Technical Information

LCL1, LCL2

Capacitive Limit Switch

Limit Switch for Bulk Solids

ISO9001

CE

PEPPERL+FUCHS
PROTECTING YOUR PROCESS

Application

The device is designed for point level detection in light bulk solids with a grain size up to max. 30 mm (1.18 inch) and a dielectric constant $\varepsilon_r \geq 1.6$ e. g. grain products, flour, milk powder, animal feed, cement, chalk or gypsum.

Versions:

- LCL1: with rod probe for bulk solids and liquids
- LCL2: with rope probe up to 6 m (20 foot); for bulk solids
- Relay output (potential-free change-over contact/SPDT) with AC or DC power
- PNP output with 3-wire DC power

Your benefits

- Complete unit consisting of the probe and electronic insert:
  - simple mounting
  - no calibration on start-up
- Active build-up compensation
  - accurate switch point
  - high operational safety
- Mechanically rugged
  - no wearing parts
  - long operating life
  - no maintenance
- The rope probe of the LCL2 can be shortened
  - optimum matching to the measuring point
  - less stocks required

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1 Function and System Design

1.1 Measuring Principle

Point Level Detection

A metal plate at the end of the probe, within the insulation, the integrated counter-electrode and the surroundings combine to form the two electrodes of a capacitor.

If the probe is covered or free of process medium, the capacitance changes and the device switches.

Active Build-up Compensation

The device detects build-up on the probe and compensates for its effects so that the switch point is always observed. The effects of build-up compensation depend on:

- the thickness of the buildup on the probe,
- the conductivity of the buildup,
- the sensitivity setting on the electronic insert.

1.2 Measuring System

The device is an electronic switch. The complete measuring system consists of:

- the device LCL1 or LCL2
- a power supply and
- controllers, switching devices, signal transmitters (e. g. lamps, horns, PCS, PLC, etc.)

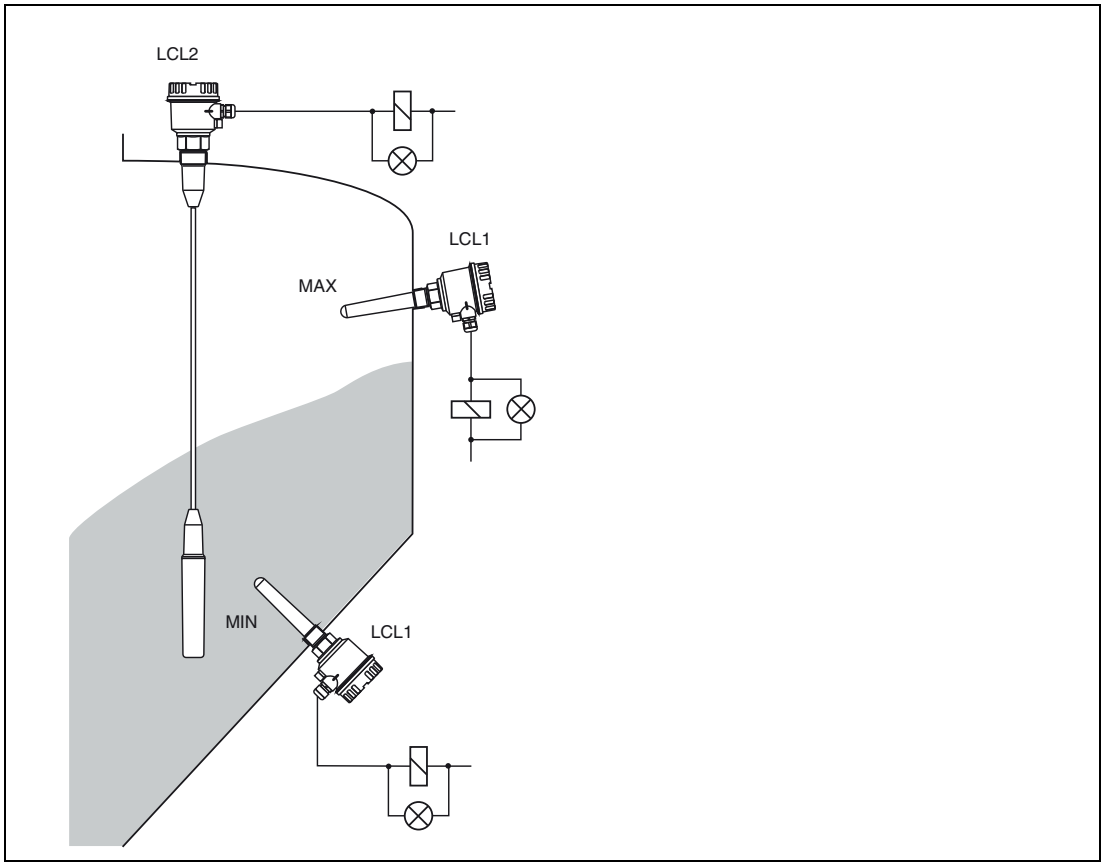

Figure 1.1 Point level detection in silos containing solids

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1.3 Function Range

There is a loose relationship between the dielectric constant ε_r and the density ρ of the material. The table on the left indicates whether the device can be used or if application limits are exceeded.

