National Firefighter Selection Process
Development and Validation of National Firefighter Selection Tests: Physical Tests
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Optimal Performance

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Section One

Executive summary

Introduction and Background

In January 2002 Water for Fish and Optimal Performance were commissioned by the Department for Transport Local Government and the Regions (now the Department for Communities and Local Government (CLG) to develop and validate new National Firefighter Selection Tests (NFSTs). The main drivers for the project were the desire to standardise the selection process across the country and to implement tests that reflected the changing role of the Fire and Rescue Service (FRS). The tests should be legally defensible and seek to minimise adverse impact among the target groups, especially female and ethnic minority candidates. This report addresses the development and validation of the physical tests. A separate report will address the psycho-social selection tests.

A considerable amount of work had been done to develop a selection test battery prior to the involvement of Optimal Performance. We built on this foundation, shoring up any gaps that were found. The absence of a strong evidence base substantiating the physical requirements of firefighters lead us to conduct an abbreviated physical demands analysis to agree and define physical job performance criteria. These job performance criteria provided the gold standard against which the new selection tests would be validated. Over the course of a series of workshops and small studies, seven job performance criteria were agreed and standards on each were proposed. A final expert panel that convened in June 2005 proposed modified standards from those previously proposed – these are presented at Table 3.

A number of potential selection tests were assembled that could be used at the time of a candidate’s application. Both fitness tests and job simulations were considered – the latter content valid approach being preferred on balance due mainly to their high level of face validity. The views of serving firefighters, expert panels, and all of the stakeholders represented on the project Steering Group were considered in designing the proposed selection test battery.
Validation Study: Trainees

A large study was conducted in which the proposed selection tests were administered at the start of initial training and the criterion performance tests were administered at the end to develop statistical models linking performance on the selection tests with those on the criterion performance tests. One hundred and thirty seven trainees from a range of FRSs took part. The participants comprised 127 males and 10 females; 124 were white and 13 were from ethnic minority groups; 122 were whole-time and 15 were retained. These trainees had passed the existing selection procedures and were therefore not representative of applicants to the FRS. Caution should therefore be exercised in applying these findings to future applicants. Nevertheless, a number of conclusions could be drawn.

The majority of trainees (96%) were able to meet all seven of the proposed criterion performance standards at the end of initial training, while the remaining minority (4%) were not. Of the 615 individual criterion performance tests that were performed, only five (1%) test scores fell below the criterion performance standards proposed by the final expert panel convened in June 2005. The high pass rates bode well given that the current selection and training processes within FRSs are not fully aligned with the job performances criteria agreed during this study.

In some of the selection and criterion performance tests, performance by female trainees was not as good as that by male trainees and the proportion of test fails was higher. In total, 1% of males failed one or more of the tests, while this figure was higher in females (30%). However the absolute number of test ‘fails’ overall (n=4), and among women in particular (n=3), is too few to quantify the adverse impact with confidence.

All the female ‘fails’ occurred in those tests that had dominant components of strength and endurance (Rural, Domestic and Ladder Lift), while none occurred in those tests with strong elements of confidence, agility and coordination (Ladder Climb, PortoPower and Enclosed Space). Gender differences in performance scores were also most apparent in these same tests.

No differences in performance on any of the selection or criterion performance tests were reported between ethnic cohorts. However, this analysis was limited to comparing whites versus all ethnic minorities, as the numbers of participants from specific ethnic minority groups was too small (n=11) to allow more detailed analysis.

Performance differences were found between whole-time and retained trainees on some tests. Whole-time trainees performed significantly faster on the Rural, Domestic and Enclosed Space selection tests compared to their retained counterparts. However, the relatively small number of retained firefighters in the sample prevents firm conclusions regarding training status being drawn.
Validation Study: Trained Firefighters

Due to the small number of female and ethnic minority trainees in this study, a further study was conducted on 50 trained firefighters, in which the proposed selection tests and criterion performance tests were performed on consecutive days. The sample comprised 31 males and 19 females; 39 were white and 11 were from ethnic minority groups; 44 were whole-time and six were retained.

The majority (78%) of trained firefighters were able to meet all seven of the proposed criterion performance test standards, while the remaining minority (22%) were not. Of the 323 individual criterion performance tests that were performed in this study only 15 (5%) fell below the criterion performance standards. It is likely that if the criterion performance tests were implemented as regular tests for trained firefighters, the physical capabilities of the least fit one quarter of firefighters would need to improve in order to pass. The fail rate on the Rural criterion performance test was the highest at 14%.

In some of the selection and criterion performance tests, performance by the female firefighters was not as good as that by the male firefighters and the proportion of test fails was higher. The fail rate across all tests was approximately 1% in men and 11% in women, indicating adverse impact in women. However the absolute number of fails overall, and among women in particular is too few to draw firm conclusions quantifying that adverse impact. The majority of the female ‘fails’ occurred in the Rural criterion performance test, with 37% of participants failing to achieve the required standard.

There was a tendency for a higher proportion of white than ethnic minority firefighters to fail the Rural and Ladder Lift tests, though again the actual number of ‘fails’ was too small to draw any firm conclusions concerning adverse impact in specific ethnic cohorts. Similarly, the number of retained firefighters was too few to draw any conclusions concerning adverse impact in this group.

Predictive models and risk management

The trainee and trained firefighter samples were combined for the purpose of boosting the sample size to develop statistical models relating performance on the selection tests to those on the job performance criteria. Satisfactory models were derived in five of the seven job performance criteria and in the other two alternative ways ahead were proposed to enable implementation of all tests. A Risk Management Strategy is proposed at Table 15, based upon the likelihood of candidates being able to meet the required job performance criteria at the end of initial training. Assuming that the criterion performance standards proposed by the final expert panel in June 2005 and presented in Table 3 are deemed appropriate, the distribution of A, B and C Grades is presented for the trainee sample. 91% of the sample achieved A Grades across all tests. Expressed by gender these figures change to 95% in the men and 40% in the women. It is the rural test that provides the greatest challenge, especially for the women, with 20% failing to achieve an A, B or C Grade.
Recommendations

Optimal Performance makes the following recommendations:

1. Communities and Local Government and the FRSs replace the various physical selection tests currently in operation with the seven new standardised physical National Firefighter Selection Tests (NFSTs), namely:
   - Rural Fire
   - Domestic Fire
   - Ladder Lift
   - Ladder Extension
   - Ladder Climb
   - PortoPower Assembly
   - Enclosed Space.

2. Selection standards on the tests are finally agreed and set. The level at which the standards are set is dependent upon two factors yet to be decided by Communities and Local Government with advice from the Steering Group and Practitioner’s Forum. First, the most recent set of standards on the criterion performance tests proposed by the expert panel in June 2005 must be confirmed, or amended. Second, the desired level of confidence and risk the organisation is willing to take in accepting candidates into training must be decided. In making these decisions, the conflicting desires for optimising operational effectiveness, health and safety and financial efficiency on the one hand, and for supporting the social agenda to diversify the work force on the other, must be balanced.

3. Applicants should be graded by merit according to their performance on the physical tests. These physical grades should be weighted according to the relevance that the physical criteria are afforded relative to the other psycho-social selection criteria. These weighted scores should be used in the final selection of successful candidates in the event that a surplus of candidates achieves the minimum standards required on all test criteria.

4. The test battery should be administered to candidates in its entirety, with feedback provided both on applicants’ performance and if appropriate their training needs.

5. Failure to achieve any of the seven standards would preclude advancement through the subsequent phases of the selection process.
6. An opportunity to retake any failed tests should be provided, ideally on the same day at the end of the test session, unless health and safety criteria dictate otherwise.

7. A minimum period of three months should be enforced between repeating the test battery, to allow time for physical training and physical development.

8. The implementation process should be monitored closely and regularly, and initially, frequent evaluations should be conducted. In practise this means that both the selection test and criterion performance test batteries should be administered and the data collected and analysed in a manner similar to that performed in this report.

9. The likely adverse impact in women should be tracked closely, as should the possible adverse impact in specific minority groups.

10. Positive action should be embraced to encourage the right calibre of candidates from minority groups to apply, and opportunities should be provided to train for and practise the physical selection tests before applicants undertake them in earnest.

11. The initial training programme conducted by FRSs should be audited and where necessary modified, to ensure it reflects individual needs. From a fitness perspective, physical training and operational training should be more specific to the job performance criteria endorsed by the Steering Group.

12. Annual physical assessments should be introduced for serving firefighters to ensure they too meet the job performance criteria defined during this project.
Section Two

Background to the requirement

In common with all public sector occupations, terms and conditions of employment in the UK Fire and Rescue Service (FRS), including selection, are subject to consultation and enshrined in law. The statutory provisions relating to firefighter recruitment and selection were until October 2004 laid out in the Fire Services (Appointment and Promotions) Regulations. Many of these regulations had remained unchanged for a number of years, though recent modifications were made in preparation for the application of the Disability Discrimination Act to the FRS in October 2004. However in October 2004 the regulations were abolished with the introduction of the Fire and Rescue Services Act 2004. The central guidance on issues relating to recruitment to the Fire and Rescue Service is now embodied in Chapter 5 of the National Framework:

5.18 ‘It is the responsibility of the Fire and Rescue Authorities to appoint, develop and promote staff on the basis of good practice in accordance with legal requirements. With the introduction of the Fire and Rescue Services Act on 1 October 2004 the Fire Services (Appointments and Promotion) (England and Wales) Regulations 2004 were repealed. For those staff previously subject to the above regulations, Fire and Rescue Authorities should have regard to the principles of IPDS (see Chapter 6), including the Personal Qualities and Attributes Framework. The provisions of the national firefighter selection tests will be introduced in spring 2005 and will inform Regional Management Boards’ regional recruitment procedures’.

Concerns have been expressed for some years about the selection processes used by FRSs, both from within the service and from external bodies. Concerns from within the service included that there was a perceived inadequacy of the fitness test, there was no national written test, that inconsistent procedures were operated across FRSs, and that attrition during training was unnecessarily high, possibly due in part to the inadequacy of the selection procedures. External concerns have also been raised about the small numbers of women and minority ethnic candidates joining the service. Allied to this concern, doubts were expressed about the defensibility of the use of tests and selection criteria developed on a predominantly white male population.
In response to these concerns an Implementation Working Group (IWG) was set up by the Chief and Assistant Chief Fire Officers Association (CACFOA), Personnel and Training Committee in 1997. The IWG undertook much useful work in the four years leading to the commissioning of this current project. Perhaps of greatest importance was the development of an integrated point of entry selection system as it was known at the time. This system was based around assessment of individuals’ potential for training to undertake the role of firefighter. Given its clear link to the firefighter role and the fact that it would be used nationally, it was hoped that the system would minimise attrition in training and eliminate wide-ranging and potentially discriminatory selection practices. The IWG recommended that its proposed selection process be validated before its adoption across the Service. The current project reflects the development and validation of the new National Firefighter Selection Tests (NFSTs), as they are now known, a project commissioned to Water for Fish, formerly Interactive Skills, and Optimal Performance Limited (OPL) in 2002 by the Department for Transport and Local Regions (DTLR). The contract was transferred to the Office of the Deputy Prime Minister (ODPM), now Communities and Local Government (CLG) later that year with the move of the Fire and Rescue Service to that department.

Around the time that the project tender was being formulated, a fundamental review of the firefighter role, and indeed every role within the Service, was being carried out. Changes were being discussed including an increased emphasis on fire prevention and greater integration of Service personnel into the communities that they served. These new roles were consolidated within the Integrated Personal Development System (IPDS) project\(^1\). The role of firefighter as described in the National Occupational Standards for fighters ‘Operations in the Community’ contained the following units:

- Inform and educate your community to improve awareness of safety matters
- Take responsibility for effective performance
- Save and preserve endangered life
- Resolve operational incidents
- Protect the environment from the effects of hazardous materials
- Support the effectiveness of operational response
- Support the development of colleagues in the workplace
- Contribute to safety solutions to minimise risks to your community
- Drive, manoeuvre and re-deploy fire service vehicles.

\(^1\) IPDS, Fire Service College, Moreton-in-Marsh.
While a greatly increased emphasis is now placed on the psycho-social aspects of the firefighter role, the need to maintain operational effectiveness clearly remains, within for example, “to save and preserve endangered life”. A series of recent reports by OPL has quantified the high cardiovascular, thermal and biomechanical requirements during both conventional and non-conventional (chemical, biological, nuclear and radiological (CBRN)) incidents\(^2\). A requirement for relatively high levels of physical fitness, especially aerobic fitness and muscular strength and endurance remains.

There is also a well substantiated link between the fitness and health of both the general population and employees in a number of occupational settings. Higher levels of fitness are associated with a reduced incidence of disease and injury, translating into the work environment via a reduced sickness absence and ill-health retirement\(^3\). Although maintaining through-life health-related fitness was not a major driver for this project (the focus was on ensuring operational effectiveness and maximising diversity in the workforce), health-related fitness cannot be ignored as it impacts on operational effectiveness via the availability of personnel and financial resources to deliver the service to which the FRS aspires.


Section Three

The requirement and approach

The overall requirement of this project was to develop a valid and legally defensible national system for the selection of firefighters. The selection process should reflect the diverse role of the firefighter and fully meet current standards of best professional practice. It should seek to provide pragmatic and cost-effective tools that will be embraced by the Service.

There is a well recognised model of best practice to develop physical selection standards. This model has been used in the UK by Rayson et al. for the armed forces and the result has been endorsed by both the Health and Safety Executive (HSE) and the Equal Opportunities Commission (EOC). A five phase approach is typical, and essentially it was this approach that was pursued during the current project:

- Describe the job requirement and establish job performance criteria
- Design a battery of potential selection tests
- Establish the relationships between performance on the job performance criteria and performance on the potential selection tests and establish standards on the selection tests
- Validate these relationships and standards in a separate sample, assess the likely impact on applicants, and check for unfair discrimination
- Implement the system and conduct ongoing monitoring and evaluation.

Careful consideration was given to achieving ‘buy-in’ from the Service by involving as many stakeholders as possible at all phases of the project. For example, key stakeholders such as Chief Fire Officer’s Association (CFOA), the Local Government Authority (LGA), the Fire Brigades Union (FBU), Networking Women in the Fire Service, the Black and Ethnic Minority Members section of the FBU (B&EMM), the Association of Local Authority Medical Advisors (ALAMA) were represented on the Steering Group. It was the Steering Group that considered and ultimately endorsed to the ODPM all key decisions made throughout this project. Around 30 different FRSs contributed actively to the development work by supplying subject matter experts, hosting workshops and contributing participants to the various studies. The EOC and Commission for Racial Equality (CRE) were involved in the consultation process, as were independent equal opportunities consultants.

Section Four

Preparatory work

4.1 Introduction

There had been considerable effort undertaken in the years preceding the commissioning of this project by other research groups and by an Implementation Working Group (IWG) set up under the auspices of the CFOA Personnel and Training Committee. The first task undertaken by the current project team at OPL was to conduct a review of the physical selection criteria in operation at that time, to review the IWG assessment tools against the needs of the Service, and to review the national and international literature on firefighter selection. The hope was to verify that the preceding work and evidence base was sufficiently robust to enable confirmation of the IWG’s recommended selection battery, and leap-frog on to Phase 3.

A review both of the selection criteria used by a sample of FRSs and of the proposed IWG recommended integrated selection package was conducted. Audits of six FRSs’ procedures (West Yorkshire, Humberside, Gloucestershire, South Wales, London and Strathclyde) were carried out, and collated data and statistics that were available on the various selection procedures were scrutinised. The review of literature focussed particularly on the UK based studies contained in the so-called Chelsea (1988), the Robens (1991) and Lilleshall Reports (1999), which concentrated on the physical elements of the selection procedures for UK firefighters.

While a considerable volume of work has been conducted since the mid-1980’s on the topic of developing legally-defensible job-related selection tests and standards, with the IWG package representing the culmination of that work, a lack of coherence, an absence of a clear audit trail, and flawed conclusions were the outcome of the audit of the IWG package. While the IWG package did have a number of points to commend it (eg the proposed tests appeared to encompass many of the most important aspects of fitness; the tests were generally well designed and the protocols well documented), the recommended package did not in OPL’s view represent the range of physical capabilities or the extent of physical capabilities required by the firefighter.

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The word ‘appear’ is used as there remains a lack of quality information about what the operational role of firefighter actually entails. The IPDS documents refer to firefighters ‘ensuring their own health and fitness for work’, ‘conducting a search to locate life’, ‘using equipment within its limitations and capabilities …’, ‘controlling and extinguishing fires’, but nowhere are the operational details or standards of performance defined in objective measurable terms. Without this solid foundation, it is impossible to be sure that the relevant aspects of fitness are covered fully in the selection test battery and that whatever standards are set on the tests are appropriate. For example, rural fires were identified in the Chelsea Report in 1988 as being perhaps the most demanding incidents that firefighters attend, yet there are no data on this type of incident. Further, OPL was unable to uncover any data on timelines and events (the basis of a physical demands analysis) during major firefighting incidents of any kind. It is the physical demands of these types of incidents that should underpin any selection and retention criteria for firefighters. The Lilleshall Study (1999) reported heart rate and lactate data at three fire stations for consecutive day-night-day shifts, but there were no major incidents during these short periods and measurement methods were not optimal for the purpose of quantifying the physical requirements associated with the job.

The difficulty encountered by previous studies in performing a thorough job analysis is a function of the infrequency of these major firefighting incidents and the diversity of these incidents as a result of the provincial location of different FRSs (eg rural, urban, coastal). As many firefighters are unlikely to encounter such incidents on a frequent basis during their career, the need to be physically prepared to deal with them has to be balanced against the chances of being involved in such an incident. This criticality vs. frequency debate needed to be addressed by the Service, to define the range of physical tasks that all firefighters should be capable of performing, in light of the likelihood of these tasks being performed.

It is known from the job analyses conducted by the Chelsea, Robens and Lilleshall groups that of those tasks measured, Breathing Apparatus (BA) operations and hose running are the most aerobically demanding tasks, and that casualty evacuations and the material handling tasks (primarily ladders and pumps) are the most taxing strength-wise. Of those scenarios monitored, rural, commercial and shipboard fires were the most physically demanding.

The absence of role-related performance tests or fitness standards for trained firefighters and of regular physical assessments for these incumbents makes the imposition of defensible physical standards for applicants problematic. This problem is compounded by reports from the three main UK studies that the fitness levels of trained firefighters fell below the IWG proposed entry standards of recruits. For example the Lilleshall Report concludes that 10% of male and more than 50% of female operational firefighters had a $\text{VO}_{2\text{max}}$ below 45 ml.kg$^{-1}$.min$^{-1}$. By inference, either these individuals are performing

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their job effectively and the standard of 45 ml.kg\(^{-1}\).min\(^{-1}\) is inappropriately high, or the standard is appropriate and individuals who fall below it are ineffective and a liability to their team and to the public they serve.

The net result of this preliminary work was that the foundation to the IWG-recommended tests was not sufficiently robust and it was recommended by the project team that these shortcomings should be addressed before proceeding with the project plan. OPL proposed that a physical demands analysis for firefighters be performed to identify critical physical tasks that all firefighters should be able to perform, and standards of performance on these critical tasks be defined. It was proposed that the test package should be extended to cover more of the physical demands required of firefighters. Noticeable by their absence were tests of lifting and carrying heavy items of equipment, and tests involving sustained or repetitive muscular contractions (i.e., strength endurance). It was also recommended that applicants be tested to their safe maximum and then ranked on a cumulative fitness score to reflect the fact that greater levels of fitness confer benefits to the performance of firefighter operations. Formal fitness assessments for incumbent firefighters should be implemented on a regular basis, with standards of performance for applicants and trained firefighters being aligned, though not necessarily identical. The changes in fitness and performance as a result of initial training needed to be quantified to set appropriate minimum standards for applicants on entry.

In the absence of an adequate description of the role of firefighters and objective and measurable standards of performance in that role, the project team embarked upon an abbreviated physical demands analysis to fill these gaps. This analysis took the form of consultation with various groups of nominated subject matter experts and cohorts of operational firefighters via a series of workshops and pilot studies, which are described on the following pages. This period of consultation was more protracted than anticipated, partly as a result of the disruption to the project caused by the industrial dispute and partly due to the changing personnel amongst the stakeholders and their evolving and sometimes disparate views on job requirements. The series of workshops reported reflect the evolutionary stages that culminated in the endorsed job performance criteria, on which the physical selection tests and their standards are founded.

### 4.2 First Workshop: Greater Manchester FRS April 2002

The first workshop was hosted by Greater Manchester FRS from 17-19 April 2002\(^\text{11}\). Eighteen training officers and experienced firefighters took part from 11 different FRSs. The objectives were threefold: to identify and document critical tasks which all firefighters need to perform; to devise single person simulations of these tasks; to define minimal and optimal standards of performance on these simulated tasks. The first scenario identified was that of conducting a search and rescue from an industrial building under conditions.
of live fire. Key tasks included getting the equipment (including ladders) off the appliance and carrying it approximately 50 metres; under-running and extending ladders; climbing ladders; entering the building, searching whilst dragging a charged hose; firefighting; locating a casualty; rescuing that casualty from the building. A first attempt at designing a single person simulation ensued that incorporated a 300 metre brisk walk, a 60 metre carry of a load representing one quarter of the 13.5 m ladder, an under-run of the ladder, ladder extension, ladder climb, entry into the building, and a 30 metre casualty (60 kg) drag. The best effort times on this simulation ranged from five minutes 30 seconds to seven minutes 15 seconds, whilst times paced by a panel of four to represent a minimum acceptable work rate were between eight and nine minutes.

A Domestic fire scenario was also developed that incorporated donning personal protective equipment (PPE); pulling out a hose reel 40 metres; crawling up a flight of stairs; and extricating casualties. An approximate time of four minutes 30 seconds was suggested for this type of scenario. A Road Traffic Incident (RTA) was also identified and partially developed as a simulation, including deploying equipment such as pumps, generators, hoses, and handling that equipment to stabilise the vehicle and cut the pillars for example. This RTA task was difficult to simulate though and no standards of performance were articulated. A grassland (rural) fire was also identified as a key task, though not developed into a single person simulation.

4.3 Second Workshop: Fire Service College June 2002

A second workshop convened on 17-20 June 2002 at the Fire Service College (FSC), Moreton-in-Marsh to follow up the Manchester workshop. A pre-meeting of stakeholders convened in London on 10 June, at which the objectives and format of the FSC workshop were agreed. A follow-up meeting of the stakeholders was also conducted on 11 July 2002 in London, to revisit the outcomes from the workshop and to formulate recommendations to the Steering Group. The objectives of the second FSC workshop were:

- To identify and document essential physically demanding tasks in an operational environment required of all trained firefighters at the end of initial training
- To devise single-person simulations of these essential tasks
- To define essential minimal standards of performance, and where appropriate higher optimal standards of performance, on these simulations.

On the basis of the outcomes from the Manchester workshop and the opinions of the stakeholders, the scenarios to be investigated were agreed by the stakeholders as:

- RTA – casualty extrication from a car that had gone down an embankment
- Domestic – search for and rescue multiple hidden casualties on the 1st floor via front door entry, while firefighting in BA
Domestic – salvage in BA to include covering roof with tarpaulin
Rural – grassland fire to include hose laying, water relay (both pumps), BA and beating.

The stakeholders judged that these scenarios spanned both the breadth and depth of physical demands encompassed by operational firefighters and that firefighters were required to be able to perform these tasks at the end of initial training. The workshop’s focus was on agreeing and detailing the ‘reasonable worst case’ within these scenarios. The workshop participants comprised seven stakeholders and 13 practising firefighters comprising seven males and six females (nine wholetime and four retained). Four were from ethnic minority groups. The firefighters came from West Yorkshire, London, Hampshire, Manchester and Cumbria FRSs.

**Rural fire scenario**

The scenario involved a vehicle on fire on the edge of a grassland area. Two crews attended the incident, with the second appliance arriving some three minutes after the first. The team from the first appliance therefore bore the brunt of the physical demands of attacking the fire, sourcing an emergency water supply (EWS), and running out hose and carrying the Light Portable Pump (LPP) to that EWS.

During the early trials of the incident the activities performed and the equipment deployed by the most active firefighters in the first crew were identified and documented. A timeline was kept of key events and distances were measured. The time from the first member of the first crew dismounting the appliance to placing the LPP down at the EWS (the event that marked the end of the most physically demanding elements of this scenario for the Firefighter with the most demanding role) was 11 minutes 28 seconds.

The group discussed each subtask performed by the individual firefighter with the most demanding role, including the equipment carried and the distance covered. The sequence of subtasks was agreed as follows:

1. Run out hose reel 50 m
2. Jog back to appliance 50 m
3. Pick up and carry 2 x 70 mm hoses. Drop first at 175 m and second at 200 m.
4. Run out the two hoses
5. Jog back to appliance 150 m
6. Pick up and carry 140 mm suction hose and basket 200 m
7. Jog back to appliance 200 m
8. Pick up and carry as a team of four a Featherweight Light Portable Pump 200 m.
These subtasks were reconstructed along a linear 50 metre course as a single person simulation and nine firefighters performed the simulation with the stakeholders and senior firefighters present moderating the pace to identify a minimum acceptable standard on the simulation of 13 minutes. Although an optimal pace was not identified, it was agreed that, within safety constraints, the faster the simulation could be performed the lower the potential risk of loss of life or property would be.

At the subsequent 11 July meeting, the stakeholders accepted the proposed single person simulation of the physically demanding tasks encountered during the rural fire. Given that developing a single national standard on each aspect of physical performance was the goal, it was agreed that the simulations should be based on the heaviest items of equipment currently deployed. In the case of the Light Portable Pump, the load should be based on the GP1600 model weighing 116 kg. The loads necessary to replicate one quarter of the weight of the LPP (a four-person task) were discussed with respect to the Manual Handling Operations Guidelines and other publications on team handling during lifting. A load of 32 kg was proposed in the form of a purpose-built metal cradle that replicates the LPP’s handle diameter.

