BEST AVAILABLE TECHNIQUES (BAT) CONCLUSIONS FOR SURFACE TREATMENT USING ORGANIC SOLVENTS INCLUDING PRESERVATION OF WOOD AND WOOD PRODUCTS WITH CHEMICALS

SCOPE

These BAT conclusions concern the following activities specified in Annex I to Directive 2010/75/EU:

6.7: Surface treatment of substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, sizing, painting, cleaning or impregnating, with an organic solvent consumption capacity of more than 150 kg per hour or more than 200 tonnes per year.

6.10: Preservation of wood and wood products with chemicals with a production capacity exceeding 75 m^3 per day other than exclusively treating against sapstain.

6.11: Independently operated treatment of waste water not covered by Directive 91/271/EEC provided that the main pollutant load originates from activities specified in point 6.7 or 6.10 of Annex I to Directive 2010/75/EU.

These BAT conclusions also cover the combined treatment of waste water from different origins provided that the main pollutant load originates from the activities specified in point 6.7 or 6.10 of Annex I to Directive 2010/75/EU and that the waste water treatment is not covered by Directive 91/271/EEC.

These BAT conclusions do not address the following:

For surface treatment of substances, objects or products using organic solvents:

- Waterproofing of textiles by means other than the use of a solvent-based continuous film. This may be covered by the BAT conclusions for the textiles industry (TXT).
- Printing, sizing and impregnation of textiles. This may be covered by the BAT conclusions for the textiles industry (TXT).
- Lamination of wood-based panels.
- Conversion of rubber.
- Manufacturing of coating mixtures, varnishes, paints, inks, semiconductors, adhesives or pharmaceutical products.
- On-site combustion plants unless the hot gases generated are used for direct contact heating, drying or any other treatment of objects or materials. These may be covered by the BAT conclusions for large combustion plants (LCP) or by Directive 2015/2193/EU.

For preservation of wood and wood products with chemicals:

- Chemical modification and hydrophobisation (e.g. using resins) of wood and wood products.
- Sapstain treatment of wood and wood products.
- Ammonia treatment of wood and wood products.
- On-site combustion plants. These may be covered by the BAT conclusions for large combustion plants (LCP) or by Directive 2015/2193/EU.

Other BAT conclusions and reference documents which may be of relevance for the activities covered by these BAT conclusions are the following:

- Economics and Cross-Media Effects (ECM).
- Emissions from Storage (EFS).
- Energy Efficiency (ENE).
- Waste Treatment (WT).
- Large Combustion Plants (LCP).
- Surface Treatment of Metals and Plastics (STM).
- Monitoring of Emissions to Air and Water from IED Installations (ROM).

DEFINITIONS

For the purposes of these BAT conclusions, the following definitions apply:

General terms	
Term used	**Definition**
Base coat	Paint which, when applied to a substrate, determines the colour and the effect (e.g. metallic, pearlescent).
Batch discharge	Discharge of a discrete, contained volume of water.
Clear coat	Coating material which, when applied to a substrate, forms a solid transparent film with protective, decorative or specific technical properties.
Combiline	Combination of hot-dip galvanising and coil coating in the same process line.
Continuous measurement	Measurement using an automated measuring system permanently installed on site for continuous monitoring of emissions, according to EN 14181.
Direct discharge	Discharge to a receiving water body without further downstream waste water treatment.
Emission factors	Coefficients that can be multiplied by known data such as plant/process data or throughput data to estimate emissions.
Existing plant	A plant that is not a new plant.
Fugitive emissions	Fugitive emissions as defined in Article 57(3) of Directive 2010/75/EU.
Grade B or C creosote	Types of creosote for which specifications are given in EN 13991.
Indirect discharge	Discharge which is not a direct discharge.
Major plant upgrade	A major change in the design or technology of a plant with major adjustments or replacements of the process and/or abatement technique(s) and associated equipment.
New plant	A plant first permitted on the site of the installation following the publication of these BAT conclusions or a complete replacement of a plant following the publication of these BAT conclusions.
Off-gas	The gas extracted from a process, piece of equipment or area which is either directed to treatment or discharged directly to air through a stack.
Organic compound	Organic compound as defined in Article 3(44) of Directive 2010/75/EU.
Organic solvent	Organic solvent as defined in Article 3(46) of Directive 2010/75/EU.
Plant	All parts of an installation that carry out an activity listed in point 6.7 or 6.10 of Annex I to Directive 2010/75/EU and any other directly associated activities which have an effect on consumption and/or emissions. Plants may be new plants or existing plants.
Primer coat	Paint formulated for use as a layer on a prepared surface, to provide good adhesion, protection of any layers below and filling of surface irregularities.
Sector	Any of the surface treatment activities that are part of activities listed in point 6.7 of Annex I to Directive 2010/75/EU and are referred to in Section 1 of these BAT conclusions.
Sensitive receptor	Area which needs special protection, such as: - residential areas, - areas where human activities are carried out (e.g. neighbouring workplaces, schools, day-care centres, recreational areas, hospitals or nursing homes).
Solid mass input	The total mass of solids used as defined in Part 5, 3(a)(i) of Annex VII to Directive 2010/75/EU.
Solvent	'Solvent' refers to 'organic solvent'.
Solvent input	The total quantity of organic solvents used as defined in Part 7, 3(b) of Annex VII to Directive 2010/75/EU.
Solvent-based (SB)	Type of paint, ink or other coating material using solvent(s) as the carrier. For the preservation of wood and wood products, it refers to the type of treatment chemicals.
Solvent-based-mix (SB-mix)	Solvent-based coating where one of the coating layers is water-based (WB).
Solvent mass balance (SMB)	A mass balance exercise conducted at least once every year according to Part 7 of Annex VII to Directive 2010/75/EU.

Surface run-off water	Water from precipitation that flows over land or impervious surfaces, such as paved streets and storage areas, rooftops, etc. and does not soak into the ground.
Total emissions	The sum of fugitive emissions and emissions in waste gases as defined in Article 57(4) of Directive 2010/75/EU.
Treatment chemicals	Chemicals used in wood and wood products preservation such as biocides, chemicals used for waterproofing (e.g. oils, emulsions) and flame retardants. This also includes the carrier of active substances (e.g. water, solvent).
Valid hourly/half-hourly average	An hourly/half-hourly average is considered valid when there is no maintenance or malfunction of the automated measuring system.
Waste gases	Waste gases as defined in Article 57(2) of Directive 2010/75/EU.
Water-based (WB)	Type of paint, ink or other coating material in which water replaces all or part of the solvent content. For the preservation of wood and wood products, it refers to the type of treatment chemicals.
Wood preservation	Activities whose purpose is to protect wood and wood products from the damaging effects of fungi, bacteria, insects, water, weather or fire; to provide long-term conservation of structural integrity; and to improve the resistance of wood and wood products.

Pollutants and parameters	
Term used	**Definition**
AOX	Adsorbable organically bound halogens, expressed as Cl, include adsorbable organically bound chlorine, bromine and iodine.
CO	Carbon monoxide.
COD	Chemical oxygen demand. Amount of oxygen needed for the total chemical oxidation of the organic matter to carbon dioxide using dichromate. COD is an indicator for the mass concentration of organic compounds.
Chromium	Chromium, expressed as Cr, includes all inorganic and organic chromium compounds, dissolved or bound to particles.
DMF	*N*,*N*-Dimethylformamide.
Dust	Total particulate matter (in air).
F^-	Fluoride.
Hexavalent chromium	Hexavalent chromium, expressed as Cr(VI), includes all chromium compounds where the chromium is in the oxidation state +6 (dissolved or bound to particles).
HOI	Hydrocarbon oil index. The sum of compounds extractable with a hydrocarbon solvent (including long-chain or branched aliphatic, alicyclic, aromatic or alkyl-substituted aromatic hydrocarbons).
IPA	Isopropyl alcohol: propan-2-ol (also called isopropanol).
Nickel	Nickel, expressed as Ni, includes all inorganic and organic nickel compounds, dissolved or bound to particles.
NO_X	The sum of nitrogen monoxide (NO) and nitrogen dioxide (NO_2), expressed as NO_2.
PAHs	Polycyclic aromatic hydrocarbons.
TOC	Total organic carbon, expressed as C (in water).
TVOC	Total volatile organic carbon, expressed as C (in air).
TSS	Total suspended solids. Mass concentration of all suspended solids (in water), measured via filtration through glass fibre filters and gravimetry.
VOC	Volatile organic compound as defined in Article 3(45) of Directive 2010/75/EU.
Zinc	Zinc, expressed as Zn, includes all inorganic and organic zinc compounds, dissolved or bound to particles.

ACRONYMS

For the purposes of these BAT conclusions, the following acronyms apply:

Acronym	Definition
BPR	Biocidal Products Regulation (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).
DWI	Drawn and wall ironed (a type of can in the metal packaging industry).
EMS	Environmental management system.
IED	Industrial Emissions Directive (2010/75/EU).
IR	Infrared.
LEL	Lower explosive limit – the lowest concentration (percentage) of a gas or vapour in air capable of producing a flash of fire in the presence of an ignition source. Concentrations lower than LEL are 'too lean' to burn. Also called lower flammable limit (LFL).
OTNOC	Other than normal operating conditions.
STS	Surface treatment using organic solvents.
UV	Ultraviolet.
WPC	Preservation of wood and wood products with chemicals.

GENERAL CONSIDERATIONS

Best Available Techniques

The techniques listed and described in these BAT conclusions are neither prescriptive nor exhaustive. Other techniques may be used that ensure at least an equivalent level of environmental protection.

Unless otherwise stated, these BAT conclusions are generally applicable.

Emission levels associated with the best available techniques (BAT-AELs)

BAT-AELs for total and fugitive VOC emissions

For total VOC emissions, the emission levels associated with the best available techniques (BAT-AELs) are given in these BAT conclusions:

- as a specific emission load calculated as yearly averages by dividing the total emissions of VOCs (as calculated by the solvent mass balance) by a sector-dependent production input (or throughput) parameter; or
- as a percentage of the solvent input, calculated as yearly averages as per Part 7, 3(b)(i) of Annex VII to Directive 2010/75/EU.

For fugitive VOC emissions, the emission levels associated with the best available techniques (BAT-AELs) are given in these BAT conclusions as a percentage of the solvent input, calculated as yearly averages as per Part 7, 3(b)(i) of Annex VII to Directive 2010/75/EU.

BAT-AELs and indicative emission levels for emissions in waste gases

Emission levels associated with the best available techniques (BAT-AELs) and indicative emission levels for emissions in waste gases given in these BAT conclusions refer to concentrations, expressed as mass of emitted substance per volume of waste gas under the following standard conditions: dry gas, at a temperature of 273.15 K and a pressure of 101.3 kPa, without correction for oxygen content and expressed in mg/Nm^3.

For averaging periods of BAT-AELs and indicative emission levels for emissions in waste gases, the following definitions apply.

Type of measurement	Averaging period	Definition
Continuous	Daily average	Average over a period of one day based on valid hourly or half-hourly averages.
Periodic	Average over the sampling period	Average value of three consecutive measurements of at least 30 minutes each ([1]).
([1]) For any parameter where, due to sampling or analytical limitations and/or due to operational conditions, a 30-minute sampling/measurement and/or an average of three consecutive measurements is inappropriate, a more representative sampling/measurement procedure may be employed.		

BAT-AELs for emissions to water

Emission levels associated with the best available techniques (BAT-AELs) for emissions to water given in these BAT conclusions refer to concentrations (mass of emitted substance per volume of water), expressed in mg/l.

Averaging periods associated with the BAT-AELs refer to either of the following two cases:

- in the case of continuous discharge, daily average values, i.e. 24-hour flow-proportional composite samples;
- in the case of batch discharge, average values over the release duration taken as flow-proportional composite samples.

Time-proportional composite samples can be used provided that sufficient flow stability is demonstrated. Alternatively, spot samples may be taken, provided that the effluent is appropriately mixed and homogeneous. Spot samples are taken if the sample is unstable with respect to the parameter to be measured. All BAT-AELs for emissions to water apply at the point where the emission leaves the plant.

Other environmental performance levels

Specific energy consumption (energy efficiency) levels associated with the best available techniques (BAT-AEPLs)

The environmental performance levels related to specific energy consumption refer to yearly averages calculated using the following equation:

$$\text{specific energy consumption} = \frac{\text{energy consumption}}{\text{activity rate}}$$

where:

energy consumption:	the total amount of heat (generated by primary energy sources) and electricity consumed by the plant, as defined in the energy efficiency plan (see BAT 19 (a)), expressed in MWh/year;
activity rate:	total amount of products processed by the plant or plant throughput, expressed in the appropriate unit depending on the sector (e.g. kg/year, m^2/year, vehicles coated/year).

Specific water consumption levels associated with the best available techniques (BAT-AEPLs)

The environmental performance levels related to specific water consumption refer to yearly averages calculated using the following equation:

$$\text{specific water consumption} = \frac{\text{water consumption}}{\text{activity rate}}$$

where:

water consumption:	total amount of water consumed by the activities carried out in the plant excluding recycled and reused water, cooling water used in once-through cooling systems, as well as water for domestic-type usage, expressed in l/year or m^3/year;
activity rate:	total amount of products processed by the plant or plant throughput expressed in the appropriate unit depending on the sector (e.g. m^2 of coated coil/year, vehicles coated/year, thousand cans/year).

Indicative levels for specific waste quantity sent off site

The indicative levels related to the specific quantity of waste sent off site refer to yearly averages calculated using the following equation:

$$\text{specific waste quantity sent off site} = \frac{\text{waste quantity sent off site}}{\text{activity rate}}$$

where:

waste quantity sent off site:	total amount of waste sent off site by the plant, expressed in kg/year;
activity rate:	total amount of products processed by the plant or plant throughput expressed in vehicles coated/year.

