SUBJECT: SPIRE Sorption Cooler Hold Time Assessment

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CHANGE RECORD

ISSUE	DATE	SECTION	CHANGE
1	20-06-01	-	New Document

CONTENTS

1. SCOPE

This document reports on thermal analysis to examine the effects of Level 1 temperature on cooler evaporator loads and hence sorption cooler hold time and cold tip temperature.

2. APPLICABLE DOCUMENTS

2.1. RAL Applicable Documents

ID	TITLE	NUMBER
AD 2.1.1	SPIRE Thermal Configuration Control Document	SPIRE-RAL-PRJ-000560 D8 (18-April-01)

Table 2.1: RAL Applicable Documents

2.2. CEA Applicable Documents

ID	TITLE	NUMBER
AD 2.2.1	Discussion on 4 litres vs 6 litres STP unit & Ultimate temperature improvement	TNS2 Issue1-0 (29-Sept-00)

Table 2.2: CEA Applicable Documents

3. INTRODUCTION

Analysis has been performed to assess the reduction in cooler hold time resulting from an increase in Level 1 temperature. The SPIRE ESATAN DTMM 'SPIRE14B.d' defined in AD2.1.1, has been used in conjunction with the spreadsheet 'hold time vs L1 temperature.xls'. This spreadsheet gives an approximation of cooler hold time, but is not as accurate as the detailed spreadsheet for cooler design created by CEA (as used in AD2.2.1).

4. ANALYSIS

A number of analysis cases have been run, assuming various Level 1 and Level 2 input powers. The results from the DTMM provide cooler temperatures at both Level 1 and Level 0, together with cooler evaporator total load (detector load plus internal cooler parasitics). These parameters are inserted into the spreadsheet which produces approximations of hold time and ultimate cold tip temperature.
The hold time is also dependant on the pump temperature, which is in turn a function of Level 0 sink temperature and strap conductance. However for the purposes of this analysis the pump temperature is calculated assuming Level 0 interfaces as defined in AD2.1.1, with some recent updates as follows:

- to include cooler thermodynamic loads and
- to assume a constant Helium mass flow rate in the Herschel cryostat of 2.30378mg/s.

5. RESULTS

The following table and plots have been produced showing the variation in hold time with both Level 1 temperature and JFET input power.

L2 Component Power	L1 Component Power	Level 2 Temperature (#10000)	Level 1 Temperature (#4000)	Level 0 Pump Temperature (#6200)	Cooler Load	Cold Tip Temperature	Hold Time
(mW)	(mW)	(K)	(K)	(K)	(microW)	(mK)	(hrs)
80	4.1	15.298	7.324	1.965	38.28	306.28	37.9
60	4.1	14.019	6.3565	1.9521	31.77	299.77	45.5
50	4.1	13.231	6.039	1.948	30	298	48.2
33	4.1	11.98	5.554	1.9425	27.53	295.53	52.4
14	4.1	10.519	5.0155	1.9368	25.17	293.17	57.3
14	8.4	10.726	5.4506	1.9414	27.02	295.02	53.4
14	5.4	10.59	5.1519	1.9382	25.7	293.7	56.1
14	3.4	10.491	4.924	1.9358	24.97	292.97	57.7
14	2.4	10.453	4.8007	1.9346	24.48	292.48	58.9
14	0	10.3446	4.5362	1.9321	23.48	291.48	61.4
1	2.4	9.4316	4.44385	1.9312	23.14	291.14	62.3
1	0	9.3222	4.165	1.9287	22.21	290.21	64.8

Table 5.1: Analysis Case Definition