



THE QUEEN'S AWARDS
FOR ENTERPRISE:
INNOVATION
2010



Superplastic Forming and Diffusion Bonding Presses

Special Purpose Machinery
For the **Aerospace** Industry



Press Manufacture

Aerospace and automotive design presents many fundamental metalforming problems. At Group Rhodes we are committed to first class, design led engineering solutions geared directly to addressing these technical needs.



Group Rhodes (incorporating John Shaw and Chester Hydraulics) have continually been at the forefront of designing and manufacturing Superplastic Forming (SPF) and Diffusion bonding (DB) presses since the mid 1970's, a period when material analysts primarily in the aircraft industry were investigating the phenomena of superplasticity in Aluminium and Titanium alloys.

Today Group Rhodes is the only UK Company, and one of only a few operations in the World capable of developing commercially available automatic SPF/DB presses. International sales success demonstrates that the company continues to be at the forefront of the design and manufacture of this innovative technology.

RHODES SPF/DB PRESS INNOVATION & DESIGN FEATURES

THERMAL INSULATION

Group Rhodes has recently undertaken extensive research and development to improve the thermal insulation qualities of their SPF/DB presses, significantly reducing heat loss during the press cycle by up to 25%, (which in many cases could be up to 100 kW)

This reduction in thermal energy loss is as a direct result of Rhodes engineers working closely with ceramic specialists to obtain a material that is both mechanically strong yet thermally efficient. These new materials are now used in various forms to encapsulate the hot dies and components within the press hot zone.

METALLIC PLATENS

Platens are usually assembled from individual segments of high temperature alloy. By segmenting the platens, overall thermal expansion is greatly reduced and the segment interfaces are easily utilised for tool fixing. Metallic platens are ideal for use in a production workshop environment and a service life in excess of 10 years is not uncommon. Ceramic (Fused Silica) platens are also available as a cost-effective option.

Main (left): Cycle testing on a 1650 tonne aluminium SPF Press

Top: Two 150 tonne SPF/DB Presses undergoing final inspection prior to dispatch. In the background a 2000 tonne SPF/DB press with hot die loading system is under construction

Bottom: The Trent engine used on the A380 Airbus includes fan blades manufactured on SPF Presses

PRESS CONSTRUCTION

Group Rhodes offers a range of press products, power requirements, desired floor space.

SPF/DB presses are available as:

- Upstroke Presses
- Down-stroke Presses
- Pull-down Presses
- Four Column Presses

SPF/DB Design Features

Utilising state of the art technology perfected over many years of in-house research and development, Rhodes SPF/DB presses have been designed to provide accurate temperature control of press tooling (to within +/- 5 Deg C), accurate gas process forming control (to within +/- 0.15 Millibar) and accurate reaction load application control (to within +/- 2 Bar).



Main (right): Jet engine hollow wide chord fan blades

Top: The exhaust bay doors for the F35 JSF are produced on a Rhodes SPF Press

Bottom (left): Twin modular 1650 tonne SPF/DB Presses

Bottom (right): 150 tonne SPF Press ready for dispatch

designs to cater for specific
loading techniques and available

- Single Frame Presses
- Multiple Frame Presses
- Shuttle Table Presses
- Modular Portal Frame Presses

SPF/DB DESIGN FEATURES (Continued)

ELECTRICAL RESISTANCE HEATING

Electrical Resistance Heating can take the form of single or multi zone cartridge type elements inserted into gun drilled holes in metallic platens, or alternatively can be a simple bare wire element laid in troughs or holes cast in ceramic platens. Multi zone cartridge elements (3 zones/cartridge element) achieve a very high degree of platen temperature control. As the platen temperature control zones can be easily balanced, there is no restriction to the size and shape of the process tooling, assuming it falls within the physical platen design parameters.

GAS FORMING CONTROL

Forming gas can be introduced from a single line for forming single sheet components using male or female dies or it can be fed via multiple control lines for forming sheet components. Group Rhodes Gas Management Systems offer complete control of multiple gas lines complete with purging, forming and vacuum facilities. Gas forming control can be achieved by one of two basic methods:-

Mass flowrate control

This method is usually used when forming enclosed capsular products where it is critical to know that internal forming is actually being achieved. The forming gas (Argon or compressed air) is introduced to the product in known volumetric quantities at predetermined pressures. Alternatively mass flow-rate meters can be utilised.