1 BAT CONCLUSIONS FOR SURFACE TREATMENT USING ORGANIC SOLVENTS

1.1 General BAT conclusions

1.1.1 Environmental Management Systems

BAT 1. In order to improve the overall environmental performance, BAT is to elaborate and implement an Environmental Management System (EMS) that incorporates all of the following features:

i. commitment, leadership, and accountability of the management, including senior management, for the implementation of an effective EMS;
ii. an analysis that includes the determination of the organisation's context, the identification of the needs and expectations of interested parties, the identification of characteristics of the installation that are associated with possible risks for the environment (or human health) as well as of the applicable legal requirements relating to the environment;
iii. development of an environmental policy that includes the continuous improvement of the environmental performance of the installation;
iv. establishing objectives and performance indicators in relation to significant environmental aspects, including safeguarding compliance with applicable legal requirements;
v. planning and implementing the necessary procedures and actions (including corrective and preventive actions where needed), to achieve the environmental objectives and avoid environmental risks;
vi. determination of structures, roles and responsibilities in relation to environmental aspects and objectives and provision of the financial and human resources needed;
vii. ensuring the necessary competence and awareness of staff whose work may affect the environmental performance of the installation (e.g. by providing information and training);
viii. internal and external communication;
ix. fostering employee involvement in good environmental management practices;
x. establishing and maintaining a management manual and written procedures to control activities with significant environmental impact as well as relevant records;
xi. effective operational planning and process control;
xii. implementation of appropriate maintenance programmes;
xiii. emergency preparedness and response protocols, including the prevention and/or mitigation of the adverse (environmental) impacts of emergency situations;
xiv. when (re)designing a (new) installation or a part thereof, consideration of its environmental impacts throughout its life, which includes construction, maintenance, operation and decommissioning;
xv. implementation of a monitoring and measurement programme; if necessary, information can be found in the Reference Report on Monitoring of Emissions to Air and Water from IED Installations;
xvi. application of sectoral benchmarking on a regular basis;
xvii. periodic independent (as far as practicable) internal auditing and periodic independent external auditing in order to assess the environmental performance and to determine whether or not the EMS conforms to planned arrangements and has been properly implemented and maintained;
xviii. evaluation of causes of nonconformities, implementation of corrective actions in response to nonconformities, review of the effectiveness of corrective actions, and determination of whether similar nonconformities exist or could potentially occur;
xix. periodic review, by senior management, of the EMS and its continuing suitability, adequacy and effectiveness;
xx. following and taking into account the development of cleaner techniques.

Specifically for surface treatment using organic solvents, BAT is also to incorporate the following features in the EMS:

i. Interaction with quality control and assurance as well as health and safety considerations.
ii. Planning to reduce the environmental footprint of an installation. In particular, this involves the following:
    a. assessing the overall environmental performance of the plant (see BAT 2);
    b. taking into account cross-media considerations, especially the maintenance of a proper balance between solvent emissions reduction and consumption of energy (see BAT 19), water (see BAT 20) and raw materials (see BAT 6);
    c. reducing VOC emissions from cleaning processes (see BAT 9).
iii. The inclusion of:
    a. a plan for the prevention and control of leaks and spillages (see BAT 5 (a));
    b. a raw material evaluation system to use raw materials with low environmental impact and a plan to optimise the use of solvents in the process (see BAT 3);
    c. a solvent mass balance (see BAT 10);
    d. a maintenance programme to reduce the frequency and environmental consequences of OTNOC (see BAT 13);
    e. an energy efficiency plan (see BAT 19 (a));
    f. a water management plan (see BAT 20 (a));
    g. a waste management plan (see BAT 22 (a));
    h. an odour management plan (see BAT 23).

Note: Regulation (EC) No 1221/2009 establishes the European Union eco-management and audit scheme (EMAS), which is an example of an EMS consistent with this BAT.

Applicability: The level of detail and the degree of formalisation of the EMS will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

1.1.2 Overall environmental performance

BAT 2. In order to improve the overall environmental performance of the plant, in particular concerning VOC emissions and energy consumption, BAT is to:

- identify the process areas/sections/steps that represent the greatest contribution to the VOC emissions and energy consumption and the greatest potential for improvement (see also BAT 1);
- identify and implement actions to minimise VOC emissions and energy consumption;
- regularly (at least once every year) update the situation and follow up the implementation of the identified actions.

1.1.3 Selection of raw materials

BAT 3. In order to prevent or reduce the environmental impact of the raw materials used, BAT is to use both of the techniques given below.

Technique	Description	Applicability

a.	Use of raw materials with a low environmental impact	As part of the EMS (see BAT 1), systematic evaluation of the adverse environmental impacts of the materials used (in particular substances that are carcinogenic, mutagenic and toxic to reproduction as well as substances of very high concern) and substitution by others with no or lower environmental and health impacts where possible, taking into consideration the product quality requirements or specifications.	Generally applicable. The scope (e.g. level of detail) and nature of the evaluation will generally be related to the nature, scale and complexity of the plant and the range of environmental impacts it may have, as well as to the type and quantity of materials used.
b.	Optimisation of the use of solvents in the process	Optimisation of the use of solvents in the process by a management plan (as part of the EMS (see BAT 1)) that aims to identify and implement necessary actions (e.g. colour batching, optimising spray pulverisation).	Generally applicable.

BAT 4. In order to reduce solvent consumption, VOC emissions and the overall environmental impact of the raw materials used, BAT is to use one or a combination of the techniques given below.

Technique		Description	Applicability
a.	Use of high-solids solvent-based paints / coatings / varnishes / inks / adhesives	Use of paints, coatings, liquid inks, varnishes and adhesives containing a low amount of solvents and an increased solids content.	The selection of the surface treatment techniques may be restricted by the activity type, the substrate type and shape, product quality requirements as well as the need to ensure that the materials used, coating application techniques, drying / curing techniques and off-gas treatment systems are mutually compatible.
b.	Use of water-based paints / coatings / inks / varnishes / adhesives	Use of paints, coatings, liquid inks, varnishes and adhesives where organic solvent is partially replaced by water.	
c.	Use of radiation-cured inks / coatings / paints / varnishes / adhesives	Use of paints, coatings, liquid inks, varnishes and adhesives suitable to be cured by the activation of specific chemical groups by UV or IR radiation, or fast electrons, without heat and without emission of VOCs.	
d.	Use of solvent-free two-component adhesives	Use of solvent-free two-component adhesive materials consisting of a resin and a hardener.	
e.	Use of hot-melt adhesives	Use of coating with adhesives made from the hot extrusion of synthetic rubbers, hydrocarbon resins and various additives. No solvents are used.	
f.	Use of powder coatings	Use of solvent-free coating which is applied as a finely divided powder and cured in thermal ovens.	
g.	Use of laminate film for web or coil coatings	Use of polymer films applied onto a coil or web in order to give aesthetic or functional properties, which reduces the number of coating layers needed.	
h.	Use of substances which are not VOCs or are VOCs of a lower volatility	Substitution of high-volatility VOC substances with others containing organic compounds that are non-VOCs or VOCs of a lower volatility (e.g. esters).	

1.1.4 Storage and handling of raw materials

BAT 5. In order to prevent or reduce fugitive VOC emissions during storage and handling of solvent-containing materials and/or hazardous materials, BAT is to apply the principles of good housekeeping by using all of the techniques given below.

Technique	Description	Applicability
Management techniques		

ANNEX

Technique		Description	Applicability
a.	Preparation and implementation of a plan for the prevention and control of leaks and spillages	A plan for the prevention and control of leaks and spillages is part of the EMS (see BAT 1) and includes, but is not limited to: • site incident plans for small and large spillages; • identification of the roles and responsibilities of persons involved; • ensuring staff are environmentally aware and trained to prevent/deal with spillage incidents; • identification of areas at risk of spillage and/or leaks of hazardous materials and ranking them according to the risk; • in identified areas, ensuring suitable containment systems are in place, e.g. impervious floors; • identification of suitable spillage containment and clean-up equipment and regularly ensuring it is available, in good working order and close to points where these incidents may occur; • waste management guidelines for dealing with waste arising from spillage control; • regular (at least once every year) inspections of storage and operational areas, testing and calibration of leak detection equipment and prompt repair of leaks from valves, glands, flanges, etc. (see BAT 13).	Generally applicable. The scope (e.g. level of detail) of the plan will generally be related to the nature, scale and complexity of the installation, as well as to the type and quantity of materials used.
Storage techniques			
b.	Sealing or covering of containers and bunded storage area	Storage of solvents, hazardous materials, waste solvents and waste cleaning materials in sealed or covered containers, suitable for the associated risk and designed to minimise emissions. The containers' storage area is bunded and of adequate capacity.	Generally applicable.
c.	Minimisation of storage of hazardous materials in production areas	Hazardous materials are present in production areas only in amounts that are necessary for production; larger quantities are stored separately.	
Techniques for pumping and handling liquids			
d.	Techniques to prevent leaks and spillages during pumping	Leaks and spillages are prevented by using pumps and seals suitable for the material handled and which ensure proper tightness. This includes equipment such as canned motor pumps, magnetically coupled pumps, pumps with multiple mechanical seals and a quench or buffer system, pumps with multiple mechanical seals and seals dry to atmosphere, diaphragm pumps or bellow pumps.	Generally applicable.
e.	Techniques to prevent overflows during pumping	This includes ensuring for example that: • the pumping operation is supervised; • for larger quantities, bulk storage tanks are fitted with acoustic and/or optical high-level alarms, with shut-off systems if necessary.	
f.	Capture of VOC vapour during solvent-containing material delivery	When delivering solvent-containing materials in bulk (e.g. loading or unloading of tanks), the vapour displaced from receiving tanks is captured, usually by back-venting.	May not be applicable for solvents with low vapour pressure or due to cost considerations.
g.	Containment for spills and/or rapid take-up when handling solvent-containing	When handling solvent-containing materials in containers, possible spills are avoided by providing containment, e.g. by using trolleys, pallets and/or stillages with built-in containment (e.g. 'catch pans') and/or rapid take-up by using absorbent materials.	Generally applicable.

Technique		Description	Applicability
	materials		

1.1.5 Distribution of raw materials

BAT 6. In order to reduce raw material consumption and VOC emissions, BAT is to use one or a combination of the techniques given below.

Technique		Description	Applicability
a.	Centralised supply of VOC-containing materials (e.g. inks, coatings, adhesives, cleaning agents)	Supply of VOC-containing materials (e.g. inks, coatings, adhesives, cleaning agents) to the application area by direct piping with ring lines, including system cleaning such as pig cleaning or air flushing.	May not be applicable in the case of frequent changes of inks / paints / coatings / adhesives or solvents.
b.	Advanced mixing systems	Computer-controlled mixing equipment to achieve the desired paint / coating / ink / adhesive.	Generally applicable.
c.	Supply of VOC-containing materials (e.g. inks, coatings, adhesives, cleaning agents) at the point of application using a closed system	In the case of frequent changes of inks / paints / coatings / adhesives and solvents or for small-scale usage, supply of inks / paints / coatings / adhesives and solvents from small transport containers placed near the application area using a closed system.	
d.	Automation of colour change	Automated colour changing and ink / paint / coating line purging with solvent capture.	
e.	Colour grouping	Modification of the sequence of products to achieve large sequences with the same colour.	
f.	Soft purge in spraying	Refilling the spray gun with new paint without intermediate rinsing.	

1.1.6 Coating application

BAT 7. In order to reduce raw material consumption and the overall environmental impact of the coating application processes, BAT is to use one or a combination of the techniques given below.

Technique		Description	Applicability
Techniques for non-spraying application			
a.	Roller coating	Application where rollers are used to transfer or meter the liquid coating onto a moving strip.	Only applicable to flat substrates ([1]).
b.	Doctor blade over roller	The coating is applied to the substrate through a gap between a blade and a roller. As the coating and substrate pass, the excess is scraped off.	Generally applicable ([1]).
c.	No-rinse (dry-in-place) application in the coating of coil	Application of conversion coatings which do not require a further water rinse using a roller coater (chemcoater) or squeegee rollers.	Generally applicable ([1]).
d.	Curtain coating (casting)	Work-pieces are passed through a laminar film of coating discharged from a header tank.	Only applicable to flat substrates ([1]).
e.	Electrocoating (e-coat)	Paint particles dispersed in a water-based solution are deposited on immersed substrates under the influence of an electric field (electrophoretic deposition).	Only applicable to metal substrates ([1]).
f.	Flooding	The work-pieces are transported via conveyor systems into a closed channel, which is then flooded with the coating material via injection tubes. The excess material is collected and reused.	Generally applicable ([1]).

Technique		Description	Applicability
g.	Co-extrusion	The printed substrate is coupled with a warm, liquefied plastic film and subsequently cooled down. This film replaces the necessary additional coating layer. It may be used between two different layers of different carriers acting as an adhesive.	Not applicable where high bond strength or resistance to sterilisation temperature is needed ([1]).
Spraying atomisation techniques			
h.	Air-assisted airless spraying	An airflow (shaping air) is used to modify the spray cone of an airless spray gun.	Generally applicable ([1]).
i.	Pneumatic atomisation with inert gases	Pneumatic paint application with pressurised inert gases (e.g. nitrogen, carbon dioxide).	May not be applicable to coating of wooden surfaces ([1]).
j.	High-volume low-pressure (HVLP) atomisation	Atomisation of paint in a spray nozzle by mixing paint with high volumes of air with a low pressure (max. 1.7 bar). HVLP guns have a paint transfer efficiency of > 50 %.	Generally applicable ([1]).
k.	Electrostatic atomisation (fully automated)	Atomisation by high-speed rotational discs and bells and shaping the spray jet with electrostatic fields and shaping air.	
l.	Electrostatically assisted air or airless spraying	Shaping the spray jet of pneumatic or airless atomisation with an electrostatic field. Electrostatic paint guns have a transfer efficiency of > 60 %. Fixed electrostatic methods have a transfer efficiency of up to 75 %.	
m.	Hot spraying	Pneumatic atomisation with hot air or heated paint.	May not be applicable for frequent colour changes ([1]).
n.	'Spray, squeegee and rinse' application in the coating of coil	Sprays are used for application of cleaners, pretreatments and for rinsing. After spraying, squeegees are used to minimise solution dragout, which is followed by rinsing.	Generally applicable ([1]).
Automation of spray application			
o.	Robot application	Robot application of coatings and sealants to internal and external surfaces.	Generally applicable ([1]).
p.	Machine application	Use of paint machines for the handling of the sprayhead / spray gun / nozzle.	
([1]) The selection of the application techniques may be restricted at plants with low throughput and/or high product variety as well as by the substrate type and shape, product quality requirements and the need to ensure that the materials used, coating application techniques, drying/curing techniques and off-gas treatment systems are mutually compatible.			

