TECHNICAL MANUAL FOR NAVY SHIPBOARD COLLECTIVE PROTECTION SYSTEM (CPS) CHEMICAL, BIOLOGICAL, AND RADIOLOGICAL (CBR) FILTER SYSTEM

OPERATION AND MAINTENANCE

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CHANGE RECORD

Change No.	Date	Title and/or Brief Description	Signature of Validating Officer
Revision 1	01/14/98	Prefilter system adjustments Freon leak testing removed Three-year gas filter life	

PREFACE

The anticipated use of chemical, biological, and radiological (CBR) weapons against Navy ships has reinforced the need to provide better defensive measures to protect personnel and vital ship spaces from toxic chemical and biological agents and radioactive fallout. The Navy Shipboard Collective Protection System (CPS) provides CBR protection to designated shipboard zones. This manual provides instructions for the use and maintenance of the CBR filter system used in the CPS. The CBR filter system is one of several elements that comprise the CPS; for a more detailed account of actual CPS operations, refer to the system description, operation and maintenance manual, SS200-AF-MMM-010.

The equipment described in this manual was developed and tested by the Naval Surface Warfare Center Dahlgren Division (NSWCDD) and approved by the Naval Sea Systems Command (NAVSEA).

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SAFETY SUMMARY

The following are general safety precautions that are not related to any specific procedures and therefore do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

KEEP AWAY FROM LIVE CIRCUITS

Operating personnel must at all times observe all safety regulations. Do not replace components or make adjustments inside the equipment with the high voltage supply turned on. Under certain conditions, dangerous potentials may exist when the power control is in the off position, due to charges retained by capacitors. To avoid casualties, always remove power and discharge and ground a circuit before touching it.

DO NOT SERVICE OR ADJUST ALONE

Under no circumstances should any person reach into or enter the enclosure for the purpose of servicing or adjusting the equipment except in the presence of someone who is capable of rendering aid.

RESUSCITATION

Personnel working with or near high voltages should be familiar with modern methods of resuscitation. Such information may be obtained from the Bureau of Medicine and Surgery.

The following warnings and cautions appear in the text in this volume, and are repeated here for emphasis.

WARNING

Do not start the fan while the outlet plenum access is open. Personnel injury may result. (Page 2-2)

WARNING

Ensure all tag-out procedures are in accordance with current shipboard instructions. (Pages 4-2 and 6-1)

WARNING

Chemical protective gear must be worn during change-out after a CBR attack. Use extreme caution to prevent any part of protective clothing from being punctured or torn. Failure to do so could result in contamination of personnel. (Page 4-3)

WARNING

To prevent personnel injury or fan damage, do not open the outlet plenum access while the supply fan is running. (Page 6-1)

WARNING

If filters become contaminated by chemical, biological and radiological (CBR) agents, a special mobile team will change out contaminated prefilters and CBR filters. Shipboard personnel shall **not** change contaminated CBR filters **or** prefilters. (Page 6-2)

CAUTION

Do not start the fan while the supply fan damper is closed. Damage to the fan may result. (Page 2-2)

CAUTION

Failure to perform prescribed maintenance will result in greatly decreased CBR filter life and damage to supply fans. (Page 2-2)

CAUTION

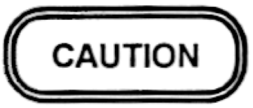
Do not allow the HEPA cover to cock or come off crooked, or the studs may be bent or broken. (Page 4-3)

CAUTION

Do not allow the gas cover to cock or come off crooked, or the studs may be bent or broken. (Page 4-5)

CAUTION

The gas filter weighs 35 lb. Do not allow it to fall and strike the studs on the filter housing. This may cause the studs to bend. (Page 4-5)



Use care when installing the O-ring gasket; do not tear or break the outside surface. The gasket is a critical component of the filter system. Improper installation will result in system failure. (Page 4-6)

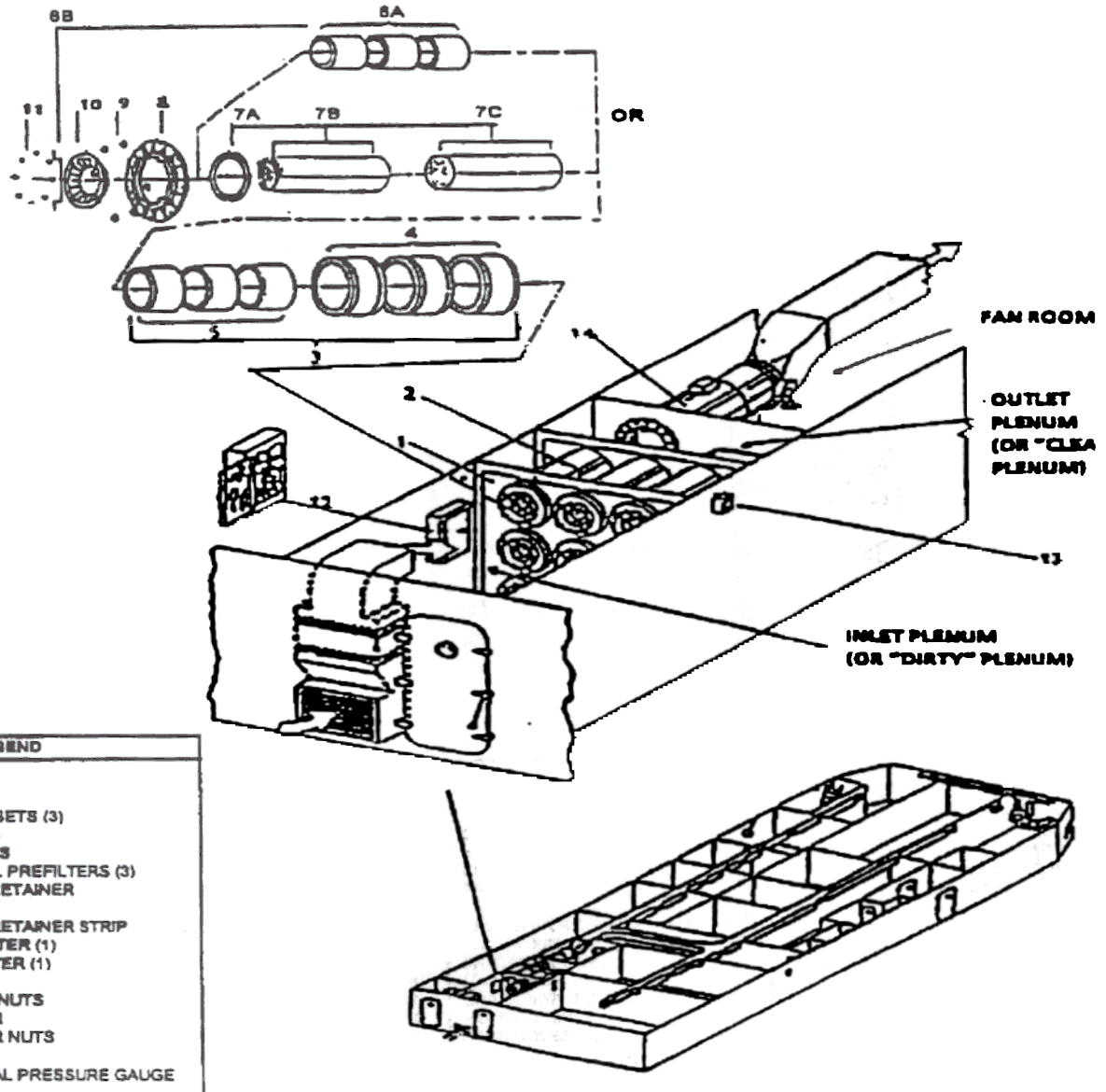
Spinning the HEPA cover nuts more than two turns may damage the HEPA filter. (Page 4-6)

The HEPA cover nuts are spring-loaded with an internal spring and plunger. The plunger must be completely compressed to ensure proper loading of the HEPA filter. The HEPA cover nuts may still feel loose. Do not tighten past this point, or the HEPA filter may be damaged, causing system failure. (Page 4-7)

To avoid a fire hazard, do not substitute a non-inert gas, such as compressed air, for nitrogen. (Page 4-9)

Because the aerosol generator produces a thick cloud of white smoke, do not turn the AEROSOL switch on with supply fan(s)off. (Page 4-9)

Do not put filter closure covers on the filter housings while the fan is running. Damage to the fan may result. (Page 6-1)



LEGEND	
1	CASING
2	HOUSING
3	CBR FILTER SETS (3)
4	GAS FILTERS
5	HEPA FILTERS
6A	CYLINDRICAL PREFILTERS (3)
6B	PREFILTER RETAINER OR
7A	PREFILTER RETAINER STRIP
7B	FLAT PREFILTER (1)
7C	BAG PREFILTER (1)
8	GAS COVER
9	GAS COVER NUTS
10	HEPA COVER
11	HEPA COVER NUTS
12	TOOL KIT
13	DIFFERENTIAL PRESSURE GAUGE
14	SUPPLY FAN

Figure 1-1. CBR Filter System and Supporting Components as Elements of CPS

CHAPTER 1
GENERAL INFORMATION AND SAFETY PRECAUTIONS

1-1 SAFETY PRECAUTIONS.

Personnel involved with the use and maintenance of the Navy Shipboard Collective Protection System (CPS) chemical, biological, and radiological (CBR) filter system must comply with the safety precautions included in this manual. The Safety Summary provides general safety precautions, as well as specific cautions contained elsewhere in this manual.

INTRODUCTION.

This technical manual covers operation and maintenance of the CBR filter system (figure 1-1) used with the Navy Shipboard CPS. The information provided includes physical and functional descriptions of the CBR filter system, instructions for use, maintenance information, and a parts list identifying all repair parts.

EQUIPMENT DESCRIPTION.

The CBR filter system is used in CPS total protection (TP) zones to remove solid, liquid, and gaseous CBR contaminants from supply air. The system consists of one or more housing assemblies, each containing three CBR filter sets and one bag plus flat, or three cylindrical prefilters, mounted in a casing assembly. The number of housings depends on the supply flow requirements of the TP zone being protected. Each housing has a rated airflow capacity of 600 cfm; each CBR filter set, 200 cfm, bag plus flat prefilter, 600 cfm, and each cylindrical prefilter, 200 cfm.

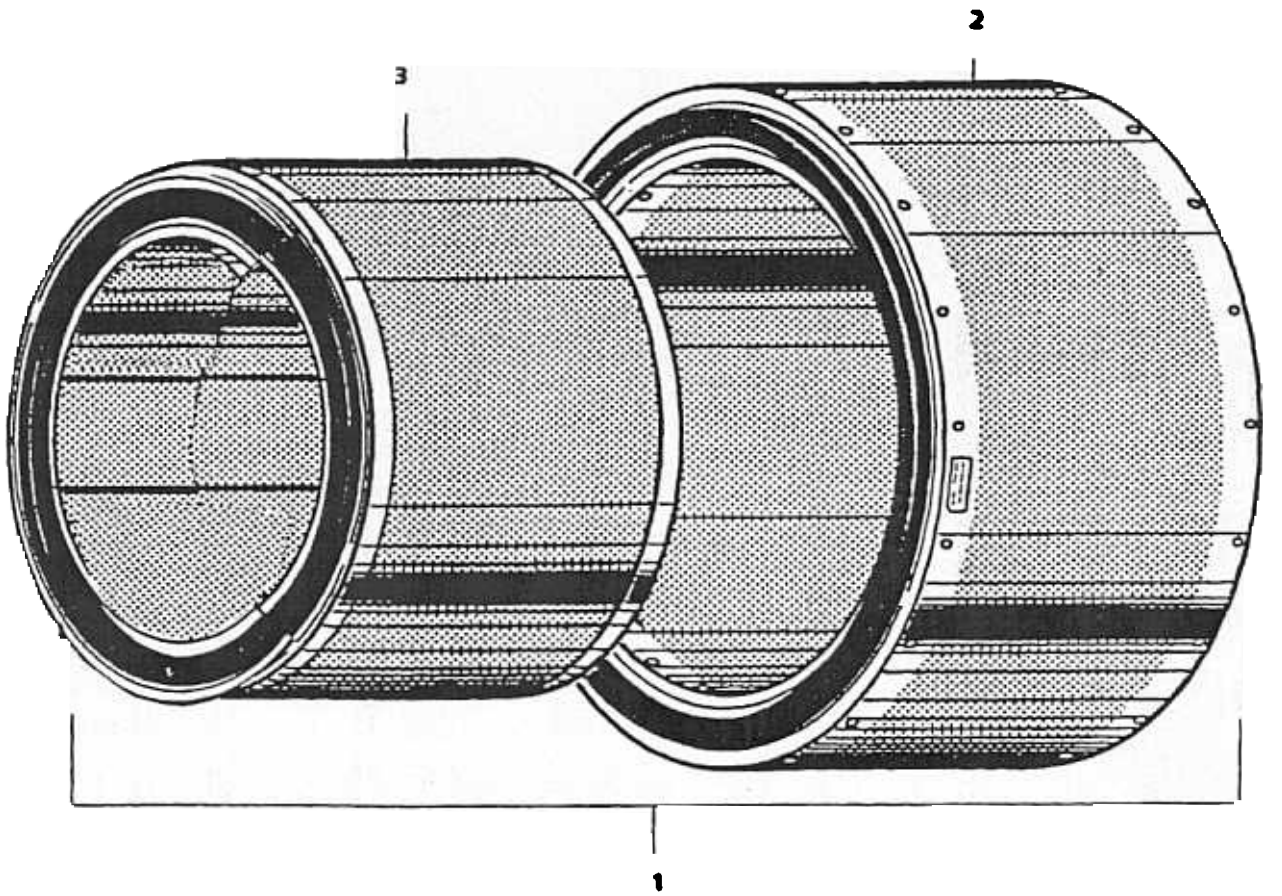
Although the basic components are the same, filter system configuration may vary between ships. Basically, the system may be one of two designs: NAVSEA Dwg No DL6263417, Revision C and earlier, or the modified design, NAVSEA Dwg No DL6263417 Revision D and later. In the original design, the CBR filter sets are supported by a center support tube (CST) in the filter housing. The housing itself is mounted in two bulkheads. In the Revision D and later designs, the filter sets are supported by rails around the outside of the filters in the housing. The housing itself is mounted to a bulkhead only in the front. The aft end is supported by vertical T-rails. Specific differences are listed in table 1-1. A detailed description of each component is provided below.