Grain, seed, legumes and their products			Minerals, inorganic materials			Plastics		
Examples	ρ in g/l (approx.)	ε_r (approx.)	Examples	ρ in g/l (approx.)	ε_r (approx.)	Examples	ρ in g/l (approx.)	ε_r (approx.)
Rice	770	3.0	Cement	1050	2.2	ABS granulate	630	1.7
Cornstarch (packed)	680	2.6	Plaster	730	1.8	PA granulate	620	1.7
Flour (wheat)	580	2.4	Chalk (packed) *	540	1.6	PE granulate *	560	1.5
Corn grist	500	2.1	Chalk (loose) *	360	1.4	PVC powder *	550	1.4
Sunflower seeds	380	1.9				PU dust *	80	1.1
Noodles	370	1.9						
Bran (wheat)	250	1.7						
Popcorn *	30	1.1						
* Gray background: application limits not reached > use Vibracon LVL-BX as level switch.								

Table 1.1

In general:

If the dielectric constant of the process medium is not known, then the bulk density can be a deciding factor. Experience shows that the device functions in foodstuffs with a density of 250 g/l and above or in plastic or mineral materials with a density of 600 g/l and above.

1.4 Setting the Sensitivity

The device is so calibrated at the factory that it correctly switches in most materials. Greater sensitivity can be set using a switch on the electronic insert. This is necessary if there is very strong build-up on the probe, or if the dielectric constant ε_r of the material is very small.

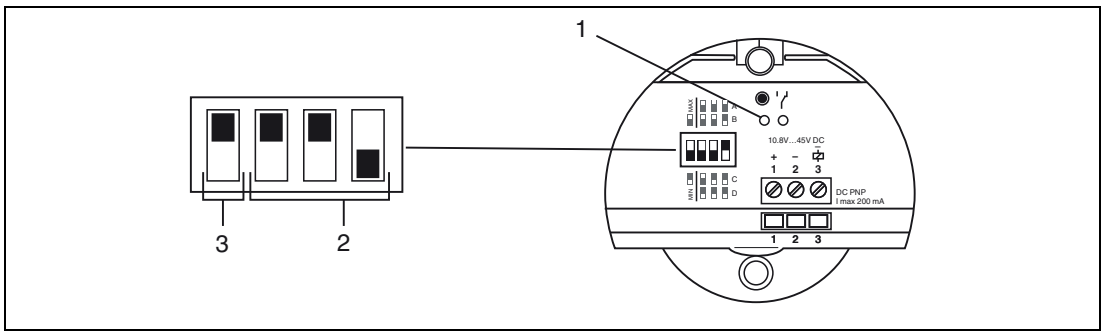

Figure 1.2

The switch positions show the factory settings:

1 LEDs

2 Switch for setting sensitivity

3 Switch for selecting safety position

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1.5 Fail-Safe Mode

MIN-/MAX detection on the electronic insert, switchable.

MIN

The output switches if the probe is uncovered or if the supply voltage is disconnected in a safety oriented manner (signal on alarm). Used for dry-running protection and pump protection, for example.

MAX

The output switches if the probe is covered or if the supply voltage is disconnected in a safety-oriented manner (signal on alarm). Used for overfill protection, for example.

