Draft SI 1505 part 1.3

טיוטה לתקן ישראלי ת"י 1505 חלק 1.3

December 2020

דצמבר 2020

ICS CODE: 13.060.20

מערכות לטיפול במי שתייה:
מערכות לטיפול מיקרוביולוגי במים באמצעות קרינה על-סגולה (UV)

Drinking water treatment units:
Ultraviolet microbiological water treatment systems

מכון התקנים הישראלי
The Standards Institution of Israel

רח' חיים לבנון 42, תל-אביב 6997701, טל' 03-6465154, פקס' 03-6412762, www.sii.org.il

תקן זה הוכן על ידי ועדת המומחים 537509 – מערכות ביתיות שאינן אוסמוזה הפוכה, לטיפול במי שתיה, בהרכב זה:
זוהר הרחול, נאור כהן, אתי מנשרוב אלוף, עטר עדות-הבלנה (יו"ר), הלה פרנקל.

כמו כן תרמו להכנת התקן: אורן גרייפנר, רוני גרניט, עירית הן, דביר זמל, אבישי שפירא.

אסנת חאג' עלי ריכזה את עבודת הכנת התקן.

הודעה על מידת התאמת התקן הישראלי לתקנים או למסמכים זרים

תקן ישראלי זה, למעט השינויים והתוספות הלאומיים המצוינים בו, זהה לתקן האמריקני NSF/ANSI 55 – 2019 בכל הנוגע למערכות או לרכיבים ממין B בלבד

הודעה על רוויזיה

תקן ישראלי זה, ת"י 1505 חלק 1.3, והתקנים הישראליים האלה:

ת"י 1505 חלק 1.1

ת"י 1505 חלק 1.2

ת"י 1505 חלק 1.4

באים במקום

התקן הישראלי ת"י 1505 חלק 1 מספטמבר 2009

פתח:

טיפול במי שתייה, מים שתויים, איכות מים, פילטרים, מכשירי חשמל ביתיים, על-סגול, ניתוח מיקרוביולוגי.

Descriptors:

Drinking water treatment, potable water, water quality, filters, household electrical appliance, ultraviolet, microbiological analysis.

עדכניות התקן

התקנים הישראליים עומדים לבדיקה מזמן לזמן, ולפחות אחת לחמש שנים, כדי להתאימם להתפתחות המדע והטכנולוגיה.
המשתמשים בתקנים יוודאו שבידיהם המהדורה המעודכנת של התקן על גיליונות התיקון שלו.
מסמך המתפרסם ברשומות כגיליון תיקון, יכול להיות גיליון תיקון נפרד או תיקון המשולב בתקן.

תוקף התקן

תקן ישראלי על עדכוניו נכנס לתוקף החל ממועד פרסומו ברשומות.
יש לבדוק אם התקן רשמי או אם חלקים ממנו רשמיים. תקן רשמי או גיליון תיקון רשמי (במלואם או בחלקם) נכנסים לתוקף 60 יום מפרסום ההודעה ברשומות, אלא אם בהודעה נקבע מועד מאוחר יותר לכניסה לתוקף.

סימון בתו תקן

כל המייצר מוצר, המתאים לדרישות התקנים הישראליים החלים עליו, רשאי, לפי היתר ממכון התקנים הישראלי, לסמנו בתו תקן:

מכון התקנים הישראלי

הקדמה לתקן הישראלי

תקן ישראלי זה הוא התקן האמריקני NSF/ANSI 55 משנת 2019, שאושר כתקן ישראלי בשינויים ובתוספות לאומיים, בכל הנוגע למערכות ולרכיבים ממין B בלבד.

התקן כולל, בסדר המפורט להלן, רכיבים אלה:
- תרגום סעיף המטרה והחלות של התקן האמריקני בשינויים ובתוספות לאומיים (בעברית)
- פירוט השינויים והתוספות הלאומיים לסעיפי התקן האמריקני (בעברית)
- תרגום חלקו העברי של התקן (באנגלית)
- התקן האמריקני (באנגלית)

מהדורה זו של התקן הישראלי, יחד עם התקנים הישראליים ת"י 1505 חלק 1.1, ת"י 1505 חלק 1.2 ות"י 1505 חלק 1.4, באה במקום מהדורת התקן הישראלי המקורי ת"י 1505 חלק 1 מספטמבר 2009, שהייתה מבוססת על התקנים האמריקניים NSF/ANSI 42, NSF/ANSI 53 ו-NSF/ANSI 55.
במהדורה זו של התקן הישראלי פוצל התקן לארבעה חלקים עשרוניים, וכל אחד מהם מאמץ תקן אמריקני.
חלקי מהדורה זו של התקן הישראלי מאמצים את התקנים האמריקניים NSF/ANSI 42, NSF/ANSI 53, ו-NSF/ANSI 55 משנת 2019 בשינויים ובתוספות לאומיים, ואת התקן האמריקני NSF/ANSI 244 משנת 2018 בשינויים ובתוספות לאומיים. לפיכך מהדורה זו שונה מהותית מהמהדורה הקודמת.

לשם השוואה מדוקדקת בין המהדורות יש לעיין בנוסח המלא שלהן.

תקן זה הוא חלק מסדרת תקנים החלים על מערכות לטיפול במי שתייה.
חלקי הסדרה הם אלה:
- ת"י 1505 חלק 1.1 - מערכות לטיפול במי שתייה: השפעות אסתטיות
- ת"י 1505 חלק 1.2 - מערכות לטיפול במי שתייה: השפעות בריאותיות
- ת"י 1505 חלק 1.3 - מערכות לטיפול במי שתייה: מערכות לטיפול מיקרוביולוגי במים באמצעות קרינה על-סגולה (UV)
- ת"י 1505 חלק 1.4 - מערכות לטיפול במי שתייה: מערכות לטיפול מיקרוביולוגי נוסף במים – סינון
- ת"י 1505 חלק 2 - מערכות לטיפול במי שתייה: מערכות אוסמוזה הפוכה

חלות התקן ומטרתו (תרגום סעיפים 1.1 ו-1.2 של התקן האמריקני בשינויים ובתוספות לאומיים)

הערה:

השינויים והתוספות הלאומיים בסעיף זה מובאים בגופן שונה.

1.1. מטרה

מטרת התקן היא לקבוע דרישות מינימום להפחתה של מיקרואורגניזמים באמצעות קרינה על-סגולה (UV). המערכות לטיפול במים בקרינה על-סגולה שתקן זה חל עליהן מיועדות למים בטוחים מבחינה מיקרוביולוגית. נוסף על כך, תקן זה מפרט את דרישות המינימום למידע בעלוני המידע של המוצר ובתיווי, שהיצרן צריך לספק לנציגים המורשים ולצרכנים של המערכת (system owners), וכן הוא מפרט את התחייבויות המינימום הקשורות לשירות שעל היצרן להעניק לצרכנים.

הערה לאומית:

בשורה השלישית, המילים "or microbiologically unsafe" אינן חלות.

1.2. חלות

תקן זה אינו חל על מערכות לטיפול במי שתייה במערכת אספקת מים, כהגדרתה בתקנות בריאות העם (איכותם התברואית של מי-שתיה ומתקני מי שתיה), התשע"ג-2013, הנמצאת באחריות ספק המים כהגדרתו בתקנות אלה.

תקן זה דן במערכות לטיפול מיקרוביולוגי במים באמצעות קרינה על-סגולה וברכיביהן עבור יישומים בנקודת השימוש (point-of-use, POU) ובנקודת הכניסה (point-of-entry, POE). תקן זה דן במערכות המשתמשות בקרינה על-סגולה בתחום שבין 240 ננומטר ל-300 ננומטר ועד בכלל. המערכות מיועדות לשמש בתנאים הספציפיים המפורטים להלן.

הערה לאומית:

סעיף 1.2.1, "Class A systems", אינו חל.

1.2.2. מערכות או רכיבים ממין B

המערכות ממין B בנקודת הכניסה ובנקודת השימוש שתקן זה דן בהן מיועדות לטיפול קוטל חיידקים משלים למים המתאימים לתקנות בריאות העם (איכותם התברואית של מי-שתיה ומיתקני מי שתיה), התשע"ג-2013, על עדכוניהן (להלן: מערכות). המערכות מתוכננות לאַבטול של מיקרואורגניזמים שייתכן שיימצאו במי שתייה (ציבוריים או פרטיים) הנחשבים בטוחים מבחינה מיקרוביולוגית ומאיכות ידועה. המערכות מיועדות לְאַבְטֵל מיקרואורגניזמים לא פתוגניים הנמצאים באופן רגיל במים ומהווים מטרד בלבד. מערכות ממין B אינן מיועדות לחיטוי של מים שאינם בטוחים מבחינה מיקרוביולוגית, ואינן יכולות לכלול הצהרות ייחודיות או כלליות בנוגע לציסטות[א]. מערכות ממין B לא יכללו הצהרות בנוגע להשפעות בריאותיות מיקרוביולוגיות. המערכות אינן מיועדות לשמש עם מים שאינם בטוחים מבחינה מיקרוביולוגית או שאיכותם אינה ידועה, ללא חיטוי הולם לפני המערכת או אחריה. מערכות שלפי הצהרות יצרן כוללות רכיבים או פונקציות שחל עליהם תקן ישראלי אחר יתאימו לדרישות הישימות המובאות בו.

[א] לפי מונחי האקדמיה ללשון העברית: כִּיסְתָּה – cyst.

פירוט השינויים והתוספות הלאומיים לסעיפי התקן האמריקני

הערה לאומית:
התקן האמריקני NSF/ANSI 55 חל על שני מיני מערכות: מערכות ממין A, שמטרתן לטפל במים שאינם ראויים לשתייה, ומערכות ממין B, שמטרתן לטפל במים ראויים לשתייה.
המים שמערכות ממין A מטפלות בהם אינם מתאימים לתקנות בריאות העם (איכותם התברואית של מי-שתיה ומיתקני מי שתיה), ולכן תקן ישראלי זה אינו חל על מערכות אלה.

הערה לאומית:
בכל מקום בתקן שבו יש התייחסות למערכת ממין A, התייחסות זו אינה חלה.

2. Normative references

במקום התקנים האמריקניים המאוזכרים בתקן והמפורטים בסעיף זה חלים תקנים ישראליים, כמפורט להלן:

התקן האמריקני המאוזכר	התקן הישראלי החל במקומו	הערות (המידע המפורט בעמודת ההערות נכון ליום הכנת תקן זה)
NSF/ANSI/CAN 53	ת"י 1505 חלק 1.2 - מערכות לטיפול במי שתייה: השפעות בריאותיות	התקן הישראלי זהה, למעט שינויים ותוספות לאומיים, לתקן האמריקני NSF/ANSI/CAN 53
NSF/ANSI/CAN 58	ת"י 1505 חלק 2 - מערכות לטיפול במי שתייה: מערכות אוסמוזה הפוכה	התקן הישראלי זהה, למעט שינויים ותוספות לאומיים, לתקן האמריקני NSF/ANSI/CAN 58
NSF/ANSI 61	ת"י 5452 - בדיקת מוצרים הבאים במגע עם מי שתייה	התקן הישראלי זהה, למעט שינויים ותוספות לאומיים, לתקן האוסטרלי/ הניו-זילנדי AS/NZS 4020: 2005 או לתקן האמריקני NSF/ANSI 61: 2015 NSF/ANSI 61: 2015 Errata

- לסעיף יוסף:

תקנים ישראליים

900 חלק 2.15 - בטיחות מכשירי חשמל ביתיים ומכשירים דומים: דרישות מיוחדות למכשירים לחימום נוזלים

חוקים, תקנות ומסמכים ישראליים

תקנות בריאות העם (איכותם התברואית של מי-שתיה ומיתקני מי שתיה), התשע"ג-2013, על עדכוניהן

6. Minimum performance requirements

לאחר סעיף 6.18 יוסף סעיף 6.19, כמפורט להלן:

6.19. בטיחות החשמל

אם המערכת היא מערכת הניזונה מרשת החשמל, המערכת תתאים לדרישות בטיחות החשמל החלות עליה לפי התקן הישראלי ת"י 900 חלק 2.15.

8. Instruction and information

הסעיף אינו חל, ובמקומו יחול:

8. הוראות ומידע

במערכות ממין B לא ייכללו הצהרות פרטניות או כלליות בנוגע לציסטות.

היחידות המוערכות בתקן זה לא יכללו הצהרות להפחתה או לאבטול של קוליפאג'ים MS-2, קוליפאג'ים $Q\beta$ או קוליפאג'ים T1.

8.1. הוראות התקנה, הפעלה ותחזוקה

8.1.1. מידע והוראות מלאות ומפורטות להתקנה, להפעלה ולתחזוקה יסופק עם כל מערכת.

המידע וההוראות יכללו את המפורט להלן:

- השם המלא של היצרן, מענו ומספר הטלפון שלו, ואם המערכת מיובאת – שם היבואן ומענו;
- מספר הדגם וכינויה המסחרי של המערכת (trade designation);
- נוהלי שטיפה ונוהלי טיפול-קדם;
- ספיקת מים נקובה בליטרים לדקה או בליטרים ליום;
- לחץ עבודה מרבי (בר);
- טמפרטורת פעולה מרבית במעלות צלזיוס;
- הוראות התקנה מפורטות הכוללות הסבר או תרשים סכמטי של החיבורים המתאימים למערכת הצנרת;
- דרישות תפעול ותחזוקה כלליות (לרבות שירות למערכת, אחריות המשתמש וזמינות החלקים והשירות);
- מקורות אספקה של רכיבים חלופיים;
- מגבלות השימוש;
- מספר הדגם של המנורה העל-סגולה;
- מרווחי החלפה נדרשים של מנורות על-סגולות לפי הוראות היצרן;
- הוראות ניקוי; וכן
- משפטים בנוגע ליישום:

"המערכת מיועדת אך ורק להפחתת הימצאות רגילה של מיקרואורגניזמים לא פתוגניים המהווים מטרד. המערכת אינה מיועדת לטיפול במים מזוהמים".

וכן משפט המציין כי יש לחבר את המערכת למים המתאימים לדרישות תקנות בריאות העם (איכותם התברואית של מי-שתיה ומיתקני מי שתיה), התשע"ג-2013, על עדכוניהן.

8.1.2. ככל שהדבר ישים ורלוונטי, ייכלל גם המידע המפורט להלן:

- מספרי הדגם של הרכיבים החלופיים;

- קיבולת נקובה \אורך החיים בליטרים (rated service life) ;
מומלץ לספק מידע בנוגע לאורך החיים גם ביחידות של זמן ;
- לחץ עבודה מזערי (בר) ;
- טמפרטורת פעולה מזערית (במעלות צלזיוס) ;
- דרישות חשמל ;
- תרשים המציג התקנה נכונה של מרווח האוויר לחיבורי תוצרי הפסולת ;
- הוראות מפורשות המסבירות כיצד פועל מחוון הביצועים.

8.2. לוחית נתונים

8.2.1. לוחית או תווית קבועה תוצמד על כל מערכת במקום נגיש ותכיל, לכל הפחות, את המידע הזה :
- מספר הדגם ומין הדגם ;
- שם היצרן ומענו, ואם המערכת מיובאת – שם היבואן ומענו ;
- לחץ עבודה מרבי (בר) ;
- טמפרטורת פעולה מרבית (במעלות צלזיוס) ;
- מספר הדגם של המנורות העל-סגולות ;
- טמפרטורת פעולה מרבית של מי ההזנה (במעלות צלזיוס) ;
- שלטי אזהרה ישימים ;
- הוראת מגבלות השימוש : "לתנאי השימוש יש לעיין בספר ההוראות" ;
- ספיקה מרבית בליטרים לדקה או בליטרים ליום ;
- המתח (וולט), הזרם (אמפר) והתדר (הרץ) של הפעלת המערכת ;
- מרווחי הזמן הנדרשים להחלפה של מנורה על-סגולה ; וכן
משפט בנוגע ליישום :
"המערכת מיועדת אך ורק להפחתת הימצאות רגילה של מיקרואורגניזמים לא פתוגניים המהווים מטרד. המערכת אינה מיועדת מיועדות לטיפול במים מזוהמים".
רכיבים שהוערכו רק עבור תכנון ומבנה, חומרים, או שניהם, יהיו פטורים מדרישה זו.

8.2.2 ככל שהדבר ישים ורלוונטי, ייכלל גם המידע המפורט להלן :
- מספר הדגם של רכיבים חלופיים ;
- דרישות חשמל ;
-תדירות ההחלפה עבור המנורות העל-סגולות החלופיות ;
- לוח זמני תחזוקה.

8.3. רכיבים חלופיים

8.3.1. אריזה של רכיבים חלופיים תסומן במידע הזה :
- מספר הדגם ושם הרכיב ;
- מספר הדגם או זיהוי סדרת המוצרים של המערכת (אחת או יותר) שבהן יש להשתמש ברכיב ; וכן
- שם היצרן ומענו, ואם המערכת מיובאת – שם היבואן ומענו.

8.3.2. ככל שהדבר ישים ורלוונטי, ייכלל גם המידע המפורט להלן :
- קיבולת נקובה \אורך החיים בליטרים (rated service life) ;
מומלץ לספק מידע בנוגע לאורך החיים גם ביחידות של זמן.
- שלבי ההפעלה או ההחלפה ; וכן
- מרווחי הזמן הנדרשים להחלפה של מנורות על-סגולות לפי להוראות היצרן.

8.4. גיליון נתוני הביצועים (Performance data sheet)

8.4.1. גיליון נתוני הביצועים יהיה זמין לקונים הפוטנציאלים עבור כל מערכת, ויכלול את המידע המפורט להלן:

- מספר הדגם ומין הדגם;
- השם המלא של היצרן, מענו ומספר הטלפון שלו, ואם המערכת מיובאת – שם היבואן ומענו;
- ספיקת מים נקובה בליטרים לדקה או בליטרים ליום;
- קיבולת נקובה \אורך החיים בליטרים (rated service life) ;
  מומלץ לספק מידע בנוגע לאורך החיים גם ביחידות של זמן.
- לחץ עבודה מרבי (בר);
- טמפרטורת פעולה מרבית במעלות צלזיוס;
- תנאי התקנה כלליים וצורכי התקנה כלליים;
- דרישות תפעול ותחזוקה כלליות הכוללות, בין השאר:
  - תדירות מוצעת להחלפת רכיב או שירות למערכת;
  - אחריות המשתמש;
  - זמינות החלקים והשירות; וכן
- משפט בנוגע ליישום:
  "המערכת מיועדת אך ורק להפחתת הימצאות רגילה של מיקרואורגניזמים לא פתוגניים המהווים מטרד. המערכת אינה מיועדת לטיפול במים מזוהמים".
- משפט המציין כי אף שהבדיקה התבצעה בתנאי מעבדה תקניים, הביצועים בפועל עשויים להשתנות;
- המאפיינים החשמליים – מתח (וולט), זרם (אמפר), תדר (הרץ);
- חיי שירות מומלצים של המנורות העל-סגולות;
- טמפרטורת פעולה מרבית של מי ההזנה במעלות צלזיוס; וכן
- מגבלות השימוש.

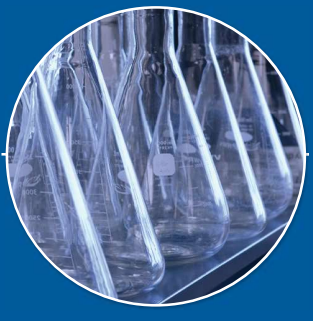
8.4.2. ככל שהדבר ישים ורלוונטי, ייכלל גם המידע המפורט להלן:

- מספר הדגם של רכיבים חלופיים;
- מפל לחץ של מערכת חדשה (בר);
- הזרימה הנקובה (מערכות POE בלבד);
- לחץ עבודה מזערי (בר);
- טמפרטורת פעולה מזערית במעלות צלזיוס;
- דרישות חשמל;
- תדירות ההחלפה עבור המנורות העל-סגולות החלופיות (מערכות ממין B); וכן
- הסבר עבור מחוון הביצועים.

NSF International Standard /
American National Standard

NSF/ANSI 55 - 2019

Ultraviolet Microbiological Water Treatment Systems


Contents

Foreword[2]

The purpose of this Standard is to establish minimum requirements for the reduction of microorganisms using ultraviolet (UV) radiation. UV water treatment systems covered by this Standard are intended for water that may be either microbiologically safe or microbiologically unsafe. This Standard also specifies the minimum product literature and labeling information that a manufacturer shall supply to authorized representatives and system owners, as well as the minimum service-related obligations that the manufacturer shall extend to system owners. Systems covered by this Standard are in keeping with the *Report of Task Force on Guide Standard and Protocol for Testing Microbiological Water Purifiers***,** April, 1987.[3]

It is recognized that the federal, state and local objectives are to provide safe water supplies without user treatment. However, many users are faced with the presence of contaminants of both aesthetic and health concern in their water supplies, and need guidance as to the availability of tested and certified point-of-entry (POE) and point-of-use (POU) UV water treatment systems. This Standard will help to meet this need but cannot be expected to address claims beyond those covered in this Standard.

Since it was not economically feasible to mount a routine testing program using all of the target microorganisms, e.g., bacteria, viruses, and protozoan cysts, an equivalent "disinfection" set of tests and requirements was developed for POE and POU UV disinfection systems.

