EK-90

with K Factor Computation

This product is discontinued!

Electronic
State Volume Corrector EK-90
Operating Instructions and Installation Information

Oper. Man.	73015399	Version	from 1.4
Issued	01/2002(f)	Edition	11

Changes
compared to Issue “e”

Changes to the operating instructions:

- Correction of text errors

All the figures and descriptions in this operating and installation manual have been compiled only after careful checking. Despite this however, the possibility of errors cannot be completely eliminated. Therefore, no guarantee can be given for completeness or for the content. Also, the manual cannot be taken as giving assurance with regard to product characteristics. Furthermore, characteristics are also described in it which are only available as options.
The right is reserved to make changes in the course of technical development. We would be very grateful for suggestions for improvement and notification of any errors, etc.

With regard to extended product liability the data and material characteristics given should only be taken as guide values and must always be individually checked and corrected where applicable. This particularly applies where safety aspects must be taken into account.

Mainz-Kastel, March 1999

Contents

I Safety information

The EK-90 Electronic Volume Corrector is suitable according to VDE 0165 for applications in Zone 1 for gases in the T3 Temperature Class, ignition temperature >200°C (e.g. natural gas, see Appendix A-2). The following information is very important with regard to this application:

F *Follow the regulations in the relevant standards, in particular DIN VDE 0165 as well as the DVGW and PTB guidelines.*

F *Make certain that the limits quoted in the Certificate of Conformance (Appendix A-2) for the devices to be connected are not exceeded.*

F *The connector for the interface must only be plugged in and withdrawn when no voltage is present on the device to be connected to the EK-90.*

Also, please follow all the information contained in the section “Installation” (Chap. 4).

II Items supplied and accessories

II-1 Items supplied

The items supplied with the EK-90 include:

a) EK-90 Electronic Volume Corrector

b) Design data sheet

c) Operating manual

II-2 Ordering data and accessories

	Order No.
EK-90 Electronic State Volume Corrector	
- Version with external pulse generator	83 462 001
- Version with internal pulse generator	83 462 003
Three-way test tap	73 008 403
Mounting brackets	73 009 575
EP-10 Pulse Generator for gas meters, for plugging onto mechanical drive output, transmission ratio 1:1	73 013 472
EBL 160 Temperature Sensor Receptacle, complete with G 3/4" weld-in sleeve and seal	73 012 100
EBL 50 Temperature Sensor Receptacle, complete with M10 x 1 weld-in sleeve	73 012 634
Weld-in sleeve, G 3/4"	73 007 917
Seal for sleeve, G 3/4"	03 113 117
Weld-in sleeve, M10 x 1	33 405 156
EBL 50 Temperature Sensor Receptacles for sleeve M10 x 1	
- EBL 50 Temperature Sensor Receptacle	73 012 556
- EBL 67 Temperature Sensor Receptacle	73 013 525
Temperature sensor receptacle for weld-in sleeve G 3/4"	
- EBL 160 Temperature Sensor Receptacle	73 011 620

1 Brief description

1.1 Functions and performance features

General / Functions:

The EK-90 Electronic State Volume Corrector is used for the conversion of the gas quantities measured by a gas meter in the operational state to gas quantities in the standard state. The momentary values of pressure and temperature are meas ured to determine the operating state.

- Takes into account the gas law deviation factor (K factor) as a constant or computation of the K-value according to S-GERG-88 in the EK-90 selectable (depends on software version).
- Saves the last 15 month's end values (counter readings) for the standard volume Vb.t.
- Data back-up daily if requested.
- Battery service life at least 5 years (normal operation, see Technical Data).
- Battery replacement without loss of data using battery replacement function.

User interface:

- 12-character LCD display, description of values with abbreviated designations.
- Operation using 4 cursor keys; special functions can be executed by simultaneous operation of 2 keys.
- Programming possible via keypad.
- Calibration switch.

Pulse inputs:

- Connections for reed contacts and transistor switches.
- Maximum counting frequency 10 Hz.
- Counters for undisturbed and disturbed volumes and for total volumes of V_b and V.

Pressure sensor:

- Connection of a PDCR 900 Pressure Sensor, integrated into housing.

Temperature sensor:

- Connection of a Pt500 temperature sensor, model EBL 50 or EBL 160.

Pulse outputs:

- 4 transistor outputs, each freely programmable as alarm / warning output or as pulse output.

Data interface:

- Serial interface conforming to RS232/V24 for communication via
- DS-100 protocol
- Volume corrector protocol
- IDOM protocol

Mechanical details / Housing:

- Class of protection: IP54
- Ambient temperature range: -10°C ... +50°C

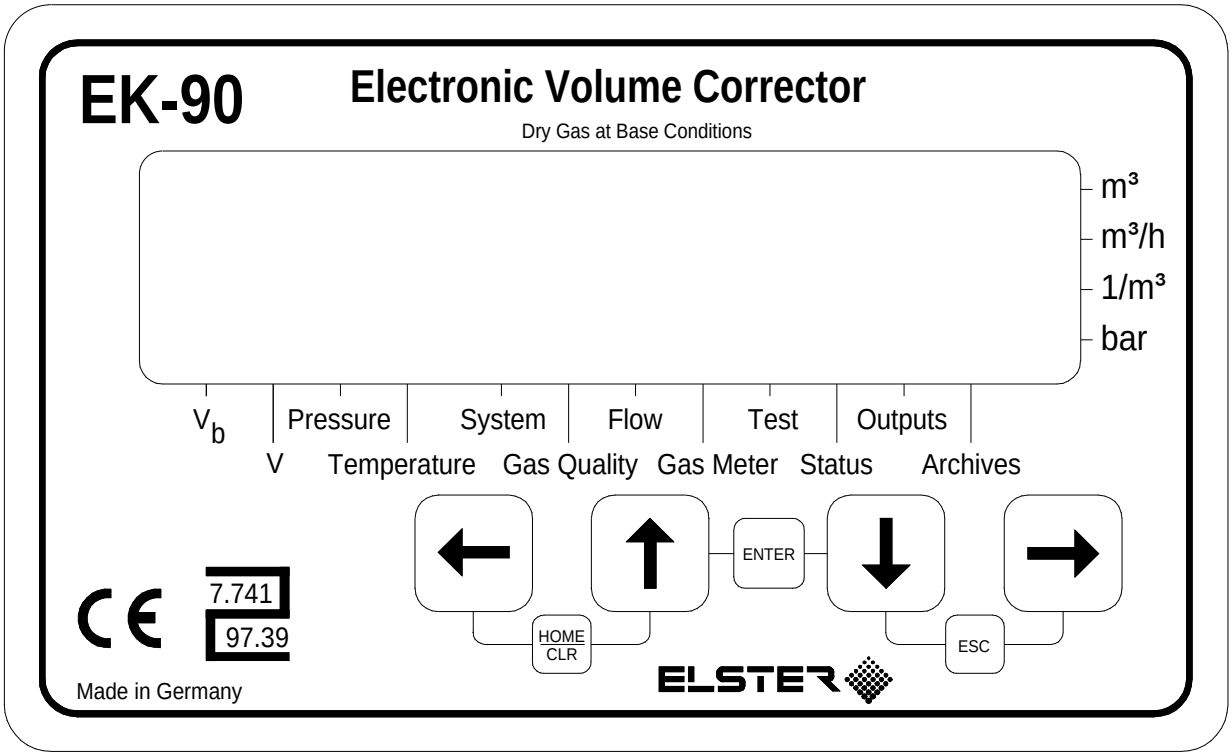
Approvals:

- PTB approved

2 Operation

2.1 Front panel

On the front panel are an LC display with 160 segments and four cursor keys.



The LCD display has the following display features:

- Single-line text display with 12 characters.
- Ten special characters at the upper edge.
- Four cursor symbols at the right edge for identifying the content of the displayed value.
- Twelve “arrows” at the lower edge for identifying the list in which the displayed value is located.
- There are four keys on the front panel for operating the EK-90. The keypad control is designed such that operation using one and using two keys simultaneously is possible (executing special functions).

Key(s)	Designation
”↑”	Up cursor key
”↓”	Down cursor key
”←”	Left cursor key
”→ ”	Right cursor key
”↓ ↑”	ENTER
”← ↑”	HOME/CLR
”← →”	HLP (Help value number)
”↓ →”	ESC (Escape)

2.2 Data structure

2.2.1 Data classes

The reaction of the device to key entries depends on the type of value which is to be entered (e.g. a trigger function such as *PROG END* or a fixed value such as the K value). In order to make these different reactions more understandable, a data class is allocated to each value.

The values in a data class are treated the same on entry.

Data class	Description
0	Constants: Values specified by the manufacturer and which cannot be changed.
1	Measurements: Values found through measurement by the EK-90 and which have no initial value as a basis (e.g. T, p, Z, flow values, etc.).
2	Measurements that can be initialised: Values found by EK-90 measurement or counting and which are based on an initial value (e.g. volume counters, Status Register 1, etc.).
3	Fixed values with a continuous value range: (e.g. customer number, serial number, fixed K value, code change, etc.).
4	Fixed values with a discrete value range: Data which can only take on a few, predefined values and which mostly set the device functions.
5	Trigger functions: Displays, via which the functions in the EK-90 can be activated (e.g. clear counters, accept parameters, etc.). The value range is 0 and 1. The number confirmed with ENTER is not saved; such a value when called displays “0” or “1”.
6	Lock: Supplier’s code and customer’s code.
7	Archived values: Archived values are replicates (copies) of data in data classes 1-4. Saving is carried out according to definable events.

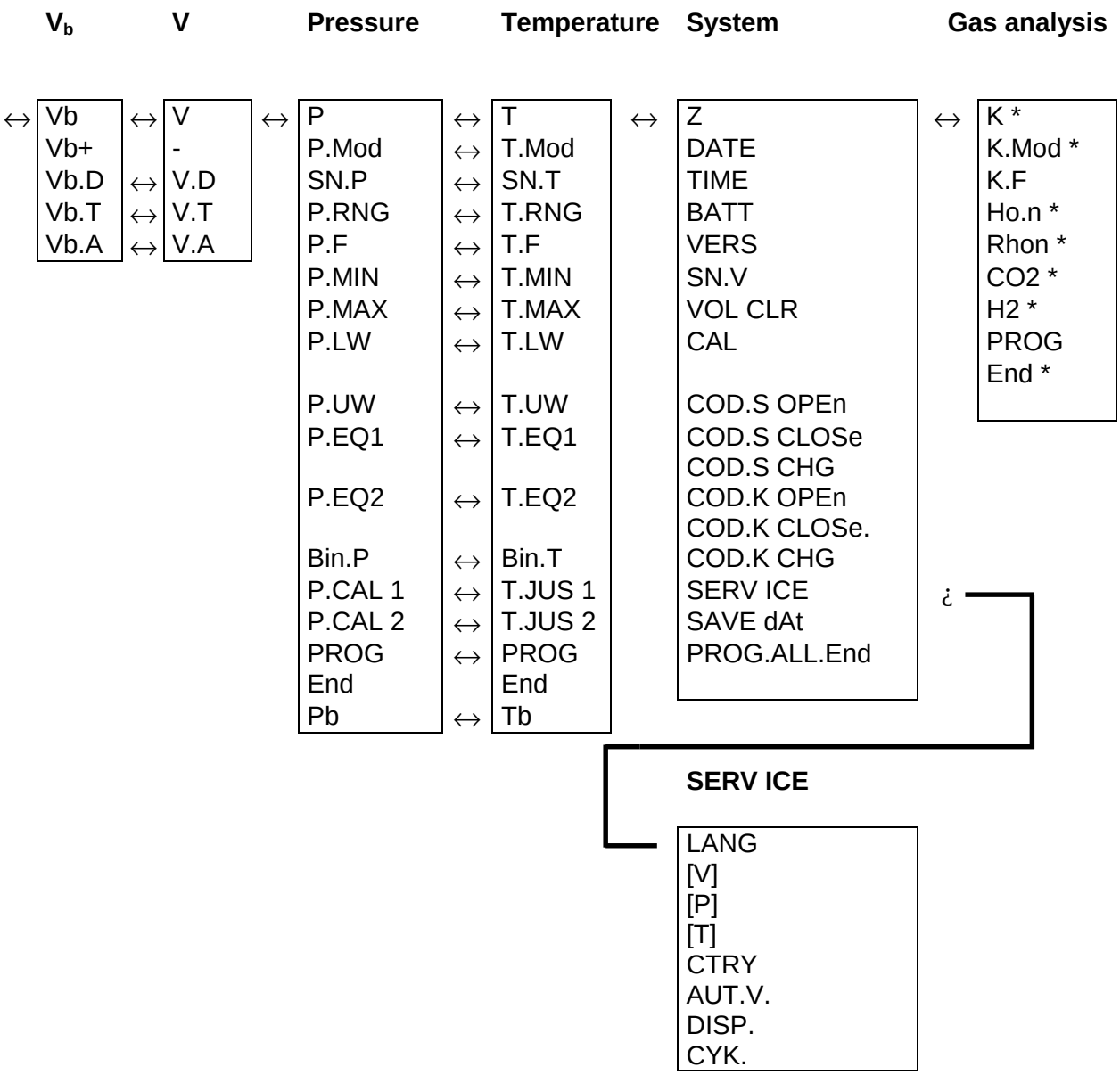
2.2.2 List structure

The data display in the EK-90 has the form of a table. Values, each with associated content, are present in the individual columns of the table.

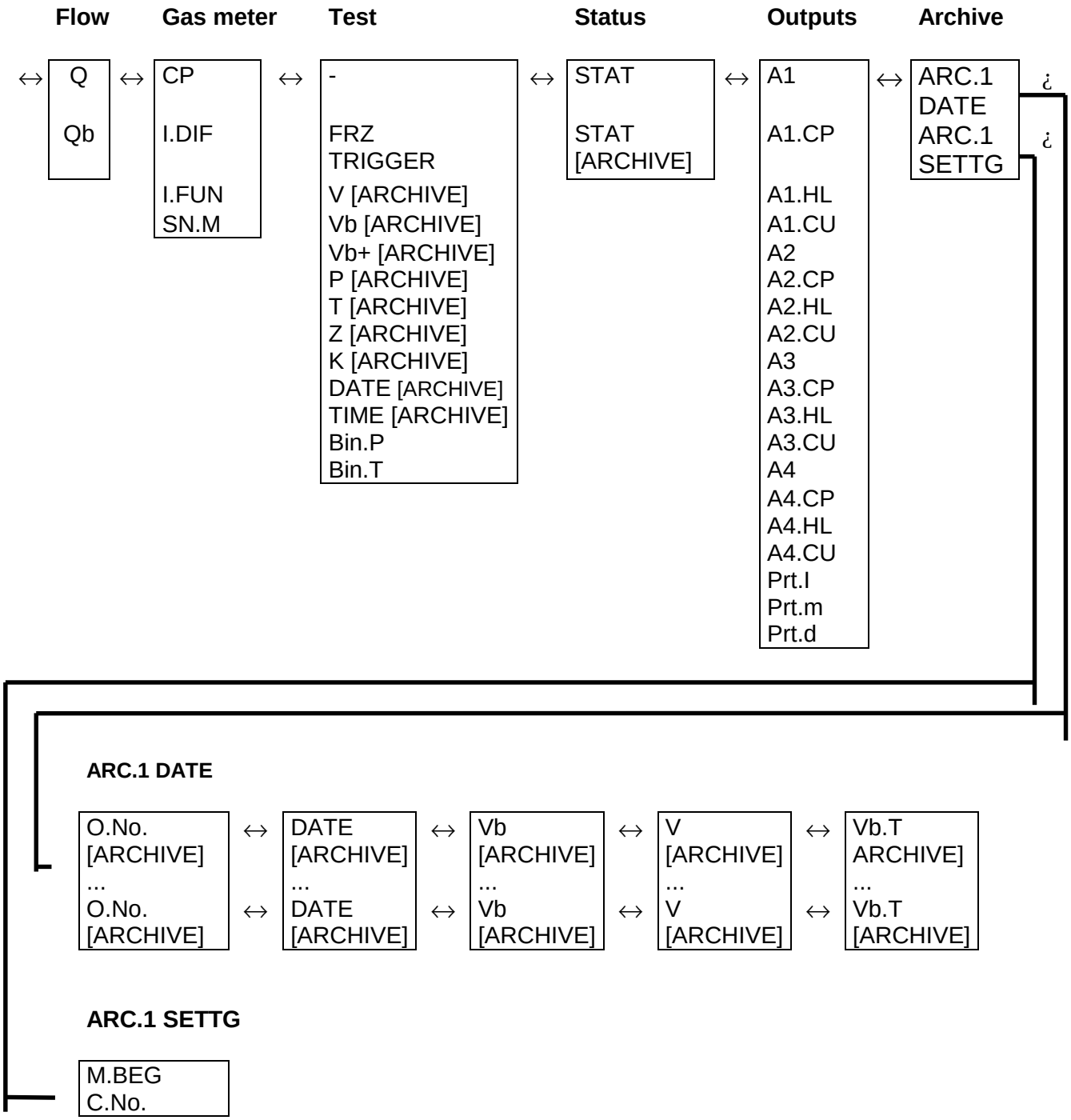
Movement within the list structure.

