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NOMOGRAM FOR THE FIRE DANGER OF FLUE PIPES

by

MARGARET LAW

February 1968.

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Summary

An equation and a nomogram are given for the temperature of a panel at different distances from a heated pipe.

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MINISTRY OF TECHNOLOGY AND FIRE OFFICES' COMMITTEE
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NOMOGRAM FOR THE FIRE DANGER OF FLUE PIPES

by

Margaret Law

1. Introduction

In their report "The Heating of Panels by Flue Pipes" [1] Lawson et al give calculated and measured temperatures of panels spaced at different distances from flue pipes of solid fuel stoves maintained at various temperatures. Their results can be used to estimate the temperature of a panel near any heated pipe and with the introduction of flue pipes for oil fired domestic heaters, for example, it is convenient to have a simple chart or nomogram relating panel temperatures to pipe temperatures.

2. Equation for temperature

Fig 25 of the report gives equilibrium panel temperatures Θp for different values of flue pipe temperature Θ_f and configuration factor ϕ. This family of curves can be represented approximately by the equation

$$\Theta p = 0.105 \, (\Theta_f)^{1.3} \, \phi^{0.5} \qquad (1)$$

where Θp and Θ_f are in ^{o}C

Deviations of equation (1) from the curves of Fig 25 are within the range of variation of the temperatures measured experimentally.

The report shows that for flue pipes which are long in relation to their distance from the panel

$$\phi \simeq \frac{1}{n}$$

where nR is the distance of the panel from the axis of the flue pipe

R is the radius of the flue pipe

and the length of the pipe exceeds 2nR

Using this approximation for short pipes errs on the safe side.

Thus equation (1) may be written

$$\Theta_p = 0.105 \; \Theta_f{}^{1.3} n^{-0.5} \qquad (2)$$

It is more convenient to give spacing from the panel to the surface of the pipe, rather than to the pipe axis, and to describe it in terms of the diameter rather than the radius.

Equation (2) then becomes

$$\theta p = 0.105\, \theta_f^{\,1.3}\, (2N + 1)^{-0.5} \qquad (3)$$

where ND is the distance between the panel and the surface of the pipe and D is the diameter of the pipe.

The report shows that if the maximum possible flue pipe temperature is maintained for only $\frac{1}{2}$ hour, as could be the case for a solid fuel heater, panel temperatures would be only about 0.7 of the equilibrium temperatures given by equation (3).

$$\text{i.e.} \qquad \theta p = 0.073\, \theta_f^{\,1.3} (2N + 1)^{-0.5} \qquad (4)$$

3. Construction of Nomogram[2]

Taking logarithms of equation (3) we obtain

$$\tfrac{1}{2} \log (2N + 1) + \log \theta_p - (1.3 \log \theta_f + \log 0.105) = 0$$

giving the determinant

$$\begin{vmatrix} \frac{1}{2} \log (2N + 1) & 0 & 1 \\ \log \theta p & 1 & 1 \\ \frac{1}{2}(1.3 \log \theta_f + \log 0.105) & \frac{1}{2} & 1 \end{vmatrix} = 0$$

i.e. for the N scale $x = \frac{1}{2} \log (2N + 1)$, $y = 0$

for the θp scale $x = \log \theta p$, $y = 1$

for the θ_f scale $x = \frac{1}{2} (1.3 \log \theta_f + \log 0.105)$, $y = \frac{1}{2}$

To give equation (4) the nomogram is only altered on the θ_f scale

i.e. for the θ_f scale $x = \frac{1}{2} (1.3 \log \theta_f + \log 0.073)$, $y = \frac{1}{2}$

The Nomogram is given in Fig 1.

References

(1) Lawson, D.I., Fox, L.L. and Webster, C.T., The Heating of Panels by Flue Pipes. Fire Research Special Report No. 1. London, H.M.S.O. 1952.

(2) Allcock, H.J., Jones, J. Reginald and Michel, J.G.L. The Nomogram. Fourth Edition, Pitman, London, 1950.

