Banlaw FillSafe™
FillSafe Zero "Non-Venting" Level Sensors

Thank you for purchasing this high quality Banlaw product. Please read through and understand the information in this Product Data Sheet (PDS) BEFORE installation or operation to avoid accidental personal injury or property damage.

1 PRODUCT DESCRIPTION

The range of **Banlaw FillSafe™ *Zero*** overfill protection (OFP) systems is designed for the safe and reliable refuelling/refilling of diesel fuel tanks, commonly used in the mining, rail, port, construction and other off-road industries. The system comprises two (2) major assemblies;

- Banlaw Flow Control Valve (e.g. BFCV23 model);
- Banlaw Level Sensor (e.g. this BLS model);
    - Refer BLS100B example to the right.

There are 2 separate product lines within the BLS family;

- **BLS###**; 2 of external Pilot Line connections with an internal shuttle style valve.
- **BLS###B**; a single (1 of) external Pilot Line connection and no internal shuttle valve.

denotes wildcard characters for the various part numbers.

IMPORTANT: This product is part of a ***system***, where the system may be one of multiple configurations. This document includes certain information for the safe and proper inclusion of this product within a FillSafe Zero system, however end-users ***must*** also refer to the following Banlaw documents when configuring, installing and commissioning a FillSafe Zero system;

- Banlaw Product Data Sheet (PDS) for the relevant FillSafe Zero Flow Control Valve.

Failure to consult such documents is likely to cause system malfunction and will void any Banlaw warranty claim.

"IF IN DOUBT, PLEASE ASK!"

Aspects of this product and the Banlaw FillSafe Zero system are subject to patents and patents pending. Please refer to www.banlaw.com for further details.

CAUTION	
	The content of this document is <u>not</u> meant to override or substitute any applicable Statutory, Regulatory, Customer/Site, etc. Health Safety & Environment (HS&E) requirements.
	All works should only be performed by trained, qualified and competent personnel who are aware of the hazards associated with the constituent components of this installation in addition to the system as a whole. Failure to comply with these practices may result in death, serious bodily injury, loss of equipment and environmental damage.
	A risk assessment (job hazard analysis - JHA) should be conducted PRIOR to the start of any works or actions within this document. Whilst every effort has been made to ensure the execution of this document represents no HS&E hazard, Banlaw takes neither responsibility nor liability for the consequences and damages that may occur in the execution of works within this document.
	Persons conducting or otherwise involved with the execution of the works within this document and project have an obligation to ensure that all HS&E requirements are known and understood, and subsequently followed at all times.

The key features of the **BLS###** series Level Sensors are illustrated in Figure 1.

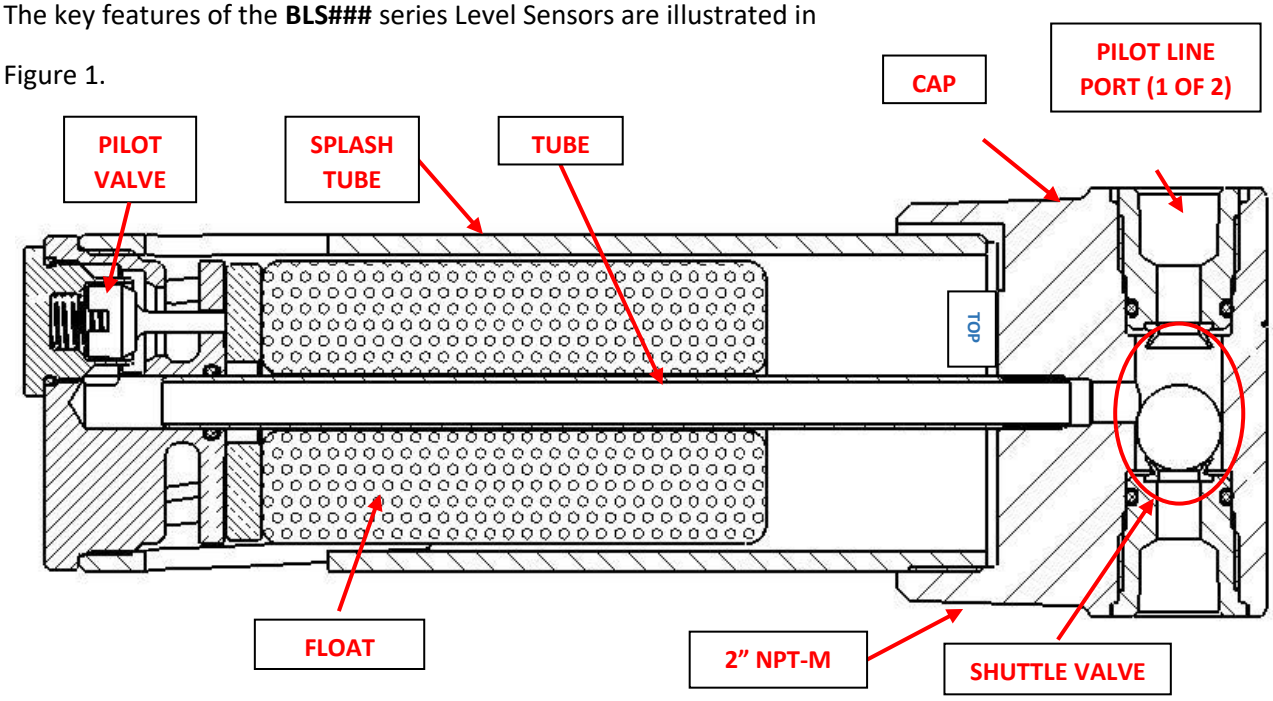
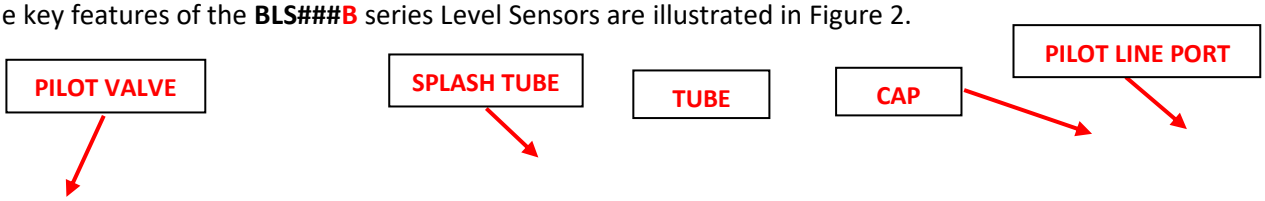


Figure 1 - Sectioned View of BLS### Series (assembly shown laying on side)

The key features of the **BLS###B** series Level Sensors are illustrated in Figure 2.



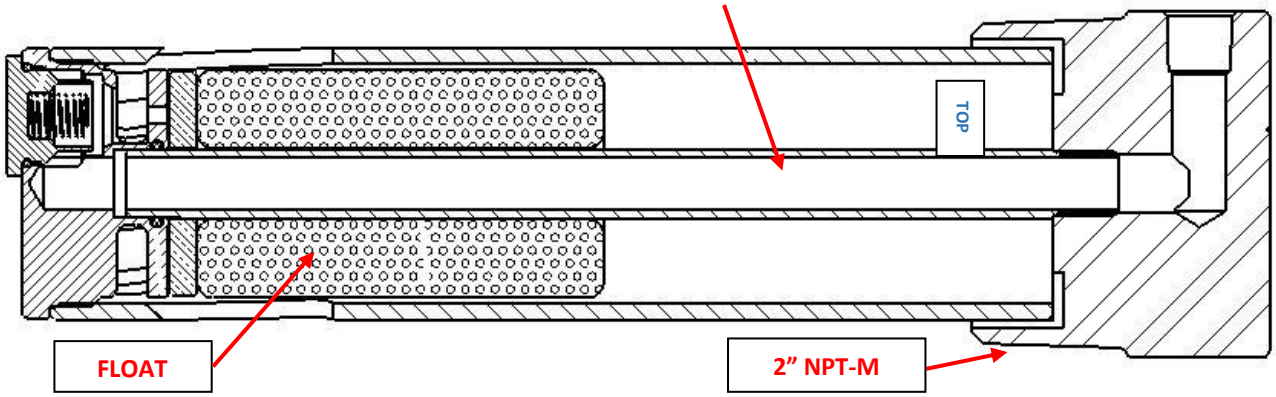


Figure 2 - Sectioned View of BLS###B Series (assembly shown laying on side)

