Austroads

Addendum to
Report AP-R667-22

Standardised Signage and Pavement Symbols for Low and Zero Emission Vehicles: Testing Results Addendum

Standardised Signage and Pavement Symbols for Low and Zero Emission Vehicles: Testing Results Addendum

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Abstract

This addendum summarises testing results for a set of proposed symbols for electric-powered vehicles and hydrogen fuel-cell powered vehicles and their charging/refuelling infrastructure, to be used on road signage and pavement markings. The symbols were developed in the Austroads Research Report AP-R677-22.

Testing was conducted according to the Australian Standards AS 1743:2018. The understanding of symbols was tested by capturing feedback from respondents from the general public. The results show that electric-powered vehicle and charging station symbols were well understood. However, hydrogen fuel-cell powered vehicle and hydrogen refuelling station symbols did not pass the test.

It is concluded that the electric-powered vehicle and charging station symbols are considered suitable for use on future road signage and pavement markings. However, as the public's awareness of hydrogen as a fuel is still low, testing of hydrogen-related symbols should be repeated in the future, or the design of or need for such symbols should be reconsidered.

Keywords

Low and zero emission vehicle, electric-powered vehicle, hydrogen fuel-cell powered vehicle, battery electric vehicle, plug-in hybrid electric vehicle, charging station, parking, lane access, road signage, pavement marking, standardisation

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About Austroads

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Austroads' purpose is to support our member organisations to deliver an improved Australasian road transport network. To succeed in this task, we undertake leading-edge road and transport research which underpins our input to policy development and published guidance on the design, construction and management of the road network and its associated infrastructure.

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- Department for Infrastructure and Transport South Australia
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- Department of Infrastructure, Planning and Logistics Northern Territory
- Transport Canberra and City Services Directorate, Australian Capital Territory
- Department of Infrastructure, Transport, Regional Development, Communications and the Arts
- Australian Local Government Association
- Waka Kotahi NZ Transport Agency.

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Summary

This addendum summarises testing results for a set of symbols that were developed in Research Report AP-R677-22 (Austroads 2022). The symbols cover the following categories: electric-powered vehicles, charging station for electric-powered vehicles, hydrogen fuel-cell powered vehicles and hydrogen refuelling stations.

Testing symbols is required to ensure the symbols are understood by road users before they get adopted on road signage and pavement markings. Testing was conducted according to the Australian Standards AS 1743:2018 which outlines specifications and testing requirement for road signage and symbols. The understanding of symbols was tested by capturing feedback from 138 respondents from the general public via an online survey.

The results show that some of the proposed electric-powered vehicle symbols and charging station symbols were well understood. However, symbols for hydrogen fuel-cell powered vehicles and hydrogen refuelling stations were not well understood and did not pass the test.

It is concluded that the electric-powered vehicle and charging station symbols which passed the test are considered suitable for use on future road signage and pavement markings. The design of symbols for hydrogen fuel-cell powered vehicles and hydrogen refuelling stations or the need for such symbols should be reconsidered.

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1. Symbol Testing Procedure

This section outlines the symbol testing procedure, including shortlisting of symbols and the symbol comprehension test.

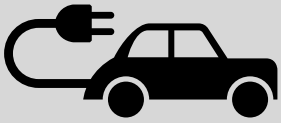
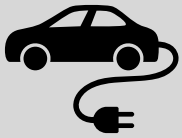
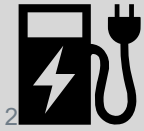
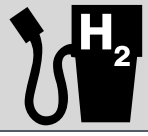
Symbol testing was conducted for some of the symbols proposed in Research Report AP-R677-22 (Austroads 2022). The testing procedure follows the recommendations of AS 1743:2018. The purpose is to evaluate the understanding of the symbols by the general public. As outlined in Section 5.6 of the research report, testing includes shortlisting of symbols as well as a comprehension test. The testing procedure is outlined in Sections 1.1 and 1.2 below.

1.1 Shortlisting Symbols for Testing

AS 1743:2018 (Clause 3.5) suggests preselecting or shortlisting symbols for comprehension testing. The preselection was done in collaboration with the MS-012 Standards Committee (Road Signs and Traffic Signals) whose members were familiar with the symbols. Shortlisting is useful to reduce the number of symbols to be tested in the comprehension test, and to eliminate symbols that have the potential to perform poorly in the comprehension test.

