Dominion Colour Corporation

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Safe Handling of PY.34 and PR.104 Pigments

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SAFE HANDLING OF PY.34 AND PR.104 PIGMENTS

CONTENTS

IMPORTANT NOTICE

The purpose of this document is to assist the recipient in developing effective programs for handling Lead Chromate based pigments namely, C.I Pigment Yellow 34 ("PY.34", with CAS number 1344-37-2) and C.I Pigment Red 104 ("PR.104", with CAS number 12656-85-8) and mixtures thereoff. The recipient must satisfy itself as to full observance of the laws of any relevant jurisdiction in connection therewith, including any requisite governmental or other consents which may be required and compliance with any other requisite formalities. The recipient should consult its professional advisors to ascertain whether any governmental or other consents may be required or any other formalities need to be observed.

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This document does not purport to contain all of the information that may be required to enable the recipient to establish effective programs to handle PY.34 and PR.104 products. DCC and its subsidiaries undertake no obligation to provide interested parties with access to any additional information or to correct any inaccuracies herein which may become apparent.

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INTRODUCTION

PY.34 and PR.104 contain lead and hexavalent chromium, both of which are metals of chronic health hazard concern. As such appropriate protocols and procedures need to be in place to ensure protection to human health and the environment. The user should always refer to the applicable Safety Data Sheets and the local regulations that are in place for health and safety information on these products.

PY.34 and PR.104, also known as Chrome Yellow and Molybdate Orange, can only be used for Industrial and Professional applications.

They **must not** be used for:

- Decorative/household/residential coatings
- Consumer products
- Printing inks for consumer products
- Food and food packaging
- Children's articles such as toys, paints, jewelry and equipment
- Drugs and medical devices
- Ceramics and Glassware
- Cosmetics and Tattoos

In order to protect consumers and the environment, some restrictions have been placed on the end uses of these pigments by governments. For example, in Canada, these products are controlled under Hazardous Products Act[1] (Surface Coatings Regulation[2], Hazardous Products Regulations[3]) and the Food and Drug Act (Cosmetic Hotlist[4]). The Canadian government agencies have analysed and authorised the use of these pigments in the existing commercial and industrial applications/settings by way of a Significant New Activity Order[5].

In the US, the Consumer Product Safety Improvement Act, 2008 (CPSIA 2008) and 16 CFR 1303[6]: Ban of Lead-Containing Paint and Certain Consumer Products Bearing Lead-Containing Paint, states the limitations and exemptions for lead in paint and surface coatings for articles intended for use by children, furniture and products sold directly to consumers. Various sections of the FDA[7] and ASTM F963[8] also address boundaries of food safety and toy safety that impact these pigments. In regard to packaging and packaging components, the Coalition of Northeastern Governors

[1] Found at: http://laws-lois.justice.gc.ca/eng/acts/H-3/index.html
[2] Found at: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2005-109/
[3] Found at: http://laws-lois.justice.gc.ca/eng/regulations/SOR-2015-17/index.html
[4] Found at: http://www.hc-sc.gc.ca/cps-spc/cosmet-person/hot-list-critique/index-eng.php
[5] Found at: http://www.gazette.gc.ca/rp-pr/p2/2012/2012-07-18/html/sor-dors144-eng.html
[6] Found at: http://www.ecfr.gov/cgi-bin/text-idx?SID=ef4fbe62fa3b14abc52400df949e040e&c=ecfr&tpl=/ecfrbrowse/Title16/16cfrv2_02.tpl#1000
[7] Found at: http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcfr/cfrsearch.cfm
[8] Found at: http://www.cpsc.gov/en/Business--Manufacturing/Business-Education/Toy-Safety/

(CONEG)[9] established the Toxics in Packaging Clearinghouse (TPCH) to reduce the amount of heavy metals (lead, chromium, mercury and cadmium) entering the waste stream.

In Europe under REACH[10], both PY.34 and PR.104 are Authorized substances. DCC PY.34 and PR.104 pigments and products are only authorized for Industrial Use[11] and Professional Use[12] in the paint/coating and plastics sectors as outlined in the Final Authorisation decision C(2016) 5644[13]:

For the paint/coating sector:

	Use description	Continued use granted until	PY.34 Authorisation Numbers	PR.104 Authorisation Numbers
Use 1	Distribution and mixing of pigment powder in an industrial environment into solvent-based paints for non-consumer use	21 May 2022	REACH/16/3/0	REACH/16/3/6
Use 2	Industrial application of paints on metal surfaces (such as machines vehicles, structures, signs, road furniture, coil coating, etc.)	21 May 2022	REACH/16/3/1	REACH/16/3/7
Use 3	Professional, non-consumer application of paints on metal surfaces (such as machines, vehicles, structures, signs, road furniture, etc.) or as road marking	21 May 2019	REACH/16/3/2	REACH/16/3/8

[9] Found at: http://www.toxicsinpackaging.org/
[10] Found at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R1907-20140410
[11] **Industrial uses** are those for industrial purposes which are performed at a location using a fixed installation for a commercial purpose.
[12] **Professional uses** are those that are not industrial but are performed in the context of the trade or profession of the operator.
[13] Found at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.C_.2016.337.01.0003.01.ENG&toc=OJ:C:2016:337:TOC

For the plastics sector:

	Use description	Continued use granted until	PY.34 Authorisation Numbers	PR.104 Authorisation Numbers
Use 4	Distribution and mixing pigment powder in an industrial environment into liquid or solid premix to colour plastic/plasticised articles for non-consumer use	21 May 2022	REACH/16/3/3	REACH/16/3/9
Use 5	Industrial use of solid or liquid colour premixes and pre-compounds containing pigment to colour plastic or plasticised articles for non-consumer use	21 May 2022	REACH/16/3/4	REACH/16/3/10
Use 6	Professional use of solid or liquid colour premixes and pre-compounds containing pigment in the application of hot melt road marking	21 May 2019	REACH/16/3/5	REACH/16/3/11

The EU Authorisation decision includes understandable conditions and requirements to ensure that risks are controlled and uses are restricted to the ones applied for.

In summary, the downstream users of DCC PY.34 and PR.104 in the EU are required to:

- Identify their use to the supplier/distributor to ensure all relevant exposure scenarios are taken into account *(REACH, Article 37 (2))*
- Notify their use to ECHA *(REACH, Article 66)*
- Verify the risk management measures and operational conditions listed in the eSDS *(EC Decision C(2016) 5644, Article 1.3.a)*
- Maintain a personal protective equipment program on the selection/use/maintenance/training *(EC Decision C(2016) 5644, Article 1.3.b)*
- Provide ECHA *(EC Decision C(2016) 5644, Article 1.3.d / Article 3.e/f):*
    - Pb in blood data
    - Cr in air data
    - surveillance record for each worker exposed to DCC PY.34 & PR.104
    - justification of use report (including an analysis of alternatives)

- Notify the supplier/DCC if risk management measures assigned in the eSDS are not appropriate and/or new information on hazardous properties is available *(REACH, Article 34).*

To promote compliance with the requirements of using DCC PY.34 and PR.104 products in the EU, DCC has also prepared additional supporting documents and guidance[14].

[14] Extended safety data sheets (eSDS) for DCC PY.34 and PR.104, REACH-IT Notification guidance and reporting templates for the EU are available. Please contact hschulpen@dominioncolour.nl for more information.

THE PIGMENTS

These pigments, PY.34 and PR.104**,** comprise a range of brightly coloured pigments, ranging from the greenish-yellow "Primrose" through the progressively redder shades of "Lemon" and "Medium" yellows through to the bright orange-red "Molybdate Oranges". The "Chrome Yellow" pigments are solid solutions of lead chromate and lead sulphate. The "Molybdate Orange" pigments are solid solutions of lead chromate, lead sulphate and lead molybdate.

