The Luftmeister® system

Energy management in air-conditioning and process air systems
Consumption-based charging of ventilation costs

IS ENERGY MANAGEMENT AND METERING A TOPIC FOR AIR-CONDITIONING AND PROCESS AIR SYSTEMS?

Recording utility usage is nothing new – for decades it has been one of the key elements used to objectively calculate a company's operating costs. It also plays a vital role when implementing energy management policies that encourage consumers to save resources. Over the years, companies have especially focused on their usage of electricity, heating, air-conditioning and occasionally compressed air. Accurately measuring the energy flow in air ducts has in the past been virtually impossible or just not economical. Though now Luftmeister® offers a solution.

INDUSTRY

An ever growing number of large and medium-sized industrial companies have been implementing energy management systems. Regardless of whether these are based on the leading energy management standard DIN EN 50001 (obligatory for large companies from 2016) or approach the issue from the direction of environmental certification (DIN EN 14001 / EMAS etc.), the central objective is the same: to reduce the consumption of materials and energy.

Three complementary motivating factors underpin this goal:

- The desire to reduce operating costs
- The desire to make a positive, sustainable contribution to protecting the environment
- Companies wish to retain subsidies such as the EEC exemption from allocation according to the Renewable Energy Law

For years, energy management officers have been "harvesting the low hanging fruit" and achieving noteworthy savings through peak load management, co-generation of power and cooling and reduction of compressed air leakages. However, over the coming years they will have to prove that they are continuing to make substantial savings! For this reason there is now more focus on the cost-intensive areas of air-conditioning and process air systems.

COMMERCIAL BUILDINGS

Commercial buildings with multiple individual commercial tenants (office buildings, shopping centres etc.) face a challenge that continues to be the reason for many legal disputes: how to attribute building utility costs. Meters generally are the accepted way on which to base the costs of air-conditioning, heating and electricity consumption. However, no such meter has been available for air-conditioning systems until now. For many years, these costs have been divided based on the size of the area rented.

Here is an example: a bookshop that occupies 7 % of the area of a shopping centre will be charged 7 % of the annual ventilation costs, the first problem with this approach is that it provides no incentive to generate savings as the costs are not linked to consumption. In addition, using a formula which is based on the area is inaccurate because different premises have different air exchange rate requirements. From Update Q4/2016, Luftmeister® and the new VDI Guideline 2077 Sheet 4 will redress this problem.

Luftmeister® is the first legal-for-trade (optional) air consumption meter on the market. As well as opening the way to fair, consumption-based billing that improves sustainability and the attractiveness of the property, it can also help reverse the trend of tenants insisting on seperate air-conditioning systems. Sharing a larger, centralised air-conditioning system (instead of a number of smaller units) often generates considerable savings in terms of both installation and operating costs.

THE MEASUREMENT TECHNOLOGY: PRECISE FLOW MEASUREMENTS IN PRACTICAL APPLICATIONS

Systems that obtain precise and continuous flow measurements in air ducts are rarely found in practical applications. In fact, they are generally completely absent in older plants. During the development of Luftmeister® the focus was on practical applications:

- Long, straight inlet and outlet pipes are very rare. After sources of **upstream interference** such as double bends, it is more typical to have only a **very short inlet pipe**. Likewise, outlet pipes are almost always too short.
- In order to accommodate the resulting asymmetric flow profiles and also cleanly record situations of **partial flow**, Luftmeister® uses an optimum combination of sensors and calibration.

TWO LUFTMEISTER® SERIES EACH FEATURING THREE MODELS

The Luftmeister range has to has to be functional in wide variety of scenarios, therefore Luftmeister® developed three different types of the **Luftmeister® 55 and 57** models. These are described in the table below.
The **MS** model offers high precision mass (and volume flow) measurements. The **LZ** model adds an air meter function (air consumption in m³ or kg). The **EZ** model also calculates air energy contributions, see page 6.

