

Smart GPS-Synchronized SRO-100 Rubidium SynClock+ Lifetime & MTBF Performance

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Lifetime Model

The aging of the Rubidium (Rb) lamps has been previously studied by Mr. C.-H. Volk and Mr. R.-P. Frueholz of the Aerospace Corporation, CA, USA, as a result of the diffusion of Rb metal into the glass walls of its bulbs. These studies have been carried out by using the differential scanning calorimetry technique. The calorimetric technique measures the elemental of the Rb content in a lamp used in normal conditions.

Temex Time uses the SCHOTT glass 8436 type in its Rb, which has been proved to be presently the best alkali resistant glass on the market. Figure 1 shows the Rb consumption of a lamp made of the SCHOTT 8436 glass, and shows a logarithmic curve of the Rb consumption, which is approximately 100µg after a period of one year of operation. Together with the Neuchatel Observatory in Switzerland, Temex Time performed the same measurement on one Rb lamp sample n° 2285 in order to validate the findings of the Aerospace Corporation. A very similar characteristic was obtained in Figure 2.

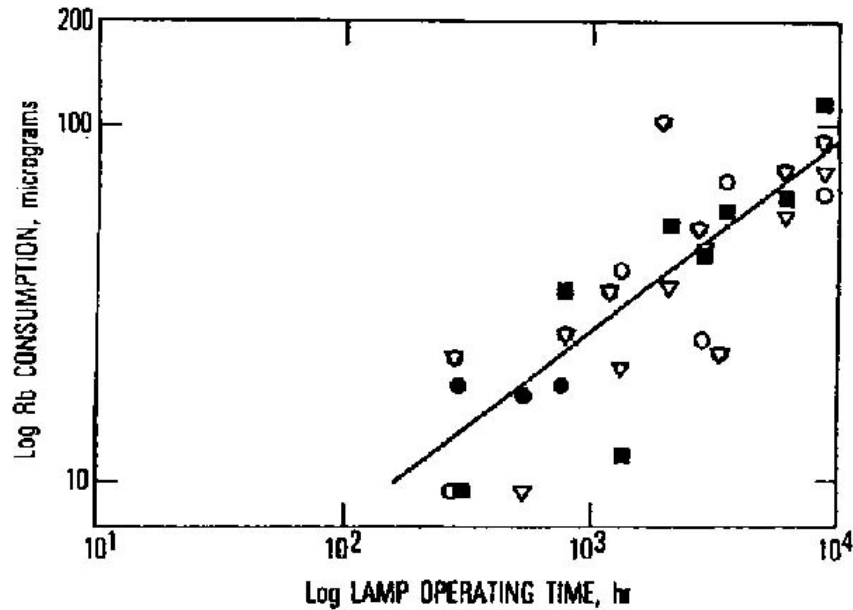


Fig 1- Aerospace Corporation's Rb Aging Performance

The Rb consumption's characteristic varies according to the square root of time as follows:

$$M(t) = (0.9 \pm 0.15) \times \sqrt{t}$$

where: M=Rb mass in mg
t=time, in hours

After 20 years of operation of a Rb, M = 376µg. The Rb lamps manufactured by Temex Time are filled with 700µg to 1000µg of Rb.

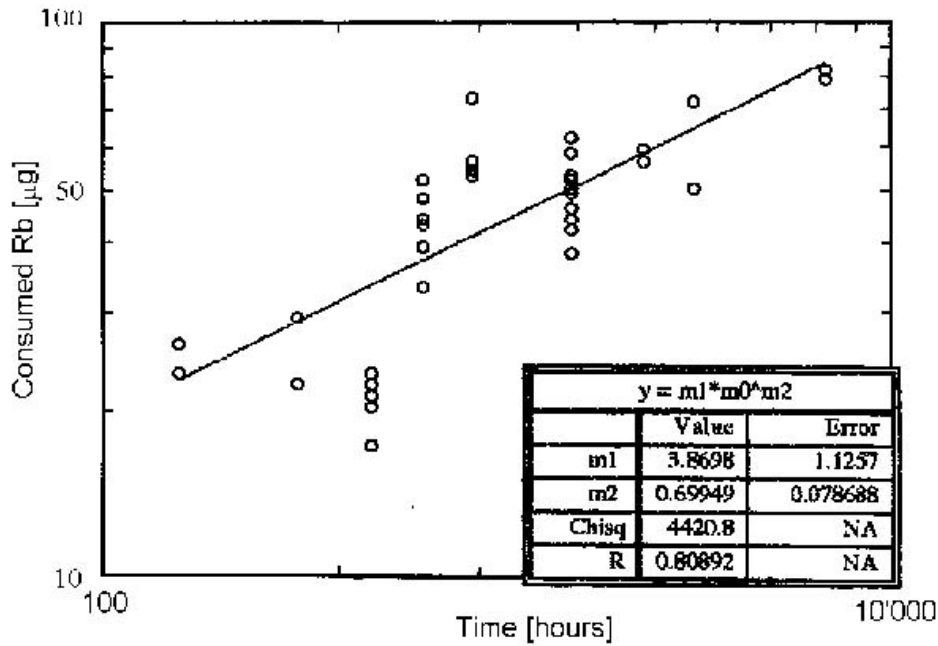


Fig 2 – Neuchatel Observatory & Temex Time’s Rb Aging Performance

Based on the above, the average lifetime of a Rb diffusion into glass wall is as follows:

$$t[h] = \left(\frac{700}{1.05} \right)^2 = 444'444 \text{ hours (50 years)}$$

MTBF Performance

Smart GPS-Synchronized SRO-100

| SRO-100 MTBF Performance Report | | | | | | | |
|---------------------------------|--------------------------|-----------------------|----------------------------------|-------------------------|--|------|-------|
| System Data | | Records: 3 | Ver: 5.0-Bell6 (Release200.1) | Model: Serial | Bellcore limited Stress-Method I --Case3 | | |
| Mini Rubidium Clock | | Basic FR= 7218.5 FITs | | MTBF= 138533.0018 hours | | | |
| Rec # | DC | Qty | TFR[%] | FR | Env. | °C | Parts |
| 1 | Circuit: CELLASSY 85°C | | SRO-100 CELL ASSEMBLY | | | | |
| | 100% | 1 | 21.65 | 1562.5817 | GB | 25°C | 39 |
| 2 | Circuit: LAMPASSY 125°C | | SRO-100 LAMP ASSEMBLY | | | | |
| | 100% | 1 | 8.09 | 583.7504 | GB | 25°C | 23 |
| 3 | Circuit: MAIN BOARD 40°C | | SRO-100 MAIN BOARD | | | | |
| | 100% | 1 | 70.27 | 5072.1646 | GB | 25°C | 332 |