
OCCUPATIONAL HEALTH DYNAMICS

Operating Manual

FitTester 3000

Respirator Leak Rate Analyzer



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FitTester 3000
Quantitative Respirator FitTester
Operating Manual

OCCUPATIONAL HEALTH DYNAMICS

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To order this manual, use Part Number 9508-0208.

Revision History		
Revision	Description	Date
B	Revised	
C	Rev/Firmware V 4.10	1/96
D	Formatted for product	1/96
E	Converted/updated V 4.30	10/99
F	Address Revision	10/00

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- Use heavy paper or cardboard to protect all instrument surfaces. Use nonabrasive material around all projecting parts.
- Use at least four inches of tightly packed, industrial-approved shock-absorbent material around the instrument.

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Should you elect to have your instrument serviced and/or calibrated by someone other than **OHD**, please be advised that the original warranty covering your product becomes void when the tamper-resistant Quality Seal is removed or broken without proper factory authorization. We strongly recommend, therefore, that you send your instrument to **OHD** for factory service and calibration, especially during the original warranty period. In all cases, breaking the tamper-resistant Quality Seal should be avoided at all cost, as this seal is the key to your original instrument warranty. In the event that the seal must be broken to gain internal access to the instrument (e.g., in the case of a customer-installed firmware upgrade), you must first contact **OHD** technical support department at 205-980-0180. You will be required to provide us with the serial number for your instrument as well as a valid reason for breaking the Quality Seal. You should break this seal only after you have received factory authorization. Do not break the Quality Seal before you have contacted us! Following these steps will help ensure that you will retain the original warranty on your instrument without interruption.

WARNING

Unauthorized user modifications or application beyond the published specifications may result in electrical shock hazards or improper operation. **OHD** will not be responsible for any injuries sustained due to unauthorized equipment modifications.

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Chapter 1

General Information

*In this chapter you will learn how to use this manual, where to get help, and about the **FitTester 3000** features and specifications.*

SAFETY CONSIDERATIONS

GENERAL

The instrument and related documentation must be reviewed for familiarization with safety markings and instructions before you operate the instrument.

WARNING

The WARNING! Sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a WARNING! Sign until the indicated conditions are fully understood and met.

CAUTION

The CAUTION Sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the instrument. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

MANUAL ADDENDA

Information concerning improvements or changes to the instrument that occur after the printing of this manual will be on an addendum sheet included with the manual. Be sure to review these changes before attempting to operate or service the instrument.

SAFETY INFORMATION

WARNING: There are internal fuses that are to be replaced by trained service personnel only.

The *FitTester 3000* AND ITS FEATURES

Introduction

The FitTester 3000 measures...

Face-to-facepiece fit of a respirator. With a perfect respirator and fit, all inhaled air is forced through the filter system, thereby providing maximum respiratory protection for the individual. If the face-to-facepiece seal leaks, unfiltered air bypasses the filter system and enters the individual's lungs during inhalation, thus reducing respiratory protection.

By design, a respirator should prevent contaminated air from entering the lungs of the individual wearing it. If the respirator is in good working order, the only way contaminated air can enter the individual's lungs is through a leak in the face-to-facepiece seal. The *FitTester 3000* measures face-to-facepiece seal leakage and then calculates the fit factor (FF) of the respirator being tested.

The FitTester 3000 uses...

The patented *Controlled Negative Pressure (CNP)* technology. An adapter configured with a squeeze-bulb-actuated valve replaces the filter cartridge and inhalation valve on the respirator.* The individual under test dons the respirator (in accordance with Association National Standards Institute [ANSI] guidelines or manufacturer's instructions), takes a breath, holds the breath, squeezes the bulb to close the adapter valve, and begins the test.

** The inhalation valve must be removed or propped open for the fit test.*

The FitTester 3000 functions by...

Creating and maintaining a negative pressure in the respirator mask. This process may last up to 8 seconds. Once the adapter valve is closed by squeezing and holding the attached bulb, sealing the respirator mask, the start key is pressed, allowing the **FitTester 3000** to remove air from the respirator mask until the challenge pressure is reached.

At this point, if there isn't a leak, the **FitTester 3000** doesn't remove any more air from the respirator mask. If there is a leak, air enters the respirator mask, and the pressure rises. The **FitTester 3000** then removes air from the respirator mask until the challenge pressure returns. This process continues for up to 8 seconds, and then the test ends. The individual under test releases his grip on the bulb and breathes normally.

During the fit test, the **FitTester 3000** measures exactly how much air it removed from the respirator mask after reaching the challenge pressure. This measurement is used by the **FitTester 3000** to calculate the leak rate.

The **FitTester 3000** has two types of protocols: Standard protocols with fixed challenge pressures and modeled breathing rates; and Custom protocols with challenge pressures and modeled breathing rates determined by user defined parameters, including work rate, mask cartridge type, mask size, and subject gender.

Challenge pressure, expressed in hundredths of inches of H₂O, is the maximum partial vacuum created in a correctly fitting mask when the user is working at a typical rate. The modeled breathing rate is the calculated total inspiration for 1 minute.

The modeled breathing rate (in liters per minute [LPM]) is multiplied by 1000 to provide cubic centimeter and then divided by the leak rate (in cubic centimeters per minute [cc/min]) is the fit factor ratio. This is a ratio of the total air inhaled to the contaminated air inhaled.

The FitTester 3000 follows...

A set procedure, or a protocol. Each protocol consists of 1 to 18 steps (a step is either a fit test or an exercise).

NOTE 1:

Refer to PROTOCOLS, TEST AND PROTOCOL RESULTS, and PARAMETERS (see Index).

NOTE 2:

Some regulatory agencies require a defined procedure or protocol.

FitTester 3000 FEATURES

If you don't have a quantitative fit-testing program, the *FitTester 3000* helps you start one. Or, if you do have a quantitative fit-testing program, the *FitTester 3000* integrates easily into your present program.

These features make the FitTester 3000 simple to use:

- Doesn't require a computer.
- Eliminates the cumbersome booth, generator, and photometry equipment required for aerosol testing.
- Doesn't require an invasive probe.
- Doesn't use messy challenge agents or alcohol.
- Reduces test time compared to other quantitative fit-test systems. This will be especially true with the introduction of the *5-step protocol*.
- **Directly** measures leakage flow - the primary measure of respirator fit.
- Tests workers in the actual respirator masks they wear in the workplace.
- Displays individual test measurement results including Fit Factor, Leak Rate, Test Time, Test-Q (Test Quality), Challenge Pressure, Modeled Breathing Rate, and Minimum Passing Fit Factor.
- Displays and prints overall fit-test protocol results including Average Percent Leak, Equivalent Fit Factor, Test Date, Test Time, Test Parameter Values, and a step-by-step summary of the protocol.
- Meets OSHA fit-testing protocol requirements.
- Offers two custom protocols that can be created and stored in nonvolatile memory.
- Displays menu-selectable commands.
- Provides a comprehensive "Help" program that is available at the touch of a button.
- Outputs test results to the display (LCD display), an external printer, or a database.
- Minimizes cross-contamination (air extracted from the mask exits through the "EXHAUST" port, located on the back of the instrument).

ACCESSORIES

STANDARD ACCESSORIES	
<i>Description</i>	<i>Part</i>
Squeeze-Bulb Assembly	9503-0024
Dual Tube Assembly #2	9503-0069
Power Cord	3010-0055
9- to 25-pin "AT" RS-232 Null Modem Cable	3010-0441
Operating Manual	9508-0208
Vinyl Accessory Pouch	9530-0030

Chapter
2

Installation

In this chapter you will find information about keyboard controls and connections for the FitTester 3000.

FRONT PANEL CONTROLS



Front View of *FitTester 3000*

Keyboard

KEY	DESCRIPTION
<Esc>	Escape: Exits a menu routine and returns to the previous screen,
<F1>, <F2>, <F3>, <F4>, and <F5>	Function keys: Executes function displayed above key when pressed.
<Ent>	Enter: Starts a menu routine or function.
<↑>, <↓>, <←>, and <→>	Arrow keys: Moves highlight bar through selections.

Five quick-disconnect adapters

FLOW	Female quick-disconnect adapter on the front panel that connects to the dual tube assembly. See <i>Preparing the FitTester 3000 for Testing (4. Dual Tube Assembly Connection)</i> .
PRESSURE	Male quick-disconnect adapter on the front panel that connects to the dual tube assembly. See <i>Preparing the FitTester 3000 for Testing (4. Dual Tube Assembly Connection)</i> .
EXHAUST	Male quick-disconnect adapter on the rear panel. DO NOT CONNECT ANYTHING TO THIS PORT!
DUAL TUBE CHECK	Two male quick-disconnect adapters on the front panel. See the <i>SYSTEM MENU, Dual Tube Calibration</i> .

Two knobs

VOLUME	Rotate this knob to increase and decrease the volume.
VIEW	Rotate this knob to change the contrast of the viewing screen.

FitTester 3000 CONNECTIONS



Rear view of *FitTester 3000*

CONNECTING THE PRINTER

You can connect any Centronics or IBM PC compatible parallel printer* to the *FitTester 3000*. OHD recommends that you use a standard IBM PC compatible parallel printer cable.

- Connect this cable to the PRINTER port, a 25-pin (DB25) female connector, on the rear panel of the *FitTester 3000*.

* Compatible with Epson (standard) or PCL5 language

CONNECTING TO COMPUTER (RS-232 Serial Port Setup)

The *FitTester 3000* has a remote control mode. The FitTrack software operates the *FitTester 3000* via the RS-232 serial port. (OHD recommends that you use the appropriate cable.)

- Connect the RS-232 cable (Part # 3010-0441) with the *FitTester 3000* and the computer.

NOTE:

If the computer's COMM port is other than a 9-pin connector, an adapter will be required to convert the 9-pin computer cable connection. **This adapter must NOT be a Null Adapter!** If an alternate cable (DB25 to DB25) is desired, please contact Customer Service.

Operating Instructions

*In this chapter you will find information about menu options and preparing the **FitTester 3000** for testing.*

Preparing the FitTester 3000 for testing

1. LOCATION

- Use a room that permits spoken communication between the operator of the **FitTester 3000** and the test subject.
- Place the **FitTester 3000** on a table large enough to also accommodate a printer and accessories, while allowing room for two seated persons.

2. PRINTER CONNECTION

- Turn the power off to both the printer and the **FitTester 3000**.
- Connect the printer to the **FitTester 3000** with a standard parallel printer cable. Plug this cable into the PRINTER port on the rear panel of the **FitTester 3000**.

NOTE:

Refer to Connecting the Printer for printer compatibility and connector specifications.

- Turn on the power to the **FitTester 3000**.
- Verify that the Printer is “available.” (Follow the Printer Verification Routine in the UTILITY MENU section of this chapter.)

3. TEST ADAPTERS

- Replace the respirator's filter cartridge (or cartridges) with the appropriate test adapter (or adapters).

NOTE:

See MECHANICAL INTERFACES on page 13 for details about the test adapters.

4. DUAL TUBE ASSEMBLY CONNECTION

- First, attach the dual tube assembly (Part # 9503-0069) to the front of the **FitTester 3000**. Use the end of the dual tube assembly that has one male quick-disconnect adapter and one female quick-disconnect adapter.
- Connect the male quick-disconnect adapter of the dual tube assembly to the female quick-disconnect adapter labeled FLOW.
- Connect the female quick-disconnect adapter of the dual tube assembly to the male quick-disconnect adapter labeled PRESSURE.
- Next, calibrate the dual tube assembly. Connect the two female quick-disconnect adapters on the dual tube assembly to either of the male quick-disconnect adapters on the **FitTester 3000** front panel labeled DUAL TUBE CHECK. Follow the *Dual Tube Calibration* procedure in the *SYSTEM MENU* section.

NOTE:

OHD recommends that you perform a dual tube calibration before:

- 1) beginning a fit-test session, at the start of the day.
- 2) after using a different dual tube assembly.

- Finally, connect the two female quick-disconnect adapters (again, orientation does not matter) to the two male quick-disconnect adapters on the test adapter that is on the respirator. One tube monitors the pressure inside the respirator mask, and the other tube removes air from the respirator mask at a controlled rate.

MECHANICAL INTERFACES

The test adapters provide mechanical connections between respirator masks and the squeeze-bulb assembly and/or the dual tube assembly. Three types of test adapters are used:

- ◆ **Type “A” provides a mechanical connection to the squeeze-bulb assembly.**
- ◆ **Type “B” provides a mechanical connection to the dual tube assembly.**
- ◆ **Type “AB” provides a mechanical connection to the squeeze-bulb assembly and the dual tube assembly.**

NOTE:

For respirator masks with a single filter cartridge, use the type “AB” test adapter.

For masks with two filter cartridges, use one each of the type “A” test adapter and the type “B” test adapter.

A test subject holds his breath and closes the valve by squeezing the bulb. When the test finishes (in 8 seconds or less), the test subject releases the squeeze bulb, placing the valve in its normally open position, which creates a breathing path.

Test-Adapter-Valve Operation

1. Connect the squeeze bulb assembly to the port on the test adapter.
2. Close the valve by squeezing the bulb. Do not apply excessive force. A firm squeeze is sufficient.

