国家海洋标准计量中心

National Center Of Ocean Standards And Metrology

CTD Calibration Facility of NCOSM(RMIC)

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National Center of Ocean Standards and Metrology, China

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Outline

1. **Overview**
2. **CTD Calibration Facility**
3. **Capability Enhancement**

1. Overview

Affiliation

- NCOSM, located in Tianjin, is one of the institutions directly under the Ministry of Natural Resources of China(MNR).
- NCOSM is a legal metrological verification institution authorized by the State Administration for Market Regulation (SAMR) of China.
- As a part of NCOSM,**CTD Calibration Facility** has been providing calibration services since 1988.It provides calibration services for thousands of CTD instruments every year.

1. Overview

CTD Calibration

A CTD–Conductivity, Temperature, and Depth (CTD) instrument is the primary instrument used to determine the essential physical properties of seawater.

It provides scientists with an accurate and comprehensive representation of the distribution and variation of water temperature, salinity, and density to understand how the oceans affect life and the environment.

1. Overview

CTD Calibration

- Modern sensors and transmitters are electronic devices that employ electrical signals such as voltage and current, which naturally drift over time.
- Calibration of the CTD is important to the quality of the measurement data.

1. Overview

Drift

Drift of RBR concerto CTD sensors

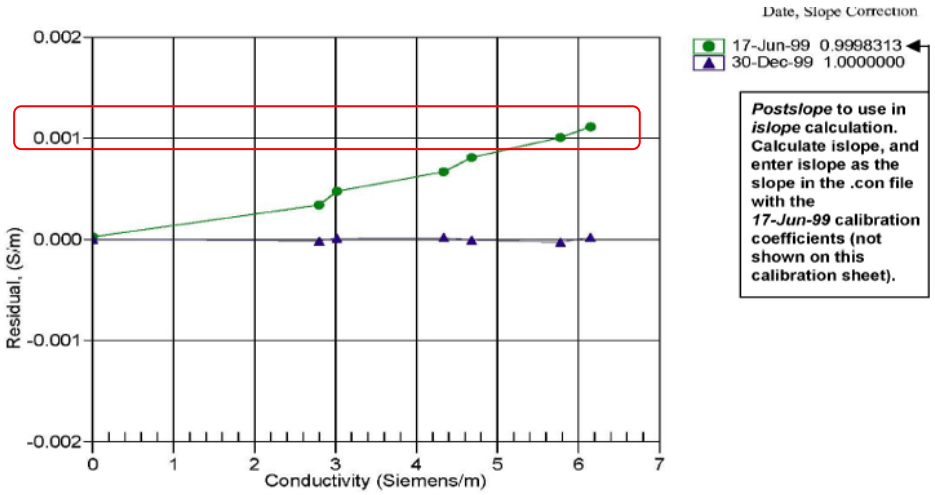
Conductivity

Range:	0-85mS/cm
Accuracy*:	±0.003mS/cm at T=15°C
Temperature dependence:	±3µS/cm between 5°C - 25°C
Drift:	~10µS/cm/year
Resolution:	<1µS/cm
Time constant:	<100ms set by flow through cell

* Defined as the root sum of the squares (RSS) of endpoint non-linearity, repeatability error and calibration uncertainty.

Temperature

Range:	-5°C to 35°C
Accuracy:	±0.002°C
Resolution:	<0.00005°C
Time constant:	~1s (standard) or ~0.1s (option)
Drift:	~0.002°C/year



Drift of SBE4c conductivity sensor in 6 months

Pressure (Depth)

Range:	20 / 50 / 100 / 200 / 500 / 740 / 1000 / 2000m (dBar)
Accuracy:	±0.05% full scale at T=20°C ±0.10% with temperature correction
Resolution:	<0.001% full scale
Time Constant:	<0.01s
Drift:	~0.2%/year

2. CTD Calibration Facility

Capabilities

- The facility calibrates a wide range of oceanographic instrumentation to a level of accuracy consistent with the world's best practice.

Certificates for Examination of Measurement Standards

Measurement Standard	Range	MPE
Temperature (℃)	-2～40	±0.002
Salinity	2～42	±0.001
Pressure (MPa)	0.05～100	±0.005%

- All Temperature & Pressure metrology standards could be traced to a higher level of measurement authority (e.g. NIM，China National Institute of Metrology) ,and SI units traceable.
- Salinity could be traced to PSS-78.

