

**NDSU**

**HEAVY EQUIPMENT  
OPERATION AND  
MAINTENANCE**

**July 1996**

NDSU

# HEAVY EQUIPMENT OPERATION AND MAINTENANCE

## I. INTRODUCTION

Improper procedures used by NDSU employees can cause injury, disability, or death. By outlining and following safe operating procedures for use of heavy equipment learn to prevent injury and safeguard ourselves and our coworkers.

## II. GOALS

To ensure all employees know and understand the safe operating procedures for the safe operation and maintenance of Heavy Equipment.

## III. PURPOSE

To reduce the risk of a work related injury or death by maximizing personal safety during Heavy Equipment operation.

### **Safe Operating Procedures For The Following Heavy Equipment:**

- equipment powered by electric motors or internal combustion engines.

- |                                  |                        |
|----------------------------------|------------------------|
| 1. Forklifts and power platforms | 6. Backhoe             |
| 2. Manlifts/Aerial Lift          | 7. Trucks              |
| 3. Tractors                      | a. Dump                |
| 4. Loaders                       | b. Garbage             |
| 5. Road Graders                  | 8. Snow Removal Equip. |

### **Heavy Equipment**

1. Only trained and authorized operators shall be permitted to operate the designated equipment.

1. Personal Protective Equipment is **mandatory** and may include the following:

- |                         |              |                      |
|-------------------------|--------------|----------------------|
| - boots or safety shoes | - long pants | - hearing protection |
| - eye/face protection   | - hard hat   | - gloves             |

2. Pre-start / Walk Around Inspection:

- Check for loose or worn parts and repair or replace immediately.
- Check all fluid/coolant levels.

**Caution: Open the radiator cap only when the engine is cooled.**

- Inspect hydraulic line connectors and hoses for leaks before applying pressure to the system. Use paper or cardboard, not your hands, to search for leaks.

**Caution: Hydraulic fluid escaping under pressure can penetrate skin and cause serious bodily harm.**

- Check tires for cuts, bulges, irregularities, abnormal wear and proper inflation.
- A fire extinguisher and first aid kit shall be mounted in the cab.

4. Machine Maintenance:

- Ensure the cab area is clean and free of debris and tools.
- Clean windshield, mirrors and lights.
- Remove all oil, grease or mud and snow from grab irons, hand rails, steps, pedals and floor to prevent slips and falls.
- Remove or secure any loose items such as tools, chains or lunch boxes from the cab.

5. Work Site:

- Check and mark the area for underground cables, gas lines and water mains.
- Know work area clearances - watch for overhead or underground objects, holes, drop offs, and partially hidden obstacles and wires.

6. Mount properly:

**DO NOT GET ON OR OFF A MACHINE THAT IS IN MOTION**

- Maintain a 3-point contact with the steps and hand rails while getting on/into the machine - **do not** use the controls or steering wheel as a handhold.
- Do not operate the machine with wet, greasy or muddy hands or shoes.

7. Starting and Testing:

**EXHAUST FUMES ARE DANGEROUS - ALWAYS HAVE A RUNNING MACHINE IN A WELL VENTILATED AREA.**

- Fasten your seat belt and adjust the seat prior to starting.
- Controls should be in neutral and the parking brake set before starting engine.
- Start the engine only from the operator's seat.
- Warn personnel in the area that you are starting the engine.
- Check all gauges, light, instruments and warning devices to assure that they are functioning properly and the readings are within normal range.
- Test steering, right and left.
- Test brakes against ground speed to be certain there is no malfunction.
- Ensure all implement controls are operating properly.

