
**Ships and marine technology —
Pneumatic quick-closing control
devices**

*Navires et technologie maritime — Dispositifs de commande
pneumatiques à fermeture rapide*

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Published in Switzerland

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC8, *Ships and marine technology*, Subcommittee SC3, *Piping and machinery*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

A pneumatic quick-closing control device is a remote operation system used to control quick-closing valves, fire dampers and shutters of marine quick-closing systems. It plays a vital role in protecting the safety of ships and offshore facilities, and reducing fire losses. It also helps to ensure compliance with the requirements specified in the applicable sections of *The International Convention for the Safety of Life at Sea (SOLAS)*^[1].

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Ships and marine technology — Pneumatic quick-closing control devices

1 Scope

This document specifies the terms and definitions, design, system components, classification, technical requirements and test methods of marine pneumatic quick-closing control devices. It also addresses system pressures, automatic controls, alarms, signal feedback, performance test methods, safety, packaging and handling of pneumatic quick-closing control devices.

This document applies to the design, manufacture and acceptance of pneumatic quick-closing control devices.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 780, *Packaging — Distribution packaging — Graphical symbols for handling and storage of packages*

GB/T 13306, *Plates*

IEC 60068-2-1, *Environmental testing — Part 2-1: Tests — Test A: Cold*

IEC 60068-2-2, *Environmental testing — Part 2-2: Tests — Test B: Dry heat*

IEC 60068-2-30, *Environmental testing — Part 2-30: Tests — Test Db: Damp heat cyclic*

IEC 60068-2-6, *Environmental testing — Part 2-6: Tests — Test Fc: Vibration (sinusoidal)*

IEC 60068-2-11, *Basic environmental testing procedures — Part 2-11: Tests — Test Ka: Salt mist*

IEC 61000-4-5, *Electromagnetic compatibility — Testing and measurement techniques — Surge immunity test*

IEC 60529, *Degrees of protection provided by enclosures (IP code)*

IEC 60533, *Electrical and electronic installations in ships — Electromagnetic compatibility (EMC) – Ships with a metallic hull*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <https://www.electropedia.org/>

3.1

pneumatic quick-closing control device

PQCD

system installation that realizes remote fast operation, status display and alarms via remote control to devices such as pneumatic quick-closing valves, pneumatic fire dampers and pneumatic shutters

3.2

control and display panel

electrical panel for electric-controlled operation and status display where the quick-closing device is installed

3.3

remote control and display cabinet

electrical cabinet for electric-controlled operation and status display in a location away from the quick-closing device (such as a control room)

