GRAPHICAL EXIT SIGNS AS AN ALTERNATIVE TO RED LETTERING SIGNS FOR PASSENGER AIRCRAFT

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ABSTRACT

Experimental research carried out on aircraft Emergency Marking since 1995 shows that graphical signage is a promising alternative to language based EXIT signs. A series of concepts derived from buildings has been developed and tested both for comprehensibility and legibility over 5 years, until three candidates could be selected.
Civil engineering provided the green and white safety colour coding and a combination of civil engineering and aircraft design standards whichever the most stringent were used as legibility and illumination criteria. The participation of European Aviation Authorities, Aircraft Manufacturers, Airlines and Cabin Crew organisations, with the technical support of On-board Human-Machine Interface and Lighting partners, has given the project the level of confidence required to put the graphical EXIT signs into use. Thorough simulation ranged from non-illuminated coloured panels, to illuminated polycarbonate covers, screen printed with ink, optimised for the transmission of light.
The visible change in the cabin interior of these aeroplanes will be the replacement of red letters, used to convey Stop and Prohibition messages, with green symbols. The colour green being used to signal Safe conditions and Means of Escape, with good performance under cabin smoke conditions.

The main merits of the new EXIT marking concept will be better comprehensibility scores. Meaning an improved level of safety, with a universal evacuation message whatever the aircraft routes, and language associated design/procurement work alleviated for manufacturers.

1 - Introduction

Triennial research conference: an opportunity to share research data gained over 5 years with significant development investment.

JAA CSSG is the place for rulemaking and developing interpretative material for JAR 25 cabin safety related paragraphs based on research data.

Example of an unplanned research subject raised by certification issues: EXIT marking undersized for language 2 on small aeroplanes.

Research plan conducted through Joint resource effort: Aviation Authorities Manufacturers, Operators.

2 - Project objective

Determine whether graphical Exit signs found in buildings constitute an acceptable non verbal alternative to current language-based emergency exit signs.

Evaluate the international travelling public's comprehension of green colour symbols over red letters to indicate the way of escape on passenger aircraft.

Building and Shipping safety sign Regulations: red is used to convey stop and prohibition messages. Green is used to signal safe conditions and means of escape.

Evaluate the illumination performance of the proposed graphical signs.

3 - Working Plan

Identification of existing building signs and applicable standards.

Development of aircraft symbol concepts for Exit locator sign, Exit marking sign, bulkhead or divider sign and Exit identifier.

Concept validation through geometrical mock-ups mounted on flight line aircraft.

Identification of design and illumination standards specific to graphical signs.

Manufacture and testing of illuminated experimental mock-ups for visibility performance.

Production of deliverables.

4 - Standards used:

ISO 3864 :   Safety Way Guidance System

ISO 9186 :   Procedures for the Development and Testing of Public Information Symbols

BS 5499 :   Part 4: Code of Practice for Escape Route Signing

5 - Deliverables:

1/ Cranfield University Report No 9706: An evaluation of the comprehensibility of graphical exit signs for passenger aircraft, April 1997.

2/ Qualification Test Program No 800-0085: Optical data validation for the introduction of a pictorial sign alternative to JAR 25.812: Issue D, July 1999, NEC SA.

3/ Qualification Test Report No 800-0098, Issue E of October 2001, NEC SA.

4/ Diagram: Conclusions from a Cranfield comprehensibility survey and CSSG evaluation, September 2001.

5/ Draft NPA 25D-XX: Graphical Exit Signs as an alternative to red exit signs for passenger aircraft. Revision 4, April 2001, JAA CSSG.

6 - Identification of exit symbols

Exit symbols developed for JAR 25.811 (d)(1),(d)(2), (d)(3) and JAR 25.812 (e)(2).

Concepts derived from buildings.

Eight candidates identified for the typical locations with 4 concepts developed for 25.811 (d)(3) only (Exits further down the aisle).

Two mock-up concept families taken from ISO 3864 as of December 1994.

   1/ Illuminated white door block + directional arrows + running person on green background (<u>European symbol</u>).

   2/ Green person traversing an illuminated white door block + directional arrow blocks on both sides, as applicable (<u>International symbol</u>).

Exit identifier part of the Floor proximity emergency escape path marking, to JAR 25.812 (e)(2): Six candidates identified for this function.

7 - Selection process: - See Reference 1 -

Comprehensibility of graphical signs evaluated through questionnaires administered to 695 participants with a diversity of 61 different first languages.

Location: Schiphol Airport, Amsterdam, The Netherlands.

Comprehensibility included an evaluation of language based signs for comparison with the graphical signs.

An iterative process in two phases: 1995 & 1996.

