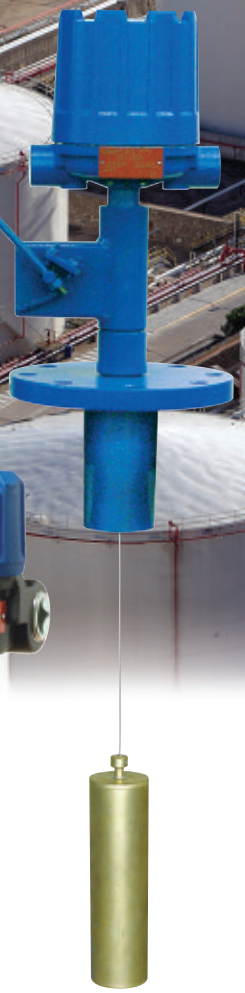




RECOMMENDATIONS
FOR API RP 2350

LEVEL INSTRUMENTS FOR TANK OVERFILL PREVENTION



SPECIAL APPLICATION SERIES

Tank Overfill Prevention: Recommended Practice for Level Control



External Floating Roof

Tank overfill incidents in recent years have resulted in loss of life and billions of dollars in damages to petroleum facilities worldwide. One of the worst incidents — the overflow of a gasoline storage tank at Buncefield Oil Depot (U.K.) — has been traced to the failure of level control to maintain containment of the flammable liquid. More common are minor spills that cause significant environmental impact and result in millions of dollars in clean-up fees and environmental agency fines.

In the wake of this incident, the American Petroleum Institute's (API) Recommended Practice (RP) 2350, the most widely accepted guideline for overfill prevention of petroleum storage tanks, has been revised. The fourth edition was published in May 2012 and combined the prescriptive standards of RP 2350 with the functional safety standards of Safety Instrumented Systems (SIS) as described in IEC 61511.

Vital to these new requirements is the application of level instrumentation as one part of a comprehensive Overfill Prevention Process (OPP).

API RP 2350: Key Points

APPLICABILITY: Above ground storage tanks (ASTs) with capacities greater than 1320 gallons (5000 L) that store Class I, II or III flammable or combustible liquids, and that receive liquids from mainline pipelines or marine vessels.

MANAGEMENT SYSTEM: API RP 2350 recommends a management system focused on overfill prevention. This system should include documented procedures for normal and abnormal conditions including safety, emergency response, trained and competent personnel, properly maintained and tested OPS, management of change process and incident reporting and investigation.

INDEPENDENCE: A key feature of API RP 2350 is that the sensors and alarms used for HH tank level or any part of the AOPS may not be used for routine tank filling operations. In addition, the HH level sensor on Category 3 tanks must be independent from all other level sensors.

REQUIRED ALARMS: High-High Alarm (Category 2 and 3) and optional Diagnostic Alarm (Category 3).

EQUIPMENT: Overfill Prevention System (OPS) typically includes an alarm signal system and allied support systems— shutdown or diversion valves, communications, sensors, and logic solvers. An OPS should be on an uninterruptible power supply. **Use of wireless communication is prohibited by API 2350.**

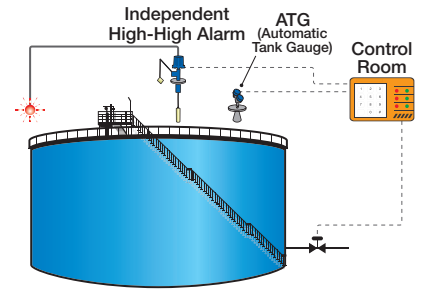
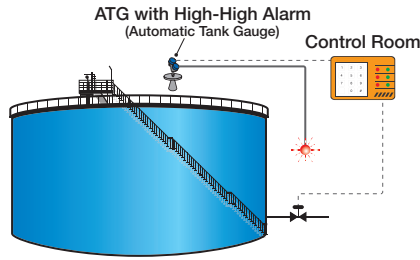
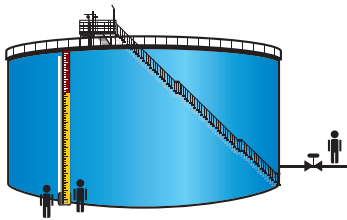
REDUNDANCY: A common strategy for critical level detection is redundancy of the sensors. Ideally, redundant sensors will be of disparate technologies to avoid multiple failures due to application concerns.

PROOF TESTING: All OPS equipment required to terminate receipt must be tested annually. The HH sensor and alarm must be tested semi-annually. Method of proof testing must stimulate an overfill situation as closely as possible, but may not require filling the tank above the maximum working level. Possible methods are manual testing, push-button testing, self-diagnostics or devising a wet probe testing.

FLOATING ROOF SENSORS: A sensor used on a floating roof tank must detect the roof as well as the liquid should it cover the roof.

Tank Categories & Recommended Instrumentation

API 2350 categorizes storage tanks by the extent to which personnel are in attendance during receiving operations. The overfill prevention methodology is based upon the tank category.



Category 1 Fully Attended

- Personnel must always be on site during the receipt of product, must monitor the receipt continuously during the first and last hours, and must verify receipt each hour.
- Level instrumentation is not required but may be used. Output will be local only. Alarms may be point or continuous level devices.
- Termination of receipt is done manually by site personnel or by the transporter as instructed by site personnel.
- Tanks where operator distraction or complex receipt is possible shall not be classified as Category 1.

Category 2 Semi-Attended

- Personnel must be present during the initial and final 30 minutes of the receipt. The transporter must assist in monitoring the high-high alarm.
- Tanks must be equipped with an Automatic Tank Gauge System (ATGS) that includes a high-high alarm and has a transmittable output signal. A single sensor may be used for both level and high-high alarm. If a separate sensor is used for high-high level it may be point or continuous.
- The control center has the ability to terminate receipt.

