1. TABLE OF CONTENTS

2. GENERAL INFORMATION

2.1. EQUIPMENT

The K-Patents Process Refractometer consists of three parts (Figure 2.10): the Sensor (A), the Interconnecting Cable (B) and the Indicating transmitter (C). *For description of the intrinsically safe K-Patents Process Refractometer, see Chapter 12.*

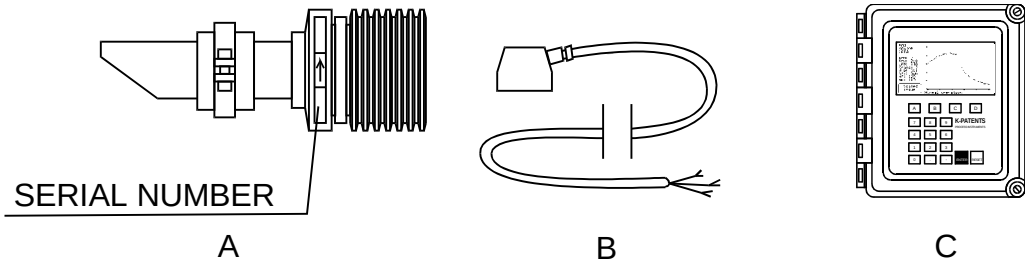


Figure 2.10 Equipment
For intrinsically safe equipment, see Figure 12.10.

The K-Patents Process Refractometer provides a 4 to 20 mA DC output signal proportional to process solution concentration. A serial output is also available as a standard.

Identification: By Serial Number (S/N) label (Figure 2.11) on the Indicating transmitter front panel and by Serial number on sensor label (Figure 2.10, Figure 2.12), e.g. 92A25-1088. The sensor type, e.g. 57, is stamped on the probe tip (Section 5.6).

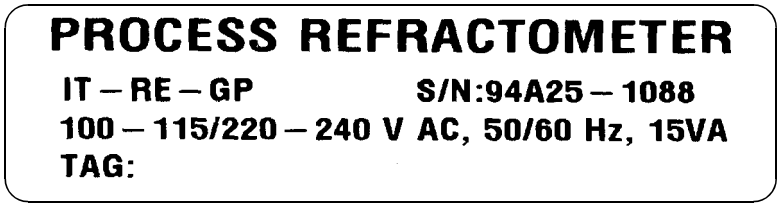


Figure 2.11 Identification label, Indicating transmitter.

Figure 2.12 Identification label, Sensor.
For intrinsically safe sensor label, see Figures 12.11, 12.12 and 12.13.

2.2. STANDARD SPECIFICATIONS

Refractive Index ranges:	Low range R.I. 1.320...1.460 High range R.I. 1.380...1.530
Max. span:	R.I. 0.08 (See Section 5.6)
Accuracy:	R.I. ± 0.0002 (corresponds typically to ± 0.1% by weight). Repeatability and stability correspond to accuracy.
Speed of response:	0.8 s undamped
Damping time constant:	Selectable up to 5 min
Process temperature:	max. 150°C (300°F), (for higher temp. consult factory)
Ambient temperature:	Sensor: max. 45°C (113°F), min. -20°C (-4°F), Indicating transmitter: max. 50°C (122°F), min. 0°C (32°F)
Process pressure:	Flange connections up to 25 bar (350 psi) Sanitary clamp max. 15 bar (200 psi) at 20 °C (70 °F)/9 bar (125 psi) at 120 °C (250 °F)
Recommended flow velocity:	above 1.5 m/s (5 ft/s)
Wetted parts:	AISI 316L stainless steel, prism gaskets Kalrez, (prism pads teflon)
Sensor weight:	Sandvik-clamp 7 kg (15 lbs)/ Flange DIN/ANSI/JIS 10.5 kg (23 lbs)
Process connection:	NS 80 (3" Sch 10s) (Sandvik clamp/Flange DIN/ANSI/JIS/Sanitary clamp)
Current output	4-20 mA/0-20 mA, max. load 1000 Ohm, Galvanic isolation 1500 V DC or AC (peak), Built-in hold function during prism wash.
Serial output:	RS485/RS232 Galvanic isolation 500 V DC or AC (peak)
Power:	100-115 V/220-240 V, 50/60 Hz, 15 VA
Interconnecting cable:	Shielded cable, 2 twisted pairs with individual shields, 0.5 mm^2. Digital transmission according to RS485.
Interconnecting cable length:	Standard 10 m (33 ft), max. 100 m (330 ft)
Indicating transmitter:	Enclosure IP66 Nema 4X
Indicating transmitter weight:	4,5 kg (10 lbs) (We reserve right to technical alterations.)
Alarms:	Two built-in signal relays, max 24V, 500 mA
Options:	- Long probe version (-LP). Probe length is 152 mm (6") longer than standard. - Wetted parts: Hastelloy C, titanium or palladium doped titanium - Cable fittings to the Indicating transmitter: European cable glands or US conduit hubs, see Section 7.3. - Built-on prism wash nozzle, see Section 8.3. - *Intrinsically Safe PR-01-S-EX/FM, see Section 12.* *BASEEFA approved EExia IIC T4 (T_{amb}=45 °C)* *Factory Mutual (FM) approved Class I, Div. 1, Groups A, B, C, D T4 (T_{amb}=45 °C)*
Accessories:	- External output unit, Section 10.1 - Digital Divert Control Unit DD-01, Section 10.2 - Retractor and isolation valve, Chapter 11. - Prism wash nozzles for steam and hot water, Section 3.4. - Flow cells according to separate drawings available from K-Patents.

Ordering information:

- Desired scale, properties of process solution
- Process temperature and pressure range
- Process flow range and pipe diameter
- Desired process connection
- Length of interconnecting cable
- Supply voltage and frequency
- Options and accessories
- User tag

2.2.1. MODEL CODE

Model and Description	Model
PR-01-S = Sensor	PR-01-S
Refractive Index range limits.....	.....
50= Low range R.I. 1.320....1.460	50
57= High range R.I. 1.380....1.530	57
Process connection.....	.....
-L = Sandvik L-clamp, 80 mm	-L
-H = Sanitary 3A-clamp, 4 inch	-H
-D = DIN-flange 2656, PN 25, DN 80	-D
-A = ANSI-flange 150 psi, 3 inch	-A
-N = ANSI-flange 300 psi, 3 inch	-N
-J = JIS-flange , 10K 80 A	-J
Sensor wetted parts material.....	.....
SS = AISI 316 L	SS
HC = Hastelloy C / ASTM C276 (b) (c)	HC
TI = Titanium / ASTM B348 (b)(c)	TI
TP = Titanium PD / ASTM B348 83GR-7 (b)(c)	TP
Electrical classification.....	.....
-GP = General purpose	-GP
-EX = BASEEFA certified for EEx ia IIC T4	-EX
-FM = FM approved IS CL.1,DIV.1 GRP.A,B,C,D T4	-FM
Sensor length.....	.....
-STD = Standard	-STD
-LPL = Long probe, insertion length 299mm (b)(e)	-LPL
-LPS = Long probe, insertion length 147mm (b)(e)	-LPS
-LPH = Retractable long probe (e)(f)(g)	-LPH
Prism wash	.....
-HPY = Integral nozzle mounting connection (b)(e)	-HPY
-HPN = Integral nozzle for water (b)(e)	-HPN
-HPS = Integral nozzle for steam (b)(e)	-HPS
-YPY = Without integral nozzle mounting connection	-YPY
Sensor options.....	.....
-JB = Junction box connection with screw termials	-JB
-SC = Stanless steel sensor housing (k)	-SC

Model and Description	Model
IT-R = Indicating transmitter	IT-R
Cable connection.....	.....
U = 1/2 inch NPT-type conduit hubs (for US)	U
E = BF11/ PG11 Cable glands (for Europe)	E
Electrical classification.....	.....
- GP = General purpose	-GP
Transmitter options.....	.....
-WR = Wash control relay unit, 2-relays	-WR
-FB = Fieldbus connection	-FB

Part Number and Description	Part No.
PR-8001 = Interconnecting cable between transmitter and sensor , incl. sensor connector	PR-8001
PR-8040 = Interconnecting cable (for -JB junction box and for Barrier Unit - IT-R connection)	PR-8040
Cable length	.....
-010 = 10 meters (33 feet), standard length	-010
- _ _ _ = Specify cable length in meters with 10 meters increments.	-_ _ _

(b) Not available with Sanitary- clamp
(c) Not available with Sandvik L-clamp
(e) AISI 316L material only
(f) Available with Sandvik L-clamp only
(g) For use with Isolation Valve HIMP-2 only
(k) Available with -JB junction box only

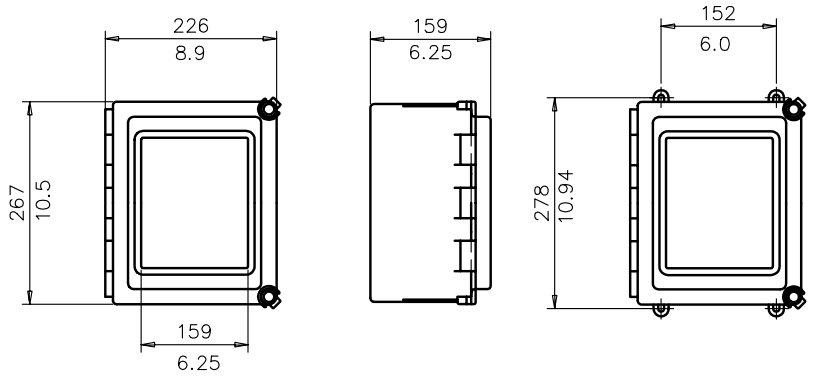


Figure 2.20 Indicating transmitter: Dimensions (mm/in) and mounting feet measures.

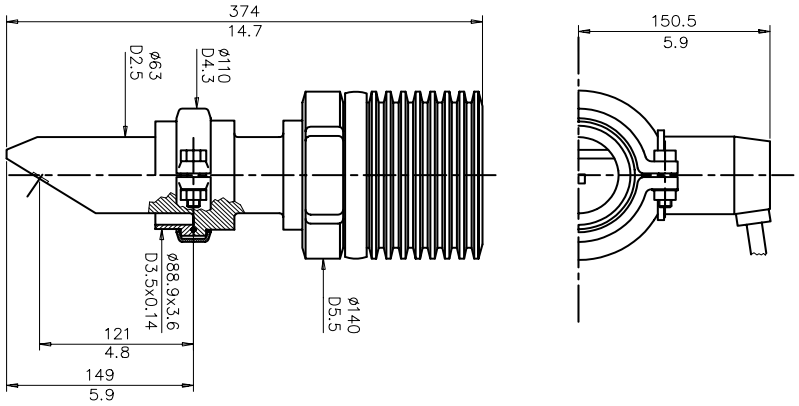


Figure 2.21 Dimensions: Sensor with Sandvik clamp (mm/in).
Note: For Sanitary clamp a separate drawing is provided.

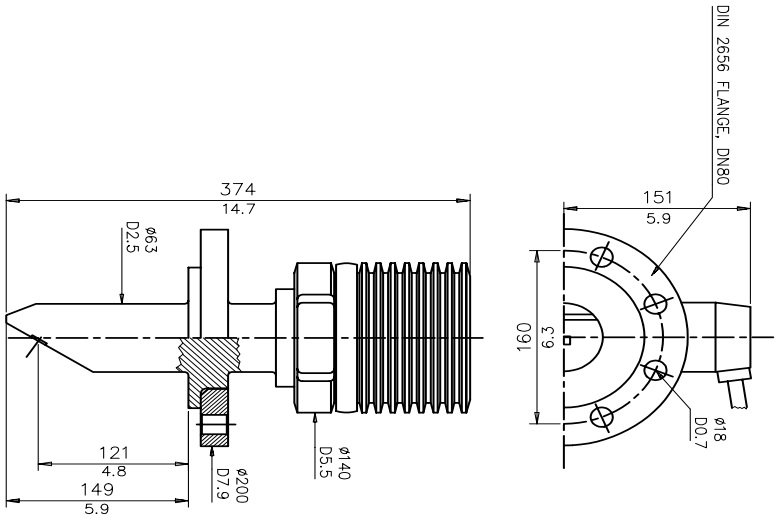


Figure 2.22 Dimensions: Sensor with flange. DIN 2656 DN 80 or ANSI B16.5 3" RF 150 PSI or JIS 1OK 80A (mm/in).

2.3. PRINCIPLE OF MEASUREMENT

The K-Patents Process Refractometer determines the refractive index (R.I) of the process solution by measuring the critical angle of refraction. The light from a light source (L) (Figure 2.30) is directed against the interface between a prism (P) and the process solution (S). The light rays meet this surface at different angles. The reflected rays form an image (ACB), where (C) is the position of the critical angle ray. The rays at (A) are totally reflected at the interface, the rays at (B) are partially reflected and partially refracted into the process solution. In this way the optical image is divided into a light area (A) and a dark area (B). The position of the borderline (C) between the areas shows the value of the critical angle and thus of the refractive index of the process solution. The refractive index normally increases with increasing concentration.

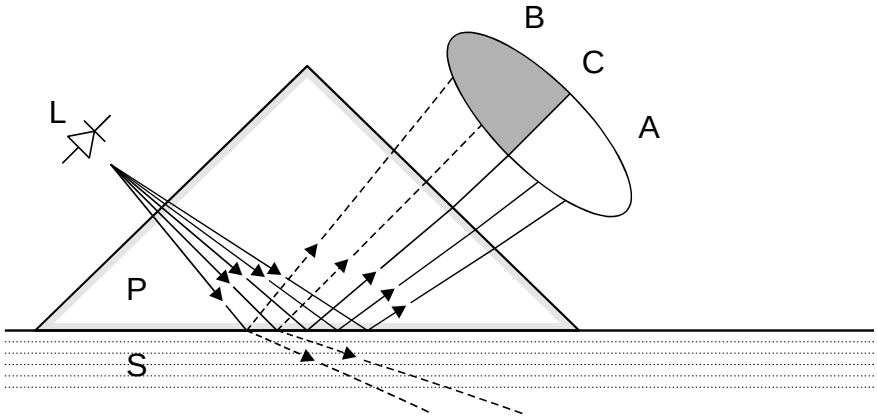


Figure 2.30 Refractometer principle.

Figure 2.31 Optical images.

From this follows that the optical image changes with the process solution concentration as shown in Figure 2.31. The optical image is converted to an electric signal by an image detector.

By this method the concentration of the solution is measured. The colour of the solution, gas bubbles or undissolved particles do not interfere with the result.

2.4. SENSOR DESCRIPTION

In the K-Patents Process Refractometer Sensor (Figure 2.40) the measurement prism (A) is flush mounted in the oblique surface near the tip. The light source (B) is a light emitting diode.

K-Patents Process Refractometer uses a digital image detector (C). The image detector consists of 256 photocells in a row integrated on one chip.

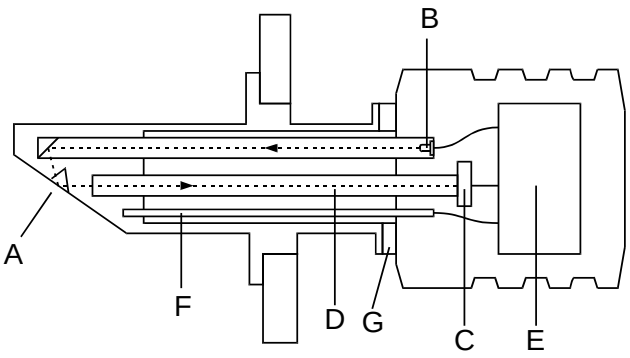


Figure 2.40 Sensor structure.

The image detector output is a pulse train as shown in Figure 2.41. This number of high pulses corresponds to the position of the shadow edge in the optical image. The number of high pulses is a direct measure of the critical angle. The image digitizer (E) transforms this pulse train to a serial digital signal. This serial signal transmits a package containing a complete description of the optical image and temperature data to the Indicating transmitter.

For automatic temperature compensation, the sensor tip contains a process temperature probe (F).

The digital image sensor (C) is separated from the process heat by fiber optics (D) and the thermal isolation (G). It is housed in the air-cooled sensor head.

a. Optical image

b. Detector window and the photocells

c. Pulse train from the detector.

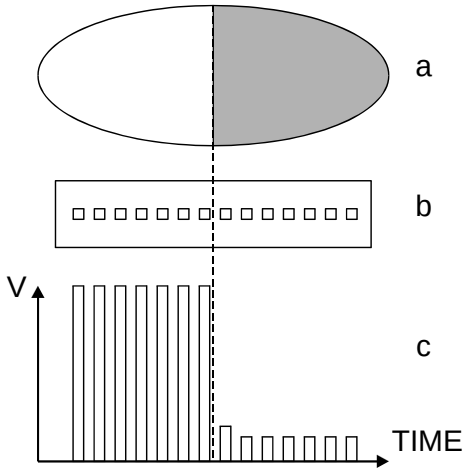


Figure 2.41 Image detector system.

2.5. THE INDICATING TRANSMITTER

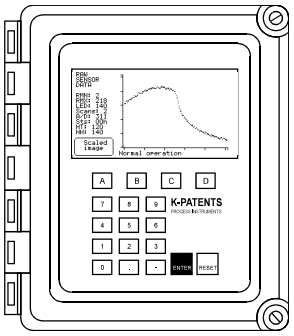


Figure 2.50 The Indicating transmitter.

The Indicating transmitter (Figure 2.50) receives a serial signal from the Sensor describing the optical image and also giving the process temperature. The microprocessor system displays the optical image (Figure 2.72) and implements an image analyzing algorithm (Figure 2.52), which identifies the exact position of the shadow edge shown in Figure 2.41.

The Indicating transmitter contains a power supply, a microprocessor system and a front panel with a Liquid Crystal Display (LCD) and a Keyboard. The output signals are a 4-20 mA concentration signal and a Serial output signal, RS232 or RS485 alternatively.

There are also two **built-in signal relays** on the power supply card inside the Indicating transmitter. These two signal relays can be configured to any relay function, except to preconditioning or wash control (described in Section 9.2). Configurations are made from the main calibration menu, see Figure 2.61. Note the default setting for the built-in signal relay 1 is No Malfunction and for the relay 2 Internal humidity above 50%. A closed contact on the relay 1 indicates that the instrument works properly. It is recommended to use this relay for alarm purpose in a control system.

The Indicating transmitter also accepts 4 input switch closures for signal HOLD or scale selection. A serial bus connects the Indicating transmitter to the external units such as Relay Unit (See Chapter 9) or External Current Unit (Section 10.1).

Unauthorized access can be prevented: Knockout padlock provisions are included in both cover latches. For password protection, see Section 2.11.

The microprocessor system linearizes the concentration reading, like in the example Figure 2.51, and performs an automatic temperature compensation.

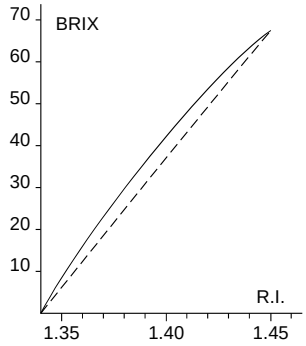


Figure 2.51 BRIX diagram.

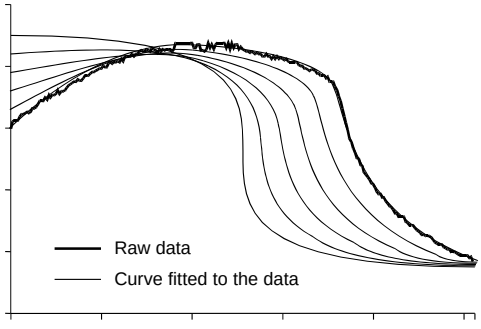


Figure 2.52 Image analyzing algorithm.

2.6. DISPLAY AND KEYBOARD

A built-in Demo program can be used for training, See Section 4.3.

The Normal Display (Figure 2.60) gives the following information:

- Concentration (large size characters) in %, g/l or other units, see Section 2.8.
- Process temperature in °C. Alternatively °F can be displayed, see Section 2.8.
- TEST value: The number of photocells at the light side in the optical image.
- Diagnostic messages like "Normal operation", see Section 6.3.
- Activated alarms
- Soft Keys: The definitions are shown above the corresponding keys A, B, C and D.

For the Normal Display Figure 2.60, pressing key A starts a prism wash cycle when a Relay Unit (Chapter 9.) is used for prism wash. If a Relay Unit is not used for that purpose, the soft key "Start prism wash" is not visible.

A timeout is set for all displays. The timeout is one hour (60 minutes) for the following displays: Diagnostics Slope, Scaled Image, Raw Sensor Data, Optical Image, Normal Display. The timeout is one minute (60 seconds) for all other displays. During the timeout the display functions the same way as pressed the “Reset” key.

The keys C and D change the Normal Display to a Calibration menu (Figure 2.81) or an Information Display (Figure 2.71) respectively.

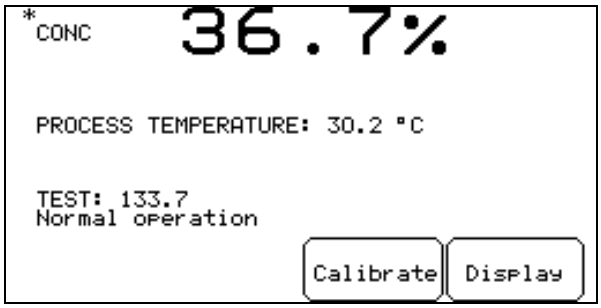
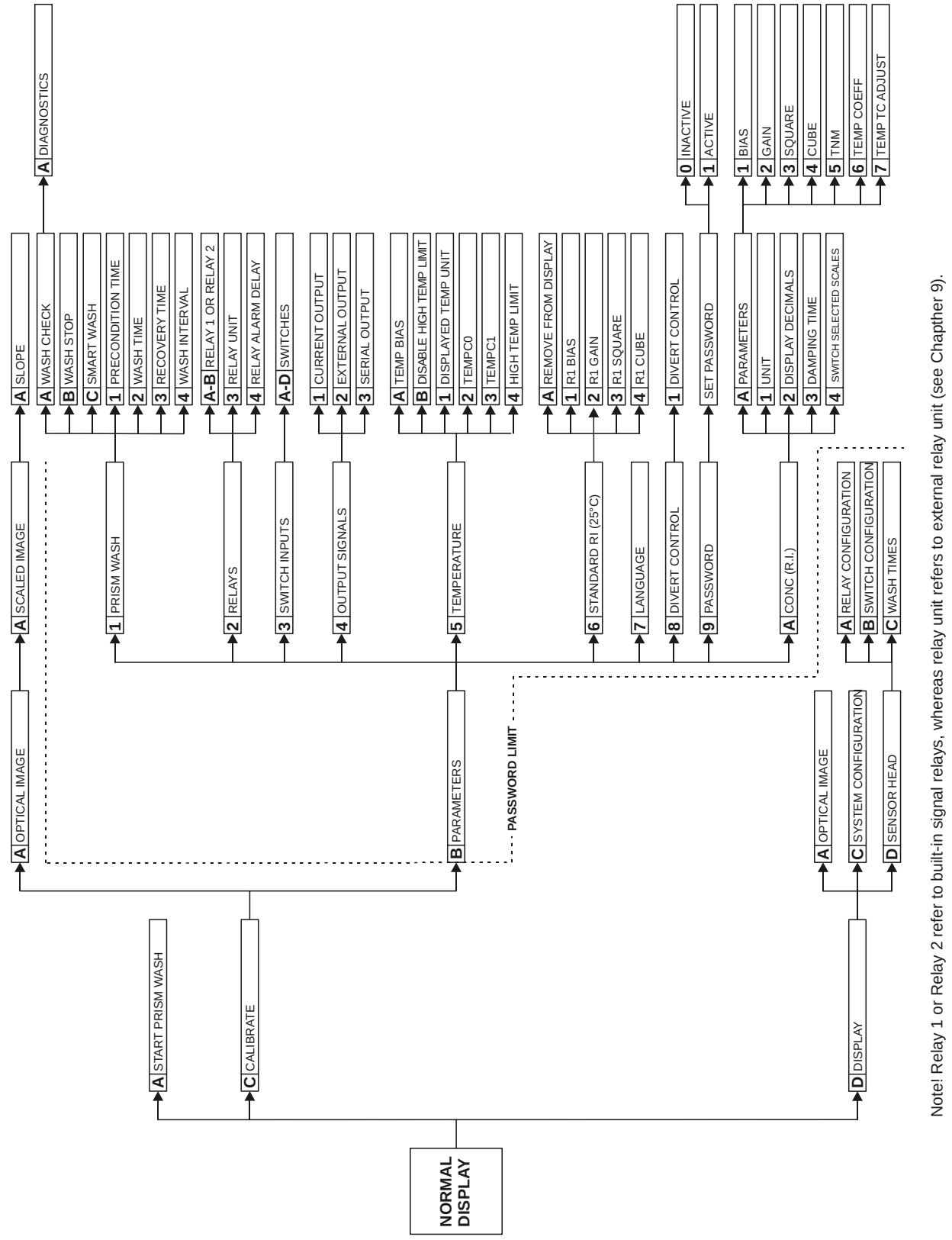


Figure 2.60 Normal Display.



Note! Relay 1 or Relay 2 refer to built-in signal relays, whereas relay unit refers to external relay unit (see Chapther 9).

Figure 2.61 The selection tree.

The selection tree:

The display selections are structured like a tree as shown in Figure 2.61. Using the soft keys (A, B, C, D) it is possible to select the next display upwards. In some cases the selection is made from a menu using a numerical key. In Figure 2.61 the Soft Key selection is indicated by letters A-D, menu selection by numbers 1-9. The display itself provides guidance to find the right path step-by-step, which minimizes the need to consult the manual.

The RESET key is used to climb down the tree, for each RESET the next display downwards is selected.

Data entry:

When "New value: _ _ _ _ " is displayed, new parameter values can be entered by the numerical keys. Erroneous numbers are erased by RESET. Press ENTER, when the number is complete. After this ENTER, as well as after any change, there appears on the display:

Press ENTER to change
(Otherwise press RESET)

2.7. INFORMATION DISPLAY

The Information Display, Figure 2.71, is selected by the soft key "Display" at the Normal Display (Figure 2.60). This "Display" branch of the selection tree is safe, because here no changes can be made to the system.

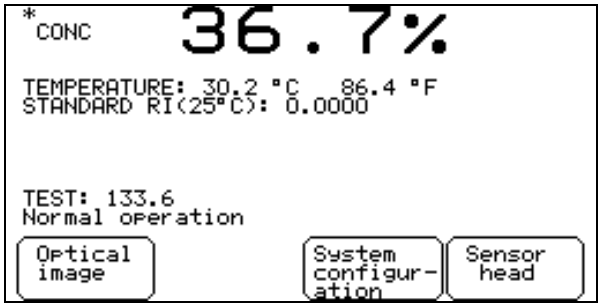


Figure 2.71 The Information Display.

The Information Display contains additional data compared to the Normal Display:

- The PROCESS TEMPERATURE in both °C and °F
- The STANDARD RI (25 °C). This shows the Refractive Index of a standard RI liquid applied to the prism, see Section 5.4.
- output current in mA

Optical image (soft key):

Shows the Optical Image, Figure 2.72. The light area (high pulses) is to the left, the dark area (low pulses) is to the right, compare to Figure 2.41. The vertical scale is 0-100 % of highest pulse amplitude, the horizontal scale expresses the numbers of the photocells 0-256. The three leftmost pulses represent additional dark reference cells.

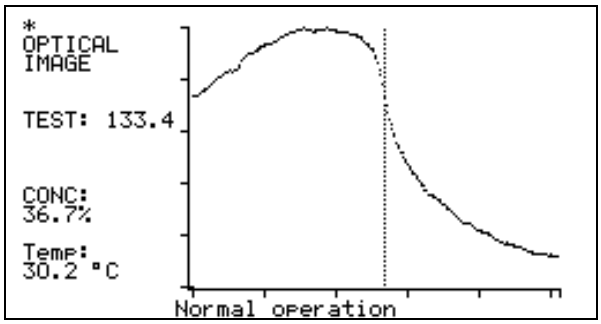


Figure 2.72 The Optical Image.

System configuration (soft key):

- Main program and sensor processor and sensor interface processor versions
- Connection and processor versions of accessory units
- Current output scale: E.g. "4...20 mA = 40.0...60.0 CONC%"
- Two soft keys, **Relay configuration** and **Wash times**. For details see Section 9.2.
- One soft key **Switch configuration**, see Section 2.8.

Sensor head (soft key):

- Head temperature
- Head humidity. For details see Section 6.1.

2.8. CALIBRATE

The soft key "Calibrate" brings forward two alternative soft keys: "Optical image" and "Parameters".

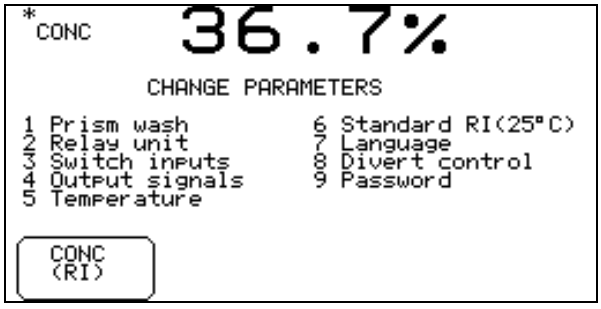


Figure 2.81 Change parameters menu.

Optical image (soft key):

Displays all raw data from the sensor including the optical image followed by the SCALED IMAGE, SLOPE AND IMAGE DIAGNOSTICS screens, see Section 6.5.

Parameters (soft key):

Displays the CHANGE PARAMETERS menu (Figure 2.81) which contains:

CONC (RI) (soft key):

Further by the soft key "Parameters", the calibration parameters for the concentration are entered, see Section 5.2.

Menu selected functions are:

1. Concentration unit, can be "CONC %", "CONC g/l", "CONC", “OECHSLE” or "BRIX". Also available is the unit RI (x °C), which is "RI measured in the laboratory at x °C" where typically x = 60 °C, displayed as RI (60 °C). The unit RI (x °C) should not be confused with "Standard RI (25 °C)" even if the x can be chosen as 25.
2. Number of CONC display decimals.
3. Damping time in seconds. This is the time it takes for the concentration measurement to reach half of its final value at a step change of the concentration
4. Switch selected scales. Provides four additional complete sets of calibration parameters, see "Switch inputs" below.

1. Prism wash:

Entering of prism wash times for the Relay Unit and a wash check, wash stop and smart wash functions, see Section 9.2.

2. Relays:

Provides relay configuration, see Sections 2.5 and 9.2.

3. Switch inputs:

The microprocessor accepts four switch inputs (A, B, C and D), for connections see Figure 3.64. The function of each switch can be individually defined from one of four alternatives

0. Not defined (which is the factory setting).
1. Remote wash start for Relay Unit wash function and external Hold. The external Hold is used with a wash timer other than the Relay Unit, or to hold the signal during stops in an intermittent flow (e.g. by contact from the pump control). A wash start is also initiated when the contact opens, if it has been closed longer than one minute.
2. Defined to select alternative process mediums. There are all together four alternative mediums selectable by closure of the corresponding switch. If no selection switch is closed, the normal medium is selected. Maximum number of mediums is five (Normal, A, B, C, D).

   Note. The range will not change. Example: medium 1 = 20 - 40 % Sugar, medium 2 = 20 - 40 % Salt.
3. External wash stop: An input switch can be configurated to an external wash stop to prevent the prism wash when the corresponding input switch is connected. “External wash stop”-message will show when automatic wash is activated. The input switch can be set to protect the refractometer e.g. if the process is stopped.
4. Calibration stop: An input switch can be configurated for calibration stop. Activating and connecting the input switch will prevent calibration through software.

4. Output signals menu:

1. Current output. Sets the zero and span in concentration units that correspond to 4-20 mA output. The signal range 0-20 mA can also be selected. The 0 will be slightly above 0 mA, typically 0,06 mA. An active HOLD function locks the signal during prism wash by the Relay Unit. When the HOLD function is inactive, the wash results can be seen as a negative peak in the output signal.
2. External current output. Defines the scale for the External Output Unit (Section 10.1) the same way as above. In addition the source has to be selected from the list Concentration/Standard RI (25 °C)/Temp °C/Temp °F.
3. Serial output. The format is to be defined, see Section 3.7.

5. Temperature menu:

The temperature calibration is made through this menu, see Section 5.8. It is also possible to select the temperature display unit in the normal display as °C/°F. A high temperature limit can be activated and set for a "High process temperature" message, Section 6.3.

6. Standard RI (25 °C):

Gives the calibration parameters for the bench calibration value with standard RI liquids, Section 5.4. The RI (25 °C) can also be added to the normal display.

7. Language

Selection of display language: 1. English 2. German.

8. Divert control

Supports the K-Patents Divert Control Unit DD-01, see separate Instruction Manual for the Digital Black Liquor Divert Control System.

9. Password

A software password can be selected to prohibit unauthorized calibration, see Section 2.11.

2.9. COMPATIBILITY WITH EARLIER VERSIONS

The model PR-01-S has been preceded by models PR-01, PR-01-E and PR-01-B.

Sensor

The Sensors of all models are using identical mounting parts, so e.g. a PR-01-B refractometer can be replaced by a PR-01-S without any process pipe changes. The critical measure, i.e. the distance between the prism and the process connection is unchanged.

Interconnecting cable and Indicating transmitter

The PR-01-S cable, and also the transmission, is different from earlier models. Neither Sensor nor Indicating transmitter of the model PR-01-S can be combined with any corresponding unit of the earlier models.

2.10. VERSIONS OF PR-01-S

The program version number consists of two digits. The first digit is the major version, the latter is the minor version. Programs with the same major versions are compatible. Also earlier major versions can usually be substituted with later major versions.

Version 1.0

Version 2.0

- Supports external output unit, Section 10.1.
- Revised calculation of Standard RI (25 °C), new style constants.
- Addition of standard RI to serial output data.

Version 2.1

- External output is set inactive by setting the output range span to 0.

Version 3.0

- Language selection English/German.
- Up-date of the optional Standard RI (25 °C) display.

Version 3.1

- The measuring task has a higher priority than the keyboard handling task.
- The default for relay alarm delay is changed from 0 to 10 s.

Version 4.0

- Supports K-Patents Divert Control unit DD-01.
- Password protection added, Section 2.11.
- The RI display is shown without the reference temperature, if both temperature coefficient values for RI are zero.

Version 5.0

- This version is accompanied by a a sensor modification: The PLUG-IN LIGHT SOURCE, eliminating the light source module adjustments to the optical image. The PLUG-IN LIGHT SOURCE should not be used with any lower program version. Program version 5.0 is compatible with all PR-01-S sensors.
- The range of the TEST display is now limited to 8...248.
- An advanced image analyzing algorithm is implemented, Figure 2.52 including IMAGE DIAGNOSTICS screen (Section 6.5).
- BRIX unit added (Section 2.8).
- The current output parameters ICAL0 and ICAL1 added to the current output calibration screen.
- Password limit moved (Figure 2.61): Raw data + Optical image available without password.

Version 6.0

- Switch input for extermal wash stop added, Section 2.8
- Switch input for calibration stop added, Section 2.8
- Wash stop when the process temperature is below the limit added, Section 9.2
- Limit to divert alarms added (Ref. difference max 2% , Solids alarm min. 58%, Solids warning min 60%)
- Output unit Oe (Oechsle) added, Section 5.2
- Temperature filtering of Intrinsically safe sensor is changed
- Support for small relay unit added
- Internal Sensor humidity and temperature added.

Version 6.2

- A check for Relay accessibility is added to wash check logic.
- Support to read the display memory is added to the display driver and the display manager modules.

Version 7.0

- Support for built-in signal relays on power supply card, Section 2.5.
- New relay signal sources: internal sensor temperature and internal sensor humidity, Section 9.2.
- Change of error classifications, Section 6.3.
- Display timeouts, Section 2.6.

Version 8.1

- Support for Sanitary Refractometer PR-03-A Sensor
- Smart Wash for prism wash, Section 9.4

Upgrading the program version

Before you upgrade any program versions, write down all current parameters from the calibration screen of the Indicating transmitter. Then insert the new program version. Choose the "Default parameter load" at start and enter the old parameters in.

2.11. PASSWORD

The "CHANGE PARAMETERS" screen can be optionally locked behind a password function. When the password function is activated, entry to this screen is not allowed without a correct password, see Figure 2.61.

The password function can be activated or inactivated by selecting: "Calibrate/Parameters/9.Password/0. Inactive or 1. Active".