Key(s)	Designation	Action
"↑"	Up cursor key	Upwards movement within the current list: From the first value in the list it is possible to move to the last value with this key.
"↓"	Down cursor key	Downwards movement within the current list: From the end of the list it is possible to move to the first value with this key.
"←"	Left cursor key	Skip from any value within a table to the top value of the column to the left. With some coded values a skip to the next cell to the left occurs, i.e. in the same line of the left column.
"→ "	Right cursor key	Skip from any value within a table to the top value of the column to the right. With some coded values a skip to the next cell to the right occurs, i.e. in the same line of the right column.
"↓ ↑"	ENTER	Activate entry mode / open submenu
"← ↑"	HOME/CLR	Skip to the top line in the current column. In the list ARC.1 DAT skip to the top left field (field 1,1) in the matrix.
"↓ →"	ESC	Skip from a submenu to the higher level menu.

2.2.3 Summarising diagrams for the list structure



* Depends on software version.


Flow
Gas meter
Test
Status
Outputs
Archive
Q
Qb
CP
I.DIF
I.FUN
SN.M
-
FRZ
TRIGGER
V [ARCHIVE]
Vb [ARCHIVE]
Vb+ [ARCHIVE]
P [ARCHIVE]
T [ARCHIVE]
Z [ARCHIVE]
K [ARCHIVE]
DATE [ARCHIVE]
TIME [ARCHIVE]
Bin.P
Bin.T
STAT
STAT
[ARCHIVE]
A1
A1.CP
A1.HL
A1.CU
A2
A2.CP
A2.HL
A2.CU
A3
A3.CP
A3.HL
A3.CU
A4
A4.CP
A4.HL
A4.CU
Prt.I
Prt.m
Prt.d
ARC.1
DATE
ARC.1
SETTG
ARC.1 DATE
O.No.
[ARCHIVE]
...
O.No.
[ARCHIVE]
DATE
[ARCHIVE]
...
DATE
[ARCHIVE]
Vb
[ARCHIVE]
...
Vb
[ARCHIVE]
V
[ARCHIVE]
...
V
[ARCHIVE]
Vb.T
ARCHIVE]
...
Vb.T
[ARCHIVE]
ARC.1 SETTG
M.BEG
C.No.

2.3 Displaying values

Movement within the list structure takes place as described under Chap. 2.2.2 List structure.

Key functions when **displaying** values:

Key	**Function**
ENTER:	For Data Class 1: After ENTER an update is carried out of all the measurements needed for determining the displayed value (e.g. with the Z value: p, T, with Qb: p, T, Q).
HOME/CLR:	No reaction in the operating mode.
HLP:	The corresponding value number of the displayed value is shown in the left four characters of the display. After the keys are released, the abbreviated designation is again shown. If no value number exists, "- - - -" is displayed.
ESC:	No reaction in the operating mode.

The identification of the data on the 12-character display is provided using abbreviated designations. An abbreviated designation usually consists of a maximum of four letters which are shown in the left part of the display. The right eight characters are normally used for the display of numbers.

Example: **TIME 13:25:34**

In special cases (executing a function via the keypad) the complete display is used for the display of text.

Example: **SAVE dAt**

2.3.1 LCD special characters and "arrows"

The special characters located at the top of the display have the following meanings:

ARCHIVE: The value in the display is an archived value, i.e. it was saved as the result of a defined event.

PROG: The segment is illuminated when the calibration switch is active.

MEM: The segment is illuminated when at least one value has been changed which must be activated with the trigger function "Accept parameters". The segment flashes when, in the display or entry modes, a value is displayed which has been changed, but not yet accepted. In this case the currently valid value, or after selecting the operating mode the new entered value, is displayed in the displayed mode. The segment is constantly illuminated while values that have been entered have not yet been accepted.

ALARM: This displays the current device status. A flashing segment indicates that the initiating cause of a fault is actively present on the EK-90. Constant illumination indicates that the cause is no longer present on the device, but the status message in the status register has not yet been acknowledged.

WARN: This displays the current device status. A flashing segment indicates that the initiating cause of a fault is actively present on the EK-90. Constant illumination indicates that the cause is no longer present on the device, but the status message in the status register has not yet been acknowledged.

BATT: The segment flashes when the calculated service life of the battery (*BATT*) has reached the limit of 3 months.

The arrows at the bottom of the display are used for orientation and for better identification of the relevant displayed value. A "column heading" in the display list (see Chap. 2.2.3) is assigned to each arrow. With the data display the relevant associated arrow is switched on (e.g. display *Vb.A* -> arrow "V_b").

The arrows located at the right edge of the display point to the units printed on the panel membrane. The relevant arrow is switched on when displaying values with corresponding units.

The four arrows pointing to the units are switched on for the identification of a menu point (list value) which leads to a submenu (e.g. "Service", "Archive").
When the operator is accessing the submenu, the arrows at the bottom of the display flash apart from the arrow pointing to the current list position. This remains constantly switched on.

2.4 Changing values

Movement within the list structure takes place as described under Chap. 2.2.2 List structure.

Functions for changing values differ slightly depending on the data class. Therefore, the operating sequences for the individual data classes (**DC**) are listed in the following.

DC	Action	Function
0	Activate	No function.
	Change	These values cannot be changed via the keypad.
	Delete	No function.
1	Activate	No function.
	Change	These values cannot be changed via the keypad.
	Delete	No function.
2	Activate	After ENTER the enter mode is activated, the most significant figure flashes.
	Change	The value of the flashing figure can be changed from 0 to 9 in a loop (i.e. after 9, 0 follows again) using the keys ↑ and ↓. Further figures to be changed are selected with ← and →. The changed number is accepted with ENTER.
	Delete	The value is described with its default value, see “Default” field in the description of the individual lists.
3	Activate	After ENTER the entry mode is activated, the most significant figure flashes.
	Change	The value of the flashing figure can be changed from 0 to 9 in a loop (i.e. after 9, 0 follows again) using the keys ↑ and ↓. The arithmetic sign of the most significant place can also be changed with some values. Further figures to be changed are selected with ← and →. The changed number is accepted with ENTER.
	Delete	No function.
4	Activate	After ENTER the entry mode is activated, the complete displayed number flashes.
	Change	The next higher, resp. lower valid value is shown with ↑ and ↓. The changed number is accepted with ENTER.
	Delete	No function.
5	Activate	After ENTER the enter mode is activated, “0” (or “1”) flashes.
	Change	The display “1” (flashing) can be toggled with ↑ and ↓. When 1 shows, the function is executed with ENTER. Successful execution of the function is indicated with “OK” on the display or “Error” for an error (both right justified).
	Delete	No function.

DC	Action	Function
6	Activate	After ENTER the hidden entry mode is activated.
	Change	The exact description is given under the Z value / system list.
	Delete	No function.
7	Activate	No function.
	Change	These values cannot be changed via the keypad.
	Delete	No function.

The following also applies to all data classes:

- ENTER activates the entry mode.
  With values which must be accepted with the release function “Accept parameters” (*PROG End*), any new entered numbers which have not yet been accepted are shown in the display.
- ESC cancels an entry.
- ENTER terminates the entry of a value and accepts the displayed value as the current value.
- When entry has finished, the operating mode becomes active again.

2.5 Calibration lock and switch

The EK-90 has a calibration lock for securing parameters which are subject to calibration regulations. This includes all values affecting the volume metering. The parameters which can only be changed with this lock open are identified with “C” in the lists in the functional description.

The calibration switch is implemented as a push-button located inside the device. It is accessible by loosening a screw on the front panel of the housing. After undoing the screw the calibration lock can be opened by pressing the push-button once.
There are various ways of closing the lock:

- After one hour without any entries the lock closes automatically.
- The calibration lock can be closed via keypad input using the value *CAL* in the system list (see Functional description).

2.6 User lock

The user lock is used for securing all data which is not subject to calibration regulations, but which should not be changed without authorisation. The user lock consists of a supplier’s code and a customer code so that only both of them together can open the user lock. Both locks are completely independent of one another and each must be entered as a six-figure number. This division enables mutual checking of the gas supplier and customer. Both the supplier’s and customer’s codes can be changed when the user lock or calibration lock is open. The calibration lock has the higher priority however. This means that with the calibration lock open, parameters which are subject to the user lock can also be modified.

3 Functional description

The following functional description is orientated to the list structure. The list data and functions are described in each chapter.

3.1 Standard volume list (V_b)

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
Vb	Standard volume, un-disturbed, predecimal places	99999999	m^3	0	C	H2.1	2
Vb+	Standard volume, un-disturbed, post-decimal places	0.9999	m^3	0	C	H2.2	2
Vb.D	Standard volume, disturbed	99999999	m^3	0	C	H4	2
Vb.T	Standard volume, total quantity	99999999	m^3	0	C	H6	2
Vb.A	Standard volume, adjustable	99999999	m^3	0	U	H24	2

AD = Abbreviated description
HLP = Value code in VC protocol
C/U = Calibration / user lock
DC = Data class

The standard volume is calculated from the actual volume using the equation

$$V_b = V \times Z$$

where

V_b = Standard volume (V_b)
V = Actual volume (V)
Z = Z value (Z)

The unit for the standard volume display depends on *[V]* (unit for volume). All standard volume quantities (with the exception of the undisturbed standard volume V_b) are only displayed in full m^3, i.e. without post-decimal places, irrespective of the c_P value of the pulse input.

With the calibration lock open, the counters *Vb* and *Vb.D* can be assigned any value.

Vb (Standard volume, undisturbed, predecimal places):
This counter is active when the device is operating without any disturbances. The post-decimal places (**Vb+**) are deleted after entry of this counter.

Vb+ (Standard volume, undisturbed, post-decimal places):
This counter is active when the device is operating without any disturbances. Four post-decimal places are shown. Direct entry of this counter is not possible.

Vb.D (Standard volume, disturbed quantity):
This counter is active when the device is in the alarm state (alarm present). Only are displayed predecimal places irrespective of the c_P value.

Vb.T (Standard volume, total quantity):
This counter is formed by the addition of *Vb* and *Vb.D* when it is to be displayed or output via the interface. Only predecimal places are displayed and transferred. Direct entry into this counter is not possible.

Vb.A (Standard volume, adjustable):
This counter acquires the total standard volume (as *Vb.T*). However, it can be set at any time when the user lock is open using the keypad or interface. It is saved in a separate register. Only predecimal places are displayed and transferred. The counter has no influence on V_b and is similar in function to a trip recorder in a car.

3.2 Actual volume list (V)

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
V	Actual volume, undisturbed	99999999.99	m^3	0	C	H1	2
V.D	Actual volume, disturbed	99999999.99	m^3	0	C	H3	2
V.T	Actual volume, total quantity	99999999.99	m^3	0	C	H5	2
V.A	Actual volume, adjustable	99999999.99	m^3	0	U	H23	2

AD = Abbreviated description C/U = Calibration / user lock
HLP = Value code in VC protocol DC = Data class

The actual volume is calculated in the EK-90 using the specified c_p value according to the equation

$$V = n/c_p$$

where

V = Actual volume (*V*)
n = Number of pulses
c_P = c_P value (*CP*), meter constant with the unit $1/m^3$.

The unit for the actual volume display depends on *[V]* (unit for volume). For c_p values ≥ 1 the number of post-decimal places for the display of the actual volume counter corresponds to the reciprocal of the c_p value and for C_p values < 1 is always shown in full m^3.

With the calibration lock open the counters *V* and *V.D* can be set with any initial value.

V (Actual volume, undisturbed):
The counter is active when the device is operating without any disturbances.

V.D (Actual volume, disturbed quantity):
This counter is active with the device in the alarm state (alarm present).

V.T (Actual volume, total quantity):
This counter is formed from the addition of *V* and *V.D* when it is to be displayed or output via the interface. Direct entry of this counter is not possible.

V.A (Actual volume, adjustable):
This counter acquires the total actual volume (similar to *V.T*). However, it can be set at any time when the user lock is open using the keypad or interface. It is saved in a separate register. The counter has no effect on *V* and is similar in function to a trip recorder on a car.

3.3 Pressure sensor list (p)

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
P	Pressure, absolute	0.1 ... 125.00	bar	-	-	L1	1
P.Mod	Pressure mode	0/1/2	-	1	C	P12	4
SN.P	Serial number, pressure sensor	999999	-	0	C	L16	3
P.RNG	Pressure range, absolute	0.1... 125.00	bar	0.8...2.0	C	L26	3
P.F	Substitute pressure	0.1 ... 125.00	bar	1.0	U[1]	P2	3
P.MIN	Lower alarm limit, pressure	0 ... 131.20	bar	0.7	C	P24	3
P.MAX	Upper alarm limit, pressure	0 ... 131.20	bar	2.1	C	P23	3
P.LW	Lower warning limit, pressure	0 ... 131.20	bar	0.7	U	P102	3
P.UW	Upper warning limit, pressure	0 ... 131.20	bar	2.1	U	P101	3
P.EQ1	Pressure equation offset	-999.999...999.999	-	0	C	P145	3
P.EQ2	Pressure equation slope	-999.999...999.999	-	0	C	P146	3
Bin.P	Pressure, binary	65535	-	-	-	L47	1
P.CAL 1[2]	Pressure adjustment, lower value	0.4 ... 125.00	bar	0.8	C	P120	3
P.CAL 2[2]	Pressure adjustment, upper value	0.4 ... 125.00	bar	2.0	C	P121	3
PROG End	Accept parameters	0/1	-	0	-	-	5
Pb	Standard pressure P_b	0.95 ... 1.05	bar	1.01325	C	L156	3

AD = Abbreviated description
HLP = Value code in VC protocol
C/U = Calibration / user lock
DC = Data class

The unit for the pressure display depends on *[P]* (unit for pressure).

P (Pressure, absolute)
Here the gas pressure used for the computation of the Z value is displayed (last measured gas pressure or substitute pressure). If the measured value is outside of the limits defined with *P.MIN* and *P.MAX*, then the substitute pressure programmed with *P.F* is displayed.

The number of displayed post-decimal places depends on the magnitude of the value and it decreases with increasing magnitude.

[1] In fixed-value mode subject to calibration lock!

[2] This value is only accepted with “PROG End”!

P.Mod (Pressure mode)
It is possible to switch between three different pressure modes with this value:

P.Mod = 0 Pressure measurement off; the substitute pressure *P.F* is used for the correction. Monitoring of alarm and warning limits is not carried out in this mode.

P.Mod = 1 Pressure measurement on.

P.Mod = 2 Current pressure is not taken into account and the function is as with *P.Mod*=0, but the substitute pressure is set the same as the standard pressure (*P.F=Pb*). The standard pressure is then also displayed for the substitute pressure *P.F*. The previously programmed substitute pressure *P.F*. still remains saved and becomes active again when *P.Mod* is set to 0 or 1.

SN.P (Serial number, pressure sensor):
Six-figure number for identification of the connected pressure sensor.

P.RNG (Pressure range, absolute):
The permissible gas pressure range is entered and displayed (specified measurement range) with lower and upper values under *P.RNG*. The two values are separated by a colon in the display.

P.F (Substitute pressure, p):
The value *P.F*. is used for correction when:
a) the measurement limits set by *P.MIN* or *P.MAX* have been violated or
b) the pressure mode *P.Mod* = 0 (measurement switched off) is programmed. The number of displayed post-decimal places depends on the magnitude of the value and decreases with increasing magnitude.

P.MIN (Lower alarm limit, pressure):
Undercutting of the minimum permissible pressure value *P.MIN* leads to an alarm, disturbance volume counting and to the error message E.15 in Status Register 1. There is no dependence on the lower value of the pressure range. The number of displayed post-decimal places depends on the magnitude of the value and decreases with increasing magnitude.

