

How good are emergency lighting systems?

M. S. Rea

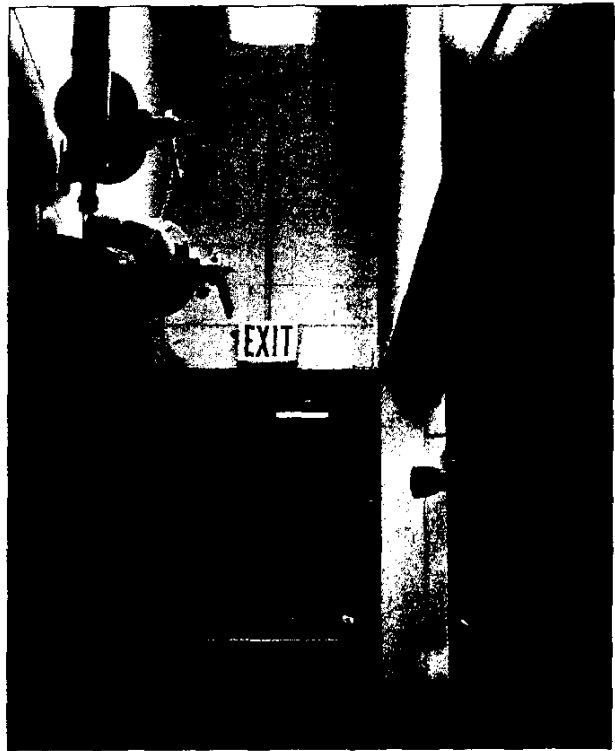
A colleague in ophthalmology once remarked that funding for lighting research will remain small because no one ever dies from bad lighting. At the time I had to agree, but we have recently completed studies of the visibility of exit signs that have altered my attitude.

We all believe implicitly that so-called emergency lighting systems, including exit signs, will safely guide building occupants through a building. This, unfortunately, is probably a naive and erroneous assumption. In fact, it is quite easy to show that conventional strategies for evacuation may be inadequate in at least one type of emergency—smoke in a building.

It is very common to find points of egress marked with a dim, incandescent, internally illuminated exit sign just above the door. Often, as in [1], these signs are found in corridors illuminated with fluorescent lamps. If a small amount of smoke enters the illuminated corridor, as in [2], visibility can be greatly reduced. The door is completely obscured, and the exit sign is very nearly so. With a bit more smoke, even the exit sign would be invisible and a disoriented person might miss the egress point altogether. Turning the corridor lights off, as in [3], can improve the visibility of the exit sign and, therefore, improve the chances of safe egress.

[1], [2], and [3] are (uncontrolled) illustrations of experimental findings recently reported by Rea, Clark, and Ouellette, 1985.¹ [4] presents some of the actual data

1. Rea, M.S., Clark, F.R.S., and Ouellette, M.J., *Photometric and psychophysical measurements of exit signs through smoke*, National Research Council of Canada, Division of Building Research Publication No. DBR 1291.



[1] A typical fire exit, indicated by an internally illuminated exit sign.

from that experiment and helps support recommendations given below for improving visibility of exit signs in smoke. The smoke density required to bring an exit sign to threshold visibility is plotted as a function of the "general brightness" of that exit sign under two conditions—with and without room lights. Two important conclusions can be drawn from this figure. First, brighter signs usually require more smoke to render them invisible. Second, room lights always impair exit sign visibility. These findings are consistent with well-known optical properties of smoke.

Interestingly, the National Fire Protection Association (NFPA) in their National Fire Code (1984) sets an upper limit on exit sign luminance at 10 cd/m². Locating that value on the abscissa of [4] shows that very little smoke is required to obscure a sign that meets this recommendation. Similarly, their current recommendation for corridor illuminance is 11 lx during emergencies. With that level of illumination, the already dim sign will very likely be invisible in very small amounts of smoke. Clearly, then, our naive assumption that currently recommended emergency lighting procedures will provide safe egress should be carefully reexamined.

A reexamination, however, is really quite difficult. There is a dearth of useful data on this subject. Safe egress from buildings is a complex problem involving the areas of vision, economics, engineering, sociology, and psychology. It is not even known whether exit signs



[2] Same as [1] with a small amount of smoke added to the corridor which is illuminated by fluorescent lamps in a ceiling fixture.



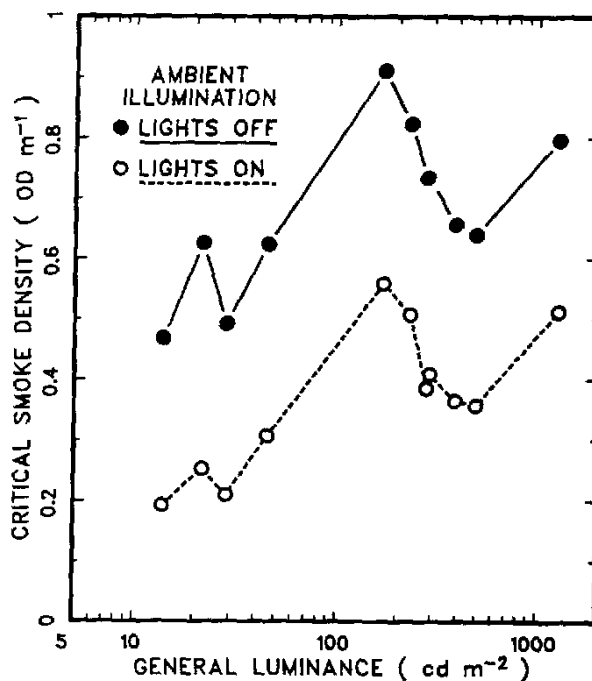
[3] Similar to [2] with corridor lights turned off.

make any difference to safe egress, even though this seems intuitively reasonable. Given that they are important, we have formulated some tentative recommendations consistent with our experimental findings and current technology in illuminating engineering.

First, exit signs should be as bright as possible in smoke. Obviously, they need not be very bright in clear atmospheres. Smoke detection with common ionic or photoelectric detectors could turn additional lamps on in the exit sign and/or signal increased voltage to those lamps. Second, illumination levels in corridors should be reduced in smoke. Fixtures in close proximity to the exit signs may even have to be extinguished. Conventional lighting control systems used in energy management could be easily programmed to accomplish this task and, perhaps, even control the exit signs. Other strategies, such as flashing the exit signs or relocating them near the floor (where, supposedly, they would be more visible to occupants crawling toward an exit), could, perhaps, improve the likelihood that people will be able to evacuate a building safely. All of these strategies should be examined experimentally.

Clearly then, we need more research in the area of emergency lighting because my colleagues may have been incorrect; people may die from bad lighting.

The author: Research Officer, Building Services, National Research Council of Canada, Ottawa, Canada.



[4] The critical smoke densities necessary to bring a variety of internally illuminated exit signs to threshold visibility, plotted as a function of the 'general luminance' of each exit sign face. Two points are plotted for each sign. Solid points represent the critical smoke densities for the various exit signs without room illumination. Open circles represent the critical smoke densities for the same signs with room illumination.