

# MACT Compliance for FRP Open Molding Operations Using Binks LEL Technology – an Overview

Bradley P. Walter  
Industrial Finishing

## Abstract

Fiber Reinforced Plastic (FRP, GRP) manufacturers in the United States must comply with EPA MACT guidelines and provide proof of emissions reduction in their manufacturing processes. To help manufacturers meet stringent styrene emissions requirements Industrial Finishing has developed a series of non-atomizing resin application guns for the open molding process. The technology utilizes impinging fluid streams to generate a flat fan-shaped pattern of large resin droplets, greatly reducing the styrene (or other monomer) emissions generated by the application of resin to the mold surface. Emissions testing was performed in December 2009 by Industrial Finishing to verify the non-atomizing performance of the Binks Century LEL series FRP guns. This report summarizes the design, proper selection and use, and emissions test results of non-atomizing resin and gel coat application technology manufactured by Industrial Finishing.

## Introduction

Any composites manufacturer in the United States that has the *potential* to emit 10 or more tons of Hazardous Air Pollutant (HAP) is subject to the EPA 40 CFR part 63 requirements to meet HAP emissions standards for their composites production processes. To meet the new standards, manufacturers must apply Maximum Achievable Control Technology (MACT) to their processes. One such available technology is called *non-atomizing resin application* (NARA). Impingement technology is a NARA method that has been documented for many years<sup>1</sup> as a way to generate a crude flat spray pattern but

only recently has been applied to the application of gel coats and laminating resins. The basic operating principle of impingement technology is to orient two or more continuous jets of fluid at each other to generate a diverging flat fan of fluid whereby the breakup of the fan into large droplets is delayed as long as possible. The large droplets eventually created have a much smaller surface area to volume ratio (SA:V) than small droplets, resulting in a lower styrene evaporation rate than a spray with the same volumetric flow rate but a larger number of smaller droplets.

**Binks LEL technology** is a combination of FRP spray guns, spray tips, air nozzles and mixing valves that provide non-atomizing application of resins and gel coats for open molding processes. LEL is an acronym for "Low Emission Laminator", but low emissions are not the only benefit of LEL technology. Other benefits of LEL technology include:

- Benefits from lower overspray
  - Increased transfer efficiency results in material savings
  - A cleaner workspace and lower worker exposure to fumes and mist
  - Less frequent booth filter changes
- Benefits from lower fluid pressure
  - Less pump wear - seals, other sliding parts
  - Lower air motor pressure results in lower compressed air consumption

---

<sup>1</sup> See patent #3,705,821 (Breer, 1972)

## Proper selection and use

To enable proper non-atomizing performance the user should follow three simple rules:

**Select the correct tip.** The fluid tip must be chosen carefully to minimize fluid pressure and velocity and still provide the correct spray pattern width for the required operation. All of the Binks Century LEL guns use the same fluid tip design. Gel coat guns will use tips with smaller fluid channels and steeper impingement angles, guns for GP resin will use larger channels and medium impingement angles, and guns for filled resins typically use very large orifices and low impingement angles. The customer should experiment with a range of different tip sizes to optimize the spray pattern.

**Use the lowest pressure possible.** After selecting and installing the tip in the gun the system would be started up and resin pressure should be gradually increased to generate a spray fan similar to the one shown below.



An increase in fluid pressure increases the velocity of the impinging fluid jets and increases the fluid fan width. If the fan is too wide for the flow rate required the emission rate will increase and the user should change to a tip with larger fluid passages and / or a smaller impingement angle.

**Refine and Record.** The user should refine the spray pattern with shaping air, if applicable, then record the relevant setup parameters to assure future non-atomizing performance. Some items to record for future reference include:

1. Pump air pressure
2. Catalyst percentage

3. Fluid tip being used
4. Solvent tank pressure
5. Heater setting if applicable
6. Shaping air pressure if applicable
7. Other gun setup items (chopper position and settings, static mixer length, etc.)