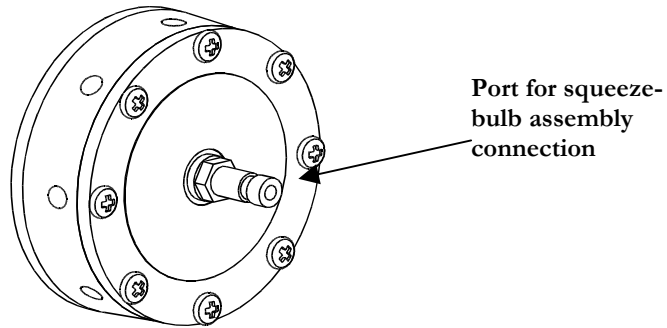
NOTE:

Ensure that a constant force is maintained on the squeeze bulb assembly when the valve is closed. Have the test subject operate the squeeze bulb assembly during the fit test.

3. Open the valve by releasing grip on the bulb; this enables the air to flow.

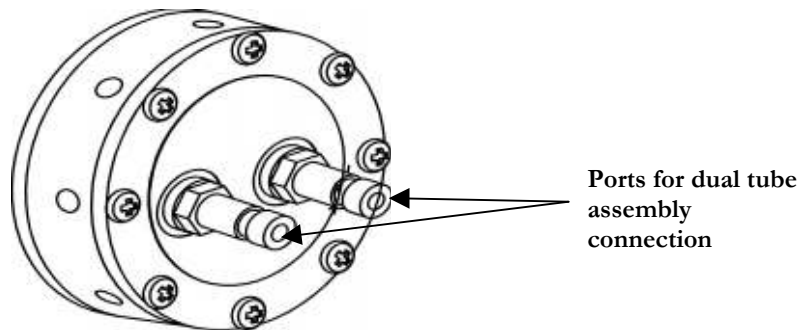
**Type “A”
Test Adapter**

The type “A” test adapter has one port that provides pneumatic control of the test adapter valve. This valve is closed by squeezing and holding the bulb during a fit test to prevent air flow. When the valve is opened, a breathing path is created for the test subject.



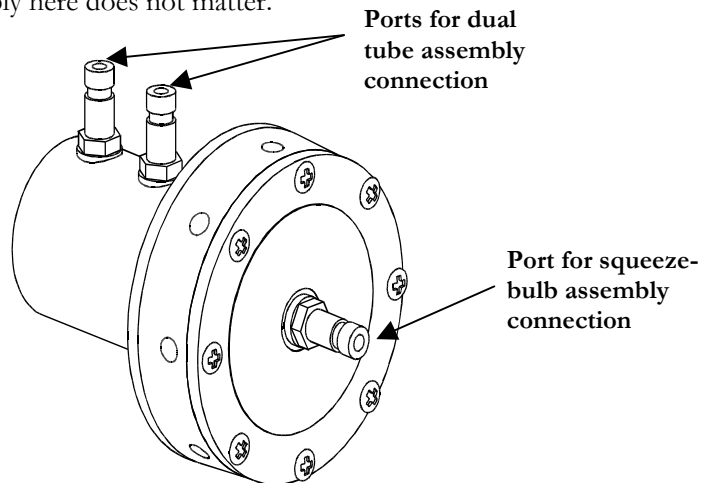
**Type “B”
Test Adapter**

The type “B” test adapter has two ports. One port monitors the pressure inside the respirator mask, and the other port removes air from the respirator mask at a controlled rate. These ports connect to the dual tube assembly. Orientation of connectors here does not matter.



**Type “AB”
Test Adapter**

The type “AB” test adapter has three ports. The ports connect to the squeeze-bulb assembly and to the dual tube assembly. Orientation of the dual tube assembly here does not matter.



QUANTITATIVE FIT-TEST OVERVIEW

Procedure

The *FitTester 3000* does not require an invasive probe in the respirator mask. In most cases, the test subject can be tested using the actual respirator mask that is worn in the workplace.

The respirator mask inlets are capped with one or two of the test adapters described in the previous section, and inhalation valves are removed or propped open. The test subject dons the respirator mask to perform the fit test. When the mask is properly positioned, the test subject takes a breath, holds the breath, and squeezes the bulb to close the adapter valve. The operator presses the start key to begin the fit test and that starts the piston moving within the cylinder inside the *FitTester 3000*. The piston movement within the cylinder removes air from the facepiece until a predetermined challenge pressure is reached (see *Challenge Pressure in Test Menu Chapter*). The fit test is completed in 8 seconds or less.

The *FitTester 3000* controls the piston movement to maintain the challenge pressure inside the facepiece. The piston speed required to maintain a constant pressure is directly related to the airflow. Since leakage is directly related to the fit of the respirator mask, the lower the leakage, the better the fit. The leak rate is reported in cubic centimeters per minute.

Protocol

A *protocol* is a series of quantitative fit tests in various positions or a combination of fit tests and exercises. One quantitative fit test consists of the 8-second-or-less procedure explained above.

The protocol is a procedure followed by a company or institution as part of its respiratory protection program.

The user may tailor the protocol to meet his company's needs or may alternatively use the factory preset protocols and test values. These protocols and values are combined to provide a comprehensive test that determines accurately and completely the fit of a given respirator mask. Consistent fit-test results are achieved by using a protocol. (Note: Some regulatory agencies may require a specific protocol.)

Fit Factor

The ratio of the modeled breathing rate to the measured leak rate is the calculated fit factor and is expressed by the following equation.

$$\text{fit factor (FF)} = \frac{\text{modeled breathing rate (MBR)}_{(cc/min)}}{\text{measured leak rate (MLR)}_{(cc/min)}}$$

The modeled breathing rate (MBR)* is the rate at which an individual breathes, predetermined for the standard protocols. The MBR is calculated from the parameters specified by the operator for custom protocols: The operator-specified parameters are inspiratory work rate, respirator mask type, cartridge type, and test subject’s gender.

The measured leak rate (MLR) is directly related to facepiece fit. It is from the leak rate measurement that all fit factor calculations are made. The leak rate is specified in cubic centimeters per minute (cc/min).

Simply stated, the fit factor is the inverse of the percentage of air inhaled as a result of the leak.

* A feature unique to the FitTester 3000 is its ability to change the modeled breathing rate in order to challenge the mask at different negative pressures. This allows the user to replicate different or extreme circumstances in the real work environment. By varying the negative pressure, the user can “challenge” or test the mask under varying stress load conditions, and discover how fit will be affected under those loads. The setting of these parameter options is discussed in the PARAMETERS section of Protocol Chapter.

NOTE:

The conservative fit factor of the *FitTester 3000* is equivalent by definition to fit factors obtained by traditional quantitative fit-test methods (that is, aerosol methods). The direct leakage measurement of the *FitTester 3000* is superior to the aerosol approximation methods, because the leakage measurement isn’t dependent on aerosol in mask particle accuracy problems, including collection and counting. The *FitTester 3000* leak measurement system uses air, not aerosols; therefore, it eliminates mixing and all other related problems associated with quantitative aerosol measurement methods.

GETTING STARTED

Preparing the Respirator for Fit-Testing

1. **SELECT** the size, brand, and style of respirator that best fits the test subject and is most suitable for the application.
2. **REMOVE OR PROP OPEN** respirator inhalation valve(s) carefully. Upon completion of the fit test, reinstall the respirator inhalation valve(s).
3. **REPLACE** filter cartridge(s) or regulator with test adapter(s).
4. **CONNECT** squeeze-bulb assembly (Part # 9503-0024) to type “A” or “AB” test adapter.
5. **CONNECT** dual tube assembly (Part # 9503-0069) to type “B” or “AB” test adapter.

NOTE:

Refer to the test-adapter illustrations on page 14.

Instructing the Test Subject

Use the instructions below to teach the test subject the procedure for holding one’s breath and the guidelines to follow during the fit test.

Have the test subject practice the following steps a few times until comfortable with the procedure.

- Take a breath and hold it, keeping mouth closed.
- Now look at a watch or any clock with a second hand. Continue holding breath for 8 seconds.
- After holding breath for 8 seconds, relax and breathe normally.

Have the test subject follow these guidelines during a fit test.

- Keep mouth closed (do not swallow or move mouth or tongue).
- Do not exhale any air through the nose.
- Do not make any head or facial movements. Sit or stand as still as possible in the position as instructed. Maintain this position for 8 seconds; then resume normal breathing.

Power-On and Menu Navigation

The power-on/off switch is located adjacent to the power cord plug on the rear panel of the *FitTester 3000*.

IMPORTANT POINTS

Use the **→** or **←** key to change *Main MENU*

Use the **↑** or **↓** key to change *Test MENU*



Use the **Esc** key to return to the previous menu. Press repeatedly and you will return to Main Menu



Press the **Ent** key to accept the selection highlighted on the menu once you have arrowed to item you want.

When you turn on the instrument, the current firmware version is displayed, followed by the **Main Menu** and the **Test Menu**, as shown below:

Main Menu →

Test Menu →

TEST	EDIT PROTOCOL	SYSTEM	UTILITY
Pre-Test	SCBA Protocol		
OSHA Protocol	Custom 1 Protocol		
REDON Protocol	Custom 2 Protocol		
MIL Protocol			

Run a single test exercise

NOTE:

The Pre-Test menu routine on the TEST MENU is active first.

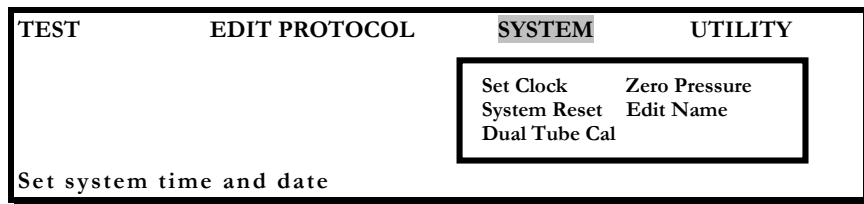
- ☐ Press the **→** key and the display shows the MAIN MENU and the EDIT PROTOCOL MENU:


TEST	EDIT PROTOCOL	SYSTEM	UTILITY
	OSHA Protocol	Custom 1 Protocol	
	Redon Protocol	Custom 2 Protocol	
	MIL Protocol	Parameters	
	SCBA Protocol		

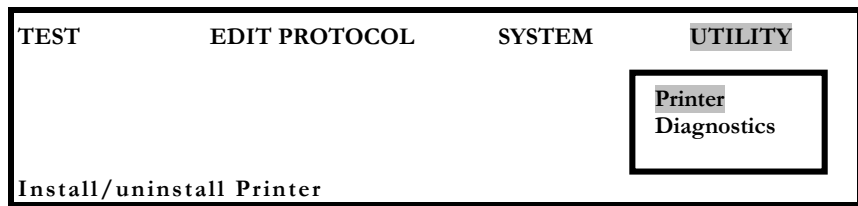
Edit, Print, or View Protocol 1

- ✓ Refer to the Protocols section for more information on viewing, editing, or printing a Protocol.
- ✓ Refer to the Parameters section for more information on viewing, editing, or printing a Parameter.
- ✓ Refer to the Pre-Test section for more information on "how to" run a pre-test.

- Press the → key again and the following appears:



- Press the ↑ or ↓ key to select “Set Clock,” “System Reset,” “Dual Tube Cal,” “Zero Pressure,” or “Edit Name.”
- Then press  key to continue. (For more information refer to the System Menu section.)
 - **SET CLOCK** sets the system’s time and date.
 - **SYSTEM RESET** reloads all system variables to factory presets, removing all user-changed settings.
 - **DUAL TUBE CAL** calibrates the dual tube assembly.
 - **ZERO PRESSURE** removes the offset from the pressure transducer.
 - **EDIT NAME** edits stored operator’s name.
- Press the → key a final time and this display appears:



- **PRINTER** turns the printer port on or off.
- **DIAGNOSTICS** runs the *FitTester 3000* diagnostic routines, which are:
 - Speaker Test
 - Display Test
 - View Cycle Count
 - Keyboard Test
 - Printer Test
 - Factory Protocol

✓ Refer to the UTILITY menu for more information on Printer and Diagnostics.

Start-up Procedure

The following start-up procedure will validate the correct operation and calibration of the *FitTester 3000* and ensure that measurements are within tolerance.

Daily Procedure

Each day the *FitTester 3000* is to be used, the operator should use the following procedure:

- 1) Power on the *FitTester 3000* using the toggle switch.
- 2) From the UTILITY MENU, verify that the printer is in the AVAILABLE mode
- 3) From the SYSTEM MENU, run the ZERO PRESSURE function.
- 4) From the SYSTEM MENU, run the DUAL TUBE CAL procedure.
- 5) SAVE the successful calibration.
- 6) Print the calibration report (optional).
- 7) Proceed to TEST MENU and begin testing.

When Replacing Dual Tube



Follow steps 3 through 7 in DAILY PROCEDURE (above).

Help Program

The HELP program provides detailed information about each of the menu routines.

The screenshot shows the HELP program interface. At the top, it displays "SYSTEM HELP (Esc = Exit) 1/221". A callout box points to the "1/221" text, stating: "The page number you are on/# of pages this help document has in it." Below this is a text box containing "SYSTEM HELP" and "You are now running a program called HELP. This HELP program is designed to answer any questions that you may have." At the bottom of the screen, there are four options: "HOME", "START", "Prev", and "Next", followed by a down arrow. A callout box points to the down arrow, stating: "The down arrow tells you there is more information."

□ Press  to Activate “HELP”

- This can be done when any one of the menu routines is active. Instructions pertaining to the currently running menu routine then appear on the display. Scroll through the HELP program (line by line) using the  or the  key.

NOTE:

The HELP program always goes to the top of the section for the active menu routine.