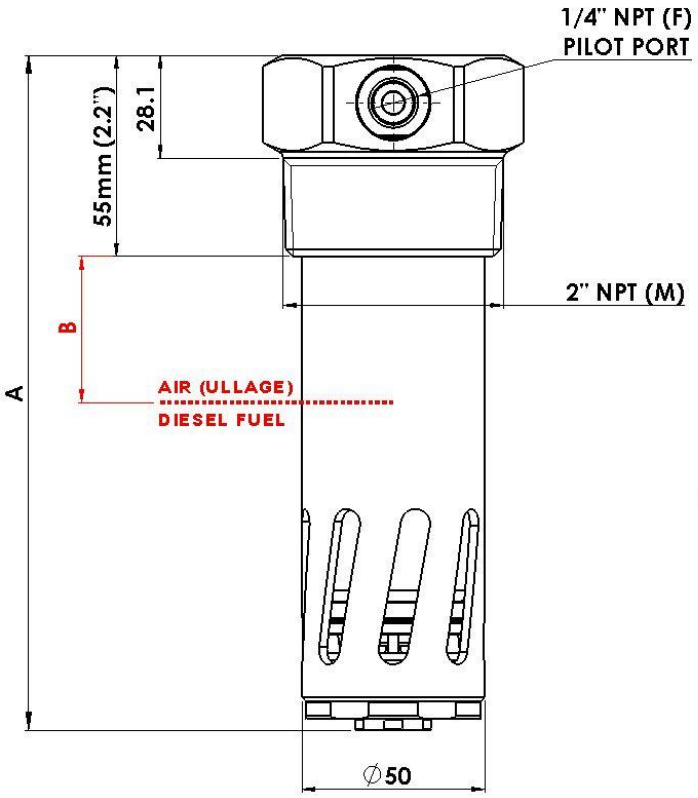
As the term *"non-venting"* implies, the BLS model Level Sensors do not incorporate any means of tank venting. When using the a BLS model Level Sensor, **a separate means of tank venting is required**. The BLS model assemblies only accommodate a Pilot Line routed *external* to the tank, i.e. **they do not incorporate an *internal* Pilot Line connection**. If a FillSafe Zero overfill protection (OFP) Level Sensor assembly is required *with* a tank venting feature and/or an *internal* Pilot Line connection, users are instead urged to use a Banlaw **BVLS** model *"venting"* Level Sensor.

The BLS model Level Sensors consist of the following separate assemblies;

1. **BLS###** series with 2 (external) Pilot Line connections and internal Pilot Line shuttle style valve;
    a. **BLS40**; **40mm (1.6")** nominated ullage[1].
    b. **BLS100**; **100mm (3.9")** nominated ullage[1].
2. **BLS###B** series with 1 (external) Pilot Line connection and no internal Pilot Line shuttle style valve;
    a. **BLS40B**; **40mm (1.6")** nominated ullage[1].
    b. **BLS40B-CT**; **40mm (1.6")** nominated ullage[1].
    c. **BLS100B**; **100mm (3.9")** nominated ullage[1].
    d. **BLS100B-CT**; **100mm (3.9")** nominated ullage[1].
    e. **BLS200B**; **200mm (7.9")** nominated ullage[1].
    f. **BLS200B-CT**; **200mm (7.9")** nominated ullage[1].
    g. **BLS300B**; **300mm (11.8")** nominated ullage[1].
    h. **BLS300B-CT**; **300mm (11.8")** nominated ullage[1].

"Arctic" (extreme cold temperature climate) Level Sensor assemblies incorporate the suffix "-CT" in the part number, e.g. BLS40B-CT.

[1] Nominal Tank Ullage – measured from the bottom (base) of the Level Sensor 2" NPT (M) mounting thread – refer Figure 3 and Figure 13. **A tolerance of ± 5mm (± 0.2") applies to dimension "B".**



ASSEMBLY	REFERENCE	DIMENSION
BLS40 and BLS40B	A	185mm (7.3")
	B	40mm (1.6")
BLS100 and BLS100B	A	245mm (9.6")
	B	100mm (3.9")
BLS200B	A	345mm (13.6")
	B	200mm (7.9")
BLS300B	A	445mm (17.5")
	B	300mm (11.8")

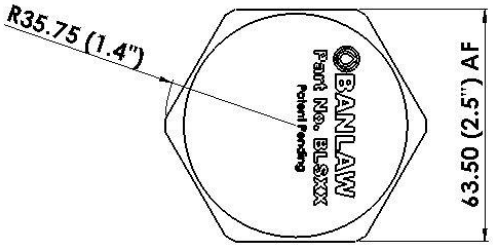


Figure 3 - BLS Model Schematic (and Tank Ullages)

The specific part number for each Level Sensor is marked on the Cap – refer Figure 4 for examples.

Figure 4 - Examples of BLS Assembly Part Numbers

Each BLS assembly is marked with a unique serial code for traceability purposes – refer Figure 5.

Figure 5 - Example of Unique Serial Code (circled)

2 KEY FEATURES AND OPERATION

Key advantages of the Banlaw FillSafe BLS series "Non-Venting" Level Sensors;

- Compatible with FillSafe Zero Flow Control Valves incorporating an ***external*** Pilot Line connection, e.g. BFCV23, BFTFCV43, BFCV80, etc.;
    - A BLS Level Sensor may also be used with some non-Banlaw (third party) OFP Flow Control Valves – please contact Banlaw for further information ***prior*** to install.
- BLS assemblies with 2 (external) Pilot Line connections (e.g. BLS40, BLS100, etc.) can be connected to either 1 or 2 FillSafe Zero Flow Control Valves. Such an arrangement is used on plant equipment incorporating 2 separate (independent) refuelling points. The shuttle valve within these BLS Level Sensors allows fuel flow through the Pilot Line connected to the Flow Control Valve in use and seals the Pilot Line port connected to the other Valve;
    - Both refuelling points (i.e. both Flow Control Valves) ***cannot be used simultaneously.***
    - When used with 1 Valve, **the Pilot Line port *not* in use must be plugged** on the BLS Level Sensor.
- Robust metal construction, specifically for parts mounted external to the fuel tank which may be subject to impact and harsh operating conditions.
- Low profile design, catering for applications with limited "head space" above a diesel tank.
- Outer "splash tube" to reduce the effects of fuel movement (i.e. sloshing) on the proper operation of the Level Sensor.
- *"Arctic"* variants available on certain Level Sensors rated for operation down to -51°C (-60°F).

2.1 BLS Normal Function – Primary OFP Operation

The Level Sensor length – specifically the dimension "**B**" in Figure 3 – must be ***pre-selected*** such that ***the Level Sensor shut-off (closure) level within the tank is below the closure level of any tank venting device,*** e.g. a Banlaw BFV225A Vent (as per Figure 6), or any other similar style vent which closes the flow of exhaust air out of the tank at a certain fuel level. This difference in levels (i.e. "**buffer**") is important to prevent such hazards as pressurisation of the tank, over-pressurisation of the tank and possible tank damage, or the potential spillage of fuel from the vent exhaust. Refer to section 5.1.1 for further information.

