E30 Headlight Wiring Instructions

Converting Sealed Beam Systems to Ellipsoid/European Style Headlight Systems Utilizing Single Filament Bulbs

X Mon™

Revision B
12 September, 2007

This document details the steps required to convert a sealed beam headlight system as found in the 1984 through 1987 and 1990 on BMW E30 to a US Ellipsoidal/Euro Smiley/Cibie CSR based system. The US Ellipsoid system uses single element 9005 and 9006 bulbs for the high and low beams respectively, whereas the Euro Smiley and Cibie CSR systems use a single element H1 bulb for BOTH the high and low beams. As an added caveat, due to the interdependence of the low beam and fog light circuits, a discussion of rewiring to maintain the fog light unloader circuit (fogs off with highs on) is also presented. This document is the first in a series of three publications describing modifications typically preformed to the headlight, high beam and fog light systems of the second generation 3 Series BMW.

The "Legal" Mumbo Jumbo

I'm human, I fuck up, my brain gets ahead of my fingers. If you find errors in anything written, let me know. I will correct them. Of course anything you do on YOUR car is at YOUR OWN risk. I cannot, will not, and refuse to be held responsible for any damage you may inflict, or any adverse performance you may encounter.

Written solely from my own experience on installations in an '89 and a '90 325iX

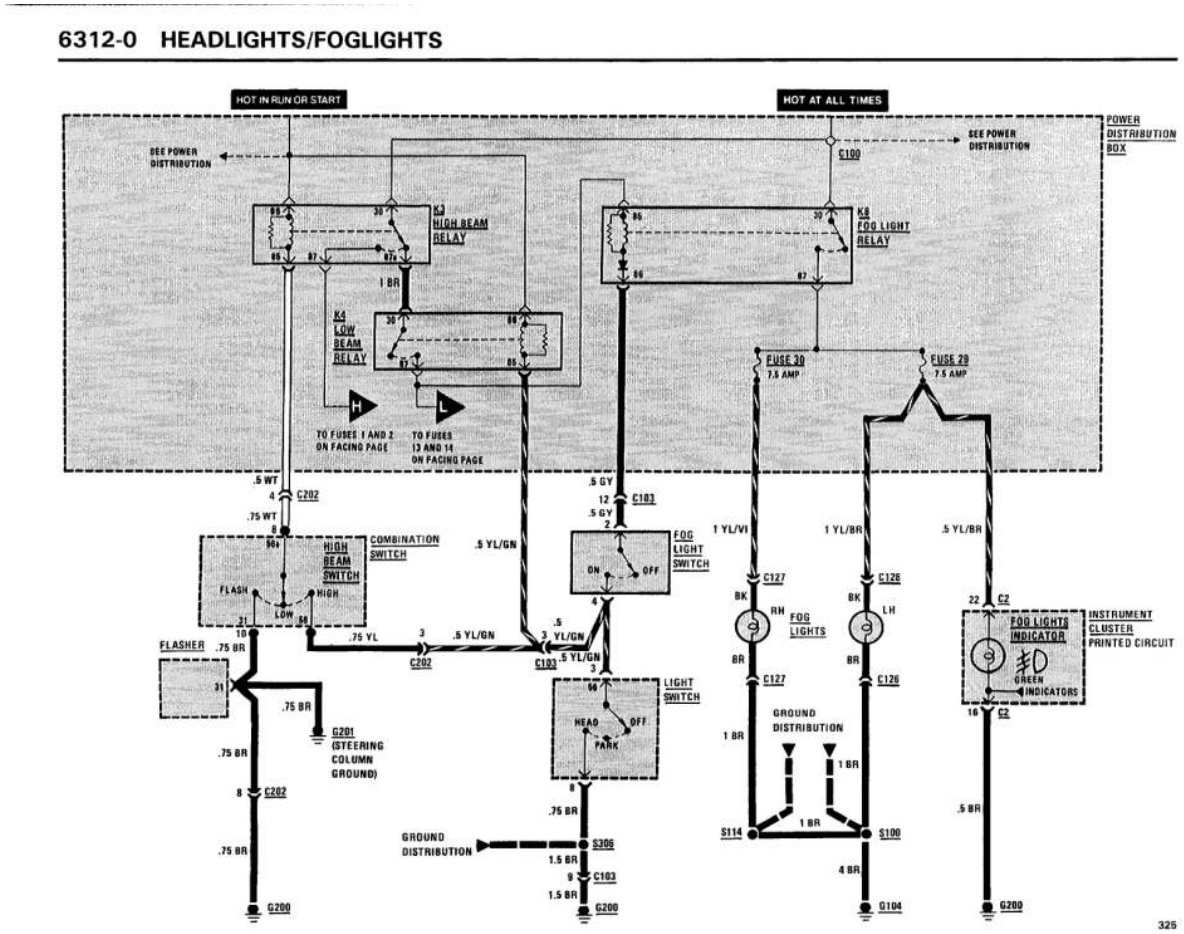
-M

Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

The Background

The US specification E30 head light wiring circuit utilized 3 different headlight/fog light configurations during its production run. BMW utilized three variants, Figure 1, an early sealed beam system that was utilized between 1984 and 1987, a late sealed beam configuration that was used from 1990 through the end of production, and an ellipsoid system during 1988 and 1989. It is interesting to note that the only difference between the early and late sealed beam wiring configurations is the difference in the headlight switch. This variance is show in the ground path of the fog light switch

Fig 1a: 1984-1987 Early Sealed Beam Wiring



Figures 1a-e ©1998 BMW of North America, Full Scale Figures at End of Document

Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Fig 1b: 1990 on Late Sealed Beam Wiring

