University of Sussex

Engine Testing and Modelling

505H3

School of of Engineering & Informatics
University of Sussex
Falmer, Brighton, BN1 9QT

Engine Testing and Modelling

Teaching Pattern

Lectures, 2 hours per week.

Project /tutorial time: 2 hours in every odd week.

Course Convenor

Dr. W.J.Wang
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Office: 3A10 Richmond

Course material

Study Direct or www.sussex.ac.uk/~tafb8/etm/etm.html

Assessments

- 2 individual projects.

- Project reports are required to be handed in to the school office in week 6 and week 10 on the relevant Thursday before 16.00pm.

- Each of the two projects will have an equal weighting of 50%.

- Mark will be deducted in the normal fashion if you are late in handing in.

Course outline

Engine testing technology and test design; the use of sensors including temperature, pressure, force, torque, velocity, displacement, mass flow, vibration, emissions and laser diagnostic techniques.

Calibration and metering technology, instrumentations for mapping and ECU communications. Interpretation of test data.
Engine control systems for fuel economy and emission level;

Modelling and simulation methods for power-trains of conventional IC engines and hybrid power systems.
Energy demand and efficiency in test cycles.

Learning outcomes

A student should be able to:

1. Understand engine testing principles and procedures.
2. Be able to design engine testing cells under practical considerations.
3. Be able to understand sensors and instrumentation, and to analyse and interpret test data.
4. Understand energy efficiency and propulsion modelling.
5. Be able to simulate fuel consumption in standard driving cycles.
6. Understand engine emission control.

Library

- Plint M, Martyr A., Engine testing theory and practice, 2nd ed., Butterworth Heinemann, 1999.
- Richard D Atkins, An Introduction to Engine Testing and Development, SAE International, 2009
- Guzzella, Lino and Sciarretta, Antonio, Vehicle Propulsion Systems, 2005
- Guzella, Lino and Onder, Christopher, Introduction to Modeling and Control of Internal Combustion Engine Systems, 2004.
- Gillespie, Thomas D., Fundementals of Vehicle Dynamics, 1992.
  Rajamani, Rajesh, Vehicle Dynamics and Control, 2005.

Assessments

Type	Learning outcomes	Timing	Weighting
Coursework			100.00%
Project Report (3500 words)	1-3	Autumn Week 6	equal weighting
Project Report (3500 words)	4-6	Autumn Week 10	equal weighting

Resit mode of assessment

Same mode

Internal-combustion Engines

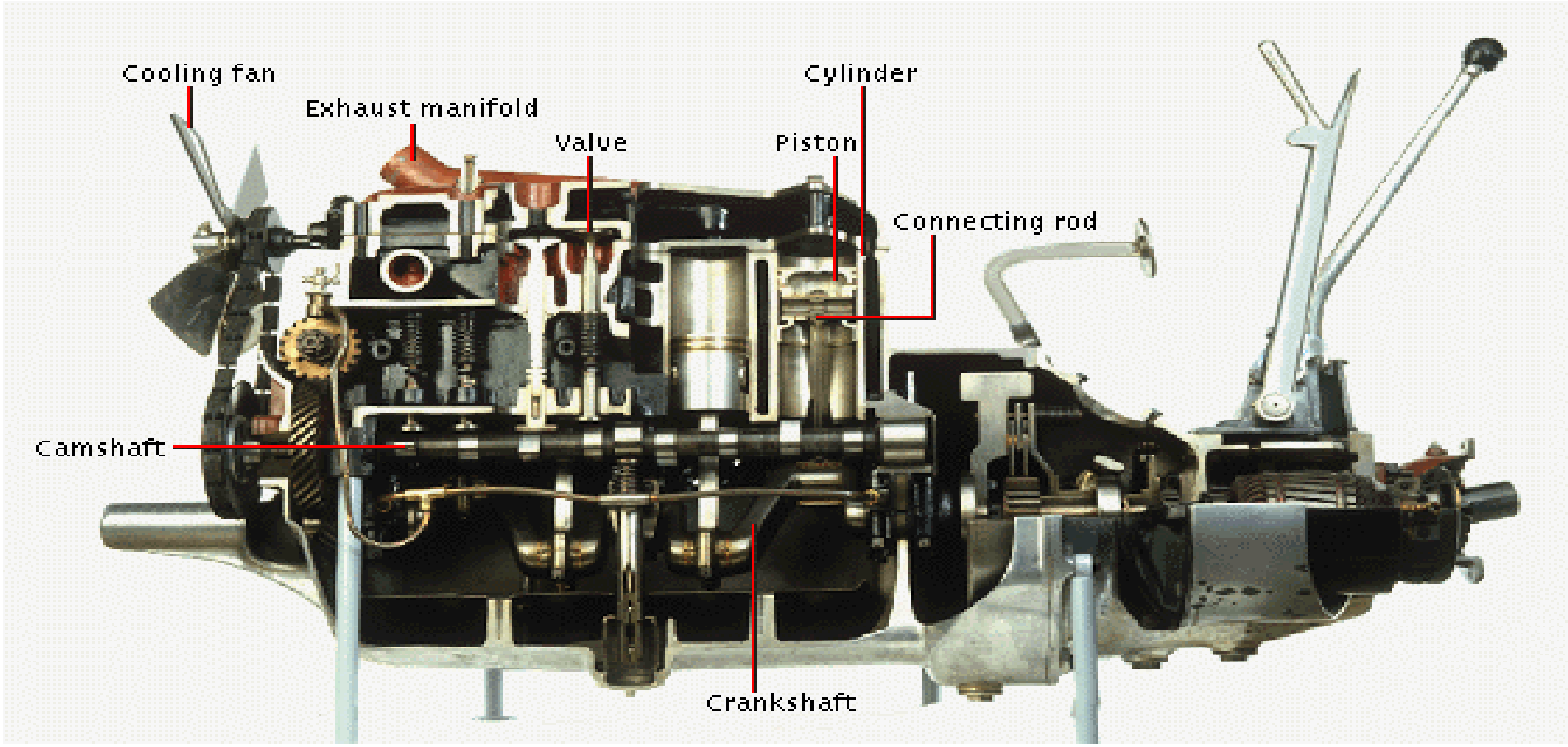
-Internal-combustion Engines are Heat engines.

-Fuel is burned inside the engine, contrasting with an external combustion engine (e.g. steam engine) in which fuel is burned in a separate unit.

