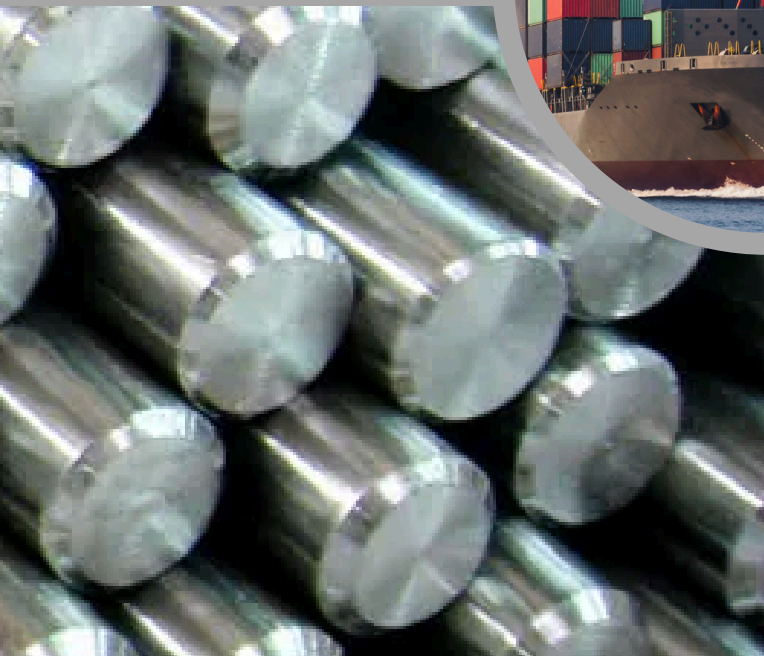


MEDSTERN CANADA LLP



RELIABLE. AUTHENTIC.

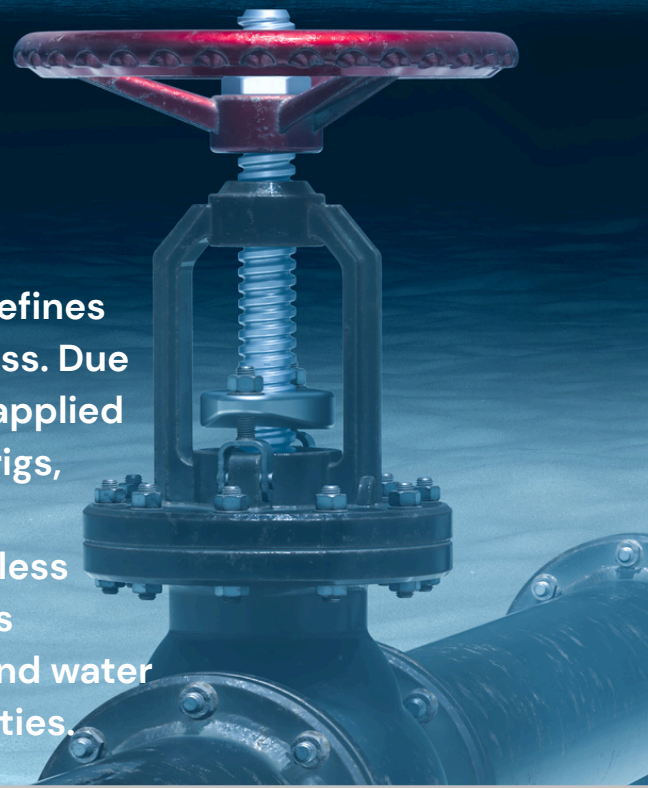
EDITION
SUMMER 2025



RELIABLE NIOBIUM

For Resilient Infrastructure

Niobium as a steel alloy results in excellent stress resistance in harsh marine environments. Niobium refines the grains in steels, improving strength and toughness. Due to its ability to withstand high pressures, it is often applied in structures such as offshore platforms, oil drilling rigs, and pipelines for transporting oil, gas, and liquids. Niobium reduces precipitation of chromium in stainless steels, improving corrosion resistance. Components of desalination plants, water purification systems, and water storage tanks benefit from Niobium's unique properties.



Railway Tracks: Niobium (Nb) is added to railway track steel to enhance its strength and toughness, making it resistant to high loads, stress, and wear.

