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EAST AFRICAN STANDARD

Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 1: General

EAST AFRICAN COMMUNITY

First Edition 2010

Foreword

Development of the East African Standards has been necessitated by the need for harmonizing requirements governing quality of products and services in East Africa. It is envisaged that through harmonized standardization, trade barriers which are encountered when goods and services are exchanged within the Community will be removed.

In order to meet the above objectives, the EAC Partner States have enacted an East African Standardization, Quality Assurance, Metrology and Test Act, 2006 (EAC SQMT Act, 2006) to make provisions for ensuring standardization, quality assurance, metrology and testing of products produced or originating in a third country and traded in the Community in order to facilitate industrial development and trade as well as helping to protect the health and safety of society and the environment in the Community.

East African Standards are formulated in accordance with the procedures established by the East African Standards Committee. The East African Standards Committee is established under the provisions of Article 4 of the EAC SQMT Act, 2006. The Committee is composed of representatives of the National Standards Bodies in Partner States, together with the representatives from the private sectors and consumer organizations. Draft East African Standards are circulated to stakeholders through the National Standards Bodies in the Partner States. The comments received are discussed and incorporated before finalization of standards, in accordance with the procedures of the Community.

Article 15(1) of the EAC SQMT Act, 2006 provides that "Within six months of the declaration of an East African Standard, the Partner States shall adopt, without deviation from the approved text of the standard, the East African Standard as a national standard and withdraw any existing national standard with similar scope and purpose".

East African Standards are subject to review, to keep pace with technological advances. Users of the East African Standards are therefore expected to ensure that they always have the latest versions of the standards they are implementing.

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Introduction

In the preparation of this East African Standard, the following source was consulted extensively:

ISO 15877-1:2009, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 1: General*

Assistance derived from this source and others inadvertently not mentioned is hereby acknowledged.

INTERNATIONAL STANDARD

ISO 15877-1

Second edition
2009-03-15

Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) —

Part 1: General

Systèmes de canalisations en plastique pour les installations d'eau chaude et froide — Poly(chlorure de vinyle) chloré (PVC-C) —

Partie 1: Généralités

Reference number
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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 15877-1 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 155, *Plastics piping systems and ducting systems,* in collaboration with ISO Technical Committee TC 138, *Plastics pipes, fittings and valves for the transport of fluids*, Subcommittee SC 2, *Plastics pipes and fittings for water supplies*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This part of ISO 15877 is part of a System Standard for plastics piping systems of a particular material for a specified application. There are a number of such System Standards.

The System Standards are consistent with general standards on functional requirements and recommended practices for installation.

This second edition cancels and replaces the first edition (ISO 15877-1:2003).

ISO 15877 consists of the following parts [1)], under the general title *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C)*:

— *Part 1: General*

— *Part 2: Pipes*

— *Part 3: Fittings*

— *Part 5: Fitness for purpose of the system*

— *Part 7: Guidance for the assessment of conformity* [Technical Specification]

1) This System Standard does not incorporate a Part 4: *Ancillary equipment* or a Part 6: *Guidance for installation*. For ancillary equipment, separate standards can apply. Guidance for installation of plastics piping systems made from different materials, intended to be used for hot and cold water installations, is covered by ENV 12108 [3].

At the date of publication of this part of ISO 15877, System Standards Series for piping systems of other plastics materials used for the same application are the following:

ISO 15874 (all parts), *Plastics piping systems for hot and cold water installations — Polypropylene (PP)*

ISO 15875 (all parts), *Plastics piping systems for hot and cold water installations — Crosslinked polyethylene (PE-X)*

ISO 15876 (all parts), *Plastics piping systems for hot and cold water installations — Polybutylene (PB)*

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

2) To be published. (Revisions of ISO 22391-1:2007, ISO 22391-2:2007, ISO 22391-3:2007, ISO 22391-5:2007.)

