



## SPECIFICATION

# ZRH CH FACTORY HEATER CALIBRATION



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Doc No: ZRH\_CPD\_SPC\_factory\_heater\_calibration

Version N°: 1.0

Page 2 of 11

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Table of Contents

---

1 Purpose.....	3
2 Scope and applicability.....	3
3 Background.....	4
3.1 Relation between resistance and temperature of the heating element.....	4
3.2 Linear approximation parameterized by $R_0$ .....	4
3.3 Observations.....	5
4 Improved calibration and regulation scheme.....	5
4.1 Piecewise linear approximation.....	5
4.2 Calibration procedure.....	6
4.2.1 Overview.....	6
4.2.2 Calibration steps.....	6
4.2.3 Constraints.....	7
4.3 Computation details.....	7
4.3.1 Resistance/temperature curve coefficients.....	7
4.3.2 Maximum error of the linear approximation.....	8
5 Accuracy considerations.....	9
6 Recommendations.....	10
7 Reference documents.....	10
8 Related documents.....	10
9 Revision history.....	10
10 Review and approval.....	10
11 Abbreviations.....	11



## SPECIFICATION

## ZRH CH FACTORY HEATER CALIBRATION

Doc No: ZRH\_CPD\_SPC\_factory\_heater\_calibration

Version N°: 1 0

Page 3 of 11

## 1 Purpose

This document defines / describes a procedure applied during the manufacturing of ZRH FPD 4.1 cigarette holders and future versions of this design to calibrate the heater resistance/temperature curve. The need for calibration comes from the fact that the electrical resistance of the heater track is a function of the temperature of the heater. Taking advantage from this property, the cigarette holder actually regulates heater resistance while it is configured with a temperature profile expressed in °C; hence it needs to be able to convert from temperature to corresponding resistance values. [Figure 1](#) illustrates the overall temperature regulation process.

(b) (4)



Figure 1: Temperature regulation process

(b) (4)



## 2 Scope and applicability

This document applies to the following:

- Discipline(s): Product Development
- Project(s): ZRH CPD Realization
- Function(s): T&PD

More specifically, this specification applies to the phase of the manufacturing process which calibrates ZRH FPD 4.1 (and followers) cigarette holder heaters. The document provides a step-by-step description of the calibration method as well as the algorithms to implement in manufacturing tools.

(b) (4)





### 3 Background

#### 3.1 Relation between resistance and temperature of the heating element

In the literature, the relation between resistance and temperature for metals such as gold, platinum and silver is commonly approximated using the Callendar ([Callendar, 1887](#)) equation:

$$R = R_0(1 + AT + BT^2) \quad (1)$$

where  $R$  is the resistance at temperature  $T$ ,  $R_0$  is the resistance at  $0^\circ\text{C}$ ,  $A$  and  $B$  are metal specific constants. For platinum, the above equation is an accurate representation of the resistance/temperature curve for  $T \geq 0$  only.

(b) (4)



SPECIFICATION

ZRH CH FACTORY HEATER CALIBRATION

Doc No: ZRH\_CPD\_SPC\_factory\_heater\_calibration

Version N°: 1 0

Page 5 of 11

(b) (4)

3.3 Observations

(b) (4)



## SPECIFICATION

## ZRH CH FACTORY HEATER CALIBRATION

Doc No: ZRH\_CPD\_SPC\_factory\_heater\_calibration

Version N°: 1 0

Page 6 of 11

## 4.2 Calibration procedure

This section describes the heater calibration procedure performed during the manufacturing of the cigarette holders. The description provides an overview of the calibration system as well as a detailed list of the steps to perform.

### 4.2.1 Overview

(b) (4)





SPECIFICATION

ZRH CH FACTORY HEATER CALIBRATION

Doc No: ZRH\_CPD\_SPC\_factory\_heater\_calibration

Version N°: 1 0

Page 7 of 11

(b) (4)





SPECIFICATION

ZRH CH FACTORY HEATER CALIBRATION

Doc No: ZRH\_CPD\_SPC\_factory\_heater\_calibration

Version N°: 1 0

Page 8 of 11

(b) (4)







SPECIFICATION

ZRH CH FACTORY HEATER CALIBRATION

Doc No: ZRH\_CPD\_SPC\_factory\_heater\_calibration

Version N°: 1 0

Page 9 of 11

(b) (4)



5 Accuracy considerations

(b) (4)





## SPECIFICATION

## ZRH CH FACTORY HEATER CALIBRATION

Doc No: ZRH\_CPD\_SPC\_factory\_heater\_calibration

Version N°: 1.0

Page 10 of 11

(b) (4)

## 7 Reference documents

Callendar, H. L. (1887). On the Practical Measurement of Temperature: Experiments Made at the Cavendish Laboratory, Cambridge. *Philosophical Transactions of the Royal Society of London. A. Volume 178*, 161-230.

Mathews, J. H. (n.d.). *The Newton Polynomial*. (California State University, Fullerton) Retrieved June 11, 2012, from <http://math.fullerton.edu/mathews/n2003/NewtonPolyMod.html>

## 8 Related documents

- [1] ZRH\_CPD\_SPC\_F42 Manufacturing Test Specification.doc
- [2] ZRH\_CPD\_TLS\_heater\_calibration\_numerical\_aspects.xlsx

## 9 Revision history

Version N°	Author	Description of change (including reason for change)	Type of change
1.0	Farine, Robin	Original issue.	1

(1. Major change/new version; 2. Minor change; 3 Review without change)

For proof of date and status, refer to the DISCO attributes tab in the document properties.

## 10 Review and approval

Select the reviewers and approvers based on document needs. Please refer to, PMI\_RD\_WKI\_000085 Quality Management Document review & approval for more details.

This document has been approved by:



## SPECIFICATION

## ZRH CH FACTORY HEATER CALIBRATION

Doc No: ZRH\_CPD\_SPC\_factory\_heater\_calibration

Version N°: 1 0

Page 11 of 11

Name	Function	Justification
Schaerer, Caroline	Quality Management Executive	Signed as Quality Reviewer
Bemauer, Dominique	Associate Staff Engineer	Signed as Subject Matter Expert Reviewer
Kuczaj, Arkadiusz	Associate Staff Scientist	Signed as Peer-Reviewer
Farine, Robin	Associate Staff Engineer	Signed as Approver/Author
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For proof of review and approval (Dates and electronic sign-off), refer to the DISCO history tab in the document properties.

Roles and responsibilities of signatories are defined in the documented work instruction

## 11 Abbreviations

Abbreviations	:	
FPD	:	Functional Product Design
PFM	:	Pulse Frequency Modulation
SME	:	Subject Matter Expert
ZRH	:	Zurich Program

For complete definition, refer to PMI OPS Glossary