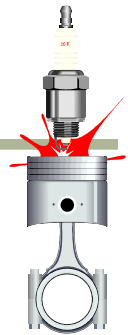


Evolution of Emissions Measurement Techniques

Past Developments and Future Trends

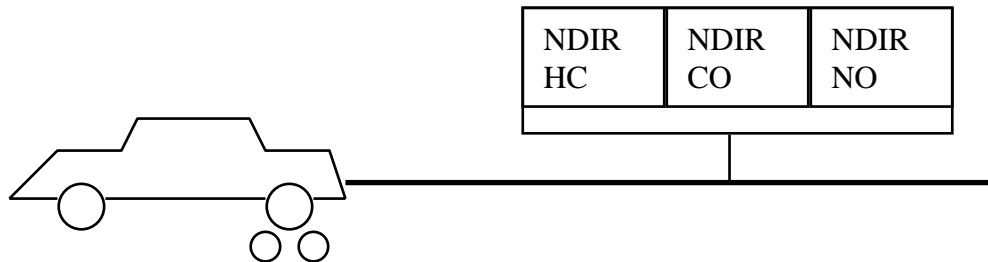
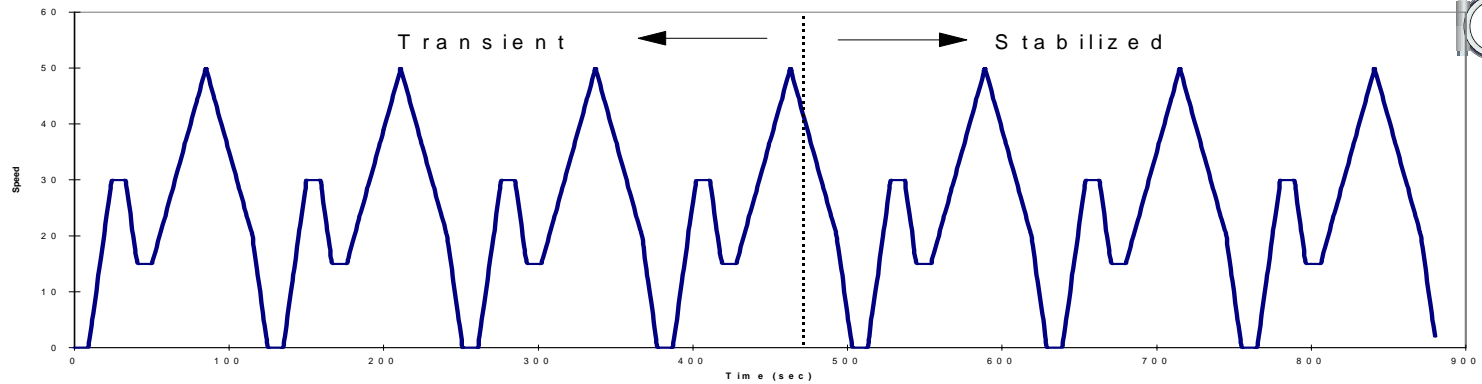
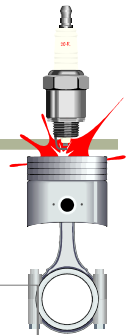
By HORIBA Instruments, Inc.
29 Apr 1998

Overview

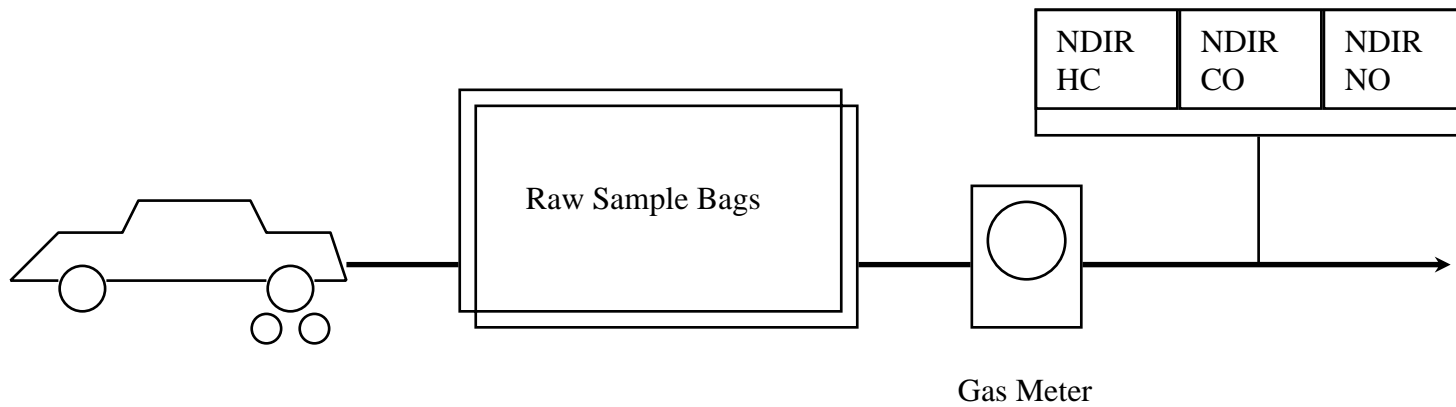
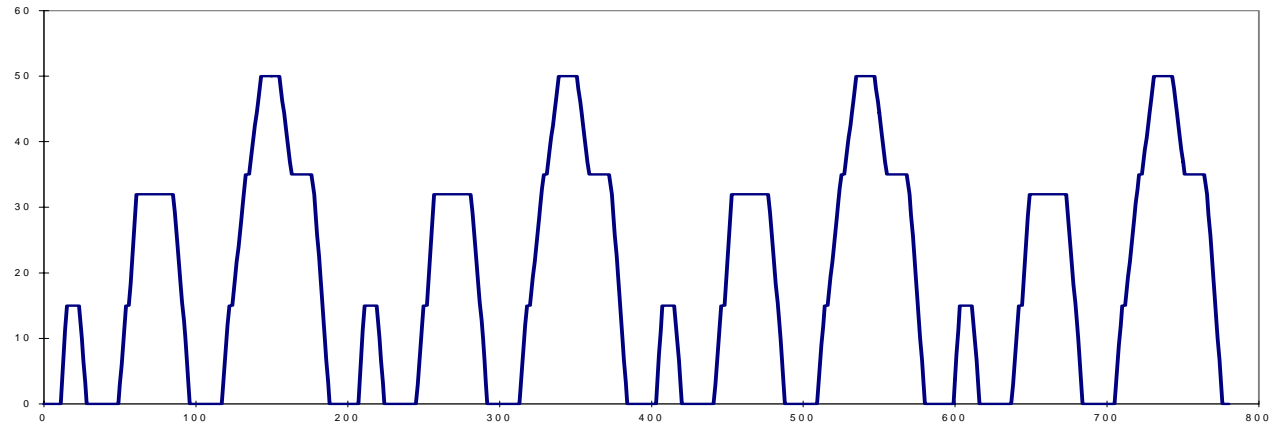
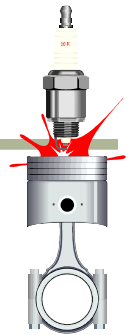


