Titanium Alloy

Material Safety Data Sheet (MSDS)/Safety Data Sheet (SDS)

www.alleghenyludlum.com or www.ATIMetals.com

Section 1 – Chemical Product and Company Identification

GHS Product Identifier: Titanium Alloy **MSDS Category:** TI

Other means of identification: Titanium steel (semi-finished steel product)

Supplier's Details: ATI Allegheny Ludlum
100 River Road, Brackenridge, PA 15014 **CAS Number:** Mixture

Phone Number (s): 724-226-5980 (M-F, 9 a.m.-4:30 p.m. EST)

Off-Hour Emergency Phone Number: 724-226-5555 **CHEMTREC**: 800-424-9300

Original Issue: 12/15/2007 **Revised/Approval:** 12/15/2011 **Expiration:** 12/15/2014

Section 2 - Hazards Identification

As sold, this product, **Titanium Alloy** (semi-finished steel products) is not hazardous according to the criteria specified in European Directives 67/548/EEC and 1999/45/EC. Under 29 CFR 1910.1200 Hazard Communication Standard, steel products are considered mixtures due to further processing which may produce dusts and or fumes. Refer to Section 3 and 8 for additional information. Refer to Section 11 for Toxicological Information.

Precautionary Statement/Emergency Overview: Odorless solid product in various forms, silver-gray color. This formed solid metal product poses little or no immediate health or fire hazards. Product may be coated - refer to appropriate coating MSDS for physical and health hazards. When product is subjected to welding, burning, melting, sawing, brazing, grinding, or other similar processes, potentially hazardous airborne particulate and fumes may be generated. These operations should be performed in well-ventilated areas, and if appropriate, respiratory protection and other PPE should be utilized.

Section 3 – Composition/Information on Ingredients

Chemical Identity of Regulated Substances under 29 CFR 1910.1200 (Hazard Communication Standard):

Ingredient Name	EC Number	CAS Number	% weight
Titanium	231-142-3	7440-32-6	88 – 99.9
Aluminum	231-072-3	7429-90-5	0-7.0
Vanadium	231-171-1	7440-62-2	0-4.5
Nickel	231-111-4	7440-02-0	0 – 0.9
Molybdenum	231-107-2	7439-98-7	0-0.4

Chemical Identity of Substances Not Regulated under 29 CFR 1910.1200 (Hazard Communication Standard), but offered as information for grade(s):

Palladium	231-115-6	7440-05-3	0 – 0.25
Iron	231-096-4	7439-89-6	0-0.5

EC - European Community
CAS - Chemical Abstract Service

Section 4 - First Aid Measures

Description of necessary first aid measures:

- **Inhalation:** If large amounts of dusts, fumes, or particulates are generated, move person to fresh air. If symptoms develop, seek medical attention.
- **Eye Contact:** For contact with dusts or particulates, flush eyes with water for 15 minutes. Eye injuries from solid particles should be treated by a physician immediately.
- **Skin Contact:** For skin contact with dusts or powders, wash immediately with soap and water. Cuts or abrasions should be treated promptly with thorough cleansing of the affected area.
- **Ingestion:** No need for first aid is anticipated if material is swallowed, however if symptoms develop, seek medical attention. For Ingestion of Dusts: IF SWALLOWED: Call a poison center or Doctor/physician if you feel unwell. Rinse mouth.

Most important acute and chronic symptoms/effects:

Primary Entry Routes: Titanium Alloy (semi-finished steel products) products in their usual physical form do not present an inhalation, ingestion or contact hazard. However, operations such as burning, welding, sawing, brazing, machining and grinding may result in the following effects if exposures exceed recommended limits as listed in Section 8.

Target Organs: Respiratory system

Section 4 - First Aid Measures (continued)

Acute Effects:

- **Inhalation:** Excessive exposure to high concentrations of dust may cause irritation to the eyes, skin and mucous membranes of the upper respiratory tract. Nickel compounds are respiratory tract irritants.
- **Eye:** Excessive exposure to high concentrations of dust may cause irritation and/or sensitization to the eyes. Molybdenum compounds are eye irritants.
- **Skin:** Repeated or prolonged contact with dusts may cause skin irritation or sensitization, possibly leading to dermatitis. Skin contact with metallic fumes and dusts may cause physical abrasion. Exposure to nickel may cause contact and atopic dermatitis and allergic sensitization. Molybdenum compounds are skin irritants.
- **Ingestion:** Ingestion of harmful amounts of this product as distributed is unlikely due to its solid insoluble form. Ingestion of dust may cause nausea or vomiting.

