

Installation, Operation and Maintenance of Air Filtration Systems Manual

Fourth Edition, 2018

National Air Filtration Association®
1818 Parmenter St, Ste 300
Middleton, WI 53562
www.nafahq.org



NAFA®

The National Air Filtration Association® (NAFA) is the trade association for heating, ventilating and air conditioning air filter manufacturers and distributors around the world. NAFA® has over 850 members and provides educational programs on the benefits of clean indoor environments through their membership. NAFA® also publishes The [NAFA Guide To Air Filtration](#) and [The Installation, Operations and Maintenance of Air Filtration Systems](#). NAFA® accredits individual members through their Certified Air Filter Specialist and NAFA Certified Technician program. Contact NAFA® at www.nafahq.org for further information or comments.



Publication Information

The Installation, Operation and Maintenance of Air Filtration Systems is published by the National Air Filtration Association®. NAFA is a non-profit, industry-supported association whose members include air filter sales and service companies, manufacturers and distributors of air filtration products, as well as professionals associated with the air filtration industry.

Additional copies of The Installation, Operation and Maintenance of Air Filtration Systems are available from NAFA® Headquarters.

First Edition 1997
Second Edition 2005
Third Edition 2012
Fourth Edition 2018

Copyright® National Air Filtration Association® 2018

All rights reserved. No part of this book may be reproduced by photocopying, recording, or by any other means, or stored, processed, or transmitted in or by any computer or other system without prior written permission of NAFA®.

ISBN No: 0-938423-16-9

NAFA® encourages architects, engineers and end-users to contact NAFA® member companies for air filter information, products and services. NAFA® members subscribe to the NAFA® Code of Ethics, and receive continuing education and training on best practice applications and emerging technologies in the air filter industry. Certified members study and pass thorough national examinations to achieve accreditation - Certified Air Filter Specialist (CAFS); NAFA Certified Technician Level I (NCT I) and NAFA Certified Technician Level II (NCT II).

A complete list of NAFA® members is on the NAFA® website at www.nafahq.org.

Foreword

The Installation, Operation and Maintenance of Air Filtration Systems was developed by the National Air Filtration Association®. This manual will be of use to all those directly involved with the correct and proper installation, operation and maintenance of air filtration systems including:

- mechanical engineers
- HVAC system designers
- mechanical contractors
- building owners
- facility managers
- air filter service personnel
- building operations personnel

The First Edition of this manual (1997) was compiled and written by the NAFA® Technical Committee in conjunction with Robert H. Avery as technical writer and consultant. For each subsequent reprint, each chapter has been reviewed and revised to reflect the most current and accurate information concerning systems and equipment.

This manual is specifically published to help educate and accredit HVAC&R Technicians working with air filter systems and to serve as a resource guide for all building operations personnel.

It is hoped that through increased knowledge of the different aspects involved in air filtration, and the different alternatives available, air filtration systems will be operated to the best advantage of any particular application.

For additional information and comments or questions about the information in this book contact NAFA® international headquarters at www.nafahq.org.

Acknowledgements

This book is made possible by the combined efforts and experience of all members of the National Air Filtration Association®.

The extra efforts, knowledge and time contribution of the following individuals deserves special recognition.

IOM Fourth Edition Committee Chairman

Leslye Sandberg, CAFS*
Permatron
A Division of Rensa Filtration
Elk Grove Village, Illinois

IOM Fourth Edition Contributors

Michael Beier, CAFS*
Products Unlimited, Inc.
Omaha, Nebraska

Scott Beier
Products Unlimited, Inc.
Omaha, Nebraska

Harry C. Elinsky, Jr., CAFS*
Filtech, Inc.
West Homestead, Pennsylvania

Keith Jordan
Sanuvox Technologies, Inc.
Forth Worth, Texas

Paula Levasseur, CAFS*
LMF Services, LLC
Portland, Oregon

Phil Maybee, CAFS, NCT*
The Filter Man, LLC.
New Caney, Texas

Dave Miller
Complete Filter Media
Lancaster, Ohio

Glen Moore, NCT II
Camfil-USA, Inc.
Washington, North Carolina

Sam Mordecai
Precision Air Technology
Morrisville, North Carolina

Stephen W. Nicholas, CAFS, NCT II*
Air Industries, Inc.
North Andover, Massachusetts

Joseph Pessa, CAFS
Dynamic Air Quality Solutions
Princeton, New Jersey

Mike Reidy, CAFS
Roto Aire Filter Sales & Service
Salt Lake City, Utah

Jim Rosenthal, CAFS
TEX-AIR Filters/
Air Relief Technologies
Fort Worth, TX

Tavatchai (Alex) S., CAFS
3V Engineering Solutions Co. Ltd.
Samutprakarn, Thailand

Amber Sparks, CAFS, NCT
Pure Air Filter Sales & Service
Fairhope, Alabama

Chris Zaker, CAFS, NCT*
Filter Technolog
Lancaster, Ohio

...and the input from
NAFA Members
across the world.

