

Chapter 5: Personal Protective Equipment

Chapter 5

Personal Protective Equipment

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5

Preparing for Delivery

Time

The *Personal Protective Equipment* chapter is approximately 6 hours of classroom training.

Follow the Lesson Plan for a guide to scheduling this course. Time allotments for specific topics are provided within the plan. You may devote more time to classroom and hands-on activities as needed, as the plan reflects the minimum suggested time allotments.

Staffing

The maximum participant – instructor ratio is 25:1.

During classroom activities, the recommended participant – instructor ratio is 10:1.

During hands-on activities, the recommended participant – instructor ratio is 5:1.

Materials Needed

For this chapter, you will need the following:

- A copy of the Infectious Disease Operations Participant Guide (PG)
- A flip chart or whiteboard and markers
- A computer and projector or monitor
- Half-face APR, FFAPR, PAPR
- Hooded Tyvek suit
- Disposable mid-calf foot covers
- Washable footwear
- Double-nitrile inner gloves
- Extended-cuff nitrile outer gloves
- Painters' tape

The table on the following page lists the materials needed for this lesson.

Chapter 5: Personal Protective Equipment

Preparing for Delivery (continued)

Chapter 5: Personal Protective Equipment

Lesson Overview	Media	Handouts
Introduction and Objectives (10 min.)	<i>Slides 1 to 5</i>	
Exercise 1: Respiratory Protection: APF and MUCs (70 min.)	<i>Slides 6 to 9</i> <i>Sample Respirators (half-face APR, FFAPR, PAPR)</i>	<i>HO 18: Group Presentations: APF and MUC</i>
Exercise 2: Respirators and Filters (40 min.)	<i>Slides 10 to 28</i> <i>Sample Respirators (APR and ASR)</i>	<i>HO 19: Respiratory Protection Information</i>
Exercise 3: Respirator Inspection, Donning/ Doffing, and Fit-testing (90 min.)	<i>Slides 29 to 32</i> <i>1 FFAPR per participant</i>	<i>HO 20: Respirator Donning/ Doffing Prep (*cut into cards, if desired)</i> <i>HO 21: Respirator Performance Checklist</i> <i>HO 22: Fit-testing</i> <i>IT 2: Rainbow Passage (Optional)</i>
Exercise 4: PPE for Different Risk Environments (60 min.)	<i>Slides 33 to 34</i>	<i>HO 23: PPE in Different Risk Environments</i>

Preparing for Delivery (continued)

Lesson Overview	Media	Handouts
Exercise 5: Donning and Doffing PPE (80 min)	<p><i>Slides 35 to 39</i></p> <p><i>One FFAPR + one full set of protective clothing per participant (Also recommended: Wide easy-peel painter's tape)</i></p>	<p><i>HO 24: Key Considerations for Donning/Doffing PPE</i></p> <p><i>HO25: PPE Donning/Doffing Procedures</i></p>
Summary (10 min.)	<p><i>Slides 2 to 5</i></p>	<p><i>Chapter 5: Things to Remember</i></p>

Chapter 5: Personal Protective Equipment

Introduction and Objectives



10
Minutes

Introduction and Objectives

Open the lesson by telling participants that in Chapter 4, they learned about the different types of OSHA Standards related to working around infectious diseases, including information about PPE and respirators. In this chapter, participants will learn about PPE for infectious disease environments.

Display Slides 1 to 5. Introduce the chapter and review the chapter objectives. At the end of this chapter, participants will be able to:

1. Define the terms *assigned protection factor* (APF) and *maximum use concentration* (MUC), and explain how they are calculated and why they are important.
2. Describe the following three air-purifying respirators (APR) and list the APF for each:
 - Half-face Air-purifying Respirator (Half-face APR)
 - Full-face Air-purifying Respirator (FFAPR)
 - Powered Air-purifying Respirator (PAPR)
3. Explain the difference between an air purifying respirator and an atmosphere supplying respirator.
4. Describe and list the limitations of a half-face APR, full-face APR, and a PAPR.
5. List and explain the different filters and canisters that are used with APRs.
6. Explain the requirements of a Respiratory Protection Program.
7. Describe the difference between a qualitative and quantitative fit-test.
8. Explain what a positive and negative user seal check is and when they need to be done.
9. Describe and demonstrate the proper inspection, donning, and doffing of an APR.
10. Describe and demonstrate the proper use and storage of an APR.
11. Explain the use of PPE for infectious diseases in both high-risk and low-risk environments.
12. Describe the proper inspection, donning, and doffing of PPE.
13. Describe the proper decontamination and/or disposal of PPE.
14. Demonstrate the proper technique for doffing inner gloves.

Invite questions about the objectives.

Exercise 1: Respiratory Protection: APF and MUCs

Exercise 1: Respiratory Protection: APF and MUCs



70
Minutes

Objectives

1. Define the terms *assigned protection factor* (APF) and *maximum use concentration* (MUC), and explain how they are calculated and why they are important.
2. Describe the following three air-purifying respirators (APR) and list the APF for each:
 - Half-face Air-purifying Respirator (Half-face APR)
 - Full-face Air-purifying Respirator (FFAPR)
 - Powered Air-purifying Respirator (PAPR)

Open the lesson by asking how many participants have already received respirator training. Ask volunteers to give a brief description of the types of respirators they have used, and in what types of situations.

Display three different types of respirators (Suggested: half-face APR, FFAPR, PAPR). On the board, write the name of each type displayed. Hold up each type and ask participants to tell you the matching name on the board. Ask them to tell you what they think some of the differences might be between the respirators.

Explain that all respirators serve the same basic purpose: to allow the wearer to breathe safely in an environment where the air contains harmful contaminants. Highlight that the main difference is how thoroughly each type of respirator protects the wearer by blocking out contaminants.

Ask participants to say which respirators they think would offer the wearer the most protection and why.

Display Slides 6 to 9 and go over the basic concepts of APF and MUC. (Note: You will need to continue to click a few times on each slide until all the information is added.) Tell participants that they will learn more about APF and MUC by preparing a group presentation in the next exercise.

Divide the class into two groups and assign each group a number (Group 1 or 2).

Instructor Note: For large classes, assign two Group 1s, Group 2s, as needed. Ideally, there should be no more than five participants in each group.

Note that Handout 18: Group Presentations: APF and MUC is used as a guide for groups as they prepare their presentations, as well as a note-taking worksheet as participants listen to other groups' presentations.



SL 6 to 9



HO Handout 18:
Group Presentations:
APF and MUC



Flip Chart and Markers



PG: 5–8 to 5–11

Sample Respirators
(Half-face APR,
FFAPR, PAPR)

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Exercise 1: Respiratory Protection: APF and MUCs (continued)

Distribute Handout 18: *Group Presentations: APF and MUC*, a flip chart, and markers to each group. Point out that the information needed to complete the handout can be found on PG pages 5–8 to 5–11. Instruct groups to read the instructions and find and read their group's assignment.

Review the instructions for the activity:

- Participants work in groups to prepare a 5–10 minute presentation on their group's assigned topic.
- Groups should use the Participant Guide to find the information about their topic.
- In groups, participants take 5–10 minutes to read the instructions individually, and then work together to discuss which points to include in the presentation. Each group chooses one person to take notes during the group discussion.
- Think about how the group can present the information to the rest of the class so that the others may understand it best.
- Use the flip chart and markers to prepare a visual for the presentation.
- Each group member must take part in the presentation. For example, one or two participants can explain the questions on the handout and others can present visual information on the flipchart paper.
- Groups have 20 minutes to prepare their presentations.