Out of all symbols proposed in Sections 5.1, 5.3 and 5.4 of the Research Report AP-R677-22 (Austroads 2022), the symbols presented in Section 6 of the report (summary) were selected for comprehension testing. This includes a set of 4 symbol variants each for the electric-powered vehicle, for the charging station for electric-powered vehicles, for the hydrogen fuel-cell powered vehicle and for the hydrogen refuelling station. These symbols are summarised again in Table 1.1.

Table 1.1: Symbols for comprehension testing

Symbols for comprehension testing			
Category 1: Electric-powered vehicle being charged			
			
Category 3: Charging station for electric-powered vehicles			
			
Category 4: Hydrogen fuel-cell powered vehicle and hydrogen refuelling station			
			
			

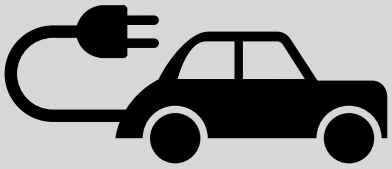
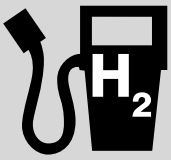
1.2 Comprehension Test

Each of the preselected symbol variants was tested in a comprehension test. Following the requirements outlined in AS 1743:2018, the following steps were taken:

- Respondents were randomly shown one variant of each set of preselected symbols and asked to write the meaning of the symbol into an answer box.
- A total of 138 respondents took part in the comprehension test. Considering that each set of proposed symbols contained 4 symbol variants (see Table 1.1), an average of at least 30 responses was achieved for most symbol variants, which satisfies the requirements in AS 1743:2018.
- The symbols were presented to the respondents on a screen (e.g. the computer or mobile device), and it was ensured that symbols were large enough for all details to be seen on the screen.
- It was ensured that only eligible respondents take part in the comprehension test, and that a representative sample was obtained. Respondents had to have a driver's licence, and a group of all ages and genders as well as people with English and non-English speaking backgrounds were selected in order to test understanding throughout different parts of the population.

An example of a set of questions to be answered by the respondents of the comprehension test survey is shown in Table 1.2.

Table 1.2: Example of a set of symbol comprehension test questions

Example questions	
What does this symbol represent if you see it on a parking sign? Your answer: _____	What does this symbol tell you if you see it on an information sign? Your answer: _____
	
What does this symbol represent if you see it on a parking sign? Your answer: _____	What does this symbol tell you if you see it on an information sign? Your answer: _____
	

The guidelines in AS 1743:2018 were followed as closely as possible during the symbol testing procedure. However, some adjustments had to be made. For example, the standards propose paper-based in-person tests (offline), which was replaced by an on-screen (online) survey with members from the general public for easier recruitment of test participants.

The respondents' descriptions of the meanings of these symbols were classified into the following 5 answer categories (refer to AS 1743:2018, Appendix E6.3):

1. **Correct:** correct understanding of the symbol is certain or likely.
2. **Marginally correct:** correct understanding of the symbol is marginally likely.
3. **Wrong:** a wrong response other than where answer category 4. below applies.
4. **Opposite:** the meaning which is stated is the opposite of that intended.
5. **Don't know:** the response given is 'don't know' (or similar, e.g. 'unsure').

For a symbol to pass the test, at least 85% of the responses should fall into answer category 1 (correct), with no more than 5% in category 4 (opposite) and no more than 10% in categories 3 and 4 combined (wrong and opposite).

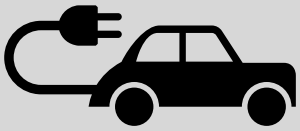
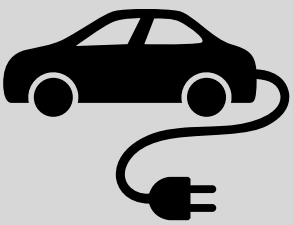
2. Test Results

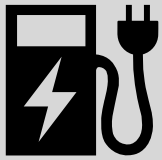
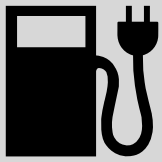
This section summarises the test results from the symbol comprehension test.

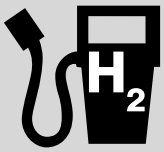
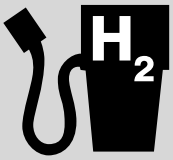
Table 2.1 summarises the test results for the individual symbols covering the electric-powered vehicle, the charging station for electric-powered vehicles, the hydrogen fuel-cell powered vehicle and for the hydrogen refuelling station.