- **Evolution of Test Procedures**
 - New rules required new tests and equipment
- **Development of Improved Test Equipment**
 - Better samplers
 - Modern analyzers
 - Electric dynamometers
- **Future Problems and Methods**
 - Fast Response, FTIR , Mass Spectrometer
 - Exhaust Flow Measurement
 - Mini-Diluter

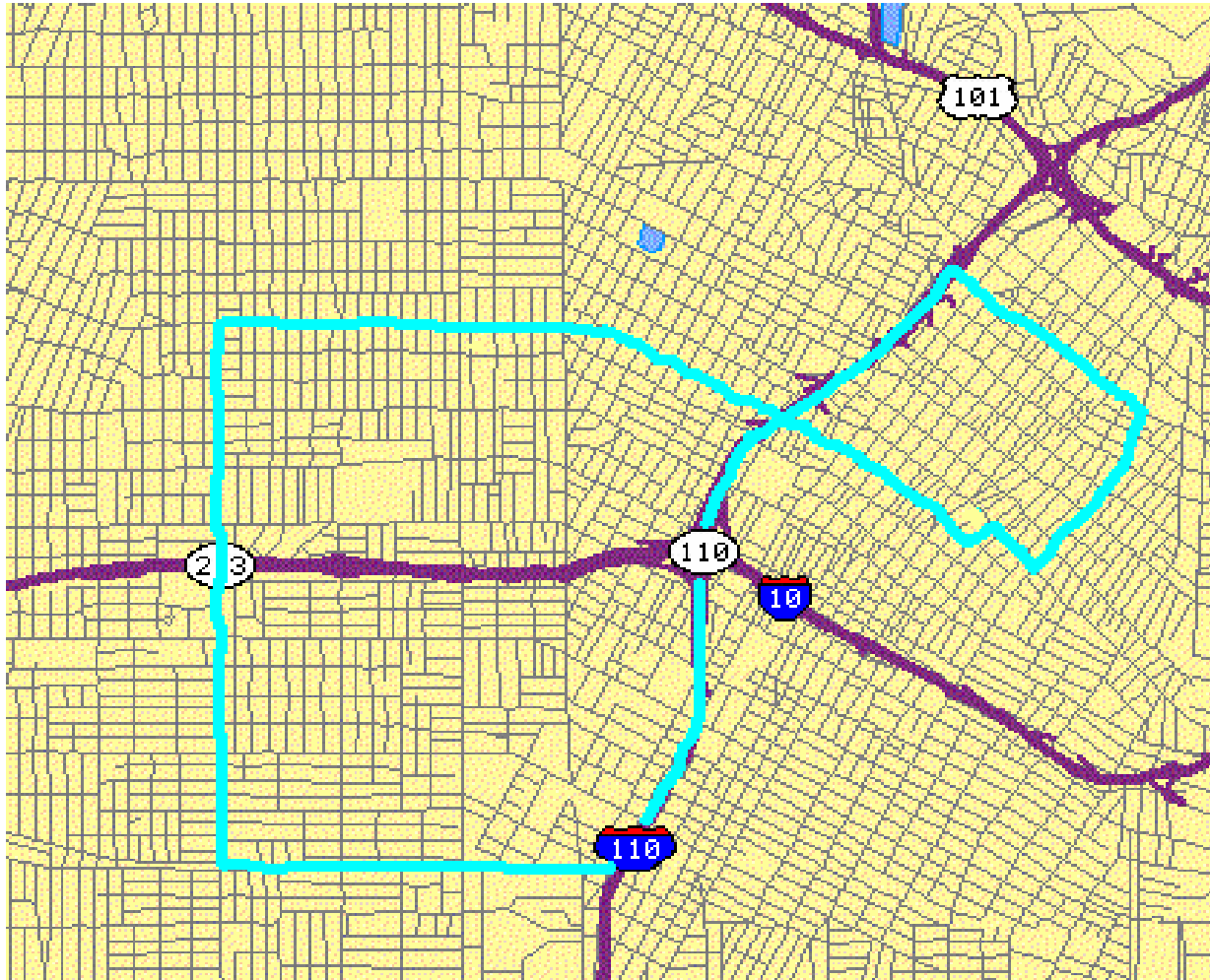
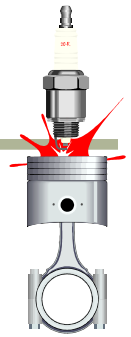
Original FTP



