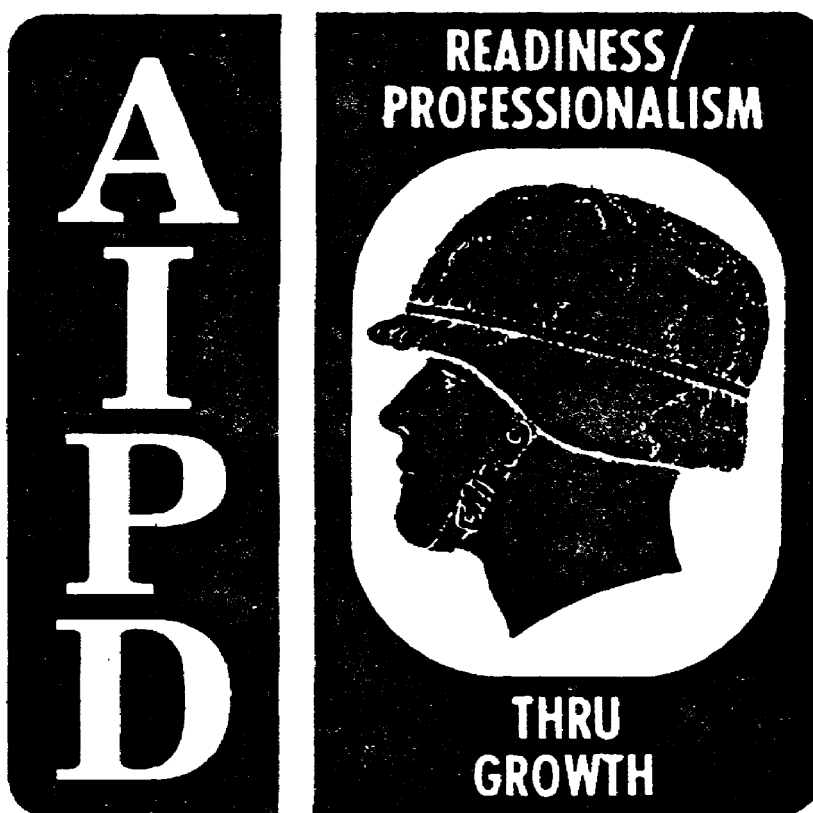


SUBCOURSE  
QM3505

EDITION  
A

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DIRECT FILTER/SEPARATOR OPERATIONS



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THE ARMY INSTITUTE FOR PROFESSIONAL DEVELOPMENT  
ARMY CORRESPONDENCE COURSE PROGRAM

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## DIRECT FILTER/SEPARATOR OPERATIONS

Subcourse Number QM 3505  
EDITION A

United States Army Combined Arms Support Command  
Fort Lee, VA 23801-1809

5 Credit Hours

Edition Date: September 1993

### SUBCOURSE OVERVIEW

This subcourse is designed to teach you how to identify the internal operation of a filter/separator; use the proper filter/separator for a specific mission; explain pressure differential; perform daily and weekly checks on a filter/separator; and identify the purpose and use of go-no-go fuses.

There are no prerequisites for this subcourse.

This subcourse reflects the doctrine which was current at the time it was prepared. In your own work situation, always refer to the latest official publications.

Unless otherwise stated, the masculine gender of singular pronouns is used to refer to both men and women.

### TERMINAL LEARNING OBJECTIVE

**ACTION:** You will identify the internal operation of a filter/separator; use the proper filter/separator for a specific mission; explain pressure differential; perform daily and weekly checks on a filter/separator; and identify the purpose and use of go-no-go fuses.

**CONDITION:** You will have information from FM 10-69.

**STANDARD:** To demonstrate competency of this task, you must achieve a minimum of 70 percent on the subcourse examination.

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## LESSON

### DIRECT FILTER/SEPARATOR OPERATIONS

Critical Task: 03-5105.00-0001

#### OVERVIEW

##### LESSON DESCRIPTION:

In this lesson, you will learn how to identify the internal operation of a filter/separator; use the proper filter/separator for a specific mission; explain pressure differential; perform daily and weekly checks on a filter/separator; and identify the purpose and use of go-no-go fuses.

##### TERMINAL LEARNING OBJECTIVE:

**ACTION:** Identify the internal operation of a filter/separator; use the proper filter/separator for a specific mission; explain pressure differential; perform daily and weekly checks on a filter/separator; and identify the purpose and use of go-no-go fuses.

**CONDITION:** You will be given information from FM 10-69.

**STANDARD:** Identifying the internal operation of a filter/separator; using the proper filter/separator for a specific mission; explaining pressure differential; performing daily and weekly checks on a filter/separator; and identifying the purpose and use of go-no-go fuses will be in accordance with FM 10-69.

**REFERENCE:** The material contained in this lesson was derived from the following publication: FM 10-69.

#### INTRODUCTION

Quality control in the handling of petroleum products is of the utmost importance. Your best tool for maintaining product quality is the filter/separator. You must ensure that each filter/separator used in your operation functions properly. To ensure proper operation, you must be thoroughly familiar with operation and maintenance procedures. You must be able to identify each filter/separator used in military operations, perform operator checks on a filter/separator, and determine the pressure differential to know when to change the filter/separator.

This subcourse provides instruction concerning the internal operation of a filter/separator, the use of the proper filter/separator for a specific mission, pressure differential, the performance of daily and weekly checks on a filter/separator, and the purpose and use of go-no-go fuses.

## PART A - FILTER/SEPARATOR OPERATION AND FUNCTION

The following types of filter/separators and their uses are discussed in their following respective subparagraphs:

- o 15 gallons per minute (GPM).
- o 50 GPM.
- o 100 GPM.
- o 350 GPM.
- o 600 GPM.

### 1. 15-GPM Filter/Separator.

The following paragraph describes the 15-GPM filter/separator. Also described are its uses.

a. Description. The 15-GPM filter/separator (shown in Figure 1-1) is a vertical, portable unit consisting of an aluminum tank mounted on an aluminum skid. The tank has fuel inlet and outlet valves, a water drain valve, and a water level sight gage. The fuel inlet and outlet valves are identical 1-inch manually operated ball valves attached near the bottom of the tank. Provided at the inlet and outlet connections are cam-locking couplings for 1-inch hoses. The water drain valve is a 1/2-inch manually operated ball valve. It is also mounted near the bottom of the filter/separator. The water level sight gage consists of a plastic sight and a ball float. It is mounted on the side of the tank to show the water level in the base of the tank.

