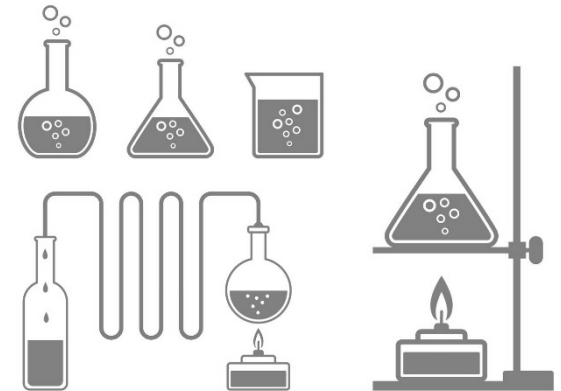
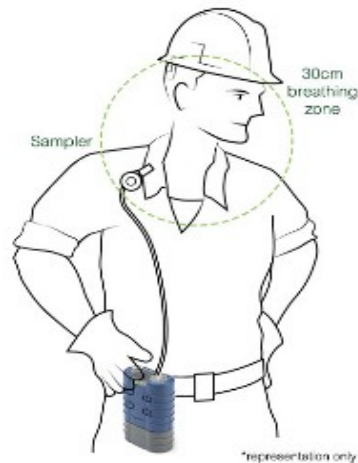


