

FOLDABLE

Music Stand

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ENGR 375

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Purpose, Audience, & Varieties

Background



Purpose and Audience

- Holds sheet music, books, tablets
- Main attraction is portability and compactness
- Musicians
 - Singers, strings, brass, percussion, beginners, advanced
 - Versatile

Music Stand Varieties

- History
 - Ancient China, Europe
- Patents
 - American patents from mid 1800s
 - No overlap with our design improvements
- Materials
 - Metal: steel, aluminum
- Build
 - Solid back or skeleton
 - Foldable
 - Portable



Product Information & Challenges

Product Analysis



Nomad™ Stand

- Original price tag: ~\$15
- Materials: Powder Coated Steel, ABS Plastic, Rubber
- Three subassemblies:
 - Main Frame
 - Shafts
 - Tripod



A close-up photograph of a dark grey or black metal bracket. The bracket has a complex, interlocking design with several flat plates and a central vertical post. A hexagonal nut is attached to one of the horizontal arms, and a screw is partially visible through a hole in the bracket. The background is plain white.

Challenges

- Many precisely interlocking parts that must move in specific ways
- Powder coating led to inconsistent dimensions from part to part
- Creating a solution that did not undermine the strengths of the product

Weight Analysis

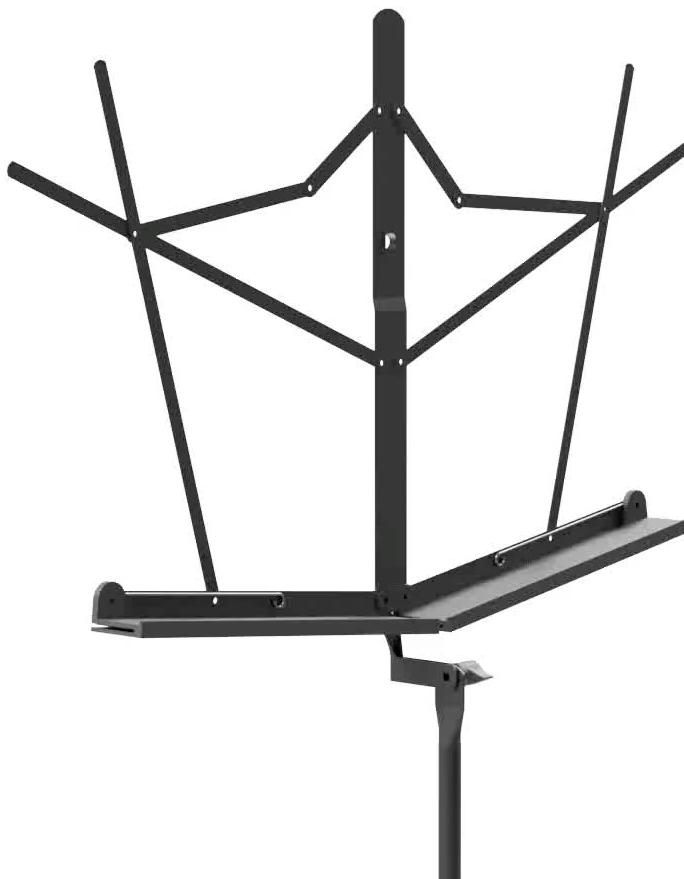
	Full	Frame	Shaft	Tripod	Extension
Actual (g)	924.6	367.2	266.2	225.2	66
Estimated (g)	777	256	247	180	94
Difference (g)	147.61	111.2	19.21	45.2	28
% Error	16.0%	30.3%	7.2%	20.1%	42.4%

Full assembly weight is off by 16%

- Steel is powder coated
- Some plastic pieces have metal inserts
- Extensions are micro carbon fiber filled nylon versus just generic thermoplastic resin

