SLOVENSKI STANDARD
SIST EN 17800:2023

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Stroški življenjskega cikla (LCC) in ocena življenjskega cikla (LCA) cevnih sistemov iz duktilne železove litine zaradi emisije CO2

Life cycle cost (LCC) and life cycle assessment (LCA) for CO2 emissions in ductile iron pipe systems

Lebenszykluskosten (LCC) und Lebenszyklusanalyse (LCA) der CO2-Emissionen von Rohrsystemen aus duktilem Gusseisen

Coût du cycle de vie (CCV) et analyse du cycle de vie (ACV) pour les émissions de CO2 dans les systèmes de canalisations en fonte ductile

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Life cycle cost (LCC) and life cycle assessment (LCA) for CO_2 emissions in ductile iron pipe systems

Coût du cycle de vie (CCV) et analyse du cycle de vie (ACV) pour les émissions de CO_2 dans les systèmes de canalisations en fonte ductile

Lebenszykluskosten (LCC) und Lebenszyklusanalyse (LCA) der CO_2-Emissionen von Rohrsystemen für Rohrsysteme aus duktilem Eisen

This European Standard was approved by CEN on 28 November 2022.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
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European foreword

This document (EN 17800:2022) has been prepared by Technical Committee CEN/TC 203 “Cast iron pipes, fittings and their joints”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by June 2023, and conflicting national standards shall be withdrawn at the latest by June 2023.

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Introduction

Studies on economic and environmental impacts are important for utility decision-makers as they seek to balance budget concerns over immediate and long-term needs across acquisition, operations, and maintenance, and planned end of life. For authorities and engineers designing pipeline systems, the life cycle cost (LCC) and live cycle assessment (LCA) serve as a tool to study various scenarios to determine the right solution for site-specific conditions and community values, as well as to provide the necessary data to support those decisions. Impacts on the circular economy should be taken into consideration too.

The intention of this document, dedicated to ductile iron pipe systems, is to define objective methodologies for LCC and LCA- carbon footprint, respectively, in order to support customers and users to optimize ductile iron pipe solutions with global cost evaluation, safety requirements and environmental criteria.

1 Scope

This document specifies the evaluation method of life cycle cost (LCC) and Life cycle assessment (LCA) of ductile iron pipes and fittings used for water applications and which are in compliance with EN 545.

LCC evaluation is based on concepts and methods developed in ISO 15686-5.

LCA evaluation is based on concepts and methods developed in ISO 15686-6, EN 15804:2012+A2:2019, EN ISO 14040 and EN ISO 14044.

In this document, LCA is limited to the evaluation of environmental impact due to CO_2 emissions associated with the consumption of natural resources or energy and waste disposal. The other categories of impacts are not in the scope of this document.

Informative annexes are included in this document as a compilation of references, consensual factors, and scenarios with different DI pipelines.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 545:2010, *Ductile iron pipes, fittings, accessories and their joints for water pipelines — Requirements and test methods*

EN ISO 14044:2006[1], *Environmental management — Life cycle assessment — Requirements and guidelines (ISO 14044:2006)*

3 Terms, definitions and abbreviated terms

For the purposes of this document, the terms and definitions given in EN 545:2010 and the following apply.

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

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1 Terms and definitions

3.1.1
life cycle cost
cost of an asset throughout its life cycle, while fulfilling the performance requirements

[SOURCE: ISO 15686-5:2017, 3.1.7, modified]

[1] As impacted by EN ISO 14044:2006/A1:2018 and EN ISO 14044:2006/A2:2020.

3.1.2
life cycle assessment
compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system

Note 1 to entry: Environmental life cycle assessment and environmental life cycle analysis are synonymous.

[SOURCE: EN ISO 14040:2006, 3.2, modified – "throughout its life cycle" at the end of the definition has been removed; Note 1 to entry has been added]

3.1.3
acquisition cost
all costs included in acquiring an asset by purchase/lease or construction procurement route, excluding costs during the occupation and use or end-of-life phases of the life cycle of the constructed asset

[SOURCE: ISO 15686-5:2017, 3.1.1]

3.1.4
operation cost
total running costs for water conveyance, including the cost for pumping and cost for water leakage

Note 1 to entry: Operation costs could include rent, rates, insurances, energy, and other environmental/regulatory inspection costs.

[SOURCE: ISO 15686-5:2017, 3.1.11, modified]

3.1.5
maintenance cost
total labour, material, and other related costs incurred to maintain pipelines in a state in which it can perform its required functions

[SOURCE: ISO 15686-5:2017, 3.1.9, modified]

3.1.6
end of life cost or revenue
total of costs or fee for disposing of an asset at the end of its *service life* or interest period, including costs resulting from pipeline dismantling, waste disposal, and revenue from material recovery

[SOURCE: ISO 15686-5:2017, 3.1.5, modified – "including costs resulting from pipeline dismantling, waste disposal, and revenue from material recovery" has been added]

3.1.7
period of analysis
period of time over which life cycle costs or whole-life costs are analysed

Note 1 to entry: The period of analysis is determined by the client.

