

XVI SAFEX CONGRESS

Mobile Manufacturing

Unit Pump Safety

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Mobile Manufacturing Units (MMU'S)

Pump Safety

- **System Rational**
- **Original System**
- **Incident Reviews**
- **System Upgrade**
- **Conclusions**

Goals Set For Systems

- Safe
- Cost Effective
- Transparent to Operator
- High Availability Factor
- Enhance Equipment Life and Performance

Program Criteria Gathered From Explosives Manufactures

- Areas Identified
 - Over Pressure
 - Under Pressure
 - Run Dry
 - Over Torque
 - Unattended Operation
 - Training Program

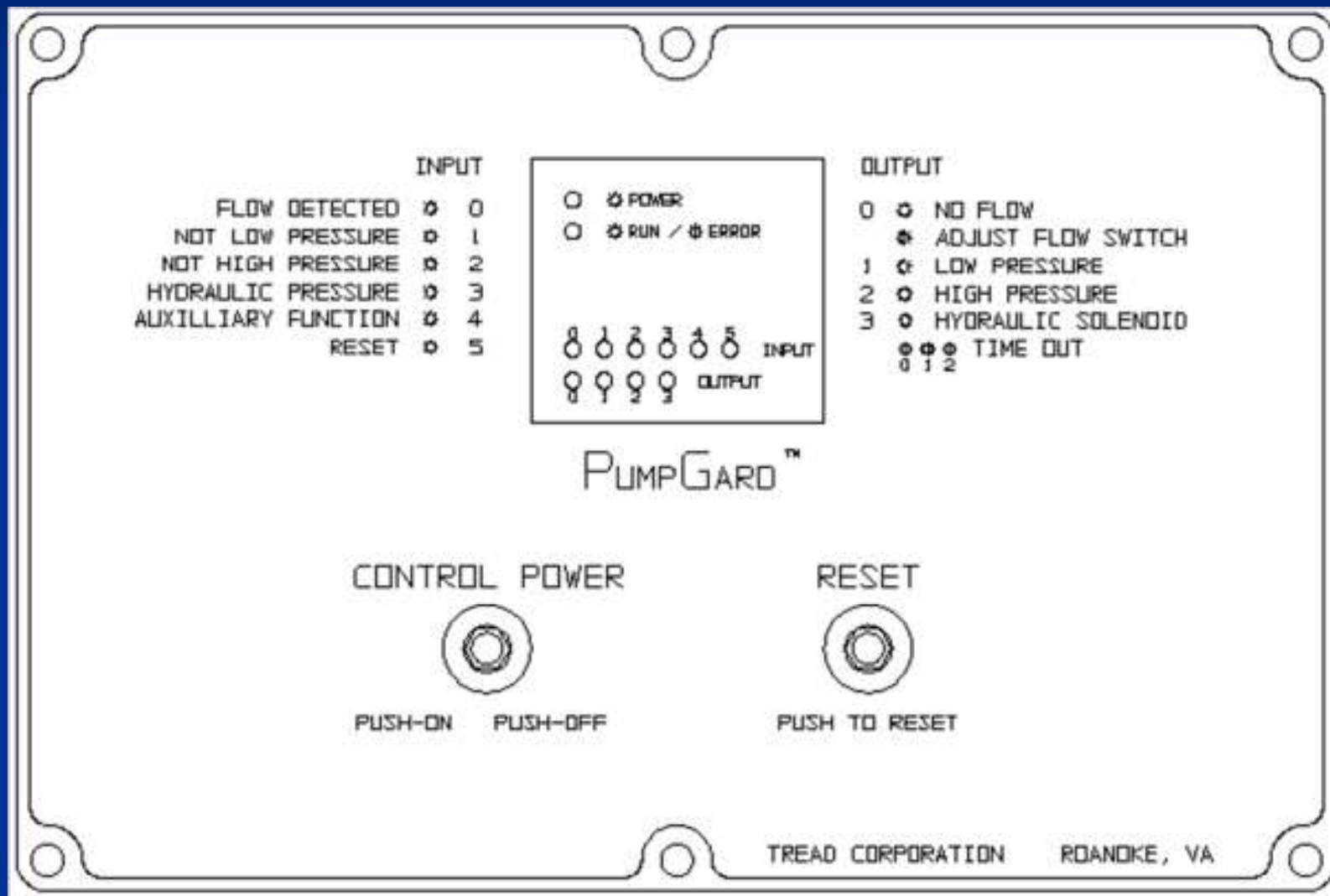
Recommended Minimum Functionality

Safety device	Hazard Condition		
	Run-dry	Dead-head	Heat buildup
Low-pressure switch	✓		
Flow switch	✓	✓	
High-pressure switch		✓	
Burst disc		✓	
Run timer			✓