The password for K-Patents PR-01-S (-Ex) is printed on the front page of this manual.

2.12. WARRANTY

K-Patents warrants that all products made by K-Patents shall be free of defects in material and workmanship. K-Patents agrees to either replace or repair free of charge, any such product or part thereof which shall be returned to the nearest authorized K-Patents repair facility within two (2) years from the date of delivery.

3. MOUNTING

Special precautions have to be taken when an intrinsically safe system is mounted, see Section 12.2.

3.1. SENSOR LOCATION

The sensor is delivered with a mounting guide attached, Figure 3.10.

The sensor is designed to be installed directly in a process line. If the sensor is located out of doors, some basic protection against direct exposure to sunlight and rain should be provided.

Air-cooling

Normally, draught and natural convection provide sufficient air cooling. Criteria for efficient air-cooling:

1. The sensor should be mounted **with the main axis horizontal**, Figure 3.10.
2. There must be no obstacles to air flow around the sensor head.
3. The red sensor cover should not be exposed to high temperature radiation.

If the ambient temperature is higher than 45°C (113°F) the air-cooling should be improved by blowing pressurized air against the red sensor cover. This is also recommended when the process temperature is above 110°C (230°F) when the ambient temperature is above 35°C (95°F).

The pressurised air can be supplied by the ventilation system. If no air is available it is possible to wind a copper coil for cooling water around the sensor head cover.

Process flow conditions

The sensor is designed to make the prism self-cleaning. To ensure a representative sample and also prism cleaning action, a good process flow should be directed against the prism surface. A flow velocity above 1.5 m/s (5 ft/s) is recommended. For lower velocities prism wash (Chapter 8) should be considered. Flow velocity is calculated from $v[m/s] = 21.2 * Flow[lit/min]/d^2[mm]$; $v[m/s] = 0.125 * Flow[Gpm]/d^2[in]$.

Accumulation of sediment or of gas bubbles should be prevented.

If the process pipe vibrates, support the pipe.

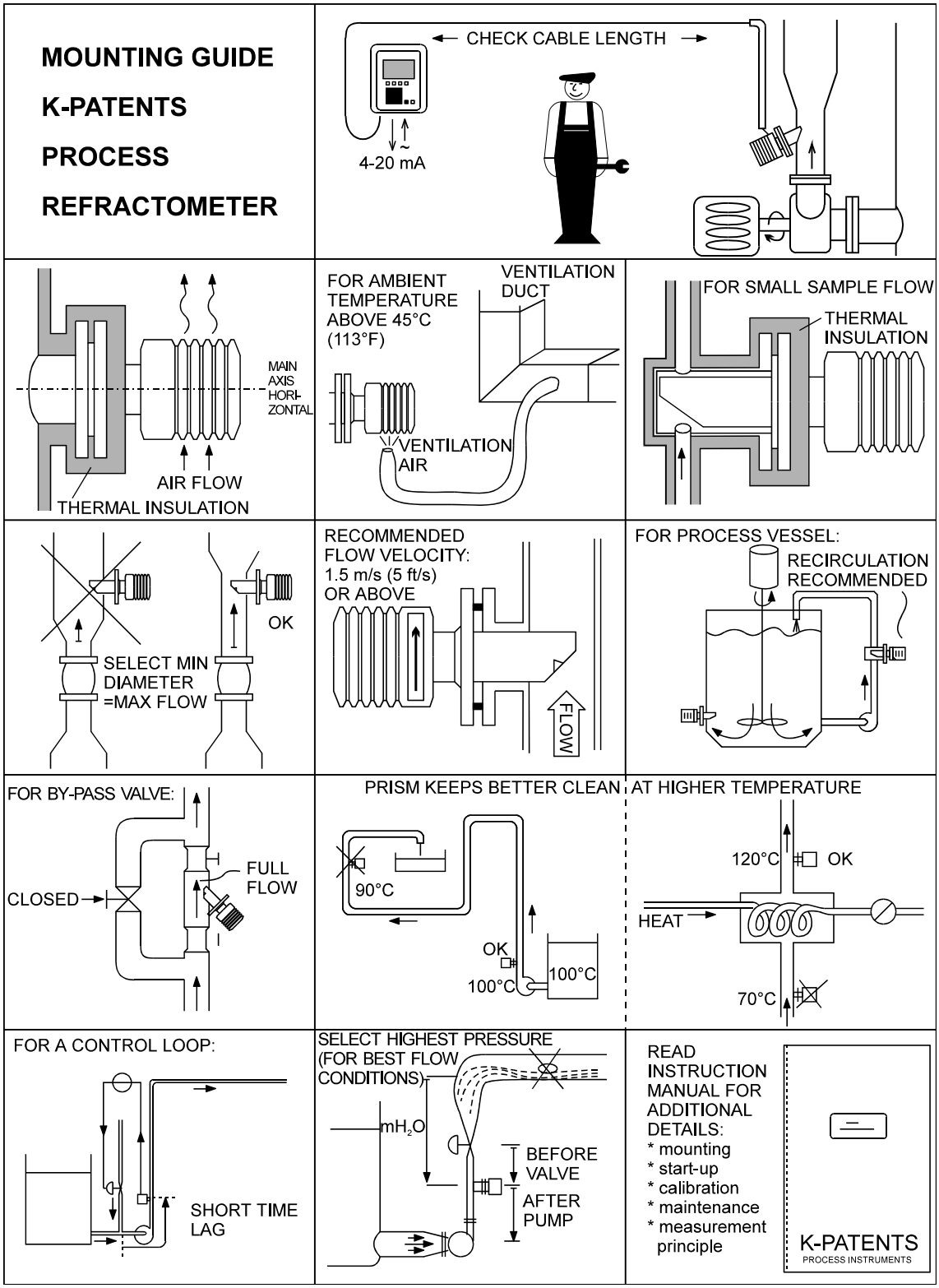


Figure 3.10 Mounting guide.

Selection of location

To decide "Where to mount" use the following criteria:

1. Process pipe is preferred to process vessel, because favorable flow conditions are difficult to ensure in a vessel.
2. If the process pipe diameter varies, select the position with the smallest diameter (and accordingly highest velocity). Then the prism keeps better clean. If the pipe is coned up after a pump, valve or magnetic flow meter, then add a length of straight pipe before the coning up and mount the refractometer there.
3. If the refractometer is used in a feed-back control loop, make the time lag small. E.g. when a dilution valve is controlled, mount the refractometer as near the dilution point as possible.
4. If the temperature varies along the process pipe, select the position with the highest temperature. Then the risk of prism coating is minimized, because higher temperature means higher solubility and also lower viscosity.
5. Often the position with the highest pressure (= low point in pipe system + after pump + before valve) has favourable flow conditions without sedimentation or air trapping risks.
6. The sensor should be conveniently accessible.

3.2. MOUNTING EXAMPLES

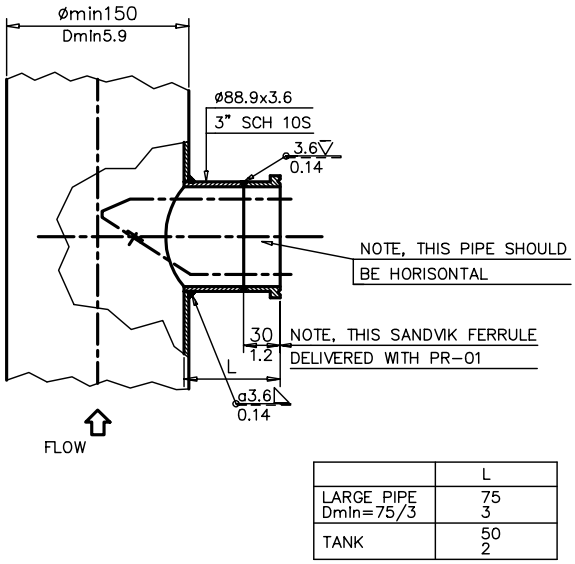
For mounting drawing for desired pipe diameter and connection type, contact the representative of K-Patents.

No special mounting parts are needed to mount K-Patents Process Refractometer. For all process pipe diameters just a standard piece of 88.9 x 3.6 steel pipe is used as adapter. For small process pipe diameters the piece of pipe is sealed in the other end to form a flow cell. Examples for different process pipe diameters are given in Figure 3.20 and Figure 3.21.

For flanged mounting, the user has to provide the counter flange. For clamp mounting K-Patents provides a weld-on ring.

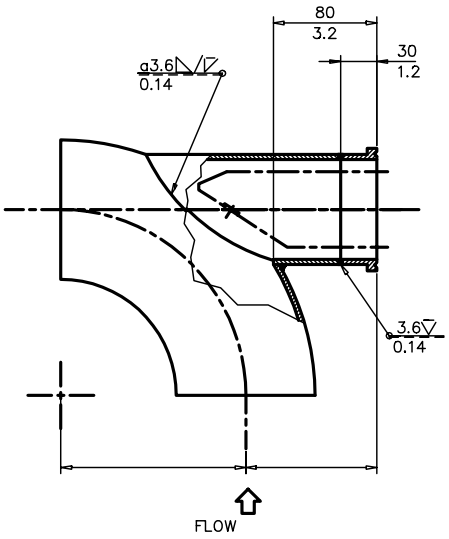
Flow cells can be supplied by K-Patents, see Section 8.5.

Large pipe:
Diameter 150 mm (6") or larger.

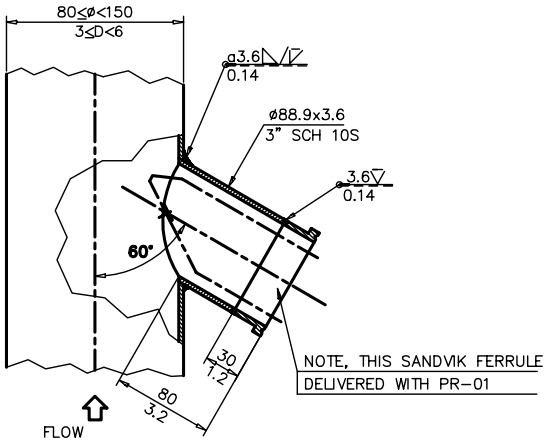


	L
LARGE PIPE Dmin=75/3	75 3
TANK	50 2

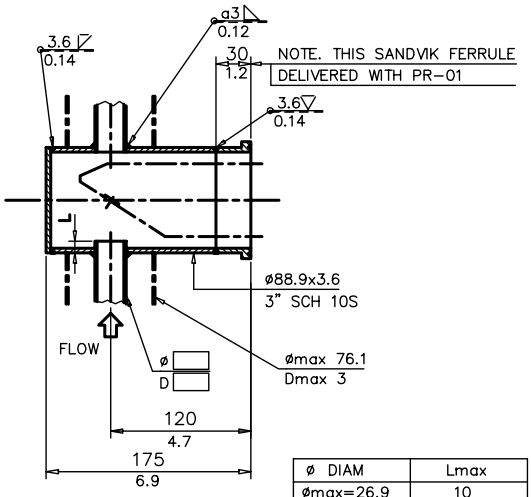
Pipe bend:
Diameter 80 mm (3") or larger.



Medium size pipe:
Diameter 80 mm (3") or larger,
smaller than 150 mm (6")



Flow cell:
Diameter smaller than 80 mm (3")

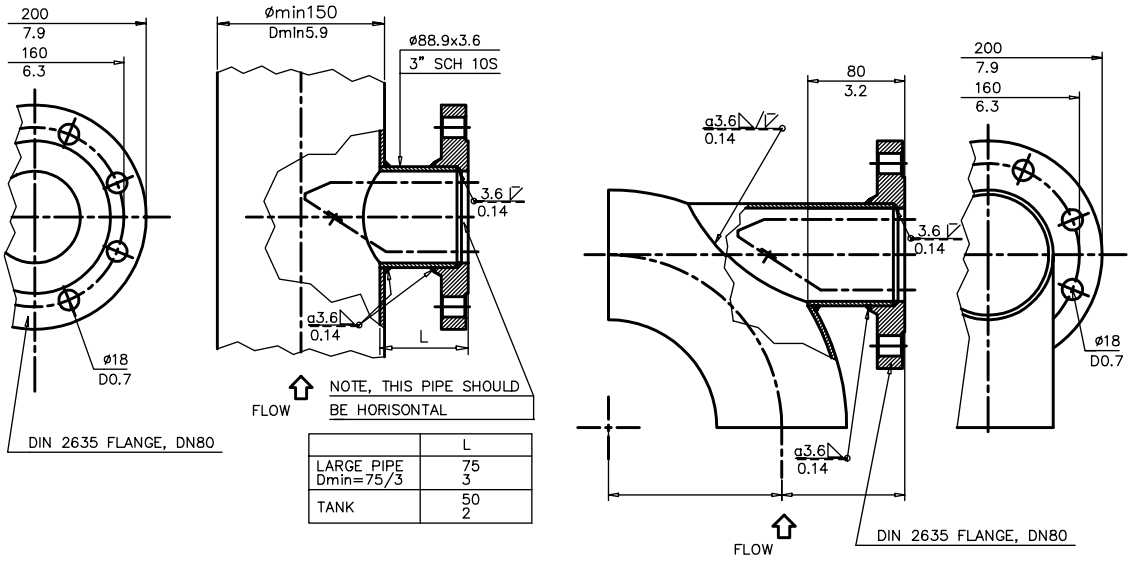


ø DIAM	Lmax
ømax=26.9 Dmax=1.1	10 0.4
ø>26.9 D>1.1	0

Figure 3.20 Sandvik clamp mounting
Note. For Sanitary clamp separate drawings are provided.

Large pipe:
Diameter 150 mm (6") or larger

Pipe bend:
Diameter 80 mm (3") or larger,
smaller than 150 mm (6")



Medium size pipe:
Diameter 80 mm (3") or larger

Flow cell:
Diameter smaller than 80 mm (3")

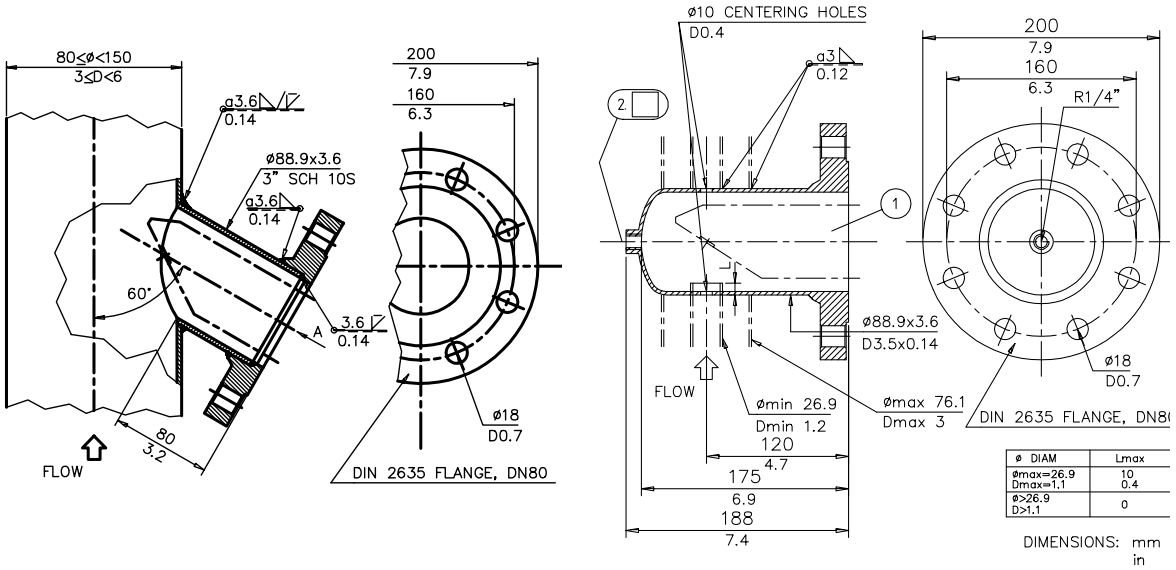


Figure 3.21 Flange mounting DIN 2635 DN 80. Note for ANSI B16.5 3" RF 150 psi or JIS 10K 80A separate drawings are provided.

3.3. MOUNTING AND DISMOUNTING

The sensor mounting procedure: (Figure 3.30)

a. Remove the prism protection sticker before the sensor is connected to the process line.

b. Identify the sensor by the serial number. Sensors are interchangeable under special conditions only and recalibration is normally required, section 3.5.

c. Check flow direction. If the fitting has a fixed flange, the bolt holes should allow proper flow alignment of probe. If this is not the case, remove the two fixing bolts, (Chapter 7, Parts list, Sensor item 2.2). The sensor flange can then be freely rotated. Save the bolts, they are useful at dismounting.

d. Heat insulate the sensor flange if it can be suspected that a too strong cooling effect can cause prism coating, Section 8.1.

Note. If the process medium is hot and sticky, it is recommended to heat the probe by using hot water before mounting. A cool prism tends to be rapidly coated.

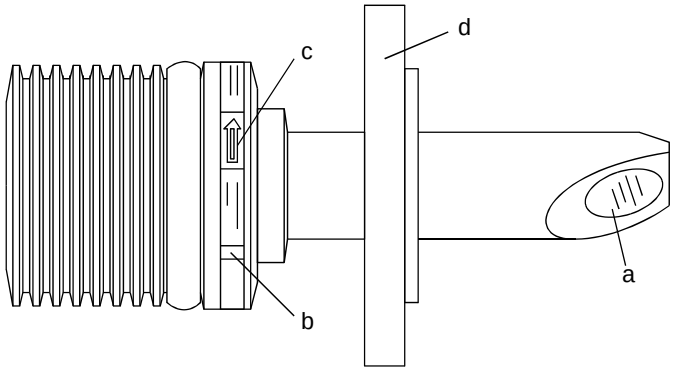


Figure 3.30 Mounting procedure.

Dismounting

If a flanged sensor sticks in the fitting, pulling force can be generated by the flange fixing bolts.

Proceed as follows:

– remove the fixing bolts (Chapter 7, Parts list, item 2.2)
– lift the sensor flange away from the flange fitting
– screw the bolts directly into the threaded holes
– tighten the bolts alternately in small steps

3.4. WASH NOZZLE FOR STEAM

For mounting of the prism wash systems, see Chapter 8.

3.5. INDICATING TRANSMITTER

The Indicating transmitter should preferably be located in an easily accessible, well lighted and dry area. The enclosure must not be exposed to rain or direct sunlight. Avoid vibration. Take interconnecting cable length into consideration.

The enclosure is mounted on a wall using four mounting feet, Figure 2.20. **Do not drill mounting holes in the enclosure.**

Note: The LCD display has an operating temperature range of 0...50°C and a storage temperature range of -20...60°C.

Check the serial number from the label, Figure 2.11.

An Indicating transmitter can be exchanged for another of the same model, but the current calibration constants have then to be entered by the keyboard (Section 5.7). For compatibility information, see Section 2.9.

3.6. ELECTRICAL CONNECTIONS

The electric terminals of the Indicating transmitters are all on the Power Supply card, Figure 6.40. This is accessible by opening the enclosure and the front panel. The front panel swings out after the two screws to the right have been loosened (Chapter 7, Parts list, Indicating transmitter, item 3.14). *For intrinsically safe connections, see Section 12.2.*

Power:

The power is specified in the DELIVERY DATA SHEET and on the Label (Figure 2.11). The position of the power select switch on the Power Supply card (Figure 6.40, SW2) should also be checked. The power select switch has two positions: 220-240 V/50-60 Hz or 100-115 V/50-60 Hz. *For potential constraints in intrinsically safe system, see Figure 12.20, Note 1.*

The primary AC power is connected to a separate terminal strip 39/40/41 on the Power Supply card marked POWER (Figure 6.40): The terminals are marked 39/L, 40/N and 41/ground symbol.

The power terminals L and N are directly connected to the transformer primary loop, and galvanically separated from the rest of the instrument. The ground terminal (41) is connected to the bottom plate of the Indicating transmitter, to the transformer shield winding and to the outer shield of the interconnecting cable.

Terminal strip:

The rest of the connections are made to the terminal strip, Figure 3.61.

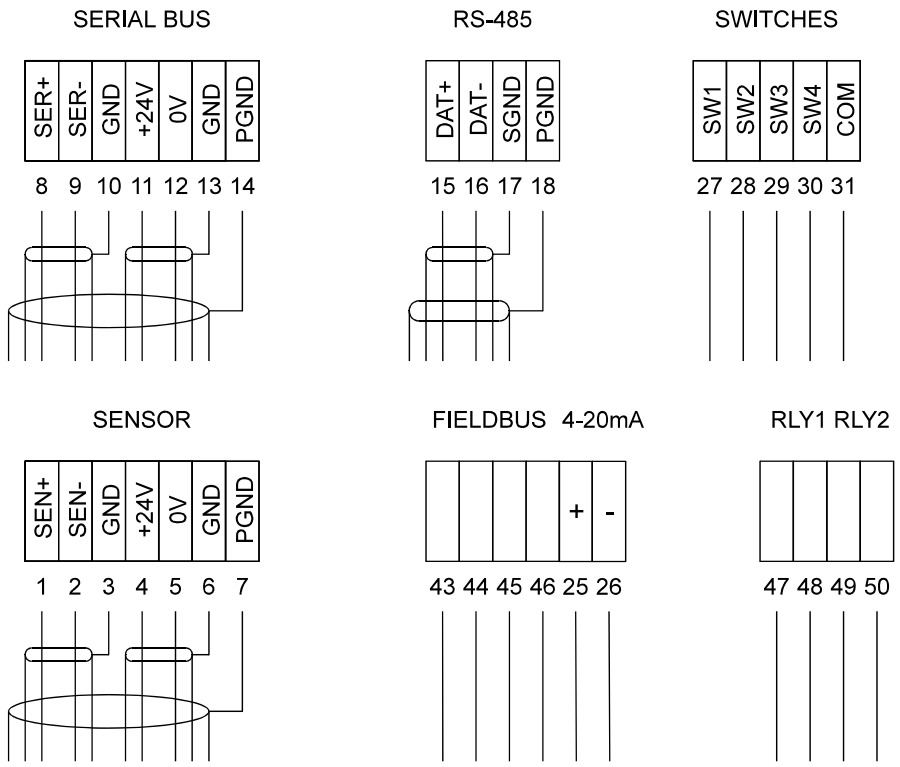


Figure 3.61 Terminal strip.

Sensor:

At the Indicating transmitter end of the interconnecting cable has leads numbered from 1 to 7 to be connected to the terminals with the same numbers. The sensor end of the interconnecting cable is terminated by a plug, Figure 3.62. The interconnecting cable may be shortened or lengthened up to the limit specified, Section 2.2. The interconnecting cable should be installed in a separate metal conduit. For cable specifications, see Section 2.2.

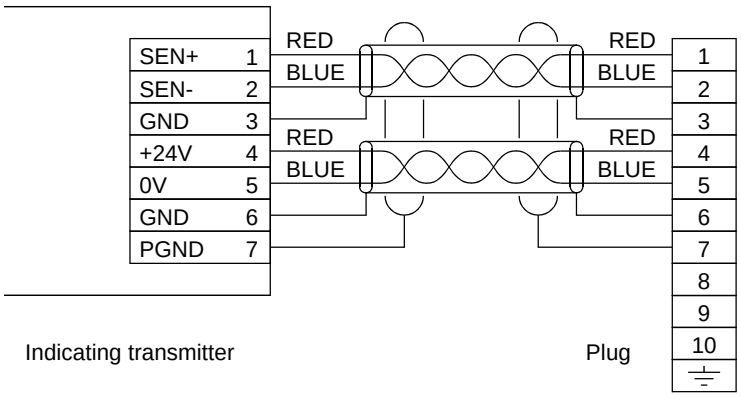


Figure 3.62 Interconnecting cable. *For intrinsically safe systems, use Figure 12.22.*

Current output:

The terminal 25 is plus (+) and 26 minus (-) for the 4-20 mA output signal. The signal is specified in Section 2.2.

Recorders, controllers, indicators etc. shall be connected to form a closed current loop, starting from terminal 25 passing each device, in at plus and out at minus, ending at terminal 26. Be careful not to exceed the specified load resistance.

The range of the output signal can be set to 0-20 mA from the keyboard (Section 2.8), select Calibrate/Output signals/Current output/Range.

Serial output RS-232/RS-485:

Terminals 15-18 and Plug connector P3, see Serial output Section 3.7.

Serial bus:

Terminals 8-14 provide connection to K-Patents accessory units, like the Relay unit (Chapter 9) and External Output Unit (Section 10.1). The same type of cable is used as for the interconnecting cable to the sensor specified in Section 2.2.

The terminals 8-14 are connected to the same numbers in the external units. Connect the external units in a chain beginning from the Indicating transmitter and ending at the Relay unit (Figure 3.63). For an intermediate unit (e.g. External output unit), the Serial bus input is terminals 8-14 /A and output 8-14/B. If there is no Relay Unit to complete the chain, connect a 120 Ohm resistor over the terminals 8/B and 9/B at the last unit.

Note: The current loop of the Serial bus must always be closed, by a Relay Unit or the 120 Ohm resistor.

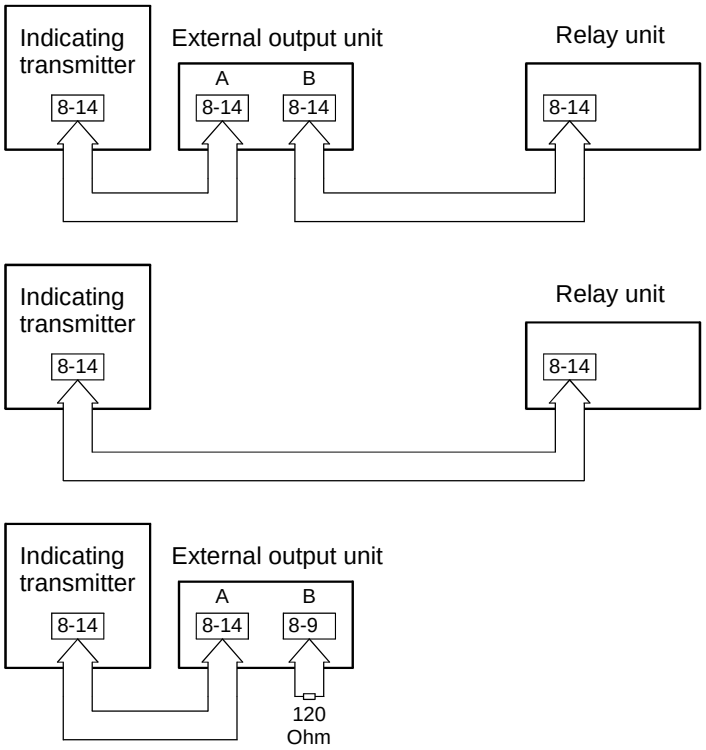


Figure 3.63 Serial bus connections.

Input switches:

Altogether four input switches A, B, C and D (Figure 3.64) can be connected: Terminals 27-A, 28-B, 29-C, 30-D, 31-Common. The switches may be separate, or together in one rotary switch. Input switches can be configured through software, Section 2.8.

A 5V voltage is provided over each switch. The switch terminals are all galvanically isolated from ground and from the rest of the electronics.

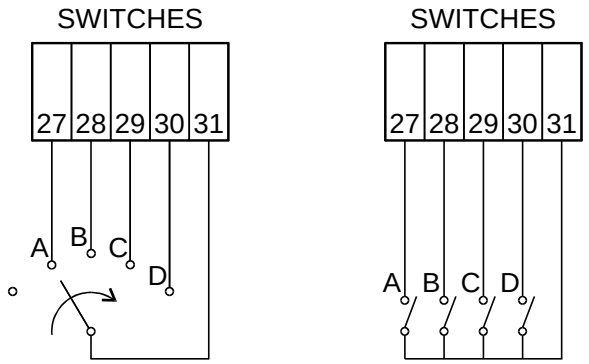


Figure 3.64 Connections to input switches.

3.7. SERIAL OUTPUT

A remote display unit, a computer, or a terminal can be connected to the PR-01-S serial output terminals. In the Indicating transmitter either RS-232 or RS-485 interface may be used.

The output measurement results are sent in ASCII code (**ISO 646**, **CCITT V.3**) using a standard asynchronous interface. The output consists of fixed-length text records. A record is sent for every measurement interval (800 ms).

RS-232: Conforms to the EIA RS-232-C and CCITT V.24 standards. The signals are available at plug terminal P3. Cable diagrams are shown in figure 3.70 (for modems) and figure 3.71 (for computers). Both 25-pin and 9-pin D-shell connector pin numbers are given. If the ITR is to be connected to a computer, connections 4-5 and 6-8-20 (see figure 3.70) may be omitted in most cases. **Note**: RS-232-C specifies a maximum cable length of 15 m.

RS-485: The physical interface conforms to the EIA RS-485. The cable should be a shielded twisted pair. The RS-485 signals are available at P3 (DAT- and DAT+ in figure 3.70) or strip terminals 15-18. For a shielded cable connection (recommended), see figure 3.61. K-Patents recommends a cable length not exceeding 200 m.

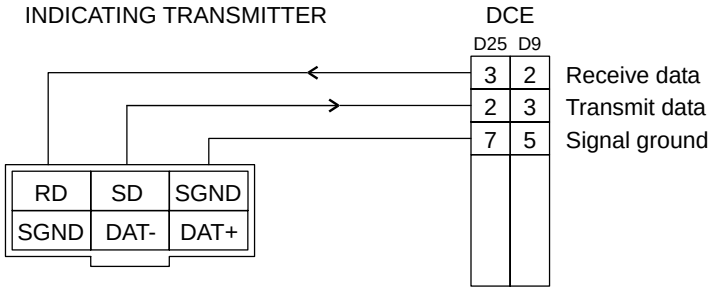


Figure 3.70 RS-232 connection to DCE-type equipment (e.g., modem).

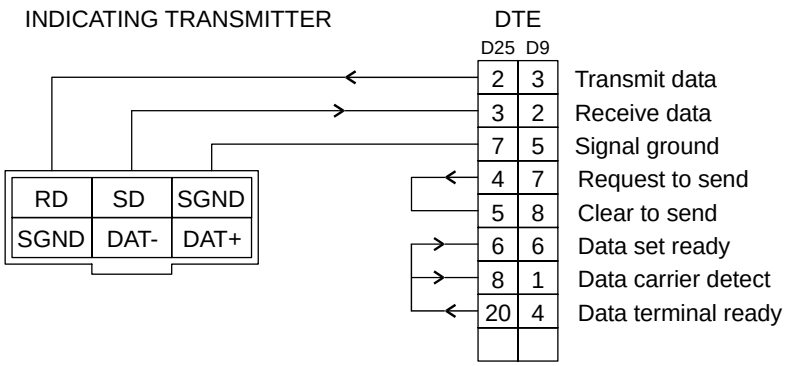


Figure 3.71 RS-232 connection to DTE-type equipment (e.g., computer).

The character structure conforms to the **ISO 1177** standard. It is compatible with the 'RS-232' interfaces of personal computers.

The character parameters are configuration selectable:

speed 1200 to 9600 bits/s
parity odd, even or none
stop bits 1 or 2
flow control hardware, XON / XOFF or none.

The set of measurement results is output in a fixed-length record. The record consists of variable-length numeric fields at fixed locations in the record. The gaps are filled with ASCII spaces (code 20 hex).

The record format is (program versions from 4.0):

Column	Field	Format	Value
1	TEST	float, 1 decimal	raw refraction value
16	CONC%	float, selected decimals	concentration value
31	temp C	float, 1 decimal	temperature, degrees centigrade
46	RI 25 C	float, 4 decimals	standard RI at 25 C
61	phase	1 digit	operation phase code
63	error	integer	error code
66	divert	integer	divert control status code
68	checksum	integer	
76	terminator	CR and LF	

If a float value is too large for its field it is output in raw decimal floating point format: +1234567+12. The first sign is the sign of the value. The 7 digit field is the mantissa value after the decimal point. The second sign is the exponent sign. The 2 digit field is the decimal exponent. The example value +1234567+12 is to be interpreted as 0.1234567E12, ie. 123456700000.

TEST: The raw refraction value is the same as in the TEST display. The value is displayed with 1 decimal. The range is 8.0 - 248.0.

Concentration: The concentration value is the same as in the CONC% display. The number of decimals is controlled by the display decimal parameter in EEPROM. The range is dependent of the concentration factors in EEPROM. The value is damped. It is held during wash, hold or recovery phases.

Temperature: The temperature value is the same as in the °C display. The value is displayed with 1 decimal.

Operation phase: For program versions from 4.0 the phase codes are:

Code	Phase codes
0	Blank
1	Wait
2	Precondition
3	Precondition
4	Wash
5	Recovery
6	Hold

Error status: For program versions from 4.0 the error status codes are:

Code	Priority	Error status
0	0	No errors
		Process disturbances:
1	1	Retrying wash
2	4	Solids warning
3	5	Solids alarm
4	7	Low concentration / no sample
5	13	Prism wash failure
		Malfunctions:
6	8	High process temperature
7	11	High conc / prism coated
		Instrument malfunctions:
8	14	External output fault
9	15	Relay unit fault
10	16	Divert control fault
11	17	Temperature measurement fault
12	18	Prism coated / LED fault
13	19	Not in line
14	20	Detector timeout
15	21	Sensor transmission error
16	22	No sensor signal
17	23	Wrong concentration parameters
18	24	Constants error
19	25	Sensor interface fault
20	26	EEPROM fault
		From version 5.0, process disturbances
21	9	Low light intensity
22	10	Dip in image
23	6	Wash stop / Temp. limit
		From version 6.0, process disturbances:
24	2	High internal humidity
25	3	High internal temperature
		From version 6.0, instrument malfunctions:
26	12	Wash stop / ext. stop

Divert status: The divert status field reports the divert control status in coded form, see Section 10.2.

The codes are:

Code	Status
0	divert not activated
1	divert failure
2	channel A, not operating
3	channel B, not operating
4	channel A, operating
5	channel B, operating

Checksum: The checksum is the arithmetic sum of ASCII codes in columns before the checksum field. For programs until version 3.1 the range is columns 1 to 65. For programs from version 4.0 the range is columns 1 to 67. Least significant 7 bits are taken into the sum: the parity bits are zeroed.

Record terminator: The record is terminated with ASCII characters CR (0d hex) and LF (0a hex) to make the record a text line.

3.8. FUSES

Fuses printed on circuit board PR-7030:

Fuse F1, F2: 5 x 20 mm, T1A (slow)	AC Main power protects electronics against wrong primary voltage
Fuse F3: 5 x 20 mm, T63 mA (slow)	4-20 mA output protection
Fuse F4: 5 x 20 mm, T2A (slow)	Secondary main fuse
Fuse F5: 5 x 20 mm, T500 mA (slow)	Sensor power protection
Fuse F6: 5 x 20 mm, T500 mA (slow)	Serial bus protection
Fuse F7: 5 x 20 mm, T1A (slow)	Processor card protection

Note. For a CSA-Certified instrument use only CSA-Certified fuses F1, F2, F4-F7.

4. START UP

4.1. INITIAL CHECK

a. Check that the Serial Numbers of the Sensor and the Indicating transmitter match (Section 2.1).

b. Check wiring and supply voltage (Section 3.6).*For intrinsic safe installations, check with Figures 12.20...12.22.*

c. Press the main power switch to ON position. The three green LEDs (LD1, LD2, LD3) on the Power Supply card (Figure 6.40) are then turned on.

d. The Normal Display (Figure 2.60) should now appear. The diagnostic message should be "Normal operation" or if the process pipe is empty "Low concentration/no sample". For any other message consult section 6.3.

e. The display should show the current process temperature.

f. TEST value in the display should be in the range 8-248. A value near 248 indicates a clean prism in an empty process pipe.

g. For the concentration reading, see Section 4.2.

h. Press soft key "Display" for additional data (Figure 2.71), like e.g. output in mA. Further data is obtained by soft keys "Optical image" and "System configuration". Return to previous display by RESET key.

i. Measure the output signal. It should agree with the mA display.

j. **IMPORTANT:** If a prism wash controlled by a Relay Unit is employed, press soft key "Start prism wash" and check the wash sequence. The TEST value should clearly increase (and the concentration reading decrease) during wash. The "Start prism wash" soft key does not show, if no relay is specified as wash relay.

If the initial check is not OK, turn to Chapter 6.

4.2. CALIBRATION CHECK

Wait until normal process conditions occur. The instrument is precalibrated at delivery (DELIVERY DATA SHEET). Hence an on-scale output should be obtained. If not, take a few samples and check that the process conditions are normal.

