



Recycled Content Materials Assessment Methodology

DRAFT

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REVISION LOG

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
May 2017	All	Information outlining the assessment of recycled content in the <i>Cradle to Cradle Certified Product Standard Version 3.0</i> , and the <i>Cradle to Cradle Certified Product Standard Material Health Assessment Methodology, Version 3.0</i> , both dated November 4, 2013, has been clarified and merged into this document so that all relevant information related to assigning material assessment ratings to these types of materials is located in one supplemental document. Note that the section numbers between the v3.0 document and this document do not correspond. Section numbers listed to the left within the SECTIONS column of this table are for this document.	S. Klosterhaus
May 2017	2.3 Recycled Content Types	Added clarification that Type 4 recycled content may only be certified up through the Bronze level.	S. Klosterhaus
August 2020	All	The <i>Recycled Content Assessment Methodology</i> document last revised in May 2017 has been superseded by the document revised in August 2020. A summary of the changes made as part of this revision are listed below (i.e. the changes with a revision date of August 2020).	S. Klosterhaus
August 2020	2. Assessment of Recycled Content	The four types of recycled content materials (“Type 1-4”) are no longer defined or referred to.	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
August 2020	2. Assessment of Recycled Content	<p>The recycled content materials that may be assessed via the standard Material Health Assessment Methodology are the same except for the following, which must now be assessed via the new process described:</p> <ul style="list-style-type: none"> • “Type 3” post-consumer materials (i.e. material from a clean narrow stream of one material type), and • Treated post-consumer paper (i.e. paper made with recycled paper inputs) 	S. Klosterhaus
August 2020	2. Assessment of Recycled Content	<p>Analytical testing requirements for the entry-level of certification (i.e. Basic in v3.1 or Bronze in the second draft of v4) and the Silver level are newly defined for several commonly recycled material types. The testing requirements are based on the Cradle to Cradle Certified Restricted Substances List (RSL) which is primarily based on REACH Annex XVII and XIV (the Restriction and Authorisation lists) and the REACH Candidate List of Substances of Very High Concern for Authorisation.</p>	S. Klosterhaus
August 2020	2. Assessment of Recycled Content	<p>Approaches for reducing the amount of testing that must be done at the Silver level are described, and a process for defining testing requirements for additional recycled content material types is provided.</p>	S. Klosterhaus

REVISION DATE	SECTION(S)	TYPE OF CHANGE	AUTHORIZED BY
August 2020	2. Assessment of Recycled Content	<p>ABC-X assessment ratings are no longer defined or used for recycled materials unless the materials can be fully defined and assessed using the standard Material Health Assessment Methodology. Instead, the new methodology described herein defines the minimum requirements that have to be met for recycled content materials for each of the Material Health achievement levels. The allowable achievement level must be indicated instead of an ABC-X rating. Recycled content materials meeting the requirements at a given level may then count as assessed on their own or within another product certified at that level.</p>	S. Klosterhaus

1 OVERVIEW

1.1 Purpose and Content

This document describes the methodology used to assess recycled content materials for the purposes of Cradle to Cradle certification. Due to the often variable and unknown composition of these materials, analytical testing is required. Recycled content materials in products being assessed for Cradle to Cradle certification are therefore assessed following this customized methodology, rather than the general Material Health Assessment Methodology alone.

This methodology is required to be used for the assessment of recycled content materials in products certifying against Version 4 (and subsequent versions) of the Cradle to Cradle Certified™ Product Standard, including drafts of Version 4 as part of the Version 4 Pilot Program.

1.2 Supporting Documents

The following documents are to be used in conjunction with this document:

- Cradle to Cradle Certified™ Product Standard, Version 4 (draft and final versions)
- Cradle to Cradle Certified™ Product Standard, Version 3.1 (optional)
- Cradle to Cradle Certified™ Material Health Assessment Methodology and Exposure Assessment Methodology
- Any additional supporting documents and guidance posted on the Cradle to Cradle Products Innovation Institute (C2CPII) website

Visit the C2CPII website (c2ccertified.org) to download the standard documents and obtain the most current information regarding the product Standard.

