Toolbox Safety Talks: Blast Safety

Instructor's Guide

Objectives:

To improve blast safety by providing information about blasting to those who work around blast sites.

Target audience:

- **Workers**
- **Blast crew members**
- **Trainees**

Contents:

4 pamphlets with tear-off cards:

A. **What is flyrock?**
B. **Recognize the blast area and blast signals**
C. **Clear the area**
D. **Protect yourself**

On one side of each pamphlet is a description of the dangers and safety problems that could exist around blasting. On the reverse side, there is a list of Best Practices and a set of Talking Points.

3 sets of postcards:

There is a set of postcards for 3 of the pamphlets. These postcards contain related photos and drawings. You may want to improve these safety talks by adding photos on your site – for example, photos of blast warning signs or flyrock damage.

1 record sheet:

This sheet can be photocopied and used to record training activities.

The tear-off card that is attached to each lesson can be used for suggestions and/or comments or you may send your comments to:
Marcia Harris, Chemical Engineer
NIOSH Pittsburgh Research Laboratory
P.O. Box 18070
Pittsburgh, PA 15236
Phone: (412) 386-5780 Fax: (412) 386-6561 e-mail: MHarris@cdc.gov

TOOLBOX TALK RECORD SHEET

BLAST SAFETY: FLYROCK AWARENESS

FLYROCK awareness

NAME:	DATE:	What is Flyrock? **Toolbox A**	Clear the Blast Area **Toolbox B**	Recognize Blast Area & Signals **Toolbox C**	Protect Yourself **Toolbox D**

Instructor's Name:_____ Date:_____

SAMPLE

NAME:	DATE:	June 24 Toolbox A	Toolbox B	July 15 Toolbox C	Aug 1 Toolbox D
Neyal Ammery		X			X
Michael Thomas		X		X	X

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Attention: Marcia Harris, Chemical Engineer

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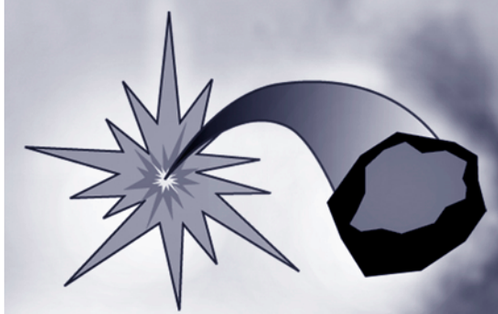
WHAT IS FLYROCK?

Tool Box Lesson A



FLYROCK awareness

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What is Flyrock?

FLYROCK is anything that is thrown by a blast and lands outside the blast area

The *BLASTER-IN-CHARGE* defines the *BLAST AREA*. For safety reasons, all people must leave that region before the shot is fired. The blaster has figured the amount of explosive needed to break the rock. However, rocks and debris sometimes travel through the air or roll along the ground and land *outside* the blast area. This is called *FLYROCK*. Any object is called flyrock if it travels outside the blast area. Flyrock can be:

- a football-sized rock
- marble-sized pieces of rock
- the stump of a tree
- mud or water

Flyrock is uncommon because of the knowledge, experience, and care taken by blasters. Millions of tons* of explosives are safely shot each year. Still, there are injuries and deaths due to flyrock.

Flyrock Travels Far and High

Flyrock has been known to land a half mile farther than planned. In Kentucky, flyrock killed a blaster by flying high enough to clear a 200-foot bench and hit him standing 550 feet away.

Flyrock is Powerful

The ISEE *Blaster's Handbook* states that each pound of explosives has the force of 76 million horsepower. An 8½-pound piece of flyrock traveled 1,200 feet from the blast and with enough power to dent the roof of a truck. The dented roof killed the worker.

Flyrock is Fast

Rocks from a blowout have been clocked at 400 miles per hour (about 200 feet from the blast). A professional baseball pitch is 90 miles per hour. If a baseball is too fast for a batter to dodge, would you want to try to dodge flyrock?

*According to the 2003 US Geological Survey, 2,290,000 metric tons of explosives were purchased to be used in the United States.

