ww2.defra.gov.uk

Sector Guidance Note SG6 (11)
Secretary of State’s Guidance for Surface Treatment Using Solvents

Integrated Pollution Prevention and Control

February 2011

Department of the Environment
www.doeni.gov.uk

Llywodraeth Cynulliad Cymru
Welsh Assembly Government

The Scottish Government

defra
Department for Environment Food and Rural Affairs

Department for Environment, Food and Rural Affairs
Nobel House
17 Smith Square
London SW1P 3JR

Tel: 020 7238 6000
Website: ww2.defra.gov.uk

Information about this publication and copies are available from:

Atmosphere and Local Environment
Defra
Area 5F
Ergon House
Horseferry Road
London
SW1P 2AL

Email: Control.Pollution@defra.gsi.gov.uk

This document is available on the Defra website:

Published by the Department for Environment, Food and Rural Affairs

Integrated Pollution Prevention and Control (IPPC)

Statutory Guidance: Surface Treatment using Solvents

Part A2 – England and Wales
Part A – Scotland
Part A – Northern Ireland

Defra would like to acknowledge the work of the Environment Agency's Local Authority Unit in the drafting of this guidance note.

ENVIRONMENT AGENCY

Contents

List of Figures

List of Tables

1. Introduction

Background

1.1 This sector guidance note is issued by the Secretary of State, the Welsh Assembly Government (WAG), the Scottish Government and the Department of the Environment in Northern Ireland (DOENI) following consultation with relevant trade bodies, representatives of regulators including members of the Industrial Pollution Liaison Committee, and other interested organisations.

1.2 The note constitutes statutory guidance in England and Wales, under regulation 64 of the Environmental Permitting (England and Wales) Regulations 2010, SI2010/675 (Ref 1), guidance in Scotland (Ref 1b) and statutory guidance in Northern Ireland (Ref 1c) on the integrated pollution control standards appropriate for the generality of new and existing A2 (England and Wales), Part A (Scotland) and Part A (Northern Ireland) installations in the Surface Treatment using Solvents (STS) sector.

These installations require a permit to operate in accordance with the 2010 Regulations (England and Wales), the 2000 Regulations (Scotland) and the 2003 Regulations (Northern Ireland). Local authority regulators in England and Wales, the Scottish Environment Protection Agency (SEPA) in Scotland and the Northern Ireland Environment Agency (NIEA) in Northern Ireland are required by the Regulations to have regard to this guidance. The Secretary of State/WAG/Scottish Government and the Northern Ireland Planning Appeals Commission (PAC) will also treat this guidance as one of the material considerations when determining any appeals made under the Regulations against a local enforcing authority decision.

1.3 The guidance also (where appropriate) gives details of any mandatory requirements affecting emissions and impacts from these installations, which are in force at the time of publication. These include requirements contained in directions from the Secretary of State/WAG/Scottish Government and DOENI.

1.4 This is one of a series of such guidance notes aimed at providing a strong framework for consistent and transparent regulation of LA-IPPC installations (England and Wales), Part A installations (Scotland) and Part A installations in and Northern Ireland.

1.5 General guidance setting out policy and procedures for such installations is contained in separate documents for England and Wales, Scotland and Northern Ireland:

England and Wales

- the General Guidance Manual on Policy and Procedures for A2 and B Installations (Ref 2) to be referred to in this document as the “General Guidance Manual”. This is designed for operators and members of the public, as well as for local authority regulators;

Scotland

- a Practical Guide for Part A activities (Ref 2b)

Ireland

- IPPC (Northern Ireland) A Practical Guide (Ref 2c)

Best Available Techniques (BAT)

1.6 BAT is the main basis for determining standards in IPPC. This sector guidance note addresses what is considered by the Secretary of State/WAG/Scottish Government and DOENI to constitute BAT for STS installations.

As made clear in chapter 12 of the General Guidance Manual (England & Wales), BAT for each installation should be assessed by reference to the appropriate sector guidance note, and these notes should be regarded by the enforcing authority as their primary reference document for determining BAT in drawing up permits. In general terms what is BAT for one installation is likely to be BAT for a comparable installation. However, determination of what is BAT is ultimately a matter for case-by-case decision taking into account that individual circumstances may affect BAT judgements and what are the appropriate permit conditions.

Thus, for each installation where solvents are used for surface treatment, regulators (subject to appeal to the Secretary of State/WAG/Scottish Government and the Northern Ireland Planning Appeals Commission) should regard this guidance note as a baseline, but ensure they take into account any relevant case-specific factors such as the individual process configuration and other characteristics, its size, location, and any other relevant features of the particular installation. Further guidance on this, including the issue of taking account of operators' individual financial position, is contained in chapter 12 of the General Guidance Manual (England & Wales).

1.7 If there are any applicable mandatory EU emission limits, these must be met, although BAT may go further. The same applies to UK regulations, except that, in reconciling BAT with the Control of Pollution (Oil Storage) (England) Regulations 2001, SI 2954, (Ref 3), the Water Environment (Oil Storage) (Scotland) Regulations 2006, SSI 133 (Ref 3b) and The Control of Pollution (Oil Storage) Regulations (Northern Ireland) 2010) (Ref 3c) it may be acceptable to achieve an equivalent level of control to that specified in the 2001 regulations (although the oil storage regulations do not apply in Wales, they should be regarded as an indication of BAT).

Who is this guidance for?

1.8 This guidance is for:

Regulators

- local authorities in England and Wales, who must have regard to the guidance when determining applications for permits and reviewing extant permits and when regulating installations which have a permit
- the Scottish Environment Protection Agency (SEPA) in Scotland; and
- the Northern Ireland Environment Agency (NIEA) in Northern Ireland.

Operators who are best advised also to have regard to it when making applications and in the subsequent operation of their activities; **and**

Members of the public who may be interested to know what standards are envisaged for the generality of installations in this sector.

1.9 The guidance is based on the state of knowledge and understanding of installations in this sector, their potential impact on the environment, and the available control techniques at the time of writing. The guidance may be amended from time to time in order to keep abreast with developments, including improvements or changes in techniques and new understanding of environmental impacts and risks. Any such amendments may be issued in a complete revision of this note, or in separate additional guidance notes which address specific issues. (N.B. It may not always be possible to issue amending guidance quickly enough to keep in absolute step with rapid changes, which might be another justification in particular, cases for diverging from this note.)

Steps will be taken to ensure that those who need to know about changes are informed of any amendments. Operators (and their advisers) are, however, strongly advised to check with the relevant local authority whether there have been any amendments before relying on this note for the purposes of applying for a permit or making any other decisions where BAT and related matters may be a consideration.

Terminology

1.10 In addition to the General Guidance Manual (England & Wales) referred to above, explanation or clarification of certain terms used in this sector guidance note may be found in a general guidance note issued under Part I of the Environmental Protection Act 1990: ‘Interpretation of terms used in process guidance notes’, known as General Guidance Note 4 (GG4) published by HMSO in 1991. Where there is any conflict between GG4 and the guidance issued in this note or in the General Guidance Manual, the latter two documents should prevail, as should any subsequent guidance issued in relation to IPPC.

Installations covered

1.11 This note covers installations, described in the following legislation:

- Section 6.4 Part A(2) (in England and Wales) of Schedule 1 to the EP Regulations 2010 (Ref 1) as follows:

  > "Unless falling within Part A(1) of this Section, surface treating substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, sizing, painting, cleaning or impregnating, in plant with a consumption capacity of more than 150 kg per hour or more than 200 tonnes per year".

- In Section 6.4 Part A (b) (in Scotland) of Schedule 1 to the PPC (Scotland) Regulations 2000 (Ref 1b) as follows:

  > Surface treating substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, sizing, painting, cleaning or impregnating, with a consumption capacity of more than 150 kg per hour or more than 200 tonnes per year".

- In Section 6.4 Part A (d) (in Northern Ireland) of Schedule 1 to the PPC (Northern Ireland) Regulations 2003 (Ref 1c) as follows:

  Surface treating substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, sizing, painting, cleaning or impregnating, in plant with a consumption capacity of more than 150 kg per hour or more than 200 tonnes per year".

In cases where there are several activities within Section 6.4, on site, which together add up to more than the above mentioned capacity figures, regard should be had to paragraph 4 of Part 1 of Schedule 1 to the EP Regulations 2010 (England and Wales) and paragraph 9 of Part 2 of Schedule 1 to the PPC Regulations 2000/2003 (Scotland/ Northern Ireland respectively).

1.12 The installation includes the main activities as stated above and directly associated activities which have a technical connection with the main activities and which may have an effect on emissions and pollution.

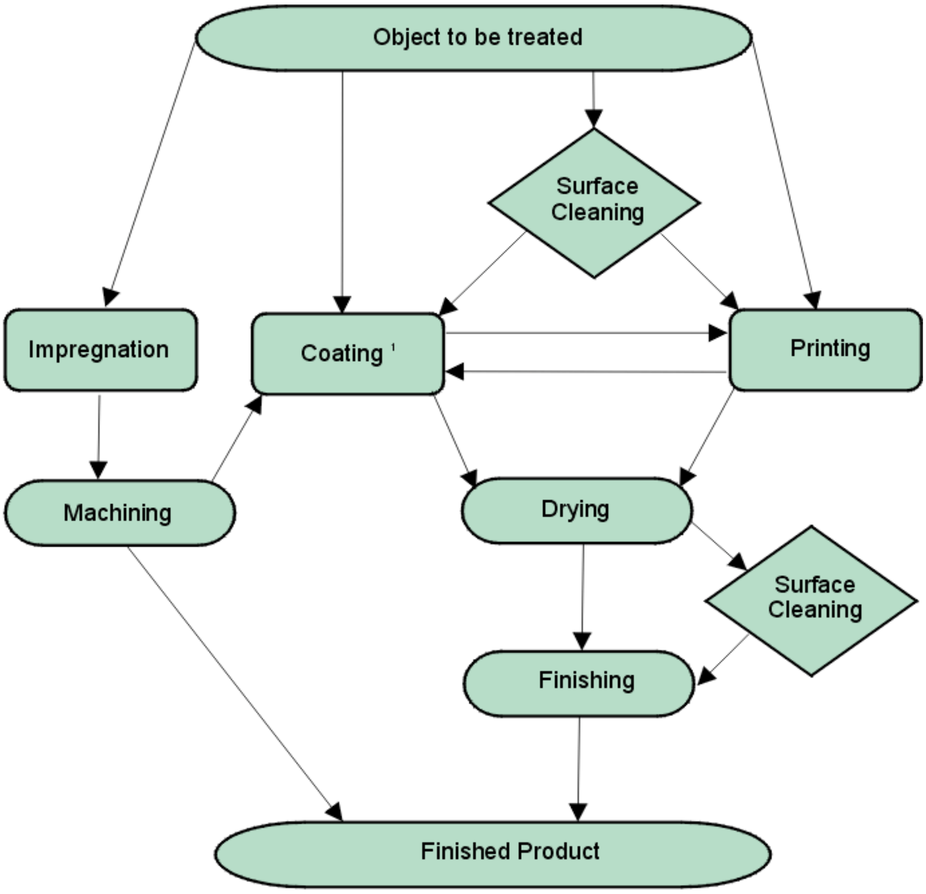
1.13 All installations covered within this note are also required to meet the mandatory requirements for the control of VOCs of the Solvent Emissions Directive 1999/13/EC (Ref 4). These mandatory requirements are written in *italic text*.

When published in 2003 the VOC emission limits to air in the previous Guidance Note were based on those required by the Solvent Emissions Directive. However, since then the European Commission BREF Guidance on the Solvents sector has been placed on the IPPC Bureau website (Ref 5). The BREF Note considers that for some industry sectors covered by this Guidance Note BAT is represented by emission figures that are more stringent than those contained within the Solvent Emissions Directive. This guidance has been taken into account during the revision of this Note.

1.14 This guidance note addresses the following aspects of the prescribed installation:

- coating of substrates to provide a decorative, protective or other functional effect on the surface and may be carried out using a number of application techniques such as spraying, brushing, application by roller, air knife or Meyer bar. Coating operations are sometimes carried out with associated activities such as printing and surface cleaning of the substrate which may be carried out before, after or during the coating operations. In addition they may be associated with cutting, shaping and machining operations in the production of the finished item.
- printing of /on substrates, to reproduce text and/or images transferring ink onto a substrate by the use of an image carrier. Printing operations may sometimes be associated with surface cleaning of the substrate that may be carried out before, after or during the printing operation. In addition they may be associated with the pre-printing operations of image and image carrier production and the post-printing operations of cutting and buffing in order to produce the finished items.
- impregnation to provide a protective or preservative loading to the surface and subsequent layers of objects and products. Impregnation activities may sometimes be associated with coating and printing, although they are most commonly associated with operations for machining the impregnated product into finished item.

Figure 1.1 - Generic diagram of surface treatment operations using organic solvents



1 Coating includes dressing,waterproofing, sizing and impregnating

This guidance note also addresses the following aspects of the prescribed installation, which are considered to be "surface treatment" operations:

- storage and handling of input (raw) materials
- printing including:
    - image preparation
    - proofing
    - image carrier production
    - printing
    - finishing
- coating general:
    - coil coating
    - textile coating
    - film coating
    - vehicle coating
    - winding wire coating
    - coating and printing of metal packaging
    - wallcovering manufacture

- emissions control
- management
- raw materials
- waste handling
- waste re-use, recovery, recycling and disposal
- energy
- accidents
- noise and vibration
- monitoring
- information provisions

Review and upgrading periods

Existing installations or activities

1.15 SG6 was first published in 2003 – SG6(03). It was revised in 2008 to amplify the guidance on all aspects other than those relating to air emissions control – SG6(08). Publication in 2007 of the Surface Treatment using Solvents BREF Note (Ref 5) has prompted this further revision.

This is reflected in the following tables:

Table 1 replicates the provisions in SG6(03) and most should now be complied with - only those for which a 6-year compliance period is appropriate may be outstanding.

Table 2 replicates the additional provisions from SG6(08) which should have been completed within 2 years of publication.

Table 3 contains the further additional provisions from this (2011) version of SG6. The main changes are to reflect the above-mentioned BREF note.

Table 5 specifies emission limits for the full range of air pollutants and is largely a copy of table 4 in the 2008 version. Row 2 is new, and there have been small changes to the wording in the second column of rows 5, 6 and 7. Table 5 only deals with VOC emissions to the extent that certain risk phrase solvents are used.

Table 6a is a new table covering the possibility that certain sectors not covered by the BREF note could be operated at greater than 200te per year solvent consumption and therefore fall under A2. In these cases, BAT for air emissions should be taken from the relevant process guidance note.

Table 6b largely replicates Table 5 in SG6(08) containing the VOC limit values, fugitive limits and reduction scheme targets which, where appropriate, reflect the SED. The main difference is that two new columns have been added at the right-hand end of the table, these two columns contain the provisions in the BREF note and, if more stringent than the earlier columns in any row, they should be considered in deciding whether BAT in any case goes beyond what is contained in the earlier columns.

There are four other differences:

a) the table is minus certain detail about emission sources (column 2 is instead headed "Activity");

b) the monitoring guidance has been transferred to a new table (Table 6c);

c) adhesive coating has been removed and is now covered by Table 6a; **and**

d) wood impregnation has been added.

Existing installations should already be compliant with the requirements of the Solvent Emissions Directive. Where this guidance note specifies provisions which are additional to, higher than or different from those in SG6(08), only in exceptional circumstances should upgrading of existing installations and activities having regard to these additional/higher/different provisions be completed later than the compliance date specified in Table 3.

Where standards or provisions in SG6(08) have been deleted in this guidance note or where this guidance note specifies less stringent provisions than those in SG6(08), the new LA-IPPC permit should reflect this straightaway.

Table 1 - Existing Compliance requirements from SG6(03)

Requirement	Reference from SG6 (03)[1]	Compliance date
New limits for VOC emissions from contained releases and Fugitive Emission Value requirements	Table 5	31 October 2007
OR		
New total emission limit values for VOC	Table 5	31 October 2007
OR		
New VOC Reduction Scheme requirements	Table 5	31 October 2005
The operator should inform the regulator which of the above compliance methods for VOC will be employed by 31 October 2004.		
New requirement to Replace, Control and Limit VOCs with Risk Phrases R45, R46, R49, R60 and R61	Table 4, Row 16 and BAT 206	Shortest possible time
New requirement to Control and Limit Halogenated VOCs with Risk Phrase R40	Table 4, Row 15	Shortest possible time
Requirements on new VOC abatement plant fitted to existing installations	Paragraph 1.18	Immediately
Limitation on sulphur in fuel purchased	Table 4, Row 9	Immediately
Competent Person for Regulator and Public Liaison	BAT 197	Within 2 years of the issue of the permit
Addition of CO or O2 monitoring	BAT 268	Within 2 years of the issue of the permit
Water Audit	BAT 211	Within 2 years of the issue of the permit
Waste Audit	BAT 209	Within 2 years of the issue of the permit
Energy Audit	BAT 224	Annually
Long-term study of alternative raw materials	BAT 205	Within 6 years of the publication of this note
All other requirements	To be complied with as soon as practicable, which in most cases should be within 12 months of the issue of the permit.	

---

[1] Previously published versions of Sector Guidance Notes may be obtained from Defra via the email link control.pollution@defra.gsi.gov.uk

Table 2 - Existing Compliance requirements from SG6(08)

Guidance	Reference from SG6(08)[2]	Compliance date
Drainage Systems Audit	BAT 165 & BAT 166	Within 12 months of issue of varied permit.
Groundwater Protection Systems	BAT 167 to BAT172	Within 24 months of issue of varied permit.
Solvent Storage Systems	BAT 173	Within 12 months of issue of varied permit.
Odour Assessments	BAT 175	Within 6 months of issue of varied permit.
Odour Control	BAT 176	Within 12 months of issue of varied permit.
Environmental Management Systems	BAT 177	Within 24 months of issue of varied permit.
Formal Structure for Environmental Control and Training	BAT 183	Within 12 months of issue of varied permit.
Benchmarking and Recording Water Usage	BAT 195	Within 6 months of issue of varied permit.
Waste Storage Provisions	BAT 201	Within 12 months of issue of varied permit.
Recycling Markets	BAT 209	Within 24 months of issue of varied permit.
All Other Requirements		To be complied with as soon as practicable, which in most cases should be within 12 months of the issue of the permit.

Table 3 - Compliance Requirements

Guidance	Reference	Compliance date
BAT Emission Values	Table 6b	See paragraph 1.16 – 1.18

1.16 The operator should aim to comply with the emission values in **Table 6b** by no later than **31 December 2018** and sooner if it constitutes BAT.

1.17 In all cases operators should submit a compliance report to the local authority regulator by no later than **31st December 2011**, setting out the steps they will take to comply with paragraph 1.16. This should include:

i. Data showing the current actual emissions and comparison with the figures in the relevant row of Table 6b;

ii. Where it is intended to comply with the relevant specified row(s) in Table 6b by 31st December 2012, a statement to that effect

iii. Where it is intended to comply with the relevant specified row(s) in Table 6b after 31st December 2012, but no later than 31st December 2014, a justification of why it is considered that the proposed date represents BAT and a plan showing the interim steps that will be taken to ensure compliance by that date

iv. Where it is intended to comply with the relevant specified row(s) in table 6b after 31st December 2012, but no later than 31st December 2018, the same information as in iii).

Exceptionally, it may represent BAT for the coating of new vehicles, for the compliance deadline to be beyond the end of 2018, notwithstanding the publication of the BREF note in January 2007. The most likely justification is the age and remaining economic life of existing plant, having regard to all other BAT considerations. Other BAT-based justifications for deferral can be included in submissions under paragraph 1.17(iii), in which case authorities should examine particularly carefully the operator's plan to comply post-2018. In such cases, operators should additionally submit periodic reports to the local authority regulator at intervals of no more than 3 years. The first report should be submitted no later than 31 December 2014. The report should provide an update of the information submitted by 31 December 2011.

---

[2] Previously published versions of Sector Guidance Notes may be obtained from Defra via the email link control.pollution@defra.gsi.gov.uk

1.18 Where applicable, replacement abatement plant for VOC must be designed to meet the relevant emission controls specified for new installations or activities. The minimum standard to be achieved is compliance with the requirements of the Solvent Emissions Directive. Where the emission values in Table 6b associated with the use of BAT are stricter than the requirements of the SED then, in general, they should be considered in deciding whether BAT in any case goes beyond what is contained in the earlier columns.

Non-VOC replacement abatement plant should normally be designed to meet the appropriate standards specified for new installations or activities.

New installations or activities

1.19 For new installations or activities - from the first day of operation the permit should have regard to the full standards of this guidance.

Substantially changed installations or activities

1.20 For substantially changed installations or activities - as from the first day of operation, the permit should normally have regard to the full standards of this guidance with respect to the parts of the installation that have been substantially changed and any part of the installation affected by the change.

Permit reviews

1.21 Permits should be reviewed in accordance with the guidance in chapter 26 of the General Guidance Manual (Ref 2). The review frequencies given in that chapter are considered appropriate for activities and installations covered by this sector guidance note.

Summary of releases

Table 4 - Summary of direct releases

SOURCE	RELEASES																				
	Oxides of sulphur	Oxides of nitrogen	Carbon dioxide	Carbon monoxide	Particulate / Total Suspended Solids	Ammonia	VOC	Halogenated VOCs Risk Phrase R40, R68	VOCs Risk Phrase R45, R46, R49, R60, R61	Isocyanates	Formaldehyde	Ozone	HF	Solid waste or sludge	Metals	Oils and greases	Acid vapours	Odours	Noise
Offset printing						A	A					A		L	L/W			*	*
Flexography							A					A		L	L/W			*	*
Rotary screen printing							A					A		L	L/W			*	*
Gravure							A					A		L	L/W		A	*	*
Print finishing					A		A							L					*
Coating general	A	A	A	A	A/W	A	A	A	A	A		A		L	L/W	L/W		*	*
Coil coating	A	A	A	A			A			A			A	L				*	*
Coating of paper		A	A	A	W	A	A					A		L				*	*
Film coating		A	A	A	W	A	A					A		L		L		*	*
Adhesive coating		A	A	A	W	A	A					A		L				*	*
Textile coating		A	A	A	A/W	A	A/W	A	A/W	A/W	A			L	L/W			*	*
Coating/printing of metal packaging		A	A	A	A/W		A			A		A	W	L	L/W	W		*	*
Paint application in vehicle manufacture	A	A	A	A	A/W		A							L	L/W	W		*	*
Coating of winding wire		A	A	A	A/W		A			A				L				*	*
Surface cleaning of substrates					W		A	A/W	A/W					L	L/W	L/W		*	
Machine cleaning in situ						A	A	A/W	A/W					L	L/W	L/W		*	
Mixing and blending operations					W/L	A	A	A	A					A L	L			*	
Storage and handling operations					A		A	A	A					L				*	
Solvent recovery plant							A	A	A					L				*	
Cooling operations														L					
Boilers, engines and turbines	A	A		A	W		A							L				*	
Drying	A	A		A		A	A					A						*	*
Oxidation plant	A	A		A			A							L				*	*
Effluent plant					W		A/W							L	L/W	L/W		*	

Note: A = Release to Air W = Release to Water L = Release to Land,

* = Potential for noise *= Potential for odour

(Note that "Release to land" covers several release routes e.g. recovery, re-use and is not specific to releases to landfill).

Substances include their compounds, except where separate reference to the compound is made.

Releases to air may also be released to land or water, depending upon the abatement technology employed e.g. via collected dust, sludge or liquor.

N.B. It should be noted that this is not necessarily an exhaustive list. Equally not all installations will necessarily have all these releases.

2. Emission limits and other provisions

Emissions to air associated with the use of BAT

2.1 Table 5 specifies emission limits for the full range of air pollutants and is largely a copy of table 4 in the 2008 version. Row 2 is new, and there have been small changes to the wording in the second column of rows 5, 6 and 7. Table 5 only deals with VOC emissions to the extent that certain risk phrase solvents are used.

Concentration limits are only applicable to contained emissions exhausted to external atmosphere.

Table 5 - Contained emissions to air associated with the use of BAT

Row	Total particulate matter	Emission limit / requirement	Monitoring (subject to paragraph 3.275)
1	Shot blasting, fettling and other finishing operations.	20 mg/m^3	Continuously recorded indicative monitoring Plus once a year extractive monitoring
2	New paint spray booths	Equipment should be designed to meet 10 mg/m^3	By guarantee supplied by the spray booth manufacturer; **or** Suitable alarmed monitoring of the surrogate measurement (see BAT 250)
3	Paint spraying vehicle bodies emissions	5 mg/m^3	Once a year extractive monitoring or a suitable surrogate measure
4	Other existing paint spraying operations	50 mg/m^3	Once a year extractive monitoring or a suitable surrogate measure
5	All other non-combustion contained sources	50 mg/m^3	Continuously recorded indicative monitoring Plus once a year extractive monitoring
6	Visible emissions combustion plant (including gas fired oxidisers)	Normal operation	No visible emissions
		Start-up and shutdown	Ringelmann shade 1
Row	**Oxides of nitrogen**	**Emission limit / requirement**	**Monitoring (subject to paragraph 3.275)**
7	From thermal abatement plant	Nitrogen containing coatings 300 mg/m^3	Once a year extractive monitoring
		Non-nitrogen containing coatings 100 mg/m^3	
8	**From winding wire machines operating on:**	**Target value**	
	Polyester or polyester-imide enamel	0.1g/kg of coated wire	
	Polyurethane enamel	0.1g/kg of coated wire	
	Polyester-imide with polyamide-imide or polyamide	5g/kg of coated wire	
	Polyimide	9g/kg of coated wire	
Row	**Carbon Monoxide**	**Emission limit / requirement**	**Monitoring (subject to paragraph 3.275)**
9	From thermal abatement plant	100 mg/m^3	**Where used as a surrogate measurement for VOC destruction:** Continuously recorded indicative monitoring Plus once a year extractive monitoring. **All other cases:** Once a year extractive monitoring

Row	**Sulphur dioxide**	**Emission limit / requirement**		**Monitoring (subject to paragraph 3.275)**
10	From fuel burnt in combustion plant. Sulphur content of fuel	When burning gas oil. (Note 1)	0.1 wt/wt sulphur in fuel	Certification by supplier using test method ASTM D86 distillation.
		When burning other fuels	1% wt/wt sulphur in fuel	
Row	**Formaldehyde**	**Emission limit / requirement**		**Monitoring (subject to paragraph 3.275)**
11	Textile and fabric finishing	20 mg/m^3 (measured as formaldehyde)		Once a year extractive monitoring
Row	**Ammonia**	**Emission limit / requirement**		**Monitoring (subject to paragraph 3.275)**
12	Textile and fabric finishing	30 mg/m^3		Once a year extractive monitoring
Row	**Isocyanate**	**Emission limit / requirement**		**Monitoring (subject to paragraph 3.275)**
13	All contained sources where isocyanate is used	0.1 mg/Nm^3 (averaged over a 2 hour period as total NCO group)		Once a year extractive monitoring
Row	**Fluoride**	**Emission limit / requirement**		**Monitoring (subject to paragraph 3.275)**
14	All contained sources where fluorine containing coating is used	5 mg/m^3 expressed as hydrogen fluoride		Once a year extractive monitoring
Row	**HCl**	**Emission limit/ requirement**		**Monitoring (subject to paragraph 3.275)**
15		10 mg/m^3		Once a year extractive monitoring
Row	**Halogenated VOC assigned a risk phrase R40, R68** *(Note 4)*	**Emission limit / requirement**		**Monitoring**
16	*All contained sources where R40 and/or R68 Halogenated VOC are used*	*20 mg/m^3 expressed as the sum of the mass concentrations of the individual VOCs concerned.(Note 2)*		*Once a year extractive monitoring*
Row	**VOC assigned a risk phrase R45, R46, R49, R60, R61** (Note 4)	**Emission limit / requirement**		**Monitoring**
17	*VOCs assigned or which need to carry the risk phrases R45, R46, R49, R60, R61, R68 where the mass flow of the sum of the compounds causing the labelling is greater than, or equal to, 10 g/h (Note 3)*	*2 mg/m^3 expressed as the sum of the mass concentrations of the individual VOC concerned (Note 2)*		*Once a year extractive monitoring*

Note 1 - Gas oil as defined in the Sulphur Content of Certain Liquid Fuels Directive (1992/32/EC).

Note 2 - Limits are derived from the Solvent Emissions Directive (1999/13/EC) and are the mandatory minimum standard.

Note 3 - VOCs assigned or which need to carry the risk phrases R45, R46, R49, R60, R61 shall be replaced, as far as possible and by taking into account the guidance as mentioned in Article 7(1) of the SED, by less harmful substances or mixtures within the shortest possible time.

Note 4 - As from 1st December 2010 “risk phrase” materials will also be known as “hazard statement” materials. Both terms will apply until 1st June 2015 when only the term “hazard statement” materials will apply.

2.2 Table 6a and Table 6b and paragraphs 2.3 - 2.6 deal with all VOCs not addressed in Table 5.

2.3 There are three anomalous situations that may arise:

a) where SG6 should be used in conjunction with a suitable Process Guidance Note (see paragraph 2.4);

b) where there are overlapping air emission requirements in the SED and the BREF Note for Surface Treatment using Organic Solvents (see paragraph 2.5);

c) where sector specific guidance is not contained in either this Note or any PG Note (see paragraph 2.6).

2.4 It is possible that the sectors listed in Table 6a, which are not covered by the BREF note, could be operated at greater than 200te per year solvent consumption and therefore fall under A2. In these cases, BAT for air emissions should be taken from the relevant process guidance note, as set out in Table 6a.

Table 6a - PG Note to be used to set air emission requirements

	Activity	**Relevant PG Note**
1	Coating of Leather	PG 6/22
2	Footwear manufacture	PG 6/32
3	Wood & Plastic lamination	No dedicated PG note – see PG 6/23
4	Adhesive Coating	PG 6/32
6	Rubber conversion	PG 6/28

2.5 The BREF document on Surface Treatment Using Organic Solvents specifies, in some cases, tighter provisions than in the Solvent Emissions Directive or in SG6(08). There are also cases where different units of measurement are used. As previously, all SED requirements are mandatory. Table 6b is largely the same as Table 5 in SG6(08). The main difference is that two new columns have been added at the right-hand end of the table: these two columns contain the provisions in the BREF note and, if more stringent than the earlier columns in any row, they should be considered in deciding whether BAT in any case goes beyond what is contained in the earlier columns.

Table 6b - Other VOC emission limits

Row	**Activity**	**Emission Limit (mg/Nm^3) (Note 1)**	**Fugitive Limit (% of solvent input) (Note 1)**	**Reduction Scheme Target (Note 1)**	**BREF Emission value associated with BAT**	**BREF Comments**
1	Wood Impregnation	*100*	*45% of solvent input*	*Total Emission Limit Value* *11 kg/m3*	No specific BREF targets	Activity not described in the SG Note – see PG 6/03
2	Printing - Heatset web offset printing	*20*	*30 % of solvent input*	n/a	New & upgraded presses: • 2.5 - 10% VOC Existing presses: • 5 – 15% VOC	BREF BAT VOC emission value is expressed as wt-% of ink consumption
3	Printing – Publication Rotogravure	*75*	*New plant:* • *10% of solvent input* *Existing plant:* • *15% of solvent input*	n/a	Sum of fugitive emissions plus VOC in waste gas discharge New plant: • 4 – 5% Existing plant: • 5 – 7%	BREF figures expressed as percentage (%) of total solvent input
4a	Printing - Flexography and other Gravure Note 2	*100*	*20 % of solvent input*	*Mass of Solvent* *=Total Mass of Solids x 1*	With oxidation: • 7.5 – 12.5% of reference emission With solvent recovery: • 10 – 15% of reference emission	BREF Reference emission is as defined in SED Annex IIB (See also Row 4b)
4b	The STS BREF details 3 scenarios for achievement of BAT. The figure in Row 4a above relates to machines that are connected to abatement equipment. Where this is not the case the figures apply to those machines connected to abatement, (if any), and the implementation of a reduction scheme by use of other measures, e.g. substitution, is detailed for solvent reduction on the non-abated machines. Reference should be made to the BREF for details.					
5	Printing – laminating or varnishing Note 2	*100*	*20 % of solvent input*	*Mass of Solvent =Total Mass of Solids x 1*	No specific BREF targets	
6	Printing - Rotary screen printing, (including printing on textiles / cardboard)	*Waste gases from oxidation plant used as abatement:* • *100* *Any other waste gases from contained sources:* • *100*	*20 % of solvent input*	*Mass of Solvent =Total Mass of Solids x 1*	No specific BREF targets	Flat-Bed Screen Printing operations are excluded from the requirements of SED. However, should such an operation exceed the consumption threshold for coating processes (use of >150kg/hr, or 200 tonnes / annum) then it would be subject to the PPC Regulations

Row	Activity	Emission Limit (mg/Nm^3) (Note 1)	Fugitive Limit (% of solvent input) (Note 1)	Reduction Scheme Target (Note 1)	BREF Emission value associated with BAT	BREF Comments
7a	Coating and Printing of Metal Packaging	*New oxidation plant:* *• 20* *Existing oxidation plant:* *• 50* *Waste gases from drying operations:* *• 50* *Any other waste gases from contained sources:* *• 75*	*20 % of solvent input*	*Food contact application:* *Mass of solvent = Total mass of solids x 0.58* *Non-food application:* *Mass of solids x 0.38*	See Row 7b below	BREF values below include fugitive emissions
7b		**BREF Emission Values**			**VOC emission level at application (g/m2)**	
					Solvent Based	**Water based**
		Food Contact: DWI drink cans (Al): DWI drink cans (Steel) Sheet for ends, cans and components Drums			• 6.7 – 10.5 • 6.7 – 10.5 • 4 – 93 • 90 - 100	• 3.2 – 4.5 • 4.6 – 7.6 • 1 - 30
		Non-Food Contact: Sheet for ends, cans and components Drums			• 4 – 93 • 60 - 70	• 1 – 30 • 11 - 20
		Print Paint: Sheet for ends, cans and components			• 2.5 - 13	• 1 - 6
8	Coating and finishing of textiles, fabric, wood, paper and film Note 2	*New oxidation plant:* *• 20* *Existing oxidation plant:* *• 50* *Waste gases from drying operations:* *• 50* *Any other waste gases from contained sources:* *• 75*	*20% of solvent input*	*Food contact application:* *Mass of solvent = Total mass of solids x 0.58* *Non-food application:* *Mass of solids x 1*	Not covered in the STS BREF, apart from wood coating.	As there are currently no A2 wood coating installations BREF figures not given.

