

We have four metals used in most Smith & Nephew implant components. The materials are: Cobalt-Chromium Alloy (Co-Cr-Mo; ASTM F-1537), Titanium Alloy (Ti-6Al-4V; ASTM F-1472), 316L Stainless Steel (ASTM F-138), and Zirconium Alloy (Zr-2.5Nb; ASTM F-2384). Chemistry limits (in weight percent) for the metals meet these specifications as follows:

**Cobalt-Chrome Alloy (Co-Cr-Mo)**

|            |             |
|------------|-------------|
| Carbon     | 0.14 max    |
| Chromium   | 26.0 – 30.0 |
| Molybdenum | 5.0 – 7.0   |
| Nickel     | 1.0 max     |
| Iron       | 0.75 max    |
| Silicon    | 1.0 max     |
| Manganese  | 1.0 max     |
| Nitrogen   | 0.25 max    |
| Cobalt     | Balance     |

**Titanium (Ti-Alloy)**

|          |            |
|----------|------------|
| Nitrogen | 0.05 max   |
| Carbon   | 0.08 max   |
| Hydrogen | 0.015 max  |
| Iron     | 0.30 max   |
| Oxygen   | 0.20 max   |
| Aluminum | 5.5 – 6.75 |
| Vanadium | 3.5 – 4.5  |
| Yttrium  | 0.005 max  |
| Titanium | Balance    |

**316L Stainless Steel**

|            |               |
|------------|---------------|
| Carbon     | 0.030 max     |
| Manganese  | 2.00 max      |
| Phosphorus | 0.025 max     |
| Sulfur     | 0.010 max     |
| Silicon    | 0.75 max      |
| Chromium   | 17.00 – 19.00 |
| Nickel     | 13.00 – 15.00 |
| Molybdenum | 2.25 – 3.00   |
| Nitrogen   | 0.10 max      |
| Copper     | 0.50 max      |
| Iron       | Balance       |

**Zirconium Alloy (Zr-Alloy)**

|           |             |
|-----------|-------------|
| Niobium   | 2.40 – 2.80 |
| Oxygen    | 0.09 – 0.13 |
| Carbon    | 0.027 max   |
| Chromium  | 0.020 max   |
| Hafnium   | 0.010 max   |
| Hydrogen  | 0.0025 max  |
| Iron      | 0.15 max    |
| Nitrogen  | 0.0080 max  |
| Tin       | 0.0050 max  |
| Zirconium | Balance     |

The content of elements specified with a maximum limit are typically about half of that limit in our material. Some elements are controlled more tightly by Smith & Nephew specification than are listed above for the industry standards. For example, our Zirconium Alloy has a maximum limit for Nickel content of 0.0035% (it is difficult to measure Nickel content if it is lower than this). Elements not listed for an alloy are not absent, just not specified. Some level of "tramp element" content is present in any alloy. For Titanium Alloy, the limit in the aerospace industry for each of these "unspecified" elements, including nickel, is 0.10%. The aerospace industry requires so much more Titanium Alloy than the medical industry that the metal suppliers also make the medical alloy to this limit (to minimize inventory). These levels are so low that Titanium Alloy is typically considered "hypo-allergenic" (unless the patient has a Titanium allergy). The same is true of Zirconium Alloy.

We regret that we are unable to provide samples of these metals at this time. If you have any further questions, please call the Materials Quality Laboratory at (800) 821-5700, Ext. 5875 or 5400.