Ramboll (formerly ENVIRON) collected the original exposure measurements on which the guidance levels for theatrical smoke and haze testing are based, and developed the air sampling protocol recommended by the Actors’ Equity Association. As such, we are uniquely qualified to provide testing services and documentation that would be responsive to any inquiries made by Equity or your cast.

Ramboll has developed a protocol for using a Thermo Scientific PDR-1000AN aerosol monitor to measure concentrations of theatrical smoke, fog and haze. The monitor measures the light scattering produced by particles in the air and reports the results in terms of mass concentration (milligrams per cubic meter, or mg/m³) with the assumption that the particles in the air are a fine dust. Because different types of particles have different light scattering properties, the readings from the monitor need to be adjusted (or calibrated) when measuring something other than dust (such as fog droplets). The user converts the dust readings to the correct mg/m³ readings for the fog droplets by multiplying the dust readings by a *calibration factor* for the particular fog fluid/fog machine combination being used for the fog, smoke or haze effect.

The following calibration factors have been developed and approved by Actors’ Equity Association and the Broadway League for use in measuring theatrical smoke, fog and haze:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Machine</th>
<th>Fluid</th>
<th>Fluid Type</th>
<th>Calibration Factor</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
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<tr>
<td></td>
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<td>(35)</td>
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<tr>
<td></td>
<td></td>
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<td>glycol</td>
<td>0.64</td>
<td>(35)</td>
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<tr>
<td></td>
<td></td>
<td>Froggy's Fog Quick Blast</td>
<td>glycol</td>
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<td>(35)</td>
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<tr>
<td></td>
<td></td>
<td>Froggy's Fog Velocity</td>
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<tr>
<td></td>
<td>Fog Storm 1700 HD</td>
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<td>glycol</td>
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<td>(35)</td>
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<td></td>
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### Approved Calibration Factors for Monitoring Theatrical Smoke, Fog, and Haze
#### (updated April 2018)

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<thead>
<tr>
<th>Manufacturer</th>
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<th>Fluid</th>
<th>Calibration Factor</th>
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<td>(35)</td>
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<td>(35)</td>
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<td>(35)</td>
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<td>(35)</td>
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### Approved Calibration Factors for Monitoring Theatrical Smoke, Fog, and Haze (updated April 2018)

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<tr>
<th>Manufacturer</th>
<th>Machine</th>
<th>Fluid</th>
<th>Fluid Type</th>
<th>Calibration Factor</th>
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<td>(35)</td>
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<td>Le Maitre Ltd.</td>
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## Approved Calibration Factors for Monitoring Theatrical Smoke, Fog, and Haze

(updated April 2018)

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<tr>
<th>Manufacturer</th>
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<th>Calibration Factor</th>
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<td>Mini Mist Canister</td>
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<td>New Rule FX</td>
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<td>Calibration Factor</td>
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<td>Rosco Light Fog Fluid</td>
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<td>Smoke In Style</td>
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<td>glycol</td>
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<td>Froggy’s Fog Cryo Freeze</td>
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<td>Froggy’s Fog Quick Blast</td>
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<td>(25,35)</td>
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**Approved Calibration Factors for Monitoring Theatrical Smoke, Fog, and Haze** *(updated April 2018)*

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<th>Fluid Type</th>
<th>Calibration Factor</th>
<th>Reference</th>
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<td>Froggy’s Fog Velocity</td>
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<td>4.95*</td>
<td>(7,25)</td>
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<td>Power Fog Industrial (PFI) or PFI 9D</td>
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<td>glycol</td>
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<td>Molecular Fog Fluid</td>
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<td>(4,11,25)</td>
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<td>(4,11,25)</td>
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<td>Power Fog Industrial 9D (PFI 9D) with LSG-MKII or equivalent chiller</td>
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<td>glycol</td>
<td>1.37</td>
<td>(4,25)</td>
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**Notes:**

* Due to monitor overloading during the calibration testing for this combination, the resulting calibration factor of 4.95 is known to be overestimated. This value can be used as a conservative (i.e., health protective) screening value. If monitoring results using this calibration factor result in exposures exceeding the guidance levels, it is recommended that additional testing to refine this calibration factor be conducted.

** Testing of e-cigarette and related products is limited to second hand exposure after being exhaled by the user; the initial amount inhaled directly from the product was not measured.

**Disclaimer:** This table does not represent an endorsement of any equipment-fluid combination by Ramboll. Please note that the use of fluids in machines other than those recommended by the manufacturer is subject to the equipment manufacturer’s terms and conditions.

**References:**


9. Letter from Le Maitre Special Effects to ENVIRON International Corporation regarding name change of Regular Fog Fluid to Directors Choice, December 5, 2005.


25. Letter from Ultratec Special Effects Inc. to ENVIRON International Corporation regarding separation of Le Maitre Special Effects Inc. from Le Maitre Ltd., and renaming of Le Maitre Special Effects Inc., to Ultratec Special Effects Inc, June 10, 2009.


28. E-mail correspondence from Le Maitre Ltd to ENVIRON International Corporation, March 4, 2011.


42. Telephone discussion with ePuffer regarding rebranding of D-1500 as Robusto, June 8, 2017.
47. Letter from Le Maitre regarding Gforce3, August 2, 2017.

Manufacturers:
Antari – http://www.antari.com
Crawford International Theatrical Corporation (CITC) - http://www.citcfx.com/
Froggy's Fog - http://www.froggysfog.com/
Hazebase – http://hazebase.com
Le Maitre Ltd. - http://www.lemaitreusa.com
Smoke Factory - http://www.smoke-factory.de/eng/sfProdukte.htm
Ultratec Special Effects, Inc. - http://www.ultratecfx.com/

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