



LABORATORY PLANNING GUIDE

L30 v2 Basic Thermodynamics Laboratory

Content

Covered subjects according to the curriculum..... 2

Main concept..... 3

Initial training provided for laboratory personnel 3

Requirements / Utilities 3

Schedule of Requirements 4



Covered subjects according to the curriculum

Major topics of learning content but not limited:

- Different measuring methods for measuring humidity
- Experimental introduction to temperature measurement
- Comparison of different pressure measurement methods
- Demonstrating the laws of state changes in gases experimentally
- Isothermal change of state, Boyle-Mariotte law
- Isochoric change of state, Gay-Lussac's 2nd law
- Adiabatic change of state of air
- Determination of the adiabatic exponent according to Clément-Desormes
- Vapour pressure curve of water
- Observation of typical forms of evaporation
- Effect on the evaporation process by flow rate, temperature and pressure
- Calculation of heat transfer coefficient
- Visualisation of different condensation processes
- Heat transfer in parallel flow and counterflow
- Heat balances
- Fundamentals of a compression refrigeration circuit
- Key components of a refrigeration system:
compressor, evaporator, condenser, expansion element
- Observing evaporation and condensation of the refrigerant
- Representing the refrigeration cycle in the log p-h diagram
- Calculation of the coefficient of performance
- Oil return in a flooded evaporator
- Layout and function of a hermetic refrigerant compressor
- Understanding of internal combustion engines
 - * Familiarisation with a two-stroke petrol engine
 - * Familiarisation with a four-stroke petrol engine
 - * Familiarisation with a four-stroke diesel engine
 - * Familiarisation with a water-cooled four-stroke diesel engine
 - * Plotting of torque and power curves
 - * Determination of specific fuel consumption
 - * Determination of volumetric efficiency and lambda (fuel-air ratio)
 - * Determination of the frictional power of the engine (in passive mode)
 - * Cylinder pressure measurements on internal combustion engines
 - * Familiarisation with and use of an electronic cylinder pressure indication system
 - * p-t diagram
 - * p-V diagram
 - * Pressure curve for gas cycle
 - * Determination of indicated power output from p-V diagram
 - * Exhaust gas analysis unit for engines
 - * Determination of exhaust gas thermal output power
- Operation of a gas turbine with power turbine
- Determining the shaft power and specific fuel consumption of a gas turbine

Main concept

The laboratory is designed for accommodation of 24 students + 2 laboratory staff:

- 2 - 4 students form a team and work together at a workstation / training system
- 14 workstations with 14 different experiment units
- Each experiment unit either floor standing or on its own table to allow short prepare times
- 5 workstations are equipped with a PC
- Each workstation is equipped with a manual containing technical information, basic theory, experiment instructions, evaluation help and safety advice.
- Student teams are scheduled to change workstations from lab session to lab session in order to perform the entire range of experiments within the course duration.
- Average time per experiment: 90 to 120 minutes.

2 workstations for laboratory staff (with PC and internet access)

1 printer for common use

1 cupboard for small parts, consumables, tools, paper etc.

Initial training provided for laboratory personnel

Trainer: Specialized engineer of G.U.N.T. Gerätebau GmbH, Germany.

To be conducted immediately after installation and commissioning of the equipment.

General topics to be covered for any of the educational systems:

- Basic familiarization with the system.
- Functions and components.
- Overall system configuration aspects.
- Start-up and operational aspects.
- Conduction experiments, including evaluation and calculation.
- Using the system with and without the software (where applicable).
- Trouble shooting and maintenance aspects.
- Hands-on, practical familiarization aspects.
- Seminar participants with the delivered system.
- Details of the manuals.
- Safe operation and preventive maintenance.

Requirements / Utilities

Power supply:

- 230 V / 50 Hz / 1 phase – at least 25 power sockets distributed according to lab lay-out
- 400 V / 50 Hz / 3 phases – at least 2 power sockets distributed according to lab lay-out

Water:

- Cold Water
- Drain

Others:

- Fresh Air
- Exit Air
- Propane gas

Laboratory computer network:

- 2 internet connections for staff
- 5 internet connections for students

Location:

- Laboratory space min 96 m²
- This laboratory should be installed on the ground floor

Schedule of requirements

Item No.	Description	Quantity
Item 1	Fundamentals of humidity measurement	1 pcs.
Item 2	Fundamentals of temperature measurement	1 pcs.
Item 3	Fundamentals of pressure measurement	1 pcs.
Item 4	Change of state of gases	1 pcs.
Item 5	Expansion of ideal gases	1 pcs.
Item 6	Vapour pressure of water - Marcet boiler	1 pcs.
Item 7	Evaporation process	1 pcs.
Item 8	Boiling process	1 pcs.
Item 9	Condensation process	1 pcs.
Item 10	Heat transfer in a tubular heat exchanger	1 pcs.
Item 11	Simple compression refrigeration circuit	1 pcs.
Item 12	Changes of state in the refrigeration circuit	1 pcs.
Item 13	Cutaway model: hermetic refrigerant compressor	1 pcs.
Item 14	Test stand for single cylinder engines, 7,5kW	1 pcs.
Item 14.1	Two-stroke petrol engine for CT 110	1 pcs.
Item 14.2	Four-stroke petrol engine for CT 110	1 pcs.
Item 14.3	Pressure transducer for CT 100.20	1 pcs.
Item 14.4	Four-stroke diesel engine for CT 110	1 pcs.
Item 14.5	Pressure transducer for CT 100.22	1 pcs.
Item 14.6	Water-cooled four-stroke diesel engine for CT 110	1 pcs.
Item 14.7	Pressure transducer for CT 100.23	1 pcs.
Item 14.8	Electronic engine indicating system for CT 110	1 pcs.
Item 14.9	Exhaust gas analysing unit	1 pcs.
Item 14.10	Exhaust gas calorimeter for CT 110	1 pcs.
Item 15	Gas turbine with power turbine	1 pcs.