
High Beam and Low Beam Filament Identification in Dual Filament Headlamp Sealed Beams and Replaceable Bulbs

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ABSTRACT

A pictorial reference for the identification and location of the filaments and electrical contacts for common motor vehicle dual filament sealed beam headlamps and dual filament replaceable headlamp bulbs is presented. The filaments and contacts shown in the reference photographs are clearly identified to facilitate comparison to headlamps or bulbs under investigation.

A common aspect of reconstruction of motor vehicle collisions is the determination of the state of illumination of the headlights at the time of impact. Changes in the surface oxide condition of the headlamp filaments, if the glass envelope is fractured, and changes in the shape of the filament coil can provide positive indications that the filament was energized at the time of impact. Dual filament headlamp units have the additional requirement that the deformed and/or oxidized filament needs to be identified as to high beam or low beam. In spite of the fact that the un-energized filament experiences some secondary heating from the adjacent filament, the energized filament generally displays more pronounced changes resulting from the collision. The identification of the high and low beam filaments must be made based upon known characteristics of the headlamp or bulb unit, as manufactured. The variety of sealed beam headlamp units, halogen-type sealed headlamps and replaceable headlamp bulbs installed on trucks, passenger vehicles and motorcycles requires a substantial amount of reference information for filament identification. One well known source of information for identification is a publication by Northwestern University Traffic Institute that addresses lamp examination for on or off¹. Although this reference does provide information for identification of the high and low beam filaments of common sealed beam headlamps,

it does not adequately discuss replaceable headlamp bulbs. Another source of information for identification of the high and low beam filaments is the applicable Society of Automotive Engineers (SAE) standards^{2,3}. Some of the necessary information for filament identification for all of the Federal Motor Vehicle Safety Standards (FMVSS) approved headlamps and bulb types can be found in the SAE standards. However, reliable identification of the correct diagram for the bulb or headlamp in question can be quite tedious and difficult. In addition, the SAE standards for sealed beams are directed towards photometric requirements for the resultant headlight beam rather than specifically addressing filament location and configuration. Finally, information could be obtained from the appropriate bulb manufacturer concerning the layout of the filaments. Identification by this method requires an adequate level of information concerning the specific type of headlamp or bulb.

The purpose of this paper is to provide a pictorial reference of all of the common dual filament headlamps and replaceable headlight bulbs available in the United States. The sealed beams and replaceable bulbs examined and photographed were purchased from several automotive supply stores. Two different bulb manufacturers are represented in the collection of samples. The photographs of the headlamp and bulb assemblies demonstrate the geometrical location and appearance of the filaments and the arrangement of the electrical contacts for the filaments. The contacts and filaments in each photograph are clearly identified. Table 1 lists the headlamps and replaceable bulbs documented in this paper.

The identification code for the sealed beam style headlamps is located on the front of the assembly, near or at the center top. The identification code for the replaceable bulbs is generally printed on the base of the bulb. Multiple versions of the 2A1, 2B1 and 2D1 headlamps are

available. The versions of each have different design lives and different design power outputs. However, each version has the same dimensions and identical filament and contact geometries. Two sealed beam type units are not included in this comparison. Types 2G1 and 2H1, as shown in SAE J1383, have the same face dimensions and contact geometry as types 2A1 and 2E1. The different designation is due to the integral mounting tabs present on the 2G1 and 2H1 type units. The sealed envelope dimensions are identical for the vacuum and halogen styles of each particular sealed unit. The replaceable bulbs listed in Table 1 include bulbs that are currently installed in motorcycle headlamps. Historically, some motorcycle manufacturers installed a large variety of uniquely styled sealed beam units for different models. No attempt was made to reference these unique sealed beams.

REFERENCE PHOTOGRAPHS

The identification of the filaments installed in the sealed beams and replaceable bulbs shown in the following photographs was based upon the appropriate SAE standards and the Northwestern University Traffic Institute publication. The following identification labels have been used in all of the photographs: High beam filament - HB, low beam filament - LB, ground contact - G.

The filament locations in the sealed beam assemblies follow a consistent pattern that is independent filament environment, vacuum or halogen. The high beam filament is always located centrally, along the axis of the beam. The low beam filament is positioned above the high beam and, therefore, somewhat off axis. The off-axis placement of the low beam filament results in a decrease in the illumination range compared to the high beam.

The most common electrical contact arrangement for the sealed beams is a "triangular" layout with the ground contact at the lower left and the low beam contact towards the top of the headlamp, at the apex of the triangle. However, for two of the sealed beam types (2A1 and 2E1) the contacts are arranged in an inverted triangle configuration. The ground contact is at the upper left of the inverted triangle and the high beam contact is towards the bottom of the headlamp, at the triangle apex. It is important to note that rotation of the 2A1 or 2E1 sealed beams such that the contact configuration matches that of most of the sealed beams will not result in proper identification of the 2A1 and 2E1 contacts.

The HB1 replaceable bulb is the only bulb with a similar filament arrangement to the sealed

beam headlamps. In this replaceable bulb, the low beam filament is located above the high beam filament. However, the position of the filaments relative to the axis of the headlamp is difficult to determine when examining the bulb alone.

A significant inconsistency exists concerning the identification of the contacts for the HB1 and HB5 replaceable bulbs. The configuration of the base and the contact arrangement for the HB1 bulb are virtually identical to those of the HB5 bulb. However, the actual contact identification for the two bulbs is different. When viewing the base of the HB5 bulb with the reference tab at the top, in the normal installed orientation, the low beam contact is on the left and the ground contact is in the middle. In viewing the base of the HB1 bulb in the same manner, these two contacts are reversed with the ground contact on the left and the low beam contact in the middle. The HB2 and H4 replaceable bulbs are essentially identical with respect to the filament locations and the arrangement of the electrical contacts.

Figure 1 shows the front of the 2B1 rectangular sealed beam (142mm X 200mm) unit on the left and the 2A1 rectangular sealed beam (100mm X 165mm) on the right. The units shown in Figure 1 are halogen style sealed beams. However, the overall dimensions and appearance of the halogen type beams are identical to the vacuum type beams.

