

ICS 13.030.50; 83.080.01

**Klassifizierung von Kunststoff-Rezyklaten durch Datenqualitätslevels für
die Verwendung und den (internetbasierten) Handel;
Text Englisch**

Classification of recycled plastics by Data Quality Levels for use and (digital) trading;
Text in English

Classification des plastiques recyclés par niveaux de qualité des données pour l'utilisation et le
commerce (digital);
Texte en anglais

Gesamtumfang 37 Seiten

Dieses Dokument wurde durch die im Vorwort genannten Verfasser erarbeitet und verabschiedet.

Contents

	Page
Foreword	4
Introduction.....	6
1 Scope	7
2 Normative references	7
3 Terms and definitions.....	7
4 Symbols and abbreviations.....	12
5 Data Quality Levels (DQL) for recyclates	12
5.1 General	12
5.2 Introduction of the Data Quality Levels (DQL)	13
5.3 Application-specific DQL.....	13
5.4 Further explanation for optional characteristics	14
5.4.1 Filler content.....	14
5.4.2 Content of contaminants in the plastic waste feedstock for recycling.....	14
5.4.3 Additives	14
5.4.4 Further details recycling process	14
5.4.5 Traceability.....	14
5.4.6 Recyclability	14
5.4.7 CO ₂ equivalents	14
5.5 Sampling and sample preparation	14
5.5.1 General	14
5.5.2 Minimum requirements for sampling and sample preparation	15
5.6 Determination of the property tolerances	15
6 Identification of recycled content.....	15
6.1 Labelling.....	15
6.2 Determination of recycled content	17
6.3 Technical documentation: Product Data Sheet (PDS).....	20
Annex A (normative) Requirements for the individual DQLs	22
Annex B (informative) Examples for technical documentation (PDS).....	25
B.1 Example for a Product Data Sheet (DQL: 1)	25
B.2 Example for a Product Data Sheet (DQL: 2)	25
B.3 Example for a Product Data Sheet (DQL: 3)	26
B.4 Example for a Product Data Sheet (DQL: 4), incl. optional characteristics	28
B.5 Example for further information to provide	30
Annex C (informative) Guidance for the characterization of plastic waste as feedstock for plastics recycling	31
C.1 Recommended characteristics of plastic waste feedstock for recycling.....	31
C.2 Additional characteristics of plastic waste feedstock for recycling.....	31
C.3 Sampling for the determination of properties of plastic waste as feedstock for recycling.....	32
Bibliography	34

Figures

Figure 1 — Illustration of terms (based on a figure drafted by IKK)	8
Figure 2 — Label.....	16

Tables

Table 1 — DQLs per required information, properties and optional characteristics.....	13
Table 2 — Label description.....	17
Table 3 — Calculation table for example 1	18
Table 4 — Calculation table for example 2	18
Table 5 — Calculation table for example 3	19
Table 6 — Calculation table for example 4	20
Table 7 — Calculation table for example 5	20
Table 8 — Material status information (optional).....	21
Table A.1 — Information (I)	22
Table A.2 — Properties (P)	23
Table A.3 — Optional characteristics (O).....	23
Table B.1 — Material status.....	25
Table B.2 — Material status.....	26
Table B.3 — Typical properties.....	26
Table B.4 — Material status.....	27
Table B.5 — Typical properties.....	27
Table B.6 — Material status.....	28
Table B.7 — Typical properties.....	29
Table C.1 — Waste Characterization Sheet.....	32

Foreword

This DIN SPEC has been developed according to the PAS procedure. The development of a DIN SPEC according to the PAS procedure is carried out in DIN SPEC (PAS)-consortiums and does not require the participation of all stakeholders.

