# Pack 440 Cubmobile Rules 2010

- You **mus**t use wheels, wheel bearings, and wheel mountings provided (wheels mounted with hardware provided in kit)
- You **may not** modify wheels or wheel bearings
- You **may** customize the car to include adding additional body work etc.

  Any additions must be securely attached and may not pose a safety hazard to drivers or spectators.
- Race officials have final say on whether a car or particular feature of a car is safe or not.
- The total weight of the car must not exceed 45 lbs.
- Drivers **must** wear bicycle helmets, long pants (not shorts) and shoes.

  Long sleeve shirt and/or jacket highly recommended while racing. Gloves, pads and other protective gear is also worth considering.
- The car must include a restraint system such as a seat belt that is securely attached to the car and that will bear the scouts weight in the event of a collision.

  **Seat belts and mounting hardware are not included in the kit. You must provide these items yourself.**

  There is a brief discussion of seat belts at the end of the assembly instructions.

Remember that the goal is for everyone to have fun on race day.

If you have any questions please ask. In general, the race committee will consider all but trivial rule clarifications as a group and respond by email.

# How Can I Make My Car Go Faster?

If you participated in last year's race, the cars will be much faster this year. The best tuning tips are as follows:

1. Build the kit carefully. Follow instructions and pay particular attention to alignment of components. The same kit assembled with care will perform better than one which was hastily assembled.

2. Try to build your car before the workshop so that your scout can use this opportunity to practice his driving skills. Driving a Cubmobile *well* requires practice - the steering behavior in particular takes time to learn. A scout who spends more time practicing before the race will get down the hill sooner than a scout with less practice who is weaving down the track.

3. Even if you can't make the workshop, arrange some practice time for your scout. **Race day is not a good time to drive the car down a hill for the first time.**

4. You *may* see some benefit from adding elements to the body that make the car more aerodynamic.

5. Some things you cannot do to improve performance:

   Anything specifically prohibited by the rules including but not limited to:

   a. You may not modify the wheels or the wheel bearings.

      The wheels are already smooth and narrow in any case.. The wheel bearings are sealed against grit and they are permanently lubricated. You may not remove the seals and apply other lubricants.

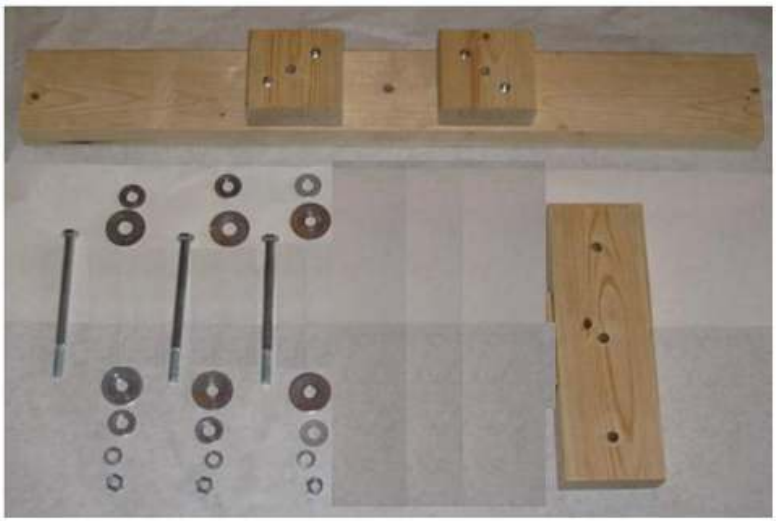
   b. You may not mount the wheels using hardware other then what is provided in the kit.

