

Instructional Framework

Heavy Equipment Operations

49.0200.00

This Instructional Framework identifies, explains, and expands the content of the standards/measurement criteria, and, as well, guides the development of multiple-choice items for the Technical Skills Assessment. This document corresponds with the Technical Standards endorsed in December 2012 and reviewed in Spring 2022.



Domain 1: Safety and Operations

Instructional Time: 35 - 40%

STANDARD 1.0 EXAMINE BASIC HEAVY EQUIPMENT OPERATION

1.1 Use basic HEO terminology to describe types of heavy equipment and their uses	<ul style="list-style-type: none">● Excavator● Wheel loader● Dump truck● Bulldozer● Motor grader● Skid steer● Backhoe
1.2 Describe the purpose and objectives of an apprenticeship training program	<ul style="list-style-type: none">● On-the-job learning● Skill development<ul style="list-style-type: none">○ Traditional based○ Competency based○ Hybrid based● Safety training● Technical proficiency● Worksite efficiency● Career advancement
1.3 Identify heavy equipment operator responsibilities	<ul style="list-style-type: none">● Walk-around inspection● Operating machine safely● Material handling● Site preparation● Following blueprints and instructions
1.4 Identify the personal characteristics of a professional heavy equipment operator	<ul style="list-style-type: none">● Communication● Professionalism● Attention to detail● Safety conscious

	<ul style="list-style-type: none"> ● Adaptability ● Flexibility ● Honesty ● Willingness to learn ● Willingness to take responsibility ● Willingness to cooperate ● Rules and regulations ● Reliability ● Positive attitude
1.5 Identify the importance of safety in relation to heavy equipment	<ul style="list-style-type: none"> ● Positive reputation <ul style="list-style-type: none"> ○ Industry ○ Community ● Equipment longevity ● Compliance with regulations ● Enhanced productivity ● Worker protection ● Competency
STANDARD 2.0 PRACTICE HEAVY EQUIPMENT OPERATION SAFETY	
2.1 Demonstrate safety measures when working in and around heavy equipment	<ul style="list-style-type: none"> ● Personal Protective Equipment (PPE) ● Emergency procedures ● Vehicle stability ● Establishing a safe zone ● Communication protocols
2.2 Identify the purposes of specific signs, tags, barricades, and lockout/tagout devices on construction sites	<ul style="list-style-type: none"> ● Personal Protective Equipment (PPE) Required ● Construction Zone Authorized Personnel Only ● Safety barriers <ul style="list-style-type: none"> ○ Tape ○ Cone ○ Concrete ● Pedestrian barricade ● Signs <ul style="list-style-type: none"> ○ Fire extinguisher ○ Danger, warning, and caution signs ● Safety tags ● Lockout devices
2.3 Identify safeguards used in a highway construction work zone	<ul style="list-style-type: none"> ● Traffic cones and barriers ● Temporary traffic control <ul style="list-style-type: none"> ○ Flaggers

	<ul style="list-style-type: none"> ○ Traffic controllers ○ Lights ● Rumble strips ● Temporary speed bumps ● Portable Variable Message Signs (VMS)
<p>2.4 Use a safety data sheet (SDS) for a hazardous chemical typically associated with heavy equipment to identify the long- and short-term health effects, first-aid measures, handling and storage, and/or required personal protective equipment</p>	<ul style="list-style-type: none"> ● Safety Data Sheet (SDS) ● First aid measures ● Handling and storage ● Emergency procedures ● Environmental hazards ● Required Personal Protective Equipment (PPE) ● Product and company identification ● Composition ● Hazard identification ● Firefighting measures ● Accidental release measures ● Exposure control/PPE ● Physical and chemical properties ● Stability and reactivity ● Toxicological information ● Ecological information ● Disposal consideration ● Transport information ● Regulatory information
<p>2.5 Identify basic and specific safety rules when operating heavy equipment</p>	<ul style="list-style-type: none"> ● Personal Protective Equipment (PPE) ● Safe Operating Procedures (SOPs) ● Maintain clear communication ● Keep safe distance from hazards ● Inspect equipment before use ● Personal safety ● Keep clear of pinch point areas
<p>2.6 Identify general guidelines for safe transportation of heavy equipment</p>	<ul style="list-style-type: none"> ● 3-points of contact ● Proper equipment inspection ● Weight distribution ● Driver training and awareness ● Securement devices <ul style="list-style-type: none"> ○ Chains ○ Binders ○ Chain boomers

