Q-FOG Rapid Ramp Heater Performance

Dave Duecker, Technical Marketing Specialist
Andy Francis, Marketing Director
Sean Fowler, Senior Technical Director
Bill Tobin, Senior Technical Marketing Specialist

Q-Lab Corporation

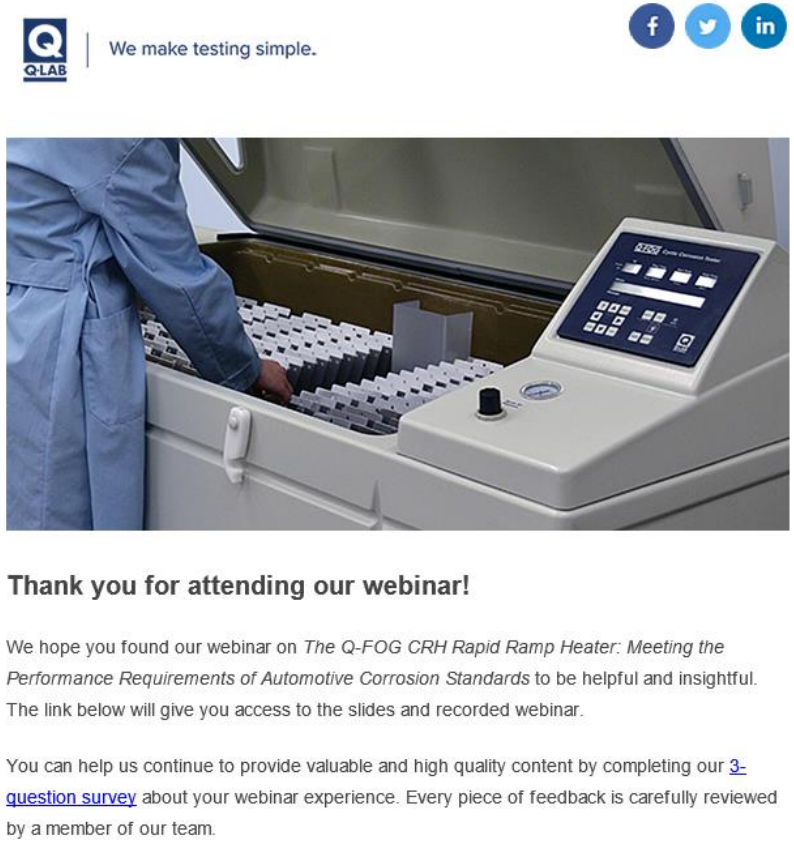
Click here to view the morning presentation.

Click here to view the afternoon presentation.

Housekeeping

You'll receive a follow-up email from info@email.q-lab.com with links to a survey, registration for future webinars, and to download the slides

- Our ongoing webinar series can be found at: q-lab.com/webinarseries
- Our archived webinars are hosted at: q-lab.com/webinars
- Use the **Q&A feature in Zoom** to ask us questions today!



Topics

- Automotive test standards now satisfied by the -HSCR configured Q-FOG CRH.
- First-Generation Cyclic Corrosion Tests and CCT type tests.
- Key factors in validating a chamber’s ability to meet the required transition times.
- Q-FOG CRH HSCR Performance

Standards Met

	Q-FOG CRH HSC	Q-FOG CRH HSCR
ISO 14993 (JASO M609)		✓
CCT-H/B		✓
CCT-C		✓
CCT-I		✓
CCT-IV		✓
Renault D17-2028 (ECC1)	✓	✓
Volvo VCS 1027, 149 (ACT I)	✓	✓
Volvo VCS 1027, 1449 (ACT II)	✓	✓
GMW 14872	✓	✓

And many more!! See LF-8131 at Q-Lab.com for extensive list.

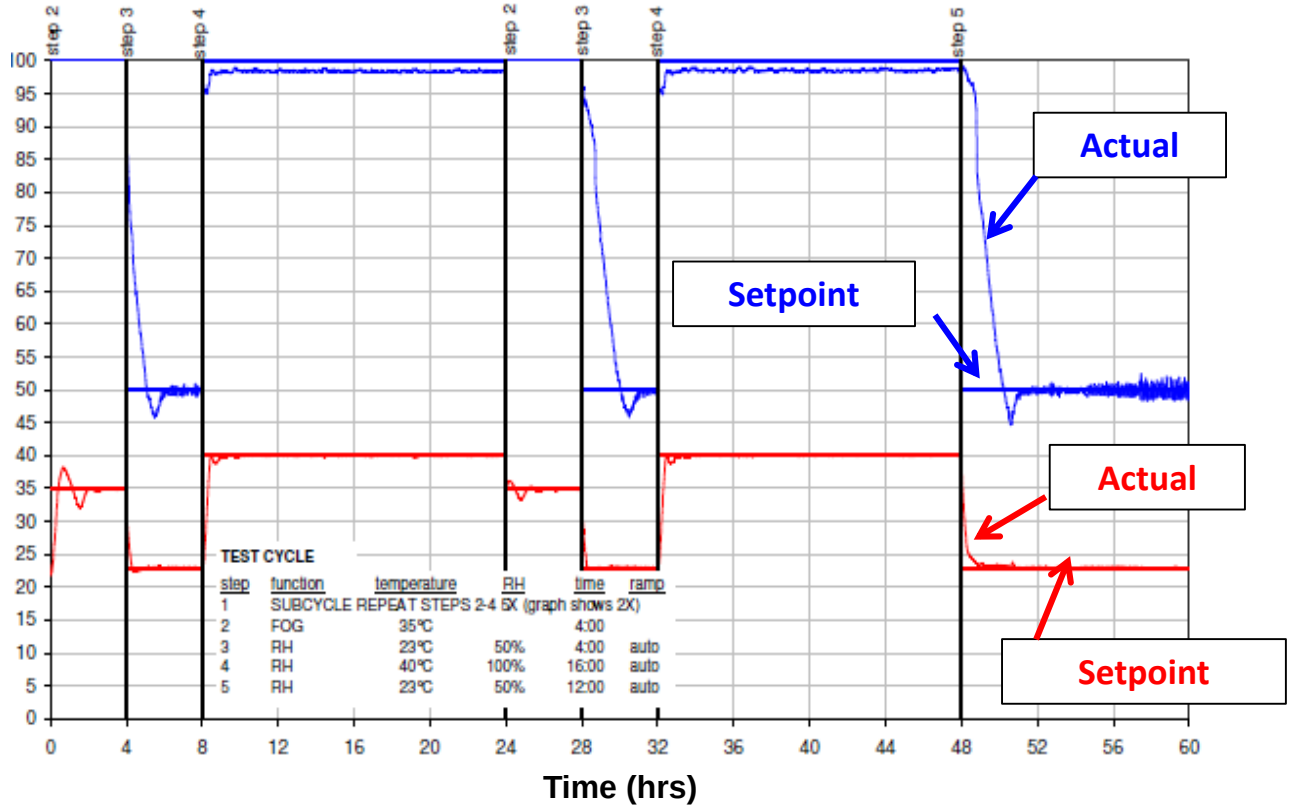
First-Generation Cyclic Automotive Tests