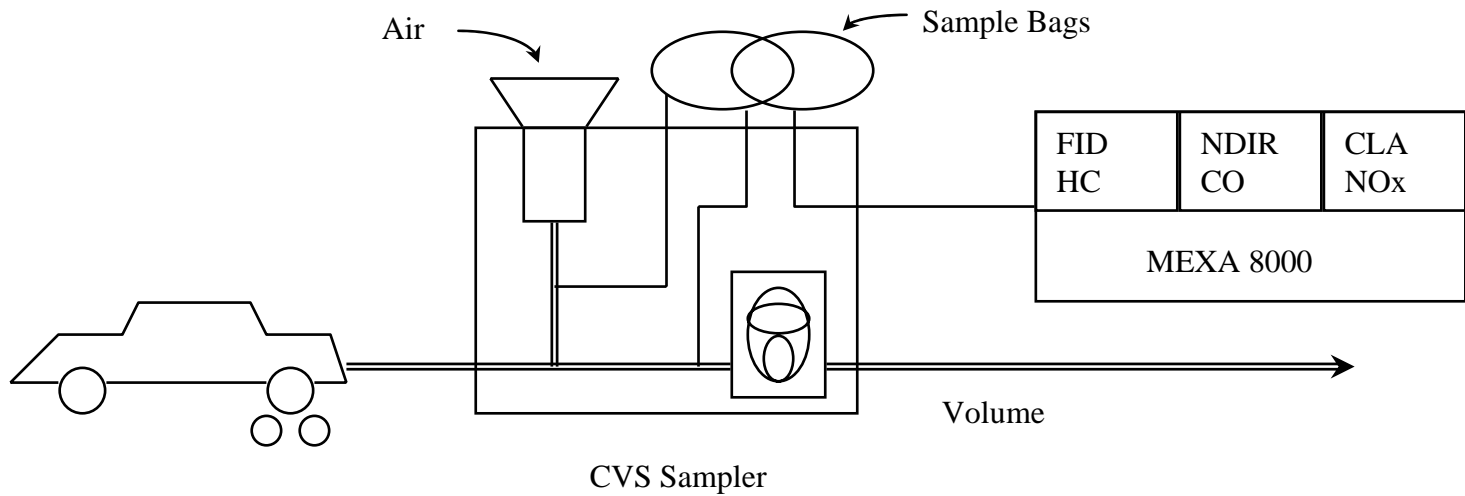
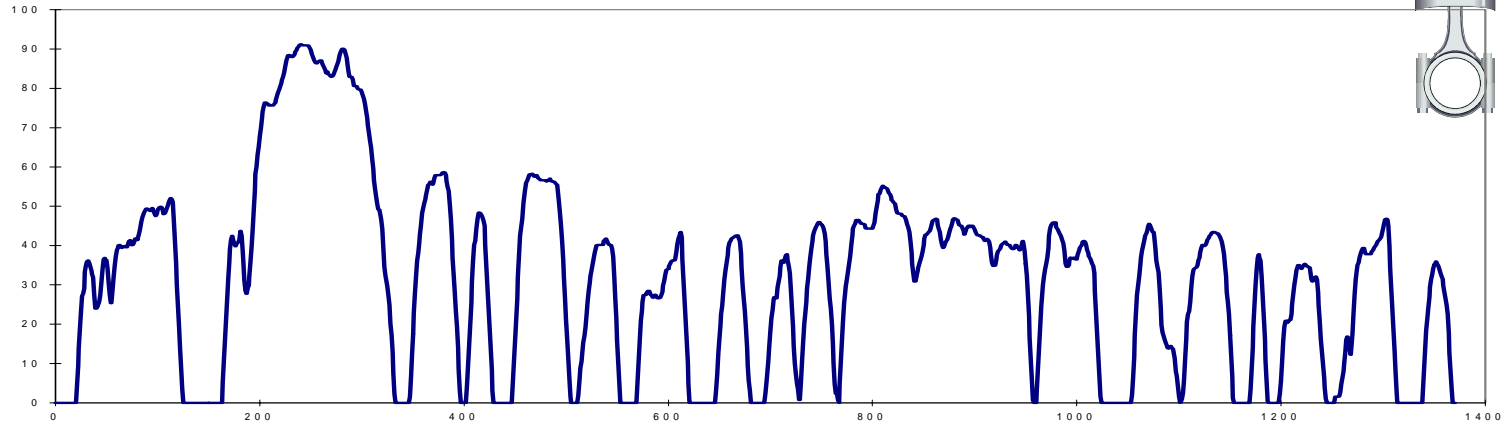
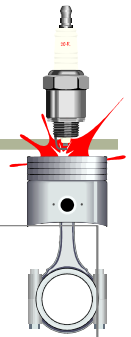
ECE Big Bag



