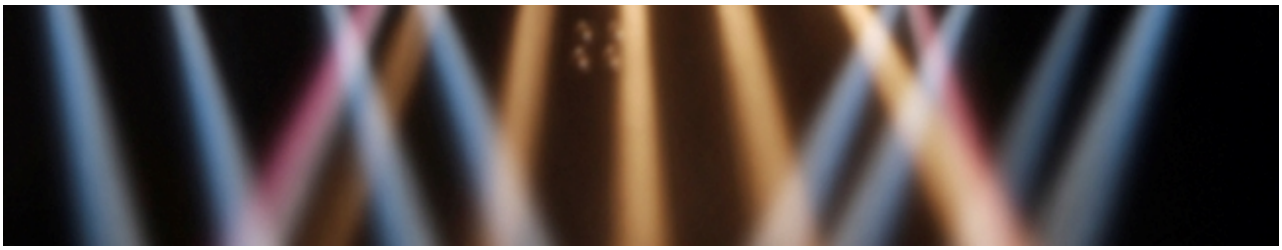

Calibration Factors
For Use of Theatrical Haze Equipment

Jem Compact Hazer Pro with Jem C+ Fluid
Jem Hazer Pro with Jem C+ Fluid
Jem Ready 365 with R365 Haze Fluid

Prepared for:
Martin Manufacturing (UK) Ltd
Belvoir Way
Fairfield Ind. Est. Louth
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Prepared by:
ENVIRON International Corporation
Westford, Massachusetts

Date:
January 2015

Project Number:
08-10829C

ENVIRON

Contents

1 Introduction

In 1997-99, at the request of Actors' Equity Association (AEA) and the League of American Theaters and Producers (LATP) and with the support of the Equity-League Pension and Health Trust Funds, investigators from the Mount Sinai School of Medicine (Mt. Sinai) and ENVIRON International Corporation (ENVIRON) conducted a study to evaluate whether the use of smoke, fog, haze, and pyrotechnics special effects in theatrical musical productions is associated with a negative health impact in actors. This effort was initiated in response to ongoing concerns by actors that the use of these theatrical effects may have an impact on their health. The results of this study were presented in the report *Health Effects Evaluation of Theatrical Smoke, Haze, and Pyrotechnics* (Mt. Sinai and ENVIRON 2000).

The results of the Mt. Sinai/ENVIRON study indicate that there are certain health effects associated with actors exposed to elevated or peak levels of glycol smoke/fog and mineral oil. However, as long as peak exposures are avoided, actors' health, vocal abilities, and careers should not be harmed. Pyrotechnics as used on Broadway at the time of the study did not have an observable effect on actors' health.

Mt. Sinai and ENVIRON recommended the following peak guidance levels with respect to glycols and mineral oil:

- The use of glycols should be such that an actor's exposure does not exceed **40 milligrams per cubic meter (mg/m^3)**.
- Mineral oil should be used in a manner such that an actor's exposure does not exceed a peak concentration of **25 mg/m^3**.
- For chronic exposures to mineral oil, the existing standards established for oil mists (**5 mg/m^3** as an eight-hour time-weighted average) should also be protective for actors in theatrical productions.

Comparable guidance levels were developed for glycerol in a subsequent study (ENVIRON 2001b):

- Glycerol should be used in a manner such that an actor's exposure does not exceed a peak concentration of **50 mg/m^3**.
- For chronic exposures to glycerol, the existing standards established for glycerin mists (**10 mg/m^3** as an eight-hour TWA) should also be protective for actors in theatrical productions.

To ensure that peak smoke, fog, and haze levels are below these guidelines, one option available to productions is to conduct show-specific testing at their theatres using an aerosol monitor. In order to conduct this testing, calibration data must be developed for each equipment/fluid combination. These calibration data are necessary to convert the readings of the aerosol monitor to glycol, mineral oil, or glycerol concentrations. A compilation of calibration factors approved for use in evaluating compliance with the peak guidance levels is provided on the Actors Equity web site (http://www.actorsequity.org/library/library.asp?cat=33).

ENVIRON was retained by Martin Manufacturing (UK) Ltd (Martin) to develop calibration factors for the following equipment-fluid combinations:

- Jem Compact Hazer Pro with Jem C+ Fluid (glycol)
- Jem Hazer Pro with Jem C+ Fluid (glycol)
- Jem Ready 365 with R365 Haze Fluid (glycol and glycerol)

Jem Compact Hazer Pro

Jem Hazer Pro

Jem Ready 365

2 Testing Methodology

2.1 Sampling Equipment and Materials

Monitoring of short-term concentrations was performed using portable real-time aerosol monitors (*personal* DataRAM Model PDR-1000) manufactured by Thermo Scientific. The PDR-1000 is a high sensitivity (i.e., photometric) monitor that uses a light scattering sensing chamber to measure the concentration of airborne particulate matter (liquid or solid), providing a direct and continuous readout as well as electronic logging of the data.

The PDR-1000 aerosol monitors as obtained are calibrated to Arizona road dust over a measurement range of 0.001 to 400 mg/m^3. In order to be utilized to measure short-term glycerol concentrations, the monitors were first calibrated for the smoke or haze machines and fluids being used where possible. Calibration of the aerosol monitors was conducted by collecting simultaneous measurements with a series of sampling pumps and PDR-1000 aerosol monitors, mounted on tripods.

For developing the calibration factors, Gilian BDX-II sampling pumps were used to draw air through collection media. The calibration sampling was conducted in conjunction with operating the PDR-1000 aerosol monitor.

For fluids containing glycols, OSHA Versatile Sampler (OVS) traps were used as the collection media, each containing two sections of XAD-7 resin (200-mg front section, 100-mg back section, separated by a polyurethane foam [PUF] plug). The XAD-7 resin was used to collect both the particulate and vapor phase of the glycol aerosol. A 13-mm glass fiber filter (GFF) plug precedes the front section and a PUF plug follows the back section. This sampling is based on a variation of NIOSH Method 5523 (NIOSH 1996; Pendergrass 1999). Bulk fluid samples are also collected and submitted for laboratory analysis to determine which species of glycols are present.

For fluids containing glycerols, air samples were collected on 37 mm 2-piece cassettes containing tared 5µm polyvinyl chloride (PVC) filters. The sampling method is based on NIOSH Method 0500.

For fluids containing glycols and glycerols, both OVS traps for glycols and cassettes for glycerols were collected and submitted for laboratory analysis.

The testing was performed at a rented film studio in Canton, Massachusetts.

