Consumer Solutions

Bringing Safety & Durability to incredible heights

Pınar Çetin, Glass Performance Days Turkey, 9th March 2018

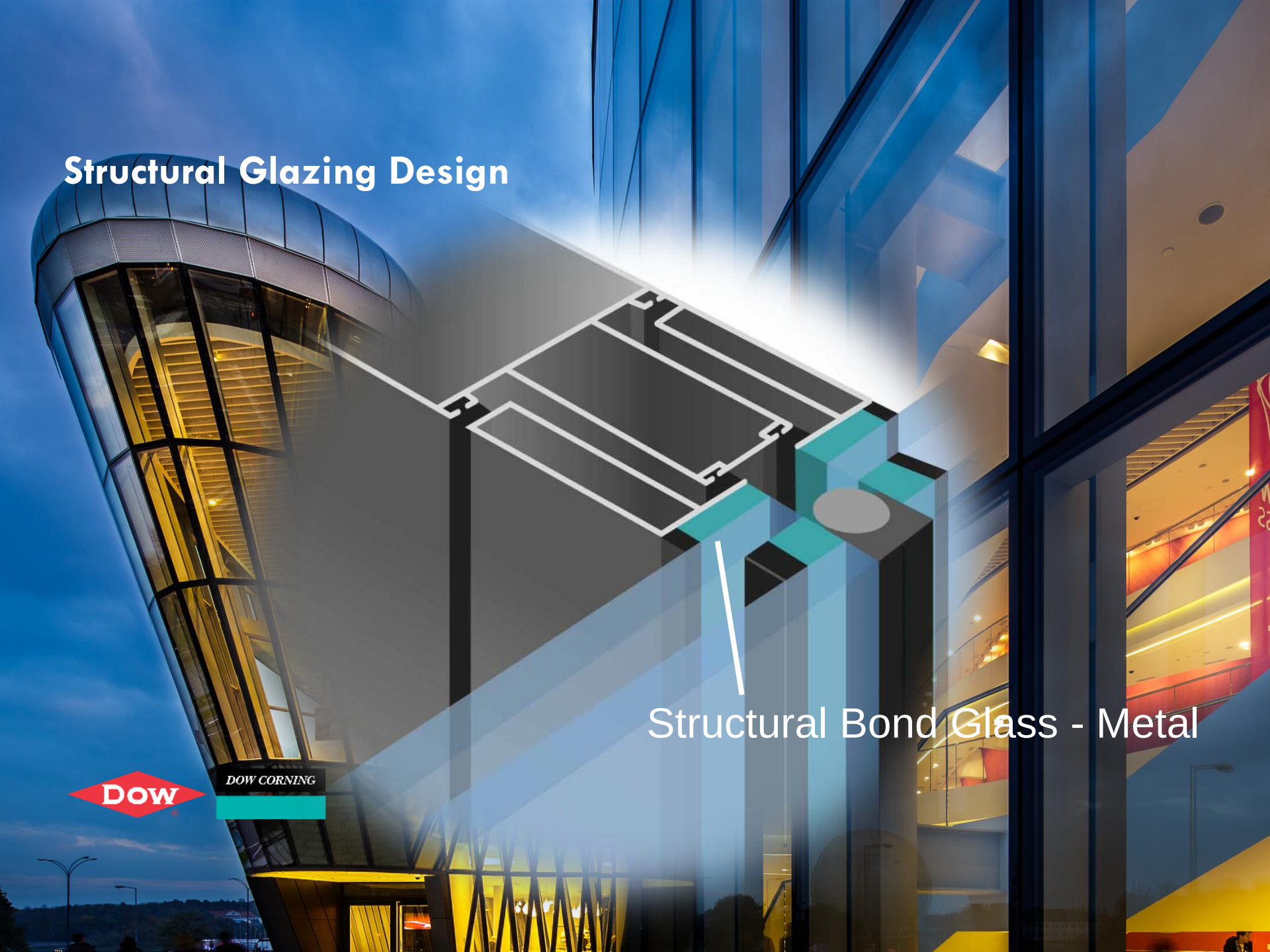
Content:

- Structural Glazing & Sealing – History, Benefits, Design
- Design Considerations
  - Durability of Sealants
  - Fire Safety Performance
  - Design Failures
- Quality of Application