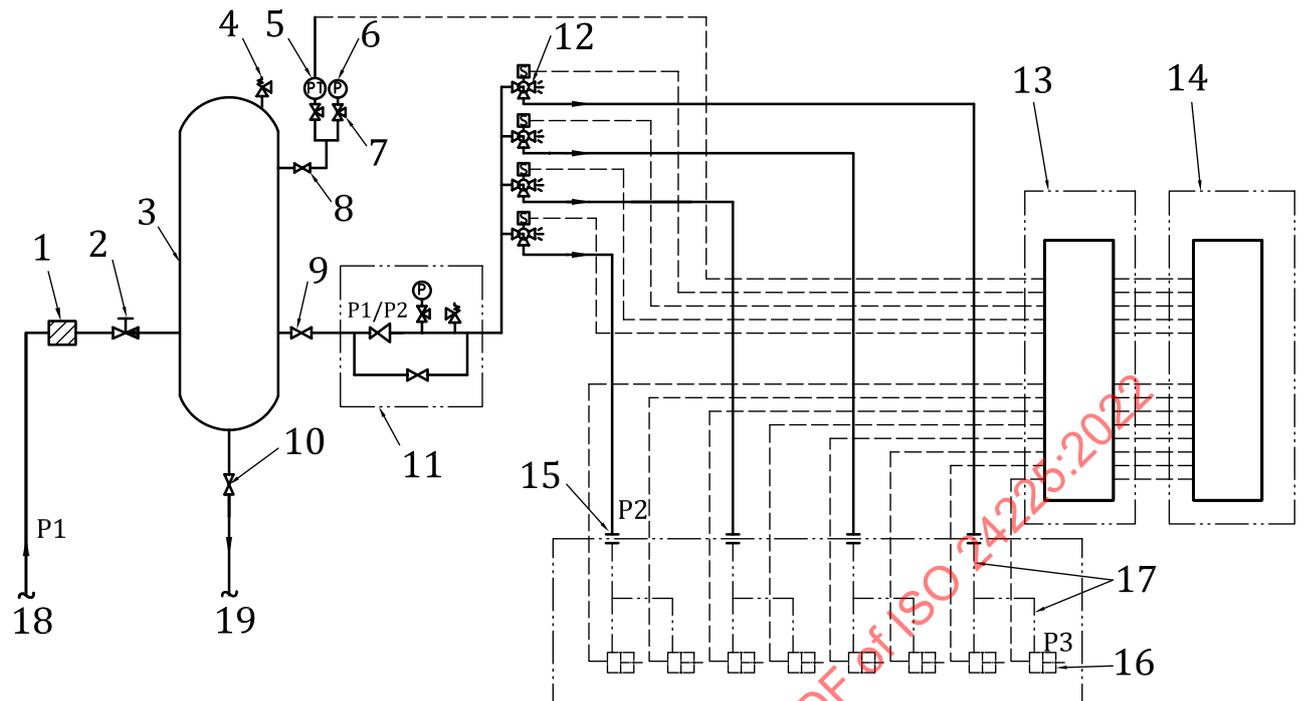
4 Design

4.1 System composition

A pneumatic quick-closing system is composed of a pneumatic quick-closing control device (PQCD), pipelines and the objects to be controlled, such as pneumatic quick-closing valves, pneumatic fire dampers and pneumatic shutters.

Other components in the PQCD system, including valves and piping, are illustrated in [Figure 1](#).

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**Key**

- 1 air filter
- 2 inlet valve
- 3 compressed air tank
- 4 safety valve
- 5 pressure transducer
- 6 pressure gauge
- 7 meter three-way test valve
- 8 meter root valve
- 9 outlet valve
- 10 drain valve
- 11 pressure reducing valve group (optional, shall be equipped only when $P1 > P2$)
- 12 three-way valve
- 13 control and display panel (optional, according to user needs)
- 14 remote control and display cabinet (optional, according to user needs)
- 15 output end of PQCD
- 16 object to be controlled (such as pneumatic quick-closing valve, pneumatic fire damper and pneumatic shutter)
- 17 pipeline
- 18 compressed air inlet
- 19 drain outlet
- P1 Max. rated input pressure
- P2 Max. rated output pressure
- P3 Min. working pressure at the input ends of controlled objects

Figure 1 — Schematic diagram of pneumatic quick-closing system

4.2 Requirements

4.2.1 Pressures of the PQCD system shall be designed as per [Table 1](#).

Table 1 — System pressure

Maximum rated input pressure P1	Maximum rated output pressure P2	Minimum working pressure P3
$P1 \leq 3,0 \text{ MPa}$	0,5 MPa –1,0 MPa	0,3 MPa –0,5 MPa

4.2.2 The air output control valve of the PQCD system shall be able to independently complete the air supply and pressure relief of the controlled pipeline, so as to facilitate the action and reset of the controlled object. A silencer shall be installed at the pressure relief outlet of the control valve. The control valve usually adopts three-way valve, which can also be replaced by other valves or valve groups with the same function as above.

4.2.3 PQCD shall be able to provide operational control to pneumatic quick-closing valves, pneumatic fire dampers and pneumatic shutters. Three-way valves shall operate correctly.

4.2.4 PQCD with valve position display shall provide real time monitoring of the open/closed status and remote display of valve position status of pneumatic quick-closing valves, pneumatic fire dampers and pneumatic shutters.

4.2.5 The PQCD shall be designed as per the fail-safe principle and shall send out alarm signals in case of failure. PQCD shall be designed such that upon failure of a component, subsystem or system, the output automatically reverts to a pre-determined design state of least critical consequence. Typical failsafe states are: as is; open; or closed. In addition, other devices or systems may also be activated as needed in order to maintain overall safety.

4.2.6 The alarms of PQCD shall include “power supply failure”, “air supply failure” and other alarms. PQCD shall separately display alarm signals of failures occurred simultaneously.

4.2.7 The indication and alarm system of the PQCD shall have a self-detection function, such as a lamp test button, which can provide an alarm (or indication) test with regard to its own fault to avoid a no alarm status or false alarm (or false indication).

4.2.8 PQCD shall be independent of other safety systems and alarm systems. In case of a fault of the PQCD, normal operation of other monitoring and alarm systems shall not be affected.

4.2.9 The design of a PQCD shall ensure that any fault occurred during the operation process does not cause any other fault occurrence, and the risks are lowered as much as possible. Power failure of PQCD or air supply interruption shall not cause the last ordered positions of pneumatic quick-closing valves, fire dampers or shutters controlled by it to change before the failure. The exception is for those controlled objects designed to act automatically in case of power failure or air supply interruption.

