

Oxygen Deficiency Hazard (ODH)

Training Course at Fermilab

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There is also a drop down menu in the upper right corner that you can use to go to a specific topic.

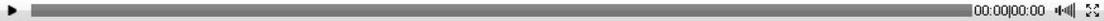


A message from:

Martha Michels
Chief Safety Officer

Completing this training and passing this exam is part of the requirement to work in ODH areas at Fermilab. In addition to this training, you must have a current physical examination and approval from the Fermilab Medical Office to be "ODH Qualified". Contact the Medical Office at X3232 to schedule an appointment for the physical.

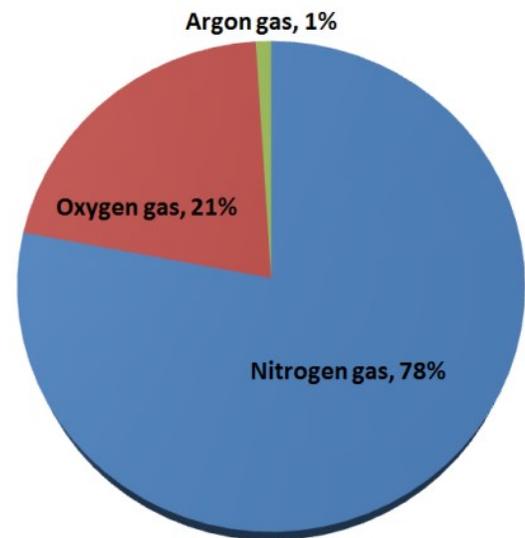
The oxygen content level is reduced to only a few percent.



Our normal breathing atmosphere consists of 3 gases:

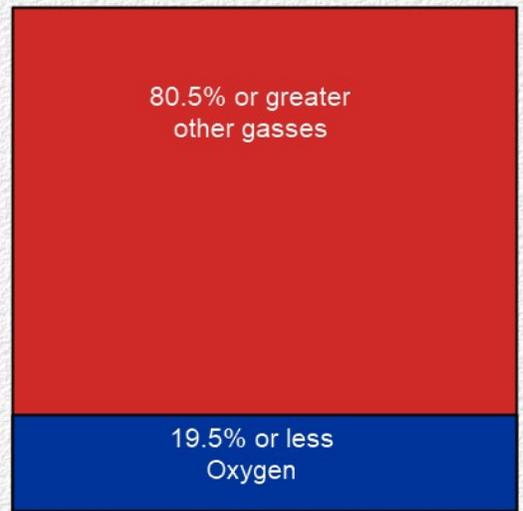
- Nitrogen (N₂), 78%
- Oxygen (O₂), 21%
- Argon (Ar), 1%

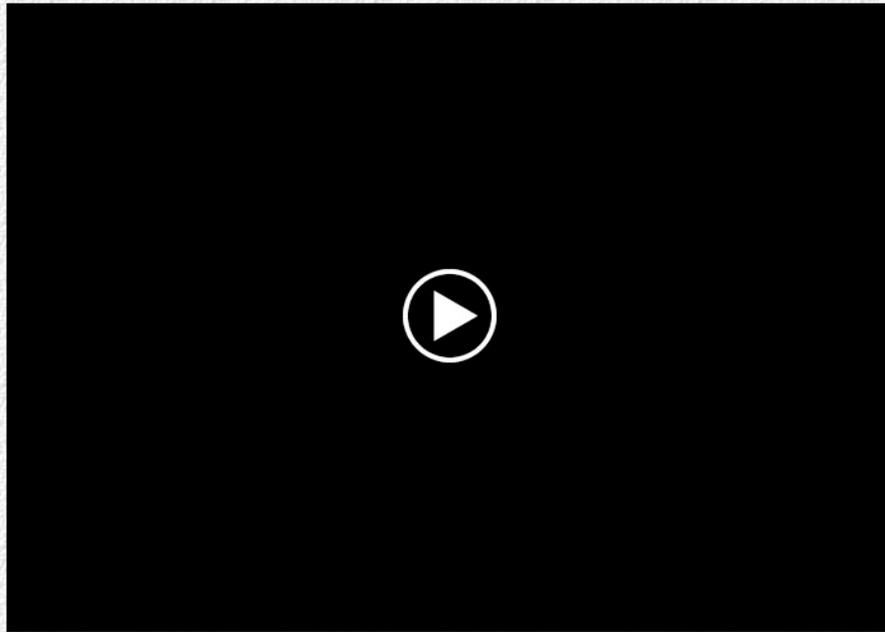
Volume of gases in our normal breathing atmosphere



An **Oxygen Deficient Atmosphere** is defined as any time the oxygen concentration drops below 19.5%.

This oxygen level is defined by OSHA and defines the alarm set point for personal and area oxygen monitors used at Fermilab.





