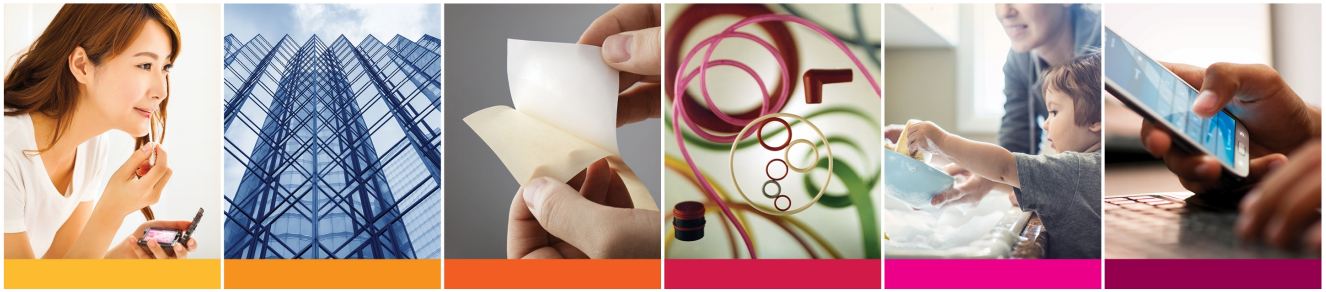
Consumer Solutions

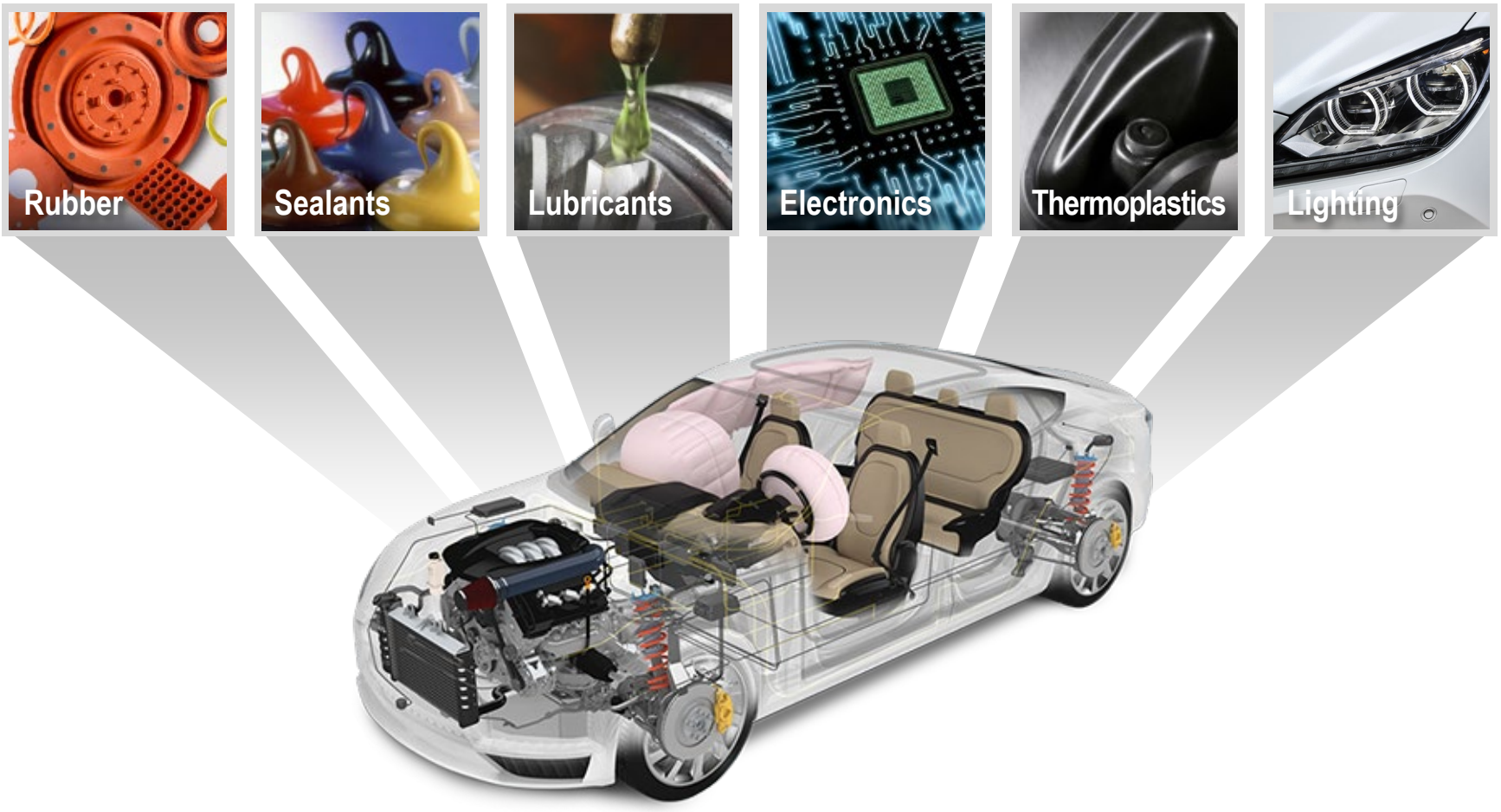


An Introduction to Silicone Dispensed Foam Gaskets (DFG)

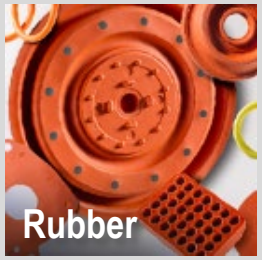
Silicone Sealing and Gasketing

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40+ Years of Silicone-based Solutions



40+ Years of Silicone-based Solutions



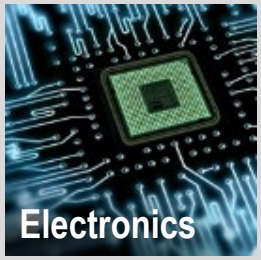
- Reduce noise, vibration and harshness (NVH)
- Eliminate heat shields to reduce mass
- Improve airbag and inflatable curtain performance
- Remain strong in heat, cold and harsh operating conditions



- Prevent squeaks and rattles by eliminating noise, vibration and harshness (NVH)
- Provide strong component bonds and seals
- Improve system sealing and gasketing durability
- Resist heat, cold and harsh conditions in long-term service



- Reduce noise, vibration and harshness (NVH)
- Provide durable, long-term lubrication
- Keep inaccessible components working as designed
- Withstand extreme temperatures and harsh operating conditions



- Dissipate damaging heat
- Provide the right combination of thermal conductivity and dielectric properties
- Reduce weight and deliver long-lasting protection of sensitive components
- Help reduce mechanical stress from vibration and thermal cycling



- Deliver a powerful combination of benefits (strength, softness and UV/chemical resistance) in a single compound
- Provide an optimum ratio of elasticity to rigidity
- Offer weight and cost reductions
- Retain performance throughout the product life-cycle



- Provide long-lasting system performance in hot, cold and severe weather