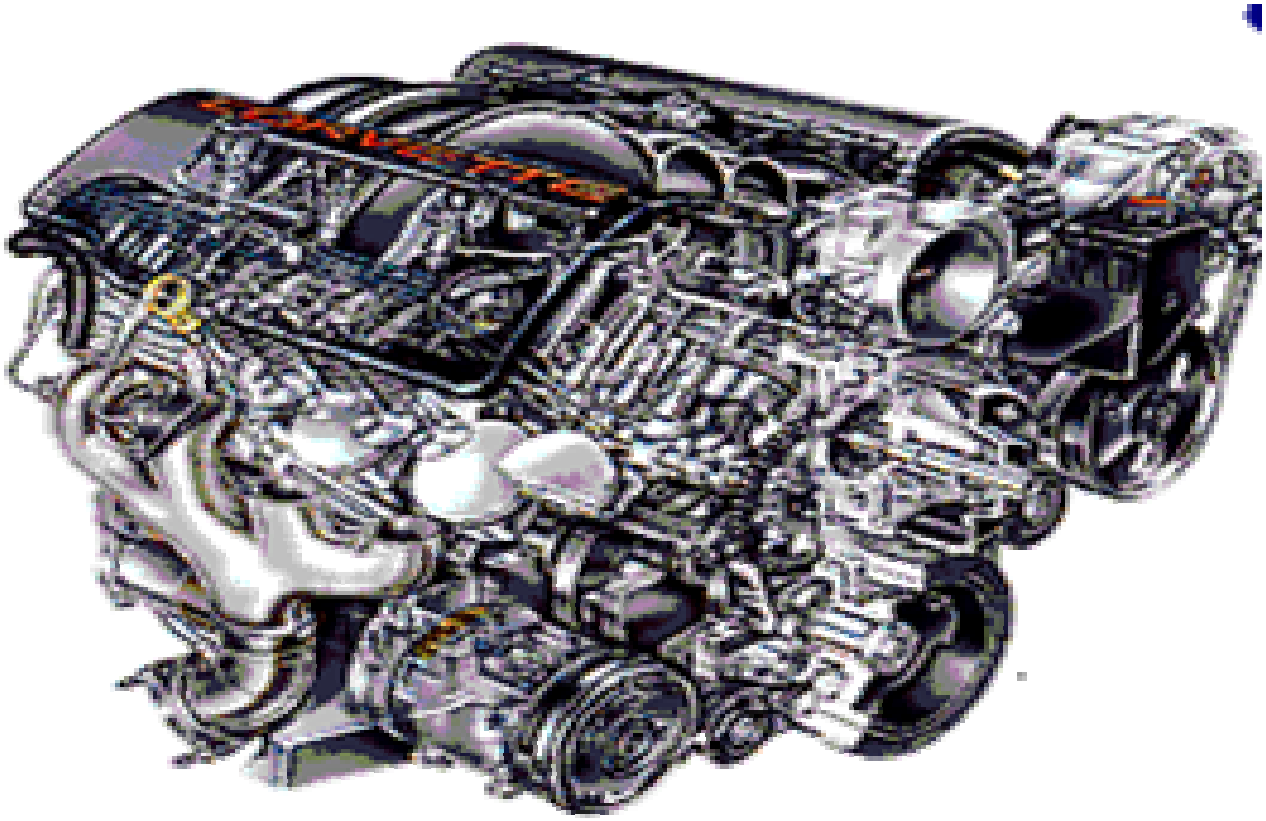
-The diesel engine and petrol engine are internal-combustion engines.

-Gas turbines and jet and rocket engines are also internal-combustion engines.
(Fuel is burnt inside their combustion chambers.)

