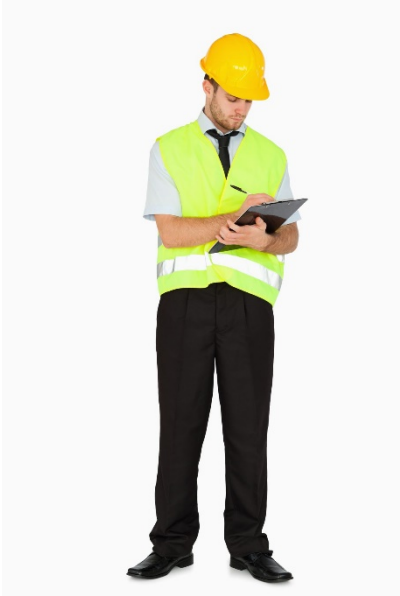
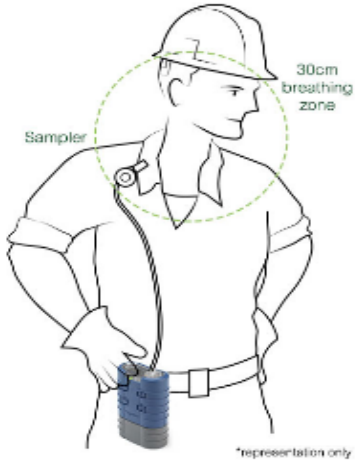
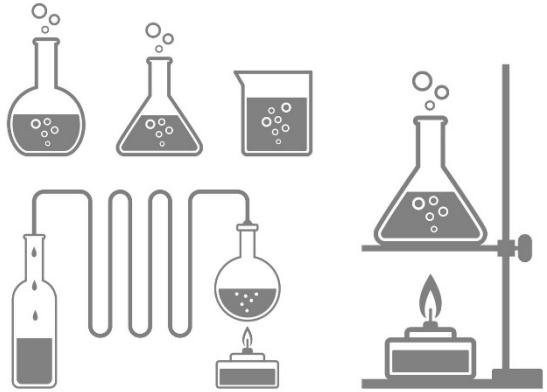
# Exposure Assessment Strategies

# Outline

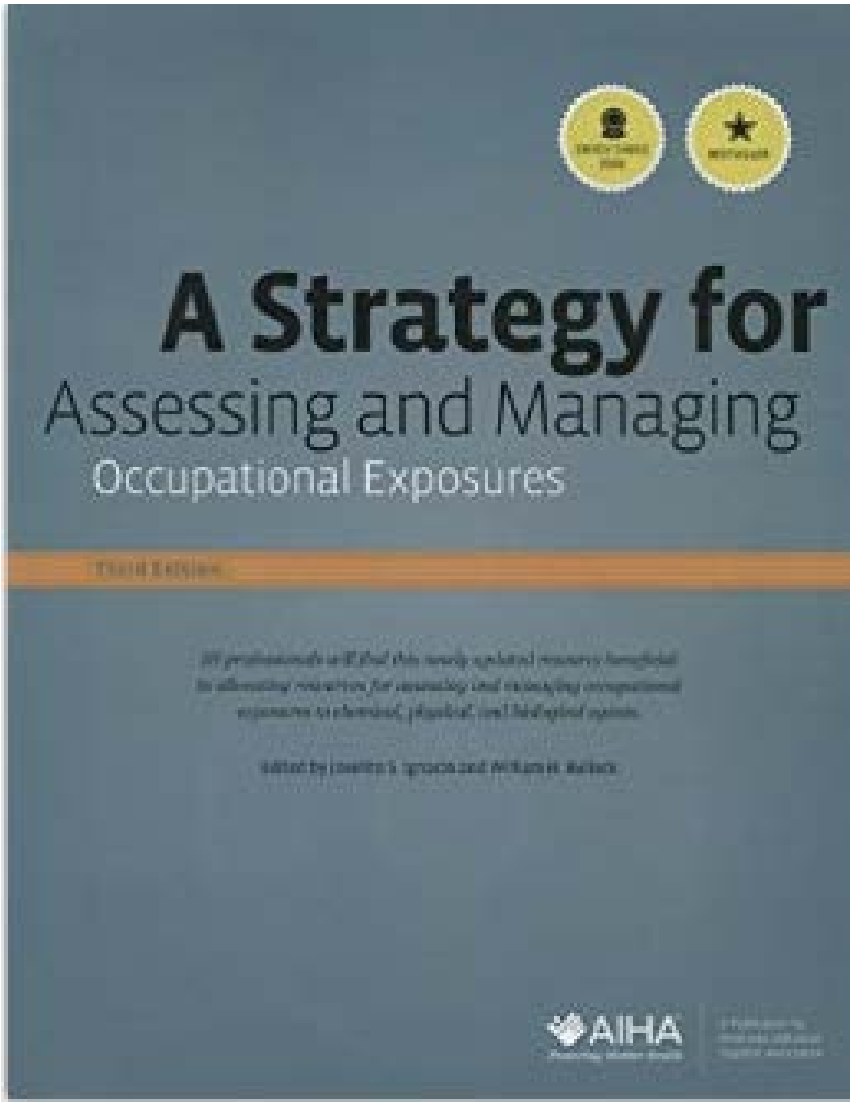
- Exposure Assessment Strategies
  - Qualitative Assessment
  - Quantitative Assessment
  - Analytical Chemistry





