

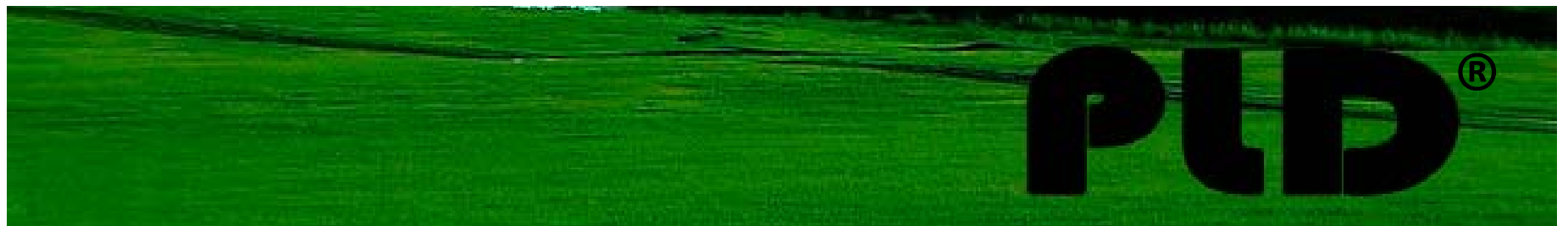


M-Squared Products & Services, Inc.



Technical Presentation:

Packing Leak Detector[®]



Senator Mary Landrieu's 12/13/2013
advocacy letter to U.S. EPA.



December 13, 2013

Gina McCarthy
Administrator, U.S. Environmental Protection Agency
Natural Gas STAR Program
MC 6207J
1200 Pennsylvania Ave., NW
Washington, DC 20460

Dear Administrator McCarthy:

I am writing on behalf of M-Squared Products & Services, Inc., which has submitted a Memorandum of Understanding to the EPA for the Natural Gas STAR Program. It is a pleasure for me to support their efforts to have their Packing Leak Detector (PLD) highly recommended to end users through this program.

This PLD allows operators to determine when packing is leaking and provides a rough measurement of the leakage amount. This allows the operator to determine the most cost effective time to change the packing, and also provides a method to redirect the leaking gas into the low pressure side of a recovery system to be recompressed for production. It is my understanding that the resulting savings in the pollution sector would be outstanding, with aggregate savings at two million tons of CO2 equivalent saved per year.

I would appreciate every appropriate consideration, within the applicable guidelines, be given to M-Squared Products & Services' application during the review. In closing, I ask for any information you may now provide on this matter, and I look forward to hearing from you about the final decision.

With kindest regards, I am

Sincerely,

A handwritten signature in blue ink that reads "Mary L. Landrieu".

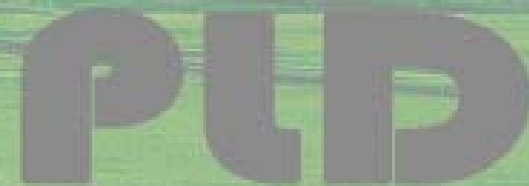
Mary L. Landrieu
United States Senator



Packing leaks are significant contributors to Green House Gases (GHG).

EPA estimates over 50,000 compressors X 4 cyl/compressor = 200,000 cylinders releasing 65 billion cubic feet (Bcf) of natural gas annually to the atmosphere attributed to packing leaks¹

Leak Rate/ Cylinder/Minute (scfm)	Leak Rate/ Cylinder/Day (Mcf)	Lost Gas Production/ Cylinder/Year (MMcf)	
5	7.20	(2.529)	average
12	17.28	(6.220)	highest



¹U.S. EPA. Inventory of US Greenhouse Gas Emissions and Sinks 1990-2011 [April 13]

