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**Plastics pipes and fittings — Equipment  
for fusion jointing polyethylene  
systems —**

**Part 2:  
Electrofusion**

**iTeh STANDARD PREVIEW**  
 *Tubes et raccords en matières plastiques — Appareillage pour  
l'assemblage par soudage des systèmes en polyéthylène —  
Partie 2: Électrosoudage*  
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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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 12176-2 was prepared by Technical Committee ISO/TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 4, *Plastics pipes and fittings for the supply of gaseous fuels*.

This second edition cancels and replaces the first edition (ISO 12176-2:2000), which has been technically revised.

ISO 12176 consists of the following parts, under the general title *Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems*:

- Part 1: *Butt fusion*
- Part 2: *Electrofusion*
- Part 3: *Operator's badge*
- Part 4: *Traceability coding*

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# Plastics pipes and fittings — Equipment for fusion jointing polyethylene systems —

## Part 2: Electrofusion

### 1 Scope

This part of ISO 12176 specifies performance requirements for electrofusion control units for use with polyethylene (PE) electrofusion fittings for the supply of gaseous fuels or for the conveyance of water for human consumption, including raw water prior to treatment, and for the conveyance of water for general purpose or other fluids.

The control units are divided into three input voltage classes: SVLV [safety, very low voltage (up to 50 V)], LV [low voltage (50 V to 250 V)] and HV [higher voltage (250 V to 400 V)].

This part of ISO 12176 is applicable to electrofusion control units designed for use in the construction of joints between PE pipes and fittings conforming to International Standards for the supply of gaseous fuels or for the conveyance of water, where the normal operating temperature of the control unit is in the range  $-10\text{ }^{\circ}\text{C}$  to  $+40\text{ }^{\circ}\text{C}$ . If temperatures outside this range are expected, suitable operating limits are subject to agreement between manufacturer and purchaser.

This part of ISO 12176 is applicable to control units with current or voltage control for fitting systems based on standard resistance wire heating technology.

### 2 Normative references

The following referenced documents are indispensable for the application 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 13950, *Plastics pipes and fittings — Automatic recognition systems for electrofusion joints*

IEC 60068-2-27, *Environmental testing — Part 2-27: Tests — Test Ea and guidance: Shock*

IEC 60335-1, *Household and similar electrical appliances — Safety — Part 1: General requirements*

IEC 60335-2-45, *Household and similar electrical appliances — Safety — Part 2-45: Particular requirements for portable heating tools and similar appliances*

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

IEC 61558-1, *Safety of power transformers, power supplies, reactors and similar products — Part 1: General requirements and tests*

IEC 61558-2-6, *Safety of power transformers, power supply units and similar — Part 2: Particular requirements for safety isolating transformers for general use*

### 3 Terms and definitions

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

#### 3.1

##### **operator**

competent person entitled to assemble polyethylene pipes with electrofusion fittings

#### 3.2

##### **control unit**

unit implementing the output fusion parameters of voltage or current and time or energy to execute the fusion cycle as specified by the electrofusion fitting manufacturer

NOTE Control units are classified with respect to electrical and process characteristics. Different types of control units are defined in 3.2.1 to 3.2.5.

##### 3.2.1

##### **preset control unit**

control unit providing a stepped output power, preset by the manufacturer and generated at one or several selectable levels of voltage or current or energy or time

##### 3.2.2

##### **variable control unit**

control unit providing a stepped output power generated from variable parameters defined from an external source

##### EXAMPLE

Bar code, magnetic card.

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##### 3.2.3

##### **multimode control unit**

control unit providing a stepped output power generated at several levels of voltage and current and covering the energy input requirements of fittings from several manufacturers within the specification of each system, using at least one preset system associated with one variable system

##### 3.2.4

##### **multipurpose control unit**

control unit providing a stepped or continuous output power generated at several levels of either voltage or current

##### 3.2.5

##### **universal control unit**

control unit providing a stepped or continuous output power generated at several levels of both voltage and current coming from a variable system

#### 3.3

##### **data retrieval unit**

any type of **control unit** (3.2) allowing the storage of the actual fusion data and permitting a read-out of these data

#### 3.4

##### **automatic control unit**

any type of **control unit** (3.2) with automatic data input or fusion cycle control, where the **operator** (3.1) cannot alter the fusion parameters

#### 3.5

##### **control cycle**

$t$

fixed period of time, composed of an on-load period,  $t_1$ , and an off-load period,  $t_2$ , i.e. the total time  $t = t_1 + t_2$

### 3.6 duty cycle

$t_d$   
proportion of the control cycle time,  $t$ , for which the output power is on load,  $t_1$ , expressed as a percentage, i.e.  
 $t_d = [t_1/(t_1 + t_2)] \times 100$

### 3.7 output voltage

output voltage value expressed as the root mean square (RMS) value (and not peak value)

### 3.8 reference output voltage

output voltage value at 75 % of the maximum output voltage of the control unit

### 3.9 soft start

stepped voltage increases over time periods of the order of seconds

## 4 Designation of the different types of control unit

The code letters in the designation of the types of control units are given in Table 1.

