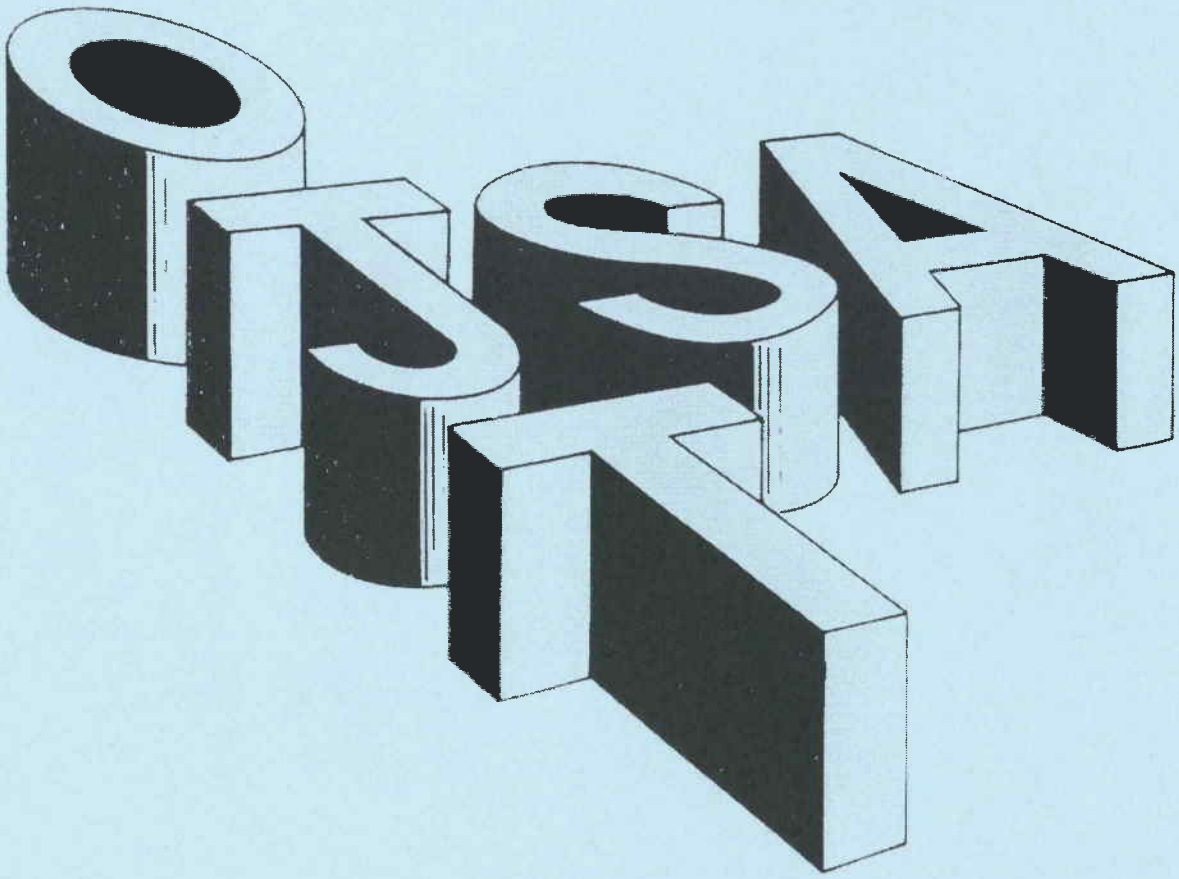
On-the-Job Training Modules – Surface Metal and Nonmetal

U.S. Department of Labor
Mine Safety and Health Administration
National Mine Health and Safety Academy

Instruction Guide Series
IG 43

1988

Revised 2004



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U.S. Department of Labor
Elaine L. Chao
Secretary

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NOTE: Modules 15, 16, and 17 are applicable to many surface metal and nonmetal mining jobs, and may be used effectively in conjunction with the other modules, as well as being used separately.

These training modules were developed cooperatively by government and industry groups. MSHA gratefully acknowledges Battle Mountain Gold Company, Echo Bay Minerals Company, and others for their valuable contributions to this Instruction Guide.

Copies of this Instruction Guide, and others in this series, may be ordered by contacting:

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This Instruction Guide is designed to supplement existing health and safety training programs. The modules are only guides, and their use is not mandatory. The material is not intended to cover all specific jobs at any given operation. Other modules may be added, and existing modules revised, in future printings of this Instruction Guide.

Individual modules can be kept together in a three-ring notebook when not in use. The last page of each module contains general information and training recommendations.

MODULE NUMBER 1
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

FRONT-END LOADER OPERATION

This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for front-end loader operation.

Front-end loaders are probably the most versatile machines utilized at surface metal and nonmetal mines. The front-end loader can be used for many purposes, including: loading haulers, pushing material, grading, hauling material, and working stockpiles or spoil areas. Front-end loaders, typically with 14-16 cubic yard buckets, are sometimes used for stripping overburden. The most common use at surface mines is for loading waste rock haulers and ore haulers.

This module is designed primarily for use in the initial training of front-end loader operators. The content deals with the loading of haulers or bins and hoppers, but can be applied to other jobs performed by a loader. The material should be used by the trainer as a supplement to practical knowledge and specific mine conditions.

Many surface metal and nonmetal miners are injured or killed each year in loader accidents. Loader accidents frequently occur when tramming an unloaded machine at high speed. Accidents also result from collisions with other machines, a person getting caught in pinch points, and spillage of material while tramming or loading. Numerous other hazards exist, and loader operators must be aware at all times of hazards that can cause injury.

Self-propelled machines that will be used during a shift must be inspected by the machine operator before operation. Particular attention should be given to the steering and braking systems, in order to ensure proper working order. Headlights, horns, and backup alarm systems must function properly at all times. Seat belts must be provided and worn.

The basic job steps included in this module are:

1. Conduct walk-around check of loader.
2. Mount loader and check cab.
3. Start loader and complete pre-shift examination.
4. Tram loader to work area.
5. Load bucket.
6. Tram to dump area.
7. Dump material.
8. Tram back to loading area.
9. Refuel and park.
10. Perform repairs and maintenance.

The operator's manual provided with the machine, and the mine's operating procedures, should also be used in training machine operators.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment

Hard hat, safety shoes, safety glasses with side shields, gloves, clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Conduct walk-around check of loader.	1. A) Frostbite, hypothermia, sunburn, heat stroke, heat cramps, heat exhaustion.	1. A) Dress to suit weather conditions.
	B) Struck by moving loader or other machines.	B) Check to be sure loader bucket is lowered to ground, and, if parked on a grade, wheels are blocked and/or turned into a bank. Be alert for nearby machines.
	C) Slips or trips, struck by flying objects such as dirt or splashed fluids, caught in pinch points.	C) Conduct walk-around inspection of loader. Avoid slick spots and keep area free of slipping or tripping hazards. Be especially careful of ruts, uneven ground, and frozen ground. Use suitable access if necessary to mount and dismount loader to check engine or other area of machine.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	C) (Continued)	Check: 1) Tires and wheels for lug nuts, cracked rims, cuts, tire pressure. 2) Area around loader for people or obstructions. 3) All bolts, guards, covers, and mechanical components of loader to make sure they are in place. 4) Engine compartment for dirt, debris, oily rags, tools. Grasp engine covers firmly when removing. Avoid over-reaching. Get help if needed. 5) Fluid levels. Wear safety glasses with side shields and gloves. Remove tank caps or covers carefully. 6) Hydraulic oil and coolant lines and hoses for breaks, leaks, rubbing lines or loose fittings, especially in the pivot area. 7) Fire extinguisher (if on outside of machine) to make sure it's in place and fully charged. 8) Loader linkage for loose pins or cracks in lift arms, bucket attachment and bucket itself. 9) Ladders and steps for broken rungs, loose bolts, breaks, cracks, missing parts, or bent and twisted steps.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	D) Sludge deposits, or ice, which might prevent valve operation - tank rupture from excessive pressure.	D) If loader has air brakes, bleed the air lines to release any condensation that might have accumulated, and trip the pressure relief to be sure it's operable.
2. Mount loader and check cab.	2. A) Slips and falls, clothing caught on control levers or other projections.	2. A) Wear snug fitting clothing. Keep ladders and boots free of mud, ice, snow, grease, and oil.
	B) Falling from ladder.	B) Use belt hooks, pockets, etc., to carry materials up ladders, and keep both hands free for climbing. Ropes can be used to hoist bulkier items. Face ladder and use three points of contact when climbing (two hands and one foot, or two feet and one hand, in contact with ladder at all times). Use handholds and select firm footing. Avoid haste and projections.
	C) Sudden machine movement on some loaders (even with engine off), falling from loader.	C) Do not use steering wheel as a grab point.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	D) ROPS failure in a rollover, canopy failure in a falling object accident. Missing or inoperative fire extinguisher.	D) Check for any damage to rollover protective structure or falling object protective structure. Check fire extinguisher.
	E) Struck by flying objects, jammed controls, projecting control levers.	E) Remove or secure any loose objects in cab. Avoid projections.
	F) Accident caused by poor visibility.	F) Inspect and clean windows and mirrors. Adjust mirrors if necessary.
	G) Thrown against cab interior, or thrown out of the machine.	G) Make sure seat belts are provided, and are in good condition. Seat belts must be worn by the operator.
	H) Machine malfunction.	H) Check all instruments and gauges before start-up to be sure they aren't stuck. Make sure all controls are in neutral position, and parking brake is set.
3. Start loader and complete pre-shift examination.	3. A) Hitting or running over persons or objects in area. Striking steering wheel or other parts of cab if loader moves suddenly.	3. A) Check machine for warning tags. Be sure bucket is lowered to ground. Check controls to be sure they are in neutral. Sound horn before starting or moving. Check backup alarm after start-up.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	B) Engine or auxiliary equipment malfunction.	B) Let engine run until it reaches normal operating temperature. Check all gauges, indicators, and warning lights again for normal readings.
	C) Engine malfunction.	C) Check engine for smooth idle and unusual smoke or noise.
	D) Poor visibility. Poor operation.	D) Check wipers and lights. Check hydraulic controls.
	E) Emergency steering failure.	E) Check emergency steering, if equipped and if recommended by manufacturer.
	F) Loss of control.	F) Check brakes and steering after moving a short distance. Brakes may also be checked against partial engine power before moving, according to company policy or manufacturer's recommendations. Check transmission operation.
	G) Potential hazards not corrected.	G) Report and, if possible, repair any defects found. Do not use machine with uncorrected safety defects. If the loader is unsafe and removed from service, tag it to prohibit further use until repairs are completed.
	H) Hearing loss.	H) Use ear protection when necessary.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. Tram loader to work area.	4. A) Personal injury.	4. A) Do not allow anyone to ride outside the cab for any reason. No one shall ride with the operator unless safe seating facilities are provided.
	B) Running over someone.	B) Sound horn before starting to tram.
	C) Poor visibility, poor stability, overturning loader, striking other machines or people.	C) Observe travel area. Adjust speed for conditions. Tram with bucket low (15 to 20 inches off the ground) to increase stability.
	D) Caught in pinch points.	D) Keep doors latched securely.
	E) Overturning loader.	E) Travel in proper gear at acceptable speeds for conditions. Avoid loose material, slick spots, and weak areas. Observe road hazards, and travel in stable areas.
	F) Loss of control, overturning loader.	F) When carrying a loaded bucket down a steep grade, travel in reverse.
	G) Loss of control, overturning loader.	G) Control speed and slow down carefully if loader starts "road-walking."
	H) Loss of steering and/or brakes - collisions.	H) Monitor gauges/indicators. Follow traffic rules.
	I) Struck by falling ore or rock.	I) Stay out from under swing of dragline.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. Load bucket.	5. A) Obstructed work area.	5. A) Clean loose material from loading area.
	B) Falling or sliding material.	B) Work material from toe, or in a manner which eliminates hazardous rolling or sliding of material. Shake off excess material before tramming out of loading area. If working next to a highwall, visually check it on a regular basis for changing and/or hazardous conditions.
	C) Buried at toe of stockpile by falling or sliding material. Failure of ground under machine weight at top of stockpile.	C) When loading from stockpile, do not allow hazardous overhangs or excessive slope angle to develop. Work material from top if necessary to maintain stockpile stability.
	D) Falling or sliding of loose, uncon-solidated material.	D) Avoid digging into loose rock or tailings banks which are higher than bucket reach.
	E) Overturning loader.	E) Watch for "soft spots," particularly on tailings pond reclamation work.
	F) Rapid tire wear, slashes and gashes in tire side walls.	F) Avoid spinning the wheels, especially in wet conditions. If loader is equipped with a variable torque converter, adjust to a lower setting.
6. Tram to dump area.	6. A) All hazards in Step 4 apply.	6. A) All procedures in Step 4 apply.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	B) Running over stationary objects, other personnel, and vehicles.	B) Check before backing, and keep backup alarm working.
	C) Reduced stability and visibility.	C) Tram at speed consistent with load and area conditions. Keep bucket low off ground for maximum stability and visibility.
	D) Loss of control - overturning loader.	D) Travel in reverse only when carrying a loaded bucket down a steep grade.
7. Dump material.	7. A) Spillage.	7. A) Position haulers perpendicular to, and backed into, material so that spillage stays close to pile.
	B) Overturning loader.	B) Load and dump on the level or uphill for greater stability. Avoid having dumping point downhill from loading point.
	C) Falling material, equipment damage, excess spillage.	C) Raise bucket while positioning loader, and tilt bucket forward to avoid spillage. Raise bucket only to height necessary for clearance. Avoid striking hauler or hopper with bucket or loader.
	D) Excess spillage, overturning, knocking hauler operator against something.	D) Position loader to avoid spillage on the off side. Make motions smooth. Tilt bucket slowly to reduce shock of sudden drop of material, and flying material. DO NOT swing loads over operating compartments of other equipment.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
7. (Continued)	E) Running over persons, falling material.	E) Be sure that other workers are clear before positioning or dumping. Have hauler operators stay in cabs or clear of dump area.
	F) Poor handling of hauler because of unbalanced load.	F) Distribute load evenly in haulers.
	G) Inefficient operation.	G) Signal hauler operator when hauler is loaded.
	H) Caught in material flow, suffocation.	H) If a hangup occurs while dumping material into a bin or hopper, do not attempt to free the material yourself unless you are experienced in this type of work. If the bin or hopper must be entered, the equipment must be locked out, and a safety belt and line must be used. The lifeline must be tended by a second person, with minimum slack maintained.
8. Tram back to loading area.	8. A) Same as Steps 4 and 6.	8. A) Same as Steps 4 and 6
9. Refuel and park.	9. A) Struck by machinery, fuel spillage, fire hazard.	9. A) Park at refueling station, place controls in neutral and set brakes. No smoking at or near the refueling station.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
9. (Continued)	B) Slips and falls. Clothing caught on control levers or other projections.	B) Dismount loader (see Job Procedures 2.A-C).
	C) Fuel on skin and in eyes.	C) Wear safety glasses. Take fuel hose from storage rack, remove tank cap slowly, and pump fuel into tank.
	D) Trips, slips, and falls. Fire hazard.	D) Avoid fuel spillage, and keep area free of extraneous materials. If necessary to climb on loader to refuel, use access ladder, steps, available rails or handholds. Keep all walking or standing areas free from slipping and/or stumbling hazards. Avoid fuel spillage onto hot engine parts.
	E) Fire hazard, fuel spillage or discharge.	E) Shut off fuel, remove nozzle hose, and replace fuel cap. Return hose to rack.
	F) Collision, runaway machine, traffic obstruction.	F) Park only at designated parking areas, and always set brakes. Avoid parking on inclines or haul roads. If necessary to park on an incline, turn wheels into bank and/or block securely. If parking on a haul road is required, pick the safest place.
	G) Unsecured raised equip-ment, runaway machine.	G) Lower bucket to ground. Place controls in neutral position. Engage parking brake.
	H) Engine damage.	H) Idle engine for a short period of time and then shut it off.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
9. (Continued)	I) Slips and falls, clothing caught on control levers or projections.	I) Dismount loader (see Job Procedures 2.A-C).
	J) Hazards due to lack of communication.	J) Always inform appropriate personnel of any abnormal conditions, defects, changes made in machine and/or job procedure or condition.
10. Perform repairs and maintenance (if applicable).	10. A) Personal injury from improper procedure.	10. A) Do not attempt repairs or maintenance you do not understand and are not trained to do.
	B) Caught by or struck by moving or falling parts, or moving machine.	B) Do not attempt any repairs or maintenance until the power is off, the machinery is blocked against motion, and all raised equipment lowered. If necessary to perform work above, under, or around a raised piece of equipment, block or mechanically secure the equipment to prevent accidental rolling, falling, or lowering. Remove ignition key to prevent loader from being started while work is performed. Tag out machine.
	C) Struck by material falling from machine.	C) Do not attempt repairs or maintenance until any frozen material under machine frame, bucket, etc., has been removed.

GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the surface metal and nonmetal mining industry in conducting effective on-the-job training (OJT) of new employees, or employees reassigned to different jobs. The use of training materials, such as this module, is an important part of an effective, systematic, OJT program.

This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs," June, 1983.

TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site where the work will be done.

The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step – explaining the job to the employee – can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom or a quiet office for the first part of the training. Any general theory or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

MODULE NUMBER 2
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

DOZER OPERATION

This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for dozer operation.

This material is designed primarily for use in the initial training of dozer operators at surface metal and nonmetal mines. The content deals with general operation and clearing and pushing, but this material can be applied to other jobs performed with a dozer. This material should be used by trainers as a supplement to practical knowledge and specific mine conditions.

Dozers are one of the strongest and heaviest pieces of equipment used at surface mines. Dozers can be used effectively for clearing operations, pushing material, grading work, compacting loose material, etc. The most common uses are for clearing and pushing operations.

Accidents involving dozers often result in disabling injuries or fatalities, due to the massive weight of the dozer. Crushing type injuries involving dozers most often result in fatalities. Most of these occur when operators are run over by their own machine. Many other hazards exist, requiring the dozer operator to remain alert at all times.

Self-propelled machines that will be used during a shift must be inspected by the machine operator before operation. Particular attention should be given to the steering and braking systems to ensure proper working order. Headlights, horns, and backup alarm systems must function properly at all times. Seat belts must be provided and worn.

The basic job steps included in this module are:

1. Conduct walk-around check of dozer.
2. Mount dozer and check cab.
3. Start dozer and complete pre-shift examination.
4. Tram dozer to work area.
5. Examine work area.
6. Clear material.
7. Push material.
8. Refuel and park.
9. Perform repairs and maintenance.

The operator's manual provided with the machine, and the mine's operating procedures, should also be used in training machine operators.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment

Hard hat, safety shoes, safety glasses with side shields, gloves, clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Conduct walk-around check of dozer.	1. A) Frostbite, hypothermia, sunburn, heat cramps, heat exhaustion.	1.A) Dress to suit weather conditions.
	B) Struck by moving dozer or other equipment.	B) Check to be sure dozer blade is lowered to ground. Be alert for nearby equipment.
	C) Slips or trips. Struck by flying objects, such as dirt or splashed fluids. Caught in pinch points.	C) Conduct walk-around inspection of dozer. Avoid slick spots, and keep area free of slipping or tripping hazards. Use suitable access if necessary to mount and dismount dozer to check engine or other area of machine.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	1. C) (Continued)	During walk-around inspection, check: 1. Area around dozer for people or obstructions. 2. All bolts, guards, covers, and mechanical components of dozer to make sure they are in place. 3. Engine compartment for dirt, debris, oily rags, tools. Grasp engine covers firmly when removing. Avoid over-reaching. Get help if needed. 4. Fluid levels. Wear safety glasses with side shields and gloves. 5. Hydraulic oil and coolant lines and hoses for breaks, leaks, rubbing lines or loose fittings, 6. Fire extinguisher (if on outside of machine) to make sure it's in place and fully charged, 7. Ladders, steps, handholds, and handrails for loose bolts, breaks, cracks or missing parts.
	D) Defects and hazards not fixed.	D) Report and, if possible, repair any defects found. Do not use equipment with uncorrected safety defects.
2) Mount dozer and check cab.	2. A) Slips and falls. Clothing caught on control levers or other projections.	2. A) Wear snug fitting clothing. Keep steps and boots free of mud, ice, snow, grease, and oil.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	B) Falling from machine.	B) Use belt hooks, pockets, etc., to carry materials up to cab. Keep both hands free for climbing. Use handholds and select firm footing. Avoid haste and projections.
	C) ROPS/FOPS failure in a rollover or falling object accident. Missing or inoperative fire extinguisher.	C) Check for any damage to rollover/falling object protective structure. Check fire extinguisher (if located at cab).
	D) Struck by flying objects. Jammed controls. Projecting control levers.	D) Remove or secure any loose objects in cab. Avoid projections.
	E) Accident caused by poor visibility.	E) Inspect and clean windows and mirrors. Adjust mirrors if necessary.
	F) Improper seat adjustment may not allow maximum brake pedal pressure in an emergency.	F) Be sure seat is properly adjusted.
	G) Thrown against cab interior, or thrown out of the machine.	G) Make sure seat belts are provided and in good condition. BUCKLE UP!

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	H) Equipment malfunction.	H) Check all instruments and gauges to be sure they are not stuck. Make sure all controls are in neutral position, and parking brake is set.
3. Start dozer and complete pre-shift examination.	3. A) Hitting or running over persons or objects in area. Striking inside of cab if dozer moves suddenly.	3. A) Check equipment for warning tags. Be sure blade is lowered to ground. Check controls to be sure they are in neutral. Sound horn before starting or moving. Check backup alarm after start-up.
	B) Engine or auxiliary equipment malfunction.	B) Let engine run at low idle until it reaches normal operating temperature. Check gauges and warning lights again for normal readings.
	C) Engine or decelerator malfunction.	C) Check engine for smooth idle, and unusual smoke or noise. Check decelerator operation.
	D) Poor visibility. Poor operation.	D) Check wipers and lights. Check hydraulic controls.
	E) Loss of control.	E) Check brakes and steering after moving a short distance. Brakes may also be checked against partial engine power before moving, according to company policy. Check transmission operation.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. Tram dozer to work area.	4. A) Personal injury.	4. A) Do not allow anyone to ride outside the cab for any reason. No one shall ride with the operator unless safe seating facilities are provided.
	B) Running over someone.	B) Sound horn before starting to tram.
	C) Poor visibility, poor stability, overturning dozer, striking other equipment or people.	C) Observe travel area. Adjust speed for conditions. Tram with blade low (15 to 20 inches off the ground).
	D) Caught in pinch points.	D) Keep doors latched securely.
	E) Overturning dozer.	E) Travel at acceptable speeds for conditions. Avoid loose material, slick spots, and weak areas. Observe road hazards, and travel in stable areas.
	F) Loss of steering and/or brakes. Collisions.	F) Monitor gauges/indicators. Follow traffic rules.
5. Examine work area.	5. A) Falling material from highwall or fill. Loose ground.	5. A) Stop dozer a safe distance away from highwall or fresh excavations where loose material could be a hazard.
	B) Struck by moving equipment.	B) Observe area for other equipment. If leaving dozer, lower blade, set brakes, and shut-off the engine.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	C) Slipping/ tripping hazards.	C) Select firm footing, avoid slick spots. Be aware and cautious of mud, snow, ice, loose material and steep inclines.
	D) Struck by falling material.	D) Inspect working areas for: 1. Overhanging material, 2. Loose rock, 3. Vertical and horizontal cracks, 4. Boulders, trees, or other material which might fall or roll, 5. Jagged sections of highwall, 6. Undercuts, 7. Sliding or falling material, 8. Miscellaneous debris, 9. Compliance with standard procedures for degree of slope, benching, etc.
	E) Slips and falls. Hypothermia.	E) Be aware of weather changes which affect ground conditions including rain, snow, freezing, and thawing. Dress for weather conditions.
6. Clear material.	6. A) Loss of brakes, equipment damage, dozer overturning, steep slopes, operator error.	6. A) Avoid overheating brakes. Maintain dozer stability. Avoid turning sideways. Frequently check gauges to be sure fluid pressures are adequate, preventing engine shutdown and transmission shifting. Be sure you know location and use of appropriate controls.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	B) Dozer over-turning, inefficient operation, equipment damage, flying brush, caught in pinch points.	B) Keep blade down and avoid running on downed material, such as felled trees. Operate in gear consistent with the area and material being cleared. Keep doors closed and securely latched.
	C) Ground personnel struck by dozer, tree, cable, etc.	C) Frequently check location of any ground personnel to ensure they are not in path of dozer or in an area where they could be struck by flying brush, falling trees, etc.
	D) Skidding or sliding, steep slopes, striking ground person-nel, unstable ground, poor visibility.	D) Use extra caution if clearing in rain, snow, ice or other conditions that could reduce traction. Be aware of limited sight distance in fog, rain, dust, or snow; operate at lower speeds to allow quicker stops, etc.
	E) Skidding or sliding.	E) Rocks, loose material, heavy vegetation, etc., will reduce traction and cause sliding/ skidding when braking. Operate in gear consistent with material, reduce load that is being pushed and operate in direction that will provide most traction and best braking surface.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
7. Push material.	7. A) Sliding equipment. Ground failure under weight of dozer.	7. A) Be alert for ground conditions which may cause accidents; loose material, large rocks and ice can result in sliding equipment. Steep slopes, cut out areas, and freeze-thaw cycles can result in weak areas that cannot support the weight of a dozer, causing the ground to break under the dozer. Avoid these areas, or repair and compact prior to beginning work. Wear seat belts at <u>all</u> times.
	B) Striking other equipment or persons.	B) Be aware of other equipment operating in the area. Frequently check the location of other equipment. Keep lights and back-up horns in operating condition.
	C) Skidding or sliding, steep slopes, striking ground personnel, unstable ground, poor visibility.	C) Use extra caution if operating in rain, snow, ice or other conditions that could reduce traction. Be aware of limited sight distance in fog, rain, dust, or snow; operate at lower speeds to allow quicker stops, etc. Keep in mind that adverse weather can cause ground conditions to change rapidly, check for these changes and adjust operation accordingly and report them to your supervisor.
	D) Falling or sliding material, inefficient operation.	D) Frequently check highwalls and storage piles. Keep blade low, and operate in gear needed for the material being worked.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
7. (Continued)	E) Loss of braking and/or steering, equipment damage, inefficient operation.	E) While working, monitor gauges and performance for proper pressures, temperatures, and possible equipment damage. Report damaged/faulty equipment to your supervisor and have repairs made before continuing. Operate the dozer for maximum performance at all times.
	F) Overturning dozer, or going over the edge. Operator error.	F) Leave berms along edges of slopes. Concentrate on work at all times. Do not over estimate your ability or the capabilities of the dozer. DO NOT take chances. Be sure you know location and function of controls.
8. Refuel and park.	8. A) Struck by equipment, fuel spillage, fire hazard.	8. A) Park at refueling station, place controls in neutral, set brakes, lower blade until firmly seated, and shut off engine. No smoking at or near the refueling station.
	B) Slips and falls. Clothing caught on control levers or other projections.	B) Dismount dozer (see 2. A-B). DO NOT JUMP. Check surrounding area for loose material and slick spots.
	C) Fuel on skin and in eyes.	C) Take fuel hose from storage rack, remove tank cap slowly and pump fuel into tank.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
8. (Continued)	D) Trips, slips, and falls, fire hazard.	D) Avoid fuel spillage and keep area free of extraneous materials. If necessary to climb on dozer to refuel, use steps, available rails or handholds. Keep walking or standing areas free from slipping and/or stumbling hazards. Avoid fuel spillage onto hot engine parts.
	E) Fire hazard, fuel spillage or discharge.	E) Shut off fuel, remove nozzle hose, and replace fuel cap. Return hose to rack.
	F) Collision, runaway equipment, traffic obstruction.	F) Park only at designated parking areas and always set brakes. Avoid parking on inclines or haulroads. If parking on a haulroad is required, pick the safest place.
	G) Unsecured raised equip-ment, runaway equipment.	G) Lower blade to ground. Place controls in neutral position. Engage parking brake.
	H) Caught between parts of dozer.	H) Keep yourself and other personnel out of pinch points while dozer is operable.
	I) Engine damage.	I) Idle engine for a short period of time and then shut it off.
	J) Struck by other equipment.	J) Observe parking area for other moving equipment before leaving dozer. Make other operators aware of your presence.
	K) Slips and falls, clothing caught on control levers or other projections.	K) Dismount dozer (see 2. A-B). DO NOT JUMP. Check surrounding area for loose material and slick spots.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
8. (Continued)	L) Hazards due to lack of communication.	L) Always inform appropriate personnel of any abnormal conditions, defects, changes made in equipment and/or job procedure or condition.
9. Performing repairs and maintenance (if applicable).	9. A) Personal injury from improper procedure.	9. A) Do not attempt repairs or maintenance you do not understand and are not trained to do.
	B) Caught by or struck by moving or falling parts, or moving machine.	B) Do not attempt any repairs or maintenance until the power is off and the machinery is blocked against motion and all raised equipment lowered. If necessary to perform work on a raised piece of equipment, securely block in place. Remove ignition key to prevent dozer from being started while work is performed.
	C) Struck by material falling from machine.	C) Do not attempt repairs or maintenance until any material frozen to frame, blade, etc., has been removed.

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MODULE NUMBER 3
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

HAULER OPERATION

This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for hauler operation.

