Report Date:	25 September 2014		
Test Started:	21 July 2014		
Test Finished:	27 July 2014		
Purchase Order:	PO dated 06/06/14	Order Line:	1
Qualtest Quote:	27831C	Quote Line:	6

Qualtest operates under the relevant quality system requirements of ISO 9001:2008 for providing testing services as recognized by TRC Registration Certificate # 00018.

SALT FOG TEST REPORT

FOR THE

STEEL COUPONS

TESTING PERFORMED BY:

QUALTEST, INC.
5325 Old Winter Garden Road
Orlando, Florida 32811-1520

Website: www.qualtest.com

FOR:

ELF LOGISTIC USA, LLC/
NANOPROTECH TM
2169 S. Tamiami Trail
Osprey, Florida 34229

TEST REPORT PREPARED BY:

Mary Webb, Technical Writer

APPROVED BY:

Brooke Swartzlander, Project Manager

NOTE

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ABSTRACT

The Steel Coupons were subjected to salt fog exposure in accordance with the RTCA/DO-160G, Section 14.3.6.7, Category T, Severe Salt Fog test. The test hardware was exposed to forty-eight (48) hours of salt fog followed by a twenty-four (24) hour dry out, and then repeated once more. A visual examination of the test hardware after application of the salt fog environment revealed varying degrees of corrosion on some of the coupons. The test hardware was returned to the customer for evaluation following test completion.

REPORT REVISION RECORD

REV.	DATE	DESCRIPTION OF CHANGE
NA	2014-07-30	ORIGINAL RELEASE
A	2014-09-25	Removed superfluous information as directed by Valeriya Mihaylova email dated 09/24/2014 15:41

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SALT FOG TEST SUMMARY

Responsible Test Conductor: Jeremy Hill

1.0 TEST HARDWARE

Nine (9) 4"x4" Steel Coupons:

- One (1) Control Sample
- One (1) Liquid Wrench Sample
- One (1) DuPont Sample
- One (1) L.C.Wax Alumaslick Sample
- One (1) Nanoprotech Sample
- One (1) Ultra Lube Sample
- One (1) WD-40 Sample
- One (1) Blaster Sample

2.0 TEST REQUIREMENTS WITH TOLERANCES

The purpose of this test is to determine the effectiveness of protective coatings and finishes on materials. It may also be applied to determine the effects of salt deposits on the physical and electrical aspects of materiel.

- Perform forty-eight (48) hour of salt fog exposure at 35±3°C, followed by twenty-four (24) hour dry out at ambient temperature with relative humidity <50%.
- Repeat initial step one more time for a total of ninety-six (96) hour salt fog exposure.
- Test articles are to be photographed at post 1st 48 hour run, post 1st 24 hour dry out, post 2nd 48 hour run, and post 2nd 24 hour dry out.

Tolerance:
Standard Ambient: 25±10°C, 20 - 80% Relative Humidity, Site Pressure
Distilled water is used for salt fog production to minimize any undesired contaminants

2.1 Test Specification:

RTCA/DO-160G, Section 14.3.6.7, Category T, Severe Salt Fog
Valeriya Mikhaylova, Nanoprotech USA, email dated 7/7/2014 at 3:00 PM: take photographs after each 48-hour exposure

3.0 TEST SETUP

TABLE 1: QUALTEST FURNISHED MEASUREMENT & TEST EQUIPMENT

(Measuring instruments used in testing are calibrated per ANSI/NCSL Z540-1 and/or ANSI/NCSL Z540.3, and are NIST traceable)

Asset #	Item	Manufacturer	Model Number	Calibration Due
100073	Chart Recorder	Honeywell	DR450T	2014-10-12
100140	pH Meter	Fisher Scientific	Accumet Basic	Before Use
100140-1	pH 4 Buffer	Inorganic Ventures	LOT#G2-WCS02024	2015-06-01
100140-2	pH 7 Buffer	Inorganic Ventures	LOT#G2-WCS02045	2015-06-01
100473	Humidity Sensor	E+E Elektronik	EE23	2014-11-29
100476	Chart Recorder	Honeywell	DR45AT	2014-10-01
100695	Scale	A&D	FX-300i WP	2014-08-07
100821	Temp/Humid Chamber	Russels	RD-16-2-2-AC	NA
100897	Salt Fog Chamber	Singleton	SCCH23	NA
101246	Thermo/Hygrometer	Fisher Scientific	14-648-52	2014-10-30

TABLE 2: MATERIEL IDENTIFICATION

Type	Manufacturer	Lot Number	Expiration Date
Sodium Chloride	Morton	RI13032049	N/A
Sodium Hydroxide	Ricca	2301881	01 Jan 2015
Distilled Water	Crystal Springs	N/A	N/A

TABLE 3: CHART RECORDER SETUP

Asset #	Channel	Pen	Type of Sensor	Function
100073	01	01	100 Ω RTD	Monitor salt fog chamber air temperature (°C)
100476	01	01	100 Ω RTD	Monitor dry-out chamber air temperature (°C)
100476	04	04	Humidity Transducer	Monitor dry-out chamber relative humidity (%)

The salt solution was prepared using 95 parts (by weight) of distilled water and 5 parts (by weight) of sodium chloride. The sodium chloride had a minimum purity of 99.95%, as certified by the manufacturer. The pH was maintained between 6.5 and 7.2 using sodium hydroxide, as needed. Chamber operation to specification was verified prior to installing the test hardware. The test hardware was placed on a non-corrosive grate in the chamber.

4.0 TEST DESCRIPTION

4.1 Non-Qualtest Personnel, Including Organization, Present for All or Part of the Test:

None

4.2 Powered/Operational State of the Hardware and by Whom:

The test hardware was not operated during the test.

4.3 Test Activities and Resulting Measurements from Observed/Recorded Data:

Atmospheric Conditions: Temp (°C): 24 Relative Humidity (%): 54 Pressure: Site Ambient

The test hardware was placed in the salt fog chamber in its normal orientation as shown in Figure 10. The test activities are summarized in Table 4.

TABLE 4: SALT FOG TEST ACTIVITIES

Date	End Time	Collection Rate Nearest to Atomizer ($ml/cm^2/hour$)		Collection Rate Farthest from Atomizer ($ml/cm^2/hour$)		pH	Specific Gravity	
							Pre-test	Post-test
07/18/14	---	Trial Run (chamber operation verified)						
07/21/14	0925	Start 2-hour precondition period						
07/21/14	1345	Start 1st 48-hour salt fog period						
07/22/14	---	1.58	1.50	1.58	1.58	6.81	1.032	1.034
07/23/14	---	1.67	1.46	1.67	1.67	6.79	1.032	1.032
07/23/14	1345	End 1st 48-hour salt fog period						
07/23/14	1350	Start 1st 24-hour dry-out period						
07/24/14	1350	End 1st 24-hour dry-out period						
07/24/14	1355	Start 2-hour precondition period						
07/24/14	1600	Start 2nd 48-hour salt fog period						
07/25/14	---	1.58	1.46	1.58	1.67	6.74	1.032	1.031
07/26/14	---	1.67	1.67	1.79	1.83	6.68	1.032	1.032
07/26/14	1600	End 2nd 48-hour salt fog period						
07/26/14	1605	Start 2nd 24-hour dry-out period						
07/27/14	1605	End 2nd 24-hour dry-out period						

Temperature and humidity data supporting Table 4 is shown in Charts 1 through 7. Figures 13 through 30 present the photographic results of test hardware salt fog exposure.

4.4 Limitations or Departures from the Test Requirements and Authorizing Source:

None

5.0 CONCLUSION

A visual examination of the test hardware after application of the salt fog environment revealed varying degrees of corrosion on some of the coupons. The test hardware was returned to the customer for evaluation following test completion.