Various grades of these pigments are available including regular, pre-darkened, low soluble lead, silica-encapsulated and other specialty grades, including low-dusting grades.

HAZARDS

TOXICOLOGY

Acute toxicology

Animal feeding studies have demonstrated extremely low acute toxicity for these pigments. The Oral LD_{50} is greater than 10,000 mg/Kg for rats.

Chronic toxicology

PY.34 and PR.104 contain lead and hexavalent chromium. Both metals are of chronic hazard concern.

a) Lead Toxicity

As far as lead toxicity is concerned, evidence from animal feeding studies indicates that PY.34 and PR.104 have a significantly lower level of toxicity than other, more soluble lead compounds. This is due to the lower bioavailability of lead from lead chromate due to its extremely low solubility[15].

White lead, for example, the pigment associated with lead poisoning in old white-painted housing in the U.S., is lead carbonate which is much more bioavailable to humans due to its solubility in the stomach acids, allowing the lead to enter the blood stream.

Chronic toxicological effects can arise from exposure above the relevant limit value to lead compounds over a prolonged period. The more serious toxic effects of chronic lead over-exposure may include damage to blood-forming organs resulting in

[15] Pure Lead Chromate has a solubility of 0.0058 g/L in water at 25 °C. The solubility in artificial body fluids is also extremely low. In lung fluid the solubility was shown to be below 0.0225 g/L. A substance is defined by the Scientific Committee on Occupational Exposure Levels (SCOEL) as poorly soluble if the solubility is below 1 g/L.

anaemia, and damage to the nervous system, urinary tract, digestive tract, reproductive systems, the unborn child and breastfed infants. These serious effects are the result of drastic overexposure due to ingestion or inhalation of lead compounds with significant bioavailability. PY.34 and PR.104 are expected to have a lower hazard potential based on the poor bioavailability, although this effect cannot be fully quantified. Based on the available data in the voluntary Risk Assessment Report for lead and inorganic lead compounds, it is concluded that woman of childbearing age, unborn children and suckling are the most sensitive groups.

b) Chromium Toxicity

EPA's health assessment document for chromium states that "animal cancer bioassay studies suggest that hexavalent chromium compounds (particularly soluble and sparingly soluble) are probably the etiological agent in chromium related human cancer. Data supporting this position exists for both rats and humans. Rat bronchial implant studies have shown that only Calcium, Strontium and Zinc chromates produced statistically significant increases in the numbers of bronchial carcinomas while no such issues were seen with seven different samples of Lead Chromate pigments[16].

The available epidemiological evidence on PY.34 and PR.104 pigments confirms these results. In every case where excess lung cancer incidences have been reported, exposure was either to Zinc Chromate alone or involved mixed exposures to various combinations of Zinc, Lead, Strontium or Barium Chromates. In studies where exposure was reported to be Lead Chromates alone, no increased incidence of lung cancer was observed[17].

The EU Scientific Committee on Occupational Exposure Limits (SCOEL) concluded in 2002 that the carcinogenic potential for Lead Chromates is low compared to other chromates based on its poor solubility[18]. The ECHA Risk Assessment Committee concluded in 2013 that the carcinogenicity of hexavalent chromium compounds is caused by the Cr(VI) ion which is released when the substance solubilises and dissociates[19]. Since PY.34 and PR.104 pigments have low solubility, the carcinogenic potential is anticipated to be low, although this reduction cannot be accurately quantified. The RAC also concluded that upon frequent, very high

[16] Levy, L.S., P.A.Martin, P.L. Bidstrup, Brit. J. of Ind. Med.,1986; 43:243-256.
[17] Davies J.M. "Lung Cancer Mortality among workers making Lead Chromate and Zinc Chromate Pigments at three English Factories", Br J. Indust. Med., 1984; 41:158-169. Lung cancer mortality among a cohort of male chromate pigment workers in Japan, K. Kano, International Journal of Epidemiology, 1993; Vol 22, 16-22. Mortality in employees in three plants which produced chromate pigments, W.C. Cooper, Equitability Environmental Health, Inc. for the Dry Color Manufacturers' Association, 1983
[18] Scientific Committee on Occupational Exposure Limits (2002). Recommendation from the Scientific Committee on Occupational Exposure Limits for lead and its inorganic compounds. SCOEL report SCOEL/SUM/83.
[19] Risk Assessment Committee (RAC) of ECHA. Application for Authorisation: Establishing a reference dose response relationship for carcinogenicity of hexavalent chromium. 04 December 2013. Reference: RAC/27/2013/06 Rev.1

exposures, very poorly soluble respirable particles may cause cancer. However, when the applicable exposure limits listed below are respected, this last mechanism will not occur.

In the European Union Risk Assessment Report (RAR) on Chromium trioxide, Sodium chromate, Sodium dichromate, Ammonium dichromate, and Potassium dichromate, the skin sensitizing potential of these Chromium compounds were reviewed. Skin sensitization was demonstrated in workers who were exposed to hexavalent Chromium compounds. Other studies also demonstrated these findings in occupational groups and patients. Furthermore, animal studies, including standard and modified guinea pig maximization tests and a mouse ear swelling test, confirm the skin sensitizing potential of hexavalent Chromium compounds. However, there is no specific data currently available for these two pigments.

The respiratory sensitizing potential of these Chromium compounds has also been documented. The available case reports and evidence from well-conducted bronchial challenge tests have concluded that hexavalent Chromium compounds can cause occupational asthma. However, no information is available for these pigments.

Overall, the likelihood of skin sensitisation and respiratory sensitisation is considered to be very low due to very poor bioavailability.

PHYSICAL HAZARDS

PY.34 and PR.104 are incombustible and do not have oxidising properties that warrant classification.

ENVIRONMENTAL CONCERNS

PY.34 and PR.104 contain high levels of lead (up to about 60%) and chromium (up to 12%) and must not be released into the environment. Tests on PY.34 and PR.104 indicate that with few exceptions they do not pass the U.S. Toxic Characteristic Leaching Procedure[20] (TCLP), exceeding the 5 mg/litre maximum for lead. PY.34 and PR.104 waste must therefore be classified as hazardous waste and disposed of appropriately in hazardous waste landfill sites in accordance with local regulations.Waste products containing PY.34 and PR.104 incorporated in a coatings or plastics resin may not be hazardous as the resin encapsulation may reduce the leachability below the 5 mg/litre limit. Leaching tests should be carried out to establish this.

In the Chemical Safety Report and EU REACH registration dossier for PY.34 and PR.104, it was concluded that due to their low water solubility these pigments are not acutely toxic to aquatic organisms, not biodegradable and have no relevant bioaccumulation potential due to their inorganic character. However, the European Commission has deemed that all products containing lead and hexavalent chromium must

[20] Found at http://www.epa.gov/epaoswer/hazwaste/test/txmain.htm
Then select Method #1311 to get http://www.epa.gov/epaoswer/hazwaste/test/1311.pdf

be considered toxic to the environment. The waste must be handled and disposed of in accordance with local regulations. Although a small fraction of lead and chromium ions will dissociate from the solids, the amounts that will dissociate are to be considered negligible as compared to the background level of lead (which is the leading substance for the environmental hazard of the pigments in the EU).

HAZARD CLASSIFICATION

"Chromium and certain Chromium compounds" including hexavalent chromium compounds are currently classified by the International Agency for Research on Cancer (I.A.R.C.) and the U.S. National Toxicology Program (N.T.P.) as carcinogens. The American Conference of Government Industrial Hygienists (A.C.G.I.H.) currently lists "chromates of lead" as "substances suspect of carcinogenic potential for man".

