Helmets for rescue

Mark Taylor
Performance Clothing Research Group
School of Design
University of Leeds, UK
What and Why

- We will cover:-
  - different types of helmet available for use in work at height and rescue
    - Quick look at relevant standards
  - Guidelines on helmet selection
  - Testing performed on each type of helmet to attain CE mark.
  - Actual impact locations on helmet shells
Which helmet?

It is obvious why those working at height or involved in vertical rescue should wear some form of head protection! (I hope so anyway 😊)

The problem is **What type of helmet should they wear?**

Generally there has been a choice of three types:

1. Industrial helmets
2. Mountaineering helmets
3. High performance industrial helmets
What is the difference?

- Most helmets look similar.
- Most actually offer similar levels of protection from low energy impacts.
- Main differences are in the way they are tested.
  - To be offered for sale as personal protective equipment (PPE) they have to be CE marked.
Standards

- EN 397 – Industrial safety helmets.
- EN 12492 – Mountaineering helmets.
- EN 14052 High performance industrial helmet.
- EN 443 – Helmets for firefighting in buildings and other structures.
- EN 16473 - Firefighters helmets — Helmets for technical rescue
- BS 8437 Code of practice for selection, use and maintenance of personal fall
Citation, commencement and interpretation

1.—(1) These Regulations may be cited as the Construction (Head Protection) Regulations 1989 and shall come into force on 30th March 1990.

(2) In these Regulations, unless the context otherwise requires, “suitable head protection” means head protection which—

(a) is designed to provide protection, so far as is reasonably practicable, against foreseeable risks of injury to the head to which the wearer may be exposed;

(b) after any necessary adjustment, fits the wearer; and

(c) is suitable having regard to the work or activity in which the wearer may be engaged.
The Construction (Head Protection) Regulations 1989 require operatives to wear protective helmets. It is advisable to follow these regulations even if the workplace is not a "site of construction" as defined in the regulations. Operatives should wear protective helmets that are suitable for the type of work being undertaken. Helmets that conform to standards for either mountaineering (BS EN 12492) or industrial use might be suitable. Some industrial helmets might not be suitable because some of the performance requirements considered necessary for the safety of rope access operatives are not specified in the standard for these helmets, BS EN 397, (i.e. they are optional) and in earlier standards were not given at all (e.g. side impact resistance). Chinstraps on helmets used in rope access work should be of a design such that when the strap is properly fastened, it prevents the helmet from coming off the head. This is typically achieved by the use of "Y" shaped straps where the two top points of the "Y" are attached to the shell of the helmet. Helmets should always be used with the chinstrap fastened. In some work situations, it might be desirable for helmets to be compatible with complementary personal protective equipment such as visors or ear defenders.
EN 397 : 2012 – Industrial Helmets

Compulsory Requirements

- Shock Absorption (49J Impact - Force < 5kN)
  - Crown: -10°C, +50°C, UV, H₂O
- Penetration (29J Impact)
  - Crown: -10°C, +50°C, UV, H₂O
- Chin strap – If fitted
  - Must release when applied load $x$, $150N \leq x \leq 250N$
- Flame Resistance

Optional Requirements

- Shock Absorption: -20°C, -30°C, +150°C
- Electrical Insulation, Lateral Deformation, Molten Metal Splash
EN 12492 : 2012 – Climbing Helmets

Compulsory Requirements

- Shock Absorption (98J Impact - Force < 10kN)
  - Crown -20°C, +35°C, UV
  - Front/ Side/ Rear (25J Impact)

- Penetration (29J Impact)
  - Crown -10°C, +50°C, UV

- Chin strap
  - Must NOT release when applied load <= 500N
  - Must not roll off to front or rear
EN 14052 : 2012 – High Performance Industrial Helmets

Compulsory Requirements

- Shock Absorption
  - Crown (100J - Force < 5kN) : Off crown (50J - Force < 15kN)
    - -10°C, +50°C, UV, H₂O
  - Penetration – flat blade
    - Crown (25J - Force < 5kN) : Off crown (20J - Force < 15kN))
    - -10°C, +50°C, UV, H₂O

