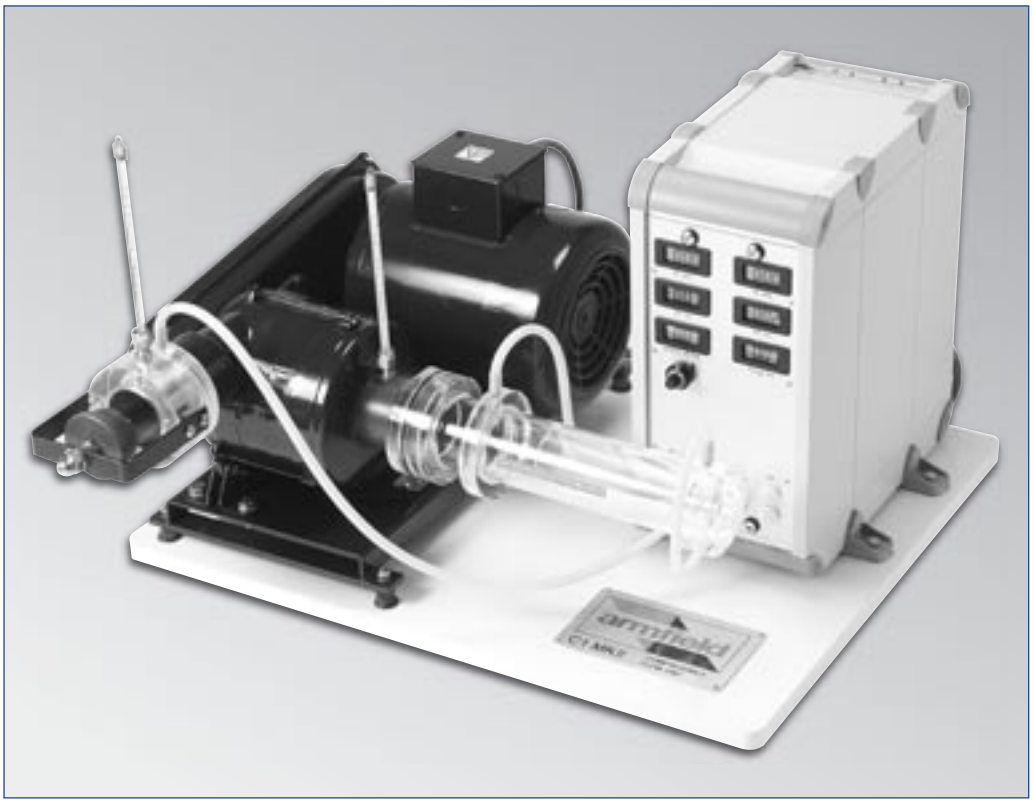
armfield

COMPRESSIBLE FLOW UNIT

C1MKII
issue 1



C1-MKII Compressible Flow Unit shown with the C1-MKII-35 Compressor Test Accessory

A versatile apparatus, based around a multi-stage, air compressor, designed to teach the concepts of compressible flow. The basic unit contains all that is required to demonstrate the fundamental principles, but also an accessory (C1-MKII-35) is available containing a number of interchangeable test sections to give a wider knowledge and understanding to the student. A further accessory (C1-MKII-35) allows full compressor performance and characterisation tests to be carried out.

This new MkII version offers greatly improved flexibility and ease of use. It also benefits from electronic instrumentation avoiding the need for mercury manometers

FEATURES

- *Variable speed compressor with accurate electronic speed control*
- *Electronic pressure sensors*
- *Standard unit includes convergent-divergent duct designed to produce Mach 1 velocity at the throat.*
- *Data Logging option*

Applied Fluid Mechanics

EXPERIMENTAL CAPABILITIES

Basic Unit (C1-MkII):-

- *Phenomenon of choking in a convergent-divergent duct*
- *Pressure flow characteristic of a convergent-divergent duct*
- *Effect of Compressibility on flow equations*
- *Determination of γ for Air*

Added Capability with C1-MkII-30 Accessory

- *Simple pipe friction*
- *Variation of friction coefficient with Reynolds number*
- *Friction coefficient for compressible flow*
- *Pressure recovery across a sudden enlargement*
- *Pressure drop across a pipeline orifice*
- *Pressure drop across a 90^{o} bend*

Added Capability with C1-MkII-35 Accessory

- *Centrifugal compressor performance characteristics*
- *Energy balance for compressor*

DESCRIPTION

The C1-MkII equipment comprises a multi stage air compressor, complete with a test section and a throttling valve, plus an electronics console containing the necessary controls and instrumentation.

