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**Stroški življenjskega cikla (LCC) in ocena življenjskega cikla (LCA) cevnih sistemov iz duktilne železove litine**

Life cycle cost (LCC) and Life cycle assessment (LCA) for ductile iron pipe systems

Lebenszykluskosten (LCK) und Ökobilanz (ÖB) für Rohrsysteme aus duktilem Gusseisen

**iTeh STANDARD PREVIEW**Coût du cycle de vie (CCV) et analyse du cycle de vie (ACV) pour les systèmes de canalisations en fonte ductile  
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oSIST prEN 17800:2022

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## Life cycle cost (LCC) and Life cycle assessment (LCA) for ductile iron pipe systems

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

Lebenszykluskosten (LCK) und Ökobilanz (ÖB) für Rohrsysteme aus duktilem Gusseisen

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EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

<b>Contents</b>	<b>Page</b>
European foreword .....	4
Introduction .....	5
1 Scope.....	6
2 Normative references.....	6
3 Terms and definitions.....	6
4 Basic concept of Life Cycle Cost (LCC) for ductile iron pipe systems.....	7
4.1 Definition of life cycle cost.....	7
4.2 Calculation method .....	8
5 Breakdown of life Cycle Cost.....	10
5.1 Acquisition cost .....	10
5.2 Operation cost.....	11
5.3 Maintenance cost .....	11
5.4 End of life cost or revenue .....	11
6 Basic concept of life cycle assessment (LCA) for ductile iron pipe systems .....	12
6.1 Definition of environmental life cycle assessment.....	12
6.2 Calculation method of CO <sub>2</sub> emissions.....	12
6.3 Other impacts.....	13
7 Breakdown of CO <sub>2</sub> emissions.....	14
7.1 CO <sub>2</sub> emissions at the acquisition stage.....	14
7.2 CO <sub>2</sub> emissions at the operation stage.....	14
7.3 CO <sub>2</sub> emissions at the maintenance stage .....	14
7.4 CO <sub>2</sub> emissions at end of life stage.....	15
8 Key drivers for LCC and LCA evaluation .....	15
8.1 Reference Service Life (RSL).....	15
8.1.1 General.....	15
8.1.2 RSL of DI pipeline.....	15
8.1.3 In-use conditions.....	16
8.2 Functional Unit (FU) .....	16
8.2.1 General.....	16
8.2.2 FU for DI pipeline:.....	16
8.2.3 Service Safety conditions .....	16
8.3 Leakage incident .....	17
9 LCC and LCA reduction in Circular economy.....	17
9.1 General.....	17
9.2 Conservation of mechanical characteristics in time .....	17
9.3 Recyclability .....	18
9.4 Conveyance capacity.....	18
9.5 Preservation of soil .....	18
9.6 Ferule collecting and Rate of reuse .....	18
9.7 Optimum pipe wall thickness.....	18

<b>10</b>	<b>Quality of data.....</b>	<b>18</b>
	<b>Annex A (informative) Pumping cost and CO<sub>2</sub> emissions with pump operation .....</b>	<b>20</b>
<b>A.1</b>	<b>Pumping cost.....</b>	<b>20</b>
<b>A.2</b>	<b>Daily pumping energy.....</b>	<b>20</b>
<b>A.3</b>	<b>Total head (H).....</b>	<b>20</b>
<b>A.4</b>	<b>CO<sub>2</sub> emissions with pump operation .....</b>	<b>22</b>
	<b>Annex B (informative) Scenarios of LCC and LCA with different DI pipelines.....</b>	<b>23</b>
<b>B.1</b>	<b>Scenario of LCC with different DI pipelines.....</b>	<b>23</b>
<b>B.2</b>	<b>Scenario of LCA with different DI pipelines .....</b>	<b>24</b>
	<b>Annex C (informative) Leakage incident rate of ductile iron pipes.....</b>	<b>26</b>
<b>C.1</b>	<b>Water leakage evaluation.....</b>	<b>26</b>
<b>C.2</b>	<b>Example of leakage incident rate of a ductile iron pipe network .....</b>	<b>26</b>
<b>C.2.1</b>	<b>General .....</b>	<b>26</b>
<b>C.2.2</b>	<b>Example in France .....</b>	<b>27</b>
<b>C.2.3</b>	<b>Example in Germany.....</b>	<b>27</b>
<b>C.2.4</b>	<b>Example in Spain.....</b>	<b>27</b>
	<b>Bibliography .....</b>	<b>29</b>