Structural Glazing & Sealing

History, Benefits, Design

Structural Glazing Design



DOW CORNING

Silicone Structural Glazing – History

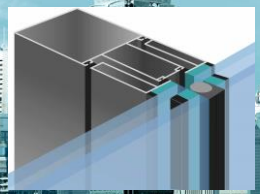
1964: First 2-sided SSG in US

1971: First 4-sided SSG „Grand Daddy", Detroit

1996: Protective Glazing SSG, UK

2010: 7.5kPa wind load SSG, Dubai

Proven Performance 50 Years +



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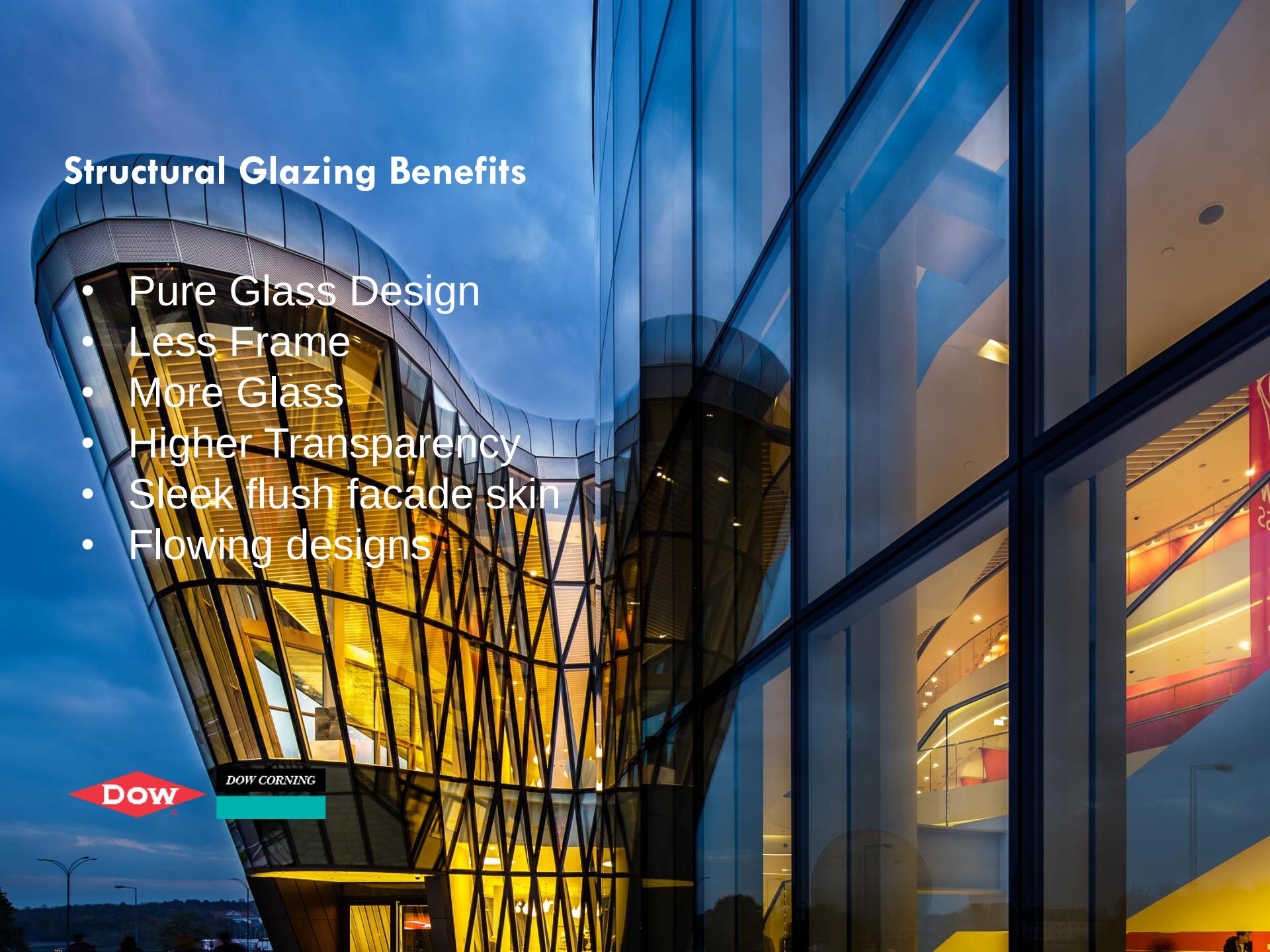
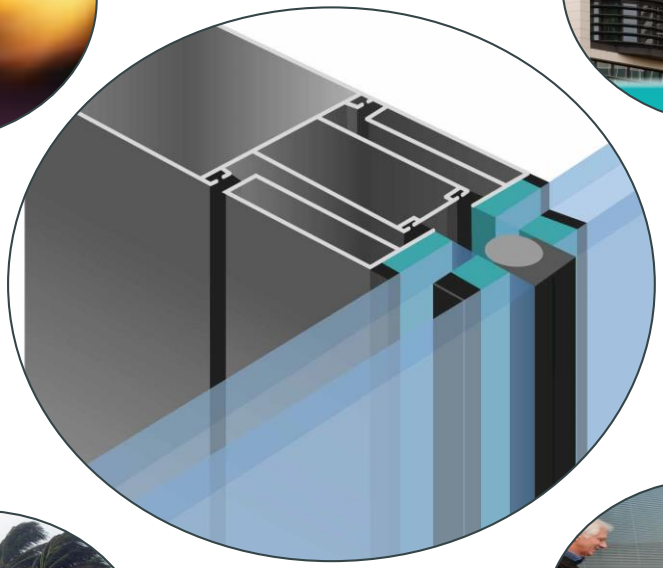

Structural Glazing Benefits
• Pure Glass Design
• Less Frame
• More Glass
• Higher Transparency
• Sleek flush facade skin
• Flowing designs
DOW
DOW CORNING

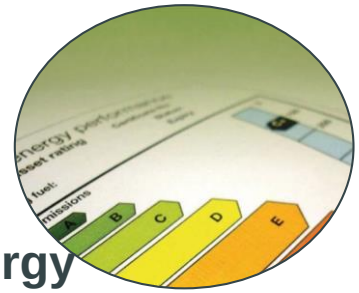
Design Considerations

Durability

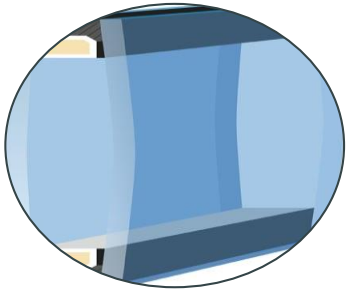
Fire Safety

Quality





Energy Efficiency



Climatic Loads

High Wind

Bomb Blast

Expertise

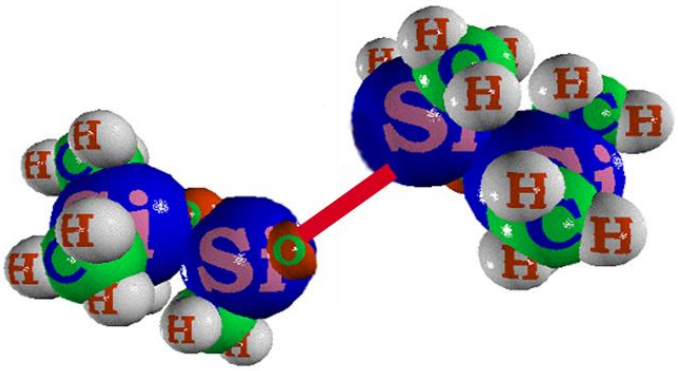
Durability of Sealants

DURABILITY – important contributors

- **Sealant Longevity**
- Design
- Substrate Adhesion
- Compatibility
- **Quality of Application**

Durability and Longevity: Why Silicones ?

