

10

WORKPLACE REGULATORY SYSTEMS AND HAZARD COMMUNICATION

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SUMMARY

- This chapter summarises the regulatory controls and other standards that may apply to proper workplace control of PGMs, and provides guidance on communicating hazards to workers. However, it does not specifically address non-occupational product regulatory controls, supply chain/sector-specific requirements, or product stewardship standards. Due to constantly evolving legal conditions and requirements in the respective jurisdictions, this overview cannot be conclusive; employers must determine compliance with applicable laws and regulations in each individual case.
- Where they are defined as hazardous, PGM chemical substances are subject to a number of regulatory controls and hazard communication duties. Such regulations include—but are not limited to—risk assessment of workplace activities, hazard identification and communication, monitoring, exposure controls, and training and awareness. New chemical management systems, typified by the EU REACH Regulation and its equivalents elsewhere, impose other specific requirements, *e.g.*, substance registration and risk assessment.
- Occupational exposure limits (OELs) are used as an important control to protect workers' health from adverse effects of exposure to chemicals. OELs for Pt metal and soluble Pt salts are available in most territories. Due to technical considerations, specific OELs for chloroplatinate salts are not currently available, but OELs for soluble Pt are used instead as a surrogate monitoring standard for chloroplatinate airborne concentrations.

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- For other PGMs: Rh metal and its soluble and insoluble compounds have OELs established in several territories, but officially set exposure limits are generally not available for Pd, Ru and Ir group PGMs. Alternative approaches are suggested in this chapter for circumstances where OELs are not yet in existence.
- Other types of benchmark values relevant to exposure control exist. These include: dermal exposure limits, biological monitoring standards, and workplace reference values enacted under specific legislation.
- Where hazardous chemicals are manufactured, used, or stored, chemical control regulations and workplace EHS management systems dictate that up-to-date hazard and safe handling information must be available and provided to the workforce (hazard communication).
- Classification and labelling of chemical substances and mixtures, covering their hazards and safe handling, applies to hazardous PGMs. Many territories have implemented legislation or standards conforming to the United Nations Globally Harmonised System (GHS) of Classification and Labelling of Chemicals. This system also governs the content and format of safety datasheets (SDS) used for the protection of workers.
- Reference sources are provided for a number of key regulations, standards, and resources across the world related to chemical control and communication (including some specific to PGMs).

10.1

FRAMEWORK CHEMICAL CONTROL REGULATIONS

FRAMEWORK CHEMICAL CONTROL REGULATIONS

Where they are defined as hazardous chemical substances, PGM substances are subject to a number of regulatory controls and hazard communication requirements. Chemical regulation can apply at an international, regional or national level, and for proper compliance it is important to assess duties at all these levels. Voluntary safe management guidelines and industry-level stewardship programmes also need to be taken into account, *e.g.*, those applicable within the precious metals sector—for instance, the recommendations in this guidance document. Readers should refer to ‘References’ for a brief compilation of worldwide legislation and resources in this area.

Most jurisdictions have enacted overarching chemical control regulations which provide a legislative framework governing the safe management of hazardous chemicals in the workplace, and which will apply to hazardous PGM substances. As examples, this is the case in North America (USA and Canada), Europe (EU), Republic of South Africa and several Asia-Pacific region territories. Specific regulations operating at regional or national level include the EU Chemical Agents Directive (CAD), and its ‘daughter’ and interfacing

workplace directives; the South African Hazardous Chemical Substances Regulations; the UK Control of Substances Hazardous to Health (COSHH) Regulations; and the US Occupational Safety and Health Standards, including the OSHA Hazard Communication Standard (HCS 2012). Whilst the formats and legislative instruments of the individual regional or national regulations vary, typically they cover aspects such as:

- Chemical hazard identification, and safety properties testing.
- Workplace chemical inventories.
- Risk assessment of workplace chemical handling activities.
- Requirements to substitute very hazardous substances with less hazardous alternatives.
- Exposure control, including Occupational Exposure Limits (OELs) and their application; and the provision and maintenance of exposure controls such as exhaust ventilation and personal protective equipment (PPE).
- Hazard communication, including safety datasheets (SDS), container marking and other warning labelling or

workplace placarding.