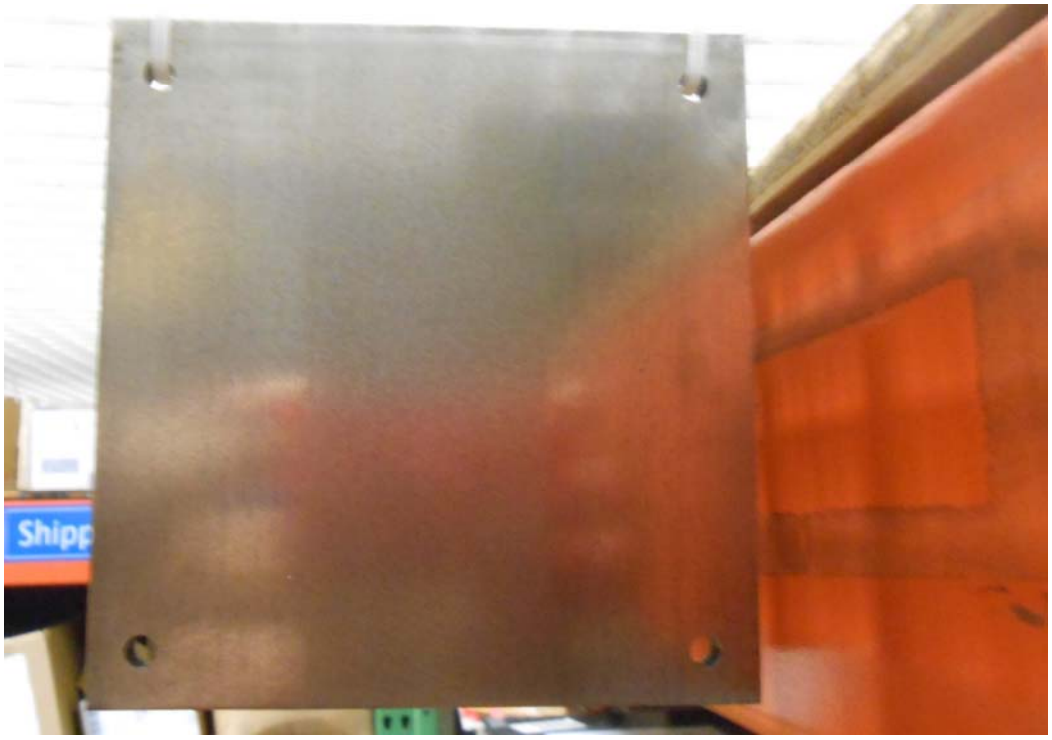

Figure 1: Control Sample appearance prior to salt fog exposure

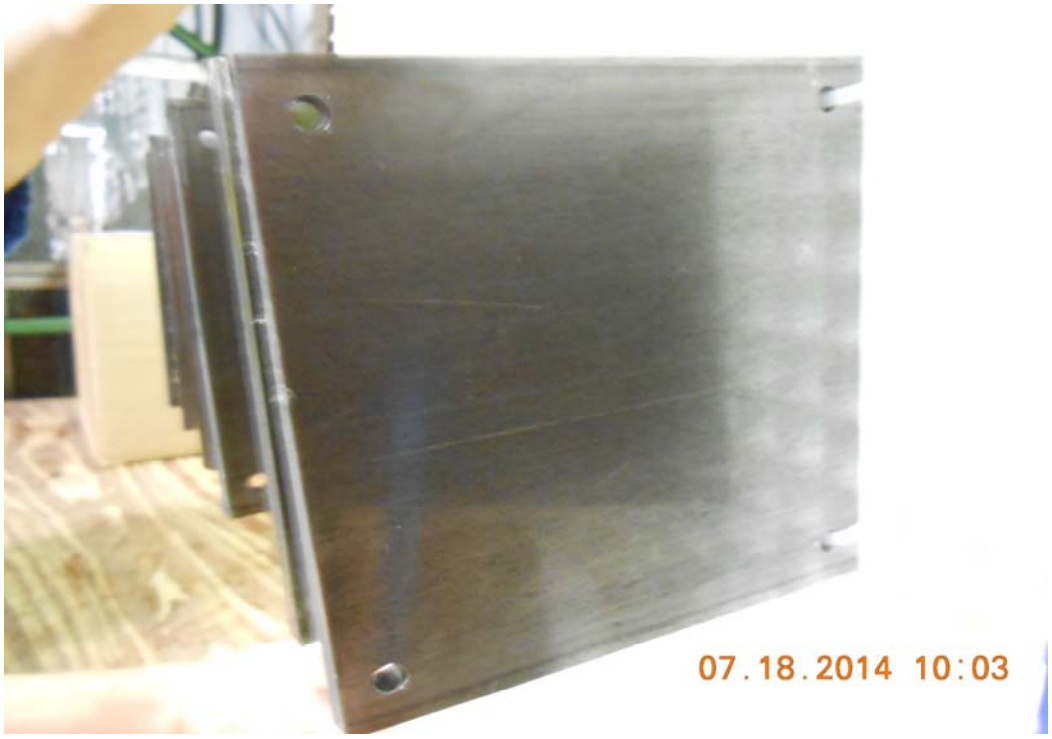

Figure 2: Liquid Wrench Sample appearance prior to salt fog exposure

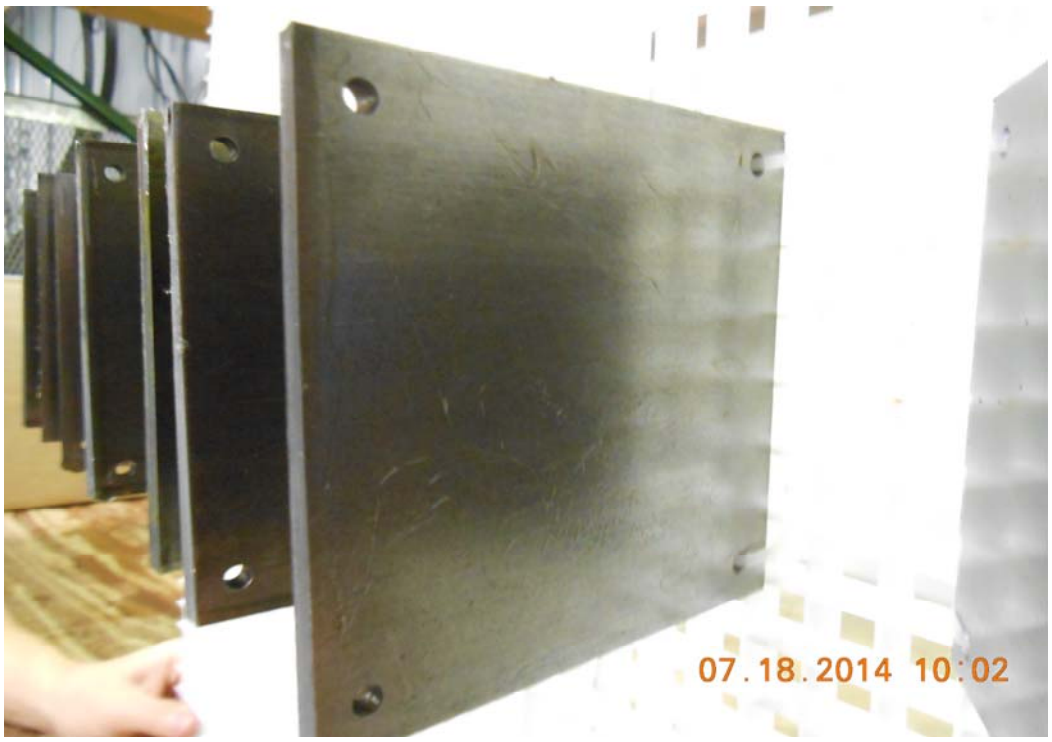

Figure 3: DuPont Sample appearance prior to salt fog exposure

Figure 4: L.C.Wax Alumaslick Sample appearance prior to salt fog exposure

Figure 5: Nanoprotech Sample appearance prior to salt fog exposure

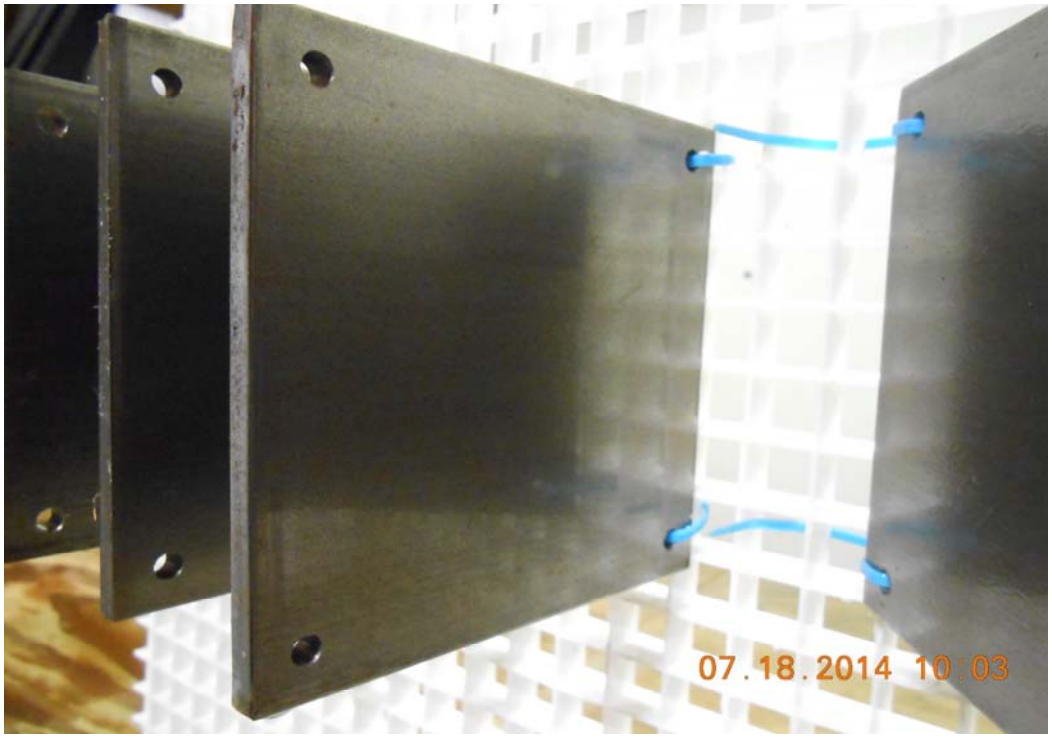

