Chapter 10
Industrial/Agricultural Vehicle and Machinery Extrication

Lesson Goal
After completing this lesson, the student shall be able to describe how design features of industrial/agricultural vehicles and machines impact extrication operations.

Objectives
Upon successful completion of this lesson, the student shall be able to:

1. Describe each class of industrial and agricultural vehicle. [NFPA® 1001, 6.4.1, 6.4.2; NFPA® 1006, 5.2.3, 10.1, 10.1.1, 10.1.2; NFPA® 1670, 8.3.4, 8.4.2]

2. Describe anatomical features of industrial and agricultural vehicles. [NFPA® 1001, 6.4.1, 6.4.2; NFPA® 1006, 5.2.3, 10.1, 10.1.1, 10.1.2, 10.1.7; NFPA® 1670, 8.2.3, 8.3.3, 8.3.4, 8.4.2]

3. Identify specific size-up concerns associated with industrial and agricultural vehicles. [NFPA® 1001, 6.4.1, 6.4.2; NFPA® 1006, 10.1, 10.1.1, 10.1.4; NFPA® 1670, 8.3.4, 8.4.2]

4. Explain methods for stabilizing industrial and agricultural vehicles. [NFPA® 1001, 6.4.1, 6.4.2; NFPA® 1006, 10.1, 10.1.1, 10.1.4, 10.1.6, 10.1.7; NFPA® 1670, 8.3.4, 8.4.2]

5. Describe methods for gaining access into industrial and agricultural vehicles during extrication operations. [NFPA® 1001, 6.4.1, 6.4.2; NFPA® 1006, 10.1, 10.1.1, 10.1.4, 10.1.6, 10.1.7; NFPA® 1670, 8.3.4, 8.4.2]

6. Identify tactics used in industrial and agricultural vehicle extrication operations. [NFPA® 1001, 6.4.1, 6.4.2; NFPA® 1006, 10.1, 10.1.1, 10.1.8; NFPA® 1670, 8.3.4, 8.4.2]
7. Describe industrial and agricultural machinery extrication procedures. \[NFPA® 1001, 6.4.1, 6.4.2; NFPA® 1006, 10.1, 10.1.1, 10.1.4, 10.1.5, 10.1.6, 10.1.7, 10.1.8, 10.1.9, 10.2, 10.2.1, 10.2.2, 10.2.3, 10.2.4, 10.2.5; NFPA® 1670, 8.2.3, 8.3.3, 8.3.4, 8.4.2, 12.1, 12.2.1, 12.2.3, 12.3.1, 12.3.3, 12.3.4, 12.4.1, 12.4.2]\]

**Skill Sheets**

10-1 Extricating a patient from a power take off (PTO) shaft \[NFPA® 1001, 6.4.1, 6.4.2; NFPA® 1006, 10.1.1, 10.1.4, 10.1.6, 10.1.7, 10.1.8, 10.2.1, 10.2.2, 10.2.3, 10.2.4, 10.2.5; NFPA® 1670, 8.3.3, 8.3.4, 8.4.2, 12.3.4, 12.4.2]\]
Text Reference


Lesson Overview

Estimated Total Time: 4 hours 30 minutes

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Audiovisuals/Handouts

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Evaluation

- Chapter 10 Test
I. CLASSIFICATION OF INDUSTRIAL AND AGRICULTURAL VEHICLES

Objective 1 — Describe each class of industrial and agricultural vehicle.

A. Commercial Vehicles

1. Include small utility vehicles and four-wheel all terrain vehicles (ATVs)

2. Used for moving personnel and small amounts of materials

B. Tractors

1. Wheel tractors

   a. Have very large rear wheels (up to 50-inch [120 cm]) and smaller front wheels (up to 38-inch [95 cm]), with rubber tires

   b. Wheel configuration depends on use – Front wheels may be set same distance apart as rear, may be very close together

   c. Have either two-wheel drive or all-wheel drive

   d. Two-wheel drive – Rear tires have traction treads; front tires are grooved for lateral purchase
e. All-wheel drive – Front and rear tires have heavy traction treads

f. Other configurations
   i. Large cast iron weights bolted to wheels to balance
   ii. Filled to approximately 90 percent with solution of calcium chloride or ethylene glycol and water to improve traction
   iii. Equipped with multiple front and/or rear wheels

g. Prone to roll over
   i. Narrow track – Horizontal distance from 60 to 100 inches [144 cm to 240 cm] between wheels on the same axle
   ii. High ground clearance
   iii. Must be equipped with seat belts and roll bars as required by OSHA

h. Center of gravity shifts depending on location
   i. Flat, level ground – Along centerline roughly halfway between front and rear axles
   ii. On hillside – Shifts toward downhill wheels
iii. Climbing steep slope – Rear axle
   i. Can rotate around rear axle, coming to rest upside down; pinning operator