- Providing information, instruction and training for employees and others.
- Monitoring of exposure and health surveillance programmes.
- Permits to work, and prescriptive controls on specific workplace activities.
- Requirements related to particular categories of substances, such as carcinogens or reprotoxic chemicals.
- Emergency planning and response.

Whilst an in-depth guide to how these framework controls apply to the occupational handling of PGMs is beyond the scope of this chapter, it is important to recognise that compliance with them is fundamental to safe workplace conditions. Comprehensive guidance and interpretation documentation is provided by the competent authorities associated with the individual regulations.

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OCCUPATIONAL EXPOSURE LIMITS

OCCUPATIONAL EXPOSURE LIMITS

Occupational exposure limits (OELs) are used as an important control to protect workers' health from adverse effects of exposure to chemicals. OELs are typically established by considering the intrinsic toxicity of a substance together with an exposure-based risk assessment. They may be purely health-based, *i.e.*, expected to be health-protective for nearly all workers, or they may represent pragmatic exposure limits which also take into account technical and economic feasibility.

OELs for airborne contaminants are set as limits of concentrations of harmful substances in the air, averaged over a period of time. Long-term exposure limit (LTEL) time-weighted averages (TWAs) are usually set to align with a typical work-shift of 8 hours per day during a 40-hour work-week, while short term exposure limits (STELs) are set to help prevent effects occurring following short periods of exposure (normally a 15-minute averaging period). Whilst dermal occupational exposure limits (DOELs) are less commonly established, the skin exposure route can be important for certain hazardous substances, including some PGM compounds; in these circumstances, objective exposure standards for skin contact should be determined

where practicable. Several limit-setting agencies specify a "skin notation"¹ in addition to an OEL where the chemical may be absorbed in toxicologically significant amounts through the skin. Where this is noted without provision of a DOEL, dermal exposures should also be controlled. However, to date, skin notations have rarely been assigned to PGM substances.

OELs are developed and published by various governmental and quasi-governmental agencies across the world. Dependent on territory and the originating agency, they vary in their application from strict regulatory standards to guideline values for exposures representing minimal or tolerable risk to workers. It should be noted that even where there are no specific OELs, there may still be a legal requirement to control exposure to hazardous substances. An example is in the General Duty Clause of the US Occupational Safety and Health Act (US OSHA) which states that: 'Each employer shall furnish to each of his employees employment and a place of employment which are free from recognised hazards that are causing, or are likely to cause, death or serious physical harm to his employees.' Therefore,

in strict terms, under US OSHA jurisdiction this will apply to significant chemical exposure hazards even if OEL has not been officially assigned. A number of other territories outside of the USA impose similar duty of care standards.

Company-level voluntary exposure standards, guideline values, targets for improvement etc., may be established to supplement official limits, or to fill a gap where no OELs are in existence. Suppliers may provide these in their safety datasheets to guide the end-users of products. Where OELs are absent, different approaches can be evaluated, *e.g.*, applying the available hazard classification or toxicology data to derive an exposure control band (so-called 'Control Banding'), and thereby to provide a rational exposure control target (ILO, 2006; NIOSH, 2013; HSE, 2016).

Resources exist which reference territorially relevant exposure limits, *e.g.*, the GESTIS OEL database; and the non-regulatory norms such as the ACGIH Threshold Limit Values (TLVs®), AIHA Workplace Environmental Exposure Levels® (WEELs®), DFG MAK Commission Maximum Workplace Concentrations (MAK values) and Biological Tolerance

¹Examples include - USA: ACGIH "skin notation"; The Quebec Occupational Safety and Health Regulation "Pc: SKIN percutaneous"; UK: EH40 Occupational Exposure limits "Sk" notation; Germany: MAK designation "H"; Japan Society for Occupational Health "S" flag.

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OCCUPATIONAL EXPOSURE LIMITS

Values (BAT values), and the US NIOSH Recommended Exposure Limits (RELs) and Immediately Dangerous To Life or Health (IDLH) values. Refer 'References' for further details.