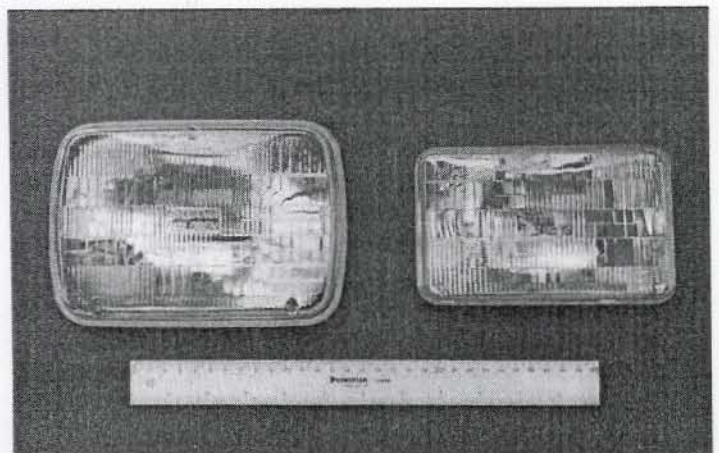


Figure 1. 2B1(left) and 2A1(right) sealed beams.

Figure 2 shows the front of the circular 2D1 sealed beam (178mm dia.) on the left and the 2C1 sealed beam (146mm dia.) on the right. Both sealed beams in Figure 2 are vacuum style units. The halogen equivalents for these two sealed beams are identical in appearance and overall dimensions.

Figure 3 is a view of the front of the rectangular 2E1 sealed beam (100mm X 165mm). This type of sealed beam is manufactured with a

halogen envelope and is not available in a vacuum style.

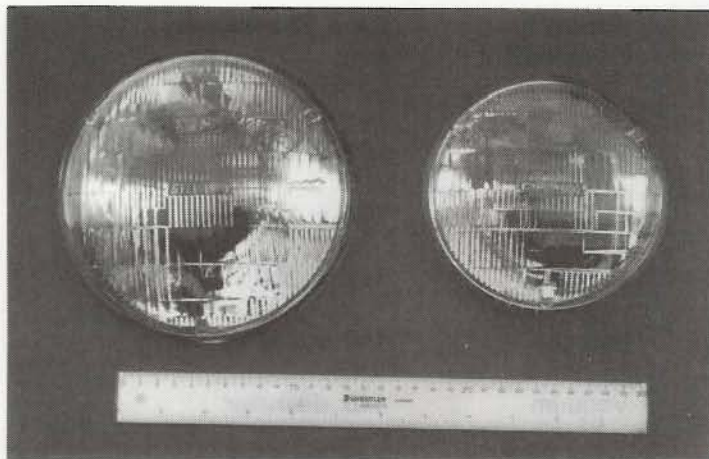


Figure 2. 2D1(left) and 2C1(right) sealed beams.

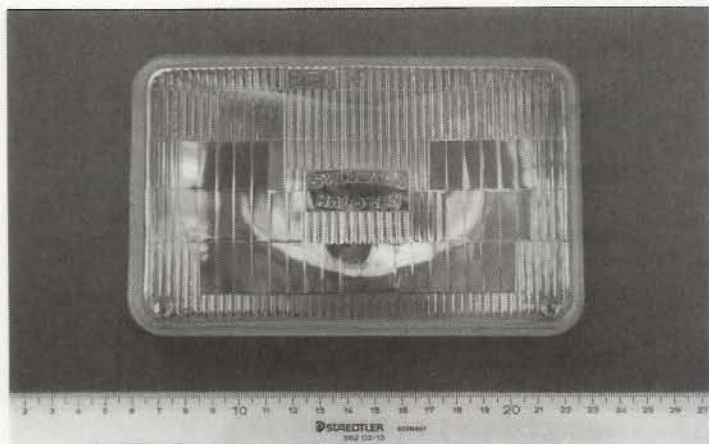


Figure 3. 2E1 sealed beam.

Figure 4 is a side view of a sectioned vacuum style sealed beam showing the filament arrangement for the 2A1 and 2B1 type units. The orientation of the filaments is upright as installed on the vehicle, with the forward direction to the right.

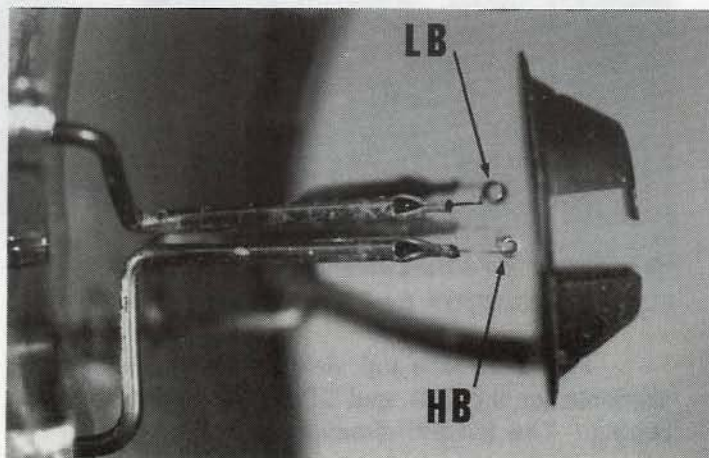


Figure 4. Side view, 2A1 and 2B1 filaments.

Figure 5 is a close-up top view of the filaments for the 2A1 and 2B1 type vacuum sealed beams. The front of the headlamp is to the right.

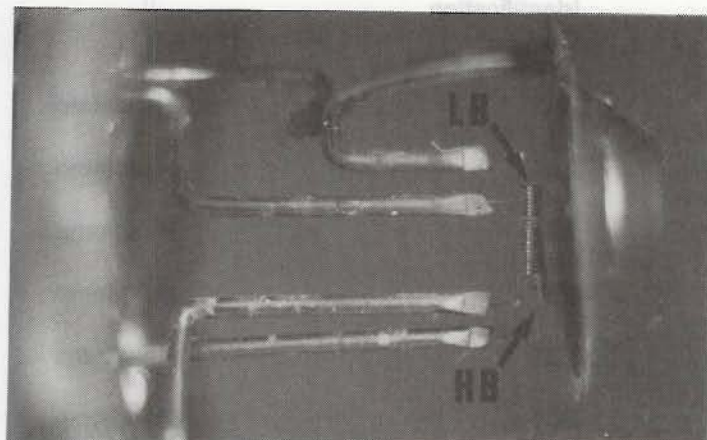


Figure 5. Top view, 2A1 and 2B1 filaments.