MS Mass flow — m³/h, kg/h, m/s, Pa_{abs}
Continuous flow monitoring
Optional: Filter monitoring, target/actual values for external flow regulation

LZ Air meter — m³ / kg
Distribution of costs based on air consumption

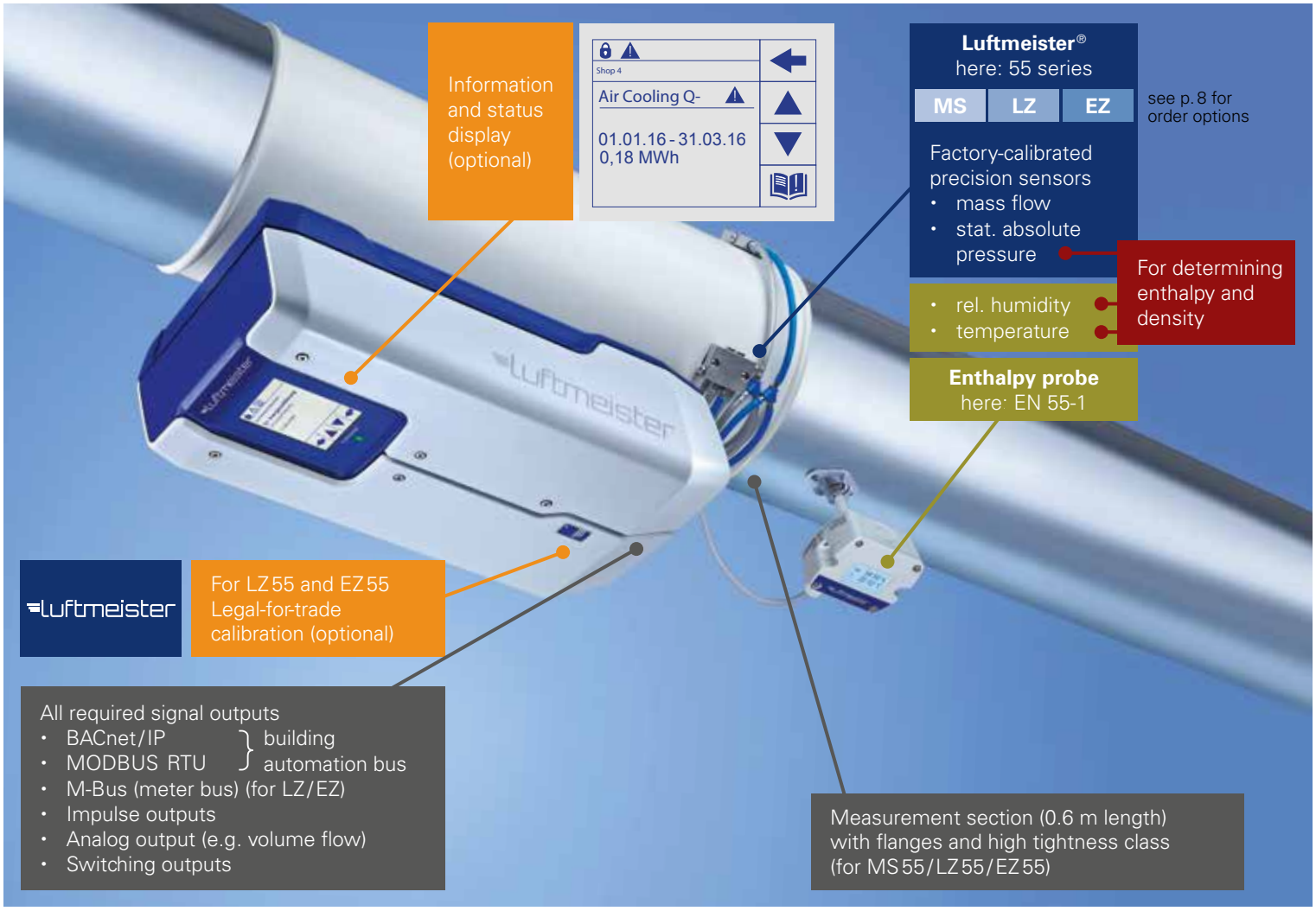
EZ Air energy meter — kWh, kWh, %rF, °C
Distribution of costs based on air and energy consumption
Collect and record climate status data, monitor hygiene
Optimise operation of AC systems

