



ITT

Enidine / Conoflow
105 Commerce Way
Westminster, SC 29693
Tel: (864) 647-9521
Fax: (864) 647-9574

Engineered for life

INSTRUCTION AND MAINTENANCE MANUAL

HPNGV2 Series Compressed Natural Gas Vehicle Regulator

WARNING: These instructions must be read carefully prior to installation and system startup.

INTRODUCTION: The HPNGV Series regulator is a self contained, pressure reducing regulator designed and qualified for 3000 and 3600 psig CNG vehicular fuel systems. This regulator is factory calibrated and is not field adjustable. Various configurations of this regulator are available, based on the application needs. Consult the factory for part numbers, service kits, or configuration assistance.

SYSTEM REQUIREMENTS: High pressure CNG filtration (1 micron rating) is required to keep particulates in the gas stream from damaging the regulator and downstream components. The filter must be located upstream of the pressure regulator. Clean, burr free fittings and lines must be used to prevent particulate damage to the regulator.

CONNECTIONS: The HPNGV Series regulator is connected to the fuel system by inlet and outlet ports. These ports use CNG compliant SAE J1926 o-ring boss connections for 3/8" size tubing at the inlet connection (9/16-18 thread) and 1/2" size tubing at the outlet connection (3/4-16 thread). These connections are labeled "INLET" and "OUTLET". The inlet and outlet lines must be sized for sufficient flow, and the outlet fitting must provide a 3/8" minimum bore for gas flow.

A coolant circulation bowl is provided which permits engine heat to warm the regulator and prevent internal icing of the regulator valve. An optional coolant circulation bowl is available with a thermostat. Both coolant bowls are labeled for coolant inlet and outlet, adjacent to the connections. Standard coolant line connections are for 3/8" reinforced rubber hose, which is secured with hose clamps.

An optional SAE-3 transducer port is available to allow a high pressure transducer to be directly installed in the regulator to measure inlet pressure.

WARNING

Conoflow's products are designed and manufactured using materials and workmanship required to meet applicable standards. The use of these products should be confined to services specified and/or recommended in the Conoflow catalogs, instructions, or by Conoflow application engineers.

To avoid personal injury or equipment damage resulting from misuse or misapplication of a product, it is necessary to select the proper materials of construction and pressure-temperature ratings which are consistent with performance requirements.

Optional pressure bias controls (manifold pressure reference) are available.

A pressure relief device (PRD) is provided. Standard (light duty) configurations discharge directly to atmosphere, while capture pipes are available for enclosed spaces or heavy duty applications.

CAUTION: The regulator's PRD is a control and not a system safety device. It may not protect the regulator or fuel system under all possible / potential failure modes. A downstream safety valve or other failsafe strategy must be used to fully protect the fuel system and vehicle. The PRD port must not be blocked by any obstruction.

MOUNTING: Two (2) M8 X 1.25 threaded holes are provided in the regulator to enable sturdy mounting. The regulator may be oriented in any direction; however Conoflow recommends that the gas ports are horizontally oriented to minimize exposure of the gas lines, and prevent collection of oil and moisture in the downstream line. The regulator must be rigidly mounted on the vehicle, and protected from impact of road debris.

WARNING: Do not mount the regulator by gas or coolant connections only. This regulator must be securely mounted by M8 x 1.25 bolts.

Please refer to the interface drawings for mounting dimensions, connection identification and connection details.

SPECIFICATIONS:

Maximum Operating Inlet Pressure: 3600 psig (248 bar)

Outlet Pressure: Factory preset – see regulator label

Outlet Pressure Variation in Service: -10 to +18 psi from labeled setting throughout the range of operating inlet pressure, temperature and gas flow. See flow performance graph to see effect of changes to inlet pressure and gas flow.

Temperature Range: -40° F to 250° F
(-40 °C to 120 °C)

Connection Torques: Inlet (SAE-6): 27 ft-lb
Outlet (SAE-8): 42 ft-lb
Transducer (SAE-3): 8 ft-lb
Mounting Bolts: 15 ft-lb

Flow Capacity: To 175 lb/hr of CNG. (Flow varies by application, consult the factory for data.)

