CDC Workplace Safety and Health

IC 9489
Information Circular/2006

Roof Bolting Machine Operator Skills Training for a Walk-Thru Roof Bolter

Trainer's Guide

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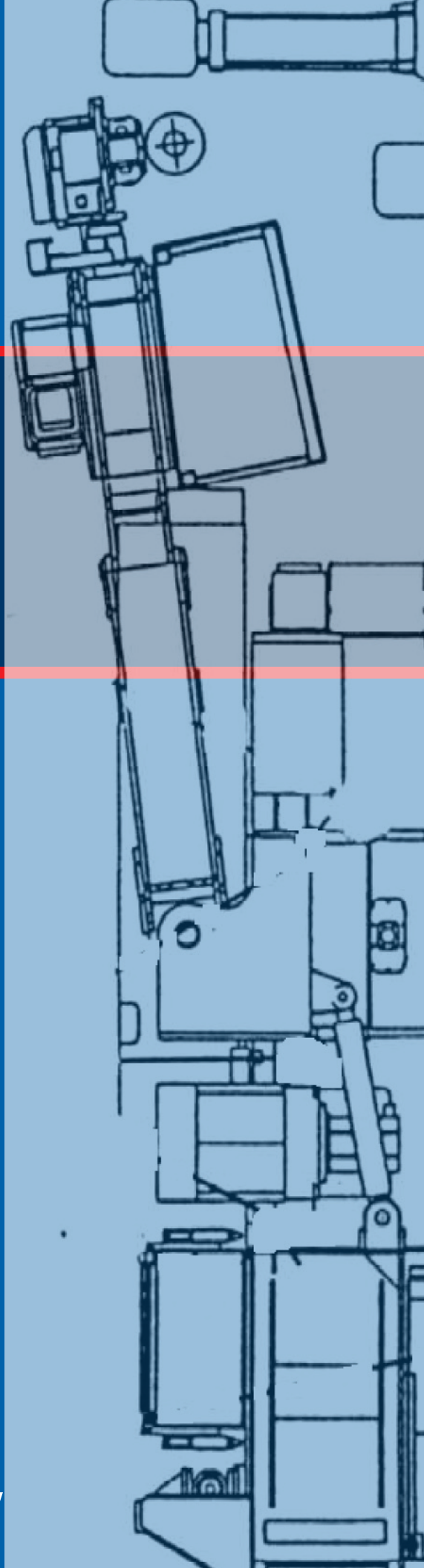

Department of Health and Human Services
Centers for Disease Control and Prevention

National Institute for Occupational Safety and Health
NIOSH

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Roof Bolting Machine Operators Skills Training for a Walk-Thru Roof Bolter: Trainer's Guide

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August 2006

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DHHS (NIOSH) Publication No. 2006–135

Acknowledgments

Twentymile Coal Co.

Roof bolter operators
Mechanics
Managers
Section supervisors
Safety and training personnel

J. H. Fletcher & Co.

G. Marston

Mine Safety and Health Administration

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This document is based on collaborative work under a Cooperative Research and Development Agreement (CRADA NIO–00–002) between NIOSH and Twentymile Coal Co.

Special thanks to B. Blakemore (Morton Salt, Inc.), J. Baugher and W. Gray (MSHA), R. L. Derick (Twentymile Coal Co.), and G. Molinda (NIOSH) for their review and comment on the draft version of this guide.

Sections

How to Use This Guide

This trainer's guide is designed as a reference manual. The purpose is to offer information and examples to skills trainers to assist them in structuring training for new operators of Walk-Thru roof bolting machines. Trainers can use this manual as a resource for helping trainees learn, understand, and apply knowledge and skills.

In this sense, the guide is not prescriptive. It is designed to offer information and trigger ideas on what might be done to accelerate learning to those who are new to the roof-bolting task. On-site trainers can modify this guide to fit their conditions, machines and equipment, and work procedures. They can integrate roof control plans, company policies and procedures, and operators' manuals from the manufacturers of the original equipment into this guide.

Every trainee is different and will come to the job with varying levels of relevant knowledge and skills. The trainer's decisions on where to start, how to organize the on-the-job and classroom training portions, and when and how to offer different aspects of the training will be based on (1) a pretraining assessment of the trainee's knowledge and skills and (2) the trainer's experience in conducting skills training. The "Skill Check" section might be useful for deciding where training should start among miners who have underground experience but limited knowledge of roof-bolting techniques. Every job carries a learning curve and likely has a number of "teachable moments" where significantly new knowledge and skills can be learned.

The videos on the DVD that accompany this guide can be shown at the beginning of training to give trainees an idea of what the job entails and related requirements. They can also be used within the training cycle (after the trainee has some experience in the job) to reinforce key points or as a trigger for eliciting questions about particularly difficult parts of the job. The video segments are meant to be visual models of good performance. They are designed to elicit discussion on good (lower risk) ways to do the job. In this context, they can be used very creatively at different times within the training cycle.

The section on "Talking Points" offers a number of questions that can be used in the classroom to support and elaborate on certain aspects of the job duties. If the trainee has a fair amount of underground experience, some of the questions can also be used to support the pretraining assessment (i.e., skill check) of knowledge and skills. Likewise, some of the questions can also be used while teaching on the job to reinforce key points affecting safety, production, or maintenance.

The section dealing with a mine's roof control plan should be used at various times in the training cycle to make sure the trainee understands the plan and knows how to apply it in performing the job.

The supplemental materials offer additional resources that can be used to support initial job training or follow-up. Learning continues well after an individual has been trained. The supplemental materials can help reinforce good operating skills and provide an opportunity for further discussion on better ways to do the job.

Concepts Behind the Trainer's Guide

This trainer's guide is based on the following concepts:

1. On-the-job training (OJT) is a common and natural way for workers to learn new skills.

2. Structured OJT requires a plan for the transfer of skills from an experienced worker (e.g., a coach) to someone with considerably less experience.

3. Structured OJT works best when it is planned and a coach is selected and trained to transfer skills to the trainee.

4. OJT implies small group or individual instruction - it is teaching in a real-world environment. It can make use of quiet, uninterrupted environments (e.g., a classroom), but instruction in either a classroom or a work environment is tightly connected to performance on the job.

5. OJT can use a team of experienced workers who intermittently coach the trainee in small, discrete instructional units. For example, a mechanic might teach the walk-around inspection component. A supervisor might teach skills related to crew coordination and the roof control plan. Experienced bolter operators and safety professionals might teach and evaluate skills related to machine functions such as tramming, drilling, and bolting, as well as how to reduce health and safety risks.

6. A coach's (OJT trainer's) job is to accelerate learning and help ensure that on-the-job performance is within acceptable boundaries. Some form of learning would likely happen without a coach, but skills can be more quickly and accurately learned if a coach is present.

7. Coaching/training someone new to a job is like navigating a car and providing help to the driver to get from where you are (point A) to an agreeable destination (point B).

8. Job training analysis (JTA) is like a road map. Road maps should save time and energy in getting to a destination. The destination is acceptable performance.

9. Defining "acceptable job performance" is difficult, but can be done via the JTA process. See the JTA example in this manual and access the MSHA Web site for additional JTA details.
   http://www.msha.gov/interactivetraining/tasktraining/index.html

A common method of teaching job-related skills is based on a model that has been around for some time: Assess – Train – Evaluate. This trainer's guide is built on this straightforward model. Once training begins, evaluation is considered continuous in

learning/practicing a skill. This is unlike traditional educational models where evaluation consists of a formal test or final exam.