**Domestic fire: Search and rescue**

The scenario involved a fire in a two-floor domestic property, with a search for and rescue of two casualties on the first floor. Two crews attended the incident, with the second appliance arriving some three minutes after the first. The first BA Team from the first appliance bore the brunt of the physical demands of attacking the fire, searching the property and rescuing the two casualties.

The whole scenario was run twice, with the fire in a first floor bedroom on the first occasion and in the downstairs kitchen on the second. During both trials of the incident the activities performed and the equipment deployed by the most active firefighters (BA Team 1) in the first crew were identified and documented. A timeline was kept of key events and distances were measured. The time for the BA Team 1 picking up the hose and entering the building to laying down the second casualty by the appliance (the event that marked the end of the most physically demanding elements of this scenario) was nine minutes 27 seconds, and nine minutes and 23 seconds, respectively.

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12 It is not possible to accommodate all possible variations of equipment and/or techniques used by all FRSs for the validation study – each element that is changed doubles the resources associated with conducting that scenario. Consequently the validation study was based on the “reasonable worst case scenario” for equipment and/or technique (e.g., using the 13.5 m ladder with no gantry system, the GP1600 LPP etc.). This would ensure that all future firefighters would be able to meet the physical standards required by all FRSs. Once the tests have been validated and appropriate national entry standards established, further work could be conducted with a view to modifying these standards as equipment evolves.


14 The load that can be handled by a team is less than the sum of their individual strengths. Evidence from the HSE’s Guidance (1992), and original papers by Karwowski (Maximum load lifting capacity of males and females in teamwork. In. Riding the Wave of Innovation. Proceedings of the Human Factors Society 32nd Annual Meeting. Santa Monica, California: The Human Factors Society, Volume 1, 680-682, 1988) and Pinder et al (Team handling: A psychophysical and biomechanical study of two person handling. Health and Safety Laboratory Report EWP/97/35, 1997) were considered in deciding the correction factor for team lifting that should be applied. Reductions in team lifting of between 4 and 30% were reported depending on the gender mix of the teams. OPL recommended, and the Steering Group endorsed applying a modest correction factor of 10% to the weight of all items handled on the single-person simulation, where operationally they would be performed by a team. This correction was applied to the 46 kg lift of the head of the ladder by two firefighters, the 100 kg casualty evacuation by two firefighters, and the 116 kg carry of the LPP by four firefighters.
The group discussed each subtask performed by the individual firefighters in BA Team 1, including the equipment carried and the distance covered and agreed the following sequence of subtasks:

1. Drag hose into house and around corners 30 m
2. Intermittently fight fire while searching house
3. Locate child casualty (~30 kg)
4. Lift & drag casualty out of house (30 m)
5. Walk back to house (10 m), pause for 30 seconds, crawl back in following hose (20 m)
6. Search and locate second adult male casualty (~80 kg)
7. Lift & drag casualty out of house (30 m).

These subtasks, with the exception of subtask 2 (fight fire and conduct search), were reconstructed along three sides of a 10 metre square as a single person simulation and 11 firefighters performed the simulation with the experienced personnel present moderating the pace to identify a minimum acceptable standard on the simulation of four minutes. Although an optimal pace was not identified, it was agreed that, within safety constraints, the faster the simulation could be performed the lower the risk of potential loss of life and property.

The shorter time for the simulation, compared to the real scenario was largely due to the elimination from the simulation of some of the confounding subtasks encountered during the scenarios. These included firefighting at intervals while entering and progressing through the house, and the more complex search procedures (the systematic search of several rooms). However, it was agreed by those present that the subtask of firefighting did not significantly contribute to the physical demand of this task, and that the additional physical challenges posed by conducting a search, sometimes in enclosed spaces, with obscured vision and while using a BA set, would be assessed separately (see Enclosed Space Search).

At the subsequent 11 July meeting, the stakeholders accepted the proposed single person simulation of the physically demanding tasks encountered during the domestic fire (search and rescue), including the rescue of both casualties, with one exception. They considered that the “heavy” casualty would more likely be performed as a two-person carry/drag, thereby reducing the load on each individual firefighter. The group also agreed that the mass of this casualty should be based on the 90th percentile male adult in the UK population, estimated to weigh 100 kg (DoH, 2000)\(^{15}\). The mass of the casualty for the single person simulation was therefore agreed at 55 kg, including the 10% loading factor.

\(^{15}\) The mean mass of males aged 16 upwards from the Department of Health’s Health Survey of England in 2000 was 81.6 kg, with a standard deviation 14.4 kg. By calculation, the 90th percentile male would be 100.0 kg (81.6 + (1.28*14.4), where 1.28 sd above the mean represents the 90th percentile).
to allow for the degradation in performance associated with team lifting. The group also agreed that a suitable adjustment should be made to the time allowed for the second casualty evacuation in light of the reduction in weight.

**Domestic fire: Salvage**

The scenario involved deploying the 13.5 m ladder, climbing the ladder with various items of equipment such as a branch, roof ladder and tarpaulin, taking a leg lock and using the item of equipment. The individual firefighter who deployed, extended, and climbed the ladder, had the most physically demanding role.

The subtasks in this scenario which were identified as of interest from a physical perspective were the removal of the 13.5 m ladder from the appliance, carrying the ladder, extending the ladder, climbing the ladder with the equipment, and having the confidence to operate at height by taking a leg lock and working hands-free. The group identified additional and unique elements to this task that had not been encompassed in the previous two scenarios and minimum performance standards were agreed on each of the following subtasks:

1. Lift and lower head of ladder to/from appliance to comfortable carrying height (as team of two on head end). Simulate as single person lift/lower with 26 kg lift/lower to/from 1.82 m to/from 0.75 m (carry height) for FRSs using appliances with the 13.5 m ladder without gantry.
2. Extend fully 13.5 m ladder in 20 seconds (or 9 m ladder in 7.5 seconds)
3. Climb 13.5 m ladder to middle of top section carrying roof ladder, take leg lock and hold in both hands roof ladder to the side and clear of the 13.5 m ladder (not time critical).

At the subsequent 11 July meeting, the stakeholders accepted the proposed single person simulations proposed, with some modifications. It was agreed that the ladder lift/lower should be validated using both the heaviest/highest primary ladder (ie 13.5 m) both with and without a gantry. Taking into account the correction factors suggested for team handling, this would mean a lift/lower of 26 kg to/from a height of 0.75-1.82 m (13.5 m) if no gantry was present and a lift/lower of 26 kg to/from a height of 0.75-1.50 m if a gantry was fitted.

It was agreed that the ladder extension should be considered in two forms: using both the heaviest primary ladder (13.5 m) operated by a single firefighter as the most demanding option, and either a two-person extension of the 13.5 m ladder or a single person extension of the 10.5 m ladder, whichever was the lighter in use across FRSs.

16 A load of 46 kg was measured at the hand positions (mean height of hands was 1.82 m) just at the point when the ladder is taken off or placed on the gantry on the appliance. The load of 26 kg was calculated as the 46 kg load measured, plus the team handling correction factor, divided by 2 persons, and rounded up.

17 A downward force of 27 kg on the rope was required to hold the weight of ladder in a stationary position. During a slow extension of the ladder mean forces of 41-44 kg and a peak force of 50 kg were recorded. During a moderately paced extension mean forces of 40-46 kg and a peak force of 61 kg was recorded.

18 This height was supplied for LFEPA's new Mercedes appliance, which is not yet in operation, via Bob Hill, FPU & LCEFA.
A ladder extension simulator would need to be used if the two-person 13.5 m extension is more physically demanding than the single person 10.5 m extension. The stakeholders also agreed that body mass could be used to extend the ladder (feet must remain on the ground) and that the use of gloves should be optional. The decision on gloves was later reversed and the wearing of SHOWA No. 310 gloves was specified as mandatory for all.

The need to climb the 13.5 ladder and take a leg lock was also agreed, but the physical strength demands involved using the roof ladder were thought to be subsumed by the previous simulations (LPP carry and casualty rescue). Although it was recognised that it would be extremely unlikely any firefighter would fail the ladder climb and leg lock at the end of initial training, this task needed to be included to justify the inclusion of a “fear of working at height” test.

Road traffic accident
The scenario involved rescuing a casualty from a car that had run off the road and down an embankment, using the power tools to cut off the roof of the car and a stretcher to carry the casualty back on to the road. The subtasks in this scenario that were identified as of interest from a physical perspective were the carrying of the power tools to the vehicle, assembly of the hydraulic cutting/spreading/lifting equipment, the operation of the power tools to release the trapped casualty, and the lifting and carrying of the casualty out of the car and on to the road.

The group identified additional and unique elements within this task that had not been encompassed in the previous three scenarios and minimum performance standards were suggested on each of the following subtasks:

1. Operate the combination cutter/spreader tool either to cut off the two doors or cut through the four pillars on one side of the car. Simulate using mock-up of combi-tool weighing 16.5 kg to make 12 cuts/spreads lasting between 10 and 30 seconds, with 10-15 seconds of ‘rest’ between cuts. Cuts/spreads to be made at six different heights and angles necessitating different postures seen during scenario. Sequence of six cuts/spreads to be repeated twice. Scored as 1-12 points, with 1 point scored for each of the 12 cuts/spreads successfully executed. Precise details to be refined.

2. Assemble a 10-ton Porto-Power unit as quickly as possible. Pieces to be numbered and connections to be colour coded. Assembly diagram to be available, but should not be required. Precise details to be refined.

At the subsequent 11 July meeting, the stakeholders rejected the proposed single person simulation of the first physically demanding task encountered during the RTA (operation of the combi-tool). This decision was based upon the RTA being a multi-person rescue, where the work of operating the combi-tool could easily be shared by handing the tool on. With appropriate operator skill and technique, the physical demands required to use the tool
would be subsumed by those already encountered in the previous simulations (LPP carry, casualty rescue and ladder lift/lower). In addition, the group had never heard reports of trainees struggling with RTA drills. The group agreed to retain the test for manual dexterity at that stage (Porto-Power), and evaluate its use during the pilot study (September 2002).

**Enclosed space search**

An aspect to firefighter operational performance not adequately encompassed within the scenarios outlined previously is that of moving in an enclosed space, while deprived of visual stimuli, and while using BA. Aspects of performance of relevance in this type of scenario are whole body co-ordination and agility. Performance under these conditions also presumes an absence of claustrophobia.

Consequently, OPL proposed to the stakeholders that this aspect of performance be assessed using the IWG proposed BA Run. It was recognized that further consideration needed to be given to refining the proposed minimum acceptable standard on this simulation. At the subsequent 11 July meeting, the stakeholders accepted the proposed use of the BA run for the validation study. Further development work was conducted in July 2003 in Southwark (refer to Workshop 4).

**Relationship with previous physical demands analyses**

This FSC workshop identified the essential physically demanding tasks that all trained firefighters should be able to perform at the end of initial training. It was reassuring to note that these physically demanding tasks were also identified by the three previous sources of data on the physical elements of firefighting in the UK, in the Chelsea, Robens and Lilleshall reports.

The Chelsea report had identified rural fires as being perhaps the most demanding incidents that firefighters attend, while all three reports identified domestic fires as being physically demanding aerobically. The Robens report provided a more detailed analysis of the physically demanding sub-tasks performed within these scenarios. BA operations and hose running were identified as the most aerobically demanding tasks, and casualty evacuations and the material handling tasks (primarily 13.5 m ladders and LPPs) as the most taxing strength-wise. All of these physical sub-tasks are contained within the Rural Fire (water relay) and Domestic Fire (search and rescue and salvage) single-person simulations that were derived at the FSC workshop and these simulations were endorsed by the Steering Group.

The physical demands of RTA incidents were monitored in both the Chelsea and Lilleshall reports, but mistakenly in our view, only the aerobic demands of these incidents were assessed. Hence, neither report identified the RTA as a “physically demanding” scenario. However, taking into consideration the mass of the RTA cutting/spreading equipment, the heights and positions they need to be used in, and the durations they are used for, it appears that RTA incidents can impose significant physical demands on firefighters (muscular strength and muscular endurance). This was confirmed by the firefighters present at both workshops. However, for the reasons stated previously, this simulation was not to be pursued.

The Robens report also supported the need for firefighters to work at height and in confined spaces wearing BA. The ability to work at height was assessed using the roof ladder in the Domestic Fire Salvage scenario. OPL proposed, and the stakeholders endorsed the recommendation that the ability to work in confined spaces would be assessed using the IWG BA run.

4.4 Third Workshop: Fire Service College September 2002

The third workshop was held at the Fire Service College from 23-27 September 2002 and the outcomes were presented to the Steering Group on 14 October 2002. The aims of the workshop were to:

1. Assess the practicalities associated with the possible selection test and job performance criterion test batteries
2. Test the equipment
3. Collect normative data
4. Glean firefighters’ views of the tests
5. Investigate the potential capability to predict performance on the single person simulations from performance scores on the possible selection tests
6. Compare the predictive capability of the ‘content’ and ‘criterion’ tests.

Two batteries of potential selection tests had been designed and assembled by OPL based on an international literature review combined with considerations of the practicalities of using particular test items. The tests were grouped into those designed for content validity (involving similar tasks to those employed in the single person simulations) and those designed for criterion validity (involving gym based ‘fitness’ tests). Twenty three firefighters participated, including six women, seven retained and one firefighter from an ethnic minority group. An expert panel, comprising nominated representatives from the Steering Group were also present to scrutinise events and provide input. An overview of the job performance criteria, the possible content and criterion selection tests are shown in the three respective columns in Table 1.

Table 1: Overview of job performance criteria and possible selection tests

<table>
<thead>
<tr>
<th>Job performance criteria</th>
<th>Possible Content Selection Tests</th>
<th>Possible Criterion Selection Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural – hose drag, hose carry, hose run, equipment carry, LPP carry.</td>
<td>Half distance rural simulation</td>
<td>Height, mass, body composition, handgrip, MSFT, 40cm upright pull</td>
</tr>
<tr>
<td>Domestic – hose drag, casualty carry, crawl, casualty drag</td>
<td>Casualty drag</td>
<td>Height, mass, body composition, handgrip, MSFT, 40cm upright pull, jumps</td>
</tr>
<tr>
<td>Domestic salvage – FEU Ladder Lift, 13.5 m Ladder Extension, Ladder Climb</td>
<td>PS Ladder Lift PS Ladder Extension IWG Ladder Climb</td>
<td>182cm upright push, upright pull, handgrip, body composition</td>
</tr>
<tr>
<td>RTA – Porto-Power Assembly</td>
<td>PortoPower Assembly</td>
<td>Manual dexterity tests</td>
</tr>
<tr>
<td>Confined space</td>
<td>IWG BA Run</td>
<td>Agility, claustrophobia, darkness</td>
</tr>
</tbody>
</table>

Where FEU refers to Fire Experimental Unit, PS refers to PowerSport and MSFT refers to MultiStage Fitness Test.

All of the objectives of the study were met. The practicalities associated with the majority of tests proved satisfactory, as did the test equipment, much of which was in prototype form. Normative data were collected from all participating firefighters providing an insight into the likely performance standards of male and female firefighters on each of the possible selection test items and the job performance criteria. The firefighters provided constructive feedback on each test, and in general the reaction was very positive. When asked their opinion on where an acceptable minimal acceptable performance standard for trained firefighters should be set, the mean response was more stringent than that proposed by the expert panel. This held true for both men and women. For example, the group as a whole suggested a mean standard of 690 seconds (s) on the rural, with the males proposing 679 s and the females 726 s. This compares with the more lenient time proposed by the expert panel time of 780 s.

To quantify and compare the ability of the possible selection tests to predict performance on the job performance criteria a Pearson Product Moment Correlation matrix was prepared. Table A1 in Appendix A shows the rank order relationships between the individual job performance criterion and the strongest individual selection tests. The highest correlation coefficients between the selection tests and job performance criteria.

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24 Note this standard referred to a 4-person carry of the LPP. A single person carry of approximately a quarter of the weight would be easier, and hence the acceptable performance standard was likely to be reduced from this 780 s proposed at that time. Similarly the load of the casualty was reduced from 80 kg to 55 kg on the domestic simulation and the carry replaced by a drag, so the expert panel proposed standard of 4 minutes on this simulation was likely to be reduced.
ranged from 0.62 to 0.96, providing evidence of strong relationships in all but the ladder climb. The content valid tests provided the strongest single predictors for four of the five job performance criteria investigated, but in each case, the advantage was marginal. For example, the rural fire simulation had the strongest relationship with the half rural selection test ($r = 0.907$), but aerobic power in litres per minute as calculated from the MultiStage Fitness Test and body mass was very similar ($r = 0.895$).

Multiple regression equations were also developed (Appendix A, Table A2) where possible to see if the addition of other selection test scores could significantly improve the ability to predict performance on each separate job simulation. These multiple regression equations were limited to either a content or criterion valid approach. Bland and Altman Limits of Agreement\textsuperscript{25} were then calculated for each equation to quantify the ability of the selection tests in combination to predict each job simulation score. The limits of agreement are reported as bias (the difference between the mean job simulation score and the predicted mean selection test score), and the standard deviation of the differences between the measured and predicted job simulation scores (SD) in both absolute (ie the units of the job simulation) and ratio units (ie as a percentage score). The SD of the differences quantifies the error involved in any prediction of job simulation performance based on the selection test variable(s). For example, using a content approach and the half rural simulation to predict performance on the full rural job simulation, we would be 68% sure (1 x SD) that the actual performance time on the full rural simulation would be within 42 s of the predicted score. We could increase our confidence in the prediction to 95% by using 1.96 x SD. Therefore we could be 95% sure that the actual job performance criteria time was within (1.96 x 42) 82 s of the predicted score. By comparing the SDs, we can quantify the impact of each approach (content vs. criterion) or the benefit of additional selection tests scores in the equation in predicting performance on the job performance criteria. Looking at the SD as a ratio or percentage score quantifies how large this prediction error is in relation to the mean score achieved by the firefighters on the job performance criteria. The final column in Table A2 (best) indicates whether the absolute (A) or the ratio (R) limits of agreement are best used to describe each equation.

In summary, the analyses showed that in general the multiple variable equations provided a better prediction than using single test scores. For example, the rural simulation prediction improved from a correlation coefficient of 0.907 to 0.930, the SD was reduced from 42 to 37 seconds with the inclusion of the two predictor tests (Half Rural & PowerSport Ladder Extension) compared to just the Half Rural alone. However, the logic in including these additional variables in the equation is questionable. This small dataset indicated the potential of both the content and criterion valid approach to predict job simulation performance well in all simulations except the Ladder Climb and the Enclosed Space test. As the Ladder Climb test needs to incorporate an element of confidence at heights, it was felt that only a content approach was applicable as a selection test. The relatively weak correlation ($r = 0.619$) between selection test and job simulation was largely due to the test not being performed at best effort (but ‘safe operational pace’) and the variable

time needed to attain the leg-lock on the selection test. Further consideration needed to be given to ascertain whether a time limit, especially on the proposed selection test, was appropriate.

The Enclosed Space Test had no significant correlations with the proposed selection tests, probably due to the highly variable nature of the searching element of both tests when vision was obscured. As this job simulation is aimed, in part, at testing whole body agility, it was felt that this element should be assessed without obscured vision. A final element to test confidence in enclosed dark space also needed to be incorporated in some form. Additional work was identified as being required to establish a relationship between a possible selection test and this job simulation.

Although the criterion based fitness tests performed equally well or in some cases better compared to the content-based selection tests, in predicting some of the job simulation performances, some issues were flagged up by OPL as potential sources of problems if the criterion approach was adopted. For example, although aerobic power (VO2max) was a strong predictor of performance on the rural simulation, the effect of body size on the prediction model could not be ignored. If the MultiStage Fitness Test were to be used as the test of aerobic fitness, applicants of different body sizes would need to achieve different scores on the test. Although this approach is scientifically valid and robust, an applicant, and indeed an employment tribunal, might have difficulty in understanding the concept. By contrast, the content valid approach ‘hides’ the effect of body size.

At a Steering Group meeting on 14 October 2002, OPL presented the case for the adoption of the content valid approach to the development and validation of physical selection tests. The content approach had been shown in this small study to be predictive of the job performance criteria. The approach was preferred by both candidates and serving personnel alike, providing what was perceived to be a useful experience for the applicant. The tests have immediate face validity – that is they are recognised as being related to the role of firefighter. Most importantly, the approach was considered to be more legally defensible. The disadvantages to the content approach were that they were more resource intensive to administer, it was impossible to eliminate all elements of skill from the tests, the tests are harder to standardise, and the risks of injury are greater.

The recommendation for adopting the content approach was endorsed by the Steering Group. The need to conduct further development work to finalise elements of both the proposed selection tests and the job performance criteria, to develop a scoring strategy for both the physical selection tests and the broader selection tests as a whole, and to commence planning for the validation study, was recognised. The Steering Group also approved the convening of a further expert panel to revisit the proposed standards on the job performance criteria, in light of the further technical developments and adjustments to the protocol details (e.g., the reductions in weights of objects). The Group also endorsed the testing of a further cohort of trained female firefighters to gain a better insight into the likely impact that the new tests and standards would have on women.
4.5 Fourth Workshop: Southwark 22 July 2003

Another small expert group convened at Southwark in July 2003, after a nine-month delay in project proceedings due to the period of industrial action by the Service, to resolve some of the technical issues outstanding on some of the proposed selection tests and job performance criteria. These mainly concerned the Enclosed Space and Ladder Extension tests.

Enclosed space test
The group agreed that all trained firefighters should be able to operate under conditions of zero visibility (either through total darkness or dense smoke), in confined spaces (such as in sewer pipes, air-conditioning ducts, bore holes, on ships), whilst under BA, and should be able to move with all of their encumbering equipment (eg PPE, hose line) in a safe and controlled manner. A suitable job simulation for trained firefighters would incorporate all of the above criteria (ie in total darkness, in an enclosed space, with full PPE) and would be safe and pragmatic for administration to relatively large numbers of firefighters at the end of initial training in a standardised fashion. The group re-confirmed that a crawlway along the lines of that proposed by the IWG would be an appropriate way of assessing an individual’s capability to move themselves and their equipment in conditions of darkness and in an enclosed space.

The group discussed many different aspects concerning the crawlway, including the internal and external dimensions, the length and complexity of the route, the appropriateness of any obstacles that were included, whether an object should be carried or dragged, as well as the safety aspects. The group agreed on a modular structure to the crawlway comprising a series of mesh ‘cages’ with dimensions of approximately 80 cm cube. The cages would have quick release walls so that fast access would be possible to anyone in need of assistance during the event. The event should include walking and crawling approximately 25 metres in total, and negotiating a series of eight obstacles. The firefighters would wear full PPE, be under air, and their facemask would be completely obscured allowing no light in. The firefighters would be instructed to follow the route at a safe operational speed. The event would be timed, but scored on a pass/fail basis. An upper acceptable time limit would be agreed by the expert panel when they convened in October.

The group agreed that a suitable selection test for applicant firefighters would incorporate as many of the criteria employed for the criterion performance test as possible, but without those elements that were deemed highly skill dependent. The group felt that given an expanded period for instruction and familiarisation, it would be appropriate to test applicants in the same environment as trained firefighters, albeit without using or carrying Self Contained Breathing Apparatus (SCBA), which was regarded as too skilled. Similarly, the inclusion of a mannequin (or some other object) drag or carry was rejected as being too skilled and unnecessarily adding to the difficulty of the task. Basic competency in being able to move your body and negotiate a route in conditions of darkness and enclosed space was the agreed requirement. The group proposed that applicants be asked firstly to travel...
the length of the crawlway while wearing an unobscured facemask, and then to reverse their travel back through the crawlway with an obscured facemask.

**Ladder extension load**

The dilemma faced here was what to set the load on the PowerSport ladder extension simulator, to reflect the physical demands of extending a 13.5 m ladder. An early report by Stanger\(^\text{26}\) indicated that the force required to extend a 13.5 m ladder was approximately 61 kg\(^\text{27}\) and that this force could be approximated by lifting 12 x 5 kg weights (total simulator weight of 72 kg) on the PowerSport simulator. Earlier work by OPL\(^\text{28}\) indicated that lifting 8 x 5 kg weights (52 kg total simulator weight) would be appropriate as a selection test to predict performance capability on extending the 13.5 m ladder (both tests requiring a force of ~ 42 kg to just start raising the ladder), but subjective reports and best effort times on both events suggested subsequently that this load was too light\(^\text{29}\). A group of 23 firefighters raised the 13.5 m ladder to full extension in 16.6 ± 5.7 s, but raised the simulator to full extension (total simulator load of 52 kg) in 10.5 ± 3.7 s at the third workshop.

During the Southwark workshop the opportunity was taken to make further dynamic and static force measures of seven individuals on both a 13.5 m ladder and LFEPAs new PowerSport simulator. The force required to just raise the simulator carriage for different loads is reported elsewhere\(^\text{30}\). The results re-confirmed that using static force measurements to set the simulator load are inappropriate, as matching the ~42 kg load from the 13.5 m ladder would again result in a simulator load of ~52 kg being chosen. The dynamic peak forces during each downward arm pull while raising the ladder and the simulator with loads of 57-72 kg were also measured. The simulator load of 67 kg (11 x 5 kg weights) matched the peak forces generated whilst raising the ladder. When the simulator was loaded with 72 kg, all firefighters took longer (by 3.1 s or 24%) and all reported the simulator to be harder to extend than the ladder. In conclusion, this work supported the adoption of a simulator load of 62-67 kg on the PowerSport ladder extension simulator to simulate extension of the 13.5 m ladder. Additional work scheduled at the FSC would confirm these conclusions.