PRD Opening: 200 +/- 40 psig (optional)
270 +/- 60 psig (standard)
350 +/- 60 psig (optional)

PRD Type: Reseatable

MATERIALS OF CONSTRUCTION:

Body: 6061-T6 Aluminum
Bonnet: 6061-T6 Aluminum
Diaphragm / Seals: Nitrile Rubber class
Valve Trim: Stainless Steel / Polyimide / PEEK

NOTE: This regulator has been tested and certified for safe and reliable service in Natural Gas Vehicles. There are significant potential hazards associated with CNG which the user and / or installer must be aware of when using this product.

CAUTION: Install the regulator in accordance with NFPA 52, CAN/CGA-B149.4 and other codes and standards applicable to the jurisdiction of installation and service.

WARNING: CNG can cause damage and / or injury due to very high pressure, flammability, and extreme cold during expansion. Suitable safeguards must be employed during installation, commissioning and service to prevent harm to personnel and property.

PRINCIPLE OF OPERATION

The HPNGV series is a mechanical pressure regulator. The main valve, within the regulator, is coupled to a diaphragm assembly. A spring preload against the diaphragm assembly pushes the main valve open. As

gas flows through the regulator, downstream pressure will increase and push the diaphragm assembly against the spring load, closing the main valve. The diaphragm and valve are dynamic, and will seek equilibrium so the inlet pressure is reduced and regulated throughout the useful range of gas flow.

When the engine is shut off, gas flow through the regulator ceases. The regulator's main valve is pulled closed by the diaphragm assembly and downstream pressure will be trapped in the low pressure side of the fuel system.

An engine coolant circulation bowl is fitted over the end of the regulator to provide engine heat to the regulator valve and the gas. This heat prevents ice buildup in the regulator, which could reduce performance and regulator life.

INSTALLATION GUIDELINES

1. Plan the installation for the best combination of accessibility, protection from engine exhaust heat, mechanical vibration or impact, and suitable mounting orientation.
SEE SYSTEM IMPERATIVES ON PAGES 3 and 4
2. A suitable lubricant (oil, synthetic grease, etc) should be applied to the o-ring of the fitting, prior to installation, to help the o-ring seat and seal.
Do not use silicon grease – silicon may poison the oxygen sensor in some vehicles. Install the fitting in the applicable gas port.
3. If the regulator is equipped with an optional PRD capture pipe, connect the system fitting to the capture pipe.
NOTE: If the optional ¼" NPT PRD Capture Pipe is used, it must be wrench supported during connection.
4. Attach regulator securely to vehicle, using two M8 x 1.25 mounting bolts (not included).
5. Connect the inlet, outlet, and coolant connections. Assure any entrapped air in regulator is fully purged from coolant bowl. If applicable, connect the PRD and transducer.
6. Pressurize the system and perform a leak test of gas connections with liquid leak detection solution or soapy water.

SYSTEM IMPERATIVES

Imperatives are those conditions, when violated, can cause regulator or system failure and an increased risk of gas release. The following imperatives are listed with potential risks to assist the fuel system integrator with system design failure modes and effects analysis.

1. Upstream Coalescing Filter

Although the regulator is equipped with an internal filter, a suitable coalescing filter must be installed immediately upstream of the regulator. This filter should be sized for suitable flow and condensate capacity. The purpose of this filter is to prevent excessive moisture and compressor oil or particulate contaminants from entering the regulator and flowing downstream to the fuel management system.

A one (1) micron filter will sufficiently protect the regulator from particulate contamination damage.

This filter must be located as close to the regulator as possible to prevent any particulate in the connection between the filter and regulator from accelerating upon system pressurization, and piercing the regulator's internal filter.

2. Upstream Lockoff (solenoid) Valve

A normally closed solenoid valve must be installed upstream of the regulator. This is a safety requirement to prevent gas from freely flowing during vehicle shutdown. Although the regulator is capable of bubble tight shutoff, the upstream lockoff valve is the correct safety device for this function.

