

**EI**  
Industrial Hygiene

Anticipation  
Industrial Hygiene  
Evaluation  
Control

**Phil Fincher, CIH, CSP**  
**VP, Safety & Health**

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■ ■ ■ ■ Overview

- Introduction to IH
- Toxicology & Routes of Exposure
- Sampling & Analytical Methods
- Data Interpretation
- Control Methods
- Standards & Guidelines
- Current Events

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■ ■ ■ ■ Introduction to Industrial Hygiene

- *Industrial Hygiene is a science and art devoted to the anticipation, recognition, evaluation, prevention, and control of those environmental factors or stresses arising in or from the workplace which may cause sickness, impaired health and well being, or significant discomfort among workers or among citizens of the community.- AIHA*

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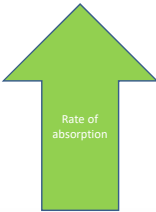
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**■ ■ ■ ■ Toxicology & Routes of Exposure**

- Intravenous
- Inhalation
- Intraperitoneal
- Subcutaneous
- Dermal



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**■ ■ ■ ■ Hazard Recognition**



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**■ ■ ■ ■ Welding/Cutting/Grinding: Metal Fumes**



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■ ■ ■ ■ Welding & Burn Table: Metal Fumes



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■ ■ ■ ■ Torch Cutting: Metal Fumes



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■ ■ ■ ■ Bridge Abatement: Lead, Cadmium, Chromium



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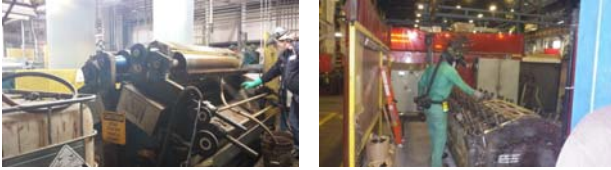
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■ ■ ■ ■ Chromic Acid & Stainless Steel: Hexavalent Chromium



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■ ■ ■ ■ Burning Coated Leads-Thermal Degradation of Polymers



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■ ■ ■ ■ Spray Finishing- VOCs and Isocyanates



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■ ■ ■ ■ Dip Tanks & Parts Washers: Organic Solvents



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■ ■ ■ ■ Bag Filling Spray Dried Materials: Total & Respirable Dusts



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■ ■ ■ ■ Drills, Lathes, CNCs: Cutting Oils/Metal Working Fluids



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■ ■ ■ ■ Furnace Insulation: Silica Dust & Refractory Ceramic Fibers



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■ ■ ■ ■ Abrasive Blasting: Silica, Iron Oxide, etc.



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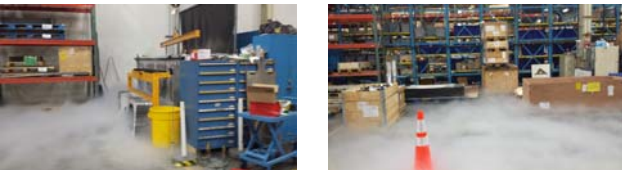
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■ ■ ■ ■ Dry Ice Dip Tank: CO2, O2 Deficiency



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■ ■ ■ ■ Bottling: Carbon Dioxide, O2 Deficiency



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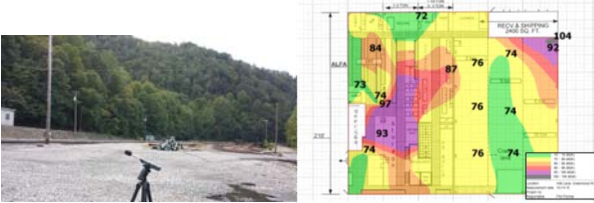
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■ ■ ■ ■ Noise/Sound Level Mapping



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■ ■ ■ ■ RR Transport & Maintenance



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■ ■ ■ ■ Laboratory Safety: Aldehydes, VOCs, Ethylene Oxide



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■ ■ ■ ■ Ionizing Radiation



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■ ■ ■ ■ The Sampling Plan

- Why sample?
- What to sample?
- Where/who to sample?
- How many?
- How frequently?
- What if:
  - No OEL (control banding approach)
  - No Method (surrogate materials)
- Whats next...employee notification, etc



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**■ ■ ■ ■ The Why....Standards & Guidelines**

- OSHA
- ACGIH TLVs
- NIOSH RELs



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**■ ■ ■ ■ OSHA**

- 1910 Subpart Z: Toxic & Hazardous Substances
  - 1910.1000, Z Tables: Limits for Air Contaminants
  - 1910.1002-1910.1053: Chemical Specific Standards (Asbestos, Benzene, Cr 6, Silica, etc.)
- 1910 Subpart G: Occupational Health & Environmental Control
  - 1910.95: Occupational Noise Exposure
  - 1910.97: Nonionizing Radiation



