

## **CHAPTER 11**

### **A 11.0 - THERMAL SHOCK TESTS**

## 11.1 TEST SPECIFICATIONS AND PROGRAMME

Following Section A11.0 of RTCM Recommended Standards for 406 MHz Satellite EPIRBs (Version 2.0 Feb 5,1997) :

### 11.1.1. LOW -TEMPERATURE THERMAL SHOCK

- With the beacon in the ready condition , place it in a temperature-controlled oven at - 30° C for a minimum of three hours.
- Remove the beacon from the oven and immerse it in fresh water at a temperature of 0° C to + 5° C. for 5- 10 seconds .
- Then control if the EUT is normally self activate within 5 minutes floating in water at that temperature .
- Remove the EUT from the water , deactivate it, set it to the ready position and place it in a temperature-controlled oven at - 40° C for a minimum of three hours.
- Immerse the beacon in salt water ( 5 % NaCl ) at a temperature of - 2° C to + 5° C for 10 seconds .
- Then control if the EUT is normally self activate within 5 minutes floating in water at that temperature .
- After 15 minutes floating, the electrical measurements should be nominal.

**Note : These electrical measurements and results are used for the COSPAS-SARSAT Type Approval Tests Report (chapter 12)**

### 11.1.2. HIGH-TEMPERATURE THERMAL SHOCK

- Proceed as described in § 11.2.1. but with oven temperature at + 70° C and the water maintained between 25° C and 35° C.

## 11.2. EQUIPMENT UNDER TEST

Beacon Unit : 2/2  
Name : JOTRON  
Type : TRON 40GPS  
Number : 7001

## 11.3. TEST SITE

Toulouse Space Center (C.S.T./ ITS) - Beacon certification laboratory .

## 11.4. TEST EQUIPMENT

- Climatic chamber : CLIMATS F.C.H. – Type: Austral 137H60/1,5E - S/N: S4880.
- Fresh or salt water container .
- KEITHLEY thermometer/multimeter ,Type : 2000, S/N 0678112 with CU-CT thermocoupler.
- Argos - Cospas/Sarsat Test Bench

