Revision of body size criteria in standards – Protecting people who work at height

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This report serves to describe a programme of work undertaken to consider whether the body size criteria in standards which are used to test Personal Protective Equipment (PPE) safety needed revision. It details the research methodology employed to ascertain a selection of anthropometric data of the working at height population, in order to accurately establish whether the dimensions and requirements of PPE test apparatus needs reviewing. This work is intended to improve safety measures for workers at height that use PPE and to further the knowledge about this population.

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ABSTRACT

The Ergonomics and Safety Research Institute was commissioned by the Health and Safety Executive to consider whether the body size criteria in standards which are used to test Personal Protective Equipment (PPE) safety needed revision. Currently, the PPE for workers at height is tested using a mass of 100 kg (BS EN 361: 2002), this being the minimum chosen weight to test this equipment. The 100kg mass represents the 95%ile weight of the UK adult population; this weight has also been used to represent the working at height population. However, anecdotal evidence suggests that many people who work at height do not fall within the normal size distribution of UK adults on which the 100 kg was based on. The main aims of this research were to determine the actual weight distribution of individuals who work at height, also to collect basic anthropometric and demographic data, to establish whether the current relevant design standards are sufficient

A total of 589 people who worked at height comprised the sample; 15 body measurements as well as demographic data were taken from each participant. Two additional dimensions were calculated (Weight of Equipment and Working Weight), to provide information on how much equipment people were carrying while working at height and to determine the total weight of the worker if they were to fall from height. Clothed Body Mass Index was also calculated for participants. Workers were allocated to one of 10 industry categories for more detailed analysis of the data.

The re-sampling technique of bootstrapping was used on these data, as it provides distributions and confidence limits for any statistic. Bootstrapped confidence intervals for the 99th and 95th percentiles are given for Weight and for Working Weight. Results show that the current figure of 100 kg significantly underestimates the actual 95th percentile for workers' Weight Without Equipment. It is likely (95% confidence) that the interval 112.3 kg – 118.4 kg covers the true value of the 95th percentile for Weight Without Equipment and the interval 116.2 kg – 122.0 kg covers the true value of the 95th percentile for Working Weight. Results also suggest that the torso dummy currently specified in BS EN 364: 1993 generally under-represents the size of people who work at height. Data that could be used in the design of a full bodied dummy or safety nets to prevent limb penetrations are presented.

Results show that there appears to be no significant difference in workers' Weight Without Equipment between the 10 industrial classifications. There was a significant difference between the 10 industrial classifications for Weight With Equipment and Working Weight. Maintenance and Repair workers, in particular overhead pylon linesmen, carried the heaviest equipment, which could weigh up to 41.2 kg.

TABLE OF CONTENTS

Appendices

TABLE OF TABLES

TABLE OF FIGURES

1 INTRODUCTION

The Ergonomics and Safety Research Institute was commissioned by the Health and Safety Executive in August 2003 to consider whether the body size criteria in standards which are currently being used to test Personal Protective Equipment's (PPE) safety needed revision. Currently, the standards for PPE for workers at height (≥ 2 metres) is tested using a mass of 100 kg. The 100kg mass represents the 95%ile weight of the adult population; this weight is also being used to represent the working at height population. However, it has been observed that many people who work at height do not fall within the normal size distribution of UK adults on which the 100 kg was based on. The main aims of this research were to determine the total weight of an individual if they were to fall from height, also to collect basic anthropometric data of people who work at height, including clothing and equipment, to establish whether the current relevant design standards are sufficient. In 2002/2003 34 people died and nearly 4,000 suffered a serious injury as a result of a fall from height in the workplace (www.hse.gov.uk/statistics). Falls from height are the most common cause of fatal injury and the second most common cause of major injury to employees, accounting for 15% of all such injuries. All industry sectors are exposed to the risks presented by this hazard although the level of incidence varies considerably. (www.hse.gov.uk/falls) This research, then, provides valuable information in detecting whether current safety standards are appropriate to protect workers at height.

1.1 OBJECTIVES

The four objectives of this research were to:

1. Collect basic body size data, in particular weight of people who work at height
2. Collect corresponding data on clothing, tools and materials, and safety equipment used by workers at height.
3. Statistically validate the data.
4. Compare the data with the current test specifications.

1.2 PROJECT BENEFITS

The benefits of the findings of this project can be summarised as:

- Establishing whether current design standards accurately represent the labour force that work at height: providing validated criteria to which safety equipment can be designed and tested.
- Reducing injuries as a result of improved equipment design.
- Helping manufacturers demonstrate 'due diligence' by ensuring their equipment is designed for the appropriate users.

2 FALL PROTECTION SYSTEMS/PPE AND STANDARDS

2.1 INTRODUCTION

There is a number of fall protection systems/Personal Protective Equipment (PPE) in use to prevent high falls from occurring. Sulowski, in *Fall protection systems – Classification* (1984) classifies fall protection equipment into collective and personal systems. Collective systems include, for example, work platforms and fall arrest nets, which in general terms are described as fall prevention systems and fall arrest systems, respectively. Personal fall protection systems would include work restraint (also known as travel restriction), for example using a belt, lanyard of fixed length and an anchor (personal fall prevention systems), and a full body harness, lanyard, energy absorber and anchor (personal fall arrest system).

According to Sulowski (1984) (cited in Seddon, 2002) "Work positioning systems and height rescue systems are sometimes mistakenly treated as fall protection systems. In fact, in neither of these two is full fall protection the purpose of the system… The work positioning system is used while the work is being done, the travel restriction system provides protection against the risk of falling, the fall arrest system stops the fall and the height rescue system is used to rescue the victim after the fall."

The European Standardization Committee (CEN) has taken a different approach to work positioning and rescue systems. While the primary function of the work positioning and rescue equipment might not be to protect against a fall, it has become normal practice to incorporate fall prevention or fall arrest function in both systems. This is recognised by the European Standards covering work positioning equipment and rescue equipment, which require static strength tests equal to those of the fall arrest equipment standards. Work positioning equipment and rescue equipment are also subjected to dynamic tests in the standards. Although the dynamic tests are less onerous than those for fall arrest equipment, the tests are nevertheless considered to be appropriate for the intended work and the potential fall protection situations likely to be encountered, (Seddon, 2002). Harnesses for protection against falls from height are used in personal fall protection systems.

The European Standardization Committee (CEN) has agreed definitions for such fall protection systems (Seddon, 2002):

Personal fall protection systems: assembly of components for protection against falls from a height at work when the risk of the fall exists, including at least a body holding device connected to a reliable anchor.
NOTE. Excludes systems for professional and private sports activities.

Fall arrest system: personal fall protection system by which a fall is arrested to prevent the collision of the user with the ground or structure.

Restraint system: personal fall protection system by which a person is prevented from reaching the position where the risk of a fall exists.
NOTE. Also known as work restraint system and a travel restriction system.

Work positioning system: personal fall protection system which enables a user to work supported in tension or suspension in such a way that a fall is prevented or restricted.

Rope access system: personal fall protection system, which uses two separately secured sub-systems, one as the means of support and the other as a safety back-up for getting to and from the place of work, and which can be used for work positioning systems.

Rescue system: personal fall protection system by which a person can carry out a rescue, rescue himself/herself or be rescued from a height or a depth by pulling, lifting or lowering.

2.2 FALL PROTECTION SYSTEMS STANDARDS IDENTIFICATION AND REVIEW

A review of standards that apply to the Personal Protective Equipment used in fall protection systems was carried out. The standards reviewed were:

- **BS EN 364:1993** Personal protective equipment against falls from height – Test methods.
- **BS EN 813:1997** Personal protective equipment for prevention of falls from height – Sit harnesses.
- **BS EN 361:2002** Personal protective equipment against falls from height – Full body harnesses.
- **BS EN 363:2002** Personal protective equipment against falls from height – Fall arrest systems.
- **BS EN 358:2000** Personal protective equipment for work positioning and prevention of falls from height – Belts for work positioning and restraint and work positioning lanyards.
- **BS EN 12277:1998** Mountaineering equipment – Harnesses – Safety requirements and test methods.

2.2.1 Test Methods Review

BS EN 364:1993 Personal protective equipment against falls from height – Test methods, specifies test methods for materials, components and systems associated with equipment for protection against falls. Specified in the standard are:

- Static testing apparatus and static test methods.
- Dynamic testing apparatus; including a torso dummy.
- Test methods for dynamic performance and dynamic strength testing of components and systems.
- Corrosion testing of metal components.
- Test apparatus and test methods for conditioning tests and endurance tests.
- The standard also makes recommendations for the scheduling of tests.

Both static and dynamic tests are carried out on PPE against falls from height, for this there are two types of apparatus used. One method utilises a dimensioned torso dummy, which can be seen illustrated in the figure below.

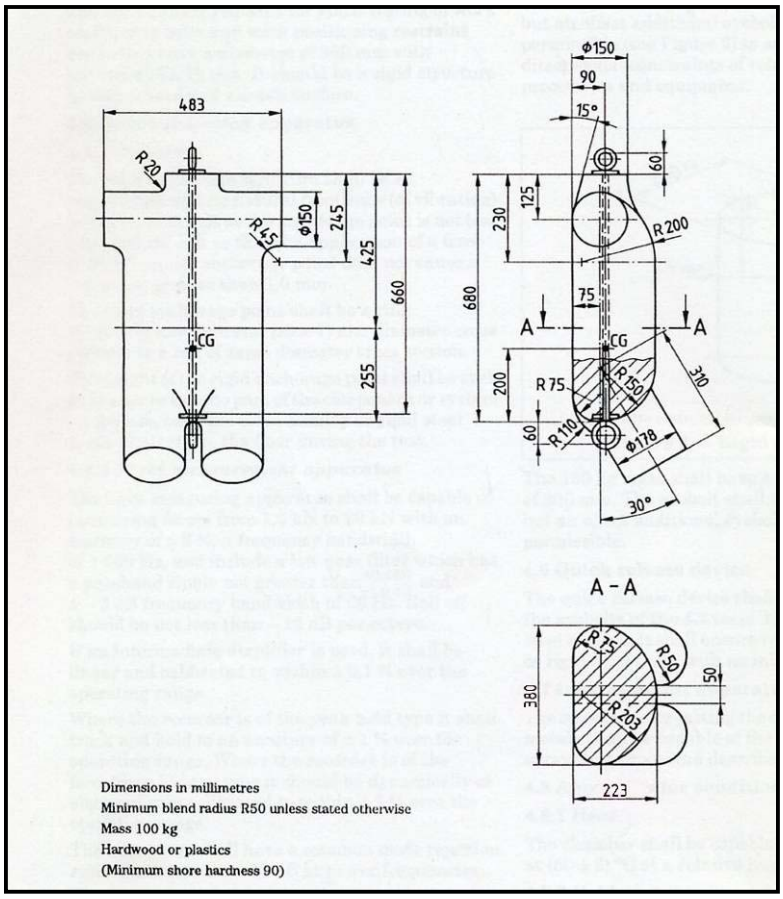


Figure 1. Torso Dummy

(Image taken from BS EN 364:1993. Reproduced with kind permission of British Standards Institution)

Within the standard it is stated that "the torso dummy for static and dynamic testing of relevant components and systems shall conform to the dimensions and requirements described in Figure 1."

The other test method utilises a solid steel mass, which can be seen illustrated in the figure below.

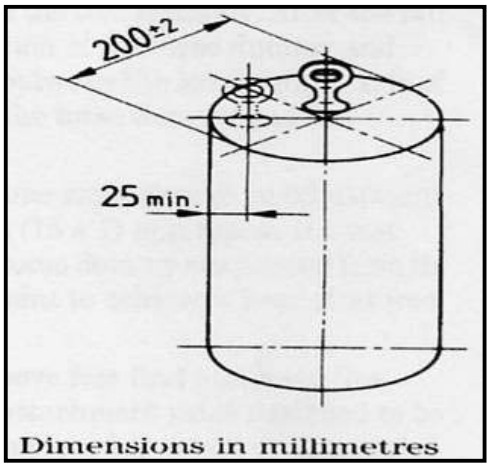


Figure 2. Rigid steel mass

(Image taken from BS EN 364:1993. Reproduced with kind permission of British Standards Institution)

The standard requires PPE used in fall protection systems to be designed and tested to withstand weights of 100 kg, this figure being drawn from the anthropometry of the general population. BS EN 361:2002 states that a full body harness must withstand two successive drop tests with a torso dummy of 100 kg when tested at each fall arrest attachment element. All personal protective equipment used in fall protection systems is tested in accordance with BS EN 364:1993 Personal protective equipment against falls from height – Test methods. BS EN 358:2000 and BS EN 813:1997 states that "the apparatus for the testing of work positioning belts, waist belts, work positioning belts and work positioning lanyards shall meet the requirements of BS EN 364:1993".

The purpose of this research was to review the apparatus used to carry out the static and dynamic tests on the PPE against falls from height. The research focused on the dimensions and the requirements of the torso dummy with the aim to establish whether current design standards accurately represent the labour force that work at height. For this to be achieved the anthropometric characteristics of the working at height population had to be defined. Furthermore, it had been discussed that if there were to be the development of a full bodied dummy these measurements would be relevant.

3 DEFINING THE TARGET POPULATION

3.1 IDENTIFICATION OF PEOPLE WHO WORK AT HEIGHT

The principal factor in determining the given target population is occupation, occupations that involve the individuals working at height. The current Temporary Working at Height Directive (2001/45/EC) states "there is no minimum requirement for work at height. They include all work activities where there is a need to control the risk of falling a distance liable to cause personal injury." This research was concerned with the standards that apply to personal protective equipment that will be used at heights of over 2 metres; it is unlikely that such equipment would be used as a safety measure if working at a lower height. The sample therefore was drawn from people that worked at over 2 metres.

The identification of the working at height population was part determined from an analysis and categorisation of RIDDOR high fall accident data (i.e. >2 metres) by BOMEL Ltd, and part expert input from the HSE project officer.

3.2 ANALYSIS OF ACCIDENT DATA

The high fall accident data quantifies the number of high fall accidents in occupations and the severity of the accident (fatal, major or other). Similar occupations with high accident rates were grouped together. 10 working at height categories were identified from this analysis, encompassing two thirds of all high fall accident occupations. The main aim with these industry categorisations was to encompass the working at height population and not just those that had high falls. The remaining third comprised people who worked rarely at height (e.g. hotel porters, teachers) or people in occupations that were represented by small numbers. The 10 categories are detailed in the table on the following page with the accident statistics for each category.

Table 1.Accident statistics for working at height categories

Categories	Total accidents	% Total accidents
New build	2896	26.4
Interior build	1913	17.5
Transport	1205	11
Offshore	1178	10.8
Steel construction	1113	10.2
Maintenance/repair	802	7.3
Agriculture/environment	563	5.1
Engineering	536	4.9
Manufacturing	454	4.1
Rescue services	298	2.7
Total	10,958	

A detailed breakdown of the accident data is presented in Appendix A to this report.

Full lists of all occupations measured are detailed in section 9 (Sample Composition) of this report. Design recommendations and anthropometric calculations made within this report are based on this population of people.

4 OBSERVATIONS OF WORK PRACTICES

4.1 INTRODUCTION

An exploratory survey of workers was carried out, through observations, to monitor different ways of working, loads carried, obvious differences in body size, clothing variation, types of protective clothing worn etc in preparation for the full survey. A number of different sites/working groups were observed. These were building site workers, tree surgeons, Heavy Goods Vehicle (HGV) drivers, overhead linesmen (work on pylons) and steel construction workers.

4.2 OBSERVATION FINDINGS

A number of different working methods and obvious differences in body size were identified through the observation survey. For example builders generally have no tools physically attached to them, where tree surgeons can have two chainsaws attached plus a number of ropes to aid and support them.

Great variations in body size were evident from this stage of the research. From the groups observed, HGV drivers were typically endomorph body shape – short thick limbs with much of the body mass concentrated around the abdominal area. Tree surgeons were typically mesomorph – muscular with triangular shaped bodies and large bones. Differences would seem to be a result of the physical demands in these occupations.

Types of PPE worn by the different working groups also ranged widely.

- HGV drivers wore minimal PPE, steel toe-capped boots, high visibility vest.
- Occupations on building sites such as builders, carpenters roofers etc. wore equipment identical to HGV drivers with the addition of a safety helmet.
- Linesmen that worked on overhead pylons wore steel toe capped boots, hard hats, a sit harness and two lanyards. They had a standard uniform that they wore (work trousers with matching t-shirt and jumper).
- Construction site workers/tradesmen generally wore casual clothes with a high visibility vest over the top. Tree surgeons wore chainsaw protective trousers with support braces over the top of casual clothes.

4.3 PRACTICALITY OF IN-FIELD MEASURING

The observation stage of the research was essential in determining the setting up of the main study. It is important to note that it was vital to this research that the people measured were wearing their work clothes and had their tools with them; reasons for this are detailed in following sections of the report. It was therefore necessary for the measuring to be carried out in the working environment. A number of issues had to be resolved prior to carrying out in-field measuring. These important findings from the observation survey shaped the experimental design for the main data collection.

4.3.1 Where Could the Measuring Take Place

Housing and steel construction sites had Portacabins on the sites where measuring could be set up and carried out. Larger arboriculture (tree surgeons) and HGV companies had depots. Smaller arboriculture companies however did not have such facilities therefore measuring would have to be carried out as near as possible to where they were working. Overhead pylon linesmen also had to be measured as near as possible to where they were working as they infrequently returned to their work depots. This meant that any equipment used to measure the workers had to be portable and robust.

4.3.2 Availability of Participants

In order to cause the minimum of disruption to the worker it was felt that in the majority of cases, workers could be measured at any point throughout the day. However, in some cases such with HGV drivers it was only possible to measure during break periods or at the beginning or end of a shift.

4.3.3 Trades on Construction Sites

Housing and steel construction sites had a variety of occupations/trades that worked at height, such as builders, joiners, roofers, painters and decorators, plumbers etc, enabling the capture of a large quantity of data from one given area.

4.3.4 Access to Participants

Feedback from the groups observed indicated that top level management of the organisations would have to give permission prior to any in-field measuring of their employees being carried out.

5 MEASUREMENT METHODOLOGY

5.1 INTRODUCTION

In the initial stages of the research the aim was to determine which anthropometric measurements were required if the dimensions and requirements of the torso dummy (BS EN 364:1993) were to be refined. Further consideration was paid to the type of anthropometric data required for this to be achieved i.e. 'static' or 'dynamic'. According to Pheasant (1986) "Static anthropometric data concern the fixed structural dimensions of the body, generally made between specified anatomical landmarks in stereotyped postures. Examples include stature, the heights of the eye or elbow in the standing or sitting position, the lengths of limbs and the breadths of shoulders or hips, and the depths of the body (from front to back) at various levels. Circumferences of the limbs and trunks and body weight are also in this category. Dynamic anthropometric data include measurements of reach or clearance made under functional conditions e.g. allowing the participants a certain degree of freedom to adopt 'natural' postures for the performance of a given task. The gathering of dynamic data must often be a 'one-off' for a particular design problem."

5.2 CLOTHING

The great majority of anthropometric surveys are conducted on participants who are nude or, at most, lightly clad. However, fall protection equipment is worn on top of clothing. Refinements to the dimensions of torso dummy therefore had to accurately represent the true body size that a harness, sit harness or work positioning belt would have to fit around. For all practical purposes the outfit is part of the person, therefore it was decided to measure the participants fully clothed and shod in their typical everyday works attire. No attempt was made to standardise the clothing worn. According to Rebiffe et al (1983) clothed surveys are only relevant for target populations whose style of dress remains constant over a reasonably long period of time. However, clothed surveys are not uncommon; in 1972 an anthropometric survey of British rail footplate staff was carried out clothed (Andrew & Manoy, 1972).

5.3 WEIGHT MEASUREMENTS

The main aim of this research was to determine the total weight of an individual if they were to fall from height. To accurately determine this, individuals were weighed in their work clothes with any equipment or tools that they would have attached to them or placed within their pockets if they were to be working at height. Tools that were carried loosely (not physically attached to them) by individuals when working at height were not included for the weight measurement; if they were to fall it is likely that such items would be dropped, not affecting the individual's total weight. A second weight measurement was taken of the individuals without their equipment and tools but with clothes and shoes to determine the mass being carried when working at height. Where no equipment was carried these two weights were the same.

5.4 MEASURING CONDITIONS

BS EN ISO 7250:1998 Basic human body measurements for technological design also specifies that the measuring conditions are documented together with the numerical results of any survey. According to this standard the conditions that should be recorded with such a survey are as follows:

- **Clothing of the participant**
- **Support surfaces** – Standing surfaces (floors), platforms or sitting surfaces shall be flat, horizontal and not compressible.
- **Body symmetry** – For measurements which may be taken on either side of the body, it is recommended that both sides are measured. If this is not possible, it should be indicated on which side the measurement was taken.
- **Measuring tools –** The standard measuring tools which are recommended are the anthropometer, sliding callipers, weighing scale and tape measure.
    - **The anthropometer** is a specialised tool for measuring linear distances between points on the body and standard reference surfaces, such as the floor or a seat platform.
    - **Sliding and spreading callipers** are used for measuring the breadth and depth of body segments, as well as distances between the reference marks.
    - **A tape measure** is used for measuring body circumferences.
- **Further conditions –** For chest and other measurements affected by breathing, it is recommended that they are taken during gentle breathing.

5.5 MEASUREMENT METHODS

5.5.1 Torso Dummy Measurements

The measurement methods used for refining the torso dummy were taken in accordance with BS EN ISO 7250:1998 Basic human body measurements for technological design. This international standard provides a description of anthropometric measurements which can be used as a basis for comparison of population groups. The list specified in this standard is intended to serve as a guide for ergonomists who are required to define population groups (the working at height population being the intended group for this research study). The measurements given in the standard are ones which are intended to provide information to ergonomists and designers on an anatomical and anthropometrical basis which can be applied in the solution of the design tasks. The standard provides a total of 55 measurements. Although not a requirement of the project, this standard was used as guidance for the survey whenever possible. In order to accurately refine the torso dummy, 8 measurements were relevant. These measurements are detailed and illustrated on the following pages. When body measurements could be taken on the left and right sides of the body they were always taken on the left hand side; this is detailed in the methodology for the relevant measurements. *(The following illustrations for the torso measurements have been taken from BS EN ISO 7250:1998. Reproduced with kind permission of British Standards Institution)*

The following 8 measurements were relevant to the torso dummy dimensions.

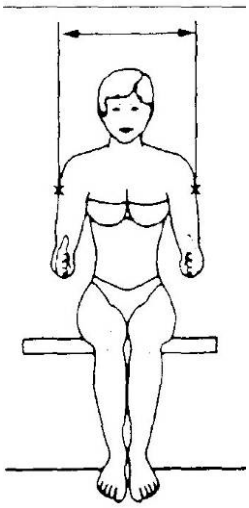
Body Mass (Without and With Equipment)

Description: Total mass (weight) of the body, clothes, with and without equipment.

Method: Make sure the scales are calibrated and on a level plane. The participant stands on the weighing scales firstly with equipment and tools, secondly without. Measurements should be recorded to 0.2 kg.

Instrument: Weighing scale

Shoulder breadth (deltoid)

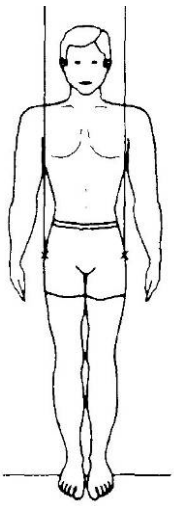


Description: Distance across the maximum lateral protrusions of the right and left deltoid muscles.

Method: Participant sits or stands fully erect with shoulders relaxed. Compact the clothes underneath the anthropometer, so no air is trapped.

Instrument: Large sliding calliper or large spreading calliper.

Hip breadth, standing

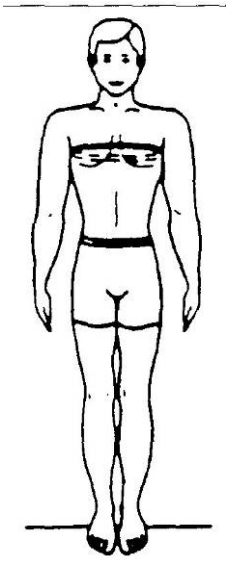


Description: Maximum horizontal distance across the hips

Method: Participant stands erect with feet together. Measurement is taken without pressing into the flesh of the hips. Always take the measurement from the front of the participant and compact clothing so that no air is trapped.

Instrument: Large spreading callipers

Chest Circumference



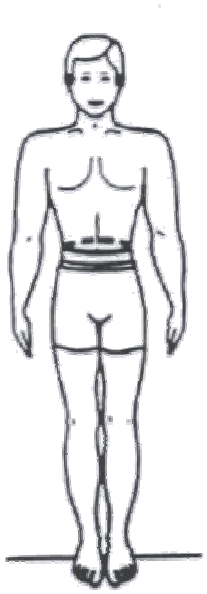
Description: Circumference at the torso measured at nipple level.

Method: Participant stands fully erect with feet together, arms hanging freely downwards. The tape measure should be placed at nipple level and the green section held at the front of the participant. The tape should be in contact with the participant all around the body. Measurement to be taken during gentle breathing.

Instrument: Tape measure

Waist Circumference

Description: Circumference of trunk at a level midway between the lowest ribs and the upper iliac crest.

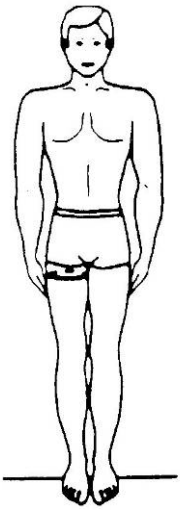


Method: Participant stands full erect with feet together and is asked to relax the abdominal muscles with the arms held slightly away from the sides of the body. The lowest ribs will be identified which may require the help of the participant if wearing many layers. The measurement will be taken just below this point at the side of the body. Measurement to be taken during gentle breathing.

Instrument: Tape measure

Thigh Circumference

Description: Maximum circumference of the thigh

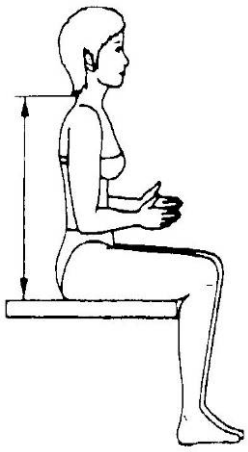


Method: Participant stands erect. Measurement taken on the left hand side of the body. Measurement is taken by passing the tape horizontally around the thigh immediately below gluteal fold, legs slightly apart, weight evenly balanced.

Instrument: Tape measure

Cervical height sitting

Description: Vertical distance from a horizontal sitting surface to the cervical



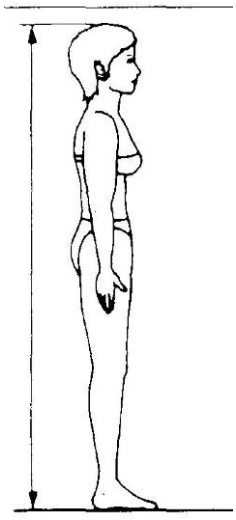
Method: Participants sit fully erect with thighs fully supported and lower legs hanging freely. Head is orientated in the Frankfurt plane.

Instrument: Anthropometer

5.5.2 Measurements for a Full Bodied Dummy

To aid the development of a full bodied dummy 3 further measurements were taken; stature, arm length (demy span) and leg length. The measuring method for stature is detailed in BS EN ISO 7250 *(Reproduced with kind permission from British Standards Institution)*; alternative measuring methods were used for the remaining measurements. For arm and leg length it was important that the methods used ensured measurement consistency, efficiency and reliability i.e. easily locatable landmarks and measurements that can be taken by an individual without assistance. The measurement method and image used for leg length was taken from ADULTDATA (1998) "The Handbook of Adult Anthropometric and Strength Measurements – *Data for Design Safety"*. The production of ADULTDATA (1998) was funded by the Department of Trade and Industry (DTI) and is intended for use in conjunction of existing safety standards. The measurement image and method used for arm length was again taken from this source; however, the measurement itself was slightly modified for measuring efficiency and reliability. The initial measurement taken from ADULTDATA (1998) to determine arm length was span. Span is measured from the tip of the middle finger on one hand to the middle finger on the other. The person stands erect, feet together and arms outstretched on either side in line with the shoulders. However, this would require two persons to accurately measure, therefore reducing measurer efficiency. For practical purposes demi-span was chosen measurement to be taken.

Stature

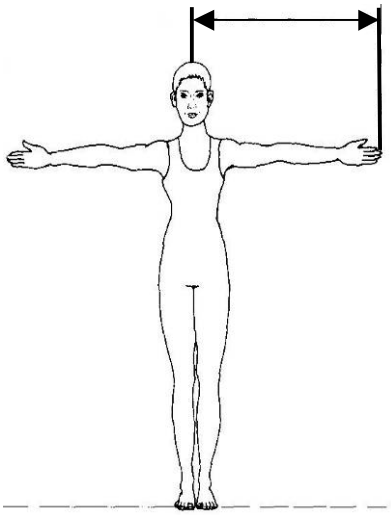


Description: Vertical distance from the floor to the highest point of the head (vertex)

Method: Participant stands fully erect with feet together. Head is orientated in the Frankfurt plane (A standard position of reference in which the upper border of the external auditory meatus is on a horizontal plane with the lower border of the eye (www.cartage.org.lb)). Make sure sliding plate touches the participants head.

Instrument: Stadiometer

Arm length – demi-span

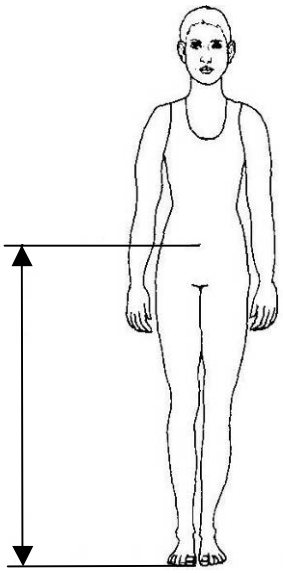


Description: Measured horizontally from the centre of C7 vertebrae at the base of the neck to tip of the outstretched middle finger on the left hand.

Method: The participant stands fully erect, feet together, looking straight ahead. Locate C7 vertebrae at the base of the neck, participant outstretches left arm so horizontal.

Instrument: Tape measure

Leg length



Description: Measured vertically from the floor to the top of the greater trochanter at the head of the thigh bone (femur).

Method: Participant should stand fully erect looking straight ahead. The forward facing point of the left hip bone will be identified which may require help from the participant if wearing many layers, measure straight down to the floor. Measured on the left hand side of the body.

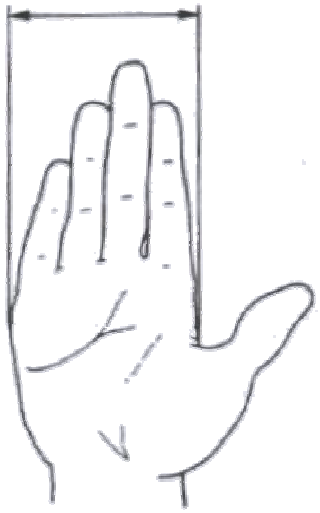
Instrument: Tape measure

5.5.3 Measurements for Safety Net Dimensions

Four measurements were taken to advise on the dimensions of safety nets, these being hand breadth, hand span, shoe length and shoe breadth. The measuring method and image for hand breadth is taken from BS EN ISO 7250 *(Reproduced with kind permission from British Standards Institution)*. However, hand span, shoe length and width is not included in this standard. The measurement methods and images used for these measurements were taken from ADULTDATA (1998). All of these measurements were taken on the left hand side of the body.

Hand breadth

Description: Projected distance between radial and ulnar metacarpals at the level of the metacarpals heads from the second to the fifth metacarpal

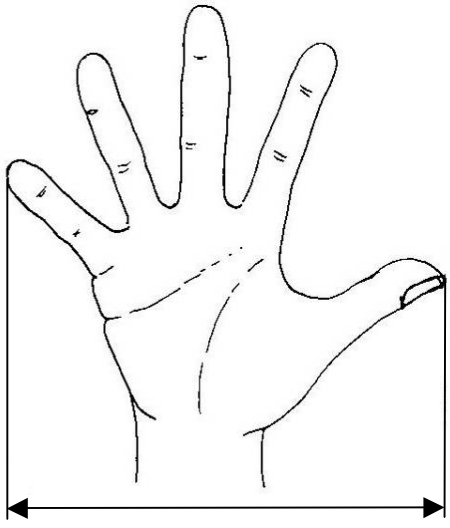


Method: Participant holds left forearm horizontal with hand stretched out flat, palm down.

Instrument: Sliding calliper

Hand Span

Description: Measured from the outer boarder of the tip of the little finger to the outer boarder to the tip of the thumb.

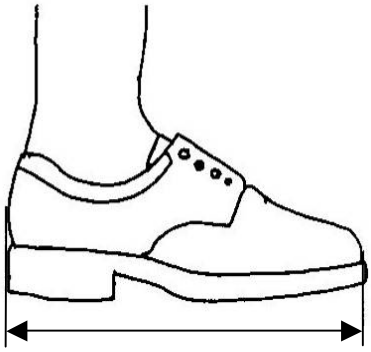


Method: The participant stretches their left fingers and thumb as widely apart as the person finds comfortable.

Instrument: Measuring plate, purpose built for the project

Shoe Length

Description: Maximum distance from the rear of the shoe to its foremost tip, measured horizontally.

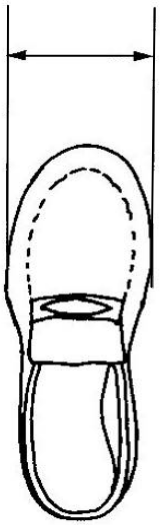


Method: Participant stands with weight equally distributed on both feet.

Instrument: Anthropometer

Shoe breadth

Description: Maximum distances across the widest part of the shoe.



Method: Measured horizontally across the widest part of the shoe, perpendicular to the length of the shoe.

Instrument: Anthropometer

In total 15 measurements were taken to establish whether current design standards accurately represent the labour force that work at height. A summarised list of all the measurements taken is detailed in the table below.

Table 2.Measurements taken

Torso dummy dimensions	Body mass without equipment
	Body mass with equipment
	Shoulder Breadth
	Hip Breadth
	Chest Circumference
	Waist Circumference
	Thigh Circumference
	Sitting Cervical Height
Full body dimensions	Stature
	Arm Length
	Leg Length
Safety net dimensions	Hand Breadth
	Hand Span
	Shoe Length
	Shoe Width

Demographic and descriptive data of each participant were recorded with the measurement data. The demographic data recorded are detailed in paragraph 6.3.1. The descriptive data recorded were clothing worn, equipment carried and any problems with eyesight, these data are detailed in paragraph 11.7

5.6 MEASUREMENT ACCURACY

The human body has very few sharp edges – its contours are rounded and it is generally squashy and malleable. The consequent difficulty in identifying landmarks and controlling posture makes it virtually impossible to achieve an accuracy of better than 5mm in most anthropometric measures. These errors however pale into insignificance in comparison with those that might occur in the application of even the most accurate tables (Pheasant, 1986). Body mass however is a safety critical measure therefore accuracy is at a premium. The scales used for measuring body mass weighed to the nearest 200g, however BS EN ISO 15535:2003 "General requirements for establishing an anthropometric database" requires body mass to be measured only to the nearest 500g, ensuring good accuracy in the survey. The anthropometric instruments used for taking linear and circumferential measures, measured to the nearest 1mm, in line with BS EN ISO 15535:2003.

5.7 SAMPLING

The general idea behind sampling theory is that a small subset, or sample of a much larger population is selected in such a way that the sample statistics will provide valid and reliable inferences or estimates with respect to the corresponding parameters of the population of interest. Of course, the question arises as to why it is necessary to look at samples at all – why not measure the variables of interest with respect to the whole population? Three specific reasons are:

- Time constraints (An answer is required within a reasonable time).
- Logistic constraints (It is not physically possible to sample all units in a population)
- Tests to destruction (testing might result in the destruction of the sample)

However, the reason that occurs most often, with this research being no exception, is related to economic or budgetary constraints.

5.8 SAMPLE SIZE

Once the decision to sample has been taken, the next consideration has to be sample size. Again, this factor is often driven by economic / budgetary considerations with the general assumption that the larger the sample, the smaller the sampling error tends to be. Accurate anthropometric calculations require reliable data for the relevant user populations. To get such data, careful measurements of large numbers of people is needed. The chart below shows how the sampling error for the 50th percentile (median) reduces with increased sample size.

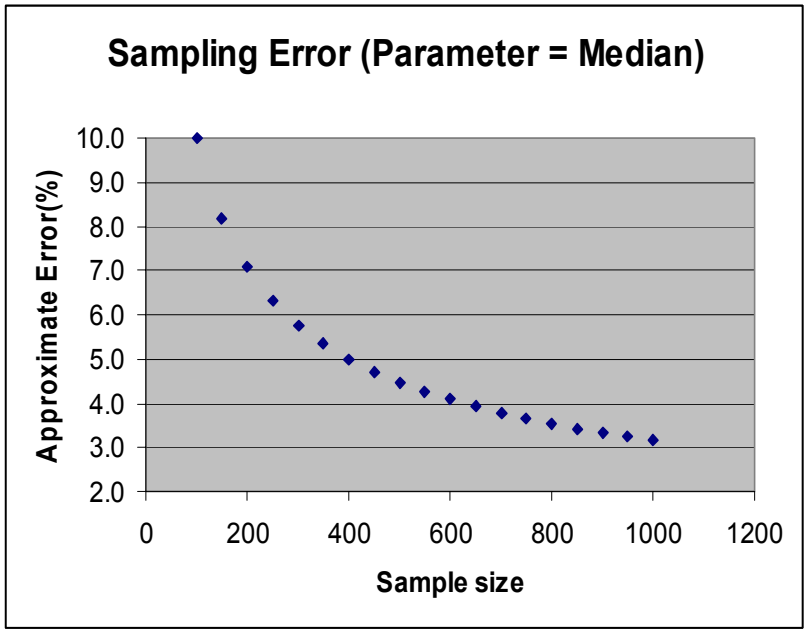


Figure 3. Sampling error

Here we can see that the sampling error has reduced from 10% at n=100 to 5% at n=400. After that the decreases become smaller and smaller with a sample size of n = 1600 being required to reduce the sampling error to 2.5%. For this reason many survey organisations suggest that n=400 is a sample size that provides a good trade-off between sampling accuracy and financial spend. According to Pheasant (1990), between 500 and 1000 individuals should suffice for anthropometric surveys, provided they are a representative sample.

Formulas for sample size can be found in statistical textbooks, although a neater formula can be found in the standard (BS EN ISO 15535:2003 General requirements for establishing an anthropometric database):

$$n = \left(\frac{1.96 \times CV}{A}\right)^2 \times 1.534^2$$

Here CV represents the coefficient of variation and A is the percentage of relative accuracy desired.

Sample figures detailed in the standard suggest sample sizes ranging from 131 participants (Stature) through 254 participants (Shoulder Breadth) to 443 participants for Chest Circumference and assume a 1% relative accuracy level and 95% confidence coefficient. Also detailed in the standard are relevant confidence intervals for percentiles of the sample mean distribution. The research focus of this study, however, is more on extreme measures, 1st, 5th, 95th and 99th percentiles (and their 95% confidence intervals). The purpose of this research is to investigate extreme values for much smaller subsets, it is therefore unlikely that an appeal to the central limit theorem would be appropriate and Bootstrap or re-sampling techniques be used. This is discussed in later sections of the report.

In general, however, it was desirable for the overall sample size to be large enough to allow us to be able appeal to the central limit theorem for proportions – and in particular the 95th and 99th percentiles. For proportions generally, the requirement for an adequate normal approximation is that:

$$npq > 5$$

Where n is the sample size, p is the proportion of the variable displaying a particular attribute and $q = 1 - p$.

For the 99th percentile for example, (our most extreme measures of particular interest). p =0.01 and q = 0.99.

This would suggest that $n > 5 / (0.01 \times 0.999)$

or $n > 505$.

This falls in line with Pheasant's minimum recommendations (1990), even for the extreme measures for the whole sample.

The research was also interested in the analysis of data taken from sub groups. The major sub-group of concern is the industrial category. A total of 10 different industrial categories were sampled and it was decided to use approximately equal sampling proportions.

In order to determine the minimum sample for the separate sub groups (industry categories) it was decided to consider a sub-sample size (ns) in which the 90th percentile could be considered approximately normal.
The equation for this is:

$$ns \times (0.1) \times (0.9) > 5$$

Or $ns > 56$

This would lead to an overall sample size of 560. However, since getting exactly 56 respondents in each sub-category might be operationally restrictive, it was decided to collect between 50 and 70 members in each sub group – provided that the total sample size was not less than 560.

5.8.1 Sampling Techniques and Requirements

BS EN ISO 15535:2003 General requirements for anthropometric databases suggests that the demographic characteristics of the population, such as nationality and occupation are indicated as clearly as possible.

A stratified sampling method was used. The sample was established by a procedure in which the population was divided into sub-groups (strata), for this research the working at height population was divided into 10 industry categories each one of which contributes with a specified number of randomly selected individuals.

5.8.2 Sample Composition

BS EN ISO 15535:2003 General requirements for anthropometric databases, details the importance of taking into account age and sex during the planning of data collection. However, occupation was the key factor in determining the sample composition for this study. Sex was taken into consideration when determining the sample composition, however, currently there are very few if any statistics relating to the sex of individuals that work at height. It was therefore not possible to determine a sample composition that was representative of the sex of the individuals that work at height. However, the stratified sample technique meant that it was possible to obtain a sample composition that was representative of people who work at height.