A virus reduction of 4 logs against a poliovirus and rotavirus challenge and a bacteriological reduction of 6 logs against a challenge of a coliform bacteria (*Klebsiella terrigena*) has been recommended by Schaub and an expert task force (1987).[3]

The technical and health protection problems (laboratory staff) and the inherent cost of establishing and maintaining a live virus test program preclude its routine application in a multipurpose standards testing laboratory. Consequently, an alternate means of assuring virus efficacy was developed.

Survival data for poliovirus and rotavirus (Chang, 1985)[4] show that between a 3 and 4 log reduction in both poliovirus and rotavirus may be accomplished by a UV dosage of 30,000 µW-sec/cm^2 while a greater than 6 log reduction of *Escherichia coli* may be projected. Additional data (Harris, 1986)[5] show a 5 log reduction of poliovirus at 40,000 µW-sec/cm^2. In NSF/ANSI 55 2000, a minimum UV dosage of 38,000 µW-sec/cm^2 at the failsafe setpoint was set as an equivalent 4 log virus reduction requirement. To be consistent with International Standards, the minimum UV dose in NSF/ANSI 55 2002 was changed to 40 mJ/cm2 (40,000 µW-sec/cm^2) at the alarm set point.

[2] The information contained in this Foreword is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. Therefore, this Foreword may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

[3] *Guide Standard and Protocol for Testing Microbiological Water Purifiers***,** Report of Task Force, submitted by Steven A. Schaub to the US EPA, April 1987.

[4] "UV Inactivation of Pathogenic and Indicator Microorganisms," Chang, J.C., Johnson, J. Doald, et al. *Journal of Applied Environmental Microbiology*, Vol. 49, pp. 1361 to 1365, 1985.

[5] "UV Inactivation of Selected Bacteria and Viruses With Photoreactivation of the Bacteria," Harris, D. George, Adams, Dean, et al., *Water Resources*, Vol. 21, pp. 687 to 692, 1986.

Prior to the late 1990s, it was thought that UV light had limited cysticidal ability, which required information for the user as to the need for a prefilter complying with NSF/ANSI 53 – *Drinking water treatment units – Health effects* for cyst reduction. Survival data for *Cryptosporidium* (Clancy, 2000)[6] and *Giardia* (Craik, 2000)[7] show that a minimum 3 to 4 log reduction in both *Cryptosporidium* and *Giardia* may be accomplished by a UV dosage of 10 mJ/cm^2.

Where drinking water is considered to be free of disease causing pathogenic organisms and has a turbidity level within acceptable drinking water standards, UV treatment may be useful for the supplemental treatment of this drinking water. It would be suitable for the reduction of normally occurring microbiological flora (nonspore forming heterotrophic bacteria) commonly found in drinking water. Survival data (Chang, 1985)[4] show that a greater than 2 log reduction of nonspore forming heterotrophic bacteria may be accomplished by an UV dosage of 16,000 µW-sec/cm^2. The yeast organism *Saccharomyces cerevisiae* was chosen as the test challenge to allow for a reasonable influent concentration and an easily measured reduction in the effluent. Most vegetative bacteria, including coliform species, are too susceptible to UV radiation at the dose range of 16,000 µW-sec/cm^2 to allow for measurable testing.

This edition of the Standard contains the following revisions:

Issue 49

This revision adds a new protocol under NSF/ANSI 55 to evaluate UV systems across a broader range of wavelengths.

This revision also includes an editorial update to the names of the Annexes within. The Annexes are being changed from alpha characters to numeric, preceded by a 'Normative' or 'Informative'. The table below shows the previous name of the Annex with the corresponding new name of the Annex:

Annexes	
Previously known as:	**Now known as:**
Annex A	Normative Annex 1 (N-1)
N/A (new)	Normative Annex 2 (N-2)
Annex B	Informative Annex 1 (I-1)
Annex C	Informative Annex 2 (I-2)

This Standard was developed by the NSF Joint Committee on Drinking Water Treatment Units using the consensus process described by the American National Standards Institute.

Suggestions for improvement of this Standard are welcome. This Standard is maintained on a Continuous Maintenance schedule and can be opened for comment at any time. Comments should be sent to Chair, Joint Committee on Drinking Water Treatment Units at standards@nsf.org, or c/o NSF International, Standards Department, PO Box 130140, Ann Arbor, Michigan 48113-0140, USA.

[6] "Using UV to Inactivate *Crypospordium*," Clancy, J. L., et al. *Journal of American Water Works*, Vol 92, Issue 9, pp. 97 to 104, 2000.

[7] "Inactivation of *Giardia Muris* Cysts Using Medium-Pressure Ultraviolet Radiation in Filtered Drinking water," Craik, S. A., et al. *Water Resources*, Vol. 34, No. 18, pp 4325 to 4332, 2000.

NSF/ANSI Standard for Drinking Water Treatment Units –

Ultraviolet Microbiological Water Treatment Units

1 General

1.1 Purpose

The purpose of this Standard is to establish minimum requirements for the reduction of microorganisms using ultraviolet (UV) radiation. UV water treatment systems covered by this Standard are intended for water that may be either microbiologically safe or microbiologically unsafe. This Standard also specifies the minimum product literature and labeling information that a manufacturer shall supply to authorized representatives and system owners, as well as the minimum service-related obligations that the manufacturer shall extend to system owners.

1.2 Scope

This Standard covers UV microbiological water treatment systems and components for point-of-use (POU) and point-of-entry (POE) applications. This Standard covers systems which use UV radiation within the range of 240 nm to 300 nm inclusive. Systems are intended to be used under the following specific conditions.

1.2.1 Class A systems

Class A POE and POU systems covered by this Standard are designed to be used for treating microbiologically unsafe water, but do not reduce chemical or inert particulate contaminants. Systems covered in this Standard are designed to inactivate microorganisms, including bacteria, viruses, *Cryptosporidium* oocysts, and *Giardia* cysts, from water. Systems covered by this Standard are not intended for the treatment of water that has an obvious contamination or intentional source, such as raw sewage, nor are systems intended to convert wastewater to drinking water. The systems are intended to be installed on visually clear water (not colored, cloudy, or turbid). Systems with manufacturer claims that include components or functions covered under other NSF or NSF/ANSI Standards or Criteria shall conform to the applicable requirements therein.

Class A systems not installed downstream of a device tested for cyst reduction / inactivation in conformance to the appropriate NSF/ANSI Standard may claim *Cryptosporidium* oocysts and *Giardia* cysts only. Class A systems installed downstream of a device tested for cyst reduction in conformance to NSF/ANSI 53 or NSF/ANSI 58 may make a general cyst claim when used on untreated surface waters, or ground water, or both, under the direct influence of surface water.

> NOTE — Current data support that *Cryptosporidium* oocysts and *Giardia* cysts are inactivated by UV treatment.

1.2.2 Class B systems or components

Class B POE and POU systems covered by this Standard are designed to be used for supplemental bactericidal treatment for the inactivation of microorganisms that may be present in drinking water (public or private) considered to be microbiologically safe and of known quality. Systems covered under this Standard are intended to inactivate normally occurring nonpathogenic nuisance microorganisms only.

The Class B system is not intended for the disinfection of microbiologically unsafe water and may not make individual or general cyst claims. Class B systems shall not make microbiological health effects claims. Systems covered by this Standard (Class B) are not intended to be used with water that is microbiologically unsafe or of unknown quality without adequate disinfection before or after the system. Systems with manufacturer claims that include components or functions covered under other NSF or NSF/ANSI Standards or Criteria shall conform to the applicable requirements therein.

1.3 Variance from minimum requirements

Variations from the minimum requirements specified in Sections 4, 5, 6, and 7 may be permitted, provided that they give the system or component the same or greater resistance to corrosion, wear, and physical damage, or that they improve the general operation or performance of the system or component. Proposed variations shall be accepted by the testing agency prior to use. Systems with components or functions covered under existing NSF Standards or criteria shall conform to the applicable requirements therein.

1.4 Alternate materials

If specific materials are mentioned, other materials that provide at least equal performance and sanitation shall be acceptable.

2 Normative references

The following documents contain provisions that, through reference, constitute provisions of this NSF/ANSI Standard. At the time this Standard was balloted, the editions listed below were valid. All documents are subject to revision, and parties are encouraged to investigate the possibility of applying the recent editions of the documents indicated below. The most recent published edition of the document shall be used for undated references.

21 CFR Parts 170-199, Food and Drugs[8]

APHA, *Standard Methods for the Examination of Water and Wastewater*, twentieth edition[9]

NSF/ANSI 53, *Drinking Water Treatment Units – Health Effects*

NSF/ANSI 58, *Reverse Osmosis Drinking Water Treatment Systems*

NSF/ANSI/CAN 61, *Drinking Water System Components – Health Effects*

NSF/ANSI 62, *Drinking Water Distillation Systems*

US EPA-600/4-84-053, *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, June 1984[10]

US EPA-600/4-84-053, *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater*, June 1984[10]

US EPA 600/479020, *Methods for the Chemical Analysis of Water and Wastes*, March 1983[10]

[8] US FDA – CFR Code of Federal Regulations Title 21. <www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm>

[9] American Public Health Association (APHA). 800 I Street, NW, Washington, DC 20001. <www.apha.org>

[10] US Environmental Protection Agency, Environmental Monitoring and Support Laboratory. Cincinnati, OH 45268. <www.epa.gov>

US EPA 600/R94/111, *Methods for the Determination of Metals in Environmental Samples, Supplement 1*, May 1994[10]

US EPA 600/488/039 *Methods for the Determination of Organic Compounds in Drinking Water*, December 1988[10]

US EPA 600/490/020 *Methods for the Determination of Organic Compounds in Drinking Water – Supplement 1*, July 1990[10]

US EPA National Primary Drinking Water Regulations, 40 CFR Part 143[11]

US EPA National Secondary Drinking Water Regulations, 40 CFR Part 143[11]

3 Definitions

Terms used in this Standard that have a specific technical meaning are defined in NSF/ANSI 330.

4 Materials

4.1 Materials in contact with drinking water

4.1.1 POE drinking water treatment units shall conform to the protocol in NSF/ANSI/CAN 61.

4.1.2 POU drinking water treatment units shall conform to the protocol in this section.

4.1.3 Acceptance criteria

4.1.3.1 Materials in contact with drinking water shall not impart levels of target compounds or tentatively identified compounds (TICs) that exceed the total allowable concentration (TAC), maximum contaminant levels (MCLs), or maximum acceptable concentration (MAC) criteria specified in NSF/ANSI/CAN 61, Annex D, Table D.1. Any extractable contaminants not listed in the referenced tables shall be reviewed and shall not exceed criteria developed in accordance with NSF/ANSI/CAN 61 Annex A.

4.1.3.2 TIC identification and quantitation shall be conducted in accordance with Section 4.3.1.2. Additional TIC identification and quantitation shall be verified using a standard of the compound in question or an alternate approved analytical method. Additional TIC identification and quantitation is recommended when the contaminant is a health risk or when the "probability based matching" process in Section 4.3.1.2 is inconclusive. When possible, the product manufacturer shall assist and support the testing laboratory in the identification of a standard for the compound and an appropriate analytical method, if applicable, so that confirmatory identification and quantification can be performed. If a standard and an adequate alternative analytical method are not available to verify the identification and quantitation of the compound, the TIC shall be evaluated according to Section 4.3.1.2.

> NOTE — Manufacturers may not be privy to formulation information, so they may not be able to assist a testing laboratory to identify a standard for the compound that extracted. Refer to Section 4.3.1.2 when the manufacturer does not have material formulation information.

4.1.3.3 Unknown contaminants detected by GC/MS analysis for which identification is unable to be made after performing the steps in Section 4.3.1 shall be reported in accordance to Section 4.1.4.2.

[11] Superintendent of Documents, US Government Printing Office. Washington, DC 20402. <www.gpo.gov>

4.1.3.4 Whole-system or component assembly extraction testing may be waived if components, when separately tested, meet the requirements of this Standard and are assembled in a manner that does not introduce any new components or materials, increase the surface area-to-volume ratio of previously evaluated components, or present potential concern based on cumulative factors. The reported extractable concentrations for components shall be arithmetically added to ensure that the whole-system or component assembly meets the allowable levels in accordance with Tables 4.1, 4.2, and 4.3 and Annexes A, D, and E of NSF/ANSI/CAN 61.

4.1.4 Data reporting

4.1.4.1 All contaminants identified and detected at or above the reporting limit (RL) shall be reported with the identification of the contaminant, the concentration, and whether it exceeds the acceptance criteria as required in Section 4.1.3. Contaminants detected below the RL shall be reported to the manufacturer as less than the RL's value.

Example: If the lab's RL is 1.0 mg/L for analyte "*X*" and the concentration was detected at 0.5 mg/L, the lab shall report less than 1.0 mg/L or < 1.0 mg/L.

4.1.4.2 If the extractable contaminant cannot be identified following the procedures in Section 4.3.1, the laboratory shall supply the manufacturer with the approximate molecular weight along with any additional information about the compound.

4.2 Materials evaluation

Complete formulation information on any material not certified as specifically compliant with the sections of the US Code of Federal Regulations, Title 21, listed in Table 4.4, shall be reviewed to determine whether the material presents a health effects concern in contact with drinking water and to assess the material's potential for contributing contaminants to the drinking water. As a minimum level of information for those materials requiring submission of formulation information, the complete chemical identity and proportion by weight (in some cases approximate weights or proportions may suffice) and ingredient sources of supply shall be provided.

The following additional information is required when available:

— a list of the known or suspected impurities within the product or material and the maximum percent or parts by weight of each impurity;

— the water solubility, hydrolysis products, and extraction rates of chemicals within the product or material; and

— a list of toxicological studies relevant to the chemicals and impurities present in the product, component, or material.

4.2.1 Analytical methods

All analyses shall be conducted in accordance with the applicable method(s) referred to in Section 2.

4.2.1.1 The laboratory shall validate the analytical method to the RL concentration following the procedures established in the referenced method. The laboratory shall evaluate its method detection limit (MDL) in reference to the RL. In all cases, the RL shall be equal or greater than the MDL. When preparing its calibration standards, the lowest calibration point shall be at or less than the RL.

4.2.1.2 For extracted techniques (e.g., US EPA Method 625), regarding the concentration of the lowest calibration point, the laboratory shall apply the concentration factor due to sample preparation. For example, a sample 1 L extracted, and the extract concentrated to 1.0 mL, for a factor of 1000, if the RL is set to 0.2 µg/L, then the lowest calibration point would be at or less than 0.2 mg/L.

NOTE — See Annex I-1 for additional information on GC/MS and other alternative methods.

4.2.2 Exposure water

Systems and components shall be exposed to locally available tap water that has been adjusted to contain 50 ± 5 mg/L total dissolved solids, 0.5 ± 0.05 mg/L free available chlorine, and to have a pH of 6.75 ± 0.25. Exposure water used to evaluate systems or components shall be 23 ± 2 °C (73 ± 3 °F). Any existing concentrations of extraction testing parameters listed in Tables 4.1, 4.2, and 4.3 found to be present in the exposure water shall be subtracted from the values obtained in the analysis of the extractant water.

4.2.3 Exposure

NOTE — The lamp shall be on during exposure testing, when appropriate.

4.2.3.1 The system or component(s) of a system shall be installed, flushed, and conditioned in accordance with the manufacturer's instructions using the exposure water specified in Section 4.2.2 at an initial inlet static pressure of 340 kPa (50 psig).

4.2.3.2 The system or component(s) shall be refilled with the exposure water specified in Section 4.2.2 and maintained for 24 h at an ambient temperature of 23 ± 2 °C (73 ± 3 °F). A 2-L water sample shall then be collected in accordance with Section 4.2.3.3. The system or component(s) shall be flushed according to the manufacturer’s instructions, refilled, and maintained for another 24 h at an ambient temperature of 23 ± 2 °C (73 ± 3 °F). A second 2-L water sample shall be collected in accordance with Section 4.2.3.3. The system or component(s) shall again be flushed according to the manufacturer’s instructions, refilled, and maintained for a third period of 24 h at an ambient temperature of 23 ± 2 °C (73 ± 3 °F). A third 2-L water sample shall be collected in accordance with Section 4.2.3.3.

4.2.3.3 A minimum sample volume of 2 L shall be collected at each sample point. If the water holding volume of the product is greater than 2 L, the entire volume shall be collected in a suitable collection vessel, and a 2-L subsample obtained from this volume. If the water holding volume of the product is less than 2 L, sufficient products shall be exposed to provide the required 2-L volume of extractant water.

4.2.3.4 All samples collected shall be composited and analyzed in accordance with Section 4.2.1.

4.2.3.5 Systems with adsorptive or absorptive media shall be tested with and without the media. Testing without media shall include removal of any granular adsorptive or absorptive media, and removal of any adsorptive or absorptive replacement elements.

4.3 Gas chromatography / mass spectroscopy (GC/MS) analysis

4.3.1 General requirements for GC/MS analysis

When determined to be required following a product-specific formulation review, US EPA Analytical Methods for semivolatiles and volatiles that include mass spectral libraries shall be performed on products or components, and shall include full-range mass spectral libraries to monitor for nontarget compounds.

Testing for semivolatiles (e.g., US EPA Method 625 or 528 or 525.2) and volatiles (e.g., US EPA Method 524.2 or 524.3) shall be conducted using the required target compounds in Tables 4.2 and 4.3 and the laboratory’s RL shall be no greater than the RL’s listed in Tables 4.2 and 4.3.

4.3.1.1 Target compounds shall be validated in accordance with the requirements of the referenced method. US EPA Methods 524.2 and 625 have specific validation requirements including precision and accuracy requirements as well as demonstration of sensitivity (MDL study).

For US EPA Method 625, the minimum instrument operation requirements for GC/MS analysis shall be in accordance with those protocols as defined by the method with the following modifications:

— to guard against significant drift from an initial instrument calibration to subsequent instrument batches, the average chromatographic peak area of each internal standard in the calibration curve shall be determined. The chromatographic peak area of each internal standard in the continuing calibration shall be greater than 50% and not more than 200% of that average; and

— due to the number of characteristics of the analytes associated with Method 625, while a continuing calibration check (CCC) is performed, concentrations of 10% of the target compounds for each analysis (e.g., base / neutral, base / neutral / acid, acid) shall be allowed to fall outside the range of 70% to 130% (outlier) of the true value. None of the concentrations shall be allowed to fall below 50% or above 200% of the true value. If a positive sample analyte result is identified for any outlier, a second CCC shall be performed. If the second CCC determines the sample analyte result no longer to be an outlier, the sample shall be reanalyzed. However, if the second CCC also determines the analyte to be an outlier, a new calibration curve shall be determined and the sample shall be reanalyzed.

NOTE — At the laboratory's discretion, a calibration may be performed specifically for the compound in question, with the reporting of its data from this second calibration. It shall be understood, that if the laboratory utilizes this approach (calibrating for the specific analyte) all method requirements as specified by Method 625 shall be achieved.

4.3.1.2 TICs are identified by comparison of the spectrum of the unknown to the mass-spectral reference library utilizing "probability based matching" (as available from instrument manufacturers) as well as interpretation by the analyst. The laboratory shall report the TIC with the best match factor (the match factor shall not be reported) except in the following circumstances:

— due to the complex nature of GC/MS interpretation and identification, when reviewing the list of possible matches for any particular TIC peak, the laboratory has the authority to assign the identification to a compound "hit" with a lower numeric match factor from the library search algorithm;

— the laboratory may determine that none of the returned compounds by the automated search algorithm is a good match for the unknown peak. In this case the compound is reported as an "unknown";

— the laboratory may utilize manual spectral interpretation to identify the peak in question;

— all TICs detected at a concentration greater than or equal to 3.0 ppb shall be reported.

The library used during the analysis shall be National Institute of Standards and Technology (NIST) 2007 or most current version. Additional spectra libraries may be used to assist in the identification of unknown compounds. For TICs, the concentration is estimated by comparison of its total ion area response to the total ion area response of the nearest internal standard. For TICs, a response factor of "1" (one) shall be utilized for the purposes of calculating the TICs estimated concentration.

NOTE — It should be understood that when utilizing mass-spectrometer library searches to identify unknown chromatographic peaks (sometimes called "TICs") that the concentration is estimated assuming that the response of the TIC is the same as the internal standard. However, for example, when analyzing for traditional semi volatile compounds by US EPA Method 625, the range of response factors is typically 0.1 to 2. Because the response factor is used as a reciprocal, and assuming that the response for the TIC falls within the range

of the compounds for which the system is typically calibrated, the true concentration for this TIC would range up to 10 times greater to half the reported TIC concentration.

4.3.1.3 Unknown compounds – contaminants detected by GC/MS analysis but are not identified and quantified against a known mass spectrum or standard – shall be evaluated as follows:

a) The molecular weight shall be reported or, if no molecular ion is identifiable, a minimum value for the molecular weight (for example, if the highest mass ion for the TIC has an m/z of 143, then report MW ≥ 143).

b) The chemical class information shall be reported if this determination is possible.

c) The laboratory shall report the presence of the common halogens chlorine and bromine utilizing their characteristic “M+2” patterns.

d) The product material formulation(s) shall be reviewed for potential identification of the unknown contaminant(s) as an ingredient or byproduct.

e) The manufacturer shall be notified and requested to provide supporting information that enables identification of the unknown contaminant(s).

f) Structure activity relationships (SAR) shall be utilized when sufficient structural identification of the unknown contaminant(s) can be made.

g) Alternative methods of analysis that may identify the unknown contaminant(s) shall be considered, such as classifying the unknown into a chemical class.

