LIFE, INSTALLATION AND

REPLACEMENT OF

RAILWAY LIGHT SIGNAL LAMPS

INSTRUCTION
PAMPHLET

U-5037

REPRINTED
JANUARY, 1959

UNION SWITCH & SIGNAL
DIVISION OF WESTINGHOUSE AIR BRAKE CO.
SWISSVALE, PA.

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LIFE, MAINTENANCE AND REPLACEMENT

PREFACE

The purpose of this pamphlet is to provide instructions which will help to reduce signal lamp failures and to set forth vital lamp characteristics for assistance in proper lamp maintenance. This information has been prepared in collaboration with lamp manufacturers from their engineering data and from service reports made by individual railroads after years of experience with signals of the light type.

Supplementary information covering 1/64 inch "Precision" Lamps as well as ordering references for various other Union Lamps and associated controlling devices will be found at the end of this pamphlet.

LAMP LIFE

GENERAL

Incandescent lamps are designed for a certain rated *average* life at a given voltage, and life tests are made by the manufacturer to insure that the rated life of the lamps as produced is equal to the calculated designed life. In spite of the rigid care taken in manufacture and test, it is not possible to control the life of individual lamps within narrow limits. This is due to a number of factors that at the present stage of the art, are, in a practical sense, beyond the control of the lamp manufacturer. In addition, the life of a lamp is affected materially by deviation from design voltage, by vibration and by mechanical defects caused by handling, shipping, etc.

LIFE RATING

The rated life of a lamp is the *average* life of that particular type lamp "burned" in large quantities at rated voltage. Of any group of lamps rated at 1,000 hours life which have been placed on life test and burned continuously, half of the group will be expected to burn out by the end of 1,000 hours on test.

The AAR, however, has adopted the following Table, (Table I) of Life Hours for lamps, based upon 5% burn-out.

Because of the fact that many different types of signal lamps are required and each type is produced in comparatively small quantities, it is not possible to secure the uniformity of production that is obtained in the manufacture of standard commercial lamps, which are produced continually in large quantities. The percentage of lamps "burned out" at the rated life, is approximately 50% of the total lamps. Since this is based on laboratory tests, somewhat less favorable results should be expected from lamps in actual service which are subject to vibration, etc.

VOLTAGE vs. LIFE

The curve, Fig. 1, shows the effect of applied voltage on lamp life for a typical signal lamp. It is evident from this curve that a very small percent variation in voltage causes a great change in lamp life. A 5% increase in voltage reduces life 50%, while a 5% decrease in voltage doubles life. This emphasizes the necessity of accurate adjustment of applied voltage, and control of voltage variation within narrow limits. Voltage regulation at the lamp of not more than 2½% above or below normal is very desirable.

TABLE I

TABLE OF LIFE HOURS FOR LAMPS

(Based on average laboratory life of 1000 hours at rated voltage)

6-volt lamps		8-volt lamps		10-volt lamps		60-volt lamps		115-volt lamps	
Applied voltage	Hours	Applied voltage	Hours	Applied voltage	Hours	Applied voltage	Hours	Applied voltage	Hours
4.8	7700	6.4	7700	8.0	7700	48	7700	92	7700
4.9	5915	6.5	6400	8.1	6650	49	6000	93	6850
5.0	4230	6.6	5570	8.2	5600	50	4300	94	5900
5.1	2890	6.7	3800	8.3	4550	51	2890	95	5050
5.2	2080	6.8	2890	8.4	3500	52	2080	96	4130
5.3	1560	6.9	2180	8.5	2890	53	1560	97	3320
5.4	1310	7.0	1780	8.6	2390	54	1310	98	2800
5.5	1040	7.1	1470	8.7	1950	55	1020	99	2300
5.6	820	7.2	1310	8.8	1620	56	820	100	1950
5.7	650	7.3	1100	8.9	1430	57	650	101	1730
5.8	510	7.4	920	9.0	1310	58	510	102	1500
5.9	420	7.5	770	9.1	1140	59	410	103	1370
6.0	350	7.6	650	9.2	970	60	350	104	1220
6.1	295	7.7	530	9.3	870	61	300	105	1090
6.2	240	7.8	465	9.4	740	62	250	106	950
6.3	200	7.9	400	9.5	650	63	200	107	870
		8.0	350	9.6	550			108	760
		8.1	315	9.7	490			109	675
		8.2	275	9.8	440			110	590
		8.3	230	9.9	390			111	520
		8.4	200	10.0	350			112	470
				10.1	320			113	430
				10.2	290			114	385
				10.3	250			115	350
				10.4	220			116	320
				10.5	200			117	300
								118	270
								119	240
								120	210

This table is based on an average of 5 per cent or less of a group of lamps failing in the hours indicated in the table for voltages shown. The voltage must be measured at the lamp. Burning at over-voltage will reduce lamp life.