[SOURCE: ISO 15686-5:2017, 3.3.6]

3.1.8
functional unit
quantified performance of a product system for use as a reference unit

[SOURCE: EN 15804:2012+A2:2019, 3.13, from EN ISO 14040:2006]

3.1.9
service life
period of time after installation during which a facility or its component parts meet or exceed the performance requirements

[SOURCE: ISO 15686-1:2011, 3.25]

3.1.10
in-use condition
any circumstance that can impact on the performance of a building or a constructed asset, or a part thereof, under normal use

[SOURCE: ISO 15686-1:2011, 3.10, modified – Note 1 to entry has been deleted]

3.1.11
reference service life
service life of a pipeline system which is known to be expected under a particular set, i.e. a reference set, of in-use conditions and which can form the basis for estimating the service life under other in-use conditions

[SOURCE: ISO 15686-1:2011, 3.22, modified – "product, component, assembly or system" has been replaced by "pipeline system"]

3.1.12
residual value
value assigned to an asset at the end of the period of analysis

[SOURCE: ISO 15686-5:2017, 3.3.8]

3.1.13
discount rate
factor or rate reflecting the time value of money that is used to convert cash flows occurring at different times to a common time

Note 1 to entry: This can be used to convert future values to present-day values and vice versa.

[SOURCE: ISO 15686-5:2017, 3.3.1]

3.1.14
failure rate
number of failures (which cause a reparation) per unit length of the pipeline per year

3.1.15
water leak volume
volume of total water lost along the pipeline in m^3 in a period of one year, (including permanent water losses on line, water losses during failure, reparation and cleaning…)

Note 1 to entry: Evaluation is depending of the measuring equipment and collecting information system put in force by water authority.

3.1.16
nominal size DN
alphanumerical designation of size for components of a pipework system, to be used for reference purposes, which comprises the letters DN followed by a dimensionless whole number which is indirectly related to the physical size, in millimetres, of the bore or outside diameter of the end connections

[SOURCE: EN 545:2010]

3.2 Abbreviated terms

FU	functional unit
LCC	life cycle cost
LCA	life cycle assessment
RSL	reference service life
SL	service life

4 Basic concept of life cycle cost (LCC) for ductile iron pipe systems

4.1 Definition of life cycle cost

The life cycle cost shall be calculated using Formula (1) as a sum of the acquisition cost, the operation cost such as the electric power usage cost of the pump operation, the maintenance cost such as the leakage cost, and the end of life cost or revenue. B.1 shows scenarios of LCC with two different pipelines.

$$C_{\mathrm{L}} = C_{\mathrm{A}} + C_{\mathrm{O}} + C_{\mathrm{M}} + C_{\mathrm{E}} \quad (1)$$

C_{L} is the life cycle cost;

C_{A} is the acquisition cost; it includes the pipe and fittings material cost, construction cost, and designing/survey cost;

C_{O} is the operation cost; it includes the pumping cost;

C_{M} is the maintenance cost; it includes the leakage cost, repair cost, etc.;

C_{E} is the end of life cost or revenue; it includes the disposal cost and benefit of recycling.

4.2 Calculation method

The life cycle cost shall be calculated using Formula (2) to (4) by totalizing all the costs in a period of analysis. Cost in the future is converted into a current value using a discount rate. In a case where the evaluation period is not just the same as multiples of the service life(SL), the residual value is deducted from the life cycle cost.

Case 1: $t_n < t_m$

$$C_L = C_A + \sum_{t=1}^{t_n}\left(\frac{C_{O,t} + C_{M,t}}{(1+r)^t}\right) - \frac{C_A \times (t_m - t_n)/t_m}{(1+r)^{t_n}} \quad (2)$$

Case 2: $t_n = t_m$

$$C_L = C_A + \sum_{t=1}^{t_m}\left(\frac{C_{O,t} + C_{M,t}}{(1+r)^t}\right) + \frac{C_E}{(1+r)^{t_m}} \quad (3)$$

Case 3: $t_m < t_n < 2 \times t_m$

$$C_L = C_A + \frac{C_A}{(1+r)^{t_m}} + \sum_{t=1}^{t_n}\left(\frac{C_{O,t} + C_{M,t}}{(1+r)^t}\right) + \frac{C_E}{(1+r)^{t_m}} - \frac{C_A \times (2 \times t_m - t_n)/t_m}{(1+r)^{t_n}} \quad (4)$$

where

C_L is the life cycle cost;

t is the time in years;

t_n is the period of analysis, in year;

t_m is the service life (SL), in year;

C_A is the acquisition cost;

$C_{O,t}$ is the operation cost in the t^{th} year;

$C_{M,t}$ is the maintenance cost in the t^{th} year;

C_E is the end of life cost or revenue;

r is the discount rate.