

Pause for Thought: Should You Install A ROPS Yourself? Lessons Learned

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On a Sunday afternoon and evening in April, my two sons and I installed a Rollover Protective Structure, or ROPS, on my eldest son's 90 hp John Deere tractor at his Garrard County, Kentucky farm. He had purchased the used tractor from another farmer a few weeks earlier.

Ordering the ROPS

We ordered the ROPS from a local John Deere dealer. Because we were willing to wait two weeks, our ROPS was shipped along with the regular two-week shipment of other materials that the dealer receives and there was no shipping charge. The total cost of the ROPS package was \$395, much less than I anticipated.

Installing the ROPS

It took the three of us about six and one-half hours to install the ROPS. If everything had gone well we could have installed it in two or three hours, tops.

The ROPS itself weighs about 370 lbs. Because it is a fold down, it came in five main pieces (two lower uprights, two upper uprights, and one top crosspiece) plus the bolts, nuts, and anchor plates. The parts, along with detailed instructions, were in a wooden crate labeled "Tractor Roll Guard."

We used a 20-ton bottle jack to lift the back wheels of the tractor up just an inch or so off the ground so we could move the rear wheels out. We centered the jack on the drawbar mount on the rear axle housing. This procedure is relatively safe because if the jack failed the tractor would drop only an inch to the ground, and would not tip over or bounce around. So there was no need to use cribbing or jack stands to support the rear axle housing of the tractor.

To move the wheels out, we simply followed the tractor manual instructions, which specified that the wheels be slightly off the ground to take the weight off the axle. The wheels are then moved outward or inward by first loosening a set of six locking bolts that clamp two split-hub wedges to the axle. A seventh bolt is loosened and turned to drive a pinion gear that pushes the wheel inward or outward along the axle. There is no danger of the wheel coming off the tractor because of the slow and precise way the pinion gear moves the wheel hub in and out along the axle as a hand-held socket or box wrench turns the bolt. (I suppose a novice with an air impact wrench on the pinion bolt could run the wheel clean off the axle and have the wheel and tire fall upon and crush him or herself. The calcium chloride solution-filled tires, wheels and wheel weights weigh about 1,200 lbs. each.)

The First Problem

Our first problem came in moving the rear wheels of the tractor to a wider position to accommodate the ROPS. Both the front and rear wheels of the tractor were set to the narrowest possible position. There wasn't room for the ROPS on the axle housing until the rear wheels were moved out. We had a very difficult time breaking loose the locking nuts and split-hubs on the right rear wheel. Our compressed air impact wrench wouldn't budge the bolts, even though the compressor is a high-capacity commercial grade machine that my son David used for several years in his automotive repair shop.

We ended up slipping a four-foot length of pipe over a half-inch breaker bar with a 1 1/8-inch socket. We broke

two wrenches before we finally got one troublesome bolt loose. Our third 1/2-inch drive breaker bar was a Snap-On and it didn't break. We really needed a 3/4-inch drive socket set as well as our 1/2-inch drive air wrench. But it was back at my other son's shop. The 1 1/8-inch large impact socket wrench that we had on hand worked well on everything except the troublesome locking bolts on the right rear wheel.

The left rear wheel locking bolts came loose easily with the air impact wrench and the 1 1/8-inch socket, and the split-hubs were not frozen to the axle, as was the case on the right side. The right rear wheel is the one that gets the most mud and dirt when plowing, and this is perhaps why it was frozen up so tight, that and the fact that it had not been moved in more than 10 years.

After we got the rear wheels free and moved out, the work went relatively well. We lowered the tractor the inch or so to the ground and removed the bottle jack. Then we positioned the lower ROPS uprights on the rear axle housing after first unbolting and moving the fenders to the side. This necessitated uncoupling the electrical wiring from the tractor chassis to the rear fender lights. The wires were too short to reach to the wider spaced fenders. To make the wires reach both rear lights, we had to add a splice of wire on both sides, solder the splices, and use heat-shrink PVC tubing insulation to cover the splices.

The fenders fitted nicely on the ROPS top anchor plates. The bolts that hold the fenders and the ROPS in place dropped into place around the rear axle housing easily, fitting right in the grooves on the front and rear of the axle housing.

The Second Problem

Then our second problem emerged. There were small casting marks on both sides of the rear axle housing that prevented the ROPS anchor plates from sitting flat. A corner of each casting mark on each side lifted the ROPS bottom plate off the axle housing by about 1.5 millimeters. We couldn't tighten the bolts

on the ROPS anchor plates unless both plates sat flat on the axle housing. To do so would create stresses on the axle housing that could cause it to fail during an overturn. We looked at the instructions, which said to grind off a small amount off the casting mark. Fortunately, we had a compressed-air-powered commercial grade hand-held grinding tool with a thin, horizontal shielded disk and were able to grind down the casting marks to accommodate the ROPS anchor plate. Both ROPS lower upright bar anchor plates then fit flat and snug on the rear axle housing.