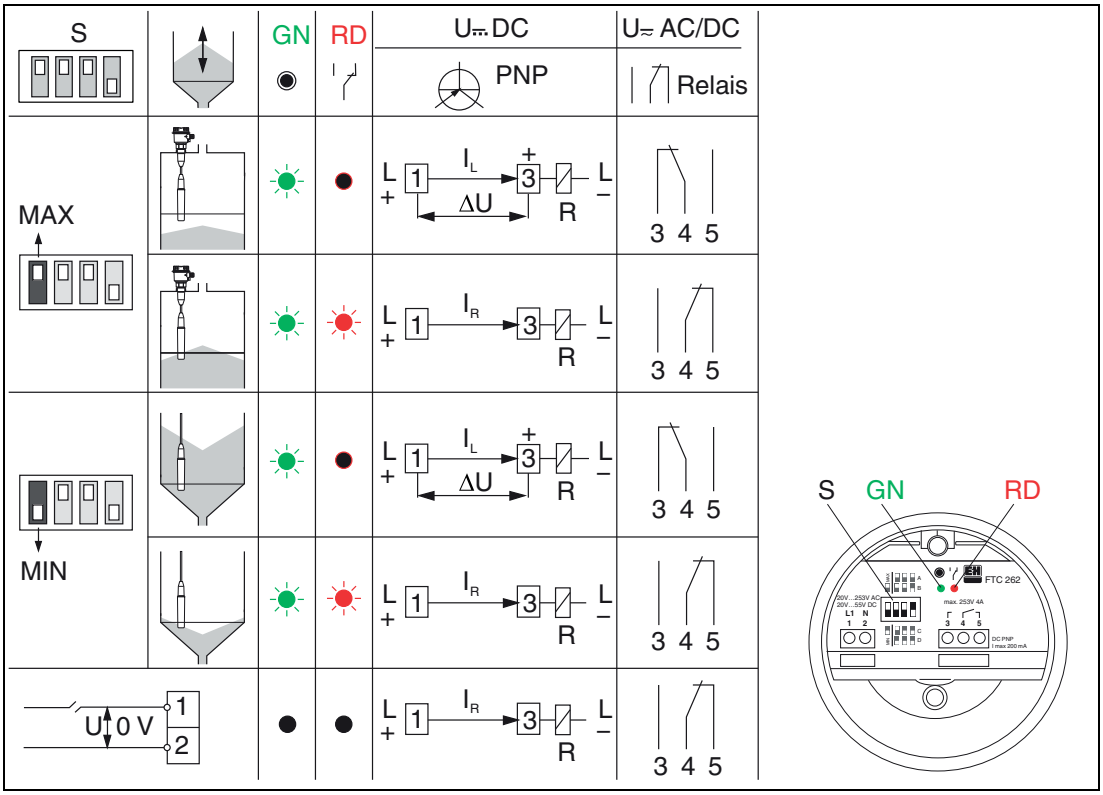

Figure 1.3 Function and selection of fail-safe mode

2 Input

2.1 Measured Variable

Point level

2.2 Measuring Range

- LCL1: $\varepsilon_r \geq 1.6$
- LCL2: $\varepsilon_r \geq 1.5$

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3 Output

3.1 Output signal

- DC, PNP transistor output:
  Switching: PNP
- I_{max} 200 mA
  - overload and short circuit protection
  - residual voltage at transistor at I_{max} < 2.9 V
- AC/DC, Relay output: Contact: change-over, potential-free
  $U_{\sim max}$ 253 V, $I_{\sim max}$ 4 A
  $P_{\sim max}$ 1000 VA, cos φ = 1
  $P_{\sim max}$ 500 VA, cos φ > 0.7
  $I_{\overline{\overline{\ }}max}$ 4 A at $U_{\overline{\overline{\ }}}$ 30 V
  $I_{\overline{\overline{\ }}max}$ 0.2 A at $U_{\overline{\overline{\ }}}$ 253 V

3.2 Signal on alarm

- DC, PNP transistor output: < 100 µA
- AC/DC, Relay output: relay de-energized

3.3 Switching Delay when Free or Covered

- LCL1: 0.5 s
- LCL2: 0.8 s

3.4 Overvoltage category

Category II acc. to EN 61010-1

3.5 Protection class

Class I acc. to EN 61010-1

4 Power Supply

4.1 Electrical Connection

To ensure that the device operates safely and without electrical interference, it must be connected to an earthed silo with metal or reinforced concrete walls.

For silos made of non-conductive materials, the external earth wire of the device must be connected to a conductive and earthed component which is earthed near to the silo. The protective earth can be connected to the internal earth terminal of the device.

Connections can be made with standard instrument cabling.

Connect the potential matching lead (PAL) when using in dust explosion hazardous areas. Note national regulations!

AC or DC Connection and Relay Output (WA)

F1 Fine-wire fuse to protect the relay contact, dependent on the connected load
F2 Fine-wire fuse, 500 mA
M Earth connection to silo or metal components on silo
E Earth

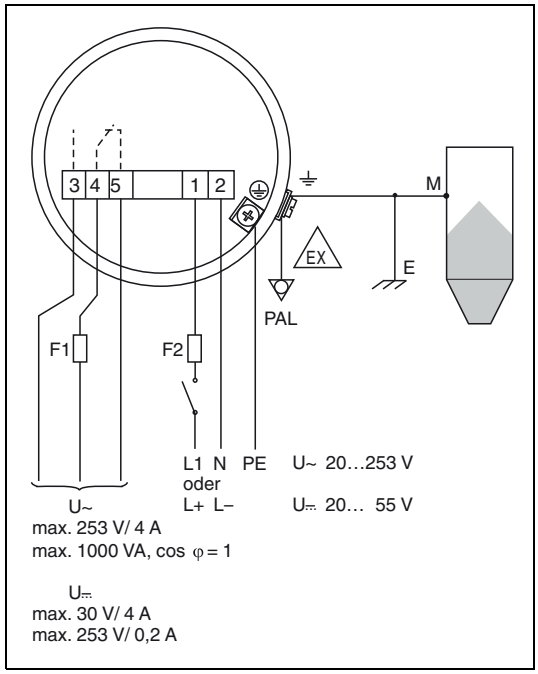

Figure 4.1

Device with F14 housing: no ground lines (PE) or potential matching lines (PAL) are required.

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3-wire DC Connection; Transistor Output PNP (E5)

R Connected load, e. g. PLC, PCS, relay
F Fine-wire fuse, 500 mA
M Earth connection to silo or metal components on silo
E Earth

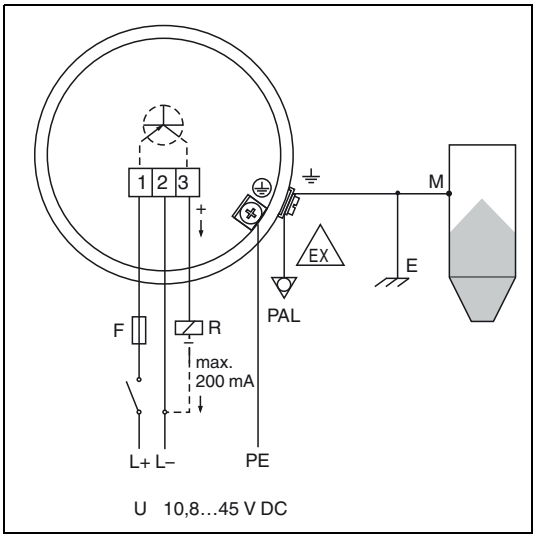

Figure 4.2

Device is protected against reverse polarity. The green LED for standby goes out if the connections are reversed.