OELs FOR PGMs

The current position for airborne substance OELs applicable to the management of PGMs can be summarised as follows:

- OELs for Pt metal and soluble Pt salts apply in most jurisdictions. Refer to Chapter 8 for more specifics on occupational hygiene aspects.
- Due to a number of technical considerations, including the difficulty of speciation, OELs specific to chloroplatinate salts are not currently utilised. Instead, OELs for soluble Pt are used as a surrogate monitoring standard for chloroplatinate airborne concentrations. See also Chapter 8.
- OELs are typically lacking for Pd metal and Pd compounds. Occasional territories have proposed standards based on a limited dataset (e.g., GESTIS OEL database; access details are provided under 'References'), and certain suppliers may make their own recommendations for exposure standards.
- A similar position exists for both Ir and its compounds, and Ru and its compounds – official OELs have typically not been set.
- Rh metal, Rh insoluble compounds, and Rh soluble compounds have OELs established in several territories.
- Although generally applicable OELs for Os and its compounds do not exist, osmium tetroxide has been recognised as possessing high toxicity and requiring stringent control; thus several territories have an OEL in place for this substance.

It should be noted that data on PGMs are constantly emerging, and as a result new OELs may be under development or existing OELs may be subject to revision. Hence such OELs should be regularly checked for validity. Up-to-date chemical safety datasheets (SDS) are expected to provide reliable information on exposure limits.

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OTHER TYPES OF BENCHMARK VALUES
RELEVANT TO EXPOSURE CONTROLOTHER TYPES OF BENCHMARK VALUES
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Airborne substance OELs only relate to control of risks arising from inhalation of hazardous substances. Other exposure routes are relevant to occupational contexts, including skin absorption, and—to a limited extent—oral ingestion. For instance, some PGM compounds can undergo dermal absorption after skin contact, and DOELs may not be available for the purposes of control of that risk. Therefore, particularly where potential systemic toxic effects are being considered, it may be appropriate to also consider applying a biomarker for total exposure by all routes, via the technique of biological monitoring—also known as biomonitoring (IPCS, 1993).

Biological monitoring reference norms carry several broadly equivalent designations including Biological Limit Values (BLVs), Biological Exposure Indices (BEIs) and Biological Tolerance Values. Whilst official reference standards have not yet been validated for the various PGMs, biological monitoring approaches have been developed which are useful for workplace control purposes (refer to Chapter 6).

Certain difficulties are acknowledged to exist with biological monitoring, including

its cultural acceptability in certain jurisdictions, and issues with interpreting monitoring data where firm biological limit values aligned with safe systemic exposures have not been established.

Other types of occupational benchmark values exist, such as the Derived No Effect Levels (DNELs) for workers which are established under the EU REACH Regulation (EC, 2006). These quantify the potential of the substance to cause adverse health effects and identify a level above which humans should not be exposed.

REACH Derived Minimal Effect Levels (DMELs)—applied when clear effect thresholds are not demonstrable—represent a reference dose where the likelihood that an identified toxicity occurs in a population is sufficiently low to be of no concern.

DNELs/DMELs may be set for inhalation, ingestion, or dermal routes, and for both systemic and local toxic effects. The exact way in which these benchmark values are first established and then interpreted for regulatory compliance differs from that of OELs, but there

is often a reasonable level of correspondence between them (Tynkkynen *et al.*, 2015).

DN(M)ELs are established by the manufacturers or importers of a substance in order to comply with the registration requirements of the EU REACH Regulation (EC, 2006). Manufacturers or importers of substances which require a REACH Chemical Safety Assessment must establish DN(M)ELs for the substance in question, and these should be declared in the Chemical Safety Report (CSR) and mirrored in any safety datasheet (SDS). As REACH dossiers—including those for PGMs and PGM compounds—are submitted, the European Chemicals Agency (ECHA) is making such DN(M)EL information publically available on its website (<http://echa.europa.eu/information-on-chemicals>).

In the USA, benchmark values include: California's Proposition 65 Safe Harbour Levels, established for 300 of 800 listed chemicals; and US EPA's Toxic Substances Control Act Significant New Use Rule New Chemical Exposure Limits (TSCA SNUR NCELs). US EPA's Integrated Risk Information System (IRIS) also establishes safe levels for chemical exposures but these are set for the general

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OTHER TYPES OF BENCHMARK VALUES RELEVANT TO EXPOSURE CONTROL

public—including the most sensitive populations—rather than workers. At the time of writing, none of these sources lists benchmark values for PGM compounds.

As mentioned previously, dermal exposure limits (DOELs) for PGMs are not officially designated. However, some companies handling PGMs—particularly higher hazard forms such as chloroplatinates—use pragmatic Acceptable Surface Limit (ASL) values aligned to ‘wipe sampling’ as a monitor of surface or equipment contamination. Such in-house ASLs are a further means to evaluate and track workplace hygienic standards. See also Chapters 8 and 9.

