NACT 262 FUGITIVE VOC EMISSIONS

COURSE OVERVIEW

- Regulated Facilities
- Components
- Estimating Emissions
- Regulations and Standards
- Method 21
- Field Inspections

DEFINITION OF LDAR

- LDAR IS A WORK PRACTICE DESIGNED TO IDENTIFY LEAKING EQUIPMENT SO THAT EMISSIONS CAN BE REDUCED THROUGH REPAIRS.
- A COMPONENT THAT IS SUBJECT TO LDAR REQUIREMENTS MUST BE MONITORED AT SPECIFIED, REGULAR INTERVALS TO DETERMINE WHETHER OR NOT IT IS LEAKING. ANY LEAKING COMPONENT MUST THEN BE REPAIRED OR REPLACED WITHIN A SPECIFIED TIME FRAME.

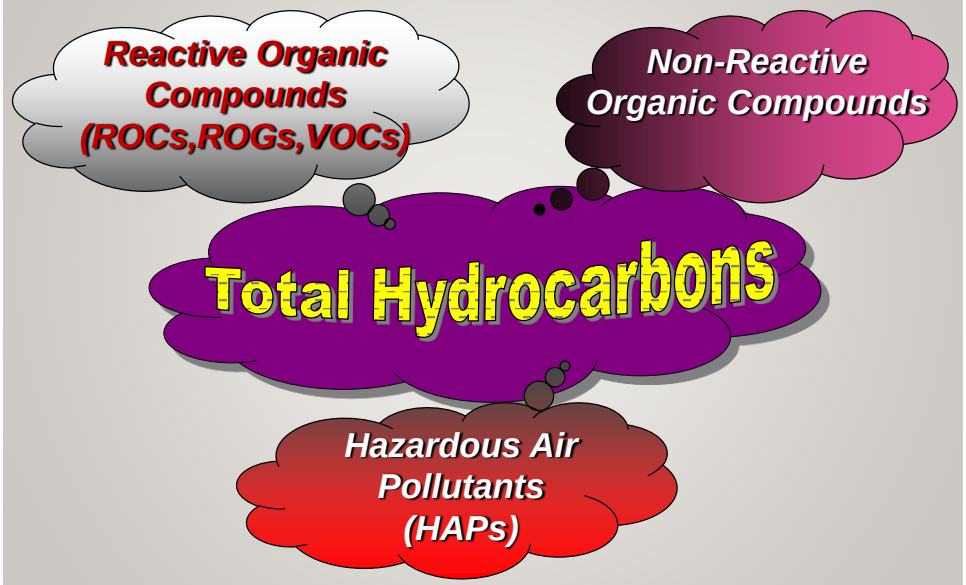
ELEMENTS OF AN LDAR PROGRAM

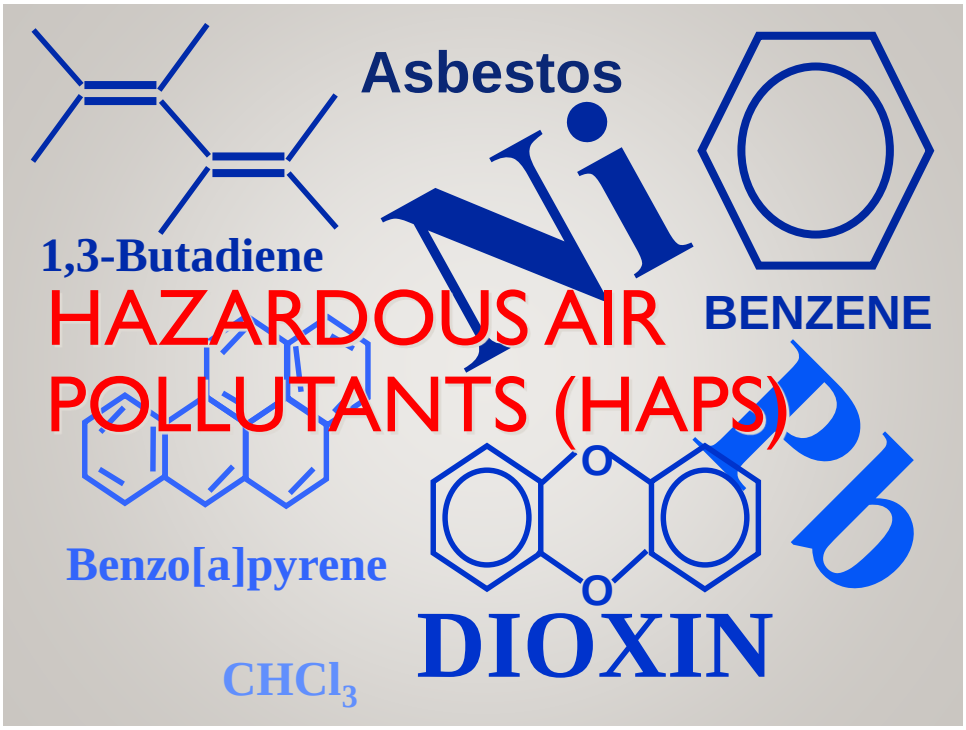
- LDAR programs. Identifying Components
- Leak Definition
- Monitoring Components
- Repairing Components
- Recordkeeping

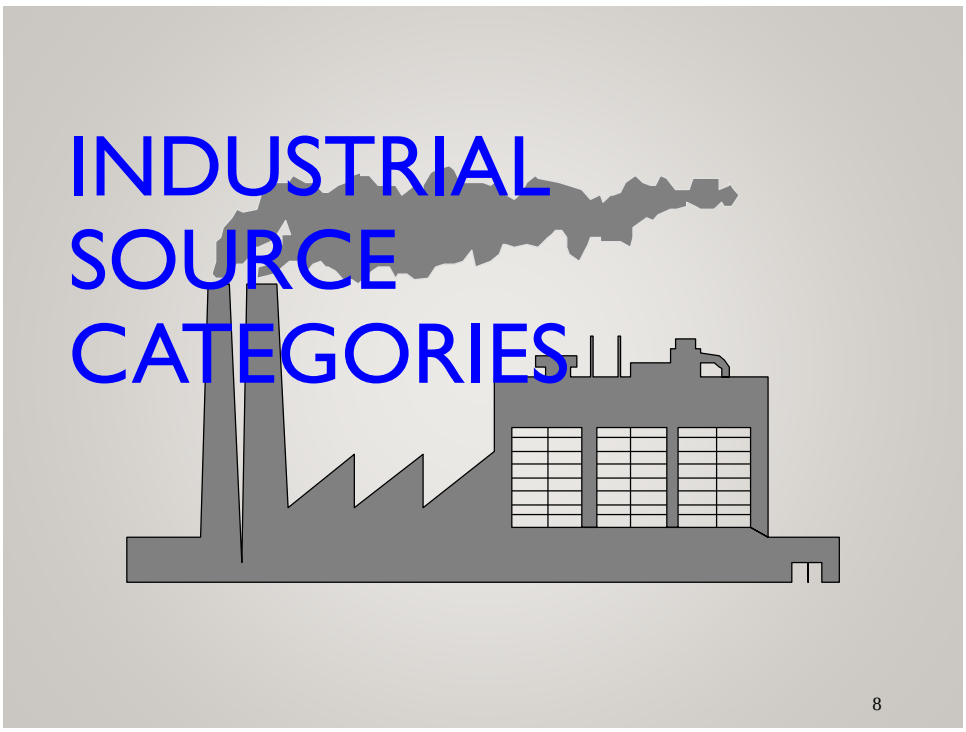
WHY CHECK FOR LEAKS?

- Public Health
- Safety
- Reliability
- Economic

THE BAD GUYS




Asbestos
1,3-Butadiene
Ni
BENZENE
HAZARDOUS AIR POLLUTANTS (HAPS)
Pb
Benzo[a]pyrene
DIOXIN
$CHCl_3$


INDUSTRIAL SOURCE CATEGORIES
8

CARB 262 – Fugitive VOC Inspections

CARB 262 – Fugitive VOC Inspections

EPA SOURCE CATEGORIES

- NSPS *(40 CFR 60)*
  - SOCMIs *(Subpart VV)*
  - Petroleum Refineries *(Subpart GGG)*
  - Natural Gas Processing Plants *(Subpart KKK)*
  - Polymer Manufacturing Plants *(Subpart DDD)*
  - Oil & Natural Gas (Proposed Subpart OOOOb, c & Appendix K)
- NESHAP *(40 CFR 61)*
  - Benzene *(Subparts J & V)*
  - Vinyl Chloride *(Subpart F)*
- HON *(40 CFR 63, Subpart H)*
- RCRA *(40 CFR 264, 265, Subparts AA, BB)*
  - Hazardous Waste TSDFs

CARB 262 – Fugitive VOC Inspections

Appendix A
Federal Regulations That Require a Formal LDAR Program With Method 21
40 CFR

Part	Subpart	Regulation Title
60	VV	SOCMI VOC Equipment Leaks NSPS
60	DDD	Volatile Organic Compound (VOC) Emissions from the Polymer Manufacturing Industry
60	GGG	Petroleum Refinery VOC Equipment Leaks NSPS
60	KKK	Onshore Natural Gas Processing Plant VOC Equipment Leaks NSPS
61	J	National Emission Standard for Equipment Leaks (Fugitive Emission Sources) of Benzene
61	V	Equipment Leaks NESHAP
63	H	Organic HAP Equipment Leak NESHAP (HON)
63	I	Organic HAP Equipment Leak NESHAP for Certain Processes
63	J	Polyvinyl Chloride and Copolymers Production NESHAP
63	R	Gasoline Distribution Facilities (Bulk Gasoline Terminals and Pipeline Breakout Stations)
63	CC	Hazardous Air Pollutants from Petroleum Refi neries
63	DD	Hazardous Air Pollutants from Off-Site Waste and Recovery Operations
63	SS	Closed Vent Systems, Control Devices, Recovery Devices and Routing to a Fuel Gas System or a Process
63	TT	Equipment Leaks – Control Level 1
63	UU	Equipment Leaks – Control Level 2
63	YY	Hazardous Air Pollutants for Source Categories: Generic Maximum Achievable Control Technology Standards
63	GGG	Pharmaceuticals Production
63	III	Hazardous Air Pollutants from Flexible Polyurethane Foam Production
63	MMM	Hazardous Air Pollutants for Pesticide Active Ingredient Production
63	FFFF	Hazardous Air Pollutants: Miscellaneous Organic Chemical Manufacturing
63	GGGGG	Hazardous Air Pollutants: Site Remediation
63	HHHHH	Hazardous Air Pollutants: Miscellaneous Coating Manufacturing
65	F	Consolidated Federal Air Rule – Equipment Leaks
264	BB	Equipment Leaks for Hazardous Waste TSDFs
265	BB	Equipment Leaks for Interim Status Hazardous Waste TSDFs

Note: Many of these regulations have identical requirements, but some have different applicability and control requirements.