- Tests like PV 1210 provided a more realistic approach to corrosion testing by incorporating Dry-Off and Wetting phases to typical Salt Fog tests.
- When first introduced in the 1980's, conditions were conducted in separate chambers
  - Conventional Salt Fog Chamber
  - Oven or Ambient Lab
  - Humidity Chamber
- Salt solution is still 5% NaCl
- All tests followed a general procedure of *Fog – Dry-off – Wetting*

PV1210 Cyclic Corrosion Test

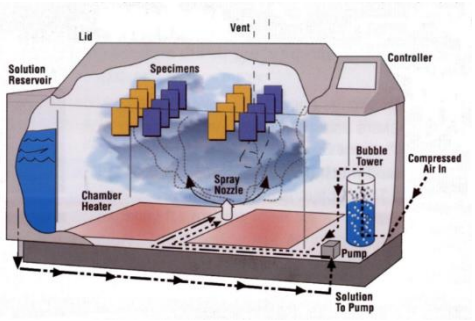
Chamber RH (%)

Chamber Temp (℃)



Three Chambers, One Test

Lab Technician moves specimens from one environment to another – potential source of variability



Automated Cyclic Automotive Test

- First Cyclic Corrosion Test written to be automated and operated in a single chamber was from the Japanese Automobile Standards Organization (JASO) M609/M610 (CCT I, II), published in 1991
- Emphasized rapid transition times to minimize test variability
- Became an international standard, ISO 14993, in 2001.
- Many Asian automotive OEM's used similar cyclic conditions to develop their own Cyclic Corrosion Tests with rapid transitions.
- Commonly referred to as CCT tests.

Validating Chamber Performance

Chamber Volume

- Q-FOG CRH HSCR is available in two sizes, 600 L or 1100 L
  - 75 x 150 mm Panel Capacity
    - 600l – 160 quantity
    - 1100l – 240 quantity
- Smaller chambers may be able to reach temperature quicker, due to less volume, but sacrifice chamber capacity.
  - ISO 14993 (JASO M609) requires chamber to be minimally 400 L
  - Many automotive CCT standards do not list a requirement

Verify that the chamber is sufficient size.

Validating Chamber Performance

Test in a full chamber

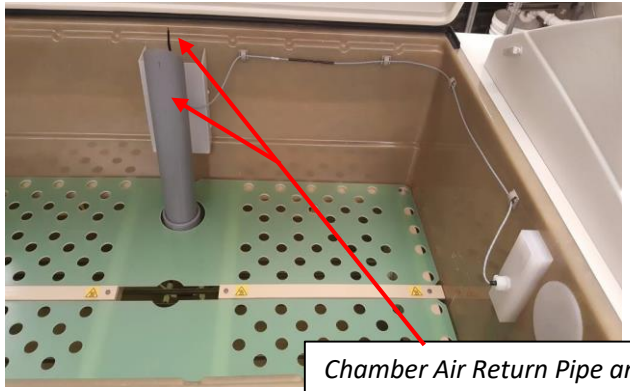
- To confirm a chamber is able to satisfy the transition requirements, validation should be conducted in a full chamber.
- Additional thermal mass of a fully-loaded chamber with metal panels will delay reaching temperature set points.

Verify that the test conditions can be reached with a chamber filled with specimens.

Validating Chamber Performance

Chamber Temperature Sensor Location

- Q-FOG CRH chamber temperature sensor is mounted on the Chamber Air Return Pipe, a more accurate representation of chamber conditions.
- The temperature sensor should not be in direct path of air outlet or close proximity to heaters, as it is not representative of chamber conditions.



Chamber Air Return Pipe and Chamber Air Temperature Sensor

Verify that the chamber temperature reading is from a representative area.

Validating Chamber Performance

Q-FOG CRH HSCR

We'll show you data that the –HSCR configured Q-FOG CRH can meet demanding test requirements, for:

- Full-sized chambers
- Tests with full specimen loads
- True reporting of chamber temperature values

Q-FOG CRH HSCR Performance

Chamber Performance

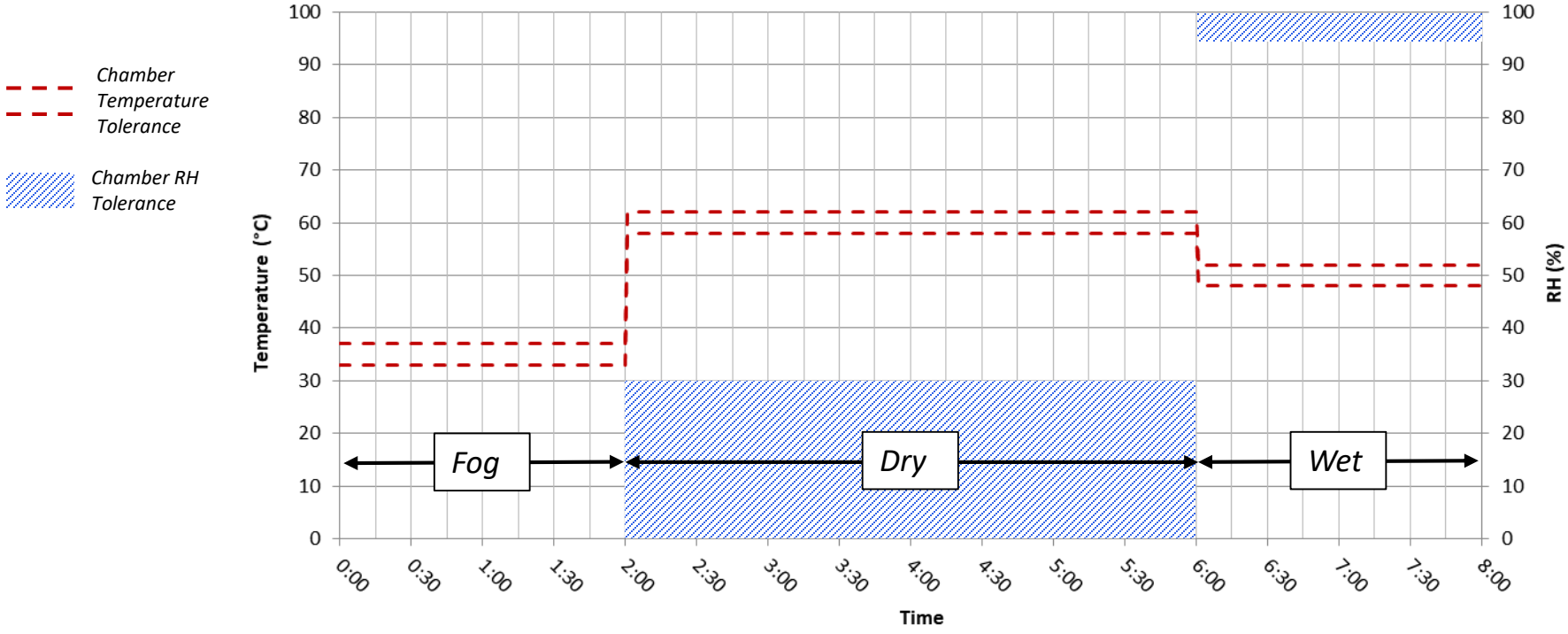
- Tests and performance data is from full chambers, which could include 200-240x aluminum or stainless steel panels.
- A 5% NaCl Salt Solution was used during the Fog cycle.
- We will review the following test standards:
  - *ISO 14993* (International standard for JASO M609)
  - *CCT-I, CCT-IV,* & *CCT-C* (Automotive OEM test standards)

