MAXIMIZING YIELD

"Paying close attention to yield can dramatically impact the bottom line of your business. Small adjustments in the processing and application of the foam can mean huge increases in profitability."

Juan Sanchez, National Technical Director

Understanding the Conditions that Affect Yield

Since there is no standardized test for "yield", we interpret yield through density. "Density" is the weight of one cubic foot (1/ft³) of the foam. Through density, we can extrapolate the theoretical yield from a set liquid chemical. For example, if the stated core density of a half-pound foam is 0.5/ft³, then a set of chemical weighing 1,000lbs should produce 2,000/ft³ of foam. Since there are 12 board feet in a cubic foot, theoretically a half-pound foam should achieve 24,000 board feet! In reality, we can never achieve that yield, *so where does it all go?* If we examine where the yield disappears to, we can have a better understanding of expected yields and how to maximize yield.

	Conditions That Effect Yield	Loss in Yield	Explanation	Recommendations
1	Starting Drum Chemical Temp & Storage	0-10%	You CAN NOT start with cold chemical in the drum.The viscosities of A&B chemicals are out of alignment whencold and the pumps can cavitate with cold, thick chemical. If it transfers into the proportioner and pressurizes cold, then as the chemical heats up volume changes,resulting in off-ratio chemical and reduced yield. *CAUTION: Using powerful block heaters to rapidly heat cold chemical may scorch catalysts and reduce the reactivity and growth of the foam. The warmer the starting chemical, the more aligned the viscosities will be.*	• **Open Cell**: Use blanket heaters to warm drums to 75°F. • **Closed Cell**: Use blanket heaters to warm drum temperatures to minimum of 55°F, but no more than 70°F (CC is susceptible to frothing if drum is too warm). · If drum temperature is too high (>75°F), then the blowing agent will expand too much when heated by block heaters and throw the pressures between A&B out of alignment. · (Band heaters or torpedo heaters NOT recommended, they do not heat evenly and can scorch the polyols and blowing agent.)
2	Substrate Type	0-10%	Concrete and metal will reduce yield. These materials have greater conductivity and suck the heat out of the chemical, thereby lowering reactivity and creating a thicker contact skin.	• Pre-heat substrate as close to 70°F as possible for concrete, but no more than 50°F for metal. • For concrete and metal, use a sacrificial flash coat of ¼" to create a thermal break between these substrate types and the subsequent full pass layer.
3	Substrate Temperature	0-30%	The substrate temperature greatly impacts the chemical reaction and growth of the foam. Even on a cold winter day, properly pre-heating a building can dramatically increase the yield. As the substrate temperatures drop below 70°F, yields will begin to fall; as they fall below 50°F they will decline exponentially more.	• Heat the building using diesel/electric heaters (avoid propane). If a large structure, concentrate heat in sections being sprayed. Try and achieve at least 50°F substrate if possible. The closer to 70°F the better (except never heat metal substrate above 50°F or may condensate). • If possible, follow the direction of the sun as it warms the substrate.
4	Substrate Contact Layer & Surface Skin	5-10%	A denser layer of the foam forms where it contacts the substrate and dense skin forms on the surface. These dense layers reduce yield.	• Heating the substrate helps improve the density of the initial contact layer. A cold substrate cools the chemical reaction and reduces the reactivity, thereby limiting its expansion. Use an infrared thermometer to gauge the substrate temperature. • Heating the ambient temperature improves the density of the skin formation. Heat the ambient temperature and substrate as close to 70°F as possible.
5	Mixing Chamber Size	0-10%	The larger the mixing chamber the harder it's to control, the poorer the mix of resin and iso, and the colder the temperature of chemical coming out of the gun. Large mixing chambers increase flow of GPM, thereby reducing the ability of the chemical to heat up properly in the proportioner.	• Many applicators report 5-10% greater yield when switching from an 02 to an 01 mixing chamber. • Make sure mixing chamber size can handle the delta T of the proportioner. • If chemical is cold, an 01 mixing chamber will allow the chemical more time to pass over the block heaters.
6	Spray Mist	3-5%	A fine mist of chemical is emitted from the gun that never makes contact with the substrate. This mist is lost chemical.	• Lower pressures to reduce mist and allow you to spray closer. • Use an 01 mixing chamber between 1,000-1200psi to reduce mist and improve yield.

Universal Polymers Corporation
Polyurethane Spray Foam Insulation

Maximizing Yield Means Maximizing Profit & Quality!

