STD.NEMA LL 1-ENGL 1997 ■ 6470247 0513432 734 ■

NEMA STANDARDS PUBLICATION

NEMA LL 1

PROCEDURES FOR LINEAR FLUORESCENT LAMP SAMPLE PREPARATION AND THE TCLP



NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

NEMA Standards Publication LL 1-1997

PROCEDURES FOR LINEAR FLUORESCENT LAMP SAMPLE PREPARATION AND THE TCLP

Published by

National Electrical Manufacturers Association
1300 North 17th Street
Rosslyn, VA 22209

© Copyright 1998 by the National Electrical Manufacturers Association. All rights including translation into other languages, reserved under the Universal Copyright Convention, the Berne Convention for the Protection of Literary and Artistic Works, and the International and Pan American Copyright Conventions.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Contents

Page

Foreword ii

Clause

Section 1 GENERAL 1
1.1 Scope 1
1.2 References 1
1.3 Definitions 1
Section 2 GENERAL REQUIREMENTS 3
Section 3 LAMP PREPARATION 5
Section 4 LEACHING 9
Section 5 FILTRATION 11
Section 6 STORAGE OF THE LEACHATE 13
Section 7 VESSEL CLEANING 15

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Foreword

Much attention continues to be focused on the disposal of mercury containing lamps, particularly fluorescent lamps. The United States Environmental Protection Agency's (EPA) Toxicity Characteristic Leaching Procedure (TCLP) is used at both the Federal level and by most states to determine whether or not spent fluorescent lamps should be classified as hazardous waste. This NEMA Standards Publication was developed by technical experts in the lamp industry in order to establish a uniform method of sample preparation for common linear fluorescent lamps in order to minimize the inherent variability associated with TCLP testing of such lamps. This document also specifies other important aspects related to the leaching process that are not specifically defined for lamps by the EPA SW846, "Test Methods for Evaluating Solid Waste (Physical/Chemical Methods)," but that have been shown in practice to contribute to test variability, if not properly controlled.

For common linear fluorescent lamps, this standard is intended to supplement the generalized EPA test procedure contained in SW846 and is designed to improve both the accuracy and repeatability when the TCLP test is applied to common lamp types.

In the preparation of this Standards Publication, input of users and other interested parties has been sought and evaluated. Inquiries, comments, and proposed or recommended revisions should be submitted to the concerned NEMA product Subdivision by contacting the:

Vice President, Engineering
National Electrical Manufacturers Association
1300 North 17th Street, Suite 1847
Rosslyn, Virginia 22209

This standard was developed at the request of the NEMA Lamp Section by its Technical Committee and a special Task Force on TCLP Testing. Section approval of the standard does not necessarily imply that all section members voted for its approval or participated in its development. At the time it was approved, the Lamp Section was composed of the following members

Durolite, Incorporated—Fairfield, NJ
EYE Lighting International of North America—Mentor, OH
GE Lighting—Cleveland, OH
OSRAM SYLVANIA Products Incorporated—Danvers, MA
Philips Lighting Company—Somerset, NJ
Supreme Corporation—Mullins, SC
Venture Lighting International, Incorporated—Solon, OH

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Section 1
GENERAL

1.1 SCOPE

Procedures for preparation of linear fluorescent lamps for Toxicity Characteristic Leaching Procedure (TCLP) are presented below. These procedures are intended to supplement the TCLP by supplying specific instructions for size reduction and for other critical procedures specific to the testing of linear fluorescent lamps.

This standard specifically covers common linear fluorescent lamp types. Additional standards are in preparation for high intensity discharge lamps, compact fluorescent lamps, and other types that require specific sample preparation instructions because of their design or construction.

The protocol that follows is grouped to include general requirements, lamp preparation, leaching, filtration, storage, and leaching vessel reuse.

1.2 REFERENCES

The following publications may be used to answer questions not covered by this standard.

"Toxicity Characteristic Leaching Procedure (TCLP)," 55 FR 126, pp. 26987–26998, June 29, 1990.
"Test Methods for Evaluating Solid Waste (Physical/Chemical Methods)," SW-846, United States Environmental Protection Agency.

