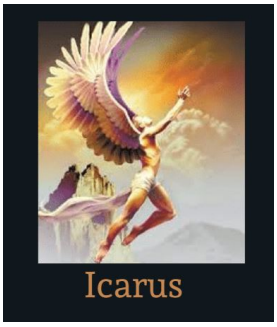

ASME
Human Powered Vehicle
Operation/Assembly Manual

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DISCLAIMER

Ride at your own risk. The NAU HPVC 2020 team is not responsible for any injuries or difficulties that may result. This bicycle is designed for maximum rider of 230 lbs and height of 6’2”. Avoid riding if you have pre-existing injuries or health conditions that prevent you from regular athletic activities. Avoid riding without proper supervision. Always wear proper protective equipment.

1 Operations

This section will explain how to change the various features of the HPV to better suit specific individual riders. This section is meant to guide the person with riding the human powered vehicle.

1.1 Seating

The seating is meant to accommodate riders between the heights of 5’2” and 6’2”. The adjustable seating comes from the ability for the seat to slide forwards and backwards.

1.1.1 Sliding

Loosen the Allen screws on the side of the clamps using a 4mm metric Allen head. Once the Allen screws are loose, slide the entire seat until you reach the desired length.

Figure 1: Seat Clamp Bracket

After reaching the desired position, tighten the Allen screws and make sure that the seat is level.

1.2 Brakes

The brakes are setup such that the rear brake lever is on the right side of the handlebars and the front brake lever is on the left side of the handlebars.

1.2.1 Braking

Test the braking system by freely spinning the front and back wheels and squeezing the brake levers. Ensure that the brake levers are tight and that the wheel ceases to rotate when the brakes are applied.

1.3 Shifting

Shifting should only occur when the chain is in motion. The front derailleur shifter is located on the left side of the handlebars while the rear derailleur shifter is located on the right side of the handlebars.

Shifting the back derailleurs involves moving the thumb for the taller gears (higher speed) and the pointer finger for the shorter gears (slower speed). This is a nine-speed gear setup.

Shifting the front derailleurs involves twisting the rotating section of the left handlebar forwards, away from the rider, for the shorter gear (slower speed) and backwards, towards the rider, for the taller gear (higher speed). This is a two-speed gear setup.

Figure 2: Front Derailleur Adjuster

Figure 3: Rear Derailleur Adjuster

1.4 Pedals

Place each foot on the respective pedal and begin pedaling to accelerate the HPV. Note, we recommend that only experienced riders use the clip in cleats if desired. If you decide to use cleats, follow the directions below.

Put on the cleats and sit in the seat. To attach the cleats to the pedals, insert the front retaining portion into the clip in pedal and press firmly down on the rear portion until it clicks into place. Once the shoe is attached, you should not be able to pull your foot from the pedal. To un-clip from the pedals, twist each foot away from the pedal with a swinging motion with your heel away from the cranks.

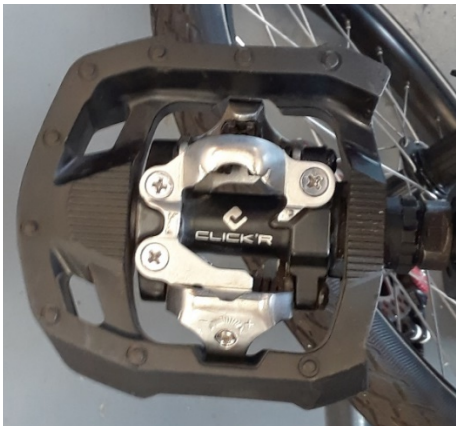

Figure 4: The clip-on pedal

1.5 Steering

To turn the vehicle, use the handlebars. To turn right, pull the handlebars toward the rider with your right hand. To turn left, pull the handlebars toward the rider with your left hand. If you have enough speed, then you can also lean into the turn to lessen the steering input. Or at slow speeds, counterbalance by leaning out of the turn to allow for a more aggressive steering angle. Figure 5 shows the handlebar setup.

