

Fire spread between caravans

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This paper describes work carried out to examine the spacing distance required to prevent the spread of fire between park homes (mobile homes) and holiday caravans. Ignitability tests were conducted on samples of caravan material and two complete caravans were fire tested. Factors taken into consideration were the construction materials, combustible items kept near the caravans and fire screens. The paper will be of interest to the caravan industry, site owners and local authorities.

INTRODUCTION

Park homes are mobile homes that are permanently occupied, whereas holiday caravans may be occupied only for the holiday season. Both are controlled on sites by the Caravan Sites and Control of Development Act 1960¹ and the Caravan Sites Act 1968². The former calls upon Model Standards issued by the Secretary of State which required that every caravan should be not less than 6 m from any other caravan in a separate occupation.

In recent years there have been requests from the caravan industry and site owners for this separation requirement to be reviewed, their case being that the structure and contents of caravans have changed significantly since 1977 when the standard was last revised. With the Department of the Environment undertaking a further revision of the Model Standards and the British Standards Institution planning a standard for the spacing of caravans, the Fire Research Station was asked to re-examine the spacing requirements in the light of changes in caravan design. Only park homes (mobile homes) and holiday caravans were studied, touring caravans being excluded. Details of the research results are given in *Fire Spread Between Park Homes and Caravans*³ and the findings have been incorporated into revised Model Standards^{4,5}.

A desk study was carried out to seek and examine background and statistical information, review current caravan design and consider other aspects of the spacing problem, including the use of fire barriers and the effects of radiation on escaping occupants. In addition the FRS fire investigation team visited a site where a park home had been badly damaged by fire, to examine the radiation damage to adjoining properties.

TESTS

The National Caravan Council (NCC) arranged for materials and caravans to be supplied for testing. A number of samples

of wall materials, curtains, etc were tested for ignitability using the ISO ignitability⁶ apparatus at FRS. The ignition of vertically orientated samples of the same materials was also investigated. In addition existing ignitability data were sought.

Two complete caravans — one a holiday caravan, the other a park home — were instrumented and fire tested. Both were representative of the models currently manufactured. Results

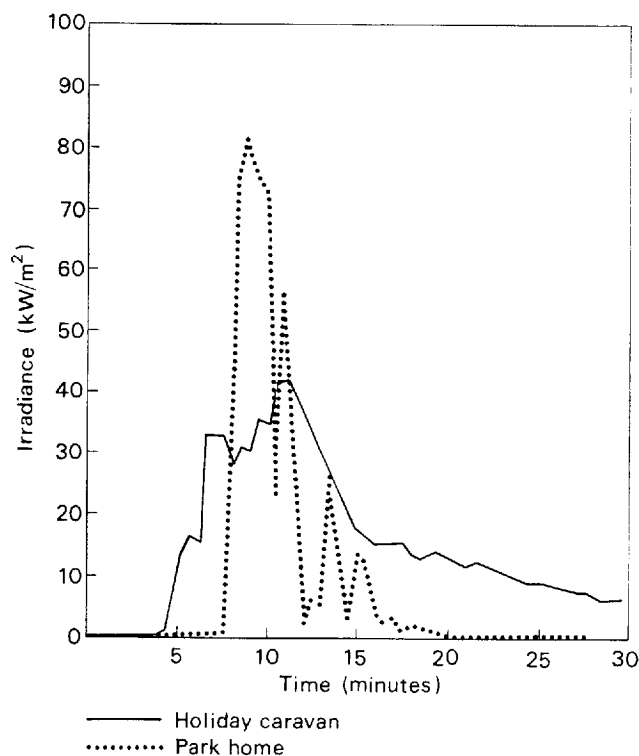


Figure 1 Heat radiation (irradiance) recorded 3m from each unit

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from the fire tests provided both input and validation data for a computer model which calculated the radiation field from a burning caravan.

RESULTS AND DISCUSSION

Full-scale tests

A holiday caravan and a park home were instrumented by Warrington Fire Research Centre and burnt at FRS's Cardington Laboratory. The heat radiation (irradiance in kW/m^2) was measured at a number of locations around each unit. These tests were believed to be representative of the range of caravan model designs, ignition conditions, age of caravans, ambient conditions, etc. so that the results could be used to propose a 'design fire' for each type of unit. The tests were carried out in still air.

