Low-Mounted Tail-Biased Wind Vane

Use a rigid rotating arrow and a fixed cardinal reference to observe the direction FROM which local air approaches a low, attended outdoor position.

Capacity and working quantity. One freely turning 12 in (304.8 mm) vane on an 18 x 18 in (457.2 x 457.2 mm) base. Nominal highest fin edge is 16 13/32 in (416.72 mm) above the support. No wind-speed, gust, response threshold or angular-accuracy rating.

Scope and limits

Low ground or low bench use in ordinary attended fair weather only. Clamp the whole base to a sound stationary support; no roof, ladder, tall mast, occupied path or unattended storm deployment is designed. There is no rated safe wind speed. Remove before forecast gusts, thunderstorms, icing or any base movement.

A large rear pressure area is deliberately separated from the smaller front pointer. Static mass balance only reduces bearing loading; it does not create the weathercock action. Actual stiction, turbulence and aerodynamic response require observation with the received assembly.

The nose indicates wind FROM; the large tail is downwind. A calm, oscillating, obstructed or sticky vane gives no dependable direction. This is not a warning, aviation, fire-weather, ventilation or official weather-station instrument.

No physical assembly, wind-tunnel, field durability or fastener-retention test has been performed. Stop if the nail lifts, sleeve bond moves, washers bind, fins crack or the base shifts.

Dimensions, stock and cutting

US customary actual inches; 12 in = 1 ft. Nominal stock labels are procurement descriptions. Reference millimeters = controlling inches x 25.4; do not recut from rounded conversions.

Wood lengths +/- 1/32 in; actual wood thicknesses +/- .010 in. Match the sleeve hole to the received tube and adhesive instructions. Pin/tube/washer limits below control the moving fit; no forced fit or numerical wind-load capacity.

Material key. PLY = exterior-bond plywood at listed actual thickness, without unknown treated salvage. WOOD = sound untreated straight softwood, finished to actual sizes. Other materials are named in their own rows.

P01 / Base, quantity 1. 18 x 18 x 3/4 in (457.20 x 457.20 x 19.05 mm). PLY. Axis at X 9, Y 9. Corner clamp bodies stay below Z 2 and outside a 14 in diameter circle centered on the axis.

P02 / Upright, quantity 1. 12 x 1 1/2 x 1 1/2 in (304.80 x 38.10 x 38.10 mm). Sound straight actual 2 x 2 wood. Vertical at X/Y 8 1/4 to 9 3/4; bottom Z 3/4, top 12 3/4. Centered top pilot for the received smooth nail.

P03 / Long foot blocks, quantity 2. 3 x 1 1/2 x 3/4 in (76.20 x 38.10 x 19.05 mm). WOOD. Stand on 3/4 in thickness along X: X 7 1/2 to 8 1/4 or 9 3/4 to 10 1/2; Y 7 1/2 to 10 1/2, Z 3/4 to 2 1/4.

P04 / Short foot blocks, quantity 2. 1 1/2 x 1 1/2 x 3/4 in (38.10 x 38.10 x 19.05 mm). Same actual 1 x 2 stock. Between P03: X 8 1/4 to 9 3/4; Y 7 1/2 to 8 1/4 or 9 3/4 to 10 1/2, Z 3/4 to 2 1/4.

P05 / Vane boom, quantity 1. 12 x 3/4 x 3/4 in (304.80 x 19.05 x 19.05 mm). Straight light clear wood, finished 3/4 in square. Centered sleeve axis 6 in from either end. Nominal sleeve projects 1/32 in above boom top. Four horizontal fin bores at local X 3/4, 2 1/4, 10 1/2, 11 1/4; all at the boom mid-height. Balance bore vertical at local X 8 1/2.

P06 / Rear fin, quantity 1. 3 x 4 x 0.02 in (76.20 x 101.60 x 0.51 mm). Flat light stiff polymer sheet, received .015 to .025 in; no sharp metal. Rectangle; two 1/8 in bores at local (3/4, 2) and (2 1/4, 2) from its lower-left corner. Installed X -6 to -3 relative to axis; height centered on boom.