Acute Effects by component:

- **TITANIUM:** Not Reported/ Not Classified
- **ALUMINUM:** Not Reported/ Not Classified
- **VANADIUM (as Vanadium Oxide):** Vanadium oxide is fatal if swallowed or inhaled, and may be harmful in contact with skin.
- **NICKEL:** Nickel may cause allergic skin sensitization.
- **MOLYBDENUM:** Molybdenum causes skin and eye irritation.

Chronic Effects by component:

- **TITANIUM:** There is no evidence of a health hazard from inhalation of titanium dioxide at airborne concentrations below 10 mg/m^3. Rats (but not mice) exposed to ultrafine TiO_2 particles at 10 mg/m^3 developed lung tumors; probably results from inhibited particle clearance from lung. The toxicity of titanium dioxide has been found to be relatively inert. Eye contact with pure material can cause particulate irritation. Skin contact with titanium dusts may cause physical abrasion.
- **ALUMINUM**: Chronic inhalation of finely divided powder has been reported to cause pulmonary fibrosis and emphysema. Repeated skin contact has been associated with bleeding into the tissue, delayed hypersensitivity and granulomas. Chronic exposure to aluminum flake has been reported to cause pneumoconiosis in workers. Repeat oral exposure to aluminum results in decrements in neurobehavioral function and development.
- **VANADIUM:** Vanadium is considered non-toxic. Excessive long term or repeated exposures to vanadium compounds, especially vanadium pentoxide, may result in chronic pulmonary changes such as emphysema or bronchitis. Vanadium pentoxide is suspected of damaging fertility or the unborn child. Vanadium pentoxide is fatal if swallowed or inhaled. It causes damage to lungs by single, repeated or prolonged exposure.
- **NICKEL:** Exposure to nickel dusts and fumes can cause sensitization dermatitis, respiratory irritation, asthma, pulmonary fibrosis, edema and may cause nasal or lung cancer in humans. Causes damage to lungs through prolonged or repeated inhalation exposure. IARC lists nickel and certain nickel compounds as Group 2B carcinogens (sufficient animal data). ACGIH 2009 TLVs® and BEIs® lists insoluble nickel compounds as confirmed human carcinogens. Suspected of damaging the unborn child.
- **MOLYBDENUM:** Certain handling operations, such as burning and welding, may generate both insoluble molybdenum compounds (metal and molybdenum dioxide) and soluble molybdenum compounds (molybdenum trioxide). Molybdenum compounds generally exhibit a low order of toxicity with the trioxide the more toxic. However, some reports indicate that the dust of the molybdenum metal, molybdenum dioxide and molybdenum trioxide may cause eye, skin, nose and throat irritation in animals. Also has been reported to cause induction of tumors in experimental animals, suspected of causing cancer. Molybdenum oxide is suspected of causing cancer in humans.

Long-term inhalation exposure to high concentrations (over-exposure) to pneumoconiotic agents may act synergistically with inhalation of oxides, fumes or dusts of this product to cause toxic effects.

Carcinogenicity: IARC, NTP, and OSHA do not list steel products as carcinogens. IARC identifies nickel and certain nickel compounds and welding fumes as Group 2B carcinogens that are possibly carcinogenic to humans. ACGIH lists insoluble nickel compounds as confirmed human carcinogens.

Medical Conditions Aggravated by Long-Term Exposure: Individuals with chronic respiratory disorders (i.e., asthma, chronic bronchitis, emphysema, etc.) may be adversely affected by any fume or airborne particulate matter exposure.

SARA Potential Hazard Categories: Immediate Acute Health Hazard; Delayed Chronic Health Hazard

Section 5 – Fire and Explosion Hazard Information

Suitable Extinguishing Media: Not applicable for solid product. Use extinguishers appropriate for surrounding materials. For fines, use a Type-D fire extinguisher or table salt to control small fires. Machining of titanium alloys will generate fine turnings, chips or dust. Warning: May Form Combustible (Explosive) Dust - Air Mixtures. Keep away from all ignition sources including heat, sparks, and flame. Keep container closed and grounded. Prevent dust accumulations to minimize explosion hazard.

Specific Hazards arising from the chemical: Not applicable for solid product.

Explosion hazard: Accumulated metal dust can be combustible. Avoid creating dust.

Special protective equipment and precautions for fire fighters: Self-contained MSHA/NIOSH approved respiratory protection and full protective clothing should be worn when fumes and/or smoke from fire are present. Heat and flames cause emittance of acrid smoke and fumes. Do not release runoff from fire control methods to sewers or waterways.