6 ANTHROPOMETRIC DATABASE

6.1 INTRODUCTION

An anthropometric database was set up for the collection of the individual body measurements (static anthropometric data) and their background information (demographic data). BS EN ISO 15535:2003 General requirements for establishing an anthropometric database is a standard designed to ensure anthropometric databases and their associated reports are internationally compatible. There was no requirement of this study to develop a database that was internationally compatible; however, BS EN ISO 15535:2003 was followed as closely as possible.

6.2 DATABASE METHODOLOGY

The following methods were used in assembling the database to try to ensure its international compatibility:

- The measuring methods in BS EN ISO 7250 Basic human body measurements for technological design were used. Any deviation has been noted.
- It is clearly indicated that when body measurements could be taken on the left and right sides of the body they were always taken on the left hand side (i.e. hand breadth, hand span, thigh circumference, arm length, leg length, shoe length and width).
- Detailed sketches of the measurements taken were provided alongside the documentation of the measurement procedures.
- For the purpose of this study the participants had to be fully clothed, however the standard requires participants to be nude or wear minimal clothing.
- Measuring conditions were detailed fully within the results of the survey.

6.3 DATA COLLECTION REQUIREMENTS

6.3.1 Basic Demographic Description of Participants

Prior to participants being measured a demographic description of each individual was recorded into the database as required. Recorded was the participants' date of birth, sex, ethnic identity and occupation. However, geographical location and dwelling area were not recorded due to its lack of relevance to the study, also due to time restraints placed on measuring the participants.

6.3.2 Detection and Treatment of Measurement Errors

The database was setup to detect obvious anomalies during the data collection phase. Using Microsoft Excel, a worksheet was configured so that it would detects figures that lay outside any reasonable range of data given for that measurement. In detecting such figures, the database was programmed so that it would turn the figure red to alert the researchers that a significant error had been made, to check the data.

6.3.3 Data Storage System

All biographical and participant data were recorded onto a laptop into Microsoft Excel. The laptop used to store the data was protected by a number of passwords for security reasons. The raw data were only available to the individuals concerned with the collection and analysis of the data, in line with the requirements of the data protection act.

6.3.4 Type of Clothing

BS EN ISO 15535:2003 requires the clothing worn by the individuals participating to be coded and identified (e.g. nude = 0, underwear = 1, light clothing = 2, other clothing as specified = 3). One of the aims of this study was to determine the maximum weight of individuals that work at height therefore the participants were all measured in their typical everyday work clothes (and as such, would be classified as 3 on the above coding system). Details of the clothes that each individual were wearing were entered into the database, although there was no further coding for this.

6.4 DATA QUALITY CONTROL

The name of the measurer who was measuring the participant was entered into the database during data collection so if questions about unusual values arouse, they could be easily resolved. To preserve the participant's anonymity a participant number was allocated.

6.5 DATABASE FORMAT

The format of the database met the following requirements detailed in BS EN ISO 15535:2003:

- Each data item was separated by a tab.
- All the data were entered in English.
- The name of each data item was shown in the first row using the designated English words.
- Item code numbers and acronyms were not used in row 1.
- The second and subsequent rows of the database contain actual data from participants within each data item in the same order as its name listed in row 1.
- Measuring items from ISO 7250 appeared as the first measurement items on the data sheet

6.6 STATISTICAL PROCESSING

The data were inspected where inconsistencies or missing data were found, these were removed in total and outlying statistical values were highlighted but as this research was an examination of extreme statistical parameters, it was felt inappropriate to remove these from the sample. For the weight measurements in particular an outlying statistical value existed, statistical values were calculated with and without this outlier to determine to what extent this skewed the sample. The affect of removing the outlier can be seen in section 11.5 of the report.

7 MEASURER TRAINING AND QUALITY CONTROL

7.1 INTRODUCTION

Two types of error needed to be monitored in this research.

- Sampling error – that is the error encountered by using a sample rather than the whole population, is discussed in the section 5.7 and 5.8.
- Measurement error caused by inconsistencies between the techniques used by the measures and variations in the posture and clothing of an individual when being measured.

BS EN ISO 15535:2003 states that frequent and regular measurer training and quality control shall be carried out by persons experienced in anthropometry, to ensure acceptable standards of accuracy. The four people undertaking the measuring in this study had qualifications and experience relating to anthropometry. They also undertook a period of training to minimise measurement error.

7.2 MEASURER TRAINING

Prior to carrying out the in-field measurements, all measurers were involved in a period of measurer training to ensure each were adequately trained in these techniques, to ensure intra-measurer and inter-measurer accuracy. Initially, to familiarise each measurer with the measuring techniques for the 15 selected measurements, all measurers were required to measure 10 different people, these measures were then repeated, following the recommendations of BS EN ISO 15535:2003. This stage was essential in the familiarisation of the measurement methods. To investigate the consistency of the measurers, statistical assessment of the data using S-Measure was conducted (Tanner & Weiner, 1949).

Following statistical analysis and revision of some of the measurement techniques, each measurer measured a further 50 people, twice. Only 5 of the 15 dimensions were used in this process.

The idea behind the S-Measure is that if an individual measures a dimension twice and records readings of x_1 and x_2 , then d, the difference between those readings will give some guidance as to the individuals accuracy.

$$\text{If} \quad d = x_1 - x_2$$

And we can assume that $x_i = \mu + \tilde{\varepsilon}_i$

For all i, where μ is the true value of the reading and $\tilde{\varepsilon}_i$ (i=1 2, …n) are identically and independently distributed random error terms with zero mean and constant variance.

Then $d = (\mu + \tilde{\varepsilon}_1) - (\mu + \tilde{\varepsilon}_2) = (\tilde{\varepsilon}_1 - \tilde{\varepsilon}_2)$

And $Var(d) = Var(\tilde{\varepsilon}_1 - \tilde{\varepsilon}_2) = 2Var(\tilde{\varepsilon})$

So that the error variance is given by $Var(\tilde{\varepsilon}) = (Var(d))/2$

And the standard deviation of the error, sometimes called the S-Measure, is given by

$$\sigma_{\tilde{\varepsilon}} = \sigma_d / \sqrt{2}$$

This allows making comparisons within a single dimension, but if comparisons over more than one dimension are to be considered then the S-Measure needs to be expressed as a percentage of the mean dimension measurement, to ensure an accuracy of 2 mm in 2000 mm can be compared easily with 1 kg in 20 kg.

A typical calculation for the Weight dimension is shown in the table below.

Table 3.Measurer accuracy example: Weight (kg) 50 participants

	Measurer 1	Measurer 2	Measurer 3	Measurer 4
Average Difference	0.02	-0.02	0.00	0.01
Standard Deviation (Diff)	0.27	0.23	0.16	0.10
S-measure	0.19	0.16	0.11	0.07
1.96 x S-Measure	0.37	0.32	0.22	0.14
Average Weight	75.41	75.40	76.18	76.18
% Error (+/-)	0.49	0.42	0.29	0.19
Overall Average % Error	0.35			

Such calculations were carried out for each measurer in the pilot study and the results are summarised below:

Table 4.Average Error (%) 10 readings data

Dimension	Avg Error
Shoulder breadth	2.2
Hip Breadth	2.4
Body Depth	4.8
Shoulder Circ	2.9
Chest Circ	1.7
Thigh circ	2.6
Hand span	1.5
Shoulder height	1.6
Leg Length	1.3
Shoe Length	1.9

After reflecting on the initial measurements, some changes were made to the dimension being taken and measurement methods were modified. For example, it was decided that arm length should be taken from the centre of C7 vertebrae at the base of the neck instead of from the acromion, using a more easily located landmark. It was also decided not to measure body depth (a dimension with considerable error) as chest and waist circumference would provide sufficient information to be able to refine this section of the torso dummy.

The main training period required each measurer to measure 50 different people twice with the participant being completely repositioned for the second set of measurements. This is a common method used in previous anthropometric surveys conducted by the Institute for Consumer Ergonomics (1983), ensuring acceptable standards of accuracy and reliability. Only 5 of the 15 measurements were taken during this phase of the pilot study, to provide an efficient but effective check of measurement accuracy. The measurements taken were weight, stature, waist circumference, arm length and hand breadth. The average error rate from the measurements is detailed in the table below:

Table 5.Average error (%) 50 readings

Dimension	Avg Error
Weight	0.3
Stature	0.2
Waist Circumference	1.7
Arm Length	0.8
Hand Breadth	1.5

Height and Weight showed good accuracy (well within the criteria of 1% stated in ISO 15535). Arm length showed acceptable accuracy (within the criteria of 1% stated in ISO 15535), as a result of the revision of the measurement technique used.
Hand breadth showed some error, which was rectified by additional training to ensure better accuracy. Waist circumference showed approx. 2% error. Although the circumference measurement exceeds the error rate criterion in the standard, it is very difficult to improve using the chosen measurement techniques, as bulky clothing, posture and breathing all affect the measure. Whilst better accuracy would be attained by measuring people who are lightly clothed, this conflicts with the research objectives of getting 'real' conditions of clothing.

It is clear from this, that the error ratings had become considerably reduced ensuring acceptable standards of accuracy and reliability. Where obvious errors were detected in the data collection and data entry, results from these participants were discarded and are not included in the data of the final sample of 589 subjects. In practice, this was rarely necessary.

8 IN-FIELD MEASURING

The in-field measuring stage of the project took place from March 2004 to June 2004 throughout the UK. A total of 589 people that work at height were measured. For each of the ten working at height industry categories, between 49 and 72 people were measured. Of the four trained measurers, two main measurers carried out 90% of the measuring for consistency, with the other two 2 standing in when necessary.

8.1 INSTRUCTIONS TO THE PARTICIPANTS

Having gained agreement from the management to attend a site, the measurer introduced themselves to the participants. Each participant was required to read and sign a consent form (a copy is included in Appendix B) prior to participating in the trials. The consent form explained the purpose of the measuring and detailed what would be required of them.

8.2 IN-FIELD MEASURING CONDITIONS

The following in-field measuring conditions were recorded:

8.2.1 Measuring Equipment

The diagram below shows the equipment used for each type of measurement taken.

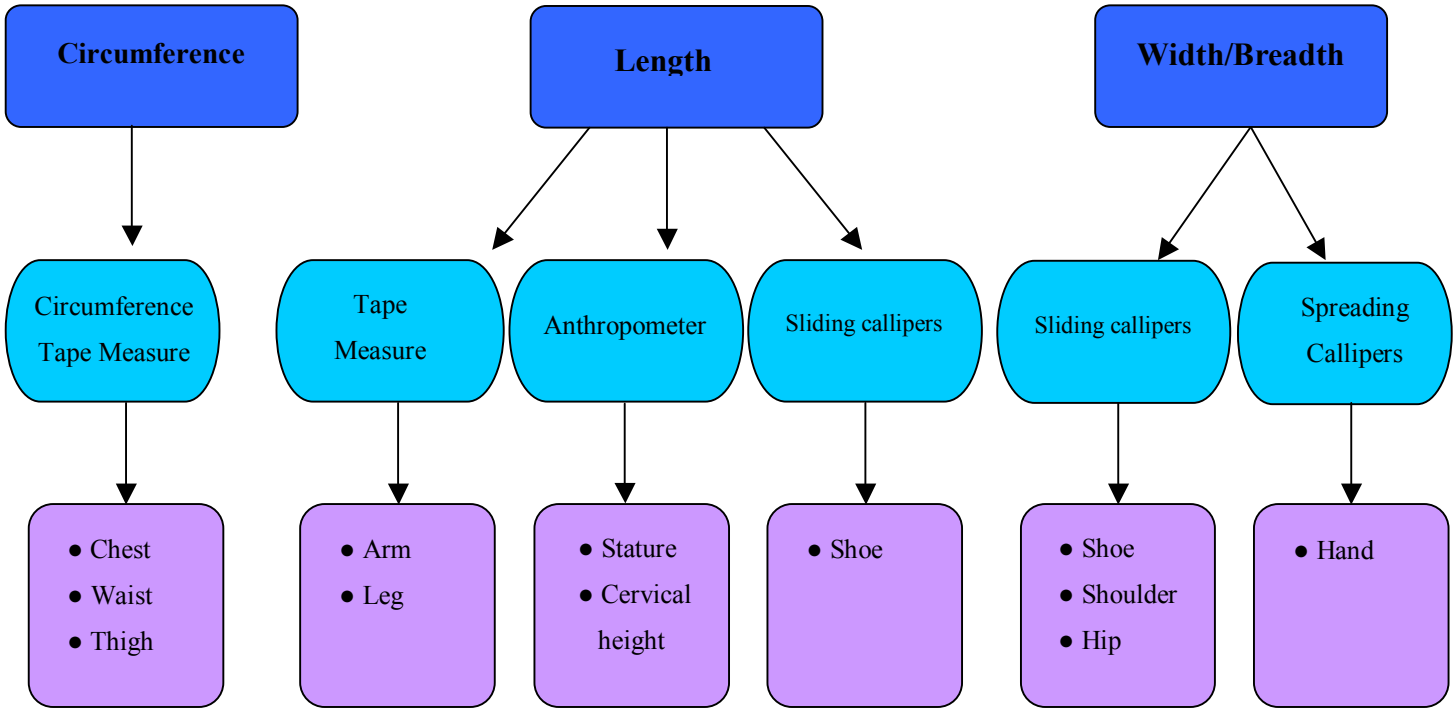


Figure 4. Measurement equipment summary

8.2.2 Measuring Environment

The measurements had to be taken in the works environment for all practical purposes relating to the very nature of this project. Examples of the types of working environments visited can be seen illustrated in figures below, and on the following page.

Figure 5. Steel Construction site

Figure 6. Fire Station

Figure 7. Heavy Haulage Company

8.2.3 Support Surfaces

Both standing surfaces (floors), platforms and sitting surfaces used to take measurements on were flat, horizontal and not compressible. Where supporting surfaces did not meet these criteria, measuring was relocated to areas where they did. Illustrated in the figure below is a typical example of the solid standing surfaces used.

Figure 8. Solid standing surface

A rigid steel measuring table was used to measure cervical sitting height; this can be seen illustrated in the figure below.

Figure 9. Solid sitting surface

Hand breadth and hand span was measured on a rigid plastic plate which was placed either on the measuring table or an alternative solid surface. An example of this can be seen in the figure below.

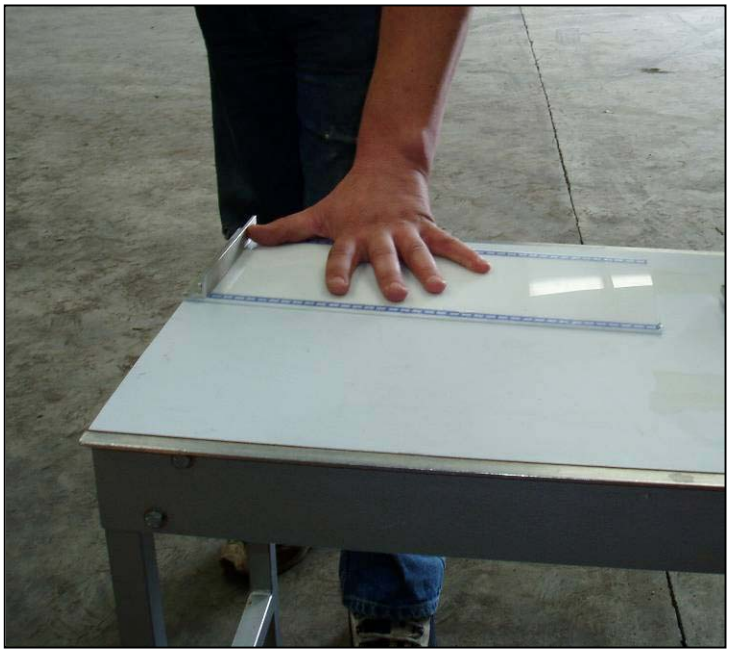


Figure 10. Rigid plastic platform placed on measuring table

8.2.4 Body Symmetry

Where the measurement could be taken on either side of the body, it was always taken on the left, which was clearly documented in the measuring procedures and methods. An example of this can be seen in the following figure.

Figure 11. Thigh circumference measured on left hand side of body

The left hand was measured for hand breadth. This is illustrated in the figure below.

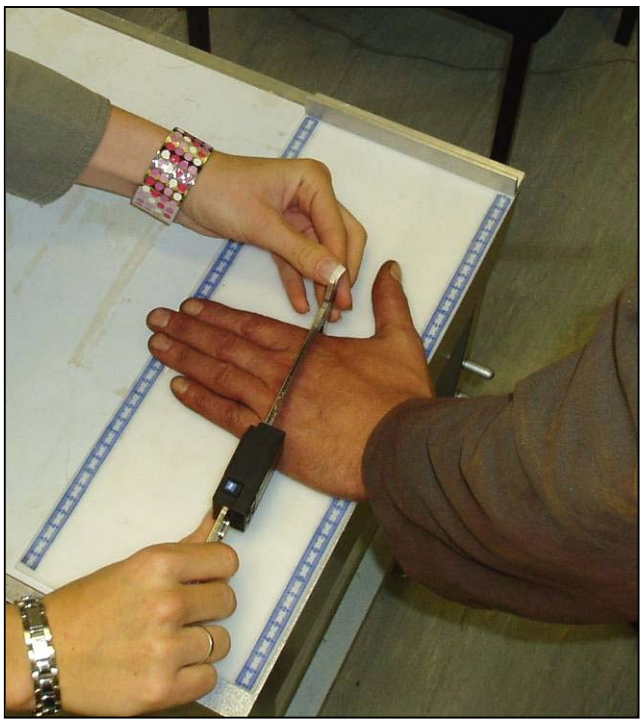


Figure 12. Left hand breadth

Hand span was also measured on the left hand. This is illustrated in the figure below

Figure 13. Left hand span

Arm length was measured on the left hand side of the body. This is illustrated in the following figure.

Figure 14. Left arm length

Leg length was measured on the left hand side of the body. This can be seen illustrated in the figure below.

Figure 15. Leg length

The length of the left shoe/boot was measured. This is illustrated in figure below.

Figure 16. Shoe length

The width of the left shoe was measured. This is illustrated in the following figure.

Figure 17. Shoe width

8.2.5 Measuring Tools

The measuring instruments used were in accordance with those recommended in BS EN ISO 7250:1998, ensuring the anthropometric measurements were taken to the required accuracy, quickly and conveniently. All measurements were read to the nearest millimetre. The measuring tools used are detailed on the following pages.

The anthropometer – is a specialised tool for measuring linear distances. This is illustrated in the figure below.

Figure 18. Anthropometer

The anthropometer was used to measure stature. This can be seen in the figure below.

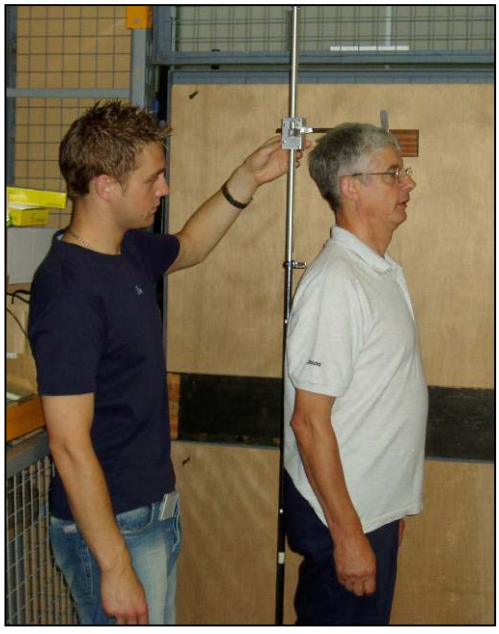


Figure 19. Anthropometer measuring stature

The anthropometer was also used to measure Sitting Cervical Height. This is illustrated in the figure below.

Figure 20. Anthropometer measuring Sitting Cervical Height

Sliding and spreading callipers – were used for measuring the breadth and depth of body segments, the sliding callipers used can be seen illustrated in the figure below.

Figure 21. Sliding callipers

The sliding callipers were used for measuring shoulder breadth, hip breadth, shoe length and width. Shoulder breadth can be seen being measured with the sliding callipers in the figure below.

Figure 22. Measuring shoulder breadth with sliding callipers

A tape measure – was used for measuring arm and leg length. The tape measure used is illustrated in the following figure.

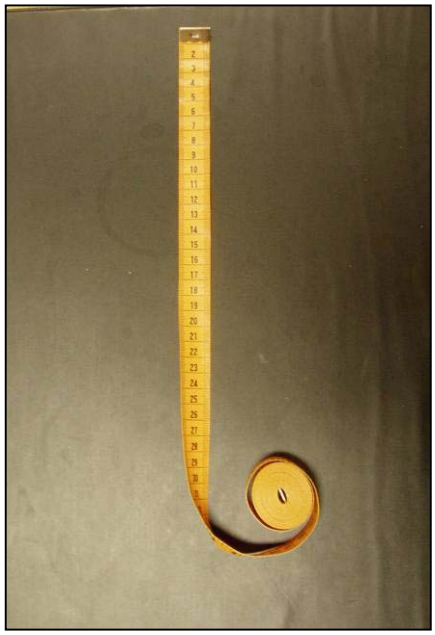


Figure 23. Tape measure

A circumference tape measure – was used for measuring chest, waist and thigh circumference. The circumference tape measure used can be seen in the figure below

Figure 24. Circumference tape measure

The circumference tape measure can be seen being used to measure chest circumference in the figure below.

Figure 25. Measuring of chest circumference

Electronic digital callipers – were used to measure hand breadth. The electronic digital callipers used are illustrated in the figure below.

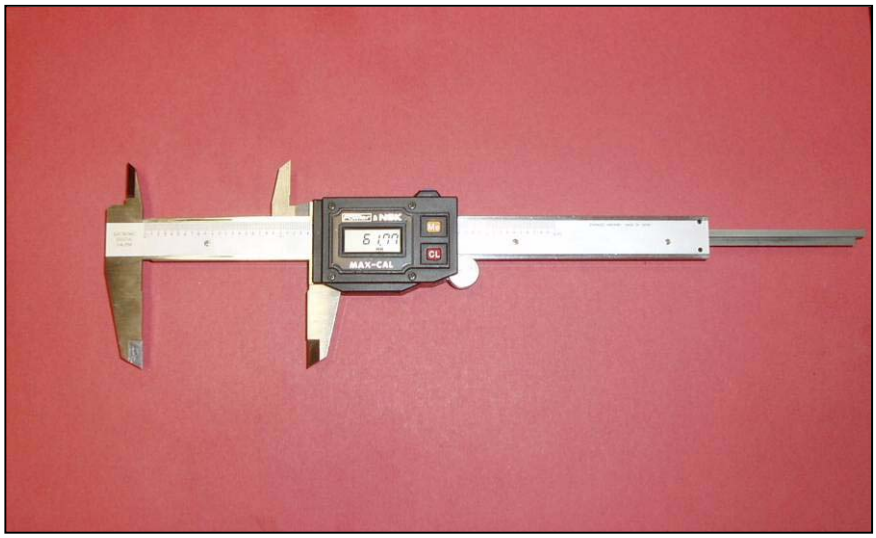


Figure 26. Electronic digital callipers

Rigid plastic measuring plate – was used to measure hand span. This can be seen illustrated in the figure below.

Figure 27. . Rigid plastic measuring plate

9 SAMPLE COMPOSITION

9.1 SAMPLE STRUCTURE: GENERAL

From 47 organisations, a sample of 589 participants was obtained. The number of participants measured in each working at height category was between 49 and 72, this is detailed in the figure below.

		Frequency	Percent
Total No. of subjects 589	Steel construction	50	8.5%
	New build	72	12.2%
	Interior build	67	11.4%
	Transport	64	10.9%
	Offshore	70	11.9%
	Manufacturing	50	8.5%
	Rescue services	63	10.7%
	Maintenance/Repair	54	9.2%
	Agriculture/Environment	49	8.3%
	Engineering	50	8.5%

Figure 28. Number of participants measured in each category

The percentages in each sample are shown in the figure below.

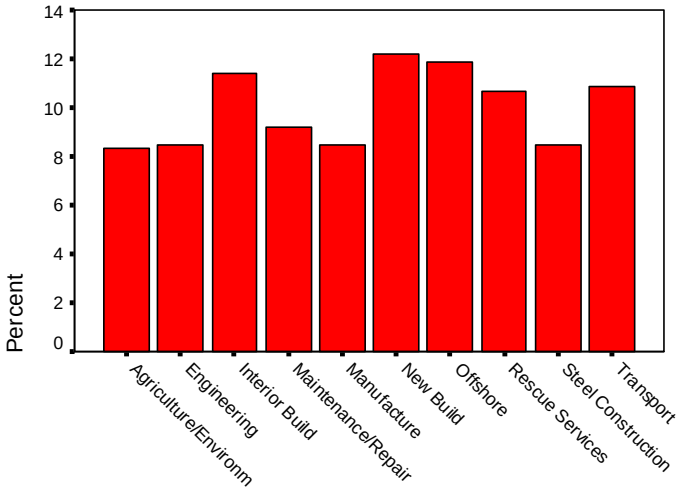


Figure 29. Sample composition by industry category

9.2 OCCUPATIONS WITHIN EACH CATEGORY

The occupations of the participants measured in each industry category were:

	Qty	Occupation
Steel construction	24	Steel erector
	8	Net erector
	5	Ceiling fitter
	4	Site supervisor
	1	Labourer
	1	Pipe fitter
	1	Site manager
	1	Construction manager
	1	Welder erector
	1	Health & Safety director
	1	Site operative
	1	Foremen roofer
	1	Contracts manager
Total:	**50**	

	Qty	Occupation
New Build	17	Bricklayer
	10	Carpenter
	9	Scaffold erector
	7	Labourer
	7	Fork lift driver
	6	Hod carrier
	5	Site manager
	3	Assistant site manager
	2	Store man
	1	Ground worker
	1	Quantity surveyor
	1	Ground worker
	1	Contracts manager
	1	Joiner
	1	General labourer
Total:	**72**	

	Qty	Occupation
Interior build	18	Plumber
	17	Painter & Decorator
	10	Plasterer
	8	Electrician
	7	Dry liner
	3	Kitchen fitter
	3	Partitioner
	1	Boarder
Total:	**67**	

	Qty	Occupation
Transport	18	PCV driver
	13	Motorway Maintenance
	6	HGV driver
	5	Training instructor (scissor lifts)
	3	Scissor lift operators
	4	HGV mechanic
	3	Trailer mate
	2	Bus mechanic
	2	Refueler parker
	2	Coach cleaner
	2	Fork lift driver
	1	Bus driving instructor
	1	HGV fitter
	1	HGV valet
Total:	**64**	

	Qty	Occupation
Offshore	29	Engineer
	18	Wire line operator
	8	Technician
	3	Slick line assistant
	3	General manager
	1	District manager
	1	Sales engineer
	1	Project manager
	1	Mechanic
	1	Electrician
	1	Fluid specialist
	1	Data acquisition technician
	1	Fitter
	1	Supervisor/driver

Table: 70

	Qty	Occupation
Manufacturing	13	Plater
	9	Welder
	6	Fettler
	4	Health & Safety officer (car manufacture)
	4	Woodworker
	3	CNC programmer/operator
	2	Machine operator
	1	Sheet metal worker
	1	Electrician
	1	Product quality supervisor
	1	Foreman
	1	Material co-ordinator
	1	Fork lift driver
	1	Tank tester
	1	Profile cutter
	1	Department manager

Total: 50

	Qty	Occupation
Rescue services	24	Fireman
	16	Mountain rescue
	13	Fire arm officers
	8	Police officer
	2	Tactical defence unit (Police)
Total:	**63**	

	Qty	Occupation
Maintenance/Repair	12	Overhead pylon linesman
	9	Maintenance fitter
	7	Maintenance electrician
	7	Process operator
	6	Rigger
	3	Rope access instructor
	2	Technical operator
	2	Instrument technician
	1	Maintenance technician
	1	Maintenance planner
	1	Assistant maintenance manager
	1	Rope access technician
	1	Abseiler
	1	Maintenance project manager
Total:	**54**	

	Qty	Occupation
Agriculture/Environment	29	Tree Surgeon
	13	Farmer/Farm worker
	6	Gardener
	1	Deer Warden
Total:	**49**	

	Qty	Occupation
Engineering	14	Electrical engineer
	5	Scissor lift service engineer
	5	Engineer
	3	Engineering team leader/building maintenance
	2	Ventilation engineer
	2	Quarry plant engineer
	2	Fitter
	2	Communication cabinet maker
	2	Fabricator
	1	Plumbing engineer
	1	Engineering surveyor
	1	Fire alarm engineer
	1	Plant fitter
	1	Engineering technician
	1	Steel worker
	1	Mobile communication field engineer
	1	Inspection engineer
	1	Sheet metal welder
	1	Wireman
	1	Plater
	1	Sales Engineer
	1	Industrial engineer
Total:	**50**	

10 DATA ANALYSIS TECHNIQUES

10.1 INTRODUCTION

Data from the 589 participants were entered into the statistical package SPSS and analysed. A separate data analysis package S-Plus was used to provide additional analyses. The measurement findings from this research are detailed throughout this section of the report. In addition to the 15 body dimensions recorded, a number of other variables were noted and three variables – Working Weight, Weight of Equipment and the Body Mass Index (BMI) were derived from the data.

For each measurement the minimum, maximum, 1%ile, 5%ile, 50%ile, 95%ile and 99%ile are detailed for the whole sample and then more limited statistics are given for each of the 10 industry categories. The bootstrapped (BS) results for the 95%ile and 99%ile are also detailed; bootstrapping provides distributions and confidence limits for any statistic and is described in more detail in the next section. Main emphasis is given to the upper extremes of the data distribution. Later, variables where the lower extremes of the data distribution may be considered to be of important are considered (Stature, Hand Breadth, Hand Span, Shoe Length and Shoe Width).

10.1.1 Bootstrap Technique

The bootstrap technique has been widely used in this research. As mentioned previously, the researchers have usually relied on the central limit theorem because of its computational traceability. However, if the normality assumption does not hold, then traditional methods can not be used to construct confidence intervals.

Re-sampling techniques like the bootstrap provide distributions and confidence limits for any statistic. The bootstrap, for example, selects random samples of a given size from the observed data. The samples are drawn with replacement and a value of the statistic of interest calculated for each individual sample (1000 in our case). From the re-sampled values it is possible to graph the distribution and calculate confidence intervals. Efron and Tibshirani (1993) and Shao and Tu (1995) give comprehensive accounts of bootstrapping.

It is only possible to compare the results of traditional (normal) techniques and the bootstrap in circumstances where normality assumptions are valid. If we are interested in predicting 95% confidence limits for the participants' weight, for example, conventional methods yield an interval from 87.2 kg to 89.6 kg. The bootstrap also yields an interval of 87.2 kg to 89.6 kg. In this case the results are identical. A graph of the bootstrapped distribution is included for illustration in the figure below.

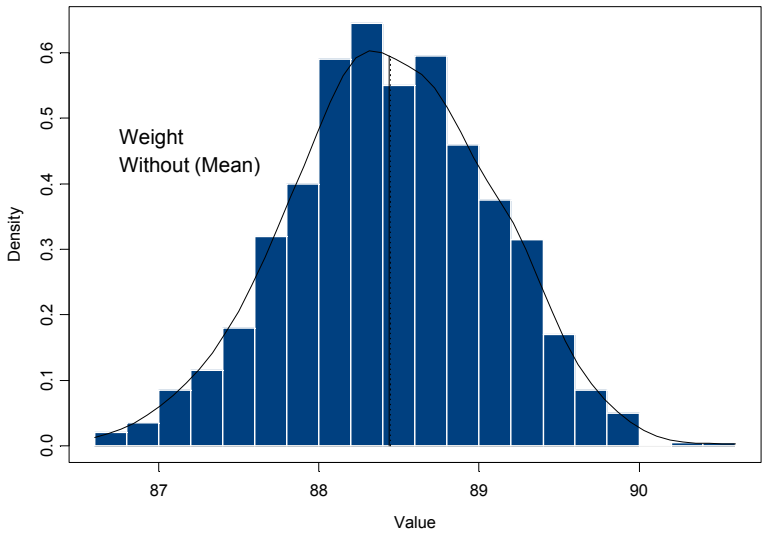


Figure 30. Bootstrapped distribution example

10.2 DISTRIBUTION OF DIMENSIONS

An evaluation of the normality of the distributions for each dimension was conducted using a variety of techniques. Many of the distributions seem to follow the normal or Gaussian distribution. As an example, consider the distribution of shoulder breadth:

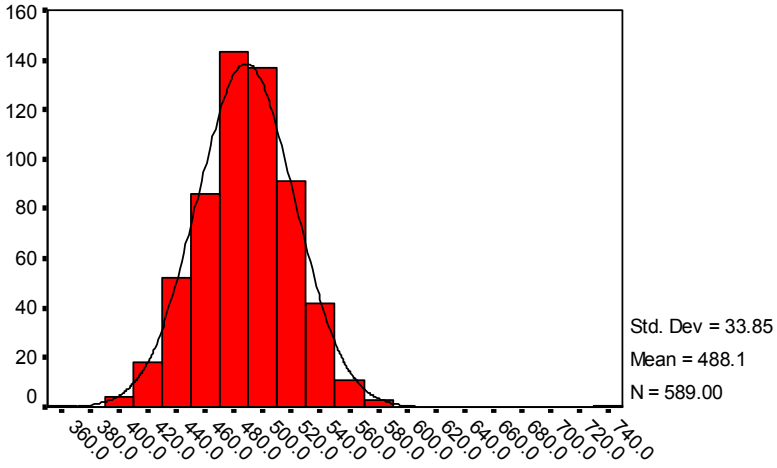


Figure 31. Example distribution (Shoulder Breadth) with normal curve

Many introductory statistical textbooks assert that such dimensions should be normally distributed but this is often not found to be the case. From the above diagram with superimposed normal (bell-shaped) curve, however, it is fairly clear that our sample suggests that this dimension is normally distributed. A single sample Kolmogorov-Smirnov supports this assertion. Details of the test for Shoulder Breadth are given below.

Table 6.Example test for normality (Shoulder Breadth)

One-Sample Kolmogorov-Smirnov Test

		SHBREAD
N		589
Normal Parameters(*a,b*)	Mean	488.0985
	Std. Deviation	33.84570
Most Extreme Differences	Absolute	.031
	Positive	.031
	Negative	-.030
Kolmogorov-Smirnov Z		.764
Asymp. Sig. (2-tailed)		.603

a Test distribution is Normal. b Calculated from data.

A more graphically appealing way of judging the goodness of fit to a normal distribution is via the P-P graph. The closer the cumulative percentile points are to the diagonal on the square in the diagram, the closer the fit is to normality. The following chart shows the P-P diagram for Shoulder Breadth. This clearly demonstrates an excellent fit.

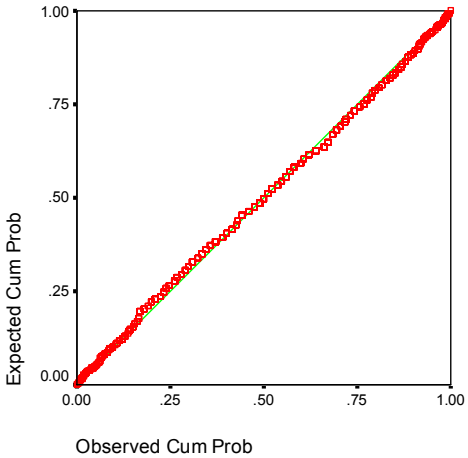


Figure 32. Example normal P-P plot (Shoulder Breadth)

The fact that a particular dimension has a frequency distribution that can be described by the normal distribution is of interest because if the fit is particularly good, the mean and standard deviation of the data can be used to read off any information that might be needed from the normal tables. As an example, the Stature dimension also seems to follow the normal frequency curve with a mean of 1772.8mm and a standard deviation of 72.78mm. Comparisons between the theoretical and observed values are given for the 1st, 5th, 95th, and 99th percentiles.

Table 7.Example percentile comparisons (Stature)

	Percentile			
	1%	**5%**	**95%**	**99%**
Normal Curve	1613 mm	1663 mm	1903 mm	1952 mm
Actual Data	1614 mm	1663 mm	1901 mm	1970 mm

Agreement between the first three percentile values is very good, the 99th percentile registers a discrepancy of just under 2 cm, less than 1%. This suggests the data are suitably robust and the sufficient sample sizes were used.

11 RESULTS

Results of the data analysis are given in the following sections. These include data for the whole sample (n = 589) as well as for the 10 industry categories (n = 49 to 72). Measured, as well as derived, dimensions are discussed.

The data were analysed to determine whether each dimension was normally distributed; the results of this analysis are shown in the table below. All but shoe width and length appeared to follow the normal curve.

Table 8.Test for normal distribution of the 15 measured dimensions

Dimension	Normal (?)
Weight	Yes
Weight with Equipment	Yes
Stature	Yes
Shoulder Breadth	Yes
Hip Breadth	Yes
Chest Circumference	Yes
Waist Circumference	Yes (Marginal)
Thigh Circumference	Yes
Hand Breadth	Yes
Hand Span	Yes
Arm Length	Yes
Leg Length	Yes
Shoe length	No
Shoe length (Males only)	Yes
Shoe Width	No
Shoe Width (Males only)	No
Sitting Cervical Height	Yes

A full set of raw data, broken down by industry category, is presented in Appendix C.

Determining the weight of the working at height population was the main aim of the research. Two weight measurements were taken; one with the participants in their work clothes with any equipment or tools they would usually have attached to them whilst working at height (Weight With Equipment) and a second weight measurement was taken of the participants without their equipment and tools, but with clothes and shoes, to determine Weight Without Equipment and Weight of Equipment.

11.1 WEIGHT WITHOUT EQUIPMENT

Data for the whole sample for Weight Without Equipment are shown below.

Table 9.Data for Weight Without Equipment – whole sample

		Observed (kg)	Bootstrapped (kg)
Percentiles	**1%ile**	58.8	
	5%ile	66.8	
	Mean	88.4	
	95%ile	114.9	115.1
	99%ile	127.8	127.6
Range	**Minimum**	53.4	
	Maximum	147.8	143.2
	Std dev	14.7	
	N =	588	

The sample distribution is shown below.

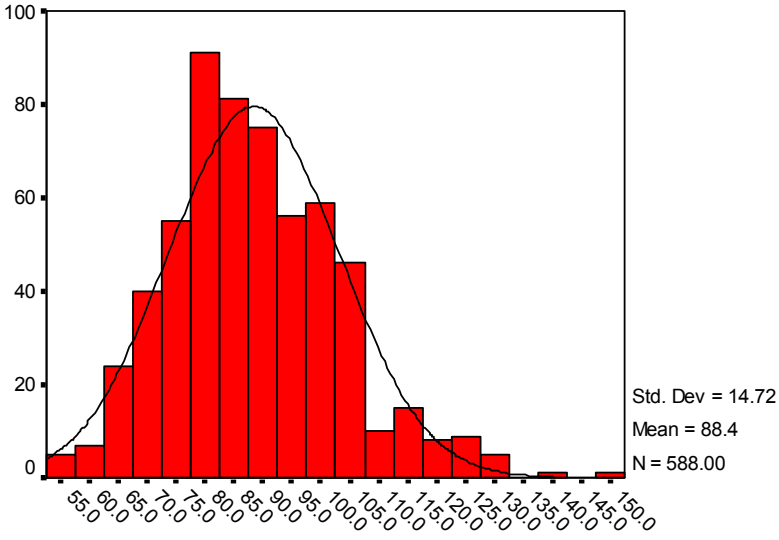


Figure 33. Whole sample distribution – Weight Without Equipment

These data were broken down into industry category and are shown below.

Table 10. Industry category – Weight Without Equipment

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	53.4	63.4	60.6	53.8	53.4	59	62.6	62.4	54.0	57.0	57.4
Max	147.8	107.0	128.8	130.2	129.0	126	138.4	127.6	126.4	147.8	129.6
Range	94.4	43.6	68.2	76.4	75.6	67.0	75.8	65.2	72.4	90.8	73.2
Mean	88.44	86.2	86.9	84.6	92.0	89.1	89.7	90.1	87.3	87.6	90.6
Std error	n/a	1.6	1.6	1.7	2.0	1.9	2.2	1.5	2.2	2.1	2.2
95%ile	114.9	105.3	114.8	106.4	116.7	120.9	114.9	106.5	115.4	114.9	116.5
95%ile BS	115.1	104.8	113.2	106.7	117.4	119	116.4	108	114.4	115	116.8
99%ile	127.8	106.5	123.1	120	126.1	124.9	132.6	121.9	125.3	127.8	127.7
99%ile BS	127.6	106.2	122.5	119	124.1	124.2	128.8	119.3	122.9	127.6	124.9
Std dev	14.7	11.4	11.9	13.9	16.4	16.3	15.9	11.8	16.0	14.4	15.8
N	588	50	71	67	64	70	50	63	54	49	50

The heaviest participant worked in Agriculture and weighed 147.8 kg; this was without any equipment. The participant's occupation was a tractor driver and the nature of this meant that no equipment or tools were required to be carried. The lightest person worked within the transport category and weighed 53.4 kg. The industry category with the heaviest mean weight was Transport (92.0 kg) and the category with the lightest mean weight was Interior Build (84.6 kg).

Mean, maximum and minimum data for each industry category can be seen illustrated in the graph overleaf.