Figure 6 is a side view of the interior bulb envelope and filaments for a halogen style 2A1 and 2B1 type sealed beam. The sealed beam section is shown upright with the forward direction to the right.

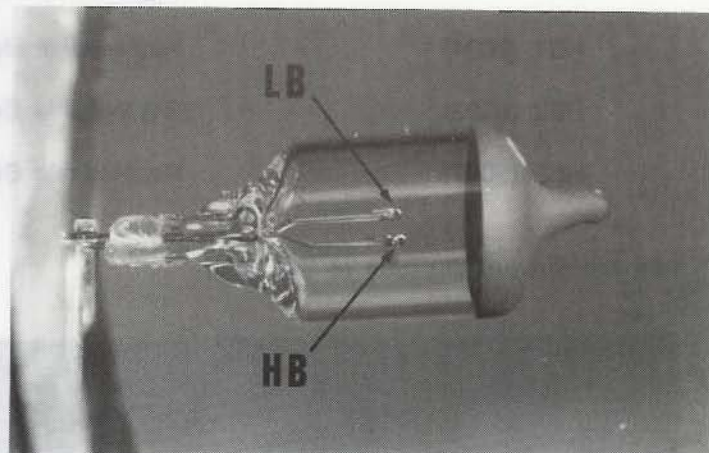


Figure 6. Side view, 2A1 and 2B1 envelope.

Figure 7 is a close-up top view of the filaments for the halogen style 2A1 and 2B1 type sealed beams. The forward direction is to the right.

Figure 8 shows the electrical contact geometry for the 2A1 type sealed beam unit. The normal upright orientation of the contacts is shown. The contact geometry is the same for both the vacuum and halogen style sealed beams.

Figure 9 is a view of the electrical contacts for the 2B1 type sealed beam. The orientation of the contacts is as installed on the vehicle.

Figure 10 is a side view showing the location of the filaments for the vacuum sealed 2C1 and 2D1 type sealed beams. The section is oriented upright

Table 1. Headlamps and Replaceable Bulbs Documented By Photographs

Headlamp or Bulb Identification Code	Assembly	Filament Environment	Face Dimensions, mm
2A1	Headlamp	Vacuum	100 x 165
2A1	Headlamp	Halogen	100 x 165
2B1	Headlamp	Vacuum	142 x 200
2B1	Headlamp	Halogen	142 x 200
2C1	Headlamp	Vacuum	146 diameter
2C1	Headlamp	Halogen	146 diameter
2D1	Headlamp	Vacuum	178 diameter
2D1	Headlamp	Halogen	178 diameter
2E1	Headlamp	Halogen	100 x 165
H4	Replaceable Bulb	Halogen	
HB1 (9004)	Replaceable Bulb	Halogen	
HB2 (9003)	Replaceable Bulb	Halogen	
HB5 (9007)	Replaceable Bulb	Halogen	

with the forward direction to the right.

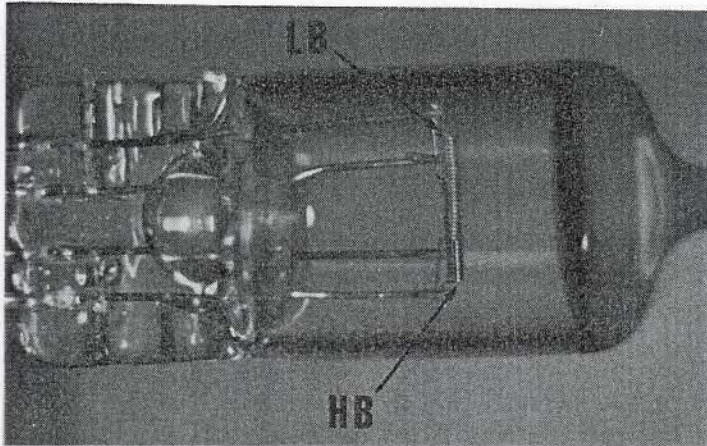


Figure 7. Top view, 2A1 and 2B1 envelope.

Figure 11 is a top view of the filaments for the 2C1 and 2D1 vacuum sealed beams. The forward direction is to the right.

Figure 12 is a side view of a halogen style sealed beam showing the glass envelope and filament locations for the 2C1 and 2D1 type sealed

beams. The section is oriented upright with the forward direction to the right.

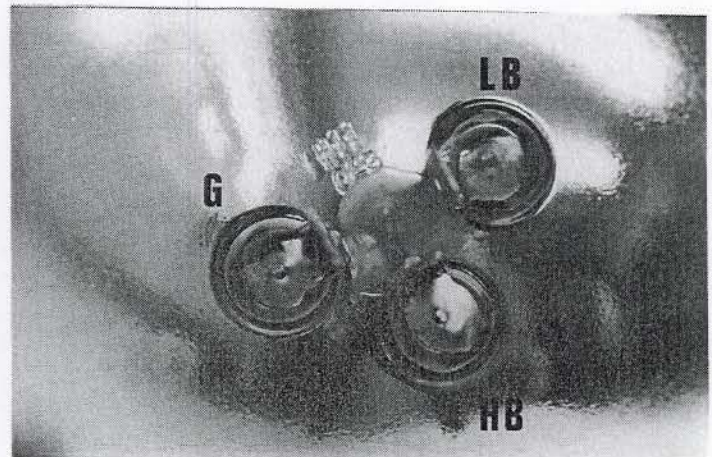


Figure 8. Contacts for 2A1 sealed beam.

Figure 13 is a top view of the envelope and filaments for the 2C1 and 2D1 type halogen sealed beams. The forward direction is to the right.

Figure 14 shows the electrical contact arrangement for the 2C1 and 2D1 type sealed

beams. The configuration shown is the same for the vacuum sealed and halogen envelope styles. The contacts are shown in the normal upright orientation.



Figure 9. Contacts for 2B1 sealed beam.