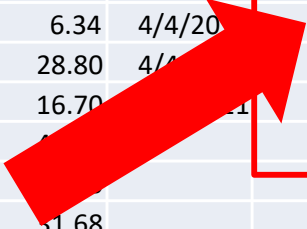


Packing Leak Rate Real World Data

Actual Field Measurements of Leaking Packing

Measurements taken with a Fox Thermal Meter Model 10A

Location	1st QTR Testing Date	Packing Leak Rate CFM	Packing Leak Rate CF/Day	Loss \$ Per /Day	1st QTR Testing Date	Packing Leak Rate CFM	Packing Leak Rate CF/Day	Loss \$ Per /Day	2nd. QTR Testing Date	Packing Leak Rate CFM	Packing Leak Rate CF/Day	Loss \$ Per /Day
	2/23/2010	2.4	3456	\$ 13.82	2/6/2011	3.10	4464	\$ 17.86	4/6/2011	0.88	1267.2	\$ 5.07
	2/23/2010	6.5	9360	\$ 37.44	2/6/2011	4.26	6134.4	\$ 24.54	4/6/2011	1.40	2016	\$ 8.06
	2/23/2010	3.5	5040	\$ 20.16	2/6/2011	2.34	3369.6	\$ 13.48	4/6/2011	0.55	792	\$ 3.17
	2/23/2010	2	2880	\$ 11.52	2/6/2011	1.76	2534.4	\$ 10.14	4/6/2011	0.31	446.4	\$ 1.79
	2/23/2010	2.8	4032	\$ 16.13	4/4/2011	0.69	993.6	\$ 3.97	4/11/2011	0.69	986.4	\$ 3.95
	2/23/2010	1.1	1584	\$ 6.34	4/4/2011	20.23	29131.2	\$ 116.52	4/11/2011	0.88	1267.2	\$ 5.07
	2/23/2010	5	7200	\$ 28.80	4/11/2011	2.30	3312	\$ 13.25	4/11/2011	0.45	643.68	\$ 2.57
	2/23/2010	2.9	4176	\$ 16.70	4/11/2011	0.35	504	\$ 2.02	4/11/2011	17.10	24624	\$ 98.50
	2/23/2010	8.1	11664	\$ 46.26	5/17/2011				5/17/2011	2.65	3816	\$ 15.26
	2/23/2010	4.6	6624	\$ 26.50	5/17/2011				5/17/2011	1.00	1440	\$ 5.76
	2/23/2010	5.5	7920	\$ 31.68	5/17/2011				5/17/2011	5.70	8208	\$ 32.83
	3/2/2010	0	0	\$ -	5/17/2011				5/17/2011	2.90	4176	\$ 16.70
	3/2/2010	0	0	\$ -	5/21/2011				5/21/2011	0	0	\$ -
	3/2/2010	1.7	2448	\$ 9.79	5/21/2011				5/21/2011	1.4	2016	\$ 8.06
	3/2/2010	0	0	\$ -	5/21/2011				5/21/2011	0	0	\$ -
	3/2/2010	1.6	2304	\$ 9.22	5/21/2011				5/21/2011	1.15	1656	\$ 6.62
	3/2/2010	1.3	1872	\$ 7.49	5/21/2011				5/21/2011	2.5	3600	\$ 14.40
	3/2/2010	4.8	6912	\$ 27.65	5/21/2011				5/21/2011	2.6	3744	\$ 14.98
					5/21/2011				5/21/2011	2.3	3312	\$ 13.25
					5/21/2011				5/21/2011	2.8	4032	\$ 16.13





Packing Leak Detection

Currently, it is neither easy nor inexpensive for mechanics to determine packing case leak rates. Compressors operate weeks or months with substantial leaks.



Model: D. Hodge

Determining packing leaks (pre-PLD):

- Handling vent lines, overheating
- Optical Gas Imaging (OGI)—static data point
- Observing oil blowing from vent line(s)
- Feeling gas in palm

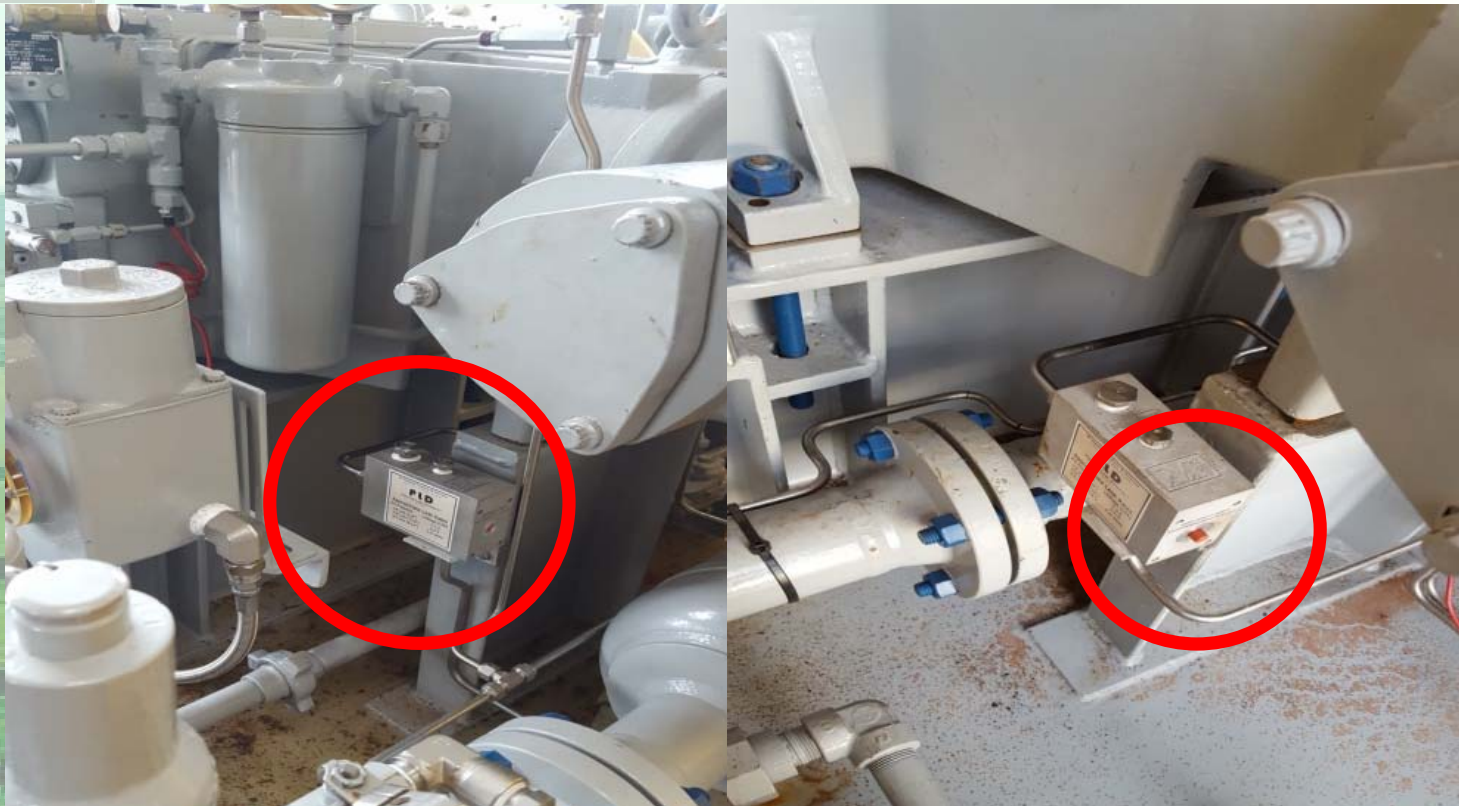
Imprecise methods don't quantify leaking gas volume