Figure 6: Ultra Lube Sample appearance prior to salt fog exposure

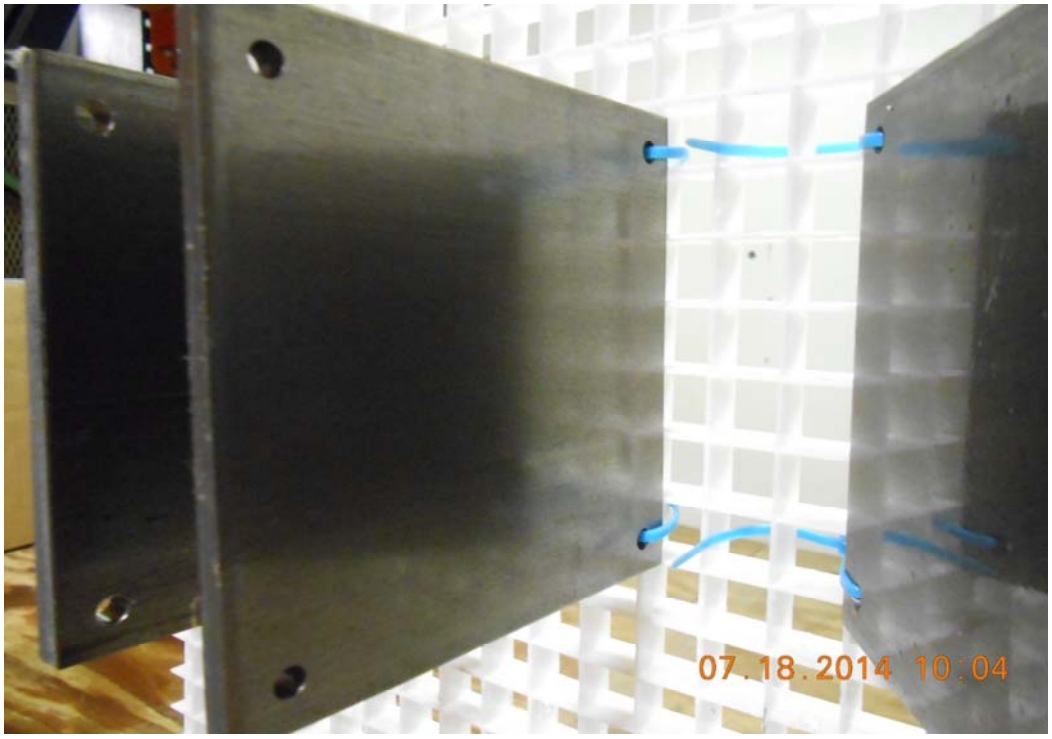

Figure 7: WD-40 Sample appearance prior to salt fog exposure

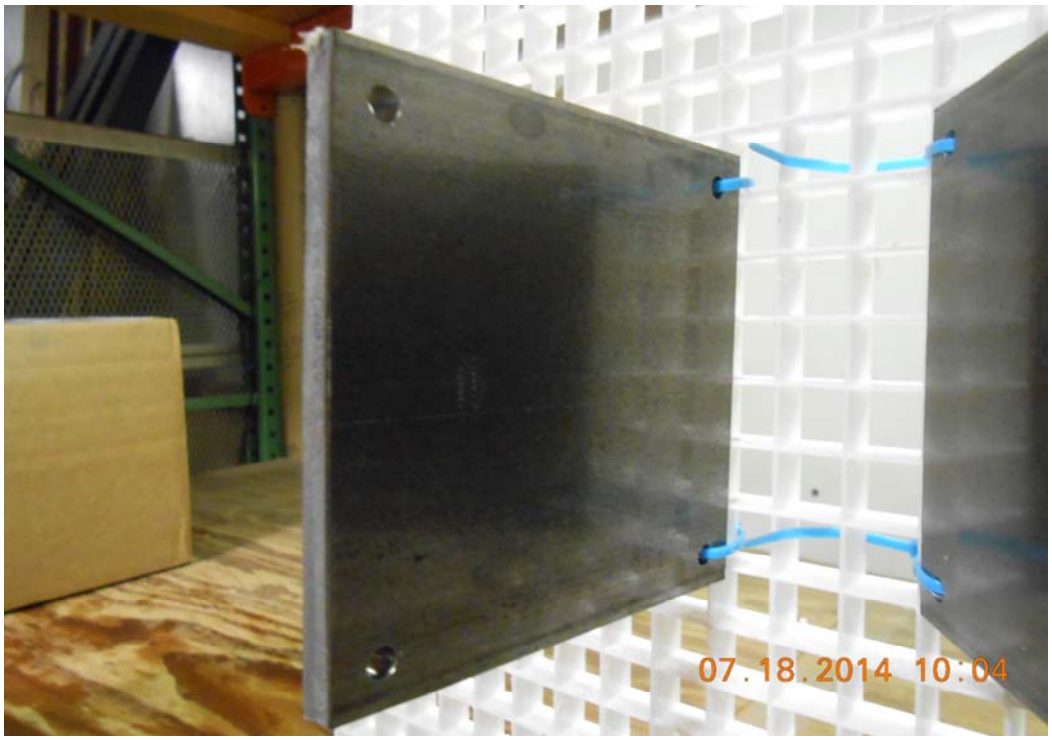

Figure 8: Blaster Sample appearance prior to salt fog exposure

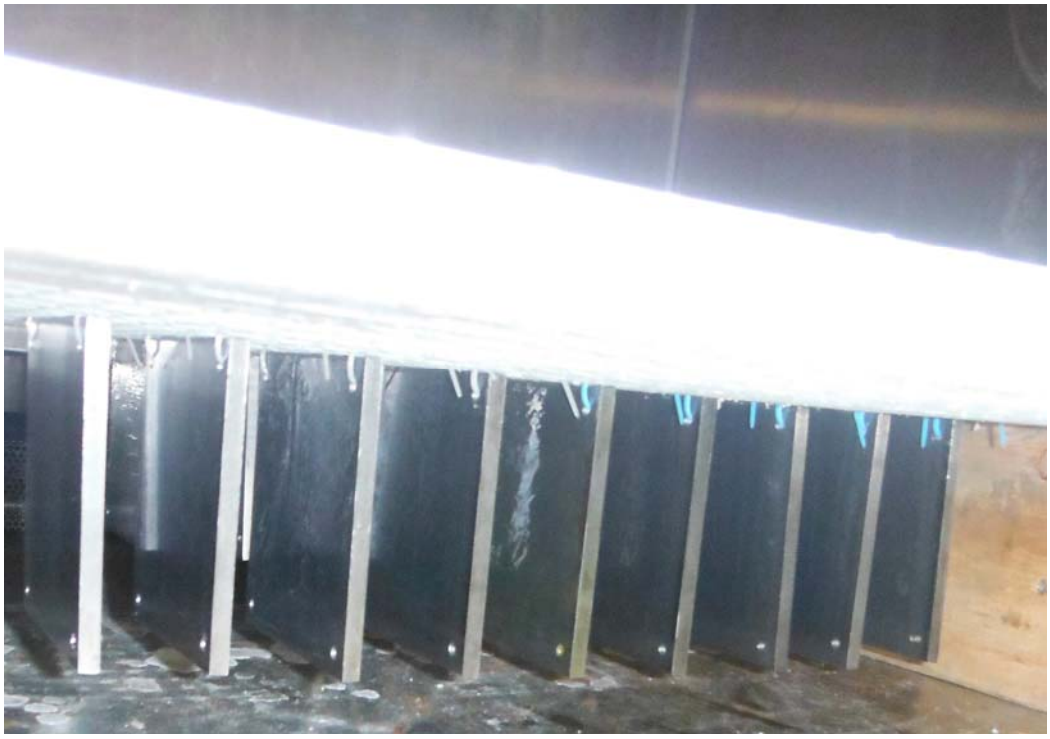

Figure 9: Test setup for the first forty-eight hours of salt fog exposure

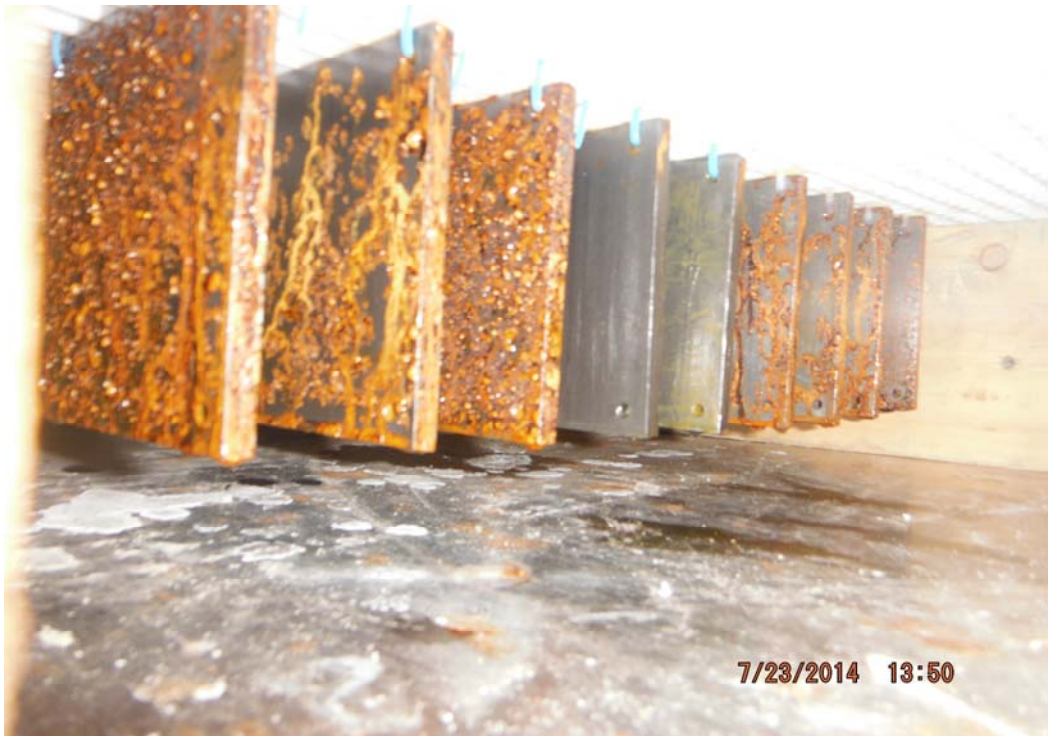

Figure 10: Coupon appearance after forty-eight hours of salt fog exposure