Assess: Assessing is discovering how much training (new skills) is necessary. It can be a rather informal process based on defining what the person knows, has done, or can do (without any coaching or training). Good assessments take a little time, but will save more time. When assessing prior knowledge and skills, it is important to put the trainee at ease. Material included in this guide can help you make good assessments. Good, practical assessments save time for the trainer and the trainee.

> Asking questions and making observations is a common way to assess what skills and knowledge exist and which ones need to be developed. Using a "skills checklist" or asking questions such as those noted under "talking points" can help to assess how much training is necessary.

Train: Training is filling in the gaps between what is expected for acceptable job performance and what the trainee can already do. The training should be based on a practical job analysis – a teaching outline (JTA) of the job components and reasons why particular tasks and steps are important. This guide includes a practical job analysis – a training outline developed at the mine site. The purpose of training - structured OJT - is to shift task performance from the trainer to the trainee. The key word is performance.

> This guide is based on a learner-centered approach. Under this approach, the trainee is an active participant in the training, asking questions, talking his or her way through a task, and verbalizing responses to the instructor's questions. A coach would ask a lot of questions, make observations, and would listen more than he or she talks [see Semb 1999]. Coaches can start with the questions found in this trainer's guide.

Evaluate: Evaluation is a form of feedback that offers well-timed and placed suggestions for improving performance on the job. Evaluation is a form of follow-up. A trainee's self-assessment of his or her skills (progress) is also a good tool, along with the trainee's feedback to the OJT trainer.

The idea behind OJT is to develop knowledge and skills; thus, well-designed written or oral tests measure only part of the learning. As the trainee performs the task, he or she is putting themselves to the test under the guidance of an instructor. In a very practical sense, evaluation becomes continuous. The trainer continuously assesses the level of knowledge and skills of the trainee and offers feedback and/or suggestions for enhancing performance.

Trainees also make their own self-assessments as they perform the work. In the driving analogy, a self-assessment is similar to knowing if one is on the right road, what adjustments are needed, or if one needs to stop and look at a map, ask someone for directions, or figure it out by trial and error.

Each of the above components – Assess – Train – Evaluate - is addressed in this trainer's guide. The sample questions can be used to engage the trainee and establish a dialog for learning. Questions often invite other questions. Listening is an important skill in effective communication. Listening skills apply to both trainer and trainee.

A notebook format and layout of materials was chosen to allow you to make changes easily. This manual is an example of the type of content appropriate for structured skills training. Your feedback would be appreciated – changes, complaints, compliments, and requests.

Skill Check for New Operators of Roof Bolting Machines

Years ago, new coal miners gained underground mine experience as general laborers before they were trained to operate equipment at the working face. This is not the case at many mines today. Miners with limited underground experience are often moved quickly into production crews.

It is important for a trainer to assess a trainee's mining experience (skills) before being trained on a piece of equipment. This checklist is a sample of mining skills that a trainer (or OJT coach) can use to assess a trainee's skills. It will help identify specific skills that may require additional training. This will save time down the road as information gained will give a coach a better (more focused) starting point for training.

GENERAL UNDERGROUND MINING SKILLS – Can the Trainee –

- ❑ Use cap-lamp signals?
- ❑ Communicate with co-workers?
- ❑ Use the mine phone/pager system?
- ❑ Use proper lifting methods?
- ❑ Sound the roof?
- ❑ Hang a curtain?
- ❑ Build a stopping?
- ❑ Build a crib?
- ❑ Set posts?
- ❑ Hang ventilation tubing?
- ❑ Read a mine map?
- ❑ Operate a fire extinguisher?
- ❑ Connect a water line?
- ❑ Use a respirator?
- ❑ Use (when and how to insert) hearing protection?
- ❑ Use eye protection?
- ❑ _____

BOLTING-RELATED SKILLS – Can The Trainee –

- ❑ Operate a roof bolting machine?
- ❑ Test for methane?
- ❑ Complete the walk-around form?
- ❑ Protect the cable?
- ❑ Handle the cable?
- ❑ Use a scaling bar?
- ❑ Apply rock dust?
- ❑ Use a torque wrench?
- ❑ Energize or de-energize power to the roof bolting machine?
- ❑ _____

Job Training Analysis[1]

This section briefly discusses job training analysis (JTA) and provides an example of a JTA for the primary duties of a roof-bolting machine operator that is specific to a mine site. As demonstrated in this trainer's guide, a JTA can be used as a guide in preparing classroom and supplemental training tools, e.g., videos segments or questions a trainer could ask during OJT.

A JTA is not the same as a job safety analysis (JSA). A JSA focuses exclusively on *safety*, while a JTA results in a skills training outline that blends *safety with production*.[2] The final product of a JTA is a tool to be used by skills trainers in preparing for and engaging in training, as well as offering feedback to those who are new to a job. The JTA process draws on the expertise of experienced workers (bolter operators, mechanics, safety personnel, and supervisors) who see a job from different perspectives. JTA makes use of their knowledge to develop an outline for training those with significantly less job experience. Outlines are useful as they help an OJT trainer cover all aspects of the job affecting safety, production, and/or maintenance.

There are different ways to analyze a job to support structured skills training. The method used for the Walk-Thru roof bolter was a "table-top" analysis. Table-top job analysis has been around for some time. MSHA and NIOSH worked with the U.S. Navy, then with several mines to refine a JTA process suitable for mine sites. Several examples of JTA products and a detailed description of the JTA process can be found on the MSHA Web site at http://www.msha.gov/interactivetraining/tasktraining/index.html

JTA applied to the Fletcher Walk-Thru Roof Bolter: A JTA for the Fletcher Walk-Thru roof bolting machine was developed at a mine (Twentymile Coal Co.) with facilitated discussions with experienced bolter operators, mechanics who service the bolters, supervisors, safety personnel, and representatives of J.H. Fletcher & Co., MSHA, and NIOSH.

The mine's JTA group divided the job of operating a Walk-Thru bolter into seven primary duties.

- Preshift inspection
- Tramming
- Drilling roof and rib
- Installing resin bolts
- End-of-shift shutdown
- Other tasks
- Responding to unusual events

[1] A job training analysis is meant to be fluid. For example, the roof bolting JTA can be updated as new information is gained regarding important aspects of roof bolting with the Fletcher Walk-Thru bolter at a specific mine site. These updates might include (1) more succinct ways of breaking down the job into teachable components, (2) reasons why certain tasks or steps are important, or (3) the relative importance of tasks and steps within this job classification. A JTA can also be used to help troubleshoot the job within the mining process and examine ways to reduce the risk of costly consequences (e.g., injury, lost production, repairs, and added maintenance).

[2] Blending safety and efficiency is not new. For example, see the "work instructions for safety and efficiency" (WISE) training checklist developed by AEP, Inc., for Fletcher's Twin Boom Model DDM-15 roof bolter.

Tasks were connected to each of these job duties. Finally, steps were identified to satisfy each of the tasks. The result was a three-level hierarchy (column 1 of the JTA worksheet).

The first column of the JTA worksheet is a job analysis. A job analysis is a logical breakdown of the job into a hierarchy of duties, tasks, and steps. The completed job analysis should make sense to those who do the work. It should be a natural, logical way of organizing the job components to make learning less difficult and complicated.

