LSGF®
Radiation-Based Detector with GEN2000®
Electronics and Frequency Output for Level Measurement
Revision history

Table 1: Revision history

<table>
<thead>
<tr>
<th>Version</th>
<th>Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>Initial release. Formerly 241741.</td>
<td>051201</td>
</tr>
<tr>
<td>1.1</td>
<td>Electronics version</td>
<td>090306</td>
</tr>
<tr>
<td>1.2</td>
<td>Added certification information and IECex label</td>
<td>090820</td>
</tr>
<tr>
<td>1.3</td>
<td>Changed company name, logo, and website</td>
<td>110301</td>
</tr>
</tbody>
</table>

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WARNING

Use this equipment only in the manner that this manual describes. If you do not use the equipment per VEGA specifications, the unit is not CE compliant, and may be damaged or cause personal injury.
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Explanation of symbols

Table 2 lists the symbols that the manual and instrument use.

Table 2: Explanation of symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>☢️</td>
<td>Radiation notice&lt;br&gt;In the manual, information concerning radioactive materials or radiation safety information is found in the accompanying text.</td>
</tr>
<tr>
<td>⚠️</td>
<td>Caution&lt;br&gt;In the manual, warnings concerning potential damage to the equipment or bodily harm are found in the accompanying text.</td>
</tr>
<tr>
<td>🌊</td>
<td>AC current or voltage&lt;br&gt;On the instrument, a terminal to which or from which an alternating (sine wave) current or voltage may be applied or supplied.</td>
</tr>
<tr>
<td>---</td>
<td>DC current or voltage&lt;br&gt;On the instrument, a terminal to which or from which a direct current voltage may be applied or supplied.</td>
</tr>
<tr>
<td>⚡️</td>
<td>Potentially hazardous voltages&lt;br&gt;On the instrument, a terminal on which potentially hazardous voltage exists.</td>
</tr>
</tbody>
</table>
Your comments

VEGA values your opinion! Please fill out this page so that we can continually improve our technical documentation.


Date: ______________

Customer Order Number: ___________________

How we can contact you (optional if you prefer to remain anonymous):

Name:  _________________________

Title:  _________________________

Company:  __________________________

Address:  ____________________________

Did you find errors in this manual? If so, specify the error and page number.

Did you find this manual understandable, usable, and well organized? Please make suggestions for improvement.

Was information you needed or would find helpful not in this manual? Please specify.

Please send this page to:

VEGA Americas, Inc.
Director of Engineering
4241 Allendorf Drive
Cincinnati, OH  45209-1599
Chapter 1: Introduction

Nuclear materials notice

This equipment contains radioactive source material that emits gamma radiation. Gamma radiation is a form of high-energy electromagnetic radiation. Only persons with a specific license from the U.S. NRC (or other regulating body) may perform the following to the source holder:

- Dismantle

**Install**

- Maintain
- Relocate
- Repair
- Test

VEGA Field Service engineers have the specific license to install and commission nuclear gauges, and can instruct you in the safe operation of your density gauge. To contact VEGA Field Service, call 513-272-0131. Users outside the U.S. and Canada may contact their local representative for parts and service.

**Note:** Special instructions concerning your source holder are found in the envelope that was shipped with the source holder and the “Radiation Safety for U.S. General and Specific Licensees, Canada, and International Users” manual and “Radiation Safety Reference Addendum” CD. Please refer to this document for radiation safety information.
Unpacking the equipment

**CAUTION!**
Make sure that you are familiar with radiation safety practices in accordance with your U.S. Agreement State, U.S. NRC, or your country’s applicable regulations before unpacking the equipment.

- Unpack the unit in a clean, dry area
- Inspect the shipment for completeness, by checking against the packing slip
- Inspect the shipment for damage during shipment or storage
- If the detector is included as a separate package in the shipment, inspect the assembly for damage that may have occurred during shipment or storage
- If there was damage to the unit during shipment, file a claim against the carrier, reporting the damage in detail. Any claim on the VEGA for shortages, errors in shipment, etc., must be made within 30 days of receipt of the shipment
- If you need to return the equipment, see the section “Returning equipment for repair to VEGA” in the “Diagnostics and Repair” chapter
- After you unpack the equipment, inspect each source holder in the shipment to assure that the operating handle is in the OFF position. In the event that you find the handle in the ON position, place it in the OFF position immediately and secure it.

**Note:** Most source holder models accept a lock. Call VEGA Field Service immediately for further instructions, at 513-272-0131, if the source holder has one of the following conditions:

- Does accept a lock and there is no lock on it
- The lock is not secured
- You are unable to secure the lock
- The operating handle does not properly move into the off position
Storing the equipment

Storing the source holder
If it is necessary to store the source holder, do so in a clean, dry area. Be sure the source holder shutter is in the OFF or CLOSED position. Check the current local regulations (U.S. NRC, Agreement State, or other) to determine if this area must have any restrictions.

Storing the detector
Avoid storage at temperatures below freezing. Store the detector indoors in an area that has temperature-control between 10 °C and 35 °C (50 °F and 95 °F) and less than 50% relative humidity. Store equipment in dry conditions until installation.

Certifications
This gauge is designed for certification compliance from the following agencies:

- ATEX Standard
- CCOE (India)
- CEPEL/INMETRO (Brazil)
- CSA
- FM Standard
- GOST-B Standard
- GOST-R Standard
- IECex
- JIS (Japan)
- KTL (Korea)
- NEPSI (China)

Safety Information for EX Areas
Please note the EX-specific safety information for installation and operation in EX areas.
LSGF specifications