BASIC HAZARD AREAS

DEVICE	PROTECTION	HAZARD
FLOW SWITCH	LOSS OF FLOW	RUNNING DRY
LOW PRESSURE SWITCH	LOSS OF FLOW	RUNNING DRY
HIGH PRESSURE SWITCH	EXCESSIVE PRESSURE	DEAD HEADED
RUPTURE DISC	EXCESSIVE PRESSURE	DEAD HEADED
TIMER	UNATTENDED RUNNING	HEAT BUILDUP
RELIEF VALVE	TORQUE LIMITING	HEAT BUILDUP

Original System Operator Display



Problems with Original System

- Visual Reference Difficult to Interpret
- Fault Finding Required Interpretation
- Indicator Lights Were Too Small
- Components were Difficult to Adjust
- Higher IP Rating was Needed

Incident February 1, 2002

- New Employee
- Operating Alone
- Friday Afternoon
- Inclement Weather
- Tasked to Unload Pump Truck Into Silo
- Task Training did Not Cover Operation



- 1. Operator opens both tanks**
- 2. Operator sits in cab during unloading**
- 3. Pump times out and stops**



4. Exits cab and climbs ladder to check tank



5. Operator opens first tank hatch, closest to ladder

6. Sees tank still has product, resets pumping process



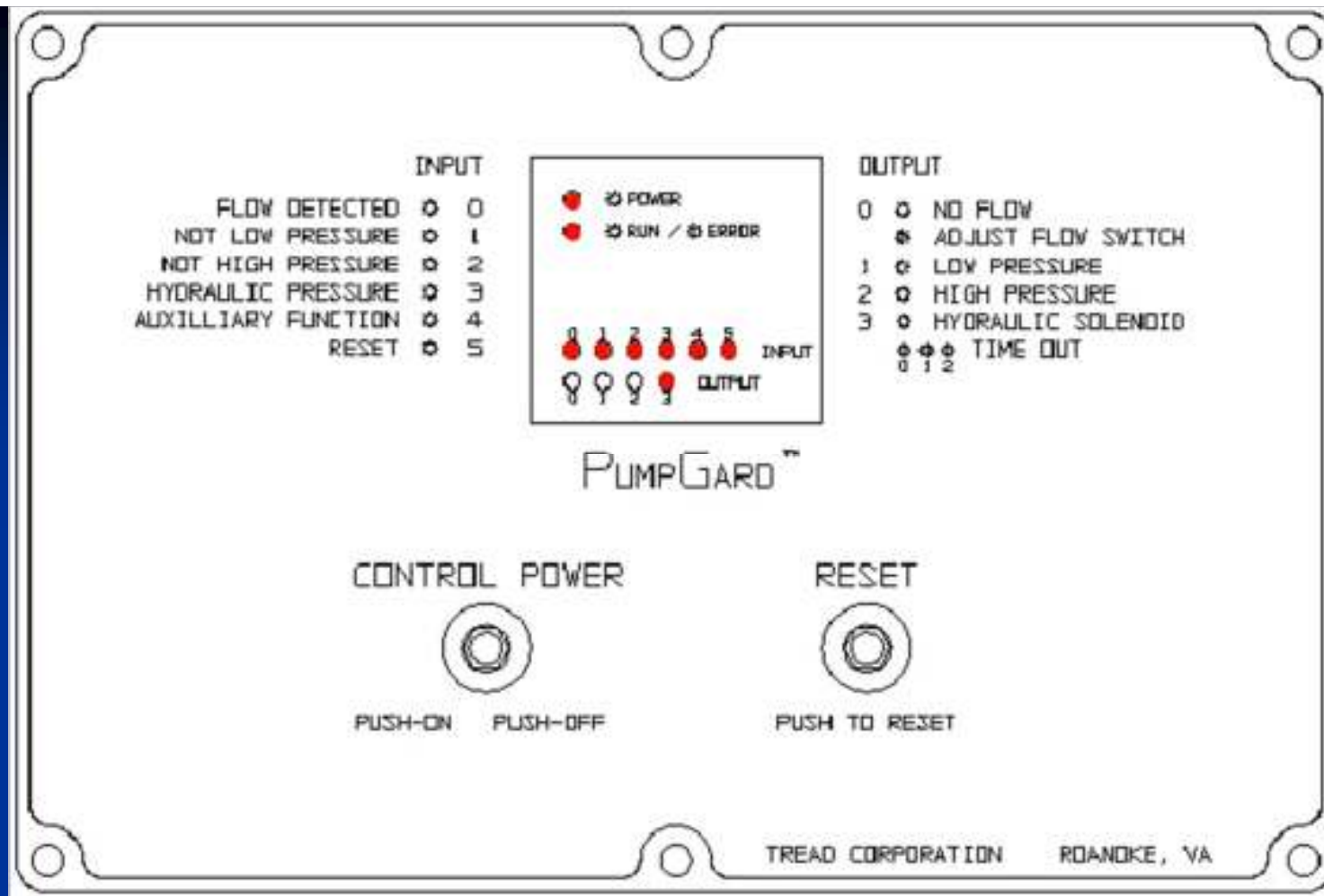
7. Does not check second tank

8. Truck is on slight incline

9. Second suction port is now exposed to atmosphere.



9. Progressive cavity pump is centered on the two tanks providing equal suction characteristics when both valves are open.
10. Off load procedure calls for the first tank emptied to be closed. This does not occur.
11. Operator now resets system for the third time.
12. Before completion of the third run cycle, there is a low order event. The hose is ruptured and separated from the pump and hose reel.
13. A product expands back through both tank valve openings and a heavy black discharge is found in both tanks.
14. The operator stops the pump manually and calls his supervisor.

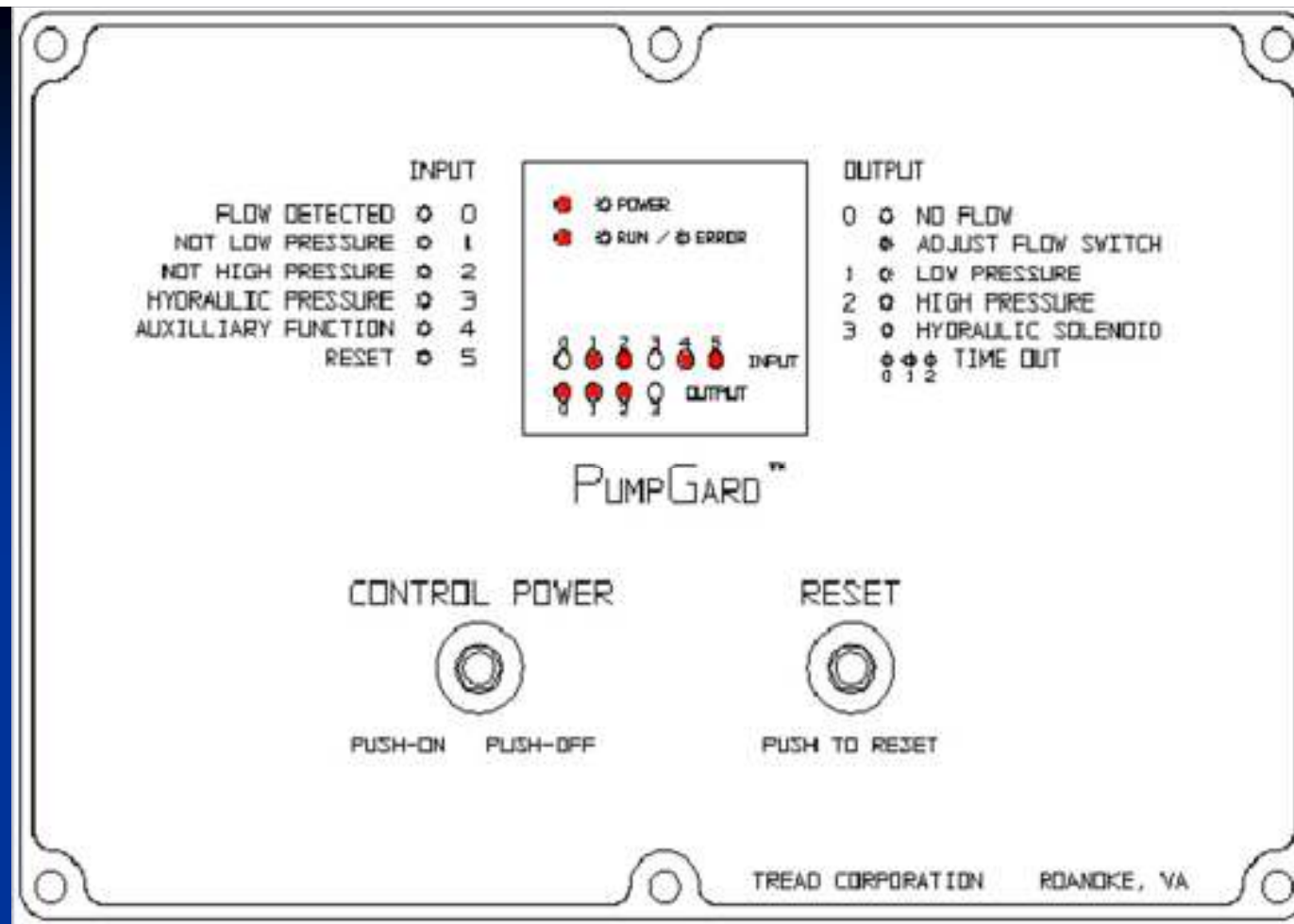


This is the control panel view as the operator would have seen it.

