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Microfluidics — Vocabulary

Microfluidique — Vocabulaire

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Foreword

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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).

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This document was prepared by Technical Committee ISO/TC 48, *Laboratory equipment*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 332, *Laboratory equipment*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This second edition cancels and replaces the first edition (ISO 10991:2009), which has been technically revised.

The main changes are as follows:

- title has been changed;
- several terms have been added to reflect the increased uptake of microfluidic technology.

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.

Microfluidics — Vocabulary

1 Scope

This document provides terms and definitions for micro process engineering and microfluidics applied in medical and veterinary diagnostics, chemistry, agriculture, pharmacy, biotechnology and the agrifood industry, as well as other application areas.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

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 General terms, relevant to microfluidics

3.1.1

biocompatibility

special quality of some materials allowing them to come into contact with biological materials without changing the materials' bioactivity

3.1.2

biomarker

biological molecule found in blood, other body fluids or tissues that is used to identify a disease or monitor the progression of a disease

3.1.3

classification

method of sorting into categories

[SOURCE: ISO 5492:2008, 4.5]

3.1.4

end-user

person or persons who will ultimately be using the *system* (3.1.15) for its intended purpose

[SOURCE: ISO/IEC 19770-5:2015, 3.13, modified — Note 1 to entry has been removed.]

3.1.5

hydrophilic

characterised by affinity to water established by hydrogen bonding

3.1.6

hydrophobic

characterised by being repelled from a mass of water

3.1.7
interested party
stakeholder

person or organization that can affect, be affected by, or perceive itself to be affected by a decision or activity

[SOURCE: ISO 9000:2015, 3.2.3, modified — EXAMPLE and Note 1 to entry removed.]

3.1.8
interoperability

property permitting diverse *systems* (3.1.15) or *components* (3.4.7) to work together for a specified purpose

[SOURCE: IEC 80001-1:2010, 2.11]

3.1.9
macroscale

scale of dimensions of 0,1 mm or greater

[SOURCE: SEMI MS003:2015, 6.59]

3.1.10
microfluidics

manipulation of fluids that are confined in a small volume with at least one dimension smaller than 1 mm

3.1.11
microscale

scale of dimensions between $0,1 \times 10^{-3}$ m to $0,1 \times 10^{-6}$ m

3.1.12
miniaturization

action of making things on a smaller scale

3.1.13
plug and play

ability to work perfectly when first used or connected, without reconfiguration or adjustment by the user and thereby enabling automatic configuration

3.1.14
wettability

ability of a liquid to spread on a specific solid surface

[SOURCE: ISO 472:2013, 2.1607, modified — wording “(such as an adhesive)” has been deleted and Note 1 to entry has been removed.]

3.1.15
system

group of interacting microfluidic, optical, mechanical or electrical *components* (3.4.7)

3.1.16
actuating resolution

lowest variation of a physical parameter that can be operated by a *system* (3.1.15)

3.1.17
capacity

flow rate through a pump at its designed conditions

3.1.18**centrifugal microfluidics**

subcategory of *microfluidics* (3.1.10) utilizing rotation

Note 1 to entry: The fluid flow is mainly controlled by centrifugal-, Euler- and Coriolis- forces.

3.1.19**closed system**

system (3.1.15) that uses preloaded manufacturer-specific reagents only

3.1.20**digital microfluidics**

subcategory of *microfluidics* (3.1.10) where discrete quantities of liquid are manipulated individually over a surface

3.1.21**droplet microfluidics**

subcategory of *microfluidics* (3.1.10) manipulating discrete quantities of liquid in a continuous flow

3.1.22**lab-on-a-chip****LoC**

highly integrated, microfluidic *system* (3.1.15) providing analytical or diagnostic functions

3.1.23**open system**

system (3.1.15) that requires an external supply of reagents

Note 1 to entry: Such an open system requires microfluidic connection(s).