- Shorten production cycle time; improve productivity; save labor and material
- Improved light output, lumen maintenance and degradation
- Deliver excellent photo and thermal stability

Agenda

Dispensed silicone discussion – gaskets and seals terminology

- Unique properties of silicone
- What is dispensed silicone foam gasketing (DFG)?
- Common applications
- Design considerations
- Equipment requirements for DFG
- Questions/discussion

Unique Properties of Silicones

- Performs in temperatures from -70 to 200˚C
- Withstands weathering, ozone, corona, radiation, moisture, chemicals, weak acids and bases, oils and fuels
- Operates in automotive, aerospace and general industrial applications
- Chemically inert
- Physical properties can provide high tensile, tear, modulus, elongation, fatigue life, resilience, damping and compression set
- Provides low flammability and smoke
- Provides extended low temperature performance and low swell in fuels (fluorosilicones)
- Heat curing (HTV) and room temperature curing (RTV) materials allow for flexibility in design

Dispensed Foam Gasketing (DFG)

- What is Dispensed Foam Gasketing?
  - Two-part foam dispensed directly on a component and cured
  - Platinum-catalyzed, room temperature or heat cure, 1:1 mix ratio
  - Self-foaming – does not require an added blowing agent
  - Provides a low modulus sealing option.
  - Typically used where the part needs to be serviceable
- When to use Dispensed Foam Gasketing
  - Seal in/out air, dust, dirt, water
  - Low modulus needed for plastic parts
  - Low compression set needed
  - Squeak and rattle elimination (NVH)

Chemistry

Hydrosilation (Addition Cure)