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HAZARD COMMUNICATION

HAZARD COMMUNICATION

Where hazardous chemicals are manufactured, used, or stored, both workplace EHS management systems (ILO, 1993) and chemical control regulations (see Section 10.1) dictate that up-to-date hazard and safe handling information must be readily available and actively provided to the workforce. Operational details of how this should be properly effected are a fundamental aspect of framework legislation such as the UK COSHH Regulations, South African Hazardous Chemical Substances Regulations, and the latest US OSHA Hazard Communication Standard. The accompanying official guidance to these and similar regulations provides further direction on specifics.

Although in practice hazard and precautionary information is most often conveyed via chemical labelling, safety datasheets (SDS), or similar information distilled into worker information sheets, it must be augmented with a suitable hazard communication programme which includes training and awareness measures. Only by giving employees the correct information, in a manner which can be readily understood, will they be able to use the control measures and safe systems of work required

to reduce hazardous substance exposures to themselves and their co-workers, and to protect the environment.

Hazard communication actions are expected to be proportionate to the identified risk from hazardous chemicals and the related exposure scenarios, and should be customised accordingly. Hence general chemical hazard communication may be common to all persons in a workplace, but may then be tailored to the specific risks and activities for particular workers. For instance, example generic scenarios relevant to PGMs with progressively more complex hazard communication requirements could include:

No exposure:

Workers operating away from refinery operations, PGM salts production, or other PGM applications, where hazardous PGM substances are not found, but other chemicals may be in use in a manner wherein the risks are assessed as low.

- General hazard communication training would likely be appropriate.

Low Hazard/Exposure:

Workers in areas where PGMs are

handled, but these are categorised as not significantly hazardous, and are used in circumstances of good containment, or where the need for engineering and other control regimes (PPE, administrative controls etc.) is limited. Monitoring has demonstrated that PGM exposures, including airborne and surface levels, are routinely low and within acceptable limits. Abnormal or emergency conditions involving hazardous PGM releases can be largely discounted.

- Straightforward specific hazard communication training on the PGMs in the workplace would be appropriate, with information on hazards, safe handling, controls, and first aid measures etc.
- Regular updates would be provided.

Higher Hazard/Exposure:

Such as workers handling incoming PGM-containing feedstocks which may contain allergenic forms, or compounds with high local toxicity; those directly involved in the separation or manipulation of chloroplatinate salts; maintenance staff with a potential to experience unpredictable or sporadic significant exposures; or other staff working in PGM refineries

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whereby there could be exposure to multiple PGM compounds and related processes. Monitoring has demonstrated that PGM exposures, including airborne and surface contamination, occurs and therefore that a series of engineering and administrative controls are necessary to ensure risk minimisation. Abnormal or emergency conditions involving hazardous PGM releases cannot be completely mitigated and might foreseeably occur.

- Under these conditions, a particularly thorough hazard communication programme would be expected with training and awareness covering activity risk assessment(s), specific PGM hazards, related safety precautions, correct selection and use of exposure controls, other administrative and hygienic practices, emergency and first aid actions, health surveillance requirements, exposure monitoring information, and consideration of normal and abnormal operating conditions etc.
- Specific training for significant risk activities would be provided on a supplemental basis to the employees involved, *e.g.*, on operational procedures intended to minimise risk.
- Training and awareness actions for individual workers would be documented in detail by site EHS professionals, and ongoing updates would be scheduled on a very regular basis.

substances are found, this may be supplemented by area placarding, chemical warning signage, and marking of equipment and pipework etc. which is generally subject to local regulatory norms. Where a supplier concludes that a chemical is non-hazardous, a product hazard label is not legally required.

Previous nationally or regionally specific chemical classification and labelling systems have largely been supplanted by the United Nations developed 'Globally Harmonised System of Classification and Labelling of Chemicals' (GHS) (UNECE, 2015). GHS is a single worldwide system for classifying and communicating the hazardous properties of industrial and consumer chemicals which integrates with the UN 'Transport of Dangerous Goods' regime. GHS specifies the criteria required for classifying chemicals according to their health, environmental and physical hazards. It also formalises uniform hazard communication requirements via defined labelling and SDS standards (see also Section 10.4).

