

# Refrigeration and Air-conditioning Technology

Climate change, the greenhouse effect and global warming – in the 21st Century there is scarcely any other subject that is more ubiquitous or “hotly” debated. Global environmental accords like the international Kyoto protocol or specifically the European directive on fluorinated gases are devoted to the problems associated with greenhouse relevant agents and the search for solutions on a political level. Refrigeration and air-conditioning applications amplify the effects of global warming.

In the first place they contribute directly and in a big way to the greenhouse effect through the emission of coolants containing fluorine like partially or wholly fluorinated hydrocarbons. One example of how these emissions are caused is because of leaks in refrigeration systems which allow coolants to escape into the atmosphere. Secondly, the operation of refrigeration systems also causes additional, indirect CO<sub>2</sub> emissions due to the not inconsiderable amount of energy required for their operation. This problem is compounded by the fact that demand for refrigeration systems is constantly increasing.

Lucas-Nülle has committed itself to this subject and developed a concept to integrate easily serviceable and effective training systems devoted to this growing sector. Refrigeration and air-conditioning technology is a professional area that builds entirely the latest educational and technical know-how. It is the many years of experience that Lucas-Nülle has accumulated combining theoretical know-how with practical applications which empowers course participants to boost their skills and competence in this area.

## Modular R134a refrigeration training system



### **Modular R134a refrigeration training system**

This modular refrigeration training system allows trainees to gain extensive experience of the materials used in refrigeration systems. The training focus of this module is to observe the refrigeration circuit itself. Rather than teaching professional skills as such, its objective is more to gain an understanding for the technology and the function of the components. Various applications, valves and other components of a refrigeration circuit are investigated by means of an authentic cold storage cell under a variety of conditions. The key aspects include how the quantity of refrigerant, the ambient temperature or faults with certain components affect the system. In addition, training is provided in the environmentally conscious handling of refrigerant when filling or emptying the system.

**Important!**

Some of the supplies employed with this equipment set are governed by regulations on hazardous goods and therefore require special handling. We recommend procuring these supplies in the respective country of use to avoid a transport of hazardous goods. The relevant supplies are summarized in the associated section.

## RCC22 Measurement and control in R134a refrigeration training system



### **RCC22 Measurement and control in R134a refrigeration training system**

This supplement to the modular R134a refrigeration training system allows for the measurement and assessment of the system's operating status. Various fault conditions are introduced and their effects on the refrigeration system are observed and assessed. Use of additional components allows the system to be modified in order to familiarise students with the effects and function of those components.

The following training contents are covered:

- Comparison and assessment of readings measured with the system in various states
- Introduction of faults and assessment of them
- Handling a digital pressure gauge
- Calculation and importance of energy efficiency ratio (EER)
- Use of pressure regulators

## Equipment set comprising the following:

### Evaporation pressure regulator KVP 12

CO3207-1H

1

The evaporation pressure controller is located behind the evaporator and adjustable via a handwheel. The evaporation pressure regulator also possesses a service connection for a low-pressure manometer.

Technical data:

- Control range: 0 ... 5.5 bars
- Temperature range: -45 ... 105°C
- Connections: 5/8" UNF flare connectors
- Service connection: 6mm screw connection
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8 kg



### Hot gas by-pass regulator KVC 12

CO3207-1J

1

The hot-gas regulator is an important element of a refrigeration system's safety sequence. It is used as a bypass controller to protect the compressor. The regulator is operated manually.

Technical data:

- Control range: 0.2 .... 6.0 bars
- Temperature range: -45 ... 105°C
- Connections: 5/8" UNF flare connection on suction side and 7/16" UNF flare connection on pressure side
- Power regulation: Up 4.8 kW
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8 kg



### Single manometer for low pressure

CO3207-1K

1

Low-pressure manometer for various refrigerants

Technical data:

- Display: Analog with damped measuring mechanism
- Pressure range: -1.0 ... 12.5 bars
- Precision class: 1.0
- Temperature range: R134A-60...50°C, R507 -100...25°C, R404A-100...25°C
- Connection: 7/16" UNF flare connector
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8 kg



### Single manometer for high pressure

CO3207-1L

1

High-pressure manometer for various refrigerants

Technical data:

- Display: Analog with damped measuring mechanism
- Pressure range: -1.0 ... 30 bars
- Precision class: 1.0
- Temperature range: R134A-60...85°C, R507 -80...60°C, R404A-100...60°C
- Connection: 7/16" UNF flare connector
- Dimensions: 297 x 114 x 60mm
- Weight: 0.8 kg



### Refrigerant mass flow-meter, glass with float

CO3207-1Q

1

Measures through-flow and monitors liquid or gaseous products in vertical pipes.

Displays the current throughput per unit time by mass or by volume

Features:

- Simple, robust and easy-to-service design
- Made entirely of transparent PVC plastic
- Unbreakable and impact resistant
- High resistance to chemicals
- Directly readable local flow-rate scale
- Precision class:  $\pm 2\%$  of maximum reading
- Temperature of measured material:  $-30^{\circ}\text{C}$  to  $+50^{\circ}\text{C}$
- Maximum pressure of measured material: max. 16 bars
- Calibrated for R134a, liquid  $+30^{\circ}\text{C}$ , 0.4-5 g/s
- Dimensions: 114 x 420 x 40mm
- Weight: 1.2 kg

#### Conditions for use:

For low-viscosity products which flow sufficiently easily, and which are free of solids, non-adhesive and unlikely to leave residues, as well as gases with linear flow properties under sufficient pressure.

