



ITT Industries

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The Natural Gas Vehicle Fuel Pressure Regulator

By: Jeff Gotthelf, Engineering Manager

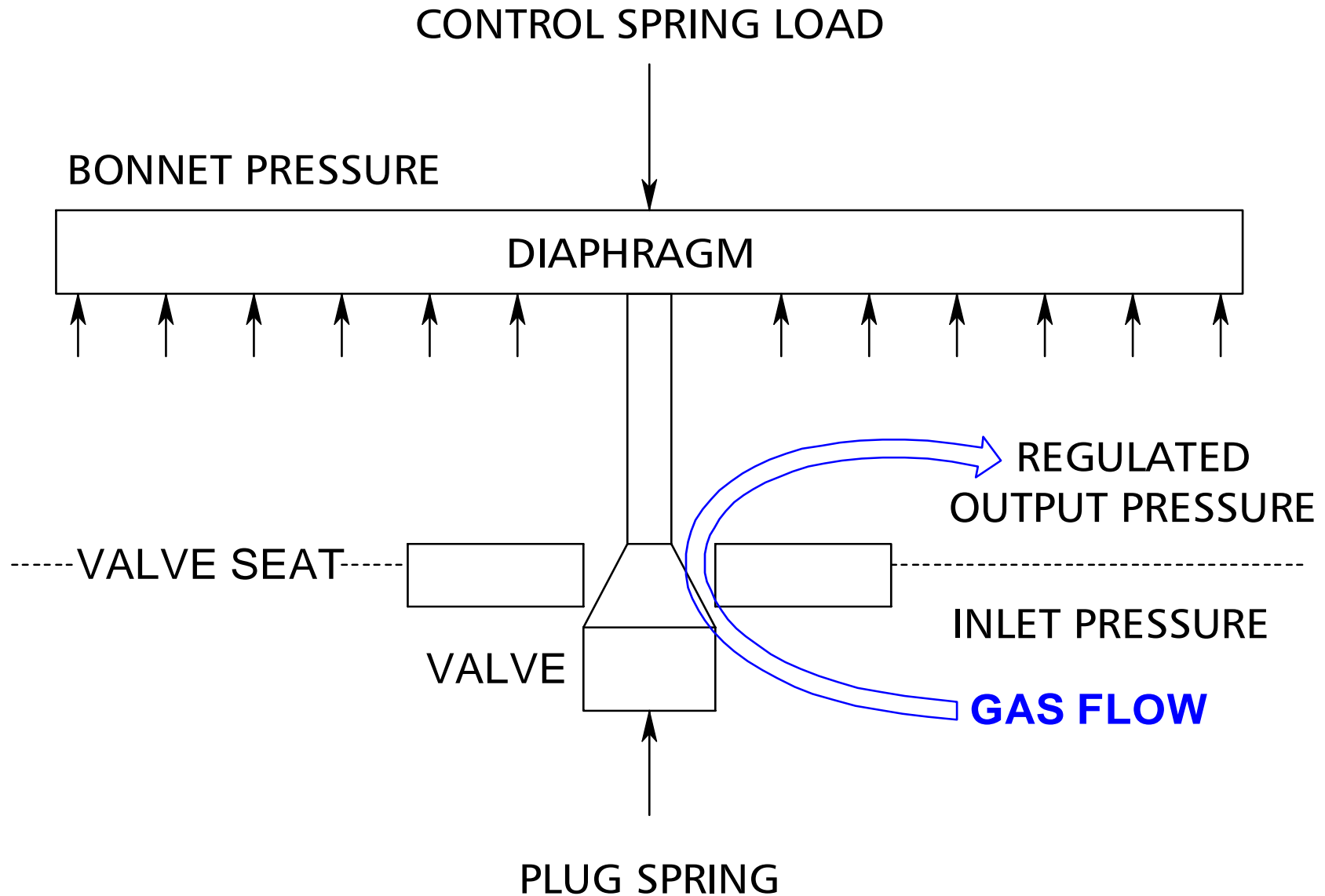
