

SAND, GRAVEL, AND CRUSHED STONE ON-THE-JOB TRAINING MODULES

Module 17 - “Primary Crushing Operation”

**UNITED STATES DEPARTMENT OF LABOR
ELAINE L. CHAO
SECRETARY**

**MINE SAFETY AND HEALTH ADMINISTRATION
DAVE D. LAURISKI
ASSISTANT SECRETARY**

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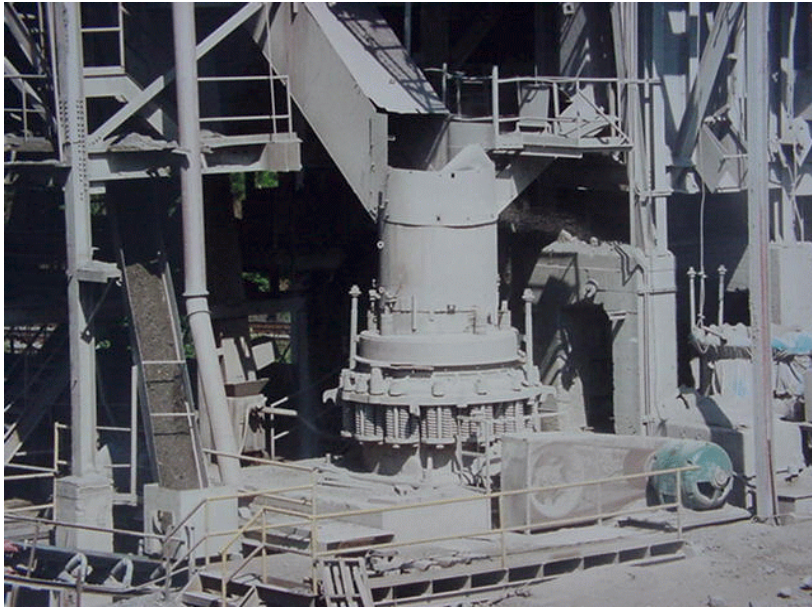
INSTRUCTION GUIDE SERIES

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**MODULE NUMBER 17
OF
INSTRUCTION GUIDE NUMBER 40**

**ON-THE-JOB TRAINING
FOR THE
SAND, GRAVEL, AND CRUSHED STONE INDUSTRY**

PRIMARY CRUSHING OPERATION



This module describes basic job steps, potential hazards and accidents, and recommended safe job procedures for primary crushing operations.

This job is normally done by the crusher operator, but may be done by other occupations. Crusher operators must protect themselves, and other people in the area, from accidents and injuries resulting from operation of the crusher and associated **equipment**. **There are several** different types of primary crushers, however, there are many similarities in the job

procedures followed by crusher operators.

Crushing is the first step in converting shot rock into usable products. Essentially, crushing is no more than taking large rocks and reducing them to small pieces. Crushing is sometimes continued until only fines remain.

At some operations, all the crushing is accomplished in one step, by a primary crusher. At other operations, crushing is done in two or three steps, with a primary crusher that is followed by a secondary crusher, and sometimes a tertiary crusher.

Raw material, of various sizes, is brought to the primary crusher by rear-dump haul units, or carried by a wheel front-end loader. Primary crushing reduces this run-of-mine rock to a more manageable size. The different types of primary crushers are: jaw crushers, gyratory crushers, impact crushers, and autogenous crushers.

JAW CRUSHER

The jaw crusher squeezes rock between two surfaces, one of which opens and closes like a jaw. Rock enters the jaw crusher from the top. Pieces of rock, that are larger than the opening at the bottom of the jaw, lodge between the two metal plates of the jaw. The opening and closing action of the movable jaw against the fixed jaw continues to reduce the size of lodged pieces of rock until the pieces are small enough to fall through the opening at the bottom of the jaw.

