Customer Product Specification

Product Name:	**EPR – D28, C1D2**
Product Description:	**DIRECT-ACTING ELECTRONIC PRESSURE REGULATOR (MODEL 28), CLASS 1 DIVISION 2**
Product Part Number(s):	**E2325331** **E2325332** **E2325333** **E2325334**
Related Drawing(s):	**E2325339_00**
Product Specification:	**PS000812_00**

CHANGE RECORD

REV	ORIG	APPR. 1	APPR. 2	APPR. 3	SEC.	DESCRIPTION	DATE
A	B. PEARSON	P. CHASE	G. BRITTON	A. GONZALEZ	All	INITIAL RELEASE	2024.07.19

CONTENTS

1 SAFETY AND WARNINGS

WARNING / AVERTISSEMENT

BEFORE BEGINNING INSTALLATION OF THIS ECONTROLS PRODUCT:

- **Read and follow all installation instructions.**
- **Please contact Enovation Controls immediately if you have any questions.**
- **A visual inspection of this product for damage during shipping is recommended before installation.**
- **It is your responsibility to ensure that qualified mechanical and electrical technicians install this product.**

AVANT DE COMMENCER L'INSTALLATION DE CE PRODUIT ECONTROLS :

- **Lisez et suivez toutes les instructions d'installation.**
- **Veuillez contacter Enovation Controls immédiatement si vous avez des questions.**
- **Une inspection visuelle de ce produit pour des dommages pendant l'expédition est recommandée avant l'installation.**
- **Il est de votre responsabilité de vous assurer que des techniciens mécaniques et électriques qualifiés installent ce produit.**

WARNING / AVERTISSEMENT

EXPLOSION HAZARD – DO NOT DISCONNECT EQUIPMENT UNLESS POWER HAS BEEN SWITCHED OFF OR THE AREA IS KNOWN TO BE NON-HAZARDOUS.

RISQUE D'EXPLOSION - NE PAS DÉBRANCHER L'ÉQUIPEMENT À MOINS QUE L'ÉLECTRICITÉ N'AIT ÉTÉ COUPÉE OU QUE LA ZONE SOIT NON DANGEREUSE.

WARNING / AVERTISSEMENT

A NORMALLY CLOSED ELECTRICALLY CONTROLLED FUEL LOCK-OFF SOLENOID VALVE IS REQUIRED UPSTREAM OF THE EPR. THE EPR IS NOT A BUBBLE-TIGHT FUEL SHUT-OFF SAFETY DEVICE.

UNE ÉLECTROVANNE DE VERROUILLAGE DE CARBURANT À COMMANDE ÉLECTRIQUE NORMALEMENT FERMÉE EST NÉCESSAIRE EN AMONT DE L'EPR. L'EPR N'EST PAS UN DISPOSITIF DE SÉCURITÉ À COUPURE DE CARBURANT ÉTANCHE AUX BULLES.

WARNING / AVERTISSEMENT

NO ARTIFICIAL PRESSURIZATION OF ANY PORTS (OTHER THAN FUEL INLET) IS PERMISSIBLE.

AUCUNE PRESSURISATION ARTIFICIELLE DES PORTS (AUTRE QUE L'ENTRÉE DE CARBURANT) N'EST AUTORISÉE.

CAUTION:

THIS EQUIPMENT IS SUITABLE FOR USE IN CLASS I, DIVISION II, GROUPS B, C AND D HAZARDOUS LOCATIONS OR NON-HAZARDOUS LOCATIONS ONLY.

CET ÉQUIPEMENT CONVIENT UNIQUEMENT À UNE UTILISATION DANS DES EMPLACEMENTS DANGEREUX DE CLASSE I, DIVISION II, GROUPES B, C ET D, OU DES EMPLACEMENTS NON-DANGEREUX

CAUTION:

WIRING TO OR FROM THIS DEVICE, WHICH ENTERS OR LEAVES THE SYSTEM ENCLOSURE, MUST UTILIZE WIRING METHODS SUITABLE FOR CLASS I, DIVISION 2 HAZARDOUS LOCATIONS, AS APPROPRIATE FOR THE INSTALLATION.

LE CÂBLAGE VERS OU DEPUIS CET APPAREIL, QUI ENTRE OU SORT DE L'ENCEINTE DU SYSTÈME, DOIT UTILISER DES MÉTHODES DE CÂBLAGE APPROPRIÉES POUR LES EMPLACEMENTS DANGEREUX DE CLASSE I, DIVISION 2, SELON L'INSTALLATION.