Function Key Operation

While in the HELP program, the function keys operate as indicated below.

Esc	Escape	Returns to the active menu routine.
F1	HOME	Returns to the beginning of the HELP section for the active menu routine.
F2	START	Moves to the beginning of the HELP program.
F3	Prev	Moves back to the Previous section.
F4	Next	Moves forward to the Next section.
F5	<i>Inactive</i>	<i>Inactive</i>
Ent	<i>Inactive</i>	<i>Inactive</i>
↑	Up arrow	Moves up one line
↓	Down arrow	Moves down one line.
←	<i>Inactive</i>	<i>Inactive</i>
→	<i>Inactive</i>	<i>Inactive</i>

TEST MENU

In this chapter you will find information about the Testing Menu and Protocols.

PRE-TEST

Introduction

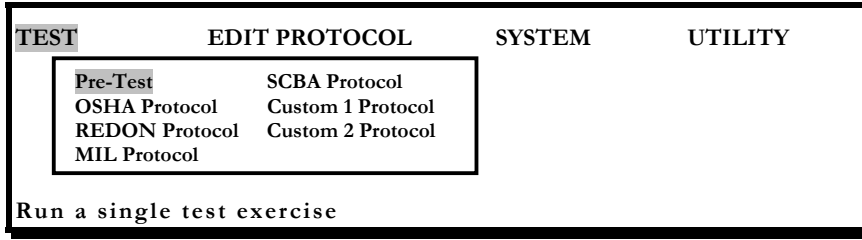
The pre-test can be used to familiarize the test subject with the fit test, to conduct donning exercises, and to let the test subject quickly see how donning affects fit factor. The pretest can also be used to “qualify” a mask before beginning a protocol. The **FitTester 3000** can quickly check fit factors on different sizes and models of masks to determine the best-fitting respirator.

This introductory section contains the following:

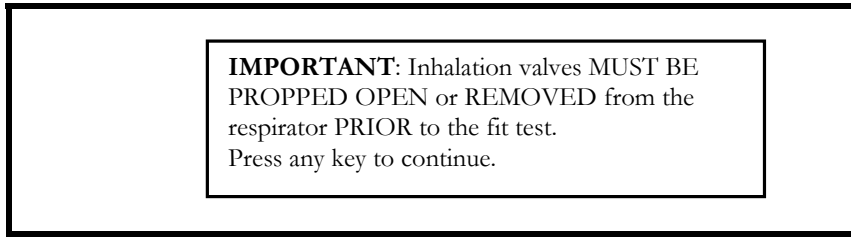
- Information shown on the display when running a pre-test. (*See instructions on running the pre-test.*)
- Challenge pressure and respirator mask pressure definitions.
- Explanations of the pre-test parameters: inspiratory work rate, respirator mask type, cartridge type, and test subject’s gender. (*NOTE: The minimum passing fit factor is a parameter for protocols only; therefore, see the Parameters section for instructions on how to change the minimum passing fit factor.*)
- When the minimum passing fit factor is changed for protocols, it affects the pretest results. (See the *Pre-test Results* section.)

Follow the steps on page 24 to view the first three displays. The third display contains the challenge-pressure value and the respirator-mask-pressure value.

- ❑ From the **MAIN MENU**, select the **TEST MENU**. Press the **↑** or the **↓** key to highlight “Pre-Test” on the **TEST MENU**. The following display appears:

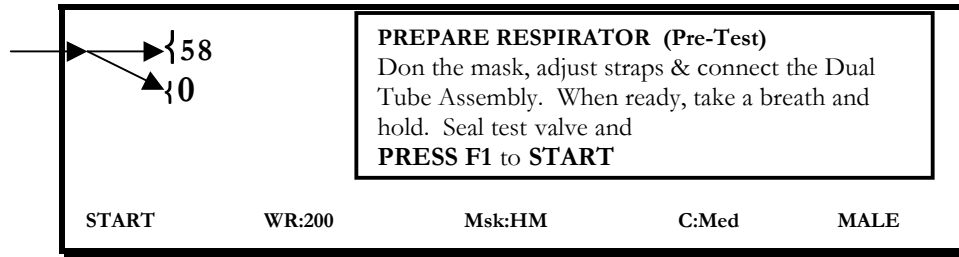


Next, press the key, and the display shows:



• Press any key to continue, and the display looks like this:

Challenge pressure and respirator mask pressure



The two numbers in the upper left corner of the above-illustrated display indicate the challenge pressure and respirator mask pressure.

The **challenge pressure (58, above)** is located immediately above the **respirator mask pressure (0, above)**. See next page for details about these pressures and the parameters.

NOTE:

Ensure that the respirator mask pressure is 0 before running the pre-test. If the respirator mask pressure is not 0, follow the *Zero Pressure* instructions.

Challenge Pressure

- For PRE-TEST, and CUSTOM 1 AND CUSTOM 2 PROTOCOLS the *FitTester 3000* calculates the negative pressure that would be produced in the respirator mask during inhalation, according to operator selected parameters.
- For the OSHA, REDON, MIL, and SCBA protocols, the challenge pressure is fixed and is not a factor of operator selected parameters.
- The challenge pressure is equal to the pressure produced in the respirator mask during inhalation, and it appears (in hundredths of an inch of water) in the upper left portion of the display during the pre-test.

NOTE:

The challenge pressure is the pressure at which the leak rate measurement is made.

Respirator Mask Pressure

The *FitTester 3000* monitors the respirator mask pressure via the PRESSURE port (located on the front panel).

The respirator mask pressure appears (in hundredths of an inch of water) below the challenge pressure in the upper left portion of the display.

Pre-Test Parameters

The operator specifies values for four parameters: inspiratory work rate, respirator mask type, cartridge type, and test subject's gender.

These parameter values are used directly in two *FitTester 3000* calculations: modeled breathing rate (which is then used to calculate the fit factor) and challenge pressure.

Before you begin the pre-test, use the function keys listed below to set the parameter values. (*An explanation of each parameter follows this list.*)

NOTE:

Setting the parameter values during the pre-test does not affect the parameter values for the protocol.



WR:

Select the inspiratory work rate.



Msk:

Select the respirator mask type.



C:

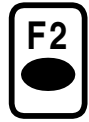
Select the cartridge type.



MALE/FEMALE

Select the test subject's gender.

Explanation of keys:



WR: The inspiratory work rate has the largest influence on internal respirator mask pressure. It is measured in units of kcal/hr (energy consumed).

When a person expends more energy (works harder), he breathes harder, causing greater airflow through the cartridge. This increased airflow results in a higher-pressure drop.

Make an estimate of the work rate that the test subject experiences under normal working conditions. Next, press <F2> to set the work rate accordingly.

- 100 kcal/hr Light - standing still or sitting at ease.
- 200 kcal/hr Moderate - walking (casual) without a load.
- 300 kcal/hr Heavy - walking with or moving a light load.
- 350 kcal/hr Extreme - walking with or moving a heavy load, climbing stairs, digging, etc.



Msk: The *FitTester 3000* tests two types of respirator masks.

- ◆ FF Full Face or Full Mask
- ◆ HM Half Mask

Because the full-face respirator mask has a CO₂ accumulation in the dead space, the test subject must take harder, deeper breaths to compensate for the lower oxygen content. Deeper breaths mean a higher instantaneous airflow rate through the filter cartridge.

Challenge pressure, the pressure differential across the filter cartridge, is directly proportional to the airflow rate through the cartridge.



C: The cartridges are classified into four categories:

- Low** Dust/mist filter
- Medium** Chemical or HEPA
- High** Combination of chemical and HEPA
- NA** Respirator masks that do not use cartridges; for example, SCBA and PAPR

The pressure drop across the cartridge is a function of cartridge resistance and airflow rate; therefore, the higher-density (more resistive) cartridge causes a greater pressure drop across the face-to-facepiece seal.



MALE/FEMALE Men and women both breathe the same volume of air (for a given work rate). They do, however, have different inhalation rates. A male inhales faster, which causes a higher instantaneous flow rate to occur and results in a higher challenge pressure.

Running the Pre-Test

NOTE:

The *FitTester 3000* checks for correct zero-pressure offset status. If there is a bad zero-pressure offset, the error message “Zero offset is too large. Testing is inhibited” appears. The offset problem must first be corrected before testing can resume. See Zero Pressure for more information.

- Set parameter values as explained in the previous section PRE-TEST, Pre-Test Parameters.
- Set the minimum passing fit factor value. Refer to the PARAMETERS section.

NOTE:


Minimum passing fit factor is a parameter for protocols only. When this value is changed for protocols, it affects the pre-test results. Refer to the Pre-Test Results section.

- Review the *breath-holding* procedure with the test subject.
- Complete steps 1–4 in *PREPARING THE FitTester 3000 FOR TESTING*.
- Complete steps 1–5 in *GETTING STARTED, Preparing the Respirator for Fit-Testing*.
- Have the test subject don the mask and adjust the straps to achieve a good fit.
- Make sure the test subject is seated or standing comfortably with shoulders facing the *FitTester 3000*.
- When the test subject is ready, have him take a breath, then squeeze and hold the bulb assembly.

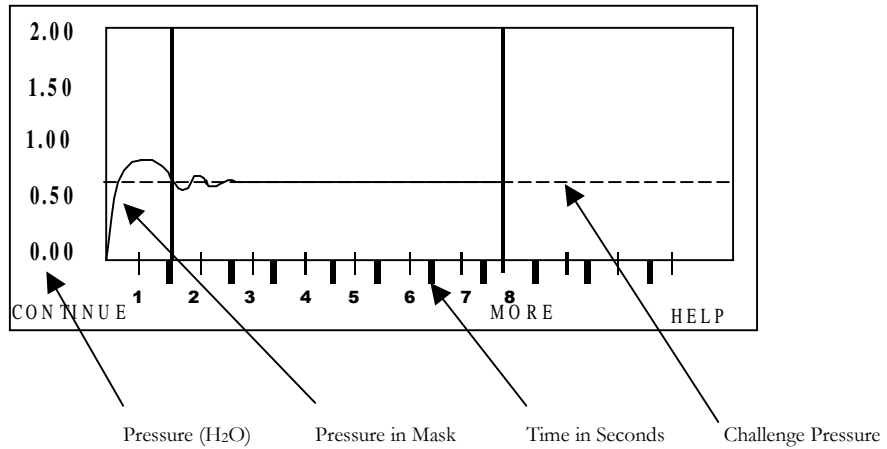
NOTE:

Remind the test subject:

1. to remain as still as possible during the test, and
2. to maintain a constant force on the squeeze bulb.

- Press the  (START) key to begin the pre-test.
- There are two beeps. On the second beep, instruct the subject to release the squeeze bulb and to breathe normally and relax.

During the pre-test, a pressure trace appears as shown below:



NOTE:

Actual numbers depend on the challenge pressure.

The *FitTester 3000* measures respirator mask leakage after the pressure in the mask stabilizes at the challenge pressure.

The two beeps signify the following:

- ◆ The first beep (visually indicated by the first vertical line) signifies that the challenge pressure has been reached.
- ◆ The second beep (visually indicated by the second vertical line) signifies the end of the test.

Pre-Test Results

The pre-test results are illustrated below and on facing page. The results are explained on pages 32 and 33.

If the leak rate of the respirator mask yields a measurable fit factor, the display will look similar to this:

TEST RESULTS			
Fit Factor	=	1408	PASS
Leak Rate	=	75.3	(cc/min)
Test Time	=	8.0	(seconds)
Test - Q	:	GOOD	


NOTE:

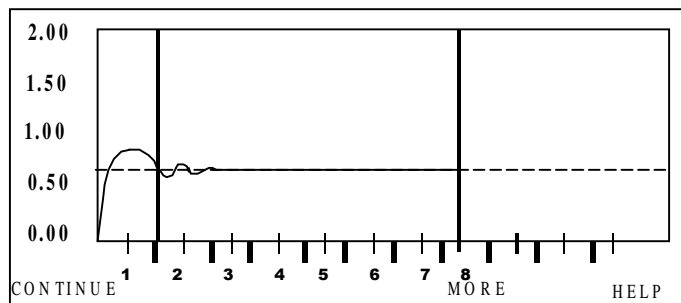
If the leak rate is so great that a fit factor cannot be measured, the display will read "NO FIT (fit factor < x)," where x is the lowest fit factor that can be measured for the particular set of parameters. Repeat the pre-test (see instructions below).


- Press  (MORE) for additional information as shown below:

TEST RESULTS (Continued)			
Challenge Pressure	=	0.58	(H2O)
Modeled Breathing Rate	=	53.8	(LPM)
Min passing Fit Factor	=	100*	

* To change the minimum passing fit factor, refer to PARAMETERS, Editing Parameters beginning on page 50.

- Press  (MORE) again, and the pressure trace is shown again:



- Repeatedly press  (MORE) to scroll through the above displays.

Repeat the Pre-Test

It is recommended that the user keep repeating the pre-test until successful test results are achieved, that is, a “GOOD Test-Q” and a passing fit factor.

- Press  (CONTINUE) to repeat the pre-test.

NOTE:

It is not necessary to output the pre-test results to the printer.

Fit Factor

The first test result is the calculated fit factor (FF), the ratio of the modeled breathing rate to the measured leak rate.

$$FF = \text{modeled breathing rate} \div \text{measured leak rate}$$

NOTE:

The fit factor of the *FitTester 3000* is equivalent, by definition, to fit factors obtained by traditional quantitative fit-test methods (that is, aerosol methods). However, the *FitTester 3000* leak measurement doesn't use aerosols; therefore, it doesn't have the mixing problems associated with quantitative aerosol measurement methods.

