

# **BLUE ANGEL**

**The Environmental Label**



**Printed matter**

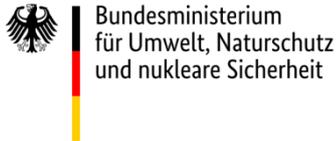
**DE-UZ 195**

**Basic Award Criteria**

**Edition January 2021**

**Version 2**

**The environmental label is underpinned by the following institutions:**



Bundesministerium  
für Umwelt, Naturschutz  
und nukleare Sicherheit

The Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection (Bundesministerium für Umwelt, Naturschutz, nukleare Sicherheit und Verbraucherschutz) is the owner of the label. It regularly provides information on the decisions taken by the Environmental Label Jury.



Umwelt  
Bundesamt

The German Environment Agency with its specialist department for "Ecodesign, Eco-Labeling and Environmentally Friendly Procurement" acts as office of the Environmental Label Jury and develops the technical criteria of the Basic Criteria for Award of the Blue Angel.



Jury  
Umweltzeichen

The Environmental Label Jury is the independent, decision-making body for the Blue Angel and includes representatives from environmental and consumer associations, trade unions, industry, the trade, crafts, local authorities, academia, the media, churches, young people and the German federal states.



**RAL**

gGmbH

RAL gGmbH is the awarding body for the environmental label. It organises the process for developing the relevant award criteria in independent, expert hearings – which involve all relevant interest groups.

If you require further information please contact:

RAL gGmbH

**RAL ENVIRONMENT**

Fränkische Straße 7

53229 Bonn

Tel.: +49 (0) 228 / 6 88 95 - 190

E-Mail: [umweltzeichen@ral.de](mailto:umweltzeichen@ral.de)

[www.blauer-engel.de](http://www.blauer-engel.de)

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# **1 Introduction**

## **1.1 Preface**

In cooperation with the Federal Ministry for the Environment, Nature Conservation, Nuclear Safety and Consumer Protection, the German Environment Agency and considering the results of the expert hearings conducted by RAL gGmbH, the Environmental Label Jury has set up these Basic Criteria for the Award of the Environmental Label. RAL gGmbH has been tasked with awarding the Environmental Label.

Upon application to RAL gGmbH and on the basis of a Contract on the Use of the Environmental Label to be concluded with RAL gGmbH, the permission to use the Environmental Label may be granted to all products, provided that they comply with the requirements as specified hereinafter. The product must comply with all the legal requirements in the country in which it is to be marketed. The applicant shall declare that the product meets these conditions.

## **1.2 Background**

Printed matter are products that are highly disseminated. The manufacturing process requires a high level of energy and resources (primarily paper, inks, metal printing plates). The printing process and the cleaning of the machines can lead to the emission of organic solvents that contribute to the production of ozone ("summer smog"). Some components in the printed matter can hamper the recycling of the paper. Auxiliary substances can be linked to environmental and health-related hazards during their use and when discharged into bodies of water.

The impact on human health and the environment is dependent on the relevant printing process used and can be reduced or prevented through the use of suitable technologies.

## **1.3 Objectives of the environmental label**

In a comparison of their impact on ecological systems, those paper products made out of recovered paper perform significantly better in terms of their use of resources, wastewater load and water and energy consumption than paper products made predominantly from virgin fibres.

Insofar as low proportions of virgin fibres are used in the manufacture of printing and publication papers, it is imperative from an ecological viewpoint that the wood is sourced from certified sustainably managed forests and forestry companies with high ecological standards. Harvesting timber from forests that are particularly worthy of protection, e.g. tropical or boreal forests, is not acceptable.

The use of paper with a high proportion of recovered paper contributes to the preservation of resources, especially ecosystems such as forests, and to a reduction in waste during the manufacture of printed matter. This is particularly true when recovered paper from households and commercial collections is used in the manufacture of the paper.

The printed matter should allow for the recycling of its paper fibres through the use of suitable inks, varnishes and adhesives as well as their applications. In order to guarantee a resource-conserving material cycle, it should be possible to separate coating substances during the preparation of recovered paper (removal of inks, varnishes and adhesives) at a reasonable cost.

If chemicals are used in the printing process, including the pre-press process and any further processing stages, there are products available that have a lower impact on the environment and health than comparable products.

Optimising procedures during the printing process can also reduce energy usage, waste paper and air and water emissions.

The "Blue Angel for Printed Matter" should inform users that products issued with this label – in contrast to other products – provide greater preventative protection for the environment and human health.

Therefore, the environmental label provides those customers who commission printed matter with a decision-making aid if they want to pay particular attention to environmental and health aspects in the manufacture of the printed matter and wish to make this clear to the users of the printed matter.

It is a voluntary label that is designed to motivate publishing houses and other customers of printing companies to select printing processes that consume less resources, enable high-quality recycling, cause lower emissions and create lower amounts of waste. Customers ordering printed matter can thus utilise the environmental label to convey this aspect of the product in a simple manner.

The environmental label should be awarded to printed matter that has the following environmental properties:

- Enables high-quality recycling due to the use of a high proportion of recovered paper in the paper and cardboard used and the use of inks, varnishes and adhesives as well as their applications that do not prevent the high-quality recyclability of the paper fibres, as well as the use of renewable raw materials
- Avoids the use of additives and materials that are damaging to the environment and health
- Reduces energy usage, waste and environmentally harmful emissions.

Therefore, the following benefits for the environment and health are stated in the explanatory box depending on the use case:



#### **1.4 Compliance with legal requirements**

The observance of relevant laws and legal requirements for those systems on which the products labelled with the environmental label are manufactured is expected as a matter of course.

## 1.5 Definitions

- **Aliphatic hydrocarbons:** Saturated hydrocarbons from mineral oils that consist of open chain hydrocarbons (paraffin) and alkylated and non-alkylated cyclic hydrocarbons (naphthalenes)
- **Aromatic hydrocarbons:** Highly alkylated aromatic hydrocarbons from mineral oils that have one or more aromatic rings
- **CLP:** Classification, Labelling and Packaging
- **DIBP:** Diisobutyl phthalate
- **Display:** Printed form of a product presentation for promoting sales (e.g. large packaging, sales stand, rack)
- **DIPN:** Diisopropylnaphthalene
- **Auxiliary printing substances:** All materials except for the paper and inks
- **EVA:** Ethylene-vinyl acetate
- **Constituent components:** Substances added to the product as such or as part of a mixture in order to achieve or influence certain product properties and those required as chemical cleavage products for achieving the product properties
- **Volatile organic solvents (VOC):** "Volatile organic solvents" in the context of these Basic Award Criteria are organic compounds (VOC) that have a vapour pressure of 0.01 kPa or more at 293.15 K (20°C) or a corresponding volatility under the particular conditions of use (e.g. dryer in heatset web offset printing).
- **ISCC:** International Sustainability and Carbon Certification
- **MDI:** Methylene diphenyl diisocyanate
- **PAH:** Polycyclic aromatic hydrocarbons
- **Paraffin waxes:** A microcrystalline product formed during either the processing of petroleum or synthetically produced. Other descriptions: Fischer-Tropsch waxes (synthetic), mineral oil waxes (from petroleum), microcrystalline waxes. They are used for abrasion protection in printing inks and hot melt adhesives.
- **PFAS:** Per- and Polyfluoroalkyl substances, here: PFAS that are added to printing inks as an abrasion protection agent (e.g. polytetrafluoroethylene)
- **Polyolefin waxes:** Waxes manufactured from olefins, for example: polyethylene wax. They are used for abrasion protection in printing inks and hot melt adhesives.
- **PUR:** Polyurethane
- **PVC:** Polyvinyl chloride
- **Reactive adhesives:** Adhesives that require a chemical process to cure or additional chemical bonding (e.g. based on polyurethane or polyolefins) in some systems
- **RSB:** Roundtable on Sustainable Biomass
- **RSP:** Roundtable on Sustainable Palmoil
- **RTRS:** Roundtable on Sustainable Soy Oil
- **Siccative:** A drying agent
- **TOF:** Total Organic Fluorine
- **Transport packaging:** Packaging that facilitates the handling and transport of goods to avoid direct contact with the goods and any transport damage. This packaging is typically not passed on to the end consumer<sup>1</sup>

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<sup>1</sup> Definition according to the definition in the German Packaging Law (VerpackG) (2017)

- **Secondary packaging:** Packaging that contains multiple units and is typically supplied to the end consumer with the units or is designed for stocking the shelves in the retail outlet<sup>1</sup>
- **Vaseline:** Aliphatic hydrocarbon compound (from petroleum or plant-based raw materials), which is used as abrasion protection in printing inks
- **Printed packaging:** Printed materials for holding, protecting, handling, delivery or presentation of goods (incl. displays), which may range from raw materials to processed products and are passed on by the manufacturer to the distributor or final consumer<sup>1</sup>
- **Applicant/licence holder:** The respective contractual partner. This is generally the printing company that has submitted the application and produces the printing products
- **Distributor/label user:** The company under whose name the product is placed on the market (e.g. whose address can be found on the printed product)
- **Client:** The company who orders the printed product from the printing company. This does not necessarily have to be the same as the distributor