<p>2.7 Identify general dangers of working around an excavation area with heavy equipment</p>	<ul style="list-style-type: none"> ● Shielding ● Utility strikes ● Struck by accidents ● Caught in or between accidents ● Equipment overturns ● Collapse hazards
<p>2.8 Identify specific safety rules for operating tractors and hydraulic systems</p>	<ul style="list-style-type: none"> ● Keep guards and shields in place ● Inspect equipment regularly <ul style="list-style-type: none"> ○ Hydraulic systems ○ Hydraulic pump ○ Reservoir with strainer ○ Valve ○ Hydraulic actuator ○ Torque converter ● Avoid overloading equipment ● Wear Personal Protective Equipment (PPE)
<p>2.9 Describe the purpose of the Occupational Safety and Health Act (OSHA)</p>	<ul style="list-style-type: none"> ● Occupational Safety and Health Act (OSHA) ● Employer responsibilities ● Protecting workers' rights ● Promote safe working environments ● Ensuring compliance ● Preventing workplace injuries ● Inspection ● Retaliation ● Minimizing occupational illnesses
<p>STANDARD 3.0 IDENTIFY TYPES OF HEAVY EQUIPMENT</p>	
<p>3.1 Identify the various types of heavy equipment used on a construction site</p>	<ul style="list-style-type: none"> ● Boom lift ● Scissor lift ● Scraper ● Dump Truck ● Crane ● Tower crane ● Roller compactor ● Loader ● Forklift ● Dozer ● Backhoe ● Excavator

	<ul style="list-style-type: none"> ● Motor grader ● Skid steer
3.2 Identify the primary use(s) of each type of heavy equipment	<ul style="list-style-type: none"> ● Excavation ● Leveling ● Material handling <ul style="list-style-type: none"> ○ Pushing earth, sand, rubble ● Compaction ● Demolition ● Trenching
STANDARD 4.0 DEMONSTRATE BASIC HEAVY EQUIPMENT OPERATION	
4.1 Identify the basic operational guidelines and techniques for heavy equipment	<ul style="list-style-type: none"> ● Pre- and post-operation inspection ● Clear communication ● Safe loading and unloading ● Proper maintenance ● Terrain assessment ● Safe operational practices
4.2 Perform basic prestart inspection, startup, operational movement, and shutdown for heavy equipment	<ul style="list-style-type: none"> ● Prestart inspection <ul style="list-style-type: none"> ○ Tires/tracks ○ Undercarriage ○ Engine compartment ○ Lights ○ Batteries ○ Signals ○ Fluid check <ul style="list-style-type: none"> ■ Engine/motor oil ■ Transmission ■ Hydraulics ■ Coolant/anti-freeze ■ Fuel levels ○ Rollover protection structure (ROPS) ○ Horns and alarms ○ Attachments ● Start-up <ul style="list-style-type: none"> ○ Adjust seat and mirror ○ Seat belt or safety bar ○ Key in start position ○ Engine warm up ○ Engage necessary safety <ul style="list-style-type: none"> ■ Parking brake

	<ul style="list-style-type: none"> <ul style="list-style-type: none"> ■ Disengaging transmission lock ■ Monitor instrument gauges ● Operational movement <ul style="list-style-type: none"> ○ Increase engine RPM ○ Release parking brake ○ Engage transmission drive system ○ Use caution accelerating and decelerating especially with heavy loads ○ Observe surroundings for obstacles and hazards ○ Maintain safe speed ○ Use signals turning or changing direction ○ Safe distance from vehicles and obstacles ○ Mindful of equipment's dimensions ○ Clearances when maneuvering
4.3 Identify the operating controls of a typical tractor	<ul style="list-style-type: none"> ● Steering wheel/joystick ● Gear shift/hydraulic controls ● Throttle/brake pedal ● Loader bucket controls/auxiliary controls ● Instrument panels/safety features/lights and wipers ● Transmission shift lever ● Clutch pedal ● Differential lock ● Power takeoff ● Ignition switch ● Battery kill switch ● Autonomous equipment
4.4 Identify safety issues when operating a tractor on slopes or hills	<ul style="list-style-type: none"> ● Roll-over risk ● Loss of traction ● Visibility challenges ● Braking issues/overturning while turning ● Mechanical failures ● Speed reduction ● DO NOT cross more than 25 degrees ● Avoid turning ● Go up steep slopes in reverse (if necessary)
4.5 Start, warm up, and shut down gasoline-powered and diesel-powered engines	<ul style="list-style-type: none"> ● Gasoline-powered <ul style="list-style-type: none"> ○ Vehicle is in park or neutral and parking brake engaged ○ Turn key to ON position- gas fuel pump engaged ○ Warm-up about a minute

