RECOMMENDATIONS FOR API RP 2350

MAGNETROL®

LEVEL INSTRUMENTS FOR TANK OVERFILL PREVENTION

SPECIAL APPLICATION SERIES

Tank Overfill Prevention: Recommended Practice for Level Control

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 is being finalized by API and is expected to combine 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 System (OPS).

API RP 2350: **Key Points**

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

EQUIPMENT: Automated Overfill Prevention System (AOPS) typically includes an alarm signal system and allied support systems—shutdown or diversion valves, communications, sensors, and logic solvers. An AOPS should be on an uninterruptible power supply.

SELF-DIAGNOSTICS: Sensors with self-diagnostics are preferred for high-high level on an AOPS.

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

MANAGEMENT SYSTEM: API 2350 recommends a formal approach to training and procedures that comprise an Overfill Prevention Process (OPP). This is a management system with formal operating procedures and practices, risk assessment, scheduled inspections, periodic testing, and equipment maintenance programs.

PROOF TESTING: All OPS equipment required to terminate receipt must be tested annually. The HH sensor/alarm must be tested semi-annually. The method of test-actuation is chosen by the operator and may include: moving the tank level; actuating a manual proofer device; initiating a wet probe test; or utilizing self-diagnostics or a push button self-test if the instrument is so equipped.

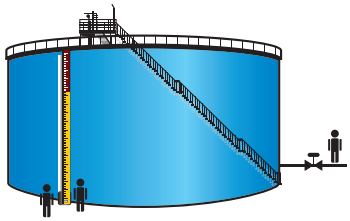
INDEPENDENCE: A key feature of API RP 2350 is that the sensors and alarms used for HH tank level or as any part of the AOPS may not be used for routine tank filling operations. In addition, the HH level sensor on Category III tanks must be independent from all other level sensors.

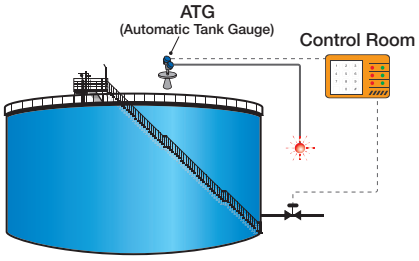
REDUNDANCY: A common strategy for critical level detection is redundancy of the sensors. Ideally, redundant sensors will be of disparate technologies to avoid multiple failures due to application concerns.

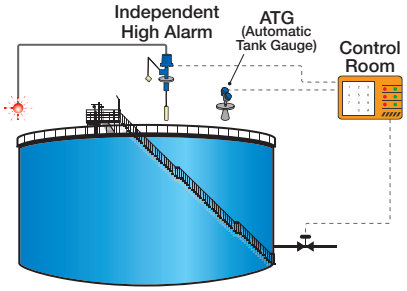
REQUIRED ALARMS: High-High Alarm (Category II and III) and optional Diagnostic Alarm (Category III).

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 catagory.







Category I
Fully Attended

- Personnel must be present continuously during the receipt of product.
- Level instrumentation is not required but may be used. Output will be local only. Alarms may be point or continuous level devices, either mechanical or electronic.
- Termination of receipt is done manually by site personnel or others as instructed by site personnel.

Category II
Semi-Attended

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

Category III
Unattended

- Personnel are not required to be present during receiving operations but are remotely located at a control center. The transporter must monitor the both 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 may be continuous electronic or point mechanical or electronic. 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	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 without level reaching CH	Alarm & Shutdown
Maximum Working Level (MW) - Required	Highest level to which tank may be filled during normal operation	None
Minimum Working Level		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.

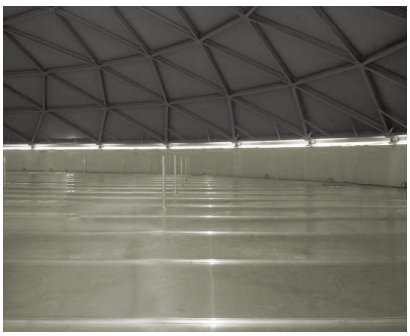
Minimum High-High (HH) Level Response Time (if not calculated)

Category 1	Category 2	Category 3
Time in Minutes: 45	Time in Minutes: 30	Time in Minutes: 15

Roof Types

Fixed Roof or Floating Roof with Instrument Well

Recommended Equipment:
- Eclipse® Guided Wave Radar Transmitter
- Pulsar® Model R86 Radar Transmitter
- Jupiter® Model JM4 Magnetostrictive Transmitter (Orion Instruments)
- Echotel® Model 961/962 Ultrasonic Switch
- Model A15 Displacer