1.1.7 Drying/curing

BAT 8. In order to reduce energy consumption and the overall environmental impact from drying/curing processes, BAT is to use one or a combination of the techniques given below.

Technique		Description	Applicability
a.	Inert gas convection drying/curing	The inert gas (nitrogen) is heated in the oven, enabling solvent loading above the LEL. Solvent loads of > 1 200 g/m^3 nitrogen are possible.	Not applicable where dryers need to be opened regularly ([1]).

b.	Induction drying/curing	Online thermal curing or drying by electromagnetic inductors that generate heat inside the metallic work-piece by an oscillating magnetic field.	Only applicable to metal substrates ([1]).
c.	Microwave and high-frequency drying	Drying using microwave or high-frequency radiation.	Only applicable to water-based coatings and inks and non-metallic substrates ([1]).
d.	Radiation curing	Radiation curing is applied based on resins and reactive diluents (monomers) which react on exposure to radiation (infrared (IR), ultraviolet (UV)), or high-energy electron beams (EB).	Only applicable to specific coatings and inks ([1]).
e.	Combined convection / IR radiation drying	Drying of a wet surface with a combination of circulating hot air (convection) and an infrared radiator.	Generally applicable ([1]).
f.	Convection drying/curing combined with heat recovery	Heat from off-gases is recovered (see BAT 19 (e)) and used to preheat the input air of the convection dryer / curing oven.	Generally applicable ([1]).
([1]) The selection of the drying/curing techniques may be restricted by the substrate type and shape, product quality requirements and the need to ensure that the materials used, coating application techniques, drying/curing techniques and off-gas treatment systems are mutually compatible.			

1.1.8 Cleaning

BAT 9. In order to reduce VOC emissions from cleaning processes, BAT is to minimise the use of solvent-based cleaning agents and to use a combination of the techniques given below.

Technique		Description	Applicability
a.	Protection of spraying areas and equipment	Application areas and equipment (e.g. spray booth walls and robots) susceptible to overspray and drips, etc. are covered with fabric covers or disposable foils where foils are not subject to tearing or wear.	The selection of cleaning techniques may be restricted by the type of process, the substrate or equipment to be cleaned and the type of contamination.
b.	Solids removal prior to complete cleaning	Solids are removed in a (dry) concentrated form, usually by hand, with or without the aid of small amounts of cleaning solvent. This reduces the amount of material to be removed by solvent and/or water in subsequent cleaning stages, and therefore the amount of solvent and/or water used.	
c.	Manual cleaning with pre-impregnated wipes	Wipes pre-impregnated with cleaning agents are used for manual cleaning. Cleaning agents may be solvent-based, low-volatility solvents or solvent-free.	
d.	Use of low-volatility cleaning agents	Application of low-volatility solvents as cleaning agents, for manual or automated cleaning, with high cleaning power.	
e.	Water-based cleaning	Water-based detergents or water-miscible solvents such as alcohols or glycols are used for cleaning.	
f.	Enclosed washing machines	Automatic batch cleaning/degreasing of press/machine parts in enclosed washing machines. This can be done using either: a) organic solvents (with air extraction followed by VOC abatement and/or recovery of the used solvents) (see BAT 15); or b) VOC-free solvents; or c) alkaline cleaners (with external or internal waste water treatment).	
g.	Purging with	Collection, storage and, if possible, reuse of the solvents	

	solvent recovery	used to purge the guns/applicators and lines between colour changes.	
h.	Cleaning with high-pressure water spray	High-pressure water spray and sodium bicarbonate systems or similar are used for automatic batch cleaning of press/machine parts.	
i.	Ultrasonic cleaning	Cleaning in a liquid using high-frequency vibrations to loosen the adhered contamination.	
j.	Dry ice (CO_2) cleaning	Cleaning of machinery parts and metallic or plastic substrates by blasting with CO_2 chips or snow.	
k.	Plastic shot-blast cleaning	Excess paint build-up is removed from panel jigs and body carriers by shot-blasting with plastic particles.	

1.1.9 Monitoring

1.1.9.1 Solvent mass balance

BAT 10. BAT is to monitor total and fugitive VOC emissions by compiling, at least once every year, a solvent mass balance of the solvent inputs and outputs of the plant, as defined in Part 7(2) of Annex VII to Directive 2010/75/EU and to minimise the uncertainty of the solvent mass balance data by using all of the techniques given below.

Technique		Description
a.	Full identification and quantification of the relevant solvent inputs and outputs, including the associated uncertainty	This includes: • identification and documentation of solvent inputs and outputs (e.g. emissions in waste gases, emissions from each fugitive emission source, solvent output in waste); • substantiated quantification of each relevant solvent input and output and recording of the methodology used (e.g. measurement, calculation using emission factors, estimation based on operational parameters); • identification of the main sources of uncertainty of the aforementioned quantification, and implementation of corrective actions to reduce the uncertainty; • regular update of solvent input and output data.
b.	Implementation of a solvent tracking system	A solvent tracking system aims to keep control of both the used and unused quantities of solvents (e.g. by weighing unused quantities returned to storage from the application area).
c.	Monitoring of changes that may influence the uncertainty of the solvent mass balance data	Any change that could influence the uncertainty of the solvent mass balance data is recorded, such as: • malfunctions of the off-gas treatment system: the date and duration are recorded; • changes that may influence air/gas flow rates, e.g. replacement of fans, drive pulleys, motors; the date and type of change are recorded.

Applicability: The level of detail of the solvent mass balance will be proportionate to the nature, scale and complexity of the installation, and the range of environmental impacts it may have, as well as to the type and quantity of materials used.

1.1.9.2 Emissions in waste gases

BAT 11. BAT is to monitor emissions in waste gases with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Substance/ Parameter	Sectors/Sources		Standard(s)	Minimum monitoring frequency	Monitoring associated with
Dust	Coating of vehicles – Spray coating		EN 13284-1	Once every year ([1])	BAT 18
	Coating of other metal and plastic surfaces – Spray coating				
	Coating of aircraft – Preparation (e.g. sanding, blasting) and coating				
	Coating and printing of metal packaging – Spray application				
	Coating of wooden surfaces – Preparation and coating				
TVOC	All sectors	Any stack with a TVOC load < 10 kg C/h	EN 12619	Once every year ([1])([2])([3])	BAT 14, BAT 15
		Any stack with a TVOC load ≥ 10 kg C/h	Generic EN standards ([4])	Continuous	
DMF	Coating of textiles, foils and paper ([5])		No EN standard available ([6])	Once every three months ([1])	BAT 15
NO_X	Thermal treatment of off-gases		EN 14792	Once every year ([7])	BAT 17
CO	Thermal treatment of off-gases		EN 15058	Once every year ([7])	BAT 17

([1]) To the extent possible, the measurements are carried out at the highest expected emission state under normal operating conditions.
([2]) In the case of a TVOC load of less than 0.1 kg C/h, or in the case of an unabated and stable TVOC load of less than 0.3 kg C/h, the monitoring frequency may be reduced to once every 3 years or the measurement may be replaced by calculation provided that it ensures the provision of data of an equivalent scientific quality.
([3]) For the thermal treatment of off-gases, the temperature in the combustion chamber is continuously measured. This is combined with an alarm system for temperatures falling outside the optimised temperature window.
([4]) Generic EN standards for continuous measurements are EN15267-1, EN15267-2, EN15267-3 and EN 14181.
([5]) The monitoring only applies if DMF is used in the processes.
([6]) In the absence of an EN standard, the measurement includes the DMF contained in the condensed phase.
([7]) In the case of a stack with a TVOC load of less than 0.1 kg C/h, the monitoring frequency may be reduced to once every 3 years.

1.1.9.3 Emissions to water

BAT 12. BAT is to monitor emissions to water with at least the frequency given below and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Substance/ Parameter	Sector	Standard(s)	Minimum monitoring frequency	Monitoring associated with
TSS ([1])	Coating of vehicles	EN 872	Once every month ([2])([3])	BAT 21
	Coil coating			

	Coating and printing of metal packaging (only for DWI cans)			
COD ([1]) ([4])	Coating of vehicles	No EN standard available		
	Coil coating			
	Coating and printing of metal packaging (only for DWI cans)			
TOC ([1]) ([4])	Coating of vehicles	EN 1484		
	Coil coating			
	Coating and printing of metal packaging (only for DWI cans)			
Cr(VI) ([5])([6])	Coating of aircraft	EN ISO 10304-3 or EN ISO 23913		
	Coil coating			
Cr ([6])([7])	Coating of aircraft	Various EN standards available (e.g. EN ISO 11885, EN ISO 17294-2, EN ISO 15586)		
	Coil coating			
Ni ([6])	Coating of vehicles			
	Coil coating			
Zn ([6])	Coating of vehicles			
	Coil coating			
AOX ([6])	Coating of vehicles	EN ISO 9562		
	Coil coating			
	Coating and printing of metal packaging (only for DWI cans)			
F^- ([6])([8])	Coating of vehicles	EN ISO 10304-1		
	Coil coating			
	Coating and printing of metal packaging (only for DWI cans)			

([1]) The monitoring only applies in the case of direct discharge to a receiving water body.
([2]) The monitoring frequency may be reduced to once every 3 months if the emission levels are proven to be sufficiently stable.
([3]) In the case of batch discharge that is less frequent than the minimum monitoring frequency, monitoring is carried out once per batch.
([4]) TOC monitoring and COD monitoring are alternatives. TOC monitoring is the preferred option because it does not rely on the use of very toxic compounds.
([5]) Monitoring of Cr(VI) only applies if chromium(VI) compounds are used in the processes.
([6]) In the case of indirect discharge to a receiving water body, the monitoring frequency may be reduced if the downstream waste water treatment plant is designed and equipped appropriately to abate the pollutants concerned.
([7]) Monitoring of Cr only applies if chromium compounds are used in the processes.
([8]) Monitoring of F^- only applies if fluorine compounds are used in the processes.

1.1.10 Emissions during OTNOC

BAT 13. In order to reduce the frequency of the occurrence of OTNOC and to reduce emissions during OTNOC, BAT is to use both of the techniques given below.

Technique		Description
a.	Identification of critical equipment	Equipment critical to the protection of the environment (‘critical equipment’) is identified on the basis of a risk assessment. In principle,

		this concerns all equipment and systems handling VOCs (e.g. off-gas treatment system, leak detection system).
b.	Inspection, maintenance and monitoring	A structured programme to maximise critical equipment availability and performance which includes standard operating procedures, preventive maintenance, regular and unplanned maintenance. OTNOC periods, duration, causes and, if possible, emissions during their occurrence are monitored.

1.1.11 Emissions in waste gases

1.1.11.1 VOC emissions

BAT 14. In order to reduce VOC emissions from the production and storage areas, BAT is to use technique (a) and an appropriate combination of the other techniques given below.

Technique		Description	Applicability
a.	System selection, design and optimisation	An off-gas system is selected, designed and optimised taking into account parameters such as: - amount of extracted air; - type and concentration of solvents in extracted air; - type of treatment system (dedicated/centralised); - health and safety; - energy efficiency. The following order of priority for the system selection may be considered: • segregation of off-gases with high and low VOC concentrations; • techniques to homogenise and increase the VOC concentration (see BAT 16 (b) and (c)); • techniques for the recovery of solvents in off-gases (see BAT 15); • VOC abatement techniques with heat recovery (see BAT 15); • VOC abatement techniques without heat recovery (see BAT 15).	Generally applicable.
b.	Air extraction as close as possible to the point of application of VOC-containing materials	Air extraction as close as possible to the point of application with full or partial enclosure of solvent application areas (e.g. coaters, application machines, spray booths). Extracted air may be treated by an off-gas treatment system.	May not be applicable where enclosure leads to difficult machinery access during operation. Applicability may be restricted by the shape and size of the area to be enclosed.
c.	Air extraction as close as possible to the point of preparing paints / coatings / adhesives / inks	Air extraction as close as possible to the point of preparing paints / coatings / adhesives / inks (e.g. mixing area). Extracted air may be treated by an off-gas treatment system.	Only applicable where paints / coatings / adhesives / inks are prepared.
d.	Extraction of air from the drying/curing processes	The curing ovens/dryers are equipped with an air extraction system. Extracted air may be treated by an off-gas treatment system.	Only applicable to drying/curing processes.

Technique		Description	Applicability
e.	Minimisation of fugitive emissions and heat losses from the ovens/dryers either by sealing the entrance and the exit of the curing ovens/dryers or by applying sub-atmospheric pressure in drying	The entrance to and the exit from curing ovens/dryers are sealed to minimise fugitive VOC emissions and heat losses. The sealing may be ensured by air jets or air knives, doors, plastic or metallic curtains, doctor blades, etc. Alternatively, ovens/dryers are kept under sub-atmospheric pressure.	Only applicable when curing ovens/dryers are used.
f.	Extraction of air from the cooling zone	When substrate cooling takes place after drying/curing, the air from the cooling zone is extracted and may be treated by an off-gas treatment system.	Only applicable when substrate cooling takes place after drying/curing.
g.	Extraction of air from storage of raw materials, solvents and solvent-containing wastes	Air from raw material stores and/or individual containers for raw materials, solvents and solvent-containing wastes is extracted and may be treated by an off-gas treatment system.	May not be applicable for closed containers or for storage of raw materials, solvents and solvent-containing wastes with a low vapour pressure and low toxicity.
h.	Extraction of air from cleaning areas	Air from the areas where machine parts and equipment are cleaned with organic solvents, either by hand or automatically, is extracted and may be treated by an off-gas treatment system.	Only applicable to areas where machine parts and equipment are cleaned with organic solvents.

