

**PUBLISHED PROJECT REPORT
PPR931**

Pedal Application Error: Pedal Indicator
Light - Human Machine Interface (HMI)

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Executive Summary

Background

Pedal application error (also known as pedal confusion) is a phenomenon which has been identified as occurring on buses. Pedal Application Error refers to situations where the driver presses the accelerator when they think they are pressing the brake pedal, which leads to an unintended acceleration. It happens extremely rarely but carries a risk of very severe outcomes. It is very difficult to understand exactly what happens in these events, and drivers are unaware of their mistake. Transport for London (TfL) is now requiring CCTV cameras to be fitted in the footwell to provide evidence in case of future incidents. In the meantime, there are a variety of measures to help a driver place their foot correctly or recover from an unintended acceleration incident.

Pedal indicator lights have been proposed as a solution to combat this by providing feedback to the bus driver as to which pedal they are pressing; assisting them in identifying potential pedal application errors. This was implemented to assist in faster recovery in instances of pedal confusion.

Objective

The aim of this study was to determine and standardise an appropriate method of warning bus drivers that they were engaging the accelerator pedal.

Method

A review of the relevant national and international standards was conducted to identify the design stipulations and restrictions that apply to bus warning icons. Following this, bus manufacturers were engaged to discuss the design restrictions of their current bus cabs and the associated Human Machine Interface (HMI). From this information, several design solutions were developed, where bus manufacturers were asked to comment on the technical feasibility of the proposed solutions, and the bus drivers were asked, by means of a survey, to provide feedback on the proposed solutions. The final solution was determined from the results obtained from the bus manufacturer and bus driver engagement.

Results

The bus drivers rated Design 2 as the most preferred and intuitive solution and the bus manufacturers showed a clear preference for implementing the solution into the programmable driver information screen. From the international and national standards, the icon is recommended to be yellow in colour on a black background, and to have a minimum pixel and pixel character matrix of 32x32 and 7x9 respectively. Moreover, the font of the text should be clearly legible (ISO 2575: 2010 + A7:2017) with the text spacing being in accordance with ISO 15008.

Recommendation

TRL recommends Design 2 as the standardised accelerator indicator light to be implemented into the driver information screen on all buses in the TfL fleet. The minimum design requirements are detailed in Section 4 of the report.

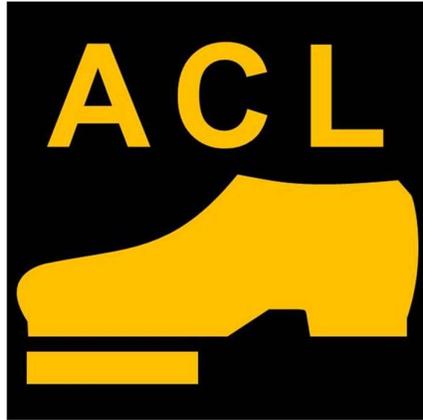


Figure 1: Recommended icon for Pedal Indicator Light

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1 Introduction

Following the completion of the Transport for London (TfL) 2018 Bus Safety Standard (BSS) project, which evaluated the potential impact of a number of safety measures on London's buses, a few of the safety measures were highlighted for further development – outside of the scope or time constraints of the original BSS project. One of those measures was pedal application error, defined as “situations where the driver presses the accelerator when they think they are pressing the brake pedal, leading to unintended acceleration”. This phenomenon, also known as pedal confusion, happens extremely rarely but carries a risk of very severe outcomes. During a pedal confusion event, the driver is typically unaware that they are pressing the incorrect pedal. Pedal indicator lights have been proposed as a solution to give feedback to the driver as to which pedal they are pressing, to help them identify the error – with the hope it would assist in faster recovery in instances of pedal confusion. The Accelerator Light System was specified on buses entering London's fleet in 2019. However, to mitigate the potential risk of confusion created from drivers switching between buses, a standard pedal indicator light is required.

1.1 Aims and objectives

This study aimed to determine an appropriate method of warning bus drivers that they were engaging the accelerator pedal. Specifically, the study aimed to develop a warning that would be easily understood by bus drivers in a single glance in situations where pedal application error had occurred. This indicator will ideally be uniform across all buses run by TfL operators.

1.1.1 Research Questions

- 1) What space is available in the bus driver's Human Machine Interface (HMI) for the symbol to be displayed?
- 2) What stipulations and restrictions are there on the creation of new indicators from international and national standards and guidelines?
- 3) Are the proposed designs technically feasible?
- 4) Which of the proposed standard-conformant-designs is best received by bus drivers?

2 Method

The project consisted of:

- 1) A review of the ISO standards relevant to vehicle HMI design and the National Highway Traffic Safety Administration (NHTSA) guidelines regarding vehicle HMI.
- 2) Engagement with bus manufacturers on the space available in their displays for an icon.
- 3) Creation of the potential design solutions and subsequent review by bus manufacturers regarding the technical feasibility of the proposed solutions.
- 4) Engagement with London bus drivers regarding their preference and interpretation of the proposed design solutions.

