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ACS Style Sheet for Writing Safety Statements

The guidelines embodied in this document were written in collaboration with the ACS Division of Chemical Health and Safety and revised by the Publications Division of the American Chemical Society in September 2021.

Preface

In support of the Society's core value of "Professionalism, Safety, and Ethics," ACS Publications has added a Safety Considerations requirement to the Author Guidelines of every ACS journal: "Authors must emphasize any unexpected, new, and/or significant hazards or risks associated with the reported work." This requirement provides authors with the opportunity to alert readers of hazards and/or conditions such that others may reproduce or build on their work safely. This style sheet offers some guidance about what information to include and provides practical examples of statements that may be used directly in manuscripts. For detailed guidance, authors are directed to the *ACS Guide to Scholarly Communication* Chapter 1.3 (Communicating Safety Information).

Inclusion of specific information will vary depending on the scope of the journal, the chemistry, and the audience. Statements should emphasize any unexpected, new, and/or significant hazards that present significant risk for the intended audience. For example, when the experimental design requires specialized equipment, specialized procedures, or specialized training for the procedures used, then authors should provide sufficient information to perform the work safely.

It should be noted that even with the presence of a safety statement, it is still always necessary for individuals following published procedures to first assess the risks from the perspective of their own specific local laboratory or teaching environment.

Checklist

Below is a checklist adapted from the *ACS Guide to Scholarly Communication* Section 1.3.5 (Formulating Safety Summary Statements) containing items that may be relevant to consider while determining what to include in a safety statement.

For chemicals and other substances

- ☐ Determine which substances are of significant hazard
  - See *ACS Guide to Scholarly Communication* Section 1.3.4 (Recognizing Hazards of Significant Concern)
  - Use IUPAC nomenclature and CAS Registry Numbers when possible
  - Consider all potentially hazardous products, intermediates, solvents, catalysts, etc.
- ☐ Note the specific hazards of those substances using the Globally Harmonized System (GHS) Classification
  - Consider including information such as the GHS pictogram, signal word, hazard statement, code, or category
  - Report hazards as appropriate for your audience (for example, different areas of chemistry such as synthetic, analytical, environmental, etc.)

- ☐ For novel compounds:
  - Estimate hazards based on those of closely related known analogues
  - Assume highest precautionary practices based on active functional groups

For processes, procedures, and equipment

- ☐ Consider emphasizing experimental details that can impact reactivity, such as:
  - Concentration of reagents
  - Reaction scale or changes in reaction scale
  - Specific laboratory apparatuses used
- ☐ Describe specialized equipment, procedures, or training associated with unique, high-hazard and/or high-risk situations
  - PPE or emergency equipment needed beyond standard laboratory procedures
  - Any additional laboratory or facility requirements required for specific hazards
  - Modifications to standard laboratory equipment
- ☐ Consider other hazards or innately high-risk situations, such as:
  - Elevated pressure or temperature
  - Electrical, mechanical, radiation, or high energy hazards
  - Highly reactive intermediates
  - Difficult to control behavior such as long, unpredictable induction periods
  - Biological agents
  - Nanomaterials

Example Statements

A hazardous material in significant quantity

If a hazardous material is deemed to be used in significant quantity (based on factors such as the specific material hazards and procedure), the manuscript must describe the hazard and how the associated risks are controlled. Other information may be necessary, such as reference to published procedures or more details included in the Supporting Information.

> ***Caution!*** *Piranha solution is a strong oxidizing agent, which reacts violently with most organic materials and must be handled with extreme care.*
>
> ***Caution!*** *Tert-butyllithium is extremely pyrophoric. It must be handled using proper needle and syringe techniques. All manipulations were performed on the smallest practical scale following the procedures described in [citation].*
>
> ***Caution!*** *Nitromethane is an extremely flammable and explosive liquid, which can detonate upon extreme heat. Contact with amines, alkali metals, and strong reducing agents should be strictly avoided.*
>
> ***Caution!*** *Catalyst X is air-sensitive and potentially pyrophoric. The spent catalyst was quenched using procedures outlined in the Supporting Information.*
>
> ***Caution!*** *Hydrogen is classified as a GHS Flammable Gas, Category 1. Hydrogen and the hydrogen balloon were handled using [standard procedures or insert citation].*

A hazardous material in very small quantity

The use of very small quantities may lower risk but the hazards of such materials should still be noted. In this case, a safety summary could note:

> ***Caution!*** *This procedure controlled risk by the use of millimolar concentration of highly flammable chemical X.*

Multiple unexpected, new, and/or significant hazards or risks

Whenever possible, authors should include multiple short safety statements at the mention of each significant hazard/risk. If space is limited, one general statement could instead be included in the experimental section, with more details in the Supporting Information as necessary. Alternatively, a combination of general and specific statements may be used.