Enthalpy + temperature probe [1]
MS/LZ: for air density compensation (1 connection) or setting a fixed value
EZ: for air density compensation and energy monitoring (max. 5 connections)

55 SERIES (for conditioned air)	57 SERIES (for conditioned and process air)
	
Compact: Ready-to-install measurement section (0.6 m)	**Remote:** On-site installation of probe
On-board measurement transmitter	Measurement transmitter installed at distance of up to 10 m
DN 100 .. 630 mm ○ / ▭ (with flange)	DN 10 .. 3000 mm ○ / ▭
-20 .. 60 °C [1]	-100 .. 500 °C [1]
Redundant "Doppelschwert" sensor system (ΔP)	Range of primary elements (ΔP), e.g. pitot tube or Venturi [2]
BAS-bus (BACnet/IP or MODBUS RTU)	
Factory-calibrated (certified)	On-site entry of k-factor
LZ/EZ: Legal-for-trade instrument	On-site calibration/adjustment
Display (in the 55 series/legal-for-trade: obligatory)	
0, 5 or 10 impulse or switching outputs	
0, 5 or 10 analogue outputs	
M-bus (only for LZ/EZ), MODBUS, BACnet	
Filter monitoring or actual/target values for external flow regulation	

Options

[1] For conditioned air: Enthalpy probe EN55; for process air -40 .. 180 °C: Enthalpy probe EN57, otherwise: analogue input for °C probe supplied by the customer
[2] We will be pleased to supply a suitable primary element for your measurement location.

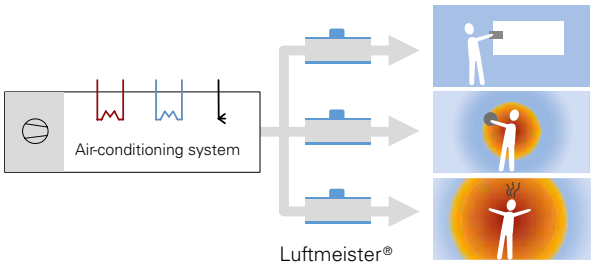


SIX USES – WHAT CAN LUFTMEISTER® DO FOR ME?

1. CONSUMPTION-BASED ATTRIBUTION OF COSTS

LZ EZ see also p. 7

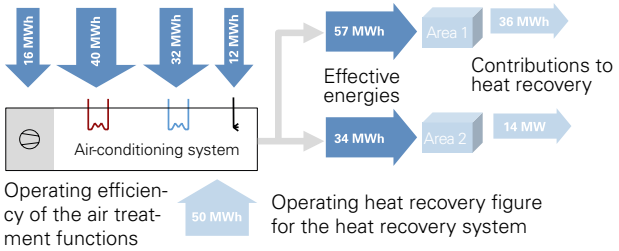
Luftmeister® allows for the replacement of the current unfair billing system, which is based on the size of tenant's rented area, through calculating expenses based on consumption. The system can be calibrated on a legal-for-trade basis (planned as an option for LZ 55/EZ 55) and therefore
offers a secure legal basis. The operator has the choice of an **air quantity meter** (m³ or kg) or an **energy meter** with separate air energy meters for heating and cooling (in kWh heat/kWh cold).



2. IDENTIFY ENERGY CONTRIBUTIONS, TEST EFFICIENCY

EZ see also p. 6

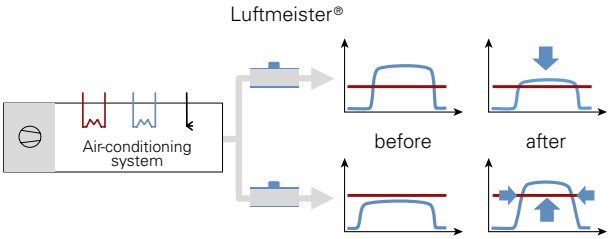
It is already possible to measure the input energies of an air-conditioning system (electricity, heating, cooling, etc.). But how are flows of effective energy distributed through the ventilation system? Which usage zones contribute the most and which contribute the least to heat recovery (HR)? And importantly: how do heat recovery systems perform in situations where there is only a partial load, at night or in seasons, for which they have not been specifically designed? Is it possible to identify potential savings that could be achieved by adjusting controls or even making structural modifications? Luftmeister® sheds light on all relevant energy contributions right down to the level of a continuous "energetic inspection" (analysis of the contribution of each stage of processing within the air-conditioning system).