2.1 Review of standards

Relevant national and international design standards and specifications were reviewed to provide a body of knowledge regarding what the new pedal indicator symbol should look like and how it should behave. These included:

- ISO 15008: 2017. *Road vehicles – Ergonomic aspects of transport information and control systems – specifications and test procedures for in-vehicle visual presentation*
- ISO 15121-3:2011. *Road vehicles – Ergonomic requirements for the driver's workplace in line-service buses. Part 3: Information device and controls*
- ISO 2575: 2010+A7:2017. *Road vehicles – Symbols for controls, indicators and tell-tales*
- NHTSA: *Human Factors Design Guidance for Driver-Vehicle Interfaces*

These documents provided very specific guidance on what the minimum size and resolution of the design should be, what colours could be used for the icon (and what they signify), which combinations of icon and background colour should be used for maximum visibility in the cab whilst driving, what the icon should look like (roughly), what size and spacing the text should be if it is to be included in the icon, and where the icon should be located within the cab.

2.2 Review of current space in bus models

This part of the project was done in parallel with the review of literature and relevant standards. This consisted of engaging with the bus manufacturers to determine how much space they had available to either hardwire an icon into the bus dashboard or programme a digital icon into the HMI displays. Manufacturers were asked to give total space available for the icon as well as the pixel concentration in that area.

2.3 Manufacturer Consultation

After the development of several potential design solutions – all of which adhere to the relevant standards and guidelines - manufacturers were engaged with regards to the technical feasibility of the solutions. Each manufacturer was sent a document (Appendix A) which detailed the potential design solutions and asked:

1. If they felt the design solution was technically feasible. If they answered that it was not, they were asked to provide feedback.
2. To give their opinions on the potential design solutions from the perspective of a bus driver if they had previously been one.

2.4 Driver Engagement (Survey)

After reviewing all the potential design solutions with the manufacturers for technical feasibility, the designs were incorporated into an online survey which was distributed to all London bus operators to disseminate to their drivers. The aim of the survey was to elicit feedback on what the driver's initial feedback on the solutions was i.e. what they perceived each of them to mean and why. After giving interpretations of the proposed selection of solutions, drivers were then given a full explanation of what the solution (i.e. icon) would signify and why it was being introduced, and then were asked to rank all the solutions in order of favourite to least favourite.

2.4.1 Data Analysis

A total of 188 drivers completed the survey - all responses were manually analysed. Survey responses regarding drivers' interpretations of proposed design solutions were thematically coded, where the top three interpretations for each design were identified and the percentage of correct interpretations was calculated. Icon design preference rankings were averaged to provide a singular mean ranking for each design (Appendix C).

3 Results

3.1 Review of standards

ISO standard 16121 dictated that the icon should be placed within Zone A, an area defined as *“the zone on the dashboard beneath the steering wheel, bounded by a horizontal tangent to the top of the steering column and its uppermost position, a vertical projected from the left- and right-hand extremities of the wheel rim and the top of the dashboard”* (Figure 2). The instrumentation that are required to be located in Zone A are the indicator lamps, the central information display and, the warning and alert indicators. The standard also states that the icons displayed in this area should be large and clear (as per the specification in ISO 2575:2010), yellow in colour if it is an early warning icon and that all messages should clearly distinguish between whether they are symbolising an early warning or an alert.

The icon should be displayed on a minimum pixel matrix of 32x32 – though if it is not recognisable then it should be made larger. ISO Standard 15008 specifies that any text in the icon that is not a permanent part of the user interface should be *“set in mixed or lower-case characters”* and should be spaced as stated in ISO 15008:2017 Sections 4.5.5. If this were to occur, ISO 15008:2017 specifies that the text would have to be a permanent part of the interface. However, this recommendation contradicts ISO 2575:2010+A7:2017, which states that *“all new symbols now yet covered in the International Standard should be constructed using elements that keep coherence with other symbols”*, where all symbols documented in ISO 2575:2010 utilise capital letters only. Moreover, NHTSA guidance on text legibility within visual interfaces, states that abbreviations and signal words should be presented *“in capital letters, or in mixed case when using fonts that maximise the texts visual angle”*. For these reasons, capital lettering was considered during the creation of the pedal accelerator icon. For each alphanumerical character included in the icon, a minimum of a 7x9 character pixel matrix should be used. ISO 15008:2017 states that in the case that all characters are capital letters the character pixel matrix can be reduced to 5x7, however if legibility of the characters is important for the task a 7x9 pixel matrix should be used.

