

Environmental Technology Verification Protocol


Drinking Water Systems Center

PROTOCOL FOR EQUIPMENT VERIFICATION TESTING FOR PHYSICAL REMOVAL OF MICROBIOLOGICAL AND PARTICULATE CONTAMINANTS

Prepared by



NSF International

Under a Cooperative Agreement with
 EPA U.S. Environmental Protection Agency

ET ✓ ET ✓ ET ✓

**EPA/NSF ETV
PROTOCOL FOR EQUIPMENT VERIFICATION TESTING
FOR PHYSICAL REMOVAL OF MICROBIOLOGICAL AND
PARTICULATE CONTAMINANTS**

Prepared by:
NSF International
789 Dixboro Road
Ann Arbor, MI 48105

Recommended by
the Steering Committee for the Verification of
Drinking Water Systems
in April 1998

Modified in May 1999, March 2002 and February 2005

With support from
the U.S. Environmental Protection Agency
Environmental Technology Verification Program

Copyright 2005 NSF International 40CFR35.6450.

Permission is hereby granted to reproduce all or part of this work, subject to the limitation that users may not sell all or any part of the work and may not create any derivative work therefrom. Contact ETV Drinking Water Systems Center Manager at (800) NSF-MARK with any questions regarding authorized or unauthorized uses of this work.

U.S. ENVIRONMENTAL PROTECTION AGENCY

Throughout its history, the U.S. Environmental Protection Agency (EPA) has evaluated technologies to determine their effectiveness in preventing, controlling, and cleaning up pollution. EPA is now expanding these efforts by instituting a new program, the Environmental Technology Verification Program---or ETV---to verify the performance of a larger universe of innovative technical solutions to problems that threaten human health or the environment. ETV was created to accelerate the entrance of new environmental technologies into the domestic and international marketplace. It supplies technology buyers and developers, consulting engineers, states, and U.S. EPA regions with high quality data on the performance of new technologies. This encourages more rapid availability of approaches to better protect the environment.

ETV Drinking Water Systems Center

Concern about drinking water safety has accelerated in recent years due to much publicized outbreaks of waterborne disease and information linking ingestion of arsenic to cancer incidence. The EPA is authorized through the Safe Drinking Water Act (SDWA) to set numerical contaminant standards and treatment and monitoring requirements that will ensure the safety of public water supplies. However, small communities are often poorly equipped to comply with all of the requirements; less costly package treatment technologies may offer a solution. These package plants can be designed to deal with specific problems of a particular community; additionally, they may be installed on site more efficiently---requiring less start-up capital and time than traditionally constructed water treatment plants. The opportunity for the sales of such systems in other countries is also substantial.

The EPA has partnered with NSF International (NSF) to verify performance of small drinking water systems that serve small communities. It is expected that both the domestic and international markets for such systems are substantial. The EPA and NSF have formed an oversight stakeholders group composed of buyers, sellers, and states (issuers of permits), to assist in formulating consensus testing protocols. A goal of verification testing is to enhance and facilitate the acceptance of small drinking water treatment equipment by state drinking water regulatory officials and consulting engineers while reducing the need for testing of equipment at each location where the equipment use is contemplated. NSF will meet this goal by working with equipment manufacturers and other agencies in planning and conducting equipment verification testing, evaluating data generated by such testing, and managing and disseminating information. The manufacturer is expected to secure the appropriate resources to support its part of the equipment verification process, including provision of equipment and technical support.

The verification process established by the EPA and NSF is intended to serve as a template for conducting water treatment verification tests that will generate high quality data for verification of equipment performance. The verification process can help in moving small drinking water equipment into routine use more quickly. The verification of an equipment's performance involves five sequential steps:

1. Development of a Product Specific Test Plan (PSTP);
2. Execution of verification testing;
3. Data reduction, analysis, and reporting;
4. Performance and cost factor (labor, chemicals, energy) verification; and
5. Report preparation and information transfer.

This verification testing program is being conducted by NSF with participation of manufacturers, under the sponsorship of the EPA Office of Research and Development (ORD), National Risk Management Research Laboratory (NRMRL), Water Supply and Water Resources Division (WSWRD) - Cincinnati, Ohio. NSF's role is to provide technical and administrative leadership and support in conducting the testing. It is important to note that verification of the equipment does not mean that the equipment is "certified" by NSF or EPA. Rather, it recognizes that the performance of the equipment has been determined and verified by these organizations.

Partnerships

The EPA and NSF cooperatively organized and developed the ETV Drinking Water Systems (DWS) Center to meet community and commercial needs. NSF and the Association of State Drinking Water Administrators (ASDWA) have an understanding to assist each other in promoting and communicating the benefits and results of the project.

NSF INTERNATIONAL

Mission Statement

NSF, an independent, non-governmental organization, is dedicated to being the leading global provider of public health and safety-based risk management solutions while representing the interest of all stakeholders.

NSF Purpose and Organization

NSF is an independent not-for-profit organization. For more than 52 years, NSF has been in the business of developing consensus standards that promote and protect public health and the environment and providing testing and certification services to ensure manufacturers and users alike that products meet those standards. Today, millions of products bear the NSF Name, Logo and/or Mark symbols upon which the public can rely for assurance that equipment and products meet strict public health and performance criteria and standards.

Limitations of use of NSF Documents

This protocol is subject to revision; contact NSF to confirm this revision is current. The testing against this protocol does not constitute an NSF Certification of the product tested.

ORGANIZATION AND INTENDED USE OF PROTOCOL AND TEST PLANS

NSF encourages the user of this protocol to also read and understand the policies related to the verification and testing of drinking water treatment systems and equipment.