Section 6 - Accidental Release Measures

Personal Precautions, Protective Equipment and Emergency Procedures: Not applicable to steel in solid state. For spills involving finely divided particles, clean-up personnel should be protected against contact with eyes and skin Collect material in appropriate, labeled containers for recovery or disposal in accordance with federal, state, and local regulations.

Environmental precautions: Not applicable to steel in solid state. Follow applicable Federal, state, and local regulations

Methods and materials for containment and clean up: Collect material in appropriate, labeled containers for recovery or disposal in accordance with federal, state, and local regulations. Follow applicable OSHA regulations (29 CFR 1910.120) and all other pertinent state and federal requirements.

Section 7 - Handling and Storage

Precautions for safe handling: Operations with the potential for generating high concentrations of airborne particulates should be evaluated and controlled as necessary. Practice good housekeeping. Avoid breathing metal fumes and/or dust.

Conditions for safe storage, including any incompatibilities: Store away from acids and incompatible materials.

Section 8 - Exposure Controls / Personal Protection

Occupational Exposure Limits (OELs): This product in its physical form as sold does not present an inhalation, ingestion or contact hazard, nor would any of the following exposure data apply. However, operations such as high temperature (burning, welding), sawing, brazing, machining and grinding may produce fumes and/or particulates. The following exposure limits are offered as reference, for an experienced industrial hygienist to review.

Ingredients	OSHA PEL [1]	ACGIH TLV [2]	NIOSH REL [3]	IDLH [4]
Titanium	15 mg/m³ (as TiO_2, total dust)	10 mg/m³ (as TiO_2)	LFC (as TiO_2) [5]	5,000 mg/m³ (as TiO_2)
Aluminum	15 mg/m³ (as total dust, PNOR[6]) 5.0 mg/m³ (as respirable fraction, PNOR)	10 mg/m³ (as metal dust) 5.0 mg/m³ (as welding fume)	10 mg/m³ (as total dust) 5.0 mg/m³ (as respirable dust)	NE
Vanadium	"C" 0.5 mg/m³ (as V_2O_5, respirable dust) "C" 0.1 mg/m³ (as V_2O_5, fume)	0.05 mg/m³ (as V_2O_5, inhalable fraction) [7]	"C" 0.05 mg/m³ (as V_2O_5, total dust or fume)	35 mg/m³ (as V, dust or fume)
Nickel	1.0 mg/m³ (as Ni metal & insoluble compounds)	1.5 mg/m³ (as inhalable fraction Ni metal) 0.2 mg/m³ (as inhalable fraction Ni inorganic only insoluble and soluble compounds)	0.015 mg/m³ (as Ni metal & insoluble and soluble compounds)	10 mg/m³ (as Ni)
Molybdenum	15 mg/m³ (as total dust, PNOR) 5.0 mg/m³ (as respirable fraction, PNOR)	10 mg/m³ (as Mo insoluble compounds, inhalable fraction) 3.0 mg/m³ (as Mo insoluble compounds, respirable fraction)[8] 0.5 mg/m³ (as Mo soluble compounds, respirable fraction)	NE	NE

NE - None Established

Notes:

1. OSHA PELs (Permissible Exposure Limits) are 8-hour TWA (time-weighted average) concentrations unless otherwise noted. A ("C") designation denotes a ceiling limit, which should not be exceeded during any part of the working exposure unless otherwise noted. A Short Term Exposure Limit (STEL) is defined as a 15-minute exposure, which should not be exceeded at any time during a workday.
2. Threshold Limit Values (TLV) established by the American Conference of Governmental Industrial Hygienists (ACGIH) are 8-hour TWA concentrations unless otherwise noted. ACGIH TLVs are for guideline purposes only and as such are not legal, regulatory limits for compliance purposes.
3. The National Institute for Occupational Safety and Health Recommended Exposure Limits (NIOSH-REL): Compendium of Policy and Statements. NIOSH, Cincinnati, OH (1992). NIOSH is the federal agency designated to conduct research relative to occupational safety and health. As is the case with ACGIH TLVs, NIOSH RELs are for guideline purposes only and as such are not legal, regulatory limits for compliance purposes.
4. The "immediately dangerous to life or health air concentration values (IDLHs)" are used by NIOSH as part of the respirator selection criteria and were first developed in the mid-1970's by NIOSH. The Documentation for Immediately Dangerous to Life or Health Concentrations (IDLHs) is a compilation of the rationale and sources of information used by NIOSH during the original determination of 387 IDLHs and their subsequent review and revision in 1994.
5. LFC – Lowest Feasible Concentration, Refer to Section 11, Toxicological Information
6. PNOR (Particulates Not Otherwise Regulated). All inert or nuisance dusts, whether mineral, inorganic, or organic, not listed specifically by substance name are covered by the PNOR limit which is the same as the inert or nuisance dust limit of 15 mg/m³ for total dust and 5.0 mg/m³ for the respirable fraction (containing less than 1% crystalline silica).
7. Inhalable fraction. The concentration of inhalable particulate for the application of this TLV is to be determined from the fraction passing a size-selector with the characteristics defined in the ACGIH 2009 TLVs ® and BEIs ® (Biological Exposure Indices) Appendix D, paragraph A.
8. Respirable fraction - The concentration of respirable dust for the application of this limit is to be determined from the fraction passing a size-selector with the characteristics defined in the ACGIH 2009 TLVs® and BEIs® Appendix D, paragraph C

