Fugitive Emissions and Directed Inspection & Maintenance:

Finding the Leaks & A Technical Overview of All Leak Detection Technologies

by

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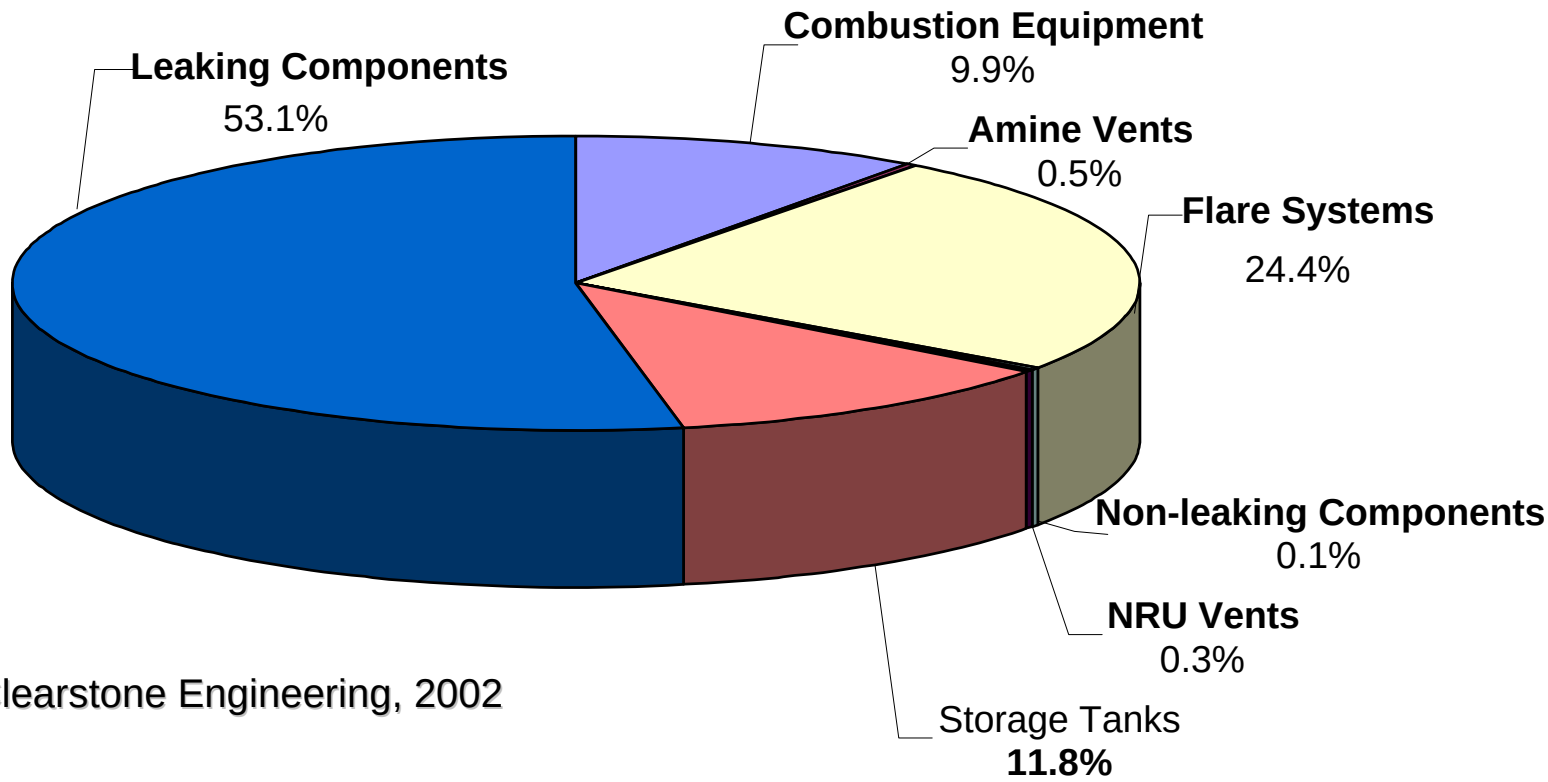
Emission Sources