The hierarchy is illustrated below.

First-order level: **Duties:** Most jobs consist of a limited number of duties.
Second-order level: **Tasks:** Tasks are short-duration activities connected to the job duty.
Third-order level: **Steps:** Steps are shorter-duration activities connected to the task.

Using such an outline helps to organize the extensive set of knowledge and skills required to operate a roof bolter. All duties, tasks, and steps listed should be *observable*.

The second column contains a series of notes that can remind the skills trainer to teach or reinforce important items about a specific work task. The second column was developed through discussions with subject matter experts at the mine site. Supporting these discussions were representatives of J.H. Fletcher & Co., MSHA, and NIOSH. In practice (i.e., during OJT), a skills trainer can also use this column to create reminders (observations, questions) while teaching job components. These notations reduce the chance that an OJT trainer will assume that a trainee will know about, or can do, certain job tasks and/or steps.

The third column is for a ranking of importance. This column can reflect the amount of attention a skills trainer gives to teaching, reinforcing, or evaluating a particular work task. The rankings address variability—the higher the ranking, the less variability is desirable in performing the job task or step. In this sense, the rankings address risks such as injury, machine downtime that causes production delays, or increased maintenance costs.

The fourth and fifth columns allow a skills trainer to make notes and offer feedback to the trainee about job tasks and steps performed acceptably and other aspects of the job needing more practice.

It took about 2 days at the mine site to develop the first draft of a practical JTA for the Walk-Thru roof bolter. About 10 subject matter experts were in the room working on the JTA. Once the JTA worksheet was completed, follow-up involved spending some time with other bolting machine operators, supervisors, and mechanics NOT in the JTA development group. This served to build ownership, validate, and clarify the work of the mine-site JTA team. It also permitted others who had a stake in the job to offer comments and improve the JTA product.

Job Training Analysis for the Walk-Thru Roof Bolting Machine

Duty 1: Preshift Inspection

Objective: Learner will be able to demonstrate how to conduct a complete workplace inspection. Learner will also be able to explain job tasks/steps, why they are conducted, and their importance.

Tasks and steps	Why Important? Consider Safety/Production/Maintenance What would be the consequence if this job task/step were skipped or not done correctly?	Importance: 1=important 2=very mport 3=critical	Satisfactory?	Needs Work?	Comments
Gather information from (or communicate with) prior shift	To update any information regarding roof and rib conditions, supplies, maintenance, and bolting machine operation. At the end of your shift, if you notice something that needs to be communicated with the next shift, write it down on the walkaround form or tell the supervisor or mechanic.				
Power-off: Inspect area up to and around bolting machine	Cable is not energized. Roof and rib conditions, location of other equipment, proper ventilation, and uneven bottom (slip and trip hazards).				
Power-off: Walk cable to bolting machine • Look for damaged cable and splices • Note locations of cables overhead or lying on bottom	Look for flat spots and torn (splice) jackets Cable problems affect safety/production/maintenance. Take note of the number of splices in the cable. Damaged cable or splices are electrical hazards. Make sure cables are hung correctly (insulated hangers) and are out of the way of equipment. Note: Splices can get hung up in the reel and complicate tramming.				
Power-off: Check to see if bolting machine is orderly and free of debris • Take corrective action	Prior shift should perform general housekeeping, including taking out worn bits, bundling material, etc. Bolts, plates, resin, and tools should be in their proper locations. Clean up any oil from a blown hose. Housekeeping is ongoing and affects all three shifts. Explain a "maintenance" cleaning (a more thorough washing down of the bolting machine).				
Power-off: Test for methane	Explain why, how, when, and where. Discuss certification for gas checks. Discuss issues with making methane checks using probes. Never go past last row of bolts to make methane checks.				

Tasks and steps	Why Important? Consider Safety/Production/Maintenance What would be the consequence if this job task/step were skipped or not done correctly?	Importance: 1=important 2=very mport 3=critical	Satisfactory?	Needs Work?	Comments
Power-off: Check free movement of machine controls Check oil level Check safety pin on fire suppression system Ensure all panels and covers are secure Empty dust box and replace dust filters Check tools and supplies • Bolts, plates, resin • Grease gun • Bits, bit clips • Tape measure and electrical tape • Paint to mark test holes	Check controls. Do all handles return to neutral? Use sight glass and note that oil checks can be tricky. If ATRS is up, for example, the oil reservoir will not appear "full." Dust filters should NOT be cleaned, ONLY replaced Stress use of respirators. Empty box as often as necessary. Stay up-wind. Any time the machine is de-energized is a good time to listen to the roof and rib. This is not only at the beginning of the shift, but during the shift as well.				
Power on: Pre-op check • Inspect stop switches, including panic bar • Test machine controls • Check ATRS • Check fire suppression system/nozzles • Check all lights are functioning and free of debris	Cable and machine are energized. Make sure controls work as intended. Includes boom controls, feed, and rotation. Do the handles operate as intended? How much 'play' is acceptable? For proper operation and identify any damage. Visual check only–nozzles and actuator assemblies.				
• Inspect hoses and connections for leaks • Check hydraulic fluid levels • Grease fittings	Discuss what are "bad" leaks. Collapse booms and ATRS to tramming position. Check fluid level. Explain practical aspects of these checks. Mast and booms.				
Complete preshift form	Hold until end of shift and update as needed.				

Duty 2: Tramming

Objective: Learner will demonstrate and explain how to tram bolting machine properly.

Tasks and steps	Why Important? Consider Safety/Production/Maintenance What would be the consequence if this job task/step was skipped or not done correctly?	Importance: 1=important 2=very mport 3=critical	Satisfactory?	Needs Work?	Comments
Walk roadway before tramming	Two people needed for moves, one to walk and one to operate bolter to avoid cables and give lamp signals. Also a good time to check and make sure no other equipment is parked in blind spots, e.g., on other side of curtains.				
Prepare for tramming: • Collapse ATRS • Bring booms in • Lower canopy • Raise drop mast • Raise drill head	Machine damage, dislodge roof supports, saves time when tramming. See operator's manual.				
Communicate intention to tram and cable reel coming on	Avoid personal injury from unexpected machine or cable movement. Include telling trainee importance of position in relation to cable and bolter.				
Monitor position of machine • Watch for contact with roof • Watch for other miners • Center machine in entry	Avoid machine damage and personal injury.				

Tramming the machine
• Note bottom conditions and clearance
• Location of other miners – communication
• Manage cable
  • Observe cable pick-up and pay-out
  • Check that there is enough cable
  • Hang cable/bridge cable to prevent other equipment from running over it
  • Stop tramming if another miner is walking by bolter
	Take your time. If not sure of conditions, stop machine and check.
	
	Watch for proper cable reel function. Note that (oversized) splices can get hung up in the reel.
	
	Prohibit standing on booms when tramming.
	
	Watch for contact with the roof and rib. Watch for pinch points – communicate with helper.
	
	Before ANYONE travels between the bolter and the rib, they should NOTIFY the bolter operator to stop tramming. Must avoid potential pinch points.				

Duty 3: Drilling roof and rib

Objective: Learner will demonstrate and explain how to drill roof and rib properly.

