Fuel systems

By H. T. C. BOUCHER
Engineering manager (systems)
BAC Filton Division

While the Concorde fuel system has been designed as far as possible along conventional lines, employing well tried principles and practices throughout, a number of new problems have arisen which have not been previously encountered with civil transport aircraft. These problems stem mostly from the following novel features of the aircraft:

1. The environment is more severe, extending to high temperatures and very low ambient pressures.
2. The high performance of the aircraft leads to a proportionately high performance requirement for the fuel system.
3. Besides the conventional function of supplying fuel to the engines, the Concorde fuel system performs the additional functions of controlling and of absorbing surplus heat.

A number of the particular problems, the research and the development that have gone into the system are described briefly below.

At high temperatures and low ambient pressures, such as experienced by Concorde when cruising at Mach 2.0 at 60,000ft, conventional kerosene may be both highly supersaturated with dissolved air and near its boiling point. It is therefore necessary to take measures to prevent loss of fuel due to boiling-off, to prevent high transient pressures in the tank and loss of fuel due to a rapid-de-aeration of the fuel, and to ensure that the tank pumps will give the required performance at these conditions. The fuel system usage sequence is arranged such as to minimise the intake of heat through the wing skin and thus keep temperatures to a minimum, but a considerable amount of research work has been undertaken, mostly by the oil companies, to provide data upon which to establish what can be the maximum temperatures of the Concorde fuel system is somewhat more complex, than the subsonic aircraft. It has a number of sub-systems for the transfer of fuel between tanks and there is a good deal of interdependence and interaction of the sub-systems. It has therefore been necessary to test the fuel in the tanks and throughout the aircraft and engine systems. In addition to the laboratory tests, over 3,000hr of testing has been carried out on a representative rig at the Shell Thornton Laboratories to confirm that the decisions taken were valid.

Because of the additional functions the Concorde fuel system has to perform, and because of the need to use the fuel in a certain manner to minimise temperature problems, the Concorde fuel system is somewhat more complex than the subsonic aircraft. It has a number of sub-systems for the transfer of fuel between tanks and there is a good deal of interdependence and interaction of the sub-systems. A considerable amount of laboratory research has been undertaken, mostly by the oil companies, to provide data upon which to establish what can be the maximum temperatures for the fuel-in-the tanks and throughout the aircraft and engine systems. In addition to the laboratory tests, over 3,000hr of testing has been carried out on a representative rig at the Shell Thornton Laboratories to confirm that the decisions taken were valid.