ENERGY

Power Plants, High-Voltage Masts



Niobium tubes and pipes are used in power plants, alloy tubes, particularly in high-temperature environments, due to their high melting point. Applications can include heat exchangers, fuel cells, industrial gas turbines, and electrodes and coatings for batteries.

INFRASTRUCTURE

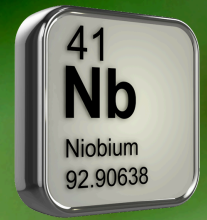
High-strength low-alloy (HSLA) steel



Niobium-enhanced steels are used in structural components where strength and durability are paramount. The high strength-to-weight ratio makes HSLA steel suitable for large-scale, concrete structures, such as tall buildings, tunnels, bridges, and hydroelectric dams.

INVESTMENT OPPORTUNITIES

Sustainable Mining, Metals, and Galvanic Industries



Canada boasts a diverse range of minerals, including traditional commodities like base metals, as well as critical minerals. The country is home to a large number of mining companies and is a leading destination for international mining finance. Foreign direct investment (FDI) in the Canadian mining sector was \$65.1 billion in 2022.

Status 2024/2025

ACCESS RESOURCES, GROW SUPPLY BASE



**MINES, MINERAL
DEPOSITS**

**METAL, GALVANIC
INDUSTRIES**

**LOGISTIC
INFRASTRUCTURE**

Including extraction, services, primary and downstream manufacturing, the Canadian Mining and Metals Sector contributed a total of \$108.5 billion to GDP in 2022. Canada has a well-established mining sector with a supportive regulatory framework, including established stock exchanges. Investors who can guarantee offtake agreements contribute significantly to the economy. Reliable and robust technologies are the key to leaving behind only clean water, healthy landscapes, and achieving greater competitive strength through value-added mining and metal commodities.

AUTHENTIC NIOBIUM

Physical and Chemical Properties

92.90637
[Kr]4d⁴5s¹

41

Nb

Transition Metal
NIOBIUM

Atomic Structure, Niobium, Nb

Electron Affinity

86.1 kJ/mol

Electronegativity (Pauling)

1.6

Periodic Table of the Elements

Niobium, Nb

Period 5

Group 5

Physical Properties, Niobium, Nb

Density at 20 °C

8570 kg/ m³

Spec. Heat Capacity

265 J/ (kg * K)

Melting point

2750 K, 2477 °C

Boiling point

5017 K, 4744 °C

Isotopes, Niobium, Nb

⁹³Nb

92.90637 u

PHYSICAL



Appearance: shiny, grey, silvery-white metal

Crystal Structure: Body-centered cubic

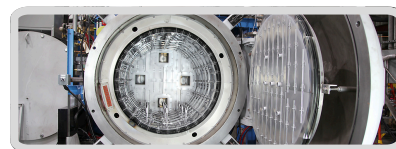
Hardness: 6.0 Mohs Scale, depending on purity

Malleability: a highly malleable, ductile metal

Conductivity: good conductor of heat, electricity

Young's Modulus: 105 GPa

CHEMICAL



Corrosion Resistance: is resistant to most mineral acids (e.g., HCl, HNO₃), fluoride salts, and seawater

Thermal Expansion (25°C): 7.3 μm (m⁻¹ · K⁻¹)

Common Oxidation States: +5, +3, also -1 to +4

Niobium Compounds: e.g., Niobium Pentoxide (Nb₂O₅), Ferroniobium (FeNb)

NIOBIUM MINERALS

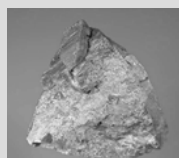
Mining Industry, Raw Materials

Ferrocolumbite ($\text{Fe}^{2+}\text{Nb}_2\text{O}_6$)



Oxide Minerals
Strunz:
4.DB.35

Euxenite ($\text{Y}(\text{NbTi})\text{O}_6$)



Oxide Minerals
Strunz:
4.DG.05

Samarskite-(Y) ($\text{YFe}^{3+}\text{Fe}^{2+}\text{U,Th,Ca}_2(\text{Nb,Ta})_2\text{O}_8$)



Oxide Minerals
Strunz:
4.DB.25

Fergusonite ($\text{Y,REE}\text{NbO}_4$)



Oxide Minerals
Strunz:
7.GA.05

FROTH FLOTATION

Ore Preparation Phase: From Gangue Material Pyrochlore to dried Niobium Pentoxide Nb_2O_5

