

SAFETY BULLETIN

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Triodyne Inc.
Consulting Engineers & Scientists - Safety Philosophy & Technology
5950 West Touhy Avenue Niles, IL 60714-4610 (847) 677-4730
FAX: (847) 647-2047
e-mail: infoserv@triodyne.com

VEHICLE SAFETY

Were His Lights On?

Minor Distortion of Vehicle Lamp Filaments in Accident Reconstruction

by Dror Kopernik, P.E.* and Michael A. Dilich**

Drivers involved in vehicle collisions frequently claim that they didn't see the other cars because their headlights, taillights or emergency flashers were not on. Sometimes, brake lights or turn signals are accused of not functioning and contributing to accidents. The validity of such claims can often be scientifically determined by examining the manner in which the condition of the subject lamp was changed by the collision.

The primary part of a lamp which may exhibit evidence of its illumination status at the time of impact is the tungsten filament coil, whether or not the glass bulb was broken during the incident. The most common types of evidence are distortion, fracture and oxidation. This Safety Bulletin addresses evidence of distortion and describes two causes of minor distortion which, unless recognized, can lead to the incorrect conclusion that a lamp was on.

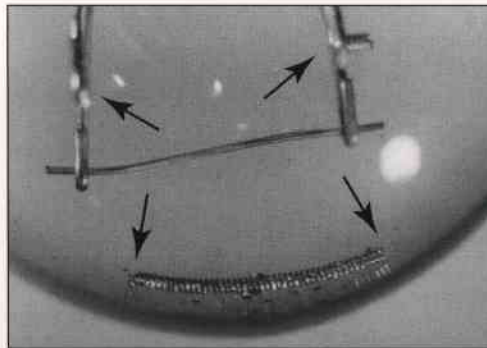


Figure 1 - Cold Shock - Thick Filament

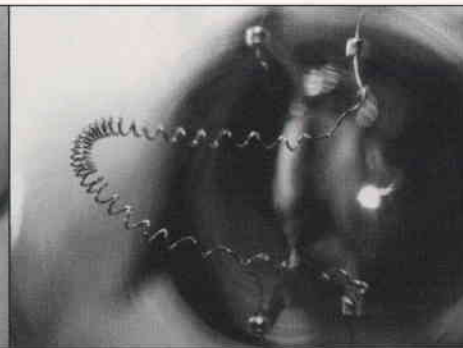


Figure 2 - Hot Shock

When a lamp is off, its filament is cold and brittle and the shock of a collision can cause it to fracture (break apart) with no permanent distortion. This condition is called "Cold Shock" (Figure 1). When a lamp is on, its filament is hot and ductile and can permanently distort during a collision. This condition is called "Hot Shock." The amount of distortion varies considerably with the level of shock the lamp sustains during the collision. Major distortion (severe twisting and stretching of the filament coils) is conclusive evidence that the lamp was illuminated at the time of impact (Figure 2). Minor distortion (slightly bowed or curved filament) is not as conclusive. It may result from hot shock, or from a normal condition that existed prior to impact which was caused by a mechanism other than a hot shock.

Minor distortion of lamp filaments can be introduced during manufacture of the lamp. When the filament is attached to its supporting posts, it can be distorted into a subtle "S" shape (Figure 3) or bow (Figure 4). Manufacturing related distortion will still display substantially uniform spacing of the filament coils (Figures 3 and 4).

* Senior Mechanical Engineer, Triodyne Inc., Niles, IL.