BAT 15. In order to reduce VOC emissions in waste gases and increase resource efficiency, BAT is to use one or a combination of the techniques given below.

Technique		Description	Applicability
I. Capture and recovery of solvents in off-gases			
a.	Condensation	A technique for removing organic compounds by reducing the temperature below their dew points so that the vapours liquefy. Depending on the operating temperature range required, different refrigerants are used, e.g. cooling water, chilled water (temperature typically around 5 °C), ammonia or propane.	Applicability may be restricted where the energy demand for recovery is excessive due to the low VOC content.
b.	Adsorption using activated carbon or zeolites	VOCs are adsorbed on the surface of activated carbon, zeolites or carbon fibre paper. Adsorbate is subsequently desorbed, e.g. with steam (often on site), for reuse or disposal and the adsorbent is reused. For continuous operation, typically more than two adsorbers are operated in parallel, one of them in desorption mode. Adsorption is also commonly applied as a concentration step to increase the subsequent oxidation efficiency.	Applicability may be restricted where the energy demand for recovery is excessive due to the low VOC content.

Technique		Description	Applicability
c.	Absorption using a suitable liquid	Use of a suitable liquid to remove pollutants from the off-gas by absorption, in particular soluble compounds and solids (dust). Solvent recovery is possible, for example, using distillation or thermal desorption. (For dust removal, see BAT 18.)	Generally applicable.
II. Thermal treatment of solvents in off-gases with energy recovery			
d.	Sending off-gases to a combustion plant	Part or all of the off-gases are sent as combustion air and supplementary fuel to a combustion plant (including CHP (combined heat and power) plants) used for steam and/or electricity production.	Not applicable for off-gases containing substances referred to in IED Article 59(5). Applicability may be restricted due to safety considerations.
e.	Recuperative thermal oxidation	Thermal oxidation using the heat of the waste gases, e.g. to preheat the incoming off-gases.	Generally applicable.
f.	Regenerative thermal oxidation with multiple beds or with a valveless rotating air distributor	An oxidiser with multiple beds (three or five) filled with ceramic packing. The beds are heat exchangers, alternately heated by flue-waste gases from oxidation, then the flow is reversed to heat the inlet air to the oxidiser. The flow is reversed on a regular basis. In the valveless rotating air distributor, the ceramic medium is held in a single rotating vessel divided into multiple wedges.	Generally applicable.
g.	Catalytic oxidation	Oxidation of VOCs assisted by a catalyst to reduce the oxidation temperature and reduce the fuel consumption. Exhaust heat can be recovered with recuperative or regenerative types of heat exchangers. Higher oxidation temperatures (500–750 °C) are used for the treatment of off-gas from the manufacturing of winding wire.	Applicability may be restricted by the presence of catalyst poisons.
III. Treatment of solvents in off-gases without solvent or energy recovery			
h.	Biological off-gas treatment	Off-gas is dedusted and sent to a reactor with biofilter substrate. The biofilter consists of a bed of organic material (such as peat, heather, compost, root, tree bark, softwood and different combinations) or some inert material (such as clay, activated carbon, and polyurethane), where the off-gas stream is biologically oxidised by naturally occurring microorganisms into carbon dioxide, water, inorganic salts and biomass. The biofilter is sensitive to dust, high temperatures or high variations in the off-gas, e.g. of the inlet temperature or the VOC concentration. Supplementary nutrient feeding may be needed.	Only applicable to the treatment of biodegradable solvents.
i.	Thermal oxidation	Oxidation of VOCs by heating off-gases with air or oxygen to above their auto-ignition point in a combustion chamber and maintaining a high temperature long enough to complete the combustion of VOCs to carbon dioxide and water.	Generally applicable.

BAT-associated emission levels (BAT-AELs) are given in Tables 11, 15, 17, 19, 21, 24, 27, 30, 32 and 35 of these BAT conclusions.

BAT 16. In order to reduce the energy consumption of the VOC abatement system, BAT is to use one or a combination of the techniques given below.

Technique		Description	Applicability
a.	Maintaining the VOC concentration sent to the off-gas treatment system by using variable-frequency drive fans	Use of a variable-frequency drive fan with centralised off-gas treatment systems to modulate the airflow to match the exhaust from the equipment that may be in operation.	Only applicable to central thermal off-gas treatment systems in batch processes such as printing.
b.	Internal concentration of solvents in the off-gases	Off-gases are recirculated within the process (internally) in the curing ovens/dryers and/or in spray booths, so the VOC concentration in the off-gases increases and the abatement efficiency of the off-gas treatment system increases.	Applicability may be limited by health and safety factors such as the LEL, and product quality requirements or specifications.
c.	External concentration of solvents in the off-gases through adsorption	The concentration of solvent in off-gases is increased by a continuous circular flow of the spray booth process air, possibly combined with curing oven/dryer off-gases, through adsorption equipment. This equipment can include: - fixed bed adsorber with activated carbon or zeolite; - fluidised bed adsorber with activated carbon; - rotor adsorber with activated carbon or zeolite; - molecular sieve.	Applicability may be restricted where the energy demand is excessive due to the low VOC content.
d.	Plenum technique to reduce waste gas volume	Off-gases from curing ovens/dryers are sent to a large chamber (plenum), and partly recirculated as inlet air in the curing ovens/dryers. The surplus air from the plenum is sent to the off-gas treatment system. This cycle increases the VOC content of the curing ovens/dryers' air and decreases the waste gas volume.	Generally applicable.

1.1.11.2 NO_X and CO emissions

BAT 17. In order to reduce NO_X emissions in waste gases while limiting CO emissions from the thermal treatment of solvents in off-gases, BAT is to use technique (a) or both of the techniques given below.

Technique		Description	Applicability
a.	Optimisation of thermal treatment conditions (design and operation)	Good design of the combustion chambers, burners and associated equipment/devices is combined with optimisation of combustion conditions (e.g. by controlling combustion parameters such as temperature and residence time) with or without the use of automatic systems and the regular planned maintenance of the combustion system according to suppliers' recommendations.	Design applicability may be restricted for existing plants.
b.	Use of low-NO_X burners	The peak flame temperature in the combustion chamber is reduced, delaying but completing the combustion and increasing the heat transfer (increased emissivity of the flame). It is combined with increased residence time in order to achieve the desired VOC destruction.	Applicability may be restricted at existing plants by design and/or operational constraints.

Table 1: BAT-associated emission level (BAT-AEL) for NO_X emissions in waste gases and indicative emission level for CO emissions in waste gases from the thermal treatment of off-gases

Parameter	Unit	BAT-AEL ([1]) (Daily average or average over the sampling period)	Indicative emission level ([1]) (Daily average or average over the sampling period)
NO_X	mg/Nm^3	20–130 ([2])	No indicative level
CO		No BAT-AEL	20–150
([1]) The BAT-AEL and indicative level do not apply where off-gases are sent to a combustion plant. ([2]) The BAT-AEL may not apply if nitrogen-containing compounds (e.g. DMF or NMP (*N*-methylpyrrolidone)) are present in the off-gas.			

The associated monitoring is given in BAT 11.

1.1.11.3 Dust emissions

BAT 18. In order to reduce dust emissions in waste gases from substrate surface preparation, cutting, coating application and finishing processes for the sectors and processes listed in Table 2, BAT is to use one or a combination of the techniques given below.

Technique		Description
a.	Wet separation spray booth (flushed impact panel)	A water curtain cascading vertically down the spray cabin rear panel captures paint particles from overspray. The water-paint mixture is captured in a reservoir and the water is recirculated.
b.	Wet scrubbing	Paint particles and other dust in the off-gas are separated in scrubber systems by intensive mixing of the off-gas with water. (For VOC removal, see BAT 15 (c).)
c.	Dry overspray separation with pre-coated material	A dry paint overspray separation process using membrane filters combined with limestone as pre-coating material to prevent fouling of the membranes.
d.	Dry overspray separation using filters	Mechanical separation system, e.g. using cardboard, fabric or sinter.
e.	Electrostatic precipitator	In electrostatic precipitators, particles are charged and separated under the influence of an electrical field. In a dry electrostatic precipitator (ESP), the collected material is mechanically removed (e.g. by shaking, vibration, compressed air). In a wet ESP, it is flushed with a suitable liquid, usually a water-based separation agent.

Table 2: BAT-associated emission levels (BAT-AELs) for dust emissions in waste gases

Parameter	Sector	Process	Unit	BAT-AEL (Daily average or average over the sampling period)
Dust	Coating of vehicles	Spray coating	mg/Nm^3	< 1–3
	Coating of other metal and plastic surfaces	Spray coating		
	Coating of aircraft	Preparation (e.g. sanding, blasting), coating		
	Coating and printing of metal packaging	Spray application		
	Coating of wooden surfaces	Preparation, coating		

The associated monitoring is given in BAT 11.

1.1.12 Energy efficiency

BAT 19. In order to use energy efficiently, BAT is to use techniques (a) and (b) and an appropriate combination of the techniques (c) to (h) given below.

	Technique	Description	Applicability
Management techniques			
a.	Energy efficiency plan	An energy efficiency plan is part of the EMS (see BAT 1) and entails defining and calculating the specific energy consumption of the activity, setting key performance indicators on an annual basis (e.g. MWh/tonne of product) and planning the periodic improvement targets and related actions. The plan is adapted to the specificities of the plant in terms of process(es) carried out, materials, products, etc.	The level of detail and nature of the energy efficiency plan and of the energy balance record will generally be related to the nature, scale and complexity of the installation and the types of energy sources used. It may not be applicable if the STS activity is carried out within a larger installation, provided that the energy efficiency plan and the energy balance record of the larger installation sufficiently cover the STS activity.
b.	Energy balance record	The drawing up once every year of an energy balance record which provides a breakdown of the energy consumption and generation (including energy export) by the type of source (e.g. electricity, fossil fuels, renewable energy, imported heat and/or cooling). This includes: (i) defining the energy boundary of the STS activity; (ii) information on energy consumption in terms of delivered energy; (iii) information on energy exported from the plant; (iv) energy flow information (e.g. Sankey diagrams or energy balances) showing how the energy is used throughout the process. The energy balance record is adapted to the specificities of the plant in terms of process(es) carried out, materials, etc.	
Process-related techniques			
c.	Thermal insulation of tanks and vats containing cooled or heated liquids, and of combustion and steam systems	This may be achieved for example by: • using double-skinned tanks; • using pre-insulated tanks; • applying insulation to combustion equipment, steam pipes and pipes containing cooled or heated liquids.	Generally applicable.
d.	Heat recovery by cogeneration – CHP (combined heat and power) or CCHP (combined cooling, heat and power)	Recovery of heat (mainly from the steam system) for producing hot water/steam to be used in industrial processes/activities. CCHP (also called tri-generation) is a cogeneration system with an absorption chiller that uses low-grade heat to produce chilled water.	Applicability may be restricted by the plant layout, the characteristics of the hot gas streams (e.g. flow rate, temperature) or the lack of a suitable heat demand.
e.	Heat recovery from hot gas streams	Energy recovery from hot gas streams (e.g. from dryers or cooling zones), e.g. by their recirculation as process air, through the use of heat exchangers, in processes, or externally.	
f.	Flow adjustment of process air and off-gases	Adjustment of the flow of process air and off-gases according to the need. This includes reduction of air ventilation during idle operation or maintenance.	Generally applicable.
g.	Spray booth off-gas recirculation	Capture and recirculation of the off-gas from the spray booth in combination with efficient paint overspray separation. Energy consumption is less than in the case of fresh air use.	Applicability may be restricted by health and safety considerations.
h.	Optimised circulation of warm air in a large-volume curing booth using an air turbulator	Air is blown into a single part of the curing booth and distributed using an air turbulator which turns the laminar airflow into the desired turbulent flow.	Only applicable to spray coating sectors.

Table 3: BAT-associated environmental performance levels (BAT-AEPLs) for specific energy consumption

Sector	Product type	Unit	BAT-AEPL (Yearly average)
Coating of vehicles	Passenger cars	MWh/vehicle coated	0.5–1.3
	Vans		0.8–2
	Truck cabins		1–2
	Trucks		0.3–0.5
Coil coating	Steel and/or aluminium coil	kWh/m^2 of coated coil	0.2–2.5 ([1])
Coating of textiles, foils and paper	Coating of textiles with polyurethane and/or polyvinyl chloride	kWh/m^2 of coated surface	1–5
Manufacturing of winding wires	Wires with an average diameter > 0.1 mm	kWh/kg of coated wire	< 5
Coating and printing of metal packaging	All product types	kWh/m^2 of coated surface	0.3–1.5
Heatset web offset printing	All product types	Wh/m^2 of printed area	4–14
Flexography and non-publication rotogravure printing	All product types	Wh/m^2 of printed area	50–350
Publication rotogravure printing	All product types	Wh/m^2 of printed area	10–30
([1]) The BAT-AEPL may not apply where the coil coating line is part of a larger manufacturing installation (e.g. steelworks) or for combilines.			

The associated monitoring is given in BAT 19 (b).

1.1.13 Water use and waste water generation

BAT 20. In order to reduce water consumption and waste water generation from aqueous processes (e.g. degreasing, cleaning, surface treatment, wet scrubbing), BAT is to use technique (a) and an appropriate combination of the other techniques given below.

