Hygienic Design of Food Processing Equipment

Dr. Sirichai Songsermpong

Dept. of Food Science and Technology

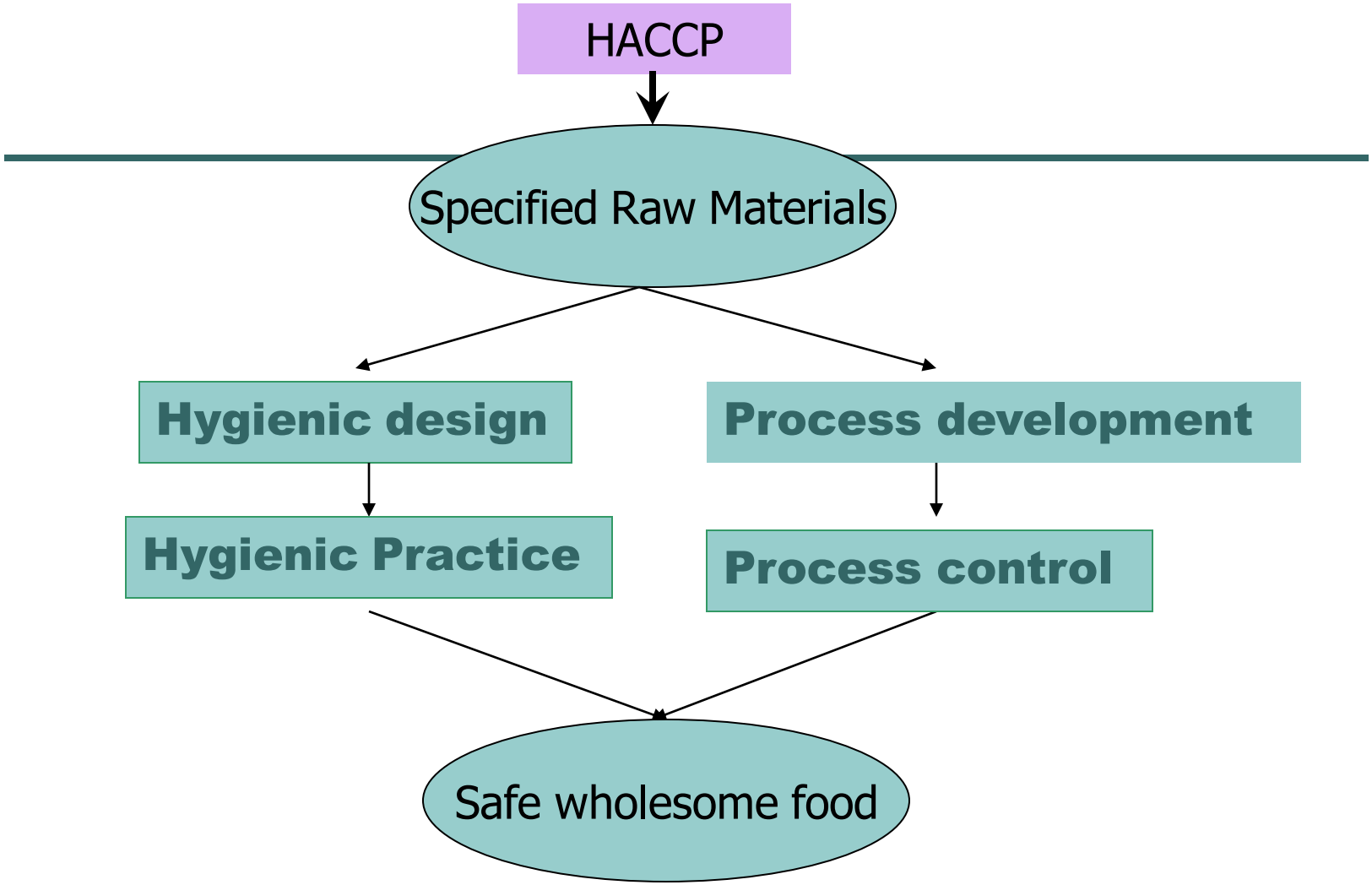
Kasetsart University

Outline

- Significance
- Hygienic equipment design
  - Standards and guidelines
  - Key criteria
  - Risk assessment
  - Basic requirements
- Equipment construction materials
- Verification and certification of hygienic design
- Trend in the hygienic design

Significance

- Highly publicised incidents
- Death and hospitalisation caused by food poisoning
- Consumer concern
- Import bans
- Global trade


HACCP
Specified Raw Materials
Hygienic design
Process development
Hygienic Practice
Process control
Safe wholesome food

Regulations of Equipments in US

- 3-A sanitary standards 1920s
- 3-A symbol 1956
- 3-A SSI 2002
- Third party verification 2003
- www.3-A.org
- Milk and food processing equipments
- Pharmaceutical equipments

Regulations in US

- USDA: Accepted meat poultry and egg equipments, Dairy equipments
- Dept of Interior: Fishery products and processing equipments
- FDA: cGMPs
- ASME: Food, drug and beverage equipments
- 3A and National sanitary foundation (NSF)

Regulations of Equipments in EU

- EU machinery directive 1988
- EHEDG 1989 “guideline”
- CE mark 1995
- European standards organization (CEN)

Key criteria

- Prevention of contamination
- Cleanability
- Inspection Testing and validation
- Compatability with processing function

Risk Assessment in Equipment Design

- Degree of risk of food
- Intended use of equipment
- Degree of further product processing
- Degree of cleaning and inspection
- The use of the machine

Basic Requirements in the Hygienic Design

- Material of construction
- Surface finish
- Joints
- Fasteners
- Drainage
- Internal angles and corners
- Dead spaces
- Bearings and shaft seals
- Instrumentation
- Doors, covers and panels
- Controls

Materials of construction

- Adequate strength
- Reasonable life
- Not tainting
- Corrosion and abrasion resistant
- Easily cleaned
- Capable of being shaped

Food contact surface

- Smooth
- Free of cracks and crevices
- Non porous
- Nonabsorbent
- Inert
- Durable
- Cleanable
- Corrosion resistant