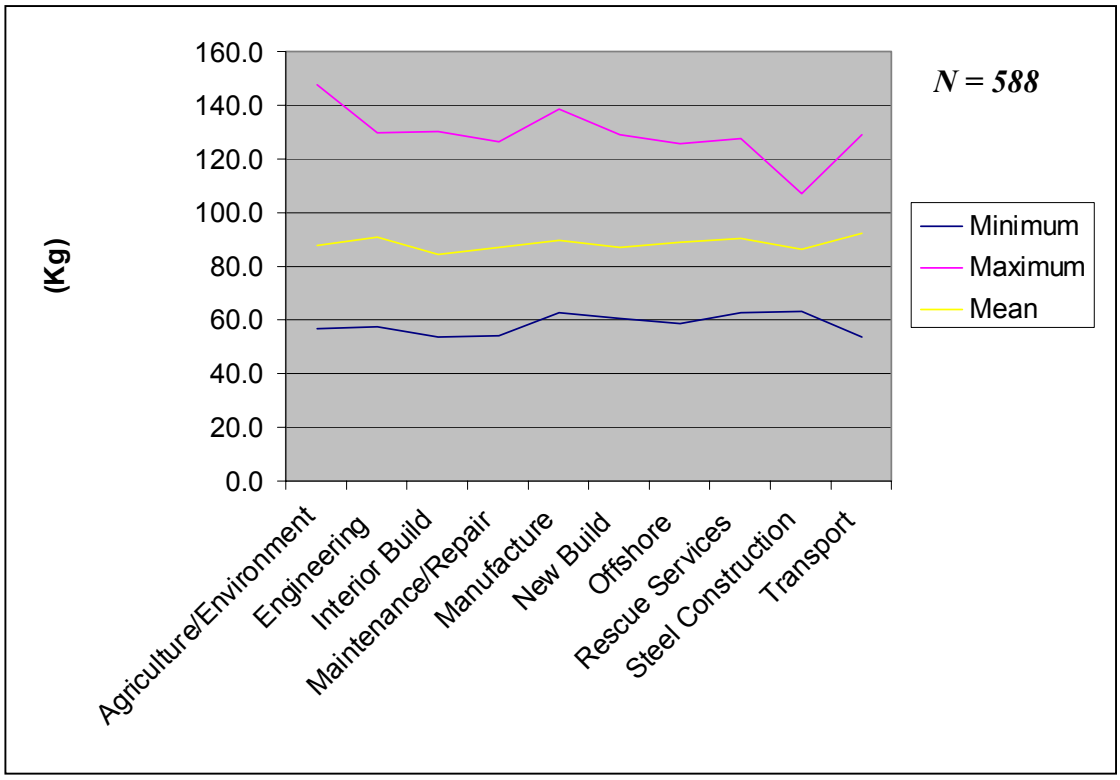


Figure 34. Industry Category statistics for Weight Without Equipment

A cursory look at the averages for the 10 categories would seem to indicate fairly similar average weights and moderately consistent standard errors of the mean. Using a one sample analysis of variance test (ANOVA) confirms that there is not a significant difference between the weights of workers in the 10 industrial categories.

Table 11. Weight Without Equipment ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3065.082	9	340.565	1.594	.114
Within Groups	123293.378	577	213.680		
Total	126358.460	586			

11.2 WEIGHT WITH EQUIPMENT

The weight with equipment sample consists of all participants measured that carried tools and equipment that weighed 0.2kg or greater. This eliminates from the sample that equipment that was minimal in weight, such as a pen, mobile phone or screwdriver, etc. Whilst it is acknowledged that this constitutes working equipment, for the purposes of this research, it provided a criterion for equipment weight of any significance. A total of 335 participants from the sample measured had tools and equipment attached to them weighing 0.2kg or greater whilst working at height. The results for Weight With Equipment are detailed below.

Table 12. Data for Weight With Equipment – eligible sample

		Observed (kg)
Percentiles	**1%ile**	61.7
	5%ile	70.3
	Mean	94
	95%ile	122.9
	99%ile	134.6
Range	**Minimum**	54
	Maximum	138.8
	Std dev	15.2
	N	335

The sample distribution is shown below.

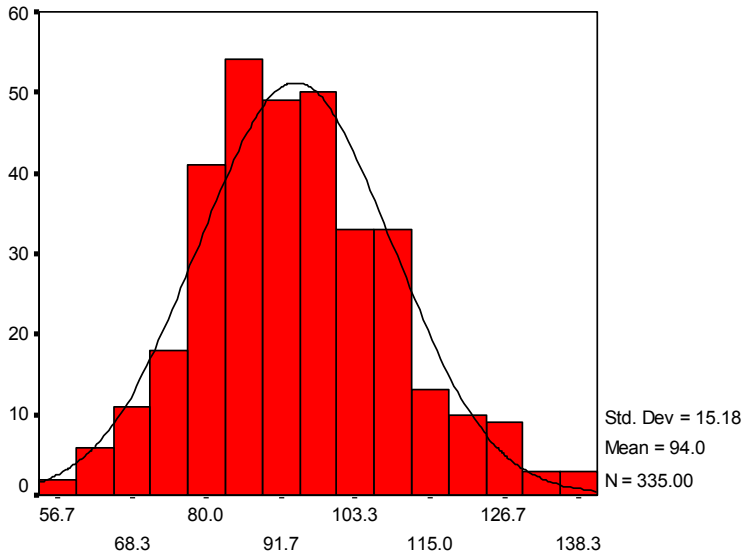


Figure 35. Eligible sample distribution – Weight With Equipment

Data for industry categories are shown below.

Table 13. Industry category – Weight With Equipment

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	54.0	69.8	61.0	54.0	85.8	64.4	—	65.4	58.6	82.8	71
Max	138.8	116.8	121.0	130.4	119.0	131.4	—	129.2	138.8	112.8	129.4
Mean	93.6	92.4	89.1	85.5	99.8	95.1	—	96.3	100.4	96.8	95.8
95%ile	122.9	110	114.3	112.1	n/a	127.8	—	122.7	137.3	111.7	113.6
95%ile BS	121.3	110.3	111.6	110.6	112.8	125.4	—	122.8	134	112.2	115.1
99%ile	134.6	115.7	119.8	124.7	117.8	130.5	—	128.5	138.5	115.7	126.2
99%ile BS	132.3	113.8	117.9	121.1	114.8	129.8	—	127.3	137.2	114.4	121.3
Std dev	15.2	11.9	13.2	14.6	9.5	17.0	—	14.2	21.7	9.22	13.6
N	335	36	43	40	13	62	—	63	28	30	20

None of the participants who worked in manufacturing had equipment attached to them, neither did they carry any tools in their pockets when working at height. A significant result was found when data for Weight With Equipment were analysed further; mean, maximum and minimum data by industry category are presented below.

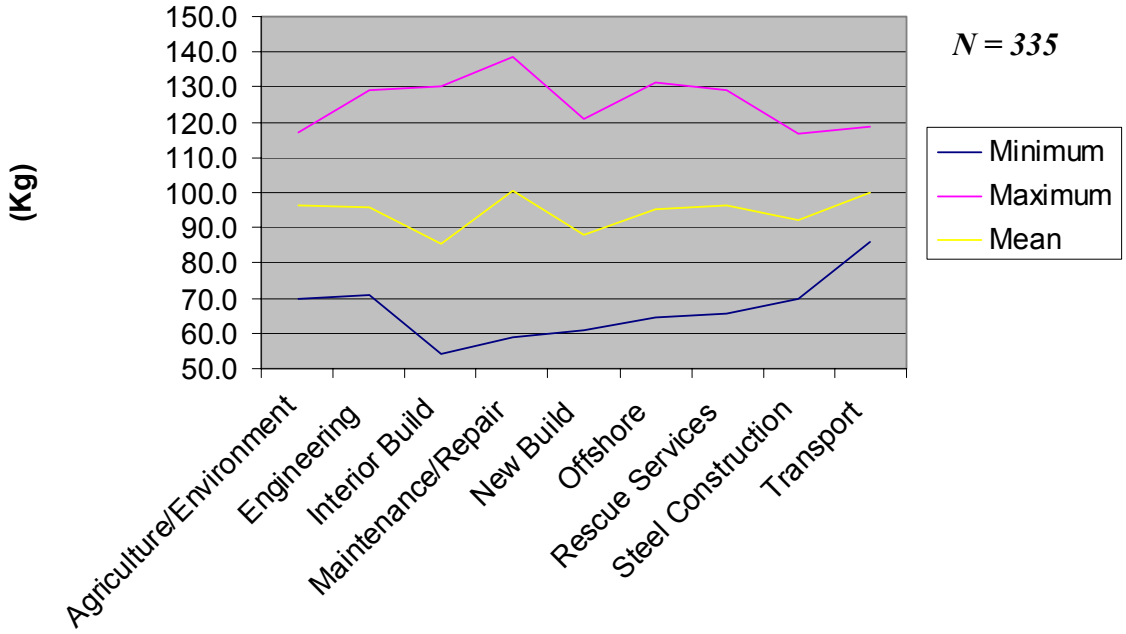


Figure 36. Industry Category statistics for Weight With Equipment

A comparison of maximum values between Weight Without and Weight With Equipment would appear to show that maximum values for Weight Without Equipment are greater than the Weight With Equipment values. This is as a result of the different compositions of the two samples; the Weight Without sample included some of the heavier participants, skewing the mean. This is discussed further in section 11.4.

This time the data do seem to reveal a difference between industrial classifications and this is again confirmed by the one variable ANOVA test.

Table 14. Weight With Equipment ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7148.997	8	893.625	4.095	.000
Within Groups	73971.867	339	218.206		
Total	81120.865	347			

Of course, this just identifies that there is a difference between the Weight With Equipment dimension for all of the 10 industrial categories. Using post hoc tests (Scheffe and Bonferroni) would suggest that significant differences exist between Interior Build and Maintenance/ Repair groups, between Interior Build and the Rescue Services categories and possible differences between New Build and Maintenance Repair. Offshore and Interior Build and Interior Build and Agriculture also signal possible significant differences.

11.3 WEIGHT OF EQUIPMENT

Weight of Equipment was derived from Weight With Equipment less Weight Without (for eligible cases). Summary statistics for the Weight of Equipment are given below. The Weight of Equipment statistics have been based on tools and equipment that weighed 0.2kg or greater.

Table 15. Data for Weight of Equipment – eligible sample

		Observed (kg)	Bootstrapped (kg)
Percentiles	**1%ile**	0.2	
	5%ile	0.4	
	50%ile	4.2	
	Mean	5.5	
	95%ile	18.8	18.1
	99%ile	37.4	34.9
Range	**Minimum**	0.2	
	Maximum	41.2	
	Range	41.0	
	Std Error	0.35	
	Std dev	6.4	
	N	335	

The minimum weight of equipment carried was 0.2 kg; generally this was a hard hat and was common in the majority of industry categories. The maximum weight of equipment carried was 41.2 kg, this was by overhead pylon linesmen, their equipment and tools consisted of a full bodied harness, 2 lanyards, tower rescue kit, capstan rope (supply rope to lower and raise items up the tower – 300 feet long) 6 step bolts and a tool bag. One individual can be responsible for carrying all of these tools and equipment at any given time.

The range of this derived variable seems quite large (41.0 kg) indicating the wide range of equipment type being carried when working at height. The spread of equipment weight is seven or eight times the mean weight. The distribution for Weight of Equipment is very skewed, and is illustrated overleaf.

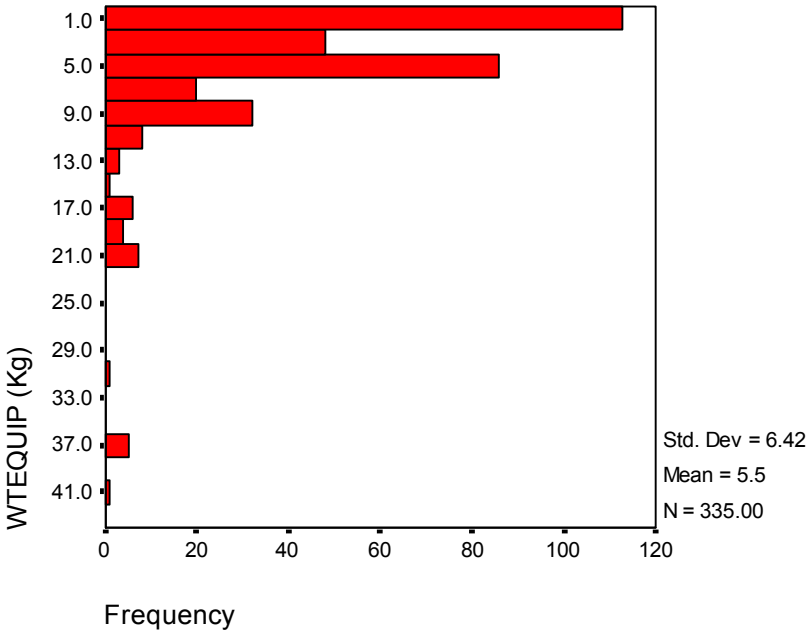


Figure 37. Distribution of Weight of Equipment (kg)

The P-P plot for Weight of Equipment demonstrates how the cumulative data deviates from the normal diagonal.

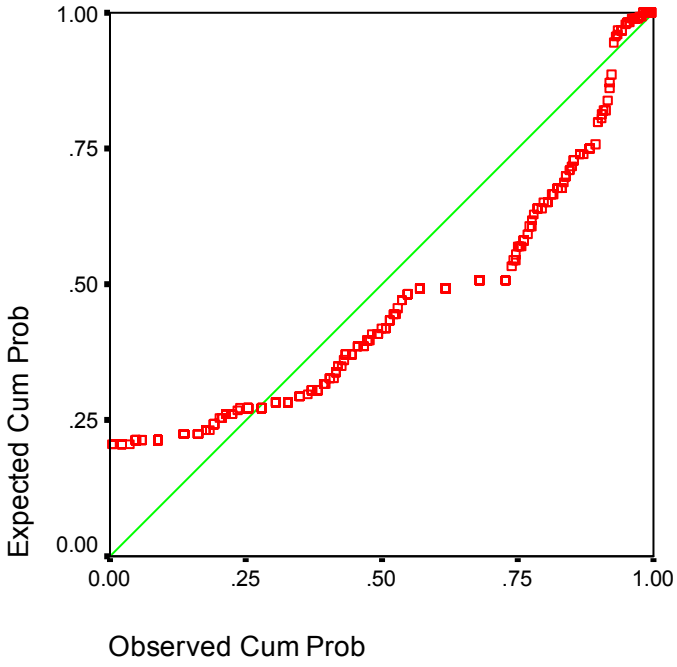


Figure 38. Normal P-P plot of Weight of Equipment

These data were broken down into industry category and are shown below.

Table 16. Industry category – Weight of Equipment

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	0.2	1.4	0.2	0.2	0.4	5.0	N/A	1.0	0.6	1.0	0.2
Max	41.2	11.4	4.6	5.6	4.2	9.2	N/A	21.2	41.2	21.2	8.2
Mean	5.5	6.4	1.3	0.9	2.8	5.5	N/A	6.3	13.2	10.4	2.9
95%ile	18.8	10.3	3.8	2.6	4.1	N/A	N/A	20.2	37.9	17.4	5.5
N	335	36	43	40	13	62	N/A	63	28	30	20

It was not possible to calculate the 95%ile figure for offshore, as 62 of the readings are very similar, they all lie between 5 kg – 6 kg.

The Weight of Equipment distribution shows some considerable variation between industrial categories. The mean plots for the industrial categories are illustrated below.

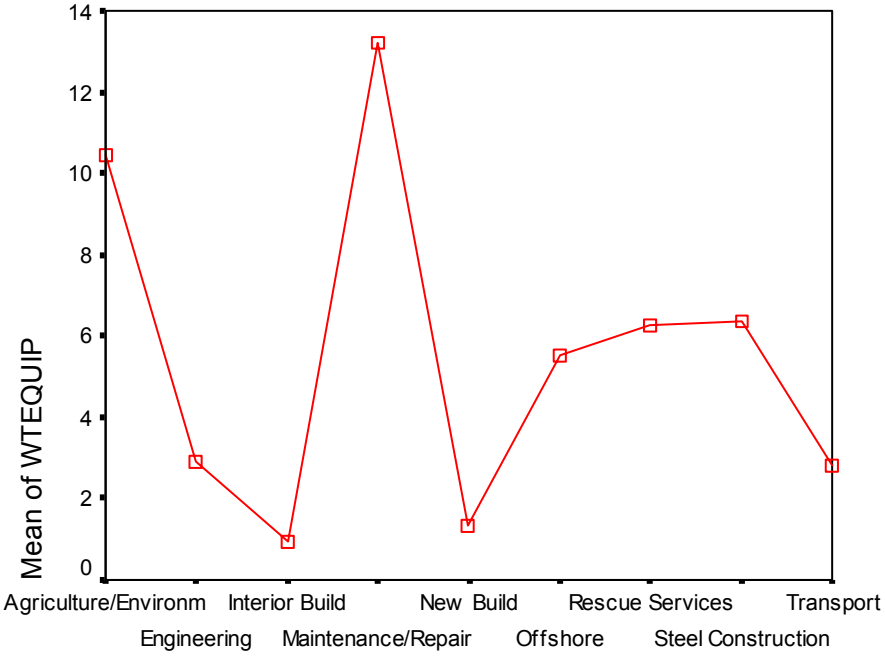


Figure 39. Mean Weight of Equipment across industry category

Not surprisingly this is reflected in the ANOVA table which shows a very high level of significance.

Table 17. Weight of equipment ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4265.521	8	533.190	18.323	.000
Within Groups	9486.533	326	29.100		
Total	13752.053	334			

The post hoc tests (Scheffe and Bonferroni) revealed so many significant differences that it is probably most sensible to summarize by saying that there was very little significant difference between the following five groups: Agriculture, Maintenance and Repair, Offshore, Rescue Services and Steel Construction. However, between these groups and the others, almost all contrasts were significant e.g. significant differences existed between Agriculture and Engineering, Agriculture and Interior build, Agriculture and New build, Agriculture and Transport, Maintenance and Engineering, Maintenance and Interior Build etc.

11.4 DIFFERENCES IN MAXIMUM VALUES

A comparison of maximum values between Weight Without and Weight With Equipment shows that, in some cases, the maximum values for Weight Without Equipment are greater than the Weight With Equipment values. The table below details the maximum values for Weight With and Without Equipment and for Weight of Equipment.

Table 18. Maximum values for weight measures (kg)

	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Weight With Equipment	116.8	121	130.4	119	131.4	N/A	129.2	138.8	117	129
Weight Without Equipment	107	128.8	130.2	129	126	138.4	127.6	126.4	147.8	129.6
Weight of Equipment	11.4	4.6	5.6	4.2	9.2	N/A	21.2	41.2	21.2	8.2

The maximum values for Weight Without Equipment are greater than the maximum values for Weight With Equipment in the New build, Transport, Manufacture, Agriculture/Environment and Engineering industry categories. All but one of these industry categories carry no greater than 8.2kg of equipment (the Agriculture/Environment industry category carried up to 21.2kg of equipment). Results and observations from this survey indicated that generally it is the lighter participants that carried the heavier equipment, e.g. the Maintenance and Repair participants that carried between 36kg - 41.2kg of equipment, weighed between 62kg – 101kg. The heavier participants in the sample generally carried no equipment, however where they did, its weight was minimal (0.2kg – 5.4kg). It is possible that the body weight of workers was less due to the physical demands of the job including loads required to be carried.

11.5 WORKING WEIGHT

The following set of statistics look at the total weight of the worker if they were to fall from height i.e. working weight. Working weight is derived from a combination of Weight With Equipment and Weight Without. 349 participants worked at height with equipment and/or tools attached to them, 238 participants did not have any tools or equipment attached to them when working at height, the statistics are based on this sample composition. Summary statistics for the weight of equipment are given below.

Table 19. Data for Working Weight – derived sample

		Observed (kg)	Bootstrapped (kg)
Percentiles	**1%ile**	59.8	
	5%ile	68.3	
	Mean	91.6	91.6
	95%ile	119.1	119.7
	99%ile	132	131.9
Range	**Minimum**	53.4	
	Maximum	147.8	144.3
	Range	94.4	
	Std Error	0.64	
	Std dev	15.6	
	N	587	

. The distribution for Working Weight is illustrated below.

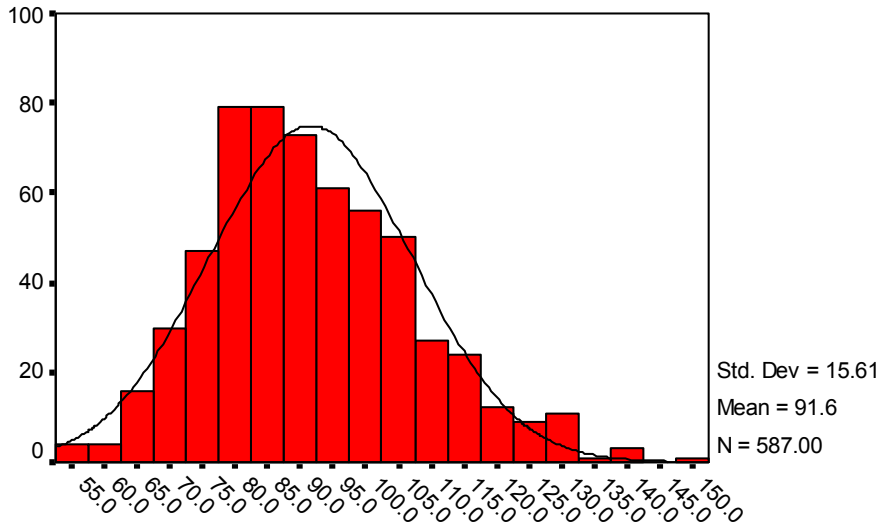


Figure 40. Distribution of Working Weight (kg)

The heaviest participant measured in the sample weighed 147.8kg, this person's weight appeared to be an outlying statistical value, being nearly 10kg heavier than the maximum weight of any other participant. To see the effect this individual was having on the sample statistics, the outlying figure was removed and percentile values were re-calculated. These comparative statistics are detailed in the table below.

Table 20. Comparison with and without outlier

		Observed (kg) (Outlier not included)	**Observed (kg)** (Outlier included)
Percentiles	**1%ile**	59.8	59.8
	5%ile	68.3	68.3
	Mean	91.4	91.6
	95%ile	119	119.1
	99%ile	130.5	132

The removal of the outlier from the sample shows a decrease of 1.5kg in the 99%ile statistical value and a slight decrease of 0.1kg in the 95%ile statistical value. However, to remove such an outlying figure would generate an untrue data set for the working at height population. The main aim of this research was to determine the extreme measures of the population so that PPE testing apparatus can accurately represent these people. From the sample obtained in this research, one outlier existed within a sample of nearly 600 people. If for example, the working at height population had around 30,000 workers, this would mean that approx 500 people would be excluded from the sample. It is for this reason that the percentile figures elsewhere in this report have included this outlier.

The spread of working weight (range) is larger that the mean for that variable. By inspection it would seem that the frequency distribution of this variable is rather too skewed to be able to be adequately described by a normal curve – and the Kolmogoroff-Smirnov test confirms this to be true.

The data for Working Weight were broken down into industry category and are shown below.

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	53.4	69.8	69.8	54	53.4	64.4	62.6	65.4	58.6	57	57.4
Max	147.8	116.8	116.8	130.4	129	131.4	138.4	129.2	138.8	147.8	129.6
Mean	91.6	90.8	90.8	85.1	93.1	94	89.7	96.3	94.2	94	91.8
95%ile	119.1	108.3	114.8	106.4	118.1	126.2	114.9	122.7	130.5	112.1	116.5
95%ile BS	119.7	109.1	113.5	107.7	117.5	124.7	116.4	122.6	130.6	114.1	117.7
99%ile	132	115.2	123.3	121.3	126	130.4	132.6	128.5	138.3	133	129.5
99%ile BS	131.9	113.6	122.5	120.1	124.3	129.6	129.2	127.4	136.5	130.1	126
Std dev	15.6		11.5	14.0	16.1		15.9		19.8	14.6	15.8
N	587	50	70	67	64	70	50	63	54	49	50

Table 21. Industry category – Working Weight

The maximum Working Weight from all industry categories was in Agriculture/Environment; this was 147.8 kg, surprisingly this was without any equipment or tools, however, their job did not require them to carry anything. This weight was nearly 10 kg heavier than any other industry category. Maintenance and Repair had the second heaviest Working Weight at 138.8 kg, although, this was with equipment, the individual's actual body weight was 101 kg. Maintenance and Repair also had the highest mean weight; this is possibly due to a high proportion of them having between 30 kg – 40 kg of equipment and tools attached to them when working at height.

The mean plots for Working Weight are illustrated in the graph below.

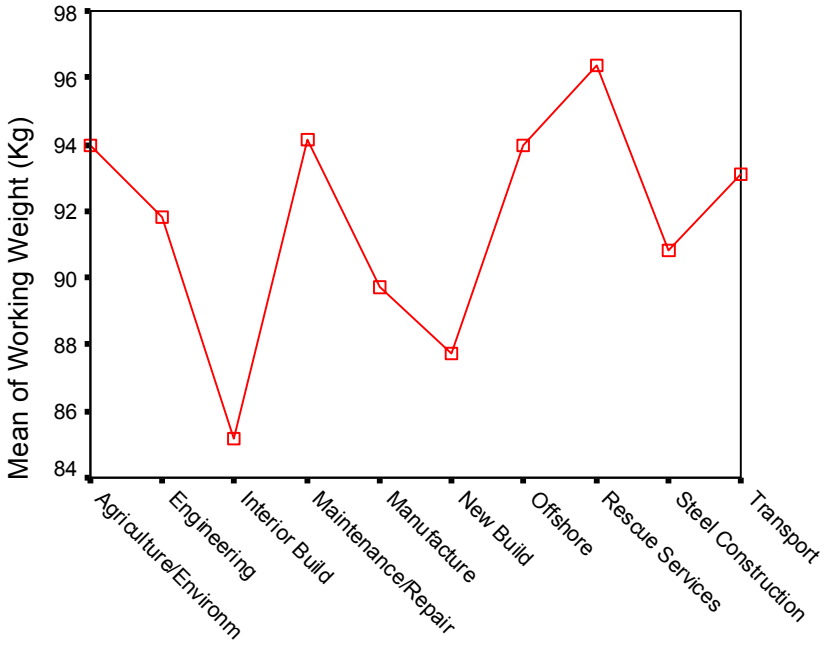


Figure 41. Mean Working Weight across industry category

The data again reveals a difference between industrial classifications and this is again confirmed by the one variable ANOVA test.

Table 22. Working Weight ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	6676.867	9	741.874	3.144	.001
Within Groups	136141.909	577	235.948		
Total	142818.776	586			

Post Hoc tests (Scheffe and Bonferroni) indicate that significant differences in Working Weight exist between the Rescue Services and Interior Build, Interior Build and Maintenance and Repair, Interior Build and Offshore along with New Build and Rescue Services.

11.6 BODY MASS INDEX (BMI)

Body Mass Index (BMI) is measure of body fat based on height and weight that applies to both adult men and women. According to the US National Heart, Lung and Blood Institute (www.nhlbisupport.com/bmi), BMI is categorised as follows:

- Normal weight = 18.5-24.9
- Overweight = 25-29.9
- Obesity = BMI of 30 or greater

One variable BMI fails to consider is lean body mass. It is possible for a healthy, muscular individual with very low body fat to be classified obese using the BMI formula. In the analysis of this research data, Clothed Body Mass Index was derived using the following formula:

$$\text{Clothed BMI} = \text{Weight Without Equipment (kg)} / \text{Stature (m)}^2$$

The Clothed BMI results obtained from this study are slightly higher than the general population as participants were weighed with their clothes and shoes on, and so are somewhat artificial (and are referred to as Clothed Body Mass Index in this report). The BMI categorisation figures listed above are based on body weight when nude or lightly clad. Summary statistics for the Clothed Body Mass Index are given below.

Table 23. Clothed Body Mass Index (including clothing and shoes)

		Observed (mm)
Percentiles	**1%ile**	19.7
	5%ile	22
	Mean	27.8
	95%ile	35.7
	99%ile	40.1
Range	**Minimum**	16.9
	Maximum	48.9
	Range	32.0
	Std Error	0.18
	Std dev	4.3
	N	587

The Clothed Body Mass Index has a mean of 27.8 which is nearly 3 points higher than the 'overweight' boundary, though, of course, the subjects were all wearing clothes and work boots/shoes.

The frequency distribution for Clothed BMI is shown below.

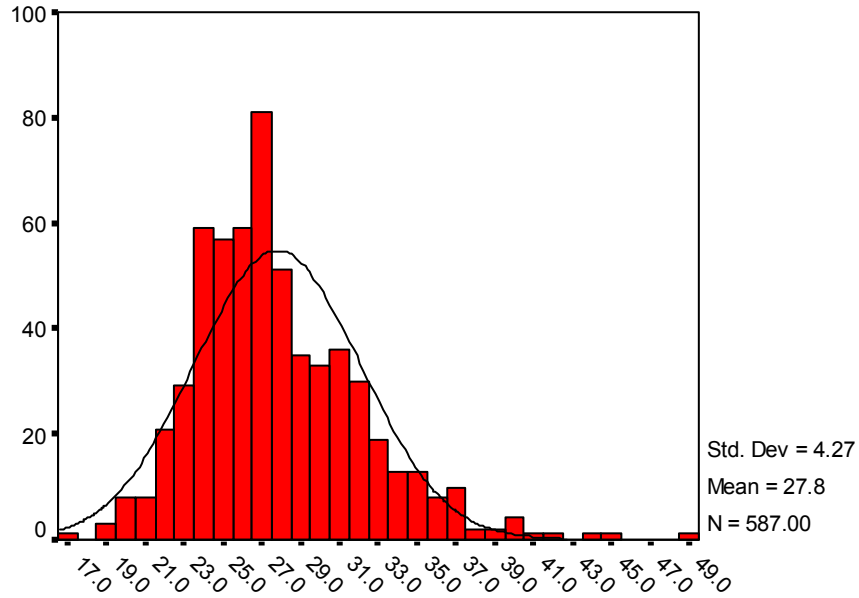


Figure 42. Distribution of Clothed Body Mass Index

Again, this data seems too skewed to fit a normal curve – and this is confirmed by the Kolmogoroff-Smirnov test.

The data for Clothed Body Mass Index were broken down into industry category and are shown below.

Table 24. Industry category – Clothed Body Mass Index

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	16.9	21.5	19.7	18.9	16.9	21.5	19.9	22.2	19.6	21.12	18.8
Max	48.9	34.3	40	44.9	44.4	40.7	42.1	36.8	39.5	48.97	40
Mean	27.8	27.1	27.2	27.1	29.5	28.1	28.9	27.1	27.2	27.4	28.5
Std dev	4.3	3.1	4.0	4.3	4.6	4.5	4.7	2.9	4.6	4.3	4.8
N	587	50	71	67	63	70	50	63	54	49	50

The highest Clothed BMI was in the Agriculture/Environment industry category at 48.97; this included the heaviest participant from the sample who weighed 147.8 kg and whose stature was 1739mm (5ft 7inches). Transport had on average the highest average Clothed BMI, unsurprisingly they were the heaviest industry sector on average; this is possibly due to their occupation requiring very minimal exercise. The mean plots for Clothed BMI are illustrated in the graph below.

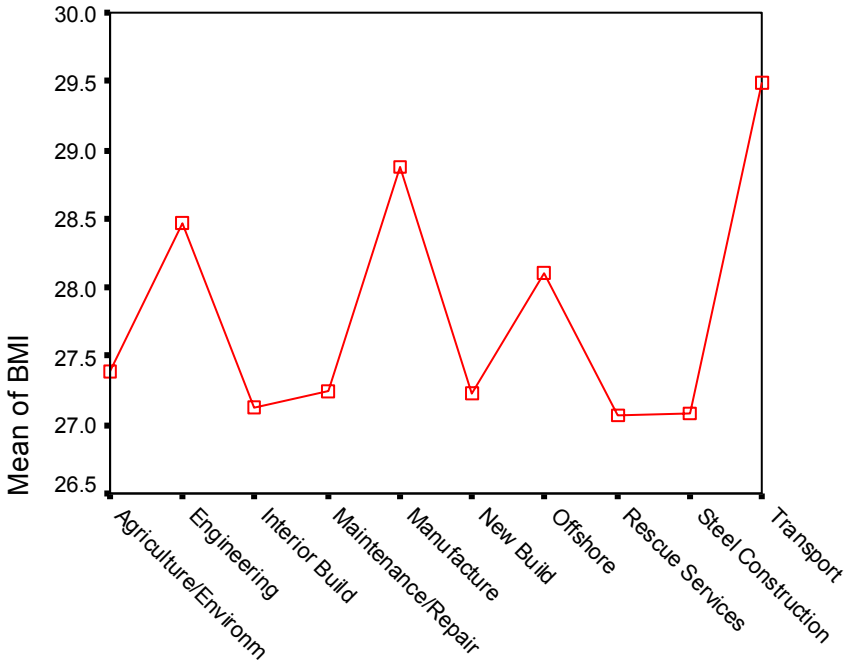


Figure 43. Mean Clothed BMI plots across industry sectors

Table 25. Clothed BMI ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	405.898	9	45.100	2.534	.007
Within Groups	10269.296	577	17.798		
Total	10675.194	586			

Here the post hoc tests do not suggest very strong differences between the industrial groups. The Bonferonni tests highlight possible significant differences between Transport and the Rescue Services, Transport and Interior Build and Transport and New Build.

11.7 OTHER DIMENSIONS – WHOLE SAMPLE

Summary statistics for the remaining 13 measured dimensions are given in the following table.

Table 26. Summary statistics for other measured dimensions

Dimension (mm)	N	Minimum	Maximum	Range	Mean	Std. Error	Std Dev
Stature	589	1565	2033	468	1783	3.0	72.8
Shoulder breadth	589	365	745	380	488	1.4	33.8
Hip breadth	589	241	444	203	330	1.1	26.6
Chest circumference	589	820	1398	578	1073	4.2	101.5
Waist circumference	589	662	1359	697	992	4.9	117.7
Thigh circumference	588	441	773	332	599	2.2	52.3
Sitting Cervical Height	589	527	782	255	672	1.3	31.9
Arm length	589	811	1078	267	936	1.8	42.6
Leg length	589	882	1258	376	1069	2.4	57.5
Hand breadth	589	71	99	28	88	0.2	4.4
Hand span	589	156	265	109	210	0.7	17.7
Shoe length	589	202	357	155	306	0.7	17.5
Shoe breadth	589	83	200	117	115	0.3	7.7

Due to gender differences, the statistics for chest circumference were analysed for both Males and Females, the results are given in the table below.

Table 27. Statistics for Male and Female chest circumference

Dimension (mm)	Sex	N	Minimum	Maximum	Range	Mean	Std. Error	Std Dev
Chest Circumference	M	572	838	1398	560	1076	4.2	100.3
	F	15	820	1192	372	972.5	26.7	103.4

Removal of the Female chest circumference data increased the mean from 1073 to 1076mm.

Percentile figures are given in the following table.

Table 28. Percentile values for the other measured dimensions

Dimension (mm)	1%ile	5%ile	95%ile	99%ile	95%ile BS	99%ile BS
Stature	1614	1664	1901	1970	1905	1965
Shoulder breadth	413	432	542	561	541	562
Hip breadth	276	291	376	406	374	403
Chest circumference	863	923	1250	1350	1251	1343
Waist circumference	745	825	1200	1277	1200	1280
Thigh circumference	480	517	692	737	690	731
Sitting Cervical Height	592	616	722	740	722	739
Arm length	833	867	1008	1052	1007	1045
Leg length	922	982	1171	1210	1169	1208
Hand breadth	75	80	95	97	95	96
Hand span	171	181	240	254	239	251
Shoe length	253	280	331	346	331	343
Shoe breadth	96	103	125	130	125	N/A

11.7.1 Stature

The distribution for Stature for the whole sample is shown below.

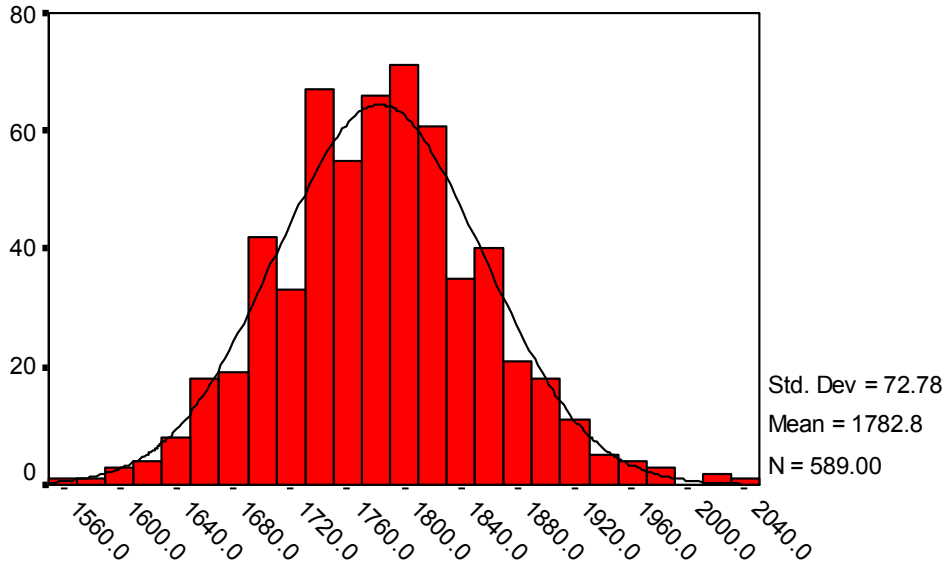


Figure 44. Whole sample distribution - Stature

Mean Stature for the whole sample was 1783 mm, with a 5th percentile value of 1664 mm and 95th percentile of 1970 mm. It must be remembered that Stature was measured with participants wearing shoes or boots, increasing their natural stature.

The data for Stature were broken down into industry category and are shown below.

Table 29. Industry category – Stature

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	1565	1667	1646	1585	1565	1597	1623	1604	1639	1643	1641
Max	2033	1927	1988	1974	1942	1945	1887	2033	2027	1939	2022
Mean	1782	1783	1786	1766	1766	1779	1762	1823	1789	1788	1785
Std dev	72.8	62.0	66.5	71.7	71.8	78.6	60.4	71.3	81.2	68.1	77.3
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed a significant different (0.0%) across industry categories. The industry category with the shortest mean stature was Manufacturing (1762 mm); the industry with the tallest mean stature was Rescue Services (1823 mm).

11.7.2 Shoulder Breadth

The distribution for Shoulder Breadth for the whole sample, together with the normal curve is shown below.

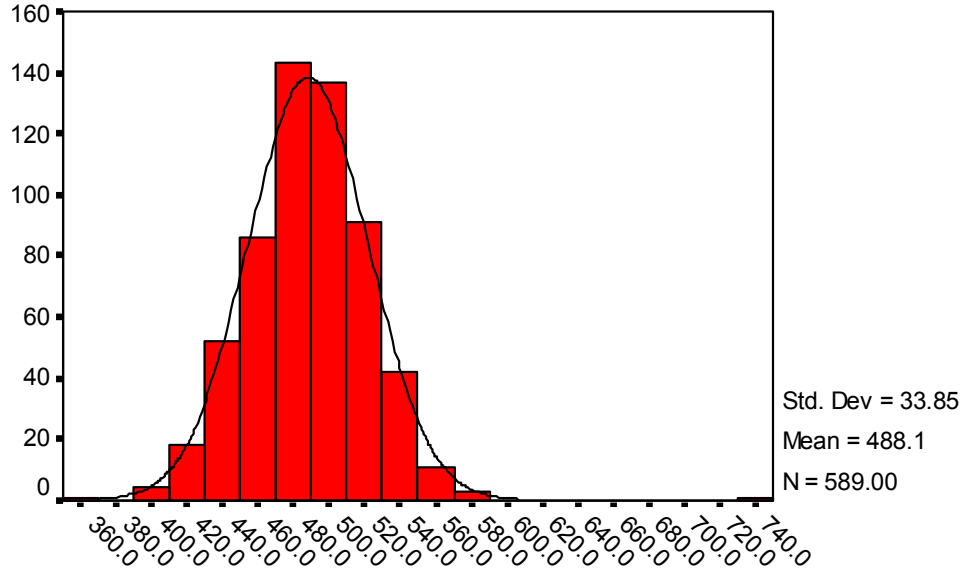


Figure 45. Whole sample distribution – Shoulder Breadth

A male PCV driver from the Transport category had the largest shoulder breadth 745mm; this was the only participant whose shoulders were too big to fit in the sliding callipers. The measurement required two measurers and a tape measure to be able to take accurately. 5th percentile shoulder breadth for the whole sample was 432 mm; 95th percentile was 542 mm. The data for Shoulder Breadth were broken down into industry category and are shown below.

Table 30. Industry category – Shoulder Breadth

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Minimum	365	415	430	409	421	404	424	399	402	365	413
Maximum	745	538	559	549	745	561	543	573	546	574	574
Mean	488	486	487	481	500	488	483	496	485	484	489
Std dev	33.9	25.8	28.1	28.5	46.6	37.4	31.4	29.7	33.6	33.3	35.8
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed a trend towards significant differences (2.8%) across industry categories. Participants in the Transport category had the largest mean Shoulder Breadth (500 mm); Participants in Interior Build had the smallest mean (481 mm).

11.7.3 Hip Breadth

The distribution for Hip Breadth for the whole sample, together with the normal curve is shown below.