ISO 14993 Conditions and Transition Requirements

Function	Temperature	Step Time	Transition Time Requirement
Fog	**35 ± 2 °C**	2:00	< 0:30
Dry	**60 ± 2 °C** **< 30% RH**	4:00	< 0:30
Wet	**50 ± 2 °C** **> 95% RH**	2:00	< 0:15

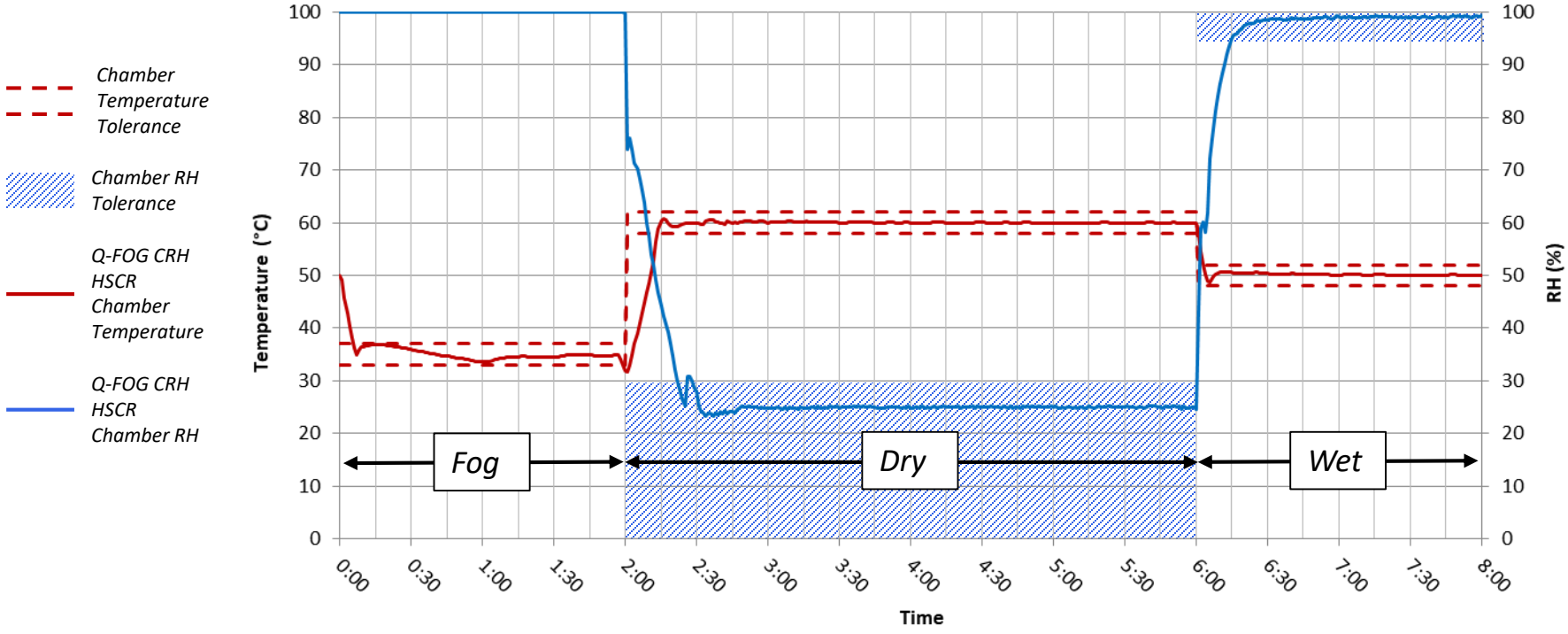
Q-FOG CRH HSCR Chamber Data

ISO 14993



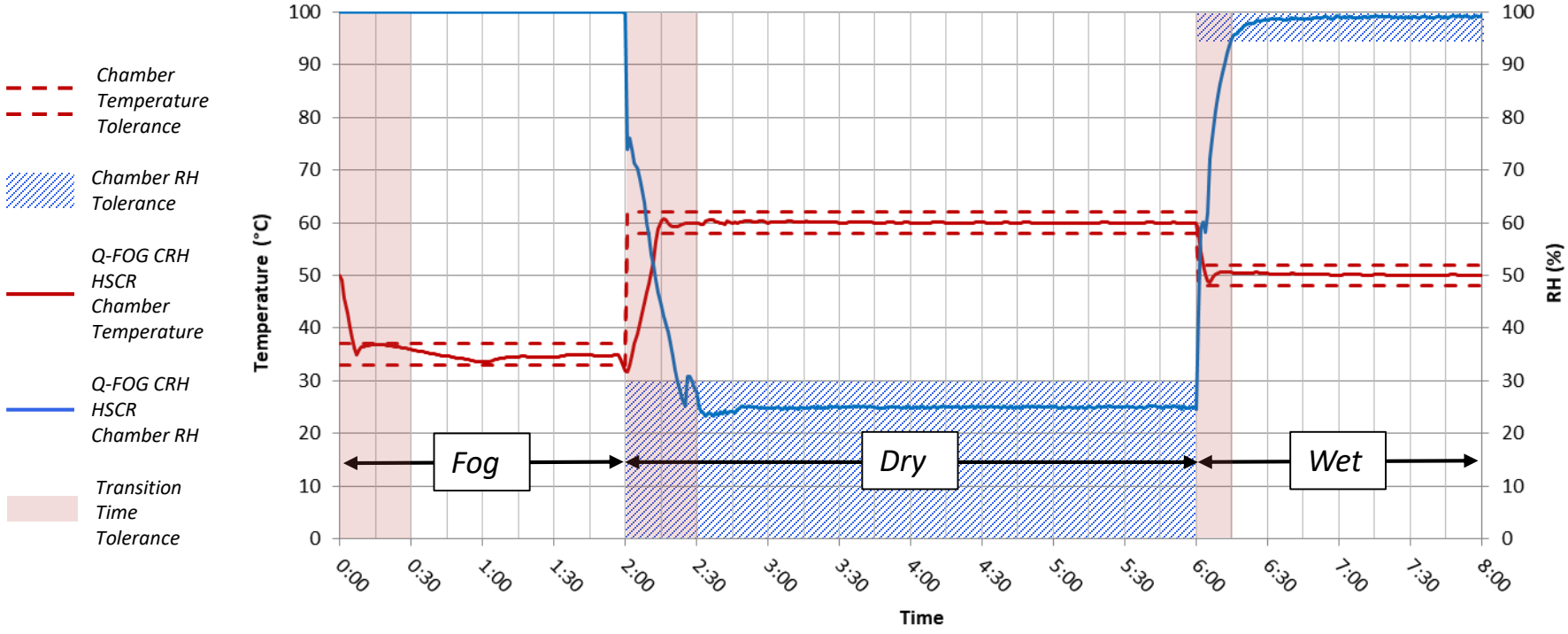
Q-FOG CRH HSCR Chamber Data

ISO 14993



Q-FOG CRH HSCR Chamber Data

ISO 14993



Q-FOG CRH HSCR Performance

ISO 14993

Transition times for ISO 14993 in full Q-FOG CRH HSCR Chamber.