**Table 1 — Code letters in the designation of the types of control units**

Type of control unit	Code letter
Preset control unit (3.2.1)	Fifth code letter: F (see A.2.1)
Variable control unit (3.2.2)	Fifth code letter: V (see A.2.1)
Multimode control unit (3.2.3)	Fifth code letter: V (see A.2.1)
Multipurpose control unit (3.2.4)	Fifth code letter: V (see A.2.1)
Universal control unit (3.2.5)	Third code letter: W (see A.1.3) Fifth code letter: V (see A.2.1) Sixth code letter: A (see A.2.2)

## 5 Construction requirements

### 5.1 General

An electrofusion control unit can be a single unit or composed of several separate units. Therefore the control panel and the regulation system may or may not be integrated in a single unit.

Where the control unit is to be connected to a power generator, the manufacturer of the unit shall specify the input power requirements.

A portable control unit, with its frame (if supplied) and any associated input cable of at least 3 m included, shall not be heavier than 35 kg.

The control unit shall not start the fusion cycle if the fusion parameters introduced are out of the specified working range of the control unit.

The control unit should be designed to allow ease of readjustment and maintenance.

The control unit should be designed and constructed to allow its safe use in normal field conditions.

The control unit and its accessories should be designed to minimize the risk of corrosion or mechanical damage due to transport and handling in the field, which are likely to impair the performance of the control unit.

The control panel (e.g. keyboard, display) should be protected from impact damage during transport and handling.

## 5.2 Electrical safety

The control unit shall be protected in accordance with IEC 60529 such that the protection against direct contacts shall be at least to IP5X and the protection against the ingress of moisture shall be in accordance with class IPX4. All printed circuit boards shall be protected against the effects of condensation. No water shall lodge or accumulate in switches or buttons mounted on the control unit.

The control unit and its accessories shall fulfil the safety requirements specified in IEC 60335-1 and IEC 60335-2-45 and shall conform to national regulations, if any.

## 5.3 Cables

### 5.3.1 General

Input and output cables may be disconnectable or permanently connected. The cables shall remain flexible over the whole range of normal operating and storage conditions (i.e.  $-10\text{ }^{\circ}\text{C}$  to  $+40\text{ }^{\circ}\text{C}$ ).

A cable winding or storage facility shall be provided on the control unit.

Cables may require additional screening to satisfy the conditions required for safe operation of portable power supplies (i.e. isolated or earthed systems) and safety features fitted to the control unit.

### 5.3.2 Input cable

If a permanently attached input cable is provided, its nominal length shall be at least 3 m and a facility for input cable winding, storage and protection during transport shall be fitted to the control unit.

### 5.3.3 Output cable

The nominal length of the output cable(s) shall be at least 2,5 m.

The output cable(s) shall be suitable for the following functions:

- supply of electrical power to the fitting;
- sensing of the applied voltage and transmission of a feedback signal;
- supply and return of the identification voltage for the fitting verification procedure (resistance sensing).

## 5.4 Cable connectors

The connectors shall conform to the requirements given in IEC 60529 (see 5.2) for use in outside weather conditions.

The connectors shall have:

- a) a contact resistance as low as practicable;
- b) an ability to sense the applied voltage;
- c) facility of attachment;
- d) protection against direct human contact when connected to the fitting during the fusion cycle.



The connectors should be suitable for typical terminal connection to electrofusion fittings, as given in the relevant product standards, e.g. ISO 8085-3<sup>[1]</sup>.

## 5.5 Operator controls

The control unit shall at least have the following operator controls:

- a) a START button which shall be green;
- b) a RESET/STOP button, operation of which under any fault conditions shall cause at least a break in the output circuit;
- c) a STOP/ON-OFF switch, which shall be red and whose operation under any fault conditions shall directly cause a physical break in the input circuit.

If allowed by national regulations, control units without a STOP/ON-OFF switch can be used.

An overload protection device shall be fitted to the input side of the control unit.

## 5.6 Displays

All displays shall be clearly visible both in bright sunlight and in subdued light conditions.

## 5.7 Temperature-sensing element for fusion energy compensation

The control unit may be equipped with a temperature-sensing element for measurement of ambient temperature with an accuracy of  $\pm 1$  °C. The temperature-sensing lead may be fitted inside the control unit or externally for manual control by the operator. If fitted inside, it shall not be influenced by the heat produced by the control unit.