- Chin strap – If fitted
  - Must release when applied load \( x \), \( 150N \leq x \leq 250N \)
  - Must not fall off more than 2 subjects

- Flame Resistance

Optional Requirements

- Shock Absorption (-20°C, -30°C, -40°C, +150°C),
- Electrical Insulation, Molten Metal Splash
EN 443 : 2008 Firefighters Helmets

Compulsory Requirements

- **Shock Absorption (123J Impact - Force < 15kN)**
  - Crown/ Front/ Side/ Rear
    - Thermal shock, solvent, (-10, -20, -30 or -40°C), +50°C, UV, H₂O

- **Projectile test**

- **Penetration (24 & 19J Impacts)**
  - Crown
    - Thermal shock, solvent, (-10, -20, -30 or -40°C), +50°C, UV, H₂O

- **Lateral crushing**

- **Chin Strap**
  - Where fitted?
    - Must release when applied load x, 500N ≤ x ≤ 1000N

- **Radiant heat, heat & flame resistance**

- **Resistance to hot solids and molten metals**

- **Electrical Properties**
EN 16473 : 2014 Firefighters helmets for technical rescue

Compulsory Requirements

- Area of coverage
- Shock Absorption
  - Crown (50J Impact - Force < 5kN)
  - Front/ Side/ Rear (25J Impact - Force < 5kN)
    - Thermal shock, solvent, (-10, -20, -30 or -40°C), +50°C, UV, H₂O
- Projectile test
- Penetration (30J Impacts)
  - Crown
    - Thermal shock, solvent, (-10, -20, -30 or -40°C), +50°C, UV, H₂O
- Lateral crushing
- Chin Strap
  - Must have one and be adjustable in length
  - Must not roll off the headform
  - Must release when applied load x, 500N <= x <= 1000N
EN 16473 : 2014 Firefighters helmets for technical rescue

Compulsory Requirements

- Flame resistance (shell and cradle)
- Lateral crushing
- Electrical Properties
- Field of Vision

- Practical performance assessment – based on 5 experienced users
Key Differences

- Off Centre Impacts
- Impact Energy
- Chin Strap

Do these matter?
A quick diversion

- A look at some old & new helmet types
- Will illustrate with Petzl helmets
- Not necessarily a recommendation 😊
Hard shell style
Foam style
Hybrid style
Normal service is resumed....
Impact Locations

Source: Hickling, 1985

Source: U.S. Department of Labor, 1980
Some helmets
Some results
Impact Energy

- Some devices only designed to absorb limited amounts of energy
Spanish TV
Chin strap

- Must keep helmet on head
  - Protects wearer and
  - Those working below
Water rescue
Water rescue

What is it?
Water rescue
Water rescue
Water rescue
Water rescue
What are the risks?

- Oakley (1997, 1998) classified head injury risks to RIB users as:
  - A. Falling overboard
    - i. Striking head against water
    - ii. Striking head against boat
  - B. Falling inside boat and striking head
  - C. Being struck by swinging objects or objects thrown or dropped onto the boat

- B was by far the greatest risk (2.0 per 100 man years)
- Followed by C, then A ii (each 0.03 per 100 man years)
More risks?

- Scoop effect?
  - Neck injuries sustained when falling at speed/ from a height into water
  - Lip of helmet contacts water in an attitude that acts as a scoop – resulting decelerations are transmitted to neck
  - 2014 fatality in Italy
    - This suggested that Elliot could have suffered whiplash when his helmet hit the water, fracturing a vertebra in his neck. *The telegraph 30th Jun 2014*
What is used?
What is used?

- Multi sport helmets (Camp, Petzl, Salewa)
- Kayaking helmets
- Water rescue helmets
Some examples

- http://gb.msasafety.com/Head-Protection/Fire/c/11203
- http://www.helmets.co.uk/fire-rescue-services/cromwell-er1
- http://www.geckoheadgear.com/company/
- http://www.future-safety.com/
- http://www.ewetsuits.com/acatalog/Kayaking-Helmets.html#a631
Relevant standards?