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**■ ■ ■ ■ Health Based Occupational Exposure Limits**

- ACGIH: American Conference of Governmental Industrial Hygienists
  - TLVs
- NIOSH: National Institute for Occupational Safety & Health
  - RELs
- AIHA: American Industrial Hygiene Association
  - WEELs



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■ ■ ■ ■ **What, How, Who...Developing a Sampling Plan**

- Raw Materials: Review Safety Data Sheets
- By-Products: Temp/Pressure Dependent, SDS, Literature Review
- Determine if there is an Exposure Limit (OSHA, AGGIH, NIOSH)
- Determine if there is an approved Analytical Method
  - Calculate Sample Volume based on method limitations to ensure you have sufficient sample volume and do not overload sample media
- Identify Similar Exposure Groups (SEGs)
- Ready, set, sample



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■ ■ ■ ■ **Analytical Methods**

- OSHA Sampling and Analytical Methods
  - <https://www.osha.gov/dts/sltc/methods/index.html>
  - Search by CAS# or Name (A-Z)
- NIOSH Manual of Analytical Methods
  - <https://www.cdc.gov/niosh/nmam/>
  - Search by CAS# or Name
- Selecting a Laboratory
  - AIHA Laboratory Accreditation Program (AIHA-LAP)



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■ ■ ■ ■ **How Many Samples**

- OSHA typically does not specify the number of samples required but sampling must be representative (shift length, tasks, etc.)
- Number of measurements depends on monitoring goal and SEG profile:
  - Highly variable production and exposures
  - 1 sample > 100% OEL or 1 sample <10% OEL: may be sufficient to determine if exposure are acceptable or unacceptable
  - 6 random samples per SEG recommended unless measured exposures are <10% OEL
  - 6-10 samples sufficient to estimate mean and standard deviation for normally distributed population



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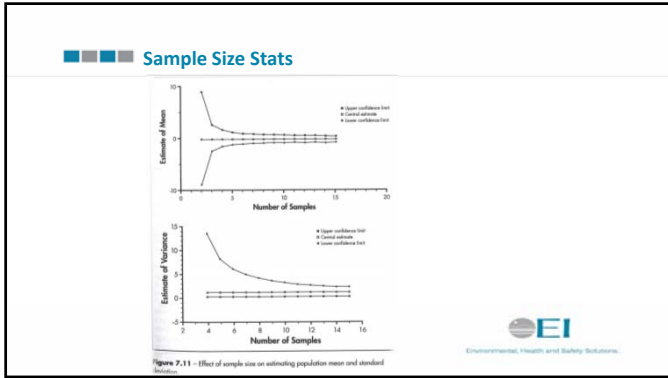
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- ### Sampling & Analytical Methods
- Dust, Mist, Fumes
  - Gases, Vapors
  - Noise Dosimetry
  - Sound Level Survey
  - OBA
  - Calibration/QC
- Environmental, Health and Safety Solutions. **EI**

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### Particulates: Dust, Mist, Fume

- Integrated air sampling= pump + filter cassette
- Pump flow rate= 0.5-4 LPM
- Sample cassette= PVC, MCE
- Pre/post calibration with primary calibration standard
- Samples analyzed by AIHA Accredited Laboratory

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**Total vs. Respirable Particulate Sampling**

- Total Particulate (~100 microns)
- Respirable Particulate (< 4 microns)

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**Gases & Vapors**

- Integrated air sampling= pump + sorbent tubes
- Charcoal shell, Tenax, etc. to adsorb gas/vapor
- Passive Dosimetry
  - Organic vapor monitor
  - Chemical specific (ammonia, etc.)

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**Gases & Vapors- Badges and Direct Read**

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**Grab Samples**

- Colorimetric Detector Tubes  
– Accuracy (+/- 25%)
- Evacuated Canisters, Tedlar bags,



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**Noise**

- Noise Dosimeter
- Sound Level Meter (SLM)



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**Air Sample Data**

- TWA: Time Weighted Average (8-hour; TWA-8)
- STEL: Short Term Exposure Limit (15 minutes)
- Ceiling Limit: Limit that shall not be exceeded at any time  
– Use direct read instrument or 15-min TWA
- Excursion Limit: 30 minute exposure limit
- IDLH: Immediately Dangerous to Life & Health



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■ ■ ■ ■ Noise Data

\* Noise dosimetry data collected using two separate criterion levels and must be compared to the Action Level and PEL