## 2 Scope

- a) These Basic Award Criteria are valid for graphical printed matter that consists primarily of paper and cardboard and is not designed for packaging purposes. The scope of the Basic Award Criteria thus includes:
- ♦ Newspapers
  - ♦ Magazines, brochures, journals
  - ♦ Books
  - ♦ Catalogues
  - ♦ Prospectuses, advertising inserts, newspaper supplements
  - ♦ Flyers, leaflets
  - ♦ Operating instructions, assembly instructions
  - ♦ Posters, billboards, displays made of cardboard
  - ♦ Annual reports, telephone books, directories
  - ♦ Loose leaf publications
  - ♦ Photo work envelopes
  - ♦ Printed postcards
  - ♦ Printed envelopes and padded envelopes
  - ♦ Printed book covers
  - ♦ Decorative calendars
- b) The printed matter within the scope of these Basic Award Criteria must be produced using one or more of the following printing processes:
- ♦ Sheet-fed offset printing
  - ♦ Coldset web offset printing
  - ♦ Heatset web offset printing
  - ♦ Rotogravure printing
  - ♦ Flexographic printing
  - ♦ Digital printing

- c) Printed packaging is excluded from the award of the environmental label. Therefore, secondary packaging and transport packaging are also excluded from the scope of these Basic Award Criteria. Finished products according to DE-UZ 14b and DE-UZ 217b, as well as products made out of recycled cardboard according to DE-UZ 56<sup>2</sup>, e.g. folders, binders and suspension files, are also excluded.
- d) An application can be submitted for:
- ♦ defined product groups (e.g. summarised as advertising prospectuses and brochures, stapled or glued, 2-96 pages, format DIN A2-A5). The following must be stated in the application: all printing machines, chemicals, types of paper and other components used for this product group, the maximum number of pages, the formats used, all possible types of further processing, etc. The base contract is always concluded with the printing company. The printing company is thus permitted to advertise that they are authorised to print products in this specific product group with the Blue Angel.  
For all actually printed products, the respective distributor must apply for an extension contract with RAL gGmbH so that the contract on the use of the environmental label can be transferred to these products.  
In the case of printed matter that is published on a recurring basis e.g. telephone books, periodicals, catalogues, etc., it is necessary to apply for a defined product group of this type.
  - ♦ defined individual products (e.g. certain yearly reports) that are defined in advance according to their title and will only be printed once. The application is examined based on the product stated in the application.

Supplements loosely inserted into the product are not covered by the Basic Award Criteria. If these loosely inserted supplements also comply with the criteria and have a valid contract on the use of the environmental label, the logo should be additionally displayed on these supplements.

### **3 Requirements**

All application documentation must be submitted via the Web Portal: <https://portal.ral-umwelt.de/>.

#### **3.1 Requirements for the printing process**

The printed matter must be manufactured using a permissible printing process named under Paragraph 2 b).

#### ***Compliance verification***

*The applicant shall state the printing process used for manufacturing the printed matter in Annex 1.*

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<sup>2</sup> until 31.12.2022

## **3.2 Requirements for the material composition**

### **3.2.1 Proportion of the total mass accounted for by the materials**

In the end product, the proportion of paper and cardboard, as well as printing inks and varnish, must be greater than 90 percent by mass. The remaining components that can comprise up to 10% by mass of the product can include e.g. film, threads, staples and textile components. For the production of hard cover products (books, etc.), it is permissible to include crepe paper and backing board (bogus paper) within the components that comprise up to 10% by mass of the product if no certified paper and cardboard according to Paragraph 3.3 is available for this purpose.

#### ***Compliance verification***

*The applicant shall estimate the proportion of the total mass that is accounted for by the materials in the printed matter, especially if materials that are not made out of paper or cardboard, or crepe paper or backing board, are used to bind the product or provide it with protection, and shall declare compliance with the requirement in Annex 1. On request, the applicant shall supply a sample that corresponds to the individual product or the product group according to Paragraph 2d) that are named in the application. The manufacturer shall state which threads, staples, textile components and similar are used and submit corresponding technical data sheets. If crepe paper and backing boards that are not certified with the Blue Angel are included within the 10% limit, declarations from two paper suppliers must be submitted annually to verify that no alternative products certified with the Blue Angel are available.*

### **3.2.2 Special material requirements**

It is not permitted for the following materials to be added to the printed matter:

- PVC
- Chrome-plated metal (except for loose leaf publications in folders, which are certified in accordance with DE-UZ 14b or DE-UZ 56<sup>2</sup>)
- Adhesives containing diisobutyl phthalate (DIBP).

The minimisation principle applies to all materials added to the product. They should only be used in the quantities required to fulfil certain functions. Varnishes should only be used – where absolutely necessary – to protect the jackets/cover sheets of brochures, magazines, books and catalogues. Film coatings should only be used for jackets on books (soft and hard covers).

#### ***Compliance verification***

*The applicant shall declare compliance with the requirements in Annex 1.*

### **3.2.3 Use of adhesives**

- a) If hot melt adhesives with a thermoplastic character are used, the following requirements must be fulfilled:
- ♦ Observance of the processing temperature for the adhesive according to the technical data sheet
  - ♦ A gluing machine with integrated overheating protection
  - ♦ Air extraction in the workplace.

- b) When PUR adhesives are used, the following requirements must also be fulfilled:
- ♦ Only polyurethane (PUR) hot melt adhesives (max. processing temperature 130°C) with a monomeric MDI content < 0.1% that are not classified with one of hazard statements listed in Table 1 may be used.
  - ♦ An extraction system must be available on the application system and retracted adhesive tanks; the rooms must also be adequately ventilated.

### **Compliance verification**

*The applicant shall declare compliance with the requirements in Annex 1 or, if external companies are commissioned for further processing steps, shall ensure that these companies confirm their compliance with the requirements in writing with their signature and using the company's own letterheaded paper. In addition, the applicant shall name the companies commissioned for these further processing steps in Annex 1.*

### **3.3 Requirements for paper and cardboard**

The paper or cardboard used in the manufacture of the printed matter must comply with the requirements of DE-UZ 14a (graphic paper and cardboard made from 100% recovered paper) or DE-UZ 72 (printing and publication papers primarily made of recovered paper) or DE-UZ 56<sup>2</sup> (recycled cardboard). Labels must comply with the requirements of DE-UZ 14b (finished products made from recycled paper and cardboard). A valid contract on the use of the environmental label in accordance with one of these Basic Award Criteria must have been concluded with RAL gGmbH for the paper or cardboard. Exemptions apply up to 31/12/2022 for the covers of journals, magazines, brochures and books, as well as for reference cards in books, if there are no suitable materials with a grammage of 130 g/m<sup>2</sup> available on the market. In this case, material made out of 100% recycled materials should be used where possible. If a material containing virgin fibres is used, the virgin fibres may not account for more than 10% by mass of the total paper in the product. As soon as a material certified with the Blue Angel is available again, this must be used.

In the case of digital printing using electrophotographic processes, in which the paper is subjected to a thermal load, the paper must comply with the requirement in DE-UZ 14a Paragraph 3.13.

### **Compliance verification**

*The applicant shall declare compliance with the requirements in Annex 1. In the case of paper, the applicant shall state the name of the paper and the registration number in accordance with DE-UZ 14a (for digital printing with verification of compliance with Paragraph 3.13), DE-UZ 14b (printed labels) or DE-UZ 72 in Annex 2. In the case of cardboard, the applicant shall state the name of the cardboard and the registration number in accordance with DE-UZ 56 in Annex 2. If magazine or book cover cardboard with a grammage greater than 130 g/m<sup>2</sup> is not available on the market, this must be certified by at least two paper merchants. If cardboard with a grammage greater than 130 g/m<sup>2</sup> that is certified with the Blue Angel is unsuitable for cover finishing, the applicant shall submit a sample to RAL gGmbH as verification. If the applicant wants to use different paper or cardboard during the term of the contract, the corresponding documents must be submitted to RAL gGmbH before it is used in the product.*

### 3.4 Requirements for the recyclability of the materials added to the printed matter

The finished products must be deinkable and any adhesive applications on the products must be removable<sup>3</sup>. The product must comply with the recyclability requirements of the European Paper Recycling Council (EPRC).

The test methods for evaluating the recyclability of printed matter are:

- INGEDE Method 11: Deinkability test (version: January 2018)
- INGEDE Method 12: Testing of adhesive applications (version: January 2013).

The evaluation of the recyclability of the product is carried out in accordance with the guidelines of the EPRC using scorecards for deinkability<sup>4</sup> and the removability of adhesive applications<sup>5</sup>, whereby the printing inks used in the product must score a least 51 points on the "Deinkability Scorecard" and the adhesive applications used in the product must score at least 71 points on the "Adhesive Removal Scorecard" from the EPRC. In addition, the product should score at least 50% of the maximum number of points available for each individual criteria of INGEDE Method 11. Redispersible and water soluble adhesive applications are exempt from the test according to INGEDE Method 12. Non-redispersible and non water-based hot melt adhesive applications are permitted without verification of their recyclability if they meet the following conditions during application and this is confirmed on the technical data sheet.

For thermoplastic adhesives:

- Softening temperature (according to R&B)<sup>6</sup>:  $\geq 68$  °C
- Thickness of the adhesive application:  $\geq 120$   $\mu\text{m}$
- Horizontal expansion of the adhesive application (every direction):  $\geq 1.6$  mm.

For reactive adhesives:

- Thickness of the adhesive application (reactive adhesive):  $\geq 60$   $\mu\text{m}$
- Horizontal expansion of the adhesive application (every direction):  $\geq 1.6$  mm.

Further information on the deinkability and removability of the adhesives can be found in Appendix B to the Basic Award Criteria for DE-UZ 195.

The following exemption applies: the deinkability criteria are only obligatory from 01/01/2023 for finished products printed using mineral oil-optimised printing inks (according to 3.8.5) in coldset web offset printing.