If the diagnostic message is "Normal operation" but the concentration reading is at the wrong level, correction can be entered by the keyboard (Section 5.2).

If the concentration reading is correct, but not the output mA, see Section 5.1.

The damping of the concentration measurement may be increased, e.g. if necessary to get a smoother recorder track, see Section 2.8. A damping time of 15 seconds is normally the best. WARNING: Avoid overdamping, the signal should not be insensitive.

4.3. DEMO MODE

The Indicating transmitter can be used as stand-alone for training of keyboard handling. The built-in Demo program contains a sensor simulator.

To activate the Demo mode

a. Disconnect the sensor cable (1-7) and all connections to the Serial bus (8-14) from the Indicating transmitter.

b. Connect terminal 1 to 8, and terminal 2 to 9, Figure 4.30.

When the Demo mode is active, a small star appears in the top left corner of the display.

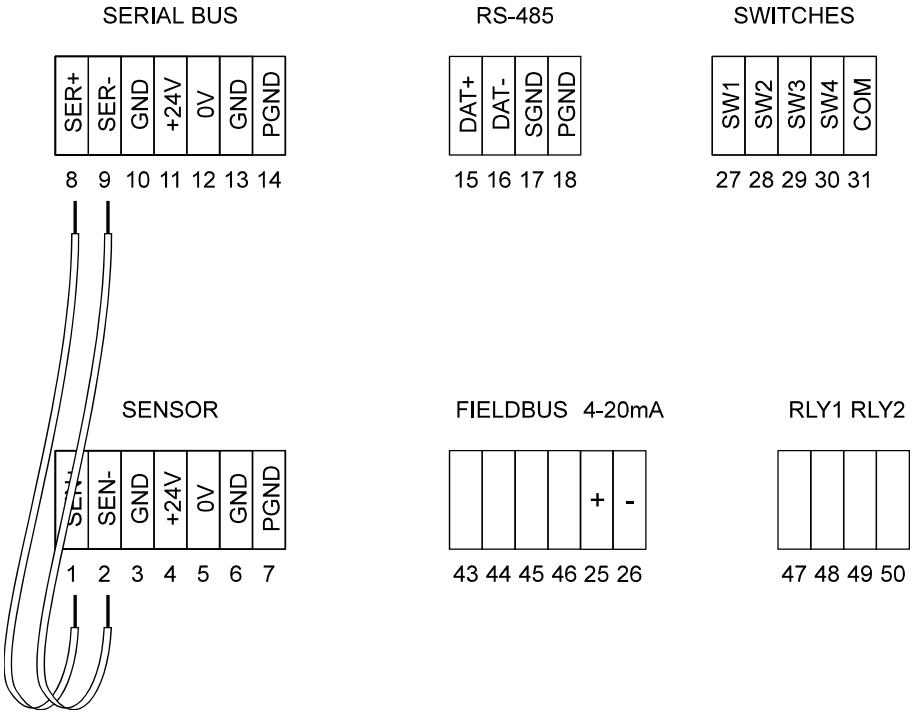


Figure 4.30 Demo connection.

5. CALIBRATION

K-Patents Process Refractometer is delivered precalibrated according to the DELIVERY DATA SHEET. Adjustments or change of range can be made by keyboard entry (Sections 5.1 and 5.2). Larger changes of measuring range may require mechanical zero adjustments (Section 5.5). For sensor rangeability, see Section 5.6.

Field calibration

The final calibration to obtain full accuracy is made by sending data to K-Patents or local K-Patents representative for calculations (Section 5.3.).

Temperature calibration is explained in Section 5.8.

5.1. OUTPUT CURRENT RANGE SELECTION

It is possible to change the concentration range of the output current, also when the instrument is installed and operating.

Example: To change 4-20 mA = 15 - 25 CONC% to 4-20 mA = 10 - 30 CONC%, key in the sequence

Calibrate/Parameters/Output signals/Current output and then enter Zero = 10 and Span = 20.

Important: This change is useful only if the TEST value is correct over the entire new range, see Section 5.6.

5.2. CONCENTRATION CALIBRATION FROM KEYBOARD

The concentration display should be in agreement with laboratory determinations. Deviations can be corrected from keyboard if the diagnostic message is Normal operation. If the TEST display is outside the range 20 - 246 (High concentration or Low concentration messages) mechanical adjustment is needed (Section 5.5).

Off-set adjustment:

A change of the calibration constant Bias influences the CONC% reading the same amount. Key in Calibrate/Parameters/CONC (RI)/Parameters/Bias to read and change the Bias.

Example: If the CONC% display is 26% and the laboratory determination is LAB% = 28%, then a value Bias = 23.456 should be changed to Bias + LAB% - CONC% = 25.456.

Note: The CONC% reading is restricted to positive values even if the mathematical calculation gives a negative value. For a negative CONC% the display shows "0.0". For BIAS adjustment it is useful to know the real CONC% value. For this reason the calculated negative CONC% reading is shown in the Calibration branch of the Selection tree, Figure 2.61.

Warning: Never try to change Bias in a day-to-day manner, or week-to-week. Frequent bias changes will increase the measurement variation, not decrease it.

Amplification adjustment. The size of CONC% changes are directly proportional to the calibration constant Gain. The point, where TEST = 128, is not influenced by Gain. From two measurement points the new Gain can be estimated by the formula Gain*(LAB%1-LAB%2)/(CONC%1-CONC%2). After the change of the Gain, the Bias has to be determined by a new sample.

The constants Square and Cube are linearity corrections that can be provided by K-Patents, see Section 5.3.

5.3. FIELD CALIBRATION

The most accurate calibration is made under normal process conditions employing the users standard laboratory determinations of sample concentration. K-Patents provides a FIELD CALIBRATION service to optimize calibration constants based on data supplied by the user.

The user should systematically record calibrating data by the CALIBRATION DATA REPORT (last page in this manual). Each data point consists of:

LAB%	Sample concentration determined by the user.

From refractometer display (Section 2.7):

CONC%	Measurement in concentration units
TEST	Number of photocells on the light side of the optical image (= primary measurement)
TEMP	Process temperature measurement in centigrades

Note: A data point is of use for calibration only when the diagnostic message is Normal operation. Do not take samples during the prism wash. A data point is useful even if the concentration value is outside the range of the output current.

To achieve an accurate calibration the sample has to be taken correctly:

– The sampling valve and the refractometer should be installed in the same place in the process.

– Take the sample and read the display at exactly the same time!

– For hot samples use a tight container (avoid evaporation)

– Run the sample before starting to collect (avoid old sample that has remained in the sampling valve).

A completed CALIBRATION DATA REPORT with 5 - 15 calibration points covering the measurement range can be sent to K-Patents or local K-Patents representative by fax. A computer analyses of the data will be made at K-Patents and an optimal calibration data will be faxed to the user.

5.4. BENCH CALIBRATION

The calibration can be checked off-line using Standard RI liquids. The exact procedure is described in a separate K-Patents brochure No. IV95 “Instrument Verification For ISO 9000 Quality System”. The "Standard RI(25 °C)" display should then show the corresponding value.

The check should be done at room temperature, but the temperature does not have to be exactly 25 °C as the displayed value is temperature compensated. If the sensor is hot, let it cool down to ambient temperature.

Standard RI (25 °C) Display: For gain = 0, the indication is 0.0000. For off-set adjustment (like in Section 5.1), the bias change has to be multiplied by 100. E.g. If indication is 0.0004 low, add 0.04 to the bias for RI(25 °C).

Standard RI liquids are available from: R.P. Cargille Laboratories, Inc., 55 Commerce Road, Cedar Grove, New Jersey 07009-1289, U.S.A. Phone: 973-239-6633, Fax: 973-239-6096.

A 12 bolttles set of RI liquids are also available at K-Patents with part number PR-2000. The complete set with 24 bottles of liquids covers the RI range 1.300 - 1.530 as follows:

1.300 - 1.390 Cat. No. 18032 AAA-1/2 Half Set, Int. 0,01	10 liquids
1.400 - 1.450 Cat. No. 18065 AA-1/5 Fifth Set, Int. 0,01	6 liquids
1.460 - 1.530 Cat. No. 1809X (in steps of 0,01) A-x Std 1/4 fl.oz. (7cc)	8 liquids

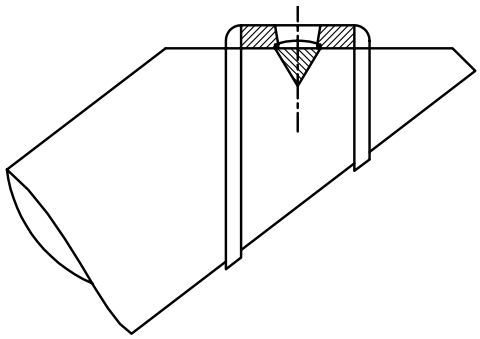


Figure 5.40 Sample holder.

Use a sample holder kept in place by a rubber link, Figure 5.40. Then just a few drops of sample are enough. Avoid strong direct light on prism. Sample leakage from holder may give measurement error. Always use repeated measurements for each sample. Sample holders are available at K-Patents (Part number PR-5002).

Dispose of used RI-liquids. Do not put liquids back into the bottle after use!

Off-line calibration using **process liquid** seldom gives reliable results, problems are caused by

– low flow which makes sample to form an unrepresentative film on the prism

– sample evaporation at high temperature or undissolved solids at low temperature giving deviations from laboratory determinations

– an ageing sample which is not representative

Calibration using the process liquid should be made in-line, see Field calibration (Section 5.3).

5.5. MECHANICAL ZERO ADJUSTMENT

A mechanical zero adjustment can be made within the limits given in section 5.6.

The mechanical zero adjustment can be made with the Sensor in-line. To make a mechanical zero adjustment remove the Image Detector Module according to the instructions in Section 6.8.

Near the tip of the module (Figure 5.50) there is a fiber optics holder (C) and two adjustment screws (See section 7, Parts list, Sensor items 9.4 and 9.5). The two screws work against each other in push-and-pull configuration. One screw (A) pushes the holder inwards and the other screw (B) pulls the holder outwards. The holder is locked by a combined push and pull force.

To increase the TEST reading move the holder (C) outwards (up in Figure 5.50), to decrease the TEST reading move it inwards (down in Figure 5.50). The output signal is generally a concentration signal inversely proportional to the TEST-reading. To be able to measure higher concentrations, move the holder (C) outwards, to measure lower concentrations move it inwards.

One turn of the adjustment screw corresponds to 45 TEST reading units. As a rule of thumb, one TEST pulse corresponds to 0.2 % concentration. Thus one turn of the screw gives a 9 % concentration change.

Note: After the mechanical zero adjustment, check the optical image, see Section 6.5.

Warning: If the sensor cover is removed, ambient light disturbs the CCD-signal.

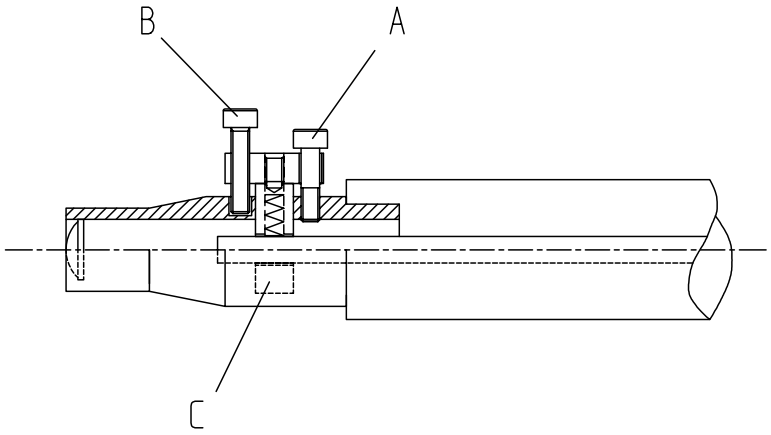


Figure 5.50 Mechanical zero adjustment

5.6. SENSOR RANGEABILITY

The Sensor is made in two versions: Probe tip angle 50 degrees and 57 degrees. The value is stamped on the probe tip.

The rangeability is described in Figure 5.60. for the two sensor versions. The shaded area shows the span for a typical mechanical zero setting. By mechanical zero adjustment (Section 5.5) the shaded area can be moved right (holder moved outwards) or left within the borders of the rectangle. E.g. The 57 degree version can measure up to RI 1.530.

If the desired measurement range cannot be achieved with the sensor version in use, then the sensor has to be exhanged.

The standard span in Figure 5.6 is based on an objective lens focal length f=18. A wider span multiplied by 1.8 (f=10) is available, with an accuracy of $\pm$ 0.0003 R.I.

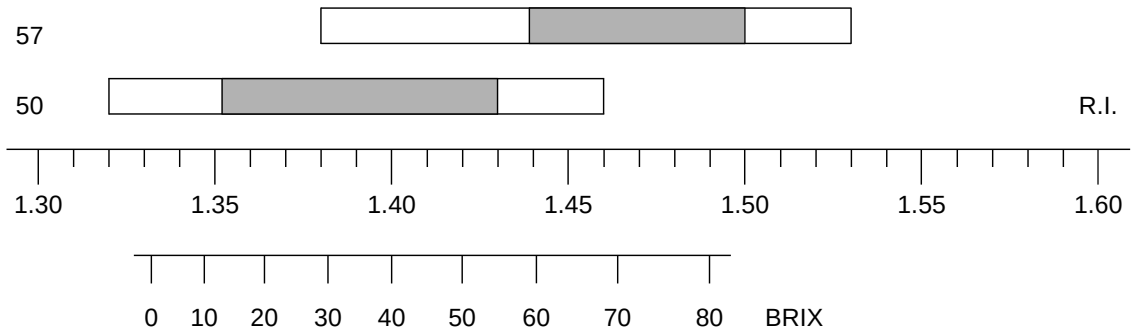


Figure 5.60 Sensor rangeability.

5.7. EEPROM PARAMETERS

How to enter the calibration parameters into the non-volatile EEPROM memory is described in Section 2.8. The factory settings are found in the DELIVERY DATA SHEET. Figure 5.70 shows how the microprocessor program is using the parameters.

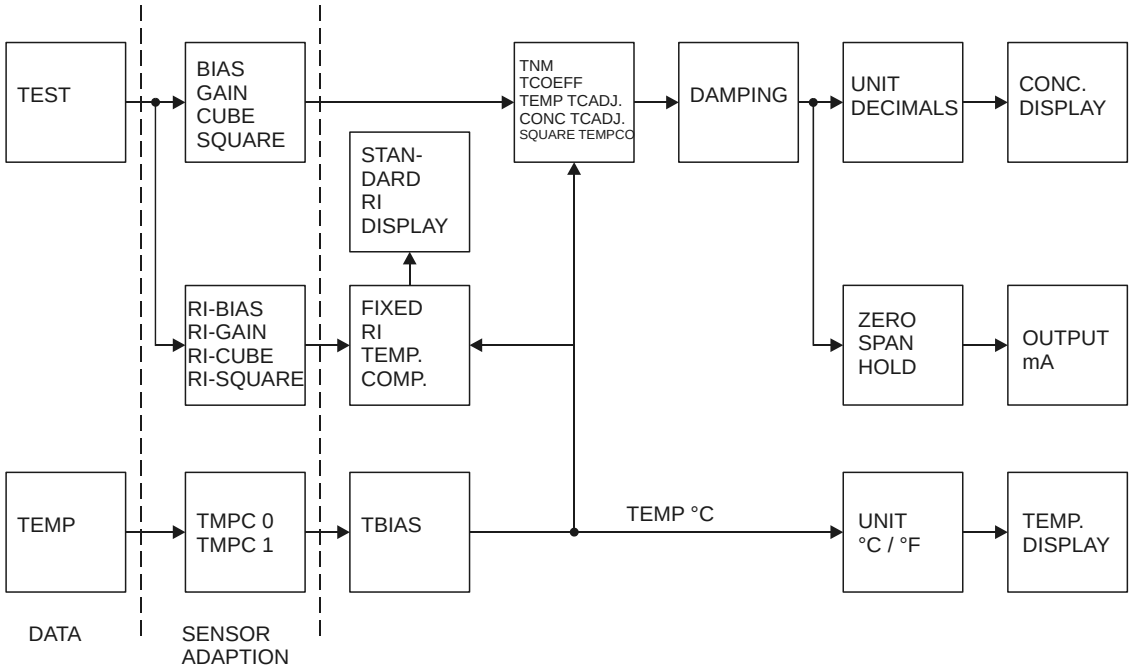


Figure 5.70 Calculation flow diagram.

The ENTER procedure contains a check of the EEPROM parameters format. A number outside the range limits cannot be entered. Only if the range limits of a parameter contain a decimal point, the parameter may contain a decimal point. For some parameters the number of characters is limited (character = digit, decimal point or minus sign).

Indicating transmitter exchange:

If the Indicating transmitter is exchanged, then all parameters and configuration determinations have to be changed.

Sensor exchange:

To substitute a Sensor by a spare Sensor calibrated for the same range, keeping the Indicating transmitter, the ten constants in the "sensor adaption" zone (Figure 5.70) have to be entered according to the constants of the spare sensor, see the DELIVERY DATA SHEET. If the Sensor is calibrated for another range (or process medium), the Bias, Gain, Square and Cube have to be determined by Field Calibration (Section 5.3).

The calibration constants:

- Concentration linearization: Bias, Gain, Square, Cube. Normally a 6 character number (.and - included). Enter from Calibration/Parameters/CONC/Parameters.
- Temperature compensation: TNM, Temp coeff, Temp TC adj, Conc TC adj, Square Temp CO. If Temp coeff = 0 and TC adj = 0, then there is no temperature compensation. Enter from Calibration/Parameters/CONC/Parameters.
- Linearization of Standard RI (25°C): RI-Bias/Gain/Square/Cube. The values are specific for each sensor. Enter from Calibration/Parameters/Standard RI.
- Temperature adjustments: TMPC0, TMPC1 are factory adjusted and specific for each sensor. For Tbias, see Section 5.8. Enter from Calibration/Parameters/Temperature.

5.8. TEMPERATURE CALIBRATION

Normally the process liquid temperature is considerably higher than the ambient. Then the heat loss through the Sensor may cause the temperature display to be about 5 °C (9 °F) lower than the process temperature. This will not impair the measurement, and the difference can be ignored.

If, however, the temperature has to show an absolute correct value, then a bias in °C can be added to the temperature reading, "Temperature bias".

Note: A change of Temperature bias will cause a small change in the concentration output, due to the temperature compensation.

6. MAINTENANCE

6.1. REGULAR MAINTENANCE

The need for regular maintenance is minimal, due to the construction with no moving parts, no trimpots and with a solid-state light source. The following rules apply:

– Keep the sensor head and the Indicating transmitter clean and dry.

– Check that the ambient temperature is not above +45 °C (113 °F). The sensor head should not be too hot to keep a hand on.

– Check that the prism wash works, see Section 8.1.

– Once a year check that the prism surface is smooth and clean. To replace prism or gaskets see section 6.7.

– The PR-01-S sensor has an internal moisture detector, except for PR-01-S-EX/FM, see below. The reading is obtained from the Indicating transmitter display (Key sequence: Display/Sensor Head). Check that reading once a month. An increasing signal indicates condensate forming in the sensor head (if the process temperature is below ambient) or prism leakage. If the moisture reading exceeds 30%, change the drying agent. If the reading exceeds 50%, check the prism seals.

– *The intrinsically safe sensor PR-01-S-EX/FM (or earlier versions of PR-01-S) is equipped with a moisture indicator (Figure 6.10). The sectors in the moisture indicator should be light blue. If sector 30% is pink, change the drying agent. If sector 40% or 50% is pink, check also the instrument. (It may indicate prism seal leakage).*

– The drying agent is contained in a perforated aluminium case inside the sensor head cover. The drying agent should appear blue through the window in the aluminium case. Regenerate the drying agent by keeping the perforated aluminium case in a 130 -150 °C oven for a few hours or dry it with a hot air blower.

Note: Never remove or try to regenerate the moisture indicator (Figure 6.10).

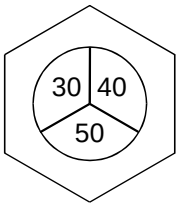


Figure 6.10 The moisture indicator of the PR-01-S-EX/FM sensor.

6.2. DIAGNOSTICS

For a systematic approach to the identification of a faulty component a basic understanding of the operation is necessary. Read sections 2.3 to 2.8 for general information. Use flow diagram Figure 6.20 for guidance.

The trouble shooting normally starts with a check of the Diagnostic message (Table 6.30). Remember that a sluggish or irregular output signal can result from unfavourable process flow conditions, section 3.1.

Figure 6.21 gives a general description of the information and power flow between different parts of the total system. Section 6.4 gives a complete description of the Indicating transmitter. Figure 6.22 shows the signals cable. Section 6.5 describes the Sensor and the optical image. Section 6.6 gives the details of the temperature measurement.

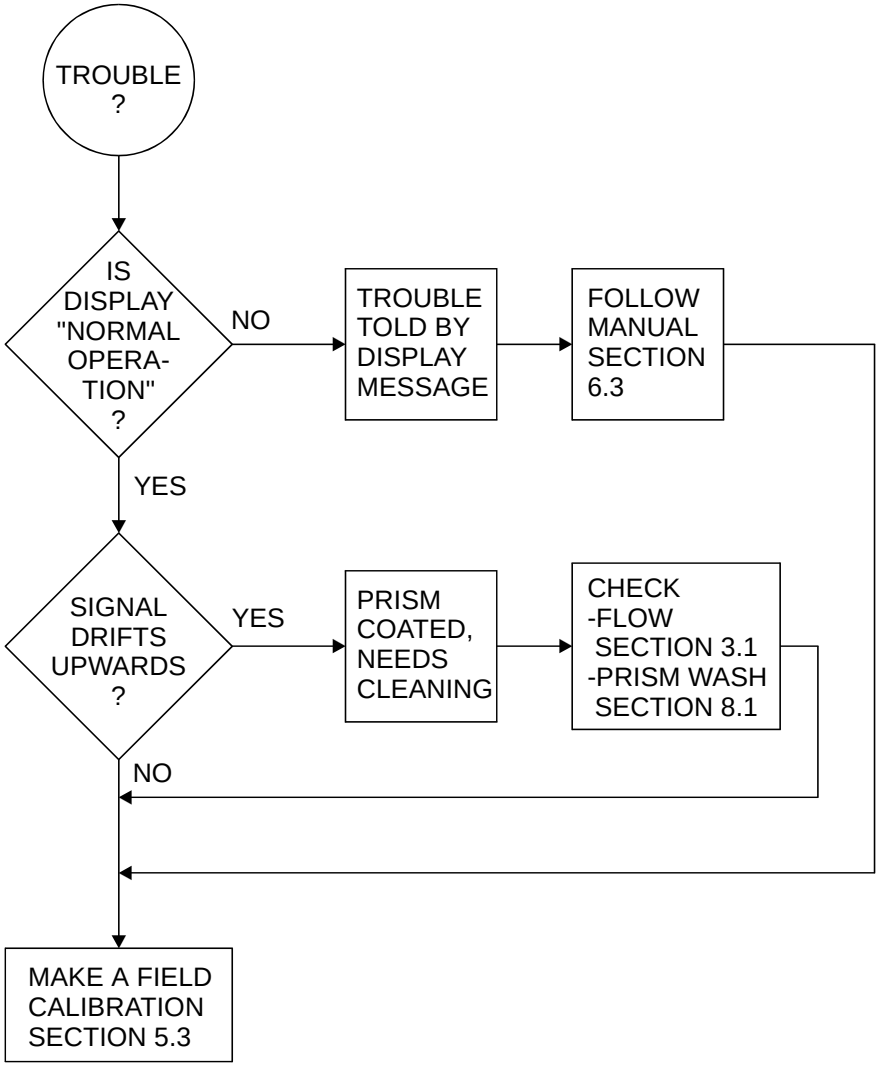


Figure 6.20 Diagnostics guide.

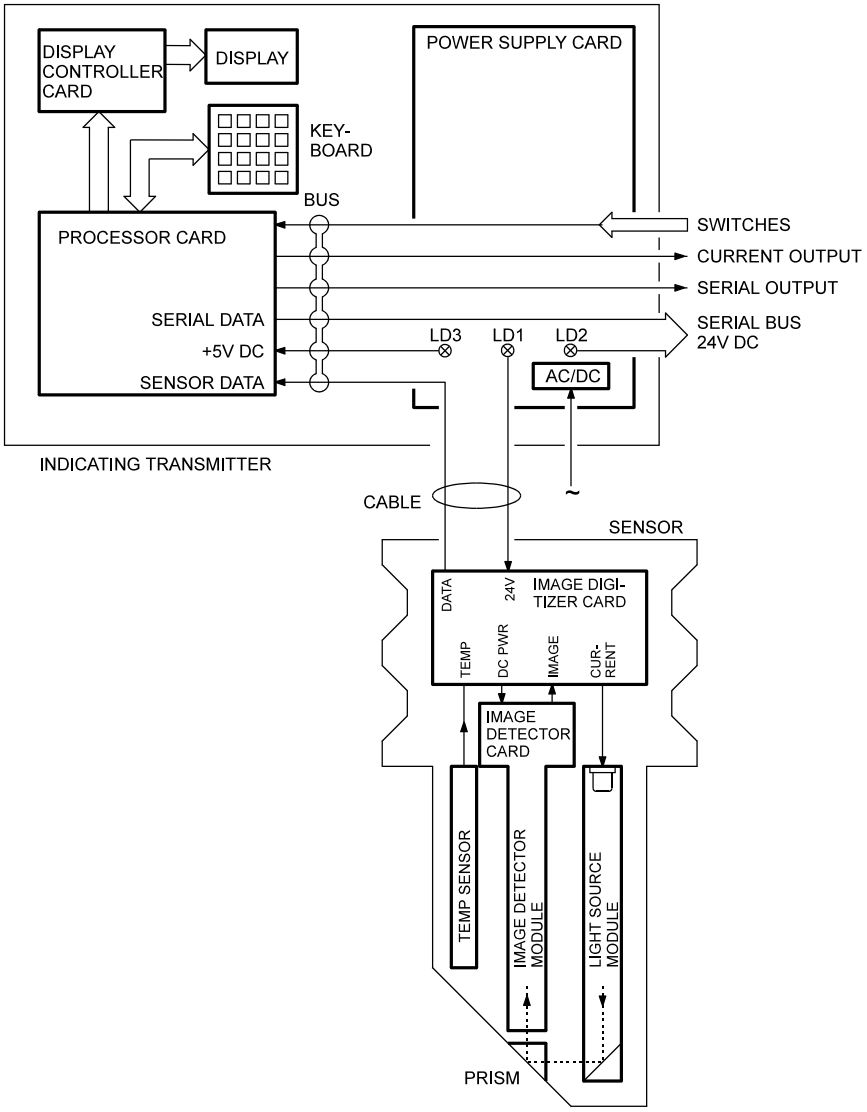


Figure 6.21 Information and power flow. *For intrinsically safe system, see Figure 12.50.*

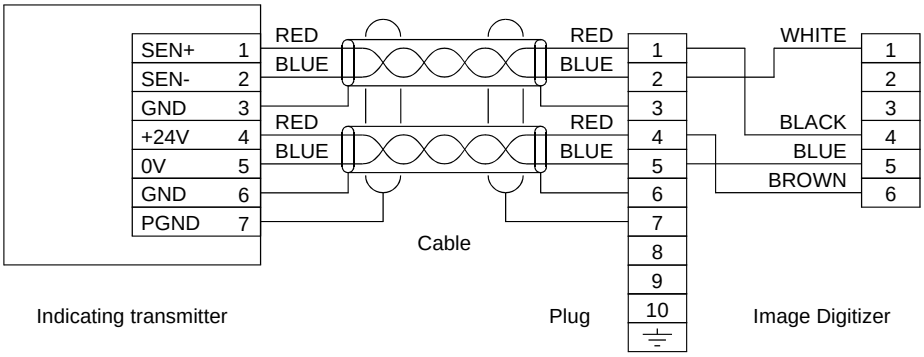


Figure 6.22 Cable signals. *For intrinsically safe systems, use Figure 12.22 (field wiring) and Figure 12.53 (internal wiring).*

6.3. DISPLAY MESSAGES

The diagnostic messages and the phase codes are listed in Table 6.30. The diagnostic messages are listed by increasing priority. E.g. if we simultaneously have “Temp measurement fault” condition and "No sensor signal" condition, the display message will be "No sensor signal".

NORMAL OPERATION:

If the CONC% display is not according to specifications, take samples and use Calibration Data Report, Section 5.3. Also check that the prism surface is clean.

PRECONDITIONING:

Shown when the preconditioning valve is activated by the Relay Unit, Chapter 9.0.

WASH:

Shown when the prism wash valve is activated by the Relay Unit. The concentration output is locked (if the HOLD function is active). The HOLD function can be inactivated from the keyboard, (Section 2.8). The concentration display is never locked, but a large "WASH" will flash when the wash starts.

RECOVERY:

Shown during the time delay after end of prism wash when the concentration output is still locked.

HOLD:

Caused by input switch closure, when the switch has been configurated as a Hold switch, Section 2.8.

HIGH INTERNAL HUMIDITY:

Caused when humidity inside the sensor is higher than 50%.

Action: Remove the sensor from the process line and check it, see Section 6.1.

HIGH INTERNAL TEMPERATURE:

Caused when the temperature inside the sensor is higher than 60 °C (140 °F).

Action: Improved air-cooling is recommended, see Section 3.1.

WASH STOP / TEMP. LIMIT:

Caused when the Wash stop is active and the process temperature is below temperature limit, Section 9.2. The message is shown until wash succeeds or the RESET key is pushed.

LOW CONCENTRATION/NO SAMPLE:

Probably caused by exceptionally low concentration or empty process pipe.

Action: If sample determination indicates normal concentration, then check optical image, Section 6.5, decision according to Figure 6.54.

Code	Diagnostig message	Cause
0	Normal operation	No fault
0	In divert control operation	No fault
0	Removed from divert control	No fault

Process related faults			
Priority	**Code**	**Diagnostic message**	**Cause**
1	1	Retrying wash	Prism wash attempt failed
2	2	Solids warning	Solids below warning limit
3	3	Solids alarm	Solids below alarm limit
4	23	Wash stop / Temp. limit	Temperature below set limit
5	4	Low concentration / no sample	Whole image bright
6	6	High process temperature	Temperature above set limit
7	21	Low light intensity	Image nearly dark
8	22	Dip in image	Optical image not correct
9	7	High conc / prism coated	No shadow edge in image

Equipment malfunctions			
Priority	**Code**	**Diagnostic message**	**Cause**
10	28	Wash stop / ext. stop	Input switch activated for wash stop
11	5	Prism wash failure	Wash fault after retries
12	8	External output failure	No response from output unit
13	9	Relay unit fault	No response from relay unit
14	10	Divert control fault	No response from divert unit
15	11	Temperature measurement fault	Temperature out of limits
16	12	Prism coated / LED fault	Light intensity too low
17	13	Not in line	In line switch contacts open
18	24	High internal humidity	Sensor internal humidity too high
19	25	High internal temperature	Sensor internal temp too high
20	14	Detector timeout	No signal from image detector
21	15	Sensor transmission error	Noisy signal from sensor
22	16	No sensor signal	No signal from sensor
23	17	Wrong concentration parameters	Makes R.I. outside range
24	18	Constants error	Wrong EEPROM parameters
25	19	Sensor interface fault	Fault on processor card
26	20	EEPROM write error	Fault on processor card

Phase codes		
Code	**Diagnostic message**	**Cause**
0	Blank	Normal operation
1	Wait	Wash permit wait
2	Precondition	Preconditioning
3	Precondition	Precondition / wash wait
4	Wash	Wash
5	Recovery	Recovery from wash
6	Hold	Hold after external wash

Table 6.30 PR-01-S messages.

HIGH PROCESS TEMPERATURE:

The process temperature exceeds the "High temperature limit" set from keyboard after Calibrate/Temperature. This alarm can be enabled/disabled. The cause may be abnormal process conditions or a leaking prism wash steam valve.

LOW LIGHT INTENSITY:

The shadow edge is still detected, but the light intensity is low, see Figure 6.54. This message probably indicates onset of prism coating.

DIP IN IMAGE:

Inspect the optical image for irregularities. Missing or low pulses in the light area may be caused by a speck of dust on the CCD window or optical fiber end.

****WASH STOP / EXT. STOP ****:**

Caused if an input switch is activated for external wash stop and the corresponding input switch is connected, Section 2.8.

HIGH CONC/PRISM COATED:

Indicates prism coating.

Action: Clean the prism surface. Use a strong solvent like nitric acid. If message persists, check optical image, Section 6.5, decision according to Figure 6.54.

Note: May be caused by exceptionally high concentration.

**** EXTERNAL OUTPUT FAULT ****:**

The External Output unit (Section 10.1) did not acknowledge the transmission. Serial bus or Output unit failure. The Output unit may also be disconnected.

To prevent this message when the Output unit is disconnected, key in Calibrate/Parameters/Output signals/External output/Source and select: "Not defined".

**** RELAY UNIT FAULT ****:**

The Relay unit (Chapter 9.) did not acknowledge the transmission, Serial bus or Relay unit failure. Maybe the Relay unit is not connected.

To prevent this message when the Relay unit is disconnected, key in Calibrate/Parameters/Relays/Relay unit and select "Not defined" for each relay.

**** TEMP MEASUREMENT FAULT ****:**

Indicates that the temperature value reported by the sensor corresponds to a value below -50 °C or above +250 °C by a margin of 10 %. Probably temperature sensor failure, see Section 6.6.

If "Temp. measurement fault" the temperature will be set to TNM (one of the CONC(RI) parameters). This value is then also used in the temperature compensation, which means that the output will be reasonable even at temperature measurement failure.

Action: Change temperature sensor.

**** PRISM COATED/LED FAULT **:**

Light intensity too low, probably due to coating.

Action: Clean the prism surface. Use a strong solvent like nitric acid. If message persists, check optical image, Section 6.5, decision according to Figure 6.54.

**** DETECTOR TIMEOUT **:**

The fault is in the sensor, Section 6.5.

No signal from the Image detector card received by the Image digitizer card. Probably CCD-element or Image detector card failure. The 15 V supply to the Image detector card may be incorrect due to a wrong position of the main power switch, see Section 3.6.

Action:

1. Check the position of the main power switch.
2. Change the Image detector card.

**** SENSOR TRANSMISSION ERROR **:**

The signal from the Sensor to the Indicating transmitter is irregular. The sensor transmission has overrun or there is a checksum error on the received message. Error is caused by noise in the sensor transmission.

**** NO SENSOR SIGNAL **:**

There is a sensor signal timeout. No signals have arrived during the 800 ms measurement interval (normally about 5 scans). Probably the interconnecting cable is not connected properly.

**** WRONG CONCENTRATION PARAMETERS **:**

This occurs only if the output unit is selected to be RI (x °C). Then this message occurs if CONC(RI) parameters give a value below 1 or above 2. To reset this message, either key in correct CONC(RI) parameters or change the concentration unit (Select Calibrate/Parameters/CONC(RI)/Unit).

**** CONSTANTS ERROR **:**

There are constants in the EEPROM outside allowed range. This error stops the measurement process.

Action: Switch power OFF/ON. Then one of two alternatives will occur

1. If the EEPROM has been changed, or the program upgraded:
   ** Constants are not available **
   Press ENTER to load default settings
   Press RESET not to change.
2. If only some constants are wrong:
   ** There are erroneous constants **
   The bad constants can be set to default setting
   Press ENTER to correct bad constants

**** SENSOR INTERFACE FAULT **:**

Error on the processor card in the Indicating transmitter (Section 6.4): The sensor interface processor (87C51) did not respond properly. Probably failure of this processor.

Action: Change the processor card.

**** EEPROM WRITE ERROR **:**

Error on the processor card: The EEPROM did not write constants correctly. Probably component failure.

Action: Change the processor card.

No message: Measure the mA output signal. If this is OK, then the display is probably faulty.

Note. Ambient temperature above specifications may dim the display.

6.4. INDICATING TRANSMITTER

Before investigating the Sensor, it is advisable to make sure that the Indicating transmitter is working. The Indicating transmitter can be tested separated from the Sensor by the following procedure:

– Power off
– Disconnect cable to sensor
– Power on

Then the diagnostic message should be

"** No Sensor signal **". Any other message indicates fault in the Indicating transmitter.