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**prEN 17800:2021 (E)**

## **European foreword**

This document (prEN 17800:2021) 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 document is currently submitted to the CEN Enquiry.

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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 DI pipe systems, is to state the concepts of Life Cycle Cost(LCC), Live Cycle assessment(LCA), reference service life (RSL), the functional unit (FU), to define objective methodologies for LCC and LCA, respectively, in order to support customers and users to optimize DI pipe solutions with global cost evaluation, safety requirements and environmental criteria.

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**prEN 17800:2021 (E)****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

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

**2 Normative references**

There are no normative references in this document.

**3 Terms and definitions**

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

**3.1**  
**life cycle cost**  
**LCC**

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

**3.2**  
**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

**3.3**  
**operation cost**

total running costs for water conveyance, including the pumping cost

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

**3.4**  
**maintenance cost**

total labor, material, and other related costs incurred to maintain pipelines

**3.5**  
**end of life cost or revenue**

total of costs or fee for disposing of an asset at the end of its *service life* (3.8) or interest period, including costs resulting from pipeline dismantling, waste disposal, and revenue from material recovery

**3.6**  
**period of analysis**

period of time over which life cycle costs (3.1) or whole-life costs are analyzed

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

**3.7**  
**functional unit**  
**FU**

the way in which the identified functions or performance characteristics of the product are quantified

[SOURCE: EN 15804]



### 3.8 reference service life RSL

service life of a construction product 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: EN 15804]

### 3.9 residual value

the value assigned to an asset at the end of the *period of analysis* (3.6)

### 3.10 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.

### 3.11 leakage incident rate

number of pipe bodies' damages or water leak per unit length of the pipeline

### 3.12 nominal size DN

alphanumeric 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 millimeters, of the bore or outside diameter of the end connections

[SOURCE: EN 545]

## 4 Basic concept of Life Cycle Cost (LCC) for ductile iron pipe systems

### 4.1 Definition of life cycle cost

The life cycle cost is 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.

$$C_L = C_A + C_O + C_M + C_E \quad (1)$$

$C_L$  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.

## prEN 17800:2021 (E)

## 4.2 Calculation method

The life cycle cost is 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, 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

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$C_L$  is the life cycle cost;

$t$  is the time in year;

$t_n$  is the period of analysis;

$t_m$  is the service life;

$C_A$  is the acquisition cost;

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

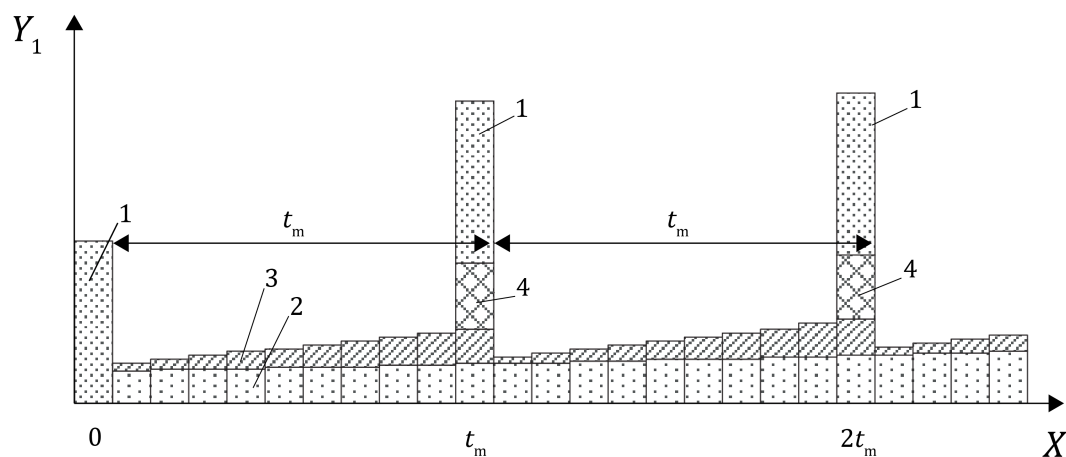
$C_{M,t}$  is the maintenance cost in the  $t^{\text{th}}$  year;