#### **Compliance verification**

*The applicant shall declare compliance with the requirements in Annex 1 and submit a test report from an independent testing institute for deinkability and the removability of adhesive particles in which compliance with the requirements is confirmed by the testing institute. The adhesive manufacturer shall declare in Annex 4 whether the adhesive application is water-based or redispersible and whether it is a reactive adhesive. In addition, the applicant shall submit technical data sheets for the adhesives used in the product and, if hot melt adhesives are used, shall state the thickness and horizontal expansion of the adhesive application used in the printed product named in the application.*

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<sup>3</sup> This does not apply to paper and kraft paper that has been made out of unbleached recovered paper from the kraft process for classification groups 4 and 5 according to DIN EN 643

<sup>4</sup> <http://www.paperforrecycling.eu/download/178/>

<sup>5</sup> [https://www.paperforrecycling.eu/wp-content/uploads/dlm\\_uploads/2018/04/EPRC\\_Scorecard\\_removability\\_of\\_adhesive.pdf](https://www.paperforrecycling.eu/wp-content/uploads/dlm_uploads/2018/04/EPRC_Scorecard_removability_of_adhesive.pdf)

<sup>6</sup> Ring and Ball (measurement method for determining the softening point)

If the printed matter is finished or further processed in another company to that owned by the applicant, the required verifications named above shall also be submitted for the adhesive applications used by these companies.

### 3.5 Requirements for all substances and mixtures added to the printed matter

In the pre-press process, printing process and further processing stages, no substances or mixtures may be used – even for cleaning or as an auxiliary substance – which according to the criteria of Regulation (EC) No. 1272/2008<sup>7</sup> are assigned the following H Phrases named in the table or which meet the criteria for such classification or are classified as carcinogenic, mutagenic or reprotoxic in the currently valid version of TRGS 905<sup>8</sup>.

The requirement relates to the labelling of the substance or mixture and not to the individual substances they contain.

The product may not contain any substances of very high concern (SVHC) that have been added to the so-called "list of candidates" according to Article 59, Paragraph 1 of the REACH regulation (EC/1907/2006)<sup>9</sup>.

The following are excluded from this requirement:

- Toluene in rotogravure printing machines using capsules that are fitted with a toluene recovery system from the waste air
- Chromium VI and copper sulphate if used for manufacturing the cylinders in rotogravure printing
- Hardening additives used in the electroplating process that are classified with the H Phrases H351, H361d, H411 and H412 and only contain up to a maximum of 5% of thiourea
- Cleaning agents and rubber blanket regeneration agents with the H Phrase H304
- Burn-in gums and end gums with the H Phrases H411, H412 and H413
- Developers with the H Phrases H371 and H373
- Anti-skin sprays/agents with the H Phrase H304
- Dampening solution additives with the H Phrase H317
- Inkjet printing inks and the associated cleaning agent with H-phrases 317 and 412

Table 1: H Phrases and associated wording

Hazard statement (H Phrase)	Hazard category	Wording
<b>Toxic substances</b>		
H300	Acute Tox. 1 Acute Tox. 2	Fatal if swallowed.
H301	Acute Tox. 3	Toxic if swallowed.
H304	Asp. Tox. 1	May be fatal if swallowed and enters airways.
H310	Acute Tox. 1 Acute Tox. 2	Fatal in contact with skin.
H311	Acute Tox. 3	Toxic in contact with skin.
H330	Acute Tox. 1	Fatal if inhaled.

<sup>7</sup> Regulation (EC) No. 1272/2008 on classification, labelling and packaging of substances and mixtures (CLP Regulation)

<sup>8</sup> <http://www.baua.de/de/Themen-von-A-Z/Gefahrstoffe/TRGS/pdf/TRGS-905.pdf>

<sup>9</sup> The version of the list of candidates at the time of application is valid. RAL gGmbH must be notified about any changes to the list of candidates that apply at the time of application. The applicant will be informed if substances have been added that were not previously on the list.

<b>Hazard statement (H Phrase)</b>	<b>Hazard category</b>	<b>Wording</b>
	Acute Tox. 2	
H331	Acute Tox. 3	Toxic if inhaled.
<b>Carcinogenic, mutagenic and reprotoxic substances</b>		
H340	Muta. 1A Muta. 1B	May cause genetic defects.
H341	Muta. 2	Suspected of causing genetic defects.
H350	Carc. 1A Carc. 1B	May cause cancer.
H350i	Carc. 1A Carc. 1B	May cause cancer if inhaled.
H351	Carc. 2	Suspected of causing cancer.
H360F	Repr. 1A Repr. 1B	May damage fertility.
H360D	Repr. 1A Repr. 1B	May damage the unborn child.
H360FD	Repr. 1A Repr. 1B	May damage fertility. May damage the unborn child.
H360Fd	Repr. 1A Repr. 1B	May damage fertility. Suspected of damaging the unborn child.
H360Df	Repr. 1A Repr. 1B	May damage the unborn child. Suspected of damaging fertility.
H361f	Repr. 2	Suspected of damaging fertility.
H361d	Repr. 2	Suspected of damaging the unborn child.
H361fd	Repr. 2	Suspected of damaging fertility. Suspected of damaging the unborn child.
<b>Other potential hazards</b>		
H317	Skin. Sens. 1	May cause an allergic skin reaction.
H334	Resp. Sens 1	May cause allergy or asthma symptoms or breathing difficulties if inhaled.
H362	Lact.	May cause harm to breast fed children.
H370	STOT SE 1	Causes damage to organs.
H371	STOT SE 2	May cause damage to organs.
H372	STOT RE 1	Causes damage to organs through prolonged or repeated exposure.
H373	STOT RE 2	May cause damage to organs through prolonged or repeated exposure.
H400	Aquatic Acute 1	Very toxic to aquatic life.
H410	Aquatic Chronic 1	Toxic to aquatic organisms.
H411	Aquatic Chronic 2	Toxic to aquatic organisms with long-lasting effects.
H412	Aquatic Chronic 3	Harmful to aquatic organisms with long lasting effects.
H413	Aquatic Chronic 4	May cause long lasting harmful effects to aquatic organisms.
H420	Ozone 1	Hazardous to the ozone layer.
EUH029		Contact with water liberates toxic gas.
EUH031		Contact with acids liberates toxic gas.
EUH032		Contact with acids liberates very toxic gas.
EUH070		Toxic by eye contact.

### **Compliance verification**

*The applicant shall verify compliance with the requirements by submitting an up-to-date safety data sheet in accordance with Regulation (EC) No. 1272/2008 (CLP Regulation) for all substances and mixtures (printing inks, varnishes, thinners, dampening agents including alcohol additives, cleaning agents, rubber blanket regeneration agents and other auxiliary substances) added to the printed matter that demonstrates that none of the above-named labelling obligations exist for the products used. The safety data sheets should not be older than 2 years.*

*If the printed matter is finished or further processed in another company to that owned by the applicant, up-to-date safety data sheets and Annex 4 according to the CLP Regulation for the substances and mixtures added by this company shall also be submitted.*

*In addition, a list of all of the substances and mixtures used (the name must be identical to the name stated on the safety data sheet) including their function, manufacturer/supplier and area of application shall be submitted as Annex 3. If the applicant wants to add different materials to the product during the term of the contract, the corresponding documents must be submitted to RAL gGmbH before they are used in the product.*

### **3.6 Requirements for biocidal products and biocidal substances**

Printed matter may not be produced using products that contain biocidal substances or biocidal products. The excluded biocidal substances and biocidal products also include film preservatives (Product-type 7 according to Regulation (EU) No. 528/2012) and fibre, leather, rubber and polymerised materials preservatives (Product-type 9).

Only the following are permitted:

- In-can preservatives in products used in the pre-press process, printing process or further processing stages, i.e. for the protection of finished products in containers against microbial deterioration to ensure their shelf life (Product-type 6) as well as
- Preservatives for liquid-cooling and processing systems (Product-type 11), under the following conditions:
- if they are approved for use as product-type 6 or product-type 11 according to Regulation (EU) No. 528/2012 of the European Parliament and of the Council or
- if approval for use as product-type 6 or product-type 11 according to Regulation (EU) No. 528/2012 is being assessed and still pending.

As an exemption to Paragraph 3.5, this also applies to substances labelled with the H phrases listed in Table 1.

If a biocidal active substance or biocidal product fulfils the conditions stated above and is labelled with H410 or H411, its use is only permitted if the bioaccumulation potential is  $< 3.0$  (log Pow octanol/water partition coefficient) or the bioconcentration factor is  $\leq 100$ .

### **Compliance verification**

*The applicant shall declare compliance with the requirements in Annex 4 and submit safety data sheets for the biocidal active products used during the production process. The product-type (e.g. 6 or 11) must be stated on the documentation, e.g. on the safety data sheet or declaration from the manufacturer.*

### **3.7 Requirements for renewable raw materials**

#### **3.7.1 Certified renewable raw materials**

If printing inks, varnishes, solvents and cleaning agents contain or are produced on the basis of renewable raw materials, it **must** be certified that they were cultivated in accordance with recognised sustainability criteria.

#### **Compliance verification**

*The applicant shall verify compliance with the requirements by either declaring that renewable raw materials are not used in the product (Annex 4) or, if renewable raw materials are used in the product, by submitting a certificate from the manufacturer to verify that they were cultivated in accordance with recognised sustainability criteria. The following sustainability criteria will be accepted: ISCC<sup>10</sup> PLUS, ISCC EU, RSB<sup>11</sup>, RSPO<sup>12</sup>, RTRS<sup>13</sup> and ProTerra<sup>14</sup>. If it is not yet possible to provide this verification, it is permissible up to 31/12/2023 for the applicant to submit a plausible justification on an annual basis for why this is the case.*

#### **3.7.2 Raw materials made of non-genetically modified substances**

If printing inks, varnishes, solvents and cleaning agents contain or are produced on the basis of renewable raw materials, it should be certified that they are not sourced from genetically modified plants.