**Table 3: Specifications list**

<table>
<thead>
<tr>
<th>System Accuracy</th>
<th>1% of span typical</th>
<th>Accuracy depends on specific application parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typical Sources</td>
<td>Cesium-137</td>
<td>0.66MeV gamma radiation emitter, 30.2 year half life</td>
</tr>
<tr>
<td></td>
<td>Cobalt-60</td>
<td>1.2 and 1.3 MeV gamma radiation emitter, 5.3 year half life</td>
</tr>
<tr>
<td>Power Requirements*</td>
<td>AC</td>
<td>100–230VAC ±10% (90–250VAC) at 50/60 Hz, at 15VA maximum power consumption (25VA max with heater) CE compliance requires 100–230VAC ±10%</td>
</tr>
<tr>
<td></td>
<td>DC</td>
<td>20–60VDC (less than 100mV, 1/1,000 Hz ripple) at 15VA, CE compliance requires 24VDC±10%</td>
</tr>
<tr>
<td></td>
<td>Wiring</td>
<td>1.63–0.643mm (#14–#22AWG)</td>
</tr>
<tr>
<td>Signal Cable</td>
<td>Maximum length</td>
<td>1,000m (3,280ft)</td>
</tr>
<tr>
<td>GEN2000*</td>
<td>4-wire hookup with DC</td>
<td>1.02–0.643mm (#18–20AWG) four conductor shielded</td>
</tr>
<tr>
<td>Electronics Housing</td>
<td>Certification to CSA and UL standards</td>
<td>Designed to meet National Electric Code (U.S. &amp; Canada)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class I, Groups A, B, C &amp; D, Div 1 &amp; 2</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Class II, Groups E, F &amp; G, Div 1 &amp; 2</td>
</tr>
<tr>
<td></td>
<td>CENELEC certification</td>
<td>EExd IIIC T5 (pending)</td>
</tr>
<tr>
<td></td>
<td>Enclosure rating</td>
<td>NEMA 4X IP-66</td>
</tr>
<tr>
<td></td>
<td>Ambient temperature</td>
<td>–20 °C … 60 °C (–4 °F … 140 °F) option for lower temperatures available</td>
</tr>
<tr>
<td></td>
<td>Humidity</td>
<td>0-95%, non-condensing</td>
</tr>
<tr>
<td></td>
<td>Vibration</td>
<td>Tested to IEC 68-2-6, IEC 68-2-27, and IEC 68-2-36</td>
</tr>
<tr>
<td></td>
<td>Material</td>
<td>Cast aluminum ASTM A 357</td>
</tr>
<tr>
<td></td>
<td>Paint</td>
<td>Polyester Powder Coating</td>
</tr>
<tr>
<td>Weight</td>
<td>Housing</td>
<td>5.44 kg (12lb)</td>
</tr>
<tr>
<td>Diagnostics</td>
<td>LED indication</td>
<td>+6V, Memory Corruption, CPU Active, High Voltage</td>
</tr>
</tbody>
</table>

* Power specifications change to 115 VAC or 220VAC at 50/60 Hz if an internal heater kit is used. For more information, see page 56.
Typical applications

VEGA level gauges accurately indicate the level of liquids or bulk materials throughout a range on vessels, reactors, or tanks.

In order to achieve a level indication over the desired length, it may be necessary to use more than one detector. The manner in which these multiple detectors link together depends upon the types of detectors used. Specific details on using multiple detectors are available in “Appendix I: Special Applications”.

A level gauge may be used in a number of applications such as the following:

Pulp and Paper
- Liquors
- Bleach plant chemicals
- Coating chemical storage
- Lime mud
- Wastewater treatment tanks

Chemical
- Low pressure/low vapor chemical storage
- Settlers
- Surge tanks

Food and beverage
- Food slurries
- Pastes
- Syrups
- Dough level
- Intermediate batch storage

Water / wastewater
- Settling/aeration tanks
- Clarifiers
- Sludge holding tanks
- Wet wells
Where to find help

If you need help finding information, check the Index and Table of Contents within this manual. In addition, the gauge has “Help” screens that you can view using the universal hand-held terminal or VEGA View™ software. These help screens are useful references for definitions of parameters and hints.

Customer Service

VEGA has Field Service Engineers or Radiation Safety Officers available for onsite service, emergency services, or equipment start up.

<table>
<thead>
<tr>
<th>Contact Information</th>
<th>Telephone Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monday through Friday 8:00 A.M. - 5:00 P.M. EST (Eastern Standard Time)</td>
<td>1-513-272-0131</td>
</tr>
<tr>
<td>Emergencies: Follow the voice mail instructions</td>
<td>1-513-272-0131</td>
</tr>
<tr>
<td>Fax</td>
<td>1-513-272-0133</td>
</tr>
</tbody>
</table>

In addition, VEGA provides field service for customers outside the U.S. and Canada. Customers outside the U.S. and Canada can also contact their local VEGA representative for parts and service.

When calling with a question, if possible, please have the following information ready:

- **VEGA Customer Order (C.O.) Number**—Locate on the engraved label on the source holder
- **Sensor serial number**—Locate on the sensor housing inside the external housing
Principle of operation

VEGA’s nuclear level gauges direct a narrow beam of radiation through the vessel to a radiation detector. The beam is collimated (shaped) so that the entire active length of the detector is exposed to a radiation field.

The material in the vessel blocks the radiation in proportion to its level, the higher level, the more radiation is blocked and the less is sensed by the detector. The material in the vessel essentially acts as a shield, preventing a portion of the detector from being exposed to the radiation field. The gauge is calibrated to associate the detector readings called counts with the level of the material in the desired engineering units. The output of the detector is a 0/100 kHz true digital frequency output, in proportion to the level of the process.
System overview

The LSGF detector uses VEGA’s GEN2000 electronics. The GEN2000 is VEGA’s newest compact electronics that support 4 ... 20 mA HART protocol, frequency, or field bus output. The level measurement system consists of three main components:

- Source holder
- LSGF detector
- SmartPro or ProPac Electronics

![System overview diagram]
The following statements describe the source holder:

- A cast or welded steel device that houses a radiation-emitting source capsule
- Directs the radiation in a narrow collimated beam through the process vessel
- Shields the radiation elsewhere
- The model chosen for each particular system depends on the source capsule inside and the radiation specification requirements
- A shutter on the source holder either shields the radiation (source off) or allows it to pass through the process (source on)

*Figure 3: Typical source holder*
Scintillator model LSGF

The following statements describe the functions of the LSGF detector assembly:

- Mounts opposite the source holder
- Inside the detector is a scintillation material
- The scintillation material produces light in proportion to the intensity of its exposure to radiation
- A photomultiplier tube detects the scintillator’s light and converts it into voltage pulses
- The microprocessor receives these voltage pulses after amplification and conditioning by the photomultiplier tube
- The microprocessor and associated electronics convert the pulses into a calibratable output to the SmartPro electronics
- The SmartPro electronics receives and reads the input and converts it into process units
- Several outputs are available on the SmartPro, including a 4 … 20 mA output of the process variable. Refer to the SmartPro Reference manual for more information.

![Figure 4: LSGF exploded view](image-url)
Communicating with the gauge

Use either a SmartPro or ProPac to enable the following:

- Initial setup
- Calibration
- Operation
Introduction

Notes
Chapter 2: Installation

Location considerations

At the time you ordered the level transmitter, VEGA sized the source for optimal performance. Notify VEGA prior to installation of the gauge if the location of the gauge is different from the original order location. Proper location of the level gauge can sometimes mean the difference between satisfactory and unsatisfactory operation.

Note: Try to locate the source holder in such a place that process material will not coat it. This ensures the continuing proper operation of the source ON/OFF mechanism. Many regulatory agencies (for example, the U.S. NRC) require periodic testing of the ON/OFF mechanism. Refer to the “Radiation Safety for U.S. General and Specific Licensees, Canada, and International Users” manual and “Radiation Safety Reference Addendum” CD that came with the source holder and the appropriate current regulations for details.