The direct leakage measurement of the *FitTester 3000* is superior to the aerosol approximation methods because the leakage measurement isn't dependent on aerosol particle-size distribution.

Notice the word “PASS” or “FAIL” next to the fit factor:

- ◆ “FAIL” indicates that the calculated fit factor is less than the *Minimum Passing Fit Factor* (explained on next page).
- ◆ “PASS” indicates that the calculated fit factor is equal to or greater than the *Minimum Passing Fit Factor* (explained on next page).

Leak Rate

The next test result is the leak rate. This is directly related to facepiece fit. It is from this leak rate measurement that all fit-factor calculations are made. Leak rate is specified in cc/min.

Test Time

This number represents the time from start to finish during which the subject holds his or her breath. The test time does not exceed 8 seconds. The total test time in seconds appears on the display beneath the “Leak Rate.”

Test-Q

The Test-Q, or test quality, is an indication of *acceptability* of the fit-test results. Accurate results depend on a constant pressure being sustained during the test measurement interval.

To achieve a “GOOD Test-Q,” the pressure in the mask averaged over the last 1.5 seconds of the test must be within 8% of the target challenge pressure. Large pressure spikes anytime during the test result in a “BAD Test-Q.”

Challenge Pressure

Shown in hundredths of an inch of water, the challenge pressure is the pressure at which the leak rate measurement is made. Challenge pressure is explained in the *PRE-TEST, Challenge Pressure* section.

Modeled Breathing Rate

The modeled breathing rate is the rate, in liters per minute, at which an individual breathes under the conditions specified in the protocol.

For Custom 1 and Custom 2 Protocols, the modeled breathing rate is set by the same parameters as the challenge pressure: work rate, respirator mask type, cartridge type, and test subject's gender. The modeled breathing rate is used to calculate the fit factor.

For the OSHA, REDON, MIL, AND SCBA Protocols, challenge pressure and modeled breathing rate are pre-set and hence are unaffected by changes in the parameters.

Minimum Passing Fit Factor

The minimum passing fit factor is the minimum fit factor required for a passing result. This parameter is operator-specified as explained in the *PARAMETERS, Editing Parameters* section and displayed here. The PASS/FAIL indication that appears next to the fit factor, is calculated based on this parameter number.

PROTOCOLS

Now that you have completed several successful pre-tests, you are ready to begin running a protocol. The protocol is a comprehensive test that accurately measures the fit of a given respirator. Consistent fit-test results are achieved by using a protocol.

The protocol is a sequence of up to 18 fit tests or exercises. The *FitTester 3000* stores four standard and two custom protocols in nonvolatile memory. After all steps in a protocol have been completed, the fit-test results are combined to calculate an “average equivalent fit factor” for the protocol. The protocol results can be printed.

Preprogrammed Protocols (4)

OSHA

The OSHA protocol is a 17-step protocol created by OSHA (Dept. of Labor, 29 CFR 1910 and 1926, Respiratory Protection; Final Rule, January 8, 1998) for the *FitTester 3000*. It consists of eight exercises and nine test measurements, which follow the exercises. Due to the unique properties of the *FitTester 3000*, OSHA only required test measurements after the exercise periods. Therefore, no fit factors are created or reported for exercises listed. As specified by OSHA, two required values are preprogrammed and are as follows:

Challenge Pressure (0.58 in. H₂O)
Modeled Breathing Rate (53.8 l/min.)

REDON

The REDON protocol comes from scientific peer-reviewed research into fit-testing of respirators. The protocol includes the significant factors that affect the fit of a respirator and provides a very conservative evaluation of the actual fit to the wearer. It is designed to be used in evaluating both Half-Face and Full-Face respirators. It uses the following values:

Challenge Pressure (0.58 in. H₂O)
Modeled Breathing Rate (53.8 l/min.)

MIL

The MIL protocol procedure is identical to the REDON above but has a higher stress level than the REDON. The MIL protocol is designed to be used in military applications, where mask stress is high and fit requirements are more critical. This extra measure of protection is expressed in the increased values of:

Challenge Pressure (1.00 in. H₂O)
Modeled Breathing Rate (55.8 l/min.)

SCBA

The SCBA protocol procedure, like the MIL, is identical to the REDON above. It is designed to place the mask under extraordinary stress to be sure the mask can provide protection in life threatening situations where the SCBA is used. This increased exposure protection is better evaluated by values of:

Challenge Pressure (1.50 in. H₂O)
Modeled Breathing Rate (93.1 l/min.)

User Definable Protocols

Custom 1 and 2

The CUSTOM 1 and 2 protocols are designed to be defined by the user. They consist of up to 18 programmable steps of exercises or test measurements. The parameter values for the tests are determined by the selection of four parameter variables (see PARAMETERS). These protocols provide the user with the option to customize a protocol to meet his specific needs.

Challenge Pressure (**VARIABLE** in. H₂O)
Modeled Breathing Rate (**VARIABLE** l/min.)

Running a Protocol

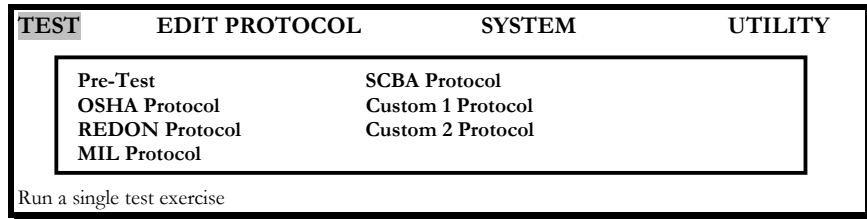
- For a simulated deep breathing exercise, it is recommended that the test subject face forward.
- The *FitTester 3000* shows a decrementing-seconds counter when an exercise is required.
- The *FitTester 3000* checks for correct zero-pressure offset status. If there is a bad zero-pressure offset, the error message “Zero offset is too large. Testing is inhibited” appears. The offset problem must first be corrected before testing can resume. (See *Zero Pressure* for more information.)

Follow these steps to run a protocol:

1. When running the OSHA, REDON, MIL, and SCBA protocols, only the gender and mask size parameters can be changed. However, changing these parameters will not affect challenge pressure and modeled breathing rate, as these are factory pre-set. The gender is printed on the protocol results report. Selecting full face or half mask does affect passing fit factor.

For Custom 1 and Custom 2 protocols, all four parameters (work rate, cartridge type, mask type, and gender) are available for modification, and they do affect challenge pressure and modeled breathing rate.

2. Review the breath-holding procedure with the test subject (see page 17).
3. Complete steps 1–4 in PREPARING THE FitTester 3000 FOR TESTING).
4. Complete steps 1–5 in GETTING STARTED, Preparing the Respirator for Fit-Testing.
5. View the protocol and ensure that it is correct. If the protocol is not correct, edit the protocol as described in the section Building and Editing a Protocol.
6. Make sure the test subject can perform the head positions required by the tests and the activities required by the exercises. Before each test or exercise, follow the on-screen prompts that instruct the test subject on which direction to face or which activity to perform.
7. From the Main Menu, select the Test Menu; then press the <↓> key to select the protocol to use.



- Press  and the following message appears:



IMPORTANT: Inhalation valves **MUST** be **PROPPED OPEN** or **REMOVED** from the respirator prior to the fit test.
Press any key to continue.

Once you are in either Custom 1 or Custom 2 protocol screens, you can get this screen.

- Press any key to continue. The display looks similar to this:

Press	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 30%;"># STEPS</td> <td style="width: 10%;">:</td> <td style="width: 30%;">17</td> <td style="width: 30%; text-align: right;">03:18:45 pm</td> </tr> <tr> <td>PASS FF</td> <td>:</td> <td>100</td> <td></td> </tr> <tr> <td>MASK TYPE</td> <td>:</td> <td>Full Face</td> <td></td> </tr> <tr> <td>SUBJECT</td> <td>:</td> <td>Male</td> <td></td> </tr> </table>			# STEPS	:	17	03:18:45 pm	PASS FF	:	100		MASK TYPE	:	Full Face		SUBJECT	:	Male	
# STEPS	:	17	03:18:45 pm																
PASS FF	:	100																	
MASK TYPE	:	Full Face																	
SUBJECT	:	Male																	
58																			
TEST	MALE	Msk: Hm	OTHER HELP																

Even though you have set parameter values (in step 1), this step provides the opportunity to make additional changes:

- Press  to identify the gender of the test subject—male or female.
- Press  to select the respirator mask type—HM (Half Mask), or FF (Full Face).

NOTE:

Press  to access the HELP program for the protocol.


Refer to GETTING STARTED, Help Program, for details about its operation.

- Press  to display this.

DEFAULT WR AND CARTRIDGE PARAMETERS

WORK RATE:	MODERATE	(20 Kcal/Hr)
CARTRIDGE TYPE:	Med	(Chem/HEPA)
SAVE	NO-SAVE	SELECT CHANGE

SELECT-- toggles the highlighted field between the two parameters.
CHANGE - cycles through the available values for each parameter. **SAVE**
 - places these parameter values in the volatile memory. **NO-SAVE** -
 exits without saving data.

- Press  (**TEST**) and the display shows:

Don the mask, adjust straps, and connect the Dual Tube Assembly.


Press any key when ready.

- Have the test subject don the mask. Press any key to continue. Instructions as to which exercise or test position to perform appears on the display.

NOTE:

For tests, it is recommended that the test subject or operator control the test adapter valve and, when ready, squeeze the bulb to close the valve.

58		
0	TEST : Face Forward Step # : 1 When ready, take a breath and hold. Seal the test valve and press <i>START</i> .	
	<i>START</i>	

- Press  (**START**) to start the test or exercise.

NOTE:

After completion of each fit test, you will be prompted to save, retry, or abort the fit test. See the next section, *TEST AND PROTOCOL RESULTS, Test Results*, for an explanation of these options.

TEST AND PROTOCOL RESULTS

There are two types of protocol results: test results and protocol results. The test results appear on the display only after each test-step is completed.

NOTE:

An exercise-step doesn't have a test result.

The protocol results appear on the display after all test-steps and exercise-steps are completed. The protocol results are a combination of each test-step's test results. From this combination of test results, the FitTester 3000 calculates the "average equivalent fit factor" for the test protocol.

Test Results

Each test result is explained under *PRE-TEST, Pre-Test Results*.

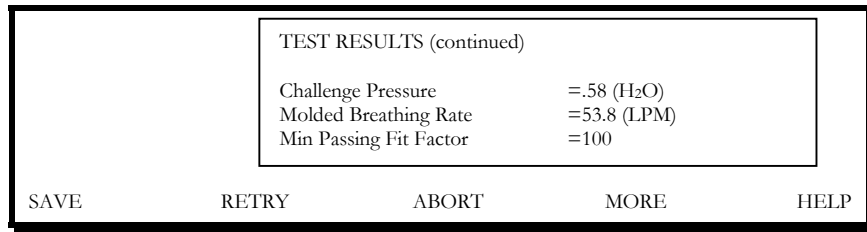
If the leak rate of the respirator mask yields a measurable fit factor, the display will look similar to this:

TEST RESULTS			
Fit Factor	=	168	PASS
Leak Rate	=	632.4	(cc/min)
Test Time	=	8.0	(seconds)
SAVE	RETRY	ABORT	MORE HELP

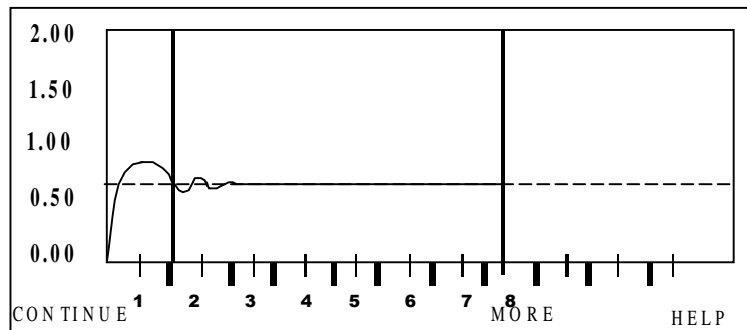
NOTE:

If the leak rate is so great that a fit factor cannot be measured, the display will read "NO FIT (fit factor < x)," where x is the lowest fit factor that can be measured for the particular set of parameters. You have several options that are explained on the next page.

- Press **F4** (**MORE**) and the display changes to this:



- Press **F4** (**MORE**) again and the pressure trace from the fit test is shown again:




- Repeatedly press **F4** (**MORE**) to scroll through the above displays.

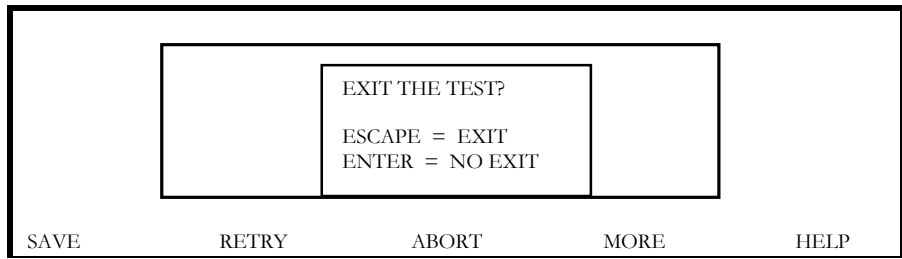
NOTE:



TEST RESULTS are explained in a previous section PRE-TEST, *Pre-Test Results*.