Row	**Activity**	**Emission Limit (mg/Nm^3) (Note 1)**	**Fugitive Limit (% of solvent input) (Note 1)**	**Reduction Scheme Target (Note 1)**	**BREF Emission value associated with BAT**	**BREF Comments**
9	Coil coating	*New oxidation plant:* • *20* *Existing oxidation plant:* • *50* *Waste gases from abatement techniques which allow recovery and reuse of recovered solvents:* • *150* *Any other waste gases from contained sources:* • *50*	*New plant:* • *5% of solvent input* *Existing plant:* • *10% of solvent input*	*New Plant:* *Mass of Solvent = Total Mass of Solids x 0.15* *Existing Plant:* *Mass of Solvent = Total Mass of Solids x 0.3*	New plant: • 0.73 – 0.84 g/m^2 waste gases • 3 – 5% fugitive emissions Existing plant: • 0.73 – 0.84 g/m^2 waste gases • 3 – 10% fugitive emissions	
10	Coating of winding wire	**Total Emission Limit:** • 10g/kg of coated wire with an average diameter equal to or less than 0.1mm • 5g/kg of coated wire all other diameters of wire			As SED	BAT is also to seek and implement low solvent techniques
11	All other A2 coating e.g. coating of plastic and metal not covered elsewhere in this table	*New oxidation plant:* • *20* *Existing oxidation plant:* • *50* *Waste gases from drying operations:* • *50* *Any other waste gases from contained sources:* • *75*	*20 % of solvent input*	*Mass of Solvent = Total mass of solids x 0.37*		

Vehicle Coating (Note 4)						
Activity		**Production Capacity (Note 3)**	**Total Emission Limit value**		**BREF Emission value associated with BAT**	**Comments**
			New	**Existing**		
12	Coating of new cars	> 5000	45 g/m^2 or 1.3 kg/body + 33 g/m^2	60 g/m^2 or 1.9 kg/body + 41g/m2	10 - 35 g/m^2 or 0.3 kg/body + 8 g/m^2 to 1.0 kg/body + 26 g/m^2	
		≤ 5000 monocoque or >3500 chassis built	90 g/m2 or 1.5 kg/body + 70 g/m2	90 g/m2 or 1.5 kg/body + 70 g/m2		
			Total Emission Limit (g/m2)			
13	Coating of new truck cabins	≤ 5000	65	85	10 – 55 g/m2	For cleaning operations associated with the coating an incremental emission figure of 20 g/m2 is to be used.
		> 5000	55	75		
14	Coating of new vans and trucks	≤2500	90	120	15 – 50 g/m2	
		>2500	70	90		
15	Coating of buses	≤ 2000	210	290	92 –150 gm/m2	
		>2000	150	225		

Note 1: Limits are derived from the Solvent Emissions Directive (1999/13/EC) and are the mandatory minimum standard

Note 2: If the coating activity includes a step in which the same article is printed by whatever technique is used, that printing step is considered part of the coating activity.

Note 3: Refers to annual production of coated item

Note 4: Where spray painting of vehicle body parts (for example, bumpers, mirrors, spoilers, etc) is undertaken within the same installation as the painting of vehicles in a manufacturing process, the operator has the option to include the coatings used for the body parts in the VOC mass emission calculation. In these circumstances an area equivalent to the painted area of the body parts should be included in the calculated electrocoat area of the vehicle used to determine the mass emission of VOC. (If the mass emission limit option is taken, the emission concentration limits should NOT be applied to the spray booth stacks)

The total emission limit values are expressed in terms of grammes of solvent emitted in relation to the electrocoat surface area of product (in square metres of car body).

The surface area of any product dealt with in the table above is defined as follows:

- the surface area calculated from the total electrophoretic coating area, and the surface area of any parts that might be added in successive phases of the coating process which are coated with the same coatings as those used for the product in question, or the total surface area of the product coated in the installation.

The surface of the electrophoretic coating area is calculated using the formula:

2 x total weight of product shell

average thickness of metal sheet x density of metal sheet

This method shall also be applied for other coated parts made out of sheets.

Computer aided design or other equivalent methods shall be used to calculate the surface area of the other parts added, or the total surface area coated in the installation.

The total emission limit value in the table above refers to all process stages carried out at the same installation from electrophoretic coating, or any other kind of coating process, through to the final wax and polish of topcoating inclusive, as well as solvent used in cleaning of process equipment, including spray booths and other fixed equipment, both during and outside of production time. The total emission limit value is expressed as the mass sum of organic compounds per m^2 of the total surface area of coated product and as the mass sum of organic compounds per car body.

Compliance is achieved if the Total Emission from the activity divided by the surface area of the coated is equal to or less than the Total Emission Limit Value

2.6 The monitoring requirements for the activities described in Table 6a & Table 6b are detailed in Table 6c below. Further details regarding monitoring are given in paragraphs 3.267 to 3.281 inclusive.

Table 6c - Monitoring Requirements for VOCs

Activity	Monitoring Requirements	Comments
All activities	Emission Limits from:	
	a) Unabated releases:- Once a year extractive monitoring.	Subject to paragraph 3.275
	b) Abated releases:- Continuously recorded indicative monitoring, plus once a year extractive monitoring	
	Fugitive emission limits – In accordance with Appendix 2	
	Target emission – Annually in accordance with Appendix 2	
	Total Emission Limit – Annually in accordance with Appendix 2	

2.7 Some of the industry sectors described by the BREF Note have not been addressed specifically by the SG Note because it is believed that very few such installations operate in the UK at a solvent consumption figure above the EPR/PPC A2 threshold.

They are:

- Abrasives manufacture
- Adhesive tape manufacture
- Coating of trains
- Coating of Agricultural machinery
- Coating of ships
- Coating of aircraft
- Manufacture of Mirrors

If such installations are found to be operating at a capacity that is above this A2 threshold then local authorities should use a combination of the relevant sections of the BREF Note, the PG Note (if one should exist for the activity in question) and the SED when determining BAT.

Benchmark emissions to water associated with the use of BAT

2.8 Limit values for water discharges will be specified in individual cases taking account of the receiving environment. For discharges to sewer conditions will be contained within the trade effluent discharge consent and would not normally be replicated in the PPC permit. For discharges to controlled water limits to ensure compliance with the receiving water EQS will be indicated by the Environment Agency. (Refer to paragraphs 3.195 & 3.196 for more information relating to the way in which permit conditions are to be considered).

2.9 On site wastewater treatment systems can maximise the removal of metals using precipitation, sedimentation and possibly filtration. The reagents used for precipitation may be hydroxide, sulphide or a combination of both, depending on the mix of metals present. It is also practicable in many cases to re-use treated water. Table 7 provides information regarding achievable levels associated with the use of wastewater treatment systems for discharge to surface water.

Table 7 - Examples of emission limits to surface water from an ETP associated with the use of BAT

Determinand	Concentration (mg/litre)	
BOD	100	
Total hydrocarbon oil	5	
	Vehicle manufacturing	100
Total suspended solids	20	
	Metal packaging	500
	Coil coating	500
	Film coating	1000
	Vehicle manufacturing	1000
Ammoniacal nitrogen (expressed as N)	15	
	Vehicle manufacturing	35
Dissolved iron	10	
Total chromium	2	
	Vehicle manufacturing	3
Dissolved nickel	2	
	Vehicle manufacturing	10
pH	Metal packaging (2 piece draw and wall iron (DWI) can manufacture	4.5 to 10
	Metal packaging extruded aluminium tube manufacture	6 to 10
	Coil coating	5 to 11
	Film coating	6 to 11
	Vehicle manufacturing	6 to 11
COD	Metal packaging (2 piece draw and wall iron (DWI) can manufacture)	1200
	Metal packaging extruded aluminium tube manufacture	2500
	Coil coating	1000
	Film coating	1000
	Vehicle manufacturing	2500
Sulphate as SO4	Metal packaging (2 piece draw and wall iron (DWI) can manufacture)	1000
	Vehicle manufacturing	2500

Copper	coil coating*	0.05
	vehicle manufacturing	3
Lead	coil coating	0.1
	vehicle manufacturing	3
Cadmium	coil coating	0.1
	vehicle manufacturing	0.2
Silver	Printing, image preparation	500
Zinc	4	
	coil coating	2
	vehicle manufacturing	5
* May not be applicable – the operator would need to demonstrate that emissions of copper cannot occur		

3. Techniques for pollution control

3.1 This section summarises, in the outlined BAT boxes, what BAT should be in most circumstances. The boxes should not be taken as the only source of permit conditions; compliance with emission limits and other provisions contained in this guidance note together with any relevant case-specific considerations will also need to be taken into account.

3.2 The standards cover the techniques and measures which, in combination with those in the relevant previous (LAPC/IPC/Waste) guidance, have been identified as representing BAT in a general sense. They also cover the other requirements of the Environmental Permitting (England and Wales) Regulations 2010, the Pollution Prevention and Control (Scotland) Regulations 2000 and the Pollution Prevention and Control (Northern Ireland) Regulations, in addition to the requirements of other regulations, such as the Waste Management Licensing Regulations and the Groundwater Regulations, insofar as they are relevant to an IPPC Permit. For the sake of brevity these boxes simply use the term "BAT".

3.3 Where techniques or operating conditions are referred to in the BAT boxes below, provided that it is demonstrated to the satisfaction of the regulator that an equivalent or better level of control of environmental impacts will be achieved, then other techniques or operating conditions may be used.

Installation description and in-process controls

3.4 The meaning of “installation” and “directly associated activity” is addressed in chapter 2 of the General Guidance Manual (Ref 2).

3.5 This section contains an overview of the solvents sector, including operations common to all sectors as well as sections relating to subsectors.

3.6 Each subsector is described giving the following information:

- the activity and its controls
- the significance of the environmental impacts
- applicable BAT boxes

3.7 The subsectors are listed below:

- Printing (general)
- Coating (general)
- Coatings Manufacture
- Coil Coating
- Textile coating and finishing
- Film Coating
- Application of paint in vehicle manufacture
- Wire winding coating
- Coating and printing of metal packaging
- Wallcovering manufacture

Since the 2008 version of this Note was published, the European Commission has published guidance on “VOC Substitution and Reduction for Activities covered by the VOC Solvents Emissions Directive”. The complete set of guidance comprises of 21 Notes, plus an introductory Chapter. Appendix 3 lists the guidance, not all of which apply to the A2 sector, plus a web link to the relevant web site. Each of these documents describes the sector it covers in detail and those wishing to expand upon the information given in the process description in this note may find it useful to access the appropriate document.

3.8 This note relates to the surface treatment of substances, objects or products using organic solvents, in particular for dressing, printing, coating, degreasing, waterproofing, sizing, painting, cleaning or impregnating, in plant with a consumption capacity of more than 150 kg per hour or more than 200 tonnes per year.

3.9 Installations where the following activities are carried out are subject to national regulatory control and the subject of separate guidance:

a) Applying or removing a coating material containing any tributyltin compound or triphenyltin compound, if carried out at a shipyard or boatyard where vessels of a length of 25 metres or more can be built, maintained or repaired; **or**

b) Pre-treating (by operations such as washing, bleaching or mercerization) or dyeing fibres or textiles in plant with a treatment capacity of more than 10 tonnes per day; **or**

c) Treating textiles if the activity may result in the release into water of any substance listed in paragraph 13 of Part 2 of this Schedule in a quantity which, in any period of 12 months, is greater than the background quantity by more than the amount specified in that paragraph in relation to that substance.

Summary of activities

3.10 For the purpose of this note "**coating activity"** means any activity in which a single or a multiple application of a continuous film of a coating is applied, (including a step in which the same article is printed using any technique). It does not include the coating of substrate with metals by electrophoretic and chemical spraying techniques.

3.11 Further **"coating"** means any mixture, including all the organic solvents or mixtures containing organic solvents necessary for its proper application, which is used to provide a decorative, protective or other functional effect on a surface.

Delivery, storage and handling of raw materials

Summary of activities

3.12 Operators of surface treatment and coating installations, in which organic solvents are used, purchase either:

- The necessary surface treatment products (e.g. degreasers, surface cleaners, coatings, inks, thinners etc), from third party suppliers, for use directly in the surface treatment or coating process; **and /or**

- Components of such products, to manufacture these on-site, for subsequent use in the surface treatment or coating process. In some cases, such product manufacture may involve the preparation of intermediate materials or of a number of intermediate steps. Components purchased can include pigments and extenders, polymers and resins, solvents and additives. All these categories of component may be supplied as solids or liquids.

3.13 Liquid products and components, many of which contain solvent, are delivered in a variety of unit quantities, typically ranging from five litres/kilos to 1000 litres/kilos, supplied in rigid metal or plastic containers, 205 litre drums and intermediate bulk containers (IBCs). Some solvents and liquid polymers may be delivered in bulk road tankers.

- Bulk solvents and polymer deliveries are discharged to bulk storage tanks;
- IBCs are off-loaded by forklift truck and stored in designated storage areas;
- Drums are off-loaded on pallets using a drum lift or vehicle tail lift and stored in designated storage areas;
- Smaller containers may be off-loaded manually or on pallets and stored in designated storage areas.

3.14 Solid or powder product components are usually delivered in 25 kilo paper or plastic bags, sacks or boxes. Some may be delivered in IBCs or bulk road tankers.

- Bulk powder deliveries are discharged to silos;
- IBCs are off-loaded by fork-lift truck and stored in designated storage areas;
- Bags, sacks and boxes are off-loaded manually or on pallets and are stored in designated storage areas.

3.15 For the prevention of accidents, the methods employed and the equipment used to ensure the correct handling and storage of flammable materials needs to be determined by trained personnel in accordance with the HSE guidance (Ref 14) and the Dangerous Substances and Explosive Atmosphere Regulations (DSEAR) SI2776 2002 (Ref 14b).

Environmental impact

Water: Run-off from solvent contaminated areas, contaminated bund-water. Run-off from dry powder contaminated areas.

Land: Spillage of solvent, during off-loading, de-canting, leakage from storage and process pipework, accidental spillage. Spillage of dry powder materials during off-loading, handling and transfer operations.

Air: VOC/odour release from spillage or vapour displacement, dust**.**

Waste: Pallets, drums, off-specification materials, out-of-date product, spillages.

Energy: Not significant

Accidents: Spillage of solvents, powders during handling operations. Leakage and containment failure of pipe work, drums, tanks etc. Fire within the storage and handling areas.

Noise: Vehicles and delivery operations may cause noise disturbance, especially if close to the site boundary. Blowing into silos from road tankers can create noise, disturbances such as pump noise, resonation in pipe work.

BAT	
1	The operator should ensure that deliveries are carried out in such a way so as to minimise noise, spillage, leaks and dusty emissions.
2	Storage areas should be under cover and protected from the elements to avoid or minimise environmental impact, except where stored materials are in suitable weather proof containers.
3	Storage areas should be hard surfaced.
4	Bulk storage tanks for solvents and solvent-containing liquids should wherever practicable be back vented to the delivery tank during filling. Where this is impracticable, for example: due to long pipe runs, back pressure, or contractual agreements over deliveries, then, displaced air vents should be sited in such a way as to prevent the arising of offensive odour beyond the site boundary
5	Bulk storage tanks for solvent storage should normally be light coloured, in order to reduce thermal increase as a resulting from sunlight. (planning restrictions may apply
6	All new static bulk solvent storage tanks containing solvent with a composite vapour pressure that is likely to exceed 0.4kPa at 20oC (293K) should be fitted with pressure vacuum relief valves. Pressure vacuum relief valves should be examined at a minimum of at least once every six months for signs of corrosion, contamination, incorrect seating and be cleaned and/or corrected as required
7	Delivery connections to bulk storage tanks should be located within a bunded/contained area, fixed and locked when not in use
8	All fixed storage tanks should be fitted with audible and/ or visual high-level alarms or volume indicators to warn of overfilling. Where practicable in relation to the viscosity of the material being handled or pumping system used, the filling systems should be interlocked to the alarm system to prevent overfilling.
9	Dusty or potentially dusty materials should be stored in silos, or in confined storage areas within buildings, or in fully enclosed containers / packaging.
10	Deliveries to bulk storage tanks should be supervised by trained personnel to avoid potential accidents and spillage.
11	Deliveries to silos should be supervised by trained personnel to avoid materials being blown into silos at a rate which is likely to result in pressurisation of the silo, especially towards the end of the delivery when the quantity of material entering the ducting is reduced.
12	Air displaced during delivery to a silo should be vented to suitable abatement plant (for example cartridge/bag filters) in order to minimise emissions. Abatement plant fitted to silos should be of sufficient size (and kept clean) to avoid pressurisation during delivery.
13	Silos and bulk storage tanks containing dry materials should be equipped with audible and/ or visual high level alarms, or volume indicator, to warn of overfilling. The correct operation of such alarms should be checked before a delivery takes place
14	If emissions of particulate matter are visible from ducting, pipework, the pressure relief valve, dust abatement plant or any other part of the plant during silo filling, the operation should cease and the cause of the problem rectified prior to further deliveries taking place. Transport of dusty materials should be carried out so as to prevent or minimise airborne particulate matter emissions. e.g. vacuum transfer system, enclosed conveyors, enclosed Archimedes screw, pneumatic.
15	Double handling of dusty materials should be avoided.
16	Solvent containing materials should be stored in closed storage containers.
17	The storage, handling and use of flammable materials should be in accordance with HSE requirements, in order to prevent accidents that may have environmental consequences

Printing general

3.16 Printing is the reproduction of text and images in which with the use of an image carrier, ink is transferred onto whatever type of surface. It includes associated varnishing, coating and laminating techniques. Printed substrates include paper, card, foil, plastics, metal and similar substrates. The printing process is made up of a number of steps all of which maybe part of a single installation:

- Image Preparation
- Proofing
- Image carrier production
- Printing
- Finishing

Image preparation

3.17 Printed material comprises text, photographs, line illustrations or a combination of the three. Today, almost all of these aspects are originated through digital electronic systems. Photography is largely carried out using digital cameras, whilst text can be made up using page make-up programs and line illustrations can be made up using either digital programs or scanned electronically from a drawing and added to the page make-up program. Once the final pages are composed and any illustrations integrated, the final images are converted into what is known as PDF (portable document format). This is simply a standard electronic process for transferring pages of electronic and digital images into a production environment for printing.

3.18 Where a photographic film is used to transfer the image then although different film types are used for each type of print method the processing of the materials is similar. The film consists of paper or plastic covered with a layer of gelatine embedded with silver halide. This is then exposed using a scanner, camera or exposure device leading to a reaction of the silver halide with light. The exposed film is then developed reducing the silver halide to black metallic silver, the residual unexposed silver halides are then removed by fixing. The fixed film is then rinsed to remove any residual chemicals left on the film.

Environmental impact

Water:	No significant releases
Land:	No significant releases
Air:	No significant releases
Waste:	No significant releases
Energy:	Not significant
Accidents:	Not significant
Noise:	Not significant

BAT	
18	BAT for image preparation is now considered to be the use of "computer to plate" systems that avoid the need to use photographic film. However, due to the cost of installing a "computer to plate" system, some operators have not invested in the new technology and still use film. In such cases the BAT boxes in this note are unlikely to apply as the solvent consumption may well be below 15 tonnes per annum.
19	In such cases the relevant BAT Boxes in the previous Note should apply.

Proofing

3.19 Proofing is the operation of making a copy of the proposed printed image for checking. A number of different proofing systems exist, but the predominant way is to make directly from the data in the computer, either by showing on a screen, or by printing out:

- Computer printouts
- Laser printouts
- Colour monitors
- Ink jet printing
- Dryline printer (Blue Prints)
- Dry toner systems
- Liquid toner system
- Colour foil systems

Environmental impact

Water:	No significant releases
Land:	No significant releases
Air:	Possible odours associated with the use of ammonia in dryline printing
Waste:	Waste from dry toner, liquid toner and colour toner systems. Waste from cleaning of press machinery as a result of short runs and colour changes.
Energy:	Not significant.
Accidents:	Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks etc.
Noise:	Not significant.

BAT	
20	All ammonia containers should be stored closed to minimise releases of ammonia.
21	All new dryline machines should be fitted with carbon filters to adsorb ammonia emissions.

Image carrier production

Offset platemaking

3.20 Since the issue of the previous Guidance Note, SG6(03), the printing industry has moved away from production of plates from photographic film to the technique known as "computer to plate". This is now seen as BAT for new, or substantially changed, installations. The number using the older technology is rapidly decreasing, with few printers likely to be using this technology in the future. The description below relates to "computer to plate" technology.

3.21 The majority of pages are sequenced and exposed onto printing plates for printing onto paper through lithographic and other printing processes. There are two types of computer-to-plate systems in existence – violet laser and thermal imaging. Alternatively, printed material is increasingly printed through digital presses where the digital PDF files are directly transmitted to a digital printing machine that translates the data into images directly onto the paper.

3.22 Violet laser plates consist of an aluminium base and are coated with a light sensitive material, either silver halide or photopolymer based. When exposed to light the surface responds to create an image. These systems can also expose conventional ultra-violet plates. The surface of the photopolymer plate is usually covered with PVA which will require removing. This may be done at the exposure stage, or on the press. In the former case the wash water should be recycled to minimise use. In the latter case the coating is removed by the dampening solution.

3.23 Thermal imaging uses laser light to create intense heat that causes the coating material to become either soluble (positive thermal) or insoluble (negative thermal). The imaging technology is based on infrared lasers generating light energy at wavelengths of 800 nm and above. Thermal plates are coated with polymers. These polymers are sensitive to intense heat within a specified range. The imaging takes place by removing the surface by ablation so that it breaks away from the base. In positive CTP the laser energy weakens chemical bonds in the plate's surface and dissolves in subsequent processing or on the printing press. In negative CTP the plate's sensitive coating is polymerised and the unexposed area is dissolved in the processor chemistry. Once exposed and processed, the plate's surface is extremely hard and durable.

3.24 Removal of the heat generated by the laser cooling is by water cooling. Where the water use is high, (usually associated with use of once through mains water), consideration must be given to either reduction by using a lower input pressure and/or recycling some or all of the water used.

3.25 With both violet laser, and thermal imaging, developing solutions are used to remove unwanted material from the plate. These solutions should be filtered and reused as much as possible prior to disposal.

3.26 Some printers still operate from conventional film processes. Where this applies, refer to the previous Guidance Note, SG6(08) (Sections 3.16 to 3.22), where the different techniques for image carrier production from photographic plates are fully described.

3.27 Waterless printing is a separate process, less common in the printing industry. Waterless plates have a photopolymer underneath a silicone coating. On exposure of the plate a strong bond is created in the light permeable areas between the silicone and the photopolymer, resulting in a hardening of the coating. A pre-treatment agent is then used on the plate which causes the silicone coating in the unexposed areas of the plate to swell, rotating brushes are then used to remove the swollen silicone parts with water.

Gravure cylinder making

3.28 Gravure cylinders are made up of a steel core that is initially covered with an electro-deposited layer of nickel. A copper layer is then deposited on top, the depth of which can vary depending on the type of cylinder being made. The copper depth varies from 32-60 mm. The copper surface is then finished to provide a suitable surface for engraving or etching the cylinder. Once the image has been transferred to the cylinder and it is free of faults, it is chromed electrolytically before being used for printing.

3.29 Existing cylinders, which are no longer required, can be reused. The residual ink and other contaminates are removed from the cylinder. The chromed surface coating and some of the copper is then removed by different methods depending on the type of cylinder. The thinned cylinder can then be returned for re-deposition of the copper, prior to finishing and transfer of the image in a similar way to that for new cylinders.

3.30 The image data is now normally transferred to the cylinder by electro-mechanical or laser engraving methods. However, a minority of cylinders are still prepared using traditional photographic etching methods. Where the cylinder is covered with a light sensitive material, this is used to make a copy of the image, the image is then developed and etched into the copper surface with ferric chloride or copper chloride in a strong solution of hydrochloric acid. The etched cylinder is then cleaned with solvent to remove any residual material left on the cylinder prior to chrome plating.

Flexography plate making

3.31 There are three main types of flexo plate: rubber, photopolymer and laser-graved roller. The most common method of manufacture employs photopolymers in either solid sheets or viscous liquids of various thicknesses. The photopolymer plate is exposed through a negative from both the back and the face with ultraviolet light, which cause the photopolymer coating to polymerise. After exposure the unexposed, non-polymerised areas are washed out using solvent or water to leave the raised area that will transfer the image. A variation on this method uses plates that have a mask coating which is not transparent to ultraviolet light over the photopolymer. A digitally controlled laser is then used to remove the coating in the areas that form the image. The plate is then exposed and washed as normal

3.32 The traditional method of making a flexo plate begins with the exposure of a metal plate through a negative and processing the exposed plate using an acid bath. The resulting metal engraving is used to mould a master using a bakelite board. The board, under pressure and heat, fills the engravings on the metal plate and, when cooled, becomes a master for moulding a rubber plate with a raised area that will transfer the graphics.

3.33 Engraving rubber flexo plates with a scanning high-powered laser makes laser-graved plates, after engraving no further processing is required.

Screen-print stencil manufacture

3.34 A frame with a fine mesh fabric (polyester, nylon or stainless steel) tightly stretched, is coated with a light sensitive emulsion. A positive film is fixed on the fabric and exposed to UV light, the exposed areas of the photo emulsion are cured. The screen is then washed to remove the non-cured areas with either manually or by automatic washers. Any corrections are then carried out on the screen prior to printing. Screens for long print runs may be provided with a protective lacquer coating which is hardened. After printing, screens, which have not been hardened, can be cleaned and used once more. Initially, any residual ink from the printing operation is removed, the screen is then placed in an automatic screen-washing unit fitted with a distillation unit to recover and recycle the cleaning solvents. Once the screen has been cleaned the image is removed using an aqueous solution containing periodate then high-pressure washed.

Table 8 - Potential environmental impacts of image carrier production

Environmental Impact	Offset plate making	Gravure cylinder making	Flexo plate making	Stencil manufacture
Water	**Positive plates:** Alkali hydroxide, sodium silicate and wetting agents from de-coating. **Negative plates:** Alcohols, alkalis surfactants from de-coating. Coating emulsion, acid alcohols and fluorides from correction. **Waterless plates:** From developing coating residues containing silicones and photopolymers, pre-treatment chemicals propylene glycol, aminoalcohols and diethylene glycol.	After degreasing, de-oxidation and during the polishing, rinse water is used. The wastewaters contain copper, chromium (III and VI) and sometimes nickel and has a low pH and some residual toluene and xylene.	Rinse water from washing out unexposed areas, containing cleaning agents and non-hardened pre-polymers.	Rinse water from developing stencils contains reactive acrylates. Ink residues from water based inks contain biocides and photo initiators. Rinse waters from screen cleaning contain solvents, ink residues, periodate, abrasive powders and hydrogen peroxide.
Air	Small amounts of VOC from alcohols in developers.	Hydrochloric acid fumes and mist containing chromium VI from plating and de-plating operations. Alcohol emissions from the development and drying of cylinders when etching is carried out.	VOC release during wash out of non-hardened pre-polymers with solvents.	VOC releases from screen cleaning operations.
Waste	Aluminium plates **Positive plates:** Alkali hydroxide, sodium silicate and wetting agents from exhausted de-coating agents. **Negative plates:** Alcohols, alkali surfactants from exhausted de-coating agents. **Waterless plates:** Pre-treatment agents: propylene glycol, aminoalcohols and diethylene glycol. Coating residues: silicones and photopolymers.	Bath residues from copper, nickel and chromium treatment baths. Filters from copper bath. Alkaline degreasing agent. Metal hydroxide sludge. Copper chromium metal from cylinder re-working. Rags contaminated with inks and solvents.	Rubber leftovers. Processed and unprocessed plates. Rinse fluid spent perchloro-ethylene. Unhardened photopolymer. Spent solvent wash out solution. Distillation sludge. Metal hydroxide sludge. UV lamps.	VOC releases from screen cleaning operations. Screen adhesive paste: Polyisocyanate. UV lamps. Ink residues. Solvents. Rags contaminated with solvents and inks. Residues from stencil manufacture.
Water Use	Offset plate making – where process-less thermal imaging is used then water consumption can be very high.			
Land	No significant releases.			
Accidents	Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks etc. Fire within the film processing area.			
Energy	No significant releases.			

BAT	
Offset plates positive, negative and reverse	
22	Plates should be developed in a developing machine, hand and dip developing techniques should not be used. Water used to remove PVA coating should be recycled where possible
23	The results from developing should be recorded and tracked to monitor the condition of the developer and ensure that it is completely exhausted when it is replaced.
24	For positive developed plates automatic filtration and replenishment of the developing bath should be used to reduce the consumption of developer.
All offset plates	
25	Offset plates made of aluminium should be recycled.
26	Water use should be minimised by reduction at source, or by recycling the water used for cooling.
Gravure Cylinders	
27	The demineralised water used for rinsing cylinders should be used to make up the evaporation losses from the copper and chromium plating baths.
28	Wastewaters from rinsing after the galvanic baths, degreasing, deoxidisation, pickling baths, cylinder correction and mechanical surface treatment of cylinders should be treated to meet the required standards.
29	Any possible accidental releases from the chromium bath should be directed to a low-level emergency tank, to prevent their release.
30	Suitable means should be available to isolate the plant sewage system from the main sewer, to prevent possible discharge that may damage the main sewer and subsequent treatment plant. Only non-mercury containing solutions should be used for the separation of Ballard skins, to prevent the release of mercury from the site.
31	Treated wastewaters should be used as rinse water where possible.
32	Exhaust ventilation from the galvanic baths should be fitted with a baffle separator with an aerosol screen to prevent emissions of chromium VI.
33	Exhaust ventilation air from de-coppering baths containing ammonia should be scrubbed, prior to discharge, to meet the required emission limit value
Flexographic Plates	
34	Halogenated solvents should not be used for cleaning operations and washing out of the non-hardened pre-polymer.
35	Where water washout of the non-hardened pre-polymer is carried out, filtering or sedimentation should be carried out on the effluent to remove pre-polymers prior to discharge.
Screen stencil making	
36	The light sensitive coatings used for stencils should not contain chromium compounds.
37	Screen blocks containing halogenated solvents should not be used
38	Cleaning of screens with solvent to remove residual inks should be carried out in separate areas to any activities that may produce wastewater, to ensure each waste stream can be treated adequately.
39	Degreasing of screens should be carried out using solvent free degreasing agents.
40	The concentration of hypochlorite in anti-ghost agent should not exceed 5%, no more than 5 grams of hypochlorite should be used per m^2.

Printing

Offset Printing

3.35 Incorporates: printing by various methods including Lithographic, Heatset Web Offset, Coldset, Sheet Feed Offset, Dry Offset and Waterless Lithographic Printing.

Lithographic

3.36 Offset lithographic is the most widely used printing process. The printing and non-printing surfaces of the lithographic printing plate are almost in the same plane. The different print areas of the plate are treated to accept "oily" printing ink, the image area, and reject the printing ink the hydrophilic non-image areas. The printing plate is dampened with a dampening solution (normally water and propan-2-ol plus additives) before inking. A thin film of ink is then applied via a roller to the image areas. The image to be printed is then transferred from the printing plate on to a rubber blanket cylinder and then on to the printing substrate, the film of ink is then dried. Offset is the term used to describe the double transfer of the image from the plate to the blanket roller to the substrate. Periodic cleaning of the blanket roller is required to remove build up of debris such as paper, dust and printing ink constituents. Cleaning is carried out using various organic solvents, either manually or automatically. At the end of each print run, cleaning of the inking rollers and ink ducts are carried out. The rollers are cleaned using various organic solvents whilst the inking ducts are usually cleaned using solutions similar to the blanket wash.

Heatset Web Offset

3.37 Heatset web offset printing is on a continuous reel "web". It is typically used for magazines and coated papers when printing large numbers of copies. It gives richer colours than cold set printing. In heat set web offset printing the ink dries in an oven. The exhaust gases from the heat set drying process contain VOCs from inks, cleaning agents and propan-2-ol. The exhaust gases are generally abated using thermal oxidation.

Coldset Web Offset

3.38 Coldset printing is on a continuous reel "web" and is typically used for newspapers printed on absorbent uncoated paper. The inks dry as a result of absorption by the substrate or oxidation. Cleaning of blanket rollers and print rollers is a more frequent requirement in coldset web offset.

Sheet Fed Offset

3.39 Sheet fed is the most common printing process used by small/medium size printers. Printing is carried out on single sheets. The inks dry as a result of absorption by the substrate or oxidation. UV curing inks are used for some applications. However, these are harder to remove from blanket rollers than conventional inks and require stronger solvents to remove them.

Dry Offset

3.40 Dry offset is the printing process commonly used in the printing of metal packaging where it is not normally possible to register individual colours onto the surface to be printed. To overcome this problem, an intermediate surface (rubber blanket) is provided which picks up the colours in sequence from each of the printing heads to create the complete image in reverse on its surface. This blanket is then brought into contact with the surface to be printed allowing the complete image to be transferred in one step. The printing inks used are highly viscous and contain very a low percentage of solvent. Where this process is used for printing on metal or plastic surfaces, which are non-absorbent or may be required to withstand heat processing for food use, the inks are cured by thermal or UV processes.

Waterless Lithographic Printing

3.41 Waterless lithographic printing is similar to cold web offset lithographic but without the use of any damping water. The printing plate used is coated with an ink repellent silicone surface and following exposure to the image the unwanted silicone is removed by development to reveal the ink attractive layer below. Ink is readily accepted where the silicone has been removed and as a result no water is needed to keep the non-image areas free of ink. Solvent blanket washes are, however, still required.

Gravure

3.42 Gravure is an operation where the image lies recessed in the surface of the printing cylinder. The cylinder is flooded with ink and the surface scraped clean (using a doctor blade) to leave ink in the recessed image areas only. Low viscosity inks are mostly used in order to fill the recesses, the image is then transferred to the substrate. Dryers are used to evaporate the solvent phase and to dry the film. As a wide variety of solvents are used, it is common for the exhaust gases from the operation to be abated using a thermal oxidiser or bio-reactor. A very small proportion of water borne gravure printing inks which give rise to significantly lower VOC emissions, are used in some applications.