Give each group up to 10 minutes to present. During each presentation, the other groups should listen and take notes on the topic in the appropriate section on the handout. After all the groups have completed their presentations, elicit the key points from participants' notes on the handout.

Instructor Note: *It is very important that participants understand the information presented during the presentations. As you go over participants' notes, fill in any gaps and clarify any information that may have been missed or unclear during the presentations. Ask participants to give examples and explain APF and MUC in detail to show that they have met each of the learning objectives listed at the beginning of this lesson.*

Conclude by saying that participants will encounter many different work environments and types of protective equipment in working around different types of infectious diseases. The knowledge and skills they learned in this exercise related to APF and MUC will help them ensure that the respiratory equipment they are using is sufficient to protect them from any potential negative on-the-job health effects.

Tell participants the next several activities will focus on different types of respiratory protection and will help participants prepare for the hands-on practice with donning and doffing respiratory PPE.

Handout 18: Group Presentations: APF and MUC



Handout 18

Group Presentations: APF and MUC

Instructions: Work with your group, prepare a five-minute presentation on your assigned topic(s).

- Use your Participant Guide (Chapter 5) to find the necessary information.
- Use the flip chart to create a visual to assist with your presentation.
- Choose one or more group member(s) to present the information to the class.

Group 1: Introduction to Protection Factors

Your group will use the Participant Guide to research and present *Introduction to Protection Factors*.

Use the chart below (*continued on the next page*) to take notes on the topics in the left column as you conduct your research.

Topic	Notes
Discuss respirator leakage.	<ul style="list-style-type: none">• All respirators leak – less leakage = better protection• Higher cost = less leakage• Concern is not air that leaks out, but contaminated air that leaks in• To measure leakage, compare amount of substance outside respirator to amount that leaks inside: $\frac{\text{OUTSIDE}}{\text{INSIDE}}$• Measures how well respirator face-piece seals to your face• OSHA tests respirators and gives each one an APF (assigned protection factor)
Explain the connection between negative air pressure and face-piece leakage.	<ul style="list-style-type: none">• When you inhale through a respirator, you create negative air pressure inside face-piece• Results in suction, which can draw contaminated air in• Leaks in face-piece compromise protection, can lead to disease or injury

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Handout 18: Group Presentations: APF and MUC (continued)



Handout 18

Group Presentations: APF and MUC

Group 1: Introduction to Protection Factors (continued)

Topic	Notes
Explain the purpose of Respiratory Protection (as related to OSHA PEL)	<ul style="list-style-type: none"> Purpose of respiratory protection is to reduce amount of contaminant inside the respirator to a level below the OSHA PEL To ensure that workers are never overexposed while wearing respirator
Explain the meaning of a lower versus a higher number for OSHA APF. Give examples to explain what the APF number means (for example, a respirator with APF 10) and how APF relates the PEL.	<ul style="list-style-type: none"> The lower the APF, the lower the protection. The higher the APF, the higher the protection. A respirator with APF 10 reduces exposure by 10 times or to 1/10 of the outside level. (This means the respirator can be used only in exposures up to 10 times the PEL) <p>Example: The work area has a chemical concentration of 500 parts per million (ppm). You are asked to wear a half-face APR which has an APF of 10. If the chemical's PEL is 50 or above, you will be protected because the $MUC = 50\text{ppm} \times 10 = 500\text{ppm}$. If the PEL is below 50, you will be overexposed, for example $MUC = 40\text{ppm} \times 10 = 400\text{ppm}$.</p>

Handout 18: Group Presentations: APF and MUC (continued)



Handout 18

Group Presentations: APF and MUC

Group 2: Protection Factors and OSHA

Your group will use the Participant Guide to research and present *Protection Factors and OSHA*.

Use the chart below (*continued on the next page*) to take notes on the topics in the left column as you conduct your research.

Topic	Notes
Explain the formula for calculating protection factor (PF) [give example of calculation].	$PF = \frac{\text{Concentration of contaminant outside respirator}}{\text{Concentration inside respirator}}$ Example: $\frac{500 \text{ ppm}}{50 \text{ ppm}} \text{ (concentration outside)}$ $= APF 10$
Explain why filtered face-pieces are generally not used for environmental work.	<i>They do offer enough protection. Disposable filtering face-pieces do not give you the same fit as other APRs and therefore, there is more of a chance for contamination to get inside the face-piece and expose the worker. Also, these respirators have an N95 rating, which do not protect against extremely small particulates, mists, fumes, etc.</i>

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Handout 18: Group Presentations: APF and MUC (continued)



Handout 18

Group Presentations: APF and MUC

Group 2: Protection Factors and OSHA (continued)

Topic	Notes		
	Respirator	APF	MUC
Give an overview of three types of respirators commonly used for infectious disease work and their APFs.	Half-face air-purifying respirator (APR)	10	1 f/cc (For every 10 fibers in the air, 1 may leak in)
	Full-face air-purifying respirator (FFAPR)	50	5 f/cc (For every 50 fibers in the air, 1 may leak in)
	Half-face powered air-purifying respirator (PAPR) Full-face powered air-purifying respirator (PAPR)	50 1,000	5 f/cc (For every 50 fibers in the air, 1 may leak in) 100 f/cc (For every 1000 fibers in the air, 1 may leak in)
Define/Explain MUC and why it is important to know	<ul style="list-style-type: none"> The MUC is the level of concentration of a contaminant that, if exceeded, will cause you to be overexposed (over the PEL). The highest exposure level in which a respirator can be used safely. 		

Exercise 2: Respirators and Filters

Exercise 2: Respirators and Filters



40
Minutes

Objectives

3. Explain the difference between an air-purifying respirator and an atmosphere-supplying respirator.
4. Describe and list the limitations of a half-face APR, full-face APR, and a PAPR.
5. List and explain the different filters and canisters that are used with APRs.
6. Explain the requirements of a Respiratory Protection Program.



SL 10 to 28



HO 19: Respiratory Protection Information



PG: 5–8 to 5–28

Sample APR and ASR
(if available)

Display Slide 10. Open the lesson by showing an example of an APR and an ASR (you can show either the real equipment, or display the photo on Slide 11), and ask participants if they can tell you the main difference between the two types of equipment. Tell participants that these are the two main types of respirators, and explain that the primary difference is where the breathing air comes from.

Distribute Handout 19: *Respiratory Protection Information* and explain that participants will use a combination of the PG (pages 5–8 to 5–11) and your slide presentation to complete the information on the handout.

Display Slides 11 to 15 and go over the information. Instruct participants to take notes on Part A of Handout 19. Have them compare notes in pairs when you finish presenting the information. (See the answer key.)

Explain that Part B of the handout focuses on different systems used to filter the air in air-purifying respirators. Instruct participants to use PG pages 5–11 to 5–28 to answer the questions. Give participants 10 minutes to complete the information in Part B.

Option: This can be done as a race with pairs competing to complete all of the information completely.

Review the answers to Part B with the whole class and answer any questions participants have. (See the answer key.)