3.1.24**resolution**

smallest change in a quantity being measured that causes a perceptible change in the corresponding measurement indication

3.1.25**sensing resolution**

lowest variation of a physical parameter that can be detected by a sensor

3.2 Terms related to microfluidic flow**3.2.1****actual flow rate**

volumetric flow rate of a gas changed to standardized conditions of temperature and pressure

3.2.2**capillarity****capillary action**

flowing of liquid through a device without external actuators but only by the surface tension and the adhesive force between liquid and the wetted material

3.2.3**compliance of a fluidic system**

increase of a fluidic *system's* (3.1.15) internal volume under the effect of pressure

Note 1 to entry: The compliance of a fluidic system is expressed in volume units per pressure units.

3.2.4

dead volume

portion of the internal volume of a *system* (3.1.15) that is not part of a continuous flow-path

Note 1 to entry: In this context dead signifies unmoving, stagnant, or un-swept. The dead-volume is expressed in volume units.

3.2.5

fall time

time required for a flow to change from a specified high value to a specified low value

Note 1 to entry: Typically, these values are 10% and 90% of the step height. The fall time is expressed in time units.

3.2.6

final steady-state value

average value of the *actual flow rate* (3.2.1), after the effects of the input transient have faded to a value equal to or below the intrinsic drift and noise

Note 1 to entry: The final steady-state flow rate value is expressed in volume units or mass units over time units.

[SOURCE: SEMI E17-0600:2000, modified — “flow rate” and “mass units” have been added in Note 1 to entry.]

3.2.7

hold-up volume

volume of fluid required to fill a device before a flow is observed at the point of interest or the outlet

Note 1 to entry: The hold-up volume is expressed in volume units such as mm³ or microlitre.

[SOURCE: SEMI MS003:2015, 6.51, modified — “units” has been added in the Note 1 to entry.]

3.2.8

hydrodynamic resistance

ratio of pressure drop over flow rate for a certain *component* (3.4.7) or *system* (3.1.15)

Note 1 to entry: The hydrodynamic resistance is expressed as pressure units per flow rate units.

3.2.9

hydrostatic pressure

pressure that is exerted by a fluid contained within a *system* (3.1.15) due to the force of gravity

Note 1 to entry: The hydrostatic pressure is expressed in pressure units.

3.2.10

internal volume

maximal total available volume comprised within a fluidic *component* (3.4.7), device or *system* (3.1.15) under normal atmospheric pressure

Note 1 to entry: The internal volume is expressed in volume units such as mm³ or microlitre.

3.2.11

mass flow rate

mass of fluid which passes per unit of time

Note 1 to entry: The mass flow rate is expressed in mass units per time units.

3.2.12

micropump

miniaturized liquid or gas pumping equipment with a *capacity* (3.1.17) of lower than 1 ml/min

3.2.13**minimal actuating pressure**

input pressure required to start moving a fluid through the fluidic *component* (3.4.7)

Note 1 to entry: Minimal actuating pressure is expressed in pressure units.

3.2.14**pressure drop**

difference of pressure between two positions in the flow path

Note 1 to entry: The pressure drop is expressed in pressure units.

3.2.15**reaction time**

time interval between the moment of the set point step change and the moment at which the flow reaches x % (below 20 %) of its intended value of rise or fall

Note 1 to entry: Typically, $x = 10$. The reaction time is expressed in time units.

Note 2 to entry: See also [Figure 1](#).

3.2.16**relative flow stability****coefficient of variation**

standard deviation of the flow rate divided by the average flow rate

Note 1 to entry: The relative flow stability is expressed as a percentage.

3.2.17**response time**

time interval between the moment of the set point step change and the moment at which the flow reaches y % (above 80 %) of its intended value of rise or fall

Note 1 to entry: Typically, $y = 90$. The response time is expressed in time units.

Note 2 to entry: See also [Figure 1](#).

3.2.18**rise time**

time required for a flow to change from a specified low value to a specified high value

Note 1 to entry: Typically, these values are 10 % and 90 % of the step height. The rise time is expressed in time units.

