

## Overview

### Useful For

Monitoring metallic prosthetic implant wear

### Special Instructions

- [Trace Metals Analysis Specimen Collection and Transport](#)

### Method Name

Inductively Coupled Plasma-Mass Spectrometry (ICP-MS)

### NY State Available

Yes

## Specimen

### Specimen Type

Serum

### Specimen Required

**Collection Container/Tube:** Plain, royal blue-top Vacutainer plastic trace element blood collection tube (T184)

**Submission Container/Tube:** 7-mL Mayo metal-free, screw-capped, polypropylene vial (T173)

**Specimen Volume:** 1.2 mL

### Collection Instructions:

1. Allow specimen to clot for 30 minutes; then centrifuge the specimen to separate serum from the cellular fraction.
2. Remove the stopper. Carefully pour specimen into a Mayo metal-free, polypropylene vial, avoiding transfer of the cellular components of blood. **Do not** insert a pipet into the serum to accomplish transfer, and **do not** ream the specimen with a wooden stick to assist with serum transfer.
3. See [Trace Metals Analysis Specimen Collection and Transport](#) in Special Instructions for complete instructions.

### Additional Information:

1. High concentrations of gadolinium and iodine are known to interfere with most metals tests. If either gadolinium- or iodine-containing contrast media has been administered, a specimen should not be collected for 96 hours.
2. If ordering the trace element blood collection tube from BD, order catalog #368380.

### Specimen Minimum Volume

0.5 mL

### Reject Due To

Gross hemolysis	OK
Gross lipemia	OK

Gross icterus	OK
---------------	----

### Specimen Stability Information

Specimen Type	Temperature	Time	Special Container
Serum	Refrigerated (preferred)	28 days	METAL FREE
	Frozen	28 days	METAL FREE
	Ambient	7 days	METAL FREE

### Clinical and Interpretive

#### Clinical Information

Titanium is the ninth most abundant element in the earth's crust. Multiple oxidation states between 2+ and 4+ allow formation of a variety of compounds. There is no evidence that titanium is an essential element. Due in part to titanium's oxide formation propensity, the element is considered to be nontoxic. Soils, drinking water, and air all contain trace amounts of titanium. The food processing industry uses large quantities of titanium as a food additive; processed foods contain higher levels than are found in most produce and organic food-stuffs. The average daily oral intake through food consumption is 0.1 to 1 mg/day, which accounts for more than 99% of exposure. Gastrointestinal absorption of titanium is low (approximately 3%) and the majority of ingested titanium is rapidly excreted in the urine and stool. The total body burden of titanium is usually in the range of 9 to 15 mg, a significant portion of which is contained in the lung. Titanium dust entering the respiratory tract is nonirritating and is almost completely nonfibrogenic in humans.

Titanium-containing alloys are used in some artificial joints, prosthetic devices, and implants. Titanium dioxide allows osseointegration between an artificial medical implant and bone. Despite their wide use, exposure to these materials has not been linked to toxicity. In one study patients monitored up to 36 months following joint replacement with titanium-containing joints showed a statistically significant increase in detectable serum titanium within the study group. While titanium concentrations are not a measure of toxicity, they are useful in determining whether implant breakdown is occurring. Serum titanium concentrations are likely to be increased above the reference range in patients with metallic joint prosthesis. Prosthetic devices produced by Zimmer Company and Johnson and Johnson typically are made of aluminum, vanadium, and titanium. This list of products is incomplete, and these products change occasionally; see prosthesis product information for each device for composition details

#### Reference Values

0-1 ng/mL

#### Interpretation

Prosthesis wear is known to result in increased circulating concentration of metal ions. In the absence of an implant, circulating titanium is <1 ng/mL. Modest increase (1.0-3.0 ng/mL) in serum titanium concentration is evident with a prosthetic device in good condition. Serum concentrations >10 ng/mL in a patient with titanium-based implant suggest prosthesis wear. Increased serum titanium concentration in the absence of corroborating clinical information does not independently predict prosthesis wear or failure.

#### Cautions

Titanium is a trace metal commonly used in alloys and readily present in the environment. Thus, contamination of the collection site and of the specimen must be avoided. Failure to use metal-free collection procedures and devices may cause falsely increased results. See Specimen Required for collection and processing information.

---

**Clinical Reference**

1. Chao EY, Frassica F, Prichard DJ, Moyer TP: Metal ion release in patients with porous coated megaprotheses. 41st Annual Meeting of the Orthopaedic Research Society, Orlando, Florida, 1995 Feb 13-16
2. Jacobs JJ, Skipor AK, Patterson LM, et al: Metal release in patients who have had a primary total hip arthroplasty. A prospective, controlled, longitudinal study. J Bone Joint Surg Am 1998 Oct;80(10):1447-1458
3. Liu TK, Liu SH, Chang CH, Yang RS: Concentration of metal elements in the blood and urine in the patients with cementless total knee arthroplasty. Tohoku J Exp Med 1998;185:253-262
4. Krachler M, Domj W, Irgolic KJ: Concentrations of trace elements in osteoarthritic knee-joint effusions. Biol Trace Elem Res 2000;75:253-263

**Performance****Method Description**

Titanium concentrations in serum can be determined by inductively coupled plasma-mass spectrometry. Aqueous acidic calibrating standards, quality control samples, patient specimens, and blanks are diluted with diluent containing an internal standard. In turn, all diluted blanks, calibrating standards, quality control samples, and patient specimens are aspirated into a pneumatic nebulizer and the resulting aerosol directed to the hot plasma discharge by a flow of argon. In the annular plasma the aerosol is vaporized, atomized, and then ionized. The ionized gases plus neutral species formed in the annular plasma space are aspirated from the plasma through an orifice into a quadrupole mass spectrometer. The mass range from 1 to 263 amu is rapidly scanned multiple times and ion counts (analyte ion count/internal standard ion count). Instrument response is defined by the linear relationship of analyte concentration versus ion count ratio (analyte ion count/internal standard ion count). Analyte concentrations are derived by reading the ion count ratio for each mass of interest and determining the concentration from the response line. (Unpublished Mayo method)

**PDF Report**

No

**Day(s) and Time(s) Test Performed**

Wednesday; 8 a.m.

**Analytic Time**

Same day/1 day

**Maximum Laboratory Time**

7 days

**Specimen Retention Time**

14 days

**Performing Laboratory Location**

Rochester

**Fees and Codes****Fees**

- 
- Authorized users can sign in to [Test Prices](#) for detailed fee information.
  - Clients without access to Test Prices can contact [Customer Service](#) 24 hours a day, seven days a week.
  - Prospective clients should contact their Regional Manager. For assistance, contact [Customer Service](#).

**Test Classification**

This test was developed and its performance characteristics determined by Mayo Clinic in a manner consistent with CLIA requirements. This test has not been cleared or approved by the U.S. Food and Drug Administration.

**CPT Code Information**

83018

**LOINC® Information**

Test ID	Test Order Name	Order LOINC Value
TIS	Titanium, S	8244-6

Result ID	Test Result Name	Result LOINC Value
89367	Titanium, S	8244-6