Tasks and Steps	Why Important? Consider Safety/Production/Maintenance What would be the consequence if this job task/step was skipped or not done correctly?	Importance: 1=important 2=very mport 3=critical	Satisfactory?	Needs Work?	Comments
Prepare to bolt • Check length of steel • Make up bolts (option) • Prepare resin • Check wrenches, bits, and other supplies • Pick up roof screen and ventilation tubes at last open crosscut and drag into face (if necessary)	Try to keep a clean and orderly work place with all tools and supplies in the proper location (i.e., trays). Scoop operator normally loads bolter. Try to take everything needed in one trip.				
Handle roof screen for installation • Retrieve roof screen from back of bolter • Position and secure roof screen onto top of ATRS.	Two-person job. Be aware of slipping and tripping when working with roof screen or walking on roof screen. Secure screen so it doesn't move or slide. Overlap roof screen and ensure correct bolt spacing.				
Set ATRS • Check position of rocker pads • Check three positive points of contact • Monitor accumulator pressure gauge	Refer to the roof control plan for spacing. Hold at least 5 seconds to make sure ATRS accumulator is properly charged.				
Position drill canopy	Canopy should not be used to support the roof. The position should be just above the operator's head. Never pressurize the canopy against the roof. If not installing roof screen, the canopy should be placed in operating position prior to drilling and setting the ATRS.				
Sound roof	Sounding the roof is a practical way to determine the need for additional roof support, especially in areas not recently bolted.				
Scale loose rock (after ATRS in place) • Roof • Ribs	Continuous operation.				
Position drill boom to desired location • Work from inside bolt to outside bolt • Watch roof screen markings and communicate when markings don't line up	Necessary to follow roof control plan. Bolt spacing needs to be according to the approved plan.				

Tasks and Steps	Why Important? Consider Safety/Production/Maintenance What would be the consequence if this job task/step was skipped or not done correctly?	Importance: 1=important 2=very mport 3=critical	Satisfactory?	Needs Work?	Comments
Drill test hole (when necessary) • Mark hole • Notify supervisor if void found	Explain why and how test holes are drilled in accordance with the roof control plan and as conditions warrant. Inexperienced bolters will not be doing this task.				
Insert starter steel into drill chuck	Check to see if drill bit is good for another hole. Check PPE: gloves, hearing protection, dust mask/respirator, and safety glasses.				
Raise drill head until drill bit penetrates roof	Use slow feed to avoid bending steel.				
Begin to drill	Use slow feed when drilling. Key is to get a straight, clean hole. At anytime when operator needs to leave the platform, use hydraulic disconnect.				
• Use rotate and feed controls to match roof strata conditions • Add extension steels as needed • Stop rotation before steel is out of hole (position depends on strata) • Change bits (when necessary) • Notify supervisor if void found while drilling	Don't place hands inside clamp or on drill head. *For new bolter operators*, lower steel completely down to add extension. Requires experience and practice. There are different techniques for doing this. Some operators drop the mast, hold the steel up in the hole with the extension (keeps the steel from falling out), and then add (connect) the extension. Prevent steel from whipping. Avoid plugged steel. Review procedure for unplugging. Requires experience and practice. Never touch rotating steel. When the top is hard, slow rotation. Do not over-drill. Disadvantage of over-drilling - resin will not be in contact with the entire bolt.				
Remove drill steels and replace in tray • Use reverse rotation at times to remove steel	Be careful handling hot drill steels. Discuss procedure for removing steels wedged in the roof.				

Duty 4: Installing resin bolts

Objective: Learner will demonstrate and explain how to install resin-grouted bolts properly into the roof and rib.

Tasks and steps	Why Important? Consider Safety/Production/Maintenance What would be the consequence if this job task/step was skipped or not done correctly?	Importance: 1=important 2=very mport 3=critical	Satisfactory?	Needs Work?	Comments
Installing resin-grouted bolts • Make up bolt assemblies (make sure plate is on bolt) • Insert resin tube in hole followed by bolt and plate • Move drill head up • Lower and align bolt in drill chuck • Raise bolt to within inch or two from top • Spin bolt • Set bolt by pushing to top and holding • Make sure plate is tight against roof • Test installed bolt	Place hand above or below drill guide (clamp or jaws) but not inside. Make sure plate is placed on the bolt in the correct direction. Requires experience and practice. Follow roof control plan. Resin: See manufacturer recommendations for the time to spin and to hold. Review procedure on how to test (visual and torque) installed bolts. Refer to roof control plan.				
Installing combination mechanical and resin-grouted bolts • Make up bolt assemblies • Insert resin tube in hole followed by bolt and plate • Move drill head up • Lower bolt and align in drill chuck • Raise bolt to within inch or two from top • Spin bolt • Set bolt by pushing to top and holding • Make sure plate is tight against roof • Torque nut to make sure plate is tight against roof • Test installed bolt	Place hand above or below drill guide (clamp) but not inside. Requires experience and practice. Follow roof control plan. Resin: See manufacturer's recommendations for the time to spin and hold. Review procedure on how to test (visual and torque) installed bolts. Refer to roof control plan.				

Installing rib bolts (horizontal and angle) • Use previous bolting steps • Use hydraulic disconnect when operator extends beyond confines of platform to put resin in hole	Discuss the advantages of using a resin inserter. Do not place self between any piece of equipment and rib. When activating the hydraulic disconnect, some operators lightly bump a lever to make sure the disconnect is functioning properly. Using the disconnect helps to avoid inadvertent control activation and being caught in a pinch point.				

Duty 5: End-of-shift shutdown

Objective: Learner will demonstrate and explain how to shut down the roof bolter and prepare the bolter for the on-coming crew

Tasks and steps	Why Important? Consider Safety/Production/Maintenance What would be the consequence if this job task/step was skipped or not done correctly?	Importance: 1=important 2=very mport 3=critical	Satisfactory?	Needs Work?	Comments
Place "Unsupported Top" (or danger) sign as necessary	To prevent others from inadvertently traveling under unsupported roof. If face is not completely bolted at end of shift, some operators back up a few rows and set ATRS.				
Park bolter in suitable place • Back out at least three rows	Tram to a suitable location for the on-coming shift to perform a safe walkaround inspection. Do not park near check curtains, etc.				
Shut down machine • Lower booms to floor • Shut off motor and lights • Disconnect at power center	Remember: If you leave the power on at the face, methane checks must be performed every 20 min.				
Clean bolter	General housekeeping includes taking out worn bits, bundling material, etc. Discuss a maintenance cleaning – a more thorough washing down of the bolter.				
Ensure cable is out of travelway	To prevent damage to the cable and possible tripping hazards.				
Communicate with supervisor and on-coming crew • Machine • Work environment • Supplies	Roof and rib conditions, maintenance needs, and supplies.				

Duty 6: Other Tasks

Objective: Learner will demonstrate and explain other bolting-related tasks (e.g., rock dusting and advancing ventilation controls).

Tasks and steps	Why Important? Consider Safety/Production/Maintenance What would be the consequence if this job task/step was skipped or not done correctly?	Importance: 1=important 2=very mport 3=critical	Satisfactory?	Needs Work?	Comments
Collect and place damaged resin cartridges in proper barrel for disposal	Review MSDS.				
Extend ventilation per plan	Review procedure for extending tubing and hanging curtain. More than one person is needed to do this task.				
Apply rock dust when bolting cycle complete	Review procedures for why your rock dust and how to apply rock dust.				