Light output varies quite rapidly with variation in voltage. At 90 per cent of rated voltage, the candlepower of the lamp is reduced to about 70 per cent of the value at rated voltage. Consequently, care must be exercised in reducing lamp voltage that the intensity of the beam is not reduced to a point where atmospheric conditions can affect the integrity of the signal aspect.

Lamps burned at less than 70 per cent of rated voltage may have their filament temperature reduced to a point where chromaticity of the signal light colors will be affected. Possible final results should be investigated.

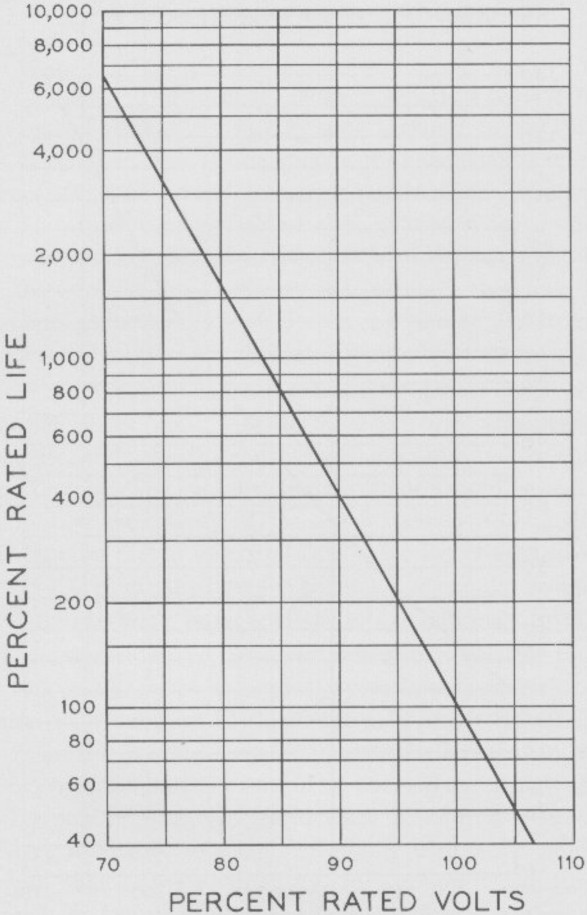


FIG. 1
TYPICAL VOLT-LIFE CURVE FOR RAILWAY LIGHT SIGNAL LAMPS

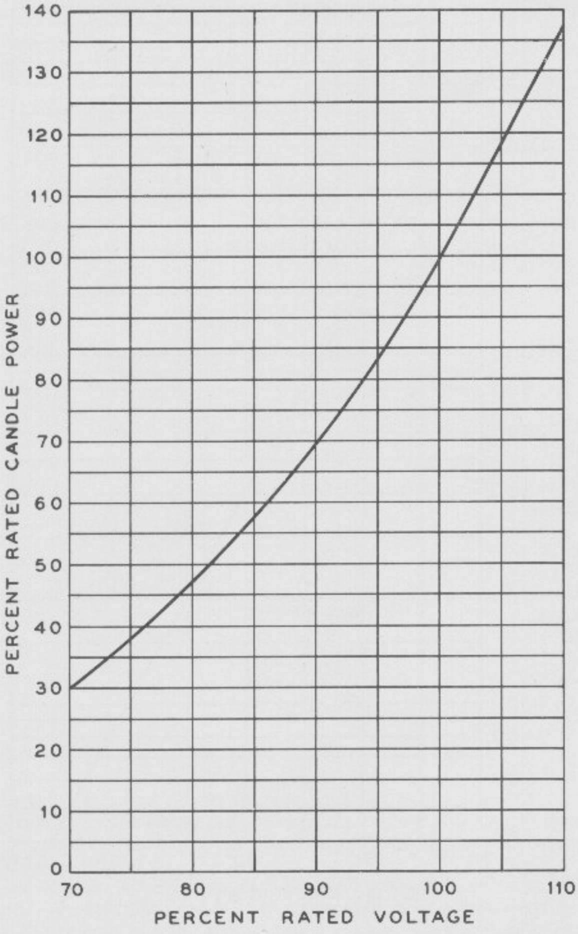


FIG. 2
TYPICAL VOLT-CANDLE POWER CURVE
FOR RAILWAY LIGHT SIGNAL LAMPS.