4.2.10 The PQCD shall be set up with a communication interface to external systems according to the user's requirements in order to transfer information (such as alarm information) to external systems and receive information from external systems.

4.2.11 In case of a power supply disruption, the PQCD can be manually operated to close all pneumatic quick-closing valves, pneumatic fire dampers and pneumatic shutters. Manual operation can be achieved by a three-way valve with manual function, or by other methods.

4.2.12 The output force of the PQCD shall meet the requirements for quick closing of controlled pneumatic quick-closing valves, pneumatic fire dampers and pneumatic shutters and 1,2 times that of the moment under minimum pressure.

4.2.13 An air filter shall be installed at the compressed air inlet of the PQCD unless the air source itself has an air filter.

4.2.14 Safety valves shall be set at the end of compressed air tanks and pressure reducing valve groups. Opening pressure of safety valves shall be 1,1 times the maximum rated working pressure. Stop check valves shall be set in the inlet of compressed air tanks.

4.2.15 The pressure reducing valve groups of the PQCD shall be equipped with a manual bypass or be set as parallel double pressure reducing valve sets.

4.2.16 Selection of pressure piping shall consider strength calculations and conform to the requirements for piping strength and materials as specified by the classification society.

4.3 Materials

4.3.1 Main materials for the PQCD system can conform to recognized national or international standards and requirements specified by the classification society.

4.3.2 Materials for compressed air tanks can conform to recognized national or international standards for pressure vessels, such as those specified by classification societies or the ASME Boiler and Pressure Vessel Code^[2].

4.3.3 Materials for piping shall be quality carbon steel with yield strength no less than 200 N/mm². Equivalent materials complying with a national or international standard can be considered for acceptance.

4.4 Classifications and types

PQCDs are classified into different types as follows:

- a) whether they are equipped with pressure reducing valve groups;
- b) whether the compressed air tank is separate from the PQCD;
- c) quantity of control pipelines;
- d) control methods;
- e) display options of valve positions.

The designation of type codes is illustrated in [Figure 2](#).

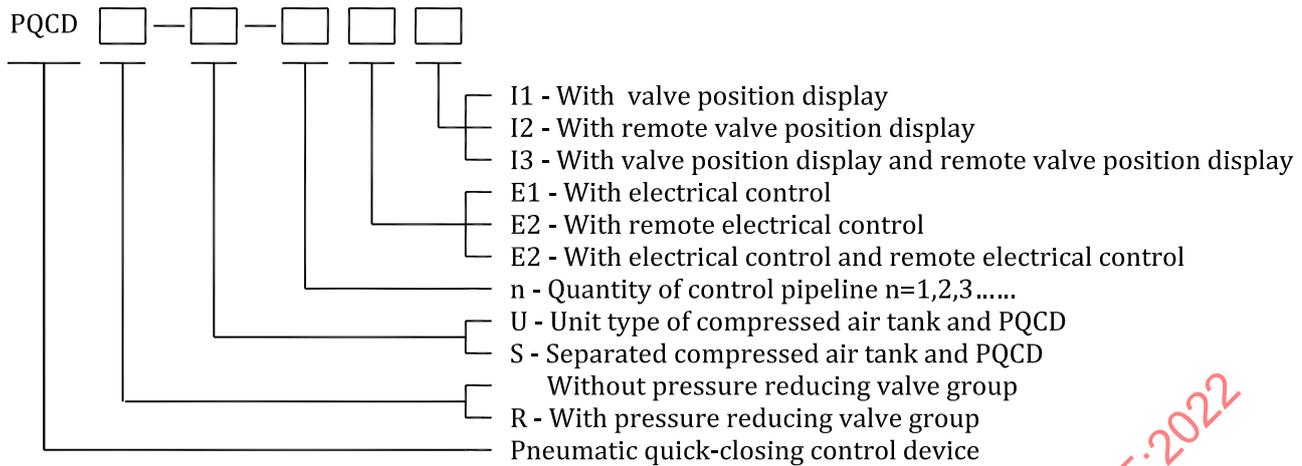


Figure 2 — Designation of type code example

5 Performance

5.1 Strength

No leakage or damage shall occur in the pneumatic pipelines or connections of the PQCD system when the air pressure is 1,5 times rated working pressure.

NOTE The pneumatic pipelines are divided into the inlet and outlet sections of pressure reducing valve's groups.