Technique		Description	Applicability
a.	Water management plan and water audits	A water management plan and water audits are part of the EMS (see BAT 1) and include: • flow diagrams and a water mass balance of the plant; • establishment of water efficiency objectives; • implementation of water optimisation techniques (e.g. control of water usage, water recycling, detection and repair of leaks). Water audits are carried out at least once every year.	The level of detail and nature of the water management plan and water audits will generally be related to the nature, scale and complexity of the plant. It may not be applicable if the STS activity is carried out within a larger installation, provided that the water management plan and the water audits of the larger installation sufficiently cover the STS activity.
b.	Reverse cascade rinsing	Multiple stage rinsing in which the water flows in the opposite direction to the work-pieces / substrate. It allows a high degree of rinsing with a low water consumption.	Applicable where rinsing processes are used.

c.	Reuse and/or recycling of water	Water streams (e.g. spent rinse water, wet scrubber effluent) are reused and/or recycled, if necessary after treatment, using techniques such as ion exchange or filtration (see BAT 21). The degree of water reuse and/or recycling is limited by the water balance of the plant, the content of impurities and/or the characteristics of the water streams.	Generally applicable.

Table 4: BAT-associated environmental performance levels (BAT-AEPLs) for specific water consumption

Sector	Product type	Unit	BAT-AEPL (Yearly average)
Coating of vehicles	Passenger cars	m^3/vehicle coated	0.5–1.3
	Vans		1–2.5
	Truck cabins		0.7–3
	Trucks		1–5
Coil coating	Steel and/or aluminium coils	l/m^2 of coated coil	0.2–1.3 ([1])
Coating and printing of metal packaging	Two-piece DWI beverage cans	l/1 000 cans	90–110
([1]) The BAT-AEPL may not apply where the coil coating line is part of a larger manufacturing installation (e.g. steelworks) or for combilines.			

The associated monitoring is given in BAT 20 (a).

1.1.14 Emissions to water

BAT 21. In order to reduce emissions to water and/or to facilitate water reuse and recycling from aqueous processes (e.g. degreasing, cleaning, surface treatment, wet scrubbing), BAT is to use a combination of the techniques given below.

Techniques		Description	Typical pollutants targeted
Preliminary, primary and general treatment			
a.	Equalisation	Balancing of flows and pollutant loads by using tanks or other management techniques.	All pollutants.
b.	Neutralisation	The adjustment of the pH of waste water to a neutral value (approximately 7).	Acids, alkalis.
c.	Physical separation, for example, by using screens, sieves, grit separators, primary settlement tanks and magnetic separation		Gross solids, suspended solids, metal particles.
Physico-chemical treatment			
d.	Adsorption	The removal of soluble substances (solutes) from the waste water by transferring them to the surface of solid, highly porous particles (typically activated carbon).	Adsorbable dissolved non-biodegradable or inhibitory pollutants, e.g. AOX.
e.	Vacuum distillation	The removal of pollutants by thermal waste water treatment under reduced pressure.	Dissolved non-biodegradable or inhibitory pollutants that can be distilled, e.g. some solvents.
f.	Precipitation	The conversion of dissolved pollutants into insoluble compounds by adding precipitants. The solid precipitates formed are subsequently separated by sedimentation, flotation or filtration.	Precipitable dissolved non-biodegradable or inhibitory pollutants, e.g. metals.

Techniques		Description	Typical pollutants targeted
g.	Chemical reduction	Chemical reduction is the conversion of pollutants by chemical reducing agents into similar but less harmful or hazardous compounds.	Reducible dissolved non-biodegradable or inhibitory pollutants, e.g. hexavalent chromium (Cr(VI)).
h.	Ion exchange	The retention of ionic pollutants from waste water and their replacement by more acceptable ions using an ion exchange resin. The pollutants are temporarily retained and afterwards released into a regeneration or backwashing liquid.	Ionic dissolved non-biodegradable or inhibitory pollutants, e.g. metals.
i.	Stripping	The removal of purgeable pollutants from the aqueous phase by a gaseous phase (e.g. steam, nitrogen or air) that is passed through the liquid. The removal efficiency may be enhanced by increasing the temperature or reducing the pressure.	Purgeable pollutants, e.g. some adsorbable organically bound halogens (AOX).
Biological treatment			
j.	Biological treatment	Use of microorganisms for waste water treatment (e.g. anaerobic treatment, aerobic treatment).	Biodegradable organic compounds.
Final solids removal			
k.	Coagulation and flocculation	Coagulation and flocculation are used to separate suspended solids from waste water and are often carried out in successive steps. Coagulation is carried out by adding coagulants with charges opposite to those of the suspended solids. Flocculation is a gentle mixing stage so that collisions of microfloc particles cause them to bond to produce larger flocs. It may be assisted by adding polymers.	Suspended solids and particulate-bound metals.
l.	Sedimentation	The separation of suspended particles by gravitational settling.	
m.	Filtration	The separation of solids from waste water by passing them through a porous medium, e.g. sand filtration, nano-, micro- and ultrafiltration	
n.	Flotation	The separation of solid or liquid particles from waste water by attaching them to fine gas bubbles, usually air. The buoyant particles accumulate at the water surface and are collected with skimmers.	

Table 5: BAT-associated emission levels (BAT-AELs) for direct discharges to a receiving water body

Substance/Parameter	Sector	BAT-AEL ([1])
Total suspended solids (TSS)	Coating of vehicles Coil coating Coating and printing of metal packaging (only for DWI cans)	5–30 mg/l
Chemical oxygen demand (COD) ([2])		30–150 mg/l
Adsorbable organically bound halogens (AOX)		0.1–0.4 mg/l
Fluoride (F^-) ([3])		2–25 mg/l
Nickel (expressed as Ni)	Coating of vehicles Coil coating	0.05–0.4 mg/l
Zinc (expressed as Zn)		0.05–0.6 mg/l ([4])
Total chromium (expressed as Cr) ([5])	Coating of aircraft Coil coating	0.01–0.15 mg/l
Hexavalent chromium (expressed as Cr(VI)) ([6])		0.01–0.05 mg/l

(1) The averaging period is given in the general considerations.
(2) The BAT-AEL for COD may be replaced by a BAT-AEL for TOC. The correlation between COD and TOC is determined on a case-by-case basis. The BAT-AEL for TOC is the preferred option because TOC monitoring does not rely on the use of very toxic compounds.
(3) The BAT-AEL only applies if fluorine compounds are used in the processes.
(4) The upper end of the BAT-AEL range may be 1 mg/l in the case of zinc-containing substrates or of substrates pretreated using zinc.
(5) The BAT-AEL only applies if chromium compounds are used in the processes.
(6) The BAT-AEL only applies if chromium(VI) compounds are used in the processes.

The associated monitoring is given in BAT 12.

Table 6: BAT-associated emission levels (BAT-AELs) for indirect discharges to a receiving water body

Substance/Parameter	Sector	BAT-AEL (1)(2)
Adsorbable organically bound halogens (AOX)	Coating of vehicles Coil coating Coating and printing of metal packaging (only for DWI cans)	0.1–0.4 mg/l
Fluoride (F^-) (3)		2–25 mg/l
Nickel (expressed as Ni)	Coating of vehicles Coil coating	0.05–0.4 mg/l
Zinc (expressed as Zn)		0.05–0.6 mg/l (4)
Total chromium (expressed as Cr) (5)	Coating of aircraft Coil coating	0.01–0.15 mg/l
Hexavalent chromium (expressed as Cr(VI)) (6)		0.01–0.05 mg/l

(1) The BAT-AELs may not apply if the downstream waste water treatment plant is designed and equipped appropriately to abate the pollutants concerned, provided this does not lead to a higher level of pollution in the environment.
(2) The averaging period is given in the general considerations.
(3) The BAT-AEL only applies if fluorine compounds are used in the processes.
(4) The upper end of the BAT-AEL range may be 1 mg/l in the case of zinc-containing substrates or of substrates pretreated using zinc.
(5) The BAT-AEL only applies if chromium compounds are used in the processes.
(6) The BAT-AEL only applies if chromium(VI) compounds are used in the processes.

The associated monitoring is given in BAT 12.

1.1.15 Waste management

BAT 22. In order to reduce the quantity of waste sent for disposal, BAT is to use the techniques (a) and (b) and one or both of the techniques (c) and (d) given below.

Technique		Description
a.	Waste management plan	A waste management plan is part of the EMS (see BAT 1) and is a set of measures aiming to: 1) minimise the generation of waste, 2) optimise the reuse, regeneration and/or recycling of waste and/or the recovery of energy from waste, and 3) ensure the proper disposal of waste.
b.	Monitoring of waste quantities	Annual recording of waste quantities generated for each type of waste. The solvent content in the waste is determined periodically (at least once every year) by analysis or calculation.
c.	Recovery/recycling of solvents	Techniques may include: • recovering/recycling solvents from liquid waste by filtration or distillation on site or off site; • recovering/recycling the solvent content of wipes by gravitational draining, wringing or centrifugation.

d.	Waste-stream-specific techniques	Techniques may include: • reducing the water content of the waste, e.g. by using a filter press for the sludge treatment; • reducing the sludge and waste solvent generated, e.g. by reducing the number of cleaning cycles (see BAT 9); • using reusable containers, reusing the containers for other purposes, or recycling the container material; • sending the spent limestone generated from dry scrubbing to a lime or cement kiln.

1.1.16 Odour emissions

BAT 23. In order to prevent or, where that is not practicable, to reduce odour emissions, BAT is to set up, implement and regularly review an odour management plan, as part of the environmental management system (see BAT 1), that includes all of the following elements:

- a protocol containing actions and timelines;
- a protocol for response to identified odour incidents, e.g. complaints;
- an odour prevention and reduction programme designed to identify the source(s), to characterise the contributions of the source(s), and to implement prevention and/or reduction measures.

Applicability: The applicability is restricted to cases where an odour nuisance at sensitive receptors is expected and/or has been substantiated.

1.2 BAT conclusions for the coating of vehicles

The BAT conclusion in this section applies to the coating of vehicles (passenger cars, vans, trucks, truck cabins,and buses), and applies in addition to the general BAT conclusions given in Section 1.1.

1.2.1 VOC emissions and energy and raw material consumption

BAT 24. In order to reduce the consumption of solvents, other raw materials and energy, as well as to reduce VOC emissions, BAT is to use one or a combination of the coating systems given below.

Coating system		Description	Applicability
a.	Mixed (SB-mix) coating	A coating system where one coating layer (primer or base coat) is water-based.	Only applicable to new plants or major plant upgrades.
b.	Water-based (WB) coating	A coating system where the primer and base coat layers are water-based.	
c.	Integrated coating process	A coating system which combines the functions of primer and base coat and is applied by spray coating in two steps.	
d.	Three-wet process	Coating system where the primer, base coat and clear coat layers are applied without intermediate drying. The primer and base coat may be solvent-based or water-based.	

Table 7: BAT-associated emission levels (BAT-AELs) for total emissions of VOCs from the coating of vehicles

Parameter	Vehicle type	Unit	BAT-AEL ([1]) (Yearly average)

			New plant	Existing plant
Total VOC emissions as calculated by the solvent mass balance	Passenger cars	g VOCs per m^2 of surface area ([2])	8–15	8–30
	Vans		10–20	10–40
	Truck cabins		8–20	8–40
	Trucks		10–40	10–50
	Buses		< 100	90–150
([1]) The BAT-AELs refer to emissions from all process stages, carried out at the same installation from the electrophoretic coating or any other kind of coating process up to and including the final wax and polish of the topcoat, as well as solvents used in cleaning of production equipment, both during and outside the production period.				
([2]) The surface area is defined as set out in Part 3 of Annex VII to Directive 2010/75/EU.				

The associated monitoring is given in BAT 10.

1.2.2 Waste quantity sent off site

Table 8: Indicative levels for specific waste quantity sent off site from the coating of vehicles

Parameter	Vehicle type	Relevant waste streams	Unit	Indicative level (Yearly average)
Waste quantity sent off site	Passenger cars	• Waste paint • Waste plastisols, sealers and adhesives • Used solvents • Paint sludge • Other paint-shop-related waste (e.g. absorbent and cleaning materials, filters, packaging materials, spent activated carbon)	kg/vehicle coated	3–9 ([1])
	Vans			4–17 ([1])
	Truck cabins			2–11 ([1])
([1]) The upper end of the range is higher if dry scrubbing with limestone is used.				

The associated monitoring is given in BAT 22 (b).

1.3 BAT conclusions for the coating of other metal and plastic surfaces

The emission levels given below for coating of other metal and plastic surfaces are associated with the general BAT conclusions described in Section 1.1. The emission levels given below may not apply where metal and/or plastic automotive components are coated in a vehicle coating plant and these emissions are included in the calculation of the total VOC emissions for the coating of vehicles (see Section 1.2).

Table 9: BAT-associated emission levels (BAT-AELs) for total emissions of VOCs from the coating of other metal and plastic surfaces

Parameter	Process	Unit	BAT-AEL (Yearly average)
Total VOC emissions as calculated by the solvent mass balance	Coating of metal surfaces	kg VOCs per kg of solid mass input	< 0.05–0.2
	Coating of plastic surfaces		< 0.05–0.3

The associated monitoring is given in BAT 10.

As an alternative to the BAT-AELs in Table 9, the BAT-AELs in both Table 10 and Table 11 may be used.

Table 10: BAT-associated emission level (BAT-AEL) for fugitive emissions of VOCs from the coating of other metal and plastic surfaces

Parameter	Unit	BAT-AEL (Yearly average)
Fugitive VOC emissions as calculated by the solvent mass balance	Percentage (%) of the solvent input	< 1–10

The associated monitoring is given in BAT 10.

