

The Tape Measure & Fractions: Layout Math You'll Use Every Day

YES Electric • Arc Workforce Academy HVAC Apprenticeship

Draft 1 (October 2026). This lesson is under review. Videos are made by other companies, not YES Electric; follow this lesson and your journeyman where they differ. Boxes marked "Shop photo coming" will get real photos from our shop in a later version.

Unit 2 • Trade Math for HVAC • RTI: Trade Math (26 hr) Class time: ~3 hrs (0.5 classroom + 2.5 bench — this is a hands-on math class)

1. What you'll be able to do

- Read a tape to **1/16"** instantly — no counting ticks, by mark-length pattern.
- Add, subtract, and halve mixed fractions in your head or on a scrap of duct: $14\text{-}3/8 + 9\text{-}13/16$, half of $23\text{-}5/8$.
- Apply the **fabrication allowances** that turn a duct sketch into a cut sheet: seam allowances, overlap, "take away the lock."
- Lay out with the tape's built-in tricks: the 16" stud marks, the 1" offset trick ("burn an inch"), drawing circles with a tape.

In sheet metal (Unit 10), a 1/8" math error is a fitting that doesn't fit. Every minute here pays off at the brake.

2. Tools & materials

- 25' tape per student (theirs to keep — tool list item #1)
- Scrap sheet metal pieces, sharpie, combination square
- Fraction drill decks (laminated cards, ours)
- NO calculators for rounds 1-2; calculators allowed and encouraged for checking

3. Watch first

Trade-math video coverage is thin on our channels — this unit is bench-taught with our own material. Two worth the time:

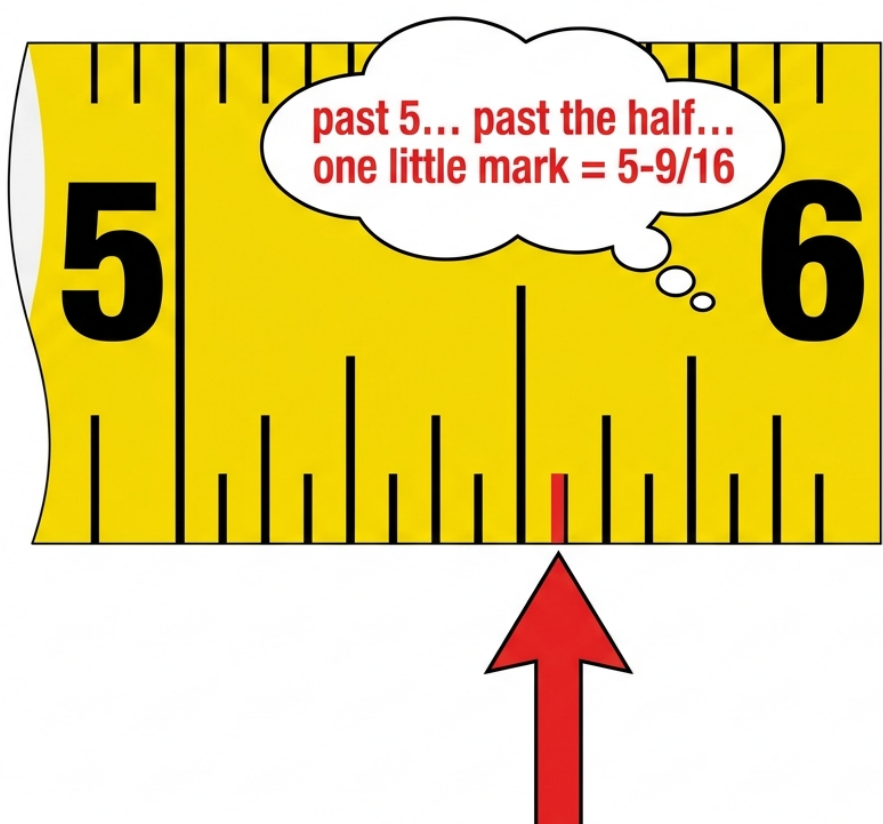
Video	Channel	Length	Why
Learn BTU-Watt Conversion Using a Toaster	HVAC School (Ty Branaman)	14:46	The style of mind: make units physical (preview of 2.2)
[OURS TO SHOOT: tape-reading + fraction layout on the shop bench — 10 min]	Arc Workforce	—	The exact drills below, on camera

4. The idea

Reading the tape by mark length

The marks have a hierarchy — longest = inch, next = $\frac{1}{2}$, then $\frac{1}{4}$, then $\frac{1}{8}$, shortest = $\frac{1}{16}$. **Nobody counts sixteen ticks**; you read the nearest big mark and step down: "past 5, past the half, one little mark = $5\text{-}9/16$."