2. CTD Calibration Facility

Temperature

- Standard Platinum Resistance Thermometers (SPRT)
- F900 AC Bridge， 6622A DC Bridge
- Water Triple Point / Gallium Melt point
- Constant temperature seawater baths

2. CTD Calibration Facility

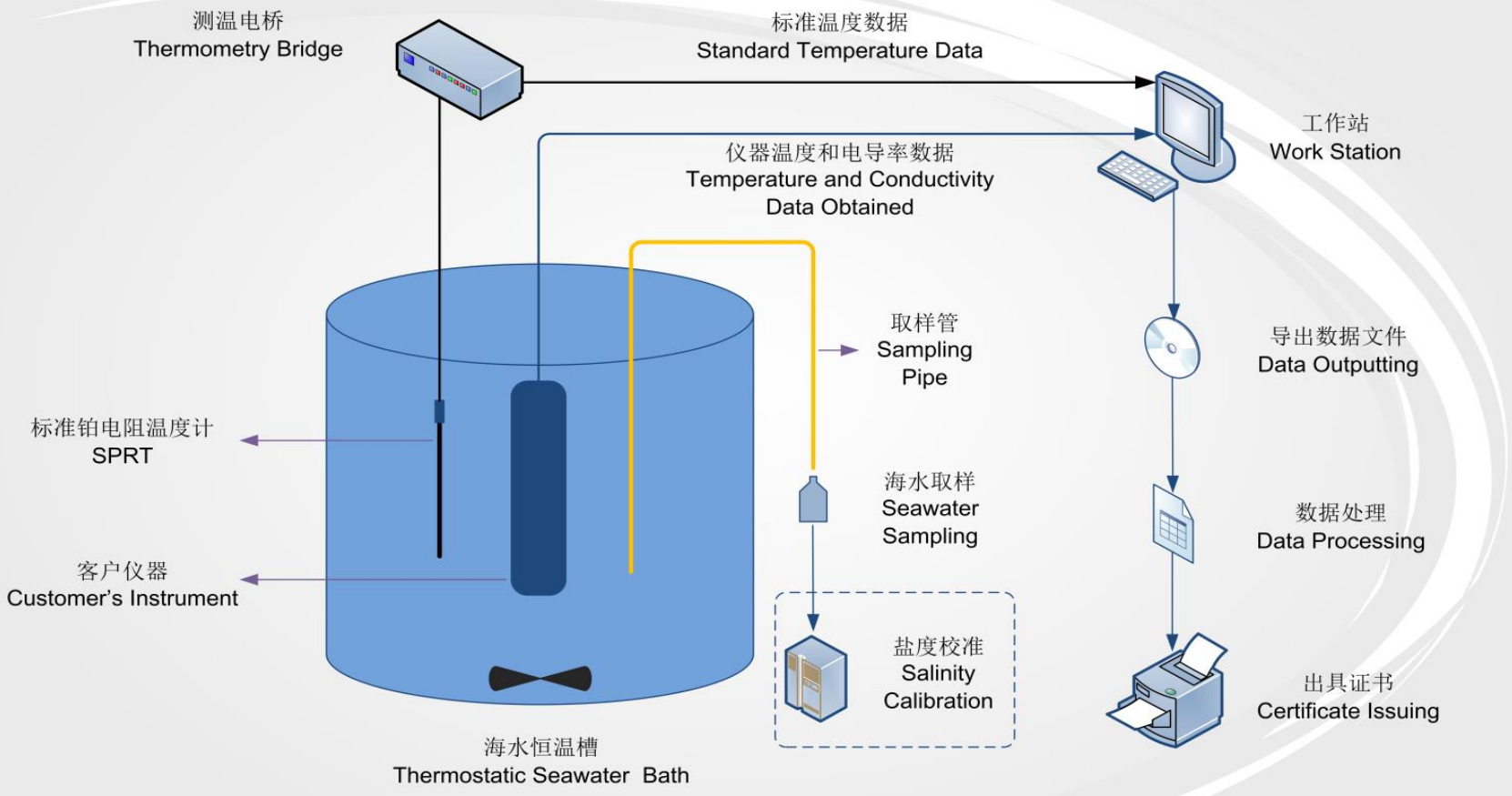
Temperature

- SPRT
  —Accuracy: Primary
  —Measurement range: (-38.8344-156.5985) ℃
- Thermostatic water bath
  —Range of temperature: (-2-40) ℃
  —Temperature stability : 0.0005 ℃
  —Temperature uniformity: 0.0005 ℃