2.2 Aerosol Monitor Calibration Procedure

A series of tripod assemblies was used for calibrating the aerosol monitors, each consisting of a sampling pump, flexible tubing, sampling media, and an aerosol monitor. The height of the tripod was approximately five feet, corresponding with the breathing zone of a typical actor. The room ventilation fans were turned off during each run; no major movement occurred in the testing room during each run that would affect haze dispersion.

a. The sampling pumps were calibrated to 2 liters per minute (LPM) (OVS traps) or 3 LPM (cassettes) using a BIOS Defender pump calibrator. The aerosol monitor was zeroed, the data logging function of the aerosol monitor was turned on, and the data logging time for the aerosol monitors were synchronized.

b. The haze machines were positioned on a table to allow a release of haze at a height of four feet. The tripods were placed at various distances from the haze machine release nozzle to achieve a range of exposure concentrations.

c. The sampling pumps were turned on, followed by the haze machines, allowing sustained fog generation to occur. After a period of approximately eight to sixteen minutes, the machines and pumps were simultaneously turned off.

d. The sampling media were capped and labeled to identify the type of haze machine and fluid, sampling location, and other sampling specifics. After being capped and labeled, OVS traps were placed in a freezer.

e. Various fans and ceiling vents were used between runs to clear residual aerosols from the testing area air by room ventilation.

Figure 1. Configuration for calibration factor procedure, consisting of the tripod assemblies with sampling pumps, OVS tubes for sampling glycols, and aerosol monitors.

The collection media and bulk fluid samples, along with appropriate field blanks, were submitted for analysis to Analytics Laboratory of Richmond, Virginia, an American Industrial Hygiene Association (AIHA) accredited laboratory.

2.3 Laboratory Analysis

All sample analyses were conducted by using validated analytical methodologies, as described in the ENVIRON Air Sampling Protocol (ENVIRON 2001a).

Samples were analyzed for glycols using a variation of NIOSH Method 5523, which involves the use of a gas chromatograph with a flame ionization detector (GC/FID). The NIOSH Method 5523 was extended to a validated level of quantification (LOQ) of 5.0 to 15.0 micrograms (μg) of each individual glycol per sample.

Samples were analyzed gravimetrically for glycerols using NIOSH Method 0500. A LOQ of 10 μg per sample was used.

3 Results and Discussion

3.1 Aerosol Monitor Calibration

Total glycol concentrations were calculated from the analytical data for the Jem Compact Hazer Pro with Jem C+ Fluid, the Jem Hazer Pro with Jem C+ Fluid. Total glycol and glycerol concentrations were calculated from the analytical data from the Jem Ready 365 with R365 Haze Fluid. For glycol species that were measured in the bulk solution, and were detected in the air sample but not above the LOQ, one half of the LOQ for that glycol species was conservatively used in calculating the total glycol concentration. To develop a calibration curve for each fluid, the average aerosol monitor readings during the period of time in which air was drawn through the sampling media for each air sample were calculated and plotted against the total glycol or glycerol concentration data.

For determining the calibration factor for any fluid containing two or more distinct chemical constituents, the calibration factors are initially determined for each constituent, and the most conservative calibration factor must be used when conducting time and distance testing or show-specific testing for the fluid as a whole. A calibration factor for an individual constituent in a fluid may be used for time and distance testing only when that constituent is the only chemical of concern.

The calibration curves for the three equipment-fluid combination tested are shown in Figures 2 through 5. First order regression curves are also shown on these figures. The calibration factors, calculated from the slope of the regression, are summarized in Table 1.

Table 1: Summary of Calibration Factors

Manufacturer	Machine	Fluid	Fluid Type	Calibration Factor
Martin	Jem Compact Hazer Pro	Jem C+ Fluid	Glycol	0.70
Martin	Jem Hazer Pro	Jem C+ Fluid	Glycol	0.88
Martin	Jem Ready 365	R365 Haze Fluid	Glycol & Glycerol (overall formula)	0.24
Martin	Jem Ready 365	R365 Haze Fluid	Glycol only	0.03
Martin	Jem Ready 365	R365 Haze Fluid	Glycerol only	0.24

3.2 Use of Calibration Factors

The real-time aerosol monitor readings can be converted to glycol concentrations using the appropriate calibration factor for the fluid, as follows:

$$CONC = C \times PDR$$

where:

CONC = air concentration of total glycols or glycerols, mg/m^3

C = aerosol monitor calibration factor $(mg/m^3)/ (mg/m^3$ aerosol)

PDR = aerosol monitor reading, mg/m^3 aerosol

For example, an uncalibrated reading of 100 mg/m^3 on the aerosol monitor would correspond to a glycerol concentration of 70 mg/m^3 for the Jem Compact Hazer Pro/Jem C+ Fluid combination. These calculated concentrations can then be compared with the peak guidance levels. The peak guidance level for glycols of 40 mg/m^3 would correspond to an uncalibrated aerosol monitor reading of 57.1 mg/m^3 for the Jem Compact Hazer Pro/Jem C+ Fluid combination.