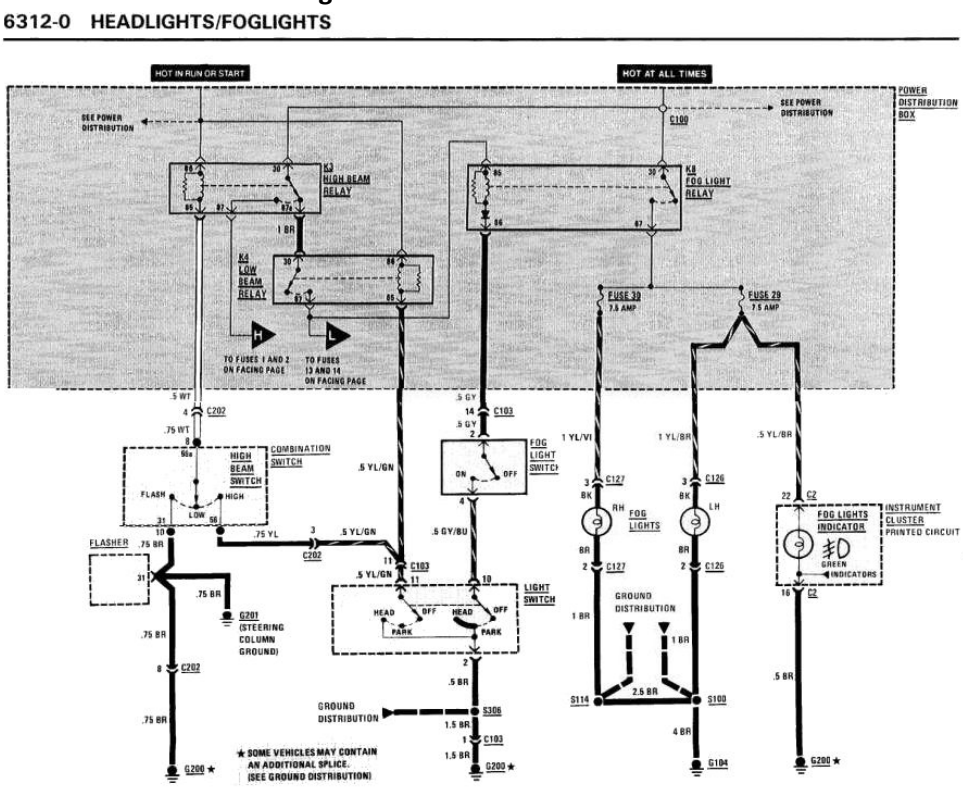
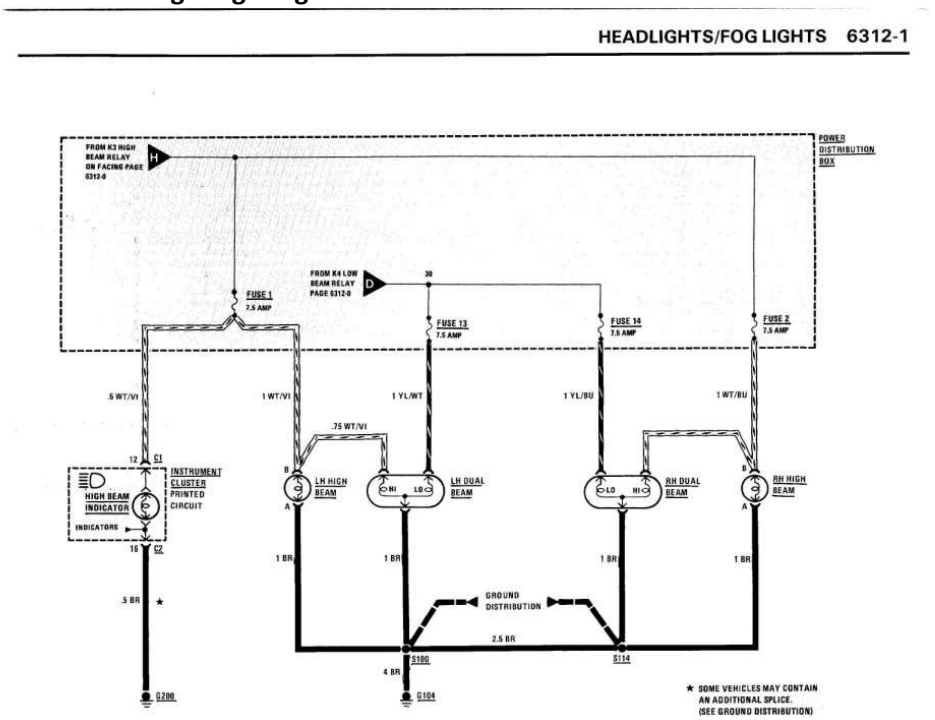


Fig 1c: Sealed Beam Wiring – Lighting



Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Fig 1d: 1988 and 1989 Ellipsoid Wiring

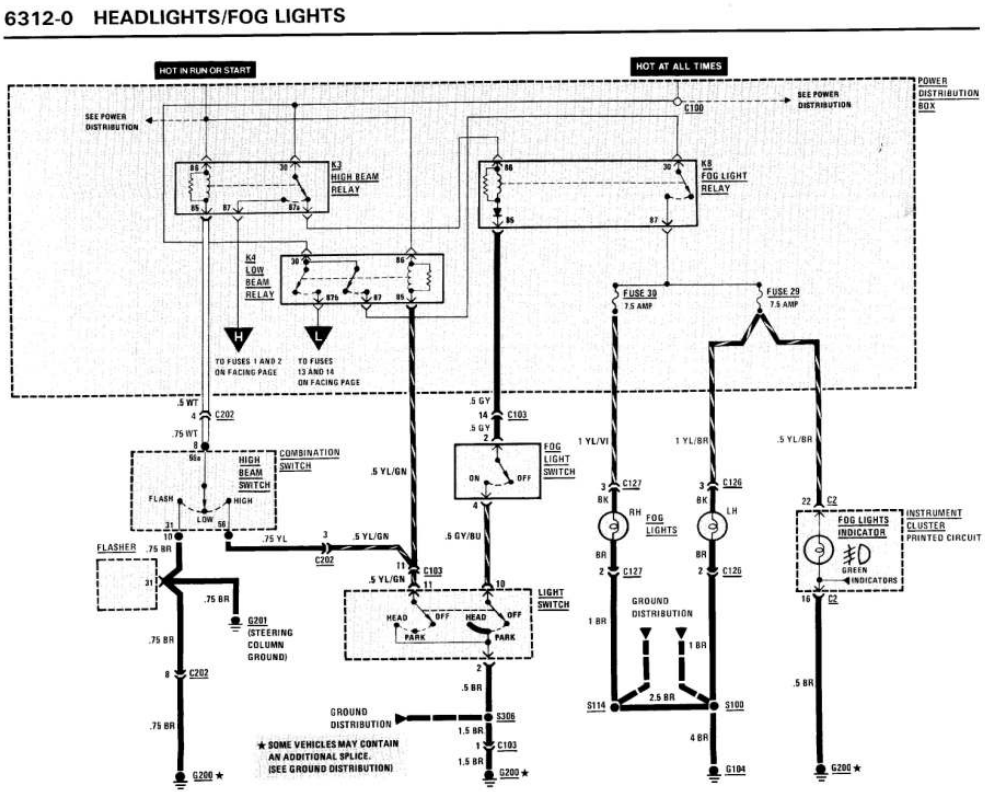
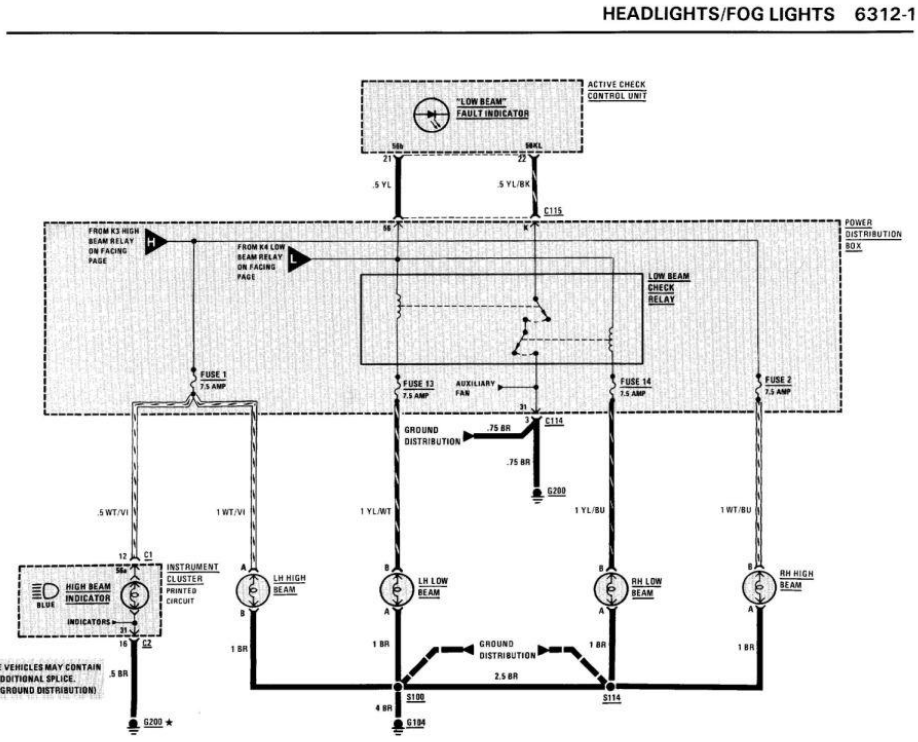


