

*A NEMA Lighting Systems Division Document*

**Tungsten-halogen Lamps (Bulbs):  
Ultraviolet, Rupture,  
And High Temperature Risks**

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## **Tungsten-halogen Lamps (Bulbs)<sup>1</sup>**

### **Ultraviolet, Rupture, and High Temperature Risks**

#### **Foreword**

Periodically, concern is expressed about the risks associated with the use of tungsten-halogen lamps. The *US lamp industry* was at the forefront of these risk assessments and in 1986, initiated the development of American National Standard ANSI C78.1451, *Use of Protective Shields with Tungsten-halogen Lamps--Cautionary Notice*, addressing requirements for safe use of these lamps. Similar requirements have been adopted internationally in IEC standards,<sup>2</sup> and much of the concern is due to a lack of awareness of appropriate safety standards for both lamps and fixtures.

This document summarizes the benefits and the safe operation of tungsten-halogen lamps.

#### **Tungsten-halogen Lamp Basics (Operation)**

Tungsten-halogen lamps were introduced in the 1960s and have been developed for use in many applications previously served by incandescent lamps. Ordinary incandescent lamps darken over life due to the evaporation of tungsten particles from the filament that condense on the cool glass wall. To improve performance and to increase life, halogen gases, such as iodine or bromine, are added to the filling gas of tungsten-halogen lamps. During lamp operation, evaporating tungsten particles are intercepted at the bulb wall and chemically combine with the halogen gas. The tungsten particles are then re-deposited back on the filament and the halogen gas is released to repeat the cycle. Because the bulb is operating under pressure and the bulb wall temperature must exceed 250° C to maintain effective operation of the halogen cycle, a strong, small diameter,

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<sup>1</sup> The lamp industry uses the term “lamp” for the light source, for what the consumer may refer to as a “bulb.” Throughout this document, lamp is used for the light source and bulb is used for the tungsten-halogen capsule incorporated inside the outer envelope.

<sup>2</sup> IEC Publication 60432-2 (1994-08), *Safety Specifications for Incandescent Lamps--Part 2: Tungsten-halogen Lamps for Domestic and Similar General Lighting Purposes*.

quartz or hard glass tube is used. Compared to ordinary incandescent lamps of the same wattage, tungsten-halogen lamps maintain their initial light output over their full life, and lamp life is increased by up to 100 percent.

### **Potential Risks**

There are three risks associated with improperly used tungsten-halogen lamps: (1) Over-exposure to ultraviolet [UV] radiation, (2) the consequences of lamp rupture, and (3) the consequences of high operating temperatures.

#### **Ultraviolet Radiation**

The light output characteristics of tungsten-halogen lamps are similar to those of ordinary incandescent lamps. Most of the radiated energy is in the infrared spectral region, much less is in the visible region, and *less than 1 percent is in the ultraviolet band*. In a regular incandescent lamp, the glass envelope absorbs almost all of this ultraviolet radiation. In tungsten-halogen lamps manufactured with a quartz bulb, the quartz absorbs little of the ultraviolet radiation. Thus, transmission of the small amount of ultraviolet energy may result in UV over-exposure if these lamps are used in an unshielded fixture, at close range, and for an extended period of time. All NEMA lamp manufacturers provide cautionary notices regarding over-exposure to ultraviolet radiation (for example, Exhibit B).

Over-exposure to UV radiation from lamps may cause skin and eye irritations, exactly as it may for over-exposure to the sun. The use of hard glass for the bulb in some tungsten-halogen lamps provides a good protective shield against the transmission of the ultraviolet energy, as in an ordinary incandescent lamp. Some lamp types have an outer jacket of heavy glass, which offers protection against UV transmission and which also provides containment in the unlikely event of a rupture (Exhibit C).

Manufacturers of halogen lamps have begun to introduce new types that are specifically designed to reduce the historic levels of UV below that achieved with a standard cover glass. These new lamps typically rely on the use of special quartz for the bulb that selectively absorbs UV wavelengths while still passing visible light.

## Lamp Rupture

Both quartz and hard glass tungsten-halogen bulbs are pressurized for proper operation of the halogen cycle. Consequently, there is a slight risk that the bulb could rupture.

If a tungsten-halogen lamp has no heavy glass outer jacket, manufacturers recommend that the lamp be used in a fixture with suitable shielding to protect against the unlikely event of a rupture. Lamp rupture is more likely for lamps that are not manufactured in accordance with IEC safety standards or other proven quality control procedures.

## High Temperature

Both quartz and hard glass tungsten-halogen bulbs operate with a high bulb wall temperature. The bulb wall temperature must exceed 250° C (480° F) for proper operation of the lamp. Depending on the bulb diameter and lamp wattage, the bulb wall temperature may approach 650° C (1200° F).

If the tungsten-halogen bulb does not have a heavy glass outer jacket (Exhibit C), manufacturers recommend that the bulb be used in a fixture with suitable shielding which will prevent the accidental contact of combustible materials with the bulb wall or other hot surfaces.