# Familiarize yourself with this text?



# Basic Characterization

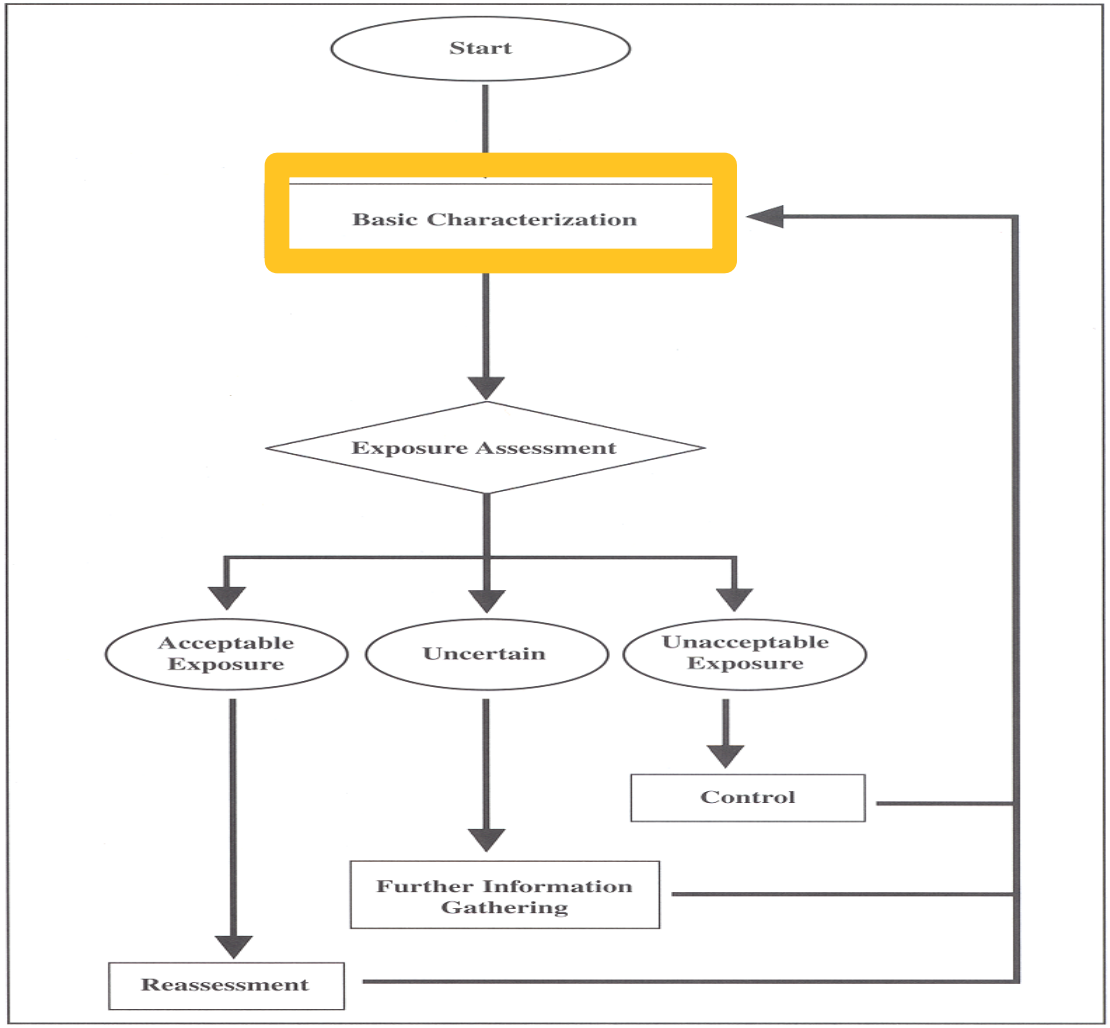



**Figure 1.2** — A strategy for assessing and managing occupational exposures.

# Basic Characterization

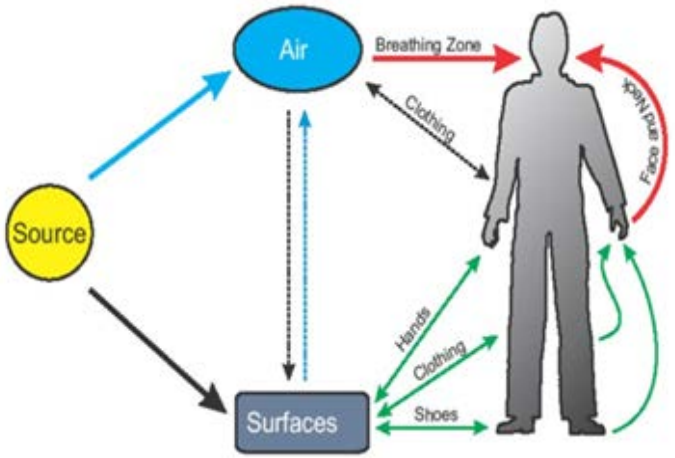
**Purpose:** Collect and organize available information on work force, workplace, agents and historical exposure data

- Steps:

1. Determine processes
2. Understand job titles and descriptions
3. Review agents
4. Characterize existing controls
5. Locate past exposure data

- Outcome:

1. Complete summary of essential information



# Do you have operations with a “Likely” Inhalation Hazard?

| Likely Inhalation Hazard Operations | |
|---|---|
| Abrasive Blasting | Laser Cutting |
| Abrasive Processing | Laser Machining |
| Abrasive Sawing | Laser Scribing |
| Annealing | Laser Marking |
| Brazing | Laser Welding |
| Bright Cleaning | Laundering |
| Brushing | Melting |
| Buffing | Photo-Etching |
| Burnishing | Pickling |
| Casting | Point and Chamfer |
| Centerless Grinding | Polishing |
| Chemical Cleaning | Process Ventilation Maintenance |
| Chemical Etching | Resistance Welding |
| Chemical Milling | Roller Burnishing |
| Coolant Management | Sand Blasting |
| Deburring (grinding) | Sand Casting |
| Destructive Testing | Sanding |
| Dross Handling | Scrap Management (Clean) |
| Electrical Chemical Machining (ECM) | Sectioning |
| Electrical Discharge Machining (EDM) | Slab Milling |
| Electron Beam Welding (EBW) | Soldering |
| Forging | Solution Management |
| Grinding | Spot Welding |
| Heat Treating (in air) | Sputtering |
| High Speed Machining (>10,000 rpm) | Swaging |
| Honing | Torch cutting (i.e., oxy-acetylene) |
| Hot Forging | Water-jet Cutting |
| Hot Rolling | Welding (ARC, TIG, MIG, etc.) |
| Investment Casting | Wire Electrical Discharge Machining (WEDM) |
| Lapping | |