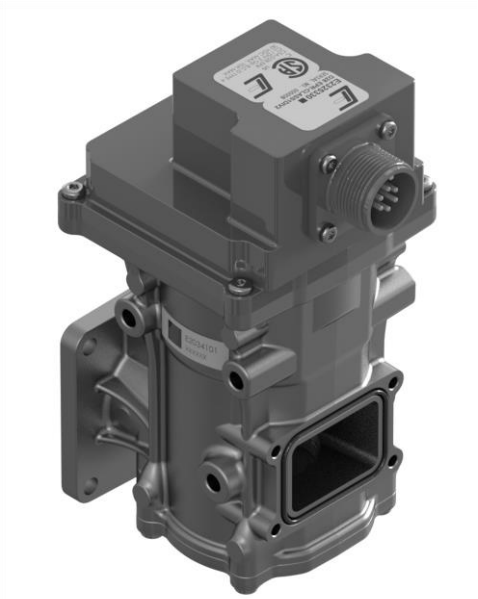
CAUTION:

ALL ELECTRICAL CONNECTIONS SHOULD BE PERFORMED BY QUALIFIED PERSONNEL AND SHOULD MEET ALL FEDERAL, STATE, LOCAL AND END USER ELECTRICAL CODES.

TOUTES LES CONNEXIONS ÉLECTRIQUES DOIVENT ÊTRE EFFECTUÉES PAR DU PERSONNEL QUALIFIÉ ET DOIVENT RESPECTER TOUS LES CODES ÉLECTRIQUES FÉDÉRAUX, D'ÉTAT, LOCAUX ET D'UTILISATEUR FINAL.

2 PRODUCT DESCRIPTIVE INFORMATION

2.1 Overview



The Direct Electronic Pressure Regulator (DEPR) is the primary fuel control device used to maintain both performance and emissions control. The DEPR contains an internal computer, which communicates to the EControls Engine Control Module (ECM) via a high-speed CAN connection.

The DEPR precisely controls the required fuel flow to the mixer to ensure commanded air/fuel mixture to the engine combustion chambers. The DEPR also contains internally mounted fuel pressure and temperature sensors, which provide input across the CAN link to the ECM for fueling calculation. The ECM in turn sends command changes back across the CAN link to the DEPR to adjust fueling.

The DEPR internal computer also maintains certain levels of diagnostics within the system to ensure emissions control.

The DEPR outlet is connected directly to the mixer on all certified engines, while the DEPR inlet connects indirectly to the Dual Stage Regulator (DSR) using an application-specific inlet fitting.

The DEPR utilized on USA emission certified engines is a critical part of the certified emissions system and does not require any periodic adjustment.

NOTE: The DEPR products described in this Product Specification are CSA Class I, Division II certified. Please see EControls documents PS000314_00 and PS000369_00 for non-CSA certified DEPR products.

2.2 Part Numbers

Part Number	Description
E2325331	EPR, D28 – C1D2
E2325332	EPR, D28 – C1D2, PARENT[1]
E2325333	EPR, D28 – C1D2, CHILD[1]
E2325334	EPR, D28 – C1D2, COUSIN[2]

NOTES:

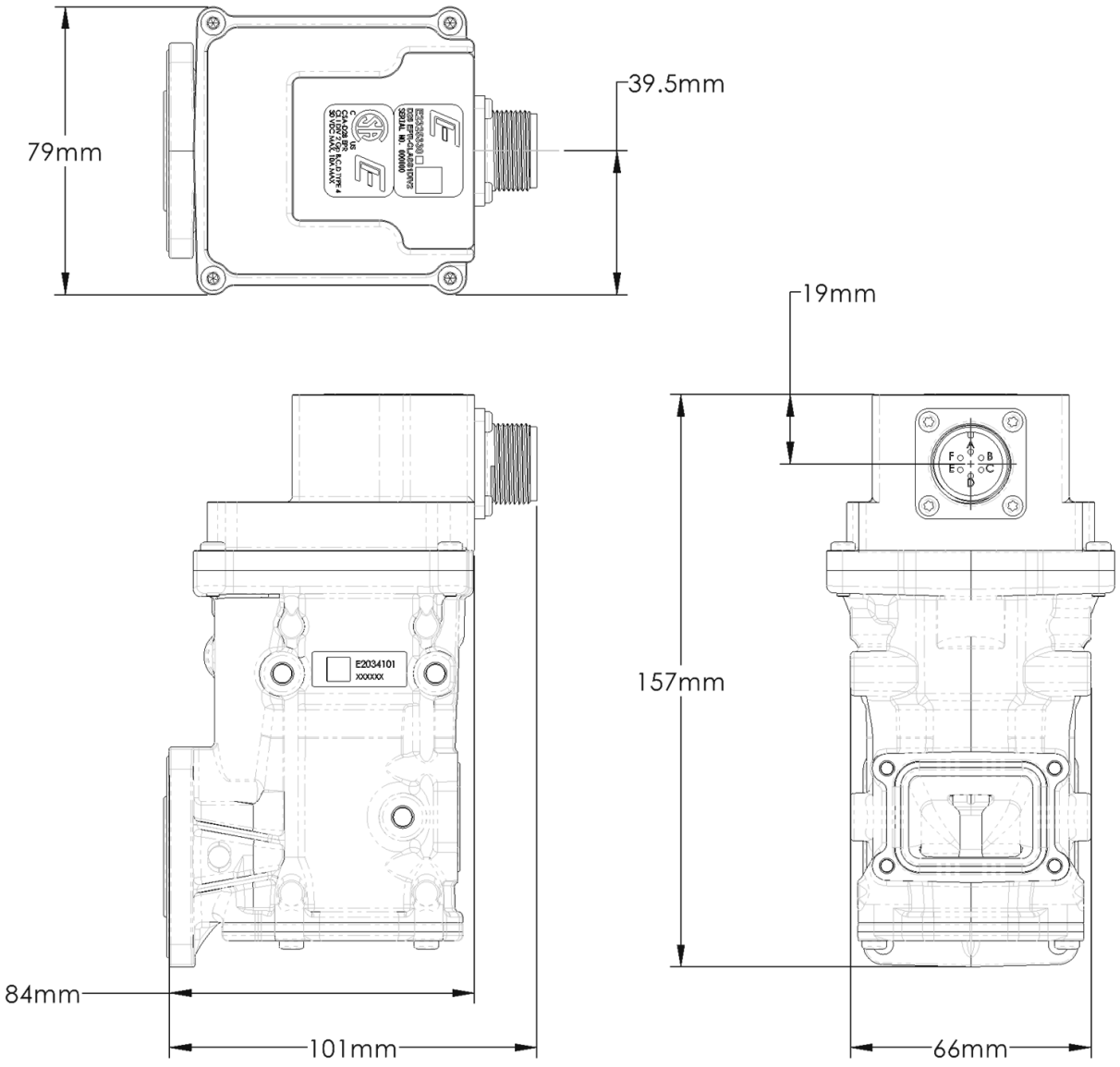
[1] **Parent/Child** – fueling commands sent from the ECM to the Parent unit; Parent unit sends required valve position commands to the Child unit. Typically used in Dual-DEPR applications with a single downstream mixer.