Stable temperature

Mount the level gauge on a portion of the line where the temperature of the process material is relatively stable. Process temperature can effect the gauge indication. The amount of the effect depends upon the following:

- Sensitivity of the gauge
- Temperature coefficient of the process material

Protect insulation

If insulation is between the measuring assembly and the process, protect the insulation from liquids. The absorption of a liquid, such as water, can affect the gauge indication because it blocks some radiation.

Avoid internal obstructions

The best possible installation of a nuclear level gauge is on a vessel that has no internal obstructions (agitator, baffle, man ways, and so forth) directly in the path of the radiation beam. If one of these obstructions is present, it can shield the radiation from the detector, causing an erroneous reading. If the vessel has a central agitator, the source holder and detector can mount to the vessel on an arc other than a diameter, so that the beam of radiation does not cross the agitator. You can also avoid other obstructions this way.
Avoid external obstructions

Any material in the path of the radiation can affect the measurement. Some materials that are present when the gauge initially calibrates pose no problem because the calibration accounts for their effect. Examples of these materials are:

- Tank walls
- Liners
- Insulation

However, when the materials change or you introduce new ones, the gauge reading can be erroneous.

Examples of these situations are:

- Insulation that you add after calibration absorbs the radiation and causes the gauge to erroneously read upscale.
- Rapidly changing tank conditions due to material buildup. Regular standardizations compensate for slowly changing tank conditions due to material buildup. See the “Calibration” chapter for information on standardization.

Avoid source cross-talk

When multiple adjacent pipes or vessels have nuclear gauges, you must consider the orientation of the source beams so that each detector senses radiation only from its appropriate source. The best orientation, in this case, is for the source holders to be on the inside with radiation beams pointing away from each other.
Mounting the measuring assembly

There are two sets of mounting tab brackets (provided by VEGA) that bolt onto the brackets securely welded to the vessel (or in some cases, nearby structure).

**Note:** The detector active area (where it is possible to make a level measurement) is from the bottom of the sensor housing to approximately 76.2mm (3”) from the bottom of the gauge.

Note

The handle on the source holder operates a rotating shutter. When installing or removing the assembly from the pipe, you must turn the handle to the closed or OFF position and lock the handle with the combination lock that VEGA provides.

**Figure 5: Mounting the detector**

![Diagram of mounting the detector with active area and 76.2mm (3”) measurement]
Wiring the equipment

VEGA provides detailed Interconnect drawings for the LSGF.

**Note:** If the instructions on the drawing differ from the instructions in this manual, use the drawing. It may contain special instructions specific to your order.

Use the drawing notes and the steps that follow to make the input and output connections. Make the connections at the removable terminal strips mounted on the CPU board. Access the CPU board by removing the explosion-proof housing cap.

**Note:** Not all connections are required for operation. See Table 4 for terminal names and positions.

VEGA provides an internal and external ground screw for connection of the power Earth ground wire. After removing the top cover, the location of the internal ground screw is at the front of the housing. The location of the external ground screw is next to the conduit entry.
Figure 7: Interconnect diagram

Figure 8: Interconnect connections
### Table 4: Terminal names and descriptions

<table>
<thead>
<tr>
<th>Terminal</th>
<th>Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>L1</td>
<td>AC power input</td>
</tr>
<tr>
<td>2</td>
<td>L2</td>
<td>AC power input</td>
</tr>
<tr>
<td>3</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>5</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>6</td>
<td>Freq+</td>
<td>Measurement signal output</td>
</tr>
<tr>
<td>7</td>
<td>Freq–</td>
<td>Measurement signal output</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>9</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>11</td>
<td>Aux+</td>
<td>Auxiliary input frequency signal</td>
</tr>
<tr>
<td>12</td>
<td>Aux–</td>
<td>Auxiliary input frequency signal</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>Not used</td>
</tr>
</tbody>
</table>
**Power**

**CAUTION!**

DO NOT APPLY POWER until a thorough check of all the wiring is complete!

The AC power source voltage input is 100–234VAC±10% (90–250VAC) at 50/60 Hz, at 15VA maximum power consumption. AC power must not be shared with transient producing loads.

The DC power source voltage input is 20–60VDC (24VDC±10% for CE compliance)(less than 100mV, 1/1,000 Hz ripple) at 15VA maximum power consumption. DC power cable can be part of a single cable 4-wire hookup, or can be separate from output signal cable. (See “Output current loop ” section)

Use wire between #14–#22AWG (1.63 to 0.643mm) for power wiring.

**Switch for CE compliance**

For CE compliance, install a power line switch no more than one meter from the operator control station.

**SmartPro and ProPac connections**

The measurement signal from pins 6 and 7 go to an VEGA SmartPro or ProPac. The measurement signal is 0/100 kHz, maximum, true digital, and satisfies RS-422 and RS-423.

See the table below for interconnect information.

<table>
<thead>
<tr>
<th>From LSGF</th>
<th>To SmartPro</th>
<th>To ProPac</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 6</td>
<td>TB 4-1</td>
<td>TB 1-4</td>
</tr>
<tr>
<td>Pin 7</td>
<td>TB 4-2</td>
<td>TB 1-5</td>
</tr>
<tr>
<td>Shield wire</td>
<td>TB 4-3</td>
<td>TB 1-12</td>
</tr>
</tbody>
</table>

**Conduit**

Conduit runs must be continuous and you must provide protection to prevent conduit moisture condensation from dripping into any of the housings or junction boxes. Use sealant in the conduit, or arrange the runs so that they are below the entries to the housings and use weep holes where permitted.

You must use a conduit seal-off in the proximity of the housing when the location is in a hazardous area. Requirements for the actual distance must be in accordance with local code.

If you use only one conduit hub, plug the other conduit hub to prevent the entry of dirt and moisture.
Commissioning the gauge

The process of commissioning the gauge includes the following:

- Taking appropriate radiation field tests
- Checking the pre-programmed setup parameters
- Calibrating on process
- Verifying the working of the gauge.

VEGA Field Service Engineers typically commission the gauge. It is necessary to remove the source holder lock the first time the gauge takes measurements in the field. Only persons with a specific license from the U.S. NRC, Agreement State, or other appropriate nuclear regulatory body may remove the source holder lock.

**Note:** Users outside the U.S. must comply with the appropriate nuclear regulatory body regulations in matters pertaining to licensing and handling the equipment.
Can you remove the source holder lock?

If you are in doubt whether you have permission to remove the source holder lock…Do not!

The license sets limits on what the user can do with the gauge. Licenses fall into two categories:

1. General
2. Specific

It is up to the user to review the license to determine if they have the appropriate permission to perform any of the following:

- Disassemble
- Install
- Relocate
- Repair
- Test
- Unlock

You can remove the source lock if installation of the gauge is in the U.S. and you have the specific license to remove the source holder lock. Confirm that your license specifically states that you have the permission to perform this operation and then contact VEGA Field Service Radiation Safety for the combination.