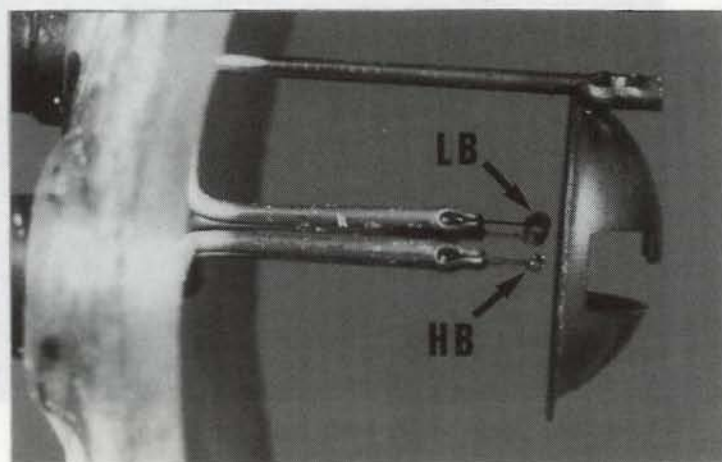


Figure 10. Side view, 2C1 and 2D1 filaments.

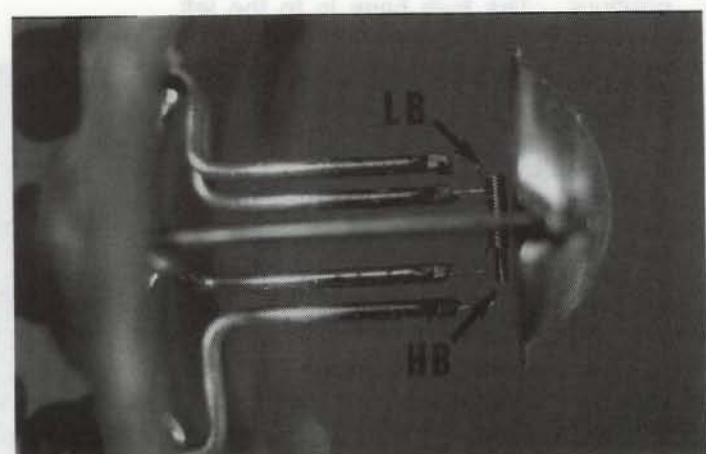


Figure 11. Top view, 2C1 and 2D1 filaments.

Figure 15 is a side view of the halogen envelope and filament locations for the 2E1 type sealed beam. The envelope is oriented upright with the forward direction to the right.

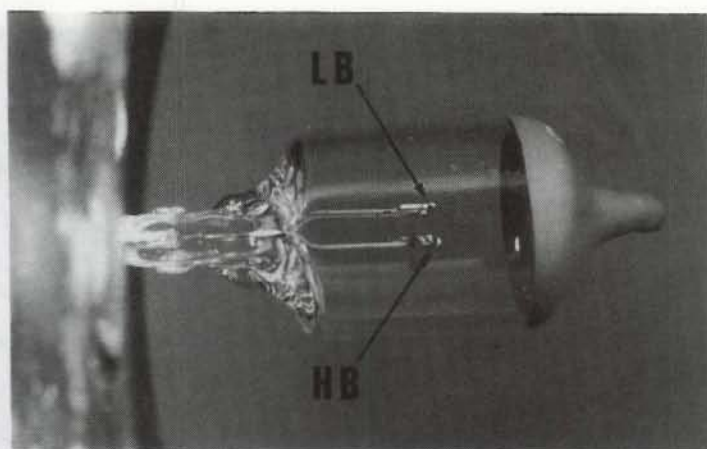


Figure 12. Side view, 2C1 and 2D1 envelope.

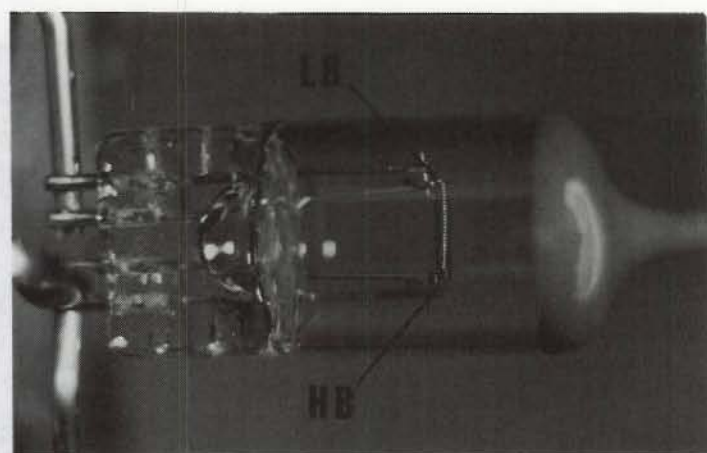


Figure 13. Top view, 2C1 and 2D1 envelope.

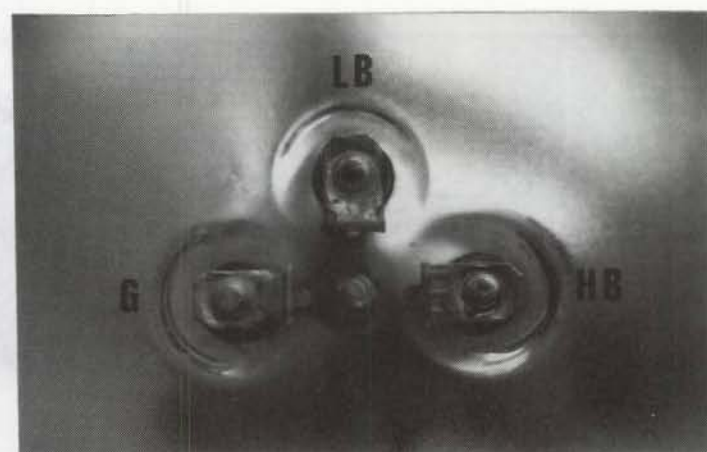


Figure 14. Contacts for 2C1 and 2D1 beams.

Figure 16 is a top view of the halogen envelope and filament positions for the 2E1 type sealed beam. The forward direction is to the right.