1.3 DEFINITIONS

linear fluorescent lamp: A low pressure mercury electric-discharge, straight-shaped source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into visible light. Linear types include four-foot lamps, with a nominal overall length of 121.9 cm (48 in.), and eight-foot lamps, with a nominal overall length of 243.8 cm (96 in.). See Figure 1-1 for a diagram of a linear fluorescent lamp with the various parts mentioned in this standards publication labeled.

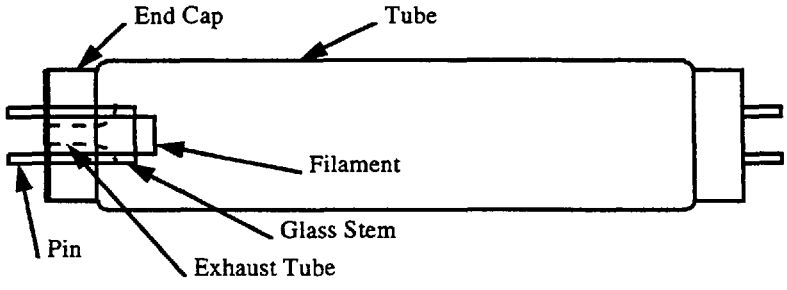


Figure 1-1
LINEAR FLUORESCENT LAMP

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 2
GENERAL REQUIREMENTS

TCLP is to be performed on the entire lamp. A single leaching vessel large enough to contain an amount equal to 20 times the weight of the lamp is recommended.

As an alternative, TCLP may be performed on the entire lamp using two leaching vessels large enough to contain an amount equal to 20 times the weight of one-half the lamp.

All lamp components must be reduced in size to pass a 0.95 cm (3/8 in.) sieve.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 3
LAMP PREPARATION

3.1 SINGLE VESSEL LEACHING METHOD

3.1.1 WARNING! Safety procedures shall be observed in carrying out the procedures given in this section. Safety glasses, gloves, and laboratory coats shall be worn at all times.

3.1.2 Clean the exterior of the lamp using a paper towel, wetted with water and/or an 80% water and 20% acetone combination. This solution is useful to remove any debris, particularly if wax or grease is present on the surface of the lamp. Wipe the surface dry with a second paper towel.

3.1.3 Weigh the lamp (in g). A photocopy of the monogram may be made for record-keeping if necessary.

3.1.4 Obtain the weight (in tare) of a suitably sized leaching vessel with corresponding lid, such as but not limited to those in Table 3-1.[1]

Table 3-1
SUITABLE VESSELS FOR LEACHING

Volume	Manufacturer	Catalog number
2 L	Nalgene	2115-2000 (PP)
4 L	Cole Parmer	H-06025-70 (HDPE)
8 L	Cole Parmer	H 06029-50 (PP)
8 L	Bel Art	F10917 (PP)

3.1.5 Perform the following steps to transfer the entire contents of the lamp to the leaching vessel:

3.1.5.1 Use needle-nosed pliers at one end of the lamp to remove the brass pins, and place them in the tared vessel.

3.1.5.2 Use needle-nosed pliers to remove the cardboard spacer between the pins, cut the spacer, and add it to the vessel.

3.1.5.3 WARNING! Wear proper eye protection because sudden piercing of the exhaust tip may cause an implosion.

3.1.5.4 Carefully relieve the vacuum by piercing the exhaust tip with a sharp pointed object.

3.1.5.5 Remove the aluminum end cap and any other large metal parts with tin snips. Cut the pieces into the TCLP recommended 0.95 cm (3/8 in) size, and place all the pieces in the vessel. Perform the same procedure to the other end of the lamp.

3.1.5.6 The linear lamp shall be sectioned in the following manner.

[1] Suitable vessels may be made of borosilicate glass, high density polyethylene (HDPE), polypropylene (PP), polyvinyl chloride (PVC) and polytetrafluoroethylene (PTFE), and should be of 2, 4 or 8 liter capacity. Suitable vessels include (but are not limited to) those in Table 3-1.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

3.1.5.6.1 WARNING! Eye protection shall be used for protection as cutting glass may generate shards.

3.1.5.6.2 The lamp shall be sectioned, by scoring with a diamond-tipped glass scoring tool, in such a manner that all the sections fit into an appropriate leaching vessel. The scoring shall be made about the outside circumference of the lamp tube by turning the lamp while the diamond tip is held firmly in place.

