Fire research news 1996

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FIRE SAFETY IN HISTORIC BUILDINGS

COLIN PACKER *Fire Adviser to the National Trust* **The Use of Loose-Fitting Fire Protective Covers**

The National Trust for England, Wales, Scotland and Northern Irelandhas, as one of its responsibilities, the conservation of 260 historicbuildings of major importance.

Over the last five years considerable progress has been made indeveloping a total risk management policy. A high priority is,and will continue to be, given to implementation of this policythroughout the Trust. Policies, standards and procedures areunder continual review, and all staff are aware that a major firecould result in the loss of a valuable building and its contents. In some properties the contents are of greater historic valuethan the buildings.

To minimise the potential for loss in the event of a major fire,emergency procedures have been formulated, and are practised bothas internal training exercises and in conjunction with the firebrigade. During these exercises it has become evident that thereare items of furniture etc. which, because of their size or weight,could not be removed.

In September 1995, the National Trust asked the Fire Service Collegeand the Fire Experimental Unit for assistance in undertaking somepreliminary tests to ascertain if loose covers, draped over thefurniture etc., had the potential to reduce fire and heat damage.

Objectives

The tests had three objectives:-

- To identify if there were materials available which couldbe draped over unmovable items to fully or partially protect themfrom the effects of flame and conducted heat.
- To determine whether protection could be achieved againstthe ingress of flame/heat under the bottom edges.
- To assess whether a fabric screen, hastily positioned acrossa doorway or other opening, would assist in reducing fire or smokespread.

How the Trials Were Conducted

The domestic fire building at the Fire Service College was thelocation for the test, with a selection of furniture, sculpture,paintings and carpets to be subjected to a moderate sized fire. A normal crib-type fire was created using paper and timber palletswith flammable liquid as an accelerator. There was no predeterminedperiod of test - it was preferred to allow the fire to burn itselfpast its highest heat output level.

Thermocouples and data logging equipment were provided in thefire area to measure the temperatures achieved. These were sitedat .91m, 1.52m and 2.13m from the floor. In addition, thermocoupleswere provided both outside and inside the protective covers ofa timber dresser, wall hung paintings and an alabaster bust. In an adjacent room, thermocouples were sited at .91m and 2.13mfrom the floor. The rooms were linked by an opening which wascovered by a fire curtain.

The Environment in the Fire Compartment

The maximum air/gas temperature reached at a height of 2.12m inthe fire room was approximately 360oC at about 9 minutes afterthe ignition of the test fire. The overall maximum temperaturerecorded during the test was approximately 580oC - this also occurredat about 9 minutes.

The maximum radiated heat measurement was approximately 8kW/m2and this again occurred at about 9 minutes. This was measuredby a radiometer pointing directly at the fire from a distanceof 2.15m. The radiometer pointing at the ceiling gave a maximummeasurement of approximately 7.5kW/m2 at this time. The faceof this radiometer was level with the arm of a sofa. (It is generallyaccepted that flashover will occur when the heat radiating downfrom the ceiling on to an object reaches approximately 25kW/m2)

The Environment in the Adjacent Room

Whilst the air temperature in the fire area reached approximately360oC and a maximum overall temperature of 580oC, the air temperaturein the adjacent room measured at the same height was approximately98oC and smoke levels were minimal.

Heat Transmission Through Or Around Protective Covers

Thermocouples located at 0.57m from the floor recorded approximately170oC in the fire area at the time when the fire was most intense,(i.e. at approximately 9 minutes). Underneath the protectivecover, 80oC was recorded. It is of particular interest that heatpenetration increased almost consistently for the 27 minutes ofthe test reaching 103oC, equalising with the fire area temperatureas the test was concluded.

Pictures and paintings are always cause for concern. Two weresited in the fire room and covered; these were positioned at heightsof 0.87m and 1.9m from the floor. Whilst maximum air temperaturesin the room reached 580oC after 9 minutes, underneath the protectivecovers, temperatures of 125oC and 250oC were recorded. This highlightsthe potential problems of protecting articles which are wall mounted.

Findings from the Tests

The use of covers to protect pictures hanging on a frame was theleast successful. Heat penetration around the sides and backsresulted in smoke and flame damage.

The use of covers to protect floor level furniture and statueswas more successful than anticipated: some items were virtuallyunmarked and, although others were subject to heat damage, conservationexperts on site during the test were satisfied that the damagecould be repaired

The fabric screen, positioned across the opening into the adjacentcompartment, was extremely effective in reducing fire and smokespread.

Future Work

This test was intended to provide basic information on the potentialof protecting specific items by the use of loose covers. Althoughthe covers used were considered to be unacceptably heavy for usein an emergency, everyone present was sufficiently encouragedand unanimous in agreeing that further testing involving realisticroom layouts should be considered.

A NATIONAL DATABASE FOR FIRE INVESTIGATION

Cath Reynolds When a serious or unusual fire occurs, the fire brigade conductsan investigation of the fire. This is often done in associationwith the police if a crime is suspected. The fire officer (orteam) who investigates the fire compiles a report of the findingsof the investigation. The reports contain similar information,such as the likely cause of fire, the behaviour of the peopleinvolved and details of any casualties. However, the format anddetails of the report vary according to brigade policy and thenature of the fire.

The information collected for these reports is very relevant tothe task of policy making, both for brigades and the governmentdepartments concerned with fire issues. In order to rationalisethe data collected, and to create a national database of fireinvestigation data which could then be used to inform policy decisions,a trial proforma has been created. It is proposed that a proformashould be completed for each fire investigated. The proformais unlikely to take the place of the written reports, but itshould mean that the valuable information contained within thereports can be collected and used easily.

The New Proforma

The proforma has been designed to be easy to complete, with tickboxes wherever possible. It asks for information on such topicsas

- the construction of the building,
- the behaviour of the people involved in the fire,
- the fire safety measures in the building, and
- the fire itself.

The sample page from the proforma shown below, asks questionsabout whether access or security devices made a difference tothe fire.

The Home Office will also provide a database program so that brigadeswhich want to, can store and analyse their own fire investigationinformation.

Where are we now ?

The proforma has been trialled in three brigades and the databaseprogram is almost complete. The next stage will be to arrangefor a more comprehensive trial in brigades, involving both theproforma and the database software.

STUDY INTO THE CAUSES OF FIRE DEATHS

Cath Reynolds Details of fires that a brigade attends are recorded on a formknown as the FDR1. The FDR1s are sent to the Home Office andare used as the basis for national fire statistics.

Fires in which people have died or where unusual circumstancesare found are investigated by fire investigation officers. Theresults of these investigations are recorded in fire investigationreports. These reports cover similar ground to the FDR1s butalso include information on the behaviour of the people involvedin the fire and more detailed accounts of how the fire startedand spread. However, these reports do not follow a standardformat and are not collected centrally. They are sent to theCoroner's Office if there is to be a Coroner's Inquest, otherwisethey remain filed at a brigade's offices.

It was suggested by Home Office Fire Safety Unit that a one-off "snapshot" of the information in brigades' reportswould be useful to supplement and confirm the information alreadycollected. It would help identify target areas for fire safetycampaigns and also ascertain what information could be gainedfrom fire investigation reports in addition to that containedin the FDR1s.

FRDG commissioned W S Atkins Management Consultants to undertakeresearch into the cause of fatal fires to assist in targetingfire safety education.

All local authority fire brigades were asked to send copies oftheir fire investigation reports of fatal fires that occurredbetween July 1994 and June 1995 to the Home Office. Forty eightresponded, giving a sample of 381 fires and 418 deaths for analysis. Interviews were also conducted with five of these brigades togain a better understanding of the fire investigation procedureand to discuss with them the main issues of fire safety.

The main findings of the study have been grouped below into generalinformation on the fatalities, the source of fire, the fire safetymeasures found and the human behavioural aspects of the fires.

GENERAL INFORMATION

More men than women died in the fires. 53% of female fatalitieswere over 65 years of age, whilst only 18% of the general femalepopulation is in this age group. 34% of male fatalities wereover 65, compared to a general population percentage of 13%.