**Hearing Conservation**

- 85 dBA Action Level
- 50% Dose
- 80-130 dB

**Permissible Exposure Limit**

- 90 dBA PEL
- 100% Dose
- 90-130 dB



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■ ■ ■ ■ What's Next

- Employee notification (5-15 days upon receipt of results)
- Controls or corrective actions
- Follow-up sampling
  - Dependent on hazard and exposure
  - OSHA chemical specific standards typically every 3 mos if > PEL; or every 6 mos if >AL.
  - Changes in process or work practices that may increase exposures
  - Best practice every 1-3 yrs



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■ ■ ■ ■ Control Methods

- Substitution/Elimination
- Enclosures
- Local Exhaust Ventilation
- Dilution Ventilation
- Work Practices/Rotation
- PPE: Respiratory Protection, Hearing Protection, Protective Clothing



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Local Exhaust Ventilation



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Current Events

- Emerging Technologies
- Regulatory Updates



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Sampling Vests



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■ ■ ■ ■ Remote Air Sampling



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■ ■ ■ ■ Bluetooth & GPS Enabled Sampling Equipment



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■ ■ ■ ■ New and Pending Regulations

- Crystalline Silica Dust (1910.1053)- Enforcement may be delayed
- Beryllium (1910.1024)- Delayed effective date until May 20, 2017
  - Reduced PEL to 0.2 ug/m3



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■ ■ ■ ■ So... What's Covered in 1910.1053?

- Respirable crystalline silica standard applies to:
- All Occupational Exposures, except
  - Construction – (1926.1153)
  - Agriculture - as defined in 1928
  - Employers with objective data that exposures will remain below the Action Level under any foreseeable conditions



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■ ■ ■ ■ Airborne Exposure Values

**Permissible Exposure Limit (PEL)**  
8-hour time-weighted average exposure limit (TWA<sub>8</sub>)

**50 µg/m<sup>3</sup> TWA<sub>8</sub>**

**Action Level (AL)**  
0.5 of PEL

**25 µg/m<sup>3</sup> TWA<sub>8</sub>**



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■ ■ ■ ■ Exposure Determination



- Two options for determining employee exposures:
  - Scheduled monitoring method
  - Performance-oriented monitoring method
- Notify employees, in writing or posted
- Analytical methods specified
- Specific requirements for labs



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### ■ ■ ■ ■ Sampling Methods




Cyclone Assemblies



Liquid Impingers



Real Time VEM



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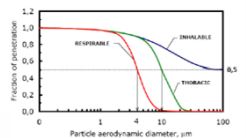
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### ■ ■ ■ ■ Sampling Methods

- Sampling device meeting ISO 7708:1995 – *Particle Size Fraction Definitions for Health Related Sampling*



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### ■ ■ ■ ■ Laboratory Requirements

- Specified analytical methods – OSHA ID-142
- Accredited to ANSI/ISO 17025/2005
- NIST traceable Instrument calibrations
- Internal QC program
- ID all polymorphs present
  - (quartz, cristobalite, tridymite)
- LOD no higher than 25% of PEL
  - Based on sample air volume



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**Scheduled Monitoring**

If initial respirable crystalline silica concentration is:

- Below the AL	→	No further monitoring, unless...
- At or above the AL	→	Monitor every 6 months Can discontinue monitoring if exposures are below AL and confirmed
- Above the PEL	→	Monitor every 3 months Can discontinue monitoring if exposures are below AL and confirmed

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**Performance Oriented Monitoring**

- Employer shall assess 8 Hr. TWA for each employee using any combination of air monitoring data, historical monitoring data, or objective data sufficient to accurately characterize employee exposure to respirable crystalline silica
- No fixed schedule for performing periodic monitoring



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**Establishment of Regulated Areas**

- Establish where  $TWA_8 > PEL$
- Must be demarcated with limited access
- Signs must be posted
- Provide and require the use of respirators to all entrants



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### ■ ■ ■ ■ Methods of Compliance

#### Engineering and work practice controls

- Shall be used to reduce exposure to or below the PEL.
- unless the employer can demonstrate that such controls are not feasible.
- When not sufficient to reduce employee exposure to or below the PEL, the employer shall nonetheless use them to reduce employee exposure to the lowest feasible level,
- and shall supplement them with the use of respirators



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### ■ ■ ■ ■ Methods of Compliance

#### • Written Exposure Control Plan

- Description of tasks involving exposure
- Engineering controls, work practices for each task
- Respiratory and other protection procedures
- Review & update annually