# Exposure Assessment

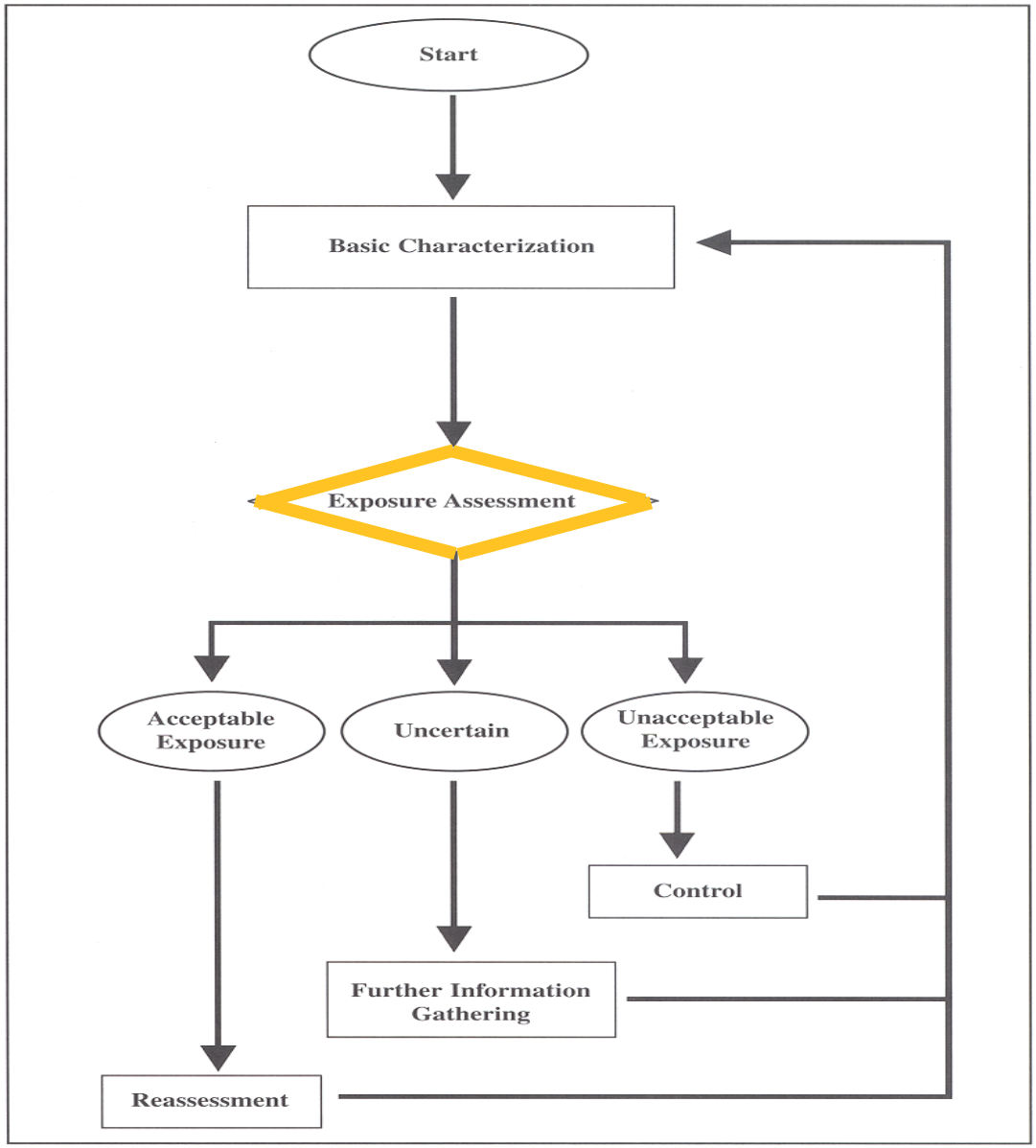



**Figure 1.2** — A strategy for assessing and managing occupational exposures.

# Qualitative Exposure Assessment

**Purpose:** Determine which processes and tasks merit quantization

- Steps:

1. Review each process
2. Review manufacturing SOP for each job
3. Observe each job throughout the process cycle
4. Identifying tasks where exposures may occur, their frequency and duration.
5. Use professional judgment to complete  form

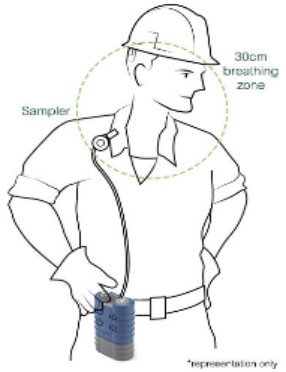
- Outcome:

1. List of jobs and tasks requiring quantitative assessment

# Quantitative Exposure Assessment

**Purpose:** establish central tendency and variation for airborne chemical levels

- Steps:




1. Collect proper number of lapel samples (N= 8-15)
2. Number/location of operators to be sampled
   - Appreciate temporal and seasonal variability
   - Process stability
3. Collect STEL samples concurrently based on qualitative assessment
4. Apply statistical treatment (% exceedance, GM, GSD, UTL 95/95)

