

# De Montfort Mark 9 Incinerator

## Introduction

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This incinerator is the recommended model for larger hospitals (generally more than 300 beds). It is a development of the Mark 3 and is to be built where high rates of combustion are required. It simplifies the construction, particularly of the steelwork, and thereby reduces the likelihood of failure due to distortion of the steel top plate.

It should be built on a concrete platform of at least two metres square, and should preferably have a roof to protect it from rain. The roof may also incorporate the support for the chimney stack.

The instructions which follow are meant to be used in all countries. The building instructions give the number and position of the bricks, but not the overall dimensions of the incinerator. This is because bricks differ slightly in size between one country and another, and it is simpler to adjust the overall size of the incinerator to the available bricks than to have to cut bricks to an exact dimension.

Similarly, only approximate dimensions of the steelwork are given. The correct procedure is to lay out the first two layers of bricks, and then measure the length and breadth of the steel which fits on top. The steel top can then be made to fit the finished brickwork.

The steel tunnel and ash door can also be dimensioned to fit the brickwork by taking measurements from the brickwork once the tunnel is formed in the first five layers of bricks.

## Summary of characteristics

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**Use:** designed especially for larger hospitals. (generally more than 300 beds)

**Capacity:** 50 kg/h

**Lifespan** (average): 3-5 years

**Approximate unit cost** in USD (materials only): 500 - 1'500 depending on the availability of refractory bricks

**Time necessary to build:** 5 – 6 days

**Remarks:** Only approximate dimensions of the steelwork are given. The correct procedure is to lay out the first two layers of bricks, and then measure the length and breadth of the steel which fits on top. The steel top can then be made to fit the finished brickwork.

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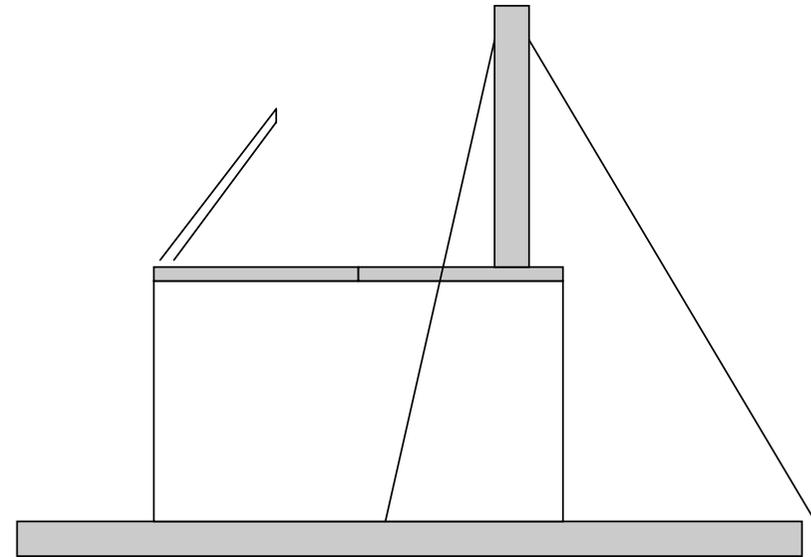


## List of materials

item	dimensions	quantity
Fire bricks	230x116x76mm	300
Cement (Portland)		250 kg
Ballast (for concrete base)		500 kg
Sand		1000 kg
Fire cement (high alumina)		100 kg
Rolled steel angle (mild steel)	40x40x3mm thick	42 metres
Rectangular section mild steel	75x75x3mm wall thickness	2 metres
Flat sheet (mild steel)	2400 x 1200 x 3mm	1 sheets
Mild steel pipe	150mm diameter x 3mm thick (approx)	3 metres
Welding rods (mild steel)		60
Steel cable	5 mm 7 strand	40 metres
Turnbuckles	M8 x 150 mm long	4 (not essential)
Rolled steel angle (mild steel)	50 x 50 x 3 mm thick	6 metres
Fuel tank with tap.	2 litres capacity approx	1
Fuel pipe, steel	350 mm long x 6mm diam.	1
Fuel pipe flexible	2 metres x 6 mm ID	
Bolts with nuts and washers	10 mm x 75 mm long	24
Wire Mesh	Any fine gauge	loose fill

Please note that the materials should be obtained before starting the construction !