During Pumping

Indicator Light	Indicator	Result
Input 0	(ON)	Flow switch was sensing flow
Input 1	(ON)	Low pressure exceeds low pressure switch rating
Input 2	(ON)	High pressure less than maximum setting
Input 3	(ON)	Hydraulic pressure applied to run system
Input 4	(ON)	Air switch input from tank vent/valve
Input 5	(ON)	Reset action is operable
Output 3	(ON)	Pump is in RUN position

Indicator Interpretation – Previous operator had rewired the system eliminating the Flow Switch. It was not possible for this sequence to appear.



This is the control panel view as the operator would have seen it – At Time Out and Pump Inhibit

Indicator Light	Indicator	Result
Input 0	(OFF)	Flow switch was not sensing flow
Input 1	(ON)	Low pressure exceeds low pressure switch rating
Input 2	(ON)	High pressure less than maximum setting
Input 3	(OFF)	Hydraulic pressure removed from system
Input 4	(ON)	Air switch input from tank vent/valve
Input 5	(ON)	Reset action is operable
Output 0/1/2	(ON/OFF)	Sequentially flashing Indicates exceeded maximum run time
Output 3	(ON)	Indicator is not illuminated Pump is in INHIBIT position

**Indicator Interpretation – Output 1/2/3
would be flashing Indication a Time Out**

Operator Gives Tread A Complete Report

- Tread Sends Technician to Correct All Systems Problems
- Tread Assembles On Site Training
- Customers Assembles Operators Annually
- Program Part of Annual Operator Training
- Tread Starts to Evaluate How to Prevent Occurrence in the Future

Goals for the New System

- Direct reading man machine interface.
- Pictorial representation
 - conditions
 - faults
- More durable components
- Direct read temperature monitor
 - shutoff capability
- Easy disassembly for cleaning the system
- More durable flow switch
 - remote adjustment
- IP 65 or better rated electrical components.