2. Crawlers
   a. Use steel or rubber tracks instead of wheels
   b. Larger and heavier than wheeled tractors
   c. Have wider track and lower profile – Less susceptible to rollover

3. Attachments/Implements
   a. Attachments – Auxiliary appliances like front-end loaders, backhoes, and scraper blades permanently attached to chassis
   b. Can affect tractor’s stability; can result in rollovers
   c. Implements – Appliances temporarily attached to and towed or carried by tractor; planters, manure spreaders, chemical spraying rigs, hay rakes, and balers
   d. Wheel tractors may have a scraper blade on the front or
rear for snow removal and light-duty grading

e. Crawlers

i. Equipped with steel blades on front ends for heavy-duty grading and excavation

ii. Have trenching attachments, rippers, or other attachments on rear

iii. Used at airports to tow aircraft from one point to another; equipped with rubber tracks or rubber pads on steel tracks to avoid damaging taxiway surface

C. Forklifts

1. Used in variety of environments – Warehouses, lumberyards, construction sites, urban search and rescue (US&R) teams in structural collapse incidents

2. Lifting capacity varies by manufacturer and model – Ranges from 2,000 to 80,000 pounds (4 400 kg to 176 200 kg)

3. Power source

   a. Rechargeable lead-acid batteries of either 24, 36, or 48 volts

   b. Internal combustion engines operate on gasoline, diesel, or
liquefied petroleum gas (LPG); may have dual fuel systems that operate on gasoline and LPG

4. Lifting device
   a. Basic – Two broad lifting forks, approximately 4 feet (1.2 m) long; can be moved laterally to adjust to the width of load
   b. Attached to a horizontal cross beam that can be elevated or lowered on rollers that travel in a pair of vertical tracks called mast

5. Mast
   a. Can be deflected from five to seven degrees from vertical to increase control of load
   b. Can be designed to telescope to increase vertical lift range and may have a side shift feature to move load laterally
   c. Four-stage telescoping mast can have a vertical lift range of up to 30 feet (10 m)
   d. Additional dangers with high lift – Increased leverage at top can lead to falling over; possible contact with power lines
6. Chassis – Design varies by manufacturer and intended purpose
   a. Low profile, made of cast iron, steel
   b. Can weigh from 2,000 pounds (907 kg) to 36,000 pounds (16,329 kg)
   c. Weight concentrated at end opposite lift mechanism for counterweight

7. Tires – Type varies depending on purpose
   a. Warehouses and other areas with concrete floors – Small solid rubber mounted on 12-inch (300 mm) to 21-inch (525 mm) wheels
   b. Outdoor use – Pneumatic or “cushion”

8. Overhead operator protection system – Designed to deflect falling objects
   a. Heavy-gauge wire screen or steel grille over steel frame
   b. Outdoor use – Fully enclosed cab; standard operator protection system enclosed with Plexiglass® panels or window
panes and laminated safety glass windshield

D. Graders/Maintainers

1. Found where unsurfaced roads are common or where highway construction is being done
2. Have ability to laterally tilt front wheels
3. Can roll over, given sufficiently steep slope and enough lateral force
4. Enclosed cabs similar to tractors and other industrial or agricultural vehicles
5. May have movable scraper blade mid-mounted and ripper teeth on blade or rear end

E. Booms

1. Vehicle-mounted boom that can telescope more than 40 feet (12 m) and lift from 7,000 to 10,000 pounds (3200 kg to 4500 kg)
2. End may be fitted with forks for lifting material on pallets, platform or basket similar to fire service aerial devices, or bucket as used on front-end loaders
3. May have both all-wheel drive and steering
4. May have enclosed cab

5. Hazards

   a. Potential contact with powerlines

   b. Vulnerable to turning over when operated on unsurfaced sites where soil is uneven/unstable, especially with strong crosswind