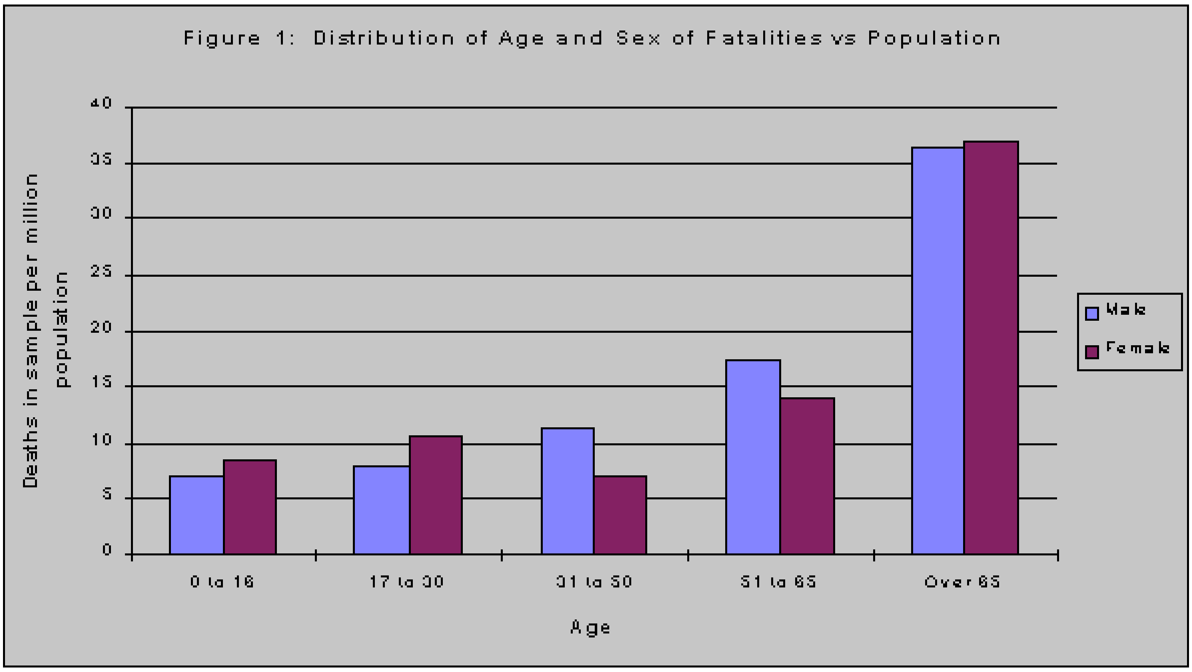


Figure 1: Distribution of Age and Sex of Fatalities vs Population

The most frequent room of origin for fatal fires was the livingroom, whilst the most common known location of fatality was thebedroom. (In many of the fire investigation reports the locationof the fatality was not recorded and these have been shown asnot known.)

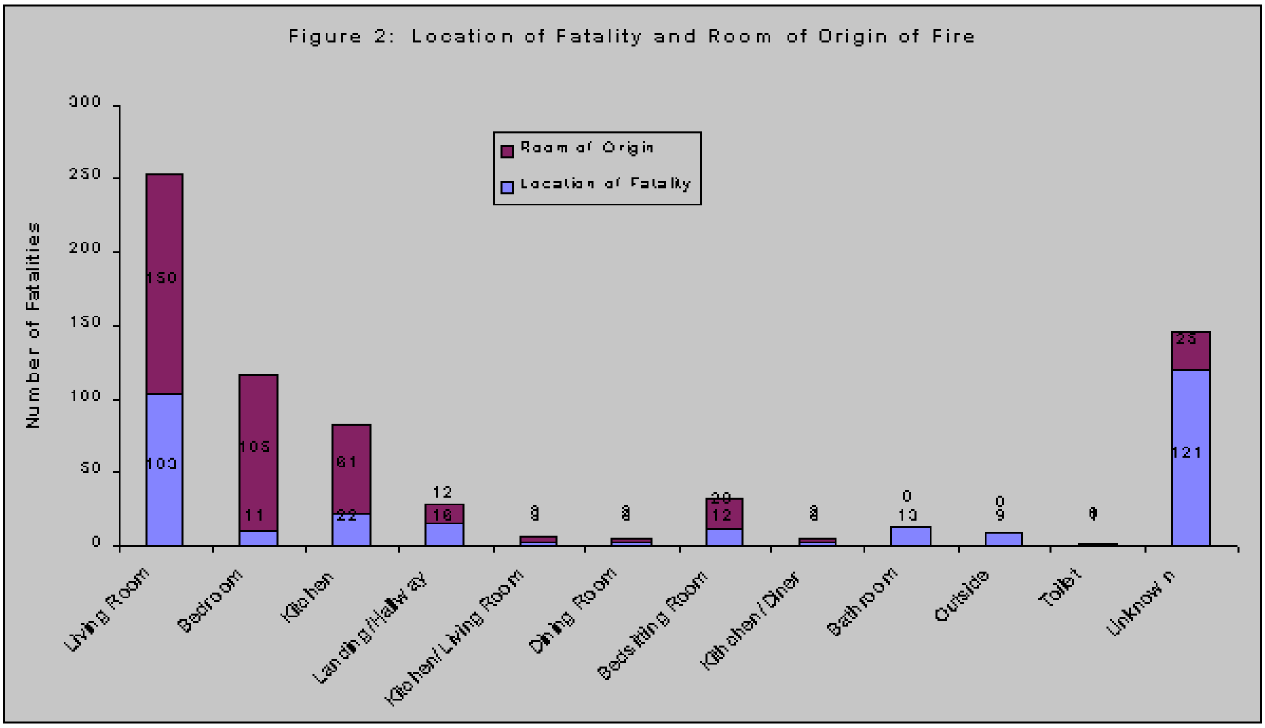


Figure 2: Location of Fatality and Room of Origin of Fire

THE SOURCE OF THE FIRE

Five main sources of fire were apparent (excluding malicious fires). These were:

1. Smoking materials

Smoking materials was the single largest source of fire with 41%of the fires in the sample starting this way. The materials ignitedincluded upholstery, bedding material, paper and clothing.

2. Cookers

Cookers were the second most frequent source of ignition identifiedwith two common causes:

Cooking being left unattended (75%)

Ignition of clothing (25%)

3. Heaters

Fires that involved heaters often started because soft furnishings,paper and clothing were placed too close to the elements. Thefatalities in this category were predominately over 65 years oldand in many instances housekeeping was poor.

4. Electrical Fires

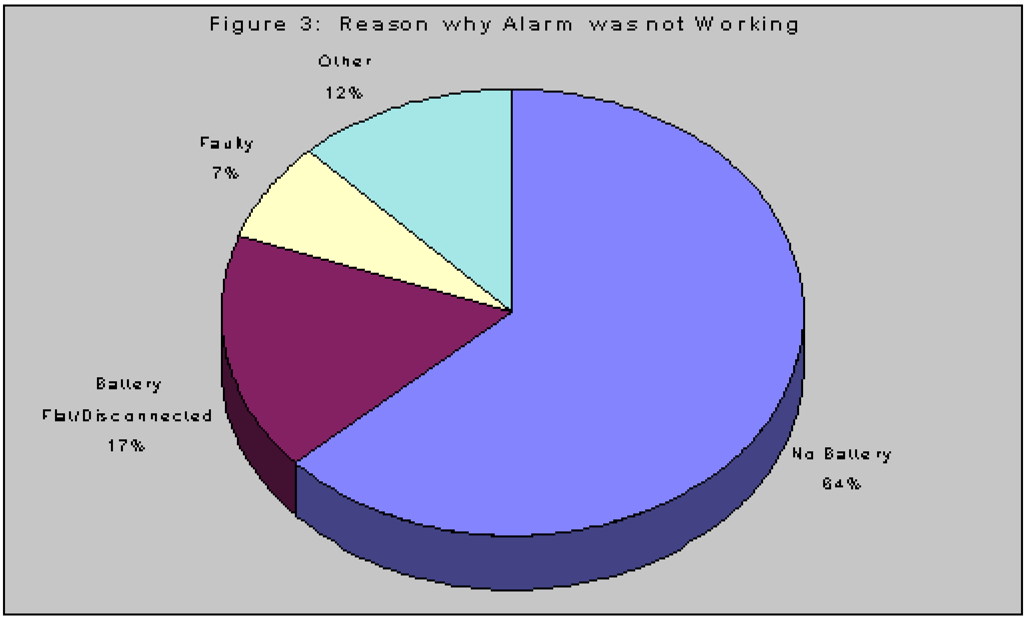
There were 29 fatalities in this group. Fires started by electricblankets are included in this group, with half of the fires startingin this way. These fires often started because the blankets wereold and had not been recently serviced. All of the fatalitiesexcept one were over 65 years old and four suffered from a mentalor physical disability. Two thirds were female but only a minoritylived alone. Other electrical faults accounted for 15 of thefires and over half of these took place between midnight and 6am.

5. Fires Started by Children

There were 16 fatalities caused by children playing with fire,of which three quarters were under the age of 16. In all cases,the fire occurred when the children were left on their own andwere experimenting with fire.