3.1.5.6.3 In a similar manner, the lamp shall also be scored approximately 0.64 cm (¼ in.) in from each end to remove mount subassemblies.

3.1.5.6.4 Once the sections have been scored, use of a Weller soldering gun (> 300 W), or equivalent, is recommended to aid in separating the sections. The Weller soldering gun shall not have been previously used with lead solder.

3.1.5.6.5 Hold the soldering gun on the scored glass with a gentle rotation about the score. This will result in a clean break into sections. Put the sections into an appropriate leaching vessel, so that the lid can be closed.

3.1.5.6.6 Segregate the two end pieces. Break them by folding them in lined paper, and hitting the paper with a hammer until the pieces are the TCLP recommended 0.95 cm (3/8 in.) size. This step is necessary since the glass stems will most likely not break when shaken. Also, cut any large metal parts with tin snips into the TCLP recommended 0.95 cm (3/8 in.) size. Place all of the pieces in the vessel.

3.1.6 Once the whole lamp is in the vessel, cap the vessel and vigorously shake the contents for at least 2 minutes. Shaking the vessel shall be performed by holding the ends (bottom and cap) with the hands, and vigorously moving the vessel away from and towards the body for at least 2 minutes. The shaking results in sizing of the pieces to the TCLP recommended 0.95 cm (3/8 in.) size.

3.1.7 Next, the appropriate amount (20 times the lamp weight) of the proper leaching fluid (normally fluid #1) shall be weighed and added to the vessel. Refer to SW846 for details.

3.1.8 The threads of the lid shall be wiped before tightening. A strap wrench can be used to tighten the lid and duct tape (on the outside of the cap) or Teflon tape (on the threads) can also be applied to prevent leakage.

3.2 TWO VESSEL LEACHING METHOD

3.2.1 The weighted average of the readings from both vessels must be used in any further statistical treatment of the data when analyzed by the method of EPA SW846. The following modifications of the preparation procedure must be made. The test results shall be considered valid only if each vessel is ±15% of the paired average or if both halves either pass or fail the test. If the test results are not valid, i.e. the above conditions are not met, then a single vessel leaching shall be performed using procedures set forth in 3.1.

3.2.2 WARNING! Safety procedures shall be observed in carrying out the procedures given in this section. Safety glasses, gloves, and laboratory coats shall be worn at all times.

3.2.3 Clean the exterior of the lamp using a paper towel, wetted with water and/or an 80% water and 20% acetone combination. This solution is useful to remove any debris, particularly if wax or grease is present on the surface of the lamp. Wipe the surface dry with a second paper towel.

3.2.4 Weigh the lamp (in g). A photocopy of the monogram may be made for record-keeping if necessary.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS Not for Resale

3.2.5 Obtain the weight (in tare) of two leaching vessels, each suitably sized to hold one half of the lamp plus 20 times its weight for leaching fluid, with corresponding lids. Record the tare weight of both vessels and label one vessel "A" and the second vessel "B."

3.2.6 Perform the following steps to transfer the entire contents of the lamp equally into the leaching vessels:

3.2.6.1 Use needle-nosed pliers to remove the brass pins at one end of the lamp, and place them in tared vessel "A." Likewise, remove the pins at the other end of the lamp, and place them in tared vessel "B."

3.2.6.2 Use needle-nosed pliers to remove the cardboard spacer between the pins from one end of the lamp, cut the spacer, and add the spacer to vessel "A." Likewise, remove and cut the spacer at the other end of the lamp, and add the pieces to vessel "B."

3.2.6.3 WARNING! Wear proper eye protection because sudden piercing of the exhaust tip may cause an implosion.

3.2.6.4 Carefully relieve the vacuum by piercing the exhaust tip with a sharp pointed object.

3.2.6.5 From one end of the lamp, remove the aluminum end cap and any other large metal parts with tin snips. Cut the pieces into the TCLP recommended 0.95 cm (3/8 in.) size, and place all the pieces in vessel "A." Perform the same procedure to the other end of the lamp and place the components into vessel "B." One mount and end cap must be in each vessel.