This filter/separator contains a go/no-go fuse, one filter element, and one canister. The go/no-go fuse monitors the filter element. Any water contaminant passing through the filter element is absorbed by the go/no-go fuse which restricts and shuts off the flow of fuel.

The cover, held in place by four bolts, has a manually operated pressure vent valve to let air out of the unit. The filter/separator is 27 1/2-inches high and weighs 20 pounds when empty. Its top working pressure is 25 pounds per square inch (PSI). You must ground the filter/separator before using it.

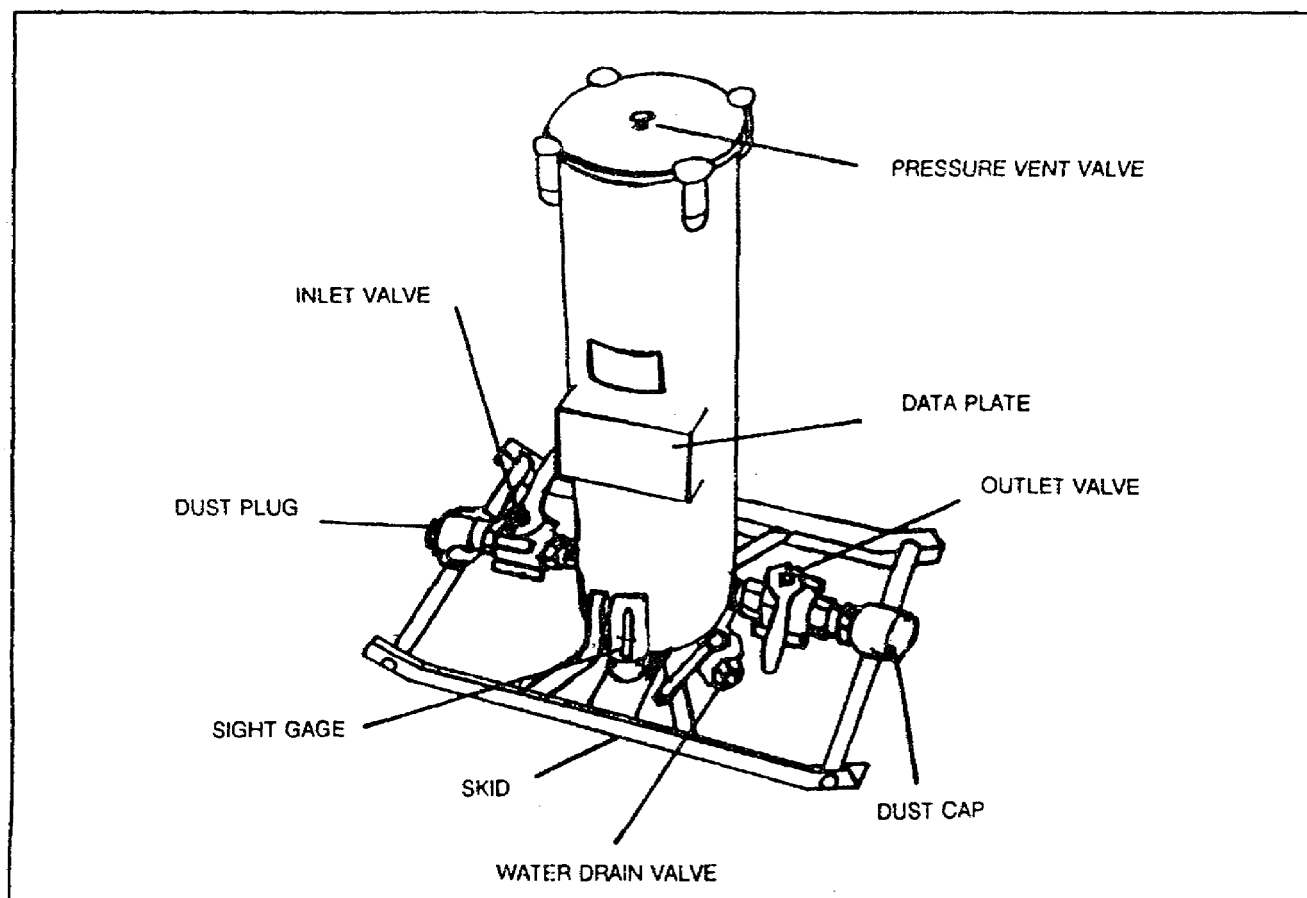


Figure 1-1. 15-GPM filter/separator

b. Use. Use the 15-GPM filter/separator with the 15-GPM, hand-operated dispensing pump to pump fuel that is free of solid contaminants and water. If no other aircraft refueling equipment is available, you may use the 15-GPM pump and filter/separator to refuel light aircraft.

## 2. 50-GPM Filter/Separator.

The following paragraph describes the 50-GPM filter/separator. Also described are its uses.

a. Description. The 50-GPM filter/separator (shown in Figure 1-2) consists of an aluminum tank with a removable cover, an inlet pipe with dust plug, an outlet pipe with dust cap, a manually operated water drain valve, an air vent valve, a pressure differential indicator, and a sight glass. Installed on a mounting plate near the bottom of the tank are four filter element and canister assemblies. A float ball in the sight glass shows how much water is in the tank. The ball sinks in fuel and floats in water. The pressure differential indicator shows when you should change the filter elements. A reading in the green

(0 to 20 psi) means the elements are clean. A reading in the yellow (20 to 35 psi) means you must change the elements at the end of the day's operations. A reading in the red (35 psi and up) means you must change the elements at once.