# Acceptable Exposure

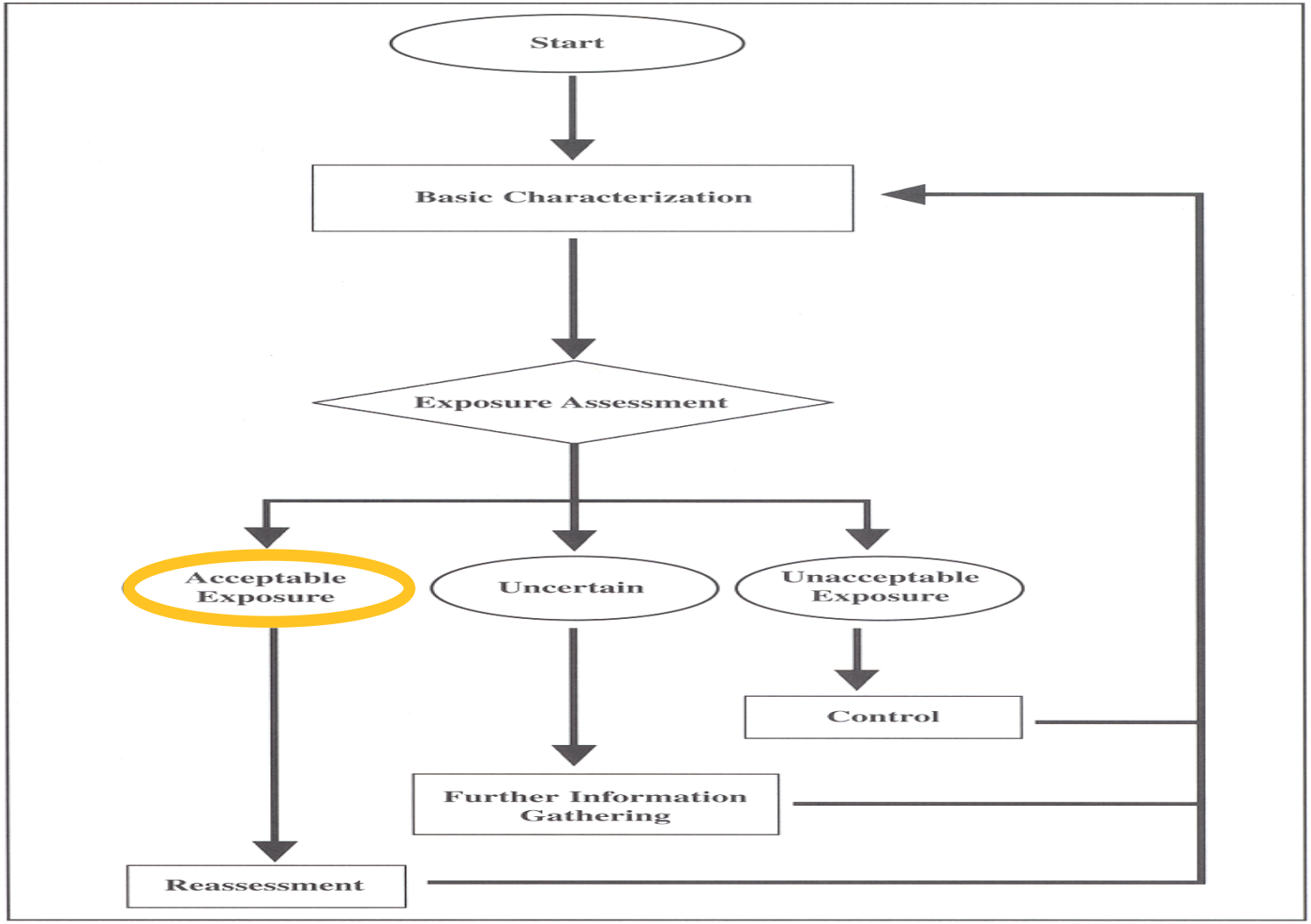



**Figure 1.2** — A strategy for assessing and managing occupational exposures.

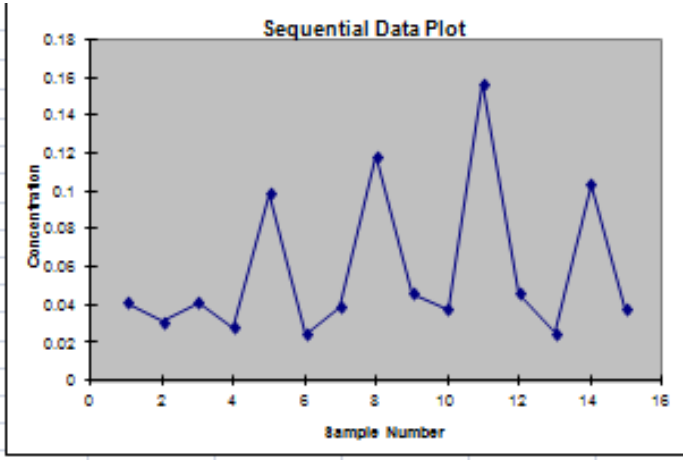
# Data Analysis

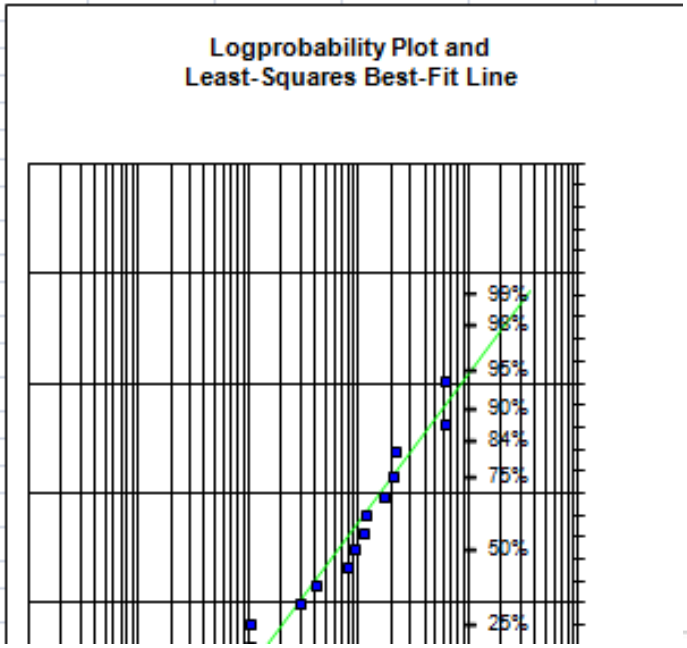
- Materion uses Percent Exceedance to assess compliance with internal standards.
- Definition: The percent of samples that would exceed the occupational exposure limit if an infinite number of samples were collected on a job
- Materion uses 1.0% PE for Beryllium  exposure
- 95% upper tolerance level is integrated into calculation
- Model sensitive to N, percent of samples at detection limit, how ND values are treated and variance
- Allows us to predict future results (very powerful)