Publication Gravure

3.43 Publication gravure is essentially the same as gravure printing, except, it is carried out on a substantially larger scale e.g. long runs such as magazines. The scale of the process means that a single solvent (toluene) system is employed to enable solvent recovery and reuse. The toluene-laden air from the ovens and often from the print line is passed through activated carbon beds where it is adsorbed. The toluene is then recovered from the activated carbon and either reused or sold back to the supplier.

Flexography

3.44 Flexographic printing involves sheet or web fed printing from a raised image on a printing plate made from either rubber or photo-polymers. Highly fluid quick drying inks are generally used. Ink is applied to the raised area of the printing plate from an engraved (anilox) roller, it is then transferred directly to the substrate. The ink must be heat dried prior to the printing of another colour. After the addition of the last colour all the residual solvents are removed in a final drying section. After finishing a printing run it is necessary to clean the printing plates, anilox roller etc with solvent similar to those within the ink. As a result of the high solvent content and the variety of solvents used, abatement of the exhaust gases from the process, using a thermal oxidiser or bio-reactor, is common. Low viscosity water borne or organic solvents borne inks are used in approximately equal proportions, with a small usage of low organic solvent UV curable inks (note that ozone can be emitted from UV lamps and dryers), or water based flexographic inks (for absorbent substrates).

Screen Printing

3.45 Screen-printing is a form of stencilling where ink is forced through the clear elements of the stencil. Screen-printing is capable of putting down a heavier ink film than other processes, this enables printing on almost any surface or material. The material to be printed on, is positioned under the stencil screen in close contact, the frame supporting the screen is then loaded with ink which is forced through the clear parts of the screen by a squeegee. UV curing inks, solvent and water borne, are used in screen-printing. The use of solvent inks gives rise to VOCs during printing, cleaning and drying operations. When oven drying is carried out the exhausted VOCs can be collected. Water borne inks (most containing between 5-15% solvent) give rise to lower levels of VOCs, however they have inferior adhesion to some substrates. UV curing inks avoid the use of solvents except for cleaning purposes, suitable UV curing inks are now available for most substrates.

Rotary Screen Printing

3.46 Rotary screen-printing is continuous web fed form of screen-printing

Table 9 - Potential environmental impacts of printing

Environmental Impact	Offset printing	Publication gravure	Flexographic and gravure	Rotary Screen printing
Water	During printing operations waste water results only from the cleaning (emptying) of the damping solution ducts and/or damping solution preparation units (no damping solution is used in lithographic printing) and from manual cleaning of the blanket. The wastewater will be contaminated with hydrocarbon cleaning agents, paper and residual ink constituents.	The condensed steam from solvent recovery contains about 0.38-0.54g of toluene/litre. After stripping with air this may be discharged to water.	Where water borne inks are used wastewater from cleaning operations containing residual ink constituents arise. Smaller quantities of wastewater are produced where solvent-borne inks are used.	During printing no discharges to water occur. However during the cleaning of equipment contaminated wastewater is produced.
Air	**Sheet Fed Offset** VOC are emitted from the use of propan-2-ol or ethanol from fountain solutions and other organic solvent used during cleaning. Ozone is also released from UV lamps used to cure UV inks **Coldset Offset** Emissions of different organic solvents occur during the cleaning of the press **Heatset Offset** The gas from heatset dryers is laden with mineral oil vapours and are normally directed to an oxidation unit where they are burnt. Intermittent releases occur during cleaning operations	Majority of organic solvent recovered fugitive losses of solvent (normally toluene) from process.	VOC releases normally directed to oxidation unit where they are burnt. Ozone releases from corona discharge lamps used for etching the surface of plastics and when using UV curing inks.	VOC releases during printing, cleaning etc. Ozone release from UV lamps used to cure UV curing inks.
Waste	Organic Solvent Rags contaminated with organic solvent and ink Paper waste Fountain solution Rubber blankets Ink residues containing mineral oil UV ink residues UV lamps	Inks residues containing organic solvent Organic solvents Distillation residues Cleaning agents containing alkalis	Inks residues containing organic solvent Distillation residues Inking unit wash residues containing organic solvent Photopolymer plates Rags contaminated with organic solvent and ink Cleaning agents containing alkalis UV ink residues/UV lamps Paper/film, plastic board	Inks residues containing organic solvent Organic Solvents Ink residues water based Distillation residues UV ink residues/UV lamps Rags contaminated with organic solvent and ink Paper/film, plastic board, textile and metal
Land	No significant releases			
Accidents	Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks etc. Fire within the film processing area. Formation of explosive atmosphere.			
Energy	Where possible some form of energy recovery should be employed on incineration plant.			

BAT	
Offset Printing	
41	For all Offset printing, where technically feasible non-dampening printing methods or physical or inorganic dampening aids should be used instead of propan-2-ol and other organic compounds.* Where organic compounds are present in dampening: • The proportion of organic compounds in dampening solutions should not exceed: a) 10% (by weight) in the case of existing presses, except where these are incapable of running at that level b) 5% (by weight) in the case of new presses
42	Cooling in order to reduce the evaporation of dampening solutions containing organic compounds should be installed.
43	For Sheet fed offset, the composite vapour pressure at 20^{o}C (293K) of the cleaning organic solvents used should be no greater than: • 0.8kPa for low odour processes (such as to avoid tainting in food packaging) • 1.6kPa for ultra violet curing processes • 0.2 kPa for all other processes. Specialist cleaning organic solvent products such as blanket reviver, which have a vapour pressure of greater than 0.1kPa should not contain more than 5% of cleaning organic solvent by weight.
Publication Gravure	
44	Waste cleaning organic solvents and waste inks should be distilled to recover their solvent content, which can then be recycled within the process
45	Condensed steam that has been stripped of toluene should be reused as boiler feed water, or used as cooling water.
46	Where the condensed steam from the organic solvent recovery plant can not be reused it should be air stripped of toluene prior to discharge to sewer to meet the emission limit requirement.
Printing General	
47	Where practicable monthly organic solvent balances should be carried out. Discrepancies between the sum of the monthly organic solvent balance and the annual organic solvent balance should be investigated.
48	Where practicable programmable scales should be used, during the mixing and preparation of quantities of inks/coatings or when mixing is infrequent, to reduce organic solvent usage. In cases where wide ranges of colours are used (Flexographic and Gravure) colour computers with photospectrometers should be used.
49	Cleaning operations should be reviewed annually to identify cleaning steps that can be eliminated. Application of cleaning organic solvents should be: • From a contained device or automatic system when applied directly on to machine rollers • Dispensed by piston type dispenser or similar contained device, when used on wipes.
50	When organic solvent is used on wipes: • Pre-impregnated wipes should be held within an enclosed container prior to use.
51	Where practicable no “organic solvent” cleaning fluids or organic solvent cleaning fluids with lower vapour pressures should be used (with or without the addition of mechanical, chemical or thermal enhancements).
52	Where there is a potential for static build during web printing the web should be treated to prevent static build up.
53	Off-line cleaning should be carried out using enclosed cleaning systems, wherever technically possible. e.g. where machine parts can be removed for cleaning. Enclosed cleaning systems should be sealed to prevent emissions whilst in operation, except during purging at the end of the cleaning cycle. Where this is not practicable emissions should be contained and vented to abatement plant where necessary.

54	Residual ink/coating contained in parts of the press should be removed prior to cleaning.
55	Wherever technically possible returned ink from presses should be: • Kept and reused • Distilled to remove the organic solvent content which may then be used in cleaning operations
56	Where water borne products are used for printing their discharge should be minimised by: • Removing as much of the water borne product prior to cleaning: • Rinsing the equipment with the minimum amount of water. The water should then be treated, distilled or disposed of as waste (hazardous or non-hazardous)
57	Organic solvents containing halogenated hydrocarbons should be substituted wherever possible. *
58	Emissions of ozone from corona discharges and UV curing systems should be captured and vented under suitable conditions to provide adequate dispersion.
*It should be borne in mind that the Health and Safety Executive will not wish to see substitutes being organic compounds with a Workplace Exposure Limit (WEL).	

Finishing processes

3.47 Finishing processes such as cutting trimming (both as part of the printing operation and after printing), spine buffing and gluing are carried out along side the printing operations.

Environmental impact

Water:	Not significant.
Land:	No significant releases.
Air:	Releases of paper dust from cutting, trimming and buffing operations. Releases of VOC from gluing operations.
Waste:	Waste paper, paper dust, excess glue.
Energy:	Not significant.
Accidents:	Spillage of paper dust, leakage and containment failure of ducting systems.
Noise:	Not significant.

BAT	
59	Bag filters or cyclone systems should be installed to dust extraction to ensure compliance with the required limit.
60	Organic solvent free gluing systems such as hot melt or water based should be used wherever technically possible. Where these systems cannot be used, e.g. due to the nature of the materials to be glued, or technical properties required in the final products, the use of organic solvent-based glues should be reviewed annually and reported to the regulator.

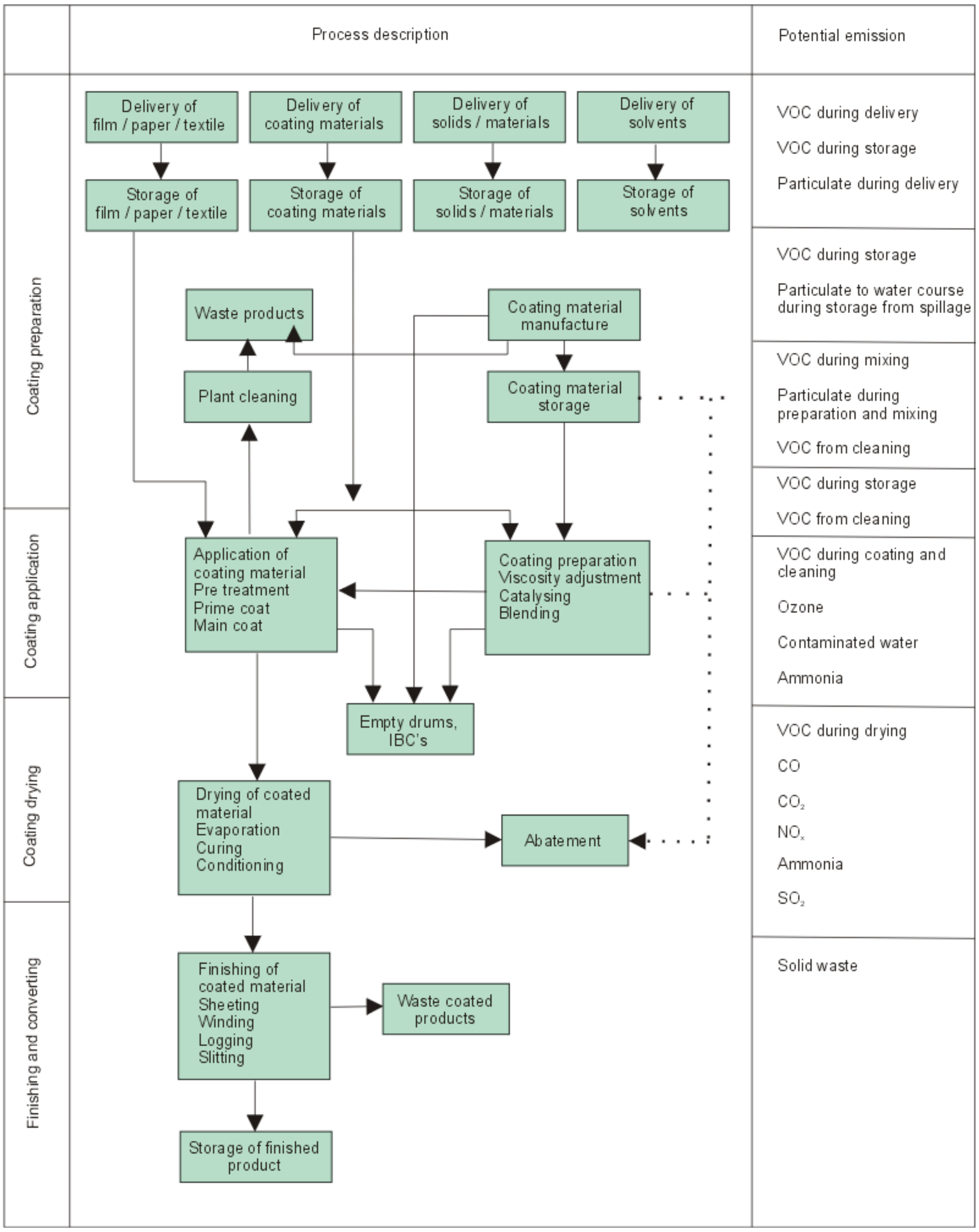
Coating general

3.48 Coating is the single or multiple application of a continuous film of any preparation, used to provide a decorative, protective or other functional effect on the surface of a substrate, such as paper, card, foil, plastics, metal and similar materials. It also includes the coating of adhesives that are applied to a surface. Coating is carried out as part of a number of manufacturing processes:

- Textiles, textile coating and textile finishing
- Coil coating of sheet aluminium, steel and other metals
- Film coating, coating of polyester film and similar substrates
- Application of paint in vehicle manufacture
- Coating of winding wire used in transformers and other electrical applications
- Coating and printing of metal packaging
- Wallpaper manufacture

3.49 Some coatings application installations will manufacture the coatings used for reasons such as economics, business control, technical formulation, etc.

Figure 3.1 - Coating Operations process diagram



Coatings Manufacture

3.50 All coatings are manufactured using a similar range of process steps. The manufacturing process is typically a batch process, which involves combining raw materials, in one or more steps, to produce the required formulation. Coatings are comprised of appropriate mixtures of four main raw material component categories:

- resins (organic (usually) or inorganic polymers)
- pigments primary (colours), extenders/fillers or activators (e.g. photochemicals)
- carriers (organic solvents, water, non-volatile liquids)
- fire retardants and antifungal/ antimicrobial agents in the case of textile coating
- natural and synthetic rubbers
- additives (a wide range of specific materials, used in small quantities to provide particular properties during manufacture, in storage, during application, in service life etc).

3.51 The coatings manufacturing stage rarely involves any chemical reaction processes, products being produced by mixing or blending usually at ambient temperatures.

3.52 Typical batch sizes can vary from 20 - 4000 Kg.

3.53 Coatings manufacture may involve up to 4 steps:

- pre-assembly and premixing
- pigment dispersing and grinding/milling
- final product assembly and viscosity adjustment
- product filtering and storage

Dispensing of raw material

3.54 Raw materials can be dispensed in various ways, depending on the size of the batch being manufactured and the scale of the process equipment, to the pre-dispersion plant. Whole bags of dry powders are assembled, typically on pallets, together with any part-bags and charged manually into the pre-dispersion equipment.

3.55 Large volume usage liquids can be piped via a ring main system to dispensing locations within the production plant or measured into intermediate containers for internal transport. Smaller volumes may be pumped from delivery barrels direct into the manufacturing stage, or may be measured into intermediate containers.

Premixing

3.56 In the premix step, liquid raw materials (e.g. organic solvents and carriers, resins and additives) are assembled and then blended in a suitable mixing container to form a viscous material. Pigments (and other extenders) are added and held in suspension in order to supply the dispersion equipment with a consistently mixed material. The premix stage results in the formation of an intermediate product.

3.57 Typical raw materials for solvent-borne coatings include resins, organic solvents, plasticizers, pigment, natural and synthetic rubbers and other speciality additives. Raw materials used for water-borne coatings include water, dispersants, pigments and speciality additives. Raw materials for UV cured coatings include acrylate polymers, monomers, initiators, and pigments.

3.58 The type of equipment used for premixing will depend on the batch size and the type of coating being produced. Drums equipped with a portable mixer may be used for small batches. These mixers normally have an impeller with three or four blades. Other materials made in portable mix tanks may be blended using larger, permanent high-speed dispersers or variable-speed mixers fitted with paddle, propeller, turbine, or disc-type agitators.

3.59 Coatings manufacturing facilities may use grinding equipment to accomplish the premix operations. This approach, common with water-borne coatings, eliminates the need to transfer the material to another type of equipment for the grinding/milling step described below.

Pigment Dispersion and Milling/Grinding

3.60 Grinding or milling reduces the agglomerate particle size of the pigment to achieve a fine particle dispersion. This process can be classified into three stages; wetting, dispersion and grinding.

3.61 In the wetting stage, various wetting agents may be used to displace the air, moisture, and gases that are adsorbed on the surface of the pigment particles. This is usually carried out at the same time as the dispersion stage. This results in the break up of the large aggregates of pigments into smaller agglomerates. Finally, milling (or grinding) is the mechanical break-up and separation of pigment clusters into individual particles and the distribution of the wetted pigment into the body of the liquid vehicle to produce a fine particle suspension. Milling usually involves the use of grinding media such as pebbles, balls, or beads to facilitate the break-up of the pigment agglomerates.

Wetting and dispersion

3.62 For many products, the first manufacturing step is the dispersion of powdered pigments in a resin/solvent blend. This is usually carried out using a high speed rotating disk (high speed dispersers) immersed in the powder/liquid mixture. The equipment can be fully enclosed - generally for large batches or long continuous runs - or commonly an open tank with a removable lid.

3.63 Where high volume production justifies it, the pre-dispersion can be diluted with extra resin solution/solvent, and pumped directly to the next stage of milling. More commonly, the pre-dispersion tank is mobile, and is mechanically transported to the mill.

Milling

3.64 As noted below, in some cases, dispersion can provide the required fineness of grind, but it is common to take the material from the dispersion stage, dilute it with extra resin solution/carrier, and to grind the pigment more finely in a mill. This dispersion stage generally involves pumping the paste through a mill, which may be enclosed or open, though in ball mills (now uncommon) the whole charge is held in the mill chamber during dispersion.

3.65 Wherever possible, enclosed mills are preferred, as they minimise any losses of volatile components (e.g. organic solvents).

3.66 A wide array of milling equipment is available. The choice is determined by a number of factors, including the resin system, the ease of dispersibility and type of pigments, the coating characteristics and the scale of production. More commonly used equipment includes the following: roller mills, ball and pebble mills, attritors, sand mills, bead and shot mills, high-speed stone and colloid mills, high-speed dispersers, high-speed impingement mills, and horizontal media mills. Roller and ball mills are somewhat outdated methods in current pigment dispersion technology.

3.67 Some products are manufactured entirely in one piece of equipment using high-speed, disk-type impellers. Because no grinding media are present in the mixing vessel, the pigment disperses through shearing forces acting in the bulk. Whilst high-speed disk milling may be appropriate for products such as thick film undercoats and primers, it will not be sufficient for products where a high degree of dispersion and fineness of pigment particle size is required.

3.68 When an acceptable degree of pigment particle size reduction and stability has been reached, either by dispersion alone, or by a combination of dispersion and milling, the batch is completed with viscosity and/or pH adjustment. This may occur with slow stirring.

3.69 These stages may be carried out in the same vessel or finishing is completed in larger closed or fixed tanks, fitted with a stirrer or other form of agitation, with hatches that can be opened to make additions and to take samples. They may also be fitted, optionally, with piped supplies of solvent or resin solution

Filtering/filling

3.70 The final step in the manufacturing process is the product filtering operation. The product is filtered to remove any oversize or undispersed particulate material and to enhance the quality and uniformity of the product.

3.71 A variety of filtering methods are used with the end use of the product determining the type of filtration required. Some products require only a cloth bag filter; other products require filtering equipment such as strainers or sieves. For high quality finishes, wound polypropylene or other resin cartridge filters are used.

3.72 The coating is passed through the filter into the appropriate sized container (pails, drums, mobile tanks or other containers). Filling may be accomplished either manually or mechanically depending on the number and size of the containers to be filled.

Process Equipment Cleaning

3.73 Process equipment cleaning is a necessary stage in the manufacturing process and can be performed in situ or external to the manufacturing plant, depending on the equipment to be cleaned. Fixed process tanks and vessels and associated connecting pipes, pumps and filters can only be cleaned in situ. The range of cleaning equipment and method will vary according to the shape of the tanks, the coating and resin systems concerned, the degree of cleanliness to be achieved and quality. Fixed tanks are often cleaned using static spray heads that can be fixed into position over the top of the tank or through a cleaning port. Usually organic solvent is used in such systems as the cleaning media and is sprayed at low pressure into the top of the vessel. Other cleaning methods may involve physical techniques using brushes instead of spray heads, and manual cleaning performed from outside or directly inside the tank. Cleaning media other than solvent may include caustic solutions, water-based cleaners and abrasive impact techniques using inert particles.

3.74 Pipe lines connecting tanks are normally flushed and cleaned using organic solvent and typically a solvent compatible with the material in process or the next planned batch.

3.75 Process equipment that is mobile, such as portable tanks and IBCs, are usually cleaned external to the manufacturing plant. Portable tank cleaning methods are typically automated or semi- automated, using spray heads or brushes, and using one or a combination of solvent, water, and caustic solutions as the cleaning media. Often, it is difficult to find one machine that can clean all sizes and shapes of portable tanks and invariably, some manual cleaning will be carried out, normally the external shell of the tank and valves.

3.76 Small parts and tools used during the manufacturing process are cleaned either in situ manually or in small baths, which contain cleaning solutions, typically organic solvent. These baths are closed and can be interlocked to local exhaust ventilation. Tools are left to soak and then cleaned with brushes manually.

3.77 Filters are cleaned either in situ as part of the pipe flushing/pigging process or as an open manual process under local or general exhaust ventilation. The method of cleaning will depend on the type of filter. Filter cleaning can be avoided by using disposable filters, which are available for certain equipment and are suitable for certain products.

Waste

3.78 Waste is generated from all the above manufacturing steps, including indirect processes such as material delivery, unloading, warehousing and process equipment cleaning. Examples of wastes generated directly from the manufacturing processes include the following:

- preassembly and premixing will generate waste packaging (e.g. bags, drums, plastic wrap and pallets);
- grinding, milling and dispersing and product finishing and blending processes will also generate waste packaging as well as liquid samples from quality control; paint residues; and spent equipment cleaning solvents
- product filling will generate dirty filters and packaging

Environmental impact

Water:	Water may be used for cleaning vessels and emitted to effluent. High water usage may be associated with installations engaged in aqueous coating formulations. In the case of textile coating some pigments (may contain cadmium), some fire retardants (may contain antimony), some stabilisers (may contain mercury), some antifungal/antimicrobial agents (may contain tri butyl tin (TBT)) handle modifiers, organic solvents
Land:	No significant releases.
Air:	VOC from organic solvent transfer, mixing and blending operations. Dust from powder use. Isocyanate release when using reagents containing free isocyanate groups
Waste:	Generated from rejected material, cleaning organic solvents, filters
Energy:	Associated with disperser, pump and air handling equipment. Generally process specific. May be < 10% of site usage
Accidents:	Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc. Fire within organic solvent handling area. Failure of VOC extraction system or abatement plant
Noise:	Not significant

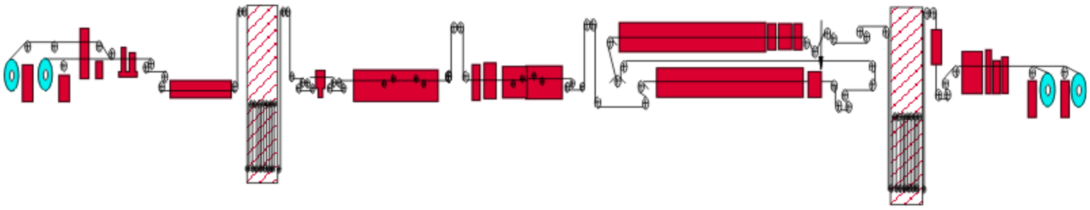
BAT	
61	Cleaning water should be minimised by using rotary spray nozzle heads and reused where technically possible.
62	Mixing and blending vessels should be enclosed during operation.
63	Air handling equipment should be fitted with VSD fans to ensure compliance with occupational health standards whilst optimising energy consumption.
64	Dust booths should be designed for maximum containment, whilst meeting relevant occupational safety standards and should be inspected on a regularly as part of a programmed maintenance schedule.
65	Bag filters or cyclone systems should be installed to dust extraction to ensure compliance with the required limit.
66	Where materials that are potentially harmful to the environment may be present in waste water, measures should be taken to prevent them from entering the water circuit. The possible contamination could include antimony from flame retardants, TBT from antifungal/antimicrobial agents, mercury compounds from stabilisers, or cadmium compounds from pigment systems. This includes water used to clean mixing blades, palette knives, mixing vessels etc.

Coil coating

3.79 Coatings applied as a liquid may include epoxy, plastisols, organosols, vinyls, acrylics, alkyds, polyesters, silicone polyesters and fluorocarbons. They are applied smooth, however they may be embossed later in the process, in thicknesses of between 5 and 250 microns (Litho plate coatings are usually 0.5 to 2 microns). This may be applied to a variety of coiled metal substrate, e.g. Steel, Aluminium, Brass, Stainless Steel. A typical coil coating operation is made up of the following operation:

- Entry End;
- Cleaning Section;
- Pre-treatment (Surface graining and anodising of coils may be classified as an A(1) Activity, where the aggregated volume of the treatment vats is greater than 30m^3);
- Coating;
- Post treatment;
- Exit end

Figure 3.2 - Typical layout of a coil coating line



Entry End

3.80 The entry end consists of machinery, which uncoils the strip and prepares it for the continuous coating operation. Coils are all measured to ensure compliance with width and gauge requirements then any leading end damaged or out of specification material is trimmed and discarded, any damaged or out of specification trailing end material is similarly trimmed off and discarded.

3.81 The leading edge of the incoming strip is welded or stitched to the tail end of the outgoing strip thus presenting a continuous length of material to the process section. Accumulators at the entry and exit end of the line allow sufficient stop time for joining and separating the strip without stopping the coating operation.

3.82 The strip may be levelled to ensure good shape prior to coating.

Environmental impact

Water: No significant releases

Land: No significant releases**.**

Air: No significant releases.

Waste: Scrap metal from coils and bindings sent for recovery and packaging.

Energy: Not significant.

Accidents: Not significant.

Noise: Not significant.

Cleaning Section

3.83 It is essential that the surface of the coil is free from impurities such as grease, oil, carbon or abraded metal particles to ensure a uniform good-quality conversion coating is achieved. Cleaning can consist of more than one stage and can include a rotary abrasive brush section, the purpose of which is to remove any localised corrosion products from the substrate. Brushing is sometimes used on hot dip galvanised steel but more often on cold rolled steel which can have severe surface contamination consisting of carbon particles and rust. Alkaline cleaners are invariably used for steel and zinc coated steel substrates and are the most efficient for removing organic soils. Alkali cleaning is also used on aluminium surfaces but acidic cleaning can also be used on this substrate. Electrolytic cleaning is infrequently used on organic coil lines that process aluminium.

Environmental impact

Water: Discharges of spent alkaline or acidic cleaner contaminated with oils, grease, iron fines, aluminium and dirt. Rinse-water from rinse operations.

Land: Not significant.

Air: No significant releases. Water vapour is emitted from the extraction system.

Waste: Solids from cleaning section, in-line filter elements.

Energy: Not significant.

Accidents: Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc.

Noise: Not significant.

BAT	
67	The use of alkaline or acidic cleaner should be used in a closed loop re-circulating system in order to minimise the use of raw materials possible.
68	Bath control parameters should be maintained within the operating limits as given by the pre-treatment supplier. It is more efficient to control the levels of contaminants in the bath by using continuous solution discard procedures. This will ensure that consistent quality is achieved.
69	Wherever technically possible and quality permits cascade rinse should be used along with squeegee rolls or knives to prevent carry over
70	Where possible the conductivity of the rinse waters should be measured and used to regulate the make-up and discharge of rinse water
71	Wastewaters from rinsing and cleaning should be treated to meet the required standards as appropriate.
72	Any possible accidental releases from the cleaning and rinsing operations should be contained e.g. by directing them to a low-level emergency tank, to prevent its release.
73	Suitable means should be available to isolate the plant sewage system from the main sewer, to prevent possible discharge that may damage the main sewer and subsequent treatment plant.
74	Only non-mercury containing solutions should be used for the cleaning operations, to prevent the release of mercury from the site.
75	Treated wastewaters should be used as rinse water where technically possible to minimise raw water consumption.
76	Exhaust ventilation air from the cleaning and rinsing baths should be fitted with a baffle separator with an aerosol screen where there is a potential for the emissions of water droplets.

Pre-treatment

3.84 The strip is dried prior to being chemically pre-treated. The pre-treatment of the substrate has the role of providing compatibility between the substrate and the applied organic coating to ensure the optimum adhesion and corrosion resistance characteristics of that coating are obtained. Pre-treatment solutions are applied by spray, immersion or reaction cell which require subsequent rinsing. New installations use a chemical roller coater or a spray / dip and squeegee wringer roll arrangement which do not require subsequent rinsing. All applied pre-treatments require to be dried using a low temperature oven or by relying on the heat in the metal substrate. Conventional conversion coatings include iron phosphate, zinc phosphate, alkaline oxide, chromates and chrome/heavy metal free systems. No-rinse processes are mainly based on chromates or chrome/heavy metal free chemistry. These types of systems have the environmental benefits of no polluting effluent and plant requirements are reduced, thus saving on energy and capital investment. Not all these systems are equally suitable for all substrates. Their performance and operational characteristics also varies. The criteria for choice, therefore, depend on plant, end-use application, quality and economics that relate to each coil coaters situation.

3.85 For some specialist products, after cleaning, surface treatment of the coil may be carried out in the form of electrochemical graining and anodising to develop the required surface properties required of the final product.

Environmental impact

Water:	Discharge of heavy metal compounds if heavy metal containing rinsed pre-treatments are used.
Land:	Not significant.
Air:	No significant releases. Where spray application is used fumes are extracted and abated. Release of combustion products where oven drying is carried out.
Waste:	Solids from heavy metal containing pre-treatments, in-line filter elements.
Energy:	High energy input required for electrochemical processes.
Accidents:	Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc.
Noise:	Not significant.

BAT	
77	No rinse application of pre-treatments should be used wherever possible, especially heavy metal free systems.
78	For rinsed pre-treatments, bath control parameters should be maintained within the operating limits as given by the per-treatment supplier. It is more efficient to control the levels of contaminants within the bath by using continuous discard procedures. This will ensure that consistent quality is achieved.
79	Any possible accidental releases from the application of the heavy metal containing pre-treatment solutions. should be directed to a low-level emergency tank, to prevent its release.
80	Suitable means should be available to isolate the plant sewage system from the main sewer, to prevent possible discharge that may damage the main sewer and subsequent treatment plant.
81	Exhaust ventilation air from the heavy metal containing pre-treatment application should be abated.

Coating

3.86 The coating process can comprise of a number of stages and be carried out by a number of different coating techniques i.e. roller coating, slot coating. Although the method of application and the type of coating may vary the general principles of operation of the coating machine are similar for all applications. As an example the coating of coil strip with a primer and finish coat on both sides is given. The strip passes through a roller coater machine, which applies a primer paint coat to both sides of the strip. The coaters are normally housed in enclosures to minimise the egress of organic solvent vapours to the bay atmosphere. The coater houses are ventilated by fan extraction to the outside of the building with a flow rate designed to maintain satisfactory working conditions at all times for the operators within the coater house.

3.87 After application of the prime paint/coating, the strip passes to an oven provided with convection heating by air recirculation to achieve the peak metal temperatures required for the curing of the paint/coating. The primary heat source for the oven is, where possible, supplemented by recovered heat. Some ovens may use electrical or infra red heating as an alternative. After curing, in some processes the strip passes through a water spray quench tank and is dried by an air blower.

3.88 In some processes the strip continues through a second, finish-coating stage, which is similar to the prime coating process and after curing is again quenched and dried. However, for PVC plastic coated strip, the strip usually passes through an embossing roll, which imprints a pattern into the paint surface immediately prior to quenching.

3.89 When a laminated product is required the adhesive required for the production of the laminate can be applied within either of the two coating sections. It is then cured in the oven after the coater and then processed through a laminator.

3.90 Solvent and other organic fumes arising in the curing oven are extracted by a fan. The extraction system is designed to maintain a mass flow and pressure balance, which will prevent escape of fumes and will normally ensure that the level of organic vapour in the dryer meets the requirements of BS EN 1539. (For information, in most cases this level does not exceed 25% of the Lower Explosive Limit (LEL)).

3.91 The fumes pass to abatement equipment, normally a thermal oxidiser (incinerator) designed to reduce the VOCs and other organics to minimal levels before being discharged to atmosphere. The thermal oxidation systems used are designed to be thermally efficient utilising regenerative bed technology or recuperative technology or have secondary heat recovery attached.

Environmental impact

Water:	Discharges of quench water, Cooling water blowdown.
Land:	No significant releases.
Air:	VOC releases from extraction from coater house, VOC from curing ovens normally directed to oxidation unit where they are burnt. Water mist/droplets from cooling towers
Waste:	Waste paint/coating, used wipes, in-line filter elements
Energy:	Energy usage in ovens and VOC abatement plant.
Accidents:	Spillage of chemicals, leakage/containment failure of pipe work/drums/tanks, etc
Noise:	Not significant.

BAT	
82	Quench water should be minimised and reused where technically possible to reduce water usage.
83	Fan motors should be fitted with VSD controls to minimise energy usage wherever possible.
84	The use of heat recovery systems should be used to reduce primary energy

Post treatments

3.92 Post treatments such as wax coating, paper coating or a strippable film may be applied, dependent on customer requirements

Exit End

3.93 The finished product is normally inspected and is coiled on a coiler, on high production rate units there may be two coilers, coils are cut to size or weight according to customer requirements. For some specialist applications the coils may be converted on site to sheet prior to dispatch to the customer.

Environmental impact

Water:	No significant releases
Land:	No significant releases.
Air:	No significant releases
Waste:	Scrap coil ends, swarf/edge trim, paper and plastic interleaving trim
Energy:	Not significant.
Accidents:	Not significant.
Noise:	Not significant.