## 11.5. TEST RESULTS OF LOW-TEMPERATURE THERMAL SHOCK

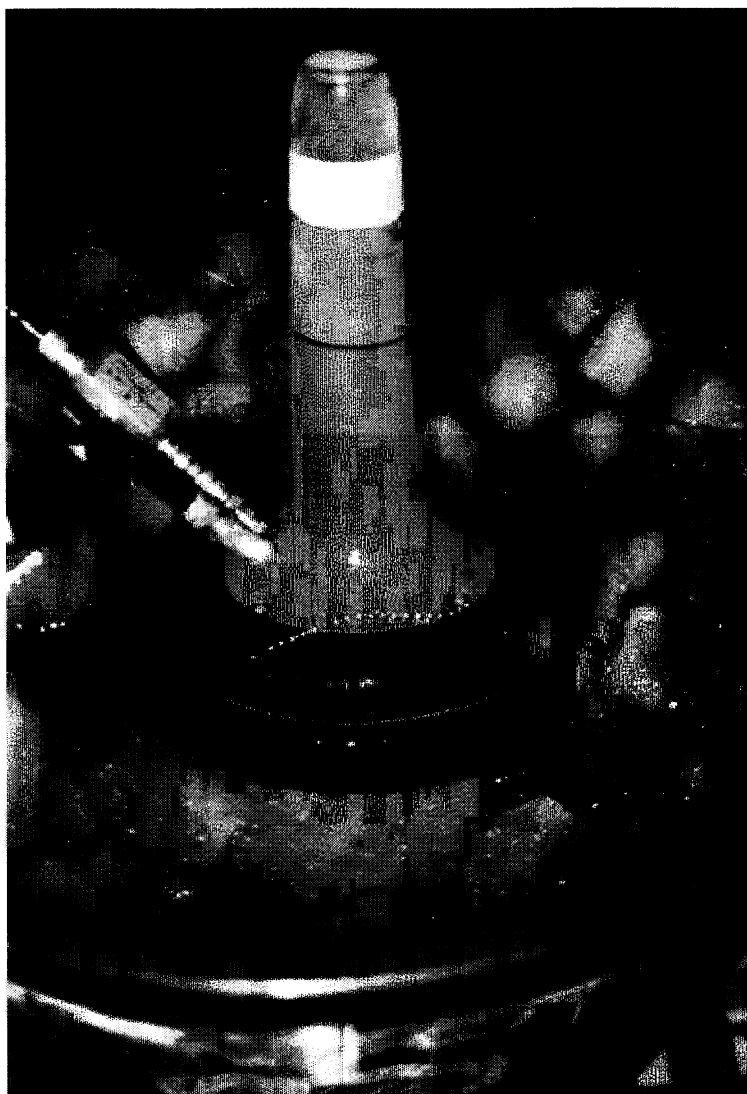
### 11.5.1 Test implementation

| Date         | Hour  | Operations                                                                                                                                              | Results                                   |
|--------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| 22 June 2000 | 18:45 | The beacon, in the ready condition, is thermally soaked at - 30° C in the temperature-controlled oven .                                                 |                                           |
| 23 June 2000 | 8:00  | The beacon is immersed in fresh water at 0° C within 10 seconds then floated for 5 minutes .                                                            | Self activation :<br>OK                   |
| 23 June 2000 | 8:20  | The beacon, in the ready condition, is thermally soaked at - 31° C in the temperature-controlled oven .                                                 |                                           |
|              | 11:29 | The beacon is immersed in salt water at 0.1 ° C within 10 seconds then floated for 5 minutes .                                                          | Self activation :<br>OK                   |
|              | 11:34 | Then, the beacon, in float free position and in salt water at 0° C is connected to the test bench and an electrical test are conducted during 2 hours . | The results are nominal after 20 minutes. |

### 11.5.2 Electrical results of Low-Temperature Thermal Shock Test

| 23 June 2000<br><br><b>Low-temperature thermal shock test :</b><br>- 31° to 0.1° C<br><br>See photo, data and graphs next pages | PARAMETERS                                                        | RESULTS AFTER<br>20 MIN.         |
|---------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|----------------------------------|
|                                                                                                                                 | Nominal carrier frequency<br>(406.025 MHz $\pm$ 0.002 MHz)        | 406.025011 MHz                   |
|                                                                                                                                 | RF output power (5 W or 37 dBm $\pm$ 2)                           | 37.4 dBm                         |
|                                                                                                                                 | Short term frequency stability<br>( $< 2 \times 10^{-9}$ /100 ms) | $\leq 2 \times 10^{-10}$ /100 ms |
|                                                                                                                                 | Mean slope ( $< \pm 1 \times 10^{-9}$ /mn)                        | $< 1 \times 10^{-9}$ /mn         |
|                                                                                                                                 | Residual frequency variation<br>( $< 3 \times 10^{-9}$ )          | $\leq 2 \times 10^{-9}$          |

