Annex to 20-l-Apparatus 7.1

TÜV SÜD Schweiz AG (Production and Distribution)
Mattenstrasse 24, CH-4002 Basel, Switzerland
www.tuev-sued.ch products.bs@tuev-sued.ch

Cesana AG (Development and Software)
Baiergasse 56, CH-4126 Bettingen, Switzerland
www.cesana-ag.ch info@cesana-ag.ch

Authors: Christoph Cesana, Richard Siwek

Please read this note !

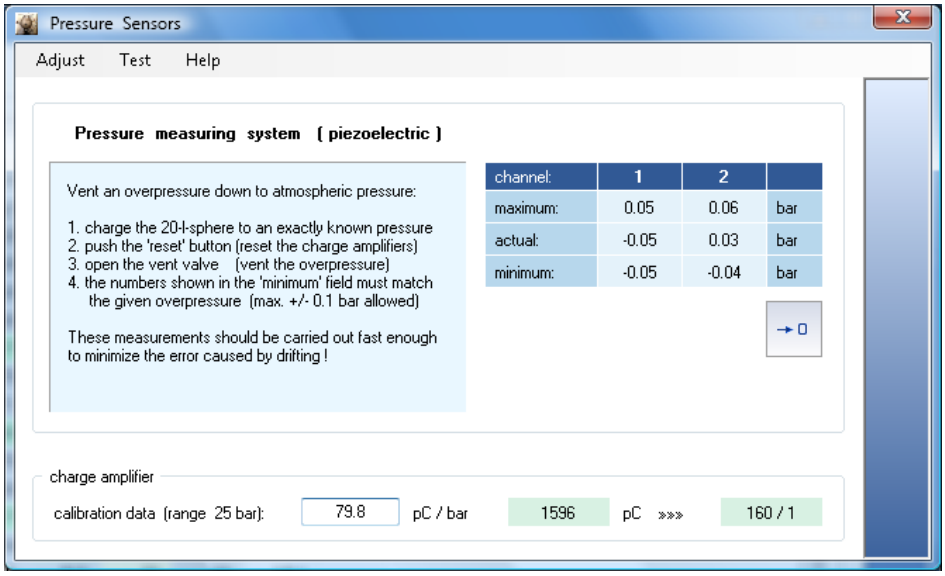
This information is helpful !

Question and answer ! What is to do, when ...

A.1 Pressure Measuring System

A.1.1 Check of Pressure Measuring System

This test program displays the actual pressure reading of both channels. The maximum and minimum values are displayed separately. Please note that piezoelectric sensor's only allow measurement of "quasi-static" pressures or pressure changes. The preferred test method is to vent a given over pressure down to atmospheric pressure. Proceed as follows:



1. Charge the 20-l-sphere to an exactly known pressure.
2. Reset the display of "maximum, minimum" and the charge amplifier reading.
3. Compare the pressure deviations between the two channels when discharging the vessel (max. +/- 0.1 bar are allowed).

These measurements should be carried out fast enough to minimize the error caused by drifting. This test is not a calibration but a function check. Ageing effects of the sensor's are negligible. As long as both channels show matching results, they are assumed to be OK.

A.1.2 Adjust offset of A/D-channels

This tool helps to compensate for the unavoidable offset error of the measuring channels. For this purpose, the charge amplifiers and the pressure sensor's have to be connected. Correction is done by subtracting the stored offset voltage from the pressure signal.

This adjustment has already been done at the factory and must only be repeated when replacing the A/D-converter chip.

A.1.3 Adjust gain of A/D-channels

1. Adjust first the offset as described above.
2. Disconnect the 5-pole cable to the charge amplifiers (on printed circuit board).
3. Connect the A/D converter reference voltage to the measuring input.
4. Adjust screen readout to 20.0 bar using the variable resistor.

This adjustment has already been done at the factory and must only be repeated when replacing the A/D-converter chip.

A.1.4 Test of A/D-channels

The input to be tested must be connected to the line recorder output by means of a reference capacitor of 220 pF (to be ordered separately). An electrical charge proportional to the linear rising output voltage will be generated across the capacitor. This simulates a linear rising pressure signal. Set the charge amplifier range to 2200 pC (220 - 1) and start the test (enter key). The following values will be checked:

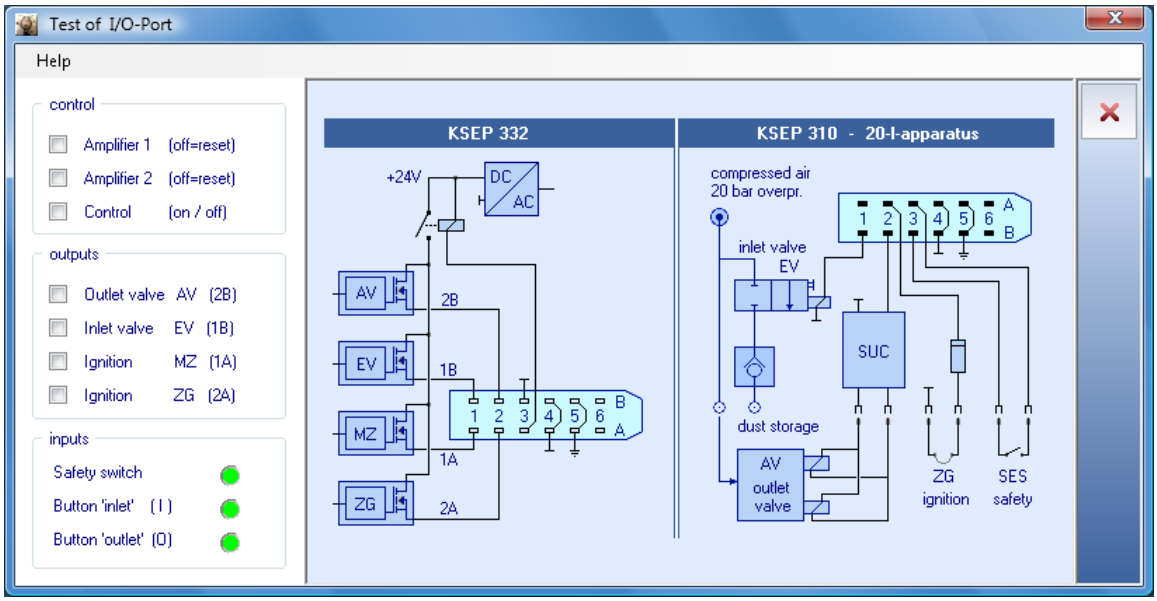
1. deviation of gain [%]	2.0
2. output of D/A [mv]	3972.5
3. input of A/D [bar]	5.12
4. stepwidth, actual	0.01
5. stepwidth, maximum	0.01
6. drift [bar/min]	0.00
7. missing codes	----------
passed	

- Deviation of gain:
  check eventually the gain settings.
- Maximum step width:
  each step corresponds to 0.01 bar. Non-linearity increase this step width.
- Maximum drift:
  during the test time of approx. 4 min., the charge amplifier is only allowed to have a certain drift. Clean all contacts and repeat the test.
- Missing codes:
  no missed positions must be displayed

This test is very sensitive regarding insulation resistance and electrical interferences. In certain circumstances, the test has to be repeated. Only a capacitor with a very high insulation resistance is suitable (e.g. a Styroflex capacitor).

A.2 Test of input / output port

This tool gives you direct access to the power outputs of the KSEP 332. These outputs can be switched on and off independently.



A.3 Analog output (recorder)

The transducer output is digitized at high resolution and stored in the KSEP 332 memory (0.2ms / 10,000 measurements per channel). The Personal Computer only receives part of it (500 measurements / channel). For test purposes the complete record of the KSEP 332 can be readout.

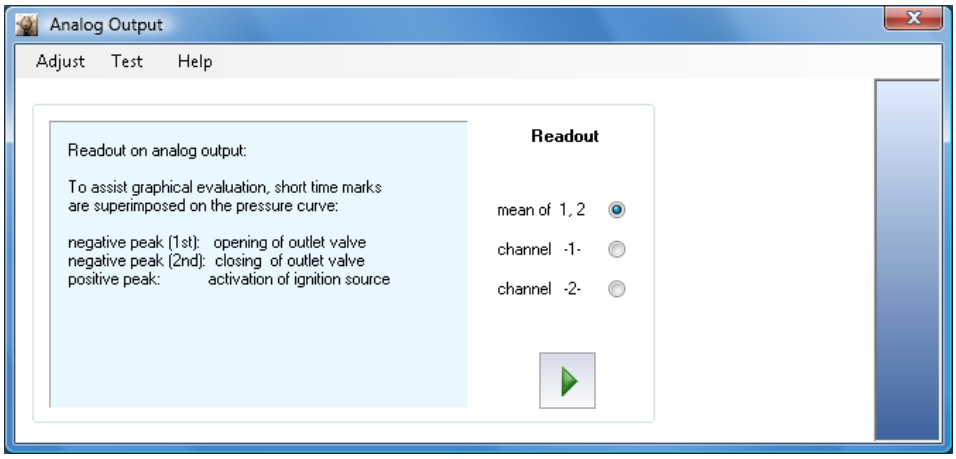
A.3.1 Adjust

Factor: this value sets the replay slow-down factor.