Introduction

The System Standard, of which this is Part 1, specifies the requirements for a piping system when made from chlorinated poly(vinyl chloride) (PVC-C). The piping system is intended to be used for hot and cold water installations and for heating system installations.

In respect of potential adverse effects on the quality of water intended for human consumption caused by the product covered by ISO 15877, the following are relevant.

a) This part of ISO 15877 provides no information as to whether the product may be used without restriction in any of the Member States of the EU or EFTA.

b) It should be noted that, while awaiting the adoption of verifiable European criteria, existing national regulations concerning the use and/or the characteristics of this product remain in force.

When using solvent cement, relevant national safety rules or regulations concerning their use (e.g. protection of workers) are to be observed.

Requirements and test methods for components of the piping system are specified in ISO 15877-2 and ISO 15877-3. Characteristics for fitness for purpose (mainly for joints) are covered in ISO 15877-5. ISO/TS 15877-7 gives guidance for the assessment of conformity.

This part of ISO 15877 specifies the general aspects of the plastics piping system.

Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) —

Part 1: General

1 Scope

This part of ISO 15877 specifies the general requirements of chlorinated poly(vinyl chloride) (PVC-C) piping systems intended to be used for hot and cold water installations within buildings for the conveyance of water, whether or not intended for human consumption (domestic systems) and for heating systems, under design pressures and temperatures appropriate to the class of application (see Table 1).

This part of ISO 15877 covers a range of service conditions (classes of application), design pressures and pipe dimension classes. For values of T_D, T_{max} and T_{mal} in excess of those in Table 1, this part of ISO 15877 does not apply.

NOTE It is the responsibility of the purchaser or specifier to make the appropriate selections from these aspects, taking into account their particular requirements and any relevant national regulations and installation practices or codes.

It also specifies the test parameters for the test methods referred to in this part of ISO 15877.

In conjunction with the other parts of ISO 15877, it is applicable to PVC-C pipes and fittings, their joints and joints with components of other plastics and non-plastics materials intended to be used for hot and cold water installations.

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 472, *Plastics — Vocabulary*

ISO 1043-1, *Plastics — Symbols and abbreviated terms — Part 1: Basic polymers and their special characteristics*

ISO 1158, *Plastics — Vinyl chloride homopolymers and copolymers — Determination of chlorine content*

ISO 1183-1, *Plastics — Methods for determining the density of non-cellular plastics — Part 1: Immersion method, liquid pyknometer method and titration method*

ISO 9080, *Plastics piping and ducting systems — Determination of the long-term hydrostatic strength of thermoplastics materials in pipe form by extrapolation*

ISO 15877-2:2009, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 2: Pipes*

ISO 15877-3:2009, *Plastics piping systems for hot and cold water installations — Chlorinated poly(vinyl chloride) (PVC-C) — Part 3: Fittings*

3 Terms and definitions, symbols and abbreviated terms

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

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472 and ISO 1043-1 and the following apply.

3.1.1 Geometrical

3.1.1.1 Nominal size

3.1.1.1.1
nominal size DN
numerical designation of the size of a component, which is a convenient round number, approximately equal to the manufacturing dimensions

3.1.1.1.2
nominal size DN/OD
nominal size, related to outside diameter

NOTE Nominal size is expressed in millimetres.

3.1.1.2
nominal outside diameter
d_n
specified diameter assigned to a nominal size DN/OD

NOTE 1 According to ISO 15877, the nominal outside diameter, d_n, of a pipe or spigot end of a fitting is equal to its minimum mean outside diameter, $d_{em,min}$.

NOTE 2 Nominal outside diameter is expressed in millimetres.

