

THE BRITISH COAL UTILISATION RESEARCH ASSOCIATION

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Calculation of Pressure Drop Through the Tube
Banks in Locomotive and Economic-Type Boilers

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SUMMARY

The estimation of draught loss is a necessary supplement to the design of a multitubular shell boiler in order that the correct fan power for all operating conditions may be provided. The general equations of fluid flow have been adapted for this purpose and four nomograms are given with which it is possible to solve these equations.

(1) Introduction

In the design of a multitubular shell-type boiler, it is desirable to be able to predetermine, sufficiently accurately for the provision of suitable fan power, the draught loss through the smoke-tube bank. A calculation of this quantity forms a useful check to the estimation which can be made from the data already in the hands of boiler-makers in the form of experience gained with previous designs.

When gas flows into, through, and out of a bank of smoke tubes, it must incur a certain loss of pressure, as a result of several pressure changes. These may be itemised as follows:

(a) On entering a bank of tubes the cross-sectional area of the gas pass normally decreases; there is a consequent increase in gas velocity and, on the principle of the conservation of energy, a reduction in pressure.

(b) The flow pattern induced by the reduction in area forms a "vena contracta" immediately inside the tube entrance; this causes some further reduction in pressure, chiefly as a result of the eddies formed during subsequent expansion back to the normal tube cross-section.

(c) In passing down the tubes the gas loses heat, and thus by increasing its density reduces its velocity and brings about an increase