	<ul style="list-style-type: none"> ○ Depress the brake pedal ○ Shutting down - lower attachments, shift vehicle to park or neutral and engage the parking brake ○ Allow engine to cool down- gas 1 minute ○ Turn off accessories and turn key to OFF position ● Diesel-powered <ul style="list-style-type: none"> ○ Vehicle is in park or neutral and parking brake engaged ○ Diesel glow plug ○ Warm-up to a few minutes ○ Depress the clutch ○ Shutting down - lower attachments, shift vehicle to park or neutral and engage the parking brake ○ Allow engine to cool down for a few minutes ○ Turn off accessories and turn key to OFF position ● 3 points of contact ● No more than 20 seconds of cranking
<p>4.6 Perform basic maneuvering with heavy equipment</p>	<ul style="list-style-type: none"> ● Straight line driving <ul style="list-style-type: none"> ○ Maintain control and speed ● Turning <ul style="list-style-type: none"> ○ Avoid tipping or losing control ● Backing up <ul style="list-style-type: none"> ○ Heightened awareness and blind spots ● Obstacle avoidance <ul style="list-style-type: none"> ○ Cluttered or uneven terrain ● Precision maneuvering <ul style="list-style-type: none"> ○ Such as grading, trenching, placing materials for accurate results ● Operate at a safe speed
<p>4.7 Connect hydraulic-powered attachments to equipment</p>	<ul style="list-style-type: none"> ● Prepare the equipment and attachment <ul style="list-style-type: none"> ○ Check wear and tear ● Identify hydraulic connections <ul style="list-style-type: none"> ○ ID hydraulic ports ● Connect hydraulic hoses <ul style="list-style-type: none"> ○ Ensure connections are tight ● Test for leaks <ul style="list-style-type: none"> ○ Look for drips or spraying ● Operational checks <ul style="list-style-type: none"> ○ Ensure operates correctly ● Shutdown procedures <ul style="list-style-type: none"> ○ Turn off hydraulic system

	<ul style="list-style-type: none"> ○ Release pressure before removing ○ Follow proper procedures
STANDARD 6.0 PERFORM EARTHMOVING OPERATIONS	
6.1 Identify earthmoving equipment	<ul style="list-style-type: none"> ● Excavator ● Bulldozer ● Loader ● Backhoe loader ● Scraper ● Dump truck ● Motor grader ● Wheel/tracked loaders ● Skid steer
6.2 Identify earthmoving operations	<ul style="list-style-type: none"> ● Land grading ● Earthwork for roads and highways ● Cut and fill ● Land reclamation ● Excavation for foundations ● Highway/roadway excavation ● Bulk-pit excavation ● Channel excavation ● Limited-area vertical excavation ● Trench excavation
6.3 Explain the need for soil stabilization on a job site	<ul style="list-style-type: none"> ● Erosion control ● Support for heavy structures ● Preventing soil settlement ● Mitigating swelling and shrinkage ● Maintaining soil integrity in sloped areas
6.4 Identify soil stabilization methods	<ul style="list-style-type: none"> ● Mechanical stabilization ● Chemical stabilizations ● Geotextiles and geogrids ● Biological stabilization ● Soil cementing ● Binding ● Compacting
6.5 Identify the best equipment for performing a given earthmoving operation	<ul style="list-style-type: none"> ● Rocky terrain ● Land grading for construction site preparations ● Trenching for pipeline installation

	<ul style="list-style-type: none"> ● Bulk earthmoving for highway construction ● Excavation in confined spaces ● Vibratory roller compactor ● Soil stabilizer
6.6 Lay out a basic earthmoving operation	<ul style="list-style-type: none"> ● Site survey and analysis ● Design and planning ● Clearing and demolition ● Excavating and grading ● Compaction and stabilization ● Drainage and erosion control ● Final grading and finishing
6.7 Demonstrate the use of laser and GPS technology	<ul style="list-style-type: none"> ● Global Positioning System (GPS) ● Surveying and mapping ● Navigation systems ● Construction and civil engineering ● Geophysical exploration ● Precision agriculture

Domain 2: Material Handling and Compaction

Instructional Time: 15 - 20%

STANDARD 7.0 OPERATE A DUMP TRUCK

7.1 Identify the types of dump trucks and their uses	<ul style="list-style-type: none"> ● Rigid frame dump truck ● Articulated frame dump truck ● Off-highway dump truck ● Side dump truck ● Transfer dump truck and pup
7.2 Describe the function and operation of the dump hoist, power takeoff unit, auxiliary axle, engine retarder, differential lockout, air brake system, and manual transmission	<ul style="list-style-type: none"> ● Lift and tilt cargo bed ● Auxiliary equipment <ul style="list-style-type: none"> ○ Hydraulic pumps ○ Generators or winches ● Increases vehicle payload capacity ● Using engine's compression to generate resistance ● Prevents wheels of the same axle from spinning independently ● Uses compressed air; apply pressure to brake shoes ● To manually select and change gears