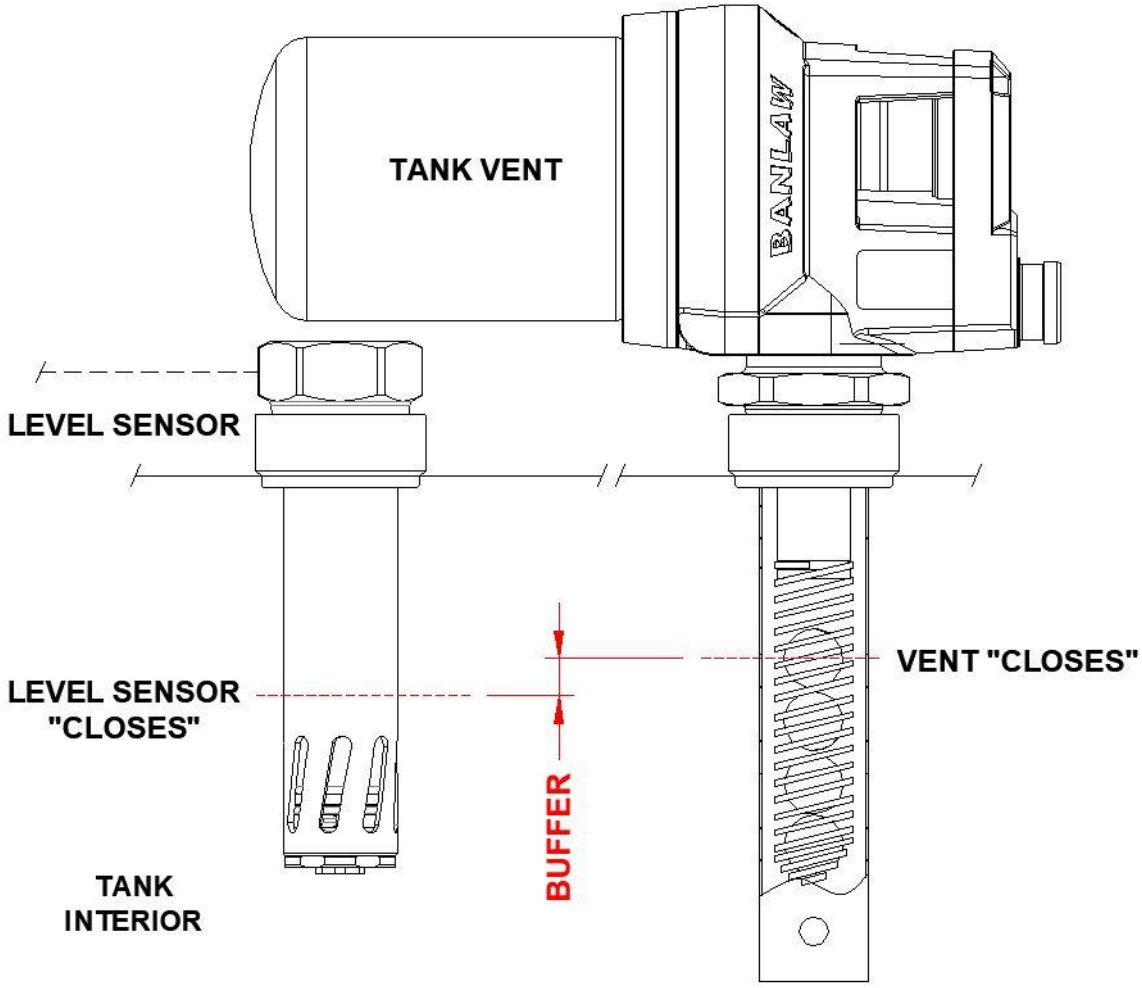


Figure 6 - Important Requirement for Level Sensor and Tank Vents

Figure 7 illustrates an example of a FillSafe Zero system incorporating a Banlaw FillSafe Flow Control Valve or in conjunction with a Banlaw BLS model Level Sensor, *external* Pilot Line, and a Banlaw BFV225 series filtered tank vent. The tank is being refilled in this illustration;

- **Level Sensor;** Float element "down" (in air), Pilot Line passage open, and Tank Vent venting air from the tank to atmosphere.
- **Flow Control Valve;** open, allowing fuel to enter the tank.
- **Dry-break Diesel Refuelling Nozzle;** securely connected and in the **ON** (open) position.

Figure 8 shows the same system at the point the tank is filled to the nominated capacity as controlled by the Level Sensor;

- **Level Sensor;** Float element "up" (in diesel), Pilot Line passage closed.
- **Flow Control Valve;** closed, terminating the flow of fuel into the tank.
- **Dry-break Diesel Refuelling Nozzle;** in the **OFF** (closed) position.

