OPERATION MANUAL

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CHARGER / DISCHARGER

UL10

0 – 40V / 0 – 40A

TKZ: UL10.040000

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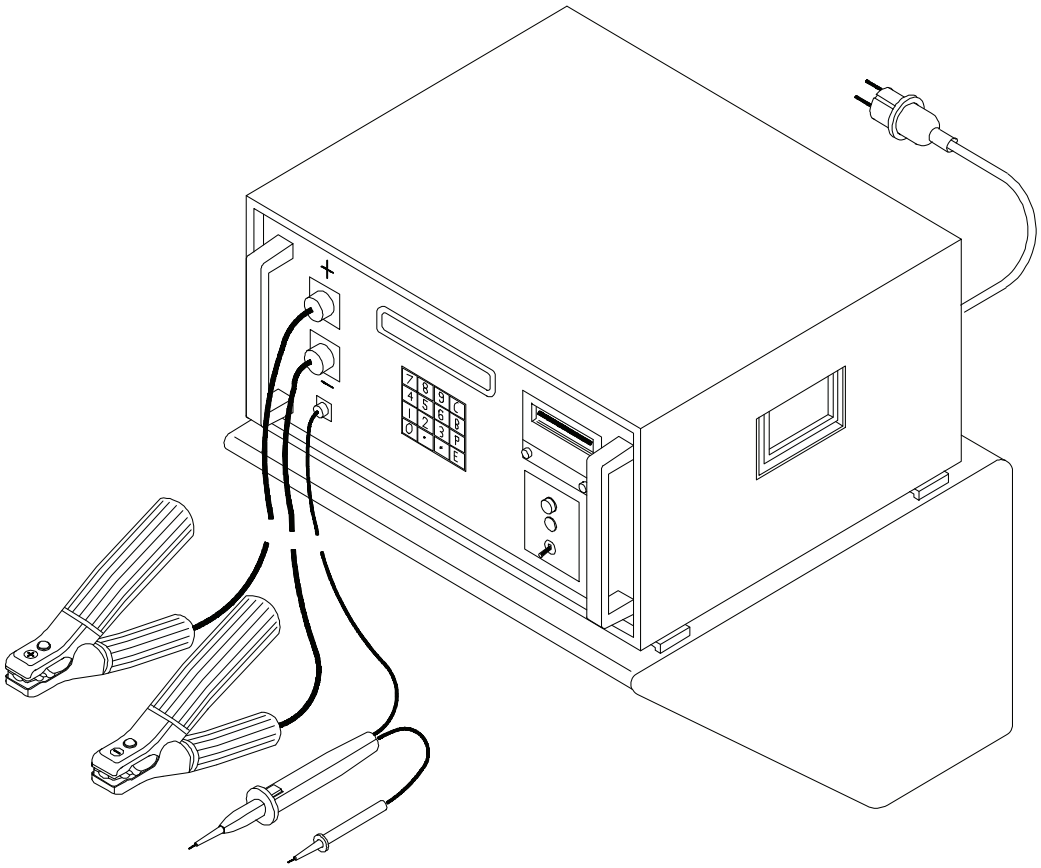
NorTec Electronics GmbH & Co. KG
An der Strusbek 32 B
D – 22926 Ahrensburg
Tel.: +49 4102 42002
Fax: +49 4102 42840
Email: info@nortec-electronics.de
Web: www.nortec-electronics.de



CHARGER / DISCHARGER UL10

Contents

1 General

1.1 Application

1.1.1 Range of functions

The battery charger-discharger UL10 serves to test, charge and discharge all types of batteries based on their particular approved characteristics and using various programs.

A menu and a touch-input keyboard control all the programs.
Also, the device can serve as a direct current source without connecting any battery.

The following software is available to measure and register voltages of individual batteries according to the current charging program or independently of operations underway:

- Measurement of voltage of an individual battery (P)

Sphere of application

The device is contained in a body to be used indoors. Its rugged design enables to install it on vibration-proof racks or to carry it in a handbag during field exercises. It is used by the navy as a tester.

Types of batteries:

The types of the batteries are the following:

00 no battery connected
10 air-tight aircraft lead acid electrolyte-filled batteries
11 Pb battery sealed commercial
16 Pb battery vented commercial
20 enclosed aircraft nickel-cadmium batteries
21 enclosed nickel-cadmium batteries type VARTA
30 enclosed nickel-cadmium batteries type SAFT
31 enclosed nickel-cadmium batteries type НКБН

Different programs serve to enter parameters of various batteries (nominal voltage, number of cells in a battery and nominal capacity) into the UL 10 enabling to ensure their long service life.

1.1.2 Design

The device consists of three main components:

1. A functional pull-out unit 19 inches. Up to 5 units can be installed in a pile. The performance of the device is tested during manufacture.
2. A read-only memory specified by a customer of energy independent reprogrammable storage with a relevant instruction manual.
3. A body
4. A set of cables (specified by the customer)

1.2 Sphere of application

The normal body of the device is designed for indoor operation without any special ventilation.

It can be installed in a laboratory, a charging room, etc.

The device is fully adapted for field service when packed into a polyethylene or corrugated card-board transport case.

The fully functional pull-out unit can be used in a separate vibration protected body or in groups of mobile or stationary framework racks.

2 Organs of control and indication

Organs of control, indication and connection of the UL 10 device for testing batteries are easily accessible from the front panel. Connections of specifically requested cells for automatic registration of voltages of batteries, such as aircraft batteries and batteries for torpedoes or connections of several PCs to the mains, are arranged on the rear face.

2.1 Front instrumentation panel

1) The POWER ON / OFF switch with a LED indicator

a) triggers the device on and off

b) The red LED indicates that the device is connected to the mains

2) The automatic protection circuit 16 A protects 220 V AC power supply.

The indicator

The LC graphic display (2 lines, 40 characters) serves to transmit information to the user and to indicate the parameters of operation of programs in the progress of charging.

2) The touch-input keyboard

The keys BREAK, CLEAR, PRINT, ENTER↵ serve to interrupt programs, to delete erroneously entered data, to print out results and to confirm input of requested data, respectively.
The digital unit enables the user to enter digital data, such as parameters of batteries and the operator number.
The key * ensures access to the information about the system menu.

3) The printer

The built-in printer for printing out protocols can be enabled at any moment before and after operations with a battery. It prints out all basic parameters of a battery and all errors, if necessary.

6) The battery tester

The battery tester is connected to the UL10 device with a plug-and-socket connector type VG 95 328 C10-6SN (6-contact). The battery tester enables to measure voltages of batteries between -4.0 to + 4.0 V.

7) Mains connection to the battery

The battery is connected via special connecting cables to the UL 10 device with two 4-pin Plug and socket connectors type VG complying with requirements VG 95 234.

8) The manufacturer/ designation of the UL 10 device

2.2 Rear Instrumentation wall

2.2.1 Mains cable

2.2.2 Source of acoustic signals

The source of acoustic signals informs the operator of the condition of the device; accordingly them the operator receives relevant instructions to execute. An error of input, a failure or operation finish can induce an acoustic signal.

3 Principle of operation

3.1 Connection

Connection is made following the instructions below:

- connect to the 220 V AC mains
- connect the battery
- put the mains switch POWER ON / OFF (2.1.1a) into position ON
- check if the red LED indicator is on.

After that the automatic self test follows.

NOTE!
The procedure is interrupted in case of an error message. After a successful self-test the parameters of the connected battery should be entered by selecting a corresponding item. This is done with the keys 4; 6 and ENTER↵. The available types of batteries correspond to item 1.1.2.

3.2 Installation

The device should be installed so that uninterrupted ventilation of and air exhaust from the device are ensured (at least 5 cm free space from the back face of the device).
The cooling air is delivered from below and exits through the rear face. When the device operates in the open air, e.g. under a tent, check that it is placed n a dust-free base otherwise the cooling process can be inhibited.

The device should be operated in the buildings designed for this purpose on corresponding bases because the pull-out unit is fitted with a fan without any extra case so that the device without a protective body can be damaged or the servicing personnel can be traumatized.

3.3 Commissioning

3.3.1 Mains Connection

- put the switch POWER ON/OFF into the position OFF

- connection to the mains 220 V AC is made with a mains cable extending through the rear face and fitted with a connector type CEBEC (at an angle 90o)

- connect the cable from the battery to the device (+ and -). It is impossible to confuse the polarity because the connector is provided with a special key

- connect the measuring cable when operating with nickel-cadmium batteries

- the battery is connected to the UL10 with the cables from the delivery set (the cables with clamps (+ and -)). Check the polarity! When connecting the battery with the cable with tapered outlet clamps with built-in temperature sensors it is impossible to confuse the polarity because of the geometry of the poles of the battery.

3.3.2 Warning

Be cautious when touching!

The rear face of the pull-out unit can heat, specifically when executing the discharge programs.

The device disconnects in case of an intolerable temperature rise.

Do not open the device when it is on!

Even when the device is disconnected from the 220 V AC mains there remains inside the device a level of voltage dangerous to touch. Exclusively the manufacturer can perform servicing of the device otherwise the warranty becomes null.

Note:
The manufacturer bears no responsibility for losses due to improper installation, commissioning or operation. Only the materials approved by the manufacturer should be used.

- Only the manufacturer can repair and calibrate the device UL 10 when it is used in aircraft.

4 Ratings

4.1 Input & Output Parameters

input voltage	220 V + 10% (single-phase alternating)
input frequency	45-60 Hz
input power	2000 VA
external mains protection	16 A, mean inertia
fan power	about 100 / 300 l/min
charge current range	0.5 – 40 A
discharge current range	0.5 – 40 A
charge voltage range	0.1 – 40 V
discharge voltage range	0.1 – 40 V
voltage error	< 0.1 % of rated parameter plus ±5 discharge
current power error	< 3 % of rated parameter plus ±5 discharge
temperature error	< ±2 C
Insulation	VDE 0160, class 1
Protection type	IP 54
working temperature	-20 C to +45 C
Weight	about 50 kg (in 19” body, without battery cable)
Dimensions	width 400 mm, height 504 mm, depth 242 mm
Free space for exhaust	> 50 mm

4.2 Working temperature range

The device operation is guaranteed within the temperature range -20 C to + 45 C.

The accuracy of the readings of the indicator and printed out discharge and charge parameters correspond to the above indicated.