Figure 17 is a view of the electrical contact arrangement for the 2E1 type sealed beam, positioned in the normal installed orientation. The contact arrangement is the same as that for the 2A1

type rectangular sealed beam.

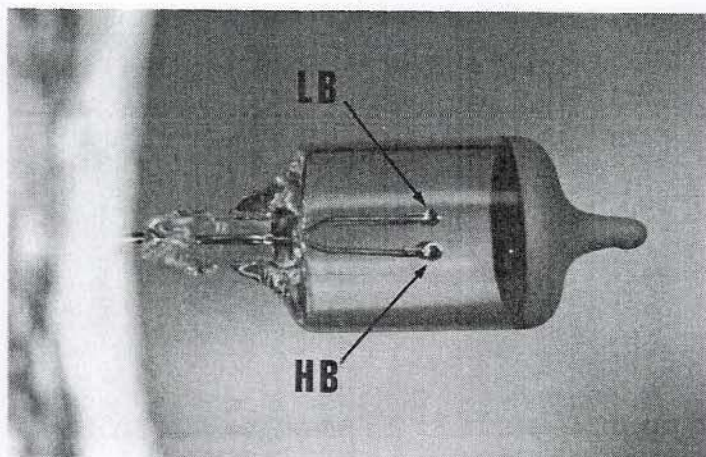


Figure 15. Side view, 2E1 envelope.

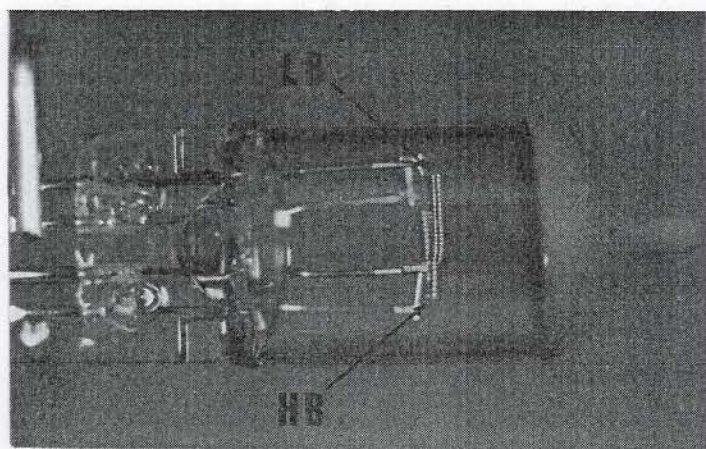


Figure 16. Top view, 2E1 envelope.

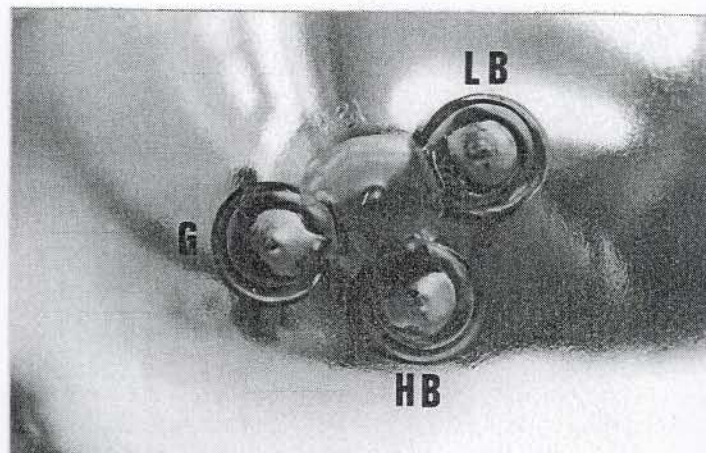


Figure 17. Contacts for 2E1 sealed beam.

Figure 18 shows the HB5 type replaceable headlamp bulb. The index tab on the base of the bulb holder, indicated by the arrow, designates the "up" position for the assembly as installed on the vehicle.

Figure 19 is a close-up side view of the HB5

bulb enclosure showing the filament locations. The base of the bulb is to the left.

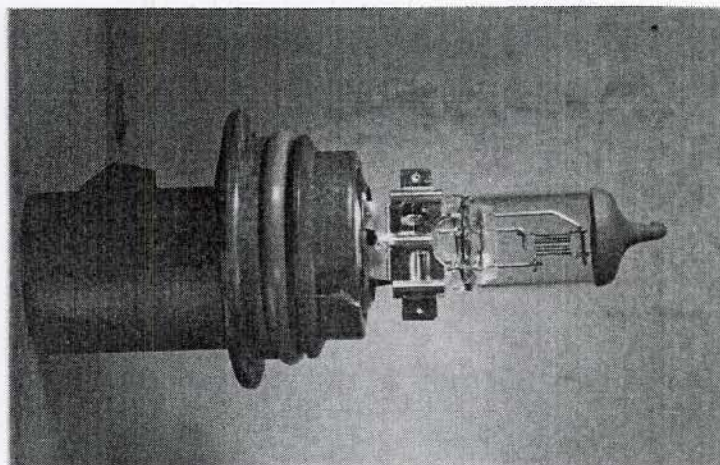


Figure 18. HB5 replaceable bulb.

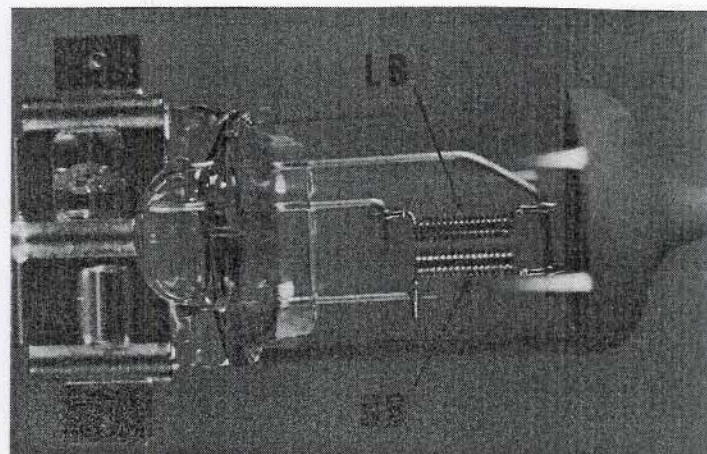


Figure 19. Side view, HB5 bulb envelope.