The two units were seen to burn in different ways (Figure 1). The roof of the holiday caravan gave way very quickly so that the fire burnt upwards with the air being drawn in through doors and windows, and later the walls (Figure 2). Because of the more robust construction of the park home its roof remained intact for some time and flames jetted from the doors and windows, resulting in a more severe fire than that in the holiday caravan (Figure 3).

The results of the ignitability tests on component materials had suggested that the aluminium of the holiday caravan could withstand thermal radiation for longer than the plywood of the park home. This difference in the standard of construction was evident in the burning behaviour of the two types, though the heating in the full-scale tests was by direct flame impingement, not just radiation.

Ignitability tests on materials

The wall structure of an aluminium skinned holiday caravan (ie outer skin, insulation and wood-based inner skin) did not ignite at irradiances below 50 kW/m^2 , although the paint burnt briefly without sustained ignition. The external fixtures and fittings (eg window frames, vents, etc) probably would have ignited at irradiances below this figure, but the actual critical value was not determined from these tests, though published data suggested values of $15\text{-}20 \text{ kW/m}^2$. However, curtains exposed directly through an open window did not ignite at irradiances below 17 kW/m^2 .

The plywood skin of a park home (with or without finish) did not ignite at irradiances below 17 kW/m^2 .

Other materials such as the tyres of cars, wood-based products and gas cylinders — all of which are likely to be found close to caravans on a site — were found unlikely to ignite at irradiances below 15 kW/m^2 , and more generally 20 kW/m^2 , although wood may have done so at 12.6 kW/m^2 .

Computer prediction of irradiance

A computer model was developed to enable the irradiance from a burning caravan to be calculated where it is incident on an adjoining unit at varying distances and orientations. The results from the full-scale tests were used to validate a design fire model for each of the two types of caravan. This was used to interpolate or extrapolate irradiances under selected conditions, such as the presence of a fire screen, for example. The model was used to show the distance from a burning caravan at which some defined irradiance would be experienced.

Some specific limitations of the model were:

- fire conditions 10 minutes after ignition when irradiances were at a maximum,
- results of a single fire (for each case) in a single model under specific conditions of ventilation and ignition,
- windless conditions,
- included some assumptions and were not exact, and
- only plane rectangular flames could be modelled.

Separation distances

The design fire

The ignitability criteria proposed, based on results of laboratory tests and available literature, and presuming the presence of a pilot flame (eg burning brand), were:

holiday caravan structure	50 kW/m^2
holiday caravan and park home generally	17 kW/m^2
other surrounding or intermediate items (eg cars, sheds, gas cylinders — including hazard to humans)	12.6 kW/m^2



Figure 2 Holiday caravan after six minutes



Figure 3 Park home after six minutes

The results of these test fires were modelled to produce irradiance fields around the two types of caravan 10 minutes after ignition, and were used to create design fire contours for the holiday caravan (Figure 4) and the park home (Figure 5). Manufacturers' variations in materials were presumed not to affect the design fires.