2 ASSESSMENT OF RECYCLED CONTENT MATERIALS

2.1 Scope

This methodology applies to all recycled content materials from post-consumer and post-industrial sources, with several exceptions. The exceptions are for the following materials, which may be fully defined and therefore are to be assessed via the general Material Health Assessment Methodology:

- Metals of known alloy grade,
- Glass for which elemental analysis has been carried out¹,
- Chemically recycled polymers,
- Other post-industrial or post-consumer recycled materials that can be traced back to the original manufacturer(s)/formulator(s), for which the trade name is known and full material disclosure has been obtained.

For chemically recycled polymers and recycled materials that can be traced back to the original manufacturers (third and fourth bullet points above), the relevant manufacturer(s) must provide a description of the collection and recycling process, including controls on contamination that are in place. The assessor is responsible for ensuring that the material is not at risk of being contaminated and/or that it is cleaned to remove possible contaminants if it is to be assessed per the general Material Health Assessment Methodology. If contamination is a concern, for example if post-industrial material is mixed with other items on the manufacturing floor and then swept up to be mechanically recycled, use of the general Material Health Assessment Methodology alone is not permitted. Note that it is rarely possible to assess post-consumer recycled materials from mixed or multiple sources per the general Material Health Assessment Methodology.

2.2 Requirements for Recycled Content Materials by Achievement Level

Table 1 below provides an overview of the requirements for recycled content materials at each achievement level. See Sections 2.3-2.6 for additional details.

Materials meeting these requirements may be certified, or count as assessed when used in certified products, at the level indicated. Basic level requirements must be met in all cases, even when the material will not count as assessed. At higher achievement levels, all lower level requirements must also be met in order for the recycled content material to count as assessed.

Table 1 - Minimum requirements for recycled content materials by achievement level

Level	Minimum Requirements
Basic (Also applicable to second draft v4 Bronze level and above)	<ul style="list-style-type: none"> ● RSL compliance for intentionally used substances and known contaminants² is verified via RSL attestations signed by the material supplier(s). ● Compliance with restrictions on toxic elements as indicated in the RSL is verified via analytical testing. (Note: Testing for an expanded list of elements is required for biological nutrient (BN) materials). ● Compliance with the organohalogen restriction is verified via analytical testing.

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¹ Does not apply to mixed crushed glass. The glass must be reprocessed and uniform in nature.

² Note: “Intentionally used substances and known contaminants” are defined in Section 2.5, Assessment of Intentionally Used Substances and Known Contaminants.

Bronze	<ul style="list-style-type: none"> ● If the material is to count as assessed at the Bronze level, all intentionally used substances and known contaminants, including residual monomers and catalysts of the recycled content in the case of polymers, have been identified by chemical name and CASRN and assessed using the general Material Health Assessment Methodology.
Silver	<ul style="list-style-type: none"> ● Compliance with the RSL is verified via analytical testing (as relevant to the material type) and full material disclosure of all intentionally used substances and known contaminants. ● Analytical testing for substances on the Candidate List of Substances of Very High Concern (SVHC) for Authorisation has been conducted (as relevant to the material type). ● The material does not contain chemicals classified or listed as carcinogenic, mutagenic, or reproductive toxicants (CMRs) or of equivalent concern, or, if these substances are present, exposure to them is unlikely or expected to be negligible. In addition, the product does not contain persistent, bioaccumulative, and toxic (PBTs) or very persistent and very bioaccumulative (vPvBs) substances. CMRs, PBT/vPvBs, and substances of equivalent concern are as defined in the draft version 4 standard Section 4.5, and compliance must be verified via analytical testing and/or full material disclosure of intentionally used substances and known contaminants. <p>Notes:</p> <ul style="list-style-type: none"> ● If the material will not count as assessed, there are no additional requirements at the Silver level beyond those listed for the Basic level. ● Depending on the product type, the Silver level VOC requirements must have been met for the entire product when applying at the Silver level (see Sections 4.9 and 4.10 of the draft Cradle to Cradle Certified Product Standard, Version 4 for details). ● For substances listed on the SVHC Candidate List for Authorisation that are not PBTs or vPvBs and not on Annex XIV (and so also not on the RSL), an exposure assessment may be conducted regardless of the concentration in the material. For most substances listed on the RSL, an exposure assessment is allowed when the concentration in the material is below the maximum allowable concentration indicated in the RSL. See the Cradle to Cradle Certified Exposure Assessment Methodology for further information.
Gold & Platinum	<ul style="list-style-type: none"> ● All intentionally used substances and known contaminants subject to review in the material (including those identified through analytical testing) are a, b, or c assessed. ● Recycled material used for food contact applications or in toys or other children’s products (when available for mouthing to occur) must be food grade