Appendix B
Federal Regulations That Require the Use of Method 21 But Do Not Require a Formal LDAR Program
40 CFR

Part	Subpart	Regulation Title
60	XX	Bulk Gasoline Terminals
60	QQQ	VOC Emissions from Petroleum Refinery Wastewater Systems
60	WWW	Municipal Solid Waste Landfills
61	F	Vinyl Chloride
61	L	Benzene from Coke By-Products
61	BB	Benzene Transfer
61	FF	Benzene Waste Operations
63	G	Organic Hazardous Air Pollutants from SOCMI for Process Vents, Storage Vessels, Transfer Operations, and Wastewater
63	M	Perchloroethylene Standards for Dry Cleaning
63	S	Hazardous Air Pollutants from the Pulp and Paper Industry
63	Y	Marine Unloading Operations
63	EE	Magnetic Tape Manufacturing Operations
63	GG	Aerospace Manufacturing and Rework Facilities
63	HH	Hazardous Air Pollutants from Oil and Gas Production Facilities
63	OO	Tanks – Level 1
63	PP	Containers
63	QQ	Surface Impoundments
63	VV	Oil/Water, Organic/Water Separators
63	HHH	Hazardous Air Pollutants from Natural Gas Transmission and Storage
63	JJJ	Hazardous Air Pollutant Emissions: Group IV Polymers and Resins
63	VVV	Hazardous Air Pollutants: Publicly Owned Treatment Works
65	G	CFAR – Closed Vent Systems
264	AA	Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities - Process Vents
264	CC	Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities - Tanks, Surface Impoundments, Containers
265	AA	Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities – Process Vents
265	CC	Interim Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities - Tanks, Surface Impoundments, Containers
270	B	Hazardous Waste Permit Program – Permit Application
270	J	Hazardous Waste Permit Program – RCRA Standardized Permits for Storage Tanks and Treatment Units

SOURCES OF EQUIPMENT LEAKS

- PUMPS
- VALVES
- CONNECTORS
- SAMPLING CONNECTIONS
- COMPRESSORS
- PRESSURE RELIEF DEVICES
- OPEN-ENDED LINES

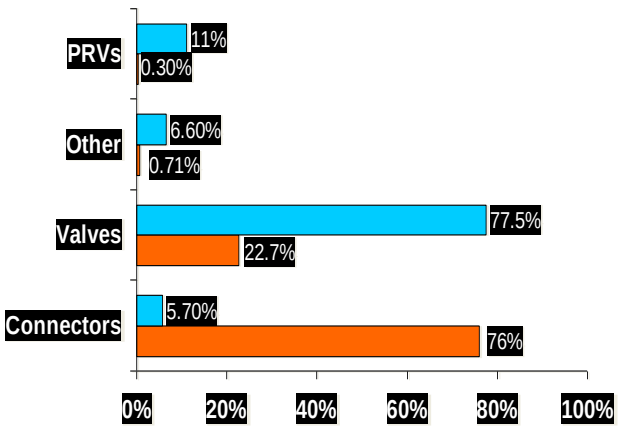
Equipment component counts at a typical refinery or chemical plant(1995)

Component	Range	Average
Pumps	10 – 360	100
Valves	150 – 46,000	7,400
Connectors	600 – 60,000	12,000
Open-ended lines	1 – 1,600	560
Samp connections	20 – 200	80
Pressure relief valv	5 – 360	90

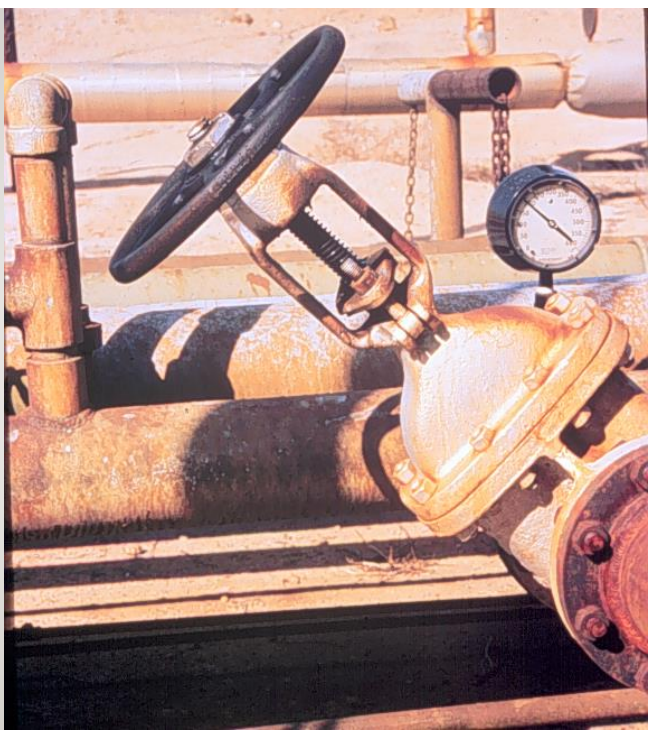
Uncontrolled VOC emissions at a typical facility (1995)

Component	Percent of Total Emissions
Pumps	3
Valves	62
Connectors	31
Open-ended lines	1
Sampling connections	2
Pressure relief valves	1
Total uncontrolled emissions	653 T/y

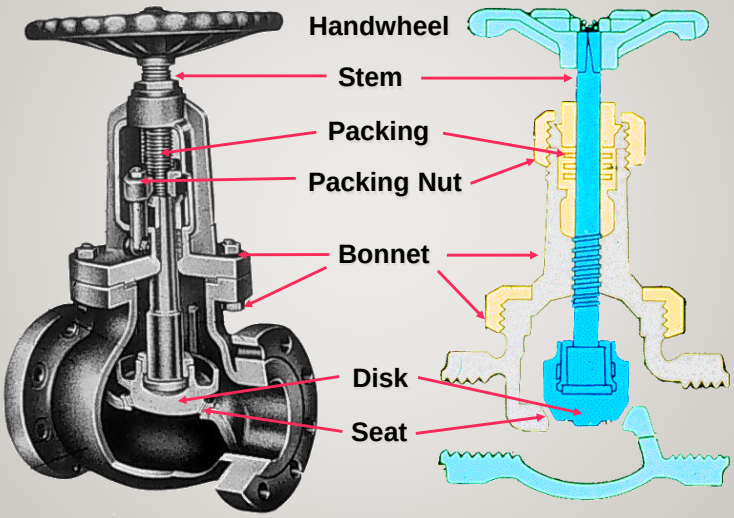
Component Population and Fugitive Emissions Profiles



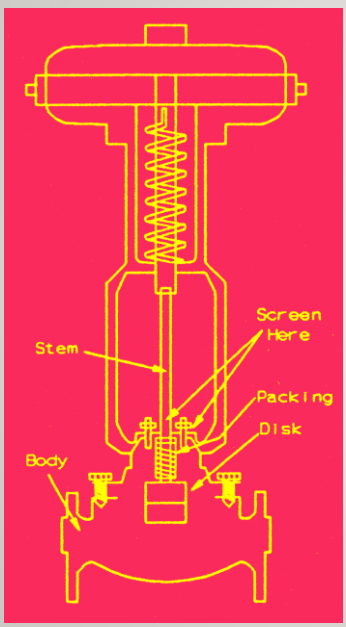
Valves



Manual Globe Valve

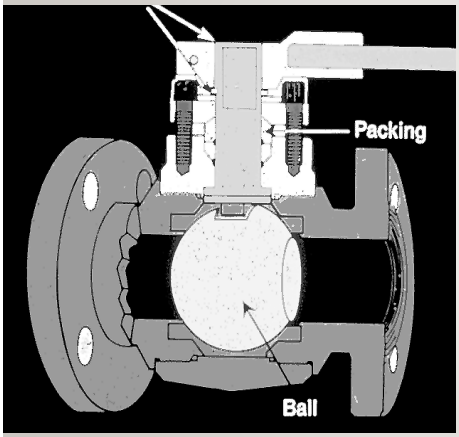


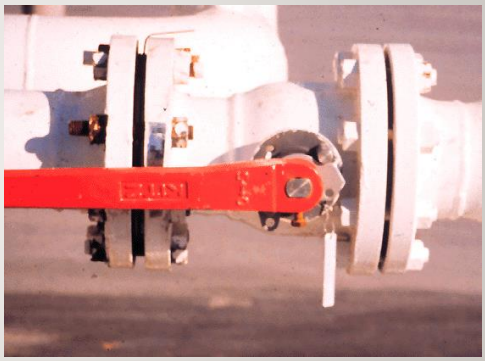
Control Valve



Ball Valve

Potential Leak Areas





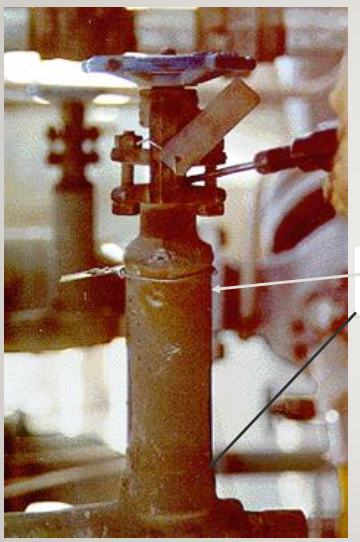
Gate Valve

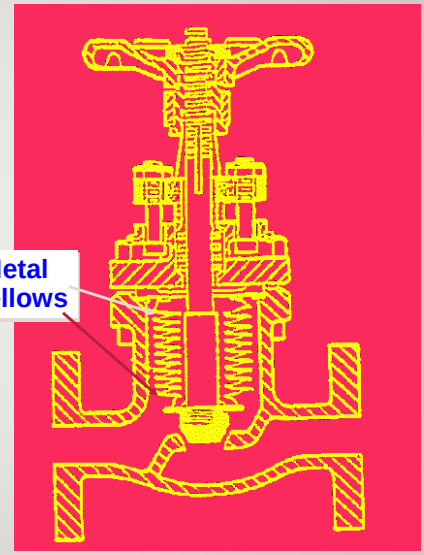
TYPES OF VALVE SEALS

- Packing Gland
- O-Rings
- Bellows Seal
- Diaphragm

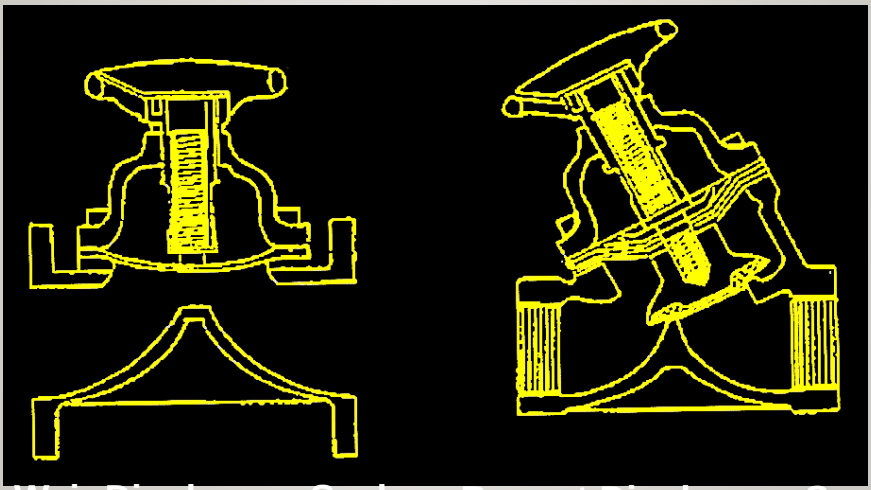
p. 33, 34

BELLOWS VALVE/SEAL





Diaphragm Valves



Weir Diaphragm Seal

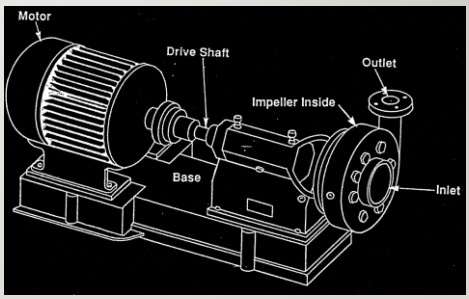
Bonnet Diaphragm Seal

FIRST ATTEMPT AT REPAIR FOR VALVES

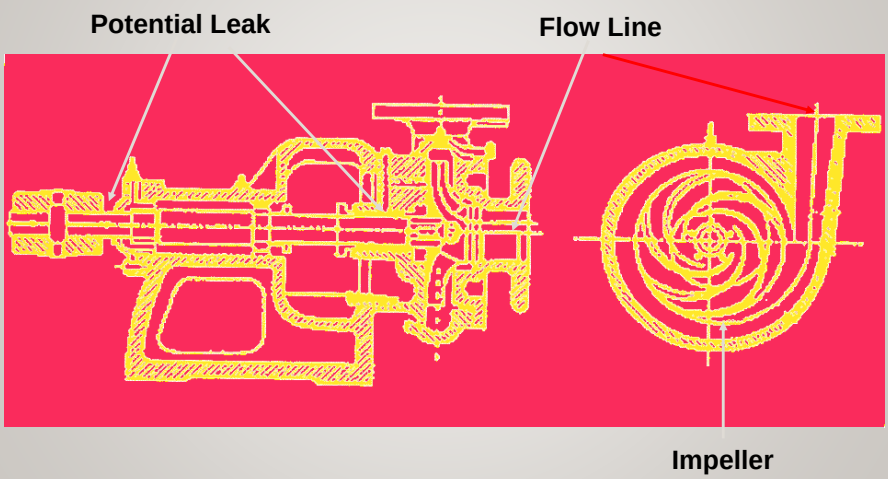
- Tightening bonnet bolts
- Replacing bonnet bolts
- Tightening packing gland nuts
- Injecting lubricant into lubricated packing