ITT Industries / Conoflow

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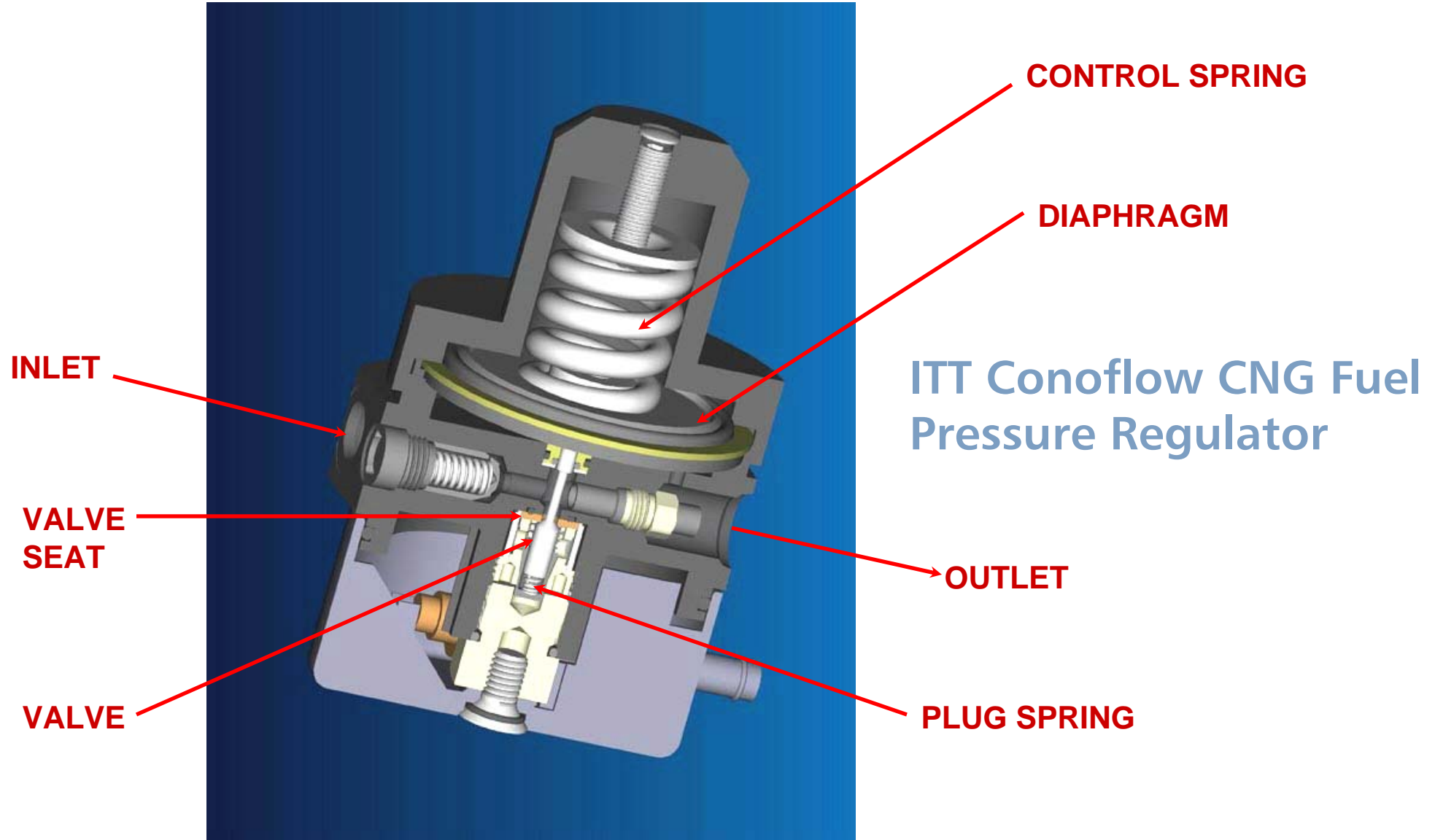
The Functions of a NGV Fuel Pressure Regulator