Appropriate Engineering Controls: Use controls as appropriate to minimize exposure to metal fumes and dusts during handling operations. Provide general or local exhaust ventilation systems to minimize airborne concentrations. Local exhaust is necessary for use in enclosed or confined spaces. Provide sufficient general/local exhaust ventilation in pattern/volume to control inhalation exposures below current exposure limits.

Section 8 - Exposure Controls / Personal Protection (continued)

Personal Protective Equipment (PPE)

- **Respiratory Protection (continued):** Seek professional advice prior to respirator selection and use. Follow OSHA respirator regulations (29 CFR 1910.134) and, if necessary, use only a NIOSH-approved respirator. Select respirator based on its suitability to provide adequate worker protection for given working conditions, level of airborne contamination, and presence of sufficient oxygen. Concentration in air of the various contaminants determines the extent of respiratory protection needed. Half-face, negative-pressure, air-purifying respirator equipped with P100 filter is acceptable for concentrations up to 10 times the exposure limit. Full-face, negative-pressure, air-purifying respirator equipped with P100 filter is acceptable for concentrations up to 50 times the exposure limit. Protection by air-purifying negative-pressure and powered air respirators is limited. Use a positive-pressure-demand, full-face, supplied air respirator or self contained breathing apparatus (SCBA) for concentrations above 50 times the exposure limit. If exposure is above the IDLH (Immediately dangerous to life or health) for any of the constituents, or there is a possibility of an uncontrolled release or exposure levels are unknown, then use a positive-demand, full-face, supplied air respirator with escape bottle or SCBA.

Warning! Air-purifying respirators both negative-pressure, and powered-air do not protect workers in oxygen-deficient atmospheres.

Protective Clothing/Equipment:

- **Eyes**: Wear appropriate eye protection to prevent eye contact. For operations, which result in elevating the temperature of the product to or above its melting point or result in the generation of airborne particulates, use safety glasses or goggles to prevent eye contact. Contact lenses should not be worn where industrial exposures to this material are likely. Use safety glasses or goggles as required for welding, burning, sawing, brazing, grinding or machining operations.
- **Skin**: Wear appropriate personal protective clothing to prevent skin contact. Cut resistant gloves and sleeves should be worn when working with steel products. For operations, which result in elevating the temperature of the product to or above its melting point or result in the generation of airborne particulates, use protective clothing, and gloves to prevent skin contact. Protective gloves should be worn as required for welding, burning or handling operations.
- **Other protective equipment**: An eyewash fountain and deluge shower should be readily available in the work area when operations which could result in fumes and/or particulates are being performed.

Section 9 - Physical and Chemical Properties

Appearance and Odor: Silver-gray metallic solid form, odorless
Odor Threshold: NA
Vapor Pressure: NA
Vapor Density (Air=1): NA
Formula Weight: NA
Density: NA
Specific Gravity (H_2O=1, 60°F): 4.5
pH: NA
Flash Point (closed cup): NA
Auto-ignition Temperature: NA
Decomposition Temperature: ND
Partition Coefficient n-octanol/water: ND
Flammability (solid, gas): Non-flammable
Explosive Properties: ND

Water Solubility: Insoluble
Fat Solubility: NA
Other Solubilities: NA
Boiling Point: Ti-5930°F
Viscosity: NA
Refractive Index: NA
Surface Tension: NA
% Volatile by volume: NA
Evaporation Rate: NA
Freezing Point: NA
Melting Point: : 2800-3040 °F
UEL: NA
LEL: NA
Oxidizing Properties: ND

NA - Not Applicable
ND - Not determined for product as a whole

Section 10 - Stability and Reactivity

Reactivity: Not Determined (ND) for product as a whole.

Stability: Steel products are stable under normal storage and handling conditions.

Polymerization: Hazardous polymerization cannot occur.