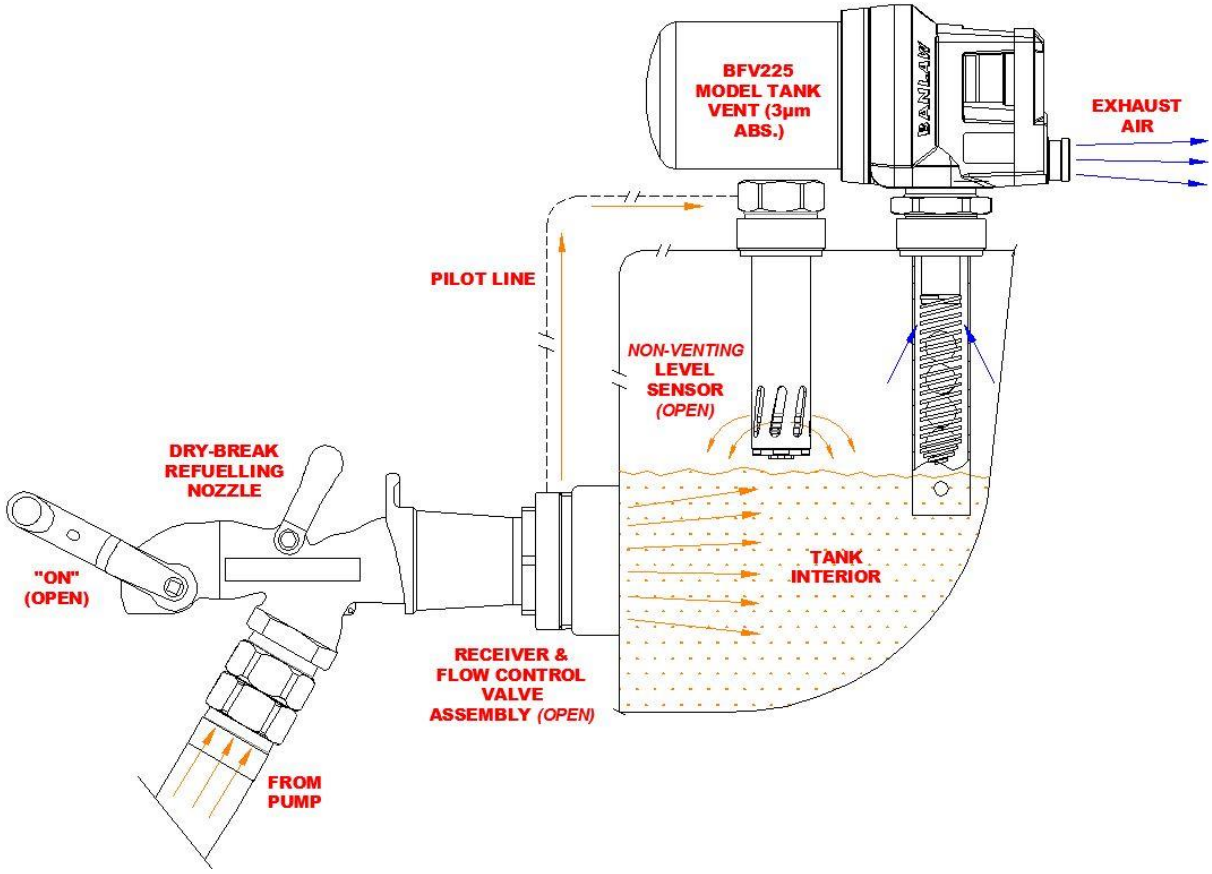


Figure 7 - Example of FillSafe Zero Install - Tank *Filling*

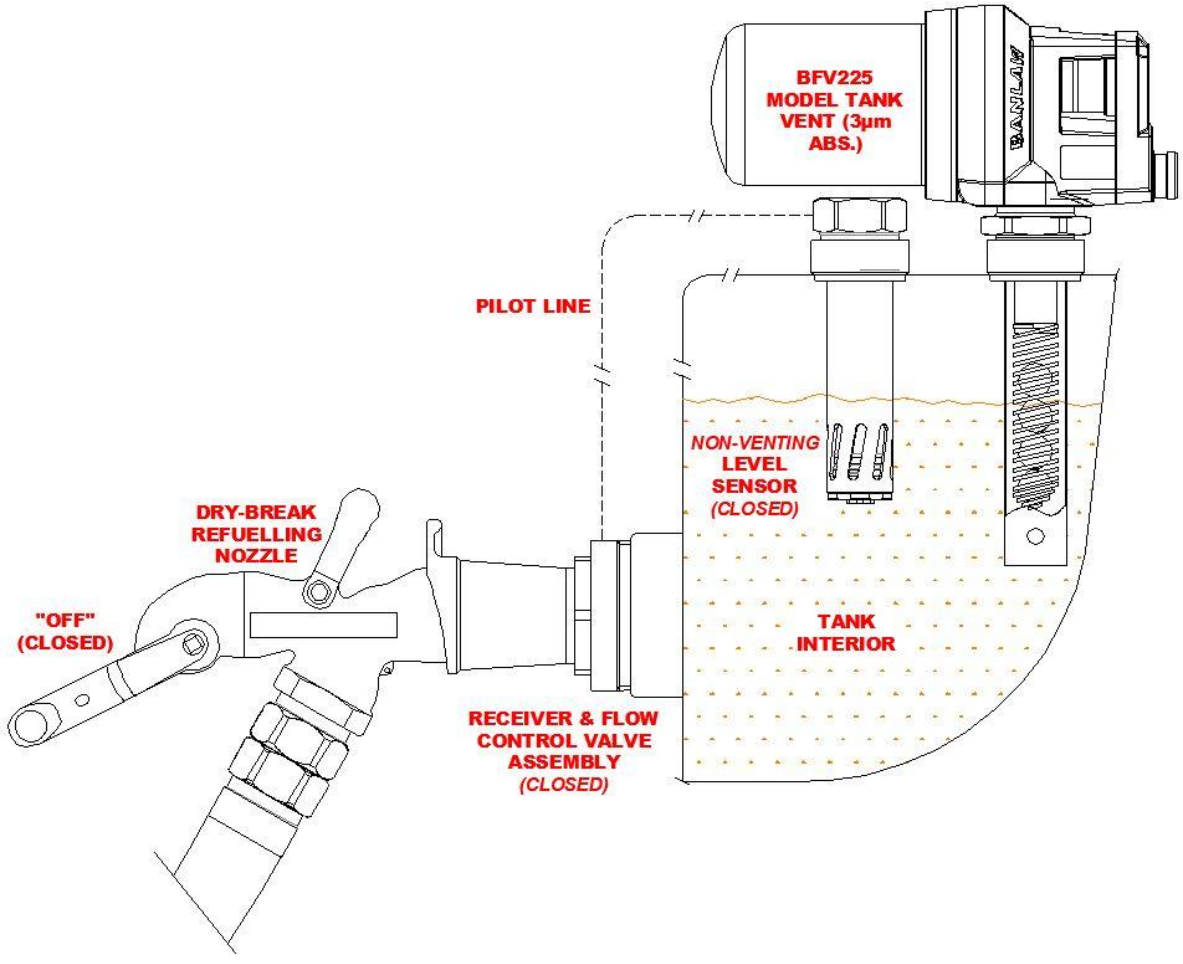


Figure 8 - Example of FillSafe Zero Install - Tank *Full*

The example systems in Figure 7 and Figure 8 will suit either a BLS### or BLS###B model Level Sensor, provided the unused Pilot Line port on the BLS### assembly is plugged (sealed). Figure 9 now illustrates a FillSafe Zero system incorporating 2 separate Flow Control Valves connected to a ***common*** BLS### Level Sensor. The shuttle valve within the Level Sensor will close the Pilot Line port connected to the Control Valve which is not in use. Both refuelling points (i.e. both Flow Control Valves) ***cannot be used simultaneously.*** Figure 9 also provides a basic schematic of the shuttle valve within the BLS### model Level Sensor, whereas is shown, Pilot Line 1 connected to the Flow Control Valve in use is open to the Level Sensor, whilst Pilot Line 2 is closed as it is connected to the Flow Control Valve not in use. As with all installations, the length of the Level Sensor must be pre-selected to ensure its closure (shut-off level) is below the closure level of the vent(s) fitted to the tank.

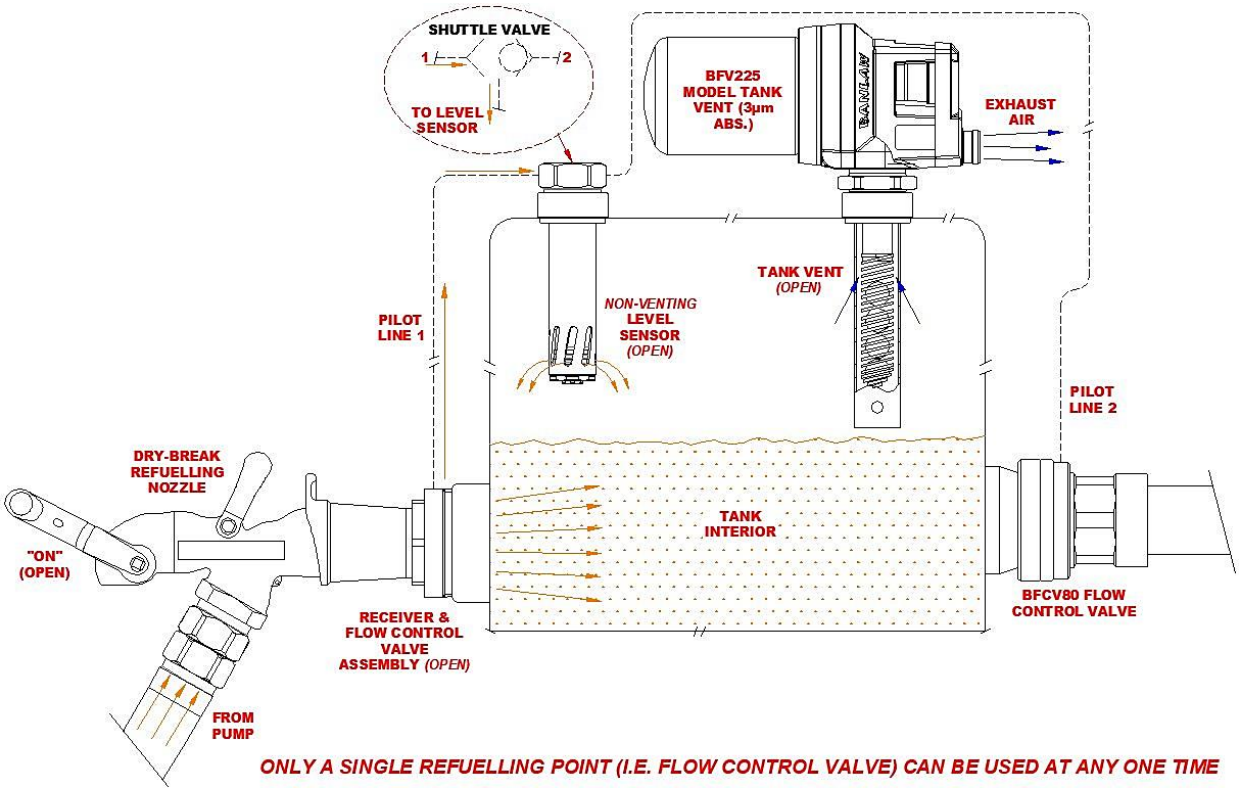


Figure 9 - Example of FillSafe Zero Install with Dual Flow Control Valves - Tank *Filling*

2.2 FillSafe Zero System Malfunction – Secondary OFP Operation

In the unlikely event of a fault with a BLS Level Sensor – or the FillSafe Zero system as whole – which disables its overfill protection (OFP) function, the safe termination of fuel flow into the tank(s) must be performed by some means of secondary OFP. Secondary OFP means may include;

- A Banlaw (or similar) "quick-fill" dry-break diesel refuelling system; comprising a Nozzle, Receiver and Tank Vent(s), this system relies on the short term (internal) pressurisation of the tank to trigger the automatic shut-off (closure) of the nozzle. For such a system to act as a reliable secondary (backup) means of OFP, the system must be correctly configured, operated and maintained.
- An audible/visual "high-high" level alarm, which alerts the refuelling operator that the SFL of the tank has been breached, and the need for them to ***promptly*** terminate the flow of fuel into the tank.
- Some other OFP means which is activated once the SFL has been breached, e.g. "high-high" level switch and actuated valve. As required by the governing risk assessment, this secondary system may be certified as a Safety Instrumented System (SIS), comprising SIL rated components.

Please refer to separate Banlaw documentation for information on the "quick-fill" dry-break refuelling system(s) available. Alternatively, contact Banlaw to discuss your secondary OFP system requirements, including a SIS.

3 IMPORTANT RESTRICTIONS ON THE USE OF THIS PRODUCT

1. The safe installation and subsequent operation of a Banlaw product relies on the completion of all necessary ***"due diligences"*** for the assessment of the Banlaw product(s) being suitable for the intended application(s). This assessment is best achieved through the cooperation of the supplier/OEM (Banlaw) and the customer or end-user. Once such an assessment deems the Banlaw product(s) to be suitable, the customer or end-user shall ensure effective ***"change management"*** applies should any influential aspect of the application (upon which the initial assessment was based) be subject to change and may affect the ongoing suitability (i.e. safety and proper function) of the Banlaw product.
2. The Banlaw FillSafe Zero BLS model Level Sensors incorporate components manufactured from **aluminium**. Products containing **external (exposed) aluminium** are typically unsuitable for use within an underground coal mine, or otherwise within an area where the use of external aluminium components (or other materials within the product) are prohibited for use in such areas in accordance with applicable governances.

1. Unless noted otherwise by Banlaw, the Banlaw FillSafe Zero tank overfill protection (OFP) system has *not* been assessed under any Regulatory or Industry Standard, Code, Directive, Guideline or other governance which may apply to the use of this product in applications where a governance applies. Please consult Banlaw prior to installation if in doubt.
2. The Banlaw FillSafe Zero system is designed for use only with ***clean*** (i.e. filtered) automotive grade diesel fuels, including commercial bio-diesel blends. This Banlaw product is ***not*** recommended for use with waste diesel fuel, or with diesel fuel containing contamination levels beyond those stipulated by governances and guidelines such as the current Worldwide Fuel Charter (WWFC) and fuel quality requirements of modern diesel engine manufacturers (OEM's). *The use of this product with fuel of higher contamination levels may cause the improper operation (failure) of the product and other detrimental effects.* Banlaw recommends adequate fuel contamination controls (e.g. filtration) for all fuels passing through the Banlaw FillSafe Zero system.
3. For *"Arctic"* model products, noticeable physical changes (e.g. clouding, additive drop-out, agglomeration, thickening, etc.) in the diesel fuel may cause reduced functionality of the product and the FillSafe Zero OFP system.

This product is unsuitable for use with AdBlue (DEF) or with an alternative fluid (or substance) whose properties may affect the safety, function or reliability of the product. Please consult with Banlaw to confirm fluid compatibility if in doubt.