Span: outputs calibration voltages to the line recorder in the range of 0...5.25V corresponding to a pressure of -1 ... +20 bar at a resolution of 0.01 bar

Pen: Remote control for pen-lift and paper feed (on/off)

A.3.2 Readout



Each channel or the arithmetic mean value of both channels may be reproduced separately. To assist graphical evaluation, short time marks are superimposed on the pressure curve:

1. negative peak: opening of the outlet valve
2. negative peak: closing of the outlet valve
   positive peak: activation of the ignition source

A.4 Trouble shooting

Pressure at the moment of ignition: not 1 bar (absolute) !

- Adjust dispersion pressure to exactly 20 bar overpressure.
- Gauge on storage chamber may be defective.
- Clean the outlet valve.

Storage chamber does not hold dispersion pressure !

- Clean outlet valve; replace O-ring if necessary.

Part of the dust remains in the storage chamber !

- Adjust compressed air to exactly 20 bar overpressure.
- Clean the outlet valve.
- Dispersion system may be plugged, clean out.

Igniters not activated during normal test sequence !

- Foul contacts, clean ignition rods.
- No pressure rise in sphere

Explosion prior to correct moment of ignition !

- The dust may have caused strong electrostatic discharge.
- Insulate ignition leads.
- Clean or wrap chemical igniters.

Differences between both pressure measuring channels !

- Renew protection layer on pressure sensor’s (silicone).
- Check adjustment of charge amplifiers.
- Re calibrate pressure sensor’s.

A.5 Technical data

A.5.1 Technical data of 20-l-sphere

- Material of construction No.: 1.4435
- Wall thickness of inner jacket: min. 4 mm
- Wall thickness of outer jacket: min. 2 mm
- Volume of sphere: 20 l
- Volume of water jacket: 1.5 l
- Design pressure of sphere: 30 bar
- Design pressure of jacket: 10 bar
- Test pressure of sphere: 39 bar
- Test pressure of jacket: 14.3 bar
- Design temperature: 60 °C
- Bayonet ring aperture: 96 mm diameter
- Cleaning aperture: 140 mm diameter
- Sight glass: 30 mm diameter
- Measuring flange: 3 tapped bores M14 x 1.25
- Venting connection: hose ID. 12 mm
- Vacuum connection: Serto, 1/4" G
- Water connections: hose ID. 10 mm
- Overall dimensions (w,h,d): 650 x 875 x 820 mm
- Weight: 75 kg

A.5.2 Technical data of KSEP 310

- Compr. air connection on back: fitting: serto 1/4" G
  nominal pressure: 20 bar
  max. pressure: 30 bar
- Vacuum connection on back: fitting: serto 1/4" G
- Overall dimensions (w,h,d): 510 x 215 x 370 mm
- Weight: 13 kg

A.5.3 Technical data of KSEP 332

Control outputs (for KSEP 310 and ignition system)

Two 12-pole connectors according to DIN 41622 connected in parallel. The contacts are as follows:

- 5A, 5B: safety ground
- 4A, 4B: common and potential isolated ground return of 1A, 1B, 2A, 2B
- 3A,..3B: Safety switch (3A = plus / 3B = minus)
- 2B: Outlet valve 24V / 4A (current limited)
- 2A: Chemical igniters 24V / 4A (current limited)
- 1B: Inlet valve 24V / 0.6A (current limited)
- 1A: MIE system 24V / 0.6A (current limited)