	per the regulations relevant to where the product is sold ³ and meet all other requirements (regardless of the certification level for the product overall).
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2.3 Analytical Testing Requirements

2.3.1 Analytes and Maximum Allowable Concentrations by Material Type

For all recycled content materials that cannot be defined and assessed per the general Material Health Assessment Methodology, the following are required:

- For all achievement levels:
 - Analytical testing for the toxic metals and metalloids listed on the RSL core list is required for all material types. Additional elements included on the RSL biological nutrient (BN) supplementary list must be tested for in BN recycled content materials (this is required for any metals, metalloids with a maximum allowable concentration ≤ 1000 ppm, and also for selenium). The maximum allowable concentrations indicated on the RSL apply.
 - In addition, analytical testing is required to ensure compliance with the organohalogen restriction for all non-exempt recycled materials except glass and metals (see Section 4.4 of the draft Cradle to Cradle Certified Product Standard, Version 4 for additional exemptions to the organohalogen restriction).
- For the Silver level and above:
 - Analytical testing for additional substances on the RSL and the REACH Candidate List of Substances of Very High Concern for Authorisation is required. Substances to be tested vary by material type because certain material types are very unlikely to contain some of the listed substances. Analytes that must be tested have been predefined for several common recycled material types including: Metals (alloy/grade unknown), glass (without full elemental analysis), paper, polymers, wood (mixed waste and clean), and textiles. ***The current draft list of analytes is provided to assessors upon request and will be published on the C2CPII website once version 4 finalized.*** The maximum allowable concentrations

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³ Food contact regulations that are pre-approved for the purposes of this requirement are those that are in place in the EU, UK, US and Japan. If applying to use recycled content material that is approved for food contact in other countries, the regulations relevant to that country must be reviewed by the assessor to ensure that they are equivalent to one or more of those that are pre-approved. If these regulations are found to be less stringent, or there is evidence that enforcement is lax, then the recycled content material may not be used in Cradle to Cradle Certified food contact or children's products.

indicated on the RSL apply. The assessor may provide rationales for reducing the list of analytes in some cases as described in the next section.

NOTE: If the applicant and/or assessor are aware of additional substances of concern (i.e. substances that would normally result in an x-assessment per the general Material Health Assessment Methodology) that are highly likely to be present in the material type under consideration, C2CPII must be informed and these substances must be added to the list of analytes for which testing must be conducted.

2.3.2 Analyte List Development & Process for Potential Reduction of Analytical Testing Requirements

In general, the lists of required analytes by material type were created by considering the current and prior uses of the listed chemicals as detailed by the relevant REACH dossiers and the United States National Library of Medicine's Hazardous Substance Data Bank (now merged with PubChem). Where a chemical is not used or has not previously been used in the given application per these references, it was not included as an analyte for the material type. Cleanliness of the recycling stream and/or a high likelihood of removal during processing due to process conditions were considered in some cases in order to remove analytes from the lists.