TYPES OF PUMPS

- Centifugal
- Rotary
- Reciprocating
- Canned
- Diaphragm
- Magnet Drive



CENTRIFUGAL PUMP



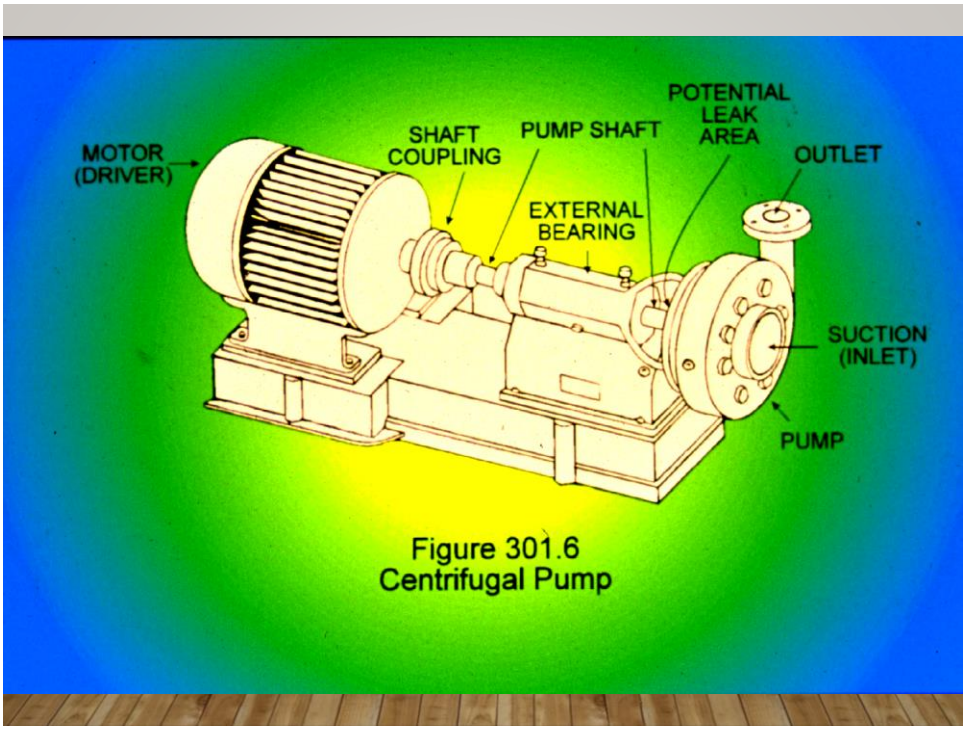
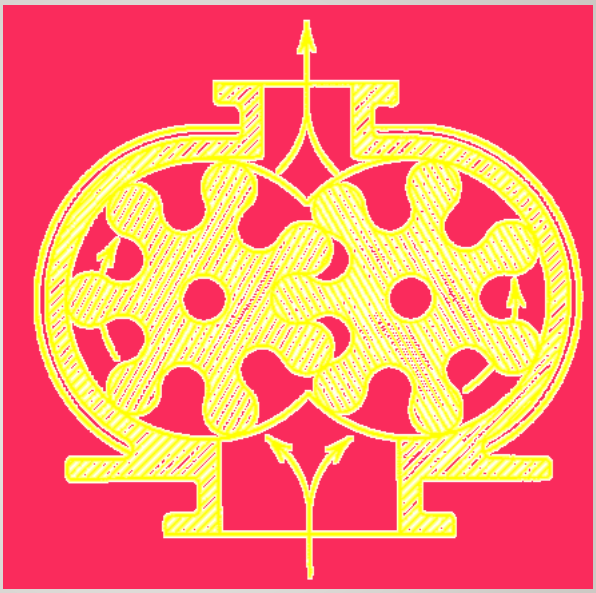


Figure 301.6
Centrifugal Pump

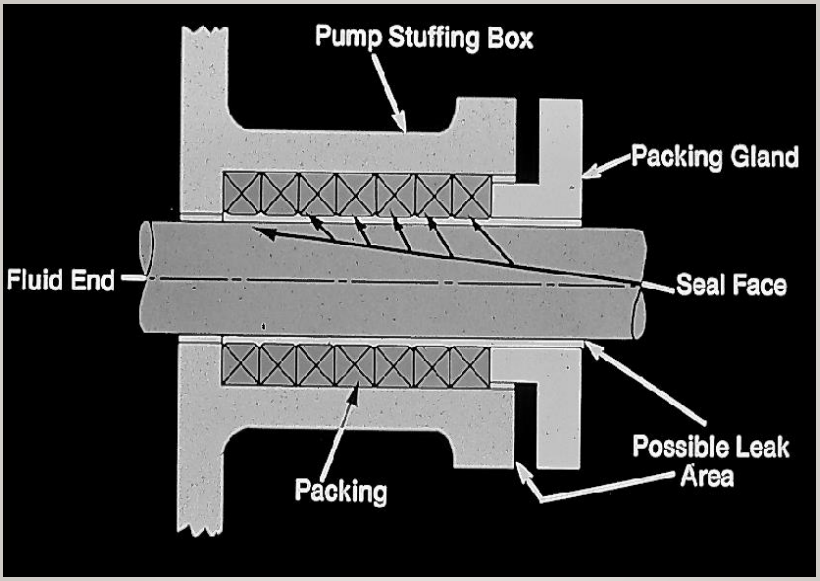
CENTRIFUGAL PUMP

ROTARY PUMP

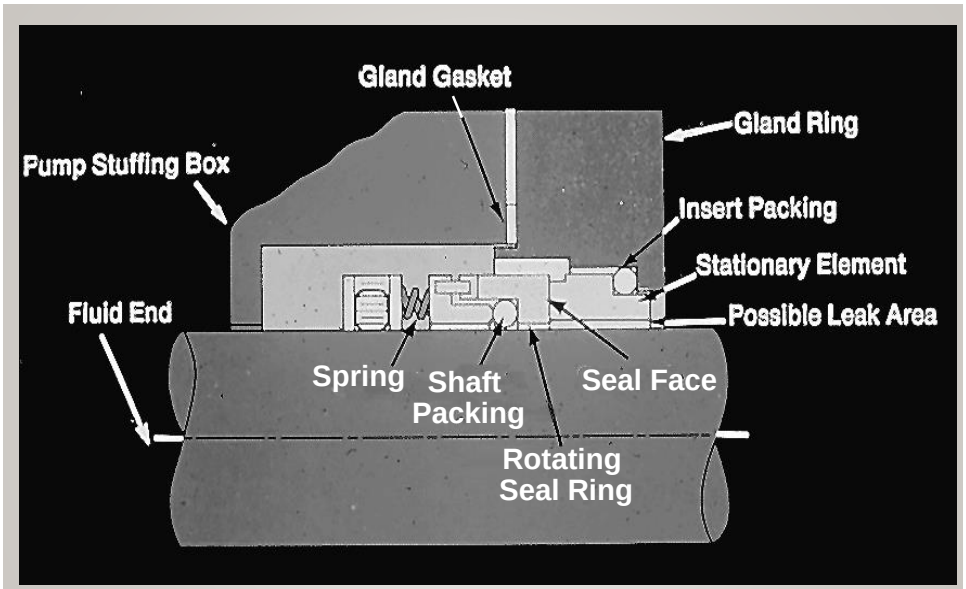


TYPES OF PUMP SEALS

- Simple Packed Seal
- Basic Single Mechanical Seal
- Dual Mechanical Seal
- Seal-Less
- Diaphragm Pump
- Magnet Drive Pump



Simple Packed Seal



Basic Single Mechanical Seal

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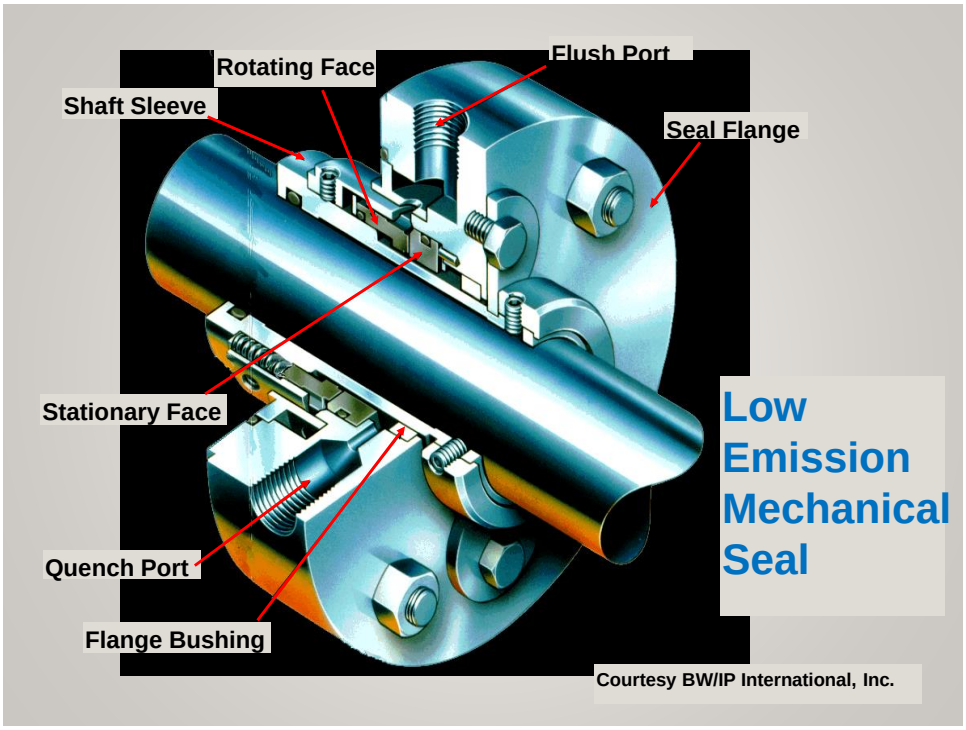
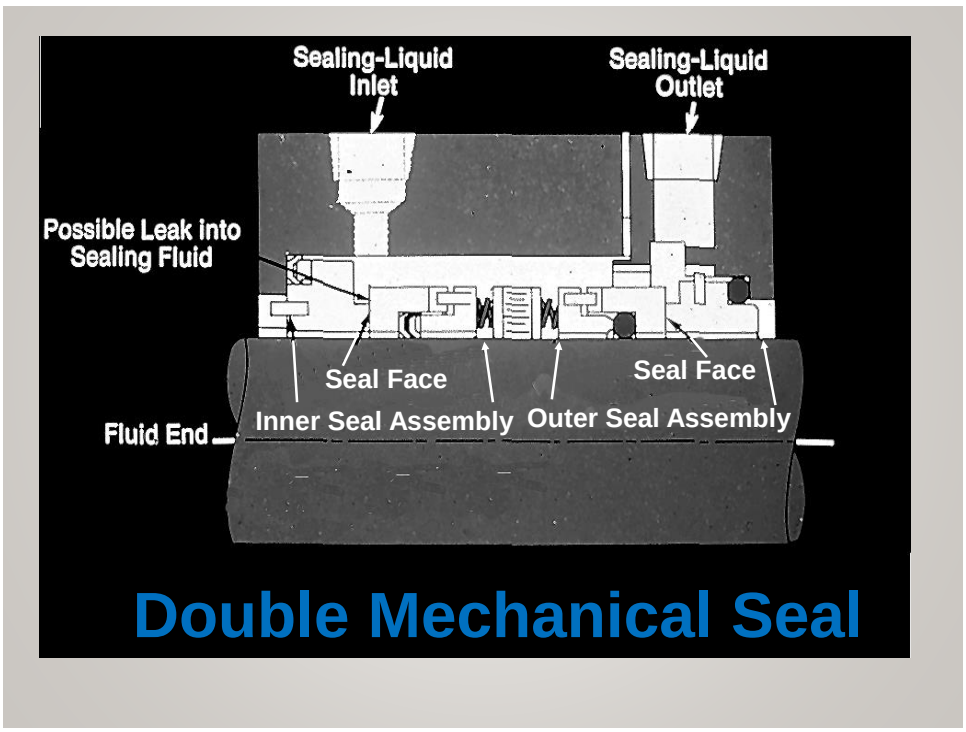
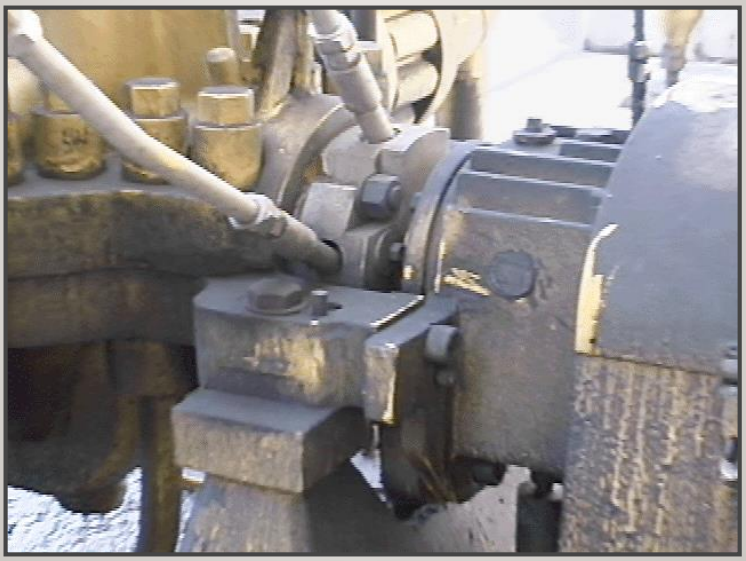
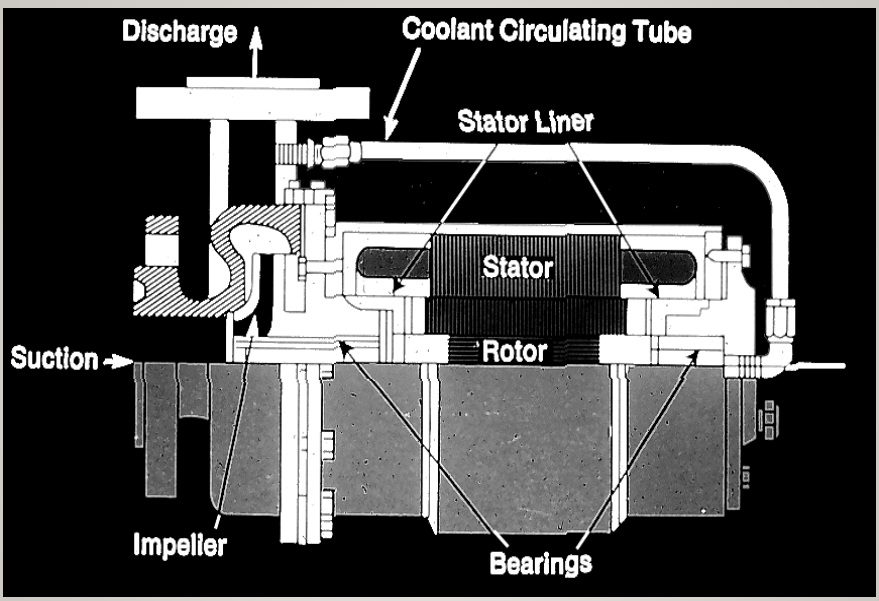