Exposure Assessment Strategies

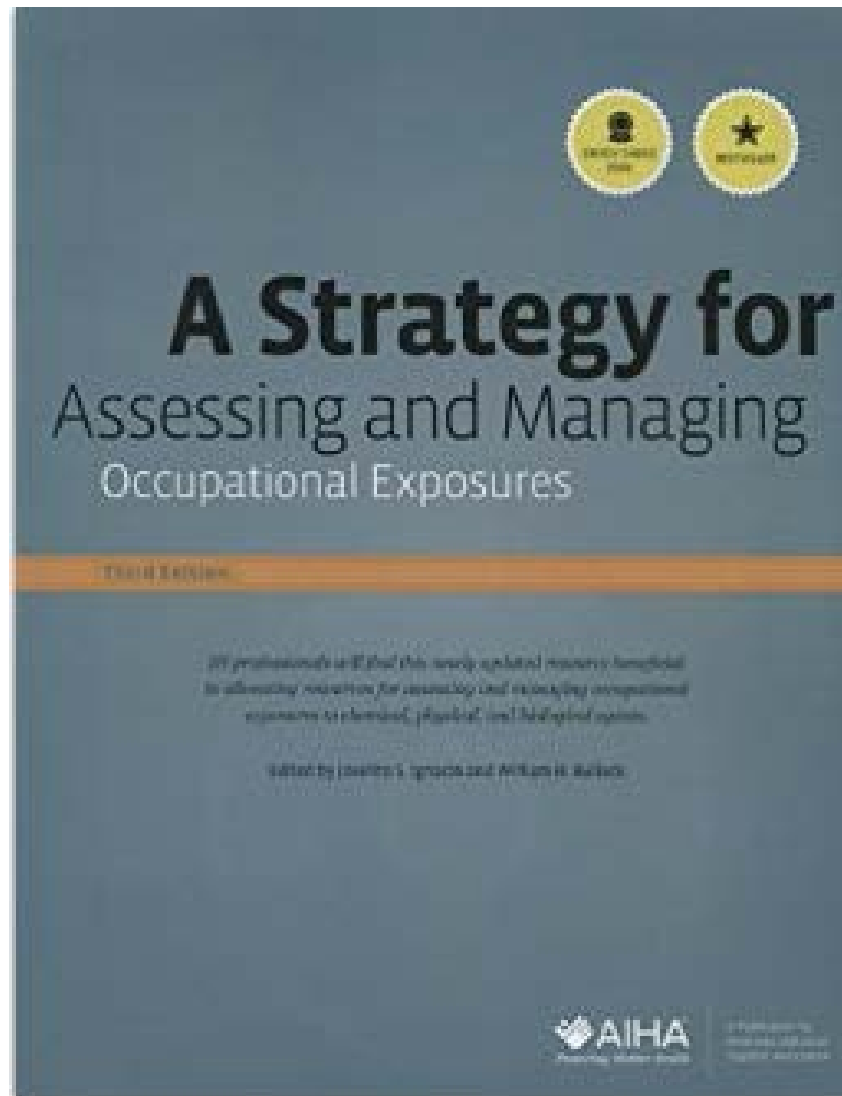
July 2018

Outline

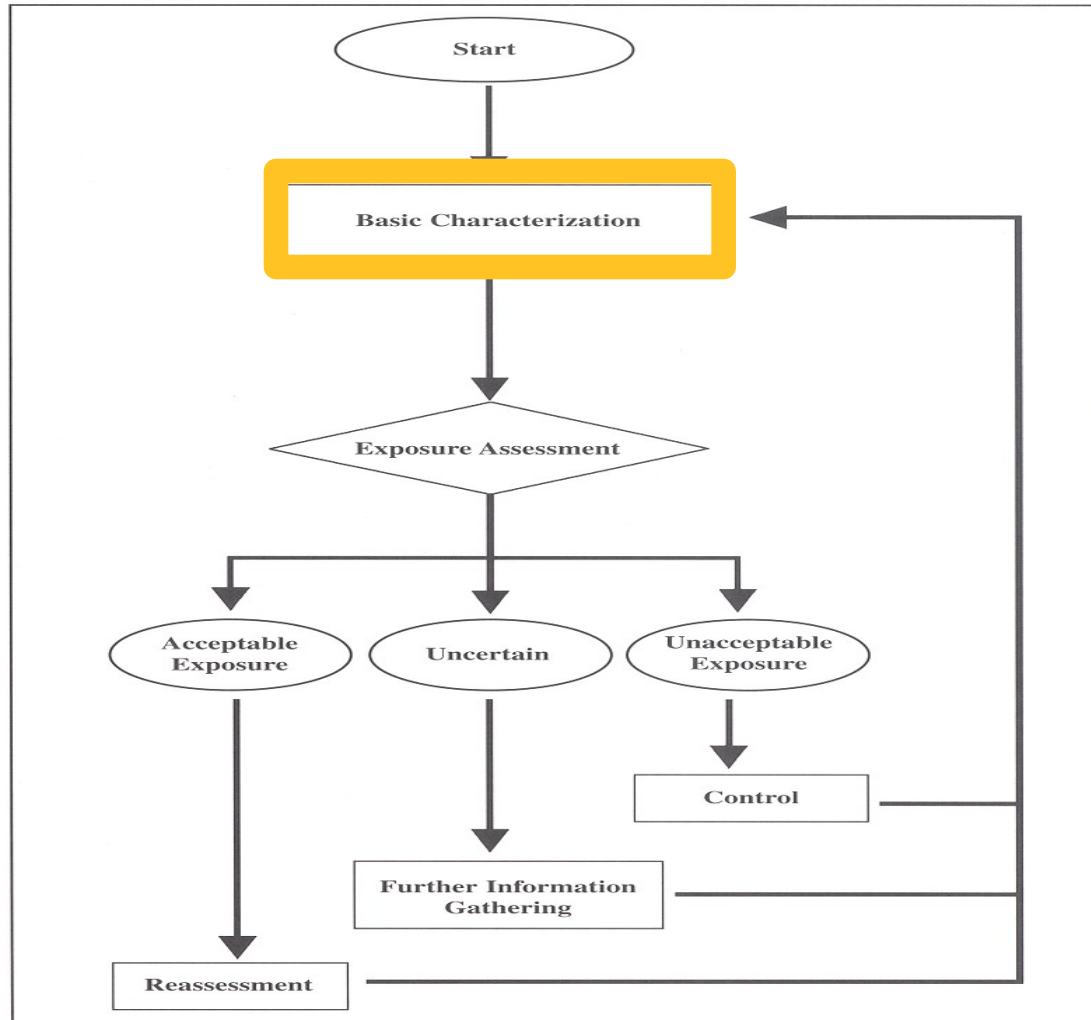
- Exposure Assessment Strategies
 - Qualitative Assessment
 - Quantitative Assessment
 - Analytical Chemistry



Familiarize yourself with this text?



Basic Characterization



1.2 — A strategy for assessing and managing occupational exposures.

Basic Characterization

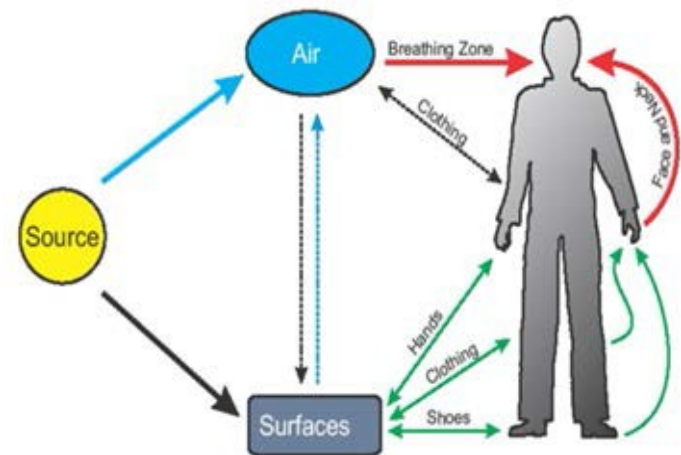
- **Purpose:** Collect and organize available information on work force, workplace, agents and historical exposure data

■ 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
Chemical Etching	Maintenance
Chemical Milling	Resistance Welding
Coolant Management	Roller Burnishing
Deburring (grinding)	Sand Blasting
Destructive Testing	Sand Casting
Dross Handling	Sanding
Electrical Chemical	Scrap Management
Machining (ECM)	(Clean)
Electrical Discharge	Sectioning
Machining (EDM)	Slab Milling
Electron Beam Welding	Soldering
(EBW)	Solution Management
Forging	Spot Welding
Grinding	Sputtering
Heat Treating (in air)	Swaging
High Speed Machining	Torch cutting (i.e., oxy-
(>10,000 rpm)	acetylene)
Honing	Water-jet Cutting
Hot Forging	Welding (ARC, TIG,
Hot Rolling	MIG, etc.)
Investment Casting	Wire Electrical
Lapping	Discharge Machining
	(WEDM)