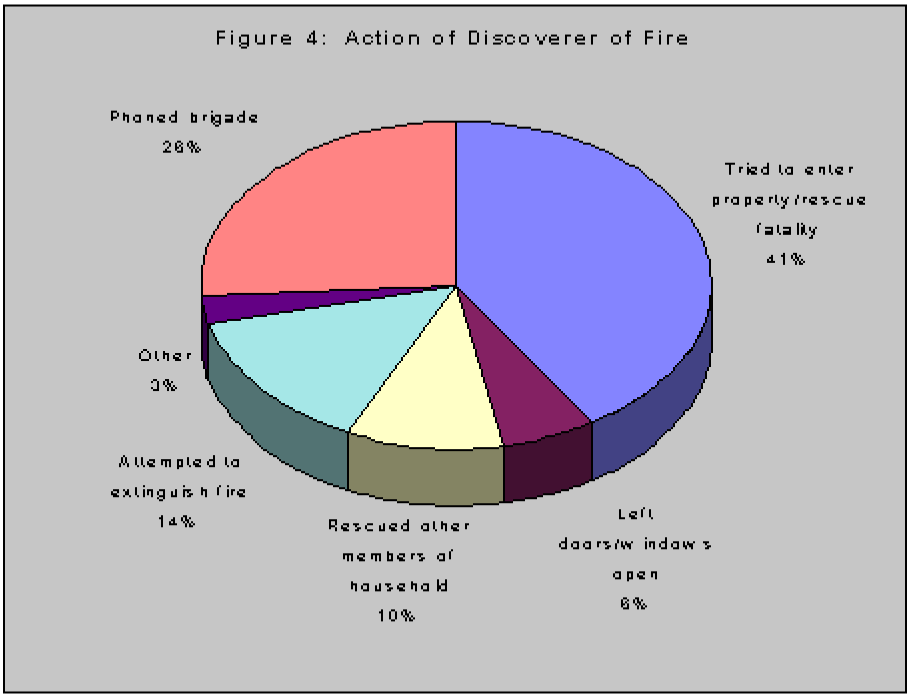
FIRE SAFETY MEASURES

57 % of the households did not have smoke alarms. Where a smokealarm was found, almost half were not working. This was mostoften due to missing or flat batteries (Figure 3). Very few householdsin the sample had fire extinguishers.



HUMAN BEHAVIOUR

The fire investigation reports varied in structure and contentbut many contained information not found in the FDR1s such ashuman behaviour (Figure 4) and views on how the fatality may havebeen prevented. The officers completing the fire investigationreports concluded that 36 of the deaths in the sample could havebeen prevented if a smoke alarm had been present in the household.



RECOMMENDATIONS

Based upon the research outlined, the consultants provided thefollowing recommendations:

1 Publicity campaigns should continue to be targeted at theelderly and the young. Interviews with the brigades suggest thateducating the young is a good way to reach adults. These campaignsshould highlight the potential fire risks of the following:

- smoking materials;
- cookers left unattended;
- electric blankets.

2 Additional data fields might be added to the FDR1 to cover:

- position of alarm;
- behaviour of casualty and rescuers;
- likely method of prevention of fatality.

These could be included as text fields in a pilot stage to identifygrouping for pre-coding in the future.

3 Brigades should be encouraged to adopt a standard structurefor fire investigation reports and the information the reportscontain should be collected and analysed nationally.

SITING OF DOMESTIC SMOKE ALARMS

Brian Hume Current Home Office advice1 recommends that, in homes of morethan one floor, smoke alarms should be installed at the bottomof the staircase and on each upstairs landing. However, eventhough smoke alarms are not expensive, some people will decideto install only one smoke alarm in their home and in this casethe advice is to site it "in a place where it can be heardthroughout your home - particularly when you are asleep".

Earlier Home Office advice2 had been to locate a single smokealarm at the bottom of the staircase in a home of morethan one storey but another view is that the upstairs landingis a better location. A smoke alarm at either location willwarn the occupants of smoke in the main escape routes but opinionsdiffer as to which location is the best. Obviously this willdepend partly on whether the fire breaks out upstairs or downstairs.

The aim of this project was to reconsider the best siting of asingle smoke alarm.

THEORETICAL STUDY

The project began with a theoretical study by FRDG covering thefollowing:

- current regulations and standards;
- previous research on the response of smoke alarms to housefires;
- previous research on the waking ability of the smoke alarm;
- statistics on fire casualties in the home.

Current Regulations and Standards

The United Kingdom Building Regulations3, which apply to all newbuildings, require that there should be at least one self-containedsmoke alarm on each floor and that they should be inter-connectedso that detection of smoke by any one unit operates the alarmsignal in all of them.

The American fire code NFPA 744 on household fire warning equipmentrecommends in Appendix B that smoke alarms should be sited onevery floor.

Previous Research on the Response of Smoke Alarms to HouseFires

A number of studies have been reported in the published literaturein which the response of smoke alarms to house fires has beenobserved using full-scale tests. These studies have shown thatto achieve a sufficient warning time of most fires, a smoke alarmis required on each floor. However, no research has been reportedwhich compares the relative merits of upstairs and downstairslocations.

Previous Research on the Waking Ability of the Smoke Alarm

To be effective the smoke alarm must first detect the fire andthen sound an alarm sufficiently loud to alert the occupants. If the occupants are asleep they will need a louder signal towake them and if there is a closed bedroom door between the sleeperand the smoke alarm the signal will need to be even louder.

Research studies have shown that the sound level required to awakenpeople varies from 75dBA to 100dBA or more, depending on whethersleeping medicines have been taken or on the stage of sleep. The British Standard on smoke alarms, BS5446 Part 1, specifiesthat a minimum level of

85dBA should be emitted by the smoke alarm. However, tests by the Fire Research Station5 have shown thatthe sound level achieved in a bedroom by a smoke alarm which complieswith this standard may be lower than the 75dBA thought to be requiredto awaken people.

No research has been reported which directly assesses the abilityof smoke alarms to wake people up but the research described aboveindicates that smoke alarms may not always awaken a sleeper.

Statistics on Fire Casualties in the Home

The United Kingdom Fire Statistics for England and Walesin 1992 were reviewed for any relevant information on the sitingof smoke alarms. The statistics include numbers of fires andcasualties from fires in dwellings by the room and floor of origin. Analysis of these statistics showed that most casualties occurredfrom fires starting downstairs although a significant number of casualties (24% of non-fatal casualties and 21% of fatal casualties)occurred from fires starting on the first floor. This might leadone to think that the downstairs location for a smoke alarm ispreferable but since smoke from a fire downstairs will tend torise, an upstairs smoke alarm might be better as it is likelyto respond reasonably early both to fires starting upstairs andfires starting downstairs.

FIRE TESTS

The theoretical review was inconclusive in showing the best sitingof a single smoke alarm. The possibility of commissioning firetests to provide more information was considered but thought tobe too expensive. However, the Fire Research Station (FRS) werealready carrying out a programme of fire tests in their housetest rig in the Cardington airship hangar, thus providing an inexpensivesource of data. FRDG therefore commissioned the FRS to analysethis data to determine the best siting of a single smoke alarm.

The FRS test programme consisted of a series of six full-scalefire tests in which the performance of domestic smoke alarms wasinvestigated. Smouldering and flaming upholstered armchair fireswere conducted in a detached 3 bedroom dwelling of typical 1970'sUK design and construction. Ambient conditions within the housewere designed to simulate an occupied dwelling during the winter. External windows and doors were closed and the heating was operational.

Optical and ionisation type domestic smoke alarms were installedin four locations within the dwelling: in the room of fire origin(the lounge), in the hall, at the top of the stairs and in oneof the upstairs bedrooms. The times from ignition to alarm wererecorded and the times from ignition to the onset of untenableconditions were calculated from temperature, smoke density andtoxic gas measurements using the Fractional Effective Dose technique. The scenario in which a fire occurs in the lounge at night andthe occupants are asleep in the bedroom was analysed in particulardetail.

As expected, the results showed that, for smouldering fires opticalsmoke alarms raise an alarm earlier than ionisation devices, whereasfor flaming fires ionisation smoke alarms respond first.

Perhaps somewhat surprisingly the results showed that during flamingfire scenarios smoke alarms at the top of the stairs raised analarm before equivalent devices down in the hall, even thoughthe fire was in the downstairs lounge. This is because the smokeemitted from the lounge door bypassed the smoke alarm in the halland rose up the stairwell.

It was concluded that if only one domestic smoke alarm is to beinstalled in a dwelling similar to that used in the FRS tests,it should be positioned at the top of the stairs. The resultsalso indicated that an optical smoke alarm would perform betteroverall than an ionisation smoke alarm.

Another interesting conclusion from these tests was that if thelounge door is closed the risk to the occupants outside the loungeis reduced even though this delays the operation of a smoke alarmlocated in the hall or landing.

FURTHER WORK

The Home Office Fire Safety Unit is now considering these resultsto see whether any further guidance on domestic smoke alarms isrequired.**REFERENCES**

1 "Wake up! Get a smoke alarm", Fire Safety Leaflet,Publication FB2, Home Office Public Relations Branch, 1995.

2. "Wake up! Get a smoke alarm", Fire Safety Leaflet,Publication FB2, Home Office Public Relations Branch, 1990.

3. The Building Regulations 1992, Approved Document B, HMSO.

4. "Standard for Household Fire Warning Equipment(NFPA 74 1975)", National Fires Codes, National Fire ProtectionAssociation, Quincy, MA.

5. P G Smith, "The Fire Hazard of Upholstered Lounge Furniturein a Typical British House", BRE Note N26/86, Building ResearchEstablishment, 1986.