Effect Thresholds for Exposure to Reduced Oxygen on a Healthy Person

17% Oxygen

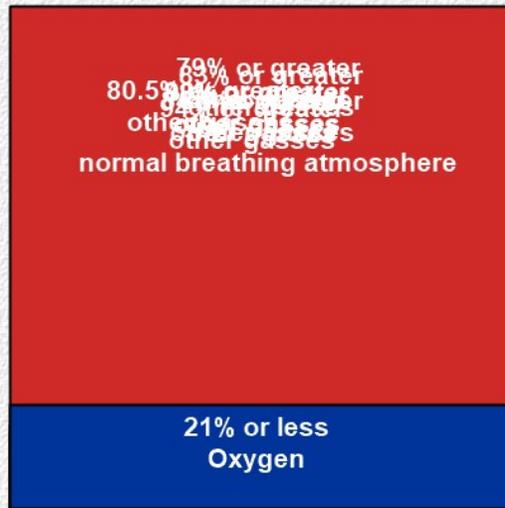
- Night vision is reduced
- Increased breathing volume
- Accelerated heartbeat

16% Oxygen

- Dizziness
- Reaction time doubled for novel tasks

15% Oxygen

- Impaired judgement
- Impaired coordination
- Rapid fatigue
- Shortened attention span



12% Oxygen

- Very faulty judgement
- Very poor muscular coordination
- Loss of consciousness
- Permanent brain damage

10% Oxygen

- Inability to move
- Nausea
- Vomiting

6% Oxygen

- Spasmodic breathing
- Convulsive movements
- **Death occurs in 5-8 minutes**

Helium, nitrogen and argon are the gases most commonly used in Fermilab's cryogenic systems.

	Liquid state temperature at	Heavier or lighter than air?	At room temperature and pressure 1 liquid liter expands to
Helium	5 Kelvin / -451°F	Lighter than air above 40 K	769 liters of gas
Argon	88 Kelvin / -301°F	Heavier than air	859 liters of gas
Nitrogen	77 Kelvin / -321°F	Heavier than air when cold	687 liters of gas

They readily mix with air and displace oxygen as they warm up. They are colorless, odorless and tasteless.

During spills of cold cryogenic fluids, you will see a cloud of vapor from moisture in air condensing at spill area. Be aware that the extent of reduce oxygen will extend beyond the cloud as gas warms.

Room temperature compressed gases, which are common at Fermilab, can also pose an oxygen deficiency hazard.

This will not create a vapor cloud. So while a vapor could be an indication of ODH conditions, do not assume that one will occur to create oxygen deficiency.



ODH Hazard Area Classifications

ODH Hazard Class	Operating hours per expected fatality without protective measures.
0	10,000,000 and higher
1	10,000,000 - 100,000
2	100,000 - 1,000

The goal of ODH risk assessment is to estimate the probability that a fatality will occur in an area and design protective measures to prevent those fatalities.

ODH class 0 areas have been evaluated and found to passively have a very low hazard risk. There are no ODH-related entry requirements. They are not posted with signs.

Some areas achieve ODH Class 0 risk from active, engineered control measures using fixed oxygen monitoring with alarms. These also have no ODH-related entry requirements. But personnel must evacuate upon alarm. Signs are posted as reminder for proper alarm response.



ODH class 1 and 2 areas have been evaluated and found to have an elevated oxygen deficiency risk. They are posted with the signs seen here.



Before entering ODH class 1 or 2 areas personnel shall be examined by the Fermilab Medical Office to determine fitness for ODH work.

Level	Meaning	Duration of Approval
ODH Qualified	Medically qualified to enter ODH Class 1 and 2 areas.	Typically 1-2 years based on the age and health status of the worker.
ODH Restricted	Medically qualified to enter ODH Class 1 and 2 areas when escorted by ODH Qualified personnel.	Typically 1-2 years based on the age and health status of the worker.
ODH Excluded	Prohibited from entering any ODH Class 1 or 2 areas.	Excluded until reclassified by the Medical Office.

Each person evaluated by the Medical Office will fall into one of the qualifications levels listed above.

Control Requirements for ODH Qualified Personnel

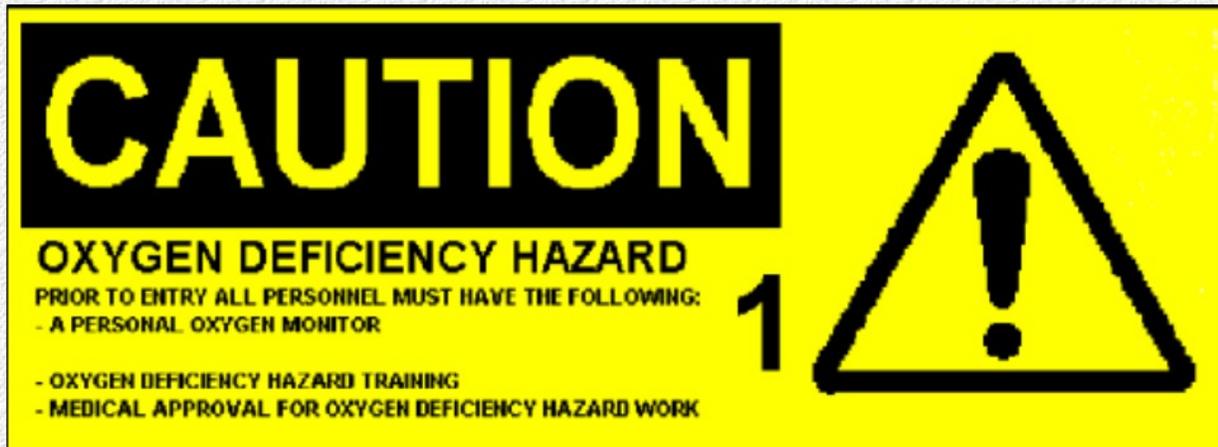
Environmental Controls	ODH Hazard Class 1	ODH Hazard Class 2
Medically approved as ODH qualified	✓	✓
ODH training	✓	✓
Personal Oxygen Monitor	✓*	✓*
Self-rescue Supplied Atmosphere Respirator	✓*	✓*
Multiple Personnel in communication (2 person rule)		✓

= required
 * = Respirators and/or personal oxygen monitors may not be required if stated in entry sign posting

⊕

⊕

Always refer to the posted entry sign for entry requirements. Some standard requirements may be excluded as shown below. In this example the emergency respirator is not required.



