

**BRANCHES, HOSELINE AND FIREFIGHTING IN HIGH RISE BUILDINGS**  
**16/10/2005**

After completing further tests/trials and to follow on from my previous reports, I now submit the following test results which I fully believe may have serious Health and Safety implications operationally.

I have used the ODPM's results published in December 2004 for the following tests/trials. They selected a professional panel to determine the appropriate criteria against which a branch is assumed to be operating safely/effectively. In establishing the subjective criteria which they used to appraise the performance of the firefighting branches at different pressures, the panel decided that firefighting branches were required to produce:

- An effective jet, as this would be required to undertake a direct fire attack.
- An effective spray on full cone, as this would be required to provide a defensive spray to protect firefighters should it be necessary to withdraw from a compartment if the conditions deteriorated.
- An effective spray pattern at 70° cone angle, which would be required to undertake 3D gas cooling. This angle was chosen as being within the 60° to 75° optimum range that is recommended by other research work that has been undertaken into compartment fires.

We carried out similar trials on both our Delta mainline DM600 branches and the results are as follows:

**DM600 Branch One**

<b>INLET PRESSURE</b>	<b>JET</b>	<b>70° CONE</b>
2 BAR	130 l/min	100 l/min
3 BAR	300 l/min	310 l/min
4 BAR	440 l/min	430 l/min
5 BAR	570 l/min	570 l/min
6 BAR	660 l/min	660 l/min
7 BAR	750 l/min	750 l/min

**DM600 Branch Two**

<b>INLET PRESSURE</b>	<b>JET</b>	<b>70° CONE</b>
2 BAR	140 l/min	120 l/min
3 BAR	290 l/min	310 l/min
4 BAR	430 l/min	440 l/min
5 BAR	550 l/min	580 l/min
6 BAR	690 l/min	690 l/min
7 BAR	770 l/min	780 l/min

The DM600 met the panels minimum criteria with an inlet pressure of 3 Bars on handle position 5 and 6 (2, 3 & position 4 did not meet the criteria).

ODPM results:

On position 6 set at a 70° cone @ 3 bar inlet pressure = a flow rate of 324 l/min

On position 6 set on a jet @ 3 bar inlet pressure = a flow rate of 303 l/min

It also met their criteria on full and half cones: we did not include these settings in our trials. You can see from our tests allowing for a small  $\pm$  tolerance subject to error that our results are comparable to theirs.

The Delta H500-65f was not trialled by the panel but we carried out the same test with two of our branches:

#### **H500-65f Branch One**

<b>INLET PRESSURE</b>	<b>JET</b>	<b>70° CONE</b>
2 BAR	90 l/min	90 l/min
3 BAR	110 l/min	110 l/min
4 BAR	140 l/min	150 l/min
5 BAR	190 l/min	180 l/min
6 BAR	230 l/min	220 l/min
7 BAR	290 l/min	260 l/min

#### **H500-65f Branch Two**

<b>INLET PRESSURE</b>	<b>JET</b>	<b>70° CONE</b>
2 BAR	90 l/min	90 l/min
3 BAR	100 l/min	110 l/min
4 BAR	120 l/min	160 l/min
5 BAR	170 l/min	180 l/min
6 BAR	220 l/min	240 l/min
7 BAR	290 l/min	280 l/min

I understand that there are some experts who believe that 200 l/min is the minimum safe flow rate for compartment below 70m<sup>2</sup> of fire involvement (10 MW). Up to 70m<sup>2</sup> of normal fire loading can be 5-15 MW.

It can be seen from our results shown above that we would need a pressure of 6 bars at the inlet of the H500-65f branch to achieve the minimum flow rate of 200 l/min.

Using what I would deem a fire ground formula for high rise buildings:

#### **Key:**

Notional storey height (NSH) = 3.5m

Pressure loss through static head (P loss) = 0.1 bar per metre

Additional riser pipe work and fittings (RPF) = 1 bar

This formula allows a small safety margin.

E.g.