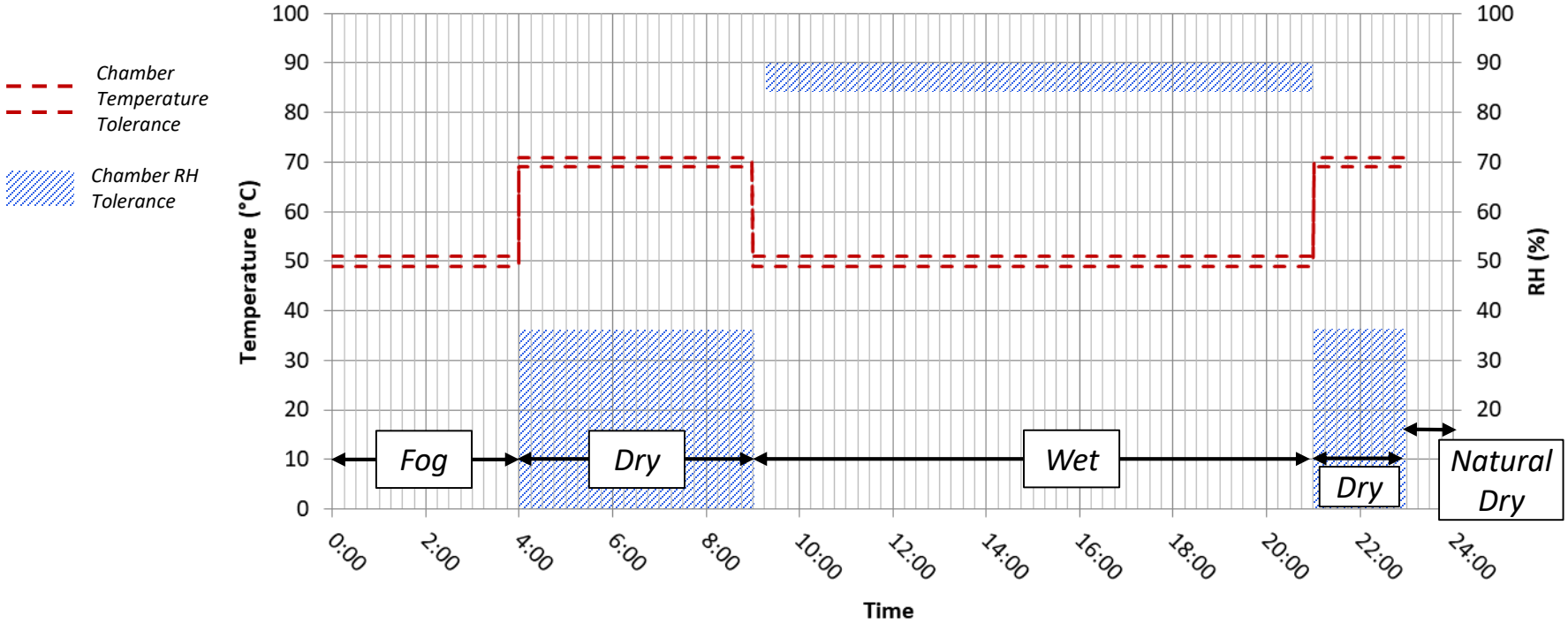
	Function	Transition	Transition Time Requirement	Actual Temperature Transition Time	Actual RH Transition Time
ISO 14993 JASO M609	Fog to Dry	35 ± 2 °C ➔ 60 ± 2 °C FOG ➔ < 30% RH	< 0:30	0:13	0:14
	Dry to Wet	60 ± 2 °C ➔ 50 ± 2 °C < 30% RH ➔ > 95% RH	< 0:15	0:04	0:15
	Wet to Fog	50 ± 2 °C ➔ 35 ± 2 °C > 95% RH ➔ FOG	< 0:30	0:06	Instantaneous

CCT-C Conditions and Transition Requirements

Function	Temperature	Step Time	Transition Time Requirement
Fog	50 ± 1 °C	4:00	< 0:30
Dry	70 ± 1 °C < 35% RH	5:00	< 0:30
Wet	50 ± 1 °C 85 - 90% RH	12:00	< 0:30
Dry	70 ± 1 °C < 35% RH	2:00	< 0:30
Natural Dry	< 60% RH	1:00	