<p>7.3 Demonstrate and state the steps of the preoperational safety inspection for equipment</p>	<ul style="list-style-type: none"> ● Visual inspection ● Functional checks ● Electrical components ● Structural components ● Fluid levels <ul style="list-style-type: none"> ○ Coolant level ○ Engine oil ○ Hydraulic fluid ○ Fuel level ○ Differential oil ● Lubrications ● Axles ● Tires ● Lights and horn ● Engine compartment ● Engine belts ● Alarms
<p>7.4 Identify the duties and responsibilities of a dump truck operator</p>	<ul style="list-style-type: none"> ● Vehicle inspection ● Loading and unloading ● Transportation ● Maintenance ● Safety compliance ● Communication ● Verify clear view in all directions before starting/usage ● Use mirrors and object detection cameras ● Keep pinch points clear
<p>7.5 Identify the controls of a dump truck</p>	<ul style="list-style-type: none"> ● Steering wheel ● Gear shifter ● Dump bed controls ● Clutch pedal ● Parking brake ● Instrument panel ● Throttle
<p>7.6 Back up a dump truck with a trailer attached</p>	<ul style="list-style-type: none"> ● Check surroundings ● Use mirrors ● Use spotter ● Position truck and trailer ● Practice

STANDARD 8.0 OPERATE A ROLLER

8.1 Identify the uses of a roller

- Compaction of soil and asphalt
- Road construction
- Landfill construction
- Trench compaction
- Sports field construction

8.2 Identify the components and controls on a typical roller

- Control panel
- Rolling drums
- Water spray system
- Safety features
- Hydraulic system

8.3 Identify the safety rules for operating a roller

- Pre-operational inspection
- Personal Protective Equipment (PPE)
- Clear communication
- Training and certification
- Shutdown procedures

8.4 Perform basic maneuvers with a roller

- Forward rolling
- Reverse rolling
- Curved rolling
- Spot compaction
- Overlapping phases

STANDARD 9.0 OPERATE A SCRAPER

9.1 Identify the uses of a scraper

- Earthmoving
- Site preparation
- Land grading
- Road construction
- Land reclamation

9.2 Identify the components and controls on a typical scraper

- Engine control
- Transmission control
- Blade control
- Instrument panel
- Hydraulic controls
- Braking system
- Instrument panel

9.3 Identify safety rules for operating a scraper

- Pre-operational inspection

	<ul style="list-style-type: none"> ● Training and certification ● Safe operating speeds ● Avoid overloading
9.4 Perform basic maneuvers with a scraper	<ul style="list-style-type: none"> ● Cutting fill ● Loading material ● Leveling ● Grading ● Spreading material
STANDARD 11.0 OPERATE A FORKLIFT	
11.1 Identify the uses of a forklift	<ul style="list-style-type: none"> ● Material handling ● Loading and unloading ● Moving trailers ● Assisting in construction assembly ● Site cleanup
11.2 Identify the components and controls on a typical forklift	<ul style="list-style-type: none"> ● Steering wheel ● Forks ● Lift controls ● Safety lights ● Accelerating pedal ● Horn and backup alarm
11.3 Identify the safety rules for operating a forklift	<ul style="list-style-type: none"> ● Proper training and certification ● Pre- and post-operational inspection ● Stable loads/load charts ● Safe operating speeds ● Parking and shutdown procedures
11.4 Perform basic forklift operations	<ul style="list-style-type: none"> ● Material transport ● Loading and unloading trucks ● Hoisting ● Waste management

Domain 3: Excavation

Instructional Time: 15 - 20%

STANDARD 10.0 OPERATE A LOADER

10.1 Identify the uses of a loader

- Material loading and transport
- Clearing, leveling, and grading
- Excavation
- Demolition
- Backfilling

10.2 Identify the components and controls on a typical loader

- Loader bucket
- Loader arms
- Hydraulic controls
- Steering wheel or joystick
- Transmission controls
- Instrument panel
- Forward, neutral, reverse (F-N-R) switch/gear selector
- Gear shifter (1st/2nd gear)
- Seat with head support
- Dash
- Hydraulic lockout switch

10.3 Identify safety rules for operating a loader

- Pre-operational inspection
- Load limits and stability
- Training and certification
- Safe operating practices
- Regular maintenance and inspections
- Personal Protective Equipment (PPE)
- Keep machine clean
- Keep all windows clean
- Seat belt
- Adjust mirrors
- 3 points of contact
- NEVER remove protective guards
- Lower attachment

10.4 Perform basic maneuvers with a loader

- Loading and dumping operations
- Spreading materials
- Pushing and stockpiling material
- Lifting and placing objects