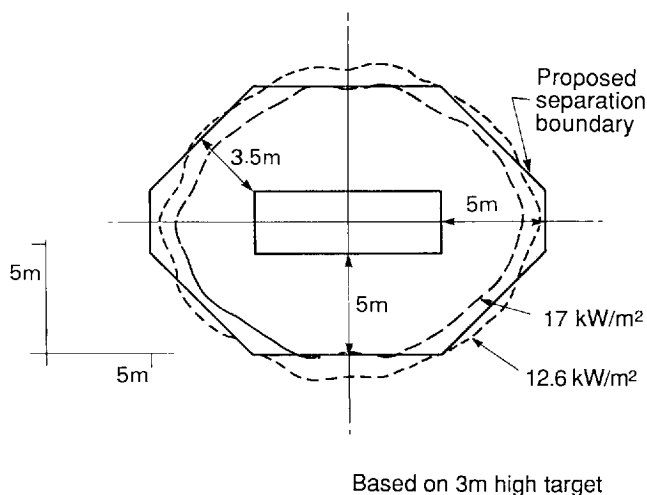


Figure 4 Holiday caravan design fire contours

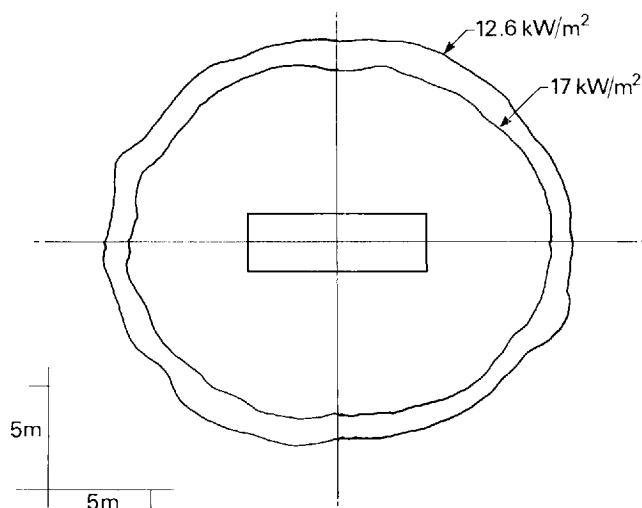


Figure 5 Park home design fire contours

Holiday caravan

The Model Standards⁷ spacing requirement of 6 m might be reduced to 5 m for holiday caravans with aluminium exteriors. The spacing contours at the corners could be cut off so that where the units are positioned 'corner to corner' a clear space of 3.5 m should be sufficient to ensure no fire spread (Figures 4 and 6). This presumes no major difference in the proportions of a holiday home caravan from the one that was tested. However, the 6 m spacing requirement should be retained for holiday caravans with a plywood exterior.

Park home

Figure 5 shows there was no flexibility to reduce the current 6 m spacing requirement for park homes. A simplified separation boundary was therefore inappropriate. There is, however, no evidence from reports of real fires to indicate any risk where the spacing is 6 m, so there was no reason to increase this distance.

Other intermediate items

There appeared to be no statistical or anecdotal evidence to suggest that the presence of sheds, cars, porches, etc between

park homes (or indeed between 6 m spaced holiday caravans) was creating a hazard to life. There was therefore little strong argument to support the use of these separation boundaries for intermediate items where holiday caravans or park homes are spaced 6 m apart.

On the basis of the fire test results it has to be presumed that any items (other than those classified as non-combustible⁸) within 3 m of a burning caravan could ignite and be an additional source of fuel and radiation, or indeed, direct flame impingement. However, certain items need to be located between units for practical reasons. The limitations that might be applied are summarised in Table 1.

RECOMMENDATIONS

- 1 There should be no change to the Model Standards³ 6 m spacing requirement for current designs of park homes.
- 2 The spacing requirement for holiday caravans with aluminium or other metallic exterior skin could be reduced to 5 m clear space, with 3.5 m space at the corners (Figures 4 and 6).
- 3 The spacing requirements for holiday caravans with an exterior skin of plywood or similar material should remain at 6 m.
- 4 Where there is a mixture of either park homes and holiday caravans, or holiday caravans made of aluminium (or other metal with similar ignitability characteristics) and plywood (or other material with similar ignitability characteristics), the separation distance should remain at 6 m.
- 5 Combustible intermediate items such as cars, gas bottles, etc associated with a separate holiday caravan occupancy with the 5 m spacing and within the separation boundary of an adjoining occupancy should be restricted (Table 1).
- 6 No combustible intermediate item should be within 3 m of an adjoining unit (ie there should be 3 m clear space between separate occupancies) except as specified in Table 1.