Category 3 Unattended

- Personnel are not required to be present during receiving operations but are remotely located at a control center. The transporter must monitor both the level and high-high alarm.
- Tanks must be equipped with an ATGS consisting of a level sensor and independent high-high sensor. The output of both instruments must be transmitted to a control center in "real time". The level sensor will be continuous. The high-high level sensor may be continuous or point. Sensors with self-diagnostics are preferred.
- The control center has the ability to terminate receipt. In addition, the HH sensor must automatically terminate flow to the tank or alert the transporter to terminate receipt. Failure of the ATGS must, also, automatically terminate flow.

Levels of Concern (LOCs)



Levels of Concern are calculated product levels in the tank upon which all alarm and alert positions and response times are based. Careful calculation of LOCs ensures the success of the OPS.

Level	Explanation	Required Action
Critical High Level (CH) - Required	Highest level before tank damage or product overflow	Spill Management Emergency Response
Automated Overfill Prevention System (AOPS) Activation Level - Required with AOPS	Maximum level at which termination can be automatically initiated without level reaching CH	AOPS Activation
High-High (HH) - Required	Maximum level at which termination can be initiated manually without level reaching CH	Alarm & Shutdown Responses
Maximum Working Level (MW) - Required	Highest level to which tank may be filled during normal operation	None
Minimum Working Level - Optional	Lowest tank level permitted during normal operation	None

Response Time

Time required from initiation of termination of receipt to prevent next higher alarm from triggering, based upon communication time, personnel response time, system response time, and safety factors.

Minimum High-High (HH) Level Response Time (if not calculated)

Category 1

Time in Minutes: 45

Category 2

Time in Minutes: 30

Category 3

Time in Minutes: 15

Roof Types



Fixed Roof or Floating Roof with Instrument Well

Recommended Equipment:

- Eclipse® Guided Wave Radar Transmitter
- Pulsar® Radar Transmitter
- Jupiter® Magnetostrictive Transmitter (Orion Instruments®)
- Echotel® Model 961/962 Ultrasonic Switch
- Model A15 Displacer Switch

Internal Floating Roof

Recommended Equipment:

- Pulsar® Radar Transmitter
- Model A15 Displacer Switch

External Floating Roof

Recommended Equipment:

- Pulsar® Radar Transmitter
- Model A15 Displacer Switch



Eclipse®



Pulsar®



Jupiter®



Echotel®



A15 Displacer

Recommended Level Switches

Point Level Sensors

Point level sensors actuate at one or more discrete levels. These types of instruments may be used as the HH sensor and may be of a mechanical or electronic technology. Sensors used on floating roof tanks must detect the roof as well as the liquid should the roof become submerged. Additional point sensors may be used for additional alarms or alerts as determined by the operator.



Single-Point Top Mount Buoyancy Displacer Switch

- Furnished with a non-sparking, hollow shell, brass displacer for dual detection of both floating roof and liquid levels.
- Proof-er Manual Check easily verifies operation without the need to move tank level.
- Automatic reset of proofer.
- Retrofit kits available to convert your model A15 from floating roof only to dual detection as required by API RP 2350.
- SIL 2 suitable with DPDT switch; SFF: 77.7%.

Single-Point Echotel® Model 961 Contact Ultrasound Switch

- Continuous diagnostics of sensor, electronics and electrical noise interference.
- DPDT HH level relay and SPDT dedicated diagnostic alarm relay.
- Push buttons for manual testing of level and diagnostic relays.
- Loop current or relay output.
- Features "Watchdog Timer."
- Metal or plastic sensors.
- SIL 2 suitable; SFF: 91.4%.

Dual-Point Echotel® Model 962 Contact Ultrasound Switch

- All the advanced features of the 961 single-point level switch, plus:
- Dual point switch for two discrete set points.
 - Allows two set points through a single tank connection.
 - SIL 2 suitable; SFF: 91.5%.

Recommended Level Transmitters

Continuous Level Sensors

Continuous level sensors output an analog-type signal over a specified range of the tank height. Continuous sensors may be used as the level sensor or as the high-high alarm sensor. Additional continuous level sensors may be used to monitor additional alarm or alert points as determined by the tank operator.



Eclipse® 706 Guided Wave Radar Transmitter

- Low dielectric media capability.
- Flexible probe to 100 ft. (30 m).
- True top-of-probe level detection.
- Quick connect/disconnect probe.
- SIL 2 suitable; SFF: 93.0%.

Pulsar® Pulse Burst Radar Transmitter

- Non-contact technology
- 5.8/6.3 GHz operating frequency offers superior performance in turbulence, foam, and heavy vapors.
- Activates on roof or liquid if roof sinks.
- Quick connect/disconnect probe.
- Continuous self diagnostics.

Jupiter® Magnetostrictive Transmitter (Orion Instruments®)

- Continuous diagnostics (electronics, sensor and float).
- Accuracy: $\pm 0.015"$ (0.38 mm).
- Repeatability: $\pm 0.005"$ (0.13 mm).
- 33.3 feet (10 meter) span.
- SIL 2 suitable (Model 26X); SFF: 90.7%.

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- **Petroleum Refining**
- **Power Generation**
- **Pulp & Paper Mills**
- **Renewable Energy**
- **Steam Generation**
- **Tank Bridle Level Measurement**
- **Understanding Safety Integrity Level (SIL)**
- **Water & Wastewater**

PLEASE NOTE: The instruments recommended in these brochures are based on field experience with similar applications and are included as a general guide to level and flow control selection. Because all applications differ, however, customers should determine suitability for their own purposes.



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