#### **Compliance verification**

*The applicant shall verify compliance with the requirements by submitting a declaration from the manufacturer as Annex 4 that certifies the exclusion of genetically modified plants. The certification system used to certify the renewable raw materials shall be stated when the application is made and the certificates submitted. In addition, the applicant shall state which genetically modified raw materials are used in the product and in what quantities. If verification cannot currently be provided, the applicant shall justify the reasons.*

### **3.8 Requirements for the dyes, toners, printing inks and varnishes**

The requirements relate to the entire colour system, meaning the ready-for-use dyes, toners, printing inks and varnishes ("ready for printing").

#### **3.8.1 Additives added at a later stage**

No additives may be added to the printed matter at a later stage (exemption: anti-skin sprays/agents for offset printing inks that comply with the requirements in Paragraph 3.5).

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<sup>10</sup> International Sustainability and Carbon Certification (<https://www.iscc-system.org>)

<sup>11</sup> Roundtable on Sustainable Biomass (<https://rsb.org>)

<sup>12</sup> Roundtable on Sustainable Palmoil (<https://rspo.org>)

<sup>13</sup> Roundtable on Sustainable Soy Oil (<https://responsiblesoy.org>)

<sup>14</sup> Pro Terra Foundation (<https://www.proterrafoundation.org>)

### 3.8.2 Heavy metals

The following heavy metals must not be added to dyes, toners, printing inks and varnishes as a constituent component (dye, pigment, siccative): lead, cadmium, chromium VI, cobalt, mercury, nickel, and copper compounds with the exception of copper phthalocyanine.

### 3.8.3 Additional requirements for manganese compounds

Manganese compounds may only be added to dyes, toners, printing inks and varnishes as a constituent component (dye, pigment, siccative) if the proportion of manganese in the printable mixture does not exceed a maximum of 0.5% by mass.

### 3.8.4 Azo dyes

No azo dyes or pigments may be added that can break down into amines. Amines are listed in Regulation (EC) No. 1907/2006, Annex XVII, No. 43, Appendix 8 or 9<sup>15</sup>, or in TRGS 614<sup>16</sup>:

Table 2: Amines that can be released from azo dyes.

Substance	CAS number
benzidine	92-87-5
4-chloro-o-toluidine	95-69-2
2-naphthylamine	91-59-8
o-aminoazotoluene / 4-amino-2',3-dimethylazobenzene / 4-o-tolylazo-o-toluidine	97-56-3
5-nitro-o-toluidine	99-55-8
4-chloroaniline	106-47-8
4-methoxy-m-phenylenediamine	615-05-4
4,4'-methylenedianiline / 4,4'-diaminodiphenylmethane	101-77-9
3,3'-dichlorobenzidine / 3,3'-dichlorobiphenyl-4,4'-ylenediamine	91-94-1
3,3'-dimethoxybenzidine / o-dianisidine	119-90-4
3,3'-dimethylbenzidine / 4,4'-bi-o-toluidine	119-93-7
4,4'-methylenedi-o-toluidine	838-88-0
6-methoxy-m-toluidine / p-cresidine	120-71-8
4,4'-methylene-bis-(2-chloro-aniline) / 2,2'-dichloro-4,4'-methylene-dianiline	101-14-4
4,4'-oxydianiline	101-80-4
4,4'-thiodianiline	139-65-1
o-toluidine / 2-aminotoluene	95-53-4
4-methyl-m-phenylenediamine	95-80-7
2,4,5-trimethylaniline	137-17-7
o-anisidine / 2-methoxyaniline	90-04-0
4-amino azobenzene	60-09-3
4-Amino-3-fluorophenol*	399-95-1
6-Amino-2-ethoxynaphthalene*	-

\* Azo dyes that can break down into this amine are not known. Analytical proof is not required here.

<sup>15</sup> Regulation (EG) No. 1907/2006

<sup>16</sup> Technical Rules for Hazardous Substances– Restrictions on use for azo dyes, which may release aromatic amines classified as carcinogens (2001)

### **Compliance verification**

*The applicant shall verify compliance with the requirements 3.8.1 to 3.8.4 by submitting a declaration from the manufacturer of the dyes, toners, printing inks and varnishes in Annex 4. If azo dyes and pigments have been used, the applicant shall verify compliance with the requirements by submitting an analysis carried out according to DIN 55610:1986 or ETAD Method 212 (2016). The proportion of primary aromatic amines in the azo dyes or pigments (e.g. due to cleavage or production-related impurities) must not exceed 0.05%.*

### **3.8.5 Hydrocarbons in printing inks and varnishes in the offset printing process**

In order to avoid unhealthy contamination during the reuse of the paper fibres, the following requirements must be fulfilled for offset printing inks and varnishes:

- In the case of aliphatic hydrocarbons, only those substances with a chain length of C10 to C20 may be used as constituent components. In addition, the following high-molecular compounds without solvent properties may be used if they have a carbon number  $C > 35$  and the proportion of those with a carbon number of C20 to C35 does not exceed a maximum of 5%: microcrystalline waxes, Vaseline, polyolefin waxes, paraffin waxes or Fischer-Tropsch waxes.
- Only those printing inks in which less than 0.1% by mass of aromatic hydrocarbons from mineral oil are used as constituent ingredients may be used for printing the printed matter. In heatset web offset printing, it is permissible for up to 1% by mass of aromatic hydrocarbons from mineral oil to be used as solvents because the oils are largely destroyed in the dryer.
- In addition, the printing ink may not contain more than 0.2 mg/kg of each of the following PAHs: Benzo[a]pyrene, Benzo[e]pyrene, Benzo[a]anthracene, Benzo[b]fluoranthene, Benzo[j]fluoranthene, Benzo[k]fluoranthene, Chrysen, Dibenzo[a,h]anthracene, Benzo[g,h,i]perylene, Indeno[1,2,3-cd]pyrene. Furthermore, the sum of **all** the above-named PAHs **in the printing ink should** be below 1 mg/kg.
- An exemption applies to coldset web offset printing in companies without a dual colour supply system: compliance with the criteria described above is only obligatory from 01/01/2023.

### **Compliance verification**

*The applicant shall verify compliance with the requirements by submitting a declaration from the manufacturer of the printing inks and varnishes in Annex 4. In addition, the applicant shall ensure that the manufacturer of the printing inks and varnishes submits information about the ingredients used in the formulations for the printing inks and varnishes to RAL gGmbH as Annex 5, as well as a measurement report according to AfPS GS 2019:01 PAK. In justified exceptional cases, the measurement can be carried out using a different method with a sufficiently low determination limit.*

### **3.8.6 Per- and Polyfluoroalkyl substances (PFAS) in printing inks and varnishes**

To avoid the release of persistent substances into the environment, the following requirements must be fulfilled: No per- and Polyfluoroalkyl substances (PFAS) may be added to the printing inks and varnishes. If no alternatives are available for maintaining the quality of the product (e.g. for covers), these substances may be used until PFAS-free products become available and if the PFAS content is stated in TOF/kg or as total fluorine in the application.

### **Compliance verification**

*The applicant shall verify compliance with the requirements by submitting a declaration from the manufacturer of the printing inks and varnishes in Annex 4. In addition, the applicant shall ensure that the manufacturer of the printing inks and varnishes submits information about the ingredients used in the formulations for the printing inks and varnishes to RAL gGmbH as Annex 5. If the use of PFAS is necessary for individual printing inks and varnishes to maintain the quality of the product, the applicant can submit a corresponding justification to RAL gGmbH up to 31/12/2022 in order to receive approval for this exemption; in this case, the applicant shall submit a measurement report measured as Total Organic Fluorine (TOF) or as total fluorine.*

## **3.9 Requirements for emissions**

### **3.9.1 Offset printing processes and further processing in all printing processes**

For all offset printing processes and further processing in all printing processes, the following requirements apply to adhesives, cleaning agents, rubber blanket regeneration agents and other auxiliary printing substances, except for the exemptions stated in Paragraph 3.7:

- The proportion of toluene, xylene and other aromatic hydrocarbons with a carbon number of more than C9 must not exceed a maximum of 1% by mass.
- The benzene content must not exceed a maximum of 0.1% by mass.
- Halogenated hydrocarbons, terpenes, n-hexanes, secondary amines and amides may not be used.

RAL gGmbH must be informed immediately about any amendments.

### **Compliance verification**

*When using offset printing processes, the applicant shall verify compliance with the requirements by submitting a declaration from the manufacturer of the auxiliary printing substances used as Annex 4.*

### **3.9.2 Cleaning of machines and machine parts in offset printing**

For cleaning machines and machine parts (except dampening rollers) in offset printing processes:

- it is a requirement that only those cleaning agents that cause low emissions of volatile organic compounds and thus have a flash point of at least 60°C stated in their safety data sheet are used.
- Only those cleaning agents that cause the lowest emissions of volatile organic compounds and thus have a flash point of at least 100°C stated in their safety data sheet should be used in the best case scenario.
- If these cleaning agents are not used for an **automatic cleaning system**, justification must be provided to demonstrate that:
  - ♦ these cleaning agents cannot be used
- or
  - ♦ there are other reasons why it is not possible to use them.
- If these cleaning agents are not used for **manual cleaning**, justification must be provided to demonstrate that:

- ♦ these cleaning agents have been tested
- and
  - ♦ the reasons for deciding against their use.