Flyrock Causes Accidents

Of the *mining* accidents that are caused by blasting, records of the Mine Safety and Health Administration show that 1 out of 10 blasting accidents since 1978 happened because of flyrock that landed outside the blast area. Accidents happened not just to blasters but also to people guarding the blast area, contractors sitting in their trucks, miners waiting to go back to work, neighbors working in their own yards, and even to people driving on the highway.

If you are a mile away or even only 500 yards away, you may be able to see flyrock coming but *it is too fast to avoid*. And if one piece of rock flies, there will likely be others with it.

READ THE POSTCARDS WITH MATCHING SAFETY DESIGN

Design/layout - Kimberly Clough Thomas

BEST PRACTICES:

Be aware -- Know where the planned blast area is today.

Be aware -- Know when a blast is scheduled.

Protect yourself -- Make sure that when a blast goes off, you are not within the blast area.

Protect yourself even when you are outside the blast area.

Plan in advance what you are going to use as shelter.

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National Mine Health and Safety Academy
1301 Airport Road
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Phone: (304) 256-3257
Fax: (304) 256-3368

TALKING POINTS:

1. **Have you ever had to stop work to move from a blast area?**
2. **Have you ever seen rocks on the ground outside the blast area?**
3. **Do you know of anyone who has had a near-miss situation with flyrock?**
4. **Where does blasting occur on your site? Where will you be during a blast?**
5. **What equipment is available on your site that you can use for shelter?**

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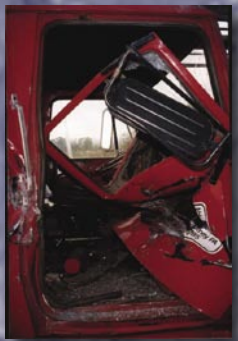

Photo: Jay Elkin, Wampum Hardware Co.

WHAT IS FLYROCK?

Flyrock can be powerful. In 1988, damage occured to this drill truck in Avonmore, PA. It was outside the blast area. No one was injured.

WHAT IS FLYROCK?

WHAT IS FLYROCK?

Flyrock can be big or small. It may even look like the rest of the shot rock. If it lands outside the blast area, it is flyrock. This is the result of a flyrock incident in Kentucky. The rocks rolled down the hill into this community, gaining speed as they traveled.

WHAT IS FLYROCK?

WHAT IS FLYROCK?

Flyrock can be stones, rocks, mud, or even water. This boulder in Kentucky which measures 12’ x 7’ x 5’ rolled down the hill along with other rocks to the trailer. The home owners were not hurt because they were out shopping.

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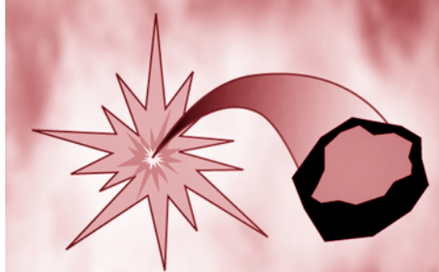
RECOGNIZE BLAST AREA & SIGNALS

Tool Box Lesson B



FLYROCK awareness

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Recognize the Blast Area and Signals

When the *BLASTER-IN-CHARGE* is about to set off a blast, the *BLAST AREA* is cleared of *everybody* (blasters can take cover within the blast area if they have safe shelter). The site supervisors know the scheduled time of the blast and will stop work in enough time to clear an area.

After the holes have been drilled, explosives are loaded in them and they are joined. Once connected to the blasting machine, the holes can be shot with a push of a button. But in the meantime, before connecting, the area is cleared and blast guards are posted. Then the blast warning signals are sounded.

Two Warnings Are Common

The first warning signals that the blast will happen soon and the second warning signals that the blast will happen right away.

Warning: some sites use only one signal!

The Early-Warning Signal

An early-warning signal occurs 5 or 10 minutes before the shot is fired. It warns that the holes have been loaded with explosives and prepared. It means that the blast area is clear, and blast guards have stopped traffic coming into the area. Then the blast crew inspects the grounds to make sure that there are no people or equipment in the blast area.

A Final-Warning Signal

A final-warning signal must be given before the blast. This will be given 1 or 2 minutes before firing. Timing is different on each site. The guards shelter themselves even if they are outside the blast area. Then the crew begins radio silence so that the blaster-in-charge can hear a signal from any road guard who needs to stop the blast. It is not unusual for a guard to call a halt while they check out their area again. They have sometimes sighted hikers at this point and stopped the blast just in time.

