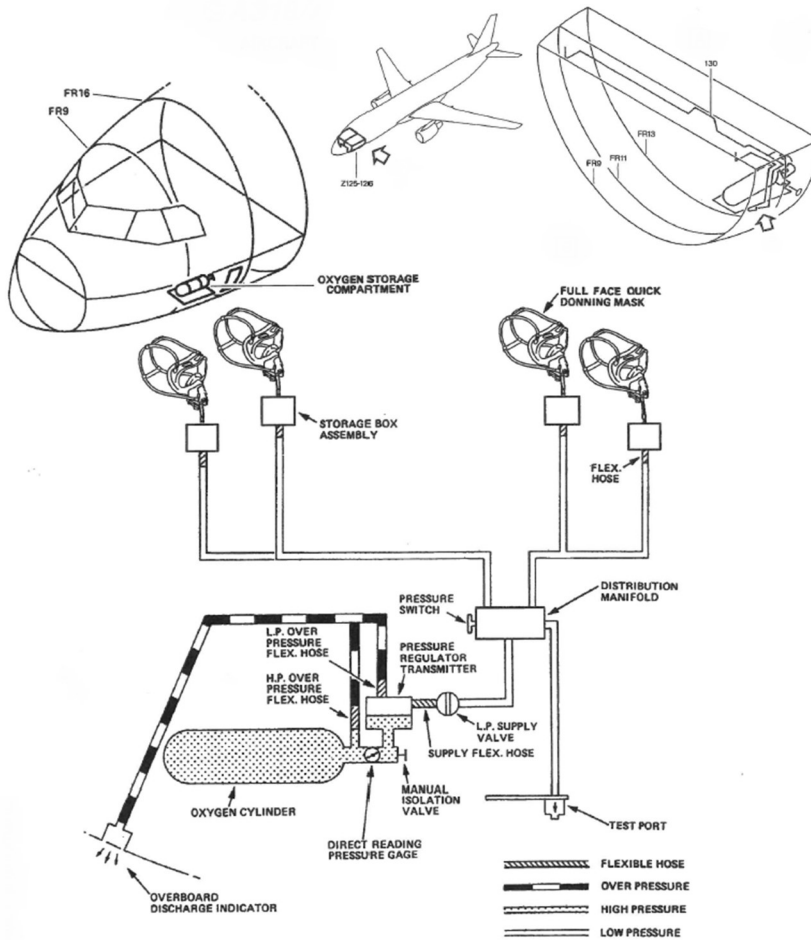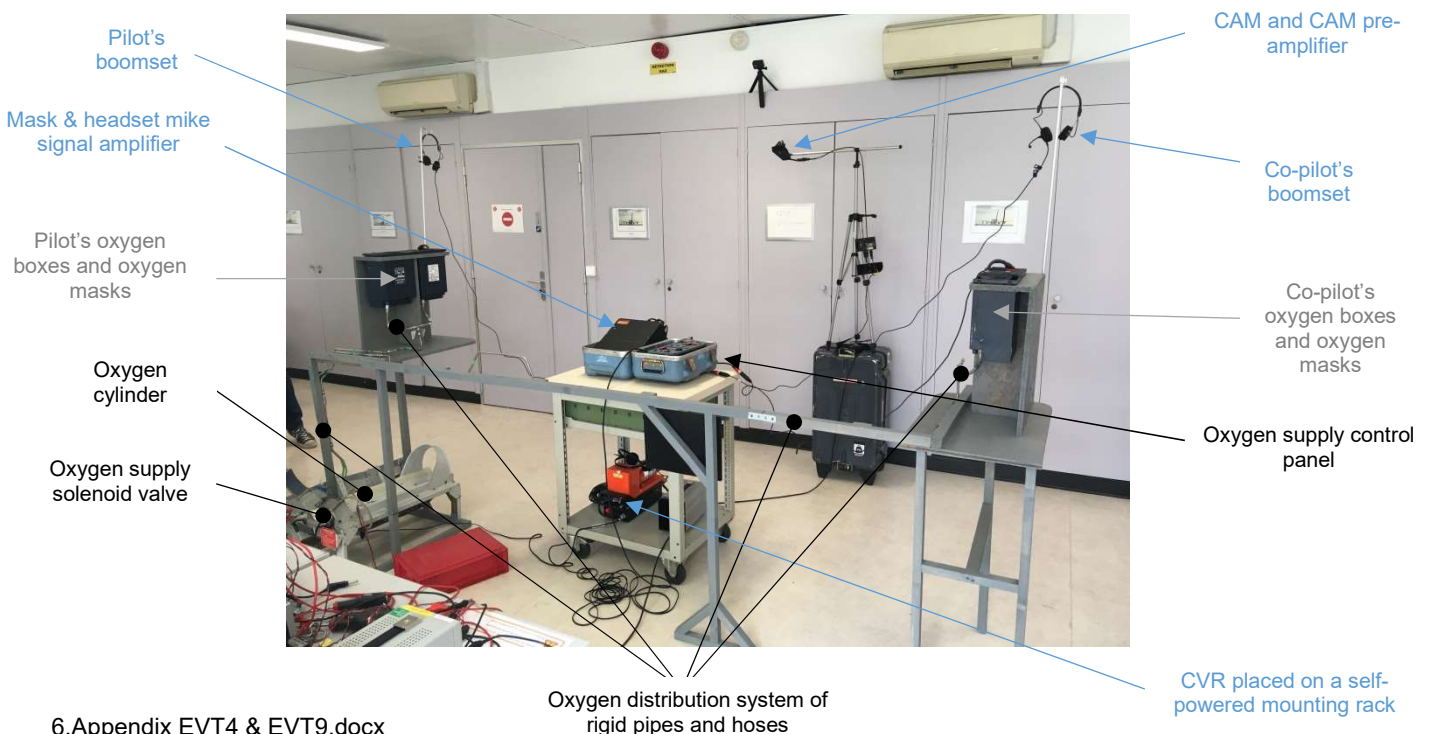# Appendix: EVT4 and EVT9

