

EXHIBIT 29

What is a CAS Number or CASRN – Chemical Abstracts Service

# CAS Registry Number

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**CAS Registry Number**,<sup>[1]</sup> also referred to as **CASRN** or **CAS Number**, is a unique numerical identifier assigned by the Chemical Abstracts Service (CAS) to every chemical substance described in the open scientific literature (currently including all substances described from 1957 through the present, plus some substances from the early or mid 1900s), including organic and inorganic compounds, minerals, isotopes, alloys and nonstructurable materials (UVCBs, of unknown, variable composition, or biological origin).<sup>[2]</sup>

The registry maintained by CAS is an authoritative collection of disclosed chemical substance information. It currently identifies more than 144 million unique organic and inorganic substances and 67 million protein and DNA sequences,<sup>[3]</sup> plus additional information about each substance. It is updated with around 15,000 additional new substances daily.<sup>[4]</sup>

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## Use

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Historically, chemicals have been identified by a wide variety of synonyms. Frequently these are arcane and constructed according to regional naming conventions relating to chemical formulae, structures or origins. Well-known chemicals may additionally be known via multiple generic, historical, commercial, and/or (black)-market names.

CAS Registry Numbers are simple and regular, convenient for database searches. They offer a reliable, common and international link to every specific substance across the various nomenclatures and disciplines used by branches of science, industry, and regulatory bodies. Almost all molecule databases today allow searching by CAS Registry Number.

On the other hand, CASRNs are not related to chemistry, are proprietary and unrelated to any previous systems, and do not readily form phonetic analogs or synonyms.

## Format

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A CAS Registry Number has no inherent meaning but is assigned in sequential, increasing order when the substance is identified by CAS scientists for inclusion in the CAS REGISTRY database.

A CASRN is separated by hyphens into three parts, the first consisting from two up to seven digits,<sup>[5]</sup> the second consisting of two digits, and the third consisting of a single digit serving as a check digit. This current format gives CAS a maximum capacity of 1,000,000,000 unique identifiers.

The check digit is found by taking the last digit times 1, the preceding digit times 2, the preceding digit times 3 etc., adding these up and computing the sum modulo 10. For example, the CAS number of water is 7732-18-5: the checksum 5 is calculated as  $(8 \times 1 + 1 \times 2 + 2 \times 3 + 3 \times 4 + 7 \times 5 + 7 \times 6) = 105$ ;  $105 \bmod 10 = 5$ .

## Granularity

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- Stereoisomers and racemic mixtures are assigned discrete CAS Registry Numbers: L-epinephrine has 51-43-4, D-epinephrine has 150-05-0, and racemic DL-epinephrine has 329-65-7
- Different phases do not receive different CASRN's (liquid water and ice both have 7732-18-5), but different crystal structures do (carbon in general is 7440-44-0, graphite is 7782-42-5 and diamond is 7782-40-3)
- Commonly encountered mixtures of known or unknown composition may receive a CASRN; examples are Leishman stain (12627-53-1) and mustard oil (8007-40-7).
- Some metals are discerned by their oxidation state, e.g. the element chromium has 7440-47-3, the trivalent Cr(III) has 16065-83-1 and the hexavalent Cr(VI) ion has 18540-29-9.
- Occasionally whole classes of molecules receive a single CASRN: the class of enzymes known as alcohol dehydrogenases has 9031-72-5.

## Search engines

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- CHEMINDEX Search via Canadian Centre for Occupational Health and Safety<sup>[6]</sup>
- ChemIDplus Advanced via United States National Library of Medicine<sup>[7]</sup>
- Common Chemistry<sup>[8]</sup> via Australian Inventory of Chemical Substances<sup>[9]</sup>
- European chemical Substances Information System<sup>[10]</sup> via the website of Royal Society of Chemistry<sup>[11]</sup>
- HSNO Chemical Classification Information Database via Environmental Risk Management Authority<sup>[12]</sup>
- Search Tool of Australian Inventory of Chemical Substances<sup>[13]</sup>

## See also

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- Academic publishing
- Beilstein Registry Number
- Chemical database
- Chemical file format
- Dictionary of chemical formulas
- EC# (EINECS and ELINCS, European Community)
- EC number (Enzyme Commission)
- Identifier
- International Chemical Identifier (InChI)
- International Union of Pure and Applied Chemistry
- List of CAS numbers by chemical compound
- MDL number
- PubChem
- Registration authority
- SMILES

