

Armstrong calculator

THE Armstrong Calculator is designed primarily for use in estimating for Flooring Materials, but is equally applicable for use wherever dimensions in feet and inches have to be turned into square feet or square yards and for then calculating their value. In addition, the normal functions of a slide-rule are available for calculating Waste, Profit, etc.

A normal slide-rule is basically a very simple instrument but is not easy to apply to shillings, pence and inches, as these have to be turned into decimals before starting the calculation. In the Armstrong Calculator the dimensions in feet and inches and the price in shillings and pence can be used immediately, without any conversion. At the same time the Armstrong Calculator saves calculation, firstly by turning dimensions in feet and inches straight into square yards and secondly by converting at a price in shillings directly into pounds value.

If one is not used to a slide-rule, a little practice is necessary to acquire dexterity and to familiarise oneself with the method and the divisions on the scales, but calculation soon becomes automatic. Make use of the cursor as much as possible, as this saves eye-strain and increases accuracy. If the cursor comes off, put it on again with the springs at the top of the slide.

Always keep one jump ahead of the slide-rule calculation by making a very rough estimate in your head. The easiest mistake is to read a result ten times too much or too little.

In all slide rules, the divisions get smaller as the values increase. It will be noted, for instance, that the Length scale starts with $\frac{1}{2}$ " divisions and finishes with 3" divisions, whilst the Sq. Yds. scale starts with 0.02 and finishes with 1.0.

Scales C, D and F are decimal, and therefore, if used for values, may involve a conversion from, e.g. fractions of a pound to shillings. Whilst in many cases this can be done in one's head, for accurate conversions or when in doubt, simply use Scales D and S together for fractions of a pound. For instance, on finding the answer 4.21 pounds, place the cursor over 21 on D and read $4\frac{2}{5}$ on S. By reversing the process one can read e.g. 6jd as 0.0271 pounds. For turning pence into decimals of a shilling, or inches into decimals of a foot, and vice versa, set 1 on C over 1.2 on D (marked as a remainder with "d" under it) and then read e.g. 2jd as 0.208 shillings.

I. AREAS

The basic and most tedious calculation in estimating is turning feet and inches into square feet or, worse still, square yards. Either operation is perfectly simple with the Armstrong Calculator.

To find the area of a room 20' 6" by 9' 4", set the cursor line over 20' 6" on A and then move the slide from left to right until 9' 4" is under the line. Then move the cursor until the line is over 1 on C and read 21.3 (say 21½) sq. yds. on D or 192 sq. ft. on F.

If the area is large and one dimension is greater than 30', the easiest way is to halve this and then double the answer. For 48' 6" by 28' 3", for instance, set 24' 3" over 28' 3", read 76.2 sq. yds. and double to find the answer at 152½ sq. yds.

If the area is less than 1 sq. yd., 1 on C will run off the D scale to the left, but one can continue to read under 100 on C, bearing in mind that the D scale now represents 0.01 to 1.00 instead of 1 to 100 sq. yds. Thus 21 lineal feet of 4" Strip is 0.78 sq. yds. or 7.0 sq. ft.

Many rooms have projections and alcoves. These small areas can be quickly calculated and then added or deducted from the main area.

The rule can, of course, be used to find the area of a roll of sheet goods. If the length is more than 30', set width at 12' for 6' wide material and halve the length. For two-metre wide Linoleum, set at 6' 6½" instead of 6'.

To calculate the area of a circle, set half the diameter (i.e. the radius) as Length, and half the diameter as Width. Then read the area under π (at 3.14 on C) in sq. yds. on scale D or sq. ft. on scale F. Thus the area of a 15' 6" circle is 7' 9" x 7' 9" x 3.14 sq. ft., this is, 189 sq. ft. or 21 sq. yds.

2. VALUES—SQ. YDS.

Having found any area between 1 and 100 sq. yds., with the cursor line set over it, simply move the slide until any price between 3d and 20/- on Scale P comes under the line and read the value in pounds on D under 1 on C. For instance, set 7/7 on P over 25 sq. yds. on D and read between 9.45 and 9.50 £, or say £9.9.6. (Actual value 9.48 or £9.9.7½, but such an error is immaterial in estimating as opposed to invoicing).

Should the price per sq. yd. be over 20/-, halve it and double the answer, or else say e.g. 37 sq. yds. at 35/6 is 37 x £1 plus 37 x 15/6, or £37 plus 28.7 £, giving £65.14.0.

If the area is greater than 100 sq. yds., simply divide the area and multiply the answer by 10. Thus for 240 sq. yds. at 8/8, set 8/8 over 24 sq. yds., read 10.4 £ and multiply by 10 to give the answer at £104.

If the value is less than £1, the readings on Scale D under 1 or 100 on C have one hundredth of the value shown, i.e. they run from 0.01 to 1.00 £. However, one normally does not want decimals of a pound, but shillings and pence. Therefore, ignore Scale D and read off the answer on Scale S, over either 1 or 100 on C.