Figure 3.3 - Flow diagram for a typical colour coat unwind and pre-treatment line

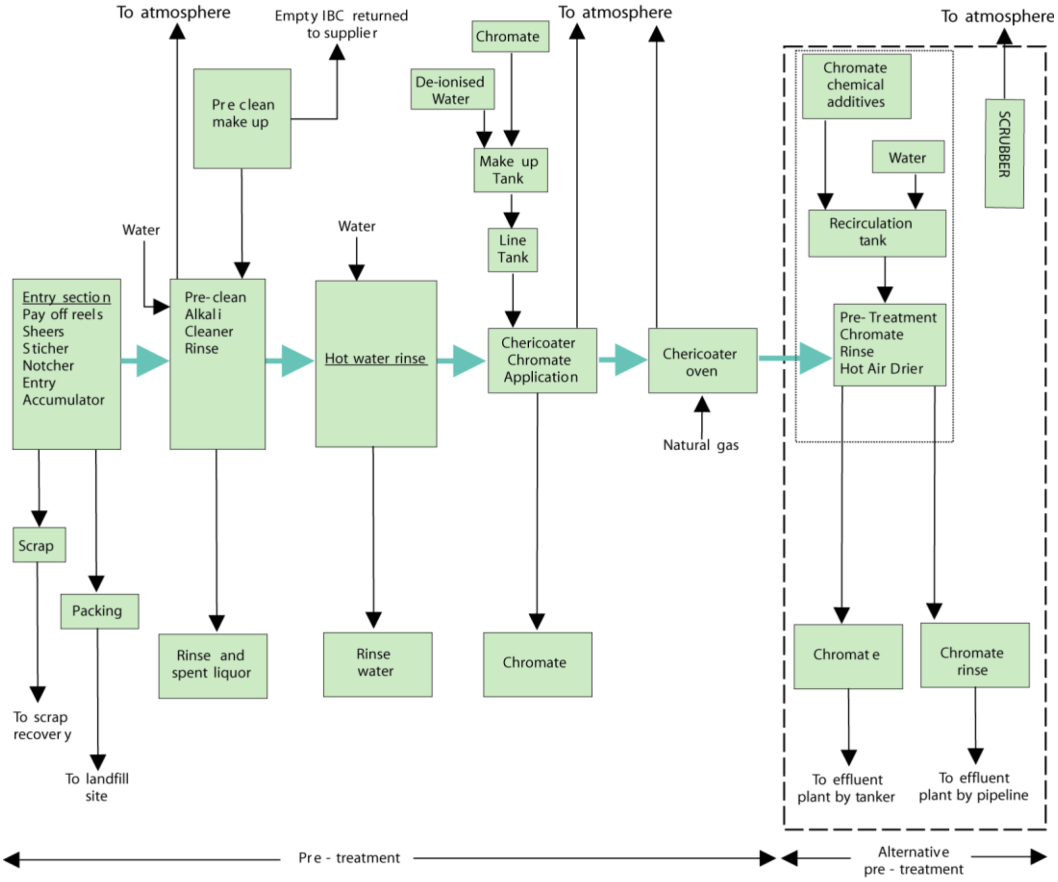
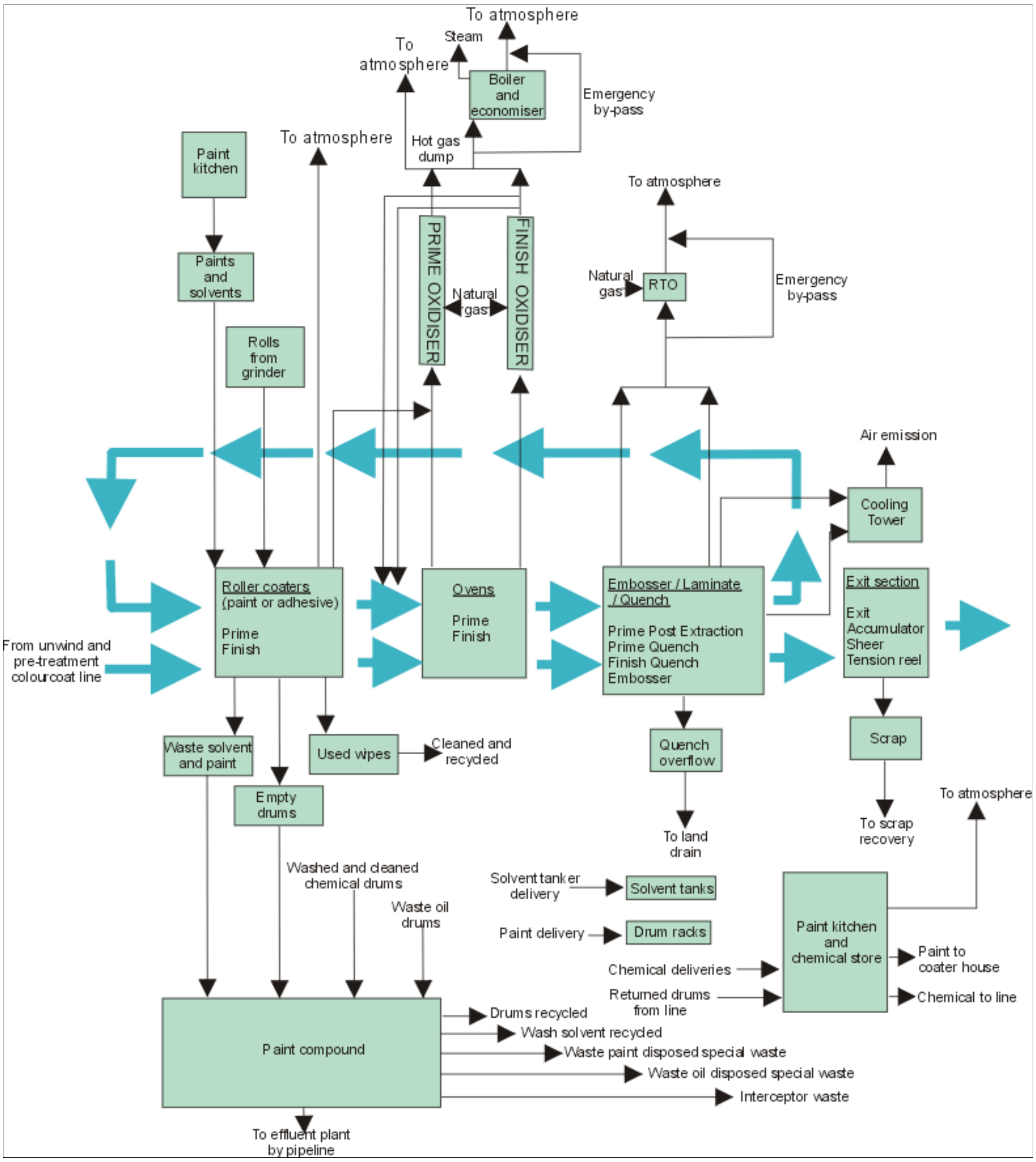


Figure 3.4 - Flow diagram of a typical rewind and colour coating line



Textile coating and finishing

3.94 These types of processes include:

- Polymer coatings, including polyurethane, PVC, polyester and polyamide;
- Anti-soiling and fire retardant finishes;
- Fluorocarbon or silicone coatings for water repellence.

3.95 Under LA-IPPC, coating textiles with PVC is not considered to be in itself a coating process unless the PVC is applied from solution in organic solvents, or as a PVC plastersol.

3.96 All textile coatings are made up of a number of process steps, which can most simply be categorised as:

- Delivery, storage and handling of raw materials
- Mixing/ preparation
- Coating/ application
- Finishing
- Cleaning

Figure 3.5 - Textile coating VOC releases to air

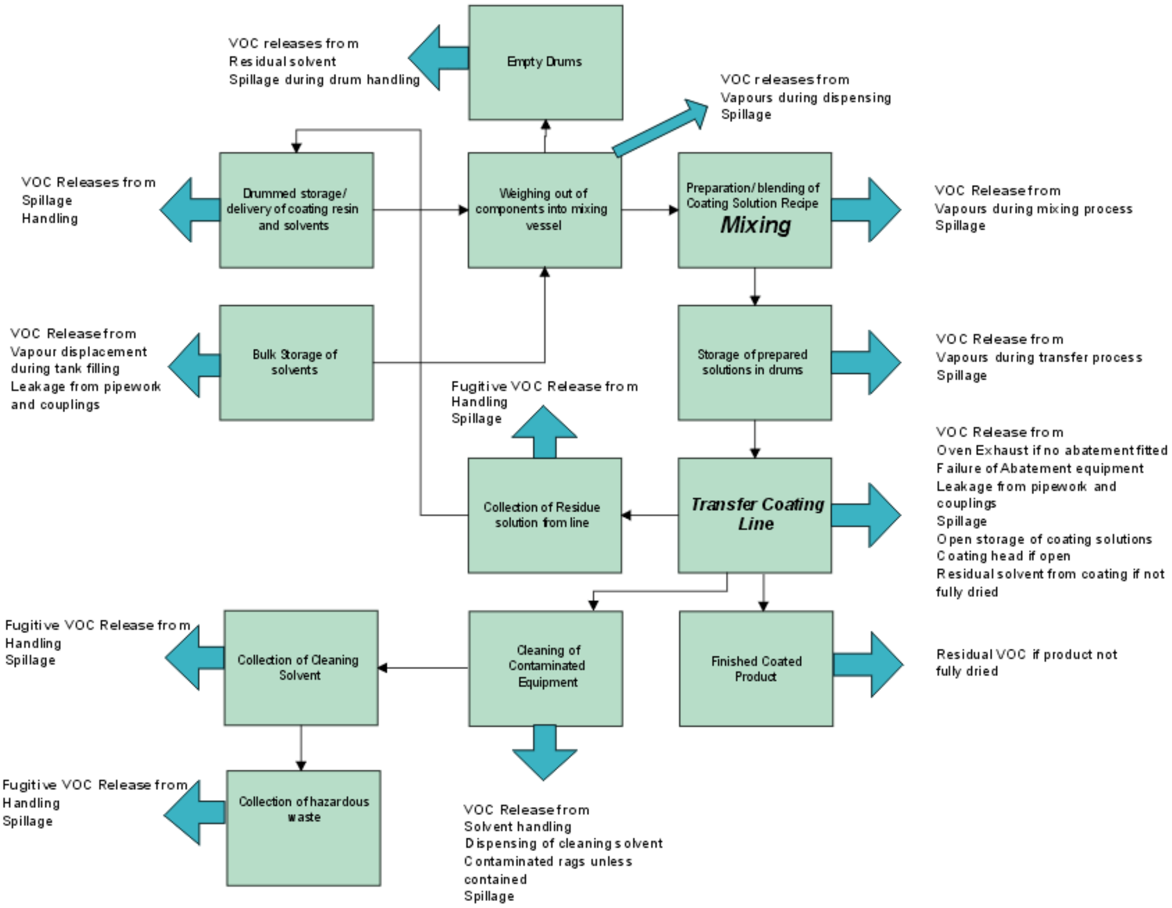


Figure 3.6 - Textile coating VOC releases to water

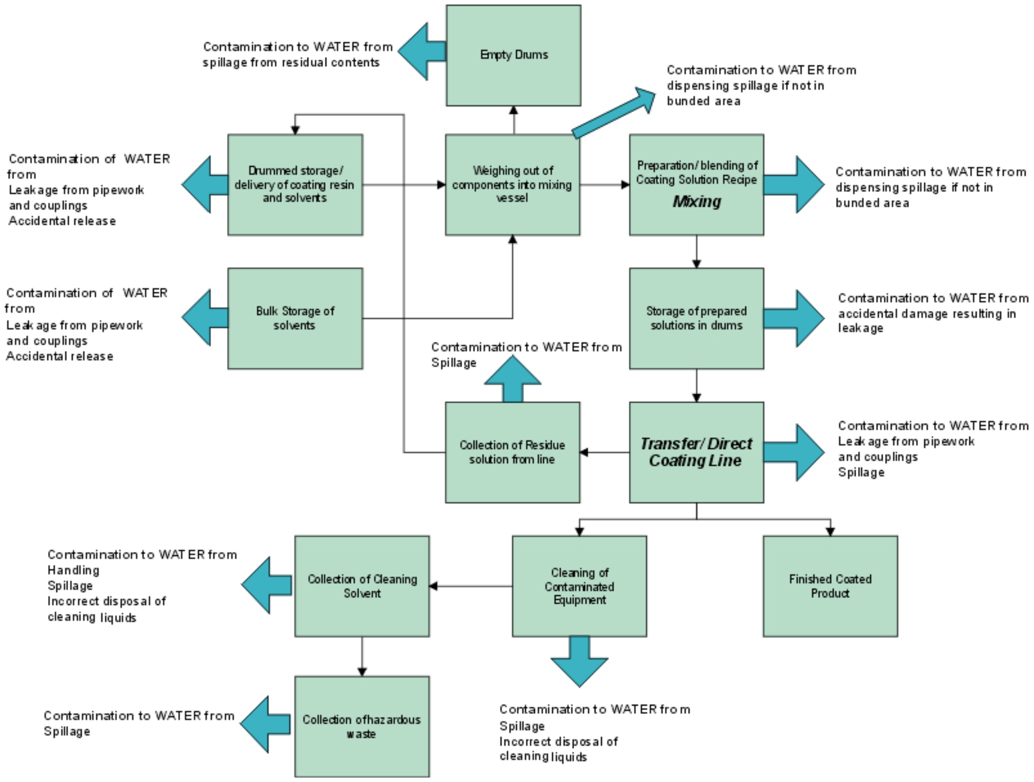


Figure 3.7 - Textile coating VOC releases to land

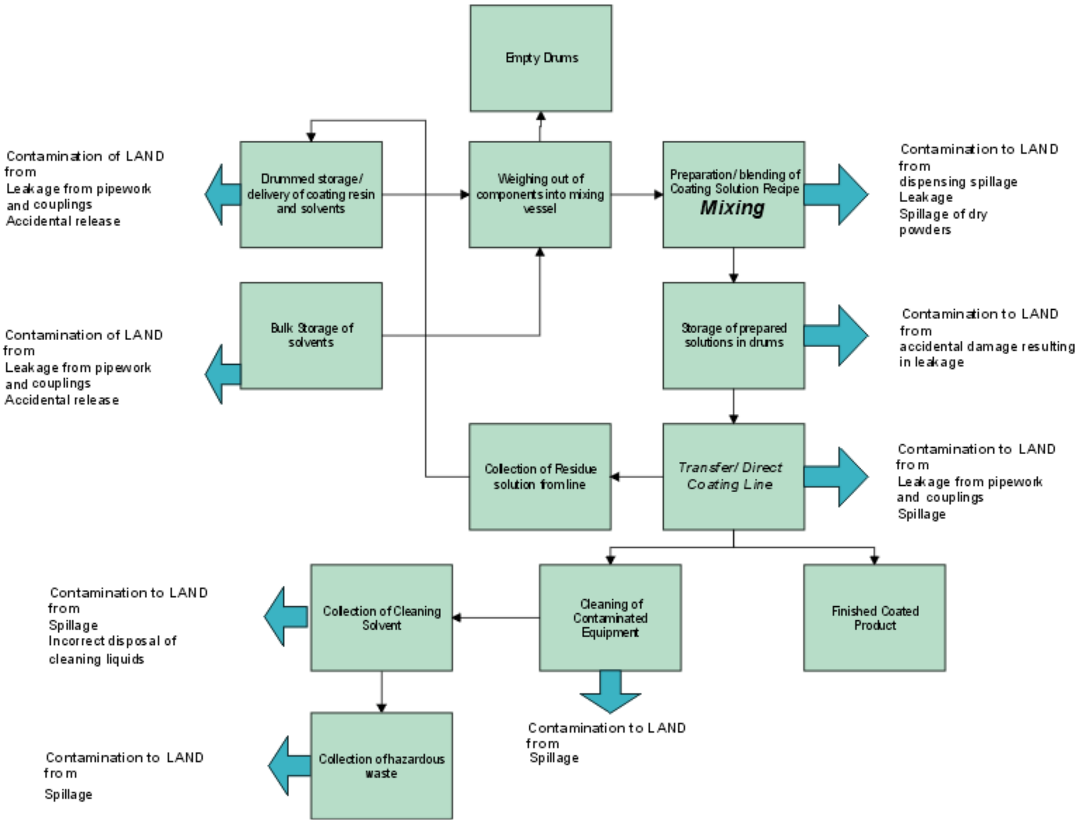
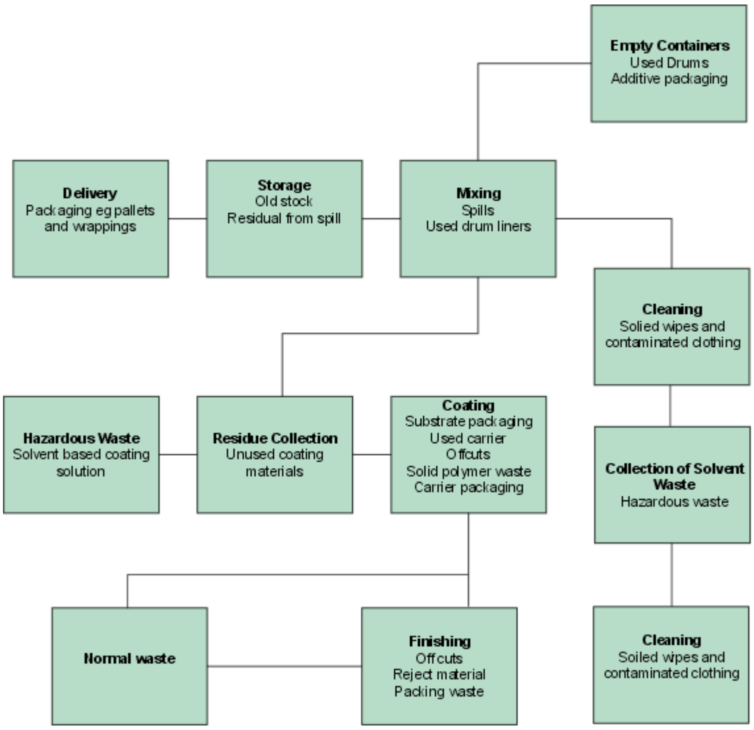


Figure 3.8 - Textile coating Waste generation



Mixing/preparation

3.97 This is the preparation of the coating chemicals. In this process chemicals are dosed into a mixing vessel and blended/ solvated to produce a homogeneous coating solution. Typical components that can be added are pigments (some contain cadmium), fire retardants (some contain antimony), stabilisers (some contain mercury), antifungal/antimicrobial agents (some contain tributyl tin (TBT)), handle modifiers, organic solvents etc

Coating/Application

3.98 The application of the coating either to a release medium or to a substrate, and the subsequent drying/ curing processes give rise to specific environmental impacts depending on application process. Coatings are usually applied as:

- Direct coating
- Transfer coating
- Impregnation coating

3.99 Direct coatings are mixed, applied by e.g. knife over plate, knife over air, or knife over roller. Anti-soiling, fire retardant, fluorocarbon and silicone coatings are also direct coatings and are often applied by immersion in a bath, or by pad or by knife over roller. The product is then dried or cured often in an oven. Some two component systems may require curing in order to react fully

3.100 Transfer coatings are applied to a carrier, e.g. a release paper, and then dried. Some two component systems may require curing in order to react fully. Several layers may be built up before an adhesive layer is applied (another layer such as polyurethane, or polyester, or acrylic), the textile adhered, cured in an oven and the release paper removed. Two component polyurethane coatings as applied may contain isocyanates. Other emissions may include acid catalysts e.g. Para-toluene sulphonic acid and formaldehyde formation from melamine systems.

3.101 Impregnation coatings, also known as coagulation coatings, are mixed, and then applied directly to a substrate. This impregnated substrate contains organic solvents, often dimethyl formamide. The impregnated substrate is then run through a water bath, which removes the majority of the organic solvent from the substrate. The material is then dried and the result is a "cellular polymer" (often polyurethane) impregnated fabric. These are often further finished either by additional coating (often transfer), to produce artificial leathers, or abrading to produce imitation nubuck leather.

Table 10 - Potential environmental impacts of textile coating application

Environmental Impact	Transfer coating	Direct Coating	Impregnation
Water	Possible release of antimony from flame retardants, TBT from antifungal/ antimicrobial agents, cadmium from pigments and mercury from stabilisers, to effluent	Possible release of antimony from flame retardants, TBT from antifungal/ antimicrobial agents, cadmium from pigments and mercury from stabilisers, to effluent.	Possible release of VOC and solvents with risk phrases into effluent dimethylformamide (DMF) R61 is used in a number of processes. Possible release of antimony from flame retardants, TBT from antifungal/ antimicrobial agents, cadmium from pigments and mercury from stabilisers, to effluent.
Air	Large volumes of VOC are released from solvent based systems on drying. Risk phrase / hazard statement solvents, where used, may also be released to atmosphere. DMF is used in a number of processes.	Large volumes of VOC are released from solvent based systems on drying. Risk phrase / hazard statement solvents, where used, may also be released to atmosphere. DMF is used in a number of processes.	Large volumes of VOC are released from solvent based systems on drying. Risk phrase / hazard statement solvents, where used, may also be released to atmosphere. DMF is used in a number of processes.
Waste	Coating solution, or adhesive that is surplus to requirements.	Coating solution that is surplus to requirements.	Water / solvent mix from the coagulation bath.
Land	No significant release	No significant release	No significant release
Accidents	Spillage of solvent-based solution. Leakage of pumps etc. Fire within the coating area.	Spillage of solvent-based solution. Leakage of pumps etc. Fire within the coating area.	Spillage of solvent-based coating solution Spillage of contaminated water from coagulation bath. Leakage of pumps etc. Fire within the coating area.
Energy	Large energy requirement if abatement is chosen route of compliance with the air emissions levels.	Large energy requirement if abatement is chosen route of compliance with the air emissions levels.	

BAT	
85	Cleaning water should be minimised and reused where possible.
86	Fan motors should be fitted with VSD controls to minimise energy usage wherever technically possible.
87	The use of heat recovery systems should be used to reduce primary energy.
88	Where there is a potential for static build during web printing the web should be treated to prevent static build up.

Finishing

3.102 Finishing includes the examination of the finished items, and packing.

Environmental impact

Water:	Not significant
Land:	Not significant
Air:	Release of VOC (including R61(DMF)) to atmosphere or possible odours, associated with any residual organic solvents remaining in the goods.
Waste:	Landfill due to disposal of solid waste, including both goods, and packaging materials.
Energy:	Not significant
Accidents:	Fire within the processing area.
Noise:	Not significant

BAT	
89	All goods must be sufficiently dried prior to examination to prevent the release of any residual VOC in the product.
90	Recycling should be maximised i.e. release paper, re use of the fabric tubes.
91	The minimum packaging possible should be used.

Cleaning

3.103 Following application of the coating, cleaning of used equipment is carried out. Enclosed cleaning machines are available for some tasks on which the cleaning organic solvent may be recovered by distillation or by off-site recovery, however manual cleaning is still carried out in some instances.

Environmental impact

Water:	Water may be used for cleaning application equipment and emitted to effluent. Cleaning water may be contaminated with heavy metals and TBT
Land:	Contamination of land as a result of spillage of cleaning materials
Air:	VOC from organic solvent transfer, and fugitive emission during use.
Waste:	Generated from rejected material, cleaning organic solvents, filters, possible heavy metal contamination
Energy:	Associated with applicator equipment and room ventilation. Not significant**.**
Accidents:	Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc. Fire within application area.
Noise:	Not significant.

BAT	
92	Where any potentially harmful materials may be present in waste water, measures should be taken to prevent them from entering the water circuit e.g. insulation of each water circuit.
93	Cleaning water should be minimised and reused where technically possible.
94	Application of cleaning organic solvents should be from a contained device or an automatic system when applied directly.
95	When organic solvent is used on wipes they should be pre impregnated and held within an enclosed container prior to use. After use they should be stored in an enclosed container, prior to disposal in accordance with the waste regulations.

Film coating

3.104 Film coating includes the coating of polyester, PVC, polyethylene or similar substrates, by applicator roller, spray, slot extrusion and similar coating techniques, followed by oven curing or drying, prior to a final finishing processes such as cutting to size , laminating, interleaving, over-printing or application of adhesive strip.

The full process normally involves the following stages:

a) Acquisition and storage of materials
b) Mixing/blending of chemical components into coating formulations (emulsions, solutions, dispersions, lacquers, adhesives, etc.)
c) Coating application to the substrate
d) Drying or curing
e) Laminating/interleaving etc. (optional)
f) Conversion/finishing (conversion to smaller units or sheets and packing)

3.105 The mixing stage may cover a variety of dispersion, blending and milling techniques involving complex mixtures of organic solvents of varying physical properties. The batch sizes may vary from 20 - 4000kg. Viscosity adjustments and filtration of coatings is also carried out during mixing.

Coating Application

3.106 The application of the coating preparation may either be as a single layer or as multi layers in a single pass operation from different application heads. Multi layer in a single application head is not common. The coating supply and application process may give rise to fugitive emissions depending on the type of technique used.

Pre-treatment of substrate

3.107 Most coating applications require a pre-treatment coat, which may be a primer coating or corona treated to enhance adhesion or a release layer to facilitate product function (e.g. a transferable adhesive).

Back Coating

3.108 In some product application areas it is necessary for the 'reverse' side of the film to be treated. This is usually to confer special technical properties e.g. enhanced ink adhesion properties, antistatic, etc.

Application of coating

3.109 There are many variations to the type of coating application head. The following is a list of the main methods currently employed.

1. Knife Coating

A rigid knife is used to remove excess liquid which has been applied to the film base from a reservoir to produce a uniform coating of desired thickness on a continuously moving, rigidly supported web. The thickness of coating depends upon the gap (between knife and web), the geometry of the knife (angle, length) and physical properties of the liquid (viscosity, surface tension). In some applications the rigid knife may be replaced with an air knife in which compressed air is directed through a controlled slot towards the surface of the applied coating.

2. Dip or Meniscus Coating (Free Meniscus Coating)

In this technique the substrate is either immersed in the coating material or engages with the surface of the liquid, acquiring a coating through viscous drag. The coating is controlled either by drainage or withdrawal since the web exit angle is normally vertical. The method is used for low viscosity liquids and thicker coatings. The thickness of coating may be affected by angle of withdrawal, web speed, and viscosity.

3. Curtain Coating

A curtain of liquid is applied to the horizontal film base normally transverse to the curtain. The liquid falls from a height under gravity from a curtain die or cascade whilst the web is supported on a backing roller. This method is capable of achieving high web speeds and multilayer coatings.

4. Roller Coating

This is the most common method of application and essentially involves applying a coating to a surface using rotating rollers or coils. The fluid flow in the gap between adjacent rollers and their relative speeds is what controls the coating thickness. Roller coating may use rigid roll in which a roller rotates in the same direction as the film web held on a backing roller with the liquid supplied onto the roller from a reservoir. In Reverse rigid roll coating, the applicator roller rotates against the film web and the liquid may be contained in the nip between the two rollers mounted in the same horizontal plane.

Coating thickness is dependent on roller speed, web speed and liquid properties.

A development of roller application is triple roll coating where the third roller is metering the amount of liquid on the applicator roller to provide greater accuracy of application.

Non-rigid roll coating is also carried out using deformable rolls or kiss coating, typically for waxes and hot melt applications.

5. Slot Coating

This method channels the coating formulation through a carefully designed slot die to provide a single layer application to the film web moving at an angle to the die. The liquid is fed into a coating die by a metering device such as a positive displacement pump. A further development of this technique is the extrusion slot coating technique in which the liquid bridge forms a short liquid curtain. The coated thickness is dependent on web speed and liquid flow rate. The method is used for photo resists and magnetic suspensions, and can cope with a wide range of viscosities.

6. Meter Rod Coating (Mayer Bar)

In this technique a wire wound bar is used to control the amount of liquid remaining on the web after application from a reservoir. The wire is usually a carefully selected gauge. The bar is normally rotated to prevent accumulated debris affecting coated quality. The method is suitable for thin coatings of low viscosity.

7. Gravure Coating

This method uses the principles of gravure printing. A roller with an engraved intaglio pattern rotates in the reservoir and excess surface liquid is removed by a doctor blade. The liquid held in the cells of the engraving is transferred by direct contact with the film web or in some cases may be off set to another roller for transfer. This method gives thin, accurate coatings for speciality application areas and is capable of high speed.

8. Slide Coating

Liquid flows through a series of slots formed from blocks mounted together on a base plate. Each slot delivers a controlled amount of liquid down an inclined slide (cascade) to provide a multilayer coating in contact with the film base held on a backing roller. This method is used for multiple layers, offering consistent uniformity of coating.

3.110 Following application of the coating, cleaning of used equipment is carried out. Enclosed cleaning machines are available for some tasks on which the cleaning organic solvent may be recovered by distillation or by off-site recovery, however, manual cleaning is still carried out in some instances

Environmental impact

Water:	Water may be used for cleaning application equipment and emitted to effluent.
Land:	No significant releases
Air:	VOC from organic solvent transfer, and fugitive emission during application. Ozone may be generated from pre-treatment processes where applicable**.**
Waste:	Generated from rejected material, cleaning organic solvents, filters,
Energy:	Associated with applicator equipment and room ventilation. Not significant.
Accidents:	Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc. Fire within application area.
Noise:	Not significant.

BAT	
96	Cleaning water should be minimised and reused where possible.
97	When solvent is used on wipes they should be pre impregnated and held within an enclosed container prior to use. After use they should be stored in an enclosed container, prior to disposal in accordance with relevant waste regulations.
98	Where there is a potential for static build-up during web printing, the web should be treated to prevent such static build-up.

Drying/Curing process

3.111 The coating application process is followed by drying through organic solvent evaporation or curing of the applied layer. The capacity of the dryer is dependant on the weight of the coating applied and the evaporation rate of the volatile components. Air or nitrogen may be used and is normally heated by steam, heat exchanger (hot oil) or direct gas fired burner. Air volume flow is controlled either by dampers or VSD fans to ensure efficient evaporation of volatile components with due regard for safe concentrations of organic solvent / air mixtures. Heated air is usually passed through a nozzle system to increase the velocity of impact on the coating surface. Coated layers may also be dried (cured) by radiation. Ultra - violet radiation is normally used.

3.112 Drying ovens may work with driven input air and/ or with driven exhaust air and may operate under positive or negative pressure for various technical reasons. Input air may be filtered for particulate removal. Organic solvent laden air has to be delivered to abatement technology at the specified condition for the satisfactory operation of the abatement technology.

3.113 UV curing systems are used for curing coatings consisting of curable oligomers and monomers. Ozone emissions may be associated with this technology

Environmental impact

Water:	No significant impact. Water use associated with water-borne coatings is evaporated to atmosphere at this stage. Where steam is raised for heating via boilers there will be boiler blow down.
Land:	No significant releases
Air:	VOC from organic solvent evaporation, oxides of nitrogen and carbon from gas burners and abatement technology. NOx may also arise from oxidation of nitrogen containing solvents. Ozone emissions may arise from UV curing lamps.
Waste:	No significant impact.
Energy:	Major use associated with web drive system for coating machinery, generation of heated air and operation of abatement technology.
Accidents:	Fire or explosion from ignition of vapour exceeding critical LFL concentrations.
Noise:	Not significant

BAT	
99	Cleaning water should be minimised and reused where technically possible.
100	Fan motors should be fitted with VSD controls to minimise energy usage wherever possible.
101	Emissions of ozone from curing lamps should be captured and vented under suitable conditions to provide adequate dispersion. Low ozone lamps should be used where possible.
102	The use of heat recovery systems should be used to reduce primary energy.

Laminating / Interleaving

3.114 Following rewinding of the dried coated material the product may be combined with other substrates for a variety of technical reasons. The coated material may be interleaved (with e.g. paper) to protect the coated layer or laminated to a release layer for transfer adhesive properties or other filmic material may be laminated for surface protection. There is minimal environmental impact from this process which may be carried out in-line (i.e. following drying) or off line as part of a conversion process

Conversion/Finishing

3.115 Dried product may be subjected to rewind inspection/trimming or a conversion operation on separate machinery. This operation is to trim unwanted coating from the finished product; i.e. edge effects or quality defects. The conversion also produces rolls of required length or sheets of required dimension. Converted product is contained in appropriate packaging. The process generates landfill waste, as there are no economic processes for recycling/reusing PET coated with other substances.

Environmental impact

Water:	No significant impact.
Land:	Conversion processes (particularly sheeting) generate significant quantities of coated film waste. Conventional disposal is to landfill.
Air:	Insignificant effect. A residual amount of organic solvent may be present in finished product but technical requirements ensure that this is minimised.
Waste:	Generated from rejected material, trim and sheeted waste areas. Conventional disposal is to landfill.
Energy:	Associated with use of slitter and conversion machinery. May be significant but usually <25% of site total. Energy consumption is higher where a classified clean room conditioned air environment is required.
Accidents:	No significant environmental effect.
Noise:	Not significant

BAT	
103	Bag filters or cyclone systems should be installed to dust extraction to ensure compliance with the required emission limit.
104	Where waste recovery is not economically or technically possible, opportunities for energy recovery on site or off-site from waste should be sought.
105	Finishing and converting equipment should be enclosed where technically possible to minimise fugitive emissions.

Application of paint in vehicle manufacture

3.116 Coating of new steel or aluminium vehicle bodies may be continuous or discontinuous coating of steel or aluminium. Variations in the activity are greatest at the pretreatment and electrocoat stages. The following description is typical for continuous coating of steel car bodies, although, coating of car parts may be carried out as part of the activities within the installation. The pre-treatment processes: cleaning phosphating, passivation rinse, are not considered in this Note where the aggregated volume of the treatment vats is greater than 30m^3.

3.117 In some cases vehicle parts painting (e.g. wheels, plastic parts, bumpers) which is a similar operation is technically connected and directly associated with the vehicle body coating. Where relevant, these operations can be fitted into the overall vehicle painting installation (Figure 3.9). The operator should agree with the regulator whether to include any or all of the parts coating activities within the vehicle body mass calculation used in determining the VOC total emission limit.

Pre-treatment

3.118 The pre-treatment of car bodies is intended to clean and prepare the metal surface to improve corrosion resistance and the adhesion of subsequent paint coatings. The pre-treatment zones use aqueous cleaning solution and spray and/or dip tanks to remove contaminants. The cleaner zones are followed by water rinses.

3.119 The cleaned body is then subjected to phosphate treatment by spaying or dipping. The treated body is then rinsed with water. Sludge, formed as a by-product of the phosphate conversion process, is removed from the solution for disposal. The rinse waters from conversion zone are often discharged to an effluent treatment plant prior to discharge from the installation. The final rinse is carried out using demineralised water. The solids from the electrocoat rinse water are removed as filter cake from the effluent treatment process.

3.120 Some plants then use a passivation zone. This is followed by a water rinse, the final rinse being carried out using demineralised water.

