# Boost Engineering Productivity With This Ultimate List of Tools

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## **Intro and Background**



















## **Augmentation Project - Retractable Claws**



## **Client Profile**





Vision

Budget



## **Design Parameters: Mr. Marten's Claws**

-Rapid deployment

- 0.2 s extension (dramatic reveal)
- 2.0 s retraction (also dramatic)
- Implant performance
  - Single hand only (budgetary reasons)
  - Reduced functionality of left hand permissible.
- Packaging
  - Must be invisible until deployed



## **Materials Specs and Availability**

- Tools for proving to a client that adamantium isn't real

### **MatWeb**

or Thick	ness; Per ASTM	F136)	-4V ELI, ASTIM GIAUE Z	5) (Annealeu, 2.50 - 4.00 II Rou				
Categories: Metal: Nonferrous Metal: Titanium Alloy: Alpha/Beta Titanium Alloy.								
Material Notes:	Medium To High Strength General-Purpose Alloy, Minimum tensile property data below are specific to this MatWeb entry; other specific form/thickness entries are also available in MatWeb. Features: A lower strength version of TIMETAL 64 with improved toughness, cryogenic ductility, and SCC resistance. Major uses are in the medical implant field, marine structural components, and oil and gas production. This variant is available for fracture critical applications. This alloy is available in most common product forms including billet, bar, wire, plate, and sheet. Data provided by TIMET.							
Vendors:	No vendors are listed for this material. Please click here if you are a supplier and would like information on how to add your listing to this material							
Physical Pro	perties	Metric	English	Comments				
Density		4.42 g/cc	0.160 lb/in*	Typical				
Mechanical F	Properties	Metric	English	Comments				
Tensile Strength, Ultimate		>= 825 MPa	>= 120000 psi	L, LT and ST Directions				
Tensile Strength, Yield		>= 760 MPa @Strain 0.2 %	>= 110000 psi @Strain 0.2 %	L, LT and ST Directions				
Elongation at Break		>= 8.0 %	>= 8.0 %	L, LT and ST Directions				
Reduction of Area		>= 15 %	>= 15 %	0.2% YS; L, LT and ST Directions				
Modulus of Elasticity 🏨		95.0 - 111 GPa @Temperature 230 °C	13800 - 16100 ksi @Temperature 446 °F	varies with heat treatment and texture				
		107 - 122 GPa @Temperature 20.0 °C	15500 - 17700 ksi @Temperature 68.0 °F	varies with heat treatment and texture				
Poissons Rati	io	0.31	0.31					
Shear Modulu	IS	41.0 - 45.0 GPa	5950 - 6530 ksi					
Bend Radius, Minimum		5.0 t	5.0 t	Typical; sheet				

### **Online Metals**

OnlineMetals.c	Search Online Metals Q				
		Material 🗸 Shape	~ Alumi	num 🗸 Stainless 🤟 All Steel 🖓	$\sim$ Red Metals $\sim$
Shop all Products		Define events		0.125" Titanium Sheet 6AL 4V C	Grade 5 - Part #: mp-00003661
Metals	~	Refine search			QTY
Plastics	~	MATERIAL	-		1
Rubber	~	Titanium			\$956.66 ea \$956.66 for
Expanded Sheet	~	SHAPE			-
Wire Mesh	~	Sheet/Plate		Compare	Add Io Cart
Framing Systems	~			Dimensions	Add to Project List
Precision Products	~	ALLOY/TYPE	-	Thickness: 0.125"	Sold and shipped by Slice of Stainless
Fittings	~	GAL-4V Grade 5		See all available dimensions for this p	roduct
Prototyping Materials	~	UNIT OF MEASURE	+	Select a Cut Size for Price	~



## **Engineering Fundamentals**

- Tools for leveraging best practices and getting back to basics

### **Theoretical Machinist**



### efunda

### 

#### 👥 Materials

Elements, Steels, Aluminum Alloys Copper Alloys, Polymers, Piezo Steam Tables, Corrosion ...more

#### Design Center

 Plastic Design, GD&T, Springs, Gages
 Bearings, Gears, O-Rings, Sensors

 Screws, I-Beams, Fiber Optics
 ...more

#### 😮 Processes

Machining, Casting, Stamping, Forging Plastic Molding, Surface Treatment Annealing, Rapid Prototyping ...more

#### 🖈 Unit Conversion

Length, Area, Volume, Mass, Pressure Force, Power, Time, Base-N, Fractions Thermal, Hardness, Currencies ...more

#### 🥖 Formulas

Mechanics of Materials, Beam, Plate Vibration, Composite, Heat Transfer Fracture, Failure, Fluid, Finance ....more

#### Mathematics

Areas, Solids, Trigonometry, Calculus Taylor Series, Least Squares, O.D.E. Fourier, Laplace, Probability ....more

### **O**<sup>°</sup>MTEC<sup>°</sup>

## **Off-the-shelf Component Information**

- Tools for specifying the right widget and getting it into CAD





## **Design and Analysis**

- Tools for showing a client why a retractable claw implant might be a bad idea

### CAD

(CATIA, Solidworks, Siemens NX, AutoCAD, Alibre, OnShape, Inventor, Creo, Rhino, Fusion360, etc.)

### Simulation

FEA: CAD native software, ANSYS, Femap,

Particle Based Simulation: Alfonso







## **Workflow Management and Documentation**

- Tools to facilitate full-rate production, just in case this works out

### PDM

(Teamcenter, ENOVIA, Smarteam, Windchill, SAP PLM, 3DExperience Works)

### **Documentation and Project Management**

Sygma, Quarter20, Git, Jira, Project, Trello







## **Small Groups**

We've got the retractable claw concept for the device. Now...

How do you implant it?

- Sketch a strategy
- Generate the list of tools you'd use
- Changes to the implant are ok if needed

You've got 10 minutes!



# **Thank You**

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get updates on the final design!