VOLTAGE vs. CANDLEPOWER

The curve, Fig. 2, shows the relation between applied voltage and light output from the lamp in spherical candlepower. Light output varies quite rapidly with variation in voltage. At 90% of rated voltage, the candlepower of the lamp is reduced to about 70% of the candlepower at rated voltage. This represents a loss in efficiency of about 19%. At this reduced output the range of a light signal is about 84% of the range obtained with the lamp at rated voltage. It is obvious, therefore, that too great a reduction in applied voltage is undesirable from the standpoint of efficiency and obtaining a satisfactory indication.

It is quite general railroad practice to operate signal lamps somewhat under rated voltage to secure the advantages of longer life, and a smaller number of lamp failures over a given period of time. The extent that the voltage should be reduced is limited by the quality of the signal indication obtained. It is our opinion that as a general rule reduction of applied voltage to 90% of rated voltage is about the maximum reduction that should be made in view of the loss of efficiency involved.

There are occasions, however, when it is desirable to further reduce the percentage of lamp failures below that obtainable with the normally used lamps. Further reduction in voltage on the existing lamp in a particular signal may result in either insufficient light output or affect the integrity of the signal aspect or both. To avoid these conditions it becomes necessary to change to a lamp of higher wattage in order to maintain sufficient light intensity. In addition to the further extension of lamp life resulting from the lower voltage used there is the additional advantage of the increased mechanical strength of the larger filament wire in the higher wattage lamp. This extended increase in lamp life together with the resultant decrease in lamp failure will materially offset the added cost of power.

From the following examples, the amount of extended lamp life is very apparent and at only a moderate increase in lamp current to produce the same light output.

Style "R-2" Signal

Lamp**	Volts	Amperes	Lamp Life*
10V — 18W	9.5	1.75	650
10V — 25W	8.68	2.30	2200

Style "H-2" & "H-5" Searchlight Signals

Lamp**	Volts	Amperes	Lamp Life*
8V — 10W	7.6	1.215	650
10V — 18W	8.65	1.67	2300
10V — 21.5W	8.74	2.02	2050
10V — 25W	8.73	2.33	2080

The values above for the 10V — 18W lamps are for the C-2V type of filament. The new lamp with the CC-6 filament will produce approximately 12% more light than shown for the C-2V filament.

*Based on 5% burnout at 350 hours life.
**S-11 Bulb lamp.

MAINTENANCE

LAMP REPLACEMENT

It is quite obvious that signal lamps must be replaced considerably before their rated life, unless an emergency filament or lamp is provided. Determination of the length of time that lamps may consistently be left-in service before replacement is worthy of careful study.

Lamps of the special double filament type, having a secondary filament connected in parallel with the main filament, but of much longer rated life, to provide a short range indication when the main filament fails, can consistently be left in service for a "burning" time period equal to the full rated life of the main filament, as calculated from the "voltage vs. life" curve, (Fig. 1), for the voltage at which the lamp is operated. A large percentage of the main filaments will of course fail before the end of this period, and the lamps should be replaced as soon as this condition is discovered. This will naturally result in different replacement dates for a large number of lamps, which is an undesirable feature. A considerably shorter "burning" time period may therefore be desirable to minimize this condition.

The secondary filament in this type of lamp, while of very long rated average life to withstand probable rise in voltage when the main filament fails, is usually of low wattage, and consequently rather fragile. It is therefore advisable that frequent inspection be made to see that the secondary filament is intact. It follows, that, if the secondary filament fails, the lamp should be replaced. The energy consumed by the secondary filament in this type of lamp is practically wasted in regular operation, and is useful only when the main filament fails before the secondary filament.

The same reasoning with reference to replacement applies where a "cut-in" relay is employed to light an auxiliary filament or lamp for emergency lighting when the main filament or lamp fails.

Single filament lamps are more efficient in light output than double filament lamps, and in addition a greater portion of the lighted filament is located closer to the focal point of the optical system of the signal, thus producing higher efficiency in the signal.

It is our opinion that the actual "burning" time in service for these lamps should not exceed 50% of their calculated average life for the particular voltage applied to them, as read from "Voltage vs. Life" curve, Fig. 1. Replacement at 30% to 40% of the calculated average life seems more logical, as 5% of the lamps will fail at or before 35% of rated average life.

Example

If failure of 5% of the lamps is considered the maximum permissible during the period between renewals, it is apparent that it is necessary to replace all lamps at 35% of rated life, i.e. at the end of 350 "burning hours" for a lamp rated at 1,000 hours average life, and operated at rated voltage. In this case an average of 5 lamps out of every 100 in service will fail within 350 "burning hours."