1-3.1 CBR Filters.

1-3.1.1 CBR Filter Set. The cylindrical CBR filter set, which is packaged and changed out as a unit, consists of a high efficiency particulate arresting (HEPA) filter nested inside a gas adsorber (figure 1-2). The same filter set configuration is used with all system configurations. This filter set configuration was selected based on the rigid construction of the filters and their ability to survive MIL-S-901 shock tests and MIL-STD-167 vibration tests when installed in filter housing above and meet Navy performance requirements. Three filter sets are mounted inside each housing.

Table 1-1. Comparison of System Configurations

Component	NAVSEA Dwg No DL6263417 Revision C and Earlier	NAVSEA Dwg No DL6263417 Revision D and Later
CBR Filters		
CBR Filter Set	None	None
Flat Prefilter	None	None
Bag Prefilter	11.25-in. outer diameter	12-in. outer diameter
or		
Cylindrical Prefilter	11.3-in. outer diameter	12-in. outer diameter
Housing	16 gas cover nuts; uses center support tube for support and alignment	8 gas cover nuts; uses stiffeners inside housing for support and alignment
Casing Assembly	Double bulkhead	Single bulkhead with T-rails (Double bulkhead optional)



LEGEND	
1	CBR FILTER SET
2	GAS ADSORBER
3	HEPA FILTER

Figure 1-2. CBR Filters

The HEPA filter is a two-stage, pleated-medium filter for removing solid and aerosol CBR contaminants. It weighs approximately 10 lb. Sealing is maintained by a gasket on each end of the filter.

The gas adsorber contains activated charcoal for removing chemical warfare gases. It weighs approximately 35 lb. Sealing is maintained by a gasket on each end of the filter

There is one filter set available for use in the CPS filter system. The filter set NSN 4240-01-369-6533 provides protection against all known agents for a period of 3 yr. It should be noted that these filters still provide significant protection after 3 yr, but they may not meet new filter specifications. It should be noted, also, that the 3 yr is for the gas filter and the charcoal used therein, and that the HEPA filter is based on pressure drops and not time. If loading on the HEPA filter is premature, an earlier change-out of the CBR filter set will be required. The CBR filter set contains ASZM-TEDA charcoal and is ***not*** considered HAZMAT.

1-3.1.1.1 Replacing CBR Filter Sets. Periodic replacement of CBR filter sets (3 yr) is performed by an Intermediate Maintenance Activity (IMA). The IMA also has special equipment to leak-test the newly installed filters to certify readiness. Ships must schedule the IMA to replace CBR filters and certify CBR filters according to the date listed on the CBR filter differential pressure gauges or as required.

Prior to long-term deployments, ships should review the CBR filter change date indicated on the CBR filter gauges. If the replacement date occurs during the deployment period, the ship should contact an IMA and ensure the CBR filter replacement and leak testing is performed prior to the deployment. This action will greatly ease logistics considerations while deployed.

1-3.1.1.2 Replacing CBR-Contaminated Filter Sets. Ship's personnel should never attempt to change CBR-contaminated filters; this job is performed by a specially trained mobile team. Due to the design of the CBR filters, CBR contaminants cannot pass through the filters, and there is no urgency for changing contaminated filters. CPS should be operated in its normal mode after encountering CBR contamination.

1-3.1.2 Prefilter. Either one bag plus one flat prefilter or three cylindrical prefilters (figure 1-3) are installed inside each CBR filter housing. The flat prefilter (NAVSEA Dwg No. 6892409-3) is available for use in filter housings both with and without a center support tube (CST). The bag prefilter is available in two diameters, (NAVSEA Dwg No. 6892410-1) for use in filter housings with a CST, and (NAVSEA Dwg No. 6892410-4) without a CST. The cylindrical prefilter is available in two diameters, (NAVSEA Dwg No. 6573317-2) for use in filter housings with a CST, and (NAVSEA Dwg No. 6573317-1) without a CST.

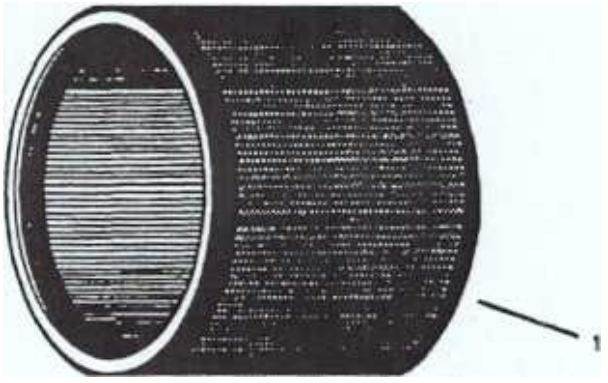
1-3.1.2.1 Replacing Prefilters. Prefilters require periodic replacement by shipboard personnel as part of routine maintenance. Procedures for determining when prefilter replacement is required can be found in Collective Protection System SYSCOM MIP 5121 (Perform zone pressurization test). The period for replacement varies from 6 to 12 months in an open ocean environment to less than 2 months in a ship construction yard environment. However, the prefilter life in a ship construction yard environment can be significantly increased by adding and maintaining additional temporary filtration measures to the exterior intakes during any dockside period, in accordance with NSTM S9086-RQ-STM-010, Chapter 510, Section 510-7.1.18.

Failure to maintain the prefilters as prescribed will result in premature loading of the expensive CBR filter sets and a possible failure of the supply fan bearings. If this happens, the ship will be required to procure all new CBR filter sets before the previously scheduled replacement, and undergo an extensive ship alteration to remove and replace the damaged supply fans. This will have a major impact on readiness and cost to the ship.

1-3.1.2.2 Replacing CBR-Contaminated Prefilters. Ship's personnel should never attempt to change CBR-contaminated prefilters. This job is performed by a specially trained mobile team.

1-3.1.2.3 Spare Prefilters. To ensure readiness, ships should always carry enough spare prefilters to perform a complete replacement (see Allowance Parts List (APL) 480190067 for Revision C and earlier, and APL 489980622 for Revision D and later systems.) All prefilters must be stored in a clean, dry area, preferably inside the CPS zone. Some ships have specially designated storerooms for these prefilters.

1-3.2 Housing. The housing provides an enclosure to support the CBR filters. In Revision C and earlier systems, the housing includes a CST. In Revision D and later systems, stiffeners run lengthwise inside the housing. In all systems, the housing is secured to the casing.



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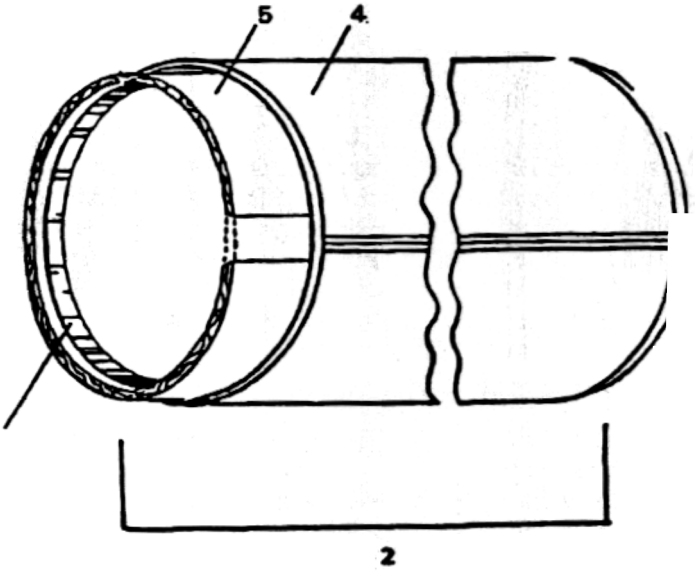


LEGEND	
1	CYLINDRICAL PREFILTER (3 PER HOUSING)
2	BAG PLUS FLAT PREFILTER (1 PER HOUSING)
3	PREFILTER RETAINER STRIP
4	BAG PREFILTER
5	FLAT PREFILTER

Figure 1-3. CBR Prefilters (Alternate Arrangement)

HEPA and gas covers are secured to the front of the housing to secure the filter elements. In Revision C and earlier designs, the HEPA cover is secured with 8 nuts and the gas cover with 16 nuts. In Revision D and later designs, the HEPA and gas covers are each secured with eight nuts. In all Revisions, one prefilter retainer strip holds the bag plus flat prefilter in place. In Revision C and earlier designs, the cylindrical prefilter is held in place with a prefilter retainer (NAVSEA Dwg No 6573684), and Revision D and later with prefilter clamps (NAVSEA Dwg No 6573312).

In all systems, a filter housing closure cover with eight cap screws and flat washers is stored in or near the clean plenum area and is secured to the aft end of the housing when a contaminated filter change-out is performed.

The casing is the structure to which the filter housings are mounted. The actual configuration of the casing depends on filter system design and capacity. In Revision C and earlier designs, the casing assembly is a double bulkhead structure. In Revision D and later systems, the casing consists of a single forward bulkhead with aft end T-rails and a mounting plate.

The capacity of the filter system affects the number of housings required, which in turn affects the size and shape of the casing. Figure 1-3 shows the recommended configurations for various system capacities.

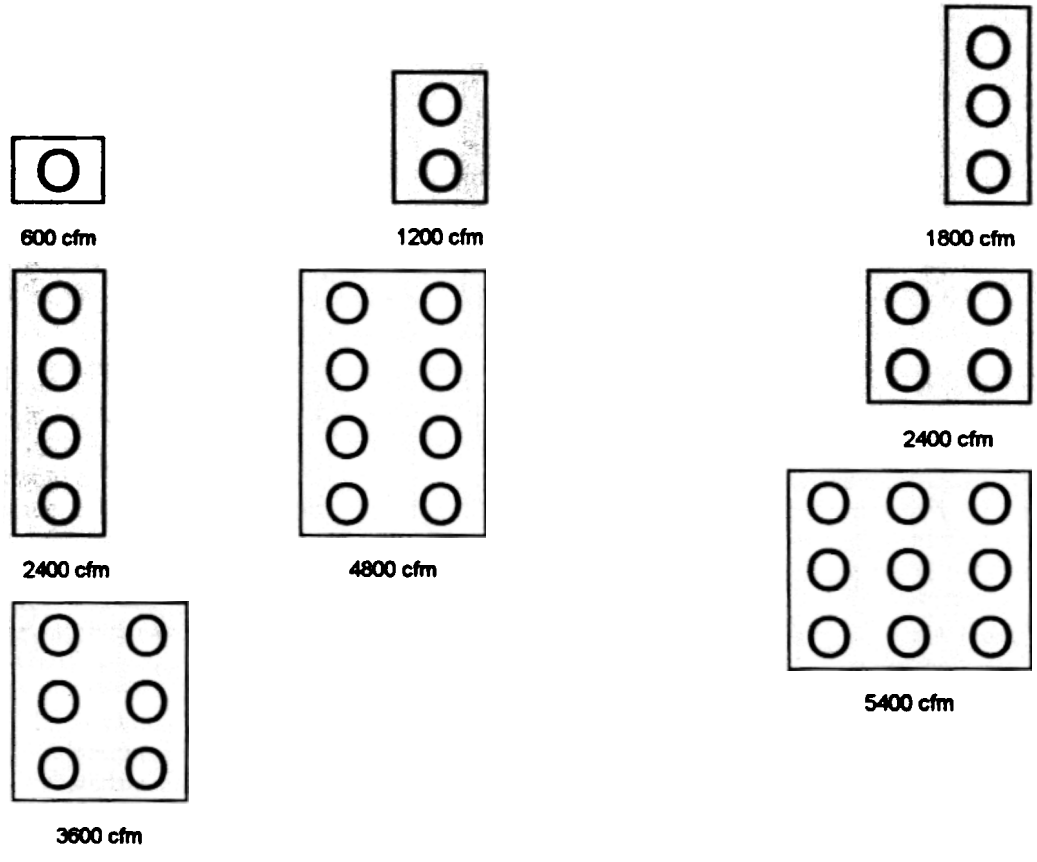


Figure 1-4. Recommended Casing Assembly Configurations

1-4 SUPPORTING COMPONENTS.

1-4.1 CBR Filter Differential Pressure Gauge. A differential pressure gauge is mounted near the CBR filter system (13, figure 1-1). This gauge measures pressure drop across the filters, providing an indication of airflow resistance. The gauge face has a sticker that indicates the start of the red region to indicate high-pressure drop and a date when the next CBR filter replacement is due. The start of the red region will vary from gauge to gauge, depending on system design and capacity.

1-4.2 Supply Fan. A high-pressure vaneaxial fan (14, figure 1-1) is located downstream of the CBR filter system. These high-pressure fans pull air through the filter system and supply it to the total protection (TP) zone through ventilation ducts.

1-5 REFERENCE DATA.

CBR filter system capabilities are described in table 1-2

1-6 EQUIPMENT AND ACCESSORIES SUPPLIED.

Table 1-3 lists equipment and accessories furnished with the CBR filter system. Accessories provided include a filter change-out tool kit (NAVSEA Dwg No 6263472). The kit contains specially-designed tools to be used under the IMA supervision for changing out a CBR filter system. It is usually located inside the inlet plenum of the fan room (12, figure 1-1). Figure 1-5 identifies all tools in the kit.

1-7 REFERENCE PUBLICATIONS.