Control Requirements for ODH **Restricted** Personnel

Environmental Controls	ODH Hazard Class 1	ODH Hazard Class 2
Must Not Be ODH Excluded	✓	✓
ODH Training or Briefing	✓	✓
Personal Oxygen Monitor	✓ *	✓ * <input type="checkbox"/>
Self- Rescue Supplied Atmosphere Respirator	✓ * <input type="checkbox"/>	✓ * <input type="checkbox"/>
One-to-one escort by ODH Qualified Personnel	✓	✓
At least two ODH Qualified Personnel		✓ <input type="checkbox"/>

 = required

* = Respirators and/or personal oxygen monitors may not be required if stated in entry sign posting

One-to-one escort by ODH-qualified personnel

An escort can be provided in special cases when the persons entering an area have not been medically classified or trained. Individuals shall be under the direct continuous supervision of individuals who are ODH medically qualified and trained. Note that escorted persons shall not have been designated as ODH-excluded by the Medical Office. If not evaluated by the Medical Office, the escort assumes responsibility for judging whether or not they believe the fitness of the escorted individual would significantly impede escape from the ODH operation in the event of an alarm. Contact the area DSO with any questions.

It is the responsibility of ODH-qualified escorts to ensure that the personal oxygen monitor(s) of those being escorted are not past due for calibration and are returned to the issuing organization or individual after use. They must ensure the air pack is full.

The escort must also brief the escorted individual on emergency procedures and ODH equipment operation.

Personal Oxygen Monitors

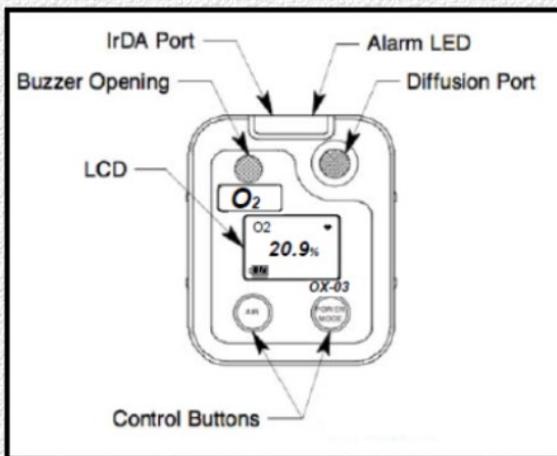


Commercial model OX-03
Series manufactured by
RKI Inc.

Fermilab use model OX-03 Series personal oxygen monitor. Monitors can be found at the Main Control Room (Accelerator Division) or at the access areas.



OX-03 Personal Oxygen Monitor



The OX-03 monitor is a small single gas personal monitor that utilizes an advanced miniature sensor to detect the presence of oxygen.

OX-03 Start-up Procedure

1. Press and briefly hold down the POWER MODE button. The backlight will turn on and all the display segments will turn on. Release the button when you hear a beep.
2. The vibrator vibrates and the alarm light flashes momentarily.



OX-03 Start-up Procedure

3. The instrument will then indicate the number of days before the next calibration is due.
4. The instrument will cycle through several display screens showing its current settings and is complete when the instrument beeps twice.



OX-03 Start-up Procedure

5. The display shown is the current percent oxygen and **MUST READ 20.9%**. If the reading is something other than 20.9%, you **MUST** perform a Fresh Air Adjustment.
6. To perform a Fresh Air Adjustment, find a fresh air environment that is of normal oxygen content and press the AIR button for 4 seconds, then release button. The adjustment will be complete and the display will be 20.9%.





OX-03 Start-up Problems

1. If the instrument indicates CAL, the instrument must not be used and **MUST BE RETURNED** to ESH&Q for calibration.
2. If the instrument indicates FAIL, the instrument must not be used and **MUST BE RETURNED** to ESH&Q for repair.

[Click here](#) for ESH&Q contact information

The OX-03 monitor must be worn on the outer surface of your clothing. It must NOT be in a pocket or covered by a coat, etc.



The sensor and speaker shown here must not be covered.

The OX-03 Monitor will sound an audible alarm, vibrate, and flash a visual alarm when the oxygen level drops below 19.5%.

The alarm will turn itself off when the oxygen concentration returns to above 19.5%.

Shutdown Procedure

1. Press and hold down the POWER MODE button for 5 seconds. The instrument will turn off.
2. This operation must be performed after each use.



Please contact a member of the [ESH&Q Industrial Hygiene team](#) for monitor calibration or failures or with any questions you may have.

Emergency Escape Packs



ELSA Packs



OCENCO

Fermilab uses two different breathing escape pack models. They are the ELSA and OCENCO packs.

Personnel in an ODH Class 1 or 2 Area may require ready access to an escape pack. Refer to posted entry requirement to determine when carrying an escape pack is required.

The ELSA pack supplies 5 minutes of air.



Emergency Life Support Apparatus - ELSA

ELSA packs are available in either orange or yellow.



The gauge on the ELSA pack should read *FULL* which is indicated by the needle being in the green area.



Do not use this escape pack. The needle is not in the green area. It is below 3/4 full.

Turn the large knob counter-clockwise to start air flow.

This small cap will not activate air flow.



Oxygen Deficiency Hazard (ODH)

ODH training



1 Alarms sounds.



2 Remove the hood found within pack & turn the large knob to open the valve.



3 Put the hood on your head.



4 Verify valve is open. Breath normally & leave the area.



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The OCENCO Escape Pack



The OCENCO escape packs:

- are not in general use at Fermilab.
- are issued to specific individuals or groups.
- require further training which your Division Safety Officer can arrange.