- **When tubed to vents & flares, impossible to determine lost gas volume**

PLD



Packing Leak Detection



PLD: *first* tool establishing real-time, ZERO-leak packing baseline, helping operators assess health & effectiveness of compressor packing

PLD



Packing Leak Detector functions

Bureau of Safety and
Environmental Enforcement
(<https://www.bsee.gov>)

Packing Leak Detectors determine:

- Over/Under-lubrication

How we tested each
packing vent on 12/2/2016



PID

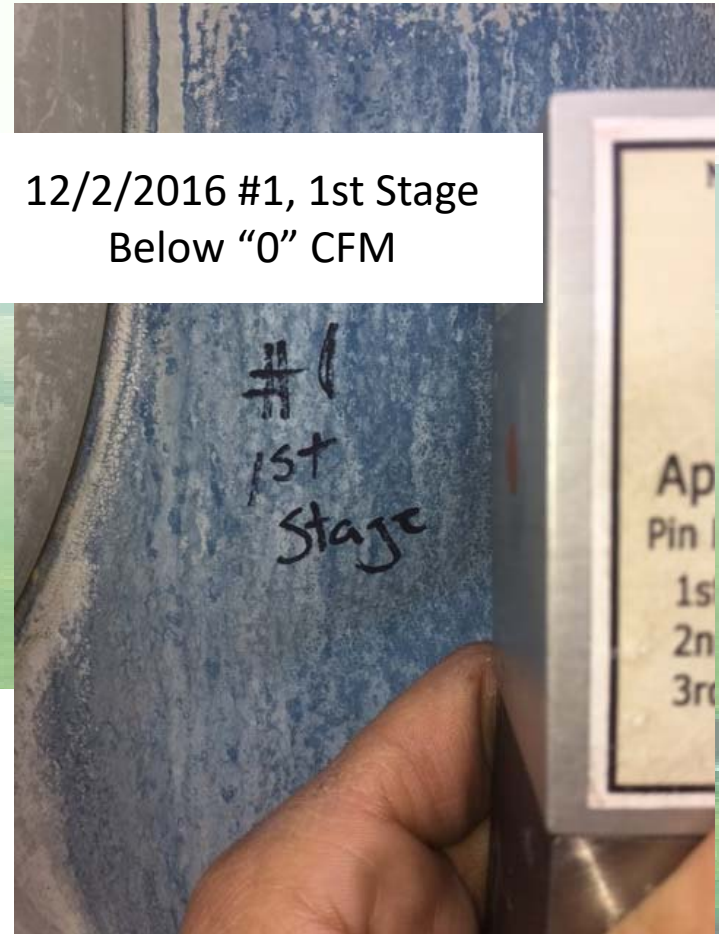


Packing Leak Detector functions

12/2/2016 #1, 1st Stage
Below "0" CFM

Packing Leak Detectors determine:

- Over/Under-lubrication
- Improper packing material



PLD



Packing Leak Detector functions

12/2/2016 #3, 1st Stage
Roughly "1" CFM



Packing Leak Detectors determine:

- Over/Under-lubrication
- Improper packing material
- Incorrect packing installation

PLD



Packing Leak Detector functions

12/2/2016 #3, 1st Stage
Roughly "1" CFM



Packing Leak Detectors determine:

- Over/Under-lubrication
- Improper packing material
- Incorrect packing installation
- Piston rod hardness/smoothness