Exposure Assessment

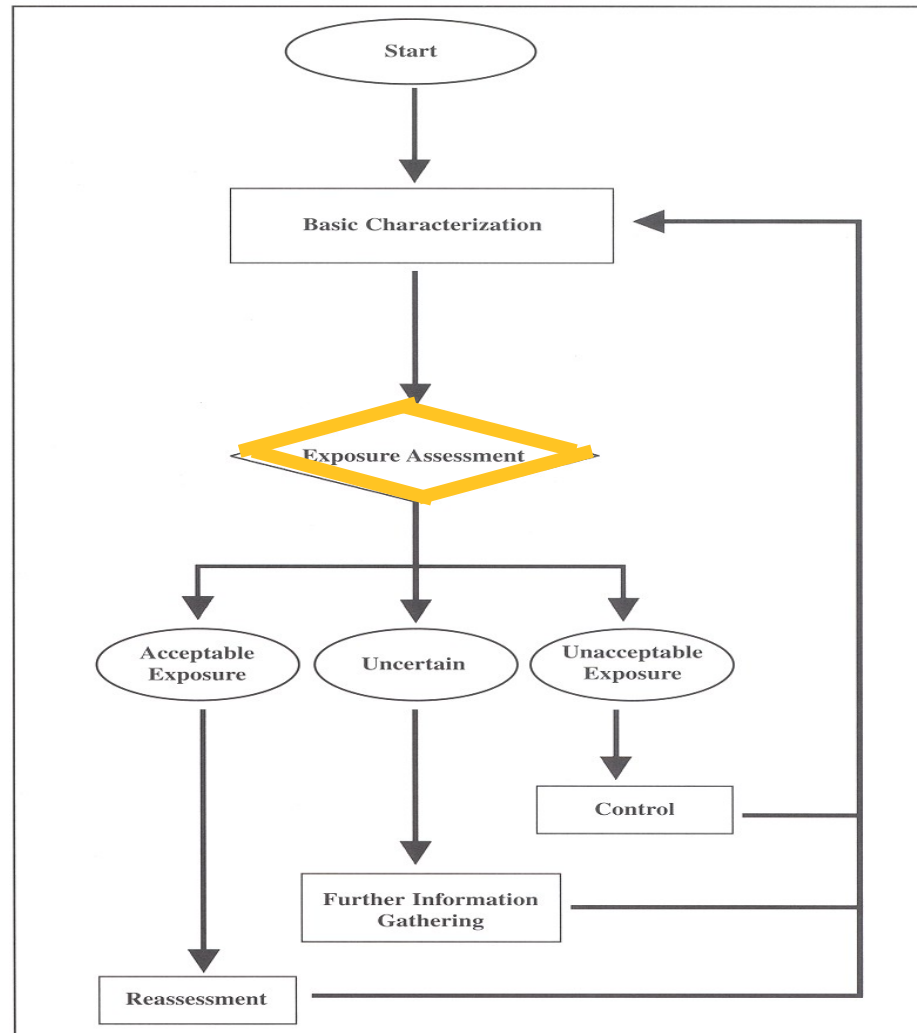


Figure 1.2 — A strategy for assessing and managing occupational exposures.

Qualitative Exposure Assessment

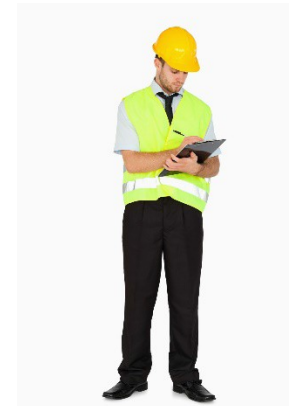
Purpose: Determine which processes and tasks merit quantization