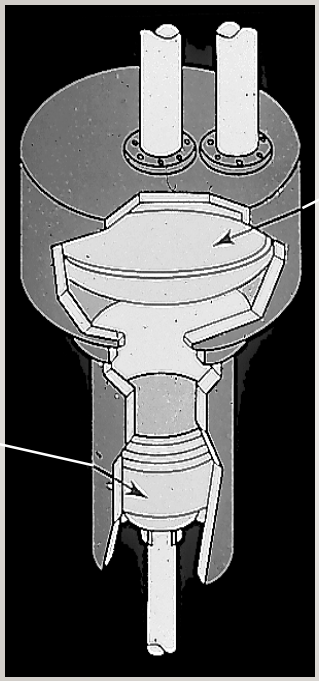


CENTRIFUGAL PUMP WITH DOUBLE MECHANICAL SEAL

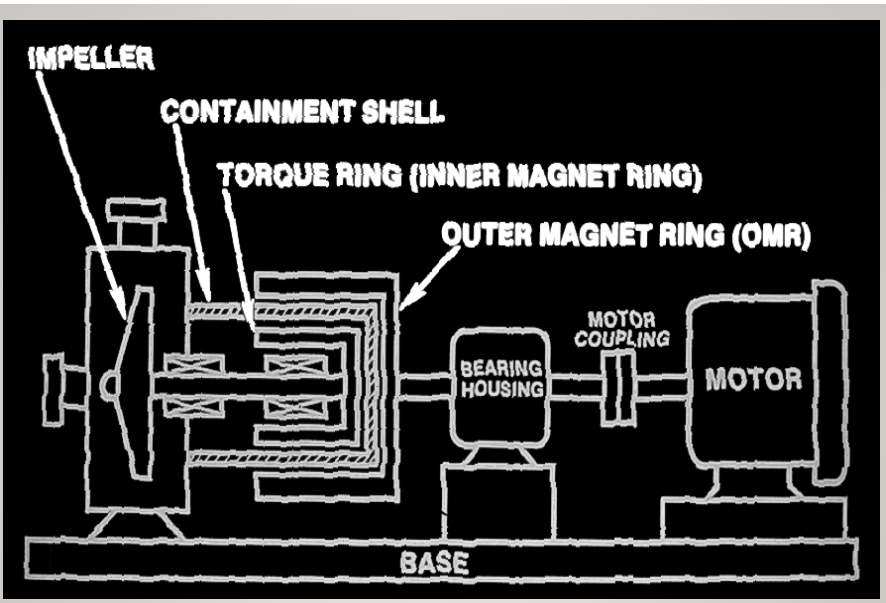




Seal-Less Canned Motor Pump



Diaphragm Pump



Magnet Drive Pump

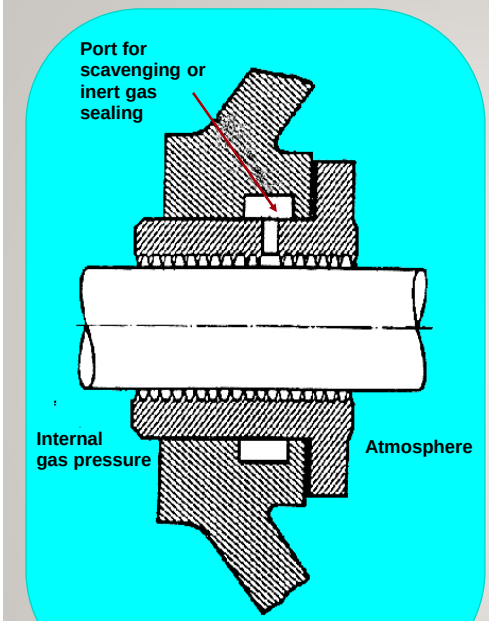
Magnet Drive Pump

TYPES OF COMPRESSORS

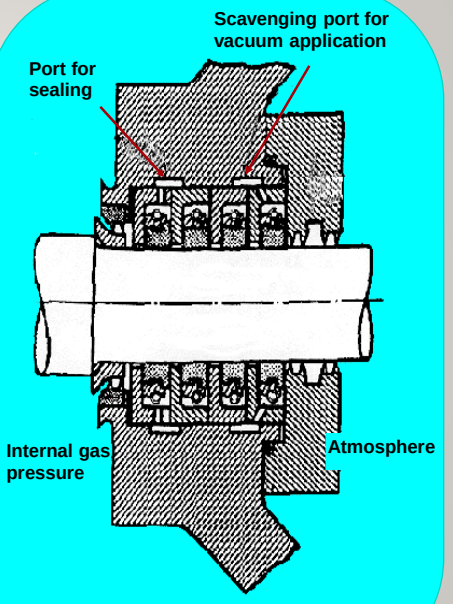
- Centrifugal
- Reciprocating
- Rotary

TYPES OF COMPRESSOR SEALS

- Labyrinth
- Restrictive Ring
- Mechanical
- Packed
- Liquid-Film



Labyrinth Seal



Restrictive Ring Seal

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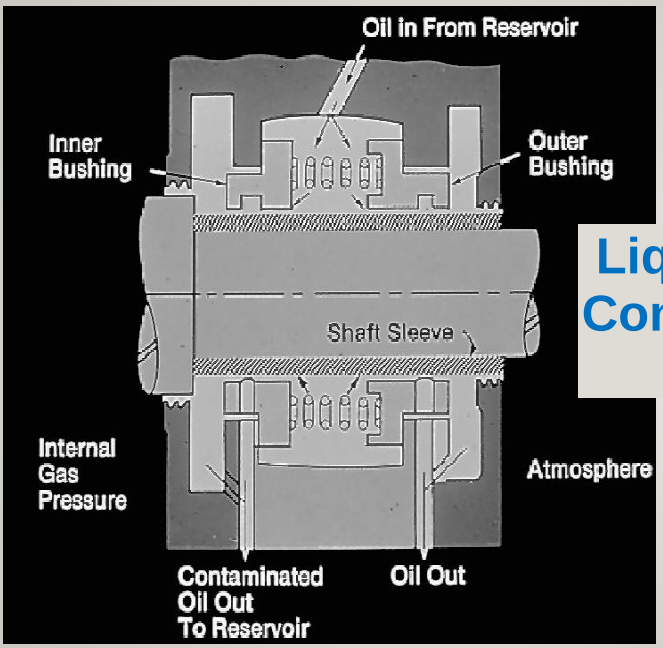


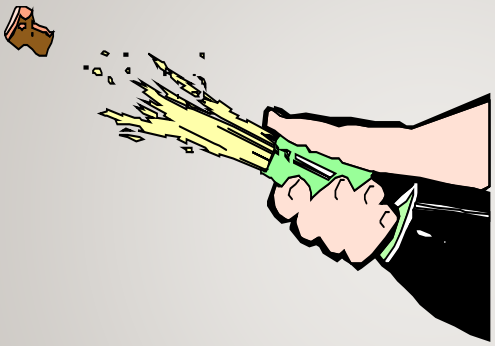
Liquid Film Compressor Seal

CLOSED VENT SYSTEMS

- Designed and operated for no detectable emissions
- Monitored at startup, annually, and as required by agency
- Facility owner/operator must verify operating parameters

CONTROL DEVICES

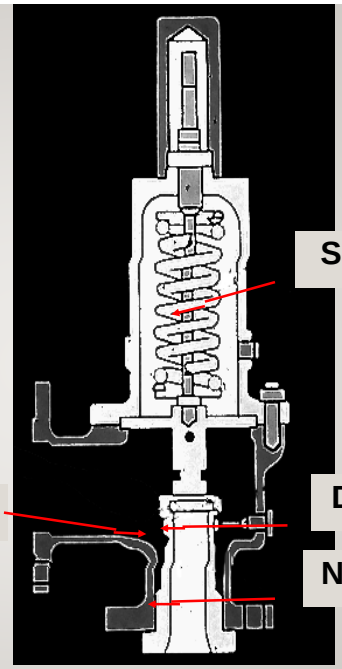
- *Vapor Recovery Systems*
  - 95% efficient
- *Incinerators/Oxidizers*
  - 95% efficient or minimum residence time and temperature
- *Flares*
  - Several conditions