The first chapter of this document describes the protocol required in all studies verifying the performance of equipment or systems removing microbiological and particulate contaminants. The remaining chapters, or Technology Specific Test Plans (TSTPs), describe the additional requirements for equipment and systems using specific technologies to attain the goals and objectives of the protocol: the removal of microbiological and particulate contaminants.

Prior to the verification testing of drinking water treatment systems, plants and/or equipment, the equipment manufacturer and/or supplier must select an NSF-qualified, Field Testing Organization (FTO). This designated FTO must write a PSTP to define the testing plan specific to the product. The equipment manufacturer and/or supplier will need this protocol and the TSTP(s) contained herein and possibly other ETV protocols and TSTPs to develop the PSTP, depending on the treatment technologies used in the unit processes or treatment train of the equipment or system. More than one protocol and/or TSTP may be necessary to address the equipment's capabilities in the treatment of drinking water.

Testing shall be conducted by an NSF-qualified FTO that is selected by the manufacturer. Water quality analytical work to be completed as a part of a TSTP shall be contracted with a laboratory that is certified, accredited or approved by a state, a third-party organization (i.e., NSF), or the U.S. EPA. For information on a listing of NSF-qualified FTOs and state, third-party, or the U.S. EPA-accredited laboratories, contact NSF.

ACKNOWLEDGMENTS

The U.S. EPA and NSF would like to acknowledge those persons who participated in the preparation, review and approval of this protocol. Without their hard work and dedication to the project, this document would not have been approved through the process which has been set forth for this ETV project.

Chapter 1: Requirements for All Studies

Writers: Joe Jacangelo, Montgomery Watson and Gary Logsdon, Black & Veatch

Technical reviewer: Ray Letterman, Syracuse University

Chapter 2: Test Plan for Membrane Filtration

Writer: Joe Jacangelo, Montgomery Watson

Technical reviewer: Mark Clark, University of Illinois

Chapter 3: Test Plan for Coagulation and Filtration

Writer: Gary Logsdon, Black & Veatch

Technical reviewer: Ray Letterman, Syracuse University

Chapter 4: Test Plan for Bag Filters and Cartridge Filters

Writer: Gary Logsdon, Black & Veatch

Technical reviewer: Charles Gerba, University of Arizona; Joan Rose, University of South Florida; and Donna Jensen, South Hills Environmental Management

Chapter 5: Test Plan for Precoat Filtration

Writer: Gary Logsdon, Black & Veatch

Technical reviewer: Charles Gerba, University of Arizona; Joan Rose, University of South Florida; and Donna Jensen, South Hills Environmental Management

Chapter 6: Test Plan for Backwashable Depth Filtration

Writer: Gary Logsdon, Black & Veatch

Technical reviewer: Donna Jensen, South Hills Environmental Management

Steering Committee Members that recommended Chapters 1, 3 and 5:

Mr. Jerry Biberstine, Chairperson

Ms. Donna Cirolia

Mr. Stephen W. Clark

Mr. Allen Hammer

Mr. Joe Harrison

Dr. Joseph G. Jacangelo

Dr. Gary S. Logsdon

Mr. Bob McCarthy

Mr. Greg McKelvey

Mr. Renee Pelletier

Mr. Dallas Post

Mr. John Sadzewicz

Mr. Ken Schmidt

Mr. Peter Shanaghan

Mr. David Spath

Mr. John Trax

Steering Committee Members that recommended Chapter 2:

Mr. Jim Bell

Mr. Kevin Brown, Chairperson

Mr. John Dyson

Mr. Buck Henderson

Mr. Jerry Lane

Mr. Peter Shanahan

Mr. Jerry Biberstine

Mr. Stephen Clark

Mr. Joseph Harrison

Mr. Joseph Jacangelo

Mr. Gary Logsdon

Mr. Robert Mann

Steering Committee Members that recommended Chapters 4 and 6:

Mr. Jim Bell

Mr. Jerry Biberstine, Chairperson

Ms. Donna Cirolia

Mr. Stephen W. Clark

Mr. John Dyson

Mr. Allen Hammer

Mr. Joe Harrison

Dr. Joseph G. Jacangelo

Dr. Gary S. Logsdon

Mr. Bob McCarthy

Mr. Renee Pelletier

Mr. Dallas Post

Mr. John Sadzewicz

Mr. Peter Shanaghan

Mr. David Spath

Mr. John Trax

TABLE OF CONTENTS

	<u>Page</u>
Chapter 1: EPA/NSF ETV Protocol for Equipment Verification Testing for Physical Removal of Microbiological and Particulate Contaminants: Requirements for All Studies	1-1
Chapter 2: EPA/NSF ETV Equipment Verification Testing Plan - Membrane Filtration for the Removal of Microbiological and Particulate Contaminants.....	2-1
Chapter 3: EPA/NSF ETV Equipment Verification Testing Plan - Coagulation and Filtration for the Removal of Microbiological and Particulate Contaminants	3-1
Chapter 4: EPA/NSF ETV Equipment Verification Testing Plan - Bag Filters and Cartridge Filters for the Removal of Microbiological and Particulate Contaminants	4-1
Chapter 5: EPA/NSF ETV Equipment Verification Testing Plan - Precoat Filtration for the Removal of Microbiological and Particulate Contaminants.....	5-1
Chapter 6: EPA/NSF ETV Equipment Verification Testing Plan - Backwashable Depth Filtration for the Removal of Microbiological and Particulate Contaminants	6-1