THE DEVELOPMENT OF HOME OFFICEADVICE ON POSITIVE PRESSURE VENTILATION AS A FIREFIGHTING TACTIC

Martin Thomas

Back in 1994, Warrington Fire Research Consultants were contracted toundertake a survey of the whole field of ventilation as a firefightingtactic. Their report, FRDG Report No 6/94 was published later that year.

It concluded that there was not sufficient known in the field, and thatfurther work was required. This led to the ventilation research projectwhich is described in the article in this issue by John Foster and GuyRoberts.

The consultants also reported that brigades were showing considerableinterest in Positive Pressure Ventilation (PPV), as now being applied inthe USA and parts of Europe, and that there was insufficient known aboutits successful application. A second research project was proposed, todevelop guidance for the United Kingdom fire service on the practical useof PPV as quickly as possible. This was supported by the Joint Committeeon Fire Brigade Operations. A two-pronged approach was agreed:

- A survey of the expertise available in the USA and other European countrieswould be commissioned.
- Experimental work into various scenarios would be undertaken by theFEU.

Forced Ventilation

The main techniques of forced ventilation are:

 Positive Pressure Ventilation (PPV). PPV can be achievedby forcing air into a building using a fan. The effect of this will beto increase the pressure inside, relative to atmospheric pressure. PPVsimply refers to blowing air in through the inlet vent.

 Negative Pressure Ventilation (NPV). NPV refers to extractingthe smoke and hot gases from the outlet vent. This will have the effectof reducing the pressure inside the building, relative to the atmosphericpressure. It can be achieved by fans or water sprays.

 Heating Ventilation and Air Conditioning Systems (HVAC).Building HVAC systems can be designed so that, in the event of fire, theycan be used as a smoke control system.

 Powered Smoke and Heat Exhaust Systems. Dedicated fansand other devices which, usually triggered automatically, provide a smokecontrol system.

Clearly, built-in fire ventilation systems are extremely useful andcould be used where installed, but the majority of buildings do not havethem. The fire service need to be prepared for all eventualities, and sowould normally reckon to be able to achieve any ventilation by use of theirown resources, looking on any installed systems as a bonus.

Thus, if forced ventilation is to be used, and built-in systems arenot available, PPV and NPV are the obvious tactics the fire service wouldemploy. Of these, PPV is considered the more effective as it provides aknown route in for fresh air, and overpressure inside the building willlead to quicker movement of air smoke and gases to the outside, than canbe achieved by negative pressurisation. In some circumstances, such aswhere it is critical that the designated exit vent is the only one to beemployed, NPV can be used effectively.

From the definition of PPV given above, it can be seen that its usemeans the pressurisation of a compartment and, when it is used offensively,this means the pressurisation of the fire compartment. The PPV tactic,which has been developed in the USA and which is now being proposed foruse in the United Kingdom, has the extra feature that a fan is used whichproduces a wide cone of air. This is sited a short distance back from theinlet vent so that the cone of air totally covers the vent, preventingany flow back out through the inlet vent, as long as there is an outletvent somewhere else.

The main advantages of forced ventilation are:

- the ventilation objectives, ie smoke removal, restoration ofa tenable atmosphere etc, are achieved more rapidly;
- it makes horizontal ventilation more effective, so reducingthe need for vertical ventilation;
- it is less susceptible to erratic wind conditions;
- it is a more controllable form of ventilation.

Its disadvantages are:

- it requires the use of a mechanical device, a power sourceand additional firefighters;
- it can increase the intensity of a fire and lead to unwantedfire and smoke spread if incorrectly applied;
- in large compartments, it requires a very large fan, or a numberof smaller fans;
- it can take time to set up;
- in defensive ventilation operations, the limited airflow availablemeans that systematic room-by-room clearance is necessary.

A Study Of USA and European PPV Practices And Experiences

Warrington Fire Research Consultants, in their report on Ventilation,also advocated a fact-finding team visiting PPV practitioners, and thisled to a small team visiting the USA, Germany and Holland to find out asmuch as possible about their experiences. This team consisted of an independentconsultant from Warrington Fire Research Consultants and four serving UnitedKingdom fire officers likely to be in regular command of fires - StationOfficers, from Bedfordshire, East Sussex, Grampian and Greater Manchesterfire brigades - and they talked with their counterparts in the USA andother countries.

On the basis of their discussions, the team considered PPV to be a tacticworthy of wider application by United Kingdom brigades. No evidence wasfound to suggest that differences between the United Kingdom and othercountries, either in terms of building construction or the organisationof fire departments, would limit the potential usefulness of PPV.

The team considered PPV to be particularly suited:

- to fire attack in single family dwellings.
- to pressurise stairwells, both to protect means of escape and assistfirefighting access, in buildings where pre-installed systems are not normallyprovided, e.g. low-rise multi-occupancy dwellings and commercial properties.

The team questioned the benefits of PPV for fire attack in large volumestructures, e.g. commercial or industrial properties, because of the limitedcapacity of the portable fans involved. However, the tactic would stillbe of use in removing smoke after the fire has been controlled. It wouldbe expected to significantly reduce the time spent by crews on dampingdown and salvage operations.

The team cautioned that any move by the United Kingdom fire service toward PPV would require significant additional training. They felt that the key to success lay in developing a considered and staged programme of development and implementation, allowing time for further training, review and analysis at each stage.

POSITIVE PRESSURE VENTILATION TRIALS AT THE FIRE EXPERIMENTAL UNIT

The FEU have so far undertaken PPV trials in two scenarios:

- a cellar, where there was a pavement light;
- the ground floor of a domestic property.

In the first of these, it was shown that the combined use of PPV anda pavement light resulted in the complete elimination of any heat barrierin the stairwell down to the cellar. The fire in the cellar naturally increasedin size due to the extra supply of fresh air, but the visibility improved,making it easier for firefighters to locate the fire. There would stillbe circumstances, however, where adverse wind conditions would result inthis tactic becoming ineffective.

In the domestic property, both defensive and offensive PPV were attempted.

On two occasions, a fire on the ground floor of the domestic propertyon the Fire Service College fireground was allowed to smoke-log the entirebuilding, and the door to the fire room was then shut. On one occasionthe upper floor was then ventilated naturally by opening downwind windows,and using the upwind door as an inlet vent, and on the other occasion aPPV fan was used to drive air in through the upwind door.

The results clearly demonstrated the need for the systematic ventilationprocedure which is required when PPV is used. Any compartment where anoutside window was not opened was effectively sealed by the PPV, preventingany smoke clearance. Where PPV was not used, such a compartment clearedgradually, but this did not happen with PPV. The limited air flow froma portable PPV fan means that PPV has to be used for smoke clearance oneroom at a time. It clears small rooms extremely quickly - far more quicklythan by natural ventilation except on very windy days - and, once a roomis cleared, the windows in that room should be closed, and those to a differentroom opened. The use of PPV was not as effective in clearing rooms withupwind windows.

The rest of the domestic PPV trials were directed towards an assessmentof the effectiveness in improving a firefighter's access to the fire compartment.A wide range of combinations of window and door vents was tried, with headwinds and following winds of different strengths. Each scenario was trialledwith and without the use of PPV. The principal assessment criterion wasthe reduction in temperature at the firefighter's point of entry into thecompartment.

It was shown that, under favourable weather conditions, PPV producesa less arduous firefighting environment. However, a strong breeze actingwith the PPV fan renders the fan unnecessary - the breeze on its own issufficient. A strong breeze acting against the PPV fan overpowers the fan.Other wind conditions can produce strange effects due to the profile ofthe building.

When the inlet and outlet vents are first opened, the buoyancy of thehot smoke and gases may be sufficient to overcome the PPV fan for a shortperiod. The hot gases will flow out of both vents.

This appears to occurbecause the PPV fan does not seal the whole of the door opening equally.The majority of the air flow is along the axis of the fan. A simple testwith a piece of foil or tell-tales fixed to a ventilation opening willshow a flow in through the top of the doorway when there is no fire. However,the smoke and hot gases from a fire can overcome this and flow outwards.

It has now been agreed that the FEU will next look at the scenario ofpressurising a stairwell.

THE WAY FORWARD

The supplement to the *Manual of Firemanship* described elsewherein this issue, '**The Behaviour of Fire - Tactical Ventilation of Buildingsand Structures'** covers the whole range of ventilation techniques. Itmust be remembered that PPV is simply one of these.

The independent consultants, Warrington Fire Research Consultants, wereasked to report on the use of Positive Pressure Ventilation (PPV) in theUSA and other European Countries. The report places the findings in a UnitedKingdom fire service context. Inevitably, it has identified the trainingimplications of introducing PPV in the United Kingdom.

Ongoing research at the Fire Experimental Unit indicates that thereare scenarios where PPV may be of help, but that it can be easily overcomeby a strong breeze.

The publication of reports about PPV does not imply that the Home Officeis advocating the immediate introduction of PPV as a firefighting tacticfor the United Kingdom fire service. The Home Office is simply followingits usual practice of publishing research reports as soon as practicable,to keep the United Kingdom fire service and others informed of progress.