Draw participants' attention to Part C of Handout 19. Display Slides 16 to 22 and have participants take notes on the handout as you go over the limitations of air-purifying respirators. Have them compare notes in pairs when you finish the slide presentation.

Elicit the key information from Part C and add anything participants may have missed. Answer any remaining questions. (See the answer key.)

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Exercise 2: Respirators and Filters (continued)

Display Slides 23 to 28 and go over the key information regarding atmosphere-supplying respirators. Explain that for infectious disease work, participants will be more likely to use APR or PAPR types of respiratory protection.

Explain that Part D of Handout 19 focuses on the OSHA requirements for a written respiratory protection program. Instruct participants to use the words in the box, or look at PG pages 5–28 to 5–31 to complete the handout. Give participants 10 minutes to complete the information in Part D. Check the answers with the class. (See the answer key.)

Answer any remaining questions participants have about respirators and filters.

Conclude by saying that the type of respiratory protection worn will depend on the worksite conditions and the specific nature of the job. Familiarity with the different types of respiratory protection and the components, operation, and limitations of each will help participants perform infectious disease work safely, avoid health hazards, and troubleshoot effectively if problems arise with respiratory equipment.

Handout 19: Respiratory Protection Information



Handout 19

Respiratory Protection Information

Part A: Types of Respirators

Instructions: Listen and take notes as your instructor explains the information about respiratory protection.

Two main types of respirators	Notes
Air-purifying respirator (APR)	<ul style="list-style-type: none">use the air in your work environment as your source of breathing airuse a system, such as a filter, to clean the air
Atmosphere-supplying respirator (supplied air respirator)	<ul style="list-style-type: none">2 types: SAR & SCBAsupply clean air from a separate source

Air-purifying Respirators: Types	APF	Characteristics
Half-face Air-purifying respirator (APR)	10	<ul style="list-style-type: none">made of rubber or plasticseals across bridge of nose to under chinuses one or two purifying elements attached to clean the air and make it safe to breathe
Full-face Air-purifying respirator (FFAPR)	50	<ul style="list-style-type: none">made of rubber or plasticseals across forehead, over temples and jaw line, and under chin
Half-face PAPR	50	<ul style="list-style-type: none">battery-operated blower draws air through purifying elements and blows into face-piece
Full-face PAPR	1,000	<ul style="list-style-type: none">delivers air at a constant flow rate of 4–6 CFM, keeps a slight “positive pressure” inside face-piece

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Handout 19: Respiratory Protection Information (continued)



Handout 19

Respiratory Protection Information

Part B: Air-purifying Elements

Instructions: Use your Participant Guide to complete the missing information about air-purifying elements used with respirators. Take notes on any important information.

1. List two types of air-purifying elements (filters): **Particulate filters**
Sorbent cartridges and canisters
2. Particulate filter respirators are used for protection against solid particles, dust, fumes, or mist
(e.g., welding fumes, oil mists, asbestos, silica, asphalt fumes).
3. Write the correct filter-series letter next to the description:
N not resistant to oil
R resistant to oil, but not oilproof
P oilproof
4. Filters designated N95, R95, and P95 have a minimum efficiency of A %.
A. 95 B. 99 C. 99.97 D. 100
5. Filters designated N99, R99, and P99 have a minimum efficiency of B %.
A. 95 B. 99 C. 99.97 D. 100
6. Filters designated N100, R100, and P100 have a maximum efficiency of C %.
A. 95 B. 99 C. 99.97 D. 100
7. B filters have a service life of one shift.
A. N-series B. R-series C. P-series D. None of the above
8. If a contaminant passes through a saturated cartridge or canister, breakthrough has occurred.
9. What are four steps you should follow when breakthrough has occurred?
 - 1) Leave the work area immediately
 - 2) Go to a location with fresh air
 - 3) Notify your superior, industrial hygienist, or site safety and health officer
 - 4) Replace the filter or cartridge/canister if returning to the work area

Handout 19: Respiratory Protection Information (continued)



Handout 19

Respiratory Protection Information

Part C: Limitations of Air-purifying Respirators

Instructions: Listen. Complete the missing information and take notes as your instructor explains the limitations of air-purifying respirators.

Limitations	Notes
1. <u>Oxygen</u> -deficient atmospheres	<ul style="list-style-type: none">Never use an APR in any atmosphere that is oxygen-deficient or has the potential to become so.Oxygen level must be between 19.5 and 23.5% by volume. Normal breathing air = 21%Least effective in confined spaces or in areas where chemicals are present
2. Unknown <u>chemical</u> or concentrations	<ul style="list-style-type: none">Never wear an APR in any situation where the containment or its concentration is unknown.To calculate MUC, you must know what chemical is present and its concentration.Without this information, you cannot be certain that your assigned APR will protect you. Do not take the risk.
3. IDLH (<u>Immediately Dangerous to Life and Health</u>) Concentrations	<ul style="list-style-type: none">Never wear an APR in an IDLH atmosphere.For some chemicals, the MUC is lower than the IDLH level; however, there are many situations where the MUC can be higher than the IDLH level but no matter what, the APR cannot be worn when levels reach the IDLH limit.
4. <u>Filter</u> / Cartridge Life	<ul style="list-style-type: none">The service life of filters, cartridges, and canisters is limited by their ability to block or remove contaminants.If a particulate filter becomes clogged, it can be difficult to breathe, and the filter needs to be replaced.If a sorbent cartridge becomes saturated and no longer absorbs the chemical, it allows gas or vapor to pass through it, and breakthrough has occurred.

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Handout 19: Respiratory Protection Information (continued)



Handout 19

Respiratory Protection Information

Part C: Limitations of Air-purifying Respirators (continued)

Instructions: Listen. Complete the missing information and take notes as your instructor explains the limitations of air-purifying respirators.

Limitations	Notes
5. Cartridge / Canister <u>efficiency</u>	<ul style="list-style-type: none"> Breakthrough times and efficiency are different for every hazardous substance. An APR with cartridges or a canister should not be used for substances that have rapid breakthrough times.
6. <u>Humidity</u> / Temperature	<ul style="list-style-type: none"> Breakthrough occurs more quickly under conditions of high humidity and temperatures. Cartridges and canisters have faster absorption rates when the humidity or temperature increases, resulting in faster breakthrough times.
7. Usage / <u>Change out</u>	<ul style="list-style-type: none"> Cartridge or canister life is limited once the cartridge package is opened. Particulate filters must be changed whenever you have difficulty breathing through them or as part of a decontamination procedure.
8. <u>Eye</u> Protection	<ul style="list-style-type: none"> Half-face APRs provide no eye protection. If any hazards are present that may injure your eyes, safety glasses, goggles, or face shields must be worn.

Handout 19: Respiratory Protection Information (continued)



Handout 19

Respiratory Protection Information

Part D: Respiratory Protection Program

Instructions: Complete the missing information about requirements for a Respiratory Protection Program. Use the words below. Take notes on any important information.

cleaning	doffing	effectiveness	emergencies	fit-testing
hazards	inspecting	medical	quantity	selecting

According to OSHA 29 CFR 1910.134, a written respiratory protection program must include the following requirements:

1. Procedures for selecting respirators for use in the workplace.
2. Medical evaluations of employees who are required to use respirators.
3. Fit-testing procedures for tight-fitting respirators.
4. Procedures for proper use of respirators in routine situations and in reasonably foreseeable emergencies.
5. Procedures and schedules for cleaning, storing, inspecting, repairing, discarding, and otherwise maintaining respirators.
6. Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators.
7. Employee training in the respiratory hazards to which they are potentially exposed during routine and emergency situations.
8. Employee training in the proper use of respirators, including the following:
 - Donning and doffing (putting on and taking off)
 - Limitations
 - Maintenance
9. Procedures for regularly evaluating the effectiveness of the program.