Haulers are one of the most widely used pieces of equipment at surface, metal/nonmetal mines. They are used for hauling ore, overburden, and spoil material. Haulers are available in a wide range of sizes, and may be designed for both on-road and off-road use, or for off-road use only.

Fatalities involving haulers most often occur when a hauler leaves a haul road and overturns, backs over the edge of an embankment when the ground at the edge fails, or runs over or backs over a person.

Accidents that occur when haulers or trucks leave the haul road may be caused by equipment failure or by driver error. Proper inspection and maintenance of braking and steering systems are especially important in preventing "loss of control" type accidents. Drivers must be attentive, and select proper gears for ascending and descending grades. Gears, retarders, and dynamic braking (diesel-electric haulers) must be used to control speed, in order to prevent excessive use of brakes.

In the event of loss of control of the hauler, the driver's chances of survival are greatly improved if a seat belt is worn. A seat belt prevents the driver from being thrown around the cab, or out of the vehicle.

In an emergency situation, drivers sometimes panic and jump out of the vehicle. Many drivers have lost their lives when jumping, by being crushed under their own machine. Drivers have the best chance of survival if they resist the impulse to jump. They are much safer in the cab, with their seat belt on. The steering wheel and emergency brake may give some control. Ironically, drivers have been killed after jumping from a hauler that later came to a stop with only minor damage, or no damage at all.

Extreme caution is required when haulers must dump over the edge of a stockpile or spoil bank. Berms or bumper blocks must be provided to help prevent over-travel. Ground conditions must be carefully inspected, and hazardous conditions corrected. If there is evidence that the ground of a dumping place may fail, haulers must dump a safe distance from the edge of the bank.

Hauler operators cannot be expected to avoid running over persons they cannot see. Everyone who works around heavy haulage machines must be aware of the very limited visibility from a hauler cab, and must stay clear of the equipment. Hauler operators can do their part, by checking around the hauler before climbing in, being alert, sounding the horn before starting or moving the hauler, keeping backup alarms working, and using mirrors and/or spotters while backing. Dust control measures must be taken where dust significantly reduces visibility of machine operators, or where respirable dust standards may be violated.

Most non-fatal injuries occur to hauler operators because of slips and falls while mounting and dismounting the hauler. Another common injury is caused by the steering wheel striking the operator, often because of rough or uneven road conditions. Both hands must be kept on the wheel, and arms should not be rested in the spokes of the steering wheel.

Mobile equipment operators must be especially cautious during bad weather. Potential hazards include slippery ladders and platforms, slippery haul roads, poor visibility, rock falls, and brake failure. Material may freeze in the hauler bed, and cause the hauler to overturn while dumping.

Modern heavy-duty haulers are carefully engineered, expensive pieces of equipment. They receive a great deal of rugged use, and may be subject to abuse. Prospective drivers should be thoroughly familiar with the hauler's mechanical features, safety controls, and emergency procedures. A sound training program for operators and maintenance personnel is essential for accident prevention with this machine. A program of regular inspection and maintenance, which outlines the daily, weekly, and monthly requirements for surface mine haulers, should be rigidly enforced at all times.

Self-propelled machines that will be used during the shift must be inspected by the machine operator before operation. Particular attention should be given to the steering and braking systems, to ensure proper working order. Headlights, horns, and backup alarm systems must function properly at all times. Seat belts must be provided and worn in haulers.

Canopy shields should extend over the hauler cab far enough to protect the operator, cab, and catwalks from damage by material spillage during loading. An indicator may be attached to the dump bed canopy to give the operator positive proof that the dump bed is in the lowered position before moving. A positive-acting, emergency braking system must be installed and maintained on all haulers.

Each hauler must be equipped with a fire extinguisher(s) and/or fire suppression system of adequate size and proper type to extinguish fires which might develop on the machine. Along with proper firefighting equipment, each mine should have access to emergency rescue equipment of a design to accommodate rescue from haulers.

Haulers are built by several different manufacturers; however, there are many similarities in operating procedures.

The basic job steps included in this module are:

1. Conduct walk-around check of hauler.
2. Mount hauler and check cab.
3. Start hauler and complete pre-shift examination.
4. Drive hauler to loading area.
5. Load the hauler.
6. Travel to dump area.
7. Dump material.
8. Drive back to loading area.
9. Refuel and park.
10. Night driving.
11. Emergency procedures.
12. Perform repairs and maintenance.

The operator's manual that is provided with the machine, and the mine's operating procedures, should also be used in training machine operators.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment

Hard hat, safety shoes, safety glasses with side shields, gloves, clothing appropriate for weather conditions, hearing protection where needed.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Conduct walk-around check of hauler.	1. A) Frostbite, hypothermia, sunburn, heat stroke, heat cramps, heat exhaustion.	1. A) Dress to suit weather conditions.
	B) Struck by moving hauler or other machine.	B) Hauler should be parked in a safe location out of the traffic pattern. If hauler is parked on a grade, check to be sure wheels are blocked and/or turned into a bank. Be alert for nearby machines.
	C) Slips or trips, struck by flying objects such as dirt or splashed fluids, caught in pinch points, high pressure fuel lines and hydraulic hoses.	C) Conduct walk-around inspection of hauler. Avoid slick spots, and keep area free of slipping or tripping hazards. Be especially careful of ruts, uneven ground, and frozen ground. Use suitable access if necessary to mount and dismount hauler to check engine or other area of machine.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	C) (Continued)	C) During walk-around inspection, check: 1) Tire and wheels for lug nuts, cracked rims, cuts, tire pressure. 2) Area around hauler for people or obstructions. 3) Suspension, steering linkage, and rock ejectors. 4) All bolts, guards, covers, and mechanical components of hauler to make sure they are in place. 5) Engine compartment for dirt, debris, oily rags, tools. Grasp engine covers firmly when removing. Avoid overreaching. Get help if needed. 6) Fluid levels. Wear safety glasses with side shields and gloves. Remove tank caps or covers carefully. 7) Hydraulic oil and coolant lines and hoses for breaks, leaks, rubbing lines or loose fittings. 8) Fire extinguisher (if one is on outside of machine) to make sure it is secured and fully charged. 9) Ladders, steps, grab bars, handrails, and walkways, for broken rungs, loose bolts, breaks, cracks, missing parts or bent and twisted steps.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	D) Sludge deposits or ice which might prevent valve operation - tank rupture from excessive pressure.	D) Bleed the air lines to release any condensation that might have accumulated, and trip the pressure relief to be sure it's operable.
2. Mount hauler and check cab.	2. A) Slips and falls. Clothing caught on control levers or other projections.	2. A) Wear snug fitting clothing. Keep ladders free of mud, ice, snow, grease, and oil.
	B) Falling from ladder.	B) Use belt hooks, pockets, etc., to carry materials up ladders and keep both hands free for climbing. Ropes can be used to hoist bulkier items. Face ladder and use three points of contact when climbing (two hands and one foot, or two feet and one hand, in contact with ladder at all times). Use handholds, and select firm footing. Avoid haste and projections.
	C) Missing or inoperative fire extinguisher. ROPS failure in a rollover.	C) Check fire extinguisher to make sure it is secured and fully charged. Check for damage the rollover protective structure (on machines equipped with ROPS).

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	D) Struck by flying objects, jammed controls, projecting control levers.	D) Remove or secure any loose objects in cab. Avoid projections.
	E) Accident caused by poor visibility.	E) Inspect and clean windows and mirrors. Adjust mirrors if necessary.
	F) Thrown against cab interior, or thrown out of the machine.	F) Make sure seat belts are provided and in good condition. Seat belts must be worn.
	G) Machine malfunction.	G) Check all instruments and gauges before start-up to be sure they aren't stuck. Make sure all controls are in neutral position and parking brake is set.
3. Start hauler and complete pre-shift examination.	3. A) Hitting or running over persons or objects in area, striking steering wheel or other parts of cab if hauler moves suddenly.	3. A) Check machine for warning tags. Check controls to be sure they are in neutral. Sound horn before starting or moving. Check backup alarm after start-up.
	B) Engine or auxiliary equipment malfunction.	B) Let engine run until it reaches normal operating temperature. Check all gauges, indicators, and warning lights again for normal readings.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	C) Engine malfunction.	C) Check engine for smooth idle, and unusual smoke or noise.
	D) Poor visibility. Poor operation.	D) Check wipers and lights. Check hydraulic controls.
	E) Emergency steering failure.	E) Check emergency steering, if equipped, as recommended by the manufacturer.
	F) Loss of control.	F) Check brakes, steering and retarder after moving a short distance. Brakes may also be checked against partial engine power before moving, according to company policy or manufacturer's recommendations. Check transmission operation.
	G) Potential hazards which remain corrected.	G) Report and, if possible, repair any defects found. Do not use machine with uncorrected safety defects. If the hauler is unsafe and removed from service, tag it to prohibit further use until repairs are completed.
4. Drive hauler to loading area.	4. A) Personal injury.	4. A) Do not allow anyone to ride outside the cab for any reason. No one should ride with the operator unless safe seating facilities are provided.
	B) Running over someone.	B) Sound horn and wait a moment before moving.
	C) Poor visibility, overturning hauler, striking other machines or people.	C) Observe travel area. Adjust speed for conditions. Follow standardized traffic rules, signals, and warning signs. Only authorized persons are permitted on haulage roads.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	D) Struck by door.	D) Keep doors securely latched.
	E) Overturning hauler, running off road.	E) Travel in proper gear at acceptable speeds for conditions. Avoid loose material, slick spots, weak areas, and other road hazards.
	F) Loss of control, running off road.	F) Be sure proper berms or guards are provided on elevated roadways. Water, debris, or spillage which create hazards must be removed from haulage roads.
	G) Loss of steering and/or brakes. Collisions.	G) Monitor gauges/ indicators. Check brakes before descending grades.
	H) Collisions - loss of control.	H) Follow other vehicles at a safe distance, and limit passing to areas of adequate clearance and visibility.
5. Loading the hauler.	5. A) Use of improper procedures. Poor communication - damage to hauler or loader.	5. A) Loading the hauler may be done by a wide range of shovels or loaders. The approach and spotting procedure will vary, depending on the type of machine used.
	B) Backing over someone.	B) Always check the mirror on the blind side, making sure of your clearance. Backing in on the blind side should be avoided where possible.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	C) Tire damage.	C) Back up as far as possible without driving on top of loose material. Try to avoid running over boulders and loose material.
	D) Struck by falling material. Bounced or shaken.	D) If your hauler has an adequate cab guard, stay in the cab while hauler is being loaded and leave your seat belt fastened. If there is a hazard from falling material, park the hauler with transmission in neutral and parking brake set. Get out and wait in a safe location.
	E) Collision with loader.	E) Wait for signal before driving off.
	F) Other machines striking oversized load.	F) If hauling any material which extends more than 4 feet beyond the rear of the hauler body, mark it clearly with a red flag by day and a red light at night.
6. Travel to dump area.	6. A) All hazards in Step 4 apply.	6. A) All procedures in Step 4 apply.
	B) Uneven loading may adversely affect handling of hauler.	B) Start slowly to get the feel of driving the loaded hauler.
	C) Loss of control, collisions.	C) Travel at speed consistent with load and roadway conditions. Follow established traffic pattern. (Loaded haulers usually travel on the inside of elevated roadways).

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	D) Someone unfamiliar with traffic pattern may be in the wrong lane.	D) Watch for traffic. Only authorized persons are permitted on haulage roads, but sightseers may ignore warning signs.
	E) Loss of control, runaway hauler.	E) Be very cautious if you must travel down steep grades with a loaded hauler. Be sure you are traveling slowly in a lower gear before starting down the grade. Use retarder or dynamic braking to maintain a slow speed.
7. Dumping material.	7. A) Rollovers caused by ground failure at dump.	7. A) When approaching the dump location, observe the entire area. You should pick a location to dump and decide on how you want to turn. Before backing, you should visually inspect the dump edge for slumping or soft spots and good berms. If there is evidence the ground may fail, dump a safe distance back from the edge.
	B) Loss of control.	B) Water, debris, or spillage which create hazards must be removed from dumping locations.
	C) Over-travel at dump.	C) While backing, observe the berm and back edge of your wheels. Once you have touched the berm, stop with your service brakes - do not use the berm as a brake. Put your transmission in neutral and set your parking brake.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
7. (Continued)	D) Spotter backed over or struck by falling material.	D) If spotters are used, they must be in the clear while haulers are backing and dumping, and must use lights at night. Spotters should wear high visibility vests.
	E) Struck by falling material.	E) Adequate protection must be provided at dumping locations where persons may be endangered by falling material.
	F) Raised bed contacting power line or obstruction. Electrocution.	F) Be sure you are aware of any overhead power lines or obstructions near dumping area.
	G) Overturning because of material stuck in bed and/or rapid accel-eration with bed raised.	G) Pull your dump lever and increase your engine rpm's to dump your load. Lower your bed as quickly as possible before pulling onto the main haul road. Pull out slowly from dump area.
	H) Rolling backward.	H) When pulling away from the dump edge, be sure to engage your transmission before releasing the parking brake.
8. Drive back to loading area.	8. A) Same as Step 4.	8. A) Same as Step 4
9. Refuel and park.	9. A) Struck by machinery. Fuel spillage, fire hazard.	9. A) Park at refueling station, place controls in neutral and set brakes. No smoking at or near the refueling station.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
9. (Continued)	B) Slips and falls, clothing caught on control levers or other projections.	B) Dismount hauler (see Job Procedures 2.A-B).
	C) Fuel on skin and in eyes.	C) Wear safety glasses. Take fuel hose from storage rack, remove tank cap slowly and pump fuel into tank.
	D) Trips, slips and falls, fire hazard.	D) Avoid fuel spillage and keep area free of extraneous materials. If necessary to climb on hauler to refuel, use access ladder, steps, available rails or handholds. Keep all walking or standing areas free from slipping and/or stumbling hazards.
	E) Fire hazard, fuel spillage or discharge.	E) Shut off fuel, remove nozzle hose, and replace fuel cap. Return hose to rack.
	F) Collision, runaway machine, traffic obstruction.	F) Park only at designated parking areas and always set brakes. Avoid parking on inclines or haul roads. If necessary to park on an incline, turn wheels into bank and/or block securely. If parking on a haul road is required, pick the safest place. Lights, flares, or other warning devices should be posted when parked machine creates a hazard to vehicular traffic.
	G) Runaway machine.	G) Place transmission in neutral position or in a gear opposite to direction of grade. Engage parking brake.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
9. (Continued)	H) Engine damage.	H) Idle engine for a short period of time and then shut it off.
	I) Slips and falls, clothing caught on control levers or other projections.	I) Dismount hauler (see Job Procedures 2.A-B).
	J) Hazards due to lack of communication.	J) Always inform appropriate personnel of any abnormal conditions, defects, changes made in machine, and/or job procedure or condition.
10. Night driving.	10. A) Poor vision, collisions.	10. A) During your pre-shift inspection clean your windows, lights, and mirrors and be sure your wipers are in good condition.
	B) Striking or being struck by other machines.	B) In loading area, be aware of the light locations on all machines. For example, the shovel counterweight or rear portion of the shovel house may not be visible after dark.
	C) Collisions.	C) Meeting on-coming haulers with only headlights may present problems, because these lights may not indicate the true width of the hauler.
	D) Missed dumps.	D) If you are not sure of the dump edge stability or location of your rear tires in relation to the edge, then dump on top away from the edge.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
11. Emergency procedures.	11. A) Fire, (engine compartment), burns, entrapment.	11. A) 1. Stop hauler. 2) Shut down engine (very important) to stop the fan and hydraulic pump. Set brake. 3) Activate fire suppression system if available. 4) Use fire extinguisher to extinguish small fire or aid escape from large fire. 5) Leave the operator's cab and climb down the ladder. 6) Do not jump down unless the fire has covered the ladder areas. 7) Notify foreman/obtain firefighting assistance.
	B) Runaway (brake or retarder failure on downhill haul).	B) 1) Attempt to control speed with the brakes or retarder, whichever is working. 2) Notify foreman and other drivers of your condition, if possible. 3) Steer onto a "run out berm" or "straddle berm". 4) Do not jump from hauler.
	C) Collision with other hauler or small vehicle.	C) 1) Stop hauler if not already stopped in collision, and park securely out of traffic pattern if possible. 2) Notify foreman immediately if hauler is equipped with radio. 3) Leave cab if possible. Assist with first aid to others. 4) Make periodic fire checks.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
11. (Continued)	D) Dump edge failure, rear of hauler slips off.	D) 1) Engage front brakes if slippery road switch is activated. Set park brakes if not already done. 2) Hauler will usually stop sliding once the under carriage drags on the edge of the dump. 3) Stay in the cab until the machine stops sliding then carefully climb down. 4) Notify foreman.
	E) Hauler goes into skid on ice, snow, or mud.	E) 1) Do not apply service brakes during skid. 2) Turn front wheels into direction of skid. 3) "Power out" of skid by increasing engine rpm's. Do not over-speed engine. Notify other drivers of loss of control hazard.
12. Performing repairs and maintenance (if applicable).	12. A) Personal injury from improper procedure.	12. A) Do not attempt repairs or maintenance you do not understand, and are not trained to do.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
12. (Continued)	B) Caught by or struck by moving or falling parts, or moving machine.	B) Do not attempt any repairs or maintenance until the power is off, the machinery is blocked against motion, and all raised equipment lowered. If necessary to perform work on top of, under, around, or from a raised piece of equipment, block or mechanically secure the equipment to prevent accidental rolling, falling, or lowering. Remove ignition key to prevent hauler from being started while work is performed. Tag out machine.
	C) Towed machine running away or overtaking towing equipment.	C) If a machine must be towed, a properly sized tow bar or equivalent must be used. Unless steering and braking are under the control of an operator on the towed machine, a suitable safety chain or wire rope must be used along with primary rigging.
	D) Caught in pinch points.	D) Repairs to lines or hoses under pressure should not be done until pressure is relieved from a safe location. Securely block any raised equipment if you must be under it to relieve pressure.

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MODULE NUMBER 4
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

PAN SCRAPER OPERATION

This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for pan scraper operation.

Pan scrapers are used at surface metal and nonmetal mines for removing and spreading top soil, which is necessary for reclamation purposes; and for selectively removing and hauling ore or waste material. Scrapers are designed for operation on level, or relatively even terrain, and are generally used in the open pit mining system.

Pan scraper operators must be aware of some of the same general types of hazards as other mobile equipment operators, such as slips and falls, overturning, and collisions.

Slips and falls most often occur when mounting and dismounting, refueling, and cleaning windows or mirrors. Overturning can occur due to excessive speed for conditions, inadequate roadway width, traveling too close to roadway edges, lack of roadway berms, loss of control, etc. Collisions can be caused by failure to yield right of way, restricted visibility, and improper roadway width.

Self-propelled machines that will be used during a shift must be inspected by the machine operator before operation. Particular attention should be given to the steering and braking systems to ensure proper working order. Headlights, horns, and backup alarm systems must function properly at all times. Seat belts must be provided and worn.

The basic job steps included in this module are:

1. Conduct walk-around check of scraper.
2. Mount scraper and check cab.
3. Start scraper and complete pre-shift examination.
4. General operation.
5. Load material.
6. Push other equipment.
7. Haul material.
8. Operate on grades.
9. Refuel and park.
10. Perform repairs and maintenance.

The operator's manual provided with the machine, and the mine's operating procedures, should also be used in training machine operators.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment:

Hard hat, safety shoes, safety glasses with side shields, gloves, clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Conduct walk-around check of scraper	1. A) Frostbite, hypothermia, sunburn, heat stroke, heat cramps, heat exhaustion.	1. A) Dress to suit weather conditions.
	B) Struck by moving scraper or other equipment.	B) Check to be sure scraper bowl is lowered to ground and, if parked on a grade, that wheels are blocked and/or turned into a bank. Be alert for nearby equipment.
	C) Slips or trips, struck by flying objects such as dirt or splashed fluids, caught in pinch points.	C) Avoid slick spots and keep area free of slipping or tripping hazards. Use suitable access if necessary to mount and dismount scraper to check engine or other area of machine.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	C) (Continued)	When conducting walk-around inspection, check: 1. Tires and wheels for lug nuts, cracked rims, cuts, tire pressure. 2. Area around scraper for people or obstructions. 3. All bolts, guards, covers, and mechanical components of scraper to make sure they are in place. 4. Engine compartment for dirt, debris, oily rags, tools. Grasp engine covers firmly when removing. Avoid over-reaching. Get help if needed. 5. Fluid levels. Wear safety glasses with side shields and gloves. 6. Hydraulic oil and coolant lines and hoses for breaks, leaks, rubbing lines or loose fittings, especially in the pivot area. 7. Fire extinguisher (if on outside of machine) to make sure it's in place and fully charged. 8. Gooseneck for loose pins or cracks. 9. Ladders and steps, for loose bolts, breaks, cracks, or missing parts.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	D) Sludge deposits or ice which might prevent valve operation. Tank rupture from excessive pressure.	D) Bleed the air lines to release any condensation that might have accumulated, and trip the pressure relief valve to be sure it's operable.
	E) Uncorrected potential hazards.	E) Report and, if possible, repair any defects found. Do not use equipment with uncorrected safety defects.
2. Mount scraper and check cab.	2. A) Slips and falls, clothing caught on control levers or other projections.	2. A) Wear snug fitting clothing. Keep steps and boots free of mud, ice, snow, grease, and oil.
	B) Falling from machine.	B) Use belt hooks, pockets, etc., to carry materials up to cab, and keep both hands free for climbing. Ropes can be used to hoist bulkier items. Face ladder and use three points of contact when climbing (two hands and one foot, or two feet and one hand, in contact with ladder at all times). Use handholds and select firm footing. Avoid haste and projections.
	C) ROPS/FOPS failure in a rollover or falling object accident. Missing or inoperative fire extinguisher.	C) Check for any damage to rollover/falling object protective structure. Check fire extinguisher (if located at cab).

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	D) Struck by flying objects, jammed controls, projecting control levers.	D) Remove or secure any loose objects in cab. Avoid projections.
	E) Accident caused by poor visibility.	E) Inspect and clean windows and mirrors. Adjust mirrors if necessary.
	F) Thrown against cab interior or thrown out of the machine.	F) Make sure seat belts are provided and in good condition. BUCKLE UP!
	G) Equipment malfunction.	G) Check all instruments and gauges to be sure they aren't stuck. Make sure all controls are in neutral position and parking brake is set.
	H) Steering failure in an emergency.	H) Test emergency steering to make sure it is functioning properly.
3. Start scraper and complete pre-shift examination.	3. A) Hitting or running over persons or objects in area, striking steering wheel or other parts of cab if scraper moves suddenly.	3. A) Check equipment for warning tags. Be sure bowl is lowered to ground. Check controls to be sure they are in neutral. Sound horn before starting or moving. Check backup alarm after start-up.
	B) Engine or auxiliary equipment malfunction.	B) Let engine run at low idle until it reaches normal operating temperature. Check gauges and warning lights again for normal readings.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	C) Engine malfunction.	C) Check engine for smooth idle and unusual smoke or noise.
	D) Poor visibility. Poor operation.	D) Check wipers, lights, and hydraulic controls.
	E) Loss of control.	E) Check brakes, retarder and steering after moving a short distance. Brakes may also be checked against partial engine power before moving, according to company policy. Check transmission operation.
4. General operation.	4. A) Personal injury.	4. A) Do not allow anyone to ride outside the cab for any reason. No one shall ride with the operator unless safe seating facilities are provided.
	B) Overturning and/or collision.	B) Keep your machine under control at all times. Use prudent operating speeds consistent with conditions present. Do not coast.
	C) Overturning, bank or roadway failure.	C) Use extreme care to avoid tipping when working on hills, banks, top soil, stockpiles, or slopes. Do not get on excessive side grades. Stay a safe distance from edge of pit and slide areas.
	D) Overturning, loss of control.	D) Use extreme caution when crossing side hills, ridges, ditches, and other obstructions. Cross ditches and side hills at an angle and proceed slowly.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	E) Collision with embankment. Overturning.	E) Slow down before turning. Do not cut a corner too close when making a sharp turn. Allow enough clearance. Never turn sharply uphill or downhill.
5. Loading of material.	5. A) Loss of control.	5. A) Approach cut at reduced speed.
	B) Equipment damage.	B) Avoid excessive spinning of wheels.
	C) Loss of control, overturning.	C) Always carry the load as low as conditions permit to maintain stability.
6. Pushing other equipment.	6. A) Jack-knifing, loss of control.	6. A) Maintain alignment during pushing.
	B) Loss of control, equipment damage.	B) Make sure there is a coordination of signals between vehicles when pushing.
7. Hauling material.	7. A) Loss of control, bank or roadway failure.	7. A) Avoid large obstacles, deep holes, and soft edges.
	B) Collision.	B) Passing equipment should be done only where there is adequate clearance and visibility. Follow at a safe distance.
	C) Collision.	C) Follow traffic patterns and yield right of way to loaded haulage vehicles.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
7. (Continued)	D) Striking people, other equipment, obstructions, etc.	D) Use headlights in case of poor visibility such as fog, rain, snow, and at sundown.
	E) Loss of control, collision.	E) Traffic rules, signals, and warning signs must be followed at all times.
	F) Backing over persons, embankments, or striking other equipment or objects.	F) Be extra cautious when backing up. Blind spots may hinder your rear vision.
8. Operation on grades.	8. A) Loss of control, equipment damage.	8. A) Always anticipate grades and select proper gear range accordingly. Do not coast.
	B) Brake failure.	B) Avoid applying brake continuously on a long downgrade unless system is so designed.
	C) Equipment damage, loss of control.	C) Downshift one speed range at a time. Downshift only when scraper speed has decreased to proper speed range.
	D) Loss of control.	D) Downshift if necessary for an upgrade to avoid stalling the engine.
	E) Brake failure.	E) Use brakes firmly in one application. Avoid pumping the brake pedal. Repeated light applications of the brake may exhaust the air pressure.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
8. (Continued)	F) Loss of control.	F) Avoid sudden application of the brakes, which may cause a skid. On steep grades, drag or drop the bowl to help control descent or stop in an emergency.
9. Refuel and park.	9. A) Struck by equipment, fuel spillage, fire hazard.	9. A) Park at refueling station, place controls in neutral, and set brakes. No smoking at or near the refueling station.
	B) Slips and falls, clothing caught on control levers or other projections.	B) Dismount scraper (see Job Procedures 2. A-B). DO NOT JUMP. Check surrounding area for loose material and slick spots.
	C) Fuel on skin and in eyes.	C) Take fuel hose from storage rack, remove tank cap slowly, and pump fuel into tank.
	D) Trips, slips, and falls, fire hazard.	D) Avoid fuel spillage and keep area free of extraneous materials. If necessary to climb on scraper to refuel, use steps, available rails, or handholds. Keep walking or standing areas free from slipping and/or stumbling hazards. Avoid fuel spillage onto hot engine parts.
	E) Fire hazard, fuel spillage or discharge.	E) Shut off fuel, remove nozzle hose, and replace fuel cap. Return hose to rack.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
9. (Continued)	F) Collision, runaway equipment, traffic obstruction.	F) Park only at designated parking areas and always set brakes. Avoid parking on inclines or haulroads. If necessary to park on an incline, turn wheels into bank and/or block securely. If parking on a haulroad is required, pick the safest place.
	G) Unsecured raised equipment, runaway equipment.	G) Lower scraper bowl to ground and fully retract ejector. Place controls in neutral position. Engage parking brake.
	H) Engine damage.	H) Idle engine for a short period of time and then shut it off.
	I) Struck by other equipment.	I) Observe parking area for other moving equipment before leaving scraper. Make other operators aware of your presence.
	J) Slips and falls, clothing caught on control levers or other projections.	J) Dismount scraper (see Job Procedures 2. A-B). DO NOT JUMP. Check surrounding area for loose material and slick spots.
	K) Engine damage.	K) Shut off rear engine if applicable.
	L) Hazards due to lack of communication.	L) Always inform appropriate personnel of any abnormal conditions, defects, changes made in equipment and/or job procedure or condition.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
10. Performing repairs and maintenance (if applicable).	10. A) Personal injury from improper procedure.	10. A) Do not attempt repairs or maintenance you do not understand and have not been trained to do.
	B) Caught by or struck by moving or falling parts, or moving machine.	B) Do not attempt any repairs or maintenance until the power is off and the machinery is blocked against motion, and all raised equipment lowered. If necessary to perform work on, or from, a raised piece of equipment, securely block in place. Remove ignition key to prevent scraper from being started while work is performed.
	C) Struck by material falling from machine.	C) Do not attempt repairs or maintenance until any material frozen to frame or bowl has been removed.

GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the surface metal and nonmetal mining industry in conducting effective on-the-job training (OJT) of new employees, or employees reassigned to different jobs. The use of training materials, such as this module, is an important part of an effective, systematic, OJT program.

This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs," June, 1983.

TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site where the work will be done.

The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step – explaining the job to the employee – can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom or a quiet office for the first part of the training. Any general theory or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

MODULE NUMBER 5
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

BACKHOE AND HYDRAULIC EXCAVATOR OPERATION

This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for backhoe and hydraulic excavator operation.

Backhoes are used at surface metal and nonmetal mines for various types of applications. Their versatility makes these machines widely used pieces of mobile equipment. Backhoes were designed basically for ditching and cleanup. Their use has been broadened to include removal and loading of ore and overburden material by large backhoes, known as hydraulic excavators.

