



MAKING PTO CONNECTIONS

HOSTA Task Sheet 5.4

Core

NATIONAL SAFE TRACTOR AND MACHINERY OPERATION PROGRAM

Introduction

After spotting the hitch to connect the tractor to the implement, the operator must attach the PTO shaft of the tractor to the implement by way of the implement input driveline (IID). See Task Sheet 5.4.1. These connecting shafts can be heavy, greasy, and difficult to manipulate in the cramped space between the tractor and the equipment. The youthful operator must have a strong grip and will often have to work at an awkward angle. *Check the NAGCAT website to determine if you can handle the task of PTO connection.*

This task sheet discusses PTO design and how to make PTO connections through knowledge of that design.

PTO Stub Shaft Design

PTO Speeds: Tractor PTOs are designed to rotate at 540 rpm or 1000 rpm. Shiftable, dual-speed PTOs may reach a maximum design speed of 630 rpm or 1170 rpm.

PTO Splines: By counting the number of splines, or teeth on a PTO stub shaft, the beginning operator can identify the speed of the PTO shaft in rpms. A 540 rpm PTO shaft will have 6 splines or teeth. A 1000 rpm PTO shaft may have 20 or 21 splines or teeth.

The faster the PTO speed, the more teeth that are used to make the PTO connection between the tractor and the implement.

PTO Sizes: PTO stub shaft diameter for a 540 rpm shaft is 1 3/8 inch. The 1000 rpm stub shaft with 21 splines or teeth is 1 3/8 inch. The 1000 rpm stub shaft with 20 splines or teeth has a diameter of 1 3/4 inch.

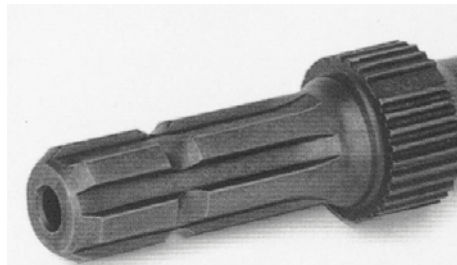


Figure 5.4.a. The 540 rpm PTO stub shaft has 6 splines or teeth and is 1 3/8 inch in diameter. *Farm and Ranch Safety Management, John Deere Publishing, 1994. Illustrations reproduced by permission. All rights reserved.*

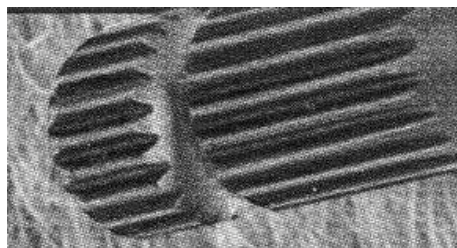


Figure 5.4.b. The 1000 rpm PTO stub shaft has either 20 splines or teeth with a 1 3/4 inch diameter or may have 21 splines or teeth with a 1 3/8 inch diameter.

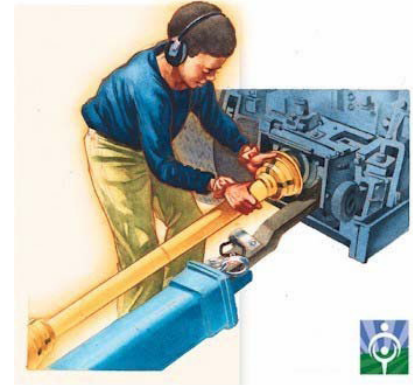


Figure 5.4.c. NAGCAT recommends that youthful farm workers wear snug-fitting clothes, non-skid shoes, and hearing protection while working around machinery. The youth's ability to lift and connect the PTO shaft must be evaluated by an adult who understands the physical development of children.

540 rpm PTOs have 6 splines or teeth.
1000 rpm PTOs have 20 or 21 splines or teeth.

Learning Goals

- To be able to attach the PTO driveline between the tractor and the implement

Related Task Sheets:

Reaction Time	2.3
Age-Appropriate Tasks	2.4
Mechanical Hazards	3.1
Using 3-Point Hitch Implements	5.3
Using Power Take-Off Implements	5.4.1