**Contributors to previous editions*

NAFA Headquarters Staff:

Michelle Czosek, CAE
Executive Director

Terry Driscoll
Association Coordinator

Kristin McGuine
Graphic Designer

Tony Veroeven
Marketing Manager

Contributors to previous editions

Katja Auer
David Brooks
Carol A. Christensen, CAFS
William Down, CAFS
Ken Evans, CAFS, NCT
Gerald Festian, CAFS, NCT II
Joe W. Fly, Jr., CAFS
Jaak Geboers
Jeff Gentry, CAFS
Santos Guzman
Jan Hammerlund
Robert Hanson, CAFS
Jim Hedback
Ron Mattson, CAFS
Earl Mielke, CAFS
Domenick Orlando, CAFS
Rick Peckham, CAFS
Bill Rasmussen, CAFS, NCT
George Spottswood, CAFS
Dr. Hector Valtierra
Alan C. Veeck, CAFS, NCT II
Rex Wilhoite, CAFS
Robert Williams, CAFS

Table of Contents

Chapter 1: Introduction	1-1
NAFA® Certification Programs	1-3
Chapter 2: Air Filtration Framing Systems - Unitary Filters	2-1
Introduction	2-1
Upstream / Downstream Servicing	2-1
Installation of Built-Up Filter Banks	2-3
Installation of Modular Track Systems.....	2-5
Media Blanket Filter Systems	2-6
Installation of Pressure Drop Measuring Devices	2-7
Chapter 3: Installation of Unitary Filters	3-1
Introduction	3-1
Construction Filters	3-1
Pre-Installation Check of Filters and Filter Banks	3-2
Installation of Filter Pads	3-3
Installation of Ring Panel and Link Type Filters	3-4
Installation of Framed Panel and Pleated Filters	3-5
Installation of Supported Media Cartridge Filters.....	3-6
Installation of Non-Supported Extended Surface Pocket Filters	3-7
Installation of Box Type Air Filters.....	3-9
Prefilters for High Efficiency Filters.....	3-11
Appendix.....	3-12
Chapter 4: System Operation and Unitary Filter Replacement	4-1
Introduction	4-1
Observation of Filter System after Start-up.....	4-2
Changing Prefilters.....	4-3
Replacing Blanket Prefilters	4-4
Changing Final Filters	4-5
Chapter 5: Side Access Housings	5-1
Introduction	5-1
Installation of Housing	5-3
Installation of Filters	5-4
System Operation and Changing Filters.....	5-5
Chapter 6: Air Handlers and Air Filters	6-1
Introduction	6-1
Installation of Air Filters and System Operation	6-3
Chapter 7: Automatic Roll Filters	7-1
Introduction	7-1
Installation of Automatic Roll Filters	7-2
Operation of Automatic Roll Filters	7-3
Filter Maintenance	7-4
Chapter 8: HEPA Filters and HEPA-Configured Filters	8-1
Introduction	8-1
Types of HEPA Filters.....	8-2
Filter Mounting Systems	8-4
Box Framing Systems	8-5
Filter Wall Systems	8-7