Contaminants that are identified after performing one or more of the above steps shall be evaluated in accordance with Sections 4.1.3.2 and 4.1.3.3. The product manufacturer, laboratory toxicologist and laboratory chemist shall assist the testing laboratory in the identification of a standard for the compound and an appropriate analytical method, if applicable, so that confirmatory identification and quantification can be performed when needed. Standard validation is needed when the identified compound is not reported in the formulation review conducted in Section 4.2.

NOTE — Items b and c above may be automated utilizing software available from NIST with their mass-spectral database.

Contaminants detected by GC/MS analysis for which no identification can be made after performing the above steps shall not be considered in the determination of product compliance to this Standard. When unknown contaminants are detected in the extractant water, the testing laboratory shall report the analytical results.

Table 4.1
Extraction testing parameters (metals)

Analyte	CAS number	Maximum reporting limit (RL) (mg/L)	US EPA Method(s)
aluminum	7429-90-5	0.1	200.7, 200.8
antimony	7440-36-0	0.001	200.8, 200.9
arsenic	7440-38-2	0.001	200.8, 200.9
barium	7440-39-3	0.2	200.7, 200.8
beryllium	7440-41-7	0.001	200.7, 200.8, 200.9
cadmium	7440-43-9	0.001	200.8, 200.9
chromium	7440-47-3	0.01	200.7, 200.8, 200.9
copper	7440-50-8	0.1	200.7, 200.8
lead	7439-92-1	0.001	200.8, 200.9
manganese	7439-96-5	0.01	200.7, 200.8
mercury	7439-97-6	0.001	200.8, 245.1
nickel	7440-02-0	0.01	200.7, 200.8
selenium	7782-49-2	0.005	200.8, 200.9
thallium	7440-28-0	0.001	200.8, 200.9

Table 4.2
Extraction testing parameters (semi-volatiles)

Analyte	CAS Number	Maximum reporting limit (RL) (mg/L)	Reference Method(s)
2,4,6-trichlorophenol	88-06-2	0.001	525.2, 528, 625
2,4-dichlorophenol	120-83-2	0.001	525.2, 528, 625
2,4-dimethylphenol	105-67-9	0.01	525.2, 528, 625
2,6-di-tert-butyl-4-methoxyphenol	489-01-0	0.003	525.2, 528, 625
2-methylnaphthalene	91-57-6	0.003	525.2, 528, 625
2-nitrophenol	88-75-5	0.001	525.2, 528, 625
2-phenyl-2-propanol	617-94-7	0.005	525.2, 528, 625
3,3-dichlorobenzidine	91-94-1	0.001	525.2, 528, 625
3-and 4-methylphenol, m&p-cresol	106-44-5 108-39-4	0.001	525.2, 528, 625
4-chloro-3-methylphenol	59-50-7	0.07	525.2, 528, 625
4-tert-butylphenol or p-tert-butylphenol	98-54-4	0.05	525.2, 528, 625
acenaphthene	83-32-9	0.004	525.2, 528, 625
acenaphthylene	208-96-8	0.0004	525.2, 528, 625
acetophenone	98-86-2	0.02	525.2, 528, 625
anthracene	120-12-7	0.0003	525.2, 528, 625
benzo(a)pyrene	50-32-8	0.0002	525.2, 528, 625
benzothiazole	95-16-9	0.003	525.2, 528, 625
bis(2-ethylhexyl)adipate	103-23-1	0.04	525.2, 528, 625
bis(2-ethylhexyl)phthalate	117-81-7	0.001	525.2, 528, 625
butyl benzyl phthalate	85-68-7	0.1	525.2, 528, 625
chrysene	218-01-9	0.003	525.2, 528, 625
diethyl phthalate	84-66-2	0.6	525.2, 528, 625
dimethyl phthalate	131-11-3	0.001	525.2, 528, 625
di-n-butyl phthalate	84-74-2	.07	525.2, 528, 625
fluoranthene	206-44-0	0.0003	525.2, 528, 625
isophorone	78-59-1	0.04	525.2, 528, 625
naphthalene	91-20-3	0.04	525.2, 528, 625
n-nitroso-di-n-butylamine	924-16-3	0.0006	525.2, 528, 625
n-nitroso-di-n-propylamine	621-64-7	0.0005	525.2, 528, 625
n-nitrosodiphenylamine	86-30-6	0.007	525.2, 528, 625
o-cresol or 2-methylphenol	95-48-7	0.001	525.2, 528, 625
pentachlorophenol	87-86-5	0.0005	525.2, 528, 625
phenanthrene	85-01-8	0.0003	525.2, 528, 625
phenol	108-95-2	0.2	525.2, 528, 625
phenyl sulfone	127-63-9	0.002	525.2, 528, 625
pyrene	129-00-0	0.0006	525.2, 528, 625

Table 4.3
Extraction testing parameters (volatiles)

Analyte	CAS Number	Maximum reporting limit (RL) (mg/L)	Reference Method(s)
1,1,1,2-tetrachloroethane	630-20-6	0. 001	524.2, 524.3
1,1,1-trichloroethane	71-55-6	0.02	524.2, 524.3
1,1,2,2-tetrachloroethane	79-34-5	0.0005	524.2, 524.3
1,1,2-trichloroethane	79-00-5	0.0005	524.2, 524.3
1,1-dichloroethene	75-35-4	0.0007	524.2, 524.3
1,1-dichloropropene	563-58-6	0.0005	524.2, 524.3
1,2,3-trichlorobenzene	87-61-6	0.0005	524.2, 524.3
1,2,3-trichloropropane	96-18-4	0.004	524.2, 524.3
1,2,4-trichlorobenzene	120-82-1	0.007	524.2, 524.3
1,2-dibromo-3-chloropropane	96-12-8	0.0002	524.2, 524.3
1,2-dibromoethane	106-93-4	0.0002	524.2, 524.3
1,2-dichlorobenzene	95-50-1	0.06	524.2, 524.3
1,2-dichloroethane	107-06-2	0.0005	524.2, 524.3
1,2-dichloropropane	78-87-5	0.0005	524.2, 524.3
1,3,5-trimethylbenzene	108-67-8	0.0005	524.2, 524.3
1,3-dichlorobenzene	541-73-1	0.06	524.2, 524.3
1,4-dichlorobenzene	106-46-7	0.007	524.2, 524.3
2-butanone	78-93-3	0.4	524.2, 524.3
2-chlorotoluene	95-49-8	0.01	524.2, 524.3
2-ethyl-1-hexanol	104-76-7	0.005	524.2, 524.3
4-chlorotoluene	106-43-4	0.0005	524.2, 524.3
4-isopropyltoluene	99-87-6	0.0005	524.2, 524.3
4-methyl-2-pentanone	108-10-1	0.7	524.2, 524.3
acetone	67-64-1	0.6	524.2, 524.3
acetophenone	98-86-2	0.02	524.2, 524.3
acrylonitrile	107-13-1	0.0006	524.2 SIM
benzene	71-43-2	0.0005	524.2, 524.3
bis(2-chloroethyl)ether or di-(2-chloroethyl) ether	111-44-4	0.0003	524.2, 524.3
bromobenzene	108-86-1	0.0005	524.2, 524.3
bromochloromethane	74-97-5	0.009	524.2, 524.3
bromodichloromethane	75-27-4	0.001	524.2, 524.3
bromoform	75-25-2	0.001	524.2, 524.3
bromomethane	74-83-9	0.001	524.2, 524.3
carbon disulfide	75-15-0	0.7	524.2, 524.3
carbon tetrachloride	56-23-5	0.0005	524.2, 524.3
chlorobenzene	108-90-7	0.01	524.2, 524.3
chloroform	67-66-3	0.001	524.2, 524.3
chloromethane	74-87-3	0.003	524.2, 524.3

Table 4.3
Extraction testing parameters (volatiles)

Analyte	CAS Number	Maximum reporting limit (RL) (mg/L)	Reference Method(s)
cis-1,2-dichloroethene	156-59-2	0.007	524.2, 524.3
cyclohexanone	108-94-1	1.0	524.2, 524.3
dibromochloromethane	124-48-1	0.001	524.2, 524.3
dichlorodifluoromethane	75-71-8	0.0005	524.2, 524.3
ethyl acrylate	140-88-5	0.001	524.2, 524.3
ethylbenzene	100-41-4	0.07	524.2, 524.3
methyl acrylate	96-33-3	0.001	524.2, 524.3
methyl methacrylate	80-62-6	0.1	524.2, 524.3
methyl tert-butyl ether	1634-04-4	0.0005	524.2, 524.3
methylene chloride	75-09-2	0.0005	524.2, 524.3
n-butyl acrylate	141-32-2	1	524.2, 524.3
n-butylbenzene	104-51-8	0.0005	524.2, 524.3
sec-butylbenzene	135-98-8	0.0005	524.2, 524.3
styrene	100-42-5	0.01	524.2, 524.3
t-butyl alcohol or t-butanol or tert-butanol	75-65-0	0.1	524.2, 524.3
tetrachloroethene	127-18-4	0.0005	524.2, 524.3
tetrahydrofuran	109-99-9	5	524.2, 524.3
toluene	108-88-3	0.1	524.2, 524.3
xylenes (total) o-xylene[2] or 1,2-xylene, m-xylene, p-xylene	95-47-6 106-42-3 108-38-3	0.1	524.2, 524.3
trans-1,2-dichloroethene	156-60-5	0.01	524.2, 524.3
dichloropropene (total) cis-1,3- trans-1,3	542-75-6 10061-01-5 10061-02-6	0.0005	524.2, 524.3
trichloroethene or trichloroethylene	79-01-6	0.0005	524.2, 524.3
trichlorofluoromethane	75-69-4	0.2	524.2, 524.3
total trihalomethanes (TTHMs) bromodichloromethane bromoform chloroform dichlorobromomethane	—	0.001	524.2, 524.3
vinyl chloride	75-01-4	0.0002	524.2, 524.3

Table 4.4
Materials listed in US Code of Federal Regulations, Title 21, not requiring formulation review

Sections	Material
172.880 178.3700	petrolatum
172.888 178.3720	synthetic petroleum wax
172.878	white mineral oil
172.884	odorless white petroleum hydrocarbons
172.886 178.3710	petroleum wax
173.25	ion exchange resins – provided that the sub-section stating the composition of the resin is specified
173.65	divinyl benzene copolymer
178.3620	mineral oil
Part 184	direct food substances affirmed as generally recognized as safe – when used in accordance with any conditions of use specified for the substance
solvents	Solvents that may be considered for solvent bonding without review are limited to acetone, methyl ethyl ketone, cyclohexanone, and tetrahydrofuran. Mixtures such as solvent cements shall be evaluated against NSF/ANSI/CAN 61 or shall be subject to formulation review. NOTE — Solvent bonding is not recommended, as solvents soak into synthetic materials and leach back out into water at relatively high levels for long periods of time. In addition, solvents can contaminate the work area and can be adsorbed by carbon in the work area. Solvents that have been reprocessed or recycled shall not be used.

5 Structural performance

5.1 Structural integrity

5.1.1 General

The purpose for testing structural integrity performance is to evaluate the materials, design, and fabrication quality of the complete water treatment system.

5.1.2 Working pressure

5.1.2.1 The pressure vessel(s) and all other components of a water treatment system that are subject to line pressure shall be designed and constructed to maintain structural integrity at a pressure of 690 kPa (100 psig) or the maximum working pressure, whichever is greater.

5.1.2.2 Portable systems not designed for direct connection to a pressurized supply line shall be designed and constructed to maintain structural integrity under the maximum pressure of the intended end-use.

5.1.3 Acceptance

Each test of structural integrity (cyclic pressure and hydrostatic pressure) shall be performed on a separate system. If the complete water treatment system is tested, a separate test of the system pressure vessel is not required.

Complete systems, pressure vessels, and components shall be tested for structural integrity in accordance with Section 5.1.4 at the pressures specified in Table 5.1. When more than one pressure is specified in Table 5.1, testing shall be done at the higher pressure.

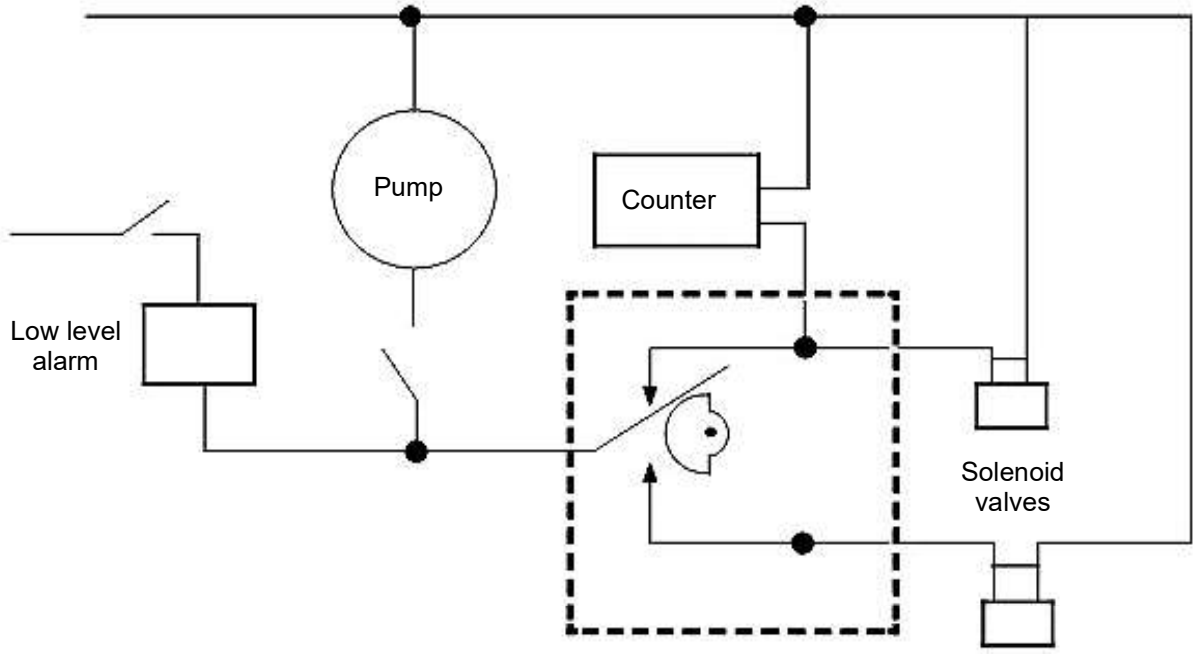
Complete systems, pressure vessels, and components shall be watertight when tested for structural integrity under Section 5.1.4.

NOTE — Weepage shall be considered acceptable at the beginning of a test, but weepage shall not begin in the middle of a test.

5.1.4 Structural integrity test methods

5.1.4.1 Apparatus

An enclosure shall be provided for each system tested to prevent injury to personnel or property damage if the system fails. An apparatus that may be used for the cyclic and hydrostatic test is shown schematically in Figure 1. Pressure measuring instruments shall have a precision and accuracy of 2% at the point of measurement.



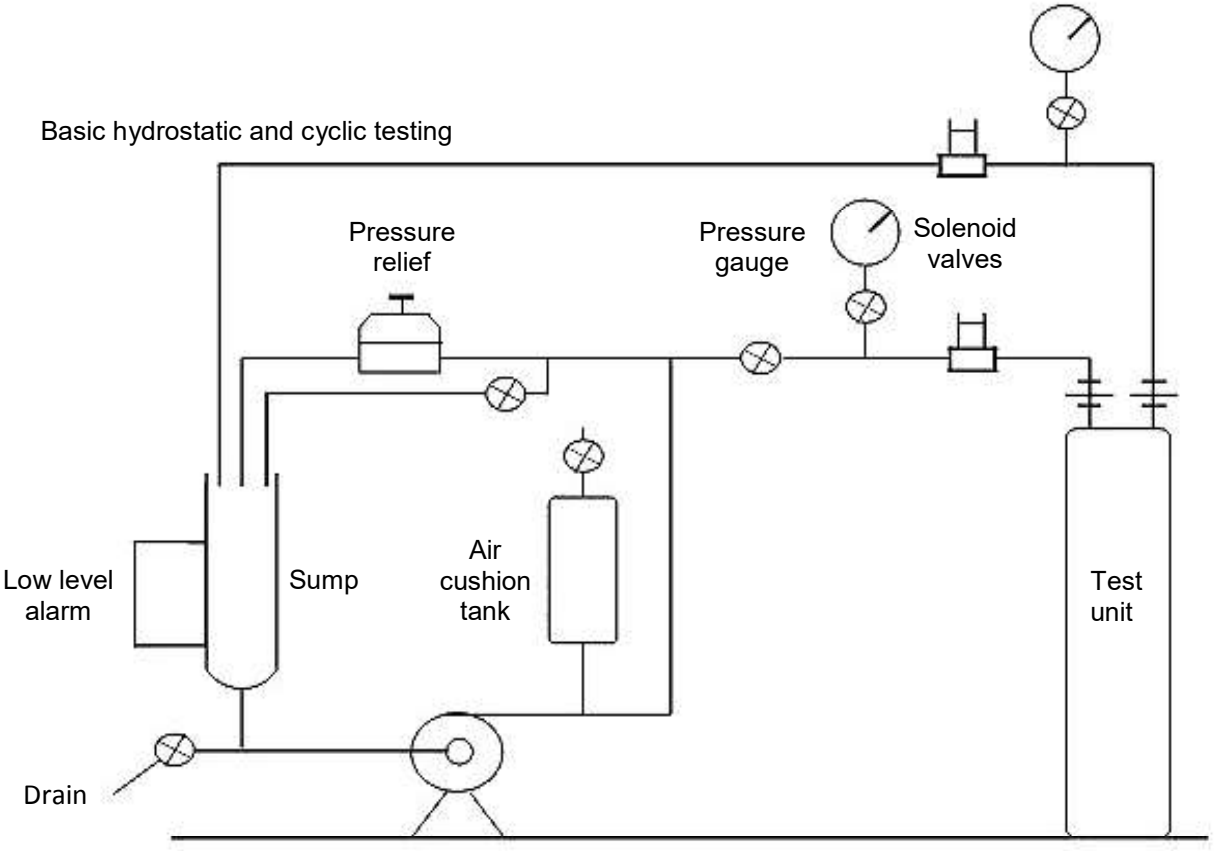


Figure 1
Structural testing apparatus

5.1.4.2 Hydrostatic pressure test – Complete systems

Systems designed to operate only at atmospheric pressure shall be exempt from the hydrostatic pressure test, but shall be watertight in normal use. Components downstream of the system on/off valve that are not subject to pressure under the off mode and contain no media subject to plugging, or that are not designed to contain media, shall be exempt from the hydrostatic pressure test, but shall be watertight in normal use. Components that are downstream of the system on/off valve but upstream of the media subject to clogging shall meet the requirements of this section. The following procedure shall be used for the hydrostatic pressure testing of other complete systems:

a) A water temperature of 13 to 24 °C (55 to 75 °F) shall be used. The test water shall be adjusted to a temperature at which condensation will not form on the surface of the test unit.

b) The inlet of the test system shall be connected to a structural testing apparatus. The system shall be in conformance to its normal state of use, with the option of plugging drain lines.

c) The test system shall be filled with water and flushed to purge air from the system. The system outlet shall be closed, and the control valve placed in the service position. All parts of the unit, including inlet and outlet fittings that may be subject to line pressure in normal operation, shall be pressurized.

d) The hydrostatic pressure shall be raised at a constant rate so that the test pressure specified in Table 5.1 is reached within 5 min. The rate of pressure increase shall not be more than 690 kPa (100 psig) per second.

e) The test pressure shall be maintained for 15 min. The system shall be inspected periodically through the end of the test period to check whether the system is watertight.

5.1.4.3 Hydrostatic pressure test – Metallic pressure vessels

The permanent increase in the circumference of the pressure vessel shall not be more than 0.2% of the original circumference when the vessel is tested in accordance with the procedures below. The circumference shall be measured at the midpoint of the side wall of the vessel and at 30-cm (12-in) intervals. The top or bottom head deflection of the pressure vessel shall not exhibit a permanent deflection exceeding 0.5% of the vessel diameter.

The test rig for metal tanks shall allow the installation of instrumentation required to measure the change in tank circumference and the deflection of the top and bottom heads. This may require elevating the tank. Distance measuring instruments or methods shall be accurate to 0.0025 cm (0.001 in).

The following procedure shall be used for the hydrostatic pressure testing of metallic pressure vessels:

a) The unit shall be installed on the elevated rack or stand. The test unit shall be prepared and filled as specified in Section 5.1.4.2, steps a, b, and c.

b) An appropriate measuring device, such as an extensometer or dial micrometer, shall be installed vertically against the tank bottom head and either the tank top head, top-mounted control valve, or another component solidly mounted to the tank top.

c) An appropriate measuring device, such as an extensometer or periphery tape, shall be installed around the tank perpendicular to its axis and 15 cm (6 in) above its bottom. Additional measurement devices shall be placed, vertically spaced not more than 30 cm (12 in) apart, up the side sheet of the tank. The uppermost device shall be within 30 cm (12 in) of the tank top head. If the tank length is less than 61 cm (24 in), a measuring device shall be placed at the midsection. When extensometers are used, the flexible wire shall be wrapped once around the tank perpendicular to its axis and 15 cm (6 in) above its bottom. One end of the wire shall be fastened to a solid post at the same elevation. The other end shall be fastened to a second post at the same elevation by means of a spring so as to maintain

the wire taut. The blocks shall be fastened to each end of the wire, adjacent to the tank, so that they are spaced 15 to 20 cm (6 to 8 in) apart. For larger tanks, the spacing shall be permitted to be increased to avoid contact between the blocks and the tank. Blocks shall be attached to each wire wrap as previously specified.

d) Initial readings shall be taken from the measurement devices before the test unit is pressurized. When extensometers are used, the distance between the blocks on each wire shall be measured with a micrometer caliper.

e) The test unit shall be pressurized as specified in Section 5.1.4.2, steps d and e.

f) Final readings shall be taken from the extensometers or measurement devices with no pressure on the unit.

g) The difference between the readings of each measurement device is the measure of permanent deformation of either the tank bottom or top head. The difference in measurement around the tank is the increase in tank circumference.