The analyte lists that are required for each material type were created as described below. The list of analytes to test for may be reduced on a case-by-case basis, pending pre-approval by C2CPII. In all cases, the assessor must provide their rationale for removal of any analyte from the lists. Examples of approaches that may be used when developing a rationale for reducing the lists are also provided below.

- Metals and glass: Due to the high processing temperatures and the inherent characteristics of these material types, there is a high likelihood that the majority of RSL chemicals (i.e. all organic compounds) will be removed during secondary processing of these materials. Therefore, only the toxic metals are included on these lists.
- Paper: Chemicals known to be used in paper manufacturing and processing and chemicals that have been used in adhesives and colorants are on this list. The list has been pared down by removing chemicals with high water solubilities (high was defined as water solubility >1000 mg/L) due to the water-based processing that occurs in re-pulping operations. It is assumed that chemicals with high water solubility will not be present in the finished recycled content material (although they could be present in effluent).

- Polymers: The current list for polymers is extensive and includes all substances that have been used in polymers or polymer processing. Examples of how the polymer-relevant list of analytes may be reduced are provided below.
 - In cases where the sorting process fully removes some polymer types from the input stream, the assessor may review prior and current uses of the listed target analytes and remove substances from the list that have been used exclusively in the polymer type(s) that are eliminated by the recycling process. Information must be provided that describes the sorting process and how the applicant ensures that polymers of other types are fully removed during the process. An indication of prior use and references supporting the conclusion that the analyte is not expected in the polymer type under consideration must be provided. For example, some polymers may be separated from others based on their density and/or near-infrared reflectance properties.
 - In cases where the polymer is thoroughly washed in water during processing, analytes with high water solubility that are also not expected to be partially or fully bound within the polymer matrix (thereby reducing the likelihood of removal during washing), may be removed from the list.
 - In cases where a thermal cleaning treatment is employed, analytes with boiling points well below the thermal treatment temperature may be removed from the list.

- Wood (mixed post-consumer): This list includes chemicals that could be present in wood preservatives, paints and stains, flame retardants, agricultural use pesticides, etc. It would most likely be difficult to shorten this list in the case of a mixed wood stream (e.g. sourced from construction and demolition waste streams and including painted and stained wood). This type of wood most likely could not be used past the Bronze level, if at all.

- Wood (clean): This list does not include wood preservatives, flame retardants, or any chemicals that could be present in paints or stains. If using this list as a starting point, the assessor must provide a description of the material source and explanation of how it is ensured that only clean untreated wood is part of the material input stream. Pesticides are included on this list. For post-industrial clean wood waste, a pesticide may be removed from the list if it is not expected to be present based on consideration of wood source, age, and potential for use of the pesticide(s) in the region during this time frame. For example, if the wood is known to be sourced only from certain regions of the EU, and a listed pesticide was banned in that region prior to original harvesting, that pesticide does not have to be tested for.

- Textiles: This list may not be reduced for textiles used in apparel or other prolonged or permanent skin contact applications. For textiles that are not used in prolonged skin contact applications, the assessor may use the same types of considerations indicated for paper and wood to reduce the list of analytes. Prolonged is defined as cases where cumulative, single, multiple or repeated long-term use or contact is likely to exceed 24 hours⁴, per ISO 10993⁵.

In addition to the various approaches and considerations described above that may be used to reduce the list of analytes, the assessor may also complete an exposure assessment per the most recent version of the Cradle to Cradle Certified Exposure Assessment Methodology prior to testing. If exposure is not plausible for specific analytes given their known properties and the way in which the product is manufactured, used, cycled, and disposed, then testing for those analytes is not required.