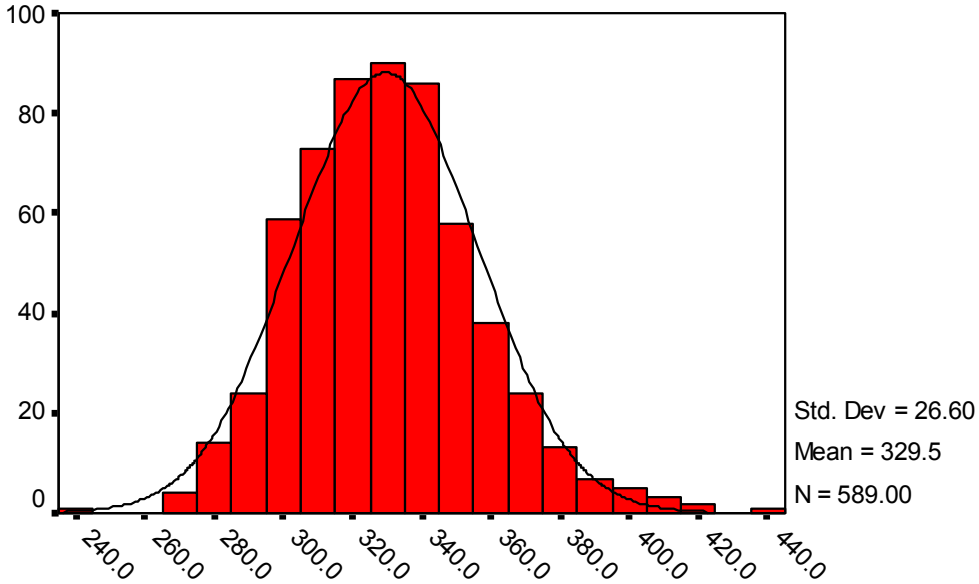


Figure 46. Whole sample distribution – Hip Breadth

5th percentile Hip Breadth for the whole sample was 291 mm; 95th percentile was 376 mm. The data for Hip Breadth were broken down into industry category and are shown below.

Table 31. Industry category – Hip Breadth

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	241	266	276	241	278	266	295	296	276	285	270
Max	444	353	403	388	408	388	444	395	369	415	396
Mean	330	317	324	324	338	333	336	337	320	336	328
Std dev	26.6	19.2	22.7	26.2	30.6	23.1	29.9	23.4	24.5	28.8	29
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed a significant different (0.0%) across industry categories. Participants in Transport had the largest mean Hip Breadth (338 mm); these were also the heaviest participants of the whole sample. Steel Construction workers had the smallest mean Hip Breadth (317 m).

11.7.4 Chest Circumference

The distribution for Chest Circumference for the whole sample, together with the normal curve is shown below.

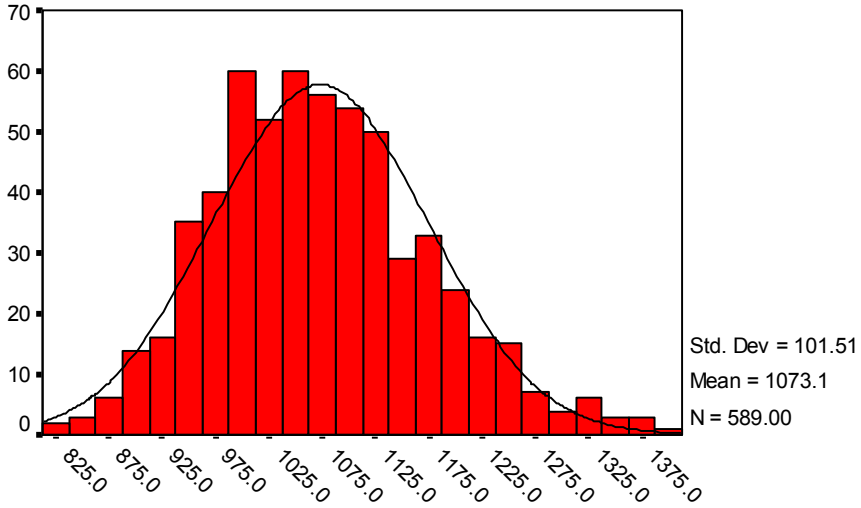


Figure 47. Whole sample distribution – Chest Circumference

5th percentile chest circumference for the whole sample was 923 mm; 95th percentile was 1250 mm. The data for Chest Circumference were broken down into industry category and are shown below.

Table 32. Industry category – Chest Circumference

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	820	883	838	840	893	868	919	923	820	836	868
Max	1398	1228	1319	1250	1371	1333	1306	1398	1303	1381	1287
Mean	1073	1045	1075	1050	1097	1066	1074	1138	1053	1043	1078
Std dev	101.5	75.8	93.0	87.6	110.6	103.2	94.9	109.9	101.7	97.1	102.1
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed a significant different (0.0%) across industry categories. Rescue Service workers had the largest mean Chest Circumference of 1138 mm. These participants often wore body armour or protective clothing and so this is included in the measurement. The industry category with the smallest mean Chest Circumference was Agriculture / Environment (1043 mm).

11.7.5 Waist Circumference

The distribution for Waist Circumference for the whole sample, together with the normal curve is shown below.

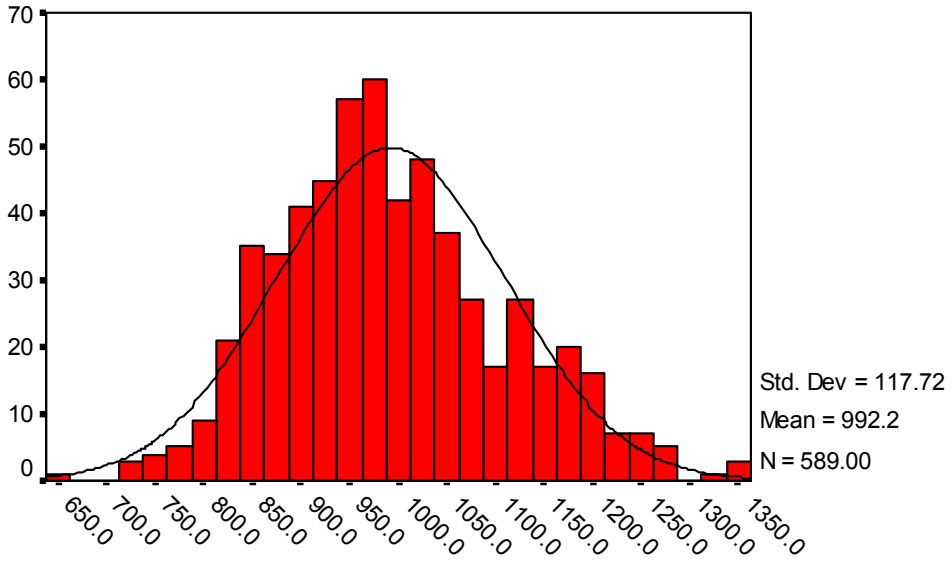


Figure 48. Whole sample distribution – Waist Circumference

The data for Waist Circumference for the whole sample were only just normally distributed. Values for the 5th and 9th percentiles for this whole sample are 825 mm and 1200 mm respectively. Waist circumference was a dimension that showed measurement error above the criteria set out in ISO 15535 (1%) in the preparatory stages of the project, given the clothing, posture and breathing factors that influence the measurement and so these findings should be considered with this in mind. It would be unwise to use the data from waist circumference with as much confidence as those from the other dimensions. That said, the data do provide a good indication of the approximate Waist Circumferences of participants who worked at height.

The data for Waist Circumference were broken down into industry category and are shown below.

Table 33. Industry category – Waist Circumference

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	662	788	721	720	799	812	727	750	662	777	740
Max	1359	1127	1240	1286	1349	1251	1336	1341	1277	1359	1277
Mean	992	946	990	963	1036	995	1015	1034	968	955	1006
Std dev	117.7	85.1	111.1	111.1	125.1	102.6	121.1	129.8	120.4	114.2	119.6
N	589	50	72	67	64	70	50	63	54	49	50

The biggest waist circumference was in the Agriculture/Environment category at 1359mm. This was the waist circumference of the heaviest person in the sample. ANOVA tests showed a significant different (0.0%) across industry categories.

11.7.6 Thigh Circumference

The distribution for Thigh Circumference for the whole sample, together with the normal curve is shown below.

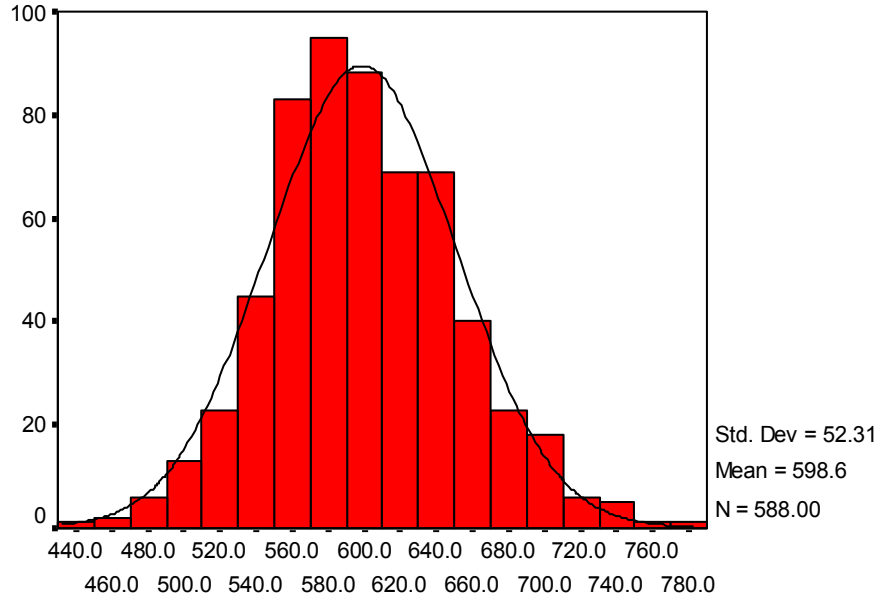


Figure 49. Whole sample distribution – Thigh Circumference

Thigh Circumference data were normally distributed for the whole sample. Values for 5th and 95th percentile Thigh Circumference were 517 mm and 692 mm respectively. Data for Thigh Circumference broken down by industry category are shown below.

Table 34. Industry category – Thigh Circumference

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	441	495	501	476	441	508	487	524	469	518	452
Max	773	650	690	696	748	747	712	761	701	773	703
Mean	599	577	583	582	601	625	584	632	589	612	597
Std dev	52.3	41.1	43.3	52.5	53.7	51.5	47.0	50.5	49.6	45.3	55.0
N	588	50	72	67	63	70	50	63	54	49	50

The largest Thigh Circumference was in the Agriculture/Environment industry category; this was again the thigh circumference of the heaviest person in the sample. ANOVA tests showed a significant different (0.0%) across industry categories. Rescue Service workers had the largest mean Thigh Circumference (632 mm) and Steel Construction workers had the smallest mean measurement (577 mm).

11.7.7 Sitting Cervical Height

The distribution for Sitting Cervical Height for the whole sample, together with the normal curve is shown below.

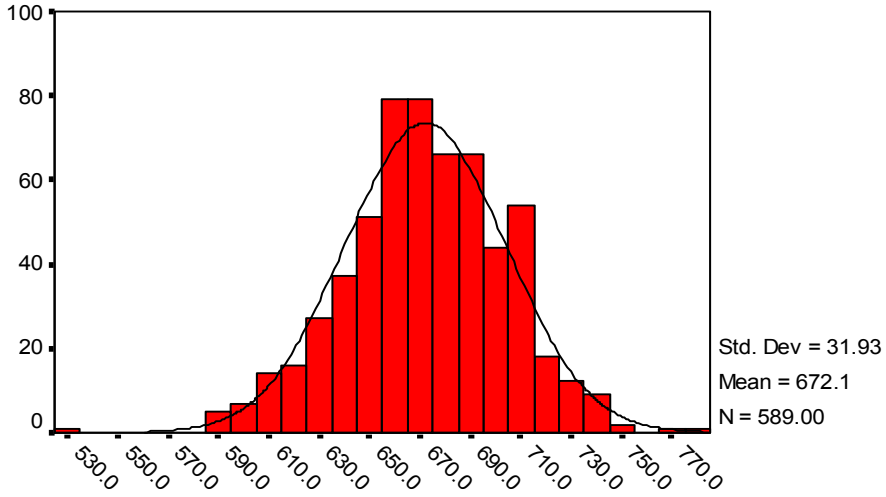


Figure 50. Whole sample distribution – Sitting Cervical Height

The data were normally distributed and 5th percentile Sitting Cervical Height for the whole sample was 616 mm; 95th percentile was 722 mm. The data for Sitting Cervical Height were broken down into industry category and are shown below.

Table 35. Industry category – Sitting Cervical Height

	Overall	Steel construction New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	527	605	610	585	588	588	592	630	590	527	611
Max	782	782	767	747	731	743	720	740	746	720	737
Mean	672	678	670	667	669	670	664	692	676	663	670
Std dev	31.9	34.1	29.1	30.5	31.7	34.5	29.9	25.6	33.1	35.1	27.3
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed a significant different (0.0%) across industry categories, with Rescue Services having the highest mean (692 mm). This group also had the tallest mean stature. Shortest mean Sitting Cervical Height was found in the Agriculture / Environment industry category (663 mm).

11.7.8 Arm Length

The distribution for Arm Length for the whole sample, together with the normal curve is shown below.

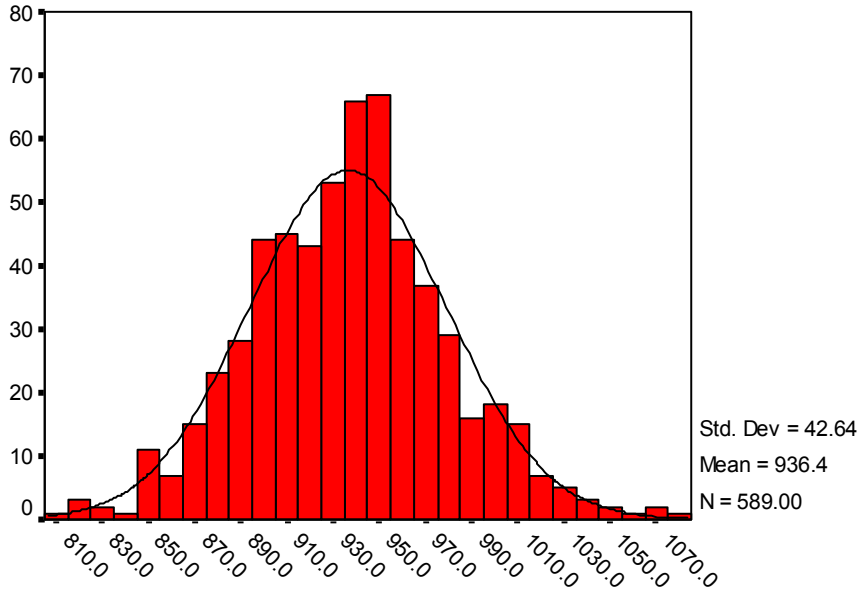


Figure 51. Whole sample distribution – Arm Length

Data for Arm Length (measured as demi-span) was normally distributed. Values of 867 mm and 1008 mm were recorded for 5th and 95th percentiles of the whole sample. The data for Arm Length were broken down into industry category and are shown below.

Table 36. Industry category – Arm Length

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	811	848	852	817	811	834	865	828	848	816	865
Max	1078	1038	1073	1031	1053	1071	1017	1078	1052	1037	1042
Mean	936	940	939	925	933	938	930	948	935	935	940
Std dev	42.6	34.1	41.1	44.3	44.9	48.4	37.0	43.2	40.6	45.2	41.8
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed no significant different across industry categories.

11.7.9 Leg Length

The distribution for Leg Length for the whole sample, together with the normal curve is shown below.

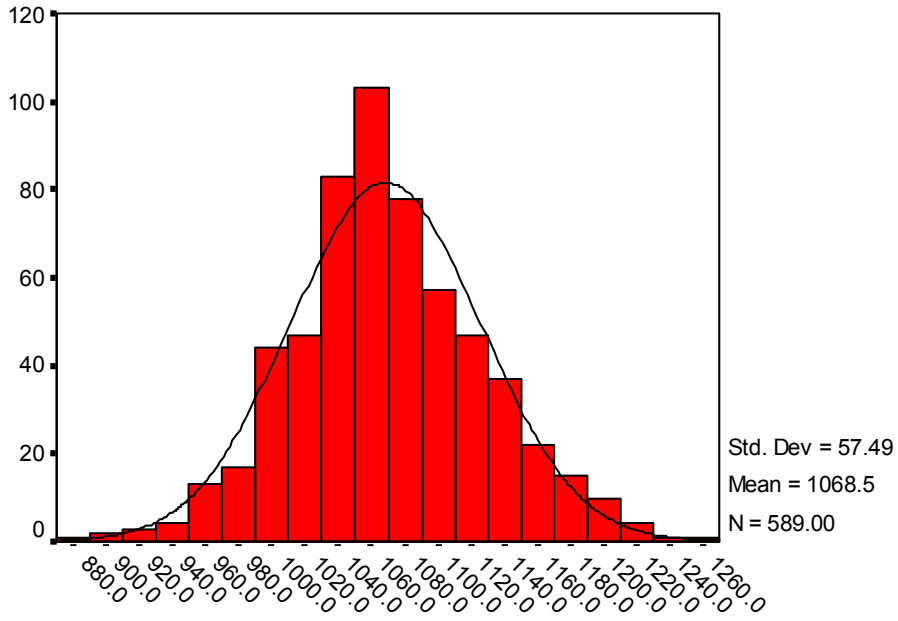


Figure 52. Whole sample distribution – Leg Length

Again, these data were normally distributed, with 5th and 95th percentile values of 982 mm and 1171 mm respectively. The data for Leg Length were broken down into industry category and are shown below.

Table 37. Industry category – Leg Length

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	882	966	945	897	945	1068	922	957	952	882	920
Max	1258	1191	1205	1211	1183	1209	1166	1211	1258	1209	1241
Mean	1069	1067	1069	1057	1058	1068	1054	1102	1066	1075	1068
Std dev	57.5	54.0	52.5	60.0	49.8	61.7	43.1	50.8	60.2	65.0	64.0
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed a significant different (0.0%) across industry categories, with Rescue Service workers having the longest mean Leg Length (1102 mm) and Manufacturing participants having the shortest mean (1054 mm). Rescue Workers were also the tallest on average and workers in Manufacturing had the shortest mean Stature.

11.7.10 Hand Breadth

The distribution for Hand Breadth for the whole sample, together with the normal curve is shown below.

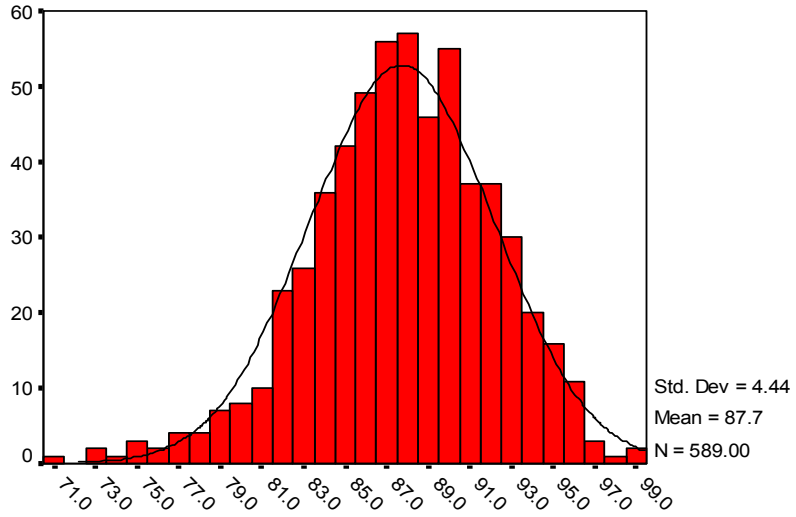


Figure 53. Whole sample distribution – Hand Breadth

Hand breadth data for the whole sample showed a normal distribution, with a 5th percentile value of 80 mm and 95th percentile value of 95 mm. The data for Hand Breadth were broken down into industry category and are shown below.

Table 38. Industry category – Hand Breadth

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	71	79	79	79	75	71	78	76	77	74	80
Max	99	95	96	97	99	96	95	99	96	97	99
Mean	88	88	88	88	88	87	88	88	88	89	88
Std dev	4.4	3.6	4.1	4.3	4.7	5.3	4.0	4.2	4.6	4.7	4.4
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed no significant different across industry categories.

11.7.11 Hand Span

The distribution for Hand Span for the whole sample, together with the normal curve is shown below.

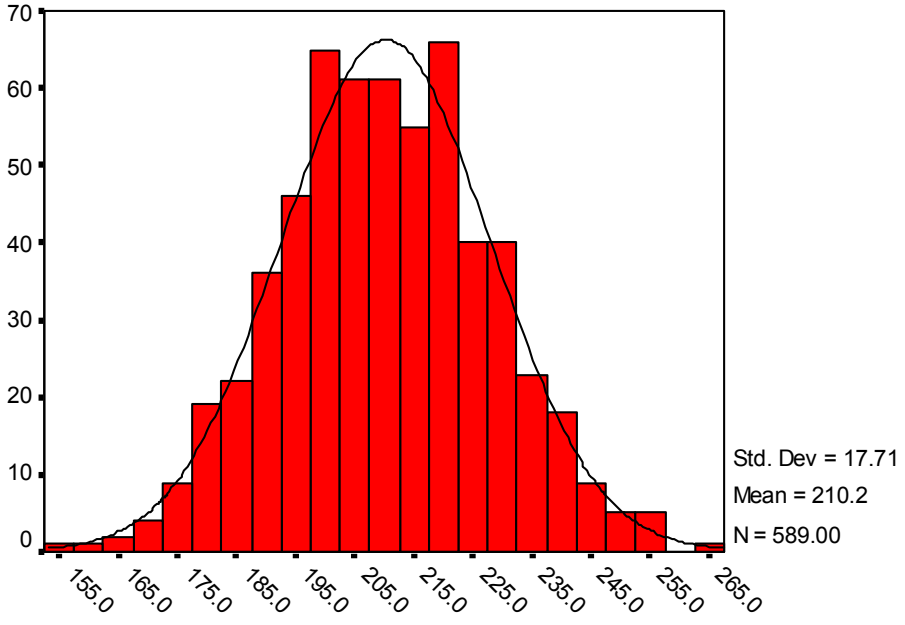


Figure 54. Whole sample distribution – Hand Span

Again, these data were normally distributed for the whole sample. Values of 181 mm and 240 mm were recorded for 5th and 95th percentile Hand Spans. The data were broken down into industry category and are shown below.

Table 39. Industry category – Hand Span

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	156	166	170	171	173	160	173	172	178	156	174
Max	265	254	256	255	239	243	247	265	256	248	244
Mean	210	209	208	207	211	205	207	218	217	217	211
Std dev	17.7	15.7	17.8	15.9	16.0	18.4	18.2	17.6	18.3	17.31	18.19
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed a significant different (0.0%) across industry categories. Workers in Rescue Services had the largest mean Hand Span (218 mm) and Offshore workers had the smallest mean (205 mm).

11.7.12 Shoe Length

The distribution for Shoulder Breadth for the whole sample, together with the normal curve is shown below.

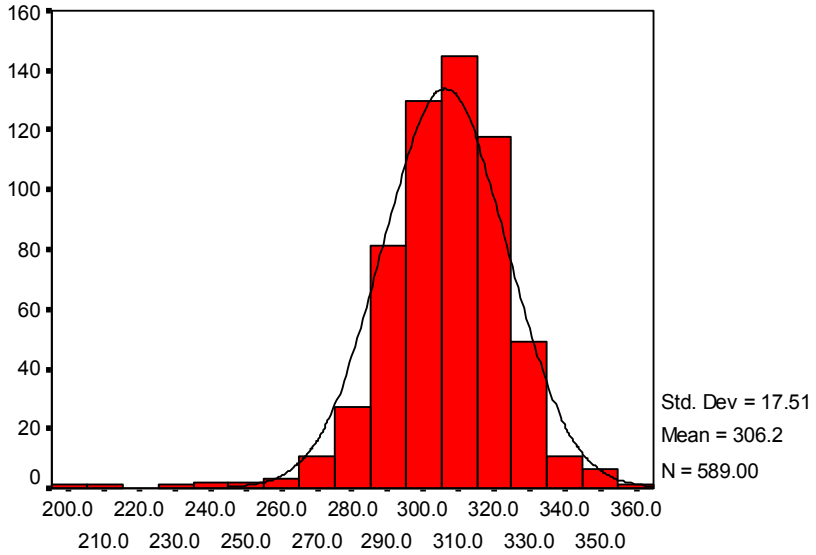


Figure 55. Whole sample distribution – Shoe Length

Shoe Length data for the whole sample were not normally distributed; however, when the data for the male only participants was considered, these were found to be normally distributed. 5th and 95th percentile values for the whole sample were 280 mm and 331 mm respectively.

The data for Shoe Length were broken down into industry category and are shown below.

Table 40. Industry category – Shoe Length

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	202	281	270	273	202	243	278	268	268	233	212
Max	357	334	349	330	334	327	338	354	330	347	357
Mean	306	306	313	305	302	299	302	316	304	312	303
Std dev	17.5	13.1	14.0	12.5	20.0	17.6	12.5	18.3	13.8	20.8	21.9
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed a significant different (0.0%) across industry categories. Offshore workers had the smallest mean Shoe Length (299 mm) and Rescue Service workers had the longest mean (316 mm).

11.7.13 Shoe Breadth

The distribution for Shoe Breadth for the whole sample, together with the normal curve is shown overleaf.

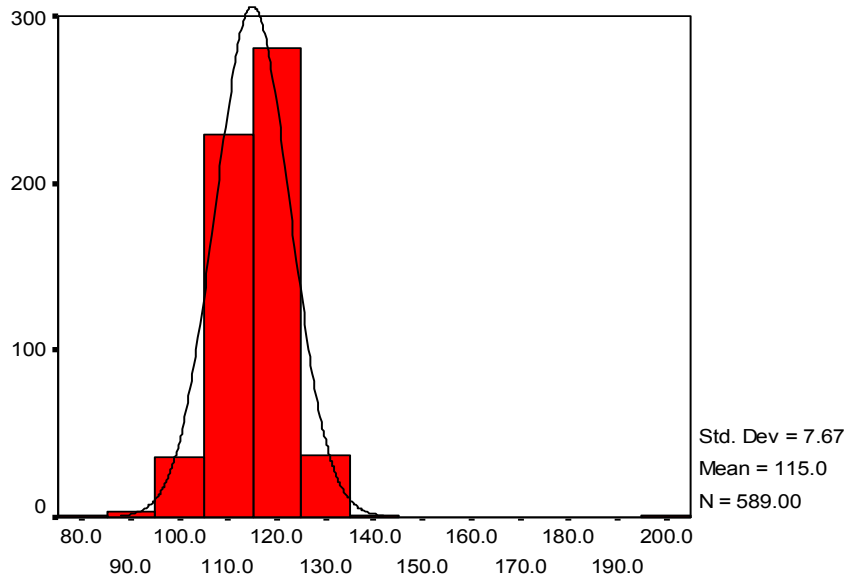


Figure 56. Whole sample distribution – Shoe Width

Shoe Width data were not normally distributed for the whole sample or for the male only data. The data for Shoe Breadth were broken down into industry category and are shown below.

Table 41. Industry category – Shoe Breadth

	Overall	Steel construction	New build	Interior build	Transport	Offshore	Manufacture	Rescue Services	Maintenance/ Repair	Agriculture/ Environment	Engineering
Min	83	98	101	99	83	88	102	96	101	98	103
Max	200	125	200	127	125	126	124	126	123	136	132
Mean	115	116	120	115	113	112	113	116	110	118	116
Std dev	7.7	5.9	11.4	6.4	6.4	7.5	4.9	6.5	5.6	7.1	5.9
N	589	50	72	67	64	70	50	63	54	49	50

ANOVA tests showed a significant different (0.0%) across industry categories, with Agriculture / Environment participants having the widest mean Shoe Breadth (118 mm) and Maintenance and Repair workers having the smallest mean (110 mm).

11.8 DEMOGRAPHIC AND DESCRIPTIVE DATA

The demographic and descriptive data collected included gender, age, ethnic origin, eyesight, clothing and equipment details. Results of the analysis of these data are included in the following sections.

11.8.1 Gender

The gender of the participants from whole sample is detailed in the table below.

Table 42. Gender of participants

Gender	Number of participants	Percent
Male	573	97.3
Female	16	2.7
Total	589	100

The number of males and females occurring within each group of participants is shown in the table below.

Table 43. Number of males & females by industry category

	Male	Female	% Males	% Females
Steel construction	50	0	100%	0%
New build	72	0	100%	0%
Interior build	67	0	100%	0%
Transport	61	3	95%	5%
Offshore	64	6	94%	6%
Manufacturing	50	0	100%	0%
Rescue services	60	3	95%	5%
Maintenance/Repair	53	1	98%	2%
Agriculture/Environment	46	3	94%	6%
Engineering	50	0	100%	0%
Total	**573**	**16**	**97.3%**	**2.7%**

Offshore and Agriculture industries had the highest proportion of females in the sample. Five of the industry categories included no female participants. As participants were drawn at random from the working population at each site, it is assumed that this reflected the gender balance working at the sites.

11.8.2 Age

The age distribution of the total sample, with participant age banded into 5 year categories, is shown below

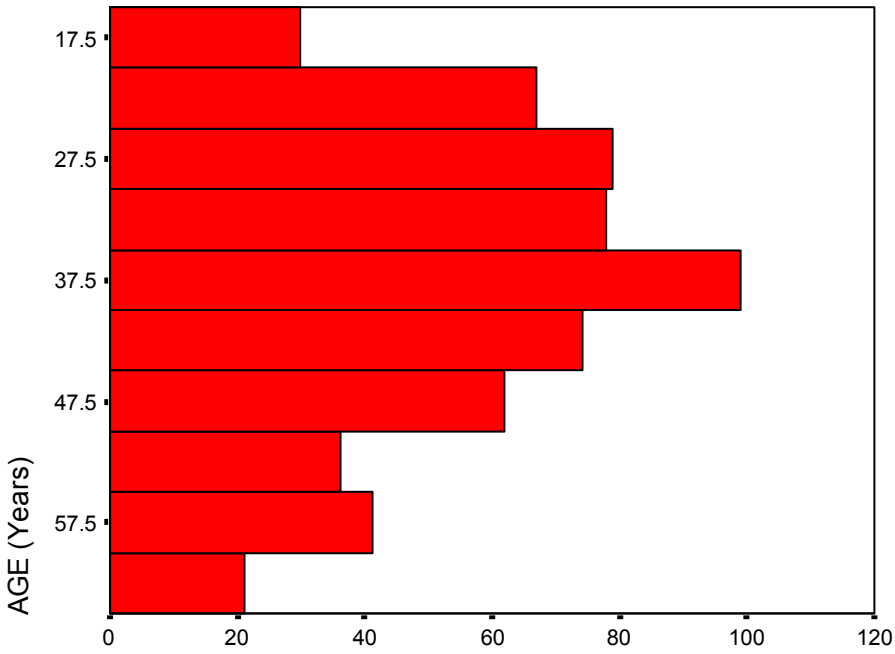


Figure 57. Age distribution

Ages ranged from 16years to 64 years with an average value of 37.3 years. A two sample t-test revealed that there was no significant difference between the average ages of males and females.

Age differences between industrial categories were considered further. It seems likely that because of the physical input required in different jobs, there may be a tendency for younger men to work in some jobs and older people to gravitate to other areas. The mean age by industry category is illustrated below.

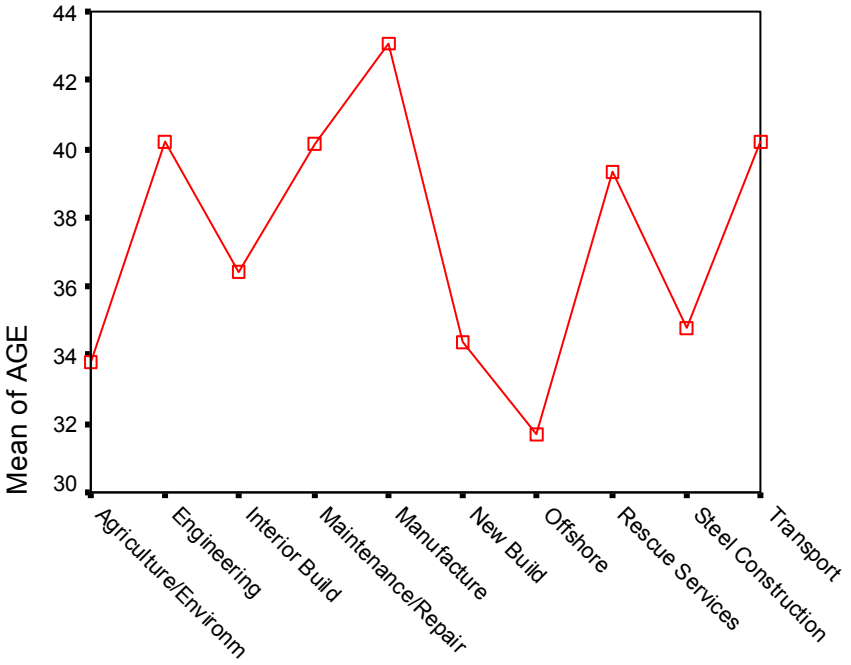


Figure 58. Mean age by industry category

The data reveals a difference between industry categories and this is again confirmed by the one variable ANOVA test.

Table 44. Age ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	7100.982	9	788.998	6.135	.000
Within Groups	74201.297	577	128.598		
Total	81302.279	586			

Not surprisingly, post hoc tests reveal significant differences between the age of Offshore Workers and Manufacturing Workers, Offshore Workers and Transport Workers, Offshore Workers and Engineers, as well as Manufacturing and Agricultural Workers and New Build and Manufacturing Workers.

11.8.3 Eyesight

Eyesight was collected at the request of the HSE Project Officer, as previous research carried out by BOMEL Ltd (Falls from height – Prevention and risk control effectiveness, 2003) for the HSE found that, "generally the roofing workforce is fit and healthy, but one area of health that may be overlooked is eyesight. It was estimated that about 20% of the workforce may have deficient eyesight, and this was felt to require further investigation." The information was collected to identify whether this research could support the anecdotal evidence.

In total, 403 participants (68.5%) reported they had no problems with their eyesight. Specific problems reported across the whole sample included being long sighted (17%), short sighted (10%) and difficulties with both near and far vision (3%). Other conditions reported were: astigmatism (0.3%), colour vision deficiency (0.3%), 'lazy eye' (0.3%) and other (0.5%). The data were further broken down into industry category and are shown below.

Table 45. Eyesight by industry category

	Good eyesight	Problems reported	% Good	% Problems
Steel construction	43	7	86%	14%
New build	61	11	85%	15%
Interior build	44	23	66%	34%
Transport	40	24	63%	37%
Offshore	48	22	69%	31%
Manufacturing	27	23	54%	46%
Rescue services	48	15	76%	24%
Maintenance/Repair	32	22	59%	41%
Agriculture/Environment	32	17	65%	35%
Engineering	28	22	56%	44%
Total	**402**	**186**	**68.4%**	**31.6%**

No one in the sample described their job as 'roofer', however many of the workers within New build had jobs that involved working on roofs e.g. joiners and bricklayers. Findings show that only 15% of the participants in New build reported problems with eyesight, this industry category had one of the lowest number of reported eyesight problems, along with Steel Construction (14%). These findings indicate there are slightly fewer eye deficiencies in this workforce than estimated in the BOMEL research (2003), but it is acknowledged that the sample may be limited for this specific issue. Manufacturing and Engineering categories had the highest percentage of participants reporting eyesight deficiencies (46% and 44% respectively).

11.8.4 Clothing

Details of participants' clothing were recorded and a summary of typical clothing in each industry category is shown in the following table. This includes a list of typical clothing, rather than total clothing worn by each person in the group.

Table 46. Clothing by industry category

	Typical clothing worn	Typical PPE & Equipment
Steel construction	Jeans, combat trousers, T-shirt, boiler suit	Hard hat, Tool belt, High-visibility vest, Harness
New build	Jeans, trousers, tracksuit bottoms, T-shirt, jumper, fleece	High-visibility Vest, High-visibility jacket, Hard hat
Interior build	Trousers, jeans, T-shirt, Shirt, jumpers, fleece	High-visibility vest, Hard hat
Transport	Overalls, trousers, jeans, shirt, jumper, T-shirt, jacket.	High-visibility vest, High-visibility jacket
Offshore	Boiler suit, trousers, T-shirt	Harness, Hard hat, Goggles, Gloves
Manufacturing	Jeans, trousers, T-shirt, overalls, Smock or boiler suit	N/A
Rescue services	Emergency services - Uniform trousers, T-shirt/shirt. Mountain rescue – walking trousers, shorts, t-shirt	Protective jacket and trousers, Boots, Helmet and gloves, Protective vest, Equipment belt, Body pads
Maintenance / Repair	Overalls, trousers, t-shirt, jumper, fleece, jeans	Hard hat, Harness, Tool bag, Ropes
Agriculture / Environment	T-shirt, overalls, protective trousers, boiler suit, fleece	Full body harness, Chainsaw, Hardhat, Ropes
Engineering	Trousers, jeans, T-shirt, boiler suit	High-visibility jacket, Hard hat

Clothing was very similar across most groups, although the Rescue Service participants often wore uniform. High visibility vests and jackets were usually worn throughout most industry sectors. Fall protection equipment was worn generally in the Agriculture/environment, Maintenance/repair, Steel construction and Offshore industry categories.

11.8.5 Ethnic Origin

The majority of participants were white / British, with most industry categories including only one or two Asian or Black British participants. However the Offshore group (n=70) contained 16 participants who were non-British. These included people from the US, Canada, Spain, Trinidad, Chad, France, Senegal, Norway, Venezuela, Algeria, Nigeria, Italy and Gabon.

11.8.6 Occupation

When considering the different data sub sets, occupation within industry category was obviously a variable of some interest. As there were a very large number of different occupations, results have only been compiled for some of those with the largest number of responses. The numbers are still rather small for purposes of statistical analysis but describing them may offer some insights.

In this instance worker's Weight Without Equipment and Weight With Equipment are considered. Comparisons might be tested using the t-test for two independent samples so that if Fire Fighters are compared with Plumbers, for example, a significant difference in Weight at the 2 per cent level ($t_{39} = 2.543$) might be shown. Similarly, it would seem that there is a significant difference in Weight at the 10 per cent level between Tree Surgeons and Police Officers. ($t_{48} = 1.853$). Because of the relatively small numbers involved and the possibility of compounding errors, this might not be a very profitable practice.

The statistics for Weight Without Equipment and Weight With Equipment are detailed for 11 occupations in the tables on the following page.

Table 47. Summary Statistics for 11 Occupations Weight without (kg)

Occupation	Industry category	N	Minimum	Maximum	Range	Mean	Std. Error
Fire-fighter	Rescue services	24	71.8	127.6	55.8	93.0	2.38
Tree Surgeon	Agr/Env	29	65.6	101.0	35.4	86.3	1.80
Bricklayer	New build	14	63.8	118.0	54.2	85.3	3.80
Plumber	Interior build	17	62.8	107.4	44.6	83.4	2.93
Steel Erector	Steel construction	15	70.2	105.2	35.0	91.6	2.74
Farmer	Agr/Env	13	66.4	147.8	81.4	92.8	6.09
Mountain Rescue	Rescue services	16	62.4	118.4	56.0	84.4	2.95
Electrician	Various	27	57.4	124.4	67.0	88.4	3.23
Police/AFO	Rescue services	21	70.6	109.2	38.6	91.8	2.36
Scaffolder	New build	9	74.0	96.0	22.0	81.7	2.70
Overhead linesmen	Maint/repair	12	62.6	106.4	43.8	88.45	4.19

From the statistical information of the 11 occupations, Scaffolders had the lowest mean body weight of 81.7kg, Fire-fighters had the heaviest mean body weight of 93kg, there being just over an 11kg difference in the mean body weight between these two occupations. Unsurprisingly the heaviest person was a Fire-fighter weighing 127.6kg, the lightest person was an electrician who weighed 57.4kg. Electricians were found to be an occupation that was not specific to one industry category, this occupation type was common in Interior build, Engineering, Maintenance/repair, Manufacture and the Offshore industry categories, however, this particular electrician worked in the Engineering industry category. Scaffolders Weight Without Equipment had the smallest range, with only 22kg between the minimum and maximum weight. The greatest variation in Weight Without Equipment was amongst Farmers, there being an 81.4 kg difference between the minimum and maximum weight.

Similar results can be produced for Weight With Equipment

Table 48. Summary Statistics for 11 Occupations Weight with equip(kg)

Occupation	Industry sector	N	Minimum	Maximum	Range	Mean	Std. Error
Fire-fighter	Rescue services	24	73.2	129.2	56.0	94.7	2.37
Tree Surgeon	Agr/env	29	82.4	112.8	30.0	97.0	1.75
Bricklayer	New build	9	64.2	118.6	54.4	88.5	5.22
Plumber	Interior build	10	63.0	95.6	32.6	79.9	3.46
Steel Erector	Steel construction	15	79.6	113.6	34.0	97.1	2.67
Farmer	Agr/env	4	69.6	117.0	47.4	91.6	9.75
Mountain Rescue	Rescue services	16	65.4	122.8	57.4	87.8	3.10
Electrician	Various	11	70.6	125.6	55.0	91.6	5.21
Police/AFO	Rescue services	21	77.2	128.0	50.8	105.4	3.02
Scaffolder	New build	7	76.0	98.0	22.0	86.2	3.30
Overhead linesmen	Maint/repair	12	88.8	138.8	50	113.8	5.24

The Weight With Equipment statistical figures for Bricklayers, Plumbers, Farmers, Electricians and Scaffolders are based on a fewer number of participants than the Weight Without Equipment statistical figures, as certain participants in these occupations did not have tools or equipment attached to them whilst working at height. The statistical figures for Farmers are based on as few as four participants. From the eleven occupations, overhead linesmen had the heaviest mean Weight With Equipment of 113.8kg and Scaffolders again had the lowest mean Weight With Equipment of 86.2kg, giving an approximate 28kg difference in mean Weight With Equipment between these two occupations. Unsurprisingly the heaviest Weight With Equipment measure was 138.8kg which was an Overhead linesmen, the lightest Weight With Equipment measure was 70.6kg, again this was an Electrician. As previously stated the Electrician occupation is not specifically related to a particular industry category, however, this participant worked in the Maintenance and Repair industry category. Scaffolders' Weight With Equipment had the smallest range of 22kg between the minimum and maximum weight, the greatest variation in Weight With Equipment within one occupation was Mountain Rescue workers, with a 57.4kg difference between the minimum and maximum weight.

