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Understanding the Environment as a Threat

Toxic Industrial Chemical / Material Intelligence Tool (TICMINT) User Guide

Michael A. Clement, Sage Broderick, and Marty Garton

November 2023



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Toxic Industrial Chemical / Material Intelligence Tool (TICMINT) User Guide

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Abstract

The Toxic Industrial Chemical / Material Intelligence Tool (TICMINT) is a web application that provides critical chemical and toxicological information to users quickly and efficiently for the purpose of enacting safe maneuvers in areas of operations. It provides an in-depth look at the makeup, properties, and hazardous effects of nearly 400 toxic chemicals of interest. It also provides background on the chemical makeup of a bevy of building materials, enabling soldiers in areas of operation to determine the toxicological risks associated with the combustion of those materials in their environment. This document's purpose is to demonstrate the functionality of the TICMINT web application and provide instructional material for those managing its content.

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Preface

This study was conducted for the US Army Corps of Engineers under Program Element 0603463A, Project Number AR6, “Understanding the Environment as a Threat.” The technical monitor was Dr. Christa M. Woodley.

The work was performed by the Scientific Software Branch of the Computational Science and Engineering Division, US Army Engineer Research and Development Center–Information Technology Laboratory (ERDC-ITL). At the time of publication, Mr. Joshua Church was branch chief; Dr. Jeffrey L. Hensley was division chief; and Dr. Robert M. Wallace was the technical director. The deputy director of ERDC-ITL was Dr. Jackie S. Pettway, and the director was Dr. David A. Horner.

COL Christian Patterson was commander of ERDC, and Dr. David W. Pittman was director.

Requirements for Use

This web application requires the use of Google Chrome, Mozilla Firefox, or a similar modern browser in order to function properly. These browsers can be obtained from their respective sources:

Chrome:

<https://www.google.com/chrome>

Firefox:

<https://www.mozilla.org/en-US/exp/firefox/>

1 Introduction

The Toxic Industrial Chemical / Material Intelligence Tool (TICMINT) is a product of the Understanding the Environment as a Threat program. It is a web application that provides toxic chemical and material information for the purpose of supporting maneuver planning. The tool contains chemical profiles for nearly 400 toxic chemicals of interest, along with the geographic location of their producers and storage facilities. TICMINT also provides a method for searching toxic building materials to discover the potential for toxic chemical release during the combustion of those materials. The web tool gives military planners the information they need to enable them to determine the toxicological risks associated with the release of a toxic industrial chemical or the combustion of a toxic industrial material in an area of operation.

This guide provides detailed information about the functionalities and features that are contained in the TICMINT web application, along with a thorough description of the usage of those features.