Materials

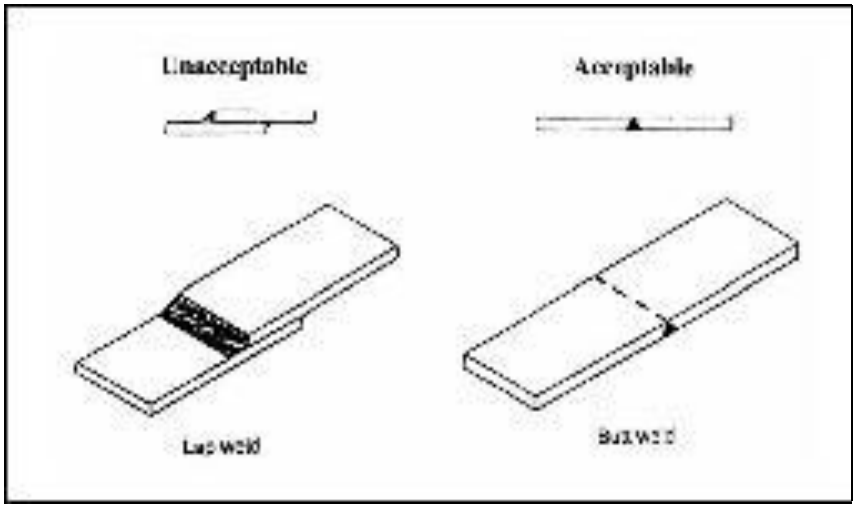
- Stainless steel 316 (18% Cr, 10%Ni)food contact 304 (18% Cr, 8%Ni) restricted use
- Titanium citrus juice, tomato products
- Gold for soldering optical sensors (fiber optics) in stainless steel fitting
- Copper for brewing industry
- Plastics rubber and rubber like material - Food grade
- Ceramic - membrane filter

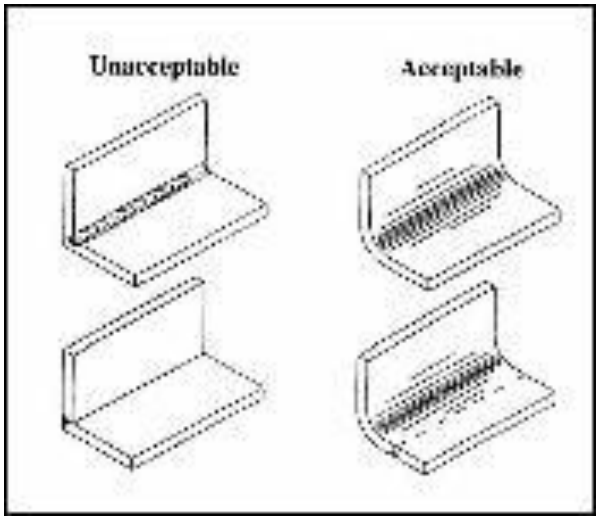
Surface finish

- Degree of surface roughness
- Easily cleaned
- Roughness< 0.8 micro meter recommend

Joints

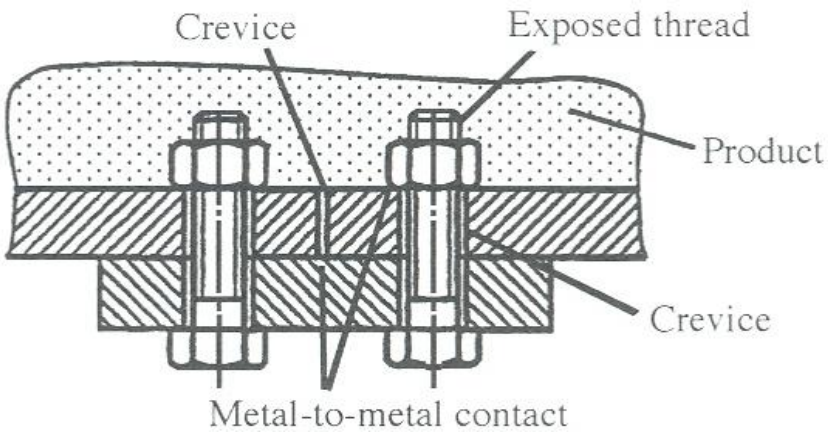
- Smooth, continuous welded joints
- No crevice



