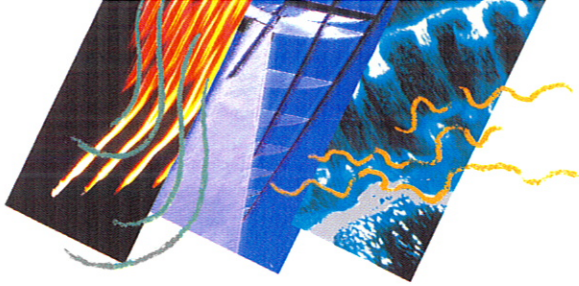

# REPORT ON CMG SMOKE-SPILL MOTOR TESTS BY FANTECH

by

J.V. Peirce & P.I. Cooper**

December 2001

## CONFIDENTIAL

BCE DOC. 01/429

CSIRO

**Building, Construction & Engineering**

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## EXECUTIVE SUMMARY

Tests have been carried out by Fantech Pty. Ltd. and witnessed by CSIRO on two CMG SGA series smoke-spill motors of 0.55kW and 90kW rated power output to determine their ability to continue to operate effectively at elevated temperatures over a period of time, according to AS 4429-1999 [1]. The 0.55 kW motor was tested in a small, temperature controlled gas fired oven while the 90 kW motor was placed in a large, gas fired oven at another location. Both motors were subject to temperature/time regimes specified by Fantech while operating. In all, two tests were carried out over two days.

The results indicated that both motors continued to operate for 2 hours at 300 °C, as totally immersed, dual purpose, horizontal drive shaft smoke-spill motors.

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## 1. INTRODUCTION

CSIRO Building, Construction and Engineering was requested by Fantech to witness and report on the smoke-spill testing of two CMG SGAHS smoke-spill motors to Australian Standard AS 4429-199, "Methods of test and rating requirements for smoke-spill fans" [1]. The motors were tested in conjunction with Elta impellers, although the primary purpose was to test the motors for subsequent approval of the CMG SGAHS range of smoke-spill motors. These tests were similar to those carried out in June 1997 and December 1998 and reported in "Tests On Smoke-Spill Fans By Fantech", DBCE DOC. 97/105(M) [2] and "Further Tests On Smoke-Spill Fans by Fantech", BCE DOC.98/255 [3]. The facility, equipment and method used were similar to that reported in [2] except that tests on the 0.55 kW motor were conducted at a different location in a smaller oven.

This report describes the fans, the motors, the temperature/time ratings, the test equipment and procedure, and the results of the smoke spill motor tests.

## 2. THE MOTORS AND IMPELLERS

Two motors, representing the smallest and largest frame sizes in the range of CMG SGAHS smoke – spill motors were tested with Elta impellers of 500 mm and 2000 mm diameter. Both fan units (comprising the motors, impellers & casings & designated by Fantech as APS0504AA10H005 & APS2008FA12H900 smoke-spill fans) were assembled by Fantech and modified for smoke spill applications according to Fantech and CMG specifications. Other details for identification purposes are given in the following Table.

| Motor Specification | Impeller Diameter<br>Hub Diameter (mm)<br>Number of Blades<br>Blade pitch (deg.)<br>Tip clearance as % of Diameter | Motor Manufacturer<br>Power (kW)<br>Motor poles | Motor Frame<br>Insulation<br>Full Load current (Amp) |
|---|---|---|---|
| M3400055SGAHS | 500<br>150<br>10<br>25<br>0.8% | CMG<br>0.55<br>4 | 80<br>H<br>1.4 |
| M3809000SGAHS | 2000<br>550<br>12<br>38<br>0.6% | CMG<br>90<br>8 | 315<br>H<br>163 |

The smaller fan had metal screens placed at the entrance and exit of the fan casing to provide a load on the fan and establish a static pressure rise. This was

not required on the large fan. Pressure tapping rings consisting of four tappings were placed upstream and downstream of each fan so that the pressure rise across the fan could be monitored during a test. One criterion specified in the Australian Standard [1] is that the fan and motor can be considered to have passed the requirements of the rating if, after correction for density variations due to temperature variations, the pressure rise across the fan did not vary by more than ±20% of that measured at the commencement of the test before heating had been applied. The Australian Standard [1] also specifies a stability criterion of no more than ±2% variation in pressure, averaged over consecutive 2 minute periods. Both requirements were met.