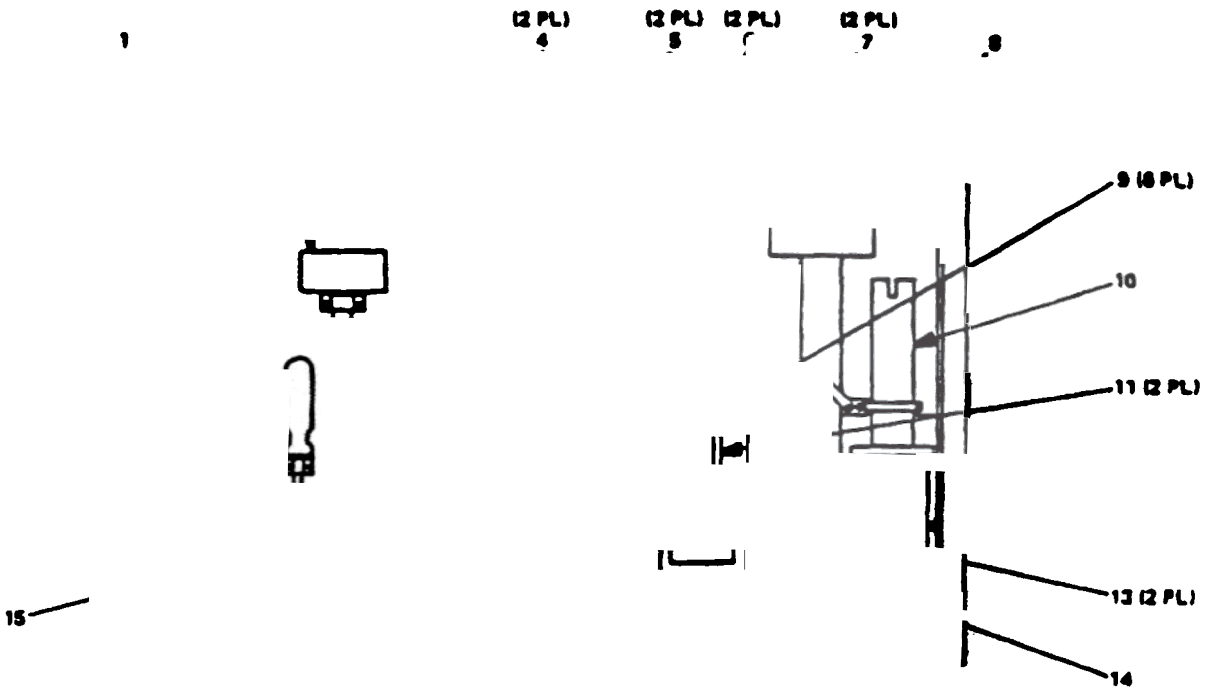
Table 1-4 provides a list of reference publications pertaining to the CPS and its other components. Additional information related to the operation and maintenance of the CPS CBR filter system may be found in the Ship Information Book (SIB), the ship's Heating, Ventilation, and Air Conditioning System Technical Manual, the Training Aid Booklet (TAB), the Damage Control (DC) book and plates, along with the booklet of general plans, NWP 62-1 and NSTM Chapters 470, 070, 079, and 510.

Table 1-2. CBR Filter System Equipment Capabilities

Equipment	Capability
CBR Filter Set (HEPA and Gas)	200 cfm
Bag plus Flat Prefilter	600 cfm
Cylindrical Prefilter	200 cfm
CBR Filter Housing	600 cfm
CBR Filter System	600 cfm minimum

Table 1-3. Equipment and Accessories Supplied

Item	Qty
CBR Filter Set	3/housing
Bag plus Flat Prefilter	1/housing
Cylindrical Prefilter	3/housing
Housing	Variable
Casing	1/system
Filter Change-Out Tool Kit	1/system



LEGEND	
1	HEPA/Gas Cover Nut Wrench
2	Rubber Hammer
3	Wrench Handle
4	Gas Filter Extractor Point
5	Gas Filter Extractor Tip
6	HEPA Filter Extractor Tip
7	Extractor Knob
8	Filter Container Opening Tool, Head Extension
9	Extractor Shaft
10	Tool Head, Opening, Filter Container
11	Tool Assembly, Groove Cleaning
12	Tool Box
13	Allen Wrench
14	Filter Container Opening Tool, Handle
15	Open End Wrench
16	Flat Tip Screwdriver

Figure 1-5. Filter Change-Out Tool Kit (NAVSEA Dwg No 6263472)

Table 1-4. Reference Publications

Publication Number	Title
SS200–AF–MMM–010	Navy Shipboard Collective Protection System (CPS) Technical Manual: System Description, Operation and Maintenance
SS200–AH–MMM–01	Navy Shipboard Collective Protection System (CPS) Technical Manual: Alarm System Operation and Maintenance
SS200–AJ–MMM–010	Navy Shipboard Collective Protection System (CPS) Technical Manual: Pressure Control Valve (PCV) Operation and Maintenance
SS200–AK–MMM–010	Navy Shipboard Collective Protection System (CPS) Technical Manual: Decontamination Station Operation and Maintenance (DRAFT)

CHAPTER 2
OPERATION

2-1 INTRODUCTION.

The chemical, biological, and radiological (CBR) filter system is part of the Navy Shipboard Collective Protection System (CPS), which provides filtered air to designated shipboard zones to protect against CBR contamination. The CBR filter system contains high efficiency particulate arresting (HEPA) filters for removing particulates and aerosols, and gas filters filled with activated charcoal for removing toxic gases.

As air continuously passes through the CBR filters, HEPA filters collect dust, gradually becoming so loaded that airflow through the system is reduced. Left uncorrected, zone pressure may not be available, and vaneaxial fan motors may be damaged by the lack of cooling air. Therefore, the operator must ensure that CPS maintenance is being routinely performed.

2-2 CONTROLS AND INDICATORS.

2-2.1 Supply Fan Controller. CPS supply fans are controlled by standard Navy fan controllers. Several different types of fan controllers may be used with CPS. The Ship Information Book (SIB) should be consulted to determine the type of fan controller, as well as specific information concerning operation and maintenance.

2-2.2 Preheater Controls. CPS uses standard Navy preheaters for treatment of incoming air for personnel comfort purposes. The preheater type may be steam or electric, and is located in the air intake/air lift. It is controlled by a thermostat and in some cases also by a humidistat, which are usually located in the CPS inlet plenum. The SIB should be consulted for information concerning the type of preheater used, as well as details regarding operation and maintenance.

2-2.2.1 Thermostat. Standard Navy thermostats are used to control the temperature of the air being delivered to the CBR filter system. The thermostat should be set to activate the preheater at a temperature of 42 °F. The SIB should be consulted to determine the type of thermostat, as well as specific information concerning operation and maintenance.

2-2.2.2 Humidistat. CPS use standard Navy humidistats to control the humidity of incoming air. These humidistats and controls are usually located in the CPS inlet plenum. The humidistats should be set to activate at a relative humidity of 70%. Several different types of humidistats may be used with CPS. The SIB should be consulted to determine the type of humidistat, as well as specific information concerning operation and maintenance.

2-2.3 CBR Filter Differential Pressure Gauge. The CBR filter differential pressure gauge is usually mounted near the CPS supply fans (see figure 1-1). It indicates the pressure drop across the CBR filters. The gauge face has a sticker that specifies a red region to indicate high-pressure drop and a date when the next filter change is due. The red region will vary from gauge to gauge, depending on system design and capacity. An example of a gauge is shown in figure 2-1.

2-2.4 Navy Standard Impingement Filter (NSIF) Differential Pressure Gauge. The NSIF differential pressure gauge is usually mounted near the CPS supply fan. It indicates the airflow resistance across the metal impingement filters. A red mark on the gauge face indicates high resistance.

2-2.5 CPS Alarm System Pressure Gauges. The CPS alarm system gauges indicate the true pressure in a CPS zone. One gauge is located in Damage Control Central (DCC), and one is at the zone sensor box (usually located inside the ship near the exterior static air probe). See NAVSEA Technical Manual SS200-AH-MMM-010 for more information.

2-2.6 Zone Pressure Gauge. Zone pressure gauges may be located near airlocks throughout the CPS zone to provide a reference to zone pressurization These gauges must not be used as true indicators of exact zone pressure, because their reference ports do not negate the effects of static pressure due to wind conditions.

2-3 OPERATING PROCEDURES.

The CBR filter system operates when the ventilation system supply fan pulls air through the filters, providing filtered air to shipboard zones.

In normal operation, the outlet and inlet plenums must both be free from obstructions and the supply fan damper open. To start up the system, proceed as follows:

a. Enter inlet plenum.
b. Ensure no loose material or flow obstructions block airflow from uptake to filter housings.
c. Ensure nothing blocks airflow into filter housings.
d Close and dog door after all personnel are out of inlet plenum.
e. Ensure supply fan damper, located downstream of fan, is open.

WARNING

Do not start fan while outlet plenum access is open. Personnel injury may result.

CAUTION

Do not start fan while supply fan damper is closed. Damage to fan may result.

f. Energize supply fan.
g. If required, see Technical Manual SS200–AF–MMM–010 for troubleshooting procedures.

2-4 OPERATOR MAINTENANCE.

The operator should regularly ensure that all preventative maintenance is up to date and has been performed in a timely manner.

CAUTION

Failure to perform prescribed maintenance will result in greatly decreased CBR filter life and damage to supply fans.

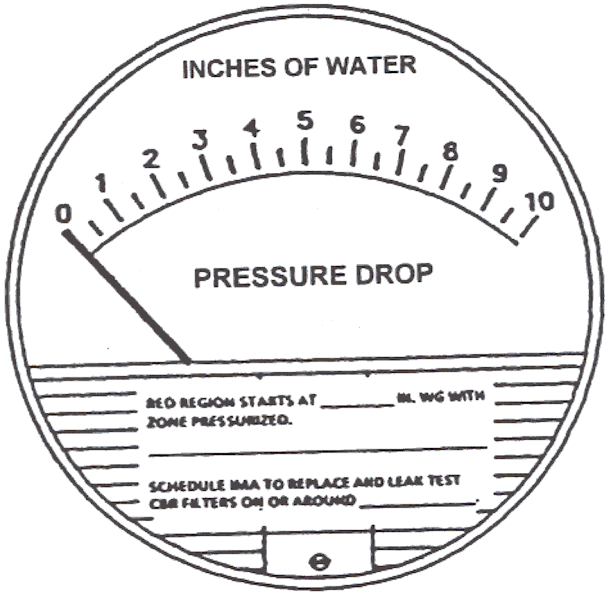


Figure 2-1. CBR Filter Differential Pressure Gauge Face (NAVSEA Dwg No 6573294-3)

CHAPTER 3
FUNCTIONAL DESCRIPTION

3-1 INTRODUCTION.

This chapter describes how the Navy Shipboard Collective Protection System (CPS) chemical, biological, and radiological (CBR) filter system operates. It provides an explanation of the overall function of the filter system, as well as a functional description of its major subassemblies.

3-2 OVERALL FUNCTIONAL DESCRIPTION.

In a CPS total protection (TP) zone, air passes through the CBR filter system where solid, liquid, and gaseous CBR contaminants, as well as normal airborne contaminants (e.g., dirt, dust, debris), are removed from supply air. The filtered air is then directed to the protected zone where it is used for ventilation and then exhausted.

The CBR filter system consists of one or more filter housings, each containing three CBR filter sets and one bag plus flat or three cylindrical prefilters, mounted to a casing assembly. The number of housings is based on the supply flow requirements of the TP zone being protected. Each housing has a rated airflow capacity of 600 cfm; each CBR filter set, 200 cfm; bag plus flat prefilter, 600 cfm; and each cylindrical prefilter, 200 cfm.

3-3 FUNCTIONAL DESCRIPTION OF SUB-ASSEMBLIES.

The major subassemblies of the CBR filter system are the CBR filters, prefilter(s), housing, and casing.

3-3.1 CBR Filters

3-3.1.1 CBR Filter Set. The CBR filter set is the main functional element of the CBR filter system. It includes a high efficiency particulate arresting (HEPA) filter and a gas adsorber. Air flows radially through the filters (figure 3-1), passing first through the HEPA filter, where particulates and aerosols are removed, and then through the gas adsorber, where activated charcoal adsorbs chemical warfare gases.

3-3.1.2 Prefilter. The one 600-cfm bag plus flat prefilter or three cylindrical prefilters are installed inside the CBR filter set. They capture coarse particulates to reduce loading on the CBR HEPA filter to greatly extend CBR filter life.

3-3.2 Housing. The housing is mounted to the casing, to enclose and support the CBR filters. In Revision C and earlier systems, a center tube provides support. In Revision D and later systems, stiffeners run lengthwise inside the housing to provide support. The HEPA and gas covers, secured by cover nuts, provide a means for securing the CBR filter sets inside the housing. O-ring gaskets for both the HEPA and gas covers ensure a sufficient seal. A filter closure cover, used by specially trained mobile teams, is secured to the aft end of each housing during filter change-out after a CBR attack to prevent contaminants from infiltrating protected areas.

3-3.3 Casing. The casing provides a structure for mounting the filter housings.