3. Sealants

Sealants are not required for the SAE o-ring boss connections. The use of sealants as a fitting leakage preventive measure can contaminate the internal passages and valve in the regulator and cause a malfunction. *Sealant use in these connections will void the factory warranty.*

4. Inlet / Outlet Lines

To prevent excessive pressure drop at flow, the inlet and outlet fuel lines should be of suitable size. The regulator has been designed for SAE o-ring boss fittings which correspond to 3/8 inch OD tubing (SAE-6) for the inlet, and 1/2 inch OD tubing (SAE-8) for the outlet. These are the recommended line sizes. Excessively large line or fitting diameters may induce instability of the delivery pressure. The minimum bore of the fittings must be a minimum of 0.27 inch (6.8 mm) for the SAE-6 inlet fitting and 0.37 inch (9.4 mm) for the SAE-8 outlet fitting. Fittings may be of type SAE J1926/2 or SAE J1926/3.

Tubing must be clean and free of burrs, which could contaminate the regulator or system. The outlet line

should not be run upward from the regulator outlet port, due to the potential for excessive oil and condensate collection. A level or downward run is preferred to prevent collection.

5. Downstream Relief Valve

Although the regulator is equipped with a pressure relief device (PRD), a high flow relief valve or other protective strategy must be installed between the regulator outlet and the remainder of the fuel system. The regulator PRD is not a high flow device and may not protect the regulator or fuel system in case of sudden failure.

6. Engine Coolant

The expansion of high pressure gas to low pressure creates a significant temperature drop. To prevent moisture from freezing inside the regulator and creating a blockage, heated engine coolant must be circulated within the regulator. The regulator is equipped with a coolant bowl for this purpose.

Engine coolant must be maintained for at least -40 degree antifreeze protection. If the coolant were to freeze in the regulator, for any reason, the coolant containment integrity may be compromised.

Suggested minimum flow: Engine idle 1-2 lpm, Moderate power 3-6 lpm, depending on engine size.

7. Excessive Temperature

The regulator is designed for safe and reliable operation within a temperature range of -40 to 250 °F. Temperatures beyond 275 °F can cause permanent damage to internal seals and must be avoided. If the regulator is located in an area with the potential for high temperature (such as radiated energy from exhaust system components, etc), suitable heat shields must be employed.

8. Fitting Torque

The correct assembly torque for the inlet (SAE-6) fitting is 27 ft-lb.

The correct assembly torque for the outlet (SAE-8) fitting is 42 ft-lb.

The correct assembly torque for the optional transducer port is 8 ft-lb.

Inadequate torque could allow the fitting to loosen in service and leak. Excessive torque could weaken or shear the threads in the inlet and / or outlet port of the regulator.

The inlet and outlet fitting is sealed with an o-ring.

9. Submergence in water

Except for bonnet bias models, the regulator uses an atmospheric reference hole in the bonnet to sense ambient pressure. This hole is "filled" with a porous hydrophobic plastic plug to prevent water intrusion from splashing, wash down, etc. This plug may not prevent water intrusion if the regulator were to be submerged in water. For this reason, the regulator should not be mounted low in a vehicle which would have to cross flooded roads, etc.

10. Chemicals in Fuel

Any cleaners or abnormal additives, drying agents, etc in the fuel could cause damage to the regulator's internal seals. The regulator is tolerant to substances that occur in compressed natural gas, including compressor oils, however ITT Conoflow should be contacted regarding other materials.

11. Rapid or Frequent Fuel System Decompression

CNG Fuel systems should not be rapidly or frequently decompressed of gas. Doing so will cause high pressure gas absorbed in non metallic materials to attempt to escape those materials, increasing the speed of component degradation.

12. Salt and/or Dirt Buildup

Excessive road salt and/or road dirt buildup will accelerate moisture attack and subsequent corrosion of the regulator at the solenoid and/or gas connections. Accelerated corrosion leads to premature external gas leakage failure.

The regulator must be installed in a manner which provides reasonable protection from road salt and debris accumulation, to reduce the risks of accelerated corrosion.

13. Pressure Adjustment

This pressure regulator is factory calibrated and tested. Removing the tamper evident cover from the adjustment will void the warranty.