	<ul style="list-style-type: none"> ● Clearing debris ● Back drag ● Leveling
STANDARD 13.0 OPERATE A BACKHOE	
13.1 Identify types of backhoes	<ul style="list-style-type: none"> ● Standard backhoe loader ● Extended reach backhoe ● Track mounted backhoe ● Mini backhoe loader ● Compact tractor loader backhoe ● Crawler-type backhoe ● Multi-purpose
13.2 Identify the components and controls on a typical backhoe	<ul style="list-style-type: none"> ● Backhoe arm ● Boom ● Stabilizer legs ● Hydraulic controls ● Front bucket/rear bucket ● Boom ● Stick ● Parking brake ● Key switch ● Service brakes ● Forward, neutral, reverse (F-N-R) switch/gear selector ● Gear shifter (1st - 4th gear) ● Manual throttle ● Differential lock ● Hydraulic lockout switch
13.3 Identify safety rules for operating a backhoe	<ul style="list-style-type: none"> ● Maintain clear visibility ● Stable ground ● Safe distance from overhead power lines ● Avoid overloading ● Clear communication
13.4 Identify accessories used on a backhoe	<ul style="list-style-type: none"> ● Hydraulic hammers/breakers ● Augers ● Grapples ● Rippers ● Buckets <ul style="list-style-type: none"> ○ Smooth ○ Teeth

	<ul style="list-style-type: none"> ● Street pad ● Compactor ● Cold planer
13.5 Perform backhoe prestart inspection and maintenance procedures	<ul style="list-style-type: none"> ● Pre- and post-inspection ● Fluid level checks ● Inspect hydraulic systems ● Greasing and lubrication ● Tire pressure ● Functional tests ● Electrical system check
13.6 Perform basic maneuvers with a backhoe	<ul style="list-style-type: none"> ● Digging ● Loading ● Grading ● Lifting heavy objects ● Backfilling
13.7 Perform basic earthmoving operations with a backhoe	<ul style="list-style-type: none"> ● Excavating trenches ● Loading and unloading ● Backfilling ● Grading and leveling ● Digging holes
STANDARD 14.0 OPERATE AN EXCAVATOR	
14.1 Identify types of excavators and their uses	<ul style="list-style-type: none"> ● Crawler excavator ● Wheel excavator ● Long reach excavator ● Amphibious excavator ● Dragline excavator
14.2 Identify the components and controls on a typical excavator	<ul style="list-style-type: none"> ● Boom and stick ● Track and wheels ● Swing mechanism ● Monitoring instruments ● Cab ● Bucket <ul style="list-style-type: none"> ○ Teeth
14.3 Identify safety rules for operating an excavator	<ul style="list-style-type: none"> ● Pre- and post-operational inspections ● Communicate effectively ● Maintain safe distances

	<ul style="list-style-type: none"> ● Use proper operating techniques ● Wear Personal Protective Equipment (PPE)
14.4 Perform basic maneuvers with an excavator	<ul style="list-style-type: none"> ● Digging ● Dumping ● Demolition ● Trenching ● Loading and lifting
14.5 Perform basic earthmoving and excavation operations with an excavator	<ul style="list-style-type: none"> ● Landscaping ● Clearing vegetation and debris ● Leveling and grading ● Excavating ● Backfilling

Domain 4: Grading and Leveling

Instructional Time: 15 - 20%

STANDARD 5.0 PERFORM GRADING OPERATIONS

5.1 Define terms associated with grade work	<ul style="list-style-type: none"> ● Cut/fill stake <ul style="list-style-type: none"> ○ Center line ● Back slope and fore slope ● Subgrade ● Compaction ● Topsoil stripping ● Erosion control ● Final grade work ● Laser level ● Global Positioning System (GPS)
5.2 Match types of stakes to their use	<ul style="list-style-type: none"> ● Wooden stakes ● Steel stakes ● Survey stakes ● Rebar stakes ● Tent stakes ● Center line stakes ● Shoulder stake ● Slope stakes ● Offset stakes

	<ul style="list-style-type: none"> ● Edge of pavement stakes ● Fill stake ● Cut stake ● Stake whiskers
5.3 Identify markings on grade stakes and benchmark (BM) stakes	<ul style="list-style-type: none"> ● Elevation ● Station number ● Directional arrows ● Benchmark information - reference points ● Material stakes ● Distance from baseline ● Fill ● Cut ● Ratio
5.4 Identify equipment used by a heavy equipment operator to check stakes	<ul style="list-style-type: none"> ● Leveling instruments ● Marking paint, or flagging tape ● Range pole ● Communication equipment ● Handheld Global Positioning System (GPS) ● Manual equipment ● Electronic measuring device
5.5 Describe and calculate slope ratio	<ul style="list-style-type: none"> ● Slope ratio ● Road gradient ● Ramp slope ● Slope of drainage canal ● Retaining wall incline ● Staircase slope
5.6 Distinguish between backslope and foreslope	<ul style="list-style-type: none"> ● Area between the ditch line and a backslope stake ● Area between the ditch line and an edge pavement stake
5.7 Verify horizontal and vertical distance of cut and fill slope stakes	<ul style="list-style-type: none"> ● Tape measure ● Surveying level ● Global Positioning System (GPS) ● Laser distance measurer ● Drone surveys
5.8 Verify finish subgrade on a cross slope	<ul style="list-style-type: none"> ● String lines and levels ● Check rods or grade stakes ● Grid method ● Water flow test