P.MAX (Upper alarm limit, pressure):
Exceeding the maximum permissible pressure value *P.MAX* leads to an alarm, disturbance volume counting and to the error message E.15 in Status Register 1. With impermissible entry (value range exceeded, see *P.RNG*) the entry error --6-- is displayed. The number of displayed post-decimal places depends on the magnitude of the value and decreases with increasing magnitude.

P.LW (Lower warning limit, pressure):
Undercutting the lower limit for the pressure measurement *P.LW* triggers a warning and the error message E.26 in Status Register 1. The number to be entered can be freely selected. With impermissible entry (internal display value range exceeded) the entry error --6-- is displayed. The number of displayed post-decimal places depends on the magnitude of the value and decreases with increasing magnitude.

P.UW (Upper warning limit, pressure):

Exceeding the upper limit for the pressure measurement *P.UW* triggers a warning and the error message E.26 in Status Register 1. The number to be entered can be freely selected. With impermissible entry (internal display value range exceeded) the entry error --6-- is displayed. The number of displayed post-decimal places depends on the magnitude of the value and decreases with increasing magnitude.

P.EQ1 (Pressure equation offset):
Offset for the pressure characteristic, see Description of adjustment under 3.3.1.

P.EQ2 (Pressure equation slope):
Slope of the pressure characteristic, see Description of adjustment under 3.3.1.

Bin.P (Pressure, binary):
Unfiltered pressure binary value of the AD converter.

P.CAL1 (Pressure adjustment, lower value):
Entry of the lower adjusting pressure for adjustment of the pressure measurement circuit. The procedure is described under 3.3.1 Pressure sensor adjustment.

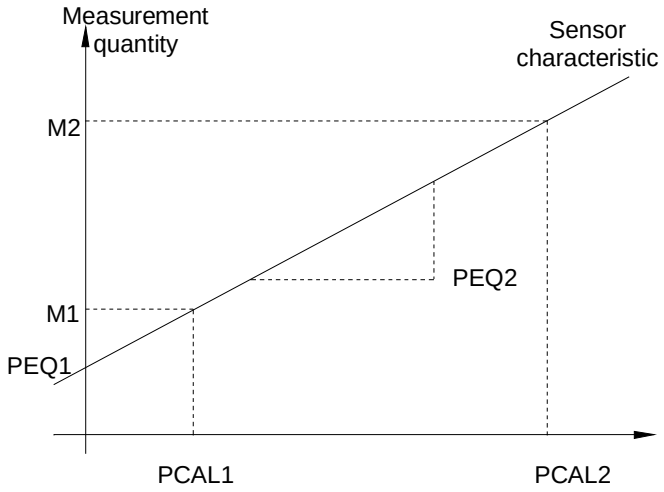
P.CAL2 (Pressure adjustment, upper value):
Entry of the upper adjusting pressure for adjustment of the pressure measurement circuit. The procedure is described under 3.3.1 Pressure sensor adjustment.

PROG End (Accept parameters):
In contrast to the function *PROG ALL.END* (= Accept all parameters) only the changed parameters in the pressure list are accepted with this function. The function can only be initiated via the keypad; “Accept all parameters” is automatically executed with *PROG End* via the interface. After execution of the function the segment “MEM” on the display is deleted provided that no changed data that has not yet been accepted is not present in other lists.

Pb (Standard pressure P_b):
Standard pressure (5 post-decimal places) used for the computation of the Z value.

3.3.1 Pressure input adjustment

To minimise measurement errors the device is adjusted to the characteristics of the pressure sensor and the pressure input. Since the pressure sensor characteristic is almost linear, this procedure can be carried out using the definition of two points (*P.CAL1* and *P.CAL2*) on a straight line. The device computes the offset (*P.EQ1*) and the slope (*P.EQ2*) of the sensor characteristic from these points.



Procedure for adjustment:

1st step: Adjust the line pressure to the lower adjustment pressure.

2nd step: Call the value *P.CAL1*. After entering ENTER the “1” disappears and the default value for the lower adjustment pressure is displayed.

3rd step: Enter the lower adjustment pressure (the currently applied pressure). Post-decimal places as with *P.F*.

4th step: The measurement is taken by pressing ENTER. The segment “MEM” is activated once the first measurement is complete.

5th step: Set the line pressure to the upper adjustment pressure.

6th step: Call the value *P.CAL2*. After entering ENTER the “2” disappears and the default value for the upper adjustment pressure is displayed.

7th step: Enter the upper adjustment pressure (the currently applied pressure). Post-decimal places as with *P.F*.

8th step: The measurement is taken by pressing ENTER.

Example of the display for *P.CAL1*:

Display		*Entry*	*Remarks*
P.CAL	*1*	*<ENTER>*	
P.CAL	*000.8000*	*<ENTER>*	*Trigger measurement*
P.CAL	*0.8000*		

Visual confirmation of the execution of measurement is obtained due to display formatting to the appropriate number of pre- and post-decimal places after ENTER (Execute measurement).

The computation of the slope and offset is executed with the initiation of Accept parameters (*PROG End*) and the new data is activated.

3.4 Temperature sensor list (T)

AD	Description	Value	Unit	Default	C/U	HLP	DC
T	Gas temperature	-99.99 ... 99.99	°C	-	-	L2	1
T.Mod	Temperature mode	0/1	-	1	C	P13	4
SN.T	Serial number, temperature sensor	999999	-	0	C	L17	3
T.RNG	Temperature range	-99.00 ... 99.00	°C	-10 ... 60	C	L27	3
T.F	Substitute temperature	-99.00 ... 99.00	°C	15.00	U[1]	P3	3
T.MIN	Lower alarm limit, temperature	-99.99 ... 99.99	°C	-10.99	C	P22	3
T.MAX	Upper alarm limit, temperature	-99.99 ... 99.99	°C	60.99	C	P21	3
T.LW	Lower warning limit, temperature	-99.99 ... 99.99	°C	-10.99	U	P152	3
T.UW	Upper warning limit, temperature	-99.99 ... 99.99	°C	60.99	U	P151	3
T.EQ1	Temperature equation offset	-999.999...999.999	-	0	C	P147	3
T.EQ2	Temperature equation slope	-9999.99...9999.999	-	0	C	P148	3
Bin.T	Temperatur binär	65535	-	-	-	L48	1
T.JUS 1[2]	Temp. adjustment, lower value	262.15 ... 334.15	K	263.15	C	P170	3
T.JUS 2[2]	Temp. adjustment, upper value	262.15 ... 334.15	K	333.15	C	P171	3
PROG End	Accept parameters	0/1	-	0	-	-	5
Tn	Standard temperature T_n	263.15... 293.15	K	273.15	C	L157	3

AD = Abbreviated description
C/U = Calibration / user lock
HLP = Value code in VC protocol
DC = Data class

The unit for the temperature display depends on *[T]* (unit for temperature). Two post-decimal places are shown on the display.

T (Gas temperature):
Here the gas temperature used for the computation of the K value (last measurement or fixed value) is displayed. If the measurement is located outside of the limits defined with *T.MIN* and *T.MAX*, then the substitute temperature programmed with *T.F* is displayed.

T.Mod (temperature mode):
T.Mod activates or deactivates the temperature measurement.
T.Mod = 0 Temperature measurement switched off and the substitute temperature *T.F* is used for the correction. Monitoring of the alarm and warning limits is not carried out in this mode.
T.Mod = 1 Temperature measurement switched on.

SN.T (Serial number, temperature sensor)
Six-figure serial number for identifying the connected temperature sensor.

[1] In fixed-value mode subject to calibration lock!

[2] This value is only accepted with “PROG End”.

T.RNG (Temperature range):

The permissible gas temperature range is entered and displayed (specified measurement range) with lower and upper values under *T.RNG*. The two values are separated by a colon in the display.

T.F (Substitute temperature):
The value *T.F*. is used for correction when:
a) the measurement limits set by *T.MIN* or *T.MAX* have been violated (then disturbance volume counting occurs) or
b) the temperature mode *T.Mod* = 0 (measurement switched off) is programmed (no disturbance volume counting occurs).

T.MIN (Lower alarm limit, temperature):
Undercutting of the minimum permissible temperature value *T.MIN* leads to an alarm, disturbance volume counting and to the error message E.16 in Status Register 1. With impermissible entry (value range exceeded, see *T.RNG*) the entry error --6-- is displayed.

T.MAX (Upper alarm limit, temperature):
Exceeding the maximum permissible temperature value *T.MAX* leads to an alarm, disturbance volume counting and to the error message E.16 in Status Register 1. With impermissible entry (value range exceeded, see *T.RNG*) the entry error --6-- is displayed.

T.LW (Lower warning limit, temperature):
Undercutting the lower limit for the temperature measurement *T.LW* triggers a warning and the error message E.26 in Status Register 1. The number to be entered can be freely selected. With impermissible entry (internal display value range exceeded) the entry error --6-- is displayed.

T.UW (Upper warning limit, temperature):
Exceeding the upper limit for the temperature measurement *T.UW* triggers a warning and the error message E.26 in Status Register 1. The number to be entered can be freely selected. With impermissible entry (internal display value range exceeded) the entry error --6-- is displayed.

T.EQ1 (T-equation offset):
Offset for the temperature characteristic, see Description of adjustment under 3.4.1.

T.EQ2 (T-equation slope):
Slope of the temperature characteristic, see Description of adjustment under 3.4.1.

Bin.P (Temperature, binary):
Unfiltered temperature binary value of the AD converter.

T.JUS1 (Temperature adjustment, lower value):
Entry of the lower adjusting temperature for adjustment of the temperature measurement circuit. The procedure is described under 3.4.1 Temperature sensor adjustment.

T.JUS2 (Temperature adjustment, upper value):
Entry of the upper adjusting temperature for adjustment of the temperature measurement circuit. The procedure is described under 3.4.1 Temperature sensor adjustment.

PROG End (Accept parameters):
In contrast to the function *PROG ALL.End* (= Accept all parameters) only the changed parameters in the temperature list are accepted with this function. The function can only be initiated via the keypad; “Accept all parameters” is automatically executed with *PROG End* via the interface.
After execution of the function the segment “MEM” on the display is deleted provided that no changed data that has not yet been accepted is present in other lists.

Tb (Standard temperature T_b):
Standard temperature used for the computation of the Z value.

3.4.1 Temperature input adjustment

The adjustment of the temperature input is carried out similar to the adjustment of the pressure input, see Chapter 3.3.1.

3.5 System list (Z value)

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
Z	Z value	170	-	-	-	L3	1
DATE	Date	dd.mm.yyyy	-	01.03.1997	U	L7	2
TIME	Time	hh:mm:ss	-	0:00:00	U	L8	2
BATT	Capacity and remaining battery service life	0.1...9.9 -150 ... 150	Ah Months	5,2 66	U	L35	3
VERS	Software version	xx	-	-	-	L34	0
SN.V	Serial number, VC	999999909999	-	0	C	L18	3
VOL Clr	Clear counter	0/1	-	0	C	P48	5
CAL	Read state of calibration lock/close	0/1	-	0	-	P90	4
COD S OPEN COD S CLOSE	Enter supplier's code	000000 ... 999999	-	000000	-	P0	6
COD S CHANGE	Change supplier's code	000000 ... 999999	-	000000	U	P9	3
COD C OPEN COD C CLOSE	Enter customer's code	000000 ... 999999	-	000000	-	P10	6
COD C CHG	Change customer's code	000000 ... 999999	-	000000	U	P11	3
SERV ICE	Service submenu	-	-	-	-	-	-
SAVE.dAt	Save data (battery change fct.)	0/1	-	0	-	-	5
PROG.ALL End	Accept all parameters	0/1	-	0	U	P99	5

AD = Abbreviated description
HLP = Value code in VC protocol
C/U = Calibration / user lock
DC = Data class

Z (Z value):
Current Z value for determining the standard volume.

DATE (Date):
Date of the internal clock.

TIME (Time):
Time-of-day of the internal clock in 24 hour format.

BATT (Remaining battery service life):
Here, the nominal capacity of the battery in ampere-hours is shown left justified and the remaining battery service life in months right justified. If remaining service life falls below three months, the error message E.7 is entered into Status Register 1, the segment "WARN" starts to flash and the segment "BATT" becomes permanently lit.
After a battery replacement with the following entry of the new capacity, the EK-90 computes the new remaining service life associated with the capacity.

VERS (Software version):
Device software version.

SN.V (Serial number, VC):
Twelve-figure serial number of the device. First, the most significant four places are displayed, then the least significant eight places when selected with ↓.

F *When changing the device number, it should be noted that the "ten thousands place" (5th place to the right of the complete number) must be occupied by 0. This place is needed by the device data storage function.*

VOL CLR (Clear counter):
After calling, “1” is present, right justified in the display and “0” can be selected with ↑ or ↓ (toggling 0, 1, 0...). The function is released with ENTER, i.e. all counters (*V, Vb*) and the counter reading, ordering and date entries in the archive are deleted.

CAL (Read calibration lock status and close):
After invoking the display, the figure 1 (open) or 0 (closed) appears. With the calibration lock open it is possible, after switching to 0, to close the calibration lock with ENTER. When the calibration lock is open, the segment “PROG” is switched on and the message “E.30” is entered in Status Register 1.
Further details about the calibration lock are given under 2.5 Calibration lock and switch.

COD S OPEn
COD S CLOSE (Enter supplier’s code):
After selecting the function, the display COD S OPEn. (or COD S CLOSE) appears. The function is activated with ENTER. COD S. is retained in the display to the left and “0_ _ _ _ _” appears to the right. The 0 indicates the place which can be changed via the keys. The superimposed figure is changed with the keys ↑ and ↓ and the next figure for entry is selected with ← and →. After selection a “0” is superimposed at the appropriate point, the previous figure disappears again out of the display and a “_” is displayed.
Further details about the user lock are given under 2.6 User lock.

COD C OPEn
COD C CLOSE (Enter customer’s code):
After selecting the function, the display COD C OPEN (or COD C CLOSE) appears. The function is activated with ENTER. COD C is retained in the display to the left and “0_ _ _ _ _” appears to the right. The 0 indicates the place which can be changed via the keys. The superimposed figure is changed with the keys ↑ and ↓ and the next figure for entry is selected with ← and →. After selection a “0” is superimposed at the appropriate point, the previous figure disappears again out of the display and a “_” is displayed.
For further details about the user lock see 2.6 User lock.

COD S CHG. (Change supplier's code):
With the user lock open, it is possible to enter a new supplier's code. After selecting the function, COD S CHG. is displayed. The function is activated with ENTER. COD S is retained in the display to the left and the current code (all places) appears to the right with the 6th (left) place flashing. After entry and selection of the next place, the entered place remains in the display, i.e. after completing the entry of the code, it can be seen on the display until terminated with ENTER. All places that have not been changed are automatically written with 0.

COD C CHG (Change customer's code):
With the user lock open, it is possible to enter a new customer's code. After selecting the function, CHG C COD. is displayed. The function is activated with ENTER. C COD. is retained in the display to the left and the current code (all places) appears to the right with the 6th (left) place flashing. After entry and selection of the next place, the entered place remains in the display, i.e. after completing the entry of the code, it can be seen on the display until terminated with ENTER. All places that have not been changed are automatically written with 0.

SERV ICE (open Service submenu):
Access to the "Service" submenu is obtained with ENTER. The data is described under 3.5.1. The values in the Service menu mainly involve device settings which normally need to be only set once.

SAVE dAt (Save data):
This function is used to save the current data in the EEPROM before a battery replacement. This data is automatically loaded again on completion of battery replacement.

PROG.ALL.End (Accept all parameters):
With this function all modified parameters are accepted which have been changed in the various lists. The function "Accept parameters" (*PROG End*) in the individual lists for pressure and temperature only refers to the relevant list. After executing this function the segment "MEM" on the display is cleared.

3.5.1 Service sublist

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
LANG.	Select language	0/1/2	-	0	C	P70	4
[V]	Unit for volume m³/ft³	0	-	0	C	P71	0
[P]	Unit for pressure bar/psi/hPas/KPas	0	-	0	C	P72	0
[T]	Unit for temperature °C/K/°F	0	-	0	C	P73	0
CTRY	Select functional variant	0	-	0	C	P74	4
AUT.V	Automatic switching to H2	0 ... 255	min	1	C	P91	3
DISP.	Continuous display	0 ... 255	min	1	U	P96	4
CYK	Cyclic period for analogue measurements	xxx.y	-	20.1	C	P14	3

AD = Abbreviated description C/U = Calibration / user lock
HLP = Value code in VC protocol DC = Data class

LANG. (Select language):
Selects the language in which the abbreviated designations appear on the display.