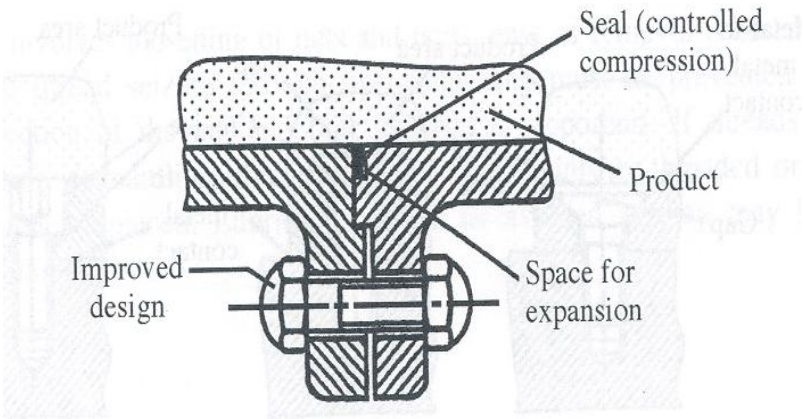


Joints

- Gasket deal for flanged joint



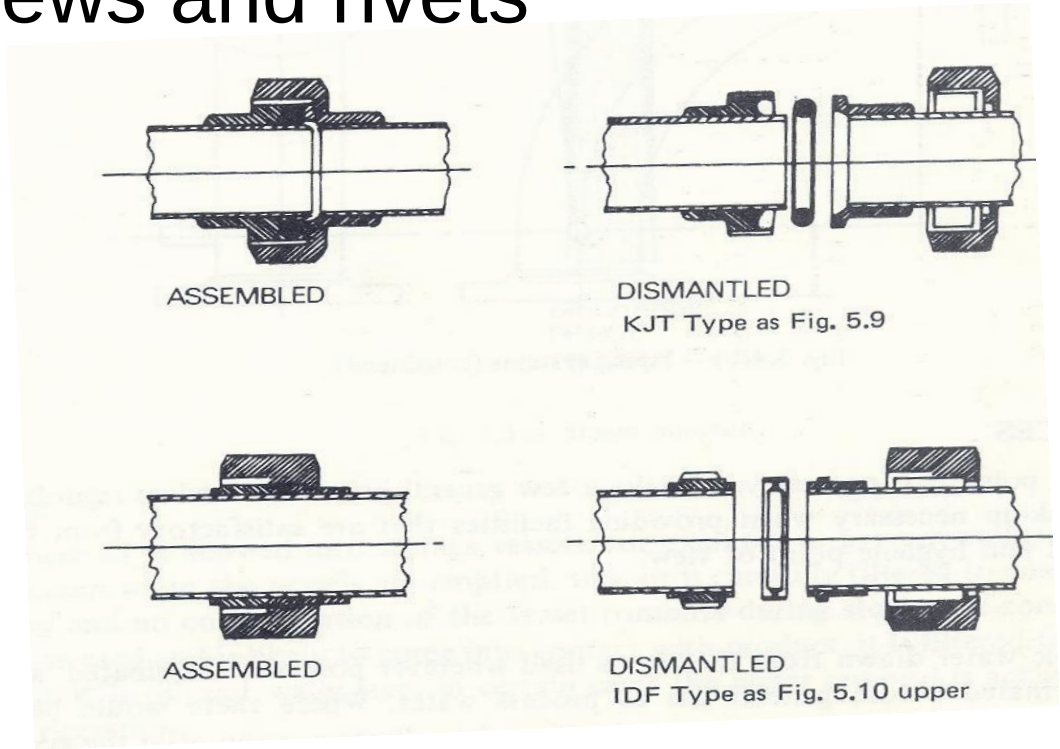
poor



good

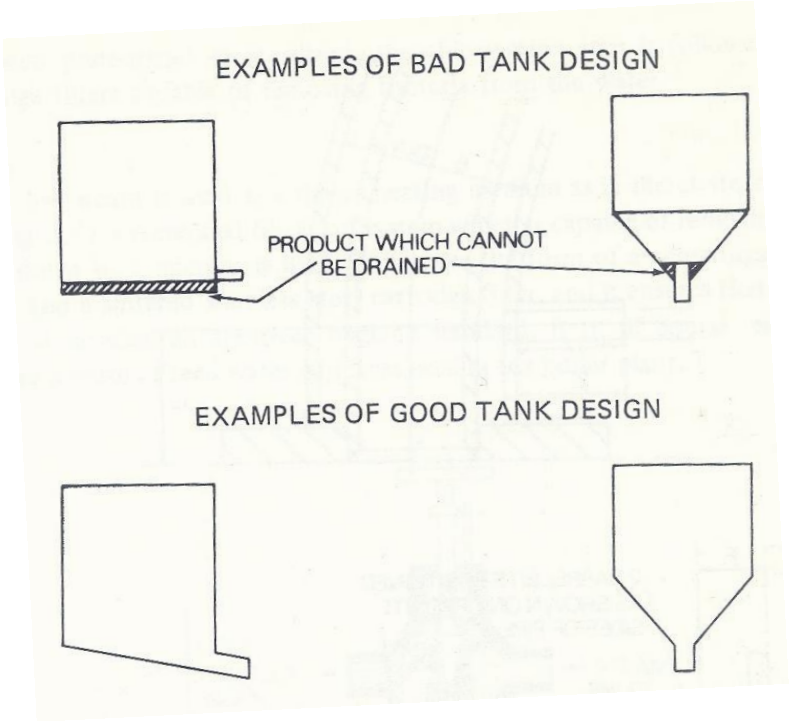
Fasteners

- No exposed screw threads, nuts, bolts, screws and rivets

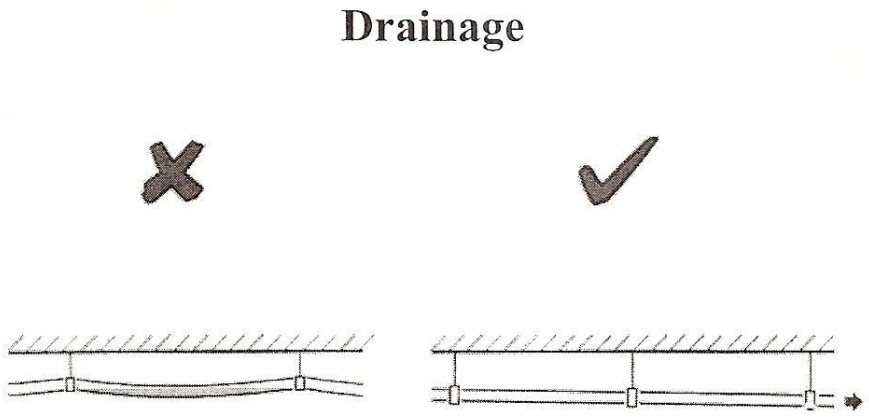


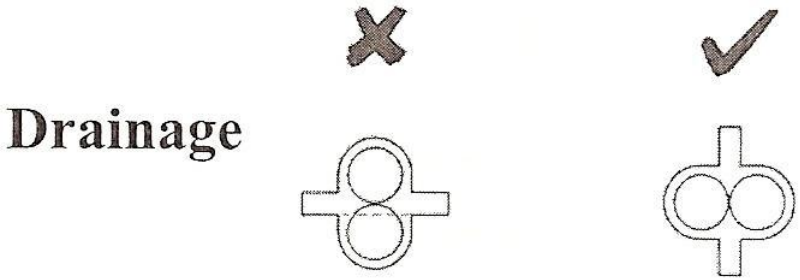
Drainage

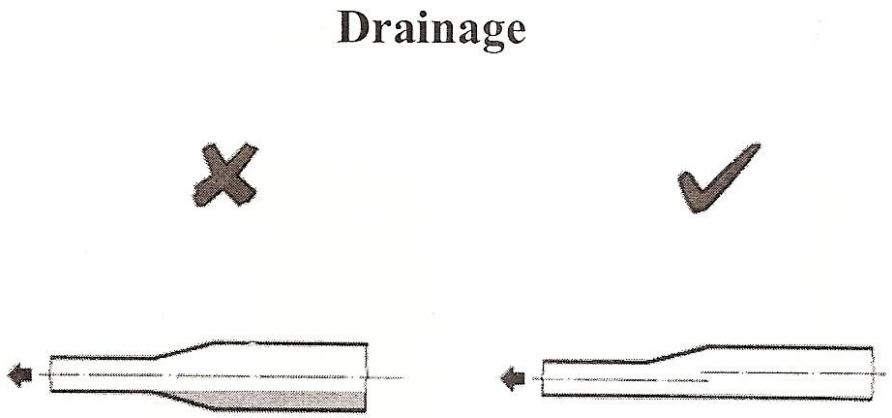
- Self draining
- slope



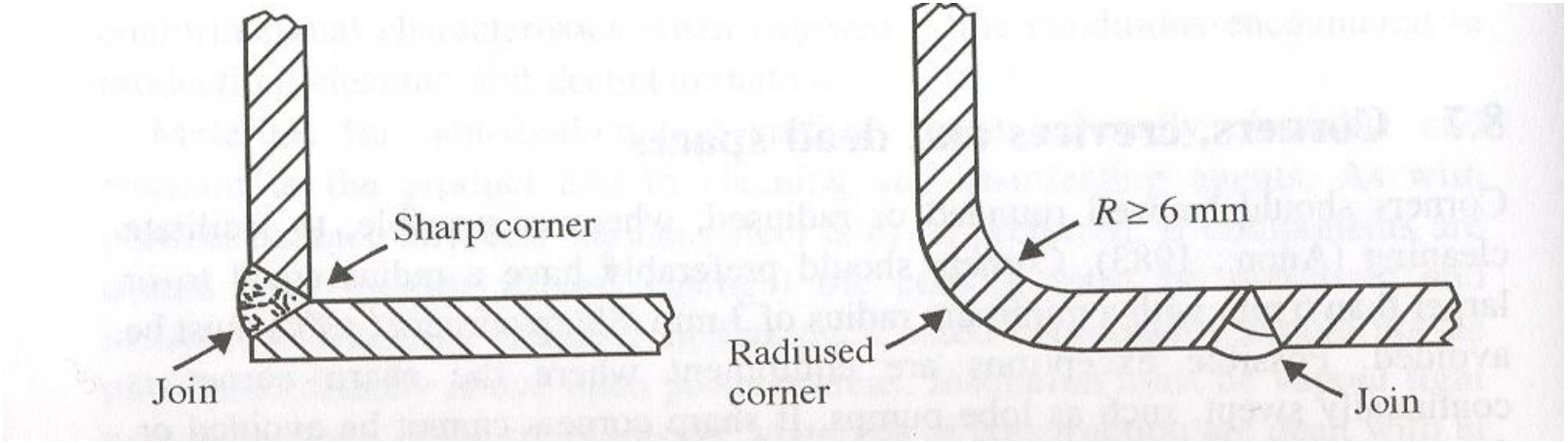