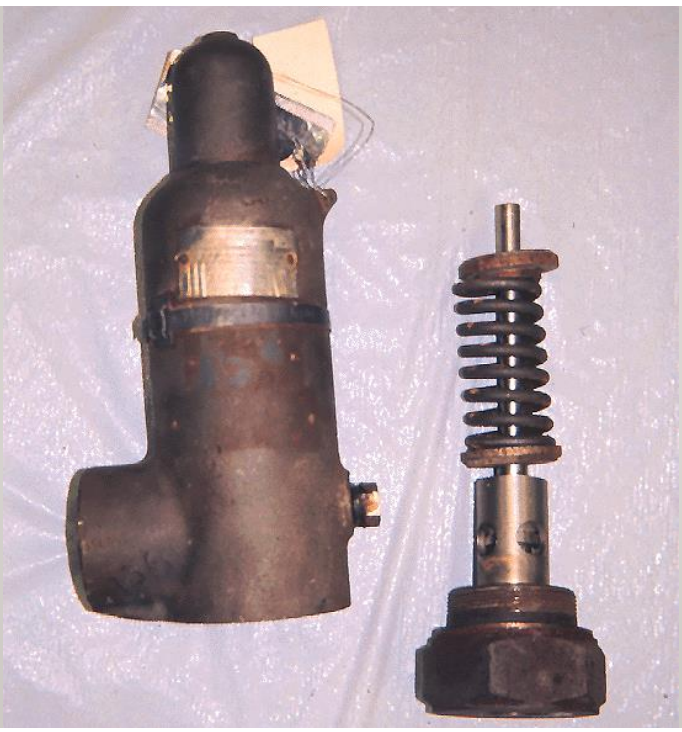


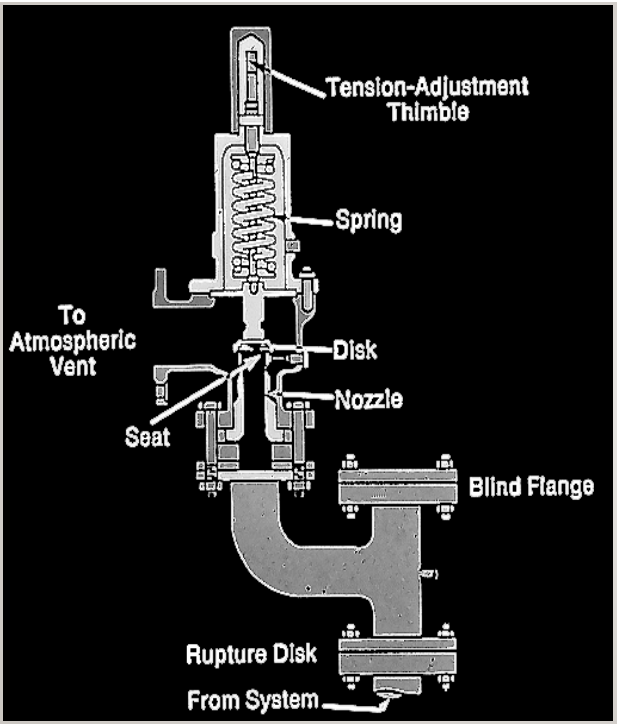
PRESSURE
RELIEF
DEVICES

Pressure Relief Valve

Spring-Loaded Pressure Relief Valve





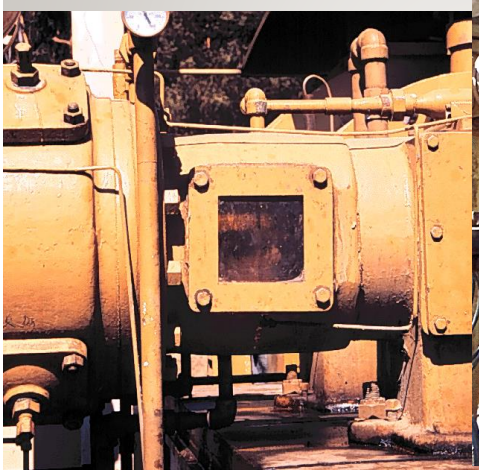


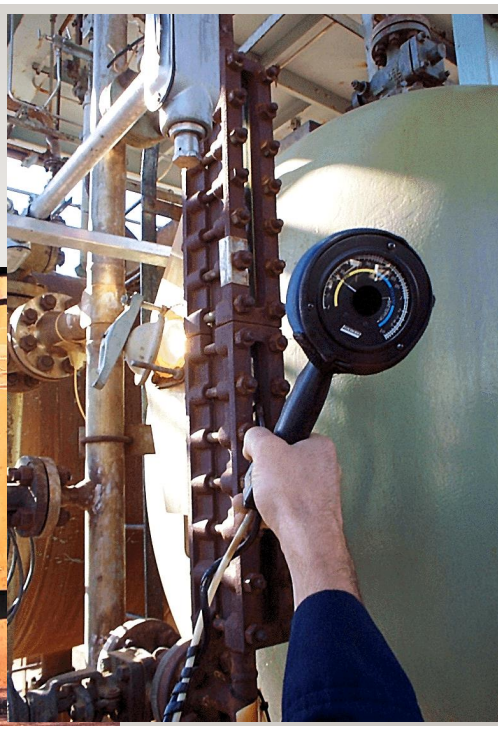
PRV with Rupture Disk

Screening Non-Vented PRVs

Open-Ended Line

Sight Glass

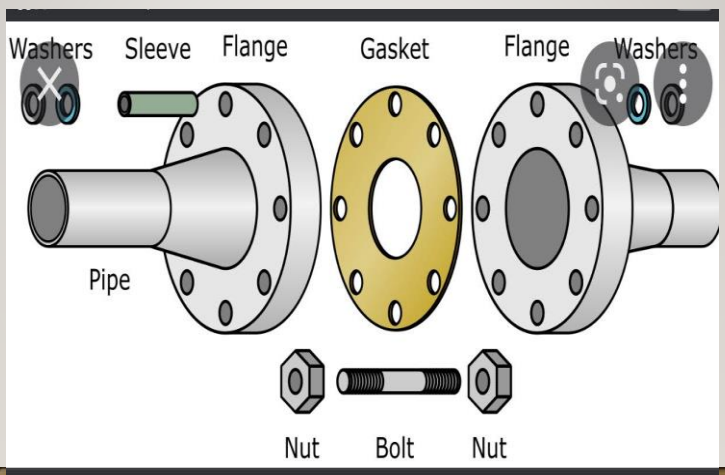




CONNECTORS

- Flanges
- Threaded
- Welded

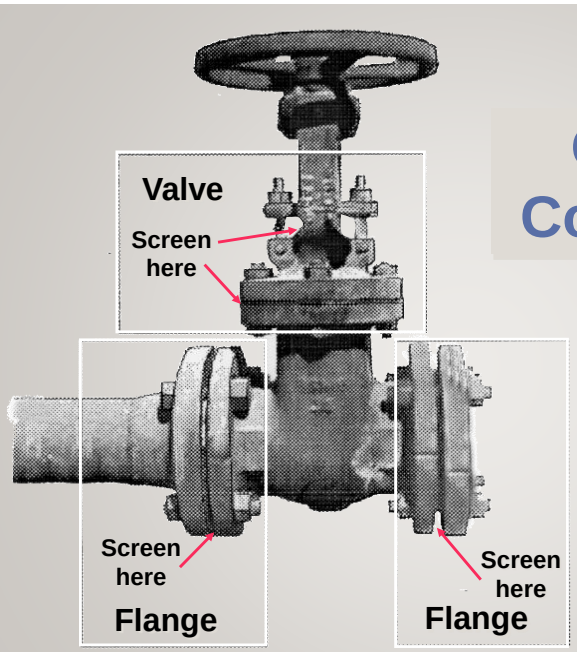
FLANGES



THREADED

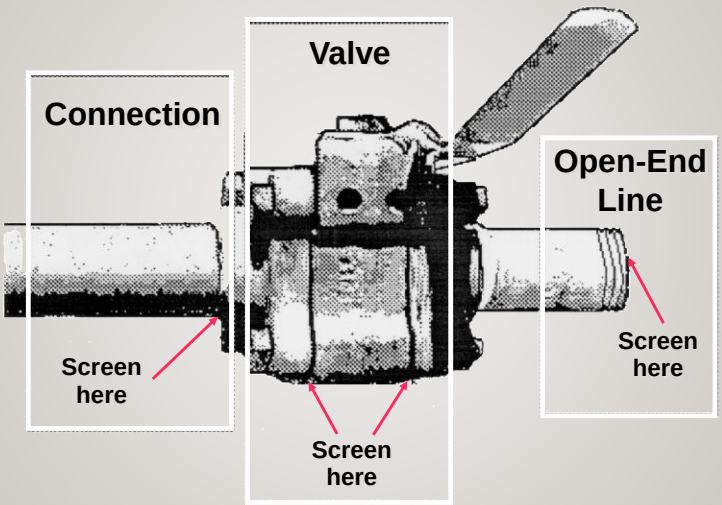
WELDED

AND NOW TO PUT IT ALL TOGETHER



Counting Components

Counting Components



Open-Ended Line?

How many components do you count?

ESTIMATING COMPONENT EMISSIONS

- Average Emission Factors
- Screening Value Ranges
- Correlation Equations
- Unit-Specific Correlation Equations

TYPES OF SERVICE

- Gas/vapor service
- Liquid service
  - light liquid service
  - heavy liquid service

IN VOC OR HAP SERVICE

VOC -- 10% by weight VOC

NSPS

HAP– 5% by weight total HAPs

MACT/NESHAPs

GAS/VAPOR SERVICE

- The equipment is in gas or vapor phase at the operating conditions
- Temperature / Pressure

LIQUID SERVICE

- The equipment is not is gas or vapor service

LIGHT LIQUID SERVICE

The total concentration of the organic compounds having a vapor pressure > 0.3 kPa at 20° C and

=>20% by weight of the total process stream and ls a liquid

HEAVY LIQUID SERVICE

- Means a piece of equipment is not in gas/vapor or in light liquid service

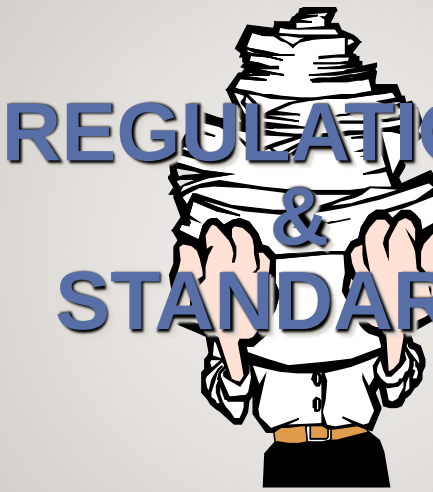
CARB 262 – Fugitive VOC Inspections

1995 EPA Protocol Refinery Average Emission Factors

Component	*Service*	*Emission Factor (kg/hr)*
Valves	Gas/Vapor	0.0268
	Light Liquid	0.0109
	Heavy Liquid	0.00023
Pump Seals	Light Liquid	0.114
	Heavy Liquid	0.0210
Compressor Seals	Gas/Vapor	0.636
Pressure Relief Valve	Gas/Vapor	0.160
Connectors	All	0. 00025
Open-Ended Lines	All	0.00230
Sampling Connections	All	0. 0150

1995 EPA Protocol Refinery Screening Value Range Emission Factors

Component	*Service*	*< 10,000 ppm Factor (kg/hr)*	*≥ 10,000 ppm Factor(kg/hr)*
Valves	Gas/Vapor	0.00060	0.2626
	Light Liquid	0.0017	0.0.0852
	Heavy Liquid	0.00023	0.00023
Pump Seals	Light Liquid	0.0120	0.437
	Heavy Liquid	0.0135	0.3885
Compressor Seals	All	0.0894	1.608
Pressure Relief Valves	Gas	0.0447	1.691
Connectors	All	0.000060	0.0375
Open-Ended Lines	All	0.00150	0.01195



GENERIC FUGITIVE VOC EMISSIONS REGULATIONS

- Applicability
- Exemptions
- Definitions
- Equipment Leak Standards/ LDAR Standards
- Identification Requirements
- Recordkeeping Requirements
- Test Methods
- Compliance Schedule

APPLICABILITY

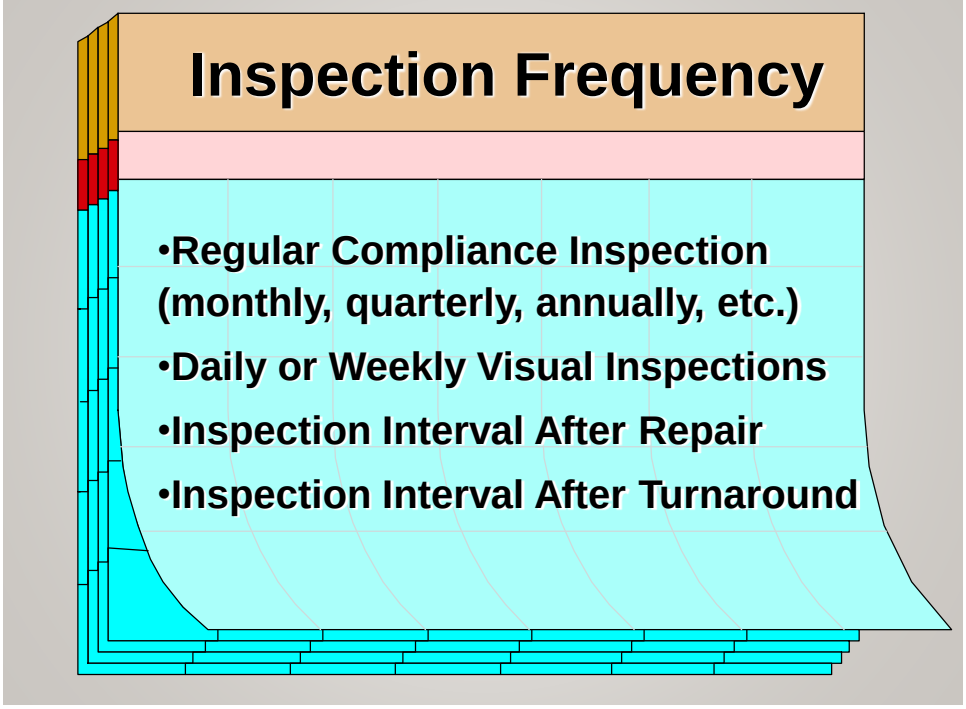
- Source Category
- Process Unit
- Equipment in process unit
- Process gas/fluid