In the European Union, Lead Chromate based pigments have a harmonised classification (in Annex VI of the CLP Regulation) as Category 1B carcinogens ("May cause cancer"), Category 1A reprotoxicants ("May damage the unborn child, suspected of damaging fertility"), STOT RE 2 ("May cause damage to organs through prolonged exposure") and Aquatic Acute 1 & Chronic 1 ("Very toxic to aquatic life with long lasting effects").
The Skin and Respiratory Sensitisation potential of these pigments should also be taken into consideration when handling PY.34 and PR.104.

POTENTIAL ROUTES OF HUMAN EXPOSURE

Human exposure to lead and hexavalent chromium in PY.34 and PR.104 can occur through three routes.

Inhalation – by breathing air containing particles of PY.34 and PR.104 pigment dust (as such or in a mixture).

Ingestion – by swallowing particles of PY.34 and PR.104, either from pigment initially inhaled then subsequently ingested or from eating and smoking by transference of the pigment from hands or clothing due to poor hygiene practices. The eating and smoking without prior washing of hands is considered misuse.

Dermal – by deposition of particles of PY.34 and PR.104 on the skin. Absorption is only possible if the skin is not intact or if the lead or chromium dissolves and then passes the skin. Therefore the dermal route is not considered a significant route of exposure because given the very low solubility, absorption of lead or chromium is unlikely.

LEGAL CONTROL REQUIREMENTS FOR INDUSTRY OPERATIONS

The requirements for handling PY.34 and PR.104 are included in National, State or Provincial Standards for working with lead and chromium compounds, for example:

Table 1. Non-limitative list of regulations relevant for PY.34 & PR.104 pigments

Region	Reference	Name
U.S.	29.CFR 1910.1025[21]	Lead Standard
U.S.	29.CFR 1910.1026[22]	Occupational exposure to Hexavalent Chromium
Ontario, Canada	Regulation 490/09[23]	Occupational Health & Safety Act, Ontario Regulation 490/09- Designated Substances
U.K.		Control of Lead at Work Regulations[24]
Europe	1999/30/EC[25]	European Directive on limit values in ambient air
Europe	96/91/EC[26]	Integrated Pollution Prevention and

[21] The US Lead Standard can be found at: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10030
[22] Found at: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=13096
[23] The Ontario Regulation regarding Lead can be found at : http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_090490_e.htm
[24] The UK Control of Lead at Work Regulations (2002) can be found at: http://books.hse.gov.uk/hse/public/saleproduct.jsf?catalogueCode=9780717625659
[25] Found at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31999L0030

		Control Directive
Europe	1907/2006/EC[27]	EU REACH
Europe	1272/2008/EC[28]	Regulation on classification, labelling and packaging of substances and mixtures (CLP)
Europe	98/24/EC (fourteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)[29]	Council Directive on the protection of the health and safety of workers from the risks related to chemical agents at work
Europe	94/33/EC[30]	Council Directive of 22 June 1994 on the protection of young people at work
Europe	92/85/EEC[31]	Council Directive on the protection of safety and health of pregnant workers etc.
Europe	2004/37/EC[32]	Directive on the protection of workers related to the exposure of carcinogens or mutagens at work

Users of PY.34 and PR.104 should abide by the appropriate jurisdictional Lead Standard for their location and use this as the basis for a Lead Control Program.

SETTING UP AN EXPOSURE CONTROL PROGRAM

It is essential that users of PY.34 and PR.104 have a good Lead and Chromium Control Program in place to ensure worker safety and protection of the environment. When creating an exposure control program attention should also be given to the appropriate Lead and hexavalent Chromium regulations for the local jurisdiction such as those listed in the Table 1.

An appropriate program will include the following:

- An assessment of the risk management measures for lead and chromium
- Air monitoring
- A medical surveillance program
- Administrative controls
- Work practices

[26] Found at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=URISERV%3Al28045
[27] Found at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A02006R1907-20140410
[28] Found at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32008R1272
[29] Found at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31998L0024
[30] Found at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01994L0033-20140325
[31] Found at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31992L0085
[32] Found at: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2004:229:0023:0034:EN:PDF

- Hygiene practices
- Personal protection program

ASSESSMENT OF RISK MANAGEMENT MEASURES FOR LEAD AND CHROMIUM

The assessment is an inspection of areas in the plant where a worker may have exposure to lead and chromium. For users of PY.34 and PR.104 pigments this is most likely to occur when bags of pigment are opened and transferred into the mixing equipment used in the coatings or plastics industries, and also during the mixing operation. In designing equipment and the selection of the risk management measures we advise application of the hierarchy of control. This means that risk management measures must be selected based on the order of priority listed below:

1. Elimination: removing the hazard from the workplace by not using a hazardous substance

2. Substitution: replacing the hazardous substance with another substance of lower hazard or by using the substance in a form which eliminates exposure (i.e. a paste eliminates inhalation exposure).

3. Engineering controls: technical measures which either eliminate or reduce emission (i.e. closed systems) or which reduce the concentration to which workers are exposed (i.e. enclosures, remote control, local exhaust ventilation, wet abrasion).

4. Administrative controls: measures that limit the number of workers exposed or the exposure duration, working procedures, training, installation of signs and warning labels

5. Personal protective clothes and equipment

Risk management must provide effective worker protection while taking into consideration the economic feasibility. Moving to a measure lower on the hierarchy of control is only allowed if a higher level measure is not feasible (from either a technical or financial standpoint) and if the higher level measures are not considered to be good practice within their sector.

It is essential to install engineering controls such as ducts, vents and hoods to draw pigment dust away from the breathing zone of the operator to control the level of pigment in the air. The effectiveness of local exhaust ventilation should be checked frequently (weekly or monthly).

In the EU the application of the hierarchy of controls is mandatory for employers and they need to explain the set of risk management measures selected. Risk management measures need to be reviewed periodically to ensure their effectiveness and appropriateness. The inspection consists of equipment checks, work practices, methods and procedures. The assessment is completed as a minimum on an annual basis or as

changes in equipment or procedures occur in areas affected. For the use of PPE the worker should verify if these are functioning correctly upon each use.

Besides testing of technical functionality (as stipulated by the instruction manual) and the proper use of the risk management measures, the review should also determine if the total RMM package reflects good practices.

The assessment, once complete, would preferably be reviewed by a site Joint Health and Safety Committee, worker representatives or Works Council for review and relevant actions set forth. Staff involved in performing the assessments should be properly trained. It is advised to archive the results of the assessments for at least 30 years after the last use of the pigments.

ASSESSMENT OF EXPOSURE LEVELS

Air monitoring

Air monitoring is conducted at regular intervals, consisting of both area and personal testing. Regular sampling areas are consistent with those areas identified in the Lead and Chromium Assessment. Additional special testing may be carried out as advised by the Health and Safety Committee, worker representatives or Works Council. Frequency of sampling and sampling strategy are determined based on local regulations and guidance documents on testing compliance to exposure limits by means of monitoring (i.e Testing Compliance with Occupational Exposure Limits for Airborne Substances published by the British and Dutch Industrial Hygiene Associations[33]). A list of relevant exposure limits is provided in Table 2.