Drainage







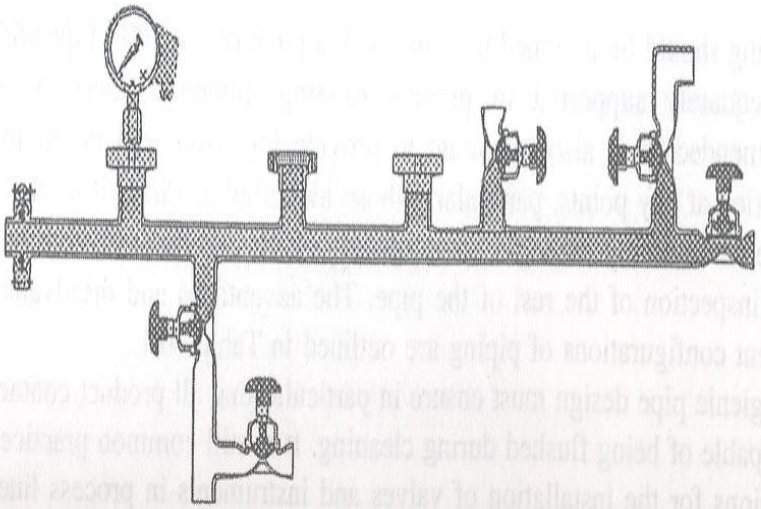
Internal angles and corners



poor

good

Dead spaces



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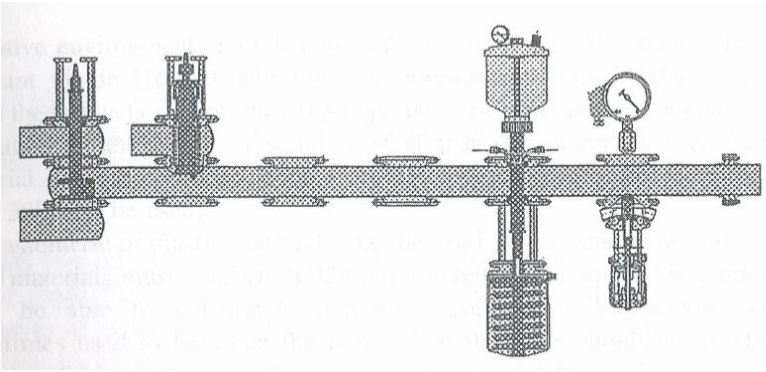


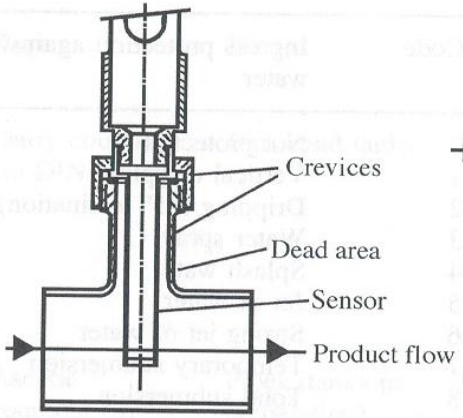
good

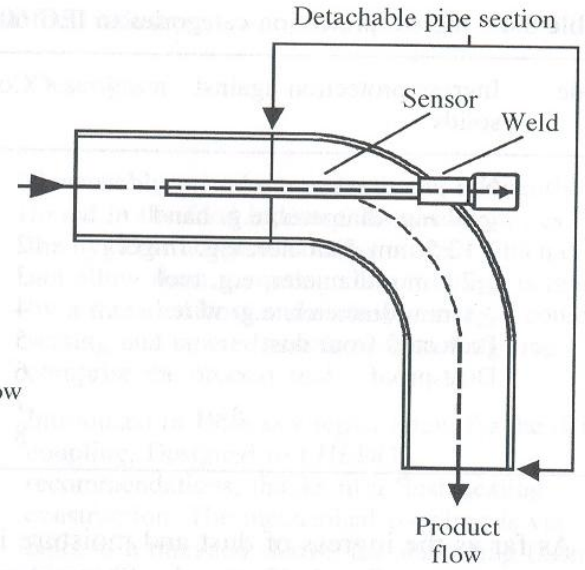
Bearing and shaft seals

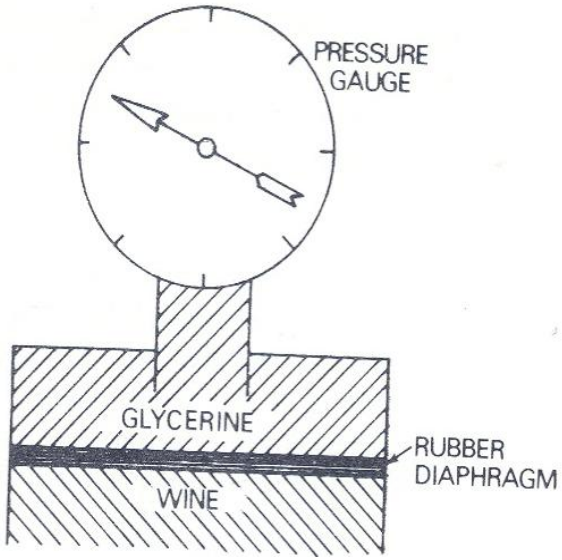
- Outside the product area
- Shaft seals easily cleaned
- Edible lubricant