## 8. Machine Operation

### **SMOKING IS PROHIBITED AT ALL TIMES.**

- Familiarize yourself with the controls before operating the machine.
- Do not use the seat belt if the roll bar is removed.
- Only the operator is permitted to ride on the machine.
- While backing up use extra care and sound the horn to clear the area.
- If a malfunction is observed, "DO NOT OPERATE" until the proper repairs have been made.
- Drive at speeds compatible with working conditions.
- Do not coast downhill. Select a gear that will prevent excessive speed when going downhill. Do not park on a steep incline.
- Know the stopping distance at any given working speed.
- Do not permit anyone to stand or pass under the bucket or lift arms.
- Follow the manufacturer's load capacity limits. Identification plates are attached to all machines.
- If the machine is stuck, back it out or stop engine and get help.
- Do not make mechanical adjustments while the unit is in motion.
- Always follow the manufacturer's recommendations for pulling or towing.
- Lower all the hydraulic equipment before shutting down or getting off the machine.
- During snow removal, be alert for any obstructions covered by snow.

## 9. Ether - Cold Start Precautions

- Diesel cold start systems contain ether which is explosive. Keep away from heat, sparks and open flames. Work in a well ventilated area.
- If swallowed, breathed or contacted on skin or eyes seek medical attention immediately. Follow recommendations on the MSDS sheets.
- Point the openings of the valve, tube or atomizer away from yourself and others while testing the diesel cold start system.

- Store replacement ether cylinders in a cool dry place away from direct sunlight. Do not keep them in the operators compartment.

## 10. Operating a PTO

- Shut off the engine and wait until the PTO stops completely before getting off, disconnecting or servicing the PTO unit.
- Wear snug fitting clothing when operating the power take-off, or when near rotating equipment.
- When operating stationary PTO equipment, always apply the parking brake and block the rear wheels front and back to prevent any unnecessary movement.
- PTO shields are mandatory on all PTO-driven equipment.

## 11. Refueling

- Shut off and cool the engine and any electrical equipment before fueling.
- Ensure the fueling area is well ventilated.
- Do not smoke while refueling. Keep open flames and sparks away from area.
- Ground the funnel or fuel nozzle against the filler neck to avoid sparks when refueling.
- Do not use gasoline or diesel fuel for cleaning parts.
- Check the battery and electrolyte levels according to manufacturers instructions.
- Know where the fire extinguishers are located.

## 12. Road Rules

- When turning, use hand or turn signals.
- Obey all traffic regulations. Know local traffic laws regarding lights, warning signs, load limits, and slow moving equipment on highways/roadways.
- When backing up traffic, pull over and allow the vehicles to pass.

## 13. Shut Down/Parking

- Park on level ground.
- When parking on a grade, position at right angles to the slope, block the wheels and set the parking brakes.
- When parking, lower all loader, buckets, hydraulics to the ground.

## **1. Fork Lifts and Power Platforms**

Includes trucks, tractors, platform lift trucks, motorized hand trucks, and other **specialized industrial trucks powered by electric motors or internal combustion.**

General Safety - Safe Operation:

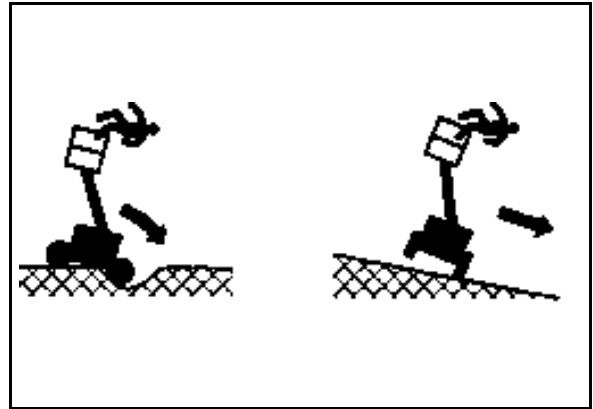
- Only trained and authorized operators shall be permitted to operate a powered industrial truck.
- No person shall be allowed to stand or pass under an elevated part of a fork lift or truck whether loaded or empty.
- Do not drive a lift truck up to anyone standing at a fixed place.
- If operator is  $\geq 25$  ft. from the truck, or out of sight of the truck, the load must be lowered, controls neutralized and brakes set to prevent movement. The equipment is to be considered unattended whether the operator has it in view or not.
- Approved trucks shall bear a label or other identifying mark indicating approval by a testing laboratory for the load capacity.
- Unauthorized personnel shall not be permitted to ride on powered industrial trucks. A safe place to ride shall be provided where riding of trucks is authorized.
- Come to a complete stop before reversing directions.
- Travel in reverse when load obstructs the operators view.
- Use the proper hand signals and safety devices when working around other people.
- Slow down when approaching intersections, blind corners, and when traveling on wet or slippery surfaces.
- Use horn when visibility is limited and at intersections.
- Yield right-of-way to pedestrians.
- Only stable or safely arranged loads shall be handled. Operators are to use extreme caution.
- Stunt driving and horseplay shall not be permitted.
- Be aware of overhead clearances. There must be sufficient headroom under overhead installations, lights, pipes, etc.
- Speeds shall be maintained to keep the vehicle under control and the load managed.