Chapter 5: Personal Protective Equipment

Exercise 3: Respirator Inspection, Donning/Doffing, and Fit-testing



90
Minutes

Exercise 3: Respirator Inspection, Donning/Doffing, and Fit-testing

Objectives

- 
- 7. Describe the difference between a qualitative and quantitative fit-test.
 - 8. Explain what a positive and negative user seal check is and when they need to be done.
 - 9. Describe and demonstrate the proper inspection, donning, and doffing of an APR.
 - 10. Describe and demonstrate the proper use and storage of an APR.



SL 29 to 32
HO 20: Respirator
Donning/Doffing Prep
(*cut into cards, if desired)

HO 21: Respirator
Performance Checklist

HO 22: Fit-testing



Optional:
IT 1: Rainbow Passage
(one copy)



PG: 5–32 to 5–57

1 FFAPR per participant

Instructor Note: This exercise covers the hands-on portion of respirator training. Allow at least two hours for preparation, practice, and evaluation. The recommended participant/instructor ratio is 5:1. You will need to evaluate participants individually. To save time, be sure that there are multiple instructors available to conduct the evaluations.

Option: To make the task more engaging, the pictures on Handout 20 can be cut up into cards, which participants can put in the correct order.

Tell participants that this exercise introduces the steps for properly inspecting, donning, and doffing a respirator. Distribute one FFAPR to each participant.

Put participants into pairs to discuss their experiences with wearing respirators and to share what they know about inspection and donning/doffing procedures.

Distribute Handout 20: *Respirator Donning/Doffing Prep* and have pairs work together to try completing the ordering task. Then have pairs combine to form groups of four and compare answers.

Using an FFAPR, demonstrate/explain the order of the procedures for inspecting and donning the respirator as participants check their answers on Handout 20. You do not need to demonstrate or explain the steps in detail at this point, as you will do that later in the exercise. Explain that participants will have time to practice inspection and donning/doffing procedures before being evaluated on their ability to do those procedures.

Distribute Handout 21: *Respirator Performance Checklist* and have participants write their names at the top.

Using an FFAPR, demonstrate the full set of procedures for inspecting and donning the respirator as participants follow along with the steps on Handout 21. Offer any helpful tips or caveats as you demonstrate. (Note: To keep participants engaged, you can intentionally skip or perform some steps incorrectly and tell participants to stop you when you make a mistake.)

Exercise 3: Respirator Inspection, Donning/Doffing, and Fit-testing (continued)

Give participants time in pairs to practice inspecting and donning/doffing their respirators. Have one partner watch while the other completes the process, noting any errors or steps that the participant has missed. Encourage them to talk through the process as they complete each step and to ask their partner if they need help remembering the steps.

Walk around and monitor participants as they practice. Assist with the correct procedures as needed. When one participant finishes, their partner should give feedback on how well they completed the steps, indicating any steps that were missed. Then partners should switch roles.

Briefly discuss issues that can affect fit and comfort, such as eyeglasses, long hair or sideburns, and facial hair. Highlight the importance of following all steps every time, and of proper cleaning and storage after use.

Display Slides 29 to 32 and go over the procedures for fit-testing. **Distribute** *Handout 22: Fit-testing*. Instruct participants to try to complete as much as they can. Then have them check their answers on PG pages 5–32 to 5–40. Review the answers with the class. (See the answer key.)

Tell participants that now begins the hands-on portion of the lesson. Explain that you will evaluate each participant's ability to follow all the proper procedures for inspecting and donning their respirator, after which you will administer each an abbreviated qualitative fit-test using smoke, banana oil, or some other testing agent.

Instructor Note: While other participants are waiting, have them work in pairs and continue practicing the steps for donning, doffing, and fit-testing. One participant can complete the steps while the other watches and then tells them any steps they missed.

Divide the class evenly among the number of instructors available. (Maximum recommended ratio for hands-on tasks is 5 participants to 1 instructor.) Have each participant come to an isolated area one at a time to perform the procedures while the instructor watches and completes the checklist.

Instructor Note: Only 100% satisfactory performance is acceptable for the Performance Checklist. If a participant misses steps or performs them incorrectly, he or she must try the full set of procedures again.

Once they have donned the respirator and performed seal checks, administer the fit-test. Ask them to move their head in all directions and talk to them to ensure they respond. Alternatively, post Instructional Tool 2: *Rainbow Passage* and require them to read it. Tell them to readjust their respirator if they can detect the testing agent and try the test again.

Instruct participants to take off their respirators and to clean, disinfect, and place them in a storage bag for future use.

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Exercise 3: Respirator Inspection, Donning/Doffing, and Fit-testing (continued)

Go over any steps missed with individuals and review with the class if there were any common issues or problems.

Conclude by telling participants that they should now be confident in their ability to use respiratory protection for infectious disease work, from assessing protection factors, to inspecting, donning, fit-testing, and adjusting equipment, as well as changing filters, doffing, cleaning, and storage. Elicit any remaining questions.

Handout 20: Respirator Donning/Doffing Prep



Handout 20

Respirator Donning/Doffing Prep

Instructions: Number the pictures in order.

APF 50	1	Match respirator to hazard / situation.	6	Adjust straps to correct fit.	4	Ensure correct cartridge or filter and expiration date. Check for cracks, dents, or evidence of prior use.
Perform positive seal check. Cover exhalation valve and exhale for a count of 10. Notice any leaks.	7	Check straps / harness for breaks, twists, broken attachments.	3	←	9	Readjust straps if necessary, and repeat seal checks. Check for good breathing.
Place chin in cup.	5	Examine face-piece for dirt, cracks, worn or missing pieces.	2	X	8	Perform negative seal check. Cover filter intakes and inhale for a count of 10. Notice any leaks.

Infectious Disease Operations

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Handout 21: Respirator Performance Checklist



Handout 21

Respirator Performance Checklist

Type of task: Individual Exercise

Group Exercise

Other: Can be done in small classes as an exercise that combines group and individual assessment

Date of assessment: ___/___/___

Name(s) of participant(s):

Task	Performance	
	Satisfactory	Unsatisfactory
Identify hazard condition and match respirator to situation.		
Examine the face-piece for <ul style="list-style-type: none"> • excessive dirt • cracks, tears, holes, or distortion from improper storage • inflexibility (stretch and massage to restore flexibility) • incorrectly mounted face-piece lens or broken or missing mounting clips • cracked or broken air-purifying element holder(s), badly worn threads, or missing gasket(s), if required 		
Examine head straps or head harness for <ul style="list-style-type: none"> • breaks • twists and loss of elasticity • broken or malfunctioning buckles or attachments 		
Remove exhalation valve cover and examine for foreign material such as <ul style="list-style-type: none"> • detergent residue, dust particles, or human hair under the valve seat • cracks, tears, or distortion in the valve material 		

Handout 21: Respirator Performance Checklist (continued)