Hybrid between inorganic (Silicon) and organic (Methyl) Molecule-Parts



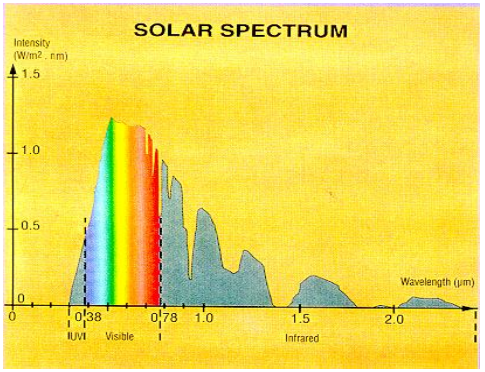
Bond energy:

SILICONE: Si-O 452KJ/mol

Polyurethane: C-O 357KJ/mol

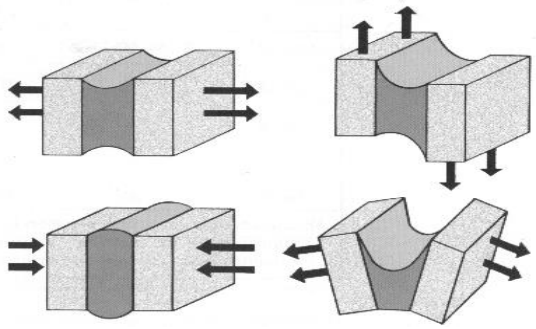
Polysulfide: C-C 360KJ/mol

UV ±400KJ/mol

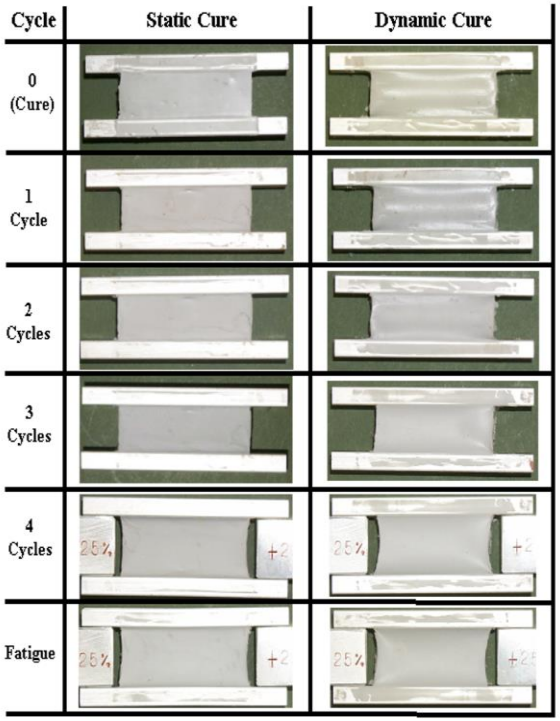


- Strong Si-O Bonding
- UV-Light Energy lower than Si-O-Si Bonding Energy
- Flexible Si-O-Chains

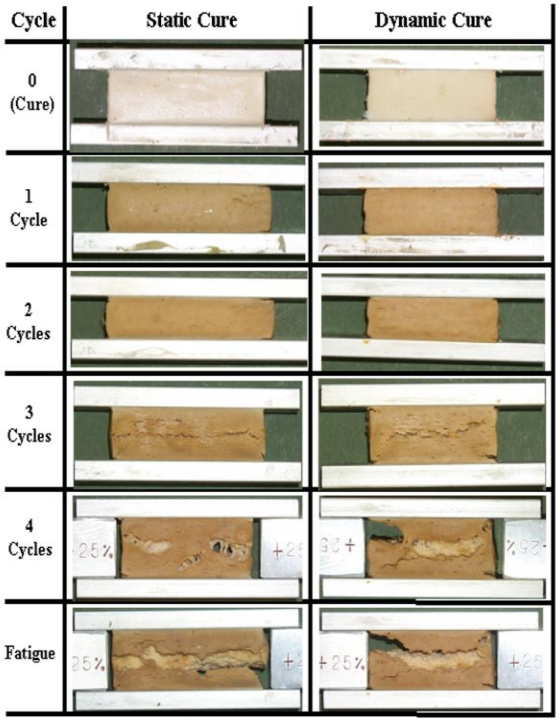
High Strenght & High Elasticity
UV-Resistant
Strong Chemical Bonds to Glass
High Temperature resistant