[2] **Cousin** – operates similar to the Standard DEPR, but on a different CAN channel (Channel 19, vs. Channel 18) from the Standard.

3 PRODUCT SPECIFICATIONS

3.1 Product Dimensional Information

Mass (approximate):	1 kilogram



NOTE:
See drawing E2325339_00 for additional dimensional information

3.2 Performance Specifications

Characteristic	Detail
Maximum Differential Pressure:	1 psid
Maximum Working Pressure	30 psig
Outlet Pressure Range:	±17" H_2O minimum
Outlet Pressure Accuracy:	< ±0.15" H_2O total error
Flow Capacity:	≥ 50 ACFM at 10"H_2O delta
Maximum Operating Voltage:	30V
Maximum Operating Current:	10A
Ambient Operating Temperature Range:	-40°C to +100°C (-40°F to +212°F), T4A
Storage Temperature Range:	-40°C to +135°C (-40°F to +275°F)
Response Time:	<5ms (typical); <10ms maximum (full range).
Fuel Requirements:	Compliant with HD-5, HD-10 or NG per SAE J1616
Filter Requirements:	≤ 20 µm (nominal)
Maximum Vibration (Operating):	15G (higher values affect fueling at some frequencies)

3.3 Communication Protocols

DEPR communication based on CAN (SAE J1939) Messages

3.4 Certifications

CLASS 3228-01 VALVES – For Hazardous Locations

CLASS 3228-01 VALVES – For Hazardous Locations – Certified to US Standards

Class I, Division 2, Groups B, C and D T4A

Direct-acting Electronic Pressure Regulator (D-EPR), Model: D28; Enclosure Type: Type 4; Ambient Temperature: -40°C to +100°C; Rated: 30 VDC MAX, 10 A MAX; Continuous Operation; MWP: 30 psig; Maximum Pressure Differential: 1 psid; Vapor Fuel Type: Natural Gas or Propane

Conditions of Acceptability:

1. Wiring to or from this device, which enters or leaves the system enclosure, must utilize wiring methods suitable for Class I, Division 2 hazardous locations, as appropriate for the installation.
2. This device is not evaluated as a safety valve. The fuel -line shutoff valve shall be provided in the end installation.
3. The device is considered a class 2 (extra-low-voltage), general-purpose (non-safety), continuous operation, modulating valve, intended for use with gaseous hazardous fluid.
4. The device is not considered an automotive-fuel valve, as defined by section 3.2 of UL 429. Device is intended for use as a fuel regulator valve for modulating operation, rather than a fuel-line shutoff valve. Device is intended for use on stationary equipment, rather than mobile equipment.