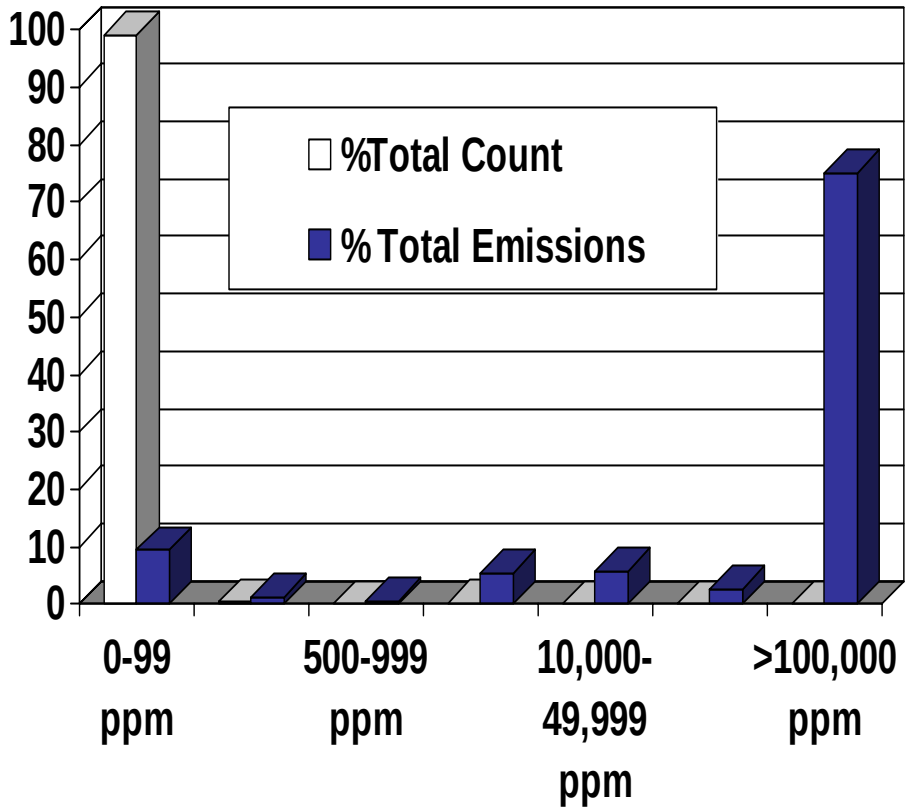
Distribution of Methane Emissions by Source Category