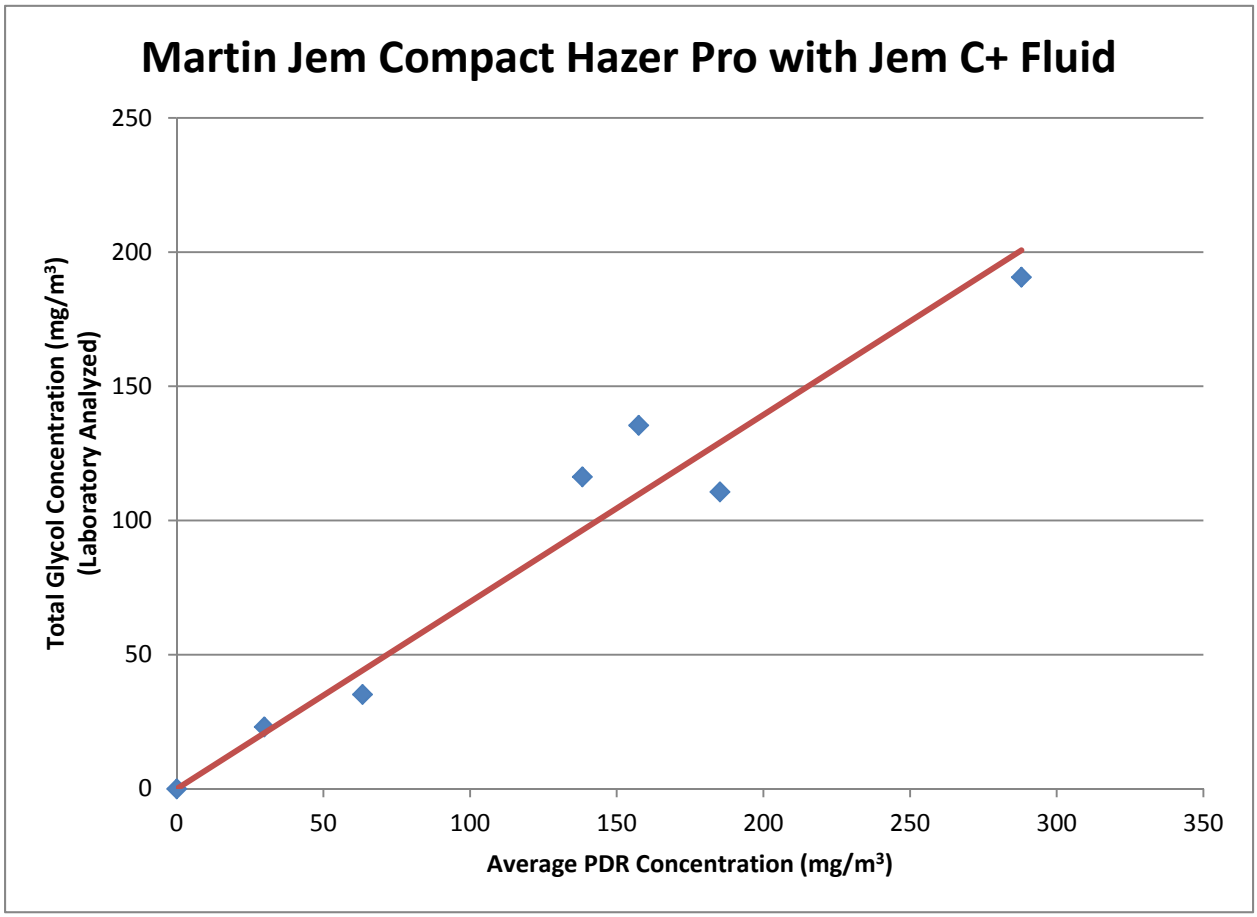


Figure 2. Calibration curve for Jem C+ Fluid in the Jem Compact Hazer Pro. Calibration factor, based on slope of curve, is 0.70 $(mg/m^3$ glycol)/ $(mg/m^3$ aerosol).

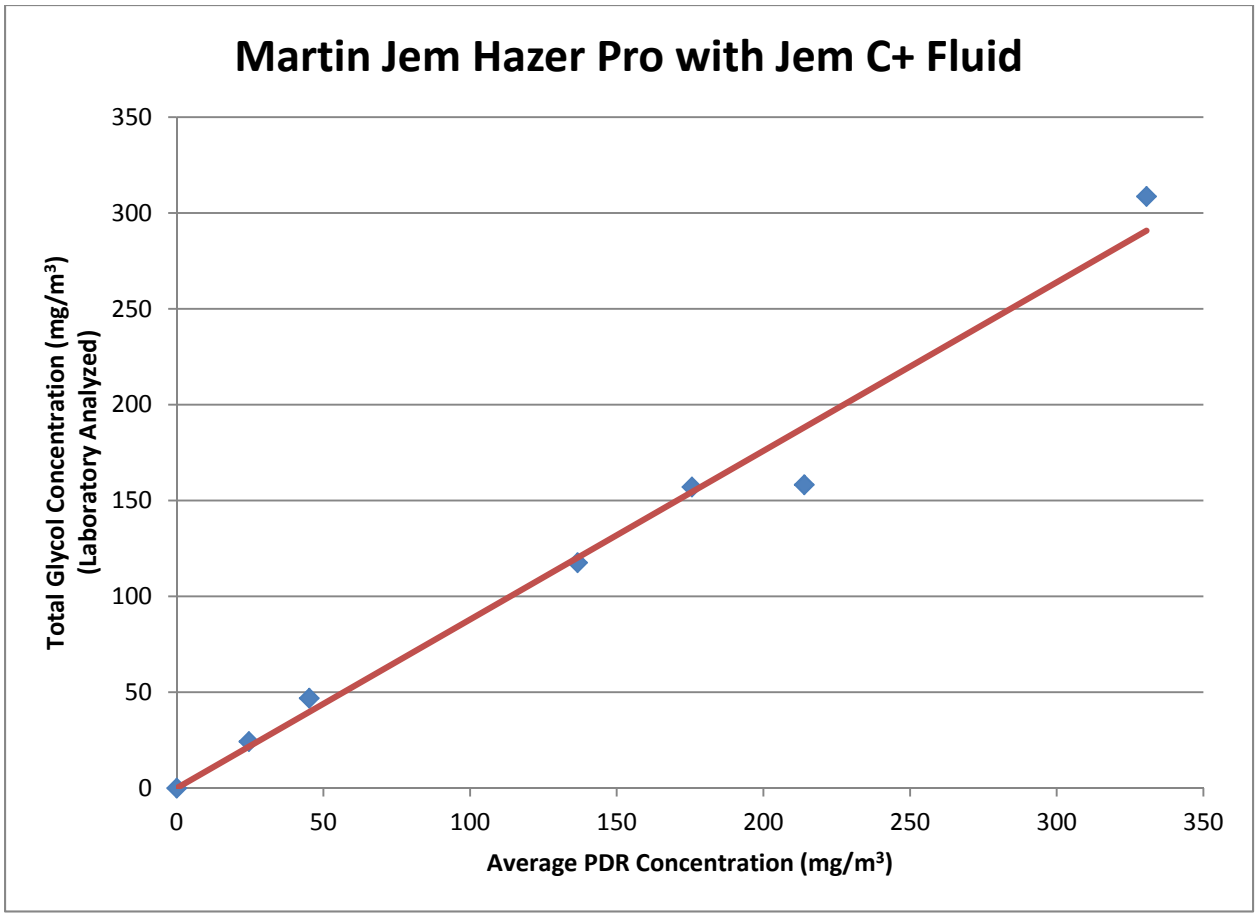
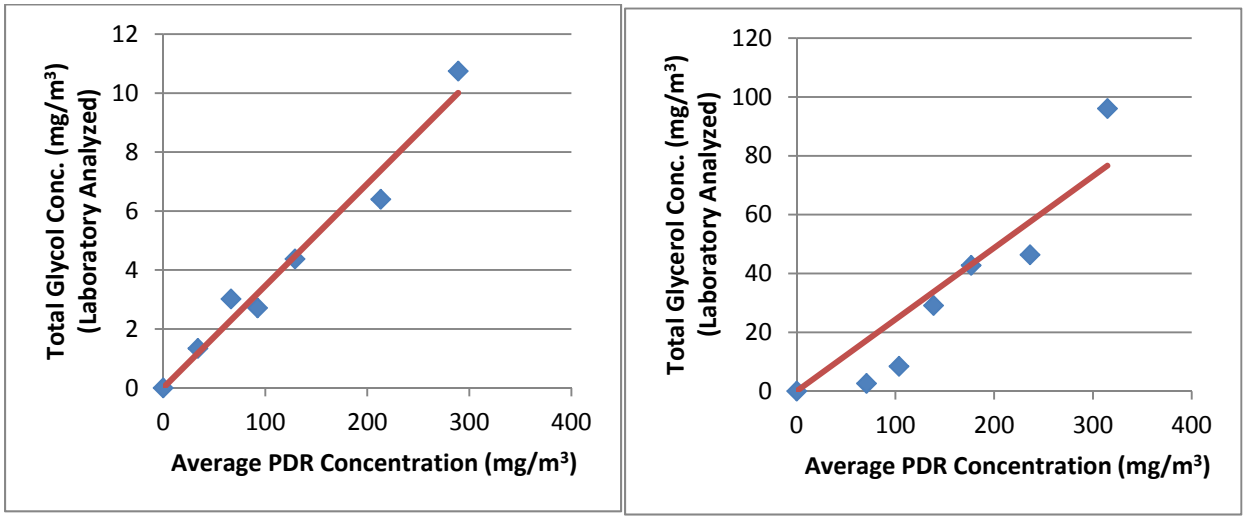


Figure 3. Calibration curve for Jem C+ Fluid in the Jem Hazer Pro. Calibration factor, based on slope of curve, is 0.88 (mg/m^3 glycol)/ (mg/m^3 aerosol).



