



TÜVRheinland®

DIN CERTCO

Precisely Right.



# Certification Scheme

## Marine Biodegradable

according to

**DIN EN ISO 22403**

(Edition: December 2022)

## Foreword

DIN CERTCO was founded in 1972 by DIN Deutsches Institut für Normung e. V., is now part of the TÜV Rheinland Group and is the certification body for issuing DIN marks and other certification marks for products, persons, services as well as companies based on DIN standards and similar specifications. Due to its independence, neutrality, competence and many years of experience, DIN CERTCO enjoys a high reputation both at home and abroad.

In order to prove the functionality of the system and our competence as a certification body, we have been accredited, certified or recognised by independent domestic and foreign bodies in both the voluntary and legally regulated areas. [Our accreditations.](#)

The "Marine Biodegradable" certification scheme was created in collaboration with the DIN CERTCO "Marine Biodegradation" certification committee (ZA-MARBIO) and will be continuously refined. It makes a distinction between the certification of products, intermediates, materials and additives.

According to the General Terms and Conditions (GTC) of TÜV Rheinland DIN CERTCO and the Testing, Registration and Certification Regulations of DIN CERTCO, this certification scheme forms the basis for suppliers to mark their manufactured items with the Certification Marks "DIN-Geprüft Biodegradable in Marine Environment" and/or "DIN*plus* Biodegradable in Marine Environment". They thereby document that their products meet all requirements of the applicable DIN EN ISO 22403 standard as well as the certification scheme.

The Certification Marks "DIN-Geprüft Biodegradable in Marine Environment" and "DIN*plus* Biodegradable in Marine Environment" gives the confidence, that an independent, neutral and competent body has carefully examined and assessed the product based on the test criteria. In addition, third-party surveillance, ensures that the quality of the product is maintained. The customer thus receive an added value, which they may take into account when deciding on purchase.

Products shall receive the Certification Mark "DIN-Geprüft Biodegradable in Marine Environment" and/or "DIN*plus* Biodegradable in Marine Environment" upon meeting the requirements listed under Section 4 according to the procedure described in this certification scheme. Certificates are issued for materials, intermediates and additives (for additives only DIN-Geprüft is possible) if the requirements mentioned in section 4 are met; in this case, the right to use the mark is only granted for marketing and advertising purposes.

A list of all valid certificate holders, which is updated on a daily basis, can be accessed via the website of DIN CERTCO ([www.dincertco.de](http://www.dincertco.de)).

## Amendments

First issue.

## Earlier versions

Initial release.

## Remark

The German version of this certification scheme shall be taken as authoritative. No guarantee can be given to the English translation.

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## 1 Scope

No (plastic) waste should end up in the (marine) environment. Therefore, preventing any type of waste from entering the environment is the primary goal. Avoiding the use of persistent plastic (e.g. in cosmetics or packaging) as well as reduction, reuse and recyclability should be the first measure for product development. However, biodegradability may offer benefits for items that are intentionally used in or near the marine environment and are highly likely to remain there. These can be products, which have a high potential of loss and which can be removed from the sea with high effort only (e.g. ghost gear, FADs, feeding bags used in aquaculture, mussel nets). In addition, unintentional entry of materials or components during use or transport (e.g. abrasion of car tires, plastic pellets, fibres from clothing, components of cosmetics (like sun or washing lotion), net structures or geotextiles) which can never completely avoided shall be considered.

Certificates issued based on this certification scheme are in no way an attestation of possible disposal in the sea. Rather, the use of certified marine biodegradable materials is one opportunity to reduce the progressive accumulation of (persistent plastic) waste in the sea. In addition to determining the biodegradability in marine environment, the physical degradation, non-toxicity and content of heavy metals and fluorine are verified.

It is to be underlined that the biodegradation of a material is a "system property" which is basically the result of three conditions:

- a) the intrinsic (i.e. potential) biodegradability of the material;
- b) the available surface and the shape of the product;
- c) the environmental conditions where the product is located.

This certification scheme applies only to basic materials, intermediates (e.g. films, papers and non-wovens), additives (e.g. substances of sun lotion) and products that are used in marine environment (e.g. fishing or mussel nets or net structures, traps). It **does not apply** to other final products like packaging, cutlery or shopping bags. In connection with the testing specifications named below, this certification scheme contains all requirements on issuing the conformity mark "DIN-Geprüft Biodegradable in Marine Environment" and "DIN*plus* Biodegradable in Marine Environment" and certificates for materials, intermediates, additives and products.

The certification scheme presented here specifies the requirements for the material, intermediate, additive or product itself as well as for the testing, surveillance and certification of these.

If a material, intermediate, additive or product demonstrates conformity to the criteria specified in this certification scheme, then a certificate will be issued. Furthermore, conformity with the "Marine Biodegradable" certification scheme is confirmed by addition to the corresponding lists of certificate holders (see Section 6.9).

There is no legal right to receive a certificate or any other confirmation of conformity.

## 2 Test and Certification Specifications

The following referenced documents are the basis for testing and certification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

DIN EN ISO 22403	Plastics — Assessment of the intrinsic biodegradability of materials exposed to marine inocula under mesophilic aerobic laboratory conditions — Test methods and requirements
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DIN EN ISO 18830	Plastics- Determination of aerobic biodegradation of non-floating plastic materials in a seawater/sandy sediment interface - Method by measuring the oxygen demand in closed respirometer
DIN EN ISO 19679	Plastics – Determination of aerobic biodegradation of non-floating plastic materials in a seawater/sediment interface – Method by analysis of evolved carbon
DIN EN ISO 22404	Plastics – Determination of the aerobic biodegradation of non-floating materials exposed to marine sediment – Method by analysis of evolved carbon dioxide
ASTM D6691	Standard Test Method for Determining Aerobic Biodegradation of Plastic Materials in the Marine Environment by a Defined Microbial Consortium or Natural Sea Water Inoculum
DIN EN ISO 23977-1	Plastics – Determination of the aerobic biodegradation of plastic-materials exposed to seawater – Part 1: Method by analysis of evolved carbon dioxide
DIN EN ISO 23977-2	Plastics – Determination of the aerobic biodegradation of plastic-materials exposed to seawater – Part 2: Method by measuring the oxygen demand in closed respirometer
OECD/OCDE 310	OECD GUIDELINES FOR THE TESTING OF CHEMICALS – Ready Biodegradability – CO <sub>2</sub> in sealed vessels (Headspace Test)
OECD 301	OECD GUIDELINES FOR THE TESTING OF CHEMICALS – Ready Biodegradability
OECD 306	OECD GUIDELINES FOR THE TESTING OF CHEMICALS – Biodegradability in Seawater
ISO 23832	Plastics- Test methods for determination of degradation rate and disintegration degree of plastic materials exposed to marine environmental matrices under laboratory conditions
DIN EN ISO 22766	Plastics — Determination of the degree of disintegration of plastic materials in marine habitats under real field conditions
ISO/DIS 5430	Plastics- Marine ecotoxicity testing scheme for soluble decomposition intermediates from biodegradable plastic materials and products used in the marine environment – Test methods and requirements
ASTM D 638-14	Standard Test Method for Tensile Properties of Plastics
ISO 527-2	Plastics — Determination of tensile properties — Part 2: Test conditions for moulding and extrusion plastics
DIN EN 13432	Packaging - Requirements for packaging recoverable through composting and biodegradation