14. Fuel System Validation

This fuel pressure regulator will dynamically respond to the CNG fuel system. In new applications it is the responsibility of the customer to validate the performance of the fuel system with this regulator. ITT cannot be responsible for the suitability of this fuel pressure regulator in every application.

15. Fuel Type / Quality

This fuel pressure regulator is designed and qualified for CNG fuel. RNG (Renewable Natural Gas) is acceptable, provided it meets the quality guidelines of the American Biogas Council (ABC) for CNG fuel. This fuel pressure regulator is not for use with raw biogas.

As part of your fuel system and vehicle protection review, ITT recommends the incorporation of a system warning label that clearly advises maintenance technicians to 1) NOT DISABLE any automatic upstream isolation valves and to 2) CLOSE upstream isolation valves, whenever feasible during servicing.

WARNING: Bleed system pressure prior to servicing or removal of the pressure regulator from the fuel system.

CAUTION: Stored spring compression within the regulator can be unexpectedly released if the regulator is disassembled incorrectly

TROUBLESHOOTING:

1. The regulator "pops" when I turn on ignition key and activate tank solenoid valve(s).

This is caused by downstream leakage, or intentional fuel system decompression. If the downstream pressure bleeds down, the inrush of high pressure CNG can cause the regulator outlet pressure to overshoot the PRD opening pressure and discharge excessive pressure from the line. Correct / repair any downstream leakage to prevent system depressurization when the vehicle is not operating.

2. After driving the vehicle, I see frost on the exterior of the regulator and outlet fuel line.

This is quite common for driving cycles where there is a significant amount of gas flow. Although the regulator is heated with engine coolant, this heat is used to protect the valve, and is not sufficient to heat the fuel completely. As the fuel flows to the engine, it will pick up heat from the fuel line. Some heavy duty applications may require a downstream heat exchanger.

3. When leak testing the system, our gas detector shows leakage from the white plug on the regulator.

A very slight amount of gas permeates from the regulator, and this is normal. A gas detector can show leakage "false alarms", as this instrument is very sensitive. Conoflow recommends using commercially available leak detection solution, or soapy water, to leak test the system.

In rare instances, the regulator's resonant frequency (typically around 380 Hz) will match the fuel system's resonant frequency. Simply changing the length of the outlet line will usually solve this issue.

MAINTENANCE

4. Loud noises are coming from the regulator.

Noisy operation can be caused by a number of system related issues. If incorrect fittings or line sizes are used (small bore fittings, tubing too small), the regulator may be starved for pressure and overshoot the steady equilibrium it is trying to achieve. This will cause internal oscillation which can create noises ranging from a buzzing sound to a rapid internal knocking sound.

Properly designed and maintained fuel systems will increase the reliability and life of this pressure regulator.

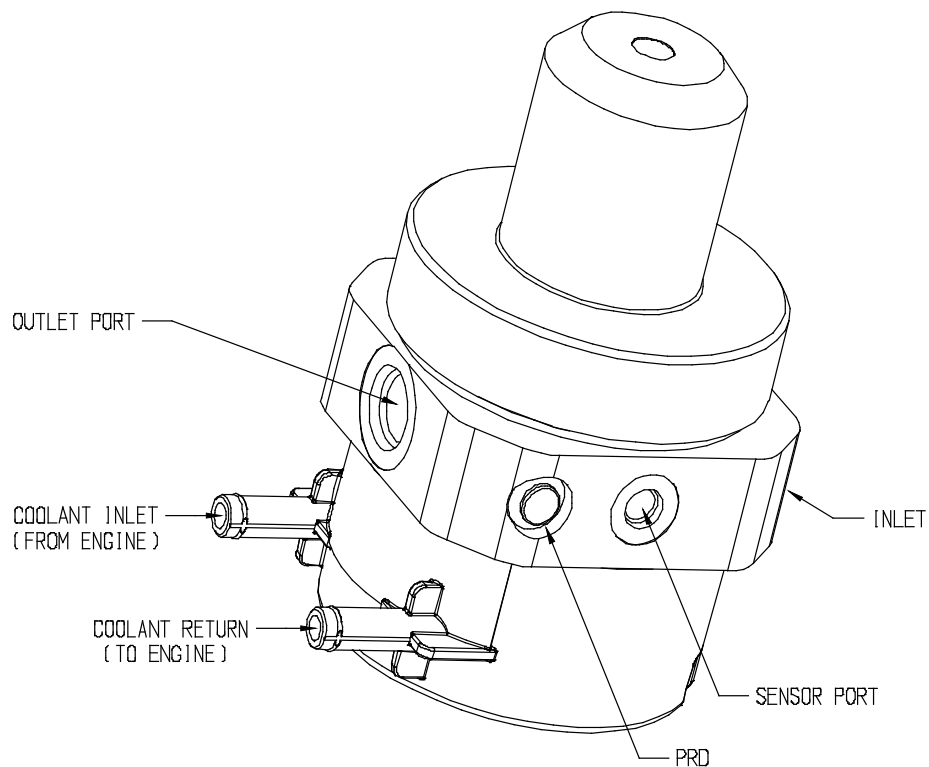
1. Follow vehicle guidelines for fuel system filter maintenance and engine coolant maintenance.
2. Keep the exterior of the regulator clean to reduce buildup. Dirt or salt buildup can attract moisture and accelerate corrosion. Protective sprays may be used in areas where dissimilar metals (gas connections, etc) meet.
3. Schedule leak testing to verify regulator gas containment. Leakage is the result of wear and aging; it is the inevitable failure mode of the pressure regulator.

