Revolutionary. Also our technologies.

TPS® technology for premium insulating glass in commercial and residential buildings

Klaus Puschmann
Bystronic glass

www.bystronic-glass.com
Bystronic glass provides pioneering solutions for the processing of flat glass
We set new benchmarks with innovative technologies

Quick triple I.G. manufacturing with TPS®
The B‘SPEED is able to produce triple insulating glass units in the same time it takes other lines to produce double units, e.g. with TPS®, the premium insulating glass of the warm edge generation.

Dynamic mixing system for the sealing
The dynamic mixing system of the speed'sealer enables the flexible sealing of triple IG units in a variety of spacer widths within a dual cycle without changing nozzles and eliminating downtimes.

The system solution for maximum requirements
B’JUMBO XXL: Individual production solution specially designed for manufacturing of large sized I.G. units or façade elements up to 18 m length
Bystronic glass is part of the Conzzeta AG, since 1994

2016:
- Revenue: 1.2 bCHF (1.1 b€)
- Employees 3,300
Bystronic glass offer consulting, sales and service throughout the world

**Headquarter and subsidiaries**

- USA
- Brasil
- Germany
  - Switzerland
  - Great Britian
  - Russia
- Singapore
- China

**Representatives**

- South America
- Austria
- Baltic States
- BeNeLux
- Bulgaria
- Czech Rep.
- Egypt
- France
- Greece
- Hungary
- Iran
- Italy
- Middle East (U.A.E.)
- Poland
- Romania
- Scandinavia
- Slovakia
- Spain/Portugal
- South Africa
- Turkey
- Australia
- India
- Indonesia
- Japan
- Korea
- Malaysia
- Pakistan
- Philippines
- Taiwan
- Thailand
- Vietnam

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TPS – Premium Insulating Glass

1. Some facts about insulating glass
2. TPS – The technology
3. Benefits of TPS
4. References
ASEAN Insulating glass market: CAGR 5% growth (2014-20)

Market: Total Window Area Demand
Effect of thermal heat blocking in cold or hot climates

Heat Loss + Temperatures on Glass in Cold Climates

<table>
<thead>
<tr>
<th>Single Glass</th>
<th>Insulating Glass</th>
<th>High Performance Glass</th>
</tr>
</thead>
<tbody>
<tr>
<td>$U^* = 5.8 \text{ W/m}^2\text{K}$</td>
<td>$U^* = 3.0 \text{ W/m}^2\text{K}$</td>
<td>$U^* = 1.2 \text{ W/m}^2\text{K}$</td>
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</table>

- Out: 174 W/m² "
- In: -2 °C

- Out: 90 W/m² "
- In: 9 °C

- Out: 36 W/m² "
- In: 16 °C

Higher temperatures on the glass surface!

Less Heat Loss

Less Cold Air Flow inside – More Comfort

Reduced Condensation inside

| Environmental Temperature: | 35 °C |
| Room Temperature:           | 24 °C |

* U-value according to EN 673

" Heat Loss

Condensation + Temperatures on Glass in Hot Climates (Night Time)

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- Out: 81 W/m² "
- In: 55 °C

- Out: 42 W/m² "
- In: 74 °C

- Out: 17 W/m² "
- In: 90 °C

Higher temperatures on the outer – lower temperatures on the inner glass surface!

Less Heat Gain and Air Conditioning

Reduced Condensation outside

| Environmental Temperature: | 10 °C |
| Room Temperature:           | 21 °C |

* U-value according to EN 673

** Condensation at 50% relative humidity

*** Heat Gain
Reduction of global warming: 

→ CO₂ balance comparison of insulating glass

Source: Glass for Europe
Optimize thermal insulation glass

⇒ Triple and Quadruple glazing

\[ U_g = 1.1 \text{ W/(m}^2\text{ K)} \]

\[ U_g = 0.5 \text{ W/(m}^2\text{ K)} \]

\[ U_g = 0.3 \text{ W/(m}^2\text{ K)} \]

Δ 0.6

Δ 0.2

4/16/4:4
24 mm

4/18/4/18/4:4
48 mm

4/20/4/20/4/20/4:4
76 mm
Optimize thermal insulation glass ➔ Warm edge spacer technology
Warm Edge Advantages

- Less condensation in the edge area
- Less maintenance in frame
- Less potential for mold
- More comfortable room climate
1. Some facts about insulating glass
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TPS® – Thermo Plastic Spacer

Standard insulating glass unit

3 parts: Rigid spacer bar with desiccant filling and butyl sealant
+ secondary sealing

TPS® insulating glass unit

1 part: PIB spacer bar with desiccant incorporated
+ secondary sealing
Improvements to the Existing Technology

3 in 1: spacer, desiccant and primary sealant in one material
No additional preprocesses for the frame production, simplified logistics
„Spacer on demand“, any production sequence of rectangular or shaped units
Homogenous, continuously applied spacer with tightest possible joint
Premium warm-edge insulating glass, reduced condensation
Various Fields of Application

- Residential
- Commercial
- Structural Glazing
- Bus
- Train
- Car
TPS® at a Glance

• Thermoplastic spacer without metal insert
• Improved heat insulation at the edge zone
• Even temperature distribution on the glass surface
• Reduced condensation
• Elastic edge seal
• Versatile and flexible design possibilities
• Ideally suited for structural glazing (with 4SG)
• High quality - long lifetime
• Gas filled units may be sealed with Silicone, PS, PU and reactive HM
• Free choice of material manufacturers
TPS® Material Suppliers

FENZI

KÖMMERLING KÖMMERLING CHEMISCHE FABRIK GMBH

H.B. Fuller Window

LJF

IGK ISOLIERGLASKLEBSTOFFE

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Reactive TPS® Material for Structural Glazing: Koedispace 4SG