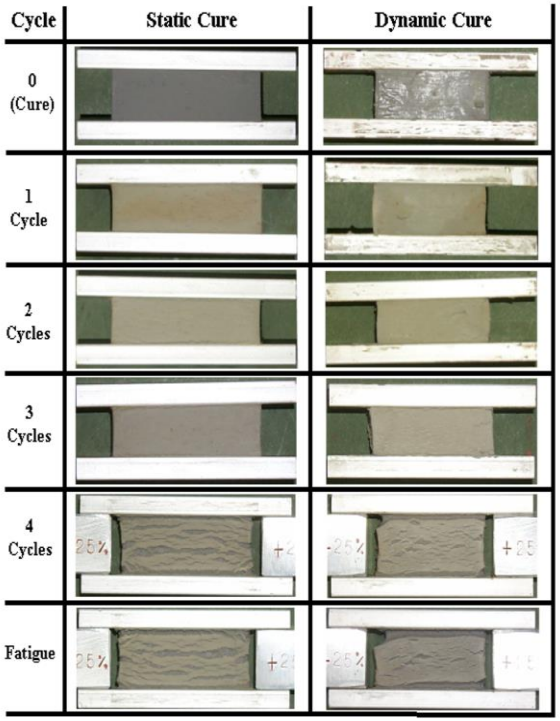
Longevity of Sealants (RILEM-Test)



Silicone



Polyurethane



Polysulphide

Silicones are superior in UV- and high temperature exposed applications

Source: Jones, Hutchinson, Wolf; *Materials & Structures* 34, 332-341 (2001)

Fire Safety Performance

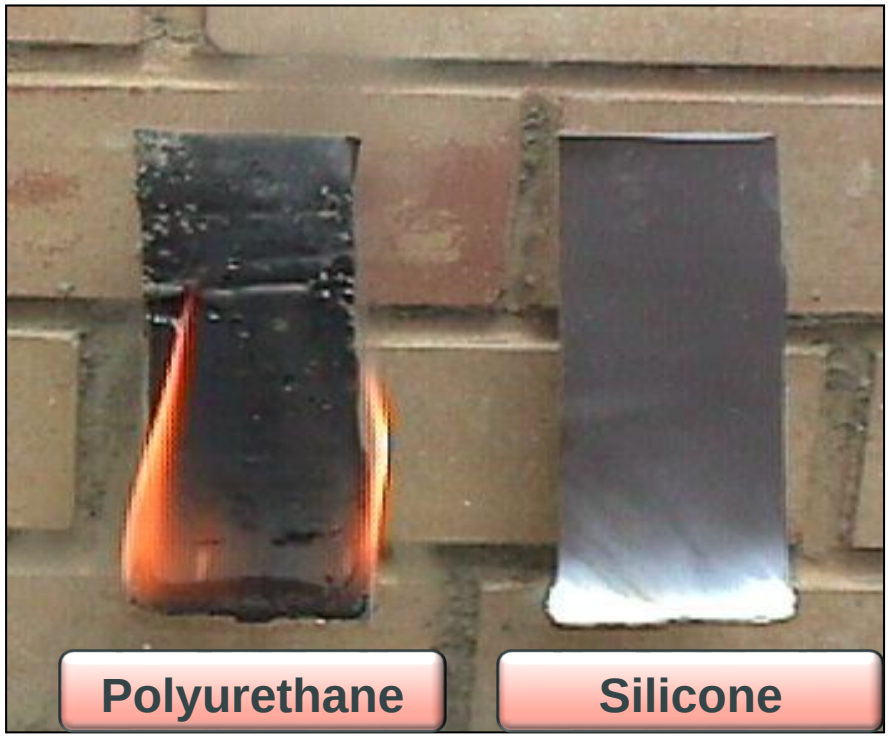
of Silicone Sealants

Silicones in Fire Safety Applications

- **Silicone temperature resistance**
  - -50° C to +150° C permanent
  - Fire Seals (**DOW**):

    +265° C and shortterm upt to +315° C

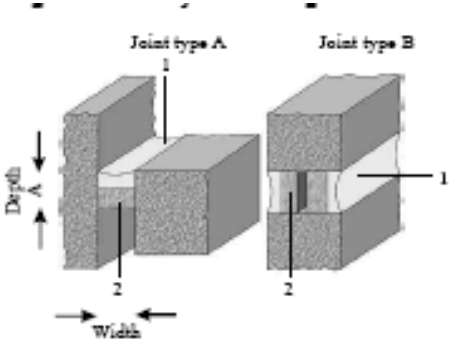
    4 hours fire rating acc. to EN1366
- **Burning behavior:**
  - Silicone sealants are **not flame propagating**
  - Silica powder is extinguishing the flame
  - Released VOCs are non-odor and non-toxic



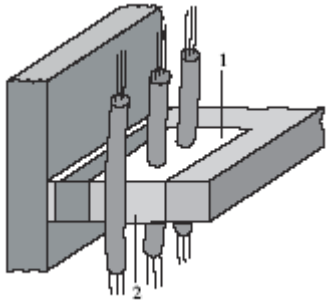
Silicones can NOT be categorized as non-flammable as they are not inorganic
Silicones provide excellent fire retardant properties compared to other sealants
For fire-safety consideration, the whole system has to be tested

Typical Applications

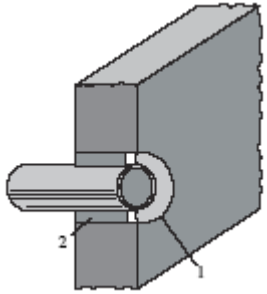
- Floor-wall connection: Smoke-Seal
- Interior and exterior joints



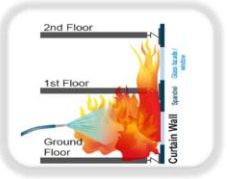
- Cable penetration Seal



- Pipe penetration Seal



Example of performing silicone in a façade system



Fire outside building T>800° C

- Glass Broke
- Aluminium melted
- Silicone kept its adhesive properties
  - Elasticity
  - Did not burn
  - Adhered to and protected the substrate