3. CONTINUOUS FLOW CONTROLLING

MS LZ EZ

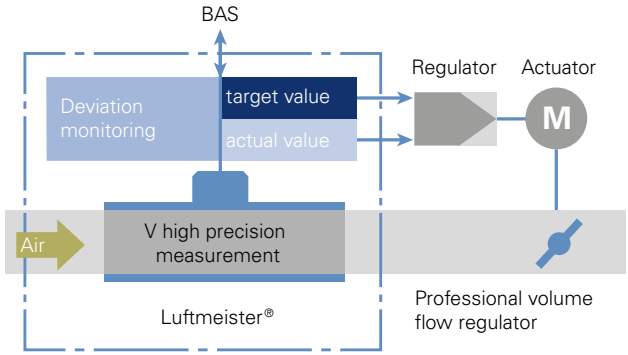
Whether it is deployed centrally in an air-conditioning system or in a decentralised role in air inflow and outflow ducts: Luftmeister® continuously records flows (mass flow/volume flow) with a high degree of accuracy. This enables the operator to monitor essential values for flow and air exchange. At the same time, it allows to identify potential savings, e.g. by switching off the system at night or reducing partial loads. This not only cuts waste but also eliminates the risk of undersupplying certain areas of the building with air.



4. SPECIFICATION OF ACTUAL / TARGET VALUES FOR EXTERNAL FLOW REGULATION (optional)

MS LZ EZ

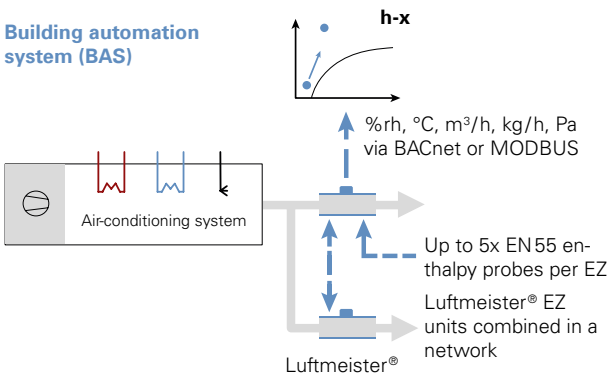
Individual rooms or complete zones are currently supplied with appropriate volume flows using volume flow regulators. Luftmeister® complements and upgrades this system into a perfect "tandem" solution by providing highly accurate actual values and target values to the regulator (via BAS-bus or as fixed values). In addition, Luftmeister® alerts the operator if the target and actual values do not converge quickly enough.



5. MEASURE AND RECORD CLIMATE CONDITIONS / MONITOR HYGIENE + OPTIMISE OPERATION OF AC SYSTEMS

EZ

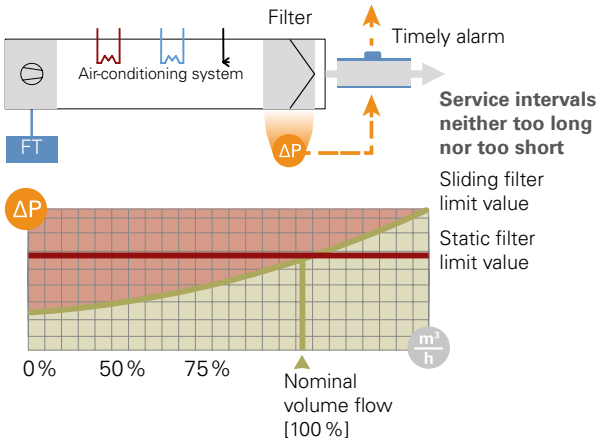
The Luftmeister® system is capable of measuring and recording a wide range of process parameters. Through connecting multiple Luftmeister® air meters allows for the creation of an extensive database. This can be used not only to measure and record consumption and energy data but also by the buildings automatic system through a GA network. The enhanced data can now be used to implement optimised regulation strategies (enthalpy zone regulation, expansion of the target corridor etc.) and reduce the time required for adjustment. At the same time, monitoring the minimum flow rate and distance to the dew point offers protection against hygiene risks.