This document has been developed and adopted by the initiator(s) and authors named below:

- cirplus GmbH (Initiator)
Christian Schiller
- IKK - Institut für Kunststoff- und Kreislauftechnik, Leibniz Universität Hannover (Consortium Lead)
Prof. Dr. Hans-Josef Endres, Dr. Madina Shamsuyeva
- BDE Bundesverband der Deutschen Entsorgungs-, Wasser- und Rohstoffwirtschaft e. V.
Dr. Andreas Bruckschen
- Der Grüne Punkt — Duales System Deutschland GmbH
Dr. Ina-Maria Becker
- Greiner Packaging GmbH
Stephan Laske
- Institut für Kunststoffverarbeitung (IKV) in Industrie und Handwerk an der RWTH Aachen
Elena Berg
- KraussMaffei Technologies GmbH
Josef Art
- Kunststoff-Institut Lüdenscheid
Martin Doedt, Jörg Guenther
- MKV GmbH Kunststoffgranulate
Rainer Zies
- MRS Materialis Recycling Solutions GmbH
Dirk Mellen
- POLIFILM EXTRUSION GmbH
Dr. Gottfried Weyhe
- REMONDIS Recycling GmbH & Co. KG
Monica Harting Pfeifer
- SKZ — Testing GmbH
Dr. Bernhard Ulmer
- STEINERT GmbH
Naemi Denz
- TOMRA Sorting GmbH
Dr. Harald Lehmann
- VDMA Verband Deutscher Maschinen- und Anlagenbau e. V.
Sören Grumptmann, Harry Reichert

At present, there are no standards covering this topic in the body of German Standards.

DIN SPECs are not part of the body of German Standards.

A draft of this DIN SPEC has been published.

Despite great efforts to ensure the accuracy, reliability and precision of technical and non-technical information, the DIN SPEC (PAS)-consortium cannot give any explicit or implicit assurance or warranty in respect of the accuracy of the document. Users of this document are hereby made aware that the consortium cannot be held liable for any damage or loss. The application of this DIN SPEC does not release users from the responsibility for their own actions and is applied at their own risk.

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

Provision of this document free of charge as a PDF via the Beuth WebShop has been financed in advance.

For current information on this standard, please go to DIN's website (<https://www.din.de>) and search for the document number in question.

Introduction

With 15 million tons of plastic waste entering the oceans every year [1], rampant plastic pollution has found its way on the international agenda of regulators and standardization bodies. At the same time, global plastic production is on a steep growth trajectory, from 400 million tons annual production in 2019 to 1 600 million tons by 2050 [2]. By 2040, the amount of mismanaged plastic waste is already projected to have reached 239 million tons (56 % of global plastic waste), combining terrestrial and ocean leakage and open burning [3] — with devastating and yet poorly understood consequences for life on the planet.

Plastics are, however, an indispensable material in every stretch of life — be that for packaging to prevent food waste, light-weight automotive construction, renewable energy or medical appliances. The poor performance in terms of reuse and recycling are tied to a fundamental dysfunctionality of plastics markets: high-quality recyclates are on average more expensive than virgin material.

Two core reasons for this current price differential are the lack of recognized standards for recyclates and the lack of digitization in the industry, making it hard to provide transparency and track the material through its life-cycle. Only with better classification of recyclates based on data depth can commodification of recyclates be achieved — spurring further investments and driving more consistent demand towards recyclates. This will allow for plastic waste to be recycled on the broadest scale possible and thus closing the loop for plastics. Such is the ambition for a truly circular economy of plastics.

Against this backdrop, the consortium of DIN SPEC 91446 has been assembled to address the lack of consistent data quality for recyclates. The classification of recyclates according to Data Quality Levels (DQL) will provide the market with a common language and remove obstacles for the industrial uptake of recyclates — both from a quantitative and qualitative point of view. It also establishes a methodology for identification and labelling of recyclates and provides guidance on consistent specification of plastic waste.

By doing so, this document will increase the acceptance of recyclates and enable them to compete with virgin plastic on equal footing — if not become the go-to material in all plastic applications wherever possible. In combination with the dissemination power of digital solutions, such as platforms, blockchain applications and machine-learning, this document paves the way for a paradigm shift towards a truly circular plastic industry, catalyzed through standardization and digitization.

This document is codified as an umbrella standard, i.e. separate standards with even greater level of granularity (for example for specific plastic materials or applications) are possible, provided that they follow the methodology of classification established in this umbrella standard.

For some specific polymer types, delivery condition characteristics for recyclates are specified in DIN EN 15342, DIN EN 15344, DIN EN 15345, DIN EN 15346 and DIN EN 15348. A general characterization of plastic waste is laid down in DIN EN 15347.