Here two independent sample t-tests suggest that there is a significant difference between Policemen and Scaffolders ($t_{26} = 4.29$) at the 0.1 per cent level. Similarly a comparison between Tree surgeons and Mountain Rescue reveals a significance level of 1 per cent ($t_{43} = 2.584$).

Table 49. Equipment/Weight Ratios

Occupation	Mean Weight	Mean Weight+Equip.	Equipment %
Firefighter	93.0	94.7	1.9
Tree Surgeon	86.3	97.0	12.5
Bricklayer	85.3	88.5	3.8
Plumber	83.4	79.9	N/A
Steel Erector	91.6	97.1	6.0
Farmer	92.8	91.6	N/A
Mountain Rescue	84.4	87.8	4.0
Electrician	88.4	91.6	3.5
Police/FO	91.8	105.4	14.8
Scaffolder	81.7	86.2	5.5
Overhead linesmen	88.45	113.8	28

Here it is interesting to note that Overhead linesmen on average carry the heaviest equipment in relation to their body weight, 28% of their Weight With Equipment is attributable to equipment. This is almost double the figure for Police and Firearms Officers, 14.8% of their weight on average is attributable to equipment, closely followed by Tree surgeons (12.5%). Steel Erectors and Scaffolders are midway down the list with Fire Fighters, surprisingly, near the bottom.

11.9 CONFIDENCE INTERVALS

Usually when estimates are made of population parameters from sample statistics it is customary to add an interval estimate or confidence interval to give some idea of the precision of a particular estimate.

When the mean or average of a variable or dimension is considered, as discussed in a previous section, we can appeal to the central limit theorem. This means that confidence intervals for means can be estimated fairly quickly using standard statistical theory. The diagram below illustrates the respective intervals for Weight for each of the 10 industrial categories.

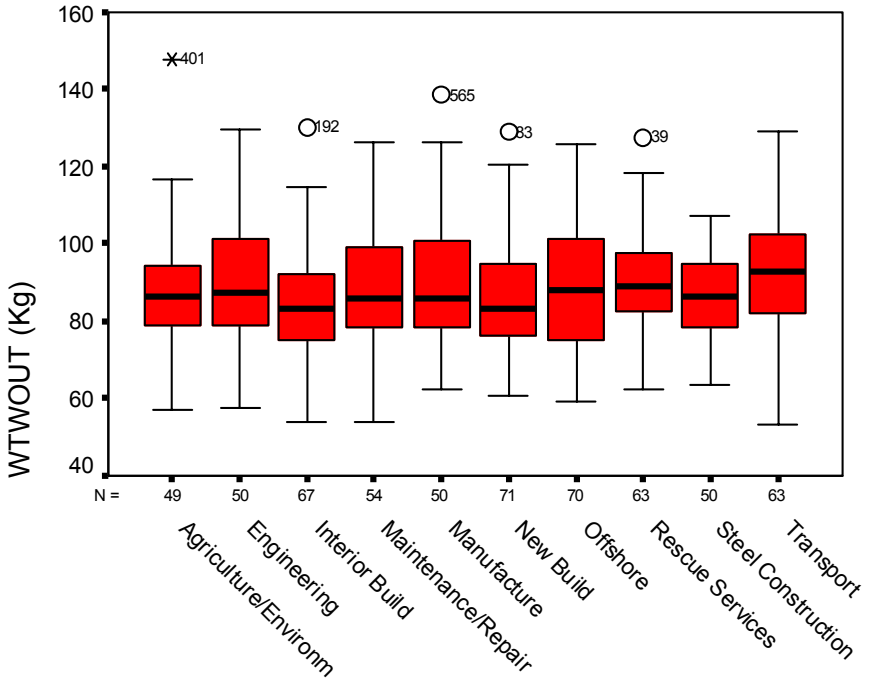


Figure 59. 95% Confidence Intervals for Mean Weight Without Equipment

The numbers in the main body of the chart represent outliers; (401, for example relates to case 401 which represents the details of a worker who weighed 147 kg). The illustration makes it easy to pick out comparisons, e.g. that the Transport sector has the highest average overall and that the steel constructors have the smallest spread.
Similar results can be obtained for Working Weight (see chart below) or any of the dimensions measured.

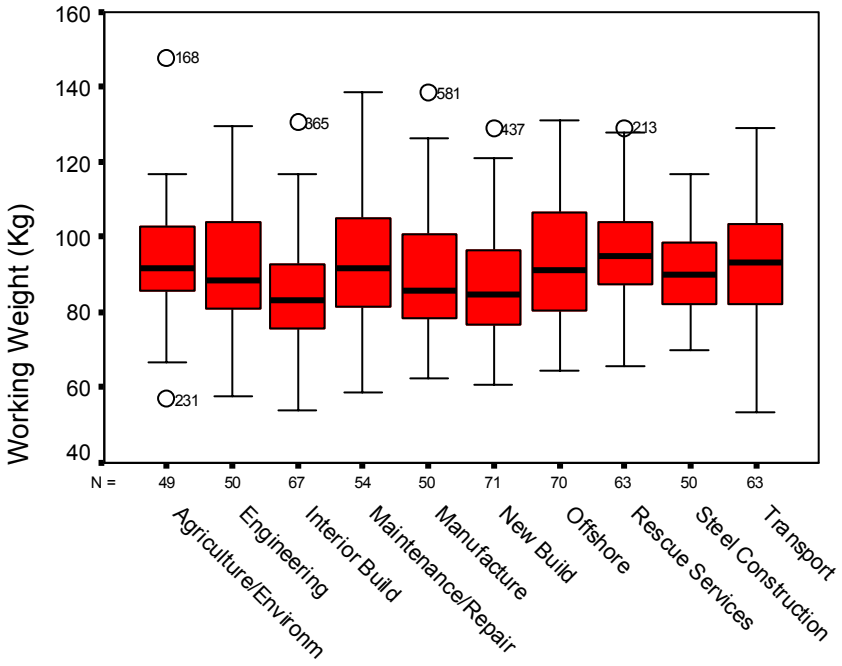


Figure 60. 95% Confidence Intervals for mean Working Weight

Unfortunately, the major focus of this investigation is the more extreme measurements, 95th percentiles and 99th percentiles. For some of the dimensions where the interest is in especially small values, then the 1st and 5th percentiles are of relevance. In these cases, because it is no longer possible to make assumptions of normality, the bootstrap or re-sampling techniques described in an earlier section to estimate the required confidence intervals are used.

The following chart illustrates the values of the 95th and 99th percentiles for the dimension Weight Without Equipment for each of the 10 industrial categories.

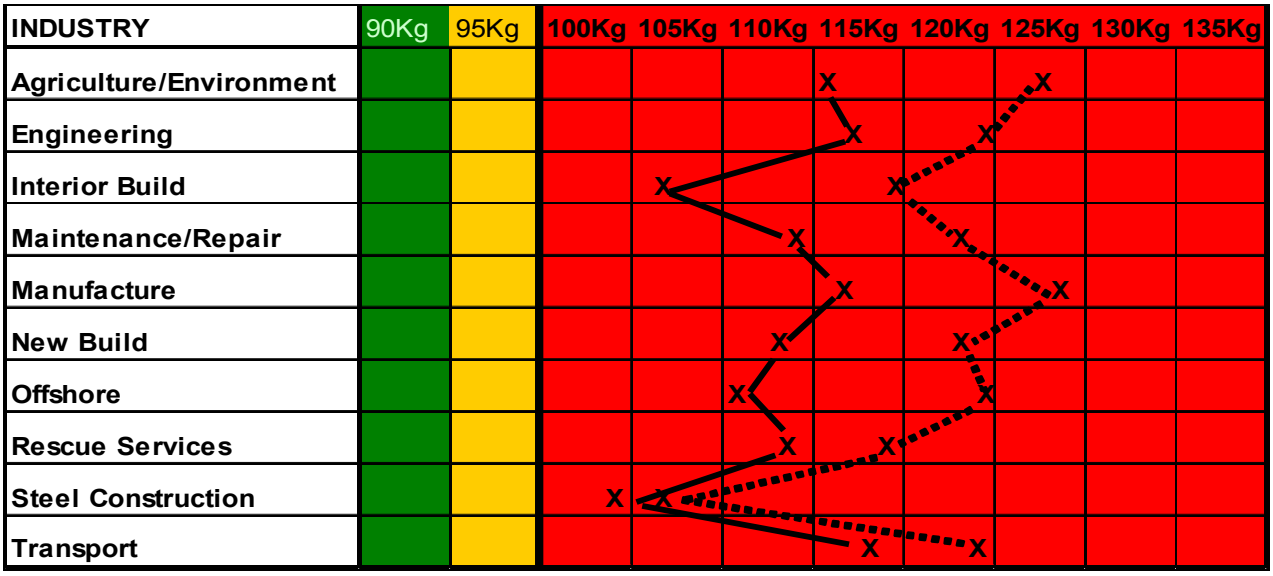


Figure 61. Weight Without Equipment (kg) for 95th and 99th percentiles

Figures for all 10 sectors are comfortably above the current standard weight of 100 kg The next chart shows the values of the 95th and 99th percentiles for the derived variable Working Weight. Here the differences are even more pronounced.

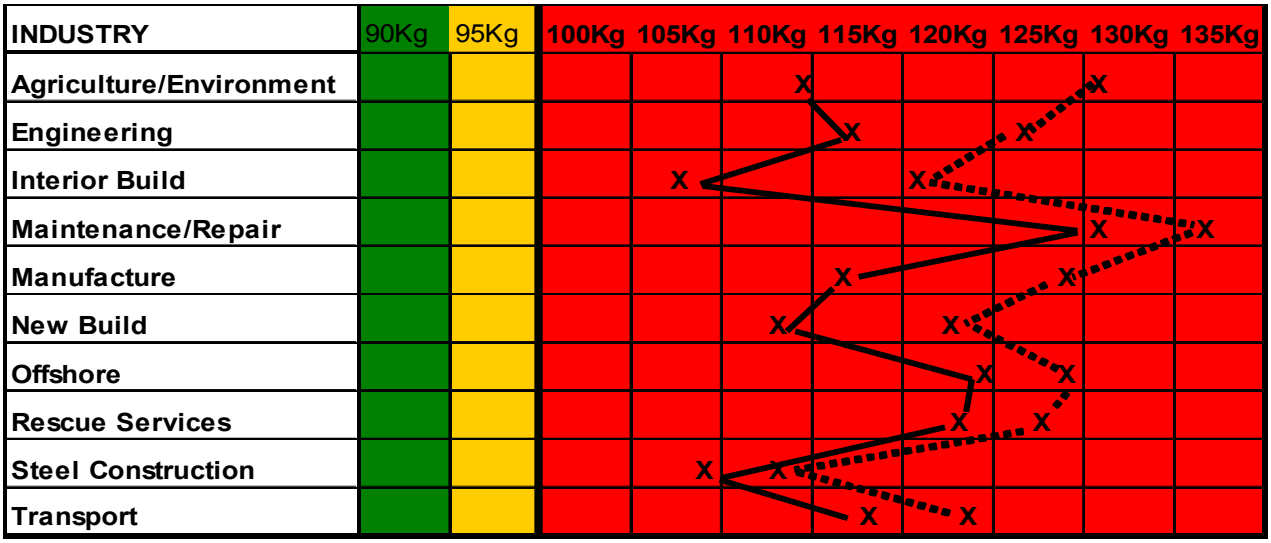


Figure 62. Working Weight (kg) for 95th and 99th percentiles

In order to be able to ascribe confidence limits to these percentiles, the re-sampling (bootstrap) option was used in the statistical software package S-Plus. An example of the output together with a graph of the re-sampling results for the Hand Breadth dimension is given below.

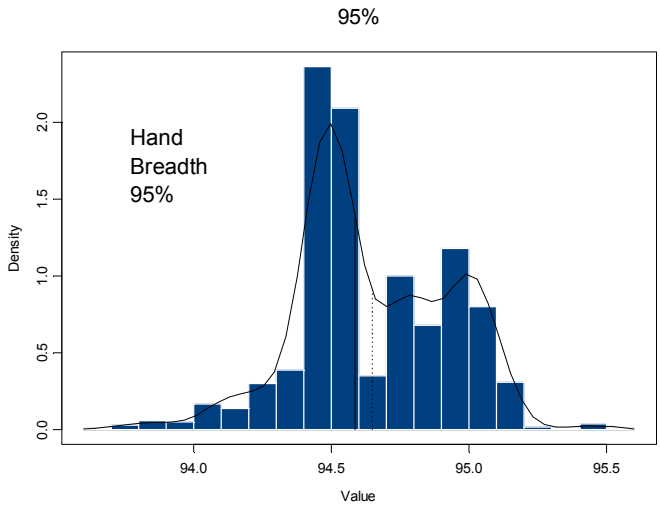


Figure 63. Example bootstrap resampling (Hand Breadth)

```
 *** Bootstrap Results ***
Call:
bootstrap(data = bbodf588, statistic = quantile(handbrth,
c(0.95)), B = 1000,
 trace = F, assign.frame1 = F, save.indices = F)

Number of Replications: 1000

Summary Statistics:
    Observed    Bias  Mean     SE
95%    94.58 0.06389 94.65 0.2794

BCa Percentiles:
     2.5%       5%    95%  97.5%
95% 94.09 94.19662 95.062 95.108
```

Figure 64. Example Bootstrap calculation (Hand breadth)

Results for the estimated confidence intervals for the 95th and 99th percentiles for all of the 15 measured dimensions, using this bootstrapped data, are given in tables on the following pages. The annotation BCa stands for Bias Corrected and adjusted.

Table 50. 95th percentiles for Weight by Industry Category (kg)

		BCa Percentiles			
Industry category	**Value**	**2.50%**	**5.00%**	**95.00%**	**97.50%**
Agriculture/Environment	115.0	112.3	112.5	118.3	118.4
Engineering	116.8	107.4	109.3	128.0	129.6
Interior Build	106.7	99.8	100.6	114.8	124.7
Maintenance/Repair	114.4	103.3	104.2	125.1	126.4
Manufacture	116.4	106.6	106.6	133.1	133.1
New Build	113.2	102.0	103.0	120.6	122.7
Offshore	119.4	110.0	111.5	124.4	125.4
Rescue Services	108.4	103.1	103.5	117.5	118.4
Steel Construction	104.8	102.0	102.8	106.6	106.7
Transport	117.4	113.9	114.0	124.2	124.2

Table 51. 99th percentiles for Weight by Industry Category (kg)

		BCa Percentiles			
Industry category	**Value**	**2.50%**	**5.00%**	**95.00%**	**97.50%**
Agriculture/Environment	127.6	124.4	124.6	129.7	130.2
Engineering	124.9	115.8	116.3	129.6	129.6
Interior Build	119.7	107.4	109.0	130.2	130.2
Maintenance/Repair	122.9	112.3	114.7	126.4	126.4
Manufacture	128.8	114.2	114.8	138.4	138.4
New Build	122.5	114.6	115.7	128.8	128.8
Offshore	124.2	120.3	120.8	126.0	126.0
Rescue Services	119.3	106.6	107.6	127.6	127.6
Steel Construction	106.2	105.1	105.3	107.0	107.0
Transport	124.1	116.8	117.4	129.0	129.0

In addition a sample of the results are presented in graphical form, which certainly seems to illustrate the fact that in all 10 of the industrial categories, the 95th percentiles of Weight and Working Weight are significantly higher than the design standard of 100 kg.

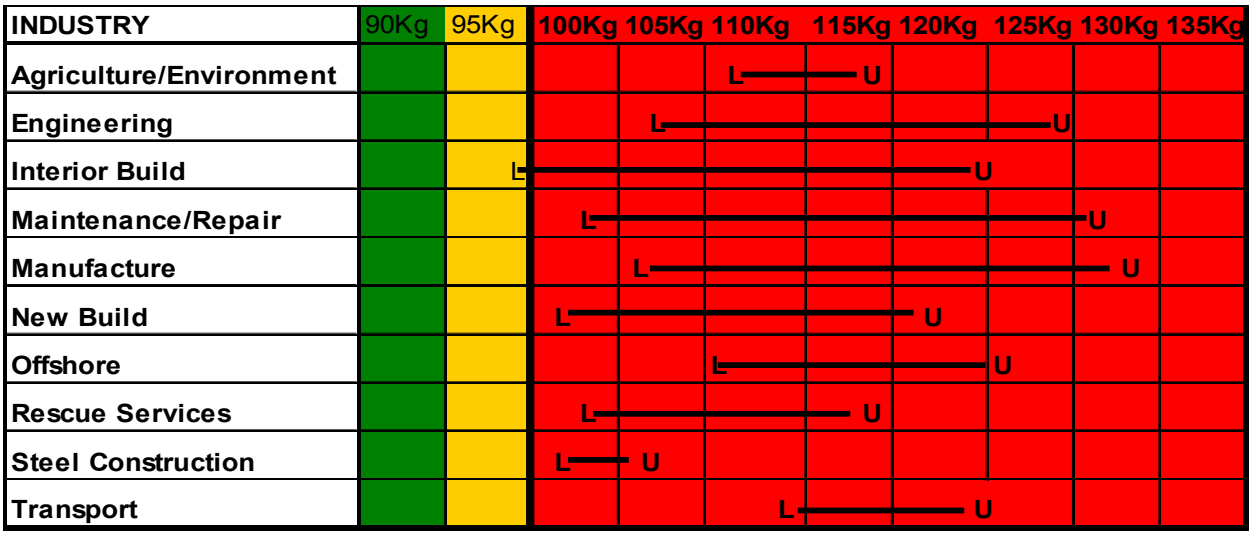


Figure 65. Weight (kg) 95 percentiles: 95% confidence limits

This exercise is repeated for the Weight With Equipment data.

Table 52. 95th Percentiles for Weight With Equipment by Industry Sector

		BCa Percentiles			
Industry category	**Value**	**2.50%**	**5.00%**	**95.00%**	**97.50%**
Agriculture/Environment	112.2	108.1	108.6	117.0	117.0
Engineering	115.1	106.6	107.6	129.4	129.4
Interior Build	110.6	96.9	99.5	129.7	129.7
Maintenance/Repair	134.0	122.9	124.0	138.8	138.8
Manufacture	N/A	N/A	N/A	N/A	N/A
New Build	111.6	102.6	102.7	119.8	121.0
Offshore	125.4	113.0	115.7	130.0	130.0
Rescue Services	122.8	113.8	117.6	128.0	128.6
Steel Construction	110.3	105.5	105.7	116.3	116.8
Transport	112.8	106.8	107.2	119.0	119.0

Table 53.99th Percentiles for Weight With Equipment by Industry Sector

		BCa Percentiles			
Industry category	**Value**	**2.50%**	**5.00%**	**95.00%**	**97.50%**
Agriculture/Environment	114.4	110.9	110.9	117.0	117.0
Engineering	121.3	107.5	107.5	129.4	129.4
Interior Build	110.6	96.9	99.5	129.7	129.7
Interior Build	121.1	108.4	110.4	130.4	130.4
Maintenance/Repair	137.2	132.4	134.0	138.8	138.8
Manufacture	N/A	N/A	N/A	N/A	N/A
New Build	117.9	110.9	113.4	121.0	121.0
Offshore	129.8	126.3	128.2	131.4	131.4
Rescue Services	127.3	122.8	124.0	129.2	129.2
Steel Construction	113.8	108.5	108.8	116.8	116.8
Transport	114.8	107.8	108.0	119.0	119.0

The next chart shows the values of the 95th percentiles for the derived variable Working Weight with 95% confidence limits.

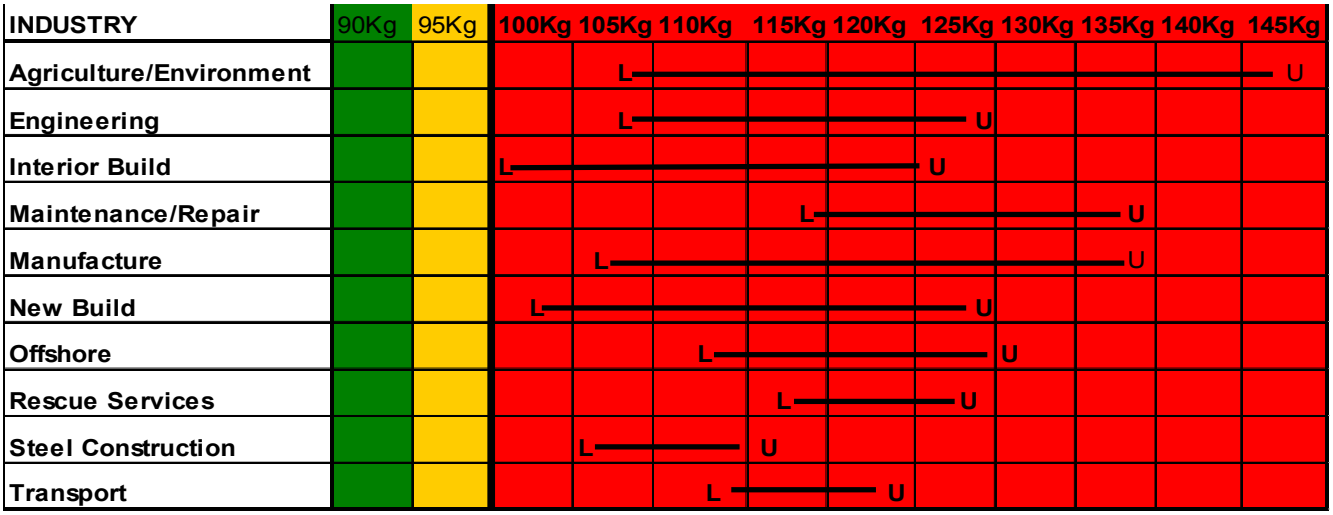


Figure 66. Working Weight (kg) 95 percentiles: 95% confidence limits

In the following table, overall figures are given for confidence limits on the 1st and 5th percentiles for the variables noted.

Table 54. Confidence limits for the 1st percentiles

		BCa Percentiles			
DIMENSION	**Value**	**2.50%**	**5.00%**	**95.00%**	**97.50%**
Stature (mm)	1624.0	1599.6	1600.0	1639.0	1641.6
Hand breadth (mm)	75.8	73.2	73.3	76.9	77.0
Hand span (mm)	171.2	160.0	165.2	173.0	173.0
Shoe length (mm)	253.4	212.0	212.0	261.0	266.2
Shoe breadth (mm)	97.1	90.0	90.0	98.0	98.0

Table 55. Confidence limits for the 5th percentiles

		BCa Percentiles			
DIMENSION	**Value**	**2.50%**	**5.00%**	**95.00%**	**97.50%**
Stature (mm)	1666.0	1653.3	1656.0	1674.0	1678.6
Hand breadth (mm)	80.4	78.9	79.2	81.2	81.5
Hand span (mm)	181.4	176.0	176.0	181.0	181.0
Shoe length (mm)	280.1	273.2	274.0	283.0	293.0
Shoe breadth (mm)	103.5	102.0	102.0	105.0	105.0

These data are particularly relevant for the design of safety nets where the gaps in nets must prevent the smallest hands or feet from passing through, limiting possible injury from limb entrapment in the net.

12 DISCUSSION OF RESULTS

One of the main objectives of the research was to determine whether or not the standard 100 kg test weight was reasonable as a 95th percentile value for the weight of workers at height.

For the whole sample, this can be done by appealing to the central limit theorem in respect of sample proportions being normally distributed. If 100 kg is the true 95th percentile for workers at height weight, then approximately 95 per cent of the observed readings should fall below this value. In practice, only 79 percent of observations fall below this value, so a simple z-test of the differences gives a value of 17.7, which is very highly significant (Sig. = 0.000%). We can therefore reject the hypothesis that 100 kg is accurate as a 95th percentile and conclude that the true value is considerably higher than that.

Indeed, if we proceed to test the hypothesis that 110 kg is a more appropriate level for the 95th Weight percentile, our observed percentage lower than this value is 92.2 per cent. The normal of z-test in this case returns a value of z= 3.111 which is significant at 0.1%.

By using a converse argument we can assert that the confidence interval for the 95% proportion (93.2% to 96.8%) for a sample of size 589 will have a 0.95 chance of covering the true value. Looking up these values in the frequency table of observed observations suggests a 95% confidence interval for workers' Weight to be 112.3 kg to 118.4 kg.

Of course, the same analysis for Working Weight would indicate that to be even further removed from a 95 percentile value of 100 kg, in this case 116.2 kg – 126.0 kg

When it comes to analysing 95th percentiles by industry category, because of the smaller numbers we can no longer appeal to the central limit theorem but must have recourse to the bootstrap analysis. The way that the bootstrap methodology approaches hypothesis testing is to look at the confidence intervals generated.

If the interval covers the test value of the parameter (in our case 100 kg), then there is no grounds for rejecting the null hypothesis that the test value is in fact accurate. If the confidence interval does not encompass the test value then the null hypothesis is rejected.

Clearly, looking at the charts for bootstrap intervals given in the previous section, with the possible exception of Interior Build, 100 kg is not a true value for the 95th percentile; from the charts it can be inferred that the true value is somewhat larger. This point is even more evident for the chart showing the bootstrap intervals for Working Weight. These results would seem to re-enforce the findings from the full sample analysis.

The data for Clothed Body Mass Index were considered further. Although there was only a small number of females in the sample, the average Clothed BMI score for females can be shown to be significantly different from the average for men. An independent two sample t-test yields a value of $t_{585} = 2.864$ with a significance value of 0.4%. Other comparisons e.g. between Rescue Services (Mean = 27.07) and Transport (Mean = 29.50) can be made on an ad-hoc basis. In this case $t_{124} = -3.585$ which has a corresponding significance level of 0.000%, suggesting a very significant difference in the Clothed BMI for these two groups.

The boundary value of BMI is usually quoted as 25, this is often used to infer that anyone exceeding this value can be classified as 'overweight'. This, of course is calculated without the added weight of clothing. It may be possible to make an assumption about the weight of the clothing worn. If a maximum weight of 3 kg for the weight of clothes is assumed and this is added to the worker's weight in kg, at least for the 'middle' weight range of workers this does not seem to increase the BMI level by more than a single unit. This implies that testing the average Clothed BMI against an overweight score of 26 would be fair.

If a one sample t-test is used to compare the overall mean, a t value of 10.19 with 586 degrees of freedom is recorded. This is significant at the 0.000% level so we can confidently say that the overall mean Clothed BMI score lies in the 'overweight' zone.

Indeed, if this is tested against a target mean value of 27, the single sample t-test produces a value of 4.519 with 586 degrees of freedom; another very significant result (0.000%) which strongly suggests that the average Clothed BMI score for the sample is at least one point into the 'overweight' category.

The following table gives the results of one sample t-tests on the mean BMI scores (Target Value = 26) for each of the 10 industrial categories. All of the sectors record significantly higher means at the 5% level.

Table 56. Single Sample t-test values for Industry Categories tested against a mean BMI value of 26.0

	Degrees Freedom	t Value	Significance Level
Agriculture/Environment	48	2.210	0.032
Engineering	49	3.611	0.001
Interior Build	66	2.118	0.038
Maintenance/Repair	53	2.007	0.050
Manufacture	49	4.340	0.000
New Build	70	2.607	0.011
Offshore	69	3.889	0.000
Rescue Services	62	2.973	0.004
Steel Construction	49	2.478	0.017
Transport	62	6.088	0.000

One final observation regarding the Clothed BMI measure is that it shows a significant correlation with age (r = 0.234). This may be due to the large sample size but the suggestion that BMI increases with age has some face validity.

12.1 TORSO DUMMY REFINEMENTS

Certain body dimensions taken in this survey were to establish whether the current size of the torso dummy needed refining to accurately represents the body size of individuals that work at height. The dimensions taken for this were:

- Weight – with and without equipment
- Shoulder breadth
- Hip breadth
- Chest circumference
- Waist circumference
- Thigh circumference
- Cervical height

With certain dimensions, direct comparisons can be made to the torso dummy e.g. shoulder breadth, hip breadth and thigh circumference. However, the depth of the body section of the torso dummy is based on a single measurement, in order to accurately refine this section chest and waist circumference were taken. The overall length of the torso dummy appears to be based on a measurement taken from the centre of the crotch to the base of the neck, for ethical reasons it was not possible to take this measurement, instead cervical height was taken (vertical distance from a horizontal sitting surface to the cervical). Weight of the torso dummy has been discussed in-depth in section 11.

Table 57. Torso dummy dimension comparison with measured data

	Torso dummy	95%ile measurement	% increase/decrease
Shoulder breadth	483	542	+12%
Hip breadth	380	376	-1%
Thigh circumference	559	692	+23%
Chest circumference	———	1250	———
Waist circumference	———	1200	———
Cervical height	680	722	+6%

Torso dummy dimensions have been compared to the 95%ile dimensions attained from the survey, as the current weight of the torso dummy appears to be based on the weight of the 95%ile British population. Results show that Shoulder Breadth of measured people that work at height is 12% bigger than the torso dummy (59mm bigger), Thigh Circumference is 23% bigger (133mm bigger) and Cervical Height is 6% bigger (42mm). Hip breadth is the only dimension taken that is smaller than the torso dummy; there is a 1% difference in size (4mm smaller).

Overall findings show that the torso dummy does not accurately represent the body size of individuals that work at height. Generally the torso dummy is smaller than the body size of the 95%ile working at height population apart from hip breadth.

13 CONCLUSIONS

The following conclusions can be drawn from this research:

- Summary statistics and 1st, 5th, 95th, and 99th percentiles are given for the 15 measured dimensions and three derived dimensions. Many of the frequency distributions for the measured dimensions follow a normal (Gaussian) curve.
- There appears to be no significant difference in workers' Weight Without Equipment between the 10 industrial classifications.
- There is a significant difference between the 10 industrial classifications for Weight With Equipment and Working Weight.
- Bootstrapped confidence intervals for the 99th and 95th percentiles are given for Weight and for Working Weight. From this analysis it can clearly be seen that the figure of 100 kg significantly underestimates the actual 95th percentile for workers' Weight Without Equipment.
- It is likely (95% confidence) that the interval 112.3 kg – 118.4 kg covers the true value of the 95th percentile for Weight Without Equipment.
- It is likely (95% confidence) that the interval 116.2 kg – 122.0 kg covers the true value of the 95th percentile for Working Weight.
- Maintenance and Repair workers, in particular overhead pylon linesmen, carried the heaviest equipment, which could weigh up to 41.2 kg. In a sample of 10 occupations, Police Officers (14.8%) and Tree Surgeons (12.5%) carried the largest weights of equipment with respect to body weight.
- There is a significant difference between workers ages in different industry categories.
- The average Clothed BMI score for each industrial category significantly exceeds the 'overweight' boundary. There is a significant difference between (mean) Clothed BMI scores for the 10 industry sectors and between men and women.
- Results suggest that the torso dummy currently specified generally under-represents the size of people who work at height.
- If a full bodied dummy was developed, data to ensure this is representative of the working at height population are presented in this report.
- Data that could be used in the design of safety nets to prevent limb protrusion are presented.

14 RECOMMENDATIONS

As a result of this research, the following recommendations are made:

Standards that related to protection of people who work at height should be modified to reflect the weight of the population who work at height, as these are significantly different to the general population. A figure between 116.2 kg – 122.0 kg should replace the 100 kg currently used, to represent a 95th percentile weight of workers, including clothing plus equipment that may be attached to them, should they fall from height. The Torso dummy used in BS EN 364: 1993 should be modified so that it more accurately represents the size of people who work at height.

95th percentile values have been quoted throughout the results and conclusions of this research, although 99th percentile values have been calculated and listed. It is common in design to use design limits as designing for the full range of the population (the very smallest to the very biggest) might prove prohibitively expensive or may result in over-engineered designs. It is common to use design limits of 5th and 95th percentiles to ensure the majority of the population are considered, without putting an excessive burden on the manufacturer. However, it must be remembered that the use of these design limits may exclude the largest or smallest 5% of the population. In a context such as working at height, this could mean a vast number of people are not catered for. Obviously the use of safety margins ensures that these people are not put directly at risk, but the safety margins are eroded for the people at the extremes.

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APPENDIX A

Detailed breakdown of accident data

(RIDDOR accident data 1996 - 1997 & 2000 – 2001. IRATA industrial rope access accident statistics 2000)

1) Steel erection

Occupation	Fatalities	Major	Other	Total
Steel erector	11	133	30	174
Construction	15	186	80	281
Scaffold/steeple	18	340	174	532
Builder	10	44	9	63
Surveyor/planner	1	19	5	25
Crane Driver	1	26	11	38
Total	**56**	**748**	**309**	**1113**

2) New Build – certain occupations fall in more than one category, accident data for these occupations have been split between the relevant categories. E.g. accident data for builder has been halved between new build and steel erection.

Occupation	Fatalities	Major	Other	Total
Roofer	57	475	207	736
Carpenter/joiner	9	596	320	925
Other construction	10	244	124	378
Builder	11	43	8	62
Bricklayer/mason	6	258	202	466
Building Labour	6	80	82	168
Glazier	2	110	49	161
Total	**101**	**1806**	**992**	**2896**

3) Interior build

Occupation	Fatalities	Major	Other	Total
Painter/decorator	18	423	205	646
Plumber/heating	2	187	141	330
Plasterer	1	67	41	109
Electric Fitter	8	475	329	803
Floorer	2	12	8	22
Total	**31**	**1164**	**724**	**1913**

4) Transport Industry

Occupation	Fatalities	Major	Other	Total
Goods Driver	6	413	272	691
Vehicle trades	2	78	38	118
Fork Lift driver	0	35	21	56
Despatch Clerks	0	64	66	130
Transport Managers	3	35	10	48
Plant drivers	0	26	18	44
Other/transport/machinery	1	16	21	38
Bus/coach driver	1	9	10	20
Vehicle finisher	0	11	8	19
Drivers mate	0	6	7	13
Road construct	0	3	7	10
Rail construct	0	5	5	10
Travel	0	5	3	8
Transport Inspector	0	2	0	2
Ambulance	0	6	1	7
Car/cab driver	0	1	1	2
Total	**13**	**715**	**477**	**1205**

5) Offshore/Rope access – There is little accident data for offshore workers, however, the majority of activities carried out within this industry are via rope access. Detailed in the table below is the number of rope access accidents that occurred in the year 2000

	On rope	Off rope	Totals
Class A	3	Nil	3
Class B	26	33	59
Totals	29	33	62

Class A – number of incidents assessed as having the potential for causing serious harm.

Class B – assessed as being unlikely to cause such harm.

(www.irata.org)

6) Manufacturing

Occupation	Fatalities	Major	Other	Total
General managers	6	82	55	143
Product Managers	4	79	28	111
Assembly/line	0	32	19	51
Plastics	0	26	21	47
Textile worker	1	16	14	31
Routine manufacture	1	14	13	28
Textile	0	12	7	19
Wood trades	0	6	3	9
Wood working machine	1	2	5	8
Paper cutting	0	1	3	4
Cabinet makers	0	2	1	3
Total	**13**	**272**	**169**	**454**

7) Rescue Services

Occupation	Fatalities	Major	Other	Total
Police	1	47	106	154
Fire – fighter/officer	0	43	78	121
Armed Forces	0	9	3	12
Ambulance	0	6	1	7
Doctors and Medics	0	3	1	4
Total	**1**	**108**	**189**	**298**

8) Maintenance/Repair

Occupation	Fatalities	Major	Other	Total
Maintenance fitter	5	200	128	333
Cleaners	1	82	74	157
Window cleaner	18	96	30	144
Caretakers	2	50	49	101
Service pipes	1	33	10	44
House keepers	0	8	8	16
Ship aircraft	0	4	3	7
Total	**27**	**473**	**302**	**802**

9) Agriculture/Environment

Occupation	Fatalities	Major	Other	Total
Farm worker	9	104	26	139
Oth/Agriculture	4	41	29	74
Gardener	2	30	40	72
Forestry	6	38	18	62
Agric/managers	9	32	7	48
Mine Quarry	5	25	10	40
Paper/wood	0	15	15	30
Refuse	1	8	19	28
Water/sewage	0	11	12	23
AG mach driver	1	10	5	16
Horticulture	0	11	5	16
Fishing	0	4	1	5
Environmental	0	4	1	5
Fishmonger	0	2	1	3
Mining	0	1	0	1
Total	**37**	**336**	**189**	**563**

10) Engineering

Occupation	Fatalities	Major	Other	Total
Engine/elec	3	131	99	233
Metal machining	0	23	25	48
Welders	4	44	29	77
Metal machine operative	0	20	21	41
Sheet metal worker	2	22	8	32
Elec/generator	1	16	14	31
Oth metal	1	14	14	29
Metal Plate work	0	20	4	24
Routine metal	1	10	12	23
Foundry Labour	0	8	8	16
Metal Furnace	0	9	4	13
Smiths/forge	0	5	4	9
Moulders	0	3	4	7
Metal coating	0	1	2	3
Total	**12**	**326**	**248**	**536**

Total number of accidents in all categories: 10,958

Group	Total accidents	% total accidents
Steel construction	1113	10.2
New build	2896	26.4
Interior build	1913	17.5
Transport	1205	11
Offshore	1178	10.8
Manufacture	454	4.1
Rescue services	298	2.7
Main/rep	802	7.3
Agr/env	563	5.1
Eng	536	4.9
Total	**10,958**	

APPENDIX B

Consent form

CONSENT FORM

Body Size Criteria

Purpose of the trials

The purpose of these trials is to assess the current standard for the testing of personal protective equipment (PPE).

What will happen during the trials

You will be measured in several different postures wearing your work clothes using anthropometric equipment. Approximately 15 measurements will be taken and a few further questions will be asked. When weighed you will be asked to carry any equipment usually attached to yourself while working at height.

Safety instructions

For reasons of safety and experimental control you will be required to follow the instructions of the experimenter at all times. Please advise us of any assistance you may require in conducting this work safely.

What happens to the data

All data obtained during these trials will be confidential. Your personal records are held on a computer that is password protected so that only authorised members of staff may gain access. All people that participate in these trials are allocated a number so that their names do not appear with their results.

Your right to withdraw

You have the right to withdraw from these trials at any time, either before or during the testing. If you wish to leave at any time, inform the member of staff. You do not have to give an explanation and none is expected. If you feel unwell at any time or if you simply want a rest, then please inform a member of staff and we will immediately pause the trials.

Any Questions?

If you have any questions then please ask the member of staff.

Consent form

If you are content to proceed with the trials then please sign your consent below.
I have read the information above and agree to take part in the trials.

Signed:……. Date:…….

Witnessed…… Date:……..

