



Development Work Notice

This document has been prepared as a notification of work in progress within the ESDU committees that will result in future product updates. It will be updated and re-issued throughout the development process.

ESDU Topic:

CFD validation studies for incompressible flow through square-edged orifice plates.

Scope:

This Technical Note discusses the studies conducted by ESDU for the CFD validation of the predictions for pressure loss coefficient and flow characteristics in square-edged orifice plates. These studies used the validation data from the literature reviewed in ESDU TN 07007.

Square-edged orifice plates are found in different engineering applications, such as flow-meters, fuel lines, hydraulic systems, air conditioning systems, and water pipe systems. The purpose of this work was to generate validated CFD predictions in:

- square-edged and thin knife-edged orifice plates, free of burrs and other contaminants,
- circular, concentric orifices in circular pipes with identical downstream and upstream cross-sectional areas,
- fully-developed flow conditions upstream and downstream of the orifice,
- swirl-free, steady flow conditions with no cross-flow upstream and downstream of the orifice plate and flow normal to the orifice plate,
- laminar, transitional and turbulent flow regimes, and
- single-phase, Newtonian liquids and gases (Mach number ≤ 0.3 at the *vena contracta* plane) in incompressible flow.

The CFD validation studies presented cover the following geometrical configurations and pipe Reynolds numbers:

- diameter ratios: $0.3 \leq \beta \leq 0.7$; orifice thickness to diameter ratio: $0.01 \leq t/d \leq 5.0$.
- laminar, transitional and turbulent flow regimes: $10 \leq Re_D \leq 10^5$.

Based on the comparisons of the ESDU CFD predictions with the experimental data in the literature, best practice guidelines are provided for the modelling of the flow characteristics and pressure loss in square-edge orifice plates.

Issue 5 – April 2011

Keywords: Best Practice Guidelines, CFD, characteristic, coefficient, discharge, experiment, experimental, flow, incompressible, laminar, LDA, long, loss, measurement, meter, modelling, orifice, perforated, pressure, square rectangular, separation, short, thick, thin, transition, turbulence, validation.

ESDU Series: Fluid Mechanics, Internal Flow.

ESDU Related Data Items/Software: None.

Target Completion Date: June 2011.

Issued ESDU Data Item No: ESDU TN10013.

Issue 5 – April 2011

IHS Global Limited, 133 Houndsditch, London, EC3A 7BX, UK
<http://www.ihs.com/contact/support.htm>



Documents
Document Sharing Hub