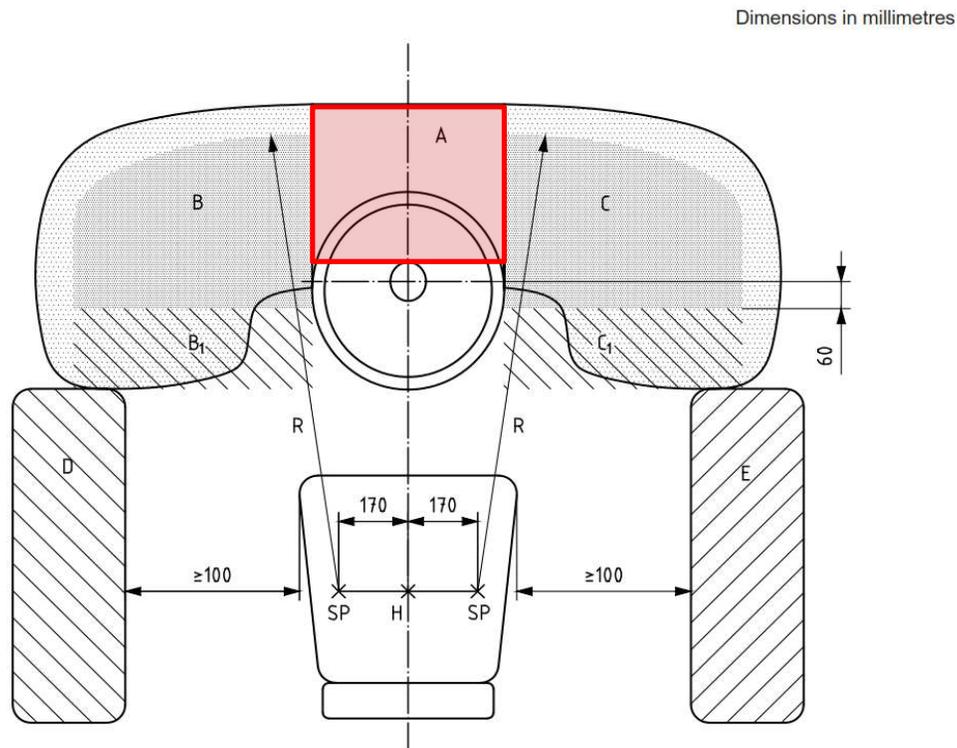


Figure 2. Definition of driver cab zones (ISO 16121-3, 2011)

ISO 2575 documents all the current ISO approved icons for controls and indicators within vehicles. It also reinforces what is stated in ISO 16121 regarding icon colour.

- Red means: “*danger to person or very serious damage to equipment; immediate or imminent*”.
- Yellow/amber means: “*caution, outside normal operating limits, vehicle system malfunction, damage to vehicle likely, or other condition which can produce hazard in the longer term*”.
- Green means: “*safe or normal operating condition*”.

The purpose of the light is to warn the driver, which fits with the ‘caution’ meaning of the yellow light. Red is inappropriate because there might be occasions where the bus driver may have their foot fully on the throttle, such as going uphill. Green is also inappropriate as the driver may be experiencing a pedal application error incident which is not depicted as safe driving and does not reflect normal operating conditions. In the case that the icon or text displayed is yellow, ISO 15008 recommends the background colour to be black. If this is not feasible, a blue or violet background is acceptable, or if the colour saturation causes a clear difference, a green, cyan, purple or red background colour may be used.

As previously mentioned, the standard states that when creating a new icon not yet covered in ISO 2575, it should be “*constructed using symbols or elements of symbols from this International Standard in a logical manner, keeping the coherence*”

with other symbols already published". Figure 3 displays the pedal icons depicted in the standard.

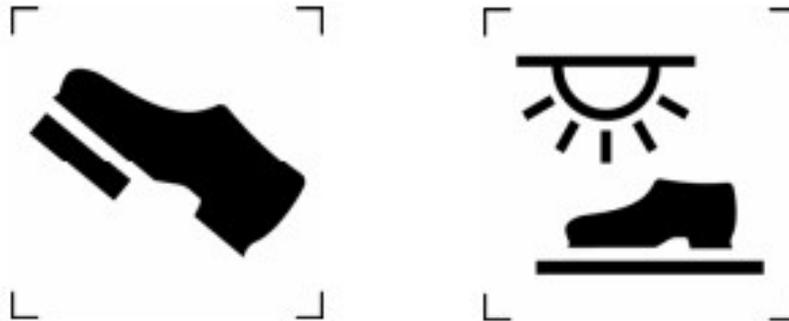


Figure 3. Similar icons from ISO 2575:2010+A7:2017

The NHTSA Human Factors Design Guidance for Driver-Vehicle Interfaces gives clear guidance on which modality should and should not be used to give non-emergency warnings. To mitigate driver annoyance, the guidelines suggest avoiding haptic or auditory modalities for cautionary warnings. The guidelines further suggest that drivers are not likely to find non-critical alarms annoying, even when they have relatively high activation rates, providing that they are unobtrusive and presented through the visual modality only. Section 11-11 supports the suggestion of a visual warning, reporting that bus drivers often tune out auditory alerts as a method of coping with noise in the cab. NHTSA, in section 6-6, recommends the same colour requirements as stated in the ISO standards. In section 5-3, the guidelines mention that any form of warning or icon can be used to convey a message (e.g. "you are pressing hard on the accelerator"), however illogical or poorly designed warnings may *"initially promote errors, require training or involve extensive trial-and-error learning"*. To mitigate these negative consequences, TRL suggest following the guidance provided by ISO 2575.

