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www.ChemTrace.com

Workorder: F200129044

Purchase Order: EdWJR
Report Date: 02/14/2020

ANALYTICAL TEST REPORT

Volatile Organic Compounds (VOC) by ATD-GC-MS (Revised Report)

Prepared for:

Mr Edward Waters

Three Squared Solutions, LLC

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Report Authorization

Quality Controlled by

Bryan Ba
Lab Analyst

Report Reviewed by

Peng Sun, Ph.D.
Technical Director

Note: Test results are confidential to ChemTrace and to the above referenced customer. This test report shall not be reproduced except in full with written approval of the laboratory. Results reported herein relate only to the sample(s), as received and tested, and do not necessarily represent the lot from which they came.

Volatile Organic Compounds (VOC) by ATD-GC-MS (Revised Report)

Requestor: Mr Edward Waters

WO# F200129044

Company: Three Squared Solutions, LLC

Sample Receipt: 01/29/2020

PO# Credit Card

Report Date: 02/04/2020 (2/14/2020, Revised to add IEST reference # on Page 3 per client's request)

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Analysis Requested

Organic Outgassing Analysis by ATD GC-MS according to ChemTrace SOP CT-OR001

Sample Information

Sample Type: Solid Seal Gasket
Sample ID: See Report Table
Sampling: Sampling done by Client
Sample Condition Sample was received packaged in double ziplock plastic bags. Sample was packaged in ziplock plastic bag instead of UHV Aluminum foil.
Sampling Plan: N/A
Customer Provided Info: N/A
Analysis Location: Fremont, CA
Sample Date: No sample date was provided.
Analysis Date: 1/29/2020

Sample Analysis

Outgassing Procedure: Sample was cut and outgassed for 30 minutes at 50°C. A chamber control was also analyzed to demonstrate cleanliness of the desorption equipment and environment prior to sample analysis.
Desorption Gas: Helium, 50 mL/min
Analysis Area: Analysis area is the entire cut sample.
Laboratory Environment: Outgassing sample preparation and analysis are performed in a class 1000 cleanroom to minimize contamination of samples during preparation and leaching. Strict cleanroom practices are followed at all times.

Instrumental Analysis

Desorption Equipment: JAI TDV-04 Coupon Outgas Collector
Analytical Instrumentation: Perkin-Elmer Turbomatrix 650 and Agilent 7890 GC/5975 MS Detector
Desorption/Carrier Gas: Helium
GC Column Temp: 40°C to 280°C.
Quantitation: The GCMS is calibrated with the external standard *n-decane*.
Method Detection Limit: Method detection limit is 0.1 ppmw as n-decane.
Note: The outgassing condition is optimized for the analysis of volatiles and semi volatiles with boiling points greater than 70°C. Very volatile organic compounds such as acetone, benzene and other light hydrocarbons (<C7) are not recovered. Analysis of light hydrocarbons requires different experimental conditions and is available upon request.

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Data Processing and Calculation

Identification:

Computer-aided search of NIST library with 195,000 spectra. Best effort manual interpretation is provided for unknowns.

Quantitation:

All compounds are calculated semi-quantitatively based on the response factor of the external standard *n-decane*. Analytical results are entered into an application program worksheet and the concentrations are calculated using the following formula:

$$\text{Concentration (ppmw)} = \frac{C_A}{R \times W}$$

Where: C_A = measured concentration (TIC Peak Area)

R = Response Factor of *n-decane* (Area/ng)

W = Weight of sample in mg used for analysis

Quality Control

The results for the replicate *n-decane* standard injections must be within $\pm 15\%$.

Method Accreditation

This analytical method was not within the scope of ISO 17025 accreditation certificate 2252.01 from the American Association for Laboratory Accreditation (A2LA).

Reference Document: IEST-RP-CC031 Method for Characterizing Outgassed Organic Compounds from Cleanroom Materials and Components.

Results and Discussions

No organic compounds were detected in the control sample as shown in Figure 1 and Table 1.

See Figure 2 and Table 2 for the types and amounts of organic compounds detected in the sample.

Additional Information concerning this technique is available on our website at www.ChemTrace.com