- EN 1385 – Helmets for canoeing and white water sports.
- PAS 028 – Marine safety helmets.
- EN 16473 – Helmets for technical rescue
EN 1385 : 2012 – Canoeing Helmets

Compulsory Requirements

- **Shock Absorption (12.5-25J Impact - Force < 12.5kN)**
  - Crown 0°C, +35°C, UV, H₂O

- **Chin strap**
  - Must **NOT** release when shock loaded (4kg – 150mm)
  - Must not roll off to front or rear

- **Bouyancy**
Compulsory Requirements

- Mass < 700g
- -20°C, +20°C, UV, H₂O (NaCl)

Shock Absorption

- Rigid mode
  - Crown (100J Impact - Force < 12.5kN)
  - Off crown (25J Impact - Force < 12.5kN)
- Falling headform
  - Off crown (15J Impact - Force < 12.5kN)

Penetration (30J Crown, 15J Off crown)

Chin strap

- Must NOT release when shock loaded (5kg – 600mm)
- Must not roll off to front or rear

Bouyancy
What should you wear if you are working at height over water?
How truly certified is your rescue helmet?

Certification and testing of Personal Protective Equipment (PPE) has often been described as a ‘dark art’ and full of grey areas. Acceptance of this view, and in numerous cases, perpetuation by manufacturers, has for many years meant that vague, inaccurate and often spurious claims by PPE suppliers have been missed, or sometimes even tolerated, by fire and rescue services and other professional users.

Thankfully, due to the increasingly high stakes nature of massive procurement exercises, such as the current Scottish PPE Tender and the SE Collaborative PPE Procurement; those responsible for verifying manufacturers’ claims product described in its EN norm - EN 16473 - as ‘Firefighters Helmets – Helmets for Technical Rescue’. This type of helmet is being increasingly used for almost every non-structural fire activity. There is an inevitable

- EN 12492 – Working at Height – Safety at Height, Aerial Platforms, Abseiling
- PAS 028 (Pending) – Water and Flood Rescue. The R6DX is therefore the ideal helmet for all non-fire operations.
Technical rescues involve the environments and conditions associated with operational scenarios such as but not limited to those found during road traffic collisions, railway incidents and when working in and around collapsed structures, often for extended periods of time, after natural disasters (flood, earthquake, etc.).

Requirements for marking and information to be supplied by the manufacturer are included.

Helmets for use while firefighting in buildings and other structures or in wildland firefighting environments, are not covered by this European Standard see [EN 443](https://en.wikipedia.org/wiki/EN_443) and [EN 16471](https://en.wikipedia.org/wiki/EN_16471).

Helmets for use in water rescue operations using craft, such as boats, canoes etc., are also not covered by this European Standard.
## Impact energy

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>EN 397</td>
<td>49</td>
<td>5</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>EN 12492</td>
<td>98</td>
<td>10</td>
<td>25</td>
<td>10</td>
</tr>
<tr>
<td>EN 14052</td>
<td>100</td>
<td>5</td>
<td>50</td>
<td>15</td>
</tr>
<tr>
<td>EN 443</td>
<td>123</td>
<td>15</td>
<td>123</td>
<td>15</td>
</tr>
<tr>
<td>EN 14673</td>
<td>50</td>
<td>5</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>EN 1385</td>
<td>25</td>
<td>12.5</td>
<td>12.5</td>
<td>12.5</td>
</tr>
<tr>
<td>PAS 028</td>
<td>100</td>
<td>12.5</td>
<td>25</td>
<td>12.5</td>
</tr>
<tr>
<td>BS 6658:1985</td>
<td></td>
<td></td>
<td>169</td>
<td>15</td>
</tr>
</tbody>
</table>
Why?

- Because it is certified for that use
- What is different?
Why?

Because it is certified for that use

What is different?

- Bouyancy
- Chin strap test
Conclusions

- Need to assess probable risk and choose helmet type accordingly.