LANG. = 0 German
LANG. = 1 English
LANG. = 5 Spanish

[V] (Unit for volume m^3):
The selection of the unit for volume is only relevant for interface communications. Depending on the country variant only one unit is displayed.

[V] = 0 m^3 (value can only be read)

[P] (Unit for pressure bar):
The selection of the unit for pressure is only relevant for interface communications. Depending on the country variant only one unit is displayed.

[P] = 0 bar (value can only be read)

[T] (Unit for temperature °C):
Selects the temperature unit. With the display of temperature values the unit is displayed in the two right-hand character segments. The setting is made according to the following values:

Setting [T]	Current gas temp. T	Measurement range T.RNG	Limits T.MAX / T.MIN / T.UW / T.LW	Standard temp. Tb
0=°C	°C	°C	°C	K

[T] = 0 °C (Value can only be read)

CTRY (Select the functional variant):
Sets country-specific default values for protection (calibration / user locks) of various data.

CTRY=	Substitute value K value K.F	Substitute value Pressure P.F	Substitute value Temperature T.F	c_P value	Display c_P value
0	B	B	B	E	1 / m^3

C = Calibration lock U = User lock

AUT.V (Automatic switching to H2):
Here, the time is entered in minutes (from the last key depression) after which automatic switching to the standard display *Vb* (H2) occurs. When the calibration lock is open (= calibration mode), automatic switching is always switched off.

AUT.V = 0 No automatic switching.
AUT.V ≠ 0 Display switches to the standard display after the period (in minutes) set with *AUT.V*.

DISP. (Continuous display):
With this value the selection can be made of whether the display is continuously active or should switch off after the period (from the last key depression) set under *DISP.* The inactive display is switched on again by pressing a key.

DISP. = 0 Continuous display.
DISP. ≠ 0 Display turns off after the period (in minutes) set with *DISP*.

CYK (Cyclic period for analogue measurements):
Setting of the time interval and the dependence of measurements on incoming pulses.

CYK = xxx.y

Xxx = 0...255 seconds, minimum interval period between analogue measurements.
Y = 1 Analogue measurement is triggered by volume pulse.
y = 0 Self-triggering analogue measurement at xxx second intervals.

3.6 Gas analysis list (K value)

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
K.F	K value	0.5000...1.5000	-	1.0000	C	P1	3

AD = Abbreviated description C/U = Calibration / user lock
HLP = Value code in VC protocol DC = Data class

K.F (K value):
The K value (fixed value) used for calculating the Z value.

Only for EK-90 with K factor computation

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
K	K value currently computed / GERG		-	-	-	L6	1
K.MOD	K value mode	0/2	-	0	C	P8	4
K.F	K value	0.5000...1.5000	-	1.0000	U	P1	3
Ho.n	Calorific value Ho,n	6...12.833	kWh/m^3	6.000	U	L145	3
Rhon	Standard density gas	0.71...1.16	kg/m^3	1.000	U	L146	3
CO2	CO2 content	0...30	Mol-%	0	U	L148	3
H2	Molar proportion of H2	0...99.999	Mol-%	0	U	L147	3
PROG End	Acceptance of calibration data	-	-	-		P99	5

K (K value currently computed):
K value used for computing the Z value, computed to S_GERG-88 or constant (P8=0).

+ *Computation according to S-GERG-88 assumes that the calorific value ($H_{o,n}$) and standard density (Rho_n) are determined according to the procedures of ISO Standard 6976 (1983) or DIN 51858. If one of these requirements is not fulfilled, adaptation according to the appendix to the Technical Regulations, DVGW Worksheet G 486 (08/92) must be made.*
The DIN regulations DIN 1871, DIN 51850 and DIN 51858 are being revised in line with ISO DIS 6976. The adaptation formula E3 (see appendix to the Technical Regulations, DVGW Worksheet G 486 (08/92)) will no longer be needed when the revised standards become effective.
To determine the K-value the adaptation formula E3 will continue to be used as before.

+ *Furthermore, the following limits must be ensured by the operator:*

Methane	***CH_4***	*50 - 100 %*	***Propane***	***C_3H_8***	*0 - 5 %*
Nitrogen	***N_2***	*0 - 50 %*	***Butane***	***C_4H_{10}***	*0 - 1 %*
Ethane	***C_2H_6***	*0 - 20 %*	***Pentane***	***C_5H_{12}***	*0 – 0.5 %*

K.MOD (K-value mode):
Switches between the K-value computation according to S-GERG-88 (P8=2) and K=constant (P8=0).

K.F (K-value):
K-value (fixed value) used for computation of the Z-value.

Ho.n (Calorific value):

Calorific value of the gas. Different ranges of validity are required for the other gas parameters depending on the gas calorific value. If conflict arises with the validity of another gas parameter when entering the calorific value, an error message (----3----) is output and the entered value is ignored.

Rhon (Standard density):
Standard density of the gas. For monitoring of the range of validity and entry, see L145.

CO2 (CO2 content):
CO_2 content of the gas. For monitoring of the range of validity and entry, see L145.

H2 (Molar proportion of H2):
H_2 proportion of the gas. For monitoring of the range of validity and entry, see L145.

PROG End (Accept parameters):
Acceptance of the changed gas analysis values for the K-value computation is triggered in the K-value column with the P99 trigger function.
The sequence for entry and acceptance of the modified values:
After calling the value to be modified, the entry mode is activated and the new figure entered. The figure is accepted with ENTER; the display remains on the new figure and the segment “MEM” flashes. When the display is switched further, the segment “MEM” lights constantly. When the changed value is called again, the segment “MEM” flashes and the current (i.e. the old) value is displayed.
After ENTER the new entered value is displayed.
Once the changed values have been accepted with P99, the segment “MEM” goes out.

3.7 Flow list (flow rates)

AD	Description / value	Value range	Unit	C/U	HLP	DC
Q	Actual flow Q	99999999.99	m3/h	-	H12	1
Qb	Standard flow Q_b	99999999.99	m3/h	-	H13	1

AD = Abbreviated description C/U = Calibration / user lock
HLP = Value code in VC protocol DC = Data class

Q (Actual flow):
The actual flow *Q* is calculated from the difference in *V* and the corresponding time difference.

$Q = \Delta V / \Delta t$, where ΔV_b = difference in actual volume
and Δt = time difference

Qb (Standard flow):
The standard flow is calculated from *Q* and the current Z value.

$$Q_b = Q \times Z$$

3.8 Gas meter list (c_P value)

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
CP	c_P value (pulse input)	0.01/0.1/1/10/100	1/m3	1	C	P4	4
I.DIF	Pulse difference for warning	0 ... 4	-	0	U	P38	4
I.Fun	Manipulation detection off/normally closed/ normally open	0/1/2	-	0	U	P39	4
SN.M	Serial number	999999999999	-	0	U	L124	3

AD = Abbreviated description C/U = Calibration / user lock
HLP = Value code in VC protocol DC = Data class

CP (C_P value, pulse input):

The c_P value indicates the pulse weighting in the unit of pulses per m^3 for the incoming volume pulses and applies to all three pulse inputs. The c_P value can only be programmed in decade steps.
When programming *CP*, all c_P values for the outputs (*Ax.CP*) are set to the value of *CP* and the output buffer cleared.

I.DIF (Pulse difference for warning):
This is the set figure for the number of “error pulses” which leads to the triggering of a warning (E.20). A warning is triggered when during operation with two pulse generators more than the number of pulses set with *I.DIF* are “missing” from one generator in a certain time interval.

I.DIF = 0 Only one pulse generator is connected.
I.DIF = 1...4 Two pulse generators are connected and the sensor fail detection is active.

I.Fun (Manipulation detection):
In the LF mode the EK-90 offers the possibility of evaluating an external manipulation contact. This is connected to Pulse Input No. 3 (E3) and can be used as a N/O or N/C contact. The message E.21 is entered into Status Register 1 on detecting manipulation.

I.Fun = 0 Manipulation detection switched off (E3 not active).
I.Fun = 1 Manipulation contact used as normally closed contact.
I.Fun = 2 Manipulation contact used as normally open contact.

SN.M (Gas meter number):
Twelve-figure number for identifying the connected gas meter.

3.9 Measurement list (test)

AD	Description / value	Value range	Unit	C/U	HLP	DC
TEST	-	-	-	-	-	-
-	Display test	-	-	-	-	5
FRZ	Freeze function	0/1	-	U	H55	5
V [ARCHIVE]	Frozen V	99999999.99	m3	-	H56	7
Vb [ARCHIVE]	Frozen Vb, pre-decimal places	99999999	m3	-	H57.1	7
Vb+ [ARCHIVE]	Frozen Vb, post-decimal places	0.9999	m3	-	H57.2	7
P [ARCHIVE]	Frozen p	0.1 ... 125	bar	-	H58.1	7
T [ARCHIVE]	Frozen T	-99.99...99.99	°C	-	H58.2	7
Z [ARCHIVE]	Frozen Z	170	-	-	H58.3	7
K [ARCHIVE]	Frozen K	0.5000...1.5000	-	-	H58.4	7
DAT [ARCHIVE]	Date of freezing	dd.mm.yyyy	-	-	H59.1	7
TIME[ARCHIVE]	Time of freezing	hh:mm:ss	-	-	H59.2	7
Bin.P	Pressure, binary	65535	-	-	L47	1
Bin.T	Temperature, binary	65535	-	-	L48	1

AD = Abbreviated description C/U = Calibration / user lock
HLP = Value code in VC protocol DC = Data class

TEST
Display of the word “TEST” in left four places of the LCD display. This text is only used for identification of the Test column.

- (Display test):

During the display test all segments of the LCD display are switched on and off alternately every 0.5 seconds.

FRZ (Freeze function):
With this function freezing of the values listed in the table is triggered. Simultaneously the date (*DATE*) and time (*TIME*) of freezing is saved. After calling this value “0” flashes and ↑ or ↓ switches to “1” (1 flashes). The freezing of the values is triggered with ENTER.

V [ARCHIVE] (Frozen V):
Meter reading *V* at the time of freezing.

Vb [ARCHIVE] (Frozen V_b, post-decimal places):

Meter reading *Vb+* at the time of freezing.

P [ARCHIVE] (Frozen p):
Pressure value *P* at the time of freezing.

T [ARCHIVE] (Frozen T):
Temperature value *T* at the time of freezing.

Z [ARCHIVE] (Frozen Z):
Z value *Z* at the time of freezing.

K [ARCHIVE] (Frozen K):
K value *K* or *K.F* at the time of freezing.

DATE [ARCHIVE] (Date of freezing):
Date of freezing (internal clock).

TIME [ARCHIVE] (Time of freezing):
Time of freezing (internal clock).

Bin.P (Pressure, binary):
Unfiltered binary pressure value of the AD converter.
(This value is also displayed in the “Pressure” list.)

Bin.T (Temperature, binary):
Unfiltered binary temperature value of the AD converter.
(This value is also displayed in the “Temperature” list.)

3.10 Errors / log book (status)

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
STAT	Status Register 1	E.x.y.z.u	-	E.0	-	L4	2
STAT [ARCHIVE]	Status Register 2	E.x.y.z.u	-	E.0	-	L5	7

AD = Abbreviated description C/U = Calibration / user lock
HLP = Value code in VC protocol DC = Data class

STAT (Status Register 1):
The status messages currently present on the EK-90 (flashing) and those which have past but have not yet been acknowledged (not flashing) are displayed in Status Register 1. An “E” for identifying the status messages is shown in the left place of the 8-character display block. The individual messages are each separated by a point and are displayed in the sequence of their importance. A point after the last status message to the right of the display indicates that other messages are present which are not displayed.

After entering ENTER the “E” flashes to indicate that the device is in the entry mode. There are the following possible methods of operation:

- In order to acknowledge status messages and obtain space for new messages, the messages can be copied into Status Register 2 and cleared from Status Register 1. To do this, after pressing the key combination CLR, the content of *STAT* is copied to *STAT [ARCHIVE]* and the previous content of *STAT* is deleted. The display of *STAT* is still shown and “E.0” or “E.30” appears. The status message “E.0” cannot be copied, so that the last occurring errors are always present in *STAT [ARCHIVE]*.
- The change is accepted by entering ENTER and it is discarded by entering ESC.

Example of the *STAT* display:

STAT E.2.6.26.30.

STAT [ARCHIVE] (Status Register 2):
The last deleted status messages from *STAT* are displayed in the same format in *STAT [ARCHIVE]*. In addition the segment “ARCHIVE” is visible. If an attempt is made to clear *STAT [ARCHIVE]*, the error message Error --4-- is displayed.

3.10.1 Statuses

ALARM:
When an alarm occurs, the disturbance volume counters and the alarm output are activated. The segment “ALARM” flashes. The status code is entered in *STAT*. An alarm is normally triggered when quantities affecting the volume acquisition or the standard volume computation are disturbed.

WARNING:
When a warning occurs, the disturbance volume counters are not activated, the warning output is activated and the segment “WARN” flashes. The corresponding status message is entered in *STAT*.

REPORT:
When a report occurs, only an entry of the status message is made in the status register. No disturbance volume counting and no activation of the alarm or warning outputs occur. “WARN” or “ALARM” does not appear on the display. Once the cause for a report is no longer active, the status code is automatically deleted from *STAT*.

The following also applies to the display of “ALARM” and “WARN”:
If the cause of the alarm or warning is no longer present on the device, the corresponding segment (“WARN” or “ALARM”) is switched to a continuous, steady display (provided no other error is active on the device). The two segments are independent of one another.

3.10.2 Status messages

Code	Description	A/W/R	Cause
E.0	No error.	-	No error present on device.
E.1	Data loss in memory or new start.	A	Start without usable data in EEPROM; when the device runs up, no data which can be evaluated was found in the EEPROM. The EK-90 starts with the default values.
E.2	Power supply failed, data is retained.	W	Start with usable data in EEPROM; the EK-90 voltage supply has been interrupted. On running up, data from the EEPROM was used.
E.6	Data error found in memory.	W	An error in memory was found during self-test (e.g. checksum error).
E.7	End of battery service life approaching.	W	The warning appears when the remaining battery service life falls below the limit of 3.0 months.
E.13	Pressure measurement circuit not adjusted.	A	This message appears after a new start of the device and after changing *P.RNG*. The error cannot be cleared, but it disappears after completion of adjustment of the pressure measurement circuit. The measured value is displayed as the pressure value (P) and is used for further computation.
E.14	Temperature measurement circuit not adjusted	A	This message appears after a new start of the device and after changing *T.RGE*. The error cannot be cleared, but it disappears after completion of adjustment of the temperature measurement circuit.
E.15	Pressure outside the alarm limits	A	The measured gas pressure is outside the limits specified by *P.MIN* and *P.MAX*. The substitute value is displayed as the pressure value (P) and used for further computation.
E.16	Temperature outside the alarm limits	A	The measured gas temperature is outside the limits specified by *T.MIN* and *T.MAX*. The substitute value is displayed as the temperature value (T) and used for further computation.
E.17	Plausibility error on analogue converter (for p,T)	A	The AD converter value corresponds to the full-scale value or a value <1% of FSD.
E.20	Permissible pulse difference exceeded.	W	During operation with a number of generators the number of “missing pulses” defined with *I.DIF* has been exceeded
E.21	Manipulation detection.	W	A signal corresponding to the setting of *I.Fun* has been detected on the manipulation input.
E.24	Overflow of inter-mediate buffer for output A1-A”n”.	W	One or more intermediate buffers for volume pulses from the pulse input have overflowed (more than 65535 pulses with the buffer stopping at 65535).
E.26	Pressure or temperature out-side the warning limits	W	A warning limit has been violated during the pressure or temperature measurement (*P.LW, P.UW, T.LW, T.UW*).
E.30	Calibration lock open.	R	The calibration switch has been operated and has not yet been deactivated with *CAL 0* or automatically after 1 h (after the last data traffic via keypad or interface). After deactivation the message E.30 is automatically cleared from Status Register 1. This message cannot appear in Status Register 2.
E.32	Battery device (display only via interface)	R	The message E.32 is appended during interrogation of the status registers via the interface and is used to identify the EK-90 as a battery device.