Backhoe operators must be aware of some of the same general types of hazards as other mobile equipment operators. Many job procedures and related hazards are common to the operation of all mobile equipment.

The most common hazards related to backhoe and excavator operation are: slipping and falling of the machine operator, tipping or overturning of the machine, and contacting energized power lines with the machine.

Slips and falls occur most often when mounting and dismounting, cleaning windows, or refueling. Tipping or overturning can occur if the machine is not properly leveled, if materials are lifted or handled improperly, or when traveling or operating without proper care for roadway conditions, grades, clearance, visibility, traffic, etc. Contacting energized power lines is most often caused by operating the machine too close to electrical lines or installations.

The basic job steps included in this module are:

1. Conduct walk-around check of backhoe or excavator.
2. Mount backhoe or excavator, and check cab and controls.
3. Start backhoe or excavator, and complete pre-shift inspection.
4. General operation of backhoe or excavator.
5. Park backhoe or excavator.
6. Refuel backhoe or excavator.
7. Perform repairs and maintenance on backhoe or excavator.

The operator's manual provided with the machine, and the mine's operating procedures, should also be used in training machine operators.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment:

Hard hat, safety shoes, safety glasses with side shields, gloves, clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Conduct walk-around check of backhoe.	1. A) Frostbite, hypothermia, sunburn, heat stroke, heat cramps, heat exhaustion.	1. A) Dress to suit weather conditions.
	B) Struck by falling equipment.	B) Make sure all raised parts of backhoe are lowered to the ground.
	C) Struck by, or run over by, backhoe or other machine. Slipping, tripping, falling.	C) If parked on a grade or incline, make sure wheels are turned into bank and/or blocked to prevent movement. Be alert for nearby machines.
	D) Slips or trips, struck by flying objects such as dirt or splashed fluids, caught in pinch points.	D) Avoid slick spots and keep area free of slipping or tripping hazards during walk-around. Use suitable access if necessary to mount and dismount backhoe to check engine or other area of machine.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	E) Check for problems that could cause the following hazards:	E) Examine:
	1) Loss of control, equipment malfunction.	1) Tires and wheels for lug nuts, cracked rims, cuts, tire pressure. If equipped with tracks, check tracks for tightness and rollers, idlers, and sprockets for damage.
	2) Running over someone.	2) Area around backhoe for people or obstructions.
	3) Caught in moving parts.	3) All bolts, guards, covers, and mechanical components of backhoe to make sure they are in place.
	4) Equipment malfunction or damage, fire hazard.	4) Engine compartment for dirt, debris, oily rags, tools, and leaks. Grasp engine covers firmly when removing. Avoid overreaching. Get help if needed.
	5) Burns, splashed fluids	5) Fluid levels. Wear safety glasses with side shields and gloves. Remove tank caps or covers carefully.
	6) Burns, high pressure fluids.	6) Hydraulic oil, coolant, and air leaks, rubbing lines, cracks or loose fittings.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	7) Fire hazard.	7) Fire extinguisher (if on outside of machine) to make sure it's secured in place and fully charged.
	8) Equipment failure.	8) Machine for any physical damage, hydraulic cylinders and hoses for leaks and/or damage, boom or lift arms for cracks or damage.
	9) Slips and falls.	9) Ladders, steps, and handholds for broken rungs, loose bolts, breaks, cracks, or missing parts.
	F) Potential hazards not corrected.	F) Report and, if possible, repair any defects found. Do not use machine with uncorrected safety defects.
2. Mount backhoe and check cab and controls.	2. A) Slips and falls.	2. A) Wear snug fitting clothing and keep steps, mounting ladders, and shoes free from mud, dirt, snow, ice, grease, and oil. On track mounted backhoe, make sure cab is positioned correctly for mounting and walkways around engine and hydraulic enclosures are free from debris and slipping or stumbling hazards. Make sure grab rails or handholds are provided and in good condition.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	B) Falling while climbing up or down, clothing caught on control levers or other projections.	B) Keep both hands free for climbing. Use handholds and select firm footing. Avoid haste and projections.
	C) Struck by flying objects, jammed controls, ROPS or FOPS failure in an accident, poor visibility.	C) Inspect cab for housekeeping (extraneous materials) and FOPS or ROPS damage. Make sure windows and mirrors are clean and in good repair.
	D) Personal injury, missing or inoperative fire extinguisher.	D) Check fire extinguisher if located at cab. Make sure starting fluid is not stored inside cab.
	E) Thrown out of cab or against cab interior.	E) Check seat belts to be sure they are in good condition. Always wear them when operating equipment.
	F) Equipment failure or rolling out of control.	F) Check all instruments, gauges, and controls before starting engine to ensure they are not stuck or malfunctioning. All controls should be in neutral position and the parking brake set.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. Start backhoe and complete pre-shift inspection.	3. A) Operating with safety or mechanical defects, struck by moving parts, or backing over person.	3. A) Check equipment for warning or out of service tags. Sound horn before starting or moving machine. Check backup alarm after starting. Be sure all persons and objects are clear before starting or moving.
	B) Engine or auxiliary equipment malfunction.	B) After starting engine, idle until normal operating temperature is reached and check gauges and warning lights again for normal readings. Check engine for smooth idle and unusual smoke or noise.
	C) Poor visibility.	C) Check lights and wipers.
	D) Loss of control.	D) Check brakes (including swing brake) and steering. Don't operate machine with uncorrected safety defects.
4. General operation.	4. A) Personal injury.	4. A) Allow no one to ride outside the cab for any reason. No one should ride with the operator unless safe seating is provided.
	B) Personal injury, falling hazard.	B) Never use basket or other attachment as a staging platform for workers.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	C) Overturning and/or collision.	C) Keep machine under control at all times. Use prudent operating speeds consistent with conditions.
	D) Loss of control.	D) Never attempt to operate backhoe from outside operator's compartment.
	E) Bystanders may not consider the swing radius at the rear of larger machines.	E) Be sure all persons and obstacles are clear before swinging or moving machine in any direction. Always have adequate clearance before swinging machine.
	F) Tipping and/or overturning.	F) Avoid fast swings, hoists, or sudden braking. Be sure of the working range and lifting capacity of the machine at all times. Move loads carefully. Be alert for trenches, open cuts, sump holes, coal rib, clearances, grades, etc. Keep machine as level as possible when operating.
	G) Fall of material, overturning machine.	G) Observe highwall, pit, and/or travel conditions. Stay away from edge of banks, pits, and highwalls. Stay clear of overhangs and slide areas. Never undercut the machine.
	H) Collision.	H) Know traffic patterns of the job location and obey flaggers, road signals, and signs.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	I) Electrocution.	I) Always check for overhead power lines and be sure you have adequate clearance if working near overhead lines. Keep boom at least 10 feet from any energized power line. High voltages may dictate distances up to 35 feet.
	J) Property damage, fire or explosion, electrocution.	J) Learn beforehand as much about your work area as possible. Be sure of the location of gas lines, sewers, utility lines, buried cables or lines.
	K) Dropping material on hauler operator or bystanders, damaging hauler, excessive spillage.	K) Don't load a hauler until the driver is in a safe place. Load the hauler from the rear or side. Load hauler evenly to avoid overloading rear axles and causing spillage. Don't drop material into truck bed from unnecessary heights. Never swing bucket over hauler cab or workers.
	L) Backing over person.	L) Never back up until you have checked to see that area is clear of personnel and/or obstructions.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	M) Tipping, over-turning, collision.	M) Use caution when working on, or crossing, sidehills, ridges, ditches, slopes, etc. Cross at an angle and at reduced speed. Except for short distances, position boom in direction of travel. Always face the direction of travel.
	N) Cable damage, shock or burns.	N) Don't cross power and/or trailing cables unless suitable crossovers or cross-unders are provided, or the cable is properly trenched.
	O) Loss of control.	O) Always set swing brake and/or lock boom when traveling to or from a job site.
	P) Loss of control, machine damage.	P) Always keep your machine under control and in safe operating condition at all times.
5. Parking.	5. A) Collision, personal injury, traffic obstruction.	5. A) Always park in designated parking area if provided or select a safe parking area. Don't park on haul roads or active work areas. If you must park in an emergency, pick the safest place and use warning signals, flares, or barriers.
	B) Struck by equipment.	B) If necessary to park on an incline, block against motion and/or turn toward embankment.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	C) Struck by machine, material, or attachment.	C) Never leave the operator's cab with the engine running or with a load or bucket suspended.
	D) Run over or struck by machine.	D) Place all controls in parking position. Set swing lock or brake and parking or traction brake or lock to prevent machine movement.
	E) Engine damage.	E) Idle engine a short period before shut down.
	F) Trips, slips and falls, clothing caught on controls or projections.	F) Dismount machine. Pay attention to travelways.
	G) Hazards due to lack of communication.	G) Always inform appropriate personnel of any abnormal conditions, defects, changes made in machine and/or job procedure or condition.
6. Refueling.	6. A) Collision, runaway equipment, traffic obstruction.	6. A) If refueling, park at fuel station and follow parking procedure (See Job Procedures 5. A-G).
	B) Slips, trips and falls, clothing caught.	B) If necessary to mount backhoe to refuel, use ladder, steps, rails, or handholds (See Job Procedures 2. A-B).
	C) Fuel on skin or in eyes.	C) Wear safety glasses. Remove fuel cap slowly.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	D) Fire or explosion hazard.	D) Avoid fuel spillage at refueling station and on hot engine parts. Do not smoke at or near the refueling station.
	E) Slips, trips, falls.	E) Keep refueling area free from extraneous material.
	F) Fuel spillage or discharge, fire hazard.	F) Always replace fuel cap on backhoe and return fuel hose and nozzle to the rack.
7. Performing repairs and maintenance (if applicable).	7. A) Personal injury from improper procedure.	7. A) Do not attempt repairs or maintenance you are not trained to do.
	B) Caught or struck by moving or falling parts, or moving machine.	B) Do not attempt any repairs or maintenance until the power is off, the machinery is blocked against motion, and all raised equipment lowered. If necessary to perform work on a raised piece of equipment, securely block in place. Remove ignition key to prevent backhoe from being started while work is performed.
	C) Caught in or struck by moving parts.	C) Replace all guards and other safety devices before starting or using backhoe.

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On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site where the work will be done.

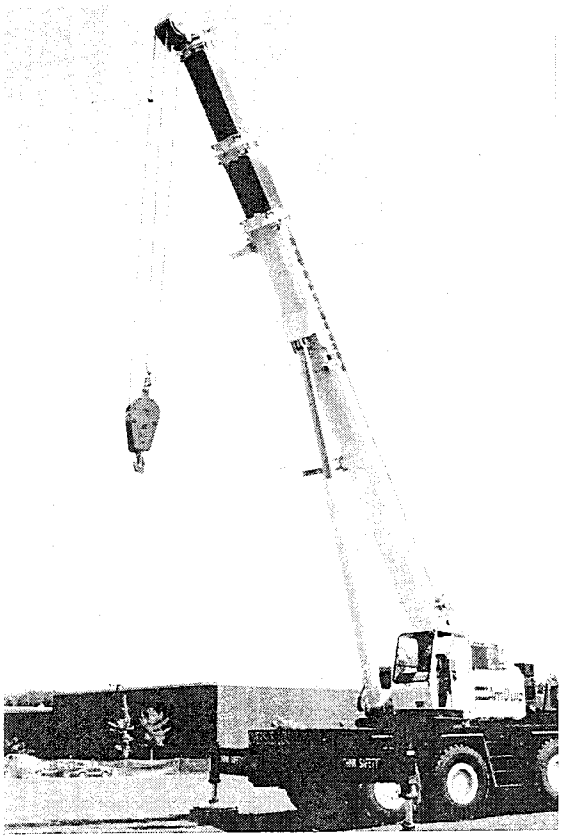
The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step – explaining the job to the employee – can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom or a quiet office for the first part of the training. Any general theory or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

MODULE NUMBER 6
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

MOBILE CRANE OPERATION



This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for mobile crane operation. Much of the material in Module 3, "Hauler Operation," may also be used in the "truck driving" portion of training for operators of truck mounted cranes.

Mobile cranes (both truck cranes and crawler cranes) are used at surface metal and nonmetal mines for various types of applications. Mobile cranes are most frequently used for hoisting and placing parts during the assembly and maintenance of large mining machines, mine/mill facilities, and buildings. Cranes are used with a breaker ball at some locations for breaking oversize boulders before loading. They are also used to hoist and move stone blocks at dimension stone operations. Mobile crane operators have a heavy responsibility for the safety of persons and equipment. A ground person (rigger) or ground crew is usually present, and can be injured if the operator makes mistakes. The loads that are handled may be expensive and fragile. Cranes often operate close to buildings or other machines. The job demands top skills, good judgement, and thorough training.

The safe operation of a crane requires careful selection and training of operators and maintenance personnel. Only trained and qualified persons should be permitted to operate cranes. Training should include a thorough review of the operating characteristics of the equipment, its limitations, and the hazards of improper usage. Operators must be thoroughly trained in safe procedures for operating the crane and handling loads.

Most accidents related to crane operations involve falling, dropped, or swinging loads. Slings and other fastenings sometimes break or slip off. Overturning the crane is, of course, extremely dangerous and damaging, as is boom collapse. Crane operators must be alert for power lines and other overhead obstructions. Operators are also subject to slipping and falling while mounting and dismounting, cleaning windows, inspecting the machine, and refueling. Ground personnel can be caught in rigging if the crane operator begins hoisting while they are still making adjustments.

Standardized signaling between the ground person and crane operator is very important to safe operation. Taglines must be attached to loads that may require steadying or guidance while suspended. Hitches and slings must be suitable for the particular material handled. Everyone, including the ground crew, must stay clear of suspended loads.

Serious hazards include overloading, dropping or slipping of the load caused by improper hitching or slinging, obstruction to free passage of the load, and using the machine for a purpose for which it was not intended or designed.

No one is permitted to ride on loads or hoisting hooks except in certain unusual situations where this method eliminates a greater hazard. If persons must be lifted, safety precautions specified in ANSI/ASME Standard B30.5 must be taken. Standard B30.5, "Mobile and Locomotive Cranes", is published by the American Society of Mechanical Engineers.

Chains, slings, ropes, or tongs are used to fasten the load for lifting. The lifting ability of a crane depends primarily on balance, rather than engine power. Cranes are more efficient than other machines for most hoisting work because: (1) they do not carry the dead weight of a bucket and other digging parts, (2) slower and smoother lifting can be achieved by increasing the number of lines, and (3) the operator has a better view of the hook and the load.

A crane can lift maximum loads only if the boom is held high enough to keep the load close to the crane. A crane can handle lesser loads with greater safety and convenience if the loads are close enough so that there is no question about stability. It is therefore customary to operate cranes with their booms held high. This practice does, however, involve two dangers - the boom falling over backwards; and overturning the crane by abrupt swinging.

The basic job steps included in this module are:

1. Conduct walk-around check of crane.
2. Mount crane and check cab.
3. Start crane and complete pre-shift examination.
4. General operation.
5. Lift, transport, and lower material.
6. Load and move crane.
7. Use of breaker ball.
8. Use of magnet.
9. Shutdown procedures.
10. Perform maintenance and repairs.

The operator's manual provided with the machine, and the mine's operating procedures, should also be used in training machine operators.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment:

Hard hat, safety shoes, safety glasses with side shields, gloves, clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Conduct walk-around check of crane.	1. A) Frostbite, hypothermia, sunburn, heat stroke, heat cramps, heat exhaustion.	1. A) Dress to suit weather conditions.
	B) Slips or trips, struck by flying objects such as dirt or splashed fluids, mechanical hazards.	B) Be aware of slick spots and debris while making safety checks. Be especially careful of ruts, uneven ground, and frozen ground. Use suitable access if necessary to mount and dismount crane to check engine or other area of machine.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	B) (Continued)	Check: 1) tires and wheels on truck mounted cranes for lug nuts, cracked rims, cuts, tire pressure, embedded stones, or abnormal wear. 2) tracks on crawler cranes for tightness and rollers, idlers, and sprockets for damage. 3) area around, under, and on crane for people or obstructions. 4) bolts, guards, covers, safety devices, and mechanical components of crane to make sure they are in place. 5) visually for oil leaks. 6) engine compartment for dirt, debris, oily rags, tools. Grasp engine covers firmly when removing. Get help if needed. 7) fluid levels. Wear safety glasses with side shields and gloves. 8) hydraulic oil and coolant lines and hoses for breaks, leaks, rubbing lines or loose fittings. Pay particular attention to hydraulic hoses which flex in normal operation of crane. 9) fire extinguisher (if on outside of machine) to make sure it's fully charged. 10) bolts and pins for looseness or excessive wear. 11) wire ropes for obvious frays, kinks, or broken strands.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	B) (Continued)	12) wire rope terminations and sheaves, drums and rollers for improper installation, wear and damage. 13) load hooks for damage, cracks, spreading, or twisting. 14) surrounding area where crane is parked by checking; (a) clearances under bridges, overhead lines, or any overhead obstruction, (b) side clearance, when tight, to be sure there is clearance for tail swing. 15) ladders, steps, handholds, and handrails for loose bolts, breaks, cracks, missing parts, or bent and twisted steps.
	C) Sludge deposits or ice which might prevent valve operation - tank rupture from excessive pressure.	C) If your truck mounted crane has air brakes, bleed the air lines to release any condensation that might have accumulated and trip the pressure relief to be sure it's operable.
	D) Potential hazards going uncorrected.	D) Report and, if possible, repair any defects found. Do not use machine with uncorrected safety defects.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. Mount crane and check cab. NOTE: Check truck cab prior to driving truck mounted cranes. Check crane cab prior to operating crane.	2. A) Slips and falls, clothing caught on control levers or other projections.	2. A) Wear snug fitting clothing. Keep ladders and boots free of mud, ice, snow, grease, and oil.
	B) Falling from ladder.	B) Use belt hooks, pockets, etc., for carrying materials up to cab and keep both hands free for climbing. Ropes can be used to hoist bulkier items. Face ladder and use three points of contact when climbing (two hands and one foot, or two feet and one hand, in contact with ladder at all times). Take only one step at a time. Use grab rails or handholds and select firm footing.
	C) Being thrown from ladder, struck by machine.	C) Notify operator when mounting machine that is already in operation. Do not get on or off a moving crane.
	D) Tripping, slipping and stumbling hazards.	D) Keep the cab, deck, footholds and handholds free of mud, ice, snow, grease, and oil.
	E) Missing or inoperative fire extinguisher.	E) Check fire extinguisher.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	F) Struck by flying objects, jammed controls, projecting control levers.	F) Remove or secure any loose objects in cab. Avoid projections.
	G) Accident caused by poor visibility.	G) Inspect and clean windows. (Clean and adjust mirrors if applicable.)
	H) Machine malfunction.	H) Check all instruments and gauges before start-up to be sure they aren't stuck. Make sure all controls are in the proper shutdown position.
3. Start crane and complete pre-shift examination.	3. A) Hitting or running over persons or objects in area, striking interior of cab if crane moves suddenly.	3. A) Check machine for warning tags. Check controls to be sure they are properly positioned. Warn any members of nearby work crews that you are starting your machine by sounding start-up signal. Check backup alarm (if applicable) after start-up.
	B) Engine or auxiliary equipment malfunction.	B) Let engine run until it reaches normal operating temperature. Check all gauges, indicators, and warning lights again for normal readings.
	C) Loss of control, improper operation.	C) Test all controls to be sure they are properly adjusted according to manufacturer's recommendations.
	D) Electrocution.	D) Be cautious of overhead power lines at all times. Pay particular attention to clearance.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	E) Thrown against cab interior or thrown out of the machine.	E) When driving truck mounted cranes, wear seat belts (if provided).
4. General operation.	4. A) Overloading, tipping the crane.	4. A) Know the rated capacity of your crane for various boom angles, and be sure to check boom angle indicator. When figuring the weight of the load be sure to include the weight of the hook, block, or any material handling device such as a concrete block, magnet, etc. Safe ratings are based on operating the machine on firm, level ground.
	B) Overloading.	B) Determine (if possible) the weight of the load, or estimate it, before lifting.
	C) Tipping the crane.	C) Check stability before lifting loads. Ensure the outriggers are firmly positioned on solid surfaces, crane is level, brakes are set, and load is properly rigged. Lift load slightly off the ground and confirm stability before hoisting further.
	D) Tipping the crane, overloading.	D) Do not operate crane too fast. Avoid fast swings, hoists or sudden breaking.
	E) Dropping load, tipping the crane.	E) Lift only the proper types of materials. Do not handle large heavy loads in strong winds, as the wind could create an unstable condition.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	F) Fall to ground. Crushed against a stationary object.	F) Do not allow anyone to ride the load or load hook.
	G) Striking nearby personnel or equipment.	G) Make a "dry run" in tight areas to help determine the safest way to operate under existing conditions.
	H) Electrocution, electric shock, fires.	H) Keep boom away from overhead lines. NEVER ALLOW ANY PORTION OF THE MACHINE OR LOAD TO PASS WITHIN 10 FEET OF AN ENERGIZED HIGH VOLTAGE POWER LINE. Consider every overhead line energized until the power company states otherwise. If you do hit a power line, remember: 1) Stay inside cab, if possible, until line is cleared or power is shut off. 2) Warn all persons in the area to keep clear of the crane and the suspended load. 3) If you must leave the cab, such as in the event of a fire, be sure to jump clear of the machine. Do not contact any part of the machine or the load.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. Lifting, transporting, and lowering material.	5. A) Catching ground personnel in pinch points, dropping load, striking personnel or obstructions.	5. A) Be certain that proper signal procedures are established between ground personnel (hookman) and crane operator. Crane operator should communicate with only one signal person; however, crane operator should observe any stop or emergency signal.
	B) Caught in pinch point, struck by dropped or swinging load.	B) Ground personnel must ensure proper rigging, stay out of pinch points, and stay clear of hoisted loads. Tag lines permit steadying or guiding a load from a safe distance.
	C) Dropping load, setting load on persons or obstructions.	C) Ensure the area beneath the load is clear of all obstructions and personnel. Make sure the load is well secured and that lines are not kinked.
	D) Boom failure or damage.	D) Make sure the hoist line is vertical. Do not make side loadings.
	E) Overloading, overturning, losing control of load, machine damage.	E) Avoid sudden starts and stops. Keep speeds low when lifting and lowering loads.
	F) Additional strain on rigging, rigging coming off hook, hazards in hooking and unhooking loads.	F) Do not hoist two or more separately rigged loads in one lift, even though the combined load is within the crane's capacity.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	G) Overheating hoist brake, losing control of load.	G) When lowering load always use "power-controlled lowering", if possible. When lowering heavy loads, keep hoist brake as a reserve.
	H) Boom or jib damage or failure.	H) Avoid boom or jib "whipping". Do not let load strike boom or outriggers. Avoid hitting nearby structures with boom.
	I) Wire rope or load attachment failure.	I) Allow maximum clearance between hook and head sheaves.
	J) Overturning from unbalanced load, loss of brakes.	J) Use the shortest boom possible. Keep near-capacity loads as close to the ground as possible.
	K) Overturning from excessive load for boom angle, loss of brakes.	K) Test stability before fully lifting load by: 1) lifting load slightly off the ground 2) checking the machine for movement, and checking to be sure the brakes hold with the load elevated.
	L) Overturning from unbalanced load.	L) Be aware of centrifugal force when swinging. Swing crane slowly to avoid outward swings of load. If necessary, attach tagline to the load to control the swing.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	M) Damaging or over-stressing boom, boom failure.	M) Watch for boom "kickback". Never operate with boom at a higher angle than shown on the capacity plate. Know what controls give you emergency stopping.
	N) Striking equipment or people with boom.	N) Always control load. To prevent excess motion during travel, use taglines to guide or snub the load. Never carry suspended loads over personnel.
	O) Hoist line failure, boom failure or damage.	O) Watch for "two-blocking". "Two-blocking" happens when hook block collides with boom point sheaves. Continuing pull on hoist lines can break the cables, or pull boom over cab on some types of machines. With hydraulically telescoping booms, be sure to pay out hoist line when extending and reel in hoist line when retracting. If your crane has a two-blocking warning device check it occasionally by a safe means.
	P) Tipping of crane.	P) Always use outriggers to make any lifts, except light loads with pick-and-carry units. Lower outrigger jacks to completely remove all machine weight from tires and level unit to safely reach the full capacity of the machine. Recheck and, if necessary, reset outriggers between heavy lifts.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	Q) Striking truck cab with boom.	Q) Watch out for the truck cab on truck-mounted units. Keep boom high enough, when swinging the boom, to be sure it clears the truck cab.
	R) Carrier shifting or rolling.	R) Lock carrier air brakes "on" when operating crane and check air pressure frequently.
6. Loading and moving crane.	6. A) Personal injury from improper procedure.	6. A) Always use ramp when loading machine on trailer. If ramp is not available, use blocking to build one.
	B) Wrecking or striking obstructions while trans-porting, machine damage.	B) Lock turntable before traveling on highway. Use house lock or swing brake, and lower boom into rack to prevent swing.
	C) Striking objects, tipping of crane.	C) Carefully observe the area when traveling your machine.
	D) Collision on highway, bridge collapse under weight of crane.	D) Obey all traffic rules when traveling on highway. Use proper warning flags and signs. Check bridges before crossing to make sure they will support the weight of the machine.
	E) Machine stalled or damaged in river, drowning.	E) Check river depths by lowering line and hook to gauge depth. Swing side-to-side and check depth before proceeding.

GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the surface metal and nonmetal mining industry in conducting effective on-the-job training (OJT) of new employees, or employees reassigned to different jobs. The use of training materials, such as this module, is an important part of an effective, systematic, OJT program.

This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs," June, 1983.

TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site where the work will be done.

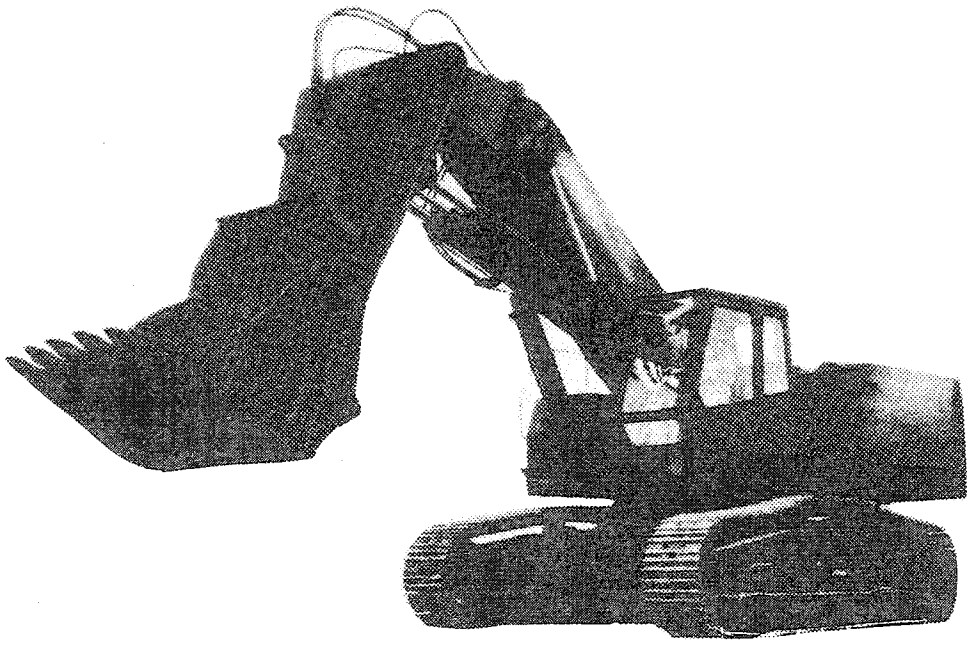
The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step – explaining the job to the employee – can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom or a quiet office for the first part of the training. Any general theory or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

MODULE NUMBER 7
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

HYDRAULIC SHOVEL OPERATION



This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for hydraulic shovel operation.

Hydraulic shovels are used at surface metal and nonmetal mines for overburden and ore loading. They are becoming increasingly popular because of their mobility, ability to mine selectively, and independence of electric power. Hydraulic shovels can also work on steeper slopes than electric shovels. They can be fitted with a backhoe attachment, which permits them to dig below ground level.

Potential accidents relating to hydraulic shovel operation include slips and falls, caught in or struck by moving mechanisms, tipping or overturning the machine, contacting energized power lines, and injuries to persons who are standing or walking near the machine while it is in operation.

Slips and falls are most likely when mounting and dismounting, and when performing maintenance, repair, cleaning, or refueling. Miners may be struck by moving mechanisms during greasing or oiling, or when performing maintenance or repair. Tipping or overturning may be caused by lifting or handling materials improperly, or by traveling or operating with disregard to roadway conditions, grades, clearance, visibility, etc. Contact with power lines can occur if the machine is operated too close to energized electrical lines or installations. Persons standing or walking near the machine are especially vulnerable when they are in the area of the shovel, and the shovel operator is unaware of their location.

The basic job steps included in this module are:

1. Conduct walk-around inspection of shovel and work area.
2. Mount and dismount.
3. Conduct on-board inspection and start shovel.
4. General operation.
5. Park.
6. Refuel.
7. Perform repairs and maintenance.