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### ■ ■ ■ ■ Housekeeping

- Shall not use dry sweeping or brushing where it could cause exposure, *except where HEPA-filter vacuuming or wet methods are not feasible.*
- Compressed air, dry sweeping, and dry brushing shall not be used to clean clothing *unless as a part of a system that captures the dust cloud created.*



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■ ■ ■ ■ Respiratory Protection

- When will you need respiratory protection?
  - Where PEL is exceeded during periods necessary to install or implement feasible engineering and work practice controls
  - Where exposures exceed the PEL during work operations for which engineering and work practice controls are not feasible
  - Operations where all feasible controls have been used and exposures are still above the PEL
  - During periods when the employee is in a regulated area




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■ ■ ■ ■ Medical Surveillance

- Exposed at or above the AL( 25 µg/m³) for 30 or more days per year
  - Within 30 days of initial assignment, unless within the last three years
  - At least every three years or as recommended by PLHCP
- Contents of exam
  - Medical & work history
  - Physical exam (respiratory system)
  - Chest X-ray (interpreted by NIOSH certified “B” reader)
  - PFT (NIOSH approved technician)
  - TB test




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■ ■ ■ ■ Medical Surveillance



- Provided by or under the supervision of a physician or other licensed health care professional (PLHCP)
- Made available at no cost to employee and at a reasonable place and time
- Performed by PLHCP
  - Written Medical Report - for employee
  - Written Medical Opinion - for employer
- Referral to pulmonary specialist on recommendation of PLHCP (30 days)




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■ ■ ■ ■ **Communication of Hazards to Employees**

- **Hazard Communication**
  - Specific to respirable crystalline silica
  - Container labels, SDS
  - ensure that at least the following hazards are addressed: cancer, lung effects, immune system effects, and kidney effects.
- **Signs shall be posted at all entrances to regulated areas**

DANGER  
 RESPIRABLE CRYSTALLINE SILICA  
 MAY CAUSE CANCER  
 CAUSES DAMAGE TO LUNGS  
 WEAR RESPIRATORY PROTECTION IN THIS AREA  
 AUTHORIZED PERSONNEL ONLY




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■ ■ ■ ■ **Employee Information & Training**

- **Assure that each employee covered by this section can demonstrate knowledge and understanding of the following:**
  - Health hazards associated with exposure to RCS
  - Specific operations in the work area that can result in exposure to RCS, especially those > PEL
  - Specific protection procedures (engineering controls, work practices & respirators)
  - The contents of this section
  - Purpose and description of medical surveillance program




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■ ■ ■ ■ **Additional Issues**

- **Employer shall make a copy of this section readily available without cost to each covered employee.**
- **Recordkeeping**
  - Air monitoring, objective data, medical surveillance, all in accord with 1910.1020
- **Start up dates:**
  - Effective Date: June 23, 2016
  - Medical Surveillance (>PEL): June 23, 2018
  - Medical Surveillance (>AL): June 23, 2020
  - All others: June 23, 2018
- **Appendix A: Methods of Sample Analysis**
- **Appendix B: Medical Surveillance Guidelines**




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So.... What's Different in Construction?

- Retains the definition of *Competent Person*
- Table 1 specifies *Exposure Control Methods*
  - If fully and properly engineering control requirements do not apply
  - Combines engineering controls and respiratory protection
  - Provides options for combining multiple tasks
- No requirement for regulated area(s) or signs
  - But ECP must specify procedures for restricting access




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Table 1—Exposure Control Methods

TABLE 1—SPECIFIED EXPOSURE CONTROL METHODS WHEN WORKING WITH MATERIALS CONTAINING CRYSTALLINE SILICA

Equipment/task	Engineering and work practice control methods	Required respiratory protection and minimum assigned protection factor (APF)	
		<4 hours/shift	≥4 hours/shift
(i) Stationary masonry saws	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions.	None	None
(ii) Handheld power saws (any blade diameter)	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. —When used outdoors _____ —When used indoors or in an enclosed area _____	None APF 10	APF 10 APF 10
(iii) Handheld power saws for cutting non-ferrous metal (with blade diameter of 8 inches or less)	For tasks performed outdoors only: Use saw equipped with commercially available dust collection system. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. Dust collector must provide the air flow recommended by the tool manufacturer, or greater, and have a filter with 99% or greater efficiency.	None	None
(iv) Walk-behind saws	Use saw equipped with integrated water delivery system that continuously feeds water to the blade. Operate and maintain tool in accordance with manufacturer's instructions to minimize dust emissions. —When used outdoors _____ —When used indoors or in an enclosed area _____	None APF 10	None APF 10




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Questions?




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