A=Alarm, W=Warning, R=Report

3.11 Output list (outputs)

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
A1	Assignment, Signal Output DA1	0 ... 9	-	0	U	P310	4
A1.CP	c_P value, Signal Output DA1	0.01/0.1/1/10/100	$1/m^3$	1	U	P311	4
A1.HL	Logic, Signal Output DA1	0/1	-	0	U	P314	4
A1.CU	Signal output DA1 under calibration/user lock	0/1	-	0	C/U	P315	5
A2	Assignment, Signal Output DA2	0 ... 9	-	0	U	P320	4
A2.CP	c_P value, Signal Output DA2	0.01/0.1/1/10/100	$1/m^3$	1	U	P321	4
A2.HL	Logic, Signal Output DA2	0/1	-	0	U	P324	4
A2.CU	Signal output DA2 under calibration/user lock	0/1	-	0	C/U	P325	5
A3	Assignment, Signal Output DA3	0 ... 9	-	0	U	P330	4
A3.CP	c_P value, Signal Output DA3	0.01/0.1/1/10/100	$1/m^3$	1	U	P331	4
A3.HL	Logic, Signal Output DA3	0/1	-	0	U	P334	4
A3.CU	Signal output DA3 under calibration/user lock	0/1	-	0	C/U	P335	5
A4	Assignment, Signal Output DA4	0 ... 9	-	0	U	P340	4
A4.CP	c_P value, Signal Output DA4	0.01/0.1/1/10/100	$1/m^3$	1	U	P341	4
A4.HL	Logic, Signal Output DA4	0/1	-	0	U	P344	4
A4.CU	Signal output DA4 under calibration/user lock	0/1	-	0	C/U	P345	5
Prt.I	IDOM protocol immediately	0/1	-	0	-	P56	4
Prt.m	IDOM protocol every xx min.	0...60	min	0	-	P57	4
Prt.d	IDOM protocol at xx:00 hrs.	0...24	h	0	-	P58	4

AD = Abbreviated description C/U = Calibration / user lock
HLP = Value code in VC protocol DC = Data class

The EK-90 has four switching outputs which can be assigned various signals. The logic of the outputs can be programmed separately. The switching of the level for programming as a volume output occurs with the wake-up of the controller. i.e. the frequency of the (volume) outputs is 1 Hz. A buffer, in which pulses still to be output are temporarily stored, is provided for each input for the temporary storage of volume pulses. The c_P values of the outputs (*Ax.CP*) must be smaller or equal to the c_P value of the input (*CP*). The error message Error --3-- appears if *Ax.CP* is not entered correctly. All outputs can be made into outputs that can be officially calibrated and vice versa using a software setting.
The programming of the outputs is only described once here, because the same procedure is used for each output.

Ax (Assignment, signal output):
A signal output can be programmed with one of the following functions:

Ax	Output function	Relevant counter
0	Clear pulse memory, output has no function	-
1	Pulse output, V undisturbed	V
2	Pulse output, Vb undisturbed	Vb
3	Pulse output, V disturbed	VD
4	Pulse output, Vb disturbed	Vb.D
5	Pulse output, V total	V.T
6	Pulse output, Vb total	Vb.T
7	Alarm	-
8	Warning	-
9	Alarm or warning	-

A buffer is provided for the intermediate storage of pulses still to be output. When the buffer overflows, the error E.24 is entered into the status register. The buffer is cleared when the function of the output is changed (i.e. reprogramming of the parameter *Ax*) or the c_P value (*CP*) is changed.

Ax = 0: After entering “0” - ENTER all pulses saved in the buffer memory of the output are deleted and the output has no function.

Ax = 1...6: The weighting of the output pulses is set via *Ax.CP*. The output frequency f_O = 1 Hz.

Ax = 7...9: The output is switched when Alarm and/or Warning are active, i.e. corresponding segments on the LCD display flash. When the cause of the error is no longer present on the device (continuous, steady illumination of the segments), the output is deactivated. The output logic is set with *Ax.HL*.

Ax.CP (c_P value, signal output):
The weighting of the volume pulse output (*Ax* = 1...6) is set via *Ax.CP*. The output pulse weighting (c_P value) of the output must always be smaller or equal to the c_P value of the input (*CP*). The error message Error --3-- is displayed for impermissible entries. When reprogramming the c_P value for the pulse inputs (*CP*), the c_P values of the outputs are automatically set to the value of *CP* and the output buffer is cleared.

Ax.HL (Logic, signal output):
Logic setting for the signal outputs when programming Ax = 1...9.

Ax.HL = 0 Output active means transistor conducts.
Ax.HL = 1 Output active means transistor is turned off.

Ax.CU (Signal output DAx under calibration/user lock)
Make a signal output subject to calibration or user lock.

Ax.CU = 0: Ax.CP and Ax.HL can be changed with the user lock open.
Ax.CU = 1: Ax.CP, Ax.HL and Ax.CU can only be changed with the calibration lock open.

3.12 Archive

Abbreviated designation	Description
ARC.1 DATE	Submenu, archive values
ARC.1 SETTG	Submenu, settings

The display point *ARCHIVE* is subdivided into two submenus:

ARCHIVE VALUES and SETTINGS.

Under the menu point ARCHIVE VALUES (*ARC.1 DATE*) values are displayed which have been saved due to preset events.

Under the menu point SETTINGS (*ARC.1 SETTG*) the events which led to the saving of archive values are displayed along with additional information and can be changed.

3.12.1 Archive values

O.No.	Block number	«	DATE	Monthly value date	«	Vb	Last monthly value V_b	«	V	Last monthly value V	«	Vb.T [ARCHIVE]	Monthly value Vb.T

The archive is set up as a matrix with each line corresponding to a data block containing data associated in time. A total of 15 such data blocks (lines) can be saved, identified by a block number.

AD	Description / value	Value range	Unit	HLP	DC
O.No. [ARCHIVE]	Block number	1 ... 65535	-	-	-
DATE [ARCHIVE]	Monthly value, Date	dd.mm.yyyy	-	-	2
Vb [ARCHIVE]	Last monthly value, Vb	99999999	m3	H8	2
V [ARCHIVE]	Last monthly value, V	99999999.99	m3	H7	2
Vb.T [ARCHIVE]	Monthly value Vb.T	99999999	m3	-	2

AD = Abbreviated description C/U = Calibration / user lock
HLP = Value code in VC protocol DC = Data class

O.No. (Block number):
The block number is used as identification of each data block. With the first saving of a block, the block number 1 is issued, then 2, etc. In the display the highest value block number, i.e. the last saved monthly value, is displayed first. After the first 15 month-end values have been saved, the next data block is labelled with the block number "+" 16.

DATE. (Monthly value, date):
Date of saving the monthly values in the corresponding “archive cell”.

Vb (Last monthly value, V_b):
Here, the final value of the undisturbed standard volume counter *Vb* of the past month is displayed. The value is saved on the first of the current month at the time set with *M.BEG*. This value always only exists for the last month.

V (Last monthly value, V):
Here, the final value of the undisturbed actual volume counter *V* of the past month is displayed. The value is saved on the first of the current month at the time set with *M.BEG*. This value always only exists for the last month.

Vb.T (Monthly value, $V_{b.T}$):
Here, the final value of the totalising standard volume counter *Vb.T* of the last month is displayed. The value is saved on the first of the current month at the time set with *M.BEG*.

3.12.2 Settings

AD	Description / value	Value range	Unit	Default	C/U	HLP	DC
M.BEG	Month boundary (time)	hh:mm:00	-	06:00:00	U	L12	3
C.No.	Customer number	999999999999	-	0	U	L123	3

AD = Abbreviated description C/U = Calibration / user lock
HLP = Value code in VC protocol DC = Data class

M.BEG (Month boundary):
Time of saving the month-end readings of *V, Vb* and *Vb.T* on the first of each month. The daily data back-up in EEPROM also occurs at this time.

C.No (Customer number):
Twelve-figure customer number. First the upper four places are displayed, then (continuing with ↓) the lower eight places.

3.13 Entry errors

Entry errors are output on the display when incorrect entries are made by the operator via the keypad.
Display:

Error --x--

x = Error code according to the table.

Error code	Description	Cause
1	Incorrect or non-existent code entry.	A value number, non-existent in the EK-90, has been interrogated via the interface.
3	Value conflict with associated values.	The current value entry is not possible, because another programmed value forbids it.
4	Parameter is write-protected.	An attempt has been made to change a read-only value.
5	Calibration or user lock is closed.	An attempt has been made to change a value protected by the calibration or user lock, although the corresponding lock is closed.
6	Entered value is outside the permissible limits.	The entry is outside the permissible value range.
7	Incorrect user code.	The entered customer's or supplier's code is not correct.
12	Incomplete adjustment.	A measurement has been carried out at only one of the two adjustment points.

About Error Code 3:
With values which are accepted with ENTER the entered input is checked when the function is executed.

Examples:

- When programming the c_P value of a pulse input (*Ax.CP*), a check must be made of whether the value is smaller or equal to the programmed c_P value of the pulse input (*CP*). When programming *CP*, this need not be taken into account, because all c_P values, *Ax.CP*, are set to the same value as *CP* and the output buffer is cleared.
- When programming the pressure and temperature ranges as well as the limits (e.g. alarm limits).

3.14 DS-100 function

In the measurement and data system of the LIS-100 Long-Term Pulse Acquisition System the DS-100 function integrated into the EK-90 has the task of data acquisition “at the point of measurement”.

In this case the DS-100 function does not represent an independent device, but rather a software module is involved which saves data in the two channels:

Channel 1 = V channel - actual volume
Channel 2 = V_b channel - standard volume

In addition to the device data, which is listed in the following tables, the last 15 month-end counter readings for the totalised standard volume (**V_b.T**) are saved.

To differentiate between the two channels the number of the relevant channel is entered in the 5th place from the right (10,000s place) when the device number is issued. A zero is displayed in this place on the EK-90 display in Menu Z under the plain text designation *SN.V* (serial number, volume corrector).

3.14.1 Data transmission

The transmission of the device data, in particular the last 15 saved month-end counter reading $\mathbf{V_bT}$, occurs over the integral serial interface. There are the following possible methods for transmitting and processing this data on a PC:

- AS-200 Read-Out Device (or AS-100 from version 5.32)
- DAS-100 Direct Read-Out Software
- Remote data transmission using a modem

In the following tables 3.14.1 and 3.14.2 all values are shown which can be set and evaluated with the AS-200 (AS-100).

Table 3.14.1: AS-100/200 data traffic with EK-90 Channel 1 - V actual volume.

Data designation	Display in the AS-100/200	Setting with AS-100/200	EK-90 display		
			Menu	Plain text	Value no.
Change the access code in the EK-90	---	B 666		---	---
Date, time of last read-out	A 1	Automatic		---	---
Date, time of penultimate read-out	A 2	Automatic		---	---
Adjustable counter reading	A 3	B0 or B2 [1]	V	VA	H23
Totaliser reading	A 4	---	V	V	H1
Month-end value of adjustable counter	A 13	---		---	---
Customer number	A 17	B2 [1]	ARCHIVE	C.No	L123
Meter number	A 18	B2 [1]	cp	SN.M	L124
Device number	A 19	B2 [2]	Z	SN.V	L18
Content of DS status register	A 20	[4]		---	---
c_P value	A 21	B0 or B2 [2]	cp	CP	P4
Interval period	A 22 [3]	---		---	---
Name of read-out operator	A 23	Automatic		---	---
Manually entered meter reading	A 24	---		---	---
SW version	A 25	---	Z	VERS	L34

1) Only when the user lock is open.
2) Only when the calibration lock is open.
3) The value, “88” = No interval value, is transmitted in Channel 1 as interval period.
4) The DS status register is automatically cleared after a read-out process, unless the current error is still present.

Table 3.14.2: AS-100/200 data traffic with EK-90 Channel 2 - Vb standard volume

Data designation	Display in the AS-100/200	Setting with AS-100/200	EK-90 display		
			Menu	Plain text	Value no.
Change the access code in the EK-90	---	B 666		---	---
Date, time of last read-out	A 1	Automatic		---	---
Date, time of penultimate read-out	A 2	Automatic		---	---
Reading of undisturbed counter V_b	A 3	---	Vb	Vb	H2
Totaliser reading	A 4	---	Vb	Vb.T	H6
Month-end value, undisturbed counter V_b	A 13	---	ARCHIVE	Vb	H8
Last month-end value of totaliser	A 14 [5]	---	ARCHIVE		---
Penultimate month-end value of totaliser	A 15 [5]	---	ARCHIVE		---
Consumption in last month (A14-A15)	A 16 [5]	---		---	---
Customer number	A 17	B2 [1]	ARCHIVE	C.No	L123
Meter number	A 18	B2 [1]	cp	SN.M	L124
Device number	A 19	B2 [2]	Z	SN.V	L18
Content of DS status register	A 20	[4]		---	---
c_P value	A 21	B0 or B2 [2]	cp	CP	P4
Interval period	A 22 [3]	---		---	---
Name of read-out operator	A 23	Automatic		---	---
Manually entered meter reading	A 24	---		---	---
SW version	A 25	---	Z	VERS	L34
15 month-end counter readings V_bT	[6]	---	ARCHIVE		

1) Only when the user lock is open.
2) Only when the calibration lock is open.
3) The value, “98” = Monthly back-up, is transmitted in Channel 2 as interval period.
4) The DS status register is automatically cleared after a read-out process, unless the current error is still present.
5) These values only become available when an evaluation has been carried out for the device channel with the command A88.
6) The last 15 month-end counter readings, V_b total, can be displayed and processed with the AWS-100 Evaluation Software.

Remarks about the setting commands

The values listed in Tables 3.14.1 and 3.14.2 for

- Access code
- Customer number
- Meter number
- Device number (serial number of the volume corrector)
- c_P value

are only saved once physically in the EK-90 for both channels. This means that modification to these values in one channel applies also to the other channel. Here, the device itself automatically sets the 5th place from the right in the device number to 1 or 2.

3.14.2 Designation of the counter readings

Within the LIS system an adjustable counter and a totaliser counter are operated per DS-100 device and channel.

The adjustable counter can be freely programmed by the user and is normally used to check the mechanical meter mechanism in the gas meter.

The totaliser counter counts up from zero at the time of starting up the device and cannot be influenced.

No adjustable counter reading exists for the DS-100 standard volume channel in a volume corrector because the standard volume is computed. Instead the undisturbed standard volume is saved.

There please note:

In a DS-100 channel recording the standard volume data the counter readings for the undisturbed standard volume are designated as adjustable counters.

3.14.3 DS-100 status messages

Table 3.14.3: Assignment of VC status messages to DS status messages:

Status message DS-100 function		**A**larm **W**arning **R**eport	Description	Status message
Chan. 1 V	**Chan. 2 Vn**			**EK-90**
-	-	-	No error.	E.0
1	1	A	Data loss in memory or new start.	E.1
2	2	W	Power supply failure, data is retained.	E.2
6	6	W	Data error found in memory.	E.6
7	7	W	Battery service life approaching end.	E.7
-	3	A	Pressure measurement circuit not adjusted.	E.13
-	3	A	Temperature measurement circuit not adjusted.	E.14
-	4	A	Pressure outside the alarm limits.	E.15
-	4	A	Temperature outside the alarm limits.	E.16
-	3	A	Plausibility error in analogue converter (for p, T).	E.17

The status messages E.20, E.21, E.24, E.26, E.30 and E.32 have no effect on the DS status messages.

The status messages in the VC protocol are identical with those for manual operation. Their meaning is explained in Chap. 3.10.2.

The output and clearing of the DS status register occurs depending on the channel, i.e. there are two status registers in the DS function in the EK-90 (one register for the V channel and one for the Vb channel).

The contents of the DS status register cannot be viewed on the EK-90 and can only be read out via the serial interface. The relevant status register can be viewed with the AS-200 after the read-out process using the command A20. With the direct read-out software (DAS-100) and on calling the data with the control station software (LSM-100) via a modem, the content of the relevant status register is displayed with a descriptive text.

The DS status registers are cleared after a read-out process unless an error is still present.

3.15 Volume corrector protocol

One method of reading out and changing values held in a volume corrector over the serial interface without special read-out software is provided by the volume corrector protocol. With this all values, which are coded with a value number (Hxxx, Lxxx or Pxxx), can be transferred (e.g. to a PC with a terminal program). The coding/assignment of the value numbers to the values (data) is identical with all ELSTER volume correctors (with only a few exceptions).

