ISO FORM 1
ISO TS/P 309

PROPOSAL FOR A NEW FIELD OF TECHNICAL ACTIVITY

PROPOSER:

AFNOR (France)

DATE OF CIRCULATION:

2023-03-11

CLOSING DATE FOR VOTING:

2023-06-03

A proposal for a new field of technical activity shall be submitted to the Office of the CEO, which will process the proposal in accordance with ISO/IEC Directives, Part 1, Clause 1.5.

Furthermore, a proposal will be considered as complete if every information field is complete and follows the guidelines for proposing and justifying a new field of activity given in the ISO/IEC Directives, Part 1, Annex C.

TITLE

Specialty metals and minerals

SCOPE

Standardization in the field of specialty metals and minerals. It includes: terminology, classification, sampling, testing and chemical analysis methods, and delivery conditions.

A list of specialty metals and minerals is included as follows: antimony, beryllium, cobalt, chromium, graphite, niobium, platinum group metals.

Excluded:

- Finished products;
- Sustainability issues;
- Mining, already covered by ISO/TC 82 “Mining”;
- Elements already covered by existing ISO technical committees: ISO/TC 18 “Zinc and zinc alloys”, ISO/TC 20/SC 18 “Materials” (under ISO/TC 20 “Aircraft and space vehicles”), ISO/TC 26 “Copper and copper alloys”, ISO/TC 79 “Light metals” (aluminum, titanium, magnesium), ISO/TC 132 “Ferroalloys” (manganese, chrome in ferroalloys), ISO/TC 155 “Nickel and nickel alloys”, ISO/TC 183 “Copper, lead, zinc and nickel ores and concentrates”, ISO/TC 298 “Rare earth”, ISO/TC 333 “Lithium”.

PURPOSE AND JUSTIFICATION

Specialty metals and minerals are defined as commodities and commodity groups related to a broad range of existing and emerging technologies, renewable energy and national security.

The technological innovations developed toward the energy transition require the use of specialty metals and minerals. Indeed, low-carbon technologies that support global energy policies are more material-intensive than traditional ones.

Namely, specialty metals and minerals are used for:

- electric vehicles: cobalt, lanthanum, lithium,
- fuel cells: platinum, palladium, zirconium,
- solar and photovoltaic technologies: cadmium, indium, gallium,
- batteries: lithium, cobalt, nickel, graphite, vanadium, silicon,
- magnets: cobalt, rare-earth, niobium, antimony, beryllium,
- electronics: bismuth, palladium, silicon, tantalum,
- X-ray windows, radiation windows, lightweight alloys for aerospace: beryllium,
- aerospace and superalloys: tungsten, vanadium, hafnium, niobium,
- capacitors: tantalum,
- nuclear reactors and nuclear fuel cladding: zirconium,
- etc.

The use of specialty metals and minerals requires addressing challenges in several areas:

- economic: some markets are poorly organized and lack transparency. Chemical analysis method standards will contribute to the transparency of the orders and deliveries in the global market.
- technological: some of these metals and minerals are co-products of mining activities. Chemical analysis method standards will provide tools to check their chemical characterization.
- geopolitical: the limited availability of these metals and minerals generates tensions in international markets. International markets will benefit from ISO standards, which will clarify global commercial transactions.

See Annex A on specialty metals and minerals market, sorted by element.

Specialty metals and minerals are not an unlimited resource, to the point that the reserves of ores used to recover specialty metals and minerals may be exhausted within a few decades.

In this context:

- complementary standardization work on classification of specialty metals and minerals and packaging would help to facilitate trade;
- common definitions and a global designation system would improve the transparency of production and contribute to more stable and more predictable markets;
- chemical analysis methods would also be useful in dispute resolution between suppliers and customers on the quality of the delivered metals and minerals;
- all the above would contribute to strengthen market transparency and reliability, across the whole value chain, from mining companies to end users;
- in addition, such work would also contribute to supporting UN SDG 9: Industry, innovation and infrastructure.

In 2021, ISO/TMB established a Strategic Advisory Group (SAG) with the mandate to undertake an analysis of existing and potential standardization work within ISO in the area of critical minerals from the point of initial extraction and processing steps through to pre-cursor materials and make recommendations to the TMB in this regard. Following the initial mandate, a second phase of work was agreed which requested the SAG to review tools and standards outside ISO on Environmental Social Governance issues (ESG) specific to Critical Minerals, examine the market need of the suggested activities, and set priorities for future work. This work is due to be presented to the TMB in June 2023.

This proposal shows that there is active deliberation and discussion on the need to consolidate Technical Committees, and their work programs, relating to Critical Minerals, which to date have lacked co-ordination and have come into being in a somewhat ad-hoc manner. The outcomes of the consultation of this new work item will be examined in conjunction with the outcomes of the final report being prepared by the Strategic Advisory Group.