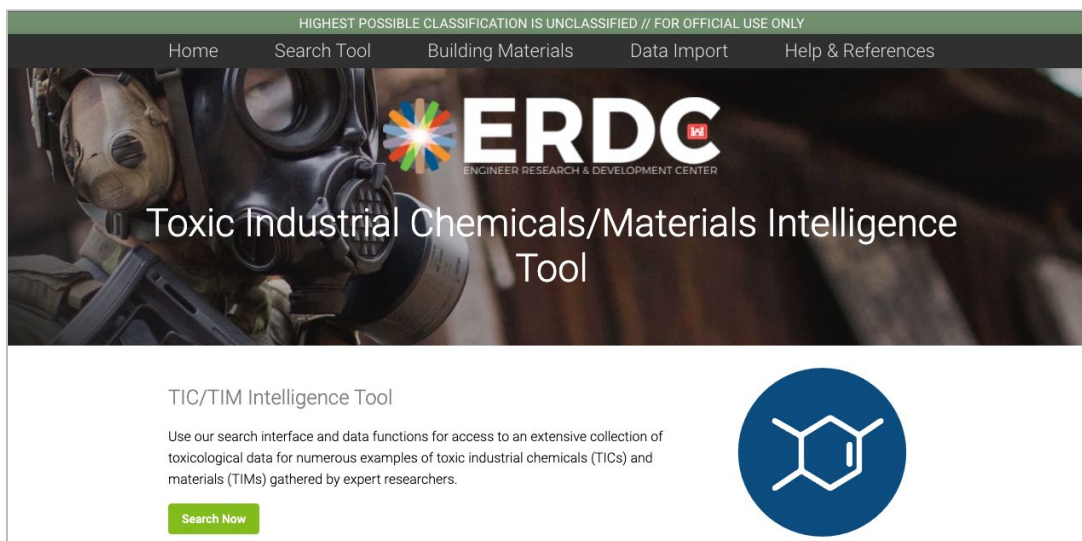
2 Access

A key design concern when producing the TICMINT application was ease of access. TICMINT was constructed as a web application (as opposed to a native desktop application) to enable access across a range of devices without complicated or brittle installation requirements. Rather, users may simply access the site, log in, and browse the content.

This section provides details regarding accessing the TICMINT web application and a high-level overview of the components contained therein.

When accessing the site at the beginning of a session, ensure a Common Access Card (CAC) is inserted into the computer. Next, navigate to <https://ticmint.erdcdren.mil> using a modern web browser. Upon doing so, a prompt will appear and ask for the CAC PIN. After entering their PIN, the user will be taken to the TICMINT web application (Figure 1):

Figure 1. Toxic Industrial Chemical / Material Intelligence Tool (TICMINT) front page.



The application has special roles for content editors, and these roles will be automatically applied as required when users log in to the site. For example, if a user has been assigned an editing role in the application, then those editing permissions will be automatically applied without any additional credentials or user input. Please refer to Section 7 of this document for more information regarding the editing of content.

3 Application Overview

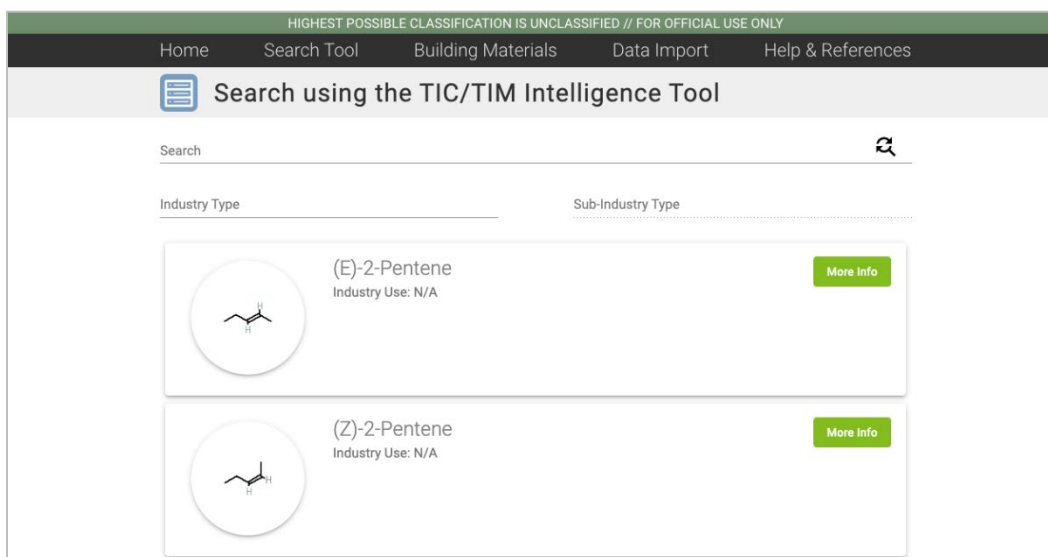
TICMINT has three primary functions. These functions are Chemical Search, Building Material Search, and Data Import. Chemical Search enables users to search for individual chemicals based on criteria such as industry usage, and then view in-depth details about the specified chemical. Building Material Search functions similarly, allowing the user to search for a particular type of construction material and identify its chemical byproducts. The Data Import function allows site administrators to upload new chemical and building material data to the tool, providing a means to keep information current and maximally useful.