\(^{27}\) The correct SI unit of force, where force = mass x gravity is the Newton (N). However, assuming the acceleration due to gravity is constant at 9.81 m.s\(^{-2}\), force will be expressed here in kg for ease of reference.

\(^{28}\) OPL. Summary of London Visit Report. 23/07/02


4.6 Fifth Workshop: Fire Service College  
13-16 October 2003

This workshop, convened at the Fire Service College in October 2003 had two main objectives: to have an expert panel representing the Steering Group scrutinise the revised job simulation protocols and to propose minimum acceptable standards on each; and to assess the likely impact of these standards on trained women firefighters. The first objective was in effect a rerun of the workshop conducted June 2002. A number of small but significant amendments had been made to the protocols which would affect performance on the job performance criteria, so the draft standards proposed previously needed to be revisited. Due to the physiological and biomechanical differences that exist between the genders, women are disadvantaged in the performance of some tasks requiring high levels of aerobic fitness and muscular strength. The extent to which trained women firefighters could meet the proposed standards was seen as an important benchmark, as it would enable the likely adverse impact in women to be estimated. A cohort of female volunteers was invited to participate to address this issue.

The expert panel addressing the first objective had access to nine trained firefighters, five men and four women from six brigades (Manchester, Hampshire, South Yorkshire, Devon, Lincolnshire, and London). One was retained and two were from ethnic minority groups. The small group had a good range of age, experience and body size, providing an ideal ‘spread’ of firefighters to undertake the job performance criteria, while the panel observed and discussed. The second separate sample which was used to address the second objective concerning the impact of the proposed standards on trained female firefighters comprised 19 women firefighters from 11 brigades (London, Surrey, Manchester, Cheshire, Hampshire, Staffordshire, West Yorkshire, Devon, Hereford & Worcestershire, North Wales and South Yorkshire). Seven were retained and one was from an ethnic minority group. Again a good range of age, experience and body size was present.

Both workshops were successful in meeting their objectives. The expert panel succeeded in agreeing proposed standards for all job performance criteria. The proposed Ladder Lift load of 30 kg at the head of the ladder was 4 kg heavier than that proposed previously. The previous load of 26 kg was based on the static forces measured during the lift of a 135 ladder (23.5 kg), plus a 10% team lifting correction factor. However, having tentatively set a load of 26 kg in July 2002, reports from both male and female firefighters from both the June and September workshops in that year suggested that a load of 26 kg on the Ladder Lift Simulator did not adequately reflect the load experienced when lifting the head of the 13.5 m ladder. A 30 kg load corresponded to the mean best estimate of equivalent load by the sample of nine firefighters, suggesting that for this lift the 10% team lift correction factor applied may not have been optimal and that 20% may have been more appropriate.

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31 A 10% correction factor was proposed by OPL, though other expert groups such as the HSE propose a 50% correction factor for team lifting.
The nineteen female firefighters underwent the proposed job performance criteria and achieved scores in all instances. These scores were then assessed relative to the proposed standards. The expert panel’s proposed standards are presented in Table 2.

<table>
<thead>
<tr>
<th>Job Simulation</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ladder Lift</td>
<td>30 kg&lt;sup&gt;32&lt;/sup&gt;</td>
</tr>
<tr>
<td>PortoPower assembly &amp; disassembly</td>
<td>240 s (4 min)</td>
</tr>
<tr>
<td>Ladder Climb</td>
<td>30 s</td>
</tr>
<tr>
<td>Domestic Search &amp; Rescue</td>
<td>240 s (4 min)</td>
</tr>
<tr>
<td>Rural Fire (water relay) Simulation</td>
<td>750 s (12 min 30 s)</td>
</tr>
<tr>
<td>Ladder Extension</td>
<td>25 s</td>
</tr>
<tr>
<td>Enclosed Space</td>
<td>420 s (7 min)</td>
</tr>
</tbody>
</table>

The pass rate among women firefighters ranged from 100% on the Domestic Simulation and Enclosed Space Test to only 37% on the Ladder Climb. Only 21% of the women passed the proposed standards on all of the tests, though the highest failure rate on the Ladder Climb could be explained by procedural shortcomings, and the second highest failure rate on the Rural Simulation might in part be explained by cumulative fatigue. The retained firefighters tended to perform less well on the tests than the wholetime firefighters, with higher failure rates.

In OPL’s opinion pass rates below around 90% are unacceptable in a supposedly trained workforce. By argument, either the standards proposed by the expert panel are unrealistically high or the standard of performance among the women firefighters is unacceptably low. In the case of the Ladder Climb it was our contention that the women paced the event wrongly and many more would have passed had they known the pass score.

Communities and Local Government with advice from the Steering Group must ultimately decide on where the standards should be set. Endorsement of the standards proposed by the expert panel may provide a hurdle to the achievement of recruitment targets for women firefighters. Lowering these standards may compromise operational effectiveness. There being a further opportunity to assess firefighter performance on the job performance criteria, relative to the proposed pass standards, in the forthcoming validation study, the final decision on endorsing the standards was deferred. A technical report detailing this work has been published elsewhere<sup>33</sup>.

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<sup>32</sup> Load at the lifting position, requiring the addition of 12.5 kg to the cradle on the simulator.

4.7 Sixth Workshop: Fire Service College, November 2004

The physical selection test battery was intended to include the single person full extension of a 13.5 m ladder as a job simulation (a physical requirement needed by a trained firefighter), and a single person full extension of the PowerSport ladder extension simulator as a selection test (a physical requirement needed for applicants to be accepted into training). These details were proposed by subject matter experts (SMEs) at previous workshops and endorsed by the Steering Group. However, for several reasons the ladder extension selection test was not included initially in the validation study. These reasons include the limited availability of the PowerSport ladder extension simulator (18 are thought to exist in different FRSs around the country), the fact that it seemingly was no longer commercially available, and due to safety concerns over the absence of a guard around the stacked weights and the resultant potential risk of trapping fingers.

There were also renewed discussions questioning the requirement for a single person extension of the 13.5 m ladder in trained firefighters and therefore the inclusion of this test in its Steering Group-endorsed form, as part of the test battery. Further, the question of which type of gloves should be worn during the ladder extension, and indeed during all the selection tests, still remained unresolved. Hence, there was a need to revisit whether the single person extension of a 13.5 m ladder remained a valid requirement. If it was, there was a need to examine possible alternatives to the use of the PowerSport simulator as a selection test and to set loads that would simulate those involved in a 13.5 m ladder extension.

Another expert panel were therefore convened at the Fire Service College on 22 November 2004. The objectives for this workshop were six fold.

1. The panel to assess the suitability of a range of working gloves for ladder extension and PortoPower assembly and to make a recommendation as to which gloves to adopt.
2. The panel to decide the ‘reasonable worst case scenario’ requirements of trained firefighters for the extension of a 13.5 m ladder (one person vs. two person event; distance of extension).
3. The panel to agree a minimal acceptable standard (duration) to complete the agreed ladder extension job simulation.
4. All present to evaluate the Tallescope aluminium work platform as a suitable alternative to the PowerSport ladder extension simulator.
5. OPL to measure the forces needed to extend the Tallescope aluminium work platform.
6. OPL to calculate the additional load needed on the Tallescope aluminium work platform to simulate the load encountered during extension of a 13.5 m ladder and recommend a selection test protocol.
After trialling a number of different pairs of gloves assembled by the Fire Experimental Unit, the panel agreed that the SHOWA No. 310 gloves offered the best combination of grip and ‘feel’ for both the ladder extension and the PortoPower assembly.

After considerable discussion, the panel agreed the following ‘reasonable worst case scenario’ as a requirement for trained firefighters for extension of a 13.5 m ladder:

- One person to extend the 13.5 m ladder one storey (estimated as extending the ladder from the 1st to the 9th pawl)
- The start and end point of the job simulation test should be with the pawls engaged
- Twelve seconds is a suitable minimum acceptable standard for trained firefighters.

The force needed to just initiate movement of a 13.5 m ladder was verified (static force), and values of 46 and 47 kg were recorded. These compare to a value of ~42 kg recorded previously by OPL. Slight differences between ladders can be expected due to the varying degrees of resistance on the ladders associated with age, condition and maintenance of the parts.

Static and dynamic forces were also measured on the Tallescope aluminium work platform, using two subjects and a range of additional weights on the ladder (0-30 kg). It was found that a load of 30 kg added to the Tallescope aluminium work platform best approximated the forces required to extend the 13.5 m ladder (ie, ~50 kg static force and ~68 kg dynamic force). Static and dynamic forces measured on the Tallescope with 30 kg added load were very comparable to static and dynamic forces measured on the PowerSport ladder extension simulator set at a total load of 62-67 kg. A number of trials were attempted by members of the panel and their comments were noted. A full description of these findings has been reported elsewhere\(^3\).

1. The following conclusions and recommendations were made to the Steering Group at a meeting held on 25 February 2005:
2. The 13.5 m ladder extension should remain as a single-person requirement but for a reduced extension distance.
3. The standard required for trained firefighters is to extend the ladder from the 1st to the 9th round in 12 seconds.
4. The Tallescope aluminium work platform loaded with 30 kg, and the PowerSport simulator set at the 10th pin hole, should both be incorporated as potential selection tests, affording FRSs a choice of selection test equipment.
5. The ladder extension tests should be incorporated in the Pilot Study 2 currently being conducted and in the proposed validation study on 75 trained firefighters, at the earliest opportunity.

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6. Modifications to the Tallescope line – to match the composition and size of that used on the 13.5 m ladder – should be carried out.

The Steering Group endorsed the recommendations, but proposed an additional clause that both the ladder lift and ladder extension requirements should not be mandatory for all FRSs. At that time it was suggested that FRSs which could demonstrate that lifting a 13.5 m ladder on to an appliance was not necessary due to the presence of gantries on their appliances, and those FRSs which did not require a single person extension of the 13.5 m ladder to be performed in any circumstances\(^{35}\), could opt out of these two test items. However, this proposal was later withdrawn by the Steering Group on 28 April 2005. Two major reasons were cited. First, was the desire to retain common standards for all firefighters across the country. Second, while the specific need in some services to lift and extend ladders may be avoided by ergonomic or procedural modifications, there remained other tasks (such as under-running a 135 ladder), which continued to be performed and required similar levels of exertion.

4.8 Seventh Workshop: Fire Service College, 9-10 June 2005

This workshop was convened following the issuing of a draft report by OPL\(^{36}\) and a presentation to the Steering Group on 28 April 2005, which outlined the theoretical impact on both trainee and trained firefighters of the criterion performance standards proposed by a previous expert panel and presented in Table 2. The theoretical ‘failure’ rate of 19\% for trainees at the end of initial training (18\% in males; 30\% in females), and 34\% for trained firefighters (23\% in males; 53\% in females) reported by OPL was the driver for this additional workshop. It seemed that either the standards expected of trained firefighters was unrealistically high, or that performance standards in these groups were unacceptably low.

This workshop reconsidered the performance standards proposed by former expert panels and the NFST Steering Group on the seven criterion performance tests. The workshop’s objective was again to define minimal acceptable standards of performance that were commensurate with operational effectiveness for all trained firefighters on each of the tests.

The expert panel, nominated by the ODPM, comprised Milo Bodrozic representing the former Implementation Working Group, Jan Ozimkowski representing HMFSI, Allan Hughes representing CFOA, Richard Stevenson representing FireFit, Lorraine Moore from Bedfordshire FRS, Paul Hayles representing the HR Modernisation Team, and Paul Woolstenholmes and Kerry Baigent representing the FBU. Also present to contribute to the discussions were Dr Steve Cole, Human Factors advisor to the ODPM, Edwin Wilson from the Fire Service College, and John Johnstone and Gill McManus from the ODPM. Mark Rayson from OPL facilitated the meeting.

\(^{35}\) Pitching the ladder over an obstacle using a crew of 4 necessitates a single person extension of the 135 ladder.

The expert panel had access to six trained firefighters who undertook the criterion performance tests, comprising four men and two women, from Manchester, London and Gloucestershire FRSs. They ranged in age from 32 to 49 years, and had between three and 25 years of experience. All were whole-time and one was from an ethnic minority.

Following an overview of the work done to date, the approach taken was for the panel to observe the firefighters undertaking the criterion performance tests, to participate in the criterion performance tests, and to discuss what would constitute a minimum acceptable standard of performance. Views of former expert panels were considered, as were normative data on cohorts of trainees and trained firefighters (see section 5). The event culminated in the expert panel being asked to provide both their individual recommended minimum acceptable standard of performance on each criterion performance test, and to cast their vote on the most commonly proposed standards.

The workshop was successful in meeting its objective. The previously-proposed standards on four of the criterion performance tests were reconfirmed (PortoPower Assembly; Domestic; Ladder Extension; Enclosed Space), whilst those on the remaining three were lowered (Ladder Climb; Rural; Ladder Extension). The proposed revisions to the standards are shown in Table 3. Standards proposed by the individual panel members are provided in Appendix A, Table A3.

In the criterion performance tests where standards were lowered, the panel felt that the previously proposed standards were unnecessarily onerous. The Ladder Climb was regarded as a safety-critical task that should not be rushed. While the previously proposed 30 second standard represented a typical operational pace, it was considered to be too fast as a minimum acceptable standard. A standard of 40 seconds was unanimously agreed as more appropriate.

Regarding the Rural criterion performance test, the panel varied in their opinions as to what constituted an acceptable pace, with proposed standards ranging from 12 minutes 30 seconds to 13 minutes 30 seconds. In a vote by expert panel members, a small majority (four of seven) voted for 13 minutes.

The Ladder Extension standard, formerly proposed at 12 seconds, was universally regarded by the panel as unnecessarily onerous. A unanimous vote for 14 seconds was recorded as being more appropriate.

Additional discussions were had regarding other aspects of the criterion performance tests. While most of these points were outside the scope of the panel’s brief, they merit mention and in some cases specific recommendations to overcome the issue were made.

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37 The FBU representatives abstained from this vote as they considered the 13.5 m Ladder Extension – on which the test is based – to be a 2-person task.
The first concerned the debate over whether the Ladder Extension criterion performance test, which simulates a single person extension of the 13.5 m ladder from the second to the third storey, is a valid requirement of all firefighters. The argument for its retention is based upon a four-person crew extending the ladder with ‘props to face’. Although, the Training Manual does describe a four-person extension drill, it specifies that two firefighters extend the line, while one foots the ladder and the other secures both props. The Communities and Local Government team will pursue the rationale for retaining this test as a single person requirement. Should Communities and Local Government establish that this task is a two-person requirement, alternatives for modifying this selection test include halving, approximately, the resistive load on the ladder extension simulators or matching the force requirements to that of a single person extension of a 9 m ladder instead. Earlier pilot work by OPL established that the static force required to initiate movement with the 9 m ladder was approximately 28 kg, while mean forces during an extension were approximately 45 kg. This compares to forces of 42 kg and 57-72 kg, respectively on the 13.5 m ladder, the 9 m ladder forces equating to around 60-70% of the forces exerted on the 13.5 m ladder.

The second concerned the Ladder Lift test and its requirement to restrict the lifting position to the end of the simulated ladder requiring the individual to raise the hands to a mean height of approximately 1.82 metres, thereby penalising individuals of shorter stature. A modification to the protocol was proposed which would enable the lifter to move along the ladder, requiring them to lift proportionally greater load to a lower absolute height. This technique would still ensure the head of the ladder could be lifted to approximately 2 m height, equivalent to the height required to load the ladder onto an appliance that was not fitted with a gantry or lowered suspension system. This flexibility in the way the test was administered would also better reflect the latitude that would be possible when under-running the ladder; under-running being a further rationale for retaining this test. The panel recommended the term ‘Ladder Handling’ be used in lieu of Ladder Lift, to reflect its association with both ladder lifting and ladder under-running.

### Table 3: Revised proposed standards for trained firefighters on the job performance criteria

<table>
<thead>
<tr>
<th>Job Simulation</th>
<th>Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ladder Handling</td>
<td>30 kg</td>
</tr>
<tr>
<td>PortoPower assembly &amp; disassembly</td>
<td>240 s (4 min)</td>
</tr>
<tr>
<td>Ladder Climb</td>
<td>40 s</td>
</tr>
<tr>
<td>Domestic Search &amp; Rescue</td>
<td>240 s (4 min)</td>
</tr>
<tr>
<td>Rural Fire (water relay) Simulation</td>
<td>780 s (13 min)</td>
</tr>
<tr>
<td>Ladder Extension</td>
<td>14 s</td>
</tr>
<tr>
<td>Enclosed Space</td>
<td>420 s (7 min)</td>
</tr>
</tbody>
</table>

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Section Five

Validation study: May 2004 – April 2005 nationwide

5.1 Introduction

Having established the job performance criteria and the potential battery of selection test, the next phase of the project was to establish the relationships between selection test and job performance criteria and to validate those relationships in representative personnel. Standards on the selection tests could also then be set. Ideally this study would have entailed testing candidates on the selection tests at the time of application to the service, and testing them on the job performance criteria at the end of initial training immediately prior to their deployment on operational duty. However, the attrition rates between application and successful completion of training was high and untenable, so trainees were recruited for the study instead. A shortfall in the target numbers of female firefighters and those from ethnic minorities necessitated recruiting and testing an additional cohort of trained firefighters to boost the numbers for the statistical analysis.

5.2 Approach

The trainee firefighter data collection took place between 20 May 2004 and 30 March 2005. Each firefighter was tested at their or another Fire and Rescue Service (FRS) during their initial training period. All participants were briefed on the day of testing by the ODPM data collection team and informed written consent was obtained. Ethics approval for the procedures had previously been obtained from the University of Birmingham, School of Sport and Exercise Sciences, Ethics sub-committee. The trainee firefighters from each FRS were tested on two separate occasions at either end of their initial training. The first occasion involved the performance of the selection tests and occurred during the first few weeks of training. Participant height and weight was also measured during the first visit. The second occasion involved the criterion performance tests and occurred during the latter stages of training.

The selection tests and criterion performance tests were carried out according to the protocols in Appendices 2 (selection tests) and 3 (criterion performance tests). Where possible the participants carried out both the selection tests and the criterion performance tests in the following order:
Development and Validation of National Firefighter Selection Tests: Physical Tests

- Enclosed space test
- Domestic simulation
- Ladder climb
- Ladder extension
- Ladder lift
- PortoPower
- Rural simulation.

The enclosed space test involved the greatest effort setting-up, which was often done the day before the testing or immediately on arrival. The rural simulation was the most physically demanding test and was carried out last to prevent participant fatigue influencing subsequent tests. The test order was not always as stated above due to the need to meet the requirements of the individual FRSs, whose primary objective was to carry out the initial training programme. On some occasions study participants were required to attend lessons, the net result being that the order of the tests had to be altered to coordinate with the FRS.

The trained firefighters participated in the tests as per the trainee firefighters but with two differences. Firstly, all the tests were conducted at the Fire Service College at Moreton-in-Marsh between 9 February and 10 March 2005. Secondly, the administration of the two batteries of tests (selection tests and criterion performance tests) was not separated by a period of firefighter training – the selection tests were conducted on the first day and the criterion performance tests on the next day.

5.3 Statistical analysis

The test results in this report are expressed as mean ± one standard deviation (SD). Comparative analyses between the different cohorts (eg male vs. female, white vs. ethnic minority) were performed using standard parametric statistics (ANOVA and independent sample t-tests) run on Statistical Package for the Social Sciences (SPSS) version 11 for Windows. Post-hoc pair wise comparisons, where relevant, were made using Tukey’s honestly significant differences test. Statistical significance was set a-priori at p<0.05; where p<0.05 indicates the probability that the difference documented occurred by chance is less than 0.05, or 5%. P values of 0.01 and 0.001 indicate significance at the 1% and 0.1%, respectively, indicating progressively increasing degrees of confidence in the differences reported. The terms ‘approaching statistical significance’ or ‘tended’ are used to denote a probability of less than 0.1 or 10%.

Bivariate (paired) correlation analysis was used to compare individual selection tests with each other and individual criterion performance tests with each other. Correlation analysis produces a correlation coefficient (R value). The R can range between 0 and 1, where 1
represents a situation in which one variable shares a perfect relationship with another, and 0 indicates the complete absence of a relationship. This analysis confirms whether the tests are measuring something unique, or whether there is overlap between the tests and by argument whether one or more of the tests are redundant. If the latter scenario occurs there may be statistical grounds to drop one or more of the test battery.

This report gives details of attempts to model (predict) the criterion performance test data from the selection test data and explores whether other participant descriptors (ie age, height, weight, gender, training status, ethnicity etc) contribute or add to the prediction. To predict criterion performance test performance (Section 6), the data for all trainee and trained firefighters (containing a maximum of 158 datasets) were pooled, and analysed using multiple linear regression. The ‘dependent’ (predicted) variable was taken as that recorded for the criterion performance test and all other predictor variables (selection test, gender, ethnicity, etc.) were entered as ‘independent’ (predictor) variables. The preferred model was obtained by a process of ‘backward elimination’. This involves fitting all possible predictor variables and removing the least significant (non-significant) predictor variable one at a time to arrive at the simplest model to predict the criterion performance test performance.

Regression analysis produces an R2 value and an error value (SD). The R2 can range between 0 and 1, where an R2 of 1 represents a situation in which the model perfectly predicts the observed data. Alternatively, an R2 of 0 implies that a unit change in the predictor variable (eg the Rural selection performance time) has no effect on the outcome variable (eg the Rural criterion performance time). If a variable does, to some extent, significantly predict an outcome, then the R2 value should be significantly different from 0. All models reported produced values for R2 that differed significantly from 0 (p<0.05) and as a result the p values are not reported for each individual model.

It was recognised that gender might be a significant predictor of at least several of the criterion performance tests due to the widely accepted gender differences in muscular strength, power and endurance. However, the sample size of females in the trainee dataset was too small (n≤10 for all criterion performance tests) for robust statistical analysis concerning gender to be run. Therefore, the trainee and trained datasets were combined and analysed together. To account for the 12 week training period undertaken by trainees, but not trained firefighters, between the selection and criterion performance tests, a new variable referred to as ‘training status’ (coded as ‘trained’ or ‘trainee’) was included in the regression analysis as a descriptive variable.

Where the total number in the combined data set exceeded 50, the combined data set was randomly split into two groups (both containing some trained and some trainee data). The first group was used to develop a model to predict criterion performance using the backward elimination method described. Initially, in addition to the relevant selection test score, height, weight, gender, ethnic status, and training status were allowed into the equation to derive the best predictive model. The presence of gender or ethnic status in
the equation provides evidence of differential validity, eg the presence of gender in the equation means that a single common equation for males and females is not statistically valid, and a better prediction for both genders can be achieved either via including gender as a predictor variable or by having different equations for the two genders. However, both of these options would result in having differing selection standards for males and females in order to achieve the same criterion performance standard.

As this approach conflicts with the Communities and Local Government's and FRS’s desire for common standards across gender and ethnic group, and may breach current Equal Opportunities legislation, additional models were developed in which only two dependent variables were used – the selection test score and training status (trained or trainee). All models developed were thus both gender- and ethnicity-free.

The second group of data were used to validate the equations developed from the first group using Bland and Altman's Limits of Agreement (1986). Using the standard deviation derived from this method, standards on the selection tests were calculated which afford between 90% confidence (A grade), through 80% confidence (B grade), to 70% confidence (C grade), in passing the relevant criterion performance test.

Where the combined data set comprised less than 50 participants, the whole data set was used to develop the models and Bland Altman Limits of Agreement calculated on this same data set. Thus, in these cases, there was no cross-validation of the models on a separate data set.

5.4 Results and discussion

Trainee firefighter data
In total 137 trainees performed the selection tests from 17 different FRSs. Table 4 shows a breakdown of the trainee cohort who took part in the selection tests and Table A4 in Appendix A shows the breakdown of FRS representation. As is clear from the table the sample is dominated by white, whole-time, male trainees, with female, ethnic minority and retained trainees making up only a small proportion of the total sample, as indeed is the case under current recruitment and selection practices. The ethnicity of the sample is shown in more detail in Table 5. Although each of the ethnic groups is represented, the number in all groups except white is too small to draw conclusions on the effect of individual ethnic group. Discussion in this report has therefore by necessity been restricted to ethnic minorities as a whole, incorporating all ethnic groups other than white.
Table 4: Selection test sample by gender, ethnic and employment status

<table>
<thead>
<tr>
<th>Volunteer Cohort</th>
<th>Sample Size (n)</th>
<th>Sample Size (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Tested</td>
<td>137</td>
<td>100</td>
</tr>
<tr>
<td>Male</td>
<td>127</td>
<td>93</td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Whites</td>
<td>124</td>
<td>91</td>
</tr>
<tr>
<td>Ethnic Minority</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>Whole-time</td>
<td>122</td>
<td>89</td>
</tr>
<tr>
<td>Retained</td>
<td>15</td>
<td>11</td>
</tr>
</tbody>
</table>

This table includes any volunteers who performed one or more of the selection tests other than the Ladder Climb which all trainees had completed during their selection process.

Table 5: Selection test sample by ethnic group

<table>
<thead>
<tr>
<th>Volunteer Cohort</th>
<th>Sample Size (n)</th>
<th>Sample Size (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>124</td>
<td>91</td>
</tr>
<tr>
<td>Asian or Asian British</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Black or black British</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Chinese</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Mixed – white &amp; Asian</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Mixed – white and black</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Participant attrition (due to fatigue, injuries and illness for example) and the alteration of test protocol (namely the Ladder Extension test) prevented the collection of complete selection test data sets for the 137 trainees. The percentage of trainees completing the Rural, Domestic, Ladder Lift, Enclosed Space and PortoPower tests exceeded 95% (132-136 data sets per test). The Ladder Climb test was not carried out as part of the selection test data collection as discussed previously. At the time of the study 120 of 137 trainees tested had successfully completed the Ladder Climb. Significantly less data were collected on the Ladder Extension test. As explained previously (Sections 4.5 and 4.7), the Ladder Extension test protocol was subject to numerous changes during the data collection period. As a result, selection data for two different Ladder Extension tests exist: PowerSport Simulator ($n = 19$) and the Tallescope Platform ($n = 6$).
In total 108 trainees performed the criterion performance tests. Table 6 shows the cohort breakdown by gender, ethnic and employment status. As with the selection tests, the criterion performance sample was dominated by white, whole-time, male trainees, with females and ethnic minorities making up only a small proportion of the sample. None of the retained trainees participated in the criterion performance tests. The ethnicity of the criterion performance sample (CPS) is shown in more detail in Table 7.