### **Compliance verification**

*When using offset printing processes, the applicant shall mark all of the substances and mixtures that are used as cleaning agents or rubber blanket regeneration agents in the safety data sheets submitted in accordance with Paragraph 3.5. The safety data sheet must demonstrate a flash point of at least 60°C. If the flash point is between 60°C and 100°C, the use of this cleaning agent or rubber blanket regeneration agent must be justified by the applicant in Annex 1a. In the event of changes to the machine park or use of new cleaning agents, a new test and a new justification must be sent without request to RAL gGmbH.*

### **3.9.3 Dampening solution additives in offset printing processes**

In the case of all offset printing processes, the following requirements apply for dampening solution additives:

- The isopropanol or ethanol content in the dampening solution must not exceed 3% by volume. In order to reduce the amount of alcohol used, correspondingly designed rollers and dampening solution additives should be used. In justified exceptional cases, it is permissible for the isopropanol or ethanol content in the dampening solution for printing machines built before 2000 that have a maximum of two printing mechanisms to be higher but it must not exceed 6%.
- Dampening solution additives should not have a volatile organic compound – i.e. substances with a vapour pressure greater than 0.1 hPa (0.01 kPa) – content of greater than 10% by mass. If the additives have a higher volatile organic compound content, justification must be provided.
- Continuous monitoring of the isopropanol or ethanol content with an infra-red or ultrasonic measurement system must be available when using heatset web offset printing machines and sheet-fed offset printing machines with four or more ink or coating units.

### **Compliance verification**

*The applicant shall verify in Annex 1a that the isopropanol or ethanol content in the dampening solution is set to a maximum of 3%. The applicant shall submit the safety data sheet to verify that the dampening solution additive does not have a highly volatile organic compound (substances with a vapour pressure greater than 0.1 hPa (0.01 kPa)) content of greater than 10%. If the substances used have higher contents, this must be justified in Annex 1a and verification that tests have been carried out using at least two approved dampening solution additives must be submitted. The applicant shall name the measure selected for reducing and monitoring the alcohol content in Annex 1a. In the event of changes to the machine park or use of new cleaning agents, a new test and a new justification must be sent without request to RAL gGmbH.*

### **3.9.4 Emissions of volatile organic compounds in sheet-fed offset printing and coldset web offset printing**

When using sheet-fed offset and coldset web offset printing processes, the following requirements for the emission of volatile organic compounds must be observed:

- The quantity of volatile solvents purchased (i.e. cleaning agents and rubber blanket regeneration agents with a flash point less than 100°C, dampening solution additives such as isopropanol and substances in dampening solution additives with a vapour pressure greater than 0.1 hPa) over a 12 month period in relation to the amount of paper purchased and provided (paper which is used in the printing processes at the company) during the same period must not exceed the following values; whereby solvents in waste may only be subtracted if verification of its solvent content is submitted; in the case of cleaning cloths, a standard solvent content of 40 g per cloth can be used:
  - ♦ For coldset web offset printing: Key figure for the quantity  $\leq 2$  kg/t
  - ♦ For sheet-fed offset printing: Key figure for the quantity  $\leq 3$  kg/t
  - ♦ If the grammage used for sheet-fed offset printing is usually less than 100 g/m<sup>2</sup> (> 80% of the printing processes) or the number of sheets per job is usually less than 2000 sheets (> 80% of the printing processes), a key figure for the quantity of  $\leq 4$  kg/t applies.
- In companies that use coldset web offset printing, the quantity of volatile solvents purchased over a 12 month period should also be compared to the surface area of the paper purchased and provided (paper which is used in the printing processes at the company) during the same period, given as grams per square metre. In companies that use sheet-fed offset printing, this key figure should be reported to RAL if it can be calculated based on the material management system with a reasonable amount of effort.

#### **Compliance verification**

*The applicant shall verify compliance with the requirement by submitting a tabular list of the amount of paper purchased and provided as well as the purchased quantities of the named solvents contained in the product over a 12 month period as Annex 6 and state the values in Annex 6. The content of volatile organic solvents (according to the definition in Paragraph 1.6) in the respective products must be requested from the suppliers or this information must be stated in Annex 4. However, the end of the 12 month period must not be earlier than 12 months before the application. Verification of compliance with the requirements must be submitted without request to RAL gGmbH every year at the latest 9 months after the end of the 12-month period.*

### **3.9.5 Emissions of volatile organic compounds in heatset web offset printing**

When using heatset web offset printing, the following requirements for the emission of volatile organic compounds must be observed:

- Irrespective of the solvent consumption, the waste gases from the dryer must be continuously measured and must not exceed 15 mg C/Nm<sup>3</sup>.
- Those dryers for which it has been verified through continuous measurement of their waste gases over a period of 10 days that the emissions do not exceed 15 mg C/m<sup>3</sup> or a value of 5 mg C/m<sup>3</sup> was not exceeded in any of the half hour individual measurements are exempt from the requirement for continuous measurement. The measurements must be carried out

by testing institutions accredited in accordance with DIN ISO 17025 and must not be more than 3 years old.

- Irrespective of the solvent consumption, the annual average figure for the diffuse emissions of volatile organic compounds must not exceed a proportion of 10% of the solvents used.
- The quantity of volatile solvents purchased (i.e. cleaning agents and rubber blanket regeneration agents with a flash point less than 100°C, dampening solution additives such as isopropanol and substances in dampening solution additives with a vapour pressure greater than 0.1 hPa), less the VOC in the waste gas and the VOC destroyed or recovered in the waste gas purification system and the properly disposed of solvent waste, over a 12 month period in relation to the amount of paper purchased and provided (paper which is used in the printing processes at the company) during the same period must not exceed 1 kg/t.
- The quantity of volatile solvents purchased over a 12 month period should also be compared to the surface area of the paper purchased and provided (paper which is used in the printing processes at the company) during the same period.

### **Compliance verification**

*The applicant shall verify compliance with the requirement for the waste gas emissions by submitting a measurement report from an approved testing institution.*

*The applicant shall verify compliance with the requirement for the diffuse emissions by submitting a solvent balance in accordance with the Solvent Ordinance (31st BImSchV)<sup>17</sup> and the corresponding balance guidelines in VDI Directive 2587 and state the values in Annex 6.*

*The applicant shall verify compliance with the requirement by submitting a tabular list of the amount of paper purchased and provided, as well as the purchased quantities of the named solvents contained in the product over a 12 month period as Annex 6. The content of volatile organic solvents (according to the definition in Paragraph 1.6) in the respective products must be requested from the suppliers or this information must be stated in Annex 4. However, the end of the 12 month period must not be earlier than 12 months before the application. The value of 10% must be complied with for the first time in the period 01/01-31/12/2021 and then verified again for subsequent 12-month periods. A value of 12% must be complied with before this period. Verification of compliance with the requirements must be submitted without request to RAL gGmbH every year.*

### **3.9.6 Emissions of volatile organic compounds in rotogravure printing**

When using rotogravure printing, the following requirements for the emission of volatile organic compounds must be observed:

- Toluene must be regenerated out of the waste gas and the emissions from the regeneration plant must be continuously measured. The emissions must not exceed 20 mg C/Nm<sup>3</sup> as a daily average.
- The total emissions of volatile organic compounds must not exceed a proportion of 2.5% of the solvents used over a 12 month period. The solvents used comprise the quantity of solvents purchased and the quantity reused after the recovery process. Volatile organic

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<sup>17</sup> 31st Ordinance for the implementation of the Federal Immission Protection Act (ordinance for limiting the emission of volatile organic compounds due to the use of organic solvents in certain installations) from 21 August 2001 (BGBl. I S. 2180), which was last amended by Article 5 of the Ordinance from 24 March 2017 (BGBl. I S. 656).

compounds contained in waste or which result from the recovery process and were subsequently sold do not count as emissions (see Appendix C Point 2 for the calculation formula).

- The quantity of volatile solvents purchased (toluene as an ink solvent, as a cleaning agent or for correcting the cylinder, etc.), less the volatile organic compounds sold after the recovery process, over a 12 month period in relation to the amount of paper purchased and provided over the same period must not exceed 2 kg/t (see Appendix C Point 2 for the calculation formula).
- The quantity of volatile solvents purchased, less the volatile organic compounds sold after the recovery process, over a 12 month period should also be compared to the surface area of the paper purchased and provided (paper which is used in the printing processes at the company) over the same period (see Appendix C Point 2 for the calculation formula).
- The emissions of toluene in the ready-to-deliver printed matter must not exceed 300 mg per kilogram of printed matter, measured in accordance with the method described in Appendix D.