Throughout this section, these functions will be elaborated on, and brief descriptions of how they work together will be provided.

3.1 Chemical Search

The Chemical Search page (<https://ticmint.erdcdren.mil/search>) (Figure 2) allows users to search for specific chemicals by name or industry type.

Figure 2. Chemical search page.



To search for chemicals, type the search term in the search field. The chemical results will filter automatically as the user types.

For additional filtering, select an industry type and subindustry type from the dropdowns below the search field. Choosing an option from the

industry dropdown will unlock the subindustry dropdown and automatically filter results (Figure 3).

Figure 3. Chemical Search filter dropdowns.

The screenshot shows a web application interface for chemical search. At the top, a green banner reads "HIGHEST POSSIBLE CLASSIFICATION IS UNCLASSIFIED // FOR OFFICIAL USE ONLY". Below this is a navigation bar with links: Home, Search Tool, Building Materials, Data Import, and Help & References. The main heading is "Search using the TIC/TIM Intelligence Tool". A search bar contains the text "chloro". Below the search bar, two dropdown menus are visible: "Industry Type" set to "33: Manufacturing (products metallic)" and "Sub-Industry Type" set to "334: Computer and Electronic Product Manufacturing". The search results are displayed in three cards, each for a different chemical:

- 1,1,2,2-Tetrachloroethane**: Industry Use: N/A. Includes a chemical structure icon and a "More Info" button. Below the card are blue buttons for "Other Miscellan...", "Computer System...", "Pharmaceutical...", and "Steel Product M...", followed by "+6 more industry groups".
- Chloroform**: Industry Use: N/A. Includes a chemical structure icon and a "More Info" button. Below the card are blue buttons for "Oil and Gas Ext...", "Navigational, M...", "Nonmetallic Min...", and "Water, Sewage a...", followed by "+45 more industry groups" and a "Click to show more" button.
- Epichlorohydrin**: Industry Use: N/A. Includes a chemical structure icon and a "More Info" button. Below the card are blue buttons for "Plastics Produc...", "Warehousing and...", "Other Nonmetal...", and "Waste Treatment...", followed by "+32 more industry groups".

At the bottom right of the results area, there is a pagination control showing "Items per page: 10" and "1 - 3 of 3" with navigation arrows.

To view the complete chemical information, click the green “More Info” button. Clicking on any of the blue industry buttons within a search result will filter the results further, using that industry.

3.2 Building Material Search


The Building Materials search page (<https://ticmint.erdcdren.mil/building-materials>) allows users to search for specific building materials by name and see a list of what chemicals are contained within those building materials (Figure 4).

Figure 4. Building Material search page.

The screenshot shows a web application interface for searching building materials. At the top, there is a green header with the text "HIGHEST POSSIBLE CLASSIFICATION IS UNCLASSIFIED // FOR OFFICIAL USE ONLY". Below this is a dark navigation bar with links for "Home", "Search Tool", "Building Materials", "Data Import", and "Help & References". The main content area has a light gray header with a search icon and the text "Search Building Materials". Below this is a search input field with the placeholder text "Building Material". The search results are displayed in two white boxes. The first box is for "Carbon monoxide from Extruded polystyrene" and includes a green "More Info" button. The second box is for "Hydrogen cyanide from Extruded polystyrene" and also includes a green "More Info" button. Each result box contains detailed information such as "Other Names", "Odor", "Source", and "Symptoms".

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Home Search Tool Building Materials Data Import Help & References

 Search Building Materials

Building Material

Carbon monoxide from Extruded polystyrene [More Info](#)

Other Names: Flue gas, monoxide, carbonous oxide, and carbon (I) oxide
Odor: No
Source: Materials containing carbon, incomplete combustion of any organic material
Symptoms: Headache, nausea, vomiting, dizziness, fatigue, and weakness feeling.