All motors were powered through a starter unit supplied by Fantech. The current and power consumption of each motor could be derived from a power meter on the starter unit.

## 3. TEMPERATURE/TIME RATINGS

Fantech had a requirement to show that both motors are suitable for dual purpose application (see [1], clause 1.4.1) and that they will operate continuously with inlet air temperatures of 300 °C for 120 minutes.

## 4. MEASUREMENTS AND PROCEDURE

### 4.1 Measurements

Measurements made during the course of a test were air inlet temperatures to each of the fans (or the "oven" temperature as the fans provided circulation and mixing within the oven), the motor carcase and fan case temperatures and the static pressure rise across each fan. In addition, measurements were made from which the average current per phase and motor power could be derived throughout the test. All temperature measurements were made with Type K thermocouples and recorded on a datalogger controlled by a PC.

Fan static pressure rise measurements were made manually with a digital electronic manometer.

*4.1.1 Instrumentation*

Details of the instrumentation used during the tests are as follows: -

**Data Logger**

Datataker 605, S/N 66243 (Techrentals)
Calibrated 25th Nov. 2001, Ref. No. 217250

**PC**

Toshiba 310CDT "Satellite" Notebook (Fantech)

**Pressure transducer**

Furness CPFM, S/No. 9404170, (Fantech), Calibrated 12th July 2001, Report No. LP0107287

**Power meter**

Multitek M800-MD9 Multi-Din Power Measuring System, S/No. 8314 003 (Calibrated Fantech 6th Feb. 1999)

### 4.2 Procedure

Tests on the fans were carried out on the 13th and 14th of December 2001. The fans under test were place in the oven and connections made for measuring temperatures and pressures. Initially the fans were run at ambient temperature and the static pressure rise across each was measured. Readings were taken of the average pressure rises over consecutive two minute period to confirm that the pressure stability criterion was met. The units were then operated for at least 60 minutes and longer if the motor carcase temperature was increasing more than 2°C in 10 minutes (see clause 5.4.2 in [1]) for testing as a dual purpose fan. In all cases, carcase stability had been reached in 60 minutes. The 500 mm diameter fan was tested outside the small oven during this warmup period to limit the temperature rise to close to ambient. With the large oven the door was closed but the oven ambient temperature rise during warmup was not excessive because of the large volume of the oven.

Following the warmup period, the oven gas heaters were turned on and logging commenced. The temperature rise times during heating of both the small and large ovens were longer than the maximum of 10 minutes specified clause 5.4.3 of [1]. This is not considered to be significant (as long as it is acceptable to the client) as the longer time period at an elevated temperature is certainly more taxing on the fan than the specified test time.

Fan air inlet, motor carcase and fan case temperatures were recorded automatically every 30 seconds minute via the PC/data logger system, while static pressure rise was recorded manually every 5 minutes. Current and power draw parameters were also monitored 5 minutes.

## 5. RESULTS

Both fans successfully operated at 300 °C for 2 hours. The M3400055SGAHS motor was tested in the smaller oven while the M3809000SGAHS was tested in the larger oven the next day.

The test results are shown in Figures 1 to 4, which graphically indicate air inlet, motor carcase and average fan case temperatures and pressure differential and fan shaft power as a function of time over the test periods. The pressure differentials and fan shaft powers have been normalised to an air density of 1.2 $kgm^{-3}$ at 20 °C. Fan shaft power was estimated from the measured electrical power input and a knowledge of the electrical and mechanical efficiencies of the motors at their operating condition. At all times the motors were operating at a least 80% of their rated output (Clause 5.1 in [1]). The fan case temperatures are

the average of four circumferential measurements. At all times the measured fan pressure differentials while the fans were operating were within ±20% of that measured at the end of the warmup period (after corrections for reduced densities at the higher temperatures, and all normalised to 20 °C).

## 6. CONCLUSIONS

CMG M3400055SGAHS and M3809000SGAHS smoke-spill motors have been placed in ovens in Fantech APS0504AA10H005 & APS2008FA12H900 smoke-spill fans using Elta impellers and subjected to a specified temperature/time regime. The tests broadly followed the requirements of Australian Standard AS 4429-1997.