The purpose of the volume corrector protocol is primarily the automation of parameterisation and adjustment procedures and the simple operation of devices with restricted keypad functions.

Additional information about the volume corrector protocol can be obtained from Elster Handel.

Switching the VC protocol on/off:
The volume corrector protocol is activated in the terminal device on reception of the character

01h = <CTRL>A (= SOH = <ALT>01) and deactivated on receiving the character

17h = <CTRL>W (= ETB = <ALT>23).

Any amount of input and output of data within the protocol can occur between these characters.

Data interrogation:
The data is interrogated via the value numbers (Hxxx, Lxxx or Pxxx) which unambiguously identify each value (note the capital letters!).
The entry of the value number must be terminated with <CR> or with <=>.

Data output:
The EK-90 responds with
<STX> <LF> value number = value <LF> <CR> <ETX>.
Following this, a new interrogation can be initiated or, if required, the last transferred value can be changed.

Data input:
The following procedure must be adopted to change a value:

- Interrogation of the value to be changed by entering the value number (see above).
- Device responds with the currently valid value (see above).
- Entry of the value to be programmed (without entry of the value number), terminating with <CR>.
- Device responds with the new set value (see above).

Entry and transmission errors:
The volume corrector responds with an error message (without value number) in reaction to impermissible input or erroneous communication via the interface. This message corresponds to the input error messages which appear on the display of the volume correctors in the form ----X---- (X = error number). The error messages are transmitted with the following format via the volume corrector protocol:

- X -

The following error messages are possible:

Error number	Meaning
1	Incorrect or non-existent value number entry
3	Value conflict between associated values
4	Parameter is write-protected
5	Calibration or user lock closed
6	Entered value outside permissible limits
7	Incorrect supplier's or customer's code
10	STX/ETX incomplete
11	Transmission error
12	Adjustment incomplete

In the volume corrector protocol the following values are each transmitted in a data block just separated with a semi-colon:

Vb; Vb+
Vb[ARCHIVE];Vb+[ARCHIVE]
P[ARCHIVE];T[ARCHIVE];Z[ARCHIVE];K[ARCHIVE]
DATE[ARCHIVE];TIME[ARCHIVE]

3.16 IDOM protocol

Data can be output automatically once or cyclically via the serial interface using the IDOM protocol. The data is structured such that it can be immediately printed on a serial printer. All the data is output in ASCII format. Each item of data is labelled and terminated with ”RETURN” (ASCII 13). The following data is output:

Description	Label	Value number
Actual volume, total	V.T:	H5
Standard volume, total	Vb.T:	H6
Absolute pressure	P	L1
Absolute temperature	T	L2
Error identifier	@	L4

The volumes are output with 8 figures in full m^3. Leading zeroes are inserted.

The pressure (abs.) is output with three post-decimal and a maximum of three pre-decimal places. No leading zeroes are inserted, but zeroes are appended as required.

Examples 1.030 110.008 6.000 0.050 in bar abs.

The temperature output occurs with two post-decimal and two pre-decimal places in °C. A negative temperature is shown with the sign ”-”. No leading zeroes are inserted, but zeroes are appended if required.

Examples: 25.05 15.88 6.70 0.50 0.00 -3.78 -10.00 in °C

The error identifier is output for any error (alarm, warning or report) and without a following value (status message) as long as the error is present. When the volume corrector operates without errors again (L4=0), the error identifier is omitted.

Overall there is then the following structure (example only):

At least 1 error present:	or:	**No error present:**
V.T:12345678<Return>		V.T:12345678<Return>
V_b.T:12345678<Return>		V_b.T:12345678<Return>
P100.008<Return>		P40.008<Return>
T-3.78<Return>		T-3.78<Return>
@<Return>		

The interface parameters are defined as follows

Baud rate: 2400 Bd; Parity: even; Data bits: 7; Stop bits: 1

This corresponds to the interface parameters for the DS-100 function. The changeover is made by activating the protocol (see below) with automatic return to the DS-100 interface parameters after the transfer. This means that the DS-100 function and the value number protocol can be accessed at any time. If it is time to transfer with the IDOM protocol and data from the DS-100 function or the value number protocol is being transferred simultaneously, the IDOM protocol is suppressed and also not later made up.

3.16.1 Activating / deactivating the IDOM protocol

The output of the IDOM protocol is carried out in the list ”Outputs”. The following options can be selected:

”Immediately”	Immediate, once only data output	(=P56)
”every xx minutes”	Cyclical with a period of xx minutes	(=P57)
”at xx:00 hrs”	Cyclical at the quoted time	(=P58)

With P57 and P58 the time must be stated; output every ”17 min.” with P57 then occurs for example at: 08:00, 08:17, 08:34, 08:51, 09:00, 09:17, etc.). The entry for P58 corresponds to the time at which the IDOM protocol is to be output (e.g.: P58=12 means that the data is output every day at 12:00 hrs).

The interface parameters are changed back if possible immediately after the output of the data.

If the output mode is to be changed, the previously set output form must be set to ”0”. Otherwise no entries can be made.

4 Installation

If the EK-90 is supplied on request ready-mounted on a gas meter, then the work on mounting and setting up on site is not required.

4.1 Procedure

The following steps must be carried out to install the device:

1. Mount the EK-90 on the gas meter or on the wall.
2. Connect the pressure line and insert the temperature sensor in the temperature receptacle.
3. If required, connect the external pulse generator and, where applicable, the following devices.
4. The calibration official seals the device according to the sealing plan.

4.2 Cable connections and earthing

The connecting cables for the temperature sensor and the pulse input (for the device version with external pulse generator connection) are permanently connected to the EK-90 via screw-type cable glands.

The connecting cables for the interface and the pulse outputs are connected via circular connectors. These are non-interchangeable to prevent incorrect connection.

To divert high energy and high voltage electromagnetic interference the EK-90 housing must always be earthed. A screw is provided for this purpose on the left side of the housing.

The earthing must be of as low a resistance as possible. Optimum conditions are present when a direct link via a short and thick cable (at least 4 mm^2) is provided to the local potential equalisation strips.

All permanently terminated cables and connectable cables have a screen which must be earthed at both ends to prevent interference from high frequency electromagnetic fields. The screen connection must be made complete and flat and must surround the terminal. On the side of the EK-90 this is provided by the correct connection of the screen to the connector case. With the permanently connected cables the screen is connected via the EMC screw-type cable gland to the housing of the device.

To minimise inductive coupling of interference, all cables must be routed such that they enclose the least possible area, i.e. they should run as parallel to one another as possible.

With the correct connection of the cable screens and correct routing of the cables, effects due to equalisation currents should not be expected. If, however, interference does occur, then potential equalisation leads, which should be connected as close as possible to the cable screen connection points, can be laid in parallel to the cables.

4.3 Sealing

Note about the obligatory presence of the calibration officer for installation or resiting:

"The responsible calibration authority must be immediately informed. It will carry out a measurement check under the prevailing operating conditions with a check of the correctness of the signal transmission, thereafter securing all the signal leads."

The following connections and housing parts must be sealed on the EK-90 with wire or adhesive seals:

- Pressure connection, e.g. with wire seal through the union nut.
- Calibration switch, e.g. with wire seal through the closing cap on the front.
- Housing, e.g. with wire seals through the housing screws.

Note: The pulse generator lead must be sealed on the gas meter.

5 Maintenance

The EK-90 operates without any maintenance.
When cleaning the housing no aggressive cleanser (e.g. acetone, petroleum spirit, etc.) should be used. A damp cloth with a soapy solution or similar is sufficient.

5.1 Battery

The minimum service life of the EK-90 for the standard operating case defined in Chapter B-2 is more than five years. The internal counter for displaying the remaining service life is set to 5.5 years (66 months) ex-works and is decremented automatically at the start of each month.
When the remaining service life of the battery reaches three months, the segment BATT in the display flashes to indicate that a battery replacement is required.

F *Frequent interface operation, shortening the measurement interval period and frequent activation of the display reduce the residual service life. These effects are NOT however taken into account with the display of the remaining service life (list "System", Display "BATT"). Battery replacement must in these cases be carried out earlier, even if a residual service life is being displayed by the device.*

F *Battery replacement can be carried out without the presence of a calibration official, because battery replacement is not an official procedure and the battery compartment does not need to be sealed with a calibration label.*

F *Replacement should only be carried out by ELSTER Service or by trained personnel.*

5.1.1 Carrying out the battery replacement

(1) To prevent unwanted loss of data, the function "Data backup" (display "Dat back") under the list "Test" should be carried out[1]:
ENTER => "0" flashes; switch to "1" with ↑ or ↓ , 1 flashes, again ENTER =>, data backup is executed.

(2) Unscrew the covering cap of the battery compartment (existing adhesive seal must be opened). The battery is then accessible.

(3) Turn the flat side of the battery such that it can be pulled out using the connecting lead.

(4) Unplug the old battery. **Release the mech. locking mechanism.**

(5) To ensure that the EK-90 starts again without any problem, it is recommended that you wait one minute after removing the battery and then continue with (6).

(6) Plug in the new battery. A quickly incrementing number and letter combination can be seen on the LCD and then: "INIT EEPROM" – Display test – Vb.

(7) Insert the battery into the battery compartment with its flat side towards the connecting cable.

(8) Screw on the covering cap of the battery compartment and, where applicable, seal it with an adhesive label.

(9) To check the function of the EK-90, the gas temperature T can, for example, be called and updated with ENTER.

(10) Correct the time (list "System").

(11) Clear the status message "E.2" (Power supply failed) in Status Register 1 (List "Status").

(12) This successfully concludes the battery replacement.

[1] If the function "Data backup" is not executed, then after concluding the battery replacement, the data of the last automatic data backup is restored (occurs each day at 06:00 hrs).

A Approvals

A-1 EC Declaration of Conformance

Konformitätserklärung

gemäß "Gesetz über die elektromagnetische Verträglichkeit von Geräten (EMVG)"
bzw. EMV-Richtlinie 89/336/EWG des Rates vom 3. Mai 1989 (EMV-Richtlinie)
sowie der Artikel 5 und 14 der Richtlinie 93/68/EWG des Rates vom 22. Juli 1993
zur Änderung der Richtlinie 89/336/EWG

Nr **KCE100**

Anbieter: ELSTER Produktion GmbH

Anschrift: Steinernstrasse 19-21
D-55252 Mainz-Kastel

Produkt: Zustands-Mengenumwerter
Typ EK-90

Das oben beschriebene Produkt ist konform mit:

Dokument-Nr	Titel	Ausgabe/ Ausgabedatum
DIN EN 50081-1	Fachgrundnorm Störaussendung	März 1993
DIN EN 50082-1	Fachgrundnorm Störfestigkeit	November 1997

Zusätzliche Angaben

Mainz-Kastel, 19.08.98
(Ort und Datum der Ausstellung)

O. Pfaff, Ltg. -Segm. E i.V. O. Pfaff
(Name, Funktion) (Unterschrift)

A-2 EC Declaration of Conformance

(Translation of German document)

Declaration of Conformance

according to the “Law on the electromagnetic compatibility of equipment (EMCL)” and the EMC Guideline 89/336/EWG of the Council of 3rd May 1989 (EMC Guideline) as well as Articles 5 and 14 of the Guideline 93/68/EWG of the Council of 22nd July 1993 about the modification of Guideline 89/336/EWG.

No. **KCE100**

Supplier: ELSTER Produktion GmbH

Address: Steinernstrasse 19-21
D-55252 Mainz-Kastel

Product: State Volume Corrector
Type EK-90

The product described above conforms to:

Document No.	Title	Issue / Issue date
DIN EN 50081-1	Generic emission standard	March 1993
DIN EN 50082-1	Generic immunity standard	November 1997

Additional details

Mainz-Kastel, 19.08.98
(Place and date of issue)

O. Pfaff, Mangr. Segm. E.
(Name, function) (Signature)

A-3 Certificate of Conformance EX Zone 1

DMT-Gesellschaft für Forschung und Prüfung mbH
Fachstelle für Sicherheit elektrischer Betriebsmittel
Bergbau-Versuchsstrecke

DMT

BVS

Elektrische Betriebsmittel für explosionsgefährdete Bereiche

(1) **Konformitätsbescheinigung**

(2) BVS 98.D.2036

(3) Diese Bescheinigung wird ausgestellt für:

Zustands-Mengenumwerter Typ EK-90

(4) Hergestellt und zur Bescheinigung vorgelegt von:

ELSTER Produktion GmbH
D 55248 Mainz-Kastel

(5) Die Bauart dieses elektrischen Betriebsmittels sowie die verschiedenen zulässigen Ausführungen sind im Anhang zu dieser Konformitätsbescheinigung festgelegt.

(6) Die Bergbau-Versuchsstrecke, zugelassene Stelle entsprechend Artikel 14 der Richtlinie des Rates der Europäischen Gemeinschaften 76/117/EWG vom 18. Dezember 1975,

- bescheinigt, daß das elektrische Betriebsmittel mit den folgenden Harmonisierten Europäischen Normen übereinstimmt:

EN 50014-1977 + A1 - A5	(VDE 0170/0171 Teil 1/1.87) Allgemeine Bestimmungen
EN 50020-1977 + A1 - A5	(VDE 0170/0171 Teil 7/4.92) Eigensicherheit 'i'

und mit Erfolg die nach diesen Normen vorgeschriebenen Typenprüfungen bestanden hat,

- bescheinigt, daß ein vertraulicher Prüfbericht über diese Prüfungen erstellt wurde.

(7) Das Kennzeichen des elektrischen Betriebsmittels ist:

EEx ia IIB T3

(8) Diese Bescheinigung darf nur vollständig und unverändert vervielfältigt werden.

Postfach 14 01 20 D-44321 Dortmund Beylingstr. 65 D-44329 Dortmund Telefon: 0231/2491-0 Telefax: 0231/2491-224

DMT

BVS 98.D.2036 vom 15.06.1998

(9) Konformitätsbescheinigung BVS 98.D.2036

(10) Durch die Kennzeichnung der gelieferten Betriebsmittel bestätigt der Hersteller in eigener Verantwortung, daß diese elektrischen Betriebsmittel mit den im Anhang zu dieser Bescheinigung erwähnten darstellenden Unterlagen übereinstimmen und mit Erfolg die nach den harmonisierten Europäischen Normen, wie sie in (6) weiter oben erwähnt sind, vorgeschriebenen Stückprüfungen bestanden haben.

(11) Die gelieferten elektrischen Betriebsmittel dürfen das in Anhang II der Richtlinie Nr. 84/47/EWG vom 16. Januar 1984 dargestellte Gemeinschaftskennzeichen tragen. Dieses Kennzeichen erscheint auf der ersten Seite dieser Bescheinigung; es muß an den elektrischen Betriebsmitteln gut sichtbar, lesbar und dauerhaft angebracht sein.

(12) Steht das Zeichen X hinter der Nummer der Konformitätsbescheinigung, so bedeutet dies, daß dieses elektrische Betriebsmittel den besonderen im Anhang zu dieser Bescheinigung aufgeführten Auflagen/Bedingungen für die sichere Anwendung unterliegt.

44329 Dortmund, den 15.06.1998
BVS-Tha / Kn A 9700477

DMT-Gesellschaft für Forschung und Prüfung mbH
Fachstelle für Sicherheit elektrischer Betriebsmittel
Bergbau-Versuchsstrecke

Dr. Wenzel

DMT-Fachstelle für Sicherheit elektrischer Betriebsmittel - Bergbau-Versuchsstrecke DMT

DMT

Anhang zur Konformitätsbescheinigung BVS 98.D.2036

(A1) **Zustands-Mengenumwerter Typ EK-90**

(A2) **Beschreibung**

Der Mengenumwerter dient der Ermittlung und Anzeige des Normvolumens, der Betriebs- und Normbelastung brennbarer gasförmiger Medien. Die brennbaren Medien dürfen nicht ständig oder langzeitig explosionsfähige Atmosphäre bilden bzw. müssen soweit frei von Luft und Sauerstoff sein, daß sie nicht explosionsfähig sind. Der Druckanschluß ist in die wiederkehrende Druckprüfung der Anlage einzubeziehen. In dem Leichtmetallgehäuse (Mg < 6%) des Mengenumwerters sind die elektronischen Bauteile und eine Batterie untergebracht. Der Deckel des Gehäuses ist mit einer Schauscheibe zur Beobachtung des LC-Displays und vier Drucktastern zur Bedienung ausgerüstet. An die Steckverbinder Nr. S2 und Nr. S3 darf jeweils ein eigensicherer Stromkreis angeschlossen werden. Potentialfreie Kontaktgeber dürfen an die vorkonfektionierte Leitung (Stecker intern: X4, X5 und X6) angeschlossen werden.