LCL1 with F14 housing: no ground lines (PE) or potential matching lines (PAL) are required.

4.2 Supply Voltage

- DC, PNP transistor output: U⎓ 10.8 to 45 V DC
  - transient pulses to 55 V
  - current consumption max. 30 mA
  - reverse polarity protected
- AC/DC, Relay output: U~ 20 to 253 V AC or U⎓ 20 to 55 V DC
  - current consumption max. 130 mA

4.3 Terminal Compartment

- Stranded wires max. 1.5 mm^2 (16 AWG) in end sleeves
- Electric wire max. 2.5 mm^2 (14 AWG)

5 Performance Characteristics

5.1 Reference Operating Conditions

In plastic container:

- Ambient temperature: 23 °C (73 °F)
- Medium temperature: 23 °C (73 °F)
- Medium pressure p_e: 0 bar (0 psi)
- Medium: dielectric constant $\varepsilon_r = 2.6$
- Conductivity: < 1 µS
- Sensitivity setting: C

5.2 Hysteresis

- LCL1: 4 mm (0.16 inch) horizontal, 7 mm (0.28 inch) vertical
- LCL2: 5 mm (0.2 inch) vertical

5.3 Switch Point

- LCL1: Probe center -5 mm (-0.2 inch) horizontal, above probe tip 40 mm (1.57 inch) vertical
- LCL2: Above probe tip: 35 mm (1.38 inch) vertical

Probe length tolerances; mm (inch):

Probe length L	Tolerances
up to 1000 (39.4)	+0/-10 (+0/-0.39)
up to 3000 (118)	+0/-20 (+0/-0.79)
up to 6000 (236)	+0/-30 (+0/-1.18)

5.4 Power Up Response

- LCL1: Correct switching after max. 1.5 s
- LCL2: Correct switching after max. 2 s

5.5 Long-term Drift

- LCL1: 3 mm (0.12 inch) horizontal, 6 mm (0.24 inch) vertical
- LCL2: Vertical 6 mm (0.24 inch)

5.6 Influence of Medium Temperature

Depending on material to be measured

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6 Installation

6.1 Installation Conditions

Silo Material

The device can be used in a range of silos made of different materials.

Mounting Point

Note the angle of the material mounds and the outlet funnel when determining the mounting point or probe length of the LCL2.

Note!

The material flow must not be directed at the probe!

6.2 Installation Instructions LCL1

Correct Installation **Incorrect Installation**

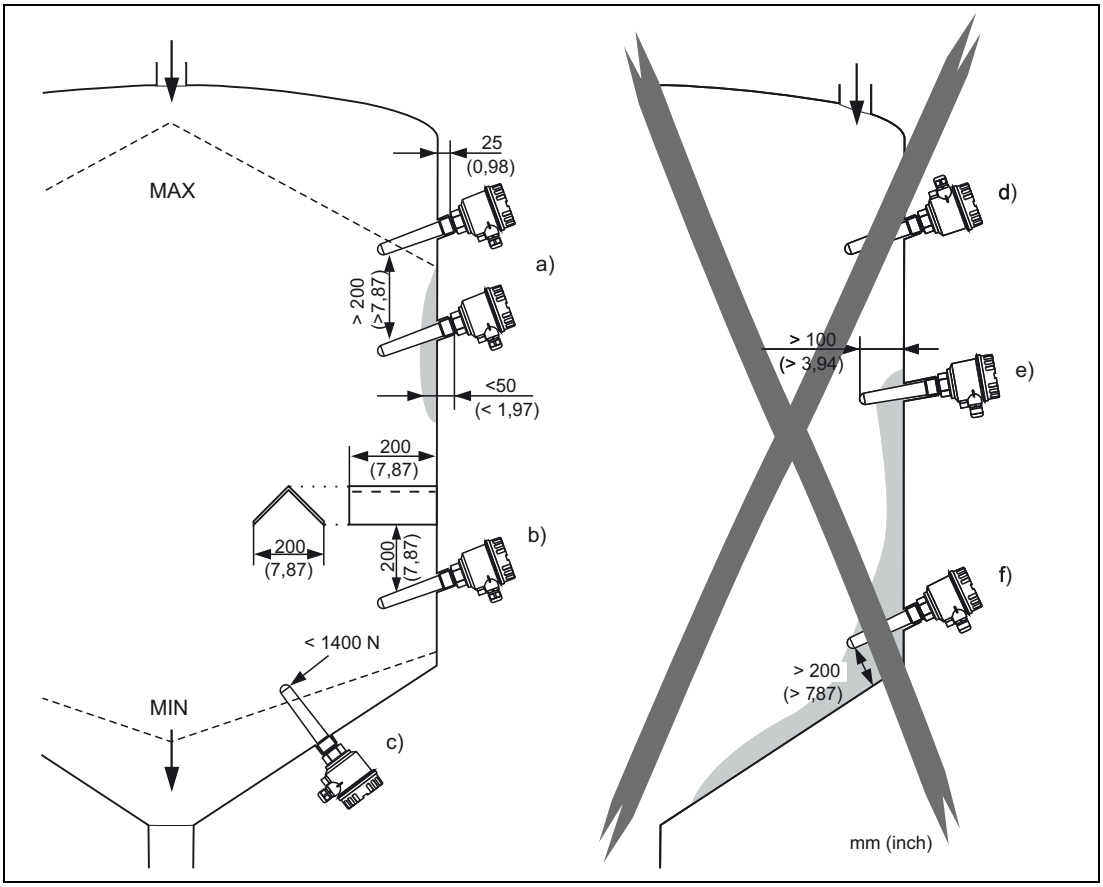

Figure 6.1 General information and recommendations for installing a LCL1 level switch