DIN EN ISO 10253	Water quality - Marine algal growth inhibition test with <i>Skeletonema sp.</i> and <i>Phaeodactylum tricornutum</i>
ISO 14669	Water quality - Determination of acute lethal toxicity to marine copepods (Copepoda, Crustacea)
DIN EN ISO 11348-3	Water quality - Determination of the inhibitory effect of water samples on the light emission of <i>Vibrio fischeri</i> (Luminescent bacteria test) - Part 3: Method using freeze-dried bacteria
DIN EN ISO 11348-1	Water quality - Determination of the inhibitory effect of water samples on the light emission of <i>Vibrio fischeri</i> (Luminescent bacteria test) - Part 1: Method using freshly prepared bacteria
DIN EN ISO 11348-2	Water quality - Determination of the inhibitory effect of water samples on the light emission of <i>Vibrio fischeri</i> (Luminescent bacteria test) - Part 2: Method using liquid-dried bacteria

- This certification scheme
- The General Terms and Conditions of TÜV Rheinland DIN CERTCO
- The Testing, Registration and Certification Regulations of DIN CERTCO
- The associated schedule of fees of DIN CERTCO

The obligation to comply with laws and regulations governing the respective products is in no way affected by this certification scheme.

### 3 Definitions

For the purposes of this certification scheme, the following definitions shall apply:

Additive	Substances and product constituents added to a product or material in order to, for example, generate certain properties (e.g. adhesives, antiblocking agents).
Blend	Physical mixture of 2 or more materials without reactive process.
Certification	Proof of conformity with the requirements of the named standards as well as with this certification scheme.
Coating	Covering on a substrate, which has protective, decorative, or specific technical properties.
Intermediate	Semi-finished item optional state between material and product, e.g. laminates consisting of several layers of material.
Intrinsic biodegradability	Ability of a polymer or plastic material to be biodegraded established under controlled laboratory conditions.
Organic constituent	Chemical constituent that contains carbon covalently linked to other carbon atoms and to other elements, most commonly hydrogen, oxygen or nitrogen.

Manufactured item	Material, intermediate, additive or product according to this certification scheme.
Material	Material that is (in case of polymers) primarily based on organic chain molecules and used to manufacture products or parts of products. Materials generally contain further inorganic or low molecular weight organic materials used to influence processing or application properties. Materials can also consist of materials other than plastics.
Not chemically modified	Substance whose chemical structure remains unchanged, even if it has undergone a chemical process or treatment, or a physical mineralogical transformation, for instance to remove impurities.
PFAS	Poly- and perfluoroalkyl substances; organofluorine compounds containing only carbon-fluorine bonds and carbon-carbon bonds but also other heteroatoms.
Product	Article that is applied in marine environment, is manufactured from (polymeric) materials and frequently also contains additives.
Product unit	Product containing several parts (e.g. Fish Aggregating Devices (FADs) may include ropes, rafts, floats and chains). A product units can be certified as a whole or only parts of it can be certified according to this scheme.
Production facility	Location at which production of manufactured items is carried out according to this certification scheme. This is not necessarily identical to the certificate holder's address.

#### 4 Product Requirements

According to the requirements of the underlying standards, the requirements named in the following shall be fulfilled. Section 6 describes the details on providing the associated evidence.

- Compliance with the threshold values named in Annex B 1.1.
- Poly- and perfluoroalkyl substances (PFAS) shall not be intentionally added to the manufactured item (Annex B 1.2).
- Each substance of very high concern (SVHC) that exceeds a concentration limit of 0.1 % (by dry weight) and appears on the Candidate List of substances of very high concern for Authorization shall not be applied<sup>1</sup> (Annex B 1.3).
- Intrinsic aerobic biodegradability according ISO 22403 (90 % absolute, or 90 % referred to a suitable reference substrate) not longer than 2 years at 15 – 25°C (not exceeding 28 °C). Evidence shall be proven via a test according to the standards named under Annex B 2.

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<sup>1</sup> Candidate List of substances of very high concern: <https://echa.europa.eu/candidate-list-table>



- Organic constituents present in a concentration of between 1 % and 15 % (by dry mass) in the material, intermediate or product shall demonstrate intrinsic biodegradability separately.
- The sum of organic constituents which do not need to demonstrate intrinsic biodegradability separately shall not exceed 1 % by dry weight for each organic constituent and 5 % by dry weight in total. From 2028 the percentage of the total dry weight shall not exceed 3 % by dry weight<sup>2</sup>. Otherwise the respective certificate will be withdrawn (see Section 6.12).
- Disintegration rate. Evidence shall be demonstrated via testing according to the standard named under Annex B 3.1.
- All components of a manufactured item (including additives) shall not have any toxic effect on (micro)organisms in the sea. Evidence shall be proven according to the standard named under Annex B 4.
- Only required for "DINplus Biodegradable in Marine Environment": Disintegration degree under real field conditions ( $\geq 90$  % disintegration no longer than 3 years). Evidence shall be demonstrated via testing according to the standard named under Annex B 3.2. Information on the test region and environment (e.g. temperature) is published on the DIN CERTCO website (see Section 6.9).
- Test samples shall not be subjected to any pre-treatment (e.g. by heat or an exposure to radiation exposure).

## 5 Testing

### 5.1 General Information

To carry out the required tests that form the basis for the assessment and certification of the products, DIN CERTCO uses testing laboratories that have been awarded DIN CERTCO recognition.

All documents shall be submitted in German or English language.

### 5.2 Types of Tests

#### 5.2.1 Initial Test (Type Testing)

The initial test is a type test that determines whether the manufactured item meets the requirements specified in Section 4 of this certification scheme.

Section 6.2 shows which tests are necessary for individual cases.

#### 5.2.2 Surveillance Test (Control Test)

Surveillance testing is performed on products, intermediates, materials and additives.

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<sup>2</sup> Note: The 5 % (from 2028: 3%) maximum dry weight limit is to discourage intentional use of non-biodegradable organic constituents but still allows the use of inks, coatings, or glues including these constituents.

Surveillance testing is performed in recurring, predefined intervals and establishes whether the certified product, material, intermediates or additive corresponds to the manufactured item tested during initial certification.

This shall be evidenced on time by a positive test report from a testing laboratory recognised by DIN CERTCO.

Test reports are assessed by DIN CERTCO.

For this purpose samples of the certified manufactured items are obtained from manufacturers' production facilities and provided to DIN CERTCO free of charge.

### **5.2.3 Supplementary Testing**

A supplementary test shall take place when additions, extensions or modifications (see Section 6.13) are made to the certified manufactured item, which may influence the manufactured item's conformity with the fundamental requirements.

The type and scope of the supplementary test shall be determined in individual cases by DIN CERTCO in consultation with the testing laboratory.

### **5.2.4 Special Test**

A special test is conducted if

- defects are detected
- required by DIN CERTCO - reasons to be specified
- requested in written form by a third party if there is a particular interest in maintaining a proper market situation in a competitive or qualitative manner.

The nature and the scope of the special test is to be determined by DIN CERTCO for the purpose of each individual case, if necessary in coordination with the testing laboratories.

When defects are detected in the process of the special test or when the special test is carried out while the production is suspended, then the certificate holder will bear the costs of the examination procedure.

If the special test is requested by a third party and reveals no defects, then the third party will bear the costs.

## **5.3 Sampling**

The samples for initial, surveillance and renewal testing are generally delivered by the manufacturer to the testing laboratory which has been commissioned to perform the tests. The costs for this shall be paid by the manufacturer.