# Statistical Spreadsheet

| OEL |
|---|
| 0.2 |
| |
| **Sample Data** (max n = 50) No less-than (<) or greater-than (>) |
| 0.04094 |
| 0.03089 |
| 0.04091 |
| 0.02817 |
| 0.09893 |
| 0.02460 |
| 0.03881 |
| 0.11840 |
| 0.04605 |
| 0.03795 |
| 0.15707 |
| 0.04627 |
| 0.02500 |
| 0.10362 |
| 0.03723 |

| DESCRIPTIVE STATISTICS | |
|---|---|
| Number of samples (n) | 15 |
| Maximum (max) | 0.15707 |
| Minimum (min) | 0.024598 |
| Range | 0.132472 |
| Percent above OEL (%>OEL) | 0.000 |
| Mean | 0.058 |
| Median | 0.04091 |
| Standard deviation (s) | 0.041 |
| Mean of logtransformed data (LN) | -3.024 |
| Std. deviation of logtransformed data (LN) | 0.592 |
| Geometric mean (GM) | 0.049 |
| Geometric standard deviation (GSD) **(Goal < 2.5)** | **1.807** |
| **TEST FOR DISTRIBUTION FIT** | |
| W-test of logtransformed data (LN) | 0.867 |
| Lognormal (a = 0.05)? | No |
| W-test of data | 0.762 |
| Normal (a = 0.05)? | No |
| **LOGNORMAL PARAMETRIC STATISTICS** | |
| **Estimated Arithmetic Mean - MYUE** | 0.057 |
| $LCL_{1,95\%}$ - Land's "Exact" | 0.045 |
| $UCL_{1,95\%}$ - Land's "Exact" | 0.081 |
| **95th Percentile** | 0.129 |
| $UTL_{95\%,95\%}$ | 0.222 |
| **Percent above OEL (%>OEL)** | 0.84165 |
| $LCL_{1,95\%}$ %>OEL | <0.1 |
| $UCL_{1,95\%}$ %>OEL **(Goal < 5.0%)** | **6.484** |
| **NORMAL PARAMETRIC STATISTICS** | |
| **Mean** | 0.058 |
| $LCL_{1,95\%}$ - t statistics | 0.040 |
| $UCL_{1,95\%}$ - t statistics | 0.077 |
| **95th Percentile - Z** | 0.125 |
| $UTL_{95\%,95\%}$ | 0.16 |
| **Percent above OEL (%>OEL)** | 0.024 |



# Materion's Airborne Beryllium Exposure Compliance Model

Purpose: determine central tendency and variation for airborne beryllium levels

- Statistical treatments
  - **% exceedance (95CI): < 1.0 PE of 0.2 μg/m $^3$**
  - GM: generally < 0.08 μg/m $^3$
  - GSD: < 2.5