GYRATORY CRUSHER

A gyratory crusher breaks rock by squeezing the rock between an eccentrically gyrating spindle, which is covered by a wear resistant mantle, and the enclosing concave hopper. As run-of-mine rock enters the top of the gyratory crusher, it becomes wedged and squeezed between the mantle and hopper. Large pieces of ore are broken once, and then fall to a lower position (because they are now smaller) where they are broken again. This process continues until the pieces are small enough to fall through the narrow opening at the bottom of the crusher.

IMPACT CRUSHER

Impact crushers, which are also called hammer mills, break rock by impacting the rock with hammers that swing on a rotating shaft. The practical use of impact crushers is limited to soft materials, such as phosphate, gypsum, weathered shales, etc. Impact crushers cannot handle as large a top sized material as jaw, or gyratory, crushers can; however, impact crushers can make a finer sized product.

AUTOGENOUS CRUSHER

In recent years, autogenous crushers have been adapted for crushing run-of-mine rock in primary crushing circuits. Consequently, autogenous mills have increased in importance as a means of crushing and grinding. In autogenous crushers, the rock to be crushed also provides the crushing force. Crushing is accomplished by the tumbling action of the rock. Flexible crushing circuits can be constructed so that hard ores, as well as soft ores, can be processed. Wet, sticky ores can be processed in autogenous mills, while the same ore would present difficulties for other types of crushers.

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, RESPIRATOR, SAFETY BELT AND LINE.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. Start pumps. (Oil pump for crusher and/or hydraulic pumps)	1. A) Slips/trips/falls.	1. A) Practice good house-keeping. Keep walkways clear of extraneous materials. Clean up spills.
2. Check crusher.	2. A) Grease and oil leakage.	2. A) Visually inspect crusher for leakage, loose bolts and nuts, and cracks in housing or supports.
3. Start crusher, and then start feed to crusher.	3. A) Person caught in equipment. B) Belt breaking.	3. A) Make sure personnel are clear. B) Periodically check belts to ensure that they are in good condition.
4. Watch haul trucks or loaders dump material.	4. A) Material flying out and hitting personnel.	4. A) Make sure door is closed at work station, or stand behind screen guards. Make sure area is clear of personnel.

**SEQUENCE OF
BASIC JOB
STEPS**

**POTENTIAL ACCIDENTS
OR HAZARDS**

**RECOMMENDED SAFE JOB
PROCEDURES**

	B) Detonation of explosives.	B) If dynamite or cap is observed in rock, do not try to remove it. Shut off crusher and feeder, and call supervisor.
5. Free large stone in feeder or crusher using pry bar, hammer and wedge, hydraulic hammer, grappling or crane hook, or dynamite.	5. A) Equipment starting. B) Falling rock from truck or feeder. C) Fall into crusher. D) Struck by slings and hooks, or caught between sling or hook and rock. E) Pry bar slipping. F) Eye injuries. G) Wedge fly-back. H) Sledge hammer glancing.	5. A) Turn off, lock out, and tag all switches before going into crusher or feeder. B) Barricade truck dump. C) Use safety belt and line. D) Keep other personnel clear of slings and hooks. Attach slings and hooks securely to rock. E) Beware of pry bar pinch points and hazards. F) Wear safety glasses or goggles. G) Use approved type wedge device only. H) Use short-handled hammer in close places.

SEQUENCE OF BASIC JOB STEPS	POTENTIAL ACCIDENTS OR HAZARDS	RECOMMENDED SAFE JOB PROCEDURES
6. Turn light on, or otherwise signal haul units or loaders to start dumping. (Light is usually turned on automatically.)	6. A) Excess material. B) Crush, or injure, personnel due to excess material.	6. A) Make sure crusher is empty before another haul unit dumps material. B) Make sure area is clear of personnel.
7. Turn off conveyor belts and crusher.	7. A) Material left in crusher could jam.	7. A) Make sure material clears crusher and belts before shutting down.

GENERAL INFORMATION

This module is part of an Instruction Guide that was developed to assist the sand, gravel, and crushed stone 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"

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.