Environmental impact

Water:	Release of spent alkali cleaner from cleaning water rinses, release zinc, nickel and chromium from phosphate conversion and chromate rinse waters.
Land:	Sludge from phosphate conversion is disposed of to landfill as is filter cake from the rinse water treatment.
Air:	Insignificant effect. A small amount of moist air contaminated with cleaner and treatment chemicals may be released from local exhaust ventilation extraction.
Waste:	Sludge from phosphate conversion, spent treatment chemicals during maintenance shutdowns.
Energy:	Not significant.
Accidents:	Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc.
Noise:	Not significant.

BAT	
106	Rinse water should be recycled to be used as make up water wherever technically possible to reduce raw water consumption
107	Where possible the conductivity of the rinse waters should be measured and used to regulate the make-up and discharge of rinse water
108	Wastewaters from rinsing and cleaning should be treated to meet the required standards of the permit
109	Any possible accidental releases from the cleaning and rinsing operations should be directed to a low-level emergency tank, to prevent its release
110	Suitable means should be available to isolate the plant sewage system from the main sewer, to prevent possible discharge that may damage the main sewer and subsequent treatment plant
111	Non-mercury containing solutions only should be used for the cleaning operations, to prevent the release of mercury from the site.
112	The effectiveness of the phosphate conversion coating, rinse and passivation should be monitored to minimise raw materials usage and carry-over of treatment solutions to the rinse system.

Electrocoat

3.121 Electrocoat is a highly transfer efficient electrophoretic coating process for applying the first primer coat to enhance corrosion protection and adhesion of subsequent coatings. The body of the vehicle is dipped in to a tank containing a water-borne coating. An electric current is passed through the paint between the vehicle body and the electrodes mounted within the tank. When the vehicle leaves the dip tank it is rinsed a number of times with water before final rinsing with demineralised water. The electrocoat is then stoved in an oven at around 180^{o}C. The rinse waters used are normally cascaded to minimise water usage and ensure that only the strongest effluent discharges to the effluent treatment plant. The treated effluent is normally discharged to sewer.

Environmental impact

Water:	Release of rinse waters contaminated with electrocoat primer.
Land:	Sludge deposits of electrocoat in dip tank and filter cake from the rinse water treatment are disposed of to landfill.
Air:	Insignificant effect. A small amount of moist air contaminated with electrocoat may be released from local exhaust ventilation extraction. Combustion gases from stoving oven
Waste:	Sludge deposits of electrocoat in dip tank,
Energy:	The design of the stoving oven can have a considerable effect on the energy usage.
Accidents:	Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc.
Noise:	Not significant.

BAT	
113	Rinse water should be recycled to be used as make up water wherever technically possible to reduce raw water consumption
114	Wastewaters from rinsing and cleaning should be treated to meet the required standards.
115	Any possible accidental releases from the cleaning and rinsing operations should be directed to a low-level emergency tank, to prevent its release.
116	Suitable means should be available to isolate the plant sewage system from the main sewer, to prevent possible discharge that may damage the main sewer and subsequent treatment plant
117	The effectiveness of the electrocoat coating should be monitored to minimise raw materials usage and carry over of treatment solutions to the rinse system
118	Lead free electrocoats should always be used..

Sealing and Underseal

3.122 At this stage, holes used for pre-treatment and electrocoat material ingress and drainage can be sealed.

Seam sealant is applied to selected body panel joints to improve corrosion resistance and/or render the body watertight. A PVC-based underseal is sometimes sprayed to coat areas of the body underside that are vulnerable to stone chip damage.

Any faults in the electrocoat are also sanded out at this stage. The seam and under-sealant are later cured in the primer ovens.

Sound Deadening Material

3.123 Sound deadening material is applied on some areas of internal structure and floor panels. The sound deadening material is later cured in the primer oven.

Environmental impact

Water:	Not significant
Land:	Not significant.
Air:	A small amount of VOC released from bonding and sealing and application of PVC underseal. Small amounts of dust from sanding operations.
Waste:	Particulate matter collected during sanding operations, waste sealant, bonding materials and cleaning materials which may be contaminated with organic solvent.
Accidents:	Not significant.
Energy:	Not significant.
Noise:	Not significant.

BAT	
119	VOC releases should be minimised by the use of sealers and adhesives with a low VOC content wherever technically possible.
120	Dust emissions from sanding operations should be abated where necessary to meet the emission limit values in Section 2.

Primer-Surfacer

3.124 Primer-surfacer materials are applied by a combination of air spray and electrostatic application equipment in a spray booth. The coatings have stone chip resistance properties and provide some smoothing of the substrate surface texture. This coating can be coloured similar to the intended topcoat. The coatings are oven cured.

Colour Coat

3.125 The colour coat is also applied by a combination of an air spray and electrostatic equipment in a spray booth. This coat improves the gloss and durability of the finished surface. The colour coat may be applied as a final coat or in combination with a subsequent clear coat (clear over base). Where clear over base is applied the coats may be dried by infra red before oven curing.

3.126 Both the primer and colour coats (including clearcoat) are applied in a laminar flow paint booth, where the air from the spraying operations is drawn through a water abatement weir. The solids captured in the water are sometimes filtered out using ultra-filtration techniques and recycled.

Environmental impact

Water:	Small amount of blow down from the water system.
Land:	Not significant.
Air:	VOC, particulate matter released from spray coating operations. Release of combustion gases from oven abatement plant.
Waste:	Contaminated cleaning materials. Sludge from ultra filtration system. Paint residues.
Energy:	Significant energy use in drying ovens.
Accidents:	Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc.
Noise:	Not significant.

BAT	
121	Electrostatic spray techniques should be used on all automatic spray coating operations to obtain the highest transfer efficiency.
122	Where manual spraying is carried out the techniques used must have achieved a transfer paint efficiency of at least 65% under test conditions (Ref 16). Fan motors should be fitted with VSD controls to minimise energy usage wherever technically possible.
123	The use of heat recovery systems should be used to reduce primary energy

Finishing Operations

3.127 The finished coat is inspected for defects and wet or dry sanding and/or polishing techniques are used to rectify defects.

Wax

3.128 Wax is injected into certain box sections and sometimes door inners to enhance corrosion resistance. In some plants the underside of the body may be spray coated in wax.

Paint Repair

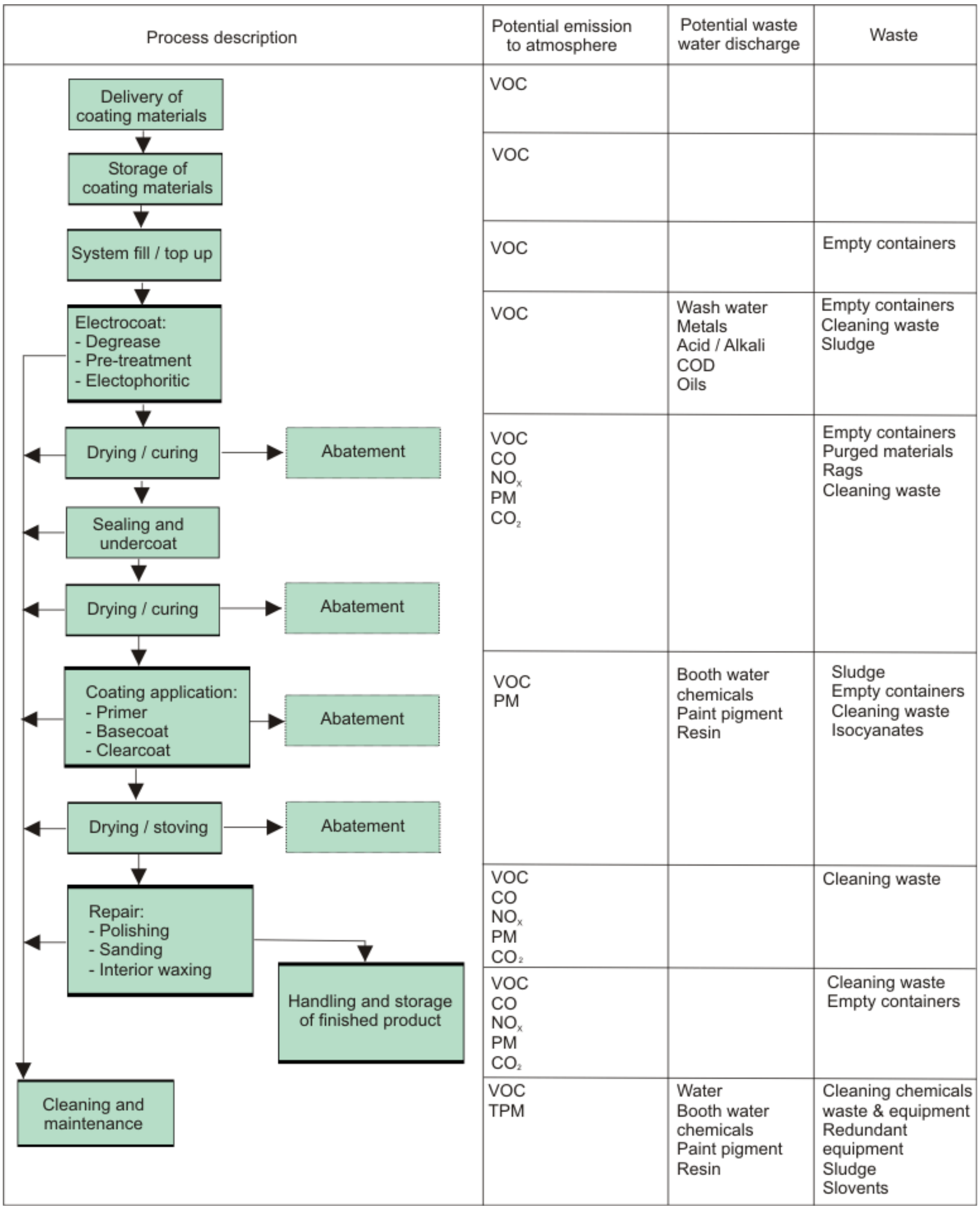
3.129 In some cases certain defects may require some repainting to achieve acceptable customer standards. Spot repairs are dried with IR lamps.

Environmental impact

Water:	Not significant.
Land:	Not significant.
Air:	VOC, particulate matter released from spray coating operations. Dust from sanding operations
Waste:	Contaminated painting and cleaning materials, paint residues. Dust collected from sanding operations.
Energy:	Not significant.
Accidents:	Spillage of chemicals, leakage and containment failure of pipework, drums etc.
Noise:	Not significant.

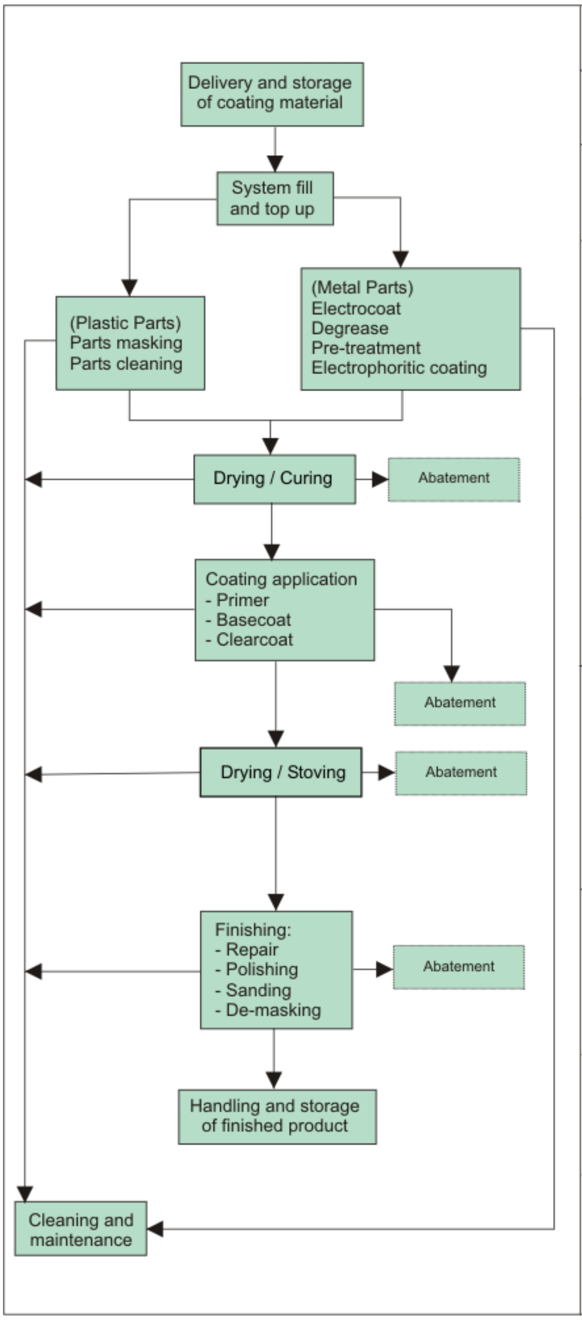
BAT	
124	Where manual spraying is carried out the techniques used must have achieved a transfer paint efficiency of at least 65% under test conditions (Ref 16).
125	Particulate matter extracted from sanding activities should be abated if necessary to meet emission limits.

Figure 3.9 - Potential releases from typical application of paint in vehicle manufacturing



Process description	Potential emission to atmosphere	Potential waste water discharge	Waste
Delivery of coating materials	VOC		
Storage of coating materials	VOC		
System fill / top up	VOC		Empty containers
Electrocoat: - Degrease - Pre-treatment - Electophoritic	VOC	Wash water Metals Acid / Alkali COD Oils	Empty containers Cleaning waste Sludge
Drying / curing Sealing and undercoat Drying / curing	VOC CO NO_x PM CO_2		Empty containers Purged materials Rags Cleaning waste
Coating application: - Primer - Basecoat - Clearcoat Drying / stoving	VOC PM	Booth water chemicals Paint pigment Resin	Sludge Empty containers Cleaning waste Isocyanates
Repair: - Polishing - Sanding - Interior waxing	VOC CO NO_x PM CO_2		Cleaning waste
Handling and storage of finished product	VOC CO NO_x PM CO_2		Cleaning waste Empty containers
Cleaning and maintenance	VOC TPM	Water Booth water chemicals Paint pigment Resin	Cleaning chemicals waste & equipment Redundant equipment Sludge Slovents

Figure 3.10 - Releases from typical small car parts coating application process



Potential release to atmosphere	Potential waste water discharge	Waste
VOC		
VOC		Empty containers
VOC	Wash water Acid / Alkali COD Metals Oils	Empty containers Cleaning waste Sludge
VOC CO NOX PM CO_2		Cleaning waste
VOC PM	Water booth chemicals Paint pigment Resin	Empty containers Cleaning waste Sludge Isocyanates
VOC CO NOX PM CO_2		Cleaning waste
VOC CO NOX PM CO_2		Cleaning waste Empty containers
VOC PM	Water booth chemicals Paint pigment Resin	Cleaning chemicals waste & equipment Redundant equipment Sludge Solvents

Winding wire coating

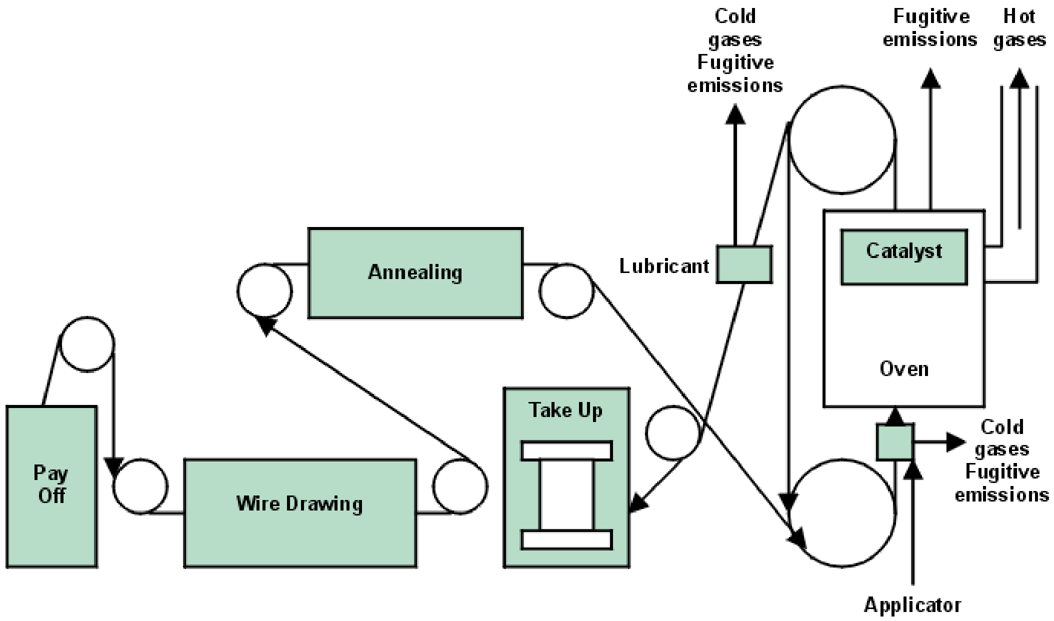
3.130 Wire winding involves the coating of a non-ferrous conductor (normally copper, although aluminium is sometimes used) with an enamel film carried in an organic solvent, typically not less than 10 layers are applied. The thickness other properties of film and are defined in international standards (IEC 60317).

3.131 The thickness of the film is in proportion to the wire diameter and accounts for less than 1% of the total diameter of the wire. Having such a thin film allows very dense windings, which produce the high-density electromagnetic fields required in energy efficient transformers and electric motors

3.132 The mechanical, electrical and chemical resistance of the film can only be achieved by using high specification polymers dissolved in organic solvents. Currently, water borne or organic solvent free systems cannot achieve the properties to allow operation in electrical products or to meet the above specifications.

- The full process normally involves the following stages:
- Drawing of the conductor to size and shape
- Annealing
- Application of the coating material
- Drying/curing/stoving of the coating
- Lubrication of finished product and storage

Figure 3.11 - Winding wire manufacturing techniques



3.133 Copper wire is drawn out to the appropriate shape and size depending upon customer specification. This part of the process involves drawing the wire through a succession of appropriately shaped dies reducing the wire in size until it reaches the desired specification. The wire is then annealed in an annealing oven prior to coating.

Environmental impact

Water: Not significant

Land: Not significant.

Air: Not significant.

Waste: Scrap metal from coils and bindings sent for recovery, Packaging

Energy: Energy use in annealing ovens

Accidents: Not significant

Noise: Not significant.

3.134 The appropriately sized and shaped wire is then enamelled. This is carried out in either a vertical or horizontal (depending on the diameter of the wire) enamelling machine. Copper wire is drawn through a reservoir of enamel and then through oversized dies. This coats the wire with enamel. Following passage through the die, the coated wire passes into a heating chamber, which evaporates the organic solvent and cures the resin.

3.135 The cured enamel is then cooled and the enamelling process repeated a number of times to increase the thickness of the enamel layer. The final enamelled wire is either then wound onto reels for delivery or prior to winding and depending upon customers' requirements passed over a wax impregnated pad which coats the wire and allows for closer winding.

3.136 The enamel coating areas are under negative pressure drawing any gases into the heating chamber.

3.137 Organic solvent laden gasses generated during the enamelling process are exhausted from the enamelling chamber and pre heated in a heat exchanger where a large percentage of the organic solvent gasses are destroyed by thermal decomposition. Thereafter, further gases are removed by passing the heated gasses through a precious metal catalyst. This gas is then returned to the enamelling oven where it will contribute to maintaining the temperature of the oven. A certain proportion of this air is continually vented to the atmosphere through another catalyst

Stoving/curing

3.138 There are two basic schemes used dependant on the heating source.

a) Gas Heating: Organic solvent laden air is passed directly into a gas burner, the design of the burner allows intimate mixing of the secondary air and oxidation occurs. Dilution air is required to ensure that the organic solvent concentration does not rise beyond the lower explosive limit. The air requirement is therefore greater than would normally be used on an equivalent steam boiler or air heating burner but is essential to prevent an explosion within the enamelling machine. The efficiency of oxidation is however sufficient to ensure that the emission control limit of 50mg/Nm^3 is always achieved.

b) Electrical Heating: As the organic solvent laden air passes over heating elements it achieves a temperature in excess of 500ºC. this is generally sufficient to achieve complete oxidation. In all cases electrically heated machines have precious metal catalysts which ensure that the emission control limit of 50mg/Nm^3 is always achieved.

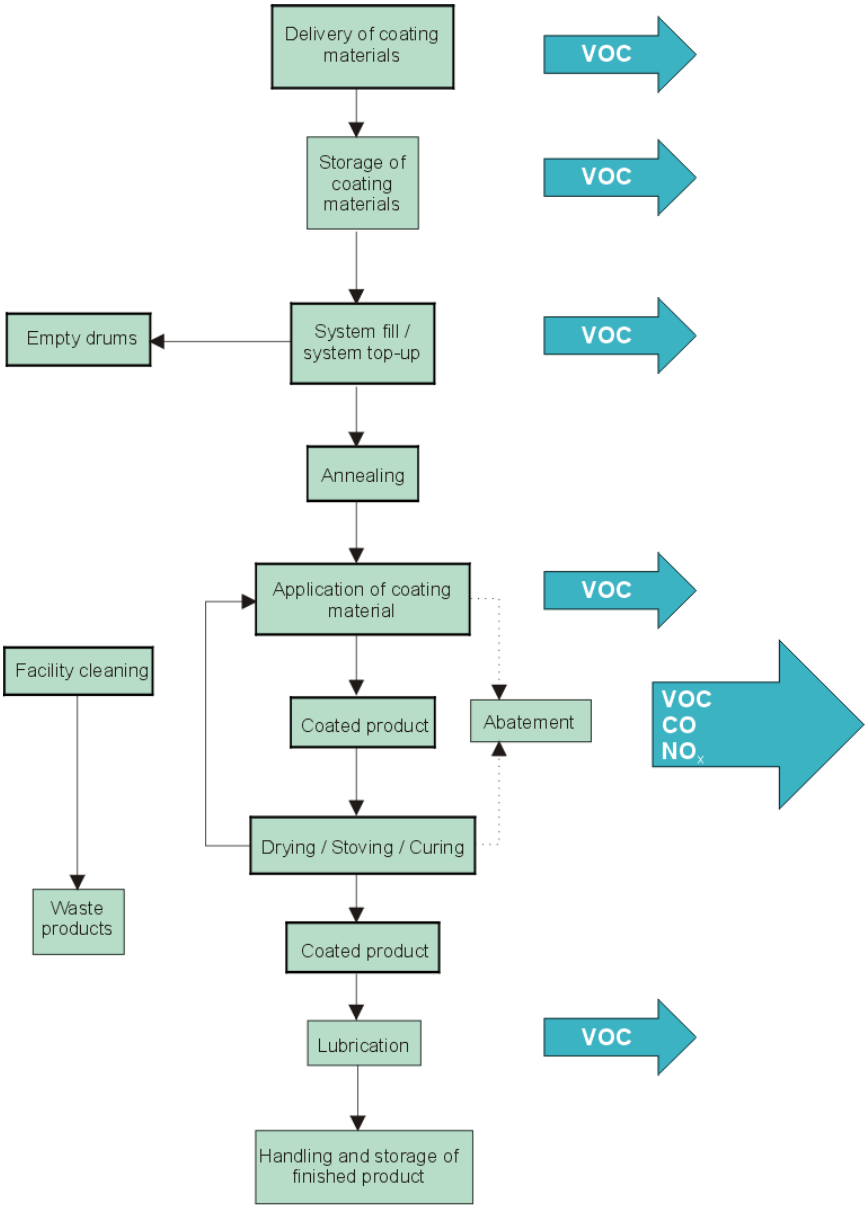
c) Recycling of a significant part of the air stream allows the machines to operate with minimum energy consumption. Irrespective of the heating method employed, approximately 50% of the heating requirement is derived from the combustion of the organic solvent.

Environmental impact

Water:	From cooling baths contaminated with small amounts of lubricant emulsions from drawing operations.
Land:	No significant releases.
Air:	CO_2, VOC releases and fugitive emissions from organic solvent-borne enamels, carbon monoxide and nitrogen oxides from curing/stoving operations. Isocyanate release where polyurethane wire enamels are applied. Some emissions may be odorous.
Waste:	Bare or coated copper wire that is an unavoidable part of the production during start-up and change of product. The metal has a high intrinsic value and is suitable for recycling to allow re-entry as a refined metal. Waste enamel either as a liquid or a solid consisting of enamel contaminated filters, rags, and absorbent. The material is classified as hazardous waste.
Energy:	Significant energy use in curing and stoving of coatings.
Accidents:	Fire or explosion from ignition of vapour exceeding critical LFL concentrations. Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc.
Noise:	Fans associated with air movement are a potential source of environmental noise.

BAT	
126	Cleaning water should be minimised and reused where technically possible to reduce raw water consumption.
127	Fan motors should be fitted with VSD controls to minimise energy usage wherever technically possible.
128	The use of heat recovery systems should be used to reduce primary energy.
129	The enamelling chamber should be maintained under negative pressure to allow capture of fugitive emissions from the die bar and to contain any degradation products or products of combustion from entering the workplace air.
130	Water borne wiredrawing lubricant emulsions should be filtered or centrifuged to remove contamination and prolong its working life.
131	Scrap bare copper should be kept separate from enamelled conductor to allow recycling by the most direct route to the casting plant without the need of further refining.
132	Combination of the airflows from the oven exhaust and the cooling zone may be used to increase the exit velocity of the final discharge of stacks to atmosphere.

Figure 3.12 - Releases from winding wire coating



Coating and printing of metal packaging

3.139 There are five basic manufacturing processes which are carried out within this sector one or more of which may be carried out within a specific installation. These are:

- Flat sheet coating and printing
- 3-piece can manufacture
- Draw and wall Iron (DWI) can manufacture
- Impact extruded aluminium tube (monobloc aerosols and collapsibles) manufacture
- End manufacture

Flat sheet coating and printing

3.140 The substrate materials used in the flat sheet printing and coating process are mainly tinplate, tin-free steel, blackplate, or aluminium. The material is received either as stillages of pre-cut sheets or as coils which have to be processed on site into the cut sheets.

3.141 Metal sheets may pass through the printing and coating lines several times as several coating and decorative application and curing passes are sometimes required. Internal can coatings, as required by the product being packed, are usually applied first. This can be followed by application of an external base coat, a printed design and an external varnish in various combinations as required by the finished product.

3.142 On the coating lines the material required for the design is pumped from a reservoir at the machine up to the application rollers. The subsequent excess material is collected and returned to the reservoir. The film weight is accurately set on the coating machine as required by quality standards and measurements.

3.143 On the printing lines ink is spooned onto the application rollers by hand. Any subsequent excess material is collected and returned to the container on completion of the production run. The application of the ink to the sheet is measured to ensure the minimal required application rate is applied to achieve the desired depth of colour. The printing techniques commonly used are offset lithographic, dry offset and in some cases a waterless lithographic process may be employed.

3.144 Periodic cleaning of the coating and print rollers is required to remove the build up of coating and ink constituents. Excess coating is removed from the bottom roller whilst the machine is running by a scraper, to prevent contamination of the underside of the sheet.

3.145 At changeovers, more thorough cleaning of the coating and printing machines is carried out using various organic solvents, including reclaimed solvents, either manually or automatically. The waste organic solvent is often distilled and reblended either on or off site.

3.146 The coated or printed sheet is then transferred to the thermal curing oven where it is heated to the required curing temperature.

3.147 VOCs from the organic solvent used in the materials applied from the oven exhaust and machine hoods are collected in ductwork and exhausted by fans to atmosphere or to abatement equipment.

3.148 The cured sheet is then cooled by drawing outside ambient air through fans and ducts and blowing it over the sheets. This reduces sticking together of the materials and the stack of sheets is rebuilt on stillages for subsequent transfer to the next stage of the process.

3.149 Where UV curing inks and coatings are used Ultra Violet lamps are used. This does not release VOCs but creates a low level of ozone which is exhausted to atmosphere.

Environment Impact

Water:	Small quantities of waste water contaminated with iso-propanol and residual coating constituents result from the cleaning (emptying) of the damping solution ducts and/or preparation units.
Land:	No significant releases.
Air:	VOC releases during printing, cleaning etc. Ozone release from UV lamps used to cure UV-cured inks. Combustion products from curing ovens and oxidation unit where fitted.
Waste:	Coating residues and rags contaminated with organic solvent and ink cleaning agents containing alkalis (caustic). Printed metal sheets.
Energy:	Significant energy use in curing and compressed air used to power machinery.
Accidents:	Fire or explosion from ignition of vapour exceeding critical LFL concentrations. Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc.
Noise:	Not significant.

BAT	
133	The weight of film applied should be monitored to minimise organic solvent usage and scrap.

Three piece can manufacture

3.150 3-piece can making process covers products as diverse as food cans, paint cans, oblongs, and aerosols.

3.151 Tinplate sheets coated and/or decorated, as described earlier under Flatsheet Coating and Printing, are slit into individual body blanks. These body blanks are automatically fed into a welding machine that rolls the body blank into a tube and then welds it along its length to produce a straight-sided welded cylinder. During slitting excess tinplate is trimmed off and subsequently re-cycled. The welding rolls and welding head are water-cooled using chilled re-circulating water. To ensure a quality weld, copper wire is fed over the internal and external weld rolls such that the entire length of each weld is produced using fresh copper wire as the electrodes. The used copper wire is chopped-up, collected and returned to the manufacturers for re-casting. An alternative means of joining the side seam is by mechanical clinching. In some cases, the circular cylinders so formed can be reformed into other shapes such as rectangular.

3.152 Immediately after welding, and while still on the welding machine, the internal surface and external surface of the weld may have a protective coating applied depending on the specification of the 3-piece can being manufactured. This protective coating is called a side stripe and may either be an organic solvent-based lacquer, water-based lacquer or a powder coating depending on the intended end use of the container. In the case of side stripe lacquers, these are applied using rollers or airless spray guns and any overspray is collected and ducted to atmosphere. In the case of powder coatings these are applied electrostatically and any overspray is collected and re-cycled.

3.153 Following welding/ side stripe application, the cylinders pass through an oven to cure the applied side stripe. These ovens are generally either hot air or induction and apply a localised heat to the weld area of the cylinder. Emissions from the side striping oven are emitted directly to atmosphere via exhaust stacks.

3.154 Following side stripe curing, some specifications of 3-piece cans (typically food cans) are then automatically fed into a beading machine so that strengthening beads can be fabricated into the body wall of the cylinder. This process is purely mechanical and requires no additional process materials. After beading or side stripe curing, depending on the can specification, the welded cylinders are automatically fed into either necking and flanging machines or just flanging machines so that both ends of the cylinder can be profiled ready to accept an end component. Again, necking and flanging are purely mechanical processes requiring no additional process materials.

3.155 The fabricated body is then automatically passed to an end seamer where an end component, previously manufactured, is fed and seamed onto one end of the fabricated cylinder. The seaming operation is also purely mechanical and does not require any additional process materials.

3.156 For some specifications, such as food cans, the 3-piece can is supplied to the user with only one end seamed on and in this case end seaming is followed by palletisation. However, with other 3-piece cans such as paint cans, oblong cans and aerosols the cans pass through a second seaming machine and a second end component is seamed on prior to palletisation.

Environmental impact

Water:	No significant releases.
Land:	No significant releases.
Air:	VOC releases during internal and external side striping operations, particulate emissions from spray operations, combustion products from curing ovens and oxidation unit where fitted.
Waste:	Coating residues containing organic solvent rags contaminated with organic solvent and cleaning agents. Scrap tinplate, copper and packaging.
Energy:	Significant energy use in curing, compressed air used to power machinery and welding.
Accidents:	Fire or explosion from ignition of vapour exceeding critical LFL concentrations. Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc.
Noise:	Potential noise release.

BAT	
134	Trim and process scrap metal substrate and used copper welding wire should be segregated and stored prior to recycling off site.
135	The sidestripe thickness and width should be monitored regularly to minimise the solvent usage
136	A test pack should be used to control the sidestripe oven temperature profile and minimise scrap.

Two-Piece Draw and Wall Iron (DWI) Can Manufacture

3.157 This generic description covers the manufacture of both beverage cans, which normally carry an external printed design, and food cans, which are normally finished with a colourless clear external coating and not printed.

3.158 Aluminium or packaging steel is supplied in continuous coil strips and is fed automatically through a cupper, which produces cups by means of a mechanical press. The cups are then transferred automatically to the body maker machines where cans are formed by the wall ironing process using a power press. Excess metal is then trimmed off and reclaimed. These metal forming operations use a water-borne synthetic lubricant, plus a small amount of biocide, both subsequently removed in the washer. There is also the possibility of tramp hydraulic oil from the presses mixing with the metal forming lubricant.

3.159 The cans are automatically conveyed to the can washer where they are cleaned and etched in a multi-stage process using acid or alkaline aqueous solutions, rinsed with demineralised water and then passed through a drying oven, fired with natural gas. Emissions from the can washing and drying are emitted directly to atmosphere via exhaust stacks. Given the need for an ultra-clean can to receive subsequent organic coatings, the deionised (DI) water stages are controlled for quality by conductivity in a closed loop system with the DI water regeneration plant. There is a natural carry-out of water via the wet cans entering the oven. DWI food cans are not decorated, so a clear external protective coat is applied to the upturned can via a curtain coater, between the canwasher and drying oven. The coated cans then have a period of drainage, before entering the oven to both dry them and cure the external coating. The external washcoat system is a recirculating system with the process designed to collect as much of the excess coating as possible. Effluent from the can washer, DI unit and the washcoat is treated prior to discharge.

3.160 After the dryer oven, beverage cans are then passed automatically for external decoration, which involves two similar operations; basecoating and printing. In basecoating the cans are coated in either a coloured or clear organic solvent or waterborne coating and the can rim is varnished. Applicator rollers are enclosed and emissions ducted to atmosphere via exhaust stacks. Following coating, the cans pass into a thermal oven to cure the coatings. The cans first pass through a hot zone from which emissions are passed via exhaust stack and then through a cooling zone. These emissions are collected in ductwork and exhausted by fans to atmosphere or to abatement equipment.

3.161 After the basecoat curing process, the cans are automatically transferred to the printer where the required decorative logo is applied using inks and a series of rollers. The printed can is then cured in a thermal oven similar to that for the basecoating, with emissions exhausted to atmosphere or abatement from the curing oven and the cooling exhaust.