Correct Installation

a Minimum distances:
To prevent mutual interference with the LCL1, there must be a minimum distance of 200 mm (7.87 inch) between two probe tips.

b Mounting point:
Tip of probe points slightly downwards so that process medium can slide off more easily. The protective cover protects the probe rod from collapsing mounds or mechanical strain at the outflow when the LCL1 is set to minimum detection.

c Mechanical load:
The maximum lateral load on the probe rode must be taken into account when used for minimum detection. It should therefore only be used for minimum detection with loose materials that have good flow characteristics.

Incorrect Installation

d The probe may be damaged by inflowing material and cause faulty switching. Cable gland pointed upwards can allow moisture to enter.

e Threaded socket too long with material build-up on the silo wall. (Minimum mounting depth 100 mm (3.94 inch) not reached).

f Mounted near build-up in the silo. The probe tip is too near to a silo wall (less than a minimum distance of 200 mm (7.87 inch)).

6.3 Installation Instructions LCL2

Correct Installation **Incorrect Installation**

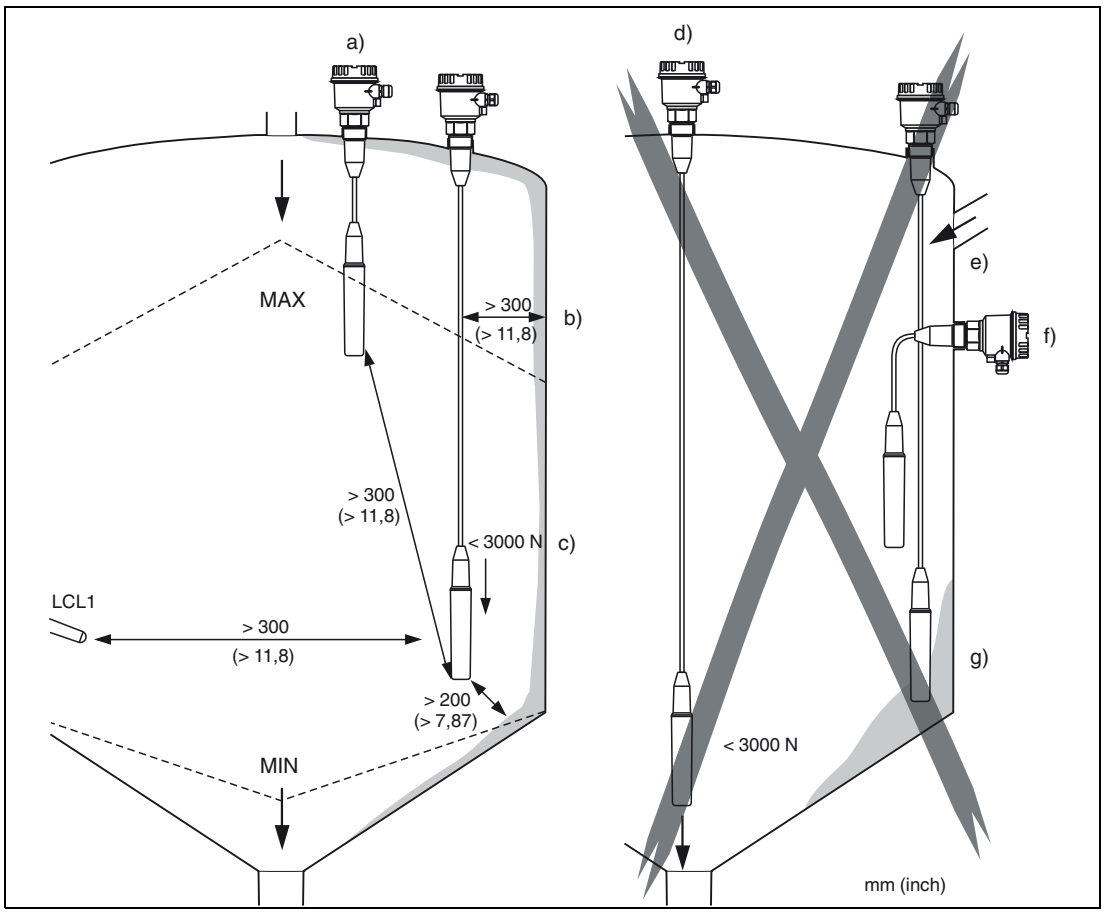

Figure 6.2 General notes and recommendations for installing a LCL2 level switch

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Correct Installation

a Minimum distances:
Sufficient distance from the material filling curtain and the other probe.

b Mounting point:
Do not install in the center of the outlet cone. Ensure there is sufficient distance from the silo wall and from material build-up on the wall.

c Mechanical load:
Note the tensile strain on the probe rope and the strength of the silo roof when used for minimum detection.
Very high tensile forces may occur at the material outlet especially with heavy, powdery bulk materials which tend to form build-up. These forces are significantly greater over the outlet than at the silo wall.
For minimum detection LCL2 should only be used for light, easily flowing solids, and that do not tend to form build-up.