Continuing this example, assume that the lamp under consideration is a 10 volt, 1,000 hour lamp, and that a satisfactory signal indication is obtained with 9.0 volts applied at the lamp. At 9.0 volts, the lamp is operated at 90% rated voltage. From the "Voltage vs. Life" curve, Fig. 1, it is found that the average life becomes approximately 400% of rated life or 4,000 "burning hours." The "burning" period before replacement is then 35% of 4,000 or 1,400 "burning hours." The lamp failures are still 5% or 5 failures per each 100 lamps, but these 5 failures are spread over 1,400 "burning hours," instead of over 350 "burning hours." At the reduced voltage there is one lamp failure per 280 hours as compared with one failure per 70 hours, with lamps operated at rated voltage. If the lamps are "burned" an average of three hours per day, as on approach lighting, there should therefore be an average of one failure per 100 lamps in approximately 94 days. This is equivalent to 1.25% during the 350 hour "burning" period, as compared with 5% with lamps operated at rated voltage. As frequency of lamp failures is the important consideration from the standpoint of efficiency of a signal system, the percentage of lamp failures must be qualified by reference to the factor of "burning" time.

From the foregoing it is evident that *average* lamp performance under a given set of conditions can be forecast with a fair degree of accuracy. To establish a schedule for lamp replacement, it is necessary to know the *average* rated life of the lamp used, and the *average* number of hours the lamps are "burned" per day. The *average* rated life for any particular lamp based on laboratory tests under ideal conditions is available. A correction factor for lamps in service subject to vibration and variation in applied voltage may be found necessary. Such a correction factor should be based on a prolonged period of test. Where lamps are "approach lighted," it is necessary to estimate the *average* "burning" time per day by observation in the field. Observations should be made of automatic signals, interlocking signals, and highway crossing signals which are typical of groups of signals operating under about the same average conditions as to frequency of operation and time per operation.

For an automatic signal of the searchlight type, which employs only one lamp, if it is found the lamp is lighted an average of six minutes per train and the average number of trains per day is thirty, the "burning" time per day is 180 minutes or 3 hours. Assuming a 10 volt 1,000 hour lamp operated at 90% rated voltage, the "burning hours" on the basis of replacement at 30% of rated life, is 1,200 hours. This divided by 3 hours "burning" per day equals 400 days that the lamp can be kept in service before replacement. This service period should be worked out in like manner for each group of lamps.

For signals having separate lamps for each indication, the service period should be worked out for each lamp. This is obviously necessary as the usual indication of a signal is "proceed," and a "caution" indication is comparatively infrequent.

Preliminary "Burning"

A preliminary "burning" test of all lamps at normal voltage is desirable, to eliminate the lamps that have developed weak filaments, air leaks, etc. due to handling and shipment. Since this test is mainly for detecting lamps damaged in shipment and handling, and because lamp filaments are more fragile after being "burned," it is advisable that the test be made by the railroad company as near as practicable to the location where lamps are to be used. The large majority of lamps having defects that will be detected by a "burning" test will fail in the first few minutes of the test. A very few may fail in a longer test. We have in the past recommended a 24-hour preliminary "burning" test, but a test of this duration necessitates placing the lamps in a test rack, removing them again and installing them later in the signals. Experience of various railroads indicates that this extra handling and mechanical straining of the lamps in placing them in the socket and removing them will very likely be the cause of more failures than would be prevented by extending the duration of the test beyond 10 or 15 minutes. It is therefore our recommendation that the lamps be placed in the signals and lighted for 10 to 15 minutes and observed by the maintainer at the end of this period, to see if they have failed or show signs of early failure. Discoloration of the bulb or excessive brightness of the filament with normal voltage applied, indicate probable short life. Also, the filament should still have a shiny surface after the preliminary "burning" test, and if it turns black it is probable the lamp will fail in a short time. Lamps showing such defects should, of course, be replaced.

Handling

Lamps should not be stored in a damp place as continued exposure to dampness tends to deteriorate the basing cement and cause bases to loosen when subjected to the strain of placing them in the lamp sockets. Lamps should always be handled with care and should be well packed for local shipment. The surface of the base and contact should be wiped clean just before placing the lamp in service. Lamps which have been in service for a considerable time should not be removed and then replaced in the socket, as this practice tends to loosen the base from the bulb, and also may cause breakage of filaments which always become fragile in service. Signal lenses and reflectors should therefore be cleaned, where practicable, without removing the lamp from the socket. For the same reasons, we favor a lamp replacement schedule for each class of lamp, instead of transferring lamps from one indication unit to another on signals having separate lamps for each indication.

