HEAVY-DUTY COMPRESSED NATURAL GAS FUEL RAIL

Design Objective

Design a compressed natural gas (CNG) fuel rail to accommodate two different injector sizes used by Innovative Fuel Systems (IFS). The fuel rail will be designed to supply CNG of equal pressure to each injector.

Client Specifications

- Fuel rail should cost less than $1,500
- Consist of fewer fittings than the current prototype
- Should have less than 1.8ms delay time
- Should be able to transport 300 psig of fuel at 80°C
- Should comply with Natural Gas Vehicle (NGV) standards
- Should be compatible with 550 HP I6 MX-13 Paccar Engine

Product Specification

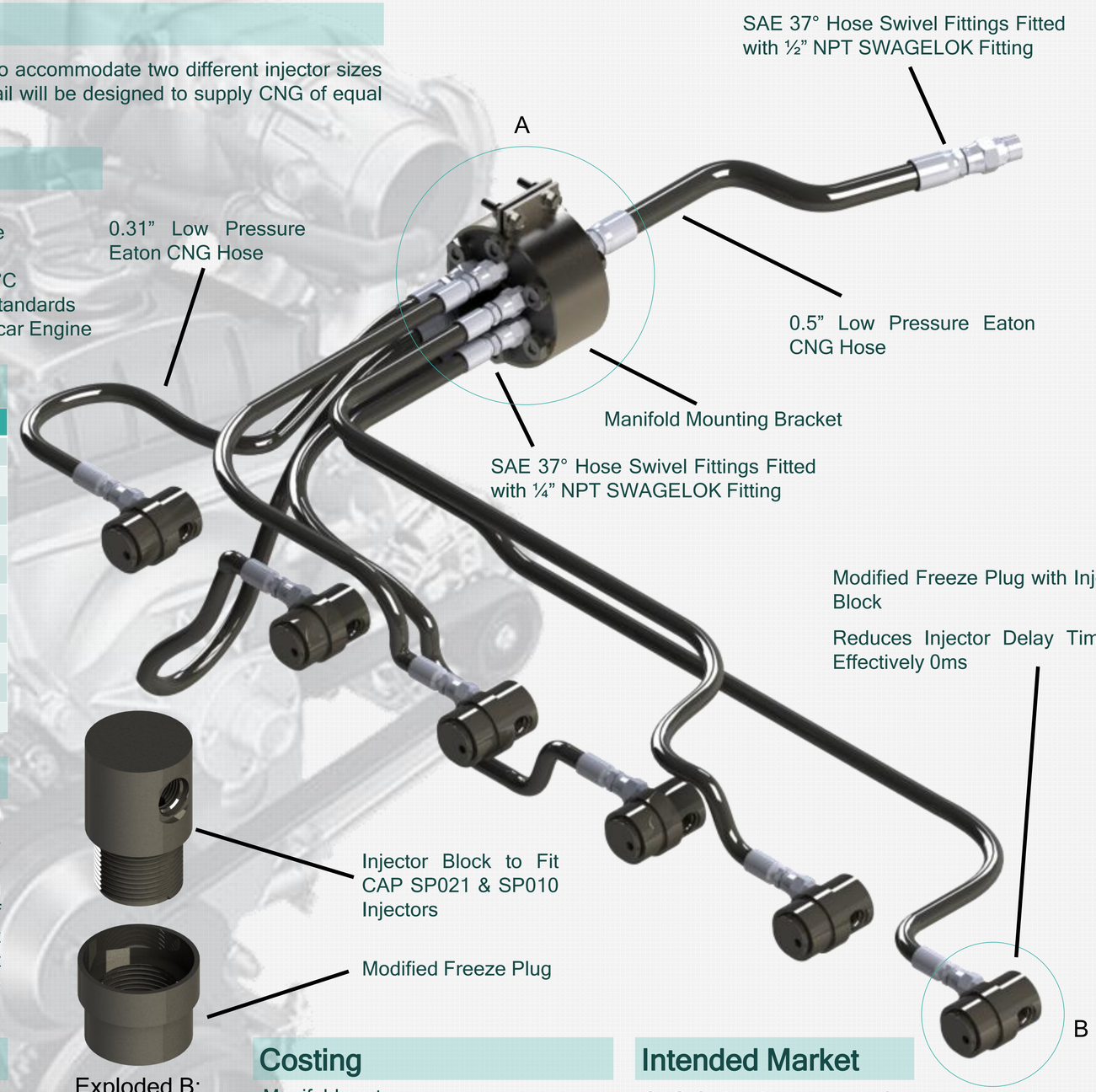
Specification	Value
Inner diameter	2.50”
Outer diameter	4.00”
Length	2.00”
Inlet diameter	0.50”
Outlet diameter	0.25”
Total pressure drop	0.57 psi
Yielding safety factor based on pressure-vessel stress	17.60
Fatigue safety factor based on pressure-vessel stress	20.10
Yielding safety factor based on thermal stress	3.00
Yielding safety factor based on shear flow stress	2.70