00:00|00:00



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Many ODH areas have permanently mounted area oxygen monitors. The area monitors:

- are set to alarm at 19.5% oxygen concentration.
- do not replace personal monitors as part of ODH control measures (unless an exclusion is posted).
- allow for remote monitoring of oxygen concentration and/or active ventilation control.
- In-place area oxygen monitors alarm with a high-pitched siren and flashing red light.

ODH Emergency Response Procedures

If your personal oxygen monitor alarms (oxygen <19.5%), follow the procedure below.

One person working alone



Put on the escape pack, evacuate the area and call x3131 to report the emergency.

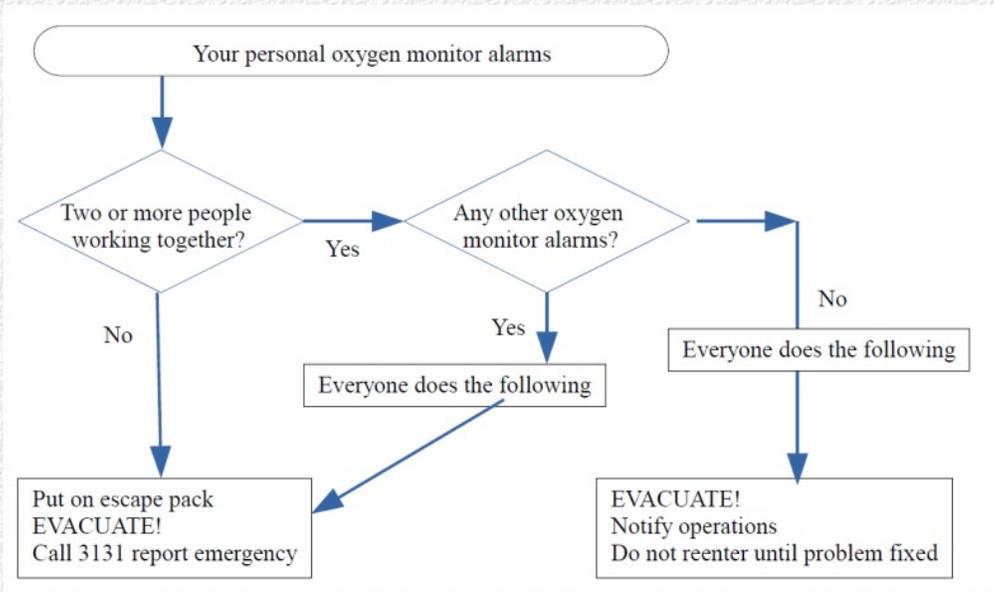
Two or more people working together



If any other personal monitor is also alarming, everyone must put on his/her escape pack, evacuate the area and call x3131 to report the emergency.

If no other personal monitors are alarming, everyone must evacuate the area going away from the assumed source of the alarm. Notify operations personnel of the problem. Do not re-enter the area until the issue is resolved.

If your personal oxygen monitor alarms, (oxygen <19.5%) follow the procedure below.



[Click here](#) to view a larger version or this chart or to print it.

If the area monitor alarms, follow the procedure below.**One person working alone**

If your personal monitor is alarming, put on the escape pack, evacuate the area and call x3131 to report the emergency.

If your personal monitor is not alarming, evacuate the area going away from the assumed source of the alarm. Notify operations personnel of the problem. Do not re-enter the area until the issue is resolved.

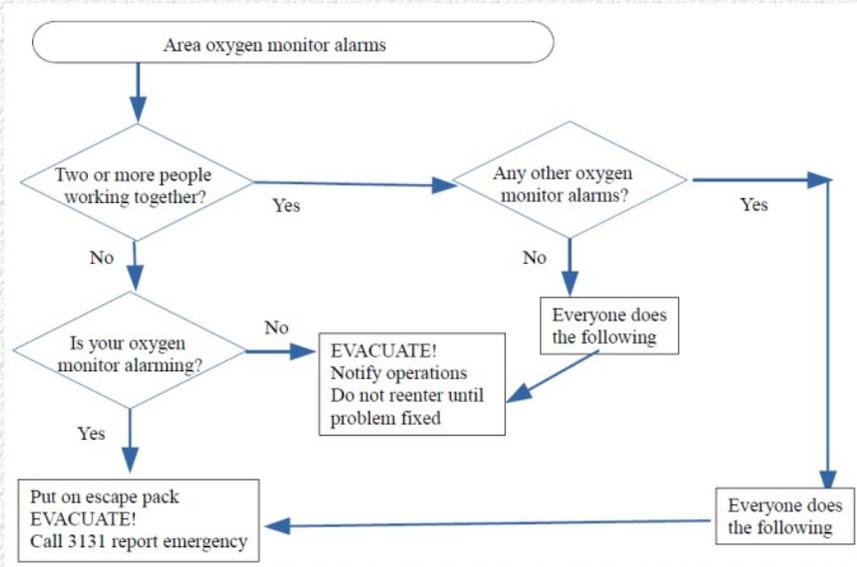
Two or more people working together

If any personal monitor is alarming, everyone must put on his/her escape pack, evacuate the area and call x3131 to report the emergency.

If no personal monitors are alarming, everyone must evacuate the area going away from the assumed source of the alarm. Notify operations personnel of the problem. Do not re-enter the area until the issue is resolved.



If the area monitor alarms, (oxygen <19.5%) follow the procedure below.



[Click here](#) to view a larger version of this chart or to print it.

If there are any other indications of a possible gas leak such as a vapor cloud or the sound of a gas leak, you should follow the procedures below.



One person working alone

If your personal monitor is alarming, put on the escape pack, evacuate the area and call x3131 to report the emergency.