Handout 21

Respirator Performance Checklist

Task	Performance	
	Satisfactory	Unsatisfactory
Examine air-purifying element for <ul style="list-style-type: none">• correct cartridge canister/filter for the hazard• correct installation, loose connections, missing or worn gaskets, or cross-threading in holder• expired shelf-life date on cartridge or canister• cracks or dents in outside case of filter, cartridge, or canister• evidence of prior use of sorbent cartridge or canister, indicated by absence of sealing material, tape, foil, etc., over inlet		
Place chin in cup.		
Pull crown strap over head.		
Adjust bottom, middle, and top strap to correct fit.		
Perform positive seal check by placing palm of hand over exhalation valve cover and exhaling slightly for a count of 10. Notice any leaks.		
Perform negative seal check by placing palm of hand over exhalation valve cover and inhaling slightly for a count of 10. Notice any leaks.		
Readjust straps if necessary.		
Repeat fit checks if readjustment occurs.		
Check for good breathing.		
Comments:		

Chapter 5: Personal Protective Equipment

Handout 22: Fit Testing



Handout 22

Fit-testing

Instructions: Read each statement and decide whether it is true or false. Make a check (✓) in the correct column. Correct the false statements by rewriting the statement in the "correction" column. Check your answers in your Participant Guide.

Statement	True	False	Correction
1. You must be fit-tested on the same make, model, size and style of respirator you will wear for the job.	✓		
2. A fit-test must be conducted monthly.		✓	annually, or as needed
3. Fit-testing must be done with the respirator in positive-pressure mode.		✓	negative-pressure mode
4. A qualitative test uses a sensory agent, such as smoke or banana oil.	✓		
5. A quantitative test uses a machine to measure your fit factor.	✓		
6. Qualitative testing is less reliable and lowers the protection factor of a respirator.	✓		
7. An irritant smoke test must be conducted with a full-face respirator.		✓	when wearing half-face, must close eyes
8. Isoamyl Acetate (IAA) is known as banana oil because it smells like banana.	✓		
9. Both the saccharin and Bitrix tests rely on your sense of smell.		✓	sense of taste
10. Quantitative fit-tests use a machine to measure leakage into the face-piece and is more accurate than qualitative methods.	✓		

Infectious Disease Operations

Instructional Tool 2: Rainbow Passage



Instructional Tool 2

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look but no one ever finds it. When a man looks for something beyond his reach, his friends say he is looking for the pot of gold at the end of the rainbow.

Infectious Disease Operations

Chapter 5: Personal Protective Equipment

Exercise 4: PPE for Different Risk Environments



60
Minutes

Exercise 4: PPE for Different Risk Environments

Objective

11. Explain the use of PPE for infectious diseases in both high-risk and low-risk environments.



SL 33 to 34



HO 23: PPE in Different Risk Environments



PG: 5–40 to 5–44

Display Slides 33 and 34. Open the lesson by asking, “Would you wear the same PPE for all types of infectious disease operations? Explain.” Write participants’ answers on the board. Explain that participants will now learn about other protective clothing and equipment necessary to work safely with infectious diseases.

Distribute Handout 23: *PPE in Different Risk Environments*. Divide the class into pairs and have participants work together to find the answers to the handout in their PG pages 5–40 to 5–44. Allow 10–15 minutes. Walk around and monitor each group’s progress and answer any questions or help.

Check the answers quickly with the whole group. (See the answer key.) Answer any questions that may have come up in the completion of the handout.

Conclude by saying that every work situation is different, and that it is the employer’s responsibility to ensure that workers have access to and are trained in the use of PPE. In an infectious disease setting, the PPE used may be of a higher level than the situation seems to suggest is necessary. When there are unknown factors about pathogens that may be present, erring on the side of higher risk protection helps ensure workers’ safety on the job.

Handout 23: PPE in Different Risk Environments



Handout 23

PPE in Different Risk Environments

Instructions: Write answers to the questions. Use your Participant Guide to find the correct information.

1. What is the main difference between defining high-risk and low-risk PPE environments?
High-risk PPE environments have the potential for exposure to blood and bodily fluids. Low-risk PPE environments do not have this potential for exposure.
2. Which agencies have provided recommendations for PPE used in infectious disease settings?
OSHA, CDC, the Nebraska Biocontainment Unit, Emory Healthcare, the New York City Environmental Contractors Association, and the Mason Tenderers' Union within LIUNA.
3. TRUE or FALSE: only protective suits with thumb hooks should be used.
FALSE: taping the sleeve of the gown or protective suits over the inner glove may also be used.
4. TRUE or FALSE: SARs or SCBA are recommended for most infectious disease cleanup operations.
FALSE: their use may be needed for evaluating contaminated areas of unknown concentrations that will need to be cleaned, and also in evaluating the set-up of the decontamination unit that may be needed in case of an emergency event.
5. In which environment(s) can street clothes be worn under PPE?
Street clothes should never be worn under PPE.
6. What are the differences between Level A and Level C HAZWOPER PPE ensembles?
*Level A: Investigation team, fully-encapsulated suit, SCBA respirator, gloves, foot cover.
Level C: Work remediation team, double suit, tight-fitting PAPR or APR with a P100 filter rating, gloves, foot cover.*
7. Write *H* for PPE used in high-risk environments, *L* for PPE used in low-risk environments, or *B* for both.
 - A. *B* Gloves inner: double nitrile.
 - B. *H* Gloves inner: triple nitrile.
 - C. *H* Gloves outer: extended cuff nitrile, neoprene.
 - D. *B* Gowns & Protective Suits: Full-body garment constructed of durable viral penetration-resistant material.
 - E. *H* Head covers.
 - F. *B* Foot protection: Rubber boots that extend to at least lower calf, or footwear or covers with viral-penetration barrier layer.
 - G. *L* Face shield.
 - H. *H* PAPR.
 - I. *L* Filtering face-piece with an N95 rating.
 - J. *B* APR with a P100 rating.
 - K. *B* Plastic aprons.

Infectious Disease Operations

Chapter 5: Personal Protective Equipment

Exercise 5: Donning and Doffing PPE



80
Minutes

Exercise 5: Donning and Doffing PPE

Objectives

- 12. Describe the proper inspection, donning, and doffing of PPE.
- 13. Describe the proper decontamination and/or disposal of PPE.
- 14. Demonstrate the proper technique for doffing inner gloves.



SL 35 to 39



HO 24: Key Considerations
for Donning/Doffing PPE



HO 25: PPE Donning and
Doffing Checklists



PG: 5–44 to 5–57

1 set of PPE,
including PAPR or
FFAPR, to demonstrate
donning and doffing

Nitrile gloves (at least
1 pair per participant)

Display Slides 35 and 36. Tell participants that they are going to learn how to don and doff PPE properly. Ask, “Why do you think training in donning and doffing procedures are so critical in an infectious diseases work environment?” Write their answers on the board. (Suggested answers: If PPE is not donned properly, it could expose the worker to contaminants during the decontamination and disinfection process. If PPE is not doffed correctly, it could expose the worker as well as the trained observer/trained observer’s assistant to contaminants.) Stress that this is why training is so important, to ensure the safety of workers and those around them.