F. Cranes

1. May have pneumatic tires and can be driven from site to site

2. May be crawlers that must be transported from site to site on lowboy trailers

3. Subject to same hazards as booms

G. Harvesters

1. Wide, low center of gravity, usually stable; also called combines

2. Can rollover, given sufficiently steep slope and enough lateral force

3. Designed to discharge grain into a following truck or trailer

   a. Workers that enter can be trapped in grain and suffocate

   b. Auger can pull extremities in when clothing becomes entangled
4. Disentanglement
   a. Involves disassembly of drive chains, gears, or belts before entry
   b. Begin at end farthest from patient when operated by flowing hydraulics

**Review Question:** What are distinguishing features of each type of industrial and agricultural vehicles?
*See pages 418-423 of manual for the answer.*

**Section II: Anatomy of Industrial and Agricultural Vehicles**

**II. ANATOMY OF INDUSTRIAL AND AGRICULTURAL VEHICLES**

**Objective 2 — Describe anatomical features of industrial and agricultural vehicles.**

**A. Two-Wheel Drive Vehicles**

1. Configuration – Driving wheels at rear, steering wheels at front; forklifts configured other way with driving in front, steering in rear

2. Prone to rollovers on hillsides and slopes due to poor traction
3. May slide sideways and down slope if attempting to move diagonally up and across; striking obstruction could cause rollover

B. All-Wheel Drive Vehicles

1. Better equipped to handle poor traction and steep slopes
2. May have all-wheel steering
3. Maneuverability can lull drivers into sense of invulnerability, leading to risks and possible rollover

C. Tracked Vehicles

1. Direction of travel controlled by manually operated levers or joysticks that apply or release separate brake for each track
2. Tracks spread weight of vehicle
3. Vulnerable to rollovers when used on steep enough angles
4. Size and weight make extrication more difficult

D. Articulating Telescoping Vehicles

1. Articulating vehicles – Large earthmovers, large tractors, all-wheel drive farm tractors, log skidders, large front-end loaders, rough-terrain forklifts, large dump trucks
2. Stable due to huge wheels, low center of gravity

3. Steep slope, unstable soil, sufficient lateral force can cause rollover

4. Telescoping vehicles – Booms and cranes capable of lifting heavy loads

**E. Oversized Vehicles**

1. Examples – Massive dump trucks, drilling rigs, tunnel boring machines, and steam shovels

2. Rock slides, cave-ins, other similar events can cause to overturn

**F. Operational Controls**

1. Variety used – Range from steering wheel to hydraulics or “clutch-brake” system

2. Tracked vehicles may use joystick

3. Used to increase vehicle’s stability or to power or control auxiliary devices

4. Global positioning satellite (GPS) may guide without operator input

**G. Auxiliary Power Sources**

1. Increase versatility

2. Power take-offs (PTOs) to operate implements
3. Hydraulic pumps to raise or lower implements

4. Operators can become entangled if used without proper guards in place or without appropriate caution

H. **Rollover Protection Systems (ROPS)**

1. Required by OSHA on every vehicle except those in which operator stands

2. May be installed by manufacturer for liability reasons even if not required

3. May be required by operator’s insurance; often removed or altered by owner to reduce vehicle height

I. **Fuels**

1. Diesel – Can carry up to 100 gallons (378.5 L)

2. Gasoline and/or LPG, usually propane

3. Compressed natural gas (CNG)

4. Electricity from banks of rechargeable wet-cell batteries

5. Liquid or gaseous fuels add danger of fire to collisions, rollovers, other
hazards – Assess need for Class B foam as part of size-up

6. Flammable gases – Shut off at source or allow to burn out

7. Fuel tank failure – May occur due to lightweight construction; could release large amounts of fuels

J. Brakes

1. Mounted inside rear axle; wet or dry systems

2. Rear brakes – Operated independently or locked together with bar mounted to pedals

3. Crawler tractors and other tracked vehicles use for steering
   a. To turn left operator applies right brake
   b. Greater difference in speed between tracks, more abrupt the turn

K. Tires

1. Pneumatic or solid rubber, tread designs depend on vehicle use and working environment

2. Pneumatic tires
   a. Variety of sizes from small to large
b. Improve traction of drive wheels on large size – Filled to about 90 percent with water or some other inert fluid such as anti-freeze, and then inflated to normal operating pressure

3. Cushion tires – Solid rubber that look like pneumatic, lack valve stem

4. Solid rubber – Smaller in diameter than other two types, no traction treads

L. Jacks

1. Hydraulically-operated devices that extend from both sides of vehicle

2. Intended to stabilize vehicle operating attachment

3. Normally lift wheels off ground, bear full weight of vehicle

4. Hazards

   a. Loss of pressure in one or more jacks can cause vehicle to lurch to one side

   b. Downslope jack failure can cause vehicle to topple if positioned across slope

   c. Ground collapse under jacks could cause vehicle to roll over
III. SPECIFIC SIZE-UP CONCERNS
FOR INDUSTRIAL AND
AGRICULTURAL INCIDENT
EXTRICATION

Objective 3 — Identify specific size-up concerns associated with industrial and agricultural vehicles.