Hydrogen cyanide from Extruded polystyrene [More Info](#)

Other Names: Prussic acid, hydrocyanic acid, and formonitrile
Odor: Bitter almond
Source: Products composed of carbon and nitrogen, polyurethane, polyamides, acrylics, wool.
Symptoms: Exposure to lower concentrations of hydrogen cyanide may produce eye irritation, headache, confusion, nausea, and vomiting followed in some cases by coma and death

To search for building materials, type or select the name of a building material from the autocomplete field above the search results. To view the complete chemical information, click the green “More Info” button.

4 Chemicals

The chemical data housed in TICMINT provide users with vast insight into the physical and toxicological properties of particular compounds that may be encountered in the field. At a quick glance, users of the tool can broadly understand the impacts of interacting with these substances and know how to mitigate the risks.

This section provides an overview of the chemical detail pages, the information they house, and how to read the values stored therein.

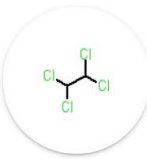
4.1 Chemical Information Overview

The chemical information page displays details and characteristics pertaining to a specific chemical (Figure 5). The user is presented with a wide variety of details ranging from production locations to toxicological impacts and more. The page is divided into sections, details of which follow.

Figure 5. Chemical information page.


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Home Search Tool Building Materials Data Import Help & References



1,1,2,2-Tetrachloroethane
Industry Use: N/A

Edit



Properties

CAS Number: Edit

Industries: [Manufacturing \(products non-metallic\)](#) [Chemical Manufacturing](#)

[Pharmaceutical and Medicine Manufacturing](#) [Pharmaceutical and Medicine Manufacturing](#)

[Medicinal and Botanical Manufacturing](#) [Pharmaceutical Preparation Manufacturing](#) [Basic Chemical Manufacturing](#)

[Petrochemical Manufacturing](#) [Petrochemical Manufacturing](#) [Synthetic Dye and Pigment Manufacturing](#)

[Synthetic Dye and Pigment Manufacturing](#) [Other Basic Organic Chemical Manufacturing](#)

[Cyclic Crude, Intermediate, and Gum and Wood Chemical Manufacturing](#) [Industrial Gas Manufacturing](#)

[Industrial Gas Manufacturing](#) [Other Basic Inorganic Chemical Manufacturing](#)

[Other Basic Inorganic Chemical Manufacturing](#) [Ethyl Alcohol Manufacturing](#)

[All Other Basic Organic Chemical Manufacturing](#) [Other Chemical Product and Preparation Manufacturing](#)

+34 more industries

Building Materials: N/A

Physical Properties

| Chemical Physical States | Color | Odor | Chemical Storage States | Melting Point | Boiling Point | Vapor Density | Water Solubility |
|--------------------------|-------|------|-------------------------|---------------|---------------|----------------------|------------------|
| Liquid | n/a | n/a | n/a | -41.1889 °C | 145.738 °C | 5.7925 dimensionless | 0.0180422 mol/L |

NFPA Properties

| Health | Flammability | Reactivity | Special |
|--------|--------------|------------|---------|
| 3 | n/a | n/a | n/a |

Tox Properties

| 8 hour Air MEGs (mg/m3) | | | 1 hour Air MEGs (mg/m3) | | | 10 minute Air MEGs (mg/m3) | | |
|-------------------------|----------|----------|-------------------------|----------|----------|----------------------------|----------|----------|
| Negligible | Marginal | Critical | Negligible | Marginal | Critical | Negligible | Marginal | Critical |
| n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

4.2 Chemical Production Locations

For chemicals that feature this data, locations of known producers will be displayed on a map at the top of the chemical detail page (Figure 6). This information is further detailed in the chemical producers table (discussed in Section 4.5). Hovering over the pin will also display the name of the chemical producer.

Figure 6. Chemical production locations.

4.3 Chemical Industries and Building Materials

This section displays the chemical’s Chemical Abstracts Service (CAS) number along with a list of all known industries that leverage it (Figure 7). Clicking on a blue industry badge will then perform a search for other chemicals that also fit this criterion. Clicking the “more industries” text below the badges will display any additional industries (if applicable).

It is important to note that the blue industry badges listed are at a subindustry level. Some chemicals may have hundreds of associated industries.