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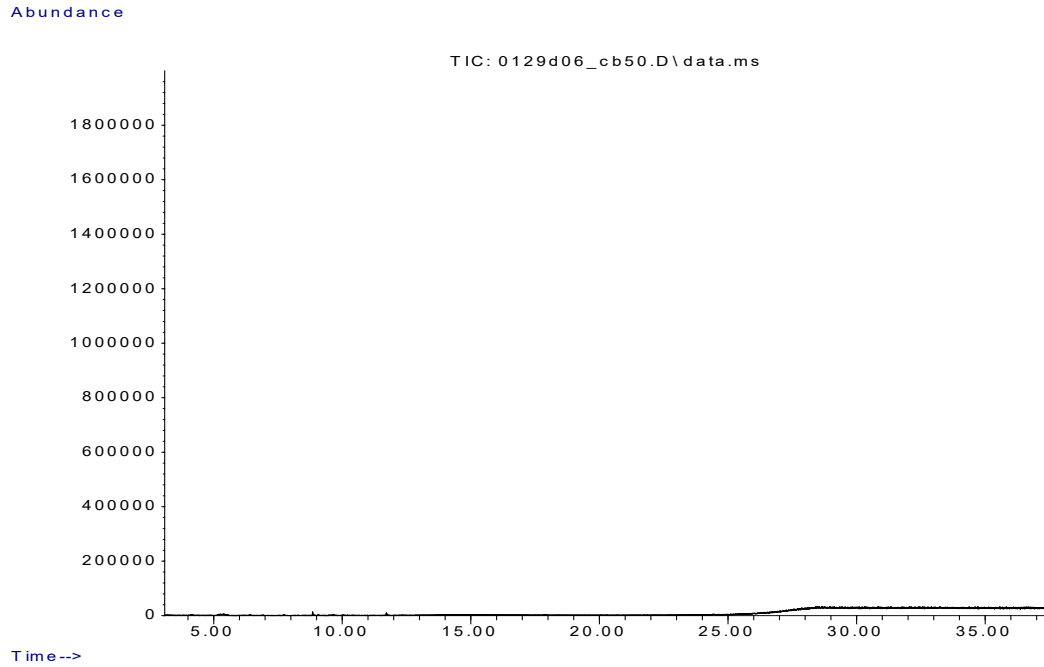


Figure 1. GC-MS Chromatogram of Control (50°C for 30 minutes)

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Abundance

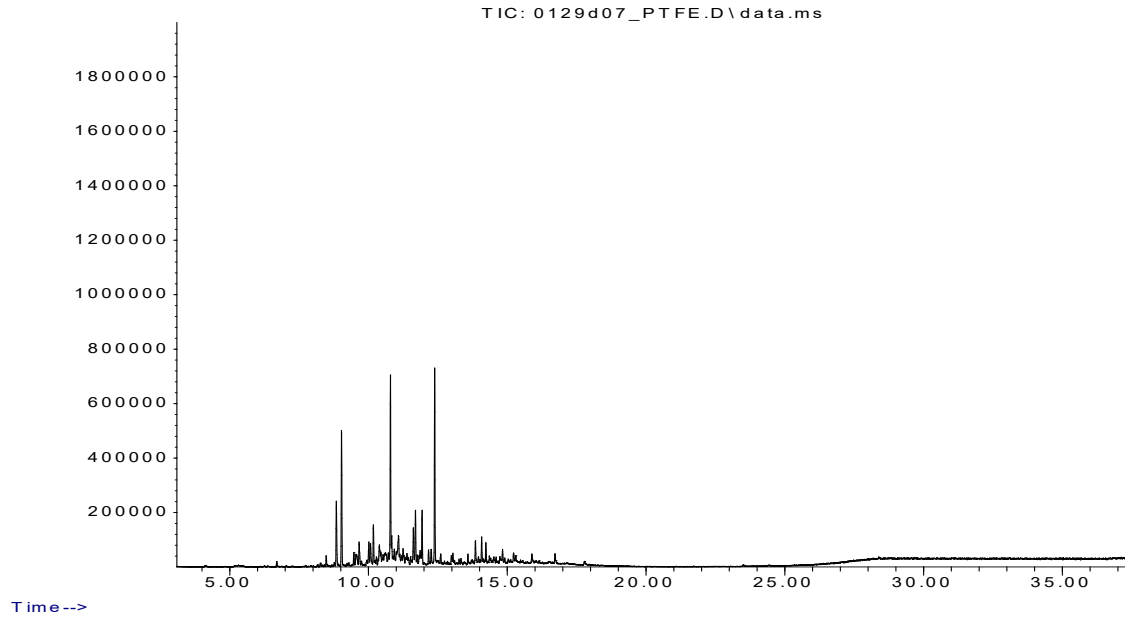


Figure 2. GC-MS Chromatogram of Solid Seal Gasket, White Solid , PTFE (Teflon) (50°C for 30 minutes)

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Table 1. Result of Volatile Organic Compounds (50°C for 30 min)

| Sample ID | R.T. (min) | Outgassing Compounds | Concentration ppmw (ng/mg) |
|-----------------|------------|--|----------------------------|
| Chamber Control | | No organic compounds were found in the control | N/A |
| | | Total Outgassing Compounds | < 0.1 |

Notes:

(1) R.T. = Retention Time, +/- 0.20 min.

(2) Semi-quantitation is based on the response factor of external standard *n-decane*, the detection limit was estimated to be 0.1 ppmw.

(3) The amount of total outgassing compounds include all the peaks integrated in the chromatogram.