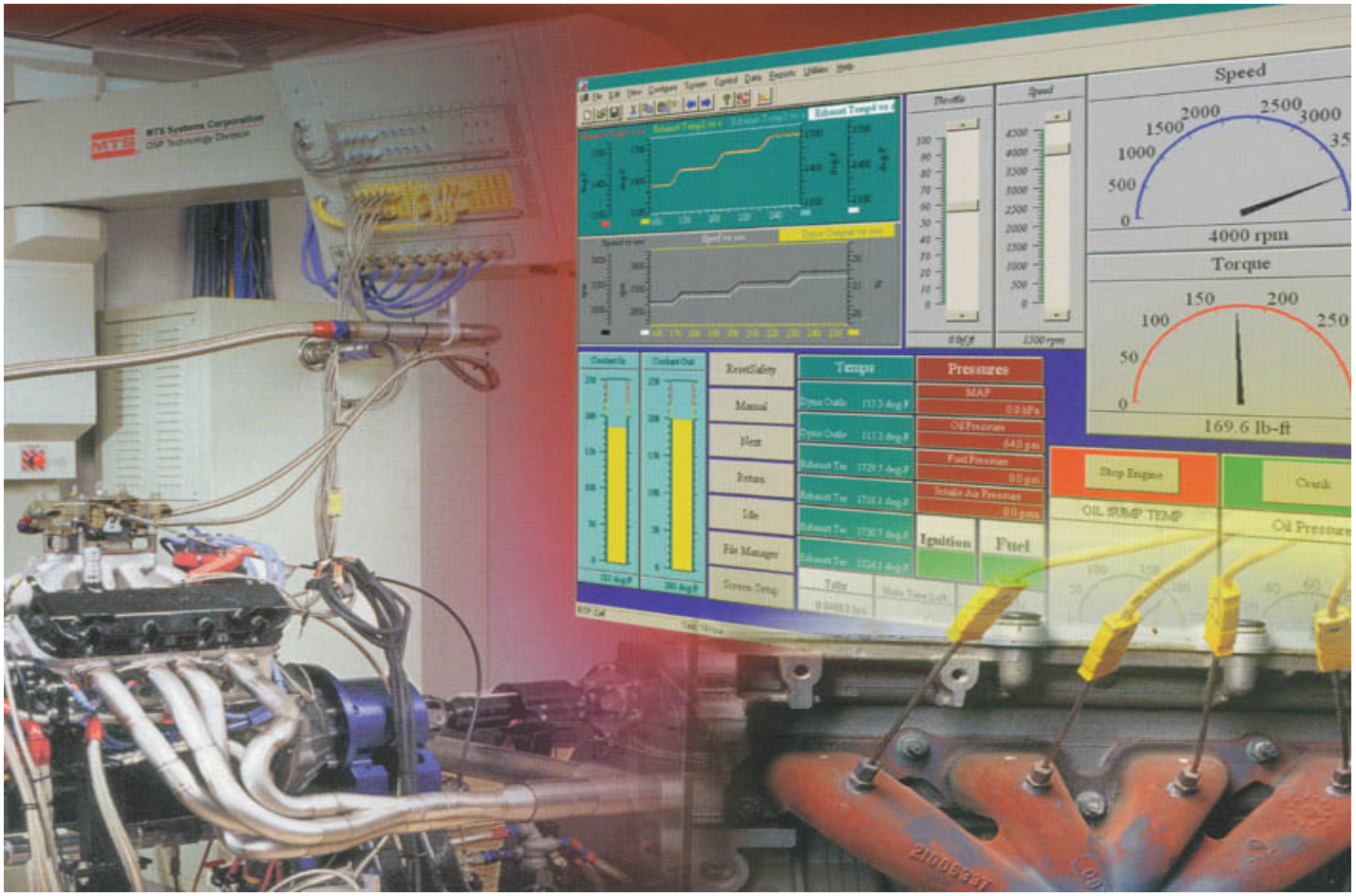
An engine of 1930's

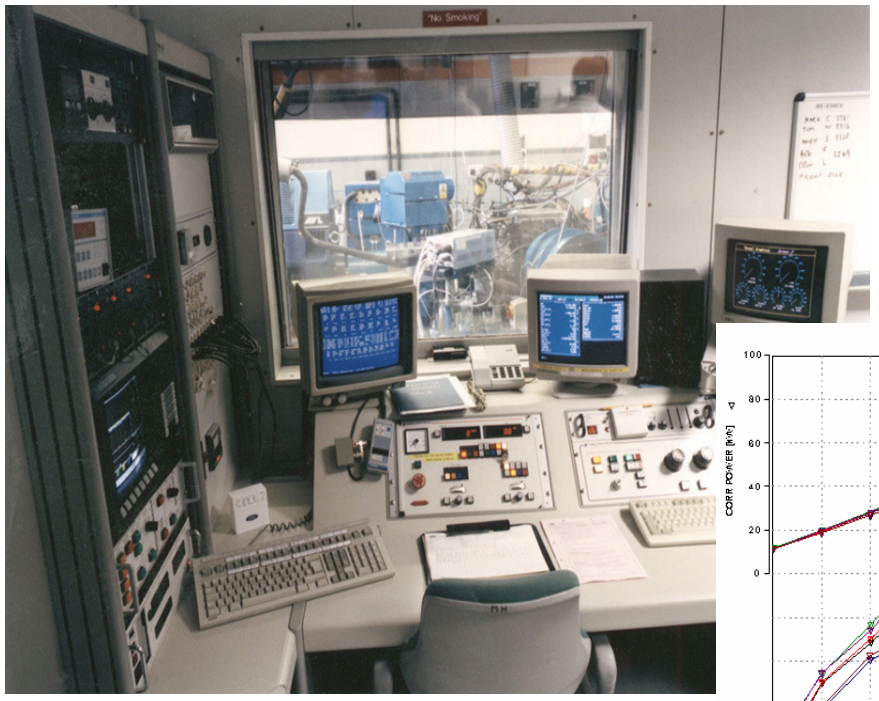


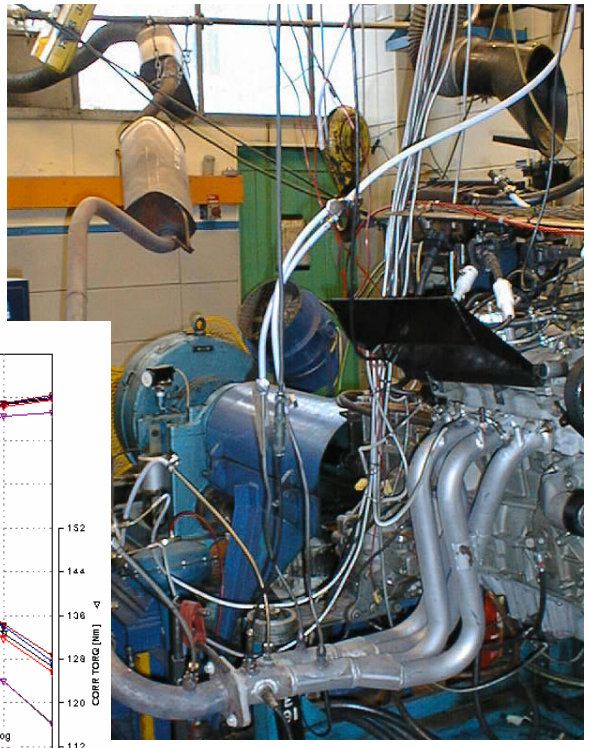
Modern engine brings technology complications