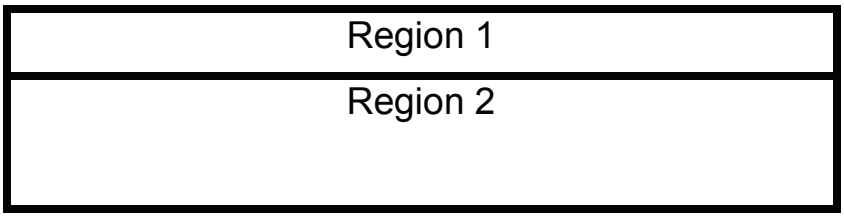
The accuracy of output values within the temperature range -20^{o}C to +45 ^{o}C is guaranteed for 2 years since the time of delivery of the device.

5 Controls

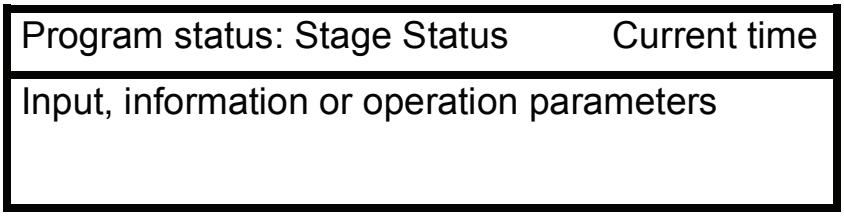
5.1 General

5.1.1 Indikation

The display of the device a UL 10 is divided into two parts (region 1 and region 2 below).



The following Figure shows when information each region displays:



Program Status
This line indicates the general condition of the device.
Among other messages there can be: PROGRAM SELECTION, PROGRAM START and PROGRAM COMPLETION

Stage Status
This line indicates the program current stage and description of the program stages in the process of functioning.

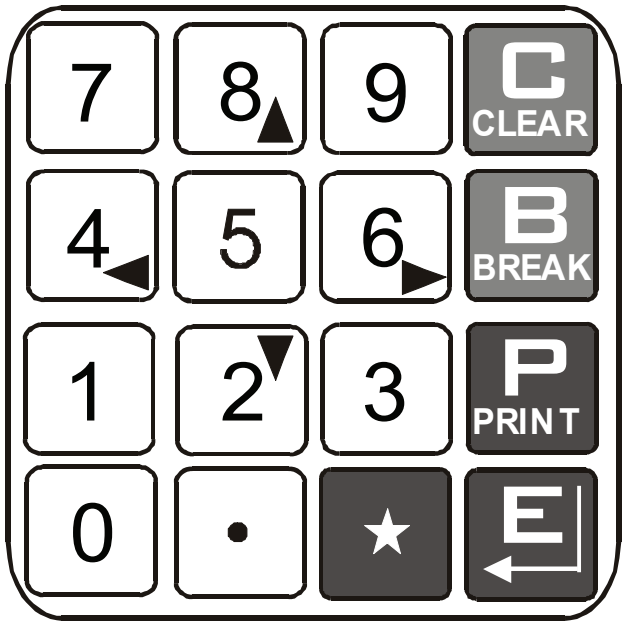
Current time
The time is indicted in the format hours – minutes – seconds

Input, information or operation parameters
All the current parameters are displayed in this region, such as:
- input parameters and data
- Messages about errors in open text
- Operation parameters (current, voltage, etc.) in the process of operation of the battery
- Information about menu execution, temperature indication

5.1.2 Keyboard

Functions of keys

Key	C	=	CLEAR
Key	B	=	BREAK
Key	P	=	PRINT
Key	E	=	ENTER
Key	★	=	Special Program
Key	●	=	Decimal Point
Key	0-9	=	Digits 0-9
Key	4◀	=	Digit 4 corresponds to command "forward"
Key	6▶	=	Digit 6 corresponds to command "backward"
Key	2▼	=	Digit 2 corresponds to command "downward"
Key	8▲	=	Digit 8 corresponds to command "upward"



- **to 9 and .**

Input of digital data separated by a decimal point.

- **ENTER ↵**

Confirmation of data input and messages or exit from information windows.

- **BREAK**

Interruption and /or completion of the current program at any moment of time.

- **PRINT**

In the process of operation with the battery or upon completion of the program all current parameters are printed out. In case of a failure an error message can be printed out by hitting the key PRINT.

- **CLEAR**

Cancel the last data input.

- **4◀**

Return to the previous item in the menu in the mode of program input.

- **6 ▶**

Proceed to the next item in the menu in the mode of program input.

5.2 Self-Test

Put the switch POWER ON/OFF (2.1.1a) into the position ON.
The red LED indicator on the front panel (2.1.1b) should light; no voltage in the mains. The Display is lit.
After voltage is switched on the display should show the following information for 2 seconds
- the rights of the manufacturer
- the device model
- the software version
- the software date
- the check status

COPYRIGHT 2000-2003 BY NORTEC **UL10 V20.108 REVISION 11.10.2003 SELFTEST**

Test OK

The test is complete
Concurrently a short sound beep sounds indicating that the device is ready for operatation.
If the self-test detects any failure in the device the following message is displayed:

FAILURE: EQUIPMENT **KEYBORD**

The appendix lists possible failure messages. These messages are in English, as a rule.
If the device operates without failures the information about the type of the connected battery is to be input (see item 6.6)
Then a pre-installed program 0-8 to service the battery and the program P and * are selected.
The key B enables to return to the item of selection of the battery type.

6 System adjustment

After self test and selection of the battery type the key * opens the menu to show options of Changing various parameters of the device. The input data are saved in the energy-independent memory of the device and remain available when the device is switched on again or when voltage fails in the mains.
When the key * is hit a menu of system adjustment is displayed in order to select a language of messages and to select the date and specific time indication.

6.1 Language Selection

By hitting the key 0 the current language selection is confirmed (English by default), use the key 1 to scan consecutively the available languages. After that the display shows messages in the selected language. So far the following languages are available in the UL-10 device:

- English
- German
- French
- Russian
(- Dutch: only four languages can be choose!)

6.2 Date Input

After the language is selected the time is set.

Date	Time
13.07.01	09:20:07

The cursor appears under the first item of the date. When the key ENTER↵ is hit the input data are saved. The cursor moves to the item of time. The digital keys (0 … 9) serve to enter the current time. The point is entered by default. Any error in the date input is rejected.

6.3 Time Input

The internal clock is adjusted with digital keys (0 … 9). The colon (separating hours from minutes) is entered by default. When the input is confirmed by the key ENTER↵ or the last digit of indication of minutes is entered the display switches over to the main menu.
The counting of seconds starts automatically.

6.4 Print out functions

6.4.1 General

The device is provided with a printer with electronic controls. It enables to register results of any operation with a battery in the form of a printed out acknowledgement. The print function in the menu can be enabled irrespective of the program input.

6.4.2 Print Equipment

The printer includes the following components:
- a **printer body**
It is attached to the front panel. The rear face has a 21-pin port for the printing mechanism.
- a **printing mechanism with a matrix EPSON printer**
- a removable front panel
- normal printing paper 50 mm wide
- 2 knurled head screws to secure the printer
- a self-test start pushbutton
- a color ribbon
- a rear 13-pin connector
- a printer controller
The board BT20-9 controller on the rear face of the printer body inside the device controls printing functions.

6.4.3 Printing Programs

6.4.3.1 General

By hitting the key P the last printout appears in the main menu or in the submenu in the PP mode.

6.4.3.2 Program P: printer and measurements of voltages of individual batteries

The Program P is a special program serving to print out the protocol while another program is running, in particular when measuring and registering voltages of individual batteries. The following options are available:
- Automatic protocol print-out in the program
- Manual protocol print-out in the program

NOTE: Automatic protocol print-out is possible only when the cable is available to measure voltages of individual batteries (optional).

DATA OF ALL PRINT-OUT PARAMETERS
The capacity data in % relate to the battery nominal capacity.
The line TEMPERATURE is printed out only when both temperature sensors are connected. The reading relates to a battery with a higher temperature.
INSTRUCTIONS HOW TO MEASURE VOLTAGES OF INDIVIDUAL BATTERIES
In the program x type of batteries 20.
The voltages of individual batteries are possible to measure only in the manual protocol print-out mode is indicated by a short beep. At this moment it is possible to measure voltage with the measuring cable and to print out voltages of individual batteries. The maximum number of batteries is 99.
If during voltage measurement a beep sounds the measurement should be repeated. The counting of cells is continued only providing the measurement is correct. The voltage of a battery is displayed and printed out simultaneously.
If the sign * is printed before the relevant battery voltage it means that it is less than 1.55 V (the voltage at the end of charging of an individual nickel-cadmium battery). If the measurement is made at a proper moment of time (according to the requirement of the battery manufacturer) the 1.55 V may prove that the battery is faulty.
If individual batteries are not measured the lines CELL 01 – CELL # are not printed. In case the program print-out does not respond to the data input the device receives a repeated inquiry after 30 seconds, etc., and resumes the normal program run mode.

6.4.3.3 Determination of battery voltage

```
================================
COPYRIGHT      NORTEC
2000-2003     UL10 V20.108
SN: 110 350
--------------------------------
        DATE:     03.04.12
  BATTERY NO:     12345
 OPERATOR NO:     0002
NOM. VOLTAGE:     24:00 V
   RATED CAP:     004.0 AH
     PROGRAM:     420
--------------------------------
PROGRAM START      08:42:24
      VOLTAGE =  26.66 V
--------------------------------
P420:S1: DISCHARGE 1 08:42:24
     VOLTAGE =    25.91 V
     CURRENT =    04.01 A
    CAPACITY =   000.0 AH
             =   000.0 %
        TIME =   000 MIN
--------------------------------
*   CELL 01:  1.292 V
*   CELL 02:  1.291 V
*   CELL 03:  1.294 V
--------------------------------
```

6.5 Program Selection

6.5.1 Principles of Program Selektion

All working programs of the UL 10 device have digital designations:
- The first digit represents the operation type
- The second and third digits represent the battery type

6.5.1.1 Types of Operation

6.5.1.1.1 Discharge (=Operation type 0)

Any battery with the nominal voltage within up to 40 V can be discharged with the UL 10 device; with the discharge current up to 40 A. It is performed with discharge load circuits that enable to bring the battery's voltage to 0 V. The energy the battery receives is dissipated into the environment by radiators and fans.