2.3.3 Analytical Testing Methods and Laboratory Accreditation

- For REACH Annex XVII substances, the methods indicated in ECHA's '[Compendium of Analytical Methods Recommended by the Forum to check compliance with REACH annex XVII restrictions](#)' (most recent version) must be employed.
- For all other substances, the appropriate analytical methods to use must be determined by the selected laboratory.
- For the organohalogen testing requirement, a general screening test may be employed. For example, oxygen bomb combustion sample preparation followed by ion chromatography to identify the concentrations of organic (and inorganic) bromine, chlorine, and fluorine may be used. If the elemental concentration of each halogen is less than 100 ppm in the finished homogeneous material, further analytical testing in support of counting the recycled content material as assessed at the Silver level or above in Material Health is not required for the majority of individual halogenated substances (see current list of analytes for details). In these cases, a supplier declaration will be accepted as evidence that the restrictions on individual halogenated substances with RSL thresholds below 100 ppm have been met.
- Sampling must be carried out based on a predefined sampling plan in coordination with an ISO 17025 accredited laboratory. Sampling plans shall, whenever reasonable, be based on appropriate statistical methods.
- If a specific detection limit is indicated in the RSL, it must be applied. Otherwise, detection limits must be below the maximum allowable concentration indicated in the RSLs, below 100 ppm, or below the Specific Concentration Limit (if any), whichever is lower.

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⁴ Note: Prolonged is defined as 24 hours to 30 days. Greater than 30 days of contact is defined as permanent skin contact per ISO 10993

⁵ <https://www.fda.gov/downloads/medicaldevices/deviceregulationandguidance/guidancedocuments/ucm348890.pdf>

- If it is possible to show that all individual substances with exposure potential (other than intentionally used substances, e.g. other than the specific polymer that is being recycled) are each present below 100 ppm through GC/MS and/or other testing methods, it may then only be necessary to test for substances on the RSLs with thresholds below 100 ppm. In addition, if using this approach, it is not necessary to fully identify all individual substances/contaminants as long as it can be determined that the required thresholds are met.⁶
- Laboratories must be ISO 17025 accredited to carry out the specific tests that are conducted.
- Tests may be conducted on the recycled content itself or on the final homogeneous material that the recycled content becomes a part of. However, in either case, the RSL and 100 ppm thresholds apply to the final homogeneous material (i.e. the concentration in the final homogeneous material can be calculated based on the ratio of recycled input to final material if the recycled content is tested rather than the final material).

2.3.4 Analytical Testing Frequency

- Basic and Bronze levels: Tests must be repeated prior to each two-year renewal/recertification.
- Silver level and above: Tests must be conducted and results provided on a quarterly basis during the first two-year certification period (although if prior test results completed on the same or similar interval prior to applying for certification are available, those may be provided instead). If RSL substances are not identified above the RSL or the 100 ppm threshold (as relevant) during the first two years, then the frequency of testing and result reporting may be reduced to once prior to each two-year renewal period. If a change in the recycling process or material source occurs, testing must be reset to be conducted on a quarterly basis.

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⁶ In an example case, mechanically recycled HDPE pellets were tested using a methyl tert-butyl ether extraction at 60°C for 30 minutes followed by GC/MS. The method was capable of determining that all individual volatile and semi-volatile substances with boiling points < 350°C and carbon chain length up to C24 were each present below 100 ppm in the HDPE. Some substances (e.g. phthalates) with higher boiling points and longer chain lengths are also detectable and quantifiable via this method (depending on vapor pressure although the critical pressure beyond which substances cannot be identified or quantified was not disclosed). The argument was made that exposure was not plausible for any substance that was not extracted and identified (or at least partially identified and determined to be present below 100 ppm) via this method. Total halogens and toxic metals were tested for separately and found to be below the required thresholds. Note that, depending on the material type and test results, restricted substances with restriction limits below 100 ppm may also need to be tested for individually if using this approach.