# Cubmobile Assembly Instructions

Questions or problems with the instructions? Contact richard@ver-steeg.com

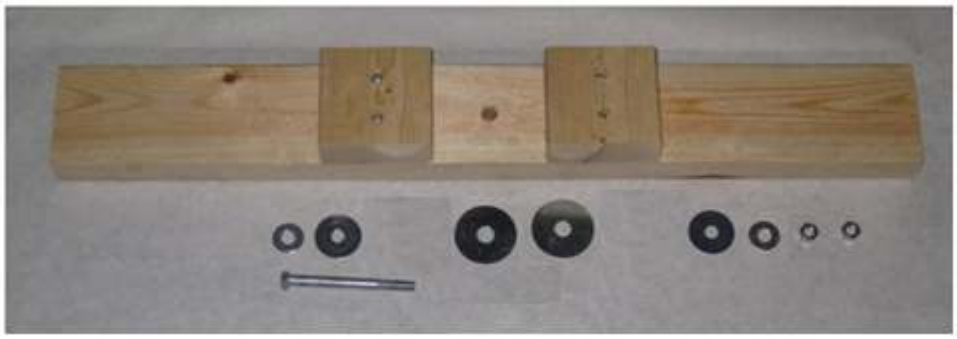
## Parts List

### Rear Axel



| | |
|---|---|
| 1 | 28” x 2x4 axel with pre-installed stiffening blocks (3 bolt holes) |
| 1 | 10 ½“ x 2x4 brace |
| 3 | $^{3}/_{8}$” x 5 ½” hex bolts |
| 6 | $^{3}/_{8}$” washers |
| 6 | $^{3}/_{8}$” x 1 ½” fender washers |
| 3 | $^{3}/_{8}$” lock washers |
| 3 | $^{3}/_{8}$” nuts |

## Front Axel



1 28” x 2x4 axel (note single $^{1}/_{2}$” hole)

2 3 ½“ x 2x4 steering limit blocks

4 2” screws

1 $^{3}/_{8}$ x 3 $^{1}/_{2}$” ” hex bolt

2 $^{3}/_{8}$” washers

2 $^{3}/_{8}$” x 1 ½” fender washers

2 ½” x 2” fender washers

2 $^{3}/_{8}$” nuts

1 3” plastic tube (not shown)

## Body

1 52” 2x4 body

1 30 ½” 2x2 body rail (2x4 cut in half)

4 2” screws for body rail

## Seat

(Appearance and dimensions of seat components will vary – they won't be painted blue or any other color for one thing)

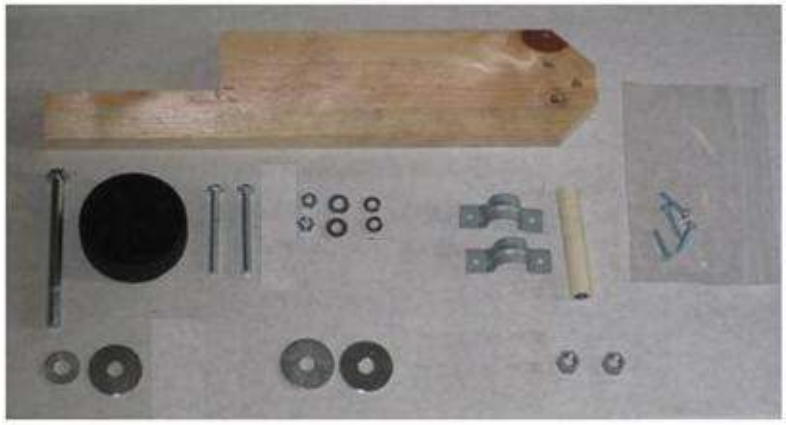
1 ½" x 18" x8" plywood seat back

1 ½" x 18" x 11½" plywood seat bottom

2 ½" x 12" x 11" plywood seat braces

1 15" x 2x4 seat back post

## Brake



| | |
|---|---|
| 1 | 16” x 1x4 |
| 1 | brake handle sleeve |
| 1 | $^{3}/_{8}$ x 6” ” hex bolt |
| 1 | $^{3}/_{8}$” washers |
| 3 | $^{3}/_{8}$” x 1 ½” fender washer |
| 2 | $^{3}/_{8}$” nuts |
| 2 | ¼” x 2 ½” hex bolts |
| 2 | ¼” washers |
| 2 | ¼” lock washers |
| 2 | ¼” wing nuts |
| 1 | hockey puck |

## Wheel Assemblies (4)

| | |
|---|---|
| 4 | 8” wheels with bearings |
| 4 | $^{3}/_{8}$” x 6” hex bolts |
| 4 | axle sleeves (pre-assembled) |
| 8 | $^{3}/_{8}$” nuts |
| 12 | 3/4” x ½” rubber strips |
| 12 | ½” pipe straps |
| 24 | 1 ¼” screws |

## Step-by-Step Assembly Instructions

**Note**: You will find that some (but not all) of the wooden parts have been marked to indicate a specific orientation of the part or a specific location where other parts should be attached. Look carefully for these markings when assembling the kit. If something doesn't seem to fit right, the part may not be oriented correctly.