# Reassessment

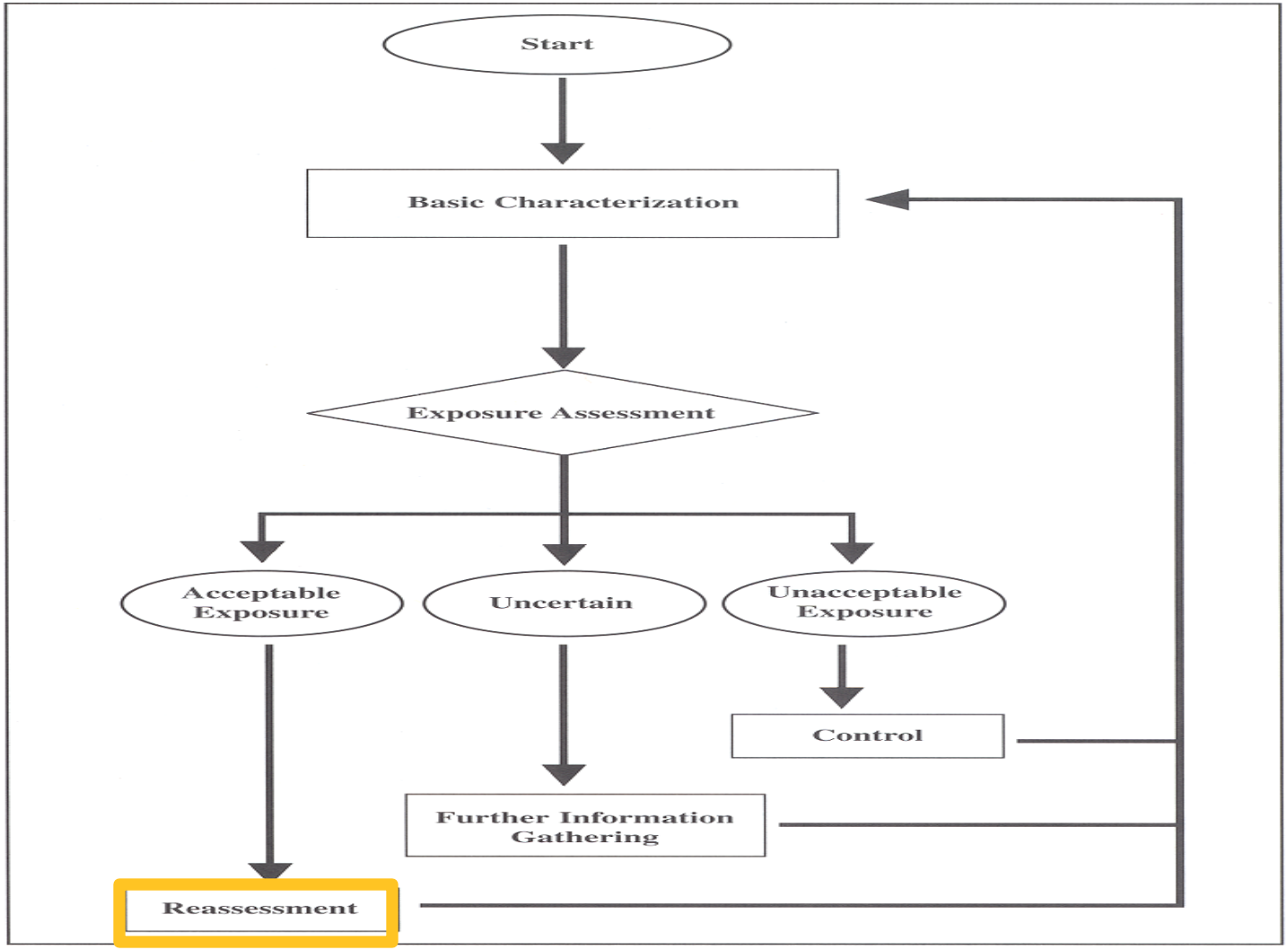


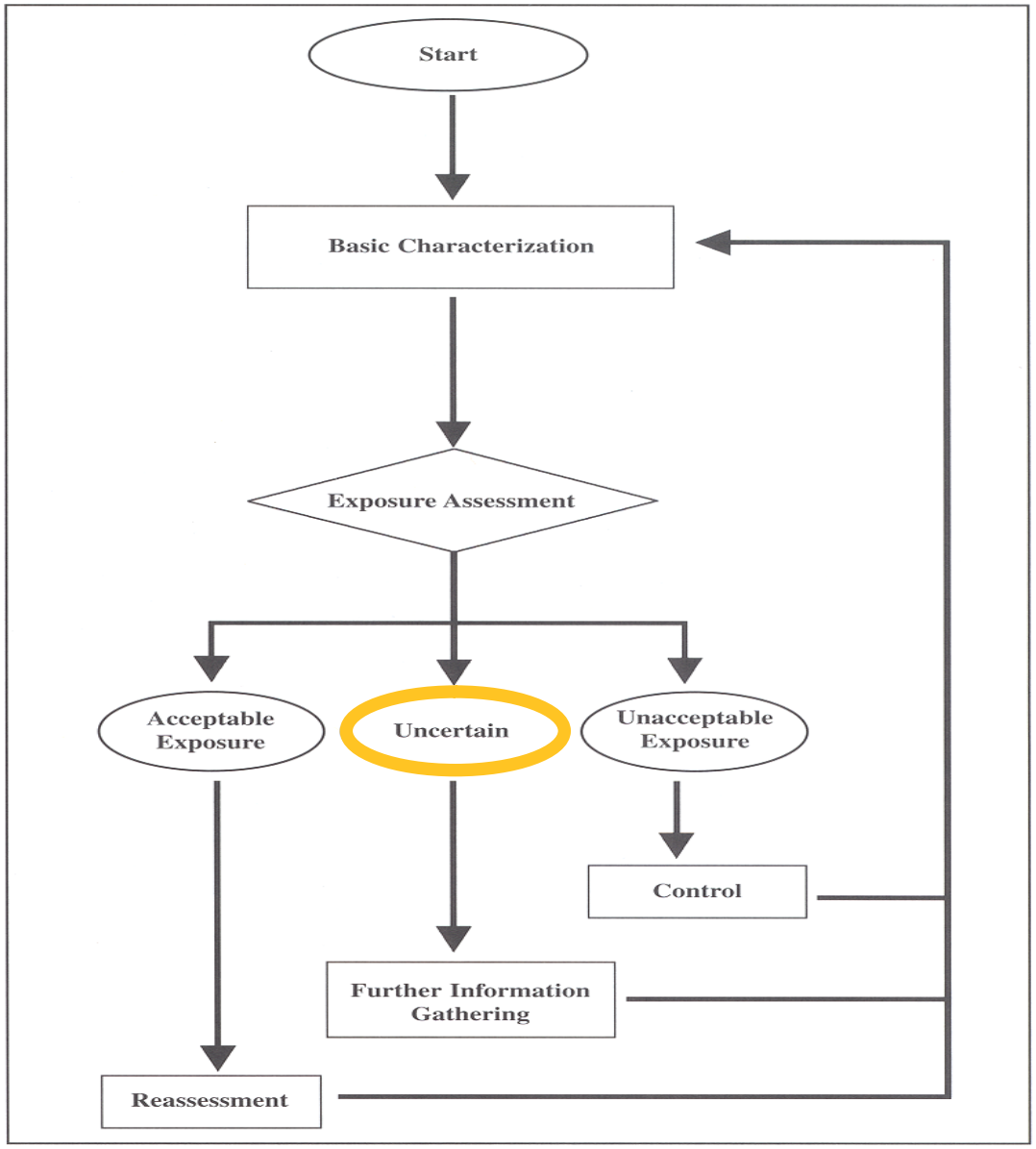

**Figure 1.2** — A strategy for assessing and managing occupational exposures.

# Reassessment

- Resample job only if there has been a process change that may increase exposure.
- We review each job annually or during process improvement projects.

# Uncertain

- PE nearing 1.0
- GSD 2.5- 3.0
- Unstable or unpredictable process
- More samples needed