4 PRODUCT VALIDATION

4.1 Third Party Product Validation

Category	Test Limits	Test Standard
Elastomers & Plastics		
Accelerated Aging	Condition for 70 hours at 100°C – No cracking / deterioration allowed	UL Std. SU 1337 Section 19
Gas Compatibility	Condition for 70 hours in n-Hexane at 21°C *– Max. volume change allowed is +25 % to -1% & Max. weight loss of 10%*	UL Std. SU 1337 Section 20
Non-metallic Synthetic Im.	Condition for 70 hours in Natural gas at 21°C and 20 MPa *– Max. volume change allowed is +25 % to -1% and Max. weight loss of 10%.*	ISO 15,500-2 Section 13
Elastomers		
Low Temperature	Condition for 24 hours at -40°C, then bend samples around a ¼"mandrel *– No cracking allowed*	UL Std. SU 1337 Section 21
LPG / CNG Compatibility	Condition for 72 hours in n-Pentane at 21°C *– Max. volume change allowed is +20 %* *– Max. weight loss of 5% after drying for 48 hours at 40°C*	ECE R67 Annex 15 Section 11
Resistance to Dry Heat	Condition for 168 hours at 120°C *– Max. tensile strength change allowed is +25 %* *– Max. change in elongation is -30 % to +10%*	ECE R67 Annex 15 Section 13
Ozone Aging	Condition for 168 hours in Ozone with specimen stressed to +20 % *– No cracking allowed*	ECE R67 Annex 15 Section 14
Oxygen Aging	Condition for 96 hours in oxygen at 70 °C and 2 Mpa *- No cracking allowed*	ISO 15,500-2 Section 11
Component		
Ignition Protection Test	Charge device with combustible mixture of LP gas and ignite; repeat 50 times	UL Std. 1500
Leakage Test	Pressurize to twice rated inlet pressure with outlet plugged for 1 minute	UL Std. SU 1337 Section 13
Endurance	Pressurize inlet (100 psig static) & vary the outlet press for 100,000 cycles *– Conduct Leakage Test before & after Endurance test*	UL Std. SU 1337 Section 14
Vibration	Induce vibration of 3.2 mm amplitude at a frequency of 17 Hz for 200 hours *– Conduct Leakage Test before & after Vibration test*	UL Std. SU 1337 Section 16

4.2 EControls Product Validation

Category	Test Limits	Test Standard
Operating Voltage	6 to 32 V	
Nom. Operating Temp	-40°C to 105°C (Electronics; Fuel Composition Dependent)	SAE J1455 - Section 4.1
Max. Operating Temp	125°C for <10% & <5 min per occurrence	SAE J1455 - Section 4.1
Storage Temp	-40°C to 135°C	SAE J1455 - Section 4.1
Accelerated Durability	100 Million cycles at 40 Hz (full stroke) between -40°C and +125°C	E1874001
Vibration	Sine Wave testing	JDQ Section 6.1.8.1 Level 3
	Random Wave testing	JDQ Section 6.1.8.2 Level 3
	Operating Shock testing	JDQ Section 6.2 Level 2
Shock	30G, 3 cycles	E1875001
Handling Drop	1m Drop onto Concrete Surface	SAE J1455 - Section 4.10.3.1
Salt Spray	36 Hr, 5% Calcium Chloride solution	ASTM B117-73
Water Intrusion	15 min, 4 inches, 1500 psig, 50°C, Harness Connected	SAE J1455 - Section 4.5.3
Radiated Immunity	Tri-Plate (200 V/m 10 kHz to 512 MHz, 100 V/m 512 MHz to 1 GHz)	Ford ES-XW77T-1A278-AB * - RI 110
	Parallel Wire Ignition Noise (30 cm coupling)	Ford ES-XW77T-1A278-AB * - RI 120
	Parallel Wire Misc Noise - Chattering Relay (1 m coupling)	Ford ES-XW77T-1A278-AB * - RI 130
Conducted Immunity	Normal Sinewave (20 Hz to 600 Hz, 0.2 V p-p)	Ford ES-XW77T-1A278-AB * - CI 210-A1
	Normal Sinewave (600 Hz to 10 kHz, 0.5 V - 2.0 V p-p)	Ford ES-XW77T-1A278-AB * - CI 210-A2
	Abnormal Sinewave (100 Hz)	Ford ES-XW77T-1A278-AB * - CI 210-B1
	Abnormal Sinewave (600 Hz to 10 kHz)	Ford ES-XW77T-1A278-AB * - CI 210-B2
	Inductive Switching Transients (-100 V, 2 ms, Rs = 10 Ω)	Ford ES-XW77T-1A278-AB * - CI 220-A
	Inductive Switching Transients (+150 V, 50 µs, Rs = 4Ω)	Ford ES-XW77T-1A278-AB * - CI 220-C
	Inductive Switching Transients (-150 V, 0.1 µs, Rs = 50Ω)	Ford ES-XW77T-1A278-AB * - CI 220-D
	Inductive Switching Transients (+100 V, 0.1 µs, Rs = 50Ω)	Ford ES-XW77T-1A278-AB * - CI 220-E
	Load Dump (Vbat = +64 V, 300 ms & R=0.7Ω Vbat = +30 V, 150 ms)	Ford ES-XW77T-1A278-AB * - CI 240
	Ground Shift Transient (± 5 V, 10 µs, 100 Hz)	Ford ES-XW77T-1A278-AB * - CI 250-A
	Ground Shift Sinewave (0.2 V, 1 kHz to 5 kHz)	Ford ES-XW77T-1A278-AB * - CI 250-B
	Reverse Battery (-32 Vdc for 1 minute)	Ford ES-XW77T-1A278-AB * - CI 270-A
	Overvoltage (36 Vdc for 1 hour)	Ford ES-XW77T-1A278-AB * - CI 270-B
	Jump Start (40 Vdc)	Ford ES-XW77T-1A278-AB * - CI 270-C
	Electrostatic Discharge (C = 150 pF, R = 2 kΩ, ±10 kV)	Ford ES-XW77T-1A278-AB * - CI 280-A