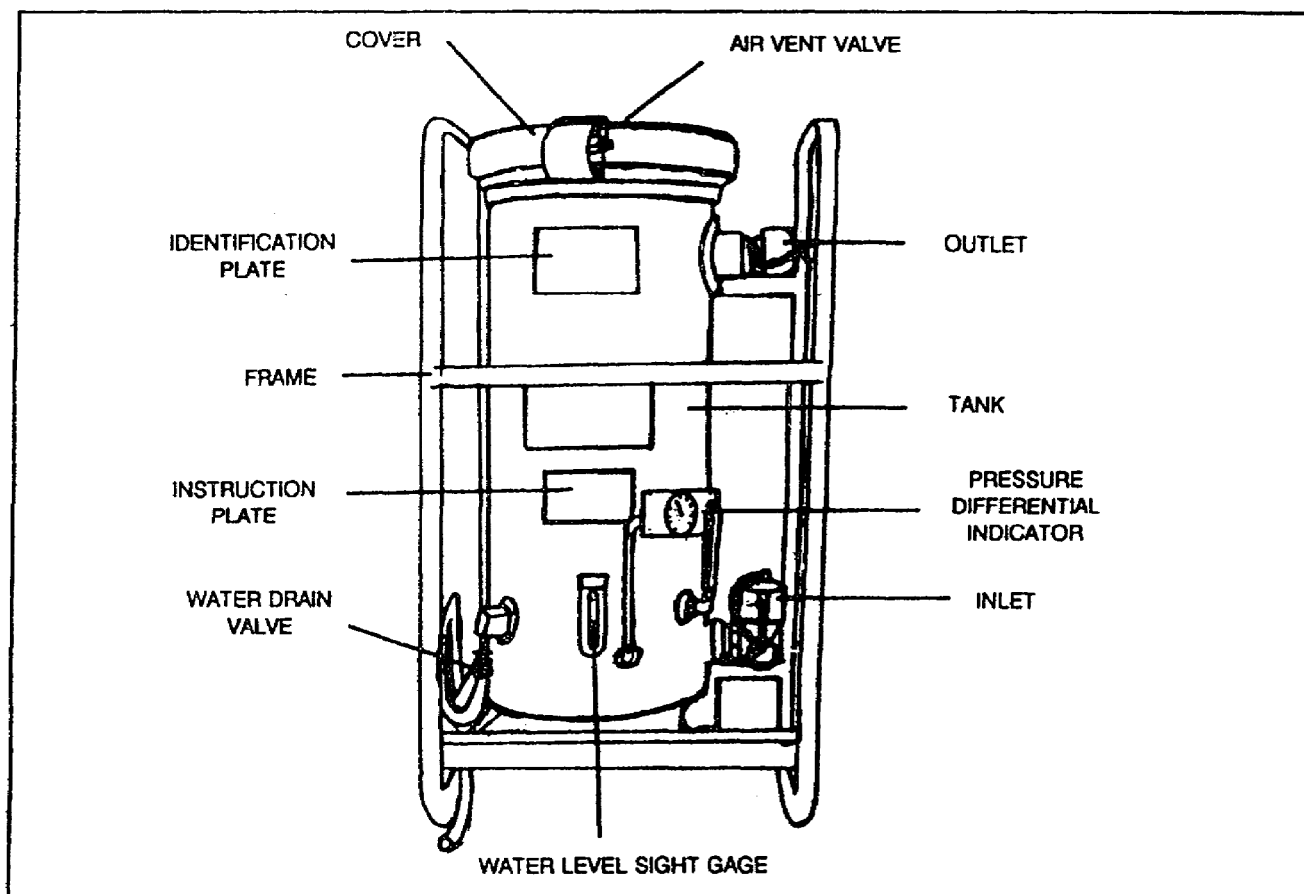


Figure 1-2. Frame-mounted (type 1) 50-GPM filter/separator

Also change the elements whenever any of the following conditions exist:

- o The pressure differential exceeds the allowable limits.
- o There is no pressure differential.
- o Samples indicate excessive fuel contamination.
- o You change to a higher grade of product.
- o After 24 months elapse.

Whenever you change elements, follow these precautions:

- o Change all elements.
- o Check gaskets and rings.
- o Prevent damage to the aluminum canister.

The unit is 36 inches high, 20 1/2-inches long, and 16 inches wide. It weighs 85 pounds. It has a flow rate of 50 GPM. You must ground the filter/separator before using it. A grounding rod and cable come with the unit.

b. Use. Use the 50-GPM filter/separator with the 50-GPM pumping assembly in refueling systems at airfields and with equipment to service ground vehicles. The type I filter/separator (shown in Figure 1-2) is frame-mounted. Employ it for open field use. The type II model has no frame. Employ it with the tank and pump unit.

### 3. 100-GPM Filter/Separator.

The following paragraph describes the 100-GPM filter/separator. Also described are its uses.

a. Description. The 100-GPM filter/separator (shown in Figure 1-3) has an aluminum tank with a removable cover. Its female inlet has a dust plug. Its male outlet has a dust cap. Five filter elements, each in a canister, sit on a mounting plate near the bottom of the tank. The filter/separator is mounted on a tubular aluminum frame. The filter/separator has an air vent valve, a pressure differential indicator, a sight glass, and a manually operated water drain valve. A float ball in the sight glass shows how much water is in the tank. The ball sinks in fuel but floats in water. The pressure differential indicator shows when to change the filter elements. A reading in the green (0 to 20 psi) means the elements are clean. Change the elements at the end of the day's operation when a reading is in the yellow (20 to 35 psi). Change the elements at once when a reading is in the red (35 psi and up).

NOTE: When you change elements, follow the precautions listed in paragraph 2a.

The flow rate of the filter/separator is 100 GPM. Its top working pressure is 75 psi. Ground the unit before using it.

b. Use. You mainly use the 100-GPM filter/separator with the 100-GPM pumping assembly as part of the forward area refueling equipment (FARE) system. However, it is also issued as an individual item of equipment that you use with various models of 100-GPM pumping assemblies.