Configuration

The tests were carried out on an installation that reproduced an A320 oxygen system, consisting of the elements below:

An original A320 cockpit oxygen system was taken from an aeroplane and set up in the laboratory at SAFRAN's.

The audio pick-up was performed by a "mobile CVR" system composed of original equipment (microphones, preamplifiers, mounting rack, etc.) taken from an A320. A signal conditioning unit sent signals to the microphones on the co-pilot's mask and on the two flight crew boomsets.
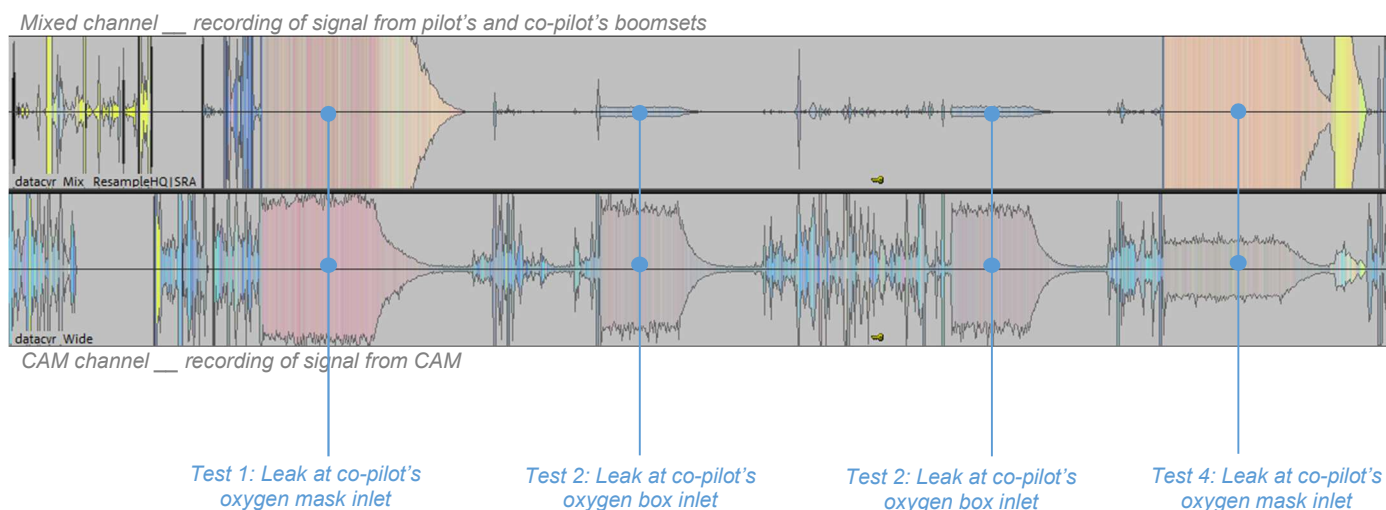

Purpose

The purpose of this test was to produce the complete emptying of a cockpit oxygen cylinder by creating a continuous oxygen leak either upstream of the personal installation of a crew member (before an oxygen box) or in a crew member's oxygen box (before the oxygen mask). The oxygen cylinder was emptied of its contents and recharged to its maximum capacity[1] with ambient air before each test. The CVR recorded the noise picked up by the various microphones of the installation.

