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**Information for Physicians Who Believe They May Have A Patient with Sensitivity to Metal**

The most common metallic sensitizers that are used in orthopedic alloys are nickel, cobalt, and chromium. Orthopedic grades of stainless steel and cobalt-chromium alloys both contain these materials while titanium alloys do not. Information is attached concerning the composition of ConMed Linvatec titanium, stainless steel and cobalt-chrome alloys. The excellent biocompatibility of titanium and its alloys, such as Ti-6Al-4V alloy, is well documented. Persons with a history of allergies, including sensitivities to cobalt, chromium, or nickel, generally do not exhibit or develop sensitivity to titanium or other constituents of Ti-6Al-4V alloy. [1]

Standard sensitivity testing has not proven to be an accurate predictor of the likelihood of a reaction to a metallic implant. Clinical experience has shown that patients who have tested positive for metal sensitivity generally do not exhibit a reaction when the sensitizing material is implanted as an orthopedic device.[1]

In the past, physicians recommended external metal disc skin testing for allergic reaction and provided test samples of various implant alloys to be used for this purpose. ConMed Linvatec does not recommend this procedure.

1. Taping dry metal disks to a patient's skin is not considered the optimal method for metal sensitivity testing. In order to challenge a patient's response to an implant constituent, the metal should be in water-soluble ion form.[2]

2. Solid test specimens may irritate the underlying skin by rubbing and pressing against it. This nonspecific irritation may be mistaken for a positive reaction to the components of the metal.

ConMed Linvatec recommends that a patient with a potential metal sensitivity be seen by a dermatologist or allergist and undergo appropriate testing before having surgery. Dermatologists and allergists should have access to products that can be used for metal sensitivity testing.

There may be other sources for metal sensitivity testing not mentioned here. If you are located in an area where there is no access to a dermatologist or allergist who is familiar with patch testing for metal allergens, it is suggested that you call the American Academy of Dermatology's American Contact Dermatitis Society subgroup for a reference (telephone number 847-330-0230).

If you have any questions, please contact the ConMed Linvatec Regulatory Affairs Department at 727-392-6464.

Sincerely,

ConMed Linvatec
Manager, Regulatory Affairs

## Chemical Composition of ConMed Linvatec Titanium Implant Metals

All of Conmed Linvatec's Titanium implant devices are constructed of 6Al-4V E.L.I.(extra low interstitial) titanium alloy. Titanium 6Al-4V E.L.I. meets the rigid test standards of the "American Society for Testing and Materials" (ASTM) Standard Section 13, " Medical Devices," Designation: F136, Standard Specification for Wrought Titanium 6Al-4V E.L.I. Alloy for Surgical Implant Applications[3] and F620 Specification for Titanium 6Al-4V E.L.I., ALLOY Forgings for Surgical Implants[4]. According to the ASTM, Titanium 6Al-4V E.L.I. implants have been successfully used in surgical implant procedures.[3]

The alloy composition, Titanium 6Al-4V E.L.I., listed in the ASTM standards and used by ConMed Linvatec, has exhibited an acceptable level of local biological response in human implants for over a decade.[3]

ConMed Linvatec has conducted independent laboratory testing to further demonstrate the acceptable biocompatibility characteristics of the Titanium 6Al-4V E.L.I. alloy implants. Tests performed according to the United States Pharmacopoeia (USP), ISO 10993-1[5] and FDA G # - 95, Memorandum for Cytotoxicity, Sensitization, Implantation and Genotoxicity (Ames test) have established that Titanium 6Al-4V E.L.I. is biocompatible.

ConMed Linvatec has determined Titanium 6Al-4V E.L.I. metal alloy implants are safe and effective for use as implantation devices.

**Ti-6Al-4V Alloy – Wrought ELI Grade**
**Standards: ISO 5832-3[6,7]/ASTM F136[3]**

Composition (weight percent):

| | | |
|---|---|---|
| Aluminum – 5.50 to 6.50 | Nitrogen – 0.05 max | Iron – 0.25max |
| Vanadium – 3.50 to 4.50 | Oxygen – 0.13 max | Titanium – balance |
| Carbon – 0.08 max | Hydrogen – 0.012 max | |

## Chemical Composition of ConMed Linvatec Stainless Steel Implant Metals

Conmed Linvatec stainless steel implants are constructed of 316L or 316 LVM (L – Vacuum Melted) grade stainless steel identified in ISO and ASTM standards for surgical implant grade stainless steels, ISO 5832: 1997 Composition D[8,9], BS 7252-1: 1997 Composition D[6], and ASTM F138[12]. Metallurgical requirements are stringent to ensure sufficient corrosion resistance, nonmagnetic response, and satisfactory mechanical properties.