<table>
<thead>
<tr>
<th>Volunteer Cohort</th>
<th>Sample Size (n)</th>
<th>Sample Size (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Tested</td>
<td>108</td>
<td>100</td>
</tr>
<tr>
<td>Male</td>
<td>98</td>
<td>91</td>
</tr>
<tr>
<td>Female</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Whites</td>
<td>97</td>
<td>90</td>
</tr>
<tr>
<td>Ethnic Minority</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>Whole-time</td>
<td>108</td>
<td>100</td>
</tr>
<tr>
<td>Retained</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

This table includes any volunteers who performed one or more of the criterion performance tests.

<table>
<thead>
<tr>
<th>Volunteer Cohort</th>
<th>Sample Size (n)</th>
<th>Sample Size (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>97</td>
<td>90</td>
</tr>
<tr>
<td>Asian or Asian British</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Black or black British</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Chinese</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Mixed – white &amp; Asian</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Mixed – white and black</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Similar to the selection tests, participant attrition and inclement weather at the incident ground prevented the collection of complete criterion performance data sets for any of the 108 trainees. The percentage of trainees completing the Domestic, Ladder Lift, Enclosed Space and PortoPower tests exceeded 90% (100-108 data sets per test); the percentage completing the Rural and Ladder Climb tests was 85% (n = 92 and 91, respectively); and the percentage completing the Ladder Extension was 16% (n = 17).
The performance standards on the criterion performance tests for trained firefighters (ie at the end of initial training) are repeated in Table 8.

<table>
<thead>
<tr>
<th>Job Test</th>
<th>Proposed Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ladder Lift</td>
<td>30 kg</td>
</tr>
<tr>
<td>PortoPower assembly &amp; disassembly</td>
<td>240 s (4 min)</td>
</tr>
<tr>
<td>Ladder Climb</td>
<td>40 s</td>
</tr>
<tr>
<td>Domestic Search &amp; Rescue</td>
<td>240 s (4 min)</td>
</tr>
<tr>
<td>Rural Fire (water relay) Test</td>
<td>780 s (13 min)</td>
</tr>
<tr>
<td>Ladder Extension</td>
<td>14 s</td>
</tr>
<tr>
<td>Enclosed Space</td>
<td>420 s (7 min)</td>
</tr>
</tbody>
</table>

Ladder Lift
The Ladder Lift selection test scores and the distribution of scores are shown in Figures 1 and 2. The load is expressed as the total load at the lifter end of the simulator.

Where total refers to all tested trainees (n = 132), M refers to males (n = 122), F refers to females (n = 10), W refers to whites (n = 119), EM refers to ethnic minorities (n = 13), WT refers to whole-time (n = 121) and R refers to retained (n = 11).

The male trainees achieved a significantly higher score than the female trainees (p<0.0001), which may have been expected due to the physical nature of the ladder lift task and the widely recognised gender differences in strength. There were no significant differences between whites and ethnic minorities, nor were there differences between
whole-time and retained trainees. The female cohort showed the greatest spread of scores (Figure 2), whilst the other cohorts had almost no spread with over 90% of trainees achieving the maximum score possible (44 kg)\(^{40}\). As with all the tests, caution should be exerted when drawing conclusions that concern the females, ethnic minorities and retained cohorts due to their relatively small sample sizes. It should also be noted that the proposed latitude in the lifting position proposed by the expert panel in June 2005 (Section 4.8) was not permitted in this study.

![Figure 2: Distribution of the selection ladder lift test scores](image)

The Ladder Lift criterion performance scores and the distribution of scores are shown in Figures 3 and 4.

![Figure 3: Performance scores for the Ladder Lift criterion performance test](image)

\(^{40}\) This test was ‘capped’ for safety reasons.
Where CPS refers to the criterion performance standard proposed by the expert panel, total refers to all tested trainees (n = 108), M refers to males (n = 98), F refers to females (n = 10), W refers to whites (n = 97) and EM refers to ethnic minorities (n = 11). The numbers in white inserted into each of the black bars refer to the number of trainees within that category failing to reach the criterion performance standard.

In total 108 trainees were tested on the criterion performance test and only 1 (1%) did not reach the 30 kg criterion performance standard. As with the selection test, males achieved a significantly greater score compared to females (p<0.001). There was no statistically significant difference between ethnic cohorts (p=0.845). The female cohort displayed the greatest spread of scores, with the majority of all cohorts lying to the right of the criterion performance standard (Figure 4).

![Figure 4: Distribution of the criterion performance ladder lift test scores](image)

Where the dashed vertical line represents the criterion performance standard.

**PortoPower**

The PortoPower selection test times and the distribution of times are shown in Figures 5 and 6.

---

41 Trainees achieving a maximum lift of 28 kg may also have lifted 30 kg but this was not established as the lift increments were in 4 kg. Only those firefighters lifting 32 kg or more definitely attained the criterion performance standard. Therefore, the maximum number of trainees that could have failed the ladder lift criterion performance standard was 1.
Where \( n = 132 \) (Total), 122 (M), 10 (F), 119 (W), 13 (EM), 121 (WT) and 11 (R).

The mean time to complete the PortoPower selection test was 2 minutes and 43 seconds. There were no differences in times between gender, ethnicity or employment status cohorts \((p>0.250)\). The absence of statistical differences between cohorts, especially gender, reflects the physical requirements of the PortoPower test. Unlike the Ladder Lift test, which has a dominant strength component and a concomitant male bias, the PortoPower is a test of manual dexterity and hand eye coordination, and there appears to be no gender difference in the performance of this test. All of the cohorts display a distributed dataset, with the majority of trainees in each cohort scoring between 2.1 and 3.5 minutes.
The PortoPower criterion performance test times and the distribution of times are shown in Figures 7 and 8.

**Figure 7: Performance times for the PortoPower criterion performance test**

[Bar chart showing performance times for different cohorts]

Where $n = 104$ (Total), 94 (M), 10 (F), 93 (W) and 11 (EM).

In total 104 trainees were tested on the criterion performance test and only one (1%) did not achieve a time within the 4 minute criterion performance standard. As with the selection test, there were no significant differences between gender or ethnic cohorts. Each cohort displays a distributed dataset, with the majority in all cohorts lying to the left (pass) of the criterion performance standard (Figure 8).

**Figure 8: Distribution of the PortoPower criterion performance test times**

[Line chart showing distribution of times]
Ladder Climb
One hundred and twenty of the 137 trainees who took part in the selection tests had passed the Ladder Climb test during their initial selection. The remainder were untested.

The Ladder Climb criterion performance test times and the distribution of times are shown in Figures 9 and 10.

Figure 9: Performance times for the Ladder Climb criterion performance test

![Figure 9: Performance times for the Ladder Climb criterion performance test](image)

Where $n = 91$ (Total), 83 (M), 8 (F), 85 (W) and 6 (EM).

In total 91 trainees participated in the criterion performance Ladder Climb test, and all of these achieved a time within the 40 second criterion performance standard. The Ladder Climb test has elements of anaerobic power, agility and confidence of working at heights, but had no noticeable gender or ethnic bias ($p > 0.850$).

Figure 10: Distribution of the Ladder Climb criterion performance test times

![Figure 10: Distribution of the Ladder Climb criterion performance test times](image)
Domestic
The Domestic selection test times and the distribution of times are shown in Figures 11 and 12.

**Figure 11: Performance times for the Domestic selection test**

Where n = 132 (Total), 122 (M), 10 (F), 123 (W), 13 (EM), 121 (WT) and 11 (R).

Males achieved a significantly faster time in the selection test compared to females (p<0.001), a difference of approximately six seconds. This may have been expected due to the physical nature of the Domestic selection test and the widely recognised gender differences in strength and anaerobic power. There were no significant differences between whites and ethnic minorities (p=0.829), but there was a significant difference between whole-time and retained trainees (p<0.001). This difference, equating to a three second faster time in whole-time trainees, may reflect a greater level of manual handling experience and/or anaerobic power of whole-time trainees relative to their retained counterparts. Each cohort has a relatively tight spread of performance times, grouping around the 16-20 or 21-25 second mark (Figure 12).
The Domestic criterion performance test times and the distribution of times are shown in Figures 13 and 14.

Where \( n = 100 \) (Total), 91 (M), 9 (F), 89 (W) and 11 (EM).

In total 100 trainees completed the criterion performance test, and only one (1%) did not attain the 4 minute criterion performance standard. The male cohort achieved a significantly faster performance time compared to the female cohort, a difference equating to approximately 30 seconds \((p<0.0001)\). As with the selection test there was no significant difference between ethnic cohorts \((p=0.828)\). Each cohort has a relatively tight spread of performance times, all grouping around the 2.6-3.0 minute mark, apart from the female cohort which is grouped around the 3.1-3.5 minute mark.
Rural Fire
The Rural selection test times and the distribution of times are shown in Figures 15 and 16. Split times for the test are shown in Table A5 in Appendix A.

Males achieved a significantly faster time in the test compared to females (p<0.05), a difference of approximately 70 seconds. This difference may have been expected due to the physical nature of the test and the widely recognised gender differences in strength and aerobic power. There were no significant differences between white and ethnic minorities (p=0.781), but there was a significant difference between whole-time and
retained trainees (p<0.01). This difference, equating to approximately a 25 second faster time in whole-time trainees, may reflect a greater level of manual handling experience and/or aerobic power of whole-time trainees compared to their retained counterparts. Each cohort has a relatively tight spread of performance times, grouping around the 4.1-5.0 or 5.1-6.0 minute mark (Figure 16).

The Rural criterion performance test times and the distribution of performance times are shown in Figures 17 and 18. Split times are shown in Table A6 in Appendix A.

Where n = 92 (Total), 83 (M), 9 (F), 82 (W) and 10 (EM).
In total 92 trainees completed the criterion performance test, and only two (2\%) did not attain the 13 minute criterion performance standard. The male cohort achieved a significantly faster performance time compared to the female cohort, a difference equating to approximately 2.5 minutes (p<0.001). As with the selection test there was no significant difference between ethnic cohorts (p=0.448). Compared to the selection test performance times, the criterion performance test data display a greater distribution of performance times (Figure 18). The majority of the cohorts (M, W and EM) are grouped around 8.6-10.5 minutes, whilst the females are grouped largely between 9.6-11.5 minutes. This spread of distribution within each cohort is a reflection of the differing level of fitness among the participants.

**Figure 18: Performance times for the rural criterion performance test**

![Figure 18: Performance times for the rural criterion performance test](image)

**Ladder extension**

As described previously, two different protocols for the Ladder Extension selection test were used, and these were introduced only towards the latter end of the data collection period. Due to the small sample sizes collected, the pooled results from all trainees only are reported in Table 9.

**Table 9: Performance times for the ladder extension selection test**

<table>
<thead>
<tr>
<th></th>
<th>PS</th>
<th>TS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Time (sec)</td>
<td>7.6</td>
<td>7.3</td>
</tr>
<tr>
<td>SD</td>
<td>2.3</td>
<td>1.5</td>
</tr>
<tr>
<td>n</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>Gloves worn</td>
<td>SHOWA No. 310</td>
<td>SHOWA No. 310</td>
</tr>
</tbody>
</table>

Where PS to the PowerSport ladder and TS to the Tallescope ladder.
The Ladder Extension criterion performance test times and the distribution of performance times are shown in Figures 19 and 20.

**Figure 19: Performance times for the ladder extension criterion performance test**

![Bar chart showing performance times](chart.png)

Where \( n = 17 \) (Total), 15 (M), 2 (F), 12 (W) and 5 (EM).

In total 17 trainees completed the test, with none failing to attain the 14 second criterion performance standard. The male cohort achieved a faster performance time than the female cohort, a difference of approximately 2.5 seconds.\(^{42}\) A difference may have been expected between genders as the Ladder Extension test requires relatively high levels of strength and power in the arms and upper torso and, if the correct technique is used, the test can favour heavier individuals. There was no significant difference between the ethnic cohorts \((p>0.05)\). All of the cohorts apart from the females show a distribution of performance times grouped largely between four and six seconds (Figure 20). The female cohort is distributed between eight and 10 seconds, although the sample size of two prevents firm conclusions being drawn.

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\(^{42}\) The statistical significance of this difference cannot be ascertained due to the sample size of the female cohort \((n = 2)\).
The CPS at 14 seconds is not shown on Figure 20 as it is off the scale of the x-axis, with all participants passing the standard by a large margin.

**Enclosed Space**
The Enclosed Space selection test performance times for the first half of the test performed with vision, and the distribution of performance times are shown in Figures 21 and 22.

Where \( n = 135 \) (Total), 125 (M), 10 (F), 122 (W), 13 (EM), 122 (WT) and 13 (R).

The mean time to complete the first half of the selection test with vision permitted was approximately one minute. There were no significant differences in time between the gender \( (p=0.299) \) and ethnic cohorts \( (p=0.747) \). However, the times were significantly
slower in the retained compared to the whole-time cohort, a difference of approximately 15 seconds (p<0.0001). This difference may reflect a greater level of training experience and technique of crawling whilst wearing a BA set in whole-time trainees versus their retained counterparts. All of the cohorts display datasets which are not widely distributed, with the majority grouped between 0.6-1.5 minutes (Figure 22).

The mean Enclosed Space selection test performance times for the second half of the test performed with obscured vision and the distribution of performance times are shown in Figures 23 and 24.

Where n = 135 (Total), 125 (M), 10 (F), 122 (W), 13 (EM), 122 (WT) and 13 (R).
A similar story is reported for the vision obscured times, as was reported with the vision permitted times. The mean time to complete the selection test with vision obscured was approximately one minute and 40 seconds. The times did not differ between gender (p=0.395) and ethnic cohorts (p=0.820). However, times were significantly slower in the retained compared to the whole-time cohort, a difference of approximately 15 seconds (p<0.001). Unlike the vision permitted half of the test, each of the cohorts in the vision obscured half produce datasets which are widely distributed (Figure 24).

The Enclosed Space criterion performance test times and the distribution of performance times are shown in Figures 25 and 26.

Where n = 74 (Total), 70 (M), 4 (F), 65 (W) and 19 (EM).
A similar story is reported with the criterion performance test (vision obscured) as was reported with the selection tests. The mean time for the 74 trainees to complete the criterion performance test was approximately three minutes. The times did not differ between gender (p=0.611) or ethnic (p=0.396) cohort. No trainees failed to reach the criterion performance standard, reflecting the deliberately-set conservative standard agreed by the Steering Group. All cohorts display a narrow spread of distribution, grouping primarily around the 2.1-3.0 minute mark and all to the left of the criterion performance standard (Figure 26). As might be expected, the variability in this test under obscured vision conditions was reduced following a training period.

![Figure 26: Distribution of the enclosed space criterion performance test times](image)

5.5 Trainee criterion performance test ‘fail’ rates

The number of trainees that failed to achieve the criterion performance standard on each of the criterion performance tests is summarised in Table 10. Caution should be exercised when drawing conclusions about the fail rates in females and in the ethnic minority groups, as the numbers in each group are very small (n = 1-11).

In the total sample, 4% (four of 108 trainees) failed to achieve the criterion performance standard on one or more of the criterion performance tests, and therefore, by the criteria proposed by the expert panel in June 2005 (Section 4.8), are not fully competent at the end of initial training and would have failed. Of the 615 individual criterion performance tests that were performed by the trainees only five (1%) fell below the proposed criterion performance standards.
In the total sample, the criterion performance test with the highest failure rate is the Rural test, with 2% of trainees failing. 1% or less of trainees failed the remaining tests.

Among the male cohort, only 1% (one of 98 trainees) failed to achieve the criterion performance standard on one or more of the criterion performance tests. Only the Porto Power test was failed by one participant (1%), with the remaining tests having zero fail rates.

Among the female cohort, 30% (three of 10 trainees) failed to achieve the criterion performance standard on one or more of the criterion performance tests. Amongst this small cohort it was the Rural test that resulted in the highest fail rate at 25%, followed by the Domestic at 11% and the Ladder Lift at 10%.

| Table 10: Number of Trainee Firefighters ‘Failing’ the Criterion Performance Tests |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
|                 | Ladder Lift*   | Porto Power    | Ladder Climb    | Domestic        | Rural           | Ladder Extension| Enclosed Space  |
| criterion       | 30 kg          | 4 min          | 40 sec          | 4 min           | 13 min          | 14 sec          | 7 min           |
| performance     |                 |                |                 |                 |                 |                 |                 |
| standard        |                 |                |                 |                 |                 |                 |                 |
| Total           | 1 (108)         | 1 (104)        | 0 (91)          | 1 (100)         | 2 (92)          | 0 (17)          | 0 (103)         |
| Males           | 0 (98)          | 1 (94)         | 0 (83)          | 0 (91)          | 0 (83)          | 0 (15)          | 0 (94)          |
| Females         | 1 (10)          | 0 (10)         | 0 (8)           | 1 (9)           | 2 (8)           | 0 (2)           | 0 (9)           |
| W               | 1 (97)          | 0 (93)         | 0 (85)          | 1 (89)          | 2 (82)          | 0 (12)          | 0 (92)          |
| EM              | 0 (11)          | 1 (11)         | 0 (6)           | 0 (11)          | 0 (10)          | 0 (5)           | 0 (11)          |

Where the numbers in parenthesis refer to the number of trainee firefighters in that specific category.

5.6 Trainee firefighter summary

This study involved administering the proposed selection tests at the start of initial training and the criterion performance tests at the end of initial training on 137 trainees. They comprised 127 males and 10 females, 124 were white and 13 were from ethnic minority groups, and 122 were whole-time and 15 were retained. These trainees had passed the existing selection procedures and therefore were not representative of applicants to the FRS. Caution should therefore be exercised in applying these findings to future applicants.

* Firefighters achieving a maximum lift of 28 kg may also have lifted 30 kg but this was not established as the lift increments were in 4 kg. Only those firefighters lifting 32 kg or more can be certain of attaining the criterion performance standard. Therefore, the maximum number of trained firefighters that could have failed the ladder lift test was 4.
The following conclusions can be drawn:

1. The majority of trainees (96%) were able to meet all seven of the proposed criterion performance standards at the end of initial training. Further, of the 615 individual criterion performance tests that were performed, only five (1%) test scores fell below the proposed criterion performance standards. The high pass rates bode well given that the current selection and training processes within FRSs are not aligned with the job performance criteria agreed during this study.

2. In some of the selection and criterion performance tests, performance by female trainees was not as good as that by male trainees and the proportion of test fails was higher. In total, 1% of males failed one of more of the tests, while this figure was higher in females (30%). However the number of test ‘fails’ overall, and among women in particular, is too few to draw firm conclusions quantifying that adverse impact.

3. All of the female ‘fails’ occurred in those tests that had dominant components of strength and endurance (Rural, Domestic and Ladder Lift), while none occurred in those tests with strong elements of confidence, agility and coordination (Ladder Climb, PortoPower and Enclosed Space). Gender differences in performance scores were also most apparent in these same tests.

4. No differences in performance on any of the selection or criterion performance tests were reported between ethnic cohorts. However, this analysis was limited to comparing whites versus all ethnic minorities, as the numbers of participants from specific ethnic minority groups was too small to allow more detailed analysis.

5. Performance differences were found between whole-time and retained trainees on some tests. Whole-time trainees performed significantly faster on the Rural, Domestic and Enclosed Space selection tests compared to their retained counterparts.

5.7 Trained firefighter data

In total 50 trained firefighters performed both the selection and criterion performance tests and 12 different FRSs were represented. Table 11 shows the cohort breakdown of the trained firefighters who took part in both sets of tests and Table A4 in Appendix A shows the breakdown of FRS representation. As with the trainees, the sample is dominated by white, whole-time, male firefighters. However, unlike the trainee sample, female firefighters had a greater representation in the trained sample (38%). Ethnic minorities and retained firefighters still only contributed a small proportion of the total trained sample. The ethnicity of the sample is shown in more detail in Table 12. As with the trainee data, the representation is too small to draw conclusions concerning each individual ethnic group. Therefore, all analyses were restricted to ethnic minorities as a whole, incorporating all the ethnic groups in Table 12 other than whites.
Table 11: Trained firefighter sample by gender, ethnic and employment status

<table>
<thead>
<tr>
<th>Volunteer Cohort</th>
<th>Sample Size (n)</th>
<th>Sample Size (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Tested</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>Male</td>
<td>31</td>
<td>62</td>
</tr>
<tr>
<td>Female</td>
<td>19</td>
<td>38</td>
</tr>
<tr>
<td>Whites</td>
<td>39</td>
<td>78</td>
</tr>
<tr>
<td>Ethnic Minority</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>Whole-time</td>
<td>44</td>
<td>88</td>
</tr>
<tr>
<td>Retained</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>

Table 12: Trained firefighter sample by ethnic group

<table>
<thead>
<tr>
<th>Volunteer Cohort</th>
<th>Sample Size (n)</th>
<th>Sample Size (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>White</td>
<td>39</td>
<td>78</td>
</tr>
<tr>
<td>Asian or Asian British</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Black or black British</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Chinese</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mixed – white &amp; Asian</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mixed – white and black</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

The number of trained firefighters that failed to achieve the criterion performance standard on each of the criterion performance tests is shown in Table 13. Conclusions cannot be drawn concerning the parity or otherwise of performance between whole-time and retained firefighters due to the small sample of retained (n = 4-6). Similarly conclusions cannot be drawn on performance and fail rates between the different ethnic minority groups, as the numbers in each group are too small (n = 0-6).

Four firefighters (8%) failed to achieve the Ladder Lift standard; three of four of these were female. Interestingly, the percentage of the total trained sample failing the ladder lift test (8%) was greater than the percentage of trainees failing the same test (1%). However, this discrepancy might be explained by greater number of females tested and failing in the trained sample.

All of the trained firefighters achieved the criterion performance standard on the PortoPower test, as was reported with the trainees.

One trained firefighter (3%) failed to achieve the criterion performance standard on the Ladder Climb test; this compares with no trainees failing the same test.
Three trained firefighters failed to achieve the standard on the Domestic test, comprising one male and two females; this compares to only one female trainee. The number of firefighters failing the Domestic test is too small for any conclusions to be drawn.

Seven trained firefighters failed to achieve the standard on the Rural test, all of which were female. The bias in favour of males on the Rural test is a reflection of the physical requirements needed to achieve a fast time, namely muscular strength and aerobic endurance. In the trainee sample, two firefighters failed to achieve the Rural standard (both females). The greater number of trained firefighters failing the Rural test is likely, in part, to be a result of the greater number of trained females tested relative to the number of female trainees.

None of the trained firefighters failed to achieve the standard on the Ladder Extension test; similarly no trainees failed this test.

All trained firefighters achieved the standard on the Enclosed Space test, as was also the case in the trainee study. This result was to be expected as the criterion performance standard reflected a test of confidence rather than physical capability.

In total, of all the criterion performance tests performed by the trained firefighters 5% of scores were below the criterion performance standards. This compares to a value of 1% of scores in the trainees. One factor accounting for the small discrepancy between these ‘fail’ rates was the greater proportion of females tested in the trained study and their greater propensity to fail those tests where muscular strength, power and/or aerobic endurance predominate.

An additional factor which may also be contributing to the difference in fail rates between trained and trainees is the potential drop-off in fitness levels of some trained firefighters that occurs following completion of their initial firefighter training. It has been reported previously that the aerobic fitness and general strength of a group of 40 UK firefighters fell following 18 months of firefighting service compared with their fitness levels immediately after completing initial training (Ellam et al. 1994). The fail rate in trained firefighters reported here suggests that a proportion of incumbent firefighters are unfit to perform the task required of them. The introduction of mandatory regular fitness assessments backed up with role-related fitness training is the obvious way ahead to mitigate the risks inherent in continuing to deploy trained firefighters on operations who by the criterion performance tests are sub-standard.
Table 13: Number of Trained Firefighters Failing the Criterion Performance Tests

<table>
<thead>
<tr>
<th></th>
<th>Ladder Lift</th>
<th>Porto Power</th>
<th>Ladder Climb</th>
<th>Domestic</th>
<th>Rural</th>
<th>Ladder Extension</th>
<th>Enclosed Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>criterion</td>
<td>30 kg</td>
<td>4 min</td>
<td>40 sec</td>
<td>4 min</td>
<td>13 min</td>
<td>14 sec</td>
<td>7 min</td>
</tr>
<tr>
<td>performance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>standard</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>4 (49)</td>
<td>0 (50)</td>
<td>1 (32)</td>
<td>3 (50)</td>
<td>7 (50)</td>
<td>0 (42)</td>
<td>0 (50)</td>
</tr>
<tr>
<td>Males</td>
<td>1 (31)</td>
<td>0 (31)</td>
<td>0 (19)</td>
<td>1 (31)</td>
<td>0 (31)</td>
<td>0 (28)</td>
<td>0 (31)</td>
</tr>
<tr>
<td>Females</td>
<td>3 (18)</td>
<td>0 (19)</td>
<td>1 (13)</td>
<td>2 (19)</td>
<td>7 (19)</td>
<td>0 (14)</td>
<td>0 (19)</td>
</tr>
<tr>
<td>W</td>
<td>3 (38)</td>
<td>0 (39)</td>
<td>1 (27)</td>
<td>3 (39)</td>
<td>5 (39)</td>
<td>0 (33)</td>
<td>0 (39)</td>
</tr>
<tr>
<td>EM</td>
<td>1 (11)</td>
<td>0 (11)</td>
<td>0 (5)</td>
<td>0 (11)</td>
<td>2 (11)</td>
<td>0 (9)</td>
<td>0 (11)</td>
</tr>
<tr>
<td>WT</td>
<td>4 (43)</td>
<td>0 (44)</td>
<td>0 (28)</td>
<td>1 (44)</td>
<td>6 (44)</td>
<td>0 (38)</td>
<td>0 (44)</td>
</tr>
<tr>
<td>R</td>
<td>0 (6)</td>
<td>0 (6)</td>
<td>1 (4)</td>
<td>2 (6)</td>
<td>1 (6)</td>
<td>0 (4)</td>
<td>0 (6)</td>
</tr>
</tbody>
</table>

Where the numbers in parenthesis refer to the total number of firefighters in that specific category.