The Demo mode, Section 4.3. Disconnect all connections to terminals 1 - 14, and make connection as in Figure 4.30. Then the Serial bus output will work as a sensor head simulator, and the whole Processor card will be checked, see the block diagram Figure 6.42.

Power supply card

The Power supply card is described by Figure 6.40 component lay-out and Figure 6.41 circuit diagram.

The following DC powers are supplied by the card:

1. +5V to Processor card. Should be 5V ± 5 %. Typical load about 350 mA, should be below 500 mA. Indicated by the green LED LD3, see Figure 6.40.
2. +24V to Sensor. Typical value 25V ± 10 %, indicated by the green LED LD2.
3. +24V to serial bus, to supply accessory units, as the Relay unit, Chapter 9. Typical value 25 V ± 10 %, indicated by the green LED LD1.

The Test point "0V", see Figure 6.40, is also the 0V at the Processor Card, in the Sensor and in the serial bus to accessory units.

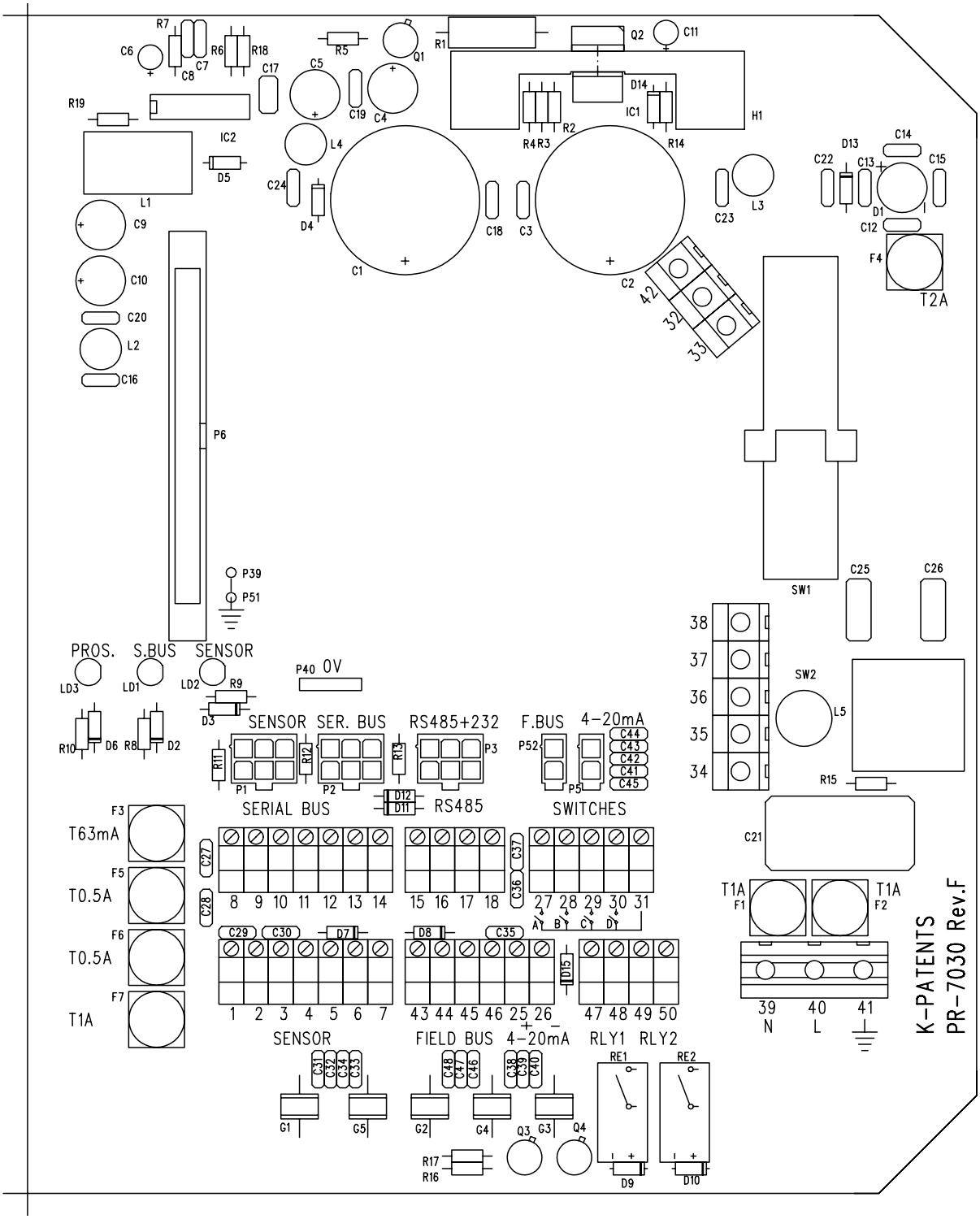


Figure 6.40 Power supply card component lay-out.

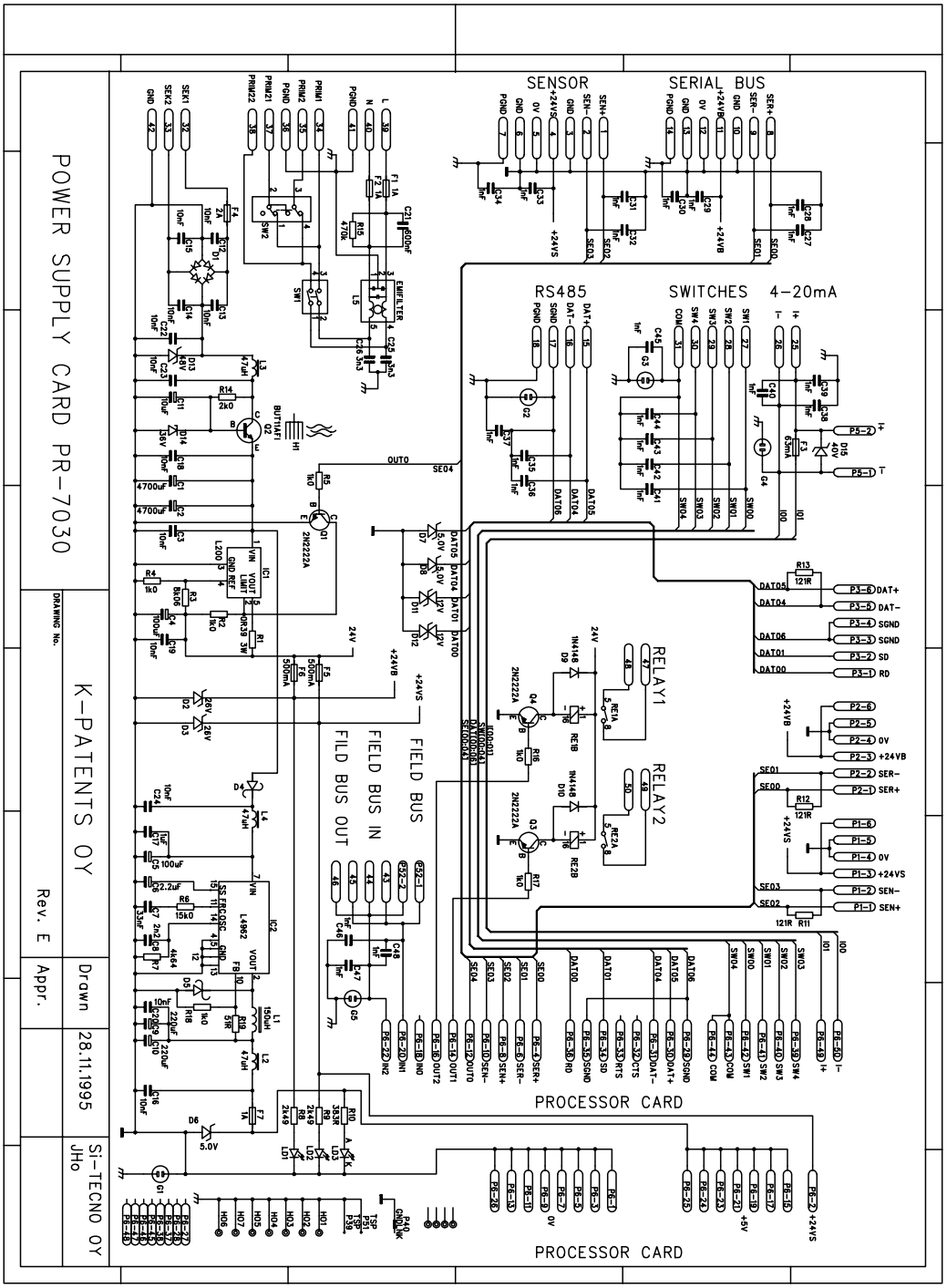


Figure 6.41 Power supply card circuit diagram.

Processor card

The function of the Processor card is described by the block diagram Figure 6.42 and the component lay-out Figure 6.43.

When measuring voltages on the Processor card it is important to remember that some parts are galvanically separated form each other, see Figure 6.42. It is essential to use the right ground for measurement:

– TP 0V for processor, and also for DC power supply, Serial bus and Sensor.

– TP CLGND is 4-20 mA current loop ground

– TP SGND is RS-232/RS-485 serial output ground

– TP COM is switch input common terminal

Diagnostic LEDs

Two LEDs on the Processor card indicate the CPU (80C186) activity, see Figure 6.43:

LED D3 is lit when the processor is running

LED D4 is lit during interrupt service

Both LEDs should show a blinking light if the processor is working normally. Four rythms with different intervals are overlapping: 10 ms clock, 150 ms new sensor data, 800 ms new value calculation, 1 s timer count. The most obvious rythm is th 800 ms; first a short D4 blink, then a 200 ms D3 flash.

Processor startup errors

The processor hardware is checked on startup. The startup failures are announced as blinking codes on the LED D3. The error code is 1 to 5 blinks on D3 with D4 dark. The error code is the following:

– 1 blink: The chip select unit on the CPU chip (80C186EB) is faulty.

– 2 blinks: The CPU failed the register test. The CPU chip is faulty.

– 3 blinks: The RAM memory failed the address uniqueness test. The memory or its bus interface is faulty.

– 4 blinks: The RAM memory failed the pattern test. There is a bad RAM chip.

– 5 blinks: The code in ROM failed the CRC check. The code is protected with a CRC check. The ROM chip or program pattern in it is faulty.

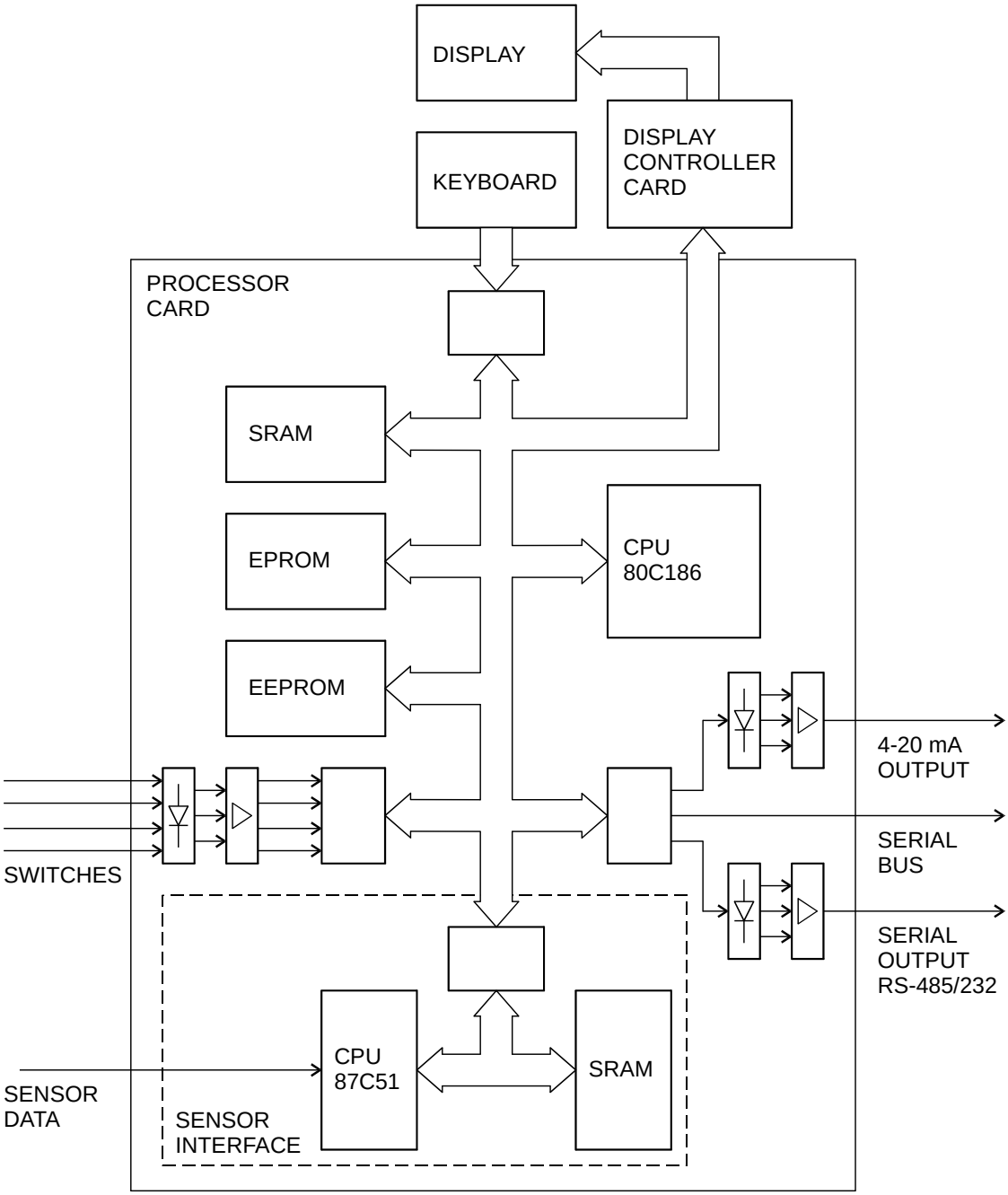


Figure 6.42. Processor card block diagram.

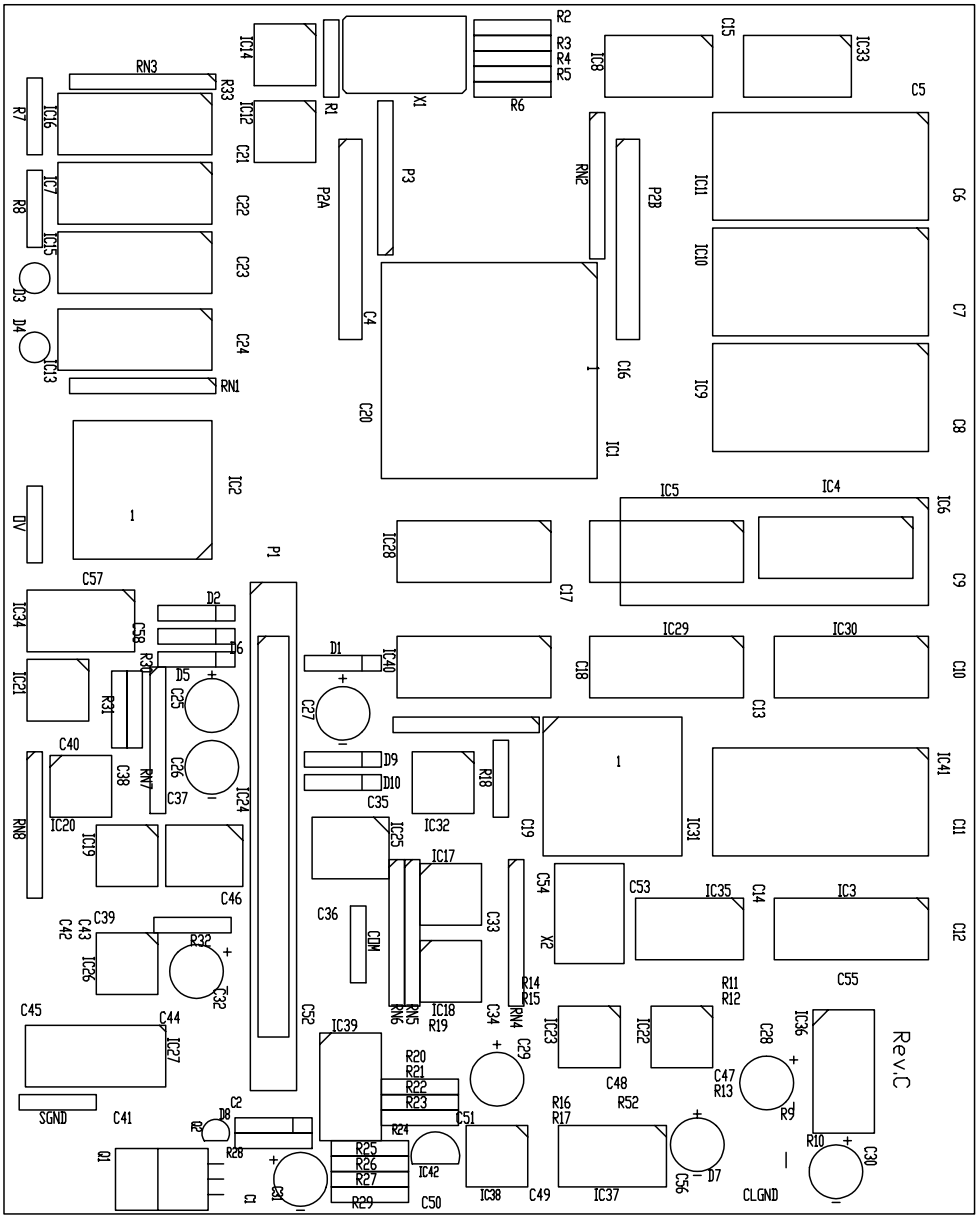


Figure 6.43 Processor card component lay-out.

Display controller card

The Display controller card has the components surface mounted, and it should be considered as one part.

Keyboard

The Keyboard switch matrix is given by Figure 6.46.

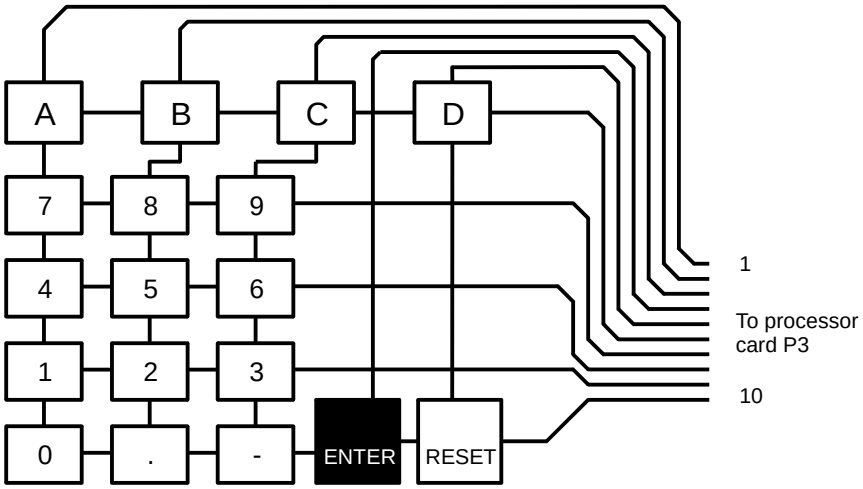


Figure 6.46 Keyboard switch matrix.

Transformer

For transformer colour code, see Figure 6.47. The leads are connected to the following Power card terminals (compare to Figure 6.40):

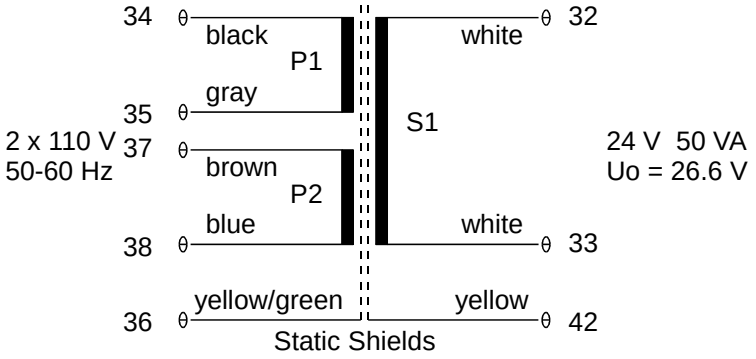


Figure 6.47 Transformer.

6.5. SENSOR CHECK

Study Figure 6.50 to get a basic understanding of how the Sensor works.

Select Calibrate/Optical image from the Normal Display (Figure 2.60). The screen (Figure 6.51) contains now all raw data from the Sensor including the signals from each photo cell, i.e. the raw video signal. This differs from the Optical image, Figure 2.72, selected through the "Display" key.

The video signal describing the optical image should look like Figure 6.51. In that case the Sensor is OK, and it should not be touched. If the concentration output does not agree with laboratory values, a Field calibration (Section 5.3) should be done.

The video signal can also be measured directly by an oscilloscope. Use an oscilloscope with a 10 MOhm probe (10x) in AC mode. Connect the signal ground to TP 0V, and the channel to TP4, see Figures 6.52 and 6.50. The duration of one image is 3 ms. The voltage amplitude is 2.5 - 3.7 V corresponding to Indicating transmitter display 0 - 255.

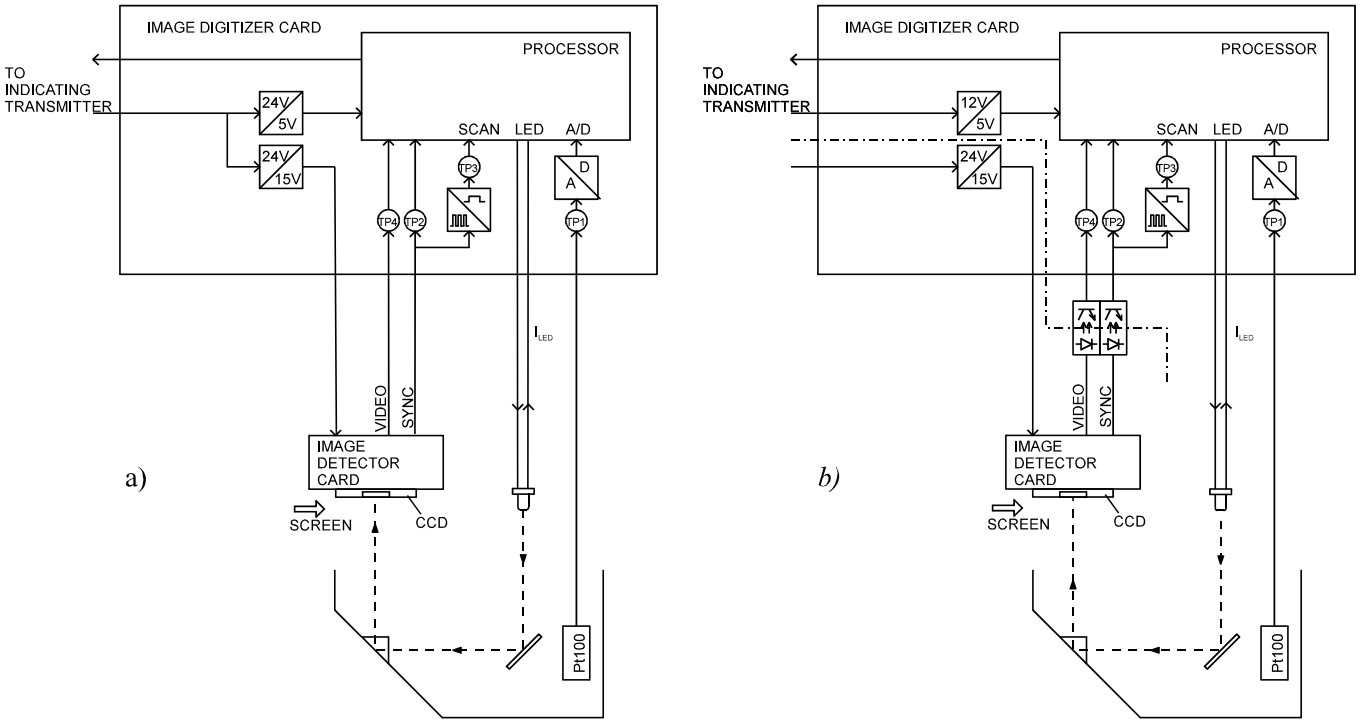


Figure 6.50 Sensor information and power flow.
a) Standard sensor. *b) Intrinsically safe sensor.*

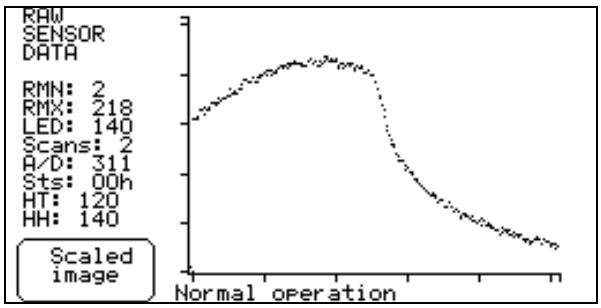


Figure 6.51 Optical image and raw data.

Raw data explanations:

RMN, RMX: Minimum and maximum of the raw video signal. This signal is calculated on the Processor card from the video signal. The scale is 0 - 255, corresponding to full scale on display.

LED: The LED current control signal on a scale 0-255 corresponding to 0 -8 mA. This is the current control signal from the Processor, and not an actual measurement of the LED current. The red light of the LED can be seen directly, Figure 6.80. If the operation is correct, the displayed LED value should be above 20 and below 200.

Scans: Number of optical images during one calculation cycle, typically 3 to 4. The scan pulses (with 5 V amplitude) can be measured at TP 3 (Figure 6.50).

A/D: This refers to the temperature measurement, Section 6.6.

Sts: Sensor status bits. Should be "00h" for a standard and Intrinsically Safe sensor. Status "01h" indicates "Detector timeout".

HT: Sensor head temperature sensor reading. This value is used in calculating the actual Sensor head internal temperature.

HH: Sensor head humidity sensor reading. The actual relative humidity in the Sensor is calculated from HH and HT.

Sensor faults:

Sensor faults can be distinguished by the following indications:

The diagnostic message ** No sensor signals **:

> The fault may be in the single path from Image digitizer to the interconnecting cable to the Processor card, see Figure 6.22. If the signal path is OK, then the Image digitizer does not work. Check the 24 V and the 5 V supply to Processor card, Figure 6.52. If the supply is OK, change the Image digitizer card.

The diagnostic message ** Detector timeout **:

> The scan pulses (Figure 6.50) are missing at TP 3 (Figure 6.52). Check the 15 V supply to the Image detector card, Figure 6.52. If the 15 V supply is OK, but the sync signal TP2 is absent, then change the Image detector card. The sync signal is similar to the video signal but the pulse amplitude is constant. Check also the main power selection switch position, see Section 3.6.

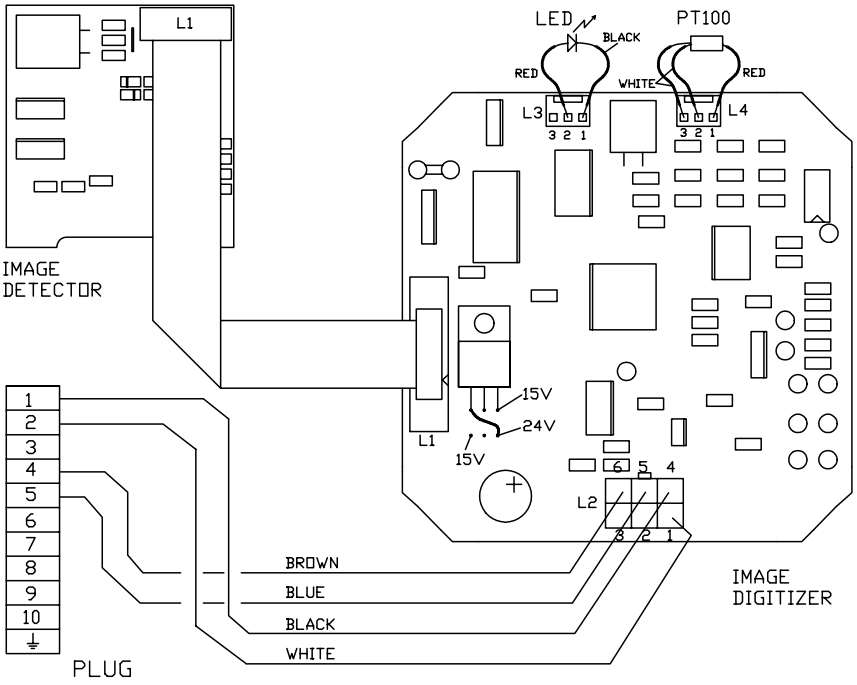
A way to check the function of the Sensor is to place an opaque screen before the CCD-element, see arrow marked screen in Figure 6.50. When the screen blocks the light to the photocell, the video pulses should decrease. When the Max value drops below 200, the LED control signal should increase, which in turn should make the LED brighter.

If a light e.g. from a flashlight is directed on the screen to illuminate the photocells, then the video signal should increase, the LED control should decrease and the LED should get dimmer.

Scaled image:

The following display is the scaled image, Figure 6.53. The optical image is now modified mathematically. The following information is provided (where the numbers refer to Figure 6.53):

a)



b)

Figure 6.52 Sensor electronics test points.
a) Standard transmitter. *b) Intrinsically safe.*

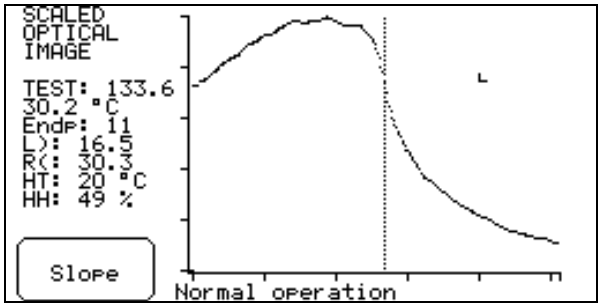


Figure 6.53 Scaled optical image.

1. TEST: The calculated TEST value, range 8...248. Indicated by a dotted vertical line.
   T: indicates the process temperature, to facilitate field calibration
2. Endp: the value of the rightmost point in % of span.
3. L): A measure of the left side curvature of the optical image.
4. R(: A measure of the right side curvature of the optical image.
   A zero curvature indicates a straight line. Both curvature values are defined as positive for an image as Figure 6.53.
5. HT: Sensor head internal temperature in °C.
6. HH: Sensor head internal relative humidity in %RH.
7. An L-shaped corner mark. **For a clean prism in air the optical image should form a smooth hill and be above the corner mark.**

Slope:

This display shows the slope curve of the optical image. At the TEST value, the SLOPE curve should have a sharp dip. The following additional values are given:

Max: The filtered value of the maximum light intensity RMX of the raw data (Figure 6.51).

Slope: The absolute value of the slope curve dip at TEST. The value of Slope must be above 1 to be acceptable.

Image diagnostics:

This display lists the critical values for TEST acceptance according to the image analyzer decision rules in Figure 6.54.

Max intensity OK (above 100)? Yes/No
Endpoint below 75 %? Yes/No
Image below corner? Yes/No
Slope OK (above 1)? Yes/No
Left curve OK (above 1)? Yes/No
Right curve OK (above 1)? Yes/No
For measurement with a normal sample, all answers should be "Yes".

A message "Dips in image" appears if the optical image is irregular.

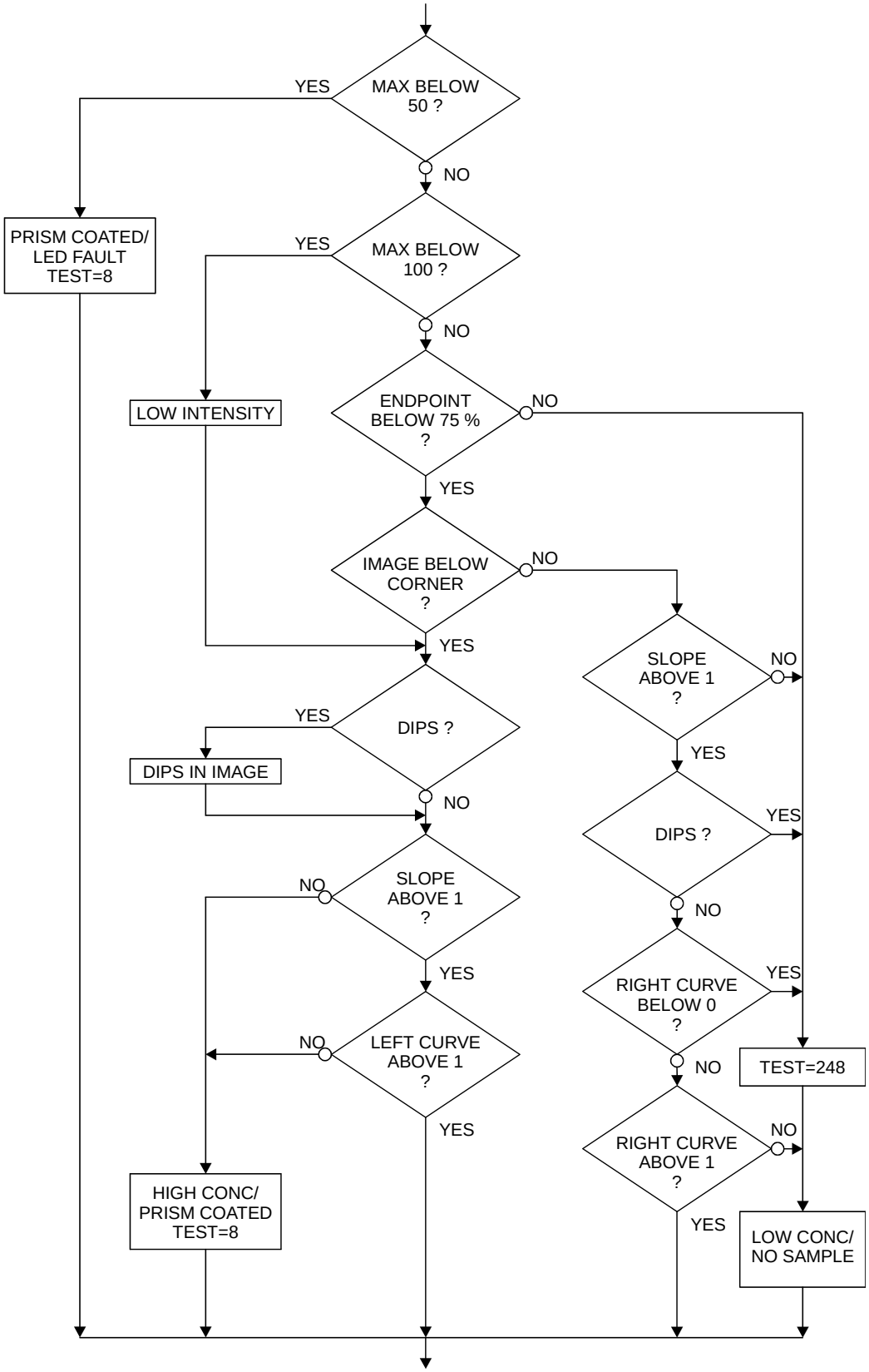


Figure 6.54 Image analyzer decision rules.

6.6. TEMPERATURE MEASUREMENT

The temperature is measured by a Pt100 platinum resistance element, see Figure 6.52 and also Section 7.1, Sensor parts, item 10. The Sensor raw data (Section 6.5) gives the A/D value, which refers to the temperature A/D converter: 0 - 1023 corresponds to 1.8 - 3.0 V corresponding to -75 °C .. 300 °C.

The temperature bias calibration was treated in Section 5.8. The temperature correction parameters TMPC0 and TMPC1 are specific for the Image digitizer card, not for the Pt100 element.

To check the temperature measurement, the Pt100 element can be disconnected from the terminal L4, and substituted by a Pt100 calibrator. Alternatively, terminal 3 and 2 are connected by a jumper, and 2 and 1 by suitable resistors, e.g. 100 Ohm for 0 °C and 138.5 Ohm for 100 °C.

6.7. PRISM GASKET REPLACEMENT

Prism dismounting

If the prism surface has been damaged or if the prism seal leaks the prism has to be dismounted:

Remove the sensor head from process and wash thoroughly with warm water. Dry completely e.g. by compressed air.

Open the two screws (Figure 6.70).