5.1.4.4 Cycle test

The following procedure shall be used for the cyclic testing:

a) A water temperature of 20 ± 3 °C (68 ± 5 °F) shall be used throughout the test. The test water shall be adjusted to a temperature at which condensation will not form on the surface of the test unit.

b) The inlet of the test system shall be connected to a structural testing apparatus. The system shall be in conformance to its normal state of use, with the option of plugging drain lines.

c) The test system shall be filled with water and flushed to purge air from the system. The system outlet shall be closed and the control valve placed in the service position. All parts of the unit, including inlet and outlet fittings that may be subject to line pressure in normal operation, shall be pressurized.

d) The counter shall be set to zero, or its initial reading recorded, and pressure cycling shall be initiated. The pressure rise shall be ≥ 1 s, and the pressure in the test unit shall return to 14 kPa (2 psig) before the initiation of another cycle.

e) The pressure shall be cycled as specified in Table 5.1. The system shall be inspected periodically through the end of the test period to check whether the system is watertight.

Table 5.1
Structural integrity testing requirements

	Hydrostatic pressure test[1]	Cyclic pressure test[1]
Complete systems		
complete systems with pressure vessels having a diameter < 203 mm (8 in)	2.4 × maximum working pressure or 1654 kPa (240 psig)	—
complete systems with pressure vessels having a diameter of ≥ 203 mm (8 in)	1.5 × maximum working pressure or 1,040 kPa (150 psig)	—
complete systems designed for open discharge[2]	1.2 × maximum working pressure or 867 kPa (120 psig)	10,000 cycles at 0 to 345 kPa (0 to 50 psig)
complete portable systems pressurized by user[3]	1.5 × maximum working pressure	none
Components		
metallic pressure vessels having a diameter < 203 mm (8 in)[4]	2.4 × maximum working pressure or 1654 kPa (240 psig)	—
metallic pressure vessels having a diameter of ≥ 203 mm (8 in)[4]	1.5 × maximum working pressure or 1,040 kPa (150 psig)	—
nonmetallic pressure vessels having a diameter < 203 mm (8 in)	2.4 × maximum working pressure or 1654 kPa (240 psig)	—
nonmetallic pressure vessels having a diameter of ≥ 203 mm (8 in)	—	100,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure
disposable pressure vessels and components	2.4 × maximum working pressure or 1654 kPa (240 psig)	10,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure
valves and controls[5]	—	100,000 cycles at 0 to 1,040 kPa (0 to 150 psig) or maximum working pressure

[1] When a choice is given in the table, testing shall be done at the greater pressure.

[2] Components downstream of the system on/off valve that are not subject to pressure under the off mode and contain no media subject to plugging or are not designed to contain media shall be exempt from the hydrostatic pressure test, but shall be watertight in normal use.

[3] Portable systems designed to utilize only atmospheric pressure or gravity flow shall be exempt from the hydrostatic pressure test but shall be watertight in normal use.

[4] Metallic pressure vessels require measurement of circumference and head deflection. The pressure vessel circumference shall not exhibit a permanent increase of more than 0.2% when measured at the midsection and at 30 cm (12 in) intervals. The top and bottom head deflection of the pressure vessel shall not exhibit a permanent deflection exceeding 0.5% of the vessel diameter.

[5] Subject to line pressure and tested as separate components.

6 Minimum performance requirements

6.1 General

A system or component evaluated under this Standard shall be designed and constructed so that its intended purpose will be accomplished when the system or component is installed and operated according to the manufacturer's instructions. Systems and components shall be designed to prevent UV exposure to humans when operated and serviced according to manufacturer's recommendation.

Materials used in the construction of systems or components shall be capable of withstanding exposure to the intended use environment. Materials exposed to UV irradiation shall not impart hazardous chemicals to the water upon irradiation.

NOTE — Materials exposed to UV irradiation should be formulated to resist deterioration over the service life of the unit.

6.2 Performance indication

6.2.1 Class A systems

Class A systems shall be equipped with a UV sensor to indicate when the UV irradiance at the sensor is below the minimum required by this Standard. One or more of the following means shall be used to indicate ineffective operation:

— a visual alarm;
— an audible alarm; or
— a system that terminates discharge of water.

The alarm or shut-off system shall be evaluated in accordance with Section 6.2.3.

6.2.2 Class B systems

Class B systems shall be exempt from performance indication requirements. If a UV sensor is provided on a Class B system to measure the UV transmission, the alarm or shut-off system shall be evaluated in accordance with Section 6.2.3.

6.2.3 UV alarm performance

6.2.3.1 Purpose

This test is performed to determine that the UV alarm provided with the system shall activate 10 consecutive times in response to decreased UV intensity. This test is performed after the microbiological test method specified in Section 7.2.

6.2.3.2 Apparatus

The apparatus shown in Figure 3 shall be used.

6.2.3.3 Procedure

The following procedure shall be used to evaluate alarm performance:

a) Conduct all testing at the system's maximum flow rate.

b) Prepare the test system by cleaning it in accordance with the manufacturer's instructions.

Measure the volume (V) of the reactor and associated plumbing from the injection point to the reactor. This equals to one void volume. Determine the time (T) it takes for that volume to pass through the reactor at maximum flow (F).

$$T = V/F$$

c) For continuous flow units, warm the system up according to manufacturers' instructions. For systems with an instant on, no warm-up shall be conducted.

d) The UV absorbant shall be Superhume® and vanillian formula as described in Section 7.3.1.4.2. If the system solely uses low pressure mercury UV lamp as the UV source (254 nm), then parahydroxybenzoic acid (PHBA) shall be used.

e) Determine the injection pump setting that shall deliver a dose of UV absorbant into the feed stream sufficient to activate the alarm system. This is the "dose volume." Measure the UV absorbance, as referred to in Section 7.2.1.3.d, of the resulting challenge water.

f) Reset the alarm and resume feeding the clean general test water in Section 7.2.2.4.1.

g) Activate the injection pump to deliver the "dose volume" of UV absorbant. Verify alarm activation within the time it takes for three void volumes to pass through the system plus 3 s.

h) Repeat steps e and f until the alarm has been activated 10 consecutive times.

NOTE — If the alarm fails to activate during the test, verify that there has been no increase in power to the unit and the challenge water UV absorbance has not changed. If these conditions have changed, restart from step b; if not, terminate the test.

6.2.3.4 Acceptance

The sensor / alarm system, as supplied with the system, shall activate 10 consecutive times, within the time specified in Section 6.2.3.3.g and at a UVT that is within ± 2% of the mean UVT measurement, in response to decreasing UV intensity.

6.3 Elements

Cartridges, filters, and similar replacement components shall be removable.

6.4 Flow control

An automatic fixed flow rate control shall be provided to prevent flow above the manufacturer's maximum rated flow over the manufacturer's recommended operating pressure range. The manufacturer's maximum rated flow for a POE system shall be equal or greater than 15 lpm (4 gpm) with an inlet pressure of 103 kPa (15 psig) when tested in accordance with Section 7.2.2.7 or 7.3.1.7.

6.5 Waste connections

Waste connections or drain outlets, if provided, shall be designed and constructed to provide for connection to the sanitary waste system through an air gap of two pipe diameters or 25 mm (1 in), whichever is larger.

6.6 Product water dispensing outlets

Product water dispensing outlets, if provided, shall be designed, constructed, and located so that the discharge orifice is directed downward and the lower edge of the outlet shall be at an elevation not less than 51 mm (2 in) above the flood rim of the waste receptacle.

6.7 Hazards

All component parts shall be free of nonfunctional rough or sharp edges or other hazards that may cause injury to persons adjusting, servicing, or using the system.

6.8 Lamp operation indication

The UV system or component shall be provided with a visual means to verify electrical operation of all lamps.

6.9 Lamp replacement – Systems without UV sensor alarm

The recommended lamp replacement intervals for Class B systems without a UV sensor alarm that meets the requirements of Section 6.2.3 shall be verified by submittal of irradiance vs. time curves. Lamp replacement shall be recommended to occur prior to the time 70% of the initial irradiance is reached.

6.10 Maintenance

The system or component shall be designed to be accessible for cleaning and required maintenance. The product literature or label shall include instructions for the prevention of UV exposure to users during cleaning and maintenance, or the system shall be designed to prevent UV exposure to users while the system is being cleaned and maintained.

6.11 Temperature resistance

Systems, or components, or both, shall be constructed of materials suitable to withstand temperatures generated during sustained periods of no water use.

6.12 Corrodible materials

Corrodible materials shall be provided with a corrosion-resistant protective coating completely covering all wetted surfaces.

6.13 Gaskets, O-rings, shaft seals, and packing materials

Gaskets, O-rings, shaft seals, and packing materials shall conform to the applicable requirements of Section 6.1.

6.14 Dissimilar metals

Dissimilar metals not normally considered compatible on the electromotive scale shall not be in direct contact.

6.15 Insulating fittings

Insulating fittings shall be provided when materials are not compatible with adjoining fittings or parts.

6.16 Plastics

The manufacturer shall provide information to substantiate that plastic components exposed to UV will not lose structural integrity after prolonged exposure to the extent that the performance of the system is adversely affected.

6.17 Welding

Welded seams and deposited weld material shall meet the requirements of Sections 6.1 and 6.15.

6.18 UV Sensor

The UV sensor shall have a spectral response within the germicidal range of 240 to 300 nm.

The manufacturer shall provide information to substantiate the calibration procedure, indicating the alarm set point measurement at the time of factory calibration. All sensors shall be calibrated to within ± 10% relative to the working range. The sensor set point shall not be adjustable by someone other than the manufacturer.

7 Elective performance claims – Test methods

7.1 General

Systems covered under this Standard shall be designed to meet the microbiological performance requirements at the manufacturer's recommended operating pressures and flow rates. Systems using solely low-pressure mercury lamps as the UV source shall be evaluated under Section 7.2. or 7.3 as requested by the manufacturer. Systems using alternate UV sources shall be evaluated under Section 7.3.

7.2 Microbiological performance – Low pressure mercury lamps only

7.2.1 UV sensitivity of challenge organisms

7.2.1.1 General

Calibration is performed to determine the UV sensitivity of the MS-2 coliphage American Type Culture Collection (ATCC)[12] # 15597-BI (Class A) or T1 coliphage ATCC #11303 (Class B) challenges used in the performance test methods outlined in Section 7.2.2.

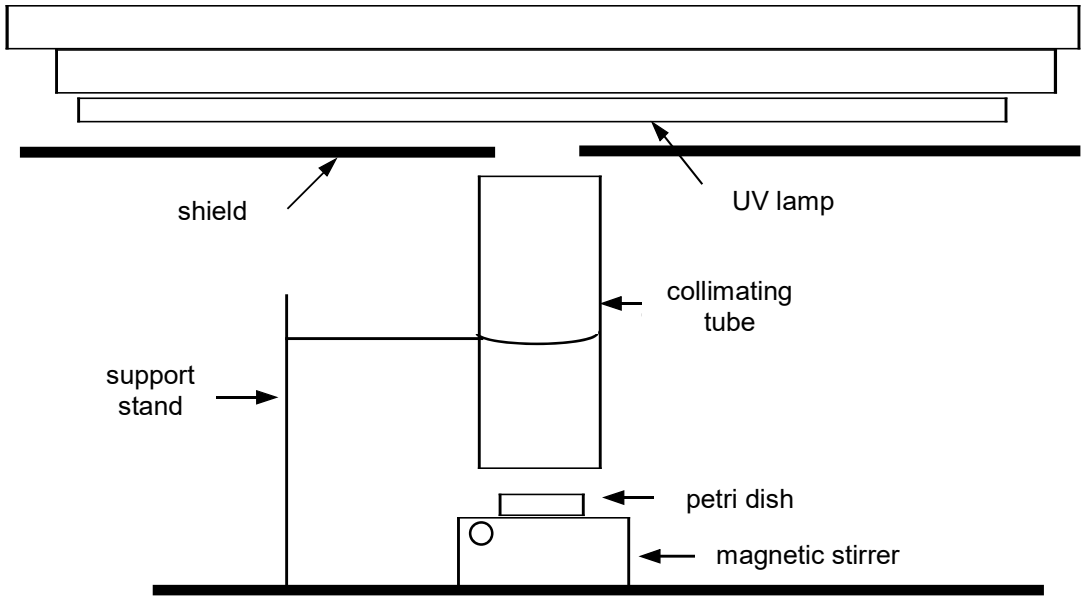
Microbiological methods for stock culture preparation, enumeration/analysis, and storage for MS-2 coliphage and T1 coliphage shall be performed as specified in Annex N-1.

7.2.1.2 Apparatus

An apparatus shall be assembled in which a small stirred sample can be irradiated in a nearly collimated beam. A radiometer meeting specification in Section 7.2.1.2.1 can then be used to measure the incident irradiance (*Eo*).

A low-pressure mercury vapor UV lamp shall be wired to a ballast and a voltage regulator (Figure 2). A solution contained in a small dish equal to or smaller in diameter than that of the collimated tube shall be used. The solution shall be 1 cm deep. *Eo* shall be measured at the surface of the liquid by removing the dish and stirrer and placing the radiometer at the corresponding position from which the dish was removed. The UV irradiance at each point of the surface shall be within ± 5% of the average irradiance across the solution surface.

[12] American Tissue Culture Collective. PO Box 1549, Manassas, VA 20108. <www.atcc.org>



NOTE 1 — The collimating tubes shall be a minimum of 53 cm (21in) in length and the interior shall be painted flat black.

NOTE 2 — The support stand, if used, shall be adjustable to raise or lower the collimating tube to the surface of the petri dish.

NOTE 3 — The petri dish shall be set so the surface of the liquid is at the same level as the radiometer.

NOTE 4 — Measurement of the UV dose must be done at the same point at which the petri dish surface is exposed.

Figure 2
Collimated beam apparatus

7.2.1.2.1 Radiometer specifications

A radiometer with the following specification shall be used:

— linearity: ± 0.5%;

— spectral response: visible-blind detector with narrow band-pass filter centered at 254 nm, full width at half maximum = 20 nm or less;

— spatial response: cosine response ± 5%;

— calibration: radiometer calibration (including optics, transducer and electronics) shall be traceable to NIST or another national standards laboratory. Calibration shall be performed annually or at the intervals specified by manufacturer, whichever is more frequent;

$$E_{ave} = 0.98 \left[\frac{E_O}{L} \left(\frac{(T)^L - 1}{\ln [T]} \right) \right]$$

— uncertainty: the calibration documentation provided with each radiometer (including optics, transducer, and electronics) shall include both calibration uncertainties (transfer uncertainty to customer) and the uncertainty associated with the calibration standard. The NIST (or other national laboratory) uncertainty is added the transfer uncertainty to customer to yield total uncertainty; and

— maximum total uncertainty: ± 9 % at 254 nm.

7.2.1.3 Challenge organism bioassay – Dose response method

a) Prior to the bioassay – dose response of the appropriate challenge organism, the challenge suspension shall be prepared (see Annex N-1).

b) On the day of the bioassay – dose response, the agar plates shall be prepared properly. The UV source shall be turned on for 30 min to equilibrate the UV output. Multiple measurements of the UV output shall be taken over the 30 min time period of the equilibration to verify nonfluctuation of the UV source to ± 5% of the UV output.

c) Aliquots of the harvested challenge organism suspension shall be diluted using appropriate dilution solution to yield a concentration of 5×10^4 to 5×10^5 organisms per milliliter.

d) The UV absorbance of the suspension at 254 nm with 1 cm path length shall be determined using *Standard Methods for the Examination of Water and Wastewater*, Method 5910 UV Absorbing Organic Constituents.

e) The UV lamp irradiance of the collimating beam shall be measured at the level of the top of suspension (*Eo*).

f) The average irradiance in the stirred solutions from Section 7.2.1.3.c shall be calculated by using the radiometer *Eo* measurement and the following equation. The calculation requires use of the UV absorbance of the suspension that is irradiated at 254 nm (as determined in Section 7.2.1.3.d).

Where:

T = 1 - A
A = UV absorbance for a pathlength of 1 cm
L = depth of solution irradiated in a collimated beam (cm)
Eo = incident irradiance (mW/cm^2)
E_{ave} = average irradiance in water (mW/cm^2)

NOTE — Calculation of the doses is made by assuming the 2% of the measured *Eo* is reflected from the water surface. The average intensity multiplied by exposure time is used as the dose. The concentration of the challenge organism is such that the UV absorbance of the solution is very small and hence any error in calculation of UV absorbance is almost negligible.

g) The dose at the following percentage(s) of the minimum dose requirement shall be determined: 0%, 15%, 30%, 45%, 60%, 75%, 90%, 105%, 120%, 135%, and 150%. The exposure time at each dose shall be determined using the following formula:

$$\text{Exposure time} = \text{dose}/E_{ave}$$

h) 33 sterile 60 × 20 mm petri dishes with 10 × 3 mm sterile stir bars shall be prepared. Sufficient diluted challenge suspension (to a depth of 1 cm) shall be added to each sterile 60 × 20 mm petri dish. Three petri dishes shall be irradiated per dose as determined in Section 7.2.1.3.g.

i) Irradiated samples shall be handled aseptically. Analysis shall be initiated within 1 h of exposure. Prior to analysis, samples shall be stored in the dark. Serial dilutions of exposed samples (10^0 to 10^{-5}) shall be made using sterile dilution solution. Dilutions shall be plated on agar plates in triplicate. The plates shall be rocked to spread inoculum evenly. After the agar has solidified, it shall be inverted and incubated at the appropriate temperature and time.

j) Plates containing 25 to 250 distinct colony forming units (CFU) / plaque forming units (PFU) shall be selected using a Colony Counter. The concentration of the challenge organism suspension shall be calculated by multiplying the number of CFU/PFU obtained by the inverse of the dilution factor. Results shall be expressed as the number of CFU/mL or PFU/mL.

NOTE — All log reductions shall be established using only plates containing 25 to 250 CFU/PFU.

k) The final dose used at each point of exposure shall be adjusted based upon the Eave using the following formula:

final dose = E_{ave} × exposure time

l) The log survival of organisms shall be calculated by using the following equation for log survival:

log survival of organisms = Log(N_s/N_o)

Where:

N_o = geometric mean of nonirradiated sample concentrations at dose zero
N_s = geometric mean value of irradiated sample concentrations at each dose

m) The bioassay – dose response curve is produced by plotting the log survival values for the exposed organism suspension on the y-axis and the final UV dose mJ/cm^2 (μW-sec/cm^2) values on the x-axis.

n) A linear regression shall be performed on the data to obtain an equation for the dose response relationship. The log reduction shall be calculated at the required minimum UV dose.

7.2.1.4 Quality assurance/quality control (QA/QC)[13]

7.2.1.4.1 General

The QA/QC for the collimated beam and challenge organism shall be performed to provide assurance that the propagation, harvest, and preparation of the challenge stock produce a homogenous, monodispersed suspension of the challenge organisms prior to the suspension's introduction to the UV system.

7.2.1.4.2 QA/QC

The following lines shall be plotted on the graph produced in Section 7.2.1.3.m:

1) -log10(*Ns*/*No*) = 0.040*[UV dose, mJ/cm2] + 0.64
2) -log10(*Ns*/*No*) = 0.033*[UV dose, mJ/cm2] + 0.20

7.2.1.4.3 Specifications

All data points in the specified UV dose ranges shall be included in the regression analysis. The final regression and 80% of the data points shall lie inside the defined area in Section 7.2.1.4.2 in the appropriate UV dose range.

NOTE — The results that are outside the limits specified in Section 7.2.1.4.3 shall be reported, but shall not be used to determine the bioassay-dose response curve or verify the UV system.

[13] American Water Works Association Research Foundation, National Water Research Institute. December 2000. *Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse*. <www.waterresearchfoundation.org>

7.2.2 Microbial performance testing

Component filters or other media that may interfere with the testing of a system shall be removed or bypassed during the test.

Microbiological methods for stock culture preparation, enumerations / analysis, storage, and stock challenge concentration for challenge test for MS-2 coliphage and T1 coliphage shall be performed as specified in Annex N-1.