## Complete layout



**Figure 1:** De Montfort incinerator Mark 9

## Preparing the concrete base

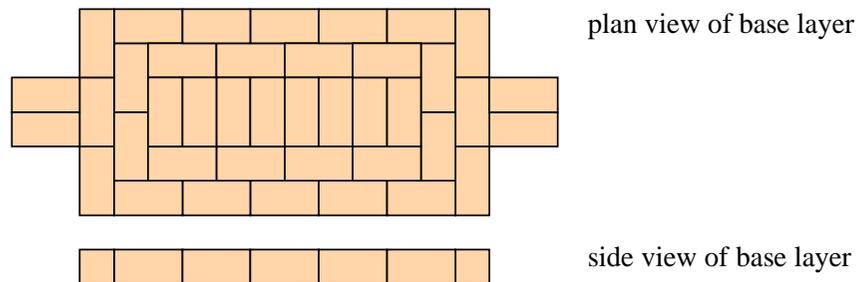
A concrete platform of at least 3 m x 2 m x 150 mm thick should be prepared on the chosen site, preferably with a roof about 3 m high to protect the incinerator and the operator from the effects of weather.

Once ready, the building of the brick body can start.

## Building the brick body

The base layer of bricks should be laid on a bed of refractory mortar on the foundation. The bricks should be laid in the pattern shown below, with a minimum thickness (about 6mm) of refractory mortar between them.

When this is completed, the overall dimensions of the incinerator can be measured so that the steelwork can be started.



Subsequent layers of bricks are then laid on top of the base layer as shown in the following diagrams. Care should be taken to keep all walls vertical and straight.

Build up the refractory brick body in layers as shown below, taking care to keep all walls vertical. Insert the two mild steel tunnels (3 bricks high x 2 bricks wide) and the air ducts (2 on the primary side, 1 on the secondary side) and fill the gaps with refractory cement and firebrick chips.



Photo 1: building the brick body

Diagram 2: layers 1&3

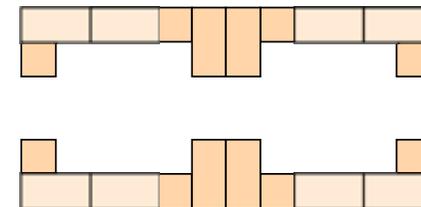
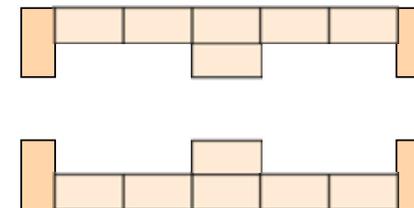
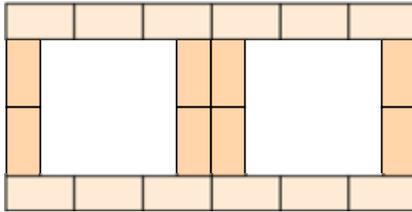


