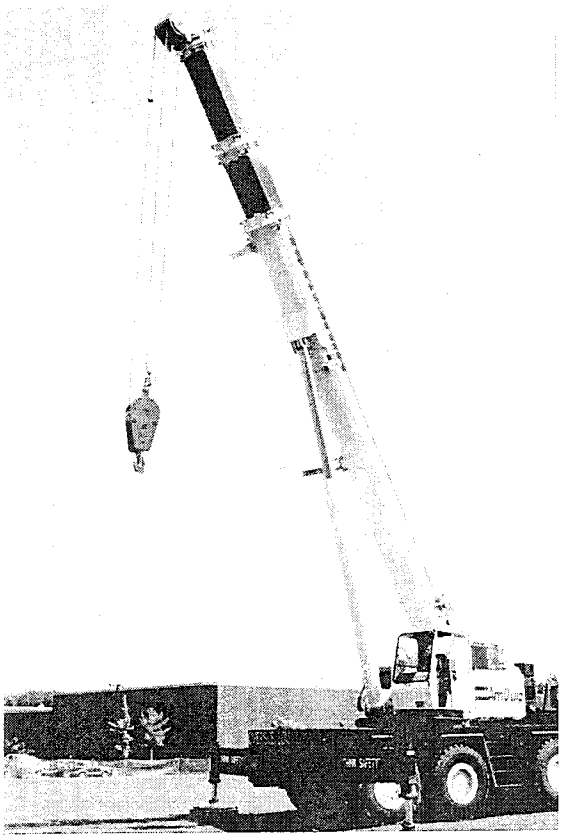
MODULE NUMBER 6
OF
INSTRUCTION GUIDE NUMBER 43

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.