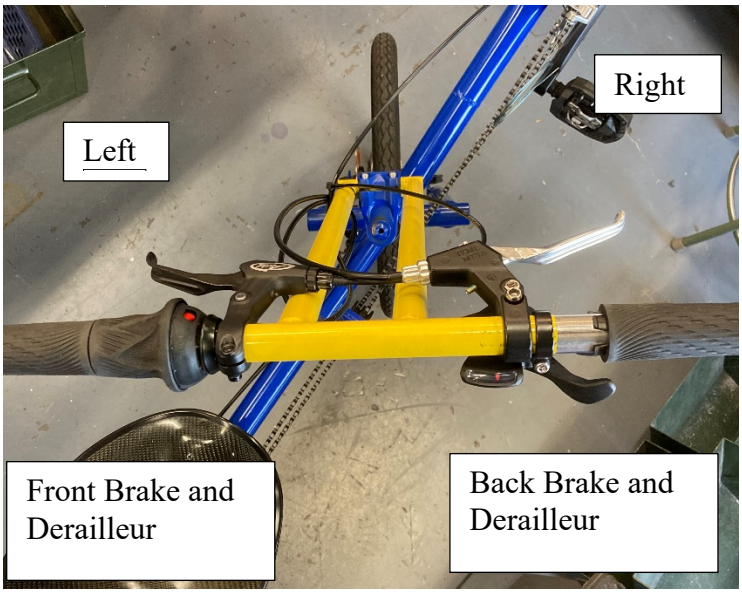

Figure 5: Handlebars with Brakes and Derailleurs

2 Assembly/Disassembly

This section will cover the assembly and disassembly of various parts of the vehicle. This will help when performing maintenance on the vehicle and replacing broken parts. Recommended tools include an assortment of metric and imperial Allen wrenches, channel locks, screwdrivers, and an adjustable wrench.

2.1 Seat

The seat is mounted on to the frame using two seat brackets as shown in Figures 6 and 7.

Figure 6: Front Seat Mount Bracket

Figure 7: Rear Seat Mount Bracket

2.1.1 Disassembly

To remove the seat from the HPV, remove the 4 ¼ -20 countersink screws that attach the seat to the mounting bracket and lift the seat away from the brackets. Be cautious not to lose the two spacers for the rear seat mount bracket. If it is desired to remove the clamps from the frame, remove the two ¼ -20 socket head cap screws on the threaded side of the clamp, then remove the two pinch bolts located on the side of each clamp. The process is the same for both front and rear clamps and is also how the seat is adjusted forward and back to accommodate different riders.

2.1.2 Assembly

To reassemble the seat, reverse the disassembly process by first attaching the frame clamps using the two smaller pinch bolts located on the side of each clamp. Insert and tighten the top plate ¼ -20 socket head cap screws to the top plate. Re-attach the seat to the front and rear mounting brackets using the longer countersink ¼ - 20 screws remembering to place the spacers between the seat and bracket on the rear of the assembly. Once everything is in place, make sure the seat is level and set for the appropriate height for the rider and tighten all bolts.

2.2 Brakes

This HPV utilizes front and rear disc brakes for stopping power. Rotors attach to their respective wheels, and calipers are secured to the front fork and rear section of the frame. Cables are then routed between the hand controls and their respective calipers.

2.2.1 Disassembly

Removing the brake assemblies will be the same process for the front or rear brakes. Begin by loosening the pinch bolt holding the brake cable in place. Slide the cable out of the caliper housing and loop upon itself to keep out of the way while continuing the disassembly process. Remove the two 6mm socket head cap screws that mount the caliper to either the frame or the front fork. Be careful not to lose the spacers located between the mounting brackets and calipers. The caliper can now slide off the rotor and free of the assembly. To remove the rotor, first remove the wheel. Next remove the 6 torx screws holding the rotor to the hub of the wheel assembly. The rotor will come off now.

2.2.2 Assembly

To assemble the brake system, first attach the rotors to the hub of the wheels using the 6 torx screws. It is recommended that a drop of non-permanent thread locker is used for this step. Secure the wheels to their respective mounting locations on the fork and rear of the frame. Slide the brake calipers over the rotors and bolt them in place using the 6mm socket head cap screws making sure to insert the provided spacers between the bracket and caliper. Route the appropriate cable to each caliper and slide the cable into the housing. Pull all slack out of the cable and tighten the pinch bolt around the cable to lock it in place. Adjust cables so that the wheel spins freely but comes to a quick stop when the lever is actuated.