Conmed Linvatec is aware of published reports that metal implants containing nickel have been implicated in allergic reactions. Between 3% and 5% of the population is allergic to nickel.[10] High quality stainless steel is not regarded to be a health hazard, but some types of stainless steel release enough nickel to provoke a reaction in nickel sensitive patients. Haudrechy et. al.[10] showed that 14 % of nickel-allergic patients reacted on patch testing to high sulfur stainless steel (AISI 303 grade), whereas low sulfur stainless steel (AISI 304, 316L and 430) did not elicit allergic reactions.

The biocompatibility of implant quality stainless steel has been proven by successful human implantation for decades. [11] [12]

**316L Stainless Steel – Cast or Wrought**
**Standards: ISO 5832-1[8]or 5832-9[6]/ASTM F138[12] or F139[13]**

Composition (weight percent);

| | | |
|---|---|---|
| Carbon – 0.030 max | Silicon – 0.75 max | Nitrogen – 0.10max |
| Manganese – 2.0 max | Chromium – 17.00 to 19.00 | Copper – 0.50 max |
| Phosphorous – 0.025 max | Nickel – 13.00 to 15.00 | Iron - balance |
| Sulfur – 0.010 max | Molybdenum – 2.25 to 3.00 | |

## Chemical Composition of ConMed Linvatec Cobalt-Chrome Implant Metals

Cobalt chrome alloys are widely used in orthopedic implants, such as knee and shoulder prostheses, and as fracture fixation devices. This alloy nominally contains 30% chromium, 7% molybdenum, 1% manganese, 1% nickel, 0.75% iron, 0.35% carbon, and the balance cobalt. The 50-year clinical experience and history of the use of cobalt-chromium as an implant material in orthopedics, dentistry, and plastic surgery more than adequately establish its safety and effectiveness. The Cobalt-Chrome implants conform to ASTM F75 Standard Specification for Cast Cobalt-Chromium-Molybdenum Alloy for Surgical Implant Applications.

The biocompatibility of implant quality Cobalt-Chrome has been proven by successful human hip implantation for decades. [14]

**Standards: ISO 5832-4[6.15]/ASTM F-75[14]**

Composition (weight percent);

| | | |
|---|---|---|
| Chromium – 30% | Molybdenum – 7% | Manganese – 1% |
| Nickel – 1% | Iron – 0.75% | Carbon – 0.35% |
| Cobalt - balance | | |

## References


[1] Duchna HW, Nowack U, Merget R, Muhr G, Schultze-Werninghaus G. Prospective study of the significance of contact sensitization caused by metal implants. , Zentralbl Chir. 1998: 123:1271.
[2] Niki Y, Matsumoto H, Otani T, Yatabe T, Kondo M, Yoshimine F, Toyama Y. Screening for symptomatic metal sensitivity: a prospective study of 92 patients undergoing total knee arthroplasty., Biomaterials 2005: 26/9: 1019.
[3] ASTM F136-02a Standard Specification for Wrought Titanium-6 Aluminum-4 Vanadium ELI (Extra Low Interstitial) Alloy for Surgical Implant Applications (UNS R56401)
[4] ASTM F620-00 Standard Specification for Alpha Plus Beta Titanium Alloy Forgings for Surgical Implants.
[5] ISO 10993-1: 2003 Biological evaluation of medical devices.
[6] BS ISO 5832: Implants for surgery. Metallic materials for surgical implants (supersede BS 7252-1:1997.)

[7] ISO 5832-3: 1996 Implants for surgery -- Metallic materials – Part 3: Wrought titanium 6-aluminium 4-vanadium alloy
[8] ISO 5832-1: 1997 Implants for surgery – Metallic materials – Part 1: Wrought stainless steel.
[9] ISO 5832-9: 1992 Implants for surgery -- Metallic materials -- Part 9: Wrought high nitrogen stainless steel
[10] Haudrechy P, Foussereau J, Mantout B, Baroux B. Nickel release from nickel-plated metals and stainless steels. Contact Dermatitis 1994: 31: 249.
[11] Disegi JA, Eschbach L. Stainless steel in bone surgery. Injury, Int. J. Care Injured 2000: 31: S-D2-6.
[12] ASTM F138-03 Standard Specification for Wrought 18 Chromium-14 Nickel-2.5 Molybdenum Stainless Steel Bar and Wire for Surgical Implants (UNS S31673).
[13] ASTM F139-03 Standard Specification for Wrought-18 Chromium-14 Nickel-2.5 Molybdenum Stainless Sheet and Strip for Surgical Implants (UNS S31673).
[14] ASTM F75-01 Standard Specification for Cast Cobalt-Chromium-Molybdenum Alloy for Surgical Implant Applications. (UNS R30075)
[15] ISO 5832-4: 1996 Implants for surgery -- Metallic materials -- Part 4: Cobalt-chromium-molybdenum casting alloy