- ❑ **Reduces CNG pressure from fuel cylinder(s).**
 - ❑ Inlet from 250 to 3600 psig
 - ❑ Factory setting ranges from 30 to 175 psig
 - ❑ **Manages gas pressure to engine fuel system.**
 - ❑ Must respond quickly to changing gas flow
 - ❑ Must have very predictable output pressure throughout range of flow, temperature and tank pressure.
 - ❑ **Manages varying gas compositions.**
 - ❑ Discussion of Joule-Thomson effect
 - ❑ Requires heat to prevent icing inside regulator
 - ❑ Resists damage from compressor oils
 - ❑ **Enable options for pressure sensor, HP and LP gas fittings, relief valve connection, etc.**
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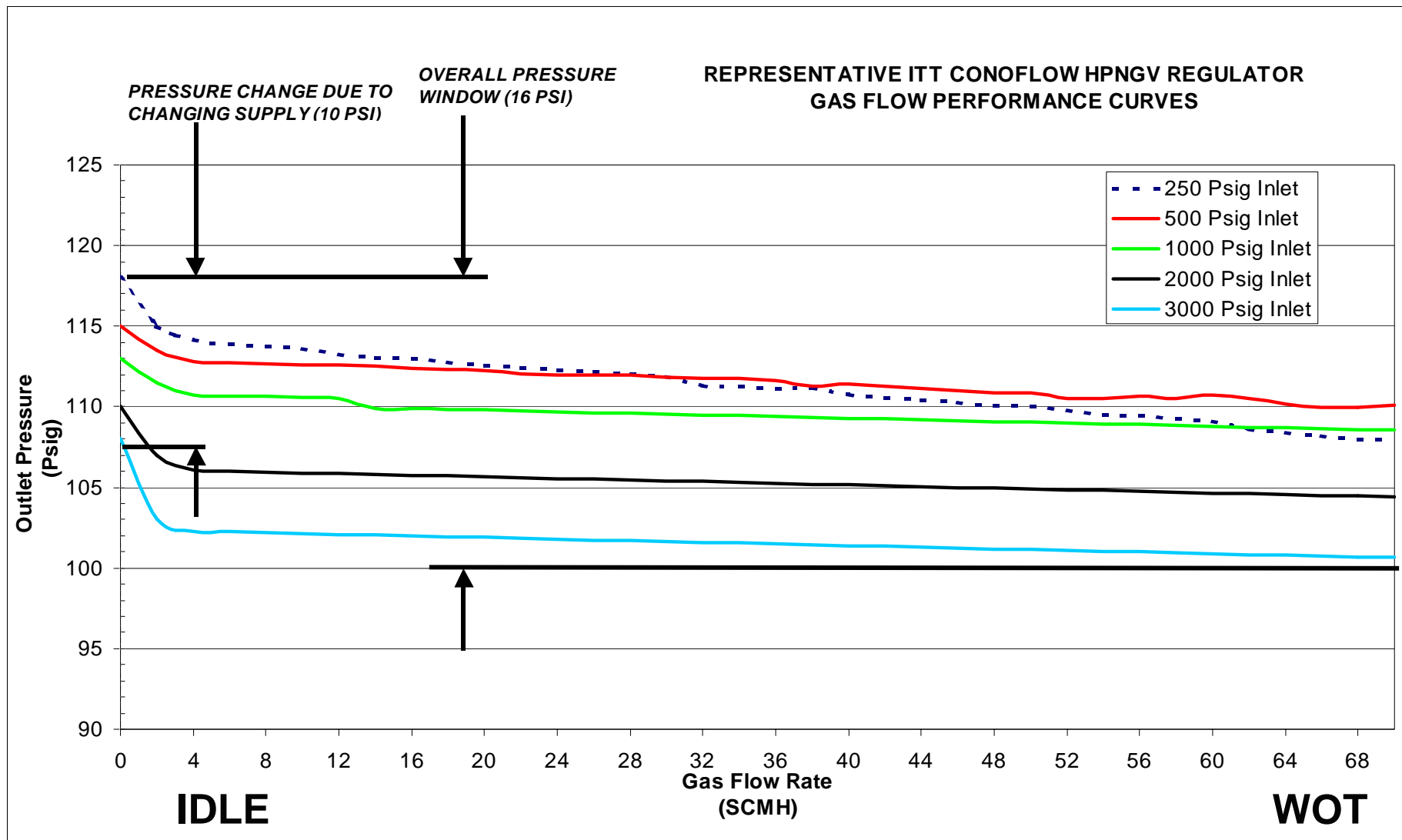
How Does an NGV Pressure Regulator Work?



