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PROCEDURES FOR HIGH-INTENSITY DISCHARGE LAMP SAMPLE PREPARATION AND THE TCLP

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Procedures for High-intensity Discharge Lamp Sample Preparation and the TCLP

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Foreword

Much attention continues to be focused on the disposal of mercury containing 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 high-intensity discharge lamps should be classified as hazardous waste. This NEMA Standards Publication was developed by technical experts in the lamp industry to establish a uniform method of sample preparation for high-intensity discharge 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 SW-846, "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 high-intensity discharge lamps, this standard is intended to supplement the generalized EPA test procedure contained in SW-846 and is designed to improve both the accuracy and repeatability when the TCLP is applied to these lamp types.

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

Duralite, 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

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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Section 1
GENERAL

1.1 SCOPE

Procedures for preparation of high-intensity discharge (HID) lamps for the 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 HID lamps.

This standard specifically covers high-intensity discharge lamp types. Additional standards are in preparation or have been prepared for linear fluorescent and compact fluorescent lamps and for 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

high-intensity discharge (HID) lamp: an electric discharge lamp in which the wall temperature stabilizes the light producing arc, and the bulb wall loading of the arc tube is in excess of 3 W/cm^2. Groups of lamps known as mercury, metal halide, and high pressure sodium are included in the category of HID lamps. See Figure 1 for a diagram of a high-intensity discharge lamp.

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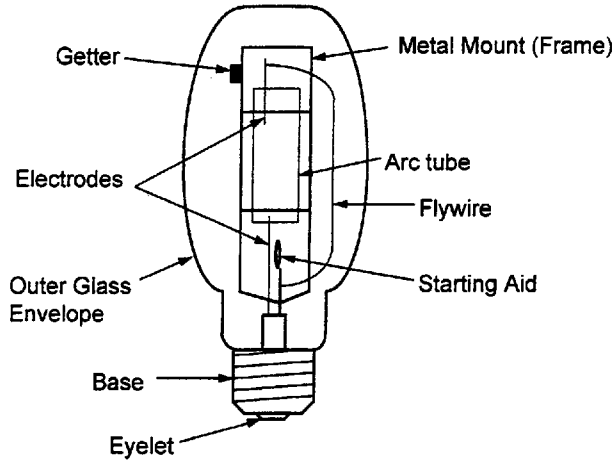


Figure 1—High-intensity Discharge Lamp

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Section 2
GENERAL REQUIREMENTS

TCLP is to 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 through a 0.95 cm (3/8 in) sieve.

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Section 3
LAMP PREPARATION

3.1 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.

3.2 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.

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

3.4 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)
12 L	Nalgene	2240-0025 (PP)
20 L	Nalgene	2211-0050 (PP)

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

3.5.1 Place the lamp on a clean sheet of plastic-lined laboratory paper (an example of which is Fisher, catalog number 12-007-186). Place the plastic side toward the lamp and form a loose envelope around the lamp. Fold the edges of the paper together and staple closed.

3.5.2

With a hammer, lightly strike the outer glass envelope in order to fracture it, taking care to keep the arc tube intact.

3.5.3 After fracturing the outer glass envelope, open the plastic-lined paper and remove the lamp base, arc tube, and metal harness. Set these aside for later. Continue to size reduce the outer glass envelope with a hammer such that the pieces pass through a 0.95 cm (3/8 in) sieve.

[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, 8, 12, or 20 liter capacity. Suitable vessels include (but are not limited to) those in Table 3-1.

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3.5.4 Place the pieces of the broken outer envelope into the leaching vessel. Carefully rinse the plastic-lined paper with leaching fluid (normally fluid #1) to transfer all the pieces to the vessel.

3.5.5 Using wire cutters, separate the arc tube from the mount and base. Set aside the arc tube and other starting aids, such as capacitors, resistors, UV enhancers, or glowbottles. Cut the mount, wires, etc. into pieces such that they pass through a 0.95 cm (3/8 inch) sieve, and place them into the leaching vessel. Cut the base with tin snips so that the pieces are less than 0.95 cm (3/8 in), and place all the pieces in the vessel.

3.5.6 Using wire cutters or the like, cut the starting aids, such as the resistors or capacitors, so that the pieces would pass through a 0.95 cm (3/8 in.) sieve. The UV enhancer or glowbottle shall be wrapped in a loose envelope of plastic-lined paper and struck with a heavy object to break it. All the pieces shall be small enough so that they would pass through a 0.95 cm (3/8 in) sieve. Lift the plastic-lined 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. Rinse the paper with leaching fluid as in 3.5.4.

3.5.7 Wrap the arc tube in a new piece of plastic-lined paper as described in 3.5.1. All of the mercury is generally contained within the arc tube, and may be visible as a free bead. Care must be taken not to allow the mercury to roll away. In the case of high pressure sodium lamps, the arc tube contains a sodium-mercury amalgam (Na-Hg) or pure sodium (Na). Upon opening in air, sodium could possibly enflame the air and in turn ignite the paper. The following operation should be performed in a nonflammable enclosure or environment. One strike with a hammer should shatter the arc tube. However, continue to size reduce the larger pieces to pass through a 0.95 cm (3/8 in) sieve. Carefully open the envelope over the leaching vessel, and transfer the arc tube pieces to the vessel. Rinse the paper with leaching fluid as in 3.5.4.

3.5.8 Weigh and add the appropriate amount (twenty times the lamp weight) of the proper leaching fluid (normally fluid #1) to the vessel so that the total weight includes the amounts of leaching fluid used in 3.5.4, 3.5.6, and 3.5.7. Refer to SW-846 for details.

3.5.9 Wipe the threads of the lid before tightening. A strap wrench may be used to tighten the lid, and duct tape (on the outside of the cap) or Teflon tape (on the threads) may also be applied to prevent leakage.

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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 and, if foaming is present, crack the seal to relieve any excess pressure.

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Section 5
FILTRATION

5.1 Samples may be left standing for up to 30 minutes to allow for easier filtration. Samples shall be filtered within two hours after the leaching step has been completed.

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).

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Section 6
STORAGE OF THE LEACHATE

6.1 All samples should be acidified to a pH of less than two 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 SW-846 procedure.

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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 three 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 uses to check for contamination. If the test result is greater than one percent of the regulatory threshold for any of the analyzed elements, the vessel should either be re-cleaned or no longer used.

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