Traffic Standards and Guidelines
1995/96 Survey

Traffic Signal Light Output

LAND transport safety AUTHORITY

June 1997

Survey of Traffic Standards and Guidelines

The Land Transport Safety Authority is a stand-alone authority responsible for promoting safety in Land Transport at reasonable cost. Part of its function defined in statute is to "monitor adherence to safety standards within the land transport system".

For a number of years the regional engineering sections of the Land Transport Safety Authority have had a programme to survey the implementation of various safety standards by road-controlling authorities.

The purpose of the surveys is to:

- assist and advise road controlling authorities on the implementation of selected traffic standards and guidelines that affect traffic safety;
- measure the uptake of standards and guidelines by road controlling authorities;
- provide a national summary of the uptake and compliance with standards and guidelines and report findings to road controlling authorities and other interested parties; and
- identify changes to improve standards, guidelines or traffic rules.

The surveys are usually carried out in two parts:

- Part 1 uses a questionnaire to look at the systems and procedures a road controlling authority has in place to deliver on the standard.
- Part 2 uses a field survey to measure where possible the actual delivery from the users viewpoint. It essentially provides a snapshot of delivery at the date of the survey.

This report presents the national results of one of those surveys. They have previously been presented to the Traffic Management Workshop. I hope you find the information of value and can use it to further the interests of road safety in New Zealand.

Please contact the Regional Engineer at the LTSA's Auckland, Wellington or Christchurch Office if you would like further information or assistance with implementing traffic standards or guidelines.

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Executive Summary

Introduction

- Interview surveys were conducted in mid-1996 at a sample of 30 road controlling authorities to investigate procedures and programmes for three safety areas - traffic signal light output, street lighting, and the treatment of slip lanes at traffic signals.

- Field surveys were also done at a sample of sites to obtain a “snapshot” of the on-road situation relative to the standards, verify responses to the interview and to discuss problems/successes on-site with road controlling authority staff.

- This report details the results of the survey of traffic signal light output. Companion reports detail the results of the other two safety areas.

Results

- Most authorities reported a quarterly cycle for cleaning lamps and replacing incandescent lamps and a cycle of two years or more for replacing quartz halogen lamps.

- No authority had a programme for routine monitoring of lamp performance.

- Only five authorities did not have a programme for upgrading traffic signal lamps to quartz halogen lamps.

- 30% of the sites surveyed had quartz halogen lamps and the rest were incandescent

- approximately 20% of incandescent lamps and 80% of quartz halogen lamps in service met the required light output standard.

- 31% of traffic signal lanterns surveyed were at AUSTROADS mounting heights.

Discussion

- Upgrading the light output and mounting heights of all remaining traffic signals in New Zealand to AUSTROADS standards would cost an estimated $13 million.

- The estimated annual crash saving from upgrading remaining signals is $17.5 million.

Recommendations

- All road controlling authorities should have a programme to upgrade their traffic signals to quartz halogen lamps.

- Those with a programme in place should give consideration to accelerating the rate of upgrading sites.

Contents

1. Introduction

In mid-1996 the Regional Offices of the Land Transport Safety Authority (LTSA) conducted surveys of three standards and guidelines in 30 road controlling authorities.

The standards and guidelines surveyed were:

- traffic signal light output (Australian Standard AS 2144)
- street lighting (New Zealand Standard NZS 6701:1983)
- treatment of slip lanes at traffic signals (RTS9 - Guidelines for Signing and Layout of Slip Lanes)

This report describes the procedures for the survey of traffic signal light output and presents the results.

2. Purpose of the Survey

The purpose of the survey of traffic signal light output was to:

- review the procedures used by road controlling authorities for maintaining and upgrading their traffic signal lamps.
- measure the performance of traffic signal lamps against AS2144.
- assist and advise road controlling authorities.
- recommend any justifiable changes to standards and policies for traffic signal light output and traffic signal maintenance.

3. Methodology

3.1 Sample Selection

A sample of 30 road controlling authorities was chosen for inclusion in the survey. The sample was biased toward authorities not included in the previous year's LTSA surveys.

3.2 Interview Surveys

Interview surveys were conducted with representatives in each authority. Survey forms were sent in advance to allow time to research answers if necessary. Questions centred on programmes, procedures and criteria used for maintenance and upgrading of traffic signal lamps.