5.2 Tightness

No leakage shall occur to the PQCD system under rated working pressure.

5.3 Operational performance

The PQCD shall meet the requirements of two actions of all pneumatic quick-closing valves, pneumatic fire dampers and pneumatic shutters controlled by them, and exhibit no leakage or damage in the pneumatic pipelines or connections after action.

5.4 Air fluctuation

The PQCD shall work properly when air pressure fluctuates between $\pm 20\%$ of rated working pressure P1.

The PQCD shall work properly when the output pressure equals minimum working pressure P3.

5.5 Electrical properties

5.5.1 Power supply fluctuation

The PQCD should work under the following conditions:

- a) When using AC power for pneumatic quick-closing devices:
 - steady voltage is $+6\% \sim -10\%$ of rated voltage;
 - frequency is $\pm 5\%$ of rated frequency;

- transient voltage is ± 20 % of rated voltage;
 - recovery time is 1,5 s;
 - frequency is ± 10 % of rated frequency;
 - recovery time is 5 s.
- b) When using DC power for pneumatic quick-closing devices:
- steady voltage is $+30$ % ~ -25 % of rated voltage.

5.5.2 Power supply fault

Under rated working voltage and frequency, power supply to the PQCD is shut off three times in 5 min. Each power-off time lasts 30 s, and the PQCD shall recover automatically after restoration of power supply.

5.5.3 Insulation resistance

The insulation resistance of independent electrical circuits to enclosures in PQCD shall conform to [Table 2](#).

Table 2 — Insulation resistance

Rated voltage V	Voltage class of megger V	Insulation resistance M Ω	
		Before test	After test
24	250	≥ 10	≥ 1
220	500	≥ 100	≥ 10

5.5.4 Voltage withstanding

Components and enclosures of the PQCD shall withstand voltages as specified in [Table 3](#) for 1 min without breakdown or flashover phenomena.

Table 3 — Voltage withstanding

Rated voltage V	Test voltage V	Frequency Hz
24	548	50 or 60
220	1 500	

5.6 Environmental adaptability

5.6.1 Dry heat and cold

The PQCD shall work properly under an ambient temperature of 0 °C ~ 55 °C and no paint cracks or peeling, and no component deformation shall occur.

5.6.2 Damp heat

The PQCD shall work properly under an ambient temperature of (25 ± 3) °C and relative humidity of 95 % \pm 3 % or high temperature of (55 ± 2) °C and relative humidity of 70 % \pm 3 %.

5.6.3 Inclination and swinging

The PQCD shall work properly under inclination in all directions and swinging of 22,5° (at an interval of 10 s) and linear acceleration of $\pm 9,8 \text{ m/s}^2$ in the vertical direction.

5.6.4 Vibration

Meters and indication lamps of the PQCD shall be securely fixed. The PQCD shall work properly under vibration conditions of frequency of 2 Hz ~ 13,2 Hz and amplitude of $\pm 1 \text{ mm}$, and frequency of 13,2 Hz ~ 100 Hz and acceleration of $\pm 0,7 \text{ g}$.

5.6.5 Salt mist

Painted or galvanized control and display panels, and remote control and display cabinets shall be exposed to salt mist conditions for 48 hours and shall have no obvious rust or peeling phenomena.

5.6.6 IP code

The IP code of control and display panels, and remote control and display cabinets shall be no less than IP44. The IP code of control and display panels, and remote control and display cabinets installed on the open deck shall be no less than IP56.

5.7 Electromagnetic compatibility

If the buyer has a request, PQCD shall meet the related requirements for electromagnetic compatibility in accordance with IEC 60533.

6 Test and inspection

6.1 Strength test

Components of the PQCD system, including pipes, valves, fittings and air tanks, shall be subjected to a hydrostatic strength test at 1,5 times the maximum allowable working pressure (MAWP). If a pneumatic strength test is performed in lieu of a hydrostatic test, the pressure should be at least 1,1 times MAWP but no more than 1,3 times MAWP. The MAWP of system components should correspond to the maximum system pressures in [Table 1](#) (P1, P2). Strength tests may be conducted at the manufacturer or shipyard prior to shipboard installation.

Test personnel should consider the risks of pneumatic test versus hydrostatic test when choosing the test methods.