Source: Clearstone Engineering, 2002

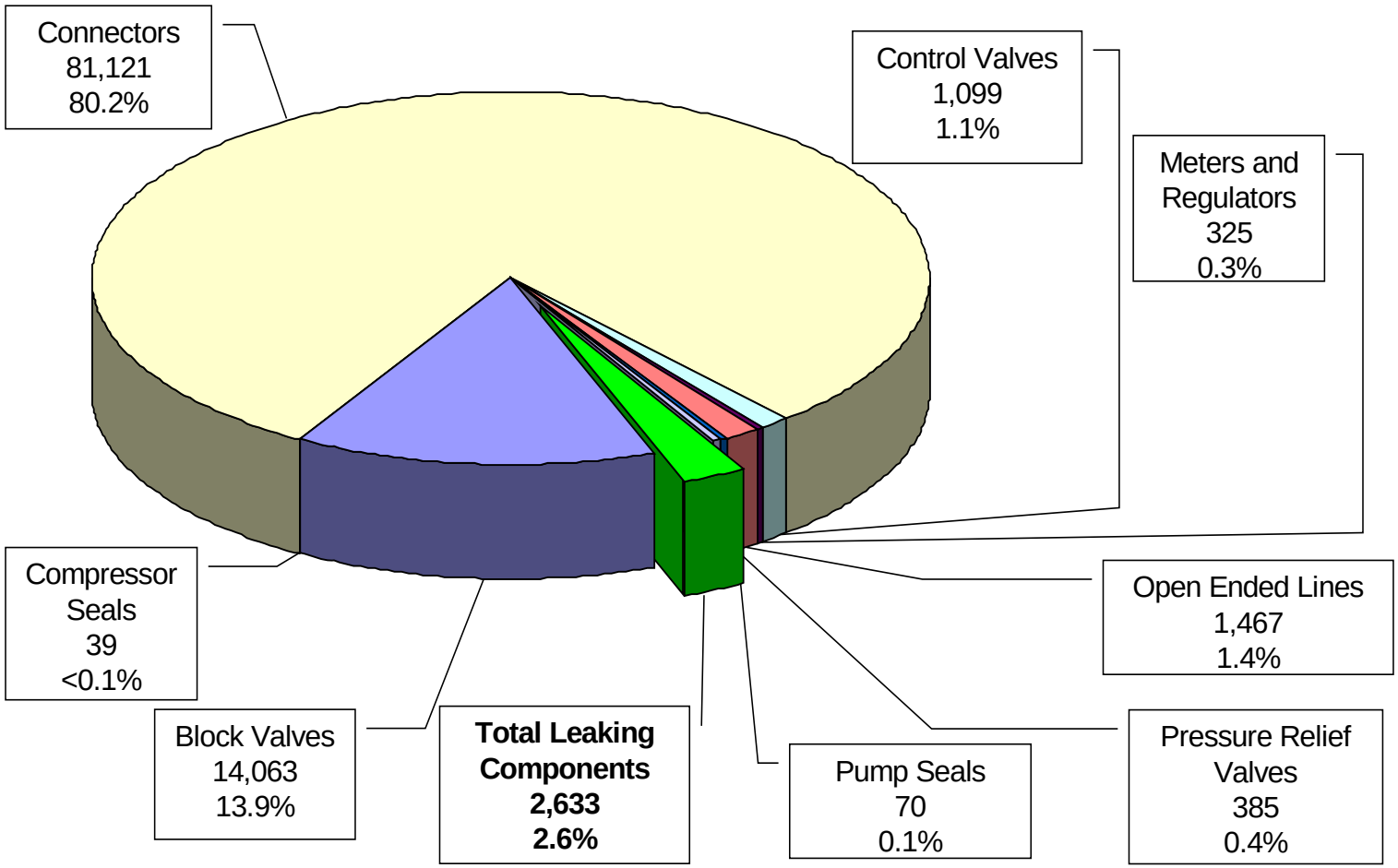
Component Contribution

- API Study Showed That 92% of Reducible Emissions Come From Only ~ 0.13% of Components
- Leaks Occur Randomly
- Few Significant Repeat Leakers Found
- Los Angeles Refineries Programs