Existing European Norms and guidelines

- ETAG 026 – Fire Stopping and Fire Sealing Products (part 1, 2 and 3)
- ETAG 028 – Fire retardant Products
- EN 1366
  - Parts 1 to 7 – Fire Resistant Tests for service installation
  - Part 3 - Fire Resistant Tests for service installation penetration seal
- EN 1364 – Fire Resistance tests for non-loadbearing elements
- ISO 834 – Fire resistance tests
- Potential local norms to be considered

Design Failures

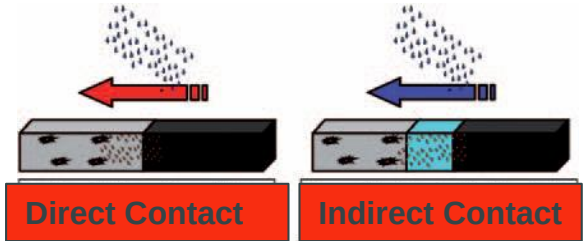
Compatibility & Sealant choice

Why Sealants Joints Fail

- **Adhesion Performance:**
  - Adhesion NOT tested prior to use
  - Improper surface preparation (dust-free, oil-free)
  - Lack of primer or wrong primer
  - Moisture – wet substrate

- **Application:**
  - Poor joint filling, tooling
  - Wrong / No Baker rod
  - Wrong Sealant choice
  - Joint dimensions not considered
  - Application temperatures (>+50° C)
  - etc.

- **Compatibility**
  - Materials in direct or indirect contact must be tested prior to use to avoid whole system failure



Delamination – laminated glass

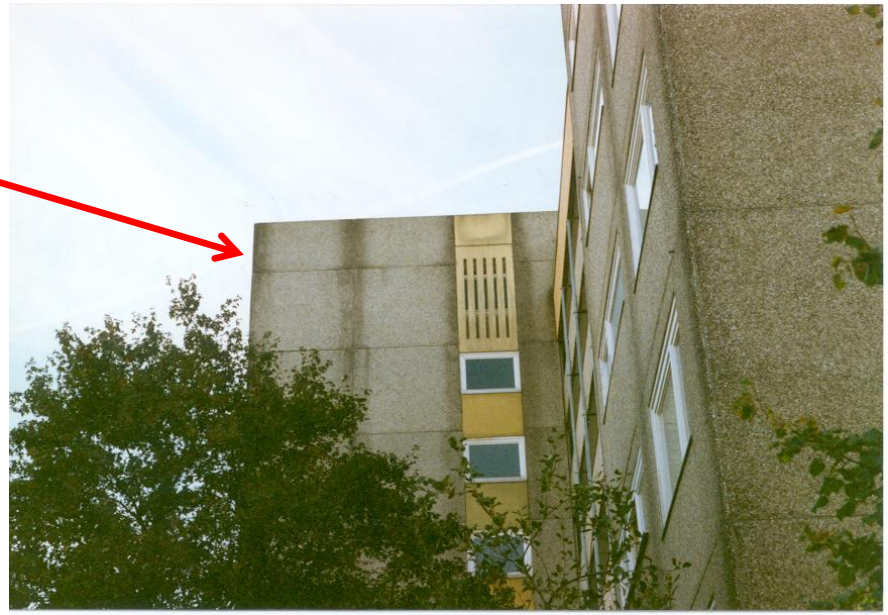
Plasticizer Migration
Sealant to laminate & Laminate to sealant

Incompatible Setting blocks

Setting blocks in contact with fire rated laminated glass: Plasticizer migration from one setting block to the other

Staining in natural and artificial stone applications

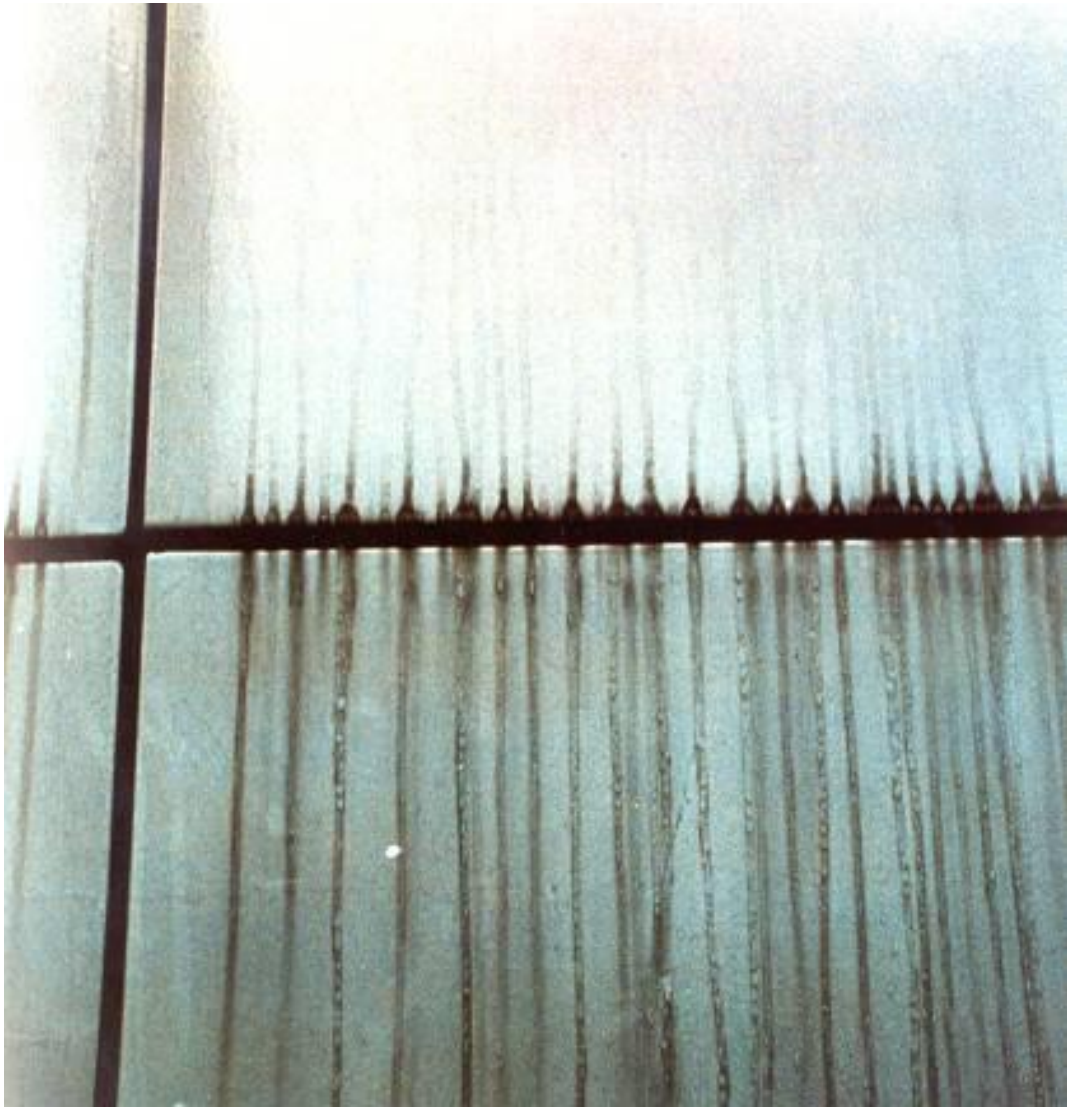
Diluted Silicone with organic plasticizer caused staining