Both motors passed the specified time/temperature tests. It is concluded that the CMG M3400055SGAHS and M3809000SGAHS motors, the smallest and largest frame sizes in the CMG SGAHS range of smoke-spill motors, are capable of operating effectively at an air temperature of 300 °C for 120 minutes as totally immersed dual purpose motors with their drive shafts horizontal.

## REFERENCES


1. Method of test and rating requirements for smoke-spill fans. Australian Standard AS 4429-1999.
2. COOPER, P.I., Tests on smoke-spill fans for Fantech, DBCE DOC. 97/105(M), June 1997
3. COOPER, P.I., Further tests on smoke-spill fans by Fantech, BCE DOC. 98/255, Dec. 1998

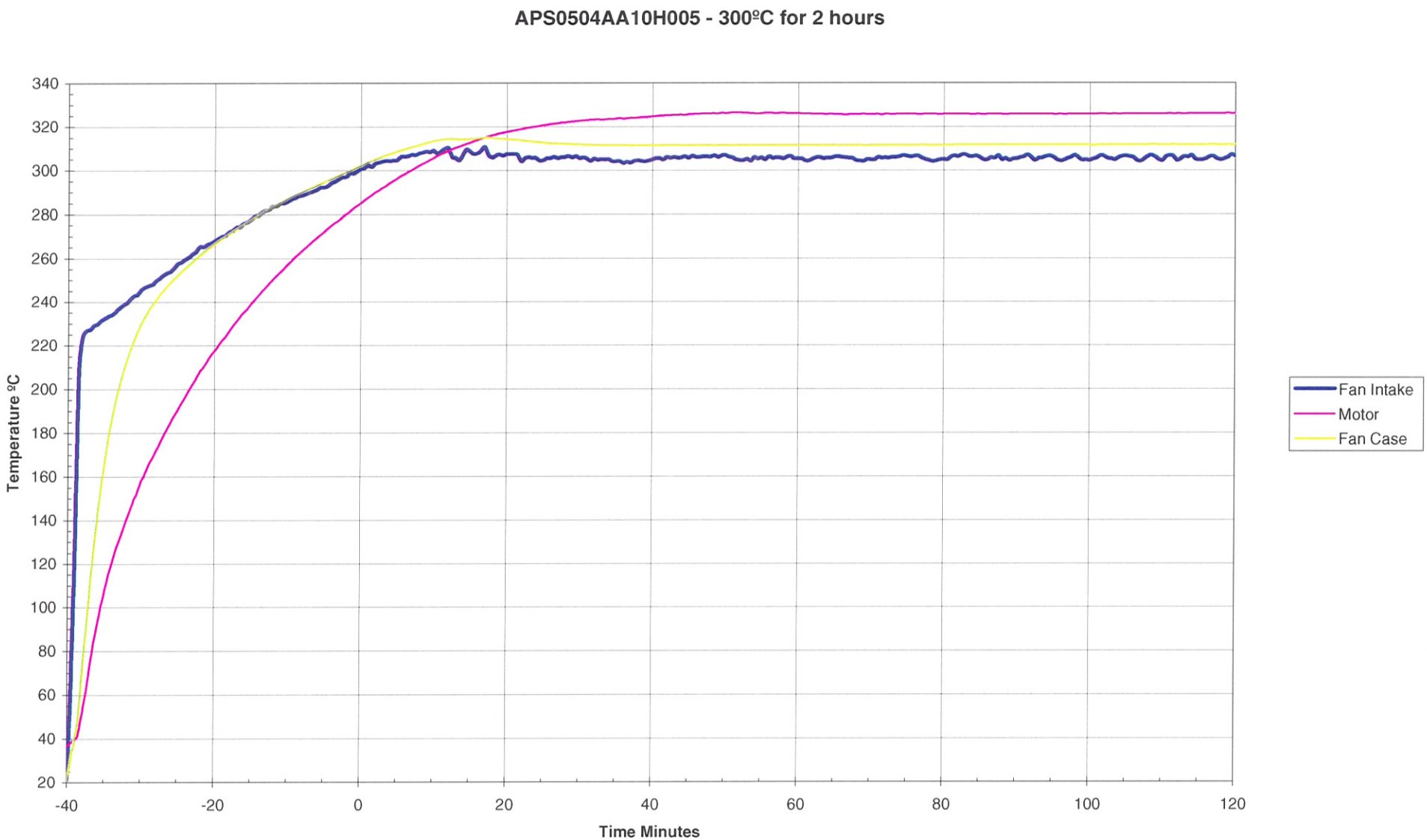


Figure 1 - Air inlet, motor carcase and average fan case temperature as a function of time for APS0504AA10H005 at 300 deg.C for 2 hours.