3.2 Review of current space in bus models

3.2.1 *Manufacturer Visit(s)*

A team from TRL attended two workshops with two bus manufacturers to assess the available space in the bus cabin. The aim of the workshop was to develop an understanding of the potential advantages and disadvantages of various pedal indicator light positions. To gather this information, TRL firstly had a discussion with the manufacturers regarding the space available in the bus cabin. This was followed by a static inspection of various bus models, where various indicator light positions were discussed focusing on 1) the technical feasibility of the positions and 2) the potential impact of the positions on the bus driver. The information gathered from the engagement with the manufacturers, including photos, was used to identify technically feasible pedal indicator light positions and fed into the creation of the potential design solutions.



Figure 4. Example 1 of bus dashboard inspected during walk-around



Figure 5. Example 2 of bus dashboard inspected during walk-around

3.2.2 *Manufacturer Engagement*

The bus manufacturers were sent information regarding the space requirements of the dash icon as dictated by the ISO standards and were asked:

- Whether there was room in their current dash design for the inclusion of the icon.
- To specify where that would be in the dash.

All manufacturers confirmed that they had the required space and stated a preference for the icon to be programmed into the HMI screen in the middle of the driver's dash - referred to as the "driver information screen". This was primarily because it would not require any physical changes to the bus cabins, and thus would be more cost effective to implement.

3.3 **Manufacturer design consultation**

Manufacturers were sent a document where they were asked to comment on the technical feasibility of the proposed design solutions and, if they had previous bus driver experience, to provide their opinions on the design solutions (Appendix A). All the manufacturers that replied (five of the seven manufacturers who were contacted) confirmed that all the proposed design solutions were technically feasible. However, the manufacturers pointed out that for some of the design solutions (containing text or speed dial), the space available on the driver information screen may reduce the clarity of the icons. Manufacturers also expressed a lack of understanding of the design solutions that included arrows. This feedback was noted but was not essential because bus manufacturers will not be the ones interacting with the icon on a daily basis.

3.4 Driver engagement (survey)

With only the knowledge that it would be shown on the driver information screen, drivers were asked to interpret and to provide their reasoning for their interpretation for each of the design solution. After they had reviewed all the potential icons, respondents were given a full explanation of what the aim of the survey was and were asked to rank the icons from 1-9, with one being their most preferred and nine being their least preferred icon (Appendix B).

Table 1: Driver potential design solution feedback

Ranking	Name	Image	Score	Correct interpretations (percentage of responses)
1	Design 2		3.46	50.4%
2	Design 4		3.56	32.7%
3	Design 3		3.86	39.6%
4	Design 5		4.14	22.3%

The drivers most preferred design was Design 2 (Table 1). This design was also the most correctly interpreted, with over half of the drivers interpreting it as “engagement with the accelerator pedal”. Design 4 was very similarly ranked by drivers being scored only 0.1 less on the 1-9 scale, however less than a third of participants interpreted the icon correctly. The only other designs that ranked in the top half of the driver preferred icons (i.e. an average rank of between 1 and 4.5) were Design 3 and Design 5, which were correctly interpreted just under 40% and 23% of the time respectively. All other designs were ranked in the lower half of the scale and were correctly interpreted less than 15% of the time.

4 Recommendations

The design that was the most preferred and intuitive (with an average ranking of 3.46) was Design 2 (Figure 6). This is the design that TRL recommends being implemented into Zone A of the driver dashboard (likely in the programmable driver information screen). It is recommended that the icon is to be displayed on a minimum pixel matrix of 32x32. Moreover, the icon should be yellow on a black background and all text should be presented on a minimum character pixel matrix of 7x9. The font of the text is not specified but should be clearly legible (ISO 2575: 2010 + A7:2017) with the text spacing being in accordance with ISO 15008.

Even though Design 2 had the largest number of correctly identified interpretations, nearly half of the respondents did not correctly interpret it. Thus, TRL recommends training bus drivers on the new icon i.e. detailing what the icon is and when it will be activated. This will ensure the correct awareness of the icon and bus driver response if it is activated.

The pedal indicator light is relatively inexpensive to implement in future buses, having already generated the logic and symbol. A draft of the BSS documentation has been updated to reflect the recommendations made in this report.