Note 2 to entry: See also [Figure 1](#).

3.2.19**set point**

target flow rate value

Note 1 to entry: See also [Figure 1](#).

3.2.20**settling time**

time elapsed from the application of an ideal step input to the time at which the output has been entered and remained within a *specified (error) band* (3.2.21)

Note 1 to entry: The settling time is expressed in time units.

Note 2 to entry: See also [Figure 1](#).

**3.2.21
specified error band
specified band**

the difference between the specified most negative and specified most positive deviation from the set point

Note 1 to entry: See also [Figure 1](#).

**3.2.22
step response time**

time between the *set point* ([3.2.19](#)) step change and the instant when the actual flow first enters the specified band

[SOURCE: SEMI E17-0600:2000, modified — “the instant” has been added.]

**3.2.23
swept volume**

portion of a volume that is part of the flow path

Note 1 to entry: The swept volume is expressed in volume units.

Note 2 to entry: The swept volume is the internal volume minus the dead volume.

**3.2.24
transient overshoot**

maximum change in actual flow minus the steady-state change in actual flow expressed as a percentage of the *set point* ([3.2.19](#)) step change

Note 1 to entry: See also [Figure 1](#).

[SOURCE: SEMI E17-0600:2000]

**3.2.25
transient undershoot**

maximum amount that the actual flow passes beyond the *final steady-state value* ([3.2.6](#)), in the opposite direction of overshoot, expressed as a percentage of the *set point* ([3.2.19](#)) step change

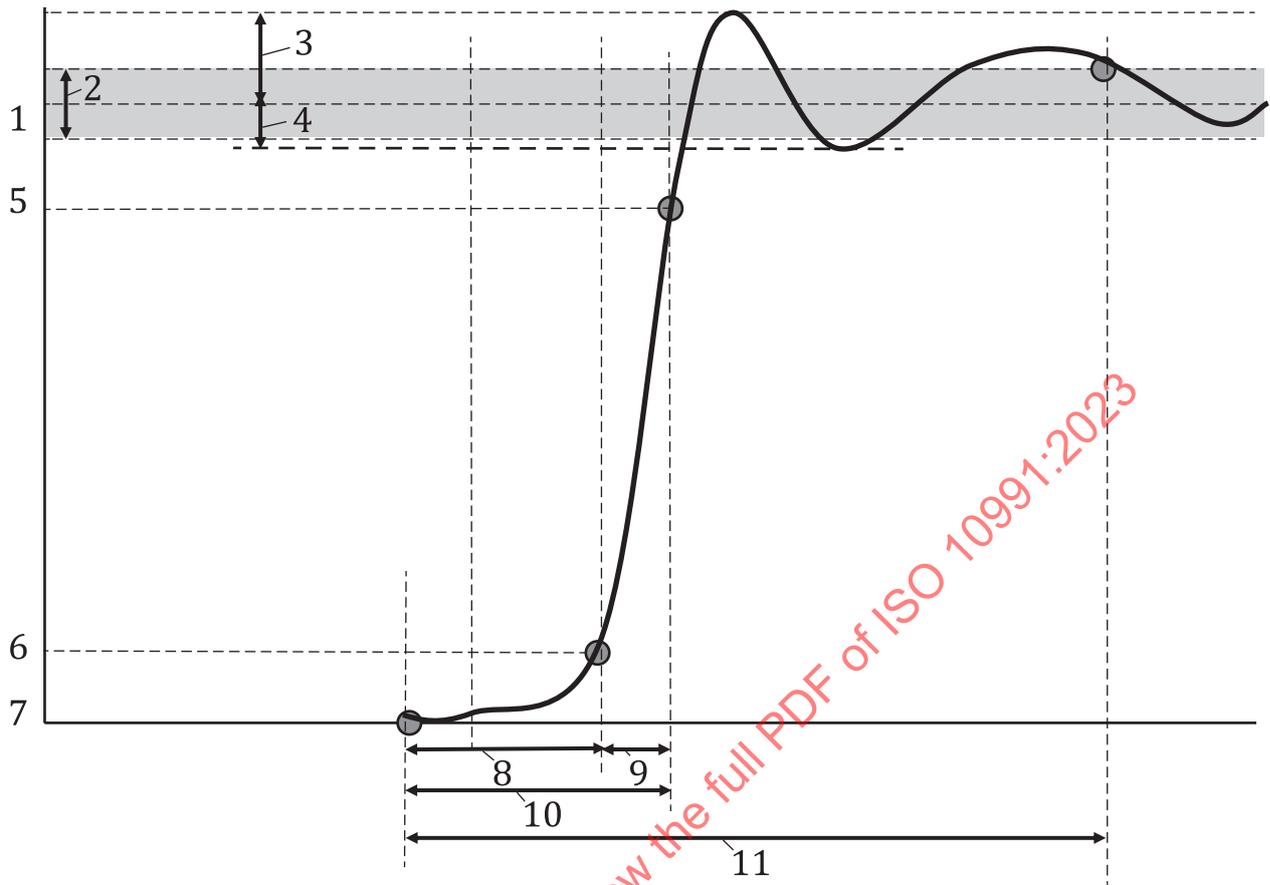
Note 1 to entry: See also [Figure 1](#).