TYPES OF STANDARDS

- Performance Standards
- Equipment Standards
- Work Practice Standards (LDAR)

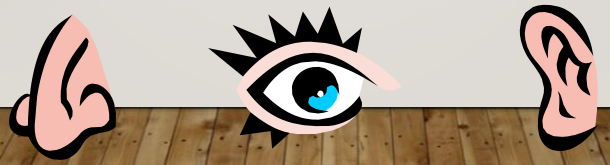
LEAK DETECTION AND REPAIR STANDARDS

- Inspection Frequency
- Definition of Leak
- Repair Interval
- Percentage Leaking

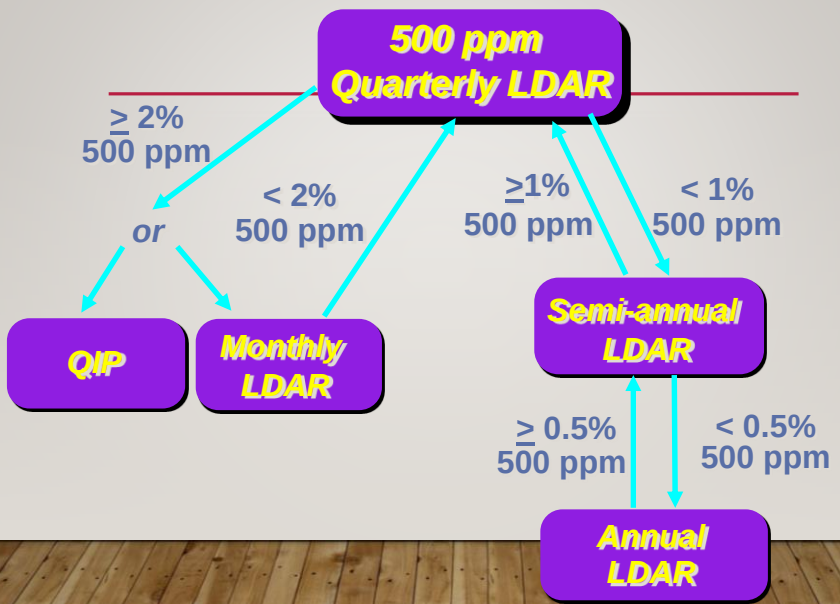


DEFINITION OF LEAK

- Basic standard: 10,000 ppm
- Range: 50,000 ppm - 100 ppm
- Liquid leaks : 3 (or more) drops per minute
- Other definitions



HON LDAR STANDARDS FOR VALVES



87

REPAIR INTERVAL

- Basic standard: 15 days
- First attempt: 5 days
- Range: 1-15 days
- Repeat leakers: Possible replacement
- Delay of Repair: Until next shutdown (DOR) 6-month to 5-year limit
- Percentage awaiting repair

COMPONENT IDENTIFICATION

- Tags
  - Inaccessible components tagged
  - Leaking components: brightly-colored, waterproof tag with date leak detected, other info
- P & IDs

RECORDKEEPING REQUIREMENTS

1. Component ID code, description, process unit, service, material transported, concentration, compliance method
2. Dates of inspection
3. Emission levels (compliance or leak) and method of detection
4. Dates of repair (or attempt) and reinspection
5. Emission levels after repair or replacement
6. Repair delayed, reason, expected date of repair
7. List and number of components awaiting repair
8. Portable monitoring instrument records

REPORTING REQUIREMENTS *(NSPS, NESHAP)*

- Notification of Construction or Reconstruction
- Initial Semiannual Reports
- Semiannual Reports
- Percentage of Valves Leaking

TEST METHODS

- EPA Method 21
- EPA Method 25
- ASTM Methods
- Alternative methods

PORTABLE HYDROCARBON ANALYZERS

- Types of VOC Analyzers
- Response Factors
- Method 21
- Factors in Selection and Use
- Safety Concerns

TYPES OF ANALYZERS USED FOR FUGITIVE INSPECTIONS

Flame Ionization Detector

(FID, OVA)

Catalytic Combustion Analyzer

(CCA, TLV)

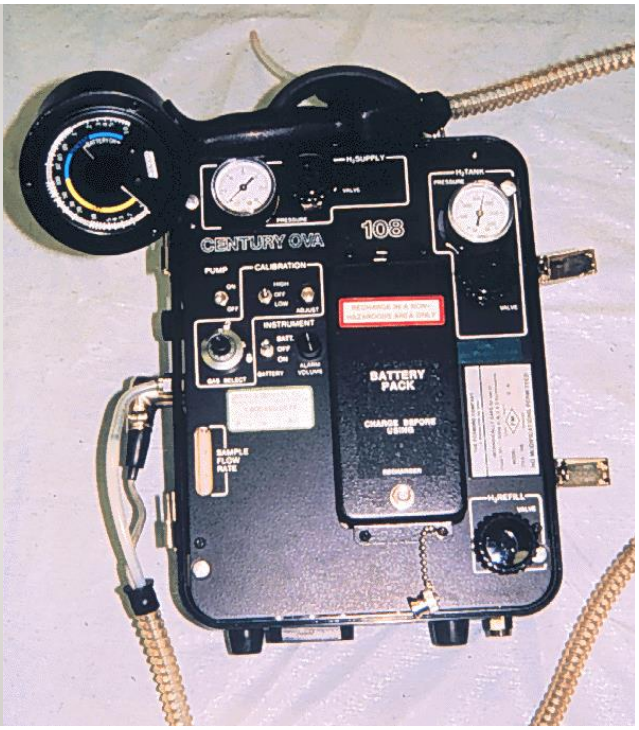
Photo Ionization Detector

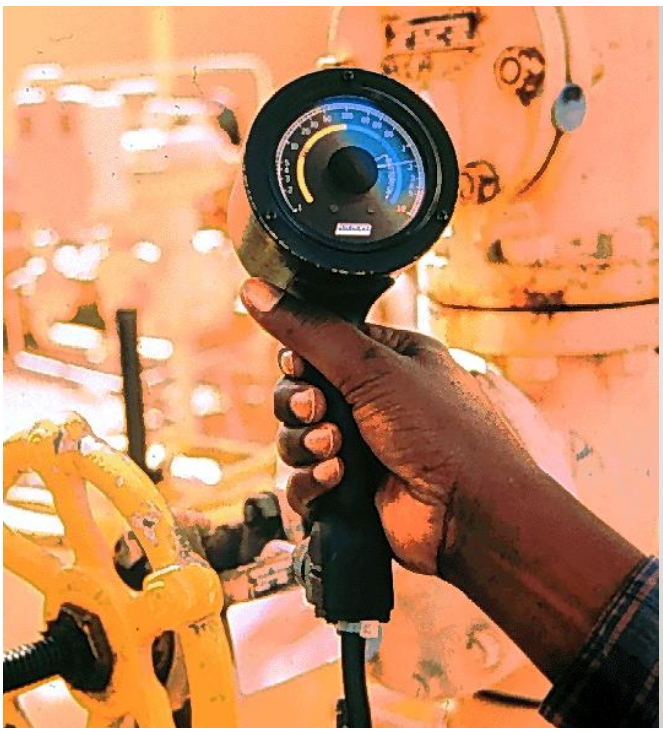
(PID)

LDAR EQUIPMENT/METHODS

- Organic Vapor Analyzer (OVA)
- Threshold Limit Value Meter (TLV)
- Flame Ionization Detector (FID)
- Photoionization Detector (PID)
- Infrared Detector (FLIR)
- Look and Listen
  - Soap Solution
  - Visual Distortion
  - Odor

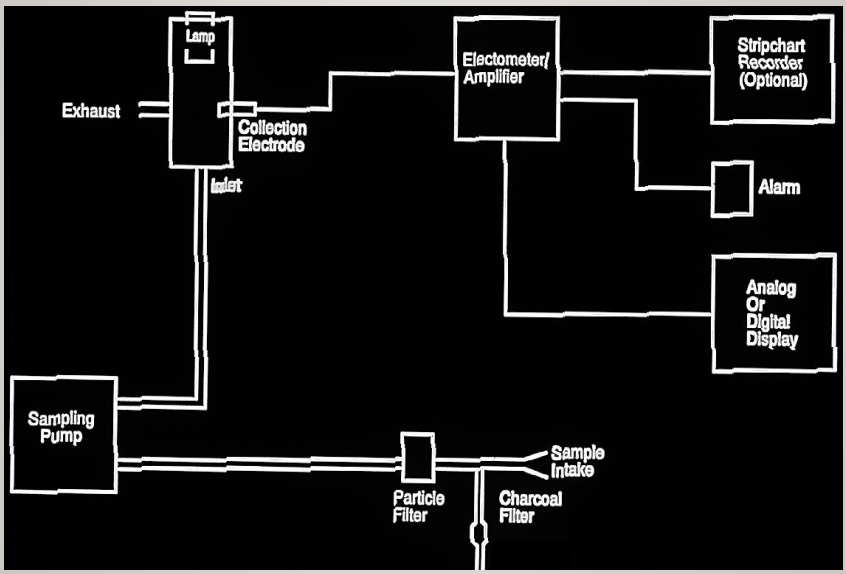
Century OVA 108





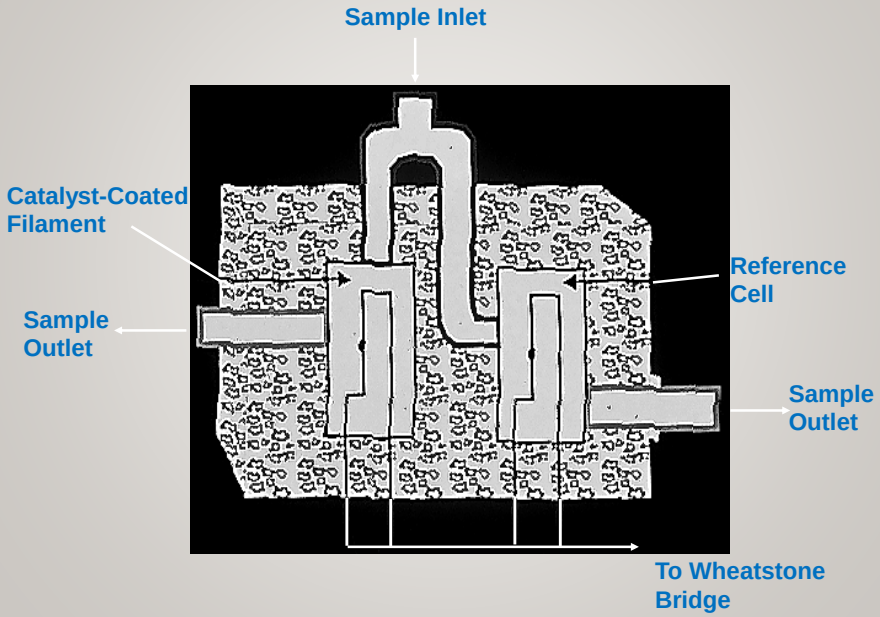
OVA 108 Readout

VOC Analyzer Using PID



FOXBORO TVA – 1000 (Toxic Vapor Analyzer)

Catalytic Combustion Analyzer (TLV)



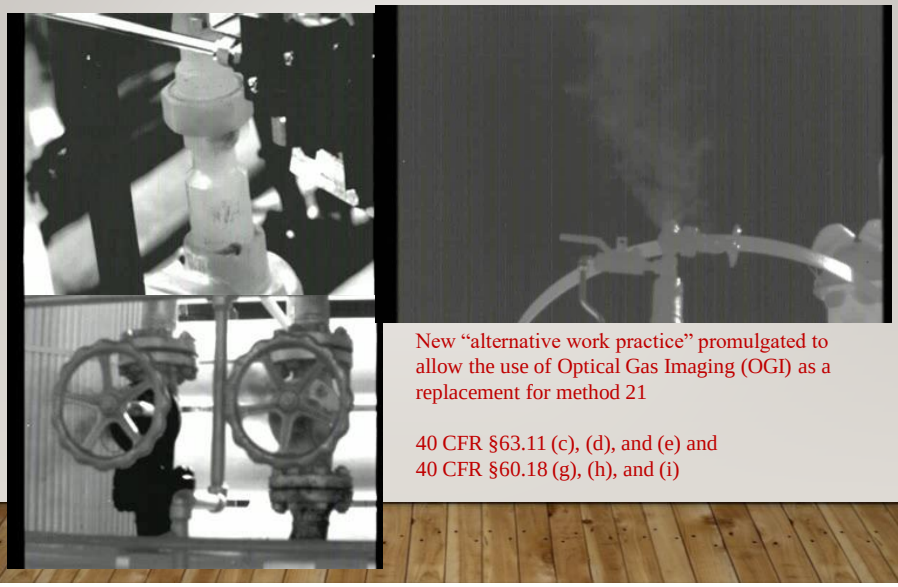
IR CAMERA DEVELOPMENT

•Is there a better way?
•Hydrocarbon energy absorb and emit infrared at specific wavelengths within the IR spectrum
•Camera sees IR energy, but has a filter to allow only IR energy in the 3.3 – 3.5 µm wavelength band to be detected
•Hydrocarbons that absorb IR energy in that range will be detected and imaged as a visible plume

