Home Depot Robot Materials Database

This dataset covers standard construction materials available at retail hardware stores (Home Depot/Lowe's). Note that "Trade Size" does not equal physical dimensions for plumbing/electrical parts.

1. PVC Pipe (Plastic)

- **Standard:** ASTM D1785 (Schedule 40)
- **Use Case:** Light frames, prototyping.
- **Engineering Toolbox Source:** PVC Pipe Dimensions

Simulation Properties:

```
json
Copy code
{
  "material": "PVC (Polyvinyl Chloride)",
  "youngs_modulus_psi": 400000,
  "yield_strength_psi": 7000,
  "density_lbs_in3": 0.049
}
```

Common Dimensions (Schedule 40):

Trade Size	Outside Diameter (OD)	Inside Diameter (ID)	Wall Thickness
1/2"	0.840"	0.622"	0.109"
3/4"	1.050"	0.824"	0.113"
1"	1.315"	1.049"	0.133"
1-1/4"	1.660"	1.380"	0.140"

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2. Galvanized / Black Iron Pipe (Steel)

- **Standard:** ASTM A53 / ANSI Schedule 40
- **Use Case:** Heavy bases, high-load static legs.
- **Engineering Toolbox Source:** ANSI Schedule 40 Steel Pipe

Simulation Properties:

```
json
Copy code
{
  "material": "Carbon Steel",
  "youngs_modulus_psi": 29000000,
  "yield_strength_psi": 35000,
  "density_lbs_in3": 0.284
}
```

Common Dimensions (Schedule 40):

Trade Size	Outside Diameter (OD)	Inside Diameter (ID)	Wall Thickness
1/2"	0.840"	0.622"	0.109"
3/4"	1.050"	0.824"	0.113"
1"	1.315"	1.049"	0.133"

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3. EMT Conduit (Electrical Tubing)

- **Standard:** ANSI C80.3
- **Use Case:** Lightweight steel frames (The "Budget" Robot Frame).
- **Engineering Toolbox Source:** Electrical Conduit Sizes

Simulation Properties:

```
json
Copy code
{
  "material": "Low Carbon Steel (Galvanized)",
  "youngs_modulus_psi": 29000000,
  "yield_strength_psi": 30000,
  "density_lbs_in3": 0.284
}
```

Common Dimensions (Thinwall):

Trade Size	Outside Diameter (OD)	Inside Diameter (ID)	Wall Thickness
1/2"	0.706"	0.622"	0.042"
3/4"	0.922"	0.824"	0.049"
1"	1.163"	1.049"	0.057"

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4. Copper Pipe (Plumbing)

- **Standard:** ASTM B88 (Type M is standard retail).
- **Use Case:** Aesthetics, soldered joints.
- **Engineering Toolbox Source:** Copper Tube Dimensions

Simulation Properties:

```
json
Copy code
{
  "material": "Copper",
  "youngs_modulus_psi": 17000000,
  "yield_strength_psi": 30000,
  "density_lbs_in3": 0.323
}
```

Common Dimensions (Type M - Thin Wall):

Trade Size	Outside Diameter (OD)	Inside Diameter (ID)	Wall Thickness
1/2"	0.625"	0.569"	0.028"
3/4"	0.875"	0.811"	0.032"
1"	1.125"	1.055"	0.035"

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5. Structural Tubing (Hardware Aisle)

Unlike "Pipe," these items are measured by exact outside diameter. They are found in the metal rack, not the plumbing aisle.

Aluminum Tube (Round)

- **Source:** Aluminum Tube Properties
- **Properties:** E = 10,000,000 PSI | Yield = 35,000 PSI (for 6061-T6)

Steel Tube (Round & Square)

- **Source:** Steel Tube Properties
- **Properties:** E = 29,000,000 PSI | Yield = 40,000+ PSI

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6. Master Simulation Table (Young's Modulus)

Use this lookup table for your physics engine to calculate deflection/bending.

Material Key	Young's Modulus (PSI)	Stiffness Rating
`pvc_plastic`	400,000	Low (Floppy)
`wood_pine`	1,500,000	Low-Mid (Varies)
`aluminum_6061`	10,000,000	Medium
`copper_drawn`	17,000,000	High
`steel_structure`	29,000,000	Very High