6.5.1.1.2 Commissioning (=Operation type 1)

Depending on the process of manufacture of batteries the manufacturer delivers them charged or uncharged. Deliveries are possible via intermediate storages.
Battery manufacturers provide only the instructions how to use them before their first start, the instructions may differ depending on the manufacturing processes. For some manufacturers the parameters of commissioning of the batteries are saved in the UL 10 memory depending on the battery type.

6.5.1.1.3 Charging (=Operation type 2)

To fulfill the «CHARGING» operation the memory of the UL 10 device contains programs of charging of each battery type recommended by manufacturers or specified by the customer. The programs required for optimum charging of batteries run fully automatic. In the process of charging the validity of the input battery data is checked, primarily the following:
- Initial voltage
- Final voltage after charging
- Current at the charging start
- Current at the charging end
- Charging duration
- Temperature

After the charging process is over the battery condition is rated. Faulty batteries are identified and marked as faulty according to the program used.

6.5.1.1.4 Maintenance (=Operation type 4)

This program serves to analyze the condition of the battery that the user of the UL 10 is unaware of. This program enables:
- To achieve the maximum possible power
- To determine fitness of a battery for further use
- To re-charge the battery for further use.

The battery type is selected in 7 stages. The user is guaranteed failure-free operation of the battery after it is checked. The batteries need periodic servicing and maintenance. Such maintenance is performed using operations type 4.

6.5.1.1.5 Charging with direct current (=operation type 5)

The operator selects the charging with direct current and the charging time.

6.5.1.1.6 Charging with direct voltage (=operation type 8)

In this type of operation the device UL10 can be used for both, with and without the connected battery as a direct voltage source.

Without the battery = (battery type 00)
The device operates as a source of voltage of direct current with a power 40 V / 40 A. The voltage and current can be set in steps 0.01 V / 0.01 A.

With the battery = (battery type 10-31)
If the battery type >0 is selected the device automatically switches over to the optimal direct voltage selected for the battery in order to ensure its prolonged charging without affecting the battery's characteristics.

6.6 Types of batteries

The data of the main types of batteries are pre-installed in the UL 10device. Other types of batteries can also be checked and they can be charged using the available types.

- **00**: the battery is not connected
- **10**: air-tight aircraft lead acid electrolyte-filled batteries
- **11**: Pb battery sealed commercial
- **16**: Pb battery vented commercial
- **20**: enclosed aircraft nickel-cadmium batteries
- **21**: enclosed nickel-cadmium batteries type VARTA
- **30**: enclosed nickel-cadmium batteries type SAFT
- **31**: enclosed nickel-cadmium batteries type NKBN

The following types of operations can be used:

- **0:** Discharge
- **1:** In service
- **2:** Charge
- **4:** Maintenance
- **5:** I-Charge
- **8:** U-Charge

6.7 Programming Matrix

The above types of operations (0-8) and the 6 types of batteries (00-31) enable up to 43 possible combinations of different charging programs.

BA Type / Operation	00	10	11	16	20	21	30	31
0	-	10	11	16	20	21	30	31
1	-	110	111	116	120	121	130	131
2	-	210	211	216	220	221	230	231
4	-	410	411	416	420	421	430	431
5	-	510	511	516	520	521	530	531
8	800	810	811	816	820	821	830	831

The program for the battery type SAFT and НКБН is executed upon customer's request. The above programs have no emergency program disable function. The operations should be used extremely cautiously. See additional information about individual programs.

6.8 Input of battery data

The charging program by the UL 10 device depends on the entered data of batteries and the selected operation type. The data is required about the type and the battery parameters for the entered data to enable proper execution of the program.

6.8.1 General

When inputting the battery type and parameters the operation type is selected and the program is assigned automatically that the UL10 device should use. For proper execution of programs the data is needed about the composition of the connected battery.

6.8.2 Operation without battery P:00

When there is no battery (the battery is at 00) only one operation type 8 is possible, or the device is enabled just as a source of direct current voltage.
There is an option «the battery is not connected + discharge» = program 000. In this case the final discharge voltage and final current are indicated.
This program is disabled; it is enabled by an additional request from the customer because there is a risk of ruining the battery.

6.8.3 Operation without Lead acid batteries

The information below relates to aluminum types of batteries with the data input starting with 1x.
Below is the full list of the types in question:

- Type 10: air-tight aircraft lead acid electrolyte-filled batteries
- Type 11: standard air-tight lead acid electrolyte-filled batteries
- Type 16: standard enclosed lead acid electrolyte-filled batteries

After the type is selected with the keys 4 and 6 it is confirmed by hitting Enter↵ and the operation type is to be entered.
For lead acid batteries all methods of maintenance can be used. For example, when "maintenance of air-tight aircraft lead acid batteries" is selected hit 6 and proceed to the required operation type, confirm by hitting Enter. The LED message is:

P 410:	**PARAMETER INPUT**	
	NOMINAL VOLTAGE	**00 0V**

The input of parameters
Nominal voltage

The battery nominal voltage should be entered. It is shown on the next tag. It is 12 V usually. The UL 10 device can be used for connecting several batteries in series in exceptional cases.

Batteries with different nominal capacities should be not connected to the mains in series.

Note:
The lead acid batteries consist, as a rule, of several batteries each with 2 V voltages.
The following are standard:

- the battery 2 V
- the battery 6 V
- the battery 12 V
- the battery 24 V

The device approves the input of the data as multiples of 2.0 V, otherwise the data are rejected as false.
The input voltage is confirmed by hitting ENTER↵. The LED reads:

P 420:	**PARAMETER INPUT**	
	RATED CAPACITY	**000.0Ah**

Input of parameters
nominal capacity

The nominal capacity in Ampere/hours (Ah) characterizes the physical value of an individual battery that determines the current magnitude to which it is possible to charge or discharge it. The label can also have an indication of power. Depending on the input of discharge current magnitude the batteries of a similar design can be discharged to different powers. The following rule applies: the higher the selected discharge current the lower is the output power of the battery.

The aircraft lead acid batteries are often designed for a 5-hour discharge.

The capacities of other batteries are calculated depending on their application and the effective standard of discharge current within a range 10 to 100 hours. This is provided for the types of batteries in the memory. After the capacity is input (with steps of 0.1 Ah) it is confirmed by hitting ENTER↵ and the start menu appears:

P 410:	**PARAMETER INPUT**
1 = START	**P = WITH PRINT 0 = NEW**

(0) the device returns to the main menu to select:

- the battery type and
- the operation type

(1) starts the checking process from the first stage of the program : discharge by 5-hour current. The protocol is not printed out usually. Still it can be printed out at any moment of time by hitting the key (P).

During the first print-out the lacking data are requested:

- the battery number
- the operator identification number

and the last data input appears as a tentative setting.
After the input is confirmed by hitting ENTER↵ the protocol is printed out together with its relevant heading.

The subsequent print-outs can be produced by hitting the key (P) once again. The reference «Additionally printed out» is printed in the acknowledgement and the current parameters are indicated.

6.8.4 Operation with nickel-cadmium batteries

The information below relates to all types of batteries with the data input beginning with 2x and 3x. Below is the list of the types in question:

- Type 20: enclosed aircraft nickel-cadmium batteries
- Type 21: enclosed nickel-cadmium batteries type VARTA
- Type 30: enclosed nickel-cadmium batteries type SAFT
- Type 31: enclosed nickel-cadmium batteries type NKBN

After the battery type is selected with the keys ← → and confirmed by hitting the key ENTER↵ the type of operation should be selected.
Any type of operation can be entered.
For example let us select the type 4: a enclosed aircraft nickel-cadmium battery. The LED reads:

P 420: PARAMETER INPUT
NUMBER OF CELLS 00 CELLS

Input of parameters
The number of cells

For the nickel-cadmium battery the number of batteries should be indicated and the battery voltage is calculated by the device.

Note:
The nominal voltage of a nickel-cadmium battery is 1.2 V. The voltage 1.55 V is selected to charge it fully. Unlike the lead acid batteries the nickel-cadmium batteries have sometimes a nonstandard number of batteries.

The standard number of batteries
5 cells 5 x 1.2 V = battery 6 V
10 cells 10 x 1.2 V = battery 12 V
20 cells 20 x 1.2 V = battery 24 V

An example of the non-standard number
2 cells in portable lamps – 2.4 V
4 cells in portable lamps – 4.8 V
6 cells in piles of batteries for electric drills – 7.2 V
8 cells in piles of batteries for electric drills – 9.6 V
11 cells in piles of batteries for video recorders – 13.2 V
19 cells – special aircraft batteries
26 cells aircraft / guided flying missile Cormoran

Note:
It means that any input of the data and the number of nickel-cadmium batteries requires **utmost caution** not to damage a battery.

Because of flexible data input the UL 10 is a perfect tool to charge and maintain batteries with uncommon configurations of cells that masks the risk of their improper use!

The maximum tolerable input of the number of cells is 26 (in the program 31:25) that correspond to the maximum:

- nominal voltage 31.2 V and
- final charge voltage 40.3 V

To avoid false calculation the user should input just the number of batteries and hit ENTER↵.
To determine the maximum currents the battery capacity is indicated in Ah.

P 420:	**PARAMETER INPUT**	
	RATED CAPACITY	**000.0Ah**

Input of parameters
nominal capacity

After the capacity is entered and confirmed by hitting ENTER↵ the start menu appears

P 420: PROGRAM START
1 = START P = WITH PRINT 0 = NEW

- **(**0) or (V) the device returns to the main menu.
- (1) Starts the process of checking with the first stage– discharge with the nominal current during 6 minutes. The key P is hit to print out the protocol.

The additional data
- the battery number
- the user identification number

are input or confirmed by hitting the key ENTER↵.