$C_E$  is the end of life cost or revenue;

$r$  is the discount rate.

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**Key**

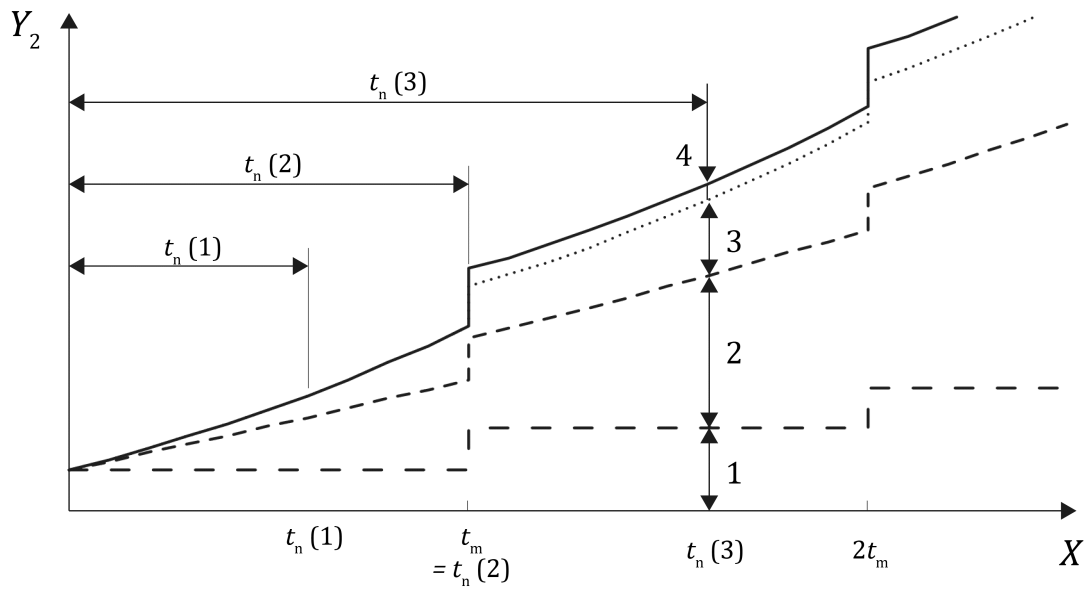
- 1 acquisition cost
- 2 operation cost
- 3 maintenance cost
- 4 end of life cost or revenue
- $X$  time in year
- $Y_1$  cost
- $Y_2$  LCC

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**Figure 1 — Costs per year**

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**Key**

- 1 acquisition cost
- 2 operation cost
- 3 maintenance cost
- 4 end of life cost or revenue
- X time in year
- $Y_1$  cost
- $Y_2$  LCC

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**Figure 2 — Accumulated costs during the service life**

## 5 Breakdown of life Cycle Cost

### 5.1 Acquisition cost

The acquisition cost is calculated using Formula (5) as a total of the pipe material cost, construction cost, and designing/survey cost.

$$C_A = A_P + A_C + A_D \quad (5)$$

where

$C_A$  is the acquisition cost;

$A_P$  is the pipe and fittings material cost;

$A_C$  is the construction cost (pipe laying cost, trenching cost, backfilling cost etc.);

$A_D$  is the designing/survey cost (all the studies useful for the project).