In December 2022, the ISO/TMB/SAG on Critical Minerals launched an International Survey to identify the metals and minerals that ought to be considered as priorities for standardization. The results of this survey pointed to a list of the most used chemical analysis methods and the highest-ranking minerals: antimony, cobalt, chromium, graphite and beryllium. Also identified as critical by this survey were the platinum group metals -in Asia- and niobium -in Europe.

Along to their answers to this survey, several stakeholders called for the creation of a new ISO Technical Committee dedicated to critical metals and minerals. This was discussed by the SAG in early 2023, which gave AFNOR the opportunity to get feedback from the group on the draft for this proposal.

PROPOSED INITIAL PROGRAMME OF WORK

Two categories of standards for specialty metals and minerals are proposed:

1. Basic standards
   – Terms and definitions;
   – Classification and designation;
   – Delivery conditions: packing, transport and storage.

2. Chemical analysis methods standards
   – All stages of analytical methods, including sampling;
   – Chemical analysis.

Metals and minerals have different physical and chemical characteristics, which entails different approaches or requirements with regard to testing methods (procedures, apparatus, reagents, etc.).

The following working groups could be created first:

– WG 1 – Terms and definitions;
– WG 2 – Classification and designation;
– WG 3 – Packing, transport, storage and delivery conditions;
– WG X – …

The technical committee is expected to set priorities in terms of which metals and minerals to deal with as a matter of short, middle or longer-term planning. The technical committee will discuss and decide to create working groups or subcommittees, as relevant. New work item proposals will be submitted and deciding upon according to the ISO/IEC Directives.

Based on the preparatory work carried out by the ISO/TMB/SAG on critical minerals, the following chemical analysis methods would be standardized:

– Flame atomic absorption spectrometric method;
– Method for X-ray fluorescence spectrometric analysis;
– Inductively coupled plasma atomic emission spectrometry;
– Potentiometric method;
– Gravimetric method;
– etc.

The type of deliverable of preference would be International Standards (IS):

1. ISO standard "Terms and definitions of specialty metals and minerals";
2. ISO standard "Classification and designation system of specialty metals and minerals";
3. ISO standard "Packing, marking, transport and storage of specialty metals and minerals";
4. ISO standards on sampling, testing and chemical analysis methods.

RELATION OF THE PROPOSAL TO EXISTING INERNATIONAL STANDARDS AND ON-GOING STANDARDIZATION WORK

☒ The proposer has checked whether the proposed scope of the new committee overlaps with the scope of any existing ISO or IEC committee or JTC1 sub-committee

Inspired by the work of the ISO/TMB/SAG on Critical Minerals, AFNOR proposes to set up a new technical committee on "Specialty metals and minerals". As of today, there is no technical committee in charge of standardization for antimony, beryllium, cobalt, chromium, graphite, niobium, platinum group metals (PGM), which is essential given that these metals and minerals are used in many innovative products such as photovoltaic cells, magnets, batteries, etc.

Since its creation, ISO has undertaken a number of standardization initiatives for metals. Thus, ISO/TC 79 "Light metals" was created in 1953, after which several subcommittees were set up on aluminium, magnesium, titanium. New committees were created later on, for instance ISO/TC 333 "Lithium" in 2021. The creation of a technical committee for specialty metals and minerals would contribute to the consistent response of the ISO system to new market needs, as it avoids two drawbacks:

- the multiplication of technical committees, each dedicated to a single mineral,
- a complicated system of multiple cross-liaisons between all such technical bodies.

To ensure that no overlap occurs, the new technical committee would only deal with the designation system, classification, packing, physical and chemical analysis methods for the identified metals and minerals as stated above.

As a consequence, this new ISO technical committee would not consider metals and minerals covered by the existing technical committees that have been excluded from its scope:

- ISO/TC 18 "Zinc and zinc alloys"
- ISO/TC 20/SC 18 "Materials" (under ISO/TC 20 "Aircraft and space vehicles")
- ISO/TC 26 "Copper and copper alloys"
- ISO/TC 79 "Light metals"
- ISO/TC 132 "Ferroalloys" (manganese, chrome in ferroalloys)
- ISO/TC 155 "Nickel and nickel alloys"
- ISO/TC 183 "Copper, lead, zinc and nickel ores and concentrates"
- ISO/TC 298 "Rare earth"
- ISO/TC 333 "Lithium"

Liaisons with the following technical committees are proposed:

- ISO/TC 17 "Steel"
- ISO/TC 18 "Zinc and zinc alloys"
- ISO/TC 20/SC 18 "Materials" (under ISO/TC 20 "Aircraft and space vehicles")
- IEC/SC 21A "Secondary cells and batteries containing alkaline or other non-acid electrolytes"
- ISO/TC 26 "Copper and copper alloys"
- IEC/TC 35 "Primary cells and batteries"
- ISO/TC 79 "Light metals"
- ISO/TC 82 "Mining"
- ISO/TC 132 "Ferroalloys" (manganese, chrome in ferroalloys)
- ISO/TC 155 "Nickel and nickel alloys"
- ISO/TC 183 "Copper, lead, zinc and nickel ores and concentrates"
- ISO/TC 188 "Small craft"
- ISO/TC 298 "Rare earth"
- ISO/TC 333 "Lithium"

The proposed technical committee will not cover components and products however cooperation and liaisons are proposed with ISO and IEC product-related technical committees such as ISO/TC 20/SC 18 "Materials" (under ISO/TC 20 "Aircraft and space vehicles"), ISO/TC 188 "Small craft" (especially its working group 32 on Li-ion batteries), IEC/SC 21A "Secondary cells and batteries containing alkaline or other non-acid electrolytes" and IEC/TC 35 "Primary cells and batteries".

Mining topics will not be covered as they fall under the scope of ISO/TC 82 "Mining". Sustainability issues will not be covered.

In line with the recommendations of the ISO/TMB/SAG on critical minerals, additional specialty metals and minerals not covered by existing ISO technical committees may be added in future, subject to requests expressed by the Membership and in accordance with the ISO/IEC Directives.

LISTING OF RELEVANT DOCUMENTS (SUCH AS STANDARDS AND REGULATIONS) AT INTERNATIONAL, REGIONAL AND NATIONAL LEVEL

See Annex B.

LISTING OF RELEVANT COUNTRIES WHERE THE SUBJECT OF THE PROPOSAL IS IMPORTANT TO THEIR NATIONAL COMMERCIAL INTERESTS

Antimony: Campine NV, Yiyang Huachang Antimony Industry Co, Ltd, BASF SE, Korea Zinc Co. Ltd, US Antimony are the major companies operating in the antimony market. The most important antimony mining countries are China (Xikuangshan, Hunan - Mesozoic intrusions): 60,800 tons; Russia: 10,500 tons; Bolivia: 7,050 tons; South Africa: 4,534 tons; Mexico, Yugoslavia and Czech Republic. Antimony is smelted with lead and the resulting alloy (solid solution) is used in lead batteries. Other alloys incorporating the element are used to make bullets, cable sheaths, solder and even organ pipes.

Beryllium: In 2015, the global mine production of beryllium was estimated at 300 t Be with the USA (92%) and China (7%) as main producers. The US reserves are estimated at 15 kt Be. The main companies are: Leqing changjiang precision alloy co.,ltd, Salomon´s Metalen B.V., TECHNOLOGICA GmbH, E. Wagener GmbH - Special metals, Ulba Metallurgical Plant JSC, IBC Advanced Alloys Corp, Materion Corporation, IBC Advanced Alloys, NGK Metals Corporation, National Atomic Company Kazatomprom, American Elements.

Chromium: In 2015, the global mine production of chromium was estimated at 8.4 Mt Cr and the metallurgical production reached 4.6 kt. The reserves in 2017 were as follow: Kazakhstan (46%), South Africa (40%) and India (11%). These three producers own reserves that can contribute to increase the production to face a growing demand. The main companies are: Kermas Group Ltd, Assmang Proprietary Limited, CVK Group, Glencore PLC, Odisha Mining Corporation.

Cobalt: In 2019, the metallurgical production was estimated at 125.9 kt Co with the main producers being China (64%), Finland (11%), Canada (5%) and Belgium (5%). The Democratic Republic of Congo accounts for half of the world's Co reserves (49.5%), with the rest of the reserves located mainly in Australia (17%) and Cuba (7%). The main companies are as follow: Treibacher Industrie AG, United Magnetics CO.,Ltd, CRONIMET Rohstoff handels gesellschaft, Glencore, CMOC International, Fleurette Group, Vale, GECAMINES.

Graphite: The main graphite producers in 2021 were: China (820 000 t), Brazil (68 000 t), Mozambique (30 000 t), Russia (27 000 t), Madagascar (22 000 t), Ukraine (17 000 t), Norway (13 000 t), Canada (8 600 t). The reserves are distributed as follow: Turkey 39%; Brazil 31%; China 24%. Possible resources are more widely distributed (Canada, Australia, South Africa, Australia, Northern Europe). The main companies are: Tirupati Carbons & Chemicals, Chotanagpur *Graphite* Industries and Carbon, Leading Edge Materials Corp., Next Source Materials Inc., Syrah Resources Limited, Talga Group Ltd., Triton Minerals Limited., Asbury Carbon, Mitsui, LKAB, Imerys.

