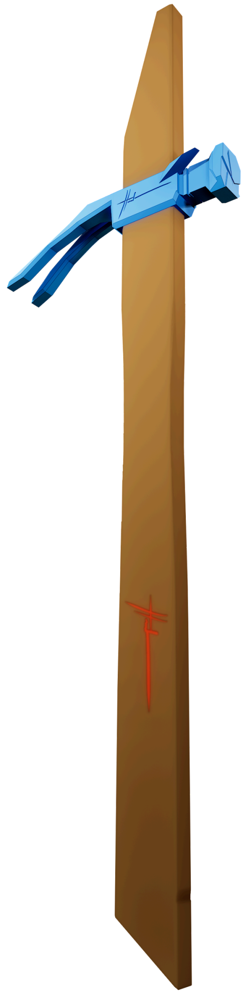

Hercules Alloy

20oz

Limited Laboratory Procedures

By AuroraScript GPT

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Formal Procedure by Justin Venable (To Be Dated)

DART Meadow

Hercules Alloy Creation Procedure

Hercules Alloy Composition:

- Titanium: 30%
- Tungsten: 4%
- Aluminum: 60%
- Zinc: 0.85%
- Cobalt: 0.15%
- Copper: 5%

Procedure Outline:

1. Preparation of Materials:
 - Ensure Purity: Source high-purity metals to minimize unwanted impurities.
 - Weight Measurement: Measure the metals according to their weight percentages.

2. Surface Preparation:
 - Clean the metal surfaces by mechanical grinding or chemical etching to remove contaminants.

3. Melting Process (If Limited Equipment Available):
 - Use a crucible furnace to melt metals.
 - Start with Tungsten and add Titanium, followed by Aluminum, Zinc, Cobalt, and Copper.
 - Maintain an inert argon atmosphere to prevent oxidation.
 - Stir the mixture continuously for homogeneity.

4. Cooling and Solidification:
 - Cool the alloy slowly or quench in water if necessary.

Here’s a procedure outline based on the metals and your request to create a Hercules hammerhead alloy with limited lab equipment:

Hercules Alloy Composition:

Titanium: 30%

Tungsten: 4%

Aluminum: 60%

Zinc: 0.85%

Cobalt: 0.15%

Copper: 5%

Procedure Outline:

1. Preparation of Materials:

Ensure Purity: Source high-purity metals or closely related alloys. The aim is to minimize the presence of unwanted impurities that may affect the final alloy properties.

Weight Measurement: Measure the exact amounts of each metal using a precision balance, according to the percentage weight. Example: For a 1 kg batch, you would weigh 300g of titanium, 40g of tungsten, 600g of aluminum, 8.5g of zinc, 1.5g of cobalt, and 50g of copper.

2. Surface Preparation:

Clean the Metal Surfaces: Remove any oxide layers or contaminants from the surface of each metal using mechanical cleaning (grinding, sanding) or chemical etching (with acids appropriate for each metal). This ensures better alloying during the melting process.

3. Melting Process (If Limited Equipment Available):

Utilize a Crucible Furnace: If access to high-end lab equipment is limited, use a crucible furnace that can reach temperatures above 1200°C, capable of melting titanium (melting point: 1668°C), tungsten (melting point: 3422°C), and aluminum (melting point: 660°C).

Start with Tungsten: Begin by melting tungsten, as it has the highest melting point. While tungsten is highly refractory, it will not dissolve easily into the melt but will remain as a particulate, contributing to the alloy's hardness.

Sequential Metal Addition:

Add Titanium: Once tungsten is molten or dispersed at high temperature, slowly add titanium.

Add Aluminum: Aluminum has a lower melting point and will melt quickly when added after titanium. Ensure proper mixing.

Add Zinc, Cobalt, and Copper: These metals should be added last to avoid evaporation, as they have lower boiling points (Zinc boils at 907°C).

4. Mixing and Stirring:

Use Argon Gas: To avoid oxidation, perform the alloying process under an inert argon atmosphere. This will prevent the formation of oxides on titanium and aluminum.

Stirring: Continuously stir the molten metal mixture to ensure uniform distribution of the tungsten particulates and homogeneity of the alloy. If no mechanical stirrer is available, use manual stirring with a heat-resistant ceramic rod.

5. Cooling and Solidification:

Controlled Cooling: Slowly cool the alloy in the furnace or mold it into the desired shape (e.g., hammerhead mold). This prevents the formation of cracks and ensures a refined grain structure.

Water Quenching: If rapid cooling is necessary, the alloy can be quenched in water to achieve a specific microstructure, though this will depend on desired mechanical properties (e.g., hardness vs toughness).

6. Post-Processing:

Heat Treatment: If necessary, perform heat treatment (annealing or tempering) at 400–500°C to relieve internal stresses and refine the microstructure of the alloy.

Machining: Once the alloy is solidified, use precision machining tools to give the hammerhead its final shape and polish.

7. Testing and Verification:

Hardness Testing: Perform hardness tests using a Rockwell or Vickers hardness tester to ensure the alloy meets the desired specifications.

X-ray Diffraction (XRD): Analyze the crystallographic structure of the alloy to ensure homogeneity and correct phase formation.

Tensile and Impact Testing: Conduct mechanical tests to verify the strength and toughness of the alloy.