Instrumentation

- Use hygienic design instrumentation
- Install properly







Doors, covers and panels

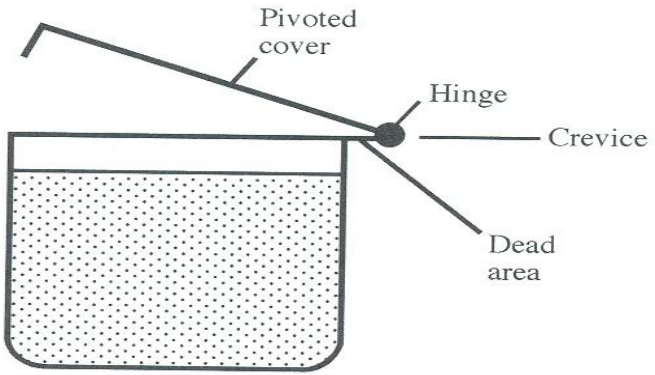
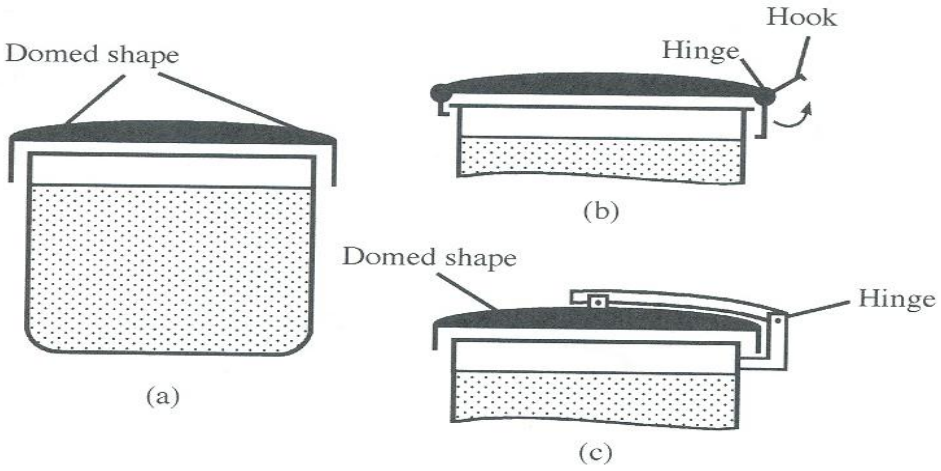
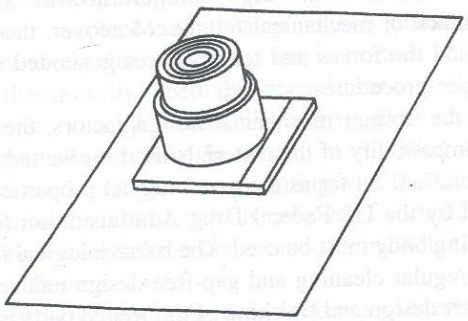


Fig. 8.31 Hygiene risks from equipment covers.



Controls

- Prevent ingress of contamination
- Easily clean



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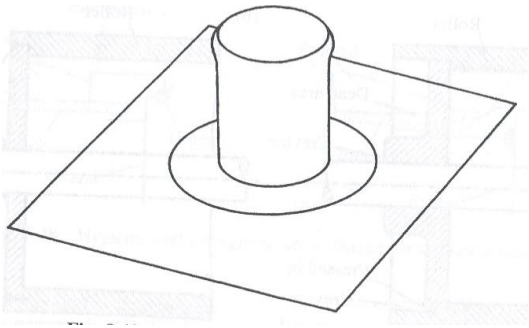
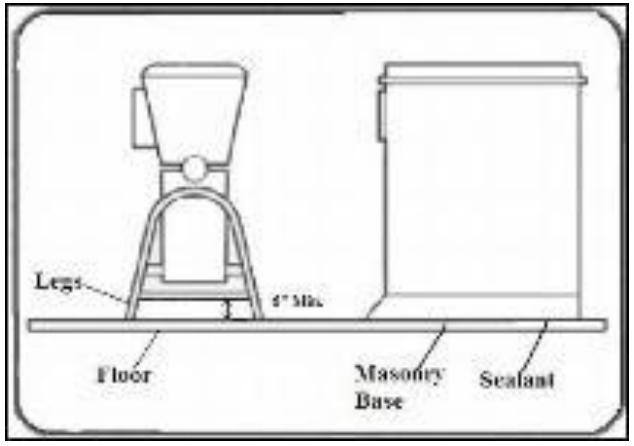


good

Installation of equipment

- Avoid cross contamination
- Spacing between equipment and wall
- No harbourage for insect and rodent



Verification and certification of hygienic design

Open equipments: examination and dismantling for inspection

Closed equipments : cleanability test

Test method development

- **Microbe** : *Pseudomonas fragi, Phobacterium leiognathi, Bacillus thuringiensis, B. stearothermophilus*
- **Soil** : milk + starch + oil or magarine based soil or soured milk based soil
- **Cleaning Protocol** :Open surface : Detergent foam 20 min and spraying with potable water 250 psi 5 s
  - Closed surface : cold water rinse 1 min , 1% mild detergent 63 C10 min, final cold water rinse 1 min (flow rate 1.5 m/s)

Test

- Detection
  - Ultrasound
  - Traditional swab method
  - ATP hygiene testing system
  - Direct Epifluorescent microscopy
  - Image analysis

Trend in hygienic design

- Material of construction (Curiel, 2001)

  - New materials to replace glass

  (polysulfone and new plastics)

  (glass to stainless steel fusion)

  - Ceramic materials with extremely low surface roughness and low surface energy

  - Ceramic material with silver particles with antimicrobial activity

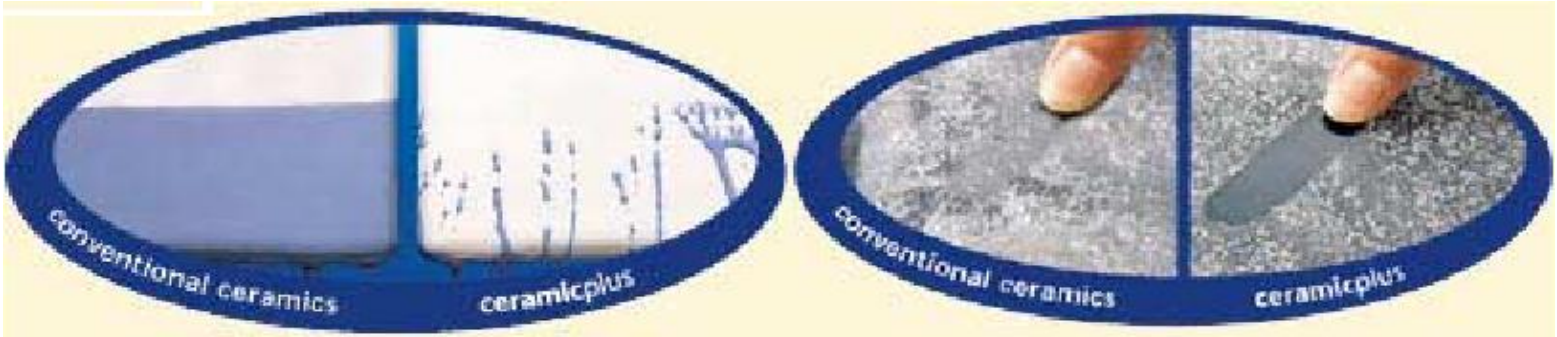
Manufacturing process to allow the safe use of glass