Incorrect Installation

d In the center of the material outflow; the high tensile forces at this point may tear off the probe or damage the silo roof.

e The probe may be damaged by inflowing material.

f Mounted laterally.

g Too near silo wall; when swinging gently the probe can hit the wall or touch any build-up which may have formed. This can result in error switching.

7 Environment

7.1 Ambient Temperature Range T_{amb}

- -40 to +80 °C (-40 to +176 °F)
- For Dust-Ex version: -40 to +60 °C (-40 to +140 °F)

7.2 Storage Temperature

-40 to +80 °C (-40 to +176 °F)

7.3 Climate Class

Climate protection acc. to EN 60068 part 2-38 (Z/AD), (IEC 68-2-38)

7.4 Degree of Protection

- IP66; Type 4 encl. (with F14 housing)
- IP66; Type 4x encl. (with F34 housing)

7.5 Impact Resistance

Probe with F34 housing: 7 J

7.6 Vibrational Resistance

EN 60068-2-64 (IEC 68-2-64),
a(RMS) = 50 m/s2; ASD = 1.25 (m/s2)2/Hz; f = 5 to 2000 Hz, t = 3x2 h

7.7 Operating Height

Up to 2000 m (6600 foot) above mean sea level.

7.8 Electromagnetic Compatibility

- Interference Emission acc. to EN 61326, Electrical Equipment Class A
- Interference Immunity acc. to EN 61326, Annex A (Industrial) and NAMUR Recommendation NE 21 (EMC)

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8 Process

8.1 Process Temperature T_p

- LCL1: -40 to +130 °C (-40 to +266 °F)
  For Dust-Ex version: -40 to +80 °C (-40 to +176 °F)
- LCL2: -40 to +80 °C (-40 to +176 °F)

8.2 Process Pressure Range p_p

- LCL1: -1 to +25 bar (-14.5 to +362 psi)
- LCL2: -1 to +6 bar (-14.5 to +87 psi)

8.3 Temperature Diagrams

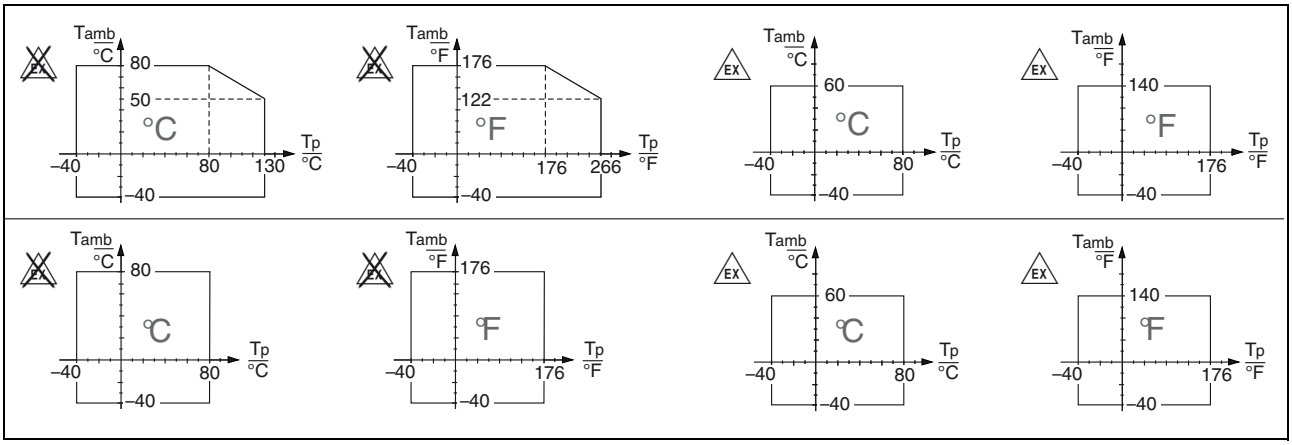

Figure 8.1

9 Mechanical Construction

Note!

All dimensions in mm! (100 mm = 3.94 inch)