Measuring unit

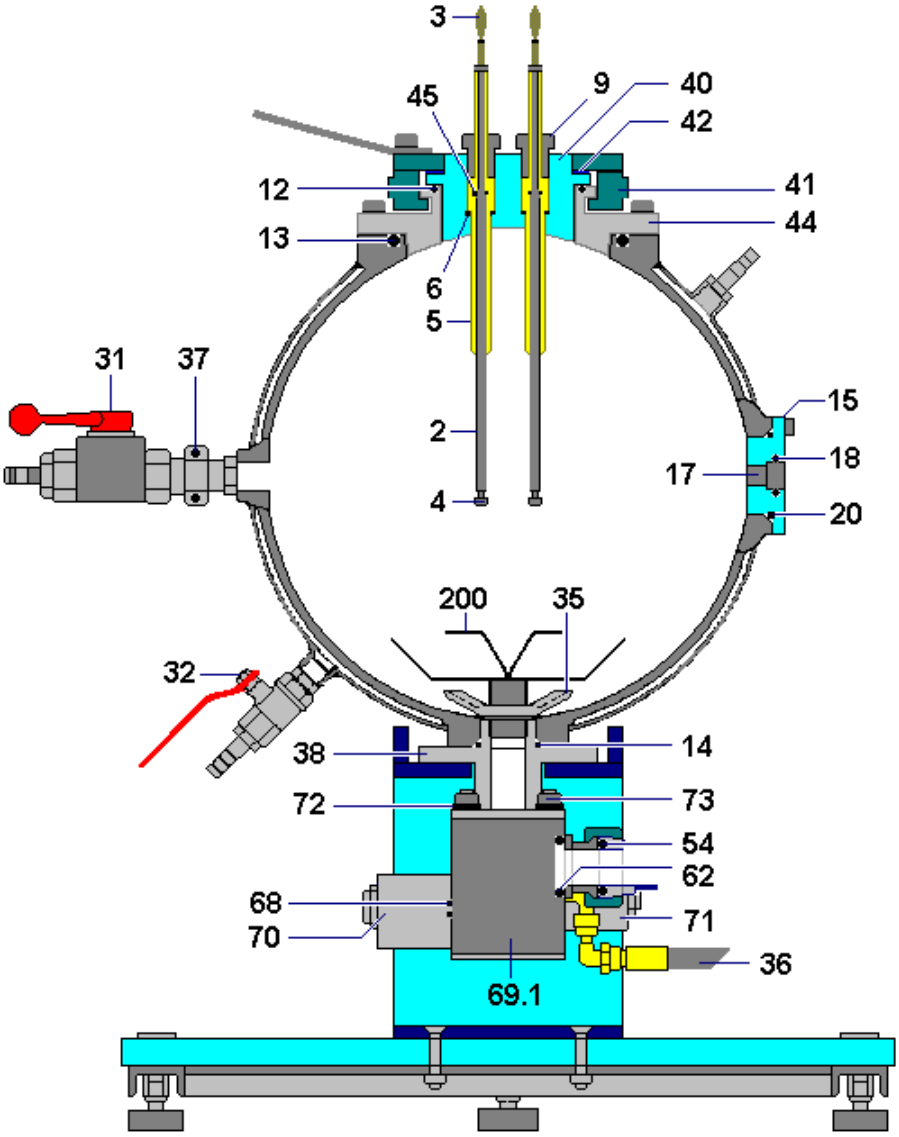
- Pressure range: +/- 20 bar
- Pressure resolution: 10 mbar
- Sampling time: 0.2 ms
- Recording time: 2.0 s
- Pressure transducer (2): Kistler Type 701A
- Charge amplifiers (2): Kistler Type 5041B
- Recorder output: 5.25V = +20 bar / 0V = -1 bar

Computer

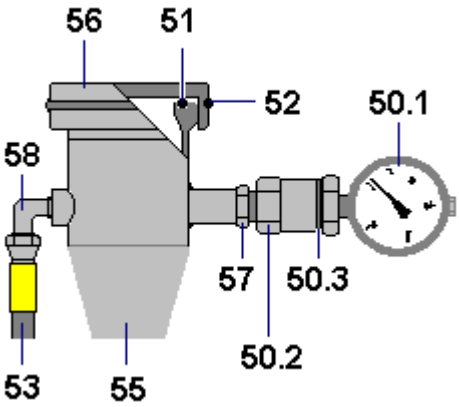
- CMOS-Microprocessor: HD64180
- Program storage: EPROM 32 Kbytes
- Data storage: static CMOS RAM 32 Kbytes
- Data protection: Lithium Battery for CMOS RAM
- Interface: RS 232: 4800, N, 8, 2
- Mains supply: 230/115V, 50/60 Hz, 110W