Additional information was sought on the use of dimming facilities, retrofit kits for upgrading lamps and backing boards.

3.3 Field Surveys

Field surveys measured traffic signal light output to:

- obtain a "snapshot" of performance against the standard;
- verify responses to the interview questionnaire; and
- discuss problems or successes on-site with road controlling authority staff.

For each of the road controlling authorities a sample of signalised intersections and mid-block crossings was chosen by surveying:

- all intersections and crossings, or
- a sample based on a number reasonably completed in one day.

Specific features recorded for one traffic signal lantern at each site were:

- lantern height
- approach speed limit
- diameter and light output of the red, yellow and green aspects.

4. Results

4.1 Interview Surveys

4.1.1 Programmes for Cleaning/Replacement of Lamps

Table 1 in the Appendix summarises the reported cleaning and replacement programmes for both incandescent and quartz halogen lamps.

The most common maintenance cycles reported were:

- 3 months/13 weeks for both cleaning and replacement of incandescent lamps
- 3 months/13 weeks for cleaning quartz halogen lamps
- 2 years or longer for replacing quartz halogen lamps

4.1.2 Programmes for Monitoring Light Output of Signals.

No authority had a regular programme of instrumented checks on light output.

- 3 authorities (10%) had done one-off surveys in the past,
- 9 authorities (30%) reported regular visual inspections,
- 2 authorities (6%) reported "the signals are maintained to manufacturer's specifications."

4.1.3 Programmes for Upgrading to Quartz Halogen Lamps

Nineteen out of the 27 authorities for which responses were available reported some form of programme to upgrade to quartz halogen lamps.

Of these:

- 2 (7%) had completed their programme
- 8 (30%) had a planned programme
- 9 (33%) upgraded as equipment needed replacing, as funds allowed, or used quartz halogen for all new installations

Only five authorities had no upgrading programme at all.

4.1.4 Dimming Facilities

Only four authorities reported having dimming facilities installed:

- Christchurch City at about half their 141 signal installations,
- North Shore City at 8 installations,
- Transit NZ Auckland at four sites in Manukau City, and
- Hamilton City at one installation.

4.1.5 Retro-fit Kits

Seven authorities reported using retrofit kits:

- Dunedin City (at one location only),
- Transit NZ Dunedin (at two sites in Invercargill),
- Christchurch City (“sometimes”),
- Waitakere City (planned as part of maintenance schedule),
- Wanganui District (Aspex kits with replacement lenses),
- Hutt City (Aspex kits without replacement lenses.),
- Auckland City (routinely use David Reid retrofit kits.)

4.1.6 Backing Boards

All authorities except three (Ashburton District, Tauranga District and Waitakere City) installed backing boards whenever it was practical to do so.

The three exceptions installed them where background sun was a problem with Waitakere adding a background of advertising signs as a further reason.

4.2 Field Surveys

Some authorities are known to have completed their cleaning or replacement just before the field surveys were done. No attempt was made to correlate the results of the field surveys with the maintenance or replacement programme cycles.

4.2.1 Light Output Standards

The light output for each signal aspect was measured against Australian Standard AS2144. AS2144 requires luminous intensity measured on the geometric axis of at least:

- 200 candelas for red and green aspects; and
- 500 candelas for yellow aspects.

Table 2 in the Appendix summarises the results for each authority. It also includes information on the number of signal installations not included in the field surveys.

Table 2 shows an estimated 25% of signals nationally complied with the light output requirements of AS2144 (1995) at the time of the field surveys (mid-1996.) A large majority (91%) of these installations had quartz halogen lamps.

Apart from the yellow signal the on-axis output requirements of AS2144 are identical to the New Zealand Standard NZS5431. There were only two installations surveyed complying with NZS5431 but not AS2144.

Table 3 in the Appendix details compliance by the colour of the aspect. Overall there is little difference in the proportion of each colour complying with the standard. This result is shown more clearly in Figures 1 and 2 for the different lamp types.

4.2.2 Lamp Types

Of the surveyed lanterns, 93 (30% of the total sample) had quartz halogen lamps.