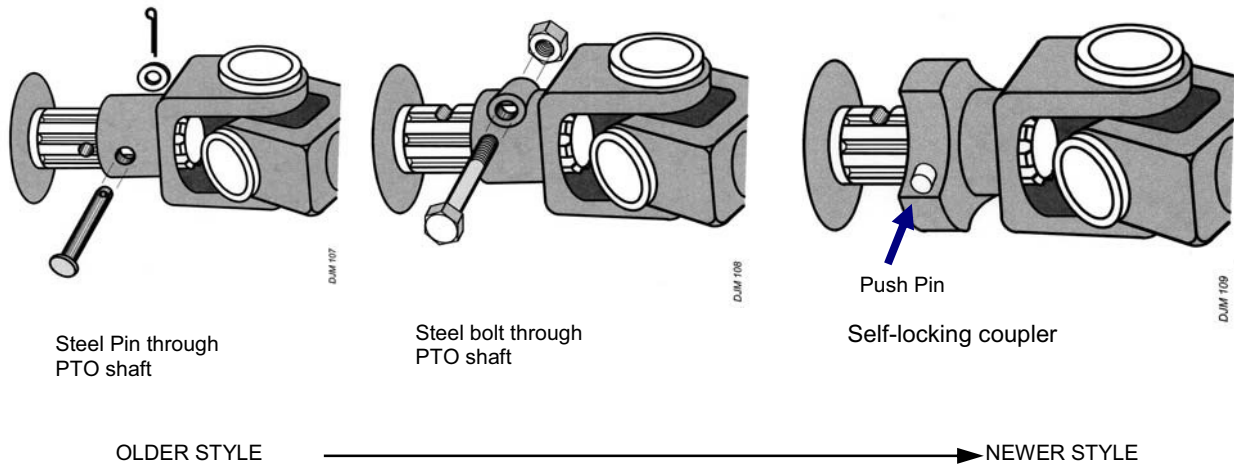


Figure 5.4.d. Various means to secure the PTO shaft to the stub shaft have been used over the years. Besides those connection methods shown above, another popular style is the push pin detent locking type shown in Figure 5.5.e. All types of locking device areas must be guarded as they are wrap points where the operator can become entangled in the PTO.

PTOs must be guarded to prevent an entanglement hazard.



Figure 5.4.e. The push pin detent lock on the PTO driveline has a metal rod which fits in the PTO stub shaft groove to secure it. A firm grip is needed to press the pin. Do you have enough hand strength to push this pin in all the way?

Connecting the PTO

Follow these steps to attach the PTO shaft of a 3-point hitch implement.

1. Connect the tractor to the drawbar or to the 3-point hitch of the implement using the approved steps. See Task Sheets 5.1, 5.2, and 5.3.
2. Attach the PTO shaft of the implement to the PTO stub shaft of the tractor.

Here are some suggestions to make the PTO connection easier.

- A. Align the driveline PTO shaft splines with the splines of the stub shaft of the tractor. If the splines will not align, try turning the tractor PTO stub shaft slightly, or use the implement flywheel to move the implement's PTO shaft. Have this procedure shown to

you if necessary.

- B. Press the detent lock push pin inward (Figure 5.4.e) as you slide the implement shaft onto the tractor stub shaft.
- C. Slide the implement shaft forward far enough to make sure the detent pin has snapped into the lock position.

PTO Care and Use

Dirt and grease can make the PTO shaft difficult to grasp and connect. Keep the PTO shaft off the ground. Wipe the excess grease from the PTO shaft with a cloth.

Important: A new PTO shaft has paint inside the splines. This may prevent the shaft from fitting over the PTO stub. The paint must be removed.

PTO Phasing

Older PTO shafts can be separated or pulled apart. The two parts are made so that one part fits into the other. The PTO must be able to telescope in and out to permit machine operation over irregular terrain. If the parts become separated, they must be re-assembled “in phase” to avoid placing extra strain on the universal joints. Many shafts are designed to prevent this from happening.

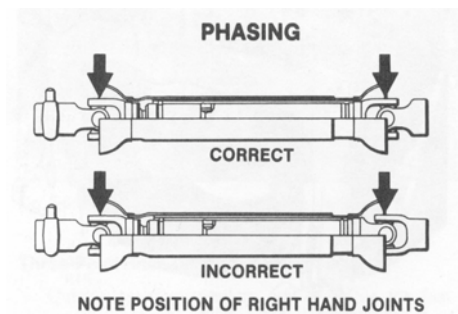


Figure 5.4.f. The upper portion of the drawing illustrates a correctly placed universal joint. You may wish to check the phasing on a PTO shaft.

NAGCAT Guidelines

NAGCAT recommendations for connecting and disconnecting a PTO shaft are shown in this section. These recommendations were developed by a knowledgeable group of safety experts as a means of helping parents to match youthful agricultural workers with the tasks that are appropriate to their development.

The PTO guidelines are presented here.

Adult Responsibilities:

- Be sure implement is in working order.
- Be sure that all safety features are in place.
- Be sure the work area has no hazards.
- Be sure the youth has long hair tied up out of the way, has non-skid shoes, and snug-fitting clothes. Hearing protection is recommended as well.

The adult in charge should also evaluate you using the following questions:

1. Can the youth drive the tractor skillfully?
2. Can the youth hitch and unhitch implements?
3. Does the PTO shaft weigh more than 10-15% of the youth’s body weight? To avoid back injury, this should be the maximum weight you should be asked to lift.
4. Can the youth follow a 5-step process?
5. Has the youth been trained in proper lifting techniques?
6. Has an adult demonstrated connecting and disconnecting a PTO?
7. Can the youth do the job 4 or 5 times under direct supervision?
8. Can an adult provide the recommended supervision?