PLD

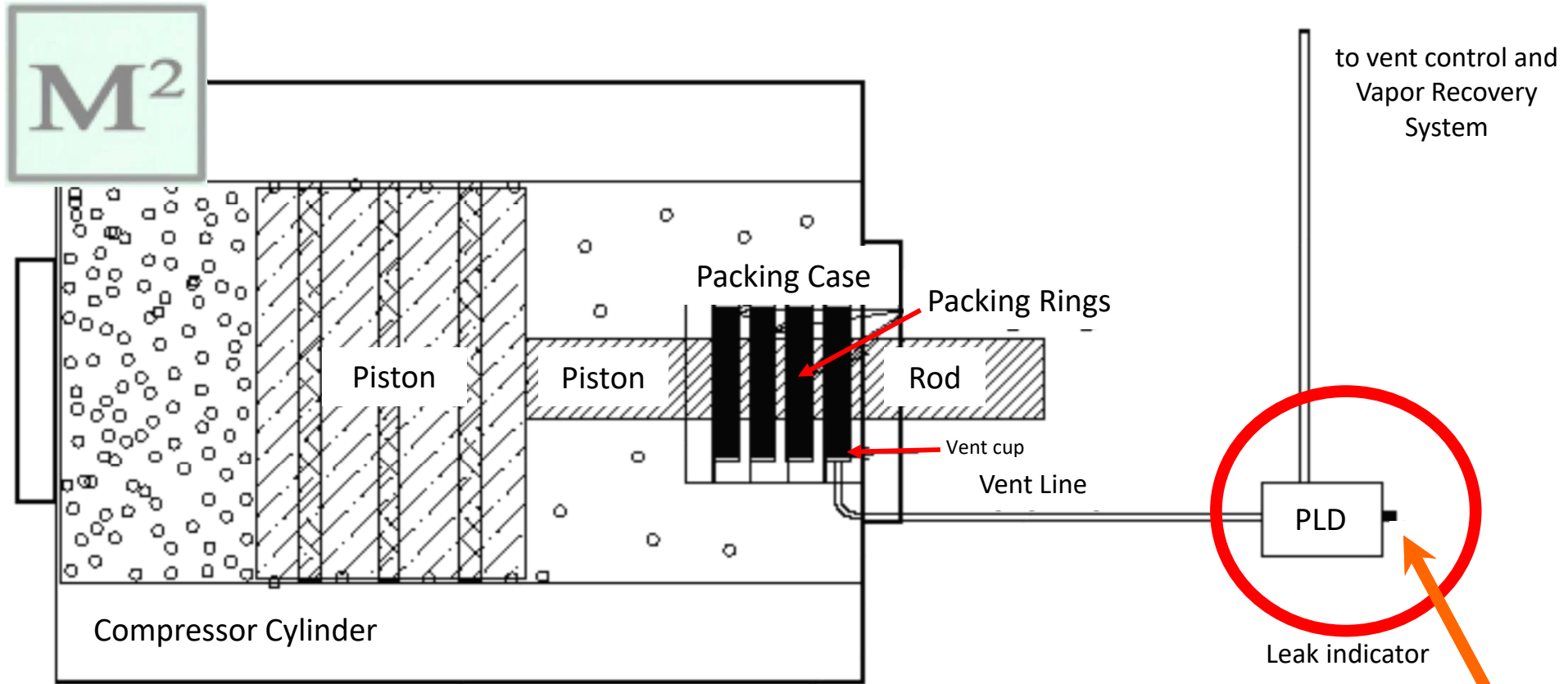


Packing Leak Detector functions

Packing Leak Detectors determine:

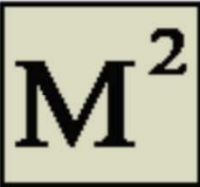
- Over/Under-lubrication
- Improper packing material
- Incorrect packing installation
- Piston rod hardness/smoothness
- Piston ring wear / rod drop
- 24 hour monitoring (dynamic or static state)
- Compatible for different type gases on multiple services
- Ensure packing gland health





As packing rings wear, gas migrates along piston rods to packing case vent cups. Gas flows through vent lines to connected Packing Leak Detectors (PLDs). As leaking pressure achieves specified thresholds, PLDs provide mechanical visual leak indications and send electronic signals via transmitters to PLD Human Machine Interface (HMI) monitor panels (when configured).

Monitored PLD systems offer remote access capability for temperature and pressure data via Modbus RTU RS232 or RS485 Serial COMM. Data can be manipulated to meet requirements.

	Packing Leak Detector operating with compressor			
	TITLE			
P.O. Box 62840, Lakeview, LA 70608	SIZE	CAGE CODE	DWG NO	REV
	A			
	SCALE	SHEET		
	None	1 of 1		



Packing Leak Detection: Future

M-Squared Packing Leak Detectors are simple, inexpensive devices tubed to packing vents.

- Pre-determined, industry-appropriate or general leak rate thresholds, such as 1.0-2.5 scfm, can be calibrated.

Mechanical Pin PLDs

A visual indicator (pin) extends in response to packing leaks

- Pins are calibrated to indicate gas leak rate/volume.

Transmitter-equipped PLDs

Offer remote monitoring capability & include temperature and pressure data.