5 PRE-INSTALLATION INFORMATION

5.1 Required / Recommended Accessory Hardware

The following hardware components are required and/or recommended for installation of the D28 EPR C1D2:

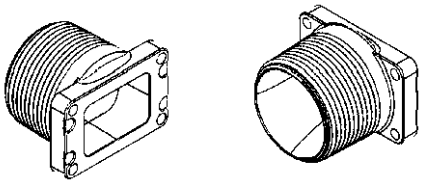
5.1.1 Recommended Fasteners

Function	Fastener Description	Qty	Torque Specifications
D28 EPR-to-Engine	CAPSCREW, M6-1.0[1] FLG SERRATED HEX HD, STEEL, GR8.8, ZINC PLATED	3	2.3 N-m (20 in-lbs)
Inlet Fitting to D28 EPR	CAPSCREW, M4-0.7 X 16MM, SOC HD, GR12.9 ALLOY STEEL, ZINC PLATED	4	3.6 N-m (32 in-lbs)[2]
	WASHER, LOCK, M4, STEEL, ZINC PLATED	4	(N/A)
D28 EPR-to-Mixer	CAPSCREW, M5-0.08 X 14MM, HEX HD, STEEL, GR8.8, ZINC PLATED	4	7.34 N-m (65 in-lbs)[2]

[1] *Length of M6-1.0 to be determined based on application-specific engine mounting requirements.*

[2] *Indicated torque recommendations are reference only. Torque values are calculated to produce bolt preload of 80% of yield strength and are based on a bolt of the class shown, certain assumptions of fit, finish, cleanliness, material & plating, and without lubricants or thread lockers. Final torque specifications vary greatly with these factors and can only be determined with experimentation. Customers are responsible for validating the final specification for their assembly with their fastener hardware. Alternate material classes may be suitable in the application, but torque values must be adjusted accordingly.*

5.1.2 Fuel Inlet Fitting – 1 1/4 " NPT

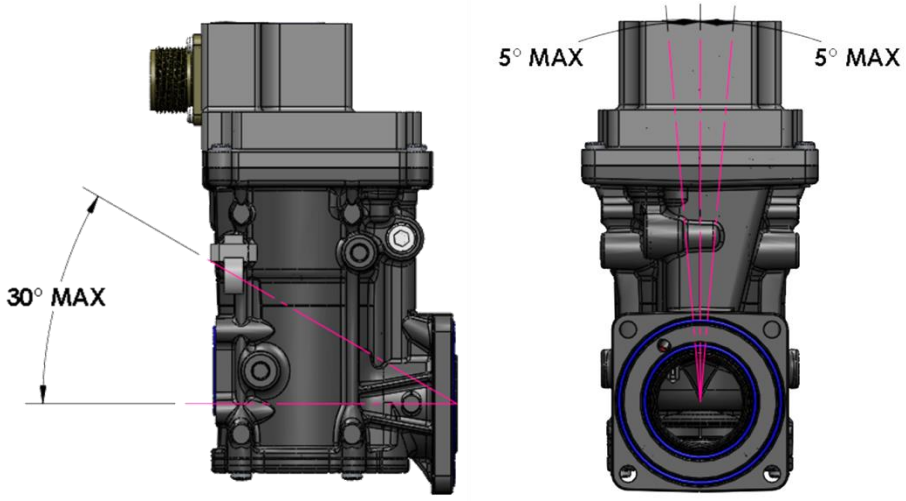
Part Number	E2356402 or similar[1]
Product Description	The fuel inlet fitting is designed to connect the fuel line from the regulator to the D28 EPR inlet flange. The E2356402 fitting is sized for 1 1/4” NPT pipe (other designs as needed by application). A pipe collar or elbow (user-supplied) will be required with this application
Image	

[1](E2356402 shown in this document for reference – Inlet Fitting connection detail may vary based on application)

5.2 Orientation Requirements

IMPORTANT:
For installation instructions in Section 6, observe the mounting orientation requirements shown in the table and figure below:

Orientation Characteristic	Requirements
Horizontal	0° preferred, up to 30° tilt allowed from horizontal in one direction as shown in the figure below.
Vertical	0° preferred, up to 5° tilt allowed in either direction from vertical, as shown in the figure below.
Location	D28 EPR fuel outlet must not be lower than mixer fuel inlet.
Vibration	D28 EPR must be mounted such that vibration levels of the EPR or any equipment directly coupled to the EPR must not exceed maximum vibration specified in Section 3.2.



6 PRODUCT INSTALLATION

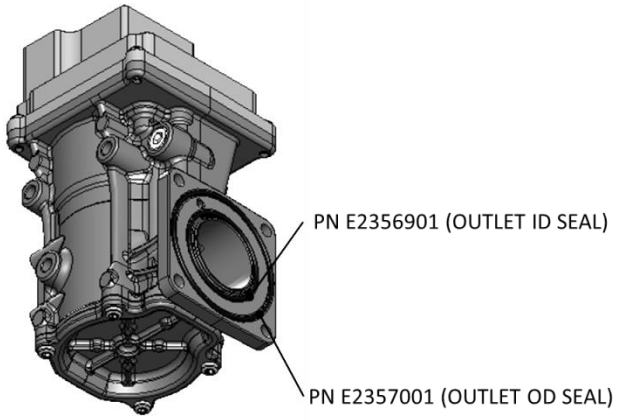
IMPORTANT:
Any deviation to the following requirements must be approved in writing by EControls Engineering in advance or warranty is void.

