Standard Operating Procedure

Task: Supplementary Information for Reading a Safety Data Sheet (SDS)
Date: 02/14/2019

Background:

- A Safety Data Sheet (SDS), formerly called a Material Safety Data Sheet (MSDS), provides critical information on the physical properties, hazards, storage, transportation, and usage of laboratory chemicals.
- Any time you encounter a chemical or material that you are unfamiliar with, you should acquire and review its SDS.
- No reaction should be set up without first reviewing the SDSs of all reagents and possible products.
- This SOP includes a range of information to help understand SDSs.

Training Requirements:

- Lab safety training

Potential Hazards:

- N/A

Special PPE Requirements:

- N/A

Materials Needed:

- SDS document for review

Sections of an SDS

Section 1: Identification

- This section contains the chemical name. Double check that the name is correct. There may be multiple SDSs for a single reagent if it is sold as both a pure chemical and also as mixtures or solutions.

Section 2: Hazard(s) identification

- This section identifies the hazards of the chemical and provides appropriate warning information associated with those hazards
- Pictograms are included here. See below for more on pictograms.
- GHS classification and hazard statements (h-codes) and precautionary statements (p-codes) are included here. See below for more on h-codes and p-codes.

Section 3: Composition/information on ingredients

- This section identifies the ingredient(s) contained in the chemical/material, including impurities and stabilizing additives.

Section 4: First aid measures

- This section describes the initial care that untrained first responders should provide to an individual who has been exposed to the chemical/material.

Section 5: Firefighting measures

- This section provides recommendations for fighting a fire caused by the chemical, including suitable extinguisher choice, and warnings about hazardous conditions that can arise when the specific chemical/material burns.

Section 6: Accidental release measures

- This section recommends appropriate responses to spills, leaks, or releases.

Section 7: Handling and storage

- This section provides guidance on safe handling and storage conditions for the chemical/material. Precautions for safe handling and chemical hygiene practices are included, along with recommendations on the conditions for safe storage, including any incompatibilities.

Section 8: Exposure controls/personal protection

- This section indicates the exposure limits, engineering controls, and personal protective measures that can be used to minimize worker exposure.

Section 9: Physical and chemical properties

- This section identifies physical and chemical properties associated with the chemical/material.

Section 10: Stability and reactivity

- This section describes the reactivity hazards and stability of the chemical/material.

Section 11: Toxicological information

- This section provides toxicological information when available.

Section 12: Ecological information

- This non-mandatory section provides information on the potential environmental impact of the chemical/material in the environment.

Section 13: Disposal considerations

- This non-mandatory section provides guidance on proper disposal practices.

Section 14: Transportation information

- This non-mandatory section provides classification information for shipping and transporting of the chemical/material.

Section 15: Regulatory information

- This non-mandatory section identifies any specific regulations not indicated anywhere else on the SDS.

Section 16: Other information

- This section sometimes contains miscellaneous useful information.

GHS Classification (OSHA HCS / HazComm)

- Classifies the hazard and provides a “category” rating
- This is the most commonly presented hazard scale prominently located in an SDS.
- Scale from 1 to 4
- **1 is the most severe**

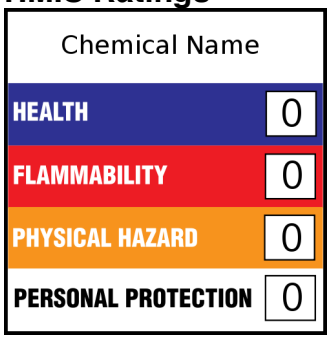
GHS Pictograms

Images: https://www.osha.gov/Publications/HazComm_QuickCard_Pictogram.html

GHS specific hazard codes

The GHS provides a series of codes (h-codes and p-codes) that describe specific hazards. A glossary of codes is provided as an Appendix below.

HMIS Ratings



- Four-bar signage
- Health (blue) / Flammability (red) / Reactivity (yellow/orange) / Personal Protection (white)
- Scale from 0 to 4
- **4 is the most severe**

NFPA Ratings

- Four-diamond signage
- This scale is most commonly encountered on building/door signage, not always in SDS.
- Health (blue) / Flammability (red) / Reactivity (yellow) / Special hazards (white)
- Scale from 0 to 4
- **4 is the most severe**

Exposure Controls

Quantitative exposure guidelines are provided, when available. The exposure controls provide recommended limits below which workers should not experience adverse effects.

There are two types of exposure guidelines:

TWA: time-weighted average exposure limits of a certain amount of time
CEIL: ceiling exposure limits that should not be exceeded for any amount of time

Different government agencies have specific guidelines for generating either TWA or CEIL exposure control recommendations:

PEL (OSHA): Permissible Exposure Limits — generally based on **8-hour time-weighted average** exposure. This is a legally binding limit enforceable by OSHA.