Staining in marble applications – plasticizer free sealants have to be used

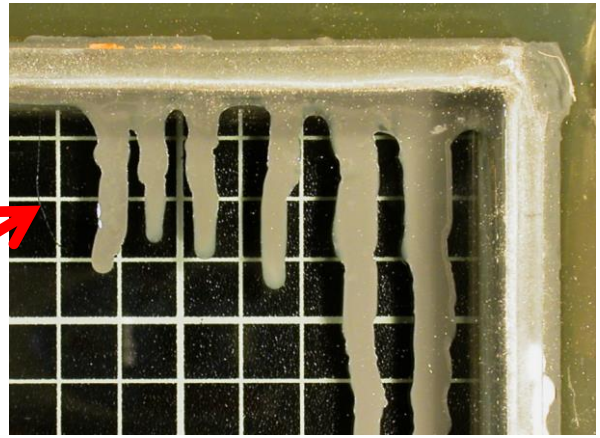
Streaking

- Dust & Dirt traces from rain over time
- Avoid streaking with a „clean“ plasticizer free sealant
- Diluted sealants with organic oils increase streaking

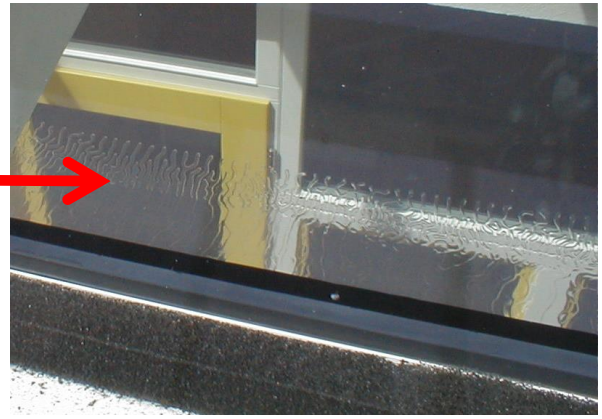


Other design failures

• Butyl dissolved from plasticizer – incompatible weathersealant : indirect contact through IG secondary seal

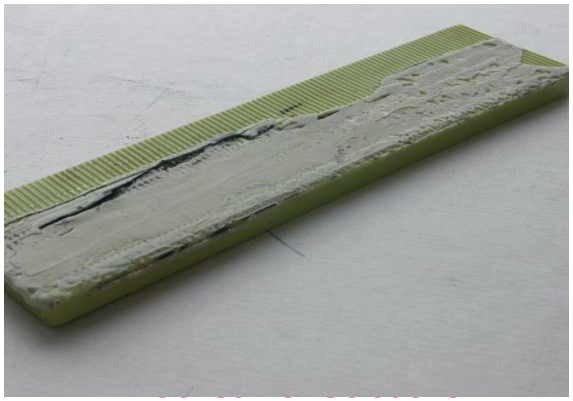


• Delamination due to incompatibility: Highly diluted sealant has been used



Butyl (PIB) Failure

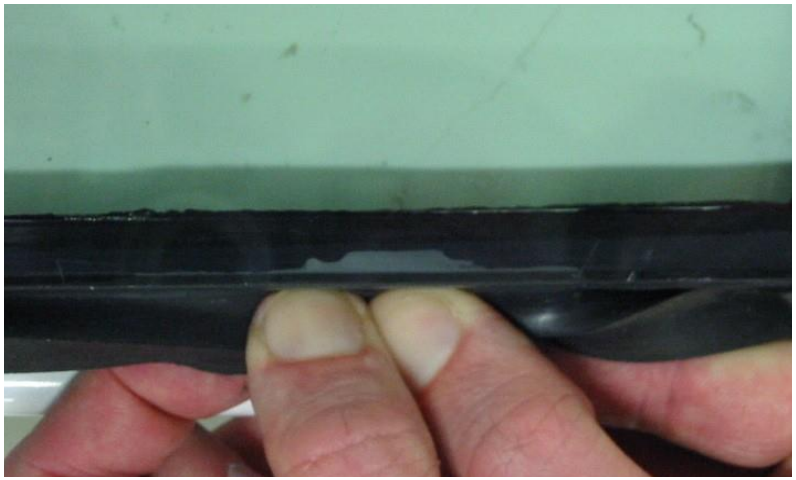
Setting blocks fixed with highly diluted sealant containing mineral oil as plasticizer