5.8 Trained firefighter summary

This study involved administering the proposed selection tests and the criterion performance tests on consecutive days to 50 trained firefighters. They comprised 31 males and 19 females, 39 were white and 11 were from ethnic minority groups, and 44 were whole-time and six were retained. The following conclusions can be drawn:

1. The majority (78%) of trained firefighters were able to meet all seven of the proposed criterion performance test standards. In total, of the 323 individual criterion performance tests that were performed in this study only 15 (5%) fell below the criterion performance standards. It is likely that if the criterion performance tests were implemented as regular tests for trained firefighters, the physical capabilities of the least fit one quarter of firefighters would need to improve in order to pass.

2. In some of the selection and criterion performance tests, performance by female firefighters was not as good as that by male firefighters and the proportion of test fails was higher. The fail rate across all tests was approximately 1% in men and 11% in women, indicating adverse impact in women. However the number of fails overall, and among women in particular is too few to draw firm conclusions quantifying that adverse impact.

44 Firefighters achieving a maximum lift of 28 kg may also have lifted 30 kg but this was not established as the lift increments were in 4 kg. Only those firefighters lifting 32 kg or more can be certain of attaining the criterion performance standard. Therefore, the maximum number of trained firefighters that could have failed the ladder lift test was 4.
3. The majority of the female ‘fails’ occurred in the Rural criterion performance test, with 37% of participants failing to achieve the required standard.

4. There was a tendency for a higher proportion of white than ethnic minorities firefighters to fail the Rural and Ladder Climb tests, though the actual number of ‘fails’ was too small to draw any firm conclusions concerning adverse impact in specific ethnic cohorts.

5. The number of retained firefighters was too few to draw any conclusions concerning adverse impact in this group.
Section 6

The inter-relationships between selection tests and criterion performance tests

6.1 Introduction

The seven selection tests were correlated with each other to look for inter-relationships and possible redundancy in the test battery. The correlation matrix showing the output is provided in Table A7 in Appendix A. This analysis did not involve the Ladder Climb as numeric data were not collected on this selection test. The strongest paired correlation was found between the two Ladder Extension selection tests, using the Tallescope and PowerSport protocols ($r = 0.92$), a finding which is not surprising as both are variations of the same test. Both should remain as options in the test battery as they were specifically chosen to offer FRSSs a choice of equipment. The Ladder Lift selection test shared a strong correlation with both the Tallescope selection test ($r = 0.83$) and the PowerSport selection test ($r = 0.68$). However, both correlations are not sufficiently strong to justify the removal of one of the tests from the selection battery. The Rural selection test and the Domestic selection test also had a moderate correlation ($r = 0.57$), which may have been expected due to the strong physical components of both tasks. Again, the correlation is not sufficiently strong to justify the removal of either the Rural or Domestic selection tests.

Six of the criterion performance tests were correlated with each other and the correlation matrix is shown in Table A8 in Appendix A. This analysis did not involve the Ladder Climb criterion performance test as it had not been included in the selection test correlation analysis. In general, the correlations between criterion performance tests were not as statistically strong as the correlations between the selection tests. The strongest correlation was found between the Rural criterion performance test and the Domestic criterion performance test ($r = 0.62$). However, this correlation is not sufficiently strong to remove either as a stand alone test.
6.2 Modelling criterion test performance from selection test performance and other participant descriptors

**Rural Fire**

The multiple regression analysis to predict Rural criterion performance found that gender was not only a significant predictor of performance but also had an interaction effect. This interactive effect means that the genders behaved differently in the relationship between the selection and criterion performance tests ie both the intercepts with the y axis and the gradients of the line were different so a common equation encompassing both genders was statistically invalid (refer to explanatory Figures A1 and A2 in Appendix A). As a result, separate predictive equations were produced for males and females to overcome the differential validity found. To confound matters further, differential validity was also found for ethnic group in the male model, requiring ethnicity to be coded in the equation\(^{45}\).

The statistically strongest model to predict Rural criterion performance in males involved the predictor variables Rural selection test, training status and ethnicity:

\[
\text{Rural criterion performance} = 116 + (1.62 \times \text{Rural selection}) - (23.1 \times \text{training status}) + (24.5 \times \text{ethnicity})
\]

\[R^2 = 0.45; \ SD = 45 \text{ sec}; n = 114\]

Where training status is coded 0 for trained and 1 for trainee and ethnicity is coded 0 for whites and 1 for ethnic minorities.

The \( R^2 \) of 0.45 means that 45% of the variance in the Rural criterion performance is accounted for by this model ie male Rural selection performance, training status and ethnicity combined.

Below is a worked example for a trainee, white male whose time on the Rural selection test was 300 seconds;

\[
\text{Rural criterion performance} = 116 + (1.62 \times 300) - (23.1 \times 1) + (24.5 \times 0)
\]

\[
\text{Rural criterion performance} = 116 + (486) - (23.1) + (0)
\]

\[
\text{Rural criterion performance} = 579 \text{ seconds}
\]

\(^{45}\) It must be noted that the code used for ethnicity in the Rural Fire test predictive equations was inadvertently crude. Although ethnicity was a significant predictor of Rural Fire criterion performance, the sample size was insufficient to describe predictive equations for each separate ethnic group (described in Tables 5, 7 and 12). As a result, all ethnic minority data were pooled under the term ‘ethnic minority’, and analysed together as one single group. All white firefighters were termed ‘white’. 
The statistically strongest model to predict Rural criterion performance in females involved predictor variables Rural selection test and training status:

\[ \text{Rural criterion performance} = -139 + (2.70 \times \text{Rural selection}) - (72.5 \times \text{training status}) \]

\[ R^2 = 0.71; \ SD = 62 \text{ sec}; \ n = 26 \]

Where training status is coded 0 for trained and 1 for trainee.

In females, Rural selection test performance and training status together account for 71% of the variation in Rural criterion performance. Unfortunately, the female ethnic sample size (n = 3) was insufficient to determine the predictive significance of ethnicity.

Given the moral and legal challenges associated with implementing different models for men and women and the differing selection standards that would result, models that were common for men and women and those from different ethnic groups were also derived. The data set was sufficiently large to divide into two groups, formulate the models on the first group and cross-validate on the second group, as described in Section 5.3. The following model to predict Rural criterion performance was produced:

\[ \text{Rural criterion performance} = -149 + (2.638 \times \text{Rural selection}) - (45 \times \text{Training status}) \]

To simplify the model for trainee firefighters the equation can be reduced to:

\[ \text{Trainee Rural criterion performance} = -194 + (2.638 \times \text{Rural selection}) \]

\[ R^2 = 0.68; \ SD = 54 \text{ sec}; \ n = 77 \]

Using the models above, which ignore the differential validity reported for gender and ethnic group, Rural selection test performance and training status account for 68% of the variation in Rural criterion performance. When cross validated with the second data set, a non-significant bias of -0.1 %, and satisfactory 95% Limits of Agreement of 19.4% (n = 64) were found. An example plot of the selection test data (x axis) versus the criterion performance data (y axis) is shown at Figure 27.
Where the dashed horizontal line represents the criterion performance standard and the solid black line represents the linear relationship (n = 141).

**Domestic Fire**
The statistically strongest model to predict Domestic Fire criterion performance involved the predictor variables Domestic Fire selection test and gender. Unlike the Rural model, there was no interactive effect of gender (refer to explanatory Figures A1 and A2 in Appendix A) allowing gender to be encompassed in one predictive model:

\[
\text{Domestic Fire criterion performance} = 128 + (2.37*\text{Domestic selection}) + (16.7*\text{gender})
\]

\[ R^2 = 0.37; \ SD = 19 \text{ sec}; n = 148 \]

Where gender is coded 0 for males and 1 for females.

This model accounts for 37% of the variation in Domestic Fire criterion performance.

For the reasons associated with implementing different models and selection standards for men and women discussed previously, a model that was identical for men and women was also derived. The data set was sufficiently large to divide into two subsets, formulate the models on the first and cross-validate on the second. The following model was produced:

\[
\text{Domestic Fire criterion performance} = 77.4 + (5.423*\text{Domestic selection}) + (53.9*\text{Training Status}) - (3.217*\text{Domestic selection} \times \text{Training Status})
\]
Within this model as well as the Domestic selection test and training status being significant predictors, there was also a significant interaction between the Domestic selection test and training status, requiring the final clause in the equation. To simplify the model for trainees the equation can be reduced to:

\[ \text{Trainee Domestic Fire criterion performance} = 131.3 + (2.206 \times \text{Domestic selection}) \]

\[ R^2 = 0.38; \ SD = 19 \text{ sec}; \ n = 83 \]

These Domestic Fire models, requiring Domestic selection test performance and training status, account for 38% of the variation in Domestic Fire criterion performance. When the model was cross validated with the second data set, a non-significant bias of 1.5% and satisfactory 95% Limits of Agreement of 19.5% were found \( n = 65 \).

**Ladder Lift**

Due to the ceiling effect of both the selection and criterion performance Ladder Lift tests (44 kg for the selection and 56 kg for the criterion performance tests) preventing differentiation between the better performers, all participants who attained the ceiling scores on either test were removed from the regression analysis. This resulted in only those (weaker) participants who reached their maximum score being left in the analysis to predict criterion performance \( n = 23 \). Unfortunately this greatly reduced sample contained insufficient numbers to split the data set, insufficient ethnic minorities to determine the predictive significance of ethnicity, and insufficient numbers of males (two) to explore the effect of gender.

The statistically strongest model to predict Ladder Lift criterion performance involved the variables Ladder Lift selection test and training status (trained or trainee), described by the following equation:

\[ \text{Ladder Lift criterion performance} = -8.6 + (\text{Ladder Lift selection} \times 1.204) + (4.2 \times \text{Training status}) \]

To simplify the model for trainee firefighters the equation can be reduced to:

\[ \text{Trainee Ladder Lift criterion performance} = -4.4 + (1.204 \times \text{Ladder Lift selection}) \]

\[ R^2 = 0.74; \ SD = 3.5 \text{ kg}; \ n = 23 \]

Where training status is coded 0 for trained and 1 for trainees.

Ladder Lift selection test performance with training status accounted for 74% of the variation in Ladder Lift criterion performance. Cross validation was not possible, but a non-significant bias of 0.3% and Limits of Agreement of 19.6% \( n = 23 \) were calculated for the whole dataset.
**Ladder Extension**

Separate equations were developed to take into account the two different Ladder Extension selection tests used. The statistically strongest model to predict Ladder Extension criterion performance from the PowerSport test involved the predictor variables PowerSport selection test, training status and gender:

\[
\text{Ladder Extension criterion performance} = 2.4 + (0.49\times\text{PowerSport selection}) + (1.3\times\text{gender}) - (0.6\times\text{training status})
\]

\[R^2 = 0.76; \ SD = 1.1 \ sec; \ n = 59\]

Where gender is coded 0 for males and 1 for females, and training status is coded 0 for trained and 1 for trainee.

PowerSport selection performance, training status and gender account for 76% of the variation in Ladder Extension criterion performance.

The statistically strongest model to predict Ladder Extension criterion performance from the Tallescope test involved the predictor variables Tallescope selection test and gender:

\[
\text{Ladder Extension criterion performance} = 1.9 + (0.46\times\text{Tallescope selection}) + (1.3\times\text{gender})
\]

\[R^2 = 0.75; \ SD = 1.1 \ sec; \ n = 47\]

Tallescope selection test performance and gender accounted for 76% of the variation in Ladder Extension criterion performance. While training status was not a significant predictor of criterion performance in the Tallescope model, this finding was based upon a relatively small sample size (n = 6), and as a result, caution is required when ruling out training status as a predictive variable.

As with the Ladder Lift, the datasets for the PowerSport and Tallescope tests were too small to split into subsets. The resulting model using the whole sample was:

\[
\text{Ladder Extension criterion performance} = 1.6 + (\text{PowerSport selection}\times0.634) - (0.8\times\text{training status})
\]

To simplify the model for trainee firefighters the equation can be reduced:

\[
\text{Trainee Ladder Extension criterion performance} = 0.79 + (0.634\times\text{PowerSport selection})
\]

\[R^2 = 0.73; \ SD = 1.1 \ sec; \ n = 59\]
Using the models above, PowerSport selection test performance and training status account for 73% of the variation in Ladder Extension criterion performance. Cross validation was not possible, but a non-significant bias of 1.4% and 38.8% Limits of Agreement were calculated for the whole dataset (n = 59).

The following model to predict Ladder Extension criterion performance from the Tallescope selection test was produced:

\[
\text{Ladder Extension criterion performance} = 1.0 + (\text{Tallescope selection} \times 0.595)
\]

\[R^2 = 0.72; \text{SD} = 1.2 \text{ sec}; n = 47\]

The model does not require simplification for trainee firefighters as training status was not a significant predictor. Using the model above, Tallescope selection test performance accounts for 72% of the variation in Ladder Extension criterion performance. Cross validation was not possible, but a bias of 1.3% and Limits of Agreement of 37.7% were calculated for the whole dataset (n = 47).

**PortoPower**

The statistically strongest model to predict PortoPower criterion performance involved the predictor variables PortoPower selection test, training status and gender:

\[
\text{PortoPower criterion performance} = 45.0 + (13.6 \times \text{training status}) + (10.4 \times \text{gender}) + (0.47 \times \text{PortoPower selection})
\]

\[R^2 = 0.52; \text{SD} = 21 \text{ sec}; n = 150\]

Where training status is coded 0 for trained and 1 for trainee and gender is coded 0 for males and 1 for females.

PortoPower selection test performance, training status and gender account for 52% of the variation in PortoPower criterion performance.46

When the data was spilt into two subsets, the following model to predict PortoPower criterion performance was produced:

\[
\text{PortoPower criterion performance} = 48.0 + (0.531 \times \text{PortoPower selection})
\]

\[R^2 = 0.50; \text{SD} = 23 \text{ sec}; n = 86\]

---

46 It should be noted that ethnicity when expressed as separate ethnic groups was a significant predictor of criterion performance. However, this significance was lost when the ethnic groups were coded as white and ethnic minorities. As a result, the true effect of ethnic minorities are not realised in the above predictive equation, highlighting the problems associated with a small sample size.
The model does not require simplification for trainee firefighters as training status was not a significant predictor. Using the model above, PortoPower selection test performance accounts for 50% of the variation in PortoPower criterion performance. When cross validated with the second subset a significant bias of 5.3% was found (p=0.007), while Limits of Agreement were 34.0% (n = 66). The significant bias indicates that the two randomly split groups behaved differently in their response to the PortoPower tests – this should be monitored during the implementation period.

**Enclosed Space**

Initially, the times for the Enclosed Space selection test with vision, Enclosed Space selection with vision obscured, and total time of both combined, were all included in the regression analysis. The results indicated that the total time was a significantly stronger predictor of criterion performance compared to either half of the test alone.

The statistically strongest model to predict Enclosed Space criterion performance involved the predictor variables for the total Enclosed Space selection test and training status:

\[
\text{Enclosed Space criterion performance} = 45.9 + (13.3 \times \text{training status}) + (0.67 \times \text{Enclosed Space selection})
\]

\[R^2 = 0.37; \ SD = 35 \text{ sec}; n = 151\]

Where training status is coded 0 for trained and 1 for trainee.

Enclosed Space selection performance and training status accounted for 37% of the variation in Enclosed Space criterion performance.

When the data set was spilt into two subsets, the following model was produced:

\[
\text{Enclosed Space criterion performance} = 53.85 + (0.675 \times \text{Enclosed Space selection})
\]

\[R^2 = 0.42; \ SD = 35 \text{ sec}; n = 85\]

The model does not require simplification for trainee firefighters as training status was not a significant predictor. Using the model above, Enclosed Space selection test performance accounts for 42% of the variation in Enclosed Space criterion performance\(^{47}\). When cross validated with the second subset of data a non-significant bias of 2% and Limits of Agreement of 57.4% were found (n = 66). The large Limits of Agreement can be explained, in part, by the fact that the Enclosed Space tests are not best effort but primarily a test of confidence and assurance with obscured vision in confined spaces. Speed is therefore not crucial, probably accounting for the greater variations in performance times.

\(^{47}\) This model does not include any rest time between the vision and obscured parts of the Enclosed Space selection. It is recommended that the stopwatch be stopped at the completion of the vision phase, not re-set, but re-started when the firefighter begins the obscured phase.
Section 7

Summary of recommended models

Table 14 lists the models that are recommended for implementation. The Ladder Climb and Ladder Lift have no prediction models associated with them.

<table>
<thead>
<tr>
<th>Criterion Performance Test</th>
<th>Prediction Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>$-194 + (2.638 \times \text{Rural selection})$</td>
</tr>
<tr>
<td>Domestic Fire</td>
<td>$131.3 + (2.206 \times \text{Domestic selection})$</td>
</tr>
<tr>
<td>Ladder Extension</td>
<td>$0.79 + (0.634 \times \text{PowerSport selection}) + (\text{Tallescope selection} \times 0.595)$</td>
</tr>
<tr>
<td>PortoPower</td>
<td>$48.0 + (0.531 \times \text{PortoPower selection})$</td>
</tr>
<tr>
<td>Enclosed Space</td>
<td>$53.85 + (0.675 \times \text{Enclosed Space selection})$</td>
</tr>
</tbody>
</table>
Section 8

Risk management and impact assessment

All selection tests are associated with varying degrees of error and result in the misclassification of a proportion of candidates. It is the responsibility of the scientists and researchers to reduce these errors as far as is practicable by designing valid and reliable tests and procedures, but it is up to the employer to decide what level of confidence they want, and level of risk they are prepared to tolerate, in employing candidates. In deciding the level of confidence/risk to accept the employer must balance the often conflicting desires to optimise the operational effectiveness of employees, to have the most favourable health and safety policies and practises, and to maximise financial efficiency, while embracing the social agenda both within and outside of their organisation. The social agenda within Communities and Local Government and the Local Fire and Rescue Authorities (FRAs) to increase the diversity of the work force is a potent influence that moderates the other three drivers, which individually and collectively influence the employer to raise standards of performance. This is especially so in the arena of physical selection testing, where in general terms, higher levels of performance are associated with enhanced operational effectiveness, improved health and safety, and financial efficiency.

To provide a flexible system that will enable Communities and Local Government and the FRAs to quantify and manage the potential impact on the total numbers of candidates liable to pass the proposed new national selection criteria, we have devised a risk management strategy, based upon the likelihood of candidates being able to meet the required job performance criteria at the end of initial training. These probabilities are based on the empirical data collected during the two studies on trainees and trained firefighters and use the mean responses and the variation in responses (SD and Limits of Agreement) in the samples measured. These data are not ideal as the basis for quantifying the impact of the proposed standards on the numbers of successful applicants, as they are from job incumbents and trainees who are themselves unrepresentative of applicants by having come through the extant selection processes. The participants in this study, especially the trainees, are likely to be fitter and perform to higher standards than are job applicants.

The Risk Management Strategy that we propose for adoption is shown in Table 15. The table shows the proposed predicted standards required on each of the Criterion Performance Test using the criterion performance standards presented in Table 3, Section 4.8, and the selection tests and models presented in Sections 6 and 7 for three given levels of risk. An A Grade standard corresponds to a 90% probability of achieving the required criterion performance test standard at the end of initial training, a B Grade
corresponds to an 80% probability, and a C Grade corresponds to a 70% probability. In effect, Table 15 provides a ‘look-up’ guide depending on the level of risk deemed to be acceptable. Communities and Local Government with advice from the Steering Group and the Practitioner’s Forum must ultimately decide on where the standards should be set. So for example, if it is decided that both the standards on the criterion performance tests proposed by the June 2005 expert panel are appropriate, and a 90% probability of success in trainees was deemed desirable (meaning that 10% or one in 10 candidates who scored at the level of the cut-score or standard would be predicted to fail to reach the CPS at the end of initial training), a standard of 337 seconds on the Rural, 37.4 seconds on the Domestic etc would be set.

Of note are the columns for the Ladder Lift and Ladder Climb. The Ladder Lift scores are calculated by a different method to the remainder. The original model produced a Ladder Lift selection test A Grade standard of 38.6 kg which is 8.6 kg higher than the 30 kg score needed on the criterion performance test. The potentially higher selection test score reflects the fact that while some of the participants scored higher on the criterion performance test than the identical selection test, others performed worse (both trainee and trained). This might be due to poor test-retest reliability or to a sub-optimal training programme which is ineffective at enhancing, or even maintaining lift capability. Thus we propose that the mean change (+0.3 kg) in performance between selection test and job performance test be used as the basis for setting a single selection standard on the Ladder Lift. In practise this means that the 30 kg job performance criteria required at the end of training will also be required at the time of selection. The Ladder Climb selection test, being primarily a test of confidence at height, has no proposed standard. The outcome of the selection tests will be judged to be a success if the task is completed, irrespective of the time taken.

Table 16 shows the percentage of trainee firefighters participating in the validation study that achieved each Grade on each selection test, again assuming that the criterion performance standards proposed in Table 3 at Section 4.8 are deemed appropriate. In the total sample, 91% of trainees achieved an A Grade across all the selection tests with only 9% failing to achieve ‘straight As’. All trainees achieved an A Grade on four of the selection tests: Domestic Fire, Ladder Extension (PowerSport and Tallescope), and Enclosed Space. The Ladder Lift and PortoPower selection tests saw only 1% and 2% of all trainees failing to achieve an A Grade. The Rural selection test had the lowest distribution of grades, perhaps not surprisingly as it is the most physically demanding of the tests. Still 92% achieved an A Grade, with a further 4% achieving a B Grade, and 2% achieving a C Grade. The final 2% fell below the C Grade score.

Represented by gender, 5% of male and 60% of female trainees failed to achieve ‘straight As’ across all the selection tests. It is the rural test that provides the greatest challenge for the women, with 40% achieving an A Grade, 30% B, 10% C, and the remaining 20% failing to achieve an A, B or C Grade.
### Table 15: Standards on the selection tests commensurate with the proposed Risk Management Strategy

<table>
<thead>
<tr>
<th>Grade</th>
<th>Rural (sec)</th>
<th>Domestic (sec)</th>
<th>Ladder Lift (kg)</th>
<th>PowerSport (sec)</th>
<th>Tallescope (sec)</th>
<th>Ladder Climb (sec)</th>
<th>Porto Power (sec)</th>
<th>Enclosed Space (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (90%)</td>
<td>337</td>
<td>37.4</td>
<td>30</td>
<td>16.5</td>
<td>17.4</td>
<td>n/a</td>
<td>283</td>
<td>383</td>
</tr>
<tr>
<td>B (80%)</td>
<td>347</td>
<td>41.3</td>
<td>30</td>
<td>17.9</td>
<td>18.9</td>
<td>n/a</td>
<td>308</td>
<td>433</td>
</tr>
<tr>
<td>C (70%)</td>
<td>356</td>
<td>44.3</td>
<td>30</td>
<td>18.9</td>
<td>20.0</td>
<td>n/a</td>
<td>328</td>
<td>472</td>
</tr>
</tbody>
</table>

### Table 16: Application of the Risk Management Strategy in classifying trainees by Grade

<table>
<thead>
<tr>
<th>% Pass</th>
<th>Cohort</th>
<th>Rural % (n)</th>
<th>Domestic % (n)</th>
<th>Ladder Lift % (n)</th>
<th>PowerSport % (n)</th>
<th>Tallescope % (n)</th>
<th>Ladder Climb % (n)</th>
<th>Porto Power % (n)</th>
<th>Enclosed Space % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>All</td>
<td>92 (136)</td>
<td>100 (132)</td>
<td>99 (132)</td>
<td>100 (19)</td>
<td>100 (6)</td>
<td>p</td>
<td>98 (132)</td>
<td>100 (135)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>96 (126)</td>
<td>100 (122)</td>
<td>100 (122)</td>
<td>100 (17)</td>
<td>100 (6)</td>
<td>p</td>
<td>98 (122)</td>
<td>100 (125)</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>40 (10)</td>
<td>100 (10)</td>
<td>90 (10)</td>
<td>100 (2)</td>
<td>n/a (0)</td>
<td>p</td>
<td>100 (10)</td>
<td>100 (10)</td>
</tr>
<tr>
<td>B</td>
<td>All</td>
<td>4</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
<td>0</td>
<td>p</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>2</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
<td>0</td>
<td>p</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>30</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
<td>n/a</td>
<td>p</td>
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<td>0</td>
</tr>
<tr>
<td>C</td>
<td>All</td>
<td>2</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
<td>0</td>
<td>p</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>2</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
<td>0</td>
<td>p</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>10</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
<td>n/a</td>
<td>p</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>&lt;C</td>
<td>All</td>
<td>2</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
<td>0</td>
<td>p</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>0</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
<td>0</td>
<td>p</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>20</td>
<td>0</td>
<td>n/a</td>
<td>0</td>
<td>n/a</td>
<td>p</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Where the numbers in parenthesis refer to the total number of trainees within that cohort and p refers to a ‘pass’ on the ladder climb selection test. Standards cannot be set for the Tallescope selection test as the number of female trainees that performed the test was zero.
Section 9

Recommendations

Optimal Performance makes the following recommendations:

1. Communities and Local Government and the FRSs replace the various physical selection tests currently in operation with the seven new standardised physical National Firefighter Selection Tests (NFSTs), namely:
   - Rural Fire
   - Domestic Fire
   - Ladder Lift
   - Ladder Extension
   - Ladder Climb
   - PortoPower Assembly
   - Enclosed Space.

