METEOROLOGICAL OFFICE

INVESTIGATIONS DIVISION TECHNICAL NOTE NO 6

Requirements for Meteorological Information from Concorde

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1. The requirement for the provision of meteorological information from Concorde is stated in FTG 2/71 (French) and FTG 506/71 (English). This requirement has been partially met by data supplied in graphical and tabular form by the aircraft companies to their respective meteorological services. The data are extracted from the flight test data tape by computer using relatively simple programmes (BAC QUICKLOOK and SNIAS BANG). As was illustrated in IDTN No 5 the outputs from these programmes differ significantly from one another and both suffer from having inadequate corrections applied. Proposals were made at a meeting at Toulouse on 8 December 1971 for the permanent recording of meteorological data on magnetic tape, but it would be most unwise to proceed with this until an improved data extraction programme (e.g. using subroutines from PERF A) is available.

2. Uses of Concorde meteorological data

Meteorological information is needed for a variety of purposes, including the following:

a. Analysis of rapid temperature changes (para 3).

b. Detailed examination of occurrences of large temperature ramps and/or severe turbulence (para 4).

c. Compilation of a world climatology of temperature and wind at Concorde cruising levels (para 5).

d. Checking of forecast accuracy.

3. Temperature Ramps

Some useful information has been obtained from specially instrumented research aircraft on extreme temperature ramps, but information on the frequency of ramps of various sizes is scanty. Concorde will undoubtedly be the best future source of such data, and because of the effect of rapid temperature changes on the performance of SST engines it is most important that information on these changes be obtained. At Mach 2 the maximum temperature ramps expected according to TSS 1-0 are about

5°C in 0.1 sec or 0.03 n mile
10°C in 0.3 sec or 0.1 n mile
15°C in 1 sec or 0.3 n mile
21°C in 3 sec or 1 n mile.

In order to deal with the lower end of this spectrum a recording rate of between 5 and 25 per second is needed. In view of the accuracies attainable a rate of 5 per second is probably all that is justified, but once a second is not adequate. (FTG 2/71 and 506/71 are not explicit on this point). It is probably not meaningful to talk about absolute accuracies for ambient temperature of better than 0.5°C, but since we are mainly concerned with temperature differences we should record to 0.1°C. This accuracy will be approached if total temperature is initially recorded in steps no longer than 0.3°C, but the existing recording to

about 0.6°C is not good enough. (Again FTG 2/71 and 506/71 are not explicit). Since ambient temperature depends on static and dynamic pressure readings, a suitable programme is needed to avoid the introduction of spurious temperature ramps caused when steps in the fine scale readings of pressure occur. In order that all the necessary corrections (e.g. lag) can be applied a number of non-meteorological parameters will have to be recorded.

4. Analysis of Incidents

After a large temperature ramp (or gust) has been experienced there is a need for a detailed analysis of the incident. Some definition of a large temperature ramp for this purpose is needed and the following is tentatively suggested:

1°C in 0.2 sec
2°C in 0.5 sec
3°C in 1.0 sec
4°C in 2.0 sec

For investigation of an incident the accuracy and frequency of temperature records specified in para 3 will be needed. Since any relation to turbulence will be of interest records of accelerations and aircraft attitude will also be needed. For comparison with crew subjective reports accelerometer readings from a point near the cockpit would be useful. Accelerometer readings are available at 1/25 second intervals and probably should be so recorded for meteorological investigations.

5. Climatological Records and Forecast Accuracy

For these purposes a frequency of recording much less than five per second is all that is required. One, or perhaps two, records per minute should be ample.

6. Method of processing meteorological data

a. The first step must be the extraction of all the relevant parameters at 1/5 second intervals from the flight tape and calculation of the fully corrected values of the meteorological parameters.

b. The second step is to use these data to

(1) prepare and store frequency tables of temperature ramps of various sizes

(2) identify incidents with large temperature ramps or gusts and store all relevant data

(3) extract and store basic meteorological data for the climatological record.

c. The third step will be to examine the incidents of para 6b(2). This may well require graphical output of the data and/or visual CRT display.

7. Alternative ways of carrying out the above steps are:

a. Firms to perform step a. and produce a magnetic tape (plus optional printout of selected items); meteorological services to perform step b. on their own computers; aeronautical research establishments in conjunction with meteorological services to perform step c.

b. Firms to perform both steps a and b on a single computer run and produce a much shorter magnetic tape for step c to be carried out by aeronautical establishments and meteorological sources.

8. If a programme is developed which can accurately determine ambient temperature from either intake or nose probe sensors then useful information could be obtained from flights already made by 001 and 002. Ideally all these flights should be reprocessed but that may not be practicable. However data ought to be re-calculated for flights which were known to have experienced interesting incidents (e.g. 001 flights 105, 121, 122 142,143 178, 185, 186, 193 and 002 flights 114, 115, 139, 160).

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