Display Slide 37. Explain that depending on the situation, a decontamination unit may be used. In some cases this may consist of two, three, or more stages. In other cases, however, such as in a hospital setting, an anteroom may be set up outside a patient’s room for doffing PPE, and the clean room may be an adjacent, empty hospital room. (Tell participants that they will be learning and practicing more with decon units in Chapter 6.) Tell participants that in addition to learning the different steps for donning and doffing PPE, there are other key considerations to keep in mind.

Distribute Handout 24: *Key Considerations for Donning/Doffing PPE*. Have participants complete the handout in pairs. Tell them to look at PG pages 5–44 to 5–57 as a reference. When they are done, have them check their answers with another pair.

Review the answers to the handout with the class. (See the answer key.) Answer any questions that may have come up in the completion of the handout.

Display Slide 38. Review the information about the role of a trained observer/trained observer’s assistant in the donning/doffing process. Answer any questions that participants may have. Explain that in the next activity, participants will learn about the steps for donning and doffing PPE.

Distribute Handout 25: *PPE Donning and Doffing Checklists*. Tell participants that you are going to demonstrate the donning and doffing process. They will act as trained observers/trained observer’s assistants as they read through the checklists. Give participants a few minutes to read through each of the checklists and answer any questions they may have before you begin the demonstration.

Exercise 5: Donning and Doffing PPE (continued)

Have participants take turns reading the instructions on the checklists aloud, and demonstrate each step as it is read. Provide additional details that may be helpful (for example, common mistakes people make in certain steps of the process), and encourage participants to write any additional notes on the handout as each step is completed. After you finish the demonstration, answer any remaining questions on donning/doffing.

Instructor Note: *While this demonstration would normally be done in a decontamination unit, the focus of this activity is only for participants to understand the correct procedures for donning and doffing PPE. You may want to remind participants that on an actual worksite, donning and doffing would occur in different parts of a decon unit. Participants will have a chance to practice donning and doffing PPE in a decon unit setting in the activities for Chapter 6.*

Explain that healthcare workers are trained in glove-doffing protocols, and because they don and doff gloves so frequently, the procedure becomes second nature to them. However, for workers that may only don and doff gloves as part of a cleanup operation, it is crucial to ensure that safe procedures are followed to avoid possible contamination. The entire decon process itself has many steps, and workers may be under duress as they go through the procedure. Therefore, before practicing the entire PPE donning and doffing process (which takes place in Chapter 6), they will first have an opportunity to practice donning and doffing inner gloves.

Display Slide 39. Explain that the CDC has established a protocol for doffing inner gloves safely. Talk through each of the steps, and ask why the doffing process is done this way. (To reduce the risk of contamination of the wearer's hands.)

Put on a pair of nitrile gloves. Refer to Slide 39 again, and narrate each step in the process of doffing the gloves as you demonstrate the procedure for the class. Ensure that all participants have a chance to view the technique up close.

Distribute a pair of nitrile gloves to each participant. Divide the class into pairs. Have participants in each pair take turns to practice donning and doffing the gloves, with one member of the pair acting as an observer. Monitor and have pairs practice until all participants have demonstrated the safe doffing process.

Explain that participants will have a chance for hands-on practice of the donning and doffing procedures they have learned as they cover Chapter 6: *Work Area Preparation, Decontamination, and Disinfection*.

Conclude by reminding participants that as workers on an infectious disease site, they will perform all of the PPE donning and doffing procedures many times during their careers – every time they enter and leave their job site. Highlight the fact that each time, the steps need to be done with the same focus and care and in the correct order in order to protect workers, their families, and the general public from exposure to pathogens.

Chapter 5: Personal Protective Equipment

Handout 24: Key Considerations for Donning/Doffing PPE



Handout 24

Key Considerations for Donning/Doffing PPE

Instructions: When are these considerations used? Write *N* for donning PPE, *F* for doffing PPE, or *B* for both.

1. **F** A trained observer's assistant must wear PPE.
2. **F** A place for sitting that can be easily cleaned and disinfected.
3. **B** A PPE-trained observer to oversee and minimize the risk of contamination.
4. **F** Avoid touching face or skin.
5. **F** Decontamination of equipment.
6. **F** Disinfecting gloves and soiled areas, and then putting on a clean pair of gloves.
7. **B** Inspect PPE.
8. **F** Leak-proof infectious waste containers for discarding used PPE.
9. **B** Perform hand hygiene.
10. **B** Practice the process.
11. **N** Remove all clothing and personal items.
12. **F** Showering.
13. **B** Step-by-step procedures, use of a posted checklist.
14. **F** Supplies for disinfection of PPE.
15. **N** Verify that a sufficient range of motion exists to perform work tasks.

Infectious Disease Operations

Handout 25: PPE Donning/Doffing Procedures



Handout 25

PPE Donning/Doffing Procedures

Part A: Recommended Process for Donning PPE

Instructions: Check (/) the appropriate box for each step below.

Correct	Incorrect	Step
		Engage trained observer: The trained observer may enter the clean room to observe the worker donning process.
		Inspect PPE Prior to Donning: Visually inspect the PPE ensemble to be worn to ensure that it is in serviceable condition, that all required PPE and supplies are available, and that the sizes selected are correct for the worker.
		Remove Clothing and Personal Items: No personal items (for example, jewelry, watches, cell phones, pagers, pens) should be brought into the contaminated room.
		Don Inner Suit: Put on disposable boxers or cotton underwear (optional). Don the inner suit. Prepare and put on disposable duct tape belt and attach the PAPR battery to the disposable belt (if a PAPR is used).
		Perform Hand Hygiene: Perform hand hygiene with alcohol-based hand rubs (ABHRs). When using ABHRs, allow hands to dry before moving to next step.
		Don Inner Gloves: Put on first pair of gloves. Be sure cuffs of inner gloves are tucked under the sleeve of the inner suit.
		Don Outer Suit: Do not zip the suit up at this time. Ensure outer suit is large enough to allow for unrestricted freedom of movement.
		Don Rubber Boots: The outer suit should be placed over the rubber boot and should be taped to the boot. No part of the suit should be exposed on the boot past the tape. If being used, put on boot covers at this time.
		Don Respirator: Connect the PAPR battery and don the respirator face-piece. Perform the positive and negative user seal checks. Turn on the PAPR fan (if this type of respirator is being used).
		Don Hoods: Don the double hoods over the respirator head harness (straps) and zip up the outer suit. Tape outer hood to the brim of the respirator face-piece to gain proper seal. Be sure the entire area around the respirator is taped so there are no gaps. You may also be required to put tape over the outer suit zipper as well.

Chapter 5: Personal Protective Equipment

Handout 25: PPE Donning/Doffing Procedures (continued)



Handout 25

PPE Donning/Doffing Procedures

Part A: Recommended Process for Donning PPE (continued)

Correct	Incorrect	Step
		Don Face Shield: By wearing a face shield over the PAPR, you will be able to reuse the PAPR.
		Don Outer Gloves: Put on second pair of gloves (with extended cuffs). Put the sleeve of the outer suit over the outer glove and tape the outer suit to the outer glove. Be sure to leave a tab on the tape for easy removal.
		Don Apron: If an apron is being used, don a full-body apron to provide additional protection to the front of the body.
		Verify: After completing the donning process, the integrity of the ensemble is verified by the trained observer. The cleanup worker should be comfortable and able to extend the arms, bend at the waist, and go through a range of motions to ensure there is sufficient range of movement while all areas of the body remain covered. A mirror in the room can be useful for the healthcare worker while donning PPE.
		Disinfect Outer Gloves: Disinfect outer-gloved hands with ABHR. Allow to dry.