Figure 11: Test setup for the second forty-eight hours of salt fog exposure

Figure 12: Steel Control Sample appearance after completing salt fog exposure

Figure 13: Steel Liquid Wrench Sample appearance after completing salt fog exposure

Figure 14: Steel DuPont Sample appearance after completing salt fog exposure

Figure 15: Steel L.C.Wax Alumaslick Sample appearance after completing salt fog exposure

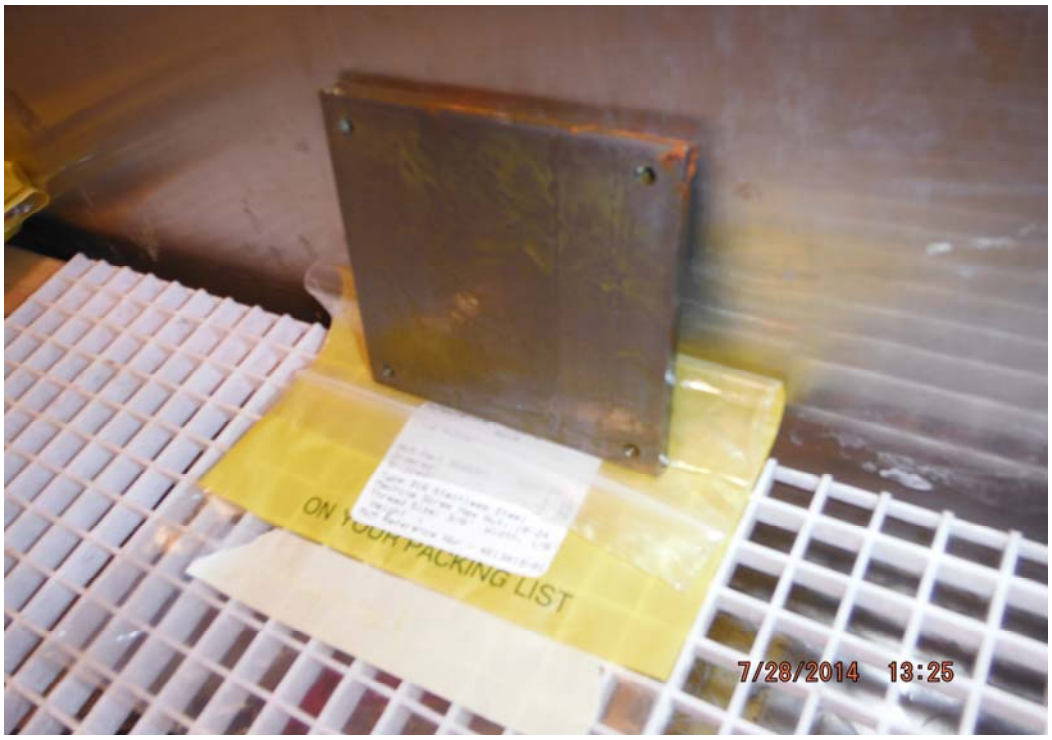

Figure 16: Steel Nanoprotech Sample appearance after completing salt fog exposure