Regulator Model Breakdown (CED Code)

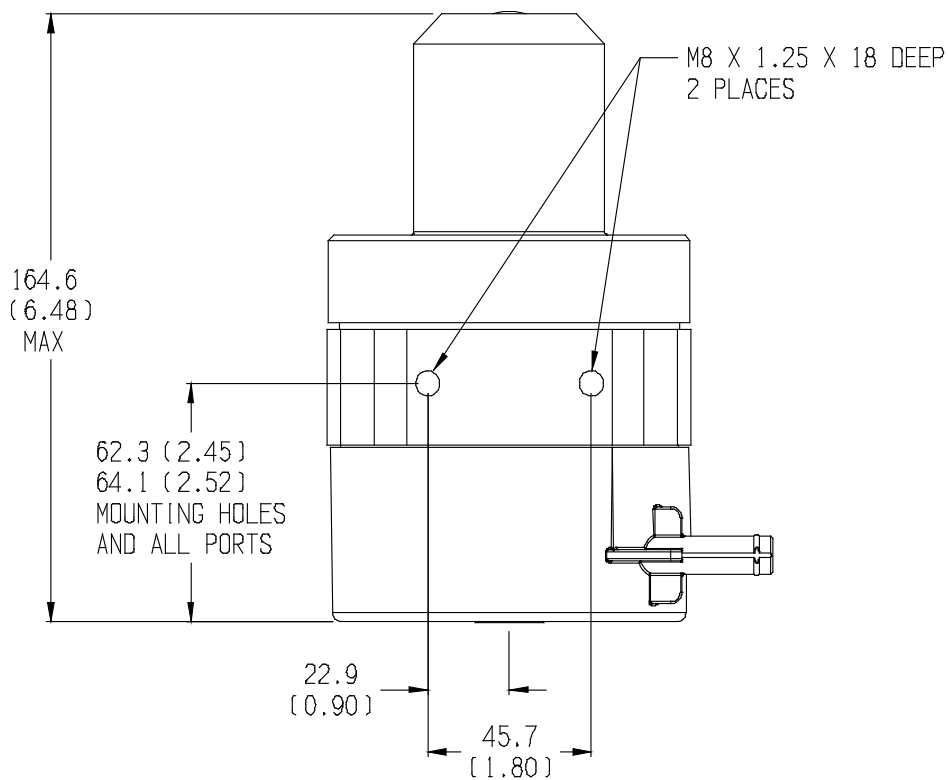
1 through 6	HPNGV2	Regulator Base Model
7	S	Standard Bonnet
	C	3/16" Straight Hose Barb Connection on Bonnet
	E	1/4" Tube Elbow (for Poly Tubing) Connection on Bonnet
8	X	No Sensor Port
	3	SAE-3 Sensor Port
	4	SAE-4 Sensor Port
	W	Sensor (Installed) 0.25 to 4.75 Volt Output
	Y	Sensor (Installed) 0.50 to 4.50 Volt Output
9	T	Integral Coolant Hose Connections
	H	Brass Coolant Hose Connections
10	A	200 psi (+/- 40) PRD Setting
	B	270 psi (+/- 60) PRD Setting
	C	350 psi (+/- 60) PRD Setting
11	X	PRD Discharges to atmosphere
	P	1/4" Male NPT PRD Capture Pipe
	T	1/2" Tube Stub PRD Capture Pipe
12 through 14	XXX	Output Pressure Setting (PSI)

