BRITISH STANDARD

BS EN
1264-4:2009

Water based surface embedded heating and cooling systems

Part 4: Installation

ICS 91.140.10

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 1264-4:2009. It supersedes BS EN 1264-4:2001 which is withdrawn. Together with BS EN 1264-3:2009, it also supersedes BS EN 15377-2:2008 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee RHE/6, Air or space heaters or coolers without combustion.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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Systèmes de surfaces chauffantes et rafraîchissantes hydrauliques intégrées - Partie 4: Installation

Raumflächenintegrierte Heiz- und Kühlsysteme mit Wasserdurchströmung - Teil 4: Installation

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Foreword

This document (EN 1264-4:2009) has been prepared by Technical Committee CEN/TC 130 “Space heating appliances without heat sources”, the secretariat of which is held by UNI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2010, and conflicting national standards shall be withdrawn at the latest by March 2010.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN [and/or CENELEC] shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN 1264-4:2001. Together with EN 1264-3:2009, this document also supersedes EN 15377-2:2008.

The series of European Standards EN 1264 "*Water based surface embedded heating and cooling systems*" consists of the following parts:

Part 1: Definitions and symbols;

Part 2: Floor heating: Prove methods for the determination of the thermal output of floor heating systems using calculation and test methods;

Part 3: Dimensioning;

Part 4: Installation;

Part 5: Heating and cooling surfaces embedded in floors, ceilings and walls — Determination of the thermal output.

The two main changes with respect to EN 1264-4:2001 are listed below:

a) The scope is expanded over floor heating, now additionally includes ceiling and wall heating as well as cooling surfaces in floors, ceilings and walls;

b) The content generally is attuned to the state of the technology.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

1 Scope

This European Standard applies to heating and cooling systems embedded into the enclosure surfaces of the room to be heated or to be cooled.

This document specifies uniform requirements for the design and the construction of heating and cooling floor, ceiling and wall structures to ensure that the heating/cooling systems are suited to the particular application.

The requirements specified by this Standard apply only to the components of the heating/cooling systems which are part of the heating/cooling system. This document excludes all other elements which are not part of the heating/cooling system.

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.

EN 1057:2006, *Copper and copper alloys - Seamless, round copper tubes for water and gas in sanitary and heating applications*

EN 1254 (all parts), *Copper and copper alloys — Plumbing fittings*

EN 1264-1:1997, *Water based surface embedded heating and cooling systems - Part 1: Definitions and symbols*

EN 1264-2, *Water based surface embedded heating and cooling systems - Part 2: Floor heating: Prove methods for the determination of the thermal output using calculation and test methods*

EN ISO 15874-1, *Plastics piping systems for hot and cold water installations - Polypropylene (PP) - Part 1: General (ISO 15874-1:2003)*

EN ISO 15874-2, *Plastics piping systems for hot and cold water installations - Polypropylene (PP) - Part 2: Pipes (ISO 15874-2:2003)*

EN ISO 15874-3, *Plastics piping systems for hot and cold water installations - Polypropylene (PP) - Part 3: Fittings (ISO 15874-3:2003)*

EN ISO 15874-5, *Plastics piping systems for hot and cold water installations - Polypropylene (PP) - Part 5: Fitness for purpose of the system (ISO 15874-5:2003)*

EN ISO 15875-1, *Plastics piping systems for hot and cold water installations - Crosslinked polyethylene (PE-X) - Part 1: General (ISO 15875-1:2003)*

EN ISO 15875-2, Plastics piping systems for hot and cold water installations - Crosslinked polyethylene (PE-X) - Part 2: Pipes (ISO 15875-2:2003)

EN ISO 15875-3*, Plastics piping systems for hot and cold water installations - Crosslinked polyethylene (PE-X) - Part 3: Fittings (ISO 15875-3:2003)*

EN ISO 15875-5, *Plastics piping systems for hot and cold water installations - Crosslinked polyethylene (PE-X) - Part 5: Fitness for purpose of the system (ISO 15875-5:2003)*