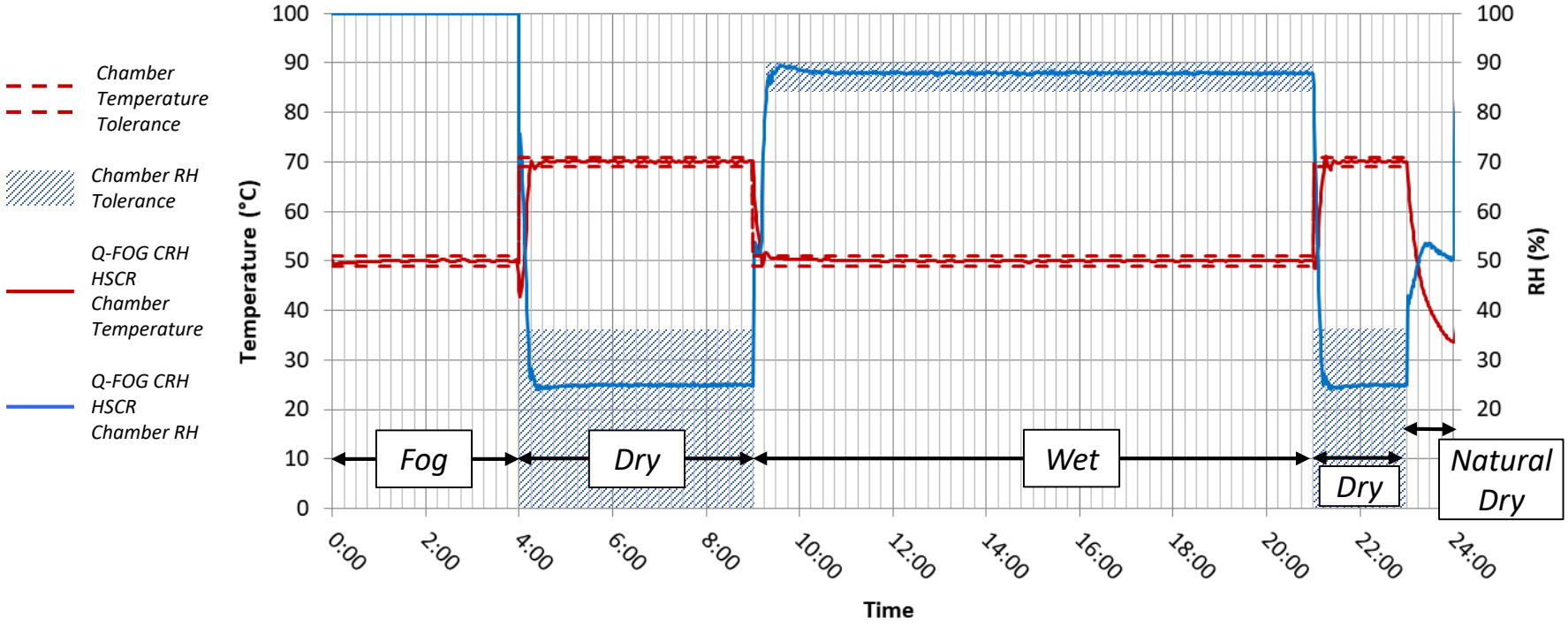
Q-FOG CRH HSCR Chamber Data

CCT-C



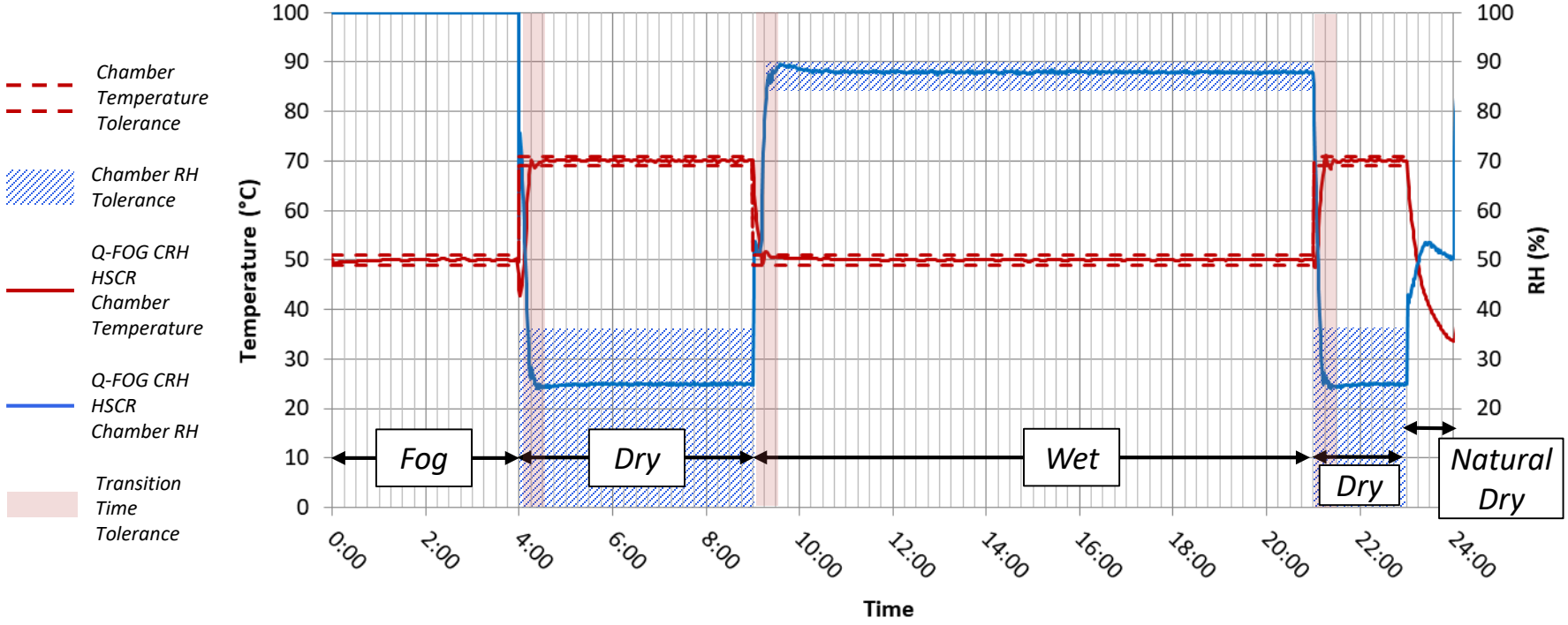
Q-FOG CRH HSCR Chamber Data

CCT-C



Q-FOG CRH HSCR Chamber Data

CCT-C



Q-FOG CRH HSCR Performance

CCT-C

Transition times for CCT-C in full Q-FOG CRH 1100 HSCR Chamber.

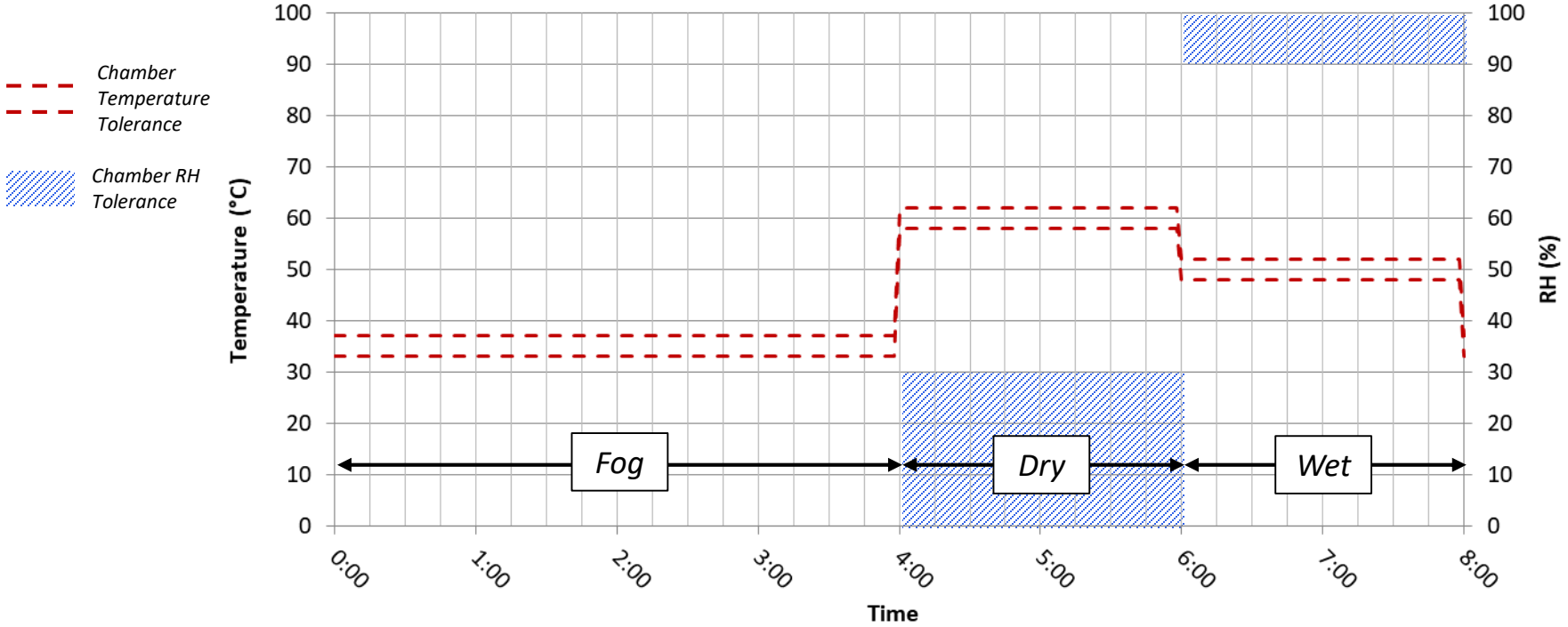
	Function	Transition	Transition Time Requirement	Actual Temperature Transition Time	Actual RH Transition Time
CCT-C	Fog to Dry	50 °C ➔ 70 ± 1 °C FOG ➔ < 35% RH	< 0:30	0:14	0:13
	Dry to Wet	70 ± 1 °C ➔ 50 ± 1 °C < 35% RH ➔ > 85% RH	< 0:30	0:10	0:18
	Wet to Dry	50 ± 1 °C ➔ 70 ± 1 °C > 85% RH ➔ < 35% RH	< 0:30	0:14	0:11

