Notes and Hints on the CAS Numbers, the REACH Regulation (1907/2006), and the RoHS Directive (2011/65/EU)

There has been a lot of speculation regarding the need for the **CAS Numbers**, the **REACH Regulation (1907/2006)** and the **RoHS Directive (2011/65/EU)** for stainless steel. Lately, the **SCIP Database** has entered the scene, but what do they all mean, and, are they relevant to the consumer?

CAS Registry Number

CAS is an abbreviation of *Chemical Abstracts Service* and is a division of the *American Chemical Society*, which is based in Columbus, Ohio, United States. The CAS system covers anything from single elements to long DNA sequences, and it's very useful in order to provide chemicals a universal name/number, regardless if you are in Denmark, Japan or Papua New Guinea. The name may change, but the numbers remain the same.

The uniform nomenclature is a bit like the Latin names of plants and animals. The German "Hecht", the English "pike" and the Danish "gedde" are all the very same fish, but biologists from the three countries would find it hard to understand each other, unless they had a common, unambiguous language. Hence the Latin names, and "*Esox Lucius*" is the universal name of the fish.

Nobody would ever refer to Esox Lucius in daily speech, just like no chemical engineer would ever use "7664-93-9" instead of the colloquial word term "sulfuric acid", but in reports and data sheets, the CAS number is quite useful in order to prevent misunderstandings. The CAS system is a bit like "the Latin of chemistry".

#	Element	Abbrev.	CAS number	EC number
6	Carbon	**C**	7440-44-0	231-153-3
14	Silicon	**Si**	7440-21-3	231-130-8
15	Phosphorus	**P**	7723-14-0	231-768-7
16	Sulphur	**S**	7704-34-9	231-722-6
22	Titanium	**Ti**	7440-32-6	231-142-3
24	Chromium	**Cr**	7440-47-3	231-157-5
25	Manganese	**Mn**	7439-96-5	231-105-1
26	Iron	**Fe**	7439-89-6	231-096-4
27	Cobalt	**Co**	7440-48-4	231-158-0
28	Nickel	**Ni**	7440-02-0	231-111-4
29	Copper	**Cu**	7440-50-8	231-159-6
41	Niobium	**Nb**	7440-03-1	231-113-5
42	Molybdenum	**Mo**	7439-98-7	231-107-2

Table 1 *The CAS numbers of the most commonly used elements in stainless steel, arranged according to their atomic number.*
The right column shows the correlating EC-numbers (EU).

Each CAS number consists of three sections separated by strokes (-). The first number is two to seven digits (usually *four* for pure elements), the second always two digits, and third section is just a single digit. The latter digit is actually a check digit calculated from all the others ones, and as such not a variable. The maximum capacity is 10^9 = 1 billion unique numbers.

Even though CAS includes the word "chemical", all free elements (including all metals) are also included in the system. To some authorities, this number is important, even though chemical abbreviation, and thereby the atomic number, should be enough. For stainless steel the most relevant alloying elements and their correlating CAS and EC numbers are shown in **Table 1** above. Very few stainless steel grades deliberately contain elements outside this table. Note, by the way, that the EC numbers are not the same as the CAS numbers, but equally unambiguous.

References:

https://en.wikipedia.org/wiki/Chemical_Abstracts_Service

https://www.cas.org/support/documentation/chemical-substances/faqs

The REACH Regulation (1907/2006)

REACH is an abbreviation for "*Registration, Evaluation, Authorisation and Restriction of Chemicals*", and the regulation attempts to control the use of potentially hazardous chemicals in the products. In stainless steel, all the metals and other elements actually appear in the EU list (listed in the table, above), however, as chemicals they are hardly relevant, as the steel is a physical mixture between free metals, all in the oxidation state of 0. Stainless steel is an alloy, not a chemical.

In addition, REACH deals with "*Substances of Very High Concern*" (SVHC), however, most of these are organic compounds of which there is absolutely nothing in the stainless steel. This is impossible due to the high temperature during the melting process (> 1500 °C), causing all organics to break down and combust.

A few metal salts are listed as SVHC compounds, however, these metals are not relevant for the consumer of stainless steel. Among them are lead (Pb), cadmium (Cd), and none of these are used as alloying elements in stainless steel. In contrast, they harm the physical and chemical properties of stainless steel, so the mills do whatever they can to avoid them.