- Via Modbus RTU RS232 or RS485 Serial COMM
- Provided Modbus registered data can be manipulated to meet requirements



PLD



- **PLD PLC Panel**
- Modbus RTU via RS485/RS232
- Analog inputs
- Fits in existing panel or stand-alone NEMA enclosure
- 24 VDC
- Class 1 Division 2-rated
- SD card slot
- PLD Panel Program



Sample PLD[®] Monitor Screen Shots

Menu

Setup Menu

Select only one of the two options below

Temperature Transmitter Option	Fixed Temperature Option
Flow Rate Calcs and Alarms	Pressure Transmitter Ranges
Modbus Setup	Alarm Screen

Return

Flow Rates in SCFM

Cylinder #1	3.00	Cylinder #4	3.04
Cylinder #2	3.17	Cylinder #5	3.08
Cylinder #3	3.99	Cylinder #6	3.56

Temperature Information Screen	Pressure Information Screen	ALARMS
Modbus Information Screen		Modbus OK
		System Setup

Modbus Information

Presets (Factory Setups)
Port 2 RS485 Standard 9600, 8, None, 1, No FC
Adjustable in Setup Menu
Modbus I.D. Fail Timer

Operations

Modbus Status	Failed
Total Sessions	0
Function in Progress	No

Return

Current Alarms

	Transmitters		
	Flow	Press	Temp
Cylinder #1	OK	OK	OK
Cylinder #2	Hi Flow Alm	OK	OK
Cylinder #3	Hi Flow Alm	OK	OK
Cylinder #4	OK	OK	OK
Cylinder #5	OK	OK	OK
Cylinder #6	Hi Flow Alm	OK	OK

Modbus Failed

Return

Temperatures

	Deg. F
Cylinder #1	99
Cylinder #2	99
Cylinder #3	99
Cylinder #4	225
Cylinder #5	225
Cylinder #6	225

Return

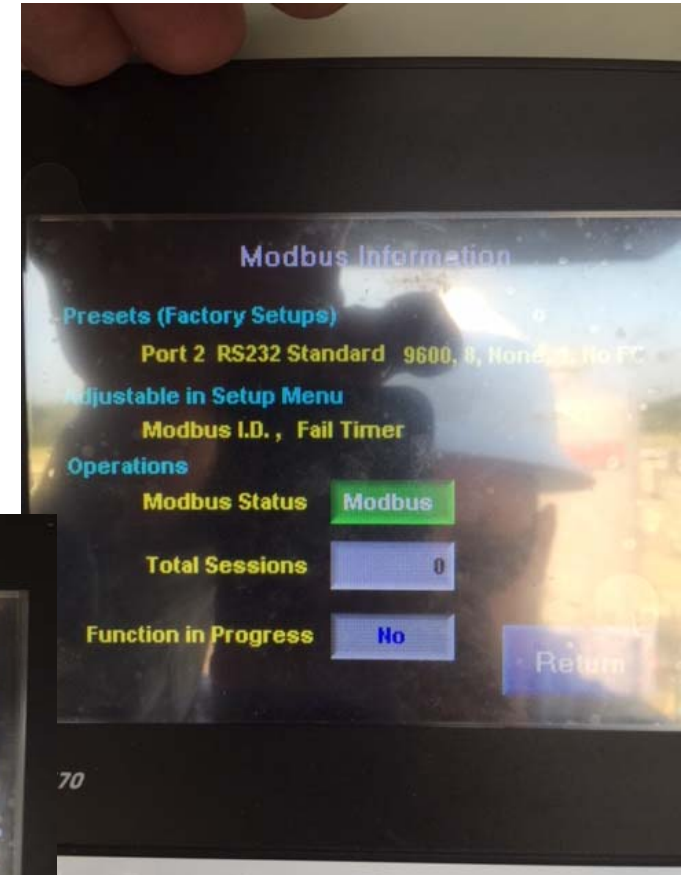
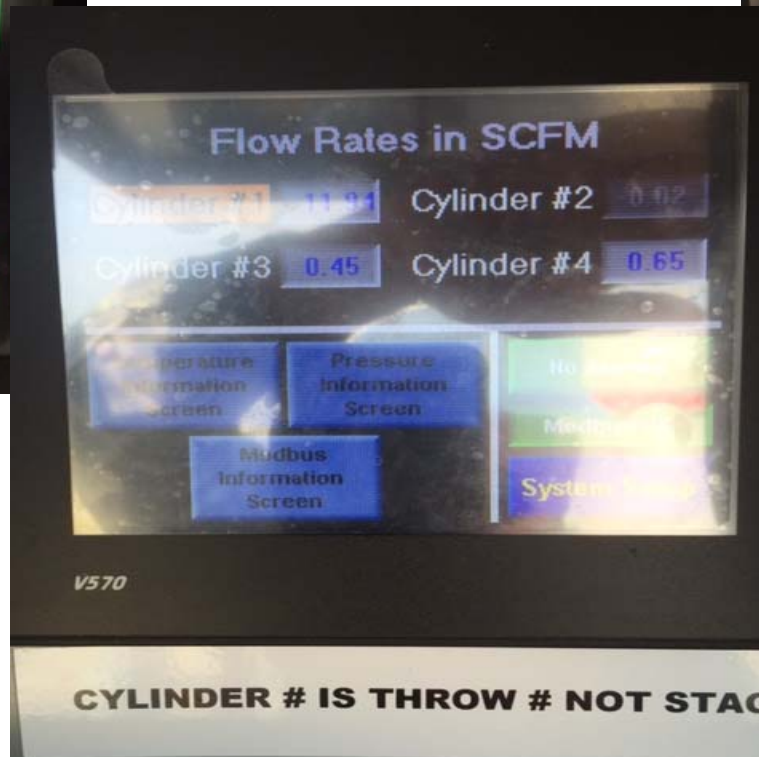
Pressures

	PSIG
Cylinder #1	0.9
Cylinder #2	1.8
Cylinder #3	2.8
Cylinder #4	2.8
Cylinder #5	1.6
Cylinder #6	1.2