Fire Officers should note the clear message which has come across -that PPV should not be introduced as an offensive firefighting tactic untilfirefighters have a clear understanding of the use of natural ventilationas an offensive firefighting tactic, and of its effect on fire behaviour.

VENTING OF LARGE SCALE FIRES - VALIDATION TRIALS

John Foster & Guy Roberts Project Update Venting

Regular Readers of Fire Research News may recall articles in recenteditions on the current project looking at tactical venting.

This is an extensive project and it is likely to be several yearsbefore the work is completed. Progress is being made and we willkeep you informed through Fire Research News. It may be helpfulto remind you of the background to this project before bringingyou up-to-date.

Several years ago, Fire Services Unit of Fire & EmergencyPlanning Directorate commissioned a study into large fires toidentify where research might be of benefit. The use of ventingas a tactical option was proposed as one of the projects and,after endorsement by the Joint Committee on Fire Brigade Operations,Fire Research & Development Group (FRDG) was asked to carryout the work. This is being done at the Fire Experimental Unitat Moreton-in-Marsh.

The objective of the work is to determine what is likely to happenwhen tactical ventilation is used in various conditions. Withsuch information it is hoped that it will be possible to providethe officers-in-charge with practical guidance to help them makethe right decision.

The correct use of ventilation can remove the products of combustion- hot flammable gases, and smoke. It can speed fire suppressionand extinction by removing heat and smoke so that firefighterscan enter the building earlier and, with improved visibility,make it easier for them to locate and tackle the fire. Firespread may be reduced by limiting the movement of smoke and hotgases.

However, in some conditions, or when misused, ventilation mayresult in an increase (not a reduction) in the fire spread andcan pose serious hazards to firefighters. For these reasons therehave been reservations about its use in the United Kingdom. With the benefit of the results of a survey commissioned fromWarrington Fire Research Consultants and other training documents(mainly from the USA), it has been possible to produce some guidancefor the United Kingdom fire service on the use of tactical ventilation,before the research is completed. This has resulted in the productionof a second Supplement to the Manual of Firemanship.

The FEU's Research Programme

In pursuing their research into ventilation of large structures,the FEU has been forced by the high cost of large-scale fire trials,to try to make use of computer modelling to undertake a theoreticalexploration of the effects of tactical ventilation in a numberof scenarios. This modelling work is being carried out undercontract to FRDG by AEA Technology Ltd based at Harwell.

However, if this computer modelling is to be of any use, FRDGand the fire service need to be convinced that the it accuratelyreflects the behaviour of real fires. The model needs to bevalidated by comparing computer predictions with experimentalresults. Experimental data from small fires in small compartmentswas available, but no results could be found where there had beena large fire in a large building. To obtain reliable experimentalresults, it was necessary for FRDG to carry out trials.

Validation Trials

A series of eight validation trials were carried out in theIndustrial B Building at the Fire Service College in November1995. This building has a relatively large open room (17m x 9m)on the first

floor with two external doors and a pitched roof. There are four roof vents in the building, although only twovents were used in the tests. This arrangement gave the opportunityto explore the effects of various combinations of roof vents anddoors.

The fuel used was n-heptane, in three trays, to give a fire areaof 3.9m2. This was considered to be as large a fire as possible,given the constraints of safety and the risk of damage to thebuilding.

The fire was ignited remotely and allowed to burn for 5 minutesbefore the building was ventilated. Sufficient fuel was usedto allow the fire to burn for 10 minutes, given an adequate supplyof fresh air.

The building was instrumented to measure:

- gas temperatures inside the building
- gas velocities through the doors and vents
- smoke density inside the building
- surface temperatures on the walls
- heat flux from the fire
- wind speed and direction outside the building
- fuel depth
- static pressure inside the building

Results

In total, over 120 channels of data were logged and generallythe instrumentation performed satisfactorily. The trials weresuccessful and valid data for comparison purposes was obtained.

The figures illustrate the type of data that was produced andshow the results from one of the tests. In this test, the upwinddoor and a downwind vent were opened after five minutes. Thegraphical results from one of the temperature trees, a radiometerand the two smoke density meters are shown. Still images takenfrom a video camera inside the building are included, althoughthey are not very good quality.

It can be seen that the fire died down because of the limitedair supply after one minute and remained so until the door andthe vent were opened. The fire then grew, with an initial improvementin visibility.

In fires in real buildings, ventilation can result in fire spread. With the refractory tiles in the Industrial B building, and withthe fuel contained in trays, fire spread could not take place. However, it is a major factor in real fires and is the next areato be addressed if the modelling of the validation tests provesreasonably accurate. To make a preliminary exploration of firespread during some of these tests, pieces of wood were positionedat various locations within the compartment during the test firesand examined for signs of charring afterwards.

One test was carried out with a PPV fan fitted into one of thedoors, with the second door used as an outlet vent. Althoughit was not physically possible to deploy the fan in the appropriateposition for accepted PPV methods, a test with a fan was includedto give experience of its use in a large building.

Although the main objective of the trials was to obtain experimentaldata for comparisons with the computer predictions, a limitedrange of tactical options was explored in the wind conditionsprevailing at the time.

The Effect of Ventilation Options

The various tactical ventilation options were compared by producinga figure of merit for the temperature changes after ventilation. There were no surprises in the results, and the ranking orderwould no doubt have been predicted by experienced firefighters:

The most effective ventilation was with one upwind door andtwo roof vents open. The least effective was the cross-ventilationcase with two doors open and no roof vents open.

When one roof vent and one door were used, an upwind doorand a downwind vent were the best combination. A door and roofvent at opposite ends of the building were more effective thana door and roof vent at the same end.

The fire became ventilation limited after the first minuteand remained so until ventilation took place at five minutes. The fire was still ventilation limited after venting unless anupwind door and at least one roof vent were open.

The PPV fan mounted into a doorway produced results whichwere similar to those achieved with natural ventilation undervery similar wind conditions - with the wind blowing directlyinto the one door, and a second door used as an outlet vent. This was the least effective natural ventilation condition, andthe use of PPV did not improve on it.

At present the computer model is being run to predict what happenedin two of the tests, given the wind conditions at the time. The predicted and experimental data is being compared and initialcomparisons are showing that the predictions are not adequate. One reason for the discrepancies may be that the air leakagefrom the building needs to be quantified, and tests are plannedto measure the leakages from various parts of the building.

Future work on the use of modelling will depend on the outcomeof the comparisons between the predicted and experimental results.

ARTIFICIAL AIDS TO VISION ON THE FIREGROUND

Chris Gooderson ***But the bravest are surely those who have the clearest visionof what is before them, glory and danger alike, and yet notwithstanding,go out to meet it.***

Thucydides, 460-400 BC

In the past, there had been increasing concern about the numberof firefighters leaving the fire service due to failing eyesight. In response the Home Office commissioned a study, which startedin 1992. The aims of the study were:

- to investigate recent developments in the production of breathingapparatus (BA) sets compatible with artificial aids to vision(AAV), to make an assessment of the reliability and safety ofsuch sets and to identify any implications which they may havefor the visual acuity of those wearing them with either spectaclesor contact lenses,
- to assess the safety and efficacy on the fireground of themore recently developed spectacles and contact lenses when theseare worn without BA,
- to assess the technological advances in surgical/laser techniquesfor improving eyesight defects and to determine the safety andreliability for operational service on the fireground of eachof the new techniques, with and without BA, looking particularlyat the effects of post-operative trauma, and,
- to investigate the visual requirements of firefighters; nearand distant visual acuity and colour vision, which was to includethe identification of suitable eyesight tests for the Fire Service.

Issue 17, (Summer 1994), of Fire Research News carried an articleby Tom Margrain and Chris Owen of the Fireground Vision ResearchUnit, (FVRU), City University, entitled Firefighters' Vision. At that time the FVRU was one year into a three year researchproject and the authors described the work they had completedso far and indicated what was left to do.

The project was completed in May 1996 and this article summarisesthe work and includes, where appropriate, examples of the guidanceproduced for the Fire Service by the Fire and Emergency PlanningDirectorate of the Home Office after discussion of the resultsby the CFBAC Joint Working Party on Medical and Physical Standards.

The research was undertaken in four phases which are describedbelow.

Phase 1 was a data collecting phase in which informationon BA sets compatible with AAV, and on all available types ofspectacles and contact lenses suitable for use on the firegroundwas collected from manufacturers. A literature review on thewearing of AAV in adverse environments was conducted and confidentialquestionnaires were sent out to firefighters to elicit informationon the current use and performance of AAV.

Phase 2 involved practical work in the laboratory and withfire brigades. It included looking at the effects of spectaclesides on BA mask leakage and the effects of spectacles and contactlenses on visual acuity in adverse conditions. The safety andefficacy of contact lens wear on the fireground was also investigatedby conducting a contact lens trial which involved fitting 50 firefightersfrom 17 brigades with different types of contact lenses, and monitoringtheir progress over a 10 month period.