Niobium: The main niobium producer in 2014 was Brazil with 89% followed by Canada with 9.3%. The reserves are distributed as follow (in 2016): Brazil (95%) and Canada (5%). In 2014, global mine production was estimated at 58 kit Nb content. The main companies are: Companhia Brasileira de Metalurgia e Mineracao (CBMM), NIOBEC (Magris Resources Inc.), China Molybdenum Co. Ltd, contributing to around 98% of the global supply. The world's largest deposit is located in Araxa, Brazil and is owned by Companhia Brasileira de Metalurgia e Mineracao (CBMM). The reserves are enough to supply current world demand for about 500 years, about 460 million tonnes.

Platinum Group Metals: The platinoids, are six neighbouring metals in the Mendeleev table, ruthenium (Ru), rhodium (Rh), palladium (Pd), osmium (Os), iridium (Ir) and platinum (Pt). Especially, in 2016, the global mine production of palladium was estimated at 210.4 kt Pd. The main producers are Russia (41%), South Africa (38%), North America (Canada and USA) (13%) and Zimbabwe (6%). Primary metallurgical production is roughly equivalent to mine production. South Africa produces 73% of the world's platinum, followed by Russia (14%). It also produces 80% of rhodium, followed by Russia (12.5%). Companies: Russia's Norilsk Nickel, Sibanye-Stillwater, Impala Platinum Holdings, Eastern Platinum Limited.

Main sources: https://www.mineralinfo.fr/fr, https://www.usgs.gov/, https://www.mordorintelligence.com/industry-reports, https://www.expertmarketresearch.com/, https://www.databridgemarketresearch.com, …

LISTING OF RELEVANT EXTERNAL INTERNATIONAL ORGANIZATIONS OR INTERNAL PARTIES (OTHER THAN ISO AND/OR IEC COMMITTEES) TO BE ENGAGED AS LIASONS IN THIS WORK

World Trade Organization https://www.wto.org/index.htm
United Nations Industrial Development Organization https://www.unido.org/
International Council on Mining and Metals https://www.icmm.com/
European Commission https://ec.europa.eu/info/index_fr

IDENTIFICATION AND DESCRIPTION OF RELEVANT AFFECTED STAKEHOLDER CATEGORIES (Please see ISO Connect)

	Benefits/Impacts/Examples
Industry and commerce – large industry	Market transparency – transparency of definitions and classification system – quality of orders – efficiency of marking and quality of packing – safety of shipping
Industry and commerce – SMEs	Market transparency –transparency of definitions and classification system for all stakeholders – quality of orders - efficiency of marking and quality of packing – safety of shipping
Government	Global market transparency and stability - transparency of definitions and classification system for all stakeholders
Academic and research bodies	Accuracy of testing methods
Standards application businesses	Market transparency – availability of global sampling, chemical and physical methods – delivery quality control
Non-governmental organizations	Market transparency - transparency of definitions and classification system
Other (please specify)	See below.

ISO Standardization will be an asset for all stakeholders in global trade:

- manufacturers,
- mining companies,
- metal and mineral transformers,
- suppliers,
- end users…

Proposed ISO Standards, and especially those on physical and chemical analysis methods will provide common methods for all stakeholders and thus prevent commercial disputes.

Common definitions and a global designation system will improve the transparency of the productions and contribute to the stabilization and development of markets. Standards for specialty metals and minerals will contribute to:

- transparency of definitions and classification system for all stakeholders
- availability of global sampling, chemical and physical methods for mining companies, laboratories, customers…

Standards on delivery conditions, packaging and transportation will contribute to;

- quality of orders for suppliers and customers
- efficiency of marking and quality of packing for transport companies, suppliers and customers
- safety of shipping for transport companies
- delivery quality control for suppliers, customers (manufacturers, laboratories…)

EXPRESSION OF LEADERSHIP COMMITMENT FROM THE PROPOSER

AFNOR is willing to undertake the work of the new Technical Committee secretariat when the proposal is approved.

☑ **The proposer confirms that this proposal has been drafted in compliance with iso/iec directives, part 1, annex c**

SIGNATURE OF THE PROPOSER

Franck LEBEUGLE
AFNOR Standardization Director

COMMENTS OF THE ISO CENTRAL OFFICE (IF ANY)

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Annex A
Specialty metals and minerals market

Antimony: The Antimony market is growing at nearly 5% over the next 5 years. Antimony is used as an additive in fiberglass composites. It is widely used because of its better heat and chemical resistance properties. The market for fiberglass composites is expected to grow at a rapid rate. Composites are rapidly replacing all conventional materials in many applications, such as aerospace, automotive, construction, electrical and electronics, due to their high strength, low cost, ease of processing and availability in various shapes and forms with good aesthetics. In the semiconductor industry, it is used to manufacture diodes, hall-effect devices, and infrared detectors. Electronic products, such as smartphones, OLED TVs, tablets, etc., have the highest growth in the consumer electronics segment. By type, the market is segmented into metal ingots, antimony trioxide, antimony pentoxide, alloys, and other types.