- Accelerated by heat
- No by-products

- Catalyst easily poisoned
- Variable pot life

Curing of Silicone Foams from Dow

- When the A and B components are mixed, the following reactions occur:
  1. Hydrogen formation
  2. Formation of gas cells and cell growth (foam expansion)
  3. Curing (formation of the elastomeric network)
- All reactions are temperature-dependent but at different rate constants
- To ensure a homogeneous cell size distribution, a proper mixing of the components and proper dispense tip selection are essential

Curing of Silicone Foams from Dow

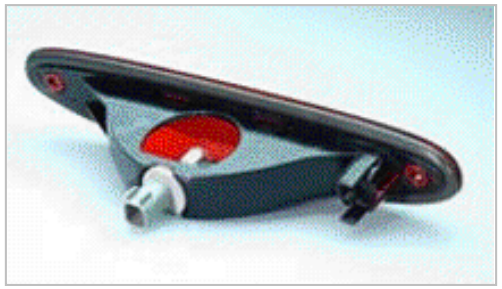
Foaming mechanism:

- DFG products from Dow create the foaming gas during the crosslinking reaction (hydrogen as by-product)
- Typical amount of H2 evolved: 0.5-1.3 g/kg product
  (based on “worst case” consideration using low density 8257 foam)
- Typical expansion ratio: 1:2.5 to 1:4
- To ensure optimal foam structure a good mixing of the components is required
- In case of dynamic mixing air nucleation is typically recommended

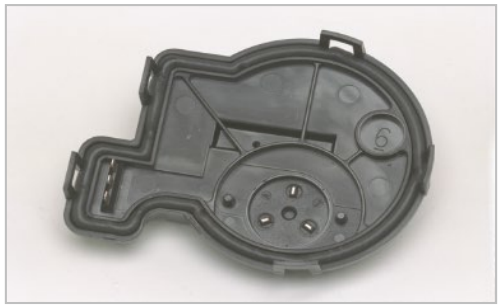
DFG Applications

Typical Automotive Applications:

- ABS brake modules
- Power distribution/ECU Modules
- Filter housings
- Beauty covers
- Transportation inspection covers
- Thermostat housing
- Timing chain and timing belt covers
- Wheel cover
- Exterior lighting
- NVH/acoustic