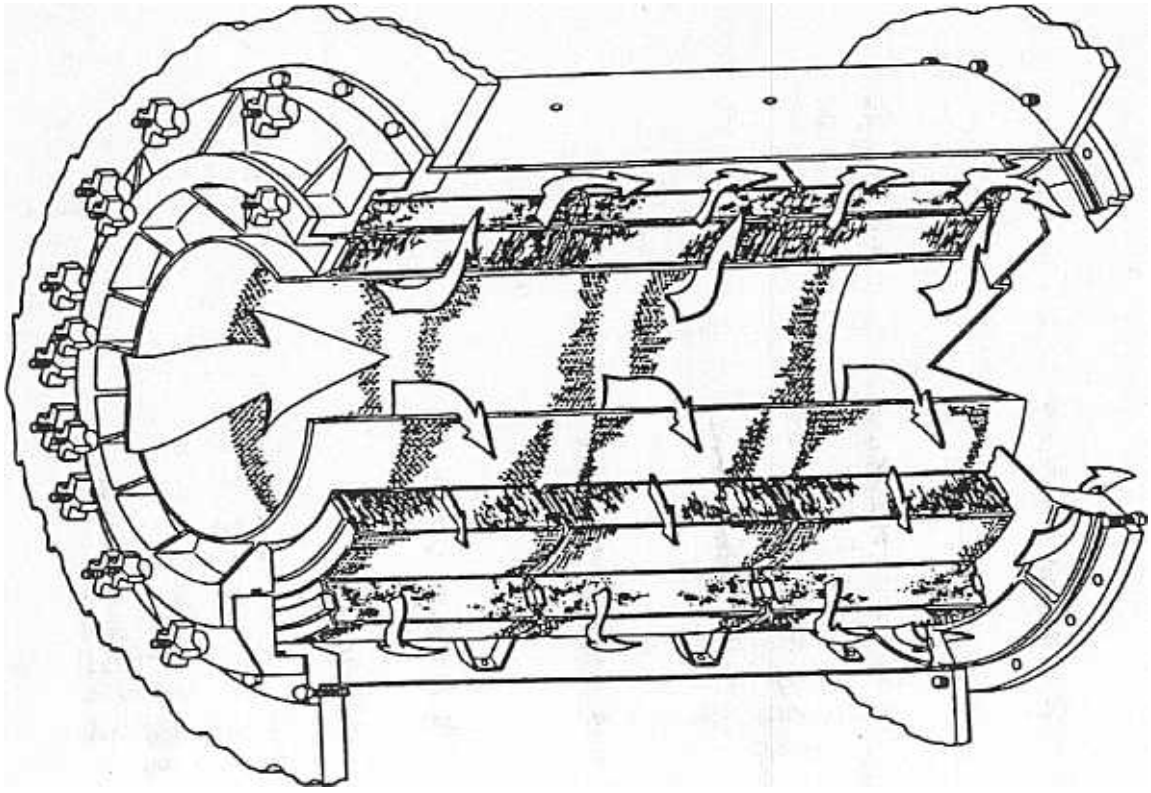


Figure 3-1. Airflow Through CBR Filters (Shown with NAVSEA Dwg. No DL6263417, Rev C, with Center Support Tube and Prefilter(s) Removed)

CHAPTER 4
SCHEDULED MAINTENANCE

4-1 INTRODUCTION.

This chapter identifies all scheduled maintenance actions for the chemical, biological, and radiological (CBR) filter system used with the Navy Shipboard Collective Protection System (CPS). CPS scheduled maintenance includes both organizational and intermediate maintenance; no depot-level maintenance is required.

4-2 ORGANIZATIONAL-LEVEL SCHEDULED MAINTENANCE.

Organizational-level scheduled maintenance instructions for the CBR filter system are furnished in the Planned Maintenance System (PMS). Table 4-1 lists the organizational-level scheduled maintenance actions to be performed. Intermediate-level maintenance is limited to filter maintenance actions listed in table 4-2. These actions are also among those listed in Technical Manual SS200–AF–MMM–010.

Calibration of alarm and CBR filter system differential pressure gauges should be performed every 24 months in accordance with NAVSEA OD45845, using approved calibration procedures NAVAIR 1720, MP–16, MP–41, or MP–164.

4-2.1 Replacing Prefilters. Prefilters require periodic replacement by shipboard personnel as part of routine maintenance. Procedures for determining when prefilter replacement is required can be found in Collective Protection System SYSCOM MIP 5121 (Perform zone pressurization test). The time for replacement varies from 6 to 12 months in an open ocean environment to less than 2 months in a ship construction yard environment. However, the prefilter life in a ship construction yard environment can be significantly increased by adding and maintaining additional temporary filtration measures to the exterior intakes, in accordance with NSTM S9086–RQ–STM–010, Chapter 510, Section 510-7.1.18.

Failure to maintain the prefilters as prescribed will result in premature loading of the expensive CBR filter sets and a possible failure of the supply fan bearings. If this happens, the ship will be required to procure all new CBR filter sets before the previously scheduled replacement, and undergo an extensive ship alteration to remove and replace the damaged supply fans. This will have a major impact on readiness and cost to the ship.

4-2.2 Replacing CBR-Contaminated Prefilters. Ship's personnel should ***never*** attempt to change CBR-contaminated prefilter(s). This job is performed by a specially trained mobile team. Because the CBR filter/prefilter system was designed to operate effectively while contaminated, there is no urgency required for CBR filter or prefilter replacement.

4-3 INTERMEDIATE-LEVEL SCHEDULED MAINTENANCE.

Intermediate-level maintenance is limited to the filter maintenance actions listed in table 4-2.

Periodic replacement of CBR filter sets (3 yr) is performed by an Intermediate Maintenance Activity (IMA). The IMA also has special equipment to leak-test the newly installed filters to certify readiness. Ships must schedule the IMA to replace CBR filters and certify CBR filters according to the date listed on the CBR filter differential pressure gauges. Ship's force personnel replace CBR filters under supervision of IMA. IMA then conducts leak testing to certify.

Table 4-1. Organizational-Level Scheduled Maintenance Actions

Perform zone pressurization test
Remove prefilters/Install new prefilters /Submit work request to Intermediate Maintenance Activity (IMA)

Table 4-2. Intermediate-Level Scheduled Maintenance Actions

Replace CBR filters (including compressed air CBR filters)
Perform CBR filter system leak test

Ship's personnel alone should ***never*** attempt to change CBR-contaminated filters; this job is performed by a specially trained mobile team. Due to the design of the CBR filters, CBR contaminants cannot pass through the filters, even after time; therefore, CPS should be operated in its normal mode, even after encountering CBR contamination.

Filter leak tests must be conducted following replacement of CBR filters to verify installation integrity. Leak testing will identify system deficiencies which, if present, could allow contaminated air to bypass the CBR filters.

Before conducting leak tests, prefilter(s) should be removed, as their presence will affect the results of aerosol leak tests.

Filter systems that fail leak testing must be repaired and retested. Filter systems generally fail because of damaged or missing filter housing O-ring gaskets, damaged filters, or loose/missing hardware.

The test procedures described herein involve testing all the individual filter housings associated with one supply fan as a system (bank test). The bank test reduces test time and determines if there is a breach in the filter casing plate (i.e., leaks through pressure gauge lines, electric lines, etc.). Bank tests should only be performed when the fan room configuration allows for the even dispersement (±10%) of the aerosol or gas. The flow rate through each filter housing must be within ±10% of each other, as verified with an airflow meter. In situations where a bank test indicates a leak is present, individual housing tests should be performed as necessary to identify and correct the leak.

4-3.1 CBR Filter System Change-Out. CBR filter system change-out should be performed by ships force with IMA overseeing to ensure proper installation and testing.

4-3.1.1 Uncontaminated vs. Contaminated Filters. Personnel performing routine replacement of uncontaminated CBR filters may do so in regular work clothing. Special mobile teams removing filters contaminated with CBR agents must be suited in chemical protective overgarments, boots, gloves, and masks as listed in 4-3.1.2.d. Filters should only be removed after the inlet plenum area has been decontaminated per paragraph 4-3.1.4.1. All further reference to contaminated filter maintenance and use of protective clothing in this chapter shall only apply to specially trained mobile teams.

4-3.1.2 Tools, Parts, Materials, Test Equipment.

a. Materials
   1. Tag, safety
   2. Rags, wiping
   3. Grease, silicon, MIL-T-22361

b. Parts
   1. High efficiency particulate arresting (HEPA) cover O-ring seal, NAVSEA Dwg No 6263430-1 (one per housing)
   2. Gas cover O-ring seal, NAVSEA Dwg No 6263430-2 (one per housing)
   3. CBR filter set, NSN 4240-01-369-6533
   4. Cover, filter closure (See NAVSEA Dwg No 65263428 for Rev C or earlier, or 6264245 for Rev D or later) (one per housing)

c. Tools
   1. CBR filter change-out tool kit, NAVSEA Dwg No 6263472

d. Miscellaneous
   1. Overgarment, chemical protective, MK III
   2. Footwear covers, chemical protective
   3. Gloves, chemical protective
   4. Mask, protective, MCU-2/P or MK V
   5. Bags, plastic, large (two per filter set)

4-3.1.3 Perform Preliminary System Preparation.

WARNING

Ensure all tag-out procedures are in accordance with current shipboard instructions.

a. De-energize supply fan(s) for system being serviced and tag "Out of Service."

NOTE

When replacing contaminated filters, enter outlet filter plenum area and install filter housing closure covers. Exit outlet plenum area when all closure covers are installed and close entrance doorway, sealing off clean area.

b. Refer to figure 4-1 and assign personnel to teams as illustrated:
   (1) Position filter removal team inside inlet plenum.
   (2) Position filter disposal team outside inlet plenum.
   (3) Position new filter installation team near inlet plenum.

4-3.1.4 Filters. Removal and disposal of old filters is performed by the filter removal and disposal team. When all filter sets have been removed and disposed of, the filter removal and disposal team will exit the area and, if necessary, proceed to the decontamination station by the designated route. Replacement of filters is performed by the filter installation team. See paragraph 4-3.1.4.7.b. for handling and disposal of CBR filters.

WARNING

Chemical protective gear must be worn during change-out after a CBR attack. Use extreme caution to prevent any part of protective clothing from being punctured or torn. Failure to do so could result in contamination of personnel.

4-3.1.4.1 Access and Decontaminate Inlet Plenum. Open inlet plenum access door to expose filter housings. If filter change-out is being accomplished as a result of a CBR attack, decontaminate inner surfaces of plenum and door using a spot decon solution.

4-3.1.4.2 Remove Prefilters. Prefilters are removed by the filter removal team.

a. Remove the prefilter clamps, retainer, or retainer strip.
b. Slide prefilters from housings and dispose of if old or contaminated or, if troubleshooting procedures determine that filters have remaining service life, relocate outside plenum in an area to prevent damage during change-out.

4-3.1.4.3 Remove HEPA Cover. HEPA covers are removed by the filter removal team.

a. Loosen HEPA cover nuts (smaller of two sets). To ensure covers do not cock or come off crooked, loosen two opposite nuts two turns each, continuing with adjacent nuts until all are loose.
b. Spin off and remove nuts.
c. Place tip of flat-blade screwdriver behind lip on top of HEPA cover and pry outward. Repeat for right, bottom, and left side of cover.

CAUTION

Do not allow the HEPA cover to cock or come off crooked, or the studs may be bent or broken.

d. Place hands between studs, with fingers under HEPA cover lip.
e. Pull cover straight off studs.

4-3.1.4.4 Remove HEPA Cover O-Ring Gasket. HEPA cover O-ring gaskets are removed by the filter removal team.

a. After HEPA cover is removed, turn back of cover toward second man.
b. Second man, place hands 6 to 8 in. apart on gasket, then press down on gasket while pushing hands together. Gasket will loop up.
c. Place thumb through loop, remove O-ring gasket.
d. Remove HEPA cover from plenum and relocate to prevent damage during change-out.

4-3.1.4.5 Remove Gas Cover. Gas covers are removed by the filter removal team.

a. Loosen gas cover nuts (larger of two sets). To ensure covers do not cock or come off crooked, loosen two opposite nuts two turns each, continuing with adjacent nuts until all are loose.
b. Spin off and remove nuts.

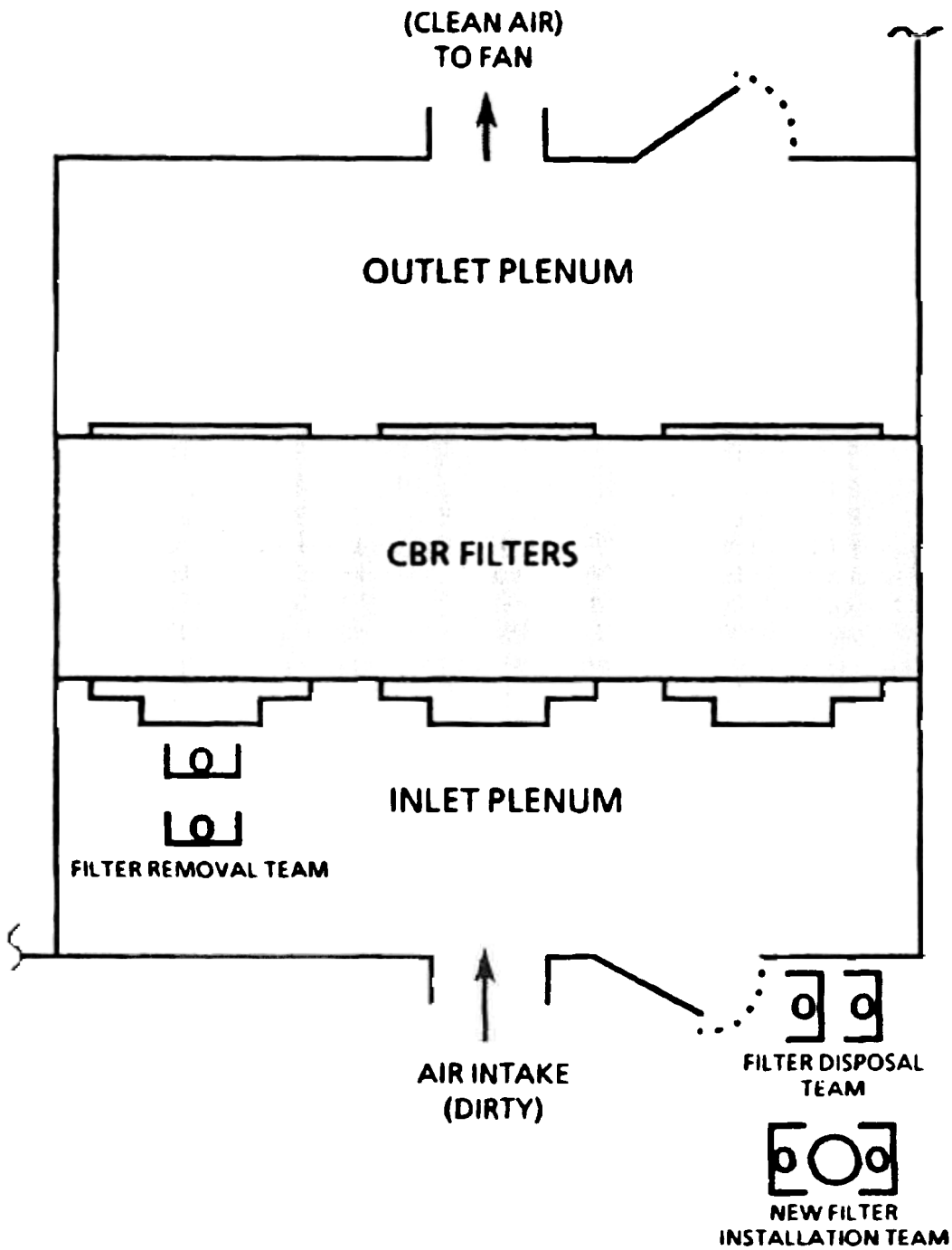


Figure 4-1. Filter Change-Out Teams

CAUTION

Do not allow the gas cover to cock or come off crooked, or the studs may be bent or broken.

c. Place tip of screwdriver behind lip on top of gas cover and pry outward. Repeat for right, bottom, and left side of cover.
d Grasp gas cover on opposite sides with both hands and pull gas cover straight off studs.
e. Remove gas cover from plenum and relocate to prevent damage during change-out.