Crushing

Grinding

Classification

Beneficiation

- ☐ Jaw-, Impact crushers
- ☐ Ball mills, vertical roller mills
- ☐ Gravity centrifuges, magnetic fields
- ☐ Froth flotation, rougher stage, cleaner stages
- ☐ Pyrochlore head grade 0.1 to 2% Nb_2O_5
- ☐ smaller-sized rocks, fragments
- ☐ particle size 90% < 150 mesh
- ☐ Mineral recovery at particle size, impurity removal

Conditioning

Reverse Gangue Flotation

Cleaner Flotation

Drying

- ☐ Slurry preparation, water
- ☐ Flotation cell, aeration, floating out the CaO content
- ☐ Floating of pyrochlore, acidic pH
- ☐ Multiple cleaning stages
- ☐ Dewatering
- ☐ Pyrochlore with high CaO content
- ☐ Collectors, e.g., sodium oleate, dodecylamine
- ☐ Collectors, e.g., cationic amine
- ☐ Pyrochlore concentrate: 60 % Nb_2O_5

Conditioning

Reverse Gangue Flotation

Cleaner Flotation

Drying

- ☐ Slurry preparation, water
- ☐ Flotation cell, aeration, floating out sulfide minerals
- ☐ Floating of pyrochlore, acidic pH
- ☐ Multiple cleaning stages
- ☐ Dewatering
- ☐ Pyrochlore with high S^{2-} content
- ☐ Collectors, e.g., cationic amines, tallow diamine, alkaline pH
- ☐ Subsequent, e.g., xanthates
- ☐ Pyrochlore concentrate: 40-50 % Nb_2O_5

NIOBIUM PROCESSING

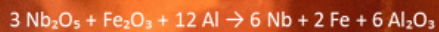
The Metal and Galvanic Industries

From Pyrochlore concentrate, Niobium Pentoxide Nb_2O_5 to Ferroniobium FeNb70

Aluminothermic Reduction

Ferroniobium Melting

Refining



- ☐ Highly exothermic reaction
- ☐ Al_2O_3 slag removal
- ☐ $\text{Nb} + \text{Fe} = \text{FeNb}$
- ☐ Cooling to FeNb ingots
- ☐ Combination with iron oxide, aluminum powder
- ☐ Electric arc furnace (EAF), steel container, Temp.: $> 2500^\circ\text{C}$
- ☐ FeNb grades: FeNb70 for HSLA Steel

ELECTRIC ARC FURNACE

From FeNb70 grade Ferroniobium to Railway Tracks made of High-Strength-Low-Alloy Steels (HSLA)

Smelting

Steelmaking

- ☐ $\text{CO}_2 + \text{C} \rightarrow 2\text{CO}$, primary reducing agent
- ☐ Casting molten Fe in e.g., slabs, blooms, billets
- ☐ Cooling HSLA steel
- ☐ $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$ in blast furnace $> 1600^\circ\text{C}$
- ☐ Addition of FeNb70 to molten Fe
- ☐ Steel grain microstructure refinement

Welding

- ☐ Reheating $> 1250^\circ\text{C}$, using railway track profiles as casting
- ☐ HSLA steel
- ☐ Machining to railway tracks

TRANSPORTATION SUPPORT SERVICES

Supply Chain Integration



Tailored logistics support services are available to B2B Partners, outsourcing their supply chain needs, including secure storage in warehouses, freight rail transportation, and specialized service providers for cargo handling and management, to ensure products get to market on time and within budget.

MODES OF TRANSPORTATION

- Trucks: for short distance hauls and last-mile delivery
- Trains: for long-distance transport of products, goods
- Ships: for large volumes of commodities via ocean freight

TRANSLOADING FACILITIES

- Access to distribution centers, warehouses, and storage space
- Secure transfer of commodities between modes of transportation, e.g., rail-to-ship

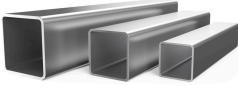
LOGISTICS SUPPORT

- Optimized shipping processes, analysis, including route planning, cost calculation, carrier identification, shipment tracking, and tracing for precision, real-time product movement
- Automated reporting

NIOBIUM PRODUCT FORMATS

Industrial Formats for Niobium, Nb

Tailored product formats can be made accessible to B2B Partners, based on achieved off-take agreements. The highlighted products on this page are a selection of possible product alternatives available for trade.