Allowed us to estimate plastic as ABS versus PC/ABS or HDPE

Folding



Folding



Folding





Disassembling

Details of each section

Sub-Assembly



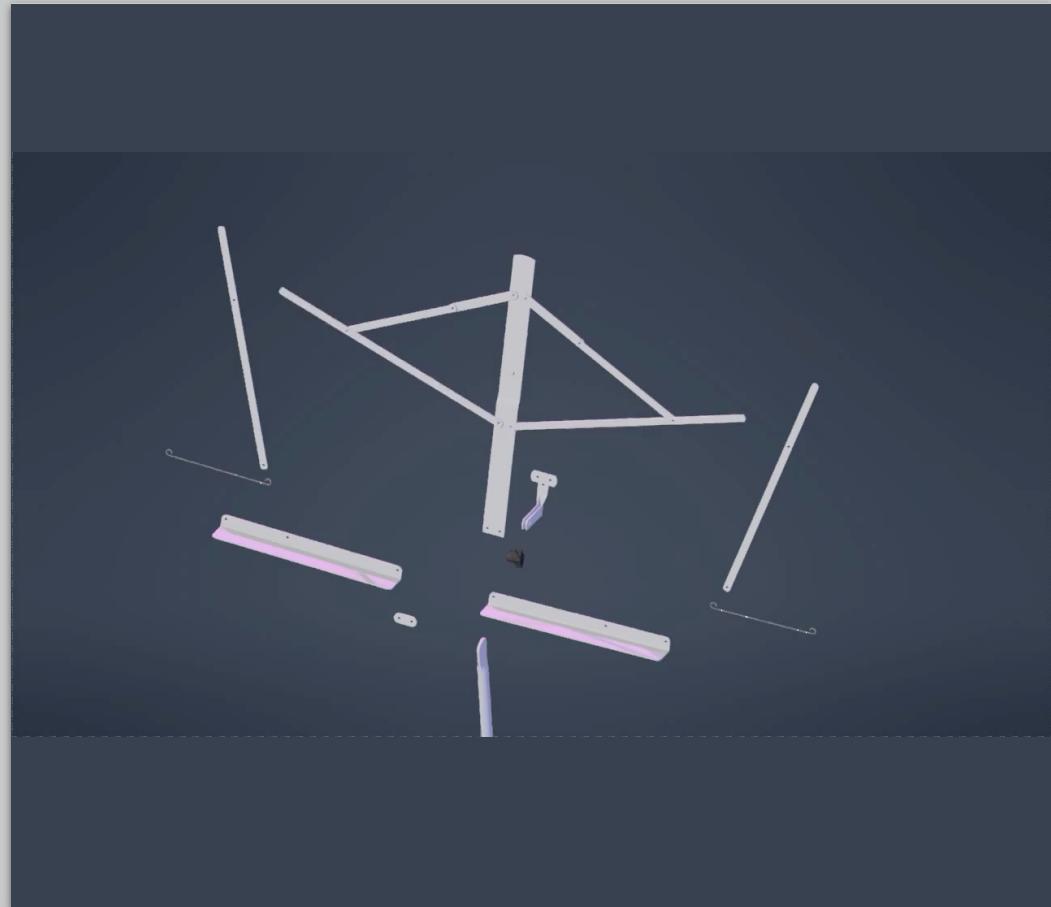
Frame

- Foldable for compact
 - Holding music books, sheets, etc.
 - Adjustable angle
-
- Actual weight: 367.2 g
 - Estimated: 256 g



Frame Components

- Long Linkages x4
- Med. Linkages x2
- Small Linkages x2
- Spine
- Base x2
- Bracket
- Joint
- Clasps x2
- Knob



Frame Component Purposes



- Linkages
 - Give support for sheets
- Spine
 - Main support for back
- Bracket
 - Connects base to joint
- Joint
 - Connects frame to shaft
- Sheet clasps
 - Clip in sheets to frame
- Knob
 - Allows for angled adjustment