From API Publication 310

Total Screened Components



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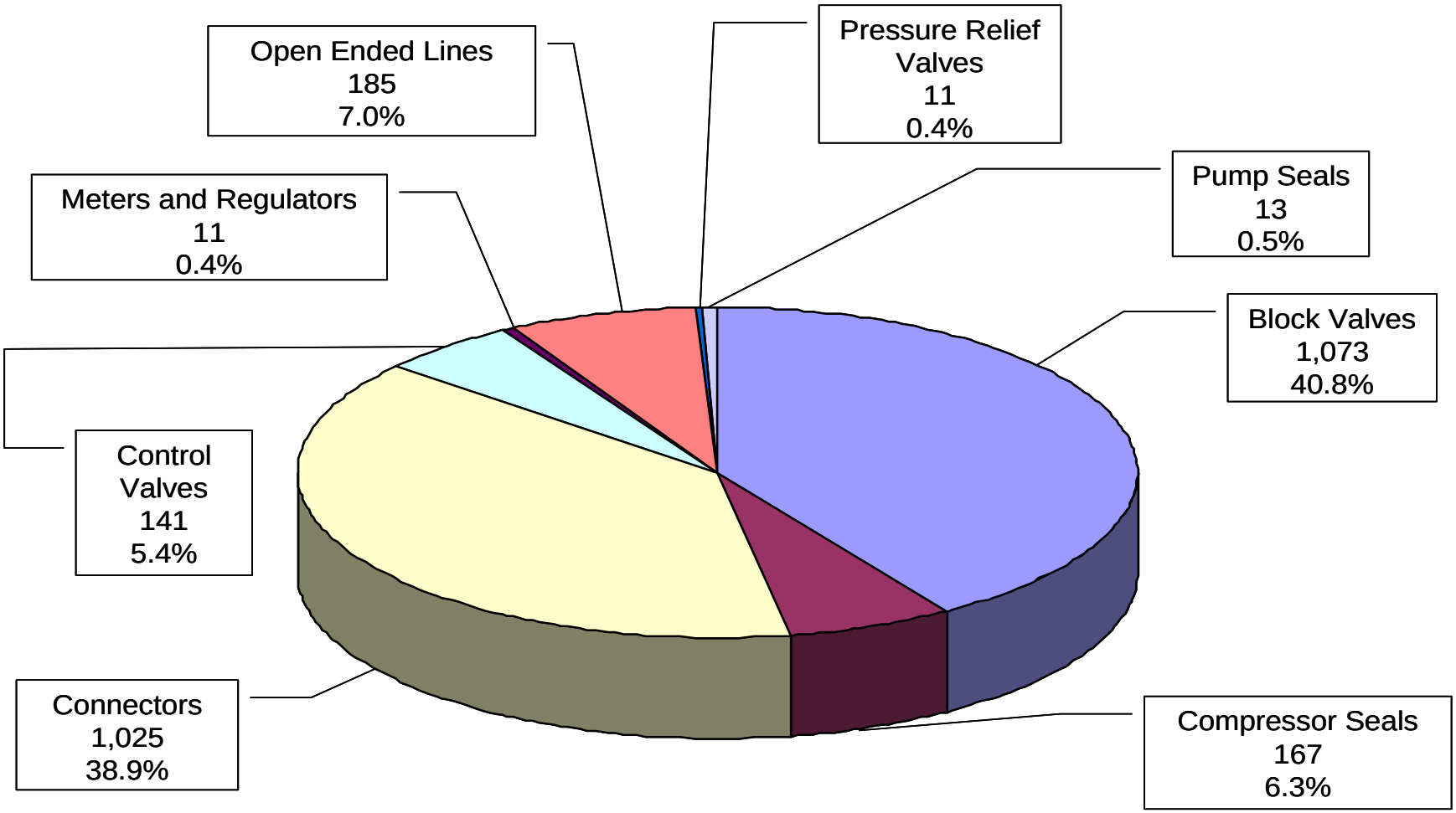
Leaker Results



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Traditional Leak Detection Methods

- Soap Solution
- Method 21
- Ultrasonic

Soap Solution

Use of detergent solution to detect escaping vapor from a potential leaking interface

Pro's

- No initial investment
- Inexpensive to apply
- Minimum Training
- Leak / No Leak result
- Effective detection of moderate level leaks

Con's

- Limited by equipment surface temperature
- Does not work on rotating equipment
- Very large leaks don't make bubbles
- Not able to quantify leak rate

Method 21

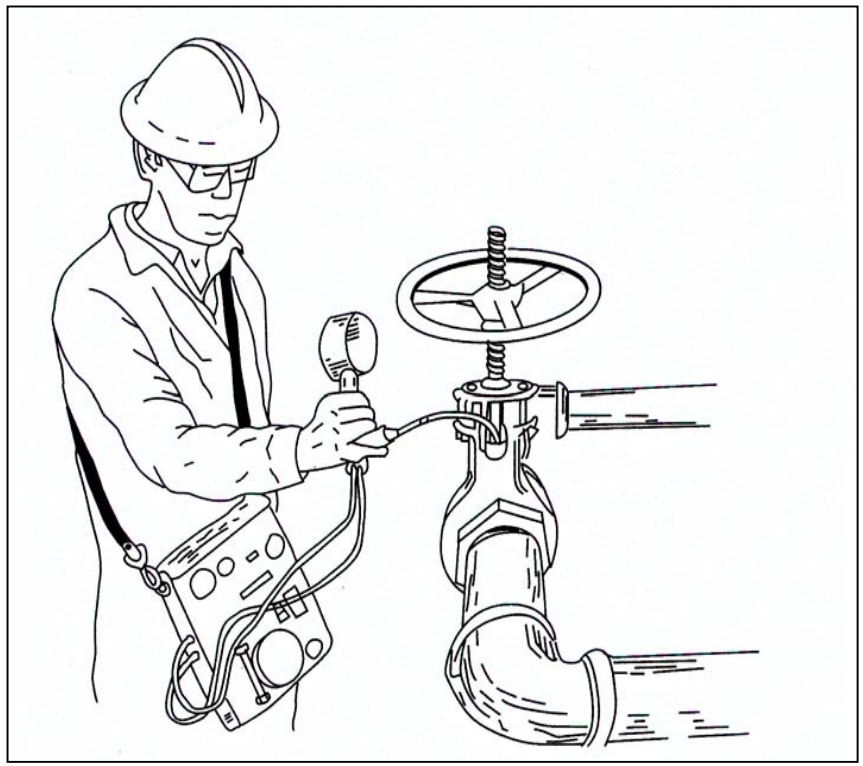
Use OVA/TVA to locate leak from a suspected leaking interface