Table 11: BAT-associated emission level (BAT-AEL) for VOC emissions in waste gases from the coating of other metal and plastic surfaces

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
TVOC	mg C/Nm^3	1–20 ([1])([2])
([1]) The upper end of the BAT-AEL range is 35 mg C/Nm^3 if techniques are used which allow the reuse/recycling of the recovered solvent. ([2]) For plants using BAT 16 (c) in combination with an off-gas treatment technique, an additional BAT-AEL of less than 50 mg C/Nm^3 applies to the waste gas of the concentrator.		

The associated monitoring is given in BAT 11.

1.4 BAT conclusions for the coating of ships and yachts

The BAT conclusion in this section applies to the coating of ships and yachts, and applies in addition to the general BAT conclusions given in Section 1.1.

BAT 25. In order to reduce total emissions of VOCs and dust emissions to air, to reduce emissions to water and to improve the overall environmental performance, BAT is to use techniques (a) and (b) and a combination of techniques (c) to (i) given below.

Technique		Description	Applicability
Waste and waste water management			
a.	Segregation of waste and waste water streams	Docks and slipways are constructed with: • a system to collect and handle dry waste effectively and keep it separate from wet waste; • a system to separate waste water from storm water and run-off water.	Only applicable to new plants or major plant upgrades.
Techniques relating to preparation and coating processes			
b.	Restrictions for adverse weather conditions	Where the treatment areas are not fully enclosed, blasting and/or airless spray coating are not carried out if adverse weather conditions are observed or forecast.	Generally applicable.
c.	Partial enclosure of treatment areas	Fine nets and/or water spray curtains are used around areas where blasting and/or airless spray coating are carried out to prevent dust emissions. They may be permanent or temporary.	Applicability may be restricted by the shape and size of the area to be enclosed. Water spray curtains may not be applicable in cold climatic conditions.

Technique		Description	Applicability
d.	Full enclosure of treatment areas	Blasting and/or airless spray coating are carried out in halls, closed workshops, areas tented with textiles or areas fully enclosed with nets to prevent dust emissions. Air from the treatment areas is extracted and may be sent to off-gas treatment; see also BAT 14 (b).	Applicability may be restricted by the shape and size of the area to be enclosed.
e.	Dry blasting in a closed system	Dry blasting using steel grit or shot is carried out in closed blasting systems equipped with a suction head and centrifugal blasting wheels.	Generally applicable.
f.	Wet blasting	Blasting is carried out with water containing a fine abrasive material, such as a fine cinder (e.g. copper slag cinder) or silica.	May not be applicable in cold climatic conditions and/or in enclosed areas (cargo tanks, double bottom tanks) due to the heavy mist formation.
g.	(Ultra-)High-Pressure ((U)HP) water jetting or blasting	(U)HP blasting is a dustless surface treatment method using extremely high-pressure water. There are options with or without an abrasive.	May not be applicable in cold climatic conditions, or due to surface specifications (e.g. new surfaces, spot blasting).
h.	Stripping of coatings by induction heating	An inductor head is moved over the surface, causing localised fast heating of the steel to lift old coatings.	May not be applicable for surfaces with a thickness of less than 5 mm and/or for surfaces with components sensitive to induction heating (e.g. insulation, flammable).
i.	Underwater hull and propeller cleaning system	Underwater cleaning system using water pressure and rotating polypropylene brushes.	Not applicable for ships in full dry dock.

Table 12: BAT-associated emission level (BAT-AEL) for total emissions of VOCs from the coating of ships and yachts

Parameter	Unit	BAT-AEL (Yearly average)
Total VOC emissions as calculated by the solvent mass balance	kg VOCs per kg of solid mass input	< 0.375

The associated monitoring is given in BAT 10.

1.5 BAT conclusions for the coating of aircraft

The BAT conclusion in this section applies to the coating of aircraft, and applies in addition to the general BAT conclusions given in Section 1.1.

BAT 26: In order to reduce total emissions of VOCs and to improve the overall environmental performance of coating of aircraft, BAT is to use technique (a) or both of the techniques given below.

Technique		Description	Applicability
a.	Enclosure	Component parts are coated in enclosed spray booths (see BAT 14 (b)).	Generally applicable.

Technique		Description	Applicability
b.	Direct printing	Use of a printing device to directly print complex layouts on the aircraft parts.	Applicability may be restricted by technical considerations (e.g. accessibility of the applicator gantry, customised colours).

Table 13: BAT-associated emission level (BAT-AEL) for total emissions of VOCs from the coating of aircraft

Parameter	Unit	BAT-AEL (Yearly average)
Total VOC emissions as calculated by the solvent mass balance	kg VOCs per kg of solid mass input	0.2–0.58

The associated monitoring is given in BAT 10.

1.6 BAT conclusions for coil coating

The emission levels for coil coating given below are associated with the general BAT conclusions given in Section 1.1.

Table 14: BAT-associated emission level (BAT-AEL) for fugitive emissions of VOCs from coil coating

Parameter	Unit	BAT-AEL (Yearly average)
Fugitive VOC emissions as calculated by the solvent mass balance	Percentage (%) of the solvent input	< 1–3

The associated monitoring is given in BAT 10.

Table 15: BAT-associated emission level (BAT-AEL) for VOC emissions in waste gases from coil coating

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
TVOC	mg C/Nm^3	1–20 ([1])([2])
([1]) The upper end of the BAT-AEL range is 50 mg C/Nm^3 if techniques are used which allow the reuse/recycling of the recovered solvent. ([2]) For plants using BAT 16 (c) in combination with an off-gas treatment technique, an additional BAT-AEL of less than 50 mg C/Nm^3 applies to the waste gas of the concentrator.		

The associated monitoring is given in BAT 11.

1.7 BAT conclusions for the manufacturing of adhesive tapes

The emission levels for the manufacturing of adhesive tapes given below are associated with the general BAT conclusions given in Section 1.1.

Table 16: BAT-associated emission level (BAT-AEL) for total emissions of VOCs from the manufacturing of adhesive tapes

Parameter	Unit	BAT-AEL (Yearly average)
Total VOC emissions as calculated by the solvent mass balance	Percentage (%) of the solvent input	< 1–3 ([1])

([1]) This BAT-AEL may not apply to the manufacturing of plastic films used in temporary surface protection.

The associated monitoring is given in BAT 10.

Table 17: BAT-associated emission level (BAT-AEL) for VOC emissions in waste gases from the manufacturing of adhesive tapes

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
TVOC	mg C/Nm^3	2–20 ([1])([2])
([1]) The upper end of the BAT-AEL range is 50 mg C/Nm^3 if techniques are used which allow the reuse/recycling of the recovered solvent. ([2]) For plants using BAT 16 (c) in combination with an off-gas treatment technique, an additional BAT-AEL of less than 50 mg C/Nm^3 applies to the waste gas of the concentrator.		

The associated monitoring is given in BAT 11.

1.8 BAT conclusions for the coating of textiles, foils and paper

The emission levels for the coating of textiles, foils and paper given below are associated with the general BAT conclusions given in Section 1.1.

Table 18: BAT-associated emission level (BAT-AEL) for fugitive emissions of VOCs from the coating of textiles, foils and paper

Parameter	Unit	BAT-AEL (Yearly average)
Fugitive VOC emissions as calculated by the solvent mass balance	Percentage (%) of the solvent input	< 1–5

The associated monitoring is given in BAT 10.

Table 19: BAT-associated emission level (BAT-AEL) for VOC emissions in waste gases from the coating of textiles, foils and paper

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
TVOC	mg C/Nm^3	5–20 ([1])([2])
([1]) The upper end of the BAT-AEL range is 50 mg C/Nm^3 if techniques are used which allow the reuse/recycling of the recovered solvent. ([2]) For plants using BAT 16 (c) in combination with an off-gas treatment technique, an additional BAT-AEL of less than 50 mg C/Nm^3 applies to the waste gas of the concentrator.		

The associated monitoring is given in BAT 11.

1.9 BAT conclusions for the manufacturing of winding wire

The BAT conclusion in this section applies to the manufacturing of winding wire, and applies in addition to the general BAT conclusions given in Section 1.1.

BAT 27. In order to reduce total emissions of VOCs and energy consumption, BAT is to use technique (a) and one or a combination of the techniques (b) to (d) given below.

Technique	Description	Applicability

a.	Process-integrated VOC oxidation	The air/solvent mix resulting from solvent evaporation during the repeated enamel curing process is treated in a catalytic oxidiser (see BAT 15 (g)) integrated in the curing oven/dryer. The waste heat from the catalytic oxidiser is used in the drying process to heat up the circulating airflow and/or as process heat for other purposes within the plant.	Generally applicable.
b.	Solvent-free lubricants	Solvent-free lubricants are applied as follows: • the wire is drawn through a lubricant-wetted felt; or • a lubricant-impregnated filament is run with the wire and the paraffin wax melts due to the residual heat of the wire and the frictional heat.	Applicability may be limited due to product quality requirements or specifications, e.g. diameter.
c.	Self-lubricating coatings	A solvent-containing lubrication step is avoided by using a coating system that also contains lubricant (a special wax).	Applicability may be limited due to product quality requirements or specifications.
d.	High-solids enamel coating	Use of enamel coating with a solids content of up to 45 %. In the case of fine wires (with a diameter less than or equal to 0.1 mm), the solids content is up to 30 %.	

Table 20: BAT-associated emission level (BAT-AEL) for total emissions of VOCs from the manufacture of winding wire

Parameter	Product type	Unit	BAT-AEL (Yearly average)
Total VOC emissions as calculated by the solvent mass balance	Coating of winding wire with an average diameter greater than 0.1 mm	g VOCs per kg of coated wire	1–3.3

The associated monitoring is given in BAT 10.

Table 21: BAT-associated emission level (BAT-AEL) for VOC emissions in waste gases from the manufacture of winding wire

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
TVOC	mg C/Nm^3	5–40

The associated monitoring is given in BAT 11.

1.10 BAT conclusions for the coating and printing of metal packaging

The emission levels for the coating and printing of metal packaging given below are associated with the general BAT conclusions given in Section 1.1.

Table 22: BAT-associated emission level (BAT-AEL) for total emissions of VOCs from the coating and printing of metal packaging

Parameter	Unit	BAT-AEL (Yearly average)
Total VOC emissions as calculated by the solvent mass balance	g VOCs per m^2 of coated/printed surface	< 1–3.5

The associated monitoring is given in BAT 10.

As an alternative to the BAT-AEL in Table 22, the BAT-AELs in both Table 23 and Table 24 may be used.

Table 23: BAT-associated emission level (BAT-AEL) for fugitive emissions of VOCs from the coating and printing of metal packaging

Parameter	Unit	BAT-AEL (Yearly average)
Fugitive VOC emissions as calculated by the solvent mass balance	Percentage (%) of the solvent input	< 1–12

The associated monitoring is given in BAT 10.

Table 24: BAT-associated emission level (BAT-AEL) for VOC emissions in waste gases from the coating and printing of metal packaging

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
TVOC	mg C/Nm^3	1–20 ([1])
([1]) For plants using BAT 16 (c) in combination with an off-gas treatment technique, an additional BAT-AEL of less than 50 mg C/Nm^3 applies to the waste gas of the concentrator.		

The associated monitoring is given in BAT 11.

1.11 BAT conclusions for heatset web offset printing

The BAT conclusion in this section applies to heatset web offset printing, and applies in addition to the general BAT conclusions given in Section 1.1.

BAT 28. In order to reduce total VOC emissions, BAT is to use a combination of the techniques given below.

Technique		Description	Applicability
Material-based and printing techniques			
a.	Use of low-IPA or IPA-free additives in dampening solutions	Reduction or avoidance of isopropanol (IPA) as a wetting agent in dampening solutions, through substitution by mixtures of other organic compounds which are not volatile or have a low volatility.	Applicability may be limited by technical and product quality requirements or specifications.
b.	Waterless offset	Modification of the press and the pre-press processes to enable the use of specially coated offset plates, eliminating the need for dampening.	May not be applicable for long print runs due to the need for more frequent changes of plates.
Cleaning techniques			
c.	Use of VOC-free solvents or solvents with low volatility for automatic blanket cleaning	Use of organic compounds which are not volatile or have a low volatility as cleaning agents for automatic blanket cleaning.	Generally applicable.
Off-gas treatment techniques			
d.	Web offset dryer integrated with off-gas treatment	A web offset dryer with an integrated off-gas treatment unit, enabling incoming dryer air to be mixed with a part of the waste gases returned from the off-gas thermal treatment system.	Applicable to new plants or major plant upgrades.
e.	Extraction and treatment of air from the press room or the press encapsulation	Routing of extracted air from the press room or the press encapsulation to the dryer. As a result, a part of the solvents evaporated in the press room or press encapsulation is abated by the thermal treatment (see BAT 15) downstream of the dryer.	Generally applicable.

Table 25: BAT-associated emission level (BAT-AEL) for total emissions of VOCs from heatset web offset printing

Parameter	Unit	BAT-AEL (Yearly average)
Total VOC emissions as calculated by the solvent mass balance	kg VOCs per kg of ink input	< 0.01–0.04 ([1])
([1]) The upper end of the BAT-AEL range is related to the production of high-quality products.		

The associated monitoring is given in BAT 10.

As an alternative to the BAT-AELs in Table 25, the BAT-AELs in both Table 26 and Table 27 may be used.

Table 26: BAT-associated emission level (BAT-AEL) for fugitive emissions of VOCs from heatset web offset printing

Parameter	Unit	BAT-AEL (Yearly average)
Fugitive VOC emissions as calculated by the solvent mass balance	Percentage (%) of the solvent input	< 1–10 ([1])
([1]) The upper end of the BAT-AEL range is related to the production of high-quality products.		

The associated monitoring is given in BAT 10.

Table 27: BAT-associated emission level (BAT-AEL) for VOC emissions in waste gases from heatset web offset printing

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
TVOC	mg C/Nm^3	1–15

The associated monitoring is given in BAT 11.

