# HJ

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# Technical specifications for automatic monitoring of surface water (Trial)

地表水自动检测技术规范

（试行）

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# Technical specifications for automatic monitoring of surface water (Trial)

## 1 Scope of application

This standard specifies the technical requirements for the construction, acceptance, operation and management of the automatic water quality monitoring system (except seawater).

This standard applies to the automatic water quality monitoring system which is constructed by the environmental protection department.

## 2 Normative references

The contents of this standard refer to the terms in the following documents. For undated references, the valid version applies to this standard.

GB 3838 Environmental quality standards for surface water

HJ/T 96 The technical requirement for water quality automatic analyzer of PH

HJ/T 97 The technical requirement for water quality automatic analyzer of electroconductivity

HJ/T 98 The technical requirement for water quality automatic analyzer of turbidity

HJ/T 99 The technical requirement for water quality automatic analyzer of dissolved oxygen

HJ/T 100 The technical requirement for water quality automatic analyzer of permanganate index

HJ/T 101 The technical requirement for water quality automatic analyzer of ammonia

HJ/T 102 The technical requirement for water quality automatic analyzer of total nitrogen

HJ/T 103 The technical requirement for water quality automatic analyzer of total phosphorous

with the facilities for waste liquid treatment and domestic sewage collection.

The construction of the fixed station building includes the main building for carrying the system equipment and the external supporting conditions. The main building consists of the instrument room, the quality control room, the living room of the duty guard. External supporting conditions refer to the introduction of clean water, electricity, communications, building access roads, flattening, greening, solidifying the land covered.

The simple station building and the small station building are suitable for the construction of water stations which have limited floor space, complicated geographical conditions, short project construction period, the need to relocate or adjust the monitoring section. The design dimensions of the station building shall meet the installation requirements of the instrument and system integrated device. The material of the station building should be made of light materials, which have functions such as constant temperature, heat insulation, rain proof and alarm, etc.

The water fixed platform station and the water buoy (ship) station are a monitoring system that integrates monitoring instruments on the platform and is equipped with power supply equipment such as solar energy and wind energy, has functions such as warning against collision and alarming, etc.

### 4.4 Construction of each unit of water station

#### 4.4.1 Water collection & distribution unit

The water distribution & distribution unit is the key part to ensure the normal operation of the whole system and to obtain the correct data. It must ensure that the water samples provided are reliable and effective, including the water collection unit, the pretreatment unit and the water distribution unit. The water collection unit includes the water collection method, the water collection pump, the laying of water collection pipeline. The pretreatment unit provides pretreatment device for different monitoring items, to meet the requirements of the analytical instrument for the settling time and filtration accuracy of the water sample. The water distribution unit supplies water directly to the automatic monitoring instrument, the water quality, water pressure and water quantity provided by the water distribution unit must meet the requirements of the automatic monitoring instrument.

#### 4.4.2 Control unit

The control unit is the command center that controls the coordination of the various units within the system.

#### 4.4.3 Detection unit

### 6.2.1 Routine maintenance

Routine maintenance includes station building's surrounding inspection, inspection of instrument and system, replacement of consumables, replacement of reagent, pipeline cleaning, and so on. The operational maintenance organization shall conduct regular patrol inspections of the water station, the frequency of patrol inspection shall not be less than once a week, the conditions of patrol inspection shall be recorded. The following work is performed each time performing patrol inspection of the water station:

a) Check the operating status and main technical parameters of each analytical instrument and auxiliary equipment, to determine whether the operation is normal; check whether the power supply, process temperature, stirring motor, sensor, electrode and working sequence are normal; check whether there is liquid leakage, whether there is air bubble in the pipeline; regularly clean the conventional five parameters, chlorophyll and blue-green algae electrodes;

b) According to the operation of the instrument, the water quality of the section and the environmental conditions of the water station, determine the replacement cycle of consumables (such as pump tubes, joints, seals, etc.), ensure finishing replacement before the expiration of the consumables; if it is necessary to replace the spare parts (such as electrodes), it shall have inventory to ensure timely replacement;

