**Box Car Assembly Instructions 2013**

**Kit Contents**

1. Wheels (4)
2. Axle bolts (4)
3. Wheel fender washers [1/2”] (4)
4. Axle clamps [two-hole straps] (12)
5. Short screws [1-1/4”] for axle clamps (24)
6. Medium screws [1-5/8”] to assemble box (40)
7. Long screws [2-1/2”] for steering poles (4)
8. Steering bolt assembly:
   1. 3-1/2” x 3/8” hex bolt
   2. 3/8” fender washers (2)
   3. 3/8” washer
   4. 3/8” lock washer
   5. 3/8” lock nut
9. Steering poles [26” long] (2)
10. Steering handles [10” long] (2)
11. Tennis balls (2)
12. Sandpaper, 60 grit
13. Sandpaper, 100 grit
14. Wood parts:
    1. Plywood base
    2. Plywood sides [left and right] (2)
    3. Plywood seat back
    4. Side rails [2 x 2 x 43”] (2)
    5. Seat blocks [2 x 2 x 6”] (2)
    6. Front axle [2 x 4 x 16”]
    7. Rear axle [2 x 4 x 18”]
    8. Front bumper [2 x 4 x 6”]

**Tools Required**

* Drill driver with #2 Philips bit
* Drill with 3/32” bit for pilot holes
* Screwdriver, #2 Phillips
* Hammer
* Two adjustable or 9/16” wrenches (or wrench and deep socket)