Figures 4a and 4b. Calibration curve for Jem Ready 365 with R365 Haze Fluid, based on glycol (left graph) and glycerol (right graph) laboratory data. Calibration factors, based on slope of curve, are 0.03 (mg/m^3 glycol) / (mg/m^3 aerosol) and 0.24 (mg/m^3 glycerol) / (mg/m^3 aerosol).

4 References

ENVIRON International Corporation (ENVIRON). 2001a. Evaluation of short-term exposures to theatrical smoke and haze: Air sampling protocol. Prepared for Equity-League Pension and Health Trust Funds. May 14.

ENVIRON International Corporation (ENVIRON). 2001b. Theatrical Haze and Fog Testing for Mamma Mia!, Winter Garden Theatre. Prepared for Mamma Mia! Broadway and Nina Lannan Associates. November 12.

Mount Sinai School of Medicine and ENVIRON International Corporation (Mt. Sinai and ENVIRON). 2000. Health effects evaluation of theatrical smoke, haze, and pyrotechnics. Prepared for Equity-League Pension and Health Trust Funds. June 6.

National Institute for Occupational Safety and Health (NIOSH). 1996. Method 5523: Glycols, Issue 1. NIOSH Manual of Analytical Methods (NMAM). Fourth Edition. May 15.

Pendergrass, S.M. 1999. Determination of glycols in air: Development of sampling and analytical methodology and application to theatrical smokes. AIHA Journal, 60:452-457.

Appendix A:
Safety Data Sheets

SAFETY DATA SHEET

MARTIN SMOKE & HAZE FLUID

1. Identification of the Substance/Mixture & Of The Company/Undertaking

1.1. Product Identifier:

Name (Synonyms): Pro Smoke Super Fluid (ZR Fluid)
Pro Smoke Studio Fluid (DX Fluid)
Pro Smoke High Density Fluid (SP Fluid)
Pro Steam Simulation Fluid (Pro Steam Fluid)
Regular DJ Fluid (DJ Fluid)
i-Fog Fluid (i-Fog Fluid)
Pro Haze Fluid (Pro-Haze Fluid)
Heavy Fog A1 Fluid (A1 Fluid)
Heavy Fog B2 Fluid (B2 Fluid)
Heavy Fog C3 Fluid (C3 Fluid)
K1 Haze Fluid (K1 Fluid)
C-Plus Haze Fluid (C-Plus Fluid)
Pro Clean Supreme Fluid (Pro Clean Fluid)

1.2. Relevant Identified Uses Of The Substance Or Mixture And Uses Advised Against:

Fluid mixture for use in the creation of smoke or haze effects using a dedicated JEM or Martin brand smoke or haze machine.

1.3. Details Of The Supplier Of The Safety Data Sheet:

Martin Manufacturing (UK) Plc.
Belvoir Way,
Fairfield Industrial Estate,
Louth,
Lincolnshire,
LN11 0LQ
UK
Tel: +44 (0) 1507 604399
Fax: +44 (0) 1507 601956
Email: jem-service@martin.dk

1.4. Emergency Telephone Number:

+45 87 40 00 00 (24Hr)

2. Hazards Identification:

2.1. Classification Of The Substance Or Mixture:

This substance does not meet the criteria for classification in accordance with Regulation (EC) No 1272/2008.
No risk or safety phrases stipulated.

2.2. Label Elements:

Label Name: Pro Smoke Super Fluid (ZR Fluid)
Pro Smoke Studio Fluid (DX Fluid)
Pro Smoke High Density Fluid (SP Fluid)
Pro Steam Simulation Fluid (Pro Steam Fluid)
Regular DJ Fluid (DJ Fluid)
i-Fog Fluid (i-Fog Fluid)
Pro Haze Fluid (Pro-Haze Fluid)
Heavy Fog A1 Fluid (A1 Fluid)
Heavy Fog B2 Fluid (B2 Fluid)
Heavy Fog C3 Fluid (C3 Fluid)
K1 Haze Fluid (K1 Fluid)
C-Plus Haze Fluid (C-Plus Fluid)
Pro Clean Supreme Fluid (Pro Clean Fluid)

No other elements are needed in accordance with Article 25 and Article 32(6) of Regulation (EC) No 1272/2008.

2.3. Other Hazards:

This mixture is for the production of synthetic smoke in an appropriate JEM or Martin brand smoke machine only.

Ingestion	Very low toxicity
Eye/skin	Very low toxicity
Inhalation	Low concentration of hazardous substances in vapour. Undiluted vapour should not be inhaled. (Note: The concentration of smoke components in the final product is below the OES under normal operating conditions)

3. Composition/Information On Ingredients

3.1. Substances:

Food/High Grade glycols:
Monopropylene Glycol: CAS Registry Number: 57-55-6
Triethylene Glycol: CAS Registry Number: 112-27-6

De-mineralised water.

Contains no substances stated in the Globally Harmonised System of Classification and Labelling of Chemicals.

Contains monopropylene glycol, for which a community workplace exposure limit has been set.

3.2. Mixtures:

The largest single component of this product is de-mineralised water.
Other ingredients: 5% - 40%

4. First Aid Measures

4.1. Description Of First Aid Measures:

Exposure Route	Symptom	Treatment
Inhalation	Mild irritation of nose & throat	Remove from exposure, rest and keep warm. In severe cases, or if recovery is not rapid or complete, seek medical attention
Skin Contact	Mild irritation	Drench the skin with plenty of water. Remove contaminated clothing and wash before re-use. If large areas of the skin are damaged or if irritation persists seek medical attention
Eye Contact	Mild irritation	Irrigate thoroughly with water for at least 10 minutes. Obtain medical attention
Ingestion	Mild irritation of gastro-intestinal tract	Wash out mouth with water. Do not induce vomiting. If patient is conscious, give water to drink. If patient feels unwell seek medical attention

4.2. Most Important Symptoms And Effects, Both Acute And Delayed:

Mild irritation of nose & throat

Remove from exposure, rest and keep warm.
In severe cases, or if recovery is not rapid or complete, seek medical attention.

4.3. Indication Of Any Immediate Medical Attention And Special Treatment Needed:

None stated.

5. Fire Fighting Measures

5.1. Extinguishing Media:

Suitable Extinguishers:
Alcohol-resistant or all-purpose-type foam.
Use carbon dioxide or dry powder for small fires only.