7.2.2.1 Class A systems

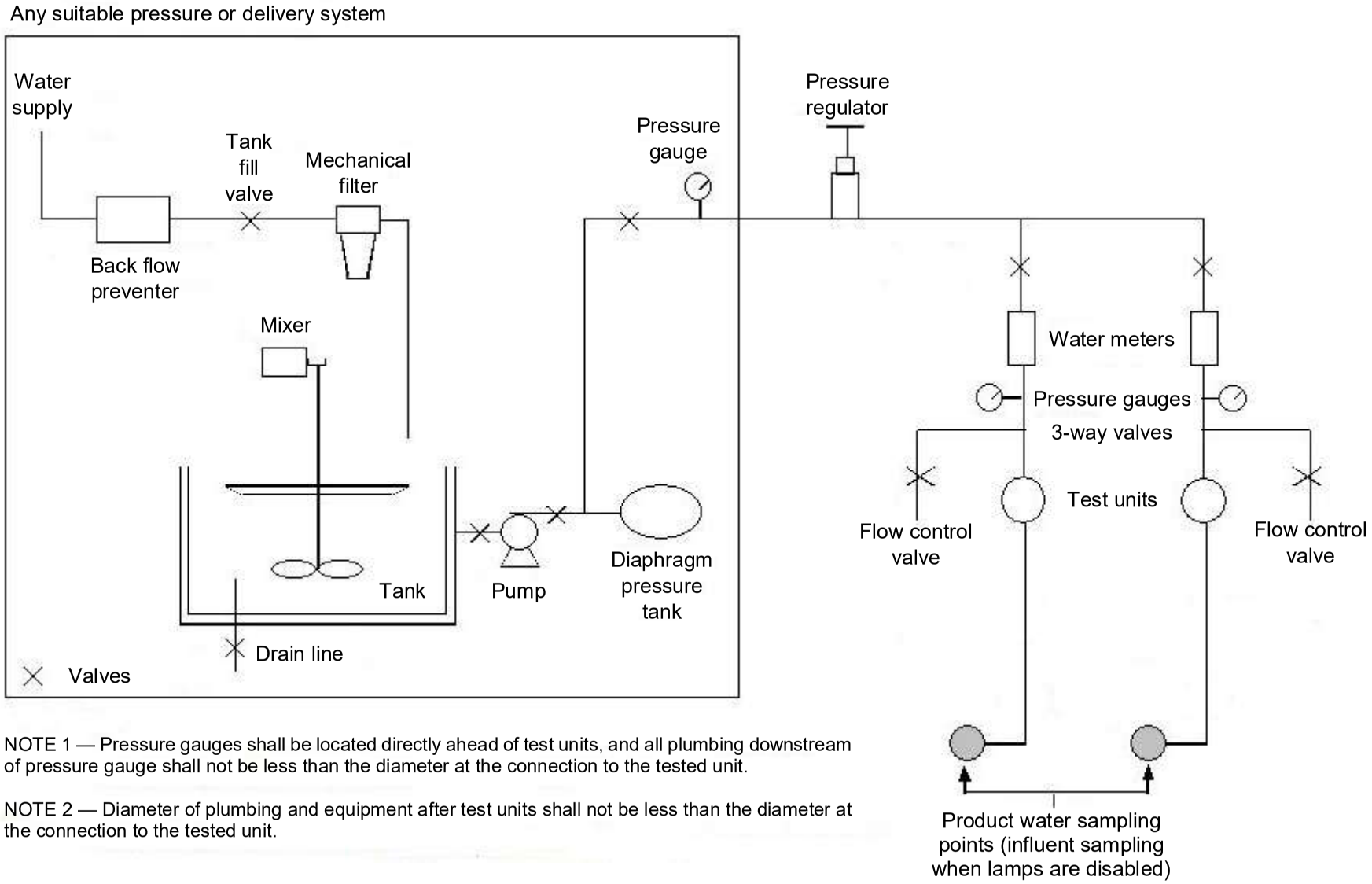
A Class A system shall deliver a UV dose at least equivalent to 40 mJ/cm2 (4.0 × 104 µW-sec/cm^2) at the alarm set point when the system is tested in accordance with Section 7.2.2.7 or 7.2.2.8 as applicable. The equivalence of the UV dose shall be determined by comparing the system's inactivation of MS-2 coliphage to the inactivation obtained in accordance with Section 7.2.1.3.

7.2.2.2 Class B systems

A Class B system shall deliver a UV dose at least equivalent to 16 mJ/cm^2)1.6 × 104 µW-sec/cm^2) at a UV lamp output that is 70% of normal or at the alarm set point when the system is tested in accordance with Section 7.2.2.7 or 7.2.2.8 as applicable. The equivalence of the UV dose shall be determined by comparing the system's inactivation of T1 coliphage cells to the inactivation obtained in accordance with Section 7.2.1.3.

7.2.2.3 Apparatus

The test units shall be installed and operated using the test apparatus shown in Figure 3. The test systems shall be plumbed in parallel to simulate normal installation. Manifolds shall be representative of household plumbing (2.0 to 6.5 cm [0.75 to 2.5 in] pipe sizes).



NOTE 1 — Pressure gauges shall be located directly ahead of test units, and all plumbing downstream of pressure gauge shall not be less than the diameter at the connection to the tested unit.

NOTE 2 — Diameter of plumbing and equipment after test units shall not be less than the diameter at the connection to the tested unit.

Figure 3
Example test apparatus

7.2.2.4 Test water

7.2.2.4.1 General test water

A chlorine free water with the following characteristics shall be used:

pH	7.5 ± 0.5
UV transmittance	98 ± 2% (prior to adding PHBA)
turbidity	< 1.0 NTU
temperature	20 ± 2.5 °C (68 ± 5 °F)
TDS	200 to 500 mg/L

7.2.2.4.2 Challenge organism

The appropriate organism shall be added to the above water:

MS-2 coliphage ATCC #15597-B	5×10^4 to 5×10^5 PFU/mL
T1 coliphage ATCC #11303	5×10^4 to 5×10^5 CFU/mL

7.2.2.5 Determination of test operating conditions

For UV devices not equipped with an alarm set point mechanism, Section 7.2.2.5.2 shall be used to determine the normal output.

7.2.2.5.1 Systems with UV sensor and alarm set point

Sufficient PHBA shall be added to reduce UV light transmission to the alarm set point in the device. No less than the quantity of PHBA required to give a mean UV absorption of 0.3/cm at 254 nm shall be used.

NOTE — Refer to *Standard Methods for the Examination of Water and Wastewater*, Method 5910 UV Absorbing Organic Constituents.

7.2.2.5.2 Measurement of normal output for Class B systems

The following procedure shall be used to measure the normal output:

a) Two bulb and ballast components identical to the system's bulb and ballast component shall be installed into a container coated with material that does not reflect UV radiation. The container shall be large enough to allow for measurement of the UV intensity at 1.0 m (3.3 ft).

b) A regulated voltage source shall be set at the manufacturer’s minimum recommended voltage.

c) The lamp shall be operated for 100 h and record the intensity at 1.0 m (3.3 ft).

d) The voltage to the lamps shall be reduced until the irradiance reaches 70% of normal output measured at 100 h. The voltage and intensity shall be recorded.

e) The lower of the two voltage reductions shall be used to adjust the system to 70% of its normal output.

f) Test shall be conducted with lamps conditioned for 100 h.

NOTE — Alternative methods may be used to reduce the irradiance by 70%.

7.2.2.6 Analytical methods

The analytical methods shall be as specified in Section 2. All bacteriological samples shall be collected aseptically in sterile bottles without neutralizer.

7.2.2.7 Microbiological test method – Flow through systems

Table 7.1
Sampling for disinfection performance

Sampling point		Influent	Effluent
Day 0	condition system	no sample	no sample
Day 1	start up	x	x[1]
	4 h	x	x[2]
Day 2	start up	x	x[1]
	4 h	x	x[2]
Day 3	start up	x	x[1]
	4 h	x	x[2]
Day 4	start up	x	x[1]
	4 h	x	x[2]
Days 5, 6	48 to 72 h stagnation	no sample	no sample
Day 7	start up	x	x[1]
	4 h	x	x[2]

[1] Samples shall be collected at the start-up of each day following a minimum 16 h stagnation according to the sampling requirements in Sections 7.2.2.7 and 7.2.2.8. Samples shall be of the first three unit void volumes (or minimum quantity required for analysis, whichever is larger) from the system or component. Sampling will be delayed until the plumbing downstream of the three-way valve and the sampling point has been purged.

[2] Samples shall be collected after a minimum of 15 min of operation.

The following procedure shall be used as the disinfection test method for flow through systems:

a) Two systems shall be installed as shown in Figure 3, and each system shall be conditioned in accordance with the manufacturer's instructions using the general test water without the challenge organism. If a prefilter or postfilter is supplied with the system, the filter shall be removed before testing. A three-way valve shall be installed immediately prior to the test unit to allow the influent to bypass the test unit. The flow rate of the test system shall be determined by subjecting the system to inlet pressures of 140 kPa (20 psig), 103 kPa (15 psig), 210 kPa (30 psig), 280 kPa (40 psig), 340 kPa (50 psig), 410 kPa (60 psig), 480 kPa (70 psig), 550 kPa (80 psig), 620 kPa (90 psig), 690 kPa (100 psig) and the system’s maximum working pressure ± 5%, and measuring the flow rate at each sample point. The maximum flow rate observed shall be the evaluation service flow. The UV lamp shall be disabled during influent sampling.

b) Appropriate techniques of dilution and adequate mixing shall be used to prepare the general test water in Section 7.2.2.4.1.

c) Before the test is started, the influent shall be analyzed for pH, total dissolved solids, turbidity, residual chlorine, and temperature. Other parameters may be used for purposes of future comparison and for documentation.

d) 70% of the lamp's normal output as determined in Section 7.2.2.5.2 shall be obtained, or if a performance indicating device is provided, sufficient PHBA to meet the required UV light transmittance determined in Section 7.2.2.5.1 shall be added.

e) The three-way valve installed immediately prior to the test system shall be set to bypass at the testing flow rate. The challenge organism used in the calibration method in Section 7.2.1 shall begin to be fed. Once the injection system has stabilized, the valve shall quickly be turned to feed the challenge to the test unit. The effluent samples shall be collected at the times specified in Table 7.1 at the sample point immediately following the test unit as shown in Figure 3.

f) Duplicates shall be generated from all collected microbiological samples. Effluent samples shall be collected first. Immediately after the effluent is collected, the UV lamp shall be shut off and a minimum of 5 unit void volumes allowed to pass through the unit. The effluent sample shall be collected downstream of the test unit to represent the influent. The system shall be operated only as long as required to collect the required samples. The system shall be energized with no flow between sample points.

g) Influent and effluent samples shall be collected aseptically in sterile bottles with no neutralizer. Samples shall be stored in the dark prior to analysis. For all microbiological samples, analysis shall be initiated within 1 h. See Annex N-1 for methods. Steps d through g shall be repeated for each sample point in Table 7.1. The test units shall be energized throughout the testing and shall only be deactivated during influent sampling.

7.2.2.8 Batch treatment systems

The following procedure shall be used as the disinfection test method for batch systems:

a) Two systems shall be tested. Each system shall be conditioned prior to the start of the test in accordance with the manufacturer's instructions, utilizing the general test water. The system shall be energized throughout the test.

b) The voltage to the system shall be adjusted to obtain 70% of the lamp's normal output as determined in Section 7.2.2.5.2, or if a performance indicating device is provided, sufficient PHBA to meet the required UV light transmittance as determined in Section 7.2.2.5.1 shall be added.

7.2.2.8.1 Sampling

NOTE — Influent samples shall be collected by removing an aliquot from the midpoint of the raw water reservoir by pipette.

Day 1 – The system shall be started and operated for the recommended treatment time specified by the manufacturer. The complete batch shall be collected for analysis. The system shall be refilled with the general test water.

Days 2 to 4 – The system shall be spiked with the challenge organism into the general test water in the system from the previous day. The system shall be restarted and a batch generated for sampling. Systems shall be turned off and filled with general test water for next day's testing.

Days 5 to 6 – The systems shall remain stagnant for 48 h with challenge water remaining in the system.

Day 7 – The system shall be spiked with the challenge organism into the general test water in the system from Day 4. The system shall be restarted and a batch generated for sampling.

7.2.2.8.2 Acceptance

7.2.2.8.2.1 Class A systems

For Class A systems, the geometric mean of all MS-2 coliphage plaques on influent samples minus the geometric mean of counts on all effluent samples shall demonstrate a log reduction greater than or equal to the reduction caused by a dose of 40 mJ/cm^2 [4.0 × 104 µW-sec/cm^2] as calibrated in Section 7.2.2.

7.2.2.8.2.2 Class B systems

For Class B systems or components, the geometric mean of all T1 coliphage cell counts on influent samples minus the geometric mean of counts on all effluent samples shall demonstrate a log reduction equivalent to or greater than the reduction caused by a dose of 16 mJ/cm^2 [1.6 × 104 µW-sec/cm^2] as calibrated in Section 7.2.2.

7.3 Microbiological performance

7.3.1 Microbial performance testing

Component filters or other media that may interfere with the testing of a system shall be removed or bypassed during the test.

Microbiological methods for stock culture preparation, enumerations / analysis, storage, and stock challenge concentration for challenge test for Qβ coliphage shall be performed as specified in Annex N-2.

7.3.1.1 Class A systems

A Class A system shall deliver a UV dose to achieve a 4.00 log reduction of the challenge organism concentration in the influent at the alarm set point when the system is tested in accordance with Section 7.3.1.7 or 7.3.1.8 as applicable.

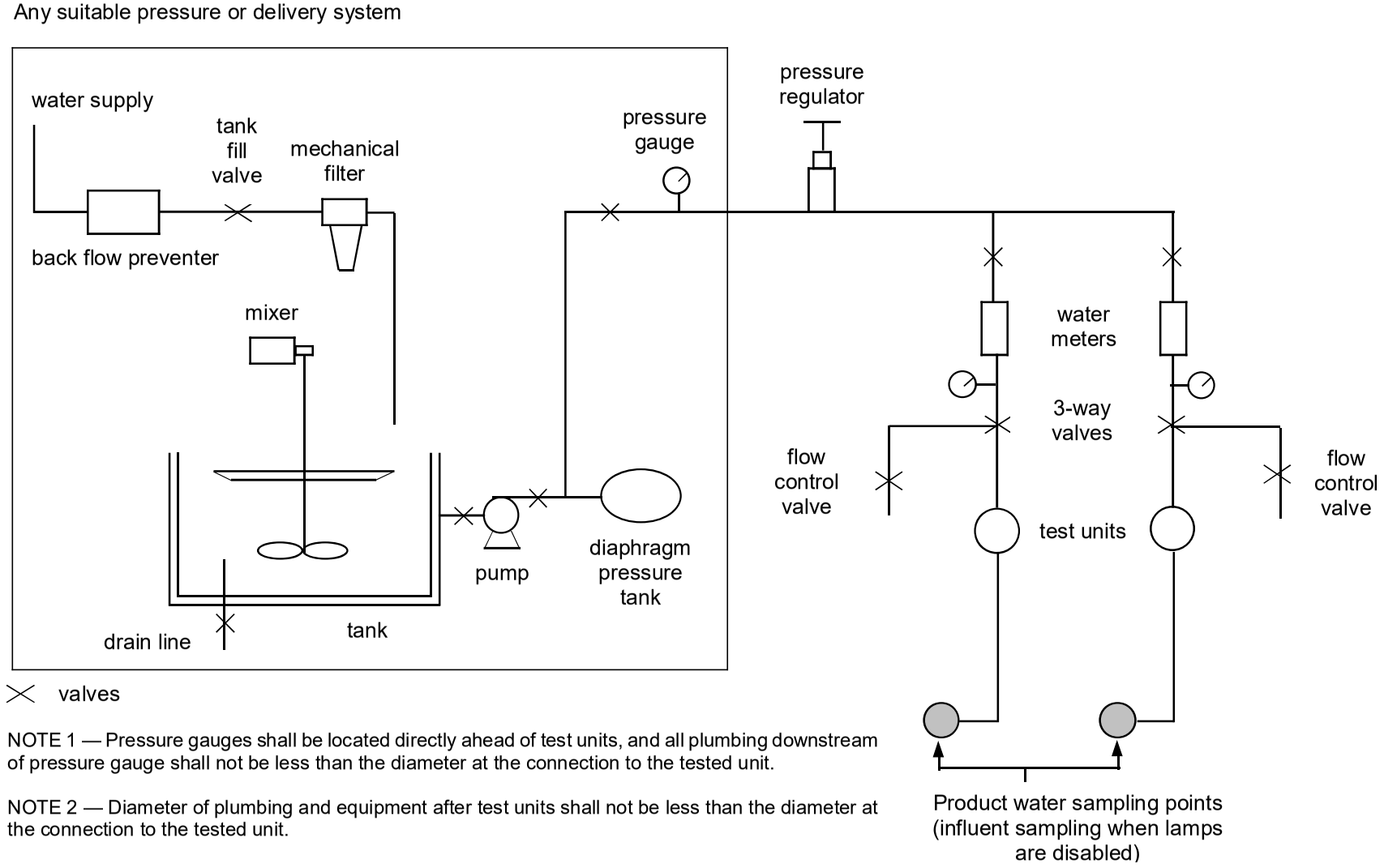
7.3.1.2 Class B systems

A Class B system which is evaluated with the UV source irradiance at normal output shall deliver a UV dose to achieve a 2.14 log reduction of the challenge organism concentration in the influent when the system is tested in accordance with Section 7.3.1.7 or 7.3.1.8 as applicable.

A Class B system which is evaluated with the UV source irradiance at 70% of normal output, or at the alarm set point, shall deliver a UV dose to achieve a 1.50 log reduction of the challenge organism concentration in the influent when the system is tested in accordance with Section 7.3.1.7 or 7.3.1.8 as applicable.

7.3.1.3 Apparatus

The test units shall be installed and operated using the test apparatus shown in Figure 4. The test systems shall be plumbed in parallel to simulate normal installation. Manifolds shall be representative of household plumbing (2.0 to 6.5 cm [0.75 to 2.5 in] pipe sizes).



NOTE 1 — Pressure gauges shall be located directly ahead of test units, and all plumbing downstream of pressure gauge shall not be less than the diameter at the connection to the tested unit.

NOTE 2 — Diameter of plumbing and equipment after test units shall not be less than the diameter at the connection to the tested unit.

Figure 4
Example test apparatus

7.3.1.4 Test water

7.3.1.4.1 General test water

A chlorine-free water with the following characteristics shall be used:

pH	7.5 ± 0.5
UV transmittance	98 ± 2% (prior to adding UV absorbant)
turbidity	< 1.0 NTU
temperature	20 ± 2.5 °C (68 ± 5 °F)
TDS	200 to 500 mg/L

7.3.1.4.2 UV absorbant

The UV absorbant shall be comprised of vanillin (CAS# 121-33-5) and SuperHume®[14]. The vanillin and SuperHume® shall be combined while maintaining a ratio of 1.0 mg vanillin to 0.02 mL SuperHume®. These compounds shall be diluted as needed prior to addition to the test water with deionized water.

7.3.1.4.3 Challenge organism

The appropriate organism shall be added to the general test water:

Qβ coliphage ATCC #23631-B1	5×10^4 to 5×10^5 PFU/mL

7.3.1.5 Determination of test operating conditions

7.3.1.5.1 Systems without UV sensor and alarm set point

For UV devices not equipped with an alarm set point mechanism, UV absorbant shall not be added to the test water.

7.3.1.5.2 Systems with UV sensor and alarm set point

Sufficient UV absorbant shall be added to reduce UV light transmission to the alarm set point in the device. No less than the quantity of UV absorbant required to give a mean UV absorption of 0.30 per cm (70% UVT) at 254 nm shall be used.

NOTE — Refer to *Standard Methods for the Examination of Water and Wastewater*, Method 5910 UV Absorbing Organic Constituents.

7.3.1.5.3 Configuring Class B systems for evaluation

Two methods are available to prepare a Class B system for evaluation. These methods both effectively simulate the UV source irradiance at end of life (70% of initial output at 100 hours). The procedure under Section 7.3.1.5.3.1 shall be the default procedure. Section 7.3.1.5.3.2 shall be utilized if the system is conducive to this procedure and is requested by the manufacturer.

[14] Available from UAS of America, 534 CR 529 A, Lake Panasoffkee, Florida 33538 as Cropmaster® SuperHume® or AquaHume®.

7.3.1.5.3.1 Adjustment of Class B criteria to simulate UV source end of life

To simulate the UV irradiance at end of life for systems which are operated at the normal output, the reduction criteria shall be a log reduction greater than or equal to 2.14 when the system is evaluated under Section 7.3.1.7 or 7.3.1.8 using UV sources conditioned for 100 hours.

7.3.1.5.3.2 Measurement of normal output and establishment of 70% irradiance for Class B systems

The following procedure shall be used to measure the normal output:

a) Two UV sources and ballast components identical to the system's UV source and ballast component shall be obtained and prepared for irradiance measurement in accordance with the appropriate International Ultraviolet Association Testing Protocol for measurement of UV device output.[15]

b) A regulated voltage source shall be set at the manufacturer's minimum recommended voltage.

c) The UV source shall be operated for 100 hours and record the UV source irradiance (normal output).

d) The voltage to the UV source shall be reduced until the irradiance reaches 70 ± 1% of normal output measured at 100 hours. The voltage and irradiance shall be recorded.

e) The lower of the two voltage measurements shall be used to adjust the system to 70% of its normal output during the evaluation under Section 7.3.1.7 or 7.3.1.8.

f) Test shall be conducted with UV sources conditioned for 100 hours.

7.3.1.6 Analytical methods

The analytical methods shall be as specified in Section 2 and Annex N-2. All bacteriological samples shall be collected aseptically in sterile bottles without neutralizer.