FAILURES

It is evident from the discussion under the heading of "Lamp Replacements" that occasional lamp failures must be expected even within a few hours after the lamps are placed in service. The average percent failures for a fixed period of time, however, can be predicted with a fair degree of accuracy under a given set of conditions. Very little as to cause of failures can be determined from inspection of a few lamps that have failed, except in such cases as a loose base, a broken lead wire, a defect in the bulb causing leakage of air into the bulb, etc. Where cause of failure is not apparent, it is desirable that several "unburned" lamps from the shipment of lamps which proved unsatisfactory should be returned for tests and check by the manufacturer. Generally, however, the information necessary in order to draw reasonable conclusions as to lamp performance, is a record of lamp failures for a fixed period in percent of the number of lamps in service. If it is found, for instance, in the example where 10 volt lamps are operated at 9.0 volts, that appreciably more than 5% of the lamps fail in the 1,200 hour "burning" period, a recheck of the design and methods of manufacture should be made. As occasional lamp failures may occur at any time before the end of this period, it it not feasible to recheck the design and production every time premature failures of a few lamps are reported. Since the applied voltage at the lamp is such a vital factor in lamp life, as indicated by the percent "Voltage vs. Life" curve, Fig. 1, it is always advisable in case of a premature lamp failure to check the voltage at the lamp with a lighted lamp in the socket.

RECORDS

Where doubt exists as to whether proper lamp life is being obtained, we suggest that a record of lamp life be kept by the railroad company at least for a typical section over a reasonable period, so that the necessary information can be furnished the manufacturer as to the results obtained. Such a record should include total number of lamps in service on the record section, the voltage at which the lamps are operated by signal location, (the voltage to be measured at the lamp with the lamp lighted), the number of lamps that fail before replacement and the hours of operation of each lamp before failure, by signal location. Information of this character often leads to improvement in products, and to the discovery of unfavorable factors in operation such as improper adjustment and control of voltage, etc. Correction of faults thus brought to light eventually revert to the advantage of the railroad, and compensate for the cost of keeping the records.

While we are always ready and willing to take up complaints about lamps vigorously with the manufacturers, we are not in a position to do this with effect unless fortified with the necessary information from which definite conclusions can be drawn.

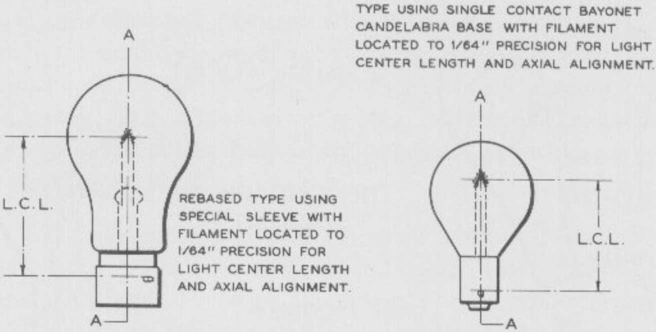


FIG. 3
"PRECISION" TYPE SIGNAL LAMPS
MARKED "SIGNAL PRECISION"
EITHER ON BASE OR ON BULB.

PRECISION LAMPS

A light signal is judged largely by its indication. The quality of the indication and the alignment of the light beam are vitally affected by the location of the lamp filament with respect to the focal point of the lens system. Lamps carefully selected for accuracy of filament location, from large quantity production of commercial lamps, give satisfactory results. Selected lamps, however, are not available to meet the various signaling requirements as to voltage, wattage and filament shapes. Precision type lamps, shown in Fig. 3, accurately based to locate the filament within $\frac{1}{64}$ inch of its true location in axial alignment and light center length, are necessary to assure satisfactory results. The use of $\frac{1}{64}$ inch precision type lamps enables replacements being made without the need of readjustment of lamp receptacles.

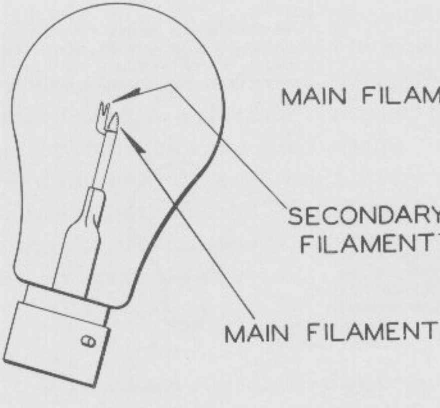


FIG. 4
Double filament lamp
A-15 bulb

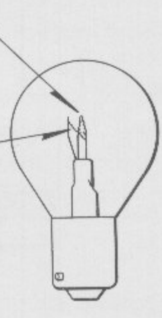


FIG. 5
Double filament lamp
S-11 bulb

DOUBLE FILAMENT LAMPS

Double filament lamps having two filaments of different rating with respect to voltage, wattage and average life, and connected in multiple have been in general use for many years.