3. VALUES—SQ. FT.

Set the value per sq. ft. on P over the square footage on F, then read the value in pounds on F instead of D. Values read under 1 on Scale C are £9 to £900 as shown. Values under 100 on C are 0.09 £ to £9. Do not read small values direct on Scale S, but use S in conjunction with D to turn decimals of a pound into shillings and pence.

4. WASTE

Having found the area of a room, it is necessary to allow for waste. This is extremely simple to calculate on the slide-rule. Suppose the area is 58.2 sq. yds. If you move the cursor from 1.0 on C to 1.1, then the reading on D below the line will be the square yards at C1 multiplied by 1.1 or 110/100, that is, increased by 10%. Supposing you envisage 5% waste. Move the cursor to 1.05 and read 61.1 sq. yds. If you have to buy the tile in 5 yard cartons, you must order either 60 or 65 sq. yds. Move the cursor to 60 on D and read 1.03 on C, and to 65 and read 1.12. Twelve cartons will therefore allow only 3% for waste whereas thirteen will give 12%.

5. CUTTING CHARGES

The value of a cut length, where the cutting charge is a percentage of the basic price, can be quickly calculated. Thus to find the value of a cut length of 8/4 Linoleum 25' 3" wide at 16/1 per sq. yd., plus 15% cutting charge, proceed as follows: Set 25' 3" on Length and 6' on Width (if required, read 16.8 sq. yds. on D) then move cursor to 1.15 on C, bring 16/1 on P under cursor line and read 15.6 £, or £15.12.0, on D.

6. PURCHASE TAX

Purchase Tax can similarly be calculated, either as a separate sum or else the basic price can be grossed up.

If the rate of tax is 10% on invoice value less cash discount of 4½%, the effective rate is 9.575%. To find value, including Purchase Tax, on £15.12.0, set 1 on C over 15.6 on D, then move cursor to 1.096 on C and read 17.1 £ or £17.2.0, on D. If tax is required as a separate item, the cursor is set over 9.58. For 15.6 £ this would be at a point beyond 100 on Scale D. Therefore in such cases reset with 1 on C over 1.36 £ on D, then move the cursor to 9.58 on C and read 14.95 on D. As 15.6 £ was reset at 1.56, this 14.95 £ must be read at 1.495 £, or £1.9.11.

It must be remembered that, for any material, Purchase Tax is calculated on Trade Price. Should any quantity discount be involved, therefore, Purchase Tax must be calculated separately on the normal price.

7. TILES PER DIMENSION

Simply to guess a waste figure on a percentage basis is wasteful. The Armstrong Calculator can be used to determine exactly how many tiles are required to fit into a given length or breadth. The quantity so found can then be used in setting-out procedure.

(a) Square Designs

7.1
2.4
No problem arises with $12'' \times 12''$ tile. If a room is $23' 3''$ long, one knows that 24 tiles will be required, giving $7\frac{1}{2}''$ cutting at each end.

With $9'' \times 9''$ tile, the calculation often has to be done with paper and pencil. Calculation with the slide-rule is easy. Set 100 on C over 75 on D, then read off any dimension on D as tiles on C. Thus $24' 8''$, 24.67 feet, is the equivalent of 32.9 tiles. If 33 tiles were used, the cuttings would be too small, apart from the danger that the wall ran off-square. So one sees immediately that 34 tiles are needed, giving approximately $5''$ cuttings.

Supposing that one had calculated that 34 tiles are needed, giving approximately $5''$ cuttings, and set 1 on C above it. Then move cursor to 2.8 on C. Then, since there are sixteen $9'' \times 9''$ tiles per square yard, draw the slide until 1.6 on C comes under the cursor. Read 5.9 (5.925) on D under 1 on C. Obviously the answer is neither 5.9 nor 590 sq. yds., so it must be 59 (59½). Tiles are sold in 5 yard cartons, or a split carton of one square yard may be obtainable. Say 60 square yards to order, leaving a dozen tiles in excess to cover breakages, bad cuts, etc.

For $18'' \times 18''$ tiles set 1 on C over 1.5 on D and proceed as before to find the number of tiles per dimension. The above is for exact sizes only. For H. B. Linoleum Tiles, $9'' \times 9''$, $12'' \times 12''$ and $18'' \times 18''$ are nominal sizes, requiring $1\frac{1}{2}\%$ to 2% more material in length. Therefore (on $18'' \times 18''$ tiles) e.g. set at 1.50 then move cursor to 1.02 and reset the slide.

(b) Diagonal Designs

Calculation by paper and pencil for diagonal designs is much more difficult, but can as easily be done on the slide rule. For exact size tiles, dimensions are:

$$9'' = 12\frac{1}{4}'' \text{ or } 1.06'$$

$$12'' = 16\frac{1}{4}'' \text{ or } 1.42'$$

$$18'' = 25\frac{1}{4}'' \text{ or } 2.12'$$

Therefore, to find the number of $12''$ tiles to be laid diagonally within a length of $26' 5''$, set 1 on C above 1.42 on D and read 18.6 tiles on C above $26.4'$ on D.