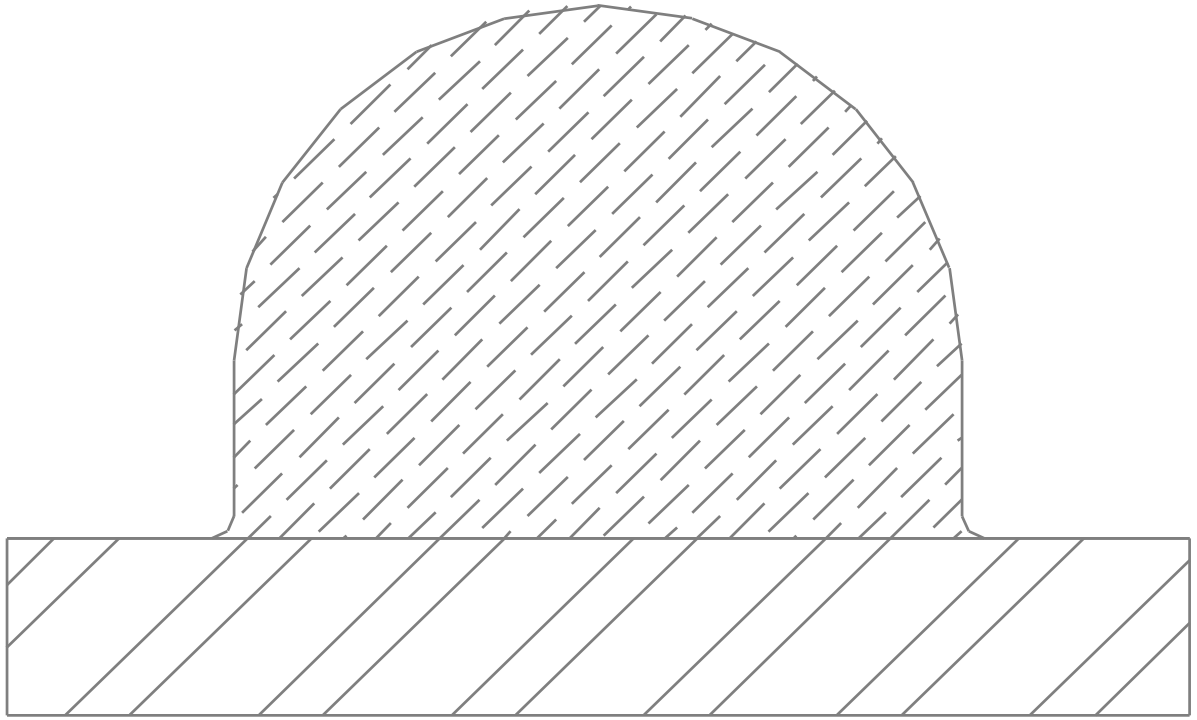


CIPG/DFG: Primary Design Considerations

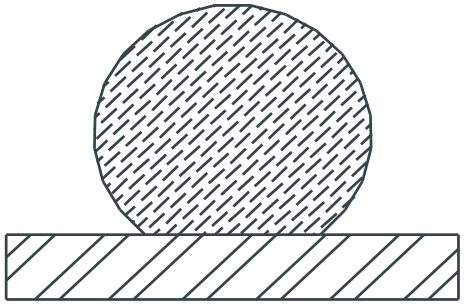
- Bead design
- Aspect ratios
- Flange groove/void volume design