Beryllium: The Beryllium Market is segmented by Product Type (Alloys, Metals, Ceramics, and Other Product Types), End-user Industry (Industrial Components, Automotive, Healthcare, Aerospace and Defense, Oil and Gas, Electronics and Telecommunication, and Other End-user Industries). Beryllium has very unique properties. As such, it is only used in very specific applications such as hardening agent in certain alloys, where it is difficult to substitute without significant loss of performance and reliability. The Beryllium Market is projected to register a CAGR of more than 2% over the next 5 years. Post-COVID-19, the rising demand for beryllium from end-user industries like the automotive and aerospace end-user industries is likely to revive the market. In the short term, the market is likely to be driven by big things like the growing use of beryllium in medical equipment because of its great properties and its wide use in aerospace and military applications. In the future, the need for beryllium oxide to make nuclear power is likely to present an opportunity.

Chromium: The chromium market faces a constant rise in demand and is expected to grow approximately by 4% over the next 5 years. The increasing use of chromium alloys with other metals in automobiles, construction equipment, commercial and military aircraft engines is driving the market growth. Chromium has been more and more used in metallurgical processes to increase hardenability (hardening steel), creep and impact strengths, resistance to corrosion and oxidation to other metals. The global stainless-steel production largely relies on chromium supply. As a major steel producer, China produces and supplies a large quantity of stainless-steel using chromium from South Africa and exports it to various countries.

Cobalt: World cobalt consumption is heading for strong growth (7-10%/year), driven by the energy storage (rechargeable batteries) and superalloy sectors (although the aerospace sector has been badly affected by the global pandemic in 2020). It is expected to reach 200 kt Co by 2025. Despite a fundamental trend towards the substitution of cobalt by nickel in Li-ion batteries for electric vehicles, rechargeable batteries used in electronic devices have high cobalt content. Appliances favour high levels of cobalt and account for 60% of cobalt use in rechargeable batteries. Thus, the development of 5G compatible technologies is expected to drive cobalt demand upwards.

Graphite: The Graphite Market is Segmented by Type (Natural Graphite and Synthetic Graphite), Application (Electrodes, Refractories, Casting, and Foundries, Batteries, Lubricants, and Other Applications), End-user Industry (Electronics, Metallurgy, Automotive (Including EV/HEV Vehicles), and Other End-user Industries). Natural graphite consumption is dependent on:

- the steel industry which production is expected to remain stable or to decrease slightly
- the mining sector, which is growing
- the Li-ion batteries industry, which is growing strongly.

Over the short term, augmenting demand from the burgeoning lithium-ion battery industry and an increase in steel production in Europe, Asia and the Middle East are significant factors driving the growth of the market. The increasing application of graphite in green technologies is likely to create lucrative growth opportunities for the global market soon.

Niobium: The Niobium Market is segmented by Occurrence (Carbonatites and Associates and Columbite-Tantalite), Type (Ferroniobium, Niobium Oxide, Niobium Metal, and Vacuum Grade Niobium Alloys), Application (Steel, Superalloys, Superconducting Magnets, Capacitors, Glass, and Other Applications), End-user Industry (Construction, Automotive and Transportation, Aerospace and Defense, Oil and Gas, and Other End-user Industries. Niobium is mainly used for the manufacture of alloys including stainless steel. Its properties improve the strength of alloys and therefore the products can be used in the construction field or the automotive industry. Its superconducting properties make it also interesting in the field of magnetism. The growth rate is estimated at 7-8%. per year. Over the medium term, accelerating usage of structural steel and increased usage in aerospace applications are driving the market's growth. Increasing demand for high strength and lightweight steel in oil and gas pipelines is likely to act as an opportunity in the future.

Platinum Group Metals: The use and perspectives for platinoids are noticeable and in constant growth. For instance, rhodium and platinum have the same use regarding the automotive sector. Ruthenium and Iridium are mostly used in the electric and electronic industry for hard drives, solar panels (34% of the use in the world of ruthenium) and in screens for digital devices (30% of the use in the world of iridium). The strong growth in the use of these products with the addition of the development of 5G technology should lead to an increase of the demand for iridium in the following years. Around 80% of the produced palladium is used in the automotive industry, for catalytic converters. The second field of use of palladium is the electronic sector with the production of connectors. Its properties are very unique but its use at an industrial level is limited due to its price. The demand for palladium keeps increasing over the years with an annual evolution of around 4%.