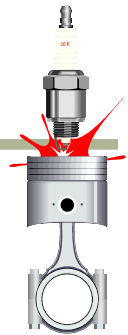
Route of the LA-4



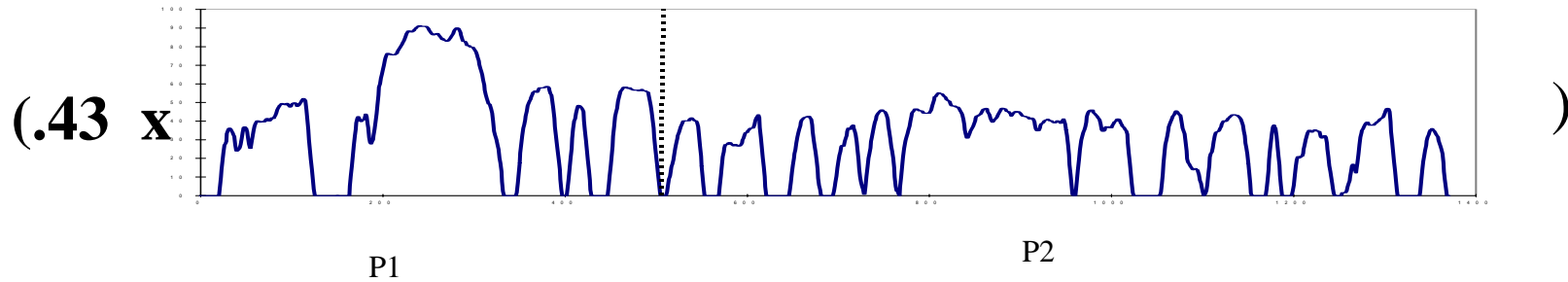
US CVS Test



US 1975 3-Phase Test

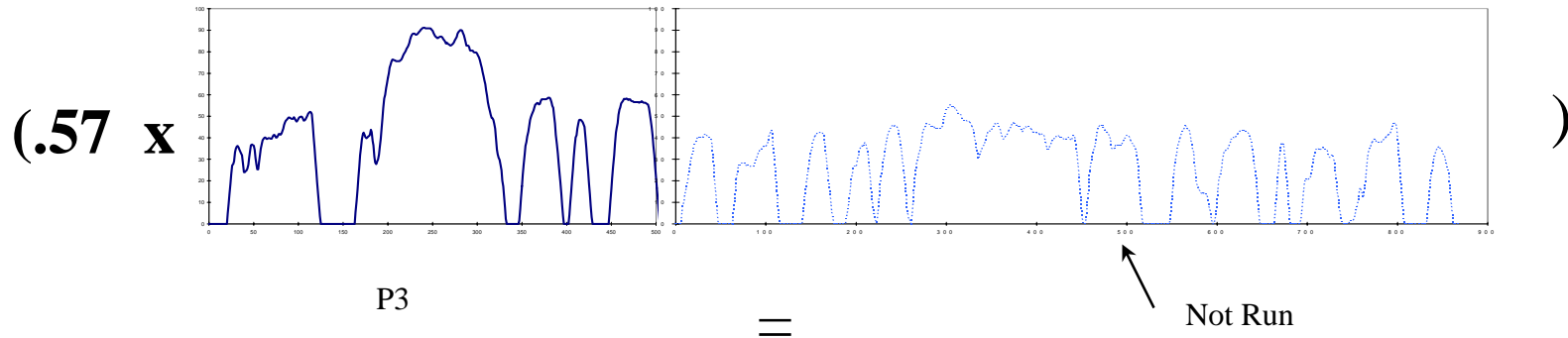


Cold Portion



+

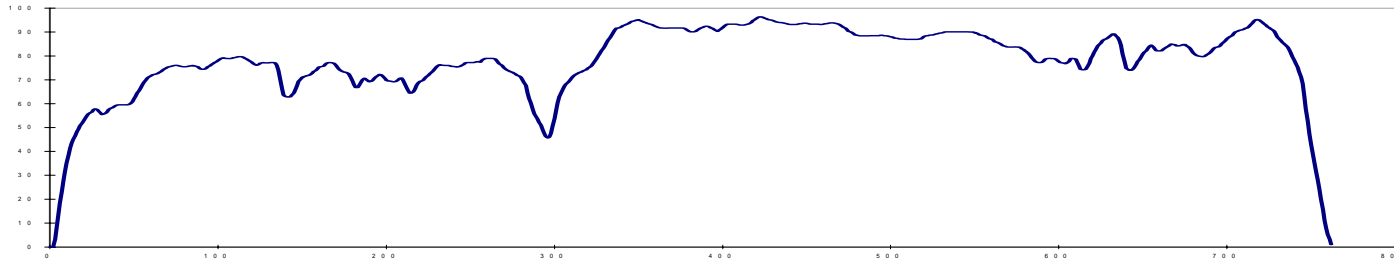
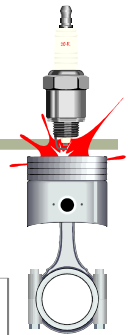
Hot Portion



=

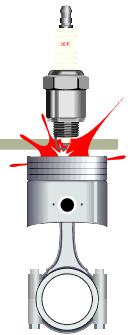
Weighted Result

Highway Fuel Economy Test



- **Rotary Engine Controversy**
- **Ohio Turnpike Drive Trace**
- **Stats:**
 - 10.5 Miles
 - 765 Seconds
 - Max
 - » Speed 63 mph
 - » Accel ?