- UN number

## Notes

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1. CAS registry description (<http://www.cas.org/expertise/cascontent/registry/regsys.html>) Archived (<https://web.archive.org/web/20080725010848/http://www.cas.org/expertise/cascontent/registry/regsys.html#>) 25 July 2008 at the Wayback Machine.. by Chemical Abstracts Service
2. American Chemical Society. "CAS Registry and CASRNs" (<https://web.archive.org/web/20080725010848/http://www.cas.org/expertise/cascontent/registry/regsys.html#q2#q2>). Archived from the original (<http://www.cas.org/expertise/cascontent/registry/regsys.html#q2>) on 25 July 2008. Retrieved 25 July 2009.
3. "CAS database counter (updated daily)" (<https://www.cas.org/about/cas-content>). *www.cas.org*. Retrieved 12 September 2018.
4. Chemical Substances - CAS REGISTRY (<https://www.cas.org/content/chemical-substances>)
5. 2014-06-18, <https://www.cas.org/content/chemical-substances/faqs>
6. Canadian Centre for Occupational Health and Safety. "CHEMINDEX Search" (<http://ccinfoweb.ccohs.ca/chemindex/search.html>). Retrieved 13 July 2009.
7. United States National Library of Medicine. "Advanced" (<http://chem.sis.nlm.nih.gov/chemidplus/>). Retrieved 1 December 2009.
8. American Chemical Society. "Substance Search" (<http://www.commonchemistry.org/>). Retrieved 8 July 2009.
9. National Industrial Chemicals Notification and Assessment Scheme. "AICS Detailed Help / Guidance Notes" ([https://web.archive.org/web/20090709011639/http://www.nicnas.gov.au/industry/AICS/Search/AICS\\_Detailed\\_Help.asp](https://web.archive.org/web/20090709011639/http://www.nicnas.gov.au/industry/AICS/Search/AICS_Detailed_Help.asp)). Archived from the original ([http://www.nicnas.gov.au/Industry/AICS/Search/AICS\\_Detailed\\_Help.asp#CAS\\_Number\\_Search](http://www.nicnas.gov.au/Industry/AICS/Search/AICS_Detailed_Help.asp#CAS_Number_Search)) on 9 July 2009. Retrieved 8 July 2009.
10. European Commission Joint research Centre. "ESIS : European chemical Substances Information System" (<https://web.archive.org/web/20140101220543/http://esis.jrc.ec.europa.eu/>). Archived from the original (<http://esis.jrc.ec.europa.eu/>) on 1 January 2014. Retrieved 11 July 2009.
11. Library & Information Centre. "Finding a CAS Registry Number" (<http://www.rsc.org/Library/Features/Tips/CASNumbers.asp>). Retrieved 11 July 2009.
12. Environmental Risk Management Authority. "HSNO Chemical Classification Information Database" (<https://web.archive.org/web/20090711220034/http://www.ermanz.govt.nz/Chemicals/ChemicalSearch.aspx>). Archived from the original (<http://www.ermanz.govt.nz/Chemicals/ChemicalSearch.aspx>) on 11 July 2009. Retrieved 14 July 2009.
13. National Industrial Chemicals Notification and Assessment Scheme. "AICS Search Tool" (<https://web.archive.org/web/20090514095645/http://www.nicnas.gov.au/Industry/AICS/Search.asp>). Archived from the original (<http://www.nicnas.gov.au/Industry/AICS/Search.asp>) on 14 May 2009. Retrieved 11 July 2009.

## External links

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- CAS registry description (<https://web.archive.org/web/20080725010848/http://www.cas.org/expertise/cascontent/registry/regsys.html>), by Chemical Abstracts Service

To find the CAS number of a compound given its name, formula or structure, the following free resources can be used:

- NLM,NIH ChemIDplus (<http://chem.sis.nlm.nih.gov/chemidplus/>)
- NIST Chemistry WebBook (<http://webbook.nist.gov/chemistry/>)
- NCI/CADD Chemical Identifier Resolver (<https://cactus.nci.nih.gov/chemical/structure>)
- ChemSub Online (Multilingual chemical names) (<http://chemsub.online.fr/>)
- NIOSH Pocket Guide to Chemical Hazards, index of CAS numbers (<https://www.cdc.gov/niosh/npg/npgdcas.html>)

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