Creating an Organized/Safer Way for Contractors to Carry Oversized Spare Tires

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Construction is an industry that needs trucks/vehicles to travel across large dirt construction sites without getting stuck. This typically means upgrading to a larger wheel width/diameter to create the largest possible surface area for the tire to cover while off-road. Managing to get a flat tire whether it is rolling a bead in the dirt from being aired down or running over objects such as nails/screws, it is always important to carry a spare tire that fits the application. This causes an increased need to safely lock down an oversized spare when the time comes for one. Most of the time a larger wheel/tire combo will not fit in the stock under bed mounting location. Creating a resolution for this scenario will need a fabricated part to allow for safe and organized storage while also not taking up needed bed space. The goal is to create a multipurpose and removable aftermarket spare tire carrier.

Key Words: Organization, Manufacturing, Fabrication, Automotive Design

How Project Came About

A colleague asked if there was any way to make a simple yet effective way to store an oversized spare tire in a work related vehicle. With removability and ease of use being the main concern, ideas were then brainstormed to create a fabricated part to complete this goal. Being in the construction industry most work trucks need to be equipped with oversized tires to help get around the job site without getting stuck. In particular this colleague works for an underground utility company whose main purpose is to get around large job sites while laying down pipes in freshly ground up dirt foundations. Having a spare tire in case of a flat is essential to keeping the day running smoothly, but it comes with one factor to think about. How will this spare tire be stored in the case of it ever being needed?

The stock under the bed compartment was eliminated since the new tire size was upgraded to a thirty-five inch diameter and twelve and a half inch width. This allows for a larger tire surface area on the ground to enable the truck from getting stuck in the dirt. A tire of this size can now be a hassle to bring anywhere due to the fact that it is much larger than the stock spare. From then on ideas went in to help create a product that was not only efficient with carrying tires but to help strengthen the vehicles frame, add secondary storage to maximized lost space, and allow for it to be removable with a few simple bolts if the full bed was ever needed.

What Process Did The Student Go Through

In this next section pictures were taken throughout the fabrication process to demonstrate what was done in the creation of this product. For ease of understanding how this was made the process will be broken up into three different sections including: Foundation, Tube Work/Mounting, and Finishing.

Foundation

With creating a solid foundation for this part structural rigidity was the first overall goal. When looking at the colleague’s truck bed below (In figure 1) one key factor was noticed that gave the idea of how to make the design as multipurpose as possible. There were a total of six bolts that went through the truck bed straight to the frame. Not only did this allow for structural rigidity both parallel and perpendicular to the frame but also allowed for no holes to be cut into the bed and gave the removable option that was desired.
With this first discovery deciding how to make the tire storage removable was the next step. What was done next was removing the four bolts closest to the cab to help maximize storage space in the rear and made for a way of tying into these bolts. (For simplicity all tube work used in this project was 1.5” .120 wall DOM). Figures 2-4 demonstrate the process of attaching the base of the tire carrier to the four main bed bolts.

For simplicity of the project the four vertical tubes were cut using a chop saw with a metal cutting disk. Each tube was cut at two inches to allow for the horizontal tubes of an inch and a half to fit at a later time. The main way in which these tubes were tied into the four bed bolts was by using four washers put through the four bolts and then welded to the vertical tubes. (Figure 2 shows the tubes after being cut along with the bolts with washers). Next to get a clean weld that would penetrate the .120 wall tubing a clean and even bevel was needed. (Figure 3 demonstrated a beveled edge of the side of the tube that would be welded). Beveling hard edges allows for max penetration and allows somewhere for the weld puddle to go without lumping over both materials. Once the welding of these four pieces was done they were then bolted back into the bed for the next set of measurements.

**Tube Work/Mounting**

This next section explains the three main tubes that were made and how they were laid out to maximize efficiency. When cutting and notching tubes it is extremely important to measure correctly in order to not cut too long or short of a piece. Too short of a piece results in a wasted tube which can begin to add up as more and more tube is wasted. Also there will not be a tight fit that results in a poor weld when trying to fill a gap. While on the other hand too long of a tube will not fit the desired area and will need to be continuously cut down to make fit.