3.162 The cans are then sprayed internally with a waterborne coating and cured in a thermal oven. These emissions are collected in ductwork and exhausted by fans through the ducts. These ducts are then connected to a main collection duct, which transfers the emission to atmosphere or to abatement equipment. The sprayers for the internal coating, the can conveyor system and the curing oven inlet are all enclosed and any emissions from these systems are exhausted via a stack. Initially, the emissions from the internal sprayers are cleaned via a bag filter plant to remove particulate matter before being exhausted to atmosphere. The filter bags are shaken automatically and the particulate matter is collected in a container which, when full, is sealed and stored for disposal by a contractor.

3.163 Finally, the cans are automatically transferred to a machine, which finishes the necks of the cans to accept the ends, which may be supplied from alternative plants and are fitted by the filler. All the cans pass through a light tester prior to palletising, any with potential leaks are rejected and reclaimed.

Environmental impact

Water:	Large volumes of water used in can washing process. Effluent from can washing process may contain metals, oils and greases, acid, alkali, fluoride, sulphate and detergents
Land:	No significant releases.
Air:	VOC releases from the coating, printing and internal lacquer spraying, combustion products from curing ovens and oxidation unit where fitted. Particulate matter from internal lacquer spraying
Waste:	Coating residues, waste materials contaminated with organic solvent, oil from drawing operations, scrap steel, aluminium and packaging, filter cake from effluent treatment.
Energy:	Significant energy use in curing, compressed air used to power.
Accidents:	Fire or explosion from ignition of vapour exceeding critical LFL concentrations. Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc
Noise:	Potential noise release

BAT	
137	Deionised water should be regenerated and recycled within the process to minimise releases.

Extruded Aluminium Tube Manufacture

3.164 Aluminium slug (99.5% pure aluminium) is lubricated then converted in a series of high impact drawing operations into a tube with a single open end. The open end is trimmed to produce an even cylinder and the trim collected for recycling. Further separate metal-forming operations may inwardly dome the closed end for pressure resistance (aerosol), perforate it for later addition of a plastic screw thread and cap or further form into a screw thread (the latter two for collapsible tubes).

3.165 The formed article is then washed in a continuous washer to remove residual lubricant and to prepare the surface for application of organic coatings. The chemicals used in the wash and etch process comprise caustic-based anionic detergents. The contaminated wash-water may be dispensed partly or totally to sewer under local consent and/or re-used to feed the caustic scrubber system described below as a means of fume abatement.

3.166 The cleaned cylinders are then transferred to a basecoater whereby a metered coating of clear or pigmented basecoat is applied by roller with the cylinder rotating. The coating material is contained in a reservoir in which the pick-up roller runs and excess material removed by the metering system is fed back into the reservoir. Typical basecoats are organic solvent-based but water-borne coatings may also be used. The coating station is extracted by fan and generally ducted to atmosphere via high-stack chimneys. From the basecoater, the coated cans pass automatically into a drying/curing oven, the extract from which is collected and sent directly to atmosphere via a stack (of suitable height to achieve dispersion) or to abatement equipment.

3.167 The cured basecoat provides the key for the subsequent printed design, which is applied via a multicolour decorator using the dry offset process. Inks are hand-spooned to the reservoir rolls and a precision system of rolls accurately meters each colour separately onto the applicator roll, which picks up the colours in register and transfers the complete image to the work piece. A protective overvarnish is applied as the final operation before the cylinder passes automatically into an oven for drying and curing. There is fume extraction at the decorator, which is ducted to atmosphere having passed through a caustic scrubber and separate ducting of the oven exhaust to atmosphere or abatement equipment.

3.168 For aerosol cans, the cylinder undergoes further reforming, with controlled application of a mineral lubricant, to 'neck-in' and curl the open end to accept the valve assembly which will be fitted subsequently to filling.

Environmental impact

Water:	Effluent from washing process may contain metals, oils and greases, acid, alkali, fluoride, sulphate and detergents.
Land:	No significant releases.
Air:	VOC releases from the coating, printing and internal lacquer spraying, combustion products from curing ovens and oxidation unit where fitted. Particulate matter from internal lacquer spraying.
Waste:	Coating residues, waste materials contaminated with organic solvent, oil from drawing operations, scrap steel, aluminium and packaging.
Energy:	Significant energy use in curing, compressed air used to power.
Accidents:	Fire or explosion from ignition of vapour exceeding critical LFL concentrations. Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc.
Noise:	Potential for noise release.

BAT	
138	Wash water effluent should be recycled within the process wherever technically possible, to minimise raw water consumption.
139	Scrap aluminium derived from trim or defective production should be segregated and stored prior to recycling of site.

End, Cap and Closure Manufacture

3.169 Manufacture is either from plain or pre-coated/decorated sheet or coil in aluminium or packaging steel. The metal may be pre-lubricated prior to fabrication.

3.170 The metal is fed to a stamping press where the initial forming is carried out. Additional forming operations are performed to complete the profile. The completed shell then proceeds to a lining machine where a sealant or gasket is applied. Organic solvents may be contained in the sealant.

3.171 Additionally for easy opening ends, once the shell has had the compound applied it proceeds on to a conversion press where the pull-tab is fabricated and fitted and a final pressing is carried out to complete the end. Sometime, the end score will be repaired with a spray lacquer.

3.172 Some sealants and gaskets require passage through an oven for forced drying or curing.

3.173 Once completed the can end is packed and palletised for despatch to customers.

Environmental impact

Water: No significant releases.

Land: No significant releases.

Air: VOC releases from the organic solvent-borne sealant and gasket compounds, from sealant application nozzles doused with organic solvent, from tab forming lubricants containing organic solvents. Spray lacquer repair.

Waste: Small quantities of sealant and gasket compounds, lubricating oils, scrap packaging steel, aluminium and packaging.

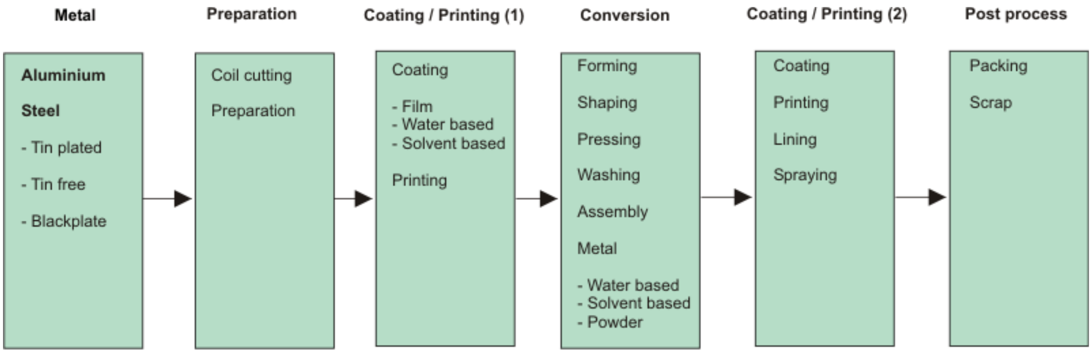
Energy: Significant energy use in curing, compressed air used to power the stamping presses.

Accidents: Fire or explosion from ignition of vapour exceeding critical LFL concentrations. Spillage of chemicals, leakage and containment failure of pipe work, drums, tanks, etc.

Noise: Potential noise release.

BAT	
140	Trim and process scrap metal substrate should be segregated and stored prior to recycling off-site.
141	Low VOC content tab-forming lubricant should used to minimise VOC emissions.

Figure 3.13 - Generic processes for metal packaging manufacture



Wallcovering manufacture

3.174 Wallcovering manufacture consists of a number of operations which may be carried on a base coating material, examples of which include paper, cotton/polyester non-wovens, and woven cloth. Operations may include:

- Base coating including PVC coating and Pre-pasting;
- Printing using techniques such as Gravure, flexographic and Rotary Screen Printing (see above);
- Embossing or laminating;
- Finishing

3.175 Some or all of these operations may be utilised in the manufacture of a particular wallpaper design, or in a particular installation.

Base coating

3.176 Base paper for non-vinyl wallpaper is normally bought in pre coated with a china clay finish from the paper manufacture ready for printing. Base paper for vinyl wallpaper is PVC coated and may be supplied pre-coated with PVC or coated on site. Coating processes are split into several different types dependent upon the substrate being coated and the form of the coating compound.

PVC plastisol coating, which is a mixture of PVC, plasticisers, fillers, pigments and organic solvent with other additives that may include blowing agents, may be manufactured on site, or supplied ready for application to the base paper. The coating of the base paper or non-woven material with PVC to produce a vinyl wall covering is carried out by coating the base with a layer of PVC plastisol and then gelling and fusing the PVC by passing it though a heated oven. VOCs from the process are abated generally using thermal oxidation techniques.

Dry Blend Coating produces a dry version of a PVC plastisol by calendering it into a film which is then laminated to a base either as an integral part of the calendering process or separately following further processing e g printing of the unsupported film.

3.177 Both non-vinyl and vinyl wallpapers may be supplied pre-pasted or pasted on site. This may be carried out at the same time as PVC coating in the case of vinyl wallpaper. The process involves the coating of the back surface of the base paper with a water-activated adhesive. The adhesive can be either water or organic solvent based and is applied using a rotary screen-printing or air knife technique. The adhesive is then dried in an oven, the organic solvent which is driven off is normally abated by thermal oxidation.

Printing

3.178 Printing of both the vinyl and non-vinyl coverings, or unsupported film, may be carried out as part of the wallpaper production process, print is carried out before or after pre-pasting. The printing techniques commonly used are: Gravure, Flexography, Screenprinting.

3.179 The inks used in the printing operations are normally bought in as full strength coloured inks, consisting of pigment resin, organic solvent and filler, and in some cases water. These full strength inks are then blended and diluted on site with water or organic solvent prior to printing. Final viscosity adjustments of the ink with solvent are normally carried out at the printing station.

Embossing

3.180 Embossing involves the decoration of the surface of the wall covering by passing it through embossed rollers and may be carried out hot or cold. The hot emboss process is used on vinyl papers, the PVC coating on the paper is softened by a radiant heater or tunnel heater. Then a textured impression is transferred to the softened coating as it passes through the embossed rollers. The embossing process may also involve laminating an unsupported film to a fabric base using the texturing process to create a bond.

The cold embossing process only involves pressure and is normally carried out on non-vinyl wall coverings. Duplex embossing is also used, this involves the sticking of two layers of paper with a water based adhesive, cold embossing, then drying with hot air. Any solvent which may be driven during the hot embossing process is abated generally using thermal oxidation techniques.

Finishing operations

3.181 Finishing operations such as cutting and trimming can give rise to particulate releases in the form of dust. If significant dust is generated by these operations, extraction should be used to minimise the potential particulate release.

Cleaning operations

3.182 Cleaning of equipment takes place at the beginning and/or end of each print run or in some cases during runs, to remove debris and ink build-up. Enclosed cleaning machines are used for detachable equipment such as screens, plates, drums, rollers and ink trays. Emissions from these machines may be contained or vented via suitable abatement equipment.

Emissions control

Point source emissions to air

3.183 The nature and source of the emissions to air expected from each activity are given in previous sections. In general they comprise:

- VOC from most surface treatment and coating operations;
- Particulate matter from the handling of powders or dusty materials and cutting and finishing operations;
- "Sticky" particulate matter from spray coating operations;
- Acidic vapours from pre-treatment operations;
- Odorous compounds from VOC and non-VOC compounds and the thermal breakdown of compounds during drying operations;
- Combustion gases from heated processes.

Dispersion and dilution of stack emissions

3.184 The basis upon which stack heights are calculated using HMIP Technical Guidance Note D1 (D1) (Ref 6) is that pollutants are dispersed and diluted in the atmosphere to ensure that they ground at concentrations that are harmless under the theoretical conditions of the D1 model. The emission limit in this sector note should be used as the basis for chimney height calculation. The chimney height so obtained is adjusted to take into account local meteorological data, local topography, nearby emissions and the influence of plant structure. It is necessary that the assessment also takes into account the relevant air quality standards that apply for the emitted pollutants.

The calculation procedure of D1 is usually used to calculate the required chimney height but alternative dispersion models may be used in agreement with the regulator. D1 relies upon the unimpeded vertical emission of the pollutant. A cap or other restriction over the stack impedes the vertical emission and hinders dispersion. For this reason where dispersion is required such flow impeders should not be used. A cone may sometimes be useful to increase the efflux velocity and achieve greater dispersion.

An operator may chose to meet a tighter emission limit in order to reduce the required chimney height.

3.185 Liquid condensation on internal surfaces of chimney flues and exhaust ducts might lead to corrosion and ductwork failure or to droplet emission.

- Adequate insulation should be provided to minimise the cooling of waste gases and prevent liquid condensation by keeping the temperature of the exhaust gases above the dewpoint

3.186 Unacceptable emissions of droplets could possibly occur as a result of entrainment from wet abatement plant where the linear velocity within the associated ductwork exceeds 9 m/s. The use of mist eliminators reduces the potential for droplet emissions.

- Where a linear velocity of 9 m/s is exceeded in the ductwork of existing wet abatement plant, the linear velocity should be reduced, subject to health and safety considerations, to ensure that droplet fallout does not occur.

3.187 The dispersion from all emission points to air can be impaired by low exit velocity at the point of discharge, or deflection of the discharge:

- Chimney flues and ductwork should be cleaned to prevent accumulation of materials, as part of the routine maintenance programme.
- A minimum discharge velocity should be required in order to prevent the discharged plume being affected by aerodynamic down wash.
- Emission points to air should not be fitted with any restriction at the final opening such as a plate, cap or cowl, with the exception of a cone which may be necessary to increase the exit velocity of the emissions.

BAT	
All releases to air	
The operator should:	
142	Ensure that all operations which generate emissions to air are contained and adequately extracted to suitable abatement plant, where this is necessary to meet specified emission limit values.
143	Ensure that potential emissions are recovered and reused where possible, e.g. returning collected particulate material to feedstock.
144	Ensure that emissions from combustion processes in normal operation are free from visible smoke and in any case do not exceed the equivalent of Ringelmann Shade 1 as described in British Standard BS 2742:2009.
145	Ensure that emissions take place from the minimum practicable number of chimneys. This is particularly important when new plants are being designed or when changes are being made to existing processes. If practicable a multi-flue stack should be used.
146	Ensure that vent and chimney heights are sufficient to ensure adequate dispersion under all normal operating conditions.
147	Ensure that the minimum vent height is 3 metres above roof ridge height of any building within a distance of 5 times the uncorrected vent height and in no circumstances should it be less than 8 metres above ground level. (Note: workplace dust extraction units do not need to meet these requirements)
148	Be able to demonstrate to the regulator that all reasonably practicable steps are taken during start-up and shutdown, and changes of fuel or combustion load in order to minimise emissions.
149	Investigate the cause and nature of any persistent visible emissions and provide a report to the regulator.
150	Ensure that emissions of water vapour are free from droplet fallout.
151	Ensure that liquid entrainment in the duct of wet abatement, leading to droplet fallout, does not occur as a result of the linear flow rate within the duct exceeding 9 m/s.
152	Ensure that flues and ductwork are cleaned to prevent accumulation of materials, as part of the routine maintenance programme.
153	Normally the discharge of exhaust gases through a stack takes place at constant volume. When this occurs stacks should achieve a minimum efflux velocity of between 10 - 15 m/sec unless dispersion modelling allows a lower velocity to achieve air quality standards. Where the discharge volume varies then the design of the stack should be optimised around the most frequent emission rate.
154	Ensure that stacks are not fitted with any restriction at the final opening such as a plate, cap or cowl, with the exception of a cone which may be necessary to increase the exit velocity of the emissions
155	Where possible, ductwork should be sufficiently lagged to prevent condensation of liquids within the duct in particular solvents.
156	Combustion processes should use low NOx burners.

Point source emissions to surface water and sewer

3.188 The nature and source of the emissions expected from each activity is given in previous sections. In general, wastewater can arise from storm water, from cooling water, from accidental emissions of raw materials, products or waste materials and from fire fighting.

3.189 The amounts of process water used in surface treatment and coating varies considerably depending on the type of activity being carried out. Where water washing and rinsing of the substrate is carried out or water borne surface treatment or coating materials are used, water consumption may be high. Where only organic solvent-borne materials are used without water based cleaning of the substrate, consumption may be low. Discharges principally comprise:

- Discharges from image and image carrier manufacture;
- Discharges from coating preparation manufacture;
- Discharge from wet scrubbers;
- Discharges from bio scrubbers;
- Discharges of cleaning water;
- Cooling water, often-containing biocides and anti-oxidants;
- Discharges of boiler water blowdown;
- Site drainage and stormwater;

3.190 The following general principles should be applied in sequence to control emissions to water:

- water use should be optimised and wastewater re-used or recycled
- the risk of contamination of process or surface water should be minimised
- wastewater treatment systems can maximise the removal of pollutants, for example metals, using precipitation, sedimentation and filtration. The mix of pollutants will define the methods and reagents used. Concentrated effluents should be pretreated as necessary before discharge into the final effluent treatment system
- ultimately, surplus water is likely to need treatment to meet the requirements of BAT (and statutory and non-statutory objectives). Generally, effluent streams should be kept separate as treatment will be more efficient. However, the properties of dissimilar waste streams should be used where possible to avoid adding further chemicals, e.g. neutralising waste acid and alkaline streams. Also, biological treatment can occasionally be inhibited by concentrated streams, while dilution, by mixing streams, can assist treatment
- systems should be engineered to avoid effluent by-passing the treatment plant

3.191 Minimising the use of water and minimising the level of pollutants in each water stream are the primary aims, followed by the recycling of waste water streams wherever possible.

3.192 The nature of the receiving water should be taken into account, with regard to any pollutant released to this media. However, irrespective of the receiving water, the adequacy of the plant to minimise emissions must be considered.

3.193 Sectors where particular attention may be needed regarding discharges to water are :

- Printing - image preparation using film
- Printing - image carrier production
- Preparation of coating materials
- Pre-treatment stages of coil coating plant
- Releases of heavy metals/VOC's during textile coating
- Rinse waters from vehicle coating
- Cleaning/conditioning water from two piece can manufacture

Local Authority Regulation

3.194 Regulation 58 of the Environmental Permitting (England and Wales) Regulations 2010 (equivalent paragraphs for Northern Ireland can be found in Regulation 13 of the PPC Regulations 2003) state that:

“(1) This regulation applies to Part A installations and Part A mobile plant for which a local authority is the regulator.

(2) At any time the [Environment] Agency may give notice to the local authority specifying the emission limit values or the conditions it considers appropriate for preventing or reducing emissions into water from the installation or mobile plant.

"(3) If such a notice is issued, the local authority must exercise its functions under these Regulations to ensure the environmental permit for the installation or mobile plant includes –

a) the emission limit values or conditions specified in the notice: or

b) such stricter limit values or more onerous conditions as the authority sees fit.”

Off site effluent treatment

3.195 Where an operator discharges to a Sewage Treatment Works via sewer, the sewerage undertaker is a statutory consultee and must be sent a copy of the application. The STW operator is likely to confirm to the Environment Agency and the local authority the levels of pollutants (considering levels specified in the trade effluent consent) that the sewer is able to take.

In all cases the effluent discharged from the installation must not give rise to a potential breach of an EQS or EAL for the final receiving water, when taken with compliance with any water company permit. In a significant number of cases the Environment Agency finds that the STW operator's discharge consent and the Environment Agency's concerns to protect watercourses are closely aligned. Where they are aligned and there is a simple discharge, it is common Agency practice just to rely on the consent and not to replicate limits in permit conditions.

3.196 For surface treatment and coating activities, although certain effluents can be defined as complex, it is unlikely that BAT equates with tighter limits than those specified by the Environment Agency. Therefore, the consent can be relied upon (as for simple discharges above) without replicating limits in permit conditions.

Further guidance on regulating water discharges from A2 Installations can be found in chapter 10 of the General Guidance Manual on Defra’s website (Ref 2).

BAT	
The operator should ensure that::	
157	All emissions are controlled, as a minimum, to avoid a breach of water quality standards (Calculations and/or modelling to demonstrate this may be required by the regulator).
158	Run-off from the installation should be controlled and managed and where necessary (given the nature of the run-off) treated before discharge in a suitable effluent treatment plant
159	All interceptors: • are impermeable • are subject to visual inspection and any contamination removed at a frequency agreed with the regulator • have an annual maintenance inspection; prior to inspection all contents should be removed
160	Procedures for dealing with the discharges from bunds should be in place.
161	Process effluent is kept separate from surface drainage unless agreed with the regulator.

Point source emissions to groundwater

3.197 There should be no intentional point source emissions of List I and List II substances to groundwater from the surface treatment sector.

BAT	
162	There should be no intentional point source emissions of List I and List II substances to groundwater

Fugitive emissions to air

3.198 Common sources of fugitive emissions are VOC and particulate matter from:

- handling, mixing, use and storage of organic solvent-borne surface cleaners, degreasers, coatings/inks and organic solvents;
- storage, handling and use of powders and dusty materials;
- storage areas (e.g. bays, stockpiles etc.);
- the loading and unloading of transport containers;
- transferring material from one vessel to another (e.g. mixing vessels or storage vessels, silos);
- conveyor systems;
- pipework and ductwork systems (e.g. pumps, valves, flanges, catchpots, drains, inspection hatches etc.);
- poor building containment and extraction;
- potential for bypass of abatement equipment (to air or water);
- accidental loss of containment from failed plant and equipment including leakage e.g. from bunds and drains.

3.199 Where there are opportunities for reductions in fugitive emissions, the permit may require an updated record of fugitive emissions to be submitted on a regular basis, and normally at least once per year.

BAT	
163	Operations should be controlled to minimise fugitive emissions.
164	Where dusty materials are handled, dust should normally be controlled by covering of skips and vessels, using enclosed conveyors, spraying water on sand conveyors, minimising drops and by avoiding outdoor or uncovered stockpiles.
165	***For VOC** where the operator uses the Emission and Fugitive limits or the Total Emission Limit Value for compliance the Fugitive VOC Emissions must be determined in accordance with the Solvent Management Plan (Appendix 2). Once completed, it need not be done again until the equipment is modified in such a way as to effect the potential fugitive release of VOCs.*
	When transferring volatile liquids, one or more of the following techniques should be employed - subsurface filling via filling pipes extended to the bottom of the container, the use of vapour balance lines that transfer the vapour from the container being filled to the one being emptied, or an enclosed system with extraction to suitable abatement plant where abatement is necessary to meet the emission limits.
	Vent systems should be chosen to minimise breathing emissions (e.g. pressure/vacuum valves) and, where relevant, should be fitted with knock-out pots and appropriate abatement equipment.
	Where possible the application of the coating should be carried out in contained conditions
	Where pre impregnated wipes are used they should be held within a closed container prior to use.
	Prior to removal from site used wipes and other items contaminated with organic solvent should be placed in a suitably labelled metal bin fitted with a self-closing lid.
	Bins should be emptied at least daily, as the contents not only present a fire hazard, but may also undergo spontaneous combustion (especially if contaminated with certain types of coating residues).
	For materials that may undergo spontaneous combustion special bins that allow air to circulate beneath and around them to aid cooling should be used.
	Application of cleaning organic solvents should be from a contained device or automatic dispensing system when applied directly.
	Closed cleaning systems should be used wherever possible.
	Oven units and ductwork should be enclosed and sealed to prevent fugitive loss of VOCs.
	All drying ovens should be operated under balanced or negative pressure to reduce VOC emissions at entry and exit points. All other apertures within the oven must be sealed sufficiently.
	Drying systems should operate to maximise the drying efficiency. Complete drying reduces the fugitive emission level of organic solvents from products.

Fugitive emissions to surface water, sewer and groundwater

3.200 The operator should have a clear diagrammatic record of the routing of all installation drainage for surface water and process effluent, to include subsurface pipework, the position of any sumps and storage vessels including the type and broad location of the receiving environment.

3.201 An inspection and maintenance programme should be established for all subsurface structures. Inspection frequencies and test methods should be chosen to prevent pollution by minimising leaks from subsurface pipework, sumps and storage vessels, having regard to the risk factors in paragraph 3.204 below.

3.202 The minimum inspection frequency should normally be no less than once every five years for yard drainage (i.e. rainwater from roofs, hardstanding etc) and no less than once every three years for process effluent. The precise choice of inspection frequency and the sophistication of the method should be guided by the level of risk presented but a likely maximum frequency may be once per annum.

3.203 Examples of inspection and test methods are pressure tests, leak tests, material thickness checks, and CCTV survey. Using secondary containment and/or leakage detection can serve to reduce the inspection frequency to the minimum quoted in paragraph 3.202.

3.204 The likely risk to the environment from drainage systems is dependant on the following factors:

- nature and concentration of contaminants in the water transferred in the drainage systems
- volume of water transferred
- vulnerability of the groundwater in the locality
- proximity to surface waters.

For yard drainage, it is likely that the minimum inspection frequency (normally no less than once every five years) and least complex inspection methods will suffice irrespective of volume of water, vulnerability of local groundwater and proximity to surface waters.

3.205 The vulnerability is defined by the nature of the subsurface, and is mapped for England and Wales in a series of Groundwater Vulnerability maps. An additional measure of risk is whether the installation sits within a Groundwater Source Protection Zone (GPZs) as defined by the Environment Agency's Groundwater Protection Policy. GPZs help to identify areas, which are particularly sensitive to groundwater pollution because of their proximity to an important water supply.

The location of GPZs can be searched on the Environment Agency website by inserting the post code of the installation into

http://www.environment-agency.gov.uk/maps/info/groundwater/

3.206 Operational areas should be equipped with an impervious surface, spill containment kerbs, sealed construction joints, and connection to a sealed drainage system unless the operator fully justifies that this is not necessary. Management controls such as recording the design and condition of the surfacing (capacities, thicknesses, falls, material, permeability, strength/reinforcement, and resistance to chemical attack), and regular inspections and maintenance should be used.

3.207 The operator should ensure that all tanks containing liquids whose spillage could be harmful to the environment are contained. Bunds should be impermeable and resistant to the stored materials, have no outlet (drains, soakaways etc) and drain to a blind collection point. Pipework should be routed within bunded areas with no penetration of contained surfaces. Bunds should be designed to have a holding capacity of at least 110% of the largest tank and be located more than 10m from watercourses and 50m from drinking water boreholes.

It is good practice for bunds to be fitted with a high-level probe and an alarm as appropriate and are inspected regularly by the operator. Where practicable rainwater should be prevented from entering bunds, but any spills and rainwater accumulations should be removed as soon as possible.

3.208 All storage tanks should be fitted with high-level alarms or volume indicators to warn of overfilling. Where practicable the filling system should be interlocked to the alarm system of prevent overfilling. Tanks should have delivery connections located within a bunded area, fixed and locked when not in use and have their integrity inspected, recorded and documented, particularly where corrosive substances are involved. These inspections should be included in the maintenance schedule.

3.209 Operators should assess the pollution risks posed by the storage of solvents. In addition to the above preventative measures, solvent storage areas should be away from surface water sources, surface water drains, soakaways, drinking water boreholes or sumps.

For further information, a Code of Practice on the use and storage of solvents is available on the Defra website (Ref 15).

BAT	
166	The operator should have a clear diagrammatic record of the routing of all installation drains, subsurface pipework, sumps and storage vessels including the type and broad location of the receiving environment.
167	The operator should identify the potential risk to the environment from drainage systems recorded by BAT 166 and should devise an inspection and maintenance programme having regard to the nature and volume of waste waters, groundwater vulnerability and proximity of drainage systems to surface waters.
168	The operator should ensure that all operational and storage areas are equipped with an impervious surface, spill containment kerbs, sealed construction joints, and connected to a sealed drainage system or such alternative requirements as approved by the regulator.
169	Oil and solid interceptors should be used if necessary for the drainage of open storage areas.
170	All sumps should be impermeable and resistant to stored materials.
171	All liquid storage tanks should be located within bunds that are designed, constructed and located following to appropriate standards and ensuring that the volume is more than 110% of the largest tank.
172	Storage tanks should be fitted with high-level alarms or volume indicators to warn of overfilling and where practicable the filling system should be interlocked to the alarm system to prevent overfilling. Delivery connections should be located within a bunded area, fixed and locked when not in use.
173	All tanks bunds and sumps should be subject to regular visual inspection, as agreed with the regulator, and placed on a preventative maintenance programme. The contents of bunds and sumps should be pumped out or otherwise removed as soon as is practicable after checking for contamination
174	The operator should assess the pollution risks posed by the storage of solvents and devise control measures to minimise the pollution risk.
175	For VOC where the operator uses the Emission and Fugitive limits or the Total Emission Limit Value for compliance the Fugitive VOC Emissions must be determined in accordance with the Solvent Management Plan. Once completed, it need not be done again until the equipment is modified in such a way as to effect the potential fugitive release of VOCs

Odour

3.210 The potential for odorous emissions varies according to the types of materials used, the operations carried out within the installation and the techniques used to control potential emissions. Both VOC and non-VOC compounds may give rise to odorous emissions as a result of handling storage and use within the installation, in particular thermal breakdown of compounds during drying may lead to odorous emissions.

3.211 Chapter 17 of the General Guidance Manual provides guidance on controlling odour from installations and the information required in an application. Where odour is identified as a potential problem then the requirements of the following paragraphs should be implemented. (Also refer to the Environment Agency's Horizontal Guidance relating to Odour, available on the Environment Agency website www.environment-agency.gov.uk/).

Assessment

3.212 Operators should assess the likely sources of odour and carry out olfactory assessments at the site boundary. Odour control should be carried out in the following order of priority:

- prevention – substitution
- minimisation by replacement of odorous materials with those of no or lower odour potential.
- containment and extraction
- abatement

3.213 Implementation of the best available techniques and the emission limit values and provisions of this note should ensure that offensive odours are not perceived beyond the site boundary, other than where unavoidable plume grounding occurs due to extreme weather conditions. It may be necessary to include additional controls to avoid offensive odours, for example where local meteorological conditions frequently lead to poor dispersion conditions.

3.214 The overall aim should be that all emissions are free from offensive odour outside the site boundary, as perceived by the regulator. The locality will influence the assessment of the potential for odour impact for example local meteorological conditions (all predicted wind directions and weather conditions) which may lead to poor dispersion conditions. Where the site has a low odour impact due to its remoteness from sensitive receptors, the escape of offensive odour beyond the installation would be unlikely to cause harm. In these circumstances, operations should still be optimised as described above.

Prevention

3.215 Operators should seek to prevent and minimise odours from the installation by prevention i.e. by switching to lower solvent-based materials, or to solvents with a lower odour potential.

Minimisation

3.216 Where odour generation is not preventable, odours should be minimised at source and/or contained with effective treatment prior to discharge.

Containment, Extraction and Abatement

3.217 In the case of existing processes where odour abatement equipment has been installed, the regulator should consider permitting the use of the existing equipment provided that emissions from the equipment do not result in offensive odours beyond the installation boundary. The regulator should still require that the available equipment is optimised for odour removal and should establish the odour abatement efficiency based upon operating data. Where emissions from the odour abatement equipment are still leading to offensive odours beyond the process boundary, the equipment should be upgraded.

3.218 For complex installations, for example where there are a number of potential sources of odorous releases or where there is an extensive programme of improvements to bring odour under control, an odour management plan should be maintained. The regulator may incorporate the odour management plan in the permit.

BAT	
176	Operators should conduct odour assessments to determine whether emissions result in offensive odours at or beyond the installation boundary.
177	If operations are identified as resulting in offensive odour, operators should devise an odour control programme of improvements and maintain an odour management plan.

Management

3.219 Within IPPC, an effective system of management is a key technique for ensuring that all appropriate pollution prevention and control techniques are delivered reliably and on an integrated basis.

3.220 An effective Environmental Management System (EMS) will help the operator to maintain compliance with regulatory requirements and to manage other significant environmental impacts. An EMS includes an environmental policy and programme which:

- includes a commitment to continual improvement and prevention of pollution;
- includes a commitment to comply with relevant legislation and other requirements to which the organisation subscribes; and
- identifies, sets, monitors and reviews environmental objectives and key performance indicators independently of the Permit.

3.221 The operator should have demonstrable procedures (e.g. written instructions) which incorporate environmental considerations into process control, design, construction and review of new facilities and other capital projects (including provision for their decommissioning), capital approval and purchasing policy.

Audits should be carried out, at least annually, to check that all activities are being carried out in conformity with the above requirements. Reporting should be carried out annually on environmental performance, objectives and targets, and future planned improvements. Ideally, these should be published environmental statements.

Guidance on how to develop Environmental Management Systems in the sector can be found on the Envirowise website (Ref 7).

Operations and maintenance

3.222 **Maintenance** - it is good practice to ensure:

- effective preventative maintenance on all aspects of the process the failure of which could impact on the environment
- clear written maintenance instructions for all relevant items are developed and maintained
- a method of reviewing maintenance needs, with demonstrable evidence that this process takes place

3.223 **Training** – all relevant (including operational) staff should be trained in the regulatory implications of the permit, all potential environmental impacts (under normal and abnormal circumstances). Training should also include the procedures for dealing with a breach of the permit conditions, prevention of accidental emissions and action to be taken when accidental emissions occur and also in all operating procedures.

3.224 **Responding to problems** - The regulator needs to be notified about certain events and expects the operator to respond to problems, which may have an effect on emissions to the environment. Such problems may arise within the process itself or, for example, with the abatement.

3.225 **Contractors on site** - It is important to be aware that in complying with their permit, operators will be responsible for work undertaken by contractors. Operators are advised to provide instructions to contractors regarding protecting the environment whilst working on site.

BAT	
Environmental Management System	
178	Operators should use an effective Environmental Management System with policies and procedures for environmental compliance and improvements. Audits should be carried out against those procedures at regular intervals.
Operations and maintenance	
179	Effective operational and maintenance systems should be employed on all aspects of the installation whose failure could impact on the environment. Such systems should be reviewed and updated annually.
180	Environmentally critical process and abatement equipment (whose failure could impact on the environment) should be identified and listed. The regulator should be provided with a list of such equipment.
181	For equipment referred to in BAT 180 above: • Alarms or other warning systems should be provided, which indicate equipment malfunction or breakdown; • Such warning systems should be maintained and checked to ensure continued correct operation, in accordance with the manufacturer's recommendations; • Essential spares and consumables for such equipment should be held on site or be available at short notice from suppliers, so that plant breakdown can be rectified rapidly.
182	Records of breakdowns should be kept and analysed by the operator in order to eliminate common failure modes.
Competence and training	
183	A competent person(s) should be appointed to liaise with the regulator and the public with regard to complaints. The regulator should be informed of the designated individual(s).
184	A formal structure shall be provided to clarify the extent of each level of employee's responsibility with regard to the control of the process and its environmental impacts. This structure shall be prominently displayed on the company within the process building at all times. Alternatively, there must be a prominent notice referring all relevant employees to where the information can be found.
185	Personnel at all levels shall be given training and instruction sufficient to fulfil their designated duties under the above structure. Details of such training and instruction shall be entered into an appropriate record and be made available for inspection by the regulator.
186	The potential environmental risks posed by the work of contractors should be assessed and instructions provided to contractors about protecting the environment while working on site.
Accidents/incidents/non-conformance	
187	There should be written procedures for investigating incidents, (and near misses) which may affect the environment, including identifying suitable corrective action and following up.

