附件 3

《水质监测用无人艇技术要求（试行）》
（征求意见稿）

编制说明

《水质监测用无人艇技术要求（试行）》标准编制组

2017-26

1

1.1

2017 2017

2017 413

2017-26

1.2

1.2.1

2017 6

2017

1

“ ”

1.2.2

2017 4 ~2017 10

ISO OECD ASTM

ISO 15839:2003 -

Water quality -- On-line sensors/analysing equipment for water -- Specifications and performance tests ASTM D3864 – 12 Standard Guide for On-Line Monitoring Systems for Water Analysis OECD 236

Nanosystems for Water Quality Monitoring and Purification

HJ 731-2014

HJ 915-2017

1.2.3

2017 11 14

1 2

3

2018 2 1

1 : 2 :
3

1.2.4

2018 3 ~8

1.2.5

2018 8 29 ~30

2018 11 10 ~22 3

2019 6 ~10

1.2.6

2020 5 9

2020 6 23

1 2
3 HJ 168 HJ 565

2

3

3.1

Unmanned surface vehicles Autonomous surface vehicles USV

1898 . “ ”

20 50

20 90

21

2000 MIT “Auto Cat”

2003 “Kan-Chan”

2004 MIDAS

“Springer”

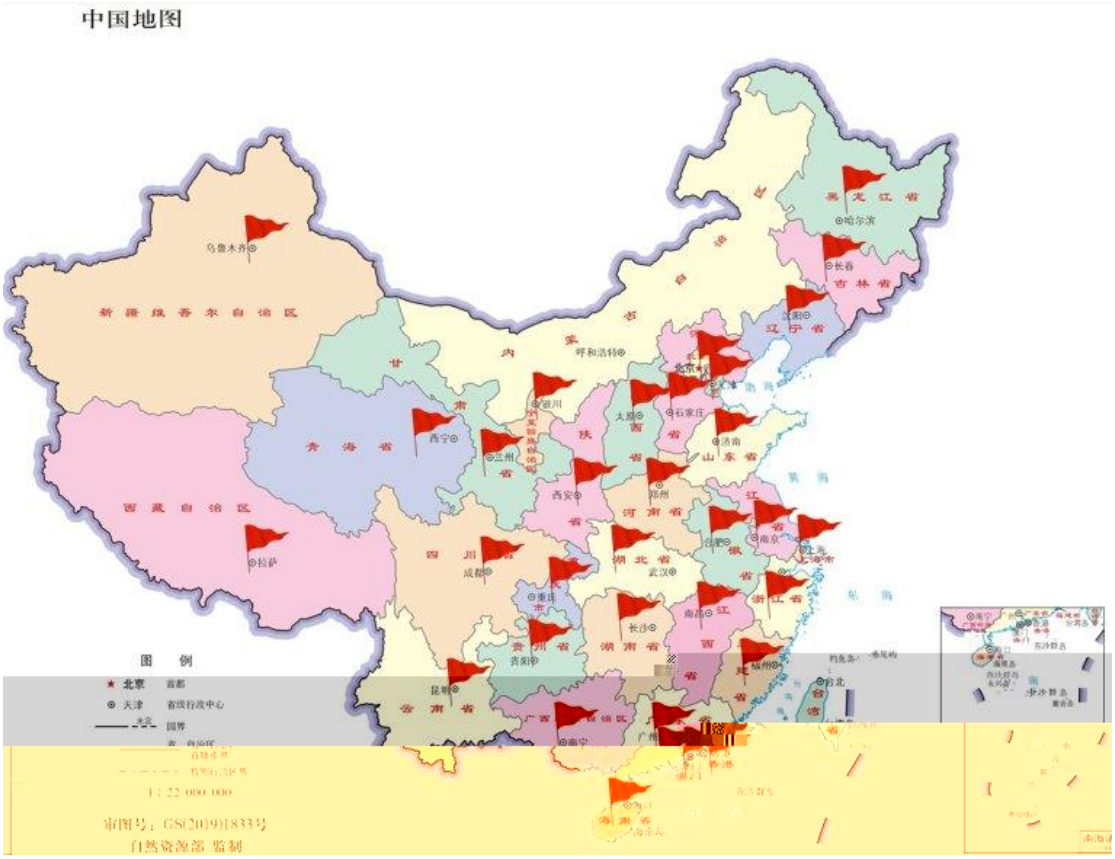
200

/ “SeaFly”“

”“ 0 ”“ ”“ ”“ 3 ”“ 5 ”“ ”