9.1 Design and Dimensions

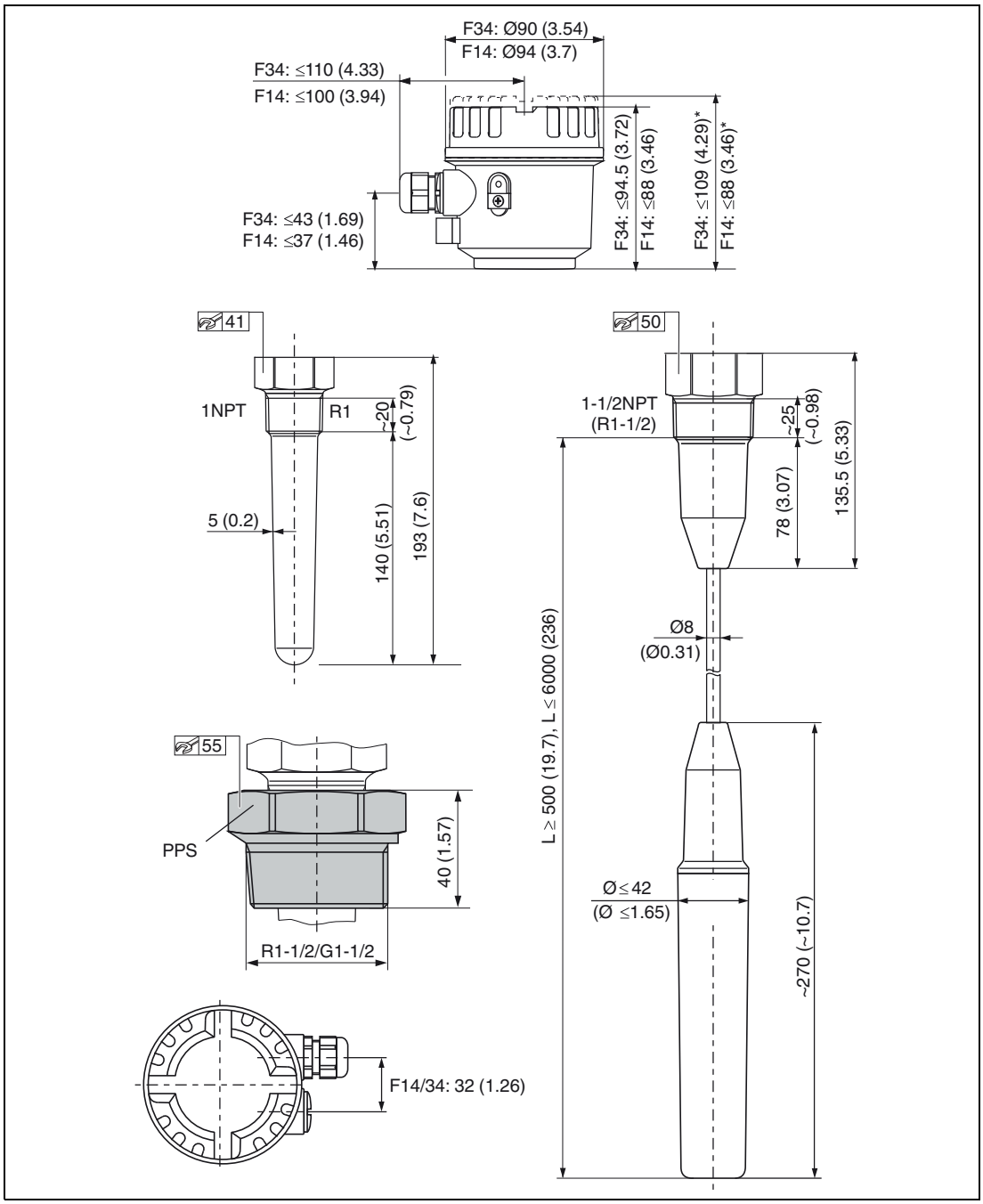

Figure 9.1

F14 Polyester PBT-FR housing, IP66

F34 Aluminum housing, IP66

* Cover with sight glass

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9.2 Material

- Probe LCL1/LCL2: PPS GF40
  FDA: FCN No. 40, 21 CFR 177.1520; Regulation (EC) No 1935/2004 and No 10/2011
- Probe rope LCL2: PE-HD
- Probe rope seal LCL2: VMQ
  FDA: 21 CFR 177.2600

9.3 Process Connections

Thread:

- LCL1
  - thread EN 10226 R1, PPS; adapter for R1-1/2 and G1-1/2, see page 27
  - thread ANSI NPT1, PPS; adapter for 1-1/4NPT, see page 27
- LCL2
  - thread EN 10226 R1-1/2, PPS
  - thread ANSI NPT1-1/2, PPS

9.4 Housing, Cable Entry

- Housing F14: polyester PBT-FR, IP66
  - Cable gland M20
  - Thread NPT1/2
  - Thread G1/2
- Housing F34: aluminium, IP66
  - Cable gland M20
  - Thread NPT1/2
  - Thread G1/2

9.5 Tensile Strength

LCL2

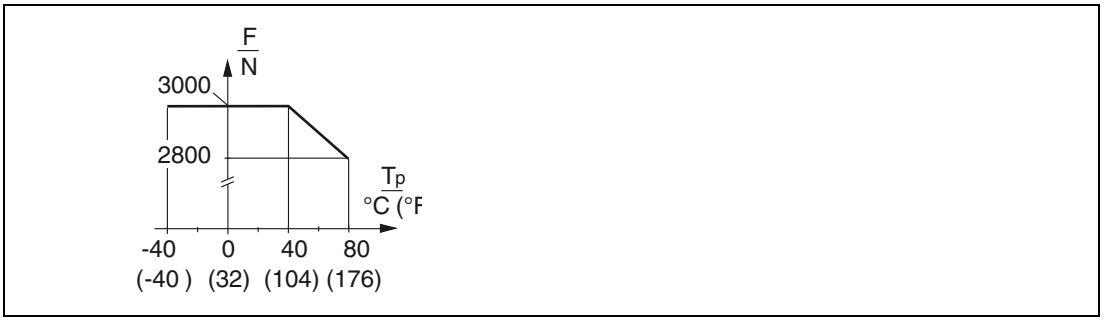

Figure 9.2

max. 3000 N up to 40 °C (104 °F)
max. 2800 N at 80 °C (176 °F)

10 Operability

10.1 Display Elements

- Green LED: stand-by
- Red LED: switch status

10.2 Operating Elements

Switch on electronic insert

- switching between minimum and maximum fail-safe mode
- sensitivity setting (depending on dielectric constant ε_r and buildup). It is usually not necessary to adjust the sensitivity, see page 6.