Unsuitable Extinguishers:
Do not direct a solid stream of water or foam into hot burning pools; as this may cause frothing and increase the intensity of a fire.

5.2. Special Hazards Arising From The Substance Or Mixture:

Hazardous Combustion Product
Oxides of carbon including aldehydes.

5.3. Advice For Firefighters:

Special equipment for fire fighting:
Self-contained breathing apparatus.

6. Accidental Release Measures

6.1. Personal Precautions, Protective Equipment And Emergency Procedures:

Wear appropriate PPE when handling - see section 8.2.

6.2. Environmental Precautions:

Prevent entry into drains and water courses.

6.3. Methods And Material For Containment And Cleaning Up:

Cover drains to prevent entry into water courses.
Bund or absorb material with sand, earth or other suitable absorbent material.
If possible, transfer to a salvage tank, otherwise absorb residues and place in suitable labelled containers and hold for waste disposal.

6.4. Reference To Other Sections:

See section 13 for disposal procedures.

7. Handling and Storage

7.1. Precautions For Safe Handling:

Avoid prolonged skin contact.
Avoid contact with eyes.
Avoid spills.
Ensure good general ventilation of area.
Avoid creating spray.
Do not breathe undiluted vapour.

7.2. Conditions For Safe Storage, Including Any Incompatibilities:

Store in original closed containers.
Store at ambient temperature.
Store away from materials listed in section 10.

7.3. Specific End Use(s):

Only for use in a designated smoke machine for the production of smoke as a special effect.

8. Exposure Controls/Personal Protection

8.1. Control Parameters:

8.1.3. Exposure Limit Values

Does not exceed 10mg/m³ for particulate suspension and 474mg/m³ for total vapour plus particulates.

OES for monopropylene glycol set at 150 ppm (total vapour and particulates) for 8-hour TWA, and 10 mg/m3 (particulates) for 15-minute STEL.

Norway - Substance with CAS number 57-55-6 has Norwegian exposure limits of: 25 ppm and 79 mg/m³

8.2. Exposure Controls:

Recommended PPE:

Respiratory	None needed under normal handling conditions
Hand	None needed under normal handling conditions
Eye	None needed under normal handling conditions
Skin	Overalls and boots
Hygiene	Always wash thoroughly after handling chemicals

9. Physical and Chemical Properties

9.1. Information On Basic Physical And Chemical Properties:

Appearance: Colourless liquid
Odour: Mild
Odour threshold: No data available to us
pH: Neutral
Melting point/range: < -20°C
Boiling point/range: 101.6 - 201.6°C
Flash point: > 78 °C (test flame extinguished at 78°C)
Evaporation rate: 0.003
Flammability: No data available to us
Flammability limits: 2.9 - 18.1 v/v (estimated)
Vapour pressure: 2.67 kPa at 20°C
Vapour density: 3.9
Relative density: 1.050 at 20 °C/20°C
Solubility: Completely miscible in water
Partition coefficient: n-octanol/water: No data available to us
Auto-ignition temperature: No data available to us
Decomposition temperature: No data available to us
Viscosity: No data available to us
Explosive properties: No data available to us
Oxidising properties: No data available to us

9.2. Other Information:

No data available to us.

10. Stability and Reactivity

10.1. Reactivity:

No data available to us.

10.2. Chemical Stability:

Stable in normal conditions.

10.3. Possibility Of Hazardous Reactions:

Possibility of explosive decomposition if combined with strong acids or bases at elevated temperatures.

10.4. Conditions To Avoid:

Elevated temperatures.

10.5. Incompatible Materials:

Strong acids and bases; strong oxidisers.

10.6. Hazardous decomposition products:

Oxides of carbon, including aldehydes.

11. Toxicological Information

11.1. Information On Toxicological Effects:

LD50 for monopropylene glycol:
21000 - 33700 mg/kg oral - rat, >10000 mg/kg skin - rabbit.

May cause slight irritation to skin, eyes and mucous membranes.
Large doses may produce adverse effects on liver, kidneys and central nervous system.
No evidence in developmental toxicity studies for either embryotoxic or teratogenic effects.

12. Ecological Information

12.1. Toxicity:

Short and long-term effects
LC50, fathead minnow = 4600 - 54900 mg/l
EC50, Daphnia magna = 4850 - 34400 mg/l

12.2. Persistence And Degradability:

The preparation is largely biodegradable:
BOD5 = 1.08 gO2/g; ThOD = 1.68 gO2/g; COD = 1.63 gO2/g
BOD20/ThOD = 86%

12.3. Bioaccumulative Potential:

Low.

12.4. Mobility In Soil:

Liquid with low volatility, soluble in water, predicted to have high mobility in soil.

12.5. Results Of PBT And vPvB Assessment:

No data available to us.

12.6. Other Adverse Effects:

13. Disposal Considerations

13.1. Waste Treatment Methods:

a. Substance:
Via an authorised waste disposal contractor to an approved waste disposal site, observing all local and national regulations.

b. Container:
As for substance. Used containers must not be cut up or punctured until completely purged of product residues.

14. Transport Information

No special precautions for transport

14.1. UN Number:

No data available to us.

14.2. UN Proper Shipping Name:

No data available to us.

14.3. Transport Hazard Class:

No data available to us.

14.4. Packing Group:

No data available to us.

14.5. Environmental Hazards:

No data available to us.

14.6. Special Precautions For User:

No data available to us.

14.7. Transport In Bulk According To Annex II Of MARPOL73/78 And The IBC Code:

No data available to us.

15. Regulatory Information

15.1. Safety, Health And Environmental Regulations/Legislation Specific For The Substance Or Mixture:

Symbol: No risk or safety phrases stipulated
Risk phrases: No risk or safety phrases stipulated
Safety phrases: No risk or safety phrases stipulated
E.E.C. Number: No risk or safety phrases stipulated

Use of this material may be governed by the following regulations:
EU Regulation 453/2010
Users are advised to consult these regulations for further information.

15.2. Chemical Safety Assessment:

No data available to us.

16. Other Information

The information contained in this data sheet does not constitute an assessment of workplace risk as required by other health and safety legislation.

No special training is required for handling this preparation other than normal precautions for safe handling of chemicals

This material is usually used for the production of synthetic smoke or haze in an appropriate JEM or Martin brand smoke or haze machine.

The concentration of smoke components is below the OES under normal operating conditions.

It must not be used for any other purpose, or in any other equipment

Further details may be available on request from the supplier, whose address, telephone number and email address are given in section 1.

Sources of information:

1. Suppliers' Safety Data Sheets for substances used as raw materials in the preparation.
2. EH 40/97
3. NFPA 325M

Legal Disclaimer:

Although we always attempt to make our information as accurate, current, and complete as possible, the information herein is provided "as is" without any express or implied warranty of any kind. As such we disclaim liability for any inaccuracy, non-currency or incompleteness of any individual item herein and the inability to fulfil any purpose contemplated

We disclaim liability for any injury, damage, direct or indirect loss, consequential or economic loss or any other loss occasioned by any use of, the product not in conformity with the instructions herein.