Chemical Incompatibilities: Will react with strong acids to form hydrogen.

Conditions to Avoid: Storage with strong acids or calcium hypochlorite

Hazardous Decomposition/Combustion Products: Thermal oxidative decomposition of steel products can produce fumes containing oxides as well as other alloying elements.

Sensitivity to Mechanical Impact: ND

Sensitivity to Static Discharge: ND

Section 11 - Toxicological Information

Toxicological information has not been established for this product as sold. However, processing of this product in operations such as high temperature (burning, welding), sawing, brazing, machining and grinding may produce fumes and/or particulates, which would result in the material being classified as hazardous under OSHA 29 CFR 1910.1200. The categories of Health Hazards as defined in "GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELLING OF CHEMICALS (GHS), Third revised edition ST/SG/AC.10/30/Rev. 3" United Nations, New York and Geneva, 2009 have been evaluated and are listed below:

Potential Hazard	Hazard Category	Hazard Symbol	Signal Word	Hazard Statement
Skin Irritation	3[b]	No Symbol	**Warning**	Causes mild skin irritation
Eye Damage/ Irritation	2B [c]	No Symbol	**Warning**	Causes eye irritation
Skin Sensitization	1 [d]		**Warning**	May cause an allergic skin reaction
Carcinogenicity	2 [g]		**Warning**	Suspected of causing cancer
Toxic Reproduction	2 [h]		**Warning**	Suspected of damaging the unborn child
Specific Target Organ Systemic Toxicity (STOST) following Single Exposure	3 [i]		**Warning**	May cause respiratory irritation
STOST following Repeated Exposure	1 [j]		**Danger**	Causes damage to lungs through prolonged or repeated inhalation exposure. Causes damage to the central nervous system.

Notes:

a. No **LC_{50} or LD_{50}** has been established for **Titanium Alloy** (semi-finished steel products). The following data has been determined for the components:

- **Nickel:** LD_{50} > 9000 mg/kg (Oral/Rat); LC_{50} > 10.2 mg/l (Inhalation/Rat)

b. No **Skin (Dermal) Irritation** data available for **Titanium Alloy** (semi-finished steel products) as a mixture. The following Skin (Dermal) Irritation information was found for the components:

- **Nickel**: Slight irritation only in rabbits
- **Molybdenum:** Irritating

c. No **Eye Irritation** data available for **Titanium Alloy** (semi-finished steel products) as a mixture. The following Eye Irritation information was found for the components:

- **Molybdenum:** Causes eye irritation
- **Nickel:** Slight eye irritation from particulate abrasion only.

d. No **Skin (Dermal) Sensitization** data available for **Titanium Alloy** (semi-finished steel products) a mixture. The following Skin (Dermal) Sensitization information was found for the components:

- **Nickel**: Human skin sensitizer

e. No **Germ Cell Mutagenicity** data available for **Titanium Alloy** (semi-finished steel products) as a mixture. The following Mutagenicity and Genotoxicity information was found for the components:

- **Nickel**: Positive results *in vitro and in vivo* but insufficient data for classification
- **Aluminum:** Not mutagenic *in vitro*; but has marginal effects *in vivo*

f. **Carcinogenicity**: IARC, NTP, and OSHA do not list **Titanium Alloy** (semi-finished steel products) as carcinogens. The following Carcinogenicity information was found for the components:

- **Welding Fumes**, IARC Group 2B carcinogen, a mixture that is possibly carcinogenic to humans.
- **Nickel and certain nickel compounds** - IARC Group 2B carcinogens that are possibly carcinogenic to humans. Insoluble nickel compounds - ACGIH confirmed human carcinogen. Nickel - EURAR Insufficient evidence to conclude carcinogenic potential in animals or humans; suspect carcinogen classification Category 2 Suspected of causing cancer. Nickel Oxide – HSDB listed as Category 1a, may cause cancer. Human data in which exposure to nickel refinery dust caused lung and nasal tumors.

h. No **Toxic Reproduction** data available for **Titanium Alloy** (semi-finished steel products) as a mixture. The following Toxic Reproduction information was found for the components:

- **Nickel**: Oral administration to experimental animals caused fetotoxicity.
- **Aluminum**: May cause delay in development of neurobehavioral indices.

i. No **Specific Target Organ Systemic Toxicity (STOST) following a Single Exposure** data available for **Titanium Alloy** (semi-finished steel products) as a mixture. The following STOST following a Single Exposure data was found for the components:

- **Molybdenum**: May cause respiratory irritation.