2. Selection standards on the tests are finally agreed and set. The level at which the standards are set is dependent upon two factors yet to be decided by ODPM with advice from the Steering Group and Practitioner’s Forum. First, the most recent set of standards on the criterion performance tests proposed by the expert panel in June 2005 must be confirmed, or amended. Second, the desired level of confidence and risk the organisation is willing to take in accepting candidates into training must be decided. In making these decisions, the conflicting desires for optimising operational effectiveness, health and safety and financial efficiency on the one hand, and for supporting the social agenda to diversify the work force on the other, must be balanced.

3. Applicants should be graded by merit according to their performance on the physical tests. These physical grades should be weighted according to the relevance that the physical criteria are afforded relative to the other psycho-social selection criteria. These weighted scores should be used in the final selection of successful candidates in the event that a surplus of candidates achieves the minimum standards required on all test criteria.

4. The test battery should be administered to candidates in its entirety, with feedback provided both on applicants’ performance and if appropriate their training needs.
5. Failure to achieve any of the seven standards would preclude advancement through the subsequent phases of the selection process.

6. An opportunity to retake any failed tests should be provided, ideally on the same day at the end of the test session, unless health and safety criteria dictate otherwise.

7. A minimum period of three months should be enforced between repeating the test battery, to allow time for physical training and physical development.

8. The implementation process should be monitored closely and regularly, and initially, frequent evaluations should be conducted. In practice this means that both the selection test and criterion performance test batteries should be administered and the data collected and analysed in a manner similar to that performed in this report.

9. The likely adverse impact in women should be tracked closely, as should the possible adverse impact in specific minority groups.

10. Positive action should be embraced to encourage the right calibre of candidates from minority groups to apply, and opportunities should be provided to train for and practise the physical selection tests before applicants undertake them in earnest.

11. The initial training programme conducted by FRSs should be audited and where necessary modified, to ensure it reflects individual needs. From a fitness perspective, physical training and operational training should be more specific to the job performance criteria endorsed by the Steering Group.

12. Annual physical assessments should be introduced for serving firefighters to ensure they too meet the job performance criteria defined during this project.
Section 10

Acknowledgements

We would like to acknowledge the contributions made to this project by:

- The ODPM (now Communities and Local Government) for their financial and human support throughout
- All the trainee and trained firefighters, and the training and operational staff who participated in the many workshops and studies that has lead to this final report
- Members of the Steering Group for their advice on direction and endorsement of outcomes from this project
- Paul Hayles and Russell Hocken for their sterling efforts during the execution of the Validation Study
- Jayne Monkhouse and Sue Scott for their steer on equal opportunities issues
- Our friends and colleagues at Water for Fish, formerly Interactive Skills for their project management, advice, support and friendship throughout.
## Appendix A

### Supporting data

#### Results FSC Workshop September 2002

<table>
<thead>
<tr>
<th>Table A1: Rank order relationships between the job performance criteria and possible selection tests</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>OUTPUT/Rank</strong></td>
</tr>
<tr>
<td>-----------------</td>
</tr>
<tr>
<td>Rural</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Domestic</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>FEU Ladder Lift</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>13.5 m Extension</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>13.5 m Climb</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

where ** indicates p<0.01, and * indicates p<0.05.
<table>
<thead>
<tr>
<th>Table A2: Linear and multiple regression equations using both a content and criterion approach for each output test and their associated Limits of Agreement</th>
</tr>
</thead>
<tbody>
<tr>
<td>RURAL Content</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>Half Rural</td>
</tr>
<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.907</td>
</tr>
<tr>
<td>Ratio bias</td>
</tr>
<tr>
<td>42</td>
</tr>
<tr>
<td>Best A/R</td>
</tr>
<tr>
<td>7.6</td>
</tr>
<tr>
<td>RURAL Criterion</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>VO_{2max} (L)</td>
</tr>
<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.895</td>
</tr>
<tr>
<td>Ratio bias</td>
</tr>
<tr>
<td>45</td>
</tr>
<tr>
<td>Best A/R</td>
</tr>
<tr>
<td>8.0</td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>Criterion</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>Casualty Drag</td>
</tr>
<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.878</td>
</tr>
<tr>
<td>Ratio bias</td>
</tr>
<tr>
<td>12</td>
</tr>
<tr>
<td>Best A/R</td>
</tr>
<tr>
<td>7.6</td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>DOMESTIC Content</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>Casualty Drag</td>
</tr>
<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.878</td>
</tr>
<tr>
<td>Ratio bias</td>
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<tr>
<td>12</td>
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<tr>
<td>Best A/R</td>
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<tr>
<td>7.6</td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>Criterion</td>
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<tr>
<td>Single</td>
</tr>
<tr>
<td>VO_{2max} (L)</td>
</tr>
<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.841</td>
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<tr>
<td>Ratio bias</td>
</tr>
<tr>
<td>14</td>
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<tr>
<td>Best A/R</td>
</tr>
<tr>
<td>9.1</td>
</tr>
<tr>
<td>A(r)</td>
</tr>
<tr>
<td>Criterion</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>Fat Free Mass</td>
</tr>
<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.943</td>
</tr>
<tr>
<td>Ratio bias</td>
</tr>
<tr>
<td>33</td>
</tr>
<tr>
<td>Best A/R</td>
</tr>
<tr>
<td>5.6</td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>LADDER LIFT</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>FEU Ladder Lift</td>
</tr>
<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.908</td>
</tr>
<tr>
<td>Ratio bias</td>
</tr>
<tr>
<td>9.3</td>
</tr>
<tr>
<td>Best A/R</td>
</tr>
<tr>
<td>13.7</td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>Criterion</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>40 cm Upright Pull</td>
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<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.838</td>
</tr>
<tr>
<td>Ratio bias</td>
</tr>
<tr>
<td>12.1</td>
</tr>
<tr>
<td>Best A/R</td>
</tr>
<tr>
<td>19.8</td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>Criterion</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>Fat Free Mass</td>
</tr>
<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.956</td>
</tr>
<tr>
<td>Ratio bias</td>
</tr>
<tr>
<td>1.7</td>
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<tr>
<td>Best A/R</td>
</tr>
<tr>
<td>12.0</td>
</tr>
<tr>
<td>A</td>
</tr>
<tr>
<td>Criterion</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>Standing Vertical Jump</td>
</tr>
<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.905</td>
</tr>
<tr>
<td>Ratio bias</td>
</tr>
<tr>
<td>2.4</td>
</tr>
<tr>
<td>Best A/R</td>
</tr>
<tr>
<td>15.9</td>
</tr>
<tr>
<td>R</td>
</tr>
<tr>
<td>LADDER EXTENSION</td>
</tr>
<tr>
<td>Single</td>
</tr>
<tr>
<td>IWG Ladder Climb</td>
</tr>
<tr>
<td>Absolute bias</td>
</tr>
<tr>
<td>0.619</td>
</tr>
<tr>
<td>Ratio bias</td>
</tr>
<tr>
<td>4.0</td>
</tr>
<tr>
<td>Best A/R</td>
</tr>
<tr>
<td>14.5</td>
</tr>
<tr>
<td>R</td>
</tr>
</tbody>
</table>
Table A3: Expert Panel’s recommended minimum operational performance standards on the Criterion Performance Tests

<table>
<thead>
<tr>
<th>Name</th>
<th>Rural Units</th>
<th>Domestic Units</th>
<th>Ladder Handling$^48$</th>
<th>Ladder Extension</th>
<th>Ladder Climb</th>
<th>PortoPower Assembly</th>
<th>Enclosed Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Richard Stevenson</td>
<td>≤ 13.00</td>
<td>4.00</td>
<td>30</td>
<td>14</td>
<td>40</td>
<td>4.00</td>
<td>7.00</td>
</tr>
<tr>
<td>Jan Ozimkowski</td>
<td>13:30</td>
<td>4.00</td>
<td>30</td>
<td>14</td>
<td>40</td>
<td>4.00</td>
<td>7.00</td>
</tr>
<tr>
<td>Paul Hayles</td>
<td>13:30</td>
<td>4.00</td>
<td>30</td>
<td>14</td>
<td>40</td>
<td>4.00</td>
<td>7.00</td>
</tr>
<tr>
<td>Milo Bodrozic</td>
<td>13:00</td>
<td>4.00</td>
<td>30</td>
<td>14</td>
<td>40</td>
<td>4.00</td>
<td>7.00</td>
</tr>
<tr>
<td>Steve Cole</td>
<td>12:30-13:00</td>
<td>4.00</td>
<td>30</td>
<td>14</td>
<td>40</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Allan Hughes</td>
<td>12:30</td>
<td>4.00</td>
<td>30</td>
<td>14</td>
<td>40</td>
<td>4.00</td>
<td>5.00</td>
</tr>
<tr>
<td>Lorraine Moore</td>
<td>13:00</td>
<td>4.00</td>
<td>30</td>
<td>14</td>
<td>40</td>
<td>4.00</td>
<td>7.00</td>
</tr>
<tr>
<td>Paul Woolstenholmes/Kerry Baigent</td>
<td>13:30</td>
<td>4.00</td>
<td>30</td>
<td>abstain</td>
<td>40</td>
<td>4.00</td>
<td>7.00</td>
</tr>
<tr>
<td>Edwin Wilson</td>
<td>13:00</td>
<td>4.00</td>
<td>30</td>
<td>14</td>
<td>40</td>
<td>4.00</td>
<td>7.00</td>
</tr>
</tbody>
</table>

$^48$ Equivalent force at lifting end of ladder (~25 cm from the end of the bar).
<table>
<thead>
<tr>
<th>Fire and Rescue Service</th>
<th>Trainees</th>
<th>Trained Firefighters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bedfordshire</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Cheshire</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Cleveland</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Derbyshire</td>
<td>8</td>
<td>0</td>
</tr>
<tr>
<td>Gloucestershire</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>GMC</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>Hampshire</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Hertfordshire</td>
<td>10</td>
<td>1</td>
</tr>
<tr>
<td>Humber</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Kent</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Lancashire</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Leicestershire</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>London</td>
<td>19</td>
<td>11</td>
</tr>
<tr>
<td>Merseyside</td>
<td>15</td>
<td>6</td>
</tr>
<tr>
<td>North Yorkshire</td>
<td>7</td>
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<tr>
<td>Northern Ireland</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Oxford</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Staffordshire</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Surrey</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Warwickshire</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>West Midlands</td>
<td>17</td>
<td>10</td>
</tr>
<tr>
<td>West Yorkshire</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>137</strong></td>
<td><strong>50</strong></td>
</tr>
</tbody>
</table>
### Table A5: Performance split times in trainees for the Rural selection test

<table>
<thead>
<tr>
<th></th>
<th>Suction Split (min:ss)</th>
<th>LPP Split (min:ss)</th>
<th>Total Time (min:ss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>2:09 (0:15)</td>
<td>3:52 (0:24)</td>
<td>4:55 (0:34)</td>
</tr>
<tr>
<td>Males</td>
<td>2:07 (0:12)</td>
<td>3:49 (0:20)</td>
<td>4:50 (0:25)</td>
</tr>
<tr>
<td>Females</td>
<td>2:37 (0:20)</td>
<td>4:33 (0:32)</td>
<td>5:58 (1:08)</td>
</tr>
<tr>
<td>W</td>
<td>2:09 (0:15)</td>
<td>3:52 (0:24)</td>
<td>4:55 (0:35)</td>
</tr>
<tr>
<td>EM</td>
<td>2:12 (0:13)</td>
<td>3:55 (0:21)</td>
<td>4:58 (0:26)</td>
</tr>
<tr>
<td>WT</td>
<td>2:08 (0:15)</td>
<td>3:50 (0:24)</td>
<td>4:53 (0:35)</td>
</tr>
<tr>
<td>R</td>
<td>2:16 (0:11)</td>
<td>4:08 (0:18)</td>
<td>5:16 (0:22)</td>
</tr>
</tbody>
</table>

Where the numbers in parenthesis refer to 1 SD of the mean and LPP refers to the light portable pump.

### Table A6: Performance split times in trainees for the Rural criterion performance test

<table>
<thead>
<tr>
<th></th>
<th>Suction Split (min:ss)</th>
<th>LPP Split (min:ss)</th>
<th>Total Time (min:ss)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>4:17 (0:40)</td>
<td>7:27 (0:58)</td>
<td>9:32 (1:12)</td>
</tr>
<tr>
<td>Males</td>
<td>4:10 (0:27)</td>
<td>7:16 (0:40)</td>
<td>9:20 (0:54)</td>
</tr>
<tr>
<td>Females</td>
<td>5:29 (1:07)</td>
<td>9:11 (1:34)</td>
<td>11:40 (1:47)</td>
</tr>
<tr>
<td>W</td>
<td>4:16 (0:41)</td>
<td>7:26 (1:00)</td>
<td>9:31 (1:13)</td>
</tr>
<tr>
<td>EM</td>
<td>4:25 (0:31)</td>
<td>7:35 (0:45)</td>
<td>9:47 (0:59)</td>
</tr>
</tbody>
</table>

Where the numbers in parenthesis refer to 1 SD of the mean and LPP refers to the light portable pump.

### Table A7: Correlation matrix for the selection tests

<table>
<thead>
<tr>
<th></th>
<th>Rural</th>
<th>Domestic</th>
<th>PortoPower</th>
<th>Enclosed Space</th>
<th>Ladder Lift</th>
<th>Tallescope</th>
<th>PowerSport</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>1</td>
<td>0.568**</td>
<td>0.242**</td>
<td>0.336**</td>
<td>-0.506*</td>
<td>0.565**</td>
<td>0.515**</td>
</tr>
<tr>
<td>Domestic</td>
<td>0.568**</td>
<td>1</td>
<td>0.153*</td>
<td>0.278**</td>
<td>-0.555**</td>
<td>0.522**</td>
<td>0.524**</td>
</tr>
<tr>
<td>PortoPower</td>
<td>0.242**</td>
<td>0.153*</td>
<td>1</td>
<td>0.201**</td>
<td>-0.456*</td>
<td>0.418**</td>
<td>0.502**</td>
</tr>
<tr>
<td>Enclosed</td>
<td>0.336**</td>
<td>0.278**</td>
<td>0.201**</td>
<td>1</td>
<td>-0.159</td>
<td>0.170</td>
<td>0.132</td>
</tr>
<tr>
<td>Lift</td>
<td>-0.506*</td>
<td>-0.555**</td>
<td>-0.456*</td>
<td>-0.159</td>
<td>1</td>
<td>-0.829**</td>
<td>-0.681**</td>
</tr>
<tr>
<td>Tallescope</td>
<td>0.565**</td>
<td>0.522**</td>
<td>0.418**</td>
<td>0.170</td>
<td>-0.829**</td>
<td>1</td>
<td>0.921**</td>
</tr>
<tr>
<td>PowerSport</td>
<td>0.515**</td>
<td>0.524**</td>
<td>0.502**</td>
<td>0.132</td>
<td>-0.681**</td>
<td>0.921**</td>
<td>1</td>
</tr>
</tbody>
</table>

** Correlation significant at the 0.01 level, * correlation significant at the 0.05 level.
Table A8: Correlation matrix for the criterion performance tests

<table>
<thead>
<tr>
<th></th>
<th>Rural</th>
<th>Domestic</th>
<th>PortoPower</th>
<th>Enclosed Space</th>
<th>Ladder Lift</th>
<th>Ladder Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural</td>
<td>1</td>
<td>0.615**</td>
<td>0.140</td>
<td>0.156</td>
<td>-0.364</td>
<td>0.128</td>
</tr>
<tr>
<td>Domestic</td>
<td>0.615**</td>
<td>1</td>
<td>0.251**</td>
<td>0.229**</td>
<td>-0.546**</td>
<td>0.131</td>
</tr>
<tr>
<td>PortoPower</td>
<td>0.140</td>
<td>0.251**</td>
<td>1</td>
<td>0.243**</td>
<td>-0.374</td>
<td>0.501**</td>
</tr>
<tr>
<td>Enclosed Space</td>
<td>0.156</td>
<td>0.229**</td>
<td>0.243**</td>
<td>1</td>
<td>-0.251</td>
<td>0.185</td>
</tr>
<tr>
<td>Ladder Lift</td>
<td>-0.364</td>
<td>-0.546**</td>
<td>-0.374</td>
<td>-0.251</td>
<td>1</td>
<td>0.051</td>
</tr>
<tr>
<td>Ladder Extension</td>
<td>0.128</td>
<td>0.131</td>
<td>0.501**</td>
<td>0.185</td>
<td>-0.139</td>
<td>1</td>
</tr>
</tbody>
</table>

** Correlation significant at the 0.01 level.

Figure A1: Rural test displaying an effect of gender and a gender interaction

The different intercept points on the y axis of Figure A1 (approximately 116 for males and -211 for females) indicates that there exists a significant effect of gender ie for any given Rural selection time males and females will achieve a different Rural criterion performance time. Furthermore, the different gradient of male and female slopes (female being the steeper) indicates that there was a significant gender interaction ie the genders behaved differently in the relationship between the selection and criterion performance tests.
The different intercept point on the y axis of Figure A2 once again indicates a significant gender effect in prediction of Domestic criterion performance. However, the identical male and female gradients indicate the absence of a gender interaction.
Appendix B

Selection test protocols

Rural Fire selection test

<table>
<thead>
<tr>
<th>Test Description:</th>
<th>Rural Fire Single Person Simulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute(s) to be Measured:</td>
<td>Firefighter Rural Firefighting Ability</td>
</tr>
<tr>
<td>Test to be Performed:</td>
<td>Candidate (performing along a 25 m shuttle) to drag a hose reel from the appliance for 25 m, jog back 25 m, pick and carry 2 x 70 mm coiled hoses dropping them at 100 m, run out the one dropped hoses (25 m), jog back 75 m to appliance, Pick up and carry 100 mm suction hose and basket 100 m, jog back 100 m to appliance, pick up and carry LPP simulator 100 m</td>
</tr>
</tbody>
</table>

Conditions Required for Testing

- Resource/Equipment Requirements:
  - Appliance with > 25 m hose reel
  - 2 x 70 mm hose (all to remain coiled) (~15 kg)
  - 100 mm suction hose
  - Suction basket
  - LPP simulator
  - Use LPP bar with 1 x 5 kg and 3 x 2.5 kg weights + 2 safety pins + 2 spring clips at each end (~32.9kg)
  - Stopwatch
  - Tape measure
  - Marker cones
  - Straight 25 m of flat tarmac/ concrete area
  - Full fire gear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
  - Schedule of Events
  - PES Input Result Sheet
  - Practical aptitude test administrator’s guidance document.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification
Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- Emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- Emergency first aid kit and resuscitation equipment
- Course is free from obstacles/slip hazards
- Personal protective equipment suitable for the task
- Affirmation that candidates have had time to warm-up/stretch
- Affirmation of candidate’s physical readiness to proceed with test.

Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- To explain to the candidate(s) the purpose of the test and what attribute is being measured
- To detail the test safety points in respect of the correct method of carrying the 70 mm hose, 100 mm suction hose and basket and LPP simulator
- To invite candidates to familiarise themselves with the route and the mass of the equipment
- To detail the measure of acceptable performance – Not applicable yet
- To invite questions from the candidate(s) and address these accordingly
- To ascertain whether the candidate wishes to proceed with the test
- To instruct the candidate to proceed if they wish to do so
- To withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:

Time: Candidate to attempt to complete the course in the fastest possible time

Test brief

- Carry out a risk assessment of the area and equipment.
- Ensure candidates are physically fit enough to undertake the test.
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that simulates setting up a water relay for use on a rural or grassland fire scenario.”

Explain what is being tested by saying

“To complete the test successfully you will need to combine endurance, upper and lower body strength and co-ordination to complete the test as quickly as possible.”
Describe the test by saying

“Start level with the first cone (indicate first/start cone). The second cone is 25 m from the start point (indicate second cone). Drag the hose reel off the drum 25 m to the second cone and put it down (spare firefighter to stop over-run of hose off drum). Jog back 25 m to the start cone (indicate start cone). Pick up and carry (NO ARMS THROUGH THE HOSE) two secured 70 mm coiled hoses (indicate 2 secured 70 mm hoses) back and forth along the 25 m route, dropping one hose at 100 m (indicate the start cone). With the other hose, simulate running out a 70 mm hose (by carrying it at shoulder height) towards the second cone (indicate the second cone). Place the reel down. Jog back 75 m to the start cone (indicate the start cone) following the 25 m route. Pick up and carry the 100 mm suction hose and basket 100 m along the 25 m route. Place them down at the start cone and jog 100 m back to the start cone along the 25 m route. Pick up and carry the light portable pump (LPP) simulator 100 m along the 25 m route back to the start cone (indicate the start cone). You must adopt a front carrying position only (not by your side) using a hand grip (no resting on forearms). You may rest the LPP at any time, but you must put the LPP on the ground before resting or changing grip. You will be reminded of the sequence of each task and where they start and finish by the assessor as the test progresses. You must not run while carrying equipment, but may walk, jog or run when not carrying equipment if desired. You may rest during the test at any time, but remember the test is timed.”

• Demonstrate the test (not over the full distance).
• Emphasise the correct techniques (hose drag, carrying the hose, suction hose and LPP, running hose).
• Call each candidate forward to carry out the test once they have warmed up.
• Confirm that the candidate has understood the instruction by saying: “Do you understand the test? Do you have any questions?”
• Instruct the candidate to practise their techniques.
• Continue with the test by saying: “You will now carry out the test. Are you ready to start? 3, 2, 1 GO.”
• Start the stopwatch. Encourage eg “doing well” every 30 seconds to give the candidate confidence
• Record the time, rounded to the nearest second eq 4:31 minutes.
Domestic Fire selection test

Test Description: 30 m Casualty Drag

Attribute(s) to be Measured: Upper body/ back/ leg Strength

Test to be Performed: Candidate to drag a 55 kg casualty (using a two hand grip on the neck handle walking backwards whilst guided by the assessor) around a 30 m course (10 m turn left 90°, 10 m turn left 90°, 10 m) in the fastest possible time

Conditions Required for Testing

Resource/Equipment Requirements:

- 55 kg casualty
- Stopwatch
- Tape measure
- Marker cones
- 15 m² flat tarmac/ concrete area
- Full fire gear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Schedule of Events
- PES Input Result Sheet
- Practical aptitude test administrator's guidance document.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator's qualification.

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- emergency first aid kit and resuscitation equipment
- course is free from obstacles/slip hazards
- personal protective equipment suitable for the task
- affirmation that candidates have had time to warm-up/stretch
- affirmation of candidate’s physical readiness to proceed with test.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points in respect of the correct method of lifting/ dragging the casualty
- to describe the test activity whilst the safety officer demonstrates the test
- to invite candidates to familiarise themselves with the mass of the casualty
- to detail the measure of acceptable performance – Not applicable yet
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:

Time: Candidate to attempt to carry/ drag the 55 kg casualty around the 30 m course in the fastest possible time

Test brief

- Carry out a risk assessment of the area and equipment.
- Ensure candidates are physically fit enough to undertake the test.
- Brief the candidates as follows:

Explain the purpose of the test by saying:

“You are about to carry out a test that simulates dragging a 55 kg casualty over 30 minutes. This mass represents half the load for a two person drag that would cover 90% of the UK population”.

Explain what is being tested by saying:

“To complete the test successfully you will need to combine upper and lower body strength and co-ordination and complete the drag as quickly as possible.”
Describe the test by saying

“Firmly grasp the 55 kg casualty (indicate the 55 kg casualty) by the carrying handle situated below the back of the neck with both hands. Keeping your body as upright as possible and back straight, drag the casualty backwards along the 30 m route to the finish cone (indicate finish cone). You can rest as required, but remember the test is timed. You will be guided by the safety officer during the test, who will hold your shoulder as you progress backwards. They will tell you when to turn at each corner, so there is no need to look around during the test. The test will finish when the casualties feet cross the finish line. If you feel the casualty is too heavy for you to move safely you should STOP but your time will be marked as DID NOT FINISH (DNF) the test.

- Demonstrate the test.
- Emphasise the correct lift and drag technique with a demonstration.
- Instruct the candidate to practise the casualty drag and coach the candidate in their technique.
- Call each candidate forward to carry out the test after a warm-up.
- Confirm that the candidate has understood the instruction by saying: “Do you understand the test? Do you have any questions?”
- Continue with the test by saying: “You will now carry out the test. Are you ready to start? 3, 2, 1 GO.”
- Start the stopwatch
- Record the time and round to the nearest second eg 0:19 min:s.
Ladder Lift selection test

Test Description: Ladder Lift/Lower Simulator (FEU simulator)

Attribute(s) to be Measured: Ladder Lift/lower Strength

Test to be Performed: Candidate to raise the free end of the pivoted ladder arm (135 mass = 26 kg) supported 75 cm off the ground to a height of 182 cm and back down to the 75 cm support. The mass of the ladder at the lifting point will start at 20 kg and increase by 4 kg (5 kg added to the simulator) after every successful attempt (following at least 60 seconds of rest). The maximum load to be added to the simulator is 30 kg on the cradle.