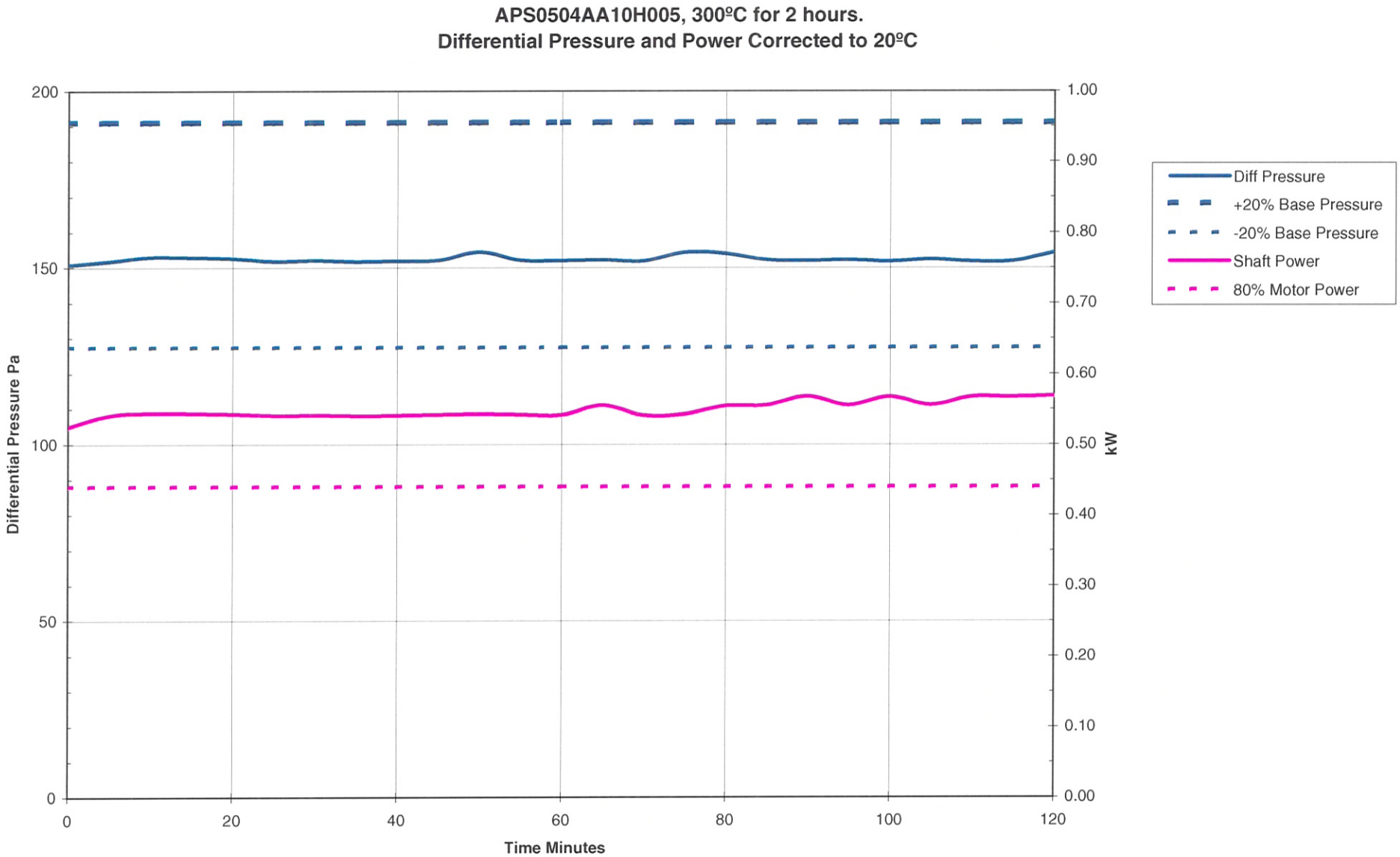


Figure 2 - Differential pressure and shaft power as a function of time for APS0504AA10H005 at 300 deg.C for 2 hours.