Figures 1 and 2 show the cumulative distributions for light output from traffic signal lamps for the two different types of lamp. The main results from these figures are:

- overall there is little difference in the proportion of each colour complying with the standard (AS 2144)
- only about 20% of incandescent lamps complied with the standard
- about 80% of quartz halogen lamps complied with the standard

Figure 1: Cumulative Light Output Curves for Incandescent Signals

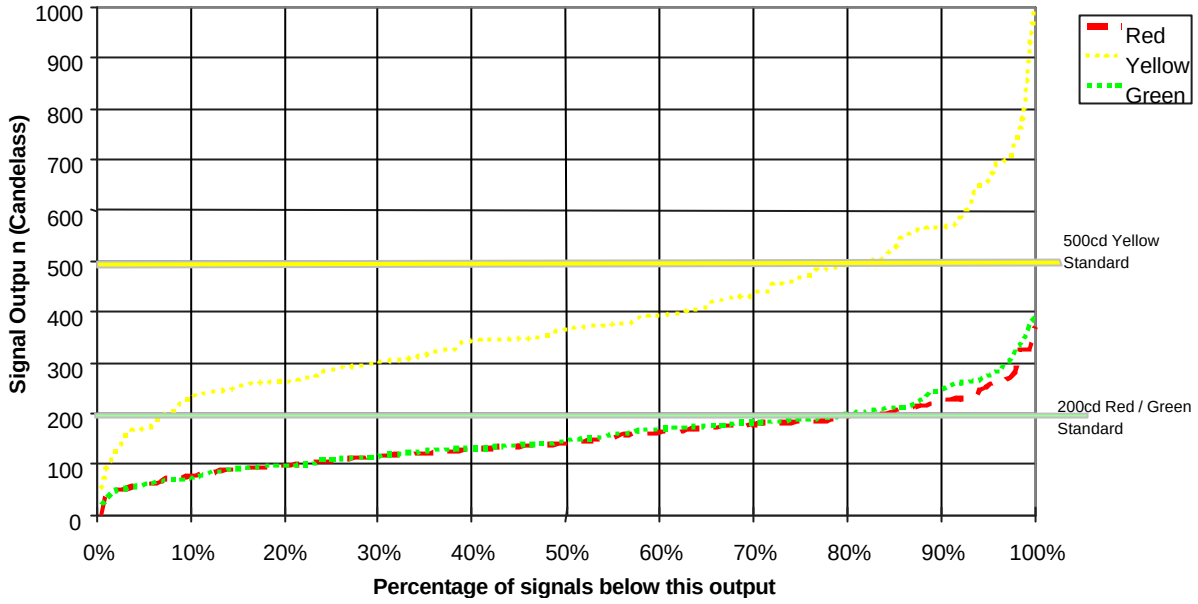
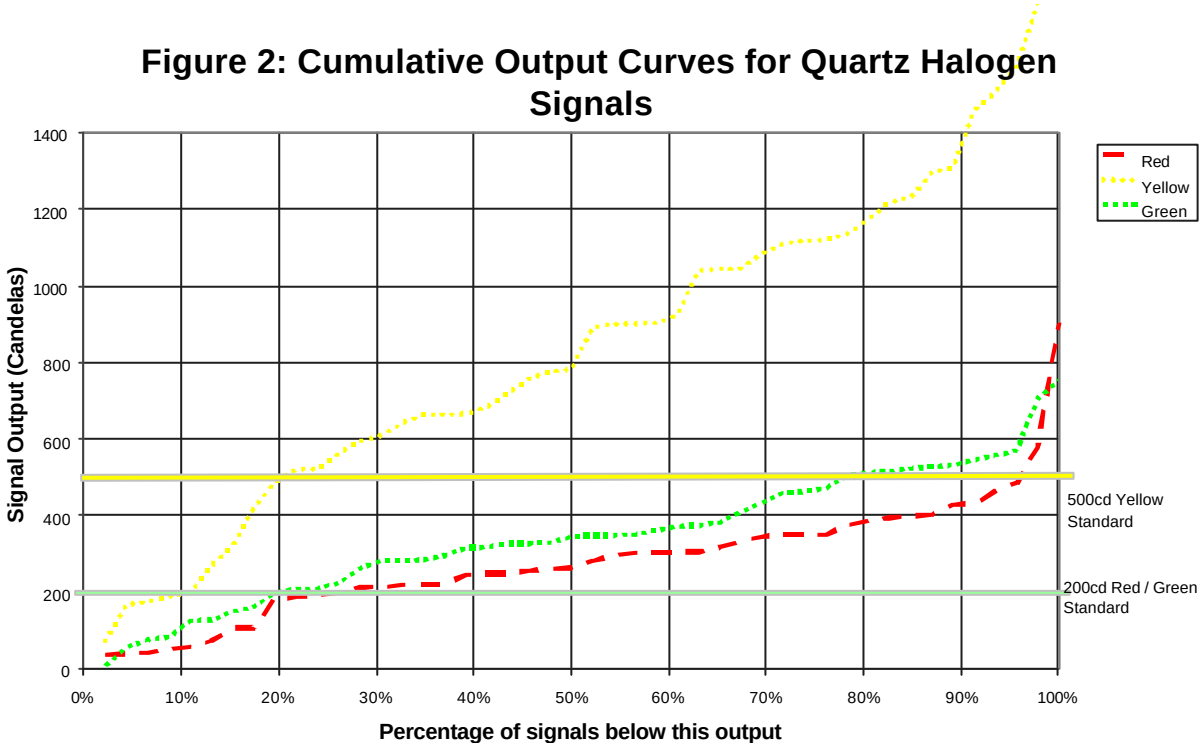