LABELLING OF CHEMICAL SUBSTANCES

On a worldwide basis, chemical container labelling is routinely used to convey keypoint information of the hazards and precautions for chemical substances and mixtures. At a workplace level where hazardous

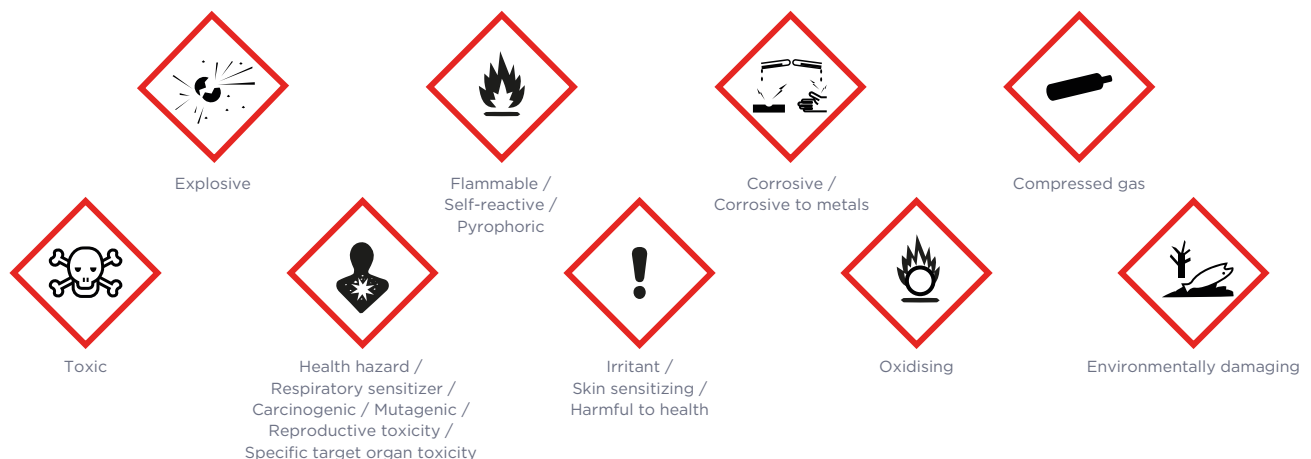


Figure 10-1: GHS hazard pictograms (simplified)

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As well as chemical identifier and supplier details, a hazard label is made up of specific symbols (known as ‘pictograms’; see Figure 10-1); signal (warning) words; and hazard and precautionary statements. These label components are set out under GHS and its territorially equivalent enactments—chemical suppliers must use them where the corresponding hazardous properties have been identified. As the UN GHS is not a legally binding international convention, individual countries or regions produce their own legislation or standards to implement its

requirements (which do differ slightly in certain fine details). As examples of locally adopted equivalents, the EU Classification, Labelling and Packaging (CLP) Regulations implement GHS; and territories including South Africa (via the SANS 10234 Standard), United States (via the Hazard Communication Standard 2012), Canada, Russia, Australia, New Zealand, and most major Asia-Pacific countries have adopted similar GHS-based regulations or standards. Further information on the status of the GHS implementation in other countries can be obtained

from the UNECE website (see ‘References’).

A representative example of a GHS product container label for a hazardous PGM substance, illustrating the various components of the label, is provided in Figure 10-2.