Figure 7. Chemical industries and building materials.

Building materials (represented by orange badges) show what materials are known to contain the specified chemical. Clicking on an orange badge will perform a search for other chemicals that also fit this criterion.

4.4 Chemical Physical, National Fire Protection Agency (NFPA), and Toxicological Properties

This section displays information pertaining to the chemical's physical characteristics (storage state, melting/boiling point, water solubility, etc.), as well as Military Exposure Guidelines (MEGs), which indicate how long humans can withstand exposure to the chemical at varying levels (Figure 8).

Figure 8. Physical, National Fire Protection Agency (NFPA), and toxicological property tables.

| Physical Properties | | | | | | | |
|--------------------------|-------|------|-------------------------|---------------|---------------|----------------------|------------------|
| Chemical Physical States | Color | Odor | Chemical Storage States | Melting Point | Boiling Point | Vapor Density | Water Solubility |
| Liquid | n/a | n/a | n/a | -41.1889 °C | 145.738 °C | 5.7925 dimensionless | 0.0180422 mol/L |

| NFPA Properties | | | |
|-----------------|--------------|------------|---------|
| Health | Flammability | Reactivity | Special |
| 3 | n/a | n/a | n/a |

| Tox Properties | | | | | | | | |
|-------------------------|----------|----------|-------------------------|----------|----------|----------------------------|----------|----------|
| 8 hour Air MEGs (mg/m3) | | | 1 hour Air MEGs (mg/m3) | | | 10 minute Air MEGs (mg/m3) | | |
| Negligible | Marginal | Critical | Negligible | Marginal | Critical | Negligible | Marginal | Critical |
| n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |

4.5 Chemical Producers

The Chemical Producers table (Figure 9) shows the entities that produce this chemical and where they are located. These locations are listed as georeferences, which are used to populate the map at the top of the page.

Figure 9. Chemical Producers table.

| Producers | | |
|---|----------------|--------------------------------------|
| Name | Countries | Georeferences |
| Chemlyte Solutions - [Producer/Contract Manufacturer/Distributor] | CHINA | (30.30814,120.08974) |
| Simagchem Corporation | CHINA | (24.473034,118.109487) |
| Nordmann UK Limited (formally Melrob-Eurolabs) - [Distributor] | UNITED KINGDOM | (53.172342,-2.220558) |
| Avantor Performance Materials, Inc. | UNITED STATES | (40.5548128172496,-75.4169168952252) |
| Harrell Industries, Inc. | UNITED STATES | (34.9510230803709,-80.9694439579515) |

4.6 Additional Properties

The Additional Properties table displays additional details that augment the informational tables displayed in previous figures (Figure 10).

Figure 10. Additional Properties table.

| Additional Properties |
|---|
| Atmospheric Oh Rate Constant: 0 |
| Density: 1.5953 g/cm ³ |
| Flash Point: 45.601 °C |
| Heat Of Combustion: -834.64 kJ/mol |
| Henrys Law Constant: 0.000367 atm m ³ /mol |
| Itf 40 Data Hazard Probability: Seldom |

4.7 Related Chemicals

The Related Chemicals section provides links to chemicals that were also displayed on the Chemical Search page (if the user arrived here after performing a search) (Figure 11).

Note: If the user navigates directly to a chemical without going through the searching process, this section will be empty.

Figure 11. Related Chemicals section.

| Related Chemicals [Ⓢ] | | | |
|--|--------------------------------------|--------------------------------------|----------------------------------|
| (E)-2-Pentene | 1,1-Dimethylhydrazine | 1,4-Bis(2-chloroethylthio)-n-butane | 2-Butene-trans |
| (Z)-2-Pentene | 1,1,2,2-Tetrachloroethane | 1,4-dioxin | 2-chloroethylchloromethylsulfide |
| 1-Butene | 1,2-Dimethylhydrazine | 1,5-Bis(2-chloroethylthio)-n-pentane | 2-Chloropropylene |
| 1-chloro-2-(chloromethanesulfanyl)ethane | 1,2-dioxin | 1H-Tetrazole | 2-Methyl-1-butene |
| 1-Chloropropylene | 1,3-Bis(2-chloroethylthio)-n-propane | 2-Butene | 2,2-Dimethylpropane |
| 1-Pentene | 1,3-Butadiene | 2-Butene-cis | |
| 1-Tetracene | 1,3-Pentadiene | | |