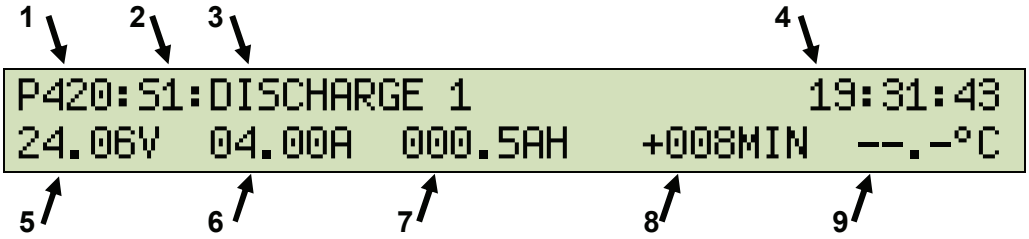
After the key P is hit and the additional data are input the process of checking of each battery starts. The print-out reads:
- the battery number
- the operator identification number

An intermediate print-out is made by hitting P once again. If the start key is pressed on the positive probe of the measuring cable the voltages of individual batteries are registered.

6.9 Readings on the LC display of program data 420

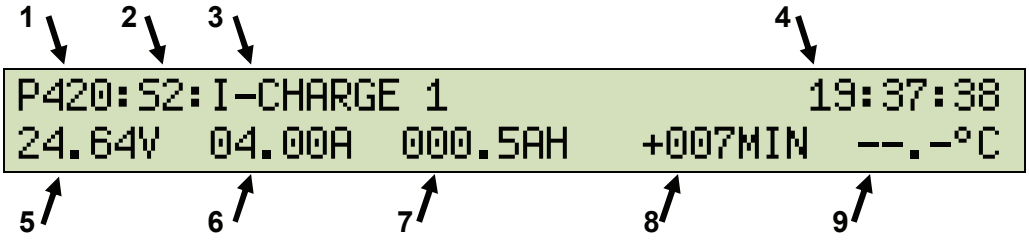
For enclosed nickel-cadmium aircraft batteries = type 20 according to requirements VG 95 238 T 110 BS with the nominal voltage 24 V and nominal capacity 4 Ah the check cycle = the operation type should be selected by the key 4. Hence, after input of special data and confirmation by hitting the key P the program # 420 is started.

6.9.1 Program 420 Stage 1



1	Program number Operation type Battery type	 4 = maintenance 20 = enclosed aircraft nickel-cadmium battery
2	number stage a	= Stage 1
3	stage name	= discharge 1
4	19:31:43	= current time
5	24,06V	= current battery voltage
6	04.00A	= current discharge current The discharge current of the enclosed nickel-cadmium aircraft battery C is equal to the nominal capacity (A), i.e. the current that discharges the battery capacity 4 Ah fully within one 1 hour. This current is 4 A.
7	000.5Ah	= the current discharge capacity at the moment of print out
8	+008MIN	Maintenance program # 4 for aircraft batteries stage 1 provided for discharge duration of 6 minutes during which the check current C should flow. It is 4 A in this case.
9	--,- °C	= the temperature measurement is disabled. The relevant protocol print-out shows the same data in addition to the data of the operator and also the current time. The protocol is drawn up automatically at the end of stage 1 when the remaining charging time is -00:00:00.

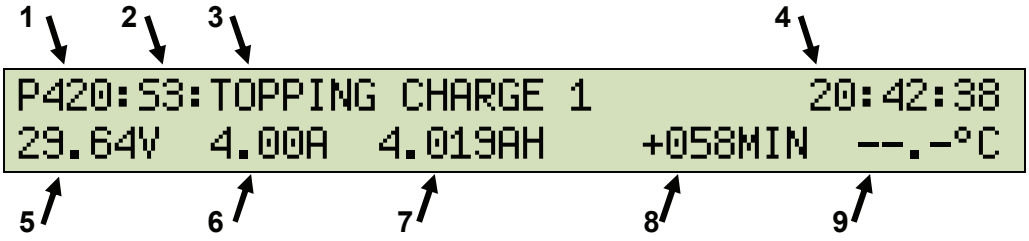
6.9.2 Program 420 stage 2



1	Program number	
	operation type	4 = maintenance
	battery type	20 = enclosed aircraft nickel-cadmium battery
2	stage number	= Stage 2
3	stage name	= I-Charge 1
4	19:37:38	= current time
5	24,64V	= current battery voltage
6	04.00A	= current charging current

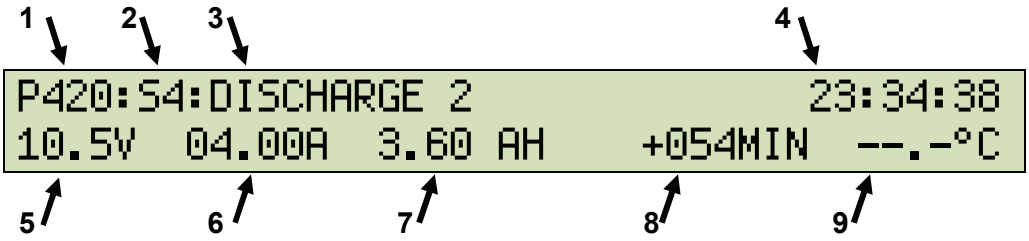
The charging current in this program of checking of the aircraft nickel-cadmium battery restores the nominal capacity during 1 h. 4 A is for the battery with 4Ah.

6.9.3 Program 420 stage 3



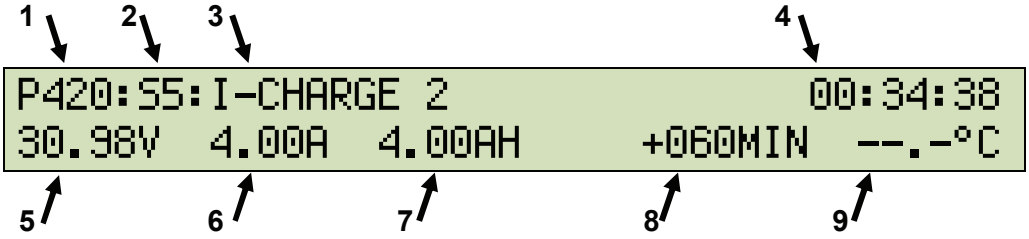
1	Program number operation type battery type	 4 = maintenance 20 = enclosed aircraft nickel-cadmium battery
2	stage number	= Stage 3
3	stage name	= topping charge 1
4	20:42:38	= current time
5	29.64 V	= current battery voltage. No charging voltage limits at the 31 V level.
6	04.00 A	= current charging current Extra charging with the 10-hour current 4 Ah/10 h = 0.4 A during 2 hours. This stage serves to equalize voltages of Individual batteries
7	4.019 Ah	The capacity indication continues. The capacity charged with direct current is 1 plus the capacity after extra charging1.

6.9.4 Program 420 stage 4



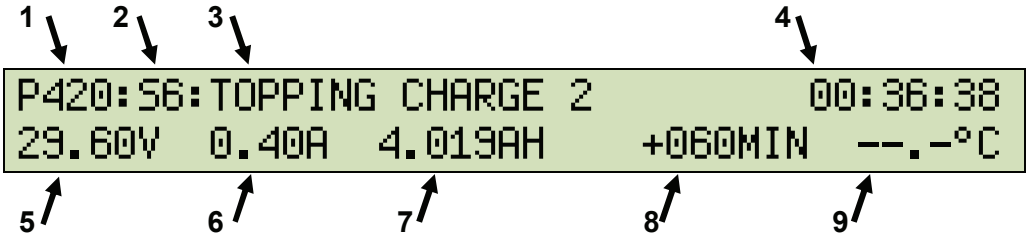
1	Program number operation type battery type	 4 = maintenance 20 = enclosed aircraft nickel-cadmium battery
2	stage number	= Stage 4
3	stage name	= discharge 2
4	23:34:38	= current time
5	10.5 V	= current battery voltage
6	4.0 A	= current discharge current The Discharge current of the aircraft nickel-cadmium battery is equal to the nominal capacity 1 C (A), i.e. the current is selected that discharges the battery with the capacity 4 Ah fully within 1 hour. This current is 4 A.
7	3.6 Ah	= at the moment of prints-out of the currently selected capacity
8	0054 MIN	When the discharge is 2 the battery is discharged with a on hour current 4A until the voltage of the battery reaches 0.5 V/battery, i.e. up to 10 V.
9	--, -oC	= the temperature measurement is disabled. The available printed out protocol shows the same data, the identification data of the operator and the time when it is made. At the end of stage 4, when the cut-off voltage of 10 V is reached, the protocol is prepared automatically.

6.9.5 Program 420 stage 5



1	Program number	
	operation type	4 = maintenance
	battery type	20 = enclosed aircraft nickel-cadmium battery
2	stage number	= Stage 5
3	stage name	= I-Charge 2
4	00:34:38	= current time
5	30.98 V	= current voltage battery
6	4.0 A	= charging current The charging current in this program of checking of the aircraft nickel-cadmium battery restores the nominal capacity within 1h. It is 4 A for the battery with 4Ah.
7	4.00 Ah	The discharged capacity in Ah after 60 minutes
8	0060 MIN	The indication of charging time with the positive sign (the forward counting).

6.9.6 Program 420 stage 6



1	Program number	
	operation type	4 = maintenance
	battery type	20 = enclosed aircraft nickel-cadmium battery.
2	stage number	= Stage 6
3	stage name	= topping charge 2
4	00:36:38	= current time
5	29.6 V	= current battery voltage
6	0.40 A	= current charging current The charging voltage grows and can exceed 31 V. Because of this all the batteries reach the final charging voltage. The capacities of the cells equalize. Extra charging 2 with the current 0.4 A (1/10 of the nominal capacity) is supplied into the cells for 90 minutes.
7	4.019 Ah	The capacity counting continues. The main charging plus extra charging. The total is 4 Ah + 2 minutes of 0.4 A = 0.019 Ah; the total is 4.019 Ah.
8	0060 MIN	Indication of the charging time. After 75 min a beep sounds.

a) the voltage of the cells should measured with the measuring cable.
b) distilled water should be added into the batteries.

