## *Industrial Ventilation System – Risk Factors for Increased IVS Monitoring*

# INHERENT MATERIAL RISK MATRIX

| | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| **Health** | No significant risk to health. | Irritation or minor reversible injury possible | Temporary or minor injury may occur. | Major injury likely unless prompt action is taken and medical treatment is given. | Life-threatening, major or permanent damage may result from single or repeated overexposures |
| **Flammability (liquids, vapors, gases)** | Materials that will not burn. | Materials that must be preheated before ignition will occur. Includes liquids, solids, and semi-solids having a flash point above 200 °F . (Class IIIB). | Materials that must be moderately heated or exposed to high ambient temperatures before ignition will occur. Includes liquids having a flash pt at or above 100 °F but below 200 °F. (Classes II & IIIA). | Materials capable of ignition under almost all normal temperature conditions. Includes flammable liquids with flash pts< 73 oF and boiling pts above 100 °F, as well as liquids with flash pts between 73 °F and 100 °F. (Classes IB & IC). | Flammable gases, or very volatile flammable liquids: Flash pts < 73 oF, and Boiling pts < 100 oF. Materials may ignite spontaneously with air. (Class IA) . |
| **Inherent Physical or Reactive** | Materials that are normally stable, even under fire conditions, and will not react with water, polymerize, decompose , condense, or self-react. Non-explosives. | Materials that are normally stable but can become unstable (self-react) at high temperatures and pressures. Materials may react non-violently with water or undergo hazardous polymerization in the absence of inhibitors. | Materials that are unstable and may undergo violent chemical changes at normal temperature and pressure with low risk for explosion. Materials may react violently with water or form peroxides upon exposure to air. | Materials that may form explosive mixtures with water and are capable of detonation or explosive reaction in the presence of a strong initiating source. Materials may polymerize, decompose, self-react, or undergo other chemical change at normal temperature and pressure with moderate risk of explosion. | Materials that are readily capable of explosive water reaction, detonation or explosive decomposition, polymerization, or self-reaction at normal temperature and pressure |
| **Combustible Dusts** | | | 0<Kst<200 bar-m/sec | 200<Kst<300 bar-m/sec | Kst>300 bar-m/sec |

### Other Considerations Demanding Better IVS Performance

- Regulated contaminant with strict limits (health, environment)
- Quality impacts of IVS?
  - Formulation changes
  - Allowing contaminant entry
  - Workplace cleanliness
- Productivity impacts of IVS?
  - Equipment failure due to contaminants
  - Housekeeping effort
- Environmental impacts of IVS?
  - Stringent stack emission limits
  - Fugitive emissions limits

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# Contaminant Inherent Risk Profile

| **Impact** | **Hazard** | **Risk Categories** | | | |
|---|---|---|---|---|---|
| | | **Low** | **Moderate** | **High** | **Severe** |
| Health | | | | | |
| Flammable Vapors | | | | | |
| Reactive Chemicals | | | | | |
| Combustible Dusts | | | | | |
| Quality | | | | | |
| Reliability | | | | | |
| Environmental | | | | | |
| Others? | | | | | |
| Low long can IVS be out of balance? | | 3 - 6 months | 1 - 3 month | 1 week – 1 day | Continuous -1 hour |
| OVERALL RATING? | | | | | |

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## Problem Particulate Contaminants

- Sticky, smearing dust (e.g. detergents, wet clay, ore after floatation)
- Hygroscopic dust (readily absorbs moisture) & ambient humidity is high enough to cause sticky or adherent dust problems
- High humidity in intake air & possible approach to the dew point that can cause sticky or adherent dust problems
- Combustible dust – avoid duct accumulations
- Heavy dust such as lead or large granule sand
- Abrasive dust that wears elbows rapidly
- Lightweight, low density dust such as paper dust
- Fibrous dust such as fiberglass fluff which can tangle and form mats in the duct
- **How quickly does the contaminant change the system? A few days, a week, a month, quarterly or longer?**

**Key Particulate Design Parameters to Maintain Conveying Velocity:**

- **In all duct branches with static pressure balancing between all branches**
- **Through the transitions in duct junctions or Y's**

## Particulate Duct Construction Contributions to Rapid Degradation

A heavier weighting on the "Most" side indicates greater likeliness of degradation for loose, friable particulates. The impact will be worse if handling a "problem particulate."

| | **Least** | | | **Most** |
|---|---|---|---|---|
| Dust loading | < 1 gr/DSCF (dry standard cubic foot | 1 – 10 gr/DSCF | > 10 gr/DSCF | Pneumatic conveying on some branches (> 0.5 # solids/ # air) |
| Flexible duct | None | Limited use of 3 ft lengths | Use of 3-6 ftlengths | Use of lengths > 6 ft |
| Elbows | Long radius R/D = 2.5 | R/D = 2.0 | R/D = 1.5 | R/D = 1.0 or mitered |
| Duct junctions or Y's join at these angles | 15 – 30 degrees | 30-45 degrees | 45 – 75 degrees | > 75 degrees or Tee |
| Y construction | Branch enters in taper from side or top | Branch enters in taper from bottom | Branch does not enter in taper but duct does enlarge to appropriate conveying velocity | - Branch is blanked off versus airbleed<br>- Sudden enlargement or contraction |
| System Complexity | - Single hood: (lab hood or unit filter)<br>- Simple: 2- 5 dust pickup points | Moderate: 5 – 15 dust pickup points | Complex: > 15 dust pickup points | Very complex: Interaction between process air exhausts and dust control exhausts with varying conditions |
| Air Cleaning Device Differential Pressure | Automatic and tight control of DP within 2 in.w.c. (ie, DP vs timer bag cleaning) | Automatic control of DP (ie, timer bag cleaning on fabric filter) | Device cleaned off line when dust system is not operating | Problem particulates plug device requiring frequent (ie, monthly manual intervention) |

