BULLETIN ADDENDUM

AAIB File:	**EW/C91/9/2**
Aircraft Type and Registration:	**Robinson R22 Beta, G-BSHF**
Date & Time (UTC):	**8 September 1991 at 1600 hrs**
Location:	**Welford-on-Avon, Warwickshire**
Type of Investigation:	**AAIB Field Investigation**

Investigation of the above fatal accident indicated that it had occurred for operational (ie handling) reasons since no technical defect was discovered which appeared to have been a causal factor. The full details were reported in AAIB Bulletin 12/91. The helicopter broke up in the air, and during the subsequent ground impact the rear bulkhead casting, which secures the horizontal and vertical stabilisers to the tail boom, ruptured. The failure of this casting was not therefore considered to have been a causal factor in the accident, but subsequent metallurgical and specialist NDT investigation did reveal that the casting contained excessive porosity due to casting 'shrinkage' during manufacture. The evidence from the ground impact and wreckage suggested that the forces which fractured the casting had not been excessive. A metallurgical report, commissioned by the AAIB, showed that the casting had fractured due to overload, but that gross interdendritic shrinkage porosity existed within the casting. The CAA were consulted and agreed to forward the fractured casting to the FAA, for onward transmission to the U.S. Army Materials Laboratory for assessment. In the event, the FAA undertook a review of the design standard and radiographic inspection records of the casting in conjunction with the Robinson Helicopter Company. In addition, a static load test was carried out which demonstrated that the casting had a large reserve factor. The FAA concluded that the casting fitted to G-BSHF had failed due to overload and that it did contain porosity, but that the radiographs showed that it met the drawing requirements and had been properly certified. These results were communicated through the CAA to the AAIB.

However the AAIB considered the FAA response unsatisfactory and so commissioned a further radiographic examination in accordance with the drawing requirements and using approved personnel and reference documentation. This showed that the lug area of the casting, as examined by the AAIB, contained excessive shrinkage porosity and appeared to fail to meet the drawing requirements by a significant margin. Full details, with the appropriate technical specifications, were communicated to the CAA by letter on 21 May 1992.

RADIOGRAPHIC INSPECTION

Radiographic inspection is a science which depends upon the skill of the radiographer to a great degree. The radiographs have to be interpreted against reference radiographs and allowance has to be made for the severity of the defects, the distribution and density of the defects against their size, and the relative material thicknesses. This interpretive skill requirement is the reason that only approved radiographers may accept, or reject, such castings. The interpretation is heavily dependent upon the quality of the radiographs, which must be within the stipulated density range and must make proper use of an Image Quality Indicator, or similar device, to enable the sensitivity to be calculated. If these two parameters are not optimum, defects may not show. Furthermore, it is possible to use shorter wavelengths and 'faster' film to speed testing; this however will tend to obscure defects.

COMPARISONS WITH SIMILAR CASTINGS

Since that work was conducted and presented to the CAA, the AAIB has had the opportunity to radiographically examine three other R22 rear bulkhead castings, all of which had been in service. One had fractured in service and this casting failed the inspection only marginally; it was not excessively porous. The other two failed the radiographic inspection by a substantial degree. The results of these examinations have also been communicated to the CAA, who have forwarded them to the manufacturer and the FAA.

The AAIB is concerned that these castings, all of which have been cleared for flight and which perform a safety critical function, do not meet the drawing specifications. The AAIB believes that this is a result of inadequate quality control rather than a considered evaluation that the porosity level present was acceptable. Furthermore, it is considered that the large static load reserve factor which the casting reportedly has does not necessarily preclude certain other modes of failure related to such porosity. Accordingly, the AAIB makes the following Safety Recommendations:

SAFETY RECOMMENDATIONS

92-82 The CAA, in conjunction with the FAA and the Robinson R22 helicopter manufacturer, establish criteria for the continued acceptance, or replacement, of rear bulkhead castings which do not to meet the associated design requirements, and actively consider requiring a one-time inspection of all R22 helicopters in order to establish the condition of the associated rear bulkhead castings, part number A148.

92-83 The CAA urge the FAA and the Robinson R22 helicopter manufacturer to review the manufacturing and quality assurance processes used in the production of the associated rear bulkhead casting, part number A148, to ensure that such castings comply with design requirements.