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AERONAUTICAL NOISE: SESSION A: JET NOISE

Paper No. 73ANA6

BOUNDARY LAYER INDUCED COCKPIT NOISE

K H HERON

ROYAL AIRCRAFT ESTABLISHMENT
Farnborough Hants

1 INTRODUCTION

Considerable attention has been given to the overall problem of cockpit noise in recent years. The prime reason for this is that many modern fighter aircraft crew experience communication difficulties due to the high background noise levels.

The major sources of cockpit noise are the air conditioning system, the external airflow and the power plant. Air conditioning system noise is receiving much attention at present and a reduction should be possible without incurring excessive penalties. In general, evidence suggests that power plant noise is not a problem at present, although some engines and engine configurations have caused concern.

Airflow generated noise can be the dominant source and is least understood. It is known that separated airflows, oscillating shock waves and generally rough airflows can cause considerably more noise than a simple turbulent boundary layer. However it is hoped that most of these sources can be eliminated on a particular aircraft by appropriate streamlining. On the other hand, noise due to the turbulent boundary layer cannot easily be reduced at source; hence the only practical reduction has to come from either increasing the transmission loss of the cockpit structure or, possibly, increasing cockpit absorption.

Most experts agree that the majority of boundary-layer-induced cockpit noise will be transmitted via the canopy. (From a visibility standpoint, future aircraft are liable to have larger canopies than current aircraft.) Furthermore, it is believed that reverberation effects on this noise source will be small, and hence cockpit absorption will be unimportant.

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Unfortunately little is known about boundary-layer-transmitted noise although there is considerable information about the spectrum of the pressure fluctuations beneath a turbulent boundary layer. At present, acoustic transmission-loss data is used for prediction purposes. This could lead to serious errors when one considers the complete dissimilarity of the correlation patterns involved.

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The objectives of the flight experiment described below are to enable boundary-layer-generated cockpit noise to be more accurately predicted than it is at present and to gain a better understanding of the mechanisms involved.

2 EXPERIMENTAL DETAILS

A Gnat aircraft has been chosen as the test vehicle for reasons of boundary-layer-dominated cockpit noise, performance and availability. The experimental aims revolve around the measurements and comparison of boundary-layer-transmitted noise and acoustic-transmitted noise.

The instrumentation consists of six Kulite pressure transducers, flush mounted in the canopy, four B and K $\frac{1}{2}$ inch microphones at various positions inside the cockpit and two accelerometers mounted on the canopy. In addition, the static pressure and dynamic head of the aircraft and the cockpit pressure and temperature are being recorded. The Kulite gauges will measure both static and fluctuating pressures.

The aircraft will fly with no cockpit air conditioning or pressurisation in order to eliminate these as possible noise sources. The flight schedule has been designed with two aims in mind. Firstly, to eliminate and/or measure power plant generated cockpit noise; this has been achieved by including various manoeuvres such as climbs and dives in the programme. Secondly, to allow maximum extrapolation either with dynamic head ('q') or Mach Number.

Ground tests are planned, using another aircraft as a noise source, to measure the acoustic transmission loss through the canopy. A sound blanket has been manufactured to allow the canopy to be acoustically blanked off for measurements of side-wall-transmitted noise.

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3 <u>GENERAL</u>

At the time of writing the programme has reached an advanced state and flying should commence shortly.

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