**1) Attach rear axle to car body.**

a) Parts

i) body (52" x 2x4)

ii) front axel

iii) rear axel

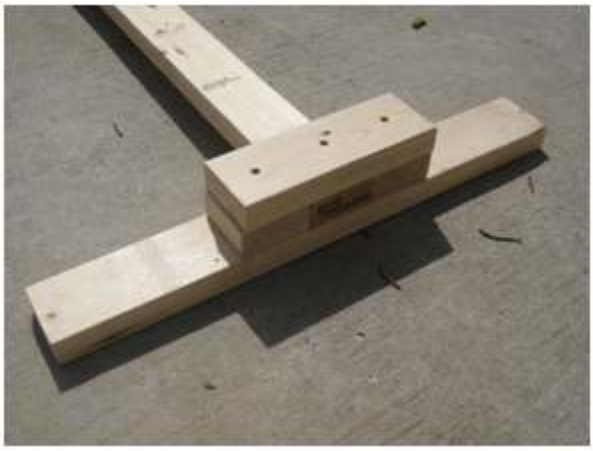
iv) brace

v) rear axle hardware

b) Lay body on top of both axels fitting it between the blocks on each axel.

c) Align the hole in the body with the corresponding hole in the rear axle (don't bother aligning the front axle – we're only using it to keep the body level).

d) Lay the brace on top of the axel and body lining up the holes.



e) Insert the bolts with 2 washers – small one on top, larger washer against the wood – through each of the 3 holes.

This arrangement of washers distributes force over a larger area when tightening the bolts.

**Note**: The bolts **will not go all the way through while the axel is lying on the ground**. You have to finish pushing them through after you pick up the car.

f) Lift the rear axle and body up and stand them on their side.

g) Use the heel of your hand to press the bolts the rest of the way into their holes. If you can't push them in with your hand, tap them in with a hammer.

h) Turn the car on its side and place the remaining washers on the end of each bolt, largest to smallest.

**Note**: There is one additional washer on the bottom of the axle - the lock washer (split ring) should be the last washer before installing the nut.

i) Finally attach and tighten the nut for each bolt.

j) **Optional** T-brace.
Modifying the brace to make a T-brace makes the axle more rigid relative to the body. This *might* make the car track straighter or might not. It's up to you whether or not to install it. You'll need to provide some additional parts if you decide to do this.

There are three loose, square blocks included in the kit. Two are used as limit blocks for the front axle. You can add the third square block to the rear axle brace so that it forma a T with a short leg resting on top of the car's body.

k) You attach the block to the brace with screws and the block to the body with glue, screws, a bolt - hardware and glue for attaching the block to the car's body **are not included in the kit**.

i) Counter sink two deep holes into one side of the block.

ii) If you plan to use glue, apply now as appropriate to the bottom of the block and/or on the body where the block will go.

iii) Place the block on the body against the brace with the two countersunk holes facing the front of the car.

iv) Attach the block to the brace using two screws.

v) If you plan to use screws or a bolt, you can add these now.

2) **Attach front axle to body.**

a) Parts:

i) body with rear axle installed

ii) front axle

iii) front axle hardware

b) Remove the bolt from the Front Axle hardware bag.

c) Undo the nut and remove everything except the last two washers.

**Note**: There is also a plastic tube (bushing) not shown in the picture below.

d) Lift the body off the front axle and lay the two large washers on the axle – align them with the hole in the axel.

These washers act as a simple bearing and make steering easier.

e) Replace the body on top of the axle making sure it aligns with the washers and the hole in the axle.

f) Insert the bolt all the way through the plastic tube until the head of the bolt rests against the plastic.

g) Insert the bolt with bushing through the hole in the top of the axle and through the car body.

**Note**: The bolt won't go all the way through while the car is laying flat on the ground.

The plastic tube is used as a bushing here. The plastic serves as a buffer between the bolt and the wood. Without the bushing, the bolt will tend to enlarge the hole as the axle is turned.

h) Flip the car on its side.

i) Take the 2 remaining washers and place them on the bolt – largest washer first.