Handout 25: PPE Donning/Doffing Procedures (continued)



Handout 25

PPE Donning/Doffing Procedures

Part B: Recommended Process for Doffing PPE

Instructions: Check (/) the appropriate box for each step below.

Correct	Incorrect	Step
		Engage Trained Observer's Assistant: The trained observer's assistant is wearing appropriate PPE and enters Stage 1 of the decon unit to observe the worker doffing process. Prior to doffing PPE, the trained observer's assistant must remind the cleanup worker to avoid reflexive actions that may put them at risk, such as touching their face. The trained observer's assistant may assist with removal of specific components of PPE, as outlined below. The trained observer's assistant disinfects their own outer-gloved hands immediately after handling any cleanup worker's PPE.
		Inspect PPE Prior to Doffing: Inspect the PPE to assess for visible contamination, cuts or tears before starting to remove. If any PPE is potentially contaminated, then disinfect using an EPA-registered disinfectant wipe. If the facility conditions permit and appropriate regulations are followed, an EPA-registered disinfectant spray can be used, particularly on contaminated areas.
		Disinfect: Disinfect apron (if used), face shield, outer gloves, outer suit, boot covers (if used, and rubber boots if covers are not used) with either an EPA-registered disinfectant wipe or with ABHRs, and allow them to dry.
		Doff Apron (if used): Remove and discard the apron, taking care to avoid contaminating gloves by rolling the apron from inside to outside. Remove and discard the outer boots (if outer boots are used).
		Disinfect: Disinfect the outer suit again, especially the portions where the apron and apron straps were covering. Disinfect rubber boots (if outer boots were used).
		Doff Face Shield: Dispose the face shield in the appropriate receptacle after doffing it.
		Disinfect: Following the face shield removal, disinfect the exposed surfaces of the respirator, including tape.
		Remove Tape: Remove all exposed tape, including the tape around the outer gloves, respirator, and rubber boots, and dispose in the appropriate receptacle.

Chapter 5: Personal Protective Equipment

Handout 25: PPE Donning/Doffing Procedures (continued)



Handout 25

PPE Donning/Doffing Procedures

Part B: Recommended Process for Doffing PPE (continued)

Correct	Incorrect	Step
		Disinfect and Remove Outer Gloves: Disinfect outer-gloved hands with either an EPA-registered disinfectant wipe or with ABHRs. Remove outer gloves, taking care not to contaminate the inner glove during the removal process. Discard the outer gloves in the appropriate receptacle.
		Inspect and Disinfect Inner Gloves: Inspect the inner gloves' outer surfaces for visible contamination, cuts, or tears. If an inner glove is visibly soiled, cut, or torn, then disinfect the glove with either an EPA-registered disinfectant wipe or with ABHRs. Then remove the inner gloves, perform hand hygiene with ABHRs on bare hands, and don a clean pair of gloves. If no visible contamination, cuts, or tears are identified on the inner gloves, then disinfect the inner-gloved hands with either an EPA-registered disinfectant wipe or with ABHRs.
		Doff Rubber Boots and Outer Protective Suit: Remove and place in the appropriate receptacle. Depending on suit design and location of fasteners, the cleanup worker can either untie fasteners, receive assistance by the trained observer's assistant to unfasten the suit, or gently break fasteners. When removing the outer suit, slowly and carefully reach for the zipper or fasteners and unzip or unfasten the outer suit completely before rolling down and turning inside out if possible. Avoid contact of the outer surface of the outer suit with the outer surface of the inner suit during removal. Pull inner suit away from the body, rolling inside out and touching only the inside of the suit. Carefully dispose of the suit in the appropriate receptacle.
		Disinfect Inner Gloves: Disinfect inner gloves with either an EPA-registered disinfectant wipe or with ABHRs.
		Remove PAPR Battery: Remove the PAPR battery (if a PAPR is used), including the duct tape belt, and place the battery in a container or area designated for the collection of PAPR components. Place the tape in the appropriate receptacle.
		Doff Inner Suit: Slowly and carefully reach for the zipper or fasteners and unzip or unfasten the inner suit completely before rolling down and turning inside out. Avoid contact of the outer surface of the disposable inner suit with skin, undergarments, or any other surface during removal. Pull inner suit away from the body, rolling inside out and touching only the inside of the suit. Carefully dispose of the suit in the appropriate receptacle.

Handout 25: PPE Donning/Doffing Procedures (continued)



Handout 25

PPE Donning/Doffing Procedures

Part B: Recommended Process for Doffing PPE (continued)

Correct	Incorrect	Step
		Disinfect Inner Gloves: Disinfect inner gloves with either an EPA-registered disinfectant wipe or with ABHRs.
		Doff Respirator: Cleanup workers can remove their respirator, being careful not to touch inside the respirator or their face.
		Disinfect and Remove Inner Gloves: Disinfect inner-gloved hands with either an EPA-registered disinfectant wipe or with ABHRs. Remove and discard gloves, taking care not to contaminate bare hands during removal process.
		Perform Hand Hygiene: Perform hand hygiene with ABHRs.
		Shower: Showers are required using antibacterial soap. Disposable towels must be provided for drying off and placed in the appropriate receptacle after use.
		Protocol Evaluation/Medical Assessment: Either the infection preventionist, infectious disease specialist, occupational safety and health coordinator, or their designee on call at the time, should meet with the cleanup worker to review the activities performed, to identify any concerns about protocols and to record worker's level of fatigue.

Chapter 5: Personal Protective Equipment

Summary



10
Minutes

Summary

Distribute *Chapter 5: Things to Remember.*



Chapter 5:
Things to Remember

Explain that the *Things to Remember* document is a take-home list of information that can be used for reference or self-study. Note that this document provides information about the chapter's learning objectives and may be used as a study guide for the end-of-course assessment.



SL 2 to 5

Display Slides 2 to 5 and briefly review the chapter objectives with the class. Review the information on the *Things to Remember* handout for each objective. Ask participants if they are comfortable with their knowledge about, or ability to do, each of the objectives, or if they need review or additional support on any of the items listed.

Ask the participants if they have any questions regarding any other topics of the chapter.

Address any questions or concerns.



PG: 5–58 to 5–59

Chapter 5: Things to Remember



Chapter 5: Personal Protective Equipment

Things to Remember

1. The *assigned protection factor (APF)* is the amount a respirator leaks, as assigned by OSHA. An APF is based on the assumption that the respirator is working properly, is worn correctly, and fits the wearer. The lower the APF, the lower your protection. The higher the APF, the higher your protection. APF is calculated by dividing the concentration of airborne contaminants outside the respirator by the concentration inside the respirator. The maximum use concentration (MUC) is the level of contamination that, if exceeded, will cause you to be exposed above the PEL (overexposed). In other words, the MUC is the highest exposure level of a contaminant or a group of contaminants for which a specific respirator can be used safely. At no time should you use a respirator in an environment that exceeds the MUC. The MUC is calculated by multiplying the APF of the respirator that is going to be used by the PEL of the chemical or substance the respirator is going to be used against.
2. The following types of respirators are common in infectious disease work:

Respirator	Features	APF
Half-face APR	Covers half of face from nose to below chin; one or two filters	10
Full-face APR	Covers full face from forehead to below chin	50
Powered Air-purifying Respirator (PAPR)	Battery-operated blower draws air through filter into face-piece; constant flow rate of 4–6 cf/m; slight “positive pressure” inside face-piece	Half-face 50 Full-face 1,000

3. There are two basic types of respirators that you can use to protect yourself against airborne contamination: air-purifying respirators (APRs) and atmosphere-supplying respirators (ASRs). APRs rely on the air in your work environment as your source of breathing air, and clean the air you breathe by filtering or removing contamination from the air before it enters your lungs. ASRs supply you with safe breathing air from a cylinder on your back or a hose connected to a source of safe air. There are two types of ASRs. Supplied air respirators (SARs) provide air delivered by an airline connected to a safe air source. Self-contained breathing apparatus (SCBA) provide air that is supplied by a compressed air cylinder on your back.