If you have purchased the product for supply to a third party, it is your duty to take all necessary steps to ensure that any person handling and using the product is provided with the information in this sheet. If you are an employer it is your duty to tell your employees and others who may be affected by any hazard described in this sheet and of any precautions that should be taken. We disclaim liability for any injury, damage, direct or indirect loss, consequential or economic loss or any other loss occasioned by you by any non-compliance with this instruction

Any further information needed please contact: Email: jem-service@martin.dk

SAFETY DATA SHEET

MARTIN READY 365 HAZE FLUID

1. Identification of the Substance/Mixture & Of The Company/Undertaking

1.1. Product Identifier:

Name (Synonyms): Ready 365 haze Fluid (R365 Haze Fluid)

1.2. Relevant Identified Uses Of The Substance Or Mixture And Uses Advised Against:

Fluid mixture for use in the creation of haze effects using a dedicated JEM Ready 365 brand haze machine.

1.3. Details Of The Supplier Of The Safety Data Sheet:

Martin Manufacturing (UK) Plc.
Belvoir Way,
Fairfield Industrial Estate,
Louth,
Lincolnshire,
LN11 0LQ
UK
Tel: +44 (0) 1507 604399
Fax: +44 (0) 1507 601956
Email: jem-service@martin.dk

1.4. Emergency Telephone Number:

+45 87 40 00 00 (24Hr)

2. Hazards Identification:

2.1. Classification Of The Substance Or Mixture:

This substance does not meet the criteria for classification in accordance with Regulation (EC) No 1272/2008.
No risk or safety phrases stipulated.

2.2. Label Elements:

Label Name: Ready 365 Haze Fluid (R365 Haze Fluid)

No other elements are needed in accordance with Article 25 and Article 32(6) of Regulation (EC) No 1272/2008.

2.3. Other Hazards:

This mixture is for the production of synthetic smoke in an appropriate JEM Ready 365 brand haze machine only.

Ingestion	Very low toxicity
Eye/skin	Very low toxicity
Inhalation	Low concentration of hazardous substances in vapour. Undiluted vapour should not be inhaled. (Note: The concentration of smoke components in the final product is below the OES under normal operating conditions)

3. Composition/Information On Ingredients

3.1. Substances:

Food Grade Glycerol:
Glycerol: CAS Registry Number: 56-81-5

Food/High Grade Glycols:
Monopropylene Glycol: CAS Registry Number: 57-55-6

De-mineralised water.

Contains no substances stated in the Globally Harmonised System of Classification and Labelling of Chemicals.

Contains monopropylene glycol, for which a community workplace exposure limit has been set.

3.2. Mixtures:

The largest single component of this product is Glycerol.
Other ingredients: 5% - 40%

4. First Aid Measures

4.1. Description Of First Aid Measures:

Exposure Route	Symptom	Treatment
Inhalation	Mild irritation of nose & throat	Remove from exposure, rest and keep warm. In severe cases, or if recovery is not rapid or complete, seek medical attention
Skin Contact	Mild irritation	Drench the skin with plenty of water. Remove contaminated clothing and wash before re-use. If large areas of the skin are damaged or if irritation persists seek medical attention
Eye Contact	Mild irritation	Irrigate thoroughly with water for at least 10 minutes. Obtain medical attention
Ingestion	Mild irritation of gastro-intestinal tract	Wash out mouth with water. Do not induce vomiting. If patient is conscious, give water to drink. If patient feels unwell seek medical attention

4.2. Most Important Symptoms And Effects, Both Acute And Delayed:

Mild irritation of nose & throat

Remove from exposure, rest and keep warm.

In severe cases, or if recovery is not rapid or complete, seek medical attention.

4.3. Indication Of Any Immediate Medical Attention And Special Treatment Needed:

None stated.

5. Fire Fighting Measures

5.1. Extinguishing Media:

Suitable Extinguishers:
Alcohol-resistant or all-purpose-type foam.
Use carbon dioxide or dry powder for small fires only.

Unsuitable Extinguishers:
Do not direct a solid stream of water or foam into hot burning pools; as this may cause frothing and increase the intensity of a fire.

5.2. Special Hazards Arising From The Substance Or Mixture:

Hazardous Combustion Product
Oxides of carbon including aldehydes.

5.3. Advice For Firefighters:

Special equipment for fire fighting:
Self-contained breathing apparatus.

6. Accidental Release Measures

6.1. Personal Precautions, Protective Equipment And Emergency Procedures:

Wear appropriate PPE when handling - see section 8.2.

6.2. Environmental Precautions:

Prevent entry into drains and water courses.

6.3. Methods And Material For Containment And Cleaning Up:

Cover drains to prevent entry into water courses.
Bund or absorb material with sand, earth or other suitable absorbent material.
If possible, transfer to a salvage tank, otherwise absorb residues and place in suitable labelled containers and hold for waste disposal.

6.4. Reference To Other Sections:

See section 13 for disposal procedures.

7. Handling and Storage

7.1. Precautions For Safe Handling:

Avoid prolonged skin contact.
Avoid contact with eyes.
Avoid spills.
Ensure good general ventilation of area.

Avoid creating spray.
Do not breathe undiluted vapour.

7.2. Conditions For Safe Storage, Including Any Incompatibilities:

Store in original closed containers.
Store at ambient temperature.
Store away from materials listed in section 10.

7.3. Specific End Use(s):

Only for use in a designated haze machine for the production of haze as a special effect.

8. Exposure Controls/Personal Protection

8.1. Control Parameters:

8.1.3. Exposure Limit Values

Does not exceed 10mg/m³ for particulate suspension and 474mg/m³ for total vapour plus particulates.

OES for monopropylene glycol set at 150 ppm (total vapour and particulates) for 8-hour TWA, and 10 mg/m3 (particulates) for 15-minute STEL.

Norway - Substance with CAS number 57-55-6 has Norwegian exposure limits of: 25 ppm and 79 mg/m³

8.2. Exposure Controls:

Recommended PPE:

Respiratory	None needed under normal handling conditions
Hand	None needed under normal handling conditions
Eye	None needed under normal handling conditions
Skin	Overalls and boots
Hygiene	Always wash thoroughly after handling chemicals

9. Physical and Chemical Properties

9.1. Information On Basic Physical And Chemical Properties:

Appearance:	Colourless liquid
Odour:	Mild
Odour threshold:	No data available to us
pH:	Neutral
Melting point/range:	No data available to us
Boiling point/range:	No data available to us
Flash point:	~ 175°C
Evaporation rate:	No data available to us
Flammability:	No data available to us

Flammability limits:	2.9 - 18.1 v/v (estimated)
Vapour pressure:	<0.01 hPa at 20°C
Vapour density:	3.17
Relative density:	1.26g/ml at 20 °C
Solubility:	Completely miscible in water
Partition coefficient: n-octanol/water:	No data available to us
Auto-ignition temperature:	370°C
Decomposition temperature:	No data available to us
Viscosity:	No data available to us
Explosive properties:	No data available to us
Oxidising properties:	No data available to us

9.2. Other Information:

No data available to us.