The operator's manual provided with the machine, and the mine's operating procedures, should also be used in training machine operators.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment:

Hard hat, safety shoes, safety glasses with side shields, gloves, clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Conduct walk-around inspection of shovel and work area.	1. A) Frostbite, hypothermia, sunburn, heat stroke, heat cramps, heat exhaustion.	1. A) Dress to suit weather conditions.
	B) Struck by falling equipment.	B) Make sure all raised parts of shovel are lowered to the ground.
	C) Personal injury, unsafe equipment or work area.	C) Visually inspect machine and work location for defective equipment and/or unsafe conditions prior to operation. Report any unsafe conditions to your supervisor and correct all defects.
	D) Rock fall. Striking personnel, or damaging machinery with shovel.	D) Inspect highwall, bank and pit conditions in your work area. Check area around shovel for people or obstructions. Know traffic patterns, and communicate with fellow workers before operating shovel. Warning signs are recommended to prohibit unauthorized persons from coming near the shovel.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	E) Slips and falls.	E) Be especially careful of ruts, uneven ground, and frozen ground. Avoid slick spots and keep area free of slipping or tripping hazards. Use suitable access if necessary to mount and dismount shovel to check engine or other area of machine. Make sure all steps, ladders, handrails, handholds, and walk-ways are in good condition and free of oil, grease, mud, snow, and ice.
	F) Falling material, improper operation, loss of control, machine damage.	F) Inspect bucket teeth and adapters for tightness. Check tracks for tightness and rollers, idlers, and sprockets for damage. Check for oil leaks, gear wear, seized bearings, and lubrication of gears and rollers.
	G) Caught in moving parts.	G) Check all bolts, guards, covers, and mechanical components of shovel to make sure they are in place.
	H) Equipment malfunction or damage, fire hazard.	H) Check engine compartment for dirt, debris, oily rags, tools, and leaks. Grasp engine covers firmly when removing. Avoid overreaching. Get help if needed.
	I) Splashed fluids, burns.	I) Check fluid levels. Wear safety glasses with side shields and gloves. Remove tank caps or covers carefully. It is important to know if gear cases are hot or cold.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	J) Burns, high pressure fluids.	J) Check for hydraulic oil or coolant leaks, rubbing lines, cracks or loose fittings. Pay particular attention to hydraulic hoses which flex in normal operation of shovel functions.
	K) Equipment failure.	K) Check machine for any physical damage, especially boom or lift arms for cracks or damage.
2. Mounting and dismounting.	2. A) Rock fall, caught between shovel and other machines.	2. A) Never walk or stand between the shovel and the bank, highwall, or other nearby machines while mounting.
	B) Clothing caught on control levers or other projections.	B) Wear snug fitting clothing.
	C) Slips and falls.	C) Make sure cab is positioned correctly for mounting and walkways around engine and hydraulic enclosures are free from debris and slipping or stumbling hazards. Make sure grab rails or handholds are provided and in good condition. Keep both hands free for climbing. Keep boots, steps, ladders, etc., free from oil, grease, mud, etc. NOTE: Slip resistant flooring is recommended for walkways.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. Conduct on-board inspection and start shovel.	3. A) Controls jammed by debris, poor visibility.	3. A) Make sure cab is free from debris, etc., and windows are clean.
	B) Equipment movement and/or failure, stuck or inoperative controls.	B) Check all instruments, gauges, and controls before starting engine to ensure they aren't stuck or malfunctioning. All controls should be in neutral position, bucket lowered to the ground, and the parking brake set.
	C) Caught in, or struck by, moving parts.	C) Make sure all guards and safety devices are in place and in good condition.
	D) Slips, trips, falls.	D) Check for uncovered openings, and slipping, or tripping hazards. Practice good housekeeping.
	E) Fire hazard.	E) Know location and operation of fire extinguishers, and make sure they are fully charged and operable. Clean up spills of flammable or combustible materials or liquids. Practice good housekeeping.
	F) Operating with safety or mechanical defects, struck by moving parts, or backing over person.	F) Check equipment for warning or out-of-service tags. Sound horn before starting or moving machine. Be sure all persons and objects are clear before starting or moving.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	G) Engine or auxiliary equipment malfunction.	G) After starting engine, idle until normal operating temperature is reached and check gauges and warning lights again for normal readings. Check engine for smooth idle and unusual smoke or noise.
	H) Poor visibility.	H) Check lights and wipers.
	I) Loss of control.	I) Check brakes (including swing brake) and steering.
	J) Potential hazards remaining uncorrected.	J) Report and, if possible, repair any defects or hazards found during walk-around or on-board inspections. Do not use machine with safety defects. If the shovel is unsafe and removed from service, tag it to prohibit further use until repairs are completed.
4. General operation.	4. A) Personal injury.	4. A) Do not allow anyone to ride outside the cab for any reason. No one should ride with the operator unless safe seating is provided.
	B) Personal injury, falling hazard.	B) Never use bucket or other attachment as a staging platform for workers.
	C) Overturning and/or collision.	C) Keep machine under control at all times. Use prudent operating speeds consistent with conditions.
	D) Loss of control.	D) Never attempt to operate shovel from outside operator's compartment.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	E) Striking or catching other personnel.	E) By visual observation or verbal communication, make certain all persons and machines are clear before starting. Sound an audible horn prior to starting shovel in motion, after repairs or after being idle.
	F) Machine or control malfunction.	F) Make sure pressures are in proper operating range. Check out motions of machine and all controls, limits, and warning devices. Check all brake systems. Stop machine if you feel or see any unusual response or hear any abnormal sounds.
	G) Personal injury, inefficient operation.	G) Clearly understand any work assignment before starting. Make certain helpers and others know and understand all signals.
	H) Personal injury, machine damage.	H) When operating and/or moving shovel, be alert for pit elevations, highwalls, banks, trenches, faults, clearances, traffic, machine crew, other workers, sump holes, and power cables. Keep shovel on good, sound footing.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	I) Injury or equipment damage from fall of material, excessive spillage, increased maintenance costs and tire wear because of overloading.	I) Never swing bucket over workers, vehicles or machines. When loading haulers don't swing over cab. Be sure of clearance over hauler bed and position bucket before tripping. Load hauler evenly to avoid overloading rear axles and causing spillage. Don't drop material into truck bed from unnecessary heights.
	J) Equipment damage, overturning.	J) Avoid fast swings, hoists, or sudden braking, except in an emergency. Avoid jerking and abrupt motions. Be sure of the working range and lifting capacity of the machine at all times. Move loads carefully.
	K) Fall of material and/or bucket.	K) Do not leave a loaded or empty bucket in the air for long time periods. Lower to ground when not in use.
	L) Ground failure, rock fall.	L) Observe condition of highwall and banks at all times. When freezing, thawing, rain, etc., have created a potential highwall or bank failure condition, immediately notify crew, others working in the area, and your supervisor. Use machine's audible alarm signal to warn personnel of this immediate danger if necessary.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	M) Ground failure, rock fall. NOTE: IG 43, Module 15, contains more information on ground control.	M) Loose hazardous material must be stripped for a safe distance (10 feet or more) from the top of pit or quarry walls, and loose unconsolidated material must be sloped to the angle of repose. Leave highwall as safe as possible before moving up.
	N) Cab struck by rolling material, machine damage.	N) When dumping to a higher level, be alert for rocks or material rolling down the bank, especially when cab is beside the bank.
	O) Fall of material.	O) Do not work between machines and the highwall or bank, where your escape from falls or slides may be hindered. Stay away from edge of banks, pits, and highwalls. Stay clear of overhangs and slide areas.
	P) Electrocution, burns, machine damage.	P) Never work or swing boom within a minimum distance of 10 feet from any energized overhead power line.
	Q) Backing over person, tipping or overturning.	Q) Do not back up until you have checked to see that area is clear of personnel and/or obstructions.
	R) Tipping, overturning, collision.	R) Use caution when working on, or crossing, sidehills, ridges, ditches, slopes, etc. Cross at an angle and at reduced speed. Except for short distances, position boom in direction of travel. Always face the direction of travel.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	S) Cable damage, shock or burns.	S) Don't cross power and/or trailing cables unless suitable cross-overs or cross-unders are provided or the cable is properly trenched.
	T) Loss of control.	T) Always set swing brake and/or lock boom when traveling to, or from, a job site.
	U) Loss of control, machine damage.	U) Always keep your machine under control and in safe operating condition at all times. Report and correct any unsafe conditions and/or job procedures.
5. Park.	5. A) Collision, personal injury, traffic obstruction.	5. A) Always park in designated parking area, if provided, or select a safe parking area. Don't park on haul roads or active work areas. If you must park in an emergency, pick the safest place and use warning signals, flares, or barriers.
	B) Struck by machine, material, or attachment.	B) Never leave the operator's cab with the engine running or with a load or bucket suspended.
	C) Run over or struck by machine.	C) Place all controls in parking position. Set swing lock or brake, and set parking or traction brake or lock, to prevent machine movement.
	D) Engine damage.	D) Idle engine a short period before shutdown.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	E) Trips, slips and falls, clothing caught on controls or projections.	E) Dismount machine (see Job Procedures 2.A-C).
	F) Hazards due to lack of communication.	F) Always inform appropriate personnel of any abnormal conditions, defects, changes made in machine and/or job procedure or condition.
6. Refuel.	6. A) Collision, equipment movement, traffic obstruction.	6. A) If refueling, park at fuel station and follow parking procedure.
	B) Slips, trips and falls, clothing caught.	B) If necessary to mount shovel to refuel, use ladder, steps, rails, or handholds (see Job Procedures 2. A-C).
	C) Fuel on skin or in eyes.	C) Wear safety glasses. Remove fuel cap slowly.
	D) Fire or explosion hazard.	D) Avoid fuel spillage at refueling station, and on hot engine parts. Do not smoke at or near the refueling station.
	E) Slips, trips, falls.	E) Keep refueling area free from extraneous material.
	F) Fuel spillage or discharge, fire hazard.	F) Always replace fuel cap on shovel and return fuel hose and nozzle to the rack.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
7. Performing repairs and maintenance (if applicable).	7. A) Personal injury from improper procedure.	7. A) Do not attempt repairs or maintenance you do not understand, and have not been trained to perform.
	B) Caught or struck by moving or falling parts, or moving machine.	B) Do not attempt any repairs or maintenance until the engine is off, the machinery is blocked against motion, all raised equipment lowered, and hydraulic pressure is relieved. If necessary to perform work on top of, under, around, or from a raised piece of equipment, block or mechanically secure the equipment to prevent accidental rolling, falling, or lowering.
	C) Personal injury.	C) Plan any work to be done and maintain good communications. Know and observe safe work practices. Inspect tools, and maintain in good condition.
	D) Caught in, or struck by, moving parts.	D) Replace all guards and other safety devices before starting or using shovel.

GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the surface metal and nonmetal mining industry in conducting effective on-the-job training (OJT) of new employees, or employees reassigned to different jobs. The use of training materials, such as this module, is an important part of an effective, systematic, OJT program.

This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs," June, 1983.

TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site where the work will be done.

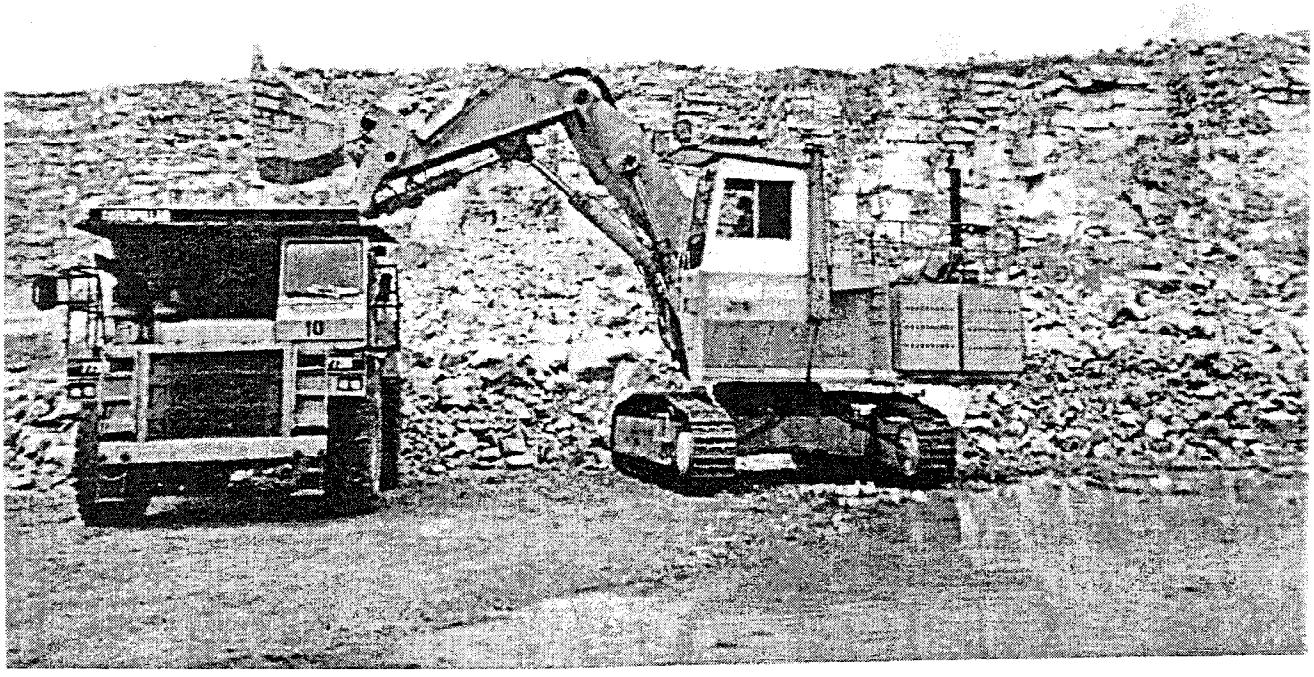
The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step – explaining the job to the employee – can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom or a quiet office for the first part of the training. Any general theory or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

MODULE NUMBER 8
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

POWER SHOVEL OPERATION



This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for power shovel operation.

Power shovels are used at surface metal and nonmetal mines for overburden removal and for ore loading. Many different sizes of shovels may be used, depending on the type of operation and application.

Accidents relating to shovel operation most often result from slips and falls, becoming caught in or struck by moving mechanisms, and standing or walking near the machine while it is in operation.

Slips and falls occur most often during maintenance, repair, or cleanup, and when mounting and dismounting the machine. Miners are most often struck by moving mechanisms during greasing or oiling, or when performing maintenance or repair. Injuries to persons standing or walking near the machine often occur when the person is in the area and the shovel operator is unaware of their location.

The basic job steps included in this module are:

1. Conduct walk-around inspection of shovel and work area.
2. Mount and dismount.
3. Conduct on-board inspection.
4. General operation.
5. Shutdown procedure.
6. Perform repairs and maintenance.

Several of these procedures apply to the oiler and groundman as well as the shovel operator.

The operator's manual provided with the machine, and the mine's operating procedures, should also be used in training machine operators.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment:

Hard hat, safety shoes, safety glasses with side shields, gloves, clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Conduct walk-around inspection of shovel and work area.	1. A) Personal injury, unsafe equipment or work area.	1. A) Visually inspect machine and work location for defective equipment and/or unsafe conditions prior to operation. Report any unsafe conditions to your supervisor and correct all defects.
	B) Electrocution.	B) Visually inspect trailing cable for cuts, abrasions, and other damage (electric power shovels). If inspection requires handling the cable, power must be off at switch house, or proper protective equipment (insulated hooks, tongs, ropes, or slings) must be used.
	C) Rock fall. Striking personnel, or damaging machinery with shovel.	C) Inspect highwall, spoil and pit conditions in your work area. Know traffic patterns, and communicate with fellow workers before operating shovel. Warning signs are recommended to prohibit unauthorized persons from coming near the shovel.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	D) Falling material, improper operation.	D) Inspect bucket dipper teeth and adapters for tightness. Inspect latch bar for wear and proper adjustment.
	E) Slips and falls.	E) Be especially careful of ruts, uneven ground, and frozen ground. Make sure all steps, ladders, handrails, handholds, and walkways are in good condition and free from oil, grease, mud, snow, and ice.
	F) Machine damage, rope failure. NOTE: IG 43 Module 14, contains detailed procedures for inspecting wire rope and related items.	F) Check for oil leaks, gear wear, seized bearings, loose or damaged crawlers or rollers, lubrication of gears and rollers. Check ropes and boom structural strands (to the extent possible).
	G) Splashed fluids, burns.	G) Check fluid levels. Wear safety glasses with side shields and gloves. Remove tank caps or covers carefully. It is important to know if gear cases are hot or cold.
2. Mounting and dismounting.	2. A) Slips, falls, caught between shovel and other machine.	2. A) Use caution when mounting or dismounting. Do not get on or off until the operator is notified.
	B) Struck by or thrown from ladder.	B) Do not get on or off while the shovel is in motion.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	C) Slips and falls.	C) Use steps, ladders, handholds, etc., provided for mounting and make sure they are in good condition. Keep both hands free for climbing.
	D) Rock fall, caught between shovel and other machines.	D) Never walk or stand between the shovel and the bank, highwall, spoil, or other nearby machines while mounting.
	E) Clothing caught on control levers or other projections, slips and falls.	E) Wear snug fitting clothing and keep boots, steps, ladders, etc., free from oil, grease, mud, etc. NOTE: Slip resistant flooring is recommended in walkway zones.
	F) Ladder failure.	F) Raise boarding ladder (if provided) and be sure it is secured.
3. Conduct on-board inspection.	3. A) Equipment movement and/or failure, stuck or inoperative controls, poor visibility.	3. A) Check operator's cab. Make sure all controls are in the neutral position, brakes set, and bucket lowered to the ground. Make sure cab is free from debris, etc., and windows clean.
	B) Caught in, or struck by, moving parts.	B) Make sure all guards and safety devices are in place and in good condition.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	C) Slips, trips, falls, fire hazard.	C) Check decks and house area for uncovered openings, slipping, or tripping hazards, and accumulations of flammable or combustible material or liquids. Practice good housekeeping.
	D) Fire hazard.	D) Know location and operation of fire extinguishers, and make sure they are fully charged and operable. Don't smoke or use open flame sources around combustible or flammable liquids or materials.
	E) Fire and/or explosion hazard.	E) Keep all compressed gas cylinder tanks secured, and keep covers in place. Keep all compressed gas cylinders, hoses, torches, and regulators free of grease and oil. Do not store this equipment in the same enclosed area where flammable or combustible liquids are stored.
	F) Electrocution, burns, equipment failure.	F) Be sure all electrical equipment (switches, breakers, controls, panels, guarding, etc.) is in proper operating position and in good condition. Never perform any electrical work or enter any energized electrical panels or cabinets unless you are a qualified electrician. Be sure to lock out and tag the equipment or circuit.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	G) Boom or gantry failure, rope failure caused by sheave failure, excessive rope wear.	G) Inspect boom, boom pockets, and gantry for cracks, breaks, structural damage, excessive wear, missing parts, etc. Check point sheaves and saddle blocks for damage or excessive wear.
	H) Rope failure.	H) Check both the running ropes and the boom structural strands for broken strands and loose sockets. Periodic nondestructive testing of sockets is recommended.
	I) Trips and falls.	I) Check all steps, ladders, handrails, platforms, and walkways for cracks, corrosion, damage, or any deterioration.
	J) Potential hazards that remain uncorrected.	J) Report and, if possible, repair any defects or hazards found during walk-around or on-board inspections. Do not use machine with safety defects. If the shovel is unsafe and removed from service, tag it to prohibit further use until repairs are completed.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. General operation.	4. A) Striking or catching other personnel.	4. A) Sound an audible horn prior to starting shovel in motion, after repairs or after being idle.
	B) Personal injury due to lack of communication.	B) By visual observation or verbal communication, make certain machine crew (oiler/ groundman) and all other persons and machines are clear before starting. Be sure the machine crew reports to you throughout the shift, so that you have a general idea of where they are at all times.
	C) Machine or control malfunction.	C) Make sure air pressure is at proper operating range. Check out motions of machine and all controls, limits, and warning devices. Check all brake systems. Stop machine if you feel or see any unusual response or hear any abnormal sounds.
	D) Personal injury, inefficient operation.	D) Clearly understand any work assignment before starting. Make certain machine crew and others know and understand all signals.
	E) Unsecured raised equipment, injury from sudden machine movement when power is restored, equipment damage.	E) In the event of a power failure, move all brake switches to set position, place other controls in the neutral position, and secure the machine's position until power is restored.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	F) Personal injury, machine damage.	F) When operating and/or moving shovel, be alert for pit elevations, highwall, spoil, trenches, faults, clearances, traffic, machine crew, other workers, sump holes, and trailing cables. Keep shovel on good sound footing.
	G) Injury or equipment damage from fall of material.	G) Never swing bucket over workers, vehicles, machines, or trailing cable. When loading haulers, don't swing over cab. Be sure of clearance over hauler bed and position bucket before tripping.
	H) Equipment damage, overturning.	H) Never suddenly set brakes while swinging, except in an emergency. Avoid jerking and abrupt motions.
	I) Fall of material and/or bucket.	I) Do not suspend a loaded or empty bucket in the air, with the brakes set, for long time periods. Lower to ground when not in use.
	J) Ground failure, rock fall.	J) Observe condition of highwall and spoil banks at all times. When freezing, thawing, rain, etc., have created a potential highwall or spoil bank failure condition, immediately notify crew, others working in the area, and your supervisor. Use machine's audible alarm signal to warn personnel of this immediate danger if necessary.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	K) Ground failure, rock fall. NOTE: IG 43, Module 15, contains more information on ground control.	K) Loose hazardous material must be stripped for a safe distance (10 feet or more) from the top of pit or quarry walls, and loose unconsolidated material must be sloped to the angle of repose. Leave highwall as safe as possible before moving up.
	L) Cab struck by rolling material, machine damage.	L) When dumping to a higher level, be alert for rocks or material rolling down the bank, especially when cab is beside the bank.
	M) Striking other machines/ vehicles with falling material or machine.	M) After being notified, allow sufficient time for vehicles or machines to pass by shovel before resuming normal operations.
	N) Fall of material.	N) Do not work between machines and the highwall or spoil bank where your escape from falls or slides may be hindered.
	O) Electrocution, burns, cable damage, strains and overexertion.	O) Protect trailing cable from damage. Never carry or move cable with bucket unless slings are used. If energized cable must be moved manually, use proper protective equipment (insulated hooks, tongs, ropes, or slings). Keep kinks, twists, and short bends out of trailing cable. Don't pull long lengths at one time. Take several loops to minimize strain on cable. Don't run over power cables.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	P) Electrocution, burns, machine damage.	P) Never work or swing boom within a minimum distance of 10 feet from any energized overhead power line.
5. Shutdown procedure.	5. A) Personal injury, equipment damage.	5. A) Park shovel on firm ground in a position where it does not create a traffic hazard and is not subject to damage by slides or falling material.
	B) Fall of equipment, machine damage.	B) Place bucket on ground firmly and release cable tension.
	C) Injury or equipment damage if machine moves when energized.	C) Place all controls in proper position. Make sure all brake controls are in the set position.
	D) Personal injury.	D) Do not permit anyone to get on or off the shovel while it is in motion unless equipped to do so safely.
	E) Slips, trips, falls, caught between ladder and other machine or obstruction.	E) Dismount shovel (see Job Step No. 2).
	F) Hazards due to lack of communication.	F) Communicate with fellow employees and supervisor at end of shift. Notify of any hazardous conditions, machine malfunctions, etc.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. Performing repairs and maintenance (if applicable).	6. A) Personal injury from improper procedure.	6. A) Do not attempt repairs or maintenance you do not understand and have not been trained to do.
	B) Caught by, or struck by, moving or falling parts, or moving machine.	B) Do not lubricate any moving part unless guarding, and extended fittings, prevent access to hazardous moving parts. Do not attempt any repairs or maintenance until the power is off, the machinery is locked out and tagged and blocked against motion, and all raised equipment lowered. If necessary to perform work on top of, under, around, or from a raised piece of equipment, block or mechanically secure the equipment to prevent accidental rolling, falling, or lowering.
	C) Fall of person.	C) Don't climb boom or gantry while shovel is in motion. Use safety belts with lanyards in elevated positions outside work platform, or where there is a danger of falling.
	D) Fall of hoisted loads or equipment.	D) Do not overload hoisting or lifting device. On hoisted materials that require steadying and guidance, use taglines.
	E) Personal injury.	E) Plan any work to be done and maintain good communications. Know and observe safe work practices. Inspect tools and maintain in good condition.

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TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site where the work will be done.

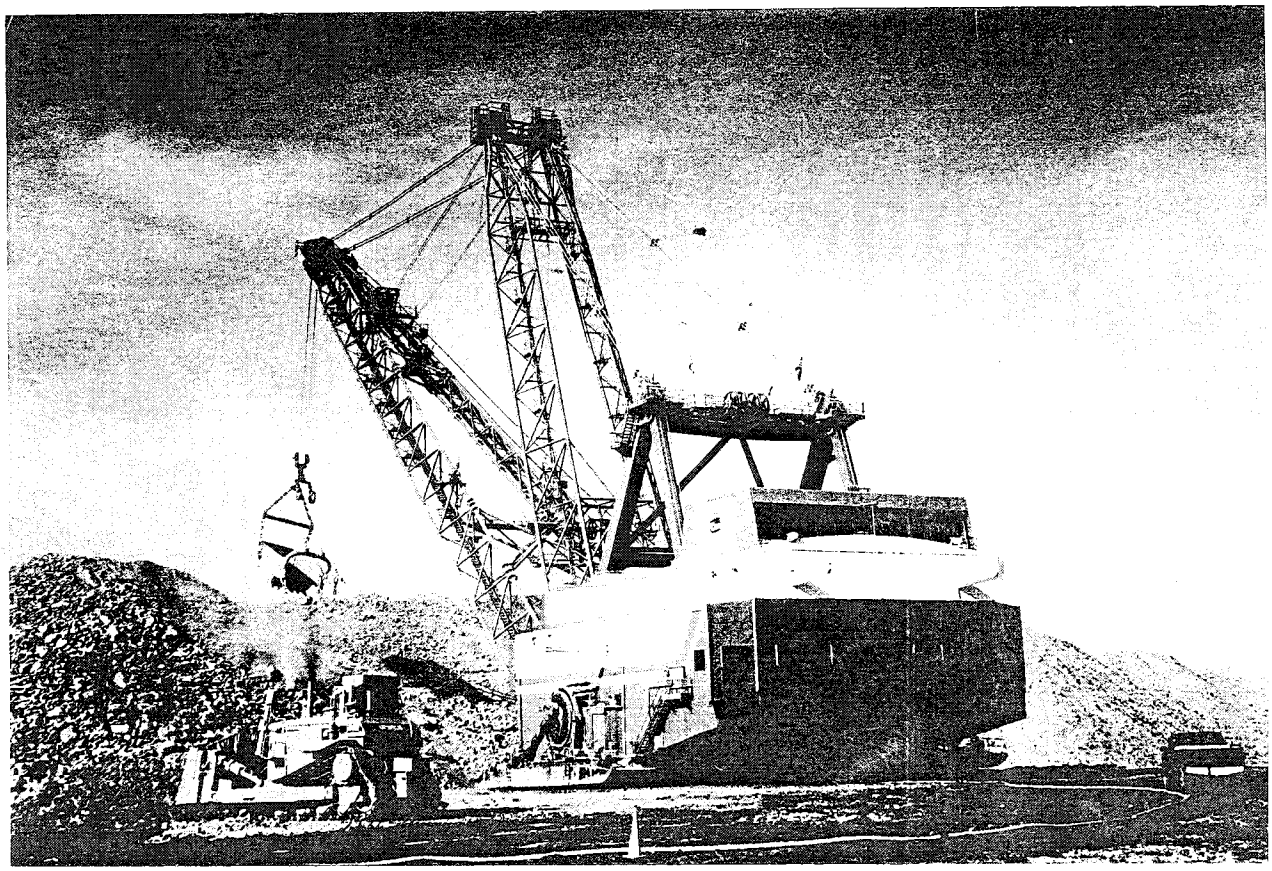
The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step – explaining the job to the employee – can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom or a quiet office for the first part of the training. Any general theory or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

MODULE NUMBER 9
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

DRAGLINE OPERATION



This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for dragline operation.

Draglines are used in surface metal and nonmetal mining for overburden and ore removal, and for reclamation. Many different sizes of draglines may be used, depending on the type of operation and application.

Accidents relating to dragline operation most often result from slips and falls, being caught in or struck by moving parts, and standing or walking near the machine while it is in operation.

Slips and falls occur most often during maintenance, repair, or cleanup, and when mounting and dismounting the machine. Miners are most often caught or struck by moving parts during greasing or oiling, or when performing maintenance or repairs. Injuries to persons standing or walking near the machine often occur when persons are in the area of the dragline, and the dragline operator is unaware of their location.

The basic job steps included in this module are:

1. Conduct walk-around inspection of dragline and work area.
2. Mount and dismount.
3. Conduct on-board inspection.
4. General operation.
5. Shutdown procedure.
6. Perform repairs and maintenance.

Several of these procedures apply to the oiler and groundman as well as the dragline operator.