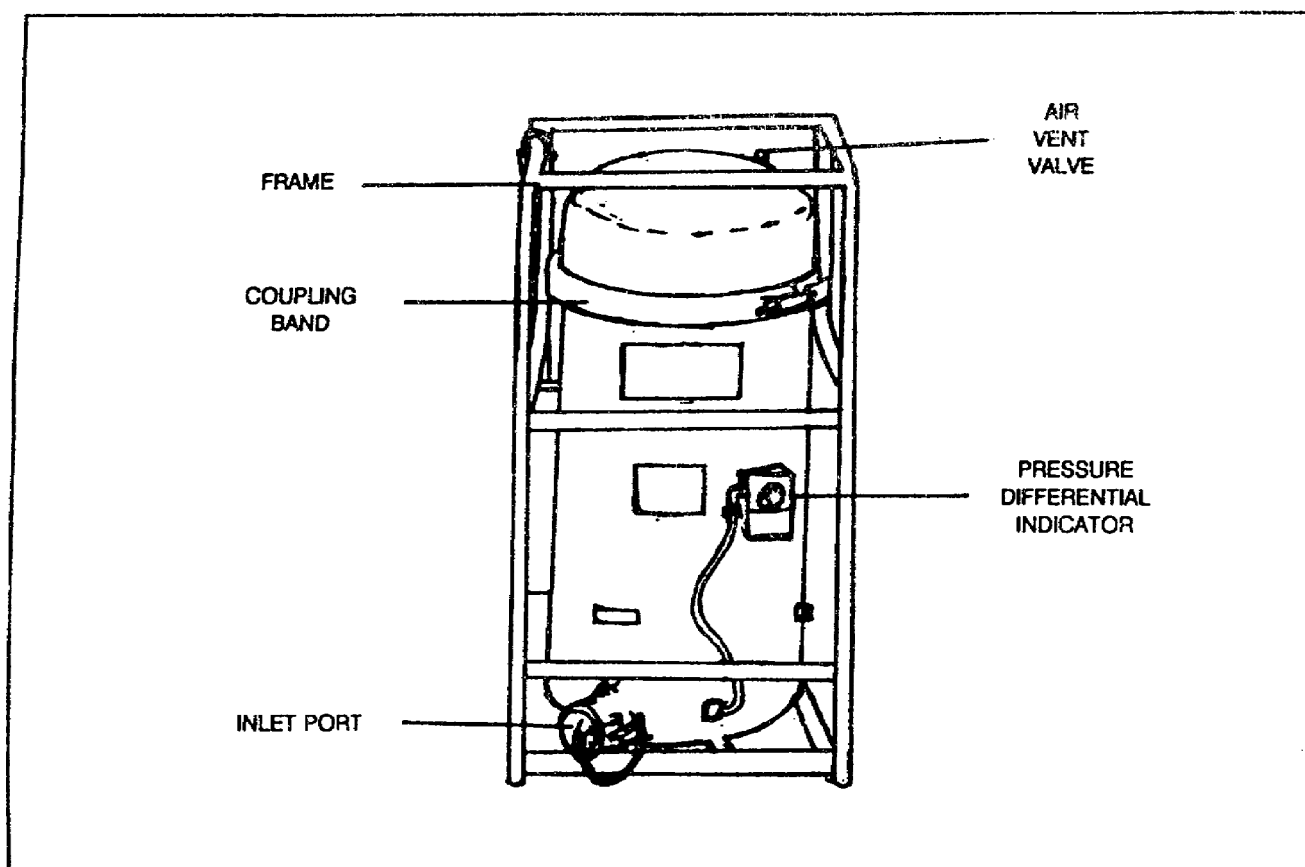


Figure 1-3. 100-GPM filter/separator

#### 4. 350-GPM Filter/Separator.

The following paragraph describes the 350-GPM filter/separator. Also described are its uses.

a. Description. The 350-GPM filter/separator (shown in Figure 1-4) consists of an aluminum pressure tank with a removable head. The tank is welded on a tubular aluminum frame for support and protection. It has an inlet pipe through which unfiltered fuel enters, an outlet pipe through which the filtered fuel leaves, an internal inlet manifold, and risers for mounting 18 filter element and canister assemblies. The filter/separator also has an air vent valve so that air can be let out of the tank, a sight glass to indicate the water level by means of a float ball, and a manually operated water drain valve to drain water from the tank. A pressure differential indicator shows when you need to change the filter elements. A reading in the green (0 to 20 psi) means the elements are clean. Change the elements at the end of the day's operations when a reading is in the yellow (20 to 35 psi). Change the elements at once when a reading is in the red (35 psi and up).