## **2. Man-Lift/Aerial Lift - intended for conveyance' of a person only.**

General Safety - Safe Operation:

- Visual inspection is necessary prior to each days use.
- Repair/replace items as needed prior to use.
- Never exit or enter the platform by any other means than the access system provided and place the boom in the lowest position to the ground before shutting down or getting off the machine.

- Do not position the work platform near holes or drop-offs and never drive it into holes, curbs or other obstacles on the ground.
- If you should encounter a tipping situation, immediately retract the boom. DO NOT lower the boom in a tipping situation.
- Do not elevate the platform if wind speed exceeds 20 MPH (32 km/h).



- DO NOT EXCEED THE PLATFORM'S RATED CAPACITY (printed on the capacity plate on the machine). Be sure that any load on the platform is secure and evenly distributed.
- Be aware of all overhead clearances, especially when working around powerlines.
- Employees shall stand firmly on the floor of the basket, and shall not sit or climb on the edge of the basket or use planks, ladders, or other devices for a work position.
- Maintain a FIRM FOOTING on the floor of the platform at all times.  
(NEVER CLIMB ONTO THE PLATFORM RAILING OR ONTO ANY OBJECTS ON THE PLATFORM FLOOR TO ATTAIN ADDITIONAL WORKING HEIGHT.)
- A body belt shall be worn and a lanyard attached to the boom or basket when working from an aerial lift.
- An aerial lift truck may not be moved when the boom is elevated in a working position with the personnel in the basket except for equipment which is specifically designed for this type of operation.
- Means shall be provided whereby personnel on the platform can shut off power to the truck.
- Never operate the work platform if it is TAGGED-OUT nor attempt to do so until it is restored to proper operating condition and all tags are removed. *Reference NDSU'S Lock Out/Tag Out Procedure or contact the supervisor for assistance.*
- If the work platform must be towed, plan the route and follow proper towing procedures.

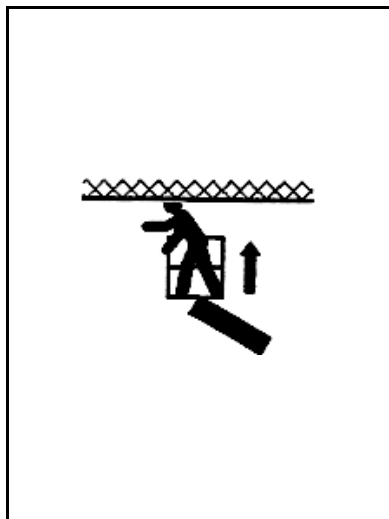
- Do not allow personnel on the ground to operate, service, or in any other way tamper with the work platform when the platform is occupied, except in an emergency situation where platform personnel are unable to fully lower and exit the platform.
- Cold weather requires special starting procedures and ample time for hydraulic oil to warm-up. Keep the platform free of ice and snow.

### CRUSHING HAZARD

- Always be aware of what is below, above, beside, before and behind the work platform during any elevating, lowering, extending, retracting, swinging, rotating, leveling, or driving function. Always look in the direction of travel.