c) Check the reagent status, add and replace reagents regularly. The pure water and reagents used must meet the relevant technical requirements. The replacement period shall not exceed the shelf life of the reagents as specified in the operating procedures or instrument specifications. It shall shorten the replacement period when the indoor temperature is high. Each time the primary reagent is replaced, it shall recalibrate the instrument according to the appropriate operating procedures or instrument instructions. Reagent shall be prepared by a qualified laboratory, providing proof of reagent source and labeling;

d) Timely organize the station building and instrument, complete the collection of waste liquid, do well in the processing and disposal according to the relevant requirements, keep the file for future reference; keep the water station building and all instruments clean and tidy, close the doors and windows in time, to avoid all kinds of analytical instruments from exposure to direct sunlight;

e) Check whether the water collection system and the water distribution system are normal, such as the fixed condition of the water collection buoy, the operation of the self-priming pump, etc.; regularly clean the water collection & distribution system, including the water collecting head, the

maintained and overhauled at least once a year;

b) According to the requirements specified by the manufacturer's use and maintenance manual, based on the service life, replace the key components such as light source, electrode, peristaltic pump and sensor in the monitoring instrument;

c) Perform inspection of the leakage and pressure of the liquid path of the instrument; inspect and clean the optical path, liquid path, circuit board, various connectors and sockets, etc.;

d) Check and calibrate the output zero and full scale of the instrument, check the output linearity of the instrument;

e) After completing each overall maintenance and overhauling, or after replacing the key components such as light source, electrode, peristaltic pump, sensor, etc. in the instrument, it must calibrate and check the instruments again, record the overhauling and calibration information.

### 6.2.3 Troubleshooting

Troubleshooting refers to the targeted inspection and repair of faulty instrument and equipment. Troubleshooting shall be done as such:

a) According to the characteristics of the instrument used and the maintenance manual provided by the manufacturer, prepare the work instructions for judging and repairing common faults;

b) For problems that can be clearly diagnosed at site and can be solved by replacing spare parts (such as the control failure of solenoid valve, the rupture of pump tube, the blockage of liquid path, the aging of light source, etc.), it shall be troubleshooted at site;

c) For other faults that are difficult to diagnose and repair, it shall use the standby instruments to replace the faulty instruments; send the faulty instruments or spare parts to the laboratory or the instrument manufacturer for inspection and maintenance;

d) After each troubleshooting, according to the troubleshooting items and the replaced parts, calibrate the instruments. For maintenance of the common consumables (such as replacement of pump tube, cooling fans, fluid path joints or connectors), it shall perform at least calibration of standard liquid. For maintenance of critical components (such as maintenance of moving mechanical parts, optical components, testing components and signal processing components), follow the requirements of the instrument standards and specifications to check the standard curve and precision. All troubleshooting results shall be recorded as required for reference.

# Appendix B

## (Informative)

### Technical requirements for construction of automatic water quality monitoring system

### B.1 Basic principles of site selection

Site selection must consider the following basic principles:

a) Feasibility of basic conditions: It has good basic conditions such as land, traffic, communication, electricity, clean water and geology;

b) Representation of water quality: According to the purpose of monitoring and the function of the section, it has a good representation of water quality;

c) The long-term nature of site: It is not affected by the construction of urban, rural, water conservancy, etc. It has a relatively stable water depth and river width, which can ensure the long-term operation of the system;

d) Safety of system: The environmental conditions around the water station are safe and reliable;

e) Economics of operational maintenance: It is convenient for the daily operation, maintenance and management.

### B.2 Basic conditions for the establishment of water station

To ensure long-term stable operation of the system, the selected site location must meet the following basic conditions:

a) It is convenient for traffic, the time to reach the water station is generally not more than 4 h;

b) There is reliable power supply and stable voltage, the supply voltage shall reach 380 V, the equipment voltage shall reach 220 V ± 10%, the capacity is not less than 15000 W;

c) There is tap water or a self-prepared well water source, the water quality meets the requirements of domestic water;

d) The communication conditions are good; the quality of the communication line or wireless network meets the data transmission requirements;

a) Perform design and construction according to local geological conditions, make corresponding foundation treatment when encountering weak foundation;

b) Use brick-concrete structures or frame structures, the endurance life is not less than 50 years;

c) The ground elevation can withstand the flood of 50-year frequency; the clearance height in the station building is not less than 2.7 m;