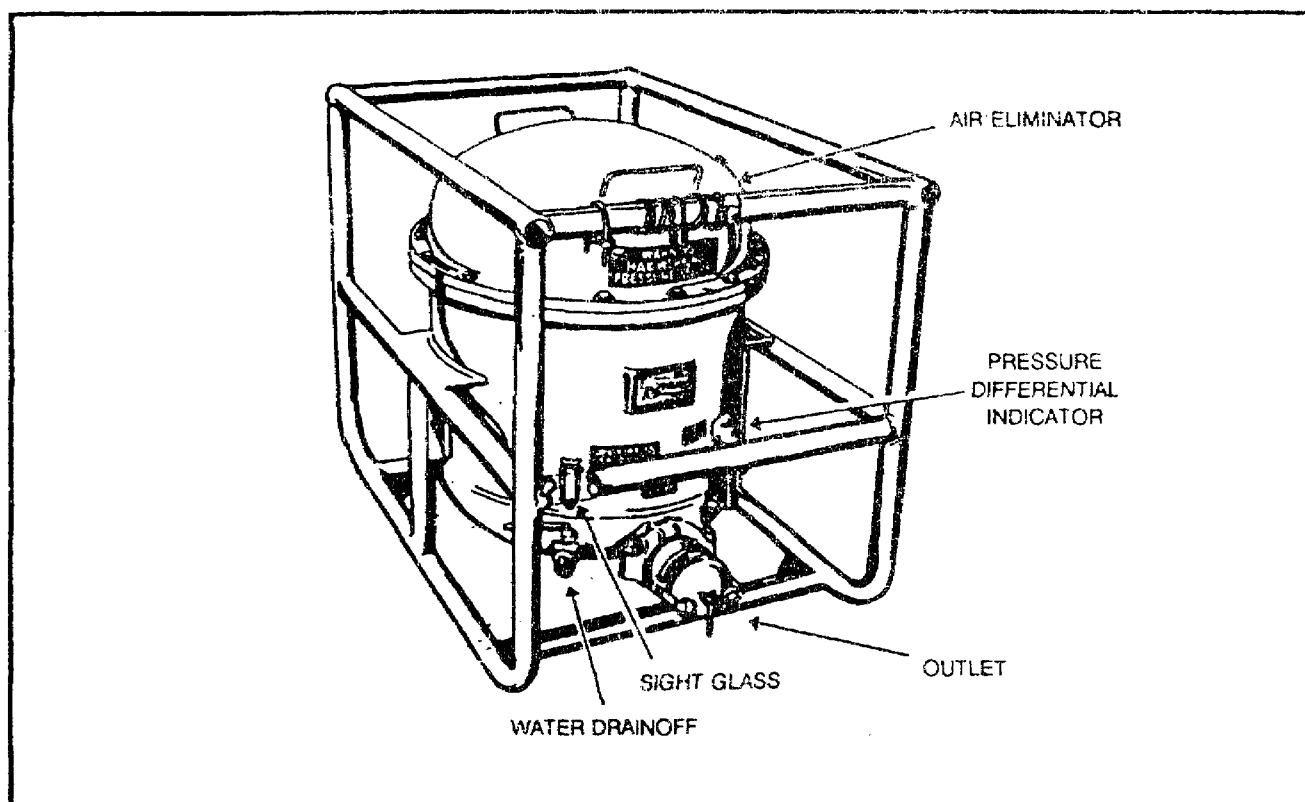


Figure 1-4. 350-GPM filter/separator

NOTE: Also change the elements when any of the conditions described in paragraph 2a exist. When you change elements, follow the precautions listed in paragraph 2a.

The filter/separator is 40 inches high, 47 inches long, and 33 inches wide. It weighs 375 pounds. It is designed for a flow rate of 350 GPM and a top working pressure of 150 psi. Ground the unit before operation.

b. Use. Use the 350-GPM filter/separator in airfield refueling systems and motor fuel servicing equipment. Also use it for military hose line systems.

#### 5. 600-GPM Filter/Separator.

The 600-GPM filter/separator contains 30 elements and 30 canisters. It is used in pipeline systems. Other than to mention the fact that the 600-GPM filter/separator exists, this subcourse does not discuss the 600-GPM filter/separator.

#### 6. Filter/Separator Controls.

Each filter/separator has manual, water drain-off controls. Each filter/separator also has a pressure differential gage.

## PART B - INTERNAL COMPONENTS' OPERATION AND MAINTENANCE PROCEDURES

### 1. Internal Components and Operation.

Contaminated fuel is often present in the field. To purify contaminated fuel, use the filter/separator. The standard filter/separator consists of a filter element and a canister assembly. The canister element serves two purposes. It keeps the elements in place, and it facilitates water coalescence. The direction of the flow of fuel aids in the function of the filter/separator.

a. Filter Element. The standard filter element (national stock number [NSN] 4330-00-983-0998) fits inside the canister. The element is a perforated tube surrounded by a fiberglass filtering material, which in turn is wrapped with several layers of different materials. The fiberglass material filters solid particles from fuel.

#### **CAUTION**

Any form of sediment may clog the filters or injector nozzles of aircraft fuel systems. By abrasive action, solids damage finely tooled aircraft fuel system components. Large particles of metallic sediment indicate a failure somewhere in the fuel system.

The outside of the element (the coalescer) consists of layers of fiberglass, acetate, cotton knit, and fiberglass screen. The coalescer combines (coalesce) small droplets into larger heavier ones so they will fall to the bottom of the container.

The coalescer consists of an outer and inner tube, as shown in Figure 1-5. The inner tube, made of perforated metal and a metal screen, supports the filter element. The outer tube is made of perforated metal lined with a nonsticking, metallic-coated screen. You can take off an end seal plate at the top of the canister in order to reach the filter element.

(1) Outer Tube. The outer tube is a fiberglass blanket. The fiberglass is so finely spun that it traps minute droplets of water in their tracks. The droplets are held securely until they finally build up or coalesce into larger drops and then, by gravity, drop to the sump. Since water is heavier than light-viscosity fuel, 99.95 percent of the water goes into the sump, not into the aircraft fuel tank.