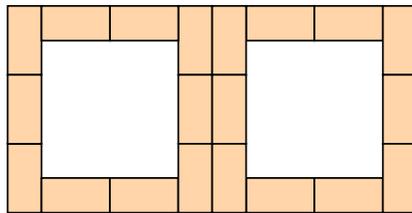
Diagram 3: layers 2&4



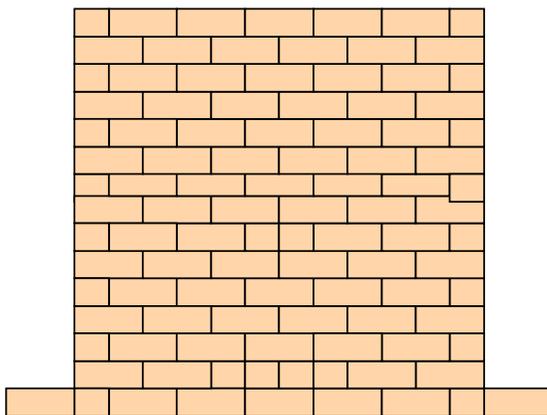
**Diagram 4:** layers 5, 7, 9, 11, 13



**Diagram 5:** layers 6, 8, 10, 12, 14



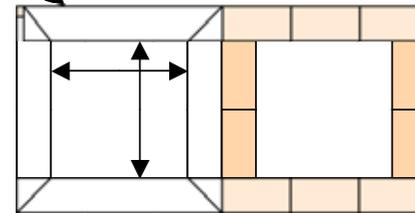
**Diagram 6:** Side elevation of completed brickwork



## Preparing the steel top-frame

Once the base layer has been laid, the overall length and breadth of the incinerator can be measured. This gives the overall dimensions of the steel top frame. More importantly, after layer 5 has been completed, the dimensions of the two rectangular sand traps that make up the top frame can be fixed so that the frame can be made.

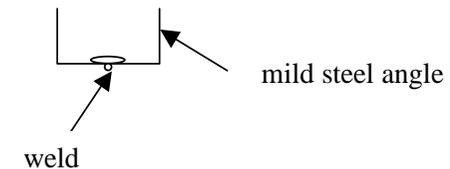
Steel frame



Layers 5, 7, 9, 11 & 13

**Diagram 7**

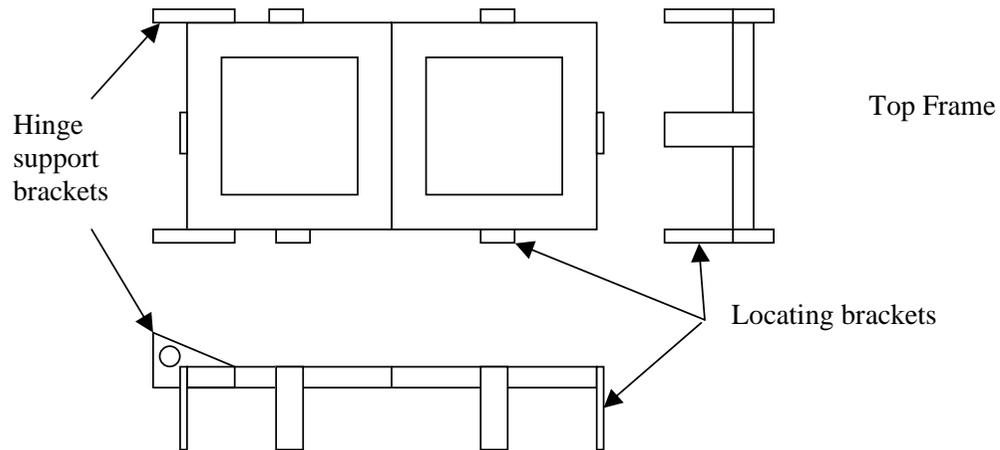
The steel top frame consists mainly of two rectangular frames made from “U” section steel, one to fit over each of the combustion chambers. In many countries it is not possible to obtain “U” section steel, but these can easily be substituted by welding together two lengths of angle steel to make a “U” of roughly the correct dimension.



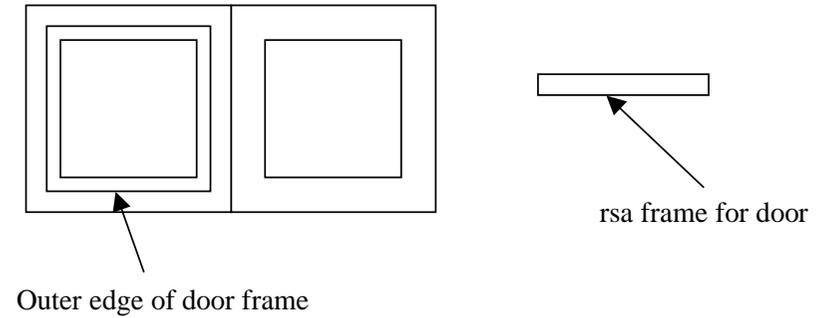
**Diagram 8**

The two rectangular frames are welded together, with the “U” facing upwards, and Hinge Support Brackets and locating brackets welded as in the diagram below.