Phase 3 collected data, using existing literature and someexperimental work, of the safety and reliability of surgical/lasertechniques for correcting deficiencies in vision. From thiswork, specific guidelines for brigade medical officers was provided. Also included in this phase was an

assessment of the distributionof refractive errors found in the fire service by examinationof a sample of 92 firefighters from West Midlands Fire Service,and a review of the distribution of errors in the general populationas a means of comparison. Finally;

Phase 4 looked to establish suitable visual standards forthe fire service. Structured interviews were conducted with 10brigade medical advisers to determine current testing proceduresand visual standards, and a visual task analysis of firefightingwas performed in order to determine suitable vision and colourstandards for firefighters.

RESULTS AND OUTCOME OF THE RESEARCH

At the end of the research, the FVRU produced a large and verycomprehensive report on the methods used in the research, theresults, and recommendations that came out of it. The outcomeis that visual standards will be removed from the AppointmentRegulations and relevant recommendations from the research willbe promulgated to the fire service in the form of 'guidance'.

Set out below are some of the most important aspects of the guidancethat will be produced by the Home Office.

Applicants to the wholetime fire service must:

- Satisfy a duly qualified ophthalmologist or optometrist thathe or she is fit to undertake firefighting duties, and that thereis no abnormality or any disease which, in either case, wouldbe likely to affect visual function, temporarily or permanently,so as to incapacitate the individual in carrying out the rangeof operational duties.
- Have uncorrected distance visual acuity of 6/6, 6/6, as measuredby an appropriate test, unaided.
- Be able to read N12 at 30cm unaided with both eyes open.
- See at least 6/60 unaided with each eye individually.
- Have a normal visual field in each eye, as determined by confrontationtechniques.
- Have no history of night blindness or any ocular disease thatis likely to progress and result in future failure of the visualstandards for firefighters.
- Have an appropriate level of colour perception. Individualswith either normal colour vision or slightly abnormal green colourvision are suitable for appointment to the fire service. Therecommended test procedure uses the Ishihara test as the initialscreen, with two additional tests if the applicant fails the screening,to determine the severity and type of colour vision deficiency.

These standards also apply to the appointment of retained firefightersexcept for the uncorrected distance visual acuity standard. In this case, distance visual acuity of 6/9, 6/9 with both eyesopen should be applied except where retained recruitmentdifficulties exist. In such circumstances, the entry standardfor visual acuity may be relaxed to 6/18, 6/24.

Visual standards for serving wholetime firefighters:

- See at least 6/9-4 and read N12 at 30cm with both eyes open,using spectacles if necessary.
- Use spectacles of an appropriate specification on the firegroundshould they be needed to obtain this standard of vision.
- See at least 6/60 and read N48 at 30cm with both eyes openwithout the use of spectacles.
- Have a normal binocular visual field.

- Have an eyesight examination every three years.

These standards also apply to retained firefighters

Spectacles suitable for use with breathing apparatus

BA facemasks that incorporate spectacle inserts must pass leakagetests as described in EN136/BS136 and have obtained appropriatecertification. Spectacles suitable for use with BA should inaddition:

- Incorporate lenses made of abrasion resistant (hard) coatedpolycarbonate to minimise lens misting.
- Be securely mounted in the mask so that they will not be dislodgedduring use.
- Have provision for adjustment within the mask so that theydo not cause the wearer discomfort.
- Be removable for the purposes of servicing and cleaning.
- Have thin frames so that they do not obstruct the visual field.
- Be supplied with a facemask for each shift of duty, becauseit is not practicable to fit inserts into a mask while attendingan emergency. It is recommended that BA facemasks suitable forspectacle inserts should be allocated to firefighters for theduration of their period of duty, not that customised facemasksbe provided to every firefighter requiring spectacles for operationalwork.

Spectacles suitable for use when not wearing BA

Firefighters who need to use spectacles should be provided withtwo pairs to allow for loss or damage. The spectacles should:

- Comply with EN166/BS166.
- Incorporate abrasion resistant coated polycarbonate lensesto minimise misting and provide a significant degree of eye protection.
- Have an acceptable cosmetic appearance because unattractivespectacles are not worn.
- Be carefully fitted so that they are unlikely to slip or falloff.
- Not have side shields that restrict the visual field.
- Be robust.
- When necessary, incorporate bifocals that cause minimal disturbanceto vision.
- Allow air to circulate between the face and spectacle lensesto minimise misting.
- Be allowed a period for familiarisation so that firefightersbecome accustomed to spectacle correction before wearing themon the fireground.

GREATER MANCHESTER COUNTY FIRESERVICE EVALUATES THE IFEX 3000

StnO Barker, GMC Fire Service In early August 1995 the Technical Department at Fire Service Headquartersarranged a demonstration to assess the Ifex 3000 Impulse Gun and Back-Packat the Brigade Training Centre.

This equipment consists of a back-pack comprising of a 12 litre capacitywater container with a 2 litre, 200 Bar, compressed air cylinder, and animpulse gun capable of firing up to 1 litre of water per shot. The watercylinder is pressurised to 6 bar to fill the gun, the gun is pressurisedto 25 bar to discharge the water.

The Technical Department wanted to assess the equipment's potentialto be carried on the Brigade's Light Rescue Vehicle (LRV). Although theLRV is not mobilised to fires, it was considered that something more thanthe 3 fire extinguishers carried on the vehicle would be advantageous,should the LRV come across a car or HGV cab fire whilst on the motorwaysystem.

A potential for the equipment could be seen, so a long term evaluationwas decided upon.

Immediately following this decision, the "spate conditions"with regard to grass fires started. During this period officers from theTechnical Department were utilised along with other staff and specialistofficers to man extra vehicles.

Although this was not the purpose of the evaluation, the Ifex 3000 wasused on a number of incidents ranging from grass and bushes to fences andtrees. In all cases it was noted that the Ifex had the ability to "knockdown" large flaming areas of fire but not necessarily totally extinguishthe fire. It did however reduce a fire to a point when a beater would easilyfinish the job.

A training exercise has since been organised in which a four door salooncar was set on fire. Once the point had been reached when the vehicle interiorwas completely ablaze, the fire was attacked using the Ifex Gun completewith its 12 litres of water. Although the fire was not totally extinguished,the knock-down was so good that, from a car fire in which flames were comingfrom every window, all that was left was an extremely small fire near thehandbrake which could be easily extinguished using a small AFFF extinguisher.

The Ifex Gun was placed on the LRV in October after the personnel atthe station had been given instructions as to its use. To date it has beenused successfully at two incidents both involving engine compartment fires,one in a saloon car the other in a transit van.

FIRE BRIGADE INFORMATION DATABASE

Greg Coleman The purpose of this article is to update fire brigades on theHome Office's development of a central database of informationon fire brigades, collated from the various returns dispatchedduring the year. Primarily the information will be collectedfrom the Operational Matters Returns OM 1 - 6 (previously forms40, 41, 41a & 44c(i) - (iii)), Fire Safety Returns FSR 1 -7, Performance Indicators, Fire Brigade Annual Inspection ReturnFSI 2 and the Statutory Establishment Return.

The overall aim of the project is to identify ways in which statisticalinformation provide by fire brigades to the Fire Service Inspectoratecan be effectively collated and disseminated to make most efficientuse of the data and of the resources of both brigades and theInspectorate. The current diffuse arrangements for collectingand analysing the information are considered unsatisfactory.

The central database developed will provide a simpler and moredirect (electronic) collection process allowing the informationto be accessed easily. It is hoped that in time all brigadeswill be able to complete the returns via the data collection softwarewhich can then be imported directly into the central database. This represents a considerable saving in effort for both brigadesand the Home Office when compared to the current format of paperreturns and the lengthy compilation required to complete the returnsand disseminate the information.

The project leader is HMI Don Kent and the members of the projectteam are AIFS Joe Donnelly, SDO Keith Pendry, SDO Bob Pringleand myself, Dr Greg Coleman from FRDG. My role in the projectis to translate the requirements and criteria of the anticipatedusers of the database into an agreed format, provide advice andguidance on the database application, draft the specificationand monitor the contract to provide a working database system.

To assist in the development of the database and the viabilityof electronic data collection a FINDS message was sent to allbrigades to request IT information which would yield an approximateidea of the IT capability of each brigade. The following informationwas requested :

- Type of PC used ie.386, 486 etc ;
- Operating system DOS based, Windows based etc. ;
- Main Software Design House: Terian Computer Services, SystemsOptions,
- Other (please specify) :
- Main word-processor and spreadsheet packages used ;
- File format(s) produced by any software in place that generatesdata for specific returns .

I hope to visit various brigades to discuss at first hand theramifications of the database with respect to the diverse levelsof IT capability amongst brigades.

Any enquiries concerning the database development can be directedto : - Dr Greg Coleman, Home Office Fire Research & DevelopmentGroup, Fire And Emergency Planning Directorate, Horseferry House,Dean Ryle Street, LONDON SW1P 2AW.