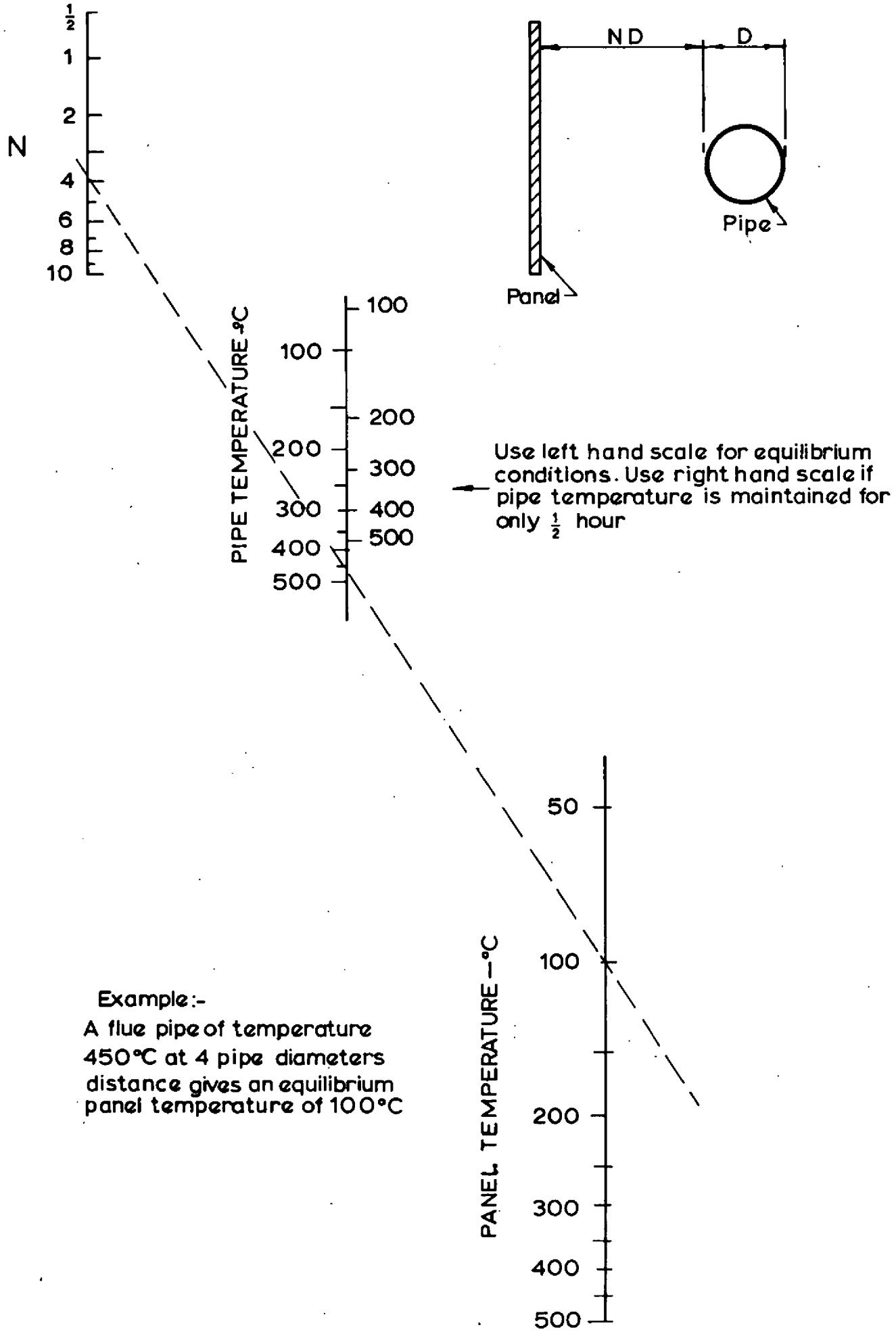

FIG.1. NOMOGRAM FOR THE FIRE DANGER OF FLUE PIPES

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