APPENDIX C

Raw data

Agriculture / Environment demographic data

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	PPE +Equipment
11	M	13/01/1941	farmer	Agriculture/environment	White British	longsighted	jumper trousers	
12	F	07/01/1947	farmer	Agriculture/environment	White British	shortsighted	jumpers trousers	
13	M	06/11/1941	farmer	Agriculture/environment	White British	perfect	shirt trousers, boiler suit	
22	M	02/08/1949	farmer	Agriculture/environment	White British	long/short	shirt, trousers, fleece, jumper	
23	M	03/03/1977	tree surgeon	Agriculture/environment	White British	perfect	t-shirt, trousers,	Sit harness, chainsaw, helmet
24	M	26/08/1960	tree surgeon	Agriculture/environment	White British	long	t-shirt, trousers,	Sit harness, chainsaw, helmet
25	M	07/07/1981	tree surgeon	Agriculture/environment	White British	perfect	t-shirt, trousers, fleece	Sit harness, chainsaw, helmet
26	M	10/12/1953	tree surgeon	Agriculture/environment	White British	shortsighted	trousers, fleece,	Sit harness, chainsaw, helmet
27	M	22/09/1975	tree surgeon	Agriculture/environment	White British	perfect	jumper, trousers,	Sit harness, spikes, chainsaw, rope, helmet
28	M	29/08/1973	tree surgeon	Agriculture/environment	White British	perfect	jumper, trousers,	Sit harness, spikes, chainsaw, rope, helmet
29	M	20/07/1983	tree surgeon	Agriculture/environment	White British	lazy eye	jumper, trousers,	Sit harness, spikes, chainsaw, rope, helmet
30	M	12/09/1984	tree surgeon	Agriculture/environment	White British	perfect	jumper, trousers,	Sit harness, spikes, chainsaw, rope, helmet
31	M	14/06/1979	tree surgeon	Agriculture/environment	White British	perfect	jumper, trousers,	Sit harness, spikes, chainsaw, rope, helmet
32	M	07/07/1980	tree surgeon	Agriculture/environment	White British	perfect	jumper, trousers,	Sit harness, spikes, chainsaw, rope, helmet
33	M	18/12/1984	tree surgeon	Agriculture/environment	White British	perfect	t-shirt, trousers,	Sit harness, chainsaw, rope, helmet, spikes
34	M	01/03/1973	tree surgeon	Agriculture/environment	White British	perfect	jumper, trousers,	Sit harness, spikes, chainsaw, rope, helmet
42	M	30/11/1948	tree surgeon	Agriculture/environment	White British	long	trousers, fleece,	sit harness, rope, chainsaw, helmet
43	M	06/08/1982	tree surgeon	Agriculture/environment	White British	perfect	trousers, fleece,	sit harness, rope, chainsaw, helmet
44	M	07/09/1983	tree surgeon	Agriculture/environment	White British	perfect	trousers, fleece,	sit harness, rope, chainsaw, helmet
97	M	29/07/1952	tree surgeon	Agriculture/environment	White British	perfect	trousers, t-shirt,	Full bodied harness, chainsaw, hardhat, rope
98	M	01/05/1985	tree surgeon	Agriculture/environment	White British	perfect	trousers, t-shirt,	Full bodied harness, chainsaw, hardhat, rope
99	M	28/01/1982	tree surgeon	Agriculture/environment	White British	short	trousers, t-shirt,	Full bodied harness, chainsaw, hardhat, rope
100	M	22/06/1984	tree surgeon	Agriculture/environment	White British	perfect	trousers, t-shirt,	Full bodied harness, chainsaw, hardhat, rope
101	M	11/10/1964	tree surgeon	Agriculture/environment	White British	perfect	trousers, t-shirt, fleece,	Full bodied harness, chainsaw, hardhat, rope
102	M	28/04/1971	tree surgeon	Agriculture/environment	White British	long	trousers, t-shirt,	Full bodied harness, chainsaw, hardhat, rope
103	M	11/02/1964	tree surgeon	Agriculture/environment	White British	perfect	trousers, t-shirt, fleece,	Full bodied harness, chainsaw, hardhat, rope
397	M	18/04/1983	farmer	Agriculture/environment	White British	perfect	jeans, wellies, t-shirt, fleece	
398	M	27/03/1976	farmer	Agriculture/environment	White British	perfect	shorts, t-shirt, boiler suit	
399	M	23/01/1987	farmer	Agriculture/environment	White British	perfect	shorts, t-shirt, boiler suit	
400	M	06/05/1976	farmer	Agriculture/environment	White British	long sighted	shorts, t-shirt, boiler suit	
401	M	26/06/1979	farmer	Agriculture/environment	White British	perfect	jeans t-shirt	
402	M	28/02/1963	farmer	Agriculture/environment	White British	perfect	shorts, t-shirt, boiler suit	
403	M	16/03/1955	farmer	Agriculture/environment	White British	long	shorts, t-shirt, boiler suit	
404	F	23/02/1957	farmer	Agriculture/environment	White British	short sighted	jeans, wellies jumper	

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	PPE +Equipment
405	M	29/06/1957	farmer	Agriculture/environment	White British	long sighted	jeans, t-shirt, fleece, wellies	
510	M	08/03/1963	tree surgeon	Agriculture/environment	White British	perfect	Chainsaw protective trousers, trousers, t-shirt	
511	M	25/02/1984	tree surgeon	Agriculture/environment	White British	perfect	Chainsaw protective trousers, trousers, t-shirt	
512	M	12/06/1975	tree surgeon	Agriculture/environment	White British	perfect	Chainsaw protective trousers, trousers, t-shirt	
513	M	21/07/1981	tree surgeon	Agriculture/environment	White British	long sighted	Chainsaw protective trousers, trousers, t-shirt	
514	M	30/12/1980	tree surgeon	Agriculture/environment	White British	long sighted	Chainsaw protective trousers, trousers, t-shirt	
515	M	03/10/1966	tree surgeon	Agriculture/environment	White British	perfect	Chainsaw protective trousers, trousers, t-shirt	
516	M	29/01/1966	tree surgeon	Agriculture/environment	White British	perfect	Chainsaw protective trousers, trousers, t-shirt	
517	M	20/04/1952	deer warden	Agriculture/environment	White British	perfect	trousers, jacket, jumper, radio	
518	M	03/08/1962	gardener	Agriculture/environment	White British	perfect	trousers, jumper, t-shirt	
519	M	01/12/1978	gardener	Agriculture/environment	White British	perfect	trousers, jumper, t-shirt	
520	M	07/05/1979	gardener	Agriculture/environment	White British	perfect	trousers, t-shirt, fleece	
521	M	30/04/1965	senior gardener	Agriculture/environment	White British	perfect	trousers, jumper, t-shirt	
522	F	21/11/1973	gardener	Agriculture/environment	White British	short	trousers, t-shirt, fleece	
523	M	16/02/1955	gardener	Agriculture/environment	White British	reading	trousers, t-shirt	

Agriculture / Environment dimension data

Subject No	Measurer	Weight with equip	Weight without	Stature	Should Breadth	Hip Breadth	Chest Circ	Waist Circ	Thigh Circ	Cervical height	Hand Breadth	Hand Span	Arm Leng	Leg leng	Shoe Length	Shoe Width
11	A		117	1784	566	415	1330	1275	611	666	93.1	223	973	1039	324	123
12	B		69.6	1692	428	333	991	914	578	626	85.06	195	851	1043	290	120
13	A		88.2	1717	481	378	1086	1026	637	655	95	225	892	1026	304	116
22	A	91.6	90.6	1847	476	354	1095	998	563	715	90.9	232	992	1082	325	125
23	A	95.6	88.4	1841	499	333	985	870	600	709	90	232	951	1131	325	121
24	A	88	78.4	1831	470	358	965	906	586	663	92.8	227	936	1169	321	114
25	A	88.8	80.4	1839	468	309	983	891	664	639	87.8	211	951	1118	327	122
26	A	100.8	92.8	1843	481	374	1037	984	573	720	94.6	211	962	1151	339	121
27	A	85.2	72.4	1760	492	378	960	839	661	668	90.94	231	952	1036	310	120
28	A	106.8	85.6	1824	476	376	1010	880	622	527	91.3	228	965	1129	333	120
29	A	111	98.6	1781	509	370	1094	980	665	694	89.9	231	957	1091	325	120
30	A	94.6	83.4	1760	479	331	1126	1030	611	704	92.78	215	954	1097	338	136
31	A	92	78.8	1694	496	337	1032	939	602	645	80.77	206	913	1009	317	119
32	A	89.2	71.8	1669	466	361	955	875	587	640	86.9	217	861	1008	300	115
33	A	109.4	92.8	1804	510	322	1080	913	657	672	91.9	221	958	1051	321	125
34	A	82.8	65.6	1663	464	336	953	889	518	600	86.15	238	911	938	311	128
42	A	85.4	76.6	1777	471	347	1005	958	576	628	85	209	913	1026	317	120
43	A	86.4	75.6	1792	450	302	937	798	569	610	84.3	224	935	1061	317	120
44	A	90.8	80	1870	508	319	1001	777	583	633	89.4	235	991	1125	233	125
97	A	105	96	1754	508	339	1121	970	667	659	89.8	201	901	1065	327	123
98	A	112.8	101	1901	509	334	1050	976	650	672	96.57	236	1006	1159	346	129
99	A	101.6	91.6	1876	505	297	988	861	640	712	92.4	201	948	1149	338	128
100	A	91.4	84	1896	484	301	1000	819	630	712	96.85	235	1001	1142	347	127
101	A	110.8	99.4	1888	501	353	1122	1027	680	674	94.79	248	997	1171	331	122
102	A	87.2	77.6	1805	365	285	938	831	626	665	87.13	207	921	1107	311	121
103	A	99.8	92	1777	507	328	1076	1006	596	698	86.71	218	930	1082	313	116
397	B		80.8	1781	487	296	994	842	594	635	89.48	234	946	1081	288	109
398	B		86.4	1762	500	346	1111	1052	620	625	84.04	220	941	1047	290	106
399	B		75.6	1764	473	309	935	853	638	643	88.39	217	908	1018	315	113
400	B		100.4	1828	508	356	1184	1131	620	664	89.67	242	935	1054	300	118
401	B		94.2	1939	487	330	1091	950	629	703	89.69	243	1037	1209	316	111
402	A		81.2	1765	455	324	1021	957	579	644	88.04	206	867	1071	303	116
403	A		147.8	1739	574	414	1381	1359	773	687	95.5	217	955	977	306	122
404	B		66.4	1653	423	323	979	862	606	647	77.03	200	851	999	271	98
405	B		108.4	1839	503	351	1206	1163	636	661	92.86	235	988	1118	315	111
510	D	84.8	76.4	1760	470	302	990	893	599	652	91.59	221	896	1066	297	109
511	D	92.6	84.8	1859	472	308	898	835	612	664	94.11	219	925	1116	338	112
512	D	107.2	98.2	1809	498	335	1039	951	671	657	90.32	201	950	1129	302	110
513	D	103	94.6	1833	499	319	1026	947	626	671	82.95	211	963	1142	308	107
514	D	101	92.2	1819	495	336	1029	930	632	642	89.25	210	947	1125	324	119
515	D	103.2	94.6	1790	506	342	1060	1015	628	675	88.41	221	947	1047	319	123
516	D	106.4	98	1716	508	341	1087	1033	634	680	87.42	223	870	1005	295	108
517	A		87	1765	485	310	1089	1024	553	711	85.64	204	928	1056	308	117
518	A		84.4	1724	454	344	1085	1021	524	645	84.65	201	901	993	309	120
519	A		89.2	1836	473	350	971	972	573	652	82.64	193	957	1122	311	121
520	A		84.4	1844	479	315	989	959	558	670	87.29	210	987	1135	320	122
521	A		86	1706	498	293	1079	990	579	690	86.41	175	877	1001	282	112
522	B		57	1643	417	302	836	796	532	646	73.3	156	816	882	270	108
523	A		97	1770	470	337	1088	1064	592	700	87.96	207	914	1075	311	118

Engineering demographic data

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	PPE + Equipment
57	M	01/10/1973	access engineer	Engineering	White British	perfect	trousers, jumper, boiler suit,	Hi-vis jacket, hard hat, Full body harness
58	M	01/01/1947	access engineer	Engineering	White British	perfect	trousers, jumper, boiler suit	Hi-vis jacket, hard hat, Full body harness
96	M	29/10/1954	Plumber/engineer	Engineering	White British	thinking of eye test	track suit bottoms, t-shirt	
116	M	24/08/1961	engineer	Engineering	White British	perfect	trousers, jumper, fleece	
117	M	06/09/1961	engineer	Engineering	White British	perfect	jeans jumper fleece	
118	M	18/12/1972	Ventilation engineer	Engineering	White British	perfect	jeans, jacket, jumper, t-shirt	
119	M	23/01/1961	engineer surveyiuor	Engineering	White British	short sited	trousers, shirt, jumper,	Hi-vis jacket
120	M	19/11/1953	Service engineer cherry pickers	Engineering	White British	Long sited	Boiler suit, t-shirt	
121	M	22/12/1984	Apprentice service engineer	Engineering	White British	perfect	Boiler suit, t-shirt, tracksuit top	
166	m	22/07/1954	fire alarm engineer	Engineering	White British	short	trousers, shirt	
167	M	13/02/1941	quarry plant engineer	Engineering	White British	long	jeans, jumper,	Hi-vis jacket, hardhat, harness
168	M	16/11/1978	quarry plant engineer	Engineering	White British	perfect	jeans, jumper,	Hi-vis jacket, hardhat, harness
169	M	13/10/1960	plant fitter	Engineering	White British	perfect	jeans, jumper,	Hi-vis jacket, hardhat, harness
170	M	13/01/1958	fitter	Engineering	White British	perfect	jeans, jumper	Hi-vis jacket, hardhat, harness
299	M	12/01/1958	engineering team leader/building maintenance	Engineering	White British	short	trousers, t-shirt,	Hard hat
300	M	04/05/1943	engineering technician	Engineering	White British	long	trousers, t-shirt,	Hard hat
302	M	29/06/1949	engineering team leader/building maintenance	Engineering	White British	short	trousers, t-shirt,	Hard hat
303	M	15/03/1949	engineering team leader/building maintenance	Engineering	White British	both	trousers, t-shirt, coat	Hard hat
316	M	13/07/1982	steel worker	Engineering	White British	perfect	combats, t-shirt	
317	M	03/10/1972	fabricator	Engineering	White British	perfect	track suit bottoms, t-shirt	
318	M	19/08/1949	Ventilation engineer	Engineering	White British	long sighted	combats, t-shirt	
319	M	18/08/1981	electrician	Engineering	White British	perfect	combats, t-shirt	
320	M	10/12/1970	electrician	Engineering	White British	perfect	combats, t-shirt, jumper.	
321	M	31/07/1982	electrician	Engineering	White British	perfect	jeans, jumper,	
322	M	02/08/1959	electrician	Engineering	White British	perfect	trousers, t-shirt, overalls,	
323	M	31/12/1968	electrician	Engineering	White British	perfect	trousers, t-shirt,	Hi-vis vest
324	M	29/10/1964	electrician	Engineering	Black British	perfect	trousers, t-shirt, overalls	
325	M	31/10/1942	electrician	Engineering	White British	long	trousers, jumper, overalls,	Hi-vis vest
326	M	06/12/1981	electrician	Engineering	White British	perfect	trousers, t-shirt	
327	M	11/06/1981	electrician	Engineering	White British	perfect	trousers, t-shirt,	Hi-vis jacket
328	M	23/03/1979	electrician	Engineering	White British	perfect	trousers, jumper	Hi-vis vest
329	M	09/11/1984	electrician	Engineering	White British	perfect	trousers, jumper	
330	M	08/03/1971	electrician	Engineering	White British	Perfect	jeans, shirt,	Hi-vis vest

331	M	04/12/1983	electrician	Engineering	White British	Perfect	trousers, t-shirt, jumper	
377	M	20/11/1944	electronics engineer	Engineering	White British	perfect	boiler suit,	
379	M	07/06/1983	field Technician	Engineering	White British	short sighted	combats, t-shirt	
382	M	08/08/1980	inspection engineer	Engineering	White British	short	trousers, shirt, tie,	hard hat, harness
385	M	23/05/1945	director,. Cabinet makers	Engineering	White British	short	jeans, jumper, t-shirt	
386	M	16/01/1980	engineer	Engineering	White British	perfect	jeans, t-shirt	
387	M	18/08/1970	sheet metal welder	Engineering	White British	Colour blind	trousers, t-shirt, jumper	
388	M	01/04/1942	wireman	Engineering	White British	both	jeans, t-shirt, jumper	
389	M	04/07/1962	director,. Cabinet makers	Engineering	White British	squint	jeans, t-shirt	
390	M	26/10/1961	engineer	Engineering	White British	perfect	trousers, t-shirt, boiler suit	
391	M	01/10/1947	engineer	Engineering	White British	long	trousers, t-shirt, boiler suit	
392	M	13/12/1942	foreman fitter	Engineering	White British	long	trousers, t-shirt, boiler suit	
393	M	19/08/1954	plater	Engineering	Asian or Asian British	long	trousers, t-shirt, boiler suit	
394	M	08/02/1953	service engineer	Engineering	White British	long	trousers, t-shirt boiler suit	
396	M	12/05/1971	sales engineer	Engineering	White British	perfect	trousers, t-shirt	
547	M	19/06/1949	fabrication engineer	Engineering	White British	long	jeans, t-shirt, overalls	
552	M	02/05/1963	industrial engineer	Engineering	White British	perfect	trousers, shirt, tie	

Engineering dimension data

Subject No	easurer	Weight with equip	Weight without	Stature	Should Breadth	Hip Breadth	Chest Circ	Waist Circ	Thigh Circ	Cervical height	Hand Breadth	Hand Span	Arm Leng	Leg leng	Shoe Length	Shoe Width
57	A	81	77.6	1784	497	322	1171	1032	576	667	89.8	221	919	1052	305	115
58	A	129.4	125.8	1890	537	390	1240	1277	685	711	95.13	238	1031	1142	357	130
96	A	112.8	112.2	1773	574	348	1287	1167	619	679	93.12	202	925	1048	306	119
116	A		107	2022	511	346	1118	1046	631	737	98.45	239	1031	1214	236	132
117	A		85.2	1877	475	315	1034	975	584	670	89.86	201	945	1093	317	122
118	A	86.2	84	1729	516	333	1116	1025	596	611	85.14	212	899	1023	297	116
119	C	98.6	95.2	1823	521	358	1132	1080	587	674	88.69	219	968	1024	308	120
120	C	103.6	100.2	1791	529	368	1155	1078	683	674	91.78	200	920	1060	324	119
121	A	85	81.6	1809	473	339	999	905	641	660	88.92	220	923	1070	311	118
166	A		92.2	1739	491	337	1110	1045	608	657	83.21	188	912	1030	298	114
167	A	86.2	82	1698	460	317	1058	1010	559	674	85.59	210	907	1042	302	103
168	A	71	67.2	1801	424	307	877	839	490	642	82.02	192	945	1086	301	117
169	A	82	78	1742	464	311	1049	1002	543	678	88.12	186	899	1025	304	120
170	A	83.6	79.6	1810	464	288	1045	947	512	661	85.78	211	969	1135	315	123
299	A	107	106.6	1858	484	362	1155	1148	624	674	85.99	241	954	1115	304	116
300	A	87.2	87	1745	472	329	1051	1011	566	684	87.49	206	916	1030	306	116
302	A	101.4	101	1749	496	358	1191	1183	571	666	88.39	200	935	920	307	115
303	A	88.8	86.2	1786	481	301	1016	953	573	660	93.16	215	977	1085	301	116
316	B	107.6	107	1724	531	351	1213	1127	633	670	89.97	203	901	968	300	111
317	B		129.6	1801	546	396	1257	1231	700	687	94.44	215	975	1111	324	123
318	B		98.6	1766	512	358	1176	1058	563	670	89.48	230	960	1112	324	124
319	B		103.8	1897	547	324	1195	1002	639	684	90.47	231	998	1170	313	125
320	B	98	97.8	1837	501	328	1080	1032	603	689	88.21	227	929	1094	297	113
321	A		68	1694	433	281	923	830	532	615	84.12	194	865	1021	212	116
322	A		93.2	1896	489	334	1078	977	581	686	84.09	191	982	1160	321	117
323	A		113.2	1777	525	344	1163	1105	681	667	89.35	190	910	1046	305	116
324	A		91.2	1809	476	320	1014	949	635	660	91.27	244	983	1101	318	117
325	A		78.8	1808	554	340	1076	1002	535	614	85.06	180	999	1126	300	112
326	A		86	1860	496	301	1049	880	581	694	93.23	222	969	1091	313	118
327	A		81.2	1820	456	298	948	863	605	668	86.91	241	928	1072	309	117
328	A		83	1958	498	311	1016	902	533	690	93.86	176	1042	1241	336	122
329	A		57.4	1749	413	279	868	740	452	617	84.34	205	923	1065	284	108
330	A		119.2	1732	533	345	1251	1207	703	655	95.08	208	919	1033	314	120
331	A		76.8	1726	449	281	953	816	585	663	87.95	228	893	1058	280	106
377	B	99.6	94.4	1743	489	330	1091	1018	653	649	92.49	243	922	989	311	111
379	B	101.2	93	1915	499	317	1020	932	606	734	91.32	238	974	1151	317	114
382	A	105.4	101.4	1871	501	322	995	963	647	683	85.58	202	991	1121	307	111
385	A		80.4	1710	444	325	1042	961	616	664	81.5	218	897	1025	298	119
386	A		73.8	1722	445	298	957	899	596	651	81.16	203	942	1041	287	106
387	A		72.2	1739	465	306	992	852	551	668	81.78	193	933	1101	307	112
388	A		74	1651	449	271	1031	897	551	626	84.34	193	884	1008	275	106
389	A		67	1722	449	270	892	833	516	670	79.65	174	893	1012	298	114
390	A		105.2	1692	510	356	1193	1155	677	667	85.87	211	923	971	290	112
391	A		107.4	1795	525	382	1224	1190	600	704	90.09	222	953	1068	309	117
392	A		90.6	1680	489	337	1083	1060	638	693	85.17	216	883	1001	292	115
393	A		78.2	1641	470	335	1061	1043	559	627	84.31	222	893	1001	276	106
394	A		110.8	1774	501	349	1170	1169	673	711	96.08	220	956	1061	320	123
396	A		78.8	1825	431	322	975	933	551	679	80.58	191	969	1136	312	117
547	A		83.6	1772	474	340	1058	962	602	668	87.93	209	962	1077	294	117
552	B		88.4	1726	487	342	1063	967	589	706	92.12	211	869	958	292	111

Interior build demographic data

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	PPE + Equipment
35	M	13/05/1960	painter	Interior build	White British	perfect	shirt and overalls	
36	M	15/01/1951	painter	Interior build	White British	long	shirt and overalls	
67	M	28/06/1944	plumber	Interior build	White British	long	trousers, jumper, shirt	Hard hat, hi-vis vest
68	M	30/11/1961	plumber	Interior build	White British	perfect	trousers, jumper	Hard hat, hi-vis vest
88	M	02/02/1967	plasterer	Interior build	White British	perfect	overalls, jeans, jumper	Hi-vis vest
89	M	01/10/1972	plasterer	Interior build	White British	perfect	jumper, overalls	Hard hat, hi-vis vest
175	M	16/03/1979	plumber	Interior build	White British	short	jeans, jacket,	Hi-vis vest, hardhat, tools
179	M	09/06/1986	Painter	Interior build	White British	Long sight	jeans, jumper, overalls,	Hi-vis waist coat
180	M	25/07/1964	Plumber	Interior build	White British	perfect	2 trousers, t-shirt, jumper,	Hi-vis waist coat
187	M	16/06/1968	plumber	Interior build	White British	short/long	trousers, jumper,	Hi-vis jacket
192	M	20/07/1948	painter	Interior build	White British	perfect	fleece, overalls,	Hivis vest, hard hat
193	M	01/07/1970	plumber	Interior build	White British	perfect	jeans, tshirt,	Hi-vis vest, hard hat
194	M	29/03/1958	painter	Interior build	White British	perfect	jumper, trousers, overalls,	Hi-vis vest hard hat,
195	M	29/11/1979	plumber	Interior build	White British	perfect	trousers, jacket,	Hi-vis vest, hard hat
196	M	15/10/1983	plumber	Interior build	White British	perfect	trousers, jumper,	Hi-vis vest, hard hat
197	M	05/09/1966	plumber	Interior build	White British	short sight	trousers, t-shirt fleece	
198	M	15/08/1976	painter	Interior build	White British	perfect	2 trousers,t-shirt, jumper	
200	M	19/05/1973	painter	Interior build	White British	perfect	trousers, jumper,	Hi-vis vest, hard hat, tools
201	M	12/05/1986	painter	Interior build	White British	perfect	trousers, jumper,	Hi-vis vest, hard hat, tools
202	M	25/08/1962	painter	Interior build	White British	perfect	trousers, jumper,	Hi-vis vest, hard hat, tools
203	M	10/07/1984	electrician	Interior build	White British	perfect	trousers, jumper,	Hi-vis vest
204	M	12/12/1973	electrician	Interior build	White British	perfect	trousers, jumper	
206	M	17/03/1958	plumber	Interior build	White British	perfect	trousers, jumper,	Hard hat
207	M	23/05/1972	plumber	Interior build	White British	short	jeans, jumper, jacket,	Hi-vis vest, hardhat
212	M	02/05/1960	plasterer	Interior build	White British	long	trousers, jumper	
213	M	04/03/1956	plasterer	Interior build	White British	perfect	trousers, jumper	
215	M	10/07/1969	kitchen fitter	Interior build	White British	perfect	jeans, jumper,	Hard hat
216	M	23/10/1983	kitchen fitter	Interior build	White British	perfect	jeans, jumper,	Hardhat, hi-vis vest
227	M	03/07/1969	electrician	Interior build	White British	perfect	trousers, jumper	Hardhat, hi-vis vest
228	M	28/06/1951	electrician	Interior build	White British	short	trousers, jumper	Hardhat, hi-vis vest
229	M	20/01/1981	electrician	Interior build	White British	perfect	trousers, jumper	Hardhat, hi-vis vest
230	M	16/01/1960	electrician	Interior build	White British	long	trousers, jumper, overalls	Hardhat, hi-vis vest
231	M	11/09/1943	painter	Interior build	White British	long	jeans, shirt,	Hardhat, hi-vis vest
239	M	09/09/1956	dryline	Interior build	White British	long	trousers, tshirt	Hi-vis vest, harness and hard hat

240	M	21/09/1939	dryline	Interior build	White British	both	trousers, fleece,	Hi-vis vest, harness
241	M	20/04/1977	dryline	Interior build	White British	perfect	trousers, jumper,	Hi-vis vest, harness
242	M	22/02/1985	dryline	Interior build	White British	short	trousers, tshirt,	Hi-vis vest , harness and hard hat
243	M	08/07/1964	plasterer	Interior build	White British	perfect	trousers, tshirt,	Harness
265	M	23/09/1978	partitioner	Interior build	White British	perfect	trousers, tshirt,	tool belt
266	M	30/09/1985	partitioner	Interior build	White British	perfect	jeans, fleece	
267	M	10/12/1972	partitioner	Interior build	White British	perfect	jeans, tshirt	
268	M	05/04/1945	plasterer	Interior build	White British	perfect	trousers and shirt	
269	M	28/01/1973	plasterer	Interior build	White British	perfect	jeans and jumper	
270	M	20/05/1951	plumber	Interior build	White British	long sighted	jeans, shirt, boiler suit	
271	M	01/10/1981	plumber	Interior build	White British	perfect	jeans, jumper	
272	M	14/04/1940	decorator	Interior build	White British	short sited	trousers, shirt, jumper, overalls	
273	M	01/10/1967	decorator	Interior build	White British	perfect	trousers, jumper, boiler suit	
274	M	08/05/1954	decorator	Interior build	White British	short sight	2x trousers, fleece and shirt	
276	M	21/05/1948	plumber	Interior build	White British	long	jeans, t-shirt, fleece,	knee pads, tool belt
277	M	10/04/1942	plasterer	Interior build	White British	long	trousers, shirt, overalls,	Hi-vis vest
281	M	03/12/1984	electrician	Interior build	White British	Perfect	trousers, jumper,	Hi-vis vest, hardhat
301	M	16/12/1955	plumber	Interior build	White British	long	trousers, shirt, jumper,	hard hat
307	M	08/11/1948	painter	Interior build	White British	long	trousers, t-shirt overalls,	Tools
314	M	13/12/1969	painter	Interior build	White British	perfect	trousers t-shirt overalls,	Hi-vis vest
315	M	27/01/1985	plasterer	Interior build	White British	perfect	trousers, t-shirt	
358	M	07/01/1967	plasterer	Interior build	White British	perfect	jeans, t-shirt,	Hi-vis vest, hardhat
359	M	29/09/1964	plumber	Interior build	White British	perfect	trousers, t-shirt,	Hi-vis vest
360	M	14/04/1975	plumber	Interior build	White British	perfect	shorts, t-shirt,	Hi-vis vest
361	M	18/02/1985	plumber	Interior build	White British	perfect	trousers, t-shirt,	Hi-vis vest
362	M	31/12/1978	painter	Interior build	White British	perfect	trousers, jumper	
363	M	02/07/1974	painter	Interior build	White British	perfect	jumper, trousers, overalls,	tools
364	M	07/04/1981	boarder	Interior build	White British	perfect	trousers, t-shirt,	tools
365	M	04/01/1979	dryliner	Interior build	White British	perfect	trousers, t-shirt	
366	M	04/03/1978	dryliner	Interior build	White British	perfect	trousers, t-shirt	
367	M	21/01/1971	electrician	Interior build	White British	perfect	trousers, t-shirt	
368	M	04/11/1953	dryliner	Interior build	White British	short	trousers, t-shirt,	Hi-vis vest
369	M	23/03/1966	kitchen fitter	Interior build	White British	long	trousers, tshirt,	tools, hi-vis vest , hardhat

Interior build dimension data

Subject No	easurer	Weight with equip	Weight without	Stature	Should Breadth	Hip Breadth	Chest Circ	Waist Circ	Thigh Circ	Cervical height	Hand Breadth	Hand Span	Arm Leng	Leg leng	Shoe Length	Shoe Width
35	A	101.4	101.4	1700	503	350	1129	1111	645	655	84.11	220	865	1024	301	111
36	A	71.2	71.2	1585	439	295	980	941	598	585	84.11	231	817	897	304	118
67	A		87.8	1820	483	359	1110	1072	568	687	85.24	199	929	1111	316	121
68	A		83.4	1766	469	319	1010	967	647	694	91.09	216	894	1052	315	121
88	A		78	1700	463	320	1025	986	608	620	82.3	207	896	992	310	126
89	A		98	1750	520	359	1108	1115	661	663	92.37	221	946	1038	317	120
175	A	83.4	82.6	1780	490	306	1020	947	588	680	87.08	216	926	1056	306	111
179	B	75.8	75.2	1974	462	348	920	866	495	705	94.09	200	1016	1210	320	127
180	B		82	1721	509	321	1134	1004	586	662	88.06	197	893	1031	292	102
187	A	95.6	94.2	1690	524	340	1141	1193	600	660	79.99	197	902	989	294	109
192	A	130.4	130.2	1703	549	388	1250	1286	694	727	93.24	218	879	921	321	118
193	A	87.4	87.2	1794	498	346	1100	984	576	656	85.58	200	911	1060	309	119
194	A	97	96.8	1857	512	344	1170	1040	574	705	95.8	189	944	1127	326	120
195	A	63	62.8	1694	433	304	953	907	483	608	82.7	212	886	1061	291	108
196	A	78.6	78.2	1878	452	305	1000	840	546	653	87.03	201	979	1116	318	119
197	B	92.2	91.6	1808	515	340	1087	983	550	694	92.17	223	972	1113	300	117
198	B	79.4	79	1721	475	313	1035	914	583	650	82.62	188	876	1015	298	113
200	A	88.8	88.2	1856	486	322	1043	915	541	685	87.56	213	1004	1116	330	119
201	A	92.2	91.8	1854	504	325	1023	907	553	677	96.78	220	975	1089	319	106
202	A	91	90.4	1795	472	354	1077	1070	563	668	85.26	200	979	1115	308	124
203	A		60.2	1600	430	310	911	823	545	603	78.51	187	822	962	283	109
204	A		92.2	1811	498	342	1050	979	612	617	87.04	210	969	1100	294	105
206	A	68.8	68.2	1794	428	291	992	843	491	662	91.05	212	942	1059	300	117
207	A	83.4	83	1781	480	339	1075	1007	611	715	84.93	206	897	1074	308	113
212	A		100.6	1810	483	339	1126	1060	609	689	93.43	214	927	1007	322	122
213	A		104.2	1810	494	360	1182	1136	629	697	87.12	205	931	1085	312	122
215	A	83.8	83.4	1749	491	338	1052	930	587	691	88.13	207	913	1034	297	113
216	A	54	53.8	1687	409	241	840	720	479	633	81.82	180	894	1047	284	108
227	A	81.4	81	1778	478	338	1031	957	577	688	83.21	217	898	1076	288	104
228	A	90.6	90.2	1870	474	330	1057	972	581	682	90.24	255	1021	1211	322	112
229	A	77.4	77	1820	490	319	1026	830	531	670	85.05	229	978	1094	307	116
230	A	92	91.4	1787	473	324	1048	1026	642	679	86.48	192	906	1031	307	114
231	A	112.6	112.2	1900	542	366	1210	1166	638	747	95.74	231	1002	1191	326	122
239	A	94.6	92.4	1732	478	316	1174	1111	625	654	86.42	214	893	1024	300	117
240	A	74.8	73	1700	471	302	1084	1001	499	648	87.78	211	901	966	284	105
241	A	69	67.2	1777	465	277	967	855	476	644	87.1	181	903	991	302	115
242	A	99.8	97.6	1811	499	339	1070	918	647	676	91.28	233	961	1116	310	118
243	A	116.6	114.8	1800	531	334	1222	1062	695	694	94.74	231	944	1132	316	121
265	A	74.6	72.2	1752	435	310	911	845	623	644	89.39	186	908	1092	298	127
266	A		73.6	1697	467	298	967	900	562	666	82.37	198	892	1051	310	121
267	A		73.8	1749	486	297	965	853	528	660	82.6	203	919	1001	279	109
268	A		63.6	1654	434	319	949	836	522	627	87.21	197	876	1011	306	116
269	B		90.2	1737	481	351	1051	966	632	662	83.98	186	881	1000	295	115
270	B		107.4	1748	516	382	1226	1172	643	713	88.51	205	953	1051	313	114
271	B		74.2	1785	474	308	935	850	559	673	86.3	178	931	1059	320	117
272	B	76.6	76	1721	445	350	986	934	561	621	93.72	232	887	1053	302	113
273	B	92.4	92	1697	516	354	1177	1071	646	661	83.87	204	913	1051	293	123
274	A		75.4	1747	492	307	1073	991	538	686	83.43	205	951	1052	312	120
276	A	80.6	78	1684	468	305	1030	963	525	646	91.96	187	870	1001	301	121
277	A		83	1664	485	351	1133	1116	553	630	85.31	223	908	1014	300	116
281	A	78.8	78.4	1750	469	316	1011	894	552	662	87.5	194	936	1043	324	121
301	A	66.2	66	1700	450	298	951	921	495	655	83.99	171	942	1017	294	112
307	A	89	88.4	1786	479	315	1089	1031	578	671	91.09	208	953	1066	315	117
314	A		96.6	1870	484	306	1108	1026	605	710	82.42	201	971	1149	314	117
315	A		83	1807	480	292	1005	850	606	647	87.46	221	925	1068	303	114
358	A	102.2	102	1728	525	362	1158	1080	634	691	81.8	193	933	990	296	114
359	A		89.8	1810	486	328	1047	935	621	694	86.88	185	945	1071	316	118
360	A		103.4	1797	496	359	1093	1003	696	666	89.38	226	967	1052	303	123
361	A		79.6	1785	467	293	963	834	598	711	89.23	198	956	1079	299	121
362	A	86.2	85.8	1757	500	289	1141	898	638	699	83.59	191	885	1047	295	104
363	A	67	66.6	1650	443	298	947	885	556	652	79.54	204	852	991	279	104
364	A	94.6	89	1909	505	320	995	905	583	650	96.08	226	1031	1151	309	116
365	A		67.8	1820	450	309	908	769	552	647	82.96	206	932	1079	273	103
366	A		71	1808	447	314	962	805	553	630	86.1	197	959	1085	299	99
367	A	78.6	77.8	1747	460	314	1004	848	558	686	88.97	203	883	1000	298	113

368	A		93.4	1812	495	305	1110	1017	597	670	87.55	223	951	1113	310	118
369	B	79.6	77.6	1713	490	310	1034	886	573	655	90.22	210	903	1022	316	115

Maintenance / Repair demographic data

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	Equipment + PPE
115	M	06/08/1967	electrician	Maintenance/repair	White British	perfect	jumper and jeans	
123	M	20/04/1964	maintenance fitter	Maintenance/repair	White British	perfect	trousers, t shirt	
124	M	15/04/1961	maintenance fitter	Maintenance/repair	White British	Long sited	trousers, t shirt, pull over, jacket	
125	M	20/12/1963	maintenance fitter	Maintenance/repair	White British	perfect	trousers and t shirt	
126	M	28/07/1947	maintenance fitter	Maintenance/repair	White British	Long sited	trousers, t shirt, pullover, boiler suit	
127	M	16/09/1967	process operator	Maintenance/repair	White British	short sighted	trouser, t shirt, pullover, jacket	
128	M	31/12/1956	process operator	Maintenance/repair	White British	long sited	2x t-shirt, jumper, trousers, overall jacket	
129	M	23/01/1961	Maintenance technician	Maintenance/repair	White British	perfect	trousers, t-shirt, jumper	
130	M	04/11/1954	technical operator	Maintenance/repair	White British	Long sited	t-shirt, trousers, jumper, jacket	
131	M	28/08/1946	process operator	Maintenance/repair	White British	long sited	trousers, t-shirt, jumper, jacjet	
132	M	06/07/1964	Instrument technician	Maintenance/repair	White British	Perfect	t-shirt, jumper, trousers, jacket	
133	M	10/05/1945	Maintenance fitter	Maintenance/repair	White British	perfect	shirt, trouser, overalls	
134	M	25/03/1974	Instrument technician	Maintenance/repair	White British	short sighted	trousers, t shirt jumper	
135	M	05/10/1952	process operator	Maintenance/repair	White British	short sighted	overalls t shirt	
136	M	11/08/1966	electrician	Maintenance/repair	White British	perfect	jumper tshirt, trousers	
137	M	07/05/1959	maitenance fitter	Maintenance/repair	White British	perfect	t shirt, overalls	
138	M	09/02/1959	electrician	Maintenance/repair	White British	long sighted	long sleeved t-shirt, trousers	
139	M	19/05/1948	Maintenance fitter	Maintenance/repair	White British	Long sighted	t-shirt, boiler suit, trousers, jacket	
140	M	10/11/1946	technical operator	Maintenance/repair	White British	Long sighted	trousers, t-shirt, works jacket	
152	M	15/10/1960	electrician (maintenance)	Maintenance/repair	White British	short sighted	fleece, trousers, harness	
153	M	11/05/1953	electrician (maintenance)	Maintenance/repair	White British	long sighted	fleece, trousers, harness	
154	M	14/07/1942	electrician technicians (Maintenance)	Maintenance/repair	White British	perfect	jeans,jumper jacket, harness	
155	M	18/12/1980	Overhead linesman	Maintenance/repair	White British	perfect	fleece, jumper, t shirt, boots, combats	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
156	M	23/04/1957	linesman	Maintenance/repair	White British	perfect	sweatshirt, tshirt jeans boots	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
157	M	28/12/1979	pylon linesman	Maintenance/repair	White British	perfect	sweatshirt, tshirt jeans boots	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
158	M	05/10/1958	overhead linesman	Maintenance/repair	White British	perfect	t-shirt, jumper,tousers, boiler suit	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
159	M	02/12/1962	Overhead linesman	Maintenance/repair	White British	perfect	combats, t-shirt, jumper, wooly hat	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
160	M	23/08/1965	Overhead linesman	Maintenance/repair	White British	Long sighted	Trousers, t-shirt, jumper, boiler suit - summer one	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
161	M	18/10/1969	Overhead linesman	Maintenance/repair	White British	perfect	t-shirt, long sleeved t-shirt, combats, rigger boats	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts

222	M	08/06/1982	linesman	Maintenance/repair	White British	perfect	trousers, jumper, tshirt, harness, ropes	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
223	M	15/09/1976	linesman	Maintenance/repair	White British	perfect	trousers, jumper, tshirt, harness, ropes	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
224	M	18/03/1957	linesman	Maintenance/repair	White British	perfect	trousers, tshirt, harness, ropes	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
225	M	14/03/1979	linesman	Maintenance/repair	White British	short	trousers, tshirt, jumper, harness, ropes	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
226	M	12/01/1953	linesman (project leader)	Maintenance/repair	White British	long	jeans, tshirt, harness, ropes	Hard hat, ropes, tool bag, tower rescue bag, ropes, harness, 2 lanyards, bolts
232	M	27/11/1974	process operator	Maintenance/repair	White British	Perfect	jeans, tshirt	
233	M	18/12/1970	process operator	Maintenance/repair	White British	perfect	trousers, jumper,	Hi-vis vest
234	M	10/03/1967	maintenance planner	Maintenance/repair	White British	perfect	trousers, jumper	
235	M	03/01/1960	maintenance fitter	Maintenance/repair	White British	perfect	trousers, jumper, boiler suit,	
236	M	04/08/1961	maintenance fitter	Maintenance/repair	White British	long and short	trousers, jumper, boiler suit	
237	M	09/08/1959	process operator	Maintenance/repair	White British	perfect	trousers, jumper	
238	M	30/04/1955	assistant maintenance manager	Maintenance/repair	White British	long	trousers, shirt	
304	M	05/11/1947	electric maintenance	Maintenance/repair	White British	short	jeans, tshirt, fleece	
370	M	25/12/1970	instructor rope access	Maintenance/repair	White British	perfect	trousers, fleece,	hard hat, harness
371	M	05/01/1958	instructor rope access	Maintenance/repair	White British	long	trousers, jumper,	hard hat, harness
372	M	21/07/1953	rigger	Maintenance/repair	White British	short	trousers, tshirts,	hard hat, harness
373	M	19/10/1974	rigger	Maintenance/repair	White British	short	trousers, tshirt,	hard hat, harness
374	M	07/01/1964	rigger	Maintenance/repair	White British	perfect	trousers, tshirt,	hard hat, harness
375	M	20/04/1976	rigger	Maintenance/repair	White British	perfect	shorts, tshirt,	hard hat, harness
376	M	04/08/1981	rigger	Maintenance/repair	South African	perfect	jeans, tshirt,	hard hat, harness
378	M	18/02/1981	rigger	Maintenance/repair	South African	perfect	jeans, t-shirt	
380	F	22/01/1961	rope access technician - paint football stadiums, put up lighting conductors	Maintenance/repair	White British	perfect	jeans, vest top	
381	M	01/06/1968	instructor	Maintenance/repair	White British	Perfect	trousers, shirt,	hard hat, harness
383	M	22/12/1984	absailer	Maintenance/repair	White British	perfect	trousers, tshirt,	Hard hat, harness
384	M	06/04/1973	project manager	Maintenance/repair	White British	perfect	jeans, jumper,	Hard hat, harness

