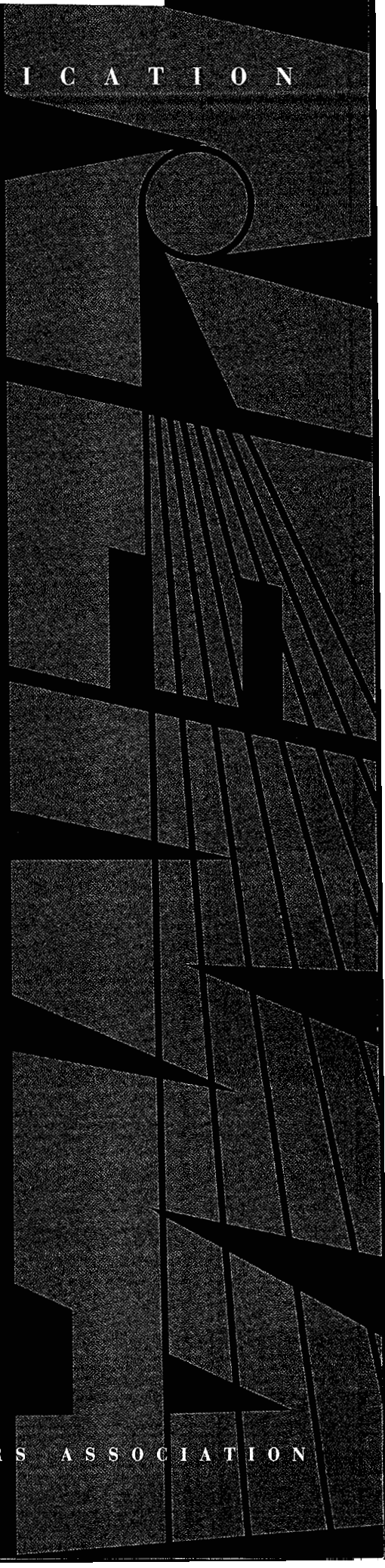
STD.NEMA LL 2-ENGL 1997 ■ 6470247 0513453 469 ■

NEMA STANDARDS PUBLICATION

NEMA LL 2

PROCEDURES FOR PIN-BASED COMPACT FLUORESCENT LAMP SAMPLE PREPARATION AND THE TCLP



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NEMA Standards Publication LL 2-1997

PROCEDURES FOR PIN-BASED COMPACT FLUORESCENT LAMP SAMPLE PREPARATION AND THE TCLP

Published by

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

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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 compact 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 compact 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:

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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

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Section 1
GENERAL

1.1 SCOPE

Procedures for preparation of compact fluorescent lamps for Toxicity Characteristic Leaching Procedure (TCLP) are presented below. These guidelines are intended to supplement the TCLP by supplying specific instructions for size reduction of compact fluorescent lamps.

This standard specifically covers compact fluorescent lamp types. Additional standards are in preparation for high intensity discharge lamps, linear 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, safety considerations, 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

compact fluorescent lamp: A low pressure mercury electric-discharge source in which a fluorescing coating transforms some of the ultraviolet energy generated by the mercury discharge into visible light. These sources are intended to replace many incandescent lamps and generally fit the same Edison-type sockets and conventional fixtures. There are two broad classes of compact fluorescent lamps, integral and pin-based.

integral compact fluorescent lamp: This class combines a lamp, ballast, and adapter (usually as a screw-in base which fits an incandescent lamp's holder or socket) in a single sealed assembly, which must be discarded when the lamp burns out.

pin-based compact fluorescent lamp: This class includes those lamps that are separate from an adapter and ballast combination. Unless otherwise noted, compact fluorescent lamp in the remainder of this standard refers to the pin-based class of lamps.

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Section 2
GENERAL REQUIREMENTS

TCLP must be performed on the entire lamp in a single leaching vessel large enough to contain an amount equal to 20 times the weight of the lamp. In cases where the weight of a single whole lamp is less than 100 grams, a number of whole lamps must be combined to provide a sample of at least 100 grams. All lamp components must be reduced in size to pass a 0.95 cm (3/8 in.) sieve.

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Section 3
SAFETY CONSIDERATIONS

Compact fluorescent lamps have a plastic base with either two or four pins. The following applies to two-pin lamps only. Compact fluorescent lamps with two pins contain a globottle and capacitor in the base. The globottle may contain gaseous krypton 85, tritium, solid thorium, or promethium.[1] Therefore, all globottles must be opened in a fume hood as described in 4.5.6.

[1] Radioactive content of globottles: Globottles may contain very small quantities of radioactive krypton, tritium, thorium, promethium, or other material. NRC regulations governing exposures and disposal do not apply other than to the initial importer or manufacturer.

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Section 4
LAMP PREPARATION

4.1 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.

4.2 Clean the exterior of the lamp using a paper towel, wetted with water and/or an 80 percent water and 20 percent 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.