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|  | Orientation | Lay out plywood parts on a flat surface. Each has a “good” side and a not-so-good side. When assembled, the base goes good side up. The sides are paired left and right, and go good side out (for looks). The seat back goes good side in (for comfort).  Separate the screws by size:   * Medium [1-5/8”] to assemble the car box * Long [2-1/2”] to assemble steering poles and handles * Short [1-1/4”] to attach axle bolts to wood axles |
|  | Bumper to Base | Place the front bumper on the base, even with the front edge of the base and about evenly spaced left to right. The bumper is slightly angled to match the car’s wedge shape. Clamp or hold the bumper in place. Flip the base over and drill two pilot holes and medium [1-5/8”] screws up through the base into the bumper. Stay at least an inch from the ends of the bumper. Flip the base right side up. |
|  | Rails to Sides | Place one side on the edge of the base, good side out. Place a side rail inside the side, rounded corners up, snug against the front bumper. Holding the side and rail in place, drill one pilot hole and medium screw through the side into the rail, about an inch from the front of the rail. Add four more pilot holes and screws spaced out in a line from front to back (five total on each side), ending about an inch from the back of the rail Keep the side rail flat against the base, but don’t attach to the base yet.  Repeat for the other side and rail. |
|  | Seat Blocks to Sides | Place both sides (with rails) on the base, and set the seat back between the sides at the back edge of the base. Set one seat block upright on the side rail, rounded edges toward front, in the corner formed by the side and seat back. Drill two pilot holes and screws through the side into the seat block. Repeat for the other seat block. |
|  | Sides to Bumper | With sides and seat back in place, drill two pilot holes and screws through each side into the end of the front bumper, keeping the side and rail flat against the base. |
|  | Seat Back to Sides | Drill two pilot holes and screws through the seat back (good side in) into each seat block (left and right, four screws total), keeping the sides, rails and seat back flat against the base.  Carefully flip the whole box over. |
|  | Sides to Base | Drill six pilot holes and screws through the base into each side rail, working from front to back, and keeping the sides centered left-to-right on the base. The sides are about 1/2” thick and the rails are 1-1/2” thick, so screws about 1-1/4” from the edge with hit rail center. |
|  | Rear Axle | Flip the car upright, and set with the rear end propped up on a block or extending over the edge of a box or table. Drill three pilot holes down through the base along a pre-marked line 5” from the back edge of the base. The holes should be about an inch from the left rail, center, and about an inch from the right rail. Insert medium [1-5/8”] screws in each hole just far enough to stick out about 1/8” through the bottom. Flip the car over and place the rear axle, slotted side out, centered left-to-right, with the axle’s back edge along a pre-marked alignment line 3-3/4” from the back edge of the base. The rear axle is longer than the front axle, and doesn’t have a hole in the center. The screws just placed will be centered on the axle, and will help keep the axle in position while you carefully lay the car back upright and tighten the three screws into the axle.  There are other ways to do this, but you need to end up with the rear axle straight, centered, and tightly attached with screws that go down through the base into the axle. |
|  | Front Axle | Locate and take apart the front axle bolt assembly. Don’t mix up these parts with the 1/2” fender washers you’ll use later for the wheels.  Place one 3/8” fender washer on the 3/8” hex bolt, and insert the bolt down through the pre-drilled hole 4” from the front edge of the base. Tip the front of the car up. Place the second 3/8” fender washer on the bolt below the base, then add the front axle, slotted side out, then the smaller solid washer, lock washer and nut. Using two 9/16” or adjustable wrenches, tighten the axle bolt assembly until you begin to compress the lock washer. It should not be loose enough that the axle spins freely, nor so tight that the axle is stiff or difficult to turn. |
|  | Steering Poles | Flip the car upright and set on a surface that won’t be damaged by the protruding front axle bolt. Line up the front axle approximately straight. Locate the four long [2-1/2”] screws.  Drill two pilot holes (one left and one right) in the top of the front axle, centered front-to-back, and 1-1/2” from each end of the axle.  Pick up a [26” long] steering pole and locate the pre-drilled screw holes at the end opposite the fat end. Insert a long screw in the hole slightly farther from the pole end, and tighten until it extends (on a slight angle) through the hole closer to the pole end, sticking out about 1/4". Now align the pole and screw with one of the axle pilot holes and insert about 1/2" into the axle; don’t tighten further until after the steering handles are in place. The pole will angle up a bit toward the center of the car box.  Repeat for the other steering pole. |
|  | Steering Handles | Locate the pre-drilled screw holes on a [10” long] steering handle. Insert a long [2-1/2”] screw straight through both holes until it sticks out about 1/8”. Insert the steering handle up through the two elongated holes in the fat end of a steering pole until it forms an even ‘T’. Don’t attach to the car box yet. Repeat for the other steering handle. |
|  | Steering Alignment | Line up the front axle straight (parallel to the rear axle). Lean the car front over the edge of a table or box to help hold the axle in alignment while attaching the steering handles to the car.  Tip one steering pole up or down a bit to center the steering handle screw on the side rail. Don’t push the steering handle front or back, but let it rest at right angles to the steering pole. Drill a pilot hole at this spot, in line with the screws attaching the side to the side rail. Tighten the steering handle screw into the side and side rail just until the fat end of the steering pole is snug against the car side.  Repeat for the other steering pole and handle.  Tighten the two long screws attaching the steering poles to the front axle just until the screw head touches the pole and the tip of the pole is snug against the front axle.  Now push the steering handles front and back to turn the front axle a bit. The axle only needs to move about an inch front to back. The steering poles can slide up or down an inch on the steering handles to make minor adjustments correcting a small bias to the left or right. If the car tends toward the left or right, or won’t turn easily in each direction, then one or more screws will need to be relocated.  Place a tennis ball (with pre-cut ‘X’) over the top end of each steering handle to protect against injuries to the driver’s face. |
|  | Wheels | Flip the car upside down, taking care not to damage steering gear. Locate the short [1-1/4”] screws.  Place an axle bolt in the rear axle center slot, with the narrow section and about 1/16” of the wider section extending past one end of the wood axle. Space out three axle clamps along the axle bolt (left, right, and center) and attach with six pilot holes and short [1-1/4”] screws. Place a wheel on the axle bolt end and verify that the wheel does not rub on the wood axle. Then place a 1/2" fender washer and a wheel cap. Use a hammer to tap the wheel cap firmly onto the end of the axle bolt. Once placed, wheel caps can only be removed with destructive force, so you may consider sanding and painting the car before placing wheel caps.  Repeat for the other rear wheel and both front wheels. Flip the finished car upright. |
|  | Driving Safety | Drivers should hold the tennis balls to steer, and avoid grasping the handles below the tennis balls to protect against pinching injuries. Drivers must keep their hands on the handles and feet inside the car at all times. Helmets are required. The competition course flattens toward the end, and is protected with straw bales and safety workers, so brakes are not required in this situation.  The boxcar design/build/event team are amateur volunteers, not automotive engineers. Our objectives are to keep drivers safe, have fun, and cure ALS. We ask drivers and parents to join us in monitoring the equipment, conditions, and ability of drivers, to maintain safety throughout the event. |
|  | Sanding and Painting | Coarse and fine sandpaper are provided to soften sharp wood corners and edges throughout the vehicle. Builders are asked to pay special attention to the top edges of the car box. These angled side cuts have high potential for splinters in the palm of an entering or exiting driver. Please carefully sand these edges and paint to reduce the potential for splinters.  Use exterior grade paint, since we have learned from experience that interior paints will soften and peel in wet conditions ☹. |