The number of samples for the product test shall be agreed between DIN CERTCO and the testing laboratory as long as it is not regulated in the valid test bases.

## **5.4 Test Procedure**

The following tests shall be performed in accordance with the requirements of DIN EN ISO 22403 and this certification scheme:

- Determination of regulated metals and other substances according Annex B 1.
- Testing of intrinsic biodegradability according to Annex B 2.
- Testing of disintegration rate according to Annex B 3.1.
- Ecotoxicity testing according to Annex B 4.
- Additionally, for identifying the material it is necessary to perform an IR spectrum in accordance with Annex C.
- Testing of Disintegration degree under real field conditions according to Annex B 3.2 (Only for "DINplus Biodegradable in Marine Environment").

## 5.5 Test Report

The testing laboratory informs the client about the test results by means of a test report. This test report shall be submitted to DIN CERTCO as an original. A PDF-file is also acceptable if it is submitted to DIN CERTCO directly by the testing laboratory.

As a rule, the test report shall not be older than 6 months at the time of submitting the application. In individual cases, older test reports may also be accepted if the testing laboratory provides written confirmation of the current validity of the information given in the respective test report.

The test report shall conform to DIN EN ISO/IEC 17025, clause 7.8 and contain at least the following information:

- Name and address of the manufacturer
- Name and address of the applicant (if different than manufacturer)
- Test basis (standards and certification scheme) including date of publication
- Type of test (e.g. type test, supplementary test, etc.)
- Date of examination
- Test result and assessment
- If testing is being performed in parallel with multiple replicates, then the individual results shall also be shown.
- identification of the person(s) authorizing the report

## 6 Certification

Certification under this certification scheme relates to the assessment of conformity of an (end) product, material, intermediate or additive by DIN CERTCO on the basis of test reports submitted by testing laboratories recognized by DIN CERTCO. For this purpose, the manufactured items to be certified are examined and subsequently monitored in respect of conformity with the requirements laid down in Section 4. Since this certification scheme is a modular system, the individual testing requirements are indicated accordingly in Section 6.2.

For certified materials, intermediates and additives the right to use the logo is only granted to the certificate holder for **marketing and advertisement reasons**, not for labelling the product itself. A registration number is issued upon granting the certificate.

References to manufactured items that have already been certified can minimise testing expenditures. The points named in the following shall apply.

Should a reference be made to an (end)product that has already been certified, then an additional agreement will be required from the certificate holder. References to certified products will only be possible if they relate to an identical product.

## 6.1 Application for Certification

Both, manufactures according to the German Product Liability Act (ProdHaftG) or suppliers (distributers) may apply for certification. They state in a written form that they place the product onto the market at their own responsibility.

The applicant shall submit the following documents to DIN CERTCO:

- The original application for certification, with a legally binding signature and company stamp.
- Completed datasheet (part of the application form) including the formulation details of the item to be certified.
- List of production facilities, including complete addresses. If production is being carried out by companies other than the certificate holder, then the company's complete name and address shall be submitted. Production can be carried out at various locations alternatively or simultaneously. In this case, all alternative production facilities shall be reported to DIN CERTCO upon application.
- Safety Data Sheets according to REACH for all applied substances (including processing auxiliaries, printing inks, etc.) being used to determine the harmlessness for microorganisms in marine environment.

If substance's harmlessness cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing laboratories.

- If required, an up-to-date test report according to Section 5.5 (see Section 5.2.1 and Section 6.2), when the test has not been contracted by DIN CERTCO within the scope of an ongoing certification process.
- Density or grammage, if applicable.
- Photo(s) of the manufactured item(s) to be certified.
- Test report on an infrared transmission spectrum according to Annex C.

### Additionally for products:

- Information on intended use and lifetime in the marine environment.
- Details on construction and layer thickness.
- Drawings, with data on all wall and layer thicknesses ( $d_{max}$ ), if applicable.

Following the application, the applicant will receive an order confirmation with a procedural number and notes regarding the further course of the procedure and, if necessary, queries concerning any missing documents from DIN CERTCO.

## 6.2 Required Tests/Documents

Depending on the composition of the (end) products, intermediates, materials and/or the additives being certified, the tests named in the following will be required.

The testing requirements for products, intermediates, materials and additives are basically identical. Therefore, the requirements named in the following apply for all manufactured items equally. Depending on composition and structure of the manufactured item, a combination of the requirements named may become necessary.

Note: Certified materials are here only those which fulfil all criteria of this certification scheme and the relevant standard.

For the award of the "DINplus Biodegradable in Marine Environment" mark the following is additionally required (only for products, intermediates and materials):

Test report on testing of disintegration degree under real field condition according to Section B 3B 3.2.

### 6.2.1 Manufactured Items consisting of Materials not yet certified

If certification is being requested for a manufactured item consisting of a material that is not yet certified, the following documents and information shall be submitted along with the application form.

- a) Disclosure of chemical composition (including substances at concentrations below 1 % by dry mass).
- b) Safety Data Sheets according to REACH for all substances being used to determine the substance's harmlessness for (micro)organisms in marine environment.

If substance's harmlessness cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing laboratories.

- c) Test report on the determination of regulated metals and other substances as specified in Annex B 1.
- d) Test report on testing of intrinsic biodegradability as specified in Annex B 2.

Organic additives present in a concentration of between 1 % and 15 % (by dry weight) in the manufactured item shall demonstrate intrinsic biodegradability separately.

The sum of organic constituents which do not need to demonstrate intrinsic biodegradability separately shall not exceed 1 % by dry weight for each organic constituent and 5 % by dry weight in total. From 2028 the percentage of the total dry weight shall not exceed 3 % by dry weight.

- e) Test report on testing of disintegration rate as specified in Annex B 3.1.
- f) Report on the testing of ecotoxicity as specified in Annex B 4.
- g) An infrared transmission spectrum in accordance with Annex C.

### **6.2.2 Manufactured Items consisting of 100% of only one already certified Material**

If certification is being requested for a manufactured item consisting solely of one material already on the list according to Section 6.9 and no further additives are used, the following documents and information shall be submitted along with the application form:

- a) Material used, including information on dry weight percentages of all constituents.
- b) Test report on testing of disintegration rate as specified in Annex B 3.1.

This test can be omitted if the manufactured item has the same shape as the tested material. E.g. if the material has been tested in form of a film, an intermediate in form of a film does not need to be re-tested. An exception exists if the product requires a different test method (due to the place of application; see also Annex B 3.1).

- c) An infrared transmission spectrum in accordance with Annex C.

### **6.2.3 Manufactured Items composed of Materials already certified (Blends)**

If certification is being requested for a manufactured item consisting solely of materials already on the list according to Section 6.9 and no further additives are used, the following documents and information shall be submitted along with the application form:

- a) List of the materials used, including information on dry weight percentages of all constituents.
- b) Test report on testing of disintegration rate as specified in Annex B 3.1.
- c) An infrared transmission spectrum in accordance with Annex C.

### **6.2.4 Manufactured Items consisting of Natural Organic Substances**

If chemically unmodified constituents of natural origin (e.g. wood, wood fibre, cotton fibre, starch, pulp or jute) are used for the manufactured item, such items are accepted by DIN CERTCO as being biodegradable without testing. The following documents and information shall be submitted along with the application form:

- a) Disclosure of chemical composition (including additives at concentrations below 1 % of mass).
- b) Safety Data Sheets according to REACH for all substances being used to determine the substance's harmlessness for (micro)organisms in marine environment.