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                    Cranfield University, UK, Human Factors Technology Group
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8 - Specific conclusions: All phases - See reference 1 -

The graphical signs evaluated which indicate the location of the exit to JAR 25.811(d)(2) were sufficiently understood by the travelling public to be put into use. Comprehension of the current language based sign was higher than the best graphical sign.

The graphical signs evaluated which indicate that exits are located to the left and right to JAR 25.811(d)(3) are sufficiently understood by the travelling public. Comprehension of the current language sign was significantly lower.

The graphical signs evaluated which indicate that the exits are further down the aisle using upwards facing arrows failed to meet the criteria. Comprehension of the best graphical sign was found to be significantly higher than the current language based sign and as such is an improvement to what is currently used.

9 - General Conclusions – See Reference 1 -

People infer meaning from all parts of the sign.

The more closely a sign resembles the actual situation, the more readily it will be understood, and the less likely it will be of being misunderstood.

One's region of origin may be a factor in how an individual comprehends the signs

Previous exposure to the signs is not significantly related to one's ability to correctly interpret the meaning of the sign.

Familiarity with the aircraft environment may assist in interpreting the meaning of the signs.

One's first language may be related to one's ability to interpret the meaning of both graphical and language based signs.

10 - Emergency lighting (I)

JAR 25. 811: Escape route signs should be both conspicuous and legible.

JAR 25.812 specifies:
- red letters at least 1.5 inches high and sign area of at least 21 square inches excluding the letters.
- lighted background-to-letter contrast at least 10: 1
- background brightness of at least 25 foot-lamberts
- high-to-low background contrast no greater than 3:1

The viewing distance of an internally-illuminated sign is affected by its luminance (Cd/m2 or Ft-L).

Building BS 5499 gives a formula to calculate the overall height of the international graphical Exit sign, given a maximum viewing distance and an appropriate distance factor linked to ranges of mean luminance of the colour contrast white.

11 - Emergency lighting: Findings (ii)

For the international Exit symbol, the maximum viewing distance should be calculated from the overall height of the illuminated surface of the sign.

The distance factor to be used for the required 25 Ft-L brightness is 200.

Height of symbols should be at least 80% of the illuminated surface of the sign.

If the minimum height calculated for the symbols is less than the minimum height required for letters, the minimum letter standard should be taken.

Minimum graphical sign area of at least 23 square inches including symbols.

Minimum contrast requirement of 10: 1 is shown with the illuminated translucent white symbols providing a significant portion of the sign.

12 - Emergency lighting: Findings (iii)

White and black smoke chamber testing: green is the most visible colour. Sensitivity of the eye is with green in the middle of the colour spectrum.

LED: a promising technology with white colour "whiter" than with incandescent light, and an improved service life.

Brightness requirement is ensured.

Flashing green LED: attractive effect over red, white and amber. Optimum application is the Exit identifier of the floor proximity escape path marking where smoke is the factor.

Emergency lighting management system contemplated with flashing LED to account for inoperative exits.

13 - Summary

Using graphical Exit signs in lieu of language based signs is proposed on a voluntary basis.

Non verbal communication should be used whenever possible, getting away from language.

Red is the colour dedicated to stop and prohibition. Green is the colour for safe conditions and Means of escape.

Main merits of the graphical sign study was to show the feasibility of the concept. Testing herein conducted on European symbol: 1995/1996

Best way practice supported by ISO 3864 now in force promotes the use of an international symbol. International Symbol is a green person traversing an illuminated white door block. Directional arrow blocks, laterally, indicate the actual direction of travel leading to the place of safety.

Confidence gained in the graphical Exit marking concept supports the idea of having graphical signs also on existing fleet. Demanding airlines could be allowed to install graphical concepts during cabin refurbishing, etc.

CONCLUSIONS FROM A CRANFIELD COMPREHENSIBILITY SURVEY AND JAA CSSG EVALUATION

CSSG EVALUATION

'Exit Identifiers' to JAR 25.812 (e) (2)

74%
65%

CRANFIELD EVALUATION

'Exit Locator sign' to JAR 25.811 (d) (1)

83% > 66%

81% > 66%

◀EXIT▶

74%

EUROPEAN TYPE SYMBOL

'Exit Marking sign' to JAR 25.811 (d) (2)

76-82% > 66%

73% > 66%

◀EXIT▶

95%

CRANFIELD EVALUATION

INTERNATIONAL SYMBOL

GENERAL CABIN LAY-OUT

FLIGHT DECK

'Exit sign at bulkhead / divider' to JAR 25.811 (d) (3)

57,6% < 66%

◀EXIT▶

41%

CRANFIELD EVALUATION

AIRBUS