**LOW-TEMPERATURE THERMAL SHOCK PHOTO**



**THERMAL SHOCK TEST RESULT ON  
TRON 40GPS JOTRON  
N° 7001**

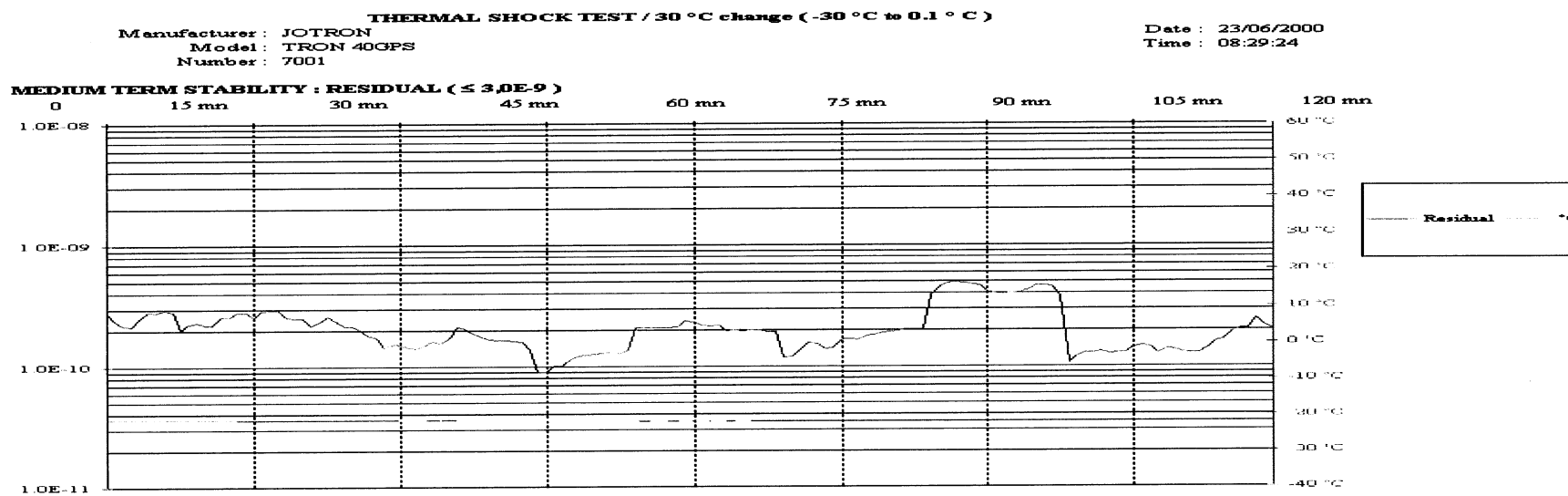
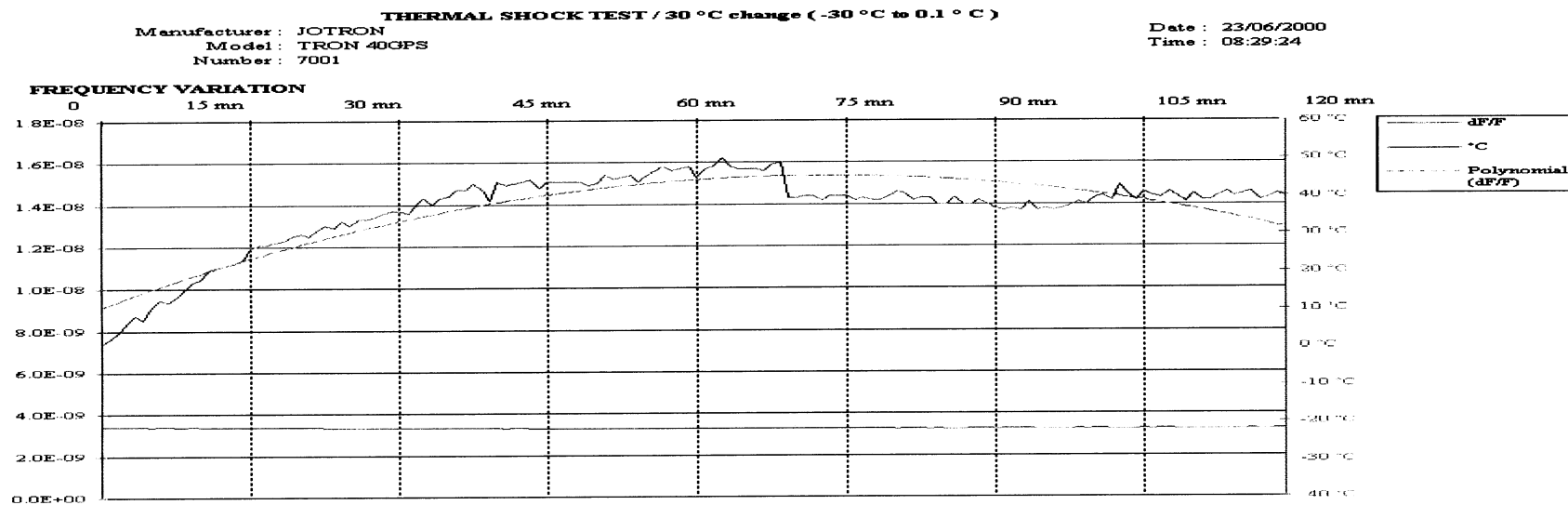
**-30°C to 0.1°C**

