

Penn State **Extension**

Organizing and Conducting

A Safe Tractor Operation Workshop



Department of Agricultural and Biological Engineering

Agricultural Safety and Health Program

JUNE 2013

Table of Contents

Introduction	Page 3
Part I: Choosing Instructors, Tractors, Machines and Driving Courses	Page 3-6
Part II: Instructional Content	Page 8-9
Part III. Conducting Training Workshops	Page 9-11
Part IV: Performance Evaluation Forms	Page 11-14
Acknowledgements	Page 15
Appendix A: Task Sheets	

Introduction

There are many new owner/operators and workers entering production agriculture, agricultural services, forestry, landscaping, golf course maintenance, and other businesses and services where agricultural tractors are used. Add to these numbers the many volunteers that mow school and church yards, cemeteries, little league ball fields and community parks, and the grounds of service clubs and organizations such as the Elks, Lions Club, VFWs, and others. Fewer people are growing up on farms or learning to operate tractors as part of a planned learning activity over time. Relatively new and untrained operators can benefit from training from experienced operators.

The manual has been developed to help farmers, employers and other experienced operators with organizing and conducting hands-on safe tractor driving workshops for your own employees, volunteers, and family members. Safe hitching and attachment of equipment is included. Workshops such as these can vary widely depending upon the needs of the farm operators and employers, and we provide options for varied types of training needs. You may decide to conduct training in a single day or may break the training into two or more days depending on how many persons need training and how intensive you want the training to be. You may want to join forces with neighbors or others for training, but this may bring liability issues to the forefront so be sure to check with your insurance carrier first.

Part I: Choosing Instructors, Tractors, Machines and Driving Courses

The suggestions listed below are most useful when several workers need training and when the majority of them have little to no experience with tractors. You should scan through all the parts of this manual before making any firm decisions about how to organize your training workshop.

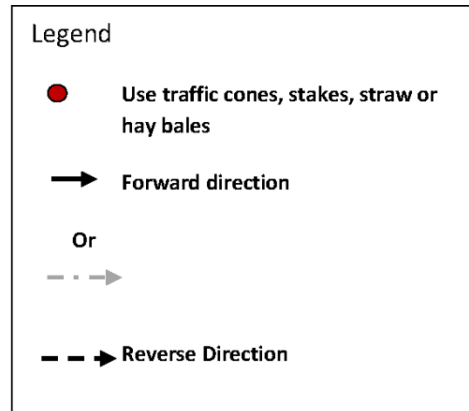
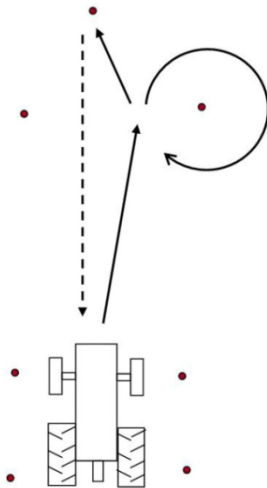
Identifying the number and characteristics of instructors, tractors, machines and driving courses are factors to be considered. Suggestions include the following.

- Instructors must be experienced, knowledgeable about safety, and have good communication skills. Instructors should have access to and thorough knowledge of the operator's manual for each tractor and implement being used for the training. Most importantly, instructors must set a good example, meaning they should use the 3-pt method for getting on and off tractors, buckle their seat belt before starting the tractor, check that controls are in neutral, etc. One to three individuals, depending upon group size, is typical for most workshops. For larger groups, consider having one instructor available to keep everyone on time, keeps groups rotating intact, watch for bystanders, provide overall supervision, etc.
- Use 1 tractor per 5 trainees that will be learning or practicing driving a tractor. These tractors should be small to medium sized tractors (40-70 hp recommended) *without a cab*. Smaller tractors without cabs facilitate communications with trainees while they are on