Common chemicals detectable by the camera

- •Benzene
- •Butane
- •Ethane
- •Ethanol
- •Ethylbenzene
- •Heptane
- •Hexane
- •Methane
- •Methanol
- •Octane
- •Pentane
- •Propane
- •Propylene
- •Toluene
- •Xylene

IR CAMERA USED FOR LDAR



New "alternative work practice" promulgated to allow the use of Optical Gas Imaging (OGI) as a replacement for method 21

40 CFR §63.11 (c), (d), and (e) and
40 CFR §60.18 (g), (h), and (i)

IR CAMERA USED FOR LDAR

Expected Benefits

- *In theory* – ability to survey equipment faster
- Cheaper/less labor intensive

Alternative work practice requires annual Method 21 monitoring

Actual Implementation

- Camera is not as sensitive
- The image can be manipulated – leaks can disappear or be seen more easily with certain camera settings
- Image affected by background, environmental conditions
- Daily calibration and recordkeeping of everything monitored
- Camera is not intrinsically safe
- Camera is very expensive

EXAMPLES FROM REAL INSPECTIONS

- Compressor distance piece oil sump at a natural gas compressor station
- Distance piece is designed to prevent lubricating oil from leaking into the compressor cylinder
- Distance piece also acts as a process gas leakage control device
- In this case, compressed gas was leaking passed the packing rings and carried over into the oil sump

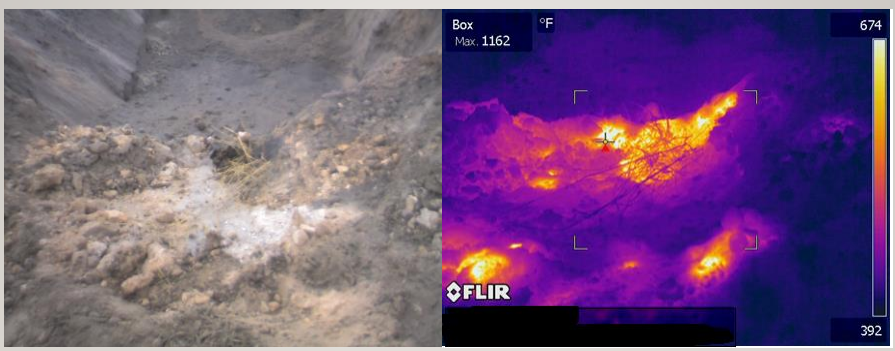
EXAMPLES FROM REAL INSPECTIONS

Storage vessel bleeder vents must be closed at all times unless the tank roof is being landed or floated off the leg supports

EXAMPLES FROM REAL INSPECTIONS

- Refinery Flare
  - Excess steam = incomplete combustion of hydrocarbons

TEMPERATURE READINGS

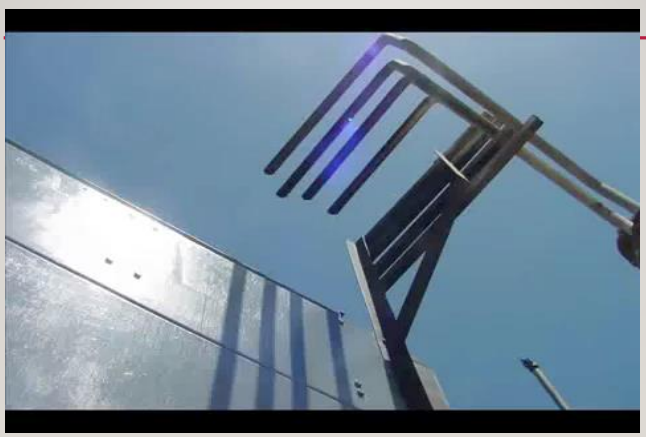


- Fruit processing plant waste dumped in a pit
- Exposure to air and decomposition caused it to heat up
- IR camera used to see elevated temperatures

Fugitive Leak Screening - FLIR

FLIR stands for forward looking infrared camera – it reads the thermal infrared signature of a plume. Although not a Method 21 device it can be used to screen for leaks quickly.

FLIR VIDEO OF VENT FROM CENTRIFUGAL PUMP



US EPA METHOD 21
(40 CFR 60 APPENDIX A)

1. Applicability/Principle
2. Definitions
3. Instrument/Calibration Gases
4. Procedures

PERFORMANCE SPECIFICATIONS
(METHOD 21 - 3.1.1)

- Must respond to organic compounds being processed
- Must be intrinsically safe for operation in explosive atmospheres
- Must measure concentration specified in the regulation
- Scale must be readable to +/- 2.5 percent of defined leak concentration
- Must have nominal flow rate of 0.1-3.0 liter/min
- Probe must be < ¼ inch OD with 1 opening

PERFORMANCE SPECS (CONTINUED)

Criteria	Requirement	Time Interval
Response factor	Must be <10 unless correction curve is used	One time before detector is put in service
Response time	Must be <= 30 seconds	One time before detector is put in service If modification to sample pumping or flow conf is made a new test is req
Calibration precision	Must be <= 10 percent of calibration gas value	Before detector is put in service and 3-month intervals or next use, whichever is later

RESPONSE FACTOR

- The ratio of the known concentration of a VOC to the observed meter reading when measured by the instrument with a reference compound

$$\text{Response Factor} = \frac{\text{Actual Concentration}}{\text{Instrument Indicated Concentration}}$$

Response Factor Examples

Actual Concentration = 1,000 ppm

Instrument Gauge Reading = 3,000 ppm

Response Factor = ??

Actual Concentration = 100,000 ppm

Instrument Gauge Reading = 10,000 ppm

Response Factor = ??

RESPONSE TIME

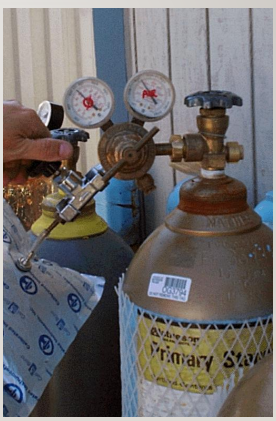
- The time interval from a step change in the VOC concentration at the input on the sampling system to the time at which 90 percent of the value is reached on the readout meter

CALIBRATION PRECISION

- The degree of agreement between measurements of the same known value, expressed as the relative percentage of the average differrence between the meter readings and the known concentration

CALIBRATION GASES
(METHOD 21 - 3.2)

- Zero air (< 10 ppm VOC)
- Span gas
- Cylinder cal gas mixtures
  - certified to ± 2 % accuracy
  - shelf life specified
- Prepared gases
  - accurate to ± 2 %
  - replaced each day



PREPARING FIDS FOR FIELD USE

1. Check hydrogen supply; refill if necessary
2. Confirm presence of exhaust port flame arrestor
3. Check battery status
4. Warm-up instrument electronics
5. Check amplifier settings ("span check")
6. Check pre-filter and probe conditions
7. Leak check probe
8. Measure sample gas flow rate at probe inlet
9. Calibrate

PREPARING PIDS FOR FIELD USE

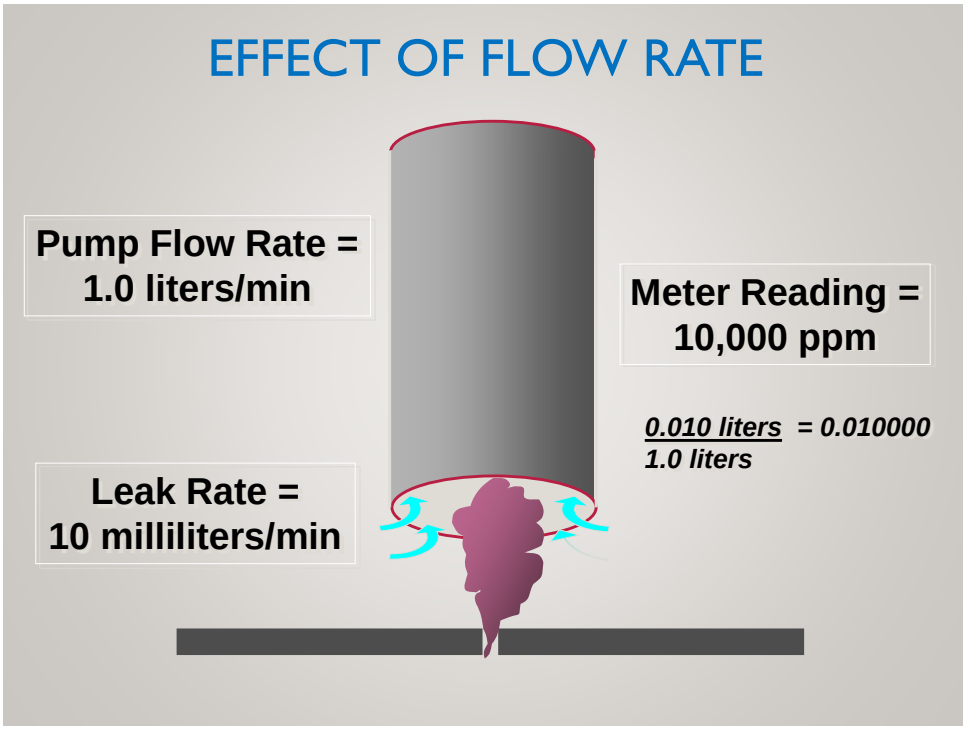
1. Check battery status
2. Check probe condition
3. Check for obvious deposits on optical window
4. Confirm detector response
5. Measure sample gas flow rate at probe inlet
6. Calibrate

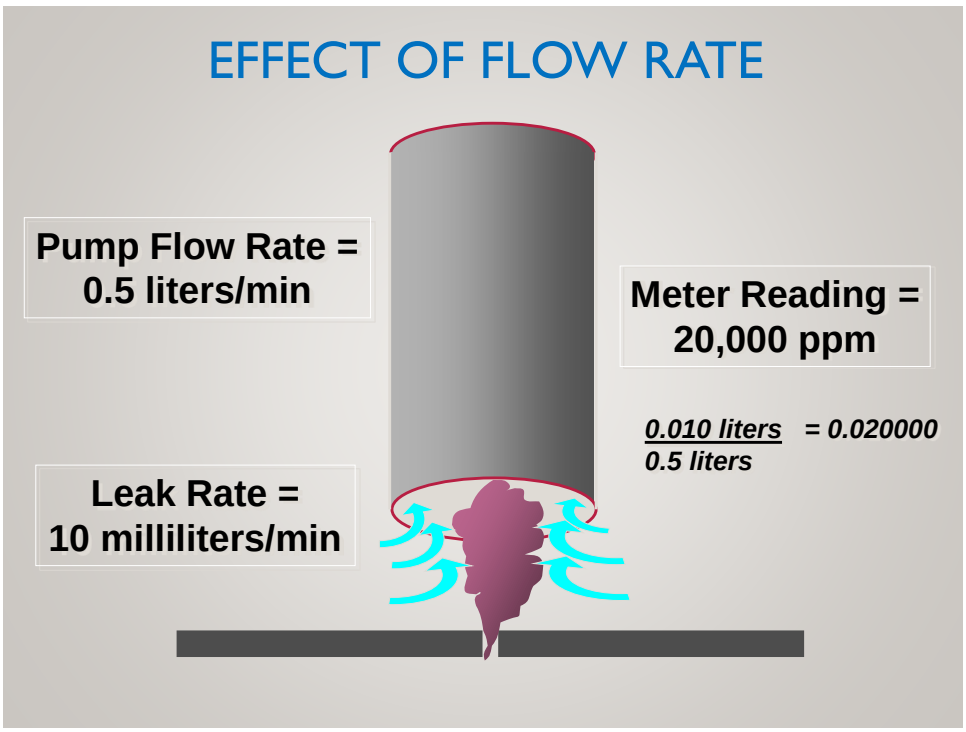
PERFORMANCE CRITERIA *(METHOD 21 - 3.1.2)*

- Response Factor less than 10
- Response time of 30 seconds or less
- Calibration precision less than or equal to 10% of calibration gas value

DETERMINING FLOW RATE

- Highly recommended
- No official protocol
- Flow rate may be affected by contamination, battery life, etc.