[15] *Method for the Measurement of the Output of Monochromatic (254nm) Low-Pressure UV Lamps*, IUVA News, Vol. 19:1, Spring 2017, and *Testing Protocol for Measurement of UV-C LED Device Output: Industry-wide Tolerance to Error*, IUVA, Sept. 2018, International Ultraviolet Association, Inc., 6935 Wisconsin Ave, Ste 207, Bethesda, MD 20815. <www.iuva.org>

7.3.1.7 Microbiological test method – Flow through systems

Table 7.2
Sampling for disinfection performance

Sampling point		Influent	Effluent
Day 0	condition system	no sample	no sample
Day 1	start up	x	x[1]
	4 h	x	x[2]
Day 2	start up	x	x[1]
	4 h	x	x[2]
Day 3	start up	x	x[1]
	4 h	x	x[2]
Day 4	start up	x	x[1]
	4 h	x	x[2]
Days 5, 6	48 to 72 h stagnation	no sample	no sample
Day 7	start up	x	x[1]
	4 h	x	x[2]

[1] Samples shall be collected at the start-up of each day following a minimum 16 h stagnation according to the sampling requirements in Sections 7.3.2.7 and 7.3.2.8. Samples shall be of the first three unit void volumes (or minimum quantity required for analysis, whichever is larger) from the system or component. Sampling will be delayed until the plumbing downstream of the three-way valve and the sampling point has been purged.

[2] Samples shall be collected after a minimum of 15 min of operation.

The following procedure shall be used as the disinfection test method for flow through systems:

a) Two systems shall be installed as shown in Figure 4, and each system shall be conditioned in accordance with the manufacturer's instructions using the general test water without the challenge organism. If a prefilter or postfilter is supplied with the system, the filter shall be removed before testing. A three-way valve shall be installed immediately prior to the test unit to allow the influent to bypass the test unit. The flow rate of the test system shall be determined by subjecting the system to inlet pressures of 103 kPa (15 psig), 140 kPa (20 psig), 210 kPa (30 psig), 280 kPa (40 psig), 340 kPa (50 psig), 410 kPa (60 psig), 480 kPa (70 psig), 550 kPa (80 psig), 620 kPa (90 psig), 690 kPa (100 psig) and the system's maximum working pressure ± 5%, and measuring the flow rate at each sample point. The maximum flow rate observed shall be the evaluation service flow. The UV source shall be disabled during influent sampling.

b) Appropriate techniques of dilution and adequate mixing shall be used to prepare the general test water in Section 7.3.1.4.1.

c) Before the test is started, the influent shall be analyzed for pH, total dissolved solids, turbidity, residual chlorine, and temperature. Other parameters may be used for purposes of future comparison and for documentation.

d) The UV absorbant shall be added at the concentration determined in Section 7.3.1.5 to achieve the desired UV absorbance in the test water.

e) The three-way valve installed immediately prior to the test system shall be set to bypass at the testing flow rate. The challenge organism referenced in Section 7.3.1.4.3 shall begin to be fed. Once

the injection system has stabilized, the valve shall quickly be turned to feed the challenge to the test unit. The effluent samples shall be collected at the times specified in Table 7.2 at the sample point immediately following the test unit as shown in Figure 4.

f) Duplicates shall be generated from all collected microbiological samples. Effluent samples shall be collected first. Immediately after the effluent is collected, the UV lamp shall be shut off and a minimum of 5 unit void volumes allowed to pass through the unit. The effluent sample shall be collected downstream of the test unit to represent the influent. The system shall be operated only as long as required to collect the required samples. The system shall be energized with no flow between sample points.

g) Influent and effluent samples shall be collected aseptically in sterile bottles with no neutralizer. Samples shall be stored in the dark prior to analysis. For all microbiological samples, analysis shall be initiated within 1 h. See Annex N-2 for methods. Steps d through g shall be repeated for each sample point in Table 7.2. The test units shall be energized throughout the testing and the UV source shall only be manually deactivated during influent sampling.

7.3.1.8 Batch treatment systems

The following procedure shall be used as the disinfection test method for batch systems:

a) Two systems shall be tested. Each system shall be conditioned prior to the start of the test in accordance with the manufacturer's instructions, utilizing the general test water without challenge organism. The system shall be energized throughout the test.

b) The UV absorbant shall be added at the concentration determined in Section 7.3.1.5 to achieve the desired UV absorbance in the test water.

7.3.1.8.1 Sampling

Influent samples shall be collected by removing an aliquot from the midpoint of the raw water reservoir by pipette.

Day 1 – The system shall be started and operated for the recommended treatment time specified by the manufacturer. The complete batch shall be collected for analysis. The system shall be refilled with the general test water.

Days 2 to 4 – The system shall be spiked with the challenge organism into the general test water in the system from the previous day. The system shall be restarted and a batch generated for sampling. Systems shall be turned off and filled with general test water for next day's testing.

Days 5 to 6 – The systems shall remain stagnant for 48 h with challenge water remaining in the system.

Day 7 – The system shall be spiked with the challenge organism into the general test water in the system from Day 4. The system shall be restarted and a batch generated for sampling.

7.3.1.8.2 Acceptance

7.3.1.8.2.1 Class A systems

For Class A systems, the geometric mean of all Qβ coliphage plaques on influent samples minus the geometric mean of counts on all effluent samples shall demonstrate a log reduction greater than or equal to 4.00.

7.3.1.8.2.2 Class B systems

For a Class B system which is evaluated with the UV source irradiance at normal output, the geometric mean of all Qβ coliphage plaques on influent samples minus the geometric mean of counts on all effluent samples shall demonstrate a log reduction greater than or equal to 2.14.

For a Class B system which is evaluated with the UV source irradiance at 70% of normal output or at the alarm setpoint, the geometric mean of all Qβ coliphage plaques on influent samples minus the geometric mean of counts on all effluent samples shall demonstrate a log reduction greater than or equal to 1.50.

8 Instructions and information

Class A systems not installed downstream of a device tested for cyst reduction / inactivation in conformance to the appropriate NSF/ANSI Standard may claim reduction of *Cryptosporidium* oocysts and *Giardia* cysts only. Class A systems installed downstream of a device tested for cyst reduction / inactivation in conformance to the appropriate NSF/ANSI Standard may make a general cyst claim when used on untreated surface waters, or groundwater, or both, under the direct influence of surface water. Class B systems may not make individual or general cyst claims.

The units evaluated in this Standard shall not make claims of reduction or inactivation of MS-2 coliphage, Qβ coliphage, or T1 coliphage.

8.1 Installation, operation, and maintenance instructions

8.1.1 Information setting forth complete, detailed instructions for installation, operation, and maintenance shall be provided with each system. Specific information shall include:

— model number and class designation;

— complete name, address, and telephone number of manufacturer;

— flushing and conditioning procedures;

— rated service flow in lpm or lpd (gpm or gpd);

— maximum working pressure in kPa (psig);

— maximum operating temperature in °C (°F);

— detailed installation instructions including an explanation or schematic diagram of proper connections to the plumbing system;

— general operation and maintenance requirements including, but not limited to, service to the system, user responsibility, and parts and service availability;

— sources of supply for replaceable components;

— a statement that the system and installation shall comply with applicable state and local regulations;

— use limitations;

— model number of UV lamp;

— required replacement intervals of UV lamp(s) in accordance with the manufacturer's instructions;

— for Class A systems, a warning to boil water in a failure situation;

— for Class A systems, a procedure to disinfect the system and plumbing during installation and after a system failure;

— cleaning instructions; and

— a statement of applications:

— Class A system:

"This Class A system conforms to NSF/ANSI 55 for the disinfection of microbiologically contaminated water that meets all other public health standards. The system is not intended to convert wastewater or raw sewage to drinking water. The system is intended to be installed on visually clear water."

"NSF/ANSI 55 defines wastewater to include human or animal body waste, toilet paper, and any other material intended to be deposited in a receptacle designed to receive urine and feces (blackwaste), and other waste materials deposited in plumbing fixtures (greywaste)."

— Class A system without a general cyst inactivation / reduction device in conformance to the appropriate NSF/ANSI Standard:

"If this system is used for the treatment of untreated surface waters or ground water under the direct influence of surface water, a device found to be in conformance for cyst reduction under the appropriate NSF/ANSI Standard shall be installed upstream of the system."

— Class B system:

"This Class B system or component conforms to NSF/ANSI 55 for the supplemental bactericidal treatment disinfected public drinking water or other drinking water that has been tested and deemed acceptable for human consumption by the state or local health agency having jurisdiction. The system is only designed to reduce normally occurring nonpathogenic nuisance microorganisms. Class B systems are not intended for treatment of contaminated water."

8.1.2 Where applicable and appropriate, the following information shall also be included:

— model number of replacement components;
— rated capacity / rated service life in liters (gallons);
— minimum working pressure in kPa (psig);
— minimum operating temperature in °C (°F);
— electrical requirements;
— a diagram showing proper air gap installation to waste connections;
— explicit instructions explaining how the performance indicator functions; and
— disinfection or cleaning instructions for Class A systems.

8.2 Data plate

8.2.1 A permanent plate or label shall be affixed in a readily accessible location on the system and shall contain, at a minimum, the following information:

- model number and class designation;
- name and address of manufacturer;
- maximum working pressure in kPa (psig);
- maximum operating temperature in °C (°F);
- model number of UV lamps;
- maximum operating feed water temperature in °C (°F);
- applicable warning signs;
- a use limitations statement: “See instruction manual for use conditions”;
- maximum flow rate in lpm (gpm or gpd);
- operational voltage, amperage, and Hertz of the system;
- required replacement intervals of UV lamp(s); and
- the following applicable statement:

  - Class A system:

    “This system or component conforms to NSF/ANSI 55 for the disinfection of microbiologically contaminated water that meets all other public health standards. The system is not intended for the treatment of water that has an obvious contamination or intentional source, such as raw sewage, nor is the system intended to convert wastewater to microbiologically safe drinking water.”

  - Class A system without a general cyst inactivation/reduction device in conformance to the appropriate NSF/ANSI Standard:

    “If this system is used for the treatment of untreated surface waters or groundwater under the direct influence of surface water, a device found to be in conformance for cyst reduction under the appropriate NSF/ANSI Standard shall be installed upstream of the system.”

  - Class B system:

    “This system or component conforms to NSF/ANSI 55 for the supplemental bactericidal treatment of disinfected public drinking water or other drinking water that has been tested and deemed acceptable for human consumption by the state or local health agency having jurisdiction. The system is only designed to reduce normally occurring nonpathogenic, nuisance microorganisms. Class B systems are not intended for the disinfection of contaminated water.”

  Components that have been evaluated only for design and construction, materials, or both, shall be exempt from this requirement.

8.2.2 Where applicable and appropriate, the following information shall also be included:

- model number of replacement components;
- electrical requirements;
- for Class B systems, recommended frequency for the replacement of UV lamps;
- maintenance schedule; and
- for Class A systems, a warning to boil water in a failure situation.

8.3 Replacement components

8.3.1 The packaging of replacement components shall be labeled with the following information:

- model number and name of component;
- model number or series identification of system(s) in which the component is to be used; and
- name and address of manufacturer.

8.3.2 Where applicable, the following information shall also be stated:

- component rated capacity / rated service life in liters (gallons);
- operating or exchange steps; and
- required replacement intervals of UV lamp(s) in accordance with the manufacturer's instructions.

8.4 Performance data sheet

8.4.1 A performance data sheet shall be available to potential buyers for each system and shall include the following information:

- model number and class designation;

- complete name, address, and telephone number of manufacturer;

- rated service flow in lpm or lpd (gpm or gpd);

- rated capacity/rated service life in liters (gallons);

- maximum working pressure in kPa (psig);

- maximum operating temperature in °C (°F);

- general installation conditions and needs;

- general operation and maintenance requirements including, but not limited to, suggested frequency of component replacement or service to the system, user responsibility, and parts and service availability; and

- a statement of applications:

  - Class A system:

    “This Class A system conforms to NSF/ANSI 55 for the disinfection of microbiologically contaminated water that meets all other public health standards. The system is not intended to convert wastewater or raw sewage to drinking water. The system is intended to be installed on visually clear water.

    “NSF/ANSI 55 defines wastewater to include human or animal body waste, toilet paper, and any other material intended to be deposited in a receptacle designed to receive urine and feces (blackwaste); and other waste materials deposited in plumbing fixtures (greywaste).”

— Class A system without a general cyst inactivation/reduction device in conformance to the appropriate NSF/ANSI Standard:

"If this system is used for the treatment of untreated surface waters or ground water under the direct influence of surface water, a device found to be in conformance for cyst reduction under the appropriate NSF/ANSI Standard shall be installed upstream of the system."

— Class B systems:

"This Class B system or component conforms to NSF/ANSI 55 for the supplemental bactericidal treatment of disinfected public drinking water or other drinking water that has been tested and deemed acceptable for human consumption by the state or local health agency having jurisdiction. The system is only designed to reduce normally occurring nonpathogenic, nuisance microorganisms. Class B systems are not intended for treatment of contaminated water."

— for Class B systems: statement that while testing was performed under standard laboratory conditions, actual performance may vary;

— electrical characteristics, voltage, amperage, and Hertz;

— recommended service life of UV lamps;

— maximum operating feed water temperature in °C (°F); and

— use limitations.

8.4.2 Where applicable, the following information shall also be included:

— model number of replacement components;
— pressure drop of new system in kPa (psig) at rated flow (POE systems only);
— minimum working pressure in kPa (psig);
— minimum operating temperature in °C (°F);
— electrical requirements;
— recommended frequency for the replacement of UV lamps (Class B systems); and
— explanation of how the performance indicator functions.

Normative Annex 1

Ultraviolet water treatment systems microbial reduction – MS-2 and T1 procedures

N-1.1 Summary

MS-2 phage and T1 coliphage are used as biological surrogates to determine the average UV dose output of UV water treatment systems. The methods that are used for suspension preparation, titration, and analysis of the challenge organisms for use in the sensitivity calibration and testing are presented in this Annex.

N-1.2 Equipment

- autoclave;
- radiometer (International light IL-700);
- UV collimating beam apparatus and 254 nm photo detector;
- incubator, 35 ± 1 °C (95 ± 1 °F);
- refrigerator, 5 ± 3 °C (41 ± 3 °F);
- water bath, 50 ± 1 °C (122 ± 1 °F);
- freezer;
- microwave;
- vortex mixer;
- UV-vis spectrophotometer;
- pH meter;
- hemocytometer;
- Colony Counter; and
- centrifuge.

N-1.3 Microorganisms

All organisms shall be obtained from ATCC.

- MS-2 coliphage (ATCC #15597-Bl);
- *Escherichia coli* (ATCC #15597) host strain for MS-2;
- T1 coliphage (ATCC #11303-B1); and
- *Escherichia coli* (ATCC #11303) host strain for T1.

N-1.4 Supplies

- sterile petri dishes, 20 × 60 mm and 15 × 100 mm;
- sterile pipettes, 1 mL and 10 mL;
- sterile centrifuge tubes, 10 mL and 50 mL;
- sample bottles, 125 mL sterile screw cap;
- test tubes, 16 × 125 mm;
- sterile inoculating loop;
- sterile filtration apparatus;
- sterile 0.22 µm polycarbonate membrane filters;
- Whatman #1 filter;
- chlorine detection kit; and
- disposable sterile 250 mL polypropylene container.

N-1.5 Reagents

—sterile buffered dilution water (SBDW). This shall be prepared according to *Standard Methods for the Examination of Water and Wastewater* (dilution water: buffered water);

—phosphate buffer saline (PBS). A stock solution shall be prepared by dissolving 80 g sodium chloride (NaCl), 2 g potassium dihydrogen phosphate (KH2PO4), 29 g hydrated disodium hydrogen phosphate (Na2HPO4•12H2O), and 2 g potassium chloride (KCl) in water to a final volume of 1 L. A working solution shall be prepared from the stock solution by diluting 1 volume of the stock with 9 volumes of water. The pH shall be adjusted using a pH meter to 7.4 with 0.1 N HCl or 0.1 N NaOH before use;

—ethylenediaminetetraacetic acid (EDTA), Sigma # ED2SS; and

—lysozyme, Boehringer Mannheim, #1 243004. Store at 2 to 8 °C (35 to 46 °F).

N-1.6 Safety precautions and hazards

N-1.6.1 Steam sterilized samples and equipment shall be handled with protective gloves when being removed from the autoclave.

N-1.6.2 Cryogenic culture vials shall be handled with cryoprotective gloves.

N-1.6.3 UV light shall be used to expose the organism during calibration. This light can result in skin cancer and retinal damage; hence personnel must be protected from exposure.

N-1.6.4 All microbiological samples and contaminated test supplies shall be steam sterilized to 121 ± 1 °C (250 ± 1 °F) at 15 psi for a minimum of 20 min prior to being discarded.

N-1.7 Growth medium

The quality of the growth media shall be monitored by examining growth promotion and sterility prior to use.

NOTE — Common bacteriological media may be purchased from bacteriological medium manufacturers and prepared according to the manufacturer's instructions.

N-1.7.1 Formula to be used for MS-2 or T1 coliphage

N-1.7.1.1 Tryptic soy broth (TSB)

Ingredient	Amount
tryptone	1.7 g
soytone	0.3 g
dextrose	0.25 g
sodium chloride	0.5 g
dipotassium phosphate	0.25 g
DI water	100 mL
pH	7.3 ± 0.2

TSB shall be dissolved by boiling and adjusted to final pH. 8 mL aliquots shall be dispensed into 16 × 150 mm test tubes. TSB shall be autoclaved at 121 ± 1 °C (250 ± 1 °F) at 15 psi for 20 min. Cooled broth shall be stored at 5 ± 1 °C (41 ± 1 °F).

N-1.7.1.2 1.5% Tryptic soy agar (TSA)

Ingredient	Amount
tryptone	7.5 g
soytone	2.5 g
sodium chloride	2.5 g
bacto-agar	7.5 g
DI water	500 mL
pH	7.3 ± 0.2

TSA shall be dissolved by boiling, adjusted to final pH, and autoclaved at 121 ± 1 °C (250 ± 1 °F) at 15 psi for 20 min. Tempered media shall be poured into sterile petri dishes. Agar plates shall be stored at 5 ± 1 °C (41 ± 1 °F). Plates shall be allowed to come to room temperature before use.

N-1.7.1.3 Phage top agar 1% TSA

Ingredient	Amount
tryptone	7.5 g
soytone	2.5 g
sodium chloride	2.5 g
agar	5.0 g
DI Water	500 mL
pH	7.3 ± 0.2

TSA shall be dissolved by boiling, adjusted to final pH, and autoclaved at 121 ± 1 °C (250 ± 1 °F) at 15 psi for 20 min. Agar shall be stored at 5 ± 3 °C (41 ± 1 °F). On the day of testing, the TSA shall be liquefied and placed in the 45 ± 1 °C (113 ± 1 °F) water bath. The MS-2 coliphage top agar shall be maintained at 45 ± 1 °C (113 ± 1 °F) to prevent agar solidification.

N-1.8 Culture of challenge organisms

N-1.8.1 MS-2 coliphage

N-1.8.1.1 Stock culture preparation of MS-2 coliphage

NOTE — This section describes the propagation and harvesting methods for stock suspensions of MS-2 coliphage for use as a challenge suspension for low flow (< 1 gpm) water treatment units. If units possessing a flow rate greater than 1 gpm are to be tested, the stock preparation procedure may have to be repeated multiple times to achieve the required volume of MS-2 coliphage. This method should also be repeated when cryogenic stocks are low.

a) One day prior to preparation of MS-2 Coliphage stock, a cryogenically frozen *E. coli* ATCC #15597 host strain shall be thawed. One TSB tube shall be inoculated with 0.1 mL of the stock suspension. The stock suspension shall be incubated at 35 ± 1°C (95 ± 1 °F) for 18 ± 2 h.

b) On the day of preparing MS-2 coliphage stock, 1% TSA shall be liquefied and the media shall be tempered in a 45 ± 1 °C (113 ± 1 °F) water bath. 1.5% TSA plates shall be room temperature prior to use.

c) Serial dilutions of MS-2 coliphage suspension (10^{-1} to 10^{-12}) shall be made using sterile PBS. 10^{-5} to 10^{-12} dilutions shall be plated in triplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted MS-2 coliphage shall be transferred. Then 0.1 mL of *E. coli* ATCC #15597 host shall be added quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates. The plates shall be rocked to spread inoculum evenly. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± 1 °F) for 18 ± 2 h.

d) Plates shall be selected that show complete lysis of host cells by the MS-2 coliphage. The surface of each plate shall be flooded with 3 mL of TSB. The 1% TSA layer shall be gently removed using a cell scraper. The contents shall be poured into two sterile 50 mL centrifuge tubes and the total volume brought to 40 mL with TSB. 0.2 g EDTA and 0.026 g lysozyme shall be added to each tube. The centrifuge tubes shall be incubated at room temperature for 2 h, mixing every 15 min.

e) After the 2 h incubation, the tubes shall be centrifuged at 9280 x g for 5 min, or 2320 x g for 20 min, at 20 ± 1 °C (68 ± 1 °F). The resulting supernatant shall be removed while avoiding the pellet. A sterile 47 mm filtration assembly shall be aseptically constructed using a 0.22 µm polycarbonate filter. The filter shall be pretreated with 10 mL of TSB just prior to the filtration to minimize MS-2 coliphage adsorption to the filter. The supernatant shall be filtered.

f) For long-term storage (greater than 28 d), $^1/_{10}$ volume of sterile glycerol shall be added to suspension, dispensed into 1 mL and 3 mL aliquots in cryovials, and stored at -70 ± 1 °C (-94 ± 1 °F).

g) The MS-2 coliphage suspension shall be titrated as in Section N-1.8.2.2. The concentration of MS-2 coliphage shall be 10^{10} to 10^{12} PFU/mL.

