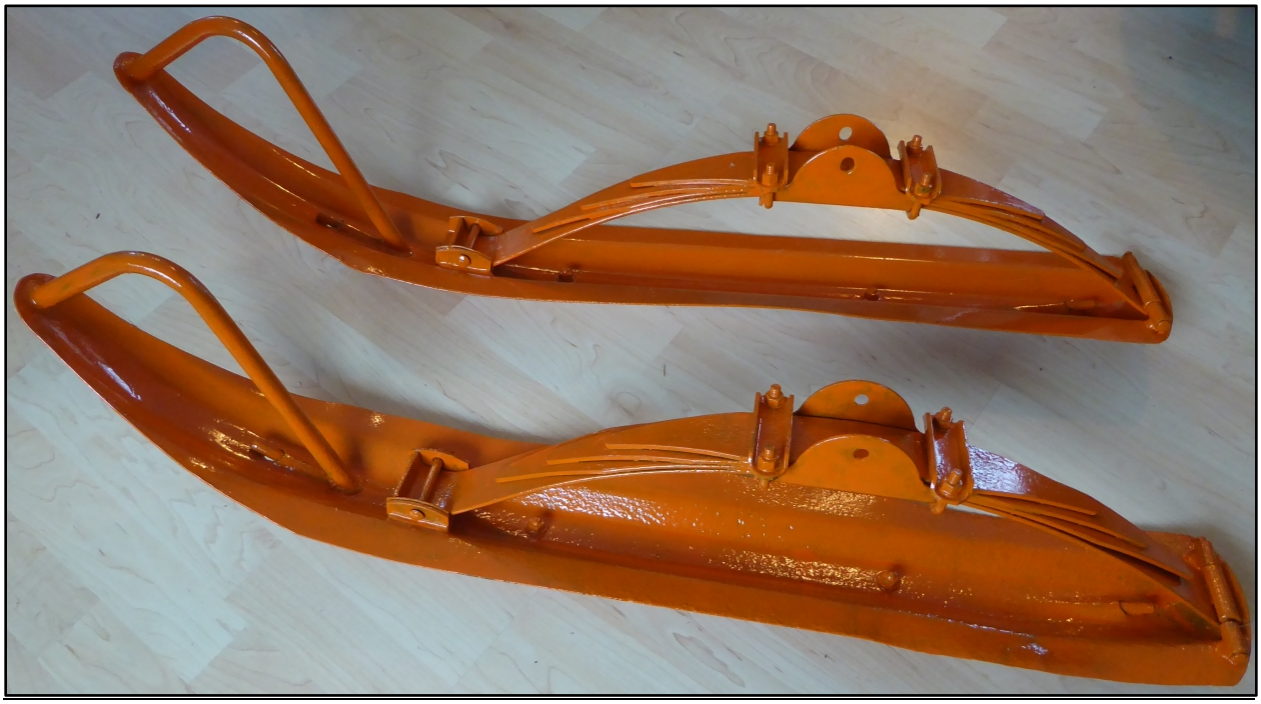


Figure 26. Snowmobile skis might be used to replace the front wheels.

Please be sure to send us your photos if you decide to build your own Cyclecar. Have fun!

Parts List

Here is the parts list for the Cyclecar. We have listed the parts here grouped by the supplier. We have also included some photos to help identify items.

The first parts listed here were purchased directly from a distributor for Azusa Engineering. We strongly suggest you download and study the printed catalog from Azusa. The catalog is available here:

http://azusaeng.com/wp-content/uploads/2015/12/AZCtlg308.pdf

The dealer we used for Azusa is ‘Go Kart Galaxy’. They are here:
http://www.gokartgalaxy.com

Description: Bucket Seat Cover, Deluxe, Item #: 1645
Note: Nice to have but not absolutely required.
Unit price: $42.95 USD
Qty: 1 Amount: $42.95 USD

Description: Throttle Control Rod Kit, Item #: 2280
Note: This is a standard go kart setup
Unit price: $10.95 USD
Qty: 1 Amount: $10.95 USD

Description: Throttle Pedal, Item #: 1811
Note: This is a standard go kart pedal
Unit price: $5.25 USD
Qty: 1 Amount: $5.25 USD

Description: "B" Type Engine Sprocket for #35 Chain, 11 Teeth, Item #: 2139-K (Note: This is the small sprocket on the jackshaft.)