10. Stability and Reactivity

10.1. Reactivity:

No data available to us.

10.2. Chemical Stability:

Stable in normal conditions.

10.3. Possibility Of Hazardous Reactions:

Possibility of explosive decomposition if combined with strong acids or bases at elevated temperatures.

10.4. Conditions To Avoid:

Elevated temperatures.

10.5. Incompatible Materials:

Strong acids and bases; strong oxidisers.

10.6. Hazardous decomposition products:

Oxides of carbon, including aldehydes.

11. Toxicological Information

11.1. Information On Toxicological Effects:

LD50 for monopropylene glycol:
21000 - 33700 mg/kg oral - rat, >10000 mg/kg skin - rabbit.

May cause slight irritation to skin, eyes and mucous membranes.
Large doses may produce adverse effects on liver, kidneys and central nervous system.

No evidence in developmental toxicity studies for either embryotoxic or teratogenic effects.

12. Ecological Information

12.1. Toxicity:

Short and long-term effects
LC50, fathead minnow = 4600 - 54900 mg/l
EC50, Daphnia magna = 4850 - 34400 mg/l

12.2. Persistence And Degradability:

The preparation is largely biodegradable:
BOD5 = 1.08 gO2/g; ThOD = 1.68 gO2/g; COD = 1.63 gO2/g
BOD20/ThOD = 86%

12.3. Bioaccumulative Potential:

Low.

12.4. Mobility In Soil:

Liquid with low volatility, soluble in water, predicted to have high mobility in soil.

12.5. Results Of PBT And vPvB Assessment:

No data available to us.

12.6. Other Adverse Effects:

13. Disposal Considerations

13.1. Waste Treatment Methods:

a. Substance:
Via an authorised waste disposal contractor to an approved waste disposal site, observing all local and national regulations.

b. Container:
As for substance. Used containers must not be cut up or punctured until completely purged of product residues.

14. Transport Information

No special precautions for transport

14.1. UN Number:

No data available to us.

14.2. UN Proper Shipping Name:

No data available to us.

14.3. Transport Hazard Class:

No data available to us.

14.4. Packing Group:

No data available to us.

14.5. Environmental Hazards:

No data available to us.

14.6. Special Precautions For User:

No data available to us.

14.7. Transport In Bulk According To Annex II Of MARPOL73/78 And The IBC Code:

No data available to us.

15. Regulatory Information

15.1. Safety, Health And Environmental Regulations/Legislation Specific For The Substance Or Mixture:

Symbol: No risk or safety phrases stipulated
Risk phrases: No risk or safety phrases stipulated
Safety phrases: No risk or safety phrases stipulated
E.E.C. Number: No risk or safety phrases stipulated

Use of this material may be governed by the following regulations:
EU Regulation 453/2010
Users are advised to consult these regulations for further information.

15.2. Chemical Safety Assessment:

No data available to us.

16. Other Information

The information contained in this data sheet does not constitute an assessment of workplace risk as required by other health and safety legislation.
No special training is required for handling this preparation other than normal precautions for safe handling of chemicals
This material is usually used for the production of synthetic haze in an appropriate JEM Ready 365 brand haze machine.
The concentration of smoke components is below the OES under normal operating conditions.
It must not be used for any other purpose, or in any other equipment
Further details may be available on request from the supplier, whose address, telephone number and email address are given in section 1.

Sources of information:

1. Suppliers' Safety Data Sheets for substances used as raw materials in the preparation.
2. EH 40/97
3. NFPA 325M

Legal Disclaimer:

Although we always attempt to make our information as accurate, current, and complete as possible, the information herein is provided “as is” without any express or implied warranty of any kind. As such we disclaim liability for any inaccuracy, non-currency or incompleteness of any individual item herein and the inability to fulfil any purpose contemplated
We disclaim liability for any injury, damage, direct or indirect loss, consequential or economic loss or any other loss occasioned by any use of, the product not in conformity with the instructions herein.
If you have purchased the product for supply to a third party, it is your duty to take all necessary steps to ensure that any person handling and using the product is provided with the information in this sheet. If you are an employer it is your duty to tell your employees and others who may be affected by any hazard described in this sheet and of any precautions that should be taken. We disclaim liability for any injury, damage, direct or indirect loss, consequential or economic loss or any other loss occasioned by you by any non-compliance with this instruction

Any further information needed please contact: Email: jem-service@martin.dk

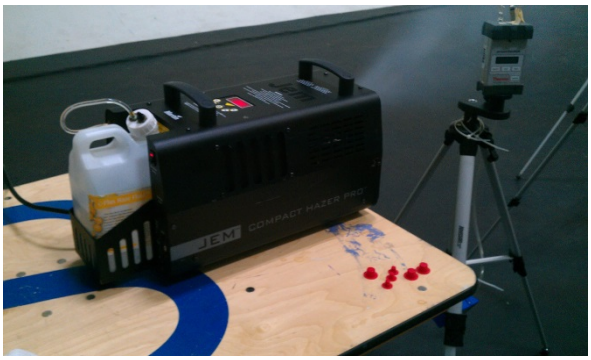
Appendix B:
Machine-Specific Fog Testing Summaries

Calibration Factor

Jem Compact Hazer Pro with Jem C+ Fluid

Prepared for Martin Professional by ENVIRON International Corporation

ENVIRON developed calibration factors for the use of Jem C+ Fluid in a Jem Compact Hazer Pro haze generator.



Jem C+ Fluid is a glycol-based haze fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the Jem Compact Hazer Pro.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

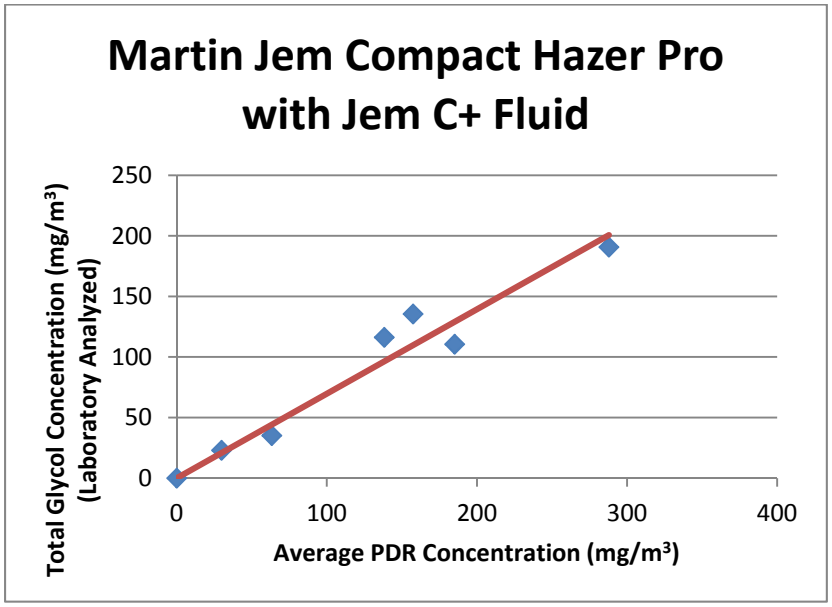


Figure 1. Calibration curve for Jem Compact Hazer Pro with Jem C+ Fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 0.70 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
Martin	Jem Compact Hazer Pro	Jem C+ Fluid	Glycol	0.70

Calibration Factor

Jem Hazer Pro with Jem C+ Fluid

Prepared for Martin Professional by ENVIRON International Corporation

ENVIRON developed calibration factors for the use of Jem C+ Fluid in a Jem Hazer Pro haze generator.

