

## **Field Test of the Crusader Cooker for BCB International. and comparison with existing MOD Issue Hexamine Stove and Fuel**

Tests carried out independently by **CADD Consultancy & Services**

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## Introduction

BCB International have produced an integrated cooking system that they believe is superior to the existing British Army Issue. One of the components of this system is the Crusader Cooker. This Cooker has been designed to use both the existing Hexamine fuel and an Ethanol based gel Fuel.

The purpose of the proposed tests is to make Objective and Subjective comparisons between the existing Army issue and the new design.

The new Crusader System is designed to be compatible with the NATO Issue Mug and Canteen and is contained within a standard Army issue webbing pouch.

The first two tests are based on the method of testing requested by DCG on behalf of the MOD in Document ASFS 7-02 Issue Date U/C which supersedes ASFS 7-02 dated 18/05/99.

### Test 1

A timed test boiling 850mls of Water using the Crusader Mug and Stove combined with Ethanol Gel Fuel. alongside an Army issue Hexamine stove boiling 850mls of water using Hexamine blocks. A controlled indoor test to eliminate variable weather conditions.

### Test 2

A timed test boiling 850mls using the Crusader Mug and Cooker combined with Hexamine fuel. A controlled indoor test to eliminate variable weather conditions.

The Third test is intended to duplicate actual field conditions but without rain or extremes of temperature.

### Test 3

An outdoor Field Test producing a Mug of Tea and an Army Ration Pack meal using the Crusader System compared with the Army issue Hexamine stove, Fuel and Mess Tin. This test is Objective with additional Subjective comments and impressions.

**Comparable weight of fuel was used with each cooker.**

<b>Comparative Table of Results</b>		
<b>Crusader Cooker with Ethanol Gel 72 grams of Fuel</b>	<b>Army Issue Hexamine Stove and Fuel 72 grams of Fuel</b>	<b>Crusader Cooker With Hexamine Fuel 72grams of Fuel</b>
850mls of water boiled in 9minutes 57seconds	850mls of water boiled in 10minutes 32 seconds	850mls of water boiled in 12minutes 29seconds
Cooker continued to burn for an additional 12minutes	Cooker continued to burn for an additional 4minutes	Cooker continued to burn for an additional 18minutes 30seconds
Easily ignites with Match or Flint & Striker	Ignites with a match.	Ignites with a match
No luminescence – Pale blue flame for the duration of the burn – Flame invisible in daylight.	Luminescent – Intermittent candle like, yellow flame for the duration of the burn	Some luminescence – Pale yellow or blue flame throughout the burn.
Decrepitation Not Applicable	No appreciable decrepitation of Blocks used in the test	No appreciable decrepitation of Blocks used in the test
No Visible Smoke	Some Visible Smoke	Some Visible Smoke but less than Army Issue Stove
No Carbon Deposit	Heavy Carbon Deposit	Some Carbon
Test fuel subjected to 24 hour immersion in water.	Test fuel subjected to 10minute immersion then dried as specified.	Test fuel subjected to 10minute immersion then dried as specified.
No appreciable odour during the burn.	Strong odour during burn	Strong odour during burn but less than Army issue stove.
Waste product – Water + CO <sup>2</sup>	Waste product – Water + toxic derivatives (not known) – not to be used without ventilation.	Waste product – Water + toxic derivatives (not known) – not to be used without ventilation.
Easily dispensed from the sachets	At least 4 tablets (blocks) broken in each pack used.	At least 4 tablets (blocks) broken in each pack used.
Complies with Document ASFS 7-02 Issue Date U/C which supersedes ASFS 7-02 dated 18/05/99.	Does NOT Comply with Document ASFS 7-02 Issue Date U/C which supersedes ASFS 7- 02 dated 18/05/99.	Complies with Document ASFS 7-02 Issue Date U/C which supersedes ASFS 7-02 dated 18/05/99.

**Test of the Crusader Cooker for BCB International.  
and comparison with existing MOD Issue Hexamine Stove and Fuel**

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**July 3<sup>rd</sup> 2006**

**Location of Test**

Pentyrch  
Cardiff

**Conditions**

Indoor Test – No Draughts  
Ambient Temperature 18°C

**Equipment for each test.**

Video Camera  
Digital Camera  
Tripod  
Issue Hexamine Stove  
Crusader Cooker  
Leatherman Multitool  
Time & Motion Stop Watch  
Thermometers  
1000ml Liquid Measure  
Water Jug  
Issue Mug  
Crusader Mug (Black)  
Issue Waterproof matches

**Method of Testing:**

As requested by DCG on behalf of the MOD in Document ASFS 7-02 Issue Date U/C which supersedes ASFS 7-02 dated 18/05/99.

1. **Ignition.** Set up the cooker with one tablet\* and apply a lighted match. Tablet\* shall ignite readily.
  
2. **Burning Characteristics:** An ignited tablet shall satisfy this test if it burns as follows:
  - a). Without decrepitation
  - b). With relatively non-luminous flame.
  - c). Without giving visible smoke.
  - d). Without depositing carbon which decreases heating efficiency.
  
3. **Heating Efficiency:** A clean, standard service mess tin containing 850mls of water, at 15°C, shall be placed on the cooker and the tablet ignited. Tablets shall be considered satisfactory if they burn for 10 – 15 minutes and the water boils within 13 minutes.
  
4. **Waterproofing:** Immerse the tablets\*\* in water at 15°C for 10 minutes, then remove and dry the surfaces with filter paper or blotting paper. The tablets\*\* shall be considered satisfactory if they then comply with the requirements of paragraphs 1, 2 and 3 above.