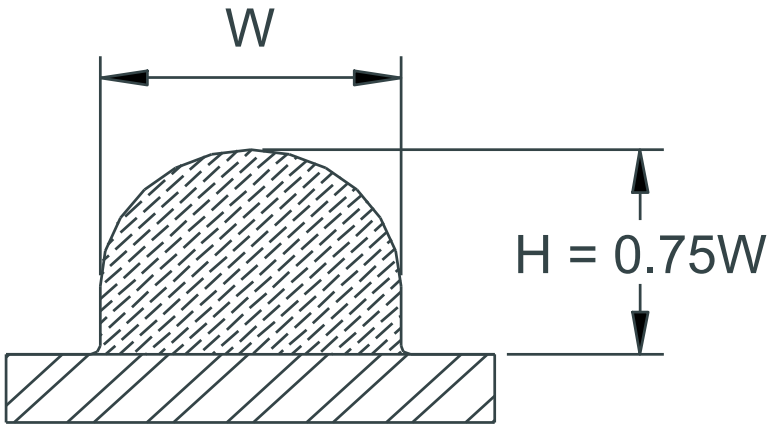
Gasket Bead Design

Generally limited to rounded, hump shape



Aspect Ratio





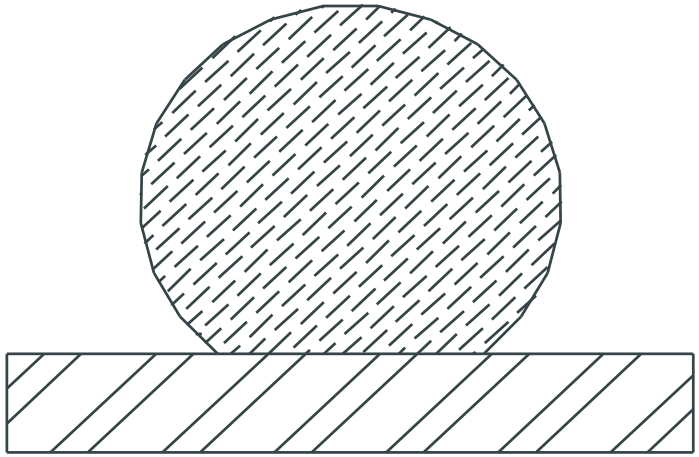
- Poor
- H = W
- Aspect Ratio = 1

- Good
- H = 0.75W
- Aspect Ratio = 0.75

Aspect Ratio

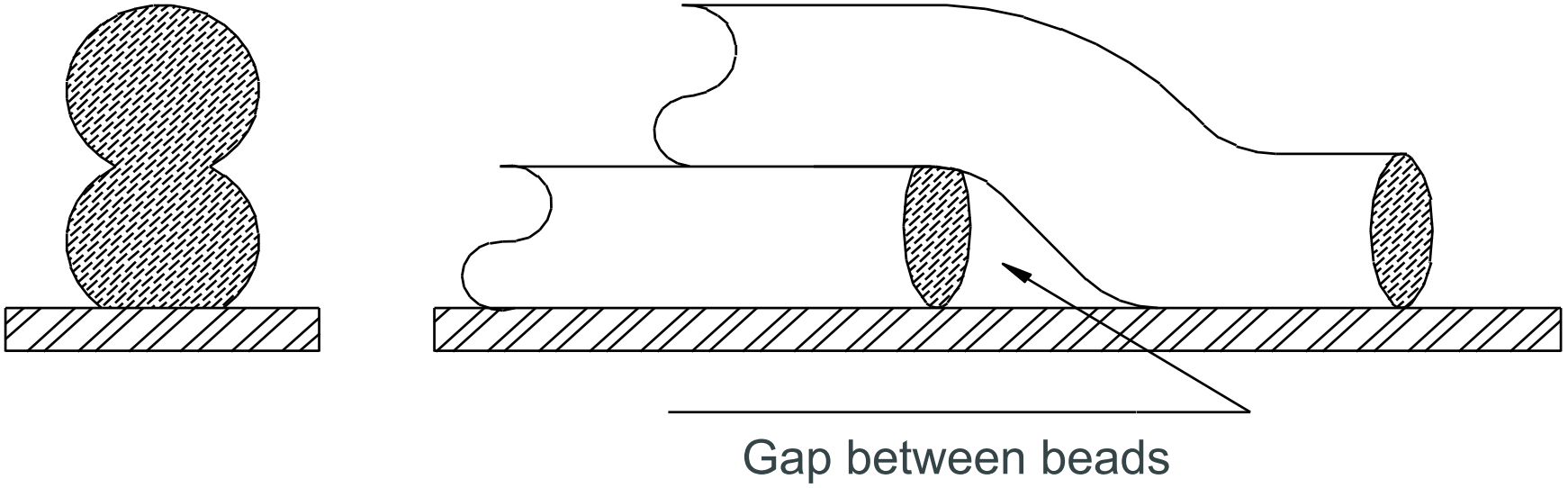
Potential issues with high aspect ratios:

- Leaves small area for adhesion
- Could have roll-over tendency

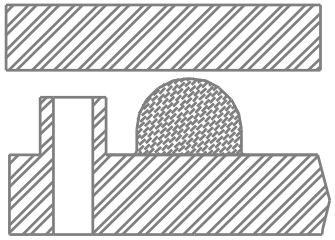


Aspect Ratio

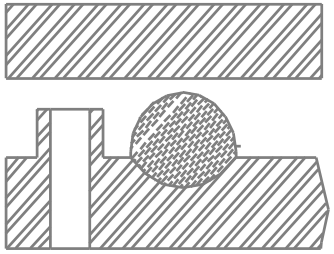
High aspect ratios can contribute to bad knit lines



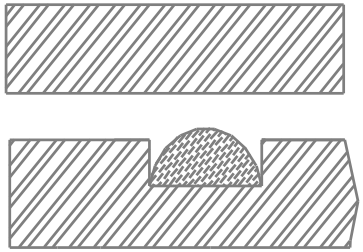
CIPG/Non-slump DFG Gasket Designs



CIPG/non-slump DFG on flat surface
with compression limiter



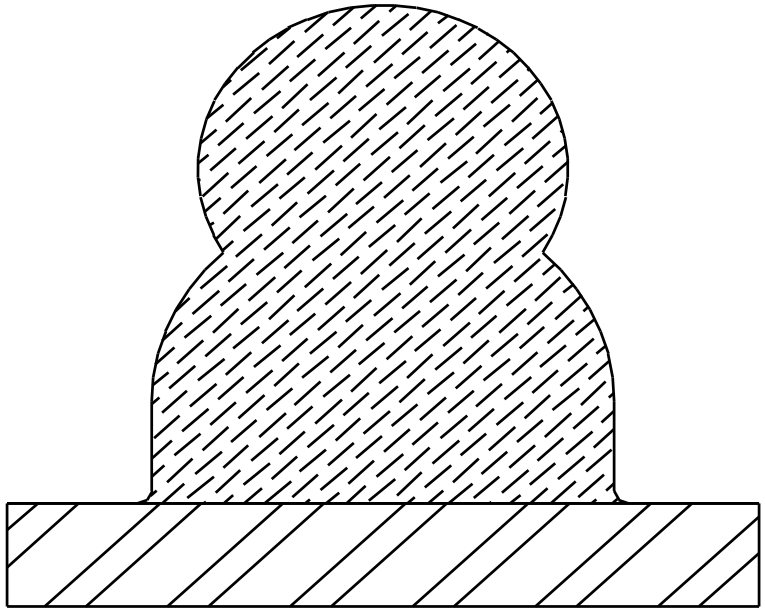
CIPG/non-slump DFG in shallow groove
with compression limiter