4 PRODUCT SPECIFICATIONS

BANLAW BLS MODEL *"NON-VENTING"* LEVEL SENSORS	
Compatible Fluid Types	***Clean*** Diesel Fuels, including Bio-Diesel Blends
Principal Material Composition	Zinc Plated Steel, Aluminium, Brass, Stainless Steel, Viton®, Nitrophyl®, Acetal, Fluorosilicone (*arctic* series)
Process Connections	Tank Mounting; 2" NPT (M)
Pilot Line Port Connections[#]	*External* Pilot Line(s); 1/4" NPT (F)
Operating Temp. Range °C (°F)[##]	"Standard" Series; -10°C (14 °F) to 55°C (131°F) "*Arctic*" (-CT) Series; -51°C (-60°F) to 55°C (131°F)
Mass of Level Sensor	*(Refer to the PSG for each product for their mass)*

Notes: [#] Option of either internal *or* external Pilot Line. Redundant (unused) connection must be ***sealed***.
[##] The core function of *"Arctic"* model Level Sensors has been tested by an independent laboratory at -51°C (-60°F).

4.1 FillSafe Zero Pilot Lines

The Banlaw *"Non-Vented"* Level Sensors (BLS model) may be connected to a Banlaw Flow Control Valve 2" (e.g. BFCV50, BFCV50R, etc.) via an ***external*** Pilot Line. The BLS series does not accommodate an internal Pilot Line, i.e. a pilot line routed within the tank. Should an application require an internal pilot line, assess whether a Banlaw "Venting" Level Sensor (BVLS model) can instead be used or contact Banlaw to discuss further options.

- **Specifications (including limits/thresholds) apply to all FillSafe Zero Pilot Lines**, so please contact Banlaw at time of order to ensure correct Pilot Line selection.
- Please refer to the applicable **Banlaw FillSafe Zero System Installation Procedure** for details on the proper installation & commissioning of internal and external Pilot Lines.
- **The use of a non-genuine Banlaw Pilot Line, or otherwise, the use of a Pilot Line which does not conform with Banlaw specifications may cause the improper, unsafe and unreliable operation of the FillSafe Zero system.**

Unless otherwise noted by Banlaw, some of the key Pilot Line specifications and requirements include;

- **External Pilot Lines;**
  a. Supplied by Banlaw, or otherwise manufactured strictly in accordance with Banlaw specifications.
  b. Minimum ID (bore); 9.5mm (3/8", DN10);
     i. 12mm (1/2", DN12) recommended for Pilot Lines exceeding approx. 4m (13.1') length.
  c. Maximum recommended overall length; 10m (33'). Contact Banlaw for applications requiring an extended length.
  d. Maximum recommended vertical head; 4m (13') between Flow Control Valve location (lower) and Level Sensor location (top). Contact Banlaw for applications requiring an extended head height.
  e. Minimum (internal) safe working pressure (SWP); 2,500kPa (25 bar, 363psi).
  f. Installed external to the diesel tank;
     i. To achieve the *minimum* possible Pilot Line length. Excess Pilot Line length should be avoided.
     ii. Adequately supported using hose clamps (or similar) – refer Figure 10.

iii. Via a routing (pathway) which minimises the probability of damage due to sharp edges, impact, excessive wear & tear, and relative movement (e.g. rubbing) between the hose and another surface. Any potential contact with sharp edges or movement against a surface should be mitigated by improved routing or support of the hose, or by inclusion of a protective sheath (outer cover) over the hose.

iv. Any twisting or sharp (small) radius bends of the Pilot Line must be avoided, including short radius hose adaptors (elbows) etc.

v. Other than the weight of the Pilot Line itself, no additional mass or tension (stretch) shall be added to the hose assembly.

vi. Routing between 2 relative moving surfaces, e.g. through an articulated region of a vehicle (e.g. front-end loader, etc.), should be avoided where possible. If not, routing and support of the hose over this region must be as per the hose OEM guidelines for such applications to avoid accelerated wear and fatigue of the hose.

Figure 10 - Example of External Pilot Line Retention

5 INSTALLATION & COMMISSIONING GUIDELINES

This Installation & Commissioning Guide is general and is not meant to replace or override installation guidelines that arise out of a *due diligence* and/or *risk* assessment of a Banlaw product for a specific (intended) application.

The scope of this section applies to the Banlaw BLS model *"Non-Venting"* Level Sensor assemblies. Whilst other FillSafe Zero products are mentioned – e.g. Flow Control Valves and Pilot Lines – end-users must refer to ***separate*** Banlaw documentation covering each product ***prior*** to installation.

Note:

General Installation Notes;

1. Conduct a **Job Hazard Analysis** (JHA) ***prior*** to install to mitigate health, environmental and equipment hazards.
2. Do ***NOT*** install any parts that are damaged or are otherwise faulty.
3. Do ***NOT*** install parts which are not compatible with mating parts or parts which do not satisfy the specifications of the FillSafe Zero system.
4. Conduct all necessary measures to ***prevent the ingress of contamination*** into the Banlaw Level Sensor and other parts.
5. Only engage threads of the same thread type. Ensure all threaded connections are clean and in good condition. Tighten to the required torque but do avoid over-tightening.
6. An appropriate thread sealant is recommended on the NPT threaded process connections. Use ***sparingly*** and ***avoid excess use of Loctite*** and similar products – *residual thread sealants etc. may cause contamination and malfunction of the FillSafe Zero system*. No thread sealant is required on the JIC Internal Pilot Line connection.
7. Use only proper ***hand tools*** for the installation of all components. Avoid the use of power or impact tools, and adjustable wrenches (e.g. Stillsons).

8. Use consumables (e.g. Loctite products) strictly in accordance with the OEM Safety Data Sheet (SDS) and operating guidelines. Do not use consumables beyond their expiry date.

5.1 Pre-Installation Guidelines

CAUTION

Any proposed installation/application/operation of the Banlaw FillSafe Zero Level Sensor shall satisfy the Specifications detailed in section 0, and other requirements within this document. The specifications for any other parts & equipment included within this install must also comply with the parameters (e.g. pressure, temperature, flowrate, etc.) of the application. ***Failure to ensure this Banlaw product and other equipment are used strictly in accordance with their applicable specifications will introduce potentially serious safety hazards.***

The maximum permissible angle (gradient) for the proper and reliable operation of the BLS model Level Sensor Assemblies is illustrated in Figure 11, i.e. ± 25° from the vertical (upright) position.

No attempt shall be made to refuel a tank using the FillSafe Zero system in the event the "angular limits" of safe operation of the Level Sensor are exceeded.

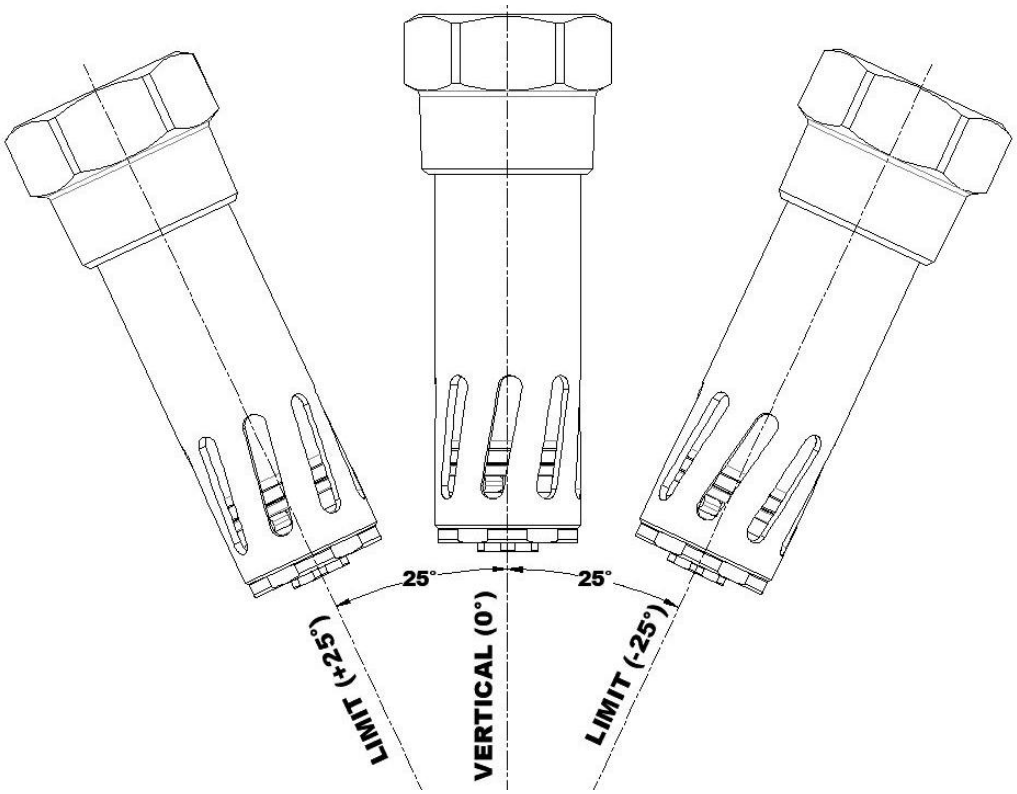


Figure 11 - Angular Limits of Level Sensor Operation

Figure 12 illustrates an important condition of an installation, specifically to avoid installing a Level Sensor within a riser, drop pipe, or extended coupling. Scenario 1 shown on the left in Figure 12 will not allow the Level Sensor to activate before the tank is overfilled. Scenario 2 on the right jeopardises the Level Sensing function as it creates a pressure lock (of air) within the pipe etc. restricting the rise of the fuel level immediately surrounding the Level Sensor when compared with the (higher) fuel level surrounding the pipe. Both scenarios – and similar cases – ***must be avoided.*** Scenario 3 shows the correct means of installation, providing ***clearance*** between the fuel level at which the Level Sensor is activated (i.e. closes) and the base of the 2" NPT half coupling to avoid potential Level Sensor malfunction and to generate the required ullage within the tank.