Fig 1e: 1988 and 1989 Ellipsoid Wiring – Lighting



Examining Figures 1c and 1e, it is soon apparent the outer sealed beam bulb is of a dual filament construction, whereas the ellipsoid style bulb is of a single filament composition. The reason for the dual filament in the outer sealed beam is that the lights are designed with two different focal points. When the low beams filament is illuminated its position relative to the reflector and face of the light bulb allow it to cast a shorter, less intense pattern, so as to not blind the oncoming driver. On the other hand, the position of the high beam filament allows the same lens optics to cast a longer, more intense pattern in front of the vehicle. Based on the design, it would be pointless to illuminate both of these filaments at the same time. Additionally, illumination of both filaments at the same time may cause early failure of the filaments due to heat related issues within the lens assembly. Therefore, the sealed beam cars were designed to have an unloader circuit, driven by the high beam relay, turn off both the fog lights and the low beam filament of the outer headlight when the high beams are illuminated. This circuitry can be seen in Figures 1a and 1b.

Turing ones attention to the High Beam Relay (K3) in Figure 1a or 1b, one finds that Pin 87a, hot with the high beams OFF, is the power source for the Low Beam Relay (K4) at Pin 30. One also notes that with K3 energized, Pin 87a is now cold, while Pin 87 is hot. Thus even with the headlight switch in the on (HEAD) position this filament will turn off when the high beams are ON. Additionally it is interesting to note that the Fog Light Relay (K8) unloads from the down relay side of K4. This means that if you modify the circuit to keep the low beam circuit active when the high beams are on, your fog lights will stay on as well. In some states this can create issues with regard to passing safety inspection. We will revisit the fog lights later. Taking a look at the Figure 1c, one sees that the high beam filament of the outer light is illuminated on a common circuit with the high beam (inner) light. Thus it is obvious that the circuit cannot be tied together on the down current side of things. However, all hope is not lost.

In the ideal world one would connect Pin 87a of K3 to Pin 86 of K8 and then connect Pin 30 of K4 to C100 inside the fuse box. This would result in fog lights with only the parking lights on while maintaining the unloader as well as keeping the head light wiring on when the high beams are turned on. This effectively suggests the creation of a circuit similar to Figure 1d overleaf. Unfortunately, the connection between Pin 87 of K4 and Pin 86 of K8 is an internal trace on the circuit board inside the fuse box.

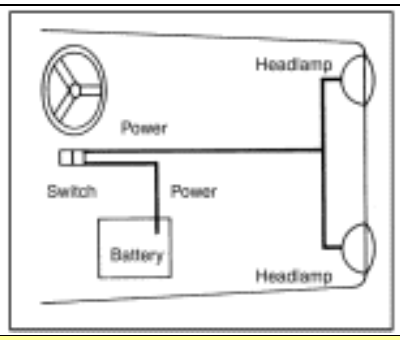
A Brief Note about Relays

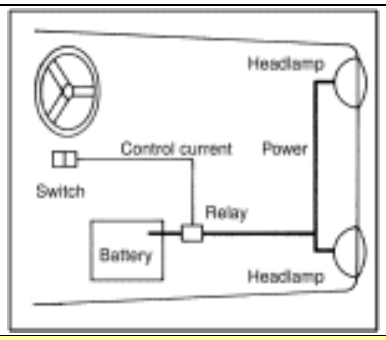
Relays are used to control electrical loads and are elementary components of modern vehicle control units. A relay is a remote-controlled switch operated by electrical current for switching circuits on, off or over. In an electro-mechanical relay, an iron armature is attracted by the current flow in the electro-magnetic coil. Through its movement, the iron armature makes or breaks one or more contacts, which in turn makes, breaks or switches over a load circuit. The current intensity and electrical voltage in the load circuit can be much greater than that in the coil. This allows extremely high voltages and/ or currents to be switched using comparatively small relays [1].