6. FILTER MONITORING (optional)

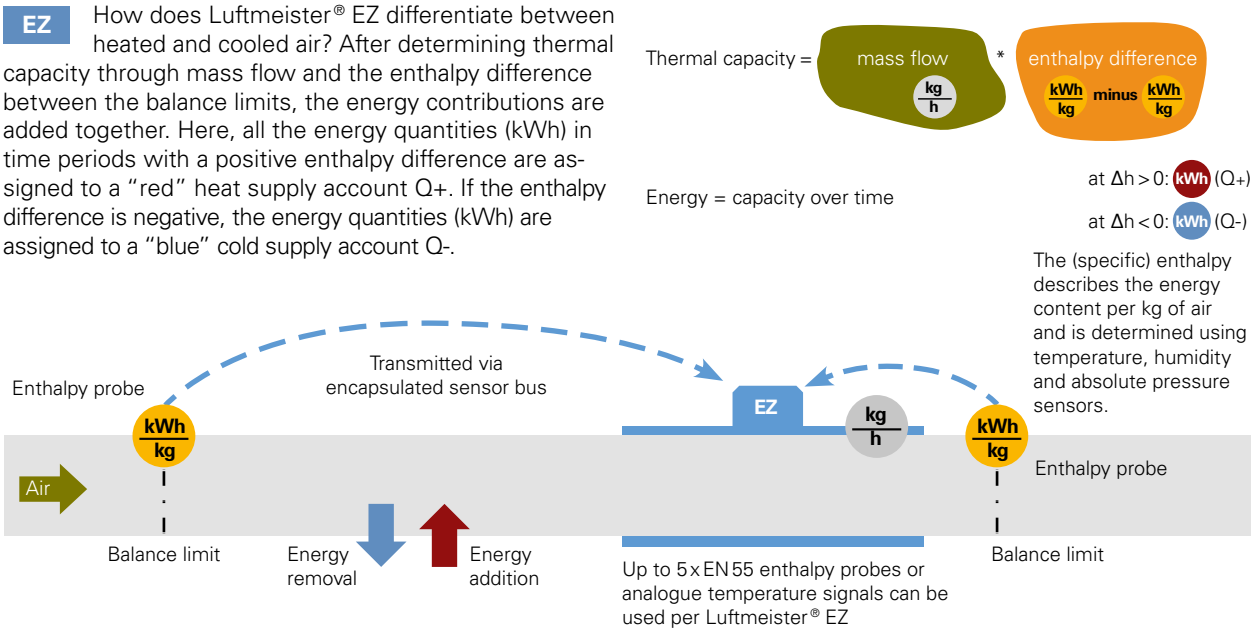
MS LZ EZ

In an air filter monitoring system, which is based on differential pressure, the current standard method of monitoring a fixed limit value (e.g. 200 Pa) is not effective if the volume flow is varied using a frequency transformer (FT). Even if the filter is dirty, it is no longer possible to reach the fixed limit value.
Luftmeister® offers a practical solution: Luftmeister® calculates a function with a sliding limit value using the connected filter differential pressure and the volume flow. An alarm is now triggered either via BAS-bus or switching output when the true limit value is reached.



SCALABLE ENERGY CONTROLLING – CONTINUOUS RECORDING OF ENERGY CONTRIBUTIONS IN THE AIR DISTRIBUTION SYSTEM

EZ How does Luftmeister® EZ differentiate between heated and cooled air? After determining thermal capacity through mass flow and the enthalpy difference between the balance limits, the energy contributions are added together. Here, all the energy quantities (kWh) in time periods with a positive enthalpy difference are assigned to a "red" heat supply account Q+. If the enthalpy difference is negative, the energy quantities (kWh) are assigned to a "blue" cold supply account Q-.