6.1 Mechanical Installation

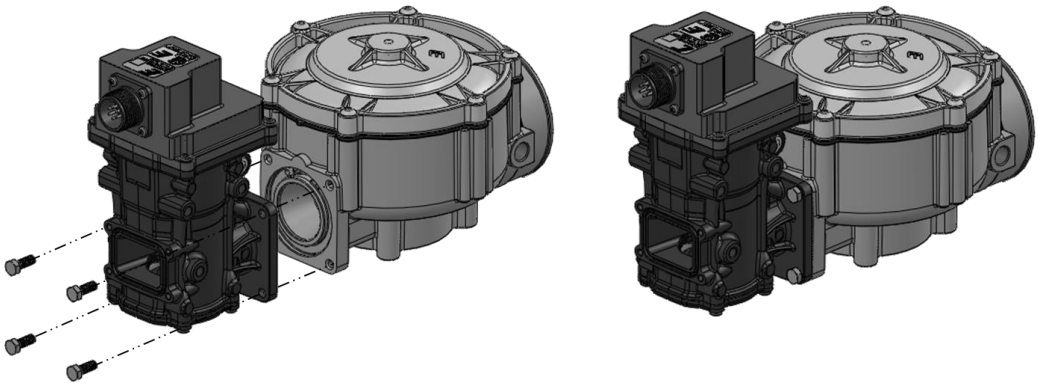
1. Install EControls system component hardware as necessary prior to installation of the D28 EPR, C1D2).

   NOTE: Installation of balance of EControls system components is beyond the scope of this manual.