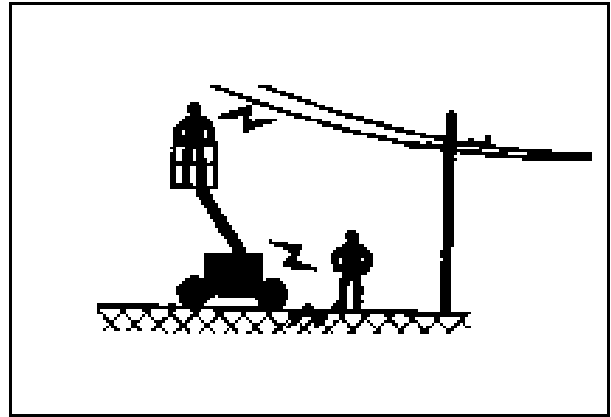
- If you are unable to clearly see in the direction of motion, post a lookout or signal person before moving the work platform.



- Never position the platform into an overhead obstruction or put yourself in a position of interference between the platform and an overhead object.
- Avoid contacting the work platform and its occupants with external objects during operation.
- Exercise caution when lowering the platform to avoid descending onto objects or personnel below.
- Clear all personnel from the counterweighted superstructure area before lowering the boom or rotating the superstructure.

## ELECTRICAL POWER SOURCES

- Never operate the work platform within any distance of a power source or power line without first notifying the power or utility company. Always obtain positive and absolute assurance that the power has been turned OFF.
- Maintain a MINIMUM clearance of 20 FEET from electrical lines and equipment at all times.
- Federal law prohibits the use of work platforms closer than 10 feet (3.05 m) to energized power sources up to 50 kV. It is Recommended twice the OSHA distance or 20 FEET (6.10m).
- Thoroughly READ and UNDERSTAND all applicable federal, state and local regulations and operate the work platform in compliance with these regulations.



### 3. Tractor

**This is a one-person machine. There should be no other person allowed in or on the machine at the same time of operation.**

General Safety - Safe Operation:

- \* An approved roll bar and seat belt must be installed for safe operation.
- \* Do not use the seat belt if the roll bar is removed from the tractor.
- \* Know and obey all local traffic regulations regarding warning flashers and sign, slow moving vehicles, and load limits.
- \* Shut the engine off and apply the parking brakes before getting off the tractor. Lower all hydraulic equipment.
- \* Drive at speeds compatible with the weather conditions and ground/road conditions. Watch for row ends, ditches, and trees.
- \* Keep the tractor in gear at all times in order to have full control of the tractors speed in various situations/terrain.
- \* Follow the manufacture's recommendations regarding towing and pulling equipment.
- \* Set the hydraulic selector lever in "position control" when the tractor has no equipment attached, when attaching equipment, or when transporting equipment.

#### **PTO Operation**

- \* PTO shields and other guards/shields area mandatory on all equipment.
- \* Shut off the engine and wait until the PTO stops completely prior getting off , servicing, or disconnecting the PTO unit.
- \* Wear snug fitting clothing when operating the power take-off or when near

rotating equipment.

- \* When operating stationary PTO equipment, apply the tractor parking brake and block the rear wheels, front and back to prevent rolling.
- \* Lower all hydraulic equipment when stopping the tractor.

#### 4. Loader

**While operating, two people should work together; one operating the machine and the other directing the operator and watching for dangers.**

General Safety - Safe Operation:

- \* This is a one-person machine, **NO RIDERS ALLOWED.**
- \* Know the pinch points and wrap points on the loader/backhoe.
- \* Operate at a speed consistent with working conditions, visibility and terrain.
- \* Ensure backhoe has an adequate rear counterweight
- \* Give the right of way to loaded equipment
- \* When crossing exposed railroad tracks, ditches, ridges or curbs reduce speed and cross at an angle.
- \* Stay in gear when traveling downhill - this will help control speed
- \* Never move or swing a load above the heads of other workmen.
- \* When operating the loader be sure the backhoe is in the transport position and that all chains and locks are secured to prevent backhoe swing.
- \* When back filling, use extreme caution, weight of the material plus the weight of the machine could cause the new construction to collapse.
- \* Before entering underpasses, tunnel or bunkers, check for hazards.
- \* Keep work area level; avoid developing ruts by occasionally back dragging the bucket to smooth the surface.