The need for a relay stems from the fact that wiring in itself is a resistive load. Resistances cause voltage drop, which means that consumer performance is reduced. One of the basic rules of electricity states that the electrical resistance of a lead depends on its length and cross-sectional area. The longer and thinner it is, the greater the resistance will be. Higher resistance means less voltage at the far end of the lead, i.e. where the power user is. If the power user is a bulb, a little less voltage means a lot less light, as illustrated in Table 1 [2].

Operating voltage*	Luminous intensity
100%	100%
95%	83%
90%	67%
85%	53%

* 100% = 6,75V
or 100% = 13,5V
or 100% = 27,0V





Important	Not Good	The Best Solution
The importance of optimum operating current and the negative effect voltage drop can have, on the luminous intensity of a bulb, can be seen from the table above.	Power current must travel from battery to headlamps - via the dashboard switch using a large gauge cable. Result: A voltage drop causing reduction in headlamp performance. Possible overloading of switch.	The power current is routed over the shortest distance between battery and headlamp via the relay. A control current lead of only 0.75 sq. mm (current consumption for this lead less than 150 mA!) is required between dashboard switch and relay.

Fortunately, as shown in Figure 2, BMW already uses relay based circuitry for all of the frontal lighting as well as many other high load requirements throughout the vehicle. For the purposes of modifying the fog lights, we will be concerned with the High Beam, Low Beam and Fog Light Relays, K3, K4 and K8 respectively, as labeled in the right hand image.

[1]: http://www.hella.com/produktion/HellaUSA/WebSite/MiscContent/Download/AutoIndustry/Electronics/TIRelais_GB_TT_14.pdf

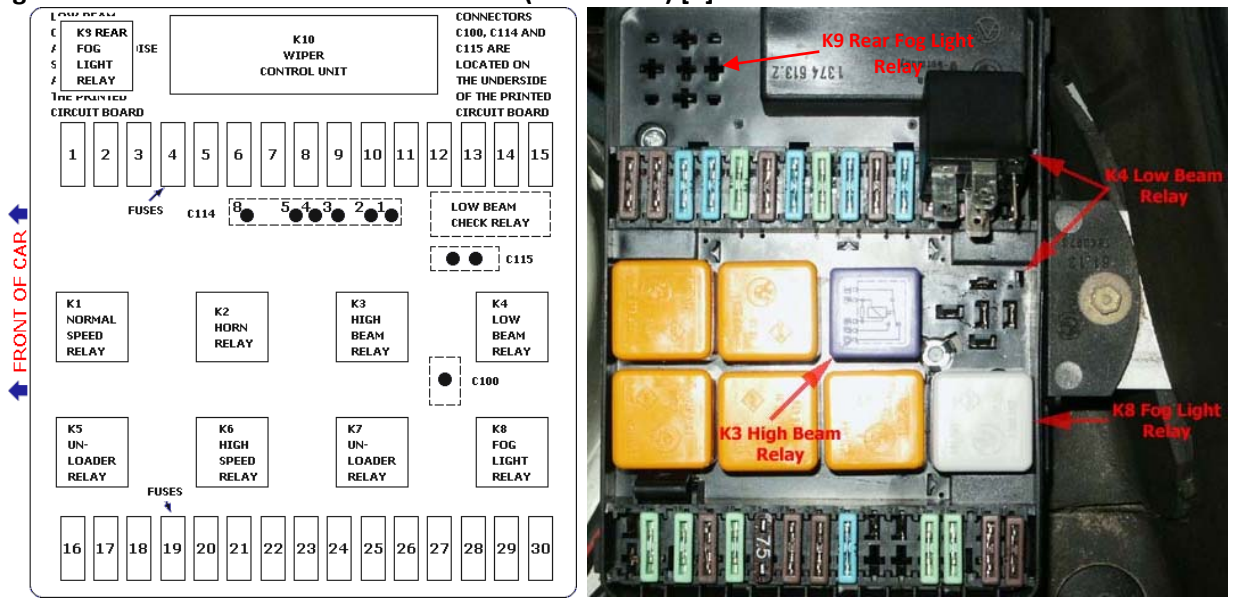
[2]: http://www.rallylights.com/hella/Relays.asp

The Conversion

In European E30s with factory rear fog light provisions, there is an additional Rear Fog Light Relay (K9) whose location is depicted in Figure 2. This relay is utilized to provide the unloader circuit for the rear fog light(s). As the single filament low beams stay illuminated with the high beams it is required that one emulates the European K9 setup with application to the front fog lights.

If you're working on a conversion also involving modification of the fog lights to allow their use with your parking lights, see the ALTERNATE set of directions provided within "E30 Fog Light Wiring Instructions: Conversions Allowing for Independent Fog Light Operation in Sealed Beam and Ellipsoid Style Headlight Systems".

Fig 2: Schematic and Photo of E30 Fuse Box (1989 325iS) [3]



Supplies Required for Wiring Conversion (Fuse Box):

3x 61 13 1 362 252 (HL87272) 6.3mm Female Blade Connector w/ Barb for Relay blocks

4x 61 13 1 370 692 Double Leaf Spring Contact – from fuse box fuses

1x 61 36 8 373 700 SPST BMW Relay (Orange Relay for Fogs, Unloader, Fan, etc)

1x14 Gauge Male Spade Terminal 

1x 14 Gauge Open Spade Terminal 

1x 18 Gauge Splice Taps 

14 & 18 Gauge Wire

[3]: http://e30.bmwdiy.info/indy-fogs/index.html

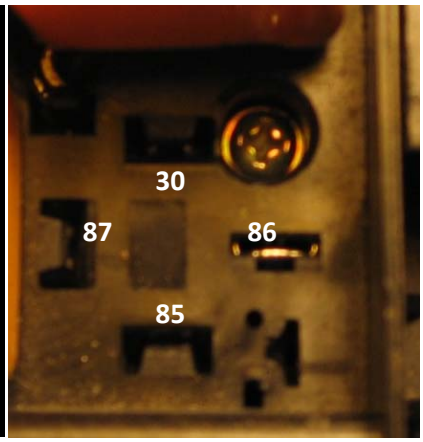
Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Steps Required for Wiring Conversion (Fuse Box):