Unit price: $8.95 USD
Qty: 1 Amount: $8.95 USD

Description: Standard Chain- Connecting Link, Item #: 4009
Note: Use this after ‘breaking’ chain to length to fit the setup.
Unit price: $0.45 USD
Qty: 2 Amount: $0.90 USD

Description: Chain Breaker for #25 thru #60 Chain, Item #: 4097
Note: Use this tool to ‘break’ the chain to fit the length you need.
Unit price: $16.25 USD
Qty: 1 Amount: $16.25 USD

Description: 72 Tooth Sprocket for #35 Chain, Item #: 2165-72
Note: This is the main axle shaft sprocket. Connects to the hub.
Unit price: $19.05 USD
Qty: 1 Amount: $19.05 USD

Description: 6" Brake Unit w/Spacer, Item #: 2552
Note: The brakes are a standard go kart setup.
Unit price: $108.00 USD
Qty: 1 Amount: $108.00 USD

Description: Brake Control Rod Kit, Item #: 2281
Note: This is a standard go kart setup.
Unit price: $8.30 USD
Qty: 1 Amount: $8.30 USD

Description: Brake Pedal, Item #: 1806
Note: This is a standard go kart brake pedal.

Unit price: $5.25 USD
Qty: 1 Amount: $5.25 USD

Description: Bucket Seat Kit, Complete, w/o Cover, Item #: 2290
Note: This seat fits the frame perfectly.
Unit price: $74.95 USD
Qty: 1 Amount: $74.95 USD

Description: Wheel Hub for 1" Live Axle, Item #: 2282
Note: Use a key with the driven wheel, and let the other freewheel.
Unit price: $40.50 USD
Qty: 2 Amount: $81.00 USD

Description: 36" Standard End Standard Steel Axle, Item #: 1401-36
Note: This shaft comes with stepped-down ends, fits perfect.
Unit price: $42.50 USD
Qty: 1 Amount: $42.50 USD

Description: Live Axle Bearing Kit with 3-Hole Flangette-For 1" Standard Axle, Item #: 1861B
Note: These are the main bearings and flanges for rear axle.
Unit price: $33.25 USD
Qty: 1 Amount: $33.25 USD

Description: Nyliner-Split Reducer Bushing/Spacer, 5/8" ID, 7/8" Length, Item #: 8215
Note: This is used where the steering wheel shaft connects to frame.
Unit price: $0.50 USD
Qty: 1 Amount: $0.50 USD

Description: Machine Key 1/4" x 1/4" x 1-1/4", Item #: 8435
Note: You will need various keys for building. This is an example.
Unit price: $0.40 USD
Qty: 1 Amount: $0.40 USD

Description: Heavy Duty Sprocket Holder/Hub, Item #: 2286
Note: This is the hub that will hold the 72 tooth large sprocket.
Unit price: $22.95 USD
Qty: 1 Amount: $22.95 USD

Description: Spindle Set, Side 1, Item #: 2516
Note: You need a spindle set for each side.
Unit price: $23.95 USD
Qty: 1 Amount: $23.95 USD

Description: Spindle Set, Side 2, Item #: 2517
Note: This is the other side to the spindle listed above.
Unit price: $23.95 USD
Qty: 1 Amount: $23.95 USD

Description: Kart Frame w/Steering Hoop, Item #: 3502
Note: This is the basic frame for building the Cyclecar. Start with this.
Unit price: $139.00 USD
Qty: 1 Amount: $139.00 USD

The heavy duty flanged wheel bearings for the front wheels, and the kill switch assembly were both ordered from BMI Karts and Supplies. (http://www.bmikarts.com)

Flanged High Speed Wheel Bearing (3/4" x 1-3/8") (600689)
Note: You only actually need 2 of these. The others are only spares.
Ordered: 5 Shipped: 5

Kill Switch (400500)
Note: This is a nice setup and reasonably priced.
Ordered: 1 Shipped: 1

Many more of the parts were purchased directly from EBAY. As you know, EBAY is constantly changing but you generally can find items by searching for keywords in the descriptions. Here are screenshots of the EBAY listings to help you find the items.