Table 2. Non-limitative lists of relevant occupational exposure limits for Lead regarding PY.34 and PR.104 pigments

Region	Limit value type	Value	Basis
U.S.	OSHA PEL for Lead[34]	50 µg/m^3 as Pb	8hr TWA
	OSHA Action level for Lead[35]	30 µg/m^3 as Pb	8hr TWA
ACGIH	Lead	50 µg/m^3 as Pb	8hr TWA
Ontario, Canada[36]	PEL for Lead	50 µg/m^3 as Pb	8hr TWA

[33] Found at: http://www.arbeidshygiene.nl/-uploads/files/insite/2011-12-bohs-nvva-sampling-strategy-guidance.pdf or http://www.bohs.org/WorkArea/linkit.aspx?LinkIdentifier=id&ItemID=1638&libID=1655
[34] https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=10030
[35] If there is a possibility of any employee exposure at or above the action level, the employer shall conduct monitoring which is representative of the exposure for each employee in the workplace who is exposed to lead.
[36] The Ontario Regulation regarding Lead can be found at :
http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_090490_e.htm

U.K.	PEL for Lead	150 μg/m^3 as Pb	8 hr TWA[37]
Europe[38]	PEL for Lead	150 μg/m^3 as Pb	Ceiling limit[39]
Europe[40] **(REACH)**	DMEL** dermal systemic for Lead	5 mg/kg bw/day	
	DMEL inhalation systemic for Lead	5.8 μg/m^3 as Pb	40 hour TWA

**Note: These Permissible Exposure Limits (PELs) are the same as recommended by A.C.G.I.H.*

***Note: DMELs are Derived Minimum Effect Levels, established for substances without a threshold for its effects.*

Table 3. Non-limitative lists of relevant occupational exposure limits for Chromium regarding PY.34 and PR.104 pigments

Region	Limit value type	Value	Basis
U.S.	OSHA PEL for Chromium(VI)[41]	5μg/m^3 as Cr	8hr TWA
	OSHA Action level for Chromium (VI)[42]	2.5μg/m^3 as Cr	8hr TWA
ACGIH[43]	Chromium	12 μg/m^3 as Cr	8hr TWA
Ontario, Canada[44]	PEL for Chromium	12 μg/m^3 as Cr	8hr TWA
U.K.[45]	PEL for Chromium	50 μg/m^3 as Cr	8hr TWA
Europe[46]	PEL for Chromium[47]	50 μg/m^3 as Cr	8hr TWA
Europe[48] **(REACH)**	DMEL inhalation for Chromium	0.067 μg/m^3 as Cr	40 hour TWA, respirable fraction

[37] Control of Lead at Work Regulations (2002) at http://books.hse.gov.uk/hse/public/saleproduct.jsf?catalogueCode=9780717625659

[38] EU Member States are responsible for setting the OELs which. may be more stringent.

[39] Council Directive 98/24/EC of 7 April 1998 on the protection of the health and safety of workers from the risks related to chemical agents at work (fourteenth individual Directive within the meaning of Article 16(1) of Directive 89/391/EEC)

[40] The DMELs for Chromium are set at such a level that the additional cancer risk for a worker is below the generally deemed acceptable level of 10^{-6} per year. For Lead the DMELs are set at such a level that even for the most vulnerable group of females of childbearing age the risk is deemed toxicologically insignificant.

[41] https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=13096

[42] https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=13096

[43] https://www.osha.gov/dsg/annotated-pels/tablez-1.html

[44] The Ontario Regulation regarding Lead can be found at : http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_090490_e.htm

[45] EH40/2005 Workplace exposure limits at http://www.hse.gov.uk/pubns/priced/eh40.pdf

[46] EU Member States are responsible for setting the OELs which may be more stringent.

[47] Scientific Committee on Occupational Exposure Limits (2004a). Recommendation from the Scientific Committee on Occupational Exposure Limits: Risk assessment for Hexavalent Chromium. SCOEL report SCOEL/SUM/86.

	DMEL oral for Chromium	1.33µg/kg bw/day as Cr	

**Note: These Permissible Exposure Limits (PELs) are the same as recommended by A.C.G.I.H.*

***Note: DMELs are Derived Minimum Effect Levels, established for substances without a threshold for its effects.*

Please note that within your jurisdiction the competent authorities may have set other limits. These local regulations need to be respected. Within the EU the exposure levels listed in extended Safety Data Sheet (eSDS) are the binding maximum exposure values for the activities listed.

In the EU the sampling frequency for lead is two times per year. This can be reduced to once a year if the conditions set in the Member States are fulfilled. For example, the UK conditions are:

- Concentration in air is below 100 µg/m^3 in two consecutive measurements, and
- There has been no material change in the work or the conditions of exposure since the last occasion of monitoring.

For Chromium, there is no fixed frequency for air monitoring is listed in the regulations. The frequency needs to be determined by the employer based on the result of his risk assessment using the documentations listed above.

The sampling and analysis of the samples should be performed using standardized methods set by relevant institutions. An example of an air monitoring procedure is outlined in Appendix A.

Results are reviewed and monitored by Management and the Health and Safety Committee, worker representatives or Works Council. Tests that fail to fall within the TLV limits (taking respiratory protection into account) are retested and investigated immediately to correct any upset conditions. Results are documented and retained as stipulated in the various regulations (ie 20 years -50 years after the last use of the pigments in Canada and EU respectively).

Biomonitoring

Biomonitoring results can reflect the effectiveness of the risk management measures. The table below provides an overview of the relevant biomonitoring limit values and action levels for both Lead and Chromium as set in Canada, US and the UK.

[48] The DMELs for Chromium are set at such a level that the additional cancer risk for a worker is below the generally deemed acceptable level of 10^{-6} per year. For Lead the DMELs are set at such a level that even for the most vulnerable group of females of childbearing age the risk is deemed toxicologically insignificant.

Table 4. Non-limitative list of biomonitoring reference values for Lead

Region	Limit value type	Action Level[49]	Suspension Level[50]
Ontario, Canada[51]: Lead	Employee	60 µg lead / 100 ml blood	70 µg lead / 100 ml blood
	woman of reproductive capacity		40 µg lead / 100 ml blood
ACGIH: Lead (BEI)[52]	Employee	30 µg lead / 100 ml blood	
	woman of reproductive capacity	10 µg lead / 100 ml blood	
OSHA: Lead[53]		40 µg lead / 100 ml blood	60 µg lead / 100 ml blood
EU: Biological Exposure Indices (BEI)[54]	Binding Limit Value	40 µg Pb/100 ml blood	70 µg Pb/100 ml blood
UK[55]: Lead Lead	Employee	50 µg lead / 100 ml blood	60 µg lead / 100 ml blood
	woman of reproductive capacity	25 µg lead / 100 ml blood	30 µg lead / 100 ml blood
	Young worker	40 µg lead / 100 ml blood	50 µg lead / 100 ml blood

Table 5. Non-limitative list of biomonitoring reference values for Chromium

Region	Limit value type	Action Level[56]	Suspension Level[57]
Ontario, Canada[58]: Chromium	Ministry of Labour	5 µmol chromium / mol creatinine	110 µmol chromium / mol creatinine
ACGIH: Chromium[59]	Total Chromium in urine end of shift at end of work week	12 µmol chromium / mol creatinine (25 µg/L)	
	Total Chromium in urine increase during	5 µmol chromium / mol creatinine (10 µg/L)	

[49] Action level: value which the monitoring results are compared and results in an action when met or exceeded
[50] Suspension level: value which results in immediate removal from exposure until deemed fit to return
[51] Code for Medical Surveillance for Lead dated May 28, 1981 and issued by the Ministry of Ontario.
[52] Found at: https://www.osha.gov/dts/osta/otm/otm_ii/pdfs/otmii_chpt2_appb.pdf
[53] Found at: https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10033
[54] EU limit value is laid down in Directive 98/24 on protection of workers against exposure to chemical agents in the workplace
[55] Control of Lead at Work Regulations (2002) at http://books.hse.gov.uk/hse/public/saleproduct.jsf?catalogueCode=9780717625659
[56] Action level: value which the monitoring results are compared and results in an action when met or exceeded
[57] Suspension level: value which results in immediate removal from exposure until deemed fit to return
[58] Ontario Ministry of Labour
[59] Found at: https://www.osha.gov/dts/osta/otm/otm_ii/pdfs/otmii_chpt2_appb.pdf

	shift		
UK: Chromium[60]	Benchmark guidance value in Urine end of shift	10 µmol chromium / mol creatinine	

Employees who work in areas with the potential for lead and chromium exposure should be tested on a regular basis as required by local regulations.