d) Make cement concrete floor around the station building, the ground outside the station building is flat, the surrounding area is clean and tidy, which is conducive to drainage, it is properly greened;

e) The shape design of the station building shall be adapted to local conditions, the appearance is beautiful and generous, the structure is economical and practical; if located in the scenic area, it shall be coordinated with the surroundings;

f) There shall be hardened roads leading to the water station, the road width is not less than 3 m and it is connected with the trunk road, there is a proper amount of open space in front of the station, to ensure the parking of vehicles and materials transportation;

g) It shall ensure that the lightning protection system, grounding system, water collection facilities, water supply and drainage, etc., are synchronized with the construction of the station building;

h) Dedicated grounding device for station building, instrument, electrical system, etc., shall have a grounding resistance not more than 4 Ω and be subjected to equipotential bonding;

i) The area map and plan (1:500 or 1:1000) of the area to be acquired shall be filed.

**B.3.3 Safety design for station building heating, lightning protection and earthquake resistance**

a) The instrument room is equipped with air conditioning and heating equipment. The indoor temperature is controlled at 18 ~ 28 °C and the humidity is within 60%. The air conditioner shall have the function of automatic reset after power restoration, the heating device is used to prevent system damage caused by power outage in winter;

b) Perform seismic design based on local seismic fortification intensity;

c) It is equipped with smoke detection, flame alarm, built-in fire extinguishing equipment;

wireless communication. When the communication cable is close to the station building, it has no flying line. When the communication cable passes through the wall, bury the wall-penetrated tube and do well in grounding.

**B.4.3 Water supply and drainage facilities**

Sample water: The location where the water collection pipe enters the station building is close to the lower part of the wall where the instrument is installed, and provided with the protective sleeve, which is 50 mm higher above the ground.

Drainage: All water drained from the station building is collected into the trunk drainage pipe, discharged into the corresponding drainage point through the external drainage pipe. The total diameter of drainage pipe is not less than DN 150, to ensure smooth drainage. The water outlet of the drainage pipe is higher than the highest flood level of the river and is located downstream of the water collection point. A drainage pipe interface for the instrument and equipment is set in the station building, the pipeline which has the total diameter of pipeline not less than DN 25 is used. The drainage pipe is 50 mm higher above the ground. It also needs to pay attention to take antifreeze measures.

Auxiliary water: Tap water or well water is introduced into the station building. The instantaneous maximum flow of water is not more than 3 $m^3/h$, the pressure is not less than 0.5 $kg/cm^2$, the water consumed per each cleaning is not more than 1 $m^3$. There is rainwater drainage system in the region outside the station building, to avoid water accumulation on the floor outside the station building.

**B.4.4 Domestic sewage collection facilities**

The station building shall be designed with a domestic sewage septic tank, which shall be constructed synchronously with the civil work of the station building.

**B.4.5 Uninterruptible power supply facilities**

The uninterruptible power supply system shall meet the requirements that the automatic monitoring instruments, communication equipment, etc., can operate normally within 2 hours of the power failure mode, including the emptying and cleaning of the analytical instrument, the operation of the data acquisition control system. When the backup power supply is used, it shall avoid the air conditioner from heating operation when the room temperature is relatively low, to ensure that the monitoring instrument has priority to use electricity.

**B.5 Water collection unit**

The function of the water collection unit is to ensure that the water sample at the water collection point is led into the instrument room under any

siltation of the water inlet and blockage of floating objects, to prevent damage to the instrument, equipment and water collection equipment due to impact, or to affect the operation and anti-theft of the system.

The water collection device takes the water collection buoy as an example. The buoy shall be made of stainless-steel skeleton and made of surface material of glass fiber reinforced plastic. There are two cylindrical spaces which is designed according to the diameter and depth of the submersible pump on the buoy. When the pump is maintained, it may open the anti-theft lock to easily remove the water pump, without having to move the buoy. Provide circular pipe guide rail on both sides of the water collecting installation platform, insert the guide rail into water, the water collecting buoy can be floated up and down along the guide rail. No matter how the water level changes, the water collecting buoy can always ensure that the water collecting depth is always 0.5 ~ 1.0 m below the water surface, thereby ensuring its normal operation without damage during the flood season and dry season; it provides with necessary thermal insulation, antifreeze, anti-corrosion, anti-pressure and anti-sludge, anti-collision and anti-theft measures, meanwhile makes necessary fixation of water collection equipment and facilities.

