BOEING

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8 Jan., 2001
REF. AEPV-12NFR Test 12/12/00

SUBJECT: High Power Test Report
A3 Chamber High-Power
Absorber

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TEST SUMMARY:

A section of high-power absorber used on the walls in the A3 Chamber was RF radiated. In summary, an applied power flux density should not cause the absorber temperature to exceed 380 °F. Use the chart on page 4 to determine the increase in temperature versus an applied flux density to the absorber.

Even though the test did not cause the absorber to smoke/burn, it was considered a success since a temp. of 600 degrees F was achieved. Whereby, we would not want to exceed 600 degrees in a chamber. Likewise, the max. absorber temperature given above is below the temperature where the absorber is likely to outgas.

Absorber manufacturer: Cuming Microwave Corporation
Absorber model # C-RAM SFC-HPHC-1/4"-12P ("-12" for 12 inches tall). Color = blue, coating = phenolic.

OBJECTIVE:

Determine what power flux density level (W/in^2) the absorber could absorb without smoking or catching on fire.

TEST GUIDELINES:

The frequency used for the test was 4.208 GHz. The C-band frequency was used because it penetrates the absorber more where there is less convection cooling capacity.
An infrared camera was used to measure the surface temperature in both tests.
The maximum allowable flux density is reduced by 3 dB to allow for margin to the burn point.

TEST DESCRIPTION:

The system setup utilized a synthesizer and a 200W TWT to send power through one filter of a RF multiplexer. The power from the multiplexer went through a coupler then on to the Standard Gain Horn (SGH) to radiate at the absorber. A reference measurement was taken at the SGH input then compared to the coupler measurement (delta = 34.75 dB) so that the power (Watts) applied to the SGH would be known. The SGH center was boresighted on the tip of the absorber. The tip of the middle cone of the absorber was placed 3" away from the SGH. The absorber was radiated inside a fume

hood for fire safety. See "High Power Test Report, TST Chamber Absorber (AEPV-12NFR)" dated 12 Dec. 2000 figure #3

1.2) System Calibration and Verification:

The power flux density at the absorber was calculated using a Mathcad (RAD lab series 1.2) simulated equation for the SGH (diameter = 6"). The resultant flux density level (on axis flux distribution) at 2 inches into the absorber is shown in figure #1 of "High Power Test Report, TST Absorber (AEPV-12NFR)" dated 12 Dec. 2000. From the figure, the power flux density at the absorber is calculated by multiplying power at the SGH output by .077. The calculation was verified by measuring the power flux density at the SGH output with a Narda Electromagnetic Radiation Monitor Probe (sensor). The Narda probe measurements were within 1 dB of the calculated.

2.0) High Power Tests:

No thermal couples could be used in the honeycomb structure. Therefore, only the fume hood temperature (TC#4) was recorded. With the use of the infrared camera, we believe an accurate breakdown temperature was measured.

Test: Starting at .01 W/in^2, the RF power was stepped in 1-3 dB increments. Usually, the TC's would stabilize within 5 minutes of reaching the next higher power level.
At 15.36 W/in.^2, the absorber started to outgas. The strong odor persisted for the remainder of the test.
At a power flux density of 27.32 W/in^2, the test was stopped because the RF setup could not deliver more power. The maximum temperature recorded was 612.9 °F using the Infrared Camera.

3.1a) Fire Prevention Procedure:

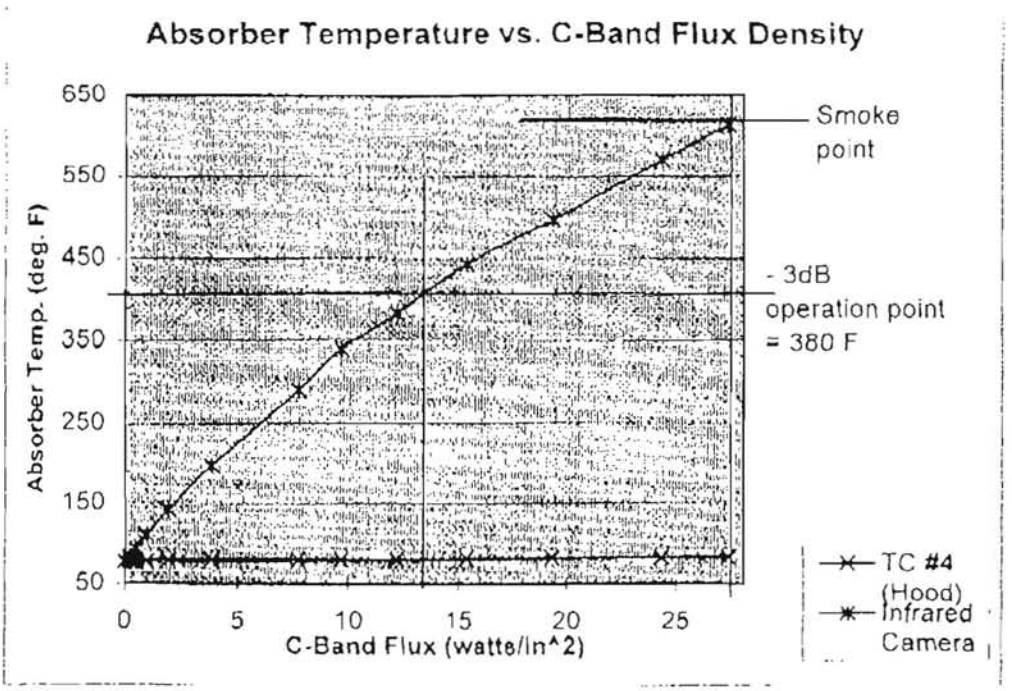
The fume hood was partially closed. All the openings of the fume hood were taped to control the oxygen intake in case the absorber caught on fire and to reduce any spilling of water if the sprinkler turned on. TC #4 showed the fume hood temperature at its fire sprinkler so that we would know if the sprinkler would turn on (rated at 165 °F). The worst case scenario was if the absorber caught on fire. In that case, the procedure was 1) turn off the RF; if the smoke or fire persisted, 2) turn on the fume hood's nitrogen gas; if the fire persisted, 3) turn on the fume hood's water (hose pointed at absorber); if the fire persisted, 4) the fume hood was to be opened and a Halon fire extinguisher (on hand) would be used to spray the fire; and as a last line of defense, 5) the fume hood's sprinkler would turn on and flood the fume hood.