If your personal monitor is not alarming, evacuate the area going away from the assumed source of the alarm. Notify operations personnel of the problem. Do not re-enter the area until the issue is resolved.



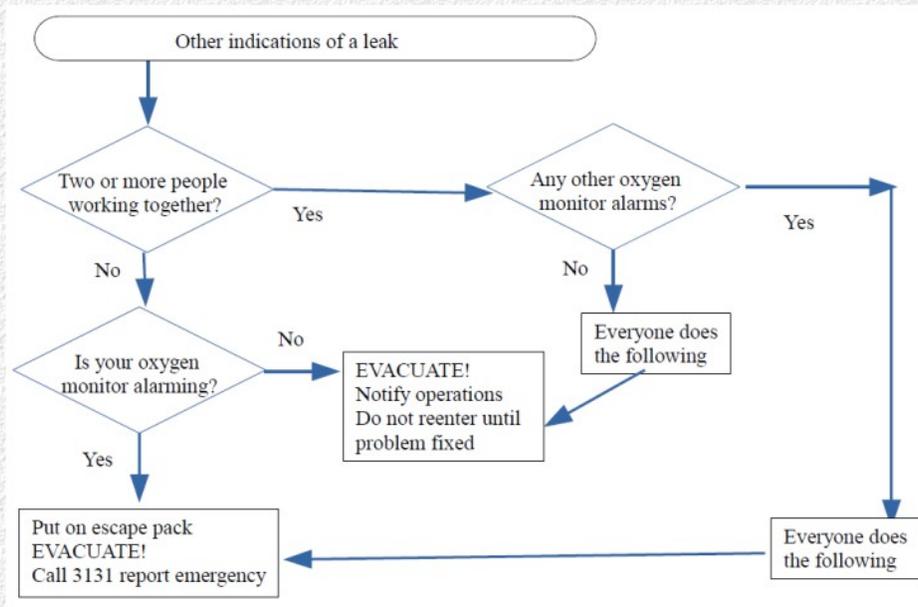
Two or more people working together

If any personal monitor is alarming, everyone must put on his/her escape pack, evacuate the area and call x3131 to report the emergency.

If no personal monitors are alarming, everyone must evacuate the area going away from the assumed source of the alarm. Notify operations personnel of the problem. Do not re-enter the area until the issue is resolved.



If there are other indications of a gas leak, follow the procedure below.