■ 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

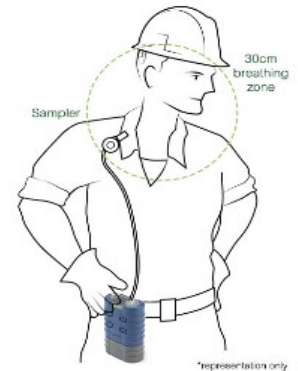


Quantitative Exposure Assessment

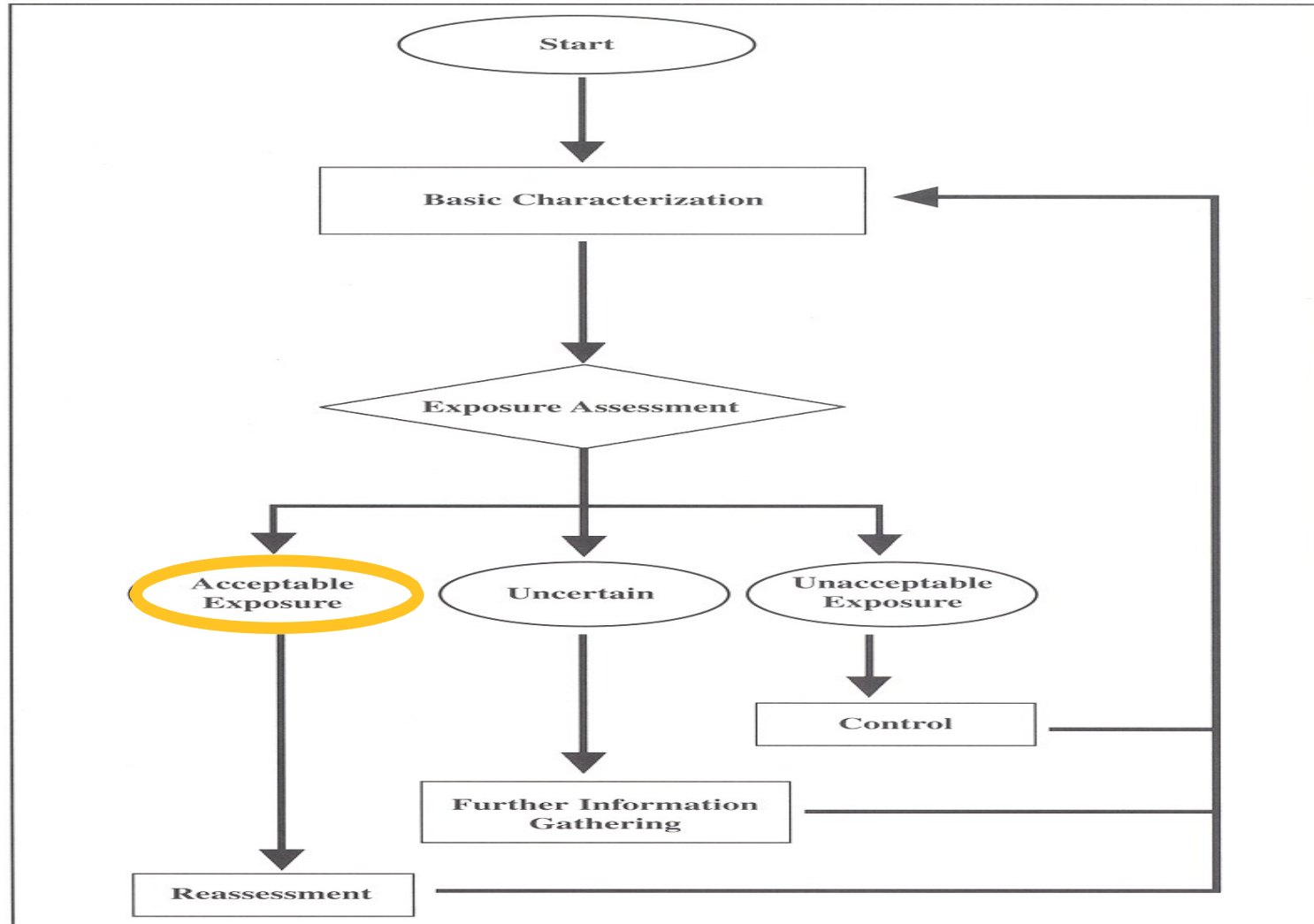
Purpose: establish central tendency and variation for airborne chemical levels

■ 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



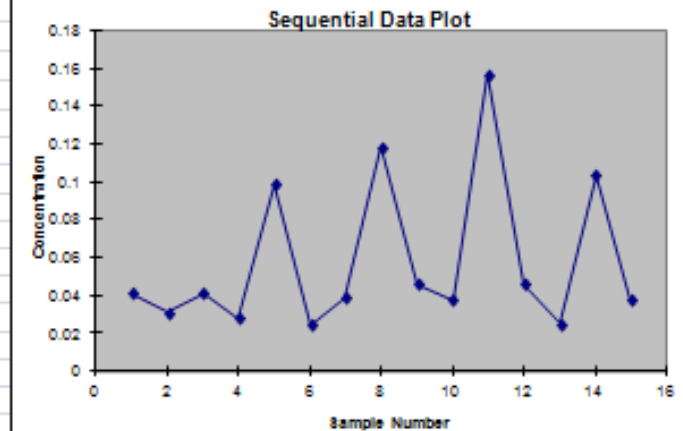
strategy for assessing and managing occupational exposures.

Data Analysis

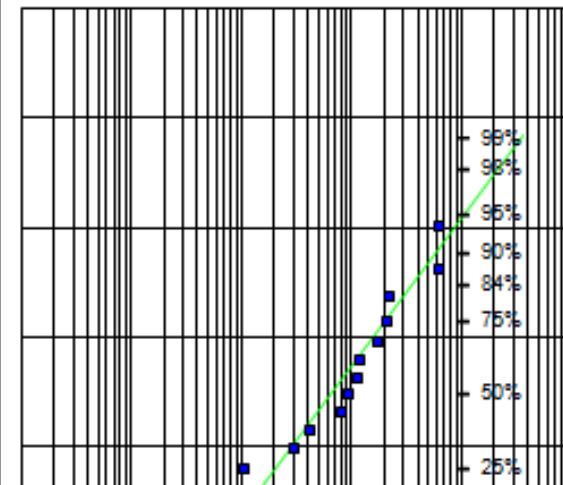
- BeST uses Percent Exceedance to assess compliance with internal standards.
- Definition: The percent of samples that would exceed the occupational exposure limit if an infinite number of samples were collected on a job
- BeST uses 1.0% PE for Beryllium exposure
- 95% upper tolerance level is integrated 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	DESCRIPTIVE STATISTICS	
0.2	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 _{1,95X} - Land's "Exact"	0.045
	UCL _{1,95X} - Land's "Exact"	0.081
	95th Percentile	0.129
	UTL _{95X,95X}	0.222
	Percent above OEL (%>OEL)	0.84165
	LCL _{1,95X} %>OEL	<0.1
	UCL _{1,95X} %>OEL (Goal < 5.0%)	6.484
	NORMAL PARAMETRIC STATISTICS	
	Mean	0.058
	LCL _{1,95X} - t statistics	0.040
	UCL _{1,95X} - t statistics	0.077
	95th Percentile - Z	0.125
	UTL _{95X,95X}	0.16
	Percent above OEL (%>OEL)	0.024