1 IDENTIFY FLOWS OF EFFECTIVE ENERGY

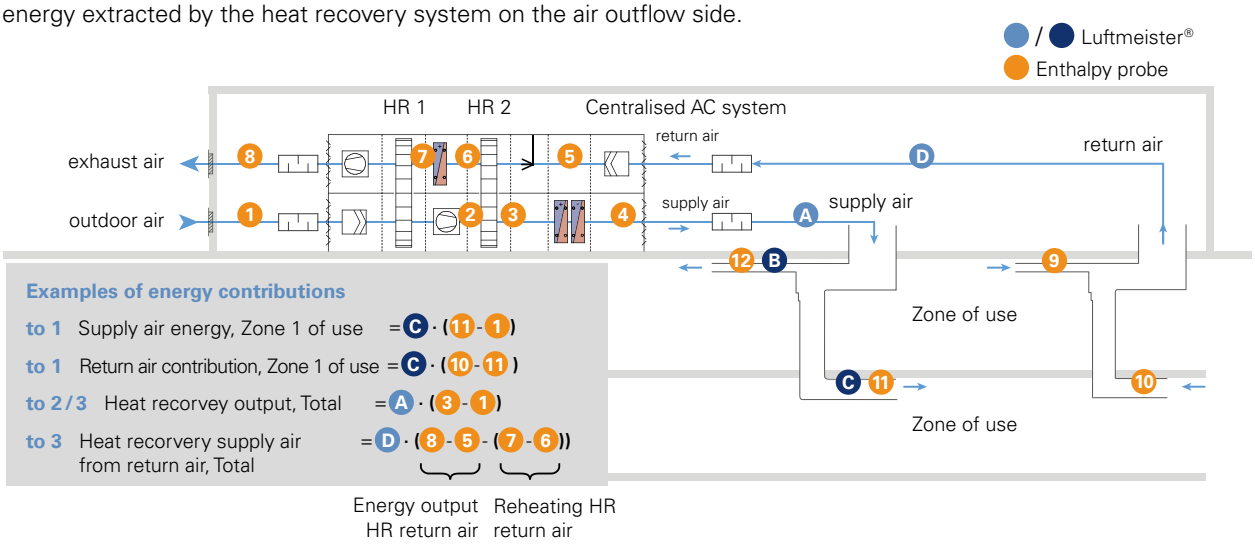
How much effective energy (separated into heating and cooling energy) flows into the individual zones of use via the supply air? How much flows out via the exhaust air system? This information is important as it can highlight leakages, heat loss or ways to optimise regulation strategies. An example of a Luftmeister® measurement concept is shown in the graphic below. The equation in the example shows how Luftmeister® C analyses the zone "Level 1".

2 CONTROLLING AIR TREATMENT FUNCTIONS

Each Luftmeister® EZ can be assigned up to five enthalpy probes. These can either be wired directly or connected via the digital Luftmeister® „EZ bus", networking all EZ and EN devices. For example, if a Luftmeister® is installed in a central air inflow duct (A in the graphic below) and an enthalpy measurement (here 1 .. 4) is taken before / after each relevant stage of air treatment, you can see the efficient energy contribution of each of these stages (e.g. the heat-exchanger for cooling) at any point in time. If you compare this specific effective energy with the energy input (e.g. using a heat energy meter on the water side), you can determine the system's level of efficiency. The result is a continuous energetic inspection.

3 CONTROLLING HEAT RECOVERY (HR)

The output/input efficiency of heat recovery can be measured at any given moment. To do this, Luftmeister® measures the energy transferred by the heat recovery system on the air inflow side and compares this with the energy extracted by the heat recovery system on the air outflow side.