1 Scope

This document defines a system for the classification of recycled plastics based on the available data depth (Data Quality Levels, DQL) and provides guidelines for the labelling of the recyclate type and recycled content in compounds. This document also gives guidance for the characterization of plastic waste as feedstock material for recycling.

It is intended to support parties involved in the use and trading of recycled plastics and plastic waste as feedstock material for recycling, explicitly including digital trading platforms.

2 Normative references

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

DIN CEN/TS 16010, *Plastics — Recycled plastics — Sampling procedures for testing plastics waste and recyclates*

DIN CEN/TS 16011, *Plastics — Recycled plastics — Sample preparation*

DIN EN 15343:2008-02, *Plastics — Recycled Plastics — Plastics recycling traceability and assessment of conformity and recycled content; German version EN 15343:2007*

DIN EN ISO 472:2013-06, *Plastics — Vocabulary (ISO 472:2013); Trilingual version EN ISO 472:2013*

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

DIN EN ISO 1043-2, *Plastics — Symbols and abbreviated terms — Part 2: Fillers and reinforcing materials*

DIN EN ISO 9001:2015-11, *Quality management systems — Requirements (ISO 9001:2015); German and English version EN ISO 9001:2015*

DIN EN ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in DIN EN ISO 472:2013-06 and the following terms apply.

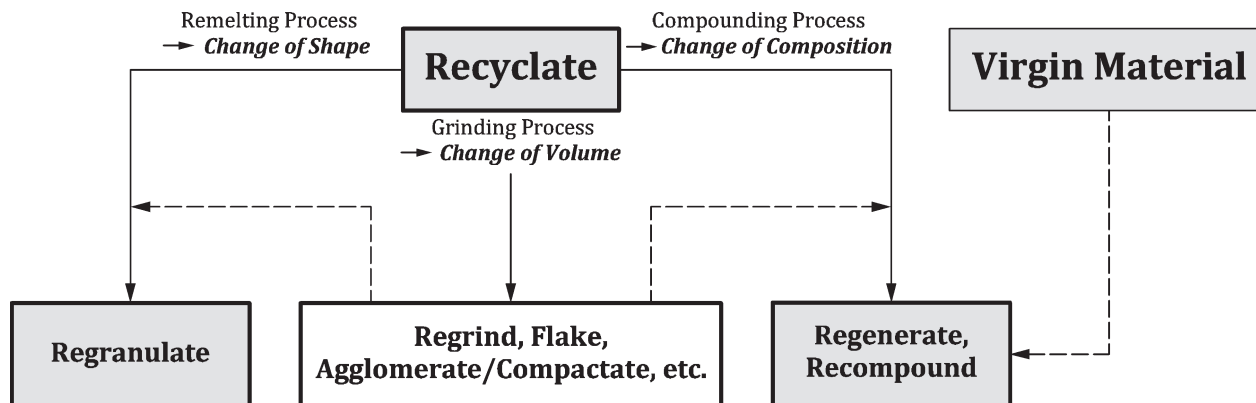
DIN and DKE maintain terminological databases for use in standardization at the following addresses:

- DIN-TERMinologieportal: available at <https://www.din.de/go/din-term>
- DKE-IEV: available at <http://www.dke.de/DKE-IEV>

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

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

In order to illustrate the relationships between the terms given below, Figure 1 was added.



NOTE References to this figure are made in the relevant definitions below.

Figure 1 — Illustration of terms (based on a figure drafted by IKK)

3.1 additives

substances which are used to process or to modify end use properties of plastics

Note 1 to entry: Mentioned substances are normally included in carrier matrix.

Note 2 to entry: Mentioned final use properties are e.g. rigidity, flexibility, color etc.

[SOURCE: E DIN EN 17615:2020-11, 3.4]

3.2 agglomerate compactate

larger particles formed by joining or binding together of smaller particles whose original identity can still be visible in the final form

Note 1 to entry: See also Figure 1.

[SOURCE: E DIN EN 17615:2020-11, 3.6, modified — “compactate” was added as alternative term, Note 1 to entry was replaced by a new Note 1 to entry.]