If the plastic tube extends below the axel, trim it flush so that it does not interfere with the washers or nuts.

j) Attach the first nut and tighten – it should be snug but remember, the axle needs to move for steering.

k) Add the second nut and **hand-tighten-only** against the first nut.

l) Using one wrench to hold the first nut in place, use a second wrench to tighten the second nut against the first nut.

m) Place the safety blocks on top of the front axle on top of the axle next to the body.
The safety blocks limit how far the axle can turn.

Make sure to maintain axle perpendicular to the body during the following steps - you want the axle set as thought the car was travelling in a straight line when you attach the safety blocks. The blocks will limit steering and you need to make sure that you'll be able to turn both left and right.

n) Use a credit card or similar item to create a very small gap between the body and each safety block.

o) Press the blocks against the credit card or other shim and attach the blocks to the body with the screws.

Use clamps if you have them or have your partner hold the block tight against the body.

p) **Note**: The slight gap is more than adequate for steering. If you make the gap too wide, the axle may turn too far and cause the car to slide or dump your scout on the pavement.

3) **Install the Footrest**

The foot rest is the rectangular piece of plywood with a V shape cut into it. It helps keep the scout's feet off the ground.

a) Parts

i) Partially assembled car.

ii) Foot Rest

b) Turn the car upside down.

c) Place the foot rest on the bottom of the front axel so that the V-shaped cutout fits around the front axle bolt.

Place the edge of the foot rest as close to the front of the axle as possible and between the wheel assemblies.

d) Secure the foot rest to the bottom of the front axle with the screws provided.

**4) Attach the Body Brace**

The brace stiffens and strengthens the body so that it can accommodate more weight.

a) Parts:

   i) partially assembled car

   ii) body brace

   iii) body hardware

b) Turn the car upside down.

c) Lay the long side of the brace on the bottom of the car body so that the ends slope down to the car body.

d) Line the pre-drilled holes in the brace up with the pre-drilled holes in the body.

**e)** Attach the brace to the body with the supplied screws.

5) **Assemble the Wheels**

**Read and understand the whole procedure before putting together the wheel assemblies. It is especially important that you understand how to tighten the nuts properly to avoid damaging the wheel bearings.**

a) Parts:

i) 4 wheels

ii) wheel hardware

b) Remove the wheel hardware from its bag.

c) Take the bolt and insert it through one of the wheels.

d) Take the axle sleeve and push it onto the bolt with the **metal part of the sleeve against the wheel.**

**e)** Place the nut on the bolt but **do not tighten yet – not even hand tight**.

f) Hold the wheel assembly by the axle sleeve with one hand and spin the wheel. Note how long it spins before it stops.

g) Tighten the nut by hand until the metal part of the sleeve touches the wheel bearing and the nut **just touches** the white PVC of the axle sleeve. Don't use a wrench unless absolutely necessary.

**Check the wheel's spin**. If it seems to spin more slowly, loosen the nut slightly and re-check.

The wheel should not be able to slide back and forth on the bolt, but you don't want the axle sleeve to put pressure on the wheel bearing.

**DO NOT OVERTIGHTEN**. If you tighten the nut too much, you'll cause the wheel to spin slower or may even damage the bearing.

h) Add the second nut and **loosely hand-tighten until it is just touching the first bolt**.

i) Using one wrench to prevent the first nut from moving, use a second wrench to tighten the second nut against the first nut.

j) Repeat the process for the remaining three wheels.

**Attach the Wheels.**

k) Parts:

   i) body with front and rear axle installed

   ii) 4 assembled wheels

   iii) wheel hardware

l) Turn the partially assembled car upside down.

   Notice the grooves cut into the bottoms of the wooden axles. You will use these to ensure that the wheels are properly aligned when you install them.

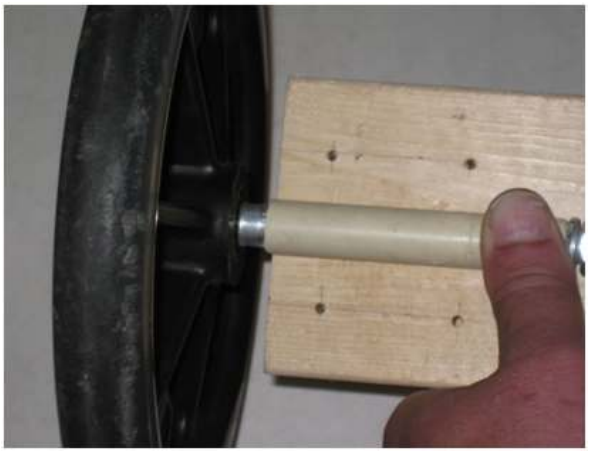
m) Remove the bracket hardware for one of the wheels from its bag.