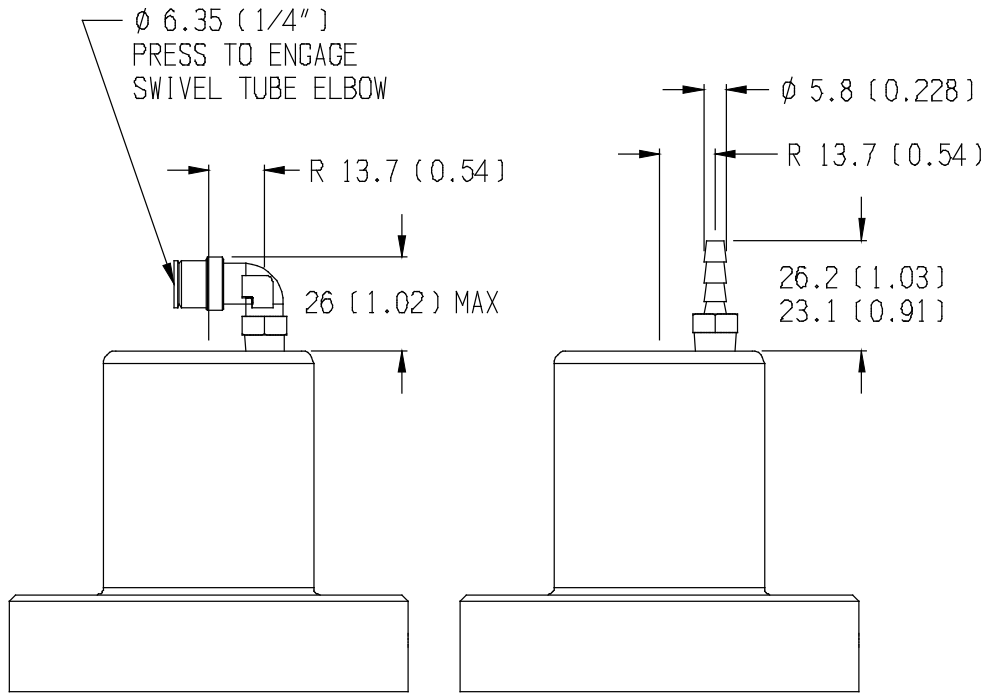
CAUTION: Regulator is factory preset. Changing the pressure setting can cause unexpected and/or potentially hazardous operation. Removal of the tamperproof cover will void the warranty.

CONNECTION IDENTIFICATION AND TYPICAL GEOMETRY
HPNGV2S3T_X___ CONFIGURATION SHOWN – DIMENSIONS IN MILLIMETER (INCH)