This design of double filament lamp shown in Figs. 4 and 5 combines some of the advantages of both single and older type double filament lamps and at the same time eliminates some of their disadvantages. The main filament of this lamp wherein the majority of the total wattage of the lamp is concentrated, is accurately located within the focal area of the lens system. The secondary filament is of lower wattage and has a very much longer average rated life.

It is apparent that the use of a main filament with a secondary filament of much longer average rated life greatly increases the probability that the secondary filament will outlast the main filament, thus providing time for discovery, reporting, and replacement before the failure of the secondary filament. While the occasional failure of secondary filaments before failure of the main filaments must be expected, the lightout protection afforded by the use of these lamps makes their use desirable since they will give much better average performance than will the older type double filament lamps having 2 equal filaments of the same wattage.

In a light signal, maximum efficiency is obtained when the light source is most concentrated and located within the focal area of the optical system. The double filament lamps having the majority of the total wattage concentrated in the focal area of the optical system, produce the same normal indication as do the corresponding single filament lamps with only a slight increase in wattage.

When the main filament fails, the signal indication is altered by a reduction in beam intensity so that the main filament failure is readily noticeable but the beam intensity is still of sufficient strength to provide a short range indication for train operation at reduced speed.

Double filament lamps with this filament construction are available in the A-15 bulb rebased type, illustrated in Fig. 4, for use in Styles "R" and "P" signals; S-11 bulb single contact bayonet candelabra base type, illustrated in Fig. 5, for use in Style "R," Style "P," searchlight and highway crossing signals and in a G-16½ bulb, single contact bayonet candelabra base type for use in Style "L" signals. The ratings available are listed in the tables showing "Ordering References and Data for Lamps" at the end of this pamphlet.

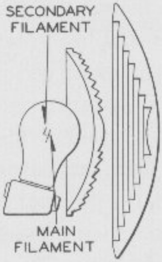


FIG. 6
Diagram showing positioning of filaments in a lensing unit having no reflector

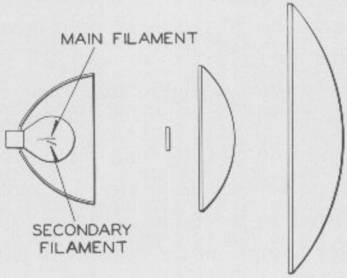
Position of Filaments

When double filament lamps are placed in lamp sockets, compliance with the following instructions is necessary:

(a) The A-15 bulb, rebased lamps and G-16½ bulb lamps with differential double filament construction should be positioned in the signal lamp socket so that the secondary filament is in back of the main filament with respect to the lens, as illustrated in Fig. 6.

(b) The S-11 bulb lamps with differential double filament construction should be positioned in searchlight signal sockets so that the secondary filament is below the main filament, as illustrated in Fig. 7.

FIG. 7
Diagram showing positioning of filaments in a searchlight signal unit



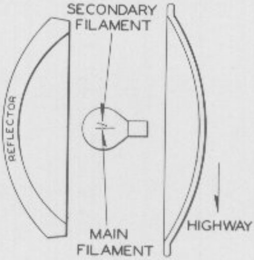


FIG. 8—Top sectional view of highway crossing reflector type unit showing positioning of filaments of S-11 bulb lamp.

(c) In highway crossing signals where S-11 bulb lamps are mounted in a horizontal position, with the plane of the main filament vertical, the lamps should be placed in the signal sockets with the secondary filament away from the highway, as illustrated in Fig. 8.

(d) In highway crossing signals where S-11 bulb lamps are mounted in a horizontal position, with the plane of the main filament horizontal, the lamps should be placed in the signal sockets with the secondary filament above the main filament, as illustrated in Fig. 9.

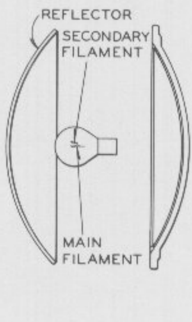


FIG. 9—Side sectional view of highway crossing reflector type unit showing positioning of filaments of S-11 bulb lamp.

