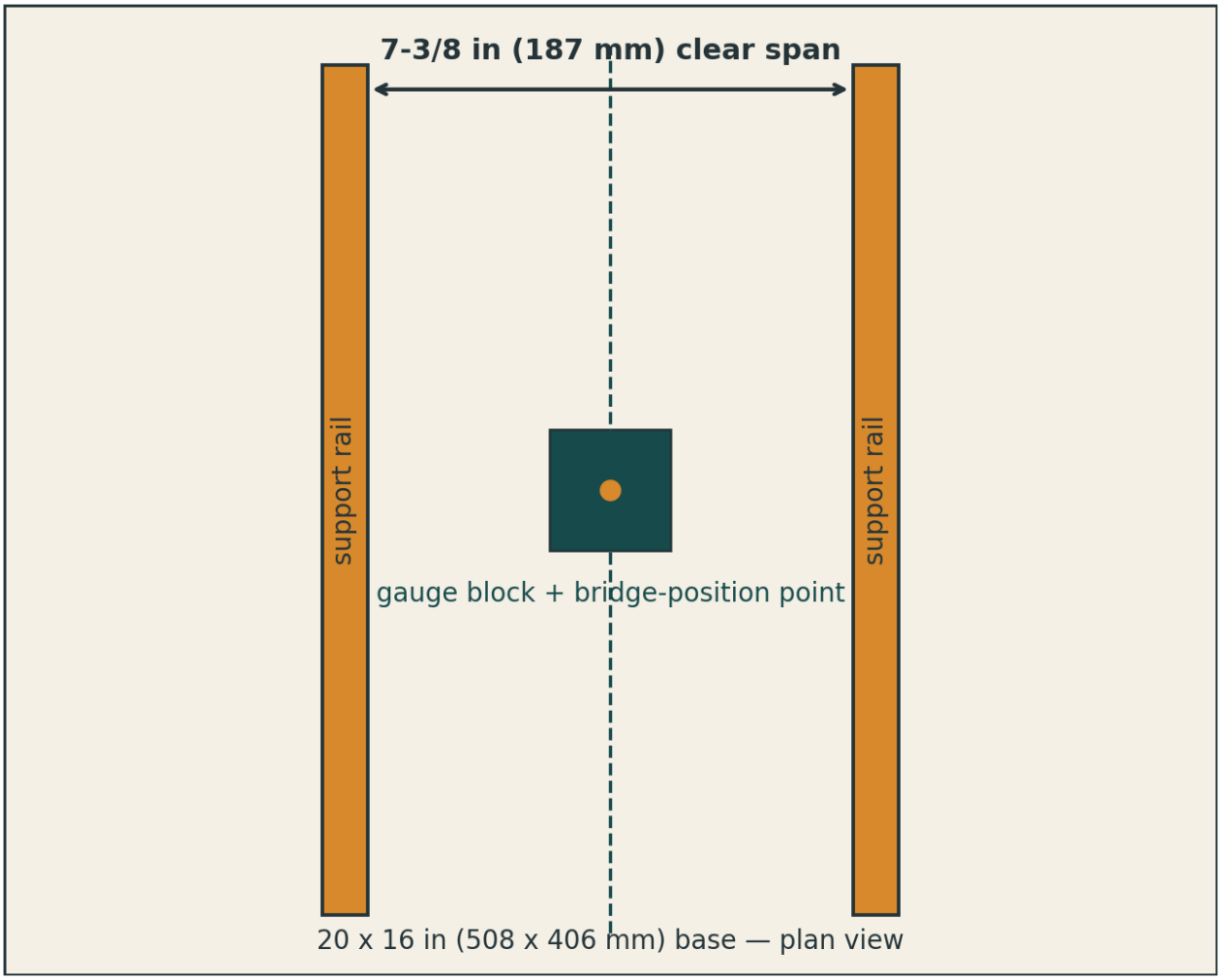
BUILD • MEASURE • COMPARE

Tenor Uke Test Rig

A shop-practical guide for repeatable loaded-deflection and tap-tone measurements

Built for the pineapple tenor ukulele class

One fixed rig, one fixed method, and one shared vocabulary for comparing top and back plates from unbraced stock through the finished instrument.



Plan view — the rails never move during the course.

Core principle Same rig, same load, same span, same method every time. The numbers are only meaningful as comparisons.

Instructor build guide • Version 1.0

1. What this rig does

This rig supports two measurements at the same build stages for every student: loaded deflection of the top and back plates, and tap-tone frequencies of free plates and the assembled instrument. Used consistently, those readings let the class compare plates and connect what stiffness feels like with what a plate sounds like.

> **Measurement philosophy** Same rig, same load, same span, same method every time — the numbers are only meaningful as comparisons.

2. Class measurement standards

STANDARD LOAD

1 kg (2.2 lb)

A labeled sandbag, weighed on a kitchen scale.

SUPPORT SPAN

7-3/8 in (187 mm)

Clear distance between rail inner edges; centered on the bridge position.

MEASUREMENT POINT

Marked bridge position

The load, gauge probe, and bridge mark share one vertical line.