### **Compliance verification**

*The applicant shall verify compliance with the requirement for the waste gas concentration by submitting a measurement report.*

*The applicant shall verify compliance with the requirement for the maximum total emissions by submitting a solvent balance in accordance with the Solvent Ordinance (31st BImSchV)<sup>9</sup> (see also Appendix C) and state the values in Annex 6. The value of 2.5% must be complied with for the first time in the period 01/01-31/12/2021 and then verified again for subsequent 12-month periods. A value of 3% must be complied with before this period.*

*The applicant shall verify compliance with the requirement by submitting a tabular list of the amount of paper purchased and provided, as well as the purchased quantities of the named solvents contained in the product over a 12 month period as Annex 6. The content of volatile organic solvents (according to the definition in Paragraph 1.6) in the respective products must be requested from the suppliers or this information must be stated in Annex 4. However, the end of the 12 month period must not be earlier than 12 months before the application.*

*The applicant shall verify compliance with the requirement for the residual toluene emissions in the form of an illustrative test certificate in accordance with the "COWI II test method for determining toluene emissions from printed matter", which may not be more than 3 months old (see Appendix D). The measurement uncertainty must not exceed a maximum of 15%. Verification of compliance with the requirements must be submitted without request to RAL gGmbH every year.*

### **3.9.7 Emissions of volatile organic compounds in flexographic printing**

When using flexographic printing, the following requirements for the emission of volatile organic compounds must be observed:

- Irrespective of the solvent consumption, the captured waste gases from the dryer must be continuously measured and must not exceed 20 mg C/Nm<sup>3</sup>, unless it can be verified that only water-based inks and varnishes are used.
- Irrespective of the solvent consumption, the annual average figure for the diffuse emissions of volatile organic compounds must not exceed a proportion of 12% of the solvents used, unless it can be verified that only water-based inks and varnishes are used. The proportion

of diffuse emissions must be determined in accordance with the solvent balance in Regulation 2010/75/EU, with the exception that untreated emissions should also be added to the diffuse emissions.

- The quantity of volatile solvents purchased (i.e. ink solvents, retarders and thinners, as well as cleaning agents with a vapour pressure greater than 0.1 hPa) over a 12 month period in relation to the amount of paper purchased and provided over the same period must not exceed 2 kg/t.

### **Compliance verification**

*The applicant shall verify compliance with the requirement for the waste gas concentration by submitting a measurement report.*

*The applicant shall verify compliance with the requirement for the maximum total emissions by submitting a solvent balance in accordance with the Solvent Ordinance (31st BImSchV)<sup>9</sup> and state the values in Annex 6. The value of 12% must be complied with for the first time in the period 01/01-31/12/2021 and then verified again for subsequent 12-month periods. A value of 20% must be complied with before this period.*

*The applicant shall verify compliance with the requirement by submitting a tabular list of the amount of paper purchased and provided, as well as the purchased quantities of the named solvents contained in the product over a 12 month period as Annex 6. The content of volatile organic solvents (according to the definition in Paragraph 1.6) in the respective products must be requested from the suppliers or this information must be stated in Annex 4. However, the end of the 12 month period must not be earlier than 12 months before the application. Verification of compliance with the requirements must be submitted without request to RAL gGmbH every year.*

### **3.9.8 Emissions of chromium VI in wastewater in rotogravure printing**

When using rotogravure printing, the following requirements for wastewater from the chromium treatment process before mixing in wastewater treatment plants must be observed:

- The treatment of the wastewater containing chromium waste must be carried out in batches separately to other wastewater.
- The concentration of chromium VI in the wastewater after the chromium treatment process and before mixing with other wastewater must not exceed 0.08 mg/l in any of the eligible samples (no utilisation of the 4 out of 5 rule). The measurements must be carried out every 2 years.
- The content of chromium VI in every batch must be additionally monitored and documented by internal inspections. The measurement values do not need to be verified using the standard reference process, but using quick tests.
- The wastewater treatment system must be fitted with a final filter (e.g. consisting of an ion exchanger or activated carbon) to hold back surfactants added to the chrome bath for the purposes of occupational safety.

### **Compliance verification**

*The applicant shall declare compliance with the requirements in Annex 1b and submit the latest three measurement reports from an approved testing institution. In addition, the applicant shall describe their electroplating and wastewater treatment plants.*

### **3.9.9 Emissions of fine particulate matter in all printing processes**

Due to the risks posed to health by particulate matter, the following requirements must be fulfilled:

- Dust created during cutting and milling work must be extracted at its point of origin using the current state of technology. Dust deposits on machines and in working areas must be removed on a regular basis.

#### ***Compliance verification***

*The applicant shall declare compliance with the requirements in Annex 1.*

### **3.10 Requirements for the pre-press process**

#### **3.10.1 Illustrations**

No films may be used to illustrate the printing plates, only digital processes are permissible.

#### ***Compliance verification***

*The applicant shall declare compliance with the requirements in Annex 1.*

#### **3.10.2 Development**

If developer fluid is used in the development of offset printing plates, it should be regenerated in the machine. Processless printing plates should be used for sheet-fed offset printing.

#### ***Compliance verification***

*The applicant shall declare compliance with the requirements in Annex 1a. If processless printing plates are not used for sheet-fed offset printing, the reason for this decision must be justified.*

### **3.11 Requirements for waste paper**

The production site for the printed matter named in the application must record key figures to show the amount of waste paper and cardboard, as well as the amounts of paper and cardboard purchased and provided. The following key figures for the last three years in each case must be provided as a minimum:

- Annual amount of waste paper<sup>18</sup>
- Annual amount of waste paper in relation to the paper purchased/used (paper and cardboard purchased or, if relevant, provided) in percent.

The following maximum values for the amount of waste per year should be observed:

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<sup>18</sup>: This includes the paper waste code numbers: 15 01 01 paper and cardboard packaging or 20 01 01 paper and cardboard.

Table 3: Maximum amount of waste per year for each printing process

<b>Printing process</b>	<b>Maximum amount of waste</b>
Sheet-fed offset printing	20% by mass
Newspaper coldset web offset printing	10% by mass
Other coldset web offset printing	18% by mass
Heatset web offset printing	20% by mass
Rotogravure printing	15% by mass
Flexographic printing	11% by mass
Digital printing	10% by mass

If multiple printing processes are carried out at one location, for which it is not possible to collect separate measurements for the amounts of waste paper, the waste paper is to be allocated according to the ratio of the paper purchased for each of the different printing processes.

If the maximum amount of waste is exceeded, the reasons for this must be analysed, documented and justified on a yearly basis.

The following measures for reducing the amount of waste paper must also be documented as a minimum:

- Cause analysis
- Countermeasures
- Training

The cause analysis must focus on the following measures as a minimum:

- Improving the utilisation of the paper
- Reducing maculature
- Reducing faulty prints
- Reducing storage damage.

In justified exceptional cases, the use of a press container is not obligatory. This justification must be sent to RAL gGmbH every four years.

### **Compliance verification**

*The applicant shall state the maximum amounts of waste for the last three years in Annex 6. In addition, the applicant shall verify compliance with the maximum amounts of waste by submitting a tabular list of the amount of paper purchased and provided, as well as notifications from the paper disposal company about the amount of paper disposed of over a 12 month period in each case for a total of three years. Verification of compliance with the requirements must be submitted without request to RAL gGmbH every year.*

*The notifications from the paper disposal company must contain weight measurements in kilograms or tonnes. The end of the last 12 month period must not be earlier than 12 months before the application.*

*The applicant shall submit documentation on reducing the volume of waste paper, insofar as the maximum permitted value for the waste has been exceeded.*

*In addition, the applicant shall declare that he/she uses a press container in Annex 1 or, if making use of the exemption, submit justification for why a press container is not being used.*

## **3.12 Requirements for energy consumption**

### **3.12.1 List of energy consumers**

The list of energy consumers at the production site for the printed matter named in the application must include all energy consuming machines, devices, heating/air conditioning and lighting. The list of energy consumers must contain at least the following information:

- Maximum output of the energy consumers (in KW) and the estimated average output (in kW)
- Measurement or estimate of the annual operating times for the energy consumers (h)
- Sum of the calculated energy consumption values and the actual energy consumption values (in kWh)
- Identification of the largest energy consumers and corresponding improvement measures.

The specific total energy consumption for the printed product named in the application must be determined based on this list. The specific total energy consumption should be determined on an annual basis and used to create year-on-year comparisons. If this key figure is higher than the previous year in the comparison, the reasons for this must be identified and stated.

#### ***Compliance verification***

*The applicant shall verify compliance with the requirement by submitting a list of energy consumers and submit information on the specific total energy consumption for a typical print run of the printed product. The applicant shall submit this key figure to RAL gGmbH on an annual basis and document the reasons for any increase in this key figure.*

### **3.12.2 Heatset web offset dryer**

The following requirements apply to the waste heat from the heatset web offset dryer used to produce the printed matter:

The energy used to dry the printing inks must be used within an integrated heating/cooling concept. The concept must be regularly checked and documented in a catalogue of measures. The energy concept must include one of the following measures:

- Combined heat and power
- Integrated drying (burning of expelled solvents for creating heat in the dryer)
- Use of waste heat for conditioning of the room air (heating/cooling) and generating hot water (non-integrated dryer).

In justified exceptional cases, it is possible to deviate from this requirement. This justification must be sent to RAL gGmbH every four years.

#### ***Compliance verification***

*The applicant shall verify compliance with the requirements or submit justifications for any deviations from the requirements.*

### **3.12.3 Compressed air system**

The compressed air system for the machine used to produce the printed matter must be optimised and fulfil the following requirements:

- Regular inspection of the compressed air system for leakages, at least once a year using a leakage detector or using a documented and similarly efficient leakage detection system in operation at the company
- Centralisation of the compressed air system
- Separation of the central compressed air network, if present, into two pressure levels for the separate supply of power units with higher and lower pressure requirements
- The room humidification system should not be operated using compressed air but rather using a high pressure water system.

In justified exceptional cases, it is possible to deviate from these requirements. This justification must be sent to RAL gGmbH every four years.

### **Compliance verification**

*The applicant shall describe the compressed air system operated on-site, its maintenance and the room humidification system. The applicant shall submit suitable documentation to explain the process for energy optimisation of the compressed air system in Annex 1 and submit justifications for any deviations from the requirements.*

### **3.13 Overview of environmentally-damaging materials and technologies under development**

Many of the requirements for certification with the Blue Angel for printed matter apply to the manufacturers of printing inks and varnishes over which the printing company only has a limited amount of influence. The feasibility of developing a Blue Angel for printing inks will thus be examined. This would significantly reduce the amount of effort required by the printing companies when submitting verifications.