CCT-I Conditions and Transition Requirements

Function	Temperature	Step Time	Transition Time Requirement
Fog	**35 ± 2 °C**	4:00	< 0:30
Dry	**60 ± 2 °C** **< 30% RH**	2:00	< 0:30
Wet	**50 ± 2 °C** **> 90% RH**	2:00	< 0:30

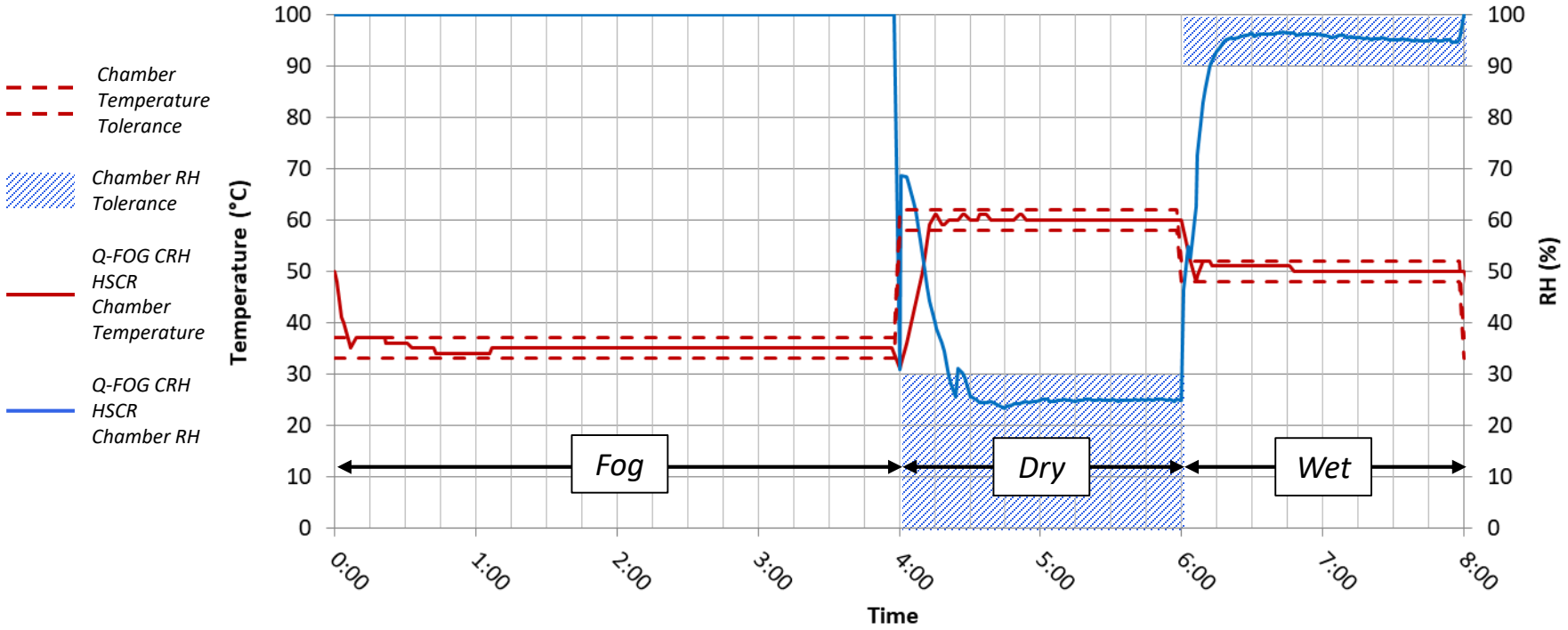
Q-FOG CRH HSCR Chamber Data

CCT-I



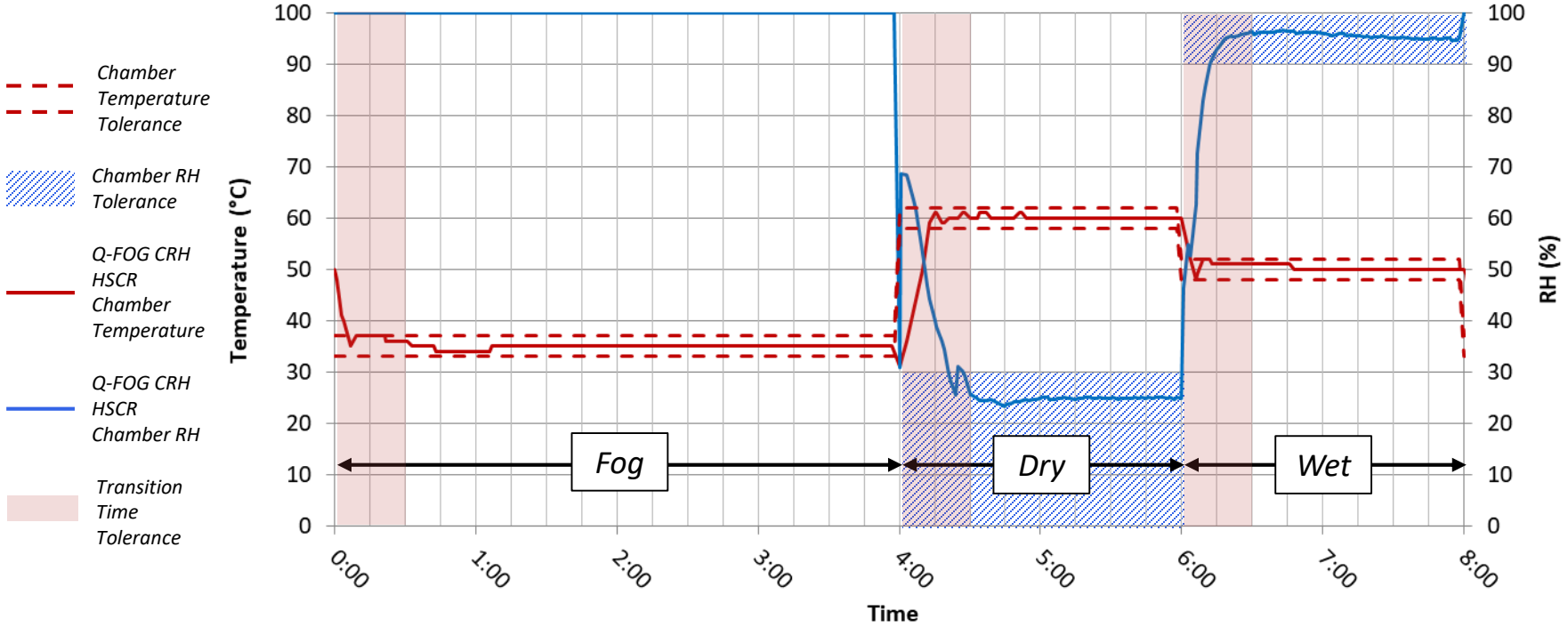
Q-FOG CRH HSCR Chamber Data

CCT-I



Q-FOG CRH HSCR Chamber Data

CCT-I



Q-FOG CRH HSCR Performance

CCT-I

Transition times for CCT-I in full Q-FOG CRH 1100 HSCR Chamber.

	Function	Transition	Transition Time Requirement	Actual Temperature Transition Time	Actual RH Transition Time