17<sup>th</sup> floor with a 100mm riser with an inlet pressure of 10 bars

$$\text{NSH} = 59.5\text{m} = \frac{59.5}{10} = 5.95 \text{ bar loss}$$

$$\text{Inlet pressure to riser } 10 \text{ bar} - 5.95 = 4.05 \text{ bar}$$

$$4.05 - \text{RPF } 1 \text{ bar} = 3.05 \text{ bar}$$

**3.05** bar at outlet on 17<sup>th</sup> floor

To fight a fire on the 17<sup>th</sup> floor using a DM600 via 3x45mm hose we would need to give an inlet pressure of 12 bar to the riser.

$$\text{NSH} = 59.5\text{m} = \frac{59.5}{10} = 5.95 \text{ bar loss}$$

$$\text{Inlet pressure to riser } 12 \text{ bar} - 5.95 = 6.05 \text{ bar}$$

$$6.05 - \text{RPF } 1 \text{ bar} = 5.05 \text{ bar}$$

**5.05** bar at outlet on 17<sup>th</sup> floor

Allowing for a frictional loss with a flow rate of 325 l/min = 2 bar

$$5.05 \text{ bar} - 2 \text{ bar} = \mathbf{3.05} \text{ bar at the branch (within minimum criteria)}$$

These figures are assuming that the branch has been got to work on the same landing as the fire, with no kinking of any the hose lines. If an attack is to be made from a lower floor this needs to be added into the equation, i.e. extended hose lines etc.

Same scenario but using a H500-65f:

$$\text{NSH} = 59.5\text{m} = \frac{59.5}{10} = 5.95 \text{ bar loss}$$

$$\text{Inlet pressure to riser } 14 \text{ bar} - 5.95 = 8.05$$

$$8.05 - \text{RPF } 1 \text{ bar} = 7.05$$

**7.05** bar at outlet on 17<sup>th</sup> floor

Allowing for frictional loss with a flow rate of 220 l/min = 1 bar.

$$7.05 \text{ bar} - 1 \text{ bar} = \mathbf{6.05} \text{ bar at the branch (gives us our minimum flow rate of 200 l/min for compartments up to } 70\text{m}^2\text{).}$$

Our hose lines are only tested to 10 bars and the same is possibly true for the riser. But for safety it can be seen that we must have an inlet pressure of a minimum of 12 bars when using the DM600 to be correctly armed. At the 17<sup>th</sup> floor we would need an even higher inlet pressure of 14 bars if using a H500-65f (which was not trialed by ODPM and would it have met their criteria?).

I have spoken to Gary Godfrey at Angus fire who informed me that they test new hose and couplings to 22.5bar. He informed me that we can test our hose to 15 bars but I am aware that we have some old hose stocks and couplings in service.

Our service high rise procedure has recently been updated and states a branch pressure of 4-5 bars is to be given unless otherwise instructed, but no guidance is given on inlet pressures. At 10 bar inlet pressure on the 16<sup>th</sup> and 17<sup>th</sup> floor you would not achieve outlet pressures of 4 bars, it is on levels up to the 12<sup>th</sup> where it would be possible to achieve an outlet pressure of 5 bars, and this does not account for the frictional loss in any hose lines used. It also states a hand controlled branch is to be taken aloft and this would probably be the H500-65f but as our flow tests show:

4 bars = 140/150 l/min & 120/160 l/min

5 bars = 190/180 l/min & 170/180 l/min.

These figures would not meet the minimum 200 l/min required for a compartment up to 70m<sup>2</sup>.

We could configure our attack hose lines to lessen frictional losses and keep them as straight as possible, i.e. 1x70mm 2x45mm or 2x70mm 1x 45mm, these practises would need to be trialled

Could our BAI's not simulate a compartment fire in a high rise and compare the H500-65f and DM600 under the above conditions.

### **Delta Foam Equipment**

I believe that we are seriously under flowing this equipment (see report 6/09/2005). Our delta H500-65f needs a branch inlet pressure of approximately 9 bars to flow 450 l/min.

A 10 bar inlet pressure to the inductor will give a flow rate of 230-240 l/min at the outlet of the inductor. As there is a 35% reduction in pressure across the inductor this would mean an inlet pressure of 10 bars would give an outlet pressure of 6.5 bars. This does not account for any hose being included in the equation and as can be seen from our tests the H500-65f only passes 220-230 l/min @ 6 bars.

If at the lower flow rates (that we have recorded) the correct proportioning of foam concentrate to water and the expansion rate of 7:1 ratio is achieved then our SIS may need to be amended to reflect this.

I have been asked to join a working party to look into hose branches and firefighting in high rise buildings. I strongly believe as a service we need to assess our firefighting equipment and procedures to include the issues above and in previous reports ASAP with the introduction of any interim procedures as required.

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