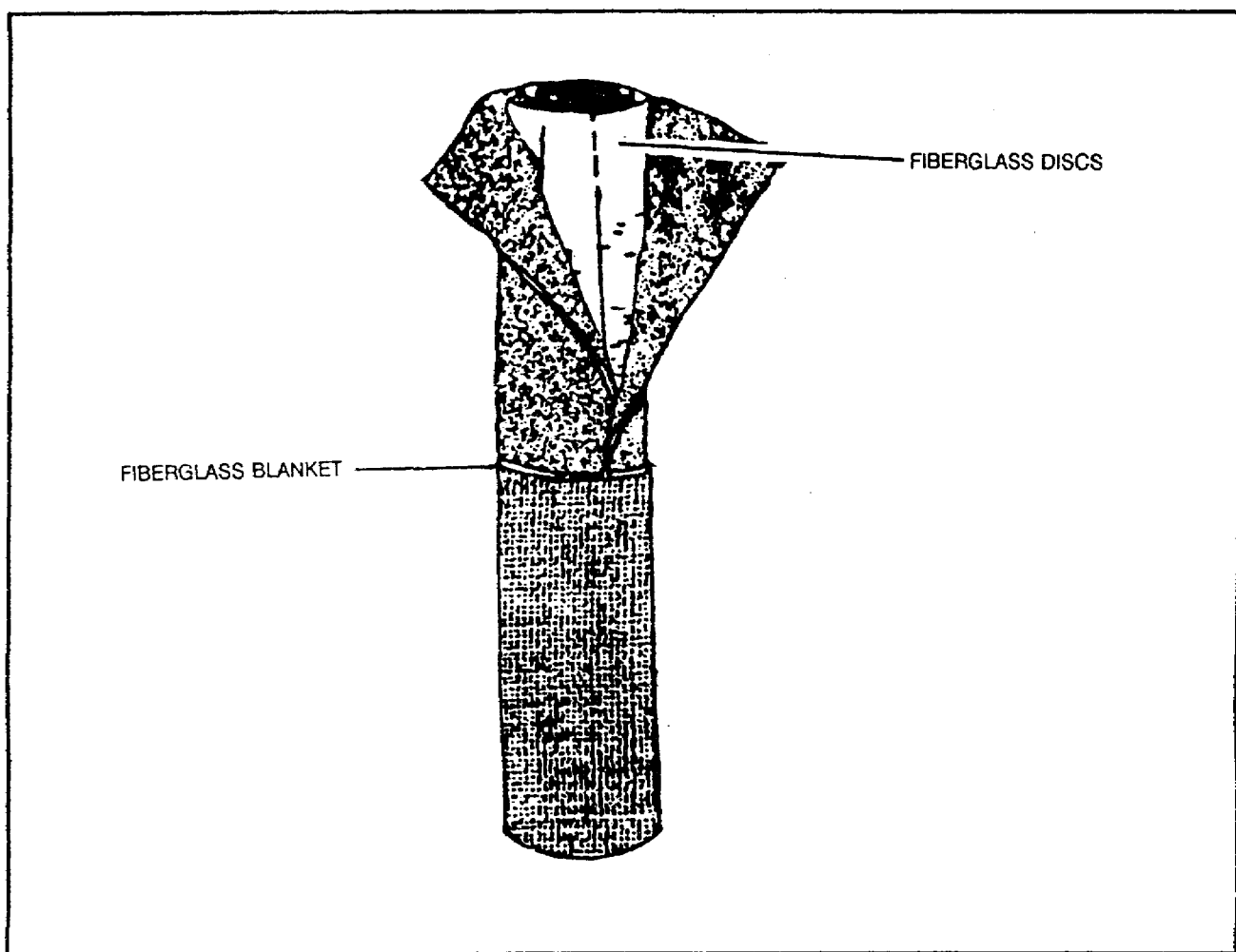


Figure 1-5. Outer and inner coalescer tubes

(2) Inner Tube. The inner tube, which consists of fiberglass discs, is the "heart" of sound filtration (described in the next subparagraph) and coalescence. No matter what the cost of the tank and the mechanical arrangement, any filter/separator is only as good as the filter element that it houses.

b. Filtering Process. The filtering process consists of two stages. One stage is filtration and the other is water coalescence.

(1) Filtration. During the filtration stage, raw fuel enters the center tube of the filter element through a fitting at the bottom of the canister. Solid contaminants are removed as the fuel flows outward from the perforated center tube through the fiberglass filtering material.

(2) Water Coalescence. As the fuel passes through the outer layers of the element, fine particles of water in the fuel coalesce into droplets. The fuel containing the coalesced water passes through the inner tube of the canister into the space between the inner and outer tubes. The metallic-coated screen of the outer tube does not allow water droplets to pass through it, and they fall to the bottom chamber of the filter/separator. Only clean fuel passes through the outer canister tube into the filter/separator tank. Figure 1-6 shows the flow of fuel through a 100-GPM filter/separator.

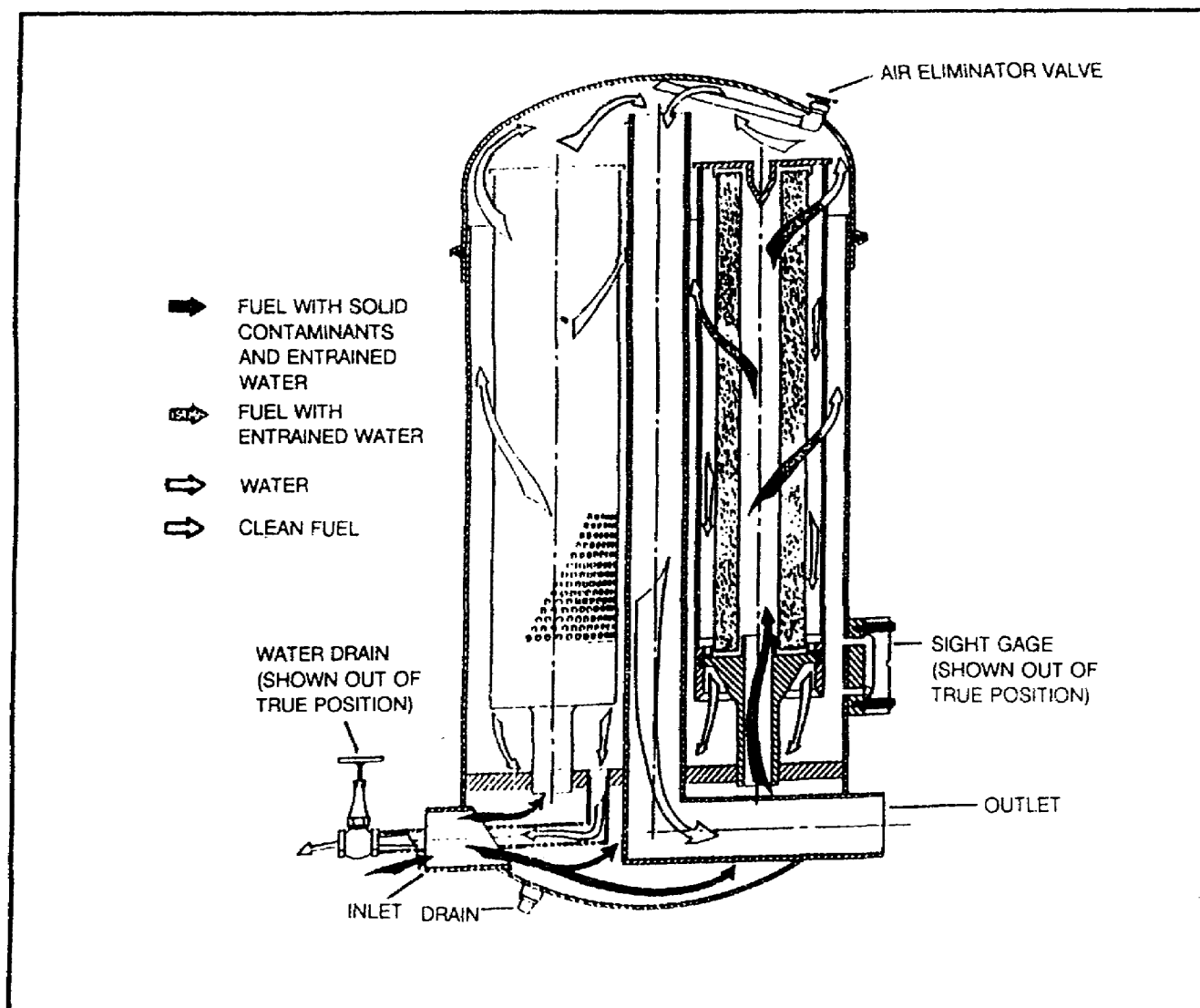


Figure 1-6. Flow of fuel through the 100-GPM filter/separator

2. Maintenance.

Your filter/separator operators are responsible for changing the filter elements and canisters when necessary. Ensure that they keep pressure differential indicator readings in a daily log to determine when maintenance is needed. You may use the suggested format for the daily log shown in Figures 1-7 and 1-8. The pressure differential will vary slightly in day-to-day operations because of different pumping rates and differences within products. However, if there is a sudden significant drop in the pressure differential, a filter element may have ruptured. If this happens, stop operations and change the filter elements immediately. Inspect the canisters, and replace them if they are damaged. When changing filter elements and canisters, always wear safety goggles and gloves to prevent fuel from contacting the eyes or skin. When you change filter elements, always stencil the date changed on the top of the filter/separator. Check the performance of all filter/separators in use every 30 days by submitting product samples to a laboratory. Immediately test those not in use prior to placing them in service and every 30 days thereafter while they are in use.