> ***Caution!*** *The GHS Category 1 corrosive chemical A, carcinogenic chemicals B and C, oxidizing chemical D, and self-reactive chemical E constitute significant safety hazards and must be handled with extreme care.*

> ***Caution!*** *This procedure requires the use of specialized equipment X and produces highly reactive intermediate Y. See the Supporting Information for additional safety details.*

Schlenk lines (vacuum gas manifolds)

Depending on the journal's audience, Schlenk lines and related vacuum apparatus may part of standard training. A statement is still necessary depending on the audience and if the system introduces particular risk or requires specialized equipment, procedures, or training.

> ***Caution!*** *Extreme care should be taken both in the handling of the cryogen liquid nitrogen and its use in the Schlenk line trap to avoid the condensation of oxygen from air.*

An unexpected reaction or event occurred

It is best practice to report events such as an unexpected release of energy during the synthesis of a novel compound. The event can be addressed in the manuscript directly with a statement or published separately and referenced (for example, in the journal *ACS Chemical Health & Safety* or the Pistoia Alliance Chemical Safety Library).

> ***Caution!*** *The reaction was found to react violently upon [conditions]. Further examination of this reactivity can be found in [citation].*

Biosafety Level (BSL) 2-4 work

Use of BSL protocols for handling biological hazards should be noted according to the specific journal guidelines and the audience. Other information (particularly for BSL 3 and 4) may need to be included when appropriate, such as extra details about specific personal protective equipment.

> ***Caution!*** *Biological agent X was handled following BSL 2 protocols.*

Ionizing or nonionizing radiation

Depending on the audience, reference to protocols based on energy or isotope should be noted.

> ***Caution!*** *Ultraviolet light is damaging to biological tissues. Caution is required when working with the lamp and protective eyewear must be used at all times.*

> ***Caution!*** *Due to the spontaneous fission and α-, β-, and γ-particle emission from ^{243}Am and its daughter ^{239}Np, the radioisotope sample represents a serious health hazard. All studies with ^{243}Am were conducted in a radiation laboratory equipped with HEPA filtered hoods.*

Extremely toxic, flammable (pyrophoric), or corrosive compressed gases or liquefied gases

Locations that use any of these materials (such as arsine, silane, hydrogen, or hydrogen chloride) usually have advanced engineering and administrative controls in place, which are driven by local and national Codes. Safety information should acknowledge this and indicate any specialized controls, procedures, or equipment used. For example:

> ***Caution!*** *Extreme toxicity hazard! 5% arsine in nitrogen was handled using the procedures described by [citation]. Self-contained breathing apparatus was worn by both members of the team when cylinders, in the gas cabinet, were changed.*

> ***Caution!*** *Pyrophoric gas! Silane was stored in a remote bunker and piped to the tool via double-wall welded stainless steel tubing. Thermal gloves and body protection and self-contained breathing apparatus were worn by both members of the team changing cylinders or if working on pressurized lines.*

> ***Caution!*** *Corrosive gas HCl gas was purchased only in lecture bottle size. The entire apparatus was set-up in a fume hood. Long-gauntlet neoprene gloves and standard lab PPE were work when working on the pressurized system. The sash was always as low as practical for the work.*

Frequently Asked Questions

Does my safety statement subtract from my word count?

Statements of <100 words will not be counted against the word limit. If you would like to include more text, the requirements will be different for each individual ACS journal. This information can be found either in the journal's Author Guidelines or by contacting the Editor-in-Chief.

What constitutes a significant hazard or risk?

Highly hazardous materials typically are considered those with GHS Category 1 or equivalent. However, some procedures or processes involving less hazardous materials pose high risk and many novel materials are not yet classified. Authors should use their discretion when reporting safety information and rely on the risk assessment of individual procedures.

When should a risk assessment be performed?

Risk assessments should be performed after identifying hazards and prior to performing the experiment. Safety statements should be written while preparing the manuscript based on your risk assessment. Information about how to perform a risk assessment may be found in the *ACS Guide to Scholarly Communication* Section 1.3.4 (Recognizing Hazards of Significant Concern).

Where should I include my statement if I have experimental information in the main text and Supporting Information?

The safety statement should generally be placed in the Materials and Methods section of a manuscript to ensure that it is not overlooked. If the Supporting Information contains details related to the procedure, then the safety information should be repeated or expanded as appropriate.

I am following a published synthesis procedure. Do I need to provide safety information if I report the same procedure in my manuscript?

In general, authors should reference authoritative safety information sources (see *ACS Guide to Scholarly Communication* Table 1.3.3, Safety Information Resources). If the manuscript you are referencing does not contain sufficient safety information, your manuscript should explain the hazards and how to control risks.

What if I'm writing a manuscript directed at an educational audience?

Refer to the journal editorial office or guidance from the *Journal of Chemical Education*.