Duty 7: Responding to Unusual Events

Objective: Learner will explain how to respond to nonroutine events (e.g., small fires on the section, procedures for preventing and treating burns from hydraulic oil)

Events to discuss	Why Important? Consider Safety/Production/Maintenance What would be the consequence if this job task/step was skipped or not done correctly?	Importance: 1=important 2=very mport 3=critical	Satisfactory?	Needs Work?	Comments
Small fire	Explain machine-mounted fire suppression system.				
Burns from hydraulic oil	Review first-aid procedures and MSDS.				
Face ignitions	Review how to avoid.				
Roof falls	ATRS operating height.				
Bolting an overcast or undercast	ATRS operating height.				

Talking Points

To the trainer: Asking a question is a good way to engage learners in the job to ensure understanding. It serves as an opportunity to discuss and reinforce important topics and principles related to roof support. Questions often invite other questions and discussion.

These questions are examples of what might be asked at any point in the training cycle – assessment, training, or follow-up (evaluation). Additional lines are provided so other questions can be added.

Unsupported roof:

1. Are there any circumstances when is it OK to go under unsupported roof?
2. If a drill steel or wrench falls beneath unsupported roof, what should you do?
3. What is supported versus unsupported roof?
4. What identifier is used at your mine to identify unsupported roof?
5. _____
6. _____

Roof conditions:

1. If you find that the roof conditions are getting worse, what should you do? Who should you tell?
2. What would you do if mining height in the bolting area was so high that the ATRS did not make contact with the roof (e.g., after a roof fall)?
3. What types of temporary supports are available at this mine? Have you had experience installing them?
4. How do you recognize a [*insert list of hazardous roof conditions at this mine, e.g., kettlebottoms, clay veins, cutter roof*]?
5. How should you support *[insert list of geological problems at this mine that require extra or unusual forms of support, e.g., kettlebottoms, clay veins, cutter roof]*?
6. How and why do you sound the mine roof? What does a competent roof sound like?

7. Why should bolting machine operators try to minimize placing their hands on top of the bolting machine?

8. _____

9. _____

Methane:

1. How do you check for methane?

2. How often should methane checks be made while bolting inby the last open crosscut?

3. How often should methane checks be made while bolting outby the last open crosscut?

4. Discuss some of the problems you might encounter in taking a methane check.

5. _____

6. _____

Preshift or walk-around inspection of the bolting machine:

1. Why would you want to measure the drill steels at the beginning of every shift?

2. What should you check before operating the bolting machine at the beginning of the shift?

3. What should you check before bolting in a new cut?

4. Where are some unsafe places to stand when you are near a bolting machine? Why?

5. Why should you walk the cable up to the bolting machine when you are starting your shift?

6. What are some of the things you look for during your power-off or pre-op check?

7. What are some of the things you inspect during your power-on check?

8. What types of problems or unusual circumstances should you mention to your foreman at the end of the shift?

9. What kinds of things would be important for bolting machine operators on the next shift to know about? How can you make sure they get this information?

10. _____

11. _____

Tramming:

1. If you are tramming the bolting machine, what should the other operator be doing?

2. What is involved in preparing the bolting machine for tramming?

3. _____

4. _____

Installation of roof screen:

1. How many people are needed to handle each sheet of the roof screen on the bolting machine?

2. What is the purpose of installing roof screen?

3. What are some of the hazards of installing roof screen?

4. _____

5. _____

Automated temporary roof support system (ATRS):

1. About how long should you hold the ATRS against the roof to pressurize it? Why do you need to hold it that long?

2. What is the maximum allowable distance from the ATRS rocker pad to the rib (or post or permanent support)?

3. _____

4. _____

Drilling:

1. If the drill steel gets stuck in the roof, how do you get it free?
2. Why should you check the length of your drill steel?
3. What do you do when the drill steel is plugged?
4. Why is it important not to over-drill a roof bolt hole?
5. Where should the drill canopy be positioned when you are getting ready to drill?
6. If the drill steel plugs while drilling, what could this be a sign of?
7. What can bolting machine operators do to prevent a drill steel from plugging?
8. What is the purpose of the hydraulic disconnect?
9. When (under what conditions) should you activate the hydraulic disconnect?
10. When should you change your drill bits?
11. When should you change your drill steels?
12. When is it OK to grab a rotating drill steel?
13. _____
14. _____

Roof bolt installation:

1. Why do we bolt the roof?
2. How does a roof bolt work?
3. How do you make sure that the roof bolts are not spaced too far apart?
4. When should you use extra roof bolts?
5. About how long do you hold a resin-grouted bolt to be sure the resin has set?
6. What should you do if a bolt plate is not in full contact with the mine roof?
7. When (under what conditions) should you activate the hydraulic disconnect?

8. _____

9. _____

Personal protective equipment (PPE):

1. What type of gloves should you use while bolting?
2. What kind of PPE must all bolting machine operators wear or take underground?
3. What kind of PPE should you wear when emptying the dust box?
4. _____
5. _____

Other items:

1. What are the most common types of injuries to bolting machine operators?
2. What causes these injuries (e.g., cutting bands on a bundle, getting caught in a pinch-point, rock fall, hot drill steel)?
3. What should you do to prevent each type of injury?
4. When is it acceptable to walk between the bolting machine and the ribs?
5. What should you do if you come across a heated or smoldering cable?
6. Explain the difference in anchorage between mechanical and resin-grouted bolts.
7. _____
8. _____
9. _____
10. _____

Location to insert the roof control plan

Roof Control Plan Exercise

To the trainer: Roof bolting machine operators need to be familiar with the roof control plan at their particular mine. The goal of the following exercise is to acquaint trainees with the plan and to increase their knowledge and understanding.

A set of sample questions are provided that can be modified to better reflect the roof control plan at your mine. The trainee can (1) review these questions, (2) read the roof control plan, and (3) prepare answers based on his or her practical understanding of the roof control plan.

By completing this exercise, the trainee will learn more about roof control procedures required by the plan and will be able to use the plan as a reference. You can use the trainee's responses as a check for his or her understanding of the plan.

Roof Control Plan Exercise
Sample Questions Related to the Roof Control Plan

To the trainee: It is important for you to know what kind of information is in the roof control plan and why you need to adhere to it. As you read through the plan, please answer the following questions:

How often must mine management and MSHA review the roof control plan?

Who must have access to the roof control plan?

What type of roof rock lies above the seam currently being mined?

What action should you take when roof conditions worsen?

Give some examples of the materials used at the mine from the "Primary Roof Support Material" list.

What is the torque range for the roof bolt you usually install?

Name three examples of the materials used at the mine from the "Supplemental Roof Support Materials" list.

What is the maximum allowable distance between bolts in each row?

What is the maximum allowable distance between the rib and the nearest roof bolts?

What must be done if pillar corners slough off after roof bolts are installed and the distance between the roof bolts and the rib exceeds 5 feet?

When operating a Walk-Thru bolting machine, which roof bolt do you install first -- the inside bolt or the outside bolt?

Why?

What is the maximum allowable entry width?

List some unusual circumstances that would prevent the use of the ATRS and require the manual installation of jacks and posts?

What is the minimum roof bolt length for resin (grouted) or combination bolts at your mine?

When using mechanical anchorage or combination bolts, how often should test holes be drilled?

If applicable, what is the minimum length of resin for each drill hole?

What is the maximum distance of advance with a remote-control continuous miner?

When using a remote-control continuous miner, how many rows of roof bolts must be installed inby the projected rib before a side cut is made?

When installing temporary supports for supplemental support and rehabilitation, where does the roof control plan allow you to position yourself relative to the permanent supports in place?