Figure 17: Steel Ultra Lube Sample appearance after completing salt fog exposure

Figure 18: Steel WD-40 Sample appearance after completing salt fog exposure

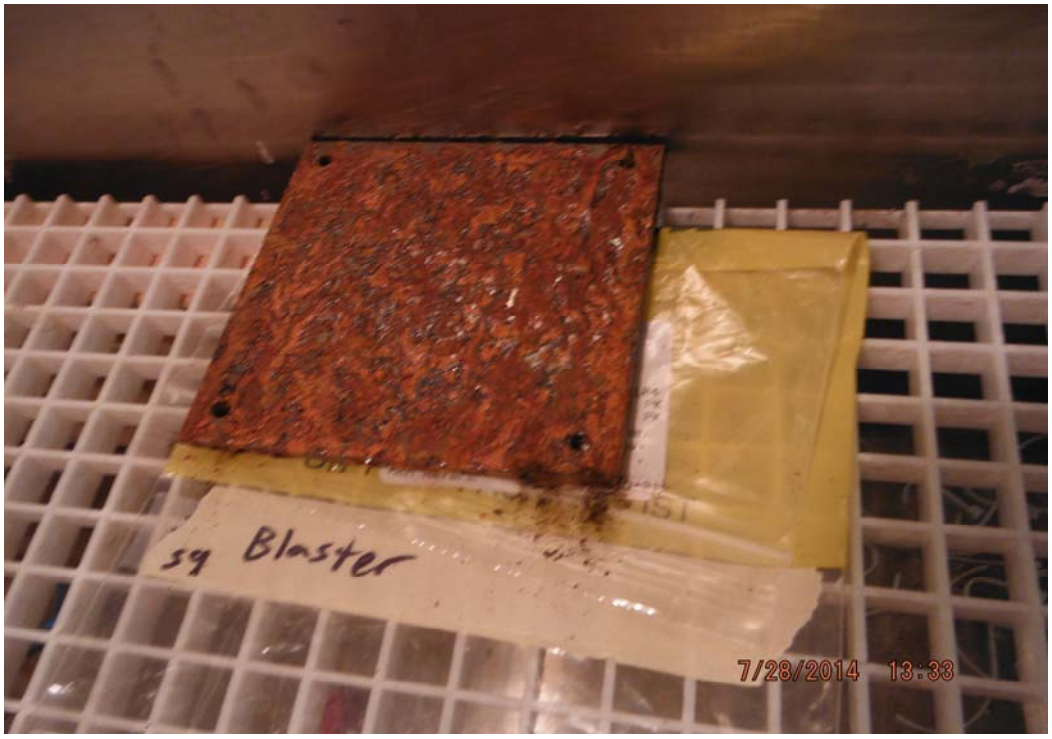

Figure 19: Steel Blaster Sample appearance after completing salt fog exposure