Home Office Tel: 020 7217 8132, Fax 020 7217 8254

A SUPPLEMENT TO THE MANUAL OF FIREMANSHIP ON TACTICAL VENTILATION

Martin Thomas Following the publication of the first supplement to the *Manualof Firemanship*, '**The Behaviour of Fire - Compartment Fires**',it was decided that a second supplement was necessary, coveringthe use of ventilation as a firefighting tactic, even though HomeOffice research into this area was continuing at the Fire ExperimentalUnit, and would not be complete for several years.

This second supplement, entitled '**The Behaviour of Fire - TacticalVentilation of Buildings and Structures'** attempts to bringtogether all the existing advice available. Very often, thisadvice is based on firefighters' experience, and has yet to besupported by experimental verification. Nevertheless, it is basedon good firefighting practice, and a sound understanding of thephysical principles involved. Much of the operational experienceoriginates in theUSA, but this supplement is intended to placethis experience in the appropriate United Kingdom firefightingcontext.

Ventilation can be used tactically in two ways:

- **Offensive Ventilation:** Ventilating close to the fireto have a direct effect on the fire itself, to limit fire spread,and to make conditions safer for the firefighters.
- **Defensive Ventilation:** Ventilating away from the fire,or after the fire is out, to have an effect on the hot gases andsmoke, particularly to improve access and escape routes and tocontrol smoke movement to areas of the building not involved inthe fire.

The supplement to the Manual of Firemanship also draws an importantdistinction between Natural Ventilation and Forced Ventilation:

- **Natural Ventilation** describes collectively the techniquesof vertical and horizontal ventilation when they are not assistedby mechanical means. This includes the use of pre-installed vents,windows, doors etc..
- **Forced ventilation** refers to the use of fans, blowers,nozzles or other mechanical devices to create or redirect theflow of air inside the building so that the fire gases are forcedout of the building.

The supplement makes the important point that, if forced ventilationis used to accelerate the effects of natural ventilation, it mustbe remembered that all the effects, both good and bad, may beaccelerated. For this reason, it is essential that the firefightersconcerned have a good understanding of the principles of ventilation,and the behaviour of fire, before the use of forced ventilationis considered.

It will probably be necessary to update this supplement at a laterdate. Research is still under way, and the Fire ExperimentalUnit's results may not be available for two to three years. Equally,firefighters in the United Kingdom with experience in the useof ventilation methods will have a contribution to make to subsequenteditions. Tactics can never remain fixed. They evolve and theexisting education and training media will have to evolve withthem.

PROJECT UPDATES

F 13.11: A Test for Smoke Alarms

Following trials at the FEU, the Home Office withdrew its advice thatmembers of the public could test their smoke alarms using a recently extinguishedcandle or taper. A specification for a suitable test device was producedand a variety of aerosols and smoke matches have been submitted by manufacturers.They all trigger the alarm in a suitably short time, and work is now proceedingto ensure that their repeated use will not affect the alarm's sensitivity.

F 14.07: Draft ISO Standard on Evacuation and Rescue

Over the last two years or so, the International Standards Organisation(ISO) has been developing a draft standard for Fire Safety Engineering.

The committee overseeing the production of the Fire Safety Engineeringstandard is ISO TC92/SC4. This committee is served by five working groups,which each deal with topics of interest to the fire safety engineer.

Each working group is responsible for producing a document describingits areas of concern. FRDG have been providing some technical input tothat part of the standard concerned with life safety.

The life safety document describes how to go about designing and assessinga building for the purposes of life safety. This obviously includes standardfire safety topics such as evacuation strategies and means of escape. Inaddition the document covers topics such as:

- "pre-movement" (the time it takes people to begin to evacuateonce they hear an alarm)
- the physiological effects of the fire on the occupants
- the psychological effects of the fire on the occupants

The draft document is due to be presented to the working group in November1996 and then should be published for comment by ISO.

F 21.02: A Study of the Degree of Protection Afforded by Firefighters'Clothing

Over the years brigades have welcomed the trend in the textile industryto offer new and improved personal protective equipment ranging from tunicsand matching overtrousers to one-piece suits, in a variety of `technical'textiles. However, there have been concerns about design shortcomings andthe additional thermal load imposed by such garments.

The findings were discussed at the Joint Committee on Appliances Equipmentand Uniforms in September 1996, and the FRDG Report will be published soon.**F21.04: A Review Of Fire Brigade Control Staff Uniform**

In 1995, after the second wearer trial had been completed, the followingimprovements were made to garments:

- a change to a superior crease resistant poly/wool twill.
- repositioning the button holes on the cardigan.
- completing the development of a blouse collar that is both comfortableand smart.

Once the uniform specifications had been finalised manufacture and supplybecame the focus of attention, and in January, 1996 a Framework Arrangementwas awarded to Alexandra Workwear. This was announced in DCOL Number Xthe same month.

During the first few months of the contract Alexandra Workwear commencedmanufacture of the uniform and sent brigades an information brochure containingdetails of the off-the-peg size range, the supply arrangements etc.

After some initial teething problems Alexandra Workwear are now fullystocked and can supply all items in any quantity. Indeed, some brigadeshave used this flexible service to order a few complete sets of uniformfor evaluation whereas others have found it helpful to add new items totheir existing uniform.

F 21.06: Breathing Apparatus Guidelines

A new guideline system is being developed, based on the need to be ableto recognise the way out whilst wearing fire gloves. Proposals were submittedto brigade trials in Cleveland, Humberside, Strathclyde and West Midlands.The results have been analysed and submitted to the Breathing ApparatusWorking Party. At present, minor changes are being evaluated, and performancespecifications for guidelines and personal lines are being written in aform that permits brigades to stick with the old system or adopt the newone.**F 23.19: Degradation of Chemical Protective Clothing**

The Working Party on Protective Clothing proposed research into howchemical protective clothing deteriorated during its life. Brigades suppliedthe Fire Experimental Unit with used old suits, from which apparently undamagedsamples were cut, and the manufacturers supplied new samples of their materials.The materials were all subjected to the battery of 15 chemicals proposedin the draft European standard. It was shown that none of the materialshad deteriorated significantly with use.

Whilst it must be born in mind that none of the materials tested weredesigned to meet the proposed standard, and that the standard may changesignificantly before it is finally agreed, it was noteworthy that onlyone of the materials tested would have met the standard, and this wouldhave had the lowest possible grading.**F 23.20: Fire Tests of Class AAdditives**

The Fire Experimental Unit undertook medium scale fire tests of as manyof the Class A additives available on the market as possible. The initialtests involved a pile of 56 wooden pallets ignited from below with heptane.These were allowed to burn for threee minutes before one of the secondedfire officers at the Unit fought the fire with a hosereel.

Initial tests showed that some of the additives did offer an improvementover the use of water alone, but it was felt that a single test of eachwas not sufficient, so a second round of trials is now under way, repeatingeach test twice more.

F 32.04: Development of a Compartment Fire Simulator.

FRN Issue 19 reported plans to develop a compartment fire simulatorto demonstrate flashover, backdraught and other related events using realisticsources of fire.

A compartment 2.4m x 1.2m x 1.2m, which represents a room at half-scale,has now been built and installed at the FEU. A gas burner system is beingdeveloped for installation in the compartment.

Once the system is commissioned, the burner will be allowed to burnuntil the flame becomes ventilation limited and eventually it will extinguishdue to oxygen starvation. After extinction the

burner will be left on toallow the unburned fuel fraction to increase. A hinged panel at one endof the compartment will then be released to allow air to enter the compartmenttowards a spark ignition source. With the appropriate conditions, a backdraughtwill be produced which will result in a fireball from the compartment.

The compartment has a glass viewing panel on one of the long sides andthis will allow events in the compartment to be recorded to provide footagefor a training video on all aspects of fire in a compartment.

The compartment will be instrumented to include measurements of gasvelocities, gas temperatures, heat flux and oxygen concentration.

Another compartment of size, 1.2m x 1.2m x 1.2m has also been producedwhich can be bolted onto the larger compartment. Where there is a corridoroutside a compartment, flammable gases may have escaped and there may thenbe an explosive atmosphere waiting for a source of ignition. Ignition mayresult from auto-ignition of the hot gases or from hot embers. The twocompartments will be used to demonstrate a backdraught outside the firecompartment.

Tests using the compartment will commence in the late summer of 1996,but it may take a little while to develop expertise in its use.

Although the compartment has been produced primarily to demonstratebackdraught, it will be a useful facility to demonstrate and research otherphenomena related to compartment fires. For example, the effects of firefighting tactics such as venting and the use of water sprays can be explored.**F32.05: A Manual of Firemanship on Foam**

Following their extensive research into firefighting foams over thelast ten years, reported in past editions of FRN and in a number of substantialresearch reports, the Fire Experimental Unit have been tasked to updatethe Manual of Firemanship so that all that has been learnt can be madeavailable to the fire service. The second draft of this manual is now withthe Fire Service Inspectorate for comment,before wider consultation takesplace.