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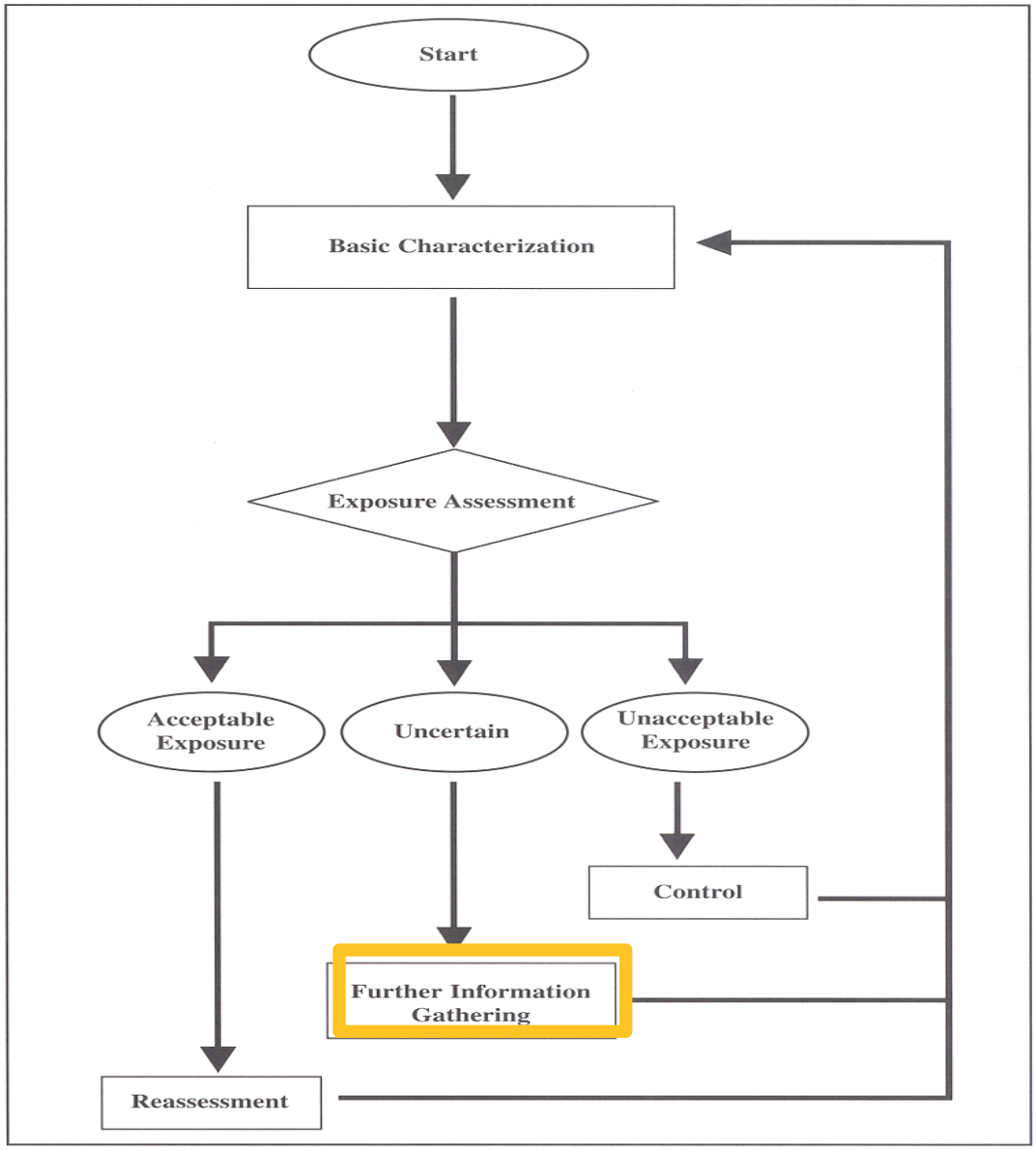
# Uncertain- Further Information Gathering

- Ensure all tasks have been characterized within the job
- Ensure job was representative of their normal duties (safety meetings)
- Evaluate process stability
- Enough samples?

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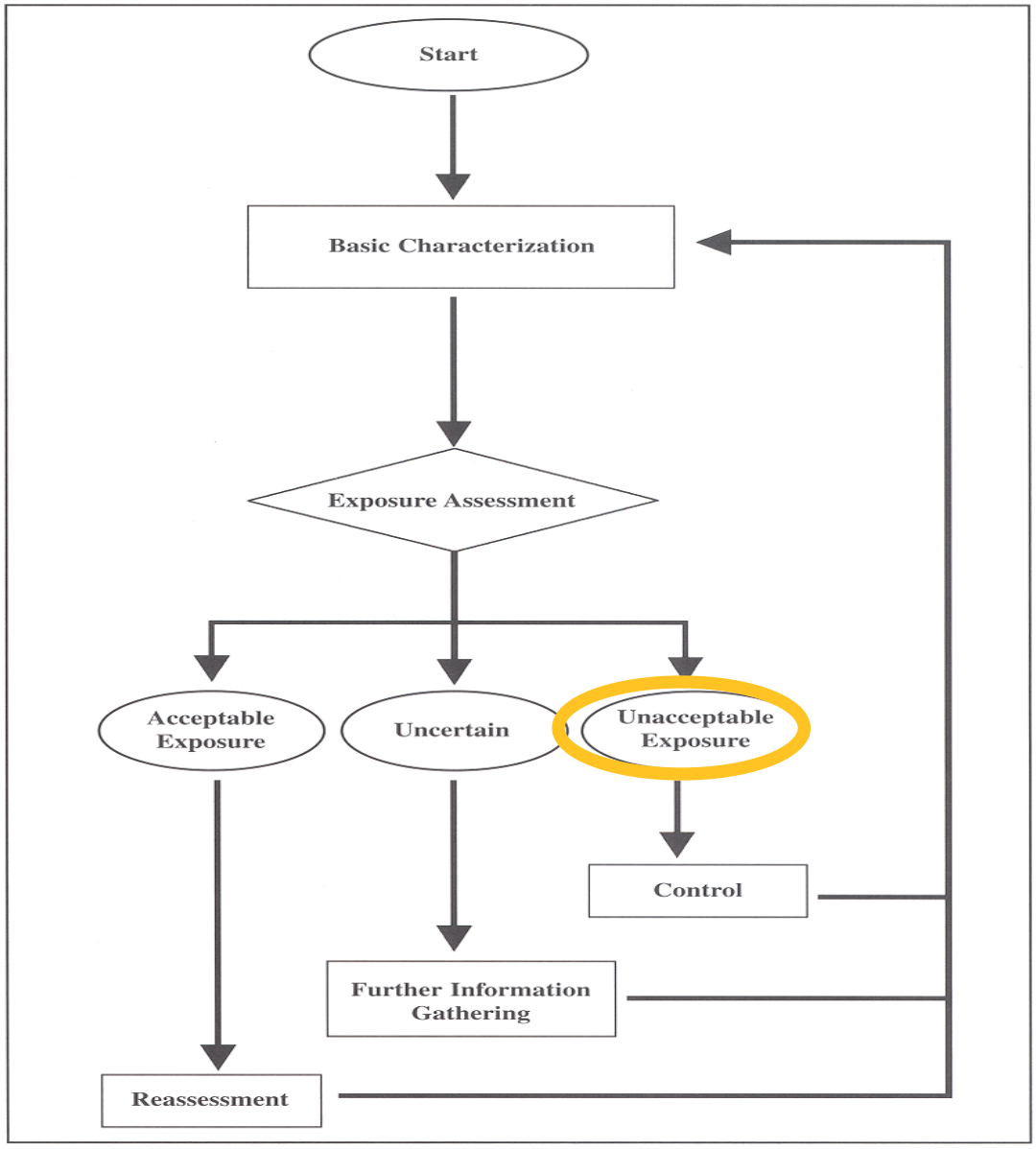
# Unacceptable Exposure

- Percent exceedance (95CI) of greater than one percent of the OEL.
- GSD > 3.0
- Unstable or unpredictable process