Appendix A: Salt fog data charts

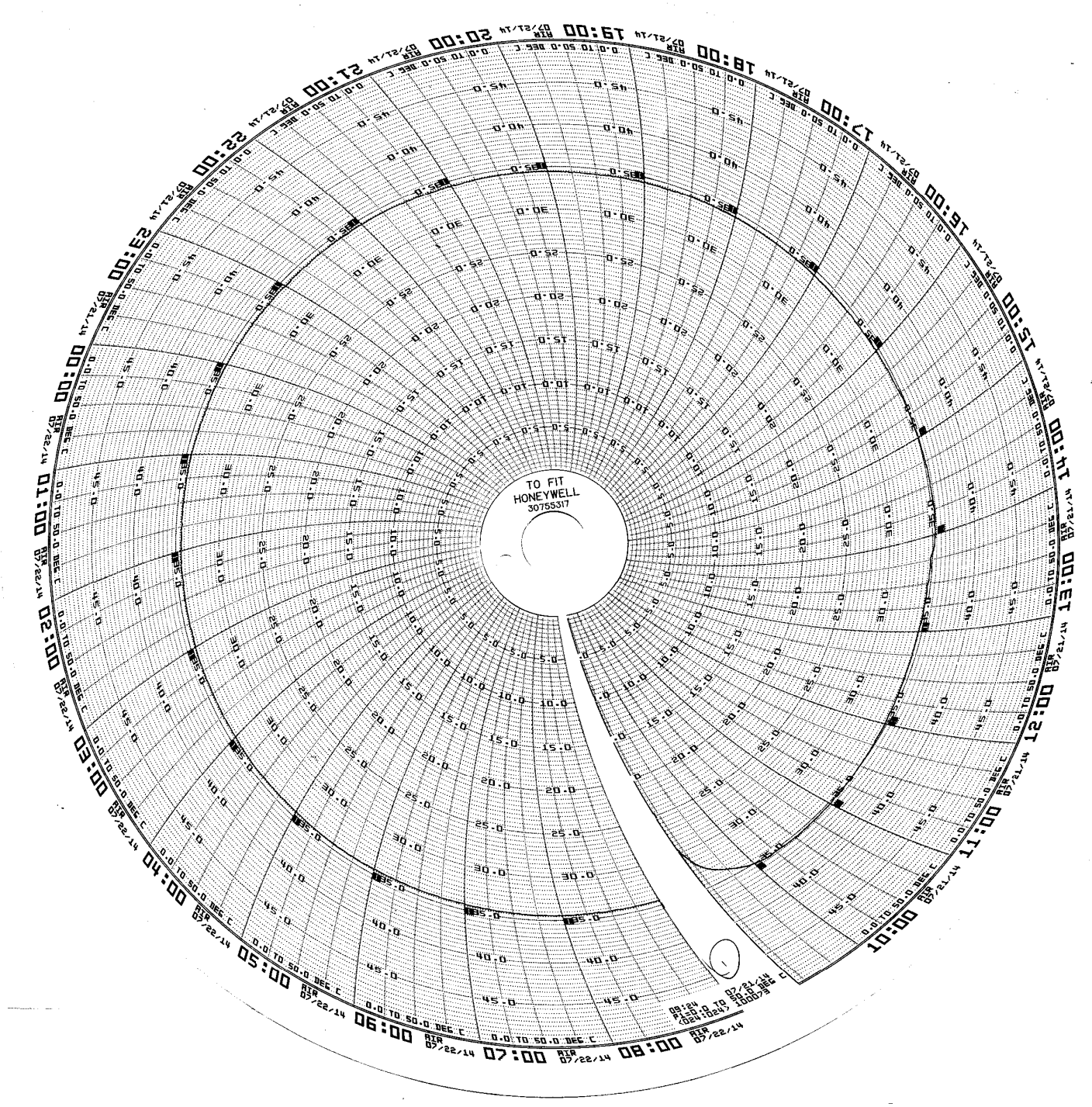

Chart 1: Salt fog temperature chart – Preconditioning and Cycle 1

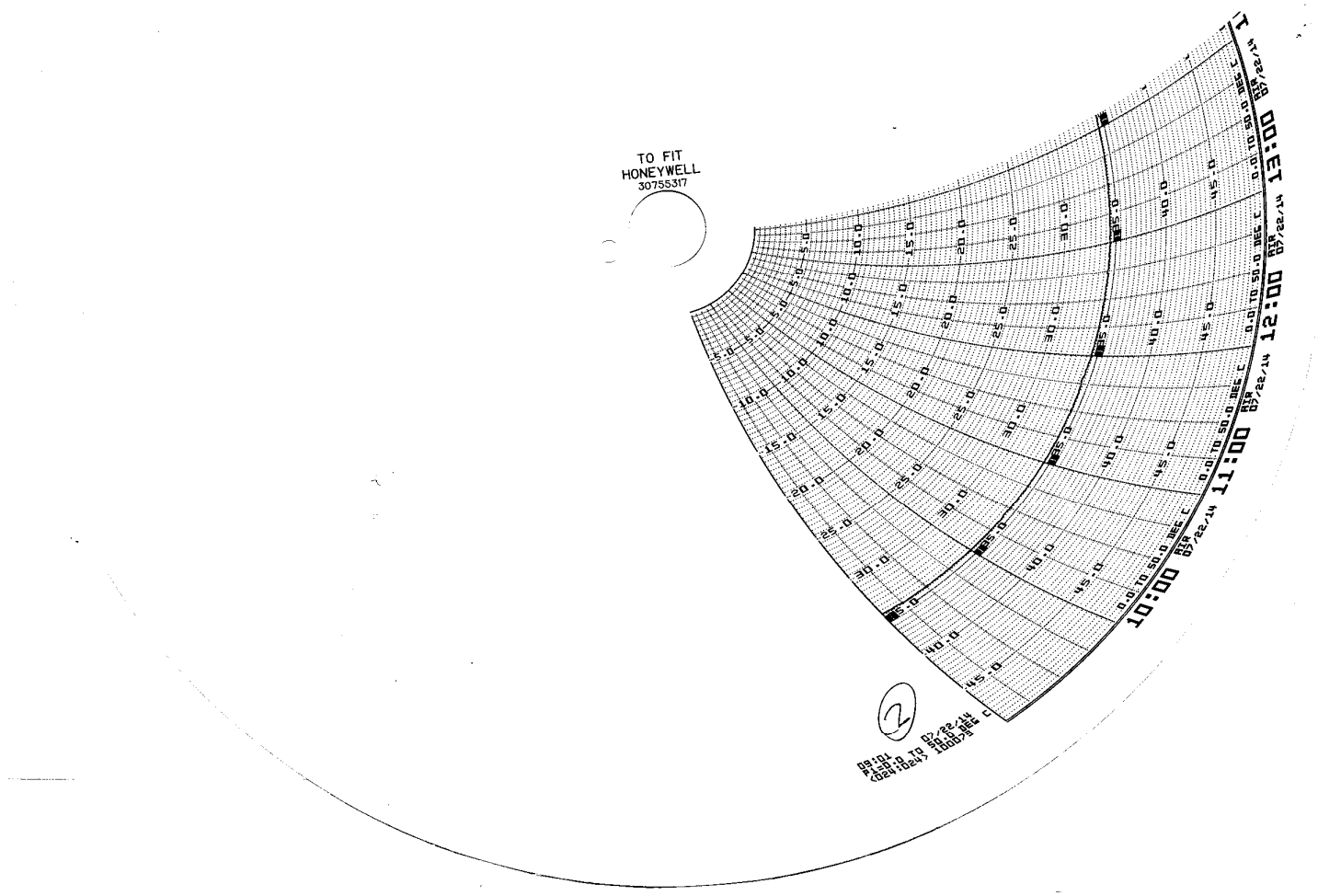

Chart 2: Salt fog temperature chart – Cycle 1