Conditions Required for Testing

Resource/Equipment Requirements:

- FEU designed 13.5 m ladder lift simulator
- 1 x 5 kg, 1 x 10 kg, 1 x 20 kg free weights
- Full fire gear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Schedule of Events
- PES Input Result Sheet
- Practical aptitude test administrator’s guidance document
- TWO SAFETY SPOTTERS wearing bump hats and protective gloves.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- emergency first aid kit and resuscitation equipment
- operation of ladder lift/lower simulator to be pre-use checked and secure
- personal protective equipment suitable for the task
- affirmation that candidates have had time to warm-up/stretch
- affirmation of candidate’s physical readiness to proceed with test.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points in respect of the correct method of lifting and lowering the ladder lift/lower simulator
- to describe the test activity whilst the safety officer demonstrates the test
- to invite candidates to familiarise themselves with the simulator using an unladen cradle
- to detail the measure of acceptable performance – provisionally at least 15 kg ON THE CRADLE
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:
Maximum Mass: Candidate to attempt to lift/lower the ladder lift/lower simulator with maximum safe load whilst maintaining good lifting posture, up to a maximum added load of 30 kg on the cradle.

Test brief

- Carry out a risk assessment of the area and equipment.
- Ensure candidates are physically fit enough to undertake the test.
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that simulates lifting and lowering a 13.5 m ladder from an Appliance without a gantry.”

Explain what is being tested by saying

“To complete the test successfully you will need to combine upper and lower body strength and co-ordination to lift the ladder to the required height and lower it safely under control.”
Describe the test by saying

“Start the lift with an underhand grip with your palms facing upward underneath the bar. Lift and drive the bar through the wrist changeover zone, pushing the ladder up past the 182 cm height mark on the support bars. Then under control, lower the bar back to its resting position on the support bar 75 cm above the ground. You must wear gloves for this test and keep your hands inside the taped area on the bar at all times. You must not squat down to start the lift, but can bend your knees if required. If you need help from the safety staff during the lift, shout “help” and they will take the bar off you and lower it back down to the support bar for you! After each successful lift, you will have at least 60 seconds rest before attempting the next weight. The initial lift will be 20 kg and increase by 4 kg each attempt (that’s 5 kg added to the cradle after each attempt), up to a maximum total load of 44 kg (that’s 30 kg in total on the cradle). You will only have one attempt at each load, and must push the bar up past the 182 cm mark at the first attempt after the wrist changeover zone. You can’t drop the bar back to your chest and have a second attempt at reaching the required height if your first attempt fails. The assessor will tell you when 182 cm is reached.”

- Demonstrate the test.
- Emphasise the correct lift/lower technique.
- Call each candidate forward to carry out the test.
- Confirm that the candidate has understood the instruction by saying: “Do you understand the test? “Do you have any questions?”
- Instruct the candidate to practise the lift with an unloaded cradle (no additional weights) and coach the candidate in their technique.
- Continue with the test by saying: “You will now carry out the test. Are you ready to start? Lift.”
- Repeat the test with 5 kg increments on the simulator (equating to a 4 kg increase in lifting load) until the firefighter is no longer able to lift the ladder, loses good technique or reaches 30 kg on the cradle.
- Rest at least 60 seconds between attempts
- Record the MAXIMUM MASS ON THE CRADLE safely lifted to 182 cm, eg 10 kg.
PowerSport selection test

Test Description: Ladder Extension (PowerSport simulator)

Attribute(s) to be Measured: Ladder Extension Power, Co-ordination

Test to be Performed: Candidate to raise a weight (~62 kg) equivalent to 90% of the weight required to extend a 13.5 meter ladder from the 1st to the 2nd floor of a building and lower it under control to the grounded position

Conditions Required for Testing

Resource/Equipment Requirements:

- A suitable validated ladder extension simulator (PowerSport Ltd)
- Full firegear for assessor/safety officer and candidate including fire tunic, overtrousers, Showa #10 Grip gloves, fire boots and helmet
- Stopwatch x2
- Schedule of Events
- PES Input Result Sheet
- Practical aptitude test administrator’s guidance document.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification.

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- emergency first aid kit and resuscitation equipment
- ensure the simulator has been regularly maintained as per manufacturers instructions
- prior to test the simulator carriage to be raised to full working height and lowered
- pawling mechanism, weight attachment securing system, line and fixings to be pre-use checked
- personal protective equipment suitable for the task
- affirmation that candidates have had time to warm-up/stretch
- affirmation of candidate’s physical readiness to proceed with test.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points in respect of the correct method of extending the ladder simulator carriage
- to describe the test activity whilst the safety officer demonstrates the test
- to invite candidates to familiarise themselves with the weight of the simulator
- to detail the measure of acceptable performance – NA yet
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:
Time: Candidate to raise the simulator weight, pulling through 4.5 m of line, as quickly as possible

Test brief

- Carry out a risk assessment of the area and equipment.
- Ensure candidates are physically fit enough to undertake the test.
- Distribute Showa #10 Grip gloves
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that simulates extending a 13.5 m Fire Service ladder from the 1st to the 2nd floor of a building.”

Explain what is being tested by saying

“To complete the test successfully you will need to combine upper body strength and co-ordination and exert maximal safe effort on the rope.”

Describe the test by saying

“Firmly grasp the extending rope. On the command you will take up the slack in the rope so that your uppermost hand is just beneath the first tape mark. Using a hand-over-hand method pull down on the rope, the weight will rise. The use of your body weight is permitted, but you must keep both feet in contact with the ground at all times. Raise the ladder as quickly as possible until your uppermost hand is beyond the second tape mark on the rope. The safety officer will tell you when this mark has been passed. At this point you should pawl the simulator before lowering it under control, again using the hand-over-hand method, until the weight reaches the bottom.”
In order to pawl the simulator, you must raise the carriage until the mechanism engages with a click sound, you may then lower the carriage down onto a ladder round where it will rest securely.

In order to un-pawl the simulator, you must raise the carriage half a round until the mechanism clicks. The pawling system is then disengaged, and you may lower the carriage to the ground. Do not allow the weight to plummet. You will not be timed during the descent part of the test.

Assistance from the safety officer is permitted during the descent part of the test and will not incur any penalty. The time will start as soon as you pull on the rope and will stop when your uppermost hand has passed the second tape mark. If at any time you feel the simulator is too heavy for you to continue to move safely, or your grip is not providing sufficient control, you should alert the safety officer, and pawl the simulator. But your time will be marked as Did Not Finish the test.”

- Demonstrate the test, including the pawling mechanism, with no additional load on the weight stack.
- Emphasise the hand-over-hand technique, moving the weight smoothly.
- Instruct the candidate to practise the test at a controlled pace with the load set at hole 6 from the top.
- Allow 1 minute of rest.
- Reset the weight to hole 10 from the top of the weight stack.
- Call each candidate forward to carry out the test.
- Confirm that the candidate has understood the instruction by saying: “Do you understand the test? “Do you have any questions?”
- Continue with the test by saying: “You will now carry out the test proper. Take up the slack in the rope. 3-2-1-Go.”
- Start timing (2 watches) and take the average of both times, rounded to the nearest second eg 19 seconds
- Any candidate who fails to successfully complete the test should be de-briefed in line with the guidance contained in this document.
Tallescope selection test

Test Description: Ladder Extension (Tallescope Ladder)

Attribute(s) to be Measured: Ladder Extension Power, Co-ordination

Test to be Performed: Candidate to raise a weight (~67 kg) equivalent to the weight required to extend a 13.5 meter ladder from the 1st to the 2nd floor of a building and lower it under control to the grounded position

Conditions Required for Testing

Resource/Equipment Requirements:

- A suitable validated ladder extension simulator (Tallescope Aluminium Work Platform)
- 30 kg of additional load (free weights) and equipment to secure it in the operator cradle
- Full fire gear for assessor/safety officer and candidate including fire tunic, over trousers, Showa #10 Grip gloves, fire boots and helmet
- Stopwatch
- Schedule of Events
- Assessment Sheet
- Practical aptitude test administrators guidance document.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification.

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- emergency first aid kit and resuscitation equipment
- ensure the simulator has been regularly maintained as per manufacturers instructions
- prior to test the simulator carriage to be raised to full working height and lowered
- pawling mechanism, weight attachment securing system, line and fixings to be pre-use
- checked personal protective equipment suitable for the task
- affirmation that candidates have had time to warm-up/stretch
- affirmation of candidate’s physical readiness to proceed with test.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points in respect of the correct method of extending the ladder simulator carriage
- to describe the test activity whilst the safety officer demonstrates the test
- to invite candidates to familiarise themselves with the weight of the simulator
- to detail the measure of acceptable performance
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:
Time: Candidate to raise the simulator weight to the full working height of the simulator as quickly as possible

Test brief

- Carry out a risk assessment of the area and equipment.
- Ensure candidates are physically fit enough to undertake the test.
- Distribute Showa #10 Grip gloves
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that simulates extending a 13.5 m Fire Service ladder from the 1st to the 2nd floor of a building.”

Explain what is being tested by saying

“To complete the test successfully you will need to combine upper body strength and coordination and exert maximal safe effort on the rope.”

Describe the test by saying

“Firmly grasp the extending rope at or above head height. Using a hand-over-hand method pull down on the rope, the operator cradle will rise. The use of your body weight is permitted, but you must keep both feet in contact with the ground at all times. Continue in this manner until the cradle reaches the top of the frame. Raise the ladder as quickly as possible to the top of the frame. At this point you should pawl the simulator. In order to pawl the simulator, you must raise the carriage until the mechanism engages (with a
click sound), you may then lower the carriage down onto a ladder round where it will rest securely. In order to un-pawl the simulator, you must raise the carriage half a round until the mechanism clicks. The pawling system is then disengaged, and you may lower the carriage to the ground, again using the hand-over-hand method, until the cradle reaches the bottom. Do not allow the cradle to plummet. You will not be timed during the descent part of the test. Assistance from the safety officer is permitted during the descent part of the test and will not incur any penalty. The time will start as soon as you pull on the rope and will stop when the cradle reaches the top. If at any time you feel the simulator is too heavy for you to continue to move safely, or your grip is not providing sufficient control, you should alert the safety officer, and pawl the simulator. But your time will be marked as Did Not Finish the test. Candidates should be aware of the support bar behind them when entering and exiting the extension area, and be careful not to trip on it.”

- Demonstrate the test, including the pawling mechanism. If necessary, perform the demonstration without the additional 30 kg of load in the operator cradle.
- Emphasise the hand-over-hand technique, extending the cradle smoothly.
- Call all candidates forward, one at a time, to carry out a practice test without the 30 kg of additional load in the cradle.
- Confirm that the candidate has understood the instruction by saying: “Do you understand the test? “Do you have any questions?”
- Instruct the candidate to practise the test at a controlled pace.
- Once all candidates have performed a practice extension, secure the 30 kg load in the cradle.
- Call the candidates forward, in turn, to carry out the test proper.
- Confirm that the candidate has understood the instruction by saying: “Do you understand the test? “Do you have any questions?”
- Continue with the test by saying: “You will now carry out the test proper. Take up the slack in the rope. 3-2-1-Go.” Start timing
- Any candidate who fails to successfully complete the test should be de-briefed in line with the guidance contained in this document.
Ladder Climb selection test

<table>
<thead>
<tr>
<th>Test Description:</th>
<th>Ladder Ascent and Descent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute(s) to be Measured:</td>
<td>Ability to work at height</td>
</tr>
<tr>
<td>Test to be Performed:</td>
<td>Candidate to ascend a fully extended 13.5 m ladder to a point two thirds of the full working height, take a leg lock, remove hands from the ladder and look down to the assessor to identify the symbol placed flat on the ground at the foot of the ladder</td>
</tr>
</tbody>
</table>

**Conditions Required for Testing**

Resource/Equipment Requirements:

- 13.5 m ladder
- Drill tower or other similar structure
- Equipment suitable for securing ladder head in position (line and bracket)
- Full body safety harness, anchor point, safety line and ancillary equipment
- Full fire gear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Schedule of Events
- PES Input Results Sheet
- Practical aptitude test administrator’s guidance document
- Symbol card of A4 size with symbol dimensions being no less than 200 mm x 150 mm in total and line thickness 10 mm.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification
- NOTE: A MINIMUM OF 2 SAFETY OFFICERS ARE REQUIRED

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- emergency first aid kit and resuscitation equipment
- safe system of work for fall arrest (to include fitting to candidate of full body harness and helmet
- personal protective equipment suitable for the task
- affirmation that candidates have had time to warm-up/stretch
- affirmation of candidate’s physical readiness to proceed with test.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points in respect of the use of the safety harness and the correct method of ascending and descending the ladder and adopting a safe working position (leg-lock)
- to describe the test activity whilst the safety officer demonstrates the test
- to fit safety harness and line to candidates
- to position safety officer number 1 at the foot of the ladder and safety officer number 2 as the person responsible for the safety line
- to invite candidates to practice the leg lock on the bottom section of the ladder for no more than 60 seconds
- to detail the measure of acceptable performance – Not applicable yet
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:
Completion of task: Candidate to successfully complete the required tasks without undue hesitation or encouragement

Test brief

- Carry out a risk assessment of the area and equipment.
- Ensure candidates are physically fit enough to undertake the test.
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that will assess your ability to work at heights.”

Explain what is being tested by saying

“To complete the test successfully you will need to show confidence and apply the correct technique to climb the ladder.”
Describe the test by saying

“You will be required to climb the ladder to two-thirds of its height, the ladder is marked to indicate that position, take a leg lock, release your hands from the ladder, outstretched your arms to the side, look down to identify a symbol, call out the symbol, regain your hand hold, remove the leg lock and descend to the ground. You should complete this task without undue hesitation, but in a safe and controlled manner. You will be wearing a full body harness and will be attached to a fall-arrest device.”

A safety officer will now demonstrate, emphasising these points:

Correct mount and dismount – “Note that the jack beam is not the first step onto, or the last step off the ladder. When descending you will be counted down 3, 2, 1 by a member of staff until you reach the ground.”

Correct climb method – “You should start with a grip on the round at shoulder height with either hand. While ascending and descending your left arm moves with your left leg, and your right arm moves with your right leg. When you reach the required height both feet should be on the same round, as should your hands. While descending you will hear the order ‘PAWLS. STEP IN.’ At this point you should take more care as you are approaching an overlap between ladder sections. You should feel for the overlap with your feet.”

How to take a leg lock – “When you reach the point marked on the ladder (indicate) you should take a leg lock as shown. You will have an opportunity to practice the leg lock near the bottom of the ladder.”

- Confirm that the candidates have understood the instruction by saying: “Do you understand the test? Do you have any questions?”
- Continue with the test by saying: “You will now carry out the test.”
- Call each candidate forward to carry out the test and fit a harness onto them. Instruct them to mount the ladder and practice climbing and taking the leg lock a few rounds off the ground. The candidate should then dismount the ladder in preparation for the start of the test
- “Are you ready to start the test? 3-2-1 Go”
- The test is scored on a PASS (read the symbol) or FAIL basis. Only coach technique during the test, and don’t give any encouragement or re-assurance to the candidate
- Any candidate who fails to successfully complete the test should be de-briefed in line with the guidance contained in this document.
Porto-Power selection test

Test Description: Porto-Power Assembly

Attribute(s) to be Measured: Manual Dexterity

Test to be Per formed: Candidate to assemble and dissemble the Porto-power unit following the colour-coded diagrams provided.

Conditions Required for Testing

Resource/Equipment Requirements:

- Colour-coded Porto-power unit
- Full fire gear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Two sets of laminated colour diagrams showing the assembly of the porto-power unit (one for waiting candidates to view, one for the test bench)
- Stopwatch
- Schedule of Events
- PES Input Result Sheet
- Practical aptitude test administrator’s guidance document.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- emergency first aid kit and resuscitation equipment
- personal protective equipment suitable for the task
- affirmation that candidates have had time to warm-up/stretch
- affirmation of candidate’s physical readiness to proceed with test.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to describe the test activity whilst the safety officer demonstrates the test
- to detail the measure of acceptable performance – Not applicable yet
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:
Time: Candidate to attempt to complete the Porto-power assembly and disassemble in the fastest possible time.

Test brief

Carry out a risk assessment of the area and equipment.

Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that will assess your manual dexterity skills.”

Explain what is being tested by saying

“To complete the test successfully you will need to assemble and then disassemble the Portable pump (whilst wearing gloves) in the manner described as quickly as possible.”

Describe the test by saying

“I will demonstrate the assembly and disassembly of the unit proving a commentary as I go. You should stand upright facing the bench. When instructed you should …

1. Pick up parts 1 & 2.
2. Screw part 2 into the base plate – Note for demonstration – DO NOT SPIN
3. Screw part 3 onto the thread of part 2 – Note for demonstration – DO NOT SPIN
4. Screw the larger ring of part 4 (painted white) onto the top of part 3. You must keep part 4 level when tightening to avoid a cross thread. – Note for demonstration – DO NOT SPIN
5. Screw part 5 onto the top of part 3, for 3 turns only or it may stick!”
6. Put part 6 through the small ring of part 4 with the three holes close together at the top.
7. Put part 7 on top of part 6 and let it slide down to touch the top of part 5.
8. Push part 8 through the hole in the side of part 7 (marked by the white paint), passing through the bottom hole of the three holes on part 6.
10. Attach and screw the end of part 10 to the attachment on the bottom of part 3.

Once the unit has been assembled completely and correctly (as per the instructions and diagram) you will be told “STOP” and your total assembly time will be noted. Once you are ready, you will be told “GO”, when you will start disassembling the unit in the reverse order, placing each item back on the board in its designated position. Once you have completed the disassembly you will be told “STOP” and your time will be recorded. If you go wrong, you will be told “STOP” and referred to the pictures on the wall, with each picture number being linked with each part number. Note, all threads should be left FINGER TIGHT only. Beware of the cross-thread on No 4 (the figure of 8 ring) and turning Part 5 more than 3 turns.

- Confirm that the candidates have understood the instruction by saying: “Do you understand the test? “Do you have any questions?”
- Continue with the test by saying: “You will now carry out the test.” No practise is permitted.
- Call each candidate forward individually to carry out the test. The remaining candidates should be seated out of sight of the test and left to study the pictures in preparation for their turn. Offer the first candidate a chance to look at the pictures before they start if they want.
- “Are you ready to start the test? 3, 2, 1 GO.”
- Start timing
- Record the separate time for assembly and for disassembly, rounded to the nearest second eg 1:59 and 2:13 minutes respectively.
Enclosed Space selection test

<table>
<thead>
<tr>
<th>Test Description:</th>
<th>Breathing Apparatus and Enclosed Space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute(s) to be Measured:</td>
<td>Ability to work in a confined space, co-ordination, flexibility</td>
</tr>
<tr>
<td>Test to be Performed:</td>
<td>Candidate to negotiate a walk/crawl way wearing a BA face mask (no cylinder) with clear vision, and return along the same route with vision obscured.</td>
</tr>
</tbody>
</table>

**Conditions Required for Testing**

**Resource/Equipment Requirements:**

- Specification Crawlway
  - See attached diagram
  - 80 cm³ modular crawlway
  - containing 8 obstacles as specified
- One BA face mask per candidate
- Obscuration mask
- Facility for cleaning BA masks
- Full firegear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Stopwatch
- Schedule of Events
- PES Input Result Sheet
- Practical aptitude test administrator’s guidance document.

**Assessor/Safety Officer Requirements:**

- Practical aptitude test administrator’s qualification
- NOTE: A MINIMUM OF 2 SAFETY OFFICERS IS REQUIRED

**Safety Issues:**

- Risk assessment of the test area
- Implementation of the appropriate control measures
- emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- emergency first aid kit and resuscitation equipment
- procedure for removing candidate quickly in the event of an emergency
- personal protective equipment suitable for the task
- affirmation that candidates have had time to warm-up/stretch
- affirmation of candidate’s physical readiness to proceed with test.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points in respect of the correct method of moving around in confined spaces
- to describe the test activity whilst the safety officer demonstrates the test
- to assist the candidate to don the BA facemask
- to detail the measure of acceptable performance – Not applicable yet
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:
Completion of task: Candidate to successfully complete the required task without undue hesitation as quickly as possible

Test brief

- Carry out a risk assessment of the area and equipment
- Ensure candidates are physically fit enough to undertake the test
- Brief the candidates as follows:

  Explain the purpose of the test by saying

  “You are about to carry out a test that will assess your ability to work in confined conditions with minimal visibility.”

  Explain What Is Being Tested By Saying

  “To complete the test successfully you will need to combine confidence, agility and stamina to negotiate the crawlway as quickly as possible.”

  Describe the test by saying

  “You will be required to negotiate a crawl/walk way. You will start the test wearing a BA face mask with clear vision. You will not carry a cylinder or breathe any compressed air. Make your way through the crawlway and walkway to the opposite end of the unit. There is only one way through the run, either forward, left, right, up or down. The test begins with a crawl section followed by a walk section. There are no doors to open. You should not remove your BA face mask during the test. When you reach the open door at the other end of the unit, an assessor will stop you, place an obscuration mask over your face mask,
turn you around and tell you to return along the route you have just taken. You should complete the test as quickly as possible, without jeopardising your safety and wellbeing. Your time will start as soon as you enter the crawlway and will stop when you exit. The finish will be indicated by a tap on the head and “STOP”. You may withdraw yourself from the test at any time. If the safety officers think you are suffering unduly you will be withdrawn from the test. There is a drop down section in the crawlway, and the assessor will advise you to “watch for the drop down” when you approach this section. After the finish, you must exit from the crawlway feet first, but this part is not timed”.

• Confirm that the candidates have understood the instruction by saying: “Do you understand the test?” “Do you have any questions?”
• Provided that the candidates wish to continue with the test proceed by saying: “You will now don a breathing apparatus face mask.”
• Candidates are called forward individually to start the test. Candidates should be positioned at the entrance to the crawlway and both hands placed on the upper floor. At no time should they have seen the crawlway beforehand. Check candidate’s readiness to start by saying, “Are you ready to start the test? 3, 2, 1, GO.”
• Start timing
• Candidates should be given brief oral feedback every 30 seconds to provide general reassurance (eg “well done, keep going”). If a candidate is held up by a particular obstacle for 30 seconds, coaching should be given to allow them to overcome this obstacle, when feedback should again cease. Similarly if a candidate has moved in the wrong direction for 30 seconds, coaching should be given to reverse their course.
• Record the time that the candidate takes to reach the far side of the unit with clear vision. Re-set the watch and time the return run with no vision (start timing as they start to walk) that ends when the assessor taps the helmet and says “stop”. Round both times to the nearest second eg 1:23 and 1:21 respectively.
Figure B1: Enclosed Space selection test Specification Crawlway

- **start and finish for input test**

**Obstacles**

- A  half height door – top half tied open, steps either side
- B  Open panel at bottom for entry into crawlway
- C  suspended plastic flaps
- D  gap with bottom half blocked
- E  gap with upper left blocked (view from D to F)
- F  double height section to allow entry to upper level
- G  gap with top half blocked
- H  gap with lower right corner blocked (view from G to I)
- I  step down to finish, feet first
Appendix C

Criterion performance test protocols

Rural Fire criterion performance test

<table>
<thead>
<tr>
<th>Test Description:</th>
<th>Rural Fire Single Person Simulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute(s) to be Measured:</td>
<td>Firefighter Rural Firefighting Ability</td>
</tr>
<tr>
<td>Test to be Performed:</td>
<td>Candidate (performing along a 50 m shuttle) to drag a hose reel from the appliance for 50 m, jog back 50 m, pick and carry 2 x 70 mm coiled hoses dropping the first at 175 m and the second at 200 m, run out the two dropped hoses (50 m), jog back 150 m to appliance, Pick up and carry 100 mm suction hose and basket 200 m, jog back 200 m to appliance, pick up and carry LPP simulator 200 m</td>
</tr>
</tbody>
</table>

Conditions Required for Testing

- Resource/Equipment Requirements:
- Appliance with > 50 m hose reel
- 4 x 70 mm hose (two to remain coiled and two to run out)
- 100 mm suction hose
- Suction basket
- LPP simulator
- Use LPP bar with 1 x 5 kg and 3 x 2.5 kg weights + 2 safety pins + 2 spring clips at each end (~32.9 kg)
- Stopwatch
- Tape measure
- Marker cones
- Straight 50 m of flat tarmac/ concrete area
- Full fire gear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Schedule of Events
- PES Output Result Sheet
- Practical aptitude test administrator's guidance document

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator's qualification
Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- emergency first aid kit and resuscitation equipment
- course is free from obstacles/slip hazards
- personal protective equipment suitable for the task
- affirmation that candidates have had time to warm-up/stretch
- affirmation of candidate's physical readiness to proceed with test

Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points in respect of the correct method of carrying the 70 mm hose, 100 mm suction hose and basket and LPP simulator
- to invite candidates to familiarise themselves with the route and the mass of the equipment
- to detail the measure of acceptable performance – provisionally 12:30 minutes
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed

Measure of Performance:
Time: Candidate to attempt to complete the course in the fastest possible time

Test brief

- Carry out a risk assessment of the area and equipment.
- Ensure candidates are physically fit enough to undertake the test.
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that simulates setting up a water relay for use on a rural or grassland fire scenario.”