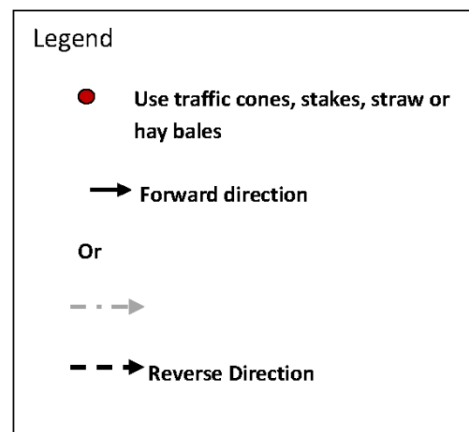
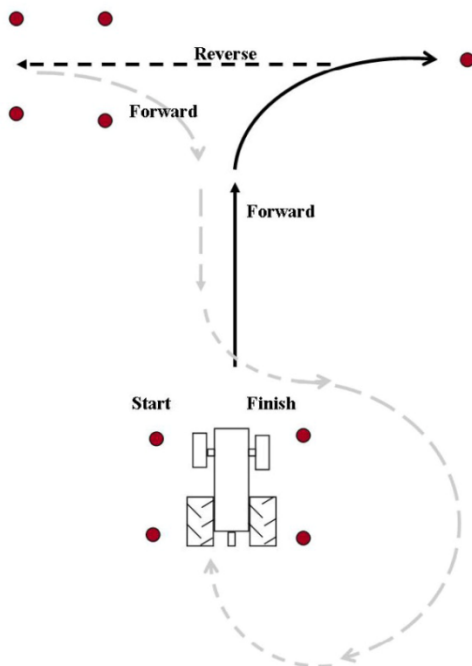
the tractor. If there is a cab, the door should be closed and a cab window opened. If only a larger ROPS enclosed tractor is available, then it should have an original equipment manufactured instructional seat to facilitate safe instruction. In no case should the instructor ride extra on a tractor. Tractors should also have these features:

- A wide front-end
 - A ROPS with a functional seat belt
 - Easily adjustable seat
 - Lockable, working brakes or a park selection
 - A PTO master shield
 - A hitch pin with safety lock/clip/pin/key
 - A clean, properly colored and mounted SMV emblem
- Driving courses can be set as a local option based upon the area available and degree of proficiency expected upon completion of the training program. It is possible to use any open area such as a field or parking lot. Space and other items for your driving course layout should include a:
 - Level surface area, free of ruts and unknown obstacles
 - Minimum distance of 50 ft. between tractor/machinery training stations
 - Traffic cones, stakes, straw bales, etc. as course markers
 - Twine or rope to form a line or artificial barrier in the course
 - Post driver to drive posts if used
- Below are four examples of driving courses going from very simple to more challenging. One can be used in its entirety or pick and choose among them to fit your needs. If you have new workers that have no tractor operating experience, a simple driving course with a tractor only is suggested. As trainees become comfortable with maneuvering the tractor by itself, a two-wheeled implement, e.g., a trailer, cart, grain drill, manure spreader, etc. could be attached to the tractor. You may also wish to have trainees practice safely hooking or attaching equipment. A simple layout for this activity is also shown.