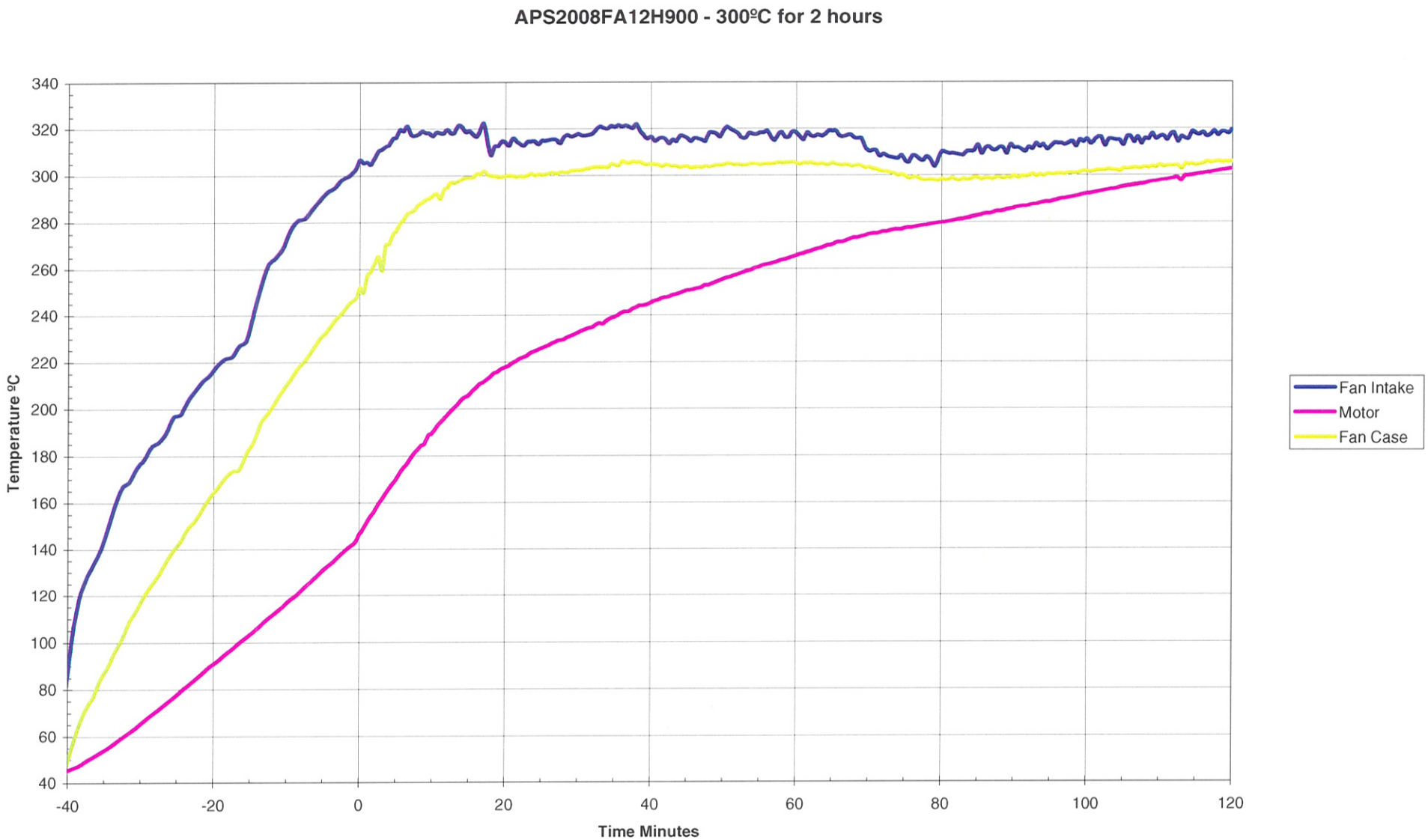


Figure 3 - Air inlet, motor carcase and average fan case temperature as a function of time for APS2008FA12H900 at 300 deg.C for 2 hours.