LEGAL-FOR-TRADE CALCULATION OF VENTILATION COSTS

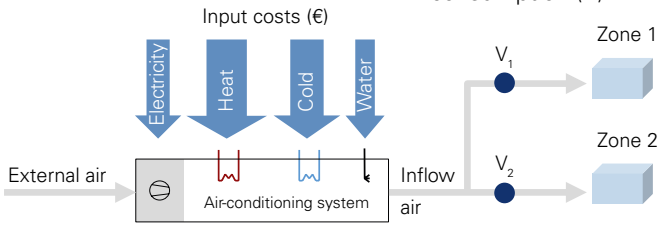
The draft of the new Guideline for Energy Consumption Accounting for Ventilation Costs (VDI 2077 Sheet 4) makes provisions for calculation of charges based on consumption on a case-by-case basis. Luftmeister® EZ covers all cases: Luftmeister® (legal-to-trade optional) records all consumption data in a legally secure format every two seconds. As well as an optional impulse or M-bus output (or MODBUS/BACnet) for transmitting consumption data, Luftmeister® can be supplied with an easy-to-use optional display. Here you can enter any key date you wish. You can therefore retrieve the consumption values recorded since this date as well as minimum and maximum values with time stamps. Generally, all consumption meters can also be read for long (monthly/annually) as well as short periods (min. ten minute intervals).

COSTS PER ZONE ...
... ACCORDING TO AIR CONSUMPTION

LZ EZ see p. 8 for order options

Every zone of use is assigned its share of the costs (total input costs) based on its share of air consumption (V).

(● Luftmeister® LZ or EZ)



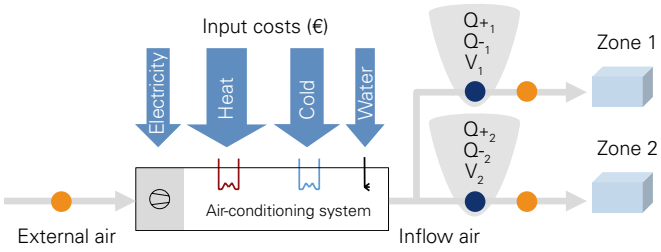
[V] = m³ or kg
(total air consumption)

$$\text{Costs (zone i)} = \text{input costs} \cdot \frac{V_i}{\sum_i V_i}$$

... ACCORDING TO AIR CONSUMPTION, WARM AND COLD SUPPLY

EZ Every zone of use is charged for its share of electricity and water costs based on its share of air consumption (V), while heated and cooled air supplied via the supply air are charged based on the zone's shares of the warm air meter (Q+) and cold air meter (Q-).

(● Luftmeister® EZ, ● Enthalpy probe EN 55)



[V] = m³ or kg
(total air consumption)

[Q+] = kWh
(heated air supply)

[Q-] = kWh
(cooled air supply)

Luftmeister® EZ has 3 meters, see p. 6 above

$$\text{Costs (zone i)} = \text{input costs (electricity, water)} \cdot \frac{V_i}{\sum_i V_i} + \text{input costs (heat)} \cdot \frac{Q+_i}{\sum_i Q+_i} + \text{input costs (cold)} \cdot \frac{Q-_i}{\sum_i Q-_i}$$

LABORATORY CALIBRATION FOR OUTSTANDING RELIABILITY

Every instrument in the Luftmeister® 55 series (MS 55/LZ 55/EZ 55) is calibrated on a certified mass flow calibration stand.

ORDERING OPTIONS (AVAILABILITY PLANNED FROM LATE 2017)

Order Code	A	B	C	D	E	F	G	H	I	J	K
Luftmeister®	–	–	–	–	–	–	–	–	–	–	–

	Typ	A
MS	Mass flow compact 55 [1]	MS 55
MS	Mass flow remote 57 [1]	MS 57
LZ	Air meter compact 55 [1]	LZ 55
LZ	Air meter remote 57 [1]	LZ 57
EZ	Energy meter compact 55 [1]	EZ 55
EZ	Energy meter remote 57 [1]	EZ 57

1) The 55 and 57 series are explained on page 3

Display [2]	B
without	0
with	1

2) Obligatory, if K = 1 (with 55 series)

Connections °C-/ enthalpy probe [3]	C
Enthalpy probe (0..5) [4] / temperature inputs (0..5)	

3) Max. 5 modules: EN55, EN57 or °C analogue input (4 .. 20 mA)
MS/LZ: optional for density compensation
EZ: required for thermal output
4) Please order the corresponding enthalpy probe EN separately

Analogue outputs	D
number 0/5/10	

Impulse or switching outputs	E
number 0/5/10	

M-bus coupling [5]	F
without	0
with	1

5) M-bus – only for LZ/EZ

BAS-bus connection	G
BACnet/IP [6]	BN
MODBUS RTU	MB

6) from 2018

Filtermonitoring / Flow regulation [7+8]	H
without	0
Filtermonitoring	1
Flow regulation [8]	2