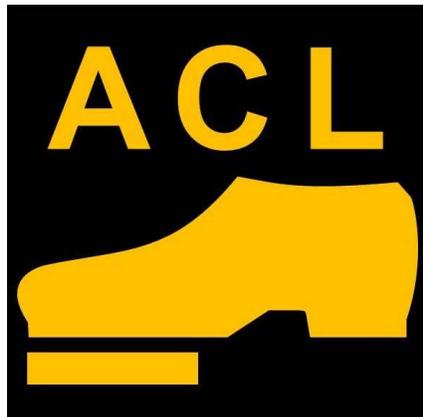


Figure 6. Pedal indicator icon Design 2

Although the introduction of Advanced Emergency Braking (AEB) systems across the TfL bus fleet may mitigate most potentially negative outcomes of pedal confusion. It is not mandatory for London's buses until 2024 (according to the roadmap), so in the interim the Accelerator Light System (ALS) will provide a mitigation to any potential negative outcomes associated with pedal confusion.

Post-2024 and implementation of AEB, the ALS will still provide value as there might be some instances where AEB cannot detect/intervene. The ALS will prove useful in the stages of an extended pedal confusion if the bus is accelerating and not yet likely to hit anything. The ALS may also provide an additional benefit in that it may have a side effect of training drivers not to accelerate harshly, like a telematics type system.

Bibliography

International Organization for Standardization. (2011). *BS ISO 16121-3:2011 Road vehicles - Ergonomics requirements for the driver's workplace in line-service buses*. BSI Standards Publication.

International Organization for Standardization. (2017). *BS EN ISO 15008:2017 Road vehicles - Ergonomic aspects of transport information and control systems - Specifications and test procedures for in-vehicle visual presentation*. BSI Standards Publication.

International Organization for Standardization. (2017). *BS ISO 2575:2010+A7:2017 Road vehicles - Symbols for controls, indicators and tell-tales*. BSI Standards Publication.

National Highway Traffic Safety Administration. (2016). *Human Factors Design Guidance For Driver-Vehicle Interfaces*. U.S. Department of Transportation.

Acknowledgements

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Appendix A Manufacturer feedback form

Below are the possible pedal indicator light symbol designs for your review and input please. The technical requirements are summarised below the table for your reference.

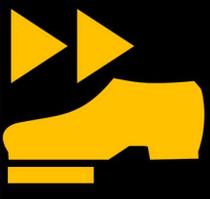
Please do not discuss with the bus operators or any of their drivers. We do not want to risk any bias of the survey of bus driver’s opinions.

The message to be communicated is **“you are pressing hard on the accelerator pedal”**

Please return to aedwards@trl.co.uk by Friday 3rd May 2019. If you do not respond we will assume that all symbols are technically feasible.

[The priority from for this is the technical feasibility in section (1). Note that if you are not a bus driver, or do not have access to bus drivers in your company, then there is no need to give an answer in (2), so leave it blank.]

Symbol	1) Technically feasible? Yes/no	If not feasible please explain why	2) Your personal opinion as a bus driver Ranking, where 1 is preferred (only complete if you are a driver)	Notes to explain your ranking
				
				

Symbol	1) Technically feasible? Yes/no	If not feasible please explain why	2) Your personal opinion as a bus driver Ranking, where 1 is preferred (only complete if you are a driver)	Notes to explain your ranking
				
				
				
				

Symbol	1) Technically feasible? Yes/no	If not feasible please explain why	2) Your personal opinion as a bus driver Ranking, where 1 is preferred (only complete if you are a driver)	Notes to explain your ranking
				
				
				

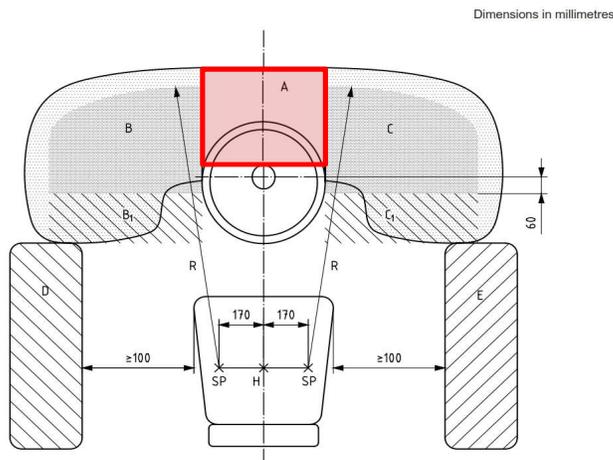
A.1 Summary of Technical Requirements

- (a) Needs to be located within Zone A
- (b) Needs to be Yellow
- (c) Yellow symbol/font to be on a black background
- (d) Text Ratio of at least 5x7 pixels, preferably 7x9
- (e) Needs to be consistent in terms of aesthetics with other symbols in ISO 2575 with a similar meaning
- (f) Text Spacing should be consistent with ISO (see explanation)
- (g) Total symbols shall be at least 32x32 pixels (unless the display is able to display shades of grey)

A.2 Explanatory Technical Notes

(a) Needs to be located within Zone A – *ISO 16121, section 4.3*

- The following instrumentation shall be located in Zone A:
 - indicator lamps;
 - central information display; and
 - the warning and alert indicators.