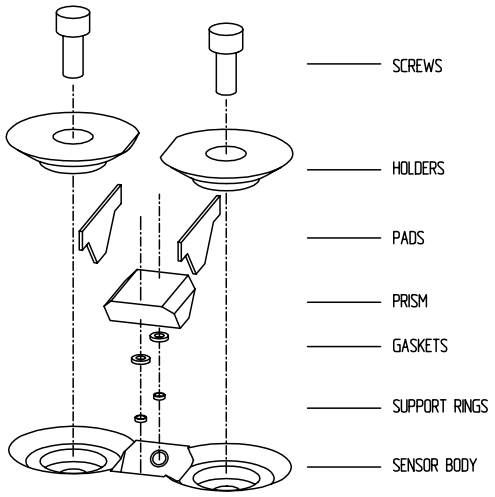


Figure 6.70 Prism mounting.

Prism mounting with Kalrez gaskets

1. Clean the seat carefully. Check that there is absolutely no dirt or dust on the sealing surfaces around the holes and that they are smooth. The prism must have clear and clean surfaces. Clean with e.g. alcohol. Do not touch the sides to the seals after cleaning.
2. Check that the support rings are undamaged. Push the support rings into the holes (Figure 6.71). The rings should fit snugly. Make absolutely sure that the rings are below the surrounding surface (d in Figure 6.71). If a ring is not below the surface, then remove and check that the hole is clean and smooth.

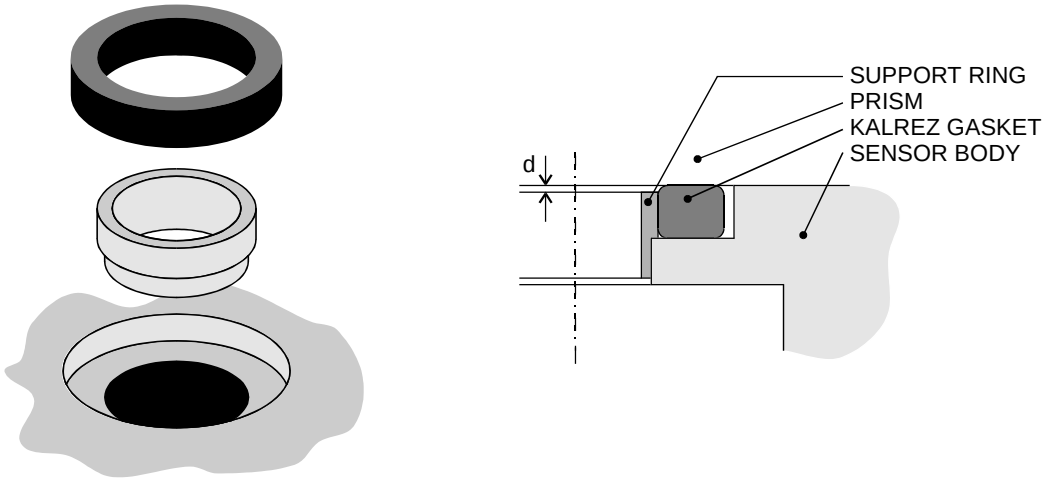


Figure 6.71 Mounting of Kalrez gaskets.

3. **Always use new gaskets.** Clean the gaskets with cleansing spray. Mount the Kalrez gaskets and put the prism in place. Slide the prism lightly in the groove in both directions (± 1 mm). This helps the gaskets to settle in the right position.
4. Put prism holders and screws in place. The teflon or compression pads should be carefully fitted between the prism and the prism holders. No part of the compression pads should be between the prism holder and the refractometer body. Tighten the screws alternatingly in small steps. Trim excess teflon with a razor blade.
5. Tighten the screws with torque wrench to 10 Newton meters.
6. Inspect the gasket contact surfaces through the prism. They should form regular concentric rings around both holes (Figure 6.72). The rings should have the same size.
7. If the contact surfaces do not look good loosen the screws and start again from the beginning.

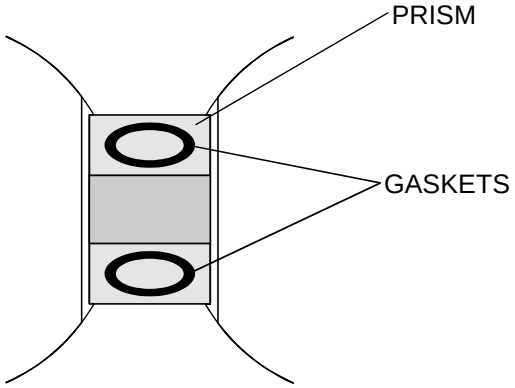


Figure 6.72 Kalrez gaskets seen through the prism

Prism mounting with teflon gaskets

Teflon gaskets are mounted the same way as Kalrez gaskets. Do not handle the teflon gaskets with metal tools like pliers or tweezers.

False leakage

Sometimes process liquid can be seen behind the prism, Figure 6.73. This is normal and does not indicate that the prism gaskets are leaking. Only the round areas inside the prism gasket rings are sealed from the process liquid. Thus leakage is indicated only if process liquid is seen in the area inside the rings.

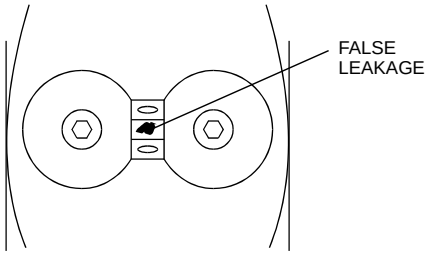


Figure 6.73 False leakage.

6.8. SENSOR DISASSEMBLY

Cover

Open the clamp using a 11 mm wrench. Lift cover carefully, the O-ring seal causes some friction.

Image digitizer card

Remove the Image Digitizer Card, Figure 6.52. Note that all connectors have latches. The color code for the terminal strip is given by Figure 6.52. **Do not touch any other screw than A in Figure 6.80 and B in Figure 6.81.**

Image detector module

Remove Screw A, Figure 6.80. Then the holder can be removed. Gently pull the module out**. Be careful not to pull the Image detector card.** Pull from the back of the module body. At assembly note the aligning pin. Do not touch the screws G or F, because they fix the Image detector card with the CCD-element for receiving optical image correctly from the optics inside of the module.

Light source module

Remove Screw B, Figure 6.81. Then the module can be pulled out. (The hole C should always be empty). The emitter assembly is locked by screw D and can be removed from the module.

Temperature sensor

Use fingers to turn the Temperature Sensor (Fig. 6.81) counter clockwise.

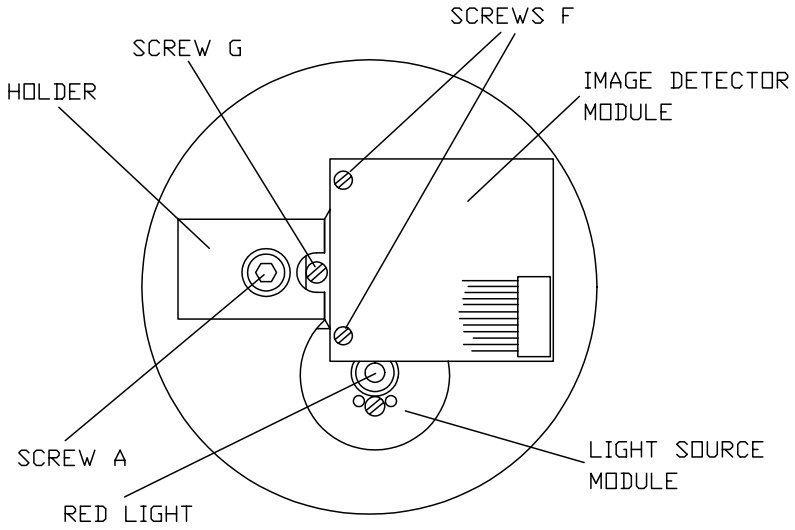


Figure 6.80 Sensor: Image Digitizer Card removed.

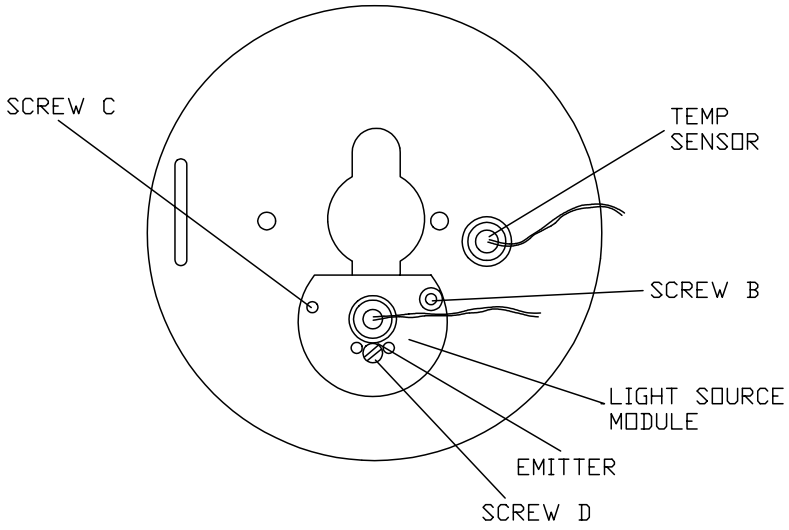


Figure 6.81 Sensor: Image Detector Module removed.

6.9. OPTICAL MODULES TESTING

The optical modules can be tested separately. Remove the module and reconnect to the Image digitizer card.

Light source module

The red light should be seen reflected from the mirror at the tip of the module. This light should focus at a 10 mm distance from module.

6.10. LED CURRENT ADJUSTMENT

The LED current is sensitive to the lenght of the light source module. With high LED current control signals (above 150 with clean prism in air or above 200 in process) the lenght of the module can be adjusted to decrease the current.

Note. The sensor should be checked first before adjusting the light source, See Sections 6.5 - 6.9.

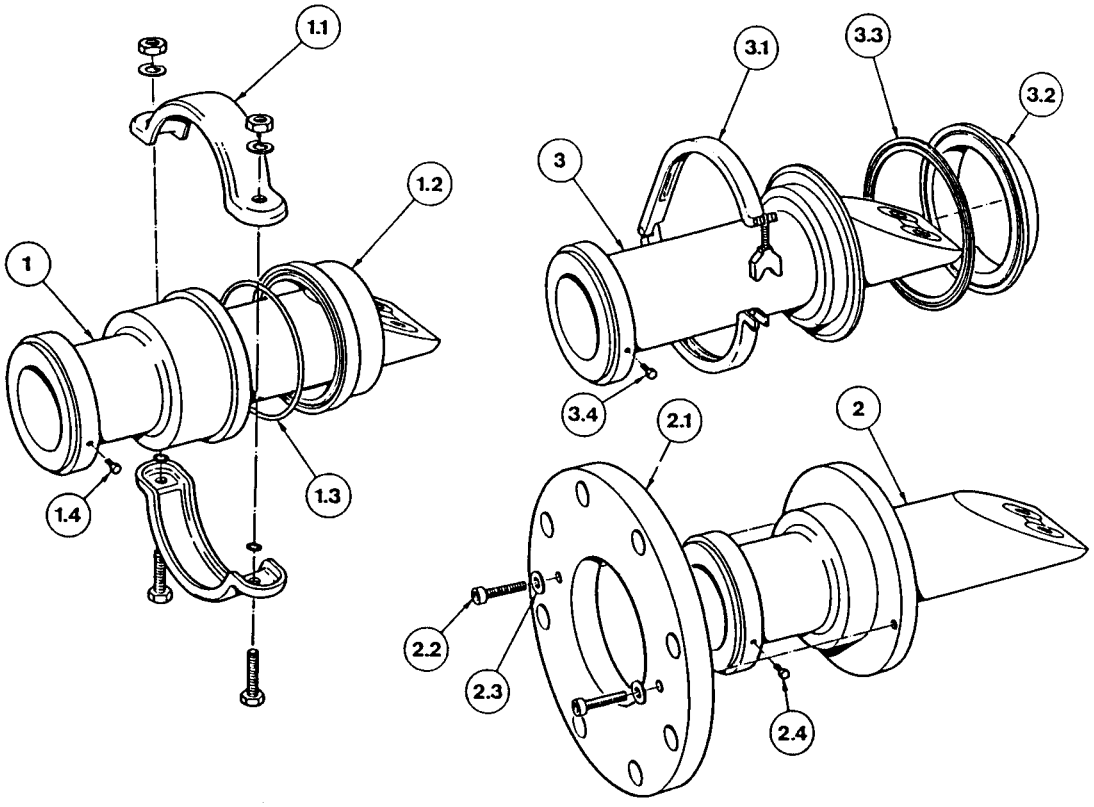
Consult K-Patents or local K-Patents representative, if you are not familiar with the sensor check.

The length can be adjusted as follows:

- Remove the screw on the tightening ring in the middle of the module.
- Loosen the tightening ring.
- Rotate the module pipe one full turn to make the module shorter or longer.
- The LED current control signal decreases or increases as a result of modifying the length.
- The correct length of the module is the one that gives the lowest LED value for clean prism in air.

7. PR-01-S PARTS LISTS

7.1. PROBE

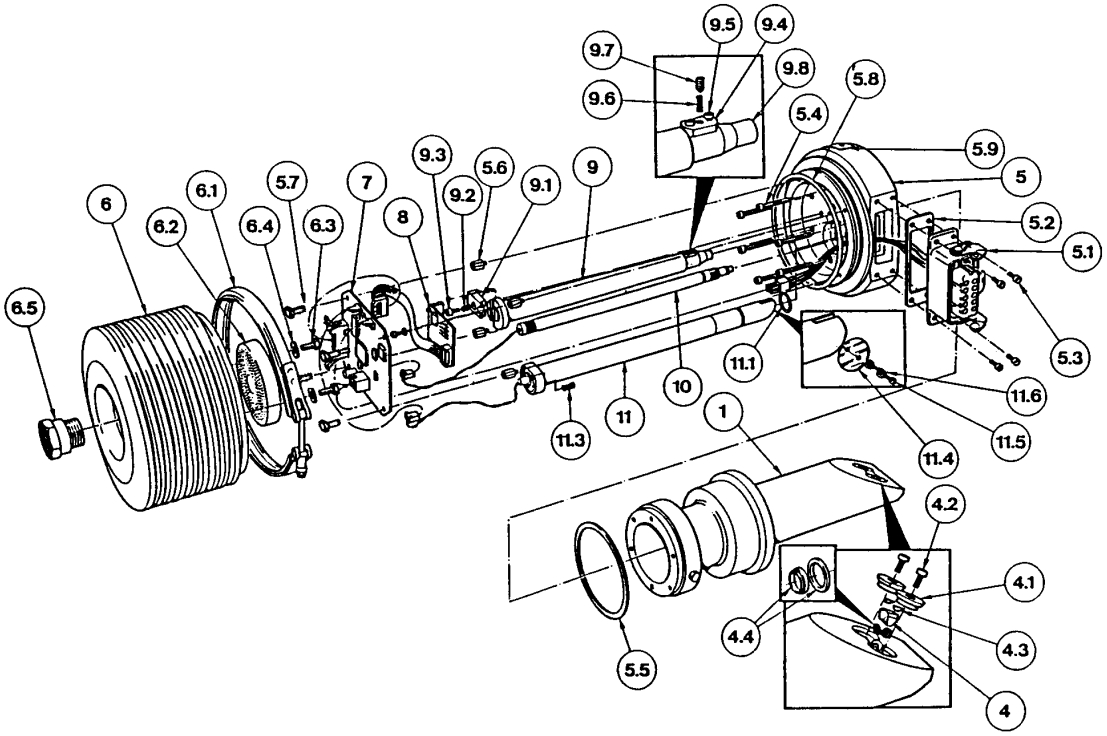


PR-01-S(-EX) PROBE

Item	Pcs.	Part No.	Description
1.	1		Probe with Sandvik clamp FCL-316L-88,9-S-T PN25
1.1	1	PR-3503	Sandvik clamp FCL-316L-88,9-S-T PN25
1.2	1	PR-3504	Sandvik ferrule
1.3	1	PR-3505	Sandvik O-ring FCLO-T-88,9/84 teflon
1.4	*1*		*Earth screw M6 x 10 DIN 933 A4 (added)*
1.5	1		Plug ISO7 DN 8 1/4" AISI 316
1.6	2		Screw DIN 7380 M4 x 6
2.	1		Probe with flange
2.1	1		Flange DIN 2656, PN 25, DN 80 (Alternatively ANSI B16.5 3" RF 150 psi or JIS 10 K 3B)
2.2	2		Screw M6 x 30 DIN 912 SS 316L
2.3	2		Washer M6 DIN 125 SS 316L
2.4	*1*		*Earth screw M6 x 10 DIN 933 A4 (added)*
2.5	1		Plug IS07 PN8 1/4" AISI 316 for Integral nozzle inlet
2.6	2		Screw DIN 7380 M4 x 6
3.	1		Probe with 3A-clamp
3.1	1	PR-3506	3A-clamp SP 13 HC 4"
3.2	1	PR-3507	3A ferrule 102 AISI 316L
3.3	1	PR-3508	3A seal 4" Viton
3.4	*1*		*Earth screw M6 x 10 DIN 933 A4 (added)*

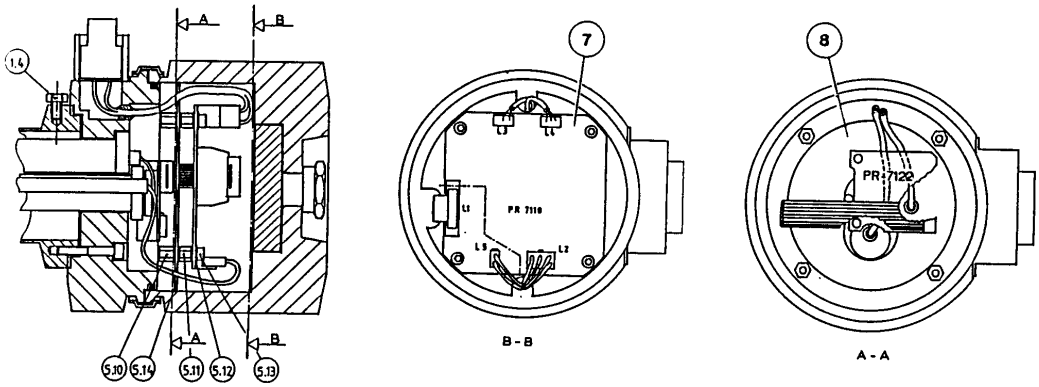
Note. *Parts printed in italics for Intrinsically safe Sensor PR-01-S-Ex/FM only.*

7.2. SENSOR



Item	Pcs.	Part No.	Description	Item	Pcs.	Part No.	Description
1	1		Probe with Sandvik L-clamp	6.	1		Sensor cover
1.4.	*1*		*Earth screw M6 x 10 DIN 933 A4 (added)*	6.1	1	PR-5012	Vee clamp CA 0600/11-130 mm-S-40
				6.2	1	PR-3107	Dryer A35
4.	1		Prism	6.3	2		Screw DIN 912 M4 x 8
4.*	1	PR-5004	Spinel prism with pads & seals assy: Items 4./4.3/4.4	6.4	2		Washer M4 DIN 125
				6.5	*1*	*PR-3116*	*Moisture indicator HUM 18 incl. O-ring*
4.*	1	PR-5007	Sapphire prism with pads & seals assy: Items 4./4.3/4.4	7.	1	PR-7130	Image digitizer card
				7.	*1*		*Image digitizer card*
4.1	2	PR-5005	Prism holders	*7.**		*PR-7115*	*Sensor electronics: Items 7./8. (matched pair)*
4.2	2	PR-5006	Prism holder screws DIN 912 M5 x 12 A4-80				
4.3	2		Teflon pads	8.	1	PR-7120	Image detector card incl. CCD-element
4.3*	1	PR-5003	Prism seals & pads assy: Items 4.3/4.4	*8.*	*1*		*Image detector card incl. CCD-element*
4.4	2		Prism seal Kalrez + support ring				
				9.	1		Image detector module
5.	1		Sensor base	9.*	1	PR-7415	Image detector module assy STD 18: Items 8./9./9.4*
5.*	1	PR-7403	Connector complete assy: Items 5.1/5.2/5.3	9.*	1	PR-7416	Image detector module assy LP 18: Items 8./9./9.4*
5.1	1		Connector complete with leads				
5.1	*1*	*PR-7404*	*Connector complete with leads (modified)*	9.*	1	PR-7418	Image detector module assy LP 15: Items 8./9./9.4*
5.2	1		Connector seal				
5.3	4		Connector screws DIN 912 M3 x8 A2	9.*	1	PR-7419	Image detector module assy STD 10: Items 8./9./9.4*
5.4	6		Screws DIN 912 M5 x 30 Zn				
5.5	1		Thermal insulator 80/90 x 1.7 teflon	9.1	1		Module holder
5.6	4	PR-3114	Plastic stand-offs & screws	9.2	1		Holder spring
5.7	*4*		*Screws DIN A2*	9.3	1		Holder screw DIN 912 M4 x 18 A2
5.8	1	PR-5011	O-ring seal 108 x 3 nitrile	9.4	1		Mechanical zero adjustment device
5.9	1		Sensor label	9.4 *	1	PR-5010	Mechanical zero adjustment assy: Items 9.4/9.5/9.6/9.7
5.9	*1*		*replaced by label Figure 12.11*				
5.10	*4*		*Stand off screw M4 x 10 (added)*	9.5	2		Screws DIN 912 M2 x 10 A2
5.11	*4*		*Stand off screw M4 x 7 (added)*	9.6	1		Spring
5.12	*4*		*Washer M4 x 6 DIN 125 (added)*	9.7	1		Screw DIN 916 M3 x 6 A2
5.13	*4*		*Screws M4 x 6 DIN 912 (added)*	9.8	1	PR-5009	Objective holder and lens 18 mm
5.14	*1*		*Isolation plate (added)*				

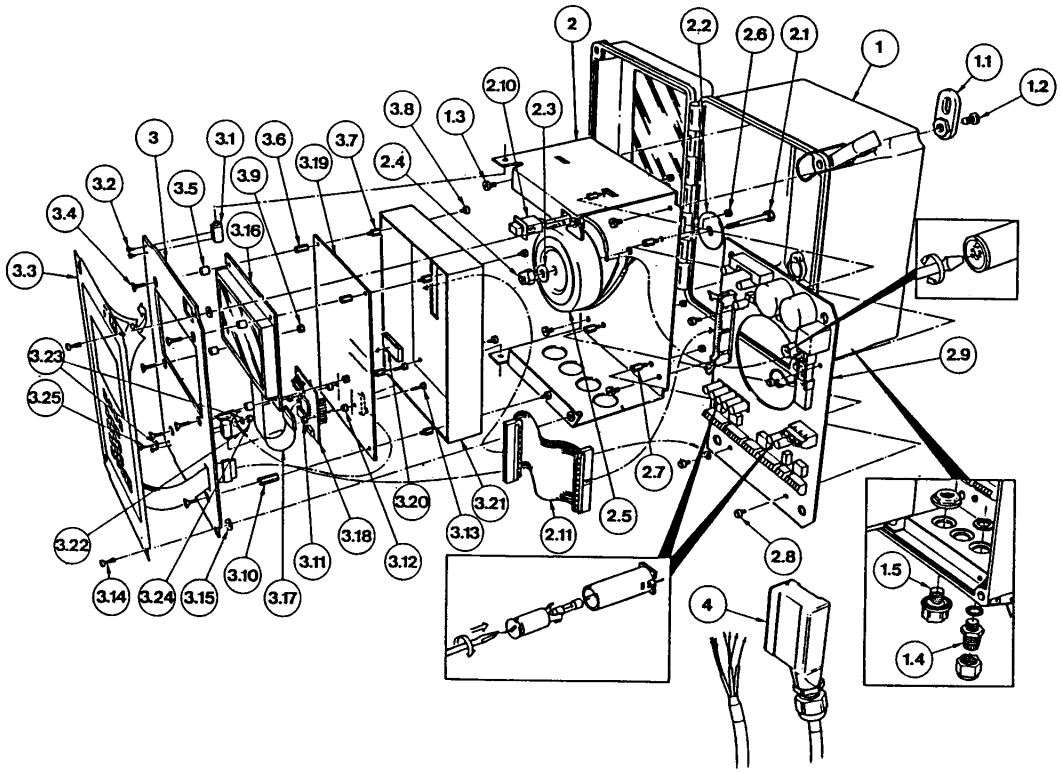
Notes. *Parts printed in italics for Intrinsically safe Sensor PR-01-S-EX/FM only.*
* = Assembly



Item	Pcs.	Part No.	Description
10.	1		Temperature sensor module
10.*	1	PR-7401	Temperature sensor module STD
10.*	1	PR-7402	Temperature sensor module LP
11.	1		Plug-in light source module
11.*	1	PR-7505	Plug-in light source module STD 50
11.*	1	PR-7506	Plug-in light source module STD 57
11.*	1	PR-7507	Plug-in light source module LP 50
11.*	1	PR-7508	Plug-in light source module LP 57
*11.**	*1*	*PR-7505-EX*	*Plug-in light source module STD50 EX*
*11.**	*1*	*PR-7506-EX*	*Plug-in light source module STD 57 EX*
*11.**	*1*	*PR-7507-EX*	*Plug-in light source module LP 50 EX*
*11.**	*1*	*PR-7508-EX*	*Plug-in light source module LP 57 EX*
11.1	1	PR-5211	O-ring seal 16 x 2 viton
11.3	1		Spring 7 x 14 x 1.2
11.4	1		Mirror
11.4*	1	PR-7514	Mirror assembly for plug-in 50
11.4*	1	PR-7515	Mirror assembly for plug-in 57
11.5	2		Screws DIN 84 M2,5 x 4 A2
11.6	2		Washers DIN 125 M2,5 A2

Note. *Parts printed in italics for Intrinsically safe Sensor PR-01-S-Ex/FM only.*

7.3. INDICATING TRANSMITTER



Item	Pcs.	Part No.	Description
1	1		Enclosure
1.1	4		Mounting feet
1.2	4		Screws 10-32 pan head
1.3	4		Screws 10-32 pan head
1.4	4		Cable clands PG 11 (European)
1.5	4		Conduit hubs 1/2" NPT-Type ST-1 (US)
2.	1		Frame plate
2.1	1		Screw DIN 912 M5 x 50 Zn
2.2.	1		Washer DIN 9021 5,2 x 18 Zn
2.3	1		Washer DIN 9021 5,2 x 18 Zn
2.4	1		Nut DIN M5 Nyloc N
2.5	1	PR-7301	Transformer
2.6	4		Nuts DIN 934 M4
2.7	4		Stand-off M4 x 15
2.8	4		Screws DIN 912 M4 x 8
2.9	1	PR-7030	Power supply card
2.10	1		Switch actuator
2.11	1	PR-7028	Ribbon cable
		PR-7029	Fuse set (10 Fuses: 4 x 1A, 1 x 63 mA, 2.2A, 3 x 0,5 A)

Item	Pcs.	Part No.	Description
3.	1		Front panel
3.1	2		Hindge
3.2	4		Screws DIN 912 M3 x 10
3.3	1	PR-7305	Key board
3.4	6		Screws DIN 799/DIN 965 M3 x 12
3.5	2		Ferrule 3,0 x 8 x 3
3.6	2		Stand-off M3 x 10
3.7	4		Stand-off M3 x 15
3.8	4		DIN 912 M3 x 8
3.9	2		Nut DIN 934 M3
3.10	2		Stand-off M3 x 15
3.11	2		Nut DIN 934 M3
3.12	2		Ferrule 5 x 8 x 3
3.13	2		Screw DIN 912 M3 x 10
3.14	2		Locking screw
3.15	2		Locking washer
3.16	1	PR-7315	Display
3.17	1	PR-7019	Display cable
3.18	1	PR-7020	Display controller card
3.19	1	PR-7010	Processor card
3.20	1	PR-7009	Program memory
3.21	1		Cover
4.	1	PR-8001-010	Interconnecting cable, 10 m (30 ftt)

8. PRISM WASH SYSTEMS

Three alternatives of prism wash systems can be provided:

– Steam wash with integral nozzle, Section 8.2.
– High pressure water with integral nozzle, Section 8.3.
– Steam and water wash for flow cell mounting, Section 8.4.

In most of the applications the prism wash is not necessary. However, installing the wash nozzle should always be considered.

A prism wash nozzle (Sections 8.2, 8.3, 8.4) can be useful in cases where normally no prism coating occurs, e.g. to clean the prism after a process stop using a manual wash valve. Washing can also be used for operational check (output signal decreases during wash) or as a part of maintenance schedule.

There is an own prism wash nozzle for Isolation and Retractor Valve HIMP-2 for LPH sensor, see Section 11.

8.1. PRISM COATING

Deposit build up on the prism surface disturbs measurement. Look out for the following indications of coating:

– Abnormally high concentration reading or upward CONC% drift.
– Low TEST values, even TEST = 8.
– High LED current (press Calibrate/Optical image), especially LED = 255 (max) (See Section 6.5).
– Prism wash (e.g. by press Start prism wash) does not increase the TEST value the appropriate amount: For steam wash TEST should be close to 248; for water wash close to the TEST value for water.

In most of the applications the prism will keep clean, but if coating occurs, check the following:

– Sensor mounted correctly in respect to flow direction (arrow on sensor head).
– Sufficient flow velocity, Section 3.1.
– A temperature difference between process fluid and sensor probe may cause coating. This may happen for small flows if the thermal insulation is inadequate. In some cases it helps to insulate also the connection flange, Figure 3.10.

If there is a coating problem, it is recommended to try to increase the flow velocity, e.g. by installing a pipe portion with smaller diameter. If this cannot be done, the prism should be automatically washed at regular intervals, e.g. by steam or hot water.

A prism wash nozzle (Sections 8.2-8.4) can be useful also in cases without coating problems, e.g. to clean the prism after a process stop using a manual wash valve.

8.2. PRISM WASH WITH INTEGRAL STEAM NOZZLE

Prism wash with integral steam nozzle is for use in applications where steam can remove coating from pipe lines. For other applications see Sections 8.3 and 8.4. The integral nozzle is mounted on the sensor head (Figure 8.21).

Integral steam nozzle (HPS) can be equipped for a standard length sensor or a long probe sensor with standard insertion length (LPS) and with the following process connections:

– Sandvik L-clamp, 80 mm
– ANSI-flange 150 lbs
– DIN flange 2556, PN25, DN 80
– JIS flange, 10 K 80A

The earlier mentioned sensors are equipped with an integral nozzle connection (HPY) as a standard. An integral steam nozzle can be easily fitted afterwards, if required.

The Figures 8.22 and 8.23 show recommended components for a prism wash system with integral steam nozzle. In Figure 8.22 the Relay unit PR-7080 is used for connections. In Figure 8.23 the Wash control relay-unit -WR is used for connections, see Chapter 9 for Relay units. The components are provided by K-Patents. The steam line should be equipped with a check valve (Figures 8.22 and 8.23). If the process medium solidifies at ambient temperature, the check valve should be insulated (Figure 3.10). A condensate trap should be used to keep the steam line hot (Figures 8.22 and 8.23).

The Relay unit (Section 9) is used to drive the wash valves, see Figure 8.51. Configuration of the Relay unit is made from Indicating transmitter keyboard, see Section 9.2.

Alternatively, an external timer can be used. The timer should be equipped with extra contact which is kept closed during prism washes. To lock the output signal (see Section 2.8), connect the extra contact to a switch input in the Indicating transmitter (Figure 3.64).

Note. Do not connect the extra contact to external voltage.

For recommended wash pressures and times see Section 8.5.

Note. *In Intrinsically Safe system solenoid valves are mounted in the safe area and the pneumatic valves in hazardous area.*

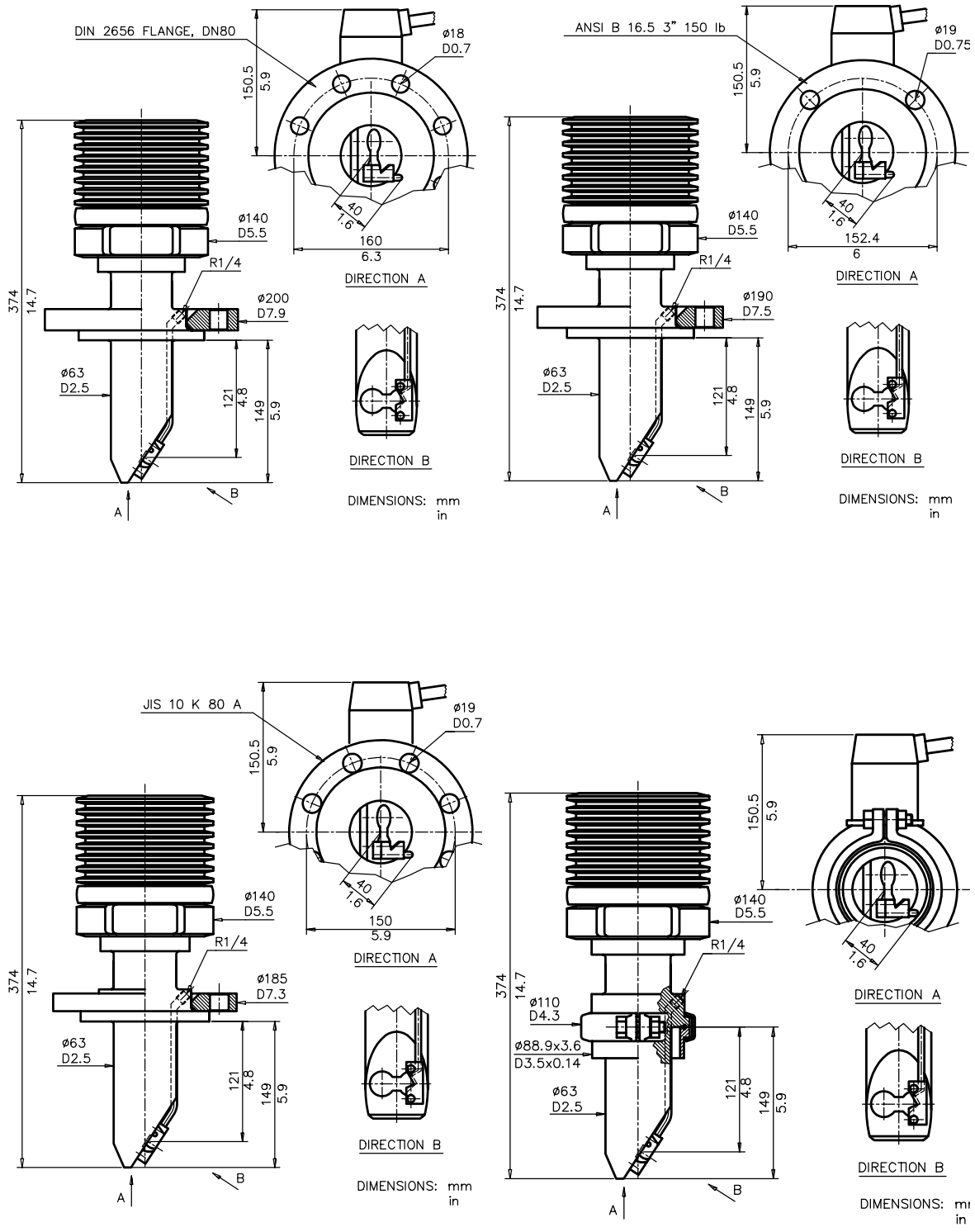


Figure 8.21 Mounting of integral steam nozzles with DIN, JIS, ANSI and Sandvik connections.