**Note:** \*The fuel used in the BCB Crusader System is a Denatured Ethanol Gel with Denatonium Benzoate. The fuel has a taste aversive additive but the manufacturer's state that the fuel is safe if ingested and the additive is to discourage ingestion. Because of the way in which this fuel is packed, for "one tablet" substitute "one filling of the fuel receiver".

\*\*The gel fuel is contained in a waterproof polyethylene sachet until use. Test samples were submerged in water for 24 hours prior to the test. It should be noted that the Sachets float and have to be weighted to submerge them. Sachets used in the test have been in storage at BCB for 6 months prior to their use in this test.

## **Results of the Test of the Crusader Cooker with Ethanol Gel Fuel.**

### **Ignition**

The Crusader Cooker fuel receiver was filled with 72grams of Gel Fuel from sachets that had been immersed in water overnight. The fuel was easily expelled from the sachets to the fuel receiver. The fuel did not contact the hands.

The fuel was ignited by using one match. The fuel ignited immediately but the flame was invisible and was detected by a heat haze and by moving a hand approximately 250mm above the cooker. The stop watch was started when ignition had been confirmed. **Complies** with MOD requirement ASFS 7-02\_1

A standard issue mess tin containing 850mls of water at 15°C was centrally placed on the cooker.

### **Burning Characteristics:**

MOD requirement ASFS 7-02 **2a** is not applicable to the ethanol fuel.

The fuel burns and is just visible to the eye in daylight (very pale translucent blue). **Complies** with MOD requirement ASFS 7-02\_2**b**.

There was no visible evidence of smoke (see video). **Complies** with MOD requirement ASFS 7-02\_2**c**

On completion of the test the base of the mess tin was observed and there was no Carbon deposit. There was a slight discolouration due to heat (oxidation of the metal base). **Complies** with MOD requirement ASFS 7-02 **2d**

### **Heating Efficiency:**

The water reached boiling point in 9minutes 57seconds and the fuel continued to burn for another 12minutes. The total burning time was 21 minutes and 57 seconds. The burning duration **Complies** with MOD requirement ASFS 7-02 **3**. The time taken to reach boiling point with 850mls in the mess tin was inside of the requirement by 3minute 3 seconds.

### **Waterproofing:**

The MOD requirement ASFS 7-02 **4** is not relevant to this fuel type. The packaging is a tough waterproof polyethylene which can be totally immersed in water almost indefinitely. The test fuel was weighted and submerged for 24 hours (the fuel and packaging has an S.G of less than 1.0). If the polyethylene packaging is taken into account then the fuel **Complies** with the MOD requirement ASFS 7-02 **1, 2, and 3**.

### **Conclusions:**

The Cooker and type of fuel that is used meets all of the Conditions of the Specification laid down in MOD document ASFS 7-02 Issue Date U/C.  
(see Comparative Test Observations)

### **Comparative Test Observations:**

The comparative test of the Army Issue Hexamine stove carried out at the same time as the Crusader Cooker test highlighted a number of issues.

1. **The Army Issue stove** and fuel do **NOT comply** with the MOD requirement **ASFS 7-02 Issue Date U/C**.
2. The Hexamine blocks used in the test were taken from Military stock. The blocks were fragmented in the cardboard package.
3. **The Army Issue** blocks burned intermittently with a blue flame and a **highly luminous yellow flame. Does NOT Comply** with MOD requirement ASFS 7-02 **2b**. (see video)
4. There is some **intermittently visible smoke from the Army Issue stove. Does NOT Comply** with MOD requirement ASFS 7-02 **2c**. (see video)
5. The bottom of the mess tin used in conjunction with the **Army Issue** hexamine stove showed an **appreciable deposit of black Carbon. Does NOT Comply** with MOD requirement ASFS 7-02 **2d**. (see video)
6. The time taken to boil 850mls was **10minutes 32** seconds using **3 hexamine blocks**. The hexamine blocks were from Army Stock(see video)
7. **The Army Issue** Hexamine stove burned for 4 minutes after Boiling point was achieved. (see video) (see video)
8. Hexamine blocks passed the 10 minute immersion test

### **Objective Conclusions of Comparative Test.**

The Army issue cooker failed to meet all the MOD Requirement ASFS 7-02.

The Crusader Cooker met all of the requirements ASFS 7-02

The existing army issue failed to meet **ASFS** 7-02\_2b, 2c, 2d, and both parts of section 3. There were five areas where the Army Issue hexamine fuel did not meet the specification

### **Subjective Conclusions:**

The Crusader cooker presents the preferred solution.

There is no smell from the ethanol gel fuel.

The fuel burns completely (no toxic fumes – CO<sup>2</sup> + Water only)

There is a strong smell from the hexamine. (Toxic fumes are given off – must not be used in confined spaces).

The heat from the gel is as high as the hexamine but it burns more cleanly and for longer.

The gel fuel is more easily handled and does not leave a strong odour on the hands if it contacts the skin.

The Crusader cooker's fuel receiver is clean enough for the unit to be packed away in its pack after cooling.

The hexamine stove shows an erratic flame and wasted heat. (no wind shielding).

The Crusader cooker can be turned to provide variable heat by presenting the air slot to the optimum draft.

The crusader cooker is more robust and will therefore have a longer life in service. The Army Issue stove was difficult to open due to in-correct storage and flimsy construction. The Crusader Cooker should prove more cost effective in the long term.

The Crusader Cooker is more “user friendly”.