N-1.8.1.2 Enumeration of MS-2 Coliphage plaques

a) A cryogenically frozen *E. coli* ATCC #15597 host strain shall be thawed. One TSB tube shall be inoculated with 0.1 mL of the stock suspension. The TSB tube shall be incubated at 35 ± 1 °C (95 ± 1 °F) for 18 ± 2 h.

b) 1% TSA shall be liquefied and the media shall be tempered in a 45 ± 1 °C (113 ± 1 °F) water bath. 1.5% TSA plates shall be room temperature prior to use.

c) Serial dilutions of MS-2 coliphage suspension (10^{-1} to 10^{-12}) shall be made using sterile PBS. 10^{-7} to 10^{-12} dilutions shall be plated in triplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted MS-2 coliphage shall be transferred. Then 0.1 mL of *E. coli* ATCC #15597 host shall be added quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates. The plates shall be rocked to spread inoculum evenly. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± 1 °F) for 18 ± 2 h.

d) After incubation, plates containing 20 to 200 distinct PFU shall be enumerated using a Colony Counter. The MS-2 Coliphage suspension titer shall be calculated by multiplying the number of PFU obtained by the inverse of the dilution factor. The concentration of MS-2 coliphage shall be 10^{10} to 10^{12} PFU/mL.

N-1.8.2 T1 Coliphage

Stock culture preparation and enumeration of T1 coliphage shall be performed following the procedures in Section N-1.8.1, utilizing *E. coli* (ATCC #11303) as the host organism.

N-1.9 Drinking water treatment unit challenge organism suspension preparation

N-1.9.1 Determination of the concentration of challenge organism

This determination will be based upon the unit flow rates, injection feed pump rate, suspension density, and the final challenge organism concentration for the unit challenge. The suspension shall be of adequate volume to deliver the challenge organism to two complete on/off cycles at each sample point.

Example:

- unit flow rate: 1.0 gpm; duplicate units tested so total of 2.0 gpm (7560 mL/min);
- injection rate: 10 mL/min;
- suspension density: 1 × 109/mL;
- final concentration: 7.0 × 104/mL; and
- on/off cycle: 10 min / 10 min (20 min on for two complete cycles).

a) To challenge for 20 min at two 10 min intervals, a total of 200 mL of suspension is needed to challenge 151,200 mL of water (7560 min × 20 min):

- (7.0 × 104/mL)(151,200 mL) = (injection feed conc.)(200 mL); and
- injection feed concentration = 5.3 × 107/mL.

b) To prepare this from the stock suspension, combine:

- (200 mL)(5.3 × 107/mL) = (mL of suspension density)(1.0 × 109/mL);
- mL of suspension density = 10.6 mL; and
- 10.6 mL of suspension to 189.4 mL of PBS.

Once suspension has been made, the suspension shall be mixed using a magnetic stirrer. A 10 mL aliquot shall be removed from the challenge suspension and set aside for density verification according to *Standard Methods for the Examination of Water and Wastewater.*

N-1.10 Analysis of influent and effluent samples

N-1.10.1 Enumeration of MS-2 coliphage plaques

a) Serial dilutions of the influent and effluent samples (10^0 to 10^{-5}) shall be made using sterile PBS. 10^0 to 10^{-5} dilutions shall be plated in duplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted MS-2 coliphage shall be transferred. Then 0.1 mL of *E. coli* ATCC #15597 host shall be added quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates. The plates shall be rocked to spread inoculum evenly. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± 1 °F) for 18 ± 2 h.

b) After incubation, plates containing 20 to 200 distinct PFU shall be enumerated using a Colony Counter. The MS-2 coliphage suspension titer shall be calculated by multiplying the number of PFU obtained by the inverse of the dilution factor. Results shall be expressed as the number of PFU/mL.

N-1.10.2 Enumeration of T1 coliphage plaques

Enumeration of T1 Coliphage plaques shall be performed following the procedures in N-1.10.2, utilizing *E. coli* (ATCC #11303) as the host organism.

N-1.11 Challenge verification

After the appropriate incubation period for MS-2 coliphage or T1 coliphage the colonies shall be counted on all of the density determination plates. The mean number of microorganisms per milliliter for plates with 25 to 250 colonies / plaques shall be calculated. This shall verify that the challenge organism was present in the challenge test water at the optimum concentration before being added to test apparatus.

Normative Annex 2

Ultraviolet water treatment systems microbial reduction – Qβ procedures

N-2.1 Summary

Qβ coliphage is used as a biological surrogate for rotavirus to determine the effective UV dose output of UV water treatment systems. The methods that are used for suspension preparation, titration, and analysis of the challenge organisms for use in testing are presented in this Annex.

N-2.2 Equipment

- autoclave;
- incubator, 35 ± 1 °C (95 ± 2 °F);
- refrigerator, 5 ± 3 °C (41 ± 5 °F);
- water bath 50 ± 1 °C (122 ± 2 °F);
- freezer;
- microwave;
- vortex mixer;
- pH meter;
- hemocytometer;
- Colony Counter; and
- centrifuge.

N-2.3 Microorganisms

All organisms shall be obtained from ATCC.

- Qβ coliphage (ATCC #23631-B1); and
- *Escherichia coli* (ATCC #23631), host strain for Qβ.

N-2.4 Supplies

- sterile petri dishes, 20 × 60 mm and 15 × 100 mm;
- sterile pipettes, 1 mL and 10 mL;
- sterile centrifuge tubes, 10 mL and 50 mL;
- sample bottles, 125 mL sterile screw cap;
- test tubes, 16 × 125 mm;
- sterile inoculating loop;
- sterile filtration apparatus;
- sterile 0.22 µm polycarbonate membrane filters;
- Whatman #1 filter;
- chlorine detection kit; and
- disposable sterile 250 mL polypropylene container.

N-2.5 Reagents

- sterile buffered dilution water (SBDW). This shall be prepared according to *Standard Methods for the Examination of Water and Wastewater* (dilution water: buffered water);

— ethylenediaminetetraacetic acid (EDTA), Sigma # ED2SS; and

— lysozyme, Boehringer Mannheim, #1 243004. Store at 2 to 8 °C (36 to 46 °F).

N-2.5.1 Safety precautions and hazards

N-2.5.1.1 Steam sterilized samples and equipment shall be handled with protective gloves when being removed from the autoclave.

N-2.5.1.2 Cryogenic culture vials shall be handled with cryoprotective gloves.

N-2.5.1.3 All microbiological samples and contaminated test supplies shall be steam sterilized to 121 ± 1 °C (250 ± 2 °F) at 15 psi for a minimum of 20 min prior to being discarded.

N-2.6 Growth medium

The quality of the growth media shall be monitored by examining growth promotion and sterility prior to use.

NOTE — Common bacteriological media may be purchased from bacteriological medium manufacturers and prepared according to the manufacturer's instructions.

N-2.6.1 Formula to be used for Qβ coliphage

N-2.6.1.1 Tryptic soy broth (TSB)

Ingredient	Amount
tryptone	1.7 g
soytone	0.3 g
dextrose	0.25 g
sodium chloride	0.5 g
dipotassium phosphate	0.25 g
DI water	100 mL
pH	7.3 ± 0.2

TSB shall be dissolved by boiling and adjusted to final pH. 8 mL aliquots shall be dispensed into 16 × 150 mm test tubes. TSB shall be autoclaved at 121 ± 1 °C (250 ± 2 °F) at 15 psi for 20 min. Cooled broth shall be stored at 5 ± 3 °C (41 ± 5 °F).

N-2.6.1.2 1.5% Tryptic soy agar (TSA)

Ingredient	Amount
tryptone	7.5 g
soytone	2.5 g
sodium chloride	2.5 g
bacto-agar	7.5 g
DI water	500 mL
pH	7.3 ± 0.2

TSA shall be dissolved by boiling, adjusted to final pH, and autoclaved at 121 ± 1 °C (250 ± 2 °F) at 15 psi for 20 min. Tempered media shall be poured into sterile petri dishes. Agar plates shall be stored at 5 ± 3 °C (41 ± 5 °F). Plates shall be allowed to come to room temperature before use.

N-2.6.1.3 Phage top agar 1% TSA

Ingredient	Amount
tryptone	7.5 g
soytone	2.5 g
sodium chloride	2.5 g
agar	5.0 g
DI Water	500 mL
pH	7.3 ± 0.2

TSA shall be dissolved by boiling, adjusted to final pH, and autoclaved at 121 ± 1 °C (250 ± 2 °F) at 15 psi for 20 min. Agar shall be stored at 5 ± 3 °C (41 ± 5 °F). On the day of testing, the TSA shall be liquefied and placed in the 45 ± 1 °C (113 ± 2 °F) water bath. The Qβ coliphage top agar shall be maintained at 45 ± 1 °C (113 ± 2 °F) to prevent agar solidification.

N-2.7 Culture of challenge organisms

N-2.7.1 Qβ coliphage

N-2.7.1.1 Stock culture preparation of Qβ coliphage

NOTE — This section describes the propagation and harvesting methods for stock suspensions of Qβ coliphage for use as a challenge suspension for low flow (< 1 gpm) water treatment units. If units possessing a flow rate greater than 1 gpm are to be tested, the stock preparation procedure may have to be repeated multiple times to achieve the required volume of Qβ coliphage. This method should also be repeated when cryogenic stocks are low.

a) One day prior to preparation of Qβ Coliphage stock, a cryogenically frozen *E. coli* ATCC #23631 host strain shall be thawed. One TSB tube shall be inoculated with 0.1 mL of the stock suspension. The stock suspension shall be incubated at 35 ± 1 °C (95 ± 2 °F) for 18 ± 2 h.

b) On the day of preparing Qβ coliphage stock, 1% TSA shall be liquefied and the media shall be tempered in a 45 ± 1 °C (113 ± 2 °F) water bath. 1.5% TSA plates shall be room temperature prior to use.

c) Serial dilutions of Qβ coliphage suspension (10^{-1} to 10^{-12}) shall be made using SBDW. 10^{-5} to 10^{-12} dilutions shall be plated in triplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted Qβ coliphage shall be transferred. Then 0.1 mL of *E. coli* ATCC #23631 host shall be added quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates. The plates shall be rocked to spread inoculum evenly. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± 2 °F) for 18 ± 2 h.

d) Plates shall be selected that show complete lysis of host cells by the Qβ coliphage. The surface of each plate shall be flooded with 3 mL of TSB. The 1% TSA layer shall be gently removed using a cell scraper. The contents shall be poured into two sterile 50 mL centrifuge tubes and the total volume brought to 40 mL with TSB. 0.2 g EDTA and 0.026 g lysozyme shall be added to each tube. The centrifuge tubes shall be incubated at room temperature for 2 h, mixing every 15 min.

e) After the 2 h incubation, the tubes shall be centrifuged at 9280 x g for 5 min, or 2320 x g for 20 min, at 20 ± 1 °C (68 ± 2 °F). The resulting supernatant shall be removed while avoiding the pellet. A sterile 47 mm filtration assembly shall be aseptically constructed using a 0.22 µm polycarbonate filter. The filter shall be pretreated with 10 mL of TSB just prior to the filtration to minimize Qβ coliphage adsorption to the filter. The supernatant shall be filtered.

f) For long-term storage (greater than 28 d), $^1/_{10}$ volume of sterile glycerol shall be added to suspension, dispensed into 1 mL and 3 mL aliquots in cryovials, and stored at -70 ± 1 °C (-94 ± 2 °F).

g) The Qβ coliphage suspension shall be titrated as in Section N-1.8.2.2. The concentration of Qβ coliphage shall be 10^{10} to 10^{12} PFU/mL.

N-2.7.1.2 Enumeration of Qβ Coliphage plaques

a) A cryogenically frozen *E. coli* ATCC #23631 host strain shall be thawed. One TSB tube shall be inoculated with 0.1 mL of the stock suspension. The TSB tube shall be incubated at 35 ± 1 °C (95 ± 2 °F) for 18 ± 2 h.

b) 1% TSA shall be liquefied and the media shall be tempered in a 45 ± 1 °C (113 ± 2 °F) water bath. 1.5% TSA plates shall be room temperature prior to use.

c) Serial dilutions of Qβ coliphage suspension (10^{-1} to 10^{-12}) shall be made using sterile SBDW. 10^{-7} to 10^{-12} dilutions shall be plated in triplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted Qβ coliphage shall be transferred. Then 0.1 mL of *E. coli* ATCC #23631 host shall be added quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates. The plates shall be rocked to spread inoculum evenly. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± 2 °F) for 18 ± 2 h.

d) After incubation, plates containing 30 to 300 distinct PFU shall be enumerated using a Colony Counter. The Qβ Coliphage suspension titer shall be calculated by multiplying the number of PFU obtained by the inverse of the dilution factor. The concentration of Qβ coliphage shall be 10^{10} to 10^{12} PFU/mL.

N-2.8 Drinking water treatment unit challenge organism suspension preparation

N-2.8.1 Determination of the concentration of challenge organism

This determination will be based upon the unit flow rates, injection feed pump rate, suspension density, and the final challenge organism concentration for the unit challenge. The suspension shall be of adequate volume to deliver the challenge organism to two complete on/off cycles at each sample point (see Section 7.3).

Example:

- unit flow rate: 1.0 gpm; duplicate units tested so total of 2.0 gpm (7560 mL/min);
- injection rate: 10 mL/min;
- suspension density: 1×10^9/mL;
- final concentration: 7.0×10^4/mL; and
- on/off cycle: 10 min / 10 min (20 min on for two complete cycles).

a) To challenge for 20 min at two 10 min intervals, a total of 200 mL of suspension is needed to challenge 151,200 mL of water (7560 min × 20 min):

- $(7.0 \times 10^4$/mL)(151,200 mL) = (injection feed conc.)(200 mL); and
- injection feed concentration = 5.3×10^7/mL.

b) To prepare this from the stock suspension, combine:

- (200 mL)$(5.3 \times 10^7$/mL) = (mL of suspension density)$(1.0 \times 10^9$/mL);
- mL of suspension density = 10.6 mL; and
- 10.6 mL of suspension to 189 mL of SBDW.

Once suspension has been made, the suspension shall be mixed using a magnetic stirrer. A 10 mL aliquot shall be removed from the challenge suspension and set aside for density verification according to *Standard Methods for the Examination of Water and Wastewater.*

N-2.9 Analysis of influent and effluent samples

N-2.9.1 Enumeration of Qβ coliphage plaques

a) Pipette sample volumes and dilutions that will yield from 30 to 300 PFU per plate. Serial dilutions of the influent and effluent samples (10^0 to 10^{-5}) shall be made using sterile SBDW. 10^0 to 10^{-5} dilutions shall be plated in duplicate on 1.5% TSA plates. In a sterile tube, 1 mL of diluted Qβ coliphage shall be transferred. Then 0.1 mL of *E. coli* ATCC #23631 host shall be added quickly to ~ 5 mL of melted 1% TSA. The inoculum and media shall be vortexed and poured on TSA plates. The plates shall be rocked to spread inoculum evenly. After the 1% TSA layer has solidified, the plates shall be inverted and incubated at 35 ± 1 °C (95 ± 2 °F) for 18 ± 2 h.

b) After incubation, plates shall be enumerated using a Colony Counter. The sample result shall be calculated from plates containing 30 to 300 distinct PFU. If there are no plates with 30 to 300 PFU, calculate the sample result from the lowest dilution plates. The Qβ coliphage suspension titer shall be calculated by multiplying the number of PFU obtained by the inverse of the dilution factor. Results shall be expressed as the number of PFU/mL.

N-2.10 Challenge verification

After the appropriate incubation period for Qβ coliphage the colonies shall be counted on all of the density determination plates. The mean number of microorganisms per milliliter for plates with 30 to 300 colonies / plaques shall be calculated. This shall verify that the challenge organism was present in the challenge test water at the optimum concentration before being added to test apparatus.

Informative Annex 1

Key elements of a certification program for drinking water treatment systems and components

The information contained in this Annex is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. Therefore, this Annex may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

A certification program for drinking water treatment systems and components shall contain the following program elements:

I-1.1 Marking the product

Requirements for product marking including:

— certified systems shall bear a registered trademark of the certifying organization;

— certified components intended to be used with other components to make a complete functional system, as defined by NSF/ANSI 55, shall bear a component mark;

— each system shall have a model designation; and

— each system shall bear a statement of claims verified through the certifying organization and substantiated by test data.

I-1.2 Listing certified companies

A published listing of all certified systems and components. The listing format shall include at least the following information:

— company name and address;
— product description;
— trademark / model designation;
— flow rate;
— rated capacity or service cycle; and
— each substance reduction claim that has been successfully evaluated and is supported by test data.

I-1.3 Annual audits

Actual physical audits of all facilities and production locations of the certified company at least annually.

I-1.4 Testing

Testing in accordance with all applicable NSF/ANSI 55 requirements prior to certification, and a retest program that includes reevaluation and retesting at least once every five years.

I-1.5 Toxicological evaluation of materials formulations

Formulation information of each material used in the fabrication of the system, or components, or both, shall be provided to and maintained on file by the certifying organization. The formulation information shall include, at a minimum:

- the complete chemical identity or proportion by weight;
- ingredient sources of supply;
- documentation regarding the health effects concern of each ingredient in the material; and
- documentation regarding the suitability of each ingredient for use in potable water contact material.

I-1.6 Corrective action

Corrective action for all items of noncompliance found during audits and reevaluation including:

- provisions for review and authorization for modifications to designs;
- modifications to certified system, or components, or both; and
- documentation and authorization of the modification maintained on file.

I-1.7 Enforcement

To preserve the integrity of the registered trademark of the certifying organization and protect public health, enforcement action shall be taken by the certifier for the following:

- use of the registered trademark of the certifying organization on a noncertified product;
- general noncompliance;
- unauthorized change to a certified product;
- unauthorized shipment or disposal of product placed on hold; and
- bribes.

I-1.8 Administrative review

Provisions for an administrative review as requested by any party directly affected by a decision or action of the certifier.

I-1.9 Appeals

Provisions for an appeals process as requested by any party directly affected by a decision or action of the certifier resulting from an administrative review.

I-1.10 Complaints

Provisions for investigation of complaints related to certified products, misuse of the registered trademark of the certifying organization by a certified company, or use / misuse of the registered trademark of the certifying organization by a noncertified company:

- certified company retention and disclosure of complaint records and remedial actions for certified products.

I-1.11 Advertising

Requirement of proper use of the registered trademark of the certifying organization on sales literature, technical publications, promotional materials, packaging, catalogs, and advertising.

I-1.12 Records

Provisions for verification of complete certified company records, including:

- installation and service for fabricators and distributors;
- purchased materials and components; and
- production, shipment, and inventory.

I-1.13 Public notice

Provisions for issuing a public notice for noncompliance with any requirement of certification.

I-1.14 Confidentiality

A strict policy of nondisclosure of any confidential information supplied to the certifier by the company regarding the product, including formulations, components, processes, ingredients, and the identity of the company's suppliers and distributors.

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Informative Annex 2

The information contained in this Annex is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. Therefore, this Annex may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to this Standard.

US EPA Method 625 is a GC/MS method developed in the early 1980s for analysis of surface water samples for toxic chemical contamination from industrial discharges. In the early to mid 1970s, the Agency was charged by Congress with the protection of the country's waterways from chemical contamination. In response to this mandate, the Agency developed a list of 65 chemicals and chemical classes. This original list was subdivided into 129 specific chemicals which shortly gained the moniker of the "priority pollutants". US EPA Method 625 was developed as part of this effort. A large part of the list were semivolatile organic chemicals. The "priority pollutants" which the technique was developed, ranged from chlorinated phenols (chloro, di-, tri-, and penta- chlorinated), nitrophenols (mono and di), nitrosoamines (dimethyl, dipropyl, dibutyl, and diphenyl), and aromatics. Further, the method has been demonstrated (by the US EPA) to be appropriate for pesticides, PCBs, and aromatic amines (benzidine and dichorobenzidine).

The use of GC/MS shall be understood as application of state of the art technology at that junction in time. GC/MS, in the late 1970s and early 1980s was an instrument of research typically costing in excess of $200,000; today, this is roughly equivalent to $500,000. It shall then be understood that the method was not "only" a wastewater procedure, but a technique employed for general applicability to surface waters for the analysis of a broad range of toxic organic chemicals.

For application of this method to NSF/ANSI DWTU applications, it is incumbent on the laboratory to demonstrate expertise in the technique through the analysis of method validation studies demonstrating capability to generate data of known and legally defensible quality. Further, as part of the Standard, MCLs are established to ensure public safety for the chemicals of concern. The laboratory must, through its validation studies have demonstrated capability to meet this sensitivity requirement.

This technique includes that capability to perform identification of unknown compounds detected in the 625 analysis as well as an estimation of concentration. This is performed through the use of spectral identification programs versus mass spectral libraries compiled by the National Institute of Science and Technology (NIST). This library exceeds 100,000 spectra of different organic chemicals. The concentration estimation is done in accordance with US EPA established protocol as part of (and not solely exclusive to) its Contract Laboratory Program. This program was initiated in 1980 for the analysis of environmental samples (soil, water, and hazardous materials). Due to the nature of this work, all data was required to be legally defensible in a court of law. Though the concentrations are estimated, this is performed following a standardized protocol allowing data users to understand the likely range of concentration of the analyte and request quantitative analysis of any particular chemical if necessary.

This Standard does allow alternative analytical techniques to be developed and employed by the analytical laboratory, particularly in those cases where the formulation would indicate chemical constituents or byproducts not amenable to Methods 524.2 and 625. Most notably would be HPLC, HPLC/MS, and triple quadrupole techniques.