Ceiling Filter Systems	8-8
Side Access Housings	8-9
System Start-up and Operation.....	8-12
Changing HEPA Filters.....	8-12
Addendum 8: Bag In / Bag Out Procedures	8.1-1
Chapter 9: Molecular Containment Control Systems	9-1
Introduction	9-1
Types of Molecular Contaminant Adsorbing Equipment.....	9-2
Installation of Molecular Containment Filtration Equipment.....	9-4
System Start-up and Operation.....	9-6
Changing of Adsorbers.....	9-8
Chapter 10: Electronic Air Cleaners “Electrostatic Precipitators	10-1
Introduction	10-1
Installation of Electronic Air Cleaners	10-2
System Start-up and Operation.....	10-4
Filter Operation.....	10-5
Chapter 11: Time to Change Filters.....	11-1
Introduction	11-1
Measuring Pressure Drop.....	11-2
Use of Prefilters.....	11-5
Chapter 12: Upgrading Air Filter Systems	12-1
Introduction	12-1
Increasing Airflow.....	12-1
Increasing Efficiency	12-3
Addendum 12: Ten-step Guideline for Air Filtration Selection.....	12.1-1
Chapter 13: Ultraviolet Germicidal Irradiation, Photocatalytic Oxidation	13-1
Introduction	13-1
How UV Works.....	13-2
Components of a UV System	13-3
Photocatalytic Oxidation - PCO.....	13-4
Chapter 14: Industrial Finishing Supply and Exhaust Filters	14-1
Introduction	14.1
Filter Changeout.....	14-1
Filter Disposal.....	14-3
Chapter 15: Equipment Protection Filters and Screens	15-1
Introduction	15-1
Chapter 16: Worker Safety	16-1
Introduction	16-1
Safety Checklist.....	16-1
Universal Biological Hazard Symbol	16-4
Glossary	G-1
Index.....	I-1

Chapter 1

Introduction

Purpose

This book is intended to serve as a guide for all those involved in the installation, operation and maintenance (I.O.M.) of air filtration systems. These three functions are rarely performed by the same person or group of people. Systems are designed by mechanical engineers, installed by mechanical contractors, operated by building engineers, and maintained by air filter service personnel. The work by the mechanical contractor may be done by its sheet metal (ventilation) department or by subcontract to a separate ventilation contractor. Air filter service may be performed by the building maintenance department or may be contracted to an air filter service organization.

This book is not a substitute for the I.O.M. instructions which air filter system manufacturers supply with their equipment. Such information is usually equipment-specific. If copies have been lost, request replacements or links to online information from the supplier or the manufacturer. This book must paint with a broad stroke. It is impossible to include all the equipment and every variation which may be encountered. However, all systems have common characteristics important to their proper operation. The purpose of this book is to highlight the important details involved in the I.O.M. of most air filtration systems.

It is important that people responsible for the I.O.M. of air filtration systems communicate effectively with each other. If this does not occur, the venti-

lation contractor may be challenged to properly install filters in the space allocated to them by the system designer. The building maintenance department may be totally unaware of what to expect from the air filter system, and it may have no information about required maintenance. The group responsible for filter changing may find that it has no information about the air filters to be replaced. Without adequate planning, the I.O.M. of filters can be stressful, cumbersome and even hazardous.

System Design Considerations

While this book is not intended specifically for the air filtration system designer, designers may use it as a check-list of the details required for an effective air filtration system. It makes no suggestion as to what type, efficiency, or capacity of air filters should be used. Those issues are the responsibility of the design engineer. However, this book suggests that, over the life of the filter system, the design of the air filter system, specifically the housing in which the filters are installed; the arrangement and location of filters within the housing; and the connecting ductwork can be as important as the proper selection of filters.

Regardless of the type of air filtration system selected, there are considerations any designer must keep in mind.

1. All applicable safety regulations must be met in both the fabrication and operation of the air filtration system. When airborne hazardous

materials are involved, special provisions must be taken in the design of the filtration system to help minimize the exposure of air filter service personnel to these hazardous materials.

2. Air filter systems must be designed and fabricated so that there is adequate space to install the filters and to maintain them properly. Three considerations are involved here:

c. The first is adequate in-line space between the filter bank and upstream air sources. High velocity air from blowers or ducts blasting into the filter plenum can create uneven airflow across the filter system and possibly damage filters. When this condition cannot be avoided, take provisions to protect the filters from any blasts by the use of diffusers or other devices which intercept the blast and make the airflow more uniform.

d. The second consideration is adequate space both upstream and downstream of the air filtration equipment to easily remove dirty filters, install clean ones, and do whatever maintenance is required. If filters cannot be installed easily and conveniently at the time of system start-up, this problem will not go away; it will exist as long as the filter system is in use.

e. The third consideration is adequate access to the filter system for clean filters to be delivered to and dirty filters safely removed from the filter site. This also applies to roll filter media and any filter-servicing equipment which may be required.

3. Air filters only clean the air that passes through them. The design engineer must clearly specify an air filter holding system that uses a positive-seal clamping mechanism. Proper gasketing should also be specified to prevent bypass air between a filter and its holding system.