CCT-I	Fog to Dry	35 ± 2 °C ➔ 60 ± 2 °C FOG ➔ < 30% RH	< 0:30	0:12	0:21
	Dry to Wet	60 ± 2 °C ➔ 50 ± 2 °C < 30% RH ➔ > 90% RH	< 0:30	0:06	0:15
	Wet to Fog	50 ± 2 °C ➔ 35 ± 2 °C > 90% RH ➔ FOG	< 0:30	0:07	Instantaneous

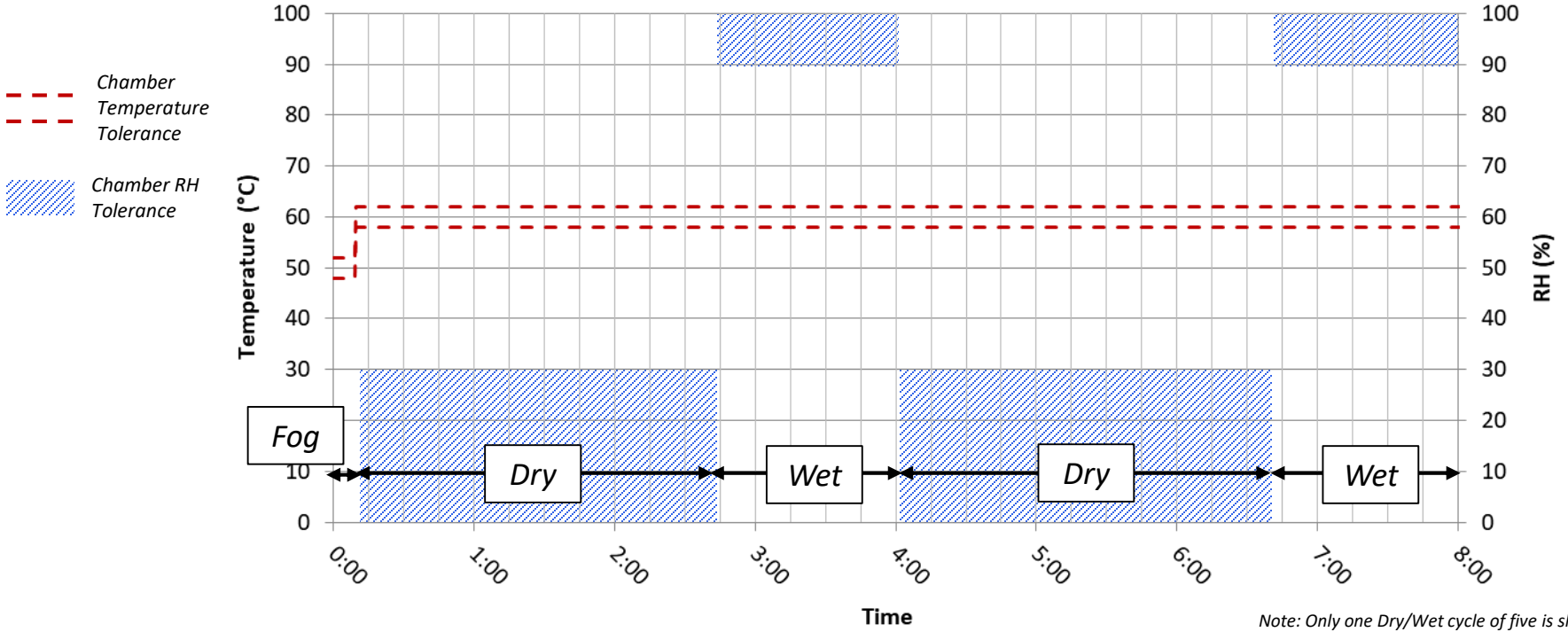
CCT-IV Conditions and Transition Requirements

Function	Temperature	Step Time	Transition Time Requirement
Fog	50 ± 2 °C	0:10	
Dry	60 ± 2 °C < 30% RH	2:35	< 0:30
Wet	60 ± 2 °C > 90% RH	1:15	< 0:30
Dry*	60 ± 2 °C < 30% RH	2:40	< 0:30
Wet*	60 ± 2 °C > 90% RH	1:20	< 0:30

Note: Final Dry and Wet Cycles are to be repeated 4x additional times.