4-3.1.4.6 Remove Gas Cover O-Ring Gasket.

a. Place hands outside two studs of filter housing.
b Press down on O-ring gasket and push hands together, to form loop between studs.
c Place thumb through loop, grasp O-ring gasket, and pull out from each stud.

4-3.1.4.7 Remove Old Filters. CBR filter sets can be removed from housings by several means. The gas filter may be gently pried outward using a screwdriver until enough is exposed to be removed by hand. Alternatively, the HEPA filter may be removed first using extractor tools in the filter change-out tool kit. Assemble the extractor tool using arrow points; pierce the HEPA end-cap, rotate 90° and pull the filter out. If filter removal is difficult, troubleshoot in accordance with Chapter 5.

CAUTION

The gas filter weighs 35 lb. Do not allow it to fall and strike the studs on the filter housing. This may cause the studs to bend.

a. Remove first filter set (HEPA and gas elements).
b Place filters and O-rings in plastic bags for disposal. For routine filter change-outs conducted at the intermediate level, filters shall be turned in to the Public Works Center (PWC)/Hazardous Material Acceptance Facility in accordance with Defense Demilitarization Manual DoD 4160.21-M-1. Filters contaminated with chemical agents shall be disposed of in accordance with the applicable requirements of NAVSEA Technical Manual S9086-T8-STM-000, Chapter 593, or at the Commander's instructions.
c. Repeat steps a. and b. above for remaining filters in housings.
d. Repeat 4-3.1.4.2 to 4.3.1.4.7c. for remaining housings if required.
e. Exit area and, if necessary, proceed to decontamination station.

4-3.1.4.8 Install New Filters. New filters are unpackaged and installed by the filter installation team. New filter sets are packaged in aluminum cans and sealed with a band of epoxy. An opening tool is provided in the change-out tool kit to open new filter cans.

a. Bring new filter containers to location near inlet plenum. Check containers. If seal is broken or can damaged, carefully inspect filter for damage. Discard if damaged.
b Open container:
(1) Pull cable ends away from container.
(2) Assemble three sections of filter container opening tool.
(3) Place tool alongside can in vertical position and lock cable loop on bolt in tool head.
(4) Twist opening tool so it rolls around filter container. This pulls cable from groove and wraps it around opening tool head.

NOTE

The direction of rotation depends upon direction in which cable is wrapped.

(5) Lift off top of container when cable is completely removed. If container halves do not separate, strike groove with rubber hammer from tool kit to break epoxy sealant.
(6) Remove gas filter from container.
c Lubricate filter gaskets with silicone lubricant as follows:
(1) First filter in: Lubricate both sides of gasket.
(2) Second filter in: Lubricate one side of gasket; install with lubricant facing inlet plenum.
(3) Last filter in: Do not lubricate.
d. Install gas filter into housing; push it in flush with

housing lip.
e. Remove HEPA filter from container.
f. Lubricate HEPA filter per step c. above.
g. Install HEPA filter into housing; push it in flush with gas filter, then push gas and HEPA together farther into housing.
h. Repeat steps b. to g. above for remaining filter sets.

4-3.1.4.9 Install New Gas Cover O-Ring Gasket. It is mandatory to install a new O-ring gasket during filter change-out, due to the permanent deformation of the O-ring gasket. Installation is performed by the filter installation team.

a. Thoroughly clean housing lip with rags and O-ring seal groove on housing lip with cleaning tool equipped with clean felt pad. Insert cleaning tool into O-ring seal groove on housing; wipe pad around groove at least twice to ensure proper cleaning.
b. Remove new gas cover O-ring from package; lubricate with silicone lubricant.

CAUTION

Use care when installing the O-ring gasket; do not tear or break the outside surface. The gasket is a critical component of the filter system. Improper installation will result in system failure.

c. Install new O-ring gasket into groove around filter housing.
d. Inspect installed gasket; ensure it is in proper position on all sides.

4-3.1.4.10 Install Gas Cover. Gas cover installation is performed by the filter installation team.

a. With clean rags, thoroughly clean gas cover sealing surfaces.
b. Install gas cover on housing, pressing up against gas filter. Make certain cover is not cocked. It must be straight and even on all sides in order to seat properly.

NOTE

Do not install the gas cover nuts at this point.

4-3.1.4.11 Install New HEPA Cover O-Ring Gasket. New HEPA cover O-ring gaskets are installed by the filter installation team.

a. Thoroughly clean HEPA cover sealing surfaces and O-ring seal groove as described in 4-3.1.4.9a.
b. Remove new HEPA cover O-ring from package and lubricate with silicone lubricant.
c. Install gasket in HEPA cover O-ring groove.
d. Inspect to ensure gasket fits into groove evenly around cover.

4-3.1.4.12 Install HEPA Cover. HEPA covers are installed by the filter installation team.

a. Grasp cover with both hands on opposite sides between stud holes.
b. Align holes in HEPA cover with studs.
c. Slide HEPA cover over studs.
d. Push cover up against HEPA filters.

4-3.1.4.13 Install Cover Nuts. HEPA and gas cover nuts are installed by the filter installation team.

a. Apply grease to all studs.
b. Install HEPA cover nuts, except for two opposite nuts, which hold prefilter retainer or clamps if applicable.

CAUTION

Spinning the HEPA cover nuts more than two turns may damage the HEPA filter.

c. Spin HEPA cover nuts two turns.
d. Install gas cover nuts and spin up to cover; do not tighten.
e. Tighten gas cover nuts using following procedure:

NOTE

As the nuts get tighter, the number of turns will be less. During final tightening, the nuts will only be turned 1/8-turn or less.

(1) Select two nuts directly opposite each other and turn both clockwise two turns.
(2) Select two adjacent nuts and turn both clockwise two turns.
(3) Repeat for remaining nuts, until all nuts are hand tight.

CAUTION

The HEPA cover nuts are spring-loaded with an internal spring and plunger. The plunger must be completely compressed to ensure proper loading of the HEPA filter. The HEPA cover nuts may still feel loose. Do not tighten past this point or HEPA filter may be damaged, causing system failure.

NOTE

Interference with center support tube may cause HEPA cover and nuts to look properly installed. With rubber hammer, strike HEPA cover in several locations to assure that HEPA cover is properly seated.

f. Tighten HEPA cover nuts as described in step e. above, but only tighten until gap at base of nut is just closed and internal plunger is completely compressed into nut.

NOTE

Do not install prefilters at this time if 4-3.1.5 or 4-3.2 is to be performed immediately after complete change-out is accomplished.

g. Install prefilters in housing as follows:
   (1) Bag plus flat prefilters:
      (a) Roll flat prefilter into a tight roll, with air-entry side on inside.
      (b) Insert flat prefilter into bag prefilter and let tight roll expand and conform to bag filter.
      (c) Insert bag plus flat prefilter into housing with flat prefilter overlapping section at the bottom.
      (d) Using end of prefilter retainer strip, push back edge of bag prefilter up against back of housing if needed.
      (e) Grasp and roll prefilter retainer strip into tight circle and place inside at front edge of bag plus flat prefilter. Release grasp, allowing strip to snap snugly against prefilters inside filter sets or center support tube.
   (2) Cylindrical Prefilters:
      (a) Install prefilters in housing with gasketed end installed first.
      (b) Install prefilter retainer or clamps and HEPA cover nuts.

h Filter housing change-out is now complete. Change out remaining housings as applicable.

i. After filter change-out is complete:
   (1) Remove rags, tools, and other materials from inlet plenum.
   (2) Close inlet plenum.
   (3) If filter housing closure covers are installed, enter outlet plenum area and remove closure covers.
   (4) Check for any airflow blockages; remove if present.
   (5) Exit outlet plenum area; close entrance doorway, sealing off area.
   (6) Remove safety tags from supply fan controllers and energize fans.
   (7) Dispose of empty filter containers as directed by Commanding Officer.
   (8) Proceed, if necessary, to decontamination station by designated route.

4-3.1.5 Prepare and Apply Differential Pressure Gauge Face Sticker. After CBR filter system change-out is complete, a sticker must be filled out and placed on the face of the CBR filter system differential pressure gauge. The sticker (figure 2-1) has blanks that must be filled in with: (1) a red region number indicating prefilter PMS needs to be accomplished and (2) a date specifying when CBR filters must be changed out and leak-tested by an IMA. The length of time between CBR filter system IMA maintenance is 36 months.

a. To determine red region number:
   (1) Ensure zone is pressurized to 2.0 ± .5 in. wg.
   (2) Observe initial pressure drop.
   (3) Add 2.5 in. wg to reading observed in (2) above.
   (4) Record red region value on sticker.

b. To determine IMA filter change-out and leak test date:
   (1) Add 36 months from date installed.
   (2) Record future date on sticker.

c Apply sticker to gauge face

4-3.2 CBR Filter System Inspection and Testing. After installing new CBR filters, the CBR filter system must be tested to ensure that no bypass or leak paths exist that would allow unfiltered air to enter the protected zone through the ventilation supply system.

Filter leak tests should be performed immediately after installing new CBR filters.

NOTE

Filter system leak testing should be performed only by IMA personnel specifically trained in the use of test equipment and analysis of test results.

Inspection and testing consists of a preliminary visual inspection followed by aerosol testing. Aerosol leak testing is conducted by challenging the filter system with a test aerosol and comparing the concentrations upstream and downstream of the filter system.

Before proceeding with the visual inspection, remove prefilters (if installed) using the following procedures:

a. Enter inlet plenum.
b Starting at one side of filter bank, slide prefilters from the filter housing(s) and store outside plenum.

4-3.2.1 Visual Inspection. A visual inspection of the filter system must be performed before aerosol testing to identify conditions that might allow for filter bypass. Deficient conditions must be repaired to an acceptable standard before continuing. Inspect the following items:

a. Gasket between filter housing and inlet plenum installed and undamaged (check from inside inlet plenum).
b. Filter pressure drop gauge securely attached to tubing. Tubing securely attached to plenums.
c. Inlet plenum and surrounding area free from excessive dirt and debris.
d. Filter housing covers and cover knobs installed and properly secured.

After completing visual inspection, make necessary repairs.

4-3.2.2 Aerosol Leak Testing. Aerosol leak testing is conducted to ensure that HEPA filter gaskets and the HEPA cover O-ring seal are free from leaks. Aerosol leak testing also identifies damage to the HEPA filters themselves. Aerosol leak testing is performed by generating dioctylphthalate (DOP) aerosol at the supply intake and sampling aerosol concentrations upstream and downstream of the filter system. A leak percentage is determined by comparing upstream and downstream measurements.

4-3.2.2.1 Equipment and Supplies. Equipment and supplies necessary for aerosol leak testing are listed in table 4-3. The test procedures in this document provide a general overview of the test sequence, but are not intended as a replacement for the step-by-step operating instructions provided with the aerosol generator and detector. Refer to manufacturer's instructions for details of setup and operation.

4-3.2.2.2 Test Equipment Setup. The following procedures assume that the aerosol generator is filled with DOP and that the aerosol detector is calibrated. Refer to manufacturer's instructions for fill and calibration procedures.

Table 4-3. Aerosol Leak Test Equipment and Supplies

Item Number	Qty Reqd	Cage Code	Part or Spec No	Description
1	1	58754	F–1000–DDF	Aerosol Detector
2	1	-----	TDA–5A	Aerosol Generator
3	AR	20484	-----	Nylon Tubing .25 OD x .12 ID
4	AR	78604	PM401	Dioctylphthalate (DOP)
5	AR	-----	-----	Nitrogen, Compressed

a. Locate aerosol generator and nitrogen tank at supply system intake as shown in figure 4-2.

CAUTION

To avoid a fire hazard, do not substitute a non-inert gas, such as compressed air, for nitrogen.

b. With nitrogen tank valve closed, attach nylon tubing from tank to fitting on top of generator.
c. Turn generator POWER switch on. READY lamp will illuminate when generator is ready.

CAUTION

Because the aerosol generator produces a thick cloud of white smoke, do not turn the AEROSOL switch on with supply fan(s) off.

d. Locate aerosol detector near filter system and connect nylon tubing from detector to duct sampling ports as shown in figure 4-3.
e. Turn detector POWER on and adjust linearity using ZERO and SPAN controls as described in manufacturer's instructions.