CIPG/non-slump DFG gasket in void volume

DFG Special Situations

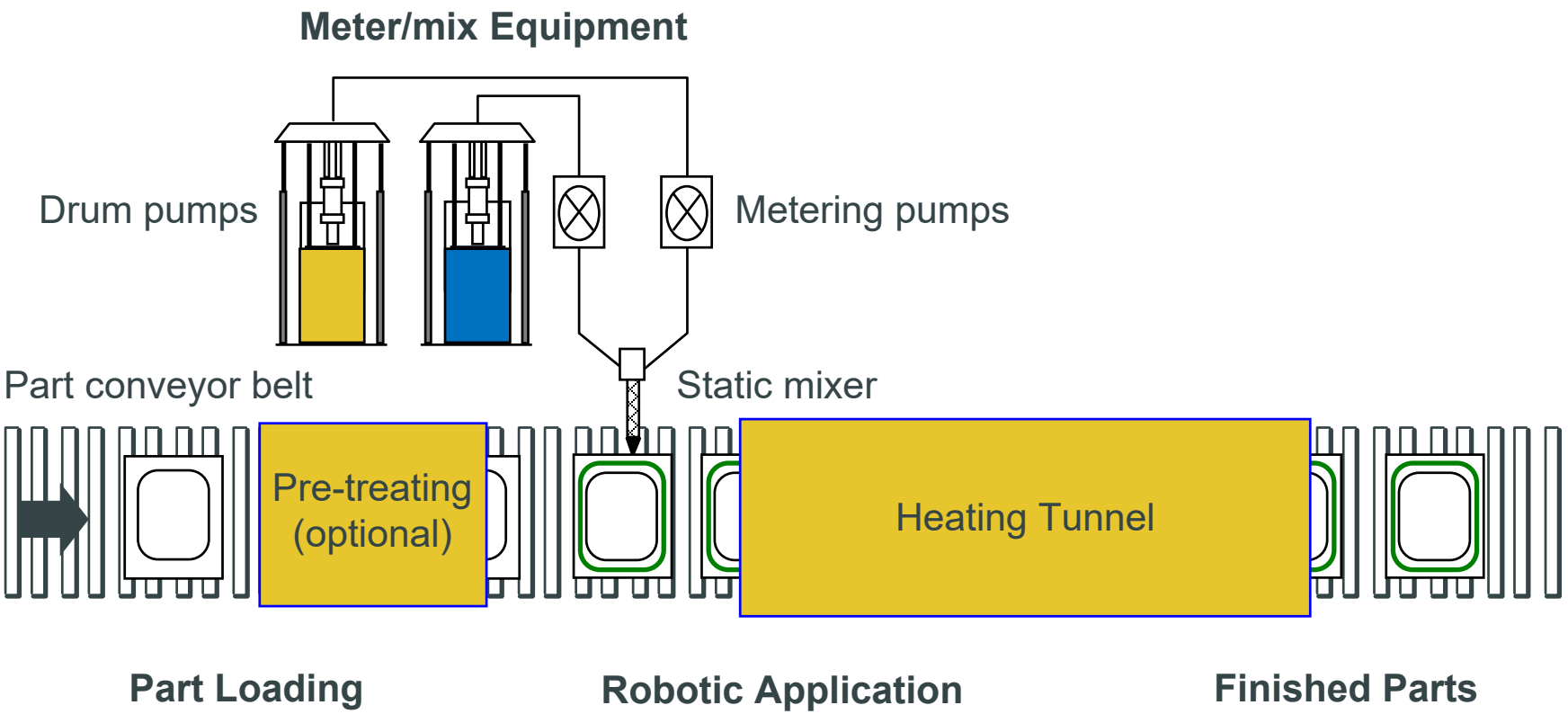
Stacked beads may be possible if using SILASTIC™ 3-8186 Thixotropic Foam due to low slump nature of the material.



Processing

- CIPG and DFG typically require:
  - Fixturing
  - Meter/mixing
  - Robotic dispensing
  - Oven curing
- Can be manual or highly automated for mass production

Typical Layout of a Production Line: DFG/CIPG



Processing

Fixturing:

- Good fixturing is *critical* for repeatable/accurate dispensing
- *Corrects* for part-to-part variation
- *Maintains* part alignment
- Poor fixturing leads to irregular gasket beads

Processing

Typical meter/mix dispense systems contain:

- Material feed pumps
- Teflon-lined stainless steel flex hoses
- Material filters
- Pressure regulators
- DC Servo motor rod-displacement metering (preferred)
- Air operated dispense gun, and static mixer elements