EN ISO 15876-1, *Plastics piping systems for hot and cold water installations - Polybutylene (PB) - Part 1: General (ISO 15876-1:2003)*

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EN ISO 15876-5, *Plastics piping systems for hot and cold water installations - Polybutylene (PB) - Part 5: Fitness for purpose of the system (ISO 15876-5:2003)*

EN ISO 15877-1, *Plastics piping systems for hot and cold water installations - Chlorinated poly(vinyl chloride) (PVC-C) - Part 1: General (ISO 15877-1:2003)*

EN ISO 15877-2, *Plastics piping systems for hot and cold water installations - Chlorinated poly(vinyl chloride) (PVC-C) - Part 2: Pipes (ISO 15877-2:2003)*

EN ISO 15877-3, *Plastics piping systems for hot and cold water installations - Chlorinated poly(vinyl chloride) (PVC-C) - Part 3: Fittings (ISO 15877-3:2003)*

EN ISO 15877-5, *Plastics piping systems for hot and cold water installations - Chlorinated poly(vinyl chloride) (PVC-C) - Part 5: Fitness for purpose of the system (ISO 15877-5:2003)*

EN ISO 21003-1, *Multilayer piping systems for hot and cold water installations inside buildings - Part 1: General (ISO 21003-1:2008)*

EN ISO 21003-2, *Multilayer piping systems for hot and cold water installations inside buildings - Part 2: Pipes (ISO 21003-2:2008)*

EN ISO 21003-3, *Multilayer piping systems for hot and cold water installations inside buildings - Part 3: Fittings (ISO 21003-3:2008)*

EN ISO 21003-5, *Multilayer piping systems for hot and cold water installations inside buildings - Part 5: Fitness for purpose of the system (ISO 21003-5:2008)*

ISO 10508, *Plastics piping systems for hot and cold water installations — Guidance for classification and design*

ISO 22391-1, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 1: General*

ISO 22391-2, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 2: Pipes*

ISO 22391-3, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 3: Fittings*

ISO 22391-5, *Plastics piping systems for hot and cold water installations — Polyethylene of raised temperature resistance (PE-RT) — Part 5: Fitness for purpose of the system*

DIN 4724, *Kunststoff-Rohrleitungssysteme für Warmwasserheizung und Heizkörperanbindung – Vernetztes Polyethylen mittlerer Dichte (PE-MDX)*

3 Terms, definitions and symbols

For the purposes of this document, the terms, definitions, and symbols given in EN 1264-1:1997 apply.

4 Requirements

4.1 Floor heating and cooling systems

4.1.1 General structural preconditions

The installation of a hot water floor heating and/or cooling system must follow the prior installation of any electrical, sanitary and other pipe facilities. The structure as specified in 4.1.2.1 with the draught-free closure of all building openings, e.g. windows and outer doors, must be completed.

4.1.2 Building layers, building components

4.1.2.1 Supporting base

The supporting base shall be prepared in accordance with relevant standards.

Any pipe work or conduits shall be fixed and encased to provide a level base upon which thermal insulation and/or acoustic insulation is added before laying the heating pipes. In this respect, the necessary structural height shall be taken into account.

In the case of service pipes installed within the insulation layer, these pipes must be protected against temperature change in accordance with National Regulations.

4.1.2.2 Insulating layers, perimeter insulating strip

4.1.2.2.1 Insulating layers

The resistance $R_{\lambda,ins}$ of the insulating layer of the heating/cooling system is specified in Table 1. These requirements are for heating and cooling systems, but for cooling only systems, these values are recommended.