You now have the following options:

- Press **F1** (**SAVE**) to save this test-step's test results. The *FitTester 3000* automatically advances to the next protocol step.
- To retry this test-step, press **F2** (**RETRY**).

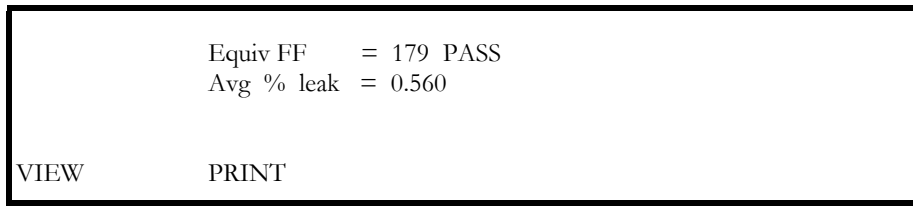
- When you press  (**ABORT**), the display shows the following:





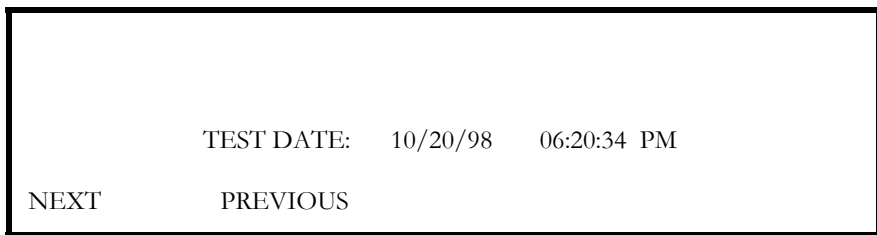
- Press  to return to the beginning of the protocol sequence.
- Press  to return to the start of this test-step.



Protocol Results

When you have completed all the test-steps and exercise-steps in a protocol, the protocol results show on the display:




- Press  (**PRINT**) and the results are sent to the attached printer,
- Press  (**VIEW**) and the display changes to the following:






- Press  (**NEXT**) and the display looks similar to this or press  [PREV] to return to the previous display.

TEST PARAMETERS	
Work Rate	: 200 Kcal/Hr (moderate)
Cartridge Type	: Chemical/HEPA (medium)
Mask Type	: Half Face
Challenge Pres	: 0.58 (in. H ₂ O)
Breathing Rate	: 53.80 (liters/min)
Subject Gender	: Male
NEXT PREVIOUS	

- Press  (**NEXT**) to view a step-by-step summary of the protocol and a summary of each step's test results.

STEP	TYPE	DESCRIPTION		
1	TEST	FACE FORWARD		
Leak Rate		Duration	FF	Q
597.60	(cc/m)	8.0 secs	177	Pass
NEXT PREVIOUS				

- Repeatedly press  (**NEXT**) to show each next step in the protocol.
- Repeatedly press  (**PREVIOUS**) to show each previous step in the protocol.
- Press  several times to return to the MAIN MENU.

EDIT PROTOCOL MENU

Introduction

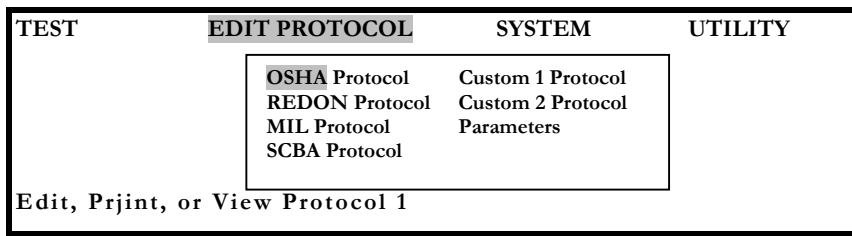
This section contains instructions on how to use the EDIT PROTOCOL MENU to make adjustments to the protocol and parameters. Explanations are included on how to:


- View, Build, Edit, and Print a Protocol.
- View, Edit, and Print Parameters.

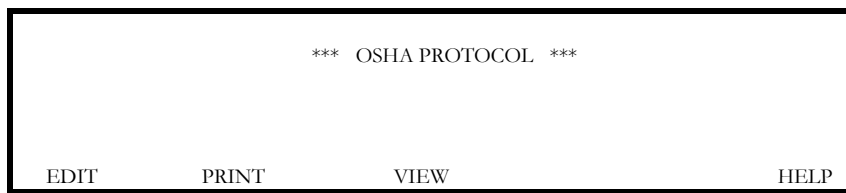
Viewing a Protocol


To ensure that the protocol is correct, view each step in the protocol as follows:

- From the **MAIN MENU**, select the **EDIT PROTOCOL MENU**; then press the **↓** key to select the protocol to view.



- Press  and the display changes to this:





- Press  (VIEW) and the first four steps in Protocol #1 appear.

*** VIEW OSHA PROTOCOL ***			
<u>Step</u>	<u>Type</u>	<u>Description</u>	<u>Duration</u>
1	Exer	Normal Breathing	60
2	Test	Face Forward	N/A
3	Exer	Deep Breathing	60
4	Test	Face Forward	N/A
ESC=Exit			↑ ↓ Scroll

NOTE:

Use the ↑ and the ↓ keys to scroll through the steps.

Press  once to return to the previous screen.


Press  twice to return to the Edit Protocol Menu, Building and Editing a Protocol.

Building and Editing a Protocol

Design your own protocol or change an existing protocol using the instructions below.

- From the MAIN MENU, select the EDIT PROTOCOL MENU; then press the ↓ key to select the desired protocol.

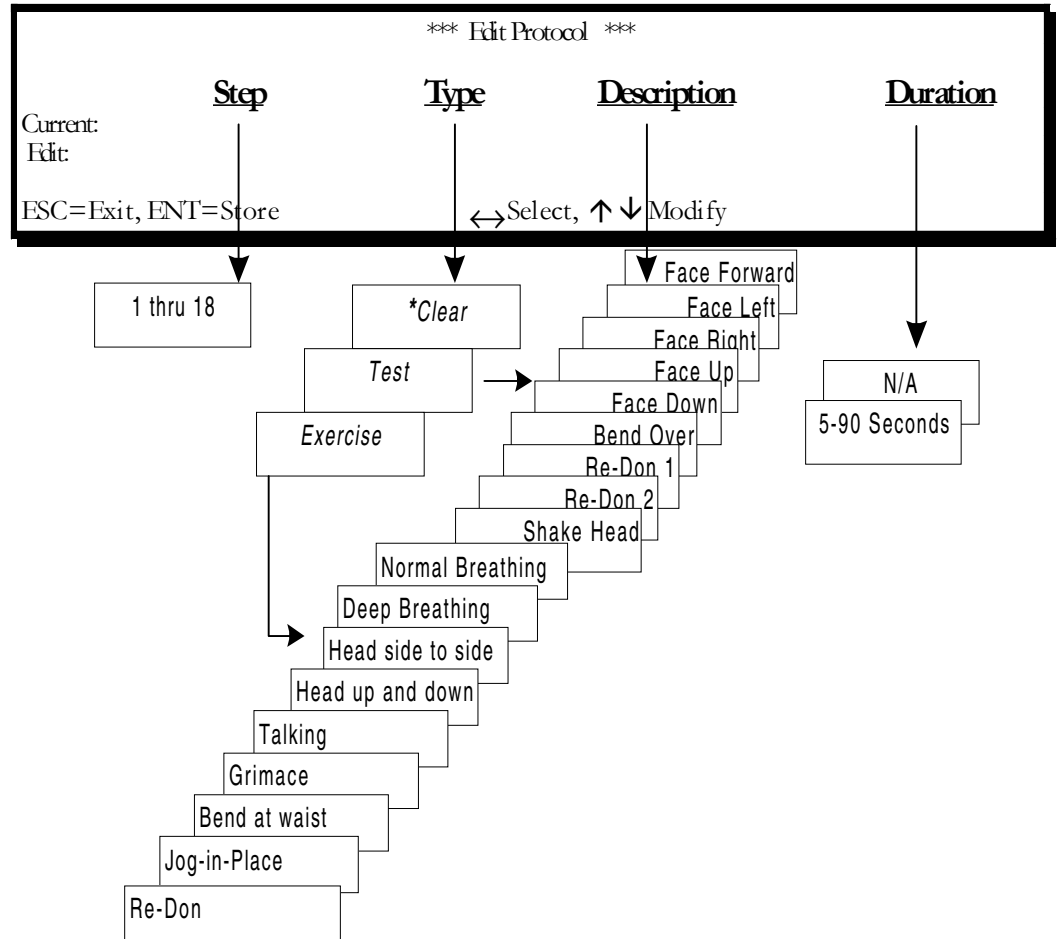
TEST	<u>EDIT PROTOCOL</u>	SYSTEM	UTILITY
	OSHA Protocol	<u>Custom 1 Protocol</u>	
	REDON Protocol	Custom 2 Protocol	
	MIL Protocol	Parameters	
	SCBA Protocol		
Edit, Print, or View Protocol 1			

- Press  and the display changes to this:

*** EDIT CUSTOM 1 PROTOCOL ***			
EDIT	PRINT	VIEW	HELP

Edit-Protocol Choices

The diagram below lists all selections. All are available for each protocol step.



Select **Clear ONLY at the end of a protocol. When the **FitTester 3000** encounters a **Clear**, it does not advance to the next step. Instead it calculates results and shows a summary report. If all 18 steps are used, the additional step with **Clear** in the **Type** column is not necessary.*

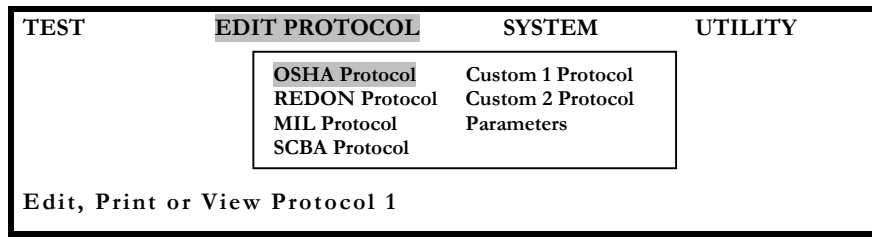
NOTE:


Use the → and the ← keys to select the column: Step, Type, Description, or Duration. Then use the ↑ and the ↓ keys to scroll through the choices for the selected column. Refer to the next section, *Edit-Protocol Choices*, for a listing of the selections.

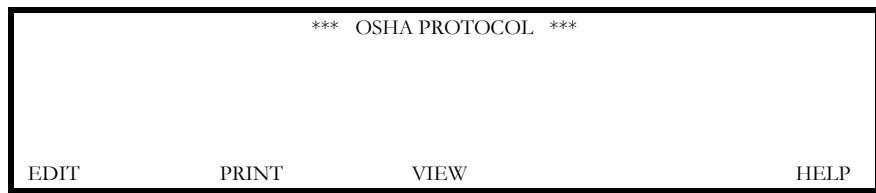
Printing a Protocol


Ensure that a printer is connected and that the *FitTester 3000* printer port is available as explained in *PREPARING THE FitTester 3000 FOR TESTING, 2. PRINTER CONNECTION*. Next, follow the instructions below to print a protocol.

- ❑ From the **MAIN MENU**, select the **EDIT PROTOCOL MENU**; then press the **↓** key to select the protocol to print. (*The FitTester 3000 prints a complete listing of the selected protocol.*)



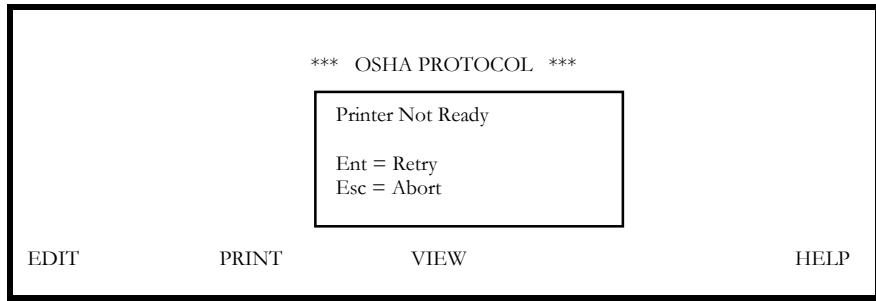
- ❑ Press  and the display changes to this:





- ❑ Finally, press  (**PRINT**) and the printer begins printing.


Printer Not Ready

If the printer does not begin printing, this message appears:



NOTE:

Press  to return to the previous display. Press  once to return to the previous screen.


The “Printer Not Ready” message is an indication that there is a problem with the cable or the printer. Check both the cable and the printer before attempting a “Retry.” Press  to retry.

PARAMETERS


Viewing Parameters

□ Select “Parameters” from the EDIT PROTOCOL MENU.

□ Press .

□ Now press  (VIEW) and the display looks similar to this:

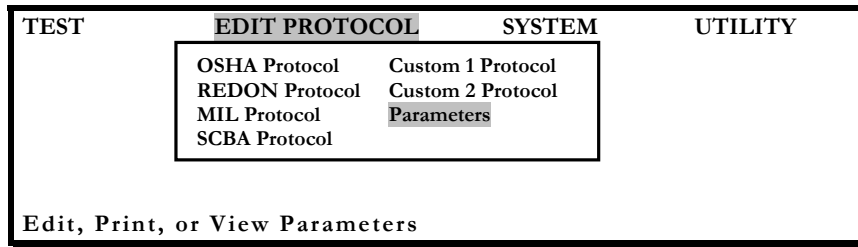
DEFAULT TEST PARAMETERS		
Mask Type	:	FULL FACE
Subject	:	MALE
HM Passing FF	:	100
FF Passing	:	500
ESC to exit		


□ Press  to return to the previous screen, ****PARAMETERS****.