Four test sequences were carried out:
- Two leaks were simulated at the inlet of the oxygen box (the supply hose was unscrewed).
- Two leaks were simulated in the oxygen box (the mask's oxygen supply hose was disconnected and replaced by an open tube connected to the oxygen box outlet valve).

Results

The waveform below shows the chronology of the test sequences:

Mixed channel __ recording of signal from pilot's and co-pilot's boomsets

datacvr_Mix_ResampleHQ|SRA

datacvr_Wide

CAM channel __ recording of signal from CAM

Test 1: Leak at co-pilot's oxygen mask inlet

Test 2: Leak at co-pilot's oxygen box inlet

Test 2: Leak at co-pilot's oxygen box inlet

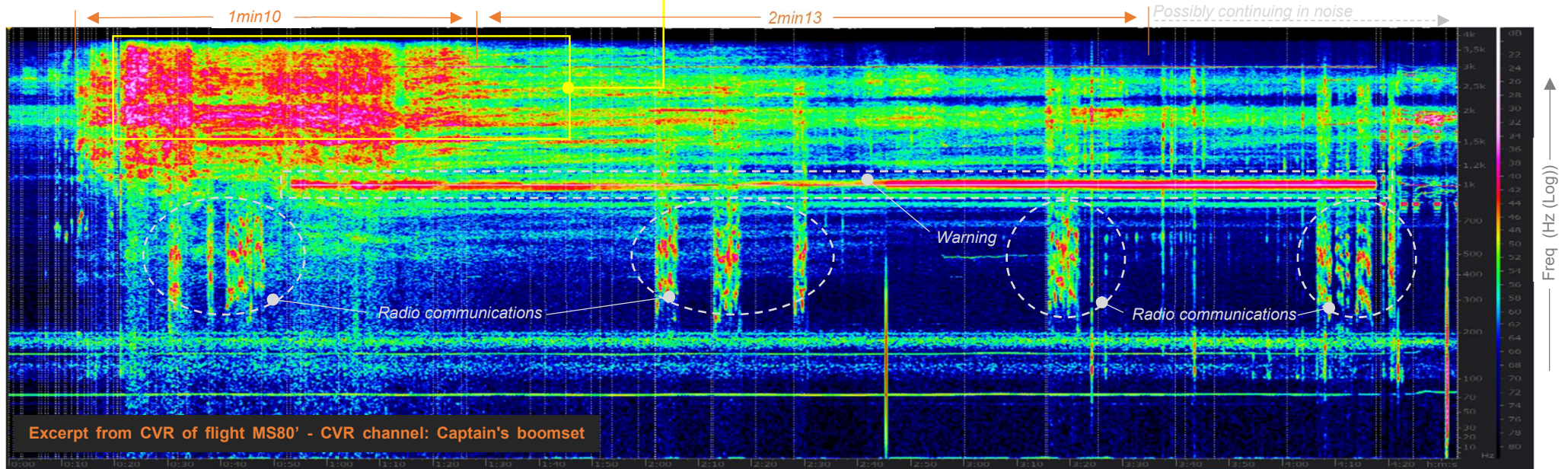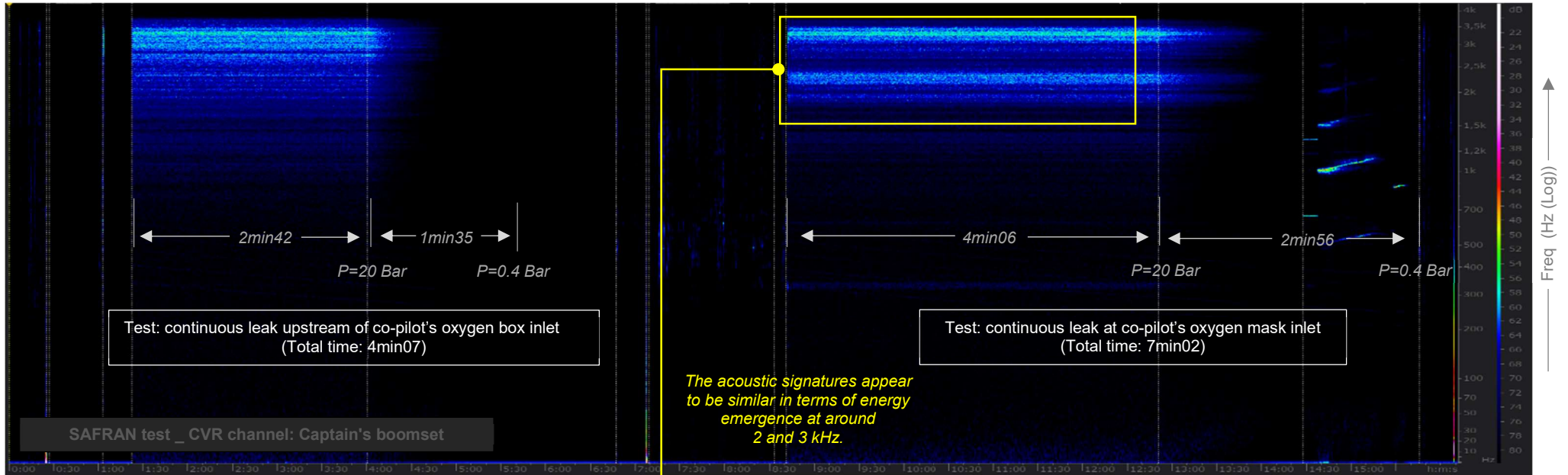Test 4: Leak at co-pilot's oxygen mask inlet