Der zulässige Umgebungstemperaturbereich beträgt -30 °C bis +50 °C.

(A3) **Darstellende Unterlagen**

3.1 Beschreibung Nr.	vom	unterschrieben am
EX_EK90.DOC (22 Bl.)	14.05.98	15.05.98
EE0071B.DOC (9 Bl.)	14.05.98	15.05.98

3.2 Zeichnung Nr.	vom	unterschrieben am
83462000	02.03.98/04.03.98	15.05.98
E-A3-1956 (2 Bl.)	03.11.97	15.05.98
E-A3-1957 (2 Bl.)	03.11.97	15.05.98
E-A3-1958 (2 Bl.)	03.11.97	15.05.98
E-A3-1959 (2 Bl.)	03.11.97	15.05.98
C-A4-0796	27.11.96	15.05.98
cpu.sch	25.02.98	15.05.98
EK9-CPU-LAY1	14.05.98	15.05.98
EK9-CPU-LAY2	14.05.98	15.05.98
EK9-CPU-LAY3	14.05.98	15.05.98
EK9-CPU-LAY4	14.05.98	15.05.98
EK9-CPU-LAY5	14.05.98	15.05.98
EK9-CPU-LAY6	14.05.98	15.05.98
EK9-CPU-LAY7	14.05.98	15.05.98
EK9-CPU-LAY8	14.05.98	15.05.98
EK9-CPU-LAY9	14.05.98	15.05.98
ek90.sch (7 Bl.)	25.03.98	15.05.98
EK9-ANB-LAY1	14.05.98	15.05.98
EK9-ANB-LAY2	14.05.98	15.05.98
EK9-ANB-LAY3	14.05.98	15.05.98
EK9-ANB-LAY4	14.05.98	15.05.98
EK9-ANB-LAY5	14.05.98	15.05.98
EK9-ANB-LAY6	14.05.98	15.05.98
EK9-ANB-LAY7	14.05.98	15.05.98

DMT

73013211 (4 Bl.)	12.01.91/10.08.94	15.05.98
73015425 (2 Bl.)	13.11.96/16.04.97	15.05.98
73013783	09.11.92	15.05.98
73012571	12.01.91/25.04.96	15.05.98
73014827	10.09.96	15.05.98
73015407	22.04.97	15.05.98
73015408	22.04.97	15.05.98
73015403	28.04.97	15.05.98
73015236 (3 Bl.)	10.01.97/16.09.97	15.05.98
73015212 (2 Bl.)	04.09.96/21.04.97	15.05.98
73015211 (2 Bl.)	04.09.96/21.04.97	15.05.98
73015210 (2 Bl.)	04.09.96/18.04.97	15.05.98
73015209 (2 Bl.)	04.09.96/18.04.97	15.05.98

3.3 Stückliste Nr.	vom	unterschrieben am
E9_EXSLA.DOC (2 Bl.)	14.05.98	15.05.98
A-A3-2232 (2 Bl.)	14.05.98	15.05.98
73015116 (3 Bl.)	14.05.98	15.05.98
73015115 (5 Bl.)	14.05.98	15.05.98

(A4) **Elektrische Daten**

Steckverbinder Nr. S3 (6-polig)

Höchstwerte:

U_i = 10 V
I_i = 100 mA
L_i= vernachlässigbar
C_i = 3,3 nF

Steckverbinder Nr. S2 (8-polig)

Höchstwerte:

U_i = 30 V
I_i = 40 mA
L_i= vernachlässigbar
C_i = 53 nF

(A5) **Kennzeichnung**

Die Kennzeichnung muß gut sichtbar, lesbar und dauerhaft sein; sie muß die folgenden Angaben umfassen:

5.1 Namen des Herstellers oder sein Warenzeichen
Typ EK-90
EEx ia IIB T3
Fertigungsnummer
BVS 98.D.2036
-30 °C ≤ T_a ≤ +50 °C

Seite 4 von 5 zur Konformitätsbescheinigung BVS 98.D.2036 vom 15.06.1998

DMT

5.2 Die Kennzeichnung, die normalerweise für das betreffende elektrische Betriebsmittel in den Konstruktionsnormen vorgesehen ist.

(A6) **Stückprüfungen**

Die Stückprüfungen sind vom Hersteller nach 23 von EN 50014-1977 (VDE 0170/0171 Teil 1/5.78) durchzuführen.

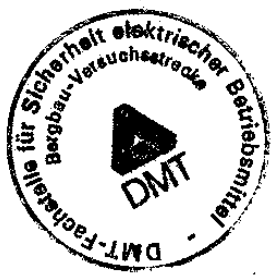
(A7) **Besondere Auflagen/Bedingungen für die sichere Anwendung**

Entfällt

44329 Dortmund, den 15.06.1998
BVS-Tha / Kn A 9700477

DMT-Gesellschaft für Forschung und Prüfung mbH
Fachstelle für Sicherheit elektrischer Betriebsmittel
Bergbau-Versuchsstrecke

Der Sachverständige



Dr. Wenzel

Thater

Seite 5 von 5 zur Konformitätsbescheinigung BVS 98.D.2036 vom 15.06.1998

A-4 Certificate of Conformance EX Zone 1

(Translation of German document)

DMT-Gesellschaft für Forschung und Prüfung GmbH
Specialists for the safety of electrical equipment
Mining Test Section

Ex BVS

Electrical equipment for areas subject to explosion hazard

(1) **Certificate of Conformance**

(2) **BVS 98.D.2036**

(3) This certificate is issued for:
State Volume Corrector Type EK-90

(4) Manufactured and submitted for certification by:

ELSTER Produktion GmbH
D 55248 Mainz-Kastel

(5) The construction of this electrical equipment and the various approved versions is specified in the appendix to this conformance certificate.

(6) The Mining Test Section, an approved station according to Article 14 of the guideline from the Council of the European Community 76/117/EWG of 18th December 1975,

- confirms that this electrical equipment meets the following Harmonised European Standards:

  EN 50014-1977 + A1 – A5 (VDE 0170/0171 Part 1/1.87) General requirements
  N 50020-1977 + A1 – A5 (VDE 0170/0171 Part 7/4.92) Intrinsic safety ”i”

  and has successfully passed the type tests specified according to these standards.

- confirms that a confidential test report on these tests has been produced.

(7) The symbol for the electrical equipment is:

EEx ia IIB T3

(8) This certificate must only produced in its entirety and unmodified.

BVS 98.D.2036 of 15th June 1998

(9) Certificate of Conformance BVS 98.D.2036

(10) With the labelling of the supplied equipment the manufacturer confirms on his own responsibility that this electrical equipment conforms to the explanatory documentation mentioned in the appendix to this description and has successfully passed the routine check tests specified according to the Harmonised European Standards, as mentioned above in (6).

(11) The supplied electrical equipment may bear the Community label shown in Appendix II of Guideline No 84/47/EWG from the Commission of 16th January 1984. This label appears on the first page of this certificate; it must be fitted to the electrical equipment so that it is easily visible, readable and permanent.

(12) If the symbol X appears after the number of the conformance certificate, then it means that this electrical equipment is subject to the special conditions for safe application which are listed in the appendix to this certificate.

44329 Dortmund, 15th June 1998
BVS-Tha / Kn A 9700477

DMT-Gesellschaft für Forschung und Prüfung GmbH
Specialists for the safety of electrical equipment
Mining Test Section

Dr. Wenzel

Appendix to Certificate of Conformance
BVS 98.D.2036

(A1) **State Volume Corrector Type EK-90**

(A2) **Description**

The volume corrector is used for the measurement and display of the standard volume and the actual and the standard flow of combustible, gaseous media. The combustible media must not form continuous or long-term atmospheres capable of causing explosions. The pressure connection must be included in the regular system pressure test. The electronic components and a battery are accommodated in the light alloy housing (Mg < 6%) of the volume corrector. The housing cover is fitted with a viewing window for reading the LCD display and with four keys for operation. An intrinsically safe circuit may be connected to each of the connectors No. S2 and No. S3. Potential-free contacts can be connected to the ready-made cable (internal connector: X4, X5 and X6).

The permissible ambient temperature range extends from –30°C to +50°C.

(A3) **Explanatory documentation**

3.1 Description no.	of	Signed on
EX_EK90.DOC (22 Pgs.)	14.05.98	15.05.98
EE0071B.DOC (9 Pgs.)	14.05.98	15.05.98

3.2 Description no.	of	Signed on
83462000	02.03.98/04.03.98	15.05.98
E-A3-1956 (2 Pgs.)	03.11.97	15.05.98
E-A3-1957 (2 Pgs.)	03.11.97	15.05.98
E-A3-1958 (2 Pgs.)	03.11.97	15.05.98
E-A3-1959 (2 Pgs.)	03.11.97	15.05.98
C-A4-0796	27.11.96	15.05.98
cpu.sch	25.02.98	15.05.98
EK9-CPU-LAY1	14.05.98	15.05.98
EK9-CPU-LAY2	14.05.98	15.05.98
EK9-CPU-LAY3	14.05.98	15.05.98
EK9-CPU-LAY4	14.05.98	15.05.98
EK9-CPU-LAY5	14.05.98	15.05.98
EK9-CPU-LAY6	14.05.98	15.05.98
EK9-CPU-LAY7	14.05.98	15.05.98
EK9-CPU-LAY8	14.05.98	15.05.98
EK9-CPU-LAY9	14.05.98	15.05.98
ek90.sch (7 Pgs.)	25.03.98	15.05.98
EK9-ANB-LAY1	14.05.98	15.05.98
EK9-CPU-LAY2	14.05.98	15.05.98
EK9-CPU-LAY3	14.05.98	15.05.98
EK9-CPU-LAY4	14.05.98	15.05.98
EK9-CPU-LAY5	14.05.98	15.05.98
EK9-CPU-LAY6	14.05.98	15.05.98
EK9-CPU-LAY7	14.05.98	15.05.98

73013211 (4 Pgs.)	12.01.91/10.08.94	15.05.98
73015425 (2 Pgs.)	13.11.96/16.04.97	15.05.98
73013783	09.11.92	15.05.98
73012571	12.01.91/25.04.96	15.05.98
73014827	10.09.96	15.05.98
73015407	22.04.97	15.05.98

73015408	22.04.97	15.05.98
73015403	28.04.97	15.05.98
73015236 (3 Pgs.)	10.01.97/16.09.97	15.05.98
73015212 (2 Pgs.)	04.09.96/21.04.97	15.05.98
73015211 (2 Pgs.)	04.09.96/21.04.97	15.05.98
73015210 (2 Pgs.)	04.09.96/18.04.97	15.05.98
73015209 (2 Pgs.)	04.09.96/18.04.97	15.05.98

3.3	Parts list no.	of	Signed on
	E9_EXSLA.DOC (2 Pgs.)	14.05.98	15.05.98
	A-A3-2232 (2 Pgs.)	14.05.98	15.05.98
	73015116 (3 Pgs.)	14.05.98	15.05.98
	73015115 (5 Pgs.)	14.05.98	15.05.98

(A4) **Electrical data**

Connector No. S3 (6-pole)

Maximum values
U_i = 10 V
I_i = 100 mA
L_i = negligible
C_i = 3.3 nF

Connector No. S2 (8-pole)

Maximum values
U_i = 30 V
I_i = 40 mA
L_i = negligible
C_i = 53 nF

(A5) **Labelling**

The labelling must be easily visible, readable and permanent; it must include the following details:

5.1 Name of the manufacturer or his trademark
Type EK-90
EEx ia IIB T3
Production number
BVS 98.D.2036
$-30°C \leq T_a \leq +50°C$

5.2 The label which is normally provided for the relevant electrical equipment according to the design standards.

(A6) **Routine check tests**

Routine check tests must be carried out by the manufacture according to 23 of EN 50014-1977 (VDE 0170/0171 Part 1/5.78).

(A7) **Special directives/conditions for safe use**

Not applicable.

44329 Dortmund, 15th June 1998
BVS-Tha / Kn A 9700477

DMT-Gesellschaft für Forschung und Prüfung GmbH
Specialists for the safety of electrical equipment
Mining Test Section Responsible official

Dr. Wenzel Thater

B Technical data

B-1 General data (mechanical)

Size (WxHxD)	124 x 75 x 124 mm
Weight	approx. 1.4 kg
Protection	IP 54 to EN60529
Ambient temperature	-10...50°C

B-2 Power supply

Battery	One lithium battery module 3.6 Volt/5.2 Ah Order no. 73015425

The minimum service life of 5 years is guaranteed for standard operation:

Display active	1 h/month
Interface active	5 min/month
Max. input frequency	f = 1 Hz
Ambient temperature	T = 20°C

B-3 Pulse inputs and manipulation contact

Generator inputs for reed contacts or transistor switches.

Nominal data of connected pulse generators:

C_p value	0.01; 0.1; 1; 10; 100 1/m³
Frequency	f_{max} = 10 Hz

With internal pulse generators:

Mech. torque	M < 0.1 Nmm
Dimensions of driver	Conforming to DIN 33800

with external pulse generator

Cable assignment for cable length 2.5 m

Pulse Input 1:	white (+)	brown (-)
Pulse Input 2:	green (+)	yellow (-)
Tamper contact:	grey (+)	pink (-)

The labels (+) and (-) are also given for the connection of a transistor switch. They have no significance with the connection of a reed contact.

Nominal data of pulse output:

Open circuit voltage	U_O	≈	3.3 V
Internal resistance	R_i	=	1 MΩ
Short-circuit current	I_S	=	3.3 µA

“On” switching point:

Resistance	R_{on}	≤	700 kΩ
Voltage	U_{on}	≤	2.0 V

“Off” switching point:

Resistance	R_{off}	≥	1 MΩ
Voltage	U_{off}	≥	1.7 V

Pulse duration	t_{on}	≥	50 ms
Interval time	t_{off}	≥	50 ms
Counting frequency	f	≤	10 Hz

B-4 Pressure sensor

Pressure sensor built into housing.

Ratings:
Measurement ranges for applications with official calibration:

0.8...2.0 bar absolute
1.4...3.5 bar absolute
2.0...5.0 bar absolute
3.0...7.5 bar absolute
4.0...10 bar absolute
8.0...20 bar absolute
14...35 bar absolute

Sensors for higher pressures (up to 125 bar) and wider pressure ranges (measurement ranges of 1:5 or 1:10) are also available on request for use outside of the field subject to official calibration. With wider pressure ranges the data quoted in Chapter “B-8” changes with respect to the measurement uncertainty for pressure and standard volume. The measurement uncertainty always remains however within the calibration error limits.

Overload rating:

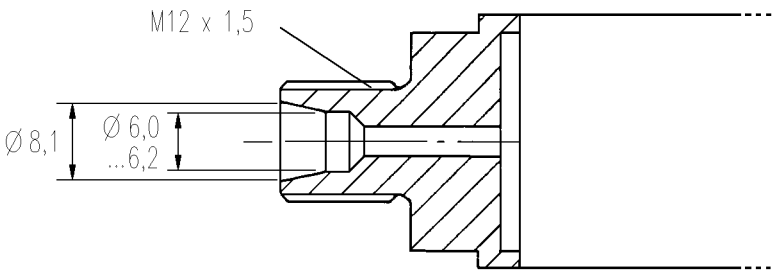
Without affecting the accuracy	twice the rated pressure
Bursting pressure	140 bar

Connection:

Pressure connection:	Ermeto M12 x 1.5 external thread
	Useful length approx. 7 mm

Installation note:
When connecting the pressure line to the integral pressure sensor, attention should be paid to the external pipe diameter to avoid damage and incorrect sealing of the screw fitting. In particular, a check of the pipe joint should be made for burrs and flaring which may cause an increase in the external pipe diameter (see the following drawing of the Ermeto connection on the pressure sensor).

Cross-section of pressure sensor connection



B-5 Temperature sensor

Temperature sensor Type Pt500 to DIN EN 60751.