MICRONIC FILTER DIFFERENTIAL PRESSURE - FUEL-SERVICING EQUIPMENT (DAILY LOG)													
NOTE ANY SERVICES TO FILTERS ON REVERSE SIDE													
EQUIPMENT NOMENCLATURE (JP-4) FILTER/SEPARATOR, TRUCK-MOUNTED							FILTER SERIAL NO 1476						
DATE	INLET PRESSURE	OUTLET PRESSURE	F/S OUTLET PRESSURE	DIFFERENTIAL	DIFFERENTIAL ACROSS FUSES	INT	DATE	INLET PRESSURE	OUTLET PRESSURE	F/S OUTLET PRESSURE	DIFFERENTIAL	DIFFERENTIAL ACROSS FUSES	INT
13 MAR 84	40	30	36	10	6	RMA	30 MAR 85	38	25	29	13	4	RMA
14 MAR 84	39	28	34	11	6	RMA	23 MAR 85	40	26	31	14	5	RMA
23 MAR 84	40	26	34	14	8	RMA	25 JUL 85	40	24	29	16	5	RMA
23 APR 84	40	25	33	15	8	RMA	24 SEP 85	40	24	29	16	5	RMA
24 APR 84	40	24	32	16	8	RMA	23 APR 85	41	24	29	17	5	RMA
1 JUN 84	38	22	30	16	8	RMA	30 SEP 85	39	20	26	19	6	RMA
28 JUL 84	39	21	30	18	9	RMA	13 OCT 85	40	21	27	19	6	RMA
21 AUG 84	37	17	26	20	9	RMA	15 OCT 85	38	16	23	22	7	RMA
28 AUG 84	40	36	38	4	2	RMA	16 OCT 85	39	30	37	9	7	RMA
28 SEP 84	41	36	38	5	2	RMA	9 NOV 85	38	27	35	11	8	RMA
23 OCT 84	38	33	35	5	3	RMA	18 NOV 85	40	29	37	11	8	RMA
23 NOV 84	39	33	36	6	3	RMA	30 NOV 85	39	27	36	12	9	RMA
30 DEC 84	40	33	36	7	3	RMA	10 DEC 85	40	24	36	16	12	RMA
23 JAN 85	38	31	34	7	3	RMA	20 DEC 85	41	24	37	17	13	RMA
18 FEB 85	40	32	35	8	3	RMA	25 DEC 85	38	19	35	19	16	RMA
8 MAR 85	41	31	34	10	3	RMA	15 JAN 86	39	33	34	6	1	RMA
19 APR 85	39	28	32	11	4	RMA	21 FEB 86	39	32	35	7	3	RMA

Figure 1-7. Suggested format for a filter/separator daily log (front)

DATE	SERVICE PERFORMED
23 AUG 84	1st STAGE FILTER ELEMENTS AND 2d STAGE GO/NO-GO FUSES CHANGED. 2d STAGE CANISTERS REMOVED, CLEANED, AND INSPECTED.
23 AUG 84	SAMPLE TAKEN FROM DOWNSTREAM SIDE OF FILTER/SEPARATOR. SAMPLE ON SPEC.
23 AUG 84	SAMPLE TAKEN FROM DOWNSTREAM SIDE OF FILTER/SEPARATOR.*
16 OCT 85	1st STAGE FILTER ELEMENTS CHANGED.
16 OCT 85	SAMPLE TAKEN FROM DOWNSTREAM SIDE OF FILTER/SEPARATOR. SAMPLE ON SPEC.
16 NOV 85	SAMPLE TAKEN FROM DOWNSTREAM SIDE OF FILTER/SEPARATOR.*
15 JAN 86	3d STAGE GO/NO-GO FUSES CHANGED. 2d STAGE CANISTERS REMOVED, CLEANED, AND INSPECTED.
15 JAN 86	SAMPLE TAKEN FROM DOWNSTREAM SIDE OF FILTER/SEPARATOR. SAMPLE ON SPEC.
15 FEB 86	SAMPLE TAKEN FROM DOWNSTREAM SIDE OF FILTER/SEPARATOR.*
	* NOTE: A SAMPLE WILL BE TAKEN MONTHLY AND SENT TO THE LAB FOR ANALYSIS.

Figure 1-8. Suggested format for a filter/separator daily log (back)

3. Preventive Maintenance Checks and Services.

Conduct preventive maintenance checks and services (PMCS) before (B), during (D), and, or after, (A) operating equipment and, or on, a weekly (W) or monthly (M) basis, as indicated in Figure 1-9. During PMCS on the 350-GPM filter/separator, inspect specific items, following particular procedures, in accordance with the instructions provided in Figure 1-9.

Interval	Item to be Inspected
B D A W M	
1	INLET AND OUTLET COUPLINGS Inspect for secure fit. Ensure that the cams are tight.
2	HEAD BOLTS Ensure that the head bolts are tight.
3	SIGHT GAGE Inspect the sight gage for cracks. Ensure that the bolts are tight.
4	AIR VENT VALVE Inspect for secure fit. Ensure that the winged screw works freely.
5	DRAIN VALVE Inspect for secure fit. Ensure that the handle is in the OFF position.

Figure 1-9. 350-GPM filter/separator preventive maintenance checks and services

LESSON

PRACTICE EXERCISE

The following items will test your grasp of the material covered in this lesson. There is only one correct answer for each item. When you complete the exercise, check your answer with the answer key that follows. If you answer any item incorrectly, study again that part of the lesson which contains the portion involved.

Situation: You are a petroleum management supervisor. You are visually inspecting filter/separators of various gallons-per-minute capacity before assigning them to operators for use. Use this situation and Figure 1-10 to answer questions 1 through 4.