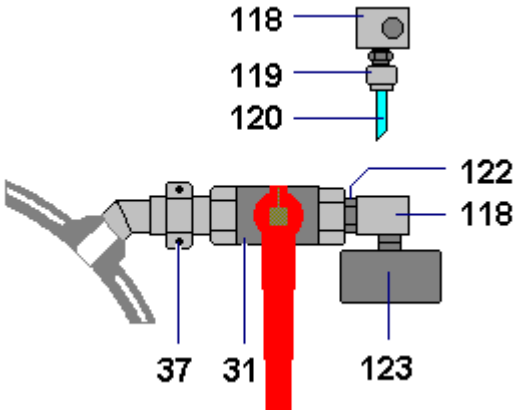
A.6 Spare parts

A.6.1 20-l-sphere

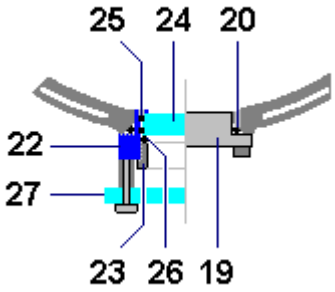


Dust storage container	Vacuum

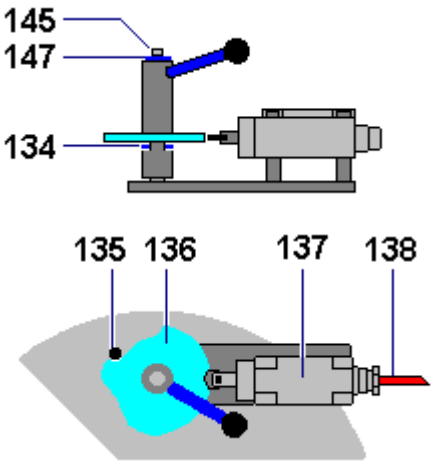




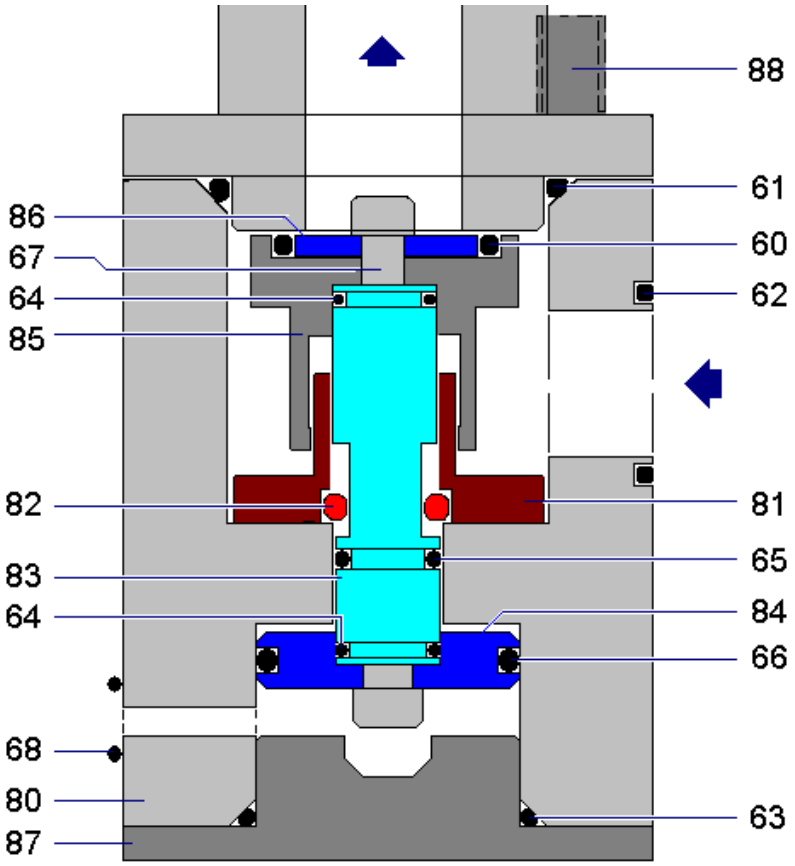
Sight glass / Flange



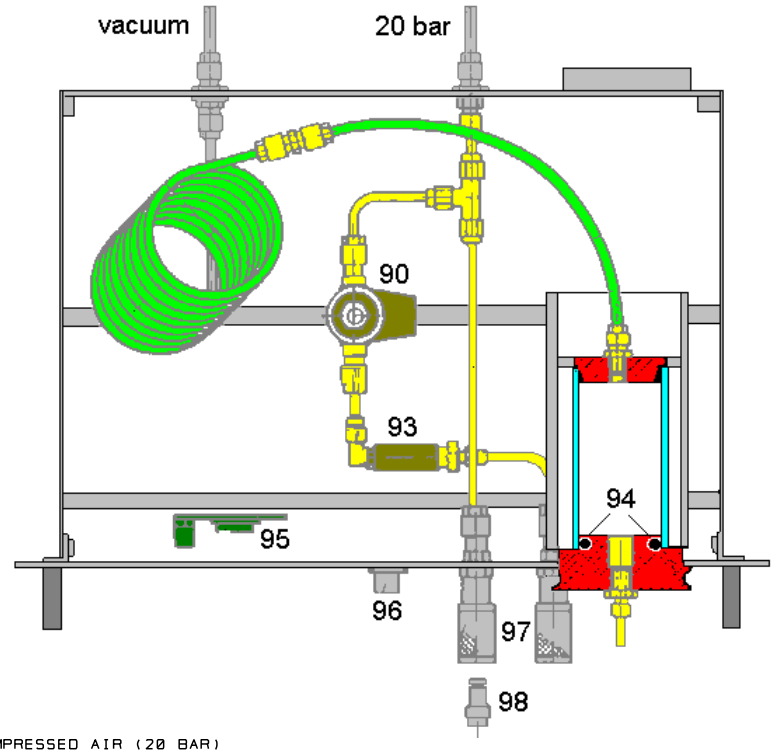
Safety

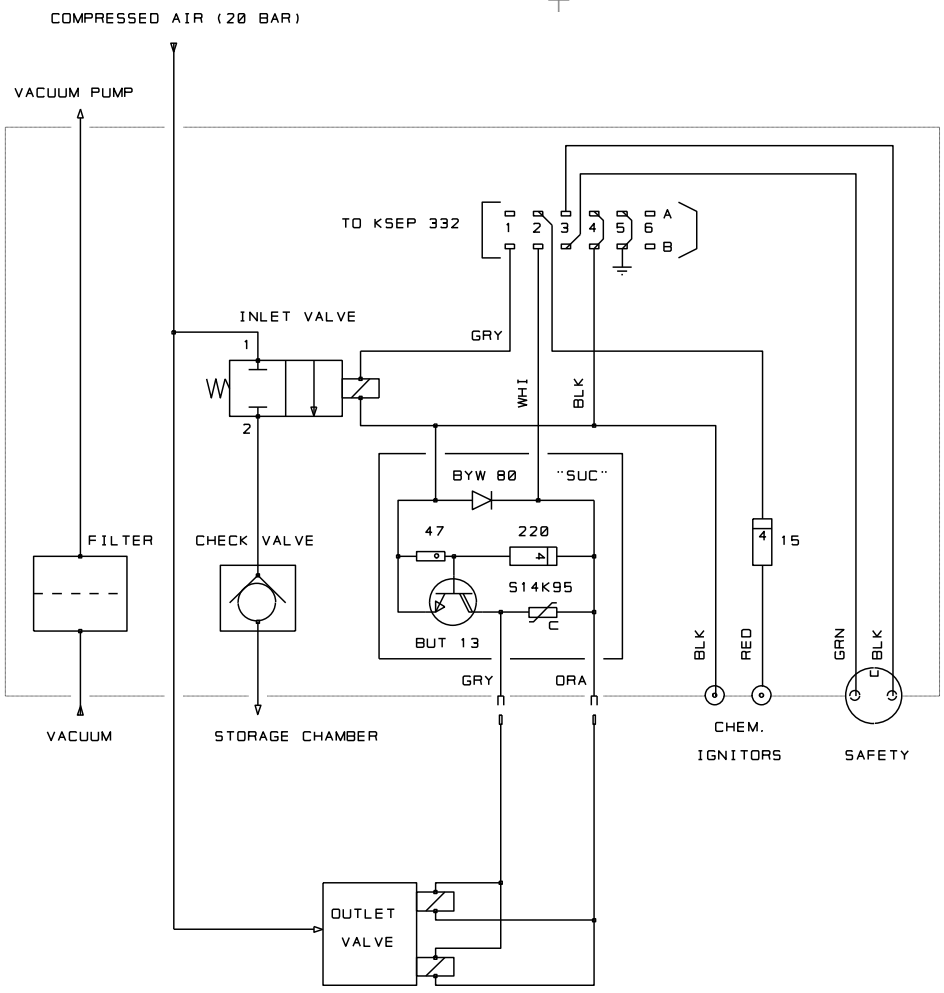


Outlet valve



A.6.2 Parts / Diagram of KSEP 310





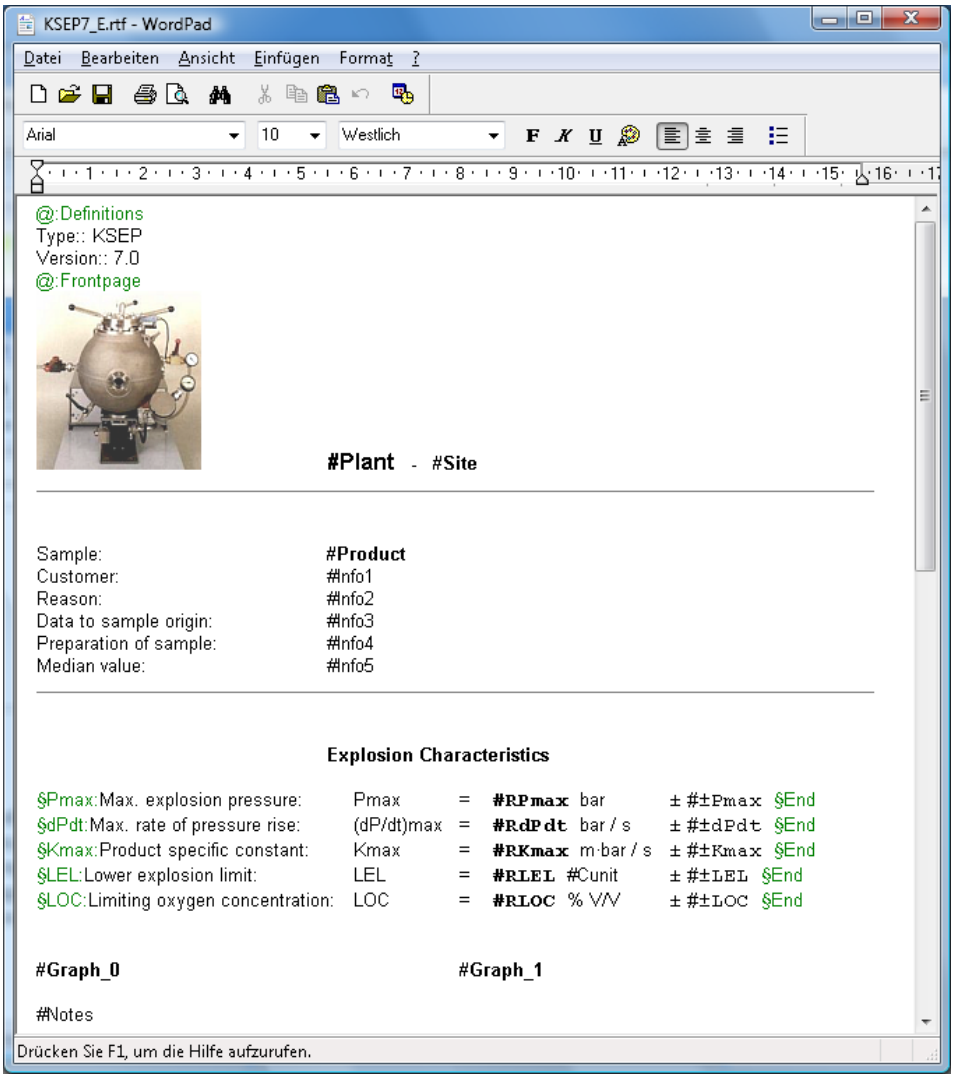
A.6.3 Spare Parts SP8xxx (number „xxx“ on drawings)

SP8000	Recommended set of spare parts
SP8001	Electrode assembly
SP8002	Rod
SP8003	Contact
SP8004	Clamping screw
SP8005	Insulator
SP8006	O-ring 14.00 x 1.78 - 015
SP8007	Electrode tips (package of 100pcs)
SP8008	Plug
SP8009	Pressure seal
SP8010	Ignition lead for chem. igniters
SP8011	Ignition lead for high voltage (pair)
SP8012	O-ring 101.19 x 3.53 - 242
SP8013	O-ring 158.12 x 5.33 - 363
SP8014	O-ring 40 x 3
SP8015	Measuring flange assembly
SP8016	Measuring flange