READING RULE

Zero + 3 readings

Zero before every reading; record the median of three.

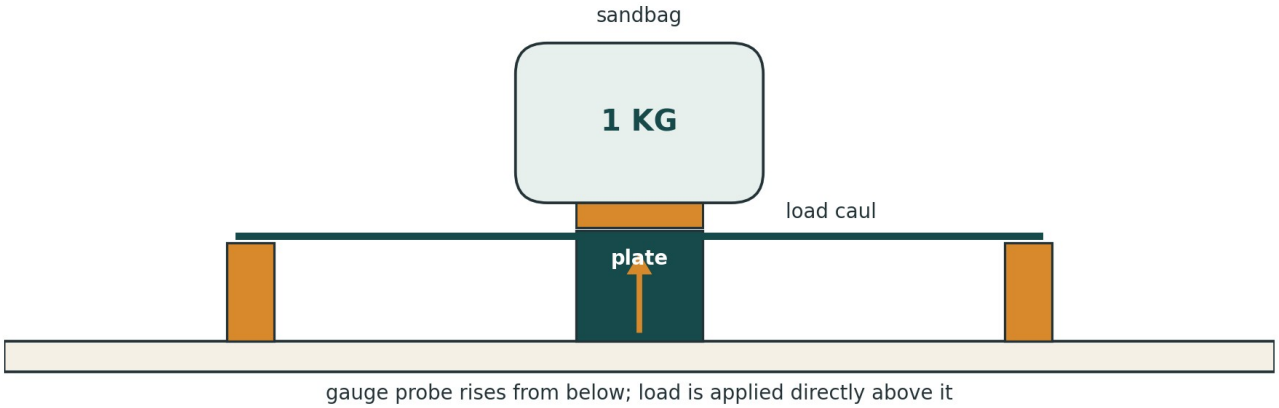
The 7-3/8 in (187 mm) class span follows the corrected span dimension published with classical builder Garrett Lee's deflection-rig demonstration. These are method standards for comparability—not quality targets.

3. Materials table

Part	Size	Qty	Notes
Base	3/4 in (19 mm) 20 × 16 in (508 × 406 mm)	1	Plywood or MDF; flat and stable.
Support rails	3/4 × 3/4 × 14 in (19 × 19 × 356 mm)	2	Hardwood; pad tops with adhesive cork or felt.
Gauge block	2 × 2 × 1-1/2 in (51 × 51 × 38 mm)	1	Hardwood; drill a snug vertical barrel hole. Test on scrap first.
Depth gauge	0.01 mm resolution mm/in readout	1	Digital tread-depth gauge. A 0–1 in dial indicator with 0.001 in graduations also works.
Load caul	2 × 2 × 3/4 in (51 × 51 × 19 mm)	1	Hardwood; ease edges and keep the faces flat.
Sandbag	About 4 × 4 in (102 × 102 mm)	1	Canvas/duck cloth; exactly 1 kg (2.2 lb) dry sand; sew or zip-tie shut; label "1 KG."
Fasteners	Wood screws	As needed	Length to suit the base without breaking through.
Consumables	—	As needed	Pencil, masking tape, adhesive cork/felt, small foam strip for damping strings.

> **Cost guide** Expect the cost of a sandbag, scrap sheet stock, and one roughly $25 gauge. No custom electronics are required.

4. Assembly steps



Cross section — load, caul, plate, and gauge probe line up at the bridge mark.

1. Cut the base to 20 × 16 in (508 × 406 mm). Draw a centerline across the middle of the 16 in (406 mm) dimension.
2. Screw the two support rails to the base. Set their inner edges exactly 7-3/8 in (187 mm) apart and symmetric about the centerline. Apply adhesive cork or felt to each rail top; trim it flush.
3. Screw the 2 × 2 × 1-1/2 in (51 × 51 × 38 mm) gauge block to the base, centered between the rails and on the centerline. On scrap, test-drill a vertical hole until the gauge probe barrel fits snugly. Drill the block so the gauge flange rests on top and its probe reaches just above rail-top height.
4. Drop the gauge into the block. With nothing touching the probe, press ZERO.
5. Make the sandbag. Fill it with dry sand until the total bag weight is exactly 1 kg (2.2 lb). Sew or zip-tie it shut and label it “1 KG.”
6. Verify the rig. Lay a scrap board across the rails; raise the gauge tip to touch it and zero the gauge. Center the load caul and sandbag above the tip. Confirm that the reading is stable and repeatable. Remove the load and confirm that the gauge returns to zero.

> **Build check** The rail inner edges, gauge probe, bridge mark, load caul, and sandbag center must remain aligned. A careful layout matters more than furniture-grade joinery.