[SOURCE: SEMI E17-0600:2000, modified — “beyond” added.]

**3.2.26
volumetric flow rate**

volume of fluid which passes the *system* ([3.1.15](#)) per unit of time

Note 1 to entry: The volumetric flow rate is expressed in volume units per time units.

**Key**

1	set point (100 % rise)	7	initial set point (0 %)
2	specified (error) band	8	reaction time
3	transient overshoot	9	rise time
4	transient undershoot	10	response time
5	y % rise	11	setting time
6	x % rise		

Figure 1 — Schematic showing flow control terms related to a step change in flow

3.3 Terms related to microfluidic interfacing

3.3.1

first-level connection

direct connection

connection enabling liquid transfer between two parts through direct contact (without *tubes* (3.4.24))

3.3.2

second-level connection

indirect connection

connection enabling liquid transfer between two parts using *tubes* (3.4.24), syringes, O-rings, *gaskets* (3.3.13) and other type of connections (chip to tube)

3.3.3

adhesive connection

connection by a length of tubing bonded to a port on the microfluidic device with epoxy or another suitable adhesive

3.3.4

connector

component (3.4.7) that allows one part of the set to be connected to another

3.3.5

dynamic seal

sealing device used between parts that have relative motion

[SOURCE: ISO 5598:2020, 3.2.241]

3.3.6

edge exclusion

area on the edge of the top or bottom surface that should be excluded from certain features or is reserved for certain features or functions

3.3.7

exclusion area

area on the chip besides the *mating area* (3.3.19) that is used to create a microfluidic connection

3.3.8

ferrule

metal, polymer or elastomer ring, *tube* (3.4.24) or cap, (or multiple arrangements thereof) placed at or fastened to the end of a tube that, when pressed against a suitable mating interface with a threaded fitting, or other clamping device, will facilitate a fluid connection

3.3.9

ferrule connection

connection enabling liquid transfer between a *tube* (3.4.24) and a device or *component* (3.4.7) using a *ferrule* (3.3.8)

3.3.10

flared connection

flanged connection

connection enabling liquid transfer between a *tube* (3.4.24) and a chip with the flattened surface of a *tube* pressed against the flat surface of a chip

3.3.11

fluidic adapter

physical *connector* (3.3.4) that links a microfluidic *component* (3.4.7) to another *microscale* (3.1.11) or *macroscale* (3.1.9) fluidic device

[SOURCE: SEMI MS003:2015, 6.45]