** Principal Mechanical Engineer, Triodyne Inc., Niles, IL.

SAFETY PRODUCTS:
Triodyne Safety Systems, L.L.C.
(Est. 1998)
5950 West Touhy Avenue
Niles, IL 60714-4610
(847) 677-4730
FAX: (847) 647-2047

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(Est. 1984)
5950 West Touhy Avenue
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(847) 647-1101

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Maywood, IL 60153-2307
(312) 261-1712
(708) 345-5444
FAX: (708) 345-4004

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Niles, IL 60714-4610
(847) 647-8866
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FIRE AND EXPLOSION:

Triodyne Fire & Explosion Engineers, Inc.
(Est. 1987)

2907 Buhrfield Road
Suite 120
Oak Brook, IL 60523-1176
(630) 573-7707
FAX: (630) 573-7721

Officers/Directors

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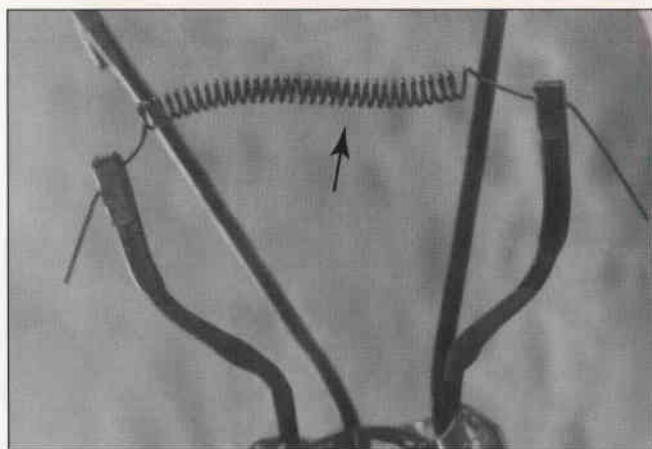


Figure 3 – Manufacturer Induced Subtle "S" Shape
(Unused "Wagner" 1157 Bulb)

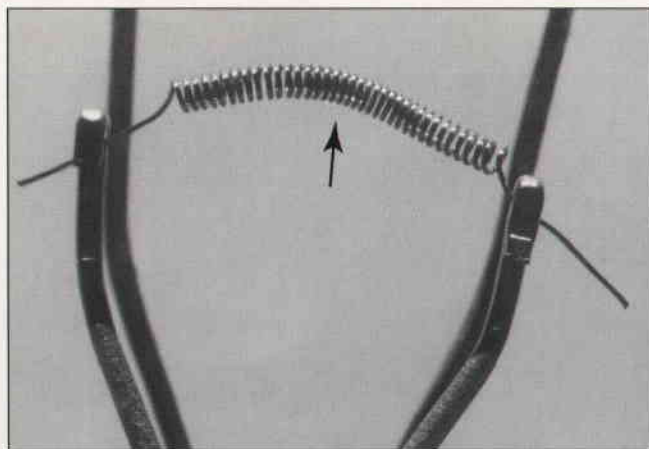


Figure 4 – Manufacturer Induced Filament Bowing
(Unused "Phillips" 1157 Bulb)