Return

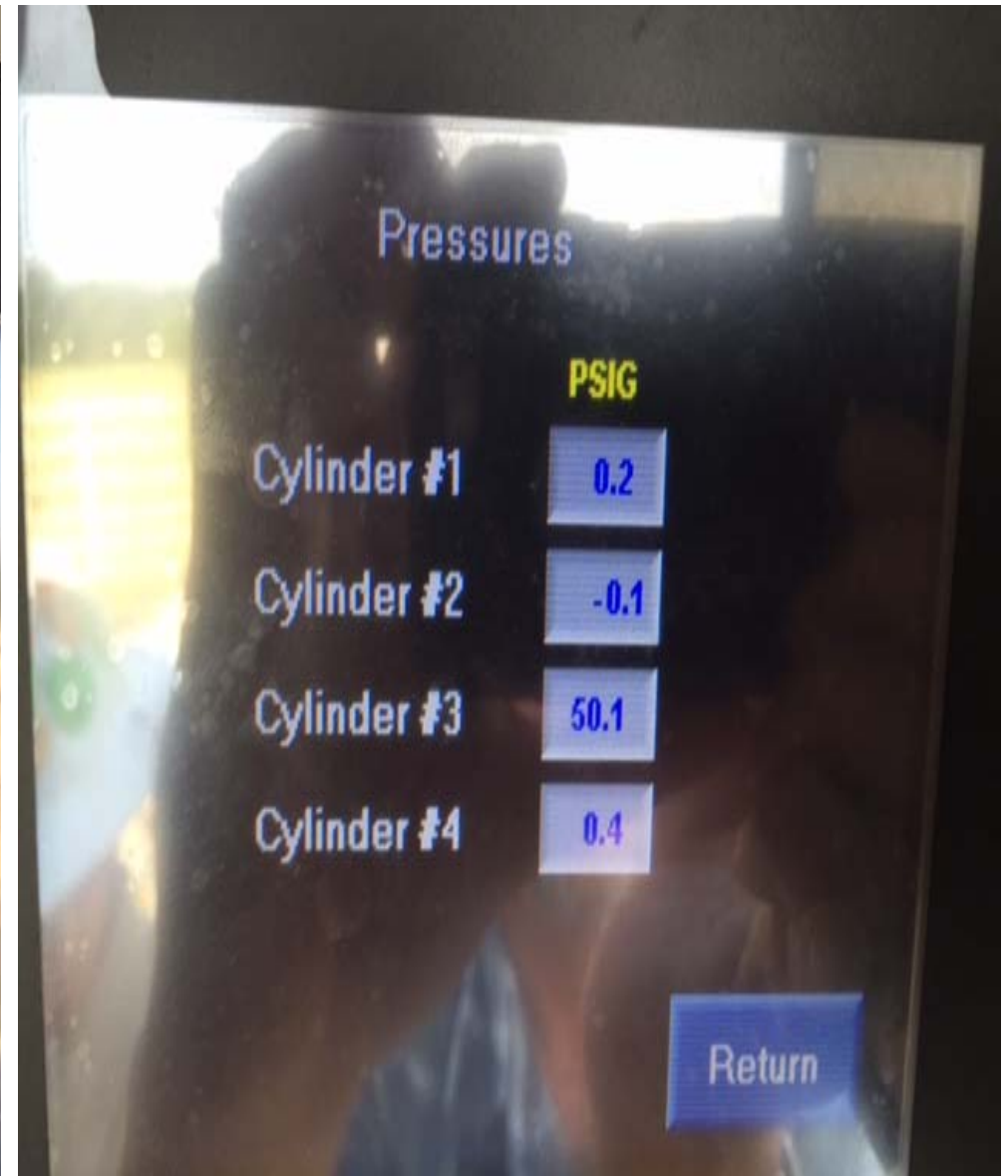


Sample PLD[®] Monitor screen shots





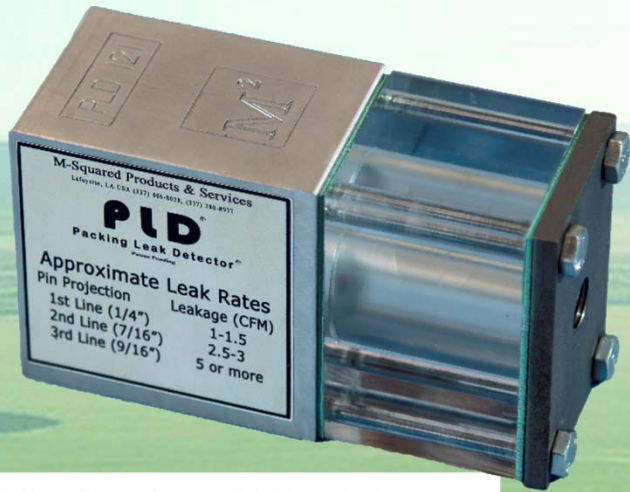
Sample PLD[®] Monitor screen shots





Configurations

PLD with pressure/temperature transmitters, cables, Zero-Emissions block, mounting bracket and wiring Condulet box²



Mechanical PLD without transmitters¹



¹Mechanical PLD, anodized aluminum or 316 stainless without pressure ports.