A. Size-Up

1. Must include systematic assessment

   a. Overall scene
   b. Vehicles involved
   c. Trapped patients
   d. Extrication requirements of particular incident

2. Questions – Should continue throughout incident

   a. Is incident location clearly known and readily accessible, or will rescue personnel have to search for the scene?
   b. Is trapped operator only person at scene who is familiar with
operation of the machine, and will farm advisor or other expert be needed?

c. Is medevac helicopter required due to remoteness of scene?

3. Questions when nearing scene

a. Is smoke (especially unusual color) or steam rising from scene?

b. Will fire protection be higher than normal priority because of known flammability hazard?

c. Will large-scale foam-making capability be needed?

d. Will hazardous materials team be needed?

e. What additional resources will be needed to control and mitigate known and potential hazards?

B. Vehicle Load

1. IC must identify what vehicle is carrying and how material is configured or arranged

a. What type of load is vehicle carrying?

b. What are load’s contents?

c. How are these arranged?
d. Are materials visible?

e. How will load affect vehicle during rescue operation?

f. Is load stable or will it need to be secured or removed in order to perform rescue safely?

2. May carry hazardous materials in industrial and agricultural settings

a. May have placards or identification decals; not apparent in farm settings

b. Private individuals not required to placard individual tank loads

c. Materials that are safe separately but hazardous when in contact often packaged separately but transported together

3. May include several patients to extricate even if not intended vehicle use

a. Size and weight of vehicle make more challenging and time consuming

b. Look for patients – Determine how many, where, medical conditions

c. Attempt to assess trapped patients without jostling vehicle
4. Extrication may require specialized equipment
   a. Consider plant resources or local equipment dealers as sources
   b. Keep contact numbers, especially after hours contacts

C. Key Points

1. Fire is threat in overturn situation if spilled fuel present; 1½ hoseline should be available, at minimum, ABC-type extinguishers

2. Before using thermal cutting equipment to free patient, consider alternative methods

3. Shut off tractor engine

4. If ground is soft, may be possible to dig patient out from under

5. Machine should be blocked or cribbed to prevent from tipping

6. Lifting tractor is best way to deal with rollovers of large, modern tractors

7. As tractor is raised, cribbing should be added for proper stability

8. Hydraulic jacks can be used to lift smaller tractors

9. Air bags can be used to raise overturned tractor
Review Question: What specific size-up concerns should an incident commander consider during industrial and agricultural vehicle extrication operations?
See pages 427-429 of manual for the answer.

Section IV: Industrial and Agricultural Vehicle Stabilization

IV. INDUSTRIAL AND AGRICULTURAL VEHICLE STABILIZATION

Objective 4 — Explain methods for stabilizing industrial and agricultural vehicles.

A. Vehicle Upright

1. Stabilize damaged suspension with measures described earlier

2. Stabilize horizontally using chocks, wedges, etc. to immobilize wheels

3. May involve usual equipment and techniques – Four- or six-point cribbing, timber shores or pneumatic shores

4. Horizontal stability may need additional equipment – Wheel chocks, wedges, and/or webbing and chains
B. **Vehicle on Its Side**

1. May appear stable

2. Can suddenly roll if resting on slope or unstable soil

3. Secure from top with webbing and/or chains attached to bombproof anchor point first

4. Install shoring on underside

C. **Vehicle Upside Down**

1. Unstable position; stabilize as soon as possible

2. May involve installing cribbing, shoring, and/or pneumatic struts at various points

3. Wheel tractors require box cribbing under rear axle, one stack on each side between differential and wheel; others may require four-point or six-point cribbing

4. Solid cribbing stacks may be needed due to heavy vehicle weight

D. **Vehicles in Other Positions**

1. Unusual angles can require long shoring or stabilization from top with webbing and/or chains or cables
2. Construct shoring system similar to that used on weakened building walls if using timber shoring