At DCC, if an employee has a reported blood lead level above 50 µg lead / 100 ml blood he or she is sent for a recheck within a 4-week period of the first test. The employee and his or her Supervisor is notified at this time of a potential problem. Should the second test indicate a level above 50 µg lead / 100 ml blood the employee is interviewed by an appropriate supervisor to determine the possible cause and a mask is provided to the employee for wearing in the plant. Should the blood lead analysis indicate a level above 60 µg lead / 100 ml blood the employee is removed to a lower exposure area until such time as his or her blood level drops below 60 µg lead / 100 ml blood. Testing for employees in this range takes place on a monthly basis.

In regard to chromium testing, the normal industrial level of exposure is 5 µmol chromium/mol creatinine. At DCC, action is takes place when chromium creatinine ratios are greater than 5 µmol chromium/mol creatinine.

The Council Directive 98/24/EC of 7 April 1998[61] on the protection of the health and safety of workers from the risks related to chemical agents at work outlines the health surveillance criteria for lead and its ionic compounds. According to this directive, health/medical surveillance is carried out if:

- Exposure to a concentration of lead in air is greater than 0.075 mg/m3 (TWA 40 hours per week, orconcentration in air is below 100 µg/m^3 in two consecutive measurements
- A blood-lead level greater than 40 µg Pb/100 ml blood is measured in individual workers (using absorption spectrometry or a method giving equivalent results)

In the UK, lead in blood content is to be monitored every 6 months. This frequency can be reduced to one time per year if all of the following conditions[62] are met:

- Lead in blood concentration of all exposed workers is below 30 µg lead / 100 ml blood, and
- Concentration in air is below 100 µg/m^3 in two consecutive measurements.

For woman of childbearing age the monitoring frequency is every 3 months unless the company doctor decides otherwise.

[60] Control of Substances Hazardous to Health Regulations 2002
[61] Found at: http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A31998L0024
[62] European Union's Chemical Agents Directive (98/24/EC) as implemented in member state legislation, i.e. UK: Control of Lead at Work Regulations 2002

If the biomonitoring shows that either the lead in blood or the chromium in urine levels are above those found in the general population, this is a strong indication that the risk management measures are insufficient. The effectiveness of the RMM then needs to be verified. One should keep in mind that non-work related sources of lead and chromium may be present which might explain high values. Furthermore the values found may reflect the exposure during the months prior to the biomonitoring.

MEDICAL SURVEILLANCE

Medical surveillance of workers exposed to the pigments is mandatory in many jurisdictions. If significant exposure is possible, it is always advised.

Objectives

The objectives of a Medical Surveillance Program are both preventive and remedial. The content of this program is based on the results of monitoring programs, the duration and frequency of handling the pigments, good practices available and the regulations in various jurisdictions.

Medical conditions that may be aggravated by exposure to pigment (lead and chromium) should be detected at a pre-placement and periodic health examination. The examining physician should alert the employer and the Health and Safety Committee, worker representatives or Works Council to exposure problems in the workplace that might otherwise go unrecognized. Remedial steps can then be taken. Health education for workers on the health effects of PY.34 and PR.104 and the manner in which exposure can be limited are also preventive functions of this program.

The examining physician should advise the company whether the worker is fit, fit with limitations or unfit for exposure to the pigments. The physician gives this opinion without disclosing the results of the examinations or tests. The company doctor keeps these records on file as prescribed in the relevant Occupational Health and Safety Act. Within the EU these files should be kept for a minimum of 50 years after the last use of the pigments.

Women of childbearing age

Women workers should be encouraged to notify the employer and the examining physician immediately if they become pregnant, or as soon as possible when they make a decision to become pregnant. When a physician is informed of either of these two cases the physician should advise the worker and the employer whether the worker should be removed from further exposure to lead.

ADMINISTRATIVE CONTROLS

The main administrative control measures address the risks for the workers (including sensitive groups), time constraints for each activity, signage, training and management supervision. These are detailed in the appropriate National, State or Provincial Standards. For the EU, details in the DCC extended Safety Data Sheet (eSDS) should also be taken into consideration.

Documentation of Risk

It is important to determine how long workers are allowed to handle the pigments and which groups of workers are to be considered sensitive (i.e. young workers and female workers of childbearing capacity). The duration of handling pigment should be documented for the workers. If the worker has the potential to be exposed to lead or chromium above the PEL, or above the listed DMELs for the EU it must be documented.

Documentation is to be added to the workers personal file and should be shared with the company physician. For the EU the worker activities must fall within the boundaries as listed in the eSDS.

In situations where there is a potential to exceed the PEL or DMEL, the additional administrative controls should be taken into consideration:

- Work Permits for short-term operations and for maintenance activities on installations which (may) contain the pigments
- Operational Safety Plans when PY.34 and PR.104 are used in ongoing or repetitive operations.

Signage

Warning signs must be posted at all entrances to areas where PY.34 and PR.104 are being used. The signage requirements vary with jurisdiction. As a minimum DCC advises to use pictograms that inform workers on the required personal protection and on specific forbidden actions.

Education and Training

As a minimum workers must be made aware of:

- The content of the appropriate Regulations
- The health and safety risks associated with the use of these pigments, which are related to the presence of lead and chromium
- The meaning of the signage
- The correct use of risk management measures
- How to protect themselves, their colleagues and the environment.

A set of documentation on the hazard of the pigments, the risk management measures needed (organizational, technical and personal) and special requirements based on

national/local regulations (e.g. eSDS or the On. Reg 490/09 - Designated Substances) should be provided to each worker.

Instruction should be provided prior to first handling of the pigments and at regular intervals. The importance of personal hygiene should be stressed, highlighting the importance of avoiding touching lips or nose with contaminated hands and of thorough washing before eating.

The employee should be advised about the blood lead program, exposure monitoring and hygiene practices. The new employee should also be fitted with personal protective equipment by qualified personnel.

New employee orientation should be completed with each employee before they start working in the plant. New employees should also complete a pre-employment medical check with the company doctor at which time a blood lead base level should be established.

Management supervision

Management supervision needs to be in place to ensure that the work practices are in line with the standards set.

HYGIENE PRACTICES

In order to avoid the inadvertent ingestion of pigment and the unintentional transfer of pigment from contaminated areas it is essential that good hygiene practices are strictly followed. Everyone must take responsibility regarding personal hygiene.

Good hygiene practices include:

- Wear all personal protective equipment necessary.
- Keep all respirators and forced air hoods clean and maintained.
- Change contaminated clothing and shoes before entering lunchroom and double locker room areas.
- Wash thoroughly before eating, drinking or smoking.
- Shower when necessary and at the end of each shift.
- Avoid biting fingernails.
- Never take work clothing home, all contaminated clothing must be washed after each use.

Facilities handling PY.34 and PR.104 must:

- Designate separate locations for eating, food and beverage storage/preparation and smoking

- Provide of change rooms where workers can keep work and street clothing segregated and shower facilities

Clean Side Locker Rooms

When handling pigment powder or when performing activities which result in high level of contact with pigment, a double locker system should be used. A "double locker" system consists of a "dirty side" locker for employees coming in from the plant and a "clean side" locker for employees going to the lunchroom or leaving the plant. Both sides are separated by shower facilities. It is critical that a high level of cleanliness be maintained on the clean side of the locker room. This is accomplished by removing shoes worn in the plant at a boot rack and changing to a separate pair. Work clothes must be removed on the dirty side and appropriate personal clean up must take place before entering the clean side of the locker room. If it ever becomes evident that PY.34 and PR.104 has been tracked to the clean side this must be cleaned up immediately.