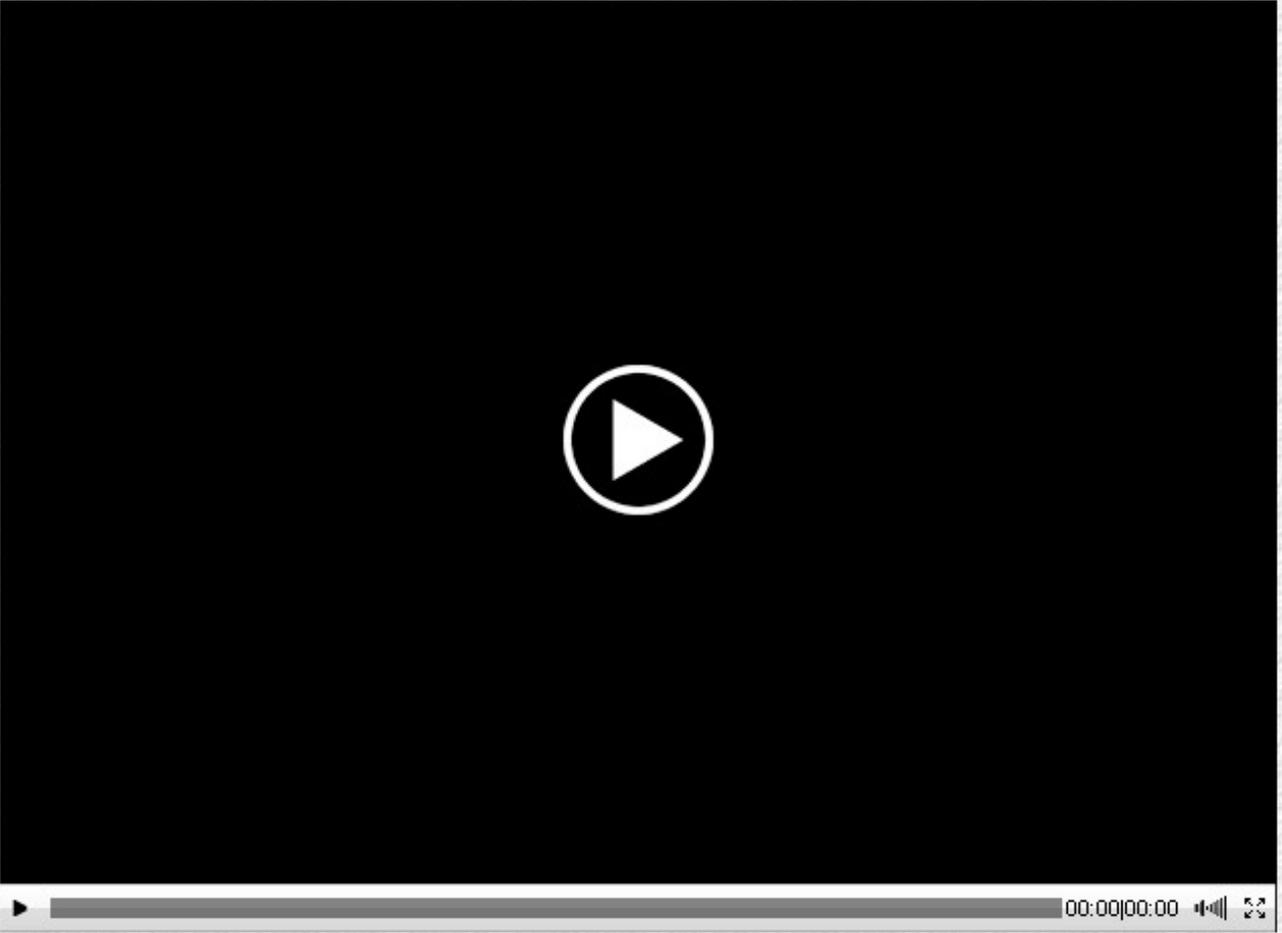


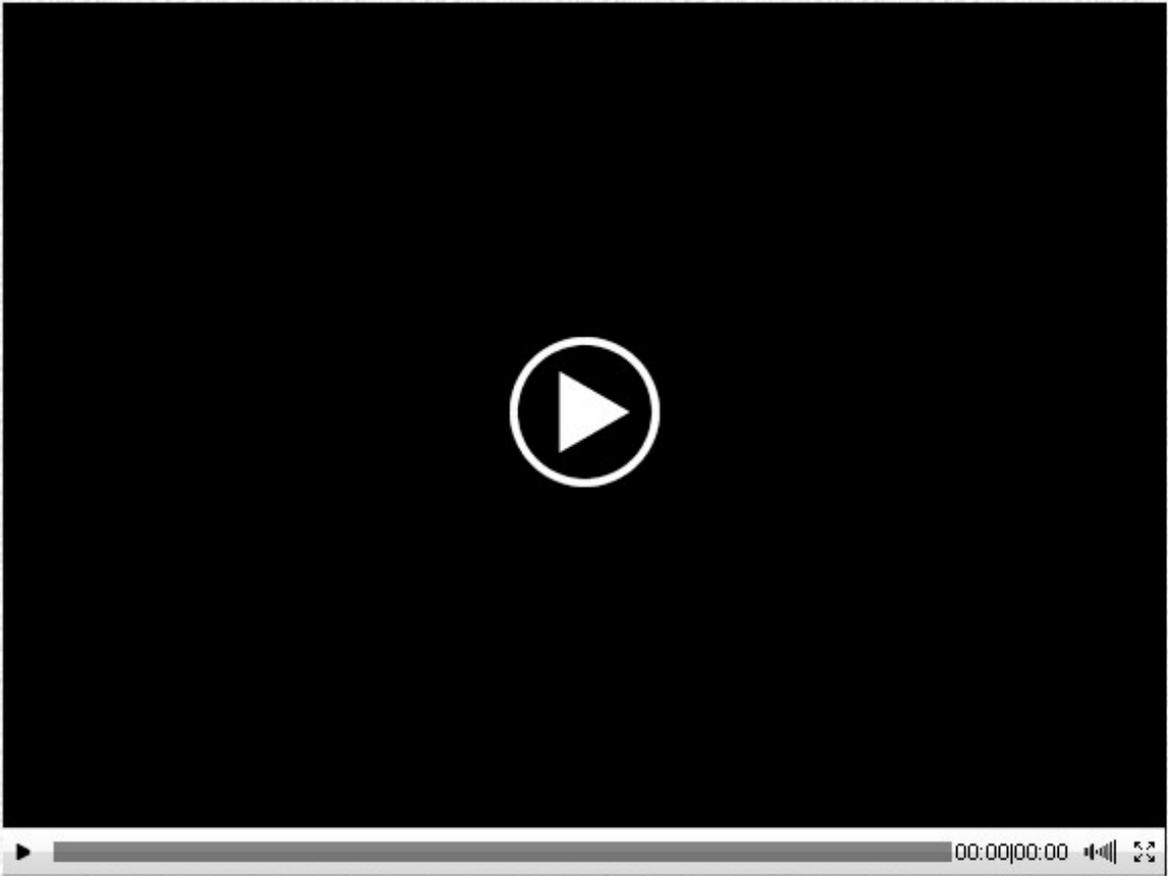
[Click here](#) to view a larger version or this chart or to print it.

This concludes Oxygen Deficiency Hazard training.

In order to receive TRAIN credit for this course you must take and pass a test. Please [click here](#) to be directed to the webpage where you can request the test.

In order to be ODH qualified you must also be evaluated by the Medical Office (x3232).





To display the MIN and MAX oxygen readings on the O1 Series monitor:



Your personal oxygen monitor alarms

Return to training

Two or more people
working together?

Yes

Any other oxygen
monitor alarms?