3. Goal – Create as many points of contact as possible between vehicle and stable surface

E. Machinery Incidents

1. Worker can be pulled into machine several ways – Working without OSHA-required guards or while wearing loose clothing

2. May be freed by cutting or slipping out of clothing

3. Machinery may be de-energized before rescuers arrive – By overload switch or coworker shutting off

4. Power may need to be left on until machine stabilized
   a. Post guard to prevent premature power shutoff
   b. May be necessary to prevent further injury when machine completes cycle to shut down

5. Use lock out/tag out procedures to ensure not re-energized

6. Stabilize with rescue tools, wedges, cribbing, chocks, webbing, chains, or cables as necessary
7. Use knowledge of coworkers or plant maintenance personnel to place stabilization equipment in appropriate place.

**Review Question:** What methods can be used to stabilize industrial and agricultural vehicles during extrication operations? See pages 429-431 of manual for the answer.

**Section V: Gaining Access into Industrial and Agricultural Vehicles**

**Objective 5** — Describe methods for gaining access into industrial and agricultural vehicles during extrication operations.

**A. Window Entry**

1. Tools and techniques vary based on materials used in windows.

2. Plexiglass – Side and rear windows.

3. Tempered or laminated safety glass – Windshield.

4. Mounting
   a. Rubber frames
   b. Industrial adhesive.
c. Bolted to steel hinges or brackets attached to frame; steel safety bars or screens mounted to them

B. Door Entry

1. Design – Outward swinging doors with window that may or may not open

2. Windows that open – Split-panel slide horizontally, swing open either partially or fully

3. Door latches – Located near bottom of door panel

4. Remove jammed door

   a. Cut off exposed hinge pins with rotary saw equipped with metal-cutting blade or with oxyacetylene torch

   b. Pry off manually or with power spreader once hinges cut

C. Roof Entry

1. Feasible if no other route accessible

2. Roof panels

   a. Made of substantial material if part of ROPS

   b. Made of thin metal if strength gained from stamped-in contours
c. Made of fiberglass or plastic for equipment access

d. Number of cross members to remove varies depending on manufacturer

**Review Question:** What methods can be used to gain access to the interior of industrial and agricultural vehicles?
*See pages 432-433 of manual for the answer.*

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**Section VI: Industrial and Agricultural Vehicle Extrication Tactics**

**VI. INDUSTRIAL AND AGRICULTURAL VEHICLE EXTRICATION TACTICS**

**Objective 6 — Identify tactics used in industrial and agricultural vehicle extrication operations.**

**A. Disentanglement**

1. Cutting or removing any part of ROPS may cause vehicle to fall injuring patient and rescuers; should only be done if necessary

2. Force to disentangle will have to equal the force that deformed

3. Dismantle cab or ROPS with power spreaders, shears, extension rams as needed
4. Tools and techniques used for pinned patient depend on situation

5. Equipment must be dismantled to point patient is freed

B. **Patient Removal**

1. Difficult to remove from inside cab due to limited working room

2. Faster and less traumatic to dismantle cab before attempting extrication

C. **Power Take Off (PTO) Incidents**

1. PTO shafts – Used to transmit power from source of power to implement
   
   a. 540 rpm – Wrap feet (138 m) of rope in one minute; a patient’s extremity 9 times a second
   
   b. 1000 rpm – Wrap 785 feet (239 m) of rope in one minute; a patient’s extremity 16 times a second

2. Injuries – Range from minor lacerations to complete body dismemberment

3. Injury patterns – Vary depending on type of clothing patient wears
   
   a. May have first and/or second degree burns
b. Nylon and other synthetics cut into skin and muscle tissue rather than rub across

4. Shaft can grind away skin, muscles, tendons, and break bones in less than three-fourths of one second

5. Tools needed may not be readily available

6. Patient may occupy space needed to disassemble

D. Skill Sheet 10-1

1. For this skill sheet, students will extricate a patient from a power take off (PTO) shaft

2. This skill sheet can be found on p. 447-448 of the manual

Section VII: Industrial/Agricultural Machinery Extrication 60 min.

VII. INDUSTRIAL/AGRICULTURAL MACHINERY EXTRICATION

pp. 434-446

Objective 7 — Describe industrial and agricultural machinery extrication operations.

