

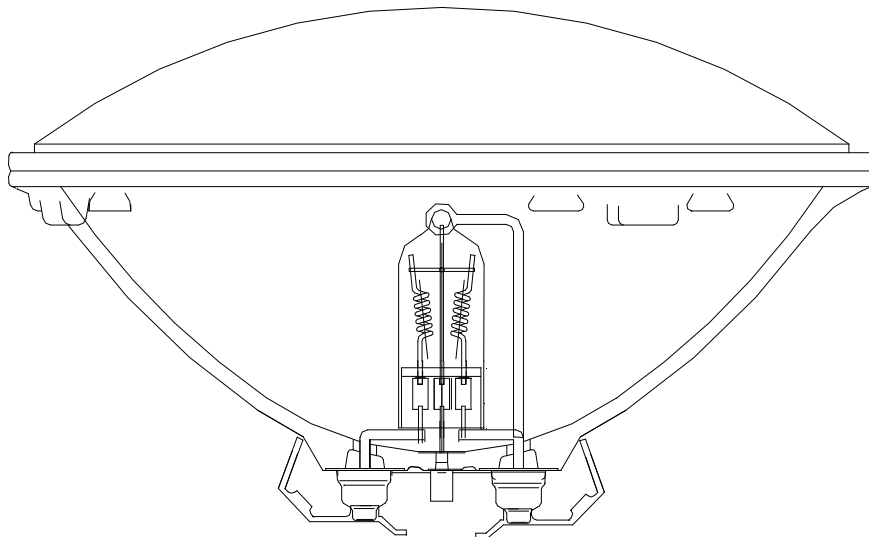


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Railroad Locomotive 75V350W PAR56 Headlights/Auxiliary lights Performance Report

*Amglo's Superior Halogen Lamp Technology
Present Greater Efficiency, Longer Service Life
and Improved Light Quality*



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Longer Service Life and Improved Light Quality*

Introduction

Compared to current incandescent 75V350WPAR56/SP, Amglo's Halogen 75V350W PAR56 provides superior luminous efficiency, extended life and better performance under vibration condition.

In the current 350WPAR56/SP incandescent lamp, tungsten from the filament evaporates over time and is deposited onto the lens and reflector (commonly referred to as bulb blackening), thus reducing the light output. In our test, the light output reduced 10% after the first 100 hours. As the filament becomes more brittle and tungsten evaporates, the lamp becomes increasingly vulnerable to failure from shock and vibration. The industry has also reported filament **sagging**. This occurs during the first 100 hours of operation and the beam angle is directed approximately 25 degrees in the opposite direction of the tracks. The industry calls this phenomenon "moon light"

Alternatively, the high fill pressure (several atmospheres) of halogen and inert gases inside the Amglo 75V 350-watt PAR56 lamp transports the evaporated tungsten to redeposit on the filament structure. This process (referred to as the halogen cycle) slows down the deterioration of the filament and stops tungsten migration to the wall of the lamp insuring no bulb blackening. Therefore, the integrity of the filament is maintained for a longer period than the conventional incandescent lamp, improving lumen maintenance and the stronger vibration performance of the lamp.

Considerable lamp testing was conducted to substantiate the advantages of Amglo's Halogen 75V 350-watt PAR56 Head lamp / Auxiliary lamp:

- Initial Luminous Intensity – Measurement of Initial Luminous Intensity Prior to Steady Burn Test
- Static Life Test – Observation of Luminous Intensity over Period of Time
- Locomotive Field Testing
- Vibration Test – Sinusoidal Testing

Initial Luminous Intensity (Candela)

Subject:

- 10 Amglo/Halogen 75V 350-watt PAR56
- 10 Incandescent 75V 350-watt PAR56/SP

Source to Detector Distance = 15 FT (4.57 M)

Initial Luminous Intensity (Candela) (Cont'd)

Table 1 Locomotive 75V350W PAR56 Ditch Lamp Data (Candela)

Lamp No	Amglo/Halogen	Incandescent 350WPAR56/SP
1	220,500	209,250
2	261,000	216,000
3	240,750	204,750
4	249,750	220,500
5	258,750	195,750
6	252,000	209,250
7	254,250	213,750
8	236,250	216,000
9	243,000	222,750
10	249,750	218,250
AVG	246,600	212,625

Static Life Test – Lumen Maintenance

Subject:

- 3 Amglo/Halogen 350WPAR56
- 3 Incandescent 350WPAR56/SP

Operating Mode:

- Lamp is powered at 75VDC
- Lamp is cycled every 24 hours

Test Measurement:

- The following test data represents lamp performance in 100-hour increments
- Test was terminated at 500 hours as the incandescent lamps had lost significant luminous intensity from their initial data.