ORDERING REFERENCES AND DATA FOR LAMPS

In general use for Railway Signals

TABLE II

LAMPS FOR STYLE "R-2" AND SIMILAR SIGNALS
(Special basing to locate filament to 1/64" precision for Light Signals)

Pc. No.	Drawing 12409 Sheet	Rating		Bulbs	Light Center Length	Base	Filament		Rated Av. Life in Hours	AAR Item No.
		Volts	Watts							
UJ71610	1	8	10	A-15	27/32	Sp. R.	Single	C-2V	1000	2
UJ71611	1	8	18	A-15	27/32	Sp. R.	Single	C-2V	1500	5
*UJ714163	1	8	18	A-15	27/32	Sp. R.	Single	CC-6	1500	..
UJ71696	1	8	18+3.5	A-15	27/32	Sp. R.	Sp. Dbl.	M C-2V S C-2V	1500	7
*UJ714164	1	8	18+3.5	A-15	27/32	Sp. R.	Sp. Dbl.	M CC-6 S CC-6	1500	..
UJ714021	1	8	40	A-15	27/32	Sp. R.	Single	C-2V	3000	..
UJ71601	1	10	10	A-15	27/32	Sp. R.	Single	C-2V	1500	10
UJ71609	1	10	18	A-15	27/32	Sp. R.	Single	C-2V	1500	15
*UJ714165	1	10	18	A-15	27/32	Sp. R.	Single	CC-6	1500	..
UJ71526	1	10	18+3.5	A-15	27/32	Sp. R.	Sp. Dbl.	M C-2V S CC-6	1500	16
*UJ714166	1	10	18+3.5	A-15	27/32	Sp. R.	Sp. Dbl.	M CC-6 S CC-6	1500	..
UJ71643	1	10	30	A-15	27/32	Sp. R.	Single	C-2V	1500	17
UJ71663	1	10	30+6	A-15	27/32	Sp. R.	Sp. Dbl.	M C-2V S CC-6	1500	18
UJ71616	1	10	40	A-15	27/32	Sp. R.	Single	C-2V	1500	19
†UJ71595	1	30	36	A-15	27/32	Sp. R.	Double	2C-2V	1500	23
†UJ71642	1	120	30	A-15	27/32	Sp. R.	Single	C-5	1500	26

Lamps shown in Table III are used in Style R-2 and similar signals which are equipped with lamp receptacles for single contact bayonet candelabra based lamps.

Sp. R —Special Rebased.
† —Special Service, Non-Precision.
* —Not Available at Present. Will Replace Lamp of Same Rating with C-2V Filament.

TABLE III

LAMPS FOR HIGHWAY CROSSING, SEARCHLIGHT AND OTHER LIGHT SIGNALS
(Special basing to locate filament to 1/64" precision for Light Signals)

Pc. No.	Drawing 12409 Sheet	Rating Volts	Rating Watts	Bulbs	Light Center Length	Base	Filament		Rated Av. Life in Hours	AAR Item No.
UJ71651	12	8	5	S-11	1¼	SCBC	Single	C-2V	1000	53
UJ71419	12	8	5+3.5	S-11	1¼	SCBC	Sp. Dbl.	M C-2V S C-12	1000	54
UJ71612	12	8	10	S-11	1¼	SCBC	Single	C-2V	1000	56
UJ71641	12	8	13+13.5	S-11	1¼	SCBC	Sp. Dbl.	M C-2V S C-12	1000	57
UJ71688	12	8	18	S-11	1¼	SCBC	Single	C-2V	1000	59
*UJ714167	12	8	18	S-11	1¼	SCBC	Single	CC-6	1000	..
UJ71602	12	8	18+3.5	S-11	1¼	SCBC	Sp. Dbl.	M C-2V S C-12	1000	60
UJ71629	12	10	5	S-11	1¼	SCBC	Single	C-2V	1000	62
UJ71511	12	10	5+3.5	S-11	1¼	SCBC	Sp. Dbl.	M C-2V S C-12	1000	64
UJ71627	12	10	10	S-11	1¼	SCBC	Single	C-2V	1000	65
UJ71656	12	10	13+3.5	S-11	1¼	SCBC	Sp. Dbl.	C-2V	1000	67
UJ71463	12	10	18	S-11	1¼	SCBC	Single	CC-6	1000	88
UJ714150	12	10	21.5	S-11	1¼	SCBC	Single	C-2V	1000	..
UJ71411	12	10	25	S-11	1¼	SCBC	Single	C-2V	1000	70
UJ71613	12	11	11	S-11	1¼	SCBC	Single	C-2V	2500	72
*UJ714168	12	11	11	S-11	1¼	SCBC	Single	CC-6	2500	..
UJ71562	12	11	11	S-11	1¼	DCBC	Single	C-2V	2500	73
*UJ714169	12	11	11	S-11	1¼	DCBC	Single	CC-6	2500	..
UJ71678	12	11.3	14.4+3.5	S-11	1¼	SCBC	Sp. Dbl.	M C-2V S C-12	1000	74
UJ71497	12	12	18+5	S-11	1¼	SCBC	Sp. Dbl.	M C-2R S C-6	1000	87

The above lamps may also be used in Style R-2 and similar signals which are equipped with lamp receptacles for single contact bayonet candelabra based lamps.