2. CTD Calibration Facility

Temperature

温度校准流程
Flowchart of Temperature Calibration



2. CTD Calibration Facility

Salinity(Conductivity)

- Laboratory Salinometer
- Chinese Standard Seawater / IAPSO Standard Seawater

0.002mS/cm

2. CTD Calibration Facility

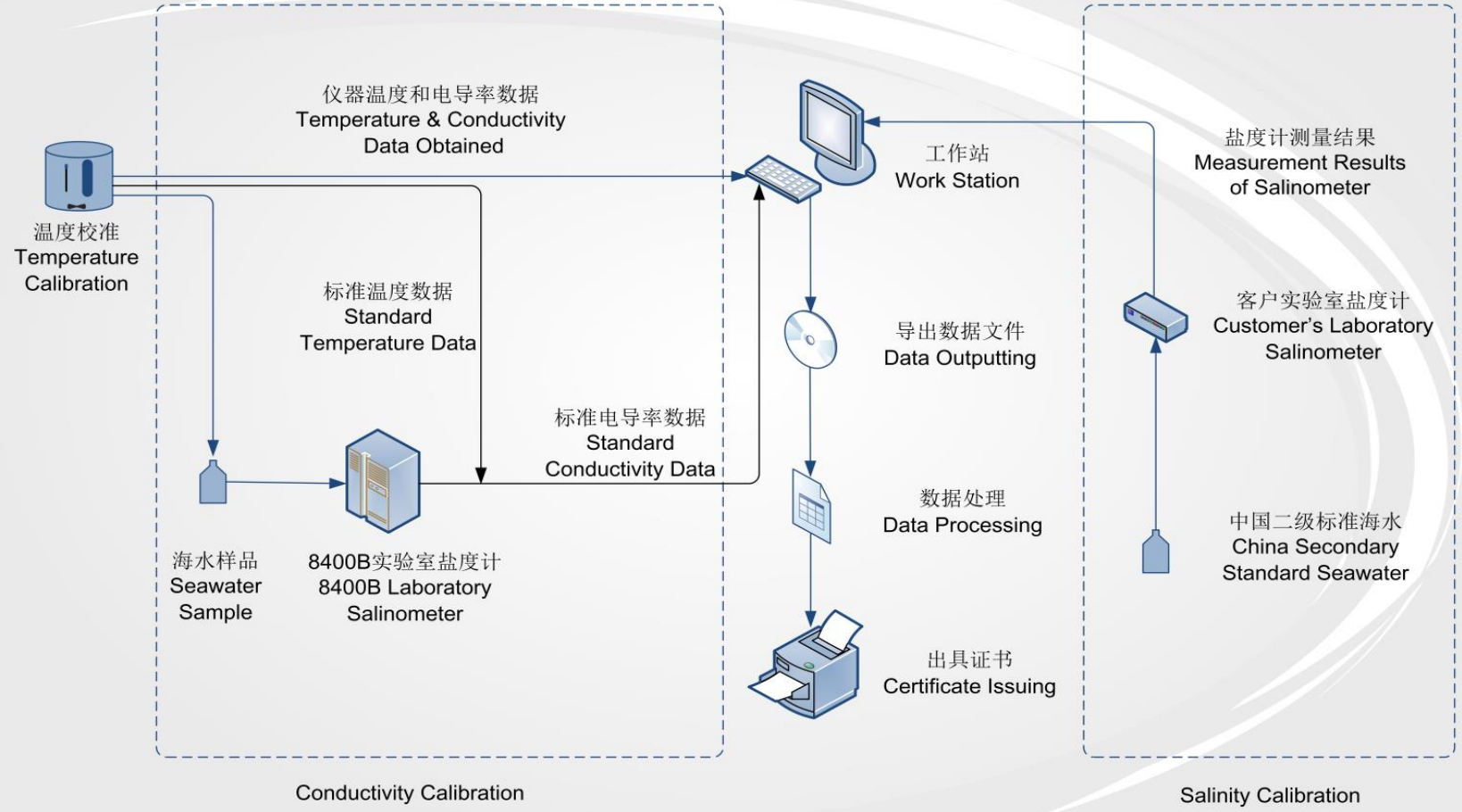
Salinity(Conductivity)

