LASICO APPLICATION NOTES

No. 010783

DETERMINATION OF THE AVERAGE VALUE OF A MEASUREMENT LINE USING A LASICO RADIAL PLANIMETER *(Model Series 1000/3000)*

The average value of a measurement line, plotted on a circular chart by a Flowmeter with linear response, can easily be measured with a Lasico series 1000 or 3000 Radial Planimeter.

However, the radial planimeter will not read the average value directly. Rather, the value read from the planimeter must be combined with a few critical chart dimensions into a simple equation to determine true average values of a measurement line. The answer will be in terms of the chart scale (pounds, inches of water, degrees, or otherwise) and is accurate for a measurement line covering any portion of a chart; for example, a 7 hour segment of a 24 hour chart.

The equation for determination of the average value of a measurement line is:

$$P_{ave} = \frac{P_m}{R_o - R_i}\left[R_{pu} \frac{R_c}{R_{puc}} \frac{t_o}{t} - R_i \right]; \qquad (1)$$

where
- P_{ave} = the average value of the measurement line
- P_m = max. scale reading (for example 100 inches of water on a 0 to 100 inches -of-water chart)
- R_o = radius of outer-mo st circle
- R_i = radius of inner-most circle (base line)
- R_c = radius at which the planimeter has been calibrated
- R_{puc} = reading of planimeter during calibration
- t_o = time span of one chart revolution
- t = time span of measurement line
- R_{pu} = readin g of planimeter after tracing measurement line

During factory calibration, the value of R_{puc} is set to 12500 when a circle of radius R_c=5 inches is measured. Substituting these values into equation (1) permits it to be simplified to the following form:

$$P_{ave} = \frac{P_m}{R_o - R_i}\left[(R_{pu})(.0004) \frac{t_o}{t} - R_i \right]; \qquad (2)$$

EXAMPLE: Suppose measurements must be made of measurement lines plotted on linear charts having the following characteristics.:

Radius of inner circle = 1.375 inches
Radius of outer circle = 5 inches
Max. scale reading of 0 to 100 inch chart = 100 inches of water
Time span of chart = 24 hours

With these values substituted into equation 2, it becomes

$$P_{ave} = 0.265 \left(\frac{R_{pu}}{t}\right) - 37.93 \text{ inches of water ;} \qquad (3)$$

If a measurement line covering an 18.5 hour time span is traced and the planimeter reads 7325, then subsituting these values into equation (3) gives:

P ave = 67.02 inches of water

Subsequent measurements of lines plotted on identical charts can all utilize this simplified equation (3).

EXAMPLE (No.2)

Suppose measurements must be made of measurement lines plotted on linear circular charts having the following characteristics:

Radius of inner circle = 1.375 inches
Radius of outer circle = 5 inches
Max. scale reading of 0 to 1500 pound chart = 1500 pounds
Time span of chart = 7 days (=168 hours)

Note: Either 7 days or 168 hours may be used as the value to; However the value of t must be in terms of the same units. For this example, units of hours will be used.

With these values substituted into equation (2), it becomes

$$P_{ave} = 27.81 \left(\frac{R_{pu}}{t}\right) - 568.97 ; \qquad (4)$$

If a measurement line covers 3.5 days (=84 hours) and the planimeter reading is 9867, the P ave is found to be

$$P_{ave} = \frac{9867}{84} - 568.97 = 2697.71 \text{ pounds;}$$

All subsequent measurements of lines plotted on charts having the same characteristics can make use of equation (4)

When tracing measurement lines plotted on circular charts, it is required to end the measurement at a radius identical to that at the starting point. If the measurement line ends at a radius that is not the same, then follow a constant time line to a point that is at exactly the same radius.

*) For instruments with a "B" serial number prefix this value is 0.000391

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