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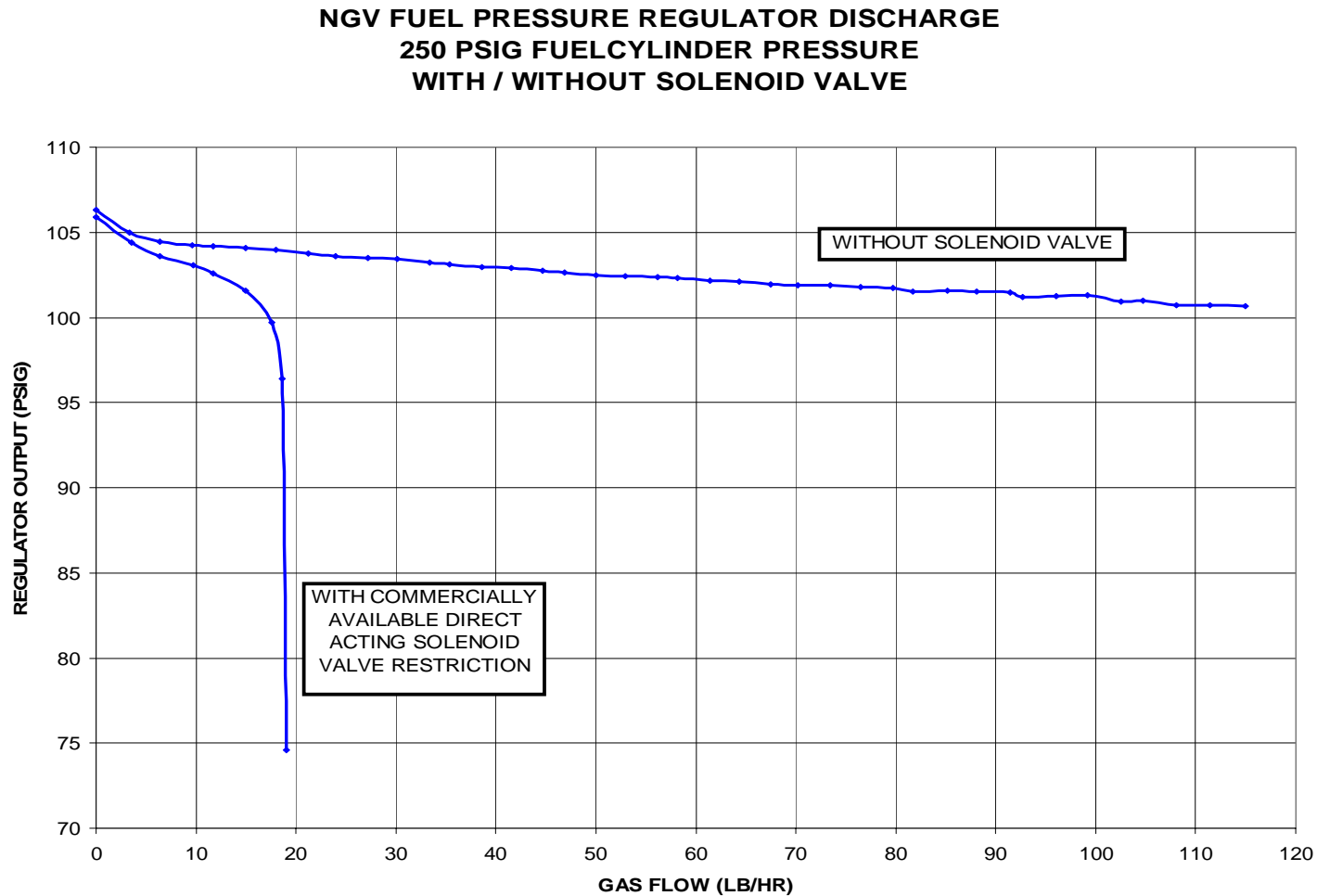


Pressure Regulator Flow Performance



Is your regulator's performance predictable?