P07 / Front pointer, quantity 1. 2 x 1 1/2 x 0.02 in (50.80 x 38.10 x 0.51 mm). Same sheet and thickness as P06. Trim triangle with vertices (0, -3/4), (2, 0), (0, 3/4). Two 1/8 in bores at X 1/2 and 1 1/4 on its midline. Installed base at axis-relative X 4, point X 6.

P08 / Pivot sleeve, quantity 1. 2 x 1/4 x 1/4 in (50.80 x 6.35 x 6.35 mm). K&S 8209 round brass tube or actual equivalent: OD .248 to .252, ID .190 to .194 in. Cut 2 in +/- 1/64, deburr without flaring; bore end relief no longer than 1/32 at either end. Round stock dimensions are length x OD x OD, not square stock.

Hardware and materials

2 - #8 x 2 1/2 in stainless flat-head wood screws. From beneath base into upright at (8 5/8, 9) and (9 3/8, 9). Shaft OD <=.164, head OD <=5/16 in; nominal receiving penetration 1 3/4 in.

8 - #8 x 1 1/2 in matching flat-head wood screws. Two upward through base into each foot block; nominal .75 in embedment. No point leaves wood.

1 - Straight 4 in smooth round-shank nail used as the fixed pivot. Measure under-head length 4 in +/-1/32, smooth diameter .148 to .165 in through the full sleeve travel, head OD .250 to .375 in and height <=1/8. No ring shank, twist, burr or coating lump in the bearing. Actual top pilot trial controls the wood joint; no holding-force rating.

2 - Smooth flat nylon pivot washers. Each actual thickness 1/16 in +/-1/128; OD .45 to .50 in, ID .177 to .190 in. One beneath sleeve, one above; received pin passes freely. Upper washer is captured by the nail head, not bonded to the sleeve.

4 - #4-40 x 1 in pan-head stainless machine screws. Horizontal fin joints; shaft <=.112 in, head OD <=.23 in and height <=.10 in. Heads on rear boom face; fins on front face. Through-bores 1/8 in.

4 - #4 washers and four #4-40 nylon locknuts. One washer under each fin locknut: thickness <=.032 in, OD <=.30 in; locknut height <=.125 in. Check two complete threads beyond each nylon insert with the actual .015 to .025 in fin.

1 - #8-32 x 1 1/2 in stainless pan-head balance screw and one nylon locknut. Vertical through boom at axis-relative X +2 1/2, Y 0. Head above, adjustable washers below boom, locknut below them. Shaft <=.164, head <=.32 OD/.12 high; nut height <=.1875, OD <=.38 in.

0 to 8 installed - #8 balance washers, plus any unused washers kept off the apparatus. Receive each OD <=.50 in and thickness <=1/32; total installed stack <=1/4 in. Begin with none and add only those needed for the light-balance check; never leave an unretained loose stack. Verify two actual full threads beyond nylon.

As needed - Adhesive and finish selected for the actual wood/brass/polymer environment. The sleeve is bonded into its matched boom hole using an adhesive explicitly suitable for the received wood and brass. Keep both bore and washer lands clean. No glue is relied on to retain the polymer fins; four bolts do that.

4 - Separate low-profile clamps for the actual support. All clamp bodies remain below Z 2 in and outside the 14 in sweep-clearance circle. The guide assigns no clamp/support or wind-load rating.

Tools and setup

Rule, tape, square, caliper and level; saw, small hacksaw/tube cutter and deburring file; clamps and backing scrap.

Drill/driver, 3/16 in clearances, trial 7/64 in wood pilot, 1/8 in machine clearances, stopped depth collar and a bit matched to the received sleeve/adhesive joint.

Scissors or snips suitable for the polymer, eye protection and matched drivers/wrenches. A magnetic compass or an already established local north reference is separate equipment.