If substance's harmlessness cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing laboratories.

- c) Test report on testing of disintegration rate as specified in Annex B 3.1.
- d) Test report on the determination of regulated metals and other substances as specified in Annex B 1.

- e) An infrared transmission spectrum in accordance with Annex C.

If additives are being used, then the requirements according to Section 6.2.9 apply accordingly.

### **6.2.5 Manufactured Items consisting of Paper**

If certification is being requested for a manufactured item consisting of paper, the following documents and information shall be submitted along with the application form:

- a) Disclosure of chemical composition (including additives at concentrations below 1 % of mass).
- b) Safety Data Sheets according to REACH for all substances being used to determine the substance's harmless for (micro)organisms in marine environment.

If substance's harmless cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing laboratories.

- c) Test report on testing of disintegration rate as specified in Annex B 3.1.
- d) Test report on the determination of regulated metals and other substances as specified in Annex B 1.
- e) Report on the testing of ecotoxicity as specified in Annex B 4.
- f) An infrared transmission spectrum in accordance with Annex C.

If additives are being used, then the requirements according to Section 6.2.9 apply accordingly.

### **6.2.6 Manufactured Items composed of certified Materials and Substances indicated in Annex A**

If certification is being requested for a manufactured item that is intended to contain the fillers and processing auxiliaries indicated in Annex A, it is possible to certify individual compositions within a predefined composition range. The following documents and information shall be submitted along with the application form:

- a) Disclosure of the manufactured item's chemical composition (including additives at concentrations below 1 % of mass).
- b) Safety Data Sheets according to REACH for all substances being used to determine the substance's harmless for microorganisms in marine environment.

If substance's harmless cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing laboratories.

- c) Safety data sheets according to REACH are to be submitted for all materials used as specified in Annex A. Proof of compliance with the requirements of Annex B 1 with respect to the regulated metals and other substances shall be supplied for each individual filler or processing auxiliary. Alternatively, chemical characterisation according to Annex B 1.1 has to be performed.

- d) Test report on testing of disintegration rate as specified in Annex B 3.1.
- e) An infrared transmission spectrum in accordance with Annex C.

If substances of Annex A are to be used in different portions, the test shall be carried out with the largest portions involved.

### 6.2.7 Coated Products

Independent on the applied amount of coating material the following documents and information shall be submitted along with the application form:

- a) Disclosure of the manufactured item's chemical composition (including additives at concentrations below 1 % of mass).
- b) Data on the coatings layer thickness.
- c) Safety Data Sheets according to REACH for all substances being used to determine the substance's harmless for microorganisms in marine environment.

If substance's harmlessness cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing laboratories.

- d) Test report on testing of intrinsic biodegradability as specified in Annex B 2. Alternatively, the testing can be performed on each single substance. This test is not required if only certified materials and materials/substances indicated in Annex A are applied.

Organic additives present in a concentration of between 1 % and 15 % (by dry weight) in the material, intermediate or product shall demonstrate intrinsic biodegradability separately.

The sum of organic constituents which do not need to demonstrate intrinsic biodegradability separately shall not exceed 1 % by dry weight for each organic constituent and 5 % by dry weight in total. From 2028 the percentage of the total dry weight shall not exceed 3 % by dry weight.

- e) Test report on the determination of regulated metals and other substances as specified in Annex B 1. Alternatively the testing can be performed on each single substance.
- f) Report on the testing of ecotoxicity as specified in Annex B 4.
- g) Test report on testing of disintegration rate as specified in Annex B 3.1.
- h) An infrared transmission spectrum in accordance with Annex C.

### 6.2.8 Manufactured Items consisting of Multiple Layer Structures made of certified Materials

If certification is being requested for a manufactured item consisting of multiple layers of materials already on the list according to Section 6.9 and are therefore demonstrated to fulfil the requirements of this certification scheme (without using auxiliary materials), then the following documents and information shall be submitted along with the application form:



- a) Disclosure of the exact structure, including information on coat thickness of the individual layers.
- b) Disclosure of the composition of each layer (including additives at concentrations below 1 % of mass).
- c) Disclosure of other additives used (including additives used at concentrations below 1 % of dry mass).
- d) Safety Data Sheets according to REACH for all substances being used to determine the substance's harmless for microorganisms in marine environment.

If substance's harmlessness cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing laboratories.

- e) Test report on testing of disintegration rate as specified in Annex B 3.1.
- f) An infrared transmission spectrum in accordance with Annex C.

If additives are being used, then each individual layer shall fulfil the requirements of this certification scheme regarding biodegradability and the use of additives.

### **6.2.9 Manufactured Items consisting of Manufactured Items already certified and Additives**

Certification of manufactured items consisting of various alternative materials/additives is possible provided the certification scheme's requirements have been met for all alternatives.

The other requirements according to Section 6.2 shall be met.

#### **6.2.9.1 Use of additives: at or below 1 % by dry weight per additive and below 5 % (from 2028 below 3 %) by dry weight in total**

Organic additives whose biodegradability has not been separately determined can be used on the following conditions:

- At or below 1 % (dry weight) of mass per organic additive.
- At or below 5 % (from 2028 3%) of mass in total (dry weight) of organic additives whose biodegradability has not been proven.

Required information/tests/documents:

- a) List of all additives, including portions of mass.
- b) Safety Data Sheets according to REACH for all substances being used to determine the substance's harmless for microorganisms in marine environment.

If substance's harmlessness cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing laboratories.

- c) Test report on testing of disintegration rate as specified in Annex B 3.1.

d) An infrared transmission spectrum in accordance with Annex C.

### 6.2.9.2 Using printing inks

It is generally possible to use printing inks. In addition to the requirements named in Section 6.2, the printed product shall also comply with the threshold values defined in Annex B 1.

No more than 1 % of mass of dry printing ink per colour (e.g. red, green, etc.) may be used, and a total of no more than 5 % printing ink. Compliance with the thresholds defined in Annex B 1.1 is required.

Additionally, the following documents and information shall be submitted along with the application form:

a) Safety Data Sheets according to REACH for each colour (e.g. red, yellow, etc.) being used to determine the additive's harmless or microorganisms in marine environment.

If substance's harmless cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing laboratories.

b) For each colour used, information on regulated metals and other substances in the form of test reports according to Annex B 1.1.

Alternatively: Test report on the chemical characterisation as specified in Annex B 1.1 of a printed product sample. The portions of the individual colours tested here will be defined as maximum useable colours.

If the individual printing inks are tested, then 80 % of the threshold defined in Annex B 1.1 may not be exceeded with the maximum colour quantity being requested.

If different colours are used, the maximum usable amount will be defined by the colour with the lowest possible concentration.

#### Example:

The inks A, B and C have been limited to the following amounts according to Annex B 1.1:

- Color A: 0.1 % of mass (dry weight)
- Color B: 0.4 % of mass (dry weight)
- Color C: 0.6 % of mass (dry weight)

The single use of each colour are therefore limited to 0.1 % of mass for colour A, to 0.4 % of mass for colour B and to 0.6 % of mass for colour C, respectively. If colour A is in use the overall amount of printing colour is limited to 0.1 %, for the use of colour B (without colour A) it is limited to 0.4 % only, etc. This is also valid for mixtures of pigments used as printing colours.