Table 1 — System Insulation

Minimum heat conduction resistance of system-insulating layers below the pipes of heating/cooling systems ($m^2 \cdot K$)/W

	heated room below or adjacent	Unheated or intermittent heated room below, adjacent or directly on the ground *)	external air temperature below or adjacent		
			external design temperature $\vartheta_d \geq 0$ °C	external design temperature 0 °C > $\vartheta_d \geq$ -5 °C	external design temperature -5 °C > $\vartheta_d \geq$ -15 °C
heat conduction resistance $R_{\lambda,ins}$	0,75	1,25	1,25	1,50	2,00
*) with ground water level ≤ 5m below the supporting base, the value should be increased.					

When installing the system-insulating layer, the insulating panels shall be butted tightly together. Multiple insulating layers shall be staggered or placed in such a way that the joints between panels of one layer are out of line with the next layer.

4.1.2.2.2 Peripheral insulating strip

Prior to the laying of the screed, a peripheral insulating strip (edge joint) shall be placed along the walls and other building components penetrating the screed and firmly secured to the supporting base, e.g. door frames, pillars and risers.

The peripheral insulating strip shall rise from the supporting base up to the surface of the finished floor and permit a movement of the screed of at least 5 mm.

In the case of multiple insulating layers, the peripheral insulating strip shall be placed prior to application of the upper insulating layer. When laying the screed, the peripheral insulating strip shall be secured against any change in position. The top part of the peripheral insulating strip which rises over the finished floor shall not be cut off until completion of the floor covering and, in the case of textile and plastic coverings, hardening of the filler.

4.1.2.3 Protective layer

Prior to laying the screed, the insulation layer shall be covered with a protective layer consisting of a polyethylene film of at least 0,15 mm thickness, with a minimum of 80 mm overlaps, or with another product of equivalent function.

In accordance with 4.1.2.2.2, the protective layer shall be turned pulled up above the upper edge of the peripheral insulating strip unless the strip itself fulfils the function of protection. The peripheral insulating strip shall be firmly secured to the insulating layer or to the protective layer to avoid the infiltration of the liquid screed.

When using synthetic resin screeds or calcium sulphate screeds, the protective layer of the insulating layer must be liquid-tight by for instance being stuck or welded together.

When using gush asphalt screeds, also a therefore suitable protective layer shall be applied, but in this case, liquid tightness is not necessary.

Protective layers are not humidity barriers.

4.1.2.4 Equipment

4.1.2.4.1 Safety

For heating systems, a safety device, independent of the control unit, and which operates even in the absence of electric power, shall cut off the heat supply in the floor heating circuit in such a way that the temperature around the heating elements does not exceed the data given in 4.1.2.8.2. For cooling systems, a dew point sensor device is required to interrupt cooling water flow just prior to condensation forming or coalescing.

4.1.2.4.2 Manifolds

The central manifold of the piping system shall be placed in such a manner to get the shortest flow pipes. Otherwise, the flow pipes can have an unwanted impact on the control of the room temperature.

4.1.2.4.3 Stop valves and balancing devices

Each circuit shall have two stop valves and a balancing device. The shut-off and balancing functions shall be independent. At least one circuit per heated/cooled room shall be installed in order to permit temperature control either manual or automatic.

4.1.2.5 Piping (pipes and couplings)

4.1.2.5.1 Plastic piping

Requirements for plastic pipes shall comply with the following Standards:

PE-X	EN ISO 15875 (parts -1, -2, -3 and -5)
PB	EN ISO 15876 (parts -1, -2, -3 and -5)
PP	EN ISO 15874 (parts -1, -2, -3 and -5)
PVC-C	EN ISO 15877 (parts -1, -2, -3 and -5)
Multilayer Piping Systems	EN ISO 21003 (parts -1, -2, -3 and -5)
PE-RT Systems	ISO 22391 (parts -1, -2, -3 and -5)
PE-MDX	DIN 4724

Calculate the minimum wall thickness in accordance with the following conditions:

a) Service conditions: Class 4 in accordance with ISO 10508;

b) Operating pressure: $\geq$ 4 bar;

c) Lifetime = 50 years.

It is recommended to use pipes with an oxygen-barrier layer in conformity with annex A. Precautions shall be taken to protect the system against corrosion.