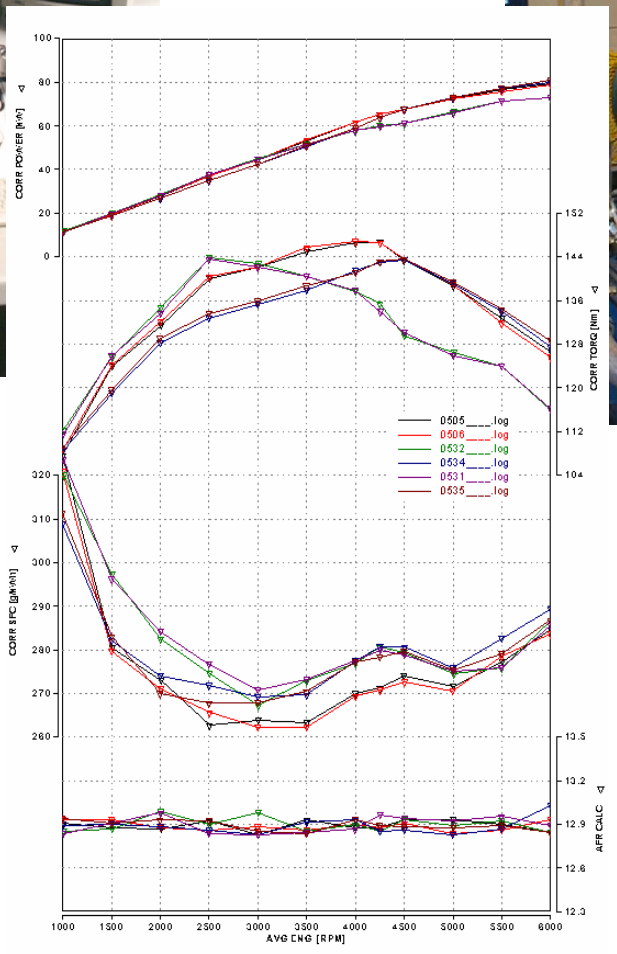


Engines have to be tested in test rooms before installation

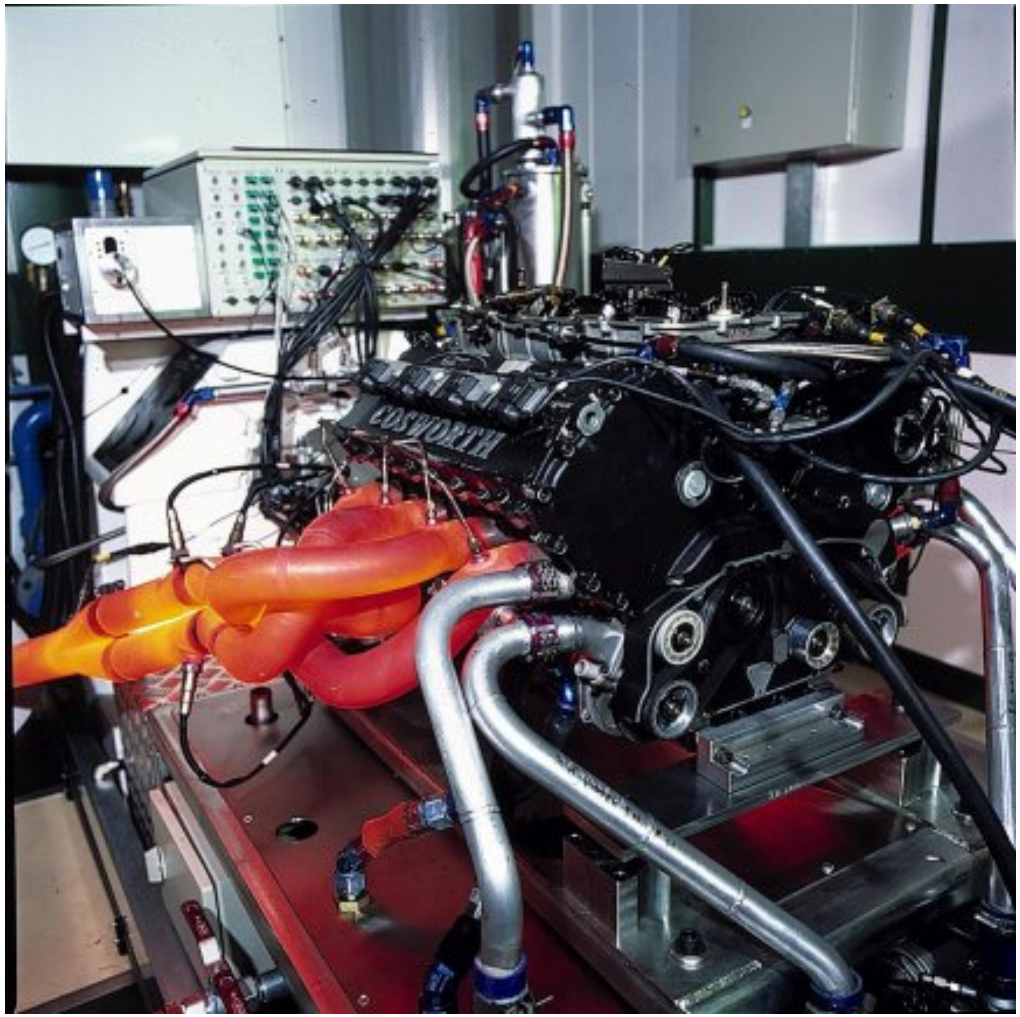


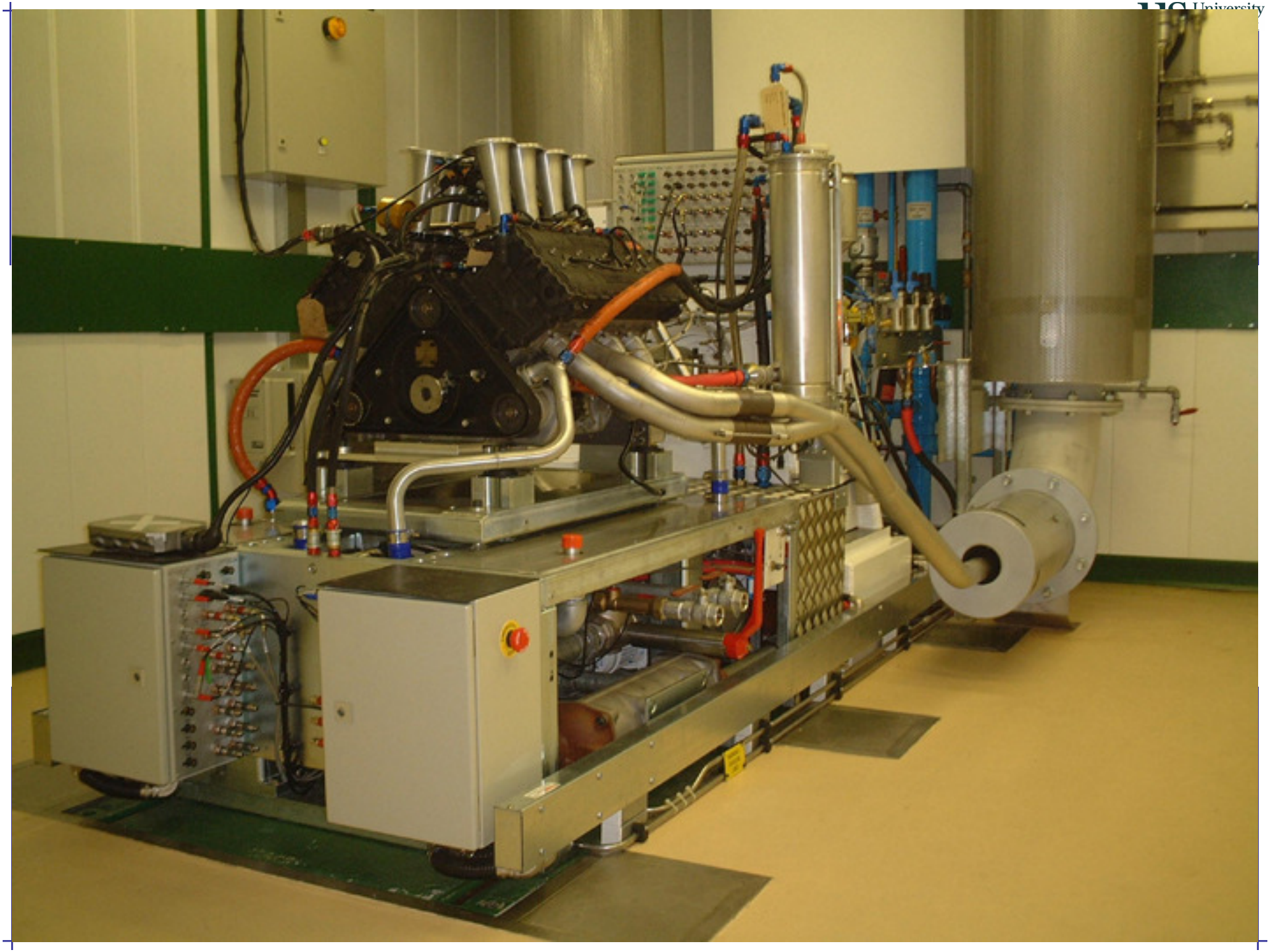

'No Smoking'