3.2

2019 1



1

3.3

8.12

2016 5 ~6 8

7 1 7 72 km 8.8 km^2

DO (NH_3-N) ORP

1

	p(DO)/(m/L $^{-1}$)			ORP/mV			/NTU			*p*(NH_3 -N)/(m/L^{-1})		
						/%			/%			/%
1	3.98	4.07	-0.09	190.32	180.6	5.38	29. 12	35.2	-17.27	1.28	1.62	-20.99
2	4.28	4.65	-0.37	191.65	181.7	5.48	0	30.5	-100.00	1.581	2.04	-22.50
3	1.86	1.95	-0.09	158.24	172.5	-8.27	0	80.3	-100.00	2.56	3.11	-17.68
4	2.75	2.93	-0.18	159.84	173.6	-7.93	0	65.4	-100.00	2.259	2.86	-21.01
5	7.02	6.85	0. 17	197.07	190.8	3.29	0	16.5	-100.00	3.36	3.94	-14.72
6	6.26	6.21	0.05	202.79	204.6	-0.88	0	25.3	-100.00	3.58	3.98	-10.05
7	6.20	6. 11	0.09	138.22	126.4	9.35	195.95	23.1	748.27	3.608	4. 10	-12.00
8	6.80	6.54	0.26	138.25	130.8	5.70	0	20.4	-100.00	3.849	4.21	-8.57
9	7.36	6.93	0.43	180.82	178.7	1.19	0	19.6	-100.00	5.401	4.89	10.45
10	5.81	6. 13	-0.32	150.3	151.3	-0.66	49.1	31.1	57.88	5.307	4.75	11.73

3.4

ISO ASTM OECD

pH

2000 U.S. Geological Survey

Guidelines and Standard Procedures for Continuous Water-Quality Monitors--Site Selection, Field Operation, Calibration, Record Computation, and Reporting 2006

Guidelines and standard procedures for continuous water-quality monitors—Station operation,record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3 ISO 15839:2003 - Water quality -- On-line sensors/analysing equipment for water -- Specifications and performance tests ASTM D3864 – 12 Standard Guide for On-Line Monitoring Systems for Water Analysis OECD 236 Nanosystems for Water Quality Monitoring and Purification

3.5

2017 12 28 (HJ 915-2017) 2014 12 23 HJ 731-2014 2015 1 1 2007 7 12 HJ/T 354-2007 2007 8 1

4

4.1

HJ 168-2010

1

2

3

4

5

4.2

1

2

3

4

4.3

HJ 168 1

2 3

4 2

5

5.1

200 kg

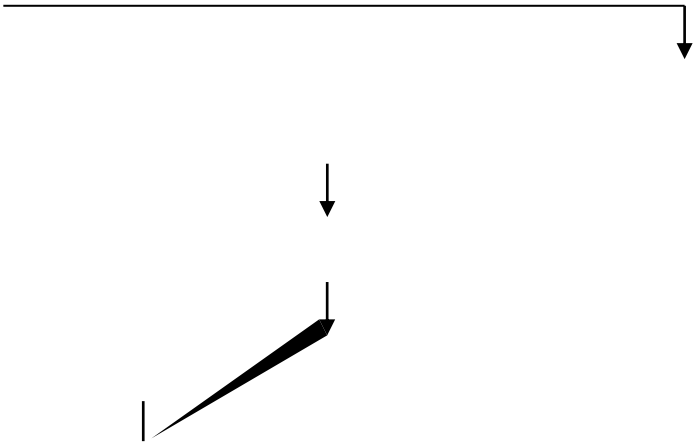
5.2

6

6.1

“ ”

“ 200 kg ”