Upstream Restriction

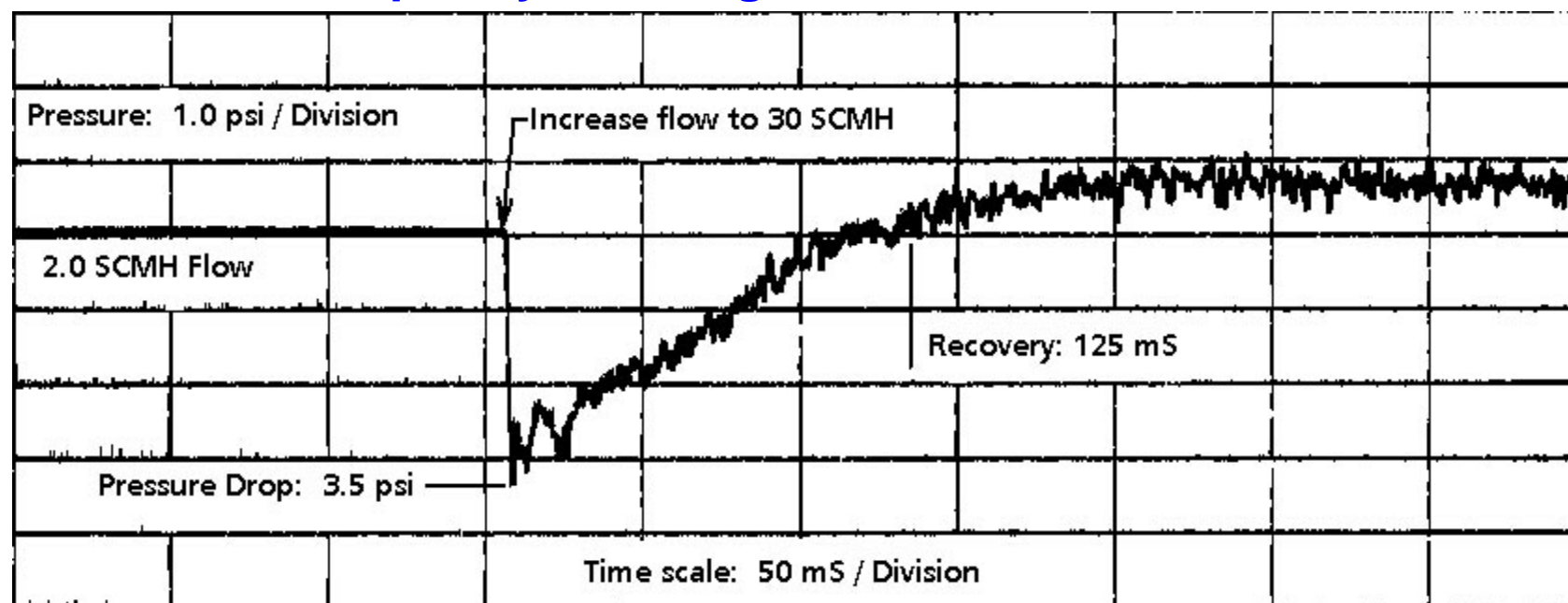


Does your regulator get sufficient gas to operate correctly?

Response to Changing Flow Requirements

Sudden flow changes (acceleration, deceleration)

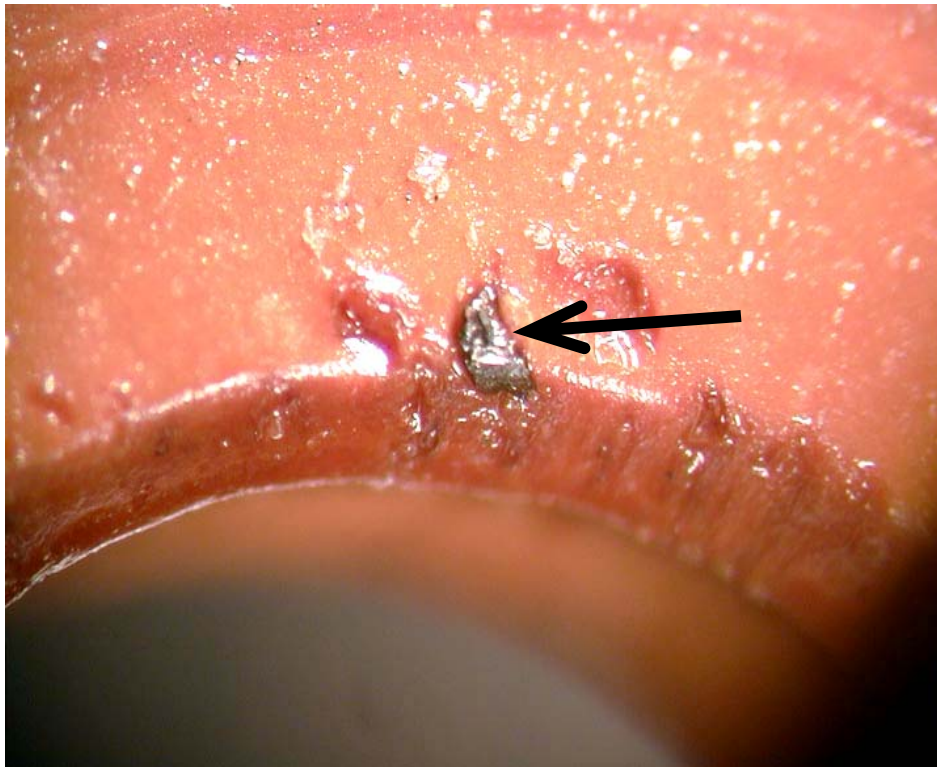
- ☐ How fast does regulator need to respond?
- ☐ How quickly does the pressure need to recover?
- ☐ How quickly does regulator need to stabilize?



Do you know what the transient response is for your regulator?

System Cleanliness / Filtration

- ❑ Upstream filtration required to protect regulator and remainder of fuel system.
- ❑ Downstream filtration can be used to protect fuel system from excessive compressor oil, moisture or other contaminants.



Metal particulates can damage regulator valve seat and create internal leakage

Is your system protected from debris?

Gas Quality – Effect on Fuel System

➤ **MOISTURE**

➤ As CNG expands it gets very cold due to Joule-Thomson effect. Moisture in CNG can form ice and hydrate deposits if the equipment is not designed to handle it.

➤ Standards SAE J1616 and ISO 15403 address permissible moisture in CNG for safe use, but not best performance.