The Blast

Normally, when the blast occurs in a trench shot, the ground raises a few feet and sets back down with no flyrock. In the case of a blast with a free face, the shot blasts the rock and moves it to a planned area where it can be hauled away. Rocks that land in a planned area, are not called flyrock.

The All-Clear Signal

The blaster can't order the all-clear signal just yet. The all-clear signal will not be sounded until it is safe. The blaster first inspects the area to see if there are any misfires. ***THE BLAST AREA MUST REMAIN CLEAR UNTIL THE ALL-CLEAR IS SIGNALED,*** no matter how long it takes. It may take minutes, hours, or even days if there has been a misfire. Before the all-clear, there may even be another blast to clear the misfire.

Stay alert and stay out of the blast area until the all-clear signal is given.

Design/layout - Kimberly Clough Thomas

BEST PRACTICES:

Be aware -- Know where the blast area is today and stay away from it if you can, even between blasts.

Listen for the blast signals. Know all of the blast signals and what they mean.

Remain aware and alert until the all-clear signal sounds.

Stay out of the blast area until the all-clear is signaled. If there is a misfire it may take hours or days for the blaster to check the area.

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TALKING POINTS:

1. **What are the postings for the blast area?**
2. **Where are they usually placed?**
3. **What is the all-clear signal on this site?**
4. **What other blast signs and warnings are used at this site?**
5. **What is the usual routine on this site when the first warning is given?**
6. **Have you ever seen the blast signals ignored? Why is this dangerous?**
7. **From the time of the blast, how long is it until the all-clear signal?**
8. **Has there ever been a misfire?**
9. **What's the longest time that you have had to wait for the all-clear signal?**

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Attention: Marcia Harris, Chemical Engineer

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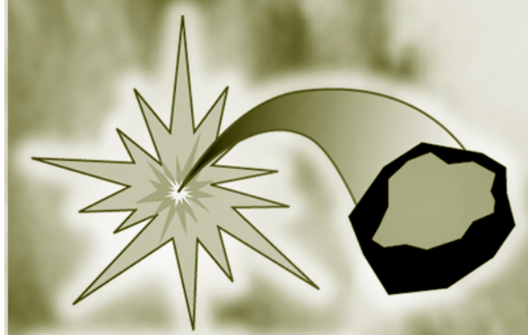
CLEAR THE BLAST AREA

Tool Box Lesson C



FLYROCK awareness

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Clear the Blast Area

The purpose of blasting is to break up large rock so that the rock can be removed easily. Sometimes a blast is set up to move (or cast) the rocks away from the work area. But usually, we blast just to break rocks small enough for our machinery to move them.

Controlled Blasts

A professional *BLASTER-IN-CHARGE* is skilled at creating controlled blasts that produce rocks of the right size and that place them in the right spot. The blaster carefully decides:

- The locations of the holes to be drilled
- The amount of explosive material to be placed in each hole
- The timing for shooting each hole

The Blast Area

It is the blaster's job to determine the area that might get hit with rocks. The blaster calls this area the *BLAST AREA*. It is very important to remove *everyone* from the blast area before a blast or to ensure that personnel inside the blast area have safe cover. If a blaster needs to remain near the blast, a safe blast shelter or cover must be used.

Clear the Blast Area

The law requires that the blast area be cleared. Yet 5 out of 10 blasting accidents in mining -- deaths and injuries -- occurred when the blast area had people in it. These people were not just the blast crew. They included contractors, road builders, miners, laborers, fishermen, and visitors. The Mine Safety and Health Administration (MSHA) reported that during the years 1978 to 2001, 559 people were killed or injured this way in mining.

Stay Aware

The blaster-in-charge has planned the blast. He or she has total responsibility for the success and safety of the blast. For your safety, it is important to follow the instructions given by the blaster and the blast crew, as well as the site's safety crew. Every blast is different.

Don't take blasting for granted.
Stay aware!

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READ THE POSTCARDS WITH MATCHING SAFETY DESIGN

Design/layout - Kimberly Clough Thomas

BEST PRACTICES:

Clear the blast area -- Remove yourself and stay away until the all-clear signal.