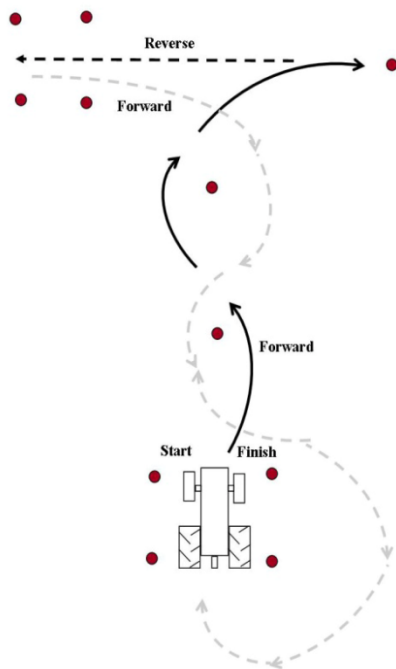
Driving Course I



Driving Course II



Driving Course III



Legend

● Use traffic cones, stakes, straw or hay bales

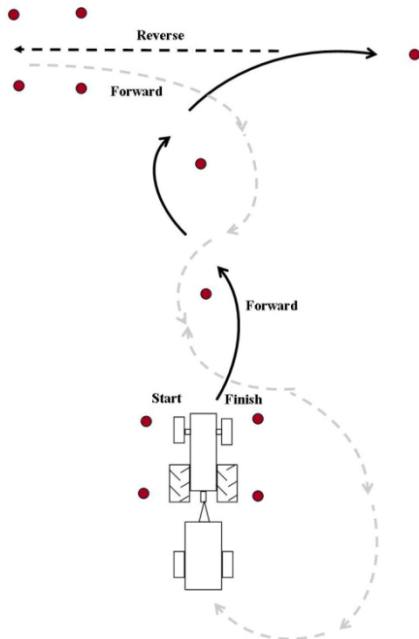
→ Forward direction

Or

--- →

--- → Reverse Direction

Driving Course IV with Implement



Legend

● Use traffic cones, stakes, straw or hay bales

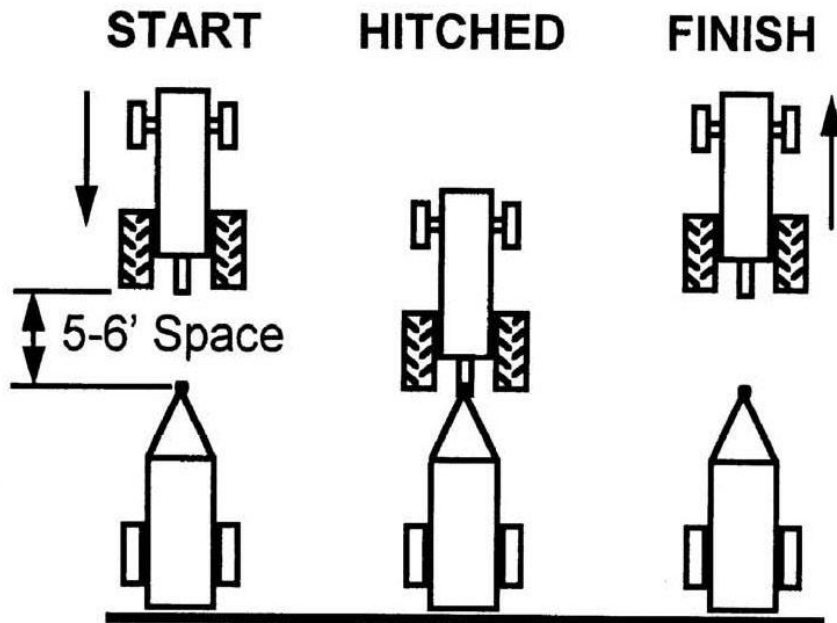
→ Forward direction

Or

--- →

--- → Reverse Direction

Hitching Layout



- If a more challenging driving course is appropriate, have available 2-3 pieces of equipment to use during tractor driving and for practice hitching equipment and attaching accessories to a tractor. With small groups you may only need 1 or 2 pieces of equipment and you may be able to use a single piece of equipment that has several of the characteristics described below. When selecting machinery and equipment, consider using:
 - A two-wheeled implement to use with a tractor for driving through a prescribed course.
 - At least one piece of equipment with a properly shielded PTO driveline
 - A machine or equipment with hydraulic or electrical connections, preferably both. Hydraulic hoses should not have any leaks or tears in the hose.
 - An implement with a jack stand
 - A three-point mounted implement
 - Chock blocks for each implement or machine
 - A clean, properly colored and mounted SMV emblem on the machinery

Part II: Instructional Content

This section offers ideas for organizing the information to be taught to new operators about safe tractor operation. Depending upon qualifications and experiences, instructors may only need to glance at this material as a refresher, or may want to follow it closely.

Intensity of training may range from an expectation of a basic exposure to tractors to a fully proficient tractor operator. It is important that trainees become comfortable with tractor controls and with starting, moving and stopping the tractor before expecting them to master maneuvers such as tight turns, backing or attaching 3-point mounted equipment. They should understand basic rules of the road before being allowed to operate a tractor on a public road. Specific instructional details are contained in task sheets identified below for beginning and more experienced training. The task sheets are listed in Appendix A or can be accessed via the Internet at www.nstmop.psu.edu, click on Download the Task Sheets (the rest of the Student Manual). Depending on the equipment used and training given, not all task sheets may be needed.