**B.6 Water distribution unit**

The water distribution unit supplies water directly to the automatic monitoring instrument; its water quality, water pressure and water volume shall meet the needs of automatic monitoring instruments.

The automatic monitor of conventional five parameters uses raw water. According to the requirements of the instruments for the water sample, after the water sample enters the water distribution unit, a part of the water sample is directly sent to the conventional five-parameter measuring cell without any pretreatment according to the principle of the shortest water collecting distance. The installation of the five-parameter measuring instrument follows the principle of the minimum distance from the water body. The water flow in the cell is guaranteed to be stable and the water level is constant.

Reserve multiple instrument expansion interfaces to facilitate system upgrade. The water distribution pipelines of each instrument adopt parallel water collection mode. The inner diameter, the lifting-water flow rate and the flow velocity of the pipeline of each instrument can be separately adjusted and respectively equipped with pressure gauges. In addition to the water requirements of the instrument, each branch of the water distribution system needs to have 2 ~ 3 sets of interfaces for conventional monitoring instruments.

The system is designed with positive & negative cleaning pumps, metering pumps, high-pressure air scrubbing pipelines, ozone de-algae function, etc. It may combine a variety of cleaning methods to achieve the best cleaning effect.

system has the functions of automatic cleaning, sand discharge and algae removal. The water sample is delivered to the grit chamber through the water collection pipeline, it is made standing to allow the larger particles to sink to the bottom of the chamber. The bottom of the chamber is provided with a discharge valve. At the end of each measurement cycle, the residual water sample in the precipitation basin is emptied and cleaned, to prepare for the entry of the water sample of the next period.

The automatic cleaning and algae removal function of the pretreatment unit is generally completed automatically by the system control, the cleaning process may be either manual operation on site or remote control. At the end of each measurement cycle, use the high-pressure gas to backwash the filter, to remove adherent, algae or sediment attached onto the surface of the filter.

**B.8 Control unit**

The control unit is the command center system that controls the coordination of each unit of the system. It adopts an integrated cabinet design; all the equipment of the control unit is integrated in the cabinet.

The control unit completes the control of the automatic water quality monitoring system, communicates with the data platform, sends instructions to the data platform or accepts instructions from data platform; the control unit has a protective operation and an automatic recovery function when the system is powered off or water is disconnected.

The control unit shall be able to guarantee a long-term unattended operation of the architecture, the control software is fully compatible with the existing remote-control software of the data platform.

The core components of the control unit include programmable logic controller (PLC), industrial computer, peripheral device actuator and circuit, isolation transformer, software and so on.

When the field control unit is powered off or not running due to damage, the entire system can still communicate normally, the mean time between failures (MTBF) is not less than 10000 h.

**B.9 Data acquisition and transmission unit**

The data acquisition and transmission unit are equipped with a high-performance workstation, for collecting and transmitting on-site monitoring data. The data acquisition and transmission are performed according to the analytical cycle, one set of data is collected every cycle, including monitoring results, monitoring instrument status, calibration records, on-site environmental status, alarm status, valve status, system working status, etc. All collected data is stored in the field server. According to the setting of the data transmission

to identify the monitoring data by means of data and identification.

The use of data receiving mode by private network or virtual private network (VPN) can automatically and simultaneously receive the data and status information uploaded from each water station, parse the data, and store it into the database. It can actively collect real-time and historical data, can remotely control the device. It can change the device range and parameters, support wireless and wired communication and protocol modes, realize remote synchronous multi-point data acquisition.

The data platform system can automatically collect the system environmental status parameters and instrument status parameters, automatically identify and process instrument faults, quality control data, and invalid data. It may, according to the user's needs, set the status parameter or fault alarm signal to automatically judge the validity of the data. It can judge the water quality class, primary pollutants, pollution index and the over-standard conditions of each item. It can perform data processing according to the user’s requirements, perform data comparison at different time periods, send the alarm information in various forms to the designated personnel terminal.