Build and use sequence

01. Receive the pin, tube and washers before wood machining. Measure the entire nail bearing segment, both tube ends and washer bores. Reject a nail outside .148 to .165 in or a sleeve outside ID .190 to .194; dry-slide the tube the full 2 in without force.

02. Cut and label P01-P08. Leave 1/8 in saw kerf between separate wood blanks and keep the fin-triangle kerf in the discarded material. From a 12 in tube, one 2 in sleeve plus a 1/8 in cut consumes 2 1/8 in before separate end trim. Deburr both bore mouths without shortening either cylindrical bearing land by more than 1/32 in.

03. Set the upright at X/Y 8 1/4 to 9 3/4 on the base. Drill two 3/16 in first-member clearances from below at X 8 5/8 and 9 3/8, Y 9. Trial 7/64 in pilots in matching end grain: full cylinder 1 13/16 in plus measured point <=.040 and 1/32 reserve, maximum receiving depth 1 15/16 in. Drive the two 2 1/2 in screws flush and square the post in two directions.

04. Fit the long and short foot blocks in the listed positions. Long-block screw axes are X 7 7/8 or 10 1/8, Y 8 1/4 and 9 3/4. Short-block axes are X 8 5/8 and 9 3/8, Y 7 7/8 or 10 1/8. Drill 3/16 through the base, trial 7/64 receiving pilots with 13/16 in full cylinder plus point <=.040 and 1/32 reserve, total <=15/16 in. Install eight 1 1/2 in screws from below; heads flush, blocks snug without distorting the post.

05. Mark the boom midpoint 6 in from either end. Make its perpendicular sleeve hole using a backed scrap trial and the actual tube/adhesive requirements; the tube must seat without crushing or splitting the wood. Do not ream the tube bore to cure a crooked wood hole.

06. Bond the clean sleeve into that hole with its upper end 1/32 in proud of the boom top. Keep it perpendicular in two directions. Nominal lower projection is 1 7/32 in with .75 in boom thickness; actual projection equals sleeve length minus boom thickness minus 1/32. Mask both tube ends; cure as the adhesive maker directs, then remove every trace of adhesive from bore and thrust lands. Mark a sleeve/wood witness line.

07. Cut the 3 x 4 in tail and the 2 x 1 1/2 in triangular pointer. Ease corners and edges; round the pointer tip by no more than 1/16 in. Drill the four 1/8 in fin holes to the pattern. No curling, cracked hole or floppy sheet is acceptable.

08. Put both fins against the FRONT boom face, with their height midlines on the boom mid-height. Rear fin runs axis-relative X -6 to -3; nose triangle starts at +4 and points to +6. Drill the four horizontal boom bores at X -5 1/4, -3 3/4, +4 1/2 and +5 1/4. Fit the four #4-40 x 1 in screws from the rear, one washer and locknut on each fin side. Tighten without crushing the sheet and verify two threads beyond each actual nylon insert.

09. Drill the vertical 3/16 in balance bore at axis-relative X +2 1/2, Y 0, clear of the sleeve and fin bolts. Fit the #8-32 x 1 1/2 in screw downward, initially with no balance washers; add its locknut. Temporarily hold the smooth pivot through the sleeve with its axis horizontal over a clear padded surface. Let the boom settle gently from both directions; add up to eight front washers below the boom to reduce persistent tail-heavy fall. Keep total washer height <=1/4 in, tighten the locknut and check two exposed threads. This is a light static comparison, not a torque or aerodynamic calibration. Reject a sheet/wood combination that cannot be made free-moving within this stack.

10. Mark the top pilot on the upright center at X 9, Y 9. Determine its diameter on identical scrap with the ACTUAL nail; a 7/64 in pilot is a starting trial, not a universal hardwood rule. Mark a nominal under-head height of 2 3/16 in above the post top: 1/16 lower washer + 2 in sleeve + 1/16 upper washer + 1/16 free gap. The 4 in nail then enters the post nominally 1 13/16 in. Stop the pilot at 2 in full cylinder plus measured point <=.040, total <=2 1/16 in, staying wholly inside the post. This also covers the maximum received nail insertion, not just its nominal 1 13/16 in.