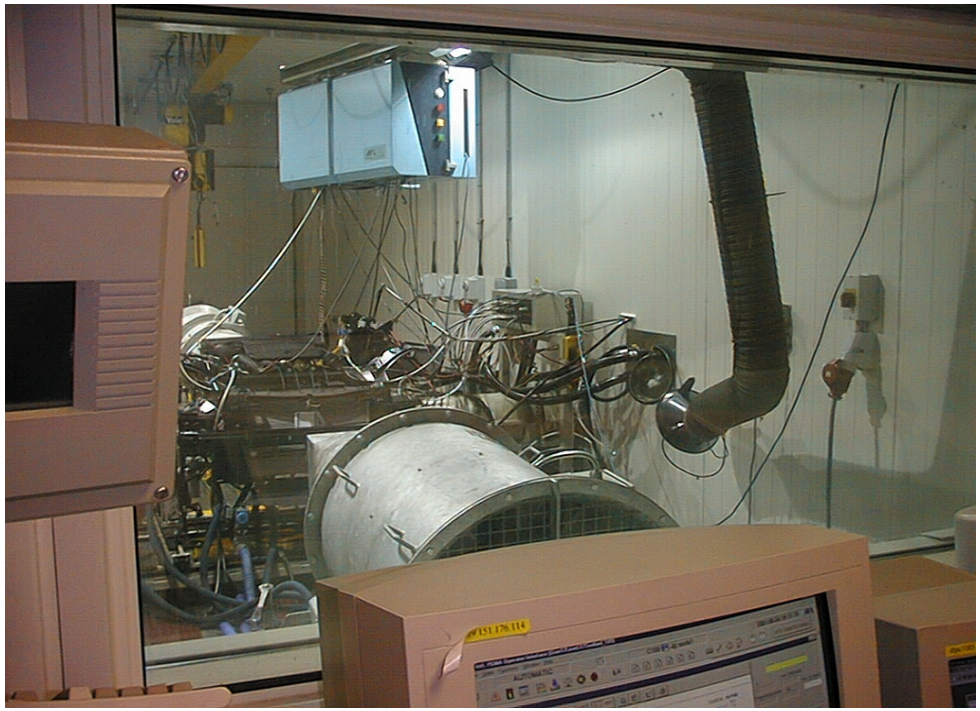

CORR POWER [kW]
CORR TORQ [Nm]
CORR SFC [g/kWh]
AFR CALC
AVG ENG [RPM]
0505____.log
0506____.log
0532____.log
0534____.log
0531____.log
0535____.log