Maintenance / Repair dimension data

Subject No	easurer	Weight with equip	Weight without	Stature	Should Breadth	Hip Breadth	Chest Circ	Waist Circ	Thigh Circ	Cervical height	Hand Breadth	Hand Span	Arm Leng	Leg leng	Shoe Length	Shoe Width
115	A		84	1802	482	323	1005	966	590	688	92.6	231	916	1038	322	121
123	A		73.2	1647	451	297	997	850	556	596	80.2	181	862	979	285	102
124	A		93.6	1970	491	326	1119	946	564	730	93.78	220	1015	1190	328	123
125	A		96.8	2027	486	352	1073	993	561	675	89.68	238	1052	1258	330	116
126	A		72.2	1707	442	291	965	915	537	628	80.41	209	910	1019	296	105
127	A		93	1866	488	307	1086	1013	600	698	93.58	211	914	1104	312	112
128	D	86.2	85.6	1843	496	332	1090	987	605	705	96.11	256	982	1090	309	114
129	D		82.6	1771	496	330	1047	921	572	667	88.96	209	941	1093	311	112
130	D		103.4	1809	522	349	1184	1197	614	736	92.4	210	959	1045	312	112
131	D		71.4	1730	461	289	929	839	512	689	94.09	243	920	964	312	111
132	D		66.4	1825	448	279	912	834	469	701	85.15	200	932	1052	296	109
133	A		79.8	1829	472	340	1050	1001	552	677	90.06	212	959	1101	314	110
134	A		91	1865	500	307	1052	904	633	709	94.25	190	956	1137	325	112
135	A		119	1736	536	357	1248	1202	701	683	90.17	202	912	1011	310	108
136	A		79.8	1835	441	306	974	914	546	667	82.1	185	943	1081	295	105
137	A		126.4	1819	540	369	1303	1277	699	660	93.54	240	965	1062	310	115
138	D		103.2	1792	518	354	1086	1031	576	678	88.29	232	923	1032	310	109
139	D		102.8	1653	546	358	1237	1218	632	649	83.43	190	894	982	293	108
140	D		65.6	1674	445	294	963	855	531	688	88.64	201	869	979	296	110
152	A	96	94	1752	510	342	1116	1053	601	704	87.12	230	901	993	283	105
153	A	125.6	124.4	1831	542	365	1259	1225	658	711	91.31	243	946	1047	310	121
154	A	70.6	68.5	1657	445	317	978	891	562	618	82.33	206	879	1025	279	101
155	A	99	62.6	1750	444	290	903	850	488	639	81.83	211	910	1000	303	102
156	A	116.2	75	1703	464	300	994	913	572	668	84.65	197	905	1001	291	103
157	A	127.4	90.6	1882	485	310	1053	898	631	707	86.7	222	962	1185	302	102
158	C	138.8	101	1765	525	356	1152	1130	631	680	88.3	213	948	1067	319	116
159	C	137.8	100.8	1782	508	344	1112	1017	620	644	95.21	229	912	1112	316	106
160	C	108.4	70.8	1703	486	312	976	946	560	619	84.18	200	923	1036	291	107
161	C	136.4	106	1728	546	339	1150	1044	650	643	85.54	206	930	1056	298	118
222	A	91.8	82	1856	463	303	983	954	553	676	82.24	202	975	1092	297	101
223	A	88.8	81.6	1754	491	301	1038	922	557	662	86.88	203	945	1033	299	109
224	A	108.8	99	1874	490	356	1092	948	633	663	93.47	221	980	1041	324	111
225	A	116.2	106.4	1907	528	321	1104	1010	640	746	89.47	223	993	1149	320	115
226	A	95.4	85.6	1781	455	297	988	890	584	687	88.77	178	899	1045	310	117
232	A		68	1756	439	276	900	767	562	663	87.39	204	907	1040	287	104
233	A		82.2	1748	475	293	1042	982	601	657	82.52	191	909	1089	287	104
234	A		83.4	1818	464	337	998	908	609	680	86.99	185	920	1079	291	104
235	A		87.2	1782	485	329	1045	1029	570	678	89	198	954	1059	304	106
236	A		98.2	1864	512	339	1136	1038	615	706	89.39	217	982	1142	312	110
237	A		88.6	1715	483	339	1080	1022	582	659	88.3	211	942	1049	290	108
238	A		78.6	1768	473	307	1029	939	532	682	81.22	198	923	1086	291	111
304	A		81.8	1805	481	323	1046	968	570	707	91.9	197	957	1081	322	118
370	A	84.8	79.2	1764	466	298	1034	919	542	670	94.24	250	941	1055	314	109
371	A	93.2	88	1773	457	322	1109	1001	591	677	88.39	230	931	1074	315	114
372	A	101.8	95	1772	500	335	1093	1060	616	690	86.36	200	917	1065	299	106
373	A	117.8	113.4	1916	535	320	1141	1066	661	724	89.59	222	1018	1151	316	120
374	A	90	83.4	1763	496	327	1060	973	593	650	85.58	196	921	1031	295	112
375	A	108.4	103.2	1940	527	328	1167	1003	653	737	85.69	237	1011	1149	306	113
376	B	85.4	80.4	1773	474	284	948	819	635	659	85.72	219	912	1101	298	115
378	B	92	87.2	1811	488	321	1075	931	581	680	89.34	225	936	1096	315	114
380	B	58.6	54	1659	402	291	820	662	525	629	77	203	857	986	268	108
381	A	64	60.2	1639	426	276	862	827	541	590	79.24	188	848	952	280	107
383	A	67.8	63.8	1798	463	313	886	746	537	680	80.77	197	931	1101	288	105
384	A	104.8	100.8	1797	528	322	1175	1061	673	675	90.42	218	951	1096	308	116

Manufacture demographic data

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	PPE + Equipment
162	M	16/02/1943	training officer H&S	Manufacture	White British	Long sighted	jeans, jumper, t-shirt	
163	M	20/02/1959	training officer H&S	Manufacture	White British	perfect	jeans, t-shirt, jumper	
164	M	25/09/1963	training officer H&S	Manufacture	White British	long	jeans, t-shirt	
165	M	10/05/1962	training officer H&S	Manufacture	White British	perfect	trousers, t-shirt	
295	M	19/08/1983	woodworker	Manufacture	White British	perfect	trousers and jumper	
296	M	15/04/1956	woodworker	Manufacture	White British	perfect	trousers and jumper	
297	M	10/04/1955	woodworker	Manufacture	White British	long	trousers and jumper	
298	M	20/03/1961	woodworker	Manufacture	White British	short	jeans and jumper	
546	M	15/05/1944	CNC programmer	Manufacture	White British	both	jeans, t-shirt	
548	M	06/04/1965	welder	Manufacture	White British	perfect	jeans, t-shirt, overalls	
549	M	11/02/1947	welder	Manufacture	White British	long	trousers, t-shirt	
550	M	07/11/1969	plater	Manufacture	White British	perfect	jeans, t-shirt, overalls	
551	M	05/07/1974	welder	Manufacture	White British	perfect	jeans, t-shirt, overalls	
553	M	13/03/1967	fettler	Manufacture	White British	perfect	jeans, t-shirt, overalls	
554	M	23/06/1951	fettler	Manufacture	White British	long sighted	jeans, t-shirt, overalls	
555	M	16/02/1964	fetler grinder	Manufacture	White British	perfect	jeans, t-shirt, overalls	
556	M	27/06/1956	plater	Manufacture	Asian or Asian British	perfect	jeans, t-shirt, overalls	
557	M	11/10/1965	plater	Manufacture	White British	perfect	jeans, t-shirt, overalls	
558	M	11/09/1974	plater	Manufacture	White British	short	jeans, jumper, overalls	
559	M	29/02/1972	welder	Manufacture	White British	short	jeans t-shirt, overalls	
560	M	22/11/1948	cnc operator	Manufacture	White British	long	jeans, t-shirt, dust coat	
561	M	06/07/1955	sheet metal welder	Manufacture	White British	long	jeans, t-shirt, overalls	
562	M	23/11/1953	fetler	Manufacture	White British	perfect	jeans, t-shirt, overalls	
563	M	15/08/1957	plater	Manufacture	White British	perfect	jeans, t-shirt, overalls	
564	M	08/08/1964	welder	Manufacture	Black or Black British	perfect	jeans, t-shirt, overalls	
565	M	12/03/1946	platter	Manufacture	White British	Long sighted	jeans, t-shirt, overalls	
566	M	22/03/1985	platter	Manufacture	White British	perfect	jeans, t-shirt, overalls	
567	M	23/03/1956	welder	Manufacture	White British	long and short	jeans, t-shirt, overalls	
568	M	06/05/1950	maintenance electrician	Manufacture	White British	short sighted	jeans, t-shirt, overalls	
569	M	16/06/1948	product quality supervisour	Manufacture	White British	long sighted	jeans, t-shirt, overalls	
570	M	01/03/1975	machine operator	Manufacture	White British	long	shirt, trousers, tie	
571	M	14/07/1942	plater	Manufacture	White British	perfect	jeans, t-shirt, overalls	
572	M	10/08/1974	plater	Manufacture	White British	perfect	jeans, t-shirt, overalls	
573	M	25/12/1956	plater	Manufacture	White British	long	jeans, t-shirt, overalls	
574	M	06/08/1948	plater	Manufacture	White British	both one of each	jeans, t-shirt, overalls	
575	M	17/11/1958	cell leader (foreman)	Manufacture	White British	perfect	jeans, t-shirt, overalls	
576	M	09/04/1968	cnc punch operator	Manufacture	White British	perfect	jeans, t-shirt, overalls	
577	M	03/04/1973	plater	Manufacture	White British	perfect	jeans, t-shirt, overalls	
578	M	17/05/1964	material coordinator	Manufacture	White British	perfect	jeans, t-shirt, overall	
579	M	12/08/1978	welder	Manufacture	White British	perfect	jeans, t-shirt, overall	
580	M	27/03/1951	plater	Manufacture	White British	perfect	jeans, t-shirt	

581	M	09/03/1953	machine operator	Manufacture	White British	long sighted	jeans, t-shirt, overall	
582	M	23/08/1952	forklift driver	Manufacture	White British	long sighted	jeans, t-shirt, overall	
583	M	13/02/1942	tank tester	Manufacture	White British	long sighted	jeans, t-shirt, overall	
584	M	05/08/1970	welder	Manufacture	White British	short sighted	jeans, t-shirt, overall	
585	M	05/10/1967	profile cutter	Manufacture	White British	perfect	jeans, t-shirt, overall	
586	M	23/12/1957	fetler	Manufacture	White British	perfect	jeans, t-shirt, overall	
587	M	28/09/1985	fetler	Manufacture	White British	perfect	jeans, t-shirt, overalls	
588	M	09/01/1962	welder	Manufacture	White British	perfect	jeans, t-shirt, overalls	
589	M	23/09/1949	departmental manager	Manufacture	White British	long sighted	shirt, trousers, tie	

Manufacture dimension data

Subject No	easurer	Weight with equip	Weight without	Stature	Should Breadth	Hip Breadth	Chest Circ	Waist Circ	Thigh Circ	Cervical height	Hand Breadth	Hand Span	Arm Leng	Leg leng	Shoe Length	Shoe Width
162	B		93.8	1714	506	338	1113	1031	602	669	87.4	201	886	1020	299	113
163	B		85	1804	454	349	1002	953	580	680	93.98	206	956	1045	314	115
164	A		114.2	1850	538	369	1179	1157	670	684	85.55	195	970	1113	323	124
165	A		108.2	1718	522	347	1176	1186	647	637	87.1	219	913	1026	304	114
295	A		69.2	1863	441	307	919	727	503	700	89.48	245	1012	1092	296	111
296	A		94	1740	516	324	1126	1064	599	673	88.13	189	922	1055	291	113
297	A		72.2	1809	453	300	930	871	535	665	94.43	229	948	1111	305	112
298	A		76.4	1766	467	299	1022	939	560	641	90.67	198	961	1084	292	102
546	A		115.4	1757	498	336	1249	1254	580	656	88.77	213	970	1100	306	115
548	A		87.2	1763	479	327	1087	974	583	704	79.98	205	891	1032	288	105
549	A		77.4	1751	444	317	995	920	548	670	89.71	195	865	1060	310	113
550	A		82.4	1705	464	320	1050	965	562	649	81.78	181	895	990	294	113
551	A		80.2	1732	462	303	1001	927	567	649	84.03	173	882	1016	282	104
553	B		62.6	1693	465	304	963	816	514	607	82.71	207	889	988	287	109
554	B		106.6	1774	529	343	1226	1105	621	678	93.62	208	937	1046	319	120
555	B		81.2	1765	459	300	999	932	583	683	85.19	189	931	1077	299	113
556	B		70.2	1670	446	308	957	940	487	599	78.34	198	882	1044	278	108
557	B		90.2	1789	495	326	1071	968	630	670	92.5	217	921	1064	317	116
558	A		86.8	1863	492	344	1060	957	592	718	95.12	247	1003	1111	338	120
559	A		83.2	1845	466	333	981	877	575	686	90.03	210	939	1116	303	111
560	A		105.2	1799	521	361	1156	1130	613	709	90.86	188	950	1080	304	113
561	A		67	1703	432	300	967	925	500	650	81.05	191	906	1063	286	105
562	A		88	1744	467	334	1047	1058	575	667	88.77	205	971	1081	300	112
563	A		73.8	1684	448	317	1018	935	550	613	80.91	189	869	1061	293	108
564	B		106.6	1735	518	342	1141	1140	588	678	85.57	217	894	998	300	110
565	B		100.2	1808	499	378	1150	1090	657	682	91.71	223	937	1038	314	119
566	B		126.6	1887	511	424	1246	1224	712	705	91.75	218	1009	1046	312	117
567	B		138.4	1814	543	444	1306	1336	699	720	87.8	221	945	1066	328	117
568	B		87.8	1881	467	341	1043	979	552	683	90.2	225	1017	1166	312	113
569	B		91.4	1821	480	341	1092	1043	570	679	91.88	210	970	1108	311	116
570	A		112.4	1787	510	366	1192	1170	604	683	84.75	186	940	1006	311	114
571	A		78.4	1702	450	336	1005	1010	560	628	91.87	231	883	1051	288	111
572	A		77.6	1686	440	320	955	879	591	630	84.6	181	906	1013	295	106
573	A		84.2	1738	493	304	1085	976	569	653	87.17	220	910	1047	296	107
574	A		100.8	1817	521	353	1224	1185	564	682	92.76	236	952	1131	298	118
575	A		84.6	1688	476	335	1066	1019	543	640	85.78	198	924	1019	315	120
576	A		106.6	1696	536	362	1199	1204	658	671	91.31	198	905	1050	309	113
577	A		82.4	1764	464	326	1009	952	601	662	89.54	206	934	1061	296	105
578	A		78.6	1722	463	300	983	927	560	637	88.84	215	898	1012	312	113
579	A		103.4	1782	532	329	1129	1001	628	639	86.02	231	915	1051	307	120
580	B		94.6	1656	516	370	1140	1143	631	671	85.76	196	897	993	303	117
581	B		87.4	1708	491	348	1094	1046	613	639	85.97	175	908	1057	288	111
582	B		74	1623	460	346	1011	986	558	592	84.96	184	901	922	284	110
583	B		78.4	1771	468	343	1064	1038	544	663	92.07	230	955	1086	288	112
584	B		85.2	1821	471	331	1072	943	585	700	84.02	205	942	1082	288	105
585	A		98	1763	504	343	1131	1115	571	681	83	201	956	1041	306	113
586	A		72	1740	424	295	954	911	535	637	85.68	240	909	1055	311	118
587	A		77.4	1765	468	300	928	874	586	627	83.59	190	933	1075	291	105
588	A		83.2	1794	468	351	1058	943	542	692	85.87	193	945	1045	311	115

589	A		103.8	1815	523	365	1141	1003	596	688	87.42	222	954	1005	303	110

New build demographic data

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	PPE + Equipment
45	M	13/09/1964	scaffolder	New build	White British	perfect	overalls, jeans, jumper and	harness
46	M	12/09/1979	scaffolder	New build	White British	perfect	Tracksuit bottoms, t-shirt,	Hi-vis vest, harness
47	M	22/01/1976	scaffolder	New build	White British	perfect	Tracksuit bottoms, t-shirt,	Hi-vis vest, harness, hard hat
48	M	19/05/1979	scaffolder	New build	White British	perfect	Tracksuit bottoms, t-shirt,	Hi-vis vest, harness, tool belt
49	M	04/08/1980	scaffolder	New build	White British	perfect	trousers, jumper,	harness, tool belt, hard hat
50	M	09/12/1982	scaffolder	New build	White British	perfect	trousers, jumper,	harness, tool belt, hard hats
53	M	13/08/1966	brick layer	New build	White British	perfect	fleece, trousers,	hard hat, hi-vis vest
60	M	09/01/1978	Ground-worker	New build	White British	perfect	trousers t-shirt jumper, cap	Hi-vis vest
61	M	12/06/1983	storeman	New build	White British	perfect	trousers, jumper,	Hi-vis jacket
62	M	30/05/1953	labourer	New build	White British	perfect	jeans, jumper, coat	Hi-vis vest, hard hat gloves
63	M	21/12/1967	fork lift driver	New build	White British	perfect	trousers, fleece,	Hi-vis vest, hard hat
64	M	30/04/1987	carpentry	New build	White British	perfect	fleece x2 trousers	Tool belt
65	M	06/05/1968	carpenter	New build	White British	perfect	fleece, jeans, t-shirt	
66	M	16/03/1960	bricklayer	New build	White British	perfect	jumper, tracksuit bottoms	
69	M	20/02/1968	builder	New build	White British	perfect	trousers, shirt	
70	M	12/11/1964	bricklayer	New build	White British	long	jeans, jumper,	hard hat
71	M	10/08/1987	carpenter	New build	White British	perfect	trousers, jumper,	hard hat
72	M	23/10/1959	bricklayer	New build	White British	bit of both	jeans, jumper,	hard hat
73	M	07/01/1965	bricklayer	New build	White British	perfect	jeans, fleece, t-shirt	
74	M	04/11/1971	fork lift driver	New build	White British	perfect	jeans, top (sweatshirt)	
75	M	08/12/1970	Hod carrier	New build	White British	perfect	jeans, t-shirt, cap	
76	M	14/09/1970	site manager	New build	White British	perfect	trousers, shirt tie	
77	M	11/02/1987	scaffolder	New build	White British	perfect	jeans, t-shirt	Hi-vis vest
78	M	12/05/1979	scaffolder	New build	White British	perfect	trousers, t-shirt,	Hi-vis jacket
79	M	18/05/1983	scaffolder	New build	White British	perfect	jeans, t-shirt	Hi-vis vest
80	M	18/11/1946	carpenter	New build	White British	perfect	trousers, jumper,	Hi-vis vest
81	M	16/04/1975	site manager	New build	White British	perfect	trousers, shirt,	Hi-vis jacket
82	M	17/02/1965	hod carrier	New build	White British	perfect	jeans, jumper,	hard hat
83	M	01/09/1969	quantity surveyor	New build	White British	perfect	trousers, fleece,	Hi-vis vest
84	M	01/06/1965	bricklayer	New build	White British	perfect	jeans, jumper, cap	
85	M	10/09/1966	bricklayer	New build	White British	perfect	t-shirt, jeans	
86	M	25/09/1948	bricklayer	New build	White British	perfect	trousers, jumper, fleece, hard hat	
87	M	16/09/1985	bricklayer	New build	White British	perfect	jeans and jumper	

90	M	24/10/1955	bricklayer	New build	White British	perfect	trousers, jumper	Hi-vis vest
91	M	27/08/1987	Hod carrier	New build	White British	perfect	tracksuit bottoms, t-shirt	
92	M	30/08/1949	assistant site manager	New build	White British	short sighted	trousers shirt, tie, jumper	
93	M	26/04/1987	Hod carrier	New build	Asian or Asian British	perfect	jeans, vest	
94	M	02/12/1978	fork lift driver	New build	White British	lazy eye	jeans, jumper, jacket	
95	M	18/01/1965	assistant site manager	New build	White British	perfect	trousers, shirt and tie	
174	M	08/06/1981	labourer	New build	White British	perfect	jeans, jumper,	Hi-vis vest, hard hat and gloves
176	M	28/12/1976	labourer	New build	White British	colourblind	trousers, jumper,	Hi-vis vest and jacket, hardhat and gloves
177	M	20/11/1983	labourer	New build	White British	perfect	jeans, jumper,	Hi-vis jacket, hardhat
178	M	28/05/1969	storeman	New build	White British	perfect	jeans, jumper,	Hi-vis jacket, gloves
181	M	19/04/1964	fork lift driver	New build	White British	perfect	tracksuit bottoms, t-shirt, jumper	
182	M	02/04/1962	carpenter	New build	Black or Black British	Perfect	tracksuit bottoms, jumper, t-shirt,	Hi-vis vest
183	M	31/05/1973	Hod carrier	New build	White British	perfect	jeans, t-shirt, jumper, fleece	
184	M	13/10/1983	carpenter	New build	White British	perfect	trousers, jumper,	Hi-vis vest, hard hat
185	M	27/04/1973	fork lift driver	New build	White British	perfect	trousers, fleece,	Hi-vis jacket
186	M	18-May-57	Hod carrier	New build	White British	perfect	trousers, jumpers,	Hi-vis vest, hard hat
188	M	12/01/1966	bricklayer	New build	White British	perfect	jeans, jumper,	Hi-vis vest, hardhat, gloves
189	M	30/09/1978	site manager	New build	White British	perfect	trousers, shirt and tie	Hi-vis jacket
190	M	19/02/1968	site manager	New build	White British	perfect	trousers, shirt and tie	Hi-vis jacket
191	M	10/07/1962	bricklayer	New build	White British	perfect	trousers, jumper,	Hi-vis vest, tools
199	M	08/03/1958	assistant site manager	New build	White British	long	shirt, jumper, trousers, tie,	Hi-vis coat and hard hat
205	M	08/01/1961	carpenter	New build	White British	perfect	jeans, jumper, fleece,	Hi-vis vest, hardhat
208	M	16/06/1983	bricklayer	New build	White British	perfect	trousers, t-shirt, jumper,	Hard hat
209	M	13/02/1949	bricklayer	New build	White British	perfect	trousers, jumper, fleece,	Hi-vis vest, hard hat, tape measure
210	M	14/06/1985	carpenter	New build	White British	perfect	trousers, jumper,	Hi-vis vest, tool belt, hard hat
211	M	24/02/1945	carpenter	New build	White British	short/long	trousers, fleece,	Hi-vis vest, tool belt, hardhat
214	M	14/08/1984	groundworker	New build	White British	long	trousers, t-shirt, jacket,	hardhat, hi-vis vest
217	M	24/04/1954	labourer	New build	White British	long	jeans, jumper,	Hi-vis vest, hivis coat hard hat
218	M	26/10/1977	labourer	New build	White British	perfect	jeans, jumper, fleece,	Hi-vis vest, hard hat, gloves
219	M	14/09/1958	contracts manager	New build	White British	perfect	trousers, tie, shirt,	Hi-vis jacket, hardhat
220	M	31/08/1966	supervisor fork lifts	New build	White British	perfect	trousers, fleece,	hard hat, hi-vis vest
221	M	20/03/1971	fork truck driver	New build	White British	perfect	jeans, t-shirt, jumper	
262	M	31/12/1967	builder	New build	White British	perfect	jeans, jumper	
263	M	26/06/1942	joiner	New build	White British	short	jeans, jumper,	Hi-vis vest
264	M	17/02/1964	carpenter	New build	White British	perfect	jeans and t-shirt,	tool belt
275	M	22/12/1943	labourer	New build	White British	long	jeans, t-shirt, shirt,	Hi-vis vest, tools, hard hat

278	M	24/11/1962	bricklayer	New build	White British	perfect	trousers, top,	Hi-vis vest
279	M	18/03/1971	general labourer	New build	White British	perfect	jeans t-shirt	Hi-vis vest
280	M	11/01/1962	site manager	New build	White British	Perfect	trousers, jumper	Hi-vis jacket

New Build dimension data

Subject No	easurer	Weight with equip	Weight without	Stature	Should Breadth	Hip Breadth	Chest Circ	Waist Circ	Thigh Circ	Cervical height	Hand Breadth	Hand Span	Arm Leng	Leg leng	Shoe Length	Shoe Width
45	A	82.2	80.2	1701	487	326	1127	1006	601	650	85.19	196	956	1040	321	121
46	A	97.8	96	1848	505	352	1114	1021	667	686	91.23	236	994	1088	330	123
47	A	98	94.4	1858	513	322	1030	1000	634	664	90.5	224	941	1097	324	128
48	A	83.8	79.6	1708	493	332	1058	978	603	680	86.16	214	880	989	303	125
49	A	86.8	82.4	1678	481	295	1070	871	613	621	88	222	855	1018	318	123
50	A	78.6	74	1853	479	320	1046	956	550	665	85.2	216	936	1154	330	131
53	A	78.8	78	1746	468	322	1043	915	548	631	87.3	213	900	1003	301	114
60	A	80.4	80.4	1832	467	311	1016	928	568	651	82.14	228	919	1099	311	109
61	A	76.2	74.6	1827	470	307	999	843	531	692	84.8	221	936	1063	326	124
62	A	92.6	91	1748	494	328	1186	1106	542	658	84	213	933	1048	308	117
63	A	83.2	82.8	1746	462	309	1051	945	591	661	89.5	214	891	1049	321	126
64	A	74.2	72.2	1802	455	300	1000	939	528	652	83.66	186	934	1149	313	126
65	A	77	77	1799	495	319	1035	933	556	657	88	226	954	1066	310	118
66	A		94.8	1721	498	358	1118	1064	633	641	90.34	241	911	1058	323	200
69	A		76.2	1810	460	294	963	909	546	699	85.85	206	904	1076	316	119
70	A	91.4	91.2	1822	453	312	1069	1011	611	686	90.65	206	948	1082	299	121
71	B	66.6	66.2	1727	436	307	928	850	522	630	85.55	220	938	1112	320	122
72	A	77	76.8	1795	494	300	1045	925	563	631	90.43	219	951	1095	330	126
73	B	75.6	75.6	1691	474	318	923	949	576	660	89.92	233	887	1006	305	115
74	B	73	73	1771	490	292	950	869	528	659	90.97	248	963	1067	320	130
75	B	80	80	1817	460	330	978	865	552	699	92.72	220	967	1076	306	116
76	A	115.2	115.2	1832	518	366	1215	1183	643	665	88	221	966	1056	331	128
77	A	76	76	1815	478	307	964	826	583	662	82.74	196	981	1093	315	120
78	A		78	1855	480	296	990	853	574	687	84.83	170	928	1109	324	119
79	A		74.8	1788	442	307	959	846	548	629	93	236	925	1064	324	123
80	A	79.2	79.2	1731	476	347	1084	1040	528	643	82.49	193	982	1051	316	118
81	A	84.2	82.6	1720	490	313	1101	1039	585	634	83.04	181	895	1000	302	118
82	A		89.6	1808	496	316	1090	979	602	682	88.2	210	900	1080	311	120
83	A		128.8	1988	559	367	1265	1162	628	767	92.6	256	1073	1205	327	119
84	A		68	1790	488	300	1023	927	515	670	85.54	206	963	1073	288	114
85	A		89.6	1810	522	313	1113	941	557	671	87.76	221	964	1097	318	121
86	A	96	94.6	1738	517	318	1203	1153	588	663	81.9	201	899	1106	322	121
87	A	64.2	63.8	1800	432	276	863	745	512	670	87.46	204	923	1032	323	123
90	A		75	1730	454	318	973	940	608	641	83.66	197	948	1065	325	125
91	B	61	60.6	1723	431	302	838	721	510	610	86.47	201	957	1063	322	121
92	B		76.2	1698	463	327	964	929	571	659	82.98	190	891	1001	293	103
93	B		89.2	1806	503	345	991	834	583	674	91.44	223	966	1044	322	125
94	B		97.4	1897	527	348	1169	1061	631	704	95.51	224	987	1134	330	129
95	A	100.8	99	1746	520	323	1175	1051	596	638	93.15	236	936	1072	330	126
174	A	83.4	82.6	1758	481	305	1060	956	585	655	83.27	182	928	1062	302	114
176	A	92.2	91.8	1772	498	314	1183	1111	559	659	96.25	196	911	1026	313	117
177	A	95	94.4	1752	500	326	1192	1112	650	694	87.5	200	944	1032	313	115
178	A		72.8	1700	460	293	1063	976	558	644	85.16	212	898	1032	281	101
181	B		93.8	1758	503	341	1130	1053	592	698	82.37	181	898	1054	300	112
182	B	100	97.6	1826	519	340	1080	1014	520	655	90.93	200	1007	1171	321	122
183	B	89.6	89.2	1796	487	360	1056	1001	587	688	87.7	185	926	1033	317	118
184	A	74.4	74.2	1738	462	315	1024	884	560	651	84.32	217	906	1031	285	110
185	A		105.4	1799	515	331	1144	1137	669	708	95.65	203	951	1062	317	122
186	A	121	120.6	1736	550	403	1319	1239	655	690	91.31	188	866	945	302	114
188	A	118.6	118	1959	521	353	1183	1240	690	729	95.75	216	1027	1158	349	132
189	A	113.4	112.2	1821	531	340	1179	1061	681	685	91.07	183	949	1144	296	109
190	A	102.8	100.6	1770	503	337	1164	1024	606	684	84.96	178	929	1060	310	121
191	A	98.6	98	1766	518	344	1130	1125	635	649	79.5	198	921	1062	300	116
199	A	90.2	89.6	1827	510	333	1132	983	572	677	93.85	203	981	1121	314	121
205	A	83.6	83	1824	485	320	1066	928	581	679	81.48	206	981	1068	312	116
208	A	87.6	87.2	1796	483	303	1014	976	598	655	90.89	201	935	1073	298	114
209	A	87.8	87.2	1646	498	340	1124	1069	634	611	83.69	210	874	956	288	111

210	A	102.6	99.2	1858	511	367	1120	1025	650	736	87.24	211	973	1081	325	118
211	A	89	86.6	1771	471	327	1113	1045	558	682	95.12	189	943	1075	301	111
214	A	76.4	76	1669	460	307	1003	897	563	669	86.27	190	852	969	308	117
217	A	82.4	80.6	1833	430	299	1036	951	566	663	87.27	208	985	1106	321	115
218	A	79.4	78.6	1928	487	317	1063	966	557	707	88.65	193	969	1188	316	117
219	A	98.8	98.6	1922	499	335	1142	1113	571	702	87.37	211	1001	1168	322	118
220	A	103.2	102.8	1815	523	345	1276	1186	611	706	87.85	231	951	1051	311	119
221	B	95		1805	511	348	1090	1033	581	685	89.73	216	975	1086	307	120
262	A		84.6	1816	475	312	1001	886	594	690	95.05	202	954	1032	284	111
263	A		80	1780	441	331	1065	982	537	644	89.91	192	946	1088	308	119
264	A	87.2	85	1844	481	312	1028	922	545	699	87.55	233	989	1125	328	126
275	A	102	101.2	1707	510	336	1162	1221	593	662	85.33	194	878	1025	332	126
278	A		74	1777	467	294	1045	938	501	660	85.91	197	954	1121	309	122
279	B		114.4	1803	523	361	1213	1153	610	724	88.37	214	948	1010	321	127
280	A		75.6	1667	456	306	1039	982	571	646	79.09	180	869	984	270	105

Offshore demographic data

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	PPE + Equipment
246	M	03/01/1964	off shore workers, district manager	Offshore	White British	perfect	shirt, trousers, boiler suit,	
247	M	26/04/1973	off shore workers, general manager	Offshore	White British	short	shirt, trousers	
248	M	15/05/1974	sales engineer	Offshore	White British	perfect	shirt trousers, boiler suit	
249	M	22/04/1976	engineer	Offshore	White British	perfect	shirt, trousers, boiler suit,	
250	M	21/09/1955	Manager	Offshore	White British	perfect	shirt trousers, boiler suit	
251	M	15/06/1962	engineer	Offshore	White British	perfect	shirt trousers, boiler suit	
252	M	13/06/1973	engineer	Offshore	White British	perfect	shirt trousers, boiler suit	
253	M	26/01/1958	Project manager offshore	Offshore	White British	long sited	shirt trousers, boiler suit	
447	M	27/03/1972	mechanic	Offshore	White British	perfect	overalls, tshirt, trousers,	harness, hard hat, goggles, gloves, harness, lanyard
448	M	13/12/1969	electrician	Offshore	White British	perfect	overalls, tshirt, trousers	
449	M	03/02/1967	Technician (maintenance)	Offshore	White British	perfect	overalls, tshirt, trousers,	harness, hard hat, goggles, gloves
450	M	18/06/1974	engineer	Offshore	White american	perfect	shirt, trousers, overalls,	harness, hardhat, goggles, gloves
451	M	30/09/1975	engineer	Offshore	White British	short	shirt, trousers, overalls,	harness, hardhat, goggles, gloves
452	M	03/12/1974	engineer	Offshore	chadian	long sighted	shirt, trousers, overalls,	harness, hardhat, goggles, gloves
453	M	28/01/1979	engineer	Offshore	White British	short sighted	t-shirt, shirt, trousers, overalls,	Harness, hardhat, goggles, gloves
454	F	09/12/1976	engineer	Offshore	spanish	short & long sighted	trousers, shirt, overalls	Harness, hardhat, goggles, gloves
455	M	05/07/1959	fluid specialist 3	Offshore	White British	long sighted	trousers, shirt, overalls + equip	Harness, hardhat, goggles, gloves
456	M	23/03/1966	Technician (maintenance)	offshore	british/trinidad	long sighted	jeans, t-shirt, overalls +equip	Harness, hardhat, goggles, gloves
457	M	06/07/1977	engineer	Offshore	french	short	trousers, shirt, overalls + equip	Harness, hardhat, goggles, gloves
458	M	06/03/1971	engineer	Offshore	senegaleese	perfect	trousers, shirt, overalls + equip	Harness, hardhat, goggles, gloves
459	F	26/04/1980	engineer	offshore	american	perfect	trousers, top, overalls + equipment	Harness, hardhat, goggles, gloves
460	F	20/02/1974	engineer	Offshore	Norwegen	short sighted	trousers, top, overalls + equipment	Harness, hardhat, goggles, gloves
461	F	07/06/1977	engineer	Offshore	Venezuelan	perfect	trousers, top, overalls + equipment	Harness, hardhat, goggles, gloves
462	F	18/10/1974	engineer	Offshore	White British	perfect	trousers, top, overalls + equipment	Harness, hardhat, goggles, gloves
463	M	28/01/1970	engineer (field specialist)	Offshore	White British	both	jeans, t-shirt, overalls	Harness, hardhat, goggles, gloves
464	M	14/04/1973	engineer	Offshore	canadian	short	shirt, trousers, overalls,	Harness, hardhat, goggles, gloves
465	M	27/12/1972	engineer	Offshore	algerian	short	fleece, jeans, overalls	Harness, hardhat, goggles, gloves
466	M	21/06/1978	engineer	Offshore	american	perfect	shirt, trousers, overalls,	Harness, hardhat, goggles, gloves
467	M	01/09/1958	engineer	Offshore	White British	short	shirt, trousers, overalls,	Harness, hardhat, goggles, gloves
468	M	25/11/1959	engineer	Offshore	White British	short	shirt, trousers, overalls,	Harness, hardhat, goggles, gloves
469	M	27/08/1945	engineer	Offshore	White British	perfect	tshirt, trousers, overalls,	Harness, hardhat, goggles, gloves
470	M	15/12/1968	Manager	Offshore	White British	perfect	shirt, trousers, dust coat	
471	M	20/10/1977	Engineer (field specialist)	Offshore	White British	perfect	jeans, rugby shirt, dust coat	
472	M	15/09/1980	Technician (maintenance)	Offshore	White British	perfect	trousers, t-shirt, overalls,	

473	M	23/05/1975	engineer (field specialist)	Offshore	White British	perfect	trousers, shirt, overalls	
474	M	05/03/1985	Technician	Offshore	White British	perfect	trousers, t-shirt, overalls	
475	M	31/10/1979	engineer (field technician)	Offshore	White British	perfect	trousers, t-shirt, overalls	
476	M	11/02/1976	Technician (maintenance)	offshore	White British	perfect	trousers, t-shirt, overalls	
477	M	02/11/1981	data aqcustion technician	offshore	White British	perfect	trousers, t-shirt, overalls	
478	M	02/04/1982	Slick line assitant	Offshore	White British	perfect	trousers, t-shirt, overalls	
479	M	20/11/1980	fitter	Offshore	White British	short sighted	trousers, t-shirt, overalls	
480	M	08/01/1982	Slick line assitant	Offshore	White British	perfect	trousers, t-shirt, overalls	
481	M	03/03/1968	engineer (field specialist)	offshore	nigerian	perfect	trousers, t-shirt, overalls	
482	M	04/07/1980	Technincian (service)	Offshore	White British	perfect	trousers, t-shirt, overalls	
483	F	15/01/1973	engineer (field)	Offshore	italian	both	trousers, shirt, overalls	
484	M	08/03/1977	engineer (field)	Offshore	gabonese	long sighted	trousers, shirt, overalls	
485	M	15/01/1973	Technician	offshore	White British	perfect	trousers, shirt, overalls	
486	M	01/02/1964	supervisor/driver	Offshore	White British	perfect	trousers, t-shirt, overalls	
487	M	13/12/1978	Slick line assitant	Offshore	White British	perfect	trousers, t-shirt, overalls	
488	M	08/07/1955	Technician	Offshore	White British	long	trousers, t-shirt, dust coat	
489	M	28/06/1974	engineer (field)	Offshore	algerian	perfect	trousers, t-shirt, overalls	
490	M	05/01/1979	engineer (field technician)	Offshore	White British	perfect	jeans, t-shirt, overalls	Harness, hardhat, goggles, gloves
491	M	11/06/1962	operator (wire line)	Offshore	White British	long	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
492	M	05/09/1970	operator (wire line)	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
493	M	25/02/1957	operator	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
494	M	27/12/1969	operator (wire line)	offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
495	M	18/05/1962	operator (wire line)	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
496	M	24/05/1956	operator (wire line)	Offshore	White British	long	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
497	M	22/10/1967	operator	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
498	M	15/11/1972	operator	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
499	M	25/04/1970	operator (wire line)	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
500	M	25/07/1975	operator	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
501	M	06/10/1982	operator	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
502	M	31/12/1978	operator	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
503	M	12/06/1975	operator	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
504	M	23/06/1979	operator	Offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
505	M	11/07/1977	operator	offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
506	M	19/03/1966	operator	offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
507	M	30/04/1979	operator	Offshore	White British	short sighted	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves
508	M	27/04/1977	operator	offshore	White British	perfect	trousers, t-shirt, overalls	Harness, hardhat, goggles, gloves