7) Alternatively, filter monitoring and flow regulation are also available
8) Actual/target values for external flow regulation

On-site adjustment [9]	I
without	0
with	1

9) Optional for 57 series, optional for 55 series only if K=0

Dimensions [mm] [10]	J
from 10 round to 3000x3000 (rectangular)	

10) For 55 series with flange specifications if no rubber lip seal, e.g. 200x400 P20

Only for 55 series

Legal-for-trade calibration [11]	K
without	0
with	1

11) only for LZ, EZ

SAMPLE ORDERS

1. Example: Air energy meter with 2 enthalpy probes
(e.g. C on page below, 10, 11 are connected)

Order code Luftmeister® air energy meter for conditioned air:
EZ 55 - 0 - 2/0 - 5 - 10 - 1 - BN -2 - 0 - DN 300 - 0
(remote solution, no display, 2 connections EN, 5 analogue outputs, 10 impulse and switching outputs, M-bus, BAS-bus connection: BACnet/IP, actual/target values for external flow regulation, without on-site adjustment, air duct diameter 300 mm)

Order code for enthalpy probe: 4 x EN55-1 (with display)

2. Example: Air meter for high temperatures (> 60 ° C)

Order code Luftmeister® air meter for conditioned and process air:
LZ 57 - 1 - 1/0 - 10 - 0 - 1 - MB - 1 - 1 - 400x600 - 0
(remote solution, display, 1 connection EN (for density compensation), 10 analogue outputs without impulse/switching outputs, M-bus, BAS-bus connection: MODBUS RTU, filter monitoring, with on-site adjustment, air duct: 400 x 600 mm)

Order code for enthalpy probe: 1 x EN57-1 (with display)

We will be pleased to supply a suitable primary element for your measurement location.

ENTHALPY PROBE

AC enthalpy probe EN 55

for standard conditioned air
-20..60 °C

Accuracy EN 55

Relative humidity
(-15..40 °C, 0..90 % rH):
± 1,3..± 1,57 % rH

Temperature:
± 0,2 °C ± 0,0067
* (measured value -20 K)

Order code: EN 55-1 with display
EN 55-0 without display

Process enthalpy probe EN 57

also for contaminated air/heated humidity sensor -40 .. 180 ° C [12]

Accuracy EN 57

Relative humidity
(-15..40 °C, 0..90 % rH):
± 1,3..± 1,57 % rH

Temperature:
± 0,2 °C ± 0,0022
* (measured value -20 K)

Order code: EN 57-1 with display
EN 57-0 without display

12) for temperatures < -40 and >180 °C: Use of customers' temperature sensors (via Luftmeister® analogue input)

TECHNICAL DATA (SEE ALSO P. 3)

Accuracy of mass flow measurement	no disturbance: ± 3 % of measured value, with disturbance: up to ± 7.5 % of measured value	Medium	55 series, EN 55: Uncontaminated air, 1..10 m/s 57 series, EN 57: Conditioned and process air 1..15 m/s (dependent on primary element)
Accuracy of static absolute pressure measurement	± 3 hPa	Calibration error limit of air meter/ air energy meter [13]	± 5 % of measured value with disturbance up to ± 7.5 % of measured value
Installation EN 55/57	for 12 mm hole, supplied with appropriate duct flange	Custody transfer calibration [13]	5 years
Standard flange for Luftmeister® 55 series others available on request	Round air ducts: connector with rubber lip seal Rectangular air ducts: with screw flanges	Recording of meter readings (LZ, EZ):	Recorded every 2 seconds and daily storage. Data available for the last 24 months resp. the key date and all minimum/maximum values with time stamps.
Power supply	90..250 V AC	Certificates	CE, custody transfer (in preparation) [13]

13) only LZ/EZ 55

Luftmeister GmbH
Ottenstraße 2
D-79199 Kirchzarten
Deutschland

www.luftmeister.de
info@luftmeister.de
Tel. +49 (0) 7661 / 3849 8–85
Fax +49 (0) 7661 / 3849 8–89