### Media:

### Interactive Lab Assistant: Measurement and control in R134a refrigeration training system

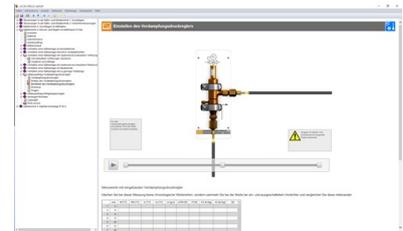
SO2801-1E

1

Multimedia experiment software with virtual instruments, instructions and documentation of results from measurements on refrigeration circuits.

Features:

- Detailed set-up animations
- Questions with feedback and evaluation logic for checking student progress
- Printable document for easy printing of instructions and solutions
- CD-ROM with Labsoft browser, course software and virtual instruments



#### Training contents:

- Measurement of pressure using a pressure gauge
- Measurement of temperature differences
- Leak testing
- Handling a leakage tester
- Operating response of a refrigeration system under various influences
- Identifying faults

## Measuring instruments:

### Power Clamp Meter with True RMS, 3 3/4-digit, 1000 A AC/DC

LM2336

1

### Power Clamp Meter with True RMS, 3 3/4-digit, 1000 A AC/DC

Digital power clamp meter for measurements of power consumption in single-phase systems. Among other measurement functions, such as voltage, current, resistance, and Hz/Duty this clamp Meter measures the power consumption during a voltage measurement in kW. Through the illuminated LCD display with 3999 counts, the non-contact current measurement up to 1000 AAC/DC and the comprehensive multimeter functions this device is universally usable.



- 3 ¾ digit, 17 mm LCD; max. indication: 3999
- True RMS
- Auto/manual range selection
- Data hold
- Backlight
- AC/DC power: 240 kW
- AC/DC current: 1000 A
- AC/DC voltage: 600 V
- Resistance- and frequency measurement
- Diode test and continuity test
- Auto power off
- Max. conductor size: 35 mm
- Safety: EN 61010-1; CAT III 600 V
- Accessories: carrying case, test leads, battery and manual

#### Technical specifications:

DC V: 400 mV/4/40/400/600 V; 100  $\mu$ V;  $\pm$  1,5 % + 3 St.  
 AC V: 400 mV/4/40/400/600 V; 100  $\mu$ V;  $\pm$  1,8 % + 5 St.  
 DC A: 1000 A; 1 A;  $\pm$  1,8 % + 5 St.  
 AC A: 1000 A; 1 A;  $\pm$  2,0 % + 5 St.  
 DC kW: 40/240 kW; 10 W;  $\pm$  2,0 % + 5 St.  
 AC kW: 40/240 kW; 10 W;  $\pm$  2,5 % + 5 St.  
 Ohm: 400  $\Omega$ /4/40/400 k $\Omega$ /4/40 M $\Omega$ ; 100 m $\Omega$ ;  $\pm$  1,5 % + 2 St.  
 Freq.: 5/50/500 Hz/5/50/100 kHz; 1 mHz;  $\pm$  1,2 % + 2 St.

- Dimensions: 80x230x40mm (WHD)
- Weight: 300g

## “Schuko”-type measurement adapter with 4 safety measuring sockets

LM2337

1

### Measurement adapter (for testing purposes only) for measuring current and voltage on 230 V conductors

This adapter makes it easy to measure AC voltage and current in appliances by plugging them directly into it. The adapter is simply connected between the appliance and the socket. Current in the live conductor “L” and the neutral conductor “N” can be measured individually without making any contact and it is also possible to measure leakage current in the protective earth conductor “PE”. The insulated measurement rods are suitable for an AC current clamp. In addition, there are safety sockets available for taking direct measurements on the individual conductors.

- CEE 7/4 earth-contact plug system
- For current and voltage measurement
- Fitting for measurement via current probe
- Every conductor can be accessed individually
- Simultaneous measurement for power analysis
- Covered 4-mm safety sockets

#### Technical data

- Rod diameter: 14 mm approx.
- Opening for current probe: 30 mm x 30 mm
- Protected against water spray (IP44)
- Connector A: Earth contact with rubber pin
- Connector B: Earth contact with rubber coupling
- Nominal voltage 250 V/AC, nominal current 16 A
- Measurement category: CAT III
- Length 0.75 m

## Digital electronic refrigerator analysing equipment in case, USB, power supply

LM8583

1

This refrigeration system analyzer is designed for all applications involving air-conditioners and heat pumps. The measuring device has high-quality sensors for measuring pressure, vacuum and temperature. A valve array for temporarily changing flow paths in the system is included. A user-friendly PC software allows data management: Overviews of all measurement data, tabular and graphic representations.



#### Technical data:

- Power supply: 230V power supply unit or 4 AA batteries
- Temperature measurement: PT100, -100 .... 200°C.
- Low-pressure measurements: max. 25 bars
- High-pressure measurements: max. 50 bars
- Moisture measurement: capacitive, 0 .. 1000%
- Connections: 3x 7/16" UNF, 1x 5/8" UNF
- Weight: 1,4 kg