   There are three U-shaped pipe brackets for each wheel. For each bracket, there is a strip of rubber and two screws

n) Lay a strip of at the bottom of one of the U-shape in one of the brackets.

o) Have one person place the axle sleeve of an assembled wheel in the groove of one of the axles (it doesn't matter which axel or which side you start with).

   The white part of the sleeve closest to the wheel should be flush with the end of the axle, the metal extending from the white part of the sleeve should extend past the end of the wooden axel.



One person should press the axle sleeve into the groove while a second person attaches the brackets as explained in the following steps.

**The forces from installing the brackets can push or pull the wheel to one side or another causing misalignment of the wheel. One or more misaligned wheels will slow the car down.**

p) Starting with the bracket furthest from the wheel, place the pipe strap (with rubber strip installed) over the nuts.

Adjust the position of the wheel if necessary to align the holes in the pipe bracket with the pre-drilled holes in the axle. The pipe strap should cover the nuts.

Insert the two screws and tighten **until they are almost touching the bracket**. Then alternate tightening each screw a few turns until the bracket is holding the end of the tube. **Do not tighten the screws completely yet**.

If you do, the force of the bracket will push the opposite side of the axle sleeve up. This will make it difficult to keep the wheel aligned.

This bracket holds the end of the wheel assembly in place **and** prevents the nuts from loosening.

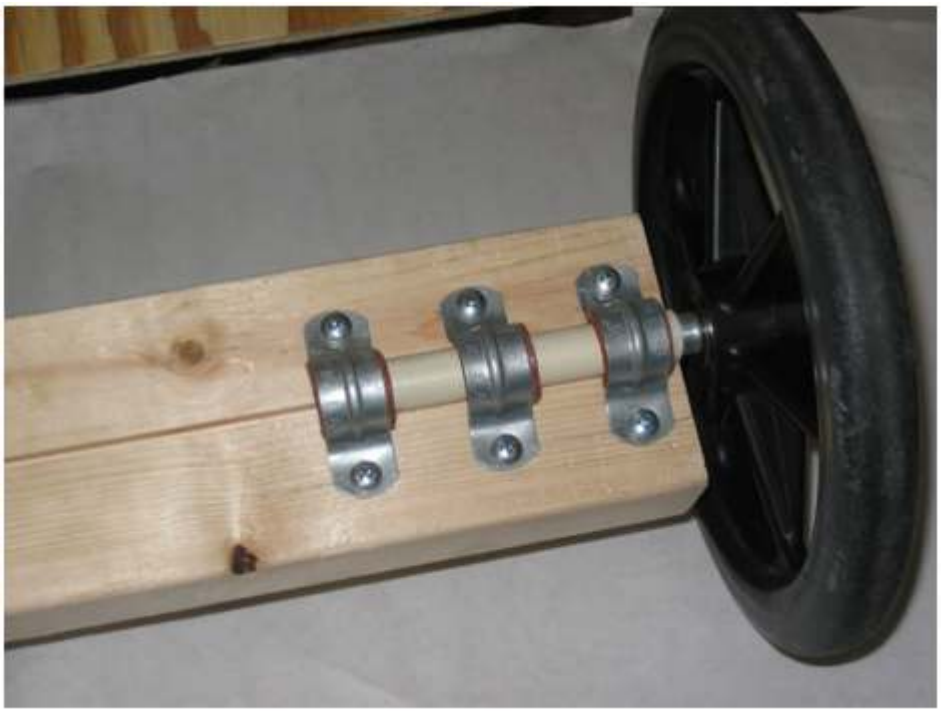
q) Install the bracket closest to the wheel next

Alternate screws for final tightening as before. Go ahead and fully tighten the screws for this bracket.

r) Go back and finish tightening the screws on the first bracket now.

It should no longer be necessary to hold the wheel in the groove. Inspect the installation so far and verify that the wheel is resting in the groove along its entire length. If it's not, you should loosen screws and correct the alignment.

s) Finally, install the third bracket between the previous two.



t) Test your installation by trying to pull the wheel out of the brackets.