11. Place the lower nylon washer on the post top, lower the sleeve over the pin location, add the upper washer and insert the nail through all three. Support the boom and drive the nail into its pilot by light controlled taps. Set ACTUAL endplay to 1/16 in +/-1/64 with a removable feeler over the top washer; do not drive down against the sleeve. Remove the feeler and verify that only the sleeve assembly turns, not the nail or post. With the base level, require the post to differ from a true vertical reference by no more than 1/16 in over its 12 in length. With all sleeve lands engaged, at least one sleeve position must align with that vertical reference within 1/64 in over 2 in; do not force or bend the nail to pass.

12. Sweep the entire vane slowly through 360 degrees and gently take up its permitted radial/end play. The sleeve's retained cylindrical land is at least 1 29/32 in. Maximum .046 in diameter clearance limits rigid relative tilt to less than 1 1/2 degrees; the drawing uses a 7 in conservative radial envelope. Relative sleeve tilt is distinct from mounting error: the preceding plumb receiving checks give a conservative 4 degree whole-rotor rigid tilt window, including the opposite allowed sleeve play. The tail is at least 3 in from the axis, clear of the 1 1/2 in post. Nothing may touch the post, base, clamp or neighboring object. Endplay is not permission to lift the sleeve over the nail head.

13. On the base draw a fixed reference cross through the pivot axis. Mark N, E, S, W clockwise when viewed from above. Align it using a separate local reference with the vane removed if metal affects a compass. Write MAGNETIC or TRUE beside N according to the method actually used; do not label a magnetic-only alignment true north. Refit and recheck the unchanged nail height if service was needed.

14. Clamp the full base to the chosen low stable support and level it in two directions. Keep every clamp below Z 2 and outside the 14 in circle. Check the post remains plumb and the base cannot creep under a gentle hand movement; this is a fit check, not a wind-load test. Keep people, animals and loose objects outside the moving vane's reach.

15. Choose a locally open observation position clear of nearby walls, vegetation and exhausts, without moving to a roof or tall mast. Note that near-ground flow and obstructions can differ from a formal station. The rear fin area is 12 square inches at a 4 1/2 in lever; the nose triangle is 1 1/2 square inches at a 4 2/3 in lever. Their ideal broadside area moments are 54 and 7 cubic inches, respectively; this pressure-area bias, not mass balance, promotes tail-downwind orientation. It is a geometric comparison, not a measured aerodynamic coefficient or guaranteed response.

16. In a gentle steady natural breeze, observe from outside the sweep. The small nose points to where the air comes FROM; read its nearest marked cardinal/intercardinal sector only when it settles. Record oscillating or calm/indeterminate instead of forcing a direction. Do not infer speed, approaching danger or remote weather from this low local indicator.

17. Remove the whole station before rough weather, icing or unattended storage. For pivot service first unclamp the empty base, support the boom and extract the nail straight upward with a suitable puller over a sacrificial wood pad; keep hands outside the fins. Lift and collect upper washer, vane and lower washer. Clean and dry the separate bore, washers and pin; no oily film that traps grit is prescribed.

18. Reject a bent nail, cracked fin, shifted sleeve witness or loosened top pilot. Do not reuse a post hole that no longer grips its received nail; replace the post and repeat the pilot trial. Reassemble the same washer order, set actual endplay with the feeler and repeat full-circle clearance, plumb, reference and settling checks. No physical wind or retention capacity is claimed.

Acceptance before use

01. All ten wood screw points remain inside sound stock; foot blocks snug and post plumb on a fully supported clamped base.

02. Actual smooth pin .148 to .165 in; sleeve ID .190 to .194, cylindrical bearing land >=1 29/32 in; two correct nylon washers and 1/16 +/-1/64 in axial play.