FLOW
INDICATOR

PUMPING
PRESSURE

PUMP IS
RUNNING

86 psi



86°F

PRODUCT
TEMPERATURE

NO FLOW
INDICATOR

PUMP NOT
RUNNING

18 psi

82°F



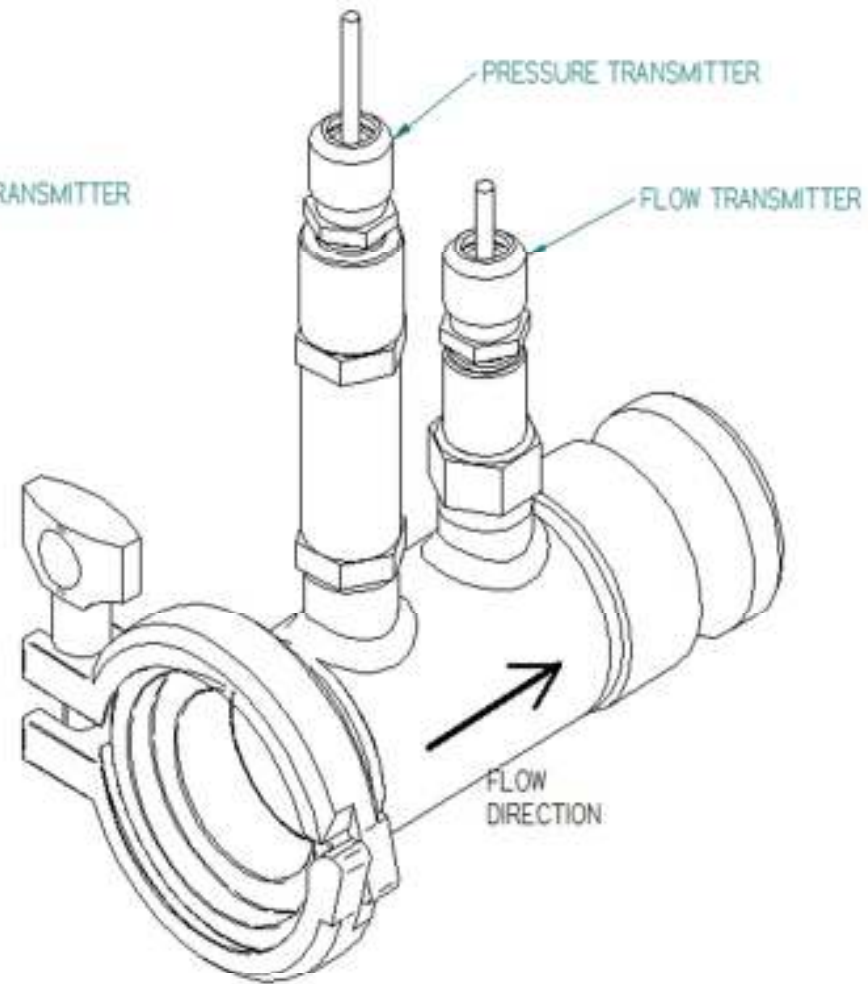
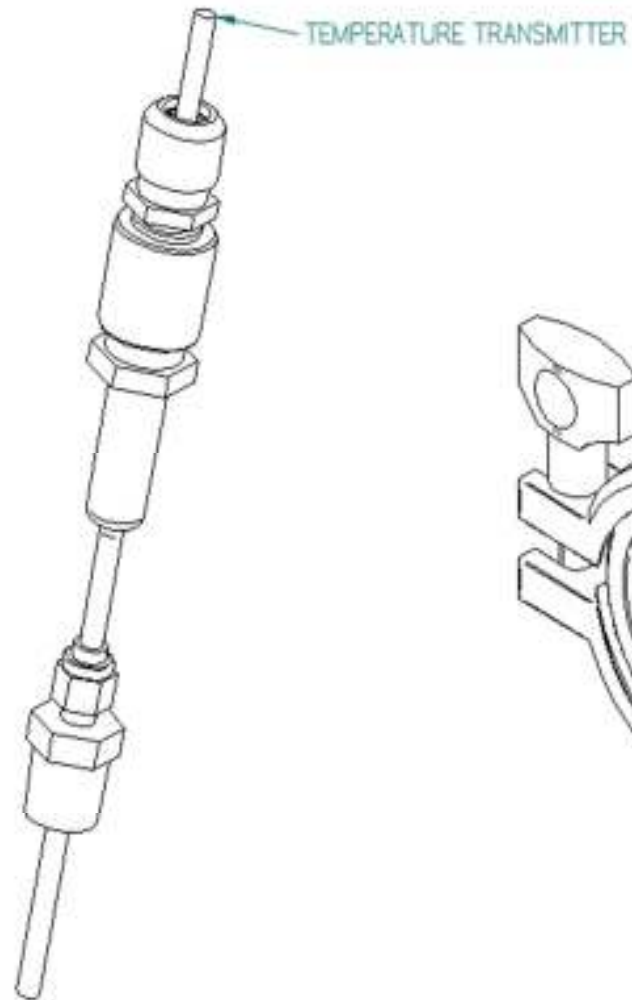
18 psi