200 kg

200 kg

6.2

14

GB/T 14581

HJ/T 91 HJ 494

HJ/T 354 HJ/T 372

CCS 2018

1

GB 4943.1 GB 17799.4

GB/T 13384

GB/T 14581

GB 6920 pH

GB 13195

GB 4943.1 1

GB 17799.4

GB/T 13384

HJ 354 COD_{Cr} NH_3-N

HJ 91

HJ/T 372

HJ 494

HJ 506

HJ 535

HJ 897 a

CCS 2018

6.3

1 unmanned surface vehicle
unmanned surface vehicle USV

2 USV for water quality monitoring

3 platform

4 mission loading

5 water sampling

6 monitoring

7 in-situ monitoring

8 communication system

9 control system
/

10 remote control
/

11 autonomous sailing

12 display and control base

13 remote controller

6.4

1

a) <100 kg <2 m

0.5 m~1 m

b) ≥ 100 kg ≥ 2 m

200 kg

2

/

6.5

6.5.1

a)

b)

c)

d) /

CCS

6.5.2

1

a)

≥ 2 m/s

b)

≥ 3 h

≥ 6 h

c)

≥ 10 km

≥ 50 km

3

1.5 m/s

0.5 m/s 3 m/s

2 m/s

3 h 6 h

1 m/s 3 h 10 km

10 km

50 km

2

a) ≤ 2.5 m

b) ± 1 °

c) ± 1 ° 0 ° ~15 °

CCS

MSC.112 73 GPS

SJ/T 11420-2010 GPS

3

a)

b)

≥ 2 km

≥ 5 km

c)

≥ 9600

≥ 4 Mbps

d ≥ 1km

4

CCS “

” UN38.3

a)

b)

c)

-
-
- 300
- UN38.3

IP67

5

CCS “ ” “ ”

a)

b)

c) ≥ 10 m

d)

e)

f)

g)

h) IP66

6

CCS “ ” “

2

”

A.

a

-
-

b

-
-

c

-
-
-
-
-
-
-

d

e

f

/

-

/

-
-

B.

a

-
-
-
-
-

b)

-
-
-
- GPS/

7

A.

HJ/T 372-2007

HJ/T 91-2002 2

2

1		G		24 h	1 L
2		G		24 h	500 ml
3		P		14 d	250 ml
4		G		24 h	1 L
5		P		14 d	250 ml
6		G		24 h	250 ml
7		P		14 d	250 ml
8		P		24 h	500 ml
9		G		24 h	500 ml
10		G		3 d	1 L
11		G		24 h	250 ml
12		G		7 d	250 ml
13	a	G		48 h	500 ml

14		G		2d	500 ml
1 G P 2 0~5℃					

1

a)

b)

c)

d)

e)

f)

g)

2

a)

- 2 L
- 7 L

b) /

- ±0.1 m
- 10 m
-

c) ± 10%

d) ≥ -0.05 MPa

e) HJ/T 372 HJ/T 91

B.

2017 12 28

HJ 915-2017 2014 12 23 2015 1 1

HJ 731-2014

HJ/T 354-2007

3

3

pH		0~14	—	—	±0.1	—	±0.2	±0.1

℃		-5~50	—	—	± 0.2	—	± 0.2	—
mg/L		0~50	—	—	± 0.3	—	± 0.3	± 0.3
μs/cm		0~100	—	± 1%	± 1%	—	±0.2	± 1%
mg/L		0~5	≤ 0.1	± 5%	± 10%	≤ 1%	± 10%	± 10%
μg/L		0~200	≤ 0.3	± 15%	± 10%	≤ 0.1%	± 10%	± 10%
	—	—		± 10%	± 10%	≤ ± 1%	± 10%	± 10%
	GB 3838 I							

1)

a) 5 pH

a

b)

2)

a)

b)

c)

2 h

d) ≥ 5 MΩ

e) 50 Hz 1500 V 1 min

f)

8

6.6

6.6.1

6.6.2

CCS 2016 “ ”

14 mm ≥ 98 kPa

1 m 0.1 m/s 30 s

3 min

6.6.3

5.2.2.5

1

3

2

3

6.6.4

/

/

HJ/T 372-2007

HJ 915-2017

HJ 731-2014

HJ/T 354-2007

1 /

2 /

3 /

/

3

a)