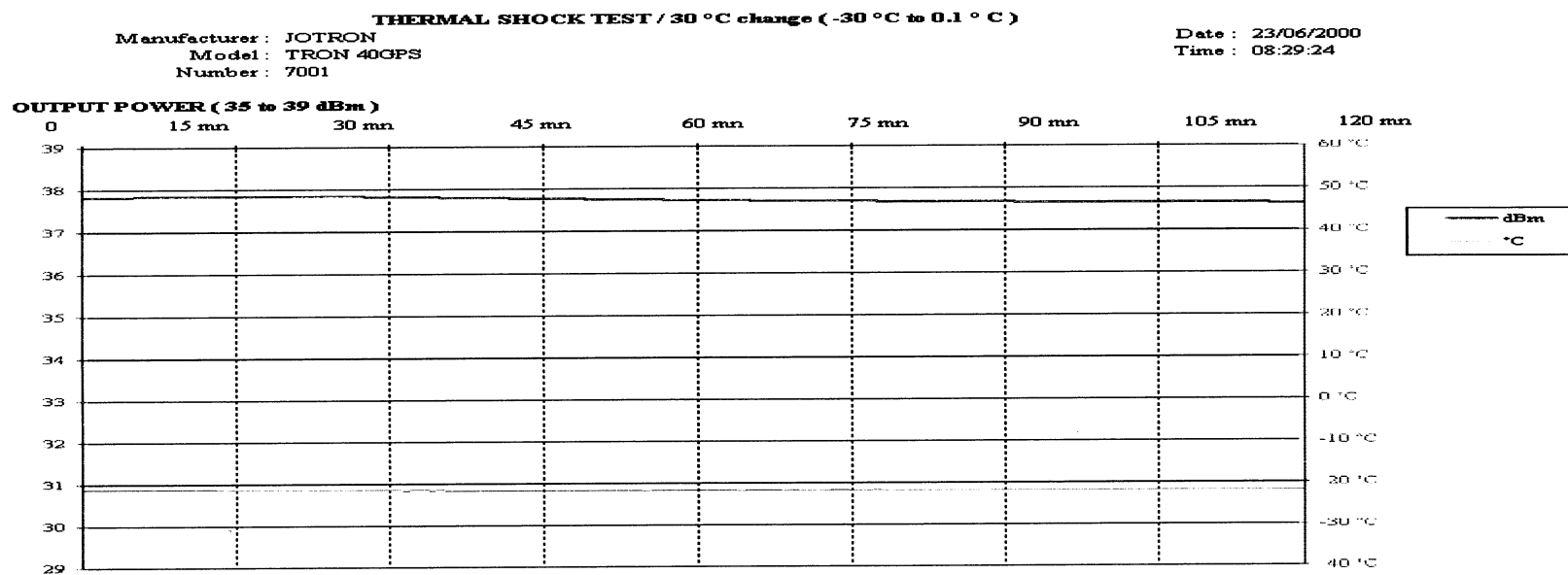
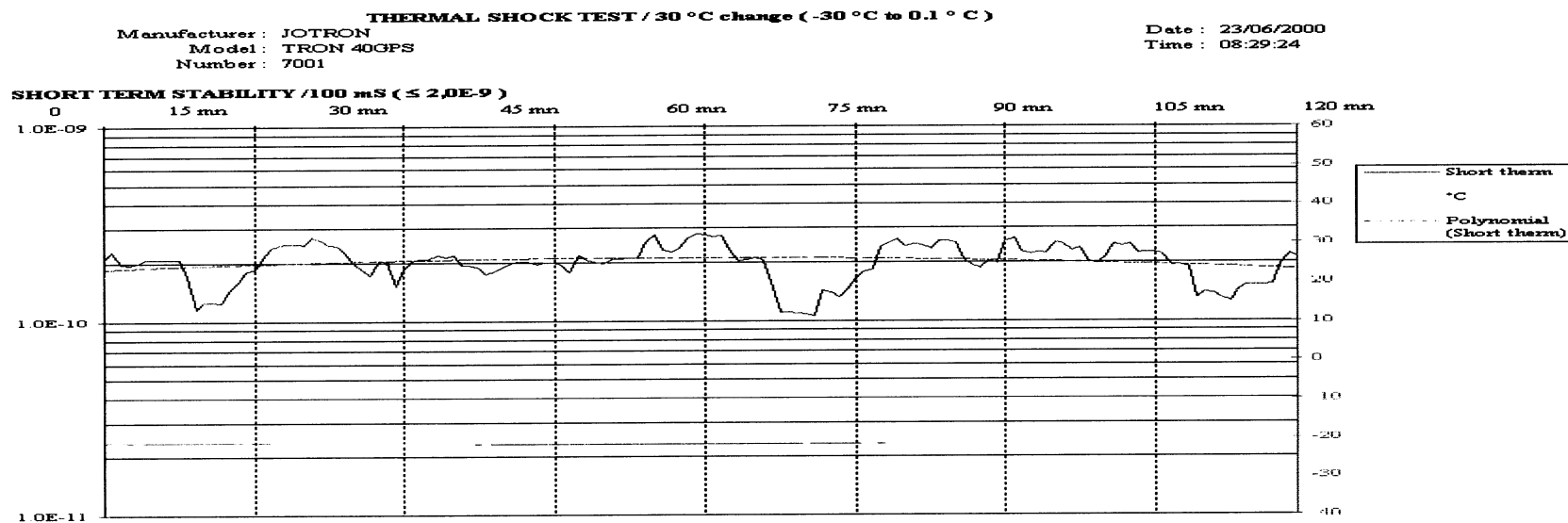
Temperature Soak : -30°C  
 Temperature Measure : 0.1°C

