



# TENNESSEE BUREAU OF INVESTIGATION

## Forensic Services Division

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### Forensic Chemistry Standard Operating Procedure Manual

### Gas Chromatography - Fourier Transform Infrared Spectroscopy

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## 22.0 GAS CHROMATOGRAPHY - FOURIER TRANSFORM INFRARED SPECTROSCOPY

### 22.1 Application

Gas Chromatography - Fourier Transform Infrared Spectroscopy (GC-IR) is an analytical technique that combines the separation capabilities of GC with the compound selectivity of IR. This instrument is used within the unit as a confirmatory test for compounds of interest.

### 22.2 Equipment

#### 22.2.1 Thermo GC-IRs

The TBI FCU currently utilizes a GC-IR system manufactured entirely by Thermo Fisher Scientific. This instrument utilizes deuterated triglycine sulfate (DTGS) detectors for use as with traditional FTIR. This system also utilizes liquid nitrogen MCT detectors for detection of the GC eluent. The hardware system is controlled by Thermo proprietary software for data collection.

#### 22.2.2 ASAP IRD3

The TBI FCU also currently utilizes an Agilent GC coupled with an ASAP Analytical IRD3 FTIR, which utilizes a liquid nitrogen MCT detector for detection of the GC eluent. The hardware is controlled by Agilent ChemStation and ASAP eFTIR software.

### 22.3 Standards

A check solution that consists of a combination of working standards appropriate for the column length will be used for GC component performance verification. These solutions contain the following compounds:

- Amphetamine, methamphetamine, and phentermine for long columns
- Cocaine, hydrocodone, and pethidine for short columns

Traceable polystyrene and/or glass standards provided by the manufacturer will be used for FTIR component performance verification on the Thermo Fisher model.

### 22.4 Method

Methodology for the GC-IR follows the same procedure as outlined in the Gas Chromatography chapter (Section 21.1.4). The TBI FCU has several GC-IR methods to produce quality results for a wide variety of analytes. Please note that the analyst must manually adjust the GC temperature control and ramp on older instruments since they lack method storage capabilities.

The operating instructions for each specific instrument can be found in instrument notebook or in Lab Documentation folder in Ensur.

The data obtained from the Thermo Fisher instrument(s) will include a Gram Schmidt reconstruction similar to a gas chromatogram as well as a FTIR spectrum unique to analyte(s) of interest. The Gram Schmidt reconstruction **cannot** be used for retention time comparisons because integration is not possible.



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While the ASAP IRD3 does produce a total response chromatogram (TRC) with its eFTIR software, this instrument will not be used to perform retention time comparisons.

#### **22.5 Quality Assurance**

Quality control protocols for the GC-IR follow the same procedure as outlined in the Gas Chromatography chapter (Section 21.1.5).

Running daily primary standards for making spectral comparisons to unknown samples is not required since all primary standards and samples are run using similar FTIR spectral parameters. Consult the instrument logbook for these parameters.

#### **22.6 Performance Verification and Acceptance Criteria**

The performance verification and acceptance criteria all GCIR instruments follow the same criteria outlined in the GC (Section 21.1.6) chapter. The Thermo Fisher instrument follows the same acceptance criteria listed in the FTIR chapter (Section 20.6). Please refer to these sections for specific verification and acceptance requirements.

Since ASAP does not use traceable polystyrene standards for performance verification, the TBI FCU has defined the following performance verification and acceptance criteria.

Instrument specific wavenumbers (between 550 - 4000  $\text{cm}^{-1}$ ) of the check standard will be verified each month. Consult the instrument maintenance log for each instrument for these specific wave numbers.

The optical alignment will be monitored weekly. The alignment value must be within  $\pm 10\%$  of the manufacturer's specification. Any values outside of this range will require optical alignment adjustment. This procedure is outlined in the instrument operations manual.

If any of the criteria are not met, the instrument will be removed from service, and the unit supervisor will be notified.

Please note that the check solutions differ based on the instrument's column length. Refer to the instrument maintenance manual to determine the correct performance verification check solution.

Refer to Appendix G for other maintenance requirements and intervals.

#### **22.7 Criteria for Initial Evaluation**

Any peak present in the Gram-Schmidt reconstruction or in the TRC that is not present on the previously run acceptable blank will be considered valid for further comparison.

#### **22.8 Interpretation**

The analyst should review all peaks in the Gram Schmidt reconstruction or in the TRC to ensure all legally significant compounds are identified within in the sample.

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The analyst will also review the compound of interest's spectrum to determine if it matches the primary reference standard. The lot number and the run date of the primary standard will be noted either in the electronic library or in the primary standard spectra depository to ensure case file traceability.