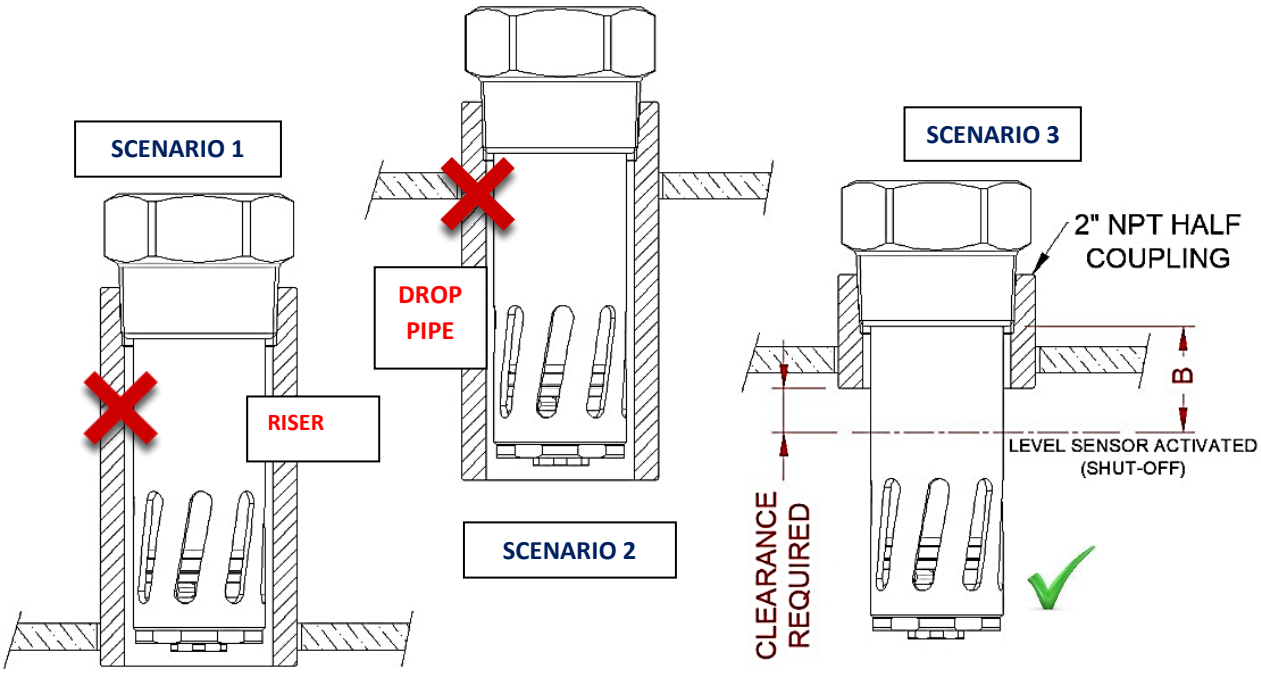


Figure 12 – Restriction on Length of 2" NPT Half Coupling with BLS Level Sensor

5.1.1 Tank Ullage – Required Tank Fill Level

The range of BLS model Level Sensors currently available – refer part numbers in section 1 – allows end-users to attain a variety of tank ullages, i.e. tank fuel fill levels (and hence fuel volume capacities). Figure 12 and Figure 13 illustrate the preferred means of installing a Level Sensor onto the top of a tank using a **2" NPT Half Coupling** (e.g. Banlaw AUS25AA-1).

CAUTION

Similarly to a Banlaw Tank Vent – as used within a Banlaw dry-break diesel refuelling system – a Level Sensor ***cannot*** be installed within a riser pipe, manual fill (splash-fill) spout, or similar device which extends the ***installed*** height of the Level Sensor above the top of the tank to the extent the proper and reliable function of the core features of the Level Sensor are jeopardised. Figure 12 and Figure 13 illustrates the required means of mounting a Level Sensor to the ***top*** of a tank. ***Please contact Banlaw or your nearest authorised Banlaw distributor for further information and advice.***

Dimension "**B**" relates to the reference dimension used to define the range of Level Sensors available, e.g. "**100**mm" for a BLS**100**. **A tolerance of ± 5mm (± 0.2") applies to dimension "B".** The remaining dimensions allow the end-user to determine the tank ullage attained once a Level Sensor is installed. This calculation must be performed ***prior*** to the installation of a Level Sensor, so that the required fuel level and fuel capacity within the tank are achieved.

REFERENCE DIMENSION	DESCRIPTION
B	As per BLS Part Number. Refer section 1.
D	Shut-Off Level from exterior of tank top.
E	Distance from exterior of tank top to top of 2" NPT Half Coupling.
F	Distance from top of BLS to top of tank
T	Thickness of tank top.
"ULLAGE"	Vapour space (height) within tank at Shut-Off Level.

ULLAGE (mm) = B - (F – 55) – T

ULLAGE (inches) = B – (F –2.2) - T

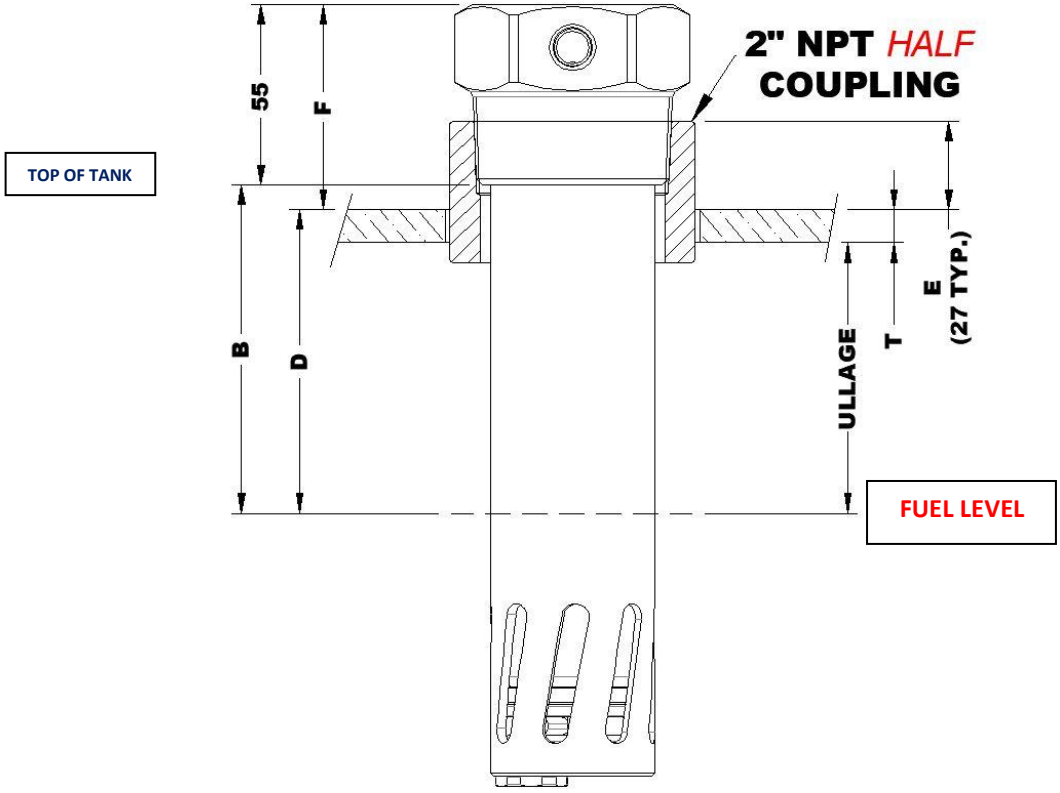


Figure 13 - BLS Level Sensor and Tank Ullage

5.1.2 Fuel Density and "Liquid Foaming"

Key performance specifications of the BLS model Level Sensors have been determined using liquid automotive grade diesel fuels, with a density (SG) range of 0.82 to 0.86. ***Specifications such as the Shut-Off Level will vary in response to liquid density.*** The proper function of other features of the Level Sensor such as the Vent Float may also be affected.