4. In all mechanical air filter systems, the life of a filter is determined by the allowable build-up of resistance of the filter as it loads with dust. Air filter manufacturers' literature frequently provides a "final pressure drop," at which point, air filters should be changed. System design may dictate some other value be used, regardless of the pressure drop at which filters should be changed, (See Chapter 11: Time to Change Filters) a pressure drop device should be installed for maintenance personnel to know when this threshold has been reached.

HEPA Filters and Systems

Because High Efficiency Particulate Air (HEPA) filters and their holding devices and systems are special in their design and operation, Chapter 8 of this manual deals specifically with HEPA filters. All other chapters present information on standard types of filters, filter framing and system information unless otherwise noted.

Changing Filters

Do not change air filters when the HVAC system is operating. Reasons for this include:

1. the possibility that dust which has been captured by the filter will be released into the airstream during filter changing
2. the chance that service personnel may be injured by filters which become airborne by the airstream, and
3. the likelihood that air filter system servicing will not be as thorough in an environment stressful to the service person.

Make sure that the person changing filters has suitable respiratory protection when handling filters which have captured toxic or hazardous materials. (See Chapter 13.)

Filter Efficiency

As a matter of convenience, there may be times in this book when air filter types are identified by efficiency. For the purposes of this book, the following classifications by the ANSI/ASHRAE Standard 52.2-2007 are used.

Low Efficiency: MERV 1-4

Medium Efficiency: MERV 5-12

High Efficiency: MERV 13-16

Filters with an efficiency greater than MERV 16 by ANSI/ASHRAE Standard 52.2 are usually rated by the DOP (dioctylphthalate), or other challenge, test method. This test is based on the ability of a filter to remove an aerosol consisting of 0.3 micrometers (μ) particles of a test challenge, usually DOP or another suitable challenge agent.

Dimensions and Measurements

All measurements are given in English values, which are most commonly used in the United States. SI (International System of Units) values, in parentheses, follow the English Measurements. They are included only when they provide key measurement data.

Technical Assistance

The selection of the correct air filtration system for any specific application is a precise science which considers more than filter efficiency. The assistance of National Air Filtration Association® Certified Air Filter Specialists (CAFS) is available to those who have this responsibility.

The installation, operation and maintenance of these systems is no less important. A NAFA® member, designated a CAFS, has a background of training and experience to offer help in any of these areas to those who need it.

The **NAFA Certified Air Filter Specialist (CAFS)** program is the first and only educational and certification program designed specifically for air filtration professionals. Anyone engaged in specifying, manufacturing, distribution or sales and service of air filters will benefit from this accreditation.

CAFSs are involved in a formalized structure for ongoing education and recertification. The NAFA® publication, *NAFA Guide to Air Filtration*, is required reading for the CAFS Certification Exam.

The NAFA Certified Technician Program

Level I (NCT I) is a certification program for technicians involved in the installation, operation, and maintenance of commercial air filtration systems.

The program has been designed and tailored to meet the needs of facility managers, building owners, HVAC&R service contractors, and others who employ technicians in the HVAC&R industry. The testing program provides education for staff on the service of air filtration systems and recognizes the knowledge and expertise of technicians.

NCTs are involved in a formalized structure for ongoing education and recertification. This manual is required reading for the NCT Certification Exam.

Because of the complex nature of hospitals and healthcare facilities, an NCT program has been designed specifically for this group of technicians.

The NAFA Certified Technician Program

Level II (NCT II) is an advanced certification utilizing the knowledge and skill of the NCT, plus additional testing and training for Bag In / Bag Out (BIBO) procedures.

Due to the biohazard nature of BIBO filter systems, special skill sets, additional training, tools and PPE equipment are required. NAFA® provides this training and certification for the safety of the technicians and the integrity of the system.