Follow the instructions of the blast crew. The instructions may have changed from yesterday.

Know where the blast area is today, and know the time of the blast.

Make sure that you are outside of that area when the shot is fired.

If, by accident, you are inside the blast area when you hear the *first* blast signal, make your presence known. Then the blasters can give you time to clear out. Sound your horn, shout, and/or get to where you can be seen. The second signal will not allow you time to do that. *Take cover!*

If you think that someone may still be in the blast area, tell your crew chief.

TALKING POINTS:

1. **At the last blast, where was the edge of the blast area?**
2. **Do you know of anyone who was in the blast area during a shot?**
3. **If you find yourself in a blast area when the warning sounds what action will you take?**
4. **If you see someone near the blast area, how do you get word to the blaster? When do you raise the alarm?**

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CLEAR THE BLAST AREA

Drawing: J Cottle, MSHA

CLEAR THE BLAST AREA

In Illinois in 1989, a production supervisor was the last to clear out of the blast area. When one of the guards saw him park his truck near the top of the hill, the guard thought that the supervisor was giving the signal that all was clear. The supervisor was not far enough away. An 8½-lb rock landed on top of the cab of his truck.

Even from more than 1,050 feet away, the power of the rock was great enough to dent the roof of the cab onto the man's head. He had no vital signs at the scene and was declared dead at the hospital.

CLEAR THE BLAST AREA

Drawing: J Cottle, MSHA

CLEAR THE BLAST AREA

In October 1990 in New Mexico, the sister of a worker wanted to take photos of a blast site. The victim, a mine worker, went with her. They were standing exposed, just 100 yards away, when the blast went off. They thought that they had more time to secure themselves.

The victim wasn't wearing a hardhat and died on the spot from a blow to the back of the head. The woman was badly injured by a rock to the chest. She survived, but was hospitalized for months. They were in full view of the blast and they waited until the last minute to shelter themselves.

CLEAR THE BLAST AREA

Photo: PA Department of Environmental Protection

CLEAR THE BLAST AREA

The holes in this barn were the result of an incident in Pennsylvania. Fortunately, the person who took shelter there was not injured. No one is allowed in the blast area during a blast.

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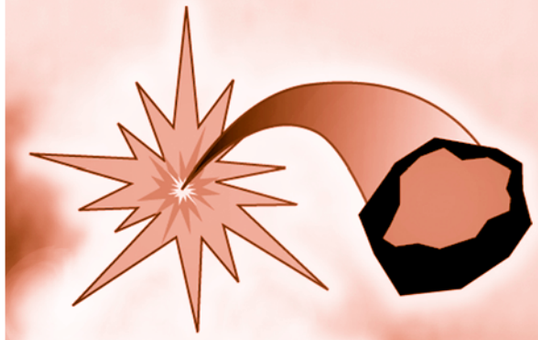
PROTECT YOURSELF

Tool Box Lesson D



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Protect Yourself

Protect Yourself Even Beyond the Blast Area

During a blast, the *BLASTER-IN-CHARGE* has carefully figured and declared the *BLAST AREA*. By law, this area must be cleared of people unless they are in a blast shelter or other safe location. Being in the blast area during a blast is not safe.

Before the time of the blast, the company will stop work and clear the blast area. Workers are moved out and away from danger. However, rocks could travel beyond the blast area. *FLYROCK* is material that lands beyond the blast area. Flyrock has been known to travel over half a mile beyond the blast area, and it travels fast!

Each Blast Is Different

Today's blast may not be the same as yesterday's blast. There could be a number of reasons. One reason could be that the blaster may have decided on a bigger blast area for this shot. Or if even one hole of the blast pattern was drilled next to a hidden mud seam or a crack or old construction, it can cause a blowout. This can cause flyrock.

When you work on or near a blast site, don't take safety for granted.

Protect Yourself

Pay attention to the area you will be in during a blast. Even though you are outside the blast area, the danger of flyrock still exists. Be aware of what you can use if something goes wrong -- nearby heavy equipment, raised, blocked beds of earth-movers, or inside portals. Make sure that if there is flyrock, you will be protected from above and from the sides.