The operator's manual provided with the machine, and the mine's operating procedures, should also be used in training machine operators.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment

Hard hat, safety shoes, safety glasses with side shields, gloves, snug fitting clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Conduct walk-around inspection of dragline and work area.	1. A) Personal injury, unsafe equipment or work area.	1. A) Visually inspect machine and work location for defective equipment and/or unsafe conditions prior to operation. Report any unsafe conditions to your supervisor and correct all defects.
	B) Electrocution, burns, equipment failure.	B) Visually inspect trailing cable for cuts, abrasions, and other damage, and proper installation (electric draglines). If inspection requires handling the cable, power must be off at switch house, or proper protective equipment (insulated hooks, tongs, ropes, or slings) must be used.
	C) Fall of material or overturning machine.	C) Inspect highwall, spoil and pit conditions. Be sure dragline is on solid ground and area is as level as possible.
	D) Striking personnel or damaging equipment with dragline.	D) Be aware of traffic patterns of equipment and personnel working in the immediate area of the dragline. Communicate with fellow workers before operating dragline. Warning signs are recommended to prohibit unauthorized persons from coming near the dragline.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	E) Equipment damage or malfunction.	E) Check for oil leaks, gear wear or damage, loose or damaged crawlers or rollers, tub cable hooks, lubrication of gears and rollers, lower lights, signal devices, and unusual conditions.
	F) Falling or flying objects, machine failure.	F) Inspect bucket, drag ropes, sockets, drag chain, sheaves, boom cables, and boom structure for any damage or unusual wear.
	G) Slips and falls.	G) Be especially careful of ruts, uneven ground, and frozen ground. Make sure all steps, ladders, handrails, handholds, walkways, etc., are in good condition and free from oil, grease, mud, snow, and ice. NOTE: Slip resistant flooring is recommended in walkway zones.
2. Mounting and dismounting.	2. A) Slips, falls, caught between dragline and other machine.	2. A) Use caution when mounting or dismounting. Do not get on or off until the operator is notified and the dragline is stopped. Never get on or off a moving machine.
	B) Slips and falls, caught on projections.	B) Use steps, ladders, handholds, and handrails provided for mounting and make sure they are in good condition. Keep both hands free for climbing.
	C) Rock fall, caught between dragline and other machines.	C) Never walk or stand between the dragline and the bank, highwall, spoil, or other nearby machines while mounting.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	D) Clothing caught on control levers or other projections, slips and falls.	D) Wear snug fitting clothing and keep boots, steps, ladders, and walkways free from oil, grease, mud, ice, and snow.
3. Conduct on-board inspection.	3. A) Equipment movement and/or failure, stuck or inoperative controls, poor visibility.	3. A) Check operator's cab. Make sure all controls are in the neutral position, brakes set, and bucket lowered to the ground. Make sure cab is free from debris, etc., and windows clean.
	B) Caught in or struck by moving parts.	B) Make sure all guards and safety devices are in place and in good condition.
	C) Slips, trips, falls, fire hazard.	C) Check decks and house area for uncovered openings, slipping, or tripping hazards, and accumulations of flammable or combustible material or liquids. Practice good housekeeping.
	D) Fire hazard.	D) Know location and operation of fire extinguishers. Check extinguishers (including automatic systems) and make sure they are fully charged and operable. Don't smoke or use open flame sources around combustible or flammable liquids or materials.
	E) Caught in, or struck by, moving parts.	E) Do not lubricate any moving part unless guarding and extended fittings are provided, which prevent access to hazardous moving parts.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	F) Fire and/or explosion hazard.	F) Keep all compressed gas cylinder tanks secured and keep covers in place. Keep all compressed gas cylinders, hoses, torches, and regulators free of grease and oil. Do not store this equipment in the same enclosed area where flammable or combustible liquids are stored.
	G) Electrocution, burns, equipment failure.	G) Be sure all electrical equipment (switches, breakers, controls, panels, guarding, etc.) is in proper operating position and in good condition. Never perform any electrical work or enter any energized electrical panels or cabinets unless you are a qualified electrician. Be sure to lock out and tag the equipment or circuit.
	H) Boom or gantry failure, rope failure caused by sheave failure, excessive rope wear.	H) Inspect boom, boom pockets, gantry, and "A" leg for cracks, breaks, bends, excessive wear, missing parts, or any other structural damage. Check point sheaves and saddle blocks for damage or excessive wear.
	I) Rope failure.	I) Check all cables for broken strands, loose sockets, or any other damage which could cause breakage or failure. Periodic nondestructive testing of sockets is recommended.
	J) Trips and falls.	J) Check all steps, ladders, handrails, platforms, and walkways for cracks, corrosion, damage, or any deterioration.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	K) Potential hazards that remain uncorrected.	K) Report and, if possible, repair any defects or hazards found during walk-around or on-board inspections. Do not use machine with uncorrected safety defects. If the dragline is unsafe and removed from service, tag it to prohibit further use until repairs are completed.
4. General operation.	4. A) Striking or catching other personnel.	4. A) Sound an audible alarm prior to starting dragline in motion, after repairs, or after being idle.
	B) Personal injury, lack of communication.	B) By visual observation or verbal communication, make certain machine crew (oiler/groundman) and all other persons and machines are clear before starting. Be sure the machine crew reports to you throughout the shift, so that you have a general idea of where they are at all times.
	C) Machine or control malfunction.	C) Make sure air pressure is at proper operating range. Check out motions of machine and all controls, limits, and warning devices. Check all brake systems. Stop machine if you feel or see any unusual response or hear any abnormal sounds.
	D) Personal injury, inefficient operation.	D) Clearly understand any work assignment before starting. Make certain machine crew and others know and understand all signals.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	E) Unsecured raised equipment, injury from sudden machine movement when power is restored, equipment damage.	E) In the event of a power failure, move all brake switches to set position, place other controls in the neutral position, and secure the machine's position until power is restored.
	F) Personal injury, machine damage.	F) When operating and/or moving dragline, be alert for pit elevations, highwall, and spoil conditions, faults, clearance, traffic, machine crew, other equipment, and trailing cables. Keep dragline on good sound footing.
	G) Injury or equipment damage from fall of material.	G) Never swing bucket over workers, vehicles, machines, or trailing cable. Do not operate in the presence of anyone who could create a hazard or be endangered.
	H) Equipment damage, overturning.	H) Never suddenly set brakes while swinging, except in an emergency. Avoid jerking and abrupt motions. Avoid off-center bucket loading and twists.
	I) Fall of material and/or bucket.	I) Do not suspend a loaded or empty bucket in the air, with the brakes set, for long time periods. Lower to ground when not in use.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	J) Ground failure, rock fall.	J) Observe condition of highwall and spoil banks at all times. When freezing, thawing, rain, etc., have created a potential highwall or spoil bank failure condition, immediately notify crew, others working in the area, and your supervisor. Use machine's audible alarm signal to warn personnel of this immediate danger if necessary.
	K) Ground failure, rock fall.	K) Loose hazardous material must be stripped for a safe distance (10 feet or more) from the top of pit or quarry walls, and loose unconsolidated material must be sloped to the angle of repose. Leave highwall as safe as possible before moving up. Be aware of caving edges or overhanging banks.
	L) Explosion hazard.	L) Be alert and observe blasting activities. Do not run over loaded holes. Be aware of any misfires in shot rock, bench, or highwall.
	M) Striking other machines/vehicl es with machine or falling material.	M) After being notified, allow sufficient time for vehicles or machines to pass by dragline before resuming normal operations.
	N) Fall of material.	N) Do not work between machines and the highwall or spoil bank where it may hinder your escape from falls or slides.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	O) Electrocution, burns, cable damage, strains and overexertion.	O) Protect trailing cable from damage. Never carry or move cable with bucket unless slings are used. If energized cable must be moved manually, use proper protective equipment (insulated hooks, tongs, ropes, or slings). Keep kinks, twists, and short bends out of trailing cable. Don't pull long lengths at one time. Take several loops to minimize strain on cable. Don't run over power cables.
	P) Electrocution, burns.	P) Do not make or break trailing cable connections until the power is off, and key is removed from interlock. Do not perform electrical work unless you are qualified. Maintain good communications with all concerned when taking power off or placing power on machine.
	Q) Electrocution, burns, machine damage.	Q) Never work or swing boom within a minimum distance of 10 feet from any energized overhead power line.
5. Shutdown procedure.	5. A) Personal injury, equipment damage.	5. A) Park dragline on firm ground in a position where it does not create a traffic hazard and is not subject to damage by slides, falling material, etc.
	B) Fall of equipment, machine damage.	B) Place bucket on ground firmly and release cable tension.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	C) Injury or equipment damage if machine moves when energized.	C) Place all controls in proper position. Make sure all brake controls are in the set position.
	D) Slips, trips, and falls, caught between ladder and other equipment or obstruction.	D) Do not permit anyone to get on or off the dragline while it is in motion.
	E) Slips, trips, and falls.	E) Dismount dragline (see Job Step No. 2).
	F) Hazards due to lack of communication.	F) Communicate with fellow employees and supervisor at end of shift. Notify of any hazardous conditions, machine malfunctions, etc.
6. Performing repairs and maintenance (if applicable).	6. A) Personal injury from improper procedure.	6. A) Do not attempt repairs or maintenance you do not understand and have not been trained to perform.
	B) Caught or struck by moving or falling parts, or moving machine.	B) Do not attempt any repairs or maintenance until the power is off, the machinery is locked out and tagged and blocked against motion, and all raised equipment lowered. If necessary to perform work on top of, under, around, or from a raised piece of equipment, block or mechanically secure the equipment to prevent accidental rolling, falling, or lowering.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	C) Fall of person.	C) Do not climb boom, gantry, or "A" leg while dragline is in motion. Use safety belts with lanyards in elevated positions outside work platform or where there is a danger of falling.
	D) Fall of hoisted loads or equipment.	D) Do not overload hoisting or lifting device. On hoisted materials that require steadying and guidance, use taglines.
	E) Personal injury.	E) Plan any work to be done and maintain good communications. Know and observe safe work practices. Inspect tools and maintain in good condition.

GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the surface metal and nonmetal mining industry in conducting effective on-the-job training (OJT) of new employees, or employees reassigned to different jobs. The use of training materials, such as this module, is an important part of an effective, systematic, OJT program.

This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs," June, 1983.

TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site where the work will be done.

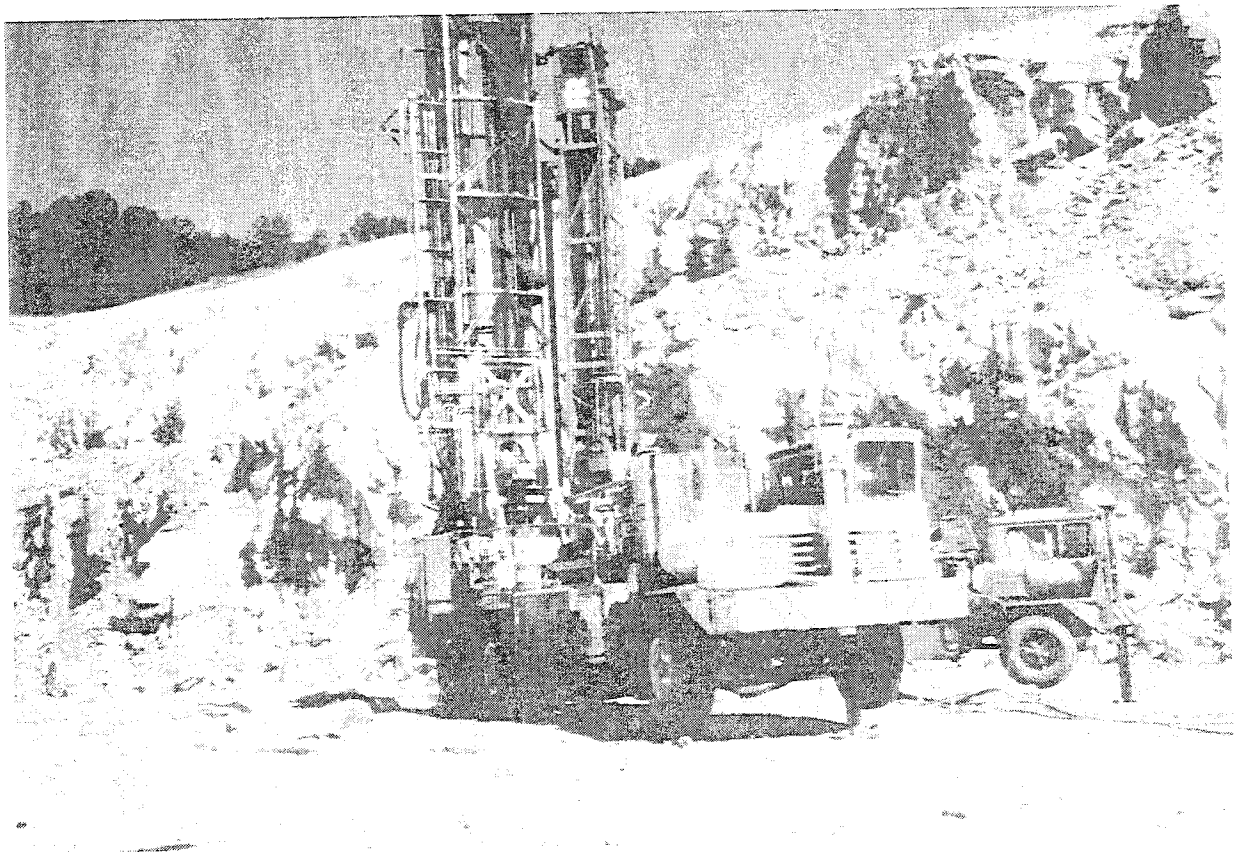
The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step – explaining the job to the employee – can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom or a quiet office for the first part of the training. Any general theory or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

MODULE NUMBER 10
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

DRILL OPERATION



This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for drill operation. It is designed for use in the training of drill operators and helpers. Where the drill crew is also involved in explosives transport or blasting operations, Module 11, "Transportation, Use, And Storage Of Explosives," should be used in conjunction with this module.

When the overburden is hard, competent rock that cannot be loaded directly by excavators, drilling and blasting of the overburden is necessary. Highwall drills are used to drill a pattern of holes for blasting, in order to fragment the overburden.

Many highwall drills are rotary type, where a bit is rotated, and rock is removed by abrasion, scraping, and chipping. Rotary drills can be mounted on trucks or trailers, or on crawlers, in the case of larger models. Smaller, crawler mounted, air-track drills, which tow their own air compressor, are also used.

A rotary drill consists of the power unit (usually a diesel engine, and a generator or hydraulic pumps); the air compressor; the controls, located on a truck, trailer, or in a housing on crawlers; and the mast for carrying the rotary motor, drill stem, and drill pipe. Rotary drill bits have diameters up to 26 inches. The most common sizes used are between 6 and 9 inches. Air-track drills generally drill a 4 or 4 ½ inch hole. Blasthole depths generally do not exceed 100 feet. The cuttings from rock drilling generally make good stemming material. Compressed air is used to flush these cuttings from the hole.

Drilling is frequently the most expensive operation in a surface mine. The cost justifies careful study and experiment to determine the most efficient hole diameter, spacing and depth, bit type, rotation speed, and pull down pressure. Flexibility must be maintained in a drilling operation to adjust for changing strata and mining conditions. Penetration rates are an indication of rock hardness, which affects blasthole loading requirements. Good drilling records should be kept, and good communication should be maintained between drillers and blasters.

Drilling and blasting operations determine highwall stability, and the loading characteristics of the broken material. Remember that each blast requires site analysis and planning. The proper drilling layout is gauged by the extent to which the layout helps reduce operating costs, and produces stable, safe highwalls. Drilling and blasting operations should break rock into sizes that can be readily loaded and handled by the equipment that is available. There is often a tendency to space blastholes too far apart. Each job is subject to many variables, which make it impractical to state a rule about the proper spacing of blastholes.

Safety problems involved in the drilling operation itself may include ground failure, highwall hazards, electrical hazards, moving machinery, broken pull-down chains or cables, whipping air or hydraulic hoses, and exposure to excessive noise levels, or to respirable

dust. These hazards are eliminated or controlled by inspection of the drilling equipment and the work area, proper maintenance of the drilling equipment, use of personal protective equipment, and by following safe job procedures. The drill operator and crew are responsible for the safe operation of the machine at all times, and under all conditions.

Dust is a major concern for drill operators. The benefits of dust suppression when drilling blastholes are:

- Clean air for drill operators.
- Longer maintenance intervals on engine air cleaner.
- Longer maintenance intervals on compressor air cleaner.
- Less accumulated dust on drilling machine.

Manufacturers are the bast source for information on how to reduce dust on their drilling machines. Manufacturers can also provide data and expert advice on other concerns which may arise about their products.

The basic job steps included in this module are:

1. Conduct walk-around inspection of drill.
2. Mounting and dismounting.
3. Check cab and controls.
4. Start drill and complete pre-shift inspection.
5. Traveling.
6. Drilling.
7. Parking and refueling.
8. Complete drilling records/reports.
9. Nighttime operations
10. Emergency procedures.
11. Performing repairs and maintenance.

Note: All procedures included will not apply to all drills. Delete procedures related to truck-mounted drills if drill is track-mounted, or procedures related to electric power cable if drill is diesel powered, etc.

The operator's manual provided with the machine, and the mine's operating procedures, should also be used in training machine operators.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment

Hard hat, safety shoes, safety glasses with side shields, gloves, snug fitting clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Conduct walk-around inspection of drill.	1. A) Accidents, injuries or inefficiency because of inattention, misunderstanding, or slow reaction time.	1. A) Try to be mentally and physically prepared to do your job each day. Be sure you clearly understand your work assignment prior to starting shift. (Drill rigs must be operated only by authorized persons.)
	B) Frostbite, hypothermia, sunburn, heat stroke, heat cramps, heat exhaustion, clothing catching fire.	B) Dress to suit weather conditions. Do not allow excessive oil or grease to accumulate on coveralls, etc.
	C) Electrocution, power failure.	C) Visually check position and condition of trailing cable when walking to drill rig.
	D) Electrocution, shock, burns.	D) If trailing cable must be handled manually, check rubber gloves and cable pull hook.
	E) Struck by moving drill or other machines.	E) Be sure brakes are set, and are properly adjusted. If rubber-tired drill is parked on a grade, check to be sure wheels are blocked and/or turned into a bank. Be alert for nearby machines.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	F) Falling or sliding over highwall (you and/or your machine), struck by falling rock.	F) Check work area, highwall, and/or bench for unsafe conditions. Look for possible cracking and soft ground which may slide. Keep drill rig on solid ground. Remain safe distance from edge of highwall.
	G) Slips or trips, struck by flying objects such as dirt or splashed fluids, caught in pinch points, high pressure fuel lines and hydraulic hoses, faulty equipment.	G) Conduct walk-around inspection of drill. Avoid slick spots and keep area free of slipping or tripping hazards during walk-around. Use suitable access if necessary to mount and dismount drill to check engine or other area of machine. Check the following: 1) tires and wheels for lug nuts, cracked rims, cuts, tire pressure. 2) area around and under drill for people or obstructions. 3) suspension and steering linkage. 4) all bolts, guards, covers, and mechanical components of drill to make sure they are in place and undamaged. 5) engine compartment for dirt, debris, oily rags, tools. Grasp engine covers or hood firmly when removing. Avoid over-reaching. Get help if needed. Visually check batteries for damage. 6) fluid levels and fuel supply. Wear safety glasses with side shields and gloves. Remove tank caps or covers carefully.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	G) (Continued)	7) hydraulic oil and coolant lines and hoses for breaks, leaks, rubbing lines or loose fittings. 8) drill rig's air system (hoses, clamps, chains, safety relief valves, receiver tanks, gauges, instruments, couplings, etc.) for safe working order. 9) safety chains or suitable locking devices at all connections of high pressure hose lines of one inch or larger inside diameter where a connection failure would create a hazard. 10) fire extinguisher (if on outside of machine) to make sure it's in place and fully charged. Know how to operate the fire extinguishers provided. 11) combustible material, grease, lubricants, paints, or flammable liquids accumulated on drill. Be sure flammable liquids are stored in their proper safety containers. Avoid storing flammable or combustible material next to electrical equipment and installations. 12) ladders, steps, handrails, and platforms for broken rungs, loose bolts, breaks, floor openings, or missing parts.
	H) Sludge deposits or ice which might prevent valve operation, tank rupture from excessive pressure.	H) Drain air tanks to release any condensation that might have accumulated and trip the pressure relief to be sure it's operable.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. (Continued)	I) Falls, struck by broken machinery or falling material, equipment malfunction.	I) Regularly inspect drilling equipment such as mast, cables, rigging, hardware, carriage, sheaves, braces, and crawlers for worn or defective parts. Use safe access, and safety belt where necessary.
	J) Explosion, tank rupture.	J) If compressed gas cylinders are present, check that they are secured in an upright position. Keep covers over valves when not in use. Keep cylinders, hoses, torches, and regulators free of grease and oil.
	K) Struck by flying parts of broken tools, shock or electrocution.	K) Check tools for safety defects.
	L) Potential hazards going uncorrected.	L) Report and if possible repair any defects or hazards found. Do not use machine with uncorrected safety defects.
2. Mounting and dismounting.	2. A) Slips and falls, being run over by machine.	2. A) No one, including the operator, should get on or off drill rig while it is moving.
	B) Shock, burns, electrocution.	B) It is a good habit to slap handrail with back of hand before taking hold to mount, in case any stray current is present.
	C) Slips and falls, clothing caught on control levers or other projections.	C) Wear snug-fitting clothing. Use extreme care in adverse weather, or if grease, oil, or water is present. Keep steps, tracks, handholds, and boots free of mud, ice, snow, grease, and oil to extent possible.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	D) Falling from ladder.	D) Use proper boarding places and handholds and handrails provided. Face ladder and climb with both hands free.
	E) Falling from mast.	E) If necessary to climb mast, climb on correct side. Use ladder with back guards and/ or safety belts or harness.
	F) Slips, trips, and falls.	F) Check walkways, passageways, and platforms for clearance, cleanliness, and good repair. Do not use walkways for storage.
	G) Slips and falls, sprains, strains, broken bones.	G) Never jump from drill when dismounting.
3. Check cab and controls.	3. A) Struck by flying objects, jammed controls, projecting control levers.	3. A) Remove or secure any loose objects in cab. Avoid projections.
	B) Accident caused by poor visibility.	B) Inspect and clean windows and mirrors. Adjust mirrors if necessary.
	C) Thrown against cab interior or thrown out of the machine.	C) Seat belts, where provided, should be in good condition and should be worn by the operator.
	D) Machine malfunction.	D) Check all instruments and gauges before start-up to be sure they aren't stuck. Make sure all controls are in neutral position and parking brake is set.
	E) Fire hazard.	E) Do not carry flammable liquids in operator's compartment.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. Start drill and complete pre-shift inspection.	4. A) Equipment damage, striking cab interior or other persons if drill moves unexpectedly.	4. A) Check machine for warning tags. Check controls to be sure they are in the proper position.
	B) Electrocution, unexpected machine movement.	B) Do not make or break trailing cable connections until the power is off. Do not touch drill rig while electrical cable is being energized. Maintain good communication with all concerned whenever power is taken off or placed on drill.
	C) Hitting, catching, or running over persons in the area.	C) Make sure everyone is in the clear prior to starting up or moving any part of the drill. Sound audible warning before starting or moving. Check back-up alarm after start-up.
	D) Engine or auxiliary equipment malfunction.	D) Let engine run at low idle until it reaches normal operating temperature. Check gauges and warning lights again for normal readings.
	E) Engine malfunction .	E) Check engine for smooth idle and unusual smoke or noise.
	F) Poor visibility, poor operation.	F) Check all lighting systems and controls on drill rig for proper operation.
	G) Loss of control.	G) Check all brake systems and steering according to company policy or manufacturer's recommendations. Check transmission operation.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. Traveling.	5. A) Injury or equipment damage due to human error.	5. A) Be sure you are trained and authorized to operate the drill.
	B) Electrocution, strain or sprain.	B) If trailing cable must be moved, inspect and use properly rated rubber gloves and insulated cable handling hooks.
	C) Various equipment operation hazards, electrocution, cable damage.	C) If trailing cable is moved with dozer or other machine, be sure you are trained, authorized, and follow safe procedures for machine being used. Do not move cable with machine blade unless proper cable sling equipment is utilized. Keep kinks, twists, knots, or short bends out of cable. Take several loops, instead of pulling long lengths, to minimize strain on cable.
	D) Personal injury.	D) Do not get on or off moving machine or permit others to do so.
	E) Striking other machines or people.	E) Be aware of the location of other machines and personnel within your working area, especially in congested areas.
	F) Caught in moving parts, run over by machine.	F) Keep clear of track when tramming.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	G) Electrocution.	G) Make sure drill rig is clear of all electrical power cables when moving. When drill rig must be moved near power lines, do so under the direction of a supervisor and use extreme caution. The mast must not pass within a minimum distance of ten feet from any energized overhead power line. High voltage may dictate distances up to 35 feet.
	H) Electrocution, shock, burns, explosions, cable damage.	H) Never run over unprotected trailing cables. Use proper crossover or crossunder points.
	I) Drill overturning, ground failure, struck by falling material.	I) Keep drill rig on solid roadway and do not operate where there is a danger of tipping over. Use extreme caution when operating over rough terrain, on frozen ground, next to coal ribs, and on benches.
	J) Loss of control, collisions, overturning.	J) Use prudent speeds consistent with conditions and keep drill rig under control at all times. Obey all traffic rules, signals, signs, and lights.
	K) Loss of control, machine damage.	K) Always anticipate grades and select proper gear range accordingly. Never over-speed the engine and never coast in neutral. Stay in proper gear when traveling uphill or downhill. Use each type of brake carefully and in accordance with manufacturer's instructions.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	L) Collisions, forcing another vehicle into an accident.	L) Know your stopping distance and follow other vehicles at a safe distance. Yield right-of-way to all loaded haulage vehicles. Limit passing to areas of adequate visibility and clearance. Don't hog the road or race with other vehicles.
	M) Collisions, overturning, striking obstructions or persons.	M) Use extreme caution and be prepared to stop at intersections, railway crossings, one-lane bridges, and underpasses . When in pit, be alert for pit elevations, trenches, benches, open cuts, sump holes, clearances, grades, and workers.
	N) Overturning, striking obstructions.	N) Slow down before turning. Allow enough clearance and do not cut corners too close when making a sharp turn. Never turn sharply uphill or downhill.
	O) Poor visibility because of blind spots behind drill.	O) When preparing to back up, check area before changing directions. Look behind drill to extent possible before and while backing up. Ask assistance from drill helper or hole loader.
	P) Poor visibility.	P) Use headlights and/or operating lights at night or in cases of poor visibility because of weather conditions.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. Drilling.	6. A) Catching someone in moving parts, running over someone.	6. A) Make sure everyone is in the clear and sound audible warning before starting up any part of drill and before moving drill.
	B) Struck by falling or sliding material, falling over highwall, overturning.	B) Always visually inspect work area, highwall, and bench for unsafe conditions, cracking, and soft ground which could slide. Keep drill rig on solid ground and remain a safe distance from edge of highwall.
	C) Ground failure under operating machines, struck by falling materials.	C) Do not drill or shoot holes underneath operating machines, such as shovels, bucket wheels, or draglines. Never get under the swinging buckets of these machines.
	D) Excessive respirable dust.	D) Use dust control equipment provided, and inspect regularly for proper operation.
	E) Slips and falls, fire hazard.	E) Do not work from a slippery platform, or use insecure footing or staging not designed for the job. Keep platform free of mud, ice, and snow, and as dry as possible. Keep oil and grease spills cleaned up.
	F) Detonating explosives.	F) Never drill in a previously drilled hole (one cannot assume that it is free of unshot powder). Do not drill holes where there is danger of intersecting a charged or misfired hole.
	G) Caught in moving parts.	G) Keep hands and clothing clear of rotating drill stems and other moving parts.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	H) Uncontrolled machine.	H) Never leave drill unattended while in operation. Stay in position where you have ready access to control levers.
	I) Struck by shifting or falling material.	I) Stay clear when making and breaking joints. Stay clear of lifted loads.
	J) Struck by falling drill steel, caught in rotating auger.	J) Keep firm grip on drill steel when handling must be done. Do not remove or install augers while power is on.
	K) Falling from mast, struck by falling objects.	K) Do not climb mast while drilling, or if drill is moving. Persons must not be on the mast while drilling unless a safe platform is provided and safety belts are used. Don't leave tools or other objects loose on the mast or mast platform.
	L) Struck by broken or whipping drill steel.	L) Keep clear of drill steel which is bowed or bent under pressure of any kind. Bent drill steel should be removed from service.
	M) Crushed between drill pipe and stationary object.	M) Always keep hands and feet clear when hoisting drill pipe to the deck.
	N) Struck by falling drill rods.	N) When storing spare drill rods in rack, make certain they are effectively secured to prevent falling from rack. Be sure safety sling is in place and secure at all times.
	O) Fire or explosion.	O) Don't smoke or use an open flame around flammable or combustible materials, or where "No Smoking" signs are posted.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	P) Burns.	P) Avoid contact with hot air lines, manifolds, etc.
	Q) Stepping\ falling into drill hole.	Q) Cover or guard drill holes which are large enough to constitute a hazard.
	R) Struck by falling or sliding objects.	R) Before moving drill from one hole to another, secure drill steel, tools, and all movable parts in a safe position.
	S) Striking persons, machines, or power cables; soft ground; roadway obstructions.	S) Before movement to the next hole site, the helper should check the area to be traveled, and make sure persons, machines, and power cables are in the clear.
	T) Running over someone.	T) Observe general area and sound alarm before moving from one hole to another. Know location of helper and shooter, and never move drill unless they can be seen or heard.
	U) Striking persons or obstructions.	U) Helper should give signals to assist operator in moving or spotting drill. Operator should observe for traffic or persons. Operator should signal before changing direction. Crew members must be sure their signals are understood.
	V) Explosion.	V) Do not run drill over loaded holes, or allow other machines to drive over them. Trailing cables of electrically operated drills or any other machines must be kept a sufficient distance from loaded holes.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	W) Crushed between equipment.	W) Do not get between drill and compressors or other equipment.
	X) Bubbles in blood from high pressure air penetration of skin, ruptured air tanks, whipping air hoses .	X) Never direct compressed air toward a person. Be sure compressed air systems are properly installed, maintained, and used.
	Y) Catching persons in moving parts.	Y) After drill has been moved up to a new hole location and leveled, drill crew should make visual or verbal contact with operator before operation is resumed.
7. Parking and refueling.	7. A) Collision, runaway equipment, traffic obstruction.	7. A) Avoid parking on inclines or haul roads. If necessary to park on an incline, position drill to prevent rolling, turn wheels into bank, and/or block securely. If parking on a haul road is required, pick the safest place.
	B) Runaway equipment.	B) Place controls in neutral position. Engage parking brake (unless this occurs automatically when machine is turned off).
	C) Engine damage.	C) Idle engine for a short period of time and shut it off.
	D) Slips and falls.	D) Dismount drill (see Job Step 2).
	E) Fire, explosion.	E) Do not smoke while fueling machine. Avoid fuel spillage. Gasoline operated machinery and engines must be shut off before being fueled.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
8. Complete drilling records/ reports.	8. A) Poor fragmentation in blast, hazardous highwall.	8. A) Maintain good drilling and blasting records. Inform shooter of hole penetration rates and other factors which may affect the blast.
	B) Flyrock.	B) Maintain effective communication with everyone concerned to eliminate any potential confusion prior to highwall shots.
	C) Hazards due to lack of communication.	C) Always inform appropriate personnel of any abnormal conditions, defects, changes made in machine, and/or job procedure or condition.
9. Nighttime operation.	9. A) Poor visibility.	9. A) During pre-shift inspection clean windows, mirrors, and all light lenses.
	B) Striking or catching persons, striking obstructions or machines.	B) Use headlights and/or operating lights at night or in cases of poor visibility, such as fog, rain, or snow.
	C) Ground failure.	C) Be sure to make a good inspection of the ground to be traversed, utilizing proper lighting.
10. Emergency procedures.	10. A) Power failure.	10. A) Place controls in the neutral position and secure the drill's position properly until power is restored.
	B) Lightning.	B) Suspend drilling activities when it is storming and lightning.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
10. (Continued)	C) Contact with power line.	C) Stay on drill until it is free of line, or power is disconnected. If you must leave machine, jump free - don't touch drill rig and ground at same time.
	D) Fire.	D) 1) Know escape (exit) routes off drill rig. 2) Stop operation and shut down engine. 3) Use fire extinguisher to extinguish small fire or aid escape from large fire. Warn anyone in the immediate area. 4) If time is available, sound audible alarm to notify other crew members and supervisors. 5) Leave the operator's cab and climb down the ladder. 6) Do not jump down unless the fire has covered the ladder areas. 7) Notify foreman/obtain firefighting assistance. 8) Proceed to fight fire under direction of foreman. 9) Machine should be deenergized as soon as possible.
11. Performing repairs and maintenance (if applicable).	11. A) Personal injury from improper procedure.	11. A) Do not attempt repairs or maintenance you do not understand. If a problem arises which requires electrical work, contact a qualified electrician or your supervisor.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
11. (Continued)	B) Increased seriousness of an injury.	B) Know the location and proper use of first aid equipment in case of emergency.
	C) Struck by flying objects; injured by slipping, dropped, or broken tools; scraped knuckles, electric shock.	C) Inspect all hand tools and portable power tools before using and maintain them in good condition. Controls of hand-held power tools must require constant hand or finger pressure to operate (or equivalent safety devices). Electric tools must have safely designed switches or other controls.
	D) Caught by or struck by moving or falling parts, or moving machine.	D) Lower all raised equipment and/or block against motion before servicing or repairing. Never work under a raised and unblocked load. Components being repaired and/or the entire drill should be blocked securely where there is any possibility of movement during repairs.
	E) Shock or electrocution, caught in moving parts.	E) Electrical equipment should be locked out and tagged prior to electrical or mechanical work.
	F) Caught in moving machinery.	F) Do not remove guards from moving machinery. Keep hands and clothing away from moving parts and do not work on moving machinery.
	G) Hot fluids, whipping hoses.	G) Relieve pressure from pressurized systems (hydraulic or air) before beginning repairs.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
11. (Continued)	H) Struck by falling or sliding material.	H) Take special precautions against groundfall hazards when work must be performed between immobilized machine and the highwall or spoil bank, where escape may be hindered.
	I) Caught in moving machinery.	I) Do not lubricate moving machinery unless extended grease fittings permit this to be done from a safe location.
	J) Struck by falling equipment.	J) When drill carriage is being worked on, it must be fully lowered or blocked in place. Hoist brake alone is not acceptable. Do not work under suspended tools or loads.
	K) Strains, sprains, ruptures.	K) Follow proper lifting procedures, using legs instead of back. Get help with heavy or awkward loads (see Module 16, "Manual Handling of Materials").
	L) Caught between load and stationary object, caught in pinch points.	L) Never position your body between an anchored object and a swinging load. Be constantly aware of pinch points which may trap hands and fingers.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
11. (Continued)	M) Fire or explosion, welding and cutting hazards.	M) Any repairs to drill rig or other machinery which require welding or cutting must be performed a safe distance from loaded holes and all other explosives (see Module 13, "Welding and Cutting"). Before repairs are made to vehicles used to transport explosives, remove all explosives and detonators.
	N) Caught in moving machinery.	N) Replace and secure all guards and other safety devices before the drill is operated.

GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the surface metal and nonmetal mining industry in conducting effective on-the-job training (OJT) of new employees, or employees reassigned to different jobs. The use of training materials, such as this module, is an important part of an effective, systematic, OJT program.

This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs," June, 1983.

TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site where the work will be done.

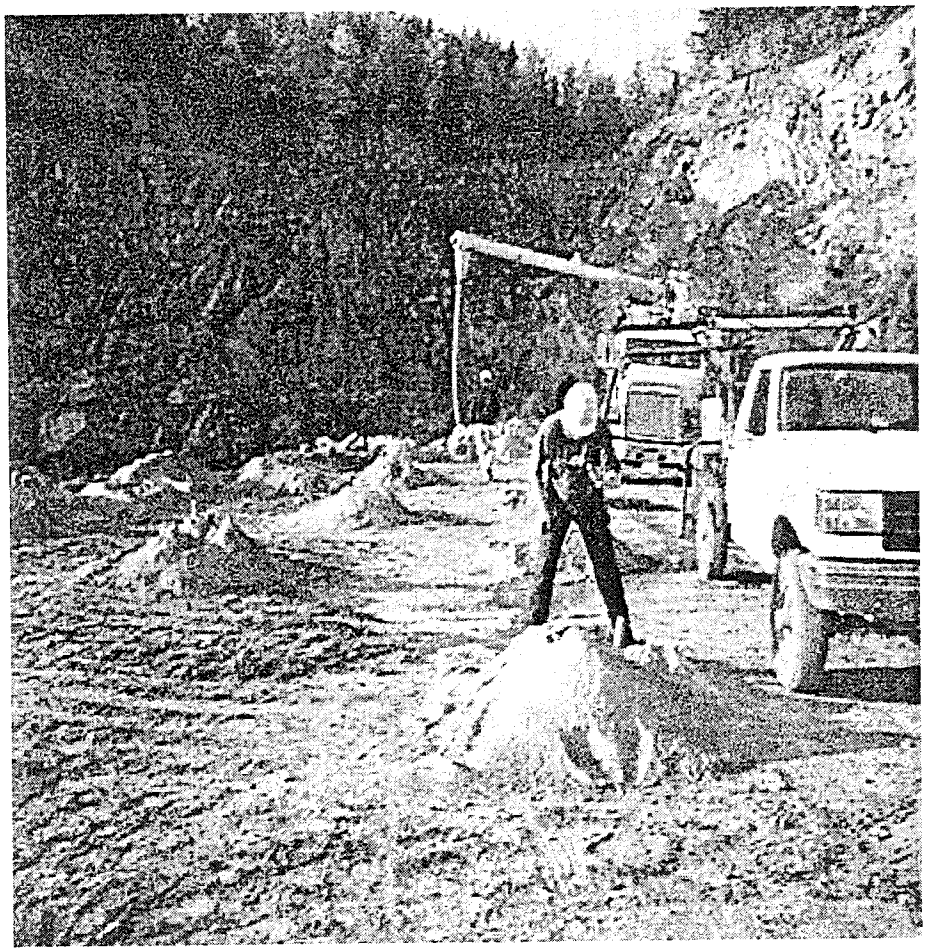
The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step – explaining the job to the employee – can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom or a quiet office for the first part of the training. Any general theory or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

MODULE NUMBER 11
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING
FOR
SURFACE METAL AND NONMETAL MINES

TRANSPORTATION, USE, AND STORAGE OF EXPLOSIVES



This module describes basic job steps, potential hazards and accidents, and recommended safe job procedures for the transportation, use, and storage of explosives, blasting agents, primers, and detonators.

Loading and blasting is normally done by a blaster, but a blaster may be assisted during loading by a driller or a general laborer. No one should handle explosives or blasting agents unless they are under the direct supervision of an authorized person. Blasting operations must be under the direct control of authorized persons. In many states, an authorized person must hold state certification, such as a blaster's certificate, or shot-firer's papers.

Quarry blasting may involve the use of various types of explosives, blasting agents, primers, and detonators. Although there are specific procedures for the safe use of each type of explosive and related products, the basic tasks can be categorized as storage, transportation, loading, and blasting.

STORAGE

Federal regulations require that detonators and explosives (other than blasting agents) be stored in magazines. The construction, location, inspection, and repair of a magazine is regulated by the Bureau of Alcohol, Tobacco, and Firearms. Appropriate regulations are found in 18 CFR, as well as 30 CFR.

Detonators provide the small, but powerful, explosion that initiates the blast. Detonating devices include blasting caps, detonating cord, and electrical detonators. Detonators must be stored in a separate magazine from explosives.

Magazines must be kept securely locked when unattended. Areas surrounding magazines, including blasting agent storage facilities, must be kept clear of trash, brush, and dry grass for a distance of not less than 25 feet.

Ammonium nitrate - fuel oil (ANFO) blasting agents must be physically separated from other explosives, safety fuse, or detonating cord that is stored in the same magazine; and, additionally, must be stored in such a manner that oil from the ANFO cannot contaminate the other materials.

Magazines must be posted with suitable danger signs, including "no smoking" signs. Signs must be located so that a bullet passing through any of the signs will not strike the magazines.

TRANSPORTATION

Explosives and detonating devices must be transported separately, or they must be separated by four inches of hardwood, or the equivalent, if they are transported in the same vehicle.

Smoking, or carrying smoking materials, is prohibited.

Vehicles used to transport explosives, other than blasting agents, must have substantially constructed bodies with suitable sides and tailgates, and must not have any sparking metal exposed in the cargo space. Explosives must not be piled higher than the side or end enclosures.

Any vehicle containing explosives or detonators must be posted with proper warning signs. Other materials or supplies must not be hauled with the explosives or detonators. Only necessary persons may ride in vehicles containing explosives or detonators. Vehicles containing explosives or detonators must not be taken to a repair shop or garage for any purpose.

Because of potential danger, all explosive materials should be handled carefully. Never drop, or roughly handle, packages containing explosives. For example, when loading explosives into vehicles, never attempt to carry more explosives than can safely be handled, and never throw explosive materials into a vehicle. Once loaded, a vehicle must never be left unattended.

When a vehicle containing explosives is parked, the brakes must be set, the engine must be shut off, and the wheels must be blocked securely against rolling.

The following safe job procedures will help to minimize incidents which could cause injuries and adversely affect production.

Required or recommended personal protective equipment:

Hard hat, safety shoes, safety glasses, gloves,
Hearing protection

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Pick up explosives.	1. A) Unmarked truck.	1. A) Place warning sign on truck.
	B) Material falling from truck.	B) Use tarp, or an enclosed truck.
	C) Sparking metal in truck.	C) Line bed of truck with plastic or wood, with no exposed nail heads.
	D) Fire.	D) Check fire extinguisher.
	E) Blasting caps in contact with explosives.	E) Place blasting caps in a separate wooden box.
2. Unload explosives.	2. A) Fire.	2. A) Keep explosives on the ground, and away from sources of heat. Do not allow any smoking.
	B) Impact.	B) Lower bags to the ground. Do not throw bags. Remove loose rock from highwalls.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. Place blasting caps.	3. A) Stray electric currents.	3. A) Place caps at least 90 feet away from electric pumps, radios, walkie talkie, etc. Keep caps shunted.
	B) Lightning.	B) Listen to weather forecast. Clear area if a storm approaches.
	C) Impact from falling materials.	C) Remove loose rock from highwalls.
	D) Impact from vehicles.	D) Keep vehicles out of blasting area.
	E) Falling.	E) Keep away from highwalls. Avoid walking backwards.
4. Load holes.	4. A) Drilling.	4. A) Never drill and load at the same time. Complete drilling before loading holes. Never move drilling equipment, or any other equipment, across blasting area.
	B) Sparking materials.	B) Use wood, or other non-sparking material, for a punch and for tamping poles.
	C) Improperly loading holes.	C) Follow loading instructions of supervisor.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. Preparing primer.	5. A) Not placing detonator securely in primer.	5. A) Put blasting cap through primer and out other side, and bring the cap in again from the other side. Make sure cap is enclosed in primer and cannot be pulled out.
	B) Detonation while lowering cap and primer into hole.	B) Put some blasting agent into the hole first, so cap does not settle into dust at bottom of hole. Do not force blasting cap and primer into hole. Do not redrill around loaded hole.
6. Clear blasting area and prepare for blasting.	6. A) Full bags of explosives left on blasting site.	6. A) Clear blasting area of all material before blasting.
7. Tie series together with circuit board.	7. A) Failure to properly tie series.	7. A) Wires should be tied together only at copper ends. Only blasters are to tie wires.
	B) Lost caps and explosives.	B) Keep accurate records.
8. Testing circuit continuity.	8. A) Inadequate wire.	8. A) Use 20 gauge copper wire. Use single wire. Do not reuse.
	B) Initiate from testing device.	B) Use only device made for testing blasting circuits.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
9. Set off explosives.	9. A) People walking or driving into blasting area.	9. A) Clear area, post guards, and sound warning siren. Post and communicate blasting times.
	B) Employees struck by fly-rock.	B) Post guards at safe distances. Blasters must have adequate shelter. Use warning siren.
10. Inspect blast area.	10. A) Live explosives.	10. A) Supervisor should check for misfires, and handle appropriately.
	B) Falling rock.	B) Loose rock must be scaled.

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MODULE NUMBER 12
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

FIELD MAINTENANCE OF SURFACE MACHINERY

This module describes the basic job steps, potential hazards or accidents, and recommended safe job procedures for field maintenance of surface metal and nonmetal mining machines.

Good preventive maintenance and repairs are essential to the safe, productive, and economical operation of surface machinery. Many maintenance and repair operations can be performed at the job site, without the necessity of removing the machine to a shop.

Field maintenance is performed by such personnel as mechanics, electricians, and their helpers; and by greasers or oilers, and the operators of various machines. Maintenance/repair work may involve:

1. Inspecting, troubleshooting, evaluating condition
2. Towing
3. Deenergizing, securing, releasing pressure
4. Removing and replacing guards or safety devices
5. Lubrication
6. Manual or powered materials handling
7. Use of hand and power tools
8. Welding and cutting
9. Changing component parts
10. Inspecting and testing completed work

Maintenance work is hazardous in comparison to other surface mining jobs. Mechanics and helpers have among the highest, if not the highest, rate of nonfatal injuries at surface mines. Common types of accidents involve material handling, suspended loads, hand and finger injuries, falling material, caught by moving or falling equipment, flying objects, slipping or broken tools, and caught between objects.

The underlying causes of maintenance accidents involve both the nature of the work and the attitudes and circumstances surrounding the work. If machines are inoperative and production must cease until repairs are made, there may be pressure (either conscious or subconscious) to take shortcuts and work hurriedly. Sometimes machine operators or others may attempt repairs they are not qualified to perform. Poor communication with co-workers, and assuming too much about what co-workers will or will not do, cause many maintenance accidents. Maintenance workers should be the first to admit they don't understand something, and should not hesitate to ask machine operators, or others, for help. Experienced maintenance workers must guard against overconfidence. Having gotten away with taking a chance in the past is no indication that good luck will continue.

Hazards inherent in maintenance work include a great deal of material handling, both manual and powered. Maintenance personnel must wear protective equipment and utilize proper lifting and moving procedures to prevent manual handling injuries. They must know

and exercise safe inspection and operational procedures for any powered handling equipment they may be using, such as truck cranes. Improperly used and poorly maintained hand and power tools cause many maintenance injuries. Maintenance people must inspect, maintain, and properly use their tools as well as the larger equipment they work on. Without proper tools, repairs are more difficult and the risk of injury is increased.

Unsafe position is a cause or contributing factor in many maintenance accidents. The safest way in which to position oneself during various steps of the job is not always obvious. Certainly one should not position any part of the body under suspended or raised loads which are not properly blocked or mechanically secured. Each maintenance or repair situation requires thought, however, as to what could slip, shift, break, or otherwise move and in what direction the movement could occur. Then a conscious effort is required to remain out of line of potential movement or pinch points.

Field maintenance operations are so numerous and varied that it is impossible for this module to contain specific procedures for each task. Instead, an attempt is made to include general procedures and precautions which may be applied to most maintenance tasks.

The basic job steps included in this module are:

1. Travel to machine in need of repair or maintenance.
2. Be sure machine is properly parked and secured.
3. Evaluate condition.
4. Tow machine (or have towed) if necessary.
5. Get on and off mobile equipment.
6. Perform repairs.
7. Remove and replace component parts as needed.
8. Perform routine maintenance and lubrication.
9. Replace all guards and shields and restore all safety devices.
10. Inspect and test completed work.

Note: Refer to Module 13, "Welding and Cutting"; Module 14, "Inspecting and Replacing Wire Ropes (Cables)"; Module 16, "Manual Handling of Materials"; and Module 17, "Prevention of Slip and Fall Accidents" as needed during OJT of maintenance personnel.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment

Hard hat, safety shoes, safety glasses with side shields, gloves, snug fitting clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Travel to machine in need of repair or maintenance.	1. A) Slipping or tripping, flying objects such as dirt or splashed fluids, caught in pinch points.	1. A) Conduct a pre-shift inspection of the vehicle to include slipping and tripping hazards, tires and wheels, surrounding area for people or obstructions, engine compartment, fluid levels, leaking or broken hoses and lines, fire extinguisher, steps, cab, windows and mirrors, seat belts, instruments and gauges, horn, engine operation, wipers and lights, and brakes and steering.
	B) Collisions, loss of control.	B) Follow traffic rules and adjust speed for conditions.
	C) Being struck or run over by heavy machines, caught in moving machinery.	C) Be sure machine operator is aware of your presence by visual contact, radio, or other means.
	D) Being struck or run over by heavy machines, runaway vehicle.	D) Park well in the clear of operating machines. Set parking brake. If on a grade, block wheels or turn into bank.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. Be sure machine is properly parked and secured.	2. A) Caught by rolling machine, crushed by falling buckets, etc.	2. A) See that buckets, bowls, etc. are lowered. Verify that parking brake is set and controls are in the neutral or shutdown position.
	B) Machine rolling during repair, operations disrupted.	B) Select a safe and easily accessible location (if possible). Mobile equipment that can be moved should be repaired on level ground out of the way of other operations. Advise others of your intentions.
	C) Rock fall or slide.	C) Reposition machine as necessary to avoid working between machine and the pit wall or bank where escape may be hindered.
	D) Caught by rolling machine.	D) Block wheels securely, especially if on a grade or if maintenance operation could possibly cause release of brakes, transmission, etc. Keep yourself to the side when installing and removing wheel blocks.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	E) Struck by falling equipment, falling from raised equipment, inadequate blocking.	E) Lower any raised parts which can be lowered. If necessary to perform work on top of, under, around, or from a raised piece of equipment, block or mechanically secure the equipment to prevent accidental rolling, falling, or lowering. Good blocking materials for most purposes include solid banks, berms, wooden crib blocks, solid concrete blocks, or specially designed locking devices, pins, etc. Cinder blocks are inadequate for many purposes.
	F) Shock, electrocution, caught in moving parts if equipment is started.	F) Power switches must be locked out and tagged before electrical or mechanical work is to be done on electrically powered equipment.
	G) Someone starting machine while repairs are underway.	G) Place warning tags on steering wheel or other prominent location, and remove ignition key.
	H) Slips and falls, rock falls or slides, fires.	H) Visually inspect work area for potential hazards. Remove debris and combustible material from job site.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	I) Struck by moving machine, caught in moving parts.	I) If equipment must be running or moving to evaluate condition, or to complete certain portions of the repair, exercise extreme caution and have good communications with everyone involved.
3. Evaluate condition.	3. A) Being struck by or caught in machinery.	3. A) If watching machine in operation, have good communications with operator and stay in a safe position.
	B) Loss of control, striking others with machine, machine damage.	B) Do not operate machine unless you are properly trained and qualified to do so.
	C) Caught in moving machinery, shock, electrocution.	C) Do not perform repairs or maintenance until the power is off and the machinery is locked out and tagged and blocked against motion, except where machinery motion is necessary for trouble-shooting, or to make adjustments.
	D) Caught in moving machinery, shock, electrocution.	D) Lock out and block against motion before guards or covers are removed from moving parts or electrical circuitry.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. Tow machine (or have towed) if necessary.	4. A) Runaway machine, loss of control.	4. A) Obtain assistance as needed for towing. Be sure the vehicle used is large enough and powerful enough to handle the job.
	B) Loss of control.	B) Do not operate any towing machine you are not trained and qualified to operate.
	C) Loss of control after machine is returned to service.	C) When towing requires disabling any failsafe brake systems or other safety devices, be sure they are restored to operative condition before the machine is returned to service.
	D) Failure of towing attachment, runaway machine.	D) If a machine must be towed, a properly sized tow bar or equivalent must be used. Unless steering and braking are under the control of an operator on the towed machine, a suitable safety chain or wire rope must be used along with primary rigging. Use proper connecting links to attach tow bar. Connections should be of soft (not brittle) steel which will bend or stretch, rather than break, upon impact.
	E) Tow bar failure, equipment damage.	E) Use a smooth, steady pull when towing. Do not snatch and jerk machine.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	F) Loss of control, machine damage.	F) Watch contour of ground carefully when towing. Use of makeshift towing equipment should be avoided.
5. Getting on and off mobile equipment.	5. A) Slips and falls.	5. A) Maintain access areas, ladders, etc. free of excess oil and grease.
	B) Fall from higher level, clothing caught on control levers or other projections.	B) Wear personal protective equipment (proper footwear) and snug fitting clothing. Keep steps and boots free of mud, ice, snow, grease, and oil.
	C) Falling to same level.	C) Do not get on and off moving equipment.
	D) Falls, strains.	D) Use proper techniques for mounting and dismounting.
	E) Falling while climbing ladder.	E) Use belt hooks, pockets, etc. to carry material up ladders and keep both hands free for climbing. Ropes can be used to hoist bulkier items. Face ladder and use three points of contact when climbing (two hands and one foot, or two feet and one hand, in contact with ladder at all times). Use handholds and select firm footing. Avoid haste and projections.
	F) Fall from higher level.	F) Do not use machinery as work platform.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	G) Equipment failure.	G) Report and/or repair damage to access components.
6. Perform repairs.	6. A) See Job Step No. 2.	6. A) Be sure machine is properly parked and secured (see Job Step No. 2).
	B) Personal injury from improper procedure.	B) Machine operators should not attempt repairs or maintenance they do not understand and are not trained to do.
	C) Whipping of pressurized hoses when disconnected, burns from hot hydraulic fluid, mechanical movement caused by release of pressure.	C) Ensure that pressure is relieved from air and hydraulic systems before any attempt to disconnect or repair hoses, cylinders, motors, etc.
	D) Fall to a lower level.	D) Use safety belt or harness and line where there is a danger of falling (when work must be done at an elevated location unprotected by railings).
	E) Injury or equipment damage from use of improper tools.	E) Select, inspect, and use the proper tools for the job. Do not use tools with mushroomed heads, loose or cracked handles, etc.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	F) Persons below being struck by falling objects, trips and falls.	F) Do not leave tools or other objects lying around loose where they could fall on someone. Rope off area, use screens, etc., if necessary, for adequate protection of those working or passing below. Do not leave tools or other objects lying around in walkways.
	G) Strains, sprains, dropping parts.	G) Utilize any substantial work stands or platforms available to minimize reaching and lifting.
	H) Machine damage, personal injury.	H) Follow company and manufacturer's policy, procedures, and safety rules for the specific repair being made.
	I) Premature failure of machinery.	I) Follow manufacturer's recommendations for replacement parts, fluids and lubricants, torque values, etc.
	J) Dirt falling into electrical boxes or mechanical parts.	J) Clean and inspect cover plates before removal.
	K) Crushed fingers or hand.	K) Keep hands, fingers, and other parts of body out of pinch points.
	L) Burns, getting fluids in eyes.	L) Avoid burns from hot bearings, hot hydraulic fluid, etc. Allow to cool if possible. Wear gloves where possible. Wear safety glasses.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	M) Hand injuries, damaging bolt heads or threads.	M) When using a wrench, seat it firmly and use steady controlled force. Avoid jerking the wrench.
	N) Flying objects in eyes.	N) Always wear safety glasses when striking objects with a hammer.
	O) Cuts, scrapes, bruises.	O) Wear gloves to handle metal parts and when using tools.
	P) Injuries or unsuccessful repairs because of lack of communication.	P) Maintain good communication with all co-workers. Tell them what you're about to do if it could cause machine movement or other hazards.
	Q) Struck by moving machinery or ropes.	Q) Assume a safe position out of direct line of potential motion of parts. Do not position yourself in the inside radius or in direct line of wire ropes being used for pulling.
	R) Skin cancer.	R) Avoid excessive skin contact with lubricants, especially penetrating oil. Use of barrier creams, waterless hand cleaner, or soap and water can minimize this hazard.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	S) Electrocution, burns, equipment failure.	S) Be sure all electrical equipment, switches, breakers, controls, panels, guarding, etc., is in proper operating position and in good condition. Never perform any electrical work or enter any energized electrical panels or cabinets unless you are qualified. Be sure to lock out and tag the equipment or circuit.
	T) Shock, equipment damage.	T) Use properly sized and rated material for the job, such as fuses and connectors.
	U) Personal injury, equipment damage.	U) Never bridge or jumper out any safety device.
	V) Electric shock, equipment damage or unexpected movement.	V) Never change wiring from the original prints or schematics.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. (Continued)	W) Struck by exploding lock ring or other parts of rim, crushed under weight of wheel assembly, strains, sprains	W) Use extreme caution when working with tires and multi-piece rims. 1. Completely deflate tires by removal of the valve core: a) before removal from machine, b) before dismounting, c) when the tire has been driven under-inflated at 80% or less of its recommended pressure, and/or d) when there is obvious or suspected damage to the tire or wheel components. 2) Be sure components are properly matched and undamaged. 3) Use inflation cages, long inflation hoses, adequate lifting and handling and dismounting tools. 4) Do not attempt to correct the seating of side and lock rings by hammering, striking or forcing the components while the tire is pressurized. 5) Stay out of the potential path of an exploding wheel assembly as much as possible during your work.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
7. Remove and replace component parts as needed.	7. A) Strains, sprains, ruptures, overexertion.	7. A) Use proper lifting procedures (see Module 16, "Manual Handling of Materials"). Obtain help when load may be too heavy.
	B) Failure of lifting device.	B) Carry and use lifting devices - jacks and hoists - to the extent possible, to avoid manual lifting. Inspect these devices regularly.
	C) Struck or caught by component falling off unexpectedly.	C) Be sure component being removed is secured or blocked as last bolts or nuts are removed.
	D) Strains, sprains, crushed or lacerated fingers.	D) Before removing a part, be sure it does not weigh more than you can handle. Stand in close to the part and be sure of good footing. Get help in advance if you think it may be needed.
	E) Failure of hoist or rigging.	E) Stay clear of suspended loads.
	F) Caught between hoisted load and stationary object.	F) Use taglines when hoisted objects require steadying or guidance. Stay out of confined areas where you could be caught between a swinging load and a stationary object.
	G) Crushed hand or fingers.	G) Keep hands and fingers clear of pinch points when lowering or placing parts.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
8. Perform routine maintenance and lubrication.	8. A) Machine damage, unscheduled downtime.	8. A) Perform scheduled preventive maintenance on all machinery in accordance with company policy and/or manufacturer's recommendations.
	B) Various hazards depending on specific job.	B) Some items which are commonly involved in routine maintenance and inspection schedules for mobile equipment include: 1) engine oil 2) tire condition 3) windshield washer level and wipers 4) lights 5) fan belts 6) coolant level 7) battery 8) fire extinguisher 9) emergency flares 10) first aid kit 11) all filters 12) brake adjustments 13) wheel balance and alignment 14) linkages greased 15) backup alarm
	C) Caught in moving machinery.	C) Do not lubricate moving equipment where any hazard exists, unless extended fittings or cups are provided. Otherwise, shut it down, lock it out, and block against motion.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
9. Replace all guards and shields and restore all safety devices.	9. A) Caught in moving parts, equipment damage.	9. A) Secure all guards, covers, and shields which protect people and equipment.
	B) Fire hazard, slipping hazard.	B) Remove any accumulations of oil and grease.
	C) Losing tools or equipment, trips and falls, struck by falling objects.	C) Be sure tools, old parts, or other objects are returned to proper storage or disposed of. Be especially careful not to leave objects in walkways or at elevated locations. Keep tools clean.
10. Inspect and test completed work.	10. A) Equipment failure, unguarded machinery, tripping hazards, losing tools.	10. A) Inspect completed work to ensure that all bolts are tightened, guards replaced, tools removed, etc.
	B) Machine damage if started with blocking in position.	B) When job is complete, remove blocks, remove locks and tags, and restore power.
	C) Machine reacting in an unexpected manner.	C) Operator should be at the controls of the machine. Other workers or observers should position themselves in a safe area before any operation of the machine. Once the machine reaction has been determined, further testing may continue.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
10. (Continued)	D) Improper operation, inoperative safety devices.	D) A final test of proper operation should be given to the equipment, including proper grounding system if applicable, before the equipment is put back into service.
	E) Recurrence of preventable damage or repairs.	E) Discuss potential causes of the damage, if applicable, with machine operators or others to prevent recurring repairs.
	F) Disrupting work schedule.	F) Notify other workers and foreman that equipment is repaired and is returning to service.
	G) Machine damage from lack of maintenance, performing unnecessary maintenance due to lack of records.	G) Keep proper maintenance records.