A. Pre-Incident Planning

1. Be familiar with locations and types of machinery installations in response area

2. Keep emergency information up to date and note changes

B. Machinery Extrication Tools and Equipment

1. May use tools used in other rescue disciplines – Cribbing, jacks, spreaders, mechanic’s tools

2. Lockout/tagout devices

   a. Used to ensure position of valves and switches not changed at critical moment of rescue

   b. Re-energizing could cause sudden and unexpected movement, placing patient and rescue personnel in danger

3. Flanges
a. Installed to stop flow within a pipe

b. Used to isolate section where rescue occurs while allowing flow to rest of system

C. Phase I: Assessment on Arrival

1. Primary assessment
   a. Size-up questions gather information about patient number, condition, location
   b. Call more resources immediately if needed
   c. Continue size-up
      i. Talk to patient, if possible
      ii. Interview witnesses
      iii. Identify hazards
      iv. Evaluate what has and is being done
      v. Weigh risk vs. benefits of available options
      vi. Contact expert assistance

2. Secondary assessment
   a. Gather information about machine type, condition, status
   b. Classify machine type by energy source and how it operates
c. Common types of machines

i. Driven by electricity, air pressure, hydraulic pressure, steam, internal combustion engine

ii. Large rollers rotate in opposite directions to flatten, emboss, or imprint material fed through rollers

iii. Enclosed or unenclosed augers rotate

iv. Conveyor belts or chains move materials horizontally or at low angles

v. Shape or form sheet metal by impact of forging hammers

vi. Material is compacted by vertical or horizontal hydraulic rams or presses

vii. Materials are cut with spinning blades

viii. Materials are rotated at high speeds during shaping operations

ix. Materials are shaped or polished with spinning abrasive wheels

x. Products are molded from molten material
d. Condition – Functionality of machine; can its own mechanism be used to free patient?

e. Status – Engerized or not; energy sources secured?

D. Phase II: Pre-Extrication Operations

1. Monitoring patient status
   a. Monitor vital signs continuously if patient accessible, report changes to IC
   b. Maintain continuous conversation if patient out of reach

2. Finalizing the incident action plan (IAP)
   a. Small operations may not need in writing; large should be in writing and reflect incident management system
   b. Must be finalized and communicated to everyone involved
   c. Structured enough to guide operation, flexible enough to deal with unexpected
   d. Should accommodate the need to rescue the rescuers
3. Gathering resources
   a. Should reflect IAP
   b. Personnel – Vary depending on extrication; request additional as needed
   c. Equipment – Varies depending on nature and extent; specialized tools unique to machine may be needed

4. Monitoring the atmosphere
   a. Immediate rescue area may be contaminated by gases or vapors from leaking fluids or exhaust from gasoline-driven rescue equipment
   b. Monitor atmosphere inside confined space from outside space
   c. Check for, in order – Oxygen concentration, flammability, toxicity
   d. Use single- or multi-gas detectors to monitor atmosphere in immediate rescue area as dictated by situation

5. Ventilation
   a. Ventilate area before rescue if necessary
i. Positive pressure from fan blowing fresh air into area

ii. Intrinsically safe fan exhausting air from within

b. Use same precautions when ventilating toxic atmospheres

c. Do not allow exhaust to contaminate rescue area when using gasoline-powered fans

6. Lighting

a. Use only intrinsically safe lighting if possibility of flammable gases or vapors

b. Do not contaminate rescue area with exhaust of gasoline-drive generator

7. Communications

a. Establish communication if incident command post (ICP) is not close enough to see patient or too much noise for unaided verbal communication

b. Type will vary depending on limitations – Portable radios, hard-wired telephones, cell phones

c. Must be intrinsically safe no matter what type is used
E. Phase III: Machinery Extrication Operations

1. General guidelines
   a. Can begin only after zero mechanical state achieved
   b. Address when determining method
      i. Time necessary to complete
      ii. Effects on patient
      iii. Effects on rescuers
      iv. Effects (damage) on the equipment involved
   c. Goal – Minimize all factors; will have to compromise
   d. Never compromise on effect to patient and rescuers
   e. Do not take steps that will place patient or rescuers in excessive danger
   f. Weigh time needed against patient condition and ability to withstand amount of waiting; may require forcible disassembly of machine
   g. Perform rescue operations simultaneously if possible
2. Stabilizing the machine

   a. May require technical expert, like machine operator or plant maintenance mechanic