F 32.06: Training Videos on Fire Growth, Backdraught, Flashover andVentilation.

It has recently been agreed that the Fire Experimental Unit should assistthe Fire Service Inspectorate in producing a series of short training videosto reinforce the messages contained in the recently published supplementsto the Manual of Firemanship covering Compartment Fires.

F 33.01: Fire Cover Model

The Geographical Information System (GIS) version of the Fire CoverModel is now in use in 25 fire brigades across the country. The fire covermodel is designed to allow users to examine the fire cover provision intheir brigade area - but many users are now going on to use the packagefor a variety of other fire cover related issues, such as:

- showing calculated and actual station grounds on a map
- determining Pre-Determined Attendances
- categorising individual buildings by risk
- creating map books
- storing hydrant information

The next major development will be an optimising routine which willallow the software to automatically suggest locations for appliances foroptimum fire cover.

For more information contact

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F 33.05: Gas Release Computer Models

In 1994, the Fire Research & Development Group were tasked to assesswhat advice could be made available to first attendance fire crews at incidentsinvolving the release of toxic or flammable gases. This work was undertakenby the Fire Experimental Unit, and led to the publication of FRDG report13/94 : An Overview of Gas Dispersion Models for Possible Use by FirstAttendance Appliance Crews.

This concluded that the Chem Met system offered as much as could beexpected, but that there was a delay of about half an hour in obtaininginformation from them. It was proposed that a work book could be produced,similar to the HazChem List, giving hazard distances, and which would beavailable to firefighters on their way to the incident.

Consultants were contracted to review existing work books and to provideguidance on their suitability for the United Kingdom. This resulted inthe production of FRDG Report 7/96 : The First Stage in the Developmentof a Gas Dispersion Prediction System for Fireground Use.

Discussions will now be held on how this information could be made availableto firefighters. **F 33.06: Review of Risk Assessment Methods**

In 1995 the Audit Commission produced a report, "In the Line ofFire", which suggested that the current methods of assessing levelsof protection against fire were inadequate in a number of respects andshould be reviewed.

This project was established to address this requirement and its mainstages are to:

1. Conduct a review of the options available to assess risk for thepurposes of providing fire cover.

2. Provide an assessment of the options available in terms of theirpracticality and applicability in the UK.

3. Produce a written report on the work, listing any assumptions orlimitations contained.

4. Provide a presentation on the findings of the study to the JointCommittee on the Audit Commission Report (JCACR).

FRDG have let a contract for the work to the risk assessment consultantsENTEC UK Ltd. So far, they have provided an overview of the types of riskassessment which could be used and are due to report back to the JCACRin October 1996 to provide more detailed methodologies for assessing risk.

F 34.01: Development of Practical Aptitude Tests for Fire ServiceRecruits

This project was undertaken in collaboration with the Robens Institute,University of Surrey. The aim of the work was to develop a battery of testsfor fire service recruits on the lines of those currently used by somebrigades, which they developed themselves. The important point is thatthe tests should be as valid and fair as possible to all potential recruitsirrespective of gender, race and previous experience. The tests shouldalso, as far as possible, distinguish between those skills/aptitudes inwhich an initial deficiency should be capable of correction through training,and other essential skills unlikely to be amenable to training.

The work was undertaken in four phases:

a. collection of data on recruit wastage and training and the basisof current selection criteria applied by brigades;

b. the physiological monitoring of recruits undergoing initial training;

c. the development of the proposed tests, and

d. in-service validation by five brigades on 100 recruits.

The proposed tests are as job related as possible, so they will alsohelp candidates to make an informed judgement about whether they wish tocontinue with their application.

The tests are based around a ladder ascent, casualty handling, breathingapparatus wear and hose running. Guidance in the use of the test batterywill be given to brigades by the Home Office.

F 34.05: Psychometric Tests for Fire Service Recruits

Fire Service Circular 2/1996 advised brigades of the introduction ofnew recruit selection tests to replace the ability range tests (ARTs).The tests were developed for the fire service by the occupational psychologists,Pearn Kandola.

However, in order to deal with a number of concerns still expressedby members of the CFBAC Joint Training Committee, Fire Service Circular6/1996 was issued to withdraw the tests in favour of a further six monthsof trials.

A FINDS message was sent out in August, 1996 inviting brigades to participatein the trials. The response was good and the trials commenced in October.They are scheduled to run through until March, 1997.

F 35.06: Effectiveness and Safety of Fire Hoods

The report on this study, considered by the Joint Committee on AppliancesEquipment & Unifirms in September, 1996, has answered questions suchas:

- could the use of fire hoods induce a false sense of security by makingfirefighters less sensitive to increases in temperature?
- what is their impact with regard to thermal strain?
- could helmet skirts funnel heat up into the helmet?

The Home Office report on the physiological effects of PPE (personalprotective equipment) is to be published soon**F 35.08: Health of ControlRoom Staff**

This study was carried out in collaboration with the Robens Institute,University of Surrey in order to:

a. investigate the environmental and ergonomic factors within the controlroom likely to induce or exacerbate stress/stress related illness amongstcontrol room staff;

b. investigate the incidence of stress and stress related illness amongstcontrol room staff and identify whether the causes are environmental, organisationalor non-work related;

c. assess the organisational/management structure within control roomsin relation to its possible role as a stressor.

A confidential questionnaire was administered to all control room staffin the UK, and 1096 were returned for analysis. Also, 18 control roomswere visited, further questionnaires given to the staff for completion,discussions held with selected individuals and the environmental and ergonomicfactors within the control room were measured and assessed.

A report on the work was produced in October 1995 and was discussedat a meeting of the Joint Committee on Fire Brigade Communications. Itis now to be discussed at the next meeting of the National Joint Council.

F 35.09: Firefighter Mortality: A second follow-up

This study is being undertaken in collaboration with the Universityof Manchester for two reasons:

a. to confirm the results of a previous study which showed that firefightershave a much lower risk of death than the general population, from all causesof disease combined and from lung cancer in particular. It also showedthat firefighters do not have an increased risk of developing ischaemicheart disease.

b. to determine whether the incidence of cancer amongst firefightersis different to that expected for the general population.

This second investigation is now possible due to the establishment ofa National Cancer Registry. This enables those participants in the studywho have contracted cancer to be identified as soon as possible after firstdiagnosis; in other words, while they are still alive.

A report was received at the end of September 1996, containing informationprovided by five brigades, the National Health Service Central Registry,the National Cancer Registry and the Office of Population Censuses andSurveys. Its findings are still being considered.

RECENT FIRE RESEARCH PUBLICATIONS FROM THE HOME OFFICE JOINT COMMITTEE ON FIRE RESEARCH

RESEARCH REPORT LIST

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64 Standards for Storage of Fire Hazardous Materials

65 Domestic First Aid Firefighting

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FIRE RESEARCH & DEVELOPMENT GROUP

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STAFF PROFILES

CHRIS GOODERSON

Chris joined the Home Office and FRDG as Head of Human Factorsin February 1996, having worked for the Ministry of Defence for23 years.

He has a physiology degree and considerable experience in HumanFactors issues related to clothing and personal equipment, stressfulenvironments and human performance. This experience, whilst workingat the Army Personnel Research Establishment, has come from laboratorypractical work and field exercises with the Army, in environmentsranging from the arctic, desert and jungle, and on the ground,in armoured fighting vehicles and in the air. His most recentappointment involved the generation of research projects and internationalcollaboration, looking to supply combat service personnel withhigh technology protective clothing and personal equipment suitablefor use in the 21st Century. He now needs to learn about thefire service and your requirements as he has responsibility forHuman Factors projects on the firefighter environment and selectioncriteria.

Chris lives in Fleet, Hampshire, is married to Trish and has a20 year old son. His hobbies include gardening, walking his TibetanTerriers, cooking, brewing and winemaking.

GREG COLEMAN

Greg joined the Fire Research & Development Group in January,1966. He graduated from the university of Salford with a first classhonours degree in Chemistry, and then went on to complete a PhDdeveloping novel flame retardants for polyurethane foams, deepeninghis enthusiasm for fire chemistry.

Since leaving the world of academia in 1993 he has worked forICI as a research scientist where he investigated combustion mechanismsof flame retarded polymers using the combined techniques of laserpyrolysis and mass spectrometry, before moving into new productdevelopment and then project management.

He has been married for over a year and lives in Surrey with nopets and definitely no children. His hobbies when he was singlewere skiing, bungee jumping, paragliding and rock climbing butnow include DIY(synonymous with house ownership) and ways to avoidgardening.

AN APOLOGY

In our last issue, in the article on fire hoods, we mistakenly stated that the Mattinson Fire Hoods were not manufactured to a particular specification. The manufacturers have rightly pointed out that their hood is manufactured to conform to 10 British Standards.

What should have been said in the article was that the hood was not manufactured to a specific Home Office specification. We are happy to correct this error and to offer our apologies for the mistake.