GENERAL INFORMATION

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This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs," June, 1983.

TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site where the work will be done.

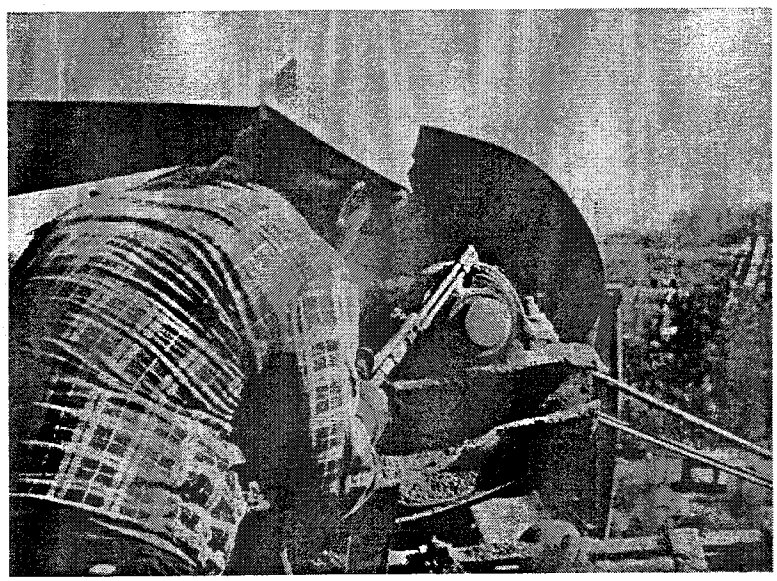
The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step – explaining the job to the employee – can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom or a quiet office for the first part of the training. Any general theory or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels, or other conditions at the job site, make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

MODULE NUMBER 13
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING
FOR
SURFACE METAL AND NONMETAL MINES

WELDING AND CUTTING



This module describes basic job steps, potential hazards and accidents, and recommended safe job procedures for welding and cutting.

Welding and cutting is done during repair or modification of existing equipment, and during construction of new equipment. Welders must protect themselves, and others, from accidents and injuries that might occur due to welding and cutting operations.

Welding is essential to the expansion and productivity of mining companies. Welding is one of the principal means of fabricating and repairing metal products. It is almost impossible to name an industry that does not use some type of welding. Welding is an efficient, dependable, and economical method of joining metal. Gas welding and arc welding are the most commonly used methods of welding.

For gas welding, intense heat is generated by the combustion of gas - usually acetylene and oxygen. The welder uses the oxyacetylene equipment to control and direct the heat on the edges of the metal to be joined, while applying a suitable metal filler. The gas welder may also do flame cutting, with a cutting attachment and extra oxygen pressure. Flame, or oxygen, cutting is used to cut various metals to a desired size or shape, or to remove excess metal from castings. Gas welders need to adjust regulators, select proper tips and filler rods, prepare metal edges to be joined, and properly manipulate the flame and the filler rods.

For arc welding, intense heat is generated by a high amperage electric arc between an electrode and the metal pieces to be joined. Molten metal from the tip of the electrode is deposited in the joint, together with molten metal from the edges of the pieces to be joined. This metal solidifies to form a sound, uniform connection. Arc welders need to properly select electric currents, select electrodes, prepare the metal edges to be joined, and manipulate the electrodes.

Welders are usually classified as skilled, or semi-skilled. Skilled welders have the ability to plan, lay out work from drawings or written specifications, and weld all types of joints in various positions. Skilled welders also have a wide range of technical knowledge involving properties of metals, effects of heat on welded structures, control of expansion and contraction forces, and recognition of welding defects. A skilled welder may be proficient in several types of gas and arc welding processes. As a rule, when the quality and strength of a weld is critical, skilled welders are certified by their employer, a government agency, or an inspection authority for the particular welding job they are required to perform.

Semi-skilled welders usually do repetitive work, which usually does not involve critical strength requirements. They usually start on simple production jobs, and gradually work up to higher levels of skill. They primarily weld surfaces only in upright positions.

Welding equipment should not be used until exact instructions on its operation have been received. Manufacturer's recommendations are very important, and should be followed at all

times. Attempting to operate a piece of equipment without instruction may damage the equipment, or result in serious injury. Welding equipment is safe to use when it is used in the proper manner.

Welding must be done in a well ventilated area. There must be sufficient movement of air to prevent the accumulation of toxic fumes, or the possibility of oxygen deficiency. Adequate ventilation is extremely critical in confined spaces where dangerous fumes and smoke are likely to collect. Where considerable welding is done, an exhaust system may be necessary in order to keep toxic gases and fumes within prescribed health limits. An adequate exhaust system is especially important when welding or cutting zinc, brass, bronze, lead, cadmium, or beryllium bearing metals. Fumes from these materials are very hazardous.

Sparks, and dangerous ultraviolet and infrared radiation, are generated by any welding or cutting operation. Consequently, suitable clothing and proper eye protection are necessary. Sparks may lead to serious burns. Radiation is extremely dangerous to the eyes. Welders should know that these dangers exist during any welding operation, and know the safe practices to follow to prevent personal injury.

Sufficient precaution should be taken to ensure that containers that are to be welded or cut are safely vented. Accumulated air or gas in confined areas will expand when heated. The enclosed pressure may build up and cause an explosion. Welding and cutting should not be done on used drums, barrels, tanks, and other containers unless they have been thoroughly cleaned of all combustible substances that may produce flammable vapors or gases. Flammable and explosive materials include gasoline, light oil, and non-volatile oils or solids that release vapors when heated. Containers of acids that can react with metals to form hydrogen gas must be thoroughly cleaned before welding or cutting.

Containers can be cleaned by flushing several times with water, chemical solutions, or steam. Water cleaning is satisfactory if the substance in the container is readily soluble in water. For all less soluble substances, containers should be cleaned with a strong commercial caustic cleaning compound, or by blowing steam into the container.

Fires often occur as a result of cutting operations because proper precautions are not taken. Sparks and falling slag can pass through cracks out of sight of the welder. Persons responsible for welding and cutting should observe the following precautions:

1. Never use a cutting torch where sparks will be a hazard, such as near rooms containing flammable materials - especially dipping and spraying rooms.

2. If cutting is to be done over a wooden floor, sweep the floor clean and wet it down before starting the cutting. Provide a bucket or pan containing water or sand to catch dripping slag.

3. Keep a fire extinguisher nearby whenever any cutting is done.

4. Whenever possible, perform cutting operations in open areas so sparks and slag will not become lodged in crevices or cracks.

5. If cutting is to be done near flammable materials, and the flammable materials cannot be moved, suitable fire-resistant guards, partitions, or screens must be used.

6. Practice good housekeeping - reduce any potential for fires and explosions by keeping work areas clean of combustible and flammable materials.

7. Keep flames and sparks, and grease and oily rags away from oxygen cylinders and hoses.

8. Never do any cutting near ventilating system intakes that could result in others being exposed to fumes.

9. Always have standby watchers nearby with fire extinguishers if the risk of fire is great.

10. Never use oxygen to dust off clothing or the work area.

Arc welding includes shielded metal-arc, gas shielded-arc, and resistance welding. Only general safety measures can be listed for arc welding because equipment varies considerably in size and type. Specific manufacturer's recommendations should be followed. Safety practices that are, in general, common to all types of arc welding operations include:

1. Install welding equipment in accordance with provisions of the National Electric Code.

2. Be sure that a welding machine is equipped with a conveniently located power disconnect switch so that power can be shut off quickly.

3. Be sure that power to welding equipment is locked-out before making any repairs to the welder. High voltages used for arc welding machines can inflict fatal injuries.

4. Properly ground welding machines. Stray current may develop which can cause severe shock if ungrounded parts are touched. Do not ground to pipes that carry gases or flammable liquids.

5. Keep connections tight between cables and electrode holders. Do not use electrode holders with defective jaws, or poor insulation.

6. Do not change the polarity switch while the welding machine is under load. Wait until the

machine idles and the circuit is open. Otherwise, the contact surface of the switch may be burned, and the person throwing the switch may receive a severe burn from the arcing.

7. Do not operate range switch under load. The range switch, which determines the current setting, should be changed only while the machine is idling and the circuit is open. Switching the current while the machine is under load will cause an arc to form between contact surfaces.

8. Weld only in dry areas, or use a dry board or rubber mat to stand on. Keep hands and clothing dry at all times. Never stand or lie in puddles of water, on damp ground, or against grounded metal when welding.

9. If other persons work nearby a welding site, the welding site must be partitioned off to protect people from the arc welding flash. Do not strike an arc if someone without proper eye protection is nearby.

10. Be careful not to touch pieces of hot metal which have just been welded or heated.

11. Make sure all hollow castings are properly vented before heating, in order to avoid an explosion.

12. Be sure that press-type welding machines are effectively guarded.

13. Be sure that suitable spark shields are used around equipment when flash welding.

14. When welding is completed, turn machine off, pull power disconnect switch, and hang electrode holder in its designated place.

Remember, accidents do not just happen. Invariably, they occur because of indifference to safety rules and regulations, and lack of information or effective training. Injury of any kind is painful, and very often can incapacitate a person, or even produce a permanent deformity. If more thought were given to the consequences of injuries, there would be less tendency to ignore safety precautions and, therefore, fewer accidents.

The following safe job procedures will help to minimize incidents that may cause injuries, and adversely affect production:

Required and/or recommended personal protective equipment:

Hard hat, steel toed shoes, welder's shield (hood) or goggles, long cuff gloves, protective clothing, leg bands, respirator, hearing protection

I. WELDING ON CONTAINERS, TANKS, AND OTHER OBJECTS

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Check work area.	1. A) Struck by equipment, or caught between equipment and stationary objects.	1. A) Notify equipment operators of your presence and your work plan. Be sure that nearby equipment is shut down and secured in place. Post warning signs. Barricade area.
	B) Fire.	B) Be sure fire extinguishing equipment is available at site.
2. Prepare container, tank, or other objects for work.	2. A) Exposure to bad weather conditions.	2. A) Dress for the weather. Do not arc-weld if weather creates shock hazard.
	B) Exposure to noxious fumes or harmful liquids.	B) Determine type of material stored in tank or container. Determine safe procedure to vent or drain liquids or gases.
	C) Skin contacted by harmful liquids or gases.	C) Wear gloves and proper protective clothing.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	D) Eye injury.	D) Wear goggles, or safety glasses with side shields, or full face shield, as appropriate.
	E) Hand injury due to tool slipping.	E) Use tool designed to open the type of plug, cap, or vent involved. Hold tools securely, and use controlled force.
	F) Overexertion or strain.	F) Get help with tanks, welder, or heavy parts.
	G) Explosion or fire.	G) Be sure tank or container is properly vented and cleaned before applying heat.
3. Hook up torch or welder.	3. A) Explosion or fire.	3. A) Check for worn places on hoses, and be sure cylinders are secured in upright position.
	B) Contact with electricity, or sharp metal.	B) Wear gloves, and avoid contact with non-insulated electrical parts.
	C) Hand or arm injury.	C) Use proper cylinder tools and controlled force.
	D) Struck by dropped tools or parts.	D) Hold tools and parts securely.
	E) Struck by compressed gas.	E) Stand clear of compressed gas stream, and crack valves slowly to blow out foreign material. Do not stand in front of regulator.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	F) Eye injury.	F) Wear goggles, or safety glasses with side shields, or full face shield.
	G) Electrical shock.	G) When arc welding, have material well grounded and securely clamped. Keep arc welding cables dry, free of grease and oil, and away from power cables. Do not weld in rain without taking proper precautions.
4. Light torch or energize welder.	4. A) Struck by compressed gas.	4. A) Turn torch away from yourself and others nearby.
	B) Burns.	B) Use a proper torch lighter (striker).
5. Perform welding on object.	5. A) Burns.	5. A) Blow metal away from body. Wear long cuff gloves, and adequate clothing.
	B) Exposed to arc, flash, or heat rays.	B) Wear adequate clothing. Use proper cutting goggles or welding shield (hood), depending on type of work. Provide protective barriers in area to protect other workers.
	C) Inhalation of toxic fumes.	C) Use ventilation system and/or respirators provided.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. Turn arc welding machine off, or extinguish torch and turn off tank valves.	6. A) Electrical shock, or hand and arm injury.	6. A) Turn switch off and reel in leads, or use proper cylinder tools.
7. Check for fire and remove hot parts.	7. A) Burns - contact with hot metal parts.	7. A) Wear gloves and handle hot parts with tongs.
	B) Fire, smoke, or explosion.	B) Search for fire or any smouldering areas. Wet down area with water, if available. Have fire extinguisher immediately available.
8. Disassemble hoses and gauges from tanks.	8. A) Striking gauges or other protruding objects.	8. A) Observe and avoid projections.
	B) Hand or arm injuries.	B) Use proper cylinders tools and seat them firmly.
	C) Struck by dropped tools or parts.	C) Hold tools and parts firmly.
9. Transport cylinders and hose to storage area.	9. A) Strains.	9. A) Get help, if needed, to handle or move cylinders.
	B) Slipping and tripping hazards.	B) Keep travelways clear.
	C) Explosion hazard.	C) Caps should be in place and hand tightened.

II. CUTTING WITH AN ACETYLENE TORCH

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Check work area.	1. A) Struck by equipment or caught between equipment and stationary objects.	1. A) Be sure nearby equipment is shut down and blocked against movement. Notify operators of equipment of your presence and work plan. Barricade off your work area.
	B) Fire.	B) Be sure that fire extinguishing equipment is readily available.
2. Hook up gauges and torch.	2. A) Explosion or fire.	2. A) Check for worn places on hoses, and be sure cylinders are secured in upright position.
	B) Hand or arm injury.	B) Use proper cylinder tools and controlled force.
	C) Struck by dropped tools or parts.	C) Hold tools and parts securely.
	D) Struck by compressed gas.	D) Stand clear of compressed gas stream, and crack valves slowly to blow out foreign material. Do not stand in front of regulators.
	E) Eye hazard.	E) Wear goggles, or safety glasses with side shields.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. Light acetylene torch.	3. A) Caught on protruding objects.	3. A) Wear gloves and snug fitting clothing.
	B) Dust or other material blown into eye.	B) Wear goggles.
	C) Struck by compressed gas.	C) Turn torch away from yourself and others nearby.
	D) Burns.	D) Use a torch lighter.
4. Cut material.	4. A) Exposed to heat from torch.	4. A) Wear adequate clothing and long cuff gloves.
	B) Inhalation of toxic fumes.	B) Use ventilation system and/or respirators provided.
	C) Struck by material being cut.	C) Stand clear of path of falling material.
	D) Contacted by hot slag.	D) Direct cutting action away from body or anyone close by.
	E) Contact with hot metal.	E) Wear gloves. Handle small hot parts with tongs.
	F) Fire or explosion.	F) Keep all connections tight. Keep torch and hoses in good repair and free of oil and grease. Keep hoses where sparks and slag will not contact them.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. Extinguish torch and turn off tank valves.	5. A) Hand and arm injury.	5. A) Use proper cylinder tools and seat them firmly.
6. Check for fire, and remove hot parts.	6. A) Burns - contact with hot metal parts.	6. A) Wear gloves and handle hot parts with tongs.
	B) Fire, smoke, or explosion.	B) Search for fire or any smouldering areas. Wet down area with water, if available.
7. Disassemble hoses and gauges from tanks.	7. A) Striking gauges or other protruding objects.	7. A) Observe and avoid projections.
	B) Hand or arm injuries.	B) Use proper cylinders tools and seat them firmly.
	C) Struck by dropped tools or parts.	C) Hold tools and parts firmly.
8. Transport cylinders and hose to storage area.	8. A) Strains.	8. A) Get help, if needed, to handle or move cylinders.
	B) Slipping and tripping hazards.	B) Keep travelways clear.
	C) Explosion hazard.	C) Caps must be in place and hand tightened. Cylinders must be secured in proper storage place.

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MODULE NUMBER 14
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING
FOR
SURFACE METAL AND NONMETAL MINES

INSPECTING AND REPLACING WIRE ROPES

This module describes basic job steps, potential hazards and accidents, and recommended safe job procedures for inspecting and replacing wire ropes. The term "wire rope" is used in this module, rather than "cable," to avoid any possible confusion with electrical cables. This module is not intended to cover wire ropes that are used for hoisting persons.

In the sand, gravel, and crushed stone industry, wire ropes are used primarily on draglines, power shovels, and drilling equipment. Wire ropes and wire rope slings are used on cranes and hoists of various types.

Wire ropes deteriorate and will break if left in service long enough. Causes of rope deterioration may include wear, peening (hammer action), corrosion, bending, flexing, kinking, crushing, overloading, and heat damage.

Companies must provide for wire rope inspection and timely replacement. The purpose of the inspection program should be to obtain all possible service from wire ropes while maintaining an adequate degree of safety. Wire rope replacement is costly, but if a wire rope breaks in service, there are risks of serious injury, equipment damage, and lengthy production delays.

Wire rope breakage can pose hazards to equipment operators and persons working nearby. Persons can be injured by falling equipment and material, or by the whipping (backlash) action of the broken rope.

Wire rope failures can be fatal, although disabling injuries are more common. Two examples of fatal accidents follow:

> A dragline operator at a sand and gravel operation was killed when the pendant rope of the dragline broke and backlashed through the cab window.
>
> A cement plant worker was killed when the boom hoist rope of a mobile crane broke, dropping the crane boom on him.

Much of the hazard of wire rope breakage can be eliminated by following a few simple safety rules:

1. Always assume a wire rope could break at anytime.

2. Do not work or pass under the buckets or booms of shovels, draglines, or cranes in operation.

3. Stay clear of suspended loads.

4. Do not ride on or in dippers, clamshells, hoisted loads, hoisting hooks, buckets, or similar hoisting items, unless special provisions for hoisting personnel, in accordance with safety rules and regulations, are followed.

Even if the above precautions are observed, safety also depends on proper wire rope maintenance and inspection procedures, and the timely removal from service of worn or damaged wire rope.

Federal mining regulations contain few requirements relating directly to inspection and replacement of wire ropes that are not used to hoist persons. Some general federal requirements, however, do apply to such wire rope. Self propelled equipment, which is to be used during a shift, must be inspected by the equipment operator before being placed in operation. Equipment defects affecting safety must be corrected before the equipment is used. Unsafe machinery and equipment must be removed from service immediately.

Additional information and guidance on wire rope inspection and replacement can be obtained from:

1. American National Standard for Wire Rope for Mines, ANSI M11.1, and other ANSI Standards relating to specific types of equipment.

2. Occupational Safety and Health Administration (OSHA) Standards for General Industry (29CFR 1910) and Construction Industry (29CFR 1926).

3. State regulations.

4. Wire rope and equipment manufacturer's specifications.

5. Safety rules of various associations and various companies.

Each company should have a wire rope inspection program which establishes inspection personnel, procedures, and frequency; and provides for reporting and record keeping. An effective inspection program should establish two general types of inspections:

1. Frequent inspections - visual wire rope inspections conducted by equipment operators before, during, and after equipment use, in conjunction with routine inspection of other equipment components.

2. Periodic inspections - careful and detailed wire rope inspections, including diameter measurements, conducted by a person who has extensive knowledge, training, and experience in the inspection of wire ropes and related equipment. The procedures used, and the inspection frequency for each wire rope, will vary depending on operating conditions, anticipated rope life, and critical nature of service.

In addition to inspecting wire rope itself, wire rope inspections should also include rope terminations (end attachments) at both ends of the particular rope and items contacted by the rope, including sheaves, drums, and rollers.

Wire Rope Basics

The following summary provides equipment operators with basic information useful for frequent inspections of wire rope. Persons responsible for making periodic, detailed inspections should have a much more comprehensive knowledge of wire rope.

Wire Rope Use

Some common uses of wire rope include:

1. Hoist and boom suspension (pendant) ropes on power shovels, draglines, clamshells, and mobile cranes.
2. Crowd, retract, and dipper trip ropes on power shovels.
3. Boom hoist ropes on draglines, clamshells, and mobile cranes.
4. Drag (rehaul) ropes on draglines.
5. Holding, closing, and tag ropes on clamshells.
6. Pull down, hoist, bull, and sandline ropes on drills.
7. Hoist ropes on overhead hoists, and overhead traveling cranes.
8. Slings.

Wire Rope Construction and Terminology

Most wire rope is constructed of many small diameter wires. This construction provides the flexibility necessary for wire rope to bend frequently in use, such as over sheaves.

Occasionally, large strands, or ropes constructed of a few wires of large diameter, will be used for applications where very little bending occurs, such as boom suspension (pendant) ropes on shovels, or draglines.

Most wire ropes consist of three parts:

1. A core, which forms the center of the rope. Cores may be either fiber cores (FC), or steel cores. Steel cores may be either "independent wire rope cores" (IWRC) - a miniature wire rope which serves as a core for larger rope, or "strand cores" (SC) - a strand, similar to other strands of the rope, which runs down the center of the rope.

2. Wires, which are twisted into strands. The individual wires that appear on the outside of the rope, and bear against sheaves and drums, are called crown wires, or simply "outer wires."

3. Strands, which are twisted around the core to form the rope.

Wire rope is designated by the number of strands, the number of wires per strand, and the rope diameter. For example, a wire that has 6 strands of 19 wires each is referred to as having a 6x19 "construction." Wire ropes of similar construction are sometimes grouped into a general "classification." The 6x19 classification usually includes 6x21 and 6x25 construction ropes, as well as 6x19 construction ropes.

Rope diameter is measured by rotating a caliper around the circumference of a wire rope until the caliper is positioned to give the maximum possible reading. The length of rope needed for one strand to make a complete turn around the core is a "lay."

Safety Factor/Design Factor

The rated breaking strength of a new rope divided by the maximum normal load to be placed on the rope is the "safety factor," or "design factor".

$$\text{Safety Factor} = \frac{\text{Breaking Strength}}{\text{Max Normal Load}}$$

A rope with a 100,000 pound breaking strength, carrying a maximum normal load of 10,000 pounds, has a safety factor of 100,000/10,000=10.

The minimum safety factors for various wire rope applications are specified in the ANSI standards. In most cases, "load" is determined by the weight of the structure and the material supported. In some cases, however, such as for drag ropes on draglines, the load is based on the maximum stall force of the power source.

Lubrication

Proper lubrication extends the service life of wire ropes. Proper lubrication:

1. Reduces wear

2. Protects against corrosion

3. Reduces friction between individual wires and strands, allowing wires and strands to move and to adjust to load and bending forces. This ease of movement increases the flexibility of the rope, allowing more even distribution of the load over all the wires, which reduces the probability of wire breakage.

New ropes need ample lubrication to ease the break-in period. The rope manufacturer should be consulted to be sure that proper types of lubricant and application methods are used. Generally, the more severe the rope operation - higher speeds, heavier loads, greater number of bends, and more corrosive conditions - the more frequently the rope should be lubricated. Light, frequent lubrication is generally better than heavy, occasional lubrication.

The following safe job procedures will help to minimize incidents which could cause injuries and adversely affect production.

Required or recommended personal protective equipment:

Hard hat, safety shoes, safety glasses, gloves,
Safety harness and line.

I. INSPECTION OF WIRE ROPES

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Plan and schedule inspection. Schedule complete inspections for idle shifts or scheduled maintenance periods if possible. Obtain an accurate caliper, if diameter measurements are to be taken.	1. A) Not inspecting frequently enough, unnecessary down-time of expensive equipment.	1. A) Schedule complete, detailed inspections on a regular basis. Interval between inspections is determined by operating conditions, anticipated wire rope life, critical nature of service, state regulations, company policy, and manufacturer's recommendations. All wire ropes should be visually inspected, to the extent possible, before, during, and after use.
2. Clean rope, if necessary.	2. A) Falling.	2. A) Work from safe location. Do not climb booms of equipment in operation, unless adequate steps, handholds, and railings are provided. Wear safety harness and line if there is a danger of falling.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. (Continued)	B) Failure to detect broken wires or other indications of rope deterioration.	B) Wipe excess lubricant from section of rope to be examined.
	C) Cut or puncture from broken wire snagging hand or glove.	C) Do not use bare or gloved hand alone on moving rope. Rag can be held around rope, while rope is run at a slow speed (50 feet per minute or less).
	D) Caught between rope and sheave, drum, or roller.	D) Do not wipe moving rope near where rope goes onto sheave, drum, or roller. Face direction rope is moving, so that rag will be pulled away from you if it snags on broken wires.
3. Visually inspect wire rope before, during, and after use, and watch equipment in operation.	3. A) Unnecessary downtime of expensive equipment.	3. A) Carefully examine all wire ropes for obvious damage, such as kinking, bird caging, broken strands, or broken wires.
	B) Improper reeving can cause ropes to wear faster, and hamper equipment operation.	B) Check for proper reeving in accordance with manufacturer's recommendations.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	C) Rope or sheave damage. Excessive vibration and stresses. Struck by falling or whipping rope; or falling load, if rope breaks.	C) Avoid excessive pull-down pressure on drills. Be sure there are no hook-ups between bucket, boom, and hoist ropes. Operate equipment smoothly. Do not jerk or drop loads attached to wire ropes. Impact loading can break even a new rope. Check that backlash guards, where provided, are in place and secure.
	D) Caught in moving equipment.	D) Remove dirt from equipment, such as rope guards and dragline fairleads, as needed. Equipment must be shut down and locked out.
4. Position equipment and yourself for complete inspection.	4. A) Failure to get close enough to wire rope and other components to detect defects.	4. A) Lower booms and masts where possible, and/or place boom against a pile of material or a bank.
	B) Fall to lower levels.	B) Do not climb booms of equipment in operation unless adequate steps, handholds, and railings are provided. Use safety harness and line where there is a danger of falling.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. Conduct complete visual/manual inspection of wire ropes.	5. A) Wire rope failure due to inadequate inspection.	5. A) Have the wire rope run past your inspection point at a slow speed (50 feet per minute, or less). Check entire rope. Usually, entire length cannot be inspected from one location. If a potential problem is detected, signal equipment operator to stop rope, and examine rope more closely.
	B) Cuts or punctures from protruding wires.	B) A rag or cotton waste can be held around the rope.
	C) Caught between rope and sheaves, drums, or rollers.	C) Face direction rope is moving. Do not wipe rope near where it enters sheaves, drums, or rollers.
	D) Rope failure due to excessive wear.	D) Look for excessive wear on crown (outer) wires. If surface of strands looks almost smooth, and valley between crown wires appears almost as a fine line, wear could be approaching 50 percent, or ½ of crown wire diameter.
	E) Rope failure due to corrosion.	E) Look for corrosion which causes pitting of wires. Look for small flecks of rust in the lubricant, or pitting or scale in strand valleys, which may indicate internal corrosion.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. (Continued)	F) Rope failure due to distortion of rope structure.	F) Look for distortion of rope structure, such as kinking, crushing, or heat damage.
6. Evaluate condition of rope.	6. A) Failure of wire rope.	6. A) Exercise judgement based on condition of rope, operating conditions, critical nature of service, and manufacturer's recommendation.
7. Report and record results of the inspection.	7. A) Possible use of equipment already determined to be defective.	7. A) Report results of inspection to appropriate officials. Record results for later reference. Tag equipment, if appropriate.

NOTE: Although the following retirement criteria apply only to wire rope used for personnel hoisting, they should be considered as indicators for potential failure in all situations. Ropes that meet or exceed these retirement criteria should be considered for retirement if the damage or deterioration cannot be removed by cutoff:

1. The number of broken wires within a rope lay length, excluding filler wires, exceeds either:

   a) Five percent of the total number of wires.

   b) Fifteen percent of total number of wires within any strand.