Niobium Pentoxide Nb_2O_5	Ferroniobium Ingots, FeNb60	Ferroniobium Ingots, FeNb70	Niobium-Nickel Ingots, NiNb65
			
Plates	Sheets, Flats	Tubes, square	Niobium-Titanium Ti47Nb53
			
Wires	Coils, Heat Exchanger	Bars, square	Niobium-Chromium X3CrNb17
			

PRIMARY NIOBIUM COMMODITIES

Classes and Standards

High-Purity Niobium

☐ High-Purity Niobium, Nb, unalloyed

- ☐ ASTM B391,
- ☐ Purity $\geq 99.8\%$, Mesh Size -325
- ☐ Ingots

☐ High-Purity Niobium, Nb, unalloyed

- ☐ Purity $\geq 99.999\%$, 5N
- ☐ Purity $\geq 99.995\%$, 4N5
- ☐ Purity $\geq 99.99\%$, 4N
- ☐ Purity $\geq 99.9\%$, 3N

Ferroniobium and other Niobium-based alloys

☐ 'Ferroniobium', Niobium-Iron alloys, FeNb70

- ☐ EN 17569, DIN 17569:2004-02, DIN EN 1090
- ☐ ISO 5453:1980, DIN EN 10088-1:2014-12
- ☐ HSLA Steel Manufacturing, Railway Tracks
- ☐ Ingots

☐ Niobium-Chromium alloys, X3CrNb17

- ☐ AISI 430Nb, ASTM B394, DIN EN 10312, EN 1.4511
- ☐ ISO EN 10088-3, DIN EN 1090
- ☐ Ferritic Corrosion-Resistant Steel
- ☐ Welded tubes for the conveyance of liquids

☐ Niobium-Titanium alloys, Ti47Nb53

- ☐ ASTM B884, ASTM B394, DIN 17860, DIN 17861
- ☐ ISO 23515, ISO 7209:2023, AWS A5.16
- ☐ High Corrosion-Resistance, Industrial Use
- ☐ Billets, bars, plates, sheets, strips, tubes, pipes

☐ Niobium-Nickel alloys, NiNb65

- ☐ EN 10302, DIN 17750, DIN 17752, DIN 17753
- ☐ ISO 22033:2011, ISO/TR 11434:1992
- ☐ High-Temperature Components, Power Plants
- ☐ Strips, sheets, bars, wires, tubes, pipes

Other Standard Measurements

☐ Measurement Standards

- ☐ ISO 4552-2:1987, Ferroniobium
- ☐ EN ISO 6507-1, Vickers Hardness
- ☐ ASTM B392, Nb, T1-T4, bars, wires
- ☐ ASTM B393, Nb, T1-T5, strips, plates
- ☐ ASTM B394, Nb, T1-T3, tubes, pipes

☐ Calibration, Delivery, Environmental

- ☐ DIN 17034, ISO 17025, Laboratories
- ☐ DIN 17569, Technical Delivery Conditions FeNb70
- ☐ EN 1090-2, ISO 9001, Structural Steel, Robust Quality
- ☐ DIN EN ISO 14001, Environmental, Water Resources

GLOSSARY

Abbreviations, Definitions

Froth Flotation	a mineral processing technique that separates valuable materials from tails based on differences in their surface properties, specifically their hydrophobicity (water-repelling) or hydrophilicity (water-attracting).
Electric Arc Furnace	a furnace that uses an electric arc to heat and melt metals, by passing an electric current through them. Key components are a furnace chamber, electrodes (e.g. graphite), a power source, and a system for charging and discharging the furnace.
Electrowinning	an electrolytic process used to recover metals from a solution by depositing them onto a cathode using an electric current. Base metals like zinc, nickel, copper, and cobalt can be recovered through electrowinning.
Standardization Institutes	ISO: International Organization for Standardization EN: European Norm/ Standard ASTA: American Society for Testing Materials DIN: Deutsches Institut für Normung

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Catalogue and B2B Centre

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about us

MEDSTERN CANADA is a
B2B Mediation company located in

Suite 700 - 838 West Hastings Street
Vancouver, BC, Canada,
V6C 0A6

For Canadian Suppliers, Vendors



Book consultation with
Mr. Randal Clark, PhD, P.Eng.
Senior Business Partner



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