7	Lift/Pass Thickness	0-30%	Thinner lifts do not generate enough exothermic reaction necessary to fully expand the foam. Applications that call for thin thickness will experience significantly less yield - bid the job accordingly.	• **Open Cell**: Thicker lifts result in greater yield. More exothermic reaction is generated to fully expand the foam. • **Closed Cell:** Only use closed-cell versions that are designed for applicable pass thickness. In other words, a High-Lift formula when only spraying at a 2" lift will not provide desired yield. Spray as close to max pass thickness as formula will allow for optimal yield. *CAUTION: Be careful, spraying more than formula permits risks excess exothermic reaction that will affect the physical properties and dimensional stability.*
8	Number of Lifts/Passes	0-20%	Each pass will produce another layer of dense skin and increase overall density. Each additional pass will reduce yield by 3-6%. It is common to see in-place density of 3lb/ft³ for a 2lb/ft³ CC foam when numerous thin passes have been applied.	• **Open Cell**: Try and spray as close to the full thickness required as possible. This takes practice. • **Closed Cell:** Spray as close to 2" in a single lift for regular versions, and 3-4" for high-lift versions.
9	Uniformity	0-10%	Technique and skill will dictate how flat the sprayer can apply the foam. If the thickness of application is uniform, then less overall foam will have to be applied to achieve minimum required thickness.	• **Open Cell**: Spray side-to-side. If a thick application requires more than one pass, then the second pass should be up-and-down. • **Closed Cell:** Spraying using the up-and-down technique will provide more uniform and flatter application.
10	Off-Ratio	0-30%	Foam can be off-ratio for a variety of reasons - cavitation, clogged Y-strainers, clogged check-valve screens, mixing chamber clogged, cold chemical, worn pump seals, etc.	• Maintain equipment. Check Y-strainers weekly, check valve screens daily, clean mixing chamber daily, rebuild pump seals every 2 years, rebuild wet portion of stick pumps every 2 years, and rebuild dry portion of stick pumps yearly. • New generation of Graco equipment utilizes flow meters to monitor the ratio of A&B and provide assurance and documentation.
11	Dialing in the Correct Temperature Settings	0-30%	This is a major factor. If your temperatures are dialed-in too cold, then lack of heat will generate poor chemical reactivity and poor yield. • Hose Temp: Start with the desired temp you want the foam coming out at the gun, set your hose to that temperature. The hose heating element is not meant to be a primary heat source, only to maintain the heat. • A-Side: Set 2-5°F higher than the Hose. • B-Side: Set 2-5°F higher than the A-Side. • Note: The A&B are set higher than the hose as we expect to lose a few degrees as it travels to the gun. The B-side should always be set higher than the A-side, the B-side has a lower viscosity.	• **Open Cell**: Start temperatures high enough that the foam shrinks slightly from the studs, then lower temps 3°F at a time until shrinkage stops - this is the yield sweet spot. • **Closed Cell:** Better to start temperatures lower. You have to establish the "wet line." The "wet line" is the dark, unreacted chemical. This line should last for 1-2 seconds for maximum yield. If the "wet line" lasts more than 2 seconds or liquid is drippy, then chemical is too cold. If "wet line" is not visible, then it is curing too quickly and foam is too hot and will burn.

UPC 500 MAX IN-FIELD YIELD SIMULATION

These are 2 hypothetical scenarios for the 500 Max. In scenario A, the 500 Max is sprayed in near perfect conditions with an experienced sprayer. In scenario B, the 500 Max is sprayed in less than optimal wintertime conditions with a novice sprayer. As you can see, Scenario B has nearly half of the yield of Scenario A. This is an example of how large the disparity in yield can be from the same exact product.

Core Density in Laboratory:	0.45/ft³
Theoretical Laboratory Yield:	26,666 board ft.

Scenario A: 85°F Summer Day, 01 Mix Chamber, 1200psi, E30, 8" Single Pass in Roof Deck, OSB Substrate @80°F, 75°F Starting Drum Temp, Sprayer with 7 Years of Experience.

Scenario B: 25°F Winter Day, 02 Mix Chamber, 1400psi, E30, Two 4" Passes in Roof Deck, OSB Substrate @30°F, 55°F Starting Drum Temp, Sprayer with 18 Months of Experience

Condition	Scenario A Loss In Yield	Scenario B Loss In Yield
Contact Layer & Surface Skin	5%	7%
Spray Mist	3%	5%
Substrate Temperature	0%	10%
Mixing Chamber Size	0%	3%
Starting Chemical Temp	0%	5%
Substrate Type	0%	0%
Lift Thickness	3%	7%
# of Passes	0%	5%
Uniformity	1%	3%
Off-Ratio	0%	2%
Temperature at Gun	0%	2%
In-Field Yield	23,466 board ft.	2%
In-Place Density	0.51lbs/ft³	0.89lbs/ft³

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