Scripts for Video Segments

Being proficient as a bolting machine operator only comes through practice on the job. However, videos are a flexible classroom tool that can provide a good visual model for work activities and prepare the trainee for on-the-job learning.

Six video segments were developed based on the job training analysis for the Walk-Thru Roof Bolter. The segments were based on the primary job duties listed below.

Preshift inspection	3 min.
Tramming	1-2 min.
Drilling bolt holes	2-3 min.
Installing resin bolts	1-2 min.
End-of-shift shutdown	1-2 min.
Other tasks	1-2 min.

The duties were divided to provide the opportunity for the trainer and trainees to discuss one major job duty at a time.

> *The videos are designed to be used as a tool for the instructor, as well as a learning aid for the trainee. For example, the trainer can stop the video, point out a subtlety in machine operation, ask questions of the trainees, address comments made in class, and rerun the segment. The videos model good practices. They can also trigger questions, discussions, and comments.*

For more information about JTA, visit the MSHA Web site at http://www.msha.gov/interactivetraining/tasktraining/index.html or contact your local MSHA office.

Preshift Inspection

Instructor Notes

Roof bolters are an essential component of the underground mining system. Whether you operate the roof bolter daily or only occasionally, safe operation of the machine is important.

This video is part of a program to promote the safe and productive operation of Walk-Thru roof bolters. This program was developed to help educate newer employees and strengthen the skills of more experienced workers.

Your shift should begin by talking with the bolter operators coming off-shift. They can tell you about the current roof and rib conditions in the section and the condition of the bolter. Pay attention to their comments and take the time to follow the bolter inspection checklist when doing your preshift walk-around inspection.

While walking along the power cable to the bolter, make note of any splices and check for obvious damage to the cable. Also, perform a visual inspection of the roof, rib, and bottom conditions.

When you get to the bolter, make sure it's clean and organized, and keep it that way throughout your shift.

Conduct your power-off preoperational checks. This includes a visual inspection of your tools and supplies. The machine's controls should move freely and return to center.

Before powering up the machine, perform the required methane examination.

Check the dust box, stand upwind, and wear your respirator. If needed, empty the box and then clean or replace the dust filters as recommended by the manufacturer.

Turn the power on and do your power-on preoperational checks.

Make sure all lights are functioning and free of debris.

Inspect hoses and connections for leaks, make sure all panels are secure, and that

the fittings on your mast and booms are greased.

Examine the ATRS for damage.

Check fluid levels and the fire suppression nozzles.

Then test the hydraulic disconnect and the stop switches.

Complete your bolter inspection checklist.

If problems are discovered during your walk-around, or on-shift, report them to your supervisor immediately.

A good walk-around is the first step in safe and productive roof bolter operation.

Tramming

	Instructor Notes
Before tramming the roof bolter to another location, make sure the ATRS is collapsed; the booms are tight against the frame, the canopies lowered, and the mast and drill head positioned off the bottom.	
Make sure miners are positioned in the clear before activating the cable take-up reel.	
Two miners are needed to move this machine safely. One operates the controls on the machine, and the other walks along the roadway, moving cables, watching for blind spots, and making sure the path is clear.	
In performing this task, both miners should always maintain contact with each other.	
Tramming requires a lot of attention by both miners.	
Watch for low spots in the roof and tight rib conditions.	
Watch for bumps or holes on the roadway.	
Also, keep an eye on the power cable,	

making sure the take-up reel is operating properly and the cable is not in a position to be damaged.

No one should ever be located between the rib and the moving bolter.

Take your time, keep good communication, and always watch out for other miners.

Drilling Bolt Holes

Instructor Notes

After the roof mesh is positioned on the ATRS, advance the bolter, then raise the ATRS and set the rocker pads firmly against the roof.

Examine the roof for loose material.

Before drilling begins, match the length of the steels with the roof bolts.

Periodically check this throughout the drilling process.

Raise and position the drill canopy.
Never place the canopy against the roof. It's not designed for roof support.

Make sure the drill bit is in good condition, then insert the starter steel into the drill pod.

Raise the drill pod until the drill bit touches firmly against the roof.

Always remove your hands before rotating the drill steel.

Begin to drill slowly. Use rotate and feed controls to match strata conditions. If extension steel is needed, drop the mast, holding the steel up in the hole with the

extension, and then connect the extension. Always try to drill a straight hole.

Sometimes it may be necessary to continue rotation while lowering the drill steel from the hole. Rotation should be stopped just before it's out of the hole. This will keep the steel from whipping.

It's important not to over-drill the bolt hole. If the hole is too long, the resin won't be in contact with the entire bolt.

Less-experienced bolter operators should always take their time and not attempt to keep up with experienced operators. Drilling clean, straight holes to the proper depth and according to the roof control plan is a critical part of your job. Taking your time to do a quality job benefits both safety and production.

Installing Resin Bolts

	Instructor Notes
When installing resin (grouted) bolts, make up the assembly by putting the plate on the bolt. Insert the resin tube in the hole followed by the bolt and plate. Move the drill head up and place the bolt head into the drill wrench, making sure the bolt is aligned in the wrench.	
Always keep your hands away from moving components.	
Raise the bolt and plate to within 1inch of the roof. Rotate the bolt for 5 to 8 seconds to mix the resin.	
Set the bolt by pushing it to the roof and holding it for about 10 seconds. Make sure the plate is tight against the roof.	
Always disconnect the hydraulics before you extend beyond the platform.	
Use the same procedures when installing bolts in the rib.	
Taking your time and doing a quality job benefits both safety and production.	

End-of-Shift Shutdown

	Instructor Notes
If you haven't finished the bolting cycle at the end of the shift, back up the bolter a few rows and hang an "Unsupported Roof" sign. This warns the next crew that the cut needs additional support and helps to keep others from accidentally going under unsupported roof.	
- Park the bolter	
- Turn off the pump motor and lights	
And, before leaving the bolter, organize supplies and clean-up by removing empty rock dust bags, used bits, and any damaged resin cartridges.	
As you walk back to disconnect the power at the power center, be sure the bolter cable is located along the rib.	
Tell your supervisor about any unusual problems or concerns regarding machine performance or roof and rib conditions.	
Also communicate the current condition of	

the bolter and the work environment with the on-coming crew. - Parking the bolter at a safe location, never behind a check curtain or in the middle of an intersection, - Maintaining good machine housekeeping, - And having good communication with the oncoming crew are excellent ways to help the next crew begin their shift.	

Other Tasks

	Instructor Notes
There are a few tasks that should be performed by roof bolter operators during or after the bolting cycle. When moving power cables, always be aware of worn spots or damaged splices. Report them immediately. Always be aware of your work area and keep an eye on the roof and rib conditions. Hang ventilation tubing as required by the ventilation plan. At the end of the bolting cycle, rock-dust the roof and ribs before you leave the area. Always maintain the equipment in a clean condition. This reduces fire hazards due to oil and grease accumulations, and it minimizes airborne dust when handling supplies. These tasks are an essential part of the roof bolting process and doing a quality job benefits both safety and production.	

Supplemental Materials

The following is a listing of supplemental materials that can be of use to skills trainers. Some of this material can be used for initial skills training, or used later to refresh or reinforce safe production skills.

Examples of supplemental materials are contained on the next few pages.