4.1.2.5.2 Copper piping

Copper piping shall comply with the requirements of EN 1057 (pipes) and series EN 1254 (fittings).The preferred temper is annealed R220 (see EN 1057:2006, clause 4).

4.1.2.6 Installation of piping

4.1.2.6.1 Storage and transport

The pipes shall be transported, stored and handled in such a way as to be:

a) protected from anything which could damage them;

b) for plastic pipes stored out of direct sunlight.

4.1.2.6.2 Clearance area

The pipes are placed more than:

a) 50 mm distance from vertical structures;

b) 200 mm distance from smoke ducts and open fireplaces, open or walled shafts, lift wells.

4.1.2.6.3 Bending radius

Use only a bending radius equal to the radius of bending for the pipes as recommended by the system supplier.

4.1.2.6.4 Couplings

All couplings within the floor construction shall be exactly located and designated on the record drawing.

4.1.2.7 Attachment of pipes

The pipes and their attachment systems shall be secured such that their horizontal and vertical positions are maintained as planned. The vertical deviation upwards of the pipes before and after application of the screed shall not exceed 5 mm at any point. The horizontal deviation of the specified pipe spacing in the heating circuit shall not exceed ± 10 mm at the attachment points. These requirements are not applicable in the area of bends and deflections. The attachment spacing necessary to comply with these requirements is dependent on the tube materials, dimensions and systems.

The manufacturer shall specify the maximum permissible distance between attachments.

NOTE Attachments that are more frequent provide greater security concerning pipe positioning. Spacing of the attachments depends on the system applied. Experience has shown that systems with individual attachments necessitate spacing of approximately 50 cm in order to comply with the above-mentioned requirements.

4.1.2.8 Weight bearing layers

4.1.2.8.1 Preface

Weight-bearing layers may be Screed or Timber. Type A and Type C Systems rely on a Screed layer. Type B-Systems use Timber for the load-bearing surface as well as Screed depending on the construction methods.

Reduced mass systems such as Timber, Fibre-Reinforced Cement Screeds, or Gypsum Planks are all examples of Type B Systems.

Only the applicable parts of this standard are to be taken into account.

4.1.2.8.2 Construction types

The following construction types are distinguished (see EN 1264-1 and EN 1264-2):

a) Type A - Systems with pipes inside the weight-bearing layer (screed);

b) Type B - System with pipes under the weight-bearing layer (screed or timber);

c) Type C - Systems with pipes in an adjustment screed, on which the screed is deposited with a double separating layer. The thickness of the adjustment screed must be at least 20 mm greater than the diameter of the heating pipes. The screed deposited shall have a thickness of not less than 45 mm.

The thickness of the screed is calculated according to relevant standard taking into account loading capacity and flexural strength class. National Standards should be used until a European Standard is available.

The nominal thickness above the heating pipes (covering height) shall be, for manufacturing reasons at least three times the maximum grain of the loading material, but at least 30 mm. For gush asphalt screed, this thickness is at least 15 mm. Otherwise, for gush asphalt screed table 2 applies.

Note The above mentioned nominal thickness of 30 mm refers to customary cement screed. Special system screeds may allow lower thickness according to the recommendations of the supplier.

Table 2 — Minimum nominal thickness of gush asphalt screed depending on loading capacity

Class	Nominal thickness in mm for loading capacity kN/m^2		
	2,0	3,0	5,0
IC 10	35	40	40

The maximum temperature around the heating pipes within the screed shall not exceed 55 °C in the case of cement or calcium sulphate. For other screed materials, this value may be reduced to, for instance 45 °C for asphalt screed. The specifications of the manufacturer should be followed.

For cooling systems, the temperature around the cooling pipes shall not reach the dew point.

4.1.2.8.3 Adjustment layer

Prior to establishment a floor heating/cooling structure of type C as defined in 4.1.2.8.2, the adjustment layer shall be applied using cement screed with a compressive strength of 20 N/mm^2 after 28 days.