3.1.1.3
outside diameter
d_e
measured outside diameter through the cross-section at any point of a pipe or spigot end of a fitting, rounded up to the nearest 0,1 mm

3.1.1.4
mean outside diameter
d_{em}
measured length of the outer circumference of a pipe or spigot end of a fitting in any cross section divided by π (≈ 3,142), rounded up to the nearest 0,1 mm

3.1.1.5
minimum mean outside diameter
$d_{em,min}$
minimum value of the mean outside diameter as specified for a given nominal size

3.1.1.6
maximum mean outside diameter
$d_{em,max}$
maximum value of the mean outside diameter as specified for a given nominal size

3.1.1.7
mean inside diameter of socket
d_{sm}
arithmetic mean of two measured inside diameters perpendicular to each other at the midpoint of the socket length

3.1.1.8
out-of-roundness
ovality
difference between the measured maximum outside diameter and the measured minimum outside diameter in the same cross-sectional plane of a pipe or spigot end of a fitting, or the difference between the measured maximum inside diameter and the measured minimum inside diameter in the same cross-sectional plane of a socket

3.1.1.9
nominal wall thickness
e_n
numerical designation of the wall thickness of a component, approximately equal to the manufacturing dimension

NOTE 1 According to ISO 15877, the nominal wall thickness, e_n, of a pipe or spigot end of a fitting is equal to the specified minimum wall thickness, e_{min}.

NOTE 2 Nominal wall thickness is expressed in millimetres.

3.1.1.10
wall thickness
e
measured wall thickness at any point around the circumference of a component, rounded up to the nearest 0,1 mm

3.1.1.11
minimum wall thickness
e_{min}
minimum wall thickness at any point around the circumference of a component, as specified

3.1.1.12
maximum wall thickness
e_{max}
maximum wall thickness at any point around the circumference of a component, as specified

3.1.1.13
tolerance
permitted variation of the specified value of a quantity, expressed as the difference between the permitted maximum and the permitted minimum value

3.1.1.14
pipe series
S
dimensionless number for pipe designation conforming to ISO 4065 [1]

NOTE According to ISO 15877, the pipe series S is used as a means of selecting pipe sizes for practical purposes (see ISO 15877-2).

3.1.1.15
calculated pipe value
S_{calc}
value for a specific pipe calculated according to the following equation, rounded up to the nearest 0,1 mm:

$$S_{calc} = \frac{d_n - e_n}{2e_n}$$

where

d_n is the nominal outside diameter, in millimetres;

e_n is the nominal wall thickness, in millimetres.

3.1.2 Related to service conditions

3.1.2.1
design pressure
p_D
highest pressure related to the circumstances for which the system has been designed and is intended to be used

NOTE The design pressure, p_D, is equal to the maximum design pressure (MDP), as specified in EN 806-1 [4].

3.1.2.2
hydrostatic stress
σ
stress induced in the wall of a pipe when a pressure is applied using water as a medium

NOTE 1 It is calculated using the following approximate equation:

$$\sigma = p \times \frac{(d_{em} - e_{min})}{2e_{min}}$$

where

p is the applied pressure, in megapascals;

d_{em} is the mean outside diameter of the pipe, in millimetres;

e_{min} is the minimum wall thickness, in millimetres.

NOTE 2 Hydrostatic stress is expressed in megapascals.

3.1.2.3
design temperature
T_D
temperature or a combination of temperatures of the conveyed water, dependent on the service conditions for which the system has been designed

3.1.2.4
maximum design temperature
T_{max}
highest design temperature, T_D, occurring for short periods only

3.1.2.5
malfunction temperature
T_{mal}
highest temperature that can be reached when the control limits are exceeded

3.1.2.6
cold water temperature
T_{cold}
temperature of conveyed cold water of up to approximately 25 °C

NOTE For design purposes, 20 °C is used.

3.1.2.7
treated water for heating installations
water, intended for heating installations, which contains additives which have no detrimental effect on the system

3.1.3 Related to material characteristics

3.1.3.1
lower predictive limit of long-term hydrostatic strength
σ_{LPL}
quantity which can be considered as a material property, representing the 97,5 % lower confidence limit of the predicted average long-term hydrostatic strength at the given temperature, T, and time, t

NOTE Lower predictive limit is expressed in megapascals.

