INTERNATIONAL STANDARD

ISO 19455-1

First edition
2019-11

Planning for functional performance testing for building commissioning —

Part 1: Secondary hydronic pump, system and associated controls

Reference number
ISO 19455-1:2019(E)

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

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/TC 205, *Building environment design*.

A list of all parts in the ISO 19455 series can be found on the ISO website.

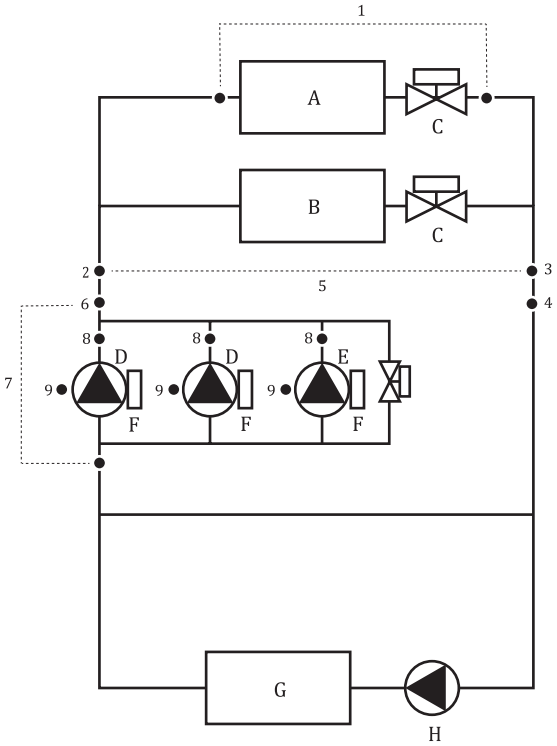
Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This document gives a methodology of planning for functional performance testing of secondary hydronic pump, system and associated controls for building commissioning, and has been prepared for building designers, i.e. architects, environmental designers and building system designers, as well as building clients, contractors, commissioning providers, government officials, and academic staff.

The aim of this document is to assist the building designers in applying a commissioning plan and a commissioning test, which are defined in ISO 16813. In order to achieve effective energy saving in building equipment systems that consume a large amount of energy, it is important not only to introduce energy efficient technologies to the system but also to verify their functional performance by tests and adjustments after the completion whether the system works properly according to its design intent. This document makes it possible to verify performance of secondary hydronic pump, system and associated controls with clear and specific processes.

As well as the intended usage for heating, ventilation and air conditioning (HVAC) systems, the secondary hydronic pump system targeted by this document is described in Figure 1.



Key

A farthest air handling unit

B air handling units

C valve

D secondary hydronic pumps

E reserve hydronic pumps

F inverter

G heat source equipment

H primary hydronic pump

1 dPw_AHU: end-pressure difference (in Pa)

2 Tw_AHUin: inlet water temperature of air handling units (in ºC)

3 Tw_AHUout: outlet water temperature of air handling units (in ºC)

4 Vw_AHUout: water flow rate of air handling units (in kg/s)

5 Qw _AHU: amount of heat exchanged in air handling units (in kW)

6 Pw_PSout: supply-side pressure (in Pa)

7 dPw_PS: pump pressure difference (in Pa)

8 Vw_PS: water flow rate of each secondary hydronic pump (in kg/s)

9 E_PS: energy consumption of each secondary hydronic pump (in kW)

Figure 1 — Secondary hydronic pump system targeted by this document

Planning for functional performance testing for building commissioning —

Part 1:
Secondary hydronic pump, system and associated controls

1 Scope

This document specifies a planning method for functional performance testing (FPT). This document is applicable to the planning of the FPT during the design phase of new buildings and retrofit projects, which is defined in ISO 16813.

This document establishes how to design building environmental systems when the FPT is being carried out. This document defines the following:

— what kind of information regarding the system is required (for example, design documents, drawings and product specifications);

— what kind of data should be measured (though concrete measurement techniques are not specified in this document);

— how the measured data is analysed.

Such clear definition of the FPT makes it possible for building designers to prepare and plan for FPT throughout the design process.

This document specifies an FPT method for secondary hydronic pump, system and associated controls in heating, ventilation and air conditioning (HVAC) systems.

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 16813, *Building environment design — Indoor environment — General principles*

ISO 16484-1, *Building automation and control systems (BACS) — Part 1: Project specification and implementation*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 16813, ISO 16484-1 and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
basis of design
BoD
document that bridges the objectives conveyed in the *owner project requirements* (3.5) and the contract documents (construction drawings and project specifications) which records through narrative, lists and calculations, the technical concepts, performance, assumptions, decisions, and product selections that fulfil the requirements of the owner project requirements

3.2
building control system
measures taken to ensure the system operates in accordance with the specified conditions

3.3
commissioning
quality-focused process for enhancing the delivery of a project which focuses upon verifying and documenting that all of the commissioned systems and assemblies are planned, designed, installed, tested, operated, and maintained to meet the *owner project requirements* (3.5)

3.4
design document
written description of the essential factors of every design stage, to be retained for future reference

3.5
owner project requirement
OPR
written document that details the ideas, concepts, and criteria that are required by the owner and outlines the requirements upon which the pre-design, design and construction phases are executed

3.6
function performance testing
FPT
testing process to demonstrate the correct installation and operation of each component, system, and associated controls in accordance with the *owner project requirements* (3.5)

3.7
supply-side pressure
hydronic pressure of pump outlet

Note 1 to entry: This is illustrated in Figure 1.

3.8
pump pressure difference
hydronic pressure difference between pump inlet and outlet

Note 1 to entry: This is illustrated in Figure 1.