Nicholson McLaren

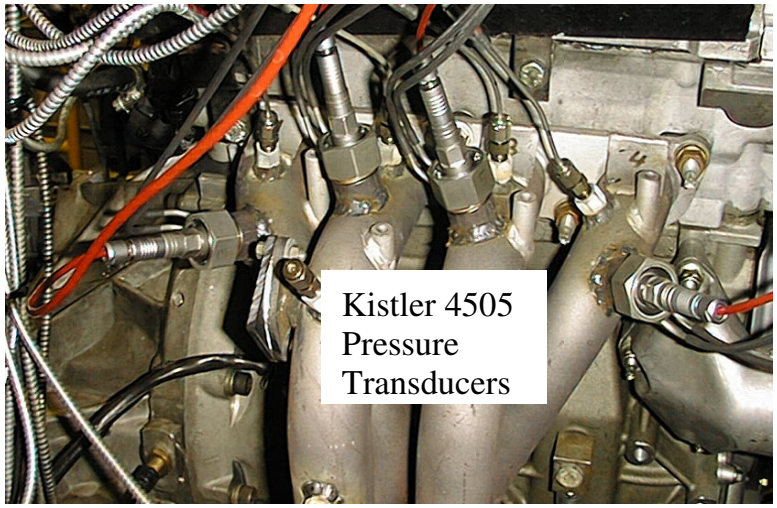


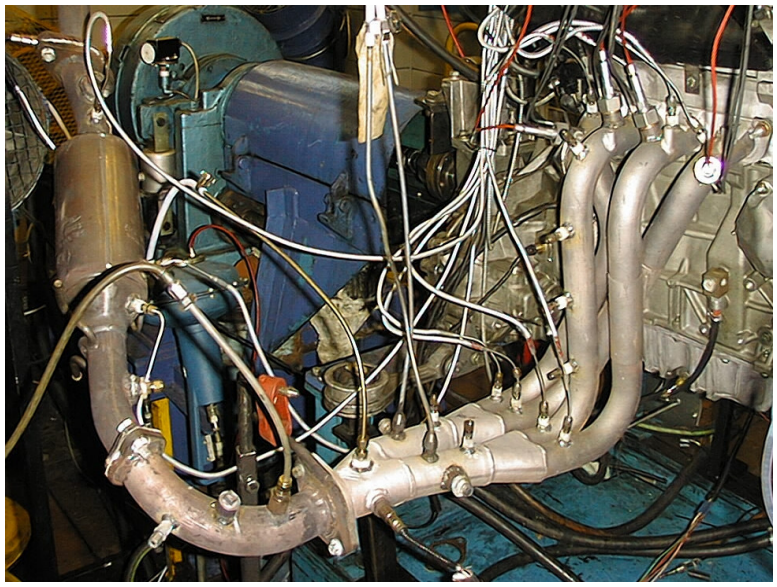


A typical engine testing control room

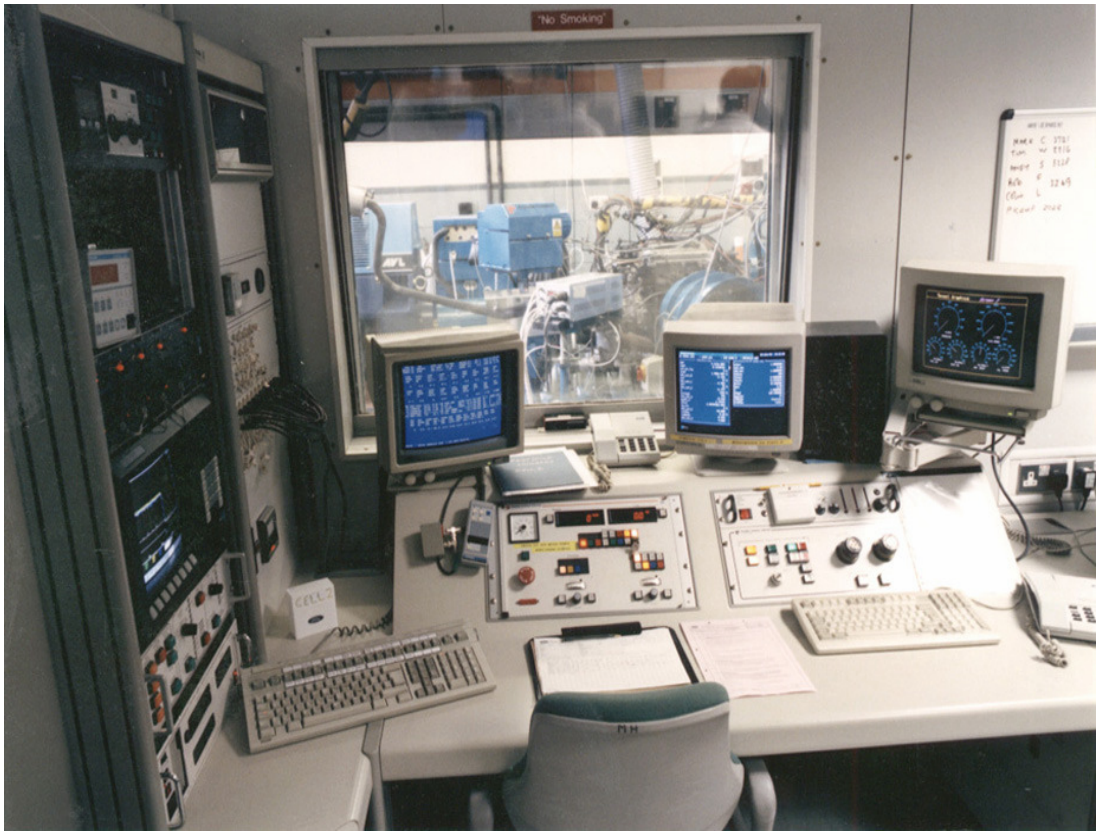


Manifold Wave Dynamics





Control Room Layout 2002



Electronic supply of test program instructions

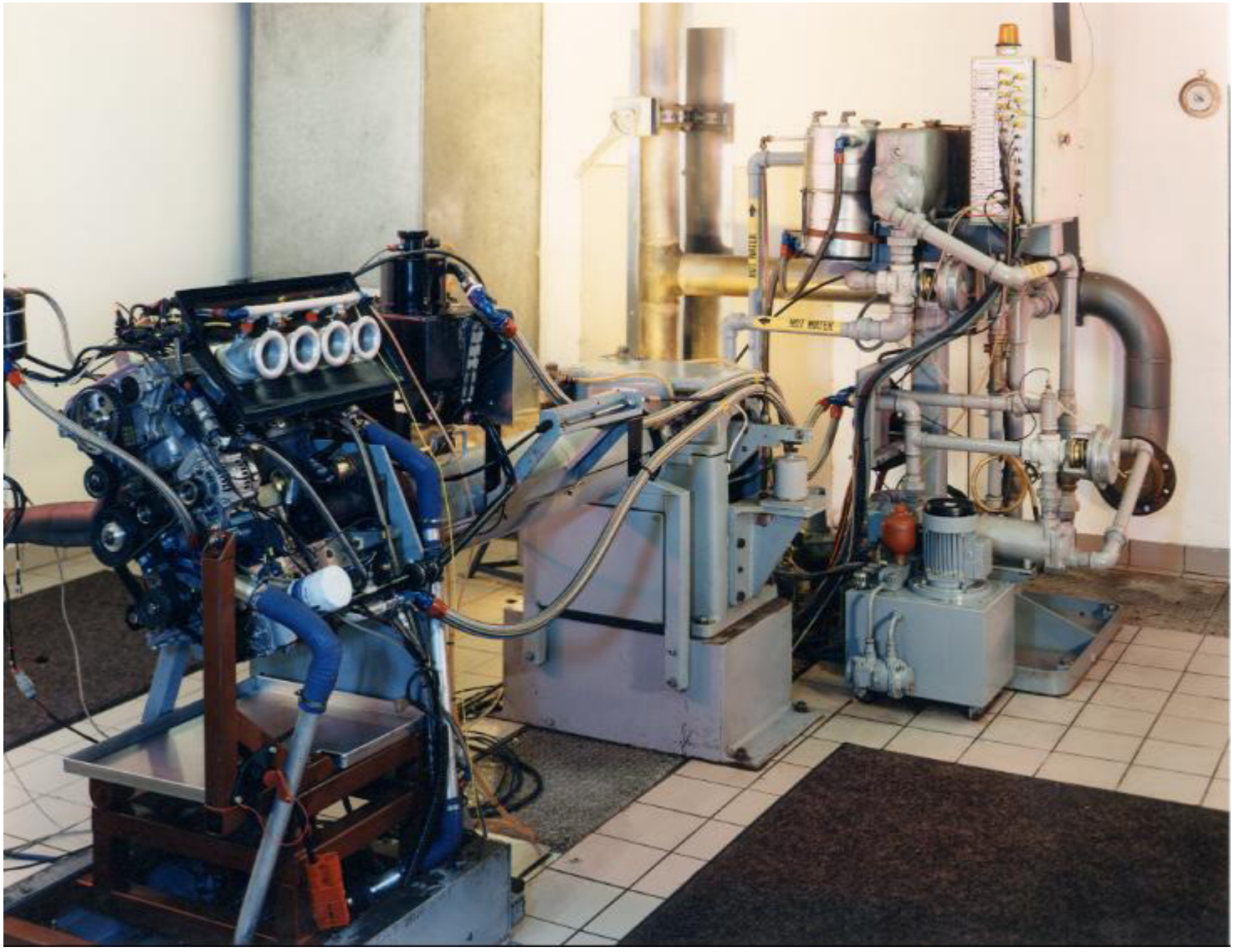
Electronic configuration of Channel data acquisition system