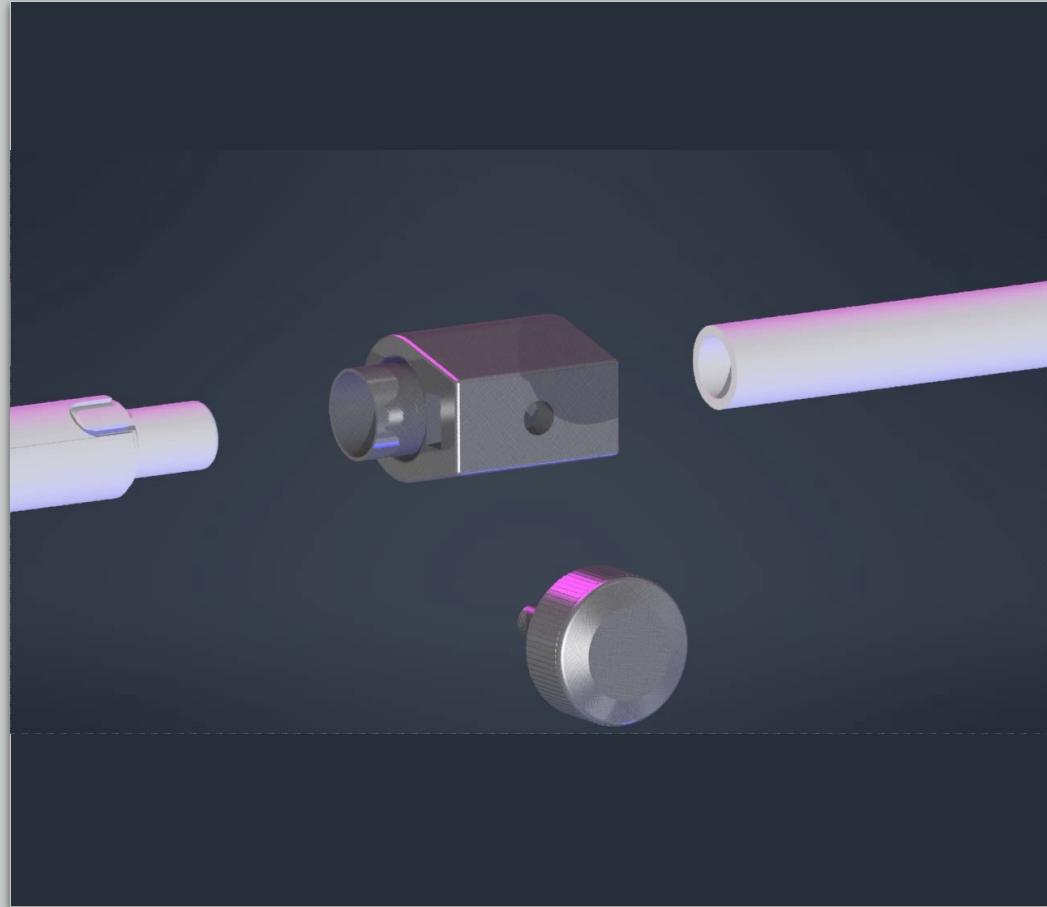


Shaft

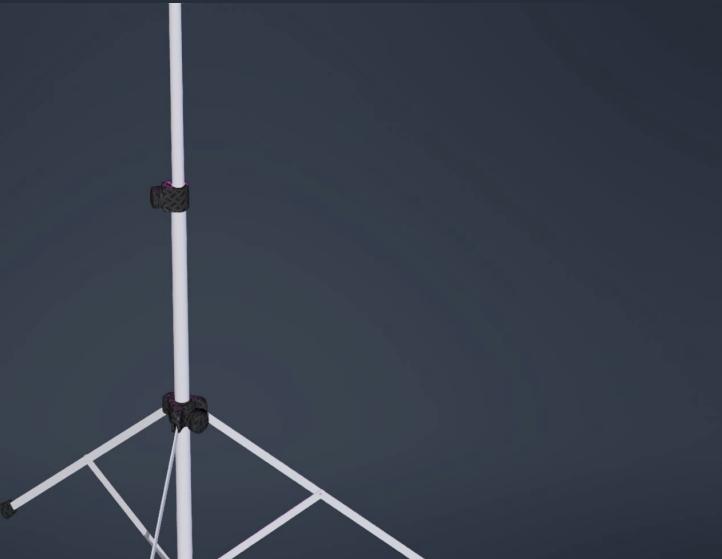
- Connection between tripod & frame
 - Adjusts height
-
- Actual Weight: 266.21 g
 - Estimated Weight: 237 g