Main sources: https://www.mineralinfo.fr/fr, https://www.usgs.gov/, https://www.mordorintelligence.com/industry-reports, https://www.expertmarketresearch.com/, https://www.databridgemarketresearch.com, …

ANNEX B
Selection of existing standards

Some existing standards on Antimony
ASTM E3063-17 Test Method for Antimony Content Using Neutron Activation Analysis (NAA)
BS 3809-10:1990 Methods for the sampling and analysis of lead and lead alloys - Antimony in lead alloys (titrimetric method)
EN 14937:2006 (all parts) Copper and copper alloys - Determination of antimony content
JIS G 1235-2 Iron and steel - Determination of antimony - Part 2: Spectrophotometric method after extraction of brilliant green complex
JIS G 1257-17-2 Iron and steel - Atomic absorption spectrometric method - Part 17: Determination of antimony - Section 2: Electrothermal atomization
NF A06-563:2013 Chemical analysis of aluminium and aluminium alloys - Determination of antimony - Spectrophotometric method
NF A08-563:1974 Chemical analysis of aluminium alloys. Determination of antimony. (atomic absorption method)
BS L 119:1975 Specification for ingots and castings of aluminium-copper-nickel-manganese-titanium-zirconium-cobalt-antimony alloy (solution treated and artificially aged) (Cu 5.0, Ni 1.5, Mn 0.25, Ti 0.2, Zr 0.2, Co 0.2, Sb 0.2)

Some existing standards on Beryllium
ASTM E 439 Standard Test Methods for Chemical Analysis of Beryllium
ASTM E 2824A Standard Test Method for Determination of Beryllium in Copper-Beryllium Alloys by Phosphate Gravimetry
ASTM E2824-18a Standard Test Method for Determination of Beryllium in Copper-Beryllium Alloys by Phosphate Gravimetry
TS 4032 Methods For the Chemical Analysis of Copper Alloys-Determination of Beryllium Content of Copper-Beryllium Alloys
ASTM B 870 Standard Specification for Copper-Beryllium Alloy Forgings and Extrusions (UNS Nos. C17500, C17510, and C17540)
GOST 23912 Alley of copper-beryllium. Specifications
GOST R 57516 Beryllium. Methods of chemical analysis
GB/T 26063 Beryllium aluminum alloy
ASTM E439-17 Standard Test Methods for Chemical Analysis of Beryllium

Some existing standards on chromium
ASTM E363-22 Standard Test Methods For Chemical Analysis Of Chromium And Ferrochromium
ASTM E353-19e1 Standard Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM UOP1031-19 Chromium (III) and Chromium (VI) Speciation in Water by IC-ICP-MS (Ion Chromatography- Inductively Coupled Plasma Mass Spectrometry
JIS G 1281 Methods for chemical analysis of nickel-chromium-iron alloys
JIS H 1412 Methods of chemical analysis for nickel chromium electric heating material
JIS H 1411 Methods of chemical analysis for iron chromium electric heating material
JIS M 8261 Chromium ores - General rules for chemical analysis
JIS G 1313-1 Method for chemical analysis of ferrochromium - Part 1: Determination of chromium content
JIS G 1325-2 Method for chemical analysis of ferrosilicochromium - Part 2: Determination of chromium content
JIS G 1323-1 Method for chemical analysis of chromium metal - Part 1: Determination of carbon content
JIS G 1323-2 Method for chemical analysis of chromium metal - Part 2: Determination of silicon content
JIS G 1323-3 Method for chemical analysis of chromium metal - Part 3: Determination of phosphorus content
JIS G 1323-4 Method for chemical analysis of chromium metal - Part 4: Determination of sulfur content
JIS G 1323-5 Method for chemical analysis of chromium metal - Part 5: Determination of iron content
JIS G 1323-6 Method for chemical analysis of chromium metal - Part 6: Determination of aluminium content
JIS G 1323-7 Method for chemical analysis of chromium metal - Part 7: Determination of various elements - ICP atomic emission spectrometric method
GOST 15848.0-90 Chromium ores and concentrates. General requirements for methods of chemical analysis
GOST R 54569-2011 Cast iron, steel, ferroalloys, metallic chromium and manganese. Standards of accuracy of quantitative chemical analysis

GOST 23916-79 Metal chromium. Sampling and sample preparation for chemical and physical-chemical analysis
GOST 17260-2009 Ferroalloys, metal chromium and metal manganese. General requirements for sampling and preparation of samples
GOST 15848.1-90 Chromium ores and concentrates. Method for determination of chromium oxide (III)
GOST 21600.17-83 Ferrochrome. Methods for the determination of chromium