Suggested Task Sheets for Safe Tractor Operator Training¹			
Topic	References See Appendix A:	Beginning Trainee	Experienced Trainee
<u>General Issues</u> : Tractor Hazards; Tractor Stability; Using the Tractor Safely, Public Road Use; Noise Hazards/Hearing Protection; Hand Signals, Front-end Loaders	4.2, 4.12, 4.13, 4.14, 6.4, 3.2, 2.9	X	X
<u>Pre-Op Checklist</u> : Preventive Maintenance & Pre-Operation Checks; Fuel, Oil & Coolant Levels; Lead Acid Batteries; Tire & Wheel Condition	4.6, 4.6.1, 4.6.2, 4.6.5	X	X
Mounting/Dismounting	4.8	X	
Operator's Platform	4.6.6	X	
Instrument Panel	4.4	X	X- new models
<u>Tractor Controls</u> : Engine Stop; Ground Motion; Power Engagement; Positioning & Adjusting; Location & Movement	4.5 through 4.5.5	X	X-review with new models
Tractor Operating Symbols	4.5.6	X	X-review with new models
Standard Shift Transmissions	4.10.1	X	
Other Transmissions	4.10.2	X	X-new models
Starting/Stopping	4.7	X	
Moving and Steering	4.10, 4.11	X	

Hitching- Drawbar	5.1 and 5.2	X	
Hitching- 3 PT hitch	5.1 and 5.3	X	
PTO Connections	5.4 and 5.4.1	X	
Hydraulic Connections	5.5	X	
Electrical Connections	5.6	X	

¹ Don't forget to also use the operator's manual

Part III. Conducting Training Workshops

This section has several suggestions involving the actual conduct of a safe tractor driving workshop. Learning activities should proceed in a logical order starting with the simplest of concepts and tasks. The length of any workshop will depend upon the number of trainees, their experience levels, and how competent you want them to be at the end of the training. You may wish to conduct two or three workshops that are only a couple hours each, especially for new tractor drivers, or you may want a workshop that is closer to an all-day event. A good training session will allow adequate time for trainees to ask questions and to not feel rushed during learning exercises.

Below are suggestions for several learning activities that could make up a safe tractor driving workshop. These major components consist of pre-operational checks of tractors, mounting and dismounting, learning how to operate the major controls, maneuvering the tractor around or through simple markers (e.g., traffic cones, stakes, straw bales), backing the tractor, and hitching to equipment. Backing the tractor with a two-wheeled piece of equipment (e.g., trailer, manure spreader, grain drill) and hitching to 3-pt mounted equipment are activities that add complexity and time to workshops. Hitching to 3-pt mounted equipment and equipment with tongues can be practiced as a lone tractor operator activity, or can be done by the tractor operator using a helper.

Here are ideas for conducting specific learning activities. The task sheets listed in Part II are useful as a reference as you move through these activities.

- **On-ground Pre-operation Check.** This activity should be done on the ground before anyone gets on a tractor and is most efficiently done with a small group. Trainees could be asked to find the items and perform the checks, or the instructor can perform the checks, explaining what and why items are being checked. The importance of pre-operation checks for protecting valuable equipment can also be emphasized. The items to be included are (in no particular order): fuel, engine oil, diesel plugins, hydraulic oil & coolant levels; air filter, battery; lug nuts on wheels, tire condition/inflation, SMV emblem, cab windows, mirrors, fluid leaks, loose or defective parts and operator platform/steps.
- **On-tractor Pre-operation Check.** This activity can be completed with either the instructor or one trainee sitting in the tractor seat with others watching. The tractor key should be removed. Items to be pointed out and discussed include (in no particular order): brakes and brake lock, clutch, gear shift(s), hand and foot throttles, seat adjustment, ignition key (button), shut off key and/or control, instrument panel, PTO control, hydraulic controls, and 3-pt hitch control.
- **Mounting and Dismounting.** Correctly getting on and off a tractor is important to minimize slips and falls, and the temptation to skip using one or more steps while getting

on or off the tractor is always present. Broken and badly sprained ankles, and broken leg femurs happen surprisingly often from recklessly or hurryingly mounting and dismounting tractors. Everyone (including the instructor) should use the 3-points of contact method for getting on and off tractors, and use all steps and handholds provided. Three-points of contact means that while facing the tractor a person always has either two hands and one foot or one hand and two feet in contact with the ground, steps, handholds or operator platform at all times.