03. Upper washer ID <=.190 and nail head OD >=.250 provide positive geometric head overlap; pin remains fixed in its received wood joint. No force rating.

04. Four fin bolts and balance screw retain their complete washer/nut stacks with two actual full threads beyond nylon. Fin edges and nose are smooth.

05. Full actual 360-degree rotation and allowed play clear the post, base, clamps and surroundings; no sleeve/wood witness movement.

06. Cardinal reference records magnetic or true basis; only a settled FROM indication is read. Calm, sticking, vibration or base movement stops observation.

Care and repeat checks

Store dry and indoors between attended sessions. Wipe grit from the pin and sleeve, inspect the polymer and renew deteriorated wood finish without coating bearing lands.

After any knock, corrosion or sleeve movement, take apart cold/dry and repeat every received fit and full-circle check before use. No replacement-size equivalence is assumed.

Primary context and original design

Original geometry, instructions and vector plates. Primary sources supply instrument or material context; they do not endorse or certify this apparatus.

Grip-Rite: Box Nail. Primary source.

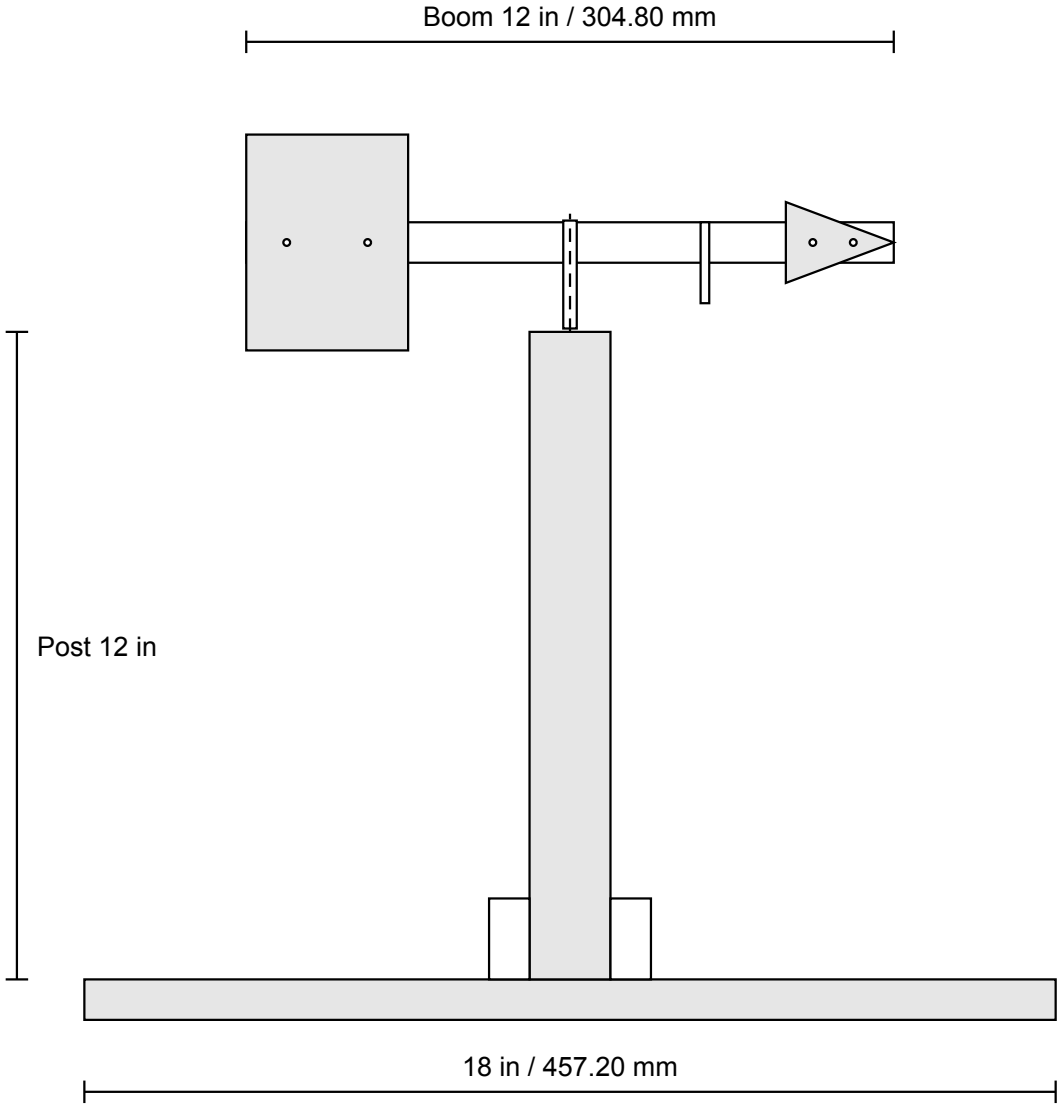
NOAA JetStream: Origin of Wind. Primary source.