4-3.2.2.3 Aerosol Leak Test Procedure. Aerosol leak testing shall be performed using the following procedures and instructions provided by manufacturer of test equipment. Record test results on data sheet (figure 4-4).

a. Start aerosol injection by turning on AEROSOL switch on generator.
b. Turn detector valve to UPSTREAM position.
c. If value is not between 80 and 100%, readjust generator for higher output or readjust detector SPAN. Read and record value.
d. Turn detector valve to CLEAR position and allow reading to stabilize. Readjust ZERO setting if necessary but do not alter SPAN.
e. Turn detector valve to DOWNSTREAM position and record value.
f. Return valve to UPSTREAM position to confirm upstream concentration did not change.
g. Stop aerosol injection by turning off AEROSOL switch on generator.

4-3.2.2.4 Analysis of Results. Analyze results from aerosol leak testing using the following steps:

a. Calculate penetration using the formula:

$$\% \text{ Penetration} = \frac{C_d}{C_u} \times 100\%$$

where C_d is downstream concentration and C_u is upstream concentration. (Values of C_d and C_u must be multiplied by their respective range settings to obtain comparable measures.)

b. If % Penetration is less than maximum allowable of .03%, the filter system is considered to have passed leak testing. If % Penetration exceeds maximum allowable penetration, correct aerosol leak per 4-3.2.3 and retest.

4-3.2.3 Correct Aerosol Leak. Filter housings usually fail aerosol leak tests for two reasons: a damaged HEPA filter or a damaged or missing HEPA or gas cover O-ring gasket. Identify the failure as bank (4-3.2.3.1) or individual (4-3.2.3.2), and proceed to the applicable one.

4-3.2.3.1 Bank Failure. When a bank failure occurs, it is usually one housing that is damaged. To find the individual filter housing that is damaged, use the following procedures:

a. Take aerosol generator into inlet plenum.
b. Inject aerosol into/around individual filter housings while monitoring downstream.
c. Check to see if anything is detected downstream.
   (1) If housing is good, proceed to next filter housing.
   (2) If housing leaks, proceed to 4-3.2.3.2.
   (3) If no housing seems to leak, inject aerosol into/around bulkhead penetrations.
   (4) If no leaks are found, proceed to 4-3.2.3.2.

4-3.2.3.2 Individual Failure.

a. Remove HEPA cover per 4-3.1.4.3.
b. Inspect HEPA O-ring gasket for damage or improper fit. Look carefully for visible indications that O-ring was pinched when installed.
   (1) Remove damaged HEPA cover O-ring per 4-3.1.4.4 and replace per 4-3.1.4.11.
   (2) If no damage to O-ring is obvious, continue with step c. below.
c. Remove gas cover per 4-3.1.4.5.

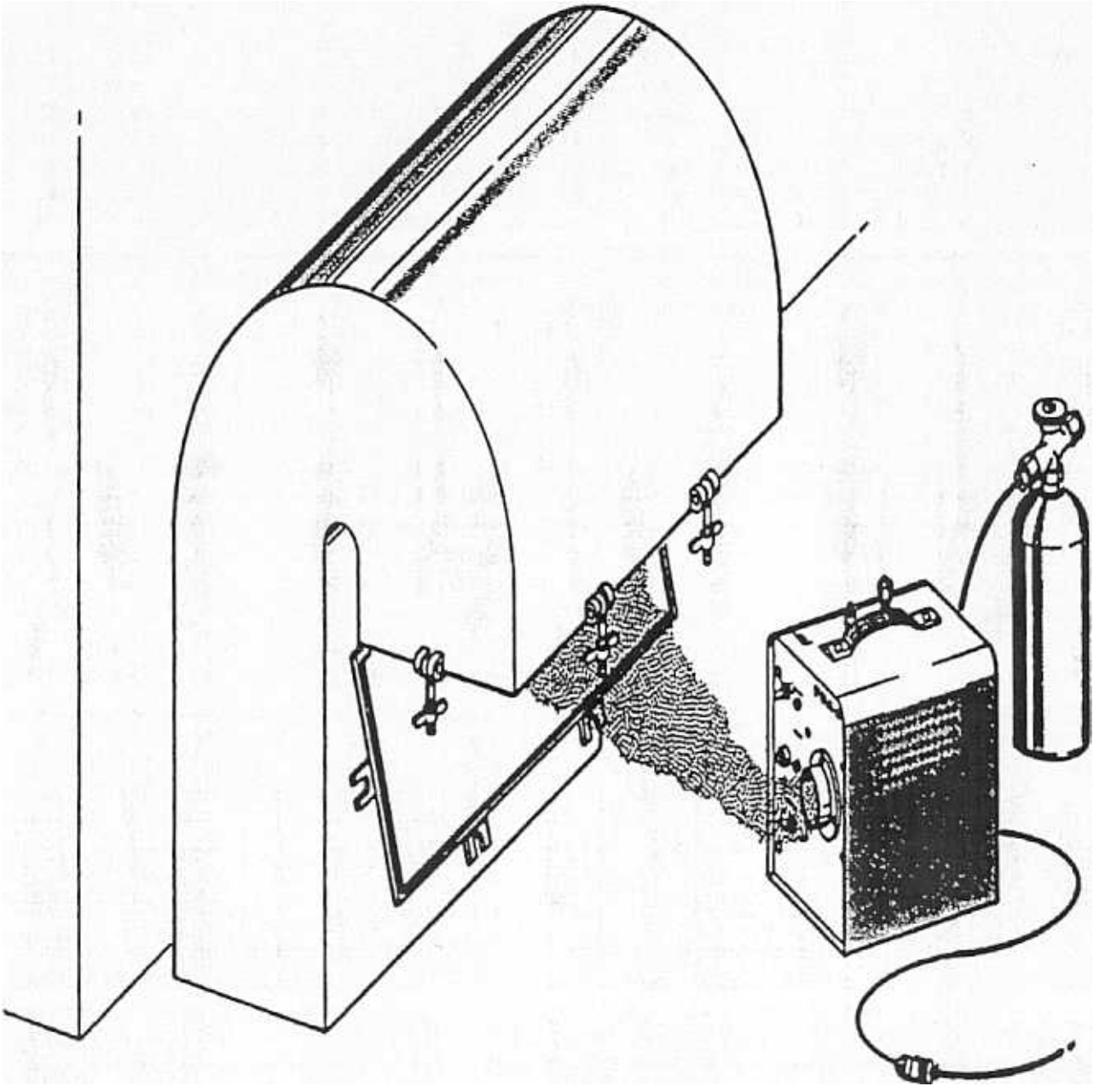
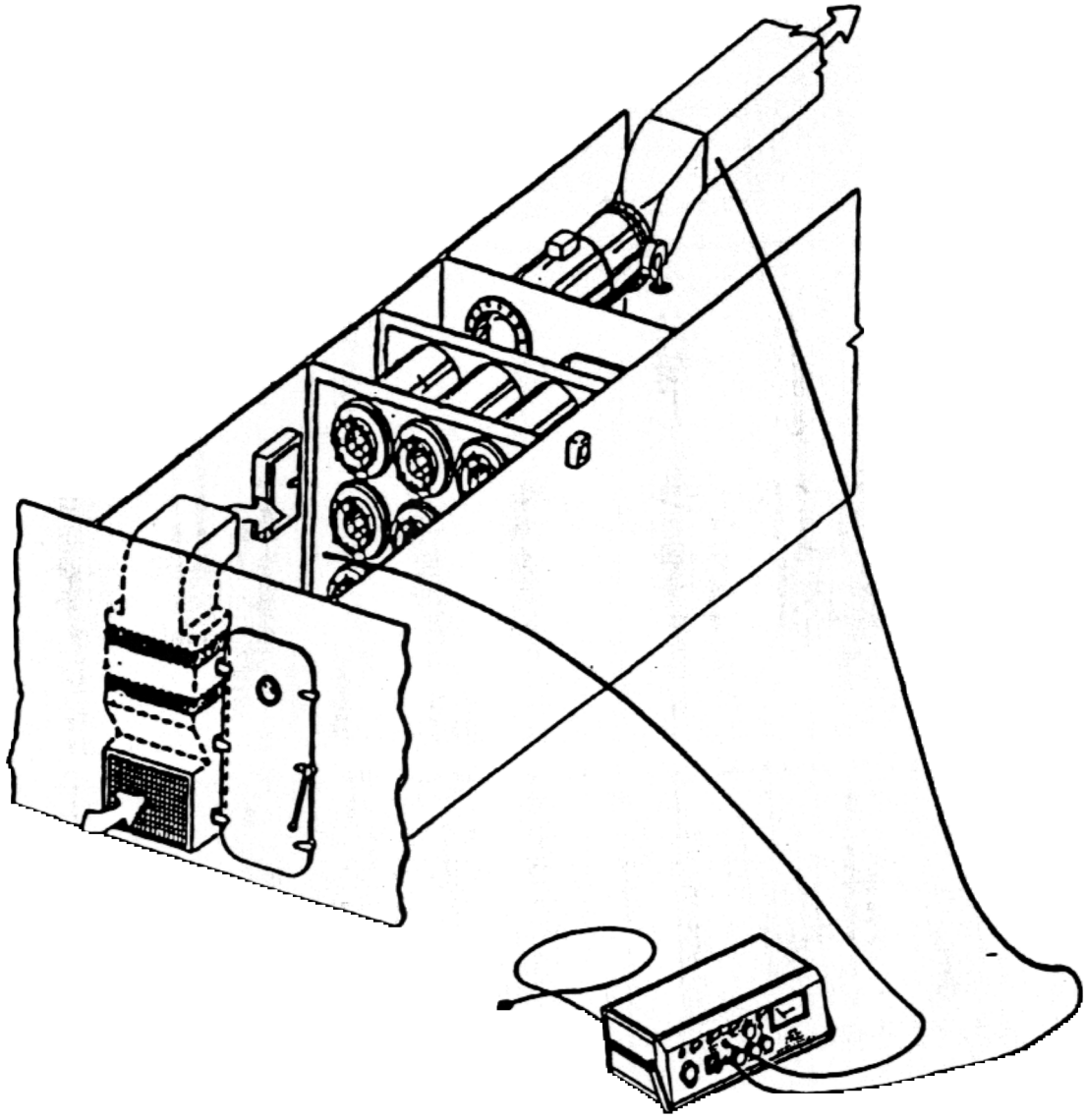


Figure ***Typical Vessel Generator Set***



Figu *Typical* *erosol Det* *Se*

AEROSOL LEAK TEST DATA SHEET

SHIP_____ DATE_____

OUTSIDE TEMPERATURE_____ RELATIVE HUMIDITY _____

TEST PERFORMED BY_____

SUPPLY SYSTEM OR HOUSING NUMBER	MEASURED PENETRATION	PASS (≤0.03) OR FAIL (>0.03)
EXAMPLE	0.03	PASS

COMMENTS OR UNUSUAL OBSERVANCES

_____

_____

_____

Figure 4-4. Aerosol Leak Test Data Sheet

d Inspect gas O-ring gasket for damage or improper fit. Look carefully for visible indications that O-ring was pinched when installed.
  (1) Remove damaged gas cover O-ring per 4-3.1.4.6 and replace per 4-3.1.4.9.
  (2) If no damage to O-ring is obvious, continue with step e. below.
e If neither O-ring is damaged, check for a damaged HEPA filter gasket or a small tear in HEPA filter media.
  (1) Remove HEPA filters.
  (2) Carefully inspect gaskets on each filter. Carefully inspect pleats of HEPA media for any small tears. Replace any HEPA filters that appear damaged.
  (3) If damage cannot be detected, all HEPA filters should be replaced.
f. Install gas cover per 4-3.1.4.10.
g Install HEPA cover per 4-3.1.4.12.
h Install HEPA and gas cover nuts per 4-3.1.4.13.
i. Retest per 4-3.2.2 to ensure leak has been corrected.

4-3.3 Remove, Reinstall, and Align Center Support Tube (CST). CST removal is occasionally necessary when a filter is stuck to the back of the filter housing. Removal of the CST allows the filter to be pried from the back plate using a screwdriver. CST alignment ensures concentricity of the CST with the filter housing, allowing filters to be installed and removed without binding. Alignment should be performed after CST removal or when binding occurs due to suspected misalignment. CST removal, installation, and alignment procedures should be conducted with the supply fan de-energized and tagged out.

4-3.3.1 Tools, Parts, Materials, Test Equipment.

a. 9/16-in. socket, 3/8-in. or 1/2-in. drive ratchet, 6-in extension.

4-3.3.2 Remove CST.

a Remove filters from housing, if possible.
b Reinstall gas and HEPA covers.
c. Enter outlet plenum and loosen opposite bolts on housing plate until all are loose.
d Proceed as follows:
  (1) If CST must be removed in order to pry loose stuck filters, proceed with step e. below.
  (2) If CST only requires alignment, align per 4-3.3.4.
e Remove bolts on housing plate.

NOTE

At this point, front of CST is supported by HEPA cover.

f. With one person in outlet plenum and one in inlet plenum guiding CST, slide CST toward outlet plenum until front of tube clears HEPA cover.
g. If necessary, use screwdriver to pry stuck filter from back plate.
h Remove filters from housing; then reinstall gas and HEPA covers.

4-3.3.3 Reinstall CST.

a Inspect rear housing gasket for damage and replace as necessary.
b With one person in outlet plenum and one in inlet plenum guiding CST, slide CST toward inlet plenum until front of tube passes through HEPA cover.
c. Rotate CST to align with bulkhead hole pattern and housing gasket.
d. Reinstall bolts through CST back plate, gasket, and into rear bulkhead. Hand tighten only.

4-3.3.4 Align CST. CST alignment is accomplished by alternately tightening bolts in CST plate while observing and maintaining uniform clearance between outside of CST and inside of HEPA cover.

a Locate one person in outlet plenum with socket wrench for tightening CST and one person in inlet plenum observing clearance between CST and HEPA cover.
b Alternately tighten bolts at 12, 6, 3, and 9 o'clock positions until bolts are snug and observer reports uniform clearance. Do not over tighten.
c Alternately snug remaining bolts without disturbing alignment obtained in step b. above.

CHAPTER 5
TROUBLESHOOTING

5-1 INTRODUCTION.

