



*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 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. The U.S. lamp industry has also participated in the development of an international IEC safety standard for lamps. This international standard has been adopted by ANSI.<sup>2</sup> Much of the concern is due to a lack of awareness of appropriate safety standards for both lamps and luminaires.

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 from the filament that condenses on the cool glass wall. To reduce this darkening and to increase life, a halogen, such as iodine or bromine, is added to the filling gas of tungsten-halogen lamps. During lamp operation, evaporating tungsten chemically combines with the halogen gas near the bulb wall. The tungsten is then re-deposited back on the filament, and the halogen gas is released to repeat the cycle. Because the bulb is typically pressurized and the bulb wall temperature must exceed 250° C to maintain effective operation of the halogen cycle, a strong, small diameter, quartz or hard glass tube is used. Compared to

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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.

<sup>2</sup> IEC Publication 60432-2 (1999-10), *Safety Specifications for Incandescent Lamps--Part 2: Tungsten-halogen Lamps for Domestic and Similar General Lighting Purposes*.

ordinary incandescent lamps of the same wattage, tungsten-halogen lamps maintain their initial light output over their full life, and lamp life can be increased by more than 100 percent.

### **Potential Risks**

Three risks associated with improperly used tungsten-halogen lamps are (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 qualitatively 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 standard quartz capsule, 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. Over-exposure to UV radiation from lamps may cause skin and eye irritations, exactly as it may for over-exposure to the sun.

Many tungsten-halogen lamps are available using materials that absorb UV. The use of hard glass for the capsule in some tungsten-halogen lamps provides a good protective shield against the transmission of the ultraviolet energy, as in an ordinary incandescent lamp. Lamps are also now available that use a capsule that is made with a special quartz, which is doped to selectively absorb the UV wavelengths while passing the visible light. Other lamp types have an outer glass jacket which offers protection against UV transmission.

All NEMA lamp manufacturers provide cautionary notices regarding exposure to ultraviolet radiation (for example, Exhibit A), if necessary for a particular lamp.

## **Lamp Rupture**

Both quartz and hard glass tungsten-halogen bulbs are pressurized for proper operation. Consequently, should the lamp envelope break, particles of extremely hot glass could be discharged.

Lamp manufacturers recommend that some tungsten-halogen lamps be used in luminaires with suitable shielding to protect against the risk of shattering. NEMA manufacturers always provide a cautionary notice with lamps having this requirement (for example, Exhibit A).

Some tungsten-halogen lamps are designed and manufactured such that luminaire shielding against shatter is not required. These lamps can be found in several styles. Examples of lamps that may not require shielding are 12-volt low-pressure lamps, lamps with G9 bases, or lamps with an outer glass jacket. Always read the information supplied with a lamp to determine if shielding is required by the lamp manufacturer. However, shielding could still be required by the UL luminaire standards.

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**

The bulb wall temperature of the halogen capsule 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). Tungsten-halogen lamps must always be used in an appropriate luminaire and in an application that will prevent the accidental contact of combustible materials with the bulb wall or other hot surfaces.

Also use caution and allow enough time for the lamp to cool before attempting replacement.

## **Luminaire Safety Standards**

The lamp industry has worked with Underwriters Laboratories (UL) to establish requirements for luminaires using tungsten-halogen lamps. Refer to UL 1598 and UL 153.

In the past consumers placed tungsten-halogen luminaires, especially torchiere types, near combustibles, such as curtains, that could come into contact with hot surfaces, increasing the risk of fire. UL revised its safety standard UL 153<sup>3</sup> to include a tungsten-halogen *abnormal operation test* to minimize this risk. Also, the current UL lighting warning notice advises users to keep the luminaire away from curtains and other combustible materials. See Exhibit B for a list of specific safety tips for application of halogen torchiere luminaires that has been released by UL.

Temporary halogen lighting, where luminaires are often not securely or permanently fastened to a structure, may require additional precautions. There have been reports that stem-type fixtures, which are normally fastened to an exhibit booth with mechanical clamps, can, if the clamp becomes loose, swing out of position and place the hot luminaire or cover glass in close proximity to combustible materials. Such applications require careful assembly of the lighting equipment. This temporary lighting should not be left unattended. Temporary halogen lighting equipment should also be carefully maintained, using only the original manufacturer's replacement components.

### **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. Exhibit A is a typical caution notice used by manufacturers based on information provided in C78.1451.

In addition ANSI C78.260, *Tubular Tungsten-halogen Lamps--Physical Characteristics*, has been revised to include a section on lamp marking. This section requires, for 500 watt, double-ended halogen lamps ONLY, that the lamp manufacturers 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 is also to 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. See the figure in Exhibit C.

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<sup>3</sup> UL 153, *Safety Standard for Portable Electric Luminaires*.

## Conclusion

Long-term industry experience indicates that the use of tungsten-halogen lamps does not pose a hazard when used with *a properly designed luminaire* in accordance with lamp manufacturers' recommendations. Requirements such as shielding are not the same for all tungsten-halogen products. Always read and heed the manufacturer's warnings and instructions that are supplied with the lamp and luminaire.

## Exhibit A Cautionary Notice

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

### Safety Tips

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.

Exhibit C  
Crossed-through Torchiere