²Digital PLD, anodized aluminum or 316 stainless with pressure and temperature ports.

PLD



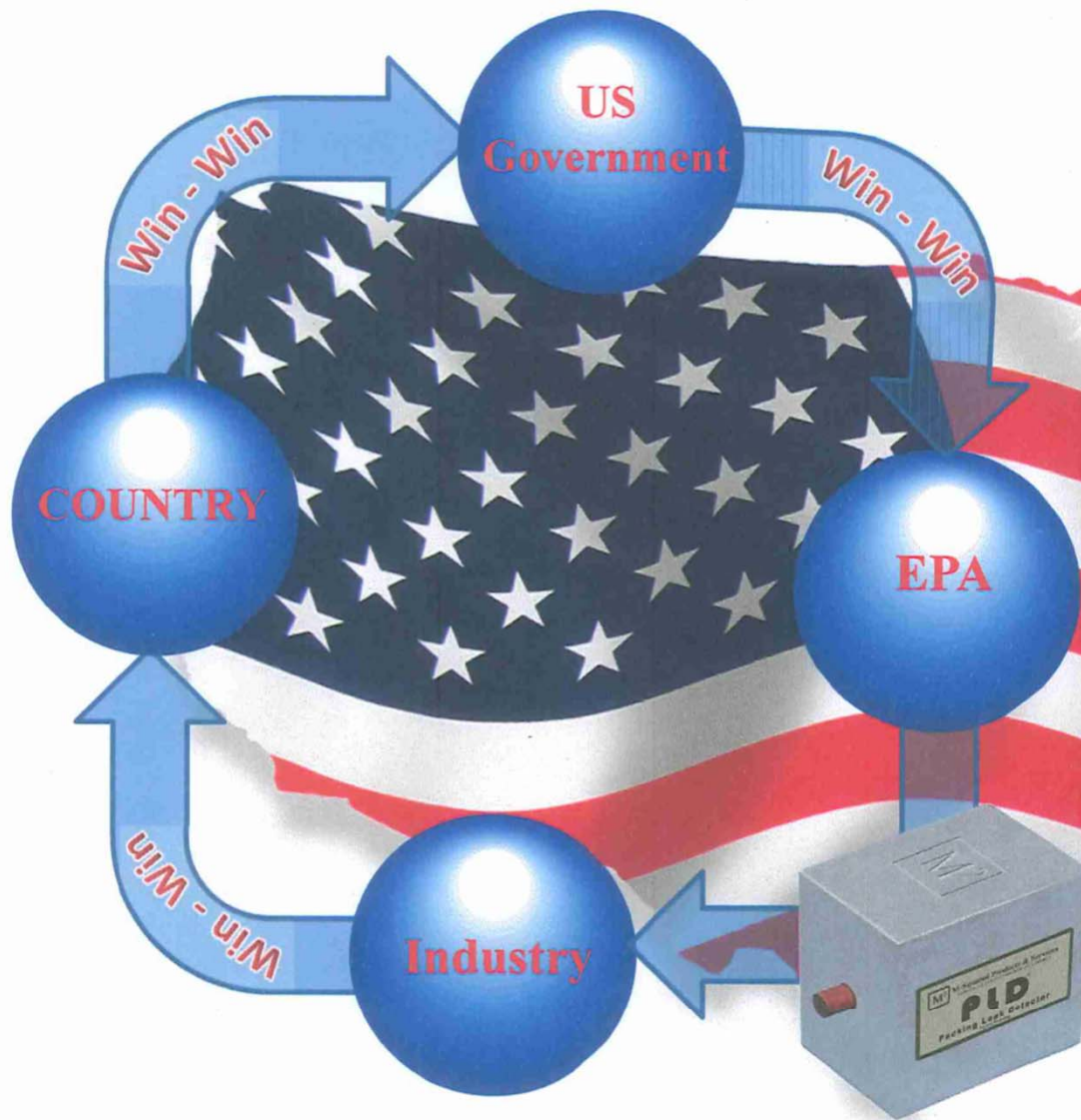
PLD Benefits

- **Real-time, ZERO-leak baselines for new or rebuilt packing**
- **Engineered for different gases and varying rates**
- **Can be used on multiple service compressors**
- **PLD outlets can be redirected for low-pressure gas applications pending packing servicing or replacement**
- **24 X 7 local monitoring**
- **Installations configured for PLD monitor panels offer capability to remotely access temperature and/or pressure data**
- **Communication via Modbus RTU RS485/RS232**
- **Data can be manipulated to meet requirements**

The letters 'PLD' are rendered in a large, bold, sans-serif font. They are superimposed on a background image of a green field with a fence line in the distance. The text is semi-transparent, allowing the background image to be seen through it.

PLD

PLD Benefits



- Win-Win for Federal & State Government, EPA, Industry, and Country.
- Domestically, using the PLD, can reduce an estimated 65.1 Bcf / Year of Methane emissions from the Production, Processing, Transportation and Storage Sectors.
- Reducing the loss of methane into the atmosphere by one half is equal to saving 45 billion dollars every year. That is 45 billion dollars in additional revenue for the producing companies, and 45 billion potential taxable dollars for the federal and state governments.
- Savings in the pollution sector would be 18 million grams of CO₂ equivalent or about 20 tons per year less pollution per cylinder. Aggregate savings would be two million tons of CO₂ equivalent saved per year.

