

# SLOVENSKI STANDARD

## SIST EN 18110:2025

01-november-2025

---

**Kakovost vode - Ocena poškodb rib pri prehodu skozi črpalne postaje in hidroelektrarne - Metode, ki temeljijo na preskusu preživetja rib in modelu udarca z lopatico**

Water quality - Assessment of damage to fish passing through pumping stations and hydropower plants - Methods based on live fish passage survival test and blade strike model

Wasserbeschaffenheit - Verfahren zur Ermittlung der Fischdurchgängigkeit von Wasserfördererschnecken, Pumpen und Spiralturbinen, die in Pumpwerken und Wasserkraftwerken verwendet werden

### Document Preview

Qualité de l'eau - Évaluation des dommages causés aux poissons transitant par les stations de pompage et les centrales hydroélectriques - Méthodes basées sur les tests de survie de poissons vivants lors du transit et le modèle de collision avec des pales

<https://standards.iteh.ai/catalog/standards/sist/9be13390-bf8d-4ce3-883b-4d8c7d26e0e2/sist-en-18110-2025>

**Ta slovenski standard je istoveten z: EN 18110:2025**

---

#### ICS:

13.060.01	Kakovost vode na splošno	Water quality in general
93.160	Vodogradnja	Hydraulic construction

**SIST EN 18110:2025**

**en,fr,de**



**EUROPEAN STANDARD**  
**NORME EUROPÉENNE**  
**EUROPÄISCHE NORM**

**EN 18110**

September 2025

ICS 93.160

English Version

**Water quality - Assessment of damage to fish passing  
through pumping stations and hydropower plants -  
Methods based on live fish passage survival test and blade  
strike model**

Wasserbeschaffenheit - Verfahren zur Ermittlung der  
Fischdurchgängigkeit von Wasserfördererschnecken,  
Pumpen und Spiralturbinen, die in Pumpwerken und  
Wasserkraftwerken verwendet werden

This European Standard was approved by CEN on 13 July 2025.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and United Kingdom.



EUROPEAN COMMITTEE FOR STANDARDIZATION  
COMITÉ EUROPÉEN DE NORMALISATION  
EUROPÄISCHES KOMITEE FÜR NORMUNG

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

## Contents

	Page
<b>European foreword</b> .....	<b>4</b>
<b>Introduction</b> .....	<b>5</b>
<b>1 Scope</b> .....	<b>9</b>
<b>2 Normative references</b> .....	<b>9</b>
<b>3 Terms and definitions</b> .....	<b>10</b>
<b>4 Drawings of the installations</b> .....	<b>14</b>
<b>5 Equipment and tools</b> .....	<b>20</b>
<b>5.1 Collection net</b> .....	20
<b>5.2 Fish introduction device</b> .....	21
<b>5.3 Transport tank</b> .....	23
<b>5.4 Storage tank</b> .....	23
<b>5.5 Keepnet</b> .....	23
<b>5.6 Small transport tank</b> .....	23
<b>5.7 Measuring board</b> .....	23
<b>5.8 Anaesthetics</b> .....	23
<b>5.9 Fish welfare journal</b> .....	24
<b>6 Fish survival test</b> .....	<b>24</b>
<b>6.1 General</b> .....	24
<b>6.2 Authorization and safety</b> .....	24
<b>6.3 Legislation and directives</b> .....	24
<b>6.4 Flow charts</b> .....	25
<b>6.5 Operating conditions</b> .....	30
<b>6.6 Choice and origin of fish</b> .....	30
<b>6.7 Preparation of a fish survival test</b> .....	32
<b>6.8 Execution of a fish survival test</b> .....	34
<b>6.9 Calculation of passage survival</b> .....	37
<b>6.10 Report</b> .....	38
<b>7 Computational method to assess fish survival</b> .....	<b>41</b>
<b>7.1 General</b> .....	41
<b>7.2 Blade strike mortality</b> .....	41
<b>7.3 Probability of collision</b> .....	42
<b>7.4 Velocity in the meridional plane</b> .....	43
<b>7.5 Relative velocity of the fish</b> .....	44
<b>7.6 Effective fish length</b> .....	44
<b>7.7 Mutilation ratio</b> .....	45
<b>7.8 Strike velocity</b> .....	46
<b>7.9 Blade thickness</b> .....	47
<b>7.10 Total mortality</b> .....	47
<b>7.11 Integral mortality</b> .....	48
<b>8 Scaling of results of fish survival tests</b> .....	<b>48</b>
<b>8.1 General</b> .....	48
<b>8.2 Geometric similarity</b> .....	48
<b>8.3 Kinematic equality</b> .....	49