In the case UV/EB inks and UV/EB overprint varnishes are used, it will be necessary to test the product regarding ecotoxicity and disintegration rate (and degree for DINplus Marine Biodegradable) after UV or EB curing. If the amount of UV/EB inks used is higher than 1%, then also biodegradability testing of the product is required after the curing process.

### **6.2.9.3 Use of additives with more than 1 % by dry weight per additive and/or more than 5 % by dry weight in total**

The following documents and information shall be submitted along with the application form:

- a) Disclosure of the manufactured item's chemical composition (including additives at concentrations below 1 % by dry weight).
- b) Safety Data Sheets according to REACH for each substance being used to determine the additive's harmless­ness or microorganisms in marine environment.

If substance's harmless­ness cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing laboratories.

- c) Test report on testing of intrinsic biodegradability as specified in Annex B 2. Alternatively the testing can be performed on each single substance.

Organic additives present in a concentration of between 1 % and 15 % (by dry weight) in the material, intermediate or product shall demonstrate intrinsic biodegradability separately.

The sum of organic constituents which do not need to demonstrate intrinsic biodegradability separately shall not exceed 1 % by dry weight for each organic constituent and 5 % by dry weight in total. From 2028 the percentage of the total dry weight shall not exceed 3 % by dry weight.

- d) Test report on the determination of regulated metals and other substances as specified in Annex B 1. Alternatively the testing can be performed on each single substance.
- e) Report on the testing of ecotoxicity as specified in Annex B 4.
- f) Test report on testing of disintegration rate as specified in Annex B 3.1.
- g) An infrared transmission spectrum in accordance with Annex C.

### **6.2.10 Certification of Biodegradable Additives ("DIN-Geprüft Biodegradable in Marine Environment" only)**

For conformity assessment purposes, the following documents are to be submitted along with the application for the certification of the additive.

- a) Description of chemical composition and maximum usage concentration in a manufactured item.
- b) Safety Data Sheets according to REACH for the substance to determine the additive's harmless­ness or microorganisms in marine environment.

If substance's harmless­ness cannot be determined using the Safety Data Sheet, testing on ecotoxicity shall be performed according to Annex B 4. This is coordinated with DIN CERTCO and, if applicable, with the testing.

- c) Test report on testing of intrinsic biodegradability as specified in Annex B 2.

If the maximum usage concentration of the additive in a final biodegradable material, intermediate or product is  $\geq 15\%$ , a testing according OECD 301 A-F, OECD 310 or OECD 306 is possible.

d) An infrared transmission spectrum in accordance with Annex C.

### 6.2.11 Certification of Complex Products (e.g. fishing nets)

A final product can consist of several parts, even if they are firmly attached. This could be for example a fishing net or FAD (Fish Aggregating Device Products) composed of a net and float. All components itself shall fulfil the criteria of the standard and the certification scheme individually. This is to ensure if components get detached from each other they still fulfill the requirements on their own.

A certificate for a complex product shall include disintegration rate or each component.

Individual components of a final product can also be certified. The labeling shall be clear and concise in order to avoid misunderstandings.

## 6.3 Types, Sub-Types and Manufactured Item Families

Products, materials, intermediates and additives that largely differ from each other in significant properties relevant to certification are defined as types or models. Properties relevant to certification include, for example:

- for products/intermediates:
  - Intended use.
  - Shapes.
  - Product characteristics beyond differences in dimensions.
- for materials/additives:
  - Chemical structures.
  - Composition.
  - Compositions that cannot be defined as composition range.

Ranges in connection with materials are grouped into one certificate.

An individual certificate will be issued for each type.

A sub-type is defined as an (end) product that is different based on dimensions. Multiple alternative subtypes are grouped into one product family of alternative dimensions.

- for products:
  - Dimensions.
  - Materials used.
  - Printing inks or print layouts used.

#### For example:

Same fishing nets (e.g. gillnets) made from different materials are sub-types.

- for materials, semi-finished items:
  - Various materials used with the same additives.
  - Percentage differences for various materials used with the same additives.

Multiple sub-types may be summarized under one certificate.

## 6.4 Sub-licences

According to DIN CERTCO's General Terms and Conditions, sub-licences are necessary if certified manufactured items are intended to be brought into the market on behalf of companies other than the main certificate holder.

It is possible to issue sub-licences for all manufactured items as defined in this certification scheme. They facilitate bringing certified manufactured items into circulation on behalf of the sub-licence holder. Sub-licences are dependent upon the validity of the main certificate. Manufactured items may not be changed (e.g. printed) by sub-licence holders.

Documents and information required for application:

- a) Application for certification, with a legally binding signature and company stamp.
- b) Sub-licence holder's declaration that the main certificate holder's products enter into commercial trade without being changed.
- c) Declaration of confirmation from the main certificate holder that a sub-licence shall be issued.

A sub-licence is issued with an own individual registration number.

## 6.5 Confidentiality

The members of committees set up to implement this certification scheme are under obligation to observe strict secrecy. The members of all participating bodies further undertake by signing a declaration of commitment not to pass on to third parties any information on products and companies they may obtain in connection with their certification activities.

## 6.6 Conformity Assessment

On the basis of the documents submitted, DIN CERTCO conducts the conformity assessment. In particular, by means of the test report, it is assessed whether the product meets the requirements of the certification scheme and the standard(s).

DIN CERTCO will notify the applicant of any deviations in writing.

## 6.7 Registration Numbers of Products, Intermediates, Materials and Additives

Composition of the registration number:

DIN-Geprüft Biodegradable in Marine Environment:

- Products 11Pxxxx
- Intermediates 11Hxxxx
- Materials 11Wxxxx
- Additives 11Zxxxx

DIN*plus* Biodegradable in Marine Environment:

- Products P8MPxxxx
- Intermediates P8MHxxxx
- Materials P8MWxxxx

## 6.8 Certificate and the Right to use the Mark

After successful testing and conformity assessment of the application documents submitted, DIN CERTCO issues a certificate to the applicant and issues the right to use the mark "DIN-Geprüft Biodegradable in Marine Environment" and/or "DIN*plus* Biodegradable in Marine Environment" for products in conjunction with the respective registration number (see Section 6.7).



**DIN-Geprüft**  
**"Biodegradable in Marine Environment"**



**DIN*plus***  
**"Biodegradable in Marine Environment"**

Products biodegradable in marine environment for which a right to use the mark "DIN-Geprüft Biodegradable in Marine Environment" and/or "DIN*plus* Biodegradable in Marine Environment" has been issued **may** be marked with the "DIN-Geprüft Biodegradable in Marine Environment"-Logo and/or "DIN*plus* Biodegradable in Marine Environment"-Logo and the respective registration number.

Materials, intermediates and additives do **only** receive the right to use the mark for **marketing and advertising purposes**. They are certified and receive registration numbers (see Section 6.7).

For each respective type, a registration number shall be issued. For design types (sub-types) of a type, the same registration number shall be issued (for information, see Section 6.3).

The mark and the registration number may only be used for the type for which the certificate has been issued and which corresponds to the type-tested product.

Sub-licenses of certificate holder gain the same right to use the mark as the main certificate holder regardless of whether an own registration number has been issued.

In addition, the General Terms and Conditions of DIN CERTCO shall be considered.

## 6.9 Publication

An up-to-date list of all certificate holders can be accessed via the DIN CERTCO website [www.dincertco.de](http://www.dincertco.de). Manufacturers, users and consumers use this research option to obtain information on certified products.

Here, in addition to the contact details of the certificate holders (telephone, telefax, e-mail, website), the technical data of the registered manufactured item can also be reviewed.