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11 Certificates and Approvals

Note!

The following documents are also available in the download area of the Pepperl+Fuchs web site: www.pepperl-fuchs.com

11.1 CE Mark

The device complies with the legal requirements of the EU directives.

In attaching the CE Mark, Pepperl+Fuchs confirms that the device conforms to all relevant EU directives.

11.2 Ex Approval

ATEX (in conjunction with F34 aluminum housing)
FM and CSA (in preparation)

12 Ordering Information

12.1 Product Structure LCL1

Note!

This overview does not mark options which are mutually exclusive.
Option with * = on request/in preparation

Device	
LCL	Capacitive limit switch

Design	
1	Compact device

Process connection	
N3	Thread NPT1, ANSI
R3	Thread R1, EN 10226

Probe length	
K	140 mm

Housing, cable entrance	
C	Polyester housing F14, IP66, NEMA 4, thread NPT1/2
H	Aluminium housing F34, IP66, NEMA 4X, thread NPT1/2
I	Aluminium housing F34, IP66, NEMA 4X, thread G1/2
J	Aluminium housing F34, IP66, NEMA 4X, cable gland M20
P	Polyester housing F14, IP66, NEMA 4, cable gland M20
Q	Polyester housing F14, IP66, NEMA 4, thread G1/2A

Electrical output	
E5	3-wire, PNP, 10.8 V DC to 45 V DC
WA	Relay, potential-free change-over contact, 20 V AC to 253 V AC, 20 V DC to 55 V DC

Additional equipment	
N	Without additional equipment
D	Cover with sight glass

Approval	
NA	Version for non-hazardous area
CS	CSA, DIP Cl.II, Gr.E-G, Cl.III
CG	CSA General Purpose
EX	ATEX II 1/3 D Ex ta/tc IIIC T105°C Da/Dc
FS	FM, DIP Cl.II,III, Gr.E-G, T5
WH	Overspill protection WHG

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12.2 Product Structure LCL2

Note!

This overview does not mark options which are mutually exclusive.
Option with * = on request/in preparation

Device	
LCL	Capacitive limit switch

Design	
2	Device with rope extension

Process connection	
N5	Thread NPT1-1/2, ANSI
R5	Thread R1-1/2, EN 10226

Probe length	
3	1500 mm (59 inch), steel, HD-PE insulated
4	2500 mm (98 inch), steel, HD-PE insulated
5	4000 mm (157 inch), steel, HD-PE insulated
6	6000 mm (236 inch), steel, HD-PE insulated
I	Specified length in inch, steel, HD-PE insulated, max. 236 inch
X	Specified length in mm, steel, HD-PE insulated, max. 6000 mm

Housing, cable entrance	
C	Polyester housing F14, IP66, NEMA 4, thread NPT1/2
H	Aluminium housing F34, IP66, NEMA 4X, thread NPT1/2
I	Aluminium housing F34, IP66, NEMA 4X, thread G1/2
J	Aluminium housing F34, IP66, NEMA 4X, cable gland M20
P	Polyester housing F14, IP66, NEMA 4, cable gland M20
Q	Polyester housing F14, IP66, NEMA 4, thread G1/2A

Electrical output	
E5	3-wire, PNP, 10.8 V DC to 45 V DC
WA	Relay, potential-free change-over contact, 20 V AC to 253 V AC, 20 V DC to 55 V DC

Additional equipment	
N	Without additional equipment
D	Cover with sight glass

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Approval	
NA	Version for non-hazardous area
CS	CSA, DIP Cl.II, Gr.E-G, Cl.III
CG	CSA General Purpose
EX	ATEX II 1/3 D Ex tc [ia Da] IIIC T108°C Dc
FS	FM, DIP Cl.II,III, Gr.E-G, T5
WH	Overspill protection WHG

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13 Accessories

13.1 Adapter

LCL1, female R1, ISO 7/1

LCL-Z11 Adapter for R1-1/2, EN 10226
LCL-Z12 Adapter for G1-1/2, DIN ISO 228

LCL1, female 1 NPT

LCL-Z13 Adapter for NPT1-1/4, steel
LCL-Z15 Adapter for NPT1-1/4, 1.4571

13.2 Rope Shortening Set

LCL-Z14 Rope shortening set for LCL2

13.3 Cover

LCL-Z10 Cover with sight glass

14 Documentation

Note!

The following document types are available in the download area of the Pepperl+Fuchs web site: www.pepperl-fuchs.com.

Document type	Document code
Technical information	TI00287O/98/EN
Brief instructions	KA00093O/98/A6 (LCL1)
	KA00155O/98/A6 (LCL2)
	KA00157O/98/A6 (Rope shortening set for LCL2)
Instruction manuals	SI00011O/98/A3 (LCL1, ATEX II 1/3 D Ex ta/tc IIIC T105°C Da/Dc)
	SI00092O/98/A3 (LCL2, ATEX II 1/3 D Ex tc [ia Da] IIIC T108°C Dc)

Table 14.1

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TI00287O/98/EN/16.16

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DOCT-0461C
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