Do not remove the lock if the gauge has a general license tag, installation is in the U.S., and you do not have the specific license that gives you permission to remove the lock. You can verify whether the gauge is a general license gauge by checking the source holder for the general license tag. If it is not there, it is not a general license device.

If you do not have permission to remove the source holder lock, an VEGA Field Service Engineer or another person with this specific license must remove it for you.
Field service commissioning call checklist

In many U.S. installations, a VEGA Field Service Engineer commissions the gauge. To reduce service time and costs, use this checklist to ensure the gauge is ready for commission before the Field Service Engineer arrives:

- Mount the source holder and detector per the certified drawings found in the custom information folder in this manual, allowing access for future maintenance.

- Make all wiring connections per the certified drawings and the “Wiring the Equipment” section in this manual. Tie in the wiring from the field transmitter analog output to the DCS/PLC/chart recorder.

- Ensure that the AC power to the transmitter is a regulated transient-free power source. UPS type power is the best.

- If using DC power, verify that the ripple is less than 100mV.

**Note:** The equipment warranty is void if there is damage to the gauge due to incorrect wiring not checked by the VEGA Field Service Engineer.

- Have process ready for calibration.

- Mount the source holder and detector per the certified drawings found in the custom information folder in this manual.

- Allow access for future maintenance.

- Make all wiring connections per the certified drawings and the “Wiring the equipment” section in this manual. Tie in the wiring from the SmartPro analog output to the DCS/PLC/chart recorder.
  
  Ensure that the AC power to the detector and SmartPro is a regulated transient-free power source. UPS type power is the best.

- Have process ready for calibration. When possible, it is best to be able to completely fill and empty the vessel, at the high and low levels for the initial calibration procedure, and when possible at 10% increments in between for the linearization procedure.

- Do not remove the lock on the source holder. Notify VEGA Field Service if the lock has been damaged or if the lock is missing.
Chapter 3: Calibration

Note: This chapter discusses calibration with a SmartPro or ProPac. If your LSGF is used to output to a HART® level transmitter, refer to the HART® level manual for calibration instructions.

Use the SmartPro or ProPac (the software in both operates identically) to calibrate the LSGF. Refer to the SmartPro Reference for instructions to use the SmartPro software. To perform the calibration, you must be familiar with the SmartPro topics:

- Navigating through the SmartPro screens
- Security access level
- Product Code
- Saving to EEPROM
- Accessing 520-level screens and changing item values

This section provides a summary of the calibration procedure for a standard level. Refer to the SmartPro Reference and the SmartPro Mini Guide to Fast Startups for more details.

SmartPro Note: The instructions in this manual are compatible with SmartPro firmware vx04.00 or later.
Memory backup

To set the EEPROM in write-protect mode, remove the jumper from pins (JP17) on the SmartPro or ProPac CPU board. The CPU saves in three different memory areas. These areas are:

- Lower RAM (active)—battery maintained
- Upper RAM (with battery-backup)—copy of lower RAM for backup
- EEPROM (non-volatile)—copy of lower RAM for redundant backup

Lower RAM is the memory that the gauge uses during operation.

The upper RAM and EEPROM data do not download unless the operator explicitly commands it to do so. The operator performs this procedure if trying to recover from a memory corruption.
Calibration with SmartPro

Calibration establishes reference points that relate the detector output to actual (or known) values of the process.

You must perform a calibration before the gauge can make measurements of any accuracy. Perform the calibration after the installation and commission of the gauge at the actual field site.

Before using the LSGF to make measurements, you must perform the following:

- Calibrate it to relate the detection of radiation from the source to the density of the process material
- Periodically, you must re-cal the system on process to adjust for changes over time

You do not need to repeat the initial calibration as long as certain critical process and equipment conditions remain the same. See "When a new initial calibration may be necessary" on page 35.

Choosing the calibration method

For each installation, the user must choose one of two ways to calibrate the level detector. The best calibration method depends on how the continuous level detector is to be used. Read the following table to decide which method to use.

**Table 6: Choosing a calibration method**

<table>
<thead>
<tr>
<th>Calibration with a linearizer curve</th>
<th>Calibration with no linearizer curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Use a linearizer curve if...the gauge is required to be repeatable and accurately indicate the level of process throughout the span.</td>
<td>Don’t use a linearizer curve if...the gauge is only required to be repeatable, but need not accurately indicate the level of process.</td>
</tr>
<tr>
<td>Typically used for vessels in which it is critical to know the accurate level.</td>
<td>Typically used for surge bins or other vessels under control, in which one level is to be maintained.</td>
</tr>
<tr>
<td>The linearizer curve must be turned on, after collection of linearizer data and entering the curve in the SmartPro (Screen 528 item 41 set to 1)</td>
<td>The linearizer curve must be turned off (Screen 528 item 41 set to 0)</td>
</tr>
</tbody>
</table>

Note: If you do not use a linearizer curve, the measurement indication will be repeatable but not accurate between the Cal Low Level and Cal High Level points. The measurement indication will not be linear with respect to the actual process level. In some applications, accuracy is not critical and this method can be used.

If your application requires a linear or accurate indication of the actual process level, you must use a linearizer curve.
Initial process calibration

The initial calibration of a LSGF is a "two-point" calibration, with known level process samples near both the high and low end of the span read by the LSGF gauge. Use the SmartPro or ProPac electronics to perform the calibration.

SmartPro Note: Refer to the SmartPro Mini Guide to Fast Startups for systematic calibration instructions. In addition, Chapter 3 of the SmartPro Reference provides detailed information on the calibration process. Be sure to follow the instructions for a level gauge as indicated on the flow chart in the beginning of the SmartPro Mini Guide to Fast Startups.

The span setting, data collection of high and low samples, and calculation of the two-point calibration establish the "endpoints" of the calibration curve (level vs. raw counts on a graph). The calibration curve is non-linear, due to the measurement method of radiation transmission. The linearizer determines the shape of the curve between the endpoints.

Note: When performing calibration or any other procedure that affects the output of the gauge, be sure to disable the gauge from your distributed control system’s (DCS) automatic control.

Set process span

The SmartPro (or ProPac) calculates the process span based on the lowest (Min Reading) and the highest level (Max Reading) that you want the LSGF to measure. Enter the low and high levels in the SmartPro SETUP MENU 2 OF 4 under the SET GAGE SPAN screen.

The measurement span was set at VEGA's factory, based on information received at the time of the order. If you move the LSGF from its intended location, or are measuring on a different span, you must modify the span setting. In any case, it is a good practice to verify that the setting is correct.
## Cal Lo on Process

Setting the low level for calibration requires measurement with the level gauge of the empty vessel or lowest level. This sets the low end (sometimes referred to in the U.S. as zero) of the calibration curve.