1.12 BAT conclusions for flexography and non-publication rotogravure printing

The emission levels for flexography and non-publication rotogravure printing given below are associated with the general BAT conclusions given in Section 1.1.

Table 28: BAT-associated emission level (BAT-AEL) for total emissions of VOCs from flexography and non-publication rotogravure printing

Parameter	Unit	BAT-AEL (Yearly average)
Total VOC emissions as calculated by the solvent mass balance	kg VOCs per kg of solid mass input	< 0.1–0.3

The associated monitoring is given in BAT 10.

As an alternative to the BAT-AEL in Table 28, the BAT-AELs in both Table 29 and Table 30 may be used.

Table 29: BAT-associated emission level (BAT-AEL) for fugitive emissions of VOCs from flexography and non-publication rotogravure printing

Parameter	Unit	BAT-AEL (Yearly average)
Fugitive VOC emissions as calculated by the solvent mass balance	Percentage (%) of the solvent input	< 1–12

The associated monitoring is given in BAT 10.

Table 30: BAT-associated emission level (BAT-AEL) for VOC emissions in waste gases from flexography and non-publication rotogravure printing

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
TVOC	mg C/Nm^3	1–20 ([1])([2])

([1]) The upper end of the BAT-AEL range is 50 mg C/Nm^3 if techniques are used which allow the reuse/recycling of the recovered solvent.
([2]) For plants using BAT 16 (c) in combination with an off-gas treatment technique, an additional BAT-AEL of less than 50 mg C/Nm^3 applies to the waste gas of the concentrator.

The associated monitoring is given in BAT 11.

1.13 BAT conclusions for publication rotogravure printing

The BAT conclusion in this section applies to publication rotogravure printing, and applies in addition to the general BAT conclusions given in Section 1.1.

BAT 29. In order to reduce VOC emissions from publication rotogravure printing, BAT is to use a toluene recovery system based on adsorption and one or both of the techniques given below.

Technique		Description
a.	Use of retention inks	Retention inks slow the formation of the dried film surface, which allows toluene to evaporate over a longer time and therefore more toluene to be released in the dryer and recovered by the toluene recovery system.
b.	Automatic cleaning systems connected to the toluene recovery system	Automated cylinder cleaning with air extraction to the toluene recovery system.

Table 31: BAT-associated emission level (BAT-AEL) for fugitive emissions of VOCs from publication rotogravure printing

Parameter	Unit	BAT-AEL (Yearly average)
Fugitive VOC emissions as calculated by the solvent mass balance	Percentage (%) of the solvent input	< 2.5

The associated monitoring is given in BAT 10.

Table 32: BAT-associated emission level (BAT-AEL) for VOC emissions in waste gases from publication rotogravure printing

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
TVOC	mg C/Nm^3	10–20

The associated monitoring is given in BAT 11.

1.14 BAT conclusions for the coating of wooden surfaces

The emission levels for the coating of wooden surfaces given below are associated with the general BAT conclusions given in Section 1.1.

Table 33: BAT-associated emission level (BAT-AEL) for total emissions of VOCs from the coating of wooden surfaces

Parameter	Coated substrates	Unit	BAT-AEL (Yearly average)
Total VOC emissions as calculated by the solvent mass balance	Flat substrates	kg VOCs per kg of solid mass input	< 0.1
	Other than flat substrates		< 0.25

The associated monitoring is given in BAT 10.

As an alternative to the BAT-AELs in Table 33, the BAT-AELs in both Table 34 and Table 35 may be used.

Table 34: BAT-associated emission level (BAT-AEL) for fugitive emissions of VOCs from the coating of wooden surfaces

Parameter	Unit	BAT-AEL (Yearly average)
Fugitive VOC emissions as calculated by the solvent mass balance	Percentage (%) of the solvent input	< 10

The associated monitoring is given in BAT 10.

Table 35: BAT-associated emission level (BAT-AEL) for VOC emissions in waste gases from the coating of wooden surfaces

Parameter	Unit	BAT-AEL (Daily average or average over the sampling period)
TVOC	mg C/Nm^3	5-20 ([1])
([1]) For plants using BAT 16 (c) in combination with an off-gas treatment technique, an additional BAT-AEL of less than 50 mg C/Nm^3 applies to the waste gas of the concentrator.		

The associated monitoring is given in BAT 11.

2 BAT CONCLUSIONS FOR PRESERVATION OF WOOD AND WOOD PRODUCTS WITH CHEMICALS

2.1 Environmental management systems

BAT 30. In order to improve the overall environmental performance, BAT is to elaborate and implement an Environmental Management System (EMS) that incorporates all of the features (i) to (xx) of BAT 1 as well as the following specific features:

i. Keeping up to date with the developments in biocidal products and in associated legislation (e.g. authorisation of products under the BPR) with a view to using the most environmentally friendly processes.
ii. Inclusion of a solvent mass balance for solvent-based and creosote treatment (see BAT 33 (c)).
iii. Identification and listing of all environmentally critical process and abatement equipment (whose failure could have an impact on the environment) (see BAT 46 (c)). The list of critical equipment is kept up to date.
iv. Inclusion of plans for the prevention and control of leaks and spillages, including waste management guidelines for dealing with waste arising from spillage control (see BAT 46).

v. Recording of accidental leakages and spillages, and improvement plans (countermeasures).

Note: Regulation (EC) No 1221/2009 establishes the European Union eco-management and audit scheme (EMAS), which is an example of an EMS consistent with this BAT.

Applicability: The level of detail and the degree of formalisation of the EMS will generally be related to the nature, scale and complexity of the installation, and the range of environmental impacts it may have.

2.2 Substitution of harmful/hazardous substances

BAT 31. In order to prevent or reduce emissions of PAHs and/or solvents, BAT is to use water-based preservatives.

Description: Solvent-based preservatives or creosote are replaced by water-based preservatives. Water acts as the carrier for the biocides.

Applicability: The applicability may be restricted due to product quality requirements or specifications.

BAT 32. In order to reduce the environmental risk posed by the use of treatment chemicals, BAT is to substitute treatment chemicals currently in use with less hazardous ones based on a regular (e.g. once every year) check aiming at identifying potentially new available and safer alternatives.

Applicability: Substitution may be restricted due to product quality requirements or specifications.

2.3 Resource efficiency

BAT 33. In order to increase resource efficiency and to reduce the environmental impact and risk associated with the use of treatment chemicals, BAT is to reduce their consumption by using all of the techniques given below.

Technique		Description	Applicability
a.	Use of an efficient preservative application system	Application systems where the wood is immersed in the preservative solution are more efficient than, for example, spraying. The application efficiency of vacuum processes (closed system) is close to 100 %. The selection of the application system takes into account the use class and the penetration level needed.	Only applicable to new plants or major plant upgrades.

b.	Control and optimisation of the consumption of the treatment chemicals for the specific end use	Control and optimisation of the consumption of the treatment chemicals by: a) weighing the wood/wood products before and after impregnation; or b) determining the amount of preservative solution during and after impregnation. The consumption of the treatment chemicals follows suppliers' recommendations and does not lead to exceedances of the retention requirements (e.g. set in product quality standards).	Generally applicable.
c.	Solvent mass balance	The compilation, at least once every year, of organic solvent inputs and outputs of a plant as defined in Part 7(2) of Annex VII to Directive 2010/75/EU.	Only applicable to plants using solvent-based treatment chemicals or creosote.
d.	Measurement and adjustment of wood moisture before treatment	Wood moisture is measured prior to treatment (e.g. by measuring the electric resistance or by weighing) and adjusted if needed (e.g. by further seasoning of the wood) in order to optimise the impregnation process and ensure the required product quality.	Only applicable if wood with a specific moisture content is needed.

2.4 Delivery, storage and handling of treatment chemicals

BAT 34. In order to reduce emissions from delivery, storage and handling of treatment chemicals, BAT is to use technique (a) or (b) and all of the techniques (c) to (f) given below.

Technique		Description
a.	Back-venting	Also referred to as vapour balancing. Vapours of solvents or creosote which are displaced from the receiving tank during filling are collected and returned to the tank or truck from which the liquid is delivered.
b.	Capture of displaced air	Vapours of solvents or creosote which are displaced from the receiving tank during filling are collected and led to a treatment unit, e.g. an activated carbon filter or a thermal oxidation unit.
c.	Techniques to reduce evaporation losses due to heating up of stored chemicals	When exposure to sunlight may lead to evaporation of solvents and creosote stored in above-ground storage tanks, tanks are covered by a roof or coated with light-coloured paint to reduce the heating up of stored solvents and creosote.
d.	Securing delivery connections	Delivery connections to storage tanks located within the bunded / contained area are secured and shut off when not in use.
e.	Techniques to prevent overflows during pumping	This includes ensuring that: • the pumping operation is supervised; • for larger quantities, bulk storage tanks are fitted with acoustic and/or optical high-level alarms, with shut-off systems if necessary.
f.	Closed storage containers	Use of closed storage containers for treatment chemicals.

2.5 Preparation / conditioning of wood

BAT 35. In order to reduce the consumption of treatment chemicals and the consumption of energy and to reduce emissions of treatment chemicals, BAT is to optimise the wood charge of the vessel and to avoid trapping of treatment chemicals by using a combination of the techniques given below.

Technique		Description	Applicability
a.	Separation of wood in packs by spacers	Spacers are placed at regular intervals in the packs to facilitate the flow of treatment chemicals through the pack and the draining after treatment.	Generally applicable.
b.	Sloping of wood packs in traditional horizontal treatment vessels	Wood packs are inclined in the treatment vessel to facilitate the flow of treatment chemicals and the draining after treatment.	Generally applicable.
c.	Use of tilting pressure treatment vessels	The whole treatment vessel is inclined after treatment so that excess treatment chemicals drain easily and can be recovered from the bottom of the vessel.	Only applicable to new plants or major plant upgrades.
d.	Optimised positioning of shaped wood pieces	Shaped wood pieces are positioned so as to prevent trapping of treatment chemicals.	Generally applicable.
e.	Securing wood packs	The wood packs are secured inside the treatment vessel in order to limit the movement of wood pieces which could change the structure of the pack and reduce the impregnation efficiency.	Generally applicable.
f.	Maximisation of the wood load	The wood load in the treatment vessel is maximised to ensure the best ratio between the wood to be treated and the treatment chemicals.	Generally applicable.

2.6 Preservative application process

BAT 36. In order to prevent accidental leakage and emissions of treatment chemicals from non-pressure processes, BAT is to use one of the techniques given below.

Technique	
a.	Double-walled treatment vessels with automatic leak detection devices
b.	Single-walled treatment vessels with sufficiently large and wood-preservative-resistant containment, fender and automatic leak detection device

BAT 37. In order to reduce emissions of aerosols from wood and wood products preservation using water-based treatment chemicals, BAT is to enclose spraying processes, collect overspray and reuse it in the preparation of wood preservation solution.

BAT 38. In order to prevent or reduce emissions of treatment chemicals from pressure processes (autoclaves), BAT is to use all of the techniques given below.

Technique		Description
a.	Process controls to prevent operation unless the treatment vessel door is locked and sealed	The treatment vessel door is locked and sealed once the treatment vessel is loaded and before treatment takes place. Process controls are in place that prevent the operation of the treatment vessel unless the door is locked and sealed.
b.	Process controls to prevent the treatment vessel from opening while it is pressurised and/or filled with preservative solution	Process controls display the pressure and whether liquid is present in the treatment vessel. They prevent the opening of the treatment vessel while it is still pressurised and/or filled.

Technique		Description
c.	Catch-lock for the treatment vessel door	The door of the treatment vessel is equipped with a catch-lock to prevent the release of liquids in the event that the treatment vessel door needs to be opened in an emergency situation (e.g. door seal is broken). The catch-lock permits the door to be partially opened to release the pressure while retaining liquids.
d.	Use and maintenance of safety relief valves	Treatment vessels are fitted with safety relief valves to protect the vessels from excessive pressure. Discharges from valves are directed to a tank of sufficient capacity. Safety relief valves are regularly inspected (e.g. once every 6 months) for signs of corrosion, contamination or incorrect fitting and are cleaned and/or repaired as required.
e.	Control of emissions to air from the vacuum pump exhaust	Air extracted from pressure treatment vessels (i.e. the vacuum pump outlet) is treated (e.g. in a vapour-liquid separator).
f.	Reduction of emissions to air when opening the treatment vessel	Sufficient time for dripping and condensation is allowed between the depressurisation period and the opening of the treatment vessel.
g.	Application of a final vacuum to remove excess treatment chemicals from the surface of treated wood	To avoid dripping, a final vacuum is applied in the treatment vessel before opening it to remove excess treatment chemicals from the surface of treated wood. Application of a final vacuum may not be necessary if the removal of excess treatment chemicals from the surface of treated wood is ensured by the application of an appropriate initial vacuum (e.g. less than 50 mbar).

BAT 39. In order to reduce energy consumption in pressure processes (autoclaves), BAT is to use variable pump control.

Description: After reaching the required working pressure, the treatment system is switched to a pump with reduced power and energy consumption.

Applicability: Applicability may be limited in the case of oscillating pressure processes.

2.7 Post-treatment conditioning and interim storage

BAT 40. In order to prevent or reduce the contamination of soil or groundwater from the interim storage of freshly treated wood, BAT is to allow sufficient dripping time after treatment and to remove the treated wood from the contained / bunded area only once it is deemed dry.

Description: To allow the surplus treatment chemicals to drip back into the treatment vessel, treated wood/wood packs are held in the contained / bunded area (e.g. above the treatment vessel or over a dripping pad) for a sufficient time after the treatment and before transfer to the post-treatment drying area. As an example, before leaving the post-treatment drying area, treated wood/wood packs are lifted by mechanical means and suspended for a minimum of 5 minutes. If no dripping of treatment solution occurs, the wood is deemed to be dry.

2.8 Waste management

BAT 41. In order to reduce the quantity of waste sent for disposal, especially of hazardous waste, BAT is to use the techniques (a) and (b) and one or both of the techniques (c) and (d) given below.