WORK PRACTICES

The employer needs to determine a set of working practices that allow for a responsible handling of the two pigments. For the EU the information in the eSDS is binding. Furthermore the following work practices need to be taken into account:
Housekeeping, General Safety Rules, Departmental Safety Rules, Procedures and Personal Protective Equipment.

Housekeeping

- All employees are responsible for cleaning and maintaining their areas. Routine cleaning should be completed on every shift (preferably near the end of shift) to ensure that each worker starts with a clean work area. Upset conditions that generate spilled pigment shall be given immediate attention and promptly cleaned up.
- Good housekeeping is crucial wherever there is PY.34 and PR.104 dust. The dust must be cleaned from machinery, floors, ledges and other surfaces by wet mopping or vacuuming using HEPA filter. A scrap receptacle, for material containing pigment dust should be kept tightly covered to prevent dust from becoming airborne. Broken bags of pigment must immediately be placed in a plastic bag and sealed.
- Keeping floors wet, where appropriate, can help to minimise dust levels.
- Remove spilt powder using an industrial vacuum cleaner fitted with a HEPA filter of by mopping.
- Recirculation of air is only permitted if concentrations in return air are below 10% of the relevant limit value.
- Vehicle wheels and footwear should be hosed down before leaving lead contaminated areas so that the dust is not transported to other areas of the workplace.

- A plant inspection at the beginning of each shift should be carried out by the supervisor and Safety Committee member to ensure that housekeeping is satisfactory.
- Management supervision must be in place to ensure proper use of risk management measures.

General Safety Rules

All employees should be familiar with and adhere to all rules. These rules are in place to ensure that each and every employee works safely to protect themselves, other employees, the environment and company property. These rules are included in departmental operating manuals posted in the plant.

Those rules that are most pertinent to working with PY.34 and PR.104 include the following:

- No eating, drinking or smoking is permitted in the plant. Eating, drinking or smoking is only allowed in designated areas. To ensure that all employees can eat and drink in a clean environment without fear of contamination, workers handling PY.34 and PR.104 must wash and change to clean coveralls before entering the lunchroom.
- Always wash before eating, drinking or smoking in designated areas.
- Wear the personal protective equipment prescribed for each operation.
- Keep your dust respirator clean and in good working order at all times. Dust respirators **MUST BE WORN** when working on equipment handling PY.34 and PR.104
- Showers at the end of each shift are compulsory.
- Regular medical services are necessary for health and safety and are compulsory in some regions
- Any spillage of PY.34 and PR.104 product must be cleaned up immediately.

Departmental Safety Rules

Additional specific safety rules which have been designed to ensure safety to each operator in a specific department.

PERSONAL PROTECTIVE EQUIPMENT PROGRAM

Personal protective equipment such as coveralls, shoe and head covers, gloves and respirators are required for operations that may generate airborne lead and chromium levels above the appropriate limit value.

For the selection of PPE please use the relevant standards. If respirators are needed the assigned protection level should be high enough to reduce the dose to the relevant limit value. Within Ontario and EU, the program for respirator selection, use and maintenance

should follow the Code of Respiratory Protection Equipment[63] and Health and Safety Guidance 53[64] published by the British Health and Safety Authority. A respirator fit test is required annually and when there has been a significant change in body weight[65]. For the EU, the assigned protection levels as listed in the eSDS should be met. Appendix B provides examples on respiratory protection that can be used when handling the pigments or mixtures of these pigments.

The company will provide all personal protective equipment that is to be worn in the plant. Each and every employee must wear their PPE in the designated areas. Prior to the start of work the employee shall test if the PPE are functional.

Selected areas in the plant may be designated as dust mask areas even though the exposure levels may fall within acceptable boundaries. These areas may include PY.34 and PR.104 offloading and storage areas, mixing and dispersion, grinding and packing areas. Selection of the type of respirators and filter is to be based on the exposure, the relevant limit value, the duration for which the respiratory protection needs to be worn, the workers characteristics and the relevant standards for selection, maintenance and use of personal protection equipment.

For the EU, the Health and Safety Guidance 53[66] published by the British Health and Safety Authority provides excellent guidance. Given the hazard of the pigments the filter should be P3 and a half face mask is minimally advised. An overview of respirators with the APF needed is listed in Appendix B.

For areas with persistent high dust levels the type recommended is a supplied air respirator with full-face piece, helmet or hood.

Coveralls are provided and are laundered after each use. Each employee is given at least four pairs of clean coveralls per day to allow changing before breaks/lunch or as needed. All types of protective clothing are provided and cleaned by the company (i.e. gloves, aprons, PVC suits, coveralls).

[63] *Code for Respiratory Equipment for Lead* dated June 30, 2000, and issued by the Ministry of Ontario
[64] Found at: http://www.hse.gov.uk/pUbns/priced/hsg53.pdf
[65] A change in body weight is significant if the change is over 10% of the original weight.
[66] Found at: http://www.hse.gov.uk/pUbns/priced/hsg53.pdf

Appendix A: SAMPLING METHOD FOR AIRBORNE INORGANIC PARTICULATE*

1) Principle of the Sampling Method

Air is drawn at a specified fixed flow rate for a known duration of time through a cellulose ester (membrane) filter of specified pore size and diameter held in a worker's breathing zone by a plastic closed-face filter holder. The particulate matter collected on the sample filter is then analyzed in a laboratory for the total quantity of lead and chromium present. It is advised to use a sample for both the inhalable and respirable fraction. Select a standardised sampling and analysis method that allows for a limit of quantification of less than 10% of the relevant limit values. Good sources for sampling and analysis methods are NIOSH[67] and the IFA/Gestis[68].

2) Equipment

The sampling equipment used to obtain an air sample of airborne inorganic lead particulate is to include the following components, and satisfy the criteria provided:

(1) A battery operated portable pump which:
   a) is capable of delivering, for 6-8 hours, not less than 2 litres of air per minute with a filter in the sampling train. The maximum deviation from the prescribed flow rate is not to exceed ± 5% and the maximum pulsation allowable in the flow is ± 5% of the total flow rate;
   b) is intrinsically safe, i.e., certified by an accepted agency as safe for use in potentially explosive atmospheres;
   c) includes a calibrated flow meter or a mechanism for maintaining a constant flow rate;
   d) has an on-off switch and flow rate control or adjustment mechanism which is tamper proof.

(2) Cellulose ester (membrane) filters of appropriate size, preferably 37 millimetres (mm) in diameter, 0.8 micrometres in pore size.

(3) Filter support pads of the same size as the cellulose ester (membrane) filters used.

(4) A closed-face filter holder of the same size as the cellulose ester membrane filter and filter support pads used, i.e. 37 mm in inner diameter and with an adapter which provides a leak proof fit for connecting flexible tubing.

(5) A sufficient length of flexible tubing with appropriate wall thickness to prevent its collapsing when air is drawn through and with appropriate inner diameter which will provide a leak proof connection to the filter holder adapter and to the inlet port adapter of the portable pump.

(6) A thermometer for ambient air temperature measurement accurate to ±1 degree C.

(7) A barometer for measuring atmospheric pressure accurate to ± 5 mm of mercury.

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* This method may also be used for area sampling at strategically selected locations by placing a sampling unit on a suitable support with the inlet port of the sampling unit facing downward.

[67] Found at: http://www.cdc.gov/niosh/docs/2003-154/

[68] Found at: http://amcaw.ifa.dguv.de/WForm09.aspx

For monitoring of chromium both the respirable and inhalable fractions are important for the risk assessment. For this monitoring, the general methods for sampling and gravimetric analysis of respirable and inhalable dust, MDHS 14/3[69] should be followed.