Offshore dimension data

Subject No	easurer	Weight with equip	Weight without	Stature	Should Breadth	Hip Breadth	Chest Circ	Waist Circ	Thigh Circ	Cervical height	Hand Breadth	Hand Span	Arm Leng	Leg leng	Shoe Length	Shoe Width
246	A		89.4	1824	494	323	1078	993	605	690	90.84	215	1011	1109	327	119
247	A		88.4	1804	496	327	1066	966	659	695	92.01	243	918	1035	327	119
248	A		74.6	1812	475	314	950	887	600	690	85.77	213	962	1081	322	116
249	A		90.2	1847	499	330	1069	942	642	689	88.01	221	934	1085	303	108
250	B		87.6	1870	490	330	1031	964	591	681	92.58	210	981	1136	311	118
251	B		74	1771	486	342	1089	947	587	656	89.42	210	922	1103	312	120
252	A		81	1922	468	324	943	858	608	695	91.05	176	1011	1199	295	109
253	B		96.2	1831	548	350	1184	1031	635	714	84.64	200	932	1071	293	114
447	A	130	124.4	1749	528	376	1303	1251	740	705	91.4	211	939	1052	307	117
448	A	118	112.4	1856	542	354	1228	1144	642	743	94.52	240	982	1072	311	113
449	A	82.2	76.2	1720	459	321	959	940	591	660	90.19	201	912	1059	291	112
450	A	105.4	99.8	1763	534	373	1171	1110	658	719	87.13	209	915	1027	310	111
451	A	106.6	101.2	1819	525	330	1075	966	689	632	93.59	223	999	1165	322	120
452	B	103	97.4	1901	498	338	1034	993	649	678	84.04	190	1071	1202	301	117
453	B	94	88.6	1843	549	334	1080	982	643	731	86.51	199	974	1117	318	118
454	B	64.4	59	1656	418	344	868	944	551	588	74.16	191	882	1052	254	95
455	B	106	100.6	1872	500	343	1147	1085	679	735	86.74	196	943	1151	301	116
456	B	94.4	89	1822	485	336	1112	993	631	654	91.59	225	953	1093	300	116
457	A	85.8	80.2	1860	476	335	998	964	572	706	86.58	222	993	1141	306	109
458	A	108.2	102.8	1915	508	359	1051	1014	691	719	85.36	191	1005	1160	316	117
459	B	84.2	78.6	1643	449	351	1015	899	705	648	75.01	186	834	994	267	104
460	B	82.2	76.6	1756	428	332	1072	1037	621	631	73.2	210	899	1083	255	92
461	B	79	73.6	1642	426	333	1013	972	614	622	70.91	204	852	973	243	88
462	B	73	67.6	1757	404	318	954	906	564	681	78.86	197	854	1061	261	90
463	A	111.8	106.2	1795	512	346	1161	1109	695	690	89.83	223	956	1100	305	116
464	A	112	106.4	1785	503	370	1143	1170	675	662	88.08	211	946	1050	315	117
465	A	80	74.4	1750	476	318	1010	1012	547	641	77.77	201	929	1056	275	104
466	A	87.2	81.8	1853	488	302	1039	924	627	726	90.47	217	1004	1123	324	121
467	A	107	101.6	1738	519	360	1177	1130	678	682	85.75	208	905	1035	289	107
468	A	107.8	102.4	1799	511	320	1193	1093	642	681	93.37	208	975	1081	306	117
469	A	78.6	73.2	1597	445	309	1023	1020	543	599	81.61	176	850	952	288	113
470	A	80.4	75	1685	449	303	949	867	585	674	84.01	186	875	1006	280	110
471	A	128	122.6	1828	539	363	1280	1171	624	659	86.85	233	974	1059	321	126
472	A	111.4	106	1815	504	345	1169	1139	687	661	86.47	217	939	1049	300	111
473	A	107.4	101.8	1824	515	326	1139	1069	681	683	88.77	203	971	1092	316	110
474	A	72.8	67.4	1741	424	316	925	839	570	618	81.87	190	886	1031	294	113
475	A	92.4	87.2	1627	483	329	1076	993	659	634	83.94	219	863	901	294	118
476	B	86.2	80.8	1820	479	328	1020	983	592	670	88.17	182	931	1033	300	110
477	B	76.4	71	1796	442	343	926	890	508	644	83.89	208	919	1066	310	113
478	B	96.2	90.6	1945	471	338	1006	934	623	663	86	179	973	1166	311	122
479	B	98.6	93.2	1762	505	327	1105	1019	655	673	95.5	207	925	1027	283	111
480	B	86.2	80.8	1739	478	311	1005	922	622	652	87.73	200	893	1041	310	121
481	A	110	104.8	1852	541	340	1105	998	669	680	88.77	223	1013	1180	301	113
482	A	75.8	70.4	1617	478	318	1005	879	593	621	77.73	166	857	931	290	117
483	B	76	70.4	1747	427	311	948	821	642	633	80.79	221	935	1060	294	114
484	B	79.2	73.6	1724	460	321	938	904	555	632	88.95	171	971	1052	296	103
485	A	88.8	83.2	1696	492	326	1040	952	625	640	89.9	225	912	1041	309	121
486	A	128.6	123.2	1872	539	388	1165	1201	702	709	94.55	241	991	1081	314	122
487	A	88	82.4	1847	487	328	977	955	565	712	90.01	226	995	1101	295	108
488	A	99.4	94	1739	478	356	1109	1051	590	710	82.75	182	925	1041	290	107
489	A	70.4	64.8	1633	455	280	893	826	564	615	78.51	206	904	984	274	114
490	A	72.6	67.2	1743	438	266	911	812	556	655	87.18	231	920	1022	285	100
491	A	81.8	76.2	1830	463	331	980	857	543	700	87.5	185	1011	1129	316	117
492	A	106.4	101.4	1935	493	341	1079	1010	664	706	94.1	212	1005	1209	322	116
493	A	131.4	126	1808	561	378	1333	1197	665	684	89.38	214	957	1076	311	117
494	A	92.8	87.4	1740	481	325	1094	1009	621	640	87.1	201	896	1035	283	98
495	A	94.2	88.8	1705	511	323	1135	1028	604	610	88.79	215	876	1035	283	108
496	A	97.8	92.2	1741	489	312	1100	1021	620	656	89.17	190	917	1024	307	110
497	A	95.2	86	1767	505	301	1098	1003	600	678	92.24	225	953	1053	300	115
498	A	124	118.4	1731	542	379	1242	1183	747	693	95.02	210	933	986	304	114
499	A	94.4	88.8	1800	478	322	1019	990	621	715	88.44	180	901	1075	291	111
500	A	77.8	72.2	1748	441	307	962	869	592	647	83.26	186	882	1056	289	111
501	A	103.2	97.6	1767	516	354	1110	1066	667	674	80.94	160	932	1042	304	113
502	A	123.4	118	1890	540	376	1131	1026	724	700	91.52	201	981	1172	304	108
503	A	79.6	74	1743	445	319	954	861	592	653	82.68	215	901	1051	285	115

504	A	83.8	78.2	1717	459	320	970	935	583	642	84.37	195	939	1041	298	108
505	A	113	107.4	1740	558	355	1253	1131	645	673	86.58	218	953	1031	299	113
506	B	84.6	79.2	1735	479	319	1071	984	593	640	87.94	186	972	1058	288	110
507	B	73.8	68.4	1674	431	303	945	884	545	635	83.94	208	886	991	284	109
508	B	115.8	110.2	1822	520	354	1208	1135	676	672	89.06	240	971	1127	322	120

Rescue Services demographic data

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	PPE + Equipment
1	M	29/04/1966	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
2	M	08/09/1972	Firefighter	Rescue services	White British	Perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
3	M	28/04/1960	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
4	M	10/11/1971	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
5	M	26/08/1950	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
6	M	01/01/1956	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
7	M	24/01/1965	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
8	M	22/06/1954	Firefighter	Rescue services	White British	long	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
9	M	15/07/1969	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
10	M	01/09/1967	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
14	M	18/12/1974	policeman	Rescue services	White British	perfect	Shirt, trousers	Protection vest, belt
15	M	24/02/1973	policeman	Rescue services	White British	perfect	Shirt, trousers	Protection vest, belt
16	M	20/10/1968	policeman	Rescue services	White British	perfect	Shirt, trousers,	Protection vest, belt
17	M	09/05/1963	policeman	Rescue services	White British	perfect	shirt trousers,	Protection vest, belt
18	M	05/08/1963	policeman	Rescue services	White British	perfect	shirt trousers,	Protection vest, belt
19	M	06/07/1965	policeman	Rescue services	White British	perfect	shirt trousers, and fleece jacket	Protection vest, belt
20	M	12/04/1968	policeman	Rescue services	White British	perfect	shirt trousers, fleece	Protection vest, belt
21	M	28/06/1954	policeman	Rescue services	White British	perfect	shirt trousers, fleece	Protection vest, belt
37	M	22/01/1979	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
38	M	21/08/1975	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
39	M	17/06/1959	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
40	M	12/07/1954	Firefighter	Rescue services	White British	shortsighted	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves, bag
41	M	20/01/1969	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
104	M	04/07/1963	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
105	M	12/12/1968	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
106	M	02/12/1968	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
107	M	15/03/1961	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
108	M	14/04/1951	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
109	M	27/03/1973	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
110	M	02/10/1952	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
111	M	16/12/1968	Firefighter	Rescue services	White British	perfect	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
112	M	01/05/1954	Firefighter	Rescue services	White British	long	Overall trousers, t-shirt	Protective jacket & trousers, boots, helmet, gloves
244	M	28/09/1965	police Tactile defence unit	Rescue services	White British	short sited	combats, t-shirt	Harness, ropes, helmet
245	F	16/12/1975	Police –Tactile defence unit	Rescue services	White British	short sited	combats, t-shirt	Harness, ropes, helmet

282	M	14/12/1959	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
283	M	23/11/1969	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
284	F	17/08/1967	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
285	M	15/10/1974	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
286	M	25/09/1971	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
287	M	14/05/1975	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
288	M	16/08/1968	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
289	M	01/01/1972	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
290	M	21/05/1973	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
291	M	08/05/1960	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
292	M	21/03/1965	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
293	M	09/04/1963	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
294	M	14/07/1965	fire arms officer	Rescue services	White British	perfect	trousers, top,	boiler suit, bullet proof vest, belt, vest
406	M	12/06/1965	mountain rescue	Rescue services	White British	driving	Tracksuit bottoms, t-shirt, jacket,	sit harness, hard hat, ropes, gloves
407	M	24/01/1964	mountain rescue	Rescue services	White British	perfect	tracksuit bottoms, t-shirt, jacket,	sit harness, hard hat, ropes, gloves
408	M	28/01/1963	mountain rescue	Rescue services	White British	driving	shorts, t-shirt,,	sit harness, hard hat, ropes, gloves
409	M	16/03/1969	mountain rescue	Rescue services	White British	short	trousers, jumper, jacket,	sit harness, hard hat, ropes, gloves
410	M	18/10/1973	mountain rescue	Rescue services	White British	perfect	shorts, t-shirt, jacket,	sit harness, hard hat, ropes , gloves
411	F	31/03/1970	mountain rescue	Rescue services	White British	perfect	walking trousers, fleece	sit harness, hard hat, ropes , gloves
412	M	03/02/1941	mountain rescue	Rescue services	White British	long sighted	walking trousers, t-shirt, water proofs	sit harness, hard hat, ropes , gloves
413	M	11/03/1945	mountain rescue	Rescue services	White British	bi-focals	walking trousers, t-shirt, water proof	sit harness, hard hat, ropes , gloves
414	M	13/08/1966	mountain rescue	Rescue services	White British	perfect	walking trousers, t-shirt	sit harness, hard hat, ropes , gloves
415	M	26/07/1947	mountain rescue	Rescue services	White British	long	walking trousers, t-shirt,	hard hat, sit harness, ropes and gloves
416	M	31/03/1953	mountain rescue	Rescue services	White British	long	walking trousers, t-shirt, jacket,	hard hat, sit harness, ropes & gloves
417	M	27/11/1979	mountain rescue	Rescue services	White British	perfect	shorts, t-shirt,	hard hat, sit harness, ropes & gloves
418	M	22/01/1945	mountain rescue	Rescue services	White British	Vari-focals	trousers, t-shirt,	hard hat, sit harness, ropes & gloves
419	M	28/08/1954	mountain rescue	Rescue services	White British	long	trousers, t-shirt,	hard hat, sit harness, ropes & gloves
420	M	21/02/1965	mountain rescue	Rescue services	White British	perfect	Shorts, t-shirt	sit harness, hard hat, ropes , gloves
421	M	03/04/1961	mountain rescue	Rescue services	White British	short	shorts t-shirt	sit harness, hard hat, ropes , gloves

Rescue Services dimension data

Subject No	easurer	Weight with equip	Weight without	Stature	Should Breadth	Hip Breadth	Chest Circ	Waist Circ	Thigh Circ	Cervical height	Hand Breadth	Hand Span	Arm Leng	Leg leng	Shoe Length	Shoe Width
1	A	98.2	96.6	1825	519	395	1138	1195	700	721	89.97	202	931	1115	331	121
2	A	94.8	93.2	1799	514	368	1110	1182	711	710	86.7	235	960	1092	325	118
3	A	94.6	93	1894	494	356	1147	1130	719	718	91.28	255	995	1175	337	123
4	A	89.6	88	1749	507	353	1168	1150	712	651	90	239	921	1082	323	115
5	A	85.2	83.7	1740	500	348	1118	1116	704	673	92.45	220	963	1036	313	111
6	A	80	78.2	1760	499	334	1081	1089	679	710	88.6	220	881	1058	305	118
7	A	87.4	85.8	1864	496	358	1113	1098	670	691	86.7	226	943	1132	308	113
8	A	99.6	98	1849	527	363	1188	1199	685	713	91.2	229	1005	1141	339	121
9	A	108.2	106.6	1818	518	384	1183	1226	737	695	91.16	239	947	1095	339	126
10	A	101.2	99.8	1823	530	314	1210	1114	700	718	85.5	210	941	1072	312	115
14	A	94.4	88.2	1843	488	343	1132	1157	601	700	88	203	936	1126	333	119
15	A	88.6	84.6	1843	490	320	1111	1151	612	688	83.75	230	941	1087	318	112
16	A	91.8	88.2	1851	485	334	1057	1130	583	671	87.6	218	955	1089	323	120
17	A	101	97.4	1868	488	348	1121	1185	658	707	88.3	224	940	1136	334	118
18	A	109.2	103.6	1951	505	370	1193	1259	634	702	87.9	235	1001	1175	328	120
19	A	89.8	83.4	1864	487	332	1128	1202	562	714	86.6	249	981	1080	317	114
20	A	97.4	90.8	1857	510	308	1185	1175	620	678	89.3	249	981	1113	327	124
21	A	77.2	71.6	1785	480	322	1123	956	553	666	91.94	229	932	1051	322	125
37	A	73.2	71.8	1739	489	330	1065	1029	607	663	93	214	941	1012	300	116
38	A	79.8	78.4	1832	478	314	1054	995	627	692	99	207	959	1124	315	113
39	A	129.2	127.6	1861	573	392	1314	1341	761	707	93	226	997	1198	354	123
40	A	94.4	91.4	1807	508	336	1185	1083	674	662	92	218	918	1056	312	115
41	A	82.2	80.4	1783	484	330	1061	1069	660	651	95	237	946	1143	312	119
104	A	87.4	84.4	1784	495	330	1103	1120	645	662	82.1	203	937	1038	310	120
105	A	93.8	92	1901	486	332	1091	1031	659	710	89.67	224	946	1152	320	123
106	A	107.6	105.8	1860	542	337	1210	1090	663	705	87.88	208	937	1123	332	118
107	A	105.8	104.2	1888	504	365	1152	1187	665	699	91.78	236	979	1105	350	125
108	A	88.6	87	1858	518	339	1117	1114	605	705	85	201	931	1113	323	116
109	A	99.6	98	1911	498	359	1101	1080	663	714	89.14	207	946	1130	322	120
110	A	95.4	93.6	1848	513	356	1141	1182	623	685	90.98	235	961	1117	320	123
111	A	99.6	97.8	1921	508	337	1123	1053	651	735	89.97	221	964	1158	331	120
112	B	97.6	96	1864	531	354	1166	1152	635	685	91.79	230	978	1106	326	120
244	B	100.4	95.4	1791	517	339	1092	976	620	698	88.74	222	912	1066	308	116
245	B	79	71.4	1692	450	320	923	750	623	647	77.85	202	880	1043	271	104
282	A	126	104.8	1759	529	353	1358	1084	664	668	90.08	230	915	1105	328	114
283	A	107.6	87.4	1809	518	303	1243	901	618	686	89.95	236	926	1110	317	112
284	B	90.8	70.6	1708	414	296	1192	821	633	692	76.93	201	850	1006	271	107
285	B	101.8	83	1764	484	328	1292	980	574	667	90.17	198	919	1052	320	115
286	A	99.4	79	1810	500	302	1127	907	584	709	81.53	196	953	1135	295	102
287	A	118.2	100.8	1879	536	344	1222	978	649	740	89.23	208	1003	1175	321	120
288	A	109.8	89.2	1717	515	296	1321	934	634	690	81.52	195	885	1055	309	110
289	A	122.2	103.2	1824	538	326	1398	973	667	710	94.5	243	940	1103	338	117
290	A	113.8	95.6	1898	527	339	1278	961	609	720	92.22	226	1023	1123	334	119
291	B	128	109.2	1802	515	360	1350	1073	704	730	88.87	209	956	1101	334	116
292	B	118	101.6	1799	521	338	1385	1031	620	699	86.65	201	953	1091	329	117
293	B	109.2	93.4	1847	492	349	1319	1031	572	709	91.64	208	986	1161	316	113
294	A	119.4	102	1960	527	359	1283	999	628	721	92.57	241	1078	1211	346	125
406	A	122.8	118.4	2033	531	388	1200	1056	637	725	92.08	265	1064	1181	335	123
407	A	88.8	86.6	1779	474	335	1033	933	614	650	83.92	219	911	1068	296	105
408	A	88	84.8	1742	468	299	1037	948	598	662	86.96	222	939	1056	299	109
409	A	96.4	93.6	1892	479	329	1039	962	631	699	91.94	206	967	1141	307	114
410	A	80	78	1726	463	302	1030	893	558	669	88.35	207	891	1020	293	118
411	B	65.4	62.4	1604	399	307	953	766	633	630	76.32	200	828	957	268	96
412	B	78.8	77.6	1868	449	322	973	835	524	689	91.18	219	971	1153	303	108
413	B	84.6	82.8	1764	479	323	1044	996	536	660	86.81	204	936	1086	285	97
414	B	85.8	84.4	1770	484	343	1118	964	559	690	87.5	211	915	1069	294	114
415	A	95	92.2	1764	471	337	1102	1016	616	704	83.23	172	906	1021	290	107
416	A	80.8	79.8	1833	463	338	993	892	565	707	89.4	216	985	1130	304	117
417	A	93	91	1900	474	348	1037	908	607	714	89.35	220	945	1180	310	118
418	A	98	77.4	1780	464	329	998	911	561	653	85.9	197	897	1092	306	113
419	A	87.8	85.2	1897	481	320	991	870	606	732	88.34	195	999	1150	322	118
420	A	77.2	76.2	1777	455	313	991	808	591	645	82.57	195	931	1091	302	113
421	A	81.6	79.6	1807	473	301	990	784	599	670	86.34	196	947	1072	300	107

Steel construction demographic data

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	PPE +Equipment
113	M	08/02/1965	steel erector	Steel construction	White British	perfect	jumper, trousers,	Hi-vis jacket, hardhat, rigger boots, harness
114	M	30/06/1967	steel erector	Steel construction	White British	perfect	jumper, trousers, fleece	Hi-vis vest, hard hat, harness
254	M	30/07/1973	net erectors	Steel construction	White British	perfect	Trousers, shirt, jumper	
255	M	12/08/1966	net erectors	Steel construction	White British	perfect	trousers, t-shirt	
256	M	20/01/1981	net erectors	Steel construction	White British	perfect	trousers, jumper	
257	M	21/06/1977	net erectors	Steel construction	White British	perfect	trousers, jumper	
258	M	27/02/1963	net erectors	Steel construction	White British	perfect	trousers, jumper, fleece	
259	M	01/04/1985	net erectors	Steel construction	White British	perfect	Combats, jumper, coat	
260	M	10/03/1986	net erectors	Steel construction	White British	perfect	Jeans, t-shirt, jumper	
261	M	17/10/1975	net erectors	Steel construction	White British	perfect	Combats, t-shirt, jumper	
306	M	21/03/1958	labourer	Steel construction	White British	perfect	jeans, jumper,	Hi-vis vest
308	M	22/01/1968	ceiling fitter	Steel construction	White British	perfect	jeans, jumper,	Hi-vis vest
309	M	12/10/1970	ceiling fitter	Steel construction	White British	perfect	jeans, jumper,	Hi-vis vest
310	M	15/07/1974	ceiling fitter	Steel construction	White British	perfect	trousers t-shirt	
311	M	27/07/1962	pipe fitter	Steel construction	White British	perfect	trousers, t-shirt, overalls	knee pads
312	M	11/10/1978	ceiling fixer	Steel construction	White British	perfect	jeans, shirt	
313	M	16/10/1964	ceiling fixer	Steel construction	White British	perfect	jeans, jumper,	Hi-vis vest
422	M	29/09/1981	steel erection	Steel construction	South African	perfect	jeans, t shirt,	hard hat, harness, rigger boots, hi-vis waste coat
423	M	01/08/1978	steel erection	Steel construction	White British	short sighted	shorts, t-shirt	hard hat, harness, rigger boots, hi-vis waste coat, tool belt
424	M	24/01/1968	steel erection	Steel construction	White British	perfect	tracksuit bottoms, t-shirt	hard hat, harness, rigger boots, hi-vis waste coat, tool belt
425	M	23/08/1966	steel erection	Steel construction	White British	perfect	jeans, t-shirt	hard hat, harness, rigger boots, hi-vis waste coat,
426	M	08/03/1969	steel erection	Steel construction	White British	perfect	jeans, t-shirt	hard hat, harness, rigger boots, hi-vis waste coat,
427	M	25/11/1980	steel erection	Steel construction	White British	perfect	combats, t-shirt	hard hat, harness, rigger boots, hi-vis waste coat, tool belt
428	M	06/06/1939	steel erection site supervisor	Steel construction	White British	vary focals	combats, shirt	hard hat, harness, rigger boots, hi-vis waste coat,
429	M	12/09/1951	steel erection	Steel construction	White British	long sighted	jeans t-shirt	hard hat, harness, rigger boots, hi-vis waste coat, tool belt
430	M	27/05/1973	steel erection	Steel construction	White British	perfect	combats - with pads in knees, t-shirt	hard hat, harness, rigger boots, hi-vis waste coat, tool belt
431	M	25/03/1958	steel erection	Steel construction	White British	Long sighted	track suit bottoms, t-shirt	hard hat, harness, rigger boots, hi-vis waste coat, tool belt
509	M	07/06/1958	Steel erector manager	Steel construction	White British	perfect	shorts, t-shirt	Hard hat, harness, hi-vis vest
524	M	02/11/1959	construction manager	Steel construction	White British	perfect	jeans, t-shirt	hard hat, harness, rigger boots, hi-vis waste coat, tool belt

525	M	26/11/1966	construction foremen	Steel construction	White British	perfect	Trousers, t-shirt, boiler suit	
526	M	07/10/1969	steel erector	Steel construction	White British	perfect	jeans, t-shirt	Hard hat, harness, hi-vis vest
527	M	16/10/1982	steel erector/welder	Steel construction	White British	perfect	tracksuit bottoms, t-shirt	hard hat, harness, rigger boots, hi-vis waste coat, tool belt
528	M	03/06/1970	steel erector	Steel construction	White British	perfect	jeans, jumper	Hard hat, harness, hi-vis vest
529	M	18/06/1961	steel erector	Steel construction	White British	long sighted	jeans/t-shirt/over coat	Hard hat, harness, hi-vis vest
530	M	23/12/1974	steel erector	Steel construction	White British	perfect	jeans, t-shirt, boiler suit	hard hat, harness, rigger boots, hi-vis waste coat, tool belt
531	M	26/05/1978	steel erector	Steel construction	White British	perfect	t-shirt, jeans, boiler suit	Hard hat, harness, hi-vis vest
532	M	17/08/1961	steel erector	Steel construction	White British	long sighted in one eye short in another	jeans, t-shirt, boiler suit	hard hat, harness, rigger boots, hi-vis waste coat, tool belt
533	M	05/01/1976	steel erector	Steel construction	White British	perfect	jeans, t-shirt, boiler suit	Hard hat, harness, hi-vis vest
534	M	02/06/1970	steel erector	Steel construction	White British	perfect	shorts, t-shirts, fleece	hard hat, harness, rigger boots, hi-vis waste coat, tool belt
535	M	14/01/1957	welder erector	Steel construction	White British	perfect	jeans, t-shirt	
536	M	28/12/1975	foreman erector	Steel construction	White British	perfect	track suit bottoms, t-shirt	
537	M	09/08/1964	health and safety director	Steel construction	White British	perfect	trousers, jumper,	Hi-vis vest, harness, tool belt, hard hat
538	M	30/11/1982	site operative	Steel construction	White British	perfect	jeans, t-shirt,	Hi-vis vest, tool belt, hard hat
539	M	19/01/1966	site foreman	Steel construction	White British	perfect	jeans, t-shirt,	Hi-vis vest, tool belt, hard hat
540	M	29/07/1945	foreman roofer	Steel construction	White British	perfect	jeans, t-shirt,	Hi-vis vest, tool belt, hard hat
541	M	13/11/1966	steel erector	Steel construction	White British	perfect	trousers, jumper	Hi-vis vest, tool belt, hardhat
542	M	30/12/1967	steel erector	Steel construction	White British	long	jeans, shirt,	Hi-vis vest, tool belt, hardhat
543	M	16/12/1966	steel erector	Steel construction	White British	perfect	jeans, t-shirt	
544	M	26/01/1971	steel erector	Steel construction	White British	perfect	jeans, t-shirt,	Hi-vis vest, tool belt, hard hat
545	M	01/03/1967	contracts manager	Steel construction	White British	perfect	trousers, shirt tie	tool belt, hard hat

Steel construction dimension data

Subject No	easurer	Weight with equip	Weight without	Stature	Should Breadth	Hip Breadth	Chest Circ	Waist Circ	Thigh Circ	Cervical height	Hand Breadth	Hand Span	Arm Leng	Leg leng	Shoe Length	Shoe Width
113	A	85.2	83.4	1736	499	323	1120	1067	546	605	82.95	233	957	1052	301	119
114	A	105	103	1818	523	335	1190	1127	596	680	85.31	230	942	1059	325	125
254	A		97.6	1824	514	333	1106	1051	584	642	92.31	207	965	1102	311	119
255	A		91.8	1740	513	310	1102	977	622	680	84.34	203	914	1031	306	116
256	A		81.8	1813	477	291	990	846	578	662	94.86	199	966	1094	322	121
257	A		77.8	1830	493	311	1009	914	563	676	83.18	218	976	1131	334	124
258	B	86.2	83.6	1777	500	338	1021	934	588	648	90.27	182	944	1092	304	120
259	B		88.6	1858	493	311	1023	975	575	687	87.59	216	987	1181	321	123
260	B		86.4	1740	492	328	976	969	627	659	88.44	212	923	1042	306	121
261	B		106	1816	504	353	1116	1090	627	700	93.47	221	976	1101	304	120
306	A		80.2	1730	477	323	1064	1055	572	610	85.49	197	956	1018	301	113
308	A		96.4	1910	506	334	1135	1058	579	739	90.75	208	949	1071	324	123
309	A		70.8	1815	439	302	938	851	524	654	87.08	206	951	1062	309	113
310	A		90.2	1838	484	320	1023	956	602	713	89.91	216	937	1070	298	112
311	A		78.2	1745	499	298	1062	943	556	672	78.68	215	955	1041	306	117
312	A		78.4	1733	447	279	965	851	609	660	89.62	199	895	1051	288	114
313	A		89.2	1836	485	316	1088	991	562	695	86.8	229	964	1151	310	119
422	A	69.8	65.2	1690	435	282	896	788	561	607	83.68	212	901	966	294	118
423	D	84	73	1750	487	284	989	830	560	640	84.32	230	929	1078	300	114
424	D	97.4	86	1718	492	304	1037	867	621	653	91.57	197	903	1067	304	113
425	D	108.8	102.6	1800	509	332	1085	958	650	689	94.46	219	932	1079	312	116
426	D	93.2	86.4	1693	468	318	1062	1020	586	650	85.31	201	918	981	294	118
427	D	89.6	81.6	1805	473	308	1016	870	584	683	88.41	216	952	1064	299	113
428	D	82.2	80	1792	457	319	1027	926	553	710	93.15	197	941	1062	305	113
429	D	82.4	75.4	1851	460	298	959	881	498	685	85.61	188	961	1079	307	113
430	D	95.4	88.6	1847	492	307	992	887	503	702	85.47	183	943	1171	304	118
431	D	70	63.4	1667	444	310	902	799	518	654	83.26	184	848	982	290	110
509	D	96.2	94.8	1777	498	345	1065	963	544	685	87.85	216	937	1013	319	125
524	A	85.4	77.4	1720	485	298	1026	839	536	650	85.36	219	933	1031	299	113
525	A	81.2	79.8	1799	477	334	1062	869	570	708	90.57	216	966	1041	310	116
526	A	83.8	82.2	1683	478	297	1050	945	588	672	86.16	199	903	1001	285	114
527	A	85.4	77.6	1709	469	309	1003	860	582	669	88.13	220	861	999	295	111
528	A	106.8	105.2	1927	509	322	1139	1070	572	700	91.45	221	1038	1190	323	120
529	A	92.8	90.6	1856	504	312	1132	1050	556	685	87.5	197	991	1151	327	117
530	A	102	94	1875	489	327	1056	957	566	705	90.44	254	998	1191	323	122
531	A	96.6	94.8	1766	512	334	1080	960	650	702	87.8	217	937	1050	304	113
532	A	107.8	99.6	1770	506	331	1109	1033	643	698	92.46	226	925	1055	331	121
533	A	102.8	101.2	1785	524	340	1144	1021	641	704	91.31	215	951	1111	309	120
534	A	98.8	91	1820	498	323	1053	972	601	683	83.61	227	951	1071	288	108
535	A	71.8	63.8	1669	415	290	883	808	495	623	85.42	189	868	1030	286	108
536	A	99.2	91.4	1796	482	333	1071	978	574	723	86.57	201	918	1061	290	113
537	A	83.6	74	1748	460	344	976	901	535	670	85.09	166	936	1036	294	112
538	A	101.8	92.2	1863	475	324	1007	902	600	782	86.62	216	944	1091	314	119
539	A	116.8	107	1787	538	352	1228	1066	645	712	90.29	213	931	1050	317	112
540	A	82.2	72.4	1753	453	309	975	897	500	641	86.91	195	931	1021	307	101
541	A	90.8	81.2	1776	495	319	1067	956	542	719	80.46	201	949	1075	281	98
542	A	113.6	104.2	1742	500	331	1189	1048	645	685	93.04	206	934	995	292	118
543	A	105	95.2	1804	530	317	1109	986	577	703	86.86	203	948	1070	323	123
544	A	79.6	70.2	1700	447	266	940	840	535	647	84.86	196	896	1001	287	101
545	A	94.6	86.2	1871	481	327	998	900	583	700	88.56	222	974	1136	311	117

Transport demographic data

Subject No	Sex	Date of Birth	Occupation	Industry Sector	Ethnic origin	Eyesight	Type of clothing	PPE + Equipment
51	M	21/07/1961	lift operators	Transport	White British	shortsighted	trousers, fleece, t-shirt	Hi-vis jackets, harness, hard hat,
52	M	16/04/1967	lift operators	Transport	White British	Perfect	trousers, fleece, t-shirt	Hi-vis jackets, harness, hard hat,
54	M	06/06/1965	lift operators	Transport	White British	perfect	trousers, jumper, boiler suit,	Hi-vis jacket, hard hat, harness
55	M	05/02/1955	training instructor	Transport	White British	long	trousers, jumper,	Hi-vis jacket, hard hat, harness
56	M	30/05/1946	training instructor	Transport	White British	shortsighted	trousers, jumper,	Hi-vis jacket, hard hat, harness
59	M	23/10/1976	lorry driver	Transport	White British	perfect	trousers, t-hirt	Hi-vis jacket
122	M	23/02/1967	instructor siccor lifts	Transport	White British	glasses for everything	t-shirt, trousers	rigger boots
141	M	30/04/1962	foreman - roadsman	Transport	White British	perfect	trousers t shirt, jacket	
142	M	22/01/1958	sernior roads man	Transport	White British	long sighted	trousers t shirt, jacket	
143	M	24/05/1958	charge hand	Transport	White British	perfect	trousers t-shirt , jacket	
144	M	25/04/1942	roadsman	Transport	White British	perfect	trousers t-shirt jumper	
145	M	27/08/1968	senior roadsman	Transport	White British	perfect	trousers t-shirt fleece	
146	M	17/07/1962	foreman roads	Transport	White British	perfect	2 x trousers, jumper t-shirt	
147	M	27/08/1969	roadman	Transport	White British	perfect	trousers, t-shirt jumper	
148	M	07/12/1958	senior roadsman	Transport	White British	perfect	trousers, t-shirt, jumper	
149	M	16/06/1968	senior roadman	Transport	White British	perfect	trousers, t-shirt	
150	M	08/04/1978	roadsman	Transport	White British	perfect	jeans, trousers, t-shirt, jumper	
151	M	14/03/1966	roadsman	Transport	White British	Long sighted	trousers, t-shirt, jumper	
171	M	31/12/1971	road worker	Transport	White British	long	trousers, jumper	Hi-vis, trousers and jacket, harness
172	M	15/12/1958	road worker	Transport	White British	perfect	Trousers, jumper	Hi-vis, trousers and jacket, harness, hard hat
173	M	24/08/1963	training instructor	Transport	White British	perfect	cords, fleece	Hi-vis vest
305	M	03/06/1994	instructor	Transport	White British	perfect	trousers, jumper, fleece,	hard hat
332	M	26/01/1947	driving instructor	transport	White British	long	suit,	Hi-vis vest
333	M	10/06/1965	bus driver	transport	White British	perfect	trousers, shirt, tie, coat,	Hi-vis vest
334	M	29/10/1962	mechanic	transport	White British	perfect	overalls, trousers, t-shirt	
335	M	03/01/1952	mechanic	transport	White British	perfect	overalls, trousers, t-shirt	
336	M	23/04/1967	trainee driver	transport	White British	long	trousers, jumper,	Hi-vis vest
337	M	22/07/1943	driver supervisor	transport	White British	short	trousers, jumper,	
338	M	12/01/1973	driver	transport	White British	perfect	trousers, shirt, coat	
339	F	06/06/1963	operations manager/driver	transport	White British	perfect	trousers, jumper	
340	M	16/03/1965	supervisor/driver	transport	White British	long sighted	trousers, shirt	
341	M	27/10/1958	refueler/parker	transport	White British	perfect	trousers, t-shirt, overalls	
342	F	01/09/1951	fueler/parker	transport	White British	long sighted	jeans, t-shirt	
343	M	11/04/1945	cleaner	transport	White British	long sighted	jeans, jumper, shirt, blazer	

344	M	09/07/1960	cleaner	transport	White British	perfect	jeans, fleece,	hi-vis vest
345	M	08/10/1956	driver	transport	White British	perfect	suit	
346	F	24/11/1942	pcv driver	transport	White British	long/short sighted	skirt, blazer, skirt	
347	M	22/04/1979	driver	transport	White British	perfect	trousers, shirt, jumper	
348	M	08/06/1969	driver	transport	White British	perfect	Trousers ,shirt, jumper	
349	M	11/12/1971	driver	transport	White British	astigmatism	trousers, shirt, jacket	
350	M	24/11/1964	driver	transport	White British	perfect	suit	
351	M	01/12/1980	driver	transport	Asian or Asian British	perfect	trousers, shirt jumper coat	
352	M	03/06/1981	driver	transport	White British	perfect	trousers, shirt, fleece	
353	M	05/09/1953	driver	transport	White British	both	suit	
354	M	13/12/1974	driver	transport	White British	astigmatism	trousers and jumper	
355	M	20/10/1948	driver	transport	White British	perfect	trousers, shirt, blazer	
356	M	16/12/1955	driver	transport	White British	right eye sees at a higher level	trousers, shirt	
357	M	16/02/1967	fork lift driver	transport	White British	perfect	jeans, t-shirt,	Hi-vis vest, hard hat
395	M	25/12/1974	fork lift driver	Transport	White British	perfect	jeans, t-shirt	
432	M	09/09/1986	Trailer mate	Transport	White British	perfect	Jeans, sweatshirt	
433	M	28/06/1983	Trailer mate	Transport	White British	perfect	sweatshirt, track suit bottoms	
434	M	13/02/1967	wagon driver	Transport	White British	perfect	sweatshirt, jeans	
435	M	15/12/1976	wagon driver	Transport	White British	perfect	sweatshirt, jeans	
436	M	18/10/1966	wagon driver	Transport	White British	perfect	t shirt, jeans	
437	M	14/06/1963	wagon valeter	Transport	White British	perfect	t shirt, jeans	
438	M	10/04/1979	2nd mate	Transport	White British	perfect	t shirt, overalls	
439	M	12/12/1947	mechanic hgv	Transport	White British	perfect	t shirt overalls	
440	M	22/11/1970	mechanic hgv	Transport	White British	perfect	t shirt overalls	
441	M	12/07/1951	wagon driver	Transport	White British	long sighted	t shirt and trousers	
442	M	20/09/1976	mechanic	Transport	White British	short sighted	overalls, trousers, t-shirt	
443	M	02/07/1947	mechanic	Transport	White British	short sighted	overalls, trousers, t-shirt	
444	M	14/02/1948	hgv driver	Transport	White British	short sighted	shorts t shirt	
445	M	24/09/1944	hgv fitter	Transport	White British	longsighted	overall t shirt, trousers	
446	M	14/12/1951	driver	Transport	White British	longsighted	trousers t shirt	

Transport dimension data

Subject No	easurer	Weight + equip	Weight without	Stature	Should Breadth	Hip Breadth	Chest Circ	Waist Circ	Thigh Circ	Cervical height	Hand Breadth	Hand Span	Arm Leng	Leg leng	Shoe Length	Shoe Width
51	A	109.2	105.4	1770	534	376	1256	1280	620	688	89.6	239	904	1031	321	125
52	A	91.2	87.6	1797	516	333	1208	1191	622	684	89.6	222	918	1066	291	111
54	A	102.8	99.4	1803	550	368	1228	1197	613	696	85.4	188	931	1137	317	119
55	A	104.6	100.8	1762	519	350	1131	1119	593	646	92.55	234	921	1081	314	115
56	A	94.6	90.4	1700	494	363	1195	1202	588	656	85.6	225	924	1023	305	117
59	A	97.6	95.8	1942	495	320	1056	950	573	693	92.76	223	1034	1183	334	117
122	C	106.6	102.4	1854	513	366	1110	1054	622	667	85.12	186	968	1130	325	123
141	A		113.2	1818	553	330	1184	1073	672	688	89.75	213	935	1089	318	114
142	A		60	1683	421	286	939	847	480	597	89.75	206	933	1021	303	114
143	A		103.4	1686	550	333	1238	1118	633	614	88.29	218	939	1025	306	116
144	A		82.4	1670	478	307	1053	1000	531	619	90.9	202	894	1002	302	115
145	A		100.4	1802	512	324	1144	987	654	660	90.77	227	945	1078	304	111
146	D		92.4	1772	512	327	1111	1023	570	673	85.76	214	936	1081	303	107
147	D		77.8	1780	478	318	968	873	552	648	86.62	227	951	1052	322	117
148	D		96.2	1753	509	329	1170	1080	585	669	85.8	195	926	1059	313	121
149	D		84.8	1736	479	305	1029	940	573	658	90.29	213	883	1043	298	110
150	D		124.2	1872	556	408	1217	1131	735	705	86	201	873	1142	329	120
151	D		92.8	1770	518	364	1010	968	606	680	92.4	201	944	1039	298	111
171	A	87.6	84	1731	518	331	1103	1045	613	681	89.8	231	912	1016	304	113
172	A	94.2	90.8	1663	523	339	1210	1120	597	657	85.55	173	881	945	292	118
173	A	119	116.8	1802	547	396	1241	1086	692	678	92.13	231	950	1090	313	113
305	A		115.2	1866	563	340	1371	1242	616	729	99.3	206	1053	1135	316	113
332	A		98	1764	504	326	1247	1104	563	673	85.24	201	967	1091	302	113
333	A		102.2	1853	505	327	1200	1028	634	692	86.8	188	1007	1135	307	115
334	A		71.6	1776	448	309	949	924	525	634	87.47	231	1003	1082	310	115
335	A		71.2	1777	452	319	1005	900	532	661	91.56	206	954	1060	309	114
336	A		65.2	1672	452	291	924	860	545	623	76.6	186	910	990	293	105
337	A		129	1704	541	389	1350	1349	628	680	89.26	220	942	1036	323	117
338	B		80.4	1704	510	288	996	943	549	674	88.98	213	937	1071	300	107
339	B		98.2	1717	447	406	1130	972	748	674	85.86	218	853	1033	267	97
340	B		101.6	1783	490	347	1146	1142	611	671	88.39	191	941	1067	293	116
341	A		85	1800	472	340	1050	1026	598	714	92.55	207	945	1041	305	115
342	B		69.6	1615	429	331	893	901	647	598	75.64	193	836	988	254	98
343	B		53.4	1777	432	298	934	911	441	640	84.83	173	939	1061	290	113
344	A		93.4	1776	477	336	1079	1119	577	713	83.89	194	886	1045	302	116
345	A		104.6	1860	499	349	1206	1162	550	681	88.78	223	1005	1111	324	123
346	B		59	1565	422	316	964	866	n/a	588	74.72	193	811	954	257	83
347	B		82	1825	470	327	1005	928	591	669	87.12	209	963	1073	304	111
348	B		115	1772	745	356	1273	1194	606	700	92.63	232	938	1021	291	113
349	A		112.6	1921	500	385	1136	1200	564	724	92.53	217	1015	1121	321	117
350	A		92.8	1850	484	341	1100	1020	580	730	90.29	236	975	1133	327	121
351	A		87.8	1797	508	340	1075	1075	586	669	85.05	207	973	1101	308	116
352	A		78.8	1748	497	278	1036	876	593	653	82.7	216	950	1050	303	114
353	A		104	1743	527	349	1214	1244	574	650	91.03	221	964	1022	292	111
354	B		98.6	1803	521	329	1110	1141	594	708	86.72	216	943	1112	302	122
355	B		86.8	1766	495	326	1124	1075	554	700	86.3	181	932	1071	291	113
356	B		96.2	1737	501	310	1092	1030	613	673	87.12	202	913	1068	306	112
357	A	85.8	85.4	1764	473	314	1055	955	610	679	89.2	192	878	1004	306	118
395	A		77.8	1689	460	290	989	878	598	644	85.34	200	896	993	284	109
432	D	96.8	95.8	1884	487	354	1010	910	624	695	94.4	223	981	1104	299	115
433	D	108	107	1804	539	368	1150	1052	634	680	89.7	220	935	1004	306	115
434	C		70.2	1683	478	319	940	880	595	671	74.95	190	900	997	286	108
435	C		114	1899	534	368	1133	1092	650	731	87.07	229	1009	1133	317	109
436	D		80.2	1730	493	312	978	879	554	670	88.82	213	888	1024	304	115
437	D		71.6	1682	470	288	968	799	528	614	83.57	210	903	1012	288	111
438	C		118.4	1823	546	398	1216	1222	721	664	81.54	206	960	1070	320	120
439	C		86.4	1758	485	364	1100	1051	648	661	90.17	222	945	1072	316	116
440	D		79.6	1774	462	312	967	914	597	658	79.47	209	903	1033	202	114
441	D		72.4	1712	438	326	912	892	569	690	90.29	229	914	1040	303	112
442	C		84	1740	461	352	1041	995	638	617	84.63	232	898	1070	276	107
443	C		88.4	1798	491	367	1063	990	597	663	94.46	227	923	1099	306	109
444	D		102.2	1658	507	368	1127	1176	640	660	91.79	204	873	952	294	111
445	D		85.4	1707	477	332	1017	982	616	666	92.35	210	908	1049	300	107
446	C		114.2	1782	515	377	1130	1133	685	685	87.68	209	938	1033	312	112