1. Begin by removing the negative lead from the battery
2. Remove the fuse box cover, and remove K8

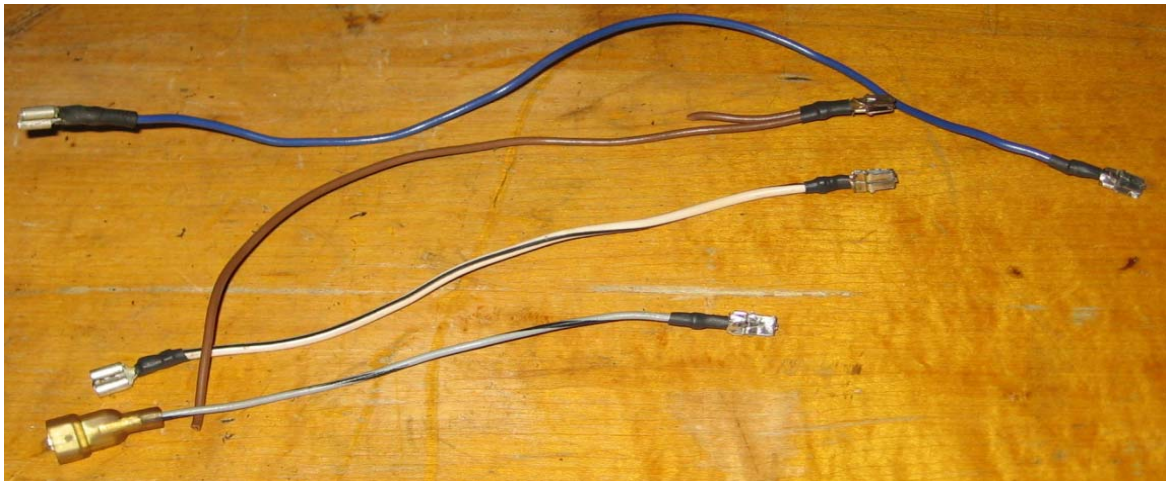
3. Remove the two (2) screws INSIDE the fuse box and the single screw on the outside near the fender
4. Carefully pry open the fuse box


5. Take a paper clip, a pin or a stiff piece of wire, and gently pry back the locking tabs on the following pins of the following relay sockets. To pry back the lock tab, stick the wire in parallel to the pin, and pull away from the pin. Pushing up from the bottom side sometimes helps.

a. 86 of the Fog Light Relay (.5mm Gray Wire) [Relay K8]
b. 87a of the High Beam Relay (1mm Brown Wire)[Relay K3]
c. 30 of the Low Beam Relay (1mm Brown Wire) [Relay K4]

6. Create five new sections of wire that will allow for the following:
   a. Connect the .5mm Gray Wire you removed from the fog light relay socket to PIN 86 of K9. (Use a spade connector to keep the original wiring intact)
   b. Make a new connection and connect pin 85 of K9 to pin 87a of K3
   c. Make a new connection and connect Pin 30 of K9 to pin 86 of K8
   d. Connect Pin 87 of K9 to Pin 31 of the Windshield Wiper Relay (1.5mm brown)



   e. Connect pin 30 of K4 to C100 using 14 gauge wire and a spade or ring terminal (Gently loosen the Allen bolt going through the fuse box under K3/4)

Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Supplies Required for Wiring Conversion (Headlights):

Solder and Heat Shrink

Proper wiring pigtails pertaining to the style of light you are installing.

For factory Euro E-Code lights you should be able to have the seller provide you with pigtails, or get them from a junk yard. The E34 chassis 5 series is a good source from which to cut the pigtails. 9005/9006 pigtails should be able to be had at a local parts store. For lights such as the Cibie CSR, you can hard splice into the chassis side of the "harness" that connects the chassis wiring to the bulb. The pictures below show a 9005/9006 style connector (top) and the low beam, city light, and high beam connectors for the Euro.

Flat Style Connector Housings

61 13 1 378 401 High Beam Connector (White)
61 13 1 378 402 City Light Connector (Grey)
61 13 1 378 403 Low Beam Connector (Yellow)

Flat Style Wiring Pigtails

61 13 0 007 441 0.5mm-1.0mm Wiring
61 13 0 007 442 1.0mm-2.5mm Wiring

Right Angled Style Connector Housings

61 13 1 378 417 High Beam Connector (White)
61 13 1 378 418 City Light Connector (Grey)
61 13 1 378 419 Low Beam Connector (Yellow)

Right Angled Style Wiring Pigtails

61 13 0 007 445 0.5mm-1.0mm Wiring
61 13 0 007 446 1.0mm-2.5mm Wiring

Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Steps Required for Wiring Conversion (Head Lights):

1. Pull the hood release so the front of the hood is open then remove the three (3) clips on the top of each outer grill section
2. Remove the two (2) screws at the bottom of each outer grill
3. Remove the outer grills




4. Remove the three (3) number 3 Phillips head screws holding the headlight frame to the radiator support.
5. Cut off old headlight connectors, splice new connectors according to the scheme overleaf.


Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Splice the connectors following the scheme presented below. For instructions on how to properly solder western union style splice joints check out the information provided here. Remember to slip the heat shrink onto one of the sides of wires BEFORE you splice them together. Hold the heat shrink out of the way so that it doesn't shrink due to the heat from soldering. Once the solder joint cools, pull the heat shrink over the joint then use a heat gun to shrink it to fit.

US Ellipsoids or Euro Ellipsoids (with or without city lights)

1.	Left Hand Low Beam:	Yellow/White to Yellow/White	Brown to Brown
2.	Right Hand Low Beam:	Yellow/Blue to Yellow/Blue	Brown to Brown
3.	Left Hand High Beam:	White/Purple to White/Purple	Brown to Brown
4.	Right Hand High Beam:	White/Blue to White/Blue	Brown to Brown

Cibie or other single filament setup

1.	Left Hand Low Beam:	Yellow/White to Low Beam (+)	Brown to Low Beam (-)
2.	Right Hand Low Beam:	Yellow/Blue to Low Beam (+)	Brown to Low Beam (-)
3.	Left Hand High Beam:	White/Purple to High Beam (+)	Brown to High Beam (-)
4.	Right Hand High Beam:	White/Blue to High Beam (+)	Brown to High Beam (-)

Connections are Chassis Side/Light Side

The final product should look like below. Note that the left hand light is a Euro low, while the right hand light is a US Ellipsoid high.

Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Supplies Required for Wiring Conversion (City Lights):

1x 61 31 1 380 352 Fog Light Switch (Case 1 or 3)

1x 18 Gauge Ring Terminal (Case 1) 

1x ATC Style Fuse Holder and 7.5Amp Fuse (Case 3) 

1x 18 Gauge Splice Tap (Case 3) 

18 Gauge Wire

Steps Required for Wiring Conversion (City Lights):

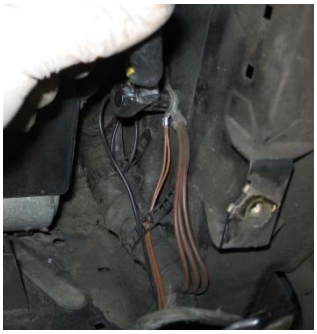
There are three different cases of possible wiring for the city light circuits.