3.3 characteristic property (3.16) of or information (3.9) about a material

3.4 compound

intimate mixture of a polymer or polymers in melt with other ingredients such as fillers, plasticizers, catalysts and colorants

[SOURCE: DIN EN ISO 472:2013-06, 2.184, modified — “in melt” was added.]

3.5**contaminant**

unwanted substance or material

Note 1 to entry: The term “impurity” is a deprecated synonym of “contaminant”.

[SOURCE: DIN EN ISO 472:2013-06, 2.1684]

3.6**Data Quality Level****DQL**

specific combination of *characteristics* (3.3) about the material

Note 1 to entry: Every DQL is defined by the amount of minimum material *characteristics* (3.3) (e.g. information and/or properties, application-specific characteristics) as specified in Annex A. For a PDS in DQL 1, it is required to provide *information* (see 3.9) only. No *properties* (see 3.16) need to be added to the PDS.

Note 2 to entry: DQLs are documented in form of a technical documentation [Product Data Sheet (PDS)].

3.7**filler**

relatively inert solid material added to a plastic or to an adhesive to modify its strength, permanence, working properties or other qualities, or to lower costs

Note 1 to entry: Fillers are for example glass fibres, carbon fibres, natural fibres, talcum, and chalk.

[SOURCE: DIN EN ISO 472:2013-06, 2.369, modified — Notes 1 and 2 to entry were removed and a new Note 1 to entry was added.]

3.8**flake**

plate-like regrind

Note 1 to entry: The shape of regrind depends both on the plastics being processed and the manner of processing.

Note 2 to entry: See also Figure 1.

[SOURCE: ISO 15270:2008, 3.15, modified — Note 2 to entry added.]

3.9**information**

material characteristic that has not been validated using a scientific measurement method

Note 1 to entry: For the purpose of this document, a *characteristic* (3.3) of the material that has been validated via a scientific measurement method is considered as a *property* (3.16).

3.10**lot**

definite quantity of some commodity manufactured or produced under conditions that are presumed uniform

Note 1 to entry: The term “batch” and in German the term “Charge” are sometimes used synonymously.

[SOURCE: DIN EN ISO 472:2013-06, 2.560, modified — Note 1 to entry added.]

3.11

mixed collection

co-mingled collection

post-consumer waste collected with a lower degree of selection in regard to the type or original use of the material

EXAMPLE Dual systems such as the German yellow bin, mixed municipal waste, mixed construction waste, mixed waste from commercial/industrial sites.

Note 1 to entry: Type of material refers to different polymer types.

Note 2 to entry: A low degree of selection means that the waste requires additional treatment steps before the material is recycled.

Note 3 to entry: The legal nature of the waste producer/waste owner (e. g. household, municipality, commercial entity) is no relevant criterion for the distinction between mixed collection and *selective collection* (3.22).

3.12

original use of material

intended and/or realized use-case of the material

Note 1 to entry: "Original use of material" does not indicate the waste stream from which the material stems. For this, see *post-consumer* (3.13) and *post-industrial* (3.14) respectively.

Note 2 to entry: Examples for "original use of material": stretch foil for packaging industry; rigid packaging for cosmetics industry.

3.13

post-consumer

generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose, including returns of material from the distribution chain

[SOURCE: DIN EN ISO 14021:2021-10, 7.8.1.1, a) 2], modified — adapted to fit style rules]

3.14

post-industrial

pre-consumer

diverted during a manufacturing process

Note 1 to entry: This term excludes re-utilized material that has been generated in a given process and is capable of being reclaimed within that same process (for example in the form of rework, regrind or scrap).

[SOURCE: DIN EN ISO 472:2013-06, 2.1701, modified — the term was changed to read "post-industrial", "pre-consumer" was kept as alternative term, "descriptive term covering material" was deleted, , in Note 1 to entry "such as rework, regrind or scrap" was replaced by expression in brackets, Note 2 to entry was deleted.]

3.15

Product Data Sheet

PDS

overview that provides basic and – depending on DQL level – additional information about the material, the source and the recycling process as well as, in addition, data as guide values that are based on a certain number of single measurements

Note 1 to entry: Due to the fundamentally different content, it is no Material Safety Data Sheet (MSDS), e.g., based on EC1907/2006 or any other legal requirement.