Logprobability Plot and Least-Squares Best-Fit Line



BeST's Airborne Beryllium Exposure Compliance Model

Purpose: determine central tendency and variation for airborne beryllium levels

- Statistical treatments
 - % exceedance (95CI): < 1.0 PE of 0.6 $\mu\text{g}/\text{m}^3$ - - Inhalable
 - GM: generally < 0.08 $\mu\text{g}/\text{m}^3$
 - GSD: < 2.5

Reassessment

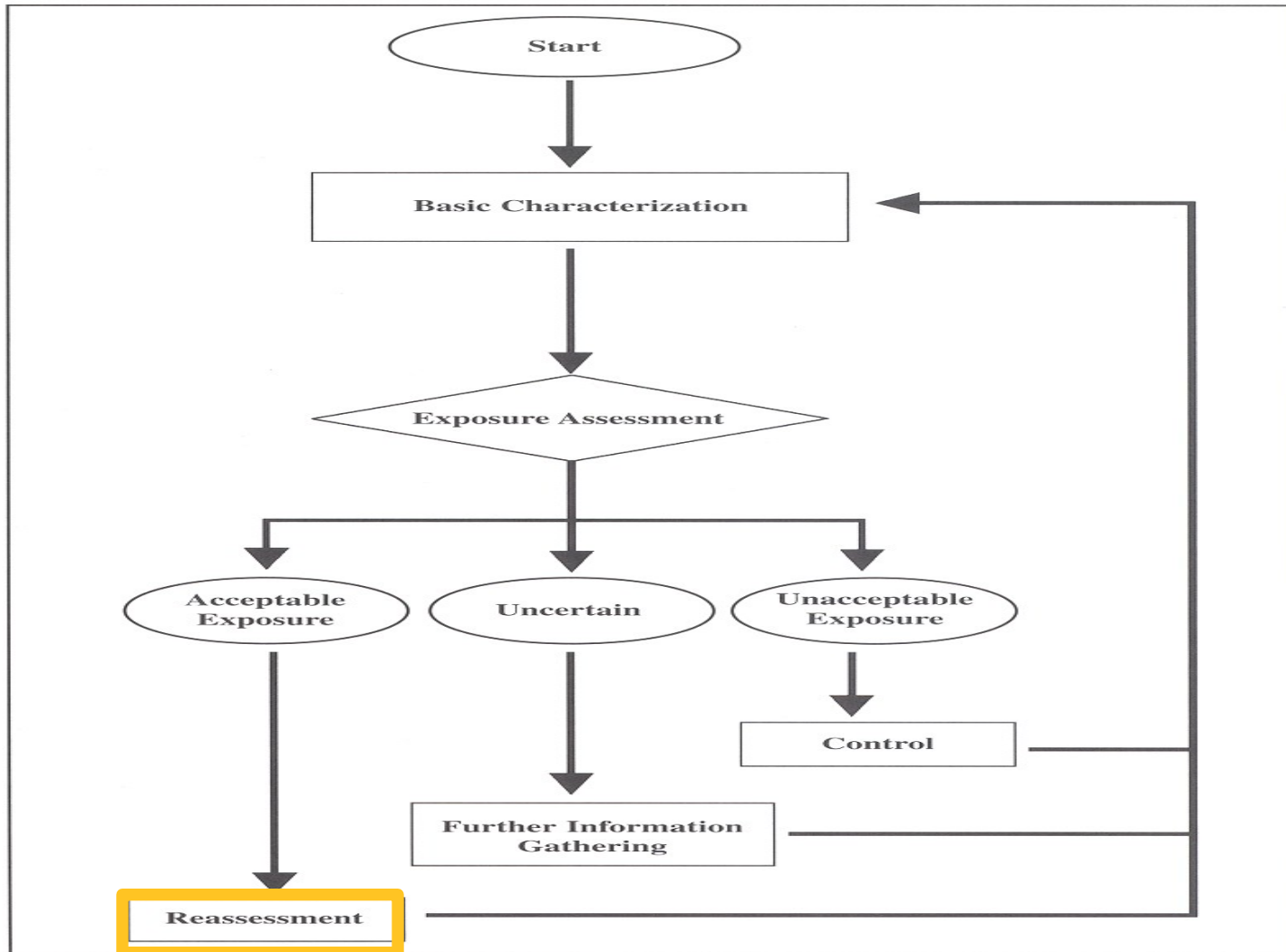


Figure 1.2 — A strategy for assessing and managing occupational exposures.

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.