7 Tabulated program progress display

7.1 Program 0. Discharge – any battery type

Stage name			Maximum duration
Program number			0
Operation number			0
Operation type		Discharge time and final voltage after discharge	Discharge
Battery type			all
Manufacturing process			all
Access to valves			All types
Battery type			0
Minimum battery capacity			0.4
Maximum battery capacity			200 Ah
Minimum battery voltage			1.2
Maximum battery voltage			31.2
Maximum number of batteries in a battery			26
Stage 1 (S1)	Discharge	Current = x (A)	x=0,01 – 40
Stage 1 (S1)	Discharge	Discharge depth V/battery	1.5
Stage 1 (S1)	Discharge	Time	**t=1min – 999min**

7.2 Program 10. Discharge – air-tight aircraft lead acid battery

Stage name				Maximum duration
Program number			**10**	
Operation number			**0**	
Operation type			Discharge	
Battery type			Lead acid Manufacturing process Gel / absorbed electrolyte	
Access to valves			unavailable	
Battery type			**10**	
Minimum battery capacity			**2** A**h**	
Maximum battery capacity			**200** A**h**	
Minimum battery voltage			**2**	
Maximum battery voltage			**30**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Discharge	Current = xC (A)	**x=0.2** max	6 h
Stage 1 (**S1**)	Discharge	Discharge depth V/battery	**1.5**	
Stage 1 (**S1**)	Discharge	Time	**t=1min – 999min**	

7.3 Program 11. Discharge – Pb battery sealed commercial

Stage name				Maximum duration
Program number			**11**	
Operation number			**0**	
Operation type			Discharge	
Battery type			Lead acid	
Manufacturing process			Gel / absorbed electrolyte	
Access to valves			unavailable	
Battery type			**11**	
Minimum battery capacity			**2** A**h**	
Maximum battery capacity			**200** A**h**	
Minimum battery voltage			**2**	
Maximum battery voltage			**30**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Discharge	Current = xC (A)	**x=0.2** Max	6 h
Stage 1 (**S1**)	Discharge	Discharge depth V/battery	**1.5**	
Stage 1 (**S1**)	Discharge	Time	**t=1min– 999min**	

Note: the program is similar to program 10

7.4 Program 16. Discharge – Pb battery vented commercial

Stage name				Maximum duration
Program number			**16**	
Operation number			**0**	
Operation type			Discharge	
Battery type			Lead acid	
Manufacturing process			Liquid electrolyte	
Access to valves			Open	
Battery type			**16**	
Minimum battery capacity			**10**	
Maximum battery capacity			**400** A**h**	
Minimum battery voltage			**2**	
Maximum battery voltage			**30**	
Maximum number of batteries in a battery			**15**	
Stage 1 (**S1**)	Discharge	Current = xC (A)	**x=0.1**	max 10 h
Stage 1 (**S1**)	Discharge	Discharge depth V/battery	**1.5**	
Stage 1 (**S1**)	Discharge	Time	**t=1min – 999min**	

7.5 Program 20. Discharge – enclosed aircraft nickel-cadmium battery

	Stage name			**Maximum duration**
Program number			**20**	
Operation number			**0**	
Operation type			Discharge	
Battery type			Nickel-cadmium	
Manufacturing process			Fused electrodes	
Access to valves			Open	
Battery type			**20**	
Minimum battery capacity			**4** A**h**	
Maximum battery capacity			**50** A**h**	
Minimum battery voltage			**1.2**	
Maximum battery voltage			**31.2**	
Maximum number of batteries			**26**	
Stage 1 (**S1**)	Discharge	Current = xC (A)	**x= 1**	max 1.2 h
Stage 1 (**S1**)	Discharge	Discharge depth V/battery	**1**	
Stage 1 (**S1**)	Discharge	Time	**t=1min – 999min**	

Programs 21, 30 are identical to program 20

7.6 Program 31. Discharge – enclosed aircraft nickel-cadmium battery

Stage name			Maximum duration
Program number			**31**
Operation number			**0**
Operation type			Discharge
Battery type			Nickel-cadmium
Manufacturing process			Fused electrodes
Access to valves			Open
Battery type			**20**
Minimum battery capacity			**4** A**h**
Maximum battery capacity			**50** A**h**
Minimum battery voltage			**1.2**
Maximum battery voltage			**31.2**
Maximum number of batteries			**26**
Stage 1 (**S1**)	Discharge	Current = xC (A)	**x= 0.4**
Stage 1 (**S1**)	Discharge	Discharge depth´V/battery	**1**
Stage 1 (**S1**)	Discharge	Time	**t=1min – 999min**

7.7 Program 110. Commissioning – air-tight aircraft lead acid battery

	Stage name			Maximum duration
Program number			**110**	
Operation number			**1**	
Operation type			Commissioning	
Battery type			Lead acid	
Manufacturing process			Gel / absorbed electrolyte	
Access to valves			unavailable	
Battery type			**10**	
Minimum battery capacity			**2 Ah**	
Maximum battery capacity			**200 Ah**	
Minimum battery voltage			**2 V**	
Maximum battery voltage			**30 V**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Discharge	Discharge current a =xC (A)	x= 0.2	
Stage 1 (**S1**)	Discharge	Discharge depth V/battery	1,5	
		Discharge voltage	<1.5 V	Error Message Use program 410
Stage 2 (**S2**)	I-Charge	Current = xC (A)	x= 0.4	8h
Stage 2 (**S2**)	I-Charge	Umax = V/battery	2.4	8h
Stage 3 (**S3**)	U-Charge	Umax = V/battery	2.4	8h
Stage 3 (**S3**)	U-Charge	Ia = xC (A)	x= 0.04	8h

Note: when the maximum output current of the device is exceeded the maximum time parameters change accordingly.

7.8 Program 111. Commissioning – Pb battery sealed commercial

Stage name				Maximum duration
Program number			**111**	
Operation number			**1**	
Operation type			Commissioning	
Battery type			Lead acid	
Manufacturing process			Gel / absorbed electrolyte	
Access to valves			unavailable	
Battery type			**11**	
Minimum battery capacity			**2 Ah**	
Maximum battery capacity			**200 Ah**	
Minimum battery voltage			**2 V**	
Maximum battery voltage			**30 V**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Discharge	Discharge current = xC (A)	x= 0.2	
Stage 1 (**S1**)	Discharge	Discharge depth V/battery	1.5	
		Discharge voltage	<1,5 V	Error message. Use program 410!
Stage 2 (**S2**)	I-Charge	Current = xC (A)	x= 0,36	8h
Stage 2 (**S2**)	I-Charge	Umax = V/battery	2.4	8h
Stage 3 (**S3**)	U-Charge	Umax = V/battery	2.4	8h
Stage 3 (**S3**)	U-Charge	Ia = xC (A)	x= 0.04	8h

Note: when the maximum output current of the device is exceeded the maximum time parameters change accordingly.

7.9 Program 116. Commissioning – Pb battery vented commercial

Stage name				Maximum duration
Program number			**116**	
Operation number			**1**	
Operation type			Commissioning	
Battery type			Lead acid	
Manufacturing process			Liquid electrolyte	
Access to valves			open	
Battery type			**16**	
Minimum battery capacity			**10 Ah**	
Maximum battery capacity			**400 Ah**	
Minimum battery voltage			**2 V**	
Maximum battery voltage			**30 V**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Discharge	The electrolyte is filled		20 min or Enter
Stage 2 (**S2**)	Discharge	Discharge current a =xC (A)	0.2	
Stage 2 (**S2**)	Discharge	Discharge depth V/battery	1.5	
Stage 2 (**S2**)		Voltage	< 1,5 V	Error message. Use program 416!
Stage 3 (**S3**)	I-Charge	Current = xC (A)	X= 0.2	8µ
Stage 3 (**S3**)	I-Charge	Umax = V/battery	2.4	8µ
Stage 4 (**S4**)	U-Charge	Umax = V/battery	2.4	8µ
Stage 4 (**S4**)	U-Charge	Ia = xC (A)	x= 0.04	8µ

Note: when the maximum output current of the device is exceeded the maximum time parameters change accordingly.

7.10 Program 120. Commissioning – enclosed aircraft nickel-cadmium battery

Stage name				**Maximum duration**
Program number			**120**	
Operation number			**1**	
Operation type			Commissioning	
Battery type			Nickel-cadmium	
Manufacturing process			Fused electrodes	
Access to valves			Open	
Battery type			**20**	
Minimum battery capacity			**4 Ah**	
Maximum battery capacity			**50 Ah**	
Minimum battery voltage			**1.2 V**	
Maximum battery voltage			**31.2 V**	
Maximum number of batteries			**26**	
Stage 1 (**S1**)	Precharge	Current = xC (A)	x **= 1**	
Stage 1 (**S1**)	Precharge	Umax = V/battery	**1.55**	max 1 h
Stage 2 (**S2**)	Discharge 1	Discharge current a = xC (A)	x **= 1**	
Stage 2 (**S2**)	Discharge 1	Discharge depth V/battery	**1**	about 30 min
Stage 3 (**S3**)	I-Charge 1	Current = xC (A)	x**= 1**	
Stage 3 (**S3**)	I-Charge 1	Umax = V/battery	**1.55**	about 60 min
Stage 4 (**S4**)	Topping charge 1	Current = xC (A)	x **= 0.2**	90 min
, Stage 5 (**S5**)	Discharge 2	Discharge current a = xC (A)	x **= 1**	
Stage 5 (**S5**)	Discharge 2	Discharge depth V/battery	**1**	about 60 min
Stage 6 (**S6**)	I-Charge 2	Current = xC (A)	x**= 1**	
Stage 6 (**S6**)	I-Charge 2	Umax = V/battery	**1.55**	about 60 min
Stage 7 (**S7**)	Topping charge 2	Current = xC (A)	x **= 0.2**	90 min
Stage 7 (**S7**)	Topping charge 2	Electrolyte level equalization	**Sound signal**	75 min

Program 121, 130 and 131 are similar to program 120.

7.11 Program 210. Charging – air-tight aircraft lead acid battery

Stage name				Maximum duration
Program number			**210**	
Operation number			**2**	
Operation type			Charging	
Battery type			Lead acid	
Manufacturing process			Gel / absorbed electrolyte	
Access to valves			Open	
Battery type			**10**	
Minimum battery capacity			**2 Ah**	
Maximum battery capacity			**200 Ah**	
Minimum battery voltage			**2 V**	
Maximum battery voltage			**30 V**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Precharge	For voltages < 2.25 V/battery Umax = V/battery	2.4	2 h
Stage 1 (**S1**)	Precharge	Ia = xC (A)	0.36	2 h
Stage 2 (**S2**)	I-Charge	I = xC (A)	0.36	8 h
Stage 2 (**S2**)	I-Charge	Umax = V/battery	2.4	8 h
Stage 3 (**S3**)	U-Charge	Umax = V/battery	2.4	8 h
Stage 3 (**S3**)	U-Charge	I a= xC (A)	0.02	8 h
Stage 4 (**S4**)	U-Charge	U = V/battery	2.4	2 h

Note: when the maximum output current of the device is exceeded the maximum time parameters change accordingly.