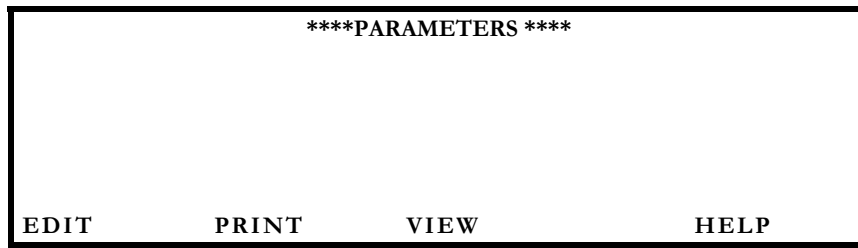
Editing Parameters


The *FitTester 3000* stores parameter values in nonvolatile memory. Follow the instructions below to change a parameter value.

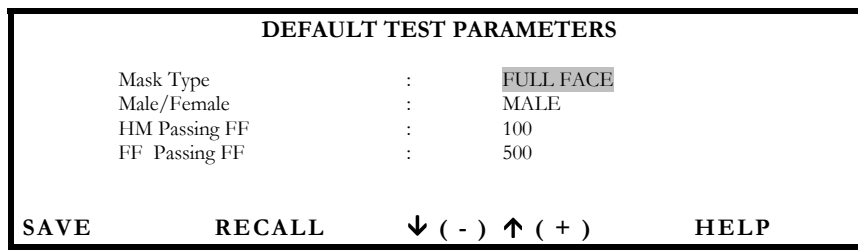
- First, select “Parameters” from the EDIT PROTOCOL MENU as indicated below:











- Next, press  and the display changes to this:



- Now press  (EDIT) and the display looks similar to this:



- The “Mask Type” parameter is highlighted first. To select another parameter, press the  or  key.
- To change a parameter value, press the   (-) or   (+) function key.
- Press  (SAVE) to save the new value.


- ❑ Press  (RECALL) to retrieve the previously saved value.

Printing Parameters

Follow the instructions below to print a complete listing of the parameter values.


- ❑ Ensure that a printer is connected and that the *FitTester 3000* printer port is turned on as explained in *PREPARING THE FitTester 3000 FOR TESTING (2. PRINTER CONNECTION)*.

- ❑ Select “Parameters” from the EDIT PROTOCOL MENU.

- ❑ Press  .

- ❑ Next press  (PRINT).

NOTE:

The “Printer Not Ready” message is an indication that there is a problem with the cable or the printer. Check both the cable and the printer before attempting a “Retry.” Press  to retry.

Default Parameter Values

(factory defaults in bold)



Work Rate*

Light (100 Kcal/Hr)

Mod (200 Kcal/Hr)

Heavy (300 Kcal/Hr)

Extreme (350 Kcal/Hr)

Mask Type*

HALF FACE

FULL MASK

Subject*

MALE

FEMALE

HM Passing **

0 to 10,000 in increments of the most significant digit. The minimum passing fit factor is the minimum fit factor required for a passing result for a half mask... **(OSHA 100)**

FF Passing

0 to 10,000 in increments of the most significant digit. The minimum passing fit factor is the minimum fit factor required for a passing result to full face mask... **(OSHA 500)**



Cartridge Type*

Low (Dust/Mist Filter)

Medium (Chemical or HEPA)

High (Chemical and HEPA)

N/A (SCBA, PAPR, etc.)

These parameters are not available in the EDIT Protocols in Parameters section. They may be changed in Custom 1 and Custom 2 Protocols using the “other” option.



*NOTE:

Refer to *Pre-Test Parameters* for an explanation of these parameters and their associated values.



**NOTE:

Refer to *Minimum Passing Fit Factor* for an explanation of this parameter. Changing this value affects the pre-test results.

SYSTEM MENU

Introduction

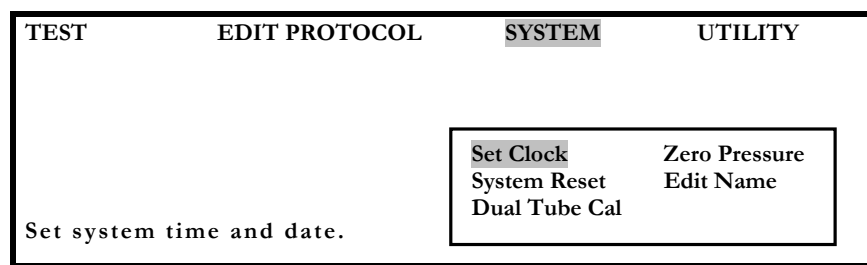
This section contains instructions on how to use the SYSTEM MENU to make adjustments to the system-level parameters. Explanations are included on how to:

- Set the clock.
- Reset protocols and parameters to the factory default values, and reset the piston in the cylinder to home position.
- Calibrate the dual tube assembly.
- Zero the pressure transducer.
- Add or edit operator name.

Set Clock

“Set Clock” allows you to adjust the time and date of the battery-backed clock. All printed reports made by the *FitTester 3000* include a time and date stamp; therefore, it is important to adjust the battery-operated clock to the current time and date.

- Select “Set Clock” from the SYSTEM MENU as indicated in the following illustration:



RESET REMOVES ALL EDITED PROTOCOLS,
PRESS F3 TO PROCEED. "ESC" CANCELS.


NOTE :

Pressing  will return the *FitTester 3000* to the "Factory Defaults" and

WILL OVERWRITE ALL USER PROGRAMMING!!!*

- If you do not wish to replace information and wish to escape, press ESC.

NOTE:

After pressing , all system variables are now reset.

Dual Tube Calibration

To accurately measure respirator-mask-fit, the leakage attributed to the dual tube assembly leak orifice* must be removed from the total measured fit-test leakage value. Calibrating the dual tube assembly accomplishes this.

The dual tube assembly is terminated with an airtight section of tubing. The *FitTester 3000* removes air at eight different flow rates. The pressure developed across the leak orifice is measured at each flow rate and stored in an array of calibration data.

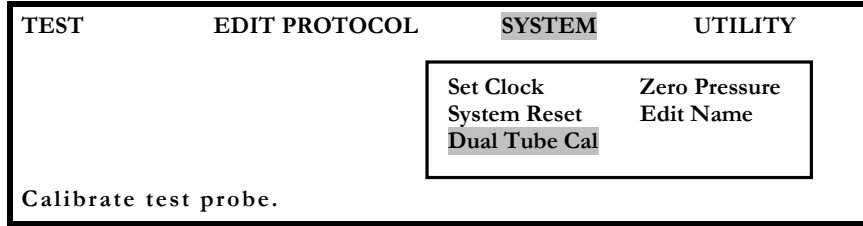
To cancel the effect of orifice leakage during a fit test, an interpolating algorithm uses the array of calibration data to determine orifice leakage at the fit test's particular challenge pressure. This calculated-leakage value is subtracted from the measured-leakage value.



***NOTE:**

The leak orifice is the hole in the gray plastic in one of the female quick-disconnect adapters on the respirator-end of the dual tube assembly.

Follow these steps to perform the dual tube calibration:

- ❑ Select “Dual Tube Cal” from the SYSTEM MENU as indicated below:







- ❑ Press . Follow the instructions on the *FitTester 3000* display and connect the two female quick-disconnect adapters on the dual tube assembly to either of the male quick-disconnect adapters on the *FitTester 3000* front panel labeled “DUAL TUBE CHECK.”
- ❑ Press  and the *FitTester 3000* begins with the engine pulling the piston away from home and then driving it home. This will aid in clearing any dirt or debris in the dual tube orifice. After completion of the clearing cycle, the dual tube assembly is calibrated at six flow rates. Results are shown on the display as the *FitTester 3000* calculates and plots them. If an ERROR MESSAGE appears see note and table on next page.

NOTE:

Listed on the next page are the error messages that may appear on the display and what action to take.

ERROR MESSAGE	ACTION TO TAKE
ERROR –Bypass orifice not within spec.	Replace the dual tube assembly.
ERROR –Check connections and repeat.	Reconnect quick-disconnect adapters and repeat this procedure.
ERROR –Check transducer calibration.	Go to the next diagnostic routine, “Zero Pressure,” and remove the offset from the pressure transducer.
ERROR –Replace orifice if necessary.	Replace the dual tube assembly.
Press any key to continue.	Press any key, returning to the SYSTEM MENU.

The *FitTester 3000* does not maintain long term internal storage of data. Therefore, to save a record of the data, printing out a copy of the data is required.

- After calibration finishes, press  (SAVE) to save the data to temporary memory, or
- Press  (NO-SAVE).
- To save a hard copy of the data, print it by pressing  (PRINT).
- Press  to return to the SYSTEM MENU.

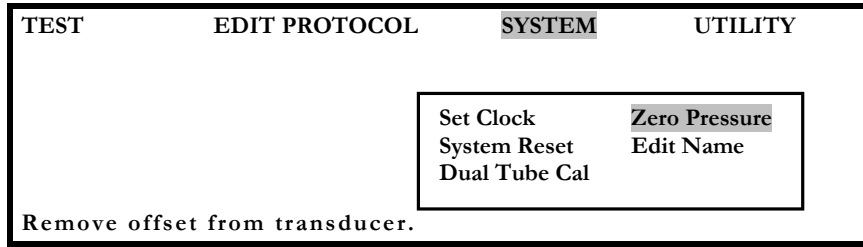
NOTE:

OHD recommends a dual tube calibration before the beginning of a fit-test session, at the start of the day, or anytime a dual tube assembly is exchanged.

Zero Pressure

“Zero Pressure” removes the offset from the pressure transducer.

- First select “Zero Pressure” from the SYSTEM MENU as indicated below:



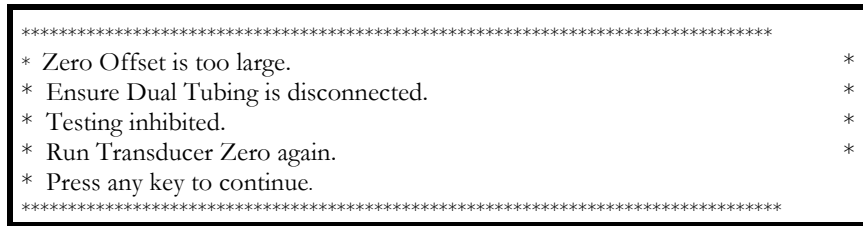
- Press  .

- Disconnect the dual tube assembly.

- Press any key and the offset from the pressure transducer is removed and SYSTEM MENU reappears

Error Message

If this procedure is unsuccessful, the following display appears:



There is an acceptable range of zero-offset values. Exceeding that range of values indicates that the dual tube assembly is connected, or that there is a problem in the pressure transducer or the conversion circuit. Fit-testing is inhibited at these times.

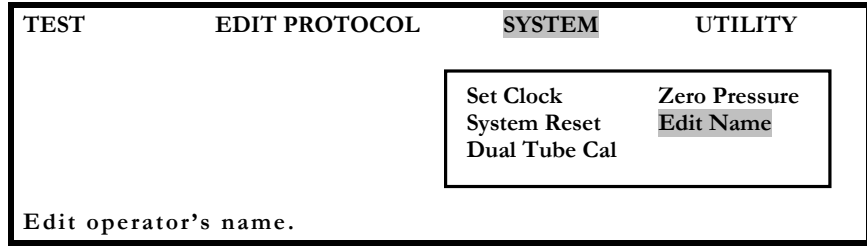
If the dual tube assembly is disconnected and the above-illustrated error message occurs, contact OHD to determine if the *FitTester 3000* needs service.

- Press any key to return to the SYSTEM MENU.

Edit Name

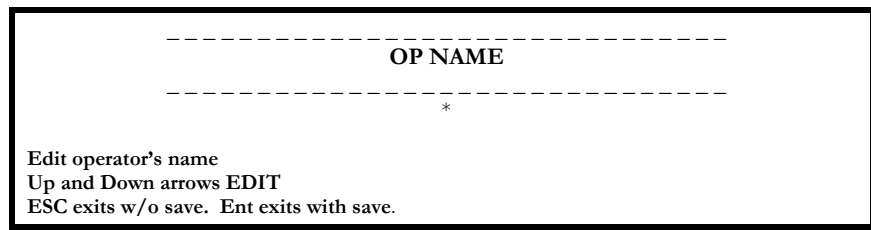
“Edit Name” allows the operator to add his name to each report output.

- First select “Edit Name” from the SYSTEM MENU as indicated below.





- Press  .

- Screen below will appear.



- Edit each letter space of the display with the arrows until the operator's name appears as desired.

- Press  to save. Saved name will remain until changed or removed.

- OR press  to exit *without* saving change.

- System returns to SYSTEM MENU.

UTILITY MENU

Introduction

This section contains instructions on how to use the UTILITY MENU to...

Turn on the *FitTester 3000* printer port using the printer installation routine.