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

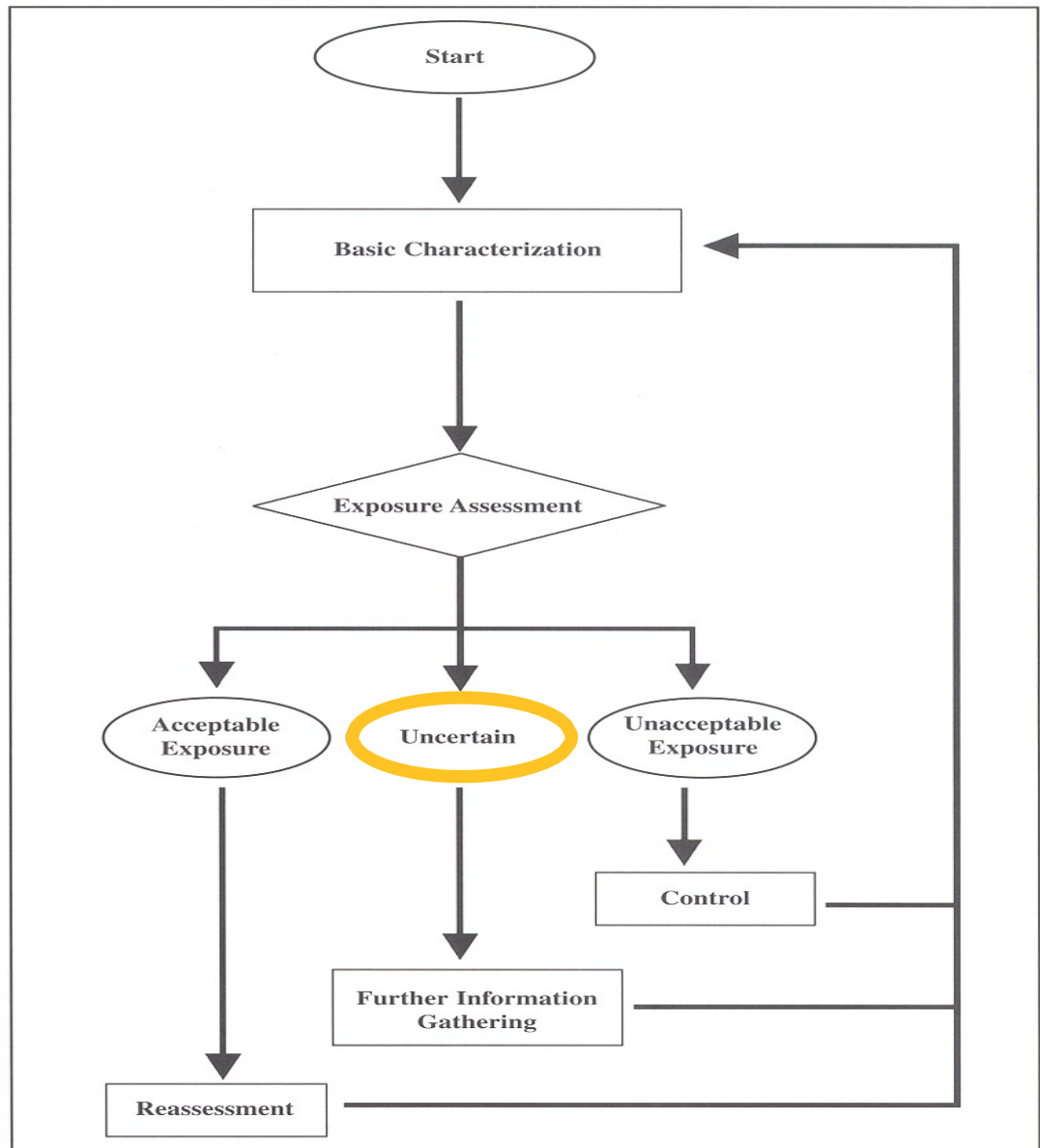


Figure 1.2 — A strategy for assessing and managing occupational exposures.

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?