Practices and techniques that are currently being developed and which should be examined in the next revision of the Basic Award Criteria include:

- Energy-efficient recovery of high-quality solvents – which evaporate in the heatset web offset dryer – and can be reused as an ink solvent
- Energy-efficient technologies for drying and waste air purification
- Definition of a uniform measurement method for determining the amount of saturated hydrocarbons as verification for Paragraph 3.8.5
- Making the production of processless printing plates an obligatory requirement
- Verification in accordance with INGEDE Method 12 for all water-based or redispersible adhesives
- Changing the criterion that “the product should score at least 50% of the maximum number of points available for each individual criteria of INGEDE Method 11” from a “should” criterion to a “must” criterion
- Exclusion of endocrine active substances
- Restriction of further PAHs in printing inks
- Excluding the use of PFAS
- Obligatory certification of freedom from genetic engineering in the cultivation of raw materials
- Definition of a uniform measurement method and introduction of maximum values to restrict the emissions of particulate matter when using dry toner in digital printing
- Obligation to use electricity sourced from renewable energies

- CO2 balance for printed matter that delivers comparable results in particular for the paper and cardboard provided and also takes account of the printing inks, auxiliary substances, fuels, material transport and travel to and from the site by employees in a standardised manner.

#### **4 Applicants and parties involved**

Manufacturers or distributors of products according to Paragraph 2 shall be eligible for application.

Parties involved in the award process are:

- RAL gGmbH to award the Blue Angel environmental label,
- the federal state being home to the applicant's production site,
- Umweltbundesamt, (German Environment Agency) which after the signing of the contract receives all data and documents submitted in application for the Blue Angel in order to be able to further develop the Basic Award Criteria.

#### **5 Use of the Environmental Label**

The use of the environmental label by the applicant is governed by a contract on the use of the environmental label concluded with RAL gGmbH.

Within the scope of such contract, the applicant undertakes to comply with the requirements under Paragraph 3 while using the environmental label.

If the environmental label is depicted on the printed matter, particularly on those used to advertise one or more products, the applicant (publisher or client) must ensure that the environmental label is kept clearly separate from this content (e.g. by depicting it in the imprint, the header or footer of the relevant printed matter). It must be sufficiently clear that the environmental label has been issued exclusively for the printed matter being used. In the case of advertising leaflets, brochures, flyers, catalogues, posters and similar, the following note must be printed next to the environmental label: "This printed matter has been awarded the Blue Angel."

Contracts on the Use of the Environmental Label are concluded to fix the terms for the certification of products under Paragraph 2. Such contracts shall run until 31 December 2025.

They shall be extended by periods of one year each, unless terminated in writing by 31 March 2025 or 31 March of the respective year of extension.

After the expiry of the contract, the Environmental Label may neither be used for labelling nor for advertising purposes. This regulation shall not affect products being still in the market.

The applicant shall be entitled to apply to RAL gGmbH for an extension of the right to use the ecolabel on the product entitled to the label if it is to be marketed under another brand/trade name and/or other marketing organizations.

The Contract on the Use of the Environmental Label shall specify:

- Applicant (manufacturer/distributor)
- Brand/trade name, product description

- Distributor (Label User), i.e. the marketing organization.

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## Anhang A Statutory regulations, testing standards and other literature

- 31st BImSchV: 31st Ordinance for the implementation of the Federal Immission Protection Act (ordinance for limiting the emission of volatile organic compounds due to the use of organic solvents in certain installations)  
[https://www.gesetze-im-internet.de/bimschv\\_31/](https://www.gesetze-im-internet.de/bimschv_31/)
- AfPS GS 2019:01 PAK: Testing and assessment of polycyclic aromatic hydrocarbons (PAHs) in the course of awarding the GS mark – specification according to § 21 (1) No. 3 ProdSG. GS specification. Product Safety Commission (AfPS), Federal Institute for Occupational Safety and Health, Dortmund, 10 April 2020  
<https://www.baua.de/DE/Aufgaben/Geschaeftsfuehrung-von-Ausschuessen/AfPS/pdf/AfPS-GS-2019-01-PAK.pdf?blob=publicationFile&v=6>
- DIN 55610:1986: Testing of pigments and solvent-soluble dyestuffs; determination of un-sulfonated primary aromatic amines <https://www.beuth.de/de/norm/din-55610/1305793>
- EPRC (2017): Assessment of Printed Product Recyclability – Deinkability Score User's Manual. European Paper Recycling Council. <http://www.paperforrecycling.eu/publications/>
- EPRC (2018): Assessment of Printed Product Recyclability – Scorecard for the Removability of Adhesive Applications, European Paper Recycling Council. <http://www.paperforrecycling.eu/publications/>
- ETAD Method 212 (2016): Identification and Quantification of Primary Aromatic Amines in Organic Pigments by HPLC. <https://etad.com/en/publications/etad-methods.html>
- INGEDE Method 11 (2018): Assessment of print product recyclability – Deinkability test. <http://pub.ingede.com/methoden/>
- INGEDE Method 12 (2013): Assessing the Recyclability of Printed Products — Testing of Fragmentation Behaviour of Adhesive Applications. <http://pub.ingede.com/methoden/>
- TRGS 614 (2001): Technical Rules for Hazardous Substances– Restrictions on use for azo dyes, which may release aromatic amines classified as carcinogens, March 2001. <https://www.baua.de/DE/Angebote/Rechtstexte-und-Technische-Regeln/Regelwerk/TRGS/TRGS-614.html>
- TRGS 905 (2020): Technical Rules for Hazardous Substances – Directory of carcinogenic and mutagenic substances and substances toxic to reproduction, March 2016, updated in 2020. <https://www.baua.de/DE/Angebote/Rechtstexte-und-Technische-Regeln/Regelwerk/TRGS/TRGS-905.html>
- VDI Guideline 2587 Sheet 1: Emission control - Heatset web offset presses <https://www.vdi.de>
- VerpackG (2017): German law for the sale, return and high-quality recycling of packaging from 5 July 2017 <http://www.gesetze-im-internet.de/verpackg/>
- Regulation (EC) No. 1272/2008 of the European Parliament and of the Council of 16 December 2008 concerning the classification, labelling and packaging of substances and mixtures [https://www.reach-clp-biozid-helpdesk.de/DE/CLP/Rechtstexte/Rechtstexte\\_node.html](https://www.reach-clp-biozid-helpdesk.de/DE/CLP/Rechtstexte/Rechtstexte_node.html)
- Regulation (EU) No. 528/2012 of the European Parliament and of the Council of 22 May 2012 concerning the making available on the market and use of biocidal products [https://www.reach-clp-biozid-helpdesk.de/DE/Biozide/Rechtstexte/Rechtstexte\\_node.html](https://www.reach-clp-biozid-helpdesk.de/DE/Biozide/Rechtstexte/Rechtstexte_node.html)
- Regulation (EC) No. 1907/2006 of the European Parliament and of the Council of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

[https://www.reach-clp-biozid-helpdesk.de/DE/REACH/Rechtstexte/Rechtstexte\\_node.html](https://www.reach-clp-biozid-helpdesk.de/DE/REACH/Rechtstexte/Rechtstexte_node.html)

## **Anhang B INGEDE methods – instructions for completion**

### **1 Deinking test according to INGEDE Method 11**

Ideally in cooperation with the printing company and the ink/varnish manufacturers, the applicant will arrange for the completion of deinking tests in accordance with INGEDE Method 11.

The test is carried out on two types of paper: coated and uncoated paper, which have been awarded the environmental labels DE-UZ 14a, DE-UZ 14b, DE-UZ 56 or DE-UZ 72. In the case of inkjet printing, it is not permissible to simplify the types of paper into coated and uncoated because the deinkability is highly dependent here on the paper, printing ink and, if used, primer. Therefore, it is only possible in this case to certify the ink used in combination with the paper used. If only one type of paper is used, it is only necessary to carry out the test on this type of paper. Precisely specified series of printing inks or varnishes from one manufacturer must be used for the test. The test report must state both the paper (trade name, coated/uncoated, mass per unit area, manufacturer) used for the test and the precise description of the printing inks (trade name, colour tone, manufacturer).

If additional varnishes or other coating materials that could influence the deinkability are used, verification of the deinkability of these defined substances must be additionally provided (paper + printing ink + varnish/coating material). These additional substances must also be stated in the test report with their trade names and manufacturers.

If printing ink series only differ with respect to the amount of solvent used to set the viscosity, it is possible to cover multiple series with two tests of the series with the lowest and highest proportion of solvent if a declaration from the printing ink manufacturer is submitted.

Example: "Fictitious ink 200" and "Fictitious ink 300" have been tested and approved for all four colour tones, which only differ due to the proportion of solvent used. As a result, the other printing products "Fictitious ink 2xx" with ink series that use a proportion of solvent that is between that used in "Fictitious ink 200" and "Fictitious ink 300" are covered by their tests and approvals.

If there is verification in accordance with the Deinkability Scorecard from the EPRC, approval will be issued by RAL gGmbH for all printed matter that is produced with these specifications – the same or lower use of printing inks, the same or higher mass per unit area of the paper – without each one requiring special individual verification.

This approval can also be issued for products from other licence holders if the corresponding verification of the deinkability (e.g. from the supplier of the ink and/or varnish) is provided to the relevant applicant. The verification of the deinkability must not be more than 3 years old.