READ THE TAPE BY MARK LENGTH — NEVER COUNT TICKS



LONGEST = INCH

$\frac{1}{2}$

$\frac{1}{4}$

$\frac{1}{8}$

SHORTEST = $\frac{1}{16}$

Fractions without fear — the 16ths trick

Everything on the tape is sixteenths. Convert once, work in whole numbers, convert back:

$$14\text{-}3/8 + 9\text{-}13/16 \rightarrow (14 \times 16 + 6) + (9 \times 16 + 13) = 230 + 157 = 387 \text{ sixteenths} \rightarrow 387 \div 16 = 24\text{-}3/16$$

Same for subtraction. For halving, halve the whole and the fraction separately and merge: half of $23\text{-}5/8 = 11\text{-}1/2 + 5/16 = 11\text{-}13/16$. With a week of drills this is faster than finding the calculator.

Fabrication allowances — where math meets metal

A 20" × 8" duct section is NOT cut at 20 and 8. The blank must include:

Allowance	Typical	Why
Pittsburgh lock	+5/16" pocket side, +1/4" flange side (machine-specific — OUR machine's numbers get verified in 10.4)	The corner seam eats metal
Snap lock	~+1/2" total	Same idea, different seam
S&D connections	−1/8" on duct length per joint	Slips/drives add back length
Hem (raw edge)	+3/8" per hem	Safety + stiffness fold

The pattern: **finished size + seam allowances = blank size**. Layout is just bookkeeping in sixteenths. (Exact allowances per seam are re-taught at the machines in Unit 10 — today you learn to ADD them without dropping a fraction.)

FINISHED SIZE + ALLOWANCES = BLANK SIZE

FINISHED: 20 in

+5/16
PITTSBURGH
POCKET

20 in
(FINISHED SPAN)

+1/4
FLANGE

BLANK = 20-9/16

CALCULATION:

$$20 + \frac{5}{16} + \frac{1}{4} = 20\text{-}9/16$$

the seam EATS metal — lay out the blank, not the finished size

Tape tricks of the trade

- **Burn an inch:** hook damaged or precision needed → start at 1", subtract 1 from every reading. Forgetting the subtraction is a famous apprentice scar — say "burning one" out loud.
- **16" black diamonds/marks** = stud/joist centers — find framing for boots and hangers without a stud finder.
- **Tape as compass:** thumb pin at center, sharpie at radius mark, swing your circle for round takeoff layout.
- **The hook slides on purpose** (true zero push vs pull) — don't "fix" it, and don't trust a bent hook: burn an inch instead.

5. Bench procedure

1. **Tape-reading gauntlet (15 min):** instructor pre-marks 20 arrows on scrap; students write each reading. 18/20 to pass; repeat with new marks until everyone clears it.
2. **Fraction drill rounds:** deck of add/subtract/halve cards. Round 1 paper, Round 2 mental on the easy ones, Round 3 (later in week) timed. The standard: 90% on add/subtract in 16ths.
3. **Layout transfer:** given finished duct size + seam table, compute the blank, lay it out on scrap with square and sharpie, label every line. Instructor checks with a tape before anything gets near snips (those come in 10.2).
4. **Burn-an-inch test:** measure five marked spans with a deliberately "damaged hook" tape. All five right = pass (forgetting once in training cures forgetting forever).
5. **Circle layout:** mark a 7" diameter circle with the tape-compass trick for a future round takeoff.

Checkout: read 5 marks cold, compute one blank size from a finished size + allowance table, lay out one rectangle to $\pm 1/16"$ — all unaided.

6. Field gotchas

- **"About" is not a measurement.** 14-5/8 means 14-5/8. The duct doesn't accept "close."
- **Measure twice, cut once** is literal economics: sheet stock costs money, and re-fab costs the afternoon.
- **Inside vs outside dimensions** — duct sizes are INSIDE dimensions (airflow is inside!). Liner makes this matter double (10.11).
- **Worn tapes lie.** A tape that's been dropped 200 times with a wobbly hook belongs in the trash, not the pouch.
- **Write it down.** Field measurements travel from attic to truck in a notebook, not in your head past two numbers.

7. Competency link

- RTI Trade Math hours; underpins **Comp 29** (duct fabrication — every layout in Unit 10) and Comp 2 (tool use).

8. Check yourself

1. Read: the arrow sits one short mark past the $\frac{1}{2}$ between 7 and 8. What's the measurement?
2. $14 - \frac{3}{8} + 9 - \frac{13}{16} = ?$
3. Half of $23 - \frac{5}{8} = ?$
4. $31 - \frac{1}{4} - 18 - \frac{7}{16} = ?$
5. Finished length 20", Pittsburgh pocket $+\frac{5}{16}$ one side, flange $+\frac{1}{4}$ the other. Blank length?
6. What does "burn an inch" mean and what must you never forget?
7. What are the 16" marks for?
8. Why are duct dimensions inside dimensions?
9. Lay out a 7" circle with only a tape and sharpie — describe the move.
10. Your hook is bent. Two acceptable responses?

Arc Workforce Academy · YES Electric LLC Apprenticeship 2026-AL-141731 · Lesson 2.1 v1.0 (2026-06-10)