H₂O



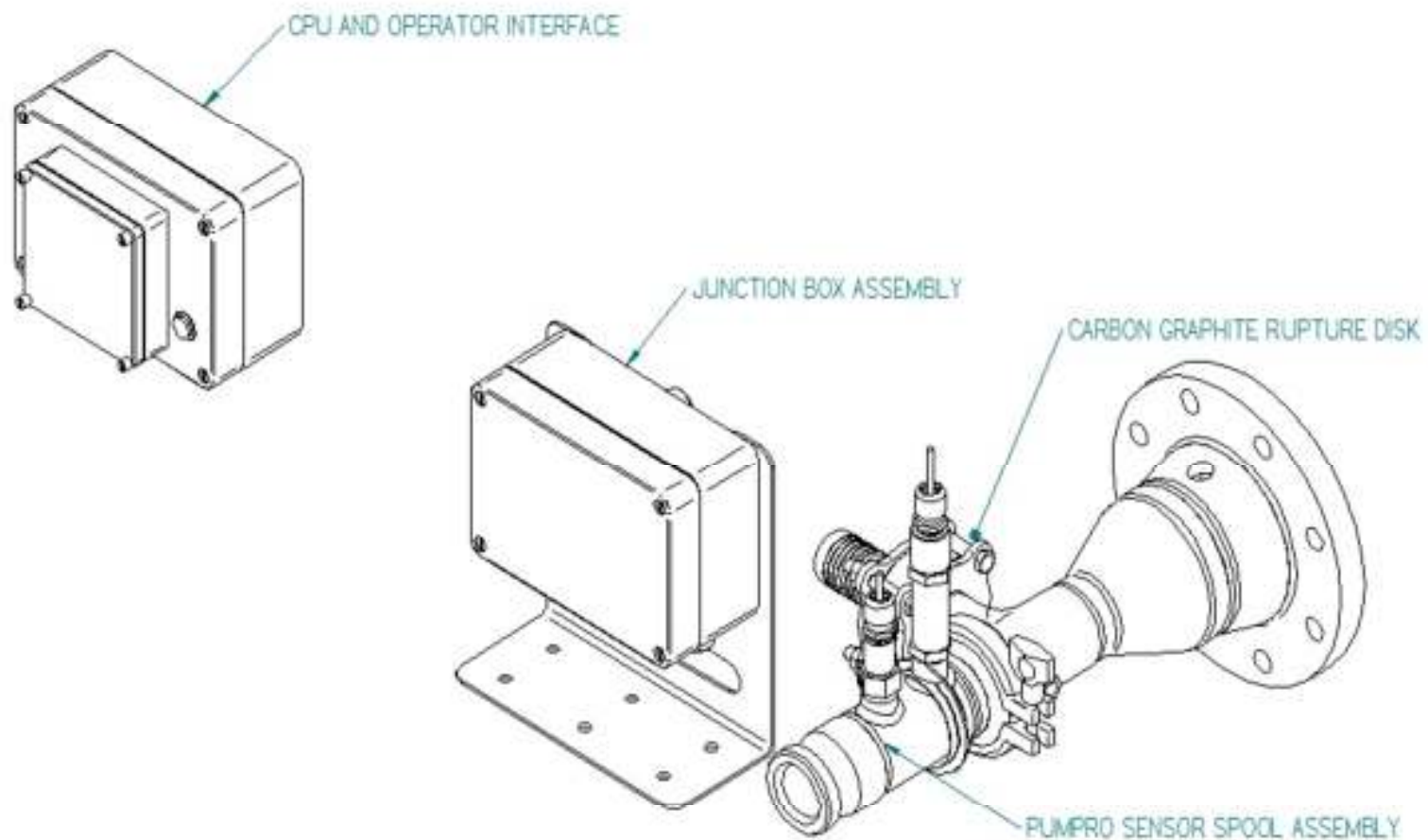
82°F

PUMPPRO SPOOL ASSEMBLY

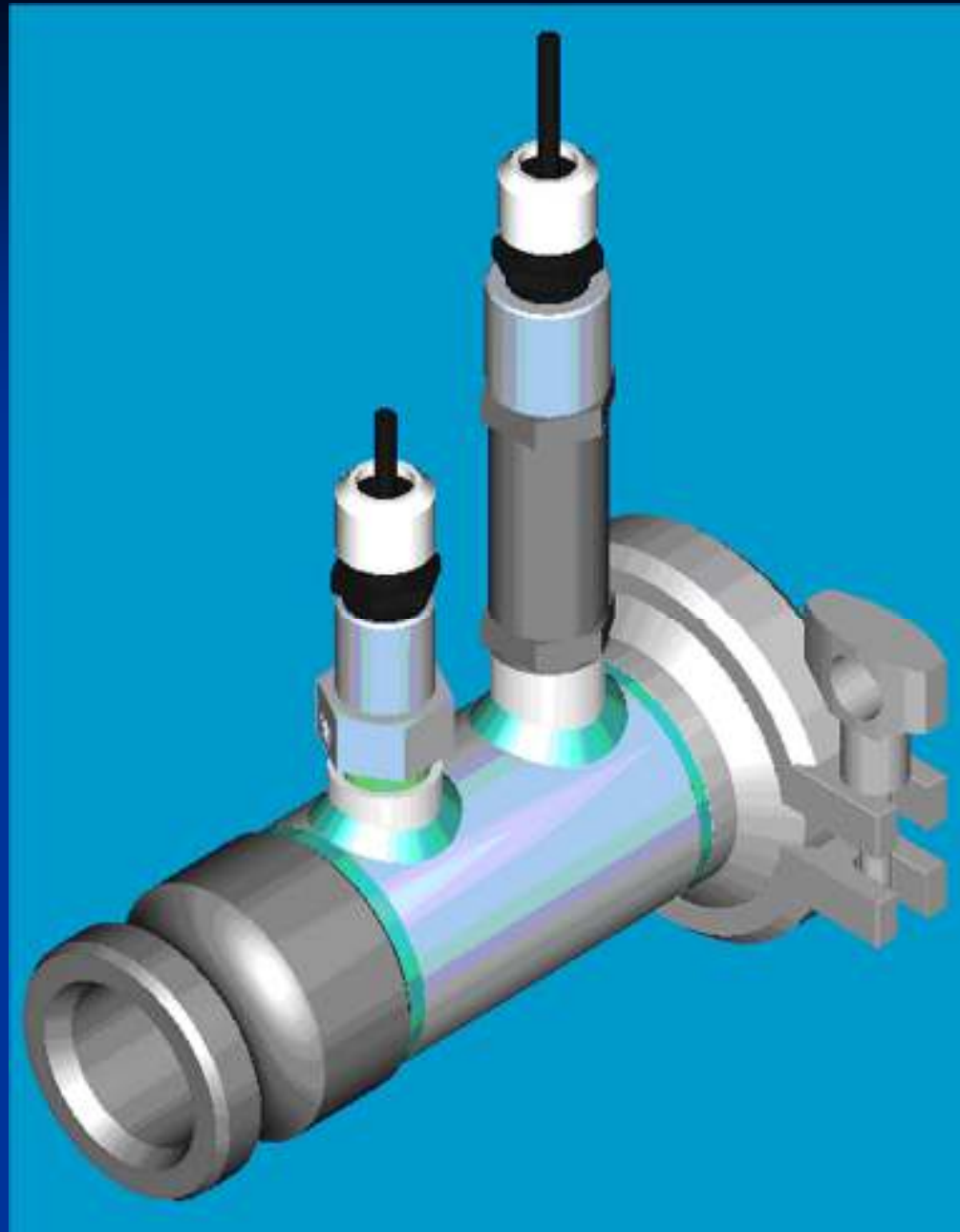