Figure 8: Brake Caliper, Rotor, and Cable

2.3 Wheels

The HPV uses a 20x1.50in front wheel, and a 700mmx28c rear wheel. These standard size wheels along with their tires and tubes can be readily found in most bike stores.

2.3.1 Disassembly

To remove the front wheel from the assembly, simply release the quick release lever from the right side of the assembly and slide the wheel out of the slots on the front fork.

Figure 9: Front Wheel Quick Release

To remove the rear wheel, first remove the rear-most mounting bolt for the rear brake caliper and loosen the front mounting bolt. This will allow the rear brake caliper to rotate up and out of the way to allow the rotor to slide past. Release the quick release and slide the wheel towards the rear of the frame taking note of the chain routing. Once free of the frame, the chain can be slid off the sprockets and the wheel is free.

Figure 10: Rear Wheel and Chain Routing

2.3.2 Assembly

To install each wheel to the vehicle, reverse the disassembly steps. Take note to ensure the chain routing is correct for the rear wheel and that the rear brake caliper is reinstalled correctly per brake assembly instructions. Make sure to lift the rear wheel in the air and pedal the cranks a few times to ensure that the chain re-locates itself onto the appropriate derailleur setting.

2.4 Handlebars

The handlebars include grips, front and rear shifters, and front and rear brake levers. These components can easily be taken off with a series of allen wrenches. The handlebar itself can also be detached from the front stem using a 6mm size allen wrench to remove the 4 bolts from the steering stem. To adjust the handlebar position, simply loosen these 4 bolts and adjust to rider preference.

2.4.1 Disassembly

In order to remove any components from the handlebars start by removing the grips on either side by loosening the 7/64" socket head cap screws from the outer end of each grip to be able to slide them off the handlebars. Next, loosen the appropriate socket head cap screws for each derailleur shifting controller and slide each to the side and off of the handlebars. The last components to be removed from the handlebars are the brake actuators. Loosen their respective pinch bolts as with previous components and slide off the sides of the handlebars. To remove the bars from the steering stem, remove the 4 pinch bolts clamping the bars in place.

2.4.2 Assembly

To install the handlebars and controls for the HPV begin by placing the handlebars in the steering stem clamp and securing them in place with the 4 8mm socket head cap screws making sure to adjust to rider preference. Slide the rear brake actuator over the right side of the handlebar and the front brake actuator over the left. Slide the rear derailleur shifter over the right side of the handlebar and the front derailleur shifter over the left. Check that shifting and brake cables are free from binding while steering the handlebars and re-route components as necessary. Slide right and left grips over their respective sides of the handlebars until the end of the grips are flush with the handlebars and tighten their pinch bolts to secure them in place. Adjust shifting and brake actuating levers to a comfortable position and tighten their respective pinch bolts to secure them in place.

Figure 11: Handlebars and Controls

2.5 Drive Train

The drive train is the heart of the HPV, without which there would be no motion produced from the vehicle. However, this crucial component has been simplified to ensure smooth and reliable operation of its components. Major components for the drive train include: the crank assembly which the operator interfaces with and provides input energy, the rear cassette and driven components which the input energy is transferred to resulting in motion, and the drive chain which connects the drive and driven components of the system.

2.5.1 Assembly

The drive train is best understood by showcasing the assembly process first, rather than disassembly. To begin the assembly process, we start at the center of the drive system with the bottom bracket. The bottom bracket is a bearing assembly which is threaded into the bottom bracket shell of the frame. This can be seen in Figure 12.

Figure 12: Bottom Bracket

Next insert the crank set into the bottom bracket and secure it in place. Install the pedals to the ends of the crank assembly. Note that the right pedal is right hand thread while the left pedal is left hand thread. This is to create a self-tightening feature for the common operating rotation.