Notching is a process in cutting the desired tube a certain way where it fits tightly against another tube. This allows for not leaving the large gaps when butting a tube against another tube. To create a sound and penetrating weld the pieces must fit up properly and be clean and prepped. Since there were no complicated or multi-angled notches involved in this project the general rule of thumb for notching ninety-degree tubes were applied. When notching tubes at ninety degrees the tube that is going to be notched will account for one third of the overall diameter. Since this tube was one and a half inches thick the extra material to be accounted for would be a half-inch extra. This half-inch allows for the notched tube to fit around the other tube for welding purposes. With this half inch of extra material cutting forty-five degrees on each side from the centerline to the two sides results in a clean notch. Proper
grinding down of the notch and beveling the edges will result in a clean fit. Below (In figure 5) is an example of what a notch welded up would look like in this project.

*Figure 5. Notched and Welded Tubes*

With the process of notching explained basically what was left to do was measure from edge of vertical tube to vertical tube to get my overall distance and then add an inch to account for half-inch notch of both sides. Once these tubes were cut, notched, and tacked into place the three mounting positions were then created. These mounting positions are what the tri-tie down strap hold onto to support the tire. Below in Figures 6-9 show the process of making these three mounting points.

*Figure 6. Cardboard  Figure 7. Tracing  Figure 8. Cutting  Figure 9. Final Product*

When creating parts made out of metal the best rule of thumb is to always start with a cardboard template for easy trimming. For this application the most aesthetically pleasing tabs looked to have all hard edges with zero curves. (Figure 6 was the general idea of what the three hold down tabs would look like, and Figure 7 showed it traced onto the 3/16” plate of metal). If making tabs with a CNC or plasma cutter these cuts would have been much simpler but doing this all by hand caused for more of a challenge. What needed to be done in order to get these hard edges was cut away as much material as possible by going at various angles until the least amount of material was left. In order to get the remaining material cut was demonstrated in Figure 8 by cutting parallel slits vertically to the horizontal line until the remaining material was all the way cut off. The tabs were then grinded down with various grinder wheels, flap disks, bench grinder, and sanded down for a clean finish. (This can be seen in Figure 9). Last these three tabs were tacked into place according to where the tri-strap ends would land.

*Finishing*

With the structure fully tacked into place there was one final to do before finish welding. This included mounting the two small boxes in each corner to take away dead space and add storage space instead. Below are Figures 10-12 describing each of these steps. In order to mount these storage containers four Trick Tabs were used for professional looking bent tabs. (See Figure 10). With these tacked on next was to drill and mount the boxes to the tabs. A spring-loaded punch in Figure 11 was used to create the point of drilling that was the direct center of the trick tab holes. Last Figure 12 shows drilling these boxes with a step bit to the correct size in order to mount the boxes.
Last was the final weld up of the entire structure. With everything tacked and bolted into place allowed for zero warping when welding the tops of all the tubes. Once the top was welded and cooled the piece was unbolted from the frame and then flipped over to weld the bottom for zero weld gaps making it as structurally sound as possible. Figures 13-14 show the finished welded product with tire strapped in.

Deliverables

What has been created due to this project is a simple yet effective way to hold an oversized spare tire in a work truck. The ability to add structural stiffness in order to help cut down frame flex and allowing for an easily removable part allows for maximized bed space. This product can help the construction industry by giving an organized work bed while even adding secondary storage areas to eliminate dead space. Knowing that a spare tire is always present in the case of a flat is an added sense of security that will in turn maximize efficiency.

Lessons Learned During The Process

Whenever starting a new fabrication project there are always lessons on what could be done better the next time. There were many various setups that could have been run but this was what was decided to be the cheapest/easiest option for the owner. One change that could have been done was to change the Torx head bolts to standard six point heads for the ease of using common sockets. This can still be done the six bolts would just have to be replaced. Other than this one common rule to be used next time is always start your tube work with the largest pieces first. This is due to the fact that if a cut is made too short on the first piece it can still be used potentially on a smaller piece rather than scrapping the tube all together. In general little small steps could have been done differently but overall the project went smoothly, was cost effective, and weighed less than twenty pounds.
References