1. Sampling Procedure

(1) Preparation of Pump

(a) The pump battery pack must be fully charged according to the manufacturer's instructions, before use in any work shift. If it is used for more than one shift, a fully charged battery pack must be substituted for the used one.

(b) Flow meters, or constant flow devices on the pumps must be calibrated at the appropriate volume (2.0 litres per minute for inhalable dust) by using a primary standard such as a bubble meter by the procedure recommended in the manufacturer's instructions for using the primary standard apparatus, with the filter/filter holder assembly in line after:

i. Not more than 40 hours of operation;
ii. Receiving unusually harsh or potentially damaging treatment;
iii. Being disassembled for maintenance.

(2) Preparation of Filter Holders

(a) Assemble the filter holders in a clean environment prior to initiation of sampling.

(b) Each filter holder must be prepared by the following procedure:

i. Use only a clean filter holder and handle the filter support pad and filter with tweezers. Place a filter support pad and a cellulose ester filter of approprioate diameter, in the base of a filter holder;
ii. Plug the inlet and outlet ports:
iii. Ensure that the joints of the filter holder are sealed with non-porous, shrinkable cellulose band or tape.

(3) Sampling

(a) The sampling train is assembled by fixing one end of the flexible tubing to the inlet port of the pump and the other end with the adapter to the outlet port of the filter holder.
(b) Check for air leaks in the sampling train by turning on the pump and inserting a clean plastic plug into the inlet port of the filter holder. The air flow indicator on pumps with a flow meter must drop to the zero flow position and oscillate slightly. If this does not occur, find and either repair the leak if possible, or replace the faulty component.

[69] Found at: http://amcaw.ifa.dguv.de/substance/sheets/125-01-S-Respirable%20aerosol%20fraction.pdf

(c) Label the filter holder with an appropriate sample number.
(d) Attach the pump to the worker's belt preferably or place it in his pocket; place the flexible tubing over the shoulder and clip the filter holder to the clothing with the inlet port facing downward, as near as possible to the breathing zone. Ensure that the equipment will not interfere with the worker's movements.
(e) Check again that all equipment is properly assembled, remove the plastic plug from the filter holder's inlet port and switch on the pump. Allow the flow to stabilize for a short duration then adjust the rate to the precalibrated mark of 2 litres per minute, if the pump has a flow meter. Pumps with constant flow devices must not be reset after the flow rate control mechanism has been calibrated to deliver air at this rate. A calibrated external flow meter may be used to check the airflow rate.
(f) Note the following information for each sample:

i. Date of sampling;
ii. Company name;
iii. Model and serial number of the sampling pump;
iv. Calibration date of the sampling pump;
v. Name of worker;
vi. Job title;
vii. Work or operation performed;
viii. Pattern of exposure;
ix. Sampling strategy;
x. Sampling procedures;
xi. Analytical methods applied;
xii. Filter holder or sample number;
xiii. Air flow rate;
xiv. Time of initiation and termination of sampling;
xv. Volume of pigments handled;
xvi. Duration of tasks performed with the pigments.

(g) Ensure that for any sampling performed during any survey, two control or blank filters are prepared in the same manner as the sample filters. These blank filters must remain in sealed filter holders during the sampling (i.e. no air is to be drawn through these filters).
(h) Sampling may be carried out for a total duration of 6-8 hours, if feasible, to obtain a time-weighted average concentration. Where necessary, sequential air samples may be taken as opposed to single air samples. The total sampling duration may or may not include lunch breaks, depending on the nature of the work exposure to be measured. Total sampling duration may be shorter than 6 hours provided that the individual air samples taken during the selected periods are representative of the worker's exposure over the entire work shift.
(i) During the sampling interval, the sampling train must be checked periodically to ensure that it is functioning properly. The air flow rate must not be re-adjusted after the initial flow rate is set. If the flow rate changes significantly, terminate sampling and take another sample.
(j) The ambient air temperature and pressure in the sampling area must be recorded at least once.
(k) To terminate sampling, perform the following sequence of steps:

i. Check the air flow rate just prior to termination of air sampling;
ii. Record the time of termination of sampling;
iii. Switch off the pump and carefully remove the sampling train from the worker;
iv. Remove the filter holder and insert clean plastic plugs into the inlet and outlet ports;
v. Ship the filter and filter holder together to an accredited laboratory and request analysis of the filter for lead.

(4) Sufficient area samples are to be taken at all work locations where necessary.

Air pumps and accessories can be obtained from Fisher Safety and Scientific Co. (Tel 1 800 234 7437). These materials can also be obtained from other sources as long as the qualifications listed above are met.

Appendix B: OVERVIEW OF RELEVANT TYPES OF DERMAL AND RESPIRATORY PROTECTION

Use of dermal protection

When working with DCC PY.34 or PR.104 products, workers should wear tight fitting long sleeved work clothes. Work clothes need to be washed by the employer and not by workers at home. Work clothes need to be stored in separate lockers.

Based on the risk assessment use of gloves is mandatory when manually handling powder pigments or paint.. These gloves must be 0.5 mm thick and made from chemically impervious materials such as:

- Nitrile rubber/Nitrile latex – NBR;
- Polychloroprene – CR;
- Polyvinyl chloride – PVC.

When DCC PY.34 or PR.104 are included into a paint, the solvents and other substances used within the paint may lead to a different selection of glove material. If chemically impervious gloves are used dermal exposure is minimised. However some dermal exposure may still arise if not adequately protected.

The use of chemically impervious gloves with 95% efficiency is required for workers where skin contact cannot be excluded. The following provisions for training are required to ensure the prescribed efficiency can be reached:

- Information on the hazard that requires the use of the gloves and the respective hazards of the substance. The training should address the correct way to put on, wear and take off protective gloves in order to ensure maximum protection.
- Testing for leakage (i.e. visual inspection or trapping air in the glove and tightly rolling the cuff towards the fingers).
- Instruction on when to use glove (which specific activities).
- Proper washing of reusable gloves.
- How and when to discard the used gloves (preferably after each use, but at a minimum at end of shift).
- Limitations of gloves as a control measure.
- Conduct training annually and maintain PPE training records.

Use of respiratory protective equipment (RPE)

In order to assess effectiveness of respiratory protection, the two values typically seen in literature, technical data and RPE user manuals are the nominal protection factor (NPF) and the Assigned Protection Factor (APF).

The NPF provides information on the maximum inward leakage of RPE when it is being worn in an optimised static setting. This value determines if a respirator fulfils the requirement of the European harmonised standard it adheres to and allows the manufacturer to place a CE mark on the RPE. The NPF **is not to be used in selecting RPE** when it is introduced in order to protect the workers' health. The proper value to use in selecting RPE used for the protection of the worker is the Assigned Protection Factor (APF), as it provides information on the level of protection one can confidently aspire to achieve. Furthermore, proper training, supervision, maintenance and fit testing are essential contributing factors.

The downstream users are advised to select RPE using the manual published by the British Health and Safety Authority (HSE) in December 2013[70] to determine if training, supervision, and fit testing programs are sufficent. They are also urged to take notice of other advice provided in this document. The British HSE Authority also hosts a website that helps downstream users in selecting the most appropriate RMM option (http://www.healthyworkinglives.com/rpe-selector). The use of this website is strongly recommended.

The user can also use EN 529 to ensure the effectiveness of their respiratory protection program. The following needs to be included in the respiratory protection policies:

- Training of the worker prior to first use of the respirator;
- Testing of the fit of the respirator face of the user prior to first use;
- Testing of the fit of the respirator after donning the respirator;
- Training on proper maintenance of the respirator;
- Testing of the medical fitness of the worker prior to first use;
- Management supervision and maintenance procedures;
- Training and testing should be repeated annually and documented.