This chapter provides troubleshooting procedures to help ship's crew identify malfunctions that might occur during operation and/or maintenance of the Navy Shipboard Collective Protective System (CPS) chemical, biological, and radiological (CBR) filter system. Since depot-level maintenance is not required for the CBR filter system, all troubleshooting procedures provided in this chapter are for organizational- and intermediate-level maintenance.

5-2 ORGANIZATIONAL-LEVEL TROUBLESHOOTING PROCEDURES.

Table 5-1 is a trouble analysis chart for the CBR filter system. Use the chart to identify a problem and probable cause, then perform the steps outlined under remedy to correct the problem.

Table 5-1. Trouble Analysis Chart for Navy CBR Filter System

Symptoms	Probable Cause	Remedy
Gas cover installation difficult	Gas cover studs bent or broken	Replace bent or broken studs per 6-2
High efficiency particulate arresting(HEPA) cover installation difficult	HEPA cover studs bent or broken	Replace bent or broken studs per 6-3
Gas nut installation difficult	Threads of nut or stud cross-threaded	Install new gas nut on same stud If installation of new gas nut is difficult, replace stud per 6-2, using original nut
HEPA nut installation difficult	Threads of nut or stud cross-threaded	Install new HEPA nut on same stud If installation of new HEPA nut is difficult, replace stud per 6-3, using original nut
Differential pressure gauge needle in red region	Airflow blocked by stored equipment or foreign material Prefilter(s) clogged CBR filters clogged	Correct blocked airflow per 6-4 Check prefilters per 6-5 Perform CBR filter change-out per 4-3.1

Table 5-1. Trouble Analysis Chart for Navy CBR Filter System (Continued)

Symptoms	Probable Cause	Remedy
Filter removal difficult	Filter misaligned or cocked in housing	Align filter; remove by pulling straight out using filter removal tools
	Filter stuck to another filter	For housings without center support tube (CST), break filters loose by tapping seam with mallet provided in tool kit; otherwise, remove stuck filters as one piece
	Filter stuck to back of housing	For housings with CST, correct per 4-3.3
		For housings without CST, enter outlet plenum; insert screwdriver through air slots to pry filters loose from back plate
Filter installation difficult	CST misaligned	Correct per 4-3.3
Filter housing fails particulate leak test	Damaged O-ring gasket or HEPA filter	Inspect installation per 4-3.2.3

CHAPTER 6
CORRECTIVE MAINTENANCE

6-1 INTRODUCTION.

This chapter provides procedures for correcting malfunctions found while troubleshooting the chemical, biological and radiological (CBR) filter system used with the Navy Shipboard Collective Protection System (CPS).

6-2 REPLACE GAS COVER STUDS.

Gas cover studs can be replaced at the organizational level if a stud is bent or broken.

a. Tap holes in lip using tap set. Replacement gas cover nuts and studs are found in the Allowance Parts List (APL).
b Rethread any cross-threaded studs with die set.

6-3 REPLACE HIGH EFFICIENCY PARTICULATE ARRESTING (HEPA) COVER STUDS.

HEPA cover studs can be replaced at the organizational level if a stud is bent or broken.

Tap holes in gas cover using tap set. Replacement HEPA cover nuts and studs are found in the APL.
b. Rethread any cross-threaded studs with die set.

6-4 CORRECT BLOCKED AIRFLOW.

Blocked airflow can be corrected at the organizational level by removing any stored equipment or foreign material from inlet and outlet plenums.

6-4.1 Inlet Plenum.

a. De-energize supply fans.

WARNING

Ensure all tag-out procedures are in accordance with current shipboard instructions.

b. Enter inlet plenum.
c. Remove any stored equipment or foreign material that blocks airflow from entering filter housing.
d Remove any equipment or material from inlet plenum.
e Close and dog inlet plenum door after all personnel are out.
f. Perform system check per 2-4.

6-4.2 Outlet Plenum.

a. If on, de-energize supply fan.

WARNING

To prevent personnel injury or fan damage, do not open the outlet plenum access while the supply fan is running.

CAUTION

Do not put filter closure covers on the filter housings while the fan is running. Damage to the fan may result.

b. Enter outlet plenum.
c. Remove any stored equipment or foreign material that blocks airflow from filter housing.
d. Ensure filter closure covers are not installed on filter housing.
e. Remove filter closure covers if bolted to filter housing, using 9/16-in. socket and speed wrench hanging in outlet plenum. Store covers on rack in outlet plenum.
f. Remove bolts and washers from filter closure covers. Store in container in outlet plenum.
g. Remove any stored equipment or foreign material from outlet plenum.
h. Close and dog outlet plenum door after all personnel are out.
Perform system check per 2-4.

6-5 INSPECT PREFILTER.

Prefilters can be removed, inspected, and replaced as necessary at the organizational level. Contaminated prefilters will be replaced by special mobile teams. One of two types of prefilters may be used. Bag plus flat prefilter or cylindrical prefilter may be used on filter housings with center support tubes (CSTs), Revision C and earlier, and without CSTs, Revision D and later. See parts below for part numbers for housing revisions.

6-5.1 Tools, Parts, Materials, Test Equipment.

a. Materials
   1. Rags, wiping
   2. Stepladder

b. Parts
   1. Prefilter, flat (NAVSEA Dwg No 6892409-3) (one per housing).
   2. Prefilter, bag (NAVSEA Dwg No 6892410-1 for Revision C and earlier; 6892410-4 for Revision D and later) (one per housing).
   3. Prefilter, cylindrical (NAVSEA Dwg No 6573317-2 for Revision C and earlier (NSN 4240-01-348-8785); 6573317-1 for Revision D and later (NSN 4240-01-426-3277)) (three per housing).

c. Miscellaneous
   1. Bags, plastic, large (one per prefilter)

6-5.2 Remove Prefilter(s).

NOTE

All filter pressure drop readings must be obtained with zone pressure at 2.0 ± 0.5 in. wg.

WARNING

If filters become contaminated by chemical, biological and radiological (CBR) agents, a special mobile team will change out contaminated prefilters and CBR filters. Shipboard personnel shall ***not*** change contaminated CBR filters ***or*** prefilters.

With supply fans running, note pressure drop as indicated by CBR filter differential pressure gauge.

b. Enter inlet plenum. For each filter housing identified as requiring maintenance, remove the prefilter retainer strip or the two HEPA filter cover nuts securing the prefilter retainer or clamps; remove retainer or clamps, then slide prefilters from housings and stack outside inlet plenum.

c. Exit inlet plenum and secure access.

d. Ensure zone pressure is at 2.0 ± 0.5 in. wg.

e. Go back and observe CBR filter gauge, then proceed as follows:
   (1) If CBR filter gauge reading is below red region, install new prefilters (see 6-5.3).
   (2) If CBR filter gauge reading is still above red region, do not install new prefilters; and submit work request to IMA (see 6-5.4).

6-5.3 Install New Prefilter(s).

NOTE

Although CBR filters are required for proper system operation, prefilters need not be installed if spares are not readily available and gauge indicates CBR filter replacement is necessary. However, operating without prefilters will cause CBR HEPA filters to load faster than normal.

a. Enter inlet plenum.

b. For each affected filter housing, install new prefilters, as follows:

Bag plus flat prefilter:
   (1) Roll flat prefilter into a tight roll, with air-entry side on inside.
   (2) Insert flat prefilter into bag prefilter, letting tight roll expand and conform to bag filter.
   (3) Insert bag plus flat prefilter into housing with flat prefilter overlapping section at the bottom.
   (4) Using the end of the prefilter retainer strip, push the back edge of the bag prefilter tightly up against the back of the housing if needed.
   (5) Grasp and roll prefilter retainer strip into tight circle and place inside at front edge of bag plus flat prefilter. Release grasp, allowing strip to snap snugly against prefilters inside filter sets or CST.

Cylindrical prefilter
   (1) Install each new prefilter with gasket facing toward the back of the filter housing. Three new prefilters are required for each filter housing.
   (2) Reinstall prefilter retainer or clamps and HEPA cover nuts.

c. Remove any foreign materials from inlet plenum.

d. Exit inlet plenum and secure access.

e. Dispose of old prefilters.

6-5.4

tenance Activity (IMA). Use the following procedure only if the CBR filter gauge reading remains above the red region with prefilters removed.

a. Enter inlet plenum.
b. Do not install any prefilters.
c. Reinstall prefilter retainer, clamp, or strip.
d. Remove any foreign materials from inlet plenum.
e. Exit inlet plenum and secure access.
f. Dispose of old prefilters.
g. Report to Work Center Supervisor (WCS) to submit work request to IMA to order CBR filters, supervise filter installation, install new prefilters, and leak- test CBR filter system.

6-6 CHANGE OUT CBR FILTER SYSTEM.

CBR filter system change-out should be performed at the intermediate level, to ensure proper installation check-out (filter leak testing). However, during emergencies, change-out can be performed at the organizational level, followed by intermediate-level CBR filter system leak tests. Replace CBR filters in accordance with paragraph 4-3.1.

CHAPTER 7
PARTS LIST

INTRODUCTION.

This chapter identifies and illustrates the parts that comprise the chemical, biological, and radiological (CBR) filter system used with the Navy Shipboard Collective Protection System (CPS). It contains a list of major components (table 7-1), list of manufacturers (table 7-2) cross-referenced to the applicable parts location illustration, and a parts list (tables 7-3 and 7-4). All parts, except attaching parts, have unique functions; therefore, a list of common item descriptions is not provided. Also, since all attaching parts are identified by military specification (MS) number on the parts list, a separate list of attaching parts is not provided.

7-2 LIST OF MAJOR COMPONENTS.

Table 7-1 lists the major components of the CBR filter system and the quantity required.

Table 7-1. List of Major Components

Qty	Name
3 each/housing	CBR filters
1 each/housing	Bag plus Flat prefilter
3 each/housing	Cylindrical prefilter
Variable	Housing
1	Casing

7-3 LIST OF MANUFACTURERS.

Table 7-2 provides the names, addresses, and codes of the manufacturers supplying drawings or parts for the CBR filter system, as referenced in column 4 or 6 of the parts lists.

7-4 PARTS LIST.

Tables 7-3 and 7-4 list all CBR filter system spare/repair parts. (See APL 480190067 for Revision C and earlier, and APL 489980622 for Revision D and later systems). Lists are cross- referenced to figure 7-1 for parts used in Revision C and earlier systems and to figure 7-2 for parts used in Revision D and later systems. They contain the following information for each part.

Table 7-2. List of Manufacturers

Code	Name and Address
53711	Department of the Navy Naval Sea Systems Command Washington, DC 20362
81361	U.S. Army Armament Research and Development Command Chemical Research, Development, and Engineering Center Aberdeen Proving Ground, MD 21010
0LM72	Met-Pro Corp. Keystone Filter Div 2385 North Penn Road Box G Hatfield, PA 19440-0380 1 (800) 822-1963
OATN2	StaClean Diffuser Company P O Drawer 1147 Salisbury NC 28145–1147 (704) 636–8697
51536	United Air Filter Company 1000 West Palmer St Charlotte NC 28234 (704) 334–5311

a. Column 1, Figure and Index Number: This column contains the figure and index number of the parts location illustrations containing the part.
b. Column 2, Description: This column contains the name of the part and descriptive data to identify the part.
c. Column 3, Quantity: This column indicates the quantity of parts required.
d. Column 4, Original Cage Code: This column contains the original part manufacturer's federal supply code identification number. Codes are not provided for common hardware items (screws, washers) that are available from many sources. However, they are identified in column 7 by MS number.
e. Column 5, Drawing Number: This column lists the drawing number assigned by the original manufacturer of the part.
f. Column 6, Supplier Cage Code: This column contains the suppliers code.
g. Column 7, Part No./NSN: This column contains the supplier's part number. Where applicable, National

Stock Numbers (NSNs) or MS numbers are provided for items available from multiple sources.

7-5 QUANTITIES/HOUSING REVISIONS.

Table 7-5 lists quantities of CBR filters and prefilters along with the housing revision per ship class.