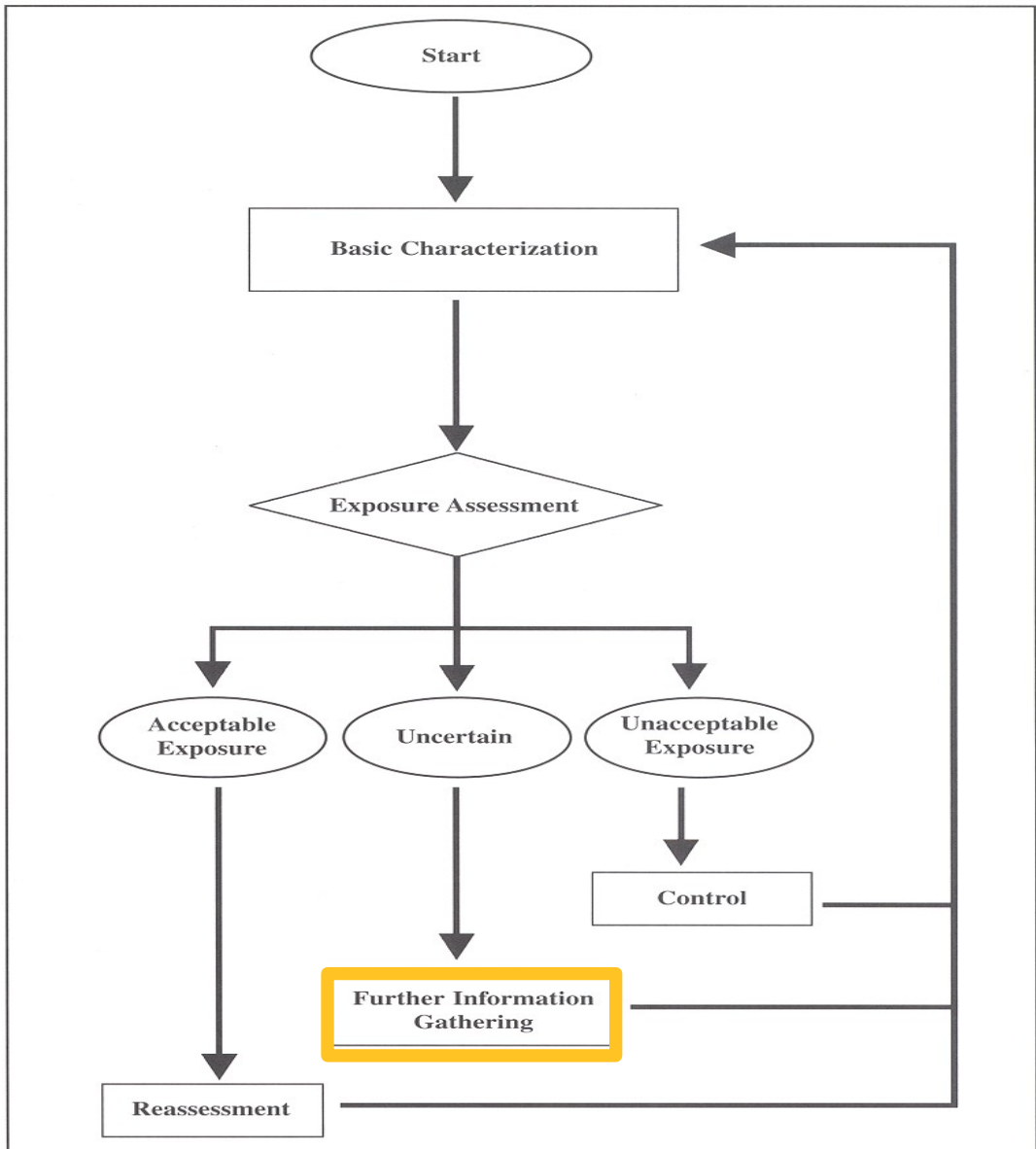


Figure 1.2 — A strategy for assessing and managing occupational exposures.

Unacceptable Exposure

■ Percent exceedance (95CI) of greater than one percent of the OEL.