## 6.10 Validity of the Certificate

The certificate for products is valid for 5 years and the certificate for materials, intermediates and additives is valid for 6 years. The period of validity is indicated on the certificate. Upon expiration of the certificate, the right to use the mark expires as well.

## 6.11 Renewal of the Certificate

If the validity of certification is to remain valid beyond the date indicated, an application for renewal shall be submitted to DIN CERTCO sufficiently in advance prior to validity expiring.

The manufactured item's current composition shall be submitted with the application for renewal. For renewals, DIN CERTCO will make an assessment based on the certification scheme valid at the time of renewal and may request supplementary documentation.

Furthermore, if no deviations were found during the verification tests performed within the validity, the certificate may be renewed.

## 6.12 Withdrawal of the Certificate

In the event that the new standard conformity examination according to Section 5 has not been completed before expiration of the validity period, the certificates and the registration number expires without the necessity for explicit notification from DIN CERTCO.

Furthermore, the certificate is withdrawn in particular if:

- the surveillance according to Section 7 are not performed on time or in their entirety.
- the conformity mark "DIN-Geprüft Biodegradable in Marine Environment" and/or "DIN*plus* Biodegradable in Marine Environment" is abused by the certificate holder.
- the requirements laid down in the certification scheme or its accompanying documents are not fulfilled.
- the certification fees are not paid on time.
- the requirements for issuing the certificate no longer exist.

## 6.13 Alterations/Amendments

### 6.13.1 Alteration/Amendment to a Manufactured Item

The certificate holder is under obligation to inform DIN CERTCO immediately of all changes to the manufactured item that affect the certification-relevant features of the product. In coordination with the testing laboratory, DIN CERTCO decides whether it is a significant alteration and to what extent testing according to clause 5.2.1 (Initial Type Test) or clause 5.2.3 (Supplementary Test) is to be conducted. The corresponding test report shall be forwarded to DIN CERTCO by the testing laboratory.

Should DIN CERTCO determine a substantial alteration, the certificate with the corresponding registration number is withdrawn. For the modified manufactured item, a new application for initial certification and the right to use of the certification mark "DIN-Geprüft Biodegradable in Marine Environment" and/or "DIN*plus* Biodegradable in Marine Environment" may be submitted.

The certificate holder remains obliged to notify of any changes in the formal information (e.g. name of certificate holder or his address). For this purpose an application for amendment shall be sent to DIN CERTCO. The certificate will be changed respectively.

The certificate holder may apply to DIN CERTCO for an extension of the existing certificate for further design-types (sub-types) of the same type. It is on DIN CERTCO to decide whether these amendments require a complementary examination. The design-types shall be entered in the certificate for the already certified product and, provided that the conditions are fulfilled, shall be regarded as an integral part of same.

### 6.13.2 Modification to the Test Specifications

If the test specifications for the certification change, an application for the modification of the certification shall be submitted within 6 months after receiving notification from DIN CERTCO and, as a rule, proof of conformity with the modified test specifications shall be submitted in the form of a positive test report after 12 months (see section 5.5).

The time limit will be defined by DIN CERTCO and might last up to the next renewal at the latest.

## 6.14 Defects in Manufactured Items

If defects are found on a certified manufactured item at the market, the certificate holder will be asked in writing by DIN CERTCO to rectify the defects.

In coordination with the testing laboratory, DIN CERTCO decides whether it is a serious or a minor defect.

In the case of defects having a direct or indirect effect on the specified properties (serious defects), the manufacturer shall ensure that the products are no longer marked with the certification mark "DIN-Geprüft Biodegradable in Marine Environment" and/or "DIN*plus* Biodegradable in Marine Environment" until the defects have been rectified.

The defects shall also be rectified without delay in products in storage. The manufacturer shall submit proof to DIN CERTCO within 24 months, in the form of a test report on a special test in accordance with Section 5.2.4, that the defects have been rectified and that the product in question again fulfils the stipulated requirements.



For defects that have no influence on the technical safety or functionality of the product (minor defects), the manufacturer shall submit suitable proof to DIN CERTCO within 3 months that the defects in the faulty product have been rectified.

Should the manufacturer fail to observe these deadlines, the certificate will be withdrawn from him and from the distributor of the product and they will no longer be permitted to use the certification mark "DIN-Geprüft Biodegradable in Marine Environment" and/or "DINplus Biodegradable in Marine Environment".

If there are still grounds for complaint, DIN CERTCO shall initially suspend the certificate and at the same time issue a final deadline to rectify the defects. If the certificate holder fails to comply with that request, or fails to comply within the set time limit, or if he is again not able to prove that the defects have been rectified, the certificate shall be withdrawn.

## **7 Surveillance**

### **7.1 General**

An essential part of the certification is the continuous surveillance of the certified manufactured item during the entire validity of the certificate.

### **7.2 Surveillance by the Manufacturer**

The manufacturer shall ensure, by suitable quality measures, that the product characteristics confirmed by the certification are maintained. This can be accomplished by means of an in-house factory production control (FPC) focussed on the product itself or on the production. Also, this can be guaranteed within the framework of a quality management system (QM-System) in accordance with DIN EN ISO 9001.

### **7.3 Surveillance by DIN CERTCO**

DIN CERTCO examines the conformity of the product with the requirements laid down in the certification scheme.

The costs incurred in such tests will be charged to the certificate holder on their completion. In individual cases, supplemental tests may be defined within the scope of certification.

### **7.4 Surveillance Tests (Control Tests)**

The verification shall be performed annually for products and for materials, intermediates and additives at regular intervals of two years.

#### **7.4.1 Products, Intermediates, Materials, Additives**

The control test covers the following:

- a) Check of identification of the Manufactured Item.
- b) Written confirmation from the manufacturer that composition has not been changed since initial certification.

- c) Checking whether all polymeric materials and additives used in manufacturing the product and present in the manufactured item to a percentage by mass greater than 1 % are identical with those specified in the type testing. For this purpose, one of the 5 submitted samples is used to perform an infrared transmission spectrum according to Annex C. Evidence is demonstrated by comparing the results of the spectral analysis submitted during type testing with the results of the spectral analysis for control testing. When compared, the spectra shall show that the two sets of polymeric materials and/or additives are identical to the polymer materials and additives from type testing.
- d) Performance of one chemical characterization according to Annex B 1 during the validity.

If production is being carried out at multiple production facilities, the following additional requirements shall apply:

- The control test is performed on products from various production facilities. If there are 3 alternative production facilities, then one sample shall be alternately submitted from each production facility for the control test. If there are more than 3 alternative production facilities, then samples shall be submitted on an alternating basis of  $\sqrt{n}$  ( $n$  = number of production facilities) for the control test. The number is rounded up to the next highest integer.
- Samples are to be additionally marked with information regarding the corresponding production facility.

## **7.5 Assessment of Surveillance Tests (Control Test)**

### **7.5.1 General**

The conformity requirements which are tested during verification test have to be fulfilled basically.

### **7.5.2 Deviations**

If deviations from the test reports submitted with the application are established while comparing results from the tested samples, then the customer will be requested to send a written statement. If no positive assessment can be reached on the basis of that position statement, then new samples shall be submitted for testing.

### **7.5.3 Complaints**

If the requirements according to Section 7.5 are not met after the re-test, the validity of the certificate will be suspended. The certificate holder will be informed immediately and requested to ensure compliance with the criteria within 3 months after receipt of such notice.