Insulating Glass with Alu-Spacer

Adhesion loss between secondary sealant and spacer due to incompatible weather sealing

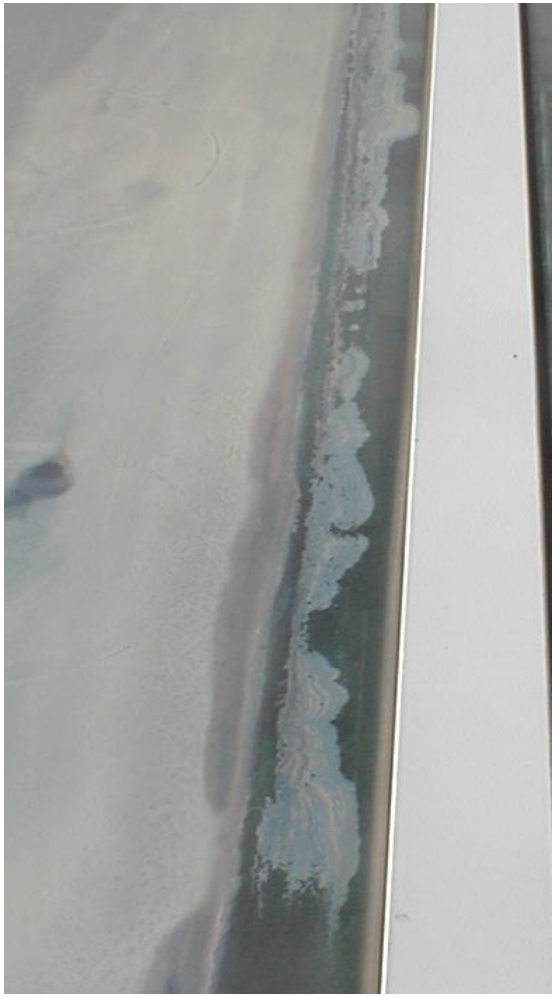
Glass: soft coating without edge deletion



no or poor edge deletion of soft coating has cause adhesion failure of secondary sealant

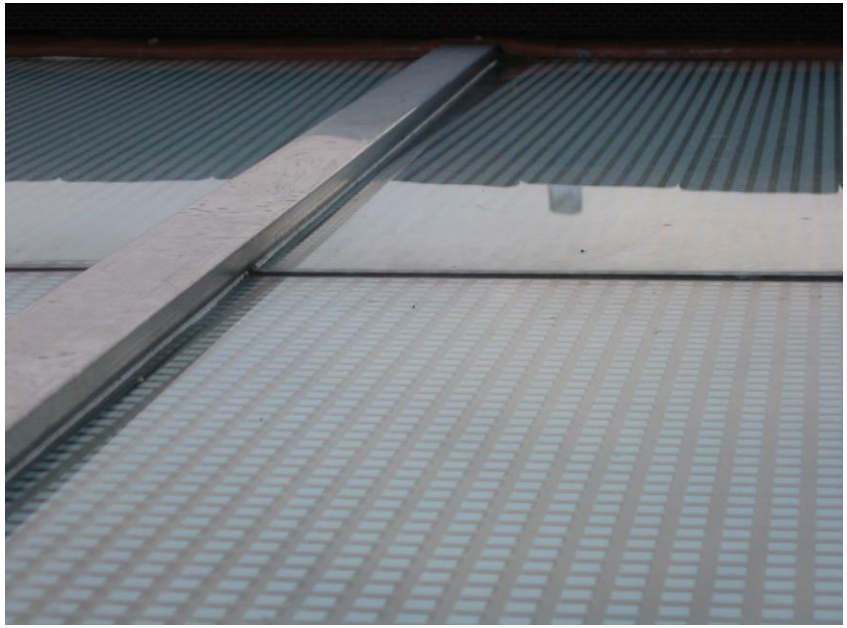
Non-UV resistant secondary sealant

Organic sealant used in UV exposed designs: adhesion failure, moisture penetration, risk of glass falling down in facade application



Cross section exterior facade

Horizontal profile with EPDM gasket in contact with vertical weather sealing. Incompatibility led to untightness of whole facade skin



