



## E J BOWMAN (BIRMINGHAM) LIMITED

### COPPER FREE IN-LINE PLATE TYPE HEAT EXCHANGER ARTICLE

Automotive Testing Technology International.

#### **A SAFE SOLUTION FOR TESTING ETHANOL BASED FUELS**

*Kevin Howell, Operations Manager, at EJ Bowman looks at the increasingly critical role played by heat exchange technology in engine test rig applications, particularly for ethanol based fuels.*

Bowman work with many leading automotive manufacturers and engineering consultants and in the past few years, we have seen an increasing trend for our customers to carry out more cycle simulations on engine test beds, as manufacturers seek to reduce the costs associated with running prototype vehicles.

However, when trying to simulate vehicle cycles accurately on a rig, it is essential that the fluid temperatures and warm-up profiles experienced in prototype vehicle test runs are simulated precisely on the test bed.



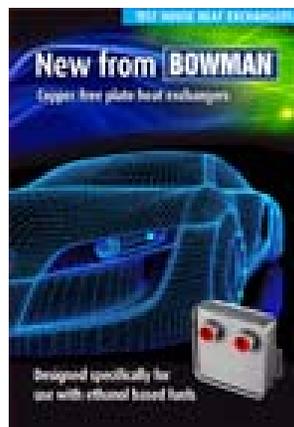
The design of the heat exchanger itself is critical to achieving the accuracy of the simulation - and stainless steel in-line 'plate' type heat exchangers have become the industry standard for cooling fuel on automotive test bed engines.

## Ethanol

However, the growing introduction of ethanol into fuels has made new demands on these stainless heat exchangers which are traditionally brazed with copper materials. In the US, Environmental Protection Agency (EPA) regulations already allow blended fuel to contain up to 10 percent ethanol and in February 2012, the US Environmental Protection Agency decided to pave the way for the sale of gasoline blended with up to 15 percent ethanol.

Powertrain systems developers, manufacturers and consultants are carrying out extensive research on ethanol based fuels to assess their ability to meet increasingly stringent fuel economy standards and engine performance.

Automotive customers based in the US or UK customers wishing to sell vehicles in the US are testing fuels on test bed engines that are either 85 to 100% ethanol. The problem is that using ethanol in fuels, even in modest amounts, can cause copper to be leached into the ethanol and deposited on to the fuel injection system, with the risk of performance problems and failures.



## Industry First

To address this issue, Bowman has developed a new design of heat exchanger which has an iron/chrome brazing compound, which is believed to be an industry first. The new unit eliminates copper from the manufacturing process, so there is no risk of it leaching into the fuel injection system.

The problem with ethanol is that it attacks the copper and removes any deposits it comes into contact with which can then be deposited onto the fuel injection system causing fouling and possible engine damage. Several of our leading automotive customers approached us to try and come up with a solution. Our R&D team has responded by developing a totally new construction method for our stainless steel in-line plate heat exchangers.

Heat exchanger design is obviously focused on the optimal transfer of heat. Bowman favours a design that dissipates heat efficiently via channelling the fuel around the maximum internal surface area of the unit.

The heat exchangers consist of numerous 316 stainless steel plates, two outer covers and four connections vacuum-brazed together to form an integral unit. Unlike other plate heat exchangers, they have a unique internal flow arrangement, which enables the inlet and outlet connections to be located in line. This means that they can be installed directly into the fuel line without the need to modify or re-route the pipework.

### **Research**

Each fluid stream flows in series through alternate plates. As a consequence, the plate spacing is larger and internal velocities are higher than is normally the case with this type of heat exchanger, thus rendering them less prone to fouling.

Normally, the plates are brazed together via a copper shim. Whilst this traditional way of constructing a plate type heat exchanger has proved satisfactory up to now, the introduction of ethanol into vehicle fuels has created a major challenge for the use of copper.

We carried out an extensive research and development programme into materials that could provide a suitable alternative to copper. As a result, we have developed a totally new brazing compound. No copper is used in the manufacturing process, eliminating the problems experienced previously.

Bowman has implemented extensive in-house testing to prove the effectiveness of the new brazing compound.

We also had to ensure that the new copper-free heat exchangers delivered all of the high heat transfer efficiency customers expect yet are totally safe for ethanol fuels.

### **Results**

The results of initial tests have proven that the new heat exchanger construction works reliably and efficiently on Ethanol based fuels, even at 100% levels. We are now putting the new unit through an intensive testing programme with a respected independent automotive engine

systems specialist to validate our initial findings and provide 'real time' performance and reliability data. The results should be available August/September 2012.

Bowman manufacture a comprehensive range of cooling products for engine test cells, including charge air, hydraulic and fuel coolers, plus exhaust gas, header tank, in-line plate type and stainless steel heat exchangers.

For more information contact:

***Kevin Howell, Operations Manager***

**E J Bowman (Birmingham) Limited,**

Chester Street, Birmingham B6 4AP, UK.

T: +44 (0) 121 359 5401.

F: +44 (0) 121 359 7495.

E: [info@ejbowman.co.uk](mailto:info@ejbowman.co.uk)

W: [www.ejbowman.co.uk](http://www.ejbowman.co.uk)