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PUMPPRO ASSEMBLY



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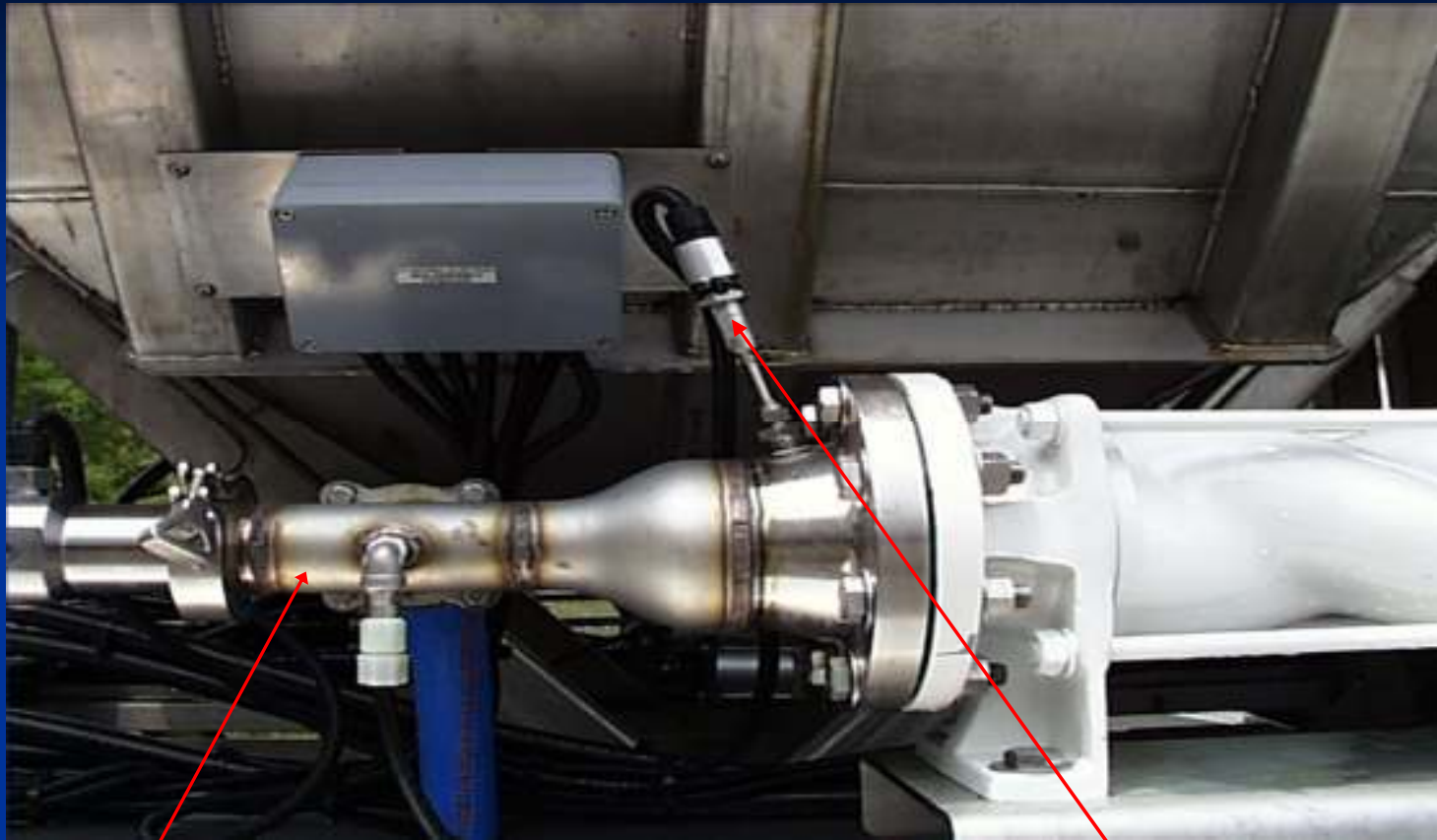