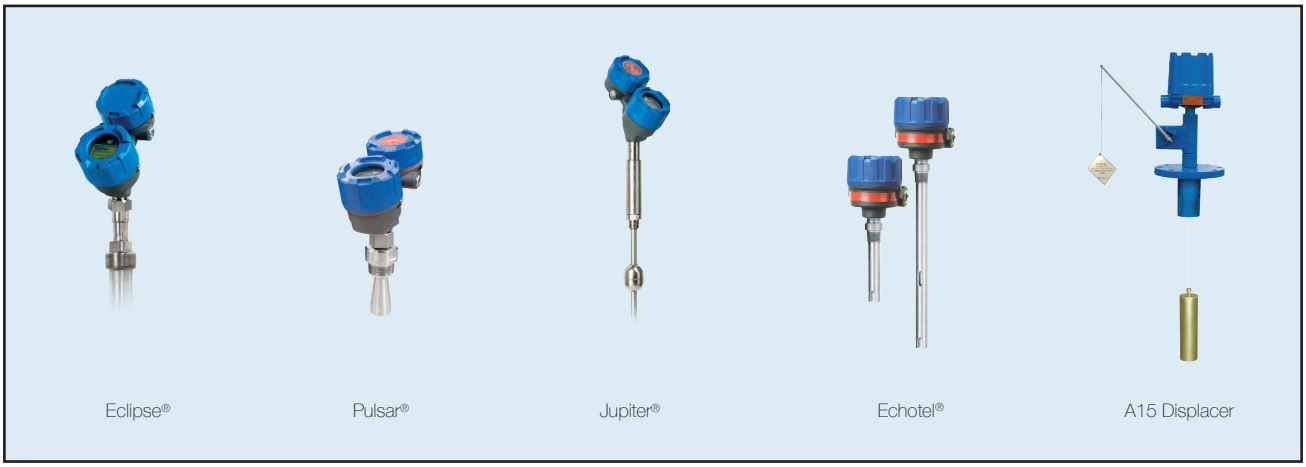


Internal Floating Roof

Recommended Equipment:
- Pulsar® Radar Transmitter
- Model A15 Displacer Switch

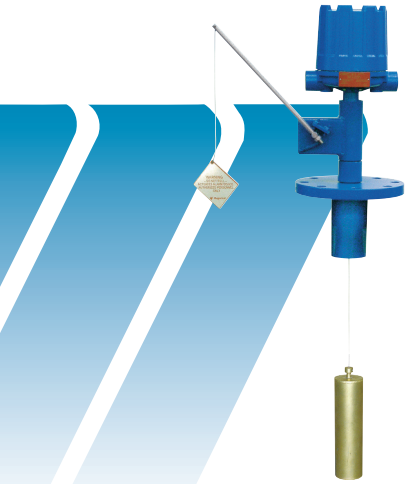
External Floating Roof

Recommended Equipment:
- Pulsar® Radar Transmitter
- Model A15 Displacer Switch



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.
- SIL 2 suitable with DPDT switch.
- Single or dual stage models.
- Retrofit kits available to convert your model A15 from floating roof only to dual detection as required by API RP 2350.

Single-Point Echotel Model 961 Contact Ultrasound Switch

- SIL 2 suitable; SFF: 91.4 %.
- 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.
- Multiple probe configurations and materials.

Dual-Point Echotel Model 962 Contact Ultrasound Switch

All the advanced features of the 961 single-point level switch, plus:

- SIL 2 suitable; SFF: 91.5%.
- Dual point switch for two discrete set points.
- Allows two set points through a single tank connection.
- 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.

Recommended Level Transmitters

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

Eclipse® Model 706
Guided Wave Radar Transmitter

- SIL 2 suitable; SFF: 91.0 %.
- Low dielectric media capability.
- Flexible probe to 100 ft. (30 m).
- IS, XP, Non-Incendive approvals.
- Ignores most foams, probe buildup.
- Quick connect/disconnect probe.
- Foundation Fieldbus™, PROFIBUS PA® and Modbus digital outputs.
- Can transmit two 4-20 mA signals when used with a HART® splitter.

Pulsar® Model R86
Pulse Burst Radar Transmitter

- 26 GHz operating frequency offers superior performance in long-range applications.
- Range up to 20 meters (65 feet).
- Quick connect/disconnect probe.
- SIL 1 suitable; SFF: 73.7 %.

Jupiter® Model JM4
Magnetostrictive Transmitter
(Orion Instruments)

- Suitable for SIL 2 applications (Model 26X).
- Continuous diagnostics (electronics, sensor and float).
- Accuracy: ± 0.01% full scale or ± 1,27 mm (0.05"), whichever is greater.
- Repeatability: ± 0.005% of full span or ± 0,36 mm (0.014"), whichever is greater.
- 10 meter (33.3 feet) span.
- Full FMEDA report available upon request.

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- ***Steam Generation***
- ***Tank Bridle Level Measurement***
- ***Understanding Safety Integrity Level (SIL)***
- ***Water & Wastewater***

PLEASE NOTE: The instruments recommended in this guide are based on field experience with similar applications and are included as a general guide to instrument selection. However, because all applications differ, customers should determine suitability for their own purposes. For complete information on Tank Overfill Prevention, you are encouraged to refer to API RP 2350.

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