Some existing standards on Cobalt
ISO 3909:1976, Hardmetals — Determination of cobalt — Potentiometric method
GB/T 23273.1 Methods for chemical analysis of cobalt oxalate - Part 1: Determination of cobalt content - Potentiometric titration method
GB/T 23365 Electrochemical performance test of lithium cobalt oxide - Test method for specific capacity and charge-discharge efficiency of the first cycle
CSN 42 0669-7 Chemical analysis of non-ferrous metals and alloys. Cobalt. Determination of sulphur by the titrimetric method and methods with the use of automatic analyzers
CSN 41 9861 Tungsten-Molybdenum-Vanadium-Cobalt steel 19 861
JIS H 1283 Methods for determination of cobalt nickel and nickel alloys
JIS T 7402-1 Cobalt based alloys for surgical implant applications - Part 1: Cobalt-chromium-molybdenum casting alloy
KS D 0280 Standard test method for conducting cyclic potentiodynamic polarization measurements for localized corrosion susceptibility of iron- , nickel- , or cobalt-based alloys
KS D 8530 Electroplated coatings of tin-cobalt alloy - Test method
KS E 3068 Determination of cobalt in ores
GOST 123 Cobalt. Specifications
GOST 8776 Cobalt. Methods of chemical-atomic-emission spectral analysis
GOST 13020.16 Metallic chrome. Method for determination of cobalt
GOST 13047.1 Nickel. Cobalt. General requirements for methods of analysis
GOST 13047.3 Nickel. Cobalt. Methods for determination of cobalt in cobalt
GOST 13047.5 Nickel. Cobalt. Methods for determination of nickel in cobalt
SS 146612 Cobalt - Alloying material
STN 42 0521 Chemical analysis of technical iron. Determination of cobalt content
STN 42 0669-1 Chemical analysis of non-ferrous metals and alloys. Cobalt. Determination of nickel by the atomic absorption method and photometric method
TS 1778 Methods for the Chemical Analysis of Copper Alloys Determination of Cobalt Content
TS 3264 Methods for the Chemical Analysis of Nickel Determination of Cobalt Content
TS 2223 Methods for the Chemical Analysis of Copper Alloys Copper-Beryllium Alloys Determination of copper, Beryllium, Nickel, Cobalt and Iron Contents
TS 5860 Iron, Nickel and Cobalt Alloys Chemical Analysis - Determination of Molybdenum Content - Spectrophotometric Method
ASTM A 801, Standard Specification for Wrought Iron-Cobalt High Magnetic Saturation Alloys (UNS R30005 and K92650)
ASTM B 880, Standard Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys
ASTM B 1011/B 1011M Standard Specification for Cobalt Alloy Spring Wire
ASTM B 1015, Standard Practice for Form and Style of Standards Relating to Refined Nickel and Cobalt and Their Alloys
ASTM E 1019, Standard Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Inert Gas Fusion Techniques
ASTM E 1473, Standard Test Methods for Chemical Analysis of Nickel, Cobalt and High-Temperature Alloys
ASTM G 61, Standard Test Method for Conducting Cyclic Potentiodynamic Polarization Measurements for Localized Corrosion Susceptibility of Iron-, Nickel-, or Cobalt-Based Alloys
ISO 5832-4 Implants for surgery - Metallic materials - Part 4: Cobalt-chromium-molybdenum casting alloy

Some existing standards on Graphite
ISO 945-1:2019, Microstructure of cast irons — Part 1: Graphite classification by visual analysis
DIN/TS 8204 Founding - Radiographic testing - Reference images for spheroidal graphite cast irons and grey cast irons; Text in English
AD 2000-Merkblatt W 3/1 Cast iron materials - Cast iron with lamellar graphite (grey cast iron) non-alloy and low alloy
AD 2000-Merkblatt W 3/2 Cast iron materials - Spheroidal-graphite cast iron non-alloy and low alloy