Processing

Robotic Dispensing:

- Multiple dispensing axis depending on part complexity; robot provides an even, accurate and repeatable gasket bead with high throughput

Dispense Options:

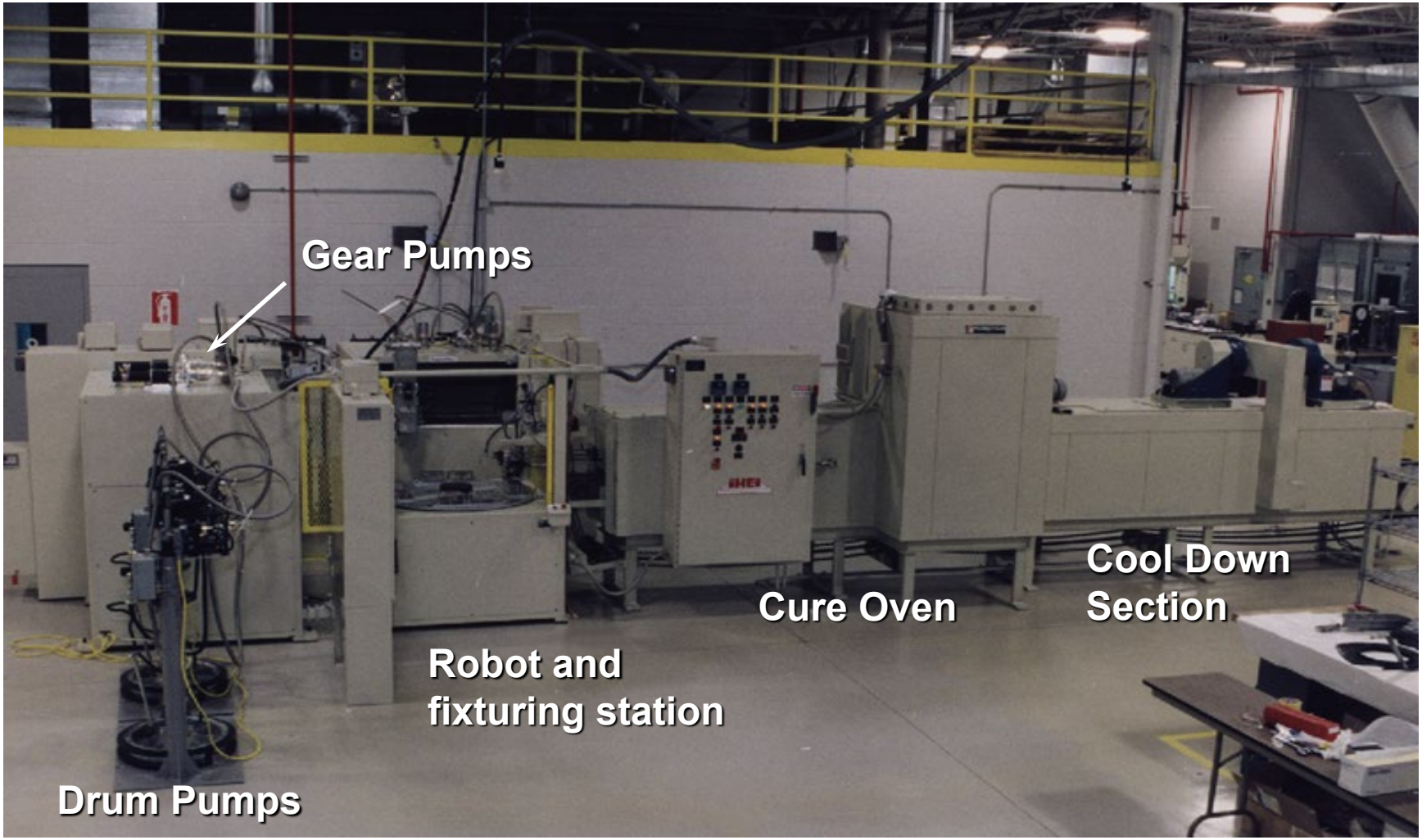
- Articulated arm
- Cylindrical (SCARA)
- XYZ gantry