For $8\frac{1}{2}''$ and $17\frac{1}{2}''$ actual size tiles add 2% and for $11\frac{1}{2}''$ tiles add 3% .

To find the number of tiles required to cover the area, multiply the number in Length by the number in Width and then double the answer.

8. MISCELLANEOUS COSTS

Calculating labour costs can be done very quickly on the slide rule. Assume an area of 76 sq. yds., an installation rate of $3\frac{1}{2}$ sq. yds. per hour and a wage cost of 6/1 per hour. Set the cursor over 76 on D and move the slide so that 3.25 on C comes over it. Move the cursor to 1 on C and, if required, read the 23.4 man-hours shown under it. Then move the slide so that 6/1 on the Price scale comes under the cursor. Then read off the cost of 7.1 £ on D.

Costs for adhesive, seal, etc., can be calculated in the same way. For 482 sq. yds. and a spreading capacity of $19\frac{1}{2}$ sq. yds. to the gallon, set 1.95 on C over 4.82 on D and read 2.47 under 1 on C, i.e. 24.7 gallons, showing that 5 x 5 gals. will be just enough. (Setting on the left-hand side on the scale is more accurate than using 48.2 and 19.5; common sense will indicate that the answer is neither $2\frac{1}{2}$ nor 247 gallons.)

Any costs can be calculated by setting the number of units (in gallons, pounds, containers, etc.) on D, bringing the price per unit on Scale P over it, then reading the value on D or S.

9. PROFIT MARGINS

A slide-rule is supreme when it comes to calculating percentages, for not only can a series of percentages be shown at a glance, but when comparing two values, mark-up and discount are shown simultaneously. For instance, set the cursor over 31 on D and bring 26 on C under the line. Now over 100 on D one can read that 26 is 84% of 31 (i.e. 31 less 16% discount) and under 1 on C one reads that 31 is 119% of 26 (i.e. 26 plus 19% mark-up).

Supposing that the estimated cost of a contract is £54.2.0 and you wish to add a gross margin of $27\frac{1}{2}\%$. Set the cursor over 54.1 on D (or preferably over 5.41 and multiply by 10 later) and bring 1 on C under the line. Now move cursor to 1.275 on C and read the grossed-up value of 69.0 £ on D. If a round sum of £70 is to be charged, set the cursor over 70 on D and read 1.29 on C, showing that the profit margin is now 29%. To convert this gross profit on cost into gross profit on selling price, set 1 on C over 1.29 on D and read 77.5 on C over 100 on D, showing a $22\frac{1}{2}\%$ profit on selling price.

Supposing that the actual cost of the contract proved to be £56.10.0, set 56.5 on C over 70.0 on D and read 80.8 on C over 100 on D. This shows that only 19% instead of $22\frac{1}{2}\%$ was achieved.

10. CONTRACT COST PER SQ. YD.

For large contracts it is usual to quote a price per sq. yd. rather than a lump sum. Since the yardage is big, it is important that the estimated cost per sq. yd. be as accurate as possible.

Supposing that material cost is 5/6 per sq. yd. plus 3½% waste, plus Purchase Tax at 10% nominal rate, set 1 on C over 66 (5/6 = 66d.) on D, move cursor to 1.035 on C for waste, bring 1 on C under cursor and move cursor to 1.096 and read 74.7 (6/2½) on D. If a quantity discount is involved, Purchase Tax will have to be calculated separately on the normal price.

Supposing that labour cost is 6/1 per hour at 3½ yards per hour, set 3.25 on C over 73.0 on D and read 22.5 (1/10½) on D under 1 on C.

Supposing that adhesive cost 7/6 per gallon with a covering capacity, including waste, of 18½ sq. yds. per gallon, set 18.5 on C over 90 on D and read 4.9d/sq. yd. on D under 1 on C.

We now have:

Material	74.7d/sq. yd.
Labour	22.5
Adhesive	4.9
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	102.1
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To this must be added an allowance for miscellaneous stores and for travelling time and fares.

Having arrived at a total cost of, say, 106.0d, this must be grossed up to allow for Net Profit, Overheads and probably General Contractor's Discount. Supposing that one aimed at 30% gross on tendered price, set 70 on C (i.e. 100 less 30) over 100 on D. Move the cursor to 1.06 on C and read 1.515 on D. This is 151.5d or 12/7½. Suppose that the quotation must be brought down to 12/5. Move the cursor back to 1.49 on D, move the slide back so that 1.06 comes under the line and read 71.2 on C over 100 on D. This shows a reduction in net profit of some 1½% as compared with the previous setting at 70.0.

For the sake of ease and accuracy, use the left-hand side of the rule, e.g. set 7.47 rather than 74.7 and bear in mind that the answer must be multiplied by ten. This sounds complicated but soon becomes a matter of habit.

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