## Testing and Verification of Non-Atomizing Performance

The Binks Century LEL Internal Mix (102-3800 series) and External Mix (102-3600 series) Guns were emissions tested in 2009 at Industrial Finishing's Louisville, Colorado facility using guidelines from the ACMA's *Styrene Emissions Test Protocol*. The Binks Century LEL Gel Coat gun was emissions tested in 2001 and again in 2007 at Purdue University. The purpose of the tests was to verify the performance of the non-atomizing technology as it relates to the "UEF equations" provided by the EPA MACT requirement for open molding of composites. In each case, the gun was set up and operated per industry best practices and the emissions were measured via EPA method 25A, which is a rigorous real-time method used to measure hydrocarbon emissions in an exhaust stack. In addition to method 25A, other EPA methods are used:

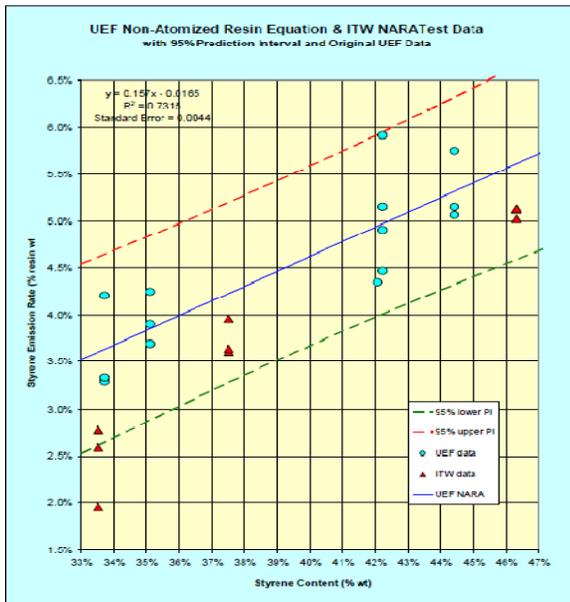
- Use of EPA methods 204, 1, 2, 3(alternative), 4(alternative) for spray booth air flow capture and measurement.
- Styrene is the only monomer present in the test resin.
- All material is applied to an ACMA-designed three sided test mold.
- Spray technique follows elements of ACMA's "Controlled Spraying Handbook"

All of the tests proved the different versions of the Century LEL technology to emit styrene at or below the levels predicted by the EPA UEF equations.

The picture below shows the Century LEL Internal Mix Gun (102-3825-1) applying catalyzed resin and chopped glass to a “test mold” designed by the ACMA and used in all of the emissions tests for Binks LEL Guns.



Figure 5 – Plot of Test Results & UEF NARA Equation versus Styrene Content



In the graph above, the red triangles represent the data from the 2009 testing with the Century LEL Internal Mix gun. The blue line represents the emissions predicted by the NARA UEF equation. In all test replicates, the Binks LEL technology provided emissions much lower than predicted.

## Conclusions and Recommendations

Any manufacturer using the Century LEL technology for the open molding process to make FRP parts may use the EPA’s UEF equations to report their emissions. The Binks Century LEL guns have all been tested per EPA guidelines and have been proven to emit monomer at or below the levels predicted by the equations. The guns, therefore, meet the EPA’s definition of Non-Atomizing Mechanical Application per the Composites NESHAP. Further, if the gun is properly set up and operated it will meet the definition of non-atomizing per California AQMD rule 1162, which states that a non-atomizing technique is a resin application technique in which resin flows from the applicator in a steady and observable coherent flow without droplets for a minimum distance of three inches from the applicator orifice(s).

The complete emissions test report is available from Industrial Finishing upon request. LEL Technology may be found in the following Binks Century series guns:  
 102-3610 external mix LEL gel coat  
 102-3600 series external mix LEL (except 102-3610) for wet-out and chop application  
 102-3800 series internal mix LEL for wet-out and chop application

## References

Haberlein, Dr. Robert A., *Test results: Styrene Emissions from Mechanical Non-Atomized Resin Applicators manufactured by Industrial Finishing*, December 2009

EPA 40 CFR Part 63, *National Emissions Standards for Hazardous Air Pollutants: Reinforced Plastic Composites Production*, Promulgated April 2003

AQMD rule 1162:

<http://www.aqmd.gov/rules/reg/reg11/r1162.pdf>