- ***Starting, Moving and Stopping a Tractor.*** Before a trainee is allowed to maneuver a tractor through any type of driving course, you must be sure they understand clutches, gear shift patterns, shuttle shift levers, brakes and throttles. Many youth grow up today operating only automatic gear shifts in cars, pickups and SUVs. Pushing in a clutch to shift a gear or to stop may be new to them. Even with hydrostatic transmissions, the clutch may need to be pushed in for safe starting or for stopping. This is also the time to make sure a person can depress a clutch and brakes all the way while sitting fully back in the seat. A seat that is properly adjusted for the operator will allow the person to have the clutch and brakes fully depressed while their back is against the seat backrest and their hands on the steering wheel with elbows and knees at approximately a 90 degree angle.

Experience has shown that nothing comes easy or automatic for some if they have never operated a tractor with a clutch. Have the trainee practice depressing the clutch and shifting gears, including reverse, with the engine off. If the tractor is a hydrostatic and/or has a gear range, let them maneuver those controls. As appropriate, be sure they understand that with the clutch depressed the tractor doesn't move; with the clutch pedal released the tractor does move. Before allowing the trainee to start the tractor, the instructor should stand clear of the tractor wheels and be sure other trainees are stationed well away from the tractor. Instruct the trainee to use as low a gear as possible to start out. Use Task Sheet 4.7 as a reference for the correct sequencing of steps for starting a tractor. You can let the trainee move the tractor straight ahead and then back it to the starting point, or you may let them move it through a driving course. Even trainees who have never been on a tractor before can learn to start and move a tractor around a few traffic cones in a short period of time.

- ***Maneuvering the Tractor through a Driving Course.*** It is always best to demonstrate the maneuvers you want trainees to execute. Be sure you follow the safe procedures that you expect of them. As shown in Part I, driving courses can be very simple or more challenging. Depending on how challenging the driving course is, you may want to walk along parts of the course to easily communicate with the driver. Critical points to remember include:
 - Stay 12-15 feet away from the tractor at all times while it is moving.
 - Never stand in front or behind a wheel while the tractor engine is running.
 - Use appropriate hand signals to communicate with the trainee (Task Sheet 2.9) if you are on the ground
 - Never be an extra rider on the tractor or trailing equipment. Use the seat belt if you are riding in an instructional seat.
- ***Hitching Equipment.*** All hitching should occur on level ground to minimize the chance of equipment rolling unexpectedly. The lowest range, gear and throttle setting should be used. A demonstration by the instructor is very valuable. Use correct hand signals from Task Sheet 2.9 to communicate with the operator. If a helper is involved, remind the

operator where the helper should be standing. If 3-pt mounted equipment will be attached, be sure the equipment and tractor sizes match. The best way to avoid surprises and difficulties is for the instructor to practice attaching the equipment beforehand.

Below is a suggested agenda if you want to conduct a five hour safe tractor driving workshop for 10 trainees with two instructors and two tractors. The agenda includes starting off with a general discussion of tractor safety issues which helps to set the stage for the rest of the day. Suggested times and activities can be adjusted depending upon your needs and resources. A schedule like this would utilize a simple driving course. By adding one hour, students could practice driving both tractors.

Topics:	Introductions/Orientation/Hand-outs	10:00-10:15 am
	General Safety Issues	10:15-11:15 am
	PTO Hazard Demonstration	
	Tractor overturns	
	ROPS w/seat belt	
	Front-end loaders/Center of Gravity	
	Extra riders	
	Hand Signals	
	Pre-Operations Checks	11:15-12:00 pm
	Preventive Maintenance	
	Mounting and Dismounting	
	Operators Platform	
	Seat Adjustment, Seat Belt	
	Operational Controls	
	Color Controls	
	Starting and Stopping Tractor Engine	
	LUNCH	12:00-12:30 pm
	Driving -- Tractor 1 (5 students)	12:30-1:30 pm
	Driving -- Tractor 2 (5 students)	
	Hitching and PTO Hook-up	
	--Tractor/Equipment 1 (5 students)	1:30-2:30 pm
	--Tractor/Equipment 2 (5 students)	
	Questions and Answers (Q&A)	2:30-2:45 pm
	Evaluations	2:45-3:00 pm
	Close	3:00 pm

Part IV: Performance Evaluation Forms

As with driving courses, evaluating a trainee's tractor operating performance can be very simple or more sophisticated. The very simplest approach is to merely watch and provide verbal feedback. More formal evaluations provide trainees with more detailed information about their performance, particularly in areas of operation where they may need more work. Ratings of Satisfactory, Unsatisfactory or Not Applicable can be used. The following pages show examples of evaluation forms for a tractor pre-operation inspection and driving and for an evaluation form that could be used with trainees to hitch or attach equipment. You may want to use these or adapt parts of them to suit your own needs.