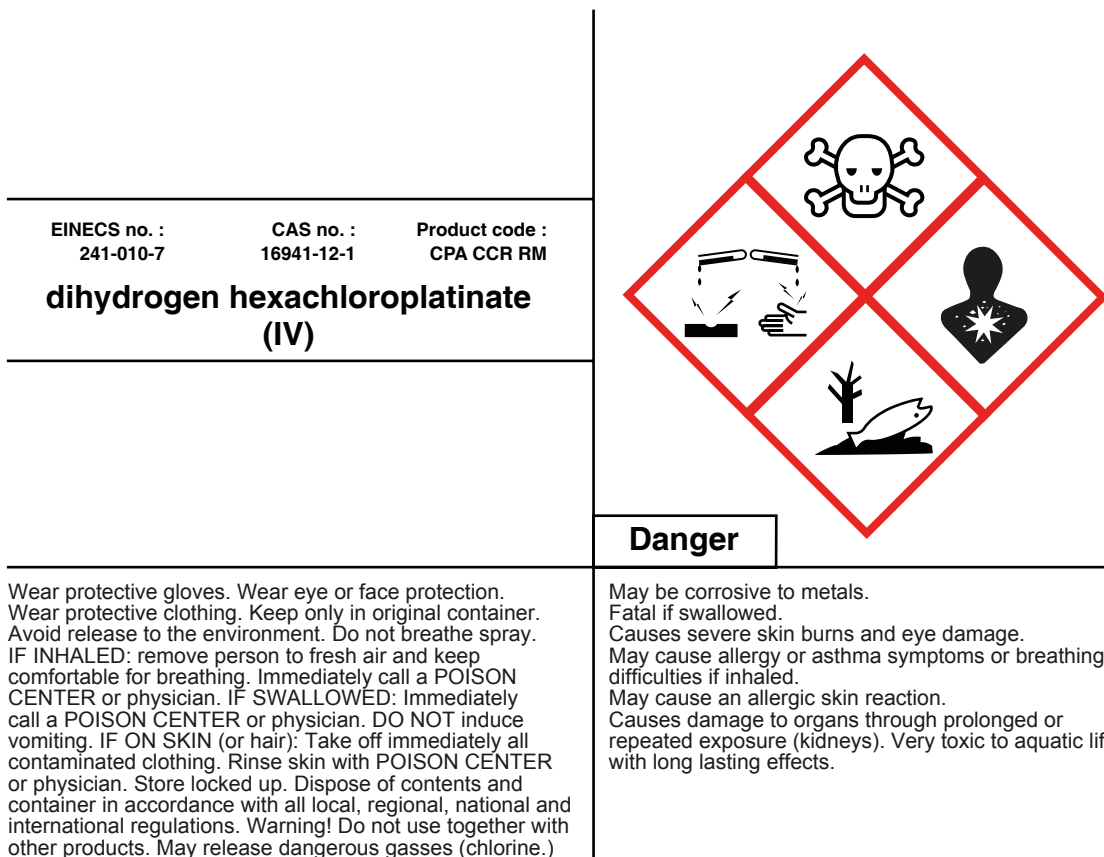


Figure 10-2: Representative GHS format label for a hazardous PGM substance

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Globally ratified GHS classifications for individual chemical substances in relation to their health, physical and environmental hazards do not currently exist. Therefore, these assignments are normally the responsibility of the company placing the substance onto the market, or producing it in the workplace, though in some territories (e.g., the EU) harmonised classifications for certain substances do exist which are legally binding and are expected to be applied by product suppliers. In order to promote consistency between suppliers, the PGM sector in Europe has agreed hazard classifications for a number of PGM substances of industrial importance (refer to the PGM substance group inventories available via the REACH Precious Metals and Rhenium Consortium website; <http://epmf.be>).

SAFETY DATA SHEETS (SDS)

Chemical safety datasheets (SDS), which were once referred to as material safety datasheets (MSDS), are a fundamental part of hazard communication in workplaces where hazardous substances and mixtures are being handled. Their vital role in

safe management practices in the workplace has been recognised for several decades (ILO, 1993). Regulatory duties related to SDS compilation and provision exist in all industrialised territories, where the principal responsibility for originating SDS, and keeping them updated, normally resides with the manufacturer or importer of chemical substances and mixtures. SDS provide both summary and detailed information on the hazards of a chemical substance or mixture, and advice on safe handling and use. Their information is also a key input into workplace risk assessment of activities where chemical exposures may occur.

The format and content of SDS in most territories is now aligned with the scheme in the Globally Harmonised System of Classification and Labelling of Chemicals (GHS)—see also Section 10.5. These requirements define the SDS format, the order of sections and their content, which should correspond with the following:

1. Identification of the substance/mixture and of the company/undertaking.
2. Hazards identification.
3. Composition/information on ingredients.
4. First-aid measures.
5. Fire-fighting measures.
6. Accidental release measures.
7. Handling and storage.

8. Exposure controls/personal protection.
9. Physical and chemical properties.
10. Stability and reactivity.
11. Toxicological information.
12. Ecological information.
13. Disposal considerations.
14. Transport information.
15. Regulatory information.
16. Other information.