	<ul style="list-style-type: none"> ● Surveying equipment
5.9 Define terms associated with plan reading, grade setting, and drainage	<ul style="list-style-type: none"> ● Cut and fill ● Benching ● Invert elevation ● Slope ● Swale
5.10 Identify construction industry practices for setting grades from a benchmark	<ul style="list-style-type: none"> ● Transit leveling ● Total station survey ● Grade rods ● Auto leveling lasers ● Global Positioning System (GPS)
5.11 Identify construction industry practices for setting grades using a laser level or string	<ul style="list-style-type: none"> ● Preparation of the site ● Calibrating the laser level ● Setting grade stakes ● Checking grade with a laser level ● Adjusting grade as needed
5.12 Identify methods for keeping construction sites well drained	<ul style="list-style-type: none"> ● Surface drainage systems ● Erosion control ● Vegetative buffer strips ● Retention and detention ponds ● Regular maintenance ● Storm water runoff ● Infiltration systems ● Rolled erosion control/straw blanket
5.13 Identify how the grade of a trench and drainpipe is set	<ul style="list-style-type: none"> ● Standard slope requirement ● Site survey and analysis ● Flow velocity considerations ● Length of run ● Topography and landscape
5.14 Interpret construction plans to determine grading requirements	<ul style="list-style-type: none"> ● Contours and elevations ● Cut and fill calculations ● Soil types and stability ● Utility placement ● Erosion control measures

STANDARD 12.0 OPERATE A DOZER

12.1 Identify the uses of a dozer

- Earthmoving
- Clearing and excavation
- Site preparation
- Road construction
- Demolition
- Pushing material and other equipment
- Cutting
- Clearing land
- Backfilling
- Moving large objects
- Finishing
- Excavating work in confined areas
- Ripping
- Towing machines

12.2 Identify the components and controls on a typical dozer

- Blade controls
- Track pedals
- Instrument panel
- Rollover protection structure (ROPS)
- Manual throttle
- Parking brake
- Rippers

12.3 Identify safety rules for operating a dozer

- Pre- and post-inspection
- Observe SOPs
- Watch for hazards
- Maintain proper visibility
- Personal Protective Equipment (PPE)
- Cycling hydraulics after shutdown
- Keep machine clean
- Keep all windows clean (if applicable)

12.4 Perform dozer prestart inspection and maintenance procedures

- Pre- and post-inspection
- Fluid level checks
- Inspect hydraulic systems
- Greasing and lubrication
- Tire pressure and track inspection
- Track inspection
 - Rear sprocket
 - Master link track

	<ul style="list-style-type: none"> ○ Rollers
12.5 Perform basic maneuvers with a dozer	<ul style="list-style-type: none"> ● Straight push ● Blade angle adjustment ● Pivot turn ● Side slope maneuvers ● Fine grading
12.6 Perform basic earthmoving and excavation operations with a dozer	<ul style="list-style-type: none"> ● Cutting and leveling terrain ● Backfilling ● Grading and sloping ● Creating embankments ● Pushing and stockpiling materials
STANDARD 15.0 OPERATE A MOTOR GRADER	
15.1 Identify the uses of a motor grader	<ul style="list-style-type: none"> ● Grading and leveling ● Road maintenance ● Creating slopes and ditches ● Pushing material ● Earthmoving ● Breaking up material ● Site preparation
15.2 Identify types of motor graders and their uses	<ul style="list-style-type: none"> ● Rigid frame motor grader ● Articulated frame motor grader ● Tandem axle motor grader ● Six-wheel drive motor grader ● Articulated six-wheel drive motor grader
15.3 Identify the components and controls on a typical motor grader	<ul style="list-style-type: none"> ● Blade <ul style="list-style-type: none"> ○ Moldboard ○ Cutting edge ○ End bits ● Circle or pivot point ● Operators console ● Hydraulic controls <ul style="list-style-type: none"> ○ Left /right blade lift ○ Blade slide ○ Blade pitch ○ Turn table ○ Blade side shift