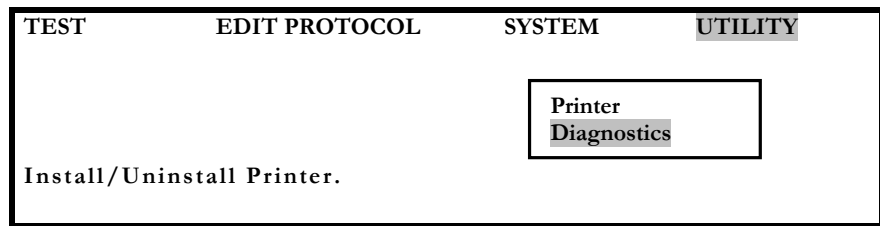
Perform a diagnostic check of the *FitTester 3000* diagnostic routines listed below:






- Speaker Test
- Keyboard Test
- Display Test
- Printer Test
- View Cycle Count
- Factory Protocol
- Print Help File

Printer Installation Routine

The printer installation routine turns the printer port on (“Available”) or off (“Not Available”).

- Select “Printer” from the UTILITY MENU as indicated below.

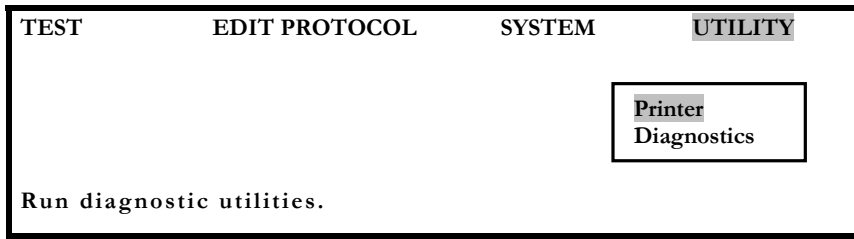


- ❑ Press  then press the  or the  key to select “Available” or “Not Available.”
- ❑ Press  again or press  to save your setting and return to the UTILITY MENU.

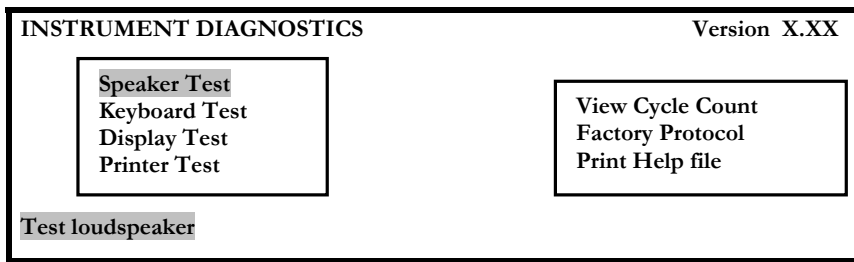
Diagnostic Routines

The seven diagnostic routines enable you to check your *FitTester 3000*.

- ❑ Select “Diagnostics” from the UTILITY MENU as indicated below.



- ❑ Press  .



NOTE:

The current firmware version is shown in the upper right corner “Version X.XX.”

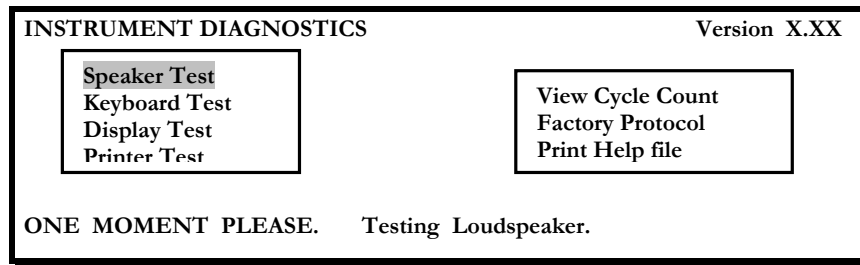
- ❑ Use the , , , or  key to select a diagnostic routine from the INSTRUMENT DIAGNOSTICS MENU.

Speaker Test

- From the INSTRUMENT DIAGNOSTICS MENU, select “SPEAKER TEST” using the **↑**, **↓**, **←**, or **→** key if necessary to position the highlight bar over “SPEAKER TEST.”



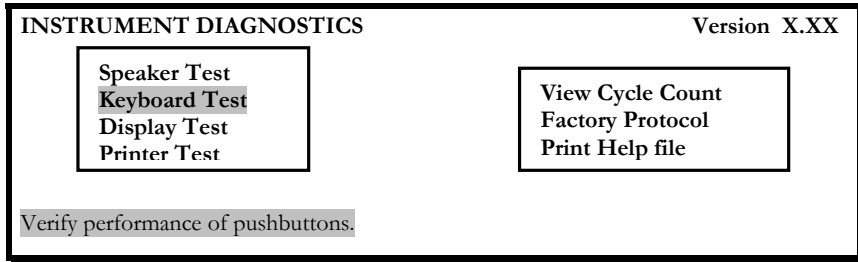
- Press **Ent** then a series of tones is output and the display shows:




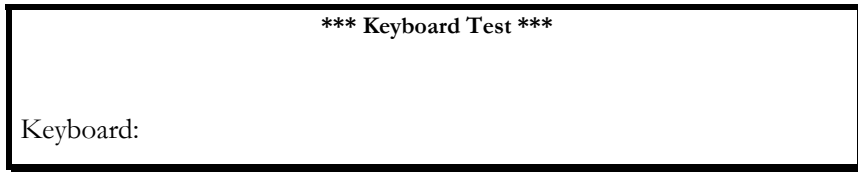
Use the “VOLUME” knob on the lower right front panel to adjust the volume.

Keyboard Test


- Press the  key to select “KEYBOARD TEST.”




- Press  and the display shows:

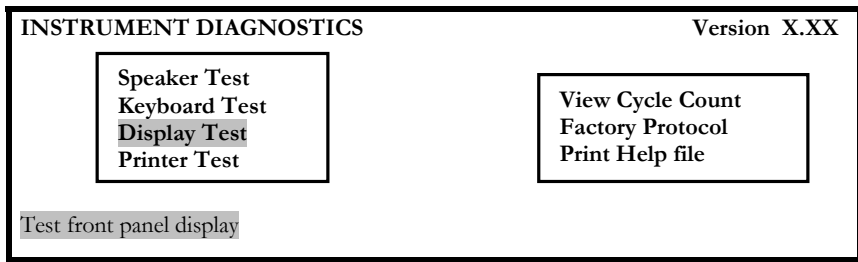



During this test, the keypad inputs are echoed to the display. When you press a key, the description of that key should show on the display.

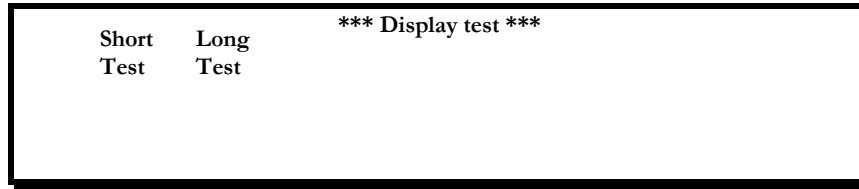
When the  key is pressed, “Escape” shows on the display and then you are returned to the INSTRUMENT DIAGNOSTICS MENU.


Display Test

- Press the  key to select “DISPLAY TEST.”

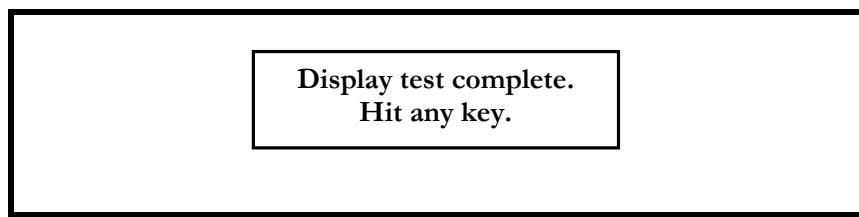
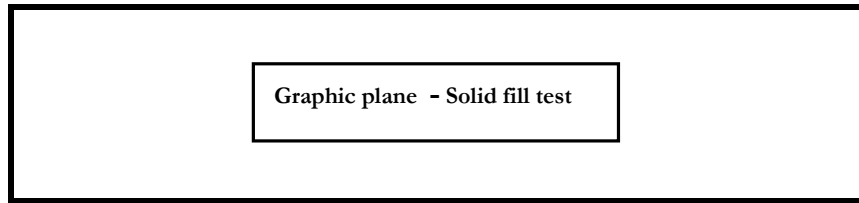
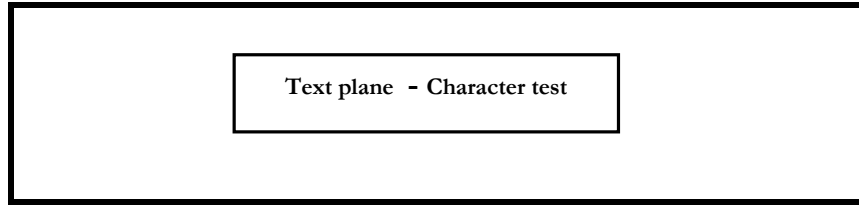




- Press  and the display shows:



- ❑ Next press  (**SHORT TEST**). First a text plane test, showing all text characters, is performed. Then a graphic plane test, showing a solid fill, is performed. At the end of the “Short Test,” press any key to return to the INSTRUMENT DIAGNOSTICS MENU.

Following are the messages that show on the display during the “Short Test.”



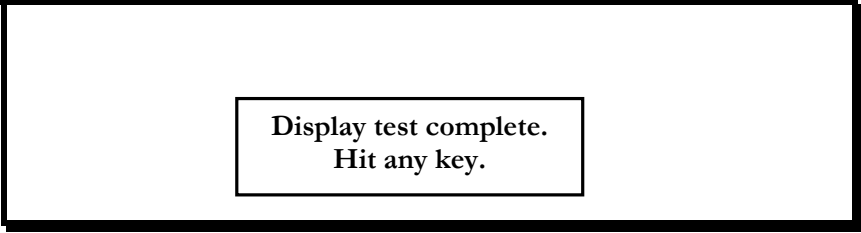
- ❑ Select “DISPLAY TEST” again from the INSTRUMENT DIAGNOSTICS MENU and press .
- ❑ Next, press  (**LONG TEST**). At the end of the “Long Test”, go to next step.

- Press any key to return to the INSTRUMENT DIAGNOSTICS MENU.

A series of tests is performed in the order shown below:

- ◆ Text plane – Even column test
- ◆ Text plane – Odd column test
- ◆ Text plane – Even row test
- ◆ Text plane – Odd row test
- ◆ Text plane – Solid fill test
- ◆ Text plane – Character test
- ◆ Graphics plane – Even vertical test
- ◆ Graphics plane – Odd vertical test
- ◆ Graphics plane – Even row test
- ◆ Graphics plane – Odd row test
- ◆ Graphics plane – Solid fill test

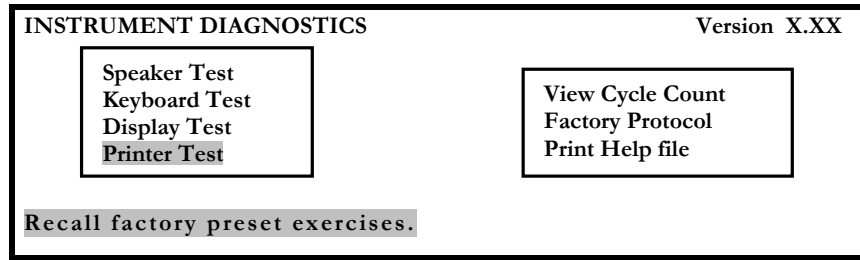
The following is the last message to show on the display in the “Long Test.”




**Display test complete.
Hit any key.**

Printer Test

- ❑ Select “PRINTER TEST” from the INSTRUMENT DIAGNOSTICS MENU.



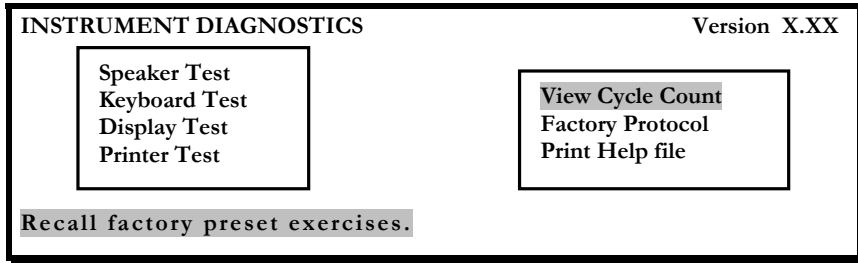
- ❑ Press . The *FitTester 3000* sends a short message to the printer.


NOTE:

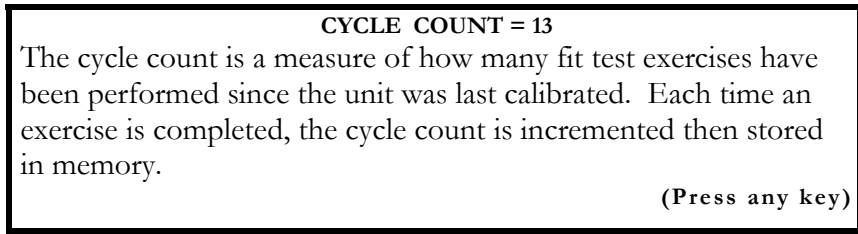
If the message “Printer Not Ready” shows on the display, ensure that the printer is turned on and that the cables are connected properly.

View Cycle Count

- Select “VIEW CYCLE COUNT” from the INSTRUMENT DIAGNOSTICS MENU.