Meets the stringent demands of the structural glazing market:
- Gas tightness in combination with silicones according the EN 1279 part 3 confirmed by the ift Rosenheim
- Better adhesion to glass:
  - 4SG physical + chemical bonding
- Adhesion to Silicone Secondary-Sealants:
  - 4SG chemical bonding
- Higher cohesion:
- Better stability under higher temperatures up to 90°C
- Improved hot shear resistance:
- Better stability under higher temperatures up to 90°C
TPS eliminates human errors with fully automated spacer production process
Steps of IG Production

a) Conventional

Glass delivery ➔ Glass storage ➔ Glass cutting ➔ Glass washing and drying ➔ Assembling ➔ Pressing ➔ Edge sealing ➔ Storage ➔ Delivery

Spacer storage ➔ Spacer cutting ➔ Molecular sieve filling ➔ Spacer frame assembly ➔ Butyl string
Steps of IG Production

b) TPS®

Elimination of separated processes for:
spacer storage, spacer cutting, molecular sieve filling, spacer frame assembly, butyl extrusion
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The original TPS joint – Less visible now

Airspace 1 – 20 mm
Proven tight since 1994
No additional heating and smoothing necessary

All formats
Triple Insulating Glass

- Infinitely variable spacer widths
- Both spacer applications without any offset
- No downtime due to material set-up times
- No over-pressing during assembly process with measure driven press robot
Unique Design

• Versatile and flexible design possibilities
• Consistent quality
• Design of free shapes via CAD-technology
Stepped Insulating Glass

- Production from 1- to 4- sided stepped Insulating Glass
Visually Attractive Blend (1)

- Window frame colour reflected onto the TPS surface
Visually Attractive Blend (2)

• Window frame colour reflected onto the TPS surface
Longer Life from Ultimate Vapor Barrier

Low initial moisture content  Further moisture adsorption
Principle of the Moisture Vapor Barrier

- Molecular Sieve unloaded
- Molecular Sieve partly loaded
- Molecular Sieve loaded
Dead Load Capability

- Test climate: 90 °C (194 °F)
- Test period: 14 days
- Result: no displacement
Pressure Stability of TPS® Edge Seal

- Load approx. 2.000 kg (4409 lb)
- > 0.5 mm pressing of the sealant after 20 h
- After relieving 100 % retraction
Comparison of Edge Seal Components

Argon permeability [l/m²d]

- Polyisobutene: 0.01
- Polyurethane: 0.3
- Polysulfide: 0.03
- Silicone: 10

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Façade Glazing

Facts to consider:
Large Sizes – Risk for Thermal Expansion!
Silicone as Secondary Sealant!

➢ Requires tight frame with minimal
thermal expansion!
50 – 62% less glass deformation with TPS due to elastic edge seal construction

Metallic Spacer

\[ p_e < p_i \]
\[ p_e > p_i \]

Ködispace 4SG

\[ p_e < p_i \]
\[ p_e > p_i \]

Source: Kömmerling Chemie

\( p_e \): external pressure
\( p_i \): internal pressure

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Glass Stress Reduction of TPS

- under temperature impact (23 °C => -20 °C)
  GU assembly 6.0/18.0/6.0 mm

![Graphs showing pane deflection for Ködispace 4SG and Metallic Spacer.]
Superior Gas Tightness of TPS

Decrease of Ar-content after multiple **EN1279p2** tests

![Climatic cycling test](chart)

- **Temp.**
- **Hum.**

1 test =
- 58 * 12 h @ climatic cycling test
- + 1176 h @ 58 °C / 100 % r.H.

Decrease of gas filling [%]

Source: Kommerling Chemie
External Test Results

- after multiple cycling acc. EN1279 p2

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<tbody>
<tr>
<td>Moisture Penetration</td>
<td>-</td>
<td>2,86</td>
<td>4,63</td>
<td>5,30</td>
<td>10,18</td>
<td>12,12</td>
</tr>
<tr>
<td>Index I [%]</td>
<td>93,4</td>
<td>92,5</td>
<td>91,6</td>
<td>90,8</td>
<td>90,1</td>
<td>89,3</td>
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<tr>
<td>Argon Concentration [%]</td>
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Test Report

National Glass Quality Supervision and Inspection Center

Test Category: Compressive Testing
Test Standard: GB/T 15784.2013 (Tempering Glass Unit)
Test Items: Dew Point, UV Resistant Properties, Long Term Test for Moisture Penetration, Dew Point after Long Term Test

Report No.: WJZL02

Date:  

The test report is only valid if partially ended, answered or stored.
International Certifications

- JIS R 3209
- NF P 78-451
- NF P 78-452 (Avis Technique)
- UNI 10593
- NEN 3567
- NS 3212
- ASTM E 773
- ASTM E 774
- EN 1279-2
- EN 1279-3
- SFS 4704
- DIN 1286/1
- DIN 1286/2
- CAN 2-12.8-M76
Certified Quality by Renowned Institutes
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Worldwide Success Story

Production Lines Worldwide

- > 100 TPS applicators all over the world
Buildings around the World
Galileo – Dresdner Bank Tower
Frankfurt (Germany)
Zlote Tarasy Warsaw (Poland)
Dalian Shang Fang Gang Jing (China)

Source: Kömmerling Chemie

www.bystronic-glass.com
Hessing Car Dealer, Netherlands

Source: Kömmerling Chemie
Art Museum Serlachius, Finland

Source: Pedro Pegenaute
EXPO Astana, Kasachstan

Source: Kömmerling Chemie
Thank you very much for your attention.