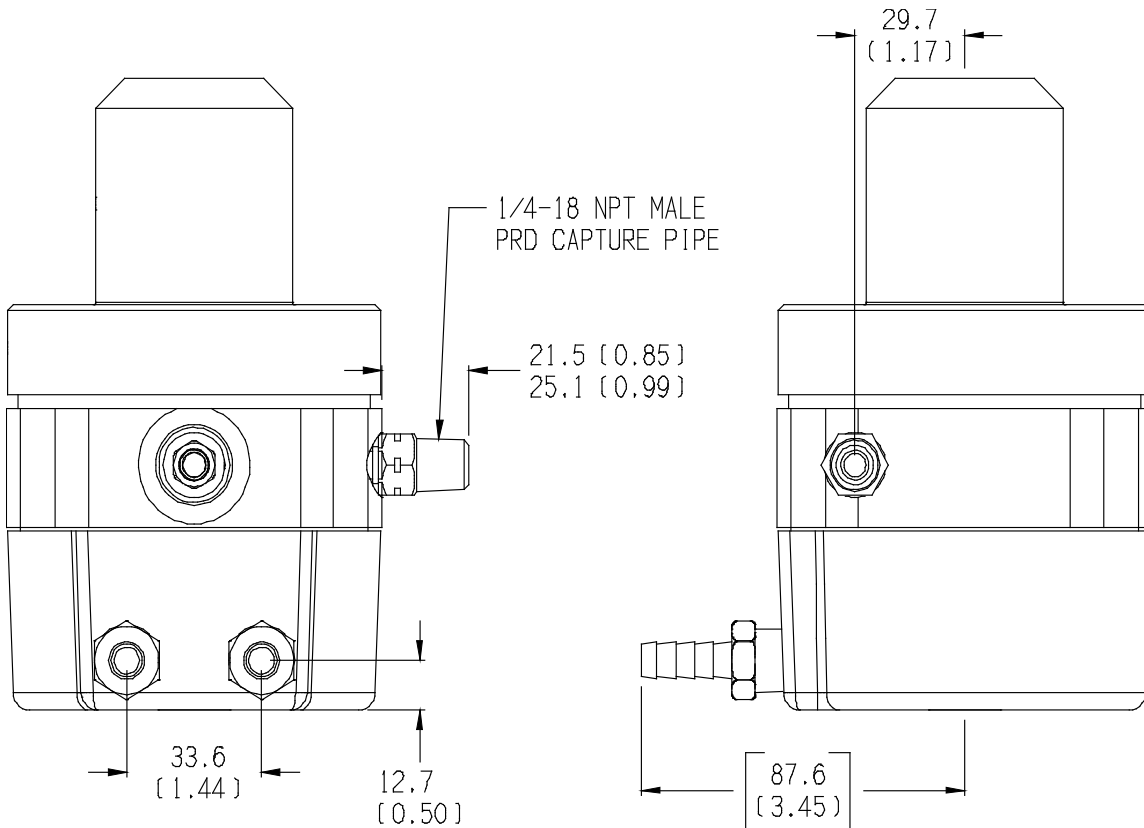
Interface Views – Options





REGULATOR BONNET
OPTION "E" (1/4" TUBE ELBOW)

REGULATOR BONNET
OPTION "C" (3/16" HOSE BARB)



COOLANT BOWL / PRD DIMENSIONS
(SHOWN WITH COOLANT BOWL OPTION "H"
AND PRD CAPTURE PIPE OPTION "N")

ELECTRICAL INTERFACE DATA

OEM pressure sensor electrical mating connector part numbers:

Housing: Delphi 12065287 (with included weather seal)

Contacts: Delphi 12110236

Suggested wire gauge: 18 gauge

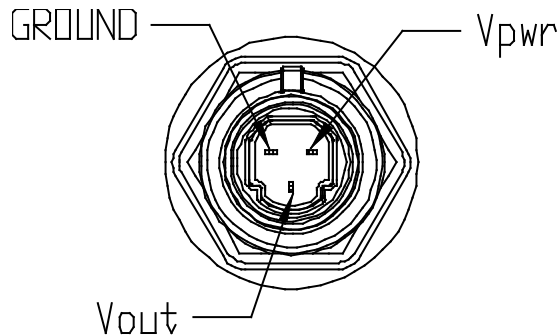
WARNING: Circuit protection with a 1A maximum current is required for sensor power lead wiring.

The components above may be substituted for functional equivalents. Other contacts and seals are available for alternative wire sizes. Consult OEM connector supplier data.

When selecting alternatives, the following guidelines must be considered:

- Mating terminals must be tin-plated. Gold-plated connectors may cause galvanic corrosion of the connection interface and ultimately prevent the pressure sensor from operating.
- Weather seals must be used between the connector bodies, and at the cable ports.

Sensor polarity / pin connection diagram:



$V_{pwr} = 5.0 \pm 0.25 \text{ VDC}$

V_{out} = Ratiometric output (product dependent)

Ground = Common ground