SP8017	Sealing screw for flange
SP8018	O-ring 15.54 x 2,62 - 114
SP8019	Solid flange
SP8020	O-ring 55.25 x 2.62 139
SP8021	Sight glass assembly
SP8022	Sight glass support
SP8023	Threaded bushing
SP8024	Sight glass 34.00
SP8025	O-ring 44.12 x 2.62 - 132
SP8026	Seal
SP8027	Protective plate assembly
SP8031	Ball valve (vent / vacuum)
SP8031.1	Repair seal set for ball valve
SP8032	Ball valve (water jacket)
SP8033	Ring nozzle assembly
SP8035	Positioning unit for pos. 8033
SP8036	Pressure line 1/8" - 1/4" 190 mm
SP8037	O-ring 21.95 x 1.78 - 020
SP8038	Lower flange
SP8040	Filler block
SP8041	Sealing ring
SP8042	Guide ring
SP8044	Upper flange
SP8045	O-ring 4.47 x 1.78 - 008
SP8050	Gauge assembly (40 bar)
SP8050.1	Gauge with pressure transfer unit
SP8050.2	Reducer with seal R 3/4" - 1/4"
SP8050.3	Seal 26.5 x 33
SP8051	O-ring 66.27 x 3.53 - 231
SP8052	O-ring 88.27 x 5.33 -341
SP8053	Pressure line 1/4" - 1/4" 450 mm
SP8054	O-ring 26.64 x 2.62 - 121
SP8055	Dust storage chamber assembly