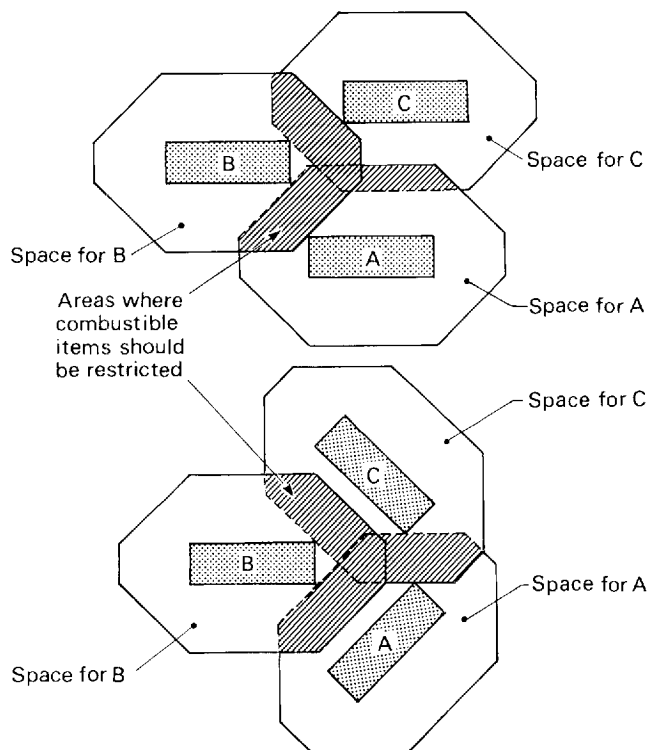


Figure 6 Holiday caravan layouts

Table 1 Restrictions on the placement of items within the separation boundary of an adjoining occupancy

- Notes: 1 The table applies to both park homes and holiday caravans, except where stated otherwise.
 2 Except for covered walkways* there need be no restriction on the size or location for items outside the separation boundaries of any adjoining occupancies.

Item	Non-combustible (NC) or combustible (C)	Recommended restrictions
Garages	NC C	Windows should not point towards an adjoining home or caravan Do not permit
Car parking	—	1. At ground level only 2. On a non-combustible surface 3. Near to associated unit 4. Only one vehicle per space
Ramps and steps	NC C	No restriction Only one such item per space, not more than 2m out from unit
Verandas	NC C	No restriction Only one per space, not more than 1.5m out from unit
Porches and bay windows	NC C	{ 1. Not more than 2m wide (along unit) 2. Not more than 1m out from unit 3. Should not face similar item on adjoining unit
Eaves (park homes)	—	Clear space between eaves of adjoining units to be 5.5m
Eaves (holiday caravans)	—	Clear space between eaves of adjoining units to be 4.7m
Car ports	NC C	Do not permit (<i>will deflect flames</i>) Thin thermoplastic sheet only
Covered walkways*	NC C	} Do not permit
Awnings	NC C	Do not permit (<i>will deflect flames</i>) { 1. Conventional materials of low mass only 2. Not more than 3m out from unit 3. Only one per space
Fences	NC C	No restriction Low (1m high max.) picket fences only
Gas bottles	—	Contained within fire resisting, ventilated and non-combustible housing only
Grass	—	To be kept trimmed
Vegetation	—	Avoid 'bridge' between units

7 3 m high fire screens may be used to reduce the spacing for holiday caravans to 3.5 m clear space. They would need to be imperforate, non-combustible and robust.

8 Consideration should be given to producing holiday caravans with an imperforate wall and roof. Such units, with blank walls facing, could be separated by only 3 m clear space.

NB Care must be taken that implementation of 7 and 8 would not compromise existing means of escape provisions.

REFERENCES

- 1 Caravan Sites and Control of Development Act 1960. London, HMSO, 1960.
- 2 Caravan Sites Act 1968, Chapter 52. London, HMSO, 1968.
- 3 Shipp M P. Fire Spread Between Park Homes and Caravans — Recommendations on the spacing prescribed in the Model Standards to prevent fire spread. London, HMSO, 1989.

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5 Department of the Environment and the Welsh Office. Caravan Sites and Control of Development Act 1960. Section 5, Model Standards 1989: Permanent Residential Mobile Home Sites. London, HMSO, 1989.

6 International Organization for Standardization. Fire tests — Reaction to fire — ignitability of building products. *International Standard ISO 5657*, Geneva, ISO, 1986.

7 Department of the Environment and the Welsh Office. Caravan Sites and Control of Development Act 1960. Model Standards (Revised 1977). London, HMSO, 1977.

8 British Standards Institution. Fire tests on building materials and structures. Part 4: Non-combustibility test for materials. *British Standard BS 476:Part 4:1970*. London, BSI, 1970.

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