3.1.3.2
design stress
σ_D
allowable stress in the pipe material, σ_{DP}, or in the plastics fitting material, σ_{DF}, for a given application or service condition, respectively

NOTE 1 See also Annex A of ISO 15877-2:2009.

NOTE 2 Design stress is expressed in megapascals.

3.1.3.3
overall service coefficient
overall design coefficient
C
overall coefficient with a value greater than 1, which takes into consideration service conditions as well as properties of the components of a piping system other than those represented in the lower predictive limit, LPL

3.1.3.4
virgin material
material in a form such as granules or powder that has not been subjected to use or processing other than that required for its manufacture and to which no reprocessable or recyclable material has been added

3.1.3.5
own reprocessable material
material prepared from rejected unused pipes and fittings, including trimmings from the production of pipes and fittings, that will be reprocessed in a manufacturer's plant after having been previously processed by the same manufacturer by a process such as moulding or extrusion and for which the complete formulation or material specification is known

3.1.3.6
pipes with barrier layer
plastics pipes provided with a thin barrier layer, e.g. to prevent or greatly diminish the diffusion of gases and the transmission of light through the pipe wall, and where the design stress requirements are totally met by the base polymer (PVC-C)

3.2 Symbols and abbreviated terms

3.2.1 Symbols

C	overall service (design) coefficient
d_e	outside diameter (at any point)
d_{em}	mean outside diameter

$d_{em,min}$	minimum mean outside diameter
$d_{em,max}$	maximum mean outside diameter
d_n	nominal outside diameter
d_{sm}	mean inside diameter of socket
e	wall thickness (at any point)
e_{max}	maximum wall thickness (at any point)
e_{min}	minimum wall thickness (at any point)
e_n	nominal wall thickness
p	internal hydrostatic pressure
p_D	design pressure
S_{calc}	calculated pipe value
$S_{calc,max}$	maximum calculated pipe value
T	temperature
T_{cold}	cold water temperature
T_D	design temperature
T_{mal}	malfunction temperature
T_{max}	maximum design temperature
t	time
ρ	density
σ	hydrostatic stress
σ_{cold}	design stress at 20 °C
σ_D	design stress
σ_{DF}	design stress in the plastics fitting material
σ_{DP}	design stress in the pipe material
σ_F	hydrostatic stress values of fitting material
σ_P	hydrostatic stress values of pipe material
σ_{LPL}	lower predictive limit of long-term hydrostatic strength

3.2.2 Abbreviated terms

DN	nominal size
DN/OD	nominal size, outside diameter related
LPL	lower predictive limit
MDP	maximum design pressure

PVC-C chlorinated poly(vinyl chloride)

S pipe series S

TIR true impact rate

VST Vicat softening temperature

4 Classification of service conditions

The performance requirements for piping systems conforming to the applicable part(s) of ISO 15877 are specified for the different compound types and application classes and are given in Table 1.

NOTE Each class is related to a typical field of application and for a design period of 50 years. The classification is taken from ISO 10508 [2]. The fields of application are given as a guideline and are not obligatory.

For any application, the parties concerned shall agree the selection of the applicable class conforming to Table 1. Each application class shall be combined with a design pressure, p_D, of 4 bar [3], 6 bar, 8 bar or 10 bar, as applicable.

Table 1 — Classification of service conditions for Type I [Classes 1 and 2] and Type II [Classes 1, 2, 4 and 5] PVC-C materials

Application class	T_D °C	Time at T_D years	T_{max} °C	Time at T_{max} years	T_{mal} °C	Time at T_{mal} h	Typical field of application
1 [a]	60	49	80	1	95	100	Hot water supply (60 °C)
2 [a]	70	49	80	1	95	100	Hot water supply (70 °C)
4	20 Followed by 40 Followed by 60 Followed by (see next column)	2,5 20 25 (see next column)	70 Followed by (see next column)	2,5	100	100	Underfloor heating and low temperature radiators
5	20 Followed by 60 Followed by 80 Followed by (see next column)	14 25 10 (see next column)	90 Followed by (see next column)	1	100	100	High temperature radiators

[a] A country may select Application Class 1 or Application Class 2 to conform to its national regulations.