| No | Δ Frequency ( Hz ) | Temp. ( °C ) | P406 ( dBm ) | P121.5 ( dBm ) |
|----|--------------------|--------------|--------------|----------------|
| 1  | 50281.00           | -31.8        | 38.4         | 16.5           |
| 2  | 50144.50           | -1.8         | 37.9         | 45.1           |
| 3  | 50141.21           | -1.7         | 38.0         | 45.1           |
| 4  | 50139.08           | -1.7         | 37.9         | 45.0           |
| 5  | 50136.93           | -1.8         | 37.7         | 45.2           |
| 6  | 50134.98           | -1.7         | 37.6         | 45.2           |
| 7  | 50133.24           | -1.8         | 37.6         | 45.1           |
| 8  | 50131.46           | -1.8         | 37.6         | 45.1           |
| 9  | 50129.84           | -1.8         | 37.7         | 44.9           |
| 10 | 50128.29           | -1.9         | 37.7         | 44.9           |
| 11 | 50124.39           | -1.5         | 37.7         | 44.9           |
| 12 | 50122.25           | -2.0         | 37.6         | 44.8           |
| 13 | 50120.75           | -1.7         | 37.5         | 44.9           |
| 14 | 50119.38           | -1.9         | 37.5         | 44.8           |
| 15 | 50117.61           | -1.9         | 37.5         | 44.9           |
| 16 | 50115.95           | -1.9         | 37.5         | 44.8           |
| 17 | 50114.26           | -1.9         | 37.5         | 44.7           |
| 18 | 50112.73           | -1.9         | 37.5         | 44.8           |

| No  | Temp. | Slope    | Sigma   | P406 | Short term | P121.5 |
|-----|-------|----------|---------|------|------------|--------|
| 1   | -1.9  | -5.7E-9  | 1.9E-9  | 37.6 | 2.1E-10    | 44.6   |
|     |       |          |         |      |            |        |
| 31  | -1.7  | -3.9E-10 | 4.4E-10 | 37.6 | 1.5E-10    | 44.4   |
| 61  | -1.6  | -5.7E-11 | 2.5E-10 | 37.6 | 1.8E-10    | 44.5   |
| 91  | -1.4  | -6.7E-11 | 1.9E-10 | 37.6 | 2.0E-10    | 44.5   |
| 121 | -1.1  | -1.5E-11 | 1.2E-10 | 37.6 | 1.5E-10    | 44.5   |

Beacon message at the end of Thermal Shock Test :  
**FFFE2F901E1E24002B80374C89B78E014CDA**





## 11.6. TEST RESULTS OF HIGHT-TEMPERATURE THERMAL SHOCK

### 11.6.1 Test implementation

| Date         | Hour  | Operations                                                                                                                                               | Results                                   |
|--------------|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------|
| 23 June 2000 | 15:40 | The beacon, in the ready condition, is thermally soaked at + 70° C in the temperature-controlled oven .                                                  |                                           |
| 24 June 2000 | 9:30  | The beacon is immersed in fresh water at 33° C within 10 seconds then floated for 5 minutes .                                                            | Self activation :<br>OK                   |
| 24 June 2000 | 10:00 | The beacon, in the ready condition, is thermally soaked at + 70° C in the temperature-controlled oven .                                                  |                                           |
|              | 13:36 | The beacon is immersed in salt water at 31 ° C within 10 seconds then floated for 5 minutes .                                                            | Self activation :<br>OK                   |
|              | 13:41 | Then, the beacon, in float free position and in salt water at 31° C is connected to the test bench and an electrical test are conducted during 2 hours . | The results are nominal after 20 minutes. |