Perform this procedure either before or after setting the high level, but after entering the process span correctly in the SET GAGE SPAN screen, from the SETUP MENU 2 OF 4.

Before starting the cal low data collection:

- ✔ Empty the vessel
- ✔ Enter the password for Supervisor-level access on screen 052
- ✔ Verify on screen 502 that the SmartPro is receiving the frequency input from the level detector, usually above 9000 counts for an empty vessel

### Note:
- You must perform data collection for the low and high level within ten days of each other for a good calibration. The low and high values must be more than 10% of the process span apart for the most accurate calibration.
- Increasing the process span usually increases the gauge accuracy.
Procedure 1: Cal Lo on Process

1. Enter the correct password to reach the security access level 1
2. Be certain the correct Product Code has been selected
3. From the MAIN MENU, press the SELECT and ENTER keys to progress through these screens:
   - CALIBRATE SYSTEM
   - CALIBRATE GAGE
   - SELECT CHANNEL (choose Channel #1)
   - MORE CAL FUNCTIONS (three times)
   - CAL LO ON PROCESS
4. On the CAL LO ON PROCESS, the LSGF measures the sample and displays a countdown
   When 0 seconds are left, press ENTER to continue
5. When prompted, enter the actual product value and press ENTER
6. Connect the write-protect jumper JP17
7. Save the results to the EEPROM
   On screen 102 RAM to EEPROM enter a 1 to upload to the EEPROM for permanent storage. (The “error code” on screen 102 should read 0, indicating the SmartPro was successful in transferring the RAM data to the EEPROM.)
Cal Hi on Process

Cal Hi on Process sets the “gain” of the calibration curve. Setting the high level for calibration can be simulated by shutting the source holder shutter. In some cases, simulating the high level may not be accurate, but you can adjust for it later when the tank is full. (See Procedure 5: Manually entering Cal Low and Cal High counts)

Before starting the cal high data collection:

☑ Turn the source holder shutter to the Off position
☑ Enter the password for Supervisor-level access on screen 052
☑ Verify on screen 502 that the SmartPro is receiving the frequency input from the level detector. With a closed shutter, the counts should be close to zero.

Perform this procedure either before or after setting the low level, but after entering the process span correctly in the SET GAGE SPAN screen, from the SETUP MENU 2 OF 4.

Note: Perform data collection for the low and high density within ten days of each other for a good calibration. The low and high values must be more than 10% of the process span apart for the most accurate calibration.

Increasing the process span usually increases the gauge accuracy.
**Procedure 2: Cal Hi on process**

1. Enter the correct password to reach the security access level 1
2. Verify that the correct **Product Code** has been selected
3. From the main menu, use the SELECT and ENTER keys to progress through these screens:
   - **CALIBRATE SYSTEM**
   - **CALIBRATE GAGE**
   - **SELECT CHANNEL** (choose Channel #1)
   - **MORE CAL FUNCTIONS** (1 time)
   - **CAL HI ON PROCESS**
4. On the **CAL HI ON PROCESS** screen, the LSGF measures the sample and displays a countdown
   
   When 0 seconds are left, press ENTER to continue
5. At the prompt, enter the actual product value and press ENTER
6. Connect the write-protect jumper JP17
7. Save the results to the EEPROM
   
   On screen **102 RAM to EEPROM** enter a 1 to upload to the EEPROM for permanent storage. (The “error code” on screen 102 should read 0, indicating the SmartPro was successful in transferring the RAM data to the EEPROM.)
Calibration

Calculate calibration with Two Point Cal
After collecting the high and low-level calibration data, the SmartPro can make the calibration gain calculation.

Note: If you do not need a linearizer curve for the installation, the calibration is complete. You need not follow the next steps to create a linearizer curve.

Procedure 3: Two Point cal

1. From the CHANNEL #1 menu, move through:
   MORE CAL FUNCTIONS
   TWO POINT CAL

2. From the TWO POINT CAL prompt, select YES
   The SmartPro uses the Cal Lo and Cal Hi data points to calculate the calibration

3. Connect the write-protect jumper JP17

4. Save the results to the EEPROM
   On screen 102 RAM to EEPROM enter a 1 to upload to the EEPROM for permanent storage. (The “error code” on screen 102 should read 0, indicating the SmartPro was successful in transferring the RAM data to the EEPROM.)

5. Disconnect the write-protect jumper JP17.
Creating a linearizer curve (optional)

To decide if you need to create a linearizer curve for the installation, check the guidelines on page 25, "Choosing the initial calibration method."

To create a linearizer curve, you must take measurements with the gauge at intermediate levels between empty and full. You will record the sensor counts at each level, and call VEGA with the data. VEGA will calculate a linearizer curve and provide you with the data to enter into the SmartPro.

Typical fill points are 25%, 50%, and 75%. The more points measured, the more accurate the linearization curve will be.

Procedure 4: Collecting linearizer data

1. Fill the vessel to 25% or your first fill level. Be sure you know the level as accurately as possible.
2. Access screen 168 Data Collect on the SmartPro. Press ENTER to begin the data collection. A countdown timer will begin
3. When the countdown reaches zero, screen 168 will display the average counts for the data collection. Record the average counts and the actual level in a table. (See below.)
4. Repeat the procedure for each fill level, including full, or 100%

Table 7: Linearizer data

<table>
<thead>
<tr>
<th>Nominal level</th>
<th>Actual level</th>
<th>Average counts</th>
</tr>
</thead>
<tbody>
<tr>
<td>25%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>75%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: You may find that the counts for a full vessel are more than the counts using a closed shutter to simulate a full vessel. This means the shutter blocks more of the radiation than the process does. Alternatively, when the vessel is full, some radiation beams over the process. If this is the case, you can manually enter the counts for a full vessel in the SmartPro memory and have it re-calculate the gain with the “Two point calibrate” function. See the procedure below.

You must know how to access the 520-level screens and change items.
Manually entering Cal High and Cal Low counts (optional, see note above)

Procedure 5: Manually entering Cal Low and Cal High counts

1. Access screen 520
2. At item 40, enter the counts that represent 100%
3. If you need to change the empty counts, enter them at item 39
4. Access screen 152 Cal Channel #1 and select Two Point Calibrate
5. On screen 155, select YES to indicate you have done a cal low and cal high
6. Connect the write-protect jumper JP17
7. On screen 157, select YES to store the calibrate result in the EEPROM
   This causes the SmartPro to calculate a new gain, based on the values you manually entered
Entering and activating the linearizer curve

Finally, the linearizer curve must be calculated and entered into the SmartPro.

**Procedure 6: Entering and activating the linearizer curve**

1. Call VEGA Field Service (513-272-0131) or FAX (513-272-4381) with the counts you obtained for the fill levels and recorded on the chart. Be sure to provide VEGA a FAX number or e-mail address where you can receive linearizer curve data points.