Yes

No

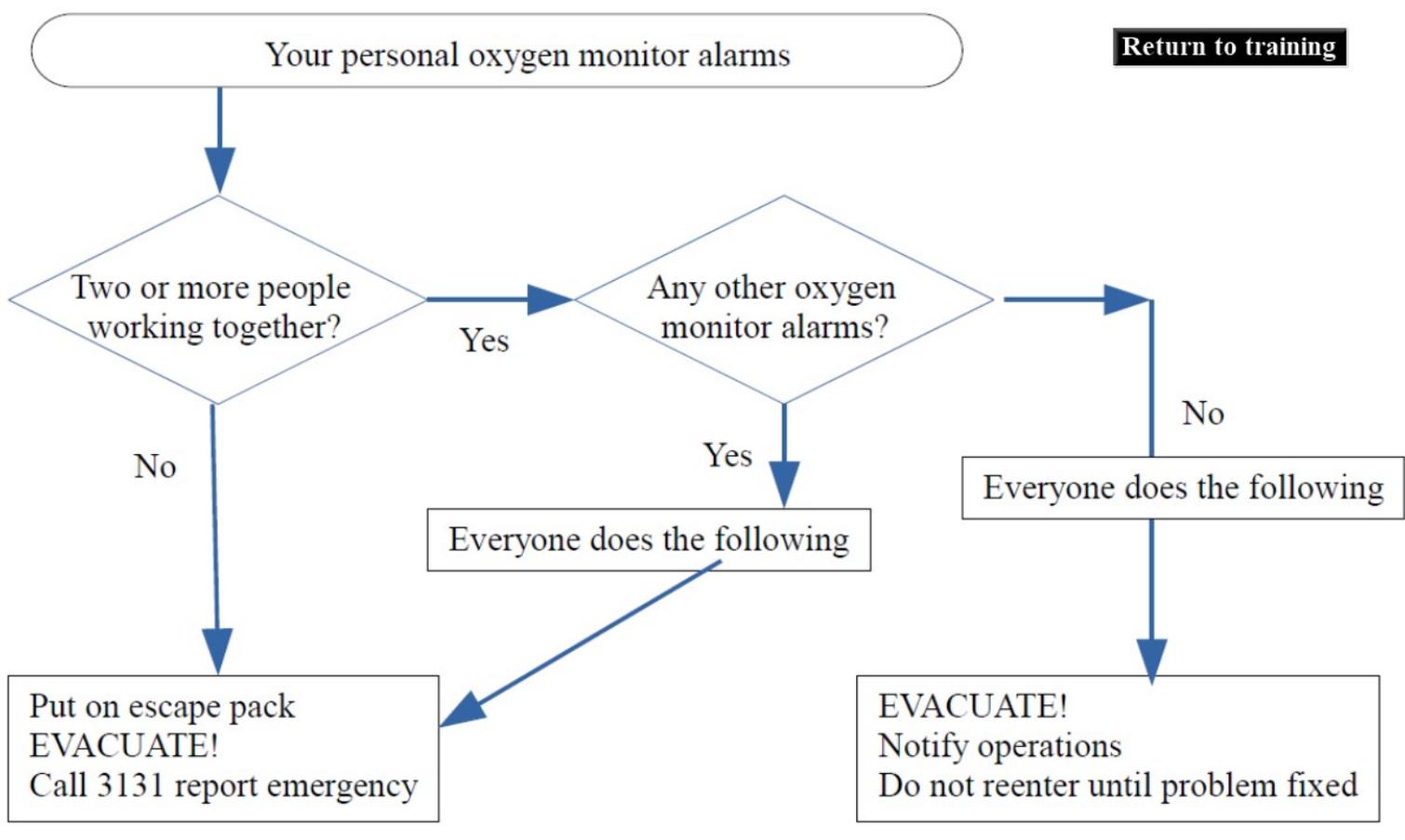
No

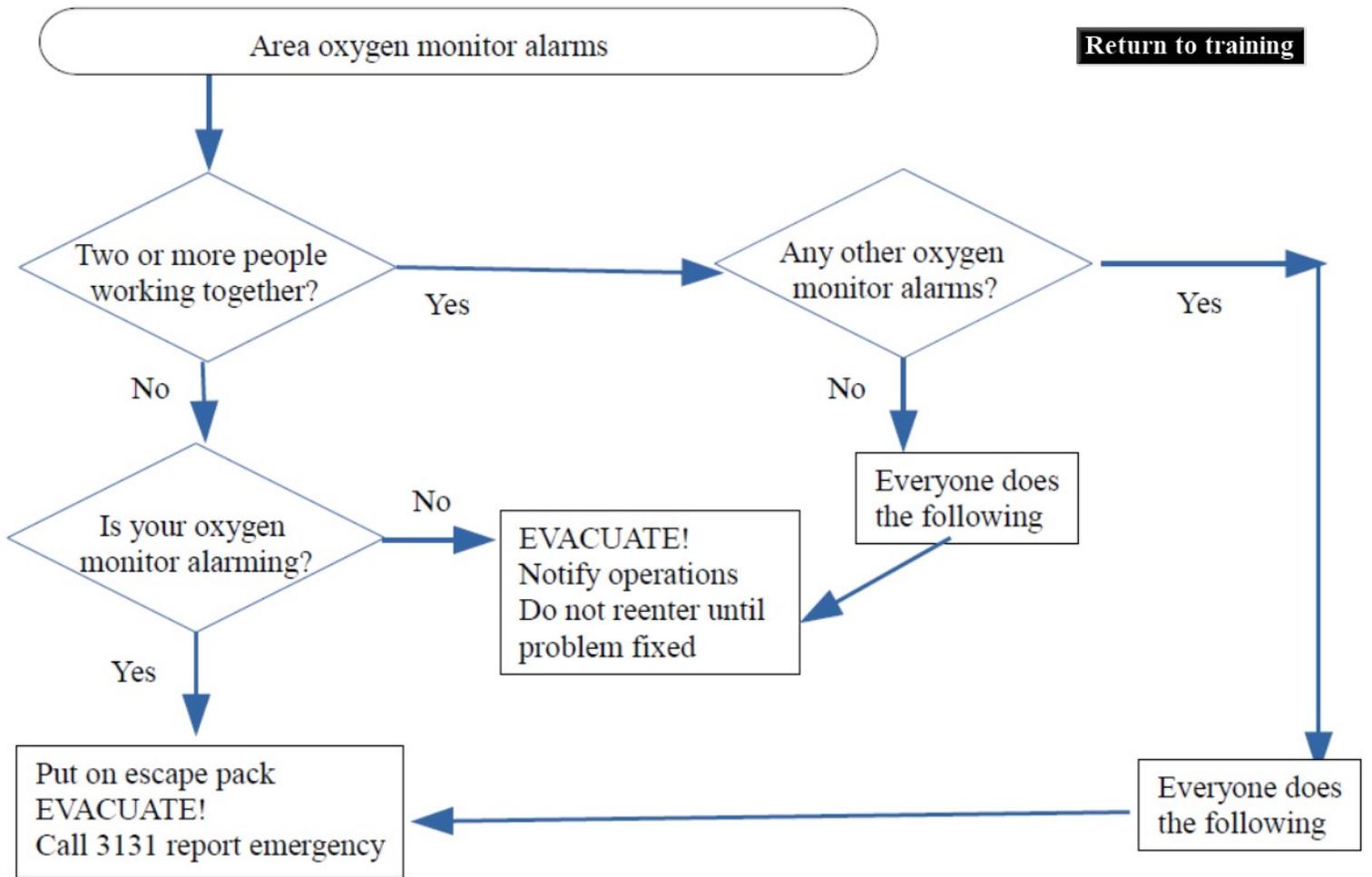
Everyone does the following

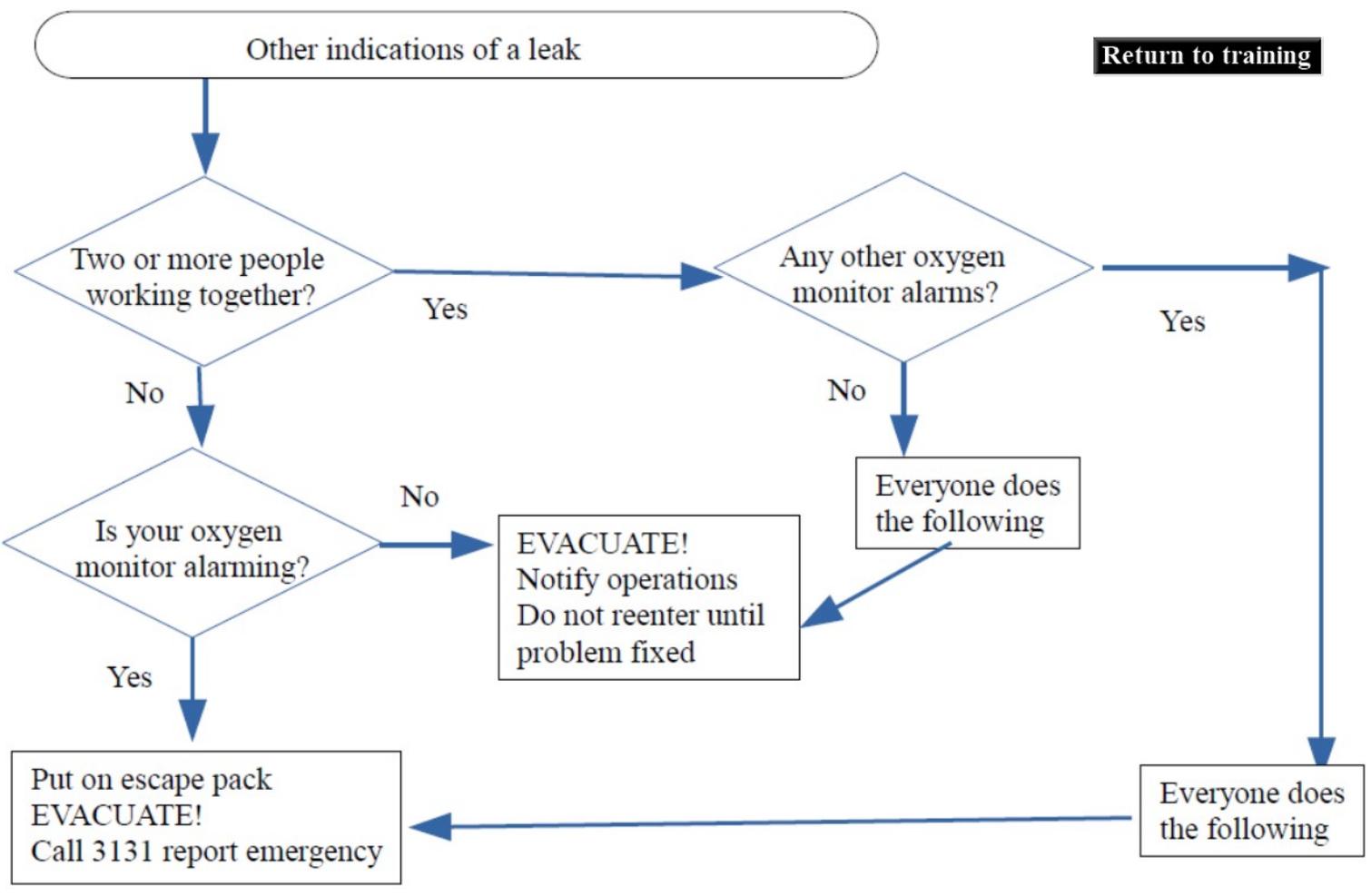
Everyone does the following

Put on escape pack
EVACUATE!
Call 3131 report emergency

EVACUATE!
Notify operations
Do not reenter until problem fixed







Other indications of a leak

Return to training

Two or more people working together?

Yes

Any other oxygen monitor alarms?

Yes

No

No

Is your oxygen monitor alarming?

No

Everyone does the following

EVACUATE!
Notify operations
Do not reenter until
problem fixed

Yes

Put on escape pack
EVACUATE!
Call 3131 report emergency

Everyone does the following