The Third Problem

Our third problem came when we tried to install the one bottom bolt that goes from the bottom anchor plate for the ROPS up inside the lower right ROPS bar. There is a heavy nut welded inside the ROPS upright bar that the bolt is supposed to screw into. When we tried to screw the bolt into the bar from the bottom, it wouldn't go and it started to mangle the threads on the 3/4-inch bolt. We discovered that welding debris had gotten into the threads of the nut inside the ROPS bar.

We needed a three-quarter inch tap to clean out the threads in the problem nut, which, of course, could not be removed because it was welded inside the ROPS bar during the fabrication process. We didn't have a 3/4-inch tap. David, my son who is a certified master mechanic, solved this problem.

Improvising

First David found another long 3/4-inch diameter hardened steel bolt in the farm shop area. He then ground the end of the bolt into a cone shape. Then, using the hand-held grinder, he cut lengthwise grooves in opposite sides of the bolt so it could be used as a tap to cut the unwanted welding debris from the threads of the problem nut.

The tap David improvised looked almost exactly like a real tap, and it worked about as well too. When he screwed it into the nut with the bad threads, it cut out the welding debris and

made clean threads. The nut inside the right ROPS upright bar was now serviceable. The bolt that fastened the bottom anchor plate under the axle to the right ROPS upright then screwed into place, as it should have the first time.

Smoother Sailing

The next part of the ROPS installation job was fairly easy. We spent some time planning the spacing of the two lower uprights of the ROPS on the axle housing to make sure the spacing was right for the ROPS top piece—not too wide or too narrow. Then we secured the lower ROPS bolts tight (but not fully tightened because we might have needed to adjust them). Next we put the two upper ROPS bars and top cross bar in place.

Because the ROPS is made from five pieces, we were able to lift all the parts into place by hand. We didn't need to use the boom we had available for the three-point hitch on another 60 hp Ford tractor (a tractor that came already equipped with an upright ROPS and seat belt). Placing the ROPS did, however, require the three of us—two to lift and put the each part in place, and the other person to position the part and fit the bolts into place.

The Fourth Problem

Our fourth problem came when we were about to install the last large bolt that holds the left fender and outermost end of the ROPS top and bottom plates in place on the axle housing. The bolt was missing! We assumed it was still in the bubble wrap inside the shipping crate. However, a thorough search failed to find the missing bolt, and we came to the conclusion it had been left out of the ROPS kit. The nearly foot-long 3/4-inch diameter bolt is made from a special hardened, but not too brittle, steel.

Improvising Again

We were forced to proceed by placing a 3/4-inch piece of steel rebar in place of the bolt, with the bar held in place with a washer and cotter pin through its top. We then put the other five

ROPS bolts in place on the ROPS anchor plate on the left side of the tractor.

Not having the sixth bolt prevented us from fully torquing the four inner ROPS bolts to the specified 300 ft-lb. and torquing the one outer longer bolt to the specified 175 ft-lb. With the one bolt missing, we were afraid to fully tighten the other bolts because it might strain and damage some of the bolts or create undue stresses on the tractor axle housing. So we snugged the bolts up tight but not to the full torque specifications.

It was about two weeks later before we received the proper bolt we ordered from the equipment dealer. After an additional two weeks, my son got around to installing the last bolt and torquing up to the proper specs all six bolts on the left side of the ROPS anchor plates.

You Shouldn't Make a ROPS

By the way, that single bolt cost \$26! This fact makes it clear that the ROPS kit was sold at cost. At that price, the 12 bolts in the ROPS retrofit kit would cost a total of \$312! We only paid \$395 for the whole kit.

A farmer cannot construct a sound homemade ROPS for fewer dollars than the cost of a ROPS that is properly engineered, certified and available from an equipment dealer. It would cost the farmer much more to purchase the proper steel and bolts to construct a ROPS than it would to purchase the ready-made ROPS from the dealer. In addition, it would take many hours for the farmer to construct the ROPS.

The task also would require precision metal cutting, drilling, and welding equipment as well as considerable skill in using this equipment to fabricate the heavy steel parts. Any errors in either the selection of the proper materials or in the fabrication process could make the ROPS vulnerable to failure during a tractor overturn.

Liability Issues

If a ROPS fails during an overturn, if someone other than a family member is injured, and if the ROPS is not an

approved and certified ROPS, the farmer is liable for an expensive lawsuit, and perhaps charges of criminally negligent behavior. The farmer can also be liable if he or someone other than a dealer improperly installs a certified ROPS and if the ROPS or the tractor axle housing fails during a tractor overturn.