Technique		Description
a.	Removal of debris prior to treatment	Debris (e.g. sawdust, woodchips) is removed from the surface of the wood/wood products before treatment.
b.	Recovery and reuse of waxes and oils	When waxes or oils are used for impregnation, surplus waxes or oils from the impregnation process are recovered and reused.
c.	Bulk delivery of treatment chemicals	Delivery of treatment chemicals in tanks to reduce the amount of packaging.
d.	Use of reusable containers	Reusable containers used for treatment chemicals (e.g. intermediate bulk containers) are returned to the supplier for reuse.

BAT 42. In order to reduce the environmental risk related to waste management, BAT is to store waste in suitable containers or on sealed surfaces and to keep hazardous waste separately in a designated weather-protected and contained/bunded area.

2.9 Monitoring

2.9.1 Emissions to water

BAT 43. BAT is to monitor pollutants in waste water and potentially contaminated surface run-off water prior to each batch discharge in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Substance/Parameter	Standard(s)
Biocides ([1])	EN standards might be available depending on the composition of the biocidal products
Cu ([2])	Various EN standards available (e.g. EN ISO 11885, EN ISO 17294-2, EN ISO 15586)
Solvents ([3])	EN standards available for some solvents (e.g. EN ISO 15680)
PAHs ([4])	EN ISO 17993
Benzo[*a*]pyrene ([4])	EN ISO 17993
HOI	EN ISO 9377-2

([1]) Specific substances are monitored, depending on the composition of the biocidal products in use in the process.
([2]) The monitoring only applies if copper compounds are used in the process.
([3]) The monitoring only applies to plants using solvent-based treatment chemicals. Specific substances are monitored, depending on the solvents in use in the process.
([4]) The monitoring only applies to plants using creosote treatment.

2.9.2 Groundwater quality

BAT 44. BAT is to monitor pollutants in groundwater with a frequency of at least once every 6 months and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

The monitoring frequency may be reduced to once every 2 years based on a risk assessment or if pollutant levels are proven to be sufficiently stable (e.g. after a period of 4 years).

Substance/Parameter ([1])	Standard(s)
Biocides ([2])	EN standards might be available depending on the composition of the biocidal products
As	Various EN standards available (e.g. EN ISO 11885, EN ISO 17294-2, EN ISO 15586)
Cu	
Cr	

Solvents ([3])	EN standards available for some solvents (e.g. EN ISO 15680)
PAHs	EN ISO 17993
Benzo[*a*]pyrene	EN ISO 17993
HOI	EN ISO 9377-2

([1]) The monitoring may not apply if the substance concerned is not used in the process and if the groundwater is proven not to be contaminated with this substance.
([2]) Specific substances are monitored, depending on the composition of biocidal products which are used or were previously used in the process.
([3]) The monitoring only applies to plants using solvent-based treatment chemicals. Specific substances are monitored, depending on the solvents in use in the process.

2.9.3 Emissions in waste gases

BAT 45. BAT is to monitor emissions in waste gases with a frequency of at least once every year and in accordance with EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

Parameter	Process	Standard(s)	Monitoring associated with
TVOC ([1])	Wood and wood products preservation using creosote and solvent-based treatment chemicals	EN 12619	BAT 49, BAT 51
PAHs ([1])([2])	Wood and wood products preservation using creosote	No EN standard available	BAT 51
NO_X ([3])	Wood and wood products preservation using creosote and solvent-based treatment chemicals	EN 14792	BAT 52
CO ([3])		EN 15058	

([1]) To the extent possible, the measurements are carried out at the highest expected emission state under normal operating conditions.
([2]) This includes: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene and pyrene.
([3]) The monitoring only applies to emissions from the thermal treatment of off-gases.

2.10 Emissions to soil and groundwater

BAT 46. In order to prevent or reduce emissions to soil and groundwater, BAT is to use all of the techniques given below.

Technique	Description

Technique		Description
a.	Plant and equipment containment or bund	The parts of the plant in which treatment chemicals are stored or handled, i.e. treatment chemicals storage area, treatment, post-treatment conditioning and interim storage areas (comprising treatment vessel, working vessel, unloading/pull-out facilities, dripping/drying area, cooling zone), pipes and ductwork for treatment chemicals, and creosote (re)conditioning facilities, are contained or bunded. Containments and bunds have impermeable surfaces, are resistant to treatment chemicals and have sufficient capacity to capture and hold the volumes handled or stored in the plant/equipment. Drip trays (made of treatment-chemical-resistant material) may also be used as local containments for the collection and recovery of drips and spills of treatment chemicals from critical equipment or processes (i.e. valves, inlets/outlets of storage tanks, treatment vessels, working tanks, unloading/pull-out zones, handling of freshly treated wood, cooling/drying zone). The liquids in the containments/bunds and drip trays are collected to recover the treatment chemicals for their reuse in the treatment chemicals system. Sludge generated in the collection system is disposed of as hazardous waste.
b.	Impermeable floors	Floors of areas which are not contained or bunded, and where drips, spills, accidental releases or leaching of treatment chemicals may occur are impermeable to the substances concerned (e.g. storage of treated wood on impermeable floors in the event that it is required in the BPR authorisation for the wood preservative used for the treatment). The liquids on the floors are collected to recover the treatment chemicals for their reuse in the treatment chemicals system. Sludge generated in the collection system is disposed of as hazardous waste.
c.	Warning systems for equipment identified as 'critical'	'Critical' equipment (see BAT 30) is equipped with warning systems to indicate malfunctions.
d.	Prevention and detection of leaks from underground storage and ductwork for harmful/hazardous substances and record-keeping	The use of underground components is minimised. When underground components are used for the storage of harmful/hazardous substances, secondary containment (e.g. double-walled containment) is put in place. Underground components are equipped with leak detection devices. Risk-based and regular monitoring of underground storage and ductwork is carried out to identify potential leakages; when necessary, leaking equipment is repaired. A record is kept of incidents that may cause soil and/or groundwater pollution.
e.	Regular inspection and maintenance of plant and equipment	The plant and the equipment are regularly inspected and serviced to ensure proper functioning; this includes in particular checking the integrity and/or leak-free status of valves, pumps, pipes, tanks, pressure vessels, drip trays, and containments/bunds and the proper functioning of warning systems.
f.	Techniques to prevent cross-contamination	Cross-contamination (i.e. the contamination of plant areas that usually do not come into contact with treatment chemicals) is prevented by using appropriate techniques such as: • design of drip trays in such a way that forklifts are not in contact with potentially contaminated surfaces of the drip trays; • design of charging equipment (used to remove treated wood from the treatment vessel) in such a way that the carry-over of treatment chemicals is prevented; • use of a crane system for handling treated wood; • use of dedicated transport vehicles for potentially contaminated areas; • restricted access to potentially contaminated areas; • use of grit walkways.

2.11 Emissions to water and waste water management

BAT 47. In order to prevent or, where that is not practicable, to reduce emissions to water and to reduce water consumption, BAT is to use all of the techniques given below.

Technique		Description	Applicability
a.	Techniques to prevent contamination of rain and surface run-off water	Rain and surface run-off water are kept separated from areas where treatment chemicals are stored or handled, from areas where freshly treated wood is stored and from contaminated water. This is achieved by using at least the following techniques: - drainage channels and/or an outer kerb bund around the plant; - roofing with roof guttering of areas where treatment chemicals are stored or handled (i.e. treatment chemicals' storage area; treatment, post-treatment conditioning and interim storage areas; pipes and ductwork for treatment chemicals; creosote (re)conditioning facilities); - weather protection (e.g. roofing, tarpaulins) for the storage of treated wood in the event that it is required in the BPR authorisation for the wood preservative used for the treatment.	For existing plants, the applicability of drainage channels and an outer kerb bund may be restricted by the size of the plant area.
b.	Collection of potentially contaminated surface run-off water	Surface run-off water from areas that are potentially contaminated with treatment chemicals is collected separately. Collected waste water is discharged only after appropriate measures are taken e.g. monitor (see BAT 43), treat (see BAT 47 (e)), re-use (see BAT 47 (c).	Generally applicable.
c.	Use of potentially contaminated surface run-off water	After its collection, potentially contaminated surface run-off water is used for the preparation of water-based wood preservative solutions.	Only applicable to plants using water-based treatment chemicals. Applicability may be restricted by the quality requirements for its intended use.
d.	Reuse of cleaning water	Water used to wash equipment and containers is recovered and reused in the preparation of water-based wood preservative solutions.	Only applicable to plants using water-based treatment chemicals.
e.	Treatment of waste water	Where contamination in the collected surface run-off water and/or cleaning water is detected or can be expected, and where the use of the water is not feasible, the waste water is treated in an adequate waste water treatment plant (on or off site).	Generally applicable.
f.	Disposal as hazardous waste	Where contamination in the collected surface run-off water and/or cleaning water is detected or can be expected, and where the treatment or use of the water is not feasible, the collected surface run-off water and/or cleaning water is disposed of as hazardous waste.	Generally applicable.

BAT 48. In order to reduce emissions to water from wood and wood products preservation using creosote, BAT is to collect the condensates from the depressurisation and vacuum operation of the treatment vessel and from creosote (re)conditioning and either treat them on site using an activated carbon or sand filter or dispose of them as hazardous waste.

Description: Condensate volumes are collected, allowed to settle and treated in an activated carbon or sand filter. The treated water is either reused (closed circuit) or discharged to the

public sewer system. Alternatively, the collected condensates may be disposed of as hazardous waste.

2.12 Emissions to air

BAT 49. In order to reduce emissions of VOCs to air from wood and wood products preservation using solvent-based treatment chemicals, BAT is to enclose the emitting equipment or processes, extract the off-gases and send them to a treatment system (see techniques in BAT 51).

BAT 50. In order to reduce emissions of organic compounds and odour to air from wood and wood products preservation using creosote, BAT is to use low-volatility impregnating oils, i.e. Grade C creosote instead of Grade B.

Applicability: Grade C creosote may not be applicable in the case of cold climatic conditions.

BAT 51. In order to reduce emissions of organic compounds to air from wood and wood products preservation using creosote, BAT is to enclose emitting equipment or processes (e.g. storage and impregnation tanks, depressurisation, creosote reconditioning), extract the off-gases and use one or a combination of the treatment techniques given below.

Technique		Description	Applicability
a.	Thermal oxidation	See BAT 15 (i). Exhaust heat can be recovered by means of heat exchangers.	Generally applicable.
b.	Sending off-gases to a combustion plant	Part or all of the off-gases are sent as combustion air and supplementary fuel to a combustion plant (including CHP (combined heat and power) plants) used for steam and/or electricity production.	Not applicable for off-gases containing substances referred to in IED Article 59(5). Applicability may be restricted due to safety considerations.
c.	Adsorption using activated carbon	Organic compounds are adsorbed on the surface of activated carbon. Adsorbed compounds may be subsequently desorbed, e.g. with steam (often on site) for reuse or disposal and the adsorbent is reused.	Generally applicable.
d.	Absorption using a suitable liquid	Use of a suitable liquid to remove pollutants from the off-gases by absorption, in particular soluble compounds.	Generally applicable.
e.	Condensation	A technique for removing organic compounds by reducing the temperature below their dew points so that the vapours liquefy. Depending on the operating temperature range required, different refrigerants are used, e.g. cooling water, chilled water (temperature typically around 5 °C), ammonia or propane. Condensation is used in combination with another abatement technique.	Applicability may be restricted where the energy demand for recovery is excessive due to the low VOC content.

Table 36: BAT-associated emission levels (BAT-AELs) for TVOC and PAH emissions in waste gases from wood and wood products preservation using creosote and/or solvent-based treatment chemicals

Parameter	Unit	Process	BAT-AEL (Average over the sampling

			period)
TVOC	mg C/Nm^3	Creosote and solvent-based treatment	< 4–20
PAHs	mg/Nm^3	Creosote treatment	< 1 ([1])
([1]) The BAT-AEL refers to the sum of the following PAH compounds: acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene and pyrene.			

The associated monitoring is given in BAT 45.

BAT 52. In order to reduce NO_X emissions in waste gases while limiting CO emissions from the thermal treatment of off-gases in wood and wood products preservation using creosote and/or solvent-based treatment chemicals, BAT is to use technique (a) or both of the techniques given below.

Technique		Description	Applicability
a.	Optimisation of thermal treatment conditions (design and operation)	See BAT 17 (a).	Design applicability may be restricted for existing plants.
b.	Use of low-NO_X burners	See BAT 17 (b).	Applicability may be restricted at existing plants by design and/or operational constraints.

Table 37: BAT-associated emission level (BAT-AEL) for NO_X emissions in waste gases and indicative emission level for CO emissions in waste gases to air from the thermal treatment of off-gases in wood and wood products preservation using creosote and/or solvent-based treatment chemicals

Parameter	Unit	BAT-AEL ([1]) (Average over the sampling period)	Indicative emission level ([1]) (Average over the sampling period)
NO_X	mg/Nm^3	20–130	No indicative level
CO		No BAT-AEL	20–150
([1]) The BAT-AEL and indicative level do not apply where off-gases are sent to a combustion plant.			

The associated monitoring is given in BAT 45.

2.13 Noise

BAT 53. In order to prevent or, where that is not practicable, to reduce noise emissions, BAT is to use one or a combination of the techniques given below.

Technique	
Storage and handling of raw materials	
a.	Installation of noise walls and utilisation/optimisation of the noise-absorbing effect of buildings
b.	Enclosure or partial enclosure of noisy operations
c.	Use of low-noise vehicles/transport systems
d.	Noise management measures (e.g. improved inspection and maintenance of equipment, closing of doors and windows)
Kiln drying	
e.	Noise reduction measures for fans

Applicability: The applicability is restricted to cases where a noise nuisance at sensitive receptors is expected and/or has been substantiated.