2.3.5 Process for Creating an Analyte List for Additional Material Types

In the case that a list of analytes has not been developed for the recycled content material type under review, a new list of relevant analytes may be created by a C2C Certified material health assessment body. The following are required:

- At a minimum, all substances listed on the RSL, REACH Annex XVII, Annex XIV, and the Substances of Very High Concern Candidate List must be included on the initial list of substances that may be present in the material.
- The assessor must review the prior uses for each chemical on these lists as indicated by REACH dossiers, Annex XV reports, and the United States National Library of Medicine's Hazardous Substances Data Bank (now part of PubChem - see Use and Manufacturing sections by substance). Additional references (e.g. SDS) may be used as well. The list must include all chemicals of concern that are used or have previously been used in the material type under consideration.
- **If the applicant or assessor is aware of additional substances of concern (i.e. substances that would normally result in an x-assessment per the general Material Health Assessment Methodology) that have a high likelihood of being present in the material under consideration, it is the assessor's responsibility to inform C2CPII and to include these on the list**, even if they are not on the REACH lists mentioned above.
- Once the full list of substances that may be present in the material has been created as described above, the list of analytes to test for is then produced by providing a rationale for the removal of any substances on the list as described in Section 2.3.2. Similar considerations as described there may be used, and the same limitations described within that section also apply. For example, if the material will be in prolonged skin contact, the list may not be reduced.
- A list of contaminants that was created by compiling all references cited must be provided to C2CPII, with each item on the list referenced back to the relevant source(s). Rationales regarding why individual substances known to have been used in the given application need not be tested for must also be provided.
- All information sources used must be provided, regardless of whether or not they were used to define the final list of analytes.
- In some cases, this type of research may have already been completed by another entity. Existing lists may apply as long as the assessor verifies that the relevant sources were adequately searched and incorporated into the list.
- New lists of analytes, including a description of the scenarios under which they apply, may be made publicly available by C2CPII for others to use in the future.

2.4 Special Considerations

The following special considerations apply to recycled content material that has been approved for food contact per United States or European Union regulations when used in applications other than food contact, toys, and other children's products.

- The Basic and Bronze level testing is still required in these cases.
- Manufacturers of these materials may provide a signed statement indicating that the material meets all of the other restricted substance thresholds, as indicated in the applicable list of required analytes for the material type under review (see the 'maximum allowable concentration at Silver level' and 'restriction notes' columns). Note: This exception does not mean that the food contact or certified materials are exempt from meeting the Silver level recycled content testing requirements, only that they are allowed to meet them in a different way (i.e. without providing test results or completing additional testing). The material health assessor is responsible for reviewing food contact regulations at the time of certification and notifying the material manufacturers/suppliers that there are some cases where substances allowed in food contact items are restricted by the C2C Certified standard (such as antimony trioxide in PET or nonylphenol in some food contact material production) and ensuring that it is appropriate for the manufacturer to sign such a statement.
- Proof of food contact approval or certification, as applicable, must be provided.
- Additional certifications that ensure screening for problematic substances has already been completed may be added to this list in the future upon special request by an assessor.

2.5 Assessment of Intentionally Used Substances and Known Contaminants

In order to be eligible for certification above Bronze level and in cases where the recycled material will count as assessed at Bronze, the intentionally used substances and known contaminants (either from the manufacturing of the virgin material, contaminants known to be picked up during the use phase, or contaminants from the recycling process), including residual monomers and catalysts in the case of polymers, must be identified by chemical name and CASRN and assessed using the general Material Health Assessment Methodology. Identification must occur via the assessor requesting a complete list of substances present in the material above the subject to review threshold from the supplier and asking about the presence and concentration of specific substances that may be expected in the material based on prior research. (For example, the base polymer, residual monomers, and residual catalyst within recycled content material, when known to remain in virgin material above inventory threshold, must be assessed even if they have not been intentionally added to the recycled material.)

2.6 Additional Requirements for Food Contact, Toys, and Other Children's Products

Recycled material used for food contact applications or in toys or other children's products (when

available for mouthing to occur) must be food grade per the regulations relevant to where the product is sold⁴ and meet all other requirements in this methodology (regardless of the certification level for the product overall). In addition, recycled content materials used in these applications are NOT exempt from the Silver level recycled content material testing requirements.