7.12 Program 211. Charging – Pb battery sealed commercial

Stage name				Maximum duration
Program number			**211**	
Operation number			**2**	
Operation type			Charging	
Battery type			Lead acid	
Manufacturing process			Gel / absorbed electrolyte	
Access to valves			unavailable	
Battery type			**11**	
Minimum battery capacity			**2 Ah**	
Maximum battery capacity			**200 Ah**	
Minimum battery voltage			**2 V**	
Maximum battery voltage			**30 V**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Precharge	For voltages < 2.25 V/battery Umax = V/battery	2.4	2 h
Stage 1 (**S1**)	Precharge	Ia = xC (A)	0.36	2 h
Stage 2 (**S2**)	I-Charge	Current = xC (A)	0.36	8 h
Stage 2 (**S2**)	I-Charge	Umax = V/battery	2.4	8 h
Stage 3 (**S3**)	U-Charge	Umax = V/battery	2.4	8 h
Stage 3 (**S3**)	U-Charge	I a= xC (A)	0.02	8 h
Stage 4 (**S4**)	U-Charge	Voltage = V/battery	2.4	2 h

Note: when the maximum output current of the device is exceeded the maximum time parameters change accordingly.

7.13 Program 216. Charging – Pb battery vented commercial

	Stage name			Maximum duration
Program number			**216**	
Operation number			**2**	
Operation type			Charging	
Battery type			Lead acid	
Manufacturing process			Liquid electrolyte	
Access to valves			open	
Battery type			**16**	
Minimum battery capacity			**10 Ah**	
Maximum battery capacity			**400 Ah**	
Minimum battery voltage			**2**	
Maximum battery voltage			**30**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Precharge	For voltages > 2.25 V/battery Umax = V/battery	2,4	6 h
Stage 1 (**S1**)	Precharge	Ia = xC (A)	0,25	6 h
Stage 2 (**S2**)	I-Charge	Current = xC (A)	0,25	8 h
Stage 2 (**S2**)	I-Charge	Umax = V/battery	2,4	8 h
Stage 3 (**S3**)	U-Charge	Umax = V/battery	2,4	8 h
Stage 3 (**S3**)	U-Charge	I a= xC (A)	0,04	8 h
Stage 4 (**S4**)	U-Charge	U = V/battery	2,4	2 h

Note: when the maximum output current of the device is exceeded the maximum time parameters change accordingly.

7.14 Program 220. Charging – aircraft nickel-cadmium battery

Stage name				Maximum duration
Program number			**220**	
Operation number			**2**	
Operation type			Charging	
Battery type			Nickel-cadmium	
Manufacturing process			Fused electrodes	
Access to valves			Open	
Battery type			**20**	
Minimum battery capacity			**4 Ah**	
Maximum battery capacity			**50 Ah**	
Minimum battery Voltage			**1,2 V**	
Maximum battery Voltage			**31,2 V**	
Maximum number of Batteries			**26**	
Stage 1 (**S1**)	I-Charge 1	Current = xC (A)	x **= 1**	72 min
Stage 1 (**S1**)	I-Charge 1	Umax = V/battery	**1.55**	72 min
Stage 2 (**S2**)	Topping charge 1	I a= xC (A)	x **= 0.2**	90 min
Stage 2 (**S2**)	Topping charge 1	Electrolyte level equalization	**Sound signal**	75 min

7.15 Program 221. Charging – aircraft nickel-cadmium battery VARTA

Stage name				Maximum duration
Program number			**220**	
Operation number			**2**	
Operation type			Charging	
Battery type			Nickel-cadmium	
Manufacturing process			Fused electrodes	
Access to valves			Open	
Battery type			**20**	
Minimum battery Capacity			**4 Ah**	
Maximum battery Capacity			**50 Ah**	
Minimum battery Voltage			**1,2 V**	
Maximum battery Voltage			**31,2 V**	
Maximum number of Batteries			**26**	
Stage 1 (**S1**)	I-Charge 1	Current = xC (A)	x **= 1**	72 min
Stage 1 (**S1**)	I-Charge 1	Umax = V/battery	**1.55**	72 min
Stage 2 (**S2**)	Topping charge 1	I a= xC (A)	x **= 0.2**	120 min
Stage 2 (**S2**)	Topping charge 1	Electrolyte level equalization	**Sound signal**	105 min

7.16 Program 230. Charging – aircraft nickel-cadmium battery type SAFT

Stage name				Maximum duration
Program number			**230**	
Operation number			**2**	
Operation type			Charging	
Battery type			Nickel-cadmium	
Manufacturing process			Fused electrodes	
Access to valves			open, SAFT Co.	
Battery type			**30**	
Minimum battery capacity			**4 Ah**	
Maximum battery capacity			**50 Ah**	
Minimum battery voltage			**1,2 V**	
Maximum battery voltage			**31,2 V**	
Maximum number of batteries			**26**	
Stage 1 (**S1**)	I-Charge 1	Current = xC (A)	x **= 1**	
Stage 1 (**S1**)	I-Charge 1	Umax = V/battery	**1.57**	
Stage 2 (**S2**)	Topping charge 1	I a= xC (A)	x **= 0.1**	240 min
Stage 2 (**S2**)	Topping charge 1	Electrolyte level equalization	**Sound signal**	225 min

7.17 Program 231. Charging – aircraft nickel-cadmium battery type НКБН

Stage name				Maximum duration
Program number			**231**	
Operation number			**2**	
Operation type			Charging	
Battery type			Nickel-cadmium	
Manufacturing process			used plates	
Access to valves			open, type НКБН	
Battery type			**31**	
Minimum battery capacity			**2 Ah**	
Maximum battery capacity			**50 Ah**	
Minimum battery voltage			**1.2 V**	
Maximum battery voltage			**31.2 V**	
Maximum number of batteries			**25**	
Stage 1 (**S1**)	I-Charge 1	Current = xC (A)	x **= 0.4**	180 min
Stage 1 (**S1**)	I-Charge 1	Umax = V/battery	**unlimited**	
Stage 2 (**S2**)	Topping charge 1	I a= xC (A)	**0.2**	120 min
Stage 2 (**S2**)	Topping charge 1	Electrolyte level equalization	**Sound signal**	105 min

Note: this program can only be used with discharged batteries!

7.18 Program 410. Maintenance – air-tight aircraft lead acid battery

Stage name				Maximum Duration
Program number			**410**	
Operation number			**4**	
Operation type			Maintenance	
Battery type			Lead acid	
Manufacturing process			Gel / absorbed electrolyte	
Access to valves			Unavailable	
Battery type			**10**	
Minimum battery capacity			**2 Ah**	
Maximum battery capacity			**200 Ah**	
Minimum battery voltage			**2**	
Maximum battery voltage			**30**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Discharge	Discharge current a = xC (A)	0.2	6 h
Stage 1 (**S1**)	Discharge	Discharge depth V/battery	1.5	6 h
Stage 2 (**S2**)	Precharge	Voltage charginga Umax = V/battery	2.4	2 h
Stage 2 (**S2**)	Precharge	Current = xC (A)	X=0.4	2 h
Stage 3 (**S3**)	I-Charge 1	Current = xC (A)	0.4	6 h
Stage 3 (**S3**)	I-Charge 1	Umax = V/battery	2.4	6 h
Stage 4 (**S4**)	U-Charge 1	Umax = V/battery	2.4	6 h
Stage 4 (**S4**)	U-Charge 1	I a= xC (A)	0.02	6 h
Stage 4 (**S4**)	U-Charge 1	Umax = V/battery	2.4	2 h
Stage 5 (**S5**)	Discharge	Discharge current a = xC (A)	0.2	6 h
Stage 5 (**S5**)	Discharge	Discharge depth V/battery	1.5	6 h
Stage 6 (**S6**)	I-Charge 2	Current = xC (A)	0.4	6 h
Stage 6 (**S6**)	I-Charge 2	Umax = V/battery	2.4	6 h
Stage 7 (**S7**)	U-Charge 2	Umax = V/battery	2.4	6 h
Stage 7 (**S7**)	U-Charge 2	I a= xC (A)	0.02	6 h
Stage 7 (**S7**)	U-Charge 2	Umax = V/battery	2.4	2 h

Note: the program is identical to program 310
Note: when the maximum output current of the device is exceeded the maximum time parameters change accordingly.

7.19 Program 411. Maintenance – Pb battery sealed commercial

	Stage name			Maximum duration
Program number			**411**	
Operation number			**4**	
Operation type			**Maintenance**	
Battery type			Lead acid	
Manufacturing process			Gel / absorbed electrolyte	
Access to valves			Unavailable	
Battery type			**11**	
Minimum battery capacity			**2 Ah**	
Maximum battery capacity			**200 Ah**	
Minimum battery voltage			**2**	
Maximum battery voltage			**30**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Discharge	Discharge current a = xC (A)	0.2	6 h
Stage 1 (**S1**)	Discharge	Discharge depth V/battery	1.5	6 h
Stage 2 (**S2**)	Precharge	Voltage charging Umax = V/battery	2.4	2 h
Stage 2 (**S2**)	Precharge	Current = xC (A) X=	0.36	2 h
Stage 3 (**S3**)	I-Charge 1	Current = xC (A)	0.36	6 h
Stage 3 (**S3**)	I-Charge 1	Umax = V/battery	2.4	6 h
Stage 4 (**S4**)	U-Charge 1	Umax = V/battery	2.4	6 h
Stage 4 (**S4**)	U-Charge 1	I a= xC (A)	0.02	6 h
Stage 4 (**S4**)	U-Charge 1	Umax = V/battery	2.4	2 h
Stage 5 (**S5**)	Discharge	Discharge current a = xC (A)	0.2	6 h
Stage 5 (**S5**)	Discharge	Discharge depth V/battery	1.5	6 h
Stage 6 (**S6**)	I-Charge 2	Current = xC (A)	0.36	6 h
Stage 6 (**S6**)	I-Charge 2	Umax = V/battery	2.4	6 h
Stage 7 (**S7**)	U-Charge 2	Umax = V/battery	2.4	6 h
Stage 7 (**S7**)	U-Charge 2	I a= xC (A)	0.02	6 h
Stage 7 (**S7**)	U-Charge 2	Umax = V/battery	2.4	2 h

Note: the program is identical to program 311

Note: when the maximum output current of the device is exceeded the maximum time parameters change accordingly.