When all the brackets are installed, you should be able to pull hard on the wheel without causing it to wiggle or slide. If it moves at all, you need to tighten the screws further.

u) Repeat the process for the remaining 3 wheels.

6) **Assemble and install the seat.**

Note: Seats will all consist of the same basic parts but the appearance of the parts may vary widely from the pictures.

Exact seat position will depend on your scout. The scout should be able to use his feet to control the front axle when seated. Move the seat forward as necessary for shorter scouts.

a) Parts:

i) seat back braces (triangles)

ii) seat back post (2 x 4)

iii) seat back (smaller rectangle)

iv) seat bottom

b) Lay the 2x4 seat post on the ground.

c) Place one of the braces against it with the **short side of the brace on the ground**.

d) Use a pencil to draw a line on the brace along the top of the seat post.

e) Repeat with the other brace.

f) Now place a seat brace against the seat post with the **long side of the brace on the ground**.

g) Position the brace so that the bottom of the seat post is at the previous marked line.

The seat back braces will extend below the bottom of the seat back post when installed.

h) Attach the brace to the post with 2 screws.

i) Repeat with the second brace.

j) Attach the seat back to the seat post using three screws.

k) Attach the seat back to the body of the car using two screws through the braces on each side. The bottom of the 2 x 4 should rest on the body of the car. The two braces should extend below the top of the body.

**The seat's position on the car body will depend on your scout's height. Position the seat back so that your scout can comfortably control the front axle with his feet while seated.**

l) Install the seat bottom so that the back of the seat bottom is against the seat back braces.

Have your scout test the seating position and adjust as necessary.

7) **Assemble and install the brake.**

The brake mounting is very similar to mountings used for the wheels.

**Note**: The hockey puck used for the brake material (or anything else you drag on pavement) wears down fairly quickly. An adult driving the car will wear the puck down *very* quickly. The puck can be removed and rotated to get more useful life out of it. If your scout plans to practice a lot before the race and will be using the brake alot, you should plan on getting some additional hockey pucks.

**Note**: There is a set of holes pre-drilled for installing the brake but you may need to move the brake further forward depending on where you installed the seat.

**Note**: This is similar to the wheel assembly.

a) Parts:

   i) brake handle

   ii) brake hardware

b) Remove the bolt, the white PVC tube, and **two** large washers from the hardware bag.

c) Insert the bolt through the PVC – it's a snug fit.

d) Place **two** large washers over the bolt and against the PVC.

e) Push the bolt through the brake handle.

   **Note**: You can mount the brake handle on either side of the car depending on your scout's preference.

f) On the other side of the brake handle, place the large washer, the small washer and the two nuts on the bolt, hand-tightening the nuts for now.

g) Attach the hockey puck to the brake using the two smaller bolts provided.

Both washers are used with the wing nut on the threaded end of the bolt.
**Note: The hockey puck must be on the same side of the brake handle as the white PVC pipe. Positioned this way, brake handle travel is limited by the puck hitting the underside of the car body. This will prevent your scout from pinching his hand between the brake handle and the body of the car.**

h) Verify brake position.
The scout should be able to comfortably reach the brake handle and pull on it while seated. You may be able to use the pre-drilled holes marked for the brake. If you need to move the brake forward, you can drill a new set of holes if you have a drill. Otherwise you can put the screws straight into the wood.

i) While one person holds the PVC on the body, the other person installs the pipe brackets (with rubber shims).

When the screws are tight, you should not be able to wiggle the bolt or pull it loose from the brackets.

j) Adjust the tension on the nuts.

Tighten the nut closest to the washer to minimize wobble. But remember that the brake handle needs to move easily back and forth.

When you are satisfied, use one wrench to hold the first nut in place while using a second wrench to tighten the second nut against the first.

8) **Install Seat Belt.**

The car must have a restraint system such as a seat belt to participate in the race, however, a seat belt is not provided as part of the kit. A typical seat belt consists of straps with a buckle attached to the body of the car behind the seat using lag bolts.

The restraint must be securely attached to the car and capable of bearing the cubs weight in the event of an impact.

Race procedures are designed to avoid the need for exercising the vehicle's restraint system but better to be safe.

9) **Customize**

**You are allowed to customize the car (subject to limitations specified in the rules) – have fun with it.**