Note 2 to entry: The division into *mixed* (or *co-mingled*) (3.11)/*selective collection* (3.22) should be integrated in the PDS.

3.16**property**

material characteristic that has been determined using a scientific measurement method

Note 1 to entry: For the purpose of this document, a *characteristic* (3.3) of the material that has not been validated via a scientific measurement method is considered as *information* (3.9).

3.17**recyclate**

plastics material resulting from the recycling of plastics waste

Note 1 to entry: The terms “secondary raw material” and “recycled plastics” are sometimes used synonymously with “recyclate”.

Note 2 to entry: As soon as the used plastics material is treated, for example at a recycler’s facility, in such a way that it is ready to replace virgin product, material or substance in a production process, it loses its characteristics as waste.

Note 3 to entry: See also Figure 1.

Note 4 to entry: Recyclates generated from post-industrial waste is called post-industrial recyclate (PIR), recyclates generated from post-consumer waste is called post-consumer recyclate (PCR).

[SOURCE: DIN EN ISO 472:2013-06, 2.1705, modified — In Note 1 to entry: “and regenerate” was deleted, in Note 2 to entry „for example at a recycler’s facility“ was added; Notes 3 and 4 to entry were added.]

3.18**recycled content**

proportion, by mass, of recycled material in compounds or a product

Note 1 to entry: Only recycled post-industrial and recycled post-consumer materials shall be considered as recycled content.

[SOURCE: DIN EN ISO 14021:2021-10, 7.8.1.1, a), modified — Adapted to fit style rules, “in a product or packaging” was replaced by “in compounds or a product”, in Note 1 to entry “pre-consumer” was replaced by “recycled post-industrial”, “recycled” was added before “post-consumer”.]

3.19**regenerate****recompound**

plastic recyclate obtained by a melting process (compounding) with changing the material composition

Note 1 to entry: See also Figure 1.

3.20**regranulate**

plastic recyclate obtained from regrind, semi-finished textile components or film without significantly changing the material composition via a melting process as granulate

Note 1 to entry: See also Figure 1.

3.21**regrind**

shredded and/or grinded recovered plastics material in the form of a free-flowing material recovered from plastics that were produced during a previous manufacturing process

Note 1 to entry: Regrind should only include shredded material and should not include re-granulated material.

Note 2 to entry: See also Figure 1.

[SOURCE: E DIN EN 17615:2020-11, 3.221, modified — “and/or grinded recovered” was added, Note 2 to entry added.]

3.22

selective collection

post-consumer waste collected with a higher degree of selection in regard to the type and original use of the material

EXAMPLE Deposit Return Scheme (Pfand), selective industrial packaging, waste from commercial sites as long as it is selectively collected.

Note 1 to entry: "Selective collection" and "segregation" or "separate collection" are sometimes used as synonyms.

Note 2 to entry: Type of material refers to different polymer types.

Note 3 to entry: A high degree of selection means that the waste does not require less additional treatment steps before the material is recycled.

Note 4 to entry: The legal nature of the waste producer/waste owner (e.g. household, municipality, commercial entity) is no relevant criterion for the distinction between *mixed collection* (3.11) and selective collection.

4 Symbols and abbreviations

C	characteristic
COA	certificate of analysis
DQL	Data Quality Level
DSC	differential scanning calorimetry
FTIR	Fourier-transform infrared spectroscopy
I	information
LCA	life cycle analysis
MC	mixed collection
MFR	melt flow rate
MVR	melt volume rate
O	optional characteristic
P	property
PCR	post-consumer recyclate
PDS	Product Data Sheet
PIR	post-industrial recyclate
SC	selective collection
SVHC	substances of very high concern

5 Data Quality Levels (DQL) for recyclates

5.1 General

In order to better match supply, increase uptake of plastic recyclates of all applications and increase demand in the area of plastic recyclates, this section defines a system for classifying recycled plastics based on the available data depth ("Data Quality Level", DQL). This system consists of information (I), properties (P) and optional characteristics (O).

The quantity of characteristics [information (I) and properties (P)] given for the recyclate defines the DQL. The DQLs are not defined by rigid values or tolerances for characteristics.