SCBC —Single Contact Bayonet Candelabra.
DCBC —Double Contact Bayonet Candelabra.
Sp. Dbl.—Special Double.

†—Special Service, Non-Precision.
*—Not Available at Present. Will Replace Lamp of Same Rating with C-2V Filament.

TABLE IV

LAMPS FOR SEMAPHORE NIGHT LIGHTING†

Pc. No.	Drawing 12409 Sheet	Rating		Bulbs	Light Center Length	Base	Filament		Rated Av. Life in Hours	AAR Item No.
		Volts	Amperes							
UJ71649	13	2.5	0.15	S-8	1¼	SCBC	Single	C-2R	1000	37
UJ71680	13	3.5	0.12	S-8	1¼	SCBC	Single	C-2R	1000	39
UJ71427	13	3.5	0.12	S-8	1¼	DCBC	Single	C-2R	1000	..
UJ71521	13	3.5	0.30	S-8	1¼	SCBC	Single	C-2R	1000	40
UJ714002	13	3.5	0.30	S-8	1¼	DCBC	Single	C-2R	1000	..
UJ71522	13	8	0.25	S-8	1¼	SCBC	Single	C-2R	1000	41
UJ71523	13	10	0.25	S-8	1¼	SCBC	Single	C-2R	1000	43
UJ71549	13	10	0.25	S-8	1¼	DCBC	Single	C-2R	1000	42
UJ71524	13	12	0.25	S-8	1¼	SCBC	Single	C-2R	1000	45
UJ71525	13	13.5	0.25	S-8	1¼	SCBC	Single	C-2R	1000	47
UJ71527	13	13.5	0.25	S-8	1¼	DCBC	Single	C-2R	1000	48

SCBC —Single Contact Bayonet Candelabra.
DCBC—Double Contact Bayonet Candelabra.
† —Special Service, Non-Precision.

TABLE V

LAMPS FOR SPECIAL APPLICATIONS

Pc. No.	Drawing 12409 Sheet	Rating Volts	Rating Watts	Bulbs	Light Center Length	Base	Filament		Rated Av. Life in Hours	AAR Item No.
°UJ71589	7	6	29	G-16½	1⅝	SCBC	Single	C-2R	3000	..
°UJ71535	7	6	29+6.5	G-16½	1⅝	SCBC	Sp. Dbl.	MC-2R S CC-6	3000	30
UJ71544	7	10	40	G-16½	1¼	SCBC	Single	CC-6	1000	32
##UJ71490	2	12	6	CT-7	1¼	SCBC	Single	C-2V	1000	..
##UJ71491	2	12	9	CT-7	1¼	SCBC	Single	C-2V	1500	27
#UJ71591	7	12	9	G-16½	1 55/64	Sp. R.	Single	C-2R	1500	33
‡UJ71541	13	13.5	17	S-11	1¼	SCBC	Single	C-2V	2000	75
†UJ71697	7	11.5	50	G-16½	1¼	SCBC	Single	CC-11	1000	..
†UJ71685	13	120	10	S-11	1¼	SCBC	Single	C-9	1000	49
†UJ714054	7	125	25	G-16½	1¼	SCBC	Single	C-5	1000	35
†UJ71508	8	30	36	G-18⅛	2 5/16	M.Sc.	Double	2C-2V	1500	36
†UJ71488	5	12	1.25	G-8	1	C.Sc.	Single	C-2V	1000	29

C. Sc. —Candelabra Screw.
M. Sc. —Medium Screw.
SCBC —Single Contact Bayonet Candelabra.
DCBC —Double Contact Bayonet Candelabra.
Sp. R —Special Rebased.
Sp. Dbl. —Special Double.
† —Special Service, Non-Precision.
* —Not Available at Present. Will Replace Lamp of Same Rating with C-2V Filament.
° —For Style "L" Signals.
‡ —For Color Position Light Signals.
# —For Position Light Signals.
—For Position Light Signals Style "PL-3".

CONTROLLING AND REGULATING DEVICES FOR SIGNAL LAMPS

In the foregoing lamp information, mention is made of light out and approach lighting relays. The following designates the type of relays utilized in the preceding information.

LIGHT OUT RELAYS

- DN-11L
- DN-22L
- PN-150BL

APPROACH LIGHTING

- Style DNL-4 (Line or Track)
- Style DN-22A (Line Only)

POWER TRANSFER RELAYS

- DN-11P
- DN-22P
- PN-150P