To learn more about the NAFA Certified Technician and Certified Air Filter Specialist Programs, log onto www.nafahq.org



Index

Afterfilters (Final Filters)	
Changing.....	4-5
Air Filter Systems	
Increasing airflow	
Same filters, shorter life.....	12-1
Lower efficiency filters.....	12-2
Higher capacity filters.....	12-2
Increasing efficiency	
Higher efficiency filters	12-3
Air Filtration Framing Systems	
Types.....	2-1
Sizing	2-1
Air Handling and Package Units	
Description	6-1
Modularity	6-2
Filter housings.....	6-2
Manufacturer's comments.....	6-2
Installation of filters.....	6-3
Measuring filter pressure drop.....	6-3
Changing filters.....	6-3
Locating Spacers	6-4
Automatic Roll Filters	
General description.....	7-1
Installation	
Special considerations.....	7-2
Operation.....	7-3
Media advancing controls	7-3
Changing media	7-4
Bag In / Bag Out Housings	
Addendum 8.....	8.1-1
Box Type Air Filters	
Description	3-9
Styles	
Extended surface pleat type	3-5
Lofted media filters.....	3-9
Separator type.....	3-9
Mini-pleat type.....	3-9
Installation in banks of holding frames	3-10
Installation in modular framing systems.....	3-11
Built-up Filter Banks	
Description	2-3
Fastening frames together	2-3
V-bank arrangements.....	2-4
2 – 4 in. holding frames	2-3
Assembly into banks	2-4
Vertical stiffeners	2-3
CAFS (Certified Air Filter Specialist)	1-3
Caulking of Leaks.....	2-4
Ceiling Filter Systems (HEPA)	8-8
Changing Bag In /Bag Out Filters	
Addendum 8	8.1-1
Changing Filters	
HVAC system not in operation	1-2
Changing prefilters.....	4-2
Changing final filters.....	4-5
Changing HEPA Filters	
Hazardous materials.....	8-13
Box framing systems.....	8-12
Filter wall systems	8-12
Side-access housings.....	8-13
Crank operated fasteners	8-13
Bolt-type	8-13
With push type clamping system.....	8-13
With pull type clamping system	8-13
Ceiling type clamping system	8-13
Changing Roll Filter Media	7-4
Clean Benches	8-2
Cleaning Filters	
Washable filters.....	3-12
Dry plastic media filters	3-12
Cleanrooms and Benches	8-2
Construction Filters	
Definition	3-1
Importance	3-1
Efficiency	3-1
Replacement with new filters.....	3-1
Design Considerations/ Air Filtration Systems.....	1-1
Dimensional Drawings	
Filter manufacturer supplied	2-3
Dimensions and Measurements.....	1-3
Downstream Servicing.....	2-1
Dry Plastic Media Filters.....	3-12

Electronic Air Cleaners		Final Filters	
Description	10-1	Changing.....	4-5
Installation		Automatic Roll Filters.....	7-2
Housing details.....	10-2	Electrostatic precipitators	10-4
High voltage wiring.....	10-3		
Access door safety switches	10-3	Final Pressure Drop	
Start-up		Definition	11-3
Short circuits	10-4	Selecting.....	11-4
Intermittent arcing.....	10-4	Measuring combined prefilter	
Prefilters.....	10-4	and afterfilter.....	11-5
Agglomerator assemblies	10-4		
Operation		Folding Frames Deeper than 4 in.	
Sources of malfunction	10-5	Assembly into filter banks.....	2-4
Cleaning.....	10-5		
Face, Bag Filter	3-7		
Filler Pieces	2-3	Framed Panel and Pleated Filters	
Filter Classification		Description	3-5
By efficiency.....	1-2	Installation in banks of holding frames	3-5
Filter Efficiency Groups	1-2	Installation in modular framing systems.....	3-5
Filter Efficiency, Increasing	12-3		
Filter Maintenance Record	4-2	Framing Systems – HEPA Filters	8-4
Filter Pads		Box framing systems.....	8-5
Description	3-3	Filter wall systems	8-7
Handling.....	3-3	Ceiling systems	8-8
Installation in bank of holding frames	3-3	Side-access housing.....	8-9
Pad holding frame vs. pad frame	3-3		
Installation in modular track systems.....	3-4	Guideline for Air Filter Selection	
Filter Pressure Drop Measuring Devices		Addendum 12.....	12.1-1
Overview	11-2		
Manometers.....	11-2	Gas Phase Controls Systems	
Pressure switches and monitors.....	11-2	Introduction	9-1
Dial and pointer gauges	11-2	Types of equipment	
Maintenance of devices.....	11-3	Tray type units	9-2
Filter Systems		Serpentine cell units.....	9-2
Pre-commissioning check.....	4-1	Adsorbent-bonded media filters	9-2
Observation after start-up		Side access tray housings.....	9-3
Pressure drop too low.....	4-2	Installation	
Pressure drop too high.....	4-2	Special considerations.....	9-4
Filter Wall HEPA Filter Framing System		Tray type units	9-4
Description	8-7	Serpentine cell units.....	9-5
Installation of filter wall	8-7	Adsorbent-bonded media filters	9-5
Installation of HEPA filters.....	8-7	Side access tray housings.....	9-5
Filters, When to Change	11-1	System start-up.....	9-6
		System operation	
		Monitoring systems.....	9-6
		Adsorbent residual activity.....	9-6
		Reactivating permanent adsorbents	
		Adsorbent exchange.....	9-7
		Adsorbent replacement.....	9-7
		Disposal of spent activated carbon.....	9-7
		Disposal of other spent adsorbents	9-7
		Changing of adsorbents	
		Permanent tray type.....	9-8
		Disposable tray type.....	9-8
		Serpentine cell adsorbents.....	9-8
		In side-access housings	9-9