Finishing Up

One of the last jobs was to move the front wheels of the tractor out to the same center width as the rear wheels. We first jacked up each front wheel and axle one side at a time with our bottle jack. We then placed two 5-ton jack stands and a few oak crib blocks under the axle to hold both front wheels off the ground. Then we uncoupled the two tie rod ends, which was fairly easy. We then used the air-powered impact wrench to loosen the four front axle bolts on each side. We removed the bolts and slid each front axle out to the correct distance so that the center of each front tire lined up with the centerline of the corresponding rear tire. Then we adjusted the tie rod ends, and set the toe-in by measuring the front tire center distance at the front and at the rear of each tire and making adjustments until we got the prescribed 1/8 to 1/4 inch toe-in for each front tire.

We then tightened all the front axle bolts to specs. Next we put the seat belt on, a simple task since the seat was designed to have a belt and already had the mounting brackets in place.

We picked up the tools and put everything away. Total job time, not counting travel and getting the tools ready, was about 6 to 7 hours for the three of us, plus the additional time involved later in ordering, picking up, and installing the missing bolt.

A Master Mechanic and His Helpers

David, my younger son, is a fully certified ASE technician who makes his living as a master mechanic and a professional fire fighter. Mark, the farmer (who is also a professional fire fighter),

is also a pretty good mechanic. I too was a truck mechanic in the Army. We were probably better equipped than many farmers, and yet we also were short two tools that we needed (a 3/4-drive socket set and a 3/4 tap).

More Difficult than You May Think

All in all, I suspect that many farmers would have trouble installing a ROPS because of (a) having difficulty finding the time required to do the job, (b) the pressures to keep the tractor in operation and not have it out of service for very long, (c) the lack of proper tools to do the job, and (d) the sort of problems that we encountered that can interfere with getting the job done in a timely manner.

Other Farmers Had Trouble Too

In the course of the Kentucky Community Partners for Healthy Farming ROPS Project, our UK project staff interviewed 56 farmers who retrofitted their tractors with ROPS. Most had the dealers install the ROPS on their tractors, which is generally the best way to proceed. Of the farmers who installed the ROPS themselves, many reported that they too had problems similar to those we experienced while putting the ROPS on Mark's tractor.

Equipment dealers can solve these problems much faster and more easily because they are experienced in doing this type of work. They also have all the necessary equipment and usually have spare parts available.

Lessons Learned

Perhaps our experience in putting a ROPS on Mark's tractor can be of value to others. Farmers may have a tendency to underestimate what is involved in installing a ROPS on a tractor.

The dealer's cost of \$100 to \$150 for a ROPS installation is an easy and reasonable alternative for most farmers. In our case it took over two months to get a ROPS on that tractor. During the two months Mark, and other family members who drove the tractor, were unprotected by a ROPS and seat belt.

The seven hours the three of us spent putting the ROPS on the tractor could have been used for doing other important work on the farm. Our total time of more than 21 hours was certainly worth more than the \$150 the dealer would have charged to install the ROPS.

Of course, one reason we installed the ROPS ourselves was to avoid having to haul the tractor to the dealer and then back to the farm again, a 70-mile round trip. This travel and waiting for the dealer to complete the work might have taken the tractor out of service for three or four days.

The Rest of the Story

While my two sons and I were involved in putting the ROPS on the tractors, our wives and the children were busy too.

Our three wives were busy washing several hundred Styrofoam tobacco seedling trays with bleach-water solution to kill any plant pathogens that might be present. Floating tobacco plants (hydroponic growing) is a great way to get good plants that are easy to set (plant in the fields with a tobacco setter and tractor) and that require no tobacco beds, no weeding, and no pulling of the plants to set them. But the downside is that floating the plants makes them more susceptible to disease.

Kids, Dogs, and Adult Supervision

Both the farm women and we three men also were jointly watching the children. The grandchildren were

watching, playing and “helping” in both major activities that afternoon. The six adults watched over the five children, ages 3 to 10, and kept an eye on the three dogs that were more prone than the kids to wander into places they should not be.

Throughout the afternoon, all of the children were in or near the two work areas, which were located in the farmyard about 200 feet apart. We were all busy and hurrying to get the work done. The kids were good, involved, and helpful.

The previous two paragraphs illustrate how farm children are usually around, near, and involved in many different farm chores on a regular basis. Many potential hazards can be present and close supervision is essential.

Motivation

Why did we put the ROPS on Mark’s tractor? When he was 11 years old he overturned a tractor on his grandfather’s farm. The tractor turned completely upside down in a ditch. He was pinned under the tractor for a few minutes. His uncle, his grandfather, and six men who stopped as they were commuting home from work, got down in the ditch and lifted the tractor off Mark. The local rescue squad took him to the hospital where he was examined and released with only a bruised knee.

A few years later, only a few hundred yards down that same road, my nephew was killed when his tractor overturned after it was struck by a car driven by a drunk driver who ran off the highway and into the field.