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Table 2. Result of Volatile Organic Compounds (50°C for 30 min)

| Sample ID | R.T. (min) | Outgassing Compounds | Concentration ppmw (ng/mg) |
|---|------------|---|----------------------------|
| Solid Seal Gasket, White Solid , PTFE (Teflon) | | No individual organic compounds greater than 0.1 ppmw were found in this sample | N/A |
| Sealant Size 12 X 16 mm | | | |
| Sample Size: 745.4 mg | | Total Outgassing Compounds | 0.92 |

Notes:

(1) R.T. = Retention Time, +/- 0.20 min.

(2) Semi-quantitation is based on the response factor of external standard *n-decane*, the detection limit was estimated to be 0.1 ppmw.

(3) The amount of total outgassing compounds include all the peaks integrated in the chromatogram.

CULD

TIC: 0111A05C.D

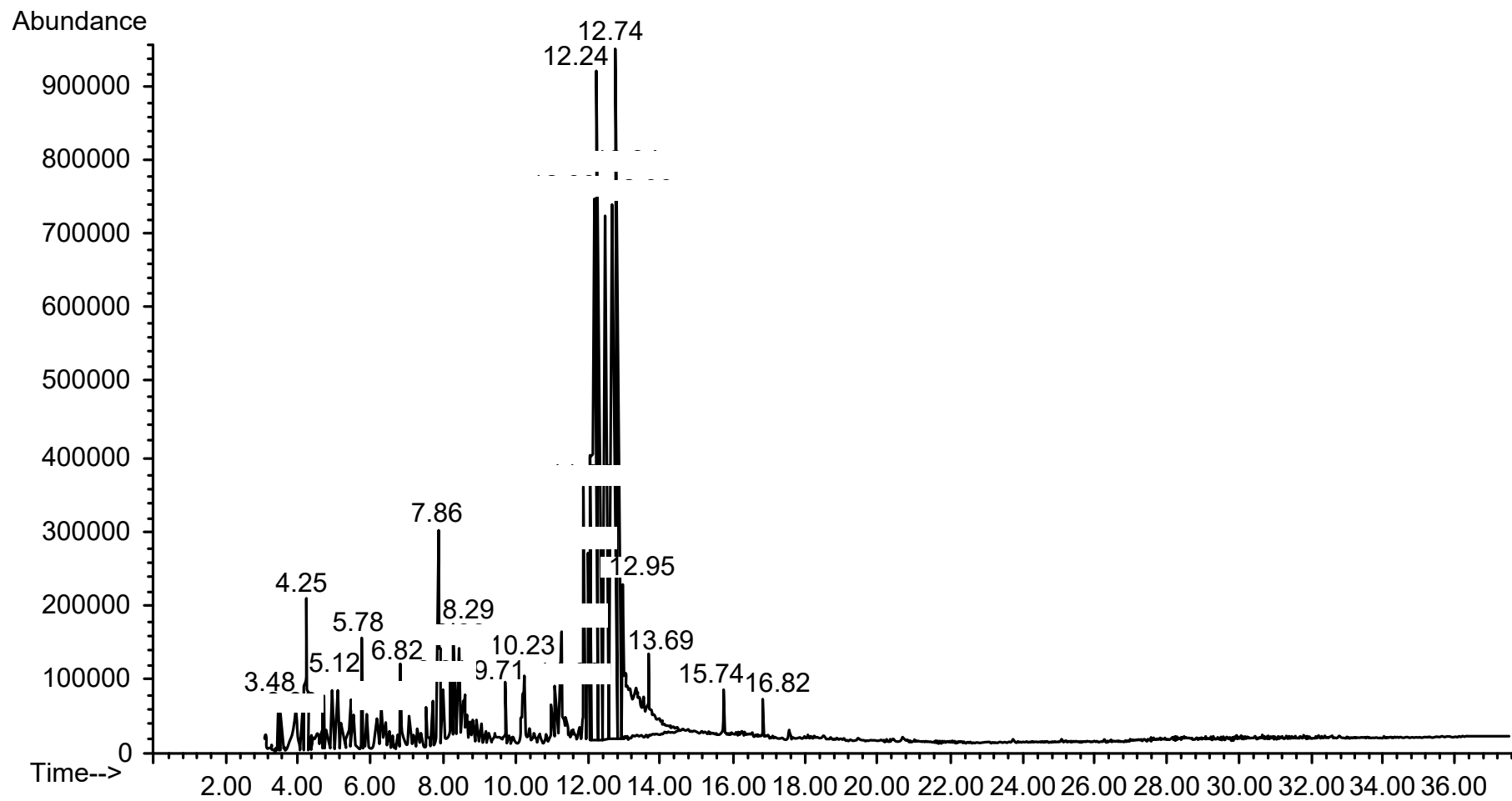


FIG. 6D