NOAA Ocean Service: Build Your Own Weather Station. Primary source.

K&S Metals: 8209 round brass tube. Primary source.

01 / Vane, post and pressure bias

CL-012 - front elevation; nominal inches, low support only



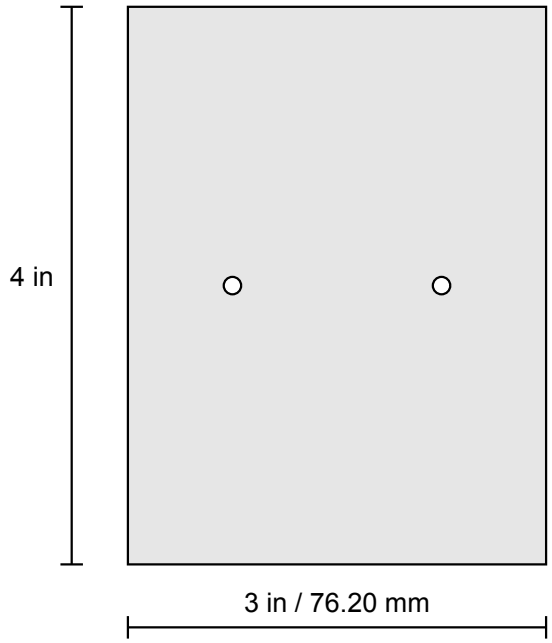
TAIL: 12 in² x 4 1/2 in = 54 in³

NOSE: 1 1/2 in² x 4 2/3 in = 7 in³

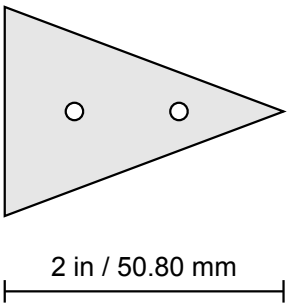
Ideal broadside pressure-area moments favor the rear. This is not a measured torque, aerodynamic coefficient or response guarantee; mass balance alone does not orient the vane.

02 / Fin profiles and fastener routes

CL-012 - original cut patterns; all four fin bolts are horizontal



P06 rear rectangle. Two 1/8 in holes: X 3/4 and 2 1/4 in, Z 2 in from its lower-left corner.



P07 nose: base height 1 1/2 in; apex at X 2. Holes at X 1/2 and 1 1/4 on the height midline.