5. Deflection measurement method

1. From the instrument plan, mark the bridge position lightly in pencil on the plate. Add a tiny center point at the planned saddle centerline.
2. Lay the plate outside-face down across the padded rails. Align the bridge mark with the base centerline.
3. Check that the gauge probe touches the plate underside directly beneath the bridge mark. With no caul or bag on the plate, press ZERO.
4. Place the load caul on the plate, centered over the bridge mark. Keep its faces flat and its edges clear of braces.
5. Gently place the 1 kg (2.2 lb) sandbag on the caul. Do not drop it.
6. Wait about 10 seconds for the reading to settle. Record the deflection in inches and millimeters.

7. Remove the bag and caul. Confirm that the gauge returns to zero. If it does not, re-seat the plate, re-zero, and repeat the reading.
8. Take three complete readings, unloading and checking zero each time. Sort the readings and record the median—the middle value.
9. Measure an unbraced plate before bracing. Measure the braced plate only after the brace glue is fully cured. Use the identical setup for top and back plates.

Record with the plate Write the 1 kg (2.2 lb) load, 7-3/8 in (187 mm) support span, bridge-position measurement point, and median deflection on the instrument's Build Specification Record.

6. Tap-tone measurement method

Use a phone microphone and a free spectrum app. TapTune for Luthiers offers basic tap recording and a live spectrum in its free tier; any spectrum analyzer that displays a frequency peak in hertz is acceptable. Use the same phone and app for the whole class when possible.

Free plates — unbraced and braced

1. Work in a quiet room. Put the phone on a folded soft cloth with its microphone facing the plate, 6 in (152 mm) away. Mark the phone and standing positions with masking tape so they can be repeated.
2. Mark a light holding point 22% of the plate length from the neck-block end, near one long edge. This free-free hold follows the GuitarTap plate method.
3. Hold the plate lightly between thumb and forefinger at that mark. Keep fingers away from the center and bridge area; do not squeeze.
4. Tap the marked bridge position with a knuckle or clean pencil eraser. Use a small, relaxed motion and about the same force each time.
5. Capture five separate taps. Ignore handling bumps and room noises. Find the strongest peak that repeats in at least three of the five taps.
6. Record that peak as both musical note and frequency in hertz. Repeat after bracing, using the same hold point, tap point, phone, app, distance, and room.

Assembled instrument — air, top, and back

1. Slip a small foam strip under all strings at the soundhole so the strings cannot ring.
2. Put the phone microphone 6 in (152 mm) from the soundhole at the same height. Mark the phone position for future tests.
3. For the top resonance, tap the bridge. For the back resonance, tap the center of the back. For the air resonance, tap the top beside the soundhole.
4. Make five taps at each position. For each set, keep the strongest peak that repeats in at least three of the five taps.
5. Record each result as note and hertz. Also record the app name, 6 in (152 mm) microphone distance, room conditions, and test date.

Tenor-uke context only The only published tenor-ukulele air-resonance numbers found in the class research were Kawika Hurd's measured 211 Hz and 214 Hz. They are context—not a target, pass/fail boundary, or design prescription.

Method note Trevor Gore's published data-collection guidance is for guitars. The systematic tapping and repeatability practices are useful here, but the guitar frequency and mobility values are not uke targets.

7. Calibration step

Before students measure anything, the instructor should measure one finished tenor ukulele with this exact setup. Record its assembled air, top, and back resonances. If reference top or back plates are available, also measure their loaded deflection and free-plate tap tones. These readings seed the class ballparks; no borrowed guitar targets are needed.

Measurement	Instructor's reference value	Date
Finished tenor — air resonance		
Finished tenor — top resonance		
Finished tenor — back resonance		
Reference top — unbraced deflection		
Reference top — braced deflection		
Reference top — unbraced tap tone		
Reference top — braced tap tone		
Reference back — unbraced deflection		
Reference back — braced deflection		
Reference back — unbraced tap tone		
Reference back — braced tap tone		

How to use the ballparks Student numbers should land in the same neighborhood. A large difference is worth a conversation about that plate—not a failure.

8. Care and shop notes

- **Protect the gauge.** Store it in its case between sessions.
- **Confirm the load.** Re-check the 1 kg (2.2 lb) sandbag on the kitchen scale at the start of each course.
- **Lock the geometry.** Keep the rail span fixed. Never move the rails mid-course.
- **Keep contact clean.** Wipe the gauge probe tip before each measurement session.
- **Watch the pads.** Replace cork or felt when it compresses, hardens, or lifts.
- **Control the room.** Run tap-tone tests in the same quiet room when practical; record any changed condition.
- **Preserve the marks.** Keep the phone, hold, tap, bridge, and gauge positions visible until all stages are measured.

9. Sources

- Kawika Hurd, "Measuring Deflections – Tops and Plates." Static wooden frame, dial-indicator, and loaded-compliance methods for ukuleles.
- Trevor Gore, "Technical Note on Data Collection." Systematic tapping and repeatability method. Guitar reference, method only—not a uke target.
- Garrett Lee, "Lutherie Demystified Ep.13." Deflection-rig construction and the corrected 187 mm span dimension used for this class standard.
- TapTune for Luthiers, Mihr Guitars. Phone-based tap recording and live spectrum analysis.
- GuitarTap Quick-Start Guide. Free-free plate hold at 22% of length and repeatable tap positions.