	<ul style="list-style-type: none"> ○ Pivot/articulation ○ Rear ripper ○ Wheel lean ● Differential lock ● Saddle lock/pin ● Circle drive housing ● Forward, neutral, reverse (F-N-R) switch/gear selector ● Gear shifter (1st - 4th gear) ● Manual throttle ● Hydraulic lockout switch
15.4 Identify safety rules for operating a motor grader	<ul style="list-style-type: none"> ● Pre- and post-operational inspections ● Use caution when starting and reversing ● Keep clear of moving parts ● Maintain safe speeds ● Follow SOPs
15.5 Identify accessories used on a motor grader	<ul style="list-style-type: none"> ● Blade extensions ● Ripper attachment ● Topcon Global Positioning System (GPS)/Global Navigation Satellite System (GNSS) ● Front mounted push block ● V-Plow attachment
15.6 Perform prestart inspection and maintenance	<ul style="list-style-type: none"> ● Pre- and post-operational inspections ● Structural inspection ● Lights and signals check ● Steering and controls check ● Fluid levels check <ul style="list-style-type: none"> ○ Engine/motor oil ○ Transmission ○ Hydraulics ○ Coolant/anti-freeze ○ Fuel levels ● Tire and brake inspection
15.7 Perform basic maneuvers with a motor grader	<ul style="list-style-type: none"> ● Blade angle adjustments ● Windrowing ● Blade lift and lower ● Leveling ● Cutting ● Bank sloping

	<ul style="list-style-type: none"> ● Breaking up material ● V-ditch
15.8 Perform basic earthmoving operations with a motor grader	<ul style="list-style-type: none"> ● Ditching and slope maintenance ● Cutting and shaping roadways ● Spreading and compacting fill material ● Rough grading for site preparation ● Fine grading and finish grading
STANDARD 16.0 COMPLETE FINISHING AND GRADING WORK	
16.1 Identify the requirements for finishing and final grading of earthwork	<ul style="list-style-type: none"> ● Smoothness and slope ● Compaction ● Drainage ● Surface finish ● Grading limits ● Verifying grade
16.2 Use heavy equipment to perform fine grading and finishing work	<ul style="list-style-type: none"> ● Motor grader ● Laser grader ● Bulldozer ● Vibratory roller ● Asphalt paver
16.3 Demonstrate techniques for finish grading of subgrade, base, slopes, parking areas, and drainage structures	<ul style="list-style-type: none"> ● Grading with Global Positioning Systems (GPS)/Global Navigation Satellite System (GNSS) technology ● Contour grading ● Slope stabilization techniques ● Topsoil stripping and replacement ● Cut and fill method

Domain 5: Site Plans
Instructional Time: 5 - 10%

STANDARD 17.0 DEMONSTRATE KNOWLEDGE OF SOILS

17.1 Identify the characteristics of different types of soils	<ul style="list-style-type: none"> ● Sandy soil ● Clay soil ● Loamy soil ● Peaty soil
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	<ul style="list-style-type: none"> ● Chalky soil ● Silty soil
17.2 Identify the various engineering properties of soil	<ul style="list-style-type: none"> ● Particle size distribution ● Moisture content ● Permeability ● Shear strength ● Soil classification
17.3 Identify factors that affect soil density	<ul style="list-style-type: none"> ● Organic matter content ● Moisture content ● Soil structure ● Compaction ● Biological activity
17.4 Identify how soil factors affect equipment selection	<ul style="list-style-type: none"> ● Soil type ● Soil moisture content ● Soil density ● Soil pH/and composition ● Presence of rocks and obstacles
17.5 Demonstrate wet digging techniques	<ul style="list-style-type: none"> ● Hydraulic excavation ● Dredging ● Dragline excavation ● Jetting ● Submersible dredge pumps ● Clamshell bucket dredging
STANDARD 18.0 PLAN CONSTRUCTION SITES	
18.1 Identify the three phases of a construction project	<ul style="list-style-type: none"> ● Pre- construction phase ● Construction phase ● Post- construction phase
18.2 Identify the steps in construction site planning	<ul style="list-style-type: none"> ● Project initiation and assessment ● Site selection and acquisition ● Design and engineering ● Resource planning and procurement ● Logistics and site organization
18.3 Identify the relationship of planning to project safety and success	<ul style="list-style-type: none"> ● Risk assessment and mitigation planning ● Safety protocols integration in project schedule ● Compliance with regulatory requirements

	<ul style="list-style-type: none"> ● Training and education planning ● Continuous monitoring and evaluation
18.4 Develop a construction site schedule	<ul style="list-style-type: none"> ● Site preparation ● Foundation work ● Structural framing ● Exterior work ● Interior work ● Finishing touches ● Finalization and cleanup
18.5 Identify costs associated with building a job	<ul style="list-style-type: none"> ● Material costs ● Labor costs ● Equipment and machinery costs ● Permit and inspection fees ● Site preparation costs ● Utilities installation costs ● Insurance and legal fees
18.6 Define production and productivity	<ul style="list-style-type: none"> ● Production <ul style="list-style-type: none"> ○ Primary production ○ Secondary production ● Productivity <ul style="list-style-type: none"> ○ Labor productivity ○ Capital productivity ○ Total factor productivity (TFP)
18.7 Identify the relationship of productivity and profit	<ul style="list-style-type: none"> ● Increased productivity leads to higher profitability ● Cost reduction ● Competitive advantage ● Employee engagement and satisfaction ● Innovation and growth ● Feedback loop
STANDARD 19.0 PERFORM EXCAVATION MATH	
19.1 Identify basic geometric shapes	<ul style="list-style-type: none"> ● Circle ● Square ● Rectangle ● Triangle ● Pentagon ● Hexagon ● Octagon