3.9
end-pressure difference
hydronic pressure difference between inlet and outlet of the farthest air handling unit

Note 1 to entry: This is illustrated in Figure 1.

3.10
multiple-unit pump staging control
number of operating pumps, which changes according to the water flow rate of air handling units or the amount of heat exchanged in air handling units

Note 1 to entry: The water flow rate of air handling units and the amount of heat exchanged in air handling units are illustrated in Figure 1.

3.11
rotation speed control with constant delivery pressure
rotation speed of pumps is changed with inverters according to *supply-side pressure* (3.7) or *pump pressure difference* (3.8) with the set point of the supply-side water pressure or the pump pressure difference being constant

Note 1 to entry: The supply-side pressure and the pump pressure difference are illustrated in Figure 1.

3.12
rotation speed control with variable delivery pressure
rotation speed of pumps is changed with inverters according to *supply-side pressure* (3.7) or *pump pressure difference* (3.8) with the set point of the supply-side water pressure or the pump pressure difference being variable according to the *end-pressure difference* (3.9)

Note 1 to entry: The supply-side pressure and the pump pressure difference are illustrated in Figure 1.

4 Planning for functional performance testing

4.1 Design of secondary hydronic pump system

Building designers determine the required function and performance of secondary hydronic pump, system and associated controls according to the owner project requirements (OPR). The requirement shall be written in the basis of design (BoD). The secondary hydronic pump control systems targeted in this document are listed in Table 1. This document assumes that there are multiple pumps in the secondary hydronic pump system:

— Type A: rotation speed control with constant delivery pressure.

  — Type A1) rotation speed of pumps is changed with inverters according to supply-side pressure. The set point of the supply-side pressure is constant.

  — Type A2) rotation speed of pumps is changed with inverters according to pump pressure difference. The set point of the pump pressure difference is constant.

— Type B: rotation speed control with variable delivery pressure.

  — Type B1) rotation speed of pumps is changed with inverters according to supply-side pressure. The set point of the supply-side pressure is variable according to the end-pressure difference.

  — Type B2) rotation speed of pumps is changed with inverters according to pump pressure difference. The set point of the pump pressure difference is variable according to the end-pressure difference.

4.2 Data acquisition

The required data for the functional performance testing is shown in Table 2. In order to measure these data, the adequate sensors shall be deployed. For new building projects, the required data could be obtained from the building control system. For retrofit projects, the required data could be obtained from the existing building control system or measured by installing temporary data loggers. Annex A gives an example of data acquisition planning.

Table 1 — Targeted secondary hydronic pump control systems

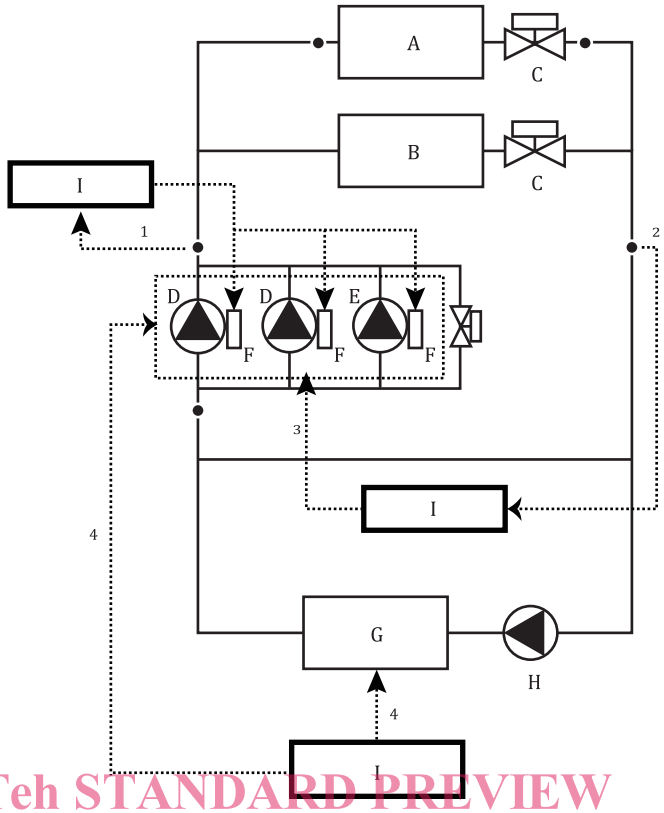
Control system type	Multi-ple-unit pump staging control	Rotation speed control				Schematic diagram
		Constant supply-side pressure	Constant pump pressure difference	Variable supply-side pressure	Variable pump pressure difference	
Type A1	✓	✓				Figure 2
Type A2	✓		✓			Figure 3
Type B1	✓			✓		Figure 4
Type B2	✓				✓	Figure 5

Table 2 — Required data for the testing described in Clause 5

Testing method	Required data						
	Water flow rate of air handling units	Amount of heat exchange in air han-dling units	Water flow rate of pump	Energy consumption of pump	Electric current or inverter frequency of pump	Sup-ply-side pressure	Pump pressure difference
Test 1 described in 5.2	✓[a]	✓[a]		✓[b]	✓[b]		
Test 2 described in 5.3			✓			✓	
Test 3 described in 5.3			✓				✓
Test 4 described in 5.4			✓	✓			

[a] Measure either of them.

[b] Measure either of them.



Key

A	farthest air handling unit	1	supply-side pressure
B	air handling units	2	water flow rate of air handling units
C	valve	3	number of operating units
D	secondary hydronic pumps	4	on or off
E	reserve hydronic pumps		
F	inverter		
G	heat source equipment		
H	primary hydronic pump		
I	building control system		

Figure 2 — Secondary hydronic pump control systems (Type A1)