Section 11 - Toxicological Information (continued)

j. No **Specific Target Organ Systemic Toxicity (STOST) following Repeated Exposure** data was available for **Titanium Alloy** (semi-finished steel products) as a whole. The following STOST following Repeated Exposure data was found for the components:

- **Hexavalent Chrome:** Inflammation of lung, skin irritation and ulceration with repeat exposures in workers.
- **Nickel**: Rats exposed to Nickel by inhalation at 1 mg/m^3 for 90 days developed lung inflammation, hyperplasia and fibrosis.
- **Aluminum:** Chronic exposure to aluminum flake has been reported to cause pneumoconiosis in workers. Repeat oral exposure to aluminum results in decrements in neurobehavioral function and development.

The above toxicity information was determined from available scientific sources to illustrate the prevailing posture of the scientific community. The scientific resources includes: The American Conference of Governmental Industrial Hygienist (ACGIH) Documentation of the Threshold Limit Values (TLVs) and Biological Exposure indices (BEIs) with Other Worldwide Occupational Exposure Values 2009, The International Agency for Research on Cancer (IARC), The National Toxicology Program (NTP) updated documentation, the World Health Organization (WHO) and other available resources, the International Uniform Chemical Information Database (IUCLID), European Union Risk Assessment Report (EU-RAR), Concise International Chemical Assessment Documents (CICAD), European Union Scientific Committee for Occupational Exposure Limits (EU-SCOEL), Agency for Toxic Substances and Disease Registry (ATSDR), Hazardous Substance Data Bank (HSDB), and International Programme on Chemical Safety (IPCS).

Section 12 - Ecological Information

Hazard Category: Not Reported

Hazard Symbol: No Symbol

Signal Word: No Signal Word

Hazard Statement: No Hazard Statement

Ecotoxicity: No data available for the product, **Titanium Alloy** (semi-finished steel products) as a whole. However, individual components of the product have been found to be toxic to the environment. Metal dusts may migrate into soil and groundwater and be ingested by wildlife as follows:

- **Aluminum:** LC_{50}> 100 mg/l for fish and algae

Mobility: No data available for the product, **Titanium Alloy** (semi-finished steel products) as a whole. However, individual components of the product have been found to be absorbed by plants from soil.

Persistence & Degradability: No Data Available

Bioaccumulative Potential: No Data Available

Note: The listing of regulations relating to an ATI product may not be complete and should not be solely relied upon for all regulatory compliance responsibilities.

Section 13 - Disposal Considerations

Disposal: Steel scrap should be recycled whenever possible. Product dusts and fumes from processing operations should also be recycled, or classified by a competent environmental professional and disposed of in accordance with applicable federal, state or local regulations.

Container Cleaning and Disposal: Follow applicable Federal, state and local regulations. Observe safe handling precautions. European Waste Catalogue (EWC): 16 01 17 (ferrous metals), 12 01 99 (wastes not otherwise specified), 16 03 (off specification batches and unused products), or 15 01 04 (metallic packaging).

Please note this information is for Titanium Alloy (semi-finished steel products) in its original form. Any alterations can void this information.

Section 14 - Transport Information

DOT Transportation Data (49 CFR 172.101):

US Department of Transportation (DOT) under 49 CFR 172 does not regulate **Titanium Alloy** (semi-finished steel products) as a hazardous material. All federal, state, and local laws and regulations that apply to the transport of this type of material must be adhered to.

Shipping Name: Not Applicable (NA) **Shipping Symbols:** NA **Hazard Class:** NA **UN No.:** Not applicable **Packing Group:** NA **DOT/ IMO Label:** NA **Special Provisions (172.102):** NA	**Packaging Authorizations** **a) Exceptions:** NA **b) Group:** NA **c) Authorization:** NA	**Quantity Limitations** **a) Passenger, Aircraft, or Railcar:** NA **b) Cargo Aircraft Only:** NA **Vessel Stowage Requirements** **a) Vessel Stowage:** NA **b) Other:** NA **DOT Reportable Quantities**: NA

The International Maritime Dangerous Goods (IMDG) and the Regulations Concerning the International Carriage of Dangerous Goods by Rail (RID) classification, packaging and shipping requirements follow the US DOT Hazardous Materials Regulation.

ADR – Regulations Concerning the International Carriage of Dangerous Goods by Road does not regulate **Titanium Alloy** (semi-finished steel products) as a hazardous material.

Shipping Name: Not Applicable (NA) **Classification Code:** NA **UN No.:** Not applicable **Packing Group:** NA **ADR Label:** NA **Special Provisions:** NA **Limited Quantities:** NA	**Packaging** **a) Packing Instructions:** NA **b) Special Packing Provisions:** NA **c) Mixed Packing Provisions:** NA	**Portable Tanks & Bulk Containers** **a) Instructions:** NA **b) Special Provisions:** NA

Section 14 - Transport Information (continued)

IATA – International Air Transport Association (IATA) does not regulate **Titanium Alloy** (semi-finished steel products) as a hazardous material.