Tractor Driving Performance

This form can be used to evaluate trainee's ability to perform a pre-operation check, safely mount and dismount, start the tractor, perform simple maneuvers, stop and park and dismount the tractor.

Tractor Driving Performance

Student Name: _____ Skills Examiner: _____
 Test Date: _____ Test Location: _____

Driving Activity (15 minutes suggested): Students must explain each activity as performed unless otherwise noted. Instructors should correct student errors where indicated.
☐ Student is dressed appropriately.

	S	U	NA	Pre-op Activities
				Pre-operation inspection: student identifies and explains what they are inspecting during walk around inspection.
				Check fluid levels - oil reservoir dipstick,
1				Check fluid levels - fuel tank cap
				Check fluid levels - coolant fill location
2				Check fluid levels - hydraulic fluid dipstick
				Check battery condition
3				Check tire condition (tractor and machine)
4				Check guards and shields (tractor and machine)
5				Check hitch and related connections
6				Can demonstrate universal hand signal for _____. (Instructor randomly selects)
				DISCUSS UNSATISFACTORY PERFORMANCE HERE
				Tractor entry and pre-start checks
7				Use handholds and steps to mount tractor
8				Buckle seat belt
9				Adjust seat, steering wheel
				Check major controls - PTO (verifies verbally)
10				Check major controls - hydraulic controls (verifies verbally)
				Check major controls - gear shift position neutral, park, or start position (verifies verbally)
11				Check major control - parking brake set
12				Adjust throttle to 1/3 open
13				Push clutch in (if equipped)
14				Can explain how to safely stop tractor movement
				Discuss Unsatisfactory Performance Here.

	S	U	NA	Driving Activities
				Tractor start-up and driving: if too high a gear and/or too high of a speed is used, or if driver appears to not have complete control or awareness of tractor and implement positioning, the driver should be stopped immediately.
15				Starts tractor engine
16				Presses foot brakes and releases parking brake
17				Starts tractor movement smoothly. Selects low gear and throttle setting. Releases clutch pedal smoothly while letting up on foot brake pedal.
18				Feet removed from clutch and brake pedal (no "riding" the clutch) while tractor is moving
				During Operation
19				Stops completely before reversing direction
20				Lowers throttle before shifting gear to reverse/forward
21				Successfully changes gears without clashing
22				Starts tractor movement smoothly in new direction
23				Drives through course without running over or crushing cones/barriers (a light touch or brushing is acceptable) or having to back up
				Tractor shut-off and exit
24				Stops tractor movement (push in clutch pedal if equipped or uses shuttle shift lever if so equipped), and applies foot brakes
25				Reduces throttle setting
26				Places gear in neutral or shift lever into PARK position
27				Sets parking brake
28				Shuts tractor engine off if exercise is complete
29				Dismount tractor by facing tractor and using handholds and steps
				DISCUSS UNSATISFACTORY PERFORMANCE HERE.

Version 12.12.2012

Tractor Hitching Performance

This form can be used to evaluate trainee's ability hitch and attach equipment including PTO, hydraulic and electrical connections.

Acknowledgements

Tractor Hitching Performance

Student Name: _____ Exam Date: _____

Skills Instructor Name(s): _____

Exam Location: _____

Skill Activities (15 Minutes Maximum):