Glass to stainless steel fusion

Curiel,2001

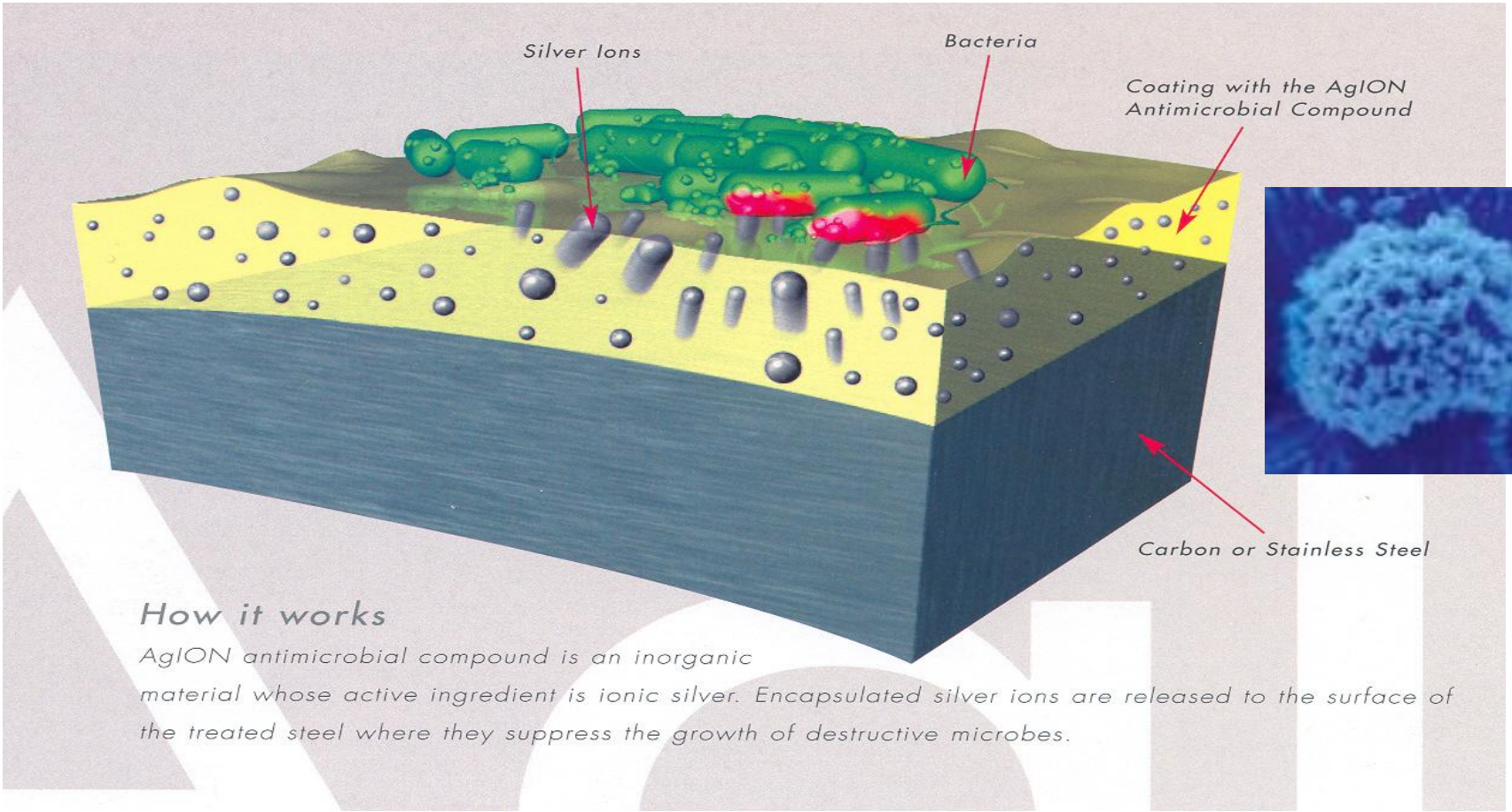
Ceramic material

- Ceramic surface with extremely low surface roughness and low surface energy
- Ceramic surface with silver particles with antimicrobial activity