5 Editing Content (for Administrators)

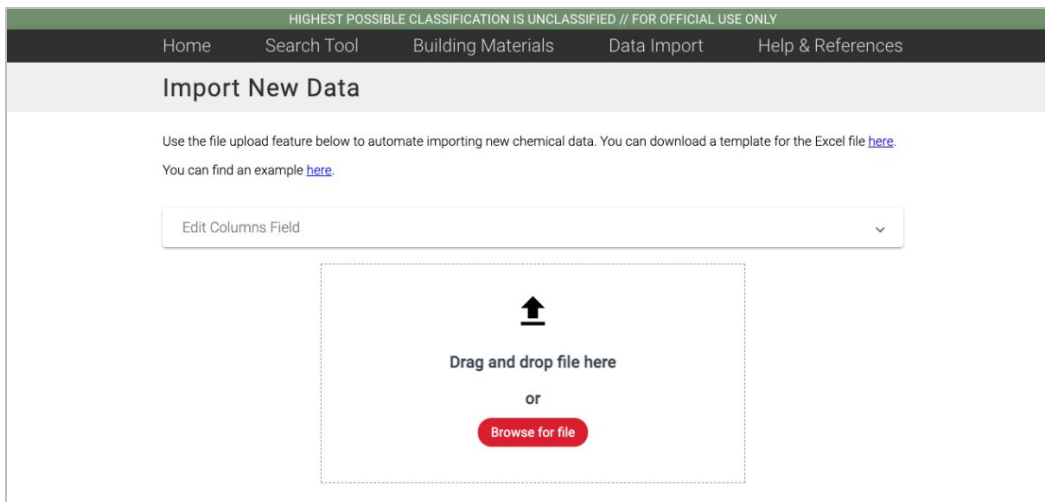
The data import functionality of TICMINT enables administrators to keep the site's content up to date and expand the utility of the tool through continued extension of the database.

This section will cover how to upload and edit chemical and building material information.

5.1 Importing Data

The Import New Data page (<https://ticmint.erdcdren.mil/data-import>) allows for direct bulk import of chemical data via Excel files (Figure 12). To upload, simply drag the file into the designated area on screen, or click the “Browse for file” button.

Figure 12. Data import page.



Once the file has been uploaded, click the “Submit” button (Figure 13). The file will be parsed and the data saved to the database.

Figure 13. Submit Excel file.

The page also includes two Excel files administrators can download. One is a clean template used to modify, upload, and submit (Figure 14). The other is a sample of how the Excel file should be formatted.

Figure 14. File upload sample.

| | A | B | C | D | E | F | G | H | I | J |
|---|--------------------|-----------|-------------------------------------|----------------------|----------------|-------------------------------|--------------------|---------------------------|-----------------------------|------------|
| | NAME | CAS | Atmospheric OH Rate Constant, g_avg | Boiling Point, g_avg | Density, g_avg | Dissociation Constants, g_avg | Flash Point, g_avg | Heat of Combustion, g_avg | Henry's Law Constant, g_avg | Kovats Ret |
| 2 | Chloroacetaldehyde | 107-20-0 | | 3.1E-12 | 87.06667131 | 1.19 | 87.82222222 | | | |
| 3 | acetaldehyde | 75-07-0 | 1.58E-11 | 20.51907803 | 0.7834 | 6.785 | -38.74092529 | -1168.79 | 0.000567 | |
| 4 | acetone | 67-64-1 | 2.19E-13 | 56.09202728 | 0.7845 | 20 | -38.01444444 | | 0.000351 | |
| 5 | ammonia | 7664-41-7 | | 33.28322778 | 0.000596 | 9.25 | 132 | 382.8 | | |

5.2 Editing Data

Chemical data can be edited directly on the chemical detail pages. If the user has sufficient privileges, an “Edit” button (denoted with either the text “edit” or a pencil icon) will be displayed next to all editable fields (Figure 15).