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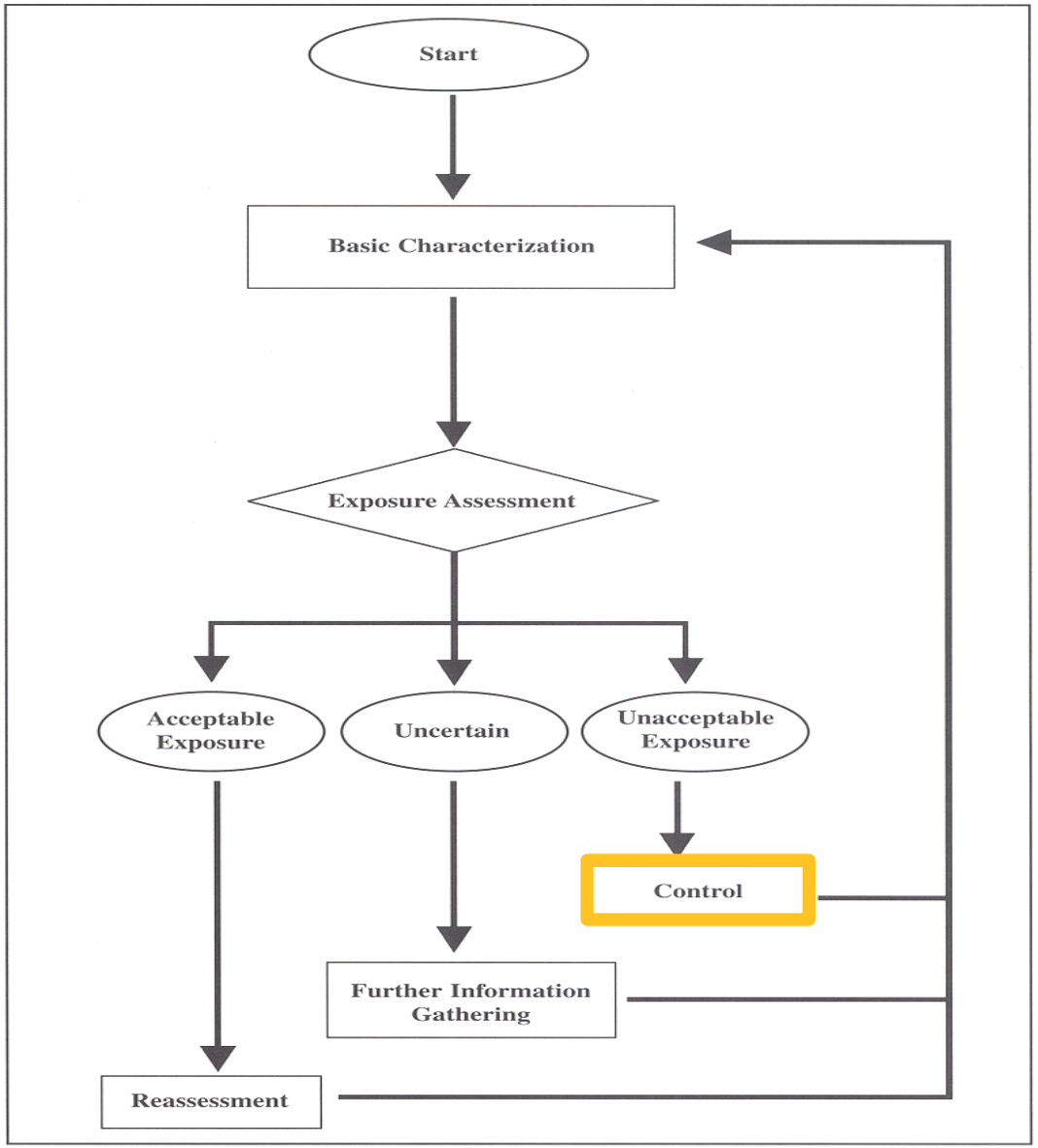
# Respiratory Protection Determination

- **Purpose:** Determine if RP is required and what level
- Use data generated during baseline sampling
- Use statistical model to establish need for RP (PE> 1.0 percent of OEL)
- Use statistical model for level of protection (UTL 95/95)
  - 10X for half face, 50X for full face, 1000 for TFPAPR

# Control

- Place employees in RP.
- Quantify task exposure based on qualitative assessment
- Evaluate work practices
- Evaluate engineering controls
- Design Intervention

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# A Little More on Sampling

- Wipe Sampling
- Analytical Chemistry

# Sampling Strategies and Their Applications

- Wipe sampling- General Technique

1. Find a nonporous surface with suspect beryllium contamination.
2. Obtain a ghost wipe
3. With clean hands, wipe a 100 $cm^2$ surface until visually clean.
4. Place in sample container and send to lab for analysis.

# Sampling Strategies and Their Applications

Wipe samples- Pros

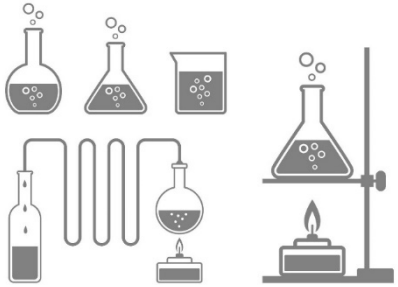
- General indication of whether beryllium is being released into the work environment.
- Assesses cleanliness of material released to general public
- General indication of effectiveness of housekeeping programs
- General indication of effectiveness of dermal protection programs

# Sampling Strategies and Their Applications

Wipe samples- Cons

- Not a substitute for air sampling
- Semi-quantitative at best
- Can’t sample porous surfaces
- Not correlated with airborne exposures
- No relationship with CBD or BeS
- Linkage between level present on skin and sensitization not established

# Analytical Chemistry



Typical Analytical Methods Used for Beryllium

- Flame AA
- ICP
- NIOSH Method 7102 – Graphite Furnace
- **NIOSH Method 7300 – ICP-AES**
  - **LOD = 0.005: Use for research**
- **OSHA Method ID-125G**
  - **LOD= 0.02: Use for OSHA compliance**

## Summary

- Determine purpose of your sampling
- Use the right statistical tool for the job
- Use the proper analytical method