While the certificate is suspended, the certificate holder is not entitled to sell manufactured items as certified ones.

If a complaint is made, the control test will be repeated within 3 months. If this re-test yields no further cause for complaint, the certificate will be set valid again. Should reason for complaints continue to exist, the certificate will be cancelled. The latest re-test named will not apply as a regular control test, but rather as a special test for which the certificate holder shall cover the costs.

## **A Annex Fillers, Colours and Processing Auxiliaries**

Materials/substances that may be used as additives or components in manufacturing or processing of materials biodegradable in marine environment according to Section 6.2.6.

### **Main Group 1: Fillers**

#### **Subgroup 1.1: Inorganic fillers and pigments**

- Aluminium silicates
- Ammonium carbonate
- Calcium carbonate
- Calcium chloride
- Dolomite
- Iron oxides (pigment)
- Gypsum
- Mica
- Graphite (pigment)
- Kaolin
- Chalk
- Sodium carbonate
- Natural silicates
- Carbon black (pigment)
- Silicon dioxide; quartz
- Talc
- Wollastonite

#### **Subgroup 1.2: Organic fillers**

##### **Section 1.2.1: Non- modified native cellulose**

- Vegetable fibers

##### **Section 1.2.2: Non-modified native Ligno-Cellulose**

- Wood flour/wood fibers
- Vegetable fibers
- Cork
- Bark

##### **Section 1.2.3: Non-modified natural starch**

- Starch
- Rye flour and other flours

**Main Group 2: Processing auxiliaries****Subgroup 2.1: Processing auxiliaries**

- Glycerin/glycerol
- Sorbite
- Xylite

## B Annex Tests

### B 1 Chemical Characterization

#### B 1.1. Regulated Metals and Fluorine

The chemical test is conducted in accordance with Table A.1 of DIN EN 13432. Deviating from this, a maximum fluorine value of 50 ppm and a maximum cobalt value of 38 ppm<sup>3</sup> is defined:

Table 1 – Maximum proportion of metals and fluorine in a marine biodegradable item

Element	mg/kg based on dry matter
Zn	150
Cu	50
Ni	25
Cd	0,5
Pb	50
Hg	0,5
Cr	50
Mo	1
Se	0,75
As	5
Co	38
F	50

#### B 1.2. Organic Fluorine (PFAS)

Poly- and perfluoroalkyl substances (PFAS) shall not be intentionally added to the material, product, intermediate or additive.

#### B 1.3. Other Hazardous Substances

The product, material, intermediate or additive **shall not**

1. be classified as hazardous to the environment according to the UN Globally Harmonized System for Classification and Labelling of Chemicals (GHS)<sup>4</sup>

and

2. be intentionally produced with a hazardous (to the environment) substance
  - meeting criteria of classification according to the UN Globally Harmonized System for Classification and Labelling of Chemicals (GHS)<sup>4</sup> as

carcinogenic (category 1A or 1B) or  
mutagenic (category 1A or 1B) or  
toxic for reproduction (category 1A or 1B), or

- having endocrine disrupting properties<sup>5</sup>, or
- having persistent, bioaccumulative and toxic properties, or

<sup>3</sup> NF T 51-800 standard

<sup>4</sup> GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING (GHS), United Nations (2011)

<sup>5</sup> WHO/IPCS, 2022. Global Assessment of the State-of-the-science of Endocrine Disruptors.

- having very persistent and very bioaccumulative properties, and
- exceeding a concentration limit of 0.1 % (by dry weight) in the manufactured item.

NOTE 1 Safety Data Sheets or other reliable sources such as the website of the European Chemicals Agency (ECHA) which provide comprehensive information about a substance or a mixture, can be used for the identification of hazardous substances fulfilling the above-mentioned criteria.

## B 2 Testing of Intrinsic Biodegradability

Testing of intrinsic biodegradability is conducted in accordance with the criteria of ISO 22403 standard in a temperature range of 15 – 25 °C (not exceeding 28 °C) by one of the following marine biodegradation test method:

- DIN EN ISO 18830      Plastics- Determination of aerobic biodegradation of non-floating plastic materials in a **seawater/sandy sediment** interface - Method by measuring the oxygen demand in closed respirometer
- DIN EN ISO 19679      Plastics – Determination of aerobic biodegradation of non-floating plastic materials in a **seawater/sediment interface** – Method by analysis of evolved carbon
- DIN EN ISO 22404      Plastics – Determination of the aerobic biodegradation of non-floating materials exposed to **marine sediment** – Method by analysis of evolved carbon dioxide
- ASTM D6691            Standard Test Method for Determining Aerobic Biodegradation of Plastic Materials in the Marine Environment by a Defined Microbial Consortium or **Natural Sea Water Inoculum**
- DIN EN ISO 23977-1    Plastics – Determination of the aerobic biodegradation of plastic materials exposed to **seawater** – Part 1: Method by analysis of evolved carbon dioxide
- DIN EN ISO 23977-2    Plastics – Determination of the aerobic biodegradation of plastic materials exposed to **seawater** – Part 2: Method by measuring the oxygen demand in closed respirometer

A biodegradation of 90 % (total or relative to a suitable reference material) is required in order to show intrinsic biodegradation in marine environment. The maximum testing duration is 24 months. The test can be stopped after reaching a plateau phase. Results shall be taken into consideration only if validity criteria of the chosen standard test method are met.

Cellulose (microcrystalline cellulose or cellulose filter paper) shall be used as reference material. If possible, the physical shape and size of the reference material should be comparable to that of the test material.

Virgin polyethylene shall be used as negative control and shall be tested in parallel with test and reference material.

Any pre-treatment of the test samples (e.g. by heat or UV-light) or naturally aging is **not** permitted.

For all organic constituents which are present in the manufactured item at a concentration between 1 % and 15 % (by dry mass) the level of biodegradation shall be determined separately.

Constituents that turned out to be readily biodegradable in a ready biodegradation test according to an OECD test guideline (OECD 301, Methods A to F); OECD 310 or OECD 306 are considered biodegradable in the context of this document.

As an alternative, the level of biodegradation of an organic constituent may be determined using an artificial blend of the same material. This artificial blend shall consist of at least 15 % of the respective organic constituent [by total organic carbon (TOC) content]. The chemical composition and the structure of the material shall remain the same, but the amount of the organic constituent under consideration shall be increased to a minimum of 15 % [by total organic carbon (TOC) content]. The artificial blend shall be produced following the same processing conditions (e.g. extrusion) as used for the production of the original material containing less than 15 % (by dry mass) of the respective constituent. In case the artificial blend meets the criteria specified above, the constituent is considered biodegradable in the context of this document. The constituent can then be used at the same (15 %) or lower concentration (<15 %; by dry mass) in a material that also contains the same co-substrate as the tested material.

### **B 3 Disintegration**

#### **B 3.1 Disintegration Rate under Laboratory Conditions**

The rate of disintegration shall be determined in order to give an indication of the lifetimes of the final product, intermediate or material under optimal conditions in marine environment.

The following method shall be applied:

ISO 23832	Plastics- Test methods for determination of degradation rate and disintegration degree of plastic materials exposed to marine environmental matrices under laboratory conditions
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Three different test methods can be applied:

- buried into a wet sandy marine sediment (method A);
- at the interface between a marine sandy sediment and the water column (method B);
- to seawater (method C).