Shipping Name: Not Applicable (NA) **Class/Division:** NA **Hazard Label (s):** NA **UN No.:** NA **Packing Group:** NA **Excepted Quantities (EQ):** NA	**Passenger & Cargo Aircraft Limited Quantity (EQ)**		**Cargo Aircraft Only**	**Special Provisions:** NA
	Pkg Inst: NA **Max Net Qty/Pkg:** NA	**Pkg Inst:** NA **Max Net Qty/Pkg:** NA	**Pkg Inst:** NA **Max Net Qty/Pkg:** NA	**ERG Code:** NA

Pkg Inst – Packing Instructions Max Net Qty/Pkg – Maximum Net Quantity per Package ERG – Emergency Response Drill Code

Transport Dangerous Goods (TDG) classification: Titanium Alloy (semi-finished steel products) does not have a TDG classification.

Section 15 - Regulatory Information

Regulatory Information: *The following listing of regulations relating to an ATI Allegheny Ludlum product may not be complete and should not be solely relied upon for all regulatory compliance responsibilities.*

This product and/or its constituents are subject to the following regulations:

OSHA Regulations: Air Contaminant (29 CFR 1910.1000, Table Z-1, Z-2, Z-3): The product, **Titanium Alloy** (semi-finished steel products) as a whole is not listed. However, individual components of the product are listed: Refer to Section 8, Exposure Controls and Personal Protection

EPA Regulations: Titanium Alloy (semi-finished steel products) is not listed as a whole. However, individual components of the product are listed:

Components	Regulations
Aluminum	SWDA, SARA 313
Vanadium	SARA 313
Nickel	CAA, CWA, SARA 313, CERCLA, RCRA, SDWA
Molybdenum	SDWA

SARA Potential Hazard Categories: Immediate Acute Health Hazard; Delayed Chronic Health Hazard

Regulations Key:

CAA	Clean Air Act (42 USC Sec. 7412; 40 CFR Part 61 [As of: 8/18/06])
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act (42 USC secs. 9601(14), 9603(a); 40 CFR Sec. 302.4, Table 302.4, Table 302.4 and App. A)
CWA	Clean Water Act (33 USC Secs. 1311; 1314(b), (c), (e), (g); 136(b), (c); 137(b), (c) [as of 8/2/06])
RCRA	Resource Conservation Recovery Act (42 USC Sec. 6921; 40 CFR Part 261 App VIII)
SARA	Superfund Amendments and Reauthorization Title III Section 302 Extremely Hazardous Substances (42 USC secs. 11023, 13106; 40 CFR Sec. 372.65) and Section 313 Toxic Chemicals (42 USC secs. 11023, 13106; 40 CFR sec. 372.65 [as of 6/30/05])
TSCA	Toxic Substance Control Act (15 U.S.C. s/s 2601 et seq. [1976])
SDWA	Safe Drinking Water Act (42 U.S.C. s/s 300f et seq. [1974])

Section 313 Supplier Notification: This product, **Titanium Alloy** (semi-finished steel products) contains the following toxic chemicals subject to the reporting requirements of section 313 of Title III of the Superfund Amendments and Reauthorization Act of 1986 and 40 CFR part 372:

CAS #	Chemical Name	Max Percent by Weight
7429-90-5	Aluminum	7
7440-62-2	Vanadium	4.5
7440-02-0	Nickel	0.9

This information should be included in all MSDSs that are copied and distributed for this material.

State Regulations: The product, **Titanium Alloy** (semi-finished steel products) as a whole is not listed in any state regulations. However, individual components of the product are listed in various state regulations:

Pennsylvania Right to Know: Contains regulated material in the following categories:

- Hazardous Substances: Nickel, Molybdenum, and Aluminum
- Environmental Hazards: Aluminum (dust and Fume), Nickel, and Vanadium
- Special Hazard Substances: Nickel

California Prop. 65: The product, **Titanium Alloy** (semi-finished steel products) may possibly contain trace quantities (generally much less than 0.1%) of metallic elements known to the State of California to cause cancer or reproductive toxicity. This includes nickel.