It adopts dual-system non-hard disk backup at site, which can automatically back up the database regularly. When the database is damaged, it may arrange the user to set the automatic recovery, meanwhile the user can select the time period to back up the monitoring data. When necessary, the user can perform database recovery, to restore the data backed up at the water station to the data transmission system.

The system has data quality control function, which can automatically analyze the availability of complete data control methods as well as the quality control data report, make corresponding identification of the suspicious data.

The system itself needs to have an automatic classification alarm, which can automatically trigger the alarm output when an alarm occurs in the system, to notify the maintenance personnel in a wired or wireless manner. For important alarm, the maintenance personnel will respond timely and perform emergency handling.

It supports remote image monitoring and video recording; it can collect alarm information of the station’s security monitoring system and on-site picture data; it can automatically record backup and form reports. When the security monitoring system has abnormal alarm information, send alarm information to designated personnel terminal in various forms.

The system can make automatically uploading according to the uploading cycle of the station’s picture information, meanwhile collect the real-time picture data at field. It supports remote data monitoring and system log monitoring. The data

# Appendix C

## (Informative)

### Technical requirements for acceptance of automatic water quality monitoring system

### C.1 Acceptance of performance of automatic monitoring equipment

#### C.1.1 Arrival acceptance of instruments

According to the contract, perform such arrival acceptance work as the visual inspection, quantity check, and so on, of each automatic monitoring equipment and spare parts, fill the “Appearance form of appearance and quantity of equipment and spare parts” (see Table C.1).

#### C.1.2 Instrument installation, power supply, warm-up test

Make installation according to the requirements of the instruction manual of instrument and equipment. After the installation, check whether the power supply system is normal, whether the instrument and equipment are installed correctly. Conduct the power-on test and warm-up of instrument and equipment under the condition that there is no error found during inspection. Fill the test results into the “Test form of instrument installation, power-on, warm-up” (see Table C.2).

#### C.1.3 Initialization test of instrument

When there is no error of the power-on test and the warm-up of instrument and equipment, perform the initialization test of the instrument and equipment according to the requirements of instruction manual, fill the “Initialization test form of instrument” (see Table C.3).

#### C.1.4 Basic function check of instrument

Check the basic functions of the instrument, fill the “Check form of the basic function of instrument” (see Table C.4).

#### C.1.5 Detection limit

After the instrument is calibrated, based on the analytical methods of sample, make 8 continuous determinations of the blank solution or the prepared low-concentration standard solution to obtain the detection limit; fill the test results into the “Record form of the determination results of instrument’s detection limit” (see Table C.5).

automatic monitoring instrument, calculate the relative error of the actual water sample comparison, determine the results according to Table A.2 of Appendix A, fill the “Record form of comparison experiment” (see Table C.9).

The qualification rate of actual water sample comparison shall be not less than 85%.

**C.1.10 Other instruments**

Other instruments that are not specified in this standard shall be accepted in accordance with the contract and Table A.2 of Appendix A. Fill the corresponding acceptance records.

**C.2 Technical requirements for system acceptance**

After the performance test of automatic monitoring instrument and equipment is completed, perform the system online test run. The content includes: whether the online instrument and equipment operation, data transmission and data platform control are normal, whether the performance indicators meet the contract requirements. Record the operation conditions.

Perform test run for at least 30 days. Fill the “Record form for average fault-free continuous operation” (see Table C.10).

The operation of the water station and data platform (software functions, software tests, operation results and records provided as required by the contract) include: the stability of functions such as data retrieval, data processing, and output statement; whether the functions proposed in the contract and equipment’s instruction manual are achievable. Record the problems found during the operation period. Fill the “Assessment form of data acquisition, transmission, control system” (see Table C.11).

Test the water collection, pretreatment, water distribution, backwashing function and auxiliary equipment of the water collection & distribution unit. Fill the “Assessment form of basic function of water collection & distribution units” (see Table C.12).

During the system acceptance, it shall assess the operation efficiency of the instrument. Make calculation according to formula (7) and formula (8), record and fill the “Record form of the operation efficiency of instrument” (see Table C.13). At the end of the running test, the operation efficiency of system instrument shall be not less than 90%.

Operation efficiency of instrument (%) = Effective operation hours / Total hours of operation assessment x 100% ..... (7)

Effective operation hours = Total hours of operation assessment - Ineffective

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