2. On a regular lay rope, more than one broken wire in valley between strands in one rope lay length.

3. A loss of more than one-third of the original diameter of the outer wires.

4. Rope deterioration from corrosion.

5. Distortion of rope structure.

6. Heat damage from any source.

7. Diameter reduction from wear that exceeds six percent of the baseline diameter measurement.

8. Loss of more than ten percent of rope strength as determined by nondestructive testing.

II. INSPECT WIRE ROPE TERMINATIONS

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Plan and schedule inspection of rope terminations.	1. A) Equipment down-time and possible injury due to failure of rope termination.	1. A) All terminations must be inspected before use of equipment. Schedule complete, detailed inspections on a regular basis. Terminations, and sections of ropes near terminations, may require more frequent inspections than the main body of rope.
2. Check for proper lubrication.	2. A) Inadequate lubrication causing failure at termination due to corrosion and/or wear.	2. A) Check for proper lubrication. If lubrication was cleaned off rope for inspection, reapply when done.
3. Inspect socket terminations.	3. A) Failure of socket or failure of rope at socket.	3. A) Check socket for cracks, deformation, and excessive wear. Check that socket is lined up square with the rope. Check for broken wires where rope enters socket.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. A) Inspect wedge socket terminations.	4. A) Rope failure at wedge, or rope slipping through wedge socket.	4. A) Be sure wedge is seated properly. Check for evidence of slippage. Be sure at least one rope lay on dead end of rope extends beyond wedge. Check for broken wires on live end of rope. Check visible portion of wedge socket for cracks, deformation, and wear.
5. Inspect U-clip terminations.	5. A) Rope failure at termination.	5. A) Check for broken wires throughout termination.
	B) Rope slipping through termination.	B) Check for evidence of slippage, such as scrubbed places on the rope, or U-clips slid together. Check for proper number, spacing, torque, and orientation of U-clips.
	C) Failure of U-clips or thimbles.	C) Check U-clips and thimbles for cracks, deformation, and excessive wear.
6. Check other types of terminations (mechanical splices, swagged sockets, etc.).	6. A) Failure of rope at termination, or failure of termination.	6. A) Check for broken wires and corrosion at termination. Check for proper installation. Check for cracks, deformation, and excessive wear.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
7. Evaluate condition of termination, and condition of rope at termination.	7. A) Failure of termination, or of rope at termination.	7. A) Exercise judgement based on condition of rope and termination, operating conditions, critical nature of service, and manufacturer's recommendation.
8. Report and record results of inspection.	8. A) Possible use of equipment found to be defective.	8. A) Report results of inspection to appropriate officials. Record results for later reference. Tag equipment, if appropriate.

NOTE: Although the following end attachment retermination and end attachment replacement standards apply only to wire rope used for personnel hoisting, they should be considered as indicators for potential failure in all situations:

1. End attachment retermination: damaged or deteriorated wire rope should be removed by cut off, and rope retermination where there is:

   a) More than one broken wire at an attachment.

   b) Improper installation of an attachment.

   c) Slippage of an attachment.

   d) Evidence of deterioration from corrosion at an attachment.

2. End attachment replacement: wire rope attachments should be replaced when cracked, deformed, or excessively worn.

III. INSPECT SHEAVES, DRUMS, AND ROLLERS

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Plan and schedule inspections of sheaves, drums, and rollers.	1. A) Equipment down-time and possible injury due to failure of sheaves, drums, or rollers, and damage to wire rope due to worn or damaged sheaves, drums, or rollers.	1. A) All sheaves, drums, and rollers must be inspected before use of equipment. Schedule complete detailed inspections on a regular basis.
2. Inspect sheaves, drums, and rollers in operation.	2. A) Sheave, drum, or roller failure.	2. A) Watch for any wobbling or out of round motion. Be sure that bearings are properly lubricated and not excessively worn. Be sure that mounting bolts are tight.
	B) Excessive rope wear or damage.	B) Notice if rope is being squeezed into sheave or drum grooves, or is scrubbing on side of the groove. Be sure that rope is spooling smoothly on drums and not cross-winding or leaving gaps.
3. Check sheave guards.	3. A) Broken or badly damaged rope, if rope jumps off sheave.	3. A) Check that rope guards are in place over sheaves which are subject to rope jumping off, such as point sheaves. Guards should usually be located about ½ inch above sheave.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. Check sheave grooves, drum grooves, and roller surface.	4. A) Rope wires being cut by sharp edges.	4. A) Check for sharp edges in sheave grooves, drum grooves, and on roller surfaces. Check for print of rope worn in these surfaces.
5. Check drum end terminations.	5. A) Rope pulling out of drum. Drum end termination failure due to excessive stress if rope is completely spooled out and stopped by termination.	5. A) Wire rope should be attached securely by clips after making one full turn around drum spoke, or shaft, or by properly assembled anchor bolts, clamps, wedges, or other design feature of drum.

IV. REPLACING WIRE ROPE AND TERMINATIONS

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Obtain new rope.	1. A) Installing improper rope.	1. A) New rope should be the same size, grade, and construction, or as otherwise recommended by manufacturer due to operating conditions.
2. Remove old rope.	2. A) Falling load.	2. A) Secure load (bucket, etc.). Slack rope slightly. Detach old rope from load and attach it to empty reel. Transfer old rope to reel. Depending on situation, use small ropes and additional drums, reels, winches, or mobile cranes to safely control handling and transfer of old rope.
3. Attach new rope to drum.	3. A) Damage to new rope.	3. A) Avoid kinking rope.
4. Transfer new rope from reel to drum.	4. A) Damage to new rope.	4. A) Avoid reverse bending.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. Cut new rope if necessary.	5. A) Not allowing sufficient length.	5. A) Allow sufficient length for maintaining minimum recommended number of dead wraps on drum, for cutting off and remaking terminations at both ends, and for turning rope end-for-end to minimize local wear.
	B) Unlaying of strands.	B) Apply seizing, strapping, or other method to prevent unlaying of strands on both sides of cut.
	C) Cutting hazards with torch, or shears, abrasive wheel, etc.	C) Wear eye protection. Wear gloves. Use controlled force with power tools.
6. Make a wedge termination, if used.	6. A) Rope damage or termination failure due to improperly made termination.	6. A) Place live (long) end of rope on the eye side of socket. Form a loop through socket, and insert wedge. Pull wedge and rope into position - final tightening occurs under full load.
	B) Mashed fingers.	B) Wear gloves, and avoid pinch points.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
7. Make other types of terminations, if used.	7. A) Rope damage or termination failure due to improperly made termination.	7. A) Make other types of terminations in accordance with ANSI Standards, or manufacturer's recommendations. If U-clips are used, be sure to use proper number and spacing of clips, and proper torque values. U-clips must be retightened periodically. If zinc sockets are used, proper unlaying of wires and proper zinc temperature are very important.
8. Record all new rope information.	8. A) No record to establish normal rope life and base diameter for wear comparisons.	8. A) Record date, rope diameter, length, manufacturer, construction, grade, and normal life. Take, and record, rope diameter measurements after initial rope stretch (break-in).

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This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs," June, 1983

TRAINING RECOMMENDATIONS

On-the-job training is usually best done by the employee's immediate supervisor. If the supervisor relies on another employee to do certain parts of the training, the supervisor should be present to monitor the training. OJT is conducted at the actual job site where the work will be done.

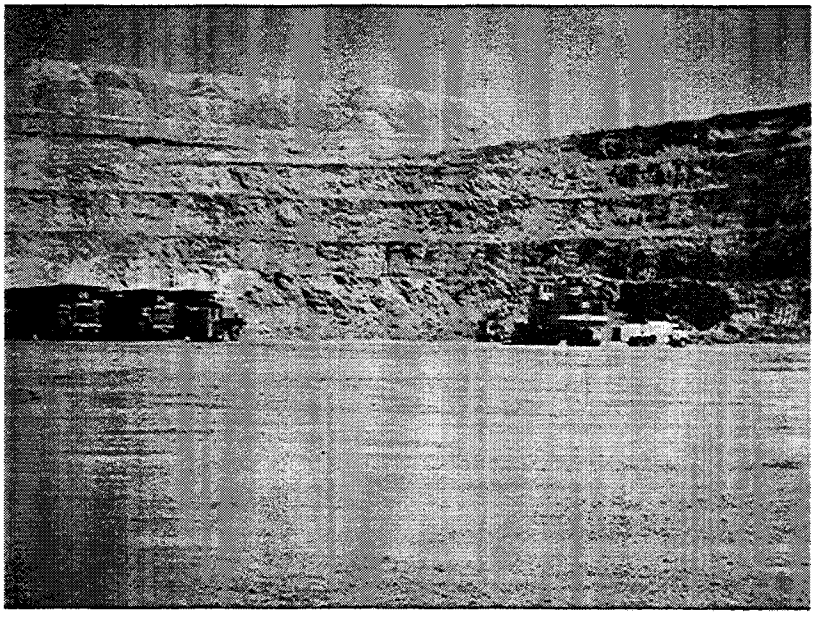
The supervisor/trainer should use the training materials (this module, or other materials) while the training is being done, to help ensure that all job steps are covered, and that no important safety precautions are omitted. Effective OJT should begin with an explanation (lecture and/or discussion) of the safe job procedure. The explanation should be followed by a hands-on demonstration of the proper job procedure. A good demonstration is, perhaps, the most important part of OJT. The demonstration is followed by supervised practice, during which the supervisor/trainer coaches (corrects and encourages) the employee, and evaluates when the employee is ready to do the job without direct supervision.

The first step - explaining the job to the employee - can be done in different ways. The supervisor/trainer and the employee can sit down and go through the training materials together. It may be advantageous to provide the employee with a copy of the training modules that are applicable to his/her job. The fact that most of the training is conducted at the job site does not preclude the use of a classroom or a quiet office for the first part of the training. Any general theory or knowledge training, as well as the initial explanation of the job procedure, may be best done in an office/classroom setting; especially when noise levels or other conditions at the job site make communication difficult. A complete series of job steps could be presented through the use of slides developed at the mining operation.

MODULE NUMBER 15
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING
FOR
SURFACE METAL AND NONMETAL MINES

GROUND CONTROL



This module describes basic job steps, potential hazards and accidents, and recommended safe job procedures for ground control. This module provides the miner with information on ground control, and hazards associated with highwalls, water pools, pits, spoil banks, and other dangers that are particular to sand and gravel, and to crushed stone operations.

This job is usually done by a supervisor or a competent person assigned by the supervisor. The supervisor, or a competent person, must examine the working area and the working faces for unsafe conditions, at least at the beginning of each shift and after blasting. Miners must examine their working places before starting work, and frequently thereafter. Any unsafe condition must be corrected.

Highwalls must be controlled along haulageways and all other work areas. A highwall is defined as the unexcavated face of exposed overburden and material on an open face or bank. Miners must be concerned with new mine development, as well as normal mining operations.

A variety of ground control hazards exist in sand and gravel operations, and in crushed stone operations. Very serious, and sometimes fatal, injuries can result from falls of highwall, and falling, rolling, or sliding material. All members of the work force need to know how to recognize these hazards.

Under federal regulations, standards for the safe control of pit walls, including the overall slope of the pit wall, must be established and followed by the operator. These standards shall be consistent with prudent engineering design, the nature of the ground, and the type of material mined; and shall ensure safe working conditions. Mining methods, including benching, shall be selected which will ensure wall and bank stability, in order to obtain a safe overall slope.

Three types of slope failure are the most serious hazards faced by surface miners: rock falls, plane shear, and rotational shear.

Rock fall slope failures are caused by planes of weakness. The most common types of rock fall slope failures are due to weaknesses caused by: bedding planes, fractured rock, faults, joints, and water pressure.

Plane shear (translational slope failure, or linear slope failure) occurs in highwalls or cliffs that have strata (layers) of different types of material. Most failures occur along existing fault planes, or other planes of weakness, causing a wedge shaped mass of earth to break free and fall.

Rotational shear (rotational slope failure) is uncommon in surface mining, because this type of failure usually occurs in banks or highwalls that are made of the same material

throughout, with no natural planes of weakness. When a rotational shear does occur, a mass of the slope or bank breaks loose in a semi-circular, or bowl shaped form.

The highwall face should be uniformly straight. If a section juts out, watch for cracks that indicate that the section is about to fall. Be alert to potential slope failures promoted by extreme weather - rain, snow, freezing, thawing. A slope that is safe during dry weather can very quickly become unsafe during wet weather. Water control is necessary in order to minimize erosion of the highwall and other slopes.

By being alert to possibly unsafe conditions, the miner is in a better position to be protected, see that appropriate corrective measures are taken, warn fellow workers of possible dangers, and change individual work habits when necessary.

Various techniques are used to control ground hazards and reduce potential ground control problems.

Earth-moving techniques of ground control include sloping, benching, and stripping overburden above the highwall.

Sloping:

-- Establishes a stable angle of ground.

Benching:

-- Establishes terrace-like steps in steep hillsides.

-- Used to prevent slides.

-- When used for roadways, usually built so that two haulage trucks can pass each other.

Mechanical techniques of ground control include the use of rock bolts and barriers.

Rock bolts:

-- Are metal rods at least 4 feet long.

-- Have bearing plates between the bolt head and the rock, in order to distribute the bolt tension.

-- Are installed in holes that are drilled into the highwall in a predetermined pattern.

-- Are tightened to a proper torque, which needs to be checked periodically.

Barriers:

-- Are nylon screens, metal fences, baffle boards, or wooden posts and planks.

Maintenance techniques for ground control include: scaling loose rock, controlling drainage, and using explosives.

Scaling:

-- Miners must approach loose rock from above, and scale from a safe location. When there is a danger of falling, miners must be properly tied off.

-- When scaling loose rock, use a long scaling bar.

-- Front-end loaders, power shovels, or draglines may be used to scale hazardous rock.

Controlling drainage:

-- Horizontal drain holes, or vertical drainage wells, are used to reduce subsurface water pressure in highwalls.

-- Collector drains located above highwalls are used to divert surface water away from highwalls.

Explosives:

-- Are used to bring down overhangs.

The following safe job procedures will help minimize incidents which adversely affect production and cause injuries:

Required, or recommended, personal protective equipment:

Hard hat, steel-toed shoes, safety glasses, hearing protection

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Examine working areas.	1. A) Struck by falling material.	1. A) Inspect working areas for: 1. Overhanging material 2. Loose rock 3. Vertical and horizontal cracks 4. Boulders, trees, or other material which might fall 5. Jagged sections of highwall 6. Undercuts 7. Fallen material 8. Debris 9. Compliance with standard procedures for degree of slope, benching, etc.
	B) Slips and falls.	B) Be aware of weather changes which affect ground conditions, including rain, snow, freezing, and thawing. Be sure all work areas are sufficiently illuminated to inspect ground conditions.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. Report and/or correct any hazardous conditions.	2. A) Personnel entering unsafe area.	2. A) Report immediately to supervisor any unsafe conditions not readily corrected. Barricade and post areas where unsafe ground conditions have not been promptly corrected.
	B) Struck by falling material. Ground failure under weight of equipment or persons.	B) Do not perform other work where unsafe conditions exist until unsafe conditions are corrected. Approach loose rock from above. Use scaling bar long enough to remain out of danger of falling material.
	C) Fall over highwall or bank.	C) Safety belts and lines shall be worn where there is a danger of falling. Stay at least 6 feet back from a stable creast.
3. Perform drilling and blasting duties.	3. A) Overturning drilling equipment.	3. A) Travel with drill mast (boom) in lowered position. Do not travel on steep grades where sliding or overturning could occur. Watch for soft shoulders.
	B) Ground failure under weight of drilling equipment.	B) Inspect drilling area for hazards, such as cracks in bench, before positioning drill.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	C) Runaway equipment.	C) Set brakes.
	D) Highwall hazards (jagged or loose material, overhangs) from improper drill-hole angle.	D) Level drill. Be sure mast (boom) is set straight, or at proper angle, if angle drilling is done. Start drill hole slowly. Keep drill steel in guides.
	E) Highwall hazards from improper drilling pattern.	E) Drill all holes to depth and pattern established by plan.
	F) Struck by falling material.	F) When drilling on lower levels, check ground above and correct any hazards.
	G) Stepping into open drill hole.	G) Cover, or guard, any drill holes large enough to create hazards.
	H) Explosives and blasting hazards.	H) Load hole according to supervisor's instructions.
	I) Overhangs and loose material created by blast may give way under a person's weight. Overhanging frozen material during cold weather can be especially hazardous.	I) Inspect blast area after air has cleared. Proceed carefully - do not hurry to highwall edge to see results of blast.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	J) Caught or struck by shifting rock.	J) Perform secondary breaking of material as required. Work from a safe location. Position, or block, material (except hanging material) to prevent hazardous movement.
4. Operate mobile equipment.	4. A) Collision with obstacles in roadway, or equipment overturning.	4. A) Watch for ground hazards, including boulders or other obstacles in roadway, or washed out roadbed. Adjust speed to visibility, roadway conditions, and traffic. Wear seat belts where provided.
	B) Failure of ground under weight of equipment.	B) At dump locations, dump material back from edge if there is evidence of unstable ground. Do not drive, or position, equipment too close to edge or on soft shoulders. Be aware of weather changes which may weaken or loosen ground, or conceal holes, ruts, or other roadway hazards.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
4. (Continued)	C) Running equipment over the edge of a road, or work area.	C) Build berms at outer edge of elevated roadways. Be sure berms, bumper blocks, or equivalent are provided to prevent overtravel and overturning at dump points. Keep all wheels or tracks on solid ground.
5. Work around highwalls.	5. A) Struck by falling material.	5. A) Be especially careful of potential rock fall hazards when working on foot around highwalls. Do not work between equipment and highwall where equipment may hinder escape.

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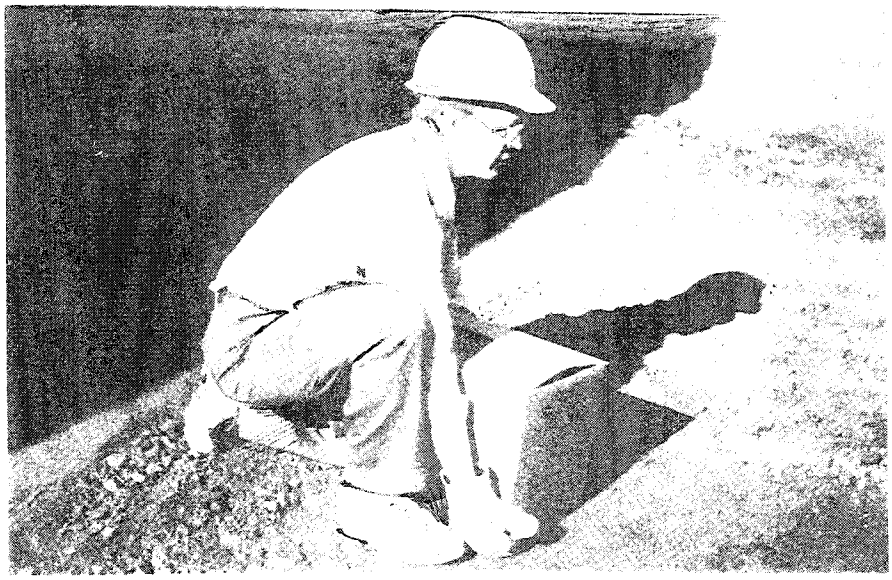
MODULE NUMBER 16
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING
FOR
SURFACE METAL AND NONMETAL MINES

MANUAL HANDLING OF MATERIALS



This module describes the basic job steps, potential hazards and accidents, and recommended safe job procedures for the manual handling of materials. Safe job procedures for standing, reaching, lifting, shoveling, and sweeping are included in this module.

This module concentrates on the prevention of back injuries. Back injuries account for a high percentage of the injuries that result from the manual handling of materials. Instances of lower back pain in the United States are increasing at epidemic proportions. The United States Department of Labor estimates that at least 75 percent of the population has had back pain. The use of good body mechanics at work, and at home, can prevent the causes of back pain - too much strain on back muscles, and too much pressure on back discs.

The spine consists of 24 bones (vertebrae) connected by interlocking joints. Most of the vertebrae are separated by shock absorbers called discs. Too much pressure on a disc can cause the disc to weaken, and bulge out to one side. This bulge can push a nerve into a bony part of the spine, and cause great pain. Doctors say that the disc has "herniated," or "ruptured." Ruptured discs do not always require surgery, but this is the most common reason for back surgery.

Muscle strain, or spasm, is another type of back injury. Hundreds of muscles and ligaments connect to, and support, the spine. When a muscle is strained, it may swell and cause pain by increasing pressure on small nerves that pass through the muscle.

Lifting objects is not the only cause of back problems. Sitting, standing, bending, and stooping - everything we do with our bodies - either takes away from, or adds to, the overall health of our backs.

The following safe job procedures will help minimize incidents which may adversely affect production and cause injuries.

Required or recommended personal protective equipment:

Hard hat, steel-toed shoes, gloves

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Standing.	1. A) Standing with knees locked while bending forward at waist puts 200 pounds of pressure on lower back discs.	1. A) Give your body a wide base of support. Put one foot in front of the other and bend the knees a little, in order to take pressure off your back. When possible, lean against something for support. When possible, stand with one foot propped up. Doing so can cut disc pressure in half.
2. Reaching over your head.	2. A) Placing extra pressure on your spine.	2. A) If object cannot be conveniently reached, use a safe platform or ladder. Keep one foot in front of the other. If possible, store materials within safe reach of floor or other secure work platform.
3. Lifting.	3. A) Bending from waist with locked knees, and holding anything in out-stretched arms, puts 10 times more pressure than normal on your back.	3. A) Establish a good base of support. Hold the object as close to your body as possible. If possible, store materials on shelving, or slightly elevated from floor.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	B) Picking up heavy items incorrectly is a common cause of injuries - especially back strains and sprains.	B) To pick up heavy items correctly: 1. Kneel with one foot forward. 2. Pull item in close. 3. Test weight by lifting one end. 4. Tuck in chin to help keep back straight. 5. Stand by pushing up with your legs. 6. Shift weight to back leg before walking, in order to test and maintain balance.
	C) If weight is too heavy, excess pressure on back discs can cause injury.	C) Test weight of object by trying to lift one end, as described above. If weight cannot be safely lifted by one person, get help, or use available hoists or other lifting aids.
4. Shoveling.	4. A) Excessive pressure on discs in your back due to lifting and twisting.	4. A) When shoveling, pivot instead of twisting when you need to throw material to one side. When you need to throw material to the left, keep your left foot forward with feet well separated. Load shovel moderately, and pull load in close. Keep right foot planted and move left foot back and to the left, toward where you are throwing the material. If throwing material to the right, keep left foot planted and pivot with the right foot.
5. Using a push-broom.	5. A) Extra pressure on discs in your back by moving arms back and forth, or bending at the waist.	5. A) Walk back and forth with handle of broom resting against hip-bone, keeping elbow bent.

GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the surface metal and nonmetal mining industry in conducting effective on-the-job training (OJT) of new employees, or employees reassigned to different jobs. The use of training materials, such as this module, is an important part of an effective, systematic, OJT program.

This Instruction Guide uses a generic Job Safety Analysis (JSA) of jobs common to the industry. The JSA format facilitates uniform basic training in safe job procedures, while requiring only a minimum of time and effort on the part of the trainer. This material is generic to the industry; therefore, each company using this guide will need to tailor the material somewhat to fit their particular requirements. In some cases, the material must be general in nature, and will not include specific details of procedures or equipment that must be taught by the trainer.

Recommendations for an overall OJT program are contained in the Mine Safety and Health Administration (MSHA) guide: "Structuring Effective On-The-Job Training Programs," June, 1983.

TRAINING RECOMMENDATIONS

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MODULE NUMBER 17
OF
INSTRUCTION GUIDE NUMBER 43

ON-THE-JOB TRAINING MODULES
FOR
SURFACE METAL AND NONMETAL MINES

PREVENTION OF SLIP AND FALL ACCIDENTS

Slips and falls are a serious safety problem. Falls account for approximately 30 percent of all accidents in the mining industry. Most lost time accidents are the result of falling to the same level and are caused by slipping or tripping over some object left in the walkways and travelways. The severity of injuries in most cases is limited to bruises, sprains, fractures, etc.

Most falls from higher levels are the result of falling less than ten feet; usually off a box, a piece of machinery, or short step ladder. The number of incidents is fewer than falls to the same level, but the severity of injuries is greater. Falls from higher levels can result in broken bones, internal injuries, permanent disability, and even death.

Slips and falls, combined with handling of materials, account for approximately 60 percent of all lost time accidents. More than 12 million people every year are injured from falls. Suffering, medical expenses, lost wages, diminished production, etc. combine to make falls one of the most costly type of accidents. Most of these falls could have been prevented.

Many falls are caused by obvious hazards - spills on walkways, tools and equipment not put away, loose ladder rungs, debris on the ground or walkways, and uneven walking surfaces. Other causes of falls are slippery spots, tripping hazards, and even poor vision. People who wear bifocal glasses should be especially careful because the two differently powered lenses sometimes confuse the wearer.

Working conditions at surface mines, such as loose blasted or excavated materials, uneven walking surfaces, adverse weather conditions, and frequent mounting and dismounting of equipment, make miners vulnerable to slips and falls. Miners sometimes have to hand-carry heavy objects. This can lead to reduced visibility and awkward body positions which can cause slips and falls. Snow, ice, and freezing rain make surfaces very slippery. Wear shoes or boots with non-slip soles. Be careful while walking.

No matter how well we guard against all exposures to dangers, we can be injured any time we do not think about protecting ourselves and others. Serious injuries can, and do, result from slips and falls.

This module is designed to highlight tasks performed at surface mines where workers are most likely to slip or fall.

The basic job steps included in this module are:

1. Traveling to and from the work place.
2. Performing primary duties in a working area.
3. Getting on and off mobile equipment.
4. Handling materials.
5. Climbing to a higher level.
6. Making required inspections.

The following safe job procedures will help minimize incidents which may cause injuries and adversely affect production:

Required and/or recommended personal protective equipment:

Hard hat, safety shoes, safety glasses with side shields, gloves, snug fitting clothing appropriate for weather conditions, hearing protection where needed

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
1. Traveling to and from the work place.	1. A) Fall to same level.	1. A) Keep travelway free of debris.
	B) Slips and falls.	B) Use proper footwear to match conditions.
	C) Fall to same or from higher level.	C) Observe step off areas. Install well-constructed handrails.
	D) Fall to same level.	D) Walk around, rather than through, visibly slippery areas and water holes.
	E) Trips/slips.	E) Maintain maximum visibility.
	F) Falling into moving machinery, caught in moving machinery.	F) Provide warning and directional signs for particularly hazardous conditions. Check guards. Wear snug fitting clothing and leg bands.
	G) Exhaustion.	G) Travel at steady pace.
	H) Falling material, struck by mobile equipment.	H) Avoid walking near highwalls, loading facilities, and moving equipment. Seek shelter, or get well in the clear, when machines approach.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
2. Performing primary duties in a working area.	2. A) Slips, trips, and falls.	2. A) Keep work areas free of debris and visually examine for tripping or slipping hazards. Keep boots free of mud, ice, snow, grease, and oil.
	B) Falling or slipping into moving machine.	B) Post warning signs and install guards where necessary.
	C) Struck by mobile equipment.	C) Watch for moving machinery. Do not position yourself in narrow, confined, or hazardous locations.
3. Getting on and off mobile equipment.	3. A) Striking against objects caused by slipping.	3. A) Maintain machines free of excess oil and grease.
	B) Fall from higher level, clothing caught on control levers or other projections.	B) Wear personal protective equipment (proper footwear) and snug fitting clothing. Keep steps and boots free of mud, ice, snow, grease, and oil.
	C) Fall from higher level or to same level.	C) Do not get on or off moving equipment.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
3. (Continued)	D) Falling while climbing ladder or steps.	D) Use belt hooks, pockets, etc., to carry material up ladders and keep both hands free for climbing. Ropes can be used to hoist bulkier items. Face ladder and use three points of contact when climbing (two hands and one foot, or two feet and one hand, in contact with ladder at all times). Use handholds and select firm footing. Avoid haste and projections.
	E) Fall from higher level.	E) Do not use machine as work platform.
	F) Falls, strains.	F) Use proper techniques for mounting and dismounting. Use handholds.
4. Handling materials.	4. A) Slips, trips, and falls while lifting or carrying materials.	4. A) Maintain visibility while lifting or carrying job related material.
	B) Strain or sprain.	B) Use proper lifting techniques. Keep load close. Lift with your legs instead of your back.
	C) Striking against, or being struck by materials due to adverse conditions.	C) Store materials properly. Maintain good housekeeping.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
5. Climbing to a higher level.	5. A) Fall from higher level, defective ladder, insecure footing for ladder.	5. A) Check ladder for defects and proper installation of ladder. Select or make a secure, even surface for ladder. Temporary ladders should be tied off when possible.
	B) Slipping from ladder.	B) Be sure shoes and ladder are dry and grease free.
	C) Falling from ladder.	C) Climb ladder correctly using three points of contact (two hands and one foot, or two feet and one hand, in contact with ladder at all times). Do not reach too far to either side of ladder.
	D) Fall from higher level, knocking objects off on someone below.	D) Keep work surfaces clear. Maintain proper balance.
6. Making required inspections.	6. A) Fall from higher level, or to same level.	6. A) Maintain good footing and only use means of safe access.
	B) Slips and falls.	B) Maintain proper housekeeping.
	C) Equipment hazards.	C) Post warning signs where necessary.

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