

///CleanBurnerSystems

Development and manufacture of;

- hydrogen burners and ignition systems
- dual fuel (natural gas / hydrogen) burners and ignition systems

Domestic Hydrogen Appliance Development Innovation SBRI



WORK PACKAGE 4

CONSORTIUM

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FOCALPOINT



UNIVERSITY OF LEEDS

Legendfires 

The CBS consortium have demonstrated that a reference product can progress from a natural gas appliance to one running on pure hydrogen, meet the exacting standards of GAR and ECOdesign, and retain its viability as a product, maintaining both financial reward and jobs.

The development has proved that the way forward will also be a balance between the visual impact of the fires' market acceptance, and compliance accreditation on hydrogen gas.

The reference product with NG (natural gas) standards compliance met market acceptance with good flame picture, efficiency, and NO_x levels within the current standard of 130 mg/kW.

The CBS burners in the Focal Point open fire on hydrogen show a significant improvement in reducing the NO_x levels, with no loss in efficiency or flame picture, and the Legend glass fronted, balanced flue achieving a certified, world beating low NO_x of 13.1 mg/kWh, and stunning flames.

The public requirement for flame picture has traditionally been placed ahead of the requirement for efficiency and low NO_x, but increasing awareness of climate change issues is changing that.

APPLIANCES DEVELOPED

OPEN GAS FIRE

Focal Point BLENHEIM Slimline with a heat input of 6.25 kW Gross (5.6 kW net).

This reference fire premixed natural gas (NG) flame with four flame zones that fired through the base ceramic.

The fuel flow was biased to shape the flame so that the central two flames had twice the fuel flow of the end two, and this is still the picture on hydrogen.



GLASS FRONTED GAS FIRE

The reference **Legend EVORA** balanced flue with heat input of 4.5 kW Gross (3.8kW net).

Efficiency on hydrogen maintained at 79%, great flame picture and world leading low NOx.



INNOVATIVE GAS FIRE

Legend INNOVATIVE, contemporary landscape design with a nominal heat input of 7kW gross, visually attractive full height hydrogen flames, unique internal gas recirculation system improving efficiency and reducing NOx.



KEY DESIGN STEPS

The solution to these issues was to make the fuel injectors a thin slot with a width less than the quench distance for hydrogen (<0.6mm) in a metal wall of 1.6mm.

The slot jets were shown to have lower NOx than the round jets due to faster air entrainment. However, the slot jets reduced the Cd of the gas holes and this reduced the fuel delivery, so the fire did not have its reference-rated thermal input when first tested at KIWA, where maximum power was 3.5kW instead of the NG ref fire of 6kW.

As a result the slot fuel injectors were increased in size and an upstream fuel metering hole added to achieve the rated gas flow at 20mb.

The combustion noise was reduced by placing the slot jets further from the ceramic surface and the final design locates them on the floor of the fire with no thermal problems.

The flame start-up time, cross lighting and shut-down time are well within certification levels.

Hydrogen made the base of the fire hotter with its higher radiation, so a new pilot has been developed and located in a recess below the front ceramic to shield the thermocouple, further enhancing the safety performance.

THE ROUTE TO MARKET

The successful completion of the Hy4heat hydrogen adaptable programme, and the continuing dual fuel programme, provide a range of options for developing product sales:

An initial product option based upon a natural gas version of the approved hydrogen fire, maintaining the gains made in efficiency and combustion due to the new burner design. A further option on the completion of the development work on dual fuel burner and pilot at CBS.

- Hydrogen adaptable, with the current fires fitted with a burner and pilot system that fits within the hydrogen fire design but runs on NG, requiring the minimum conversion to fit the hydrogen approved burner when that gas becomes available.
- Dual fuel where a variant of the new hydrogen compliant burner and pilot run on NG, seamlessly switching to hydrogen at the point of availability with minimum change.

THE FUTURE

There will be considerable potential from incorporating the benefits of the hydrogen programme into other gas fires, both specific within the Focal Point and Legend Fires product range, and to CBS worldwide customers for gas burners.

Variants of the hydrogen fires are already being considered as they can evolve easily into different shapes, sizes and set-ups, wall mounted in addition to inset.

New interest in hydrogen gas burners is already seen at CBS from current customers in Canada, Australia and Holland in particular.

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