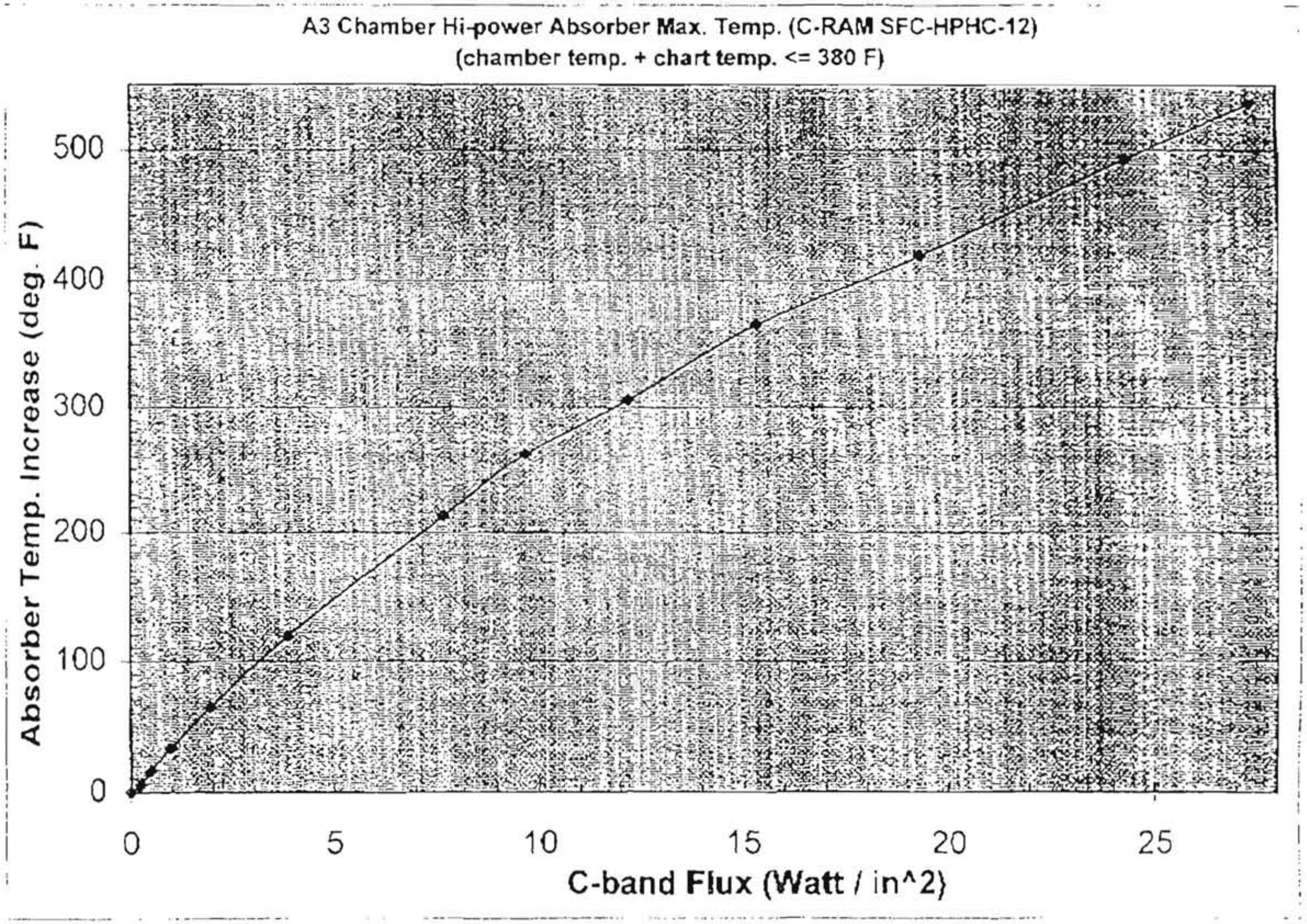
4.0) DATA SUMMARY:

The following table is the data recorded during the test. Also included is a copy of the manufacturer's technical data sheet.

A3 Chamber High-Power Absorber
Hi-Power Test
(Absorber: C-RAM SFC-HPHC-1/4"-12P)