## *Industrial Ventilation System – Risk Factors for Increased IVS Monitoring*

## Particulate Contaminant Risk Factors, continued

| | **Least** | | | **Most** |
|---|---|---|---|---|
| Air Cleaning Device and Fan Access | Installed access platforms, ladders for routinely inspections (ie, bag cleaning system on fabric filter) | Located within a short, 2-3 minute, walk from the dust controlled process equipment it serves | Find a ladder to gain access for routine inspections | Very remote from process equipment served |
| Air Cleaning Device Dust Removal | Automated, continuous dust removal system | Administrative controls to remove dust from system | ACD used as dust surge bin | Dust removal system plugs frequently as indicated by hammer marks on hopper |
| System Balancing Approach | Balance by Design as per IVM | Balance with plate orifices or locked blast gates | Balance by un-locked blast gates | Huh? What is IVS Balance? |
| Proof of System Performance or Baseline Documentation | Documentation complete, < 1 year old | Documentation complete, < 2 years old | Documentation exists but > 2 years old and not checked for accuracy | No documentation exists |
| How does the operator know of a dust control system problem? | Action limits on locally installed indicators | Routine system monitoring by trained operators | Open up the duct and look | Dust blows out of dust pickups |
| Downtime availability for IVS maintenance for known problem spots in system? | As needed | Within > 1 week | Within > 1 month | Once/year |
| Other? | | | | |

## Risk of Rapid Degradation – Overall Judgment

| | **Low** | **Moderate** | **High** | **Severe** |
|---|---|---|---|---|
| Particulate descriptions above + experience | | | | |

# *Industrial Ventilation System – Risk Factors for Increased IVS Monitoring*

## Problem Non-Particulate Contaminants

- Contaminant change from a vapor or fine mist in the duct network to
  - A solid (by drying or precipitation or freezing)
  - Condense continuously
  - Condensing conditions possible in range of operation
- For condensing vapors & oil mists, ducts not sloped to low point drains
- Duct liquid drains do not have an effective trap to prevent air entry
- Contaminant is corrosive
  - pH <2 or >12
  - pH 2-5 or 9-12
- IVS materials not corrosion resistant
- Low vapor pressure contributes to fugitive emissions
- Hazardous environmental contaminant on regulatory watch list
- Contaminant has NFPA flammability rating of (closed cup flash point, F)
  - Class I (<100 F)
  - Class II (100-140 F)
  - Class IIIA (140–200 F)
- IVS depends on dilution with fresh air to keep flam. conc. < 25% LEL
- Contaminant is flammable and could exceed 25% of Lower Explosive Limit in IVS if out of balance
- Contaminant is reactive if exposed to ambient air or moisture
- ACD: Varying differential pressure and system-wide airflow
- IVS shutdown does not automatically shut down process

## Non-Particulate Duct Construction Contributions to Rapid Degradation

A heavier weighting on the "Most" side indicates greater likeliness of degradation for non-condensable vapors or gases. The impact will be worse if handling a "problem non-particulate."

| | **Least** | | | **Most** |
|---|---|---|---|---|
| System Complexity | - Single hood: (lab hood or unit filter)<br>- Simple: 2- 5 dust pickup points | Moderate: 5 – 15 dust pickup points | Complex: > 15 dust pickup points | Very complex: Interaction between process air exhausts and dust control exhausts with varying conditions |
| Air Cleaning Device Differential Pressure | Automatic and tight control of DP within 2 in.w.c. (ie, demand bag cleaning on fabric filter) | Automatic control of DP (ie, timer bag cleaning on fabric filter) | Device cleaned off line when dust system is not operating | Problem particulates plug device requiring frequent (ie, monthly manual intervention) |

## *Industrial Ventilation System – Risk Factors for Increased IVS Monitoring*

## Non-Particulate Risk Factors, continued

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| Other? | | | | |

## Risk of Rapid Degradation – Overall Judgment

| | **Low** | **Moderate** | **High** | **Severe** |
|---|---|---|---|---|
| Non-Particulate descriptions above + experience | | | | |

# DECIDING ALERT AND DEGRADATION MONITORING

**Overall Risk Ratings from previous pages**

| | **Contaminant** | **Low** | **Moderate** | **High** | **Severe** |
|---|---|---|---|---|---|
| Contaminant Inherent Risk | | | | | |
| Risk of Rapid IVS Degradation | | | | | |

## INITIAL RISK BASED MONITORING FREQUENCY

THE FREQUENCY BELOW CAN BE ADJUSTED BASED ON ACTUAL DATA AND HISTORY FROM OPERATIONS AFTER STARTUP.

| RISK RATING | ALERT MONITORING FREQUENCY | Your analysis? | DEGRADATION MONITORING FREQUENCY | Your analysis? |
|---|---|---|---|---|
| Severe | Automatic or each shift | | Weekly | |
| High | Daily | | Monthly | |
| Moderate | Weekly | | Quarterly | |
| Low | Monthly | | Semi-annual | |