**NEMA recommends against the use of unjacketed tungsten-halogen bulbs in unshielded fixtures.** NEMA manufacturers issue cautionary notice on packaging against such applications.<sup>3</sup>

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<sup>3</sup> The following cautionary notices are included in packaging: “(1) Tungsten-halogen lamps operate at high temperature and at internal gas pressures above atmospheric pressure. Consequently a lamp may shatter. Certain lamps may also emit some amount of ultraviolet radiation. Therefore, a suitable protective shield, screening technique, or both shall be used with the luminaire to protect people and surroundings from both hazards. (2) Always read and observe the information contained in the lamp manufacturer’s caution notice.” ANSI C78.1451-1995, *American National Standard for Electric Lamps: Use of Protective Shields with Tungsten-halogen Lamps—Cautionary Notice*, National Electrical Manufacturers Association,

## Lighting Fixture Safety Standards

The lamp industry has worked with Underwriters Laboratories (UL) to include requirements for protective shields in all incandescent lighting fixtures using unjacketed tungsten-halogen lamps to protect against these risks. Refer to UL 1571.<sup>4</sup>

Recent reports indicate that consumers may be placing tungsten-halogen fixtures, especially torchiere types, near combustibles, such as curtains, that can come into contact with hot surfaces, increasing the risk of fire. UL has recently revised its safety standard UL 153<sup>5</sup> to include a new tungsten-halogen *abnormal operation test* to minimize this risk. Also, the current UL lighting fixture warning notice is being revised to advise users to keep the fixture away from curtains and other combustible materials. See Exhibit D for a list of specific safety tips for application of halogen torchiere fixtures that has been recently released by UL.

## Lamp Labeling

In the mid-1980s, the lamp industry developed a cautionary notice for the use of tungsten-halogen lamps that was first published in American National Standard C78.1451 in 1988. The current standard detailing the notice is ANSI C78.1451 (Exhibit A).

In addition ANSI C78.260, *Tubular Tungsten-halogen Lamps--Physical Characteristics*, has been revised to include a section on lamp marking. This section for 500 watt, double-ended halogen lamps ONLY requires the lamp manufacturers to add a warning statement on the front panel of the card or other package displaying these products for retail sale. If space is available, a pictogram of a crossed through torchiere fixture should also be incorporated with the warning statement. This additional marking was initiated at the request of the Consumer Product Safety Commission to warn consumers that 500 watt lamps are not for use in indoor residential lighting fixtures.

## Conclusion

Long term industry experience indicates that the use of quartz or hard glass tungsten-

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Washington, DC (1995).

<sup>4</sup> UL 1571, *Safety Standard for Incandescent Lighting Fixtures*.

<sup>5</sup> UL 153, *Safety Standard for Portable Electric Lamps*.

halogen lamps does not pose a hazard when used with *a properly designed fixture with proper shielding* in accordance with lamp manufacturers' recommendations.

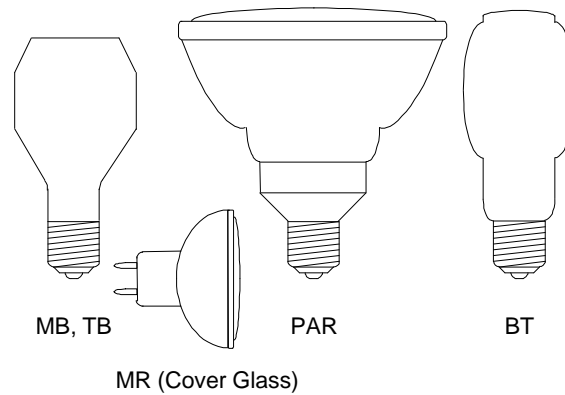
## Exhibit A

Caution: This lamp operates under pressure and produces intense heat. It also generates a slight amount of UV radiation. Therefore, the lamp must be used in a fixture that has a suitable glass or plastic shield to protect against the risk of lamp shattering and UV exposure.

## Exhibit B

### A. Glass Jacketed Lamps

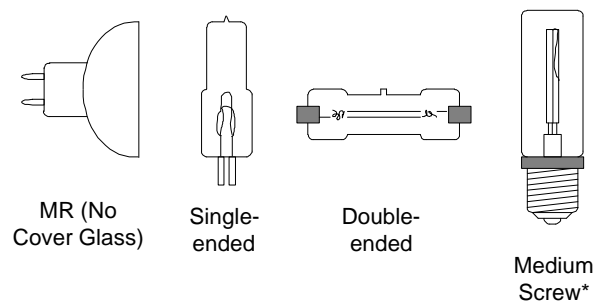
Examples of halogen lamps that have a glass outer jacket and specified by the manufacturer to require no further protection for UV or lamp rupture.



### B. Other Lamps

Examples of halogen lamps that require UV and rupture shields as part of the light fixture.

Also, surface temperatures are higher than jacketed lamps (Part A) and require properly designed fixtures complying with UL safety standards and carrying appropriate warning labels.



\*May be specified by some manufacturers to require no further protection for UV or lamp rupture.

## Exhibit C

The following excerpt is taken from a July 29, 1996 UL Press Release that summarizes safety tips for the users of portable lamp fixtures.

To reduce risk of fire and injury in your home, UL offers the following precautionary measures to follow with all portable lamps:

- Look for the UL Mark when purchasing portable lamps. The UL Mark means that representative samples of the product have been tested to and have met UL's Standards for Safety.
- Read the manufacturer's use and care instructions before using portable lamps anywhere in the home. Pay special attention to warning labels. Portable lamps are intended for indoor use only, unless marked otherwise.
- Always turn off or unplug the lamp before removing or replacing bulbs.
- Never attempt to replace or discard a bulb that is hot to the touch.
- Never use a light bulb of a different style or higher wattage than indicated by the manufacturer's use and care instructions.
- Never operate a lamp with missing or damaged components.
- Never place materials on the top of a lamp, such as clothes or towels.
- Never place lamps in locations where they can be easily tipped over by children or pets.
- Never use torchiere lamps in children's bedrooms or playrooms. Children may play with the lamps or unknowingly place combustibles, such as stuffed toys or clothing, too close to the bulb area.
- Keep torchiere lamps away from elevated beds, such as bunk beds, where bedding may get too close to the bulb area.

The U.S. Consumer Product Safety Commission released similar safety tips via a July 29, 1996 Press Release (CPSC #96-174). For more information on halogen fixture safety, contact either UL at 847-272-8800 or the U.S. Consumer Product Safety Commission at 301-504-0580, Extension 1166.