Finally, others, such as chromium salts, are irrelevant, as all alloying elements are added as free metals (oxidation level 0). As such, the risk of a measurable concentration of any of the SVHC metals in well-made stainless steel is close to zero.

References:

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32006R1907

https://echa.europa.eu/regulations/reach/understanding-reach

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R1907&from=EN

https://ec.europa.eu/environment/chemicals/reach/reach_en.htm

https://echa.europa.eu/substances-restricted-under-reach

https://en.wikipedia.org/wiki/Substance_of_very_high_concern#:~:text=A%20substance%20of%20very%20high,authorisation%20under%20the%20REACH%20Regulation

The RoHS Directive (2011/65/EU)

Fig. 1 *Where the RoHS label is relevant: Electronic parts, here a small pre-amplifier connecting a traditional turntable with the amplifier. The red arrow shows the RoHS logo.*

RoHS is an abbreviation for "*Restriction of the use of certain Hazardous Substances in Electrical and Electronic Equipment*", and the directive deals with 10 metals / chemicals. Apart from the seven organic compounds, three pure metals are included in the list: *Lead* (Pb), *mercury* (Hg) and *cadmium* (Cd).

Fortunately, none of these elements are added deliberately to any common grade of stainless steel. In contrast, as discussed above, Pb, As and Cd are all known as *unwanted contaminations* in stainless steel, so from a technical point of view, there are plenty of reasons not to add any of these elements to the steel.

In addition, it's worth noting that RoHS includes the words "…. in Electrical and Electronic Equipment". RoHS is actually a directive meant to control and reduce the amount of harmful chemicals in electronic waste, rendering the use of RoHS for stainless steel raw materials a bit silly.

All this doesn't prevent a number of customers from asking for documentation that the RoHS Directive is fulfilled. From a supplier point of view, it is hard to understand how a 6 meter round bar, type 4404 can be regarded as "electronic equipment", so in most stainless steel cases, RoHS is irrelevant.

Still, should stainless steel – one way or the other – end up as electronic equipment, RoHS shouldn't pose any problems. As mentioned above, all organic matter easily disappears when heated to the melting point of the steel, and disappears into oblivion as CO_2 and water. In addition, the three metals included in the directive, Pb, Cd and As, are never used as alloying element in any present-day grade of stainless steel.

References:

https://ec.europa.eu/environment/waste/rohs_eee/index_en.htm

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32011L0065&qid=1607327437008&from=EN

The SCIP Database

The latest addition to the flock of regulations and directives, *SCIP* (***S**ubstances of **C**oncern **I**n articles as such or in complex objects (**P**roducts))* is a database established under the Waste Framework Directive (WFD). The whole thing is administered by **E**uropean **Ch**emicals **A**gency (*ECHA*).

Fig. 2 *How elements are added to the molten steel: As pure metals (oxidation level 0 = zero), or as pre-alloys, such as Cr-Fe, Ni-Fe, Mo-Fe etc. In such pre-alloys, the metals are always in oxidation level 0.*

To the left are two Cr-Fe alloys (50-80 % Cr), the Ni-Fe (50 % Ni), anode nickel (99 % Ni), and Mn-Fe (> 50 % Mn).

As the REACH Regulation, the SCIP requires that none of the substances of very high concern (SVHCs) on the Candidate List (discussed above; REACH section) are present in the steel at a concentration above 0.1% (w/w). As discussed above, most of the compounds on the SVHC list are organic compounds, which will quickly disintegrate when brought into contact with molten steel. The metallic elements, such as lead (Pb) and cadmium (Cd) are normally *avoided* by the mills due to their harmful effect on the steel, and important alloying elements, such as Cr, are never added as the salts occurring in the SVHC list.

Therefore, no standard grade of stainless steel contains any of the compounds on the list. If, despite all precautions, the unwanted compounds or elements should occur, it's not likely to exceed 0.1 %. If so (it can be seen from the certificate), the contents should be submitted to ECHA (as from 5 January 2021).

References:

https://echa.europa.eu/

https://echa.europa.eu/scip

https://echa.europa.eu/documents/10162/28213971/scip_leaflet_en.pdf/d1180cae-aeeb-ac9e-55e5-49a4324def40