SP8056	Cover for dust storage chamber
SP8057	Glanged nipple
SP8058	Elbow fitting
SP8059	Connector-half G 3/4"
SP8060	O-ring 28.17 x 3.53 - 216
SP8061	O-ring 47.22 x 3.53 - 225
SP8062	O-ring 30 x 2
SP8063	O-ring 40 x 3
SP8064	O-ring 11 x 2.5
SP8065	Quad ring 4111 - 366Y
SP8066	Quad ring 4219 - 366Y
SP8067	Hex socket screw M6 x 16
SP8068	O-ring 10.82 x 1.78 - 013
SP8069.1	Outlet valve assembly
SP8070	Solenoid valve type 123
SP8071	Solenoid valve type 122
SP8072	Washer
SP8073	Hex nut M10
SP8074	Hex socket screw M6 x 53
SP8075	Hex socket screw M6 x 48
SP8076	Adjustable fitting
SP8077	Elbow fitting
SP8090	Inlet valve
SP8093	Check valve 1/8"
SP8094	O-ring 44.04 x 3.53 - 224
SP8095	Speed up circuit
SP8096	Chassis socket for outlet valve
SP8097	Quick connector female
SP8098	Quick connector male
SP8118	Manifold assembly
SP8123	Vacuum gauge
SP8123.1	Vacuum gauge assembly
SP8134	Slide plate
SP8137	Safety switch
SP8148	Safety assembly
SP8200	Rebound nozzle