Plan Ahead

Plan now how you can protect yourself at blast time. Sitting behind the windshield of a heavy dump truck

will not protect you -- glass breaks. Sheet metal is no defense against a baseball-sized rock flying through the air. Standing beneath tree branches is not safe shelter.

Remember -- being outside the blast area is no guarantee that you are safe from fly-rock. Remain aware of your surroundings so that you can seek safety if flyrock heads toward you. On a blast site, always stay on the alert for sudden, dangerous events.

READ THE POSTCARDS WITH MATCHING SAFETY DESIGN

Design/layout - Kimberly Clough Thomas

BEST PRACTICES:

Plan ahead and remain aware during a blast.

To protect yourself better when you are on-site (but *outside* the blast area), look for nearby heavy equipment, raised, blocked beds of earth-movers, or inside portals. Make sure that if there is flyrock, you will be protected from above and from the sides too.

If you are asked to guard the road during a blast, you will be outside the blast area, but close enough to worry. Be alert. Have protection and use it.

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TALKING POINTS:

1. **Do you know of anyone who was hit by flyrock? Has flyrock ever come close to you?**
2. **Have you ever been asked to guard an access road? How close were you to the blast?**
3. **What are the ways that guards and the blaster can warn each other?**
4. **Have you watched a blast? How far were you from the blast?**
5. **When you watched the blast, what equipment was available for protection?**
6. **What equipment at your site makes the best protection?**

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TEAR AT PERFORATION, ADD COMMENTS, AND DROP IN MAIL

PROTECT YOURSELF

Photo: PA Department of Environmental Protection

PROTECT YOURSELF

Flyrock is fast and furious. Trees are no protection. The hole in this tree is the result of a blast in Pennsylvania in November 2002.

PROTECT YOURSELF

Photo: T Lobb, MSHA Technical Support

PROTECT YOURSELF

In Pennsylvania in 1999, an equipment operator had stopped work clearing the crusher area near the blast site. He and his superintendent were parked in the usual spot, 800 ft away guarding the road. They were watching the blast. A baseball-sized piece of flyrock went through the windshield.

The victim died after surgery. He was only 32 years old. The supervisor was unharmed. Rocks flew 1,500 ft on that day.

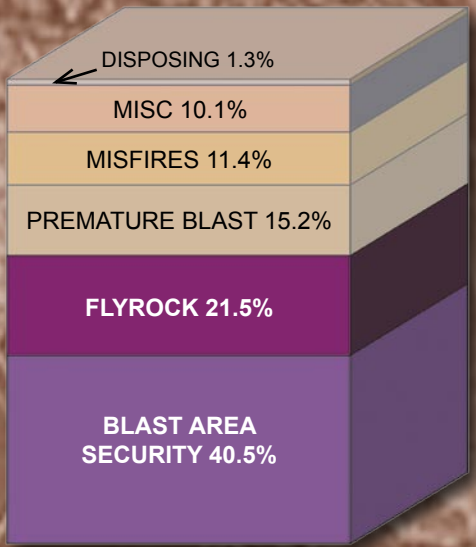
PROTECT YOURSELF

Photos: Wayne Lively, MSHA

PROTECT YOURSELF

In July 2002, a truck driver in West Virginia and his supervisor were watching a blast from ½ mile away while waiting for the all-clear signal. A rock slammed into the front windshield and exited the rear. It somehow missed both the driver and the passenger. No one was hurt.

PROTECT YOURSELF



Blasting Injuries in Surface Mining From 1994 to 2001

Source: H Verakis and T Lobb, MSHA, "An Analysis of Blasting Accidents in Mining Operations," International Society of Explosives Engineers, 2003

PROTECT YOURSELF

The greatest cause of blasting accidents in surface mining happens because someone is in the blast area during a blast.

From 1994 to 2001, there were 49 blasting accidents. Of these, 32 people were injured or killed because they were in the blast area during a blast. Another 17 people were injured or killed from flyrock—rocks that hit people outside the blast area. More than half of blasting injuries were due to flyrock and to not clearing the blast area.

There were more injuries from flyrock and from not clearing the blasting area than from any other cause of blast accident. Stay out of the blast area during blasts and even when you are outside of the blast area, stay alert!