**Diagram 9:** steel top frame

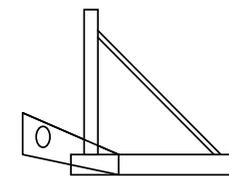


**The Loading Door** can now be made with a rolled steel angle frame of size to fit within the square channel top frame



**Diagram 10:** loading door top view

The door may now be completed by adding a mild steel plate to the frame, a pair of hinge brackets and the handle, as shown below.



**Diagram 11:** Loading Door with handle and hinge bracket (side view)



Photo 2: welding of steel top with door and chimney spigot



Photo 3: welded steel top with door and chimney spigot ready to be installed

The chimney support panel can be made in a similar manner to the door, but with extra rolled steel angle to support the chimney.

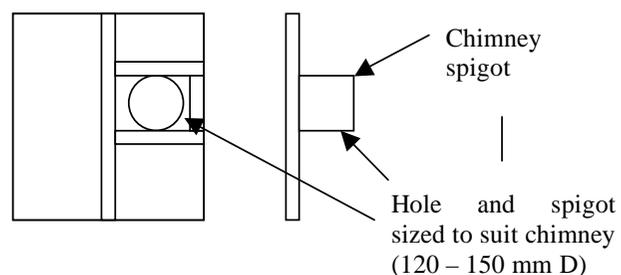


Diagram 12: chimney support plate and spigot

The sand frames of the steel top should be filled with dry sand so that the loading door and the chimney spigot plate can be sealed when closed.

The steel top may now be fitted over the firebrick core and sealed carefully with more refractory cement. This is best achieved by covering the top of the firebricks with a 5 mm layer of cement and lowering the steel top on to it, locating the top by means of the brackets already fitted.

## Steel tunnels and ash doors

Two steel tunnels should be constructed, each to be a loose fit in the gaps in the brickwork at either end of the incinerator. An ash door should be fitted to the front of each tunnel, with a 30 mm gap above the primary chamber door, and a 10 mm gap above the secondary chamber door. A flange should be attached to each tunnel so that it can be fitted to the brickwork to a depth of one brick thickness.

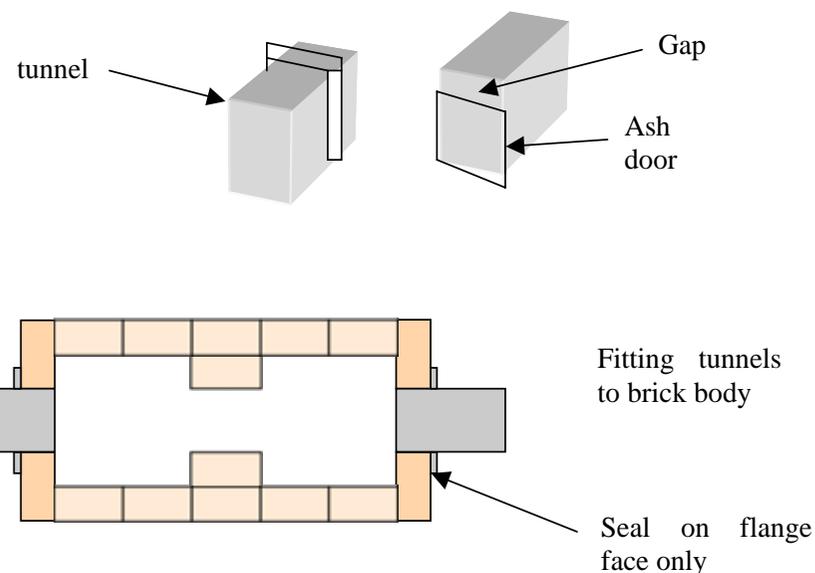


Diagram 13: steel tunnels and ash door

The tunnels are sealed to the brickwork only between the flanges and the brick face so that expansion of the tunnel will not crack the brickwork.