Figure 13: Crank and Pedal Assembly

Install the rear cassette (sprockets) onto the rear wheel with the largest sprocket being most inward (closest to the hub). Each sprocket will locate on the hub in only one position due to a specific spline pattern and there will be a plastic spacer between each sprocket. Use a pin wrench to tighten the nut which holds the assembly to the rear hub.

Install front and rear derailleurs to the frame. The rear derailleur bolts to a bracket on the right rear leg of the frame, while the front derailleur clamps onto the frontmost frame tube.

Figure 14: Rear Derailleur Mounted

Figure 15: Front Derailleur Mounted

Route the chain through the derailleurs and sprockets placing the chain on the larges front and rear sprockets. Pull the chain tight to apply tension on the rear derailleur rotating it at approximately 90° to its assembly and mark the chain in such a manner that the chain can be re-assembled to the appropriate length. Press the pin out of the chain to shorten it to the appropriate length. Re-install the master link pin where the chain was broken to reassemble the chain at the correct length.

Route shifting cables to the front and rear derailleurs and adjust to allow smooth shifting through all gears.

2.5.2 Disassembly

The drive train can be disassembled by reversing any sub-step or steps outlined in the assembly section. Special care is to be taken if:

Adjusting chain length: Try to only make changes at master link junctions. Also make sure to use an appropriate master link pin. They are different depending on the drive train. This drive train utilizes a Shimano 10-speed style chain and master link.

Adjusting shifting cables: Shifting cables are set for optimal operation. When applicable, remove derailleur from frame as an assembly vs removing cable from derailleur. This will limit the amount of adjustment required during reassembly.

3 Trouble Shooting

3.1 Flat Tire

Over time and use of the HPV it may occur that the vehicle experiences a flat tire, or tire that is low on-air pressure. In this event, first attempt to fill the tube with air using an appropriate pump. The recommended air pressure is listed on the sidewall of each tire. If filling the tire with air does not fix this issue, the inner tubing will likely need to be replaced. The back tire is a 700x28c mm, and the front tire is a 20x1.50 in. To replace the tube, begin by removing the wheel assembly from the frame. Use tire iron tools to safely dismount the tire from the rim and remove the damaged tube. Replace the tube with a new one and re-mount the tire onto the rim taking extra precaution not to damage the new tube in the process. Upon installation, inflate the new tube until the bead of the tire sets in the groove of the rim. An audible popping sound will be heard for each side of the tire properly seating against the rim. After each side has been seated, adjust the tire pressure accordingly to the appropriate pressure designated on the sidewall of the tire.

3.2 Falling

Help, I've fallen and can't get up! What do you do fall while riding the HPV? First and foremost, assess any injuries and stop operation of the HPV until further assessments can occur. If no injuries are readily noticeable, begin assessment of the HPV for any newly developed signs of critical damage. Again, if this occurs, stop riding the HPV until further evaluation is completed.

If you are observing competition and someone does fall, make sure to get a verbal confirmation that they are okay. Approach the area with caution and check to see if the rider

has any injuries. If there are any life-threating injuries or the rider is unresponsive, contact local emergency services. Once you have assessed the rider's condition and removed them from the vehicle, assess the vehicle for damages. If any damages do impede the usage of the vehicle, cease use and repair damage before putting vehicle back into service.

3.3 Loose Chain

If the chain does become loose, check to make sure the chain is on the front gear, back gear, roller, front derailleur, and back derailleur. If the chain did fall off any of the previously mentioned systems, carefully re-install the chain back on by moving the pedals or providing slack by rotating the rear derailleur arm forward.

If the chain breaks, further review will need to be conducted to determine if a new master link can suffice for repairs, or if the chain should be replaced as a whole. Route the new chain through the systems in the proper manner and place the chain on the two largest sprockets, pulling the derailleur arm near 90° of the body of the derailleur and mark the chain to be cut to the appropriate length.

3.4 Loose Brake Cables

If the brakes seem loose, first check the cables at the brake calipers. Adjust and tighten the allen screw holding the braking wire if it came loose from the pinch bolt. If the brake cable is installed in the housing and caliper correctly, use the adjustment screw at the brake actuator to provide additional tension on the brake system. Make sure the wheel spins freely when the brakes are not actuated, and the wheels come to a quick stop when they are.