7.20 Program 416. Maintenance – Pb battery vented commercial

Stage name				Maximum duration
Program number			**416**	
Operation number			**4**	
Operation type			Maintenance	
Battery type			Lead acid	
Manufacturing process			Liquid electrolyte	
Access to valves			open	
Battery type			**16**	
Minimum battery capacity			**10 Ah**	
Maximum battery capacity			**400 Ah**	
Minimum battery voltage			**2**	
Maximum battery voltage			**30**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	Discharge	Electrolyte level equalization	**Sound signal**	
Stage 1 (**S1**)	Discharge	Discharge current a = xC (A)	0.05	24h
Stage 1 (**S1**)	Discharge	Discharge depth V/battery	1.5	24 h
Stage 2 (**S2**)	Precharge	Voltage charginga Umax = V/battery	2.4	2 h
Stage 2 (**S2**)	Precharge	Ia = xC (A)	X=0.25	2 h
Stage 3 (**S3**)	I-Charge 1	Current = xC (A)	X = 0.25	8 h
Stage 3 (**S3**)	I-Charge 1	Umax = V/battery	2.4	8 h
Stage 4 (**S4**)	U-Charge 1	Umax = V/battery	2.4	8 h
Stage 4 (**S4**)	U-Charge 1	I a= xC (A)	0.04	8 h
Stage 4 (**S4**)	U-Charge 1	Umax = V/battery	2.4	8 h
Stage 5 (**S5**)	Discharge	Discharge current a = xC (A)	0.05	24 h
Stage 5 (**S5**)	Discharge	Discharge depth V/battery	1.5	24 h
Stage 6 (**S6**)	I-Charge 2	Current = xC (A)	0.25	8 h
Stage 6 (**S6**)	I-Charge 2	Umax = V/battery	2.4	8 h
Stage 7 (**S7**)	U-Charge 2	Umax = V/battery	2.4	8 h
Stage 7 (**S7**)	U-Charge 2	I a= xC (A)	0.04	8 h
Stage 8 (**S8**)	U-Charge 3	Umax = V/battery	2.4	2 h

Note: when the maximum output current of the device is exceeded the maximum time parameters change accordingly.

7.21 Program 420. Maintenance – enclosed aircraft nickel-cadmium battery

	Stage name			Maximum duration
Program number			**420**	
Operation number			**4**	
Operation type			**Maintenance**	
Battery type			Nickel-cadmium	
Manufacturing process			Fused electrodes	
Access to valves			open	
Battery type			**20**	
Minimum battery capacity			**4 Ah**	
Maximum battery capacity			**50 Ah**	
Minimum battery voltage			**1,2 V**	
Maximum battery voltage			**31,2 V**	
Maximum number of batteries			**26**	
Stage 1 (**S1**)	Discharge 1	Discharge current a = xC (A)	x = 1	max. 6 min.
Stage 1 (**S1**)	Discharge 1	Discharge depth V/battery	1	max. 6 min.
Stage 2 (**S2**)	I-Charge 1	Current = xC (A)	x = 1	max. 72 min.
Stage 2 (**S2**)	I-Charge 1	Umax = V/battery	1.55	max. 72 min.
Stage 3 (**S3**)	Topping charge 1	Current = xC (A)	x = 0.1	120 min.
Stage 4 (**S4**)	Discharge 2	Discharge current a = xC (A)	x = 1	1 h
Stage 4 (**S4**)	Discharge 2	Discharge depth V/battery	0.5	1 h
Stage 5 (**S5**)	I-Charge 2	Current = xC (A)	x = 1	1 h
Stage 5 (**S5**)	I-Charge 2	Umax = V/battery	1.55	1 h
Stage 6 (**S6**)	Topping charge 2	Current = xC (A)	x = 0.2	90 min.
Stage 6 (**S6**)	Topping charge 2	Measurement of voltages of individual batteries	**Sound signal**	75 min.
Stage 6 (**S6**)	Topping charge 2	Electrolyte level equalization	**Sound signal**	75 min.

7.22 Program 421. Maintenance – enclosed aircraft nickel-cadmium battery type VARTA

Stage name				Maximum duration
Program number			**421**	
Operation number			**4**	
Operation type			Maintenance	
Battery type			Nickel-cadmium	
Manufacturing process			Fused electrodes	
Access to valves			open, type VARTA	
Battery type			**21**	
Minimum battery capacity			**4 Ah**	
Maximum battery capacity			**50 Ah**	
Minimum battery voltage			**1.2 V**	
Maximum battery voltage			**31.2 V**	
Maximum number of batteries			**26**	
Stage 1 (**S1**)	I-Charge 1	Current = xC (A)	x = 1	72 min.
Stage 1 (**S1**)	I-Charge 1	Umax = V/battery	1.55	72 min.
Stage 2 (**S2**)	Topping charge 1	Current = xC (A)	x = 0.2	120 min.
Stage 2 (**S2**)	Topping charge 1	Measurement of voltages of individual batteries	**Sound signal**	105 min.
	Break			30 min.
Stage 4 (**S4**)	Discharge	Discharge current a = xC (A)	x = 1	54 min.
Stage 4 (**S4**)	Discharge	Discharge depth V/battery	1	54 min.
Stage 4 (**S4**)	Discharge	Measurement of voltages of individual batteries	**Sound signal**	54 min.

7.23 Program 430. Maintenance – enclosed aircraft nickel-cadmium battery type SAFT

Stage name				Maximum duration
Program number			**430**	
Operation number			**4**	
Operation type			**Maintenance**	
Battery type			Nickel-cadmium	
Manufacturing process			Fused electrodes	
Access to valves			open, type SAFT	
Battery type			**30**	
Minimum battery capacity			**4 Ah**	
Maximum battery capacity			**50 Ah**	
Minimum battery voltage			**1.2 V**	
Maximum battery voltage			**31.2 V**	
Maximum number of batteries			**26**	
Stage 1 (**S1**)	I-Charge 1	Current = xC (A)	x = 1	75 min.
Stage 1 (**S1**)	I-Charge 1	Umax = V/battery	1.57	75 min.
Stage 2 (**S2**)	Topping charge 1	Current = xC (A)	x = 0.1	240 min.
Stage 2 (**S2**)	Topping charge 1	Measurement of voltages of individual batteries	**Sound signal**	225 min.
	Break			30 min
Stage 4 (**S4**)	Discharge	Discharge current a = xC (A)	x = 1	54 min.
Stage 4 (**S4**)	Discharge	Discharge depth V/battery	1	54 min.
Stage 4 (**S4**)	Discharge	Measurement of voltages of individual batteries	**Sound signal**	54 min.

7.24 Program 431. Maintenance – enclosed aircraft nickel-cadmium battery type НКБН

Stage name				Maximum duration
Program number			**431**	
Operation number			**4**	
Operation type			**Maintenance**	
Battery type			Nickel-cadmium	
Manufacturing process			Fused electrodes	
Access to valves			open, type НКБН	
Battery type			**31**	
Minimum battery capacity			**4 Ah**	
Maximum battery capacity			**50 Ah**	
Minimum battery voltage			**1.2 V**	
Maximum battery voltage			**31.2 V**	
Maximum number of batteries			**25**	
Stage 1 (**S1**)	Discharge 1	Discharge current a = xC (A)	x = 0.4	30 min.
Stage 1 (**S1**)	Discharge 1	Discharge depth V/battery	1	30 min.
	Break			30 min.
Stage 2 (**S2**)	I-Charge 1	Current = xC (A)	x = 0.4	30 min.
Stage 2 (**S2**)	I-Charge 1	Umax = V/battery	unlimited	30 min.
Stage 3 (**S3**)	Topping charge 1	Current = xC (A)	x = 0.2	120 min.
Stage 3 (**S3**)	Topping charge 1	Measurement of voltages of individual batteries	**Sound signal**	105 min

Note: this program can only be used with discharged batteries!

7.25 Program 510. Direct current charging – air-tight aircraft lead acid battery

Stage name			Maximum duration
Program number			**510**
Operation number			**5**
Operation type			Direct current charging
Battery type			Lead acid
Manufacturing process			Gel / absorbed electrolyte
Access to valves			Unavailable
Battery type			**10**
Minimum battery capacity			**2 Ah**
Maximum battery capacity			**200 Ah**
Minimum battery voltage			**2**
Maximum battery voltage			**30**
Maximum number of batteries			**15**
Stage 1 (**S1**)	I-Charge	I	**free selection**
Stage 1 (**S1**)	I-Charge	Umax = V/battery	2.4
Stage 1 (**S1**)	I-Charge	time	**free selection**

7.26 Program 511. Direct current charging – Pb battery sealed commercial

Stage name			Maximum duration
Program number			**511**
Operation number			**5**
Operation type			Direct current charging
Battery type			Lead acid
Manufacturing process			Gel / absorbed electrolyte
Access to valves			Unavailable
Battery type			**11**
Minimum battery capacity			**2 Ah**
Maximum battery capacity			**200 Ah**
Minimum battery voltage			**2**
Maximum battery voltage			**30**
Maximum number of batteries			**15**
Stage 1 (**S1**)	I-Charge	Current	**free selection**
Stage 1 (**S1**)	I-Charge	Umax = V/battery	2.4
Stage 1 (**S1**)	I-Charge	time	**free selection**

Note: the program is identical to program 510.

7.27 Program 516. Direct current charging – Pb battery vented commercial

Stage name			Maximum duration
Program number			**516**
Operation number			**5**
Operation type			Direct current charging
Battery type			Lead acid
Manufacturing process			Liquid electrolyte
Access to valves			open
Battery type			**16**
Minimum battery capacity			**10 Ah**
Maximum battery capacity			**400 Ah**
Minimum battery voltage			**2 V**
Maximum battery voltage			**30 V**
Maximum number of batteries			**15**
Stage 1 (**S1**)	I-Charge	Current	**free selection**
Stage 1 (**S1**)	I-Charge	Umax = V/battery	2.4
Stage 1 (**S1**)	I-Charge	time	**free selection**

7.28 Program 520. Direct current charging – enclosed aircraft nickel-cadmium battery

Stage name			Maximum duration
Program number			**520**
Operation number			**5**
Operation type			Direct current charging
Battery type			Nickel-cadmium
Manufacturing process			Fused electrodes
Access to valves			open
Battery type			**20**
Minimum battery capacity			**4 Ah**
Maximum battery capacity			**50 Ah**
Minimum battery voltage			**1.2**
Maximum battery voltage			**31.2**
Maximum number of batteries			**26**
Stage 1 (**S1**)	I-Charge	Current	**free selection**
Stage 1 (**S1**)	I-Charge	Umax = V/battery	**free selection**
Stage 1 (**S1**)	I-Charge	time	**free selection**

Program 521, 530 and 531 are identical.