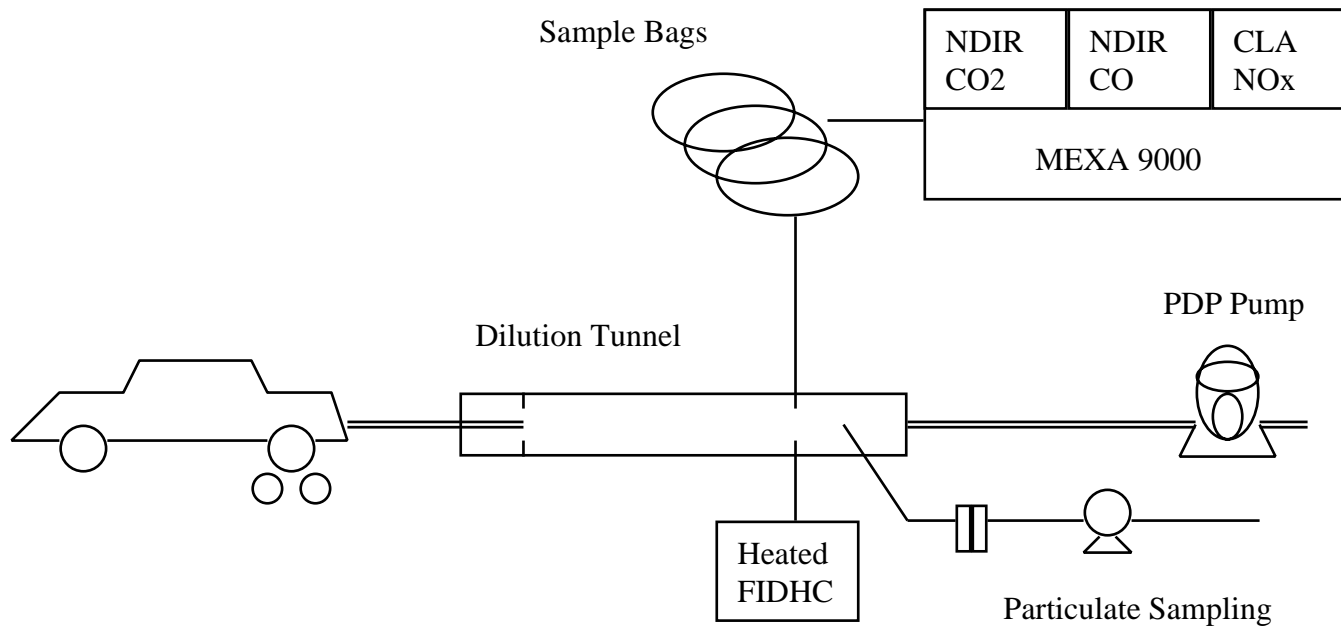
Diesel Testing



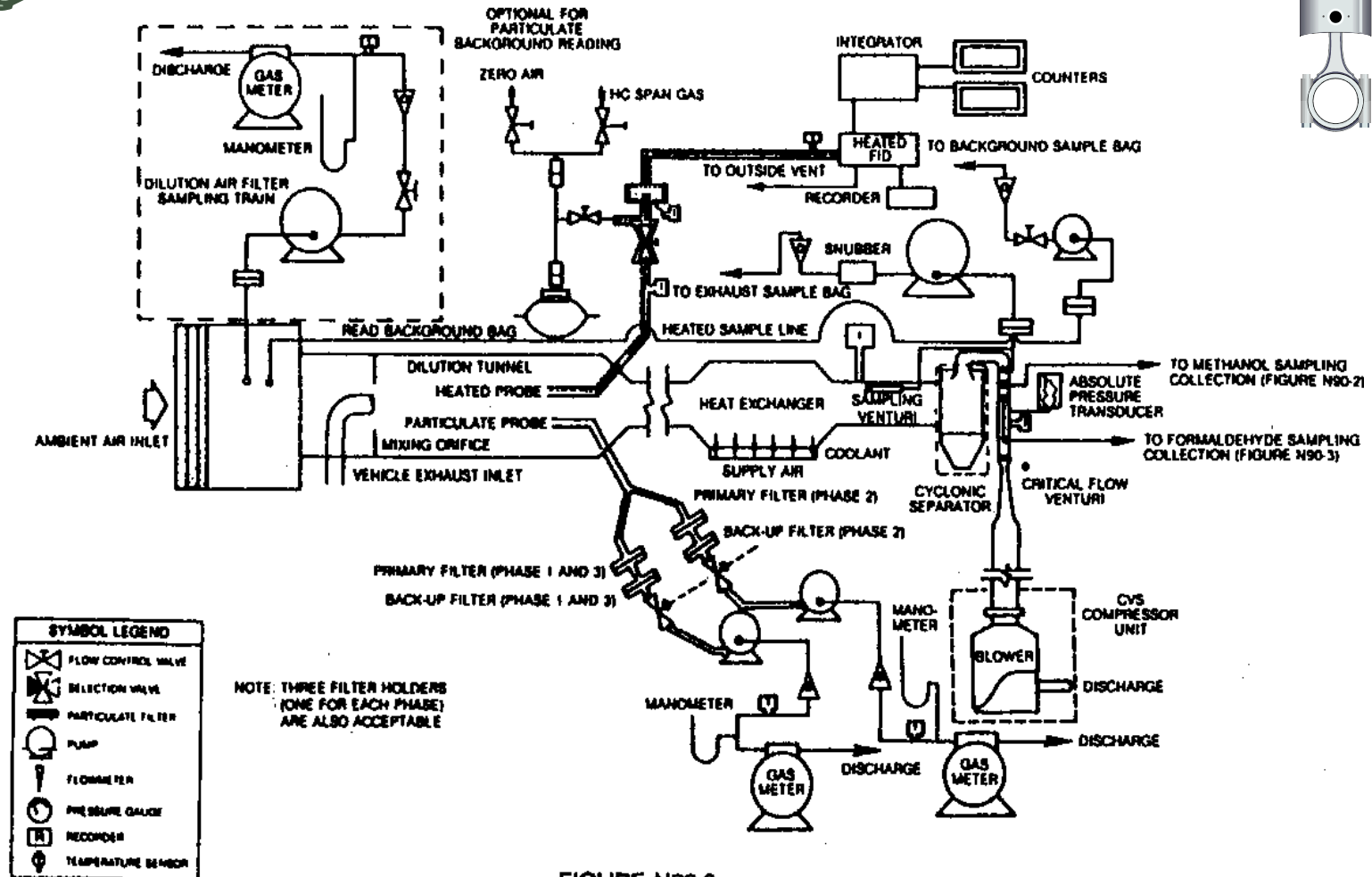
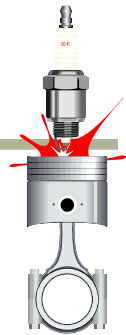
New Requirements