The waveforms and spectral content of the audio signals collected during the four test sequences were analysed and compared with those obtained from the recording of flight MS804.

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[1] The oxygen cylinder in the event was a 3250 L (115 cubic ft) cylinder. The BEA, unable to acquire a similar cylinder, acquired a 1420 L (50 cubic ft) cylinder to carry out the test.

The metrics (duration, acoustic signature, etc.) observed on the signals are illustrated in the example below:

Please note: the spectral views shown below do not have the same time scale

2min42   1min35

P=20 Bar   P=0.4 Bar

Test: continuous leak upstream of co-pilot's oxygen box inlet
(Total time: 4min07)

SAFRAN test _ CVR channel: Captain's boomset

4min06   2min56

P=20 Bar   P=0.4 Bar

Test: continuous leak at co-pilot's oxygen mask inlet
(Total time: 7min02)

The acoustic signatures appear to be similar in terms of energy emergence at around 2 and 3 kHz.

1min10   2min13   Possibly continuing in noise

Warning

Radio communications   Radio communications

Excerpt from CVR of flight MS80' - CVR channel: Captain's boomset

Duration (mm:ss)

The following information was observed:

Continuous leak sequence	Source of leak	Total leak time	Noise bumps	Leak time before 20 bar threshold	Leak time after 20 bar threshold
Test 1	In oxygen box	6min53s	Reinforced between 2 and 3 kHz	3min53s	3min
Test 2	Outside oxygen box	4min16s	Several swathes distributed from 1 to 2.8kHz	2min42s	1min34s
Test 3	Outside oxygen box	4min17s	Several swathes distributed from 1 to 2.8kHz	2min42s	1min35s
Test 4	In oxygen box	7min02	Reinforced between 2 and 3 kHz	4min06s	2min56s
Flight MS804	Undetermined	Estimated at 3min23s	Reinforced between 2 and 3 kHz	Estimated at 1min10s	Possibly 2min13s (difficult to determine due to background noise in cockpit).

Note 1: the capacity of the cylinder used for the tests was half that of the cylinder that was a priori on board the A320 registered SU-GCC.

Note 2: the equipment manufacturer of the oxygen system on board the AIRBUS indicated that it would take 17min1 for a 3250 L cylinder filled to its maximum capacity to be completely emptied in the event of a leak upstream of the oxygen box.

An oxygen leak produced by the rupture of a hose, either upstream of the oxygen box or upstream of the mask generated a broadband noise lasting <u>several minutes</u>, the <u>sound level of which decreased progressively</u> when a remaining pressure of less than 20 bar was reached.