V_1

V_2 3 1 ΔV 3

$$\Delta V = \frac{|V_2 - V_1|}{V_1} \times 100\% \qquad 1$$

ΔV——

V_1—— ml

V_2—— ml

b)

-0.1~0 MPa

4

pH				—		
	—	—		—		
mg/L	—					
μs/cm	—	0.01 mol/L KCl	0.01 mol/L KCl		0.03 mol/L KCl	
mg/L	3-5	50%	50%		80%	
a μg/L	3-5	50%	50%		80%	
	3-5	50%	50%		80%	

4

a)

4 8

2 DL

$$DL = 2.998 \times \sqrt{\frac{1}{n\text{-}1}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2} \qquad 2$$

DL——

x_i ——— i

$\bar{x}$ ———

n——

b)

4 6

3 6 S_r

$$S_r = \frac{\sqrt{\frac{1}{n-1}\sum_{i=1}^{n}\left(x_i - \bar{x}\right)^2}}{\bar{x}} \times 100\% \qquad 3$$

S_r——

x——6

n—— 6

x_i—— *i*

4 24 h 1 h

3 x_0 6 7

x_i x_0

RD

$$RD = x_i - x_0 \quad (6)$$

RD——

x_i—— i $i \geq 3$ mg/L

x_0—— 3 mg/L

$$RD = \frac{x_i - x_0}{A} \times 100\% \quad (7)$$

RD——

x_i—— i $i \geq 3$ mg/L

x_0—— mg/L

A—— mg/L

e)

10 min

10 5

8 9 $\overline{A}$

$\overline{a}$

$$\overline{A} = \frac{\sum_{i=1}^{n} \left| X_i - \overline{B} \right|}{n\overline{B}} \times 100\% \quad (8)$$

$$\overline{a} = \frac{\sum_{i=1}^{n} \left| X_i - \overline{B} \right|}{n} \quad (9)$$

$\overline{A}$——

$\overline{a}$——

X_i—— i L

$\overline{B}$——

n——

i——

5

pH		GB 6920
		GB 13195
		HJ 506

		HJ 535
a		HJ 897

6.6.5

GB 4943.1

6.6.6

GB 17799

6.7

GB/T 20000.1-2014 1

2 2

1

2

a)

b)

c)

3

a)

b)

c) 1

d)

e)

6.8

1

2

3

6.9

1

2

ŧ

7

1 “ ”

“ ”

“ ”

2

“ ”

“ 200 kg

” 200 kg

200 kg

3 “ ” “ ”

500 t

500 t 20 m

500 t

20 m “ ” “ ”

4

CCS

“ ” “ ”

“

”

“ ”

5

CCS

“

9 ” “

”

“ ”

6

“

” “ ” “ ” 2

5 “ ” 4

6 “ ”

8

9

[1] HJ 168-2010
[2] HJ/T 91-2002
[3] GB/T 6682-92
[4] GB 12997-91
[5] GB 12998-91
[6] GB 12999-91
[7] HJ/T 372-2007
[8] ISO 15839:2003 Water quality -- On-line sensors/analysing equipment for water -- Specifications and performance tests
[9] ASTM D3864 – 12 Standard Guide for On-Line Monitoring Systems for Water Analysis
[10]OECD 236 Nanosystems for Water Quality Monitoring and Purification
[11]USGS 2000 Guidelines and Standard Procedures for Continuous Water-Quality Monitors--Site Selection, Field Operation, Calibration, Record Computation, and Reporting
[12]USGS 2006 Guidelines and standard procedures for continuous water-quality monitors—Station operation,record computation, and data reporting: U.S. Geological Survey Techniques and Methods 1–D3
[13]HJ 731-2014
[14]HJ 915-2017
[15]HJ/T 354-2007
[16]CCS 2018
[17]GB 4943.1-2011 1 :
[18]GB/T 9254-2008
[19]GB/T 13384-2008
[20] , , , . / [C]// 2013 ( ). 2013.
[21] , . [J]. , 2017, 9(1):18-20.
[22] “ ” 100 http://www.lyg01.net/news/lygxw/2018/0429/110926.shtml
[23] “ ” 2016 9 21 .