US EPA Methods 524.2 and 625, though applicable to a wide range of chemicals, compounds that are thermally labile or highly polar may not chromatograph at all (by GC) or too poorly to be a reliable technique. When faced with this situation, alternative techniques may be utilized to generate the necessary data. HPLC and HPLC/MS (an HPLC with a mass spectrometer as the detector rather than a typical HPLC detector) compliment well the referenced GC/MS techniques. Where GC/MS is most applicable to relatively smaller compounds (typically below a molecular weight of 500 but may be extended up to around 700 to 800) of neutral to intermediate polarities, HPLC and HPLC/MS lends itself well to more polar compounds and those of greater molecular weight. Also, generally speaking, GC/MS systems are capable of greater resolution than HPLC and HPLC/MS (though recent advances in HPLC column technology have diminished this

differential). This is particularly important for samples with more complex chromatograms (more individual chemicals leached). Examples of chemicals particularly suited to HPLC and HPLC/MS would be carbamic acids, organic diacids, and compounds with mixed, opposing functional groups such as amino carboxylic acids (such as aminodecanoic acid).

When a reference is made to GC/MS and HPLC/MS it does not specify the type of mass-spectrometer coupled with the GC or HPLC. However, there can be significant advantages analytically to be gained here also. Typically, these instruments are single quadrupole "low-resolution" instruments. For instance, regardless if the system is a GC/MS or HPLC/MS, when the mass-spectrometer measures the mass of the ions from a compound, with a "low-resolution" instrument, they are typically capable of mass accuracy to $^{1}/_{10}$ of an AMU. When the atomic weight of an isotope of an element is obtained, it is discovered that rather than being whole numbers (except for carbon, whose primary isotope at "12" is used as the reference for the other elements) they all have some fractional component. For instance, chlorine whose primary isotope is typically considered to have a mass of 35 AMU (or Daltons) is actually 34.96885 AMU. Now if the mass spectrometer is capable of greater mass resolution (a high resolution mass spectrometer) advantage can be taken of these small differences in mass of the elements. With this approach, if an unknown peak is present in the GC/MS or HPLC/MS analysis, if the molecular ion (the ion representing the intact molecule versus the fragment ions) can be identified, then the chemical formula of the peak of interest (or at minimum a fairly short list of possibilities) can be calculated. This information can then be used to add certainty to a library search match, or give the toxicologist at least chemical formula information when a peak does not give good library search information.

A final technique which has seen application in the screening of foods, particularly fruits and vegetables, for pesticides, is directly aspirating an aqueous sample into a triple quadrupole system. This approach utilizes the initial quadrupole to control which molecular ions are transmitted through to the rest of the instrument, where it is fragmented and identified. Though this technique cannot distinguish isomers, it has the advantage of avoiding the problem of potential chromatography issues.

Interpretation Annex

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Section of the Standard for interpretation:

1.2.2 Class B systems or components

Class B POE and POU systems covered by this Standard are designed for supplemental bactericidal treatment of disinfected public drinking water or other drinking water that has been tested and deemed acceptable for human consumption by the state or local health agency having jurisdiction. The system is designed to reduce normally occurring nonpathogenic nuisance microorganisms only. The Class B system is not intended for the disinfection of microbiologically unsafe water and may not make individual or general cyst claims. Class B systems shall not make microbiological health effects claims.

Requestor's interpretation of the Standard:

NSF understands the scope of NSF/ANSI 42, 44, 53, 58, 401 and 55 Class B systems to include point-of-use, or point-of-entry systems, or both, that are designed to reduce specific contaminants from public or private drinking water supplies that are considered to be microbiologically safe and of known quality. Standard 55 Class B specifically excludes the use of these class systems for any microbiological health claim, which includes disinfection.

Atmospheric generators that are designed to condense water vapor from the atmosphere to produce drinking water are excluded from the scope of NSF/ANSI Standards 42, 44, 53, 58, 401 and 55 Class B systems for the following reasons:

1) These product types use a water source that is not microbiologically safe and of known quality. The use of atmospheric water as a water source meets the definition of a microbiologically unsafe water. The definition of microbiologically safe and unsafe water are defined in NSF/ANSI 330 and reads as follows:

> **3.182.8 microbiologically safe water:** Drinking water deemed acceptable for human consumption by a health or regulatory agency having jurisdiction.
>
> **3.182.9 microbiologically unsafe water:** Water that (1) is known to contain disease causing bacteria, viruses, protozoa or other disease-causing microbiological agents or, (2) shows a positive test for an indicator organism, or (3) is determined unsafe by a health or regulatory agency having jurisdiction or, (4) has not been shown to meet appropriate health agency microbiological guidelines.
>
> Water vapor condensed from the atmosphere is known to contain disease causing organisms. It has been clearly demonstrated that during condensation any contaminants that are airborne are present within the condensed water. This includes microorganisms that may be on particulate or within droplets in the atmosphere. This results in a water source that is known to be microbiologically unsafe. Therefore atmospheric condensed water meets the criteria for microbiologically unsafe water and cannot be considered a microbiologically safe water source.

2) These product types are not designed to reduce contaminants from a public or private drinking water supply as required in the standards:

A public drinking water supply as defined by the Safe Drinking Water Act (SDWA) is a public water system having at least 15 service connections or serves at least 25 people for at least 60 days per year.

A private drinking water supply is defined as a private ground water residential well, cistern, and larger private water systems having no more than 15 service connections or serves no more than 25 people for at least 60 days per year.

The water supply that is being used is water condensed from the atmosphere and is not recognized as a public or private drinking water supply.

Interpretation decision:

I concur that atmospheric generator products are excluded from the scope of NSF/ANSI 42, 44, 53, 55 (Class B), 58, and 401 as they are not treating water from a public or private drinking water supply of microbiologically safe and of known quality, per section 1.2 of these Standards:

"The point-of-use and point-of-entry systems addressed by this Standard are designed to be used for the reduction of specific substances that may be present in drinking water (public or private) considered to be microbiologically safe and of known quality."

Devices designed for treatment of nonpotable water or nonpotable water sources may be addressed under other standards or protocols.

Robert W. Powitz, PhD, MPH, RS, DLAAS
Chair, Joint Committee on Drinking Water Treatment Units

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Standards[14]

The following Standards established and adopted by NSF as minimum voluntary consensus Standards are used internationally:

Std. #	Standard title
2	Food Equipment
3	Commercial Warewashing Equipment
4	Commercial Cooking, Rethermalization, and Powered Hot Food Holding and Transport Equipment
5	Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
6	Dispensing Freezers
7	Commercial Refrigerators and Freezers
8	Commercial Powered Food Preparation Equipment
12	Automatic Ice Making Equipment
13	Refuse Processors and Processing Systems
14	Plastics Piping System Components and Related Materials
18	Manual Food and Beverage Dispensing Equipment
20	Commercial Bulk Milk Dispensing Equipment
21	Thermoplastic Refuse Containers
24	Plumbing System Components for Recreational Vehicles
25	Vending Machines for Food And Beverages
29	Detergent and Chemical Feeders for Commercial Spray-Type Dishwashing Machines
35	High Pressure Decorative Laminates (HPDL) for Surfacing Food Service Equipment
37	Air Curtains for Entranceways in Food and Food Service Establishments
40	Residential Wastewater Treatment Systems
41	Non-liquid Saturated Treatment Systems
42	Drinking Water Treatment Units – Aesthetic Effects
44	Residential Cation Exchange Water Softeners
46	Evaluation of Components and Devices Used in Wastewater Treatment Systems
49	Biosafety Cabinetry – Design, Construction, Performance, and Field Certification
50	Equipment for Swimming Pools, Spas, Hot Tubs, and Other Recreational Water Facilities
51	Food Equipment Materials
52	Supplemental Flooring
53	Drinking Water Treatment Units – Health Effects
55	Ultraviolet Microbiological Water Treatment Systems
58	Reverse Osmosis Drinking Water Treatment Systems
59	Mobile Food Carts
60	Drinking Water Treatment Chemicals – Health Effects
61	Drinking Water System Components – Health Effects
62	Drinking Water Distillation Systems
140	Sustainable Carpet Assessment
169	Special Purpose Food Equipment and Devices
170	Glossary of Food Equipment Terminology
173	Dietary Supplements
177	Shower Filtration Systems – Aesthetic Effects

[14] The information contained in this list of Standards is not part of this American National Standard (ANS) and has not been processed in accordance with ANSI's requirements for an ANS. Therefore, this Standards page may contain material that has not been subjected to public review or a consensus process. In addition, it does not contain requirements necessary for conformance to the Standard.

Std. #	Standard title
184	Residential Dishwashers
223	Conformity Assessment Requirements for Certification Bodies that Certify Products Pursuant to NSF/ANSI 60 Drinking Water Treatment Chemicals – Health Effects
240	Drainfield Trench Product Sizing for Gravity Dispersal Onsite Wastewater Treatment and Dispersal Systems
244	Drinking Water Treatment Units Supplemental Microbiological Water Treatment Systems – Filtration
245	Wastewater Treatment Systems – Nitrogen Reduction
305	Personal Care Products Containing Organic Ingredients
321	Goldenseal Root (*Hydrastis canadensis*)
330	Glossary of Drinking Water Treatment Unit Terminology
332	Sustainability Assessment for Resilient Floor Coverings
336	Sustainability Assessment for Commercial Furnishings Fabric
342	Sustainability Assessment for Wallcovering Products
347	Sustainability Assessment for Single-Ply Roofing Membranes
350	Onsite Residential and Commercial Water Reuse Treatment Systems
350-1	Onsite Residential and Commercial Greywater Treatment Systems for Subsurface Discharge
358-1	Polyethylene Pipe and Fittings for Water-Based Ground-Source “Geothermal” Heat Pump Systems
358-2	Polypropylene Pipe and Fittings for Water-Based Ground-Source “Geothermal” Heat Pump Systems
358-3	Cross-linked Polyethylene (PEX) Pipe and Fittings for Water-based Ground-Source (Geothermal) Heat Pump Systems
358-4	Polyethylene of Raised Temperature (PE-RT) Tubing and Fittings for Water-based Ground-Source (Geothermal) Heat Pump Systems
359	Valves for Cross-linked Polyethylene (PEX) Water Distribution Tubing Systems
360	Wastewater Treatment Systems – Field Performance Verification
363	Good Manufacturing Practices (GMP) for Pharmaceutical Excipients
372	Drinking Water Treatment System Components – Lead Content
375	Sustainability Assessment for Water Contact Products
385	Disinfection Mechanics
401	Drinking Water Treatment Units – Emerging Compounds / Incidental Contaminants
416	Sustainability Assessment for Water Treatment Chemical Products
418	Effluent Filters – Field Longevity Testing
419	Public Drinking Water Equipment Performance – Filtration
426	Environmental Leadership and Corporate Social Responsibility Assessment of Servers
455-1	Terminology for the NSF 455 Portfolio of Standards
455-2	Good Manufacturing Practices for Dietary Supplements
455-3	Good Manufacturing Practices for Cosmetics
455-4	Good Manufacturing Practices for Over-the-Counter Drugs
457	Sustainability Leadership Standard for Photovoltaic Modules and Photovoltaic Inverters
600	Health Effects Evaluation and Criteria for Chemicals in Drinking Water
14159-1	Hygiene Requirements for the Design of Meat and Poultry Processing Equipment
14159-2	Hygiene Requirements for the Design of Hand-held Tools Used in Meat and Poultry Processing Equipment
14159-3	Hygiene Requirements for the Design of Mechanical Belt Conveyors Used in Meat and Poultry Processing Equipment

***THE HOPE OF MANKIND** rests in the ability of man to define and seek out the environment which will permit him to live with fellow creatures of the earth, in health, in peace, and in mutual respect.*

NSF/ANSI Standard for Drinking Water Treatment Units –

Ultraviolet Microbiological Water Treatment Units

1 General

1.1 Purpose

The purpose of this Standard is to establish minimum requirements for the reduction of microorganisms using ultraviolet (UV) radiation. UV water treatment systems covered by this Standard are intended for water that may be either microbiologically safe or microbiologically unsafe. This Standard also specifies the minimum product literature and labeling information that a manufacturer shall supply to authorized representatives and system owners, as well as the minimum service-related obligations that the manufacturer shall extend to system owners.

1.2 Scope

This Standard covers UV microbiological water treatment systems and components for point-of-use (POU) and point-of-entry (POE) applications. This Standard covers systems which use UV radiation within the range of 240 nm to 300 nm inclusive. Systems are intended to be used under the following specific conditions.

1.2.1 Class A systems

Class A POE and POU systems covered by this Standard are designed to be used for treating microbiologically unsafe water, but do not reduce chemical or inert particulate contaminants. Systems covered in this Standard are designed to inactivate microorganisms, including bacteria, viruses, *Cryptosporidium* oocysts, and *Giardia* cysts, from water. Systems covered by this Standard are not intended for the treatment of water that has an obvious contamination or intentional source, such as raw sewage, nor are systems intended to convert wastewater to drinking water. The systems are intended to be installed on visually clear water (not colored, cloudy, or turbid). Systems with manufacturer claims that include components or functions covered under other NSF or NSF/ANSI Standards or Criteria shall conform to the applicable requirements therein.

Class A systems not installed downstream of a device tested for cyst reduction / inactivation in conformance to the appropriate NSF/ANSI Standard may claim *Cryptosporidium* oocysts and *Giardia* cysts only. Class A systems installed downstream of a device tested for cyst reduction in conformance to NSF/ANSI 53 or NSF/ANSI 58 may make a general cyst claim when used on untreated surface waters, or ground water, or both, under the direct influence of surface water.

> NOTE — Current data support that *Cryptosporidium* oocysts and *Giardia* cysts are inactivated by UV treatment.

1.2.2 Class B systems or components

Class B POE and POU systems covered by this Standard are designed to be used for supplemental bactericidal treatment for the inactivation of microorganisms that may be present in drinking water (public or private) considered to be microbiologically safe and of known quality. Systems covered under this Standard are intended to inactivate normally occurring nonpathogenic nuisance microorganisms only.

ת"י 1505 חלק 1.3 - מערכות אולטרא סגולות (UV) לטיפול מיקרוביאלי במים
טבלת השינויים לאימוץ NSF 55 משנת 2019

מהדורת התקן הישראלי, אליו מתייחסת הטבלה נובמבר 2020
תאריך הכנת הטבלה: 01.12.2020

פירוט השינויים			נימוקים לשינויים לאומיים מתחייבים לפי חוק התקנים						סנכרון בין מסלולים			אינו שינוי		שינויים שאינם מתחייבים לפי חוק התקנים		מלצות ועדה לגבי הכרזת רישמיות על השינוי הלא מתח		הערות אגף התקינה	ועדת האימוץ			
מס' הסעיף בתקן הישראלי	שם הסעיף בתקן הישראלי	מהות השינוי בתקן הישראלי	קריטריון מס' 1 התאמה לשפה ובכלל זה התאמה של הוראות הפעלה,הוראותסימון,אזהרות,או הוראות אחרות הקבועות בתקן בינל' או מסמך מחייב של גורם בינל'	קריטריון מס' 2 דרישות הנגזרות מהוראות חיקוק בישראל והפניות להוראות כאמור	קריטריון מס' 3 התאמת הפניות לחקיקה של מדינת חוץ או למסמך מחייב של גורם בינל' או לדרישה המופיעה בחקיקה או במסמך מחייב	קריטריון מס' 4 הפנייה לתקנים בינל'אחרים או לחלקים בהם, ובלבד שההפנייה היא לתקן הבינל' עצמו או שהתקן הבינל' אומץ כלשונו, או בשינויים מתחייבים על פי החוק או בשינויים לאומיים מיוחדים שאושרו ע"י השרים	הקלה על פי החוק (סעיף 8 ה 4)		הנימוק לבחירת מסלול זה	הקלה	החמרה	יישום דרישת התקן המאומץ	המלצה/ הבהרה	נימוקים	האם סעיף "ואקום"?	בעד	נגד		סוג השינוי	החלטה	נימוקים	הערות
							לעומת התקן המאומץ	לעומת התקן הישראלי הקיים														
1.1	מטרה	השמטה ההתייחסות ל- microbiologically unsafe water מסעיף המטרה. מים אלו אינם מתאימים לתקנות בריאות העם (איכותם התברואית של מי שתיה ומיתקני מי שתיה)												בהתאם לבקשת משרד הבריאות	לא							
1.2	חלות	הוסף בחלות שהתקן אינו חל על מערכות לטיפול במי שתייה במערכת אספקת מים כהגדרתה בתקנות בריאות העם											+									
		הוסרה ההתיחסות בתקן למערכות המיועדות לטיפול במים שאינם בטוחים לשתיה מבחינה מיקרוביולוגית (מערכות מסוג A). מים אלו אינם מתאימים לתקנות בריאות העם (איכותם התברואית של מי שתיה ומיתקני מי שתיה)												בהתאם לבקשת משרד הבריאות	לא							
1.2.2	חלות	הוסף בחלות שהתקן חל אך ורק על מערכות לטיפול המיועדות לטיפול במי שתיה המתאימים לתקנות בריאות העם (איכותם התברואית של מי שתייה ומיתקני מי שתיה)		+																		
		הוסף בחלות שמערכות בעלות רכיבים הנדונים בתקנים ישראליים אחרים יעמדו בדרישות החלות על רכיבים אלה											התוספת להבהרה הינה עבור רכיבים הנדונים גם בתקנים ישראליים אחרים (ולא רק בתקני NSF אחרים, כפי שנכתב בתקן ה- NSF), עליהם חלות דרישות									
2	Normative References	ההפניה לתקן NSF 53 הוחלפה בהפניה לתקן הישראלי ת"י 1505 חלק 1.2 מערכות לטיפול במי שתייה השפעות אסתטיות		+																		
		ההפניה לתקן NSF 58 הוחלפה בהפניה לתקן הישראלי ת"י 1505 חלק 2 מערכות לטיפול במי שתייה: מערכות אוסמוזה הפוכה		+																		
		ההפניה לתקן NSF 61 הוחלפה בהפניה לתקן הישראלי ת"י 5452 למוצרים הבאים במגע עם מי שתיה		+																		
		הוספה הפנייה לתקן הישראלי הרשמי ת"י 900 חלק 2.15 לבטיחות מכשירי חשמל ביתיים- דרישות מיוחדות למכשירים לחימום נוזלים.		+																		
		הוספה הפנייה לתקנות בריאות העם (איכותם התברואית של מי-שתיה ומיתקני מי שתיה), התשע"ג-2013, על עדכוניהן		+																		
		הוספה הערה לאומית שהתקן אינו חל על מערכות המיועדות לטיפול במים שאינם בטוחים לשתיה מבחינה מיקרוביולוגית (מערכות מסוג A). מים אלו אינם מתאימים לתקנות בריאות העם (איכותם התברואית של מי שתיה ומיתקני מי שתיה)												בהתאם לבקשת משרד הבריאות	לא							
6.13	בטיחות חשמל	הוסף סעיף בטיחות בחשמל ובו דרישות עבור מערכות הניזונות מרשת החשמל. עבור מוצרים אלו הוסף שהמערכת תיבדק ותתאים לדרישות בטיחות בחשמל בהתאם לתקן הישראלי ת"י 900 חלק 2.15 לבטיחות מכשירי חשמל ביתיים- דרישות מיוחדות למכשירים לחימום נוזלים.		+																		
7.2.2.1, 7.2.2.8.2.1, 7.3.1.1 , 7.3.1.8.2.1	Class A system	הדרישות המפורטות עבור מערכות מסוג A המיועדות לטיפול במים שאינם בטוחים לשתיה מבחינה מיקרוביאלית, אינן חלות.																				
8	Instruction and information	סעיף הסימון חל בתרגומו לעברית	+																			
		דרישות הסימון עבור מערכות מסוג A אינן חלות												בהתאם לבקשת משרד הבריאות	לא							
8.1.1, 8.2.1, 8.3.1,		בדרישה לסימון שם היצרן ומענו הוסף, בהתאם לצו הגהת הצרכן, שאם המוצר מיובא מסמנים את שם היבואן ומענו		התאמה לצו הגנת הצרכן (סימון טובין)																		
8.1.1, 8.1.2, 8.2.1, 8.4.1, 8.4.2,		השמטה הדרישה לסימון יחידות אמריקאיות עבור ספיקת המים וטמפרטורה					+															

8.1.1, 8.1.2, 8.2.1, 8.4.1, 8.4.2		הדרישה לסימון יחידות הלחץ ב- kPa (psig) הוחלפה בדרישה לסימון יחידות הלחץ ב- Bar	+																			
8.1.1		הוספה דרישת סימון לפיה יש לחבר את המערכת למים המתאימים לתקנות בריאות העם (איכותם התברואית של מי שתייה ומיתקני מי שתייה)		+																		
,8.1.2 ,8.3.2 ,8.4.1		הוספה המלצה לסימון אורך החיים ביחידות של זמן											*									
8.1.1, 8.2.1, 8.4.1,		הושמטו הדרישות להצהיר שהמערכת עומדת בדרישות תקן NSF 55		התאמה לחוק התקנים התאמה לחוק התקנים: "אסור לאדם לסמן מצרך באופן העלול לעורר את הרושם כי המצרך מתאים לתקן או לתקן רשמי פרט לסימון בחוק בתו תקן". כלומר, סימון מספרו של תקן על גבי המוצר עלול להטעות את הציבור שלאותו מוצר יש בהכרח תו תקן. תו תקן הנו וולונטרי. בחו"ל מס' התקן מזוהה עם יעוד המוצר. בארץ לא ניתן לרשום את מס' התקן.																	