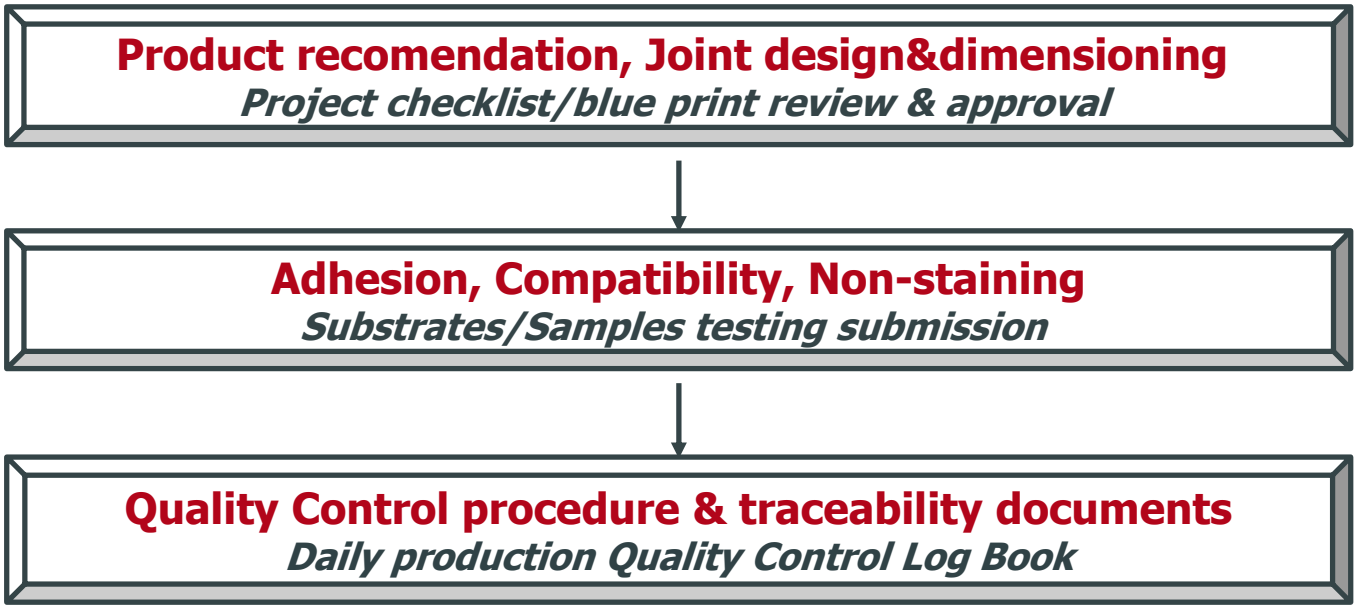
Weather Seal: damaged baker rod

Closed cell PE baker rod has been damaged. Outgazing led to bubbling of uncured sealant

Example of Quality Assurance

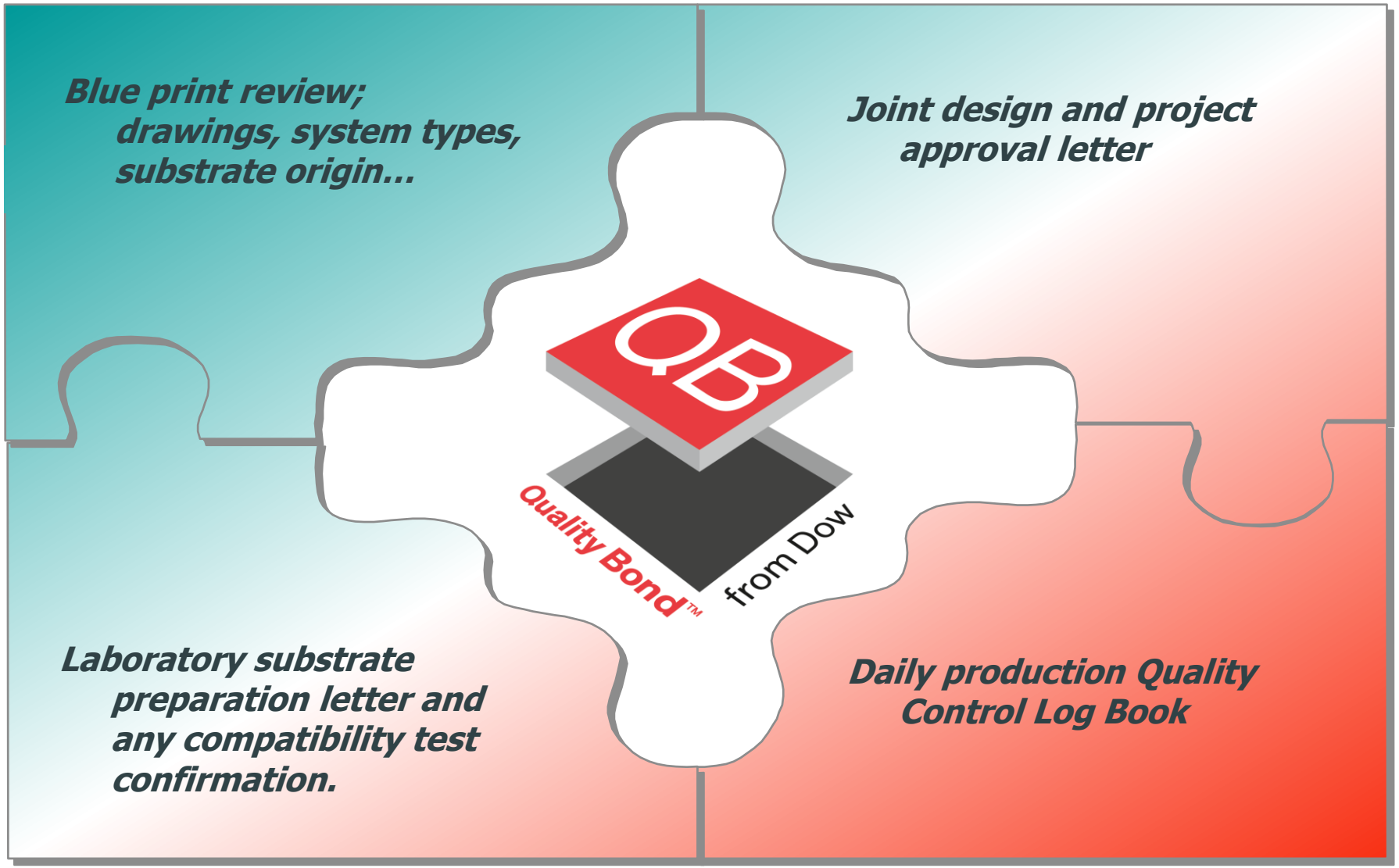
Quality Control process

(DOW SG/IG Manual ETAG-002 and/or EN 1279)



QUALITY BOND™ PROGRAM

Track / Monitor / Control application quality



Thank You

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