### 11.6.2 Electrical results of Hight-Temperature Thermal Shock Test

| 24 June 2000                                                                                                    | PARAMETERS                                                                | RESULTS AFTER<br>20 MIN.                |
|-----------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------|-----------------------------------------|
| <b>Hight -temperature thermal shock test :</b><br>+70 ° to + 31° C<br><br>See photo, data and graphs next pages | Nominal carrier frequency<br>(406.025 MHz ± 0.002 MHz)                    | 406.025062 MHz                          |
|                                                                                                                 | RF output power (5 W or 37 dBm ± 2)                                       | 37.4 dBm                                |
|                                                                                                                 | Short term frequency stability<br>( $< 2 \times 10^{-9}/100 \text{ ms}$ ) | $\leq 8 \times 10^{-10}/100 \text{ ms}$ |
|                                                                                                                 | Mean slope ( $< \pm 1 \times 10^{-9}/\text{mn}$ )                         | $< 1 \times 10^{-9}/\text{mn}$          |
|                                                                                                                 | Residual frequency variation<br>( $< 3 \times 10^{-9}$ )                  | $\leq 1 \times 10^{-9}$                 |

## HIGH-TEMPERATURE THERMAL SHOCK PHOTO



Pente et Sigma (Mesures)

Mesures du 24 Jun 1990 13:41:25

Constructeur : JOTRON  
 Type : TRON 40GPS  
 Numero : 7001  
 Reference INTESPACE : M2393-1  
 Type : SARSAT