CASE 1

If you want the lights switched while the parking lights are on, wire the hot side to the parking lights and the other side to a switched chassis ground. The heavier gauge wire on each respective side is for the front marker light, while the lighter gauge is for the side marker. Run the ground wire into the passenger compartment. Connect the wire to one side of a fog light switch, which can be placed in one of the blanks above the radio. Wire the other side of the switch to chassis ground.

CASE 2

If you don't want the city lights to have an independent switch, but rather just come on with the parking lights you can use the wiring in Case 1, but simply use a chassis ground such as the one near the left hand headlight assembly.



Connections are Chassis Side/Light Side

1. Left Hand City Light: Gray/Yellow to Gray/Yellow
   Brown to Common Brown
2. Right Hand City Light: Gray/White. to Gray/White
   Brown to Common Brown
3. Common Brown to: Case 1 – Switch, Switch to Chassis Ground
   Case 2 - Chassis Ground by Left-Hand Headlights

CASE 3

If you want the city lights switched independent of the parking light circuit, run a common source that is powered in key position 1 or 2 through the fog light switch of Case 1 and utilize the common chassis ground used in Case 2. Make sure to use a 7.5 amp fuse inline between source and switch.

Connections are Chassis Side/Light Side

1. Left Hand City Light: Gray/Yellow to Common Source, Brown to Common Brown
2. Right Hand City Light: Gray/White to Common Source, Brown to Common Brown
3. Common Brown to Chassis Ground by Left-Hand Headlights
4. Common Source to Switch, Switch to 7.5 Amp Fuse, Fuse to source hot in Key Position 1 or 2

Final Steps

1. Re-connect the battery and test the system for the desired operation. Disconnect the Battery.
2. Replace the screws holding the fuse box together, being careful not to pinch any wires.




3. Replace any relays removed during the preceding work and replace the fuse box cover
4. Reconnect the grounding strap of the battery.

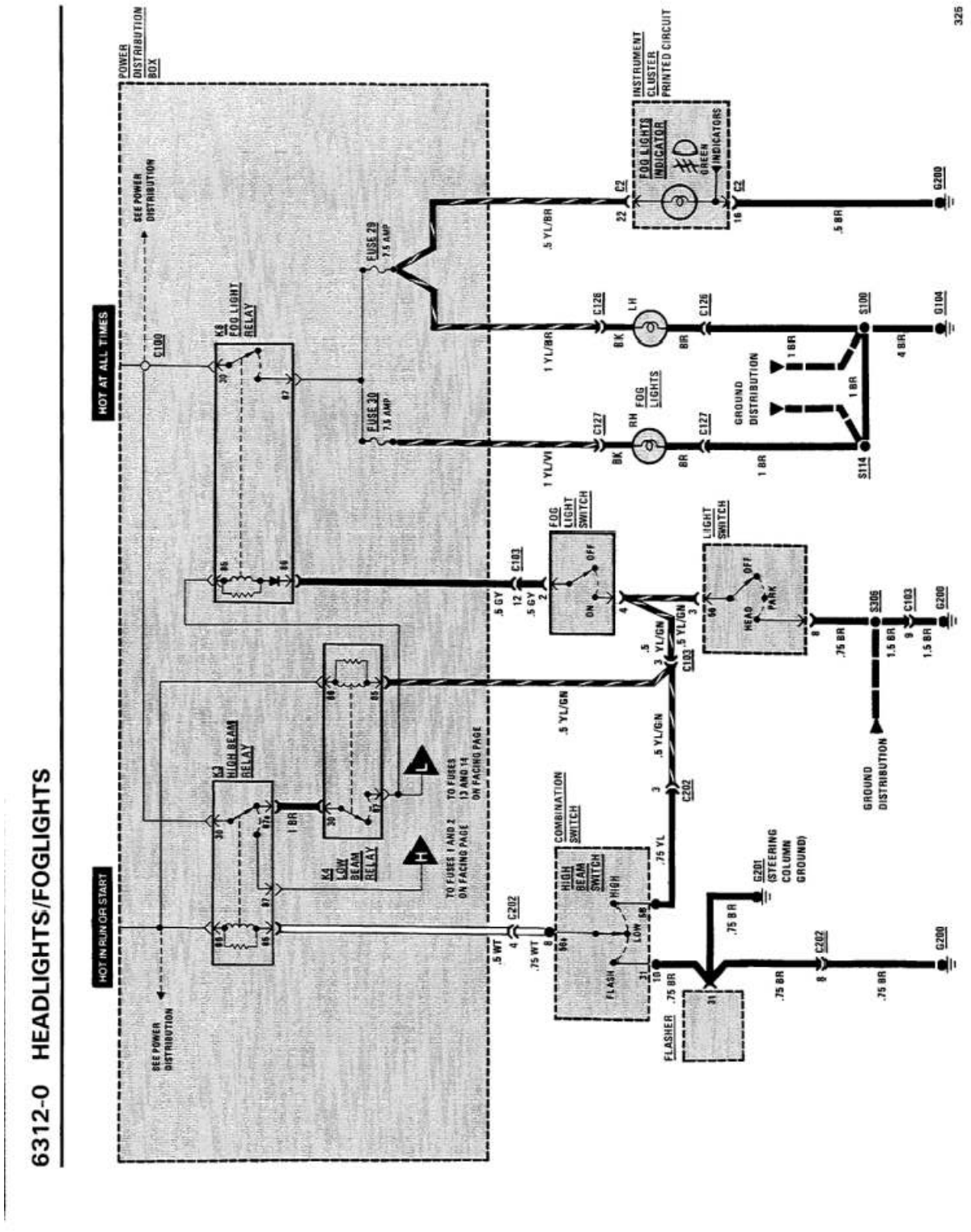

A note about further wiring modifications:

The headlight wiring in the E30 is sufficient to handle up to twice its sock current. That is to say the stock wiring will sufficiently support a 15 amp fuse versus the stock 7.5 amp without any risk of damaging the wire(s). This allows one to run up to a 110Watt bulb without having issues with the dim lighting as the voltage drop at the light is minimal. If anything such modifications as outline above provide a relaxation of the wiring requirements on the high beam circuit as now only one 55W (assuming stock wattage) H1 bulb is powered by the circuit whereas the original circuit powered both the 55W sealed beam high and the 60W high beam filament of the "low" beam, outer, bulb.