Significant reductions in liquid density will occur with diesel foaming and/or significant diesel aeration. Such issues often occur through the relatively poor design of the fuel entry into the tank, e.g. the lack of a "drop pipe" to convey the incoming fuel stream to a discharge point into the bottom (flooded) area of the tank interior. The use of a drop pipe is not always viable, however all possible measures must be incorporated into the design and location of a tank ***inlet*** to minimise or mitigate;

- The discharge of the (incoming) pressurised fuel stream into "free air".
- The lowest practicable velocity of the fuel stream as it enters the tank interior.

The discharge of fuel foam from the tank vent(s) exhaust port during refuelling will typically indicate a foaming issue within the tank. ***Unless verified otherwise, the proper, safe and reliable function of the Level Sensor and thus the FillSafe Zero system is likely to be jeopardised until the excess foaming issue is addressed.*** Please contact Banlaw or your nearest authorised Banlaw distributor for further advice.

5.1.3 Proximity to Incoming Fuel Flow

The proper function of a BLS Level Sensor may be jeopardised as a result of direct impact with (or excessive turbulence from) the incoming fuel stream. Every available effort shall be made to ensure the tank inlet and location of the Level Sensor are not arranged (positioned) such that the fuel flow impacts the Level Sensor in a manner similar to that shown in Figure 14.

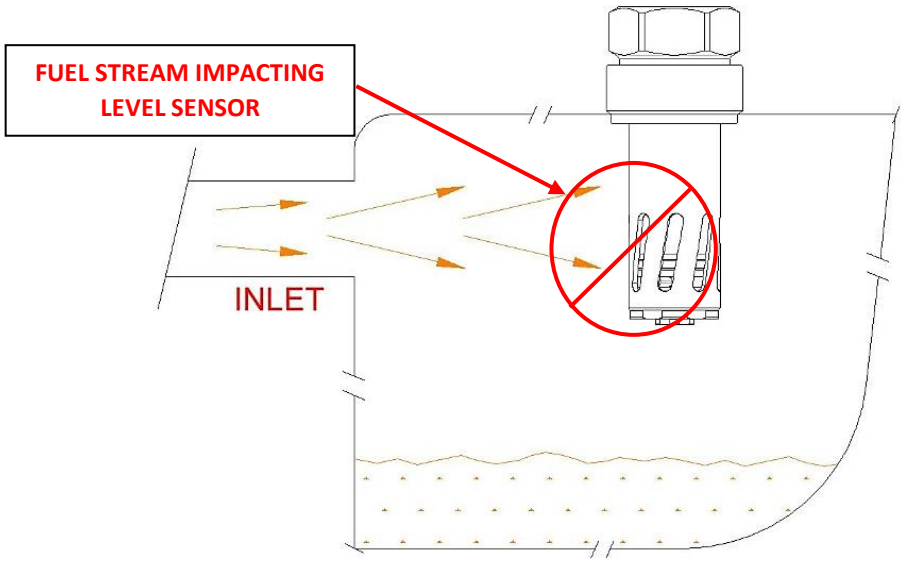


Figure 14 - Incoming Fuel Stream Impacting Level Sensor

5.1.4 Dual Flow Control Valves and Common BLS Series Level Sensor

For tanks with dual (2) refuelling lines, a single (common) BLS (e.g. BLS100) series Level Sensor can be configured as per Figure 9. The shuttle valve within the "cap" of the BLS series Level Sensors allows ***either*** (not both simultaneously) refuelling point to be used. This same configuration is not possible with the BLS###**B** series Level Sensors (e.g. BLS100B) as they do not incorporate the shuttle valve, but instead, separate check valves may be used to allow a "common" BLS###B Level Sensor to be connected to 2 Flow Control Valves as per Figure 15.

Importantly, **only a single refuelling point can be used at any one time.**

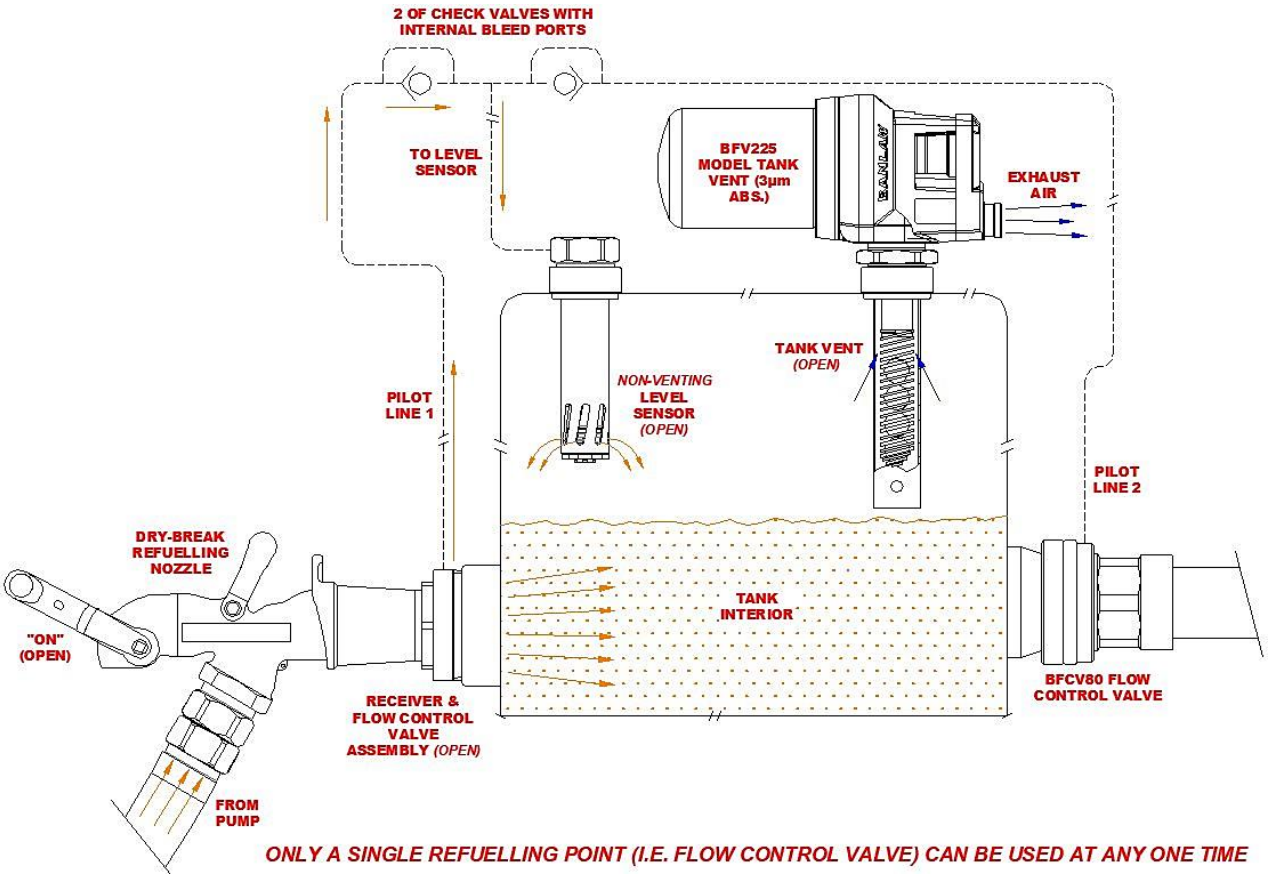


Figure 15 - Common BLS Level Sensor with Dual Flow Control Valves (2 Fill Points)

5.1.5 Applications with Multiple Tanks

A FillSafe Zero system can be tailored to suit the refuelling of plant equipment fitted with multiple diesel fuel tanks.

Due to the variety of multiple tank configurations, end-users are asked to contact Banlaw to confirm the correct specification of FillSafe Zero equipment *prior* to installation.

5.2 Installation Procedure

CAUTION

The BLS Level Sensor incorporates components which are susceptible to damage if improper storage, handling and overall care is not conducted during pre-installation and installation. Components particularly sensitive to damage include the ***Splash Tube***. Damage sustained to Level Sensor components may cause the improper, unsafe and unreliable operation of the Level Sensor and FillSafe Zero system. Damage due to abuse, improper handling, neglect or tampering will void any Banlaw warranty claim.

