True Cost of Amateur Cleanrooms

W. Lawrence Ramsey. P.E.
NASA, Goddard Space Flight Center
Code 546, 301-286-9187
W.L.Ramsey@nasa.gov

Larry Ramsey
Where do amateur cleanrooms come from?

- Scientists and Engineers
  - Need for a “clean” area to build experiments or handle sensitive parts.
  - A desire to manufacture items at reduced cost and at a preferred location.

- Project managers
  - Desire to save money.

Larry Ramsey
Where do they go wrong?

- Expanding it’s goal from lab work to fulltime production.
- Not recognizing that humans are the source of contamination and cleanrooms have to be maintained.
- Not recognizing that part of the cost for a cleanroom is quantitative verification.

Larry Ramsey
Where do they go wrong?

- Cost to maintain a amateur cleanroom is the same as an engineered one.
- Cost to monitor the cleanroom is the same as well.
- Typically you can save a few thousand dollars a month – but will it be offset by delays in the process?

Larry Ramsey
Sources of loss in amateur cleanrooms

- Sometimes maintenance costs are higher because the location requires transport time for cleanroom crews.
- Usually materials of construction are inadequate and modifications eat into potential savings.
- Product quality can suffer.

Larry Ramsey
Typical problems

- Air flow rates.
  - HEPA filters installed but airflow not enough to keep positive pressure.
  - Pressure is ok but too few air changes to eliminate particles when workers are present.
  - Flows in room are not controlled to eliminate dead spots that collect particles.
Typical problems

- Materials of construction.
  - Materials were used that produce particles or outgas unacceptably.
  - Materials contain contact contaminants i.e., phthalates or silicones.
  - Fit of materials allows movement that generates particles.

Larry Ramsey
Typical problems

- Ghost of past practices.
  - A good cleanroom is built clean.
  - Conversions can have particles crammed into every joint that act as an invisible source of contamination.
  - Some areas use building air that may contain organics (like shop oils and popcorn grease).

Larry Ramsey
Examples

- This room was located inside of a highbay used for a machine shop.
- It was previously used a machine area and tool storage.
- The original HEPA plenum was made from particle board.
Examples

- This room was located inside of a highbay used for a machine shop.
- It was previously used a quality control area and tool storage.
- The original HEPA plenum was made from particle board.

Larry Ramsey
Examples

- The plague of the flies.

Larry Ramsey
Examples

- The plague of the snake and mouse.

Larry Ramsey
Examples
Examples

The plague of the fire.

Larry Ramsey
Examples

- The plague of the flood.

Larry Ramsey
Examples

- The static tent.

Larry Ramsey