8.4 Scaling in case of true similarity .....	49
8.5 Scaling under practical conditions.....	50
Annex A (informative) Fish species.....	52
Annex B (informative) Causes of damage and mortality to fish passing through pumping stations and hydropower plants .....	53
Annex C (informative) Fish survival assessment for open-water turbines .....	59
Annex D (informative) Survival estimates, statistical precision, power, and sample size ...	67
Annex E (normative) Parameters to be described in a fish welfare journal .....	76
Annex F (informative) Legislation on the protection of test animals used for scientific purposes .....	78
Bibliography .....	79

# iTeh Standards

## (<https://standards.iteh.ai>)

## Document Preview

[SIST EN 18110:2025](#)

<https://standards.iteh.ai/catalog/standards/sist/9bef3590-bf8d-4ce3-885b-4d8c7d26e0e2/sist-en-18110-2025>

**EN 18110:2025 (E)****European foreword**

This document (EN 18110:2025) has been prepared by Technical Committee CEN/TC 230 "Water analysis", the secretariat of which is held by DIN.

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 2026, and conflicting national standards shall be withdrawn at the latest by March 2026.

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

Any feedback and questions on this document should be directed to the users' national standards body. A complete listing of these bodies can be found on the CEN website.

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

**iTeh Standards**  
**(<https://standards.iteh.ai>)**  
**Document Preview**

[SIST EN 18110:2025](#)

<https://standards.iteh.ai/catalog/standards/sist/9bef3590-bf8d-4ce3-885b-4d8c7d26e0e2/sist-en-18110-2025>

## Introduction

### *Purpose of the standard*

In recent years, there has been a growing focus on enhancing ecological water quality, with a specific emphasis on fish populations. International legal frameworks, such as the Water Framework Directive (WFD) [1], the European Eel Regulation [2], and the Benelux Free Fish Migration Decision [3], have played a pivotal role in shaping the measures adopted in this regard. Human activities related to water management, drinking water supply, irrigation, and electricity production require the installation of pumps and turbines that can have significant environmental impacts on fish populations. For the environmental sustainability of these sectors, their impact must be studied and, if needed, the best available mitigation measures must be applied. It is the reason why significant efforts are being made by various stakeholders, including water management authorities, resource agencies, pump and turbine manufacturers, ecological consultancy firms, and research institutions, to enhance the chances of survival for fish passing through pumping stations and hydropower plants.

To address these environmental challenges and ensure the effective protection of fish populations, it is crucial to establish standardized procedures for assessing the impact of new and existing turbomachines on fish survival. This standard aims at providing a basis for planning, conducting, and reporting fish survival studies in pumps and turbines. It will lead to more consistency in results among study sites and machines.

### *Mechanisms of fish mortality*

Damage to fish in pumping stations or hydropower plants can have different causes [13]. Mechanical injury by blade strike is generally regarded as the primary cause of injury and mortality in pumps and turbines with low to moderate heads. Grinding of fish along rough walls or entrapment in small gaps and clearances can also lead to damage. Other causes are rapid pressure changes that can result in barotrauma, and excessive shear forces in a fluid flow with high velocity gradients. The actual pump or turbine system is often where the risk is highest, but also other parts of a plant can be the source of damage, for instance at trash racks, in nearly closed guide vanes, long pipelines, or siphons, near butterfly valves, or oscillating no-return valves.

<https://Methods to assess fish survival standards/sist/9bef3590-bf8d-4ce3-885b-4d8c7d26e0e2/sist-en-18110-2025>

Water management authorities are increasingly transitioning to the use of pump and turbine systems that pose fewer risks to fish. Decisions to that effect are usually based on survival tests done in the field at existing plants, or on laboratory experiments done in test facilities for new designs of pumps and turbines that are safer for fish. These survival tests can use either live fish or artificial, dummy fish with integrated sensors. Another alternative route to estimating fish survival is to use computational models that are well-validated with information from prior tests. Each of these methods has its advantages and disadvantages. The final choice depends on the stage of development and the desired level of accuracy.

### *1. Fish survival tests in the field*

Fish survival tests conducted in the field at the actual plant site, using live fish and real environmental and operational conditions, yield results that most closely reflect what will be experienced in practice. The fish should be representative of the population for which the survival is being estimated, and operating conditions should reflect the most common modes of operation, or worst-case conditions if such conditions occur on a regular basis. Survival tests like these come closest to reality, where resident fish are entrained naturally into the intake structure of a plant, are subjected to all stressors during passage, and can display their natural behaviour. The use of artificial dummy fish with integrated sensors [17], can give additional information but they cannot replace tests with live fish. While the recorded values of acceleration, rotation, and pressure changes may give valuable information about stressors along a trajectory, these readings alone are (as of yet) difficult to correlate with actual damage to fish. Current studies are expected to improve their predictive powers.