With the US Government (US Senate Committee on Environment & Public Works) approving the PLD for Best Practices, Best Technology, the EPA can then endorse the PLD, and recommend the use to the industry.



The Next Step – Gas Reclamation

Combine **M² PLD[®]** with vapor/vent reclamation systems. Recover, pressurize OR redirect vented gases for gathering, pipeline or storage.

Examples:

- Driver engine fuel
- Blanket gas systems (stock tanks, corrosion inhibitor)
- Production & process system

The letters 'PLD' in a large, bold, sans-serif font, positioned in the bottom right corner of the slide.

PLD



Summary

First, dynamic packing gland health tool.

Determines

- **ZERO-leak** baselines
- Packing **leaks & rates**
- Packing leaks & rates in **dynamic or static mode**
- Packing **failure**
- **Appropriateness** of packing material
- Installation **irregularities**
- **Excessive** piston rod smoothness/hardness
- **Over/under-lubrication**
- **Local & remote** monitoring configurable

PCD



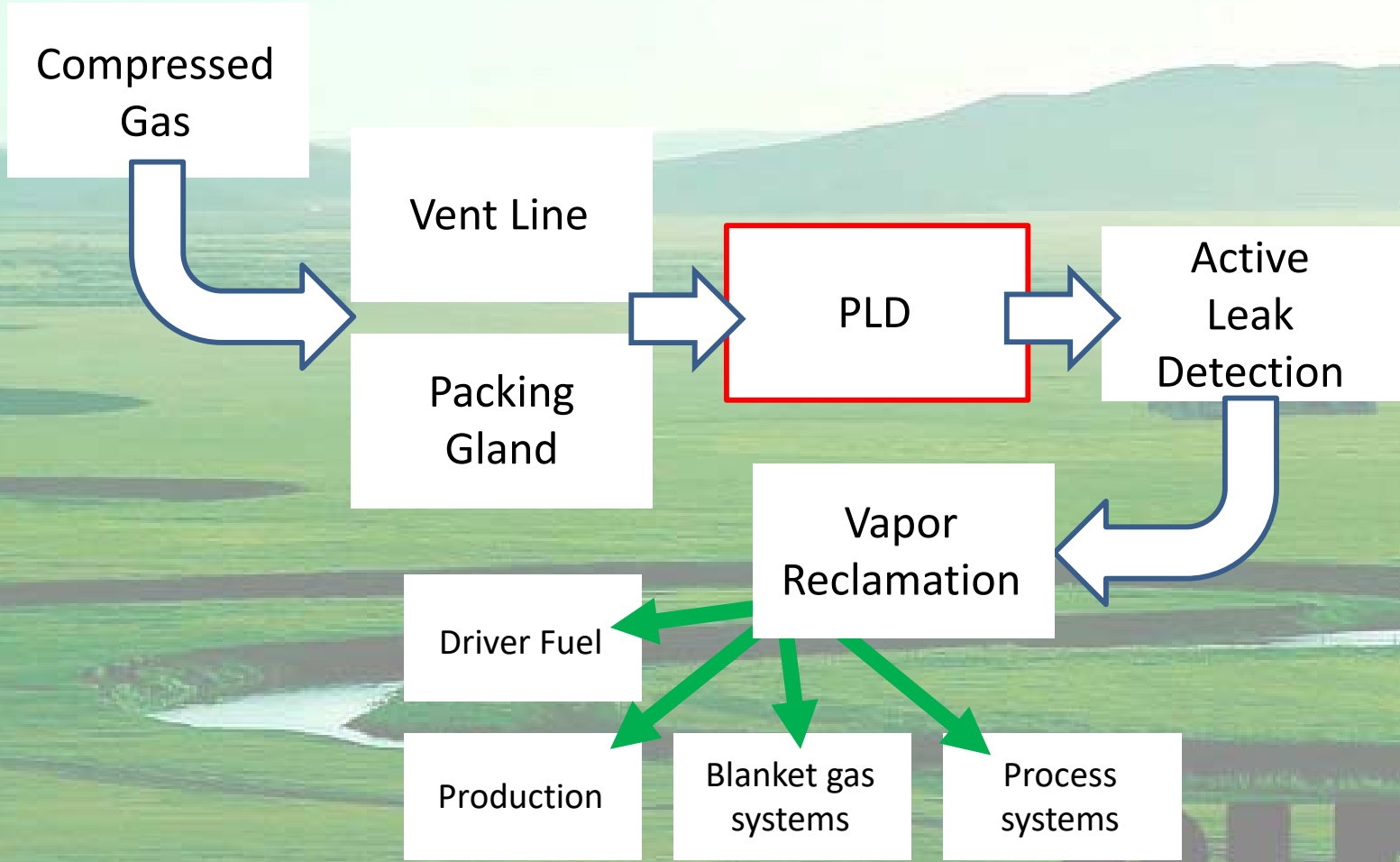
Vapor Reclamation Units



PUD



Understanding PLD integration benefits



PLD



M-Squared Products & Services, Inc.

Questions?

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PLD