   b. Prevent moving parts from completing cycle or returning to original position

   c. Shoring

      i. Install in opening between press plate and receiver

      ii. Pattern determined by potential force

      iii. Cut pieces short of length needed and use wedges to tighten if using wooden

   d. Strapping

      i. Must be sufficiently strong for potential load

      ii. Single chain looped through component and around stable anchor point; two straps/chains in direct opposition on same component

      iii. Come-alongs; two-inch (50 mm) nylon webbing; rope can be used also
3. Isolating energy sources
   a. Lock electrical switches in OFF position with padlock and tag attached that warns of danger of turning back on before authorized
   b. Assign rescuer with portable radio to stay at switch if lockout/tagout device not available
   c. Use same precautions with pneumatic or hydraulic valves that supply energy to machine

4. Patient treatment and stabilization
   a. Carried out by EMS personnel usually; performed by rescuers if needed
   b. Package patient for transport as appropriate once freed

5. Manipulative extrication
   a. Patient is manipulated
      i. Limited to situations where patient not injured, caught in something
      ii. Freed by relaxing body part, sliding out; twisting motion if needed
iii. Lubricant may be useful to reduce friction – Vegetable oil or petroleum jelly

iv. Stop and try another procedure if patient in severe pain or little/no progress is made

b. Entrapping mechanism is manipulated

   i. Operate in designed manner to advantage of patient and rescuer; not disassembly or forcing procedures

   ii. Examples – Reverse direction of auger or screw; provide larger opening in adjustable opening of machine

   iii. Plant maintenance or other civilian personnel present can ensure smooth machine operation

   iv. Machine should only be operated if parts will react as predicted

6. Disassembling the machine

   a. Require help of civilian personnel

   i. Can help minimize time to loosen or remove parts
ii. Should be closely supervised; do not attempt moves without rescue personnel approval

b. Use duplicate machinery to attempt planned maneuver if available and time allows

c. Special tools

i. May be required – Large socket wrench sets, large box end wrenches, metric wrenches, allen wrenches

ii. May be on site, keep track to return to facility

d. Allow representative of building occupant to gather and keep track of pieces removed

e. Remove only parts necessary to free patient

f. Use routine maintenance devices to assist in removing large machines if available

g. Shield patient from further harm; support parts to prevent from falling back on patient

7. Forcing the machine

a. Least desirable – Least predictable, may cause extensive damage to machine, may be risky to patient
b. Problems

i. Cannot predict actions of machine when pressure applied

ii. Rescue equipment tailored for automobile incidents; difficult to use in industrial setting

c. Consult equipment operators or maintenance personnel before forcing

i. Know which parts of machine are vulnerable and how will react

ii. Estimate amount of force needed to move piece

d. Protect patient and extrication personnel

i. Shield patient – Sheets, blankets, tarps for sparks/small debris; plywood or metal for large debris

ii. Apply water to metal parts in contact with patient to prevent burns if needed

iii. Keep charged and manned hoselines available if fire hazard associated
iv. Wear full personnel protective clothing and equipment

e. Tools chosen should be controllable under encountered circumstances

F. Phase IV: Termination

1. Once extrication accomplished
2. Follow procedures described earlier

Review Question: What procedures can be used to perform extrication on industrial and agricultural machinery?
See pages 434-446 of manual for the answer.

Section VIII: Summary and Review 5 min.

VIII. SUMMARY AND REVIEW

A. Chapter Summary

1. In order to function safely and efficiently at these incidents, personnel must be familiar with the anatomy and nomenclature of the types of vehicles and machinery that are common to their response areas.

2. Rescue personnel must keep in mind that their role is to protect themselves and others from harm, protect the trapped patients from


further harm, and to free those patients as safely and as quickly as possible.

B. Review Questions

1. What are distinguishing features of each type of industrial and agricultural vehicles? (418-423)

2. What are the hazards associated with industrial and agricultural vehicles? (427-429)

3. What specific size-up concerns should an incident commander consider during industrial and agricultural vehicle extrication operations? (427-429)

4. What methods can be used to stabilize industrial and agricultural vehicles during extrication operations? (429-431)

5. What methods can be used to gain access to the interior of industrial and agricultural vehicles? (432-433)

6. What tactics should an incident commander consider using during industrial and agricultural vehicles extrication operations? (433-434)

7. What procedures can be used to perform extrication on industrial and agricultural machinery? (434-446)