Ratings:

Measurement range: -10...+60°C

Connection:

Cable: LIYCY 2x2x0.25 mm^2 (for cable length l=2.5 m), twisted pairs

LIYCY 2x0.25 mm^2 (for cable length l=0.5 m)

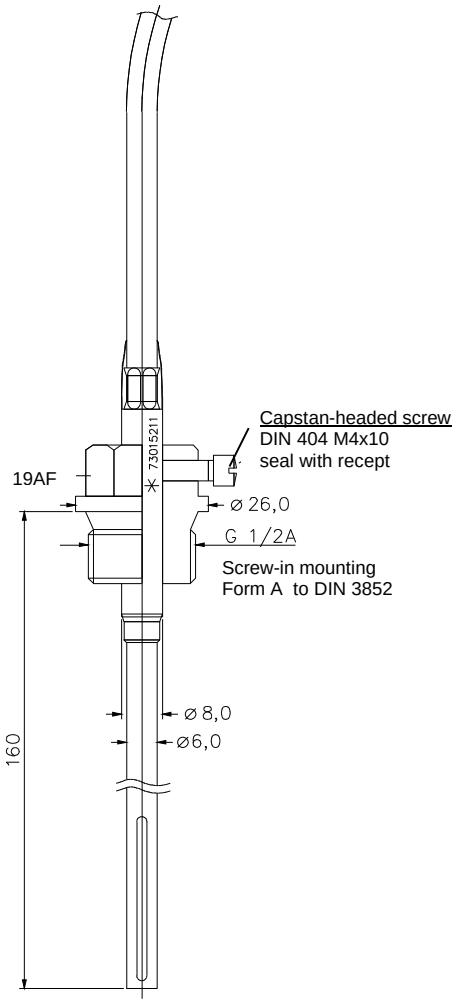
Overall screen (at least 85% coverage),

colour sequence to DIN 47 100.

B-5.1 Temperature sensor Pt500 “EBL 160KF”

Temperature sensor type:	Pt500 to DIN EN 60751
Type of connection:	Two-wire technique (for cable length 0.5 m) Four-wire technique (for cable length 2.5 m) Used in sensor receptacle with installed length EBL = 160 mm.
Measurement uncertainty:	≤ ± 0.1% of measurement
Perm. gas temperature range:	-10°C...+60°C

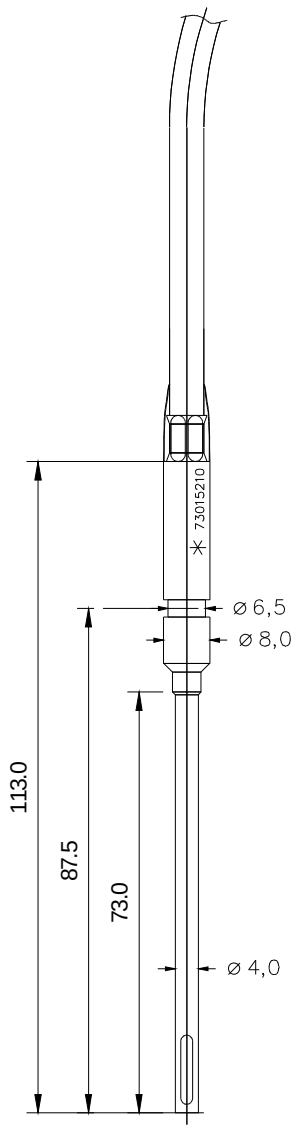
Dimensional drawing (EBL 160KF):



B-5.2 Temperature sensor Pt500 “EBL50KF”

Temperature sensor type:	Pt500 to DIN EN 60751
Type of connection:	Two-wire technique (for cable length 0.5 m)
	Four-wire technique (for cable length 2.5 m)
	Used in sensor receptacle with installed length
	EBL = 45/50/58/67 mm.
Measurement uncertainty:	≤ ± 0.1% of measurement
Perm. gas temperature range:	-10°C...+60°C

Dimensional drawing (EBL 50KF):



B-6 Serial interface

Interface similar to RS232 or V.24, electrically isolated.

Limits:
Voltages measured with respect to V-:

Input voltage V+:	0 ... +10 V
Input voltage CTS:	-10 ... +10 V
Input voltage RXD	-10 ... +10 V

Ratings:
At V+ = +5V, V- = 0 V:

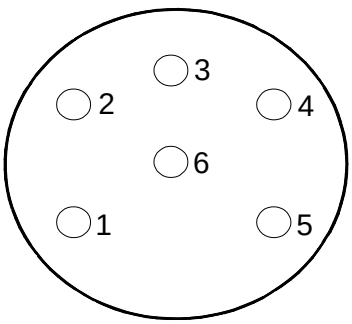
Input level	"1"	$U_i \geq 4$ V
Input level	"0"	$U_i \leq 0.5$ V
Input current		$I_i \leq 1$ mA
Rated current		"1" signal: $I_{ah} \geq$ 1mA ($U_a \geq 4.9$ V)
	"0" signal:	$I_{al} \geq 0.2$ mA ($U_a \leq 1$ V)

Data format:

Baud rate	4800 Bd
Number of data bits	8
Number of stop bits	1
Parity	None

Connections:
Viewed from outside on the EK-90
Plug connector: 6-pole circular socket

1 = V+ (Voltage supply "+")
2 = TXD (Send data)
3 = RXD (Receive data)
4 = RTS (Control output)
5 = CTS (Control input)
6 = V- (Voltage supply "-")



Plan view of device socket

B-7 Alarm / warning and pulse outputs

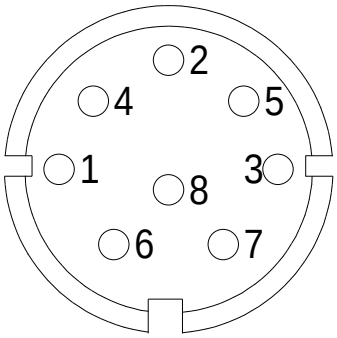
The four alarm / warning and pulse outputs are transistor outputs.
The outputs are brought out via an 8-pole circular socket on the left side of the device and they can also be connected to signal inputs with NAMUR signals (DIN 19234).

Ratings:

Max. switching voltage:	30 V
Rated current:	40 mA
Voltage drop at rated current:	£ 1 V
Voltage drop at 2.1 mA:	£ 6 V (Namur)
Leakage current (for “off” signal):	£ 0.001 mA (at U £ 24 V)
Pulse duration:	500 ms
Output frequency:	1 Hz constant

Connection:

Plan view of device socket
Connector: Circular connector, 8-pole
Pin assignment:



1: Output 1 - (A1-)
2: Output 1 + (A1+)
3: Output 3 - (A3-)
4: Output 3 + (A3+)
5: Output 2 - (A2-)
6: Output 2 + (A2+)
7: Output 4 - (A4-)
8: Output 4 + (A4+)

B-8 Error limits (Limits for measurement deviations)

The error limits (limits for measurement deviations) are defined according to (pr) EN 12405. Precise details can be obtained on request.

C Index

Abbreviated designation	List	Value no.	List
-	Display test	P88	Measurements (Test)
[P]	Unit for pressure bar/psi/hPas/ kPas	P72	Service
[T]	Unit for temperature °C/K/°F	P73	Service
[V]	Unit for volume m3/ft3	P71	Service
A1	Pin assignment, Signal Output DA1	P310	Outputs
A1.CP	cP value, Signal Output DA1	P311	Outputs
A1.HL	Logic, Signal Output DA1	P314	Outputs
A1.CU	Signal output DA1 subject to C/U	P315	Outputs
A2	Pin assignment, Signal Output DA2	P320	Outputs
A2.CP	cP value, Signal Output DA2	P321	Outputs
A2.HL	Logic, Signal Output DA2	P324	Outputs
A2.CU	Signal output DA2 subject to C/U	P325	Outputs
A3	Pin assignment, Signal Output DA3	P330	Outputs
A3.CP	cP value, Signal Output DA3	P331	Outputs
A3.HL	Logic, Signal Output DA3	P334	Outputs
A3.CU	Signal output DA3 subject to C/U	P335	Outputs
A4	Pin assignment, Signal Output DA4	P340	Outputs
A4.CP	cP value, Signal Output DA4	P341	Outputs
A4.HL	Logic, Signal Output DA4	P344	Outputs
A4.CU	Signal output DA4 subject to C/U	P345	Outputs
AUT.V.	Automatic switchover to H2	P91	Service
BATT	Remaining battery service life	L35	System (Z value)
Bin.P	Pressure, binary	L47	Pressure sensor (p)
Bin.P	Pressure, binary	L47	Measurements (Test)
Bin.T	Temperature, binary	L48	Measurements (Test)
Bin.T	Temperature, binary	L48	Temperature sensor (T)
CAL	Read state of calibration lock and close	P90	System (Z value)
C.No	Customer number	L123	Archive / settings
CO2*	CO2 content	L148	Gas analysis (K-value)
CLEAR VOL	Clear counter	P48	System (Z value)
CTRY	Selection of functional variant	P74	Service
COD.C CHG	Change customer’s code	P11	System (Z value)
COD.C OPEn COD.C CLOSe	Enter customer’s code	P10	System (Z value)
COD.S CHG	Change supplier’s code	P9	System (Z value)
COD.S OPEn COD.S CLOSe	Enter supplier’s code	P0	System (Z value)
CP	cP value (pulse input)	P4	Gas meter (cP value)
CYK	Cycle time for analogue measurements	P14	Service
DATE	Date	L7	System (Z value)
DATE	Monthly value, date	-	Archive/ archive values
DATE [ARCHIVE]	Freeze date	H59.1	Measurements (Test)
DISP.	Display, continuous display	P96	Service
FRZ	Freeze function	H55	Measurements (Test)
H2*	Molar proportion of H2	L147	Gas analysis (K-value)
Ho.n*	Calorific value Ho,n	L145	Gas analysis (K-value)
I.DIF	Pulse difference for warning	P38	Gas meter (cP value)
I.Fun	Manipulation detection off/N.C./N.O.	P39	Gas meter (cP value)
K*	K-value currently computed/GERG	L6	Gas analysis (K value)
K.F	K value	P1	Gas analysis

* Depends on software version.

Abbreviated designation	List	Value no.	List
K.MOD*	K-value mode	P8	Gas analysis (K-value)

K[ARCHIVE]	Frozen K value	H58.4	Measurements (Test)
LANG.	Language selection	P70	Service
M.BEG	Month boundary (time)	L12	Archive / settings
O.No	Block number	-	Archive/archive values
P	Pressure, absolute	L1	Pressure sensor (p)
P.CAL1	Pressure adjustment, lower value	P120	Pressure sensor (p)
P.CAL2	Pressure adjustment, upper value	P121	Pressure sensor (p)
P.EQ1	Pressure equation offset	P145	Pressure sensor (p)
P.EQ2	Pressure equation slope	P146	Pressure sensor (p)
P.LW	Lower warning limit, pressure	P102	Pressure sensor (p)
P.MAX	Upper alarm limit, pressure	P23	Pressure sensor (p)
P.MIN	Lower alarm limit pressure	P24	Pressure sensor (p)
P.Mod	Pressure mode	P12	Pressure sensor (p)
P.RNG	Pressure range, absolute	L26	Pressure sensor (p)
P.F	Substitute pressure p	P2	Pressure sensor (p)
P.UW	Upper warning limit, pressure	P101	Pressure sensor (p)
P[ARCHIVE]	Frozen p	H58.1	Measurements (Test)
Pb	Standard pressure Pb	L156	Pressure sensor (p)
PROG End*	Accept calibration data	-	Gas analysis (K-value)
PROG End	Accept parameters	-	Pressure sensor (p)
PROG End	Accept parameters	-	Temperature sensor (p)
PROG.ALL.End	Accept all parameters	P99	System (Z value)
Prt.I	IDOM protocol immediately	P56	Outputs
Prt.m	IDOM protocol every xx min.	P57	Outputs
Prt.d	IDOM protocol at xx.00 hrs	P58	Outputs
Q	Actual flow Q	H12	Flow values
Qb	Standard flow Qb	H13	Flow values
Rhon *	Standard density gas	L146	Gas analysis (K-value)
SAVE dAt	Save data (battery replacement function)	-	System (Z value)
SERV ICE	Submenu	-	System (Z value)
SN.M	Gas meter number	L124	Gas meter (cP value)
SN.P	Serial number, pressure sensor	L16	Pressure sensor (p)
SN.T	Serial number, temperature sensor	L17	Temperature sensor (T)
SN.V	Serial number, volume corrector	L18	System (Z value)
STAT	Status Register 1	L4	Errors (status)
STAT [ARCHIVE]	Status Register 2	L5	Errors (status)
T	Gas temperature T	L2	Temperature sensor (T)
T.EQ1	T-equation offset	P3	Temperature sensor (T)
T.EQ2	T-equation slope	L27	Temperature sensor (T)
T.JUS 1	Temperature adjustment, lower value	P147	Temperature sensor (T)
T.JUS 2	Temperature adjustment, upper value	P148	Temperature sensor (T)
T.LW	Lower warning limit, temperature	P170	Temperature sensor (T)
T.MAX	Upper alarm limit, temperature	P171	Temperature sensor (T)
T.MIN	Lower alarm limit temperature	P21	Temperature sensor (T)
T.Mod	Temperature mode	P22	Temperature sensor (T)
T.RNG	Temperature range	P13	Temperature sensor (T)
T.S	Substitute temperature	L157	Temperature sensor (T)
T.UW	Upper warning limit, temperature	P151	Temperature sensor (T)
T[ARCHIVE]	Frozen T	P152	Measurements (Test)

* Depends on software version.

Abbreviated designation	List	Value no.	List
TIME	Time	L8	System (Z value)
TIME[ARCHIVE]	Time of freezing	H59.2	Measurements (Test)
Tb	Standard temperature Tb	L157	Temperature sensor (T)
V	Actual volume, undisturbed	H1	Actual volume (V)
V	Last monthly value V	H7	Archive/archive values
V[ARCHIVE]	Frozen V	H56	Measurements (Test)
V.D	Actual volume, disturbance quantity	H3	Actual volume (V)
VERS	Software version	L34	System (Z value)
Vb	Last monthly value Vb	H8	Archive/archive values
Vb	Standard volume, undist., predec. places	H2.1	Standard volume (Vb)
Vb+	Standard volume, undist. post-dec. places	H2.2	Standard volume (Vb)
Vb[ARCHIVE]	Last monthly value Vb	H8	Archive/archive values
Vb[ARCHIVE]	Frozen Vb, predec. places	H57.1	Measurements (Test)
Vb+[ARCHIVE]	Frozen Vb, post-dec. places	H57.2	Measurements (Test)
Vb.D	Standard volume, dist. quantity	H4	Standard volume (Vb)
Vb.A	Standard volume, adjustable	H24	Standard volume (Vb)
Vb.T	Standard volume, total quantity	H6	Standard volume (Vb)
Vb.T[ARCHIVE]	Monthly value Vb.T	-	Archive/archive values
V.A	Actual volume, adjustable	H23	Actual volume (Vg)
V.T	Actual volume, total quantity	H5	Actual volume (V)
Z	Z value	L3	System (Z value)
Z[ARCHIVE]	Frozen Z	H58.3	Measurements (Test)

D Status messages

Error code	Description	A/W/R
E.0	No error	-
E.1	Data loss in memory or new start	A
E.2	Power supply failed, data is retained	W
E.6	Data error found in memory	W
E.7	Battery service life approaching end	W
E.13	Pressure measurement circuit not adjusted	A
E.14	Temperature measurement circuit not adjusted	A
E.15	Pressure outside specified limits	A
E.16	Temperature outside specified limits	A
E.17	Plausibility error on analogue converter (for p, T)	A
E.20	Permissible pulse difference exceeded	W
E.21	Manipulation detection	W
E.24	Overflow on intermediate buffer for output A1-A4	W
E.26	Limits exceeded	W
E.30	Calibration switch open	R
E.32	Battery device (indication only via interface)	R

A = ALARM, W = WARNING, R = REPORT

E Input error messages

Error code	Description	Cause
1	Incorrect or non-existent code entry	A value number, which is not present in the EK-90, has been interrogated in the interface mode.
3	Value conflict with associated values	The current value entry is not possible, because another programmed value forbids it.
4	Parameter is write-protected	An attempt has been made to change a read-only value.
5	Calibration or user lock is closed	An attempt has been made to change a value protected by the calibration or user lock, although the corresponding lock is closed.
6	Entered value is outside the permissible limits	The entry is outside the permissible range.
7	Incorrect user code	The entered customer’s or supplier’s code is not correct.
8	Supplier’s or customer’s code has only 6 places!	More than 6 places for one of the two codes have been transmitted during interface mode.
12	Incomplete adjustment	A measurement has been carried out at only one of the two adjustment points.