TLV (ACGIH): Threshold Limit Values — limit of exposure that a worker can be exposed to **continuously without adverse effect**.

REL (NIOSH): Recommended Exposure Limit — averaged exposure level that NIOSH believes would be safe over a working lifetime.

Toxicological (Toxicity) Data

Quantitative toxicological data are provided, when possible. These are generally derived from animal testing studies that determine the dose or concentration at which an animal will like die. Whereas exposure control recommendations are limiting values recommended to avoid any adverse effects, toxicological data is typically the critical value at which a catastrophic event may occur. If available, exposure control limits should be respected. ***Experimental, safety, and engineering controls should be taken to ensure that exposure levels never approach lethal concentration or dose ranges.***

LC_{50} (lethal concentration 50%): The concentration of gaseous (or aerosolized) material/chemical (in air) that killed 50% of the specific animal population tested in a single exposure. Testing is performed by inhalation, usually in a 1 hour or 4 hour period. The animal that was studied is specified. Typical reporting units are parts per million (ppm), micrograms per liter, or milligrams per cubic meter.

LD_{50} (lethal dose 50%): The amount of solid or liquid material/chemical that killed 50% of the specific animal population tested in a single dose. Testing can be performed by oral ingestion, dermal contact, or by injection. The species of animal and method of testing are both reported. Typical reporting units are milligrams or grams of material per kilogram body weight (mg/kg or g/kg).

Appendix: GHS Hazard statements (h-codes)

Physical hazards

H200 Unstable explosive
H201 Explosive; mass explosion hazard
H202 Explosive; severe projection hazard
H203 Explosive; fire, blast or projection hazard
H204 Fire or projection hazard
H205 May mass explode in fire
H206 Fire, blast or projection hazard: increased risk of explosion if desensitizing agent is reduced
H207 Fire or projection hazard: increased risk of explosion if desensitizing agent is reduced
H208 Fire hazard: increased risk of explosion if desensitizing agent is reduced
H220 Extremely flammable gas
H221 Flammable gas
H222 Extremely flammable aerosol

H223 Flammable aerosol
H224 Extremely flammable liquid and vapour
H225 Highly flammable liquid and vapour
H226 Flammable liquid and vapour
H227 Combustible liquid
H228 Flammable solid
H229 Pressurized container: may burst if heated
H230 May react explosively even in the absence of air
H231 May react explosively even in the absence of air at elevated pressure and/or temperature
H232 May ignite spontaneously if exposed to air
H233 Highly combustible liquid and vapour
H234 Combustible liquid and vapour
H235 May cause severe frostbite
H235 May cause serious frostbite
H236 May cause frostbite
H237 May form explosive mixtures in air
H238 May form explosive mixtures in dust
H239 May form explosive mixtures in water
H240 Heating may cause an explosion
H241 Heating may cause a fire or explosion
H242 Heating may cause a fire
H250 Catches fire spontaneously if exposed to air
H251 Self-heating; may catch fire
H252 Self-heating in large quantities; may catch fire
H260 In contact with water releases flammable gases which may ignite spontaneously
H261 In contact with water releases flammable gas
H270 May cause or intensify fire; oxidizer
H271 May cause fire or explosion; strong oxidizer
H272 May intensify fire; oxidizer
H280 Contains gas under pressure; may explode if heated
H281 Contains refrigerated gas; may cause cryogenic burns or injury
H282 May displace oxygen and cause rapid suffocation
H283 May displace oxygen and cause suffocation
H290 May be corrosive to metals

Health hazards
H300: Fatal if swallowed
H301: Toxic if swallowed
H302: Harmful if swallowed
H303: May be harmful if swallowed
H304: May be fatal if swallowed and enters airways
H305: May be harmful if swallowed and enters airways
H310: Fatal in contact with skin
H311: Toxic in contact with skin
H312: Harmful in contact with skin
H313: May be harmful in contact with skin