As the electric-powered vehicle symbols and hydrogen fuel-cell powered vehicle symbols are recommended to be considered for use on signs for controlling access to lanes and roadways designated for electric-powered and hydrogen fuel-cell powered vehicles, these test results also cover the category 5 lane access signs which, except for these new symbols, would only use text and existing symbols. Category 5 signs were therefore not tested separately to avoid unnecessary repetition and confusion of survey participants.

Table 2.1: Comprehension test results

Category 1: Electric-powered vehicle			
Symbol variants	**Test results ***		**Comments**
	**Did not pass**		Confusion of charging flash with negation, e.g. don't park/no parking (opposite meaning). Confusion of charging flash with quick stop/short parking for drop-off, with danger/lightning bolt/electric shock, or with vehicle breakdown (wrong meaning).
	Correct	47%	
	Marginally correct	19%	
	Wrong	19%	
	Opposite	16%	
	Don't know	0%	
	**Did not pass**		Issues with charging flash as above.
	Correct	27%	
	Marginally correct	27%	
	Wrong	23%	
	Opposite	20%	
	Don't know	3%	
	**Passed (preferred symbol)**		Preferred symbol (same percentage of 'correct' answers as other electric-powered vehicle symbol with charging cord and plug). Correct understanding of symbol is very likely. However, many responses with reference to electric-powered vehicle charging or presence of charging point were received, although this is not necessarily the case at an electric-powered vehicle only parking location. Respective responses were classified as marginally correct considering the use of this symbol on a parking sign but can be considered correct in terms of understanding of the symbol itself.
	Correct	16%	
	Marginally correct	84%	
	Wrong	0%	
	Opposite	0%	
	Don't know	0%	
	**Passed (preferred symbol)**		Preferred symbol (same percentage of 'correct' answers as other electric-powered vehicle symbol with charging cord and plug). Comments about correct/marginally correct responses are the same as above.
	Correct	16%	
	Marginally correct	84%	
	Wrong	0%	
	Opposite	0%	
	Don't know	0%	

Category 3: Charging station for electric-powered vehicles			
Symbol variants	**Test results ***		**Comments**
	**Did not pass**		Some confusion of charging flash with danger/lightning bolt/electric shock. However, confusion is very limited compared to the use of the same charging flash icon on the electric-powered vehicle symbol.
	Correct	76%	
	Marginally correct	8%	
	Wrong	11%	
	Opposite	3%	
	Don't know	3%	
	**Passed (preferred symbol)**		Single preferred symbol (highest percentage 'correct' answers).
	Correct	93%	
	Marginally correct	7%	
	Wrong	0%	
	Opposite	0%	
	Don't know	0%	
	**Passed**		Symbol passed test, but with a lower percentage of 'correct' answers than charging station symbol with large 'EV' letters and no display rectangle.
	Correct	85%	
	Marginally correct	3%	
	Wrong	3%	
	Opposite	0%	
	Don't know	9%	
	**Passed**		Symbol passed test, but with a lower percentage of 'correct' answers than charging station symbol with large 'EV' letters and no display rectangle.
	Correct	85%	
	Marginally correct	6%	
	Wrong	9%	
	Opposite	0%	
	Don't know	0%	
Category 4: Hydrogen fuel-cell powered vehicle and hydrogen refuelling station			
Vehicle symbol variants	**Test results ***		**Comments**
	**Did not pass**		Some confusion of 'H' (in a pentagon) symbol with h-words such as hotel, hospital, hire car, hybrid car, handicap, helium or hazardous materials. Confusion with hospital or handicapped parking were considered as potentially dangerous (classified as opposite meaning). High percentage of 'don't know' answers.
	Correct	3%	
	Marginally correct	19%	
	Wrong	29%	
	Opposite	13%	
	Don't know	36%	
	**Did not pass**		Issues with 'H' symbol as above.
	Correct	19%	
	Marginally correct	3%	
	Wrong	48%	
	Opposite	3%	
	Don't know	26%	
	**Did not pass**		Some confusion of 'H_2' with '2-hour limit'. High percentage of 'don't know' answers.
	Correct	22%	
	Marginally correct	13%	
	Wrong	38%	
	Opposite	0%	
	Don't know	28%	
	**Did not pass**		Issues with 'H_2' symbol as above.
	Correct	28%	
	Marginally correct	14%	
	Wrong	39%	
	Opposite	3%	
	Don't know	17%	