Anhydrite (calcium sulphate) screeds used in adjustment layers must be protected against long-term moisture migration from other layers. Concrete screeds should be allowed to cure before additional layers are applied.

Due to little covering above the pipes, adjustment layers used for type C have a tendency to crack because of shrinkage. However, as a rule this does not impair their efficiency.

All laitance shall be removed.

4.1.2.8.4 Reinforcement

Reinforcement shall be in accordance with relevant standard. National Standards should be used until a European Standard is available.

4.1.2.8.5 Joints

For heating screeds intended for the application of stone or ceramic coverings, joint areas shall not exceed 40 m^2 with a maximum length of 8 m. In the case of rectangular rooms, joint areas can exceed these dimensions but maximum to the length relation of 2 to 1. Any irregular areas shall have joints; the intended purpose is to have only rectangular areas with the dimensions above specified.

If induced contraction joints are placed in heating screeds, these may be cut a depth of not more than one third of the screed thickness, in the case of type A construction taking into account the location of pipes and shall be sealed after heating up.

The heating installer shall be supplied with a plan showing the joint position as a part of the specifications.

In the case of heating screeds of type A and C, movement joints and perimeter joints shall only be crossed by connecting pipes (flow pipes and return pipes of the circuit) and solely in one level. In this case, the connecting pipes shall be covered with a flexible insulation tube of some 0,3 m in length.

As far as possible, the placing of settlement joints should begin from nooks, e.g. on pilasters and fireplaces, i. e. at points where an expansion or narrowing of the screed surface may occur. Trowel-cut or settlement joints are placed in door reveals and passageways.

4.1.2.8.6 Laying of the screed

4.1.2.8.6.1 Protective measures

No components shall be affected in their functions when applying the screed and, when installing the heating elements, e.g. by using unsuitable knee-boards. When carting the screed mortar over the installed pipe system, boards or the like should be laid. Equally, short-term greater loads on the insulating layer shall be avoided so as not to reduce the insulating effect.

During the screed laying process, the screed material should contain only those additives approved by the manufacturer/supplier. Do not use admixtures which entrain more than 5% air into the screed to avoid loss of strength.

4.1.2.8.6.2 Laying

When laying the screed, the temperature of the screed and the temperature of the room shall not fall below 5°C. Subsequently, it shall be maintained at a temperature of at least 5 °C for not less than 3 days. In addition, the cement screed shall be protected against drying-out for at least 3 days (longer period required in the case of low temperatures or slow-setting cements) and following this, against harmful effects, e.g. warmth and draught, in order to keep shrinkage low. Generally, this is ensured for smaller buildings when the building is closed.

Gush asphalt screed can be laid with temperature till 0 °C.

4.1.2.8.6.3 Holes in floor

Each hole in floor shall have been preformed before the floor heating is installed in order to avoid any drilling thereafter.

4.1.3 Leak test

The leak test may be performed using water or compressed air.

Prior to the laying of the screed, the heating circuits shall be checked for leaks by means of a pressure test. The test pressure must be not less than 4 bar, or not greater than 6 bar for standard systems.

In the case of gush asphalt, during the asphalt laying process, the pipes have to be depressurized.

The absence of leaks and the test pressure shall be specified in a test record.

When there is a danger of freezing, suitable measures such as the use of frost protective or the conditioning of the building shall be taken.

When normal system operation begins, any frost protection fluids may be drained and disposed of in compliance with National Health & Safety Regulations, then flushed 3 times with clean water.

4.1.4 Initial heating up

This operation should be carried out on completed cement screeds after 21 days have elapsed, or for completed calcium sulphate screeds a period of 7 days must elapse, or for gush asphalt screed 1 day must elapse. For all screed materials, the specifications of the manufacturer shall be followed.

The initial heating up commences at a flow temperature between 20 °C and 25 °C which shall be maintained for at least 3 days. Subsequently the maximal design temperature shall be set and maintained for at least a further 4 days.

The process of heating up shall be documented.