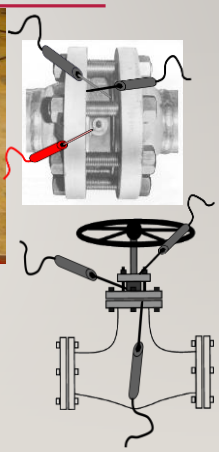

EFFECT OF FLOW RATE
Pump Flow Rate = 1.0 liters/min
Meter Reading = 10,000 ppm
0.010 liters = 0.010000
1.0 liters
Leak Rate = 10 milliliters/min

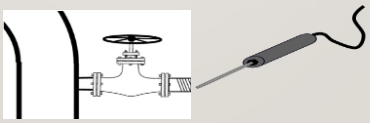

EFFECT OF FLOW RATE
Pump Flow Rate = 0.5 liters/min
Meter Reading = 20,000 ppm
0.010 liters = 0.020000
0.5 liters
Leak Rate = 10 milliliters/min

CONDUCTING AN INSPECTION

LEAK DETECTION MONITORING

- 1000's to 100s of 1000's of valves and connections that must be monitored for leaks
- 90 to 99% of valves and connections are not leaking
- Costly, monotonous, time consuming
- Work is contracted out to lowest bidder, technicians often uneducated and complacent





EPA LIST OF COMMON PROBLEMS LEADING TO ENFORCEMENT

- Failure to Identify process units and components
- Failure to follow prescribed procedures
- Incorrect or expired calibration gases
- Failure to repair and retest leakers on time
- Failure to submit quarterly records
- Failure to maintain calibration and monitoring records

EPA'S PROPOSAL FOR THE OIL & NATURAL GAS SOURCE CATEGORY

- On November 2, 2021, EPA issued a proposed rule to reduce climate- and health-harming pollution from the oil and natural gas industry (Comment Period Closed January 31, 2022, Final Rule 2022)
- The package included the proposal of 40 CFR part 60 Appendix K, EPA's procedures for use of optical gas imaging (OGI) in leak detection
  - EPA proposed that OGI surveys must be conducted according to Appendix K for OOOOb and OOOOc
  - Appendix K is written for broader applicability than the oil and natural gas sector

Protocol for Use of OGI (40 CFR Part 60 - Appendix K)

1. **Scope & Applicability**
2. Summary
3. Definitions
4. Interferences
5. Safety
6. **Equipment & Supplies**
7. **Camera Calibration & Maintenance**
8. **Initial Performance Verification & Operating Envelope**
9. **Monitoring Survey**
10. **Camera Operating Training**
11. QA/QC
12. Recordkeeping

Sections 13 & 14 References and Tables, Diagrams & Flow Charts

Protocol for Use of OGI (40 CFR Part 60 - Appendix K - Section 1)

Scope

- Oil and gas upstream and downstream sectors, including well heads, compressor stations, boosting stations, petroleum refineries, gas processing plants, and gasoline distribution facilities
- Not applicable to chemical plants at this time
- Specific component focus for surveys determined by the applicable subpart

Applicability

- Analytes: VOC (including hazardous air pollutants), methane, ethane
- Must be referenced by an applicable subpart
- Not currently applicable for use in direct emission rate measurements from sources

Protocol for Use of OGI (40 CFR Part 60 - Appendix K - Section 6)

Equipment & Supplies

OGI cameras must meet two specifications:

- Camera Spectral Range overlap with a major absorption peak for chemicals of interest
- Camera must produce a detectable image of 17 g/hr for methane & 18.5 g/hr for butane emissions at viewing distance of 2 meters, delta-T of 5° C and calm wind conditions (≤1 meter/sec)

Protocol for Use of OGI (40 CFR Part 60 - Appendix K - Section 7)

Camera Calibration and Maintenance

- The Camera does not require routine calibration for purposes of gas leak detection, but may require calibration is used for thermography (such as delta-T determination)

Protocol for Use of OGI (40 CFR Part 60 - Appendix K - Section 8)

Initial Performance Verification & Operating Envelope

- The initial performance verification is to meet Section 6
- Operating Envelope must be established for all potential configurations (operating modes of standard vs. high sensitivity or enhanced; lens; hand held vs. tripod; the viewer in OGI camera screen vs an external device; etc.)
- Use Section 6 performance specifications for gas composition, flow rate, etc. for both methane & butane

Protocol for Use of OGI (40 CFR Part 60 - Appendix K - Section 9)

Conducting the Monitoring Survey per Monitoring Plan

- Daily Verification Check
- Route Map with GPS
- View from ≥2 Different Angels & Minimum of 5 Seconds or 10 Seconds if a Leak Detected & Tag for Repair
- Avoid Camera Fatigue (Break every 20 Minutes)
- A 5 Minutes Video of Survey Techniques/Procedures Daily

Protocol for Use of OGI (40CFR Part 60 - Appendix K- Section 10)

Camera Operator Training

- **Initial Classroom** (Fundamentals of OGI, Component Survey, Calibration, Camera O&M, Common Mistakes, Best Practices, Regulatory Requirements & Record Keeping)
- **Initial Field** (Observe 10 Surveys by a Senior OGI Camera Operator; Conduct 40 Practice Surveys Side by Side with a Senior OGI Operator; Conduct 50 Independent Surveys with Senior OGI Operator Oversight; Final Site Survey Followed by a Senior OGI Operator to Confirm Zero Mistakes)
- Annual Classroom Refresher
- Quarterly Performance Audits (Comparative Monitoring or Video Review)
- Repeat the Initial Training If No Monitoring Survey Conducted in 12 Months

PRE-INSPECTION

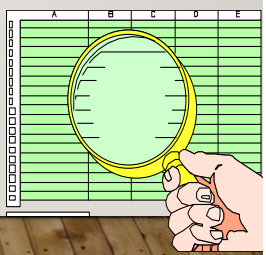
- Regulation Review
- File Review
- Permit Check
- Equipment Check

ON-SITE INSPECTION

- Initial Interview
- Records Review
- Plant LDAR Program Evaluation
- Component Screening Strategies
- Leak Monitoring

RECORDS REVIEW

- Are records complete per regulations?
- Verify unsafe and difficult-to-monitor determinations listed
- Check process unit determinations



PLANT LDAR PROGRAM EVALUATION

- Evaluate tracking system for scheduling monitoring and repairing
- Interview plant personnel
- Observe calibration of leak detection equipment
- Observe leak detection monitoring

FOCUSING ON THE INSPECTION

Most important components for monitoring:

- *components/process units with history of high leak rates*
- *valves in gas and light-liquid service*
- *pumps in light liquid service*
- *compressors*

Review component identification system

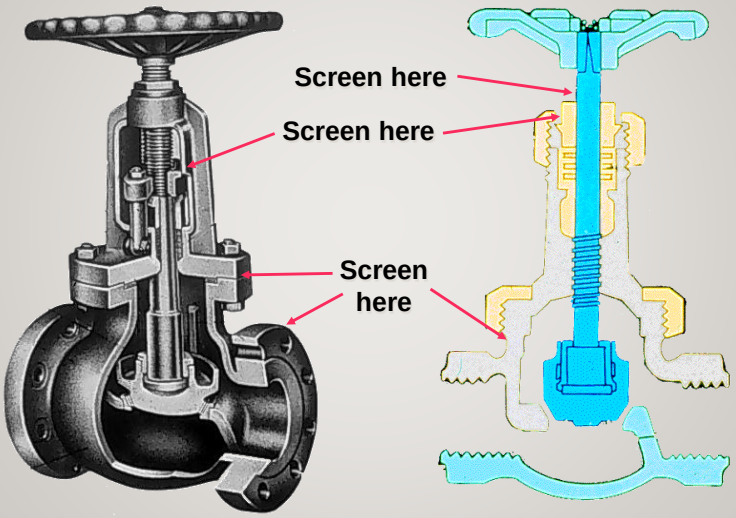
LOCATING POTENTIAL LEAKS

- Individual Component Survey
  - visual, auditory, olfactory
  - soap solution screening
  - portable VOC analyzer
- Area Survey ("Walk-Through")
- Fixed Point Monitors
- Infrared imaging

MONITORING INDIVIDUAL COMPONENTS *(METHOD 21 - 4.3.1)*

- Measure background levels
- Probe at surface of component
- Move along interface periphery while observing readout
- If increase occurs, sample until maximum reading;
- leave probe tip at this location for approx. 2 times response time
- Record results

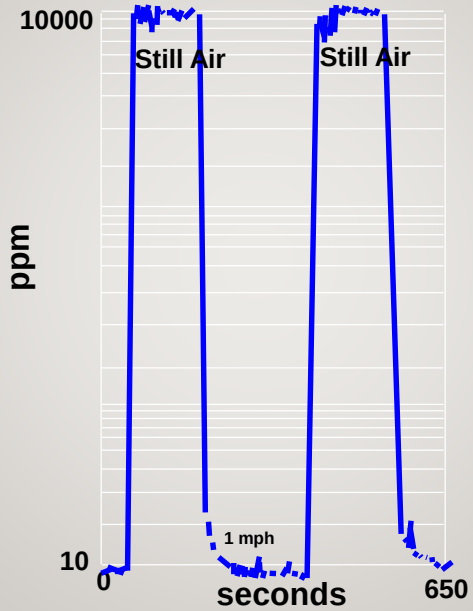
Screening Valves



LIMITATIONS AND PROBLEMS USING PORTABLE INSTRUMENTS

- Poor capture capability & pinpoint nature of most leaks --> probe should be oriented directly into plume
- Negative pressure sampling --> limited capture distance
- Air drawn into probe from all directions --> dilution
- All instruments sensitive to gas flow rates
- Cross-wind reduces capture efficiency

Effect of Wind Velocity on PPM Reading
(probe tip 1/4" from leak source)



EFFECTS OF EXCESSIVE VOC INTAKE

Flame Ionization Detectors

- Flame-out at sample concentrations above 70,000 to 100,000 ppm
- Blinding of flame arrestor
- Sustained high observed readings due to condensation & revolatilization in sample lines

Photo Ionization Detectors

- Condensation of organic materials on the optical surface
- Condensation and revolatilization

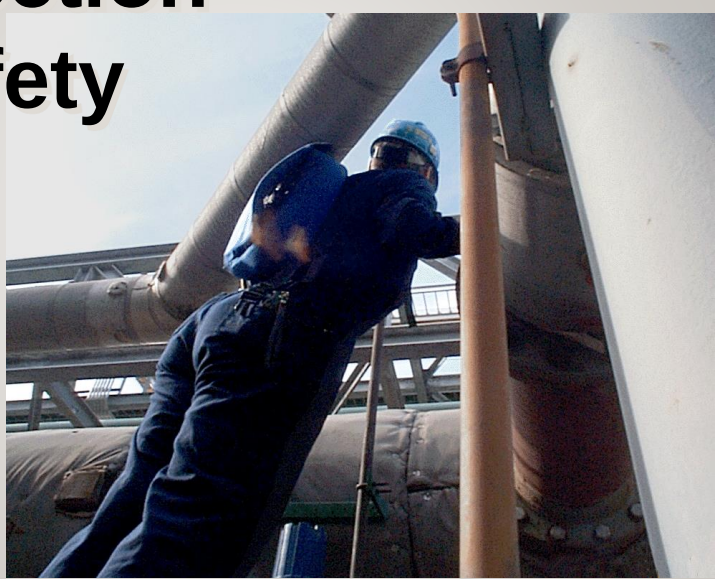
Catalytic Combustion Analyzers

- Volatilization of catalyst on detector wire
- Condensation and revolatilization

POST-INSPECTION

- Compare field inspection observations with plant records
- Review findings with plant representative(s)
- List items to be checked during follow-up inspection(s)

Inspection Safety



PRE-FIELD SAFETY

- Calibrate in well-ventilated space
- Make sure all intrinsically-safe features are intact
- Review possible on-site hazards
- Wear long-sleeved, fire protective clothing
- Be trained in use of specialized equipment

FIELD SAFETY

- Stay alert
- Move at a reasonable pace
- Be extremely cautious around hot (or cold) surfaces
- Be extremely cautious monitoring components with rotating shafts
- Stay upwind of components being screened
- Keep both hands free when climbing ladders
- Don't make "heroic" physical efforts to reach components

CARB 262 – Fugitive VOC Inspections