Curiel,2001

Stainless steel with antimicrobial compound



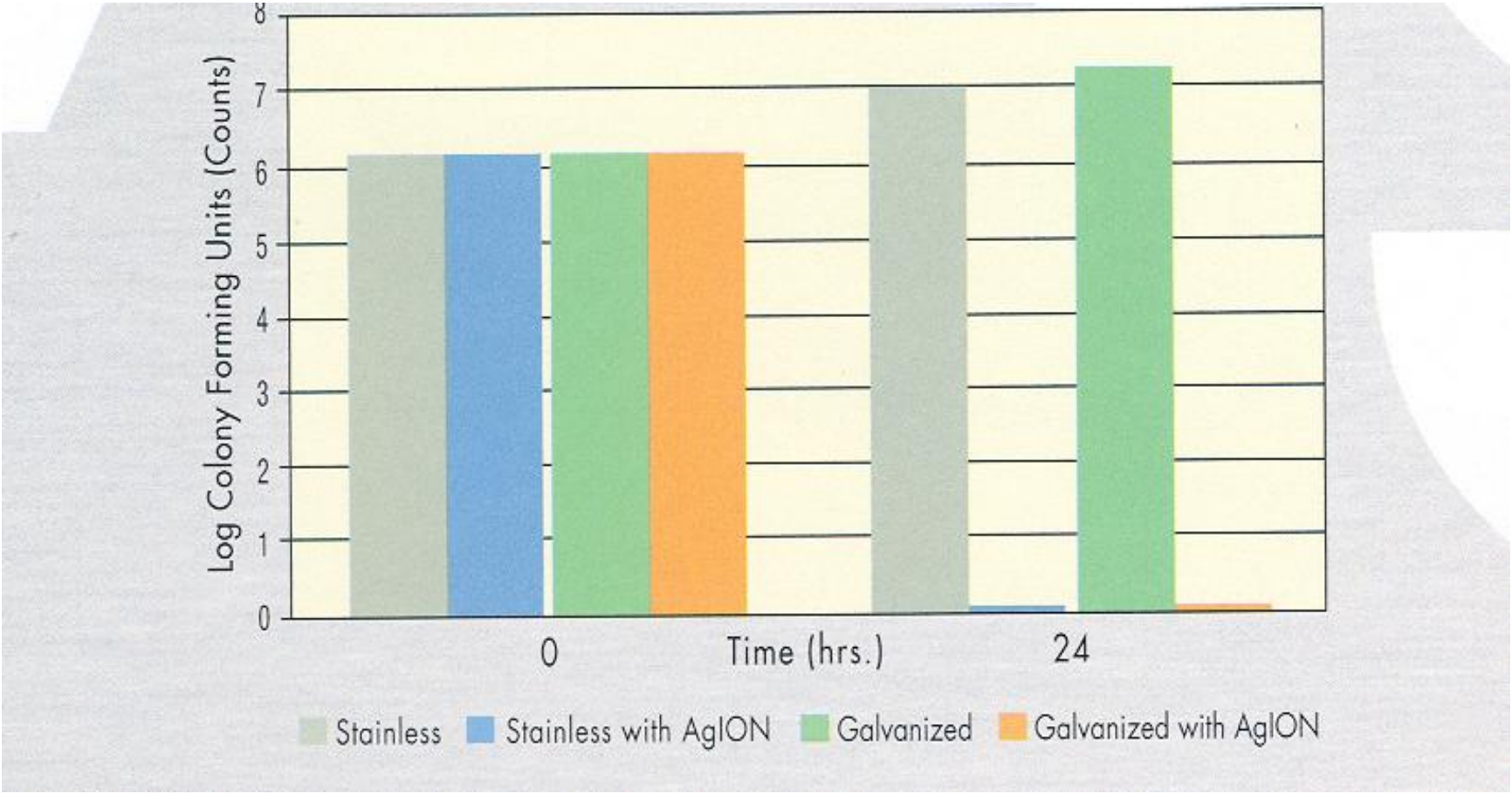
www.aksteel.com

Application

Carrier's Aero and Racan air handlers feature AgION antimicrobial-coated steel cabinets where it counts the most — in the airstream.