■ GSD > 3.0

■ Unstable or unpredictable process

■

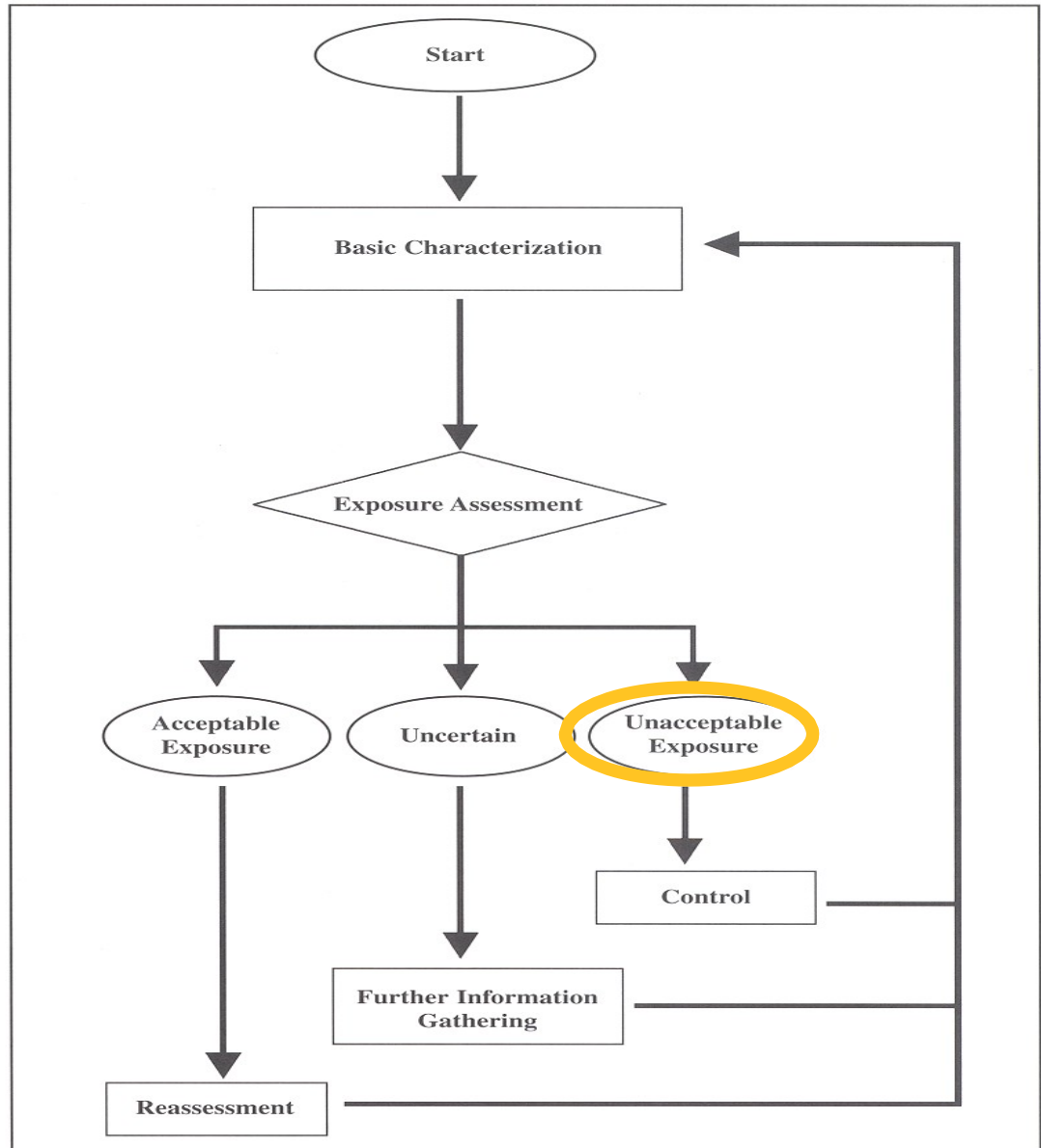


Figure 1.2 — A strategy for assessing and managing occupational exposures.

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

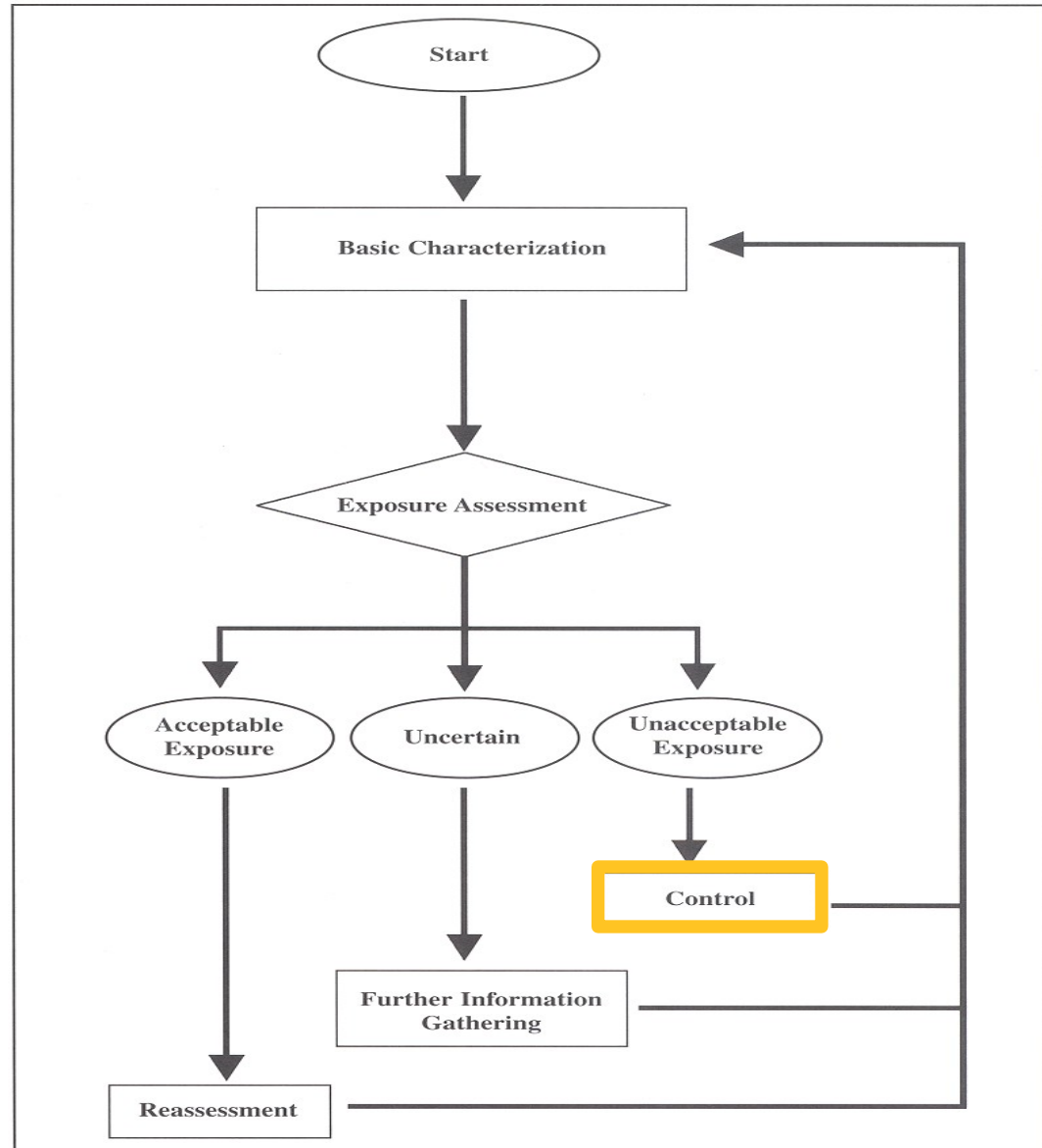


Figure 1.2 — A strategy for assessing and managing occupational exposures.