4.1.5 Floor coverings

Thermal Resistance of Floor Coverings is to be taken into consideration regarding heat transfer calculations and should be verified on installation.

Prior to lying of the floor covering, the floor covering installer shall verify the suitability for lying the floor covering on the screed.

The floor coverings are stored and installed according to the relevant standards and the manufacturer's instructions.

4.2 Heating and cooling systems embedded in ceilings and walls

4.2.1 Preface

Generally, the requirements given above for floor heating/cooling systems also apply where applicable. Therefore, the following clauses only represent additional requirements or modifications of requirements where needed.

4.2.2 General structural preconditions

Heating / Cooling systems can be installed upon or within walls or ceilings constructed from masonry, concrete or prefabricated light weight materials.

The following requirements must be fulfilled:

a) Walls or Ceilings must be structurally capable of supporting the system,

b) Tolerances, levels and datums must comply with European and National Standards where these exist,

c) All Electric Cables, Ducts, or Service Pipes must be installed and tested before heating/cooling work commences,

d) Where settlement joints exist in walls or ceilings, appropriate measures must be identified and work carried out before the heating/cooling work commences,

e) In all cases, Windows, External Doors must be installed before work continues.

4.2.3 Insulation

The insulation for ceiling and wall heating/cooling systems depending on the adjacent room or outside environment (see Table 1) may be divided into sections of layers, e.g. in the case of outside walls into a layer directly behind the system and another one outside.

4.2.4 Maximum heating water flow temperatures

Depending on material, the following maximum flow temperatures are recommended:

Plaster based on gypsum or lime $\vartheta_{V,des,max}$ = 50 °C;

loam mortar plaster $\vartheta_{V,des,max}$ = 50 °C;

plaster based on lime-cement $\vartheta_{V,des,max}$ = 70 °C;

prefabricated building slab of hard plaster $\vartheta_{V,des,max}$ = 50 °C.

Annex A
(informative)

Corrosion Prevention

Oxygen Barrier Layer

To reduce corrosion problems when combining plastic pipes with corrodible materials in heating installations, one way could be using plastic pipes carrying an oxygen barrier layer. When tested in accordance to ISO 17455 method I or method II, as applicable, pipes shall meet the requirement, oxygen permeability ≤ 0,32 mg/(m² x d) at a test (water) temperature of 40 °C.

Specimen preparation:

An accumulation of water shall be carried out on a pipe section from at least 20 meter length. 10 % of the length shall be wound around a core. The coil shows a bending radius, equal to the bending radius recommended by the system supplier. The wound up pipe section shall be fixed on the core. After assembling, a relaxation time over 24 hours without any load takes place (outside of the water bath). Afterwards, the coil shall be stored in a water bath (tap water) with a water temperature of 20 °C. During storage, the pipe has to be filled with water. Both ends of the pipe must be outside of the water bath (without any contact to the water). After the storage time, the coil will be taken out of the water bath for drying the outside surface of the pipe. Both pipe ends shall be closed, the water remains inside the pipe. The drying of the outside surface of the pipe takes place over a period of 28 days under standard atmosphere conditions according to EN ISO 291.

NOTE The unit mg/(m² d) enables results, independent from the tested dimension of the pipe.

Adoption of specific inhibitory products

Inhibitors can be used according to manufactures specifications and instructions.

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[3] EN 1264-5, *Water based surface embedded heating and cooling systems — Part 5: Heating and cooling surfaces embedded in floors, ceilings and walls – Determination of the thermal output*

[4] EN ISO/TS 21003-7, *Multilayer piping systems for hot and cold water installations inside buildings - Part 7: Guidance for the assessment of conformity (ISO/TS 21003-7:2008)*

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[10] CEN ISO/TS 15877-7, *Plastics piping systems for hot and cold water installations - Chlorinated poly(vinyl chloride) (PVC-C) - Part 7: Guidance for the assessment of conformity (ISO/TS 15877-7:2003)*

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