- Salinometer (e.g. Guildline Autosal 8400B)
  - —Measurement range of salinity(PSU): 2-42
  - —MPE: ±0.001
- China Standard Sea Water (CSSW)
  - —Salinity: *S*=35
  - —Uncertainty: *U*=0.001

2. CTD Calibration Facility

Conductivity(Salinity) 电导率/盐度校准流程

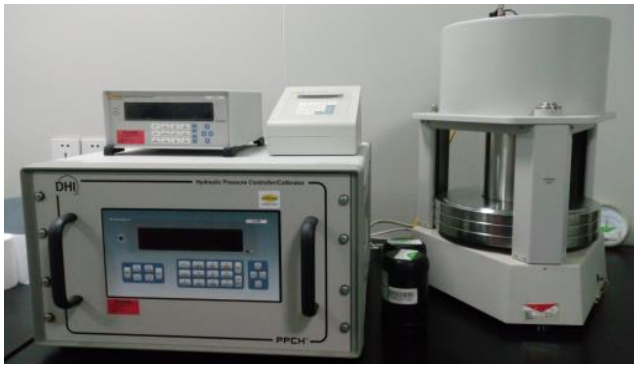
Flowchart of Conductivity & Salinity Calibration

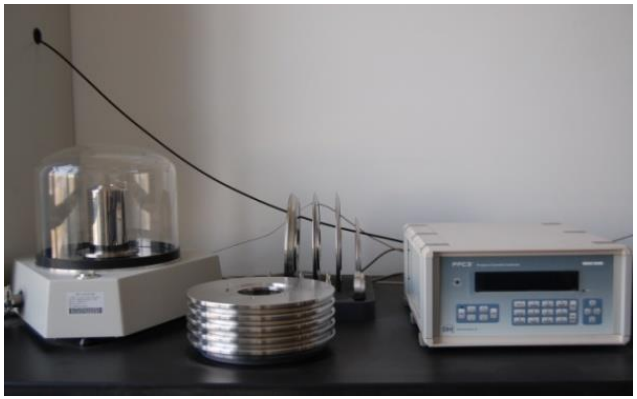


2. CTD Calibration Facility

Pressure(Depth)

- Piston Gauge (Hydraulic & Pneumatic)





2. CTD Calibration Facility

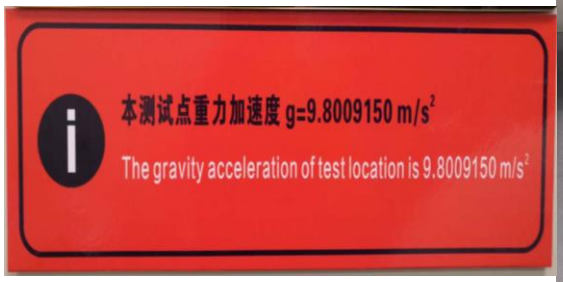
Pressure(Depth)

- Piston Gauge (Hydraulic & Pneumatic)
  - —Measurement range: (0.05-100) MPa
  - —MPE: ±0.005%
- Constant temperature and humidity laboratory
  - —Temperature : (20±1) ℃
  - —Relative humidity : (40±2)%

6270A Modular Pressure Controller

PG7302 Piston Gauge

High-precision gravity acceleration value:

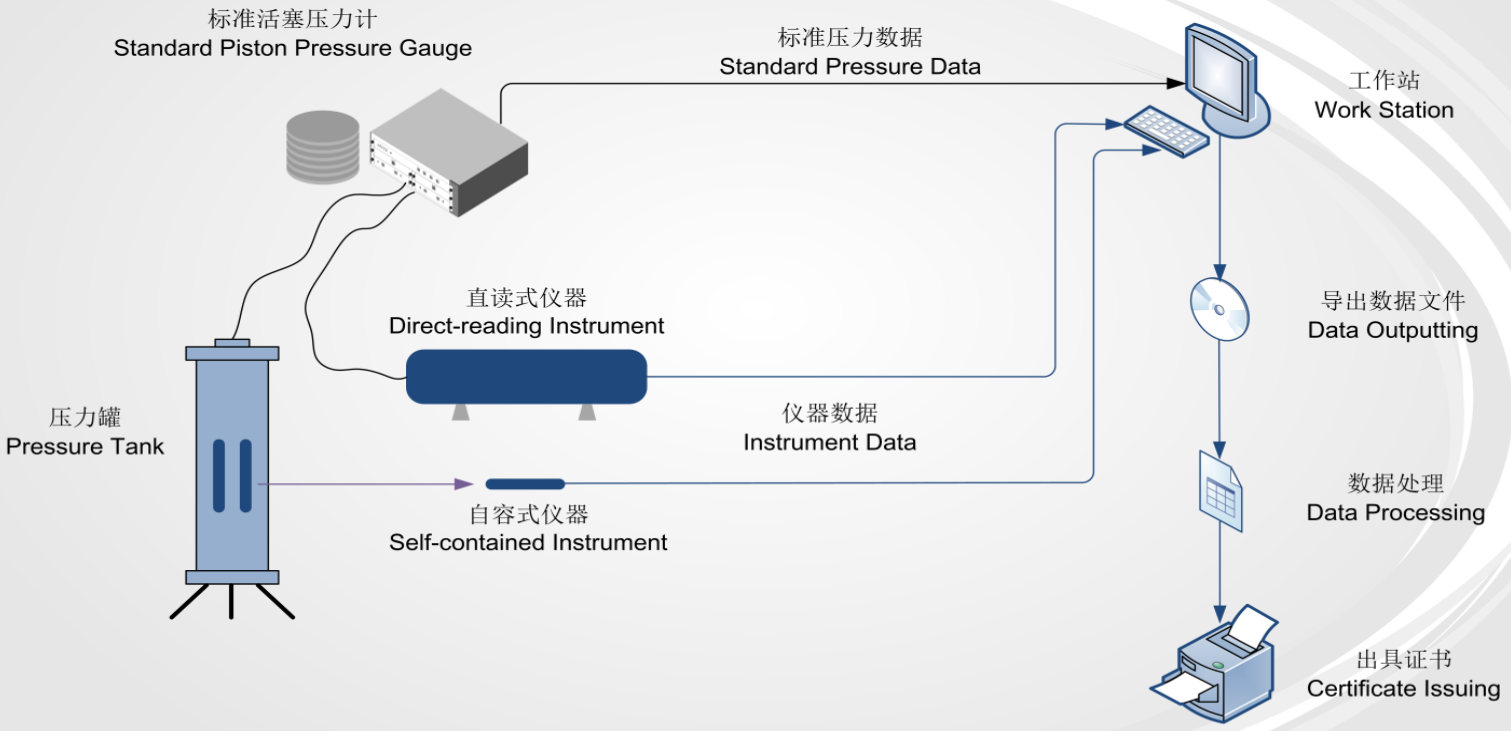


KY60 Piston Gauge

2. CTD Calibration Facility

Pressure(Depth)

压力校准流程
Flowchart of Pressure Calibration



2. CTD Calibration Facility

Calibration Certificate:

- Calibration coefficients
- Uncertainty of calibration
- Error of indication

国 家 海 洋 计 量 站

National Ocean Metrology Service

校 准 证 书

Calibration Certificate

证书编号：GHJ（2012）校字 203 号

Certificate Nc

送 校 单 位 Applicant

计 量 器 具 名 称 Name of Instrument: CTD

型 号/ 规 格 Type/Specification: SBE 917plus

出 厂 编 号 Serial No.

制 造 单 位 Manufacturer: 美国海鸟公司 Sea-Bird Electronics

校 准 依 据 Calibration Regulation: 参照 JJG763-2002《温盐深测量仪》检定规程 JJG763-2002《CTD Measurement》verification regulation

批准人 Approved by

核验员 Checked by

（校准专用章） Stamp

校准员 Calibrated by

校准日期 2012 年 5 月 29 日

Date of Calibration Year Month Day

计量检定机构授权证书号：（国）法计（2011）00008 号 Authorization Certificate No.