ORDER DATE
Jul 28, 2015

ORDER TOTAL
US $21.99

See description

1 item sold by

CENTRIFUGAL CLUTCH 5/8" BORE 35 CHAIN 11T FOR GO KART MINI BIKE ENGINE BARSTOOL
(390840623538)

ITEM PRICE:
US $21.99

ORDER DATE
Mar 07, 2016

ORDER TOTAL
US $35.00

See description

1 item sold by renos_auto

00-11 FOCUS SPARE TIRE 15X4 COMPACT SPARE 347600
(321835493558)

ITEM PRICE:
US $35.00

ORDER DATE
Mar 12, 2016

ORDER TOTAL
US $40.00

+ US $24.00 shipping

1 item sold by lamborghini-parts-wi

2000-2011 Ford Focus Mini Compact Space Saver Spare Tire & Wheel 15x4 Hankook
(161926107961)

ITEM PRICE:
US $40.00

ORDER DATE
Apr 03, 2016

ORDER TOTAL
US $9.99
+ US $3.65 shipping

1 item sold by partsandpieces2010

Honda GX100 OEM 3HP Side Shaft Engine - Motor Mount Bracket
(151538310946)

ITEM PRICE:
US $9.99

ORDER DATE
Apr 09, 2016

ORDER TOTAL
US $12.00
+ US $6.10 shipping

1 item sold by partsparts15

Martin 35BS27 3/4" Bore single chain sprocket 27 teeth
(322051456196)

ITEM PRICE:
US $12.00

ORDER DATE
Apr 09, 2016

ORDER TOTAL
US $39.95
See description

1 item sold by stevbmi

Motor Mount Plate with Jackshaft and Bearings for Go Kart Carts Parts Supplies
(191798384526)

ITEM PRICE:
US $39.95

ORDER DATE
Apr 10, 2016

ORDER TOTAL
US $12.99

+ US $2.60 shipping

1 item sold by 53ragtop

Weld in Grab Handle Grab Bar Raw 90 degrees Dune Buggy Rock Crawler
(171591874402)

ITEM PRICE:
US $12.99

ORDER DATE
Jun 11, 2016

ORDER TOTAL
US $9.60

+ US $2.60 shipping

1 item sold by

Oilite Thrust Washer Bronze 1" id x 1-5/8 x 1/4 Brass Bushing Bearing Bushing
(381651931953)

ITEM PRICE:
US $9.60

ORDER DATE
Jul 17, 2016

ORDER TOTAL
US $37.98

See description

1 item sold by

H Steering Wheel Riding Lawn Mower Racing Black Butterfly Aluminum go kart cart
(231183107627)

ITEM PRICE:
US $37.98

ORDER DATE
Jul 28, 2015

ORDER TOTAL
US $7.50
+ US $5.20 shipping

1 item sold by

ROLLER CHAIN ASSEMBLY FOR MINI BIKES,GO KARTS, #35, 5FT, 162 LINKS + 2 CON.LINKS
(130722367336)

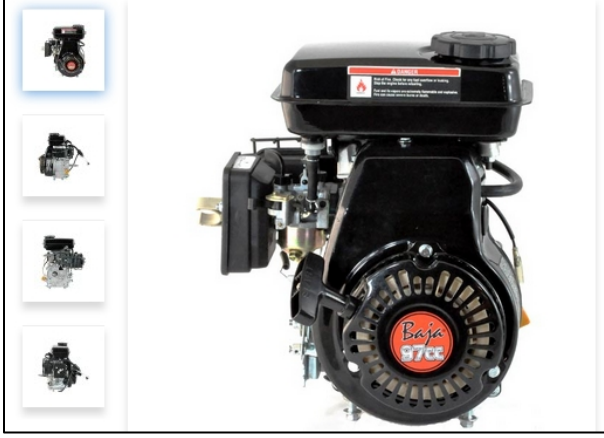
ITEM PRICE:
US $7.50

The engine was purchased from Monster Scooter Parts. They are here: http://www.monsterscooterparts.com

MONSTER Scooter Parts
MORE THAN JUST SCOOTER PARTS

97cc 2.8 Hp (Honda GX100 Clone) Pit Bike Engine for Baja Blitz, Dirt Bug, Doodle Bug, & Racer Mini Bike