Jem C+ Fluid is a glycol-based haze fluid. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols in the air after being released from the Jem Hazer Pro.

The measured concentrations should be compared against the peak exposure guidance level for glycols, which is 40 mg/m^3.

The calibration curve for glycols is shown below:

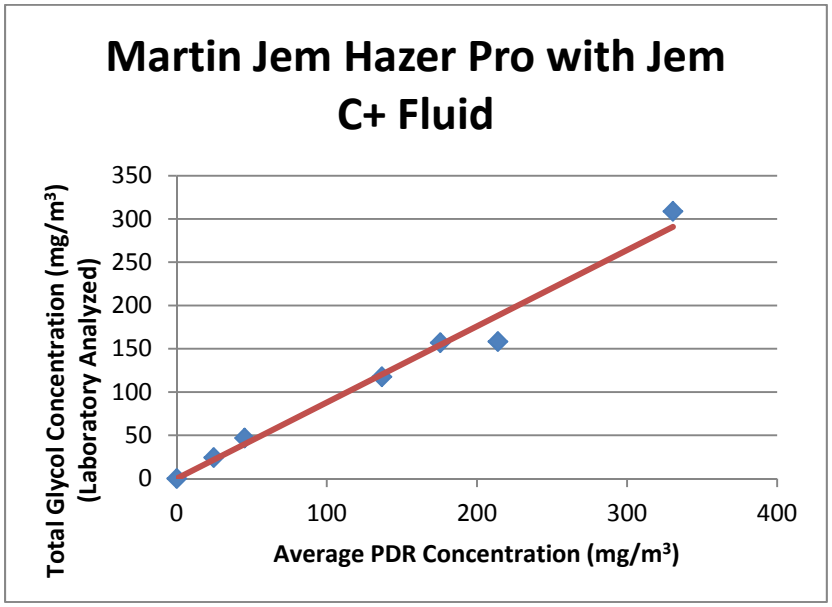


Figure 1. Calibration curve for Jem Hazer Pro with Jem C+ Fluid, based on glycol laboratory data. Calibration factor, based on slope of curve, is 0.88 (mg/m^3 glycol) / (mg/m^3 aerosol).

Summary of Calibration Factor				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
Martin	Jem Hazer Pro	Jem C+ Fluid	Glycol	0.88

Calibration Factor

Jem Ready 365 with R365 Haze Fluid

Prepared for Martin Professional by ENVIRON International Corporation

ENVIRON developed calibration factors for the use of R365 Haze Fluid in a Jem Ready 365 haze generator.

R365 Haze Fluid contains a mixture of glycerol, glycols, and water. Calibration factors were developed to allow a Thermo Scientific PDR-1000 aerosol monitor to be used to measure concentrations glycols and glycerol in the air after being released from the Jem Hazer Pro.

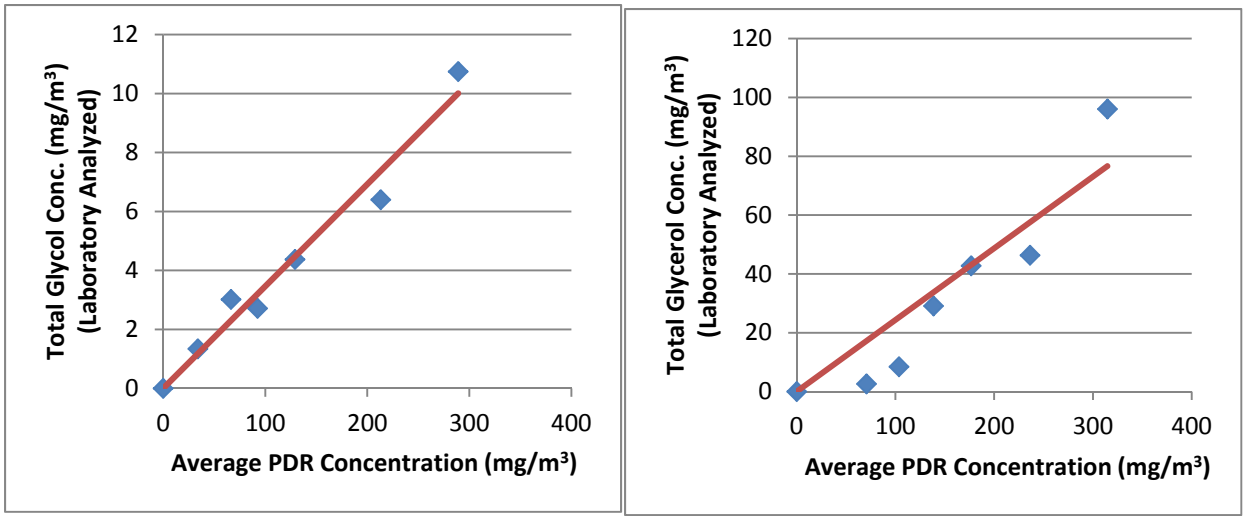
The measured concentrations should be compared against the following peak exposure guidance levels:

- Glycols: 40 mg/m^3
- Glycerol: 50 mg/m^3

Summary of Calibration Factors				
Manufacturer	**Machine**	**Fluid**	**Fluid Type**	**Calibration Factor**
Martin	Jem Ready 365	R365 Haze Fluid	Glycol & Glycerol (overall formula)*	0.24
Martin	Jem Ready 365	R365 Haze Fluid	Glycol only	0.03
Martin	Jem Ready 365	R365 Haze Fluid	Glycerol only	0.24

* For determining the calibration factor for any fluid containing two or more distinct chemical constituents, the calibration factors are initially determined for each constituent, and the most conservative calibration factor must be used when conducting time and distance testing or show-specific testing for the fluid as a whole. A calibration factor for an individual constituent in a fluid may be used for time and distance testing only when that constituent is the only chemical of concern.

The calibration curves for glycols and glycerol are shown below:



Figures 1a and 1b. Calibration curves for Jem Ready 365 with R365 Haze Fluid, based on glycol (left graph) and glycerol (right graph) laboratory data. Calibration factors, based on slope of curve, are 0.03 (mg/m^3 glycol) / (mg/m^3 aerosol) and 0.24 (mg/m^3 glycerol) / (mg/m^3 aerosol).