Table 7-3. Parts List, Revision C and Earlier Systems

Figure & Index No	Description	Qty (per housing)	Original Cage Code	Dwg No	Supplier Cage Code	Supplier Part No. / NSN
7-1-1	Nut, High Efficiency Particulate Arresting (HEPA) Cover	8	53711	6263427		NSN 4520-01-346-0918
7-1-2	Gasket O-Ring	1	53711	6263430-1		NSN 5330-01-339-0967
7-1-3	Nut, Gas Cover	16	53711	6263434		NSN 4510-01-345-8948
7-1-4	Stud, HEPA Cover	8	53711	6263420-1		NSN 5307-01-339-1017
7-1-5	Gasket, O-Ring	1	53711	6263430-2		NSN 5330-01-340-5099
7-1-6A	Prefilter, Cylindrical	3	53711	6573317-2	0LM72	051824 NSN 4240-01-348-8785
7-1-6B	Prefilter, Retainer	1	53711	6573685		NSN 5365-01-345-6001
7-1-7A	Prefilter, Bag	1	53711	6892410-1	0ATN2	PE910011SDC
7-1-7B	Prefilter, Flat	1	53711	6892409-3	51536	350143137
7-1-7C	Prefilter Retainer Strip	1	53711	6892408		
7-1-8	Filter Set, CBR	3	81361	PL5-19-6718		NSN 4240-01-369-6533
7-1-9	Cap Screw	72				MS35307-363
7-1-10	Washer, Flat	72				MS27183-14
7-1-11	Washer, Lock	64				MS35338-141
7-1-12	Stud, Gas Cover	16	53711	6263420-2		NSN 5307-01-339-1016
7-1-13	Gasket, Filter Housing	2	53711	6263419		NSN 5330-01-339-4024

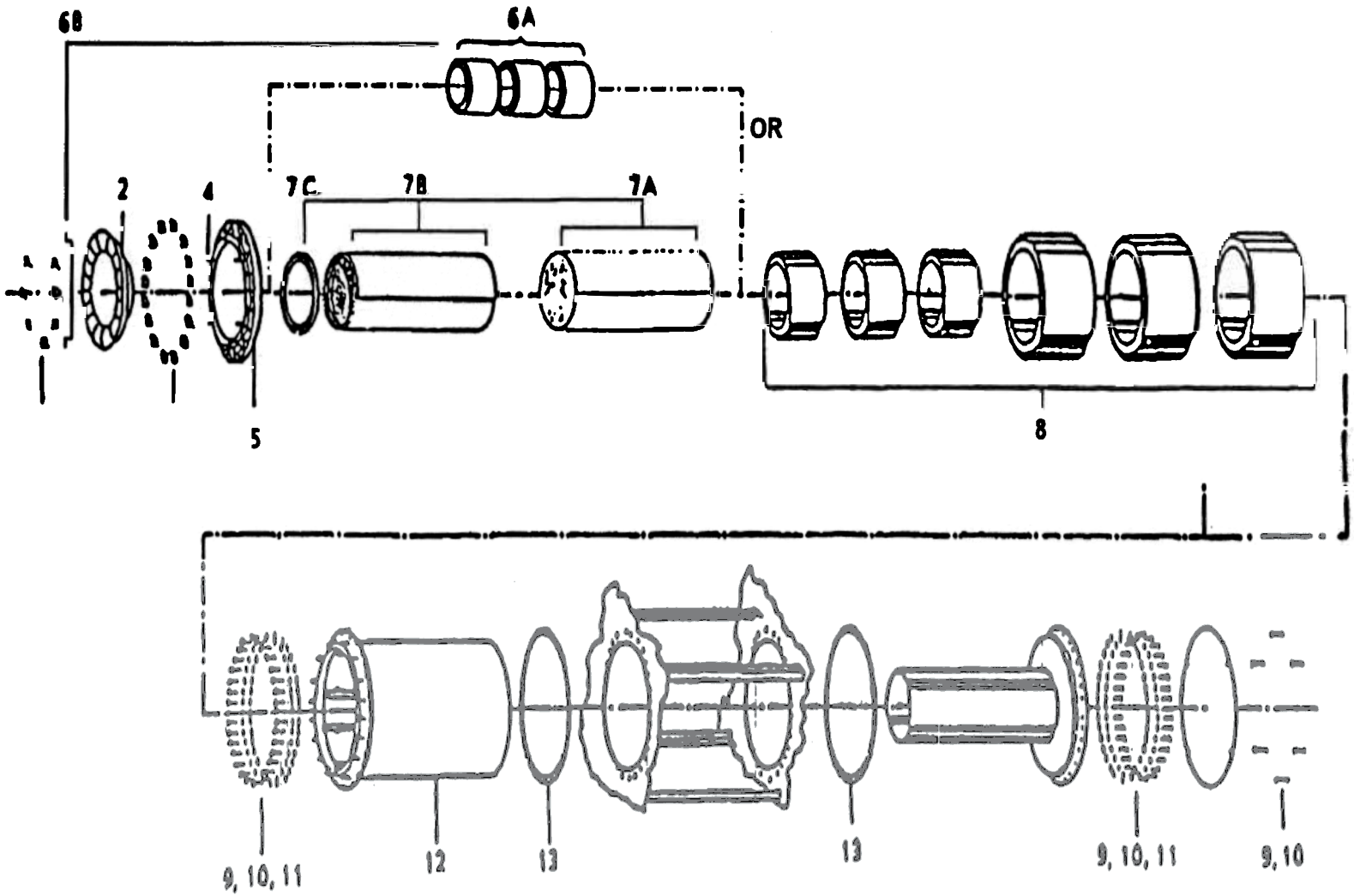


Figure 7-1. CBR Filter System, Revision C and Earlier

Table 7-4. Parts List, Revision D and Later Systems

Figure & Index No	Description	Qty (per housing)	Original Cage Code	Dwg. No.	Supplier Cage Code	Supplier Part No. / NSN
7-2-1	Nut, High Efficiency Particulate Arresting (HEPA) Cover	8	53711	6263427		NSN 4520-01-346-0918
7-2-2	Gasket O-Ring	1	53711	6263430–1		NSN 5330-01-339-0967
7-2-3	Nut, Gas Cover	8	53711	6263434		NSN 4510-01-345-8948
7-2-4	Stud, HEPA Cover	8	53711	6573702–1		
7-2-5	Gasket, O-Ring	1	53711	6263430-2		NSN 5330-01-340-5099
7-2-6A	Prefilter, Cylindrical	3	53711	6573317-1	0LM72	051824 NSN 4240-01-426-3277
7-2-6B	Prefilter, Clamp	2	53711	6573312		
7-2-7A	Prefilter, Bag	1	53711	6892410-4	0ATN2	PE9101231SDC
7-2-7B	Prefilter, Flat	1	53711	6892409-3	51536	350143137
7-2-7C	Prefilter, Retainer Strip	1	53711	6892408		
7-2-8	Filter Set, CBR	3	81361	PL5-19-6718		NSN 4240–01–369-6533
7-2-9	Cap Screw	40				MS35307–362
7-2-10	Washer, Lock	40				MS35338–141
7-2-11	Stud, Gas Cover	8	53711	6573702–2		
7-2-12	Gasket, Filter Housing	1	53711	6263419		NSN 5330-01-339-4024
7-2-13	Nut, Self-Locking	8				MS17830–6C
7-2-14	Washer, Flat	8				MS27183–14
7-2-15	Cap Screw, Socket Head	16				MS16995–64
7-2-16	Cap Screw	8				MS35307–363

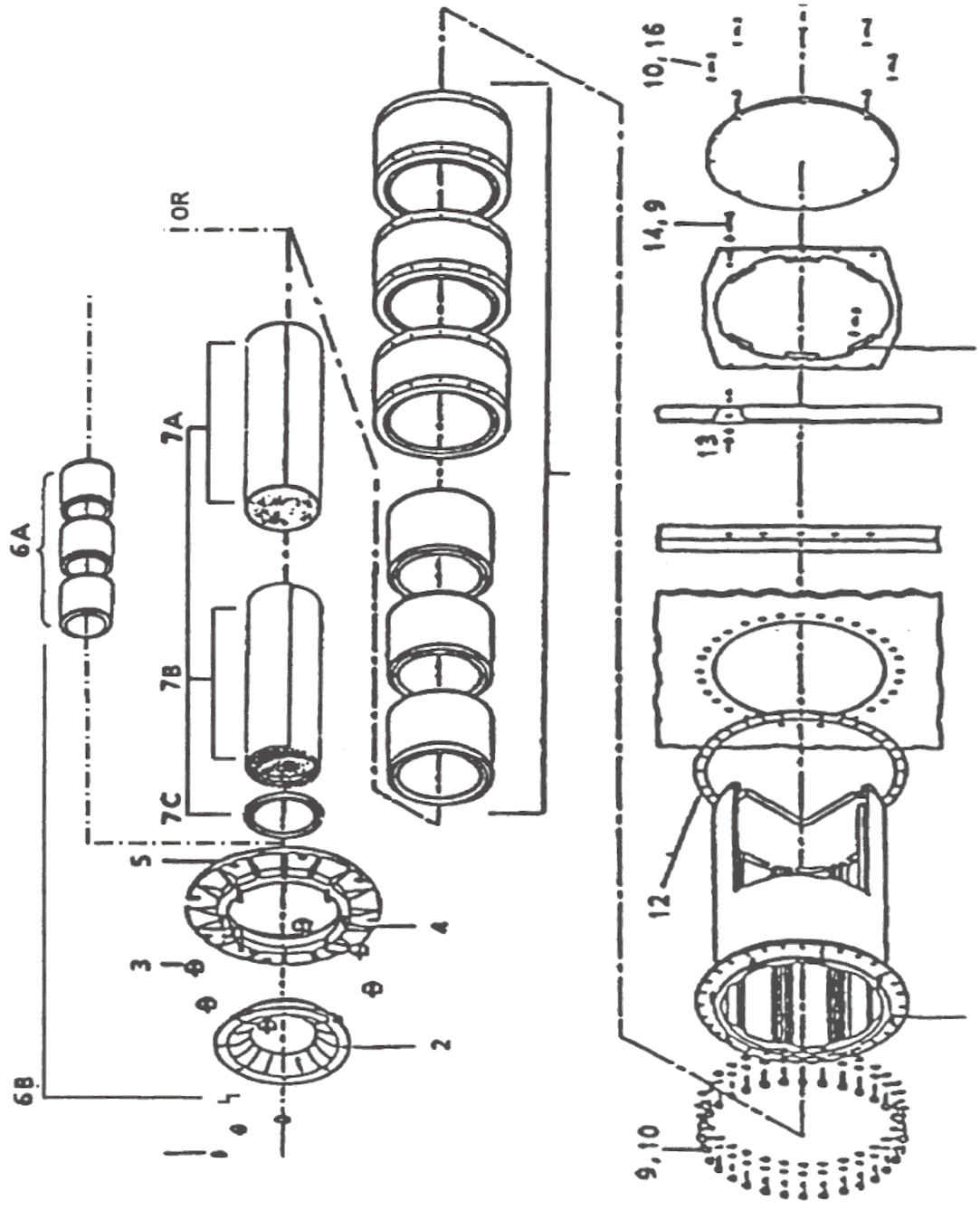


Figure CBR Filter System (Revision D and Later

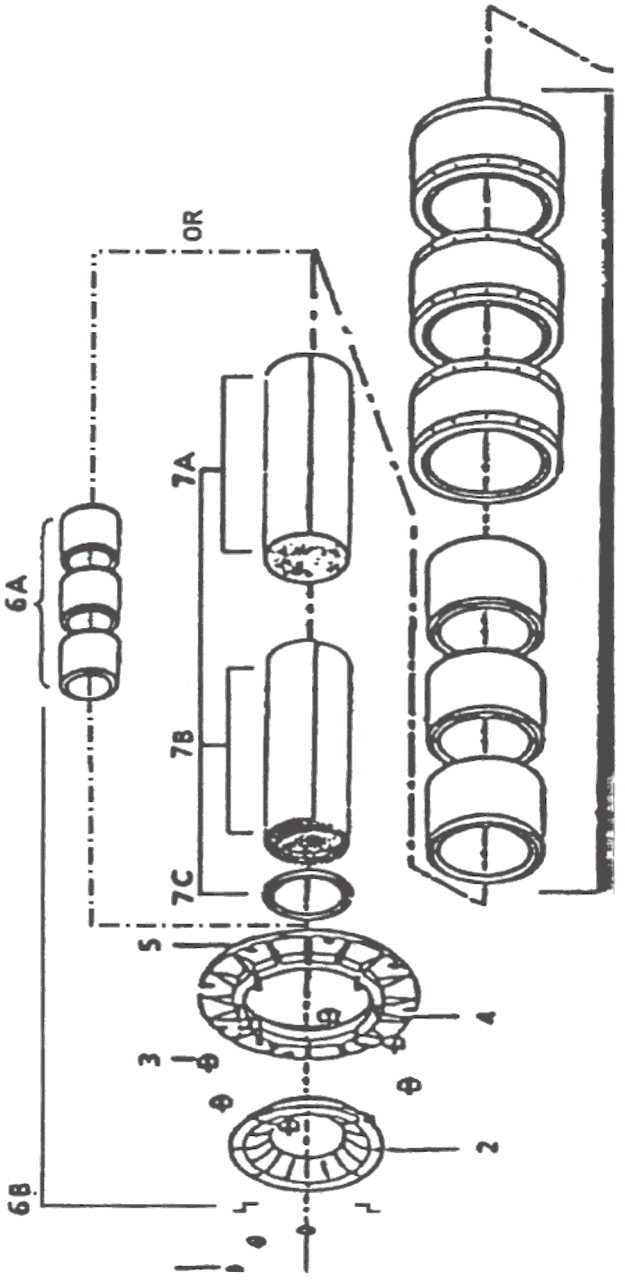

OR
7A
6A
7B
7C
5
4
3
2
6B

Table 7-5. Quantities of CBR Filters and Prefilters & Housing Revision per Ship Class

Ship Class and Hull Number	Housing Rev, NAVSEA Dwg No DL 6263417	Qty CBR Filters for TP zone	Qty CBR filters for LPAC/HPAC	Qty Cylindrical Prefilters	Qty (OR) Bag plus Flat Prefilters
LSD 44–48	Rev C and Earlier	96	12	96	32
LSD 49–52	Rev C and Earlier	102	12	102	32
DDG 51–53	Rev C and Earlier	138	5*	138	46
DDG 54–71	Rev C and Earlier	138	8*	138	46
DDG 72–78	Rev D and Later	138	8*	138	46
DDG 79–	Rev D and Later	105	6*	105	35
LHD 1–4	Rev C and Earlier	162	12	162	54
LHD 5–7	Rev D and Later	189	12	189	63
AOE 6–8	Rev C and Earlier	246	3*	246	82
AOE 10	Rev D and Later	246	6*	246	82
LHA 3	Rev C and Earlier	54	-	54	18

*NOTE: DDG 51 CLASS AND THE AOE 6 CLASS SHIPS USE THE 100 CFM M48 FILTER (NSN 4240-01-161-3710) FOR THE LPAC/HPAC.

APPENDIX
ABBREVIATIONS AND ACRONYMS

	Chemical, Biological, and Radiological
	Cubic Feet per Minute
	Collective Protection System
	Center Support Tube
	Damage Control
	Damage Control Control
	Dioctylphthalate
HEPA	High Efficiency Particulate Arresting
	Intermediate Maintenance Activity
in. wg	Inches of Water, Gauge
	Military Specification
NAVSEA –	Naval Sea Systems Command
NSWCDD	Naval Surface Warfare Center Dahlgren Division
NPFC	Naval Publications and Forms Center
NSIF	Navy Standard Impingement Filter
	National Stock Number
NSWSES –	Naval Ship Weapon Systems Engineering Station
	Pressure Control Valve
	Planned Maintenance System
	Ship Information Book
	Total Protection
WCS	Work Center Supervisor