6.2 Leakage test

After the PQCD is manufactured, it shall be checked for leaks under normal working pressure at the manufacturer or shipyard prior to shipboard installation. Seal the outlet branches of pneumatic quick-closing devices with blind plugs. Keep all three-way valves open and fill compressed air into the air supply inlet up to the maximum system pressure in [Table 1](#) (P1, P2). Keep pressure on the system for a minimum of 5 min. Check the tightness of all piping joints and connections by applying soapy water on the weld seams and other joints. Then, close all three-way valves, remove the blind plugs, check the tightness of all branch pipe outlets by applying soapy water for a minimum of 5 min. The pressure indicated on the pressure gauge should not drop.

After the system is assembled on board, the PQCD system shall be checked for leaks again under normal working pressure.

6.3 Operational performance

Connect all the pipelines of the PQCD and fill compressed air into the air tank until the pressure reaches the working pressure. Operate all objects to be controlled, such as the pneumatic quick-closing valves, pneumatic fire dampers and pneumatic shutters via remote control for two cycles and verify the effective action of each object to be controlled.

6.4 Air supply fluctuation

Fill compressed air into the air tank. When the pressure reaches $0,8P_1$, operate each three-way valve three times and check the effective action of the three-way valves. When the pressure reaches $1,2P_1$, operate each three-way valve three times and check the effective action of the three-way valves again. When the output pressure is minimum working pressure P_3 , operate each three-way valve via electrical control for three times and check the effective action of the three-way valves.

6.5 Power supply fluctuation

Keep the PQCD power-on for 15 min. Change the voltage and frequency via external simulation as required in [5.5.1](#) and operate each three-way valve three times.

6.6 Power supply fault

Under rated working voltage and frequency, black out the PQCD for three times within 5 min with each blackout lasting for 30 s. Restore the power and then check the functions of PQCD.

6.7 Insulation resistance

When the rated voltage is 24 V, measure the insulation resistance with 250 V megger between live parts or live parts and the enclosure of PQCD.

When the rated voltage is 220 V, measure the insulation resistance with 500 V megger between live parts or live parts and enclosure of PQCD.

6.8 Voltage withstanding

Printed circuits with electronic components shall be removed during the test.

When the rated voltage is 24 V, apply approximate sinusoidal test voltage to positions specified in [5.5.4](#). Raise the voltage from below 500 V to 548 V and keep 1 min. Evenly lower the voltage to below 500 V and black out the power.

When the rated voltage is 220 V, apply approximate sinusoidal test voltage to positions specified in [5.5.4](#). Raise the voltage from below 1 000 V to 1 500 V and keep 1 min. Evenly lower the voltage to below 1 000 V and black out the power.

6.9 Dry heat

Dry heat test shall be carried out in accordance with IEC 60068-2-2.

6.10 Cold

Cold test shall be carried out in accordance with IEC 60068-2-1.

6.11 Cyclic damp heat

Cyclic damp heat test shall be carried out in accordance with IEC 60068-2-30.

6.12 Inclination and swinging

Install the PQCD on the inclination and swinging test equipment as per its practical service condition and connect the rated power supply to the PQCD. Fill pressure air into the air tank of the PQCD until the pressure in the pneumatic pipelines rises to maximum rated output pressure, P₂. Incline the PQCD to 22,5° forward, backward, left and right respectively and perform function test. Test duration at each direction shall be no less than 15 min.

Carry out swinging test to tested equipment with an angle of 22,5° at horizontal and axial directions at period of 10 s and perform function test. Test duration of each axial test shall be no less than 15 min.

6.13 Vibration

Vibration test shall be carried out on the PQCD in accordance with IEC 60068-2-6.

6.14 Salt mist

Salt mist test shall be carried out on control and display panels, and remote control and display cabinets in accordance with IEC 60068-2-11.

6.15 IP code

IP code test shall be carried out on control and display panels, and remote control and display cabinets in accordance with IEC 60529.

6.16 Electromagnetic compatibility

Surge immunity test shall be carried out in accordance with IEC 61000-4-5.

Other tests on electromagnetic compatibility requirements of classification societies shall be carried out in accordance with the relevant rules of classification societies.

7 Marking, packaging, handling and storage

7.1 Marking

Plates shall be set on the conspicuous places of the PQCD in accordance with GB/T 13306. The plate shall be durable, flame-retardant, distinctive and secure. The following shall be included in the plate:

- a) maker's name or log;
- b) product name and model;
- c) product number;
- d) component weight;
- e) classification symbol;
- f) standard number;
- g) manufacture date.

7.2 Packaging

The packaging box of the PQCD shall adopt necessary protections against moisture. The PQCD and the components shall be securely fixed on the packaging box with screws or filling. The packaging shall adapt to the requirements for shipping and traffic and handling. The outer surface of the packaging box