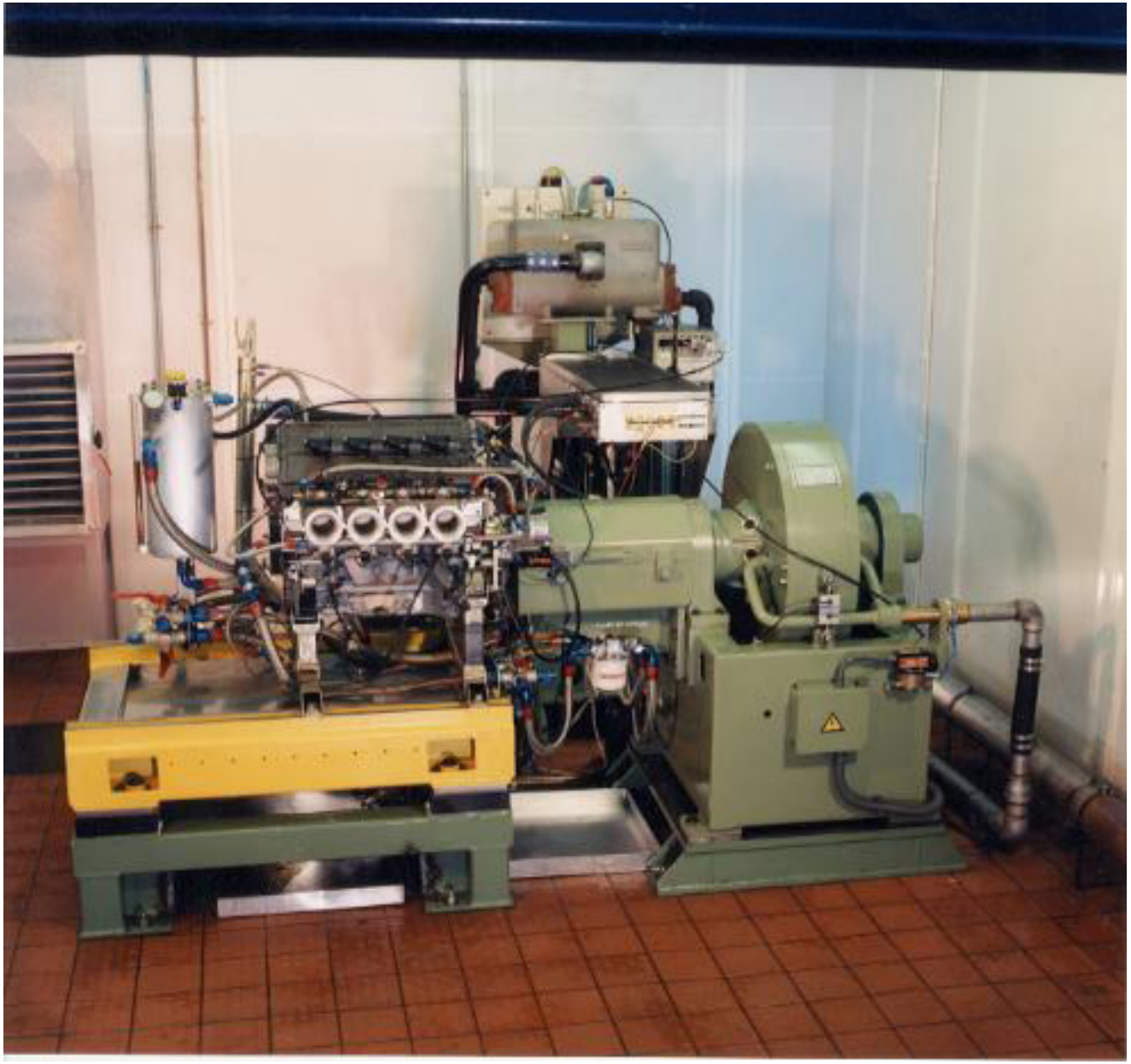
Automation of basic test programs leading to full test automation