The Manifold Design

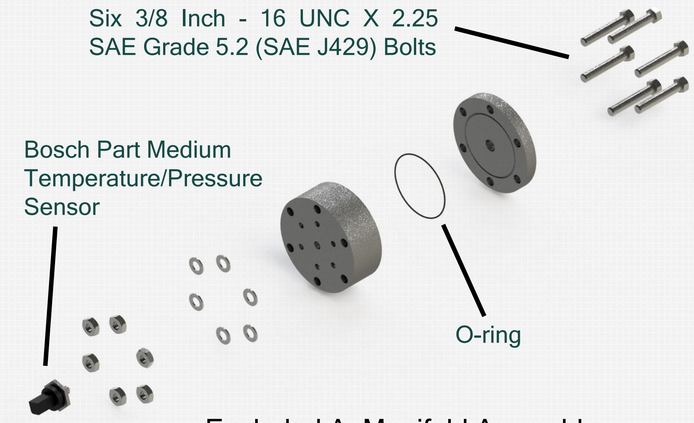
The main CNG supply line feeds into the manifold which delivers the fuel to the six injectors. This unique design allows equal pressure and mass flow distribution allowing a very stable and strong design. The small form factor plus the use of flexible hosing allows for easy and convenient installation. This also creates an adaptable product for any heavy-duty vehicle with dual fuel engine systems.

The Injector Assembly

The design repurposes the function of the freeze plug to supply CNG to the engine cylinder(s). This effectively reduces injection time delay to 0ms, ensuring all injectors can be calibrated easily.



Exploded B: Injector Assembly



Exploded A: Manifold Assembly

Costing

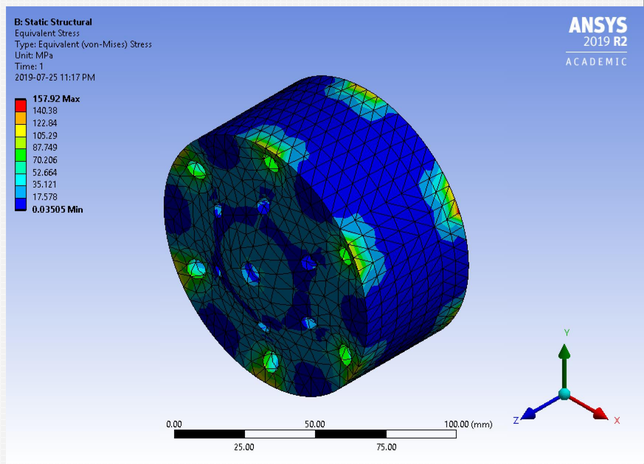
Manifold costs:
- Fuel rail material cost: $60
- Fuel rail manufacturing cost: $880

Other costs:
- Outsourced fittings cost: $840
- Outsourced hoses cost: $300

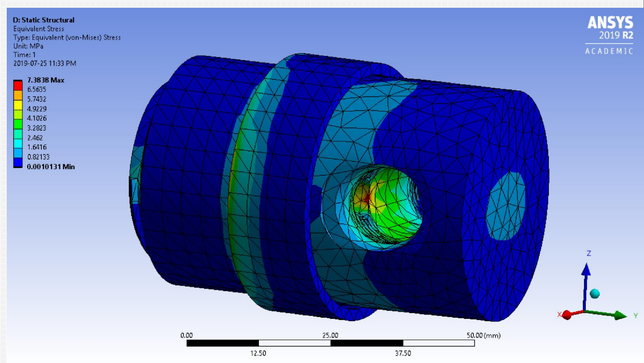
Intended Market

CNG fuel rail is intended for use in dual fuel heavy-duty engines specifically for semi-trucks.

Critical Analysis



Manifold Equivalent Stress Analysis



Injector Assembly Equivalent Stress Analysis

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