NOTE For values of T_D, T_{max} and T_{mal} in excess of those in Table 1, this part of ISO 15877 does not apply.

3) 1 bar = 0,1 MPa = 0,1 N/mm^2 = 10^5 N/m^2.

All systems which satisfy the conditions specified in Table 1 shall also be suitable for the conveyance of cold water for a period of 50 years at a temperature of 20 °C and a design pressure of 10 bar. All heating installations shall only use water or treated water as the transfer fluid.

The manufacturer of plastics pipes and fittings should give guidance on the type of treatment required and on aspects of applications such as oxygen permeation.

5 Material

5.1 General

The PVC-C material from which the pipes and fittings are made shall conform to this part of ISO 15877 and to the relevant requirements of ISO 15877-2 and ISO 15877-3, as applicable.

This part of ISO 15877 is applicable to two types of PVC-C, Type-I (suitable for Class 1 and Class 2) and Type-II (suitable for Classes 1, 2, 4 and 5). Systems comprising pipes and fittings produced from a combination of Type I and Type II materials shall only be suitable for Class 1 and Class 2.

Materials other than PVC-C used for the manufacture of fittings shall conform to ISO 15877-3.

5.2 Density

The density of the PVC-C material used for the manufacture of pipes and fittings shall be measured in accordance with the Immersion Method given in ISO 1183-1 and shall be at (23 ±2) °C between the following limits:

$$1{,}45\ \text{g/cm}^3 \leqslant \rho \leqslant 1{,}65\ \text{g/cm}^3.$$

5.3 Chlorine content

The chlorine content of the PVC-C material used for the manufacture of pipes and fittings shall be determined in accordance with ISO 1158 and shall be mass fraction of at least 55 %.

5.4 Hydrostatic stress properties

The material from which the pipes and fittings are made shall be evaluated in accordance with ISO 9080 or equivalent. The σ_{LPL}-values thus determined shall be at least as high as the corresponding values of the reference curves given in Figure 1 of ISO 15877-2:2009 and Figure 1 of ISO 15877-3:2009, as applicable.

5.5 Verification of the malfunction temperature

The verification of the malfunction temperature, T_{mal}, of the PVC-C, Type I material shall conform to Annex A.

Since LPL data for PVC-C, Type II materials are available at malfunction temperatures (see ISO 15877-2 and ISO 15877-3), products made from Type II materials are not to be tested in accordance with Annex A.

5.6 Influence on water intended for human consumption

All plastics and non-plastics materials for components of the PVC-C piping system, when in permanent or temporary contact with water which is intended for human consumption, shall not adversely affect the quality of the drinking water.

NOTE European standards on test methods for the assessment of migration, odour and flavour and for microbiological assessment are under preparation.

5.7 Reprocessable and recycable material

The use of the manufacturer's own reprocessable material obtained during the production and testing of products conforming to this part of ISO 15877 is permitted in addition to the use of virgin material. Reprocessable material obtained from external sources and recyclable material shall not be used.

Annex A
(normative)

Test method for the verification of the malfunction temperature, T_{mal}, of PVC-C, Type-I material

A.1 Scope

This annex specifies a test method for verifying the malfunction temperature, T_{mal}, of 95°C of chlorinated poly(vinyl chloride) Type I (PVC-C, Type I) material for piping systems intended to be used for hot and cold water installations and for heating systems (for classification of service conditions, see Clause 4).