Electronic test result data storage

Data acquisition and control at Nicholson McLaren 2005

Caterpillar Truck Race engine 1650 BHPc



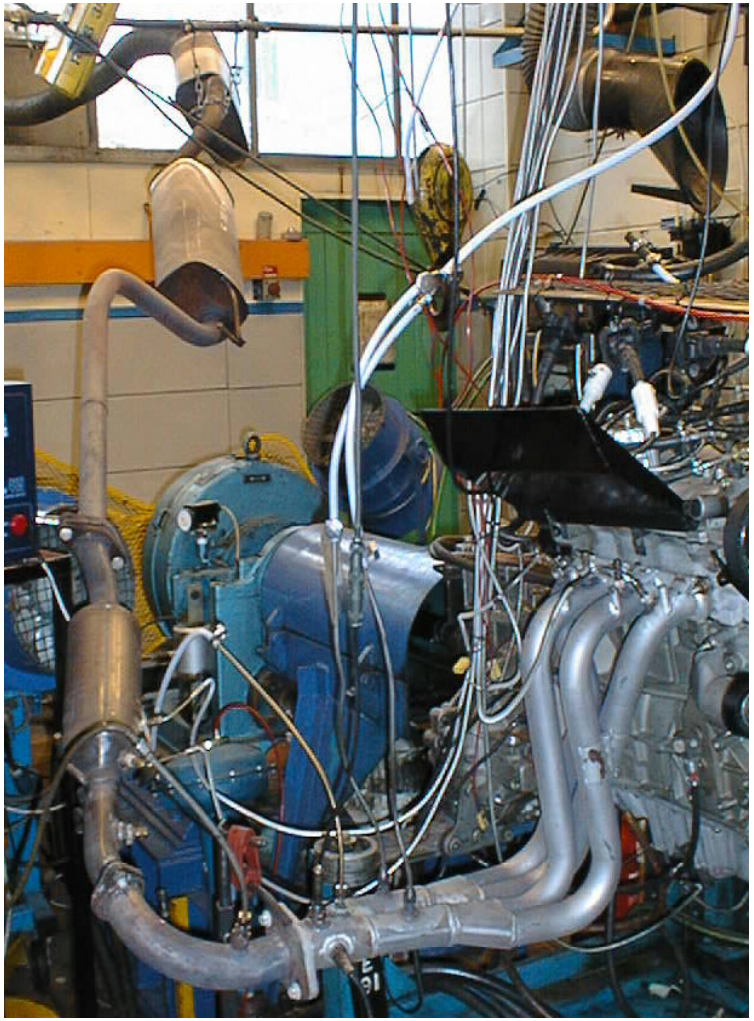


Emissions measurement system

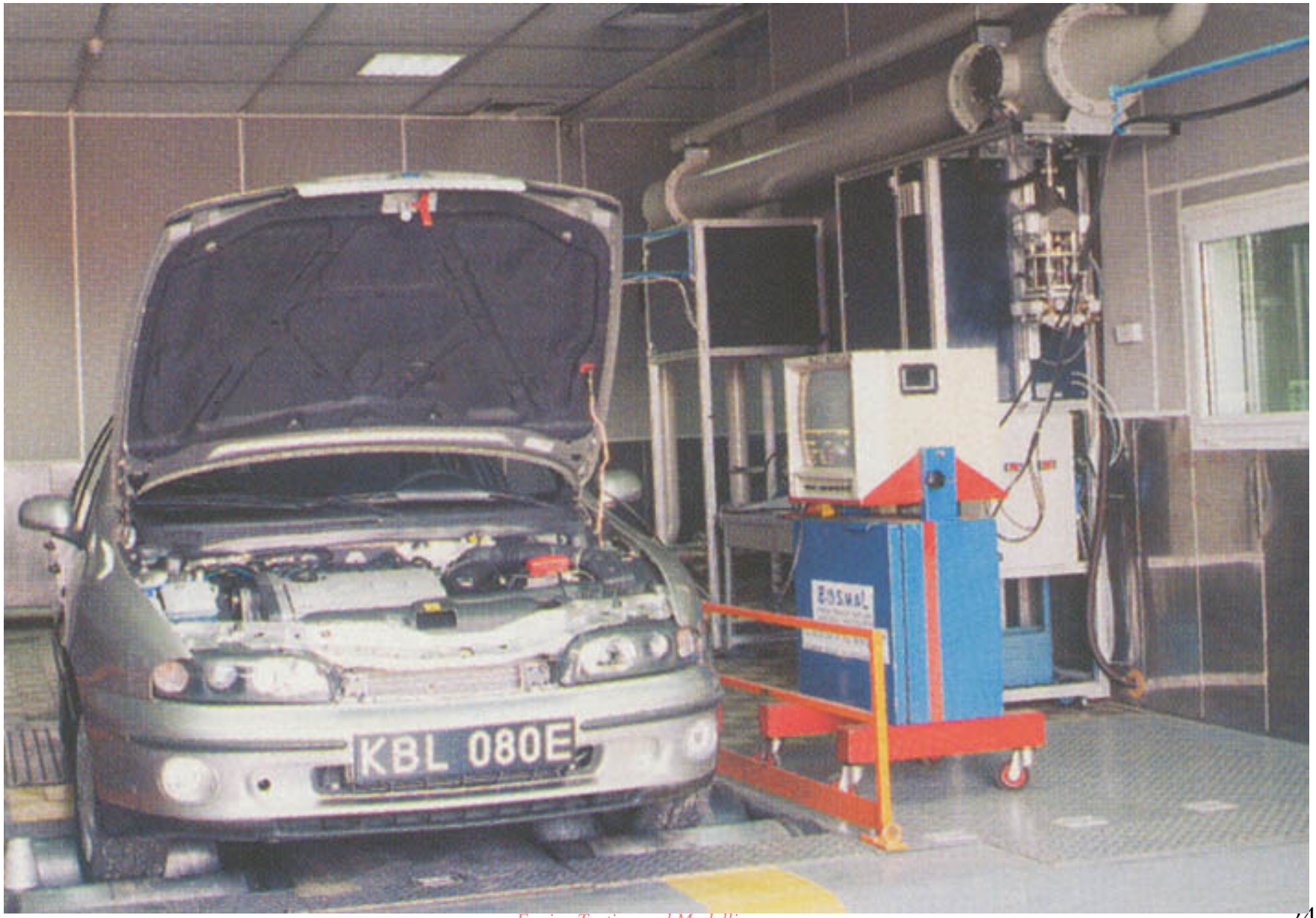
Exhaust Emission Laboratory of BOSMAL Automotive R&D Centre

A Test cell of 1970's to 1990's Ford Dunton

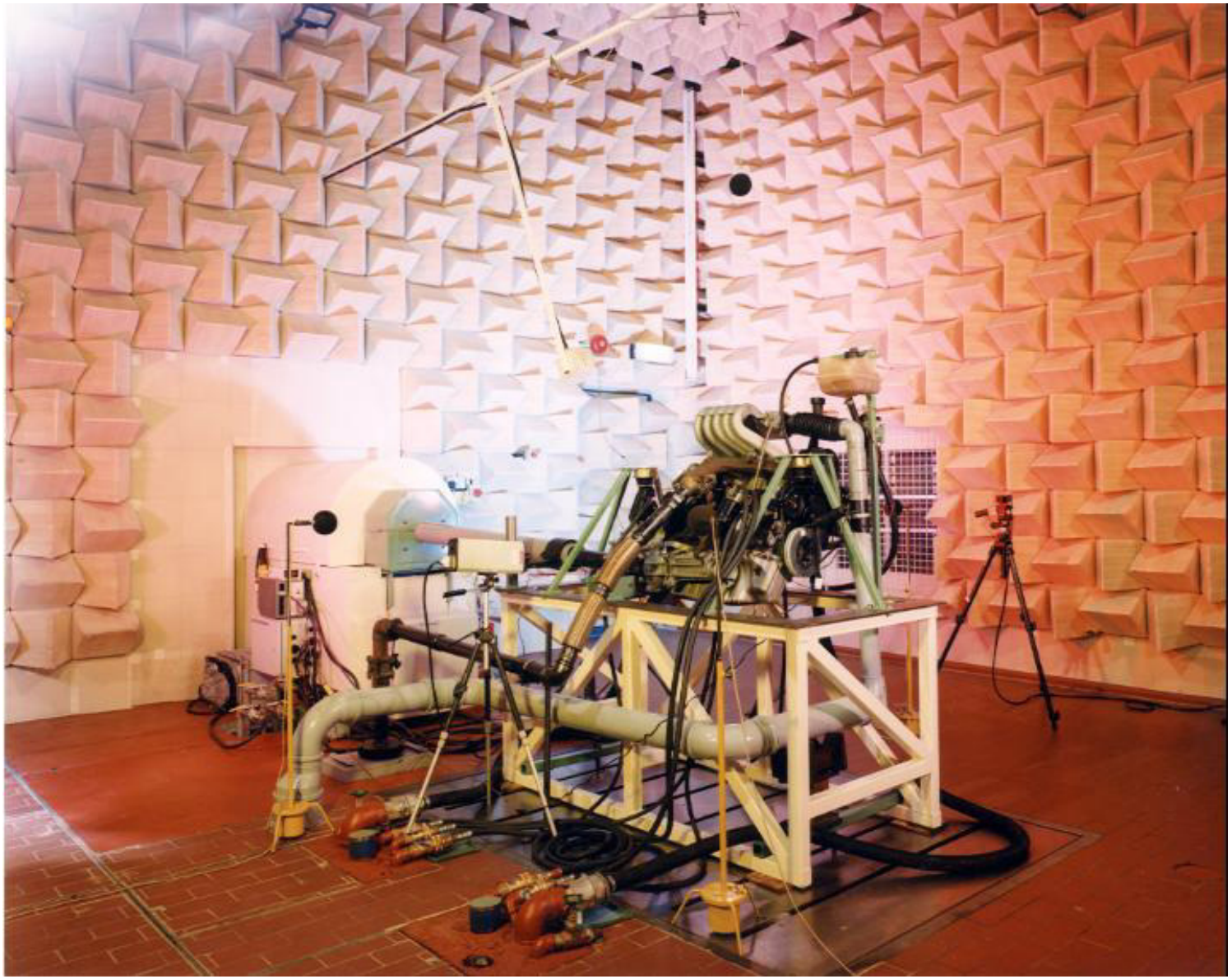
- 72 Channels Primary Data
- (Pressure Temperature)
- 72 Channels Calculated Data
- CorrTorque, Vol Effy, AFR Calc
- Eddy Current Dynamometer
  (150 kW @ 8000rpm Typical)
- Pierburg Fuel Flow Meter
- Horiba Emission Analysis
- MEXA 9000, 7000 series
- THC (total hydrocarbon), NOx, CO, CO2, O2 Analysis
- Full Induction & Exhaust System



Vehicle Testing



Testing in anechoic chamber



Outside look: CRITT M2A - Automotive Research Centre at Bethune 2006

Layout of A Typical Test Laboratory