地址：天津市南开区开园西道 219 号 Address: Jieyuan Western Road 219,Nakai district, Tianjin, China

传真：86-22-27532971 Fax

电话：86-22-27539068 Telephone

邮编：300112 Post Code

电子邮件：gjhyhz.llzx@ncosm.gov.cn Email

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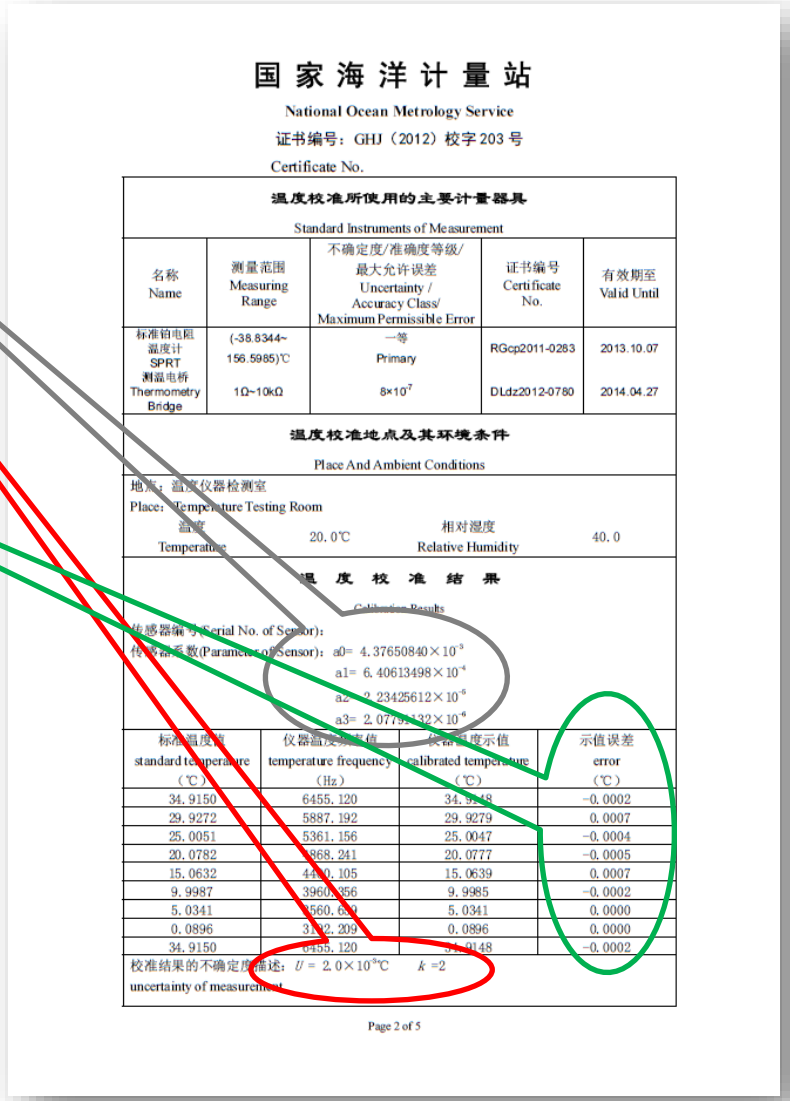

国 家 海 洋 计 量 站

National Ocean Metrology Service

证书编号：GHJ（2012）校字 203 号

Certificate No.

温度校准所使用的主要计量器具

Standard Instruments of Measurement

名称 Name	测量范围 Measuring Range	不确定度/准确度等级/最大允许误差 Uncertainty / Accuracy Class/ Maximum Permissible Error	证书编号 Certificate No.	有效期至 Valid Until
标准铂电阻温度计 SPRT	(-38.8344~156.5985)℃	一等 Primary	RGcp2011-0283	2013.10.07
测温电桥 Thermometry Bridge	1Ω~10kΩ	8×10^{-7}	DLdz2012-0780	2014.04.27

温度校准地点及其环境条件

Place And Ambient Conditions

地点：温度仪器检测室

Place: Temperature Testing Room

温度 Temperature 20.0℃ 相对湿度 Relative Humidity 40.0

温 度 校 准 结 果

Calibration Results

传感器编号(Serial No. of Sensor)：

传感器系数(Parameters of Sensor)：a0= 4.37650840×10^{-3}

a1= 6.40613498×10^{-4}

a2= 2.23425612×10^{-6}

a3= 2.07754132×10^{-7}

标准温度值 standard temperature (℃)	仪器温度频率值 temperature frequency (Hz)	仪器温度示值 calibrated temperature (℃)	示值误差 error (℃)
34.9150	6455.120	34.9148	-0.0002
29.9272	5887.192	29.9279	0.0007
25.0051	5361.156	25.0047	-0.0004
20.0782	4868.241	20.0777	-0.0005
15.0632	4410.105	15.0639	0.0007
9.9987	3960.356	9.9985	-0.0002
5.0341	3560.659	5.0341	0.0000
0.0896	3192.209	0.0896	0.0000
34.9150	6455.120	34.9148	-0.0002