4.3 Weigh the lamp(s) [in g]. A photocopy of the monogram may be made for record keeping if necessary.

4.4 Obtain the weight (in tare) of a suitably sized leaching vessel with corresponding lid, such as but not limited to those in Table 4-1.[2]

Table 4-1
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)

4.5 Perform the following steps to transfer the entire contents of the lamp(s) to the leaching vessel:

4.5.1 Place the lamp on a clean sheet of plastic lined laboratory bench paper (an example of which is Fisher, catalog number 12-007-186) approximately 25.4 cm (10 in.) wide by 61 cm (24 in.) long, with the plastic side toward the lamp. With a pair of needle-nosed pliers, remove the contact pins from one end of the lamp by twisting the posts outward; place these into the leaching vessel.

4.5.2 For lamps having an aluminum band securing the two components of the plastic base, cut the aluminum band across its width to free it from the plastic base. Cut the aluminum into pieces which will pass a 0.95 cm (3/8 in.) sieve and place the pieces in the leaching vessel.[3]

4.5.3 Open the plastic base with a flat-bladed spatula. Slide the blade into the seam on the plastic base and twist the blade so as to crack the plastic. Repeat this step, as needed, until the base can be opened and separated into pieces. Pull the sections of the base apart to expose the fused nipple which seals the glass body of the lamp and the capacitor and the globottle (if present).

4.5.4 Crush the fused nipple to release the reduced pressure within the lamp; this should leave the lamp glass fully intact.

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[2] 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 4-1.

[3] Toxicity Characteristic Leaching Procedure (TCLP), 55 FR 26987–26998, No. 126, June 29, 1990.

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4.5.5 Discharge the capacitor (if present) by a short across it with a piece of metal, and cut it free of the lead wires, and place it into the leaching vessel.

4.5.6 Cut the globottle (if present) free from the lead wires. Do not cut the leads into smaller pieces. Since the globottle may contain a radioactive material, it shall be opened in a fume hood. Place the globottle in the jaws of common pliers and hold it down into the mouth of the leaching vessel which has been located in the fume hood. Crush the globottle in such a manner that the pieces fall into the vessel. Allow a few moments for any radioactive gas to escape, then the vessel may be removed from the hood.

4.5.7 Using wire cutters or the like, break the basing cement and place it in the leaching vessel. This will release the remaining half of the plastic base from the lamp. Cut all the plastic to size such that the pieces would pass a 0.95 cm (3/8 in.) sieve.

4.5.8 Wrap the remainder of the lamp in a loose envelope of bench paper and strike it with a heavy object to break it into pieces which would pass a 0.95 cm (3/8 in.) sieve.

4.5.9 Lift the bench paper and gently shake to move all material to the center. Fold the paper into a "chute" and pour to transfer all material into the vessel.

4.6 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.

4.7 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 be also applied to prevent leakage.

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Section 5
LEACHING

5.1 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 hours.

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

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

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Section 6
FILTRATION

6.1 Samples may be left to settle for as long as 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 not more than two hours after the leaching has been completed.[4]

6.2 Filtering shall be performed using pressure filtration per standard EPA TCLP procedure using recommended materials.

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

[4] 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.

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Section 7
STORAGE OF THE LEACHATE

7.1 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 as many as 28 days.

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

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

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Section 8
VESSEL CLEANING

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

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

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

8.3 Rinse at least 3 times with deionized water.

8.4 Rinse with methanol and air dry.

8.5 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.

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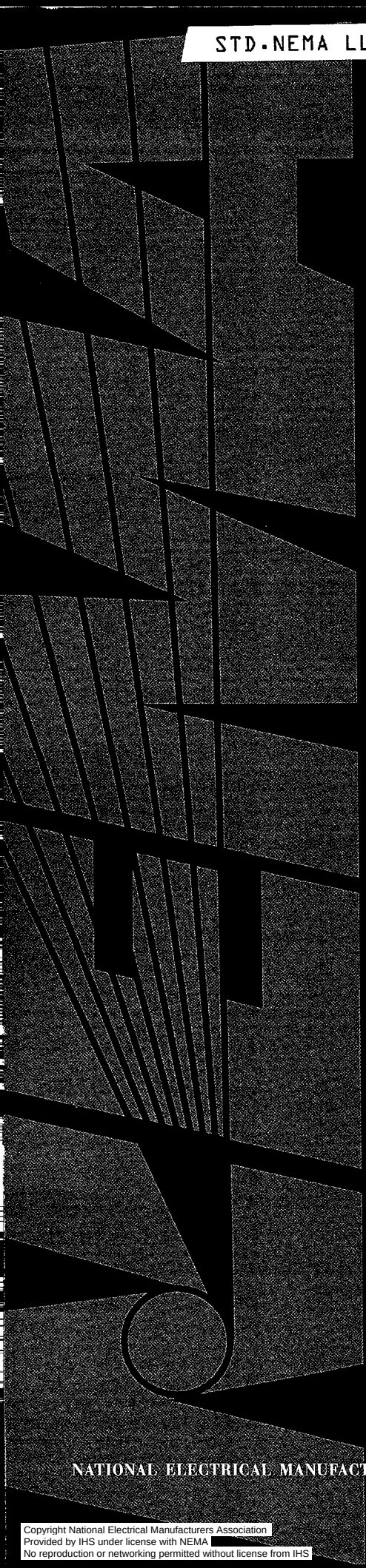
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