3.3.12

free path connection

introducing liquids into an open port on the microfluidic device with the use of an external delivery *system* (3.1.15)

3.3.13

gasket

mechanical seal that fills the space between two *mating interfaces* (3.3.20), generally to prevent leakage from or into the joined parts while under compression

3.3.14

interconnect

connect two things together

3.3.15

LUER connector

small-bore *connector* (3.3.4) that contains a conical *mating interface* (3.3.20), with a 6 % taper intended for use in intravascular or hypodermic applications of medical devices and related accessories

3.3.16**micro- to macroscale sealing**

sealing that connects a micrometric scale part with a macrometric scale part

3.3.17**macrosealing**

material used in connection at the *macroscale* (3.1.9) to prevent liquid or gas leakage

3.3.18**macrosealing dimension**

flow channel cross section having an effective diameter greater than 100 µm

[SOURCE: SEMI MS003:2015, 6.61]

3.3.19**mating area****mating face**

area on the chip that is covered by the *seal* (3.3.36) or *gasket* (3.3.13)

3.3.20**mating interface**

two areas of one or more parts that are in contact with each other

3.3.21**microfluidic connector**

arrangement of *components* (3.4.7) that facilitate the exchange of fluidics between devices

3.3.22**microfluidic fanout**

designed *element* (3.4.9) that allows reconfigurable routing of any fluid from any of n input ports to any of n output ports without interrupting continuous flow

3.3.23**microsealing**

sealing on *components* (3.4.7) at the *microscale* (3.1.11)

[SOURCE: SEMI MS003:2015, 6.73]

3.3.24**microsealing dimension**

flow channel cross section having an effective diameter of less than 100 µm

[SOURCE: SEMI MS003:2015, 6.74 modified — replaced “<25 micrometers; optionally flow channel cross sections having an effective diameter of 25 to 100 micrometers” by “less than 100 µm”.]

3.3.25**miniLuer connector**

small-bore *connector* (3.3.4) that contains a conical *mating interface* (3.3.20) with a 6 % taper intended for use to connect microfluidic devices or *components* (3.4.7) to *tubes* (3.4.24)

3.3.26**multi-connector**

connector (3.3.4) that houses a set of connections

3.3.27**multi-seal**

seal (3.3.36) or *gasket* (3.3.13) that enables a leak-free interface to an array of ports

3.3.28**nipple**

metal or polymer cylindrical or cone-shaped device intended to provide interference with the inside surface of an elastomeric *tube* (3.4.24), facilitating a fluid connection

3.3.29

**nipple-connection
barb connection**

connection having a soft wall tubing stretched over a conical or cylindrical shaped device

3.3.30

o-ring connection

elastomer ring of circular cross-section compressed between two *components* (3.4.7) to prevent fluid leakage

Note 1 to entry: O-ring connection can grip and seal onto a tube.

3.3.31

pitch

mean distance between corresponding features in a regular array of features on a surface

[SOURCE: ISO 18115-2:2021, 5.106]

3.3.32

port

access point on a chip or device for fluidic contacts

3.3.33

port layout

certain layout in the horizontal plane of a certain type of ports

3.3.34

port pitch

distance between the centres of two adjacent ports

3.3.35

push-in connection

connection where a *tube* (3.4.24) is pushed into a recess to create interference fit

3.3.36

seal

sub-system (3.1.15) of a *connector* (3.3.4) comprising a *component* or *components* (3.4.7) arranged at the end of a fluid path and, when typically used with a *connector*, will retain fluid within a microfluidics system (3.1.15)

3.3.37

side connect width

length of the side of the chip where the side *connector* (3.3.4) is placed

3.3.38

side connection

connection to the side surface of a device perpendicular to the top surface

3.3.39

static seal

seal that operates with non-moving surfaces

[SOURCE: SEMI MS006:2008, 4.2.20, modified — “seals” changed in “seal”.]