2. Ensure PN E2356901 (OUTLET ID SEAL) and PN E2357001 (OUTLET OD SEAL) are in place on the D28 EPR before installation.

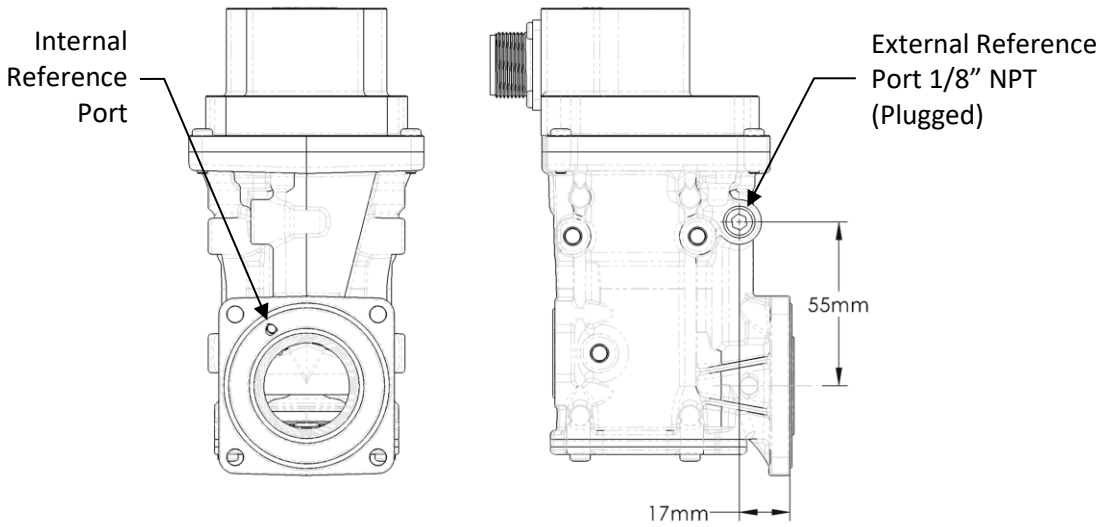


3. Install the D28 EPR to the mixer using the associated fasteners and torque requirement referenced in Section 5.1.1.



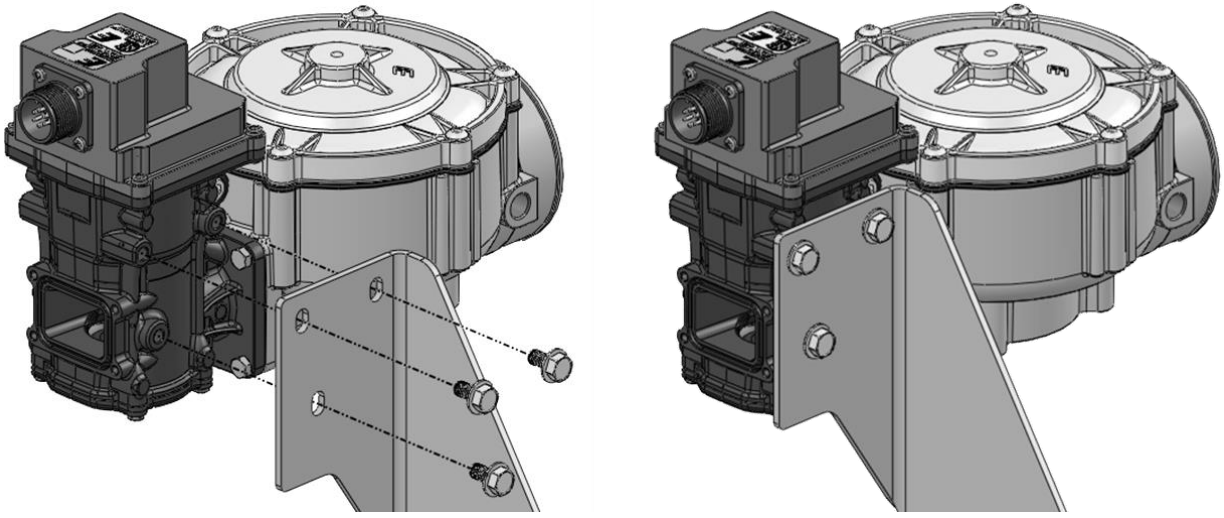
NOTE: Mixer shown is for reference only. Actual mixer as well as any mixer-to-D28 EPR interface components may vary based on application.

4. Reference pressure is communicated to the EPR from an EControls mixer through the internal reference port. In the case where an EControls mixer is not utilized, the reference pressure must be plumbed through the external reference port and the internal reference port must be blocked off.



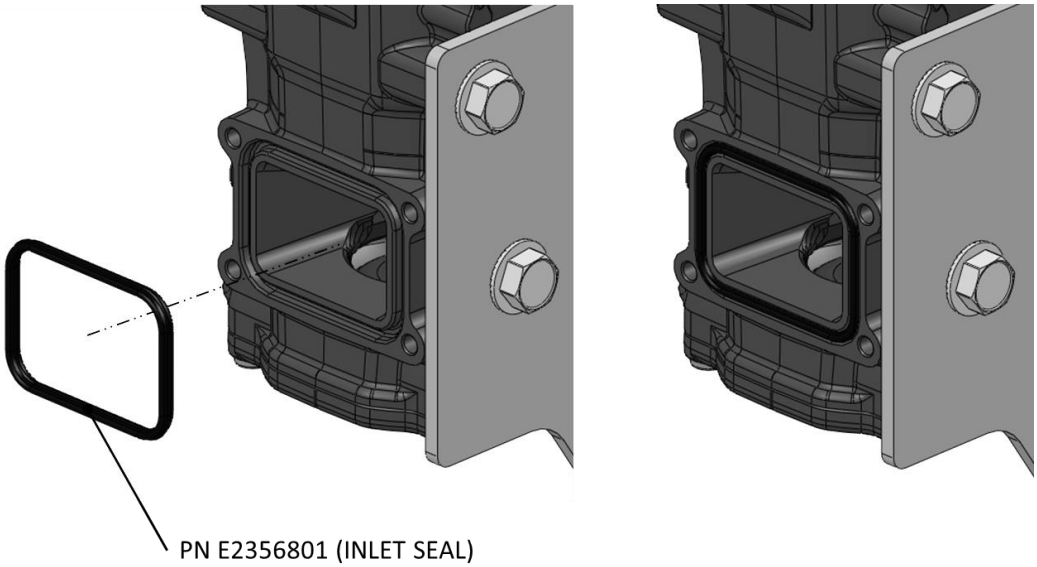
5. Using the associated fasteners and torque requirement referenced in Section 5.1.1, mount the D28 EPR to the support bracket as required by application.

IMPORTANT:
When mounting the D28 EPR, it is recommended that two to four of the six available M6 mounting points (3 per side) be utilized.