Making changes as suggested by Daniel Stern of Daniel Stern Lighting will cause the low beam fault indicator to illuminate. The author typically uses Susquehanna Motor Sports for lighting and wiring products. Their headlight wiring page is provided at the link found here. The long and short is that you can stick with the stock wiring gauge when initially doing a headlight conversion. If you insist on changing the wiring feeds to a higher gauge, this can be accomplished by replacement of the wiring from the fuse block inside the fuse box to the headlight assemblies. This should not cause issues with the fault indicator (there is slightly less resistance in the larger gauge wire, but this should be MINIMAL). Additionally, converting using such practices will allow you to run the stock relays in their stock locations, with the modifications afore mentioned here. This requires the souring of 4 pins for the fuse box connectors, which you should be able to source from Susquehanna. Tell them you are looking for pins to fit a HELLA fuse box.

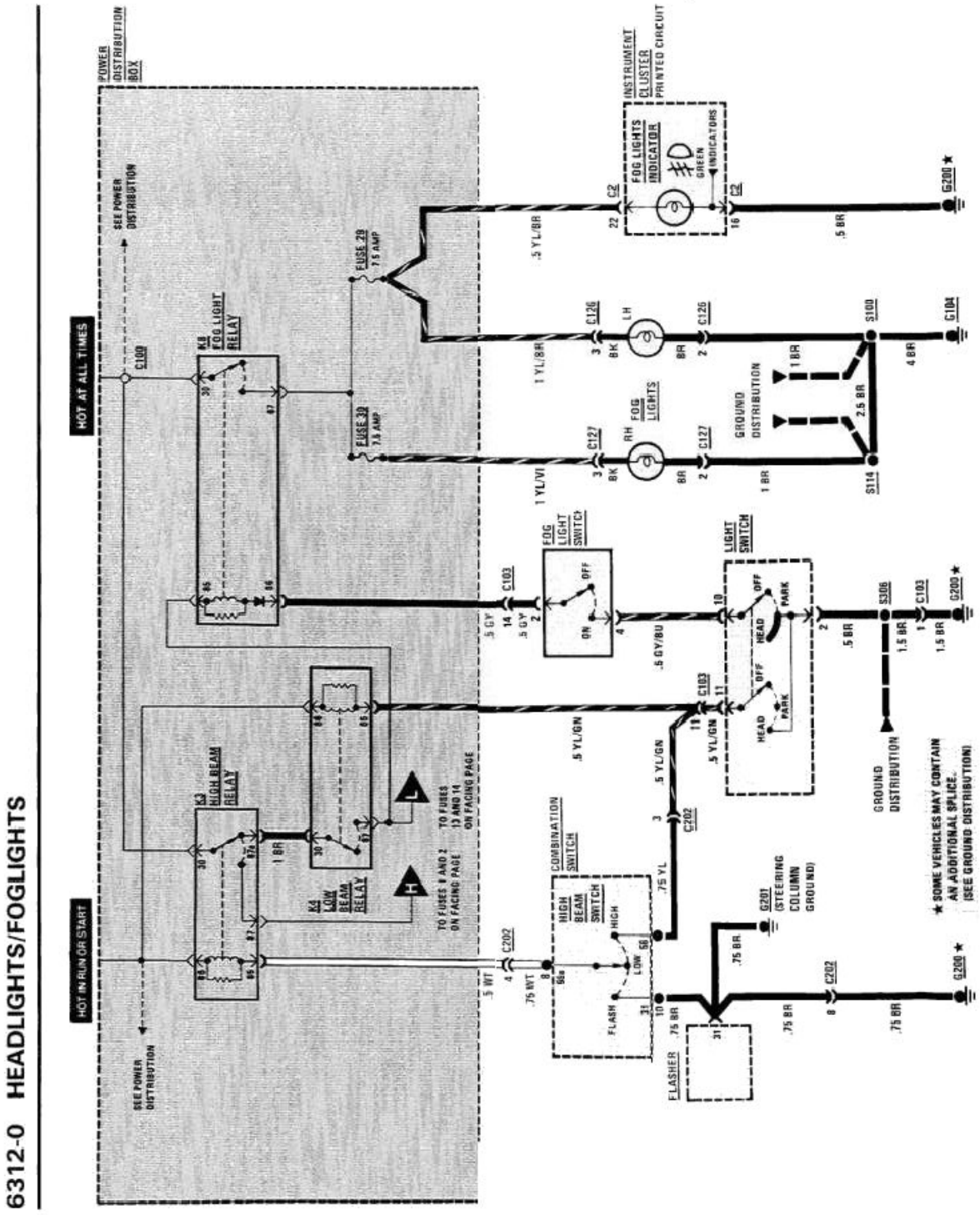
Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Fig 1a: 1984-1987 Early Sealed Beam Wiring