**PumpPro
Sensor Spool**

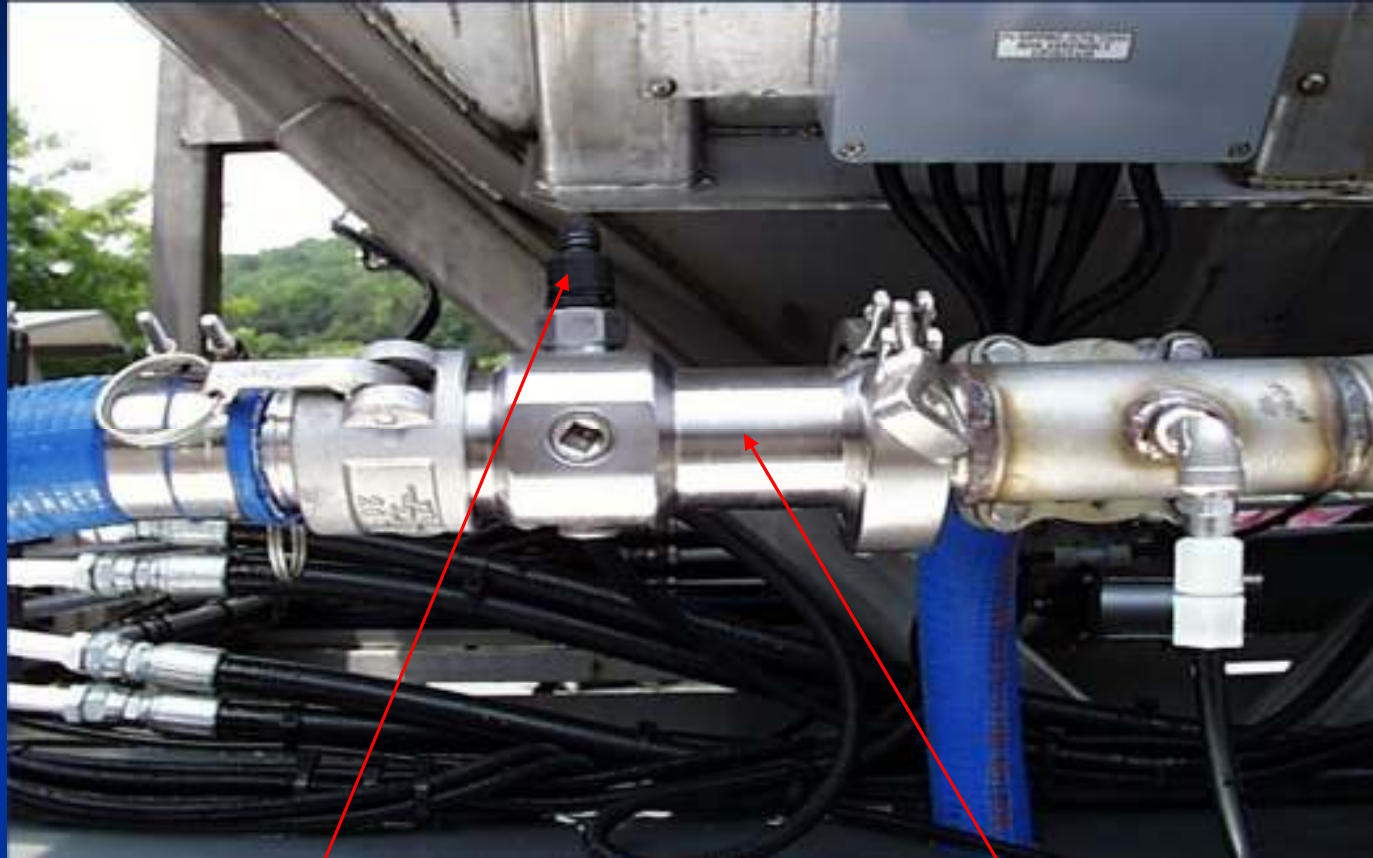
**Turk Flow
Monitor**

**Kobold
Temperature
Transmitter**



**Burst Disc
Assembly**

**Kobold
Temperature
Transmitter**



**Turk Flow
Monitor**

**PumpPro Sensor
Spool**

Recommendations

- Pump Safety System
 - Acceptable to Explosives Supplier
- Operator Training
 - Formal Annual Training
- Daily Checks
 - Verification of System operation
- Responsible Maintenance
 - Expeditiously Repaired
- Quarterly Re-Qualification
 - Full System Verification Quarterly

Conclusion

- **Operator Training Is First Line Of Safety**
- **Pump Safety System must be**
 - **Fully Understood**
 - **User Friendly**
 - **Durable**
 - **Well Maintained**
- **Explosives Pumping Carries an Inherent Risk**

Questions?