Local regulations typically require that, following their initial issue, SDS are reviewed and updated on a regular basis. SDS should certainly be updated and released to end-users as soon as possible when new information on hazards or risk management measures becomes available. Employers who receive SDS should have systems to ensure that SDS provided to workers are both complete and up-to-date.

Aside from hazard and safe handling advice (the latter including information on OELs and other exposure standards), important regulatory information is typically included in the SDS, e.g., in the EU, substances identified as being of very high concern (i.e., 'SVHC') will be designated along with REACH Authorisation and Restriction advisory statements.

SDS, with their standardised and relatively detailed content, are distinct from other abbreviated

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hazard communication formats such as worker instruction sheets and International Chemical Safety Cards (ICSC), though the latter may be useful for specific purposes such as keypoint handling guidance or emergency response.

There is no single reliable repository of SDS for PGM substances. Suppliers of these products will provide SDS as part of hazard communication regulatory duties, and end-users should in the first instance refer all related queries and information support requests to their upstream supplier.

10.5

CHEMICAL MANAGEMENT REGULATIONS

CHEMICAL MANAGEMENT REGULATIONS

Because of its wide scope, and aspects such as market-access driven data requirements, the EU REACH Regulation (Registration, Evaluation, Authorisation and Restriction of Chemicals) represents a step change in legislation for the management of chemicals, including their workplace use. It aims to provide a high degree of protection of human health and the environment from chemical risks, whilst making those who place chemicals on the market (manufacturers and importers) responsible for assessing and managing such risks and filling gaps in knowledge by performing new studies. A detailed description of REACH is beyond the scope of this chapter, and resources such as the European Chemicals Agency (ECHA) website (<http://echa.europa.eu>) provide fuller information. Similar legislation is now in place or emerging in multiple other territories (see below) which is also relevant to workplace management of PGMs.

Subject to some limited exemptions, manufacturers or importers of PGMs placed on the EU market must comply with the REACH Regulation— notably its substance registration duties requiring the submission

of detailed dossiers covering chemical identity, physico-chemical, human health, and environmental property endpoints. Parts of this information is then publically disseminated by ECHA (<http://echa.europa.eu/information-on-chemicals>). These requirements have significantly expanded the available data and knowledge on PGM substances, and represent a valuable resource for their future safe management in the workplace. Chemical regulations fully or partly similar to EU REACH have been introduced in other territories, or else are planned as part of efforts to strengthen the local legislation (e.g., Australia, Canada, China, Japan, South Africa, South Korea, Taiwan and the USA). These regimes also typically require chemical registration/notification, testing for hazardous properties, provision of information, and restriction of certain substances of concern (ranging from control of some uses to their complete prohibition, or else other types of restriction or substitution impetus). Hence PGM substances are also controlled under these regimes. Websites of national members of the International Council of Chemical Associations (ICCA; www.icca-chem.org) often contain links to information

on regional or national control regimes, and comparisons of territorial requirements.

REFERENCES

American Conference of Governmental Industrial Hygienists (ACGIH®)

Threshold Limit Values (TLVs®) and Biological Exposure Indices (BEIs®);
www.acgih.org

American Industrial Hygiene Association (AIHA)

Guideline Foundation Workplace Environmental Exposure Levels®
(WEELs®); www.aiha.org

Deutsche Forschungsgemeinschaft (DFG)

MAK Commission Maximum Workplace Concentrations (MAK values) and
Biological Tolerance Values (BAT values); www.dfg.de

EC (2006)

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Council of 18 December 2006 concerning the Registration, Evaluation,
Authorisation and Restriction of Chemicals (REACH), establishing a
European Chemicals Agency; <http://echa.europa.eu/regulations/reach/legislation>

EC (2008)

Regulation (EC) No 1272/2008 on classification, labelling and packaging
(CLP) of substances and mixtures, as further amended and adapted;
<http://echa.europa.eu/en/regulations/clp/>

European Chemicals Agency (ECHA)

Information on chemicals database; <http://echa.europa.eu/information-on-chemicals>

EU (1998)

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). Note: also referred to as the 'Chemical Agents
Directive' (CAD).

**Institut für Arbeitsschutz der Deutschen Gesetzlichen
Unfallversicherung (IFA)**

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US OSHA (2012)

Hazard Communication Standard (HCS), CFR 29.1910.1200. *Note: sometimes referred to as 'Hazcom' or 'HCS 2012'.*