2. VEGA will use special software to calculate a linearizer curve from your data. They will FAX you 41 data point values for your linearizer curve, which you must enter into the SmartPro.

3. Enter the 41 values on the SmartPro screen 528, items 0 through 40. (Item 0 will always have a value of 0, and item 40 will always have a value of 10,000.)

4. Make the curve active by entering a value 1 at screen 528 item 41. At screen 528, use the Auto/Man button and Yes/No button to increment and decrement the item number (If a 0 is entered at item 41, the SmartPro will not use the curve you just entered.)


6. Save the results to the EEPROM.

   On screen **102 RAM to EEPROM** enter a 1 to upload to the EEPROM for permanent storage. (The “error code” on screen 102 should read 0, indicating the SmartPro was successful in transferring the RAM data to the EEPROM.)

When a two-point initial calibration is impossible

In some installations, it is impossible to attain the high and low level conditions required for a two-point calibration. Calibration of the system is still possible with expert assistance. In this case, contact VEGA Field Service for advice at (513)272-0131.

When a new calibration may be necessary

Under most circumstances, you do not need to repeat the calibration procedure. The system requires only periodic re-cal to compensate for drifts over time. However, certain events can necessitate a new initial calibration. These events are as follows:

- Measurement of a new process application (contact VEGA for recommendation)
- Requirement of a new measurement span by the process
- Entry of a new measurement span setting in the software
- Installation of a new radiation source holder
- Moving the level gauge to another location (in U.S. only specifically licensed persons may relocate the gauge)
- Any change in the process vessel, for example lining, insulation, agitator
- Build up or erosion of vessel is excessive and cannot be compensated for with a re-cal
Periodic re-cal

Re-cal adjusts the system by resetting one point of the calibration curve to an independently measured or known level. This is typically performed on an empty vessel.

The frequency of re-cal depends on several factors, including the desired accuracy of the reading.

SmartPro Note: The “Simple re-cal low” method is presented in this manual, because that is typically used for continuous level gauges.

Refer to the SmartPro Reference Chapter 3, section “Re-Cal / Channel #1 (Category II Functions)” for more information about choosing a method and performing the periodic re-cal.

Setup of the Simple Re-Cal Low establishes in the SmartPro the default value of the level to use for re-cals.

Procedure 7: Setup of simple re-cal low

1. Know the value of the level (in engineering units) you use for re-calibration, for example, 0%, 0 inches, 10 cm. You must use this level each time you perform a Simple Re-Cal Low

2. From the Main Menu 1 of 2, press the SELECT and ENTER keys to progress through these screens:
   Calibrate System
   Calibrate Gage
   Select Channel (choose Channel #1)
   More Cal Functions (3 times)
   Enter Absorber Value
   Low Absorber Value

3. Connect the write-protect jumper JP17

4. On the LOW ABSORBER screen 147, enter the new value of the low level condition and press ENTER
   The screen prompts “Save?” Select YES to save the new value

5. The SmartPro automatically saves the results to the EEPROM. When finished, it displays “Attempt completed”
   Select DONE to finish.

6. Disconnect the write-protect jumper JP17
Procedure 8: Performing a simple re-cal on low

1. Be certain the correct **Product Code** has been selected

2. From the **Main Menu**, use the SELECT and ENTER keys to progress through these screens:
   - Calibrate System
   - Calibrate Gage
   - Select Channel (choose Channel #1)
   - Simple Re-cal Low

3. On the **CAL START/STOP** screen, press ENTER to “Start data collect”
   The gauge measures the sample and the SmartPro displays “Collecting Data”

4. Connect the write-protect jumper JP17

5. On screen 145, the SmartPro displays the counts for the data collect. It prompts “Save results?”
   Select **YES** to save the re-cal results

6. The SmartPro automatically saves the results to the EEPROM. When finished, it displays “Attempt completed”
   Select **DONE** to finish.

7. Disconnect the write-protect jumper JP17
Calibration

Notes
Chapter 4: Diagnostics and repair

Software diagnostics

Refer to the SmartPro manual for software diagnostics information.

Hardware diagnostics

Two circuit boards in the LSGF are replaceable. Figure 9 identifies the two boards.

The following figure may be helpful in finding test points, fuses, jumpers, and connectors on the CPU circuit board.

Access the test points on the CPU board by pulling the sensor assembly slightly out of the housing.

Figure 9: Circuit board identification
Figure 10: Test points and jumpers
Test points

Test points are located on the Power Supply and CPU board.

<table>
<thead>
<tr>
<th>Power Supply Test point label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Not used</td>
</tr>
<tr>
<td>H2</td>
<td>Not used</td>
</tr>
<tr>
<td>TP1</td>
<td>Isolated ground</td>
</tr>
<tr>
<td>TP2</td>
<td>Loop current test point 200mV/mA loop current. Referenced to isolated ground.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CPU Test point label</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Count</td>
<td>Raw input signal coming from preamp.</td>
</tr>
<tr>
<td>GND</td>
<td>Logic ground</td>
</tr>
<tr>
<td>U5 pin8</td>
<td>+5V power supply test points referenced to Logic ground.</td>
</tr>
</tbody>
</table>

Jumpers

The LSGF uses jumpers J1–J4 on the CPU board as division values for the output frequency to the SmartPro.

Note: Do not change the jumper from the current setting without consulting VEGA Field Service.

<table>
<thead>
<tr>
<th>Jumper division values</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1 Divide by 20</td>
</tr>
<tr>
<td>J2 Divide by 10</td>
</tr>
<tr>
<td>J3 Divide by 5</td>
</tr>
<tr>
<td>J4 Divide by 2</td>
</tr>
<tr>
<td>None Divide by 1</td>
</tr>
</tbody>
</table>

If the LSGF does not have a jumper, the division value is one.
LED indicators

Check the basic functioning of the VEGA electronics at the instrument with LED indicators on the CPU board. They are visible when you remove the explosion proof housing cap.

See the tables on page 42 for a summary of the LED indications.