3.2.6.6 Section the standard linear lamp in the following manner.

3.2.6.6.1 WARNING! Eye protection shall be used for protection since cutting glass may generate shards.

3.2.6.6.2 An even number of approximately equal length sections of the lamp shall be made by scoring with a diamond-tipped glass scoring tool. The scoring shall be made about the outside circumference of the lamp tube by turning the lamp while the diamond tip is held firmly in place.

3.2.6.6.3 In a similar manner, the lamp shall be scored approximately 0.64 cm (1/4 in.) in from each end to remove mount subassemblies.

3.2.6.6.4 Once the sections have been scored, use of a Weller soldering gun (> 300 W), or equivalent, is recommended to aid in separating the sections. The Weller soldering gun shall not have been previously used with lead solder.

3.2.6.6.5 Hold the soldering gun on the scored glass with a gentle rotation about the score. This will result in a clean break into sections.

3.2.6.6.6 Segregate the two end pieces. Break them by folding each of them separately in lined paper, and hitting the paper with a hammer until the pieces are the TCLP recommended 0.95 cm (3/8 in.) size. This step is necessary since the glass stems will most likely not break when shaken. Also, cut any large metal parts with tin snips into the TCLP recommended 0.95 cm (3/8 in.) size. Place all of the pieces equally into the two vessels.

3.2.6.6.7 The lamp sectioned into an even number of pieces and divided equally among the two vessels shall fit into the vessels such that the lids can be closed.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

3.2.6.7 Once the whole lamp is placed in both vessels, cap the vessels and vigorously shake the contents for at least 2 minutes. Shaking the vessel shall be performed by holding the ends (bottom and cap) with the hands, and vigorously moving the vessel away from and towards the body for at least 2 minutes. The shaking results in sizing of the pieces to the TCLP recommended 0.95 cm (3/8 in.) size.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 4
LEACHING

4.1 The vessels shall be placed in a rotary tumbler (end over end) and be tumbled at a rate of 30 ± 2 revolutions per minute for 18 ± 2 hr.

4.2 The temperature of the room shall be 23° ± 2°C.

4.3 After approximately one hour, examine the vessel(s) and, if foaming is present, crack the seal to relieve any excess pressure.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 5
FILTRATION

5.1 Samples may be left to settle for up to 30 minutes to allow for easier filtration. Decant immediately, after settling, an appropriate amount (a minimum of 150 ml), and filter as soon as possible, but no more than two hours after the leaching step has been completed.[2]

5.2 Filtering shall be performed using standard EPA TCLP procedure using recommended materials.

5.3 The pH of the filtered leachate shall be recorded prior to storage at 4°C or prior to analysis (if immediately analyzed).

[2] It has been found that further leaching of mercury can occur if the sample is not filtered within one half-hour. Limited studies have found an approximate 20–30 ppb increase over the 2 hour time period.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

--`,,,``,-`-`,,`,,`,`,,`---

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 6
STORAGE OF THE LEACHATE

6.1 All samples should be acidified to a pH of less than 2 and held at 4°C until analysis. Acidify using approximately 2 ml concentrated nitric acid to 150 ml of leachate; then test with pH paper. Samples may be held in this manner for up to 28 days.

6.2 Warm to room temperature (approximately 20°C) prior to taking an aliquot for analysis.

6.3 Analysis of the samples shall be made according to the EPA's SW846 procedure.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

--`,,,`,,`-`-`,,`,,`,`,,`---

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

Section 7
VESSEL CLEANING

The leaching vessel shall be cleaned prior to use or re-use by using the following procedure:

7.1 Add 100–150 ml concentrated nitric acid to the vessel (depending on the vessel volume). Cap the vessel and then rotate it so as to wet all surfaces with the acid.

7.2 Add 900 ml water, mix and repeat rotating the vessel.

7.3 Rinse at least 3 times with deionized water.

7.4 Rinse with methanol and air dry.

7.5 A blank leaching run should be made with each vessel every 20 runs to check for contamination. If the test result is greater than 2 ppb, the vessel should either be re-cleaned or no longer used.

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS
Not for Resale

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale

STD.NEMA LL 1-ENGL 1997 ■ 6470247 0513452 522 ■



NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION • 1300 NORTH 17TH STREET • SUITE 1847 • ROSSLYN, VA 22209

Copyright National Electrical Manufacturers Association
Provided by IHS under license with NEMA
No reproduction or networking permitted without license from IHS

Not for Resale