Figure 2: Cumulative Output Curves for Quartz Halogen Signals



4.2.3 Mounting Heights

Table 3 also shows 96 (31%) of the surveyed lanterns were mounted at AUSTROADS mounting heights.

This will be an underestimate of the actual proportion of intersections having at least some signals at AUSTROADS heights. Where an intersection had a mixture of mounting heights a low-mounted lantern was generally selected for the survey.

5. Discussion

Figures 1 and 2 clearly show the superior light output performance of quartz halogen traffic signal lamps. This superior performance together with longer life, reduced maintenance costs and reduced power consumption explain why a large majority of the authorities surveyed have either formal or informal programmes to upgrade their lamps to quartz halogen.

This is a practice LTSA encourages.

Other work by LTSA (1) and by Christchurch City Council (2) shows there are benefits in terms of crash savings from upgrading all traffic signal lamps to quartz halogen. These benefits are further enhanced by raising signal lanterns to AUSTROADS mounting heights and locating them closer to the traffic stream.

Assuming (from Table 3) that 34% of signal installations already have quartz halogen lamps and AUSTROADS heights, the total cost to upgrade the rest of the country (683 installations) is estimated at $12,979,000 (in July 1994 dollars.)

From the work referred to above, upgrading to AUSTROADS standards is estimated to save 88 injury crashes per year. At an average cost of $197,880 per urban injury crash this leads to benefits of around $17,500,000 per year.

6. Recommendation

All road controlling authorities should have a programme to upgrade their traffic signals to quartz halogen lamps. Those with a programme in place should give serious consideration to accelerating the rate of upgrading sites.

7. References

1. Land Transport Safety Authority, Transit NZ and Dunedin City Council (1993) - “Dunedin City Accident Investigation Study No. 2 - State Highway 1 One-Way Pair.”

2. Bill Sissons, Christchurch City Council (1996) - remit to 1996 Traffic Management Workshop.

Appendix

TABLE 1 NUMBER OF AUTHORITIES WITH EACH MAINTENANCE/REPLACEMENT PROGRAMME

FREQUENCY	INCANDESCENT CLEANING	INCANDESCENT REPLACE	QUARTZ HALOGEN CLEANING	QUARTZ HALOGEN REPLACE
3 mths/13 wks	16*	11**	11****	2
4 mths	4	4	3	1
6 mths	1	2	1	1
8 mths	1	1	3	0
12 mths	1	3***	3	11*****
Other/Longer	2	5	2	8

* - 5 of these clean yellow lamps every 6 mths only.
** - 6 of these replace yellow lamps every 6 mths only.
*** - 2 of these replace yellow lamps every two years only.
**** - 2 of these clean the interior every three years only.
***** - 2 of these replace yellow lamps every two years only.
"Other/Longer" includes 1 authority that replaced incandescent lamps on failure only and 4 authorities that replaced QUARTZ HALOGEN lamps on failure only.