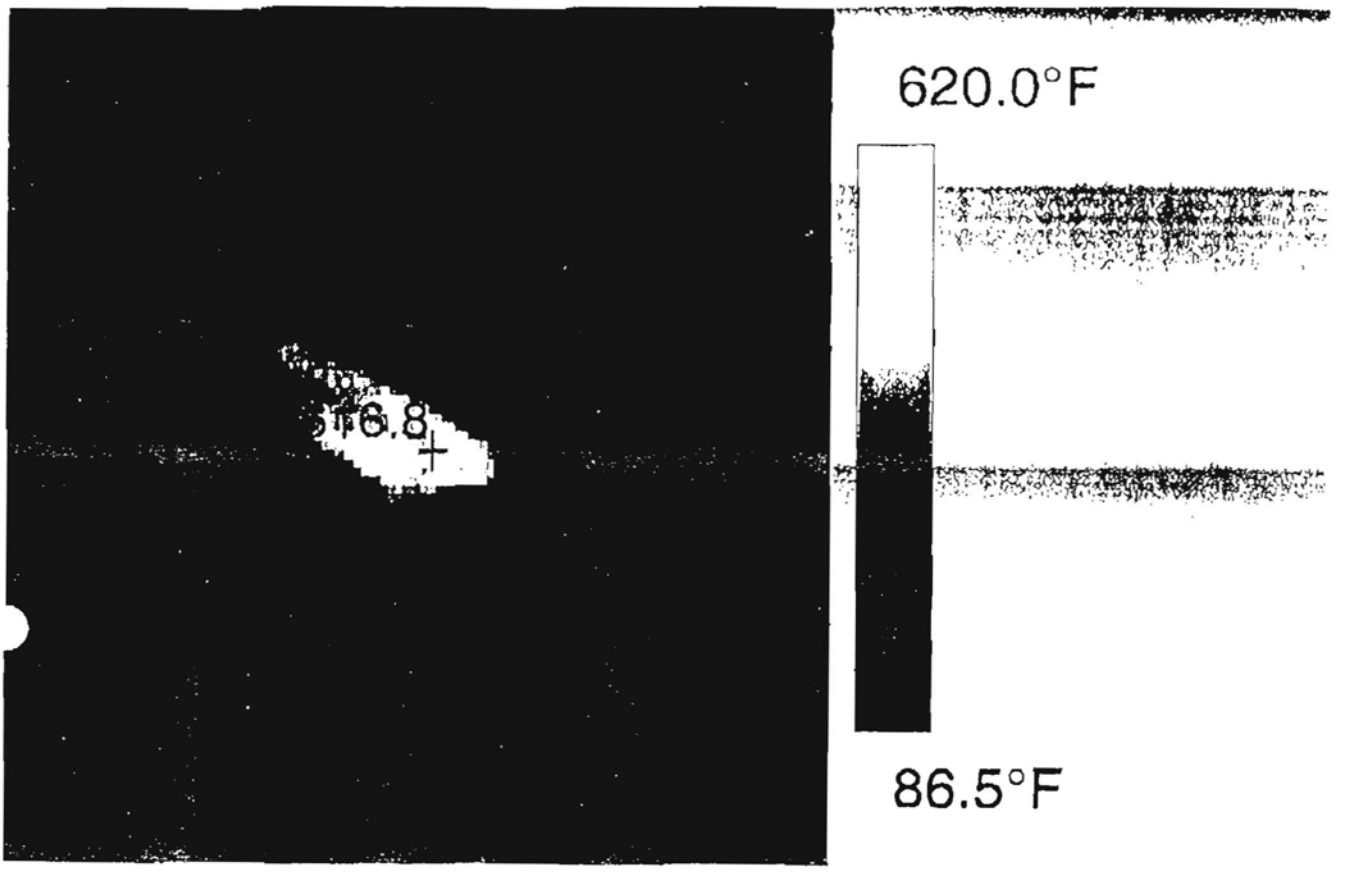
Pwr at SGH Output (Watt)	Power Meter (dBm)	Narda Measured Radiated Pwr at Absorber Tip (W/in^2)	Calculated Radiated Pwr at TC #2 Location (W/in^2)	TC #4 (Hood)	Infrared Camera	Read Time	Absorber temp increase above ambient
0.1	20.00	0.01	0.01	78.2	77.3	3:28	0.0
3.2	35.00	0.31	0.24	78.4	83.1	3:33	5.8
6.3	38.00	0.62	0.49	78.2	93.4	3:38	16.1
12.6	41.00	1.25	0.97	78.4	110.6	3:43	33.3
25.1	44.00	2.49	1.93	78.9	141.8	3:48	64.5
50.1	47.00	4.96	3.86	79.1	196.5	3:53	119.2
100.0	50.00	9.89	7.70	79.5	290.3	4:00	213.0
125.9	51.00	12.46	9.69	79.8	339.6	4:07	262.3
158.5	52.00	15.68	12.20	80.2	382.9	4:12	305.6
199.5	53.00	19.74	15.36	81.1	442.4	4:18	365.1
251.2	54.00	24.85	19.34	81.5	496.4	4:23	419.1
316.2	55.00	31.29	24.35	82.5	570.1	4:33	492.8
354.8	55.50	35.10	27.32	83.1	612.9	4:42	535.6




A3 Chamber Hi-power Absorber Max. Temp. (C-RAM SFC-HPHC-12)
(chamber temp. + chart temp. <= 380 F)
Absorber Temp. Increase (deg. F)
500
400
300
200
100
0
0
5
10
15
20
25
C-band Flux (Watt / in^2)

A3 Absorber Hi-power Test
Test #1, C-RAM HPHC-12
Infrared Camera Picture

55.5 dbm



Analysis

Label	Temp.	Max
Image		616.9
hot spot	**616.8**	

Object Parameters

Label	Emis.	Dist.	Amb.	Atm.	Trans.	Hum.	Ref.
Image	0.92	4.0 ft	79.0	68.0	0.99	50%	

Image

Name	Value
Date	1/11/01
Time	4:42:06 PM
File name	55_5dbm0002.seq
Title	
Type	ThermaCAM SC300 NTSC
Serial number	15800006
Lens	24