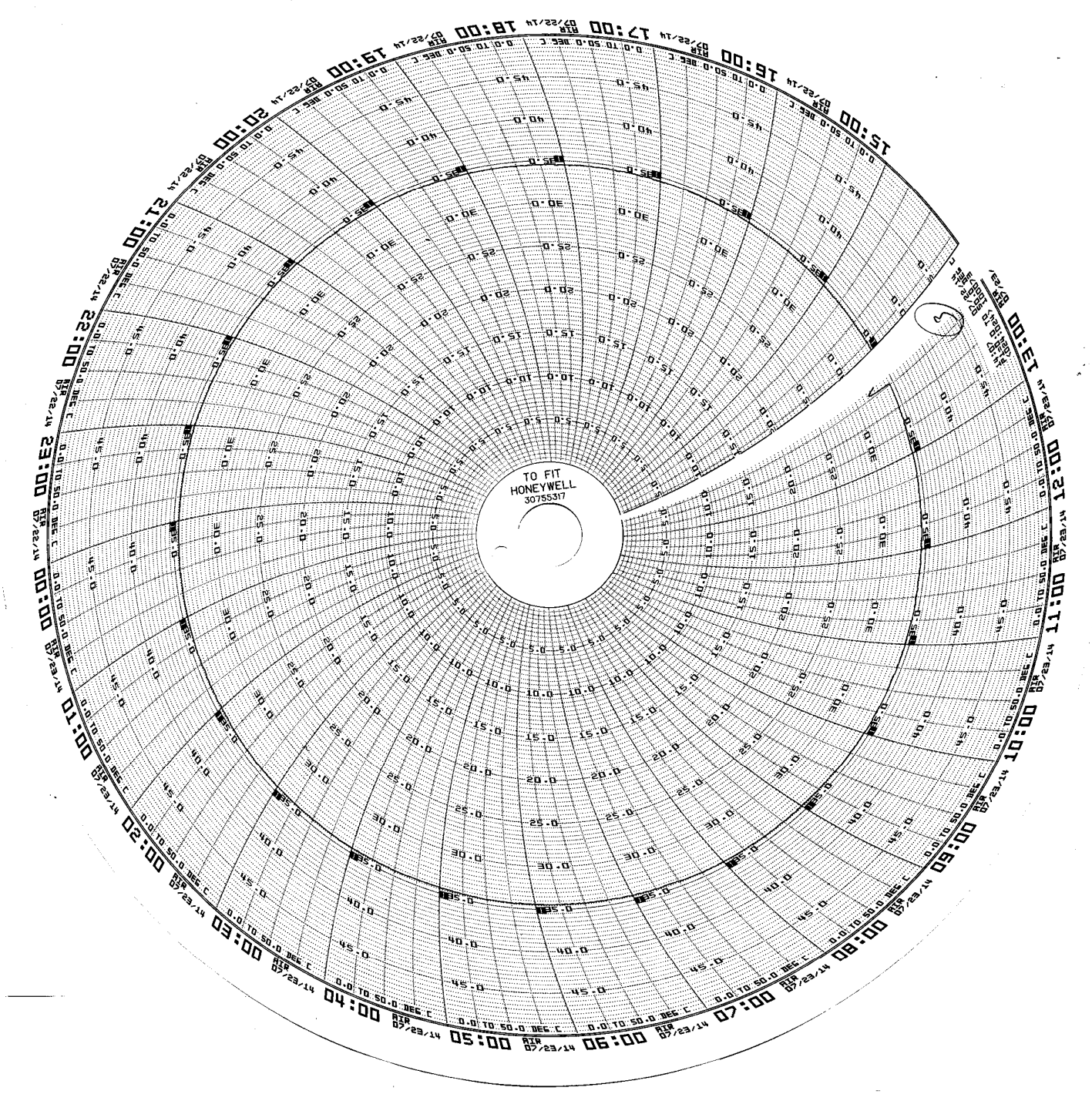

Chart 3: Salt fog temperature chart – Cycle 1

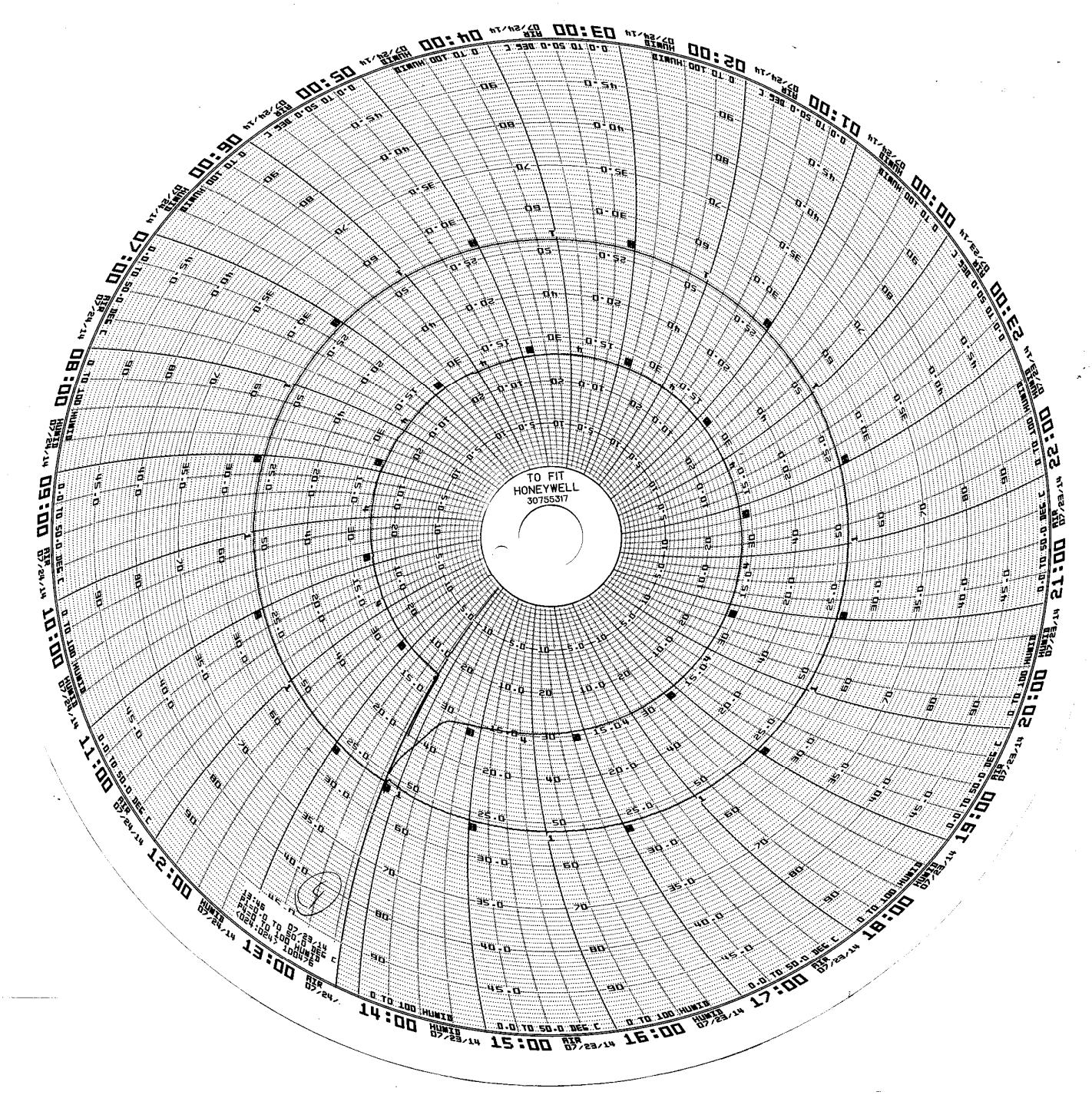

Chart 4: Salt fog dry-out temperature and humidity chart – Cycle 1

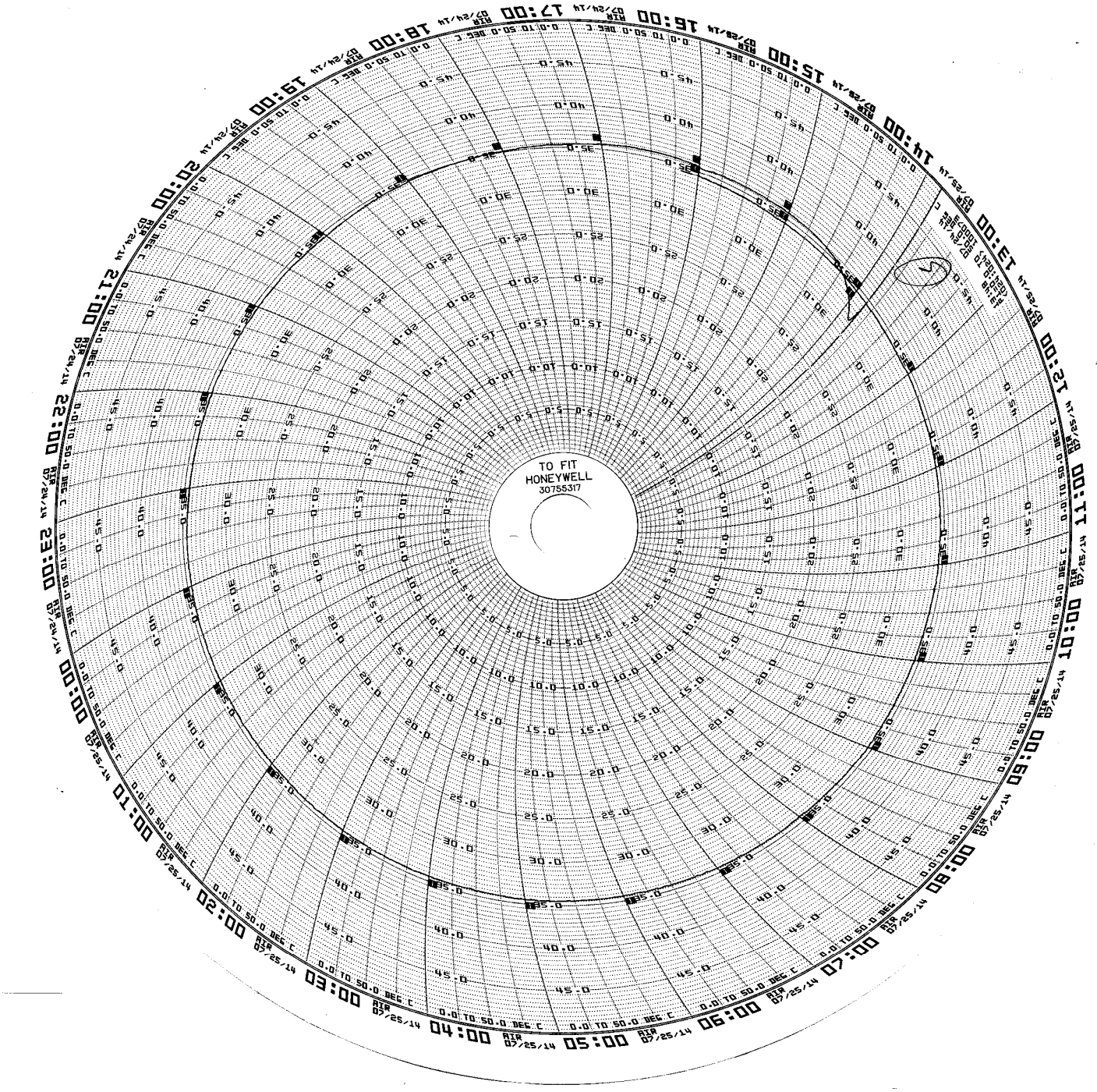