3.3.40

top connection

connection to the top or bottom surface of a device

3.4 Terms related to modularity

3.4.1

actuator

device that performs mechanical work using electric energy, chemical energy or other energy forms

[SOURCE: SEMI MS003:2015, 6.3]

3.4.2

assembly

combination of *components* (3.4.7) and units that form a functional entity

[SOURCE: ISO 10795:2019, 3.23, modified — "parts" has been removed from the definition.]

3.4.3

bubble chamber

part of a *bubble trap* (3.4.4) to give space for the bubble to be trapped

3.4.4

bubble trap

component (3.4.7) or *element* (3.4.9) intended to trap bubbles

3.4.5

building block

component (3.4.7) having a standard interface that fits with other building blocks to form a whole *system* (3.1.15)

3.4.6

cartridge

modular unit designed to be inserted into a larger piece of equipment

Note 1 to entry: A cartridge integrates by assembly several microfluidic components such as pumps, sensors and filters.

3.4.7

component

set of materials, assembled according to defined and controlled processes, which cannot be disassembled without destroying its capability and which performs a simple function that can be evaluated against expected performance requirements

[SOURCE: ISO 10795:2019, 3.48]

3.4.8

device

component (3.4.7) or assembly of *components* to perform a required function

[SOURCE: ISO 10209:2022, 3.1.29, modified — "component or" has been added before "assembly of components".]

3.4.9

element

part of a microfluidic *system* (3.1.15) with one main function

3.4.10

filter

microfluidic *component* (3.4.7) designed to withhold or detain material from fluids or gasses to purify the fluid for use further on in the *system* (3.1.15)

3.4.11

flow sensor

device (3.4.8) that detects or measures the motion of fluids

[SOURCE: SEMI MS003:2015, 6.44, modified — added “or measures”.]

3.4.12

fluidic circuit board

FCB

fluidic device with microfluidic channels and *ports* (3.3.32), and with or without electrical routing and some functionality able to have building blocks connected to it to form a microfluidic *system* (3.1.15)

3.4.13

function

intended effect of a *system* (3.1.15), product or *component* (3.4.7)

[SOURCE: ISO 10795:2019, 3.110, modified — “subsystem” has been removed, “part” has been changed to “component” and Note 1 to entry has been removed.]

3.4.14

functional element

part of a design that only performs one function

3.4.15

integration

process of physically and functionally combining lower-level functional elements (hardware or software) to obtain a particular functional configuration considered to be of a much higher-level entity

[SOURCE: ISO 10795:2019, 3.129, modified — “products” has been changed to “functional elements” and “considered to be of a much higher-level entity” was added at the end of the definition.]

3.4.16

micromixer

micro process *component* (3.4.7) whose primary function is to mix fluid substances

3.4.17

micro process module

micro process *component* (3.4.7) with standardized *component* interfaces

3.4.18

microfluidic chip

complex set of integrated fluidic *components* (3.4.7) and their interconnections on a planar substrate, created by etching, imprinting, moulding etc.

3.4.19

microfluidic chip holder

reusable microfluidic interface that provides at least one microfluidic connection and fixation of the chip

3.4.20

microreactor

device in which (bio)chemical reactions take place in a confinement with at least one lateral dimension below 1 mm

[SOURCE: Chemical Engineering and Chemical Process Technology - Volume III, 2010, modified.]

3.4.21

optical window

opening constructed in an integrated device that functions to admit optical signals to and from a microfluidic chip in the package

3.4.22**reference point**

zero point in a two or three-dimensional *system* ([3.1.15](#))

Note 1 to entry: Distance values in relation to this point give an absolute value in x-, y- or z-direction.

3.4.23**trap**

microfluidic *element* ([3.4.9](#)) designed to capture a specific material (sub-piece such as a cell, protein, etc.) or bubble from a fluid in a precise location

3.4.24**tube**

hollow cylinder for transporting a fluid either into or out of a microfluidic *system* ([3.1.15](#)), or between two microfluidic *systems* ([3.1.15](#))

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