Currently, there is no harmonised approach within the EU on the appropriate application of Assigned Protection Factors (APF) for respiratory protective equipment. Each user of DCC PY.34 or PR.104 needs to verify which RPE will provide the suitable APF for their jurisdiction. If no APF is established within a given jurisdiction, the UK standards should be considered as the minimum requirement.

Table 1. Overview of APF and associated RPE in various jurisdictions

Assigned protection factor used in CSA	**Description of RPE based on EN 529 (Appendix C)**				
	Country	**Standard***	**Description of RPE**	**Class**	**Example of Worker Activity**
10 	Fin, D, I, S, UK	EN 149	Filtering half mask	FF P2	-Equipment cleaning -Dried pigment & paint cleaning -Handling and manipulation of pigment plastic articles/plastic coated textiles/coloured road marking
	Fin, D, I, S, UK	EN 140	Half mask and quarter mask with filter	P2	
20 	Fin, S, UK	EN 149	Filtering half mask	FF P3	Mixing/Filling/Transfer of pigment paint -Cleaning vessel with solvent
	UK	EN 136	Full Face mask, all clases	GasX P3	
	Fin, D, I, S, UK	EN 12941	Powered filtering device incorporating a hood or a helmet	TH2	
30	D, I	EN 149	Filtering half mask	FF P3	Sanding of dried paint on

[70] Health and Safety Guidance 53, Respiratory protective equipment at work, A practical guide, Fourth editions, December 2013.

Assigned protection factor used in CSA	Description of RPE based on EN 529 (Appendix C)				
	Country	**Standard***	**Description of RPE**	**Class**	**Example of Worker Activity**
	D, I	EN 140	Half mask and quarter mask with filter	P2	machines/vehicles/metal articles
	D	EN 140	Half mask and quarter mask with filter	GasX P3	
	Fin, D, I, S	EN 12942	Powered assisted filtering device incorporating full face mask, half mask or quarter mask	TM2	
	UK	EN 12942	Powered assisted filtering device incorporating full face mask, half mask or quarter mask	TM3	
	Fin, D, I, S, UK	EN 136	Full face mask (all classes)	P3	
40 	Fin, D, I, S, UK	EN 136	Full face mask (all classes)	P3	Manual of pigment powder
	Fin, D, I, S, UK	EN 12941	Powered filtering device incorporating a hood or a helmet	TH3	
	Fin, D, I, S, UK	EN 12942	Powered assisted filtering device incorporating full face mask, half mask or quarter mask	TM3	
	Fin, D, I, S, UK	EN 138	Fresh air hose breathing apparatus	Full face mask	
100	Fin, D, I, S	EN 136	Full face mask (all classes)	P3	-Welding/torch cutting of painted metal (dry) -High energy manipulation of pigment plastic articles, plastic coated textiles and coloured road
	Fin, D, I, S	EN 12941	Powered filtering device incorporating a hood or a helmet	TH3	

Assigned protection factor used in CSA	Description of RPE based on EN 529 (Appendix C)				
	Country	**Standard***	**Description of RPE**	**Class**	**Example of Worker Activity**
	Fin, D, I, S	EN 138	Fresh air hose breathing apparatus	Full face mask	marking using abrasive techniques like mechanical cutting, grinding, drilling or sanding
	UK	EN 137	Self-contained open circuit compressed air breathing apparatus	Positive pressure demand	
200 	Fin, D, I, S	EN 136	Full face mask (all classes)	P3	
	Fin, I, S	EN 12941	Powered filtering device incorporating a hood or a helmet	TH3	
	Fin, D, I, S	EN 138	Fresh air hose breathing apparatus	Full face mask	
	UK	EN 137	Self-contained open circuit compressed air breathing apparatus	Positive pressure demand	
400 	Fin, D, I, S	EN 136	Full face mask (all classes)	P3	Spray testing/application of pigment paint
	Fin, D, I, S	EN 12942	Powered assisted filtering device incorporating full face mask, half mask or quarter mask	TM3	
	Fin, D, I, S	EN 14593-1	Compressed air line breathing apparatus with demand valve - Part 1: Apparatus with a full face mask	-	
	Fin, D, I, S	EN 138	Fresh air hose breathing apparatus	Full face mask	
	UK	EN 137	Self-contained open circuit compressed air breathing apparatus	Positive pressure demand	

Assigned protection factor used in CSA	Description of RPE based on EN 529 (Appendix C)				
	Country	**Standard***	**Description of RPE**	**Class**	**Example of Worker Activity**
1000 	Fin, S	EN 12942	Powered assisted filtering device incorporating full face mask, half mask or quarter mask	TM3	Spray paint application in makeshift booth
	Fin, D, I, S	EN 14593-1	Compressed air line breathing apparatus with demand valve - Part 1: Apparatus with a full face mask	-	
	D	EN 138	Fresh air hose breathing apparatus	Full face mask	
	D, I, UK	EN 137	Self-contained open circuit compressed air breathing apparatus	Positive pressure demand	

*Explanatory table with reference and title of abovementioned standards:

Standard number	Standard title
EN 136:1998	Respiratory protective devices. Full face masks. Requirements, testing, marking
EN 137:2006	Respiratory protective devices. Self-contained open-circuit compressed air breathing apparatus with full face mask. Requirements, testing, marking
EN 138:1995	Respiratory protective devices - fresh air hose breathing apparatus for use with full face mask, half mask or mouthpiece assembly. Requirements, testing, marking
EN 140:1998	Respiratory protective devices. Half masks and quarter masks. Requirements, testing, marking
EN 149:2001 + A1:2009	Respiratory protective devices. Filtering half masks to protect against particles. Requirements, testing, marking
EN 529:2005	Respiratory protective devices. Recommendations for selection, use, care and maintenance. Guidance document
EN 12941:1998	Respiratory protective devices. Powered filtering devices incorporating a helmet or a hood. Requirements, testing, marking
EN 12942:1998+A2:2008	Respiratory protective devices. Power assisted filtering devices incorporating full face masks, half masks or quarter masks. Requirements, testing, marking

EN 14593-1:2005	Respiratory protective devices. Compressed air line breathing apparatus with demand valve. Apparatus with a full mask. Requirements, testing, marking

Table 2. Overview of RPE and assigned protection factors (APF) as set by the British HSE Authority

Adequacy/suitability	Respirators				
RPE type					
	Disposable half mask – particle filter*	Reusable half mask – particle filter	Full face mask – particle filter	Powered mask	Powered hoods/helmets
Effective for particles	Yes	Yes	Yes	Yes **	4 **
Continuous wear time	Less than 1 hr	Less than 1 hr	Less than 1 hr	More than 1 hr	More than 1 hr
APF4	Yes	Yes	Yes	No	8
APF10	Yes	Yes	Yes	Yes	4
APF20	Yes	Yes	No	Yes	4
APF40	No	No	Yes	Yes	4
Table reference	3	4	5	6	7

*Sometimes referred to as a filtering facepiece or nasal respirator. The disposable half mask requires intense training and management supervision in order to be effective. Preferably only used for short and infrequent exposure.

**Only protects against particle or gas/vapour when the appropriate filter is fitted.

Table 4 cont. Overview of RPE and assigned protection factors (APF) as set by the British HSE Authority

Adequacy/suitability	**Breathing apparatus**		
RPE type			
	Fresh air hose	Constant flow airline	Demand valve
Effective for particles	Yes	Yes	Yes
Continuous wear time	Unassisted less than 1 hr Assisted/powered more than 1 hr	More than 1 hr	More than 1 hr
APF4 types	No	No	No
APF10 types	Yes	Yes	No
APF20 types	No	Yes	No
APF40 types	Yes	Yes	No
APF200 types	No	Yes	No
APF2000 types	No	No	Yes
Table reference	8	9	14