- **How Stuff Works:** "How Hydraulic Machines Work"
  http://science.howstuffworks.com/hydraulic.htm

- **J.H. Fletcher & Co.**
  http://www.jhfletcher.com

- **Mine Safety and Health Administration (MSHA)**
  1. "Hand Tools - Bars" http://www.msha.gov/Accident_Prevention/Tips/handtoolbar.htm
  2. "Work Experience Around Machinery"
     http://www.msha.gov/Accident_Prevention/Tips/workexperience.htm
  3. Preventive Roof/Rib Outreach Program: 2004 Summer PROP Initiative Roof Control Awareness Bulletins http://www.msha.gov/S&HINFO/PROP/PROPHOME.HTM
  4. Effects of Water on Mine Roof Strata
  5. Examine And Correct Hazardous Roof/Rib Conditions
  6. Proper Work Place Exams Identify Hazards
  7. Best practices roof bolting (BP Card No. 28)
     http://www.msha.gov/s%26hinfo/bpcards/roofrib/bp28.pdf
  8. Job safety tips: ST Card 11: Roof and Rib Safety in Coal Mines
     http://www.msha.gov/s%26hinfo/safety/hcard/stcrd11.htm
  9. Roof and rib fatalities: *http://www.msha.gov/s&hinfo/roofrib.pdf*
  10. Support the Roof, Rib, and Brows
  11. Best Practices for Roof Examination and Evaluation:
      http://www.msha.gov/s&hinfo/bpcards/roofrib/bp26.pdf
  12. Examples of video materials available from the National Mine Academy
      http://www.msha.gov/TRAINING/prodintr.htm
      - Roof Fall Entrapment: Eye Witness Accounts
      - Roof Fall Entrapment: Survivors' Accounts
  13. Examples of problem solving simulations available from the National Mine Academy
      http://www.msha.gov/TRAINING/prodintr.htm
      - Pete's Predicament: Unsupported Roof
      - Bull's Double Header: Too Much Unsupported Roof

- **National Institute for Occupational Safety and Health (NIOSH)**
  - "Earplug insertion steps" - http://www.cdc.gov/niosh/mining/topics/hearingloss/earplug.htm
  - "Respirators" - http://www.cdc.gov/niosh/npptl/topics/respirators
  - "Mining" - http://www.cdc.gov/niosh/mining

  "Make it safer with roof screen" - http://www.cdc.gov/niosh/mining/pubs/pdfs/miswrs.pdf

- **VA Department of Mines, Minerals, and Energy: Division of Mines HALT (Hazard Alert Live Tomorrow) Safety Alerts and Safety Alert Bulletins**
  http://www.mme.state.va.us/Dm/
    - Roof Bolter Operator Safety in VA
    - Roof Bolter Operator Safety - Hands Off Drill Steel
    - Roof Control - Crushing Experience
    - Roof Control Examinations & Evaluations
    - Roof Control Safety - #1
    - Roof Control Safety - #2
    - Roof Control Safety - Removal of Roof Support
    - Roof Fall - Look Up & Live
    - Roof Bolter Accident - 4/30/04
    - Machinery Safety

Relevant Federal Regulations from Title 30, Code of Federal Regulations	
http://www.msha.gov/30cfr/75.1107-1.htm	Fire-resistant hydraulic fluids and fire suppression devices on underground equipment
http://www.msha.gov/30cfr/75.1107-4.htm	Automatic fire sensors and manual actuators; installation; minimum requirements
http://www.msha.gov/30cfr/75.1107-9.htm	Dry chemical devices; capacity; minimum requirements
http://www.msha.gov/30cfr/75.150.htm	Tests for methane and for oxygen deficiency; qualified person
http://www.msha.gov/30cfr/75.1710.htm	Canopies or cabs; diesel-powered and electric face equipment
http://www.msha.gov/30cfr/75.1710-1.htm	Canopies or cabs; self-propelled *diesel-powered and* electric face equipment; installation requirements
http://www.msha.gov/30cfr/75.1726.htm	Performing work from a raised position; safeguards
http://www.msha.gov/30cfr/75.1719-1.htm	Illumination in working places
http://www.msha.gov/30cfr/75.202.htm	Protection from falls of roof, face and ribs
http://www.msha.gov/30cfr/75.203.htm	Mining methods
http://www.msha.gov/30cfr/75.204.htm	Roof bolting
http://www.msha.gov/30cfr/75.206.htm	Conventional roof support
http://www.msha.gov/30cfr/75.208.htm	Warning devices
http://www.msha.gov/30cfr/75.209.htm	Automated Temporary Roof Support (ATRS) systems
http://www.msha.gov/30cfr/75.210.htm	Manual installation of temporary support
http://www.msha.gov/30cfr/75.211.htm	Roof testing and scaling
http://www.msha.gov/30cfr/75.212.htm	Rehabilitation of areas with unsupported roof
http://www.msha.gov/30cfr/75.213.htm	Roof support removal
http://www.msha.gov/30cfr/75.214.htm	Supplemental support materials, equipment and tools
http://www.msha.gov/30cfr/75.220.htm	Roof control plan
http://www.msha.gov/30cfr/75.221.htm	Roof control plan information
http://www.msha.gov/30cfr/75.222.htm	Roof control plan-approval criteria
http://www.msha.gov/30cfr/75.223.htm	Evaluation and revision of roof control plan
http://www.msha.gov/30cfr/75.323.htm	Actions for excessive methane
http://www.msha.gov/30cfr/75.325.htm	Air quantity
http://www.msha.gov/30cfr/75.400.htm	Accumulation of combustible materials
http://www.msha.gov/30cfr/75.403.htm	Maintenance of incombustible content of rock dust
http://www.msha.gov/30cfr/75.503.htm	Permissible electric face equipment; maintenance
http://www.msha.gov/30cfr/75.506.htm	Electric face equipment; requirements for permissibility
http://www.msha.gov/30cfr/75.506-1.htm	Electric face equipment; permissible condition; maintenance requirements
http://www.msha.gov/30cfr/75.511.htm	Low-, medium-, or high-voltage distribution circuits and equipment; repair
http://www.msha.gov/30cfr/75.512.htm	Electric equipment; examination, testing and maintenance
http://www.msha.gov/30cfr/75.523-1.htm	Deenergization of self-propelled electric face equipment installation requirements
http://www.msha.gov/30cfr/75.604.htm	Permanent splicing of trailing cables
http://www.msha.gov/30cfr/75.606.htm	Protection of trailing cables

Other resources:

Jacobs, R.L. and Jones M.J. [1995]. Structured on-the-job training: Unleashing employee expertise in the workplace. San Francisco, CA: Berrett-Koehler Publishers, 194 pp.

Lawson, K. [1997]. Improving on-the-job training and coaching. Alexandria, VA: American Society for Training and Development, 94 pp.

Mager, R. [1999]. What every manager should know about training: An insider's guide to getting your money's worth from training. Atlanta, GA: Center for Effective Performance, 139 pp.

Mallett, L., Kowalski-Trakofler, K., Vaught, C., Wiehagen, W., Peters, R., and Keating, P., eds. [2005]. Coaching Skills for On-the-Job Trainers. NIOSH Information Circular 9479. Pittsburgh, PA: National Institute for Occupational Safety and Health. DHHS (NIOSH) Pub. No. 2005-146, 203 pp.