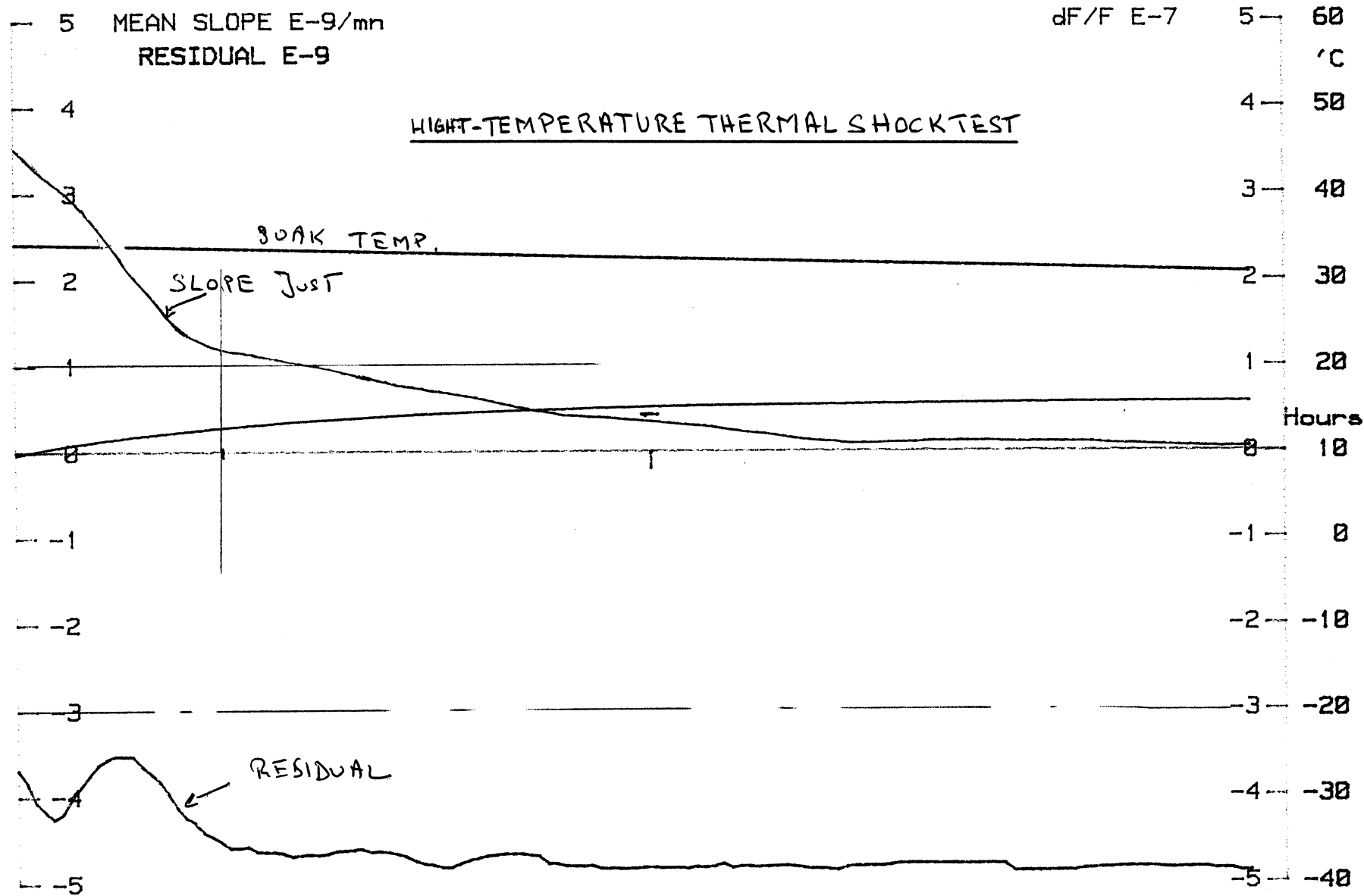
|    | Freq     | Temp. | P406  |
|----|----------|-------|-------|
| 1  | 50040.95 | 63.52 | 37.21 |
| 2  | 50042.46 | 33.53 | 37.21 |
| 3  | 50044.21 | 33.30 | 37.24 |
| 4  | 50045.73 | 33.08 | 37.24 |
| 5  | 50047.38 | 33.89 | 37.25 |
| 6  | 50048.89 | 33.68 | 37.26 |
| 7  | 50049.99 | 33.60 | 37.29 |
| 8  | 50051.08 | 33.49 | 37.29 |
| 9  | 50052.26 | 33.37 | 37.31 |
| 10 | 50053.43 | 33.10 | 37.32 |
| 11 | 50054.59 | 32.95 | 37.33 |
| 12 | 50055.70 | 32.67 | 37.34 |
| 13 | 50056.94 | 32.66 | 37.35 |
| 14 | 50057.89 | 32.48 | 37.36 |
| 15 | 50059.09 | 32.42 | 37.37 |
| 16 | 50060.19 | 32.28 | 37.37 |
| 17 | 50061.18 | 31.97 | 37.38 |
| 18 | 50062.21 | 31.88 | 37.38 |

| No  | Temp  | Slope    | Sigma    | P406 | Short term |
|-----|-------|----------|----------|------|------------|
| 1   | 31.85 | +3.5E-09 | +1.1E-09 | 37.3 | +1.3E-10   |
| 18  | 31.66 | +1.2E-09 | +8.0E-10 | 37.4 | +1.7E-10   |
| 31  | 31.52 | +1.2E-09 | +2.9E-10 | 37.5 | +2.1E-10   |
| 61  | 31.44 | +4.6E-10 | +2.1E-10 | 37.5 | +1.7E-10   |
| 91  | 31.39 | +1.3E-10 | +1.5E-10 | 37.5 | +1.8E-10   |
| 121 | 31.35 | +1.1E-10 | +1.6E-10 | 37.5 | +2.2E-10   |

Nbre d'erreurs de mesure recuperees : 0

# MEDIUM TERM STABILITY

BEACON MANUFACTURER MODEL SERIAL Nr DATE TIME 0  
 JOTRON TRON 40GPS 7001 24 Jun 2000 13:41:20



| BEACON | MANUFACTURER | MODEL      | SERIAL Nr | DATE        | TIME 0   |
|--------|--------------|------------|-----------|-------------|----------|
|        | JOTRON       | TRON 40GPS | 7001      | 24 Jun 2000 | 13:41:20 |