Raw Materials

3.226 This section covers the use of raw materials and water and the techniques for optimising their use and minimising their impact by selection (Energy and fuels are covered under Energy).

3.227 As a general principal (see Ref 8) the operator will need to demonstrate the measures taken to:

- **reduce** the use of chemicals and other materials
- **substitute** with materials presenting lower risks to the environment
- **understand** the fate of by-products and contaminants and their environmental impact

Raw materials selection

3.228 Raw materials used in the surface treatment using solvents sector may include surface cleaners and degreasers, impregnating and waterproofing materials, surface coatings and printing inks. In all cases, the selection of the product will be determined by a combination of factors, including the specific application methods, the process line configuration, the substrate, and its fitness for purpose.

3.229 The availability and suitability of low organic solvent or organic solvent free products shall be regularly reviewed. In the case of surface coatings and printing inks, low VOC-emitting alternatives include:

a) water borne inks and coatings, (low organic solvent content)
b) higher solids content inks and coatings,
c) powder inks and coatings,
d) organic solvent free liquid inks and coatings,
e) radiation cured inks and coatings (for example, ultra violet and electron beam).

3.230 The selection of cleaning materials used for both cleaning down machinery and the substrate can have an effect on the emissions from the installation.

3.231 Substances or mixtures which, because of their content of VOC classified as carcinogens, mutagens, or toxic to reproduction under Directive 67/548/EEC, are assigned or need to carry the risk phrases R45, R46, R49, R60, R61, shall be replaced, as far as possible and by taking into account the guidance as mentioned in Article 7(1) of SED, by less harmful substances or mixtures within the shortest possible time.

As from 1st December 2010 “risk phrase” materials will, broadly, also be known as “hazard statement” materials. Either term will apply until 1st June 2015, when only the term “hazard statement” materials will apply.

3.232 The criteria in Table 11 should be considered when selecting raw materials.

Table 11 - Selection of raw materials

Raw Material	Selection Criteria
Solvents	The vapour pressure, flammability, odour, Classification under the Montreal Protocol, CHIP risk phrase / hazard statement classification
Inks, coatings, adhesives, surface cleaners, etc.	• Type and amount of solvent within ink/coating • Amount of solvent used per unit area covered • Content of heavy metals in pigments
Water Proofing Materials Impregnation Materials	• Type and amount of solvent within preparation • Amount of solvent used per unit area covered • Content of heavy metals in pigments • Fungicide/ biocide within preparation
Water	Identify most sustainable source (consider recycled sources).
Fuel oils*	Sulphur content should be minimised. The maximum sulphur content of heavy fuel oil should be 1%. (See Table 5 for sulphur emission limits associated with fuel choice).

Surface treatment materials	• Limit acid strength • Consider non-organic degreasants
Solvent usage	Where solvent based degreasing is necessary then, in particular for chlorinated solvents, the requirements of the SED should be met. (See Chapter 34 of the General Guidance Manual for advice on this topic), (Ref 2). Users of trichloroethylene should also refer to the HSE Guidance regarding use of this material (Ref 17).
*Sulphur in liquid fuels regulations, Regulation 3 (3) states that combustion plant (other than new large combustion plant covered by the LCPD for which there is a separate provision) can burn heavy fuel oil with a sulphur content greater than 1% so long as the sulphur dioxide emissions from the plant is less than or equal to 1700mg/m^3 at 3% oxygen dry. Defra is the enforcing authority for these regulations.	

3.233 When selecting alternative raw materials, operators should ensure that decisions are taken on the basis of their environmental impact, whilst not compromising process quality and product integrity.

3.234 Advice on reducing raw material consumption within specific sectors can be found in the Envirowise Guidance (Ref 7).

BAT	
188	The operator should adopt procedures to control the specification of those types of raw materials with the main potential for environmental impact, such as the inks and coatings used in the process in order to minimise any such impact. An annual review of alternative raw materials should be carried out with regard to environmental impact.
189	Substances or mixtures which, because of their VOC content are assigned or need to carry risk phrases / hazard statements R45, R46, R49, R60 or R61 shall be replaced, as far as possible by less harmful substances and mixtures within the shortest possible time.
190	A programme to monitor and record the consumption of inks/coatings/organic solvent against product produced should be used to optimise the amount of organic solvent/ink used

Waste minimisation (optimising the use of raw materials)

3.235 Waste minimisation can be defined simply as: “a systematic approach to the reduction of waste at source, by understanding and changing processes and activities to prevent and reduce waste”.

3.236 A variety of techniques can be classified under the term waste minimisation and they range from basic housekeeping techniques through statistical measurement techniques, to the application of clean technologies.

3.237 Key operational features of waste minimisation should be:

- the ongoing identification and implementation of waste prevention opportunities
- the active participation and commitment of staff at all levels including, for example, staff suggestion schemes
- monitoring of materials’ usage and reporting against key performance measures or benchmarks

3.238 Using this information, opportunities for waste reduction, changes in process and improved efficiency should be generated and assessed, and an action plan prepared for the implementation of improvements.

3.239 The use and fate of all materials should be mapped onto a process flow diagram using data from the raw materials inventory and other company data as appropriate. Data should be incorporated for each principal stage of the operation in order to construct a mass balance for the installation. The mass balance can then be used to identify opportunities for improvements.

3.240 Monitoring and mapping material usage in this way can be carried out to determine benchmarks in terms of the amount of any given raw material used per tonne of product manufactured. Assessment against benchmarks can reveal whether the process is being maintained “in control” or to trigger investigations in to why raw material usage is increasing.

3.241 The regulator should enquire as to sector specific benchmarks that may be typically used for process control and waste minimisation.

3.242 There should be continuous movement towards more Sustainable Consumption and Production (i.e. doing more for less) as laid out in Government Guidance " Changing Patterns - UK Government Framework for Sustainable Consumption and Production" (Ref 8). Section 3.3 of the guidance identifies advice and funding programmes available to achieve more sustainable production practices. The National Industrial Symbiosis Programme shares information across all industrial sectors to produce guidance and case studies for resource efficiency (Ref 8). See also Envirowise Guides (Ref 7) for information.

BAT	
191	The operator should record materials usage and waste generation in order to establish internal benchmarks. Assessments should be made against internal benchmarks to maintain and improve resource efficiency.
192	The operator should carry out a waste minimisation audit at least as frequently as the permit review period.
193	If an audit has not been carried out in the 2 years prior to submission of the application it should be completed within 18 months of the issue of the first PPC permit. The methodology used and an action plan for optimising the use of raw materials should be submitted to the regulator within 2 months of completion of the audit.
194	Specific improvements resulting from the recommendations of audits should be carried out within a timescale approved by the regulator
195	Consumption of organic solvents should be reduced and minimised where practicable through good process control and the application of the appropriate techniques for the system as described in Guidance Note GG429 Cost Effective Solvent Management, available from Envirowise (Ref 7a).

Water use

3.243 The amount of water used in surface treatment using organic compounds varies considerably on the activities being carried out within the installation. Its main uses are as a coolant, as a wash medium in developing and image carrier manufacture, as a degreasing, cleaning and carrier for surface treatment substances in substrate preparation prior to coating. Water can also be used in general cleaning and house keeping operations within the installation. Where aqueous coating is carried out as part of the installation water consumption may be significantly increased.

3.244 For significant users water use should be minimised within the BAT criteria for the prevention or reduction of emissions and be commensurate with the prudent use of water as a natural resource.

3.245 Reducing water use may be a valid environmental and/or economic aim in itself, perhaps because of local supply constraints. Also, from the point of view of reducing polluting emissions, any water passing through an industrial process is degraded by the addition of pollutants, and there are distinct benefits to be gained from reducing the water used. These include:

- Reducing the size of (a new) treatment plant, thereby supporting the cost benefit BAT justification of better treatment;
- cost savings where water is purchased or disposed of to another party;
- associated benefits within the process such as reduced energy requirements for heating and pumping, and reduced dissolution of pollutants into the water leading to reduced sludge generation in the effluent treatment plant.

The use of a simple mass balance for water use may help to reveal where reductions can be made.

Advice on cost-effective measures for minimising water use can be found in (Ref 7).

3.246 The following general principals should be applied in sequence to reduce emissions to water:

- water-efficient techniques should be used where possible
- water should be recycled within the process from which it issues, treating it first if necessary. Where this is not practicable, it should be recycled to another part of the process which has a lower water quality requirement

3.247 The volumes of water used by an installation should normally be metered so that water efficiency audits can be carried out and benchmarks can be set for optimal efficiency. In addition, sub-processes that are principal water users should be metered to optimise water usage at individual process plant.

BAT	
196	The operator should carry out a regular review of water use (water efficiency audit) at least as frequently as the permit review period. If an audit has not been carried out in the 2 years prior to submission of the application it should be completed within 24 months of the issue of the first PPC permit.
197	Using information from the water efficiency audit, opportunities for reduction in water use should be assessed and, where appropriate, should be carried out in accordance with a timescale approved by the regulator.
198	Information from audits should be used to establish benchmarks. Operators should keep records of such benchmarks and make measurement against them to reveal whether the process is being maintained “in control” or to track improvements.
199	The volume of mains and abstracted water used in the activities should be directly measured when the installation is operating under normal production conditions for a sufficient period to determine the base use of the activity. Thereafter, an annual exercise should be done to confirm the measurement. All measurements should be recorded and the records held on site.
200	When parts are removed for cleaning a two bath system should be used to minimise the use of cleaning water. The water from the second bath can then be used to replenish the first bath when this water is so soiled it must be disposed of.
201	When cleaning tanks and fixed vessels cleaning water should be minimised by using rotary spray nozzle heads and reused where possible.

Waste handling

3.248 Good segregation of materials is essential to facilitate opportunities for recovery, recycling and re-use and to maximise scope for good waste management.

3.249 The most important wastes are:

- Contaminated solvents
- Residual coatings and inks
- Wipes, rags and other organic solvent contaminated wastes
- Sludge's from degreasing and cleaning operations
- Sludge from effluent treatment processes
- Contaminated powders pigments, fillers etc
- Particulate matter collected in bag or cartridge filters;
- Scrubber liquors and sludges, and output from the effluent treatment plant;
- Refractory waste from incinerators, dryers and combustion chambers;
- Chemical and oil containers;
- General non-hazardous industrial waste

3.250 Most organic solvent and organic solvent contaminated wastes can be beneficially re-used by third parties especially if some degree of segregation is carried out to prevent unsuitable materials contaminating the waste

BAT	
202	The operator should produce an inventory of the quantity, nature, origin and where relevant, the destination, frequency of collection, mode of transport and treatment method of any waste which is disposed of or recovered.
203	Operators should segregate the main waste types described in paragraph 3.249.
204	Operators should ensure that waste stored in containers that are durable for the substances stored and that incompatible waste types are kept separate.
Operators should:	
205	Ensure that waste storage areas are clearly marked and signed, and that containers are clearly labelled.
	Ensure that appropriate storage facilities are provided for substances that are flammable, sensitive to heat or light etc, and that incompatible waste types are kept separate.
	Ensure that containers are stored with lids, caps and valves secured and in place. (This also applies to emptied containers.)
	Ensure that procedures are in place to deal with damaged or leaking containers.
	Segregate waste wherever practicable
	Identify the disposal route for all waste. This should be as close to the point of production as possible.
	Ensure that dust from abatement plant is collected in robust bags that can be disposed of directly, or in fully enclosed skips to avoid the release of fugitive dusts during transfer.
206	All reasonably practicable efforts should be made to minimise the amount of residual organic solvent bearing material left in drums and other containers after use. All organic solvent contaminated waste should be stored within closed containers.
207	Prior to removal from site used wipes and other items contaminated with organic solvent should be placed in a suitably labelled metal bin fitted with a self-closing lid.
208	Bins should be emptied at least daily, as they not only present a fire hazard, they may also undergo spontaneous combustion.
209	For materials that may undergo spontaneous combustion special bins that allow air to circulate beneath and around them to aid cooling should be used. Dusty wastes should be stored in closed containers and handled in a manner that avoids emissions.

Waste re-use, recovery, recycling or disposal

3.251 Waste should be re-used, recovered or recycled unless the regulator has accepted a satisfactory BAT justification for landfill disposal.

3.252 Table 12 summarises the routes currently taken by the various waste streams from a typical surface treatment site. Whether re-use, recovery or recycling is possible at a particular site will depend on the particular fuels and raw materials being used, the products being made and the methods of operation employed. The table reflects where recycling can be achieved when the appropriate combination of these factors is in place.

3.253 In the context of this note, recycling means the residue is returned to the process from where it has been produced, re-use means that the residue is used for another purpose e.g. mixed solvent waste being used as fuel.

3.254 Operators should seek to establish markets for the recovery or recycling of wastes generated within the installation. Envirowise guides provide information on waste minimisation (Ref 7 and Ref 9). In addition, the Waste & Resources Action Programme (WRAP) researches and can provide guidance into recycling of other wastes such as wood, paper, cardboard and plastics (Ref 10).

Table 12 - Solid waste stream: routes currently taken

Process Waste Stream	Fate
Solvents	• Recovery and reuse of solvent on site • Recovery and reuse of solvent off site • Recovery as heat on-site • Off site recovery as heat substitute fuel • Incineration on-site or off site
Coatings and inks	• Recovery and reuse on site and off-site disposal of residues • Recovery and reuse of solvent content on/off site • Incineration on-site or off site
Solid waste, i.e. powders, fillers and pigments, etc	• Recycling on site as a raw material or offsite as a feed into another process • Landfill - where suitable or incineration
Effluent treatment sludge	• Recycling to remove heavy metal contamination • Landfill - not suitable for recycling and not containing List I or List II substances • Incineration on-site or off site
Contaminated wipes and rags	• Recovery and re-use of solvent on/off-site • Laundering of wipes and rags • Incineration/landfill - not suitable for recycling
Sludge from degreasing units using risk phrase/hazard statement materials	• Recovery and reuse of solvent on/off site • Incineration of residues
Particulate matter	• Some may be suitable for recycling on site as a raw material or offsite as a feed into another process • Incineration / landfill - where not suitable for recycling
Metallic waste	Recycle
Shot blasting waste	Recycled or landfilled
Scrubber liquors and sludges	Minimised, then to licensed waste disposal contractors
Wood, cardboard and paper	Segregated for off site re-use or recovery
Oil	Recovery off site

BAT	
210	The operator should carry out an annual review to demonstrate that the best environmental options are being used for dealing with the waste streams listed in Table 12.
211	At a minimum of every two years, the operator should investigate potential markets for the recovery/re-use of wastes that are currently disposed of to landfill.

Energy

3.255 BAT for energy efficiency under the PPC Regulations will be satisfied provided the operator meets one of the following conditions:

- the operator meets the basic energy efficiency requirements below and is a participant to a Climate Change Agreement (CCA) with the Government or has EU ETS (European Union Emissions Trading System) commitments: **or**
- the operator meets the basic energy efficiency requirements below and the additional energy efficiency requirements

Basic energy efficiency requirements

3.256 The requirements of this section are basic, low cost, energy standards that apply whether or not a CCA is in force or the operator has EUETS commitments for the installation.

BAT	
212	The operator should produce a report annually on the energy consumption of the installation.
213	The operator should monitor energy flows and target areas for reduction which should be updated annually. ("Sankey" diagrams and energy balances would be useful as aids.)
214	In order to optimise combustion, the operator should, where practicable, monitor waste gases. The scope of this monitoring will depend on the size of the combustion plant and, where relevant, should be determined by consulting the appropriate Statutory Process Guidance Note.
215	The operator should ensure that all plant is operated and maintained to optimise the use and minimise the loss of energy.
216	The operator should ensure that all appropriate containment methods, (e.g. seals and self-closing doors) are employed and maintained to minimise energy loss.
217	For new oxidation plant, where thermal oxidation is used, heat recovery should be maximised. Where heat recovery is not practicable, catalytic oxidation should be used wherever technically possible.

Additional energy efficiency requirements

3.257 Within IPPC it is valid to consider both the emission of direct (heat and emissions from on-site generation) and indirect (emissions from a remote power station) pollution when considering options for energy efficiency.

BAT	
Energy efficiency techniques	
218	The following techniques should be considered:
	Heat recovery from different parts of the processes
	Minimisation of water use and closed circulating water systems
	Good insulation
	Plant layout to reduce pumping distances
	Phase optimisation of electronic control motors and fans
	Optimised efficiency measures for combustion plant
	Preventative maintenance programme targeting energy drops
Energy supply techniques	
219	The following techniques should be considered:
	Use of Combined Heat and Power (CHP)
	Generation of energy from waste
	Use of less polluting fuels

Accidents

3.258 For accident management, there are three particular components:

- identification of the hazards to the environment posed by the installation/activity
- assessment of the risks (hazard x probability) of accidents and their possible consequences
- implementation of measures to reduce the risks of accidents, and contingency plans for any accidents that occur

3.259 Further guidance can be found in Chapter 20 of the General Guidance Manual (Ref 2) and BSI provide guidance that may be relevant in the event of fire. See also Ref 11 and Ref 14.

Identification of the hazards

3.260 In identifying the hazards particular areas to consider may include, but should not be limited to, the following:

- The use for flammable materials on site and potential sources of ignition static (due to poor materials selection, inadequate earth bonding),
- Spark (due to incorrect electrical zoning, mechanical movement),
- Heat (due to flames, radiant heat, friction)
- Explosive atmospheres inside process equipment dusts and abatement plant
- Powder explosions due to incorrect design, operation, or failure of powder handling systems
- Spillage and loss of containment of material

Identification of the risks

3.261 The hazards having been identified, the process of assessing the risks should address the following:

- how likely is the particular event to occur (source frequency)?
- what substances are released and how much of each (risk evaluation of the event)?
- where do the released substances end up (emission prediction - what are the pathways and receptors)?
- what are the consequences (consequence assessment – what are the effects on the receptors)?
- what is the overall risk (determination of overall risk and its significance to the environment)?
- what can prevent or reduce the risk (risk management – measures to prevent accidents and/or reduce their environmental consequences)?

Measures to reduce the risks (identified by risk assessment)

3.262 Risk reduction can be achieved by process management controls and preventative measures. The following techniques will be relevant to most installations, although this is not an exhaustive list.

Process management controls

- process design, alarms, trips and other failsafe control techniques to ensure the safe operation of the plant
- security systems to prevent unauthorised access
- records of all incidents, near-misses, changes to procedures, abnormal events and findings of maintenance inspections and procedures to learn from such incidents
- personnel suitably trained in accident management
- guidance for specific accident scenarios
- procedures to ensure good communication among operations staff during shift changes and maintenance or other engineering work
- safe shutdown procedures
- established communication routes with relevant authorities and emergency services

Preventative measures

- procedures to ensure that the composition of the contents of a bund /sump is checked before treatment or disposal
- drainage sumps equipped with a high-level alarm with automatic pump to storage (not to discharge)
- high-level alarms etc. (which should not be routinely used as the primary method of level control)
- adequate standby plant or equipment maintained and tested to operational standards
- sufficient storage to contain process waters, site drainage waters, emergency firewater, chemically contaminated waters and spillages of chemicals, which should be routed where necessary, having regard to a site-specific assessment of risks, to the effluent system
- provision to contain surges and storm-water flows, which should be treated where necessary, having regard to a site-specific assessment of risks, before emission to controlled waters or sewer
- spill contingency procedures to minimise the risk of accidental emission of raw materials, products and waste materials and to prevent their entry into water
- procedures should be in place for checking and handling raw materials and wastes to ensure compatibility with other substances with which they may accidentally come into contact.
- suitable barriers to prevent damage to equipment from the movement of vehicles, as appropriate, having regard to a site-specific assessment of risks
- there should be procedures for responding to and learning from incidents, near-misses, etc.
- the roles and responsibilities of personnel involved in incident management should be formally specified.
- where indicated by the site-specific assessment of risks, containment or abatement for accidental emissions from vents and safety relief valves/bursting discs should be provided. Where this may be inadvisable on safety grounds, attention should be focused on reducing the probability of the emission

BAT	
Accidents/incidents/non-conformance	
220	There should be written procedures for investigating incidents and near misses, including identifying suitable corrective action and following up.
221	The operator should maintain an accident management plan covering the matters listed in paragraphs 3.260 to 262 above and to the satisfaction of the regulator. The plan should be available for inspection by the regulator.
222	In the case of abnormal emissions arising from an accident, such as a spillage for example, the operator should:
	Investigate immediately and undertake remedial action as soon as practicable
	promptly record the events and actions taken
	ensure the regulator is made aware without delay.
Specific conditions: Specific conditions may need to be included within permits to prevent accidents. Examples of these are given below.	
223	Suitable solvent containment and spillage equipment should be readily available in all solvent handling areas.
224	Adequate provision to contain potential liquid and solid spillage should be provided.
225	Appropriate precautions should be taken to prevent ignition of flammable materials.
226	All spillages should be cleared as soon as possible; solids by vacuum cleaning, wet methods, or other appropriate techniques may be used, however, dry sweeping of dusty spillages should not be permitted.
227	The handling and use of flammable and explosive materials should be carried out in accordance with the requirements of the Dangerous Substances and Explosive Atmosphere Regulations SI2776 2002 (Ref 14b).

228	Areas where flammable organic solvents and organic solvent containing materials are handled or used should be suitably contained to minimise the potential spread for fire.
229	Operations working at above 25% of the organic solvent LEL must be controlled using suitable monitoring and control devices.
230	The auto-ignition temperature should not be exceeded in any organic solvent containing section of the process, with the exception of the combustion chamber of any thermal abatement plant.
231	Electrical zoning and static protection should be provided in all areas where flammable organic solvents are stored used or handled.
232	Controlled shutdown procedures should be in place for dealing with an emergency such as organic solvent levels entering the combustion plant at greater than the limit as calculated using the relevant standards. (This figure will normally be 25%).
233	The handling and storage of flammable materials should be carried out in accordance with the HSE requirements REF HS(G)140 and HS(G)176 (Ref 14).

Noise and Vibration

3.263 Within this section, “noise” should be taken to refer to noise and/or vibration as appropriate, detectable beyond the site boundary.

3.264 Noise surveys, measurement, investigation (which can involve detailed assessment of sound power levels for individual items of plant) or modelling may be necessary for either new or existing installations depending upon the potential for generating significant noise. Operators may have a noise management plan as part of their management system. Where an installation poses no risk of noise related environmental impact because the activities undertaken are inherently quiet or remote from receptors; these measures would not normally be required.

3.265 Following investigation of the impact of the installation, systems to minimise the environmental impact of the noisiest operations should be employed. The level of noise control required depends on the scale of operations and the proximity of operations to the public. Table 13 identifies the noisiest operations and the control measures that have been employed to mitigate problems.

3.266 Further guidance can be found in Chapter 16 of the General Guidance Manual.

Table 13 - Noise Mitigation Measures

Operation	Control Measure
General	Relocate equipment
Fans, pumps and motors	Acoustic screens, enclosures and baffles Fitting silencers to avoid noise travelling along ducting Selection of less noisy engineering equipment Fitting resilient hangers for wall-mounted equipment
General	Fitting noise reducing flaps to outside doors Maintaining a closed doors policy Improving sound insulation of buildings Holes and openings closed off (use mechanical where necessary) Using flexible connections between vibrating and fixed plant Preventative maintenance programme e.g. equipment wear, bearings
* Noise mitigation measures that are likely to be needed in most cases [sector specific assessment of the noise mitigation measures relevant]	

BAT	
234	The operator should identify key plant and equipment (or operations) with the potential to give rise to significant noise and take such measures as are necessary by way of mitigation and maintenance of existing plant and equipment in order to minimise noise having regard to paragraph 3.265 and Table 13 above.

Monitoring

3.267 This section describes general monitoring and reporting requirements for emissions to all environmental media. Guidance is provided for the selection of the appropriate monitoring methodologies, frequency of monitoring, compliance assessment criteria and environmental monitoring. The specific monitoring requirements with respect to emissions to air are described in Table 5 and Table 6c.

Standards for monitoring equipment and procedures

3.268 The Environment Agency has introduced its Monitoring Certification Scheme (MCERTS) to improve the quality of monitoring data and to ensure that the instrumentation and methodologies employed for monitoring are fit for purpose.

- operators should ensure their monitoring arrangements comply with the requirements of MCERTS where available, e.g. using certified instruments and equipment, and using a registered stack testing organisation etc. (Ref 13).

Sampling and analysis standards

3.269 The sampling analytical methods selected for compliance monitoring given in Tables 5 and 6c and Appendix 2 should normally be used in the following order of priority:

- Comité Européen de Normalisation (CEN)
- International Standardisation Organisation (ISO)
- British Standards Institution (BSI)
- United States Environmental Protection Agency (US EPA)
- American Society for Testing and Materials (ASTM)
- Deutsches Institut für Normung (DIN)
- Verein Deutcher Ingenieure (VDI)
- Association Française de Normalisation (AFNOR)

3.270 Guidance on standards for monitoring releases (to air, water and land) relevant to IPPC can be found in Ref 13 or on the Source Testing Association website (Ref 18).

3.271 When selecting monitoring test methods, it is important to note that test methods are normally applicable to specific matrices (in relation to water) and concentrations of various pollutants (in relation to air). It is necessary to identify the most appropriate method in consideration of the hierarchy of methods. For example, if two methods are appropriate, the hierarchy is used to determine priority.

3.272 If in doubt the operator should consult the regulator.

Monitoring and sampling protocols

3.273 Where monitoring is needed the operator should devise a monitoring strategy to address the following:

- determinands to be monitored
- selection of monitoring points
- monitoring methods and procedures (selection of appropriate Standard Reference Methods)
- reference conditions and averaging periods
- measurement uncertainty of the proposed methods and the resultant overall uncertainty
- drift correction for continuous analysers
- quality assurance (QA) and quality control (QC) protocols, including accreditation and certification
- equipment calibration and maintenance, sample storage and chain of custody/audit trail
- reporting procedures, data storage, interpretation and review of results, reporting format for the provision of information to the regulator

Monitoring frequency

3.274 The frequency of testing should be increased, for example, as part of the commissioning of new or substantially changed activities, or where the emission levels are near to or approach the emission limit.

3.275 Where non-continuous quantitative monitoring is required, the frequency may be varied. Where there is consistent compliance with emission limits, regulators may consider reducing the frequency. When determining 'consistent compliance' factors to consider include:

- the variability of monitoring results, for example, results which range from 15 - 45 mg/m^3, against an emission limit of 50 mg/m^3 might not qualify for a reduction in monitoring
- the margin between the results and the emission limit, for example, results which range from 45 - 50 mg/m^3 when the limit is 50 mg/m^3 might not qualify for a reduction in monitoring

3.276 Consistent compliance should be demonstrated using sequential results for example at least three or more monitoring exercises within two years, or two or more monitoring exercises in one year supported by continuous monitoring. Any significant process changes which might have affected the results should be taken into account.

Where effective surrogates are available they may be used to minimise monitoring costs.

3.277 Where monitoring shows that substances are not emitted in significant quantities, consideration can be given to a reduced monitoring frequency.

Monitoring emissions to air

3.278 The reference conditions of substances in releases to air from point sources are: temperature 273.15 K (0°C), pressure 101.3 kPa (1 atmosphere), measured wet, no correction for water vapour. To convert measured values to reference conditions, see Technical Guidance Note M2 (Ref 13) for more information.

Monitoring emissions to water

3.279 The appropriateness of the monitoring requirements in Section 2 will vary depending upon the sensitivity of the receiving water and should be proportionate to the scale of the operations, nature of the discharge and receiving water. For each release point the following information is required:

- the specific volume flow from the process to sewer/controlled water
- the quality of the receiving water
- the volume of discharge compared to the percentage of dry river flow of the receiving water

Environmental monitoring (beyond installation)

3.280 Environmental monitoring may be required, for example, when:

- there are vulnerable receptors
- the emissions are a significant contributor to an Environmental Quality Standard (EQS) which
- may be at risk
- the operator is looking for departures from standards based on lack of effect on the
- environment
- the operator is required to validate modelling work

Further guidance is given in chapter 15 of the General Guidance Manual (Ref 2).

Monitoring of process variables

3.281 Some process variables will have potential environmental impact and these should be identified and monitored where they have an environmental relevance. For surface treatment using solvents activities, examples of monitoring these variables include:

- keeping inventories of materials used and disposed of, in particular organic solvents
- monitoring for contaminants in raw materials where scrap is used or where there is inadequate supplier information
- monitoring temperature, pressure or flammability where relevant, for example explosive limits on dryers
- plant efficiency monitoring, for example solvent reclamation plant efficiency

BAT	
Monitoring and reporting	
235	The operator should monitor emissions, make tests and inspections of the process and keep records; in particular the operator should keep records of audits, inspections, tests and monitoring, including all non-continuous monitoring, inspections and visual assessments. Monitoring may include process variables and operating conditions where relevant to emissions. In such cases
	Current records should be kept on site and be made available for the regulator to examine
	Records should be kept by the operator for at least two years
236	The operator should notify the regulator at least 7 days before any periodic monitoring exercise to determine compliance with emission limit values. The operator should state the provisional time and date of monitoring, pollutants to be tested and the methods to be used
237	The results of non-continuous emission testing should be forwarded to the regulator within 8 weeks of the completion of the sampling. Results from continuous monitoring systems should be recorded and be made available for inspection by the regulator.
238	All results submitted to the regulator should include details of process conditions at the time of monitoring, monitoring uncertainty as well as any deviations from the procedural requirements of standard reference methods and the error invoked from such deviations.
239	Results exceeding the emission limit value from any monitoring activity (both continuous and non-continuous) and malfunction or breakdown leading to abnormal emissions should be investigated and corrective action taken immediately. The operator should ensure that the regulator is notified without delay, identifying the cause and corrective action taken. Where there is immediate danger to human health, operation of the activity should be suspended.
240	Sampling points on new plant should be designed to comply with CEN or Other Standards. e.g. BS EN 13284-1 or BS ISO 9096: 2003 for sampling particulate matter in stacks.
241	Continuous monitoring is normally expected for the main abated releases in Table 5. Where continuous monitoring is required by the permit, instruments should be fitted with audible and visual alarms, situated appropriately to warn the operator of arrestment plant failure or malfunction, the activation of alarms should be automatically recorded and readings should be on display to appropriately trained operating staff.
242	All continuous monitors should be operated, maintained and calibrated (or referenced) in accordance with the appropriate standards and manufacturers' instructions, which should be made available for inspection by the regulator. Instruments should be operated to ensure less than 5% downtime over any 3-month period and all relevant maintenance and calibration (or referencing) should be recorded
243	Where available, operators should use monitoring equipment and instruments certified to MCERTS and use a stack-testing organisation accredited to MCERTS standards or such alternative requirements as approved by the regulator.
Monitoring and reporting of emissions to air	
244	Exhaust flow rates of waste gases should be consistent with the efficient capture of emissions, good operating practice and meeting the requirements of the legislation relating to the workplace environment.
245	The introduction of dilution air to achieve emission concentration limits should not be permitted.
246	Dilution air may be added where justified for waste gas cooling or improved dispersion. In such cases, monitoring should be carried out upstream of the dilution air input or procedures designed to correct for the ratio of input air to the satisfaction of the regulator.
247	Monitoring to determine compliance with emission limit values should be corrected to the following standard reference conditions: temperature, 273.15 K (0^{o}C), pressures 101.3 kPa (1 atmosphere) and measured wet, no correction for water vapour.
248	Periodic visual assessment of releases should be undertaken as required by the regulator to ensure that all final releases are colourless, free from persistent visible emissions and free from droplets.

249	Compliance monitoring can be carried out either by use of a continuous emissions monitor (CEM), or by a specific extractive test carried out at a frequency agreed with the regulator. When periodic or continuous monitoring is required, test methods, equipment and organisation should comply with DD CEN TS 15675 or MCERTS performance standards. Where this is not achieved the regulator must satisfy themselves that the quality of monitoring is sufficient to provide reliable results.
	Where a CEM is used for compliance purposes it must be periodically checked, (calibrated), to ensure the readings being reported are correct. This calibration is normally done by carrying out a parallel stand-alone extractive test and comparing the results with those provided by the CEM All requirements for Quantified CEMS (where accuracy is required), should be made in parallel with appropriate Quality Assurance requirements (i.e. MCERTS).
	For extractive testing the sampling should meet the following requirements: • For batch processes, where the production operation is complete within, say, 2 hours, then the extractive sampling should take place over a complete cycle of the activity; **and** • For all activities the sampling period should be sufficient such that at least 3 results are obtained. Should the activity either be continuous, or have a batch cycle that is not compatible with the time available for sampling, then the data required should be obtained over a minimum period of 2 hours in total • no daily mean of all 15-minute mean emission concentrations should exceed the specified emission concentration limits during normal operation (excluding start-up and shutdown); **and** • no 15-minute mean emission concentration should exceed twice the specified emission concentration limits during normal operation (excluding start-up and shutdown).
250	Where abatement equipment is required to comply with the particulate matter provisions of the note then emissions performance of the abatement plant should be monitored, either by continuous, qualitative monitoring of the particulate matter, (using, for example, an in duct/across duct particulate monitor), or by surrogate techniques agreed with the local regulator.
	The normal frequency of monitoring for all pollutants (including particulate matter) where arrestment equipment is necessary to meet specified emission limits is annually, but for further criteria relating to frequency of monitoring see paragraphs 3.274 – 3.277.
251	*For releases of VOCs calibration and compliance monitoring must meet the following requirements as appropriate: -* *In the case of continuous measurements the emission limit values shall be considered to be complied with if:* *a) none of the averages over 24 hours of normal operation exceeds the emission limit values,* ***and*** *b) none of the hourly averages exceeds the emission limit values by more than a factor of 1,5.* *In the case of periodic measurements the emission limit values shall be considered to be complied with if, in one monitoring exercise:* *a) the average of all the readings does not exceed the emission limit values;* ***and*** *b) none of the hourly averages exceeds the emission limit value by more than a factor of 1,5*
252	Where VOC abatement equipment is fitted, the following four BAT paragraphs indicate any additional continuous monitoring and recording requirements for that specific abatement equipment.
	Any measurements of total organic Carbon should be with a heated FID method (in line with revised EN 13649).
253	Thermal oxidisers must have monitoring and recording for VOCs expressed as total carbon excluding particulate matter. After sufficient monitoring data has been collected to clearly demonstrate adequate VOCs destruction continuous monitoring of temperature and oxygen or temperature and carbon monoxide may be used as a surrogate measurement.