Figure 20 is a top view of the HB5 replaceable bulb enclosure showing the filament positions. The bulb base is to the left.

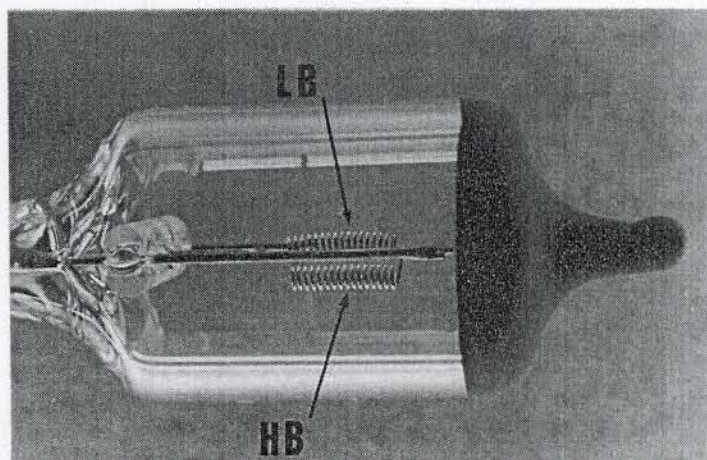


Figure 20. Top view, HB5 bulb envelope.

Figure 21 is a view of the base of the HB5 bulb showing the positions of the electrical contacts.

Note the installed position reference tab at the top of the base, indicated by the arrow. The center ground contact for this bulb is slightly offset, in a vertical direction, from the other two contacts.

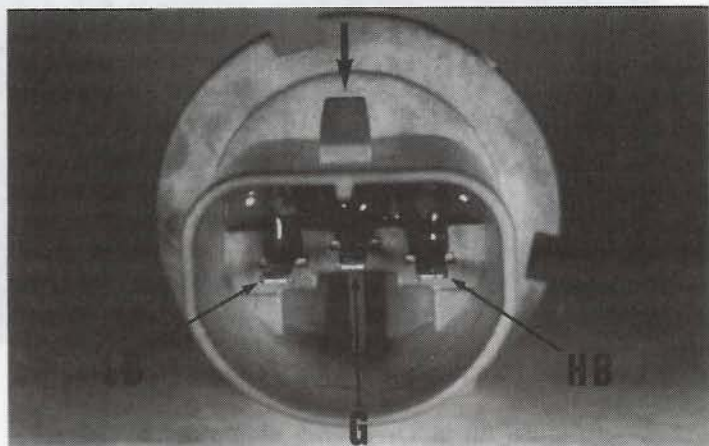


Figure 21. Contacts for HB5 replaceable bulb.

Figure 22 is an overall side view of the HB1 replaceable bulb. The "up" position reference tab on the base of the bulb is indicated by an arrow.

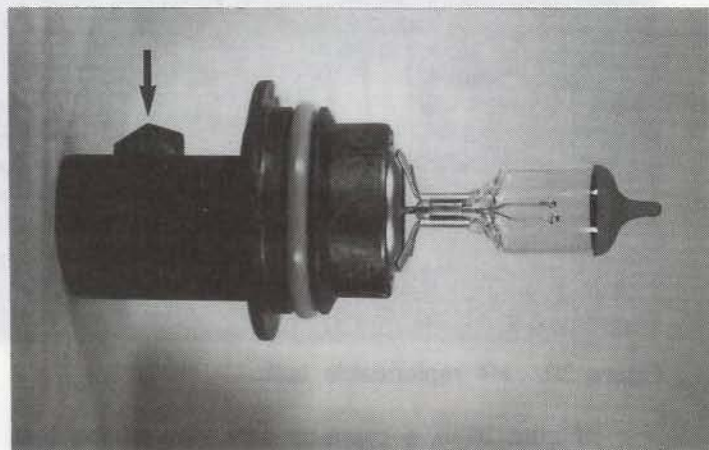


Figure 22. HB1 replaceable bulb.

Figure 23 is a close-up side view of the glass envelope for the HB1 bulb showing the filament positions. The base of the bulb is to the left in the figure.

Figure 24 is a top view of the bulb enclosure for the HB1 replaceable bulb showing the filament positions. The base of the bulb is to the left.

Figure 25 is an end view of the base of the HB1 bulb showing the arrangement of the electrical contacts. Note the position reference tab at the top of the base, indicated by the arrow. The center low beam contact for this bulb is offset from the other two contacts in a vertical direction.

Figure 26 is a side view of the HB2

replaceable headlight bulb. The bulb is oriented in the "as installed" position on the vehicle as shown in the figure.

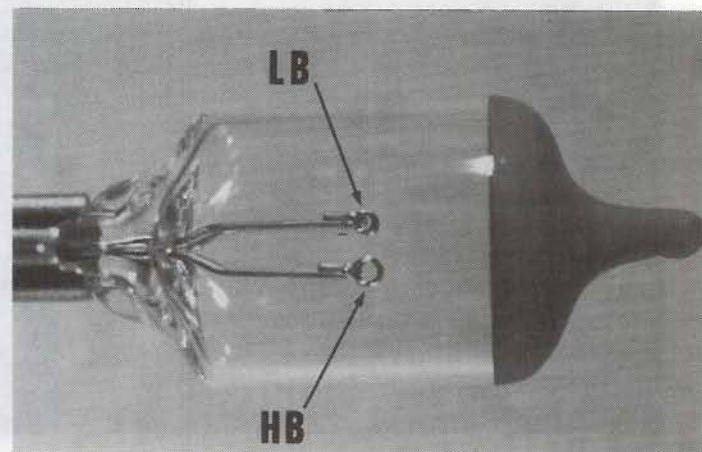


Figure 23. Side view, HB1 bulb envelope.