Shaft Components

- Upper shaft
- Lower Shaft
- Knob
- Shaft connector
- Shaft insert



Shaft Component Purposes



- Shafts
 - Main supports
- Knob
 - Allows for height adjustment
 - Connected to shaft connector
- Shaft connector
 - Connects shafts together
- Shaft insert
 - Small part inside lower shaft that inserts into shaft connector



Tripod

- Adjusts height of stand
- Provides support for the stand

Actual weight: 266.21 g

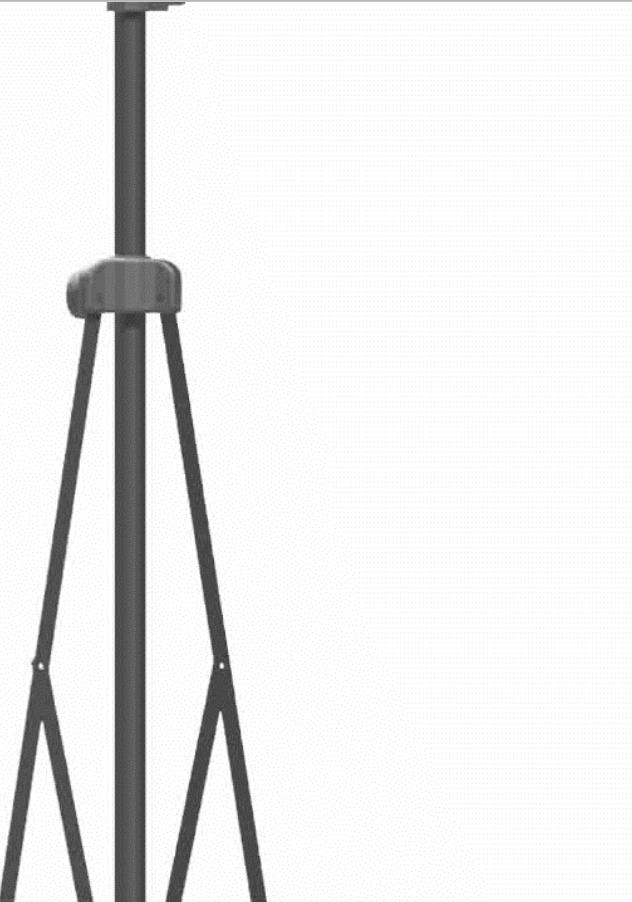
Estimated weight: 247 g

Tripod Components

- Adjustable knob
- Linkage knob
- 3 smaller linkages
- 3 rubber feet
- 3 long linkages
- Tripod runner



Tripod Component Purposes



- Linkage knob holds small linkages in place
- Tripod Runner moves long linkages up and down, expanding the base
- Knob secures Runner
- Feet provide friction

Strengths

- Transportable
 - Compact
 - Subassemblies fold up and nest
- Sturdy
 - Made of sheet metal; riveted
- Lightweight
- Inexpensive
 - \$15-20
- Adjustable
 - Height and base width can vary according to need

Weaknesses

- **Primary purpose is to hold music, but does not work well**
- 1. Flat base on our initial stand, slightly different brand only has a small bump
 - Music slides off the front
- 2. Not wide enough to hold more than 2 sheets of music
 - Requires page flipping, which then falls off of the front due to problem 1

Resolving problems and issues

Our Solution



Solution Requirements

Address two main weaknesses:

1. Music can slide off the stand
2. Base is not wide enough to hold >2 pages

Maintain strengths

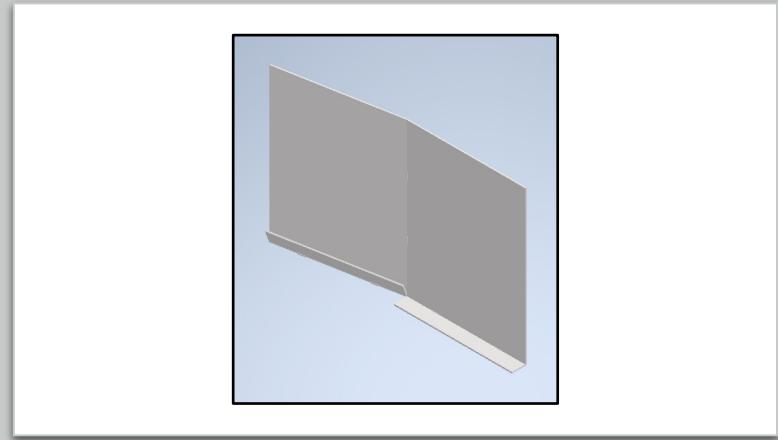
- Low cost
- Compact
- Sturdy
- Lightweight

Ease of Reproduction

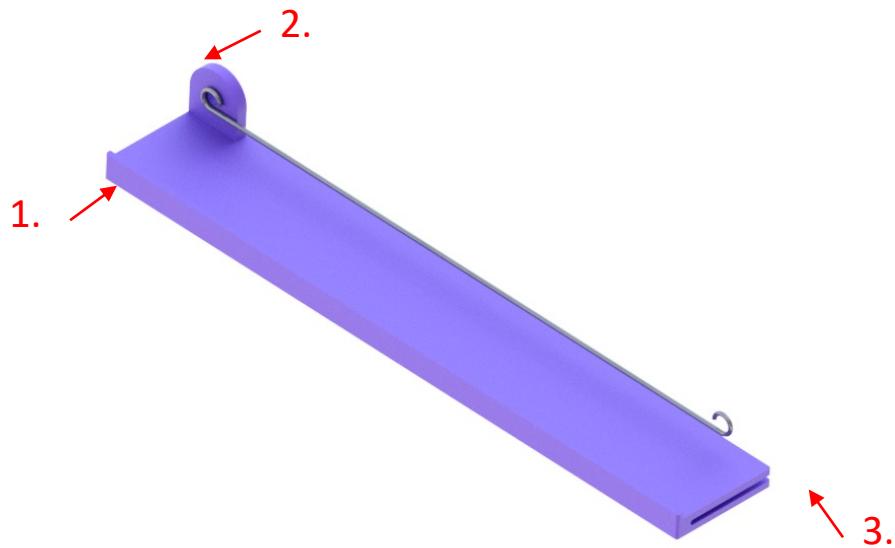
- No use of excess support material
- Limit complexity to ensure it meets four requirements

Solution Options

- Solid back that could double as a music folder
 - Costly
 - Difficult to apply to any music stand
- Shaft attachment to hold water bottle, etc.
 - Difficult to counterbalance
 - Variations already exist
- **Extension with front lip to hold more music**