254	Catalytic oxidisers must have monitoring and recording for VOCs expressed as total carbon excluding particulate matter. After sufficient monitoring data has been collected to clearly demonstrate adequate VOCs destruction continuous monitoring of carbon monoxide and temperature may be used as a surrogate measurement.
255	Bio scrubbers and reactors must have monitoring and recording for VOC expressed as total carbon excluding particulate matter. After sufficient monitoring data has been collected to clearly demonstrate adequate VOC destruction continuous monitoring of the flow and pH of the re-circulating water, fan suction, exhaust temperature and pressure drop across the packing, coupled with daily monitoring of the nutrient may be used as a surrogate measurement.
256	Turbines, reciprocating engines, boilers or any other form of VOCs abatement equipment must have continuous monitoring and recording for VOCs expressed as total carbon excluding particulate matter.
257	The frequency of manual sampling for VOC from abated releases must be at least annually
Monitoring and reporting emissions to water and sewer	
258	The appropriateness of the monitoring requirements will vary depending upon the sensitivity of the receiving water and should be proportionate to the scale of the operations, nature of the discharge and receiving water. For each release point the following information is required: • the specific volume flow from the process to sewer/controlled water • the sensitivity of the receiving water • the volume of discharge compared to the percentage dry river flow of the receiving water
259	Increased monitoring should be carried out where substances to which the local environment may be susceptible could be released from the installation, e.g. where releases of common pesticides or heavy metals may occur.
260	A full analysis, to include the substances listed in Part 1 of Schedule 1 of the EP Regulations and equivalent regulations in Scotland and Northern Ireland, should be carried out annually on a representative sample from each release point, unless it is agreed with the regulator that this is inappropriate.
Monitoring and reporting of waste	
261	The following should be monitored and recorded: • Quantity nature and origin of the waste • the physical description of the waste • a description of the composition of the waste • any relevant hazardous properties (hazard and risk phrases) • European Waste Catalogue code • Handling precautions and substances with which it cannot be mixed • Disposal routes for each waste category
Monitoring of VOC	
262	The definitions provided must be used in all calculations relating to the Solvent Management Plan (SMP) (See Appendix 2).
263	For all installations, the SMP should be used to determine the solvent consumption annually (See Appendix 2).
264	For all installations using the emission and fugitive limits, the SMP should be used for determining the fugitive emissions (See Appendix 2). Once completed, it need not be repeated until the equipment is modified.
265	For all installations using the reduction scheme, the SMP should be used to determine the actual emissions annually (See Appendix 2).
266	For all installations using the total emission limit value the SMP must be used to determine the Total Emission and the Solvent Input annually. In addition, the SMP should be used for determining the fugitive emissions (See Appendix 2). Once completed, it need not be repeated until the equipment is modified.

Information Provisions

3.282 This guidance note contains many provisions relating to information. There are two general categories of information identified in this note:

- Reports or notifications
- Additional information

3.283 Reports are required and notifications are information that should be sent to the regulator at a frequency that is specified in this guidance. Such information provisions are summarised in Table 14 below.

Table 14 - Summary of Provisions for Reporting and Notification

BAT Clause	Provision	Information Category	Frequency
BAT 237	Report of results from non-continuous emission testing forwarded to the regulator.	Report	Within 8 weeks of the completion of the sampling – typically annual
BAT 183	Notification of appointed competent person to liaise with the regulator and the public with regard to complaints	Notification	Reactive
BAT 222	Investigation of abnormal emissions arising from an accident. Remedial action taken immediately. Prompt recording of the events and actions taken. Notification of the regulator without delay*	Notification	Reactive
BAT 236	Notification at least 7 days before any periodic monitoring exercise to determine compliance with ELVs	Notification	Reactive
BAT 239	Investigation of results exceeding an ELV from any monitoring activity and malfunction or breakdown leading to abnormal emissions. Corrective action taken immediately. Notification without delay* identifying the cause and corrective action taken.	Notification	Reactive
*Without delay In most cases it should be enough to notify the local authority (by telephone or facsimile) within an hour of the start or detection of the emission. Local authorities will wish to consider what notification arrangements to require outside working hours.			

3.284 Additional information relates to procedures or records (including details of assessments, investigations and audits). Such information should be held by the operator and be accessible so that the regulator may view the information. For much of the information, on-site inspection may be sufficient for the regulator, subject to the particular circumstances. Regulators may be more likely to ask operators to send them copies of those items marked with an asterisk. The majority of this information is likely to be the same as would be required in any event when using an effective EMS, so documents can be produced which serve both purposes.

3.285 Annex 4 of ISO 14001 gives some detailed examples of information and document control but by way of generality A.4.4 states that "The extent of the environmental management system documentation may differ from one organization to anther depending on

a) the size and type of organization and its activities, products of services,
b) the complexity of processes and their interactions, and
c) the competence of personnel

Examples of documents include:

- statements of policy, objectives and targets,
- information on significant environmental impacts,
- procedures,
- process information,
- organisational charts,
- internal and external standards,
- site emergency plans, and
- records

3.286 Relating to documentation, Annex II of the EC Regulation No 1221/2009 on the eco-management and audit scheme (EMAS) provides details on what is required and includes the following headings:

- General requirements
- Environmental policy
- Planning
- Implementation and operation
- Checking
- Management review

3.287 Additional information provisions are summarised in Table 15 below.

Table 15 - Summary of Provisions for Additional Information

BAT Clause	Category	Subject
BAT 6	Procedures	Six monthly examination of pressure vacuum relief valves for signs of contamination, incorrect seating and be cleaned and/or corrected as required.
BAT 47	Procedures	Monthly solvent balance to be carried out
BAT 49	Procedures	Annual review of cleaning procedures
BAT 60	Procedures	Annual review of the use of organic based glues, if used
BAT 173	Procedures	Preventative maintenance programme for tanks, bunds and sumps.
BAT 174	Procedures	Control measures to minimise the pollution risk from solvent storage.
BAT 176	Procedures	Assessment of odour emissions.
BAT 177	Procedures	Odour control systems.
BAT 178	Procedures	Environmental Management System. Records of EMS audits.
BAT 179	Procedures	Operational and maintenance systems for all aspects of the installation whose failure could impact on the environment – annual review.
BAT 184	Procedures	Formal structure of employee's responsibility for process control and environmental impacts and training provisions.
BAT 187	Procedures	Investigating accidents, incidents and non-conformance.
BAT 188*	Procedures	Control the specification of raw materials with respect to their environmental impact. Review of alternative raw materials.
BAT 220	Procedures	Incidents and near misses investigation. Corrective action and following-up.
BAT 166	Records	Subsurface structure mapping.
BAT 167	Records	Inspections of external surfaces of process buildings, roofs, guttering, ancillary plant, roadways and open yards and storage areas.
BAT 173	Records	Visual inspection of tanks, bunds and sumps.
BAT 182	Records	Analysis of breakdowns in order to eliminate common failure modes.

BAT 188 & 198	Records	Raw material and water usage benchmarks.
BAT 192*	Records	Waste minimisation audits and improvement programme.
BAT 196* & 197	Records	Water efficiency audit and water efficiency improvement programme.
BAT 199	Records	Water usage measurements.
BAT 202*	Records	Waste inventory and treatment method.
BAT 210 & 211*	Records	Annual review of waste disposal and recovery options.
BAT 212*	Records	Annual energy report.
BAT 221*	Records	Accident management plan.
BAT 234	Records	Identification of key plant and equipment with the potential to give rise to significant noise. Mitigation measures.
BAT 235	Records	Results from continuous monitoring systems.
BAT 242	Records	Maintenance and calibration of continuous monitoring systems.
BAT 260	Records	Analysis for Schedule 5 substances (where needed).
BAT 261	Records	Records of waste monitoring and recording.
* Information that Regulators may be more likely to ask operators to send them copies of rather than relying only on inspection		

3.288 The amount of information and size of reports or documents required under the information provisions should be decided on a 'fit for purpose' basis. The label 'report' or 'record' should not be taken to imply that a sizeable document must be submitted if the required information can be provided in much shorter form. A report could comprise a paragraph or two if that was agreed to be sufficient for the purpose. Alternatively, lengthy documents may be necessary in particular circumstances.

All the information listed in Tables 14 and 15 is considered necessary either:

a) for regulators to keep a watch on the performance of an installation (e.g. monitoring data and who is the competent person to liaise with over complaints) or on the operator's efforts to improve performance (e.g. waste minimisation and energy audits); **and/or**

b) for operators to maintain an appropriate level of control over the installation, and which regulators should have access to should they wish to check that the information is being properly kept or to examine the information for regulatory purposes.

References

Environment Agency documents referred to below are available from the Environment Agency website www.environment-agency.gov.uk/ Many of the references below are being made available free of charge for viewing or download on the website. The same information can also be accessed via the SEPA website www.sepa.org.uk, or the NIEA website www.ehsni.gov.uk

Ref 1 Environmental Permitting (England and Wales) Regulations 2010, SI2010/675

Ref 1b Pollution Prevention and Control (Scotland) Regulations 2000, 2000 No 323

Ref 1c Pollution Prevention and Control (Northern Ireland) Regulations 2003, 2003 No 46

Ref 2 Secretary of State's Guidance (England and Wales): General Guidance Manual on Policy and Procedures for A2 and B Installations , March 2003 - available from the Defra website Guidance « Defra

Ref 2b A Practical Guide for Part A activities (Scotland)

Ref 2c IPPC (Northern Ireland) A Practical Guide

Ref 3 The Control of Pollution (Oil Storage) (England) Regulations 2001, SI2954. Further guidance on the Regulations , if needed, is available from http://www.environment-agency.gov.uk/business/topics/oil/default.aspx

Ref 3b Water Environment (Oil Storage) (Scotland) Regulations 2006, SSI 133

Ref 3c The Control of Pollution (Oil Storage) Regulations (Northern Ireland) 2010

Ref 4 Guidance Note from the Department for Environment, Food, and Rural Affairs and the National Assembly for Wales' on the implementation of the Solvent Emissions Directive - available from the Defra website and, in hard copy, from the Defra Publications line 08459 556000 available from http://www.defra.gov.uk/environment/policy/permits/documents/sed-guidance.pdf

Ref 5 IPPC Reference Document on Best Available Techniques in the Surface Treatment using Organic Solvents - January 2007, European IPPC Bureau www.eippcb.jrc.es/reference/

Ref 6 HMIP Technical Guidance Note (Dispersion) D1, 1993 The Stationery Office ISBN0117527947

Ref 7 EMS Guidance available from Envirowise http://envirowise.wrap.org.uk/uk/Topics-and-Issues/EMS.html

Ref 7a GG429 Cost Effective Solvent Management, available from Envirowise

Ref 8 Other Management, Resource Efficiency and Waste Minimisation References:

- Defra/DTI - Changing Patterns - UK Government Framework for Sustainable Consumption and Production Sept 2003 http://www.defra.gov.uk/environment/business/scp/
- National Industrial Symbiosis Programme http://www.nisp.org.uk/

Ref 9 Process Optimisation References available from Envirowise: www.envirowise.gov.uk

Ref 10 Waste & Resources Action Programme (WRAP), The Old Academy, 21 Horse Fair, Banbury, Oxon OX16 0AH. www.wrap.org.uk

Ref 11 BS 5908: Code of Practice for Fire Precautions in the Chemical and Allied Industries http://shop.bsigroup.com/en/ProductDetail/?pid=000000000000213156

Ref 12 Environment Agency, Pollution Prevention Guidance Note - Pollution prevention measures for the control of spillages and fire-fighting run-off, PPG 18, gives information on sizing firewater containment systems www.environment.agency.org.uk/

Ref 13 Monitoring Guidance available on the Environment Agency website and by following this link http://www.environment-agency.gov.uk/business/regulation/31829.aspx

- M1 Sampling requirements for monitoring stack emissions to air from industrial installations, Environment Agency, January 2010
- M2 Monitoring of stack emissions to air, Environment Agency, January 2010
- Guidance on sampling and testing of wastes to meet landfill waste acceptance procedures. Environment Agency http://www.environment-agency.gov.uk/business/sectors/37223.aspx
- MCERTS approved equipment http://www.siraenvironmental.com/mcerts/

Ref 14 HSE Guides to use and storage of solvents:http://www.hse.gov.uk/pubns/books/index-hsg-ref.htm

- HS(G) 51: The storage of flammable liquid containers (1990)
- HS(G) 140: Storage of flammable liquids in tanks (1998)
- HS(G) 176: The safe use and handling of flammable liquids (1996)

Ref 14b Dangerous Substances and Explosive Atmosphere Regulations (DSEAR) SI2776 2002

Ref 15 Surface water & Groundwater Protection Guidance

- Groundwater Protection Code – Solvent Use and Storage, Defra 2004 http://www.defra.gov.uk/environment/quality/water/waterquality/ground/solvents.htm

Ref 16 prEN 13966, Determination of the Transfer Efficiency of Atomising and Spraying Equipment for Liquid Coating Materials – Part 1: Flat Panels – March 12, 2001.

Ref 17 HSE's Engineering Information Sheet EIS34 Surface cleaning: Solvent update including the reclassification of trichloroethylene. http://www.hse.gov.uk/pubns/eis34.pdf

Ref 18 Source Testing Association (STA) http://www.s-t-a.org/

Abbreviations

BAT	Best Available Techniques – see IPPC General Guidance Manual or the Regulations for further definition
BAT-AEL	Best Available Techniques – Associated Emission Levels
BOD	Biochemical Oxygen Demand
BREF	BAT Reference Document
CCA	Climate Change Agreement
CEM	Continuous Emissions Monitoring
CEPE	Consul Europeen de l'industrie Peinture des Encres d'imprimerier et des Couleurs d'Art
CHP	Combined Heat and Power plant
COD	Chemical Oxygen Demand
DI	De-Ionised
DMF	Dimethylformamide
DPA	Direct Participation Agreement
DWI	Draw and Wall Iron
EA	Environment Agency
EAL	Environmental Assessment Level
ELV	Emission Limit Value
EMS	Environmental Management System
ETP	Effluent Treatment Plant
EU	European Union
EQS	Environmental Quality Standard
HSE	Health and Safety Executive
IBC	Intermediate Bulk Container
IEC	International Electrotechnical Commission
IPA	Iso-propyl alcohol
IR	Infra Red
ITEQ	International Toxicity Equivalents
LEL	Lower Explosive Limit
LFL	Lower Flammability Limit
MCERTS	Monitoring Certification Scheme
NIEA	Northern Ireland Environment Agency
NOx	Oxides of nitrogen
PET	Polyethylene Terephthalate
PVC	Poly Vinyl Chloride
QA	Quality Assured
QC	Quality Control
SAC	Special Areas of Conservation
SECp	Specific Energy Consumption
SED	Solvent Emissions Directive 1999/13/EC
SEPA	Scottish Environment Protection Agency
SMP	Solvent Management Plan
SOx	Oxides of sulphur
SPA	Special Protection Area
TBT	Tri Butyl Tin
TSS	Total Suspended Solids
TOC	Total Organic Carbon
UV	Ultra Violet
VOC	Volatile Organic Compounds
VSD	Variable Speed Drive

Definitions

***Adhesive** shall mean any preparation, including all the organic solvents or preparations containing organic solvents necessary for its proper application, which is used to adhere separate parts of a product;*

Application of continuous film of coating shall mean the application of a film of coating to the surface of a substrate, by continuous methods such as dipping, spraying, air knife coating, application by roller etc, where no repeated pattern of breaks in the coating occur;

***Coating** shall mean any mixture, including all the organic solvents or mixtures containing organic solvents necessary for its proper application, which is used to provide a decorative, protective or other functional effect on a surface;*

***Coating activity** shall mean coating activity in which a single or multiple application of continuous film of a coating is applied. If the coating activity includes a step in which the same article is printed by whatever technique is used, that printing step is considered part of the coating activity;*

Contained conditions shall mean conditions under which an installation is operated such that the VOCs released from the activity are collected and discharged in a controlled way either via a stack or abatement equipment and are therefore not entirely fugitive;

Food contact shall mean a coating which needs to comply with the requirements of the food safety legislation (the materials and articles in contact with food regulations) and is applied to packaging for food which may be consumed by humans or animals;

***Fugitive VOC emissions** shall mean any emissions not in waste gases of VOCs into air, soil and water as well as, unless otherwise stated in Annex IIA of the SED, solvents contained in any products. They include uncaptured emissions released to the outside environment via windows, doors, vents and similar openings;*

***Halogenated organic solvent** shall mean an organic solvent which contains at least one atom of bromine, chlorine, fluorine or iodine. per molecule;*

***Hazard statement** shall mean a phrase assigned to a hazard class and category that describes the nature of the hazards of a hazardous substance or mixture, including, where appropriate, the degree of hazard;*

Ink shall mean a mixture, including all the organic solvents or mixtures containing organic solvents necessary for its proper application, which is used in a printing activity to impress text or images on to a surface;

***Input** shall mean the quantity of organic solvents and their quantity in mixtures used when carrying out an activity, including the solvents recycled inside and outside the installation, and which are counted every time they are used to carry out the activity;*

Installation shall have the same meaning as in the General Guidance Manual;

***Mixture** shall mean mixtures or solutions composed of two or more substances;*

***Organic solvent** shall mean any VOC which is used alone or in combination with other agents, and without undergoing a chemical change, to dissolve raw materials, products or waste materials, or is used as a cleaning agent to dissolve contaminants, or as a dissolver, or as a dispersion medium, or as a viscosity adjuster, or as a surface tension adjuster, or a plasticiser, or as a preservative;*

***Organic compound** shall mean any compound containing at least the element carbon and one or more of hydrogen, halogens, oxygen, sulphur, phosphorus, silicon or nitrogen, with the exception of carbon oxides and inorganic carbonates and bicarbonates;*

Oxidation shall mean either thermal oxidation or catalytic oxidation;

Oxidation plant means thermal or catalytic incineration plant;

Printing activity shall mean any reproduction activity of text and/or images in which, with the use of an image carrier, ink is transferred onto whatever type of surface. Associated varnishing, coating, laminating techniques and cleaning of the equipment are included as part of the activity;

Reuse of organic solvents *shall mean the use of organic solvents recovered from an installation for any technical or commercial purpose and including use as a fuel but excluding the final disposal of such recovered organic solvent as waste;*

Risk Phrase shall mean the same as in Directive 67/548/EEC:

- R40 - limited evidence of a carcinogenic effect
- R45 - may cause cancer
- R46 - may cause heritable genetic damage
- R49 - may cause cancer by inhalation
- R60 - may impair fertility
- R61 - may cause harm to the unborn child
- R68 – possible risk of irreversible effects

Shortest possible time shall have the same meaning as in DEFRA Guidance on the Implementation of Solvent Emissions Directive (1999/13/EC) March 2002, as further explained in the General Guidance Manual, Chapter 34 (Ref 2).

Start-up and shutdown operations *shall mean operations whilst bringing an activity, an equipment item or a tank into or out of service or into or out of an idling state. Regularly oscillating activity phases are not to be considered as start-ups and shutdowns;*

Site boundary shall have the same meaning as given in Annex 3 of the GGM (Ref 2);

Standard Conditions *shall mean a temperature of 273,15 K and a pressure of 101,3 kPa;*

Substances *shall mean any chemical element and its compounds, as they occur in the natural state or as produced by industry, whether in solid, liquid or gaseous form;*

Surface Cleaning shall mean any activity except dry cleaning using organic solvents to remove contamination from the surface of material including degreasing;

Technically connected shall have the same meaning as in the General Guidance Manual (Ref 2);

Varnish *shall mean a transparent coating;*

Volatile Organic Compound (VOC) *shall mean any organic compound having at 293,15 K a vapour pressure of 0,01 kPa or more, or having a corresponding volatility under the particular conditions of use. For the purpose of the Solvents Directive, the fraction of creosote which exceeds this value of vapour pressure at 293,15 K shall be considered as a VOC*;

VOC total emissions *shall mean the sum of fugitive emissions and emissions in waste gases;*

VOC waste gases *shall mean the final gaseous discharge containing VOCs or other pollutants, from a stack or abatement equipment into air. The volumetric flow rates shall be expressed in Nm^3/h at standard conditions*

Appendix 1: Summary of Changes

Reasons for the main changes are summarised below.

Table 16 - Summary of changes

Section/ Paragraph/ Heading	Change	Reason
Front Page		
Title changed to take account of the DA’ s Regulations. Statutory Guidance: Surface Treatment using Solvents Part A2 (England & Wales) Part A (Scotland) Part A (Northern Ireland)		
1. Introduction		
Paras 1.1 – 1.12	Text revised to take account of DA’s Regulations	
Para 1.15	Detailed explanation of compliance requirements for existing installations or activities	Publication in 2007 of the STS BREF Note
Table 1	Compliance requirements from previous notes split into two tables (Table 1 and Table 2)	Includes compliance requirements from SG6(03) and SG6(08)
Table 2	Previously part of Table 1	Includes compliance requirements from SG6(08)
Table 3	Previously Table 2	Updated compliance requirements
Para 1.16	Timescale to comply with Table 6b	Table 6b reflects BAT provisions published in the 2007 STS BREF Note
Para 1.17	New paragraph specifying submission of a compliance report to the local authority regulator	Enables the regulator to be satisfied as to progress with meeting the provisions of Table 6b.
Para 1.18	Previously para 1.16 but with new text to reflect Table 6b	Table 6b reflects BAT provisions published in the 2007 STS BREF Note
Para 1.19	Previously 1.17	Insertion of new paras 1.16, 1.17
Para 1.20	Previously 1.18	Insertion of new paras 1.16, 1.17
Para 1.21	Previously 1.19	Insertion of new paras 1.16, 1.17
Table 4	Previously Table 3	Maintain continuity of Note
2. Emission limits and other provisions		
Para 2.1	New text to explain origin of Table 5 (largely copy of old Table 4) and specific changes therein: Row 2 (new), Rows 5,6,7 (small changes). Inclusion of R68 as a risk phrase	Updated compliance requirements
Table 5	Previously Table 4	Maintain continuity of Note
Para 2.2	New text to introduce Tables 6a and 6b	Maintain continuity of Note
Para 2.3	New text to explain cases where SG notes and PG notes should be used to set permit conditions	Updated compliance requirements
Para 2.4	New text to introduce Table 6a	Updated compliance requirements
Table 6a	New Table	Updated compliance requirements
Para 2.5	New text explaining origin of Table 6b (largely same	Updated compliance requirements

	as previous Table 5) and specific changes therein: 2 new columns on RHS showing BREF-derived provisions and 4 other differences	
Para 2.6	New text introducing Table 6c	Monitoring requirements previously detailed in Table 5 of SG6(08)
Para 2.7	New text explaining why and which sectors are not addressed in SG6(11)	Updated compliance requirements
Para 2.8	Previously 2.3	Maintain continuity of Note
Para 2.9	Previously 2.4	Maintain continuity of Note
Table 7	Previously Table 6	Maintain continuity of Note
3. Techniques for pollution control		
Installation description and in-process controls		
BAT numbers in SG6(11) may be different from previous versions of SG6.		
BAT 122	Text added “under test conditions”	BAT 121 previously implied an efficient transfer rate of 65% under all conditions
BAT 124	Text added “under test conditions”	BAT 121 previously implied an efficient transfer rate of 65% under all conditions
BAT 249 - 252	Text added to monitoring requirements	Improved clarification

Appendix 2: VOC compliance methods

Introduction

All activities within the scope of this document are regulated by the SED (Council Directive 1999/13/EC of 11 March 1999) and IPPC applies to the larger installations within SED control. All are therefore required to demonstrate compliance by either of the options given in the SED, both of which require the production of a Solvent Management Plan.

The STS BREF document, "Surface Treatment using Solvents" (Ref 5) details those industry sectors where compliance criteria in the BREF differ from those in the SED. It also gives advice, (Annexes 24.2 & 24.4), on solvent management plan calculations. The application of these methods to the printing industry, (Annex 24.3.1), and the automobile sector, (Annex 24.5), is also covered. Local Regulators may wish to consult the BREF where such industries are regulated.

Solvent Management Plan

Definitions:

The following definitions provide a framework for the mass balance calculations used in determining compliance with the requirements of the Solvent Management Plan and the Reduction Scheme.

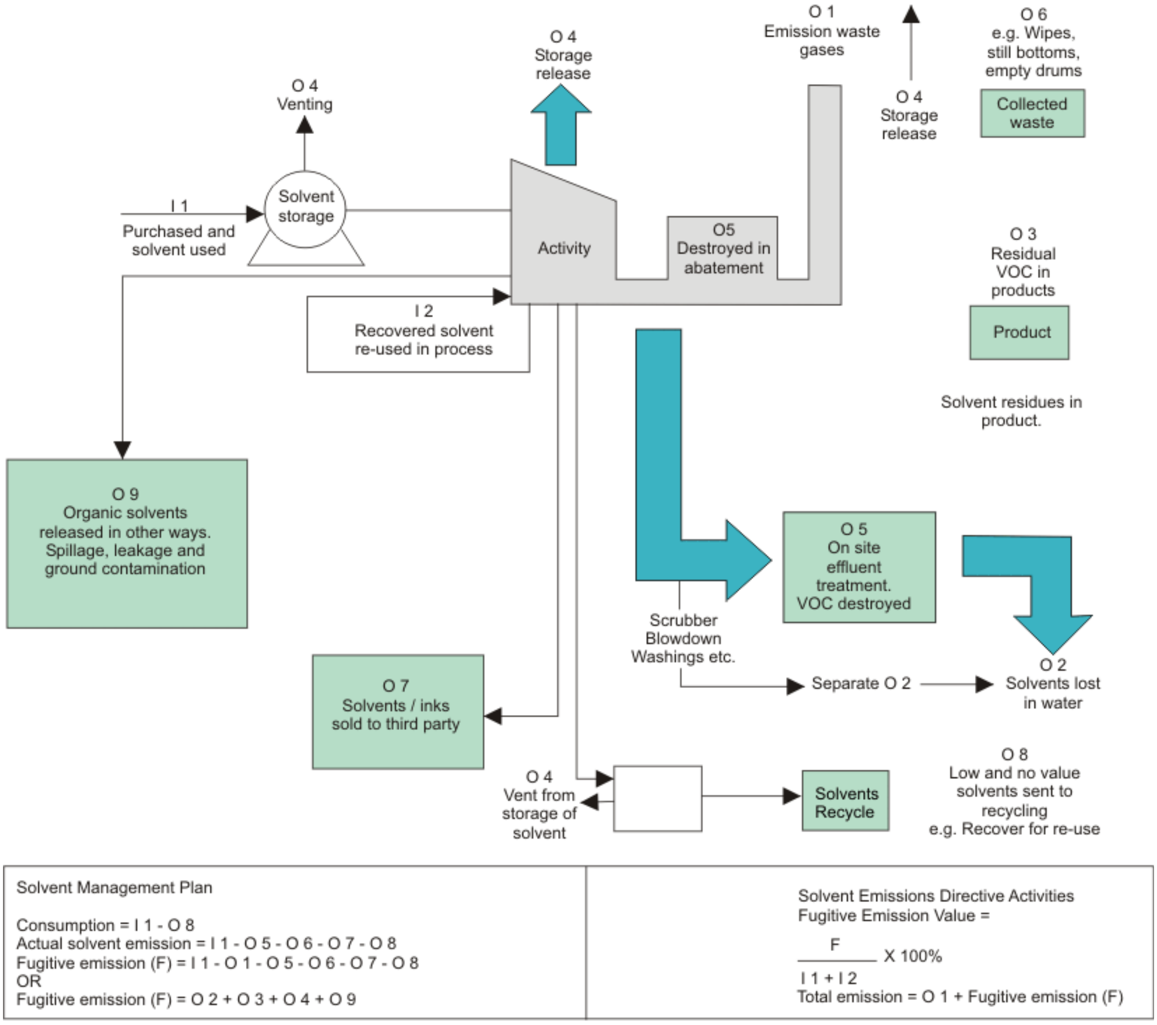
Inputs of Organic Solvent in the time frame over which the mass balance is being calculated (I)

I1	The quantity of organic solvents, or their quantity in mixtures purchased which are used as input into the process/activity (including cleaning solvents).
I2	The quantity of organic solvents or their quantity in mixtures recovered and reused as solvent input into the process/activity. (the recycled solvent is counted every time it is used to carry out the activity.)

Outputs of Organic Solvents in the time frame over which the mass balance is being calculated (O)

O1	Emissions in waste gases
O2	Organic solvents lost in water, if appropriate taking into account waste water treatment when calculating **O5**
O3	The quantity of organic solvents which remains as contamination or residue in products output from the process/activity.
O4	Uncaptured emissions of organic solvents to air. This includes the general ventilation of rooms, where air is released to the outside environment via windows, doors, vents and similar openings.
O5	Organic solvents and/or organic compounds lost due to chemical or physical reactions. (including for example those which are destroyed, e.g. by thermal oxidation or other waste gas or waste water treatments, or captured, e.g. by adsorption, as long as they are not counted under **O6, O7** or **O8**).
O6	Organic solvents contained in collected waste.
O7	Organic solvents, or organic solvents contained in mixtures, which are sold or are intended to be sold as a commercially valuable product.
O8	Organic solvents contained in mixtures 'recovered for reuse but not as input into the process/activity, as long as not counted under **O7**.
O9	Organic solvents released in other ways.

Figure 3.14 - Solvent Management Plan



Solvent Management Plan

Consumption = I 1 - O 8
Actual solvent emission = I 1 - O 5 - O 6 - O 7 - O 8
Fugitive emission (F) = I 1 - O 1 - O 5 - O 6 - O 7 - O 8
OR
Fugitive emission (F) = O 2 + O 3 + O 4 + O 9

Solvent Emissions Directive Activities
Fugitive Emission Value =

$$\frac{F}{I\,1 + I\,2} \times 100\%$$

Total emission = O 1 + Fugitive emission (F)

Determination of Consumption

Consumption (**C**): means the total input of organic solvents into an installation in the last calendar year, or previous 12-month period (**I1**), less any VOC that are recovered for reuse (**O8**).

The total mass of Solvent Inputs and Outputs must be determined and submitted to the regulator annually, preferably to coincide with the operators stocktaking requirements, in the form of a mass balance in order to determine the annual actual consumption of solvent

Where: C= I1- O8

I1 Total quantity of organic solvents, or their quantity in mixtures purchased which are used as input into the process/activity

A calculation of the purchased Solvent Input (**I1**) to the process/activity, is carried out by recording:

- mass of solvent contained in inks, coatings, diluents and cleaners in the initial stock (**IS**) at the start of the accounting period; **plus**
- mass of solvent contained in inks, coatings, diluents and cleaners in the purchased stock (**PS**) during the accounting period; **minus**
- mass of solvent contained in inks, coatings, diluents and cleaners in the final stock (**FS**) at the end of the accounting period.

Total Solvent Input (I1) = IS + PS - FS

Determination fugitive VOC emissions

To demonstrate compliance with fugitive emission values in Section 2 the operator must determine the fugitive emissions (F) from the installation using the following:

- F = I1 -O1 -O5 -O6 -O7 -O8 **or**
- F=O2+O3+O4+O9

This quantity can be determined by direct measurement of the quantities. Alternatively, an equivalent calculation can be made by other means, for instance by using the capture efficiency of the process.

The Fugitive Emission value as a percentage of the Solvent Input (**I**) is determined by

Fugitive Emission Value = 100 x F/I

Where the Solvent Input **(I)= I1+ I2** (determined as part of the Solvent Management Plan)

Fugitive emission values must be determined for each installation, once completed, it need not be repeated until the equipment is modified.

Determination of compliance with the Reduction Scheme

Compliance with Reduction Scheme is achieved if the annual actual solvent emission is less than or equal to the Target Emission.

Where the annual actual solvent emission is:

annual actual solvent emission = I1-O8-O7-O6 (-O5 if abatement has been used)

(see Definitions above)

Where a coating activity includes both food and non-food contact coating, compliance with the reduction scheme should be determined for each operation separately. Compliance is achieved if the annual actual solvent emission for both the food contact and the non-food contact coating is less than or equal to the sum of the individual target emissions for food contact and non-food contact coating.

The solids content of coating inks etc. should be determined in accordance with ISO method ISO-3251:1993(E)

Determination of compliance with the Total Emission Limit Values

Compliance is achieved if the Total Emission from the activity expressed in solvent emissions per unit of product, or otherwise as stated is equal to or less than the Total Emission Limit Value,

Where Total Emission Is equal to the mass of solvent released in waste gases Plus the fugitive emissions determined above

Total Emission = O1 + Fugitive (See above)

Appendix 3: European Commission Guidance on VOC Substitution and Reduction for Activities covered by the VOC Solvent Emissions Directive.

The guidance can be downloaded from by following this link:

0	Introduction chapter
1	Heatset web offset printing
2	Publication rotogravure
3	Other rotogravure, flexography, rotary screen printing, and laminating or varnishing units
4/5	Surface cleaning
6.1	Vehicle coating (< 15 t) and vehicle refinishing
6.2	Vehicle coating (large series)
7	Coil coating
8.1	Other metal coating
8.2	Other coating - plastic, textile, fabric, film and paper coating
9	Winding wire coating
10	Coating of wooden surfaces
11	Dry cleaning
12	Wood impregnation
13	Coating of leather
14	Footwear manufacture
15	Wood and plastic lamination
16	Adhesive coating
17	Manufacturing of coatings, varnishes, inks and adhesives
18	Rubber conversion
19	Vegetable oil and animal fat extraction and vegetable oil refining activities
20	Manufacturing of pharmaceutical products