7.29 Program 800. Constant power supply – without battery

	Stage name		Maximum duration
Program number			**800**
Operation number			**8**
Operation type			Source of voltage
Battery type			unavailable
Manufacturing process			-
Access to valves			-
Battery type			-
Minimum battery capacity			-
Maximum battery capacity			-
Minimum battery voltage			-
Maximum battery voltage			-
Maximum number of batteries			-
			Arbitrary
Stage 1 (**S1**)	voltage	**0.01, 40 V**	**max. 40 A**
Stage 1 (**S1**)	current	**0.01, 40 A**	**max. 40 V**

7.30 Program 810. Constant power supply – air-tight aircraft lead acid battery

	Stage name			Maximum duration
Program number			**810**	
Operation number			**8**	
Operation type			Source of voltage	
Battery type			Lead acid	
Manufacturing process			Gel / absorbed electrolyte	
Access to valves			Unavailable	
Battery type			**10**	
Minimum battery capacity			**2 Ah**	
Maximum battery capacity			**arbitrary**	
Minimum battery voltage			**2**	
Maximum battery voltage			**30**	
Maximum number of batteries			**15**	
Stage 1 (**S1**)	**Direct extra charging mode**	Ufloat = V/battery	**2.25**	**arbitrary**
Stage 1 (**S1**)	**Direct extra charging mode**	Imax=xC(A)	x **= 0.4**	

7.31 Program 811. Constant power supply – Pb battery sealed commercial

	Stage name			Maximum duration
Operation number			**811**	
Operation type			**8**	
Battery type			Source of voltage	
Manufacturing process			Lead acid	
Access to valves			Gel / absorbed electrolyte	
Battery type			Unavailable	
Minimum battery capacity			**11**	
Maximum battery capacity			**2 Ah**	
Minimum battery voltage			**arbitrary**	
Maximum battery voltage			**2 V**	
Maximum number of batteries			**30 V**	
Operation number			**15**	
Stage 1 (**S1**)	**Direct extra charging mode**	Ufloat = V/battery	**2.25**	**arbitrary**
Stage 1 (**S1**)	**Direct extra charging mode**	Imax=xC(A)	x **= 0.,4**	

Note: the program is identical to program 810

7.32 Program 816. Constant power supply – Pb battery vented commercial

	Stage name			Maximum duration
Operation number			**816**	
Operation type			**8**	
Battery type			Source of voltage	
Manufacturing process			Lead acid	
Access to valves			Liquid electrolyte	
Battery type			open	
Minimum battery capacity			**16**	
Maximum battery capacity			**10 Ah**	
Minimum battery voltage			**arbitrary**	
Maximum battery voltage			**2**	
Maximum number of batteries			**30**	
Operation number			**15**	
Stage 1 (**S1**)	**Direct extra charging mode**	Ufloat = V/battery	**2.25**	**arbitrary**
Stage 1 (**S1**)	**Direct extra charging mode**	Imax=xC(A)	x **= 0.25**	

7.33 Program 820. Constant power supply – enclosed aircraft nickel-cadmium battery

	Stage name			Maximum duration
Operation number			**820**	
Operation type			**8**	
Battery type			Source of current	
Manufacturing process			Nickel-cadmium	
Access to valves			Fused electrodes	
Battery type			Open	
Minimum battery capacity			**20**	
Maximum battery capacity			**4 Ah**	
Minimum battery voltage			**40 Ah**	
Maximum battery voltage			**1.2**	
Maximum number of batteries			**31.2**	
Operation number			**26**	
Stage 1 (**S1**)	**Direct current charging float**	Current=xC(A)	X**=0.025**	**arbitrary**
Stage 1 (**S1**)	**Direct current charging float**	Ufloat = V/battery	**1.55**	

8 Replacement of printing paper and ribbon

8.1 Ribbon replacement

Name: ribbon (a pack of 2 pcs.)

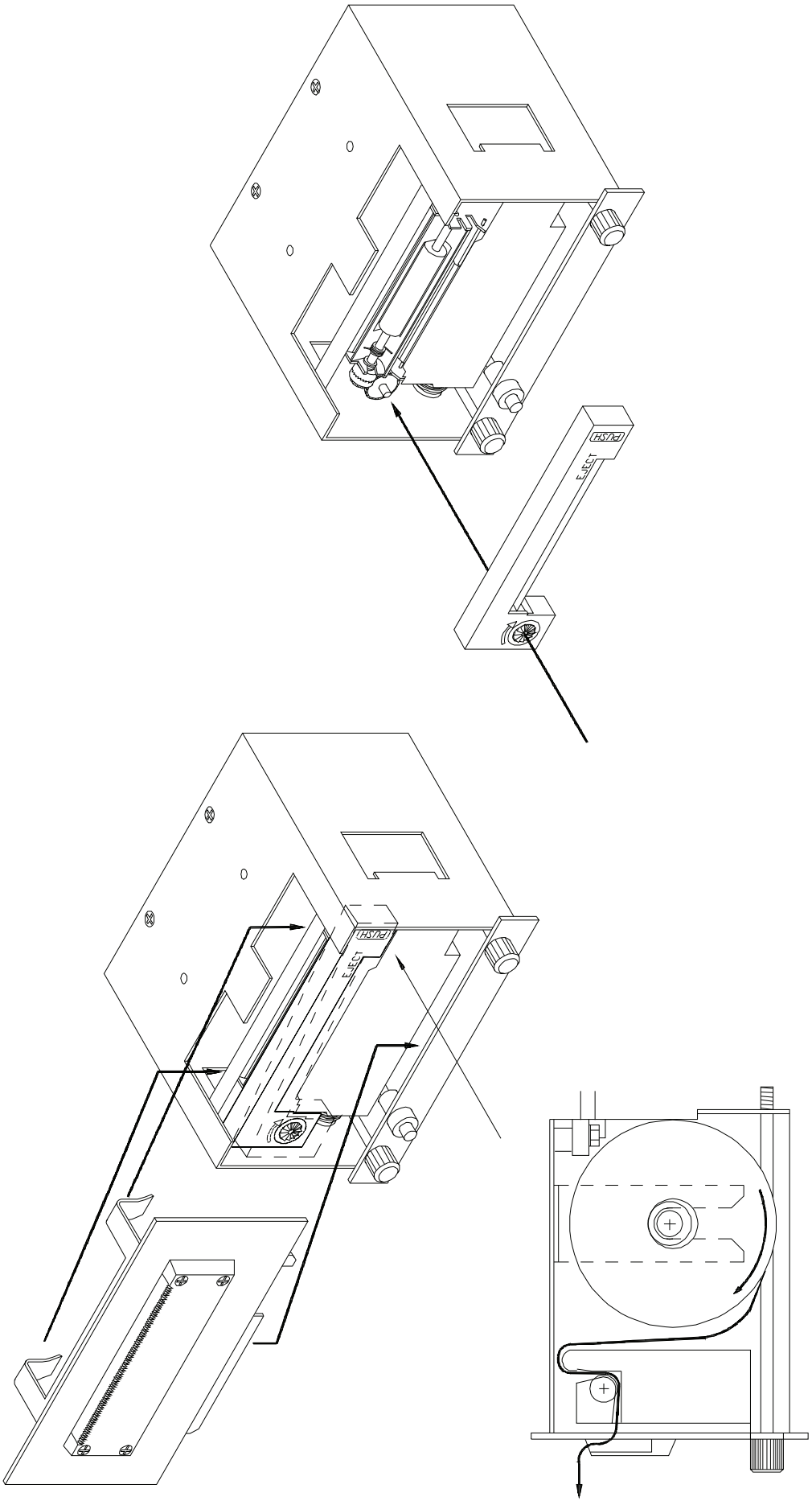
HTZ/TKZ: 101 033 111 000
The ribbon is replaced in the following procedure:
- disconnect the device 220 V from the mains
- remove 2 knurl-head screws from the head of the printer and extract it from the body
- lift the front panel of the printer and remove it
- extract the worn ribbon from the opened printer
- pull out several centimeters from the printer
- insert the paper into the ribbon and insert the ribbon by lightly pressing the printer. The position of adjustment of the printing ribbon: a free portion of the ribbon should be down, the wheel of the transfer mechanism should be leftward
- insert the front panel into the printer
- insert the printer into its body
- tighten 2 knurl-head screws
- connect the device to the 220 V mains
- perform the self-test of the printer: the printer prints a test print-out of 3 lines when the device is switched on by pressing the paper feed key
- switch off the device

8.2 Replacement of printing paper

Name: printing paper (a pack of 6 pcs.)

HTZ/TKZ: BT2000.40071
The paper is replaced in the following procedure:
- disconnect the device from the 220 V mains
- remove 2 knurl-head screws from the printer
- extract the printer from the body
- lift the front panel of the printer and remove it
- pull the ribbon out of the opened printer
- pull the used paper roll from the printer and tear the paper slightly
- pull the paper protruding from the printer in the direction of the paper feed
- insert the printing paper as it is shown on the body of the printer and move it as it is shown on the body of the printer
- insert the printer into its body
- switch on the device
- actuate the paper feed and use the free hand to insert the printing paper into the receiving slot of the printer until the paper is moved by the printer
- insert the printing paper into the ribbon and then insert the ribbon into the printer without pressure. The position of adjustment of the printing ribbon: a free portion of the ribbon should be down, the wheel of the transfer mechanism should be leftward
- insert the front panel into the printer
- insert the printer into its body
- tighten 2 knurl-head screws
- connect the device to the 220 V mains
- perform the self-test of the printer: the printer prints a test print-out of 3 lines when the device is switched on by pressing the paper feed key

- switch off the device



Protection according to DIN 34