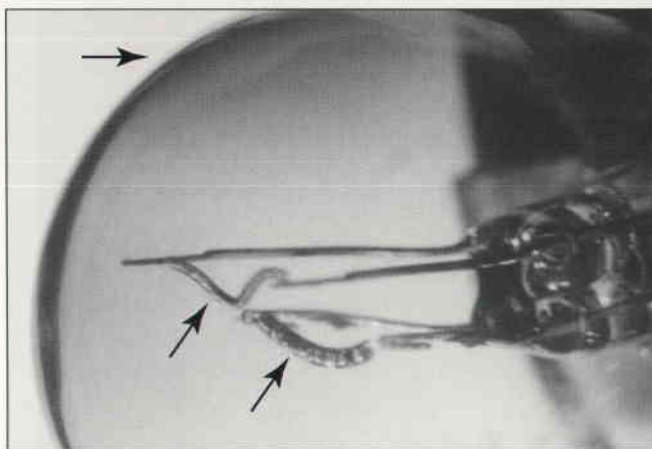


Figure 5 – Age Sag and Darkened Glass - Old Bulb

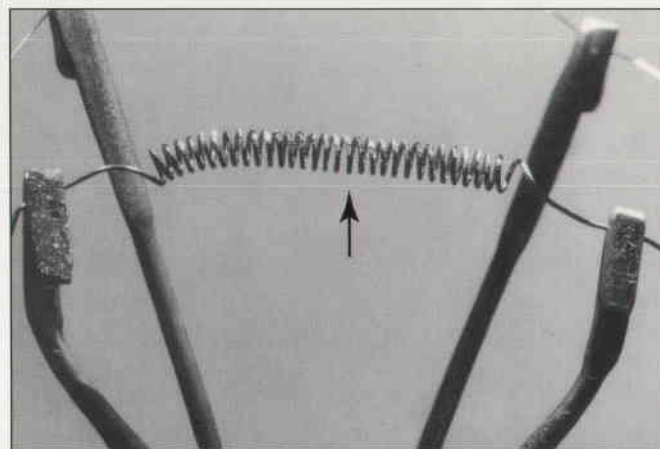


Figure 6 – Rough Pitted Surface - Old Bulb

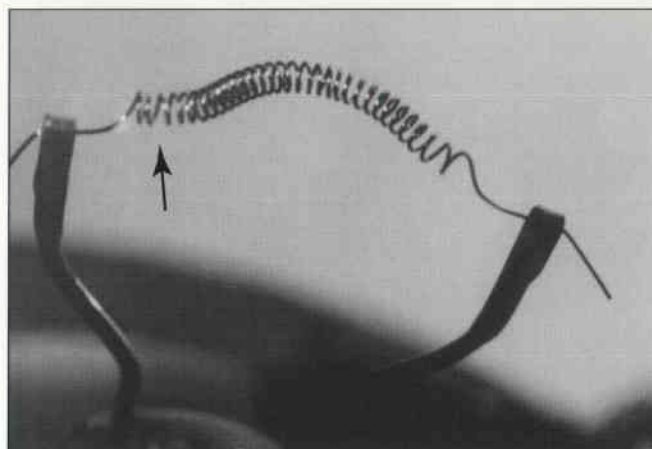


Figure 7 – Stretched Coils Near Ends of Filament
(Laboratory Test Induced Hot Shock)

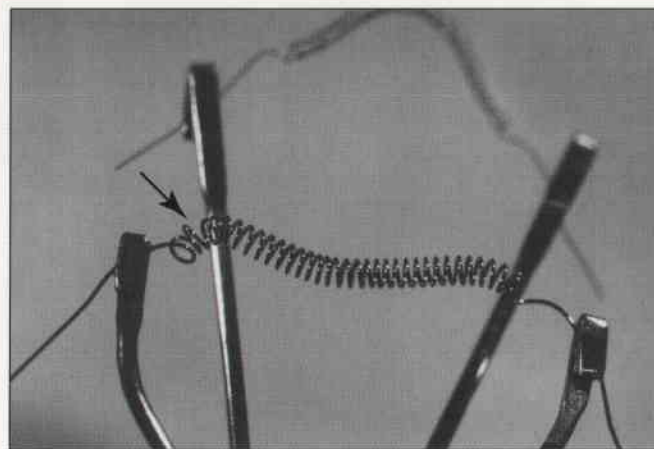


Figure 8 – Stretched Coils Near Ends of Filament
(Laboratory Test Induced Hot Shock)

Another cause of minor filament distortion is age. This distortion is always downward and is referred to as "Age Sag" (Figure 5). In addition to the minor downward distortion of the aged filament, one may find the glass above the filament darkened (Figure 5) and the filament wire rough and pitted in appearance (Figure 6). As with the manufactured distortion, the spacing of the filament coils remains substantially uniform.

Minor distortion from hot shock can be similar in degree and appearance to the distortions resulting from

manufacturing or age sag. In fact, there may be cases where all three types of distortion coexist and cannot be distinguished from one another. The presence of a few obviously stretched coils, however, generally indicates that the filament was stretched from hot shock and that the lamp was illuminated at the time of impact. For example, the stretching of coils at the ends of the filaments shown in Figures 7 and 8 was caused by mild hot shock in laboratory tests. The degree of coil stretching at the ends of these filaments is not normally caused by manufacturing or age sag.