Q-FOG CRH HSCR Chamber Data

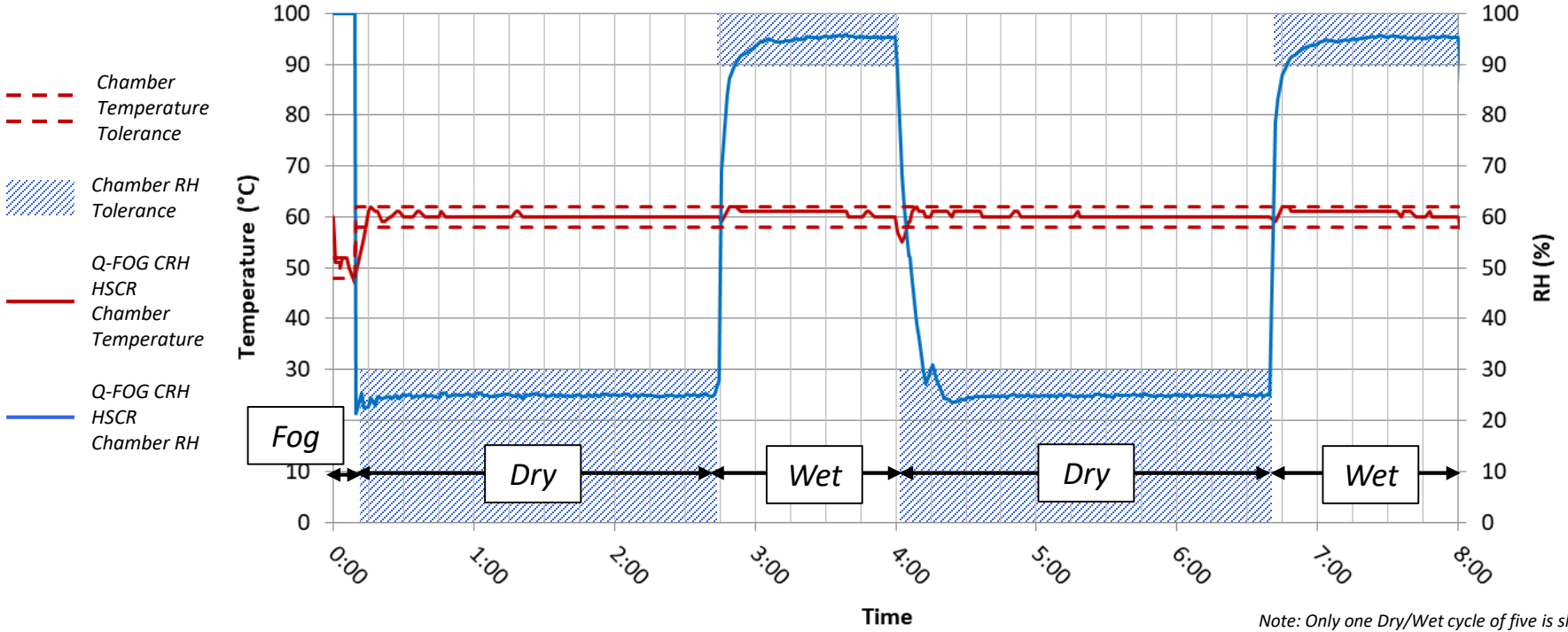
CCT-IV



Note: Only one Dry/Wet cycle of five is shown.

Q-FOG CRH HSCR Chamber Data

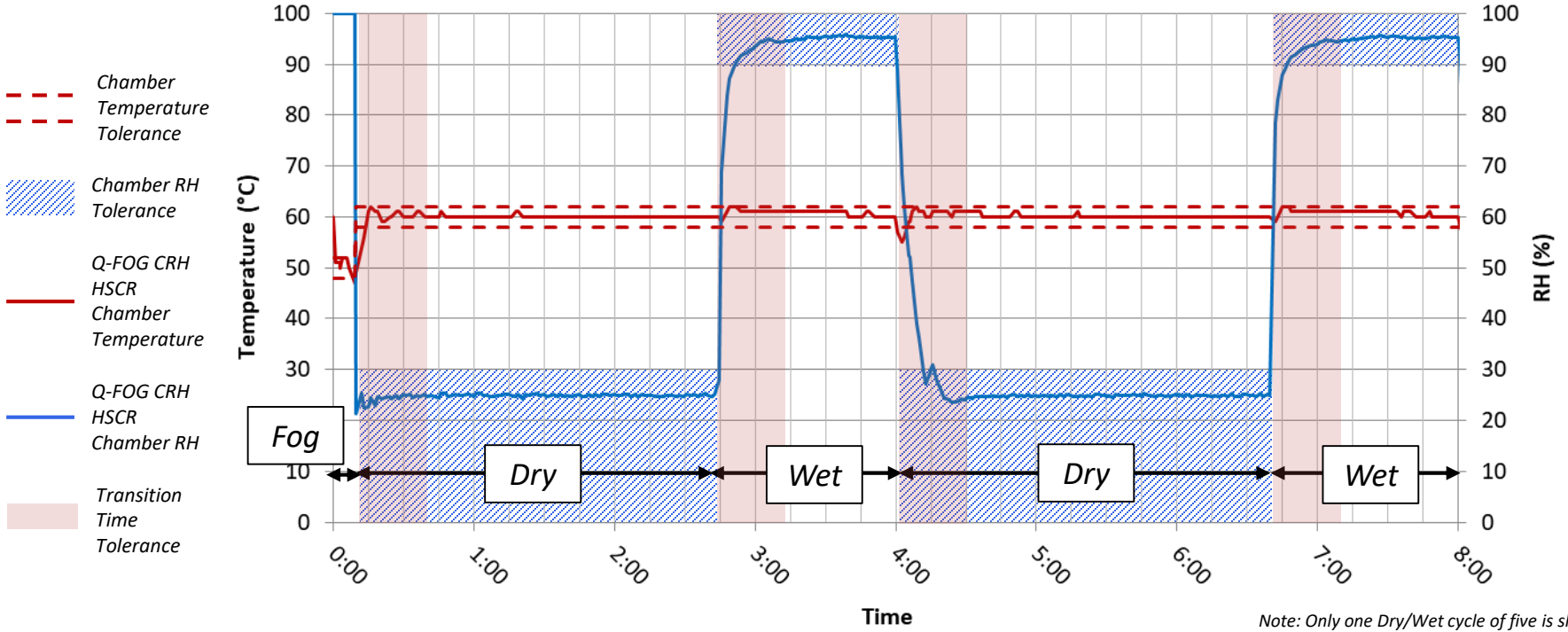
CCT-IV



Note: Only one Dry/Wet cycle of five is shown.

Q-FOG CRH HSCR Chamber Data

CCT-IV



Note: Only one Dry/Wet cycle of five is shown.

Q-FOG CRH HSCR Performance

CCT-IV

Transition times for CCT-IV in full Q-FOG CRH 1100 HSCR Chamber.

	Function	Transition	Transition Time Requirement	Actual Temperature Transition Time	Actual RH Transition Time
CCT-IV	Fog to Dry	50 ± 2 °C → 60 ± 2 °C FOG → < 30% RH	< 0:30	0:12	0:20
	Dry to Wet	60 ± 2 °C → 60 ± 2 °C < 30% RH → > 90% RH	< 0:30	0:00	0:12
	Wet to Dry	60 ± 2 °C → 60 ± 2 °C > 90% RH → < 30% RH	< 0:30	0:00	0:18

Conclusions

- The new Q-FOG CRH HSCR is able to meet the challenging transition requirements in many CCT type tests, as well as the controlled relative humidity specified in modern corrosion tests.
- Validating a chamber's performance running a CCT test should be completed with blank aluminum or steel panels, close or at full capacity.
- CCT and other first generation cyclic corrosion tests remain popular.
- Modern corrosion tests, with controlled relative humidity, offer the best realism and correlation to atmospheric corrosion.

Questions?

info@q-lab.com