Chart 5: Salt fog temperature chart – Preconditioning and Cycle 2

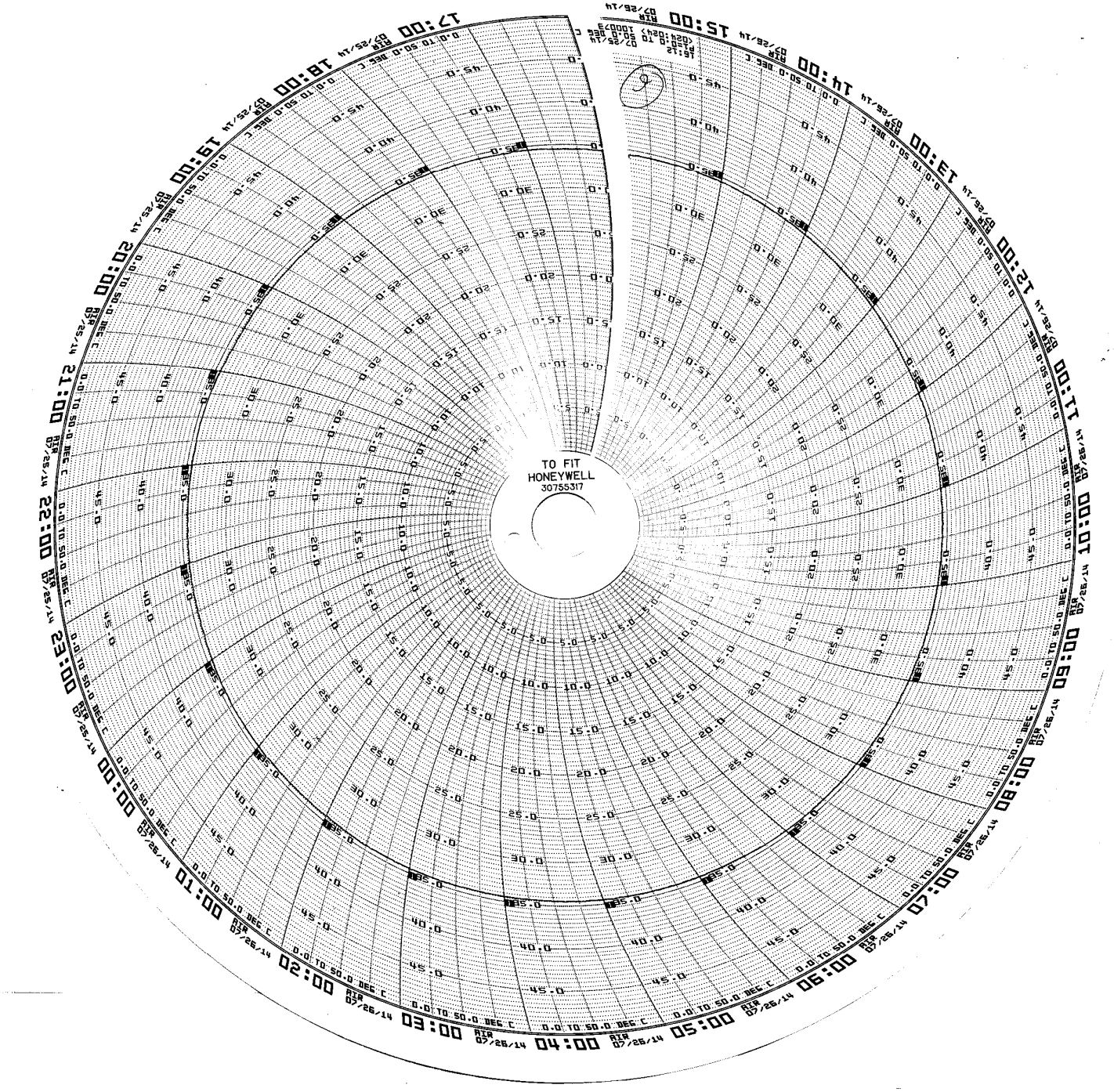

Chart 6: Salt fog temperature chart – Cycle 2

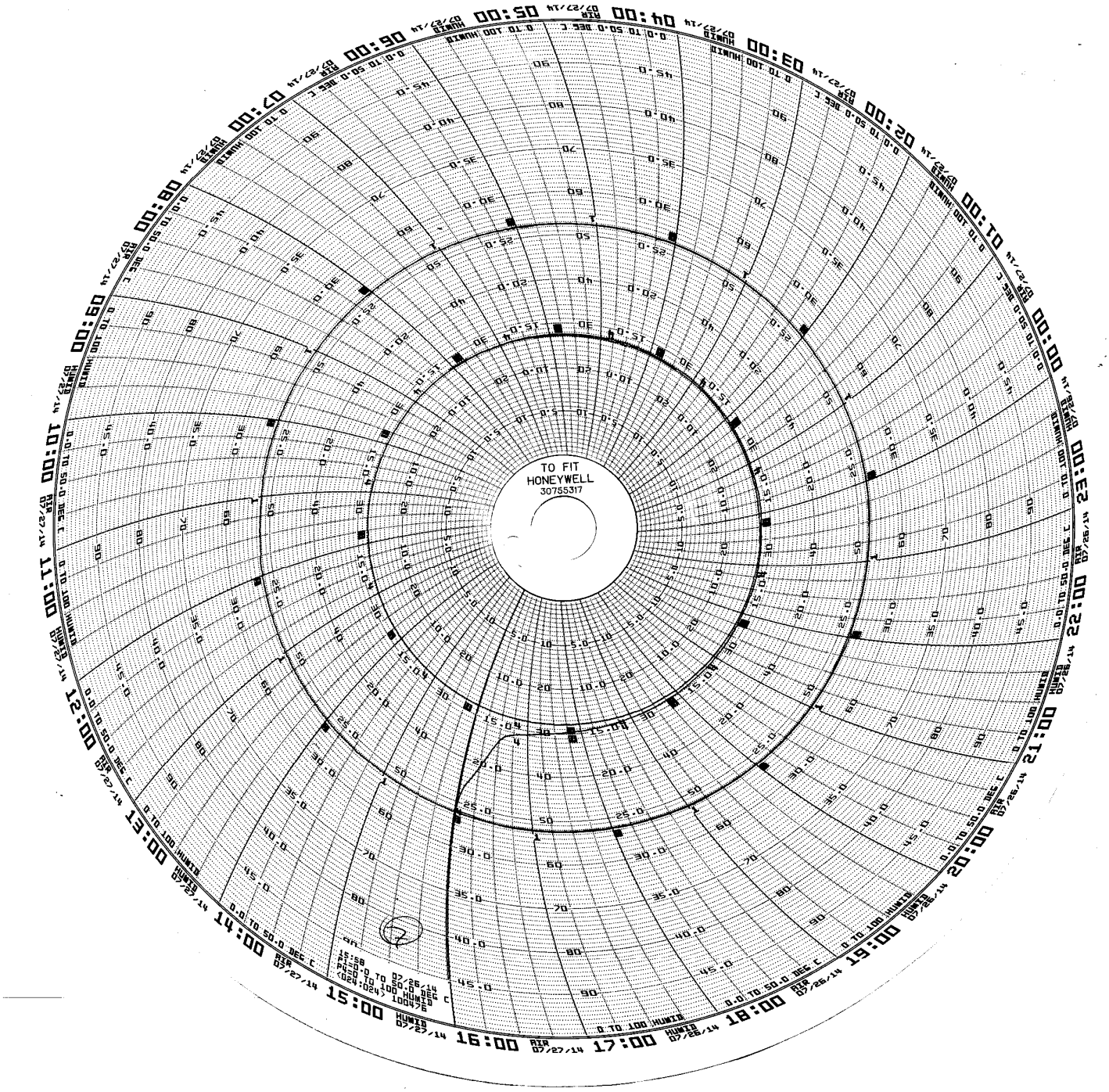

Chart 7: Salt fog dry-out temperature and humidity chart – Cycle 2