Your experience level may be acceptable to you, but proof of your expertise should be evaluated by a qualified tractor operator.

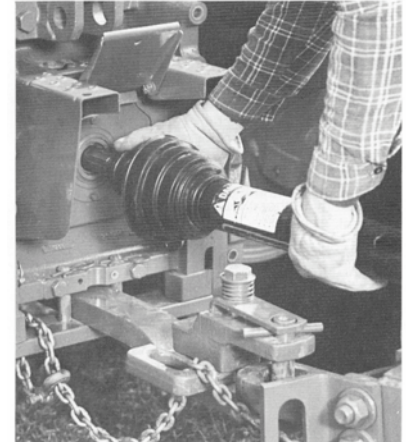


Figure 5.4.g. This is what the task of connecting a PTO looks like. You must lift a heavy object at an awkward angle while squeezing in the lock mechanism detent pin. Watch someone else connect a PTO several times before doing this job. Continue practicing connecting a PTO on your own with supervision.

Connecting a PTO shaft will be easier after practicing the job several times.

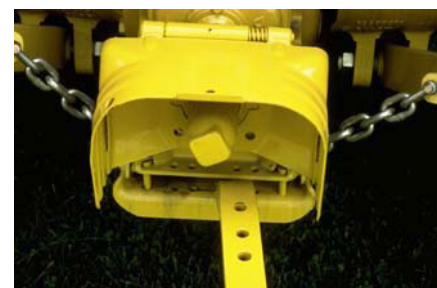


Figure 5.4.h. This PTO stub shaft is protected with a tractor master shield and stub shaft cover. To remove the stub shaft cover, grip the cover firmly and turn counterclockwise. Store the stub shaft cover where it will be available to replace when the job is done.

Safety Activities

- Using an Internet search engine, type NAGCAT and view the many guidelines presented for the various farm jobs you may be assigned to do. Are you ready to accept these jobs based upon the guidelines presented?
- Do a survey of the tractors on a farm to determine how many have 540 rpm PTO shafts and how many have 1000 rpm PTO shafts. Record the results.
- Practice lifting a PTO shaft right handed while squeezing the locking mechanism of the PTO shaft connector. Practice lifting a PTO shaft left handed while squeezing the locking mechanism of the PTO shaft connector. From which side were you able to lift and squeeze best?
- Check the phasing of three PTO shafts. Make a drawing of the universal joints on each end of the PTO shaft. Did you find any PTO shafts that were out of phase? If so, label this drawing to show what was wrong.
- Fill in the blanks:
 - A PTO shaft with 6 teeth on the shaft is designed for _____ rpms of speed.
 - A PTO shaft that has 20 teeth on the shaft is designed for _____ rpms of speed.
 - A PTO shaft that has 21 teeth on the shaft is designed for _____ rpms of speed.
 - What is the maximum weight that a 14- or 15-year-old worker should be expected to lift without straining the back muscles? _____ % of their body weight.
- Word scramble. Unscramble the following words. Then fill in the blanks to form a safety message about PTOs.

_____ all PTO _____.

d a u g r = _____

s s t a f h = _____
- From this phrase “implement input driveline,” write a word list using as many letters as you can. The words must have at least four letters. No two-letter or three-letter words are permitted. Letters may only be used as many times as they appear in the phrase. Example: RIVET can be found in the phrase.

References

- www.nagcat.org/Click on Guidelines/Scroll through the list to find a topic. February, 2003.
- www.asae.org/Click on Technical Library/ Scroll to Standards/Type in Power Take-Off/Download PDF file, ASAE S203, December 2001.
- Safety Management for Landscapers, Grounds-Care Businesses and Golf Courses, 2001, 1st Edition, John Deere Publishing, Moline, Illinois.
- Farm and Ranch Safety Management, John Deere Publishing, 1994. Illustrations reproduced by permission. All rights reserved.

Contact Information

National Safe Tractor and Machinery Operation Program
 The Pennsylvania State University
 Agricultural and Biological Engineering Department
 246 Agricultural Engineering Building
 University Park, PA 16802
 Phone: 814-865-7685
 Fax: 814-863-1031
 Email: NSTMOP@psu.edu

Credits

Developed, written and edited by WC Harshman, AM Yoder, JW Hilton and D J Murphy, The Pennsylvania State University. Reviewed by TL Bean and D Jepsen, The Ohio State University and S Steel, National Safety Council. Version 4/2004

This material is based upon work supported by the Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 2001-41521-01263. Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the view of the U.S. Department of Agriculture.