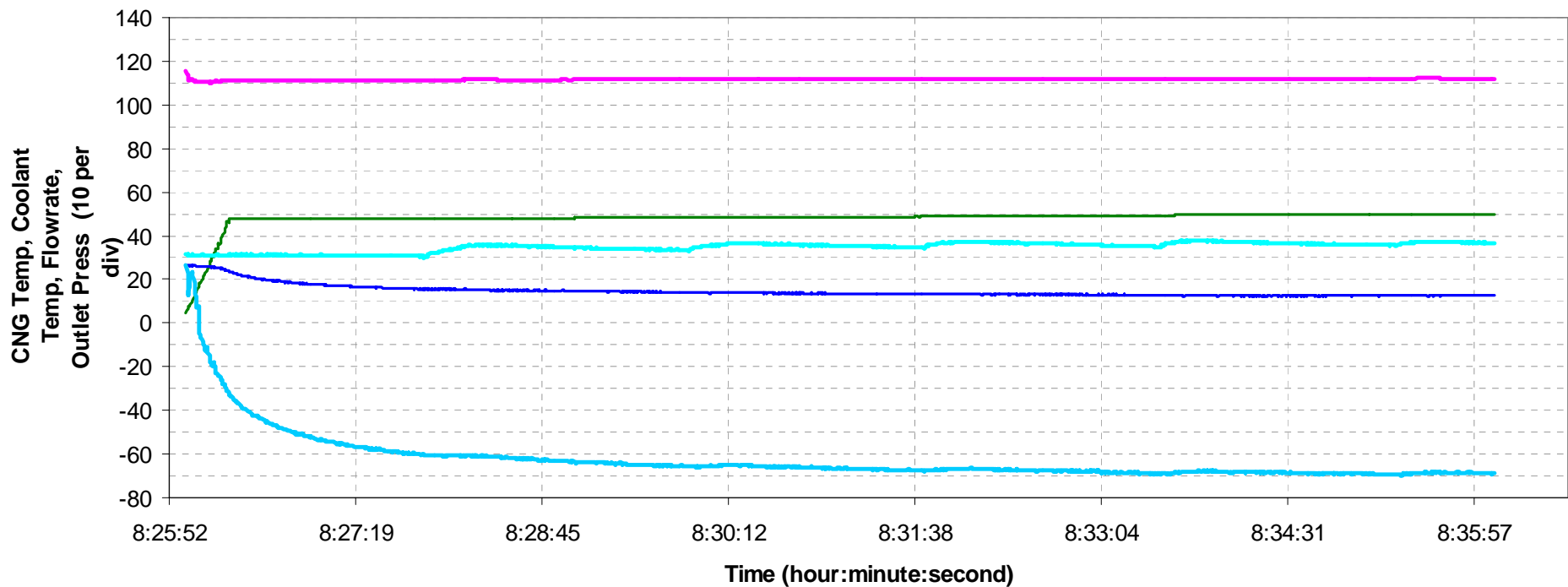
➤ **COMPRESSOR OIL**

➤ As gas expands and cools, oil dissolved in gas can drop out and load up system. Excessive compressor oils can cause problems to the fuel system.

Joule – Thomson Effect when CNG Expands

ITT Conoflow HPNGV Regulator
Temperature / Pressure data
50 SCMH Flow, 3000 PSIG Inlet
(Pipeline Quality Natural Gas)

Outlet Pressure (Psig)
Flow Rate (SCMH)
CNG Inlet Temp (Deg C)
CNG Outlet Temp (Deg C)
Coolant Inlet Temp (Deg C)



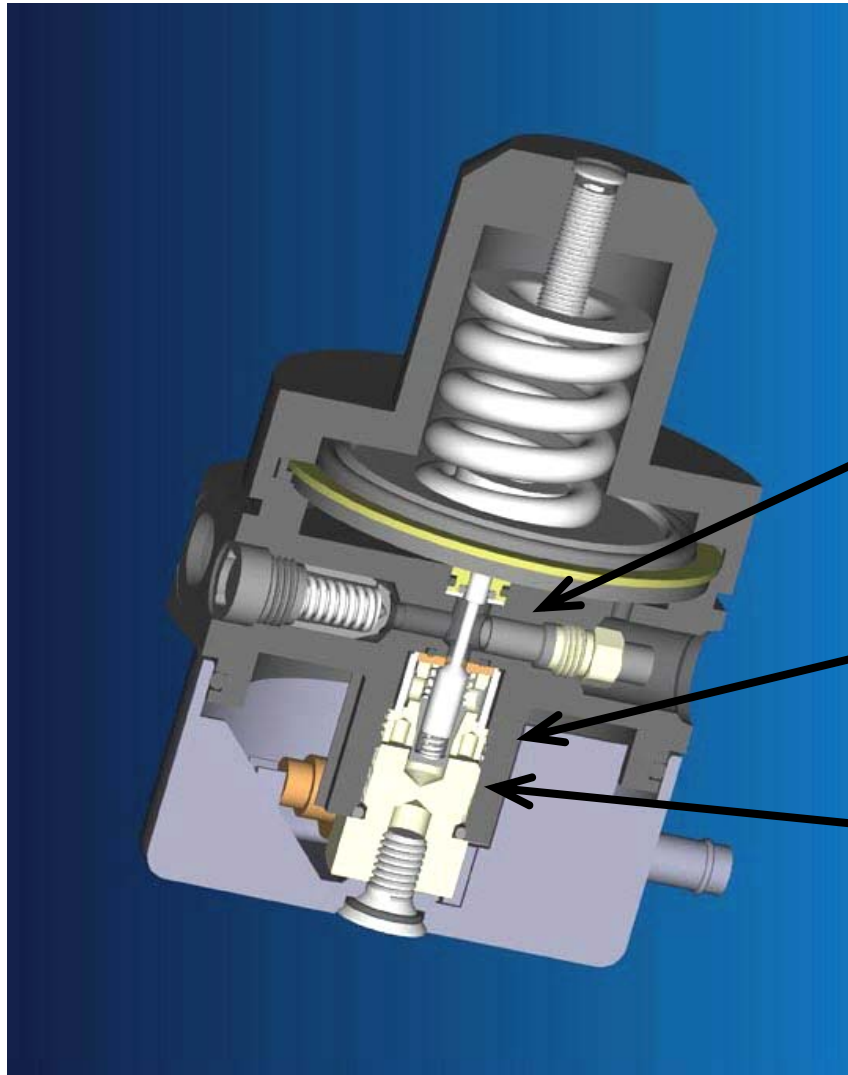
Will your regulator still perform correctly when it gets cold?