External temperature-sensing elements shall be protected from mechanical damage.

## 5.8 Input data decoder

The control unit shall be equipped with a decoder for reading the input data received from a manual keyboard or from an automatic system, e.g. using a terminal sensor, bar code or magnetic card.

Control units with an automatic fusion data recognition system as specified in ISO 13950 shall be programmed to allow decoding of such data.

It shall not be possible to introduce or modify the input data once the fusion cycle has started.

## 5.9 Digital data output connectors

### 5.9.1 General

The control unit may be equipped with a data retrieval unit which allows retrieval of stored fitting and fusion data. The data retrieval unit shall include the following components:

- a) a memory for storage of the data;
- b) an interface for data transmission (communication).

The control unit shall have a routine incorporated to facilitate data downloading.

### 5.9.2 Memory

The memory may be either an integral or removable part of the unit. The capacity of the memory shall allow a minimum storage of 250 fusion records.

A warning program may be included to prevent loss of data.

In case of memory overflow, the oldest data shall be deleted.

### 5.9.3 Interface

Units with data retrieval shall have an interface available to download the data stored in the memory to other electronic devices (e.g. personal computer, printer) for analysis and/or display and for storage.

The interface shall be a connector of a standard type (e.g. PCMCIA, serial port and/or parallel port), with or without an intermediate remote transmitter/receiver link.

### 5.9.4 Data protection

Control units with data retrieval shall include the following features to prevent loss of data:

- a) fusion data shall be recorded continuously during the fusion operation;
- b) in the event of interruption, the current fusion data shall remain available for control purposes;
- c) any data retrieval device fitted shall not operate if the memory unit is disconnected.

### 5.10 Transformers

All transformers shall be safety isolating transformers conforming to IEC 61558-1 and IEC 61558-2-6.

### 5.11 Duty cycle

For all control units with a classified output power up to and including 2 kW, the control cycle shall be 10 min. Thus, for a 60 % duty cycle (say),  $t_1$  is equal to 6 min and  $t_2$  is equal to 4 min.

For all control units with a classified output power greater than 2 kW, the control cycle shall be 15 min. Thus, for a 60 % duty cycle (say),  $t_1$  is equal to 9 min and  $t_2$  is equal to 6 min.

An example of a duty cycle is shown in Annex B. The graph is defined by the manufacturer for each control unit between 35 % and 100 % duty cycles at the reference output voltage, as defined in 3.8.

## 6 Operating procedures

### 6.1 Supply checks

When the checking system of the control unit verifies that the input voltage and frequency are within the permitted tolerance limits, these checks shall be indicated on a display. When the measured values are outside the tolerance limits, the control unit shall give an audible and/or visual warning signal and a display shall indicate the source of the fault.

## 6.2 Data input

### 6.2.1 Manual input

Units with manual data input shall be designed to introduce the process parameter(s) (voltage, current, time and/or energy) as applicable, namely:

- a) one of the parameters for preset control units (see 3.2.1);
- b) a combination of the parameters for multipurpose and universal control units.

Units with manual data input may be designed with a memory to allow a minimum storage capacity of six combinations of the details of the manufacturer/type/size of fitting; the choice of these combinations is usually based on an agreement between the purchaser and the manufacturer. The data input keyboard may also allow the introduction of the trade mark, the type of fitting (e.g. socket, saddle or reducer) and the diameter.

### 6.2.2 Automatic input

Control units provided with a system for automatic data input shall be able to decode data in accordance with ISO 13950.

Automatic input control units shall display the necessary information to permit the operator, if necessary, to check that the displayed information correspond to the type of fitting being connected.

## 6.3 Data validation iTeh STANDARD PREVIEW (standards.iteh.ai)

### 6.3.1 General

When the input of data is required to start the fusion process, means shall be incorporated to check if the data introduced correspond to the fitting being connected. This operation shall be done by the operator and/or the control unit.

If the check shows that the data introduced correspond to the fitting being connected, the data are accepted. If not, the control unit shall not start its fusion program and shall give a warning signal.

If any single part of the fusion program introduced cannot be implemented by the control unit, the fusion cycle shall be prevented from starting and the reason shall be displayed.

### 6.3.2 Data validation by the control unit

The control unit may be equipped with a system which checks the fitting being connected by measuring the resistance of the coil and comparing it with the data introduced, or the control unit may be fitted with another fitting identification system.

In the case of resistance measurement, the measured value may be displayed for verification purposes. If resistance measurement is used, the calculation shall be based on the resistivity of the coil material (data in the memory of the control unit or data introduced together with the fusion parameters) and the measured ambient temperature.

### 6.3.3 Data validation by the operator

After displaying control data, the control unit shall require operators to indicate manually that they have validated the displayed information, by pressing either the START button or a separate ACCEPT button.