Refuelling station symbol variants	Test results *		Comments
	**Did not pass**		Some confusion of 'H' (in a pentagon) symbol with 'hybrid' (vehicles).
	Correct	46%	
	Marginally correct	5%	
	Wrong	38%	
	Opposite	0%	
	Don't know	11%	
	**Did not pass**		Issues with 'H' symbol as above. High percentage of 'don't know' answers.
	Correct	20%	
	Marginally correct	7%	
	Wrong	47%	
	Opposite	0%	
	Don't know	27%	
	**Did not pass**		Some confusion of 'H_2' with '2-hour limit' and with water being available (relationship between hydrogen/H_2 and water/H_2O).
	Correct	46%	
	Marginally correct	15%	
	Wrong	28%	
	Opposite	0%	
	Don't know	10%	
	**Did not pass**		Issues with 'H_2' symbol as above.
	Correct	48%	
	Marginally correct	16%	
	Wrong	32%	
	Opposite	0%	
	Don't know	4%	

** Test result percentages rounded to nearest whole number.*

3. Conclusions and Recommendations

This section summarises the conclusions from the test results, and recommendations are made for further testing or symbol redesign.

The comprehension test shows that the electric-powered vehicle and charging station symbols which passed the test are considered suitable for use on future road signage and pavement markings. These symbols can be used for future standardisation, adoption in the road rules and signage manuals and eventually be used on road signs and for pavement markings.

The testing results for the hydrogen-related symbols which did not pass the comprehension test are understandable considering the market penetration of hydrogen today. Research into the awareness of hydrogen as an energy source (Lambert and Ashworth 2018) suggests that the knowledge of Australians about hydrogen is still low. Survey questions on the use and properties of hydrogen were mostly answered wrong, and a recommendation was made to ensure that future communication materials should not assume any prior knowledge of hydrogen. In contrast, the public's knowledge of electric-powered vehicles is increasing. Electric-powered vehicles can currently be purchased in Australia and their numbers are on the rise, whereas hydrogen fuel-cell powered vehicles are not widely available.

It can be concluded that the understanding of the hydrogen-related symbols will improve as awareness of hydrogen as a fuel and the availability of hydrogen fuel-cell powered vehicles and hydrogen refuelling stations increase. It is recommended that the current set of hydrogen-related symbols is retested in a comprehension test the future when awareness around hydrogen fuel-cell powered vehicles and infrastructure has increased in the community. Future studies on the awareness around hydrogen can help to determine a suitable timing for retesting. Considering the current hydrogen fuel-cell powered vehicle market, retesting should not be conducted for at least a year.

If retesting the hydrogen-related symbols in the future does not show improved understanding of the symbols, the symbols may not be suitable, and redesign of the symbols should be considered.
AS 1743:2018 suggests a recall test for symbols which did not pass the comprehension test. The recall test requires redesigning symbols to find more suitable symbol designs. These new symbol designs would then tested again until a suitable symbol is found. Alternatively, symbols can be abandoned if it is concluded that such symbols are not required or useful. Symbol redesign and/or recall testing has not been conducted as a part of this work.

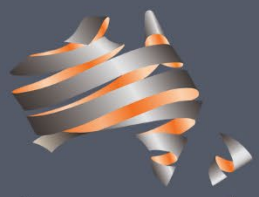
Future testing could also capture data about the vehicle ownership of respondents. This would allow to establish a relationship between the type of powertrain of the vehicle of each respondent (electric-powered, hydrogen fuel-cell powered or conventional internal combustion engine powered) and their understanding of the symbols relating to specific vehicle/fuel types.

References

Austroads 2022, *Standardised signage and pavement symbols for low and zero emission vehicles*, AP-R667-22, Austroads, Sydney, NSW.

Lambert, V & Ashworth P, 2018, *The Australian public's perception of hydrogen for energy*, project report, School of Chemical Engineering, University of Queensland, Brisbane, Qld, viewed on 8 July 2022, <https://arena.gov.au/assets/2018/12/the-australian-publics-perception-of-hydrogen-for-energy.pdf>.

AS 1743:2018, *Road signs: specifications.*



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