Result

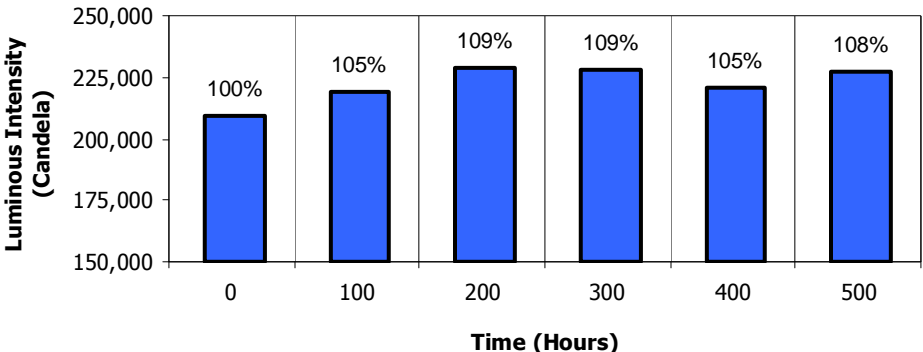
Amglo/Halogen 75V350WPAR56:

Table 2 Amglo/Halogen Static Life Test Data

Time (Hours)	Average Luminous Intensity (Candela)	% Increase
0	209,250	100%
100	219,000	105%
200	228,750	109%
300	228,000	109%
400	220,750	105%
500	227,000	108%

Static Life Test – Lumen Maintenance (Cont'd)

Figure 1 Amglo/Halogen Luminous Maintenance Graph



As the tungsten evaporates, the rough surface of the wire becomes smoother, providing an increase in luminous intensity as the tungsten temperature reaches its peak. After the complete recrystallization of the tungsten filament occurs, the luminous intensity will level out as the electrical properties of the tungsten become stable. With the halogen cycles and the greater pressure, the lamp stays clean while maintaining its full intensity.

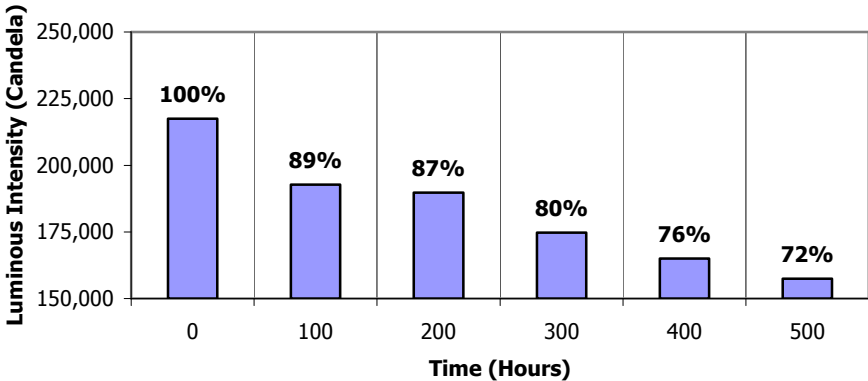
Result

75V350WPAR56/SP – Incandescent:

Table 3 350WPAR56/SP Incandescent Static Life Test Data

Time (Hours)	Average Luminous Intensity (Candela)	% Increase
0	217,500	100%
100	182,250	89%
200	189,750	87%
300	174,750	80%
400	165,000	76%
500	157,500	72%

Figure 2 350WPAR56/SP Incandescent Static Life Test



Static Life Test – Lumen Maintenance (Cont'd)

When a conventional incandescent lamp is burned, tungsten is evaporated from the tungsten filament and deposits on the lens/reflector. As the evaporative effect continues, tungsten is lost from the filament resulting in greater lens/reflector blackening causing a decrease in luminous intensity.

Locomotive Field Testing

Subject:

- 5 Amglo/Halogen 75V350W PAR56 are on test with Canadian Pacific Railway

Result

Table 4 CPR Locomotive Life Testing

CP LAMPS ON TEST	POSITION	HRS	LOCOMOTIVE#	DATE INSTALLED	DATE FAILED
LAMP #1	HEAD LAMP	907.9	CP 1624	9/4/2005	STILL ON
LAMP #2	HEAD LAMP	759.7	CP 3004	7/19/2005	STILL ON
LAMP #3	DITCH LAMP	149.5	CP 3004	7/19/2005	STILL ON
LAMP #4	DITCH LAMP	1194.2	CP 9667	8/11/2005	STILL ON
LAMP #5	HEAD LAMP	1832.2	CP 9806	8/5/2005	STILL ON

Amglo provided 75V 350-watt PAR56 lamps to CPR and CSX for field-testing to determine Halogen lamp life. The CPR results indicate that Amglo will meet or exceed the 2,000-hour requirements by the industry. (See *Table 4*)

Destructive Vibration Test

This test is conducted to demonstrate the capability of the lamps to withstand mechanical stresses. The data are gathered in the form of average lamp failure hours under the continuous test conditions shown below. That is, the lamps undergo the testing until the lamp shows indications of electrical and mechanical failure. Testing reveals that filament "arc-out" is the most prominent failure mode under these vibration conditions. The Incandescent lamps exhibit filament 'sagging' at the beginning of the test and eventually break. The Amglo/Halogen lamp, however, appear to respond more positively to the testing conditions. (See *Table 6*)

Destructive Vibration Test (Cont'd)

Subject:

- 5 Amglo/Halogen 350WPAR56
- 5 Incandescent 350WPAR56/SP

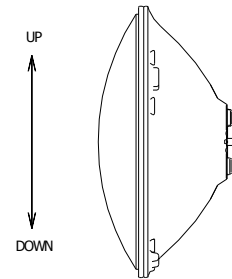
Operating Mode:

- Lamp is powered at 75VDC
- Sinusoidal Testing (20 Hz/Sec)
 1. Frequency Setting = 5 to 1,000 Hz.
 2. Acceleration Force = 0.5 to 6.0 Gpeak.

Vibration Direction:

- The lamp is rigidly mounted to a vibration platform, perpendicular to both the filaments and lead wires. (See *Figure 3*)

Figure 3 Vibration Direction Definitions



Result

Table 5 Vibration Test Data

Lamp Type	Average Vibration Time (Minutes)
Amglo/Halogen 350WPAR56	30
Incandescent 350WPAR56/SP	10