For a final product the method shall be chosen dependent on the application. E.g. an item which is applied at the surface (for example gillnets) shall be tested according method C, whereas pots and traps applied on the seafloor shall be tested according to method A or B. For materials and intermediates the applicant can choose the respective method. The disintegration rate in combination with the applied method is included in the certificate issued after positive assessment. Testing according to more than one method is permitted.

Temperature during incubation shall be between 15 °C to 25 °C, with maximum seasonal variations within  $\pm 3$  °C from the average temperature. Test temperature may be adapted to the average temperature of seawater.

The testing laboratory shall decide the experimental design, i.e. number of sampling times and replicates based on a sufficient statistical quality. However, at least three replicates shall be tested when determining the degree of disintegration at a given time.

Disintegration rates refer to erosion rate and mechanical properties loss (optional). Products and intermediates shall be tested in the same form as applied in or near the sea. Materials shall be tested with a minimum thickness of 1 mm to 4 mm, ideally in form of "dog bones" according ISO 527-2 (Type 1A or 1B) or ASTM D 638 standard.

The degradation rate of the manufactured item shall be measured as:

- a) erosion - decrease of thickness per unit time (e.g. –  $\mu\text{m}/\text{day}$ ) and
- b) tensile properties decay - decrease of strength at break per unit time (–  $\text{Pa}/\text{day}$ ) (optional)<sup>6</sup>.
- c) area loss per unit time (e.g.  $\text{cm}^2/\text{day}$ ) through photogrammetric analysis (see also Section 6.2.3 of ISO 22766) (for film samples only)

Depending on the test specimen, other methods may also be applicable in consultation with the laboratory (e.g. grammage or dtex loss per unit time for non-wovens or fibers).

Time points for measurement depends on the manufactured item/material and shall be defined by the laboratory case by case. Please note that if samples are re-introduced into the tank the disintegration rate might decrease as the biofilm of microorganisms will be destroyed during drying.

Degradation rates are determined by linear regression of the plot of the measurements (thickness, area loss and if applicable strength at break) referred to the respective sampling time for each sample. Use a suitable spreadsheet for data processing. The regression shall be determined considering a period of at least 6 months with a minimum of 3 measured data points.

### **B 3.2 Disintegration Degree under Real Field Condition (only required for “DINplus Biodegradable in Marine Environment”)**

Disintegration degree under real field conditions shall be determined according to the following test standard:

DIN EN ISO 22766                      Plastics — Determination of the degree of disintegration of plastic materials in marine habitats under real field conditions

This test is performed under natural environmental conditions in two different coastal regions. Concerned habitats are the eulittoral and sublittoral zone.

Disintegration degree is determined after an exposure time of maximum 3 years by sieving through 2 mm mesh sieve (at least 90 % < 2mm) or by means of image analysis (at least 90 % of exposed surface area is lost).

A disintegration degree of 90 % determined by sieving or image analysis is required.

An extrapolation of the disintegration degree beyond the maximum exposure time is not permitted.

### **B 4 Testing of Ecotoxicity**

Testing of ecotoxicity shall be determined according to the following test standard:

ISO/DIS 5430                      Plastics- Marine ecotoxicity testing scheme for soluble decomposition intermediates from biodegradable plastic materials and products used in the marine environment – Test methods and requirements

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<sup>6</sup> Tensile property decay is not taken into account for final disintegration rate, but can be measured to receive more information about disintegration behavior.



The ecotoxicity testing scheme covers marine organisms from four trophic levels, primary producer, primary and secondary consumer and decomposer:

- toxicity to marine algae,
- toxicity to marine invertebrates,
- toxicity to marine fish (optional)<sup>7</sup>
- toxicity to marine microorganisms.

#### **B 4.1 Preparation of Marine Matrices for Ecotoxicity Testing**

For preparation of marine matrices Section 5.1 of ISO/DIS 5430 shall be followed: Laboratory test conditions following ISO standard test method ISO 18830 (or ISO 19679), ISO 22404 or ISO 23977-1 (or ISO 23977-2) are accepted with minimal test concentration as recommended in the relevant standard test method (e.g. at least 25 mg/100 g of sediment for ISO 22404, at least 100 mg/l of seawater plus sediment for ISO 19679). In regard to test duration two options are defined:

Option 1 – limit test (to be used for pure polymers): the marine test samples for ecotoxicity testing may be used for the indicated ecotoxicity tests when the mineralization level reaches 50 %.

Option 2 – time depending test (to be used for blends): the marine test samples for ecotoxicity testing may be used for the indicated ecotoxicity tests when mineralization reaches 20 %, 40 % and a plateau (equal or greater than 60 %).

The preparation of matrices for ecotoxicity tests derived from tests in marine sediment (ISO 22404) shall be done following ISO 5667-16. Conserve the samples at low temperature (approximately 4 °C) until processing. It is recommended that the samples are used for ecotoxicity testing within one week after sampling.

#### **B 4.2 Determination of Ecotoxicological Effects on Marine Algae**

Testing of ecotoxic effects on marine algae is conducted in accordance with Section 5.2 and annex A of ISO/DIS 5430 by the following test method:

- DIN EN ISO 10253      Water quality - Marine algal growth inhibition test with *Skeletonema sp.* and *Phaeodactylum tricorutum*

Marine unicellular algae are exposed to marine matrices and the increase in cell number or in biomass of the algae is determined after 72 h.

The percentage inhibition in a test sample ( $I_{\mu ts}$ ) shall be  $\leq 10$  % of those from the control sample for both algae *Skeletonema sp.* and *Phaeodactylum tricorutum*.

#### **B 4.3 Determination of Ecotoxic Effects to the Marine Invertebrates (marine copepods)**

Testing of ecotoxic effects on marine invertebrates (marine copepods) is conducted in accordance with Section 5.3 and annex B of ISO/DIS 5430 by the following test method:

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<sup>7</sup> Due to animal welfare and amount of required inoculum this test will not be considered in this scheme.

- ISO 14669 Water quality - Determination of acute lethal toxicity to marine copepods (Copepoda, Crustacea)

Marine copepod *Acartia tonsa* is exposed to marine matrices and the surviving copepods are determined after 48 h incubation.

The mortality/immobilisation in the test sample shall be  $\leq 10\%$  of those from the control sample.

#### **B 4.4 Determination of Ecotoxic Effects on Marine Microorganisms (*Vibrio fischeri*)**

Testing of ecotoxic effects on marine microorganisms is conducted in accordance with Section 5.4 and annex C of ISO/DIS 5430 by the following test method:

- DIN EN ISO 11348-3 Water quality - Determination of the inhibitory effect of water samples on the light emission of *Vibrio fischeri* (Luminescent bacteria test) - Part 3: Method using freeze-dried bacteria

Alternatively, one of the following methods can be applied:

- DIN EN ISO 11348-1 Water quality - Determination of the inhibitory effect of water samples on the light emission of *Vibrio fischeri* (Luminescent bacteria test) - Part 1: Method using freshly prepared bacteria
- DIN EN ISO 11348-2 Water quality - Determination of the inhibitory effect of water samples on the light emission of *Vibrio fischeri* (Luminescent bacteria test) - Part 2: Method using liquid-dried bacteria

The bioluminescence in the test sample shall be  $\geq 90\%$  of those from the control sample.

#### **C Infrared Transmission Spectrum**

The spectrum should be recorded in a range between the wave lengths  $4000\text{ cm}^{-1}$  and  $400\text{ cm}^{-1}$ , and a transmission level from 0-100 % being indicated on the vertical axis.