H314: Causes severe skin burns and eye damage
H315: Causes skin irritation
H316: Causes mild skin irritation
H317: May cause an allergic skin reaction
H318: Causes serious eye damage
H319: Causes serious eye irritation
H320: Causes eye irritation
H330: Fatal if inhaled
H331: Toxic if inhaled
H332: Harmful if inhaled
H333: May be harmful if inhaled
H334: May cause allergy or asthma symptoms or breathing difficulties if inhaled
H335: May cause respiratory irritation
H336: May cause drowsiness or dizziness
H340: May cause genetic defects
H341: Suspected of causing genetic defects
H350: May cause cancer
H351: Suspected of causing cancer
H360: May damage fertility or the unborn child
H361: Suspected of damaging fertility or the unborn child
H361d: Suspected of damaging the unborn child
H361e: May damage the unborn child
H361f: Suspected of damaging fertility
H361g: may damage fertility
H362: May cause harm to breast-fed children
H370: Causes damage to organs
H371: May cause damage to organs
H372: Causes damage to organs through prolonged or repeated exposure
H373: May cause damage to organs through prolonged or repeated exposure
H300+H310: Fatal if swallowed or in contact with skin
H300+H330: Fatal if swallowed or if inhaled
H310+H330: Fatal in contact with skin or if inhaled
H300+H310+H330: Fatal if swallowed, in contact with skin or if inhaled
H301+H311: Toxic if swallowed or in contact with skin
H301+H331: Toxic if swallowed or if inhaled
H311+H331: Toxic in contact with skin or if inhaled
H301+H311+H331: Toxic if swallowed, in contact with skin or if inhaled
H302+H312: Harmful if swallowed or in contact with skin
H302+H332: Harmful if swallowed or if inhaled
H312+H332: Harmful in contact with skin or if inhaled
H302+H312+H332: Harmful if swallowed, in contact with skin or if inhaled
H303+H313: May be harmful if swallowed or in contact with skin
H303+H333: May be harmful if swallowed or if inhaled
H313+H333: May be harmful in contact with skin or if inhaled
H303+H313+H333: May be harmful if swallowed, in contact with skin or if inhaled
H315+H320: Causes skin and eye irritation

Environmental hazards
H400: Very toxic to aquatic life
H401: Toxic to aquatic life
H402: Harmful to aquatic life
H410: Very toxic to aquatic life with long-lasting effects
H411: Toxic to aquatic life with long-lasting effects
H412: Harmful to aquatic life with long-lasting effects
H413: May cause long-lasting harmful effects to aquatic life
H420: Harms public health and the environment by destroying ozone in the upper atmosphere
H433: Harmful to terrestrial vertebrates

GHS Precautionary statements (p-codes)
General precautionary statements
P101: If medical advice is needed, have product container or label at hand.
P102: Keep out of reach of children.
P103: Read label before use.

Prevention precautionary statements
P201: Obtain special instructions before use.
P202: Do not handle until all safety precautions have been read and understood.
P210: Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.
P211: Do not spray on an open flame or other ignition source.
P220: Keep/Store away from clothing/…/combustible materials
P221: Take any precaution to avoid mixing with combustibles.
P222: Do not allow contact with air.
P223: Do not allow contact with water.
P230: Keep wetted with …
P231: Handle under inert gas.
P232: Protect from moisture.
P233: Keep container tightly closed.
P234: Keep only in original container.
P235: Keep cool.
P240: Ground/bond container and receiving equipment.
P241: Use explosion-proof electrical/ventilating/lighting/…/equipment.
P242: Use only non-sparking tools.
P243: Take precautionary measures against static discharge.
P244: Keep valves and fittings free from oil and grease.
P250: Do not subject to grinding/shock/…/friction.
P251: Do not pierce or burn, even after use.
P260: Do not breathe dust/fumes/gas/mist/vapours/spray.
P261: Avoid breathing dust/fumes/gas/mist/vapours/spray.
P262: Do not get in eyes, on skin, or on clothing.
P263: Avoid contact during pregnancy/while nursing.
P264: Wash … thoroughly after handling.
P270: Do not eat, drink or smoke when using this product.
P271: Use only outdoors or in a well-ventilated area.