#### 5. Road Grader

1. General Safety - Safe Operation:

- Before operating the grader, ensure it is properly equipped and all equipment is in good working order.
- Do not permit riders in or on the grader. Grader is a one person piece of equipment.
- Pre-Inspect and walk around the grader prior to starting the grader.
- Do not dismount from the grader with the engine running - lower all attachments and stop engine first.
- Before backing up, use extra care to ensure a persons and vehicles are clear of the grader.
- Know and use hand signals required for particular jobs and know who has the responsibility for signaling.
- Adjust the seat and fasten the seat belt.
- Start and operate the grader only from the operator's seat.

- Park the grader on level ground whenever possible and apply the hand brake. On grades, park the grader with the wheels securely blocked.
- Select a gear that will prevent excessive speed when going downhill. Do not coast downhill.
- Note and avoid all hazards and obstructions such as overhangs, ledges, slide areas, electrical lines, underground cables water mains or gas lines.
- Watch for bystanders and never allow anyone to be under or to reach into the grader and its attachments while operating.

2. Job Site Precautions:

Check the local traffic laws for correct traveling requirements. If necessary, pull over and allow traffic to pass.

- When working near traffic areas or at night, use extra care. Use precautions as flares or reflectors, cones, red flags, or red lights, barricades, flashing lights and flagmen.

### 3. Special Hazard Precautions

- Do not operate the grader in areas where volatile gases, dust and combustibles may be present.
- Ensure the grader is properly equipped for grading in dry or forested areas.
- Avoid lubrication or mechanical adjustments with the grader in motion or the engine operating. Keep your head, body, limbs, feet and hands away from all moving parts.
- When servicing the grader, fasten a **Do Not Operate** tag on the steering wheel.
- Use extreme care when working with hydraulic systems. Relieve the hydraulic system pressure before performing any service. Review NDSU's **Lock Out/Tag Out Procedures** prior to servicing grader.
  
- Handle batteries carefully. Seek immediate medical care if acid is spilled.

### 4. Ether - Cold Start Precautions:

- Wear protective goggles when testing the diesel cold start system.
- Diesel cold start system contains ether which is explosive. Keep sparks and flames away. Severe personal injury or death could result.
- Point the openings of the valve, tube or atomizer away from yourself and others while testing the diesel cold start system.
- Do not burn, puncture, or attempt to remove the core from an ether cylinder.
- Store replacement ether cylinders in a cool dry place away from direct sunlight.
- Keep the fuel nozzle in constant contact with the filler tube of the tank being filled, and provide a ground to prevent static sparks from igniting the fuel.
- Do not fill the fuel tank to capacity. Leave room for fuel expansion.

### 6. Backhoe Safety

**This is a one-person machine. There should be no other person allowed in the cab or the machine at the time of operation.**

#### General Safety - Safe Operations

- Before operating the backhoe, lower stabilizers so that rear wheels are just off the ground and machine is level.
- Clear everyone from the bucket swing area. Do not swing the bucket over truck cabs.
- Operate the backhoe from the seated position. - Never from the ground.
- Do not dig under the backhoe stabilizers; A cave - in may result.
- When operating on a slope, swing to the uphill side.
- Before dismounting, be sure your backhoe is in its transport mode and the bucket is lowered to the ground. Never leave a load hanging.
- When trenching in sandy, muddy or unstable soil, use a platform under the rear

wheels and stabilizers to lessen the possibility of a cave-in.

- Lift excessively heavy objects to the rear of the backhoe to prevent tipping; ensure they are properly balanced to prevent tipping or swaying.