HEPA “Like” Filters	8-2	Overrating Filters	12-1
HEPA Filter		Packaged Air Conditioning Units	6-1
Definition	8-1	Prefilters	
Types.....	8-2	Description	3-11
Applications	8-2	Installation in banks of holding frames	3-11
Protecting.....	8-3	Installation in modular track systems.....	3-11
In downstream access filter banks.....	8-3	Changing	
Prefilters for	8-3	In separate built-up filter banks.....	4-3
In air exhaust systems	8-3	In same holding frame as afterfilter	4-3
Filter mounting systems		In modular tack framing systems	4-3
General criteria.....	8-4	Blanket type.....	4-4
Types	8-4	Collecting hazardous materials	4-3
Methods of sealing.....	8-4	Pre-installation Check	
HEPA Filter System		Filters.....	3-2
Start-up and operation	8-12	Bank of holding frames	3-2
Operation and Maintenance.....	8-12	Modular track systems.....	3-2
Installation of Systems		Media blanket holding systems	3-2
Coordination of services.....	1-1	Pressure Drop Measuring Devices	
Communication	1-1	Purpose	2-7
Job Safety	16-1	Final pressure drop – selection.....	11-3
Link Type Filters (<i>See Ring Panel Filters</i>)		Ring Panel and Link Type Filters	
Magnehelic Gauges (<i>See Filter Pressure Drop Measuring Devices, Dial and Pointer Gauges</i>)		Description	3-4
Maintenance of Filter Framing Systems	4-2	Installation in banks of holding frames	3-4
Manually Operated Roll Filters	7-2	Installation in modular track systems.....	3-4
Manufacturer’s I.O.M. Instructions		Roll Filter Combinations	7-2
Importance	1-1	Roll Filter Media Cores	7-4
Replacements	1-1	Side Access Housings	
Media Blanket Filter Systems		Description	5-1
Description	2-6	Access to filters.....	5-4
Installation	2-6	Alternative sealing design.....	5-5
Replacing.....	4-4	Variations in manufacture.....	5-2
Media Retainer Bands	3-8	Advantages and disadvantages.....	5-2
Modular Track Systems		Pre-installation considerations.....	5-2
Description	2-5	Installation	5-3
Dimensions.....	2-5	Use of construction filters.....	5-4
Assembly	2-5	Installing prefilters.....	5-4
Upstream versus downstream servicing	2-6	Installing afterfilters.....	5-4
Non-supported Extended Surface (Bag) Pocket Filters		Changing filters	
Description	3-7	Prefilters	5-5
Installation in banks of holding frames	3-7	Afterfilters.....	5-6
Installation in modular track systems.....	3-8	Side Access Housings for HEPA Filters	
		Description	8-9
		Installation of HEPA filters	
		Crank operated type	8-9
		Bolted type	
		Push type bolting assemblies	8-10
		Pull type bolting assemblies.....	8-11

S. I., International System of Units	1-3	Upgrading Air Filter Systems	12-1
SMACNA	16-1	Upstream Servicing	2-1
SULPA Filter	8-1	V-Cell Air Filters	3-12
Supported Media Cartridge Filters		Washable Filters	3-12
Description	3-6	Worker Safety	
Styles.....	3-6	Introduction	16-1
Installation in bank of holding frames		Safety checklist	16-1
Support device attached to frame	3-6	System design – I.O.M.	16-2
Support device inside header	3-6	System upgrade.....	16-3
Installation in modular track system	3-7	Ultraviolet light exposure	16-3
ULPA Filter	8-1	Confined space	16-3
Underrating Filters	12-2	Ladder safety	16-4
		Lock Out/Tag Out.....	16-4