P272: Contaminated work clothing should not be allowed out of the workplace.
P273: Avoid release to the environment.
P280: Wear protective gloves/protective clothing/eye protection/face protection.
P282: Wear cold insulating gloves/face shield/eye protection.
P283: Wear fire/flame resistant/retardant clothing.
P284: [In case of inadequate ventilation] wear respiratory protection. [As modified by IV ATP]
P231+232: Handle under inert gas. Protect from moisture
P235+410: Keep cool. Protect from sunlight
Response precautionary statements[edit]
P301: IF SWALLOWED:
P302: IF ON SKIN:
P303: IF ON SKIN (or hair):
P304: IF INHALED:
P305: IF IN EYES:
P306: IF ON CLOTHING:
P308: If exposed or concerned:
P310: Immediately call a POISON CENTER/doctor/…
P311: Call a POISON CENTER/ doctor/…
P312: Call a POISON CENTER/ doctor/…/if you feel unwell.
P313: Get medical advice/attention.
P314: Get medical advice/attention if you feel unwell.
P315: Get immediate medical advice/attention.
P320: Specific treatment is urgent (see … on this label).
P321: Specific treatment (see … on this label).
P330: Rinse mouth.
P331: Do NOT induce vomiting.
P332: If skin irritation occurs:
P333: If skin irritation or a rash occurs:
P334: Immerse in cool water/wrap in wet bandages.
P335: Brush off loose particles from skin.
P336: Thaw frosted parts with lukewarm water. Do not rub affected areas.
P337: If eye irritation persists:
P338: Remove contact lenses if present and easy to do. Continue rinsing.
P340: Remove person to fresh air and keep comfortable for breathing.
P342: If experiencing respiratory symptoms:
P351: Rinse cautiously with water for several minutes.
P352: Wash with plenty of water…
P353: Rinse skin with water/shower.
P360: Rinse immediately contaminated clothing and skin with plenty of water before removing clothes.
P361: Take off immediately all contaminated clothing.
P362: Take off contaminated clothing.
P363: Wash contaminated clothing before reuse.
P364: And wash it before reuse.
P370: In case of fire:
P371: In case of major fire and large quantities:
P372: Explosion risk in case of fire.

P373: DO NOT fight fire when fire reaches explosives.
P374: Fight fire with normal precautions from a reasonable distance.
P375: Fight fire remotely due to the risk of explosion.
P376: Stop leak if safe to do so.
P377: Leaking gas fire – do not extinguish unless leak can be stopped safely.
P378: Use … to extinguish.
P380: Evacuate area.
P381: Eliminate all ignition sources if safe to do so.
P391: Collect spillage.
P301+310: IF SWALLOWED: Immediately call a POISON CENTER/doctor/…
P301+312: IF SWALLOWED: Call a POISON CENTER/doctor/…/if you feel unwell.
P301+330+331: IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.
P302+334: IF ON SKIN: Immerse in cool water/wrap in wet bandages.
P302+352: IF ON SKIN: Wash with plenty of water/…
P303+361+353: IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water/ shower.
P304+312: IF INHALED: Call a POISON CENTER or doctor/physician if you feel unwell.
P304+340: IF INHALED: Remove person to fresh air and keep comfortable for breathing.
P305+351+338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.
P306+360: IF ON CLOTHING: Rinse immediately contaminated clothing and skin with plenty of water before removing clothes.
P308+311: If exposed or concerned: Call a POISON CENTER/ doctor/…
P308+313: If exposed: Call a POISON CENTER or doctor/physician.
P332+313: If skin irritation occurs: Get medical advice/attention.
P333+313: If skin irritation or a rash occurs: Get medical advice/attention.
P335+334: Brush off loose particles from skin. Immerse in cool water/wrap in wet bandages.
P337+313: If eye irritation persists get medical advice/attention.
P342+311: If experiencing respiratory symptoms: Call a POISON CENTER/doctor/…
P361+364: Take off immediately all contaminated clothing and wash it before reuse.
P362+364: Take off contaminated clothing and wash it before reuse.
P370+376: In case of fire: Stop leak if safe to do so.
P370+378: In case of fire: Use … to extinguish.
P370+380: In case of fire: Evacuate area.
P370+380+375: In case of fire: Evacuate area. Fight fire remotely due to the risk of explosion.
P371+380+375: In case of major fire and large quantities: Evacuate area. Fight fire remotely due to the risk of explosion.

Storage precautionary statements
P401: Store …
P402: Store in a dry place.
P403: Store in a well ventilated place.
P404: Store in a closed container.
P405: Store locked up.
P406: Store in a corrosive resistant/… container with a resistant inner liner.
P407: Maintain air gap between stacks/pallets.
P410: Protect from sunlight.

P411: Store at temperatures not exceeding … °C/… °F.
P412: Do not expose to temperatures exceeding 50 °C/122 °F.
P413: Store bulk masses greater than … kg/… lbs at temperatures not exceeding … °C/… °F.
P420: Store away from other materials.
P422: Store contents under …
P402+404: Store in a dry place. Store in a closed container.
P403+233: Store in a well ventilated place. Keep container tightly closed.
P403+235: Store in a well ventilated place. Keep cool.
P410+403: Protect from sunlight. Store in a well-ventilated place.
P410+412: Protect from sunlight. Do not expose to temperatures exceeding 50 °C/122 °F.
P411+235: Store at temperatures not exceeding … °C/… °F. Keep cool.

References and Related SOPs:

- OSHA SDS overview: https://www.osha.gov/Publications/OSHA3514.html
- PubChem
- SDS HyperGlossary: http://www.ilpi.com/msds/ref/index.html