

Imaging System Airborne Emissions Assessment Protocol

ISAEAP

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Revision History

Revision	Date	Author	Comments
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1	2001-08-31		
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PREAMBLE

The purpose of this Protocol is to provide a uniform procedure for evaluating airborne emissions from printing media that are subject to such evaluation while they are being imaged on Creo imaging systems. The Protocol is available to Creo customers. Occupational Health professionals or others familiar with air quality regulations and measurements may use the Protocol to help customers assess the effect of Creo imaging systems on the indoor air quality in operator work environments.

The test conditions defined in this Protocol are believed to be more adverse than conditions in typical installations. However, neither this Protocol, nor any reference to it provide an assurance of occupational safety under all circumstances, because of factors unknown or uncontrollable by Creo. Some of the factors that may result in unsafe conditions include, but are not limited to, the following:

- **Inadequate air ventilation or poor air mixing in the imaging room, which may cause higher than expected emissions concentrations in all or parts of the room.**
- **Imaging conditions more severe than those examined under this Protocol, which may cause higher levels of emissions to occur.**
- **Imaging of media that were not qualified by Creo.**
- **Changes to the imaging media formulation made by the media manufacturer, resulting in emissions changes. This may cause different or greater emissions than expected.**
- **Incorrect or incomplete specification of suspected emissions to Creo by the media manufacturer, which may cause different or greater emissions than expected.**
- **Combined action of airborne emissions from multiple compounds, which may – through cumulative or synergistic effects – cause greater than expected effects on human health.**
- **Airborne emissions from other sources combining with the imaging system's emissions to exceed occupational health regulations or having cumulative effects on human health greater than those expected for individual emissions.**
- **Variation in individual sensitivity to airborne emissions, which may cause greater effects on susceptible individuals.**
- **Tampering with, misuse, or incorrect maintenance of imaging equipment or emissions safety systems, which may cause additional emissions to occur.**
- **Non-compliance with instructions in user guides, warning labels or site preparation documents, which may cause excessive emissions levels.**
- **Changes in occupational health regulations or good industrial hygiene practices, which may result in a system that is considered safe being found to be unsafe at a later date.**

Because of these variables, all of which are in the control of the end user or the media manufacturers, Creo cannot warrant that, under all installations and operating conditions and with all media, its imaging system will not produce emissions that an

operator may object to or may claim are injurious. Creo's sole warranty is the one provided under its standard terms of sale. Therefore, this Protocol is not a warranty or guarantee of particular performance. Ultimately, it is the end user's responsibility to ensure continuing compliance with all Occupational Health & Safety regulations, limits and guidelines in their work environment.

THIS PROTOCOL IS NOT A PROMISE OR GUARANTEE OF A PARTICULAR LEVEL OF PERFORMANCE FOR A PARTICULAR IMAGING SYSTEM, NOR IS THE PROTOCOL A WARRANTY OF ANY KIND WHATSOEVER. CREO'S SOLE WARRANTY IS THE ONE PROVIDED UNDER ITS STANDARD TERMS OF SALE.

1. OBJECTIVE

Creo uses this Protocol to assess the level of airborne emissions released under specified conditions by an imaging medium when it is being imaged by a graphic arts imaging system (consisting of an output device equipped with a debris removal system that vents system exhaust into the imaging room). The resulting emissions concentrations can be compared to regulatory limits* as defined in this Protocol.

Certain imaging systems are quite similar in performance. When one such system has met the criteria of this Protocol with a specified imaging medium, an evaluation based on the performance of that system on that medium may, at Creo's discretion, be substituted for actual testing of the specified medium in the similar system. Another reason for the evaluation as opposed to the actual testing may be a change of the regulatory limit(s).

2. POTENTIAL EMISSIONS TO BE ASSESSED

The potential emissions to be assessed under this Protocol shall be the particular compounds identified as an airborne by-product of imaging a particular medium by the medium's manufacturer either via an MSDS (material safety data sheet) or written communication to Creo if the MSDS does not yet exist at the time of assessment or if the MSDS does not yet address the emissions released by the medium during imaging. Creo may choose to assess additional emissions compounds beyond those specified by the medium's manufacturer. Any additional emissions found shall be communicated to the medium's manufacturer for inclusion into the MSDS.

Regardless of the contents of the media manufacturer's information, the emissions of the following compounds shall be assessed for all media:

1. formaldehyde,
2. acetaldehyde,
3. nitrogen dioxide,
4. nitric oxide, and
5. carbon monoxide.

For flexographic media, the following additional compounds shall be assessed:

6. benzene, and
7. 1,3-butadiene.

3. APPLICABLE CRITERIA

To meet the criteria of this protocol, the imaging systems, when used with the media listed in Appendix 1, shall not generate concentrations of the airborne emissions selected for assessment in accordance with Section 2 that exceed the limits specified in Sections 3.1 and 3.2, under the conditions specified in Sections 3.3, 3.4 and 3.5.

* Asterisk here and elsewhere indicates term defined in Section 5.

3.1 Operator Breathing Zone Concentrations

The Total Relative Hazard* (TRH) of the airborne emissions under assessment shall be less than 1 in the operator breathing zone* (OBZ).

Individually regulated emissions*, shall have in the OBZ concentrations below 70% of the lesser of (1) the action level* or (2) the hazard communication level* for that emission.

3.2 Debris Removal Cabinet Air Outlet Concentrations

At the debris removal cabinet air outlet, the individually regulated emissions shall have concentrations below the lesser of (1) the action level or (2) the hazard communication level for that emission.

Note: The emissions in this area are not normally inhaled, unlike those in the operator breathing zone.