A.2 Principle

An assembly of pipes and fittings (see Figure A.1) for testing the material is subjected to a given internal water pressure under temperature for a given period, during which the leaktightness of the system is verified by inspection.

A.3 Apparatus

A.3.1 Pump, capable of applying and maintaining the required pressure.

A.3.2 Pressure measurement devices, capable of checking conformity to the required test pressure (see A.5).

A.3.3 Heating devices, capable of applying and maintaining the required temperature (see A.5).

A.3.4 Thermometer or equivalent, capable of checking conformity to the required test temperature (see A.5).

A.3.5 Timer, capable of recording the duration of the pressure application.

A.4 Test pieces

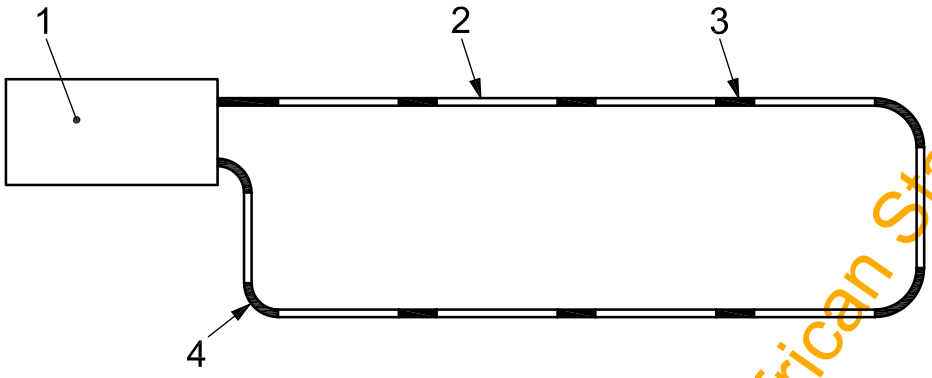
The assembly shall comprise test pieces of the following type:

— 10 pipe sections of the same length, each of them at least 300 mm and with a nominal outside diameter, d_n, specified by the manufacturer and capable of withstanding a design pressure, p_D, of at least 10 bar;

— 7 double-sockets (couplers) of the same outside diameter as the pipe sections;

— 4 elbows, each of them with an angle of 90°.

The test pieces shall be joined to each other according to Figure A.1.



Key

1 rotary pump and heating device
2 PVC-C pipe
3 double socket
4 elbow, 90°

Figure A.1 — Assembly of pipes and fittings for testing the material

A.5 Procedure

Conduct the following procedure using an assembly as given in Figure A.1, set up by solvent cementing the components. Store the components which have been connected by solvent cement for setting for at least 24 h at ambient temperature. Then condition the solvent cemented joints by filling the assembly with water at (95 ± 2) °C and maintain this state for 48 h without applying any pressure. After the conditioning, drain the water off.

Refill the assembly with water at (95 ± 2) °C which is circulated by a pump and apply a pressure of 10 bar to the assembly.

Maintain the water temperature at (95 ± 2) °C and pressure at (10 ± 0,5) bar for at least 1 000 h, during which the assembly shall be continuously monitored for leaktightness.

A.6 Test report

The test report shall include the following information:

a) reference to this annex of this part of ISO 15877, i.e. ISO 15877-1:2009, Annex A;

b) complete identification of the sample;

c) test pressure, in bar;

d) test temperature, in degrees Celsius;

e) time under pressure, in hours;

f) type(s) of failure, if any;

g) any factors which could have affected the results, such as any incidents or any operating details not specified in this annex;

h) date of test.

Bibliography

[1] ISO 4065, *Thermoplastics pipes — Universal wall thickness table*

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

[3] ENV 12108, *Plastics piping systems — Guidance for the installation inside buildings of pressure piping systems for hot and cold water intended for human consumption*

[4] EN 806-1, *Specifications for installations inside buildings conveying water for human consumption — Part 1: General*

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