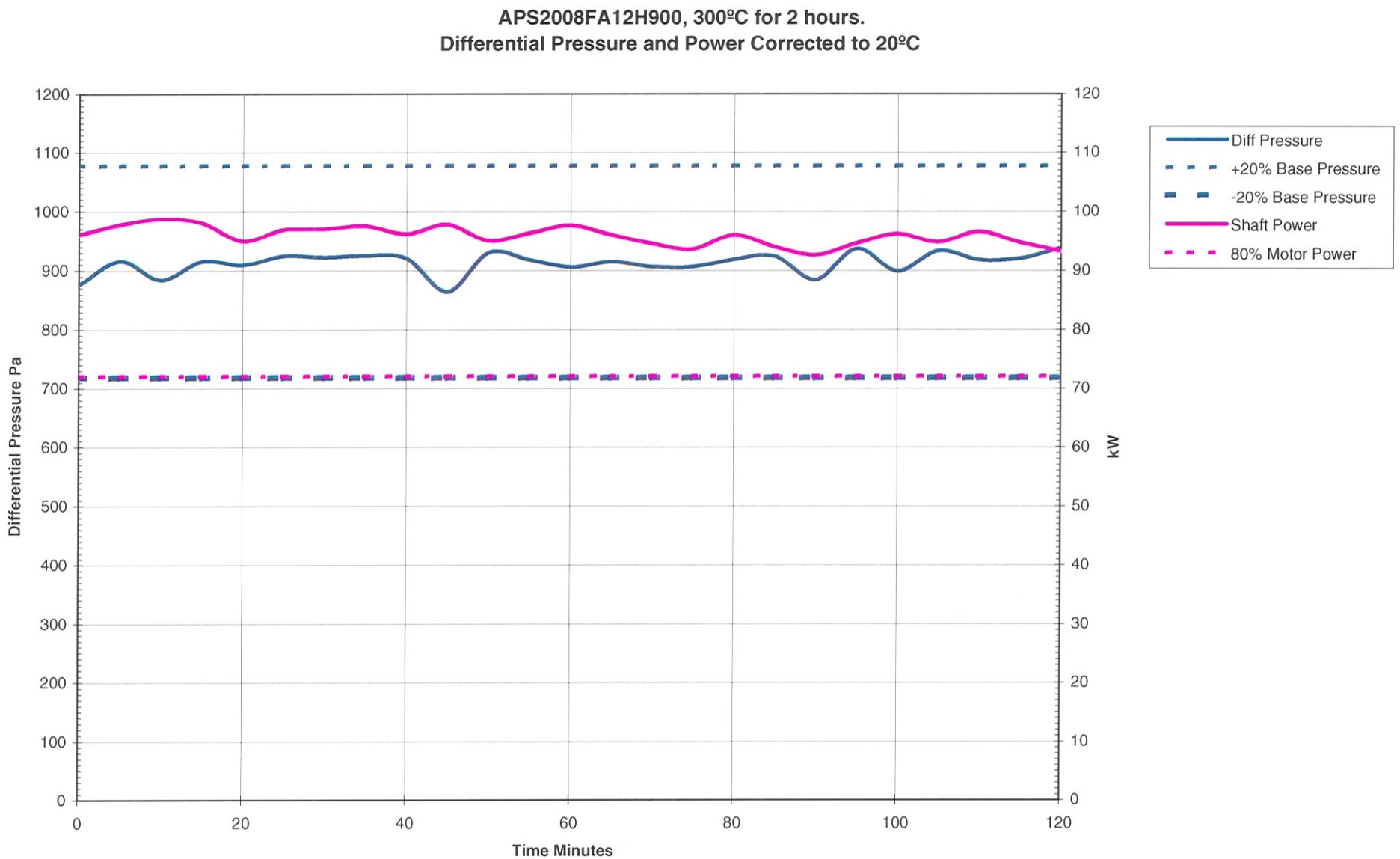


Figure 4 - Differential pressure and shaft power as a function of time for APS2008FA12H900 at 300 deg.C for 2 hours.