In the case of reasonable doubt about the conformity of the product in the application and the boundary conditions in the submitted verification of deinkability, RAL gGmbH can request a special deinking test from the applicant for the product stated in the application.

If printing ink tests from more than one manufacturer are used, the test must be carried out separately for each manufacturer.

Table 4: Examples for the number of required tests

<b>Composition of the printed matter</b>	<b>Number of tests</b>
coated paper + 1 set of printing inks	1
uncoated + coated paper + 1 set of printing inks	2
coated paper + 2 sets of printing inks (same manufacturer)	2
coated paper + 2 sets of printing inks (different manufacturers)	2
uncoated + coated paper + 2 sets of printing inks (same manufacturer)	4
uncoated + coated paper + 2 sets of printing inks (different manufacturers)	4
coated paper + 1 set of printing inks + 1 varnish	1
coated paper + 1 set of printing inks with and without varnish	2
coated paper + 1 set of printing inks + 2 varnishes	2
coated paper + 2 sets of printing inks (different manufacturers) + 2 varnishes	4
1 paper + 1 set of inks (inkjet printer)	1
2 papers + 2 sets of inks (inkjet printer)	4

## 2 Removability of the adhesive applications

A test according to INGEDE Method 12 must be submitted for all non water-based or non-redispersible adhesives.

A test must be carried out for each adhesive used. An exception is made here for side and back gluing. These can be tested in combination in a joint test.

The test report must state both the paper (trade name, coated/uncoated, manufacturer) used for the test and the precise description of the adhesive (trade name, type of adhesive, manufacturer). In addition, the coating thickness and the type of application used for the adhesive (selective, full surface) must be stated. Printed products are covered by the tested sample if the dimensions for the application of the adhesive – thickness and/or, if relevant, dot size – are the same or higher.

If more than one adhesive is used in combination for side and back gluing, a test must be carried out separately for each combination.

Table 5: Examples for the number of required tests

<b>Composition of the printed matter</b>	<b>Number of tests</b>
1 adhesive	1
2 adhesives	2
Adhesive for 1 side gluing + 1 back gluing	1
Adhesive for 2 side gluings + 1 back gluing	2
Adhesive for 1 side gluing + 2 back gluings	2
Adhesive for 2 side gluings + 2 back gluings	4

If there is successful verification of compliance with the requirements of the “EPRC-Scorecard for the Removability of Adhesive Applications”, either in the form of a corresponding test, or compliance with the conditions stated in the ANNEX (Exempted from testing) of the EPRC Scorecard, RAL gGmbH will issue approval for all of the printed matter produced in accordance with these specifications, without requiring special individual verification.

## Anhang C Calculating the solvent emissions

### 1 Definitions (based on the Industrial Emissions Directive 2010/75/EU)

#### Volatile organic solvents (VOC, also see Paragraph 1.6)

“Volatile organic solvents” in the context of these Basic Award Criteria are organic compounds (VOC) that have a vapour pressure of 0.01 kPa or more at 293.15 K (20°C) or a corresponding volatility under the particular conditions of use (e.g. dryer in heatset web offset printing).

#### Paper

In the context of these Basic Award Criteria, “paper” in the following calculations refers to printable materials (paper, cardboard) incl. maculature and trimmings. Packaging paper and cardboard packaging are not included in the calculations. Paper and cardboard provided by clients must be taken into consideration.

#### Reference period

Any previous 12 month period can be selected by the applicant as the reference period for the following calculations. However, the end of the 12 month period must not be earlier than 12 months before the application.

#### Measurement values

All reference values in the following calculations shall be given in units of mass. If only the volumes of the purchased quantities is known, this information shall be converted into mass using the density stated in the safety data sheet.

### 2 Calculation formulas

- **Total emissions:**  
Total emissions (G) [kg]:  $E - Z - A - R - L$
- **Key figure for the quantity:**  
Key figure for the quantity [kg/t]:  $G / P1$
- **Key figure for the surface area:**  
Key figure for the surface area [kg/m<sup>2</sup>]:  $G / P2$

### 3 Explanation of the abbreviations

#### Input paper (P):

- P1 Amount of paper [t] that was purchased or provided over a 12 month period  
P2 Surface area of paper [m<sup>2</sup>] that was purchased or provided over a 12 month period

#### Quantity of volatile solvents purchased [kg]:

- E Quantity of volatile solvents purchased or the proportion of volatile organic solvents in the quantity of mixtures purchased (e.g. toluene, ethanol, ethyl acetate in purchased printing inks or ethanol in dampening solution additives for offset printing), as well as the proportion of organic solvents that are volatile under the particular conditions of use (e.g. dryer in heatset web offset printing). If the safety data sheet does not state a precise value for the proportion of solvents but rather a range, the average of this range or a precise value documented by the manufacturer must be used.

#### Discharge of volatile organic solvents [kg]:

- Q Waste gas emissions downstream of a treatment plant for volatile organic compounds (oxidation/combustion or recovery), which is calculated by determining the volumetric flow

rate [m<sup>3</sup>] and total concentration of carbon [mg] (stated for standardised conditions of 273.15 K and 1013.25 hPa), as well as by converting the total carbon into total VOC [mg]. The conversion factor "C->VOC" for individual substances corresponds to the ratio of the molecular weight of the carbon content relative to the complete substance. For emissions from mixtures, a conversion factor for the mixture containing the volatile organic solvent recommended by a testing institution shall be used.

- Z Amount of volatile organic solvents destroyed by waste gas treatment (e.g. oxidation/combustion). The destroyed amount is defined as the difference between the amount of volatile organic solvents before the waste gas treatment plant and fraction "Q". The conversion of total carbon to VOC is carried out as for fraction "Q". A continuous measurement of the volumetric flow rate and total carbon in the untreated gas (e.g. lower explosive limit (LEL) measurement) should be used where possible as the basis for the calculations.
- A Proportion of volatile organic solvents in waste, which is properly disposed of and whose destruction or recovery is certified by the waste disposal company. The proportion of organic solvents in the waste should be determined using a representative measurement for every typical fraction of the waste (e.g. volatile organic residues in ink residues, contaminated cleaning agents or distillation sludge). The amount of volatile organic solvents in cleaning cloths that are properly disposed of after being stored in closed containers can be estimated by using the number of cleaning cloths delivered and taking comparative weight measurements of the cleaning cloths with/without solvents.
- R Recovered volatile organic solvents or their proportion in recovered mixtures, insofar as the solvent has not been reused within the 12 month period being considered but is instead intended for future internal use and thus increases the company's own stocks compared to the initial stock levels.
- L Volatile organic solvents contained in commercially produced products (e.g. the manufacture of printing inks, varnishes or adhesives) or recovered during operation and delivered to external companies (e.g. ink manufacturers) for direct recycling. Solvents that are delivered to waste disposal companies for treatment do not belong to the fraction "L" but rather to the fraction "A".

**Other fractions not relevant for the calculation:**

- W Volatile organic solvents recovered internally within the company in the 12 month period and reused in the same 12 month period.  
Increases in the stock levels of recovered solvents (between the start and end of the 12 month period) are to be recorded as fraction "R". Determining the fraction "W" is not required for calculating the key figures.
- X Volatile organic solvents that find their way into wastewater. It is assumed that these solvents evaporate from the wastewater before they are destroyed by microorganisms and thus escape into the environment as diffuse emissions. Determining the fraction "X" is not required for calculating the key figures.
- V Volatile organic solvents that are contained in products as impurities or residues (e.g. residual emissions from toluene, ethanol or isopropanol from finished printed matter). It is assumed that these solvents evaporate and thus escape into the environment as diffuse emissions. Determining the fraction "V" is not required for calculating the key figures.
- D Diffuse emissions of volatile organic solvents insofar as they are not contained in X, V or U – meaning emissions through windows and doors. Roof fans and other discharge outlets

without waste gas treatment belong to the fraction "D". Determining the fraction "D" is not required for calculating the key figures.

- U Volatile organic solvents that are unintentionally released e.g. due to accidents or other unplanned, uncontrolled emissions into the environment. Determining the fraction "U" is not required for calculating the key figures.

## **Anhang D COWI II test method for determining toluene emissions from printed matter**

The sample is taken at room temperature using a 5 litre glass container with a leak-tight rubber stopper. Toluene is stripped out and collected on activated carbon. The activated carbon is then tested using gas chromatography with FID. The result is given in "mg toluene/kg of sample".

Materials and equipment:

- Test container (5 litre glass container)
  - Rubber stopper with two gas inlets
  - Pump for a low flow rate (1.5 litres/minute)
  - Activated carbon vials
  - Prepurified ambient air
  - Carbon disulfide, analysis quality
  - Gas chromatograph with FID
- 
- a) Add the sample – ¼ of a brochure corresponding to 10-50 grammes – to the test container and attach the rubber stopper. Handle the sample quickly and carefully in order to minimise the evaporation of the toluene when preparing the sample.
  - b) Attach the activated carbon vials to preliminarily clean the ambient air at the inlet.
  - c) Connect the pump and another activated carbon vial to the outlet from the container.
  - d) Channel preheated ambient air at a temperature of 23°C through the container at a volumetric flow rate of 1.5 l/min for a period of 60 minutes.
  - e) Desorb the toluene from the activated carbon vials by adding 1.5 ml of carbon disulfide and shaking for 30 minutes.
  - f) Analyse the extract using gas chromatography with FID.

The results are given in milligrams of toluene per kilogram of paper.

Typical measurement uncertainty: 5-10% (standard deviation).

Determination limit: 0.2 mg/kg.