# Site Implementation Recommendations

for AutoGC sites with PerkinElmer Ozone Precursor Systems

Listed below is the equipment supplied by PerkinElmer (PE) in their Ozone Precursor system along with ancillary equipment required for the automated operation of the system.

- PerkinElmer Ozone Precursor System:
  PE Clarus GC
  PE Turbomatrix TD-300
  with ambient air sampler, Charles Austin Sample Pump trap, columns, and Dean's switch
- Parker Balston TOC1250 TOC Air Generator
- Parker Balston 75-83 Zero Air Purifier
- Compressor (135 psig 3 gal 2.3 scfm) with 100 psig regulated output
- Computer
- TotalChrom Software 6.2 or higher
- Orsat Software Applications
- Merlin MicroScience Dilution (MMSD-VOC or MMSD-MPV) System

## About the Orsat Applications:

**MERLIN MICROSCIENCE DILUTION SYSTEM (MMSD)** Orsat has installed, maintained, and operated PE Ozone Precursor systems for several state agencies for over 25 years and has developed a dynamic dilution system, the Merlin MicroScience Dilution (MMSD) System, to be used on unattended systems to monitor system performance. This system utilizes a 1 ppmC mixture to generate a ppb-level check standard that can be run automatically using the TotalChrom sequence file. This daily check standard is essential to quality control, and the MMDS system allows operators and data validators continuous quality management of the system without time consuming site visits.

Table 1 lists the recommended standard that is used both to check recoveries of benzene and propane, as well as to maintain peak identification by providing multiple reference peaks for the Total-Chrom software. Components such as acetylene and 1,3-butadiene are of particular interest because on their unique behavior.

The MMDS system is based on the dilution of span gas with zero gas from the total organic carbon (TOC) gas generator. By calibration of span and zero gas orifices via pressure settings, operators can generate multiple dilutions at ratios from 1:3 to up to 1:1000. Thus, starting concentrations of 1 ppmv can be diluted to 1 ppbv. Because concentrations this low are adversely affected by low humidity, the system is equipped with a nafion device to humidify the zero gas prior to the dilution point. This system is manufactured of all stainless steel wetted parts and low volume 1/16″ stainless steel tubing to ensure low reactivitly. Automatic operation is achieved with two solenoids. Zero gas flows continuously through the nafion device, and a three-way solenoid diverts the stream to the sample manifold. To introduce either a blank humidified air sample or a diluted standard to the sample manifold, a second two-way solenoid allows the span gas to be turned on or off. Finally, the MMSD system includes a latching relay device to allow the PE software to operate the solenoids. In addition, it requires a hard reset signal to eliminate the release of the normally closed valve at the end of the chromatographic run, because the end of the run does not correlate to the end of the sample collection on the TurboMatrix.

| Impurity | Carbon Number | Concentration (ppmC) |
|---|---|---|
| Ethane | 2 | 1 .00 |
| Propane | 3 | 1 .00 |
| n-Butane | 4 | 1 .00 |
| Acetylene | 2 | 1 .00 |
| n-Pentane | 5 | 1 .00 |
| 1,3-Butadiene | 4 | 1 .00 |
| 2-Methylpentane | 6 | 1 .00 |
| 1-Hexene | 6 | 1 .00 |
| Hexane | 6 | 1 .00 |
| Benzene | 6 | 1 .00 |
| Toluene | 7 | 1 .00 |
| m-Xylene | 8 | 1 .00 |
| n-Propylbenzene | 9 | 1 .00 |
| 1,2,4-Trimethylbenzene | 9 | 1 .00 |
| p-Diethylbenzene | 10 | 1 .00 |

*Table 1. Calibration Verification Standard*

## Software Enhancements

Orsat's unique software enhancements play an important role in the automation of the entire AutoGC system hardware.

**EZSEQUENCE** This Visual Basic program generates a text file (TX0) that when imported into the build sequence module of TotalChrom, creates a standardized sequence composed of pre-defined methods. The sequence includes daily calibrations and blanks, and specifies a unique file naming protocol for results that includes the designation of site, column, date, and hour of day.

**MMOVE** This Visual Basic program is executed from within the EZChrom method file and generates a zip file containing all raw result and TX0 files for each day, and at the end of the day, archives the methods used to generate the data that day. MMove requires a very specific file structure on the computer and requires the pre-defined methods developed with the Orsat system.

## Recommended Modifications

Several modifications are recommended on systems operated in conjunction with the above software and hardware.

**PERKINELMER OZONE PRECURSOR SYSTEM** The normal installation of the system utilizes a transfer line of fused silica. Due to problems encountered with leaks, the transfer line should be abandoned, and the BP1 column run directly through the heated transfer line to the TD to reduce fittings and thus reduce potential leaks.

It is occasionally necessary to stop and restart the TD during a GC run. To allow this, a momentary, normally open switch is installed across the ready out signal on the GC to allow the operator to pass a "ready" signal to the TD when the GC is running a sample.

Finally, a helium purifier is installed on the carrier gas supply to enhance thesystem's retention time stability.

**PERKINELMER TURBOMATRIX (TD)** In order to automate the introduction of samples via the TotalChrom method, the Orsat application requires control of the valves in the TD's ambient air sampler. Normally, the TurboMatrix hardware controls the TD's valves, but a Merlin Sample Interface, when added to the TD, includes a latching relay device on the solenoids which allows TotalChrom control of sample introduction.

**AIR SYSTEM** The air system is the most heavily used piece of the AutoGC system. Checks and redundancy in the air system are particularly important in this field application. A mass flow meter should be installed on the Total Organic Carbon (TOC) generator to monitor the use of TOC air. This ensures operators are able to easily detect leaks and overflow conditions. An inline regulator should also be used on the TOC output to ensure constant pressure is supplied to the GC/TD. This regulator should require a minimum pressure drop of 10 psig.

To ensure adequate dry air is available for the TD and MMSD systems as well as reduce demand on the TOC gas purifier, an additional zero air purifier should be installed to supply hydrocarbon free air for the FIDs in the GC.

**HYDROGEN GENERATOR (OPTIONAL)** A single cylinder of hydrogen will supply over 30 days of continuous operation. However, to avoid time consuming gas delivery arrangements as well as cylinder tracking and demurrage costs, it may be advantageous to use a hydrogen generator. A hydrogen generator must, however, be configured for auto-restart to accommodate power outages which occur commonly at remote sites. If the generator loses power for any period of time it will need to build pressure on restart. Therefore, it is necesary to keep a backup cylinder and configure the system with an automatic switch-over manifold to maintain the system during the generator's recovery period. Orsat can supply, install, and configure this system on request.

## Other Site Recommendations:

**BACKUP POWER** An uninterruptible power supply (UPS) system, or battery backup, is recommended to support the computer in the event of power loss. However, backup power cannot be practically supplied to the PE Integral Link Interface which is part of the GC system, and even short power failures will cause the system to stop. A site-wide power monitor is thus also recommended to alert operators when power failures occur.

**SAMPLING MANIFOLD** When a glass minifold is used for the retrieval of external ambient air, heat traced Sulfinert® stainless steel lines (1/8") should be installed using flexible tape heaters and insulation with a variable AC transformer, or VARIAC™, to control the temperature. Lines from the dilution system (MMDS) to the sample line should also be heated.

**Orsat, LLC**
1416 Southmore Ave
Pasadena, TX 77502
www.orsat.com
877-477-0171