Particulate Measurement- Tunnel

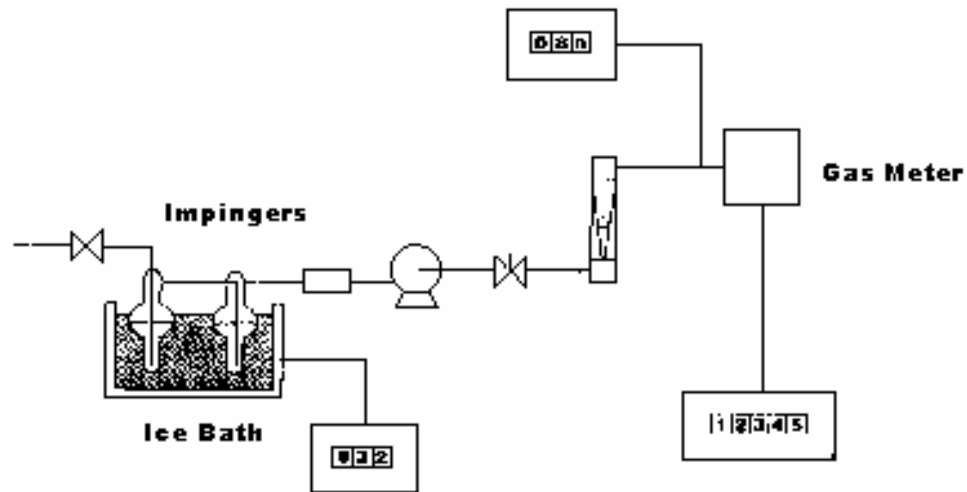
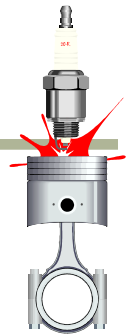
Heavier HC's - Heated FID



Full Flow Dilution Tunnel

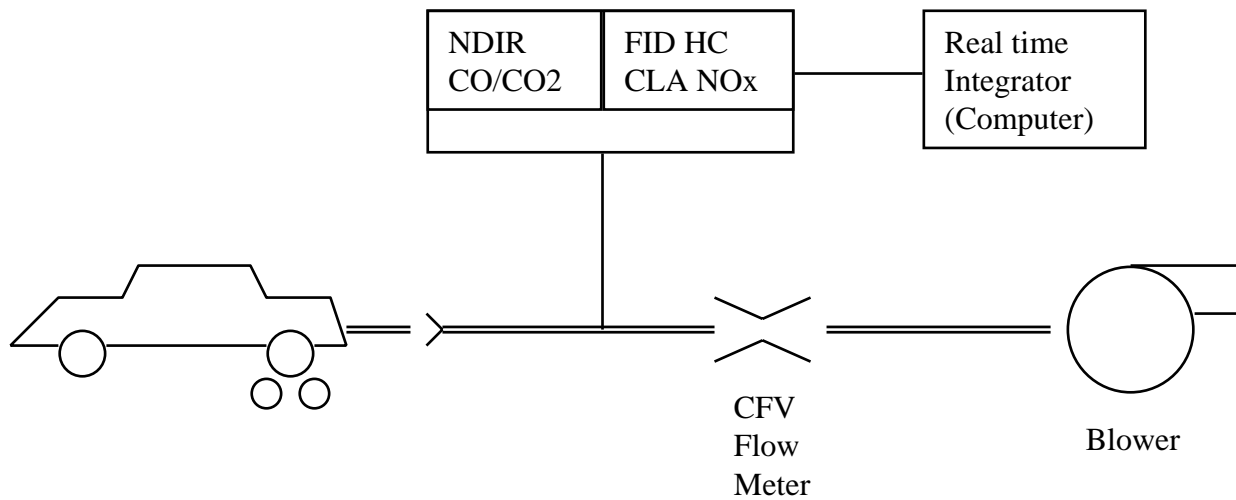
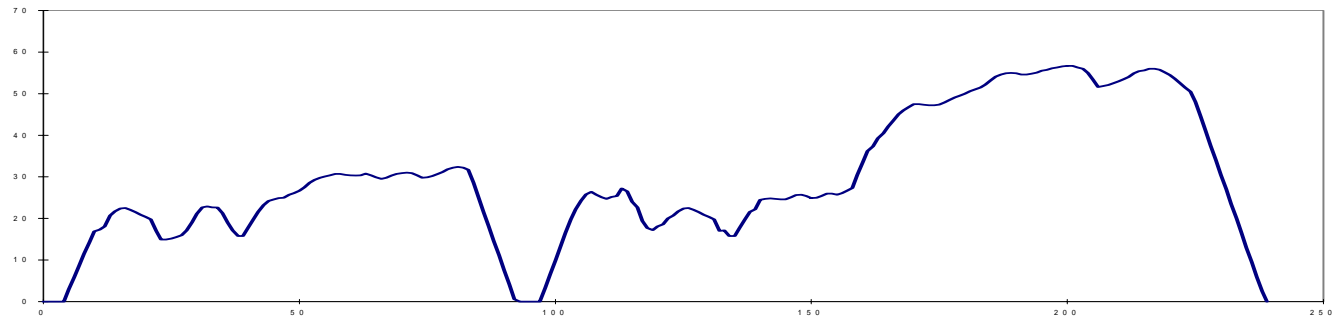
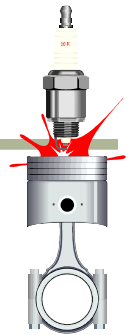