Explain what is being tested by saying

“To complete the test successfully you will need to combine endurance, upper and lower body strength and co-ordination to complete the test as quickly as possible.”
Describe the test by saying

“Start level with the first cone (indicate first/start cone). The second cone is 25 m away and the third cone 50 m away from the start point (indicate second and third cone). Drag the hose reel off the drum 50 m to the third cone and put it down (spare firefighter to stop over-run of hose off drum). Jog back 50 m to the start cone (indicate start cone). Pick up and carry (NO ARMS THROUGH THE HOSE) two secured 70 mm coiled hoses (indicate 2 secured 70 mm hoses) back and forth along the 50 m route, dropping one hose at 175 m (indicate cone two) and the other at 200 m (indicate the start cone). Pick up and run out the first unsecured 70 mm hose length towards the second cone (indicate the second cone), place the nozzle down, pick up the second unsecured 70 mm hose by the second cone and run it out towards the third cone (indicate the third cone). Place the nozzle down. Jog back 150 m to the start cone (indicate the start cone) following the 50 m route. Pick up and carry the 100 mm suction hose and basket 200 m along the 50 m route. Place them down at the start cone and jog 200 m back to the start cone along the 50 m route. Pick up and carry the light portable pump (LPP) simulator 200 m along the 50 m route back to the start cone (indicate the start cone). You must adopt a front carrying position only (not by your side) using a hand grip (no resting on forearms). You may rest the LPP at any time, but you must put the LPP on the ground before resting or changing grip. You will be reminded of the sequence of each task and where they start and finish by the assessor as the test progresses. You must not run while carrying equipment, but may walk, jog or run when not carrying equipment as desired. You may rest during the test at any time, but remember the test is timed.”

- Demonstrate the test (not over the full distance).
- Emphasise the correct techniques (hose drag, carrying the hose, suction hose and LPP, running hose).
- Call each candidate forward to carry out the test once they have warmed-up.
- Confirm that the candidate has understood the instruction by saying: “Do you understand the test? “Do you have any questions?”
- Instruct the candidate to practise their techniques.
- Continue with the test by saying: “You will now carry out the test. Are you ready to start? 3, 2, 1 GO. “
- Start the stopwatch. Encourage eg “doing well” every 30 seconds to give the candidate confidence.
- Record the time, rounded to the nearest second eg 12:30 min:s.
Domestic Fire criterion performance test

Test Description: Domestic Fire – Search and Rescue Single Person Simulation

Attribute(s) to be Measured: Firefighter Search and Casualty Rescue ability

Test to be Performed: Candidate wearing BA under air to drag a hose reel from the appliance for 30 m (10 m turn left 90°, 10 m turn left 90°, 10 m, locate and recover a 30 kg child casualty (30 m retracing route), walk 10 m (back along initial route), pause for 30 seconds (whilst BA obscuration mask fitted), crawl 20 m (following initial route), locate and recover (30 m) a second 55 kg adult male casualty (returning along initial 30 m route).

Conditions Required for Testing

Resource/Equipment Requirements:

- Appliance with > 30 m hose reel (MARK HOSE AT 30 m with TAPE). Run out ~40 m of hose on the ground in 3-4 loops behind the start line
- 30 and 55 kg casualty
- Stopwatch
- Tape measure
- Marker cones
- 15 m² flat tarmac/concrete area
- Fully functional BA set for candidate x 2
- Obscuration mask
- Knee pads
- Full fire gear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Schedule of Events
- PES Output Result Sheet
- Practical aptitude test administrator’s guidance document.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- Emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- Emergency first aid kit and resuscitation equipment
- Course is free from obstacles/slip hazards
• BA set is working correctly
• personal protective equipment suitable for the task
• affirmation that candidates have had time to warm-up/stretch
• affirmation of candidate’s physical readiness to proceed with test.

Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

• to explain to the candidate(s) the purpose of the test and what attribute is being measured
• to detail the test safety points in respect of the correct method of lifting/dragging the casualties
• to describe the test activity whilst the safety officer demonstrates the key aspects of the test
• to invite candidates to familiarise themselves with the mass of the casualties
• to detail the measure of acceptable performance – provisionally 4:00 minutes
• to invite questions from the candidate(s) and address these accordingly
• to ascertain whether the candidate wishes to proceed with the test
• to instruct the candidate to proceed if they wish to do so
• to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:
Time: Candidate to attempt to complete the course and recover the casualties in the fastest possible time

Test brief

• Carry out a risk assessment of the area and equipment.
• Ensure candidates are physically fit enough to undertake the test.
• Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that simulates searching for and rescuing casualties in a domestic fire scenario.”

Explain what is being tested by saying

“To complete the test successfully you will need to combine endurance, upper and lower body strength and co-ordination to complete the test as quickly as possible.”
Describe the test by saying

“The whole test is performed wearing BA under air. Start level with the first cone (indicate first/start cone). Drag the hose out 10 m to the second cone and pull out a further 20 m of pre-flaked hose (indicate second cone). You will be told STOP when you have dragged out the further 20 m of hose. Drag the hose 10 m to the third cone (indicate third cone) and pull through the slack hose. Drag the hose 10 m to the fourth cone (indicate fourth cone) and place the hose on the ground. Pick up and carry the 30 kg casualty (indicate the 30 kg casualty) back along the same 30 m route to the start cone. You must use a bear-hug technique, gripping the casualty under their arms and around their chest, interlocking your hands if possible. You will be guided by the safety officer during the test, who will hold your shoulder as you progress backwards. Turn around and walk back to the second cone (indicate second cone) and stop for 30 seconds whilst a BA obscuration mask is fitted. You will be told START when 30 seconds has elapsed. Using the hose as a guide, crawl 20 m past cone three to cone four (indicate cone 3 and 4). Firmly grasp the 55 kg casualty (indicate the 55 kg casualty) by the carrying handle situated below the back of the neck, and keeping your body as upright as possible and back straight, drag the casualty backwards along the same 30 m route to the start cone. You will be guided by the safety officer during the test, who will hold your shoulder as you progress backwards. They will tell you when to turn at each corner, so there is no need to look around during the test. The test will finish when the casualties feet cross the finish line. If you feel the casualty is too heavy for you to move safely you should STOP, but your time will be marked as DID NOT FINISH (DNF) the test. You will be reminded of the sequence of each task and where they start and finish by the assessor as the test progresses”

- Demonstrate the test
- Emphasise the correct carry/drag techniques with a demonstration
- Instruct the candidate to practise the casualty lift/drag and coach the candidate in their technique
- Call each candidate forward to carry out the test after a warm-up
- Confirm that the candidate has understood the instruction by saying: “Do you understand the test?” “Do you have any questions?”. Continue with the test by saying: “You will now carry out the test. Start up your BA set and indicate to me when you are ready”
- Once the candidate has indicated they are ready, say “Are you ready to start? 3, 2, 1 GO.”
- Start the stopwatch and record the time, rounded to the nearest second eg 4:01 minutes.
Ladder Lift criterion performance test

Test Description: Ladder Lift/Lower Simulator (FEU simulator)

Attribute(s) to be Measured: Ladder Lift/lower Strength

Test to be Performed: Candidate to raise the free end of the pivoted ladder arm (135 mass = 26 kg) supported 75 cm off the ground to a height of 182 cm and back down to the 75 cm support. The mass of the ladder at the lifting point will start at 20 kg and increase by 4 kg (5 kg added to the simulator) after every successful attempt (following at least 60 seconds of rest). The maximum load to be added to the simulator is 45 kg on the cradle.

Conditions Required for Testing

Resource/Equipment Requirements:

- FEU designed 13.5 m ladder lift simulator
- 1 x 5 kg, 1 x 10 kg, 2 x 20 kg free weights
- Full firegear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Schedule of Events
- PES Output Result Sheet
- Practical aptitude test administrator’s guidance document
- TWO SAFETY SPOTTERS wearing bump hats and protective gloves.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification.

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- Emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- Emergency first aid kit and resuscitation equipment
- Operation of ladder lift/lower simulator to be pre-use checked
- Personal protective equipment suitable for the task
- Affirmation that candidates have had time to warm-up/stretch
- Affirmation of candidate’s physical readiness to proceed with test.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points in respect of the correct method of lifting and lowering the ladder lift/lower simulator
- to describe the test activity whilst the safety officer demonstrates the test
- to invite candidates to familiarise themselves with the simulator using an unloaded cradle
- to detail the measure of acceptable performance
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:

Maximum Mass: Candidate to attempt to lift/lower the ladder lift/lower simulator with maximum safe load whilst maintaining good lifting posture, up to a maximum added load of 45 kg on the cradle.

Test brief

- Carry out a risk assessment of the area and equipment
- Ensure candidates are physically fit enough to undertake the test.
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that simulates lifting and lowering a 13.5 m ladder from an Appliance without a gantry.”

Explain what is being tested by saying

“To complete the test successfully you will need to combine upper and lower body strength and co-ordination to lift the ladder to the required height and lower it safely under control.”

Describe the test by saying

“Start the lift with an underhand grip with your palms facing upward underneath the bar. Lift and drive the bar through the wrist changeover zone, pushing the ladder up past the 182 cm height mark on the support bars. Then under control, lower the bar back to its resting position on the support bar 75 cm above the ground. You must wear gloves for this
test and keep your hands inside the taped area on the bar at all times. You must not squat down to start the lift, but can bend your knees if required. If you need help from the safety staff during the lift, shout “HELP” and they will take the bar off you and lower it back down to the support bar for you!. After each successful lift, you will have at least 60 seconds rest before attempting the next weight. The initial lift will be 20 kg and increase by 4 kg each attempt (that’s 5 kg added to the cradle after each attempt), up to a maximum total load of 56 kg (that’s 45 kg in total on the cradle). You will only have one attempt at each load, and must push the bar up past the 182 cm mark at the first attempt after the wrist changeover zone. You can’t drop the bar back to your chest and have a second attempt at reaching the required height if your first attempt fails. The assessor will tell you when 182 cm is reached."

- Demonstrate the test.
- Emphasise the correct lift/lower technique.
- Call each candidate forward to carry out the test.
- Confirm that the candidate has understood the instruction by saying: “Do you understand the test?” “Do you have any questions?”
- Instruct the candidate to practise the lift with an unloaded cradle (no additional weights) and coach the candidate in their technique.
- Continue with the test by saying: “You will now carry out the test. Are you ready to start? Lift.”
- Repeat the test with 5 kg increments on the simulator (equating to a 4 kg increase in lifting load) until the firefighter is no longer able to lift the ladder, loses good technique or reaches 45 kg on the cradle.
- Rest 60 seconds between attempts
- Record the **MAXIMUM MASS ON THE CRADLE** safely lifted to 182 cm, eg 15 kg.
## Ladder Extension criterion performance test

<table>
<thead>
<tr>
<th>Test Description:</th>
<th>Ladder Extension (13.5 m Ladder)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute(s) to be Measured:</td>
<td>Ladder Extension Power, Co-ordination</td>
</tr>
<tr>
<td>Test to be Performed:</td>
<td>Candidate to fully extend a 13.5 metre pitched ladder from the 1st to the 9th pawl (1 storey height), secure it, and lower it under control to the grounded position</td>
</tr>
</tbody>
</table>

### Conditions Required for Testing

**Resource/Equipment Requirements:**

- A 13.5 m ladder with one firefighter on the heel and one firefighter supporting each prop
- A training tower or similar building to pitch the 13.5 m ladder near or against for safety? – PH to decide if needed.
- Full fire gear for assessor/safety officer and candidate including fire tunic, overtrousers, Showa #10 Grip gloves, fire boots and helmet
- Stopwatch
- Schedule of Events
- PES Output Result Sheet
- Practical aptitude test administrator’s guidance document.

**Assessor/Safety Officer Requirements:**

- Practical aptitude test administrator’s qualification

**Safety Issues:**

- Risk assessment of the test area
- Implementation of the appropriate control measures
- Emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- Emergency first aid kit and resuscitation equipment
- 13.5 m ladder position, pawing mechanism, line and stabilising crew positions to be pre-use checked
- Personal protective equipment suitable for the task including SHOWA #10 Grip Gloves
- Affirmation that candidates have had time to warm-up/stretch
- Affirmation of candidate’s physical readiness to proceed with test.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points in respect of the correct method of extending the 13.5 m ladder
- to describe the test activity whilst the safety officer demonstrates the test
- to invite candidates to familiarise themselves with the weight of the 13.5 m ladder
- to detail the measure of acceptable performance – provisionally 25 seconds
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:
Time: Candidate to raise the 13.5m ladder from the 1st to the 9th pawl as quickly as possibly, ensuring the ladder is correctly pawled, before lowering it down under control in their own time.

Test brief

- Carry out a risk assessment of the area and equipment
- Ensure candidates are physically fit enough to undertake the test
- Distribute Showa #10 Grip gloves to candidates
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out an extension of the 13.5 m Fire Service ladder from the 1st to the 9th round.”

Explain what is being tested by saying

“To complete the test successfully you will need to combine upper body strength and co-ordination to exert maximal safe effort on the line.”

Describe the test by saying

“Firmly grasp the extending line at or above head height. Using a hand-over-hand method pull down on the line, the ladder will rise. You can use your body weight to assist, but must keep both feet in contact with the ground at all times. Continue in this manner until the ladder passes the 9th round, raising the ladder as quickly as possible. At this point you should anchor the ladder by engaging the pawls. You should then lower the ladder under
control, again using the hand-over-hand method, until the ladder reaches the bottom where it should be pawled on the lowest round. Do not allow the ladder to plummet. You will not be timed during the descent part of the test. The time will start as soon as you pull on the line and will stop when the ladder is pawled on or above the 9th round.”

- Demonstrate the test
- Emphasise the hand-over-hand technique, moving the ladder smoothly
- Call each candidate forward to carry out the test after a warm-up
- Confirm that the candidate has understood the instruction by saying: “Do you understand the test?” “Do you have any questions?”
- Instruct the candidate to practise the test at a controlled pace
- Allow 1 minute of rest
- Continue with the test by saying: “You will now carry out the test proper. Take up the slack in the rope. 3, 2, 1 GO.”
- Start timing (2 watches) and take the average of both times, rounded to the nearest second eg 19 seconds.
Ladder Climb criterion performance test

Test Description: Ladder Ascent and Descent

Attribute(s) to be Measured: Ability to work at height

Test to be Performed: Candidate to ascend an extended 13.5 m ladder to the third floor where they will alight onto the landing, before getting back on the ladder and descending to the ground

Conditions Required for Testing

Resource/Equipment Requirements:

- 13.5 m ladder with the round placed 2 ins above the window ledge in accordance with the Fire Service Training Manual
- Drill tower or other similar structure
- Equipment suitable for securing ladder head in position (line and bracket)
- Full fire gear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Full BA gear
- Schedule of Events
- PES Output Result Sheet
- Step to decrease height of step down from sill to tower
- Practical aptitude test administrator’s guidance document.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- emergency first aid kit and resuscitation equipment
- personal protective equipment suitable for the task
- affirmation that candidates have had time to warm-up/stretch
- affirmation of candidate’s physical readiness to proceed with test
- ensure BA Set is fitted correctly and tightly with all straps correctly done up.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points (correct method of ascending and descending the ladder and climbing off/back on to the ladder from the balcony)
- to describe the test activity whilst the safety officer demonstrates the test
- to detail the measure of acceptable performance – provisionally 30 seconds to floor of balcony
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:
Completion of task: Candidate to successfully complete the ascent and alighting onto the third floor landing within the designated time, and to complete the descent, without undue hesitation or encouragement

Test brief

- Carry out a risk assessment of the area and equipment
- Ensure candidates are physically fit enough to undertake the test
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that will assess your ability to work at heights.”

Explain what is being tested by saying

“To complete the test successfully you will need to show confidence, balance and experience and apply the correct technique to climb the ladder.”

Describe the test by saying

“You will be required to climb the ladder and exit onto the third floor landing on the tower, reversing this sequence to descend back to the ground. Your aim should be to complete the ascent onto the third floor landing at operational speed but in a safe manner. You must perform a stepped dismount (onto the window ledge) but you can assume the ledge is secure. There is a step placed on the 3rd floor to assist you to perform this task. The descent is not timed. There is a step by the window to aid entry and exit from the 3rd floor landing.”
A safety officer will now demonstrate, emphasising these points:

Correct mount and dismount – “Note that the jack beam is not the first step onto, or the last step off the ladder. When descending you will be counted down 3, 2, 1 by a member of staff until you reach the ground.”

Correct climb method – “You should start with a grip on the round at shoulder height with either hand. While ascending and descending your left arm moves with your left leg, and your right arm moves with your right leg. When you reach the required height both feet should be on the same round, as should your hands. While descending you will hear the order ‘PAWLS. STEP IN.’ At this point you should take more care as you are approaching an overlap between ladder sections. You should feel for the overlap with your feet.”

Dismount/mount from balcony technique

- Confirm that the candidates have understood the instruction by saying:
  - “Do you understand the test?
  - Do you have any questions?”
- Continue with the test by saying:
  - “You will now carry out the test.”
- Call each candidate forward to carry out the test after a warm-up
  - “Are you ready to start the test? 3, 2, 1 GO”
  - Start timing with 2 watches
  - Record the time to reach the third floor landing (when both feet touch), rounded to the nearest second eg 0:30 seconds.
PortoPower criterion performance test

Test Description: Porto-Power Assembly

Attribute(s) to be Measured: Manual Dexterity

Test to be Performed: Candidate to assemble the Porto-power unit following the colour-coded diagrams provided

**Conditions Required for Testing**

Resource/Equipment Requirements:

- Colour-coded Porto-power unit
- Full fire gear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Schedule of Events
- PES Output Result Sheet
- Practical aptitude test administrator’s guidance document.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- Emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- Emergency first aid kit and resuscitation equipment
- Personal protective equipment suitable for the task
- Affirmation that candidates have had time to warm-up/stretch
- Affirmation of candidate’s physical readiness to proceed with test.

Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- To explain to the candidate(s) the purpose of the test and what attribute is being measured
- To describe the test activity whilst the safety officer demonstrates the test
- To detail the measure of acceptable performance – provisionally 2:00 to assemble and 2:00 min:s to disassemble
- To invite questions from the candidate(s) and address these accordingly
- To ascertain whether the candidate wishes to proceed with the test
- To instruct the candidate to proceed if they wish to do so
- To withdraw the candidate from the test if they do not wish to proceed.
Measure of Performance:
Time: Candidate to attempt to complete the Porto-power assembly and disassembly in the fastest possible time.

Test brief

- Carry out a risk assessment of the area and equipment.
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that will assess your manual dexterity skills.”

Explain what is being tested by saying

“To complete the test successfully you will need to assemble and then disassemble the Portable pump whilst wearing gloves in the manner described within the prescribed time.”

Describe the test by saying

“To complete the test successfully you will need to assemble and then disassemble the Portable pump (whilst wearing gloves) in the manner described as quickly as possible.”

Describe the test by saying

“I will demonstrate the assembly and disassembly of the unit proving a commentary as I go. You should stand upright facing the bench. When instructed you should …

1. Pick up parts 1 & 2.
2. Screw part 2 into the base plate – Note for demonstration – DO NOT SPIN
3. Screw part 3 onto the thread of part 2 – Note for demonstration – DO NOT SPIN
4. Screw the larger ring of part 4 (painted white) onto the top of part 3. You must keep part 4 level when tightening to avoid a cross thread. – Note for demonstration – DO NOT SPIN
5. Screw part 5 onto the top of part 3, for 3 turns only or it may stick!
6. Put part 6 through the small ring of part 4 with the three holes close together at the top
7. Put part 7 on top of part 6 and let it slide down to touch the top of part 5.
8. Push part 8 through the hole in the side of part 7 (marked by the white paint), passing through the bottom hole of the three holes on part 6
9. Screw Part 9 to the top of part 6
10. Attach and screw the end of part 10 to the attachment on the bottom of part 3.
Once the unit has been assembled completely and correctly (as per the instructions and diagram) you will be told “STOP” and your total assembly time will be noted. Once you are ready, you will be told “GO”, when you will start disassembling the unit in the reverse order, placing each item back on the board in its designated position. Once you have completed the disassembly you will be told “STOP” and your time will be recorded. If you go wrong, you will be told “STOP” and referred to the pictures on the wall, with each picture number being linked with each part number. Note, all threads should be left FINGER TIGHT only. Beware of the cross-thread on No 4 (the figure of 8 ring) and turning Part 5 more than 3 turns.”

- Confirm that the candidates have understood the instruction by saying: “Do you understand the test?” “Do you have any questions?”
- Continue with the test by saying: “You will now carry out the test.” No practise is permitted
- Call each candidate forward individually to carry out the test. The remaining candidates should be seated out of sight of the test and left to study the pictures in preparation for their turn. Offer the first candidate a chance to look at the pictures before they start if they want.
- “Are you ready to start the test? 3, 2, 1 GO.” Start timing
- Record the separate time for assembly and for disassembly, rounded to the nearest second eg 1:59 and 2:13 minutes respectively.
Enclosed Space criterion performance test

<table>
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<tr>
<th>Test Description:</th>
<th>Breathing Apparatus and Enclosed Space</th>
</tr>
</thead>
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<tr>
<td>Attribute(s) to be Measured:</td>
<td>Ability to work in a confined space, co-ordination, flexibility</td>
</tr>
<tr>
<td>Test to be Performed:</td>
<td>Candidate to negotiate arawl way wearing a full BA set (started up) and a face mask that is obscured</td>
</tr>
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**Conditions Required for Testing**

Resource/Equipment Requirements:

- Specification Crawlway
  - See attached diagram
  - 80 cm³ modular crawlway
  - containing 8 obstacles as specified
- One BA set complete with air cylinder, harness and face mask per candidate
- Obscuration mask
- Facility for cleaning BA masks
- Full firegear for assessor/safety officer and candidate including fire tunic, overtrousers, gloves, fire boots and helmet
- Stopwatch
- Schedule of Events
- PES Output Result Sheet
- Practical aptitude test administrator’s guidance document.

Assessor/Safety Officer Requirements:

- Practical aptitude test administrator’s qualification.

Safety Issues:

- Risk assessment of the test area
- Implementation of the appropriate control measures
- emergency procedures for the safety officer(s)/assessor(s)/candidate(s)
- emergency first aid kit and resuscitation equipment
- procedure for removing candidate quickly in the event of an emergency
- personal protective equipment suitable for the task
- affirmation that candidates have had time to warm-up/stretch
- affirmation of candidate’s physical readiness to proceed with test.
Test Procedure(s) to be administered:

In accordance with the Practical Aptitude Test Administrators Guidance the assessor:

- to explain to the candidate(s) the purpose of the test and what attribute is being measured
- to detail the test safety points in respect of the correct method of moving around in confined spaces
- to describe the test activity whilst the safety officer demonstrates the test
- to assist the candidate to don the BA set
- to detail the measure of acceptable performance – provisionally 7:00 minutes
- to invite questions from the candidate(s) and address these accordingly
- to ascertain whether the candidate wishes to proceed with the test
- to instruct the candidate to proceed if they wish to do so
- to withdraw the candidate from the test if they do not wish to proceed.

Measure of Performance:
Completion of task: Candidate to successfully complete the required task without undue hesitation or encouragement within the specified time

Test brief

- Carry out a risk assessment of the area and equipment
- Ensure candidates are physically fit enough to undertake the test
- Ideally candidates are to enter the crawlway one at a time. However, more than one candidate may enter the crawlway provided a sufficient gap is allowed to prevent unnecessary pressure caused by candidates catching up with each other
- Brief the candidates as follows:

Explain the purpose of the test by saying

“You are about to carry out a test that will assess your ability to work in confined conditions with minimal visibility.”

Explain what is being tested by saying

“To complete the test successfully you will need to combine confidence, agility and stamina to negotiate the crawlway as quickly as possible.”
Describe the test by saying

“You will be required to negotiate a crawlway. You will be wearing a BA set and facemask, under air. During the test your vision will be obscured. You should complete the test as quickly as possible. Your time will start as soon as you enter the crawlway and will stop when you exit. The finish will be indicated by a tap on the head and “STOP”. You may withdraw yourself from the test at any time. If the safety officers think you are suffering unduly you will be withdrawn from the test.”. There is only one way through the run, forward, left or right or up or down. The test begins with a walk section followed by a crawl section. There are no doors to open. You should not need to remove your BA set during the test. After the finish, you must exit from the crawlway feet first, but this part is not timed”.

- Confirm that the candidates have understood the instruction by saying: “Do you understand the test?” “Do you have any questions?”
- Provided that the candidates wish to continue with the test proceed by saying: “You will now don a breathing apparatus set and facemask and start it up.”
- The obscuration mask is positioned to obscure the candidate’s vision
- Candidates are called forward individually into the room where the crawlway is located to start the test. Candidates should be positioned at the entrance to the crawlway and both hands placed on the side wall entrance. At no time should they have seen the crawlway. Check candidate’s readiness to start by saying, “Are you ready to start the test? 3, 2, 1, GO.”
- Start timing
- Candidates should be given brief oral feedback every one minute to provide general reassurance (eg “well done Jack, keep going”). If a candidate is held up by a particular obstacle for 30 seconds, coaching should be given to allow them to overcome this obstacle, when feedback should again cease. Similarly if a candidate has moved in the wrong direction for 30 seconds, coaching should be given to reverse their course
- Record the time that the candidate takes to reach the finish (ie “STOP”). Round the time to the nearest second eg 7:00 minutes.
Figure C1: Enclosed Space criterion selection test Specification Crawlway

<table>
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<tr>
<td>A     half height door – top half tied open,</td>
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<tr>
<td>steps either side</td>
</tr>
<tr>
<td>B     Open panel at bottom for entry into</td>
</tr>
<tr>
<td>crawlway</td>
</tr>
<tr>
<td>C     suspended plastic flaps</td>
</tr>
<tr>
<td>D     gap with bottom half blocked</td>
</tr>
<tr>
<td>E     gap with upper left blocked (view from</td>
</tr>
<tr>
<td>D to F)</td>
</tr>
<tr>
<td>F     double height section to allow entry to</td>
</tr>
<tr>
<td>upper level</td>
</tr>
<tr>
<td>G     gap with top half blocked</td>
</tr>
<tr>
<td>H     gap with lower right corner blocked</td>
</tr>
<tr>
<td>(view from G to I)</td>
</tr>
<tr>
<td>I     step down to finish, feet first</td>
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