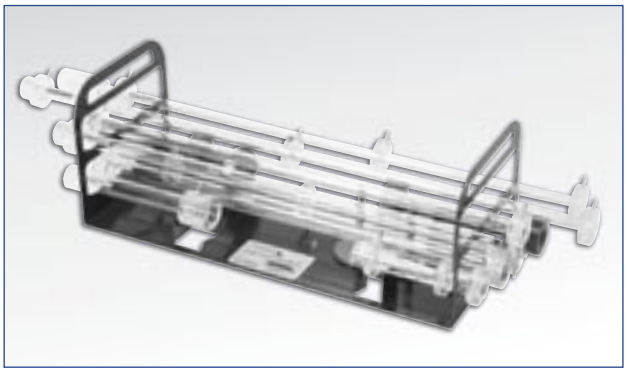
The four stage compressor is driven by a three phase AC motor via a fully guarded drive belt. The compressor speed can be varied using an advanced torque-vector frequency inverter which gives stable and accurate speed control plus direct electronic read-out of the torque produced by the motor. The compressor is fitted with an outlet duct incorporating a throttling valve, which allows the flow to be varied.

The equipment is supplied with a convergent-divergent test section, fitted on the compressor inlet, designed to produce Mach-1 velocity at the throat. The duct is fabricated from clear acrylic, enabling the student to see the construction and the profiles. A pressure sensing ring tapping is provided at the inlet, at the throat and at the discharge end of the diffuser. This duct allows all the major concepts of compressible flow to be demonstrated.

Convergent-divergent test section

The electronics console includes two high range and two low range differential pressure sensors plus a control for motor speed and displays for the compressor speed, the pressures and the motor torque.

C1-MkII-30, Additional Test Sections



C1-MKII-30 Additional Test Sections

The C1-30 option includes additional inlet test sections for further demonstrations and investigations into compressible flow. The test sections are made from clear acrylic to aid visualisation and fitted with pressure sensing ring tappings.

This accessory includes a bench stand to house all the accessories (plus the standard test section and the C1-MkII-35 test section) when these are not being used.

Additional Sections Provided:

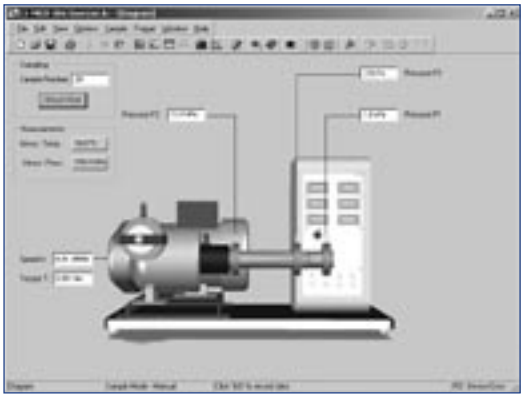
- *Three straight ducts of different diameters, to allow pressure losses incurred in a straight pipe to be studied in relation to Reynolds number.*
- *A sudden enlargement section*
- *A 34mm nominal bore test section with four interchangeable orifice plates.*
- *A 90° bend test section. Provision is made to investigate the radial pressure difference across the bend.*

C1-MkII-35 Compressor Test Accessory

C1-MKII-35 Compressor Test Accessory

The C1-35 Option comprises a test section to measure the air flow entering the compressor. This facility, in conjunction with the electronic torque measurement and thermometers on the basic C1-MkII, allows full compressor performance tests to be conducted over a wide range of shaft speeds.

C1-MkII-50 Data Logger and Educational Software



Software screen shot

The C1-MkII-50 includes electronic thermometers, and a computer interface device to allow the temperatures and pressures to be data logged on a Windows pc.