Alternative Fuels

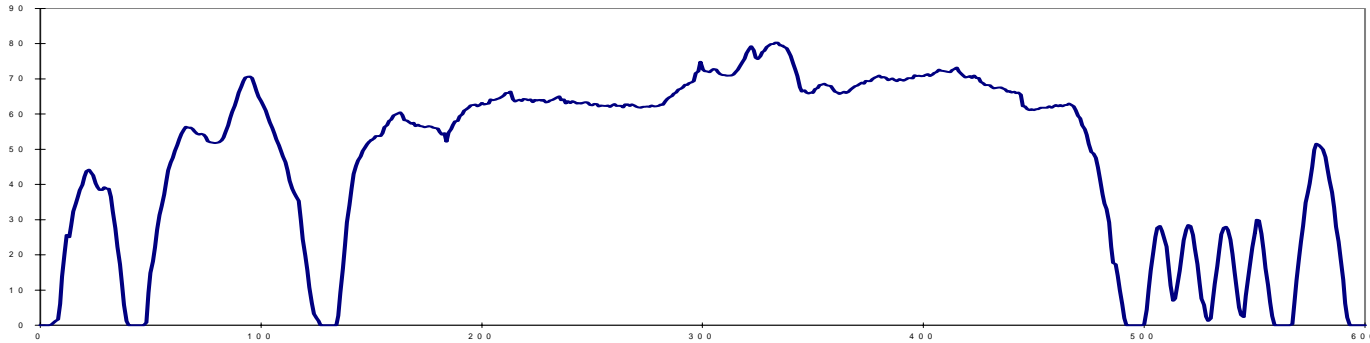
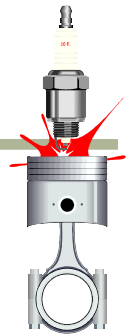


Methanol Sample Collection Flow

Inspection and Maintenance IM240 Test

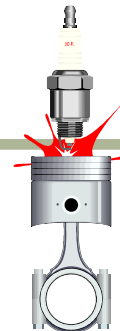


SFTP Aggressive Drive Cycle US06



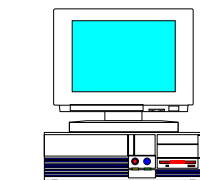
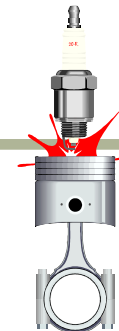
- **Supplement to FTP**
 - Capture the greater emissions from aggressive driving
- **High speeds**
 - 80 mph
- **Strong accelerations**
 - Challenge for Dynamometers
 - Difficult for small cars

Equipment Development

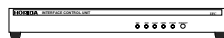


- **Analyzer Benches**
 - Computer Controllers
 - Modular Design (Mexa 7000)
- **Dynamometers**
 - From dual 8.65” rollers to single 48” roll
- **CVS**
 - CFV Type
 - SAO Type
- **Computer Automation**
 - VETS 9000
 - VETS 7000
 - VETS 7000NT
- **Diesel Sampling**
 - Mini/Micro Dilution Tunnels

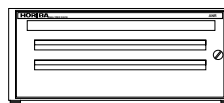
Overview of the MEXA 7000



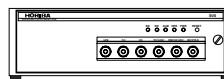
MCU - Main control unit



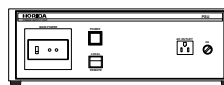
IFC - Interface control unit



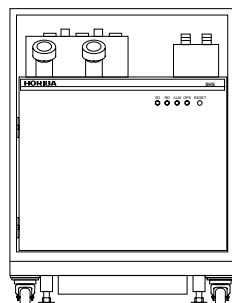
ANR - Analyzer rack



SVS - Solenoid valve unit



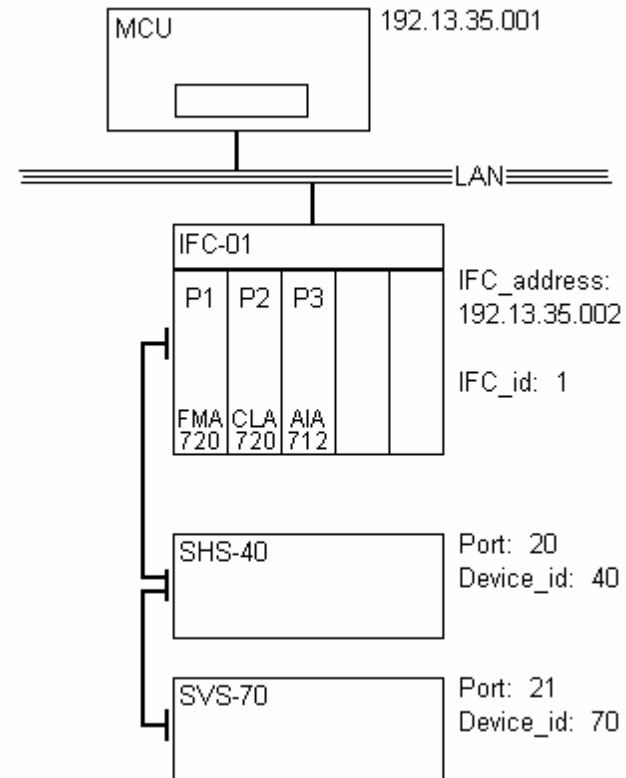
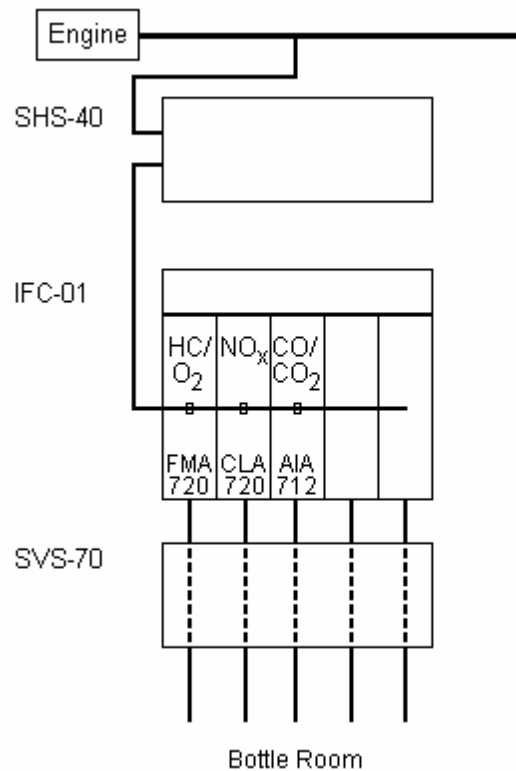
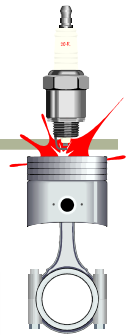
PSU - Power supply unit