Photo 5: ash door, ash tunnel and air ducts

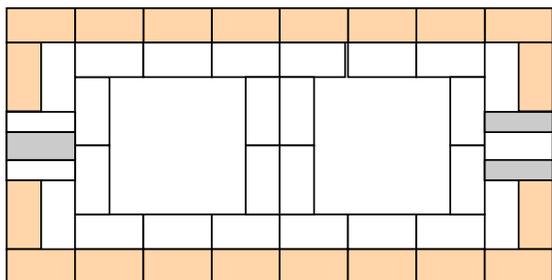
**The chimney** is best made from a length of steel tube with a minimum wall thickness of 3mm and internal diameter of between 100mm and 150mm. It should be 4 metres long (more if it necessary to clear buildings. If steel tube is not available, the chimney can be fabricated by rolling lengths of mild steel plates and joining them together. It should be remembered that the thinner the plate, the shorter will be the life of the chimney, because it can get very hot at the base.

The chimney can be raised to fit over the chimney spigot and supported by the roof trusses or by steel cables anchored into the ground around the incinerator.



Photo 4: raising the chimney

The **outer case** (if desired) can then be built up using common bricks with Portland cement mortar, as shown to a height just less than the inner core. Any space between the two types of bricks may be filled with Portland (white) cement. The top is then sealed with cement.



**Diagram 14:** incinerator outer case

A **simple fuel tank**, with tap should be fitted 500 mm above the incinerator top with a fuel pipe leading through both layers of brick into the primary combustion chamber, 100 mm below the top.

## Operation

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The incinerator should be started by putting **waste paper, cardboard** or similar easily ignited material over the grate. Burning paper can then be dropped on top, and when a good flame is established, more combustible material added till the combustion chamber is half full. If available, about 100 cc of kerosene, diesel oil or used lubricating oil can be poured on top to speed the heating process. Only dry, non-infected waste should be added for the first 10 minutes or until a fierce flame is established.

The combustion chamber should be **kept at least half full**, and infectious and/or wet waste should be added above dry materials to ensure that it dries before reaching the combustion zone. Additional liquid fuel can be added if it is suspected that the combustion rate is decreasing. Any plastic waste available will also help to raise the temperature of combustion, but both this and the oil will give rise to black smoke if used to excess.

The incinerator will be most efficient if it is operated for fairly long periods once it is ignited. **The last load before closing down should be as dry and safe as possible**, so that no unburned material is left.

## Maintenance

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As with any type of equipment, there is a need to perform some regular maintenance to ensure both that the system will continue to work properly and to prolong the life span of the incinerator.

### *Before each operation.*

- Check that ashes have been completely cleared from the grate and floor of incinerator.
- Check that loading door closes properly onto the sand seal in an air-tight manner. Loosen sand if necessary.

### *Annual inspection and rectifications*

<b>Component</b>	<b>Check</b>	<b>Rectify if necessary</b>
Chimney	Vertical fixings	Reset or renew
	Corrosion	Repair any holes or weak points. Replace chimney or section thereof if necessary
Chimney support plate	Corrosion	Replace if necessary
Top sand seals	Cement seal to brickwork. Adequate sand level	Re-seal with refractory cement. Top up sand
Ash door	Corrosion, hinges, catch, blockage in door-frame	Repair and clean as necessary
Brickwork	Missing cement	Replace with refractory cement
	Evidence of thermal damage to bricks	Line inner surface of bricks with 10 mm refractory cement

### **Disclaimer**

Since the safe and successful use of the incinerator, which operates at very high temperatures, is entirely dependent on the building, operation and maintenance thereof, the University and the organizations supplying the drawings and instructions can bear no responsibility for any mishaps to personnel or inadequate technical performance of the incinerator.

### **Information & questions**

Any questions relating to these instructions should be referred to: Professor D.J. Picken (De Montfort University, Leicester, UK)

**Contact formular** available at:

[http://www.mw-incinerator.info/en/601\\_contact\\_us.html](http://www.mw-incinerator.info/en/601_contact_us.html)