<p>19.2 Calculate the surface area of squares, rectangles, triangles, trapezoids, and circles using formulas</p>	<ul style="list-style-type: none"> ● Square <ul style="list-style-type: none"> ○ $A = s^2$ ○ Where s is the length of one side ● Rectangles <ul style="list-style-type: none"> ○ $A = LW$ ○ Where L is the length and W is the width ● Triangle <ul style="list-style-type: none"> ○ $A = \frac{1}{2}bh$ ○ Where b is the base and h is the height of the triangle ● Trapezoid <ul style="list-style-type: none"> ○ $A = \frac{1}{2}(b_1+b_2)h$ ○ Where b_1 and b_2 are the lengths of the two parallel bases, and h is the height perpendicular to the bases ● Circles <ul style="list-style-type: none"> ○ $A = \pi r^2$ ○ Where r is the radius of the circle and π is a constant equal to 3.14159
<p>19.3 Calculate the volume of cubes, rectangular objects, prisms, and cylinders</p>	<ul style="list-style-type: none"> ● Cubes <ul style="list-style-type: none"> ○ $V = s^3$ ○ Where s the length of one side of the cube ● Rectangular prism <ul style="list-style-type: none"> ○ Volume (V) = Length (L) x Width (W) x Height (H) ● Volume of a prism <ul style="list-style-type: none"> ○ $V = A \times H$ ○ Assuming a general prism with a polygonal base: If the area of the base of the prism is A and the height of the prism is H ● Volume of a cylinder <ul style="list-style-type: none"> ○ $V = \pi r^2 \times H$ ○ Where the radius of the base of the cylinder is r and the height of the cylinder is H, π is a constant equal to 3.14159
<p>19.4 Calculate the excavation volume of a job using information supplied on building plans</p>	<ul style="list-style-type: none"> ● Calculate the volume of each excavation area <ul style="list-style-type: none"> ○ Use the formula Volume = Length x Width x Depth ● Example excavation <ul style="list-style-type: none"> ○ Area A: Length = 10 meters, Width = 6 meters, Depth = 2 meters (10m x 6m x 2m = 120 cubic meters)
<p>19.5 Calculate the weight of materials from an excavation from its volume</p>	<ul style="list-style-type: none"> ● Weight = Volume x Density ● Weight is the weight of the material ● Volume is the volume of the material being excavated

	<ul style="list-style-type: none"> ● Density is the density of the material ● Example: <ul style="list-style-type: none"> ○ Weight = soil density is 1.5 tons per cubic meter, and you excavated 100 cubic meters of soil the calculations ○ Weight = 100 cubic meters x 1.5 tons /m³ weight is 150 tons
STANDARD 20.0 INTERPRET CIVIL BLUEPRINTS	
20.1 Identify the types of drawings usually included in a set of plans and the information found on each type	<ul style="list-style-type: none"> ● Site plans ● Floor plans ● Sections ● Mechanical, Electrical, Plumbing (MEP) systems ● Landscape plans ● Schedules and legends
20.2 Identify the different types of lines used on drawings	<ul style="list-style-type: none"> ● Object lines ● Center lines ● Dimension lines ● Extension lines ● Border lines
20.3 Recognize common abbreviations and symbols used on plans	<ul style="list-style-type: none"> ● Architectural abbreviations <ul style="list-style-type: none"> ○ FFL - finished floor plan ○ DR - Door ○ SHT - Sheet ○ ELE - elevation ○ WC- Water closet (toilet) ● Engineering abbreviations <ul style="list-style-type: none"> ○ AC - Asphalt Concrete ○ OC - On center ○ RW - Right of Way ○ CIP - Cast in place ● Heavy equipment operations signs and symbols
20.4 Read and interpret drawings to determine the type of excavations needed to prepare the site	<ul style="list-style-type: none"> ● Understand the site plan ● Identify key components ● Assess soil conditions ● Analyze grading requirements ● Identify utility locations ● Consider structural requirements ● Consult with engineers and architects ● Document findings

20.5 Identify the operator's duties to ensure that the job is completed safely and according to a site plan

- Pre- and post-operational inspections
- Understanding the site plan
- Safety procedures
- Communication
- Safe operation
- Monitoring
- Compliance with regulations
- Emergency preparedness
- Documentation