![LED indicators diagram](image)

**Figure 11: LED indicators**

### Power Supply Board LED summary table

**Table 11: Power Supply Board LED summary table**

<table>
<thead>
<tr>
<th>LED</th>
<th>Description</th>
<th>Normal condition</th>
<th>Error condition</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>+6V</td>
<td>+6V DC voltage level to electronics</td>
<td>ON</td>
<td>OFF</td>
<td>Electronics are not receiving +6V DC voltage required for functioning</td>
</tr>
<tr>
<td>24V</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Relay</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### CPU Board LED summary table

**Table 12: CPU Board LED summary table**

<table>
<thead>
<tr>
<th>LED</th>
<th>Description</th>
<th>Normal condition</th>
<th>Error condition</th>
<th>Recommendation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mem</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>HART</td>
<td>Not used</td>
<td>ON</td>
<td>n/a</td>
<td></td>
</tr>
<tr>
<td>CPU</td>
<td>Central processing unit on CPU board “heartbeat”</td>
<td>Blinks at rate of 1 time per second</td>
<td>LED doesn’t blink. CPU not functioning.</td>
<td>Check power input. Replace CPU board.</td>
</tr>
<tr>
<td>Aux</td>
<td>Auxiliary input frequency signal indicator</td>
<td>Blinks if auxiliary input present. OFF if no auxiliary input present</td>
<td>None</td>
<td>Check auxiliary input wiring terminals 11 and 12 with a meter for frequency signal. Check auxiliary input equipment.</td>
</tr>
<tr>
<td>HV</td>
<td>Not used</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field</td>
<td>Radiation field indicator</td>
<td>Cycles in proportion to radiation field intensity at detector. ON for 10 seconds for each mR/hr, then off for 2 seconds. (Can use LED 5 that blinks 1 time/sec to time LED 9 for field indicator.)</td>
<td>None</td>
<td>A 1mR/hr (2580nC/kg/hr) field is usually required for a measurement. Check for closed source shutter, buildup, and insulation.</td>
</tr>
</tbody>
</table>
Maintenance and repair

Periodic maintenance schedule

Since the VEGA LSGF contains no moving parts, very little periodic maintenance is required. We suggest the following schedule to prevent problems and to comply with radiation regulations:

Table 13: Maintenance schedule

<table>
<thead>
<tr>
<th>Description</th>
<th>Frequency</th>
<th>Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Re-cal</td>
<td>As required by process conditions, usually at least once a month</td>
<td>Calibration chapter</td>
</tr>
<tr>
<td>Source holder shutter</td>
<td>Every six months unless otherwise required by applicable nuclear regulatory agency</td>
<td>Radiation safety instructions (shipped separately with source holder and in the folder of this manual)</td>
</tr>
<tr>
<td>Source wipe</td>
<td>Every three years unless otherwise required by applicable nuclear regulatory agency</td>
<td>Radiation safety instructions (shipped separately with source holder and in the folder of this manual)</td>
</tr>
</tbody>
</table>

Spare parts

Contact VEGA Field Service at +1 513-272-0131 for parts, service, and repairs.

Outside the U.S., contact your local VEGA representative for parts, service, and repairs.
Field repair procedures

Very few parts are field repairable, but you can replace entire assemblies or boards. The following parts are replaceable:

- CPU circuit board
- Power supply circuit board

Use great care to prevent damage to the electrical components of the gauge. VEGA recommends appropriate electrostatic discharge procedures.

CAUTION!

NEVER remove the two screws holding down the sensor electronics. This contains the photomultiplier tube assembly. This component is easily damaged. Removing the sensor and then re-installing it can cause sensor problems.

NEVER remove the bottom cover. This protects the coupling joint of the detector. There are no serviceable parts under the bottom cover.
Replacing a circuit board

You may have to replace a circuit board if there is damage to one of its components. Before replacing a circuit board, check the troubleshooting flowcharts or call VEGA Field Service to be sure a replacement is necessary.

Procedure 9: To replace the CPU or power supply board

1. Turn off power to the gauge
2. Remove the housing cover
3. Remove the plastic electronics cover
4. Remove the terminal wiring connector
5. Remove the three (3) screws holding the electronics package in place
6. Carefully pull the electronics package out of the housing.
7. Remove the appropriate board from the clamshell assembly by removing the three (3) mounting nuts.

**Note:** If you are changing the CPU board, you must move the old firmware chip to the new board if the new board firmware is different.

8. Carefully reconnect any ribbon cables.
9. Install the electronics package in the housing.
10. Replace the three (3) mounting nuts.
11. Reconnect the terminal wiring connector.
12. Install the plastic electronics cover.
13. Install the housing cover.
14. Turn on the power to the unit.

**Note:** If you change the CPU board, a **New Hardware Found** error message normally appears when you connect with the HART communicator. In Ohmview2000, click **Diagnostics, New hardware, New CPU**, and click **OK** for a new backup of EEPROMS.
Requesting field service

To request field service within the U.S. and Canada; call 513-272-0131 from 8:00 A.M. to 5:00 P.M. Monday through Friday. For emergency service after hours, call 513-272-0131 and follow the voice mail instructions.

Returning equipment for repair to VEGA

When calling VEGA to arrange repair service, be ready with the following information:

- Product model that is being returned for repair
- Description of the problem
- VEGA Customer Order (C.O.) Number
- Purchase order number for the repair service
- Shipping address
- Billing address
- Date needed
- Method of shipment
- Tax information
Appendix I: Special applications

This chapter provides application specific information for special installations.

If your application is not in this chapter, you may find application specific information on the certified drawings. If you have other application questions, contact VEGA Field Service in the U.S. or Canada at 513-272-0131 or your local rep outside of the U.S. or Canada.
Multiple detectors summation

Some applications require a measurement length longer than the maximum level detector length.

Figure 12: Multiple detectors summation
Appendix I: Special applications

Special drawings from VEGA

Identification of applications that require multiple detectors occurs at the time of order. The end user, engineering contractor (or both) receive certified drawings for the exact equipment ordered. Refer to the drawings along with this section of the manual.

Note: If the instructions on the drawings and this manual differ, follow the drawing instructions. They will be specific to your order.

Installation requirements

A multiple detector application consists of at least one detector that is capable of summing an input frequency (e.g., model LSGF, or an LSF, LJF, or LNF). Follow these installation guidelines:

• Install the summing detector at the top of the measurement range
• Offset the detectors vertically so that the end of the top detector’s active length corresponds to the beginning of the bottom detector’s active length
• Place all detectors in the radiation beam.
Figure 13: Placement of multiple detectors
Detector wiring

Multiple-detector applications require at least two frequency output detectors electrically linked in a chain. Only the last detector in the chain sends an output to the SmartPro. The LSGF automatically sums the frequency input (auxiliary input, pins 11/12) with the frequency it generates in response to radiation. The summed frequency is output at pins 6/7. When no input is present at pins 11/12, the output is only the detector’s response to the radiation.

Jumpers to reduce counts

The SmartPro cannot accept more than 32,767 counts per second. If the total counts exceeds this, a jumper can be set on the last detector in the chain to divide the output to the SmartPro. This must be set before calibrating. Verify the frequency is fewer than 32,767 with a meter at the SmartPro input terminal on empty vessel condition. If the frequency exceeds 32,767, adjust the jumper on the last detector as required, according to the table, below.