Processing

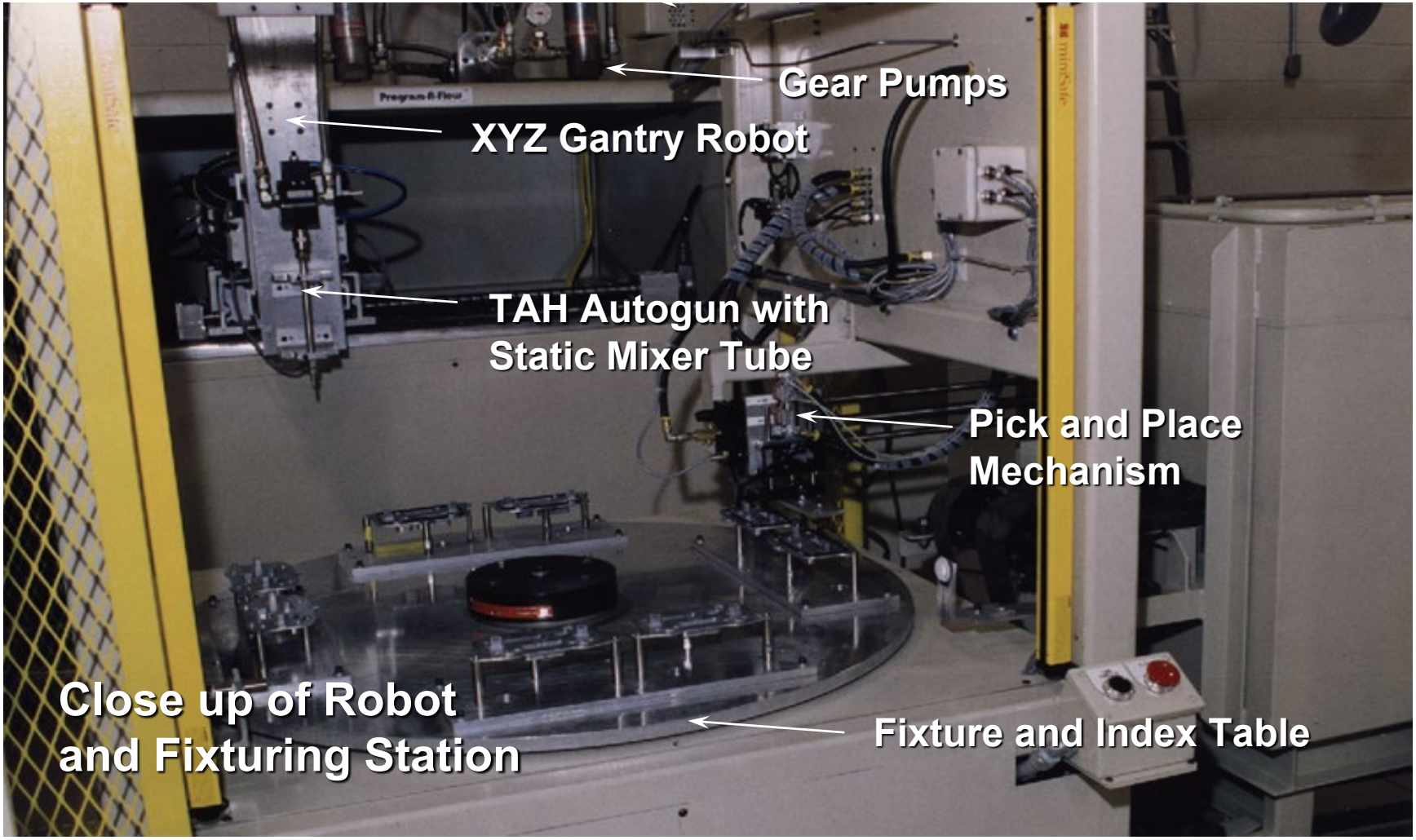
- Oven curing is typically used to cure the seal materials*
  - Basic oven types:
    - Infrared
    - Gas fired
    - Electric heated
- Any method that heats the seal material is acceptable, heat is the important factor

*Except for DOWSIL™ 3-82XX series dispensed foams

Typical CIPG/DFG Application Cell



Typical CIPG/DFG Application Cell



Summary: Main Considerations for Sealing and Gasketing

- Does this part need to be serviceable?
  - Yes: CIPG, DFG
  - No: FIPG
- Does this gasket need to seal in fluids (oil, coolant, etc.)?
  - Yes: CIPG, FIPG
  - No: DFG
- Does the gasket need to seal in pressure?
  - Yes: CIPG, FIPG
  - No: DFG
- Is there capital for equipment? Y/N?

- How many parts*?
  - 100,000 or less usually FIPG
  - 100,000 or more, CIPG, DFG

*Ball-park numbers – simply used for reference

Thank You

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