校准结果的不确定度描述：$U = 2.0\times10^{-3}$℃ $k=2$

uncertainty of measurement

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2. CTD Calibration Facility

Types of CTD

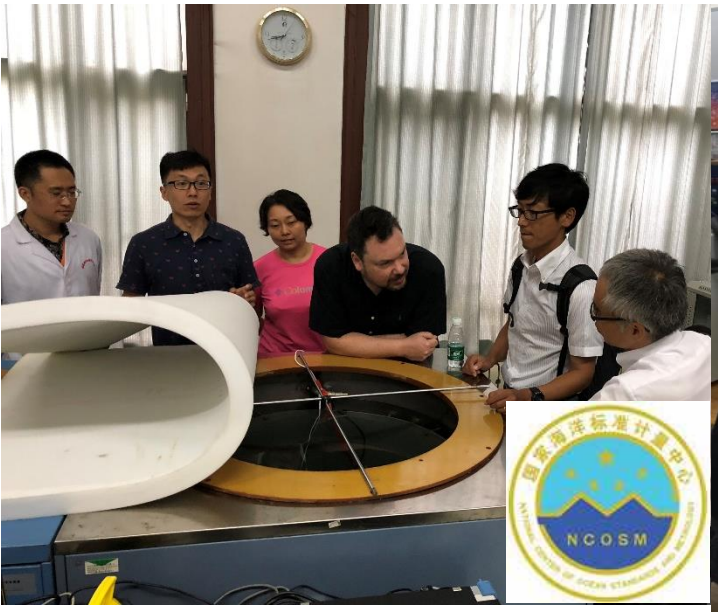
- SeaBird, RBR, JFE-Alec, Idronaut, SeaSun, KELLER
- Valeport, Aanderaa, AML, YSI, NKE, etc..

Manufacture	Model	Temperature (℃)		Conductivity (mS/cm)		Pressure (MPa)	
		Range	MPE	Range	MPE	Range	MPE
Sea-Bird Scientific	911plus	-5~35	±0.001	0~70	±0.003	0~68	±0.015%F.S
	917 plus	-5~35	±0.001	0~70	±0.003	0~68	±0.015%F.S
	25	-5~35℃	±0.002	0~70	±0.003	0~68	±0.1% F.S
	37SM	-5~35℃	±0.002	0~70	±0.003	0~68	±0.1% F.S
	49	-5~35℃	±0.002	0~90mS/cm	±0.003	0~68	0.1% F.S
	19	-5~35℃	±0.005	0~70mS/cm	±0.01	0~6	±0.1%F.S
	19plus	-5~35℃	±0.005	0~90	±0.005	0~68	±0.1%F.S
	16plusV2	-5~35℃	±0.005	0~90	±0.005	0~68	±0.1% F.S or ±0.02% F.S
RBR	XR-420CTD	-5~35℃	±0.002	0~70	±0.003	0~66	±0.05% F.S
	XR-620CTD Profiler	-5~35℃	±0.002	0~70	±0.003	0~7.4	±0.05% F.S
ALEC	COMPACT-CTD	-5~40℃	±0.02	0~60	±0.02	0~6/10	±0.3% F.S
	AAQ 1183	-5~40℃	±0.05	0~100	±0.02	0~1	±0.3% F.S
	ACTD-DF	-5~40℃	±0.02	0~60	±0.02	0~1	±0.3% F.S

3. Capability Enhancement

Inter-Comparison

- NCOSM-CSIRO-JAMSTEC
- From 2013 to 2018, several CTD calibration comparisons were performed among the 3 institutions.



3. Capability Enhancement

Software & Hardware

New software and hardware ware designed by engineers for calibration improvements.

Team

An enterprising team

Thank You

CTD Calibration Facility of NCOSM(RMIC)
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