

Development of Outside the Lab Mass Spectrometers for Rapid Trace Detection



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FLIR MS (Griffin Analytical) Overview

Milestones:

- Founded as Griffin Analytical (Nov 2001)
- Merged with ICx (Nov 2005)
- ICx acquired by FLIR (Oct 2010)



Location:

- Purdue Research Park
- West Lafayette, IN USA

Size:

- 17,000 Square Feet
- 45 full time employees
- 3/4 staff is technical (scientists and engineers)





GRIFFIN™ Family of Mass Spectrometers

9/18/2013 Page 2 FLIR Proprietary

Customer Needs Driving MS Outside the Lab

Opportunities to Improve Airport Passenger Screening With Mass Spectrometry

Technique	Increase in Information (Selectivity)
IMS	10
MS	10,000
GC/MS	10,000
MS/MS	10,000
GC/MS/MS	10,000,000

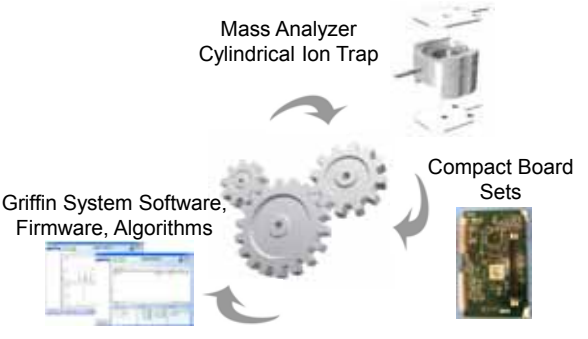


“ To improve upon the trace detection systems currently employed in airports across the US, mass spectrometry (MS) is an obvious candidate to consider. It has become the gold standard for resolving high-consequence analyses... **”**

NATIONAL RESEARCH COUNCIL OF THE NATIONAL ACADEMIES

9/18/2013 Page 3 FLIR Proprietary

Broad Spectrum Chemical Analysis Engine



Mass Analyzer
Cylindrical Ion Trap


Griffin System Software, Firmware, Algorithms

Compact Board Sets


9/18/2013 Page 4 FLIR Proprietary

Griffin™ GC-MS


- Lab quality chemical analysis on-site
- Confirms CWAs, Narcotics, Explosives, TICS, other
- Chemically Selective
- Positive ID in complex backgrounds
- Ability to handle multiple sample phases (solid, liquid, and vapor-Griffin 460 only)
- Multiple accessories allow for both prep and prepress samples



GRIFFIN 400




GRIFFIN 460










G460 tested to MIL-STD-810G

- Method 514.6 (Shock/Vibration)
- Method 501.5 (High Temp)
- Method 502.5 (Low Temp)
- Method 507.5 (Humidity)



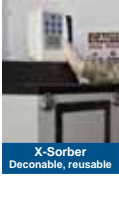
9/18/2013 Page 6

PREPRESS					
	PSI-PROBE with TAG Vapor / Solid / Liquid Narcotics, Law Enforcement	X-Sorber Vapor Fire Debris, Law Enforcement	PURGE & TRAP Water Groundwater, Enviro Remediation	DIRECT SAMPLING LINE Vapor Building Monitoring, 24/7 Security	SPME Vapor / Liquid Accidental Spill, Incident Response
PREP					
	PSI-PROBE with Twister Vapor / Solid / Liquid Narcotics, Law Enforcement	AUTOSAMPLER Liquid / Solid Research & Academia	SYRINGE Liquid / Solid Sensitive Site Exploration, Field-based Forensics	HEADSPACE Liquid / Solid Soil Contamination, Environmental Monitoring	


Griffin™ X-Sorber and Purge & Trap

PREPRESS

- Sample/preconcentrate VOC's/sVOC's
 - From air: X-Sorber
 - Water samples: Purge & Trap
- Both accessories are plug and play with the Griffin USP
- Combined with GC/MS for ppb to ppt detection



X-Sorber
Deconable, reusable



Purge & Trap

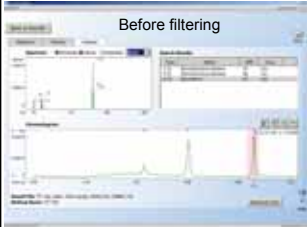


9/18/2013 Page 7

Griffin Purge & Trap


PREPRESS

Before filtering




Unfiltered tap water

After filtering



Based on calibration curves, trihalomethane concentrations below EPA's maximum contaminant level of 80 ppb






9/18/2013 Page 8

PSI-Probe with TAG

PREPLESS

- Primarily for solid samples (liquid possible)
- Plug and play with injector
- Simple 4-step process
 1. Touch TAG to sample (trace amount)
 2. Break sampling end into microvial
 3. Drop microvial into PSI-Probe
 4. Insert PSI-Probe into GC-MS injector
- Combined with GC/MS for ppb detection

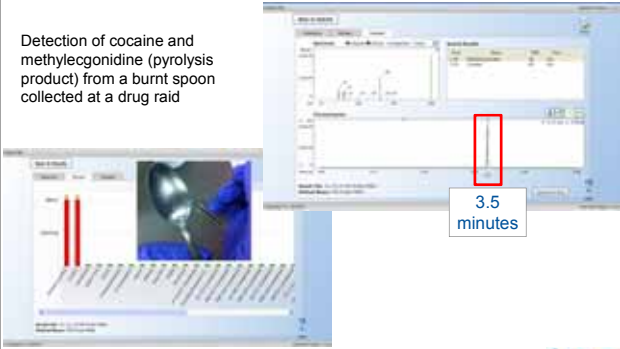



9/18/2013 Page 9 FLIR Proprietary 


PSI-Probe with TAG


PREPLESS

Detection of cocaine and methylecgonidine (pyrolysis product) from a burnt spoon collected at a drug raid