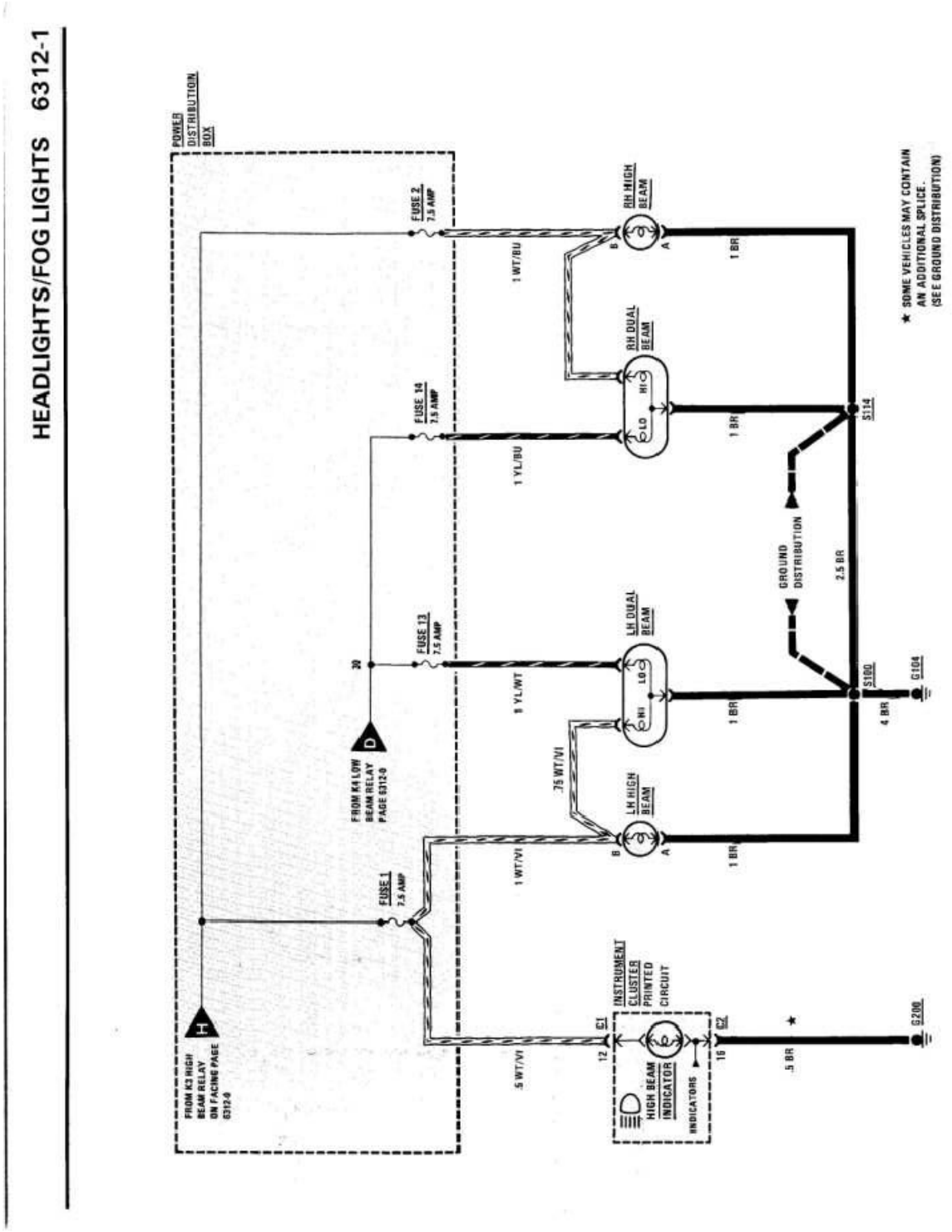
Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Fig 1b: 1990 on Late Sealed Beam Wiring



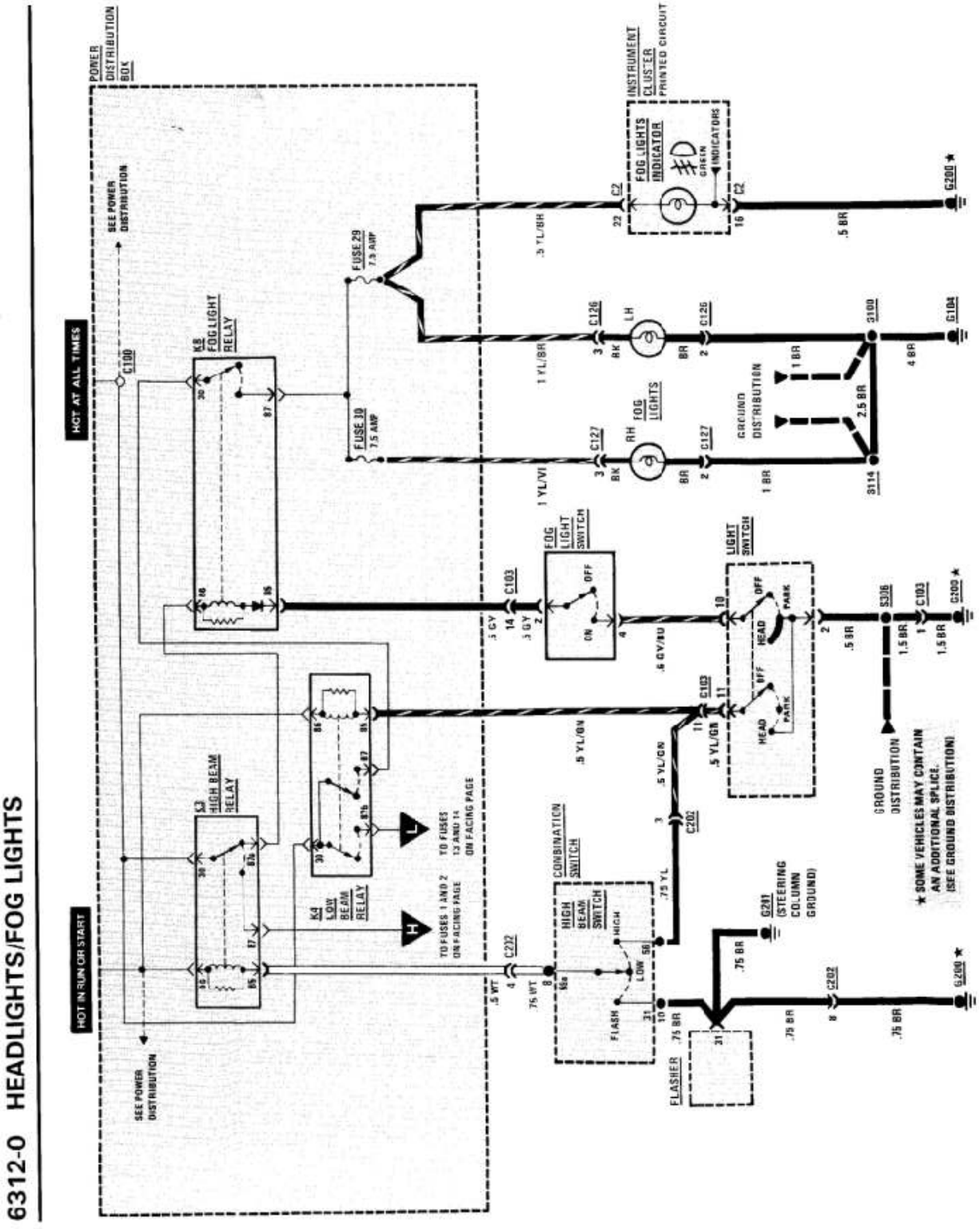
Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Fig 1c: Sealed Beam Wiring – Lighting



Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Fig 1d: 1988 and 1989 Ellipsoid Wiring



Converting Sealed Beam Systems to Ellipsoid/European Lighting Utilizing Single Filament Bulbs

Fig 1e: 1988 and 1989 Ellipsoid Wiring – Lighting