<table>
<thead>
<tr>
<th>Jumper</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>Divides counts by 20</td>
</tr>
<tr>
<td>J2</td>
<td>Divides counts by 10</td>
</tr>
<tr>
<td>J3</td>
<td>Divides counts by 5</td>
</tr>
<tr>
<td>J4</td>
<td>Divides counts by 2</td>
</tr>
<tr>
<td>No jumpers</td>
<td>Divides counts by 1</td>
</tr>
</tbody>
</table>

Initial settings and calibration requirements

No special SmartPro software initial settings or calibration methods are required. The detectors automatically sum the frequencies, so the use of multiple detectors is transparent to the SmartPro.

Use the levels for the entire measurement span as if it were one long detector when you set the span and calibrate the gauge.
Vapor pressure compensation

A nuclear level gauge works on the principle that the product shields the detector from the radiation beam, allowing more or less radiation to strike the detector as the product level falls and rises. For an accurate level indication, the variation in the detector output should depend only on the product level.

However, vapor pressure variations in the headspace of the vessel can cause erroneous product level indications. This is because the vapor also blocks some of the radiation. When the pressure is higher, more radiation is blocked; when the vapor pressure is lower, less is blocked. Therefore, even at the same product level, the detector can receive varying amounts of radiation, depending on the head vapor pressure.

You can compensate with a density measurement of the vapor space using an VEGA nuclear density gauge. It monitors the vapor space density, and sends its frequency output to the SmartPro channel 2. Input the level measurement is to the SmartPro channel 1, as usual.

Special firmware enables the elimination of the vapor density effect in the final level indication.

Figure 14: Vapor compensation system
Installation requirements

Mount the level detector as usual. You must mount the density gauge so that it is in the radiation beam, but is above the highest expected level. This ensures that the only process condition affecting the density gauge is the gaseous pressure change in the vessel.

The pressure compensation algorithm in special SmartPro firmware makes use of the change in vapor pressure to determine the amount of compensation needed to correct the level indication.

Detector wiring

Wire the level detector frequency output into the SmartPro TB4, pins 1 and 2. Wire the density gauge output into SmartPro TB4, pins 5 and 6.

Initial settings and calibration requirements

Note: Setting up a pressure-compensated level gauge system involves many application-specific considerations. VEGA Field Service should be on-site to set up the system.

To set up a system with vapor pressure compensation, follow these general guidelines with the assistance of VEGA Field Service:

Procedure 10: Vapor pressure compensation guidelines

1. At the VEGA factory, the density gauge output channel will be set up to point to the temperature compensated raw counts location

2. Set up and calibrate the level gauge as usual. See the Calibration chapter of this manual for instructions

3. After the level gauge is calibrated, establish a known, minimum pressure in the vessel

4. At the SmartPro, access screen 521, item 14. This displays the counts from the density detector when the pressure is at a minimum. Make note of the counts

5. Access screen 529, item 109. Copy the counts value from the above step to item 109. This sets up the reference counts of the density detector

6. Access screen 529, item 110. Enter an initial gain term value at this address. Initially, enter the value 1800 (which is a gain of 1.8). You may need to adjust this value later to fine tune the system

7. Access screen 529, item 120. Enter a value of 1 at this address to enable the pressure compensation feature. (A value of 0 disables the pressure compensation.)

Pressure compensation is now set up, but you must fine-tune it for it to work properly.
## Pressure compensation fine tuning

Since variables such as the vessel geometry, process material characteristics, and pressure change ranges affect the output, it is difficult to accurately predict the gain term needed for an individual installation. Fine-tuning the system requires maintaining a known level of process material, and changing the gaseous vapor pressure. By observing how the system reacts, you can adjust the gain term value on SmartPro screen 529, item 110. Follow the general guidelines below:

**Procedure 11: Fine-tuning for pressure compensation**

1. In the vessel, establish a known, repeatable minimum pressure
2. Establish a process level of approximately 30% to 60%. Make note of the initial level indication, as displayed on the SmartPro operator screen
3. Increase and maintain pressure to some value near the maximum pressure likely to be present inside the vessel. Do not adjust the process level in the vessel
4. Allow time for the level measurement to stabilize
5. Compare the level measurement at maximum pressure to the measurement at minimum pressure
   - If the level indication at maximum pressure is less than at minimum pressure, then the gain term is too large. Reduce the gain term (screen 529, item 110) in increments of 100 until the level indication is the same as it was at minimum pressure. With each change to the gain term, be sure to allow time for the level measurement to stabilize
   - If the level indication at maximum pressure is greater than at minimum pressure, then the gain term is too small. Increase the gain term (screen 529, item 110) in increments of 100 until the level indication is the same as it was at minimum pressure. With each change to the gain term, be sure to allow time for the level measurement to stabilize
6. Connect the write-protect jumper JP17
7. When the gain term is set at a satisfactory value, do an upload to the EEPROM to save the settings permanently
8. Disconnect the write-protect jumper JP17
9. If you need to disable the pressure compensation, access screen 529, item 120. Enter a value of 0 at this address. (A value of 1 enables the pressure compensation.)
SmartPro memory locations for pressure compensation

The following memory locations are used by the SmartPro in vessel pressure compensation applications (only with the special firmware):

<table>
<thead>
<tr>
<th>Description</th>
<th>SmartPro memory location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Compensated raw counts</td>
<td>Screen 520, item 7</td>
</tr>
<tr>
<td>Raw counts</td>
<td>Screen 520, item 6</td>
</tr>
<tr>
<td>Density gauge counts</td>
<td>Screen 521, item 14</td>
</tr>
<tr>
<td>Gain (entered by user)</td>
<td>Screen 529, item 110</td>
</tr>
<tr>
<td>Reference density counts</td>
<td>Screen 529, item 109</td>
</tr>
<tr>
<td>Enable (1) / Disable (0) pressure compensation</td>
<td>Screen 529, item 120</td>
</tr>
</tbody>
</table>
Internal heater kit for applications rated at –50 °C

A heater kit option is available for the LSGF for applications that require a –50 °C (~58 °F) temperature rating. With the heater option, the internal temperature of the unit rises approximately 30 °C (54 °F) degrees.

The features of the heater are as follows:

- The heater kit does not affect the functionality of the LSGF in any way. There is no requirement for special firmware.
- The factory installs the internal heater kit if you order it with the LSGF.
- Three different kits are available, one for 115VAC, one for 220VAC, and one for 24VDC. The part numbers are shown below:

<table>
<thead>
<tr>
<th>Heater kit power</th>
<th>VEGA part number</th>
</tr>
</thead>
<tbody>
<tr>
<td>115VAC</td>
<td>240723</td>
</tr>
<tr>
<td>220VAC</td>
<td>240724</td>
</tr>
<tr>
<td>24VDC</td>
<td>241912</td>
</tr>
</tbody>
</table>

Changes to specifications

The power rating changes from the specifications on page 4 of this manual when you install the heater kit on the LSGF.

With the installation of the heater, the maximum power consumption increases to 25W. The unit is either 115VAC±10% or 220VAC±10%, instead of the standard 90–270VAC range or 24VDC.
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