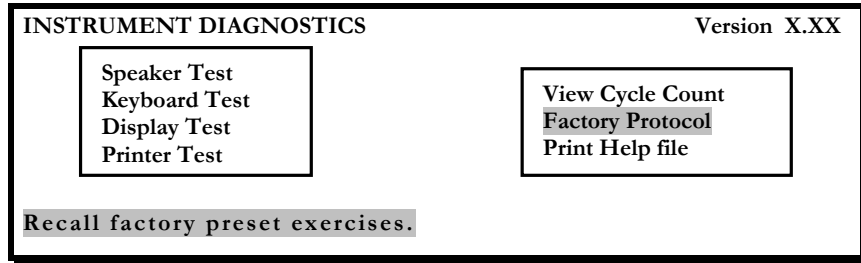
- Press . The *FitTester 3000* displays the cycle count and an explanation of the cycle count.




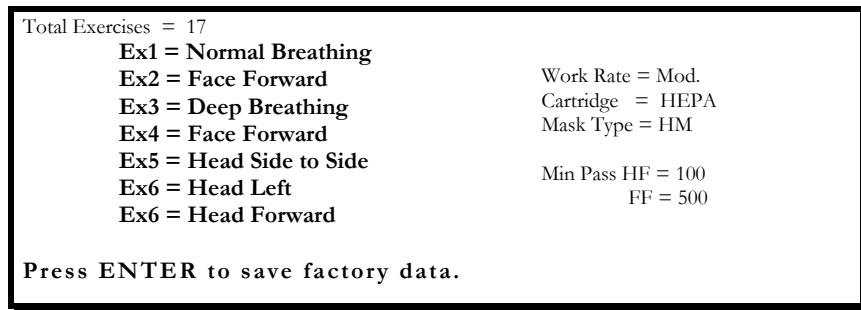
- Press any key to return to the INSTRUMENT DIAGNOSTICS MENU.



Factory Protocol

- ❑ Select “FACTORY PROTOCOL” from the INSTRUMENT DIAGNOSTICS MENU.



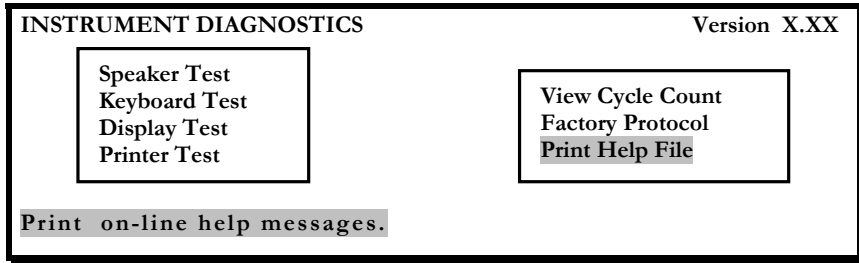
- ❑ Press . The *FitTester 3000* reloads the factory protocol – Protocol #1 (the OSHA protocol).




- ❑ Press  to save the factory protocol and return to the INSTRUMENT DIAGNOSTICS MENU.
- ❑ Press  to return to the INSTRUMENT DIAGNOSTICS MENU without saving the factory protocol.

Print Help File

- Select “PRINT HELP FILE” from the INSTRUMENT DIAGNOSTICS MENU.



- Press . The *FitTester 3000* outputs the Help File to the printer.

Troubleshooting

In this chapter you will find information about problems and possible solutions.

TEST MEASUREMENTS

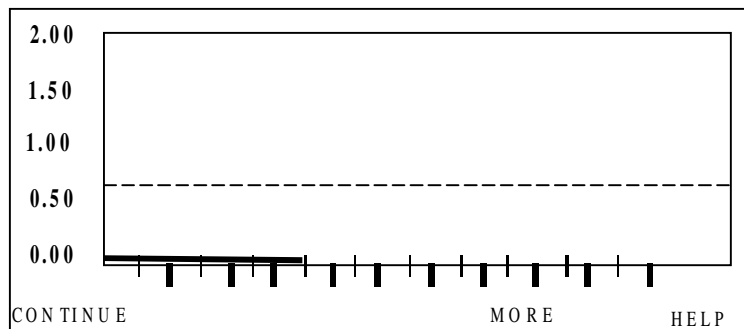
You may occasionally find a test measurement that is not as you expected. Descriptions of some of these common situations and possible solutions have been included to aid the user in obtaining more accurate measurements.

High Leakage

In many cases, the measured leakage exceeds the ability of the *FitTester 3000* to measure. Within the *FitTester 3000*, once the measuring cylinder reaches the maximum capacity, the cycle will immediately cease. This situation is accompanied by a high-pitched whine of the pump motor.

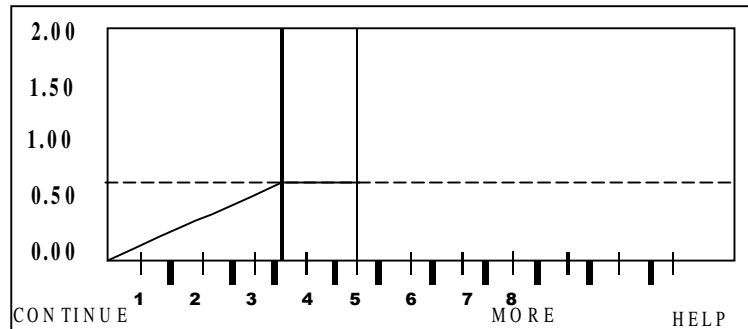
Massive Leak

The pump runs at a high pitch for about 4 seconds and stops abruptly. The *FitTester 3000* resets and reports a fit factor below 11. During the measurement the screen will look something like this:



Large Leak

At other times the *FitTester 3000* will labor to create the negative pressure only to end the test measurement before the 8-second time. This leakage, although less than maximum, still fills the cylinder and abruptly ends the test. It will look something like this:

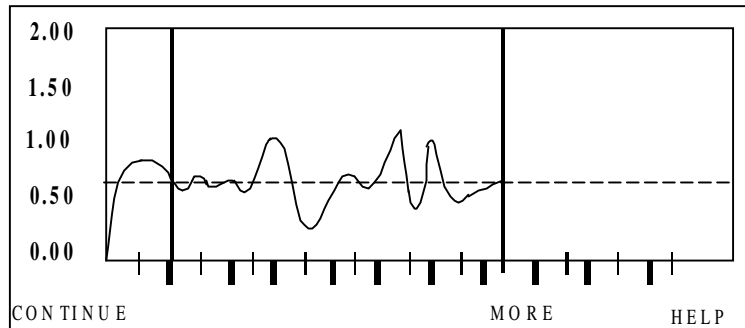


Possible Solutions

1. Check all connections for proper attachment.
2. Check to ensure that the *FitTester 3000* mask adapter is properly attached to the respirator. Look for cross-threading, loose connection, etc.
3. Make sure that the squeeze bulb was held securely closed throughout test time.
4. Check mask for proper tightness to the face and check that no hair, beard stubble, or other objects inhibit a good face-to-facepiece seal.
5. TRY A DIFFERENT MASK! Many masks SEEM to fit well but are NOT properly sized to a specific wearer. In other cases a different style may be better suited for the individual wearer.

Erratic Mask Pressure

The *FitTester 3000* is very sensitive to pressure changes inside the mask. If the pump motor sound alternates between high- and low-pitched whines and the pressure tracing line, even after challenge pressure is attained, is erratic, the *FitTester 3000* is sensing variations in pressure. The graph can vary greatly and might look like this:



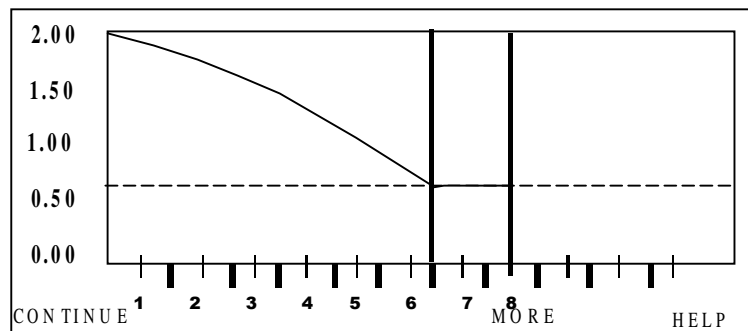
This tracing would give a **RETRY ADVISED** and be unacceptable as test measurement. You would need to rerun the measurement. There are a number of causes for this type of reading.

Possible Solutions

1. Movement by the person being tested needs to be minimized. Actions such as swallowing, opening the mouth, and moving the tongue can adversely affect the pressure sensor.
2. Air inhalation or exhalation, even slightly, creates dramatic changes within the mask. Re-instruct the test subject to maintain breath holding during the test measurement.
3. A test subject may be unable to stop the flow of air through the nose while holding his breath. A nose clip can assist the subject (be sure that the nose clip does not interfere with the fit if the respirator).

Over-breathing

If the pump motor does not seem to activate until after the challenge pressure is established or if the mask pressure line doesn't come down to the challenge pressure line, the negative pressure in the mask is greater than normal at the start of the test. A typical graph would look like this:



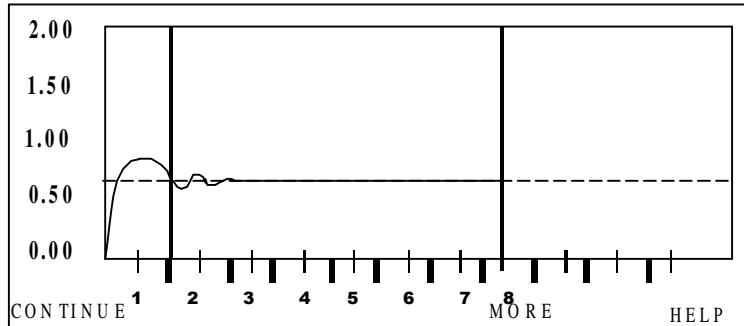
When the subject being tested continues to inhale after the squeeze bulb valve has been closed, it creates a negative pressure in the mask greater than needed for the test.

Possible Solutions

1. Re-instruct the subject, if he is operating the squeeze bulb, as to when to squeeze the bulb (after inhaling).
2. Operator should hesitate squeezing the bulb for $\frac{1}{2}$ or 1 second after the subject inhales.

Consistently Low Fit Factors

When you consistently get low fit factors, even when you know that a respirator should fit, and the pump motor is running slightly faster (at a higher pitch) than normal, the graph could look normal as this:



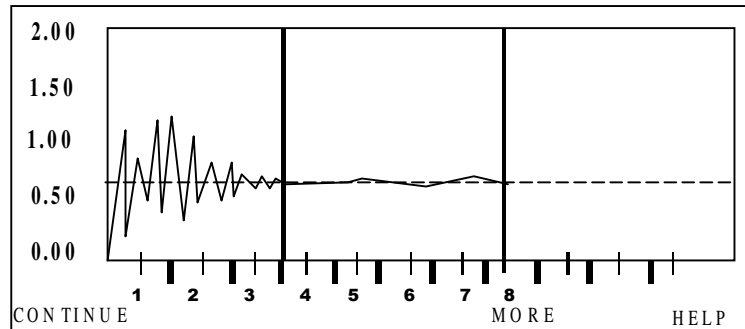
When the leak rate is high, the graph can still look somewhat normal. The *FitTester 3000* will often be able to keep up with the leak and give a good test result, regardless of the fact that the leak is too large to yield a passing fit factor.

Possible Solutions

1. As in other leakage situations (see HIGH LEAKAGE), check all hose connections, adapters, and adapter connections to respirators.
2. Check for proper tension of respirator to face.
3. Try a different size or different respirator.
4. See **SQUEEZE BULB** page 78.
5. Have Adapter checked for leaks (call OHD for this service).

Rapid or Erratic Graph Movement (Before or During Test)

When the *FitTester 3000* gives erratic, jerky movement during the test, especially before the challenge pressure is attained, and the challenge pressure takes awhile to attain, the problem might be an easy one to find and solve. The graph might look something like this:



When the inhalation valve is not propped open or removed, the *FitTester 3000* is unable to get to the airspace touching the facepiece seal. The *FitTester 3000* is only looking at the seal of the inhalation valve, which can rapidly “flutter” with the sealing and breaking of the seal. The inhalation valve can easily be missed on some full-facepiece respirators that can be converted from SCBA or airline to Air Purifying Respiratory.

Possible Solution

Insure that the *Inhalation Valve* is propped open or removed.

OTHER PROBLEMS

DUAL TUBE CALIBRATION

The Dual Tube Calibration normally functions to completion without any intervention by the user. Occasionally a problem may arise.

Symptom:

Dual Tube Calibration abruptly stops or will not continue after starting.

Possible Problem:

1. Something has blocked or partially obstructed the leak orifice on the Dual Tube Assembly and has rendered the tube out of tolerance.
2. Pressure in the transducer has not been zeroed.
3. The transducer needs factory calibration.

Possible Solutions

1. Turn ***FitTester 3000*** off at the power switch, wait 15 seconds, power on the ***FitTester 3000***, zero pressure, and retry Dual Tube Calibration.
2. Replace Dual Tube Assembly.
3. Call OHD to evaluate problem or to arrange return for factory calibration.

SQUEEZE BULB

Symptom:

The squeeze bulb takes a few seconds to inflate or does not inflate immediately after release. Fit factors are low for all types of respirators.

Possible Problem:

Pinhole leak in the mask adapter diaphragm or problem with squeeze bulb.

Possible Solutions

1. Replace the diaphragm (located under the aluminum plate with 8 locking screws on the valve adapter).
2. Replace squeeze bulb.

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