1. Complete all necessary hazard mitigation, monitoring and control actions as per the JHA.
2. Once the tank is ready to accept the new BLS model Level Sensor, remove the Level Sensor from its packaging (leave within packaging until just prior to install). Remove any thread covers and other packaging materials.
3. Using only ***gentle*** hand movement, "rock" (rotate) the Level Sensor back and forth to verify the Float freely moves under the effect of gravity. It is imperative the Float reciprocates ***freely*** on the central tube under the effect of gravity.
4. Apply thread sealant – e.g. Loctite 567 – ***sparingly*** to the 2" NPT (M) thread of the Level Sensor. Ensure the mating 2" NPT (F) port on the tank is in good condition, clean, dry and free from any debris and contamination. Align the Level Sensor concentrically with the port and carefully install the Level Sensor into the tank port. Using a 63.5mm AF spanner – tighten into the port as per;
    a. Hand tighten firmly.
    b. Tighten by no more than an additional 6.5mm (1/4") thread length.
5. ***External*** **Pilot Line Connection;** Inspect the Banlaw External Pilot Line and Level Sensor Pilot Line connection for visual damage or defects. If condition is unsatisfactory, repair or replace the damaged components.
    a. Apply thread sealant – e.g. Loctite 567 – ***sparingly*** to the ¼" NPT (M) thread of the threaded nipple and install into the external Pilot Line Port to be used. Tighten but do not overtighten.
    b. For BLS### series Level Sensors (i.e. dual Pilot Line ports), ensure the unused (redundant) port is plugged/sealed.
    c. Install the threaded hose-tail (i.e. ¾" JIC-F) onto the nipple and tighten securely.
    d. Confirm the external Pilot Line is in good working order and properly secured – refer example in Figure 10 utilising magnetic hose clamps.

Note:

- Avoid overtightening.
- Do ***NOT*** use power tools, i.e. impact wrenches etc.
- Avoid the use of Stillson's and wrenches which are more likely to damage the Level Sensor.

5.2.1 Tank Venting – Intake & Exhaust

If installing a tank vent(s) in conjunction with a Level Sensor, two basic styles of tank venting system are used;

1. Unfiltered (free to atmosphere).
2. Filtered (specifically for air ***entering*** the tank).

The ***discharge*** location of exhaust air from a tank must be in a location;

1. Away from potential ignition sources, e.g. turbochargers, engine exhausts, etc.
2. Less prone to the build-up of contamination, e.g. mud, snow, etc.

The use of a breather hose (minimum 1-1/4", DN31) from the Level Sensor intake & exhaust port to the desired discharge location will ensure the above criteria are met.

Most common diesel engine OEM's recommend or mandate the ***effective filtration or airflow entering a diesel engine fuel tank*** via the tank vent(s). Typically, the required micron rating of the filter element is no greater than ***5µm (abs.)***. Please contact Banlaw for advice on the most appropriate filtered breather solutions for your specific FillSafe Zero applications – e.g. the range of Banlaw BFV225 filtered vents, or a "standard" (unfiltered) vent with a Banlaw BRFB01A breather assembly.

5.3 COMMISSIONING

For a new and ***complete*** FillSafe Zero installation, please refer to the commissioning guidelines within the ***Banlaw FillSafe Zero Flow Control Valve Product Data Sheet (PDS)*** and other FillSafe Zero reference documentation (contact Banlaw).

For the replacement of a FillSafe Zero BLS model Level Sensor, the FillSafe system should require no further commissioning. It is however recommended the initial (first) operation of the system incorporating the new Level Sensor is closely monitored to ensure the system operates properly and that no fuel leaks occur from process connections completed during this installation.

6 MAINTENANCE & SERVICING

The Banlaw BLS model Vented Level Sensor is a ***non-serviceable*** product. No attempt shall be made to repair, service or tamper with the product. Should the Level Sensor malfunction, promptly contact Banlaw or your nearest Banlaw Distributor. Visit www.banlaw.com for warranty details and a full list of distributors near your area to source replacement parts.

The following preventative maintenance guidelines apply to the BLS model Level Sensors;

1. Ensure adequate controls and condition monitoring are in place to ensure the contamination levels (and other specifications) of your fuel supply are maintained – ***PREVENT*** poor quality fuel entering your site's fuel infrastructure and plant equipment.
2. Install inline (bulk) filtration on all diesel dispensing lines – contact Banlaw for advice.
3. Maintain the use of the Receiver Dust Cap and Nozzle Anchors, Holsters, or Dust Caps.
4. Remove any contamination from the dry-break Receiver (refuelling coupler) ***prior*** to connecting a refuelling Nozzle.
5. Ensure tank breather ports are routinely inspected and cleaned or contamination. Inspect filtered breather systems for condition and renew filter elements as required.
6. Replace the BLS Level Sensor assembly no later than every 5 years.

7. Routinely inspect the external Pilot Line for kinking, distortion (e.g. flattening), leakage and other damage. Repair/replace as necessary.

6.1 Banlaw Site Service Level Agreement (SLA)

Clients can benefit from a **Banlaw Service Level Agreement (SLA)** to assist in the preventative and corrective maintenance of a FillSafe Zero system onsite, in addition to other diesel, fuels, oils and coolant infrastructure. Clients with an SLA can *focus on their core business activities* and allow experienced Banlaw technicians and engineers to help keep such infrastructure operating at optimum ***safety, performance and reliability.***

7 TROUBLESHOOTING

For further troubleshooting guidelines, please refer to the ***Banlaw FillSafe Zero Flow Control Valve Product Data Sheet (PDS)*** and other FillSafe Zero reference documentation (contact Banlaw).

PROBLEM	PROBABLE CAUSE AND SOLUTION
Premature nozzle shut-off at the *start* of or *during* refuelling.	• Zero system requires bleeding (to remove air). With the supply pump running, cycle nozzle T-handle between ON and OFF several times to resolve this issue. • Residual pressure in Pilot line. Cycle nozzle T-handle between ON and OFF several times to resolve this issue. • Pilot line blocked/obstructed, kinked or undersized. Check Pilot line size and connections for blockages or obstructions. Avoid the use of restricted bore style fittings, sharp elbows etc. within the Pilot Line routing between the Flow Control Valve and Level Sensor. • Level Sensor installed too high (over 4m (13')) above the Flow Control Valve). • Float Valve at base of Level Sensor is "stuck" in the closed (up) position. Remove Level Sensor, investigate, identify root cause and rectify. • Faulty Level Sensor. Replace Level Sensor. • Fuel flow out of the Flow Control Valve outlet ports is "choked" – i.e. the Valve is installed within a pipe, extended socket, etc. or installed too close to the side of the tank or internal tank baffle (plate). • Piston mechanism within Flow Control Valve is "stuck" in the closed (forward) or otherwise restricted in its "free" reciprocating action. Remove Valve, investigate, identify root cause and rectify. • Faulty Flow Control Valve. Replace Flow Control Valve. • Flow rate below recommended minimum. Increase delivery flow rate. • Flow rate above recommended maximum. Reduce delivery flow rate. • The shut-off setting of the nozzle & receiver *combination* is too "low" (i.e. too light) for this application. Contact Banlaw or your nearest Banlaw agent for advice. • Faulty nozzle. Replace nozzle. • Excessive restriction to the "free" discharge of air from the tank's venting (breather). Check vent(s), vent exhaust, breather hose, and filtered breather system (if fitted) for the source of the restriction. Also confirm the venting system is rated for the tank refuelling flowrate. • Excessive restriction in the refuelling line connecting the Receiver to the Flow Control Valve. Upsize line size (bore) and remove short radius bends and unnecessary chokes to fuel flow. • Accidental/premature activation (closure) of the Level Sensor by fuel movement (sloshing) in the tank. Pause for 1 min and restart refuelling.

PROBLEM	PROBABLE CAUSE AND SOLUTION
Nozzle shut-off and/or Flow Control Valve closure as tank *approaches* SFL (capacity).	• Accidental (premature) trigger of the Level Sensor by fuel movement in the tank. Pause for 1 min (60 seconds) to allow fuel to settle and try again. • Incorrect Level Sensor for the required ullage. Contact Banlaw or your nearest Banlaw agent for advice.
Tank overfilling	• Incorrect Level Sensor (length) for the required ullage. Contact Banlaw or your nearest Banlaw agent for advice. • Leakage from Pilot Line and/or connections. Check Pilot line and connections. • Float Valve within Level Sensor has failed to close. Remove Level Sensor, investigate, identify root cause and rectify. • Faulty Level Sensor. Replace Level Sensor. • Piston mechanism within Flow Control Valve is "stuck" in the open (rearward) or otherwise restricted in its "free" reciprocating action. Remove Valve, investigate, identify root cause and rectify. • Faulty Flow Control Valve. Replace Flow Control Valve. • Flow rate below the recommended minimum. Maintain flowrate within the recommended minimum and maximum range.

8 PRODUCT RECYCLING & DISPOSAL

Banlaw values and supports the sustainable use of resources, and the safe, responsible and proper disposal or recycling of all materials within its products. For a description of the principal materials within the Banlaw FillSafe Zero system, please refer to section 0.

9 PRODUCT WARRANTY

Banlaw is committed to providing quality products and services. To provide further assurance, our products and services are backed by generous warranties.

A copy of the Banlaw product warranty terms and conditions is available from Banlaw, the Banlaw website, or your nearest authorised Banlaw agent.

END OF DOCUMENT

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