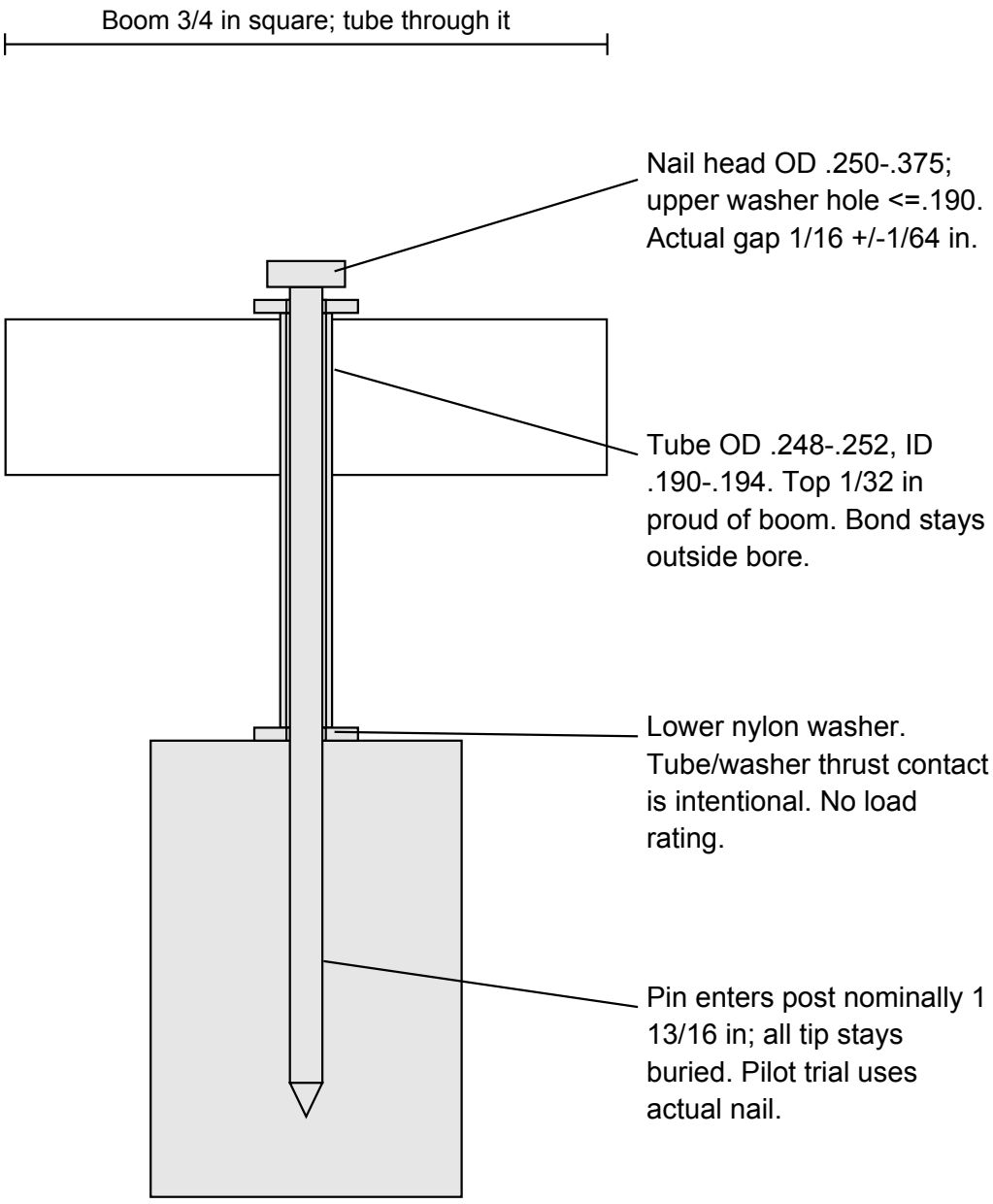
Mount both sheets on the FRONT boom face. Relative-to-pivot bolt X coordinates: -5 1/4, -3 3/4, +4 1/2 and +5 1/4 in. Four #4-40 x 1 in screws cross .75 in wood and the actual .015-.025 in sheet.

Heads on the opposite boom face; one <=.032 in washer and <=.125 in locknut per fin bolt. Worst stack .760+.025+.032+.125=.942 in leaves .058 in: verify at least two full 40-TPI threads past nylon.

Balance screw is a DIFFERENT vertical axis at X +2 1/2 in, clear of every fin bolt. Install 0-8 retained washers below the boom, total <=1/4 in; no unused loose hardware rides on the vane.