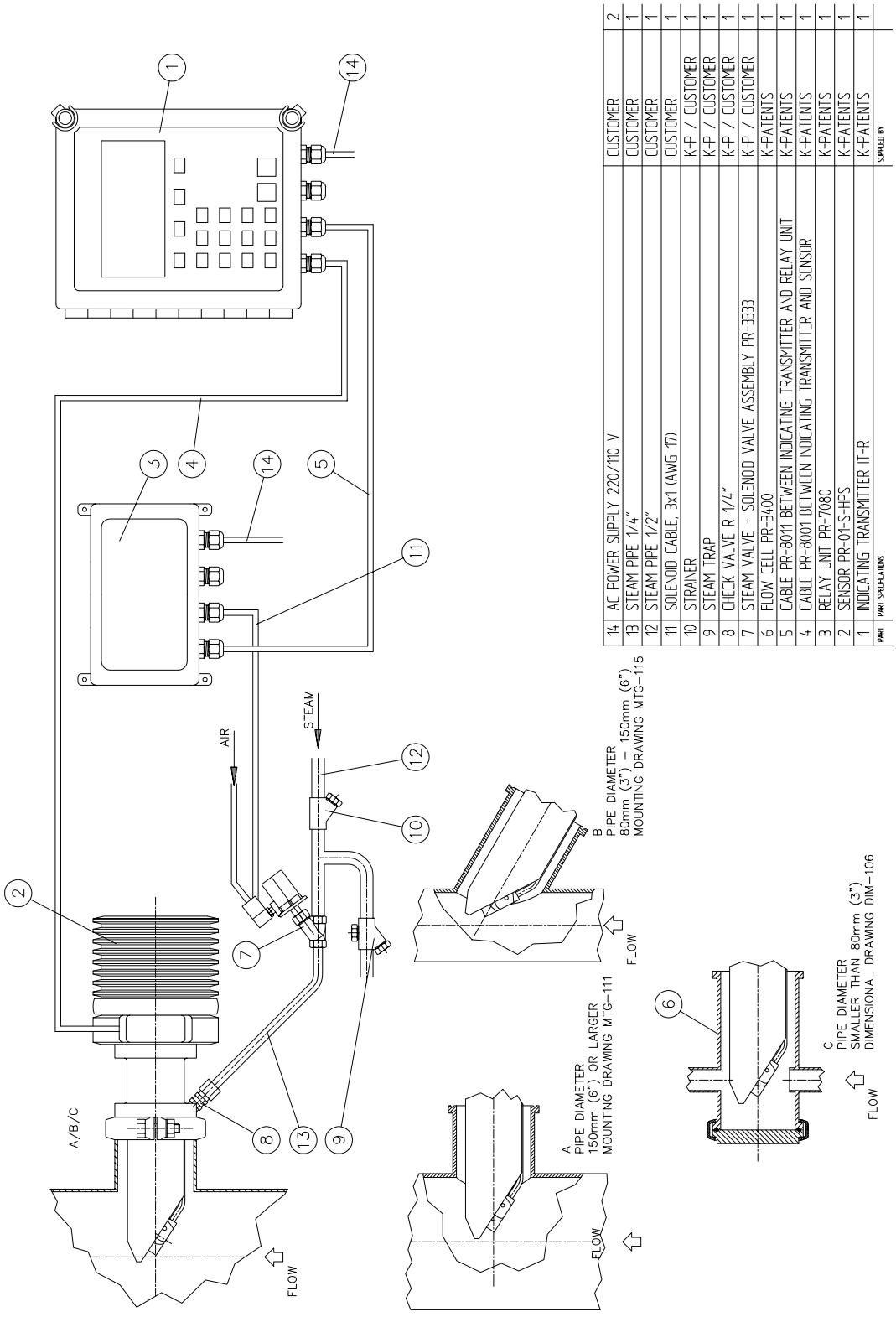
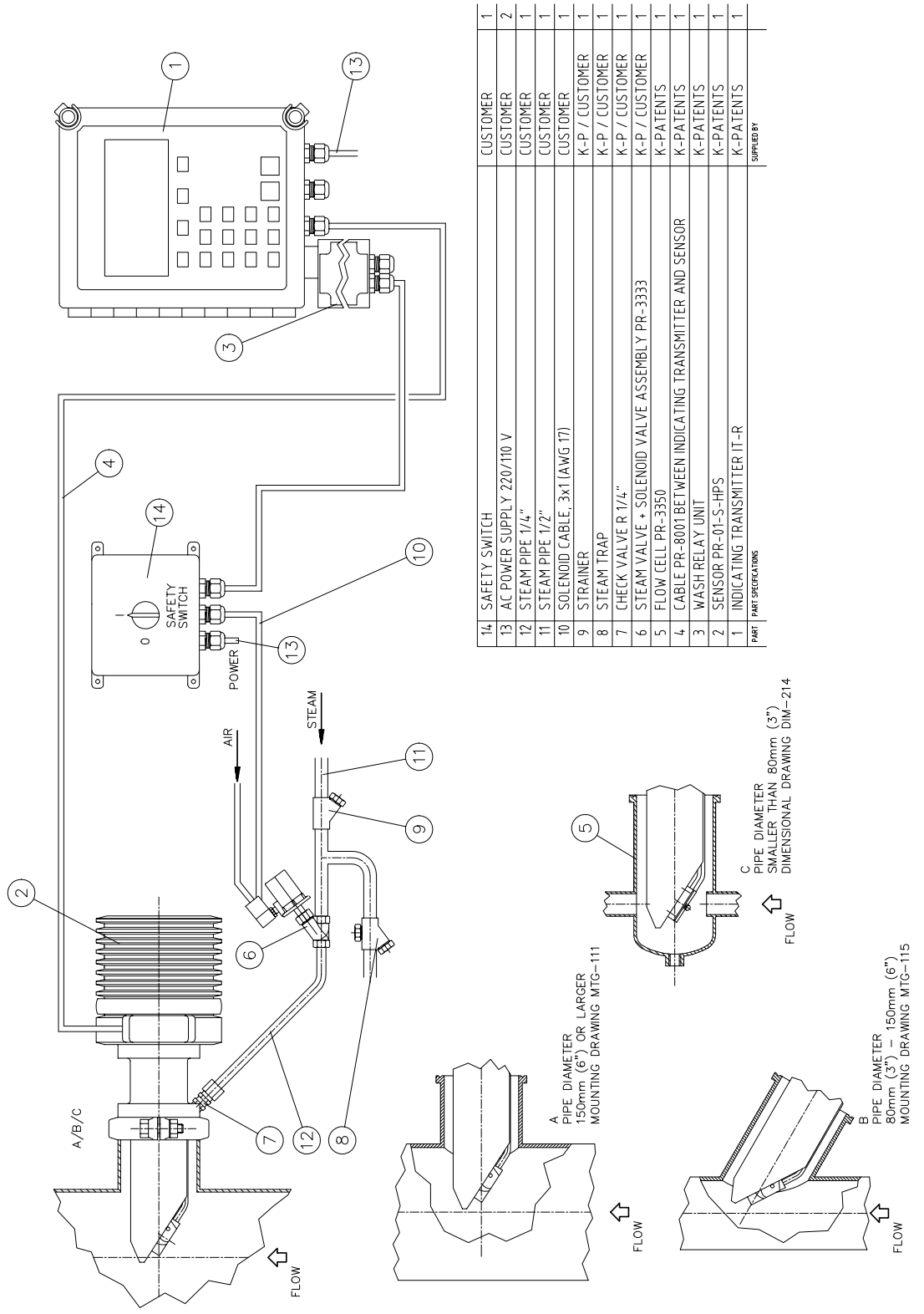


Figure 8.22 Mounting summary of integral prism wash system for steam with relay unit PR-7080.



PART	PART SPECIFICATIONS	SUPPLIED BY
14	SAFETY SWITCH	CUSTOMER
13	AC POWER SUPPLY 220/110 V	CUSTOMER
12	STEAM PIPE 1/4"	CUSTOMER
11	STEAM PIPE 1/2"	CUSTOMER
10	SOLENOID CABLE, 3x1 (AWG 17)	CUSTOMER
9	STRAINER	K-P / CUSTOMER
8	STEAM TRAP	K-P / CUSTOMER
7	CHECK VALVE R 1/4"	K-P / CUSTOMER
6	STEAM VALVE + SOLENOID VALVE ASSEMBLY PR-3333	K-P / CUSTOMER
5	FLOW CELL PR-3350	K-PATENTS
4	CABLE PR-8001 BETWEEN INDICATING TRANSMITTER AND SENSOR	K-PATENTS
3	WASH RELAY UNIT	K-PATENTS
2	SENSOR PR-01-S-HPS	K-PATENTS
1	INDICATING TRANSMITTER IT-R	K-PATENTS

Figure 8.23 Mounting summary of integral prism wash for steam with wash control relay unit -WR.

8.3. PRISM WASH WITH INTEGRAL HIGH PRESSURE WATER NOZZLE

Integral high pressure water prism wash is recommended to be used in applications where conventional wash (Section 8.2) is insufficient to remove coating. It can be used e.g. in the measurement of starch, beer worth, green liquor in the wood pulp industry or direct after the evaporation in the sugar industry.

The Figures 8.30 and 8.32 describe the recommended components for a prism wash system with integral high pressure water nozzle. The components can be supplied by K-Patents.

For recommended wash pressures and times, see Section 8.5.

Note the following in the high pressure wash system. Numbers refer to part numbers in Figure 8.30 (note different numbers in Figure 8.32):

Part No. 2 Integral water wash nozzle (HPN) built on a sensor which has a Sandvik clamp or a flange connection.

Part No. 6 For mounting a flow cell see Section 8.4.

Part No. 7 Check valve

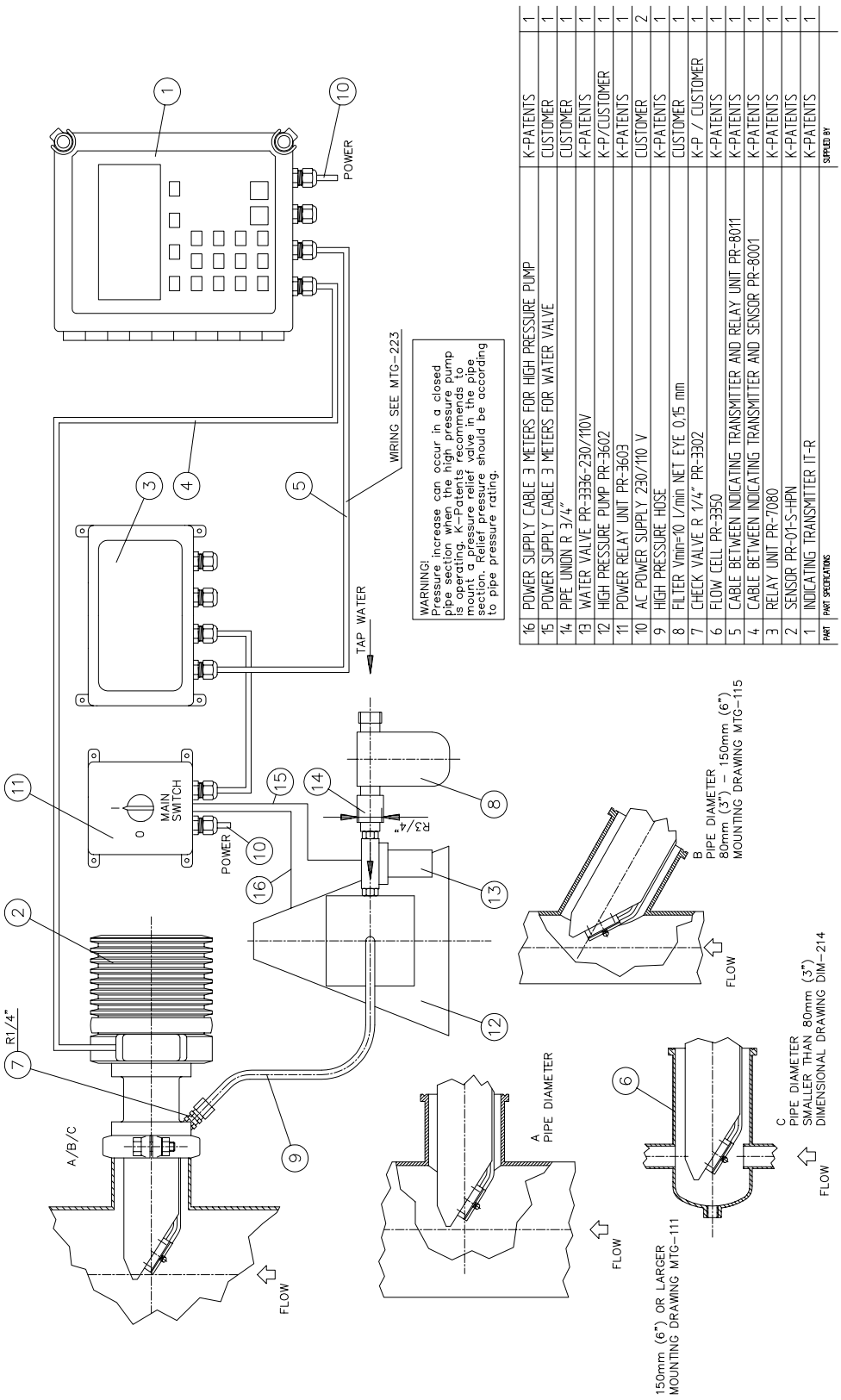
Part No. 8 It is recommended to mount a filter for the water inlet before the high pressure pump. Recommended filter size is 0.15 mm and recommended flow rate above 10 liter/minute.

Part No. 12 High pressure pump. The pump should be able to keep a pressure of 100 bar for a 1.25 mm (0.05 in) diameter nozzle.

Pump example: Kränzle 105/110. Capacity 100 bar (1450 psi), 10 ltr/min. Motor power: 1.5 kW, 11 A, cable 3-4 m and plug. Switch-on and -off with motor protection. Stepless pressure regulation. three ceramic coated plungers, dry running safety device, stainless steel valves, pump housing made of brass. Water up to 60 °C when sucking, self suction up to 0,5 m. Delivered with 8 m high-pressure hose.

Warning! Pressure increase can occur in a closed pipe section when the high pressure pump is operated. K-Patents recommends to mount a pressure relief valve in the pipe section. Relief pressure should be according to pipe pressure rating.

The Relay unit PR-7080 (Section 9) or Wash control relay unit -WR is used to drive the Power relay unit PR-3603. The Power relay unit drives the high pressure pump and the water valve. The configuration of the Relay unit is made from the Indicating transmitter key-board, see Section 9.2. For wiring the high pressure components, see Figures 8.31 and 8.33.



PART	PART SPECIFICATIONS	SUPPLIED BY
16	POWER SUPPLY CABLE 3 METERS FOR HIGH PRESSURE PUMP	K-PATENTS
15	POWER SUPPLY CABLE 3 METERS FOR WATER VALVE	CUSTOMER
14	PIPE UNION R 3/4"	CUSTOMER
13	WATER VALVE PR-3336-230/110V	K-PATENTS
12	HIGH PRESSURE PUMP PR-3602	K-P/CUSTOMER
11	POWER RELAY UNIT PR-3603	K-PATENTS
10	AC POWER SUPPLY 230/110 V	CUSTOMER
9	HIGH PRESSURE HOSE	K-PATENTS
8	FILTER Vmin=10 L/min NET EYE 0,15 mm	CUSTOMER
7	CHECK VALVE R 1/4" PR-3302	K-P / CUSTOMER
6	FLOW CELL PR-3350	K-PATENTS
5	CABLE BETWEEN INDICATING TRANSMITTER AND RELAY UNIT PR-8011	K-PATENTS
4	CABLE BETWEEN INDICATING TRANSMITTER AND SENSOR PR-8001	K-PATENTS
3	RELAY UNIT PR-7080	K-PATENTS
2	SENSOR PR-01-S-HPN	K-PATENTS
1	INDICATING TRANSMITTER IT-R	K-PATENTS

Figure 8.30 Mounting summary of integral high pressure wash system for water with relay unit PR-7080.

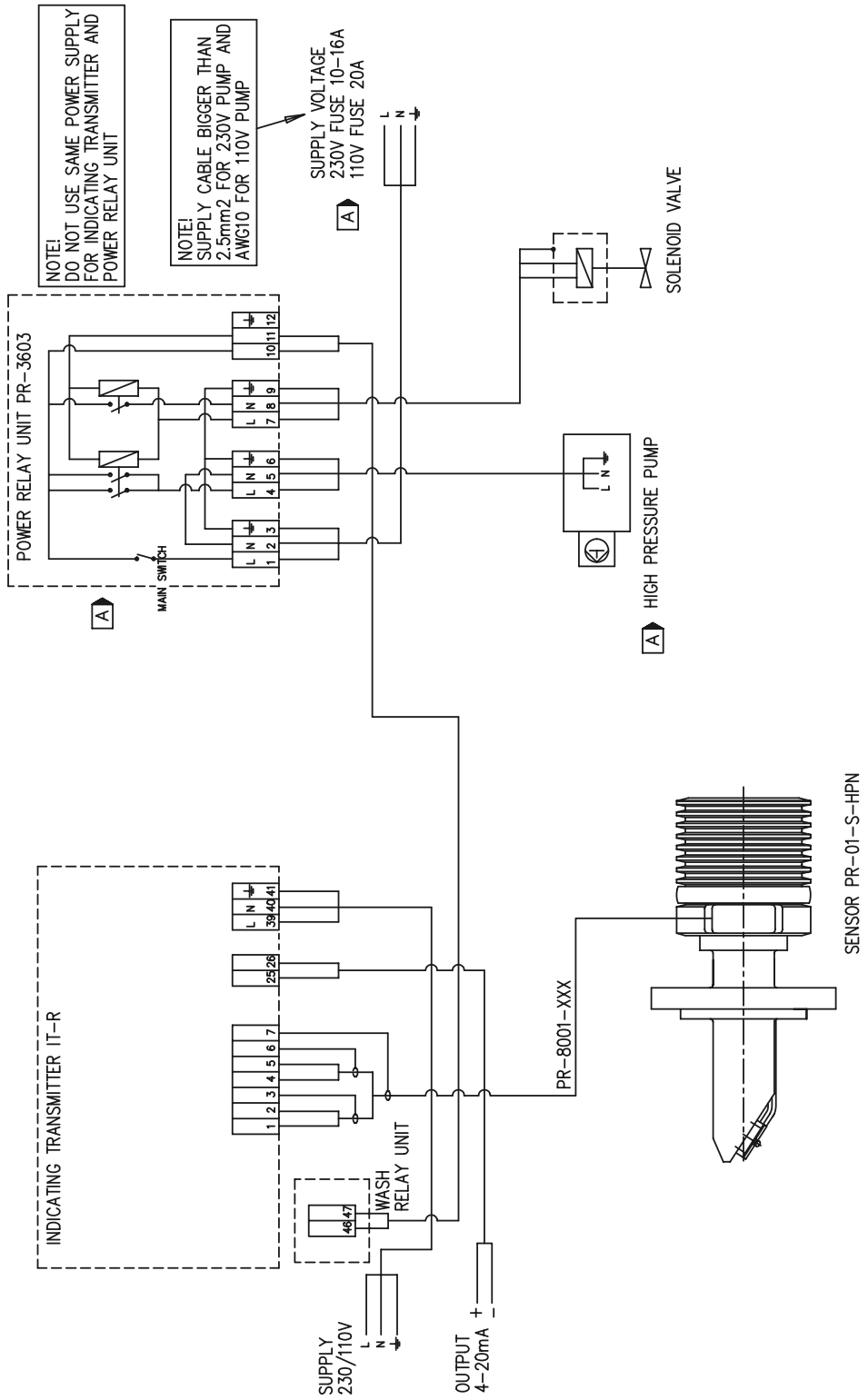


Figure 8.31 Wiring drawing: High pressure wash system for water with Relay unit PR-7080.

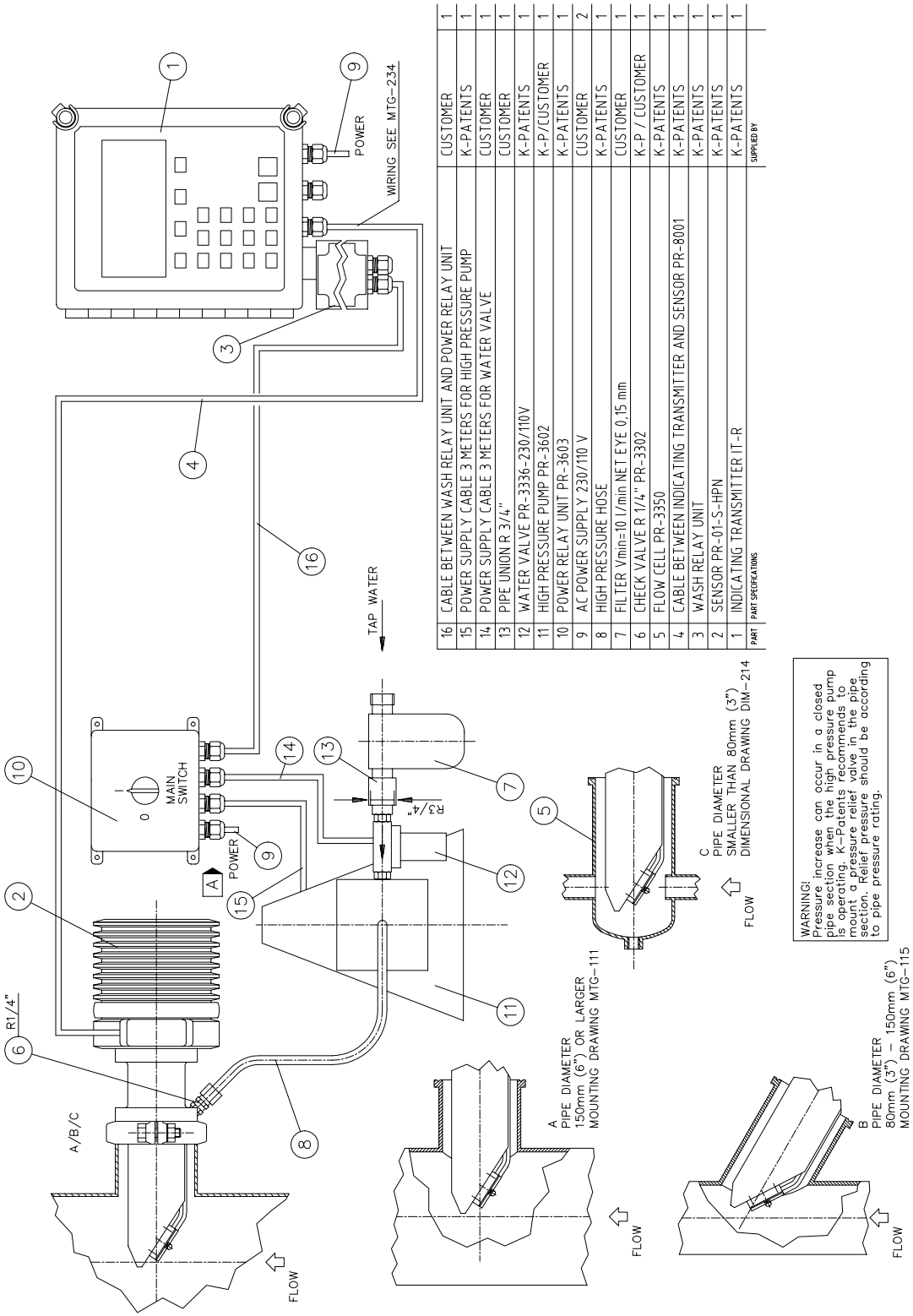


Figure 8.32 Mounting drawing for integral high pressure wash system with Wash control relay unit - WR.

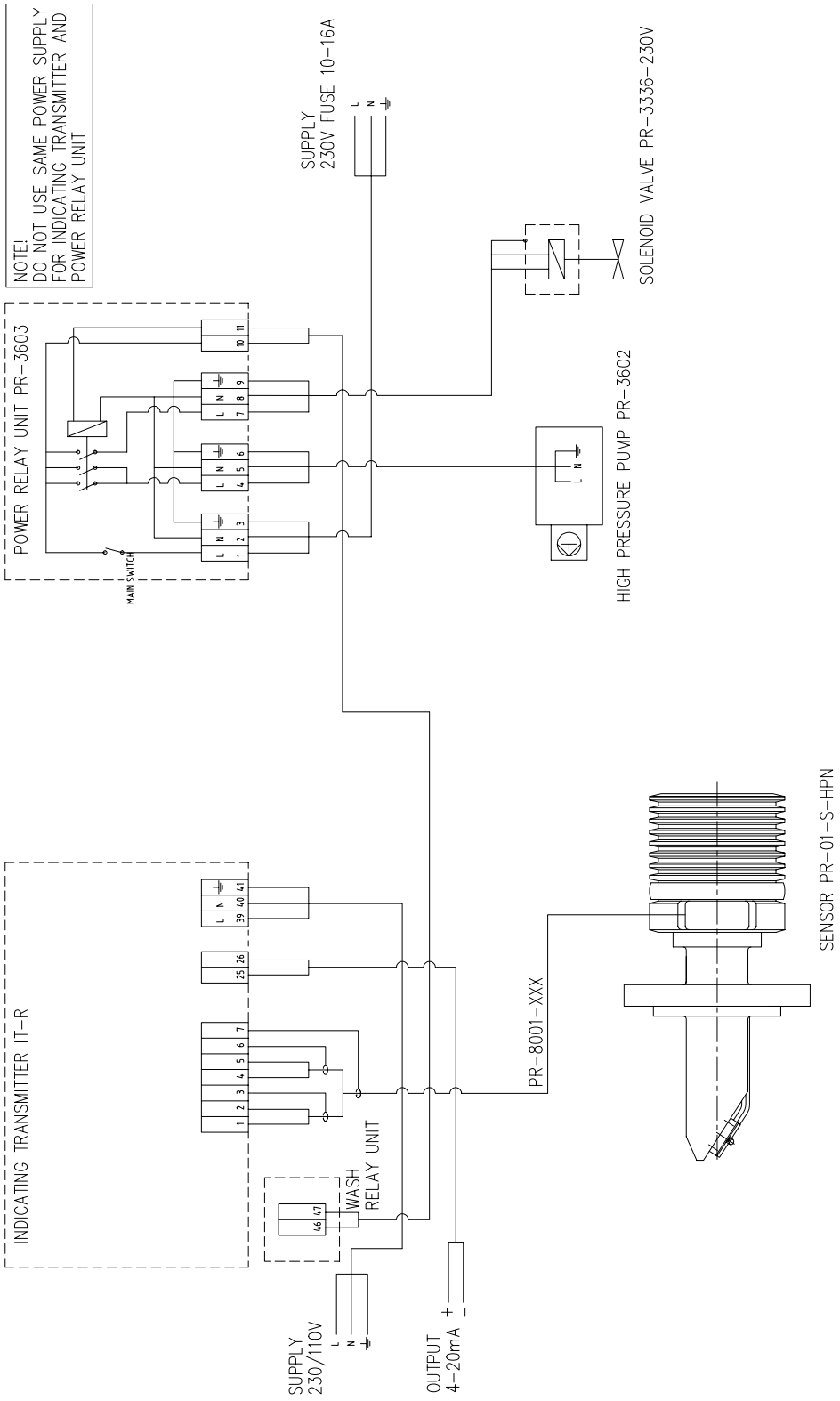


Figure 8.33 Wiring drawing: High pressure wash system for water with Wash control relay unit -WR.

8.4. PRISM WASH WITH FLOW THROUGH CELLS

For mounting the refractometer with a prism wash nozzle in a line smaller than diameter 80 mm (3") a flow through cell is provided by K-Patents. For selection of correct flow through cell see Figure 8.40.

Flow cells PR-3350 (Sandvik), PR-3351 (DIN), PR-3352 (ANSI) and PR-3353 (JIS) can be equipped with one of the following nozzles:

– PR-3354 (water)
– PR-3355 (steam)
– PR-3356 (pressurized water)

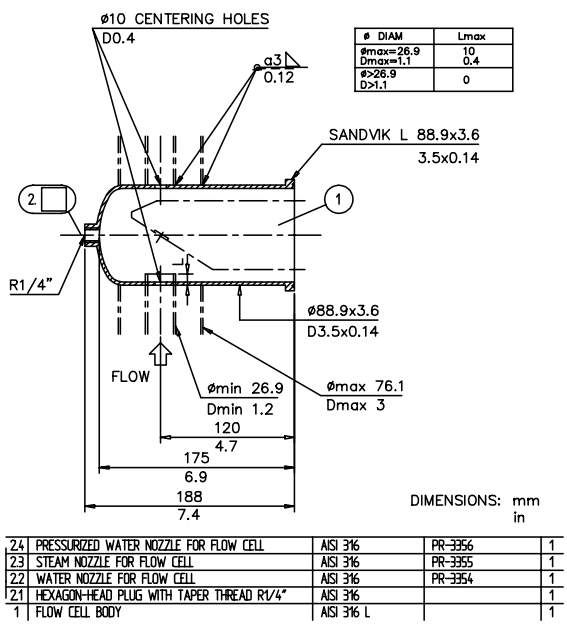
For dimensions see Figure 8.41.

The nozzles can be changed later if the process medium changes or the wash needs to be modified (Section 8.1).

If a wash nozzle is required with a Sanitary 3A-clamp 4" sensor, a PR-3402 sanitary flow through cell with a steam nozzle PR-3355 is recommended, Figure 8.40.

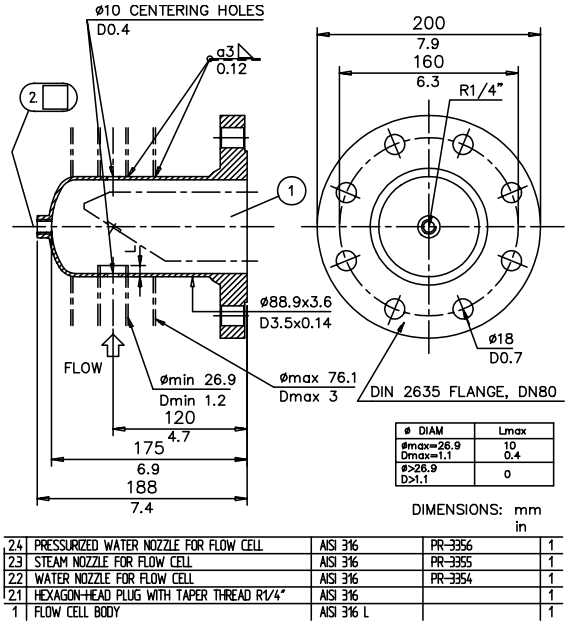
For connection of the wash components see Section 8.2.

For recommended wash pressures and times see Section 8.5.



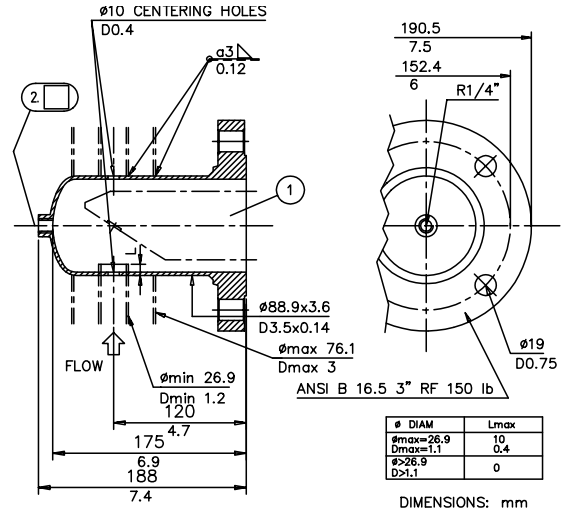
ø DIAM	Lmax
ømax=26.9 Dmax=1.1	10 0.4
ø>26.9 D>1.1	0

24	PRESSURIZED WATER NOZZLE FOR FLOW CELL	AISI 316	PR-3356	1
23	STEAM NOZZLE FOR FLOW CELL	AISI 316	PR-3355	1
22	WATER NOZZLE FOR FLOW CELL	AISI 316	PR-3354	1
21	HEXAGON-HEAD PLUG WITH TAPER THREAD R1/4"	AISI 316		1
1	FLOW CELL BODY	AISI 316 L		1



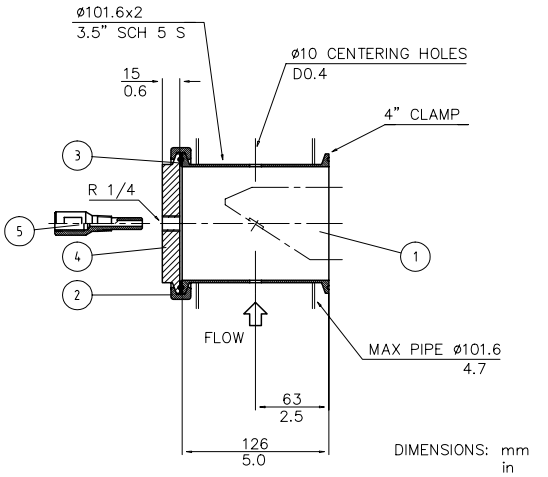
ø DIAM	Lmax
ømax=26.9 Dmax=1.1	10 0.4
ø>26.9 D>1.1	0

24	PRESSURIZED WATER NOZZLE FOR FLOW CELL	AISI 316	PR-3356	1
23	STEAM NOZZLE FOR FLOW CELL	AISI 316	PR-3355	1
22	WATER NOZZLE FOR FLOW CELL	AISI 316	PR-3354	1
21	HEXAGON-HEAD PLUG WITH TAPER THREAD R1/4"	AISI 316		1
1	FLOW CELL BODY	AISI 316 L		1



ø DIAM	Lmax
ømax=26.9 Dmax=1.1	10 0.4
ø>26.9 D>1.1	0

24	PRESSURIZED WATER NOZZLE FOR FLOW CELL	AISI 316	PR-3356	1
23	STEAM NOZZLE FOR FLOW CELL	AISI 316	PR-3355	1
22	WATER NOZZLE FOR FLOW CELL	AISI 316	PR-3354	1
21	HEXAGON-HEAD PLUG WITH TAPER THREAD R1/4"	AISI 316		1
1	FLOW CELL BODY	AISI 316 L		1



5	STEAM NOZZLE,-SN (PR-3355)	DIM-218	1
4	SANITARY BLIND FLANGE	AISI 316 L	1
3	SANITARY GASKET 102/4"	VITON	1
2	SANITARY CLAMP 4" SP13HC102	AISI 316	1
1	FLOW CELL BODY		1

Figure 8.40 Prism wash with flow through cells.

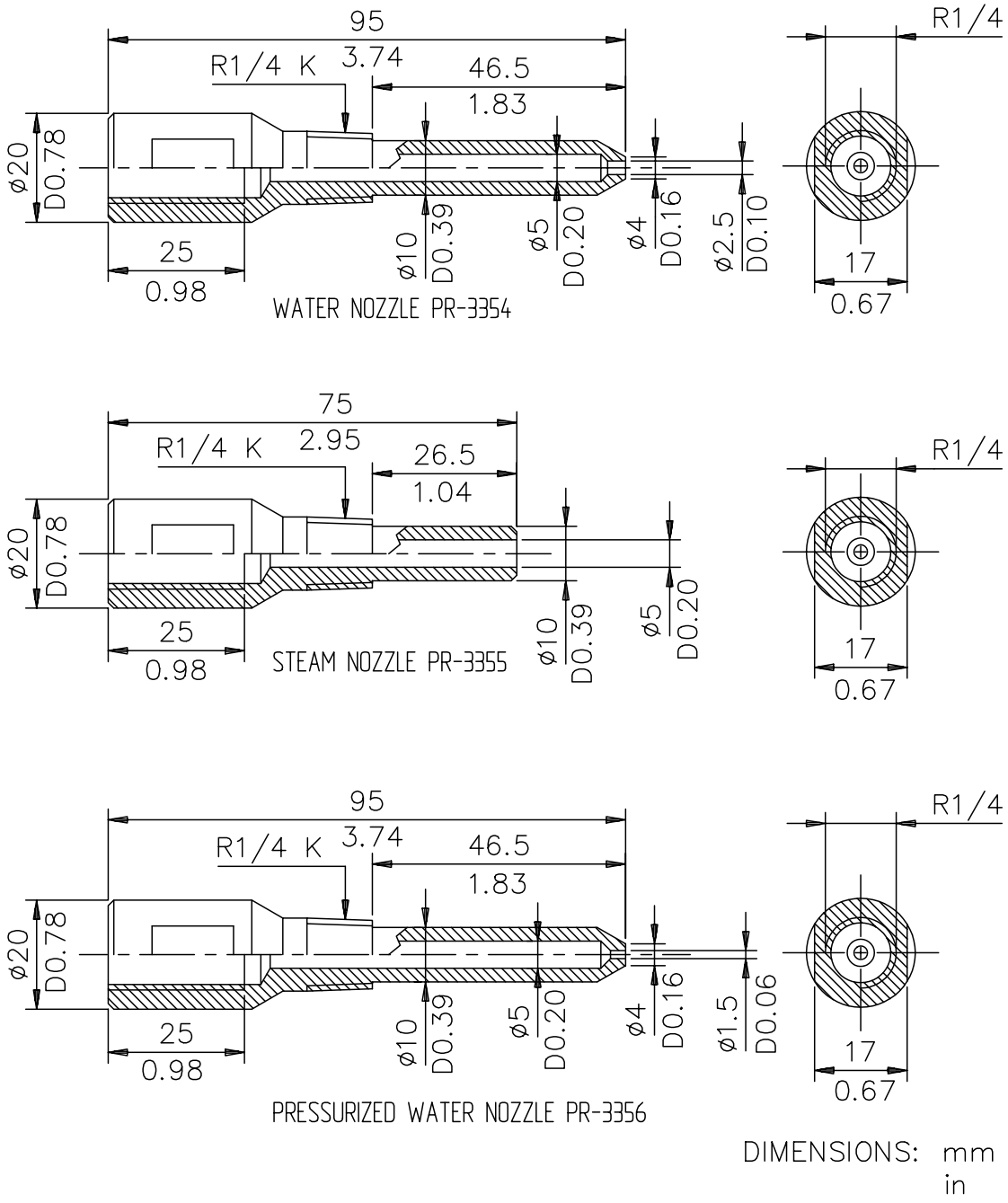


Figure 8.41 Flow through cell nozzles.