AD 2000-Merkblatt W 3/3 Cast iron materials - Austenitic cast iron with lamellar graphite
VdTÜV WB 475Lamellar graphite; tensile strength 180 N/mm2
VdTÜV WB 475 Beiblatt Cast iron with lamellar graphite - Tensile strength 180 N/mm2
NF A04-197, Spheroidal graphite cast irons - Graphite shape characterization by image analysis
GB/T 9441, Metallographic test for spheroidal graphite cast iron
GB/T 26655, Compacted(vermicular)graphite iron castings
GB/T 34904, Spheroidal graphite iron castings -Ultrasonic testing
CSN 72 1550, Foundry graphite and fillers. Common provisions
CSN 42 2456, Lamellar graphite cast iron 422456
CSN 42 2435, Grey cast iron 42 2435 with flake graphite
CSN 42 2425, Grey cast iron 42 2425 with flake graphite
UNI EU 38:1988 Chemical analysis of ferrous materials. Determination of non-combined carbon (graphite) in steels and irons. Gravimetric method after combustion in a stream of oxygen.
GOST 1412, Flake graphite iron for casting. Grades
GOST 7293, Spheroidal graphite iron for castings. Grades
GOST 28394, Vermicular graphite iron for castings. Grades
STN 42 2435, Lamellar graphite cast iron 42 2435
EN 1563, Founding - Spheroidal graphite cast irons
EN 1564, Founding - Au ferritic spheroidal graphite cast irons
EN 12680-3, Founding - Ultrasonic testing - Part 3: Spheroidal graphite cast iron castings
EN 16079, Founding - Compacted (vermicular) graphite cast irons
EN 16124, Founding - Low-alloyed ferritic spheroidal graphite cast irons for elevated temperature applications
ISO 1083, Spheroidal graphite cast irons - Classification
ISO 16112, Compacted (vermicular) graphite cast irons - Classification
ISO 17804, Founding - Au ferritic spheroidal graphite cast irons - Classification

<u>Existing standards on Niobium</u>
ISO 9441:1988, Steel — Determination of niobium content — PAR spectrophotometric method
ISO 5453:1980, Ferroniobium — Specification and conditions of delivery
GB/T 15076.1 Methods for chemical analysis of tantalum and niobium -Part 1: Determination of tantalum content in niobium -Inductively coupled plasma atomic emission spectrometry
GOST 16099 Niobium in ingots. Specifications
GOST 18385.4 Niobium. Method for the determination of tantalum
GOST 18385.1 Niobium. Methods for the determination of tungsten
GOST 18385.3 Niobium. Methods for the determination of molybdenum
GOST 18385.0 Niobium. General requirements for methods of analysis
GOST 18385.5 Niobium. Method for the determination of silicon
GOST 18385.7 Niobium. Spectral method for the determination of tantalum
GOST 18385.6 Niobium. Spectral method for the determination of the tungsten, molybdenum
GOST 18385.2 Niobium. Spectral method for the determination of silicon, titanium and iron
GOST 23862.27 Rare-earth metals and their oxides. Method of determination of niobium
GOST 25278.7 Alloys and foundry alloys of rare metals. Methods for determination of niobium
ASTM B884-11(2019) Standard Specification for Niobium-Titanium Alloy Billets, Bar, and Rod for Superconducting Applications
GB/T 25080 Niobium - Titanium alloy billets, bar and rod for superconducting applications
GOST 25278.17 Alloys and foundry alloys of rare metals. Spectral (with induction high-frequency plasma) method for determination of elements and impurities in alloys on the base of niobium
GB/T 15076.15 Methods for chemical analysis of tantalum and niobium - Determination of hydrogen content
GB/T 15076.14 Methods for chemical analysis of tantalum and niobium - Determination of oxygen content
GB/T 15076.11 Methods for chemical analysis of tantalum and niobium-Determination of arsenic antimony-lead-tin and bismuth contents in niobium
DIN 17569 Ferroniobium - Technical delivery conditions

<u>Some existing standards on Platinum Group Metals</u>
ISO 11495:2019, Jewelry and precious metals — Determination of palladium in palladium alloys — ICP-OES method using an internal standard element
ISO/DIS 11490, Jewelry and precious metals — Determination of palladium in palladium alloys — Gravimetric determination after precipitation using dimethylglyoxime
GOST 12553.1 Platinum-palladium alloys. Method for the determination of palladium

GB/T 23276 Method for chemical analysis of palladium compounds - Determination of palladium content - Complexometric titration using butanedione dioxide releasing EDTA
GOST 12225 Palladium. Methods of analysis
GB/T 39285 Method for chemical analysis of palladium compounds -Determination of chlorine content -Ion chromatography
GOST 13462 Palladium and its base alloys. Marks
GOST 12553.2 Platinum-palladium alloys. Method of spectral of analysis
GOST R 52950 Palladium. Method for determination of mass losses after ignition
GOST R 54313 Palladium. Method of atomic-emission analysis with inductively coupled plasma
GOST 34418 Palladium. Methods of atomic-emission analysis with arc excitement of a range
GB/T 33909 Methods for chemical analysis of platinum -Determination of palladium, rhodium, iridium, ruthenium, gold, silver, aluminium, bismuth, chromium, copper, iron, nickel, lead, magnesium, manganese, tin, zinc, silicon content -Inductively coupled plasma mass spectrometry