Item: E05-1249 | **Baja Motorsports:** DB30S-101, DB30R-186



$194.99

Qty: - 1 +

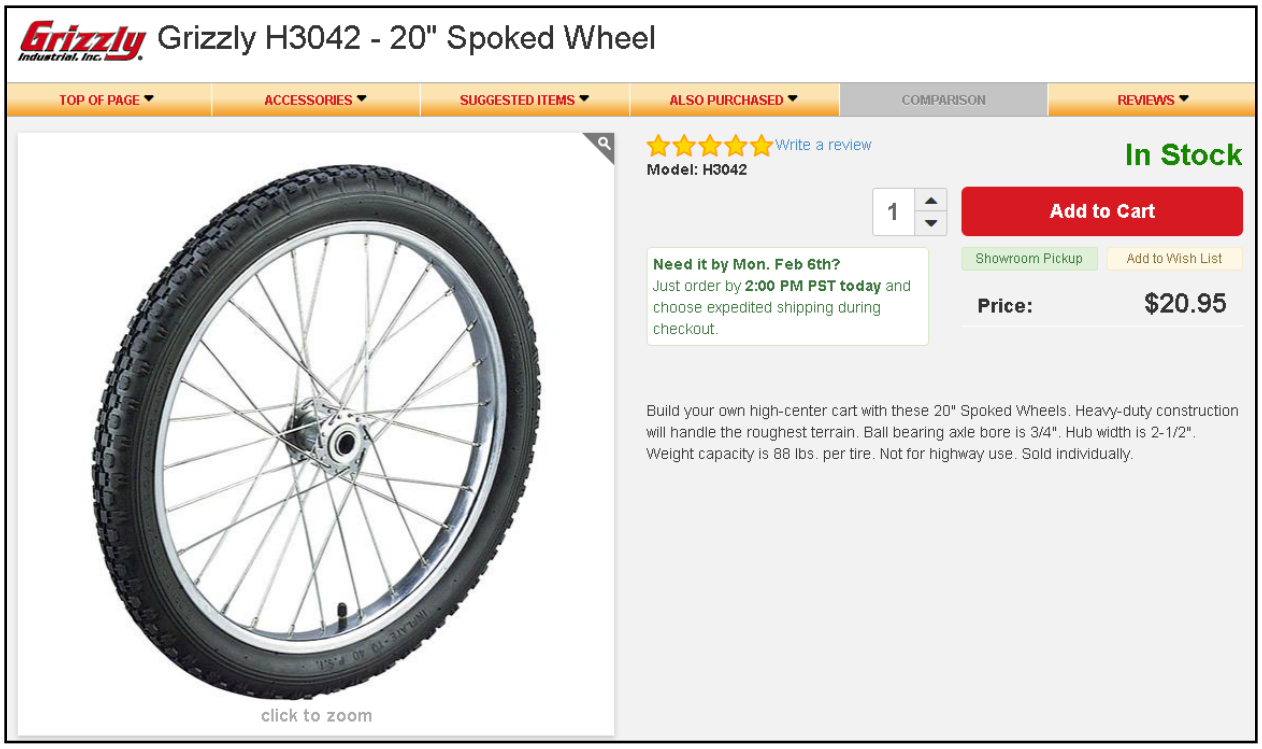
Add To Cart

In Stock - Ships Today!

Product Features

- Warranty: 30 Days

The front wheels were purchased from Grizzly, Model H3042. They are: http://www.grizzly.com



The 2 pieces shaft collars were purchased from McMaster-Carr. Also the rear wheel spacers & washers, and front wheel spacers. They are here: http://www.mcmaster.com