## 7. Trucks

### a. Dump Truck

#### General Safety - Safe Operation:

- Only trained and authorized operators shall be permitted to operate the designated equipment.
- When vehicle is in transit, the hoist control **MUST BE** kept in neutral and in the locked position and the PTO disengaged.
- Tailgate controls **MUST BE** locked when the vehicle is in transit.
- **DO NOT** dump on ground that has been recently excavated or filled without being properly compacted. The vehicle **MUST BE** on level ground before dumping.
- Operator **MUST REMAIN** at the controls during the dumping cycle.
- Tailgate controls **MUST BE** released before the front of the body is 2 feet above the chassis frame.
- When the truck is stored or not in use, the body **MUST BE** in the full lowered position, and resting on the chassis or hoist frame.
- Whenever the body is maintained in any elevated or raised position, it **MUST BE** securely propped or blocked so it cannot fall.
- **NEVER ENTER BETWEEN A RAISED DUMP BODY AND CHASSIS FRAME AS IT MAY DESCEND AND CAUSE INJURY OR DEATH.**
- All persons, except operator, must be at least 30 feet away while hoist is used.
- If you have problems with the hydraulics, if proper equipment is not available or if you are inexperienced in dumping loads, **STOP WORKING AND GET HELP.**

## 7. Trucks

### a. Garbage Truck

#### General Safety - Safe Operation:

- Only trained and authorized operators shall be permitted to operate the designated equipment.
- Stand clear when tailgate or packing mechanism is opened or in motion.
- Do not place hands or feet near any moving part or packing mechanism while the engine is running.
- Whenever the tailgate is in any elevated or raised position it must be securely propped or blocked so it cannot fall.
- Do not work on or near hydraulic pump, PTO, driveline, universal or any rotating part while the engine is running.
- Stop engine and remove ignition key before entering body.
- Keep access door closed when ejector panel is in motion.
- Do not drive or move the unit with the tailgate in any position except **fully** down and **locked.**
- Never attempt to disconnect any hydraulic line unless pressure is released in the circuit

and the machine elements to which the hydraulic actuator is attached are supported or blocked from movement.

- Instruction and warning decals are important. Clean or replace all decals if they cannot be read. Use them for quick reference information.
- Do not stand in the hopper or on the hopper sill while adjustments are being made on the packing mechanism with the machine running.
- During repairs to the tail gate, packing mechanism, or hydraulic drive system, a lockout procedure should be employed where the power shall be shut off, the ignition key removed, and a tag out sign placed on the steering wheel warning against any attempt to start the unit.
- Please refer to NDSU'S Lock Out Tag Out procedure and or contact your supervisor for assistance.

## **8. Snow Removal**

### **Snow Blowers**

General Safety - Safe Operation:

- Only trained and authorized operators shall be permitted to operate the designated equipment.
- Equipment must be in good condition. Inspections are to be done prior to each use for needed repairs or replacement items.
- Equipment such as tire chains, warning lights, additional beacons and markings may be required.
- Keep your windshield and other window areas clean and clear for the best possible visibility. Use the windshield wipers and the window defrosters.
- Be alert for any children playing or obstructions covered by snow -- such as manhole covers, curbs, bridge abutments, embankments and fire hydrants.
- Ensure all personnel are clear of the snow blowers/throwers.
- The snow should always be blown with the wind.
- Blow snow within the manufacturer's recommended ground speeds.
- Ensure the snow removal attachment is fully raised and secured when not in use.
- Engage parking brake and disengage components before leaving machine
- Observe and understand all the safety decals placed on machine.
- Never work on a snow removal machine with components running. Stop machine prior to unclogging, repair or refueling.

## **8. Snow Removal - Equipment and Attachments**

**SWEEPER** - Hydraulic powered rotary attachment which sweeps debris 30 degrees to the right or left.

General Safety - Safe Operation:

- \* Personnel must be clear of the brush and of all moving parts while operating the sweeper.
- \* Eye protection must be worn at all times by the operator and anyone within the discharge area of brush.
- \* Sweep away from people buildings or cars, etc. - toward an open area.
- \* Turn engine and brush off to allow all moving parts to stop before adjusting or servicing sweeper.
- \* This is a one operator vehicle - no riders are allowed on the sweeper or vehicle it is mounted on.
- \* Operate sweeper or tractor only with PTO guards and all protective shields in place.
- \* Do not dismount or mount, or work on sweeper or loader with the sweeper arms in the raised position.

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