To change the values, simply click the edit button and a form will be opened. Once the changes are made, click “Save,” and the changes will be committed and the page reloaded.

Figure 15. Example of editing the chemical building materials list.



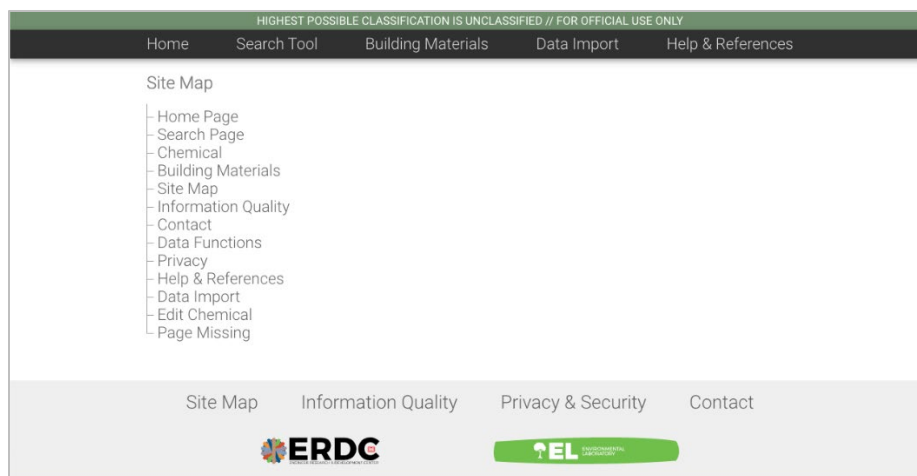
6 Additional Content

This section covers additional content on the site that is not directly tied to the chemical database.

6.1 Site Map

The site map displays a list of all locations contained within the website (Figure 16). It can be found by following the link in the footer.

Figure 16. Site map.



6.2 Help & References

The Help & References page provides access to additional resources such as the user's guide and application programming interface documentation (Figure 17). It can be found by following the link in the header.

Figure 17. Help & References page.


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Home Search Tool Building Materials Data Import Help & References

Help & References

Users' Guide

Click the icon to open the TIC/MINT Users' Guide (PDF)



API Help

Use the URL below to retrieve chemicals by their CAS number via our API. The example shown will retrieve Chlorine.

Via Web Browser

```
https://ticmint.erdcdren.mil/api/chemicalcas/7782-50-5
```

Via Command Line

```
curl https://ticmint.erdcdren.mil/api/chemicalcas/7782-50-5
```

More Questions?

Head over to the [contact page](#).

6.3 Contact Page

The Contact Us page provides a form for users to submit questions to the TICMINT team (Figure 18). It can be found by following the link in the footer.

Figure 18. Contact Us page.

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Home Search Tool Building Materials Data Import Help & References

Contact Us

Have Questions or Need Information?

Name *
Enter your name

Email *
Enter your email address

Question *
What is your question?

Submit

7 Troubleshooting and Frequently Asked Questions

This section covers troubleshooting advice for the application as well as some frequently asked questions.

7.1 Question: How do I obtain permissions to edit data?

Currently you will need to be manually added to the user list.

7.2 Question: I don't have edit access, and I know I am on the user list. What is wrong?

There is a good chance this is due to caching (e.g., arriving at the site without a certificate available, and the web browser is caching that). To remedy this, clear your browser cache and restart the browser.

Abbreviations

| | |
|---------|--|
| API | Application Programming Interface |
| CAC | Common Access Card |
| CAS | Chemical Abstracts Service |
| MEG | Military Exposure Guidelines |
| NFPA | National Fire Protection Agency |
| TICMINT | Toxic Industrial Chemical / Material Intelligence Tool |

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| 19a. NAME OF RESPONSIBLE PERSON | | | | | |