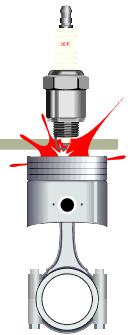
SHS - Sample handling system

- PC based controller using UNIX Windows like software
- Low sample flow requirement (approx. 10- 15 liters/min)
- Small size/foot print (1150/1970mm and 1-bay)
- Lower operating costs - 30 %
- Modularity
- Separate heated analyzers that allow short htd. lines
- True digital analyzers with 24 bit A/D converters, using LAN to connect to MCU
- Wide dynamic ranges (single range available)

MEXA 7000 Control Concept

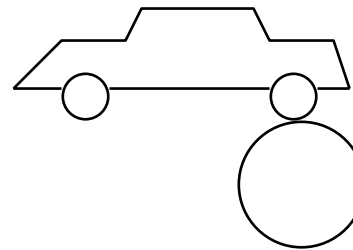
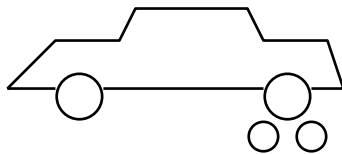


Dynamometers

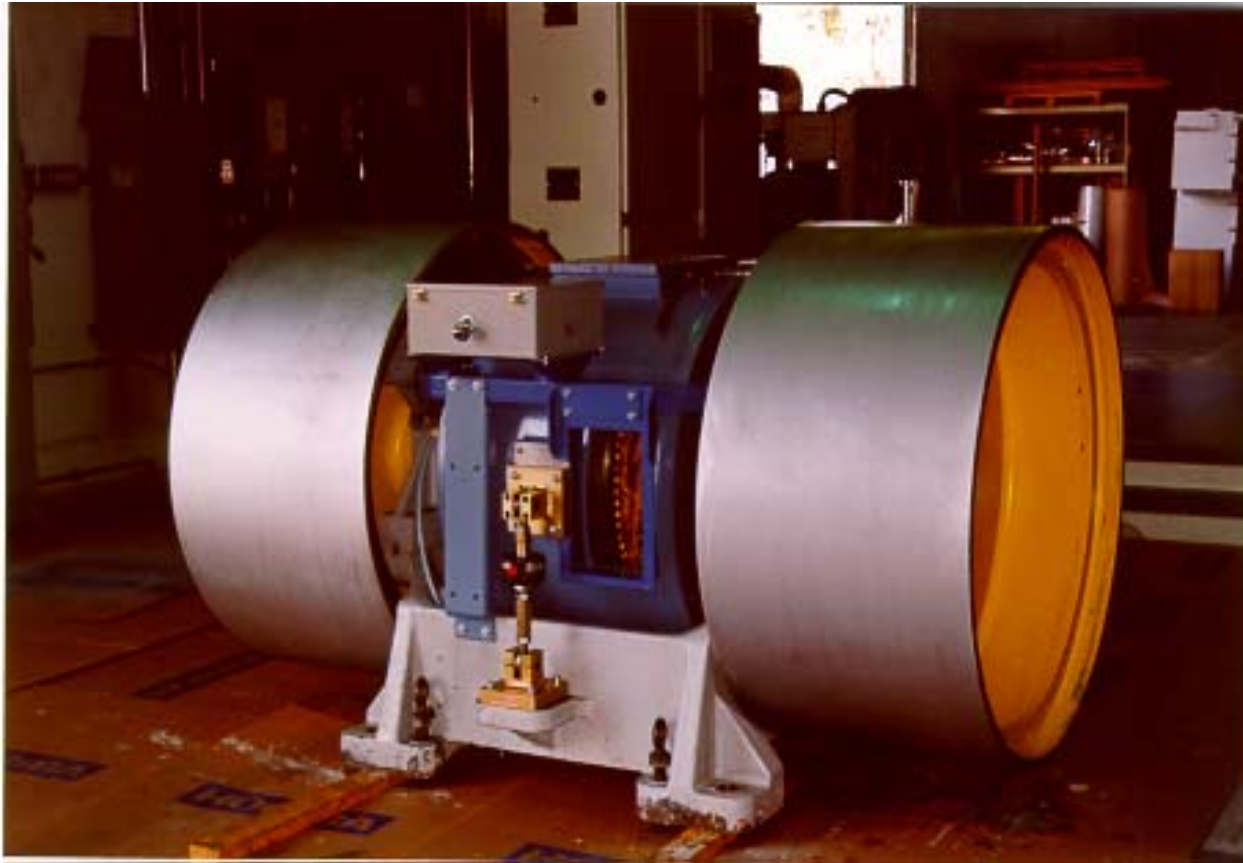
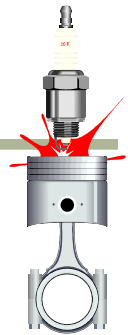


■ Improvements

- Large Roller
 - » More realistic road simulation
- Electric Inertia Simulation
 - » More precision



Horiba Large Roll Dyno



Dynamometer