TABLE 2 SIGNAL INSTALLATIONS COMPLYING WITH AS2144

ROAD CONTROLLING AUTHORITY	TOTAL SIGNAL SITES	SAMPLE	COMPLYING SITES		TOTAL SITES LIKELY TO COMPLY
			NUMBER	PERCENT	
ROTORUA	2	2	2	100%	2
DUNEDIN	26	11	10	91%	24
HUTT CITY	20	9	8	89%	18
MANUKAU	64	15	10	67%	43
NORTH SHORE	51	17	9	53%	27
TNZ DUNEDIN	30	15	7	47%	14
TNZ WELLINGTON	14	13	5	38%	5
CHRISTCHURCH	141	23	8	35%	49
TAURANGA	9	9	3	33%	3
TNZ CHRISTCHURCH	62	16	5	31%	19
WAITAKERE	36	16	3	19%	7
PALMERSTON NORTH	13	6	1	17%	2
TNZ NAPIER	13	7	1	14%	2
HAMILTON	35	15	2	13%	4
TNZ AUCKLAND	62	9	1	11%	7
WELLINGTON	78	10	1	10%	8
TNZ WANGANUI	24	14	1	7%	2
ASHBURTON	2	2	0	0%	0
AUCKLAND	245	27	0	0%	0
GISBORNE	3	3	0	0%	0
HASTINGS	12	7	0	0%	0
INVERCARGILL	12	11	0	0%	0
NELSON	10	10	0	0%	0
NEW PLYMOUTH	8	4	0	0%	0
TIMARU	2	2	0	0%	0
TNZ HAMILTON	13	10	0	0%	0
UPPER HUTT	3	3	0	0%	0
WANGANUI	10	10	0	0%	0
WHANGAREI	16	13	0	0%	0
NAPIER *	5				
RODNEY *	1				
PAPAKURA *	10				
WAIPA *	1				
TASMAN *	1				
PORIRUA *	1				
TOTALS	1035	309	77	25%	236

* These road controlling authorities were not included in the field survey.

TABLE 3 TRAFFIC SIGNAL LIGHT OUTPUT FIELD SURVEY RESULTS

ROAD CONTROLLING AUTHORITY	TOTAL SAMPLE	NUMBER COMPLYING			HEIGHT		LAMP TYPE	
		REDS	YELLOW	GREENS	** AUSTRD	LOW	QH	INCAND
ASHBURTON	2	2	0	0	2	0	0	2
AUCKLAND	27	1	3	4	2	25	3	24
CHRISTCHURCH	23	10	9	9	2	21	*10	*13
DUNEDIN	11	10	10	10	3	8	11	0
GISBORNE	3	0	0	0	0	3	0	3
HAMILTON	15	3	5	3	9	6	1	14
HASTINGS	7	0	1	0	1	6	0	7
HUTT CITY	9	8	8	8	9	0	7	2
INVERCARGILL	11	1	1	1	3	8	*3	*8
MANUKAU	15	10	11	10	2	13	11	4
NELSON	10	0	0	0	5	5	0	10
NEW PLYMOUTH	4	2	0	1	0	3	0	4
NORTH SHORE	18	9	12	10	2	15	9	9
PALMERSTON NTH	6	2	4	3	2	4	2	4
ROTORUA	2	2	2	2	2	0	2	0
TAURANGA	9	6	4	4	6	3	2	7
TIMARU	2	1	0	0	1	1	0	2
TNZ AUCKLAND	9	1	1	1	0	9	6	3
TNZ CHRISTCHCH	16	6	8	7	4	12	*8	*8
TNZ DUNEDIN	15	7	7	7	7	8	15	0
TNZ HAMILTON	10	2	1	4	2	8	1	9
TNZ NAPIER	7	1	2	2	4	3	1	6
TNZ WANGANUI	14	6	2	4	8	4	2	12
TNZ WELLINGTON	13	6	8	8	8	5	7	6
UPPER HUTT	3	0	0	0	1	2	0	3
WAITAKERE	16	5	2	7	6	10	2	14
WANGANUI	10	0	4	0	2	5	0	10
WELLINGTON	10	1	3	2	7	3	1	9
WHANGAREI	13	0	0	0	2	11	0	13
TOTALS	310	102	108	107	102	201	104	206

* - Lamp types were not specifically recorded from field surveys in Christchurch City and Invercargill City. The numbers of Quartz Halogen lamps shown in Table 3 for Christchurch and Invercargill are therefore estimates from the proportions stated in the interview questionnaires. The estimates are marked with an asterisk.

** - AUSTROADS requires the top of the lantern to be 4.1 metres above the ground. In the field surveys the height was measured to the bottom of the lantern. Any lanterns with the bottom of the lantern 3.2 metres or more above the ground were counted as being at AUSTROADS height.