(b) Needs to be Yellow – *ISO2575, section 5.1*

- yellow or amber: caution, outside normal operating limits, vehicle system malfunction, damage to vehicle likely, or other condition which can produce hazard in the longer term

(c) Yellow font to be on a black background – *ISO 15008, Annex B*

Symbol/background colour combinations

Background colour	Symbol colour						
	White	Yellow	Orange	Red ^a , Purple	Green, Cyan	Blue ^a , Violet	Black
White	-	o	+	+	++	++	
Yellow	-	-	o	o	+	++	
Orange	o	-	-	-	o	+	
Red ^a , Purple	+	o	-	-	-	+	
Green, Cyan	+	o	-	-	-	+	
Blue ^a , Violet	++	+	o	-	-	-	
Black	++	++	+	+	+	-	
++ Preferred + Recommended o Accepted with high saturation differences - Not recommended							
^a Pure red and blue should be avoided in view of the fact that the eyes may have trouble focusing on these colours because of eye chromatic aberration							

(d) Text Ratio of at least 5x7, preferably 7x9 – *ISO 15008, section 4.6.1*

- A (5 × 7) pixel (width by height) character matrix shall be the minimum used for alphanumeric characters, if characters are only upper case.
- If legibility of an individual alphanumeric character is important for the task, a (7 × 9) pixel (width by height) character matrix should be the minimum.

(e) Text Spacing, *ISO 15008, section 4.5.5*

- Typefaces selected should be evenly and proportionately spaced and the space between vertical strokes (such as between l and m) should range between 150 % and 240 % of the stem width. The space between diagonal characters and a vertical (such as between v and l) should be a minimum of 85 % of the stem width. Two diagonal characters should not touch (see Figure 9).

(f) Needs to be consistent in terms of aesthetics with other symbols in ISO 2575 with a similar meaning, *ISO 2575, section 4.13*

- New symbols for functions not yet covered in this International Standard should be constructed using symbols or elements of symbols from this International Standard in a logical manner, keeping the coherence with other symbols already published

(g) Needs to be at least 32 pixels x 32 pixels, *ISO 15008, section 4.6.2*

- For automotive symbols in accordance with ISO 2575, or similar, a (32 × 32) pixel matrix should be the minimum. A smaller matrix, e.g. (24 × 24) pixels, may be used if the display is capable of grey shades.

Appendix B Bus driver survey

B.1 About the study

Why have you been asked?

We are developing a new warning indicator symbol for the driver information screen on London buses. Bus drivers will be the ones who interact with the new indicator symbol the most, so we are interested in getting your feedback on the potential designs.

What will I be required to do?

You will be asked to give feedback on a number of potential designs for a new indicator symbol, we are interested in your initial reaction to the symbols and what you perceive them to mean. Because we are interested in your opinion please complete this survey without input from anyone else.

How long will it take?

This survey will take a maximum of 10-15 mins. Who is it for? The research is being undertaken by TRL (the Transport Research Laboratory) on behalf of TfL (Transport for London) to explore driver reactions to a number of potential designs for a new indicator symbol.

What will the results be used for?

The results of this survey will feed into final recommendations given to TfL on which symbol should be used. It will be up to TfL to make a choice on which symbol will be used so the recommended symbol might not necessarily be taken forward to production.

All feedback you provide in this survey is completely anonymous and should you choose to start the survey you are not obliged to finish it, you are free to stop at any time.

Are you still interested in taking part in this research?

If you would like any further information before answering this question, please email trials@trl.co.uk. *

Yes

No

B.2 2. Basic Information

B.2.1.1 *Are you currently an active bus driver? **

- Yes
- No

B.2.1.2 *Gender **

- Male
- Female
- Other

B.2.1.3 *Which age range do you fall into? **

- 20 or younger
- 21-30
- 31-50
- 51-70
- 71 or older

B.2.1.4 *How many years of bus driving experience do you have? **

- 1-3
- 4-6
- 7-9
- 10+

B.2.1.5 *What is the approximate number of different bus models you have driven?*

- 1-5
- 6-10
- 11-15
- 16-20
- 20+

*B.2.1.6 Which London operator do you currently drive for? **

- Abellio
- Arriva
- Go-Ahead
- HCT Group
- Metroline
- RATP Dev London
- Stagecoach
- Sullivan Bus & Coach Ltd
- Tower Transit
- Uno

B.2.1.7 Design restrictions

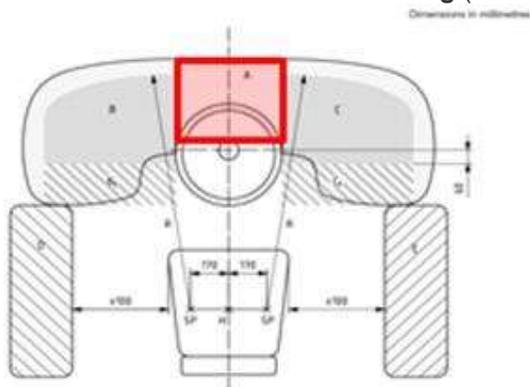
This page details the design restrictions of the new symbol. If you are interested, they are listed below, however if not please feel free to go straight on to reviewing the symbol designs