Pressure control

Forming gas is admitted to the product in an extremely accurate, controlled manner via servo controlled pressure regulators, having their own individual PID control loops.

ADVANCED ELECTRONIC CONTROL SYSTEMS

Group Rhodes control systems offer complete integration of heating, hydraulic, gas and machine functional control, together with on line and off line system monitoring.

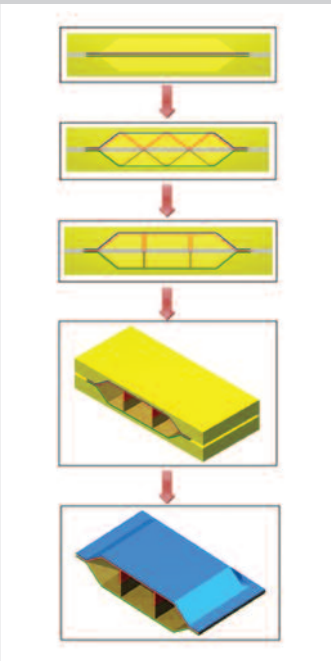
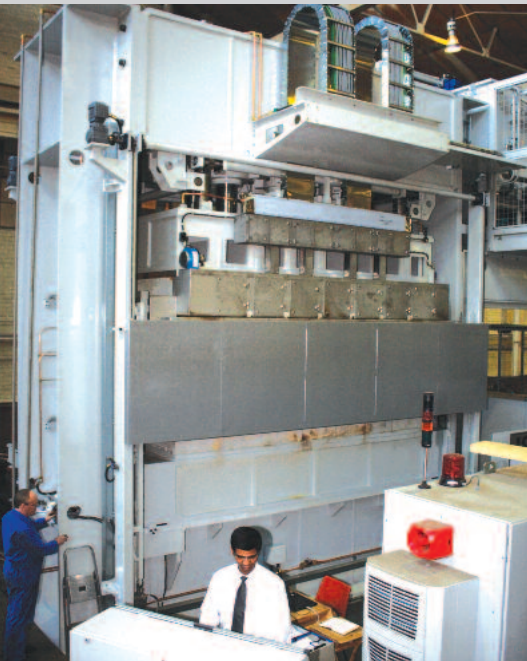
HANDLING EQUIPMENT

Hot Die Changing Equipment

Hot Die Changing Equipment allows the safe removal and insertion of tools still at their elevated forming temperatures in single or multiple press layouts. The press is maintained at its forming temperature and production down time is reduced to an absolute minimum. A typical Handling System would incorporate a semi automatic tool charger complete with tool pre heat oven, cool down table and tool location table to form a complete operational facility.

Hot component loading Equipment

To eliminate the need for operators to be in close proximity with the hot die area during loading and unloading, Group Rhodes has developed various forms of semi automatic manipulators. Each system is custom designed to suit the particular product being formed.



Left: 1200 tonne SPF Press undergoing final inspection prior to despatch

Centre: Multi sheet forming

Right: typical components manufactured on SPF presses include canard wings, jet engine fan blades and exhaust units.



The Art of Metalforming

The SPF/DB process offers freedom to produce more complex, stiffer, stronger and lighter structures in one piece thus giving improved component integrity. Efficient SPF/DB manufacturing techniques can create components that offer typical savings of 30% in cost and 20% in component weight.

SUPERPLASTIC FORMING

Superplastic Forming (SPF) offers engineers a method of accurately forming, single or multiple sheets of material into extremely complex, accurate, deep drawn shapes. The process involves heating the component sheet to a specific, accurately controlled, temperature and forming the sheet, or multiple sheets, into a mould cavity or over a male former by the application of controlled gas pressure. The process greatly reduces the formation of rippling, tearing and thickening of components, which usually occurs when they are cold formed.

DIFFUSION BONDING

Diffusion Bonding (DB) is a joining process achieved by the application of load at elevated temperatures. The resultant molecular bond offers a fully homogeneous joint, which, in many cases, is undetectable under microscopic examination.



300 Tonne SPF Press



Jet Engine Exhaust Manifolds



SPF Control System



Fan Casing