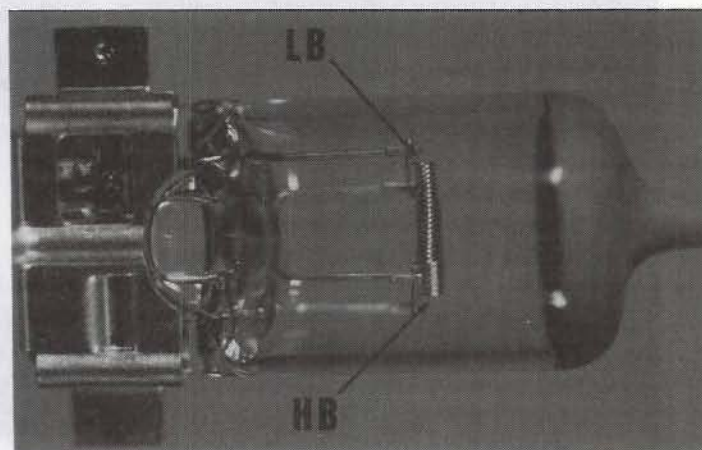


Figure 24. Top view, HB1 bulb envelope.

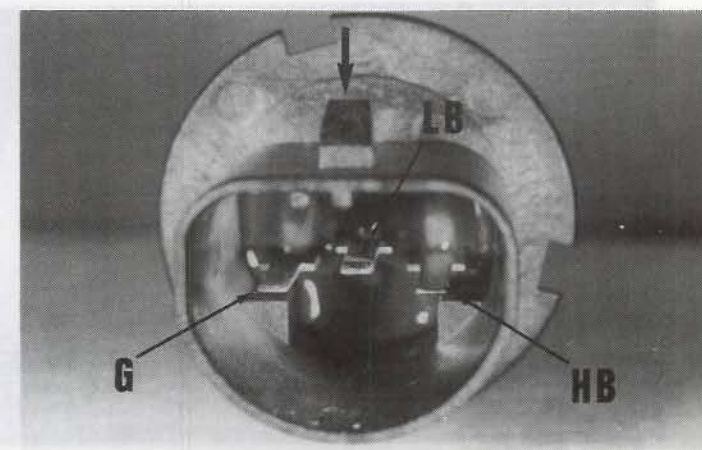


Figure 25. Contacts for HB1 replaceable bulb.

Figure 27 is a closer side view of the envelope for the HB2 bulb showing the positions of the filaments. The base of the bulb is to the left.

Figure 28 is a top view of the HB2

replaceable bulb showing the filament positions. The base of the bulb is to the left.

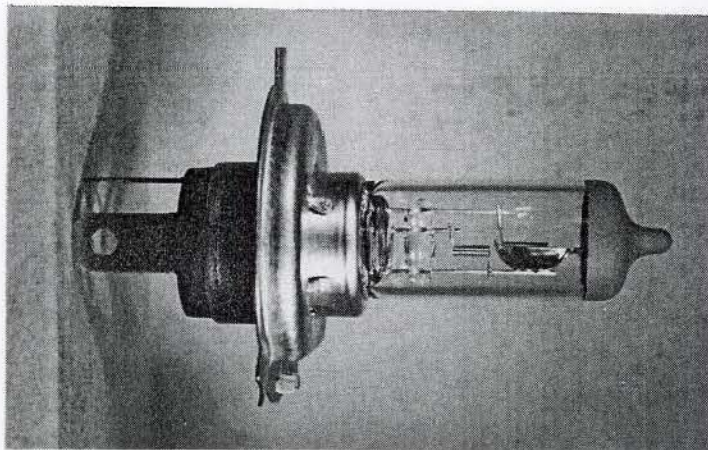


Figure 26. HB2 replaceable bulb.

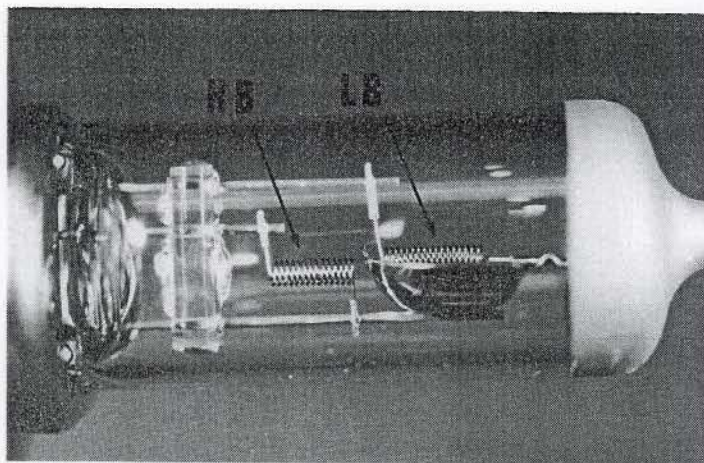


Figure 27. Side view, HB2 bulb envelope.

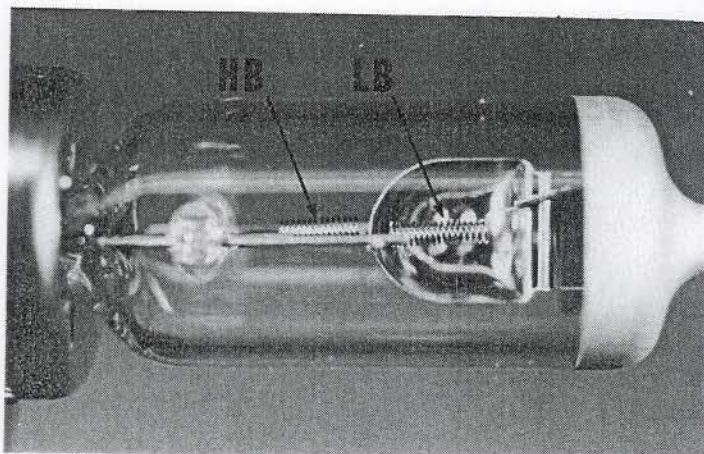


Figure 28. Top view, HB2 bulb envelope.

Figure 29 is an end view of the base of the HB2 bulb showing the arrangement of the electrical contacts. Three installation tabs are located around the perimeter of the bulb base. One of the tabs is located at the "up" position as installed on the vehicle.