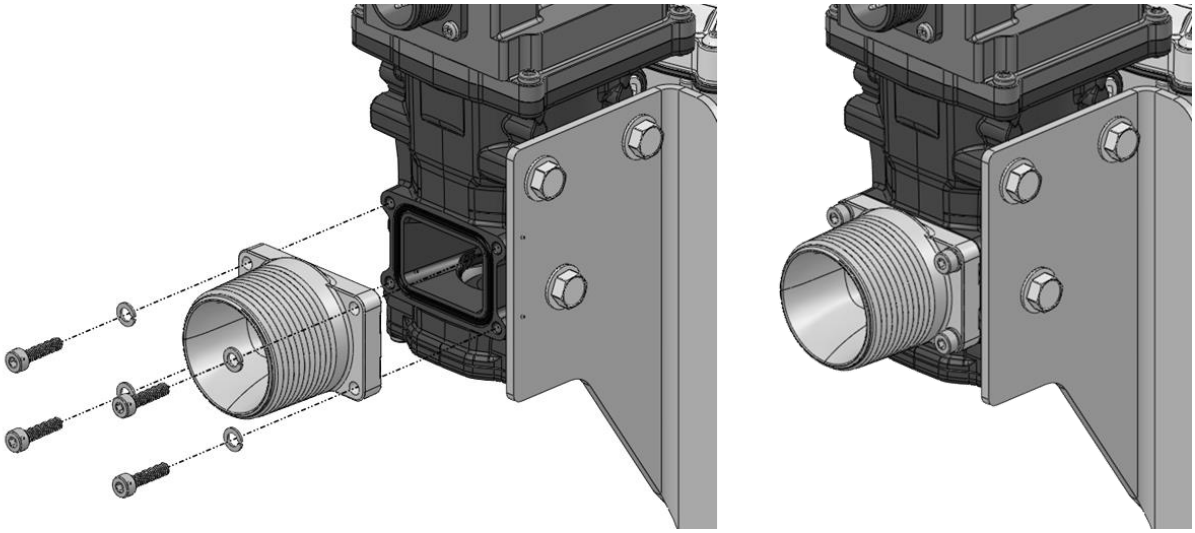


NOTE: Example bracket shown for installation reference only. Actual bracket configuration dependent on application requirements.

6. Ensure PN E2356801 (INLET SEAL) is installed on the D28 EPR as shown.



7. Attach Inlet Fitting to the D28 EPR using the associated fasteners and torque requirement referenced in Section 5.1.1.

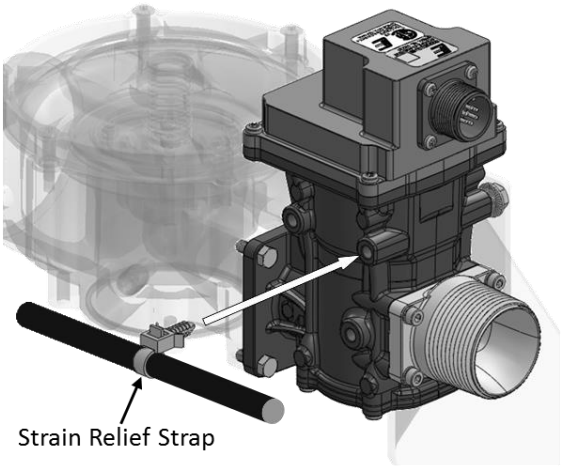


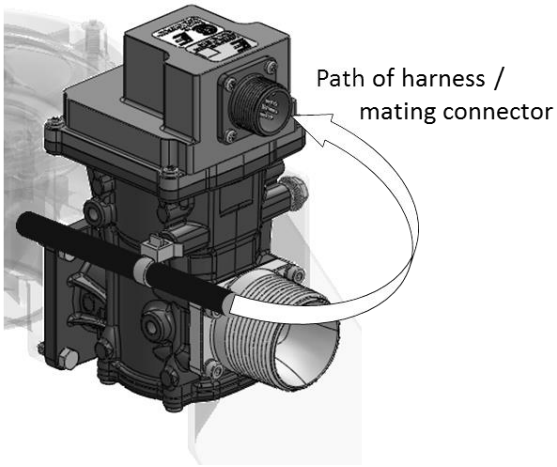
IMPORTANT:
If possible, attach plumbing fitting(s) and/or connective hose to Inlet Fitting prior to installation to D28 EPR body.

NOTE: The piping/plumbing to the D28 EPR should include some flexibility, and short hose is recommended.

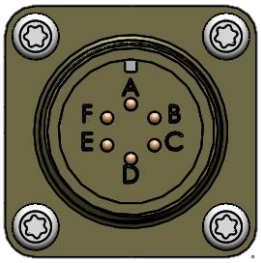
8. Connect wiring harness terminating in mating connector to D28 EPR integrated connector. Ensure threaded mating connection is hand tight.

9. A strain-relief strap (see Section 5.1.1) is not provided with the D28 EPR but is required for use in strain-relieving the harness. Affix cable tie strap to mating connector/harness, then install barbed 'fir tree' end of the strap to unused Ø6mm threaded boss on D28 EPR to prevent stress on wire ends into the connector.





6.2 Electrical Installation

Mating Connector Manufacturer:	AMP
Mating Connector Part Number:	MS3106E14S-6S
Pinout (Device View): 	(A) CAN TERM (B) CAN+ (C) VRELAY (D) GND (E) CAN- (F) VBAT
Connector Wire Gauge:	18 AWG

7 SERVICE

7.1 Service Requirements

1) No service (draining) of the D28 EPR is required if installed as specified and with the use of standard fuels. High heavy-end fuels may require periodic service (i.e., draining).
2) If not installed and located as specified, D28 EPR inlet draining is required, and the recommended service interval should be less than 150 hours.
3) Other than outlet and inlet face seal replacement (see Section 7.2), D28 EPR is not field serviceable. Warranty is void if EPR is disassembled without written authorization from EControls Engineering.

WARNING:

NO ARTIFICIAL PRESSURIZATION OF ANY PORTS (OTHER THAN FUEL INLET) IS PERMISSIBLE.

7.2 Recommended Maintenance Schedule

Item	Recommended Maintenance	Frequency
D28 EPR	Inspect for debris build- up and clean.	Yearly
Mounting Bracket	Check mounting bracket and fasteners and re-tighten if needed.	Yearly

7.3 Service Components