S	U	NA		S	U	NA	
			Tractor entry and start-up				
			Use evaluation from Tractor Driving Performance or repeat tractor driving evaluation if needed.	10			Place tractor hitch pin in hole to connect the implement, use the tractor pin safety-locking device, connect safety chains (if present) to tractor.
			Seat belt always in use!	11			Correctly connect the implement PTO, hydraulic hoses, and electrical connections as equipped.
			Tractor Back-up and Implement Hitching (Verbal Explanation Not Needed)	12			Wind-up jack, swing to storage position if so equipped.
1			With clutch pushed in, start tractor, idle down throttle.				INSTRUCTOR INSPECTS ALL CONNECTIONS, CORRECT MISTAKES
2			Select slow/low reverse gear.				Tractor Unhitching and Shut-off
3			Slowly and smoothly back tractor to within a few inches of implement tongue.	13			Lower jack stand, adjust to take weight off hitch points.
4			Stop tractor, reduce throttle, shift to neutral and set brakes or place in PARK, shut tractor off, unbuckle seat belt.	14			Disconnect the implement PTO, hydraulic hoses, electrical connections as equipped.
5			Dismount tractor by facing tractor and using handholds and steps.	15			Remove tractor hitch pin.
6			DISCUSS UNSATISFACTORY PERFORMANCE HERE	16			Use handholds and steps to mount tractor.
			Adjust height of implement.	17			Buckle seat belt, adjust throttle to one-third open, push clutch in, move gear selection to START position if so equipped, start tractor
7			Use handholds and steps to mount tractor.	18			Move tractor forward 5 to 6 feet.
8			Buckle seat belt, adjust throttle to one-third open, push clutch in, move gear selection to START position if so equipped, start tractor.	19			Stops tractor, lowers throttle, places gear in neutral and set brakes or puts gear in PARK, shuts tractor off.
9			Back tractor to align drawbar and implement tongue holes, stop tractor, reduce throttle, place gear in neutral and set brakes or place gear in PARK, shut tractor off, dismount tractor by facing tractor and using handholds and steps. Student may need to repeat steps 11-14 to align holes perfectly.	20			Dismount tractor by facing tractor and using handholds and steps.
							DISCUSS UNSATISFACTORY PERFORMANCE HERE

Version 12.12.2012

This manual was developed by Dennis J. Murphy, Professor, Agricultural Safety and Health, and William C. Harshman, Extension Assistant, Department of Agricultural and Biological Engineering, College of Agricultural Sciences, University Park, PA.

This material is based upon work supported by USDA/NIFA under Award Number 2010-49200-06201.



The Pennsylvania State University is committed to the policy that all persons shall have equal access to programs, facilities, admission, and employment without regard to personal characteristics not related to ability, performance, or qualifications as determined by University policy or by state or federal authorities. It is the policy of the University to maintain an academic and work environment free of discrimination, including harassment. The Pennsylvania State University prohibits discrimination and harassment against any person because of age, ancestry, color, disability or handicap, genetic information, national origin, race, religious creed, sex, sexual orientation, gender identity, or veteran status and retaliation due to the reporting of discrimination or harassment. Discrimination, harassment, or retaliation against faculty, staff, or students will not be tolerated at The Pennsylvania State University. Direct all inquiries regarding the nondiscrimination policy to the Affirmative Action Director, The Pennsylvania State University, 328 Boucke Building, University Park, PA 16802-5901; Tel 814-863-0471.

Appendix A: Task Sheets

Reminder: Task Sheets can be accessed via the Internet at www.nstmop.psu.edu, click on Download the Task Sheets (the rest of the Student Manual).

Task Sheet	Title
2.9	Hand Signals
3.2	Noise Hazards and Hearing Protection
4.2	Tractor Hazards
4.4	Tractor Instrument Panel
4.5	Tractor Controls
4.5.1	Engine Stop Controls
4.5.2	Ground Motion Controls
4.5.3	Power Engagement Controls
4.5.4	Positioning and Adjusting Controls
4.5.5	Location and Direction of Movement
4.5.6	Tractor Operation Symbols
4.6	Preventive Maintenance and Pre-operation Checks
4.6.1	Fuel, Oil, and Coolant Levels
4.6.2	Lead Acid Batteries
4.6.5	Tire and Wheel Condition
4.6.6	The Operator Platform
4.7	Starting and Stopping Diesel and Gasoline Engines
4.8	Mounting and Starting the Tractor
4.10	Moving and Steering the Tractor
4.10.1	Operating A Manual Shift Transmission
4.10.2	Tractor Transmissions
4.12	Tractor Stability
4.13	Using the Tractor Safely
4.14	Operating the Tractor on Public Roads
5.1	Connecting Implements to the Tractor
5.2	Using Drawbar Implements
5.3	Using Three-Point Hitch Implements
5.4	Making Power Take-Off (PTO) Connections
5.4.1	Using Power Take-Off (PTO) Implements
5.5	Using Implements with Hydraulic Components
5.6	Using Implements with Electrical Components