A.7 Report - Mask

A.7.1 Report-mask: edit / design

Aim and object of the mask is to enter repetitive text and to define all those fields in which variables (e.g. test results) should be entered automatically for the report.



The KSEP-software contains sample masks in English and German. These masks can be easily adapted to your requirements. We recommend to use the Editor-program "**WordPad**" from Microsoft.

These masks are split into several sections. Each section starts with a "@:"-code. Please do never modify this codes. All fields for variables are marked by "#"-code.

While the use of fonts designed for proportional character spacing is possible, formatting of the results table will be difficult. Therefore we recommend to use fonts with fixed character spacing (e.g. Courier New) for tables.

A.7.2 Report-mask: sections ' @: ' / variables ' # '

@:definitions	section for contents and printout	
	Type::	KSEP
	Version::	7.0

@:frontpage	section for product, final results, graphs and notes
@:tests_header	section for header of tests-table
@:tests_table	section for contents of tests-table
@:tests_footer	section for footer of tests-table
@:audit_header	section for header of audit- table
@:audit_table	section for contents of audit -table
@:audit_footer	section for footer of audit -table
@:curve	section for header of curve
@:end	end of report

global data:	
#Plant	name of your company
#Site	your lab. / your name
#Proc	test procedure
#Product	product
#File	filename
#ADate	actual date
#Graph_X	graph 0 & 1
#Funct	selected function
#XName	XPar - name
#XUnit	XPar - units
#CUnit	conc. (g/m3 or vol%)
#Info1	customer
#Info2	reason
#Info3	data to sample origin
#Info4	preparation of sample
#Info5	median value
#Notes	comments

final results:	
#RPmax	max. explosion pressure
#RdPdt	max. rate of pressure rise
#RKmax	max. explosion index K
#RLEL	lower explosion limit
#RLOC	limiting oxygen concentration
#Rt1	min. combustion time
#±Pmax	% deviation Pmax
#±dPdt	% deviation dP/dt
#±Kmax	% deviation Kmax
#±LEL	% deviation LEL
#±LOC	% deviation LOC
#t1min	% deviation [t] combustion time
audit:	
#ANr	test number
#ADate	date
#ATime	time
#ACaus	reason
#AEVT	event
#AVAL	value

single tests:	
#TNr	test number
#TSer	test number (Series)
#TConc	dust / gas concentration
#TPex	pressure
#TPm	pressure, corrected
#TdPdt	rate of pressure rise
#TPd	pressure difference
#TPi	pressure at ignition
#Ttd	delay of outlet valve
#Ttvs	ignition delay, setvalue
#Ttve	ignition delay, effective
#Tt1	duration of combustion
#Tt2	induction time
#TIE	ignition energy
#TXPar	variable parameter
#TNote	comments on tests

curve:	
#Curve	Picture curve
#CResult	result
#CNr	test number
#CSer	test number (Series)
#CConc	dust / gas concentration
#CPex	pressure
#CPm	pressure, corrected
#CdPdt	rate of pressure rise
#CPd	pressure difference
#CPi	pressure at ignition
#Ctd	delay of outlet valve
#Ctvs	ignition delay, setvalue
#Ctve	ignition delay, effective
#Ct1	duration of combustion
#Ct2	induction time
#CIE	ignition energy
#CXPar	variable parameter
#CNOTE	comments on tests