www.commercial.carrier.com

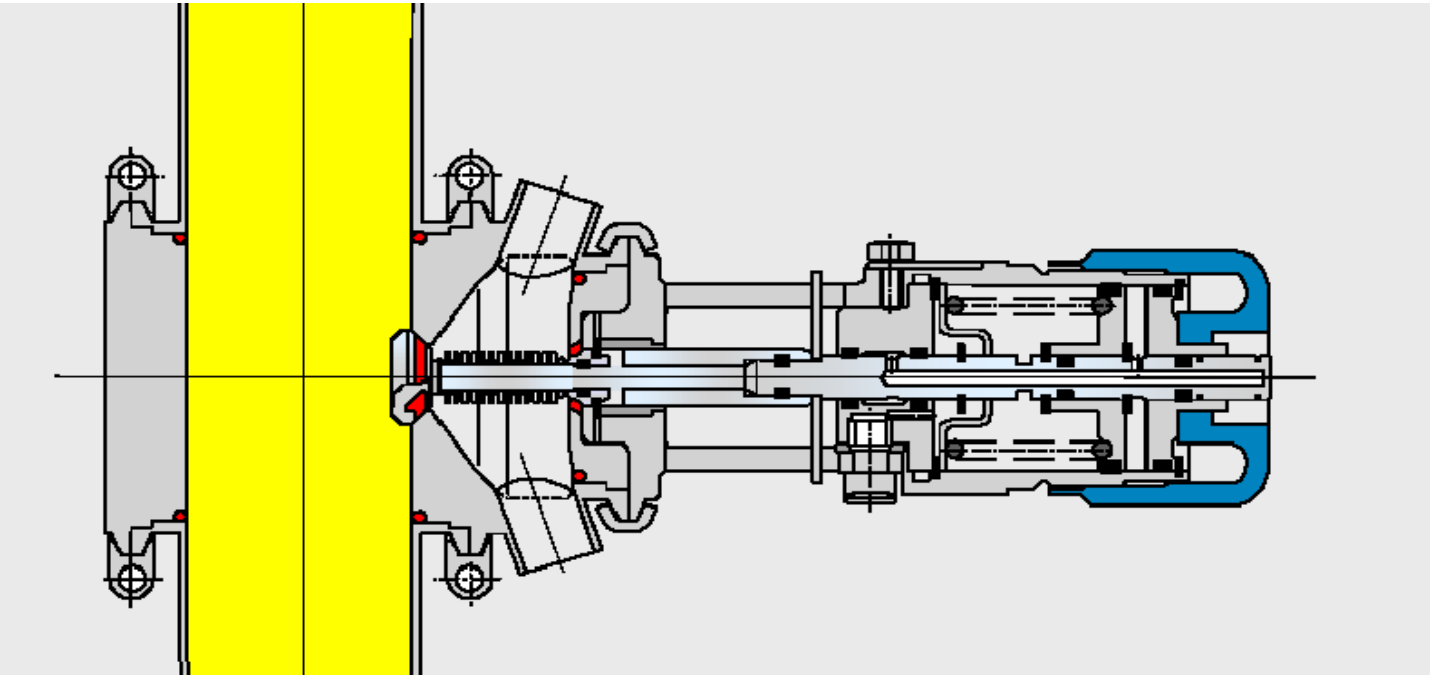
Antimicrobial Efficiency



Cowan et al, 2003

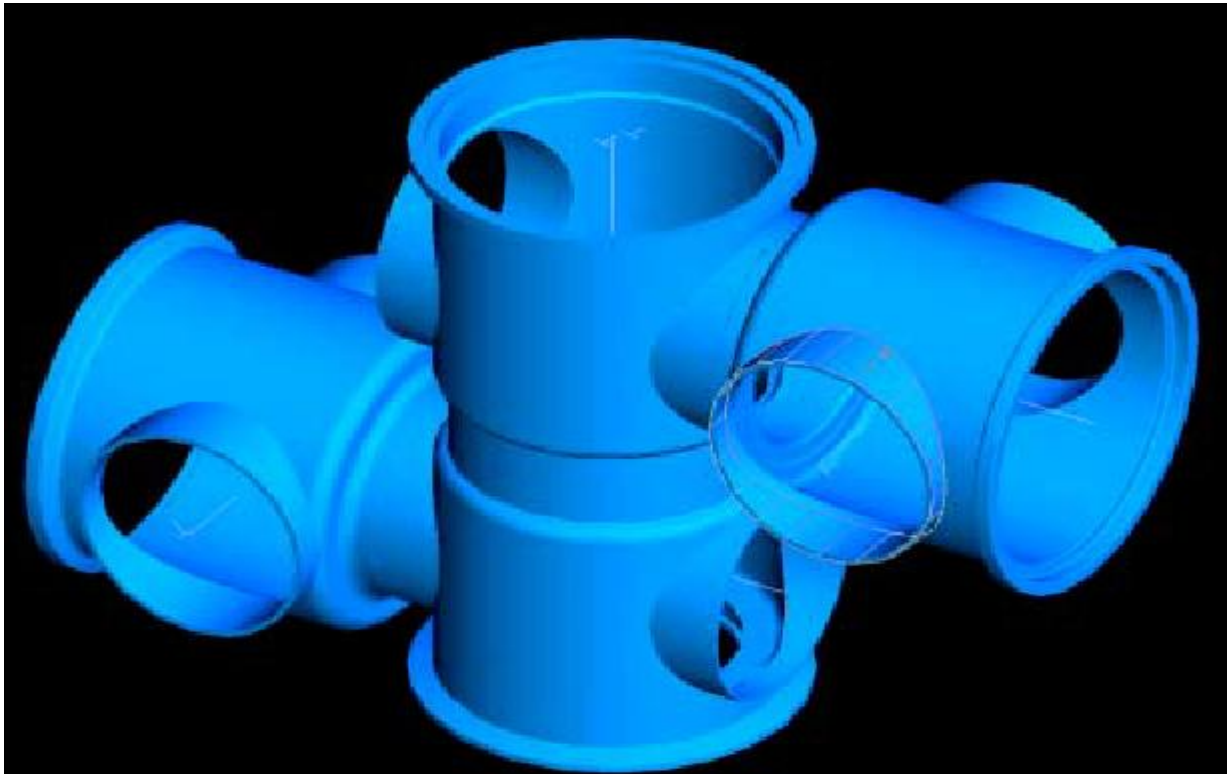
New design and technology

- Aseptic sampling valve



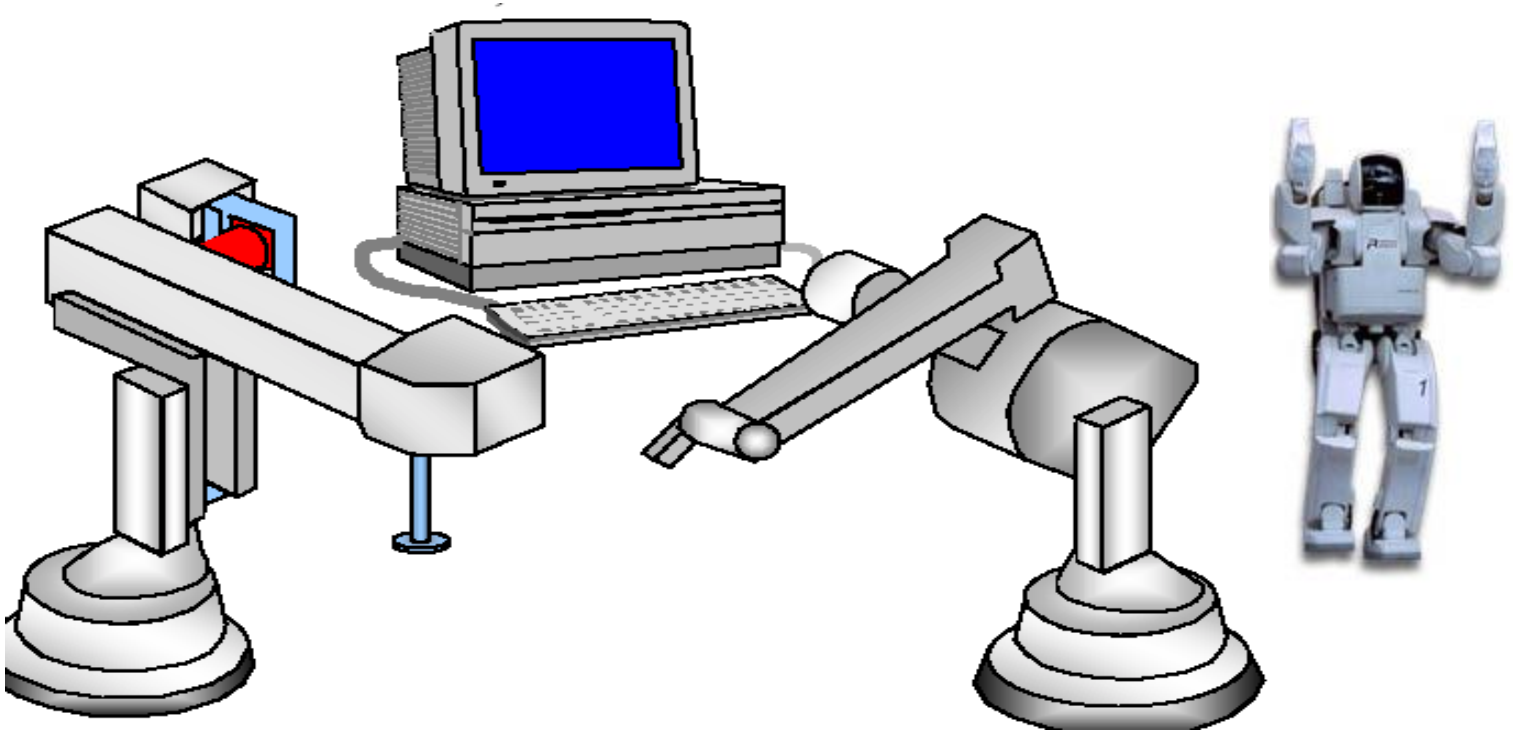
Curiel, 2001

Dead space free multi port valve



Curiel, 2001

Robotics, unmanned factories



Curiel, 2001

Summary

- Hygienic design is one of the key factors in the production of safe food
- 3-A organization and EHEDG are the leaders in developing standards and guidelines in hygienic design
- Basic requirements are construction materials, surface finish, joints, fasteners, drainage, internal angles and corners, dead spaces, bearing and shaft seals, instrumentation, doors, covers and panels and controls
- Further developments in hygienic design and operation will increase food safety

Quiz

- Why hygienic design?
- What organization give the guidelines for hygienic design?
- How do you know that the equipment has been designed with hygienic concern?
- How do you verify the hygienic design?

Quiz

- What are the basic requirements in hygienic design?
- Name the antimicrobial materials.
- What is the trend in hygienic design?