8.5. RECOMMENDED WASH PRESSURES AND TIMES

To select a recommended wash pressure use the following table:

			Pressure	
Nozzle	**Wash medium**	**Wash time (seconds)**	**Normal (over process pressure)**	**Maximum**
Integral nozzles				
- HPS	steam	5	4 bar (60 psi)	9 bar (130 psi)
- HPN	pressure water	15	40 bar (600 psi)	70 bar (1000 psi)
- HIMP-2-CR	steam	3	3 bar (45 psi)	8 bar (130 psi)
Flow cell nozzles				
PR-3356	pressure water	15	40 bar (600 psi)	70 bar (1000 psi)
PR-3355	steam	3	2 bar (30 psi)	4 bar (70 psi)
PR-3354	water	10	2 bar (30 psi)	4 bar (70 psi)
PR-3311	steam	3	2 bar (30 psi)	4 bar (70 psi)

Table 8.50 Recommended wash pressures and times.

Note. **Steam wash:** Do not use longer wash times than is recommended in the Table 8.50. In case of coating adjust the wash interval.

Note. **Water wash:** Water temperature should be above process temperature. Precondition should be used to keep the water pipe hot.

9. RELAY UNIT

The K-Patents Process Refractometer can be equipped with a separate Relay unit PR-7080 (4 relays) or an Integrated wash control Relay unit -WR (2 relays).

RELAY UNIT PR-7080 (4 RELAYS)

The Relay unit PR-7080 contains 4 relays (Figure 9.01) from left to right: Relay A, relay B, relay C and relay D. Above each relay there is a yellow LED. Light indicates that the corresponding relay is ON and the output contact closed. The enclosure classification is IP 65 (Nema 4X).

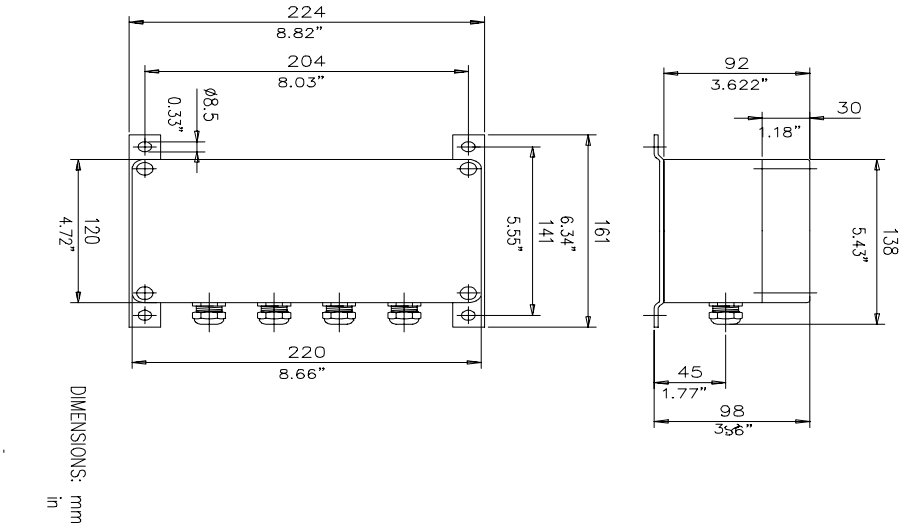


Figure 9.01 Relay unit PR-7080, dimensions.

WASH CONTROL RELAY UNIT-WR (2 RELAYS)

The Wash control Relay unit -WR contains 2 relays (Figure 9.02) from left to right: Relay A and Relay B. Next to each relay there is a yellow LED. Light indicates that the corresponding relay is on and the output contact is closed. The enclosure classification is IP66 (Nema 4X).

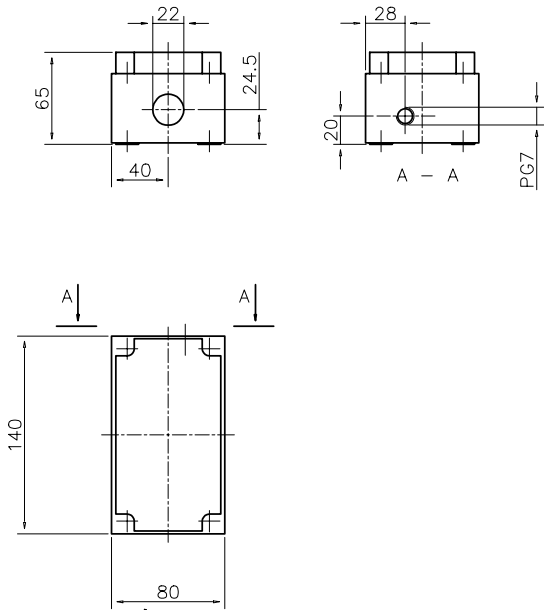


Figure 9.02 Wash control Relay unit -WR.

CABLE FITTINGS:

The cable fittings are delivered as one of two alternatives:

US: ½ NPT-TYPE ST-1 conduit hubs: 4 pcs; PR-7080, 1 pc; -WR
European: BF11/PG11 cable glands: 4 pcs; PR-7080, 2 pcs; -WR

Note: Seal all unused fittings with blind washers.

Each relay has one switch contact, for max 250 V AC, max 3 A. The Relay Card has also two monitoring functions with two LEDs, See Figure 9.30 a, b:

a. The green LED L5 is lit, if the regulated 5 V supply to the processor is within limits 4.7 - 5.4 V and the processor operates correctly. Note that the 24 V supply from the serial bus has to be checked with a Volt-meter.

b. The red LED L6 is lit, if correct serial data are missing (but the processor operates correctly).

Both checks have to be OK, otherwise all relays will go into OFF state.

9.1. CONNECTIONS

The Relay Card is connected to the serial bus for PR-7080 and to the plug connector P2 on the power supply card for wash control relay unit -WR, see Figure 3.63. The relay contacts go to the connector strip, Figure 9.10.

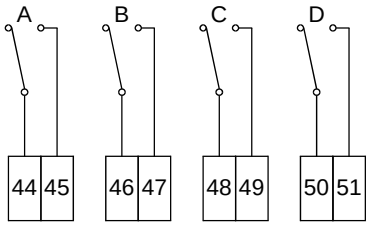


Figure 9.10 PR-7080 Relay output connections. In wash control relay unit-WR only A and B available.

9.2. RELAY UNIT CONFIGURATION

The relay functions and the wash timer settings can be seen from the Indicating transmitter. Press the key sequence Display/System configuration/Relay configuration or Wash times.

– The relay functions can be reprogrammed any time from the calibration menu:

– Program a relay by the following steps:

– Press Calibrate/Parameters/Relays. Select the relay (A,B,C,D) to be programmed. Note! Only Relays A and B are visible for Wash control relay unit-WR.

– For built in signal relays select: Relay 1 or Relay 2.

– Select the relay function

0. Not defined
1. Processor OK: The relay is ON if the processor is running
2. Normal operation: The relay is ON if the diagnostic message is Normal operation.
3. No malfunction: The relay is ON if the diagnostic message is Normal operation or Low conc/no sample.
4. Low limit: Low alarm relay, relay is ON if value below limit.
5. High limit: High alarm relay, relay is ON if value above limit.
6. Preconditioning: A preconditioning relay, Figure 8.22. (Not possible for built-in signal relays).
7. Wash: A wash relay, Figure 8.22. (Not possible for built-in signal relays).
8. In divert control. The relay is ON if the refractometer is activated in divert control system. See Section 2.8 and separate Instruction Manual for Digital Divert Control System.

– After a Low limit/High limit decision, the display asks for the alarm source, alternatively:

1. CONC %
2. Standard RI(25 °C)
3. TEMP °C
4. TEMP °F
5. TEST
6. Sensor temperature
7. Sensor humidity

Note. The alarm source can be changed by selecting relay function 9. for the alarm relay.

– When the source is decided, the alarm limit has to be entered. The default value of the limit is zero.

Note. To be complete, the specification of an alarm relay requires decision of High/Low, source and limit value.

To prevent the alarms to be too sensitive, an alarm delay in seconds can be set, common to all relays. The source value has to be out of limits during the whole delay time to activate the relay. The default value is ten seconds.

– If the Relay unit is used as a wash timer, the time settings (Figure 9.21) are entered after the sequence Calibrate/Parameters/Prism wash:

1. Preconditioning time, s (10)
2. Wash time, s (3)
3. Recovery time, s (30)
4. Wash interval, min (20)

The default values are in parenthesis. The output signal is locked during Recovery and Wash if not otherwise specified (Section 2.8, current output).

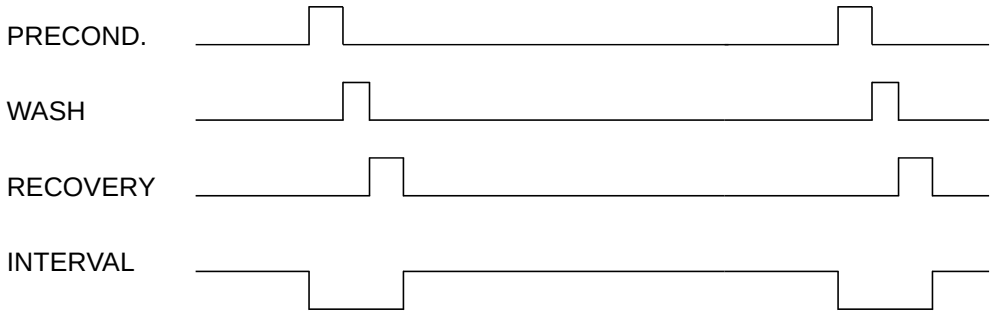


Figure 9.21 Prism wash sequence.

Interlock: The preconditioning and wash relays are not activated under "Low conc/no sample", Section 6.30, as this indicates a clean prism in an empty process line.

Wash check: This function can be defined from the prism wash menu. A prism wash is accepted if:

a. TEST exceeds "TEST limit"

b. TEST increases more than "TEST difference"

The default values of "TEST limit" and "TEST difference" are zero, which makes the Wash check inactive.

If the wash is not accepted, the diagnostic message will be "Prism wash failure", Section 6.3.

A "Wash retries" parameter can also be set for repeated wash actions if the wash check fails. The default value is zero.

Wash stop

Wash stop function can be defined from the prism wash menu. Wash can be prevented when the process temperature is below the limit or when the process is stopped. To activate the “wash stop” key sequence Calibrate/Parameters/1. Prism wash/Wash stop/1. Activate and set the temperature limit.

The default value for wash stop is inactive. When the wash is not accepted the diagnostics message is “Wash stop/temp. limit”, see Section 6.3.

9.3. COMPATIBILITY

– The Relay unit PR-7080 can not be used with models preceeding PR-01-S, see Section 2.9.

– The Wash control relay unit -WR requires a Program version 6.0 or higher.

9.4. WASH LOGICS AND SMART WASH

Figure 9.21 describes the standard prism wash sequence Preconditioning/Wash/Recovery/Interval. In some cases the wash routine should be modified to better fit the application. The Wash decision logics (Figure 9.41) of K-Patents refractometer covers a wide range of options.

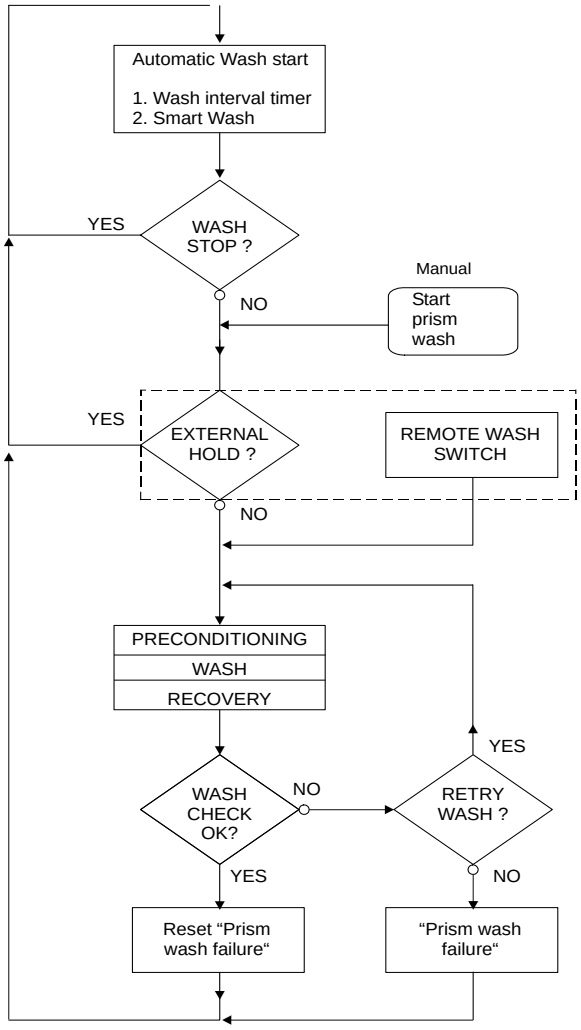


Figure 9.41 Wash decision logics.

AUTOMATIC WASH START:

1. The wash interval timer starts a wash at a preset interval after last wash, independetly of how the last wash was initiated. If the wash interval is set to zero, the timer will not initiate a wash. How to set the wash times is described in Section 9.2.

2. The Smart wash starts the wash when the prism shows signs of being coated. An early indicator of beginning coating is that the Slope decreases. Slope is a measure of the sharpness of the optical image, Section 6.5. The settings are made at Calibrate/Parameters/Prism Wash/C Smart wash:

   – Slope limit:

     A wash is initiated when the Slope value goes below this limit. The Slope limit has to be set based on observations of slope values both at clean prism and at slight coating. When the slope limit is set to zero, this Smart wash function is inactive.

   – Minimum time, 0...1440 min:

     This parameter sets a limit to how often the Smart wash is allowed to start a wash. When this parameter is zero, the Smart wash function is inactive.

   – Maximum Test:

This parameter should normally be set to zero. Then it will not influence the Smart wash function. It may be used for fine-tuning: The Smart wash will initiate Wash only if the Test value is below Maximum Test.

WASH STOP LOGICS:

1. The preconditioning and wash relays are not activated by automatic wash start under "Low conc/no sample", Section 6.30, as this indicates a clean prism in an empty process line.
2. Wash can be prevented when the process temperature is below a limit. The Wash stop function is used to prevent steam wash when the process pipe is empty or when the process is stopped. To activate the "wash stop" key sequence Calibrate/Parameters/1. Prism wash/Wash stop/1. Activate and set the temperature limit. The default value for wash stop is inactive. When the wash is not accepted the diagnostics message is "Wash stop/temp. limit", see Section 6.3.
3. Wash can also be prevented by an external contact closure, telling e.g. that the process pump has stopped. See Section 2.8, paragraph 3.3.

MANUAL WASH:

Wash can be initiated from the key A "Start prism wash". This manual wash over-rides the wash stop logics.

REMOTE WASH START/EXTERNAL HOLD:

This input switch function is described in Section 2.8, paragraph 3.2. It is useful for an intermittent process: The prism is washed when the process stops and again when it starts. Between those two washes the output signal is on Hold.

During Hold, the wash cannot be initiated, neither automatically nor manually.

WASH CHECK:

This function can be defined from the prism wash menu, Calibrate/Parameters/Prism wash. A prism wash is accepted if one of the two conditions are satisfied:

a. TEST exceeds "TEST limit"

b. TEST increases more than "TEST difference"

The default values of "TEST limit" and "TEST difference" are zero, which makes the Wash check inactive. If one of the conditions are set to zero, the other condition is valid alone. A typical case is "TEST limit" = 230, "TEST difference" = 0. The wash is accepted, if the Test value exceeds 230 during wash, and the Test difference condition is invalid.

If the wash is not accepted, the diagnostic message will be "Prism wash failure", Section 6.3. This message is reset from the keyboard "Reset" or by a succesful wash. A "Wash retries" parameter can also be set for repeated wash actions if the wash check fails. The default value is zero.

10. ACCESSORY UNITS

Accessory units provided for K-Patents Process Refractometer PR-01-S.

10.1. EXTERNAL OUTPUT UNIT PR-7090

The K-Patents Process Refractometer can be provided with a separate current output unit to give e.g. a temperature mA signal.

Cable fittings:

The cable fittings are delivered as one of two alternatives:

US: ½ NPT-TYPE ST-1 conduit hubs
European: BF11/PG11 cable glands

Note: Seal all unused fittings with blind washers.

The dimensions are the same as for the Relay unit, see Figure 9.01.

The mA output specifications are the same as for the built-in mA output of the Indicating transmitter, see Section 2.2.

Two monitoring LEDs are on the circuit card, Figure 10.10:

a. The green LED L1 is lit if the processor on the card works correctly.

b. The red LED L2 is lit if correct input data are missing.

Connections

The External output unit is connected to the serial bus, see Figure 3.63 and Figure 10.10. Note the 120 Ohm closing resistor in Figure 3.63.

The output mA signal is connected to the terminals 42+ and 43-, see Figure 10.10.

Configuration

To program the External output unit from the key-board of the Indicating transmitter, start with the sequence Calibrate/Parameters/Output signals/External output.

1. Zero = measurement value corresponding to 4 mA.
2. Span = measurement value span corresponding to mA output span.
3. Hold function: Can be selected active or inactive.
4. Range: Select 4 - 20 mA or 0 - 20 mA
5. Source: Select one of following alternatives
   - Not defined
   - CONC (RI)
   - Standard RI (25 °C)
   - Temp °C
   - Temp °F

Example: For source °C, zero = 20, span = 80 the output signal 4 - 20 mA corresponds to 20 - 100 °C.

Compatibility

The External current unit can not be used with models preceeding PR-01-S. For PR-01-S program version 2.1 or higher is required, see Section 2.9.

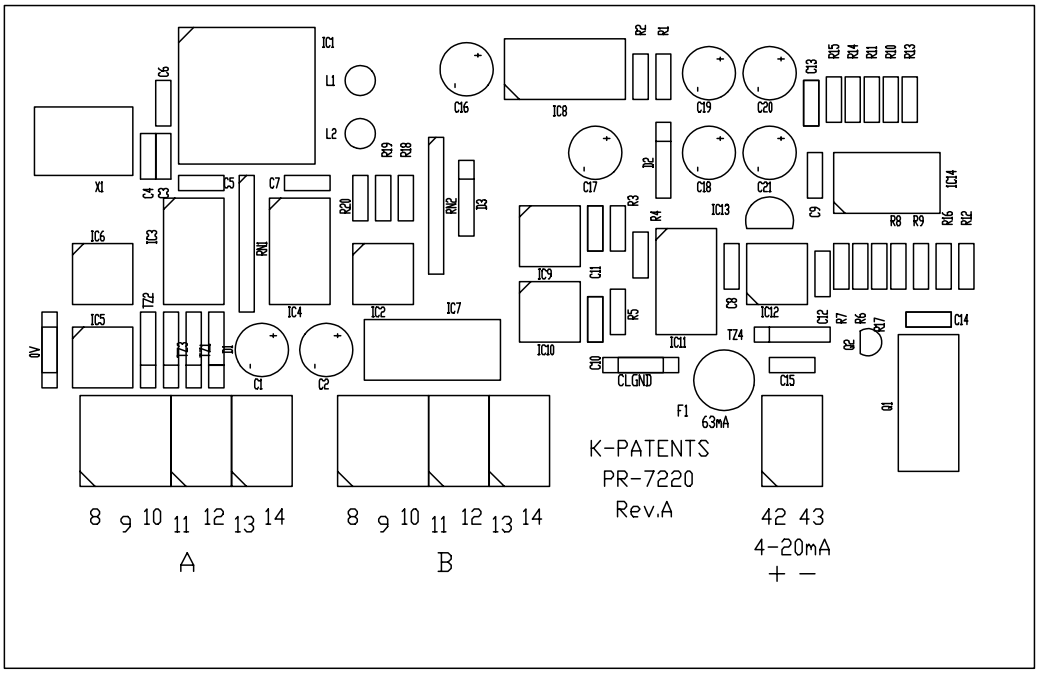


Figure 10.10. External output unit, component lay-out.

10.2. DIVERT CONTROL UNIT DD-01

The K-Patents Digital Black Liquor Divert Control System is used in the wood pulp industry to provide a divert signal preventing black liquor with dangerously low solids to reach the black liquor burners. The system is built strictly according to the principles of Recommended Good Practice "Safe Firing of Black Liquor in Black Liquor Recovery Boilers" (BLRBAC, August 1982).

A typical Black Liquor Control System contains the following equipment:

- Two K-Patents Process Refractometers complete with sensor and Indicating transmitter.
- Two Isolation valves to allow safe removal of the refractometers from the pipe at full flow and pressure. A wash nozzle is included.
- One Divert Control Unit and one alarm horn.
- Two steam control valves and four check valves for automatic prism wash.
- One spare sensor

A separate Manual is provided for the Divert Control System.

11. RETRACTOR WITH ISOLATION VALVE HIMP-2

The Retractor HIMP-2 is used for safe removal of K-Patents Process Refractometer from the process line under full process flow and pressure. Typical use is for continuous processes with infrequent shutdowns and large pipe sizes, diameter 125 mm (5") or above e.g. in wood pulp industry. For smaller pipe sizes it is more economical to install the refractometer in a by-pass line.

11.1. EQUIPMENT

The Retractor HIMP-2 is used in combination with a special version of the refractometer PR-01-S-LPH only, Figure 11.10. The process connection is a Sandvik clamp.

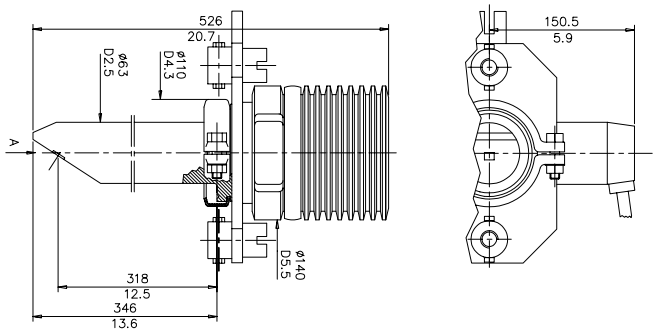


Figure 11.10 Model PR-01-S-LPH, Long Probe adapted to Retractor HIMP-2.

The Retractor HIMP-2 is delivered according to Figure 11.11. with an isolation valve (a ball valve with handle), a stuffing box and threaded force bars with covers. The following components are also included in a standard delivery:

- steam wash nozzle
- two ball valves (one for wash nozzle and one for blow out valve)
- two check-valves (one for wash nozzle and one for stuffing box)
- piping between steam wash line and stuffing box
- steam input connection R 1/4”

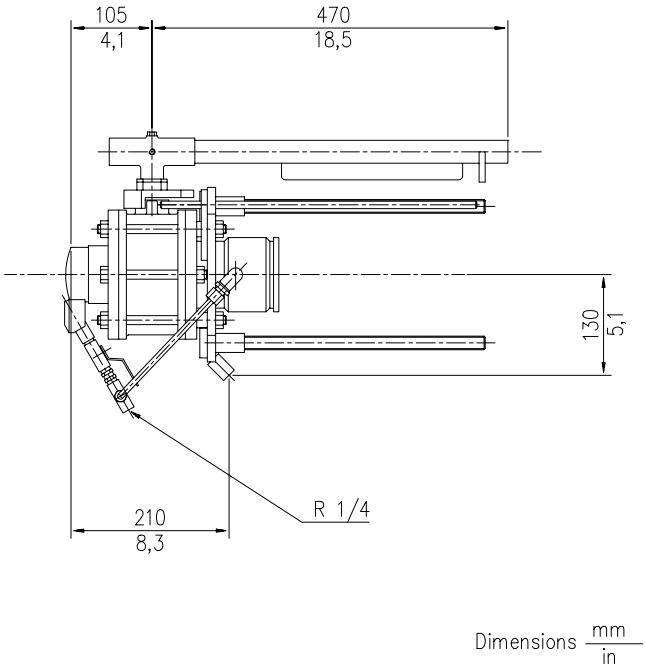


Figure 11.11 Retractor HIMP-2, standard delivery.

To turn the nuts on the two force bars synchronously to get a straight guided movement of the sensor, a Crank Unit (CR) is supplied, Figure 11.12.

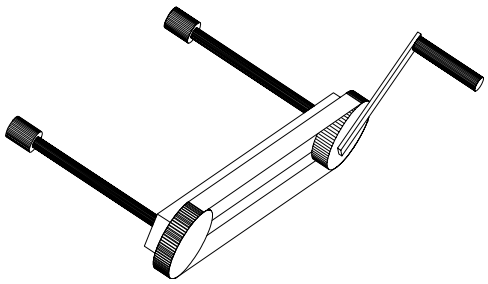


Figure 11.12 Crank (CR) for retractor HIMP-2.

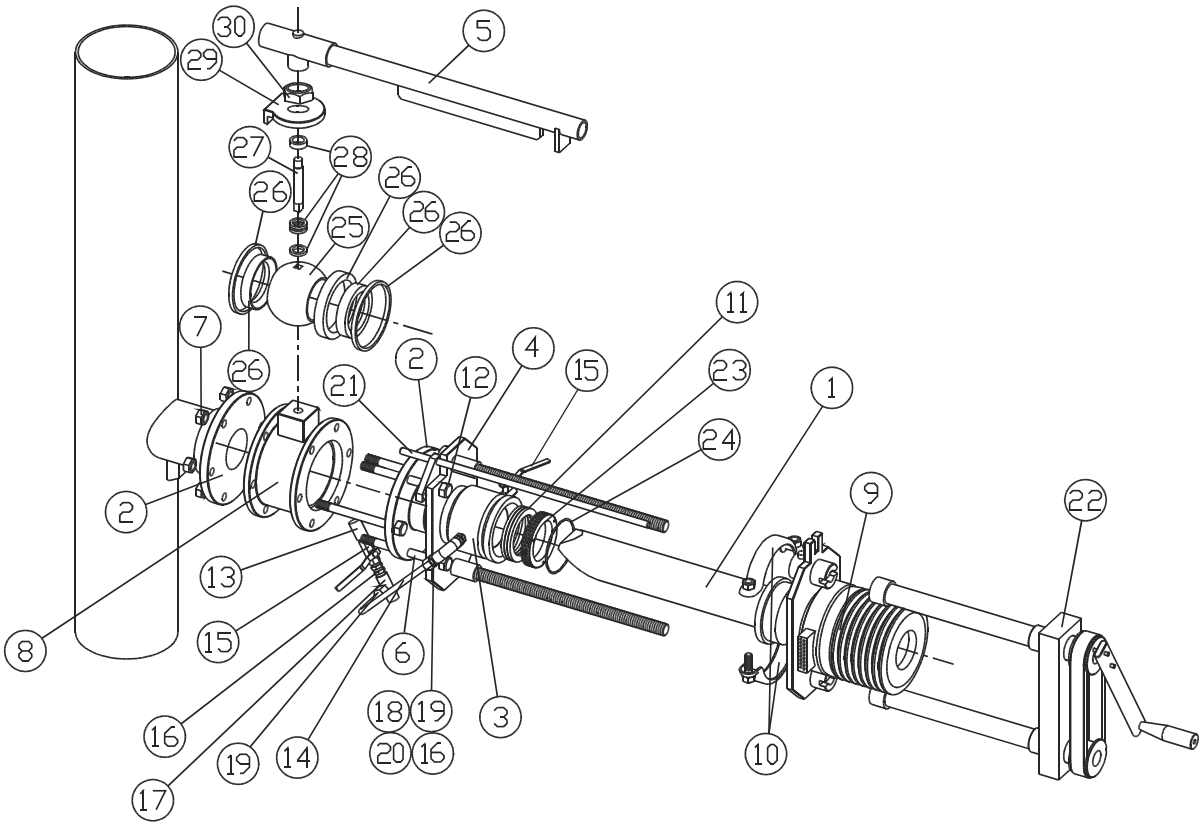
To complete the steam wash system, add according to Figures 11.11 and 11.22:

– steam valve
– necessary piping to connect the steam input
– steam trap

A steam valve and trap assembly PR-3340 is available at K-Patents.

Use 6 mm (1/4") pipe for steam connections.

11.2. RETRACTOR WITH ISOLATION VALVE PARTS LIST



Item	Pcs.	Part No.	Description
1.*	1		Sensor assembly
2.*	2		Valve gable assembly
3.*	1		Box assembly
4.*	1		Yoke for bars assembly
5.*	1		Valve handle assembly
6.	3		Spacer
7.	4		Bolt and nuts
8.	1		Ball valve DN65 Taco FB 2566
9.	1		Sensor PR-01-S-LPH
10.	1	PR-3503	Sandvik clamp FCL-316L-88.9-S-T PN25
11.	1	PR-3509	Box packing set Chesterton 172 (Seal ring FCLG-T-88.9-S-T) teflon
12.	4		Nut M12 DIN 934
13.	1		Nipple
14.	1		Pipe
15.	2		Ball valve R1/4

Item	Pcs.	Part No.	Description
16.	2	PR-3302	Check valve
17.	1		Tee R1/4 AISI 316
18.	1		Elbow R1/4 AISI 316
19.	2		Pipe connector 8 mm
20.	1		Hexagon nipple R1/4 AISI 316
21.*	1		Lock plate and safety bar assembly
22.*	1	-CR	Crank for retraction HIMP-2
23.	1		Box tightening ring
24.	1	PR-3505	Sandvik O-ring FCLO-T-88.9/84 teflon
25.	1		Ball
26.*	1	PR-3510	Body seal set for ball valve
27.	1		Stem
28.	3		Stem seal and follower
29.	1		Stop plate
30.	1		Stem retaining nut

Note. * = Assembly.

11.3. MOUNTING

Select the mounting position according to the following criteria:

- vertical process line
- free distances according to Figure 11.21
- easy access
- steam for the wash nozzles available
- hot water to flush the sensor available
- ambient temperature below 45 °C (113 °F)

Mounting procedure:

1. Cut a keyhole shaped opening (Figure 11.21) and weld the Retractor HIMP-2 to the process line.
2. It is absolutely necessary to support the Retractor by two bars according to Figure 11.21.
3. Mount the two check valves according to Figure 11.13, immediately to the nozzle and the box respectively.
4. Mount the blow-out valve to the opposite side of the box, Figure 11.13.
5. Mount the steam valve (hand valve or solenoid valve), Figure 11.13.
6. Check that the steam flow is correct, Figure 11.22.

To insert the process refractometer follow instructions in Section 11.3. starting from paragraph 15.

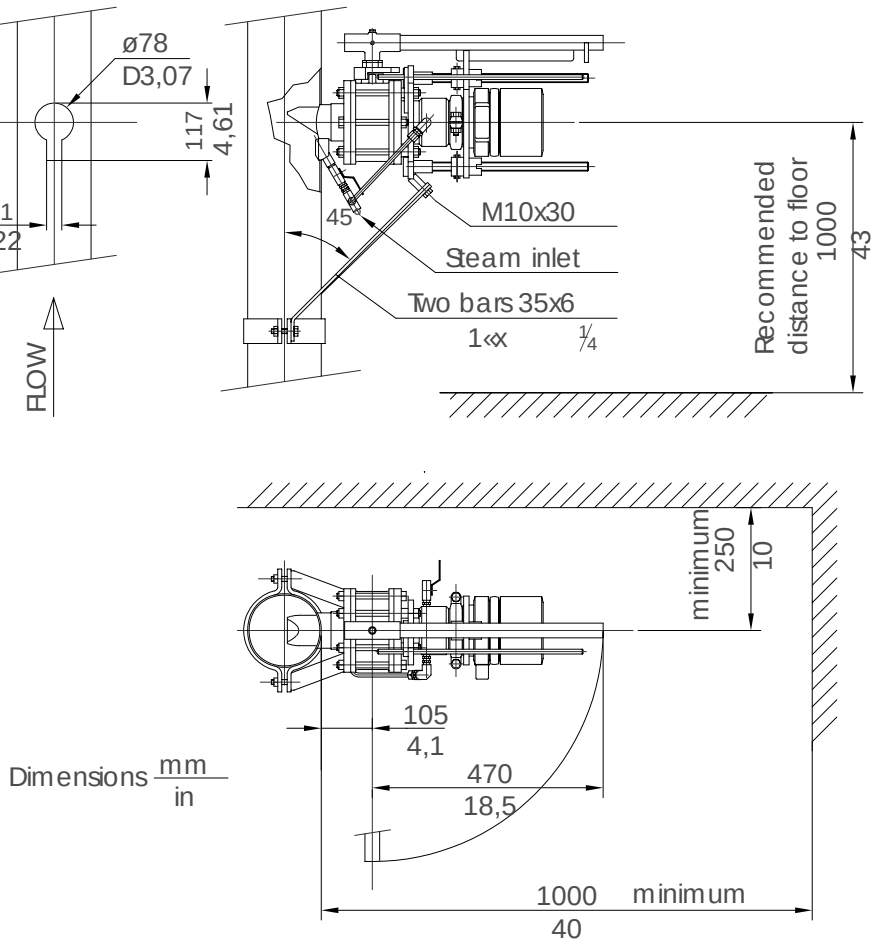


Figure 11.21 Mounting of Retractor HIMP-2.

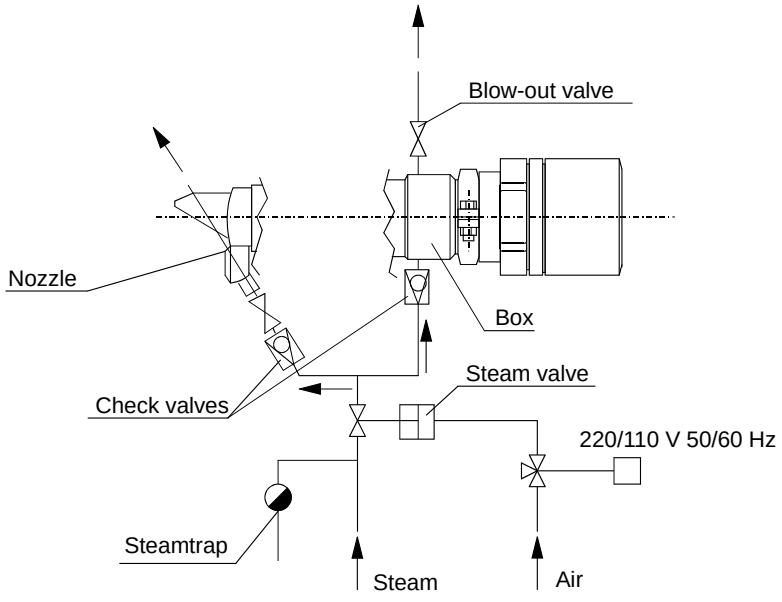


Figure 11.22 Steam flow diagram.

11.4. RETRACTION AND INSERTION

To retract the process refractometer from the process and to reinsert, proceed as following:

Warning: Read the instruction manual carefully before operating the equipment. Consult the factory if you are not familiar with the operation.

Use shields and protective clothing. Protect eyes and face.

Do not remove the ball valve handle.

1. Close the ball valve to steam nozzle and preheat the stuffing box by a manual steam wash 3-5 times.
2. Shut off the steam.
3. Switch off the power to the refractometer (and wash timer).
4. Disconnect the sensor cable. Install the protection cover on the sensor connector.
5. Remove the protection on the two threaded force bars.
6. Mount the crank..
7. Check the process pressure (max 5 bar). Put on eye and face protection.
8. Remove the Sandvik clamp.
9. Crank the sensor slowly and carefully outwards. If the sensor gets jammed, crank the sensor temporarily a little inwards. Flush the box with the box blow-out valve open.
10. When the sensor reaches the stopper on the ball valve handle, then close the ball valve (Figure 10.21). Mount a padlock at the lockplate.
11. Open the box blow-out valve.
12. Crank the sensor outwards and remove. The box contains 2 dl (6 Cu. inches) of process liquid, that will flow out.
13. Clean the box carefully. Clean also the blow-out valve and the wash valve.
14. Clean the sensor.