3.5 minutes




9/18/2013 Page 10 FLIR Proprietary 

When GC Is Too Slow


- Gas chromatography can take minutes to perform
- Samples may need some degree of preparation
- Need immediate results with little to no sample prep
- → Direct-sampling Mass Spectrometry offers results in seconds
 - Checkpoint and package screening
 - Explosives and narcotics
 - Real-time air quality monitoring
 - Rapid identification of suspicious materials




9/18/2013 Page 11 FLIR Proprietary 

Trace Detection Applications


- Mandates for checkpoint and package screening drive need for rapid sample analysis methods




Visitor screening at entry control checkpoints




Mailroom and cargo receiving areas



Vehicle inspections at entry control checkpoints




Forensic investigations


9/18/2013 Page 12 FLIR Proprietary 

Griffin 824

Griffin™ 824:

- Bench-top mass spectrometer designed specifically for rapid narcotics and explosives trace detection/identification
- Mass spectrometry → highly selective, low clear-down time, minimal maintenance
- <50 lbs
- 21" x 14" x 21"
- Everything onboard: pumps, computer, touchscreen, etc.
- No carrier gas required, reusable sample tickets
- Simplified touch interface handles all instrument operations



9/18/2013 Page 13 FLIR Proprietary 

Griffin 824

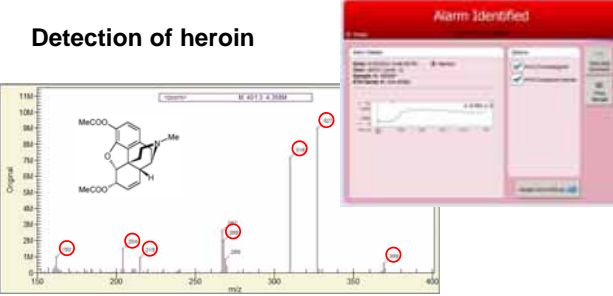


- 1 Collect sample using sample ticket
- 2 Insert sample ticket into thermal desorber sample inlet
- 3 Receive and acknowledge visual/audio alarm presented via GSS Touch screen application
- 4 Print Results (optional)

9/18/2013 Page 14 FLIR Proprietary 


Griffin 824

Detection of heroin



Alarm Identified

- Nanogram-level heroin thermally desorbed from sample ticket
- Seven identifiable fragments obtained within seconds


9/18/2013 Page 15 FLIR Proprietary 


Griffin 625

- Air quality in occupational environments is vital to personnel safety
- Real-time threat detection and identification is crucial

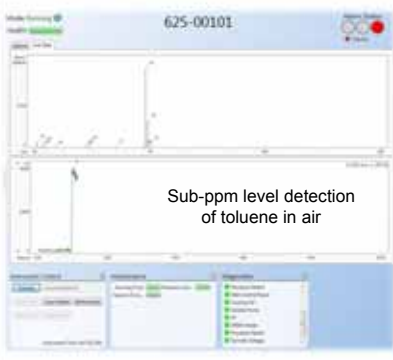
Griffin™ 625:

- Chemical sensor for 24/7 continuous indoor air monitoring for facilities protection
- Membrane inlet mass spectrometer, no carrier gas required
- 17" x 19" x 10", <40 lbs
- Fixed-site installation for remote monitoring
- Continuously samples air at >1 L/min
- Confirmatory identification of TIC's and CWA's
- Designed to be integrated into an automated network of systems for unattended monitoring
- Currently being installed on next generation frigates for a European Navy agency





9/18/2013 Page 16 FLIR Proprietary 

Griffin 625



Sub-ppm level detection of toluene in air


9/18/2013 Page 17 FLIR Proprietary

Griffin AI-MS

- Ambient Ionization (AI) is both a sample inlet and an ionization method for mass spectrometry
- Enables direct surface and liquid sampling of low volatility material

Griffin™ AI-MS:



- Compact, ruggedized instrument (MIL-STD) with simplified AI sources for field use
- Can be interfaced with DESI/ESI, DART, and APCI
- Detects and identifies CWA's, explosives, and other
- Onboard syringe pump and ion trap buffer gas
- Integrated, active gas flow controller
- m/z* range 50-1200
- 15" x 22" x 24", <95 lbs
- Power with 100-240 V_{AC} or 19-36 V_{DC}



9/18/2013 Page 18 FLIR Proprietary

Griffin AI-MS

- Simplified combination DESI/ESI source with reduced degrees of freedom
 - Sprayer held at optimum angle for DESI with simple lever to switch to ESI operation
 - Designed to use any source of compressed gas (SCBA bottles, air compressor, etc.)
 - Can be set up and analyzing samples in <15 min
 - Automated MS/MS for confirmation and alarming
 - Currently fielded with Army Chem Companies and NG CSTs








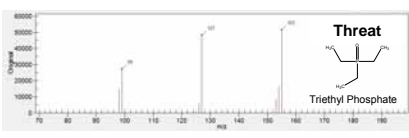
9/18/2013 Page 19 FLIR Proprietary

Griffin AI-MS


- DESI with MS/MS: Greatly improves confidence in identification



Interferent
c1ccc(cc1)/N=N/c2ccccc2
Azobenzene



Threat
CCOP(=O)(OC)OC
Triethyl Phosphate



9/18/2013 Page 20 FLIR Proprietary

Griffin AI-MS

- Non-proximate surface sampling
 - Scan cargo, baggage, etc. without the need for swipes
 - Desorb targets of interest and transport them to the mass analyzer for ionization and mass analysis
 - Handheld IR lamp based desorber
- Ionization by APCI using corona discharge
 - Provides ideal ionization conditions for certain classes of molecules, particularly explosives