Chapter 5: Personal Protective Equipment

Chapter 5: Things to Remember (continued)



Chapter 5: Personal Protective Equipment

Things to Remember

4. There are several potential limitations of APRs, including PAPRs, to be aware of:
 - **Oxygen-Deficient Atmospheres:** You cannot wear an APR in any atmosphere that is oxygen-deficient or has the potential to become so.
 - **IDLH Concentrations:** An APR should never be worn in an immediately dangerous to life and health (IDLH) atmosphere.
 - **Filter/Cartridge Life:** The service life of filters, cartridges and canisters is limited by their ability to block or remove contaminants.
 - **Cartridge/Canister Efficiency:** While one cartridge may be very efficient for some chemicals, it allows others to pass through quickly.
 - **Humidity/Temperature:** Breakthrough can occur more quickly under conditions of high humidity and temperatures.
 - **Usage/Change-Out:** The useful life of a cartridge or canister is limited once the cartridge package is opened.
 - **Eye Protection:** Since you have no eye protection when wearing a half-face APR, you must wear safety glasses, goggles, or a face shield if any hazards that may injure your eyes are present.
5. APRs are typically manufactured to use two basic types of purifying elements: Particulate filters and sorbent cartridges and canisters. Particulate filter respirators are used for protection against solid particles, dusts, fumes, and/or mists. They do not protect against gases and vapors. Sorbent cartridges and canisters are used with APRs to protect you from exposure to air that is contaminated with toxic vapors and gases. While particulate filters are effective for nearly all types of particles, sorbent cartridges and canisters are designed to protect against specific types of contaminants. Cartridges are designed to be used individually or in pairs on half and full face-pieces, and their service life is rather short. Canisters contain larger amounts of sorbent material. Therefore, they are bigger, can usually be used for a longer period of time, and are worn in situations where the concentration of gases or vapors is higher.
6. OSHA lists the following requirements for an effective respiratory protection program:
 1. Procedures for selecting respirators for use in the workplace.
 2. Medical evaluations of employees who are required to use respirators.
 3. Fit-testing procedures for tight-fitting respirators.
 4. Procedures for proper use of respirators in routine situations and in reasonably foreseeable emergencies.
 5. Procedures and schedules for cleaning, storing, inspecting, repairing, discarding, and otherwise maintaining respirators.
 6. Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators.
 7. Employee training in the respiratory hazards to which they are potentially exposed during routine and emergency situations.
 8. Employee training in the proper use of respirators, including the following:
 - Donning and doffing (putting on and taking off)
 - Limitations
 - Maintenance
 9. Procedures for regularly evaluating the effectiveness of the program.

Chapter 5: Things to Remember (continued)



Chapter 5: Personal Protective Equipment

Things to Remember

7. A qualitative fit-test (QLFT) or quantitative fit-test (QNFT) must be performed on all negative- or positive-pressure tight-fitting respirators before you wear them. A qualitative fit-test (QLFT) is a pass/fail fit-test used to check respirator fit that relies on your response to a test agent. It involves introducing a harmless odorous or irritating test agent into your breathing zone. If you do not detect the test agent, the respirator fits you properly. A quantitative fit-test (QNFT) is a more sophisticated and accurate type of fit-test done with a machine. It measures the actual amount of leakage into the respirator while you are wearing it, which gives you a "fit factor" for the respirator.
8. A respirator must be adjusted when you put it on to ensure the best possible seal. This is called a user seal check, and you must do it every time you put on your respirator. A *positive-pressure user seal check* includes covering the exhalation valve of the respirator with your palm, and exhaling gently for about 10 seconds. If your respirator seals properly, a slight pressure should build up inside your face-piece. If you feel or hear air leaking out, the respirator is not sealing properly. You must tighten your face-piece straps slightly and repeat the user seal check. A negative-pressure user seal check includes covering the filters or cartridges with the palms of your hands, and inhaling gently and holding your breath for about 10 seconds. If your respirator seals correctly, your face-piece should collapse slightly inward. If the respirator does not seal correctly, the face-piece will not collapse, and you will feel air leaking into the face-piece.
9. During a respirator inspection, the following should be checked:
 - Respirator function;
 - Connections, including tightness; and
 - Condition of all parts, especially rubber parts, for flexibility and deterioration.
10. Your employer is required to create and put in place procedures for the proper use of respirators. A fit-test must be performed before you are assigned a respirator to ensure that the respirator fits properly and affords you the required protection. User seal checks are done every time you put a respirator on to make sure it is adjusted properly and that you have a good face-piece seal. Your respirator should be packed and stored to prevent the face-piece and any other parts from chemicals, contamination, damage, dust, moisture, extreme temperatures, and sunlight.
11. Selection of PPE should always be based on risk assessment. The level of protection needed for a work environment can be grouped into two categories:
 - **High-Risk Protection:** Needed if there is a potential for exposure to blood and bodily fluids.
 - **Low-Risk Protection:** Needed if exposure does not include blood and bodily fluids. If this is the case, there is still a need for PPE and decontamination, but it is not as extensive as for bodily fluid exposures.PPE for high-risk environments includes gloves (inner and outer), gowns and protective suits, head covers, foot protection, respirators, and plastic aprons. PPE for low-risk environments includes gloves (inner only), gowns, foot protection, face shield, respirators, and plastic aprons. Training with the PPE being used is crucial in order to maximize the protection it provides. The CDC recommends administrative procedures to document the training of observers and healthcare workers for proficiency and competency in donning and doffing PPE, and in performing all necessary care-related duties while wearing PPE.

Chapter 5: Personal Protective Equipment

Chapter 5: Things to Remember (continued)



Chapter 5: Personal Protective Equipment

Things to Remember

12. There are many steps involved in the proper inspection, donning, and doffing of PPE. These steps may differ from site to site. Donning uses a trained observer and doffing uses a trained observer's assistant. Checklists insure that each stage is done properly.
13. The CDC guidelines for healthcare include disinfecting immediately any visibly contaminated PPE surfaces. Decontamination is critical because workers can become contaminated with infectious material while taking off PPE and respirators. Disposable PPE, such as protective gowns or suits, should be put into leak-proof disposable infectious waste containers. Containers should have leak-proof labeled biohazard bags that conform to DOT Hazardous Materials Regulations (HMR) specifications.
14. The CDC has a standard protocol for safe doffing of inner gloves. The protocol helps to reduce contamination to the worker in the doffing process.

