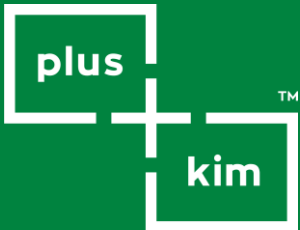


# Sandwich Panel Systems

## Application Guide



PLUSOL-R-104-47

Chemistry for **Good**  
*Steady. Accurate. Continuous.*

**PLUSOL-R-104-47** is a **five-component rigid polyurethane system** specially designed for **continuous sandwich panel production lines**. It uses **hydrocarbon (n-pentane)** as the blowing agent and is formulated for **high adhesion to metal facers** such as galvanized steel, aluminum, or PPGL.

**Key Properties:**

- **Excellent adhesion** to metal facers
- **Fine and uniform cell structure**
- **Low thermal conductivity** ( $\lambda \approx 0.022\text{--}0.024\text{ W/m}\cdot\text{K}$ )
- **High compressive strength** and **dimensional stability**
- **Controlled exothermic reaction** compatible with continuous lamination lines

### 1. System Components

Component	Description	Function
A - PLUSOL-R-104-47	Polyol blend	Core formulation
B - PLUSNATE-R-100-01	Polymeric MDI	Isocyanate component
C - PLUSAD-R-116-04	Additive package	Improves adhesion & stability
D - PLUSCAT-R-115-10	Catalyst	Controls reaction profile
E - n-Pentane	Physical blowing agent	Generates closed-cell foam

### 2. Recommended Mixing Ratio

Component	Ratio (by weight)
Polyol (A)	100
Isocyanate (B)	150
Additive (C)	2.2
Catalyst (D)	2.5

**Note:**The ratio between polyol and isocyanate directly affects index (target: 105–115) and mechanical properties.

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### 3. Material Conditioning

- **Polyol temperature:** 22–25 °C
- **Moisture content:**  $\leq 0.05\%$
- Mix polyol and additives for **15–20 min** before feeding the line.
- **Isocyanate temperature:** 24–27 °C
- Use explosion-proof mixers and maintain ventilation in pentane zones.

### 4. Mixing & Pressure Parameters

- **Mixing head type:** High-pressure impingement
- **Static mixer:** Install close to mix-head to minimize pressure loss.
- **Working pressure:** 120–130 bar (min. 100 bar)
- **Nozzle orifice:** Match to total flow; avoid excessive spray effect.
- **Mix-head cleaning:** Perform after each production cycle to prevent contamination.

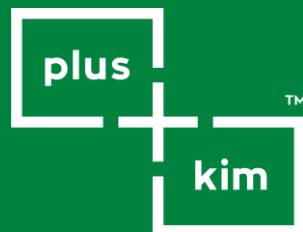
### 5. Reaction Profile

Parameter	Typical Value
Cream Time	8–12 s
Gel Time	35–45 s
Tack-Free Time	55–65 s
Free-Rise Density	32–36 kg/m <sup>3</sup>

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## 6. Conveyor & Line Speed

Line Speed	Density Effect	Comment
5.8 m/min	High density, safe	Slow rise, waste risk
6.0 m/min	Optimum	Recommended for stability
6.5 m/min	Low density	Risk of collapse or voids

Note: Average line length is 18m.

## 7. Metal & Belt Temperatures

Parameter	Recommended Range	Notes
Metal facers (top/bottom)	40–50 °C (opt. 45 °C)	Key for adhesion and surface finish
Conveyor belts	35–45 °C	Keep stable across line length
Ambient temperature	≥ 20 °C	Cold environment slows reaction

### Warning:

Too cold → poor adhesion;

Too hot (> 50 °C) → surface bubbles or gas pockets.

## 8. Metal & Belt Temperatures

- Maintain **Contact Time = Gel Time – 5 s**.
- Foam should still be flowable when meeting the upper metal.
- If contact is too early → cell collapse / brittleness.
- If too late → incomplete filling or voids.

## 9. Foam Exotherm Control

- **Maximum internal foam temperature:** 140 °C
- Use embedded thermocouples for real-time monitoring.
- Excess exotherm causes shrinkage, discoloration, and brittleness.

## 10. Pressure & Belt Settings

- **Laminator belt pressure:** 0.2–0.5 bar
- Excess pressure → crushed cells, low insulation
- Low pressure → voids or delamination

## 11. Spraying & Distribution (Mix-Head Oscillation)

- Oscillation speed must match foam rise geometry.
- Ensure homogeneous chemical flow across flute width.
- Avoid over-spraying; flow should form a smooth layer without turbulence.
- Check flute holes for blockage; clean daily.

## 12. Panel Filling Control

- Verify uniform filling along length and width.
- Foam rise should reach 90 % before entering double-belt section.
- Incomplete filling → cold spots, poor mechanical strength.
- Over-filling → surface waves or delamination.

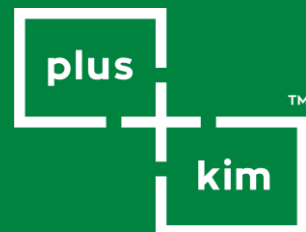
## 13. Adhesion Performance

- Proper adhesion requires:
  - Clean and degreased metal surface
  - Facer temperature between 40–50 °C
  - Balanced activator dosage
- Poor adhesion often results from low temperature or short contact-gel interval.

## 14. Density & Cell Structure

- **Target core density:** 35–40 kg/m<sup>3</sup>
- **Skin density:** 45–55 kg/m<sup>3</sup>
- Uniform cell structure indicates good mixing and temperature balance.
- Poor mixing leads to open cells, shrinkage, or uneven mechanical properties.

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## 15. Typical Process Issues & Corrections

Problem	Cause	Correction
High Density	Low line speed / cold metal	Increase conveyor speed / raise metal temp
Low Density	High line speed / high metal temp	Reduce speed / lower metal temp
Poor Adhesion	Cold surface / low activator	Heat metal / increase activator
Surface Bubbles	Overheated metal / trapped air	Lower metal temp / check venting
Panel Collapse	Low index / poor ratio control	Adjust isocyanate ratio
Cracks or Delamination	Uneven temperature / pressure	Balance belt pressure

## 16. Quality Control Tests

Test	Method	Target
Density	EN 1602	35-40 kg/m <sup>3</sup>
Adhesion Strength	EN 14509 / ASTM C297	≥ 0.12 MPa
Compressive Strength	EN 826	≥ 150 kPa
Thermal Conductivity	EN 12667	$\lambda = 0.022-0.024$ W/m·K
Dimensional Stability	EN 1604	≤ 2 % change after 7 days at 70 °C

## 17. Safety & Environmental Guidelines

- Keep pentane vapor < 20 % LEL (1.5 vol %).
- Use **ATEX-certified** equipment.
- Ensure continuous **gas monitoring** and **ventilation**.
- Operators must wear **anti-static PPE** (gloves, goggles, respirators).
- Dispose of waste according to local environmental legislation.

## 18. Storage & Shelf Life

Component	Shelf Life	Storage Temp	Remarks
A, C, D	6 months	15-25 °C	Keep sealed and dry
B (MDI)	12 months	15-25 °C	Protect from moisture
All	-	-	Avoid sunlight and heat sources

## 19. Disclaimer

The information in this Application Guide is based on laboratory and field data. Application conditions may vary and are beyond the manufacturer's control. Applicators must ensure suitability for each specific project.

## 20. Technical Support

For additional information;  
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