Mark, C. [2002]. The introduction of roof bolting to U.S. underground coal mines (1948-1960): A cautionary tale. In Proceedings, 21st International Conference on Ground Control in Mining, S.S. Peng, C. Mark, A. Wahab, and K. Heasley, eds. (Morgantown, WV, Aug. 6-8, 2002). Morgantown, WV: West Virginia University, pp. 150-160.

Robertson, S. B., Cooper, D.P., and Wiehagen, W. J. [2004]. Safety improvements for roof bolter operators. Presentation at ASSE Professional Development conference (Las Vegas, NV, June 7-10, 2004). 17 pp.

Semb G, Ellis J, Fitch M, Kuti M [2000]. On-the-job training (OJT): theory, research, and practice. In: Tobias S, Fletcher JD, eds. Training and retraining: a handbook for business, industry, government, and the military. New York: Macmillan Reference USA, pp. 289–311.

Stolovitch, H.D., and Keeps, E.J. [2002]. Training ain't telling. Alexandria, VA: American Society for Training and Development, 193 pages.

AEP, Inc. Work instructions for safety and efficiency. Training checklist: Roof bolter, Fletcher twin-boom model DDM-15, 39 pp.

Wiehagen, B., Conrad, D., Friend, T., and Rethi, L. [2002]. Considerations in training on-the-job trainers. In Strategies for Improving Miners' Training, R.H. Peters, ed. NIOSH Information Circular 9463. Pittsburgh, PA: National Institute for Occupational Safety and Health. DHHS(NIOSH) Pub. No. 2002-156, pp. 27-34.

A vignette taken from: Semb G, Ellis J, Fitch M, Kuti M [2000]. On-the-job training (OJT): theory, research, and practice. In: Tobias S, Fletcher JD, eds. Training and retraining: a handbook for business, industry, government, and the military. New York: Macmillan Reference USA, pp. 289–290.

ON TEACHING AND LEARNING: AN IMPORTANT DISTINCTION IN MY LEARNING TO FLY

By George B. Semb, University of Kansas

I took my first flight in 1951. I was eight. It originated in Philadelphia. I was to spend a month with my aunt and uncle in Alabama. My parents stood near the gate as I boarded the Eastern flight. My father waved good-bye, and my mother cried. The flight was exciting, but the long approach and sweeping turns were too much. I threw up. I also lost my wallet.

My uncle, a World War II veteran and pilot, met me at the gate. He realized immediately what had happened. In retrospect, it would have been hard for anyone who could see or smell to miss it. By the next morning, I had forgotten the flight until the doorbell rang and there stood a messenger with nothing less than my wallet. Can you imagine a messenger driving 50 miles to deliver a wallet that contained a Cub Scout card and a $10 bill? That *was* service, the way it used to be.

I flew again eight years later, shortly after my father returned from a business trip. He had just flown on a jet, a Boeing 707, from Denver to Chicago, and he was excited. He offered to give me flying lessons. We lived in a small town in northern Wisconsin. The nearest airport was 13 miles away. There were a few planes and one instructor, a man named Don.

The plane had a tail wheel and two seats, arranged one behind the other. Don gave me a quick overview of the front seat and panel: "the knob on the panel is the throttle—it controls thrust; the pedals on the floor (rudders) control right and left; the thing in the middle is the stick—it controls up and down and right and left." How two things could control right and left was not clear, but before I could ask, Don told me to climb in. He added that he "would show me how this plane can fly." I quickly learned that "showing" and "teaching" are different concepts.

My father waved as we taxied to the runway and took off. Soon, Washburn, where I lived, came into view. It was awesome. I would be the first 16-year-old in my class to fly an airplane. Then Don yelled, "I'm going to show you a couple of turns." The plane banked left, and I could see the barn below us. A few seconds later I could see the same barn off the right wing. My stomach was not happy, but I guessed that was part of flying. All the time I noticed that my feet were moving and that the stick between my legs was moving from right to left and front to back. My thought pattern was interrupted when Don yelled, "It's yours, give me a left turn." We were drifting up and to the right, so I pushed hard on the left pedal. At the same time, I pushed the stick forward and to the left as far as it could go. The airplane responded with enthusiasm. We were headed down and to the left in what I later learned was called a dive. I could see the ground in front of us, right under the nose. Don yelled, "Let go, let go!" I could feel back-pressure on the stick, so I let it go.

Next, we tried climbing. My turn. I pulled back on the stick; it didn't go up too much, so I pulled the stick into my gut and held it there. Don screamed, "Let it go," just as we experienced one of the most stunning stalls I have ever encountered. Again my stomach was not happy. We landed a few minutes later. I got out of the plane and, in what was now becoming a tradition, threw up. My father handed Don a $10 bill, which Don rejected with the simple epitaph, "George will never be a pilot."

I had failed, but my father did not reinforce that line of reasoning. He told me that someday I might try again. I swore that I wouldn't, but, hedging a bit because I had peers to impress, I vowed that if I ever did, it would be with someone who knew how to teach. That day did not come until January 1964, when I was working in Southern California on a study of visual ranging among, of all people, Navy pilots. They encouraged me to try again and gave me the name of a civilian instructor, Charlie, at the Oxnard airport. Charlie knew how to teach.

Charlie told me straight off, "Flying is serious business, but fun. Consider it your job for the next two months, and we'll get along just fine." I took what he said to heart. Learning to fly was the job, I was the trainee, and he was the trainer. He told me to read the first two chapters in the text and to come to the airport the next day prepared to preflight the airplane. Little did I know that I would be questioned on every nook and cranny until I could explain its functions and determine whether it was in proper working order. Charlie occasionally prompted a bit of action here or a poke there to complete the sequences. If I didn't understand, which meant to Charlie that I couldn't explain it to his satisfaction, he would break it down into pieces. Once I had mastered the pieces, he would ask me to put them back together.

The preflight the first day took more than two hours. By then I needed a break, so we went to the coffee shop and talked about what we had just done. Charlie didn't talk very much, though. I asked him why. "If I do all the talking," Charlie said, "I will learn something, but you probably won't. You'll learn better if *you* have to explain things. That way, I'll know what you don't understand." Charlie would ask questions and clarify things if I didn't get them right. When I was struggling with understanding what control surfaces controlled pitch, yaw, and roll, and why, he told me, "Those relationships don't make much sense until you can visualize them." He was right. Now, when I think about pitch, I visualize the elevator and going up and down. When I think about roll, I see the ailerons and banking to the left or right. Finally, when I think about yaw, I visualize the rudder and turning to the right or left.

We didn't fly that day. The next day we did, but only after I had satisfied Charlie that the airplane was safe to fly. Clever dog, he had even undone a hose to make sure I actually discovered a condition that would seriously impair the flight. After we took off, Charlie demonstrated a few things, most of which were designed to show me that the airplane liked to return to a balanced state and that minor movements are usually more effective than drastic ones. Then he let me have the controls. "First things first," he said. So we flew straight and level. Then he gradually got me to do turns. The scenario was repeated many times. He would do a short demonstration, then walk me through the procedure. As I become more proficient, he would explain in more detail what was happening. The next time, I had to both demonstrate the procedure and explain what was occurring.

Within two weeks I had soloed, and three months later I earned my private pilot certificate. Today, I coauthor an instructional guide for aspiring private pilots (Semb & Taylor, 1999). The person I thank is Charlie, my first flight instructor, for his patience and for his exceptional ability to ensure that I *learned*.

Your feedback would be appreciated.

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DHHS (NIOSH) Publication No. 2006–135