Symptoms of Freeze Up

- ☐ Power or smoothness degrades as vehicle is driven.
- ☐ Vehicle drive ability suffers.
- ☐ Seems to happen more often during warm weather.
- ☐ Problem seems to build up, then “fix itself” the next time the vehicle is operated.
- ☐ Problem is intermittent and difficult to diagnose.
- ☐ Service shows downstream pressure faults when problem is present, then fault goes away next time vehicle is started.
- ☐ May be related to different fueling locations.

Does your fuel system show these symptoms?

Managing Joule-Thomson Gas Temperature



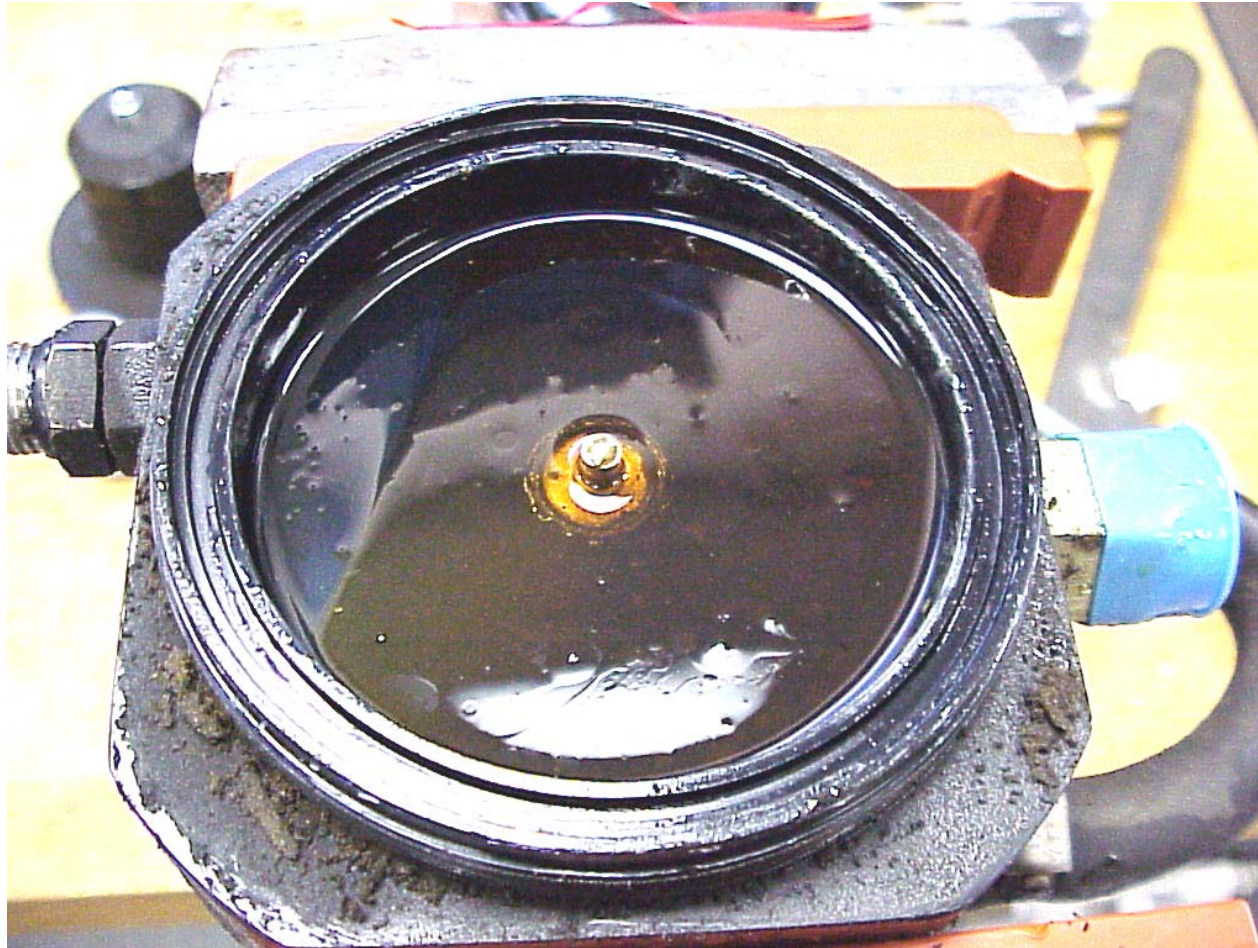
Flow bypass to prevent cold gas from freezing against diaphragm