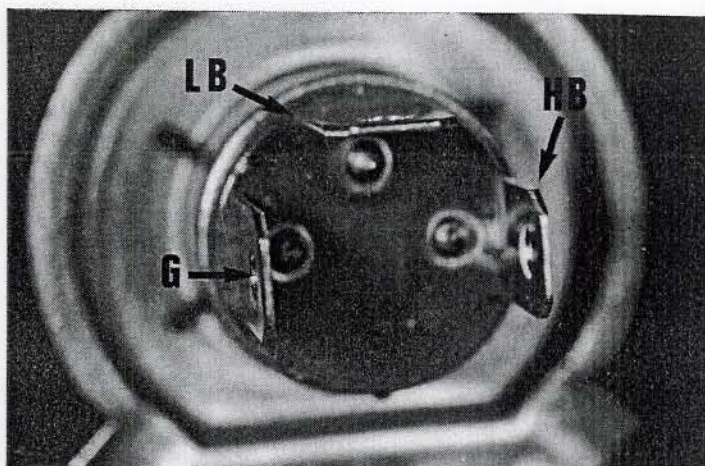


Figure 29. Contacts for HB2 replaceable bulb.

Figure 30 is an overall side view of the H4 replaceable headlamp bulb. The bulb is oriented in the "as installed" position as shown in the figure.

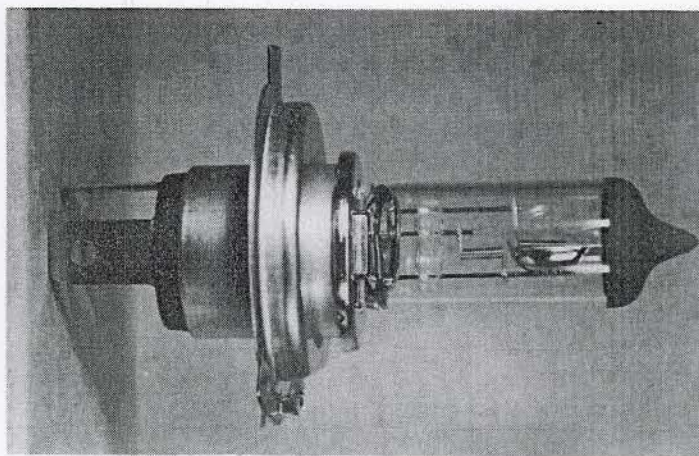


Figure 30. H4 replaceable bulb.

Figure 31 is a close-up side view of the bulb enclosure for the H4 bulb showing the positions of the filaments. The base of the bulb is to the left.

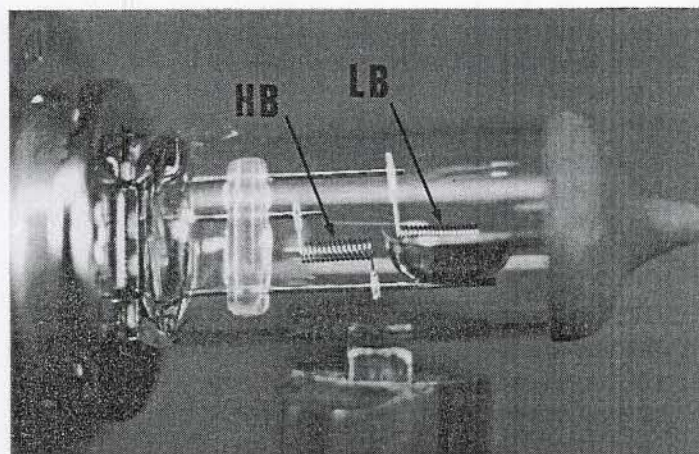


Figure 31. Side view, H4 bulb envelope.

Figure 32 is a top view of the H4 bulb enclosure showing the filament arrangement. The base of the bulb is to the left.

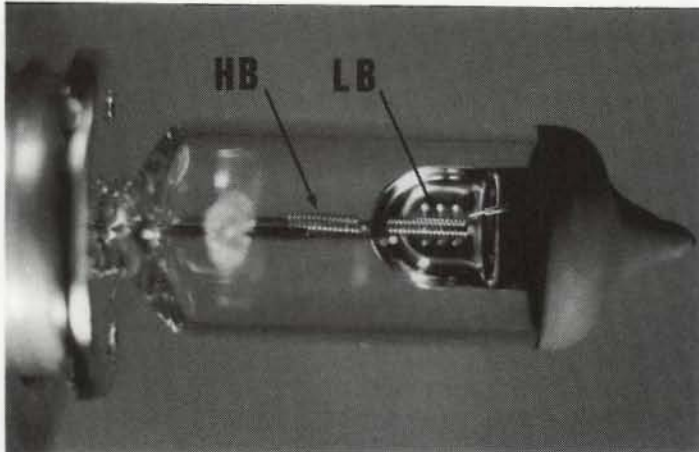


Figure 32. Top view, H4 bulb envelope.

Figure 33 is an end view of the base of the H4 bulb showing the configuration of the electrical contacts. This bulb is similar to the HB2 bulb in that the bulb base contains three location tabs around the base perimeter. As with the HB2 bulb, one of the tabs is located at the top of the base as installed on the vehicle.

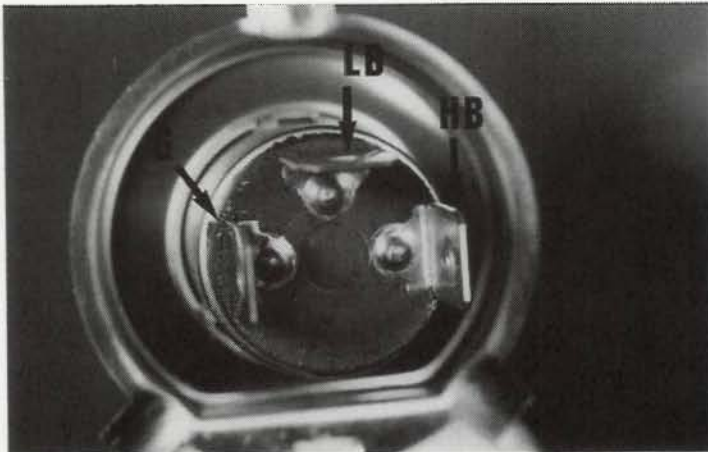


Figure 33. Contacts for H4 replaceable bulb.

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