The bus icon has to be design to the specifications in the ISO (International Organization for Standardization) standards. This limits the amount of variation the icon design can have. It must adhere to the following:

The icon needs to be located within Zone A

The symbols need to be yellow/ amber on a black background

The icon needs to be consistent with the look of other symbols documented in the in ISO standards with a similar meaning (i.e. needs to feature a pedal and a foot)



B.3 Icon Designs

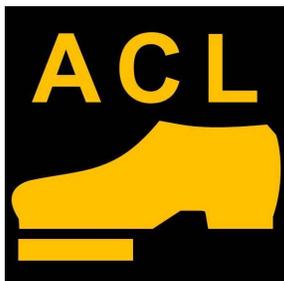
B.3.1 *Design 1*



B.3.1.1 *With the context that the icon would appear on a driver information screen; what would you assume the meaning of the symbol displayed above is? **

B.3.1.2 *Why would you assume this? **

B.3.2 *Design 2*



B.3.2.1 *With the context that the icon would appear on a driver information screen; what would you assume the meaning of the symbol displayed above is? **

B.3.2.2 *Why would you assume this? **

B.3.3 *Design 3*



B.3.3.1 *With the context that the icon would appear on a driver information screen; what would you assume the meaning of the symbol displayed above is? **

B.3.3.2 *Why would you assume this? **

B.3.4 *Design 4*



B.3.4.1 *With the context that the icon would appear on a driver information screen; what would you assume the meaning of the symbol displayed above is? **

B.3.4.2 *Why would you assume this? **

B.3.5 **Design 5**



B.3.5.1 *With the context that the icon would appear on a driver information screen; what would you assume the meaning of the symbol displayed above is? **

B.3.5.2 *Why would you assume this? **

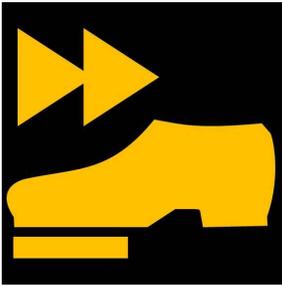
B.3.6 **Design 6**



B.3.6.1 *With the context that the icon would appear on a driver information screen; what would you assume the meaning of the symbol displayed above is? **

B.3.6.2 *Why would you assume this? **

B.3.7 *Design 7*



B.3.7.1 *With the context that the icon would appear on a driver information screen; what would you assume the meaning of the symbol displayed above is? **

B.3.7.2 *Why would you assume this? **

B.3.8 *Design 8*



B.3.8.1 *With the context that the icon would appear on a driver information screen; what would you assume the meaning of the symbol displayed above is? **

B.3.8.2 *Why would you assume this? **

B.3.9 *Design 9*



B.3.9.1 *With the context that the icon would appear on a driver information screen; what would you assume the meaning of the symbol displayed above is? **

B.3.9.2 *Why would you assume this? **

B.4 Research Description

What is this research looking at?

Why is this new indicator being introduced?

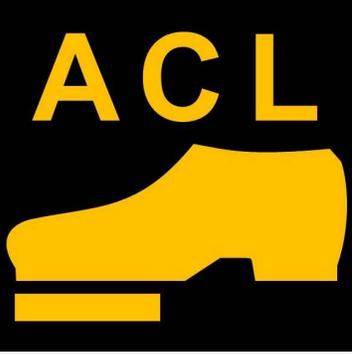
Following the publishing of TfL's 2018 Bus Safety Standard, which evaluated the potential impact of a number of safety measures on London buses, a number of the safety measures are being further developed. One of those measures was "Pedal Application Error".

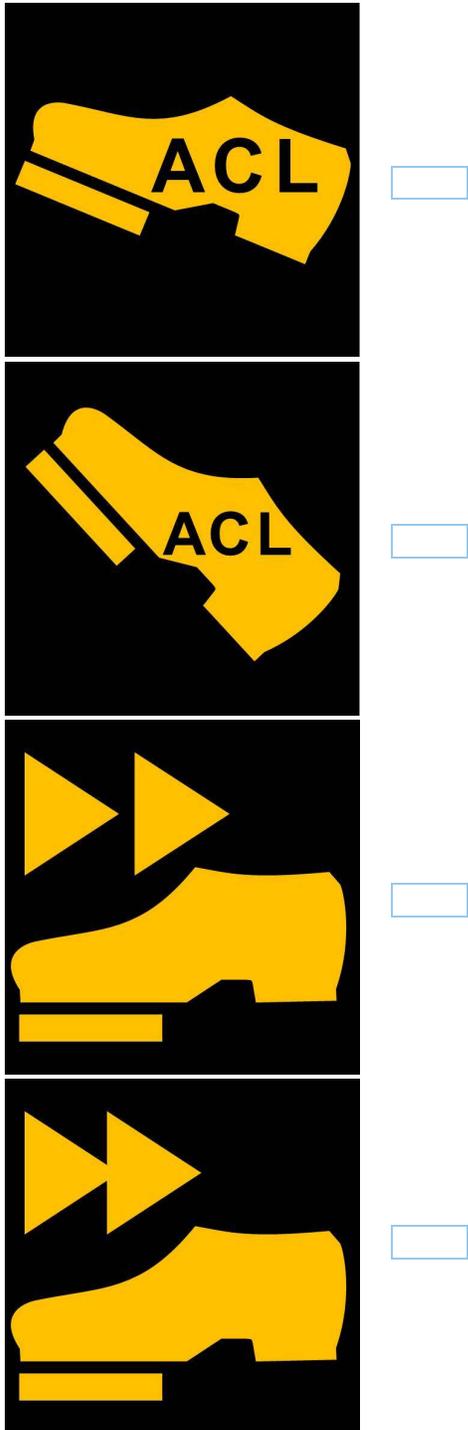
Pedal Application Error refers to situations where the driver presses the accelerator when they think they are pressing the brake pedal, which leads to unintentional acceleration. It happens extremely rarely but carries a risk of very severe outcomes. In these situations, drivers are unaware of the error that has been made. It is possible that the introduction of an indicator light which informs drivers they are pushing hard on the accelerator pedal will help drivers recover more quickly.