New Jersey: Contains regulated material in the following categories:

- Special Health Hazard Substances: Nickel
- Hazardous Substance List: Titanium, Molybdenum, Vanadium, Aluminum (dust and fume), and Nickel
- Environmental Hazards: Not Listed

Minnesota: Nickel (elemental, soluble, and insoluble compounds), and Aluminum (dust and fume)

Massachusetts: Aluminum (dust and fume), Nickel, Vanadium, and Molybdenum

Other Regulations:

WHMIS Classification (Canadian): Titanium Alloy (semi-finished steel products) is not listed as a whole. However individual components are listed.

Section 15 - Regulatory Information (continued)

WHMIS Classification (Canadian) (continued):

Ingredients	WHMIS Classification
Titanium	D26
Vanadium	D3B
Nickel	D2B
Molybdenum	B4, D2B

This product has been classified in accordance with the hazard criteria of the Controlled Products Regulations and the MSDS contains all the information required by the Controlled Products Regulations.

Section 16 – Other Information

Hazardous Material Identification System (HMIS) Classification

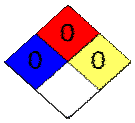
Health Hazard	0
Fire Hazard	0
Physical Hazard	0

HEALTH = **0**, No significant risk to health.

FIRE= **0**, Materials that will not burn

PHYSICAL HAZARDS = **0**, Materials that are normally stable, even under fire conditions, and will not react with water, polymerize, decompose, condense, or self-react. Non-explosives

National Fire Protection Association (NFPA)



HEALTH = **0**, No hazard beyond that of ordinary combustible materials.

FIRE = **0,** Materials that will not burn

INSTABILITY = **0**, Normally stable, even under fire exposure conditions, and are not reactive with water.

ABBREVIATIONS/ACRONYMS:

ACGIH	American Conference of Governmental Industrial Hygienists
BEIs	Biological Exposure Indices
CAS	Chemical Abstracts Service
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CNS	Central Nervous System
GI, GIT	Gastro-Intestinal, Gastro-Intestinal Tract
HMIS	Hazardous Materials Identification System
IARC	International Agency for Research on Cancer
LC50	Median Lethal Concentration
LD50	Median Lethal Dose
LD_{Lo}	Lowest Dose to have killed animals or humans
LEL	Lower Explosive Limit
µg/m³	microgram per cubic meter of air
mg/m³	milligram per cubic meter of air
mppcf	million particles per cubic foot
MSDS	Material Safety Data Sheet
MSHA	Mine Safety and Health Administration
NFPA	National Fire Protection Association
NIF	No Information Found
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
ORC	Organization Resources Counselors
OSHA	Occupational Safety and Health Administration
PEL	Permissible Exposure Limit
PNOR	Particulate Not Otherwise Regulated
PNOC	Particulate Not Otherwise Classified
PPE	Personal Protective Equipment
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RTECS	Registry of Toxic Effects of Chemical Substances
SARA	Superfund Amendment and Reauthorization Act
SCBA	Self-contained Breathing Apparatus
STEL	Short-term Exposure Limit
TLV	Threshold Limit Value
TWA	Time-weighted Average
UEL	Upper Explosive Limit

DISCLAIMER: All information, recommendations, and suggestions appearing herein concerning the product are based upon data believed to be reliable. It is the user's responsibility to determine the safety, toxicity, and suitability for their own use of the product described herein. Since the actual use by others is beyond our control, no guarantee, expressed or implied is made by AM Health and Safety, Inc. (acting consultant) and ATI Allegheny Ludlum as to the effects of such use, the results to be obtained, or the safety and toxicity of the product, nor does AM H&S or ATI Allegheny Ludlum assume any liability arising out of use by others of the product referred to herein. AMH&S and ATI Allegheny Ludlum shall not in any event be liable for special, incidental or consequential damages in connection with this MSDS. This MSDS is not intended as a license to operate under, or recommendation to infringe on, any patents. Appropriate warnings and safe handling procedures should be provided to handlers and users.

This information is not intended to serve as a complete regulatory compliance document. This information is offered as a guide to the MSDS user. No guarantees can be made whether the user will be in complete or correct compliance with all applicable regulations when this MSDS is used. It is the user's responsibility to comply with all federal, state, and local regulations.

NOTE: The percent composition in Section 3 reflects the range that is possible within this GROUP of products. These are not the technical specifications for a particular product.

PREPARED BY: AM Health and Safety, Inc. (acting consultant)	**REVISION NO.**: 1	**APPROVAL DATE**: 12/15/11
MFR. CONTACT: M.R. Shirey (724-226-5980)		**SUPERSEDES MSDS DATED**: 12-15-07

WEBSITE: www.alleghenyludlum.com or www.ATIMetals.com

Note: This MSDS supersedes all prior MSDSs issued by ATI Allegheny Ludlum.