To insert the sensor, proceed as following:

15. Place the Sandvik O-ring seal around the sensor near the head.
16. Insert the sensor and crank it inwards until the sensor reaches stop bar.
17. Check the tightness of the box, Figure 11.31. Renew the packing rings, Chesterton 1724 5/16" (8 mm), length 225 mm (8.9 in). Make the packing a little thinner by mangling it with a piece of pipe against a flat surface.
18. Close the box blow-out valve and remove the padlock from the lockplate. Open the lockplate.
19. Open the ball valve carefully.
20. Crank the sensor in. Guide the Sandvik seal O-ring.
21. Remove the crank. Equalize the tension of the two force nuts.
22. Mount the Sandvik clamp.
23. Replace the protections on the threaded force bars.
24. Connect the sensor cable.

25. Turn on the steam.
26. Switch on the power.
27. Steam wash two times.

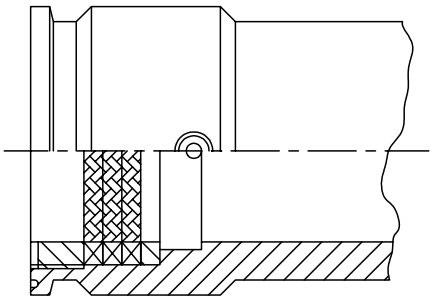
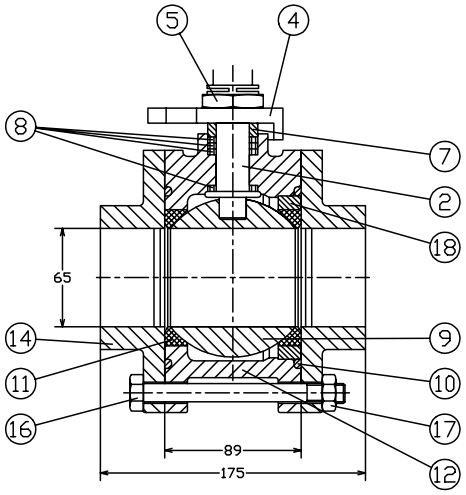


Figure 11.31 The stuffing box.

11.5. BALL VALVE

Figure 11.40 gives the Ball valve parts list.



2	Stem
4	Stop Plate
5	Stem Retaining Nut
7	Stem Seal Follower
8	Stem seal
9	Ball
10	Body seal
11	Seat
12	Body
14	Butt Weld End
16	Body Bolts
17	Body Nuts
18	Centre Ring

Figure 11.40 Ball valve parts list.

12. INTRINSICALLY SAFE REFRACTOMETER PR-01-S-EX/FM

The Intrinsically safe refractometer is used in locations made hazardous by the presence of flammable mixture of gas and air. EN 50 020, the relevant CENELEC apparatus standard, defines an intrinsically safe circuit as:

A circuit in which no spark or any thermal effect produced in the test conditions prescribed in this standard (which include normal operation and specified fault conditions) is capable of causing ignition of a given explosive atmosphere.

PR-01-S-EX is certified by BASEEFA (British Approvals Service for Electrical Equipment in Flammable Athmospheres), Certificate No. Ex 92C2539, **code EExia II C T4 (T_{amb} = 45 °C)**.

PR-01-S-EX is also certified by TIIS (Technical Institution of Industrial Safety) in Japan. Approval Number C12586, **code Exia IIC T4 (T_{amb} = 45 °C for all surfaces)**.

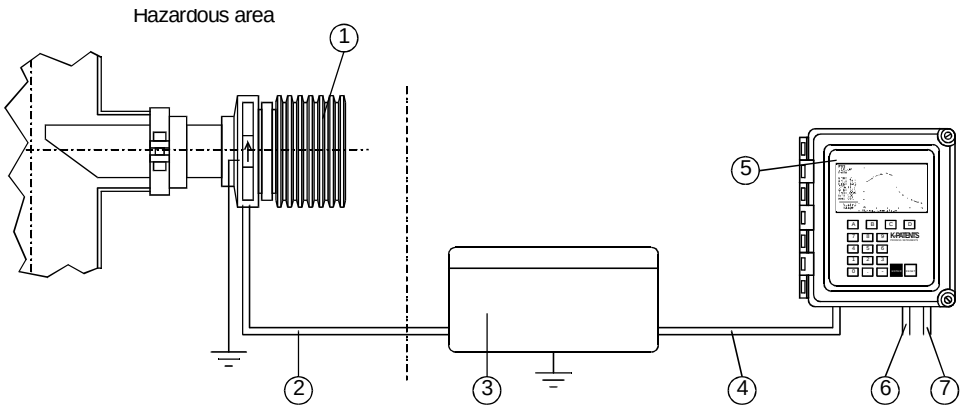
PR-01-S-FM is certified by Factory Mutual Research Corporation, Approval No. 2Y7A7.AX **for Class I, Division 1, Groups A, B, C, D,** indoor hazardous (classified) locations. Temperature identification rating for PR-01-S-FM is **T4 (T_{amb} = 45 °C).**

References to this chapter in this manual are written in *italics*.

Note. Servicing of PR-01-S-EX/FM is allowed to trained service personnel of K-Patents International Representatives only. Servicing must be done according to separate instructions defined by K-Patents and must be reported to K-Patents.

12.1. EQUIPMENT

The Intrinsically safe K-Patents Process Refractometer consists of (Figure 12.10): A modified refractometer sensor PR-01-S-EX/FM, a standard Indicating transmitter, three barriers, a barrier power unit and cabling.



1. Sensor PR-01-S-EX/FM
2. Armoured cable PR-8061
   Shielded cable PR-8050
3. Barrier unit PR-7078
4. Interconnecting cable PR-8040
5. Indicating transmitter IT-R
6. Output signal
7. Line power supply

Figure 12.10 Intrinsically safe equipment.

Note: The BASEEFA certified system in Figure 12.20 is certified under the system certificate Ex 92C2540.

The equipment is intrinsically safe only if **all** mounting instructions in Section 12.2. are followed.

The BASEEFA approved sensor PR-01-S-EX is identified by the label in Figure 12.11. The Indicating transmitter is a standard IT-RE-GP.

The TIIS approved sensor PR-01-S-EX is identified by the label in Figure 12.12. The Indicating transmitter is a standard IT-RE-GP.

The FM approved sensor PR-01-S-FM is identified by the label in Figure 12.13. The Indicating transmitter is a standard IT-RU-GP.

Figure 12.11 BASEEFA approved Intrinsically safe sensor PR-01-S-EX label.

Figure 12.12. TIIF approved Intrinsically safe sensor PR-01-S-EX label.

Figure 12.13. FM approved Intrinsically safe sensor PR-01-S-FM label.

The approvals are valid for the following variations of the Sensor:

Variations in process connections:	Flange: DIN, ANSI, JIS Sandvik clamp Hygienic clamp
Variations in material of wetted parts:	AISI 316L Hastelloy C Titanium Pd Titanium
Variations in lenght:	Standard (374 mm) Long probe (526 mm)

The difference between the standard Sensor and the intrinsically safe Sensor can be seen from the Parts list, Chapter 7.0.

Warning! Do not replace any part of an intrinsically safe sensor with a standard sensor part.

The Zener barriers are described in Section 12.3, and the Barrier Power unit in Section 12.4.

12.2. INTRINSICALLY SAFE MOUNTING

The mounting requirements for PR-01-S-EX are summarized in the Application Drawing A4-354, Figure 12.20 and Drawing Notes A4-355, Figure 12.21. The mounting requirements depend on to which group (II A, II B, II C) the flammable gas belongs. Representative gases for the three groups are Propane (II A), Ethylene (II B) and Hydrogen (II C).

The mounting of PR-01-S-FM must be in accordance with the National Electrical code (ANSI/NFPA70). For installation quidance of the PR-01-S-FM, see also ANSI/NFPA 12.6 “Installation of Intrinsically safe instrument systems in Class I Hazardous Locations”.

The electrical connections for PR-01-S-EX are described in Figure 12.22 and for PR-01-S-FM in Figure 12.23 for two alternatives:

– Connections by instrumentation cable

– Connections by armoured instrumentation cable

Cables

Following cable is included in a standard delivery:

– 10 m (33 ft) cable Indicating transmitter - Barrier power unit.
  Part PR-8040-010.
  The maximum cable length is 100 m (330 ft).

– Cable connector to Sensor with screw terminals.
  Part PR-8031 with instrumentation cable glands.
  Part PR-8032 with armoured glands.

The instrinsically safe cable can be connected to the cable connector as described in Figures 12.22 and 12.23.

Options:

– Cable between Barrier unit and sensor, Part PR-8060, armoured instrumentation cable with connector.

– Cable between Barrier unit and sensor, Part PR-8050, shielded instrumentation cable with connector.

For cables between Barrier power unit and Barriers, see Section 12.3.

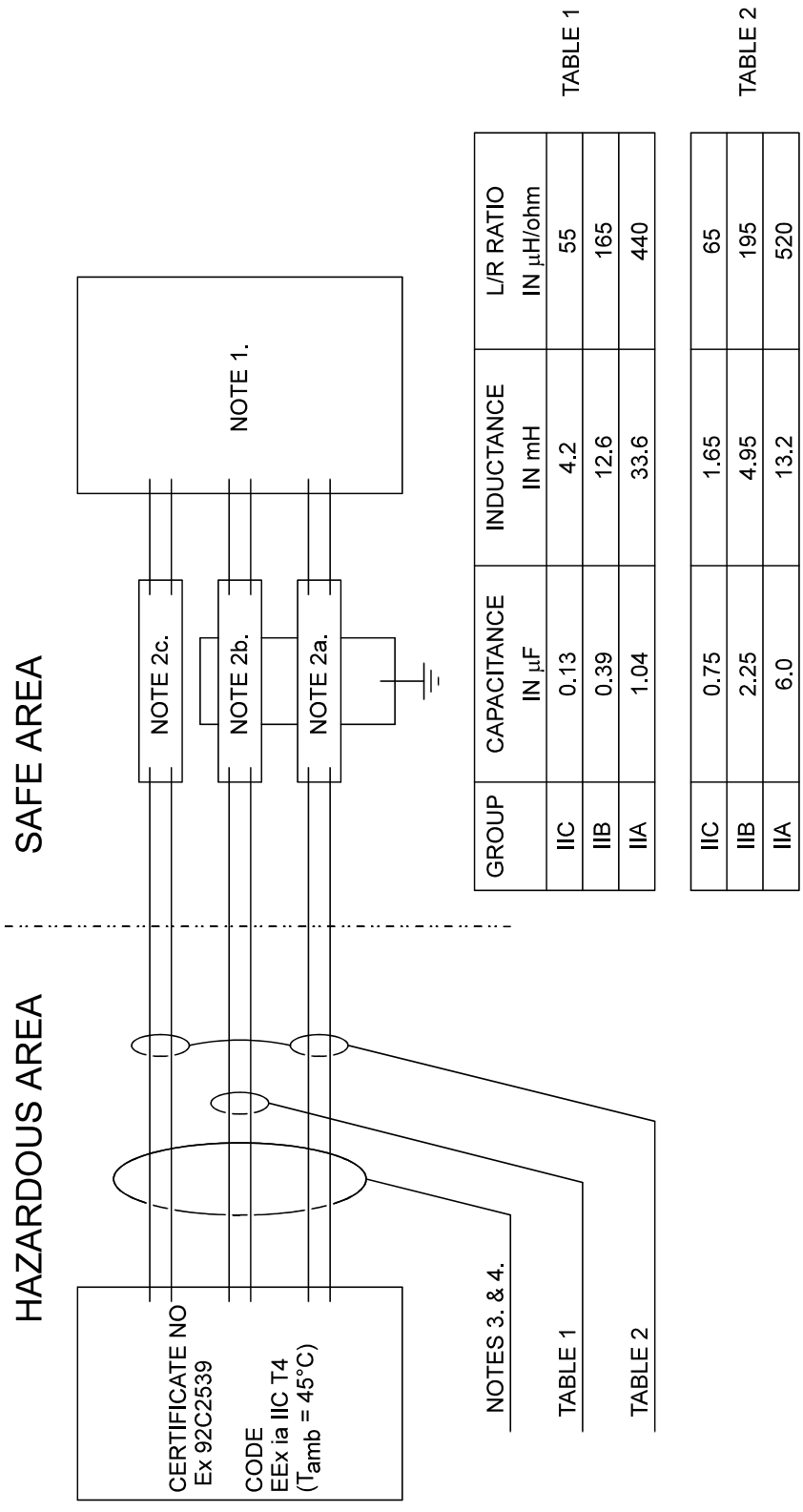


Figure 12.20 Intrinsically safe application drawing.

NOTES

1. Apparatus which is unspecified except that it must not be supplied from, nor contain, under normal or abnormal conditions, a source of potential with respect to earth in excess of 250 volts r.m.s. or 250 volts d.c.

2 a. Single channel or one channel of dual channel polarised or non-polarised Shunt Zener Diode Safety Barrier Certified by an EEC Approved Certification Body to [EEx ia] IIC whose output parameters are less than: Uz = 15,0 volts and Imax:out = 0,153 amps, and whose output current is limited by an resistor 98 Ω such that Imax:out = Uz/R.

2 b. Any single channel positive Shunt Zener Diode Safety Barrier Certified by an EEC Approved Certification Body to [EEx ia] IIC whose output parameters are less than: Uz = 28,0 volts and Imax:out = 0,093 amps, and whose output current is limited by a resistor 300 Ω such that Imax:out = Uz/R.

2 c. Opto Barrier; An Opto isolated signal Barrier ZG 44/Ex Certified by BASEEFA No. Ex 92C2221 to [EEx ia] IIC.

3. These cables may be separate cables or may be installed in a type A or type B multicore cable (as defined in clause 5.3 of BS 5501 : Part 9 : 1982, EN 50 039) provided that the peak voltage of any circuit contained within the type B multicore does not exceed 60 volts.

4. The Capacitance AND Inductance OR Inductance to Resistance (L/R) ratio of the hazardous area cable must not exceed the values given in the tables.

5. The electrical circuit in the hazardous area must be capable of withstanding an a.c. test voltage of 500 volts to earth or frame of the equipment, for one minute witout breakdown.

6. The Installation must comply with National requirements (eg. in the UK to BS 5345 : Part 4 : 1977).

7. The system must be marked with a durable label, normally affixed on or adjacent to the principle item of electrical apparatus in the system, or at the interface between the intrinsically safe and non intrinsically safe circuits. This marking shall include "BASEEFA System No.Ex 92C2540".

8. The Barrier earth must be connected via a high integrity connection, using an insulated conductor equivalent to a $4mm^2$ copper conductor, such that the impedance from the point of connection, to the main power system earth, is less than 1 ohm.

Figure 12.21 Intrinsically safe drawing notes.

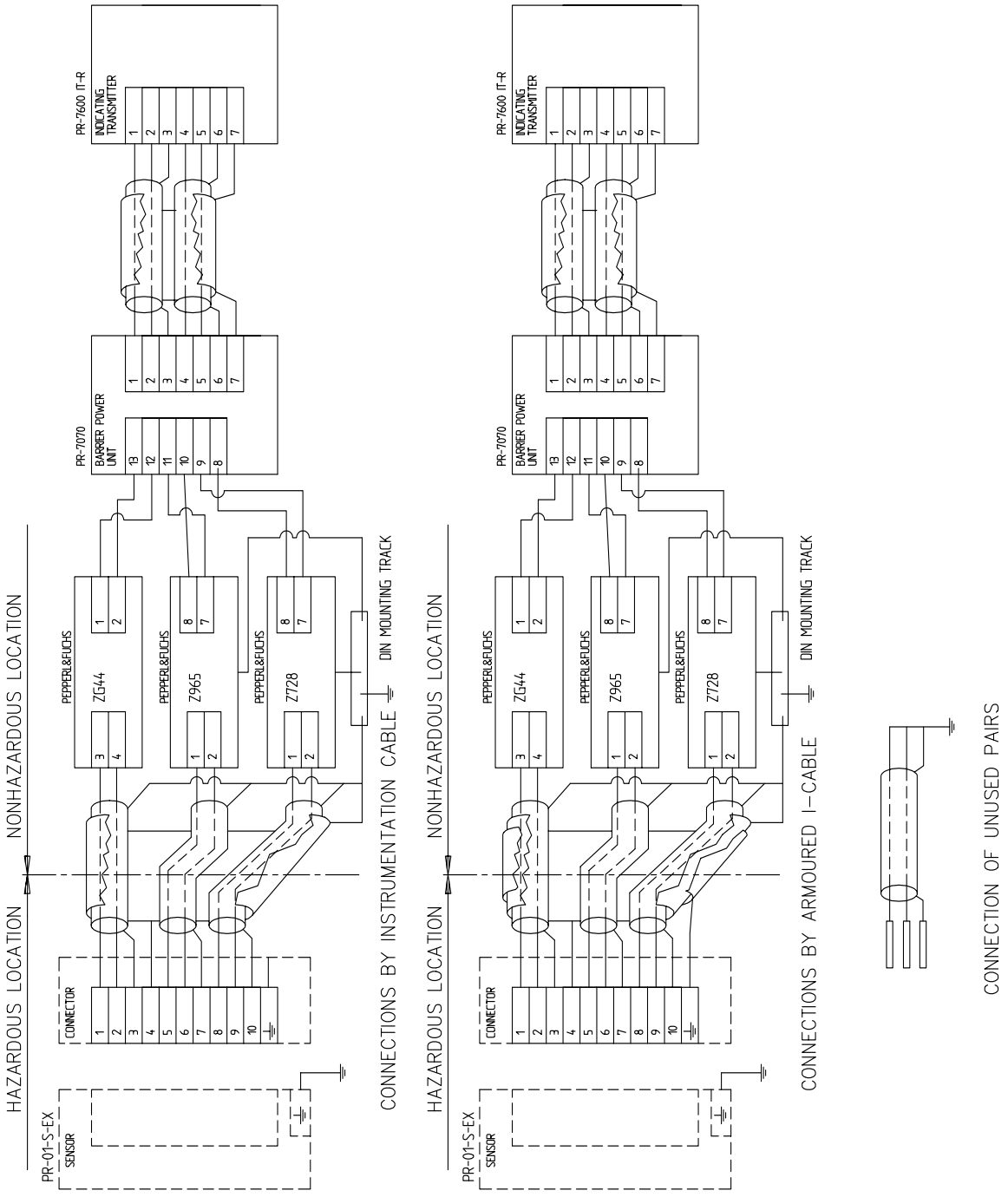


Figure 12.22 Intrinsically safe field wiring for PR-01-S-EX.

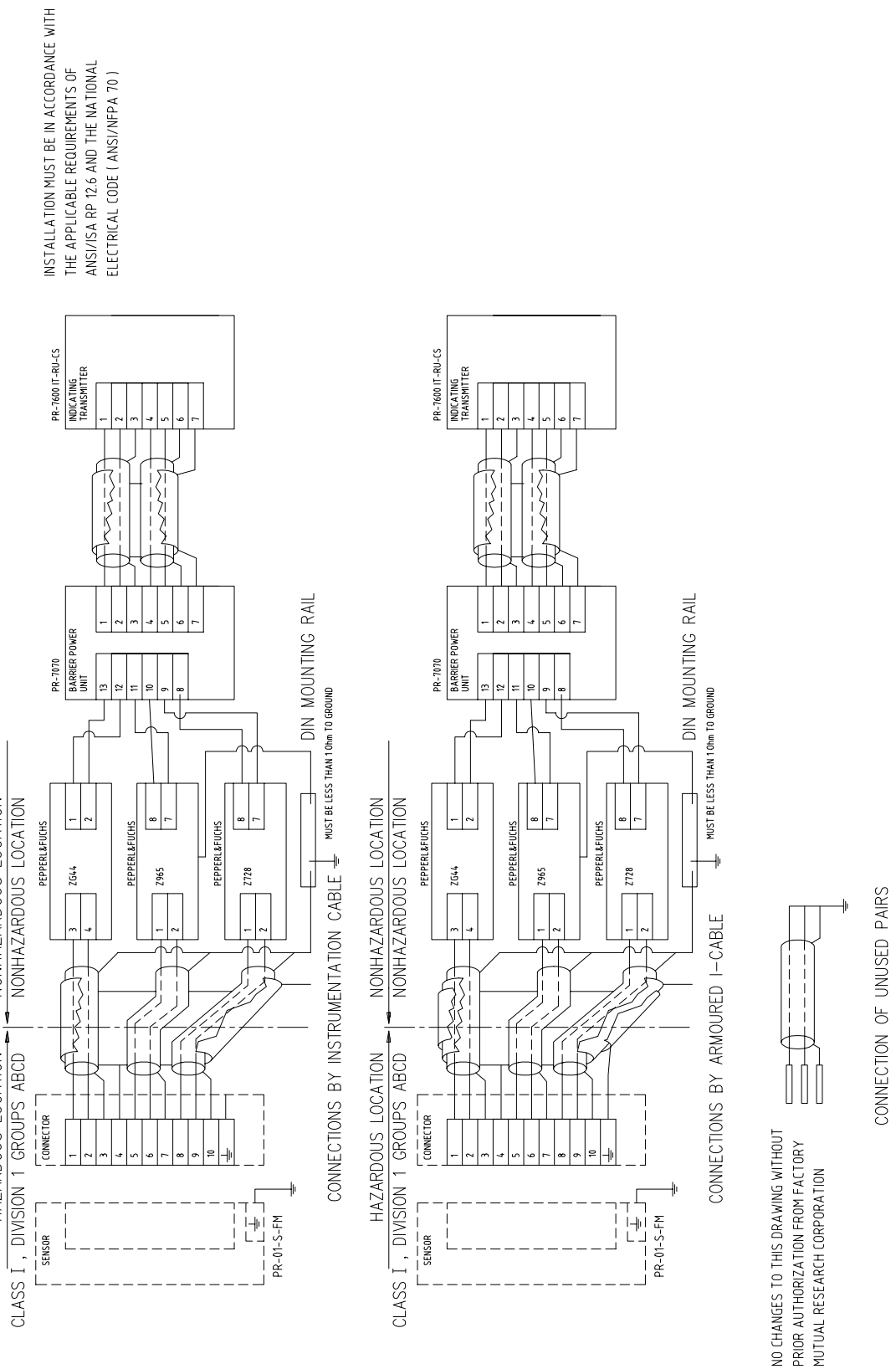


Figure 12.23 Intrinsically safe field wiring for PR-01-S-FM.

12.3. ZENER BARRIERS

The Zener barriers and accessories (Figure 12.30) are normally delivered as a complete Barrier unit PR-7078 containing the following:

Qty	Part	Description
1	PR-7073	Zener barrier Pepperl + Fuchs Z965
1	PR-7074	Zener barrier Pepperl + Fuchs Z728
1	PR-7075	Optobarrier Pepperl + Fuchs ZG44/Ex
1	PR-7070	Barrier power unit, see Section 12.4
1		Mounting rail for above equipment DIN EN 50 022 35 mm x 240 mm
1		Cables between Barrier power supply and Barriers
1		Ex-mounting plate, 162 x 240 mm
1		Ex d -mounting box, 278 x 188 x 180 mm
3		Earthing terminals
2		P6 16 Fibox cable glands
1		P6 21 Fibox cable gland

The parts have to be mounted in accordance with Figure 12.30.

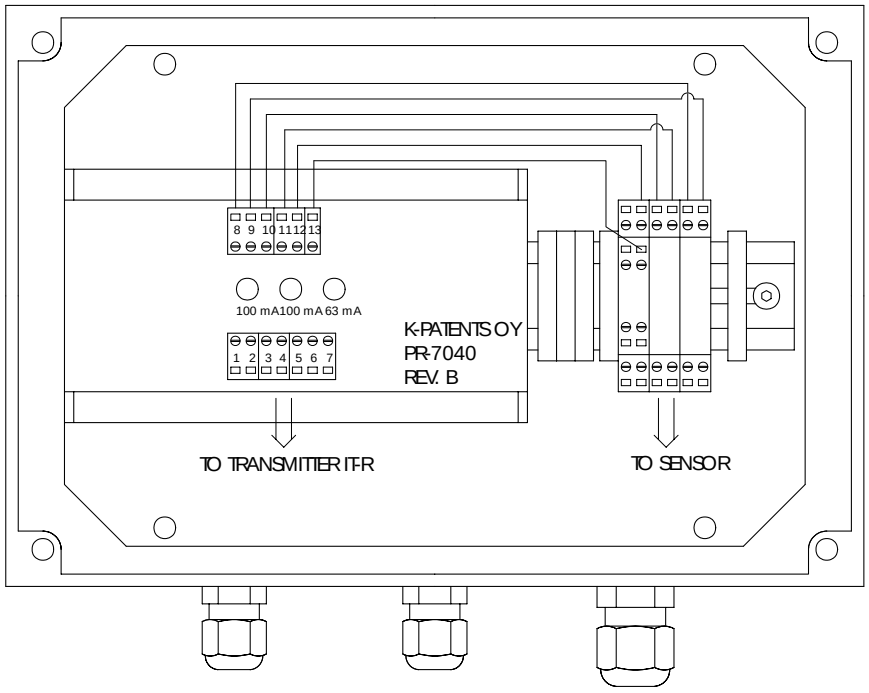


Figure 12.30 Mounting of barriers and accessories.

12.4. BARRIER POWER UNIT PR-7070

The Barrier power card accepts a 24 V DC input from the Indicating transmitter and provides the following functions:

1. 24V DC fused supply to Zener barrier Z728
2. 12V DC fused supply to Zener barrier Z965

3. Automatic gain control (AGC) and line driver for the signal from Optobarrier ZG44/Ex. The output to the Indicating transmitter is an RS 485 signal.

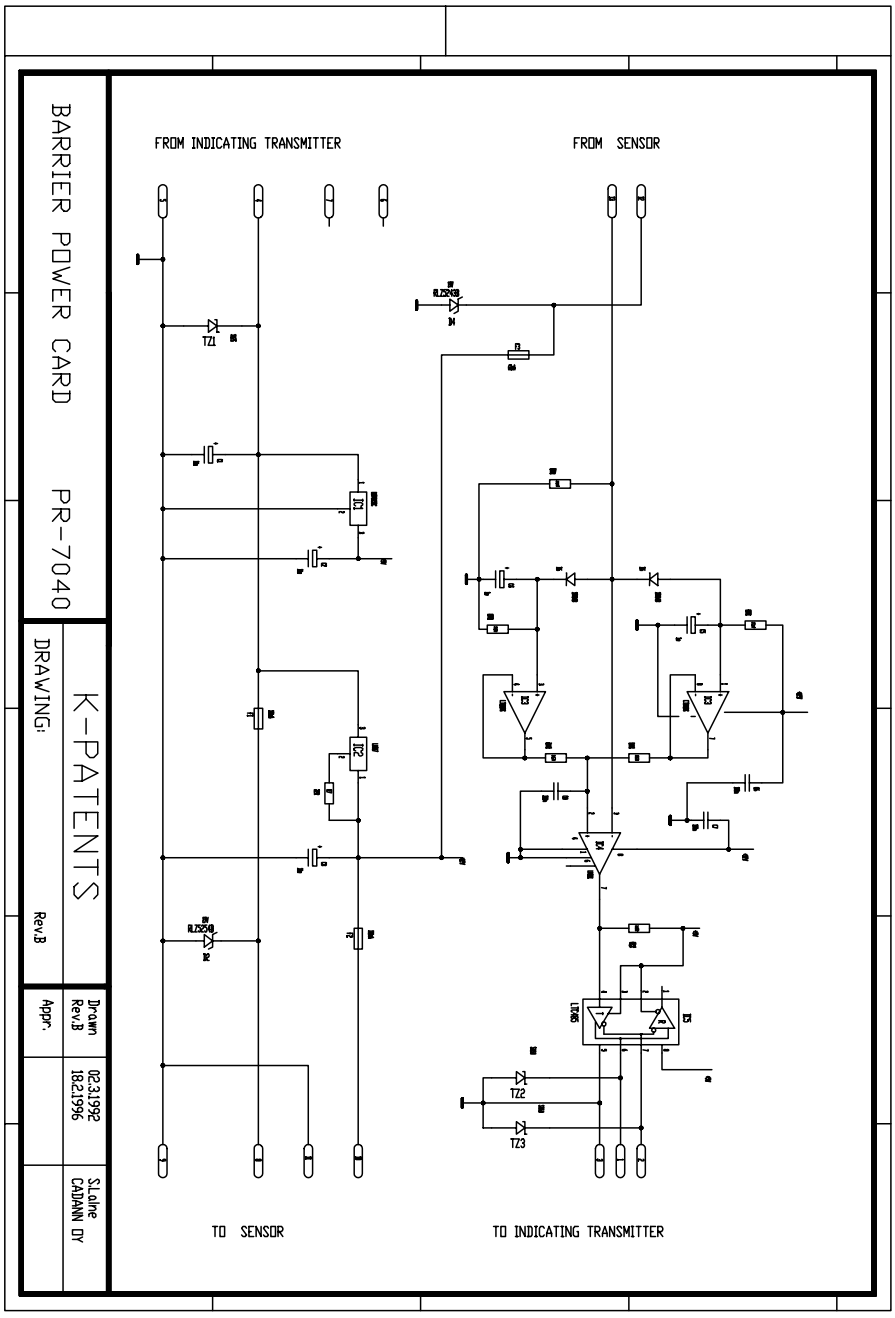


Figure 12.40 Barrier power card PR-7040, Circuit diagram.

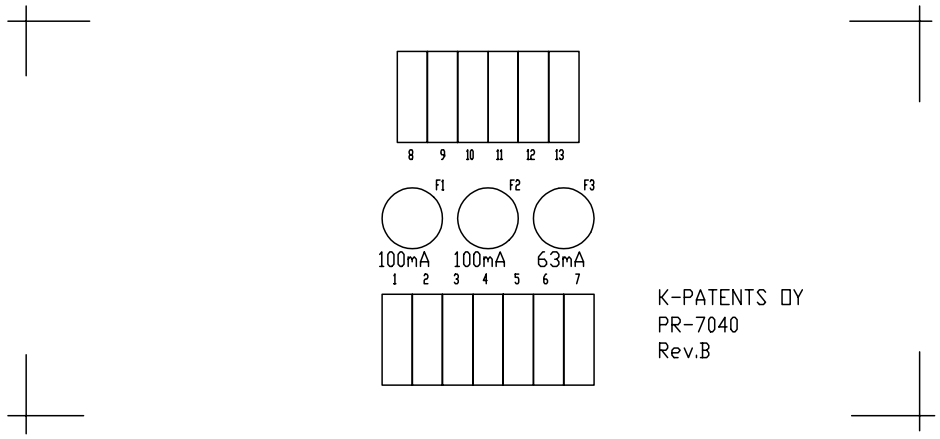


Figure 12.41 Barrier power card PR-7040, components lay-out.

12.5. FUNCTIONAL DESCRIPTION

The Information and Power flow in the intrinsically safe Sensor is in figure 6.50b. The Indicating transmitter is identical to the standard non-intrinsic version, see Figure 6.21.

The Sensor is functionally indentical to the standard Sensor, but the Image detector module is made on a separate intrinsically safe circuit. Thus the Image Digitizer card is divided into two separate intrinsically safe circuits, see Figure 12.52. (See also Figure 6.50a and 6.52b).

The Figure 12.51 is supplementary to Figure 12.50 and shows the earth connections. The Figure 12.53 describes the sensor internal wiring.

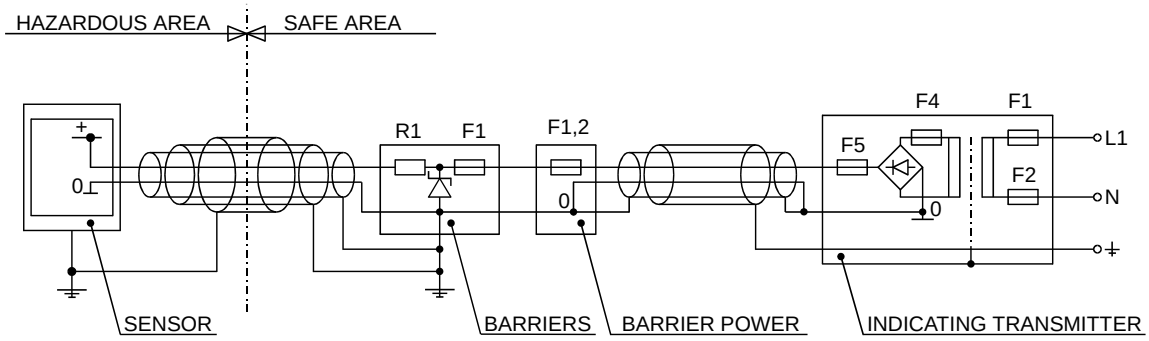


Figure 12.51 Earth connections.

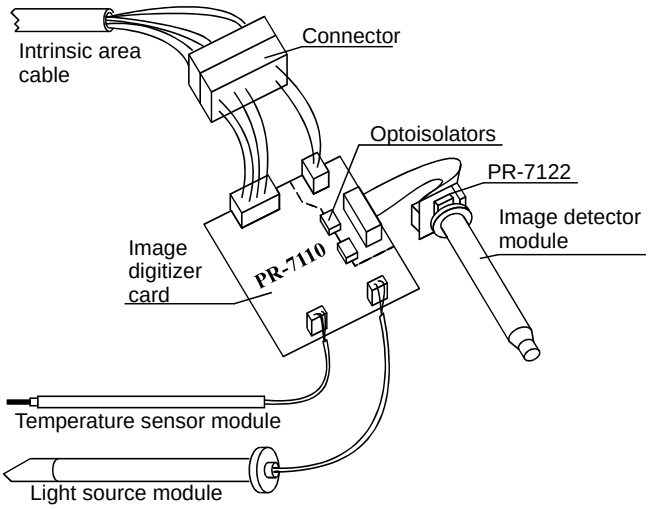


Figure 12.52 Intrinsically safe Sensor: construction of the electronics.

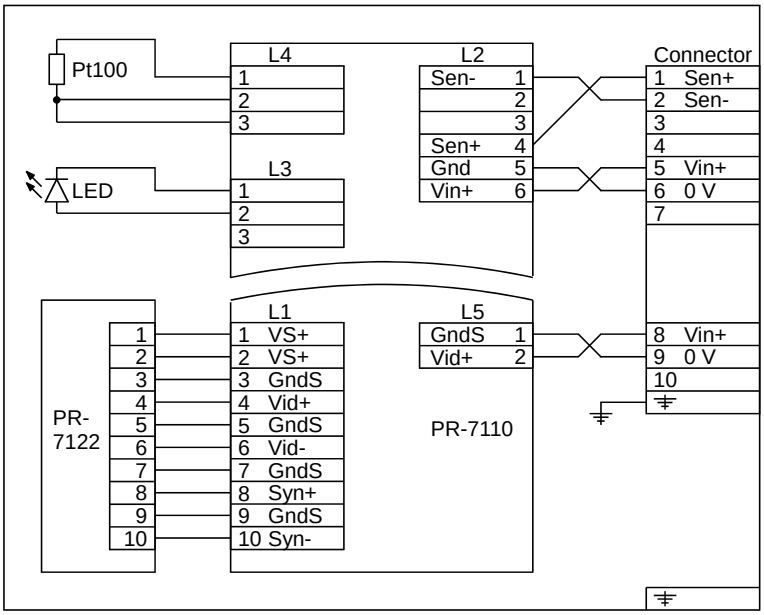


Figure 12.53 Intrinsically safe Sensor: Internal wiring.

13. K-PATENTS PROCESS REFRACTOMETER CALIBRATION DATA REPORT

CUSTOMER: _____

ADDRESS: _____

CONTACT PERSON: _____

PROCESS REFRACTOMETER MODEL: _____ **SERIAL NO.** _____

SAMPLE DESCRIPTION (DISSOLVED MATERIALS): _____

_____

SOLVENT: _____

LABORATORY METHOD: _____

DESIRED SCALE: OUTPUT 0-100 % (4-20 MA): _____ **UNIT:** _____

DATE: _____ **SIGNATURE:** _____

		DISPLAY READINGS				
SAMPLE No.	**SAMPLE CONC. LAB%**	**CONC%**	**TEST**	**TEMP. °C**	**SAMPLE DATE AND TIME**	**SIGN**