The message the indicator is meant to convey is "you are pressing hard on the accelerator pedal".

B.5 Design Rankings

B.5.1 *Please rank the symbols displayed in the table above in terms of preference with 1 being the most preferred symbol and 9 being the least preferred. Be aware: when you rank an icon, the list will reshuffle itself to reflect that ranking i.e. if you rank an icon 5, the list will shuffle so that icon is 5th down on the list. Once you have evaluated all the designs your list should be in order with you most preferred design at the top and your least at the bottom. **

	<input type="text"/>
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Appendix C Driver feedback summary

Ranking	Name	Image	Score	Most common interpretations (percentage of responses)
1	Design 2		3.46	Accelerator is being pressed – 50.4% Don't know – 20.3% Pressing a pedal (ambiguous) – 5.7%
2	Design 4		3.56	Accelerator is being pressed – 32.7% Instruction to release the accelerator – 22.1% Don't know – 9.7%
3	Design 3		3.86	Accelerator is being pressed – 39.6% Don't know – 21.7% Instruction to press accelerator – 11.3%
4	Design 5		4.14	Accelerator is being pressed – 22.3% Instruction to release the accelerator – 15.5% Don't know – 13.6%
5	Design 1		4.78	Pressing a pedal (ambiguous) – 34.2% Braking – 21.9% Accelerator is being pressed – 7.0%
6	Design 6		5.71	Don't know – 24.6% Instruction to release a pedal (ambiguous) – 18.0% Pressing a pedal (ambiguous)/ Bus is reversing – 10% each
7	Design 9		6.02	Driving too fast – 16.4% Don't know – 13.1% Accelerator is being pressed – 12.3%
8	Design 7		6.50	Don't know – 21.6% Release a pedal (ambiguous) – 19.8% Bus is reversing – 8.6%
9	Design 8		6.98	Instruction to release a pedal (ambiguous) – 24.3% Don't know – 23.5% Bus is reversing – 8.7%

Pedal Application Error: Pedal Indicator Light - Human Machine Interface (HMI)



Pedal Application Error refers to situations where the driver presses the accelerator when they think they are pressing the brake pedal, which leads to an unintended acceleration. It happens extremely rarely but carries a risk of very severe outcomes. It is very difficult to understand exactly what happens in these events, and drivers are unaware of their mistake. There are a variety of measures to help a driver place their foot correctly or recover from an unintended acceleration incident.

The Accelerator Light System (ALS) has been proposed as a solution to combat this by providing feedback to the bus driver as to which pedal they are pressing; assisting them in identifying potential pedal application errors. This was suggested with the hope it would assist in faster recovery in instances of pedal confusion.

The aim of this study was to determine and standardise an appropriate method of warning bus drivers that they were engaging the accelerator pedal.

A review of the relevant national and international standards was conducted to identify the design stipulations and restrictions that apply to bus warning icons. Following this, bus manufacturers were engaged to discuss the design restrictions of their current bus cabs and the associated Human Machine Interface (HMI). From this information, several design solutions were developed, where bus manufacturers were asked to comment on the technical feasibility of the proposed solutions, and the bus drivers were asked, by means of a survey, to provide feedback on the proposed solutions. The final solution was determined from the results obtained from the bus manufacturer and bus driver engagement.

The bus drivers rated Design 2 as the most preferred and intuitive solution and the bus manufacturers showed a clear preference for implementing the solution into the programmable driver information screen the highest. The report sets out the recommendations for the HMI of the icon, and the selected design.

Other titles from this subject area

PPR872 Bus Safety Standard: Executive Summary. TfL & TRL. 2018

PPR819 Analysis of bus collisions and identification of countermeasures. Edwards et al, Wokingham, 2018.

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