03 / Sleeve, pin and positive capture

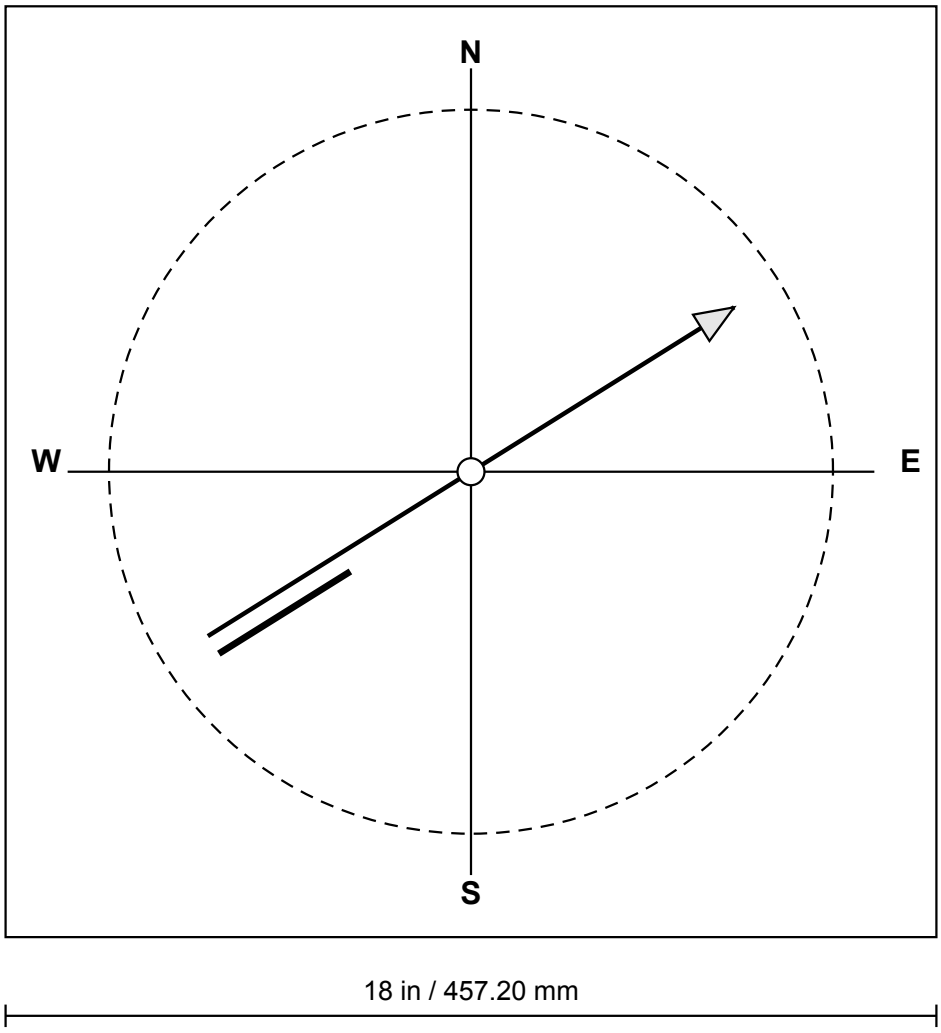
CL-012 - true pivot section; fixed post top is local Z 0



Actual cylindrical sleeve land >=1 29/32 in; maximum diameter clearance .046 in gives atan(.046/1.90625)=1.383 degrees <1.5. This rigid bound excludes bending, wear and joint loosening.

04 / Fixed reference and whole sweep

CL-012 - plan and empty-service order; no wind-speed scale



All moving parts fit the conservative 7 in radius; clamp bodies remain below Z 2 and outside that circle. Align the fixed reference and label MAGNETIC or TRUE according to the method actually used.

Service dry: support boom -> extract fixed nail -> collect upper washer -> lift vane -> collect lower washer. Restore the same stack and actual endplay before reading a settled FROM direction.