3.3 Conditions

The determination of the concentrations of airborne emissions shall be done under the following conditions:

a. Imaging at maximum rate; i.e., no idle time between plates or films except as required to load the machine.

b. Maximum imaging speed determined by the date of testing, tolerance ± 10%.

c. Maximum plate or film size, tolerance +0%, –10% (corresponding to the largest duty cycle).

d. Maximum percentage of imaged area as follows:

Negative plates*	50%
Positive plates*	100%
Film	100%

e. Imaging exposure determined by the date of testing as the optimum exposure for the printing medium, tolerance +10%, –0%.

f. Chemical and particulate filters before the end of their service life.

g. Minimum permissible air flow through the debris removal system (corresponding to the least efficient extraction of emissions), tolerance +10%, –0%.

h. Moderately mixed room air ("K" Factor ~ 5 [1]). Sampling for OBZ should be taken in the zones estimated as the stale air pockets of higher emission concentrations.

i. Room outdoor air ventilation rate of 2.8 m^3/min (100 cubic feet per minute), tolerance ±10%, unless otherwise specified in the Assessment Report in accordance with Sections 3.4 or 3.5.

3.4 Use of a Higher Ventilation Rate

An imaging system may meet the criteria of this Protocol by not generating concentrations of airborne emissions selected for assessment in accordance with Section 2 that exceed the limits specified in Sections 3.1 and 3.2, under the conditions specified in Section 3.3(a) – (h)

and with a room ventilation rate specified by the imaging system manufacturer that is higher than that provided in Section 3.3(i).

3.5 Calculation of Concentrations

If sampling in OBZ is considered impractical (e.g., if the room outdoor air ventilation rate cannot be established, or sampling time needed to reach the concentrations steady state is too long), sampling should be performed both in the filter air outlet (tailpipe) and inside the output device, and the concentration of each contaminant in OBZ should be calculated by

$$C_{OBZ} = C_{OD} + C_{AO}\frac{Q_{AO}}{Q_{vent}},$$

where C – the concentration (mg/m^3); Q – the air flow; the indexes stand for: AO – air outlet of the debris removal cabinet; OBZ – operator breathing zone; OD – inside output device; vent – outdoor air ventilation.

Q_{AO} should be accepted in accordance with Section 3.3(g); and Q_{vent}, in accordance with Section 3.3(i) or 3.4.

4. IDENTIFICATION OF AN IMAGING SYSTEM THAT HAS MET THE CRITERIA

An imaging system that meets the criteria of this Protocol with a particular imaging medium can be entered in Appendix 1. For those system-media combinations for which a higher ventilation rate than that provided in Section 3.3(i) is required, that higher rate shall be included with the listing in Appendix 1.

5. DEFINITIONS

a. Action level – for an individually regulated emission, the action level as defined in US document 29 CFR, Part 1910, Subpart Z, for that emission.

b. Hazard communication level – for an individually regulated emission, the concentration that triggers a requirement for hazard communication or training as defined in US document 29 CFR, Part 1910, Subpart Z, for that emission.

c. Individually regulated emission – an air emission for which an individual standard exists in US document 29 CFR, Part 1910, Subpart Z (OSHA regulations).

d. Negative plate – a plate where the thermally imaged area prints.

e. Operator Breathing Zone – the zone where the machine operator's head is normally expected to be. Operator breathing zone concentrations are assumed equivalent to the time-weighted average room concentrations, due to the assumption of good air mixing.

f. PNOS – particulates not otherwise specified (formerly known as PNOC – particulates not otherwise classified).

g. Positive plate – a plate where the thermally imaged area does not print.

h. Regulatory limit – the regulatory limit for each emission is the US OSHA Permissible Exposure Limit (PEL), or ACGIH Threshold Limit Value (TLV ®), or Germany's

Maximum Concentration Value in the Workplace (MAK), whichever is smaller [2]. Particulate emissions are assumed to be respirable PNOS* [3], unless otherwise specified by the media manufacturer. Reference [2] will be used as the source of information to determine the applicable regulatory limit.

i. Total Relative Hazard (TRH) – the sum of the ratios of the concentration of an emission to the regulatory limit*, for all suspected air emissions. The TRH definition follows the theory of "TLV for Mixtures" as referred to in [4], except the "regulatory limit" in this standard is used in place of the "threshold limit" per ACGIH. The TRH calculation assumes toxicity of all emissions to be additive.

APPENDIX 1

Imaging systems that have met the criteria of the Protocol with assessed imaging media

Imaging medium		Imaging system		Testing date	Outdoor air ventilation required if greater than 2.8 m^3/min = 100 cfm	Assessment Report No. and date
Manufacturer	Name	Output device	Debris removal system			
KPG (Kodak Polychrome Graphics)	Thermal No Process Plate (TNPP) "Navajo"	TS 3244	TH2 nozzle and UDRC prototype	March 09, 2001	N/a	TNPP/3244-1.01 May 1, 2001
Presstek	Anthem	4up	TH2 nozzle and UDRC prototype; Extended to TH1.7 nozzle	July 27, 2001	N/a	Anthem/4up-1.01 August 28, 2001

REFERENCES

[1] Industrial Ventilation. A Manual of Recommended Practice. ACGIH, 22nd Edition, 1995 (Section 2.3.1).

[2] Guide to Occupational Exposure Values, ACGIH (listings of OSHA PELs, ACGIH TLVs, MAK), Current Edition.

[3] Particle Size – Selective Sampling Criteria for Airborn Particulate Matter; Respirable Particulate Mass. ACGIH 2000 TLVs® and BEIs®, Appendix D-C.

[4] Threshold Limit Value for Mixtures; Additive Effects. ACGIH 2000 TLVs ® and BEIs®, Appendix C-A (1).