Pro's

- Service can be applied by company or contractor
- Widely accepted and used
- Numeric results

Con's

- Labor intensive & high cost
- Less efficient
- Prone to false positives & false negatives



Sound/Ultrasonic

Portable detector of ultrasonic sound that is produced by escaping pressurized vapor

Pro's

- Scans large number of components quickly
- Detects valve, connector and pump leaks
- Can pin point individual leaks

Con's

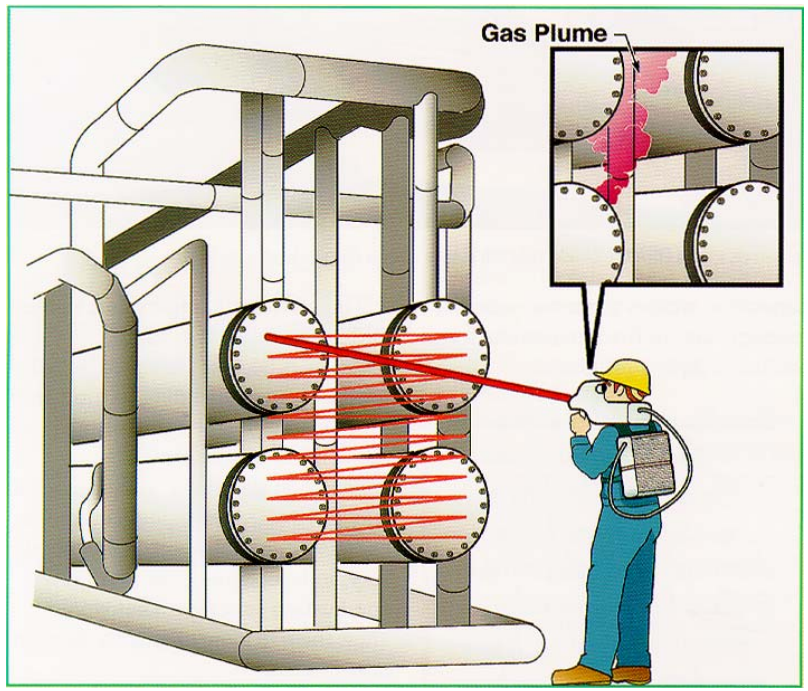
- Detection masked around pneumatic actuated valves
- Detection limited by distance
- High concentration of leaks confuses operator

Smart LDAR

Portable passive IR camera that detects mass based VOC leaks in real time, by imaging as a black cloud

Strength's

- Eliminates false positives & false negatives
- Produces leak / no leak result
- More efficient / cost effective for larger / co-located facilities



RMLD

(Remote Methane Leak Detection)

A eye-safe laser-based natural gas sensor used to locate leaks in transmission and distribution lines. Audible alarm sounds when a high conc. or quickly changing gas cloud is detected.

Strength's

- Hand held & portable
- Improved operator safety
- Audible alarm

ANGEL
(Airborne Natural Gas Emission Lidar- ITT)

- Airborne natural gas detection and reporting system that detects, quantifies, images and maps the presence of natural gas in the atmosphere.

Strength's

- Detects large leaks
- Produces mapped output
- Covers large areas

GOSAT
(Greenhouse Gas Observing Satellite)

Orbiting sensor that detects methane concentration by measuring the solar short wave infrared spectra reflected from the earth's surface.

Strength's

- Applicable to regional releases
- Spots methane plumes
- Detects CH_4 & CO_2