The advanced educational software provides a wide range of data-logging and plotting options. A personal computer running Windows 98, 2000 or XP, with a spare USB interface is required (not supplied by Armfield).

SPECIFICATIONS

Compressor speed: 12,200rpm (max)
No. Stages: 4
Motor Power: 0.56 KW
Sensors: +/- 1.2kPa 2 off
+/- 100kPa 2 off

ORDERING SPECIFICATION

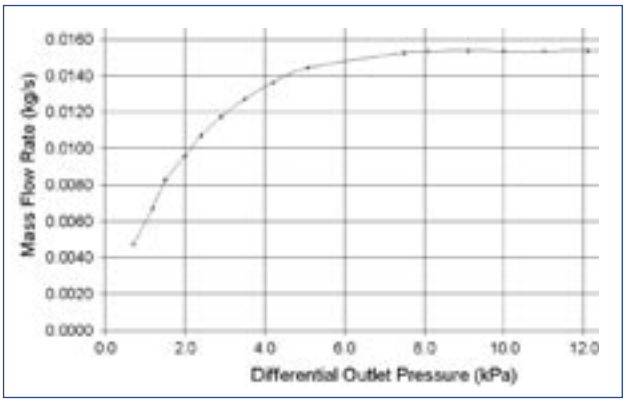
- ***A bench top unit designed to demonstrate and teach the fundamentals of compressible flow to engineering students***
- ***Complete with convergent-divergent duct capable of achieving Mach-1 velocity at the throat***
- ***Advanced torque-vector speed control with electronic torque measurement***
- ***Four electronic pressure sensors***
- ***Test Sections made from clear acrylic***
- ***Additional test sections available (6 off) complete with bench-top stand***
- ***Compressor test accessory available***
- ***Data Logging accessory, complete with educational software and electronic temperature sensors***

SERVICES REQUIRED

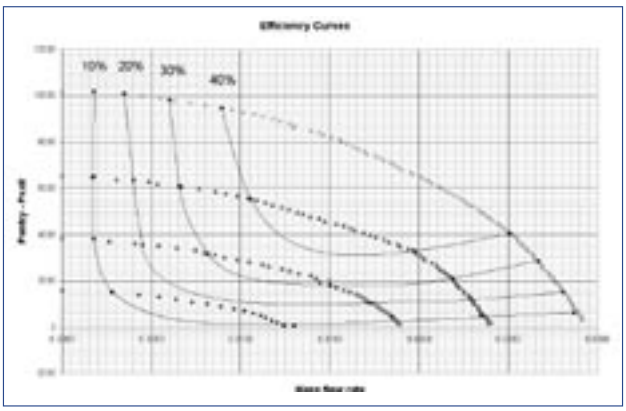
Electrical Supply:
C1-MkII-A: 220-240V/1ph/50Hz/6A
C1-MkII-B: 110-120V/1ph/60Hz/10A
C1-MkII-G: 220-240V/1ph/60Hz/6A

Armfield Limited
Bridge House West Street Ringwood
Hampshire England BH24 1DY
Tel: +44 (0)1425 478781
Fax: +44 (0)1425 470916
E mail: sales@armfield.co.uk
URL: http://www.armfield.co.uk

USA Office:
Armfield Inc.
436 West Commodore Blvd (#2)
Jackson NJ 08527
Tel: (732) 928-3332
Fax: (732) 928-3542
E mail: info@armfieldinc.com



Graph showing the effect of choking in a Convergent-Divergent duct.



Performance curve obtained with C1-MKII-35

OVERALL DIMENSIONS

C1-MkII
Height: 0.39m
Width: 0.6m
Depth: 0.66m

C1-MkII-30
Height: 0.31m
Width: 1.25m
Depth: 0.34m

SHIPPING SPECIFICATION

	Weight	*Volume*
C1-MkII	*50kg*	*0.3^3*
C1-MkII-30	*20kg*	*0.5^3*
C1-MkII-35	*10kg*	*0.03^3*
C1-MkII-50	*10kg*	*0.03^3*

Specifications may change without notice iss1/5k/0106/BCP.