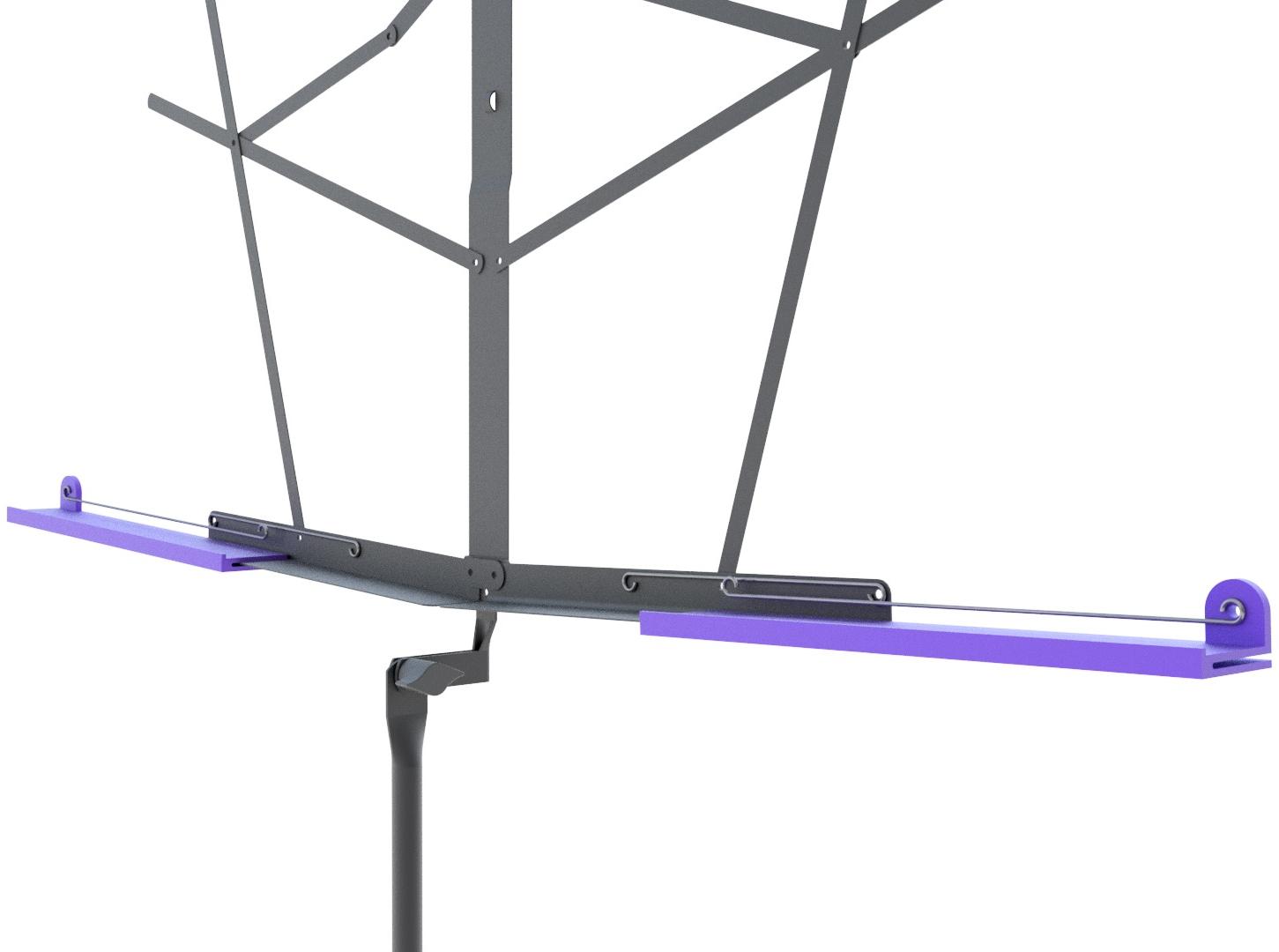


Base Extension With Lip



- Lip to prevent pages from sliding
- Tab to hold wire back support
- Gap sized for interference fit





Portability & Manufacturing

- Thin and lightweight
 - Only 66 g
 - <8% of the stand's weight
- Minimal complexity allows for easier manufacturability
- Maintain foldability



Future Design & Manufacturing

- Universal design
 - Adjustable thickness of addition
 - Snap fits
 - Sliding top piece with different height options
- Maintain product simplicity
 - Keep 3D model design
- Affordability
 - Cost of production
 - Plastic; injection molding
 - Aluminum



Conclusion

- Addresses main weaknesses
 - Prevents music from slipping off
 - Holds 4 pages of music versus 2
- Maintains existing strengths
 - Lightweight
 - Durable
 - Inexpensive
 - Versatile
 - Portable



Questions?