Clamping Two-Piece Shaft Collar

for 1" Diameter, Black-Oxide 1215 Carbon Steel

McMaster-Carr Part # 6436K18

Multipurpose Sleeve Bearing

SAE 660 Leaded TIN Bronze, for 1" Shaft Diameter, 2-1/4" Length

McMaster-Carr #6381K565

Oil-Embedded Thrust Bearing

for 1" Shaft Diameter, 1-1/2" OD, 1/8" Thickness

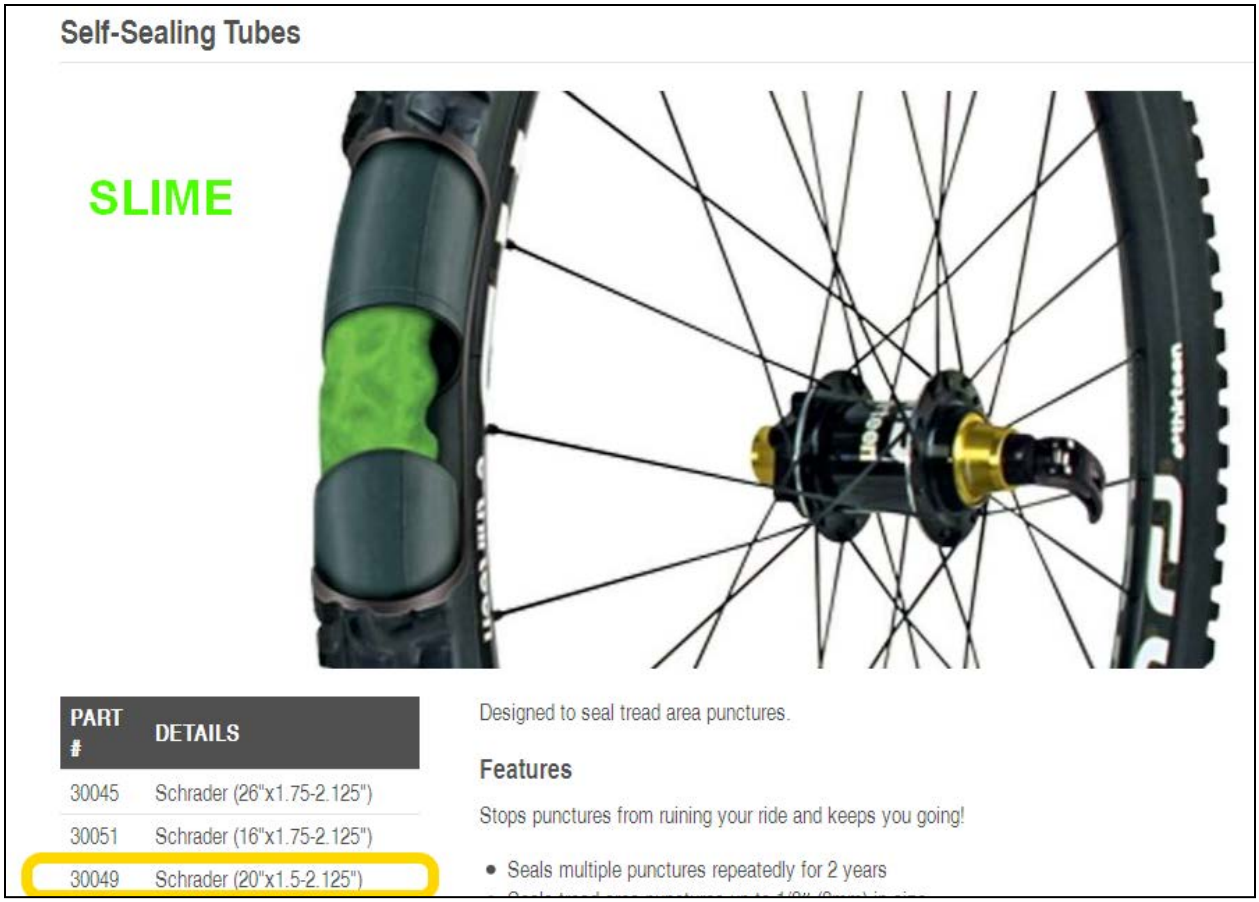
McMaster-Carr #5906K523

Multipurpose Sleeve Bearings **(Can be used for front wheel spacers.)**

These cast bronze bearings are strong, wear resistant, and excellent at handling shock loads. They also perform well in dusty environments.

McMaster-Carr # 6381K171 (1" Long)
McMaster-Carr # 6381K182 (2" Long)

The Slime-filled self sealing inner tubes were purchased from a local hardware store. They are widely available.



Please keep safety in mind in all your activities. Don't make sharp turns at high speed. Ride on level surfaces. Use proper precautions if you decide to try welding. Most importantly: Have fun!

Michael
MTM Scientific, Inc