Coolant circulation control to force convection over large surface areas

Engine coolant circulation around critical elements

Can your regulator manage chilled gas flow?

Gas Quality – Compressor Oil Carryover

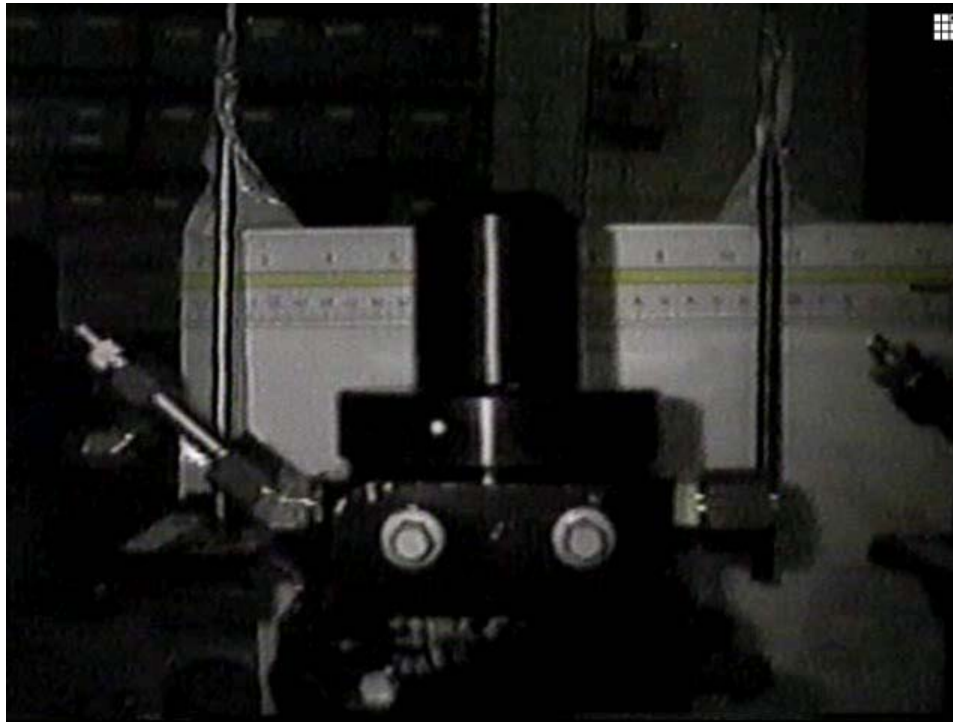


Example of oil deposits in regulator

Will your regulator and fuel system function with this much oil?

Environmental / Installation Considerations

- ❑ **Temperature – Excessive heat can cause leaks.**
 - Keep regulator away from exhaust system



- ❑ **Shock / Vibration – can reduce product life.**
 - Mount regulator to vehicle chassis, not engine
 - Mounting brackets must be rigid.

Is your regulator located and mounted properly?

NGV Fuel Pressure Regulator Configurations

- Regulator can be configured several ways to meet system needs.
 - Basic model
 - Optional items, such as sensor ports, bias ports, sub-assemblies



**Base High-Pressure
Natural Gas
Vehicle
regulator**



**Regulator customized as an assembly
with filter, sensor, and fittings**

Conclusion

A robust regulator is an essential component of a safe and reliable NGV fuel system.

It is important to know if the regulator is able to effectively manage NGV fuel system issues such as temperature, vibration, flow changes, supply pressure changes, as well as imperfect gas composition.

For further information, contact me at jeff.gotthelf@itt.com

Thank You!