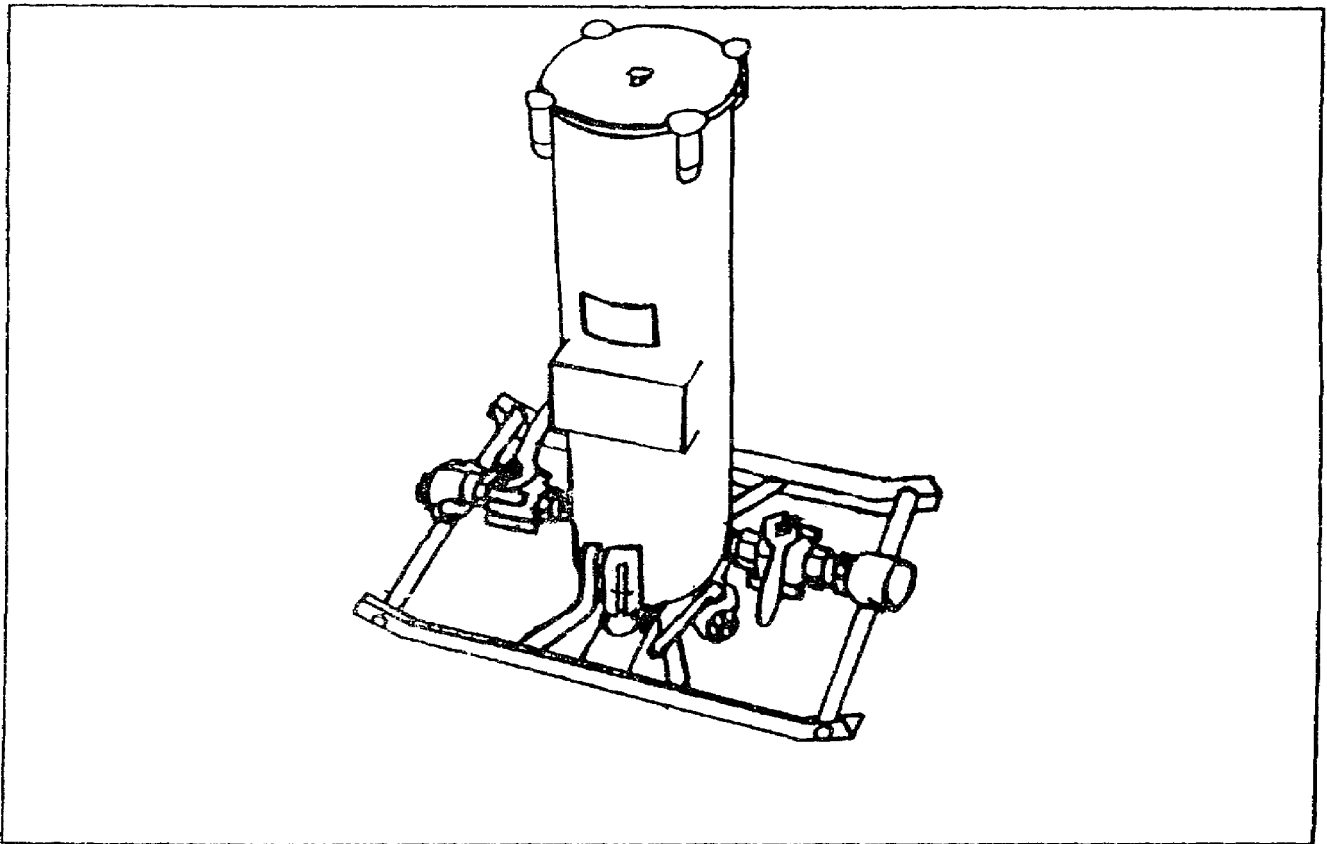


Figure 1-10. Filter/separator



1. You examine the filter/separator shown in Figure 1-10. This filter/separator is which of the following types?
  - A. 15 GPM.
  - B. 50 GPM.
  - C. 100 GPM.
  - D. 350 GPM.
  
2. The skid upon which the filter/separator shown in Figure 1-10 is mounted is made of what kind of metal?
  - A. Steel.
  - B. Cast iron.
  - C. Copper.
  - D. Aluminum.
  
3. Refer to Figure 1-10. To check the fuel inlet and outlet valves, you look at what part of the filter/separator's tank?
  - A. Top.
  - B. Bottom.
  - C. Front.
  - D. Rear.
  
4. You use the filter/separator shown in Figure 1-10 for which of the following purposes?
  - A. Pump fuel that is free of solid contaminants and water.
  - B. Fill large tanks.
  - C. Service ground vehicles.
  - D. Filter military hose line systems.

## LESSON

### PRACTICE EXERCISE

#### ANSWER KEY AND FEEDBACK

<u>Item</u>	<u>Correct Answer and Feedback</u>
1.	<p>A. 15 GPM.</p> <p>Figure 1-10 shows the 15-GPM filter/separator, which is also shown in Figure 1-1. (Page 1-3, Figure 1-1)</p>
2.	<p>D. Aluminum.</p> <p>The 15-GPM filter/separator (shown in Figure 1-1) is a vertical, portable unit consisting of an aluminum tank mounted on an aluminum skid. (Page 1-2, para 1a)</p>
3.	<p>B. Bottom.</p> <p>The tank has fuel inlet and outlet valves, a water drain valve, and a water level sight gage. The fuel inlet and outlet valves are identical, 1-inch manually operated ball valves. They are attached near the bottom of the tank. (Page 1-2, para 1a)</p>
4.	<p>A. Pump fuel that is free of solid contaminants and water.</p> <p>Use the 15-GPM filter/separator with the 15-GPM, hand-operated dispensing pump to pump fuel that is free of solid contaminants and water. If no other aircraft refueling equipment is available, you may use the 15-GPM pump and filter/separator to refuel light aircraft. (Page 1-3, para 1b)</p>

APPENDIX A - LIST OF COMMON ACRONYMS

ACCP	-	Army Correspondence Course Program
AWR	-	answer weight reference
AV	-	autovon
COML	-	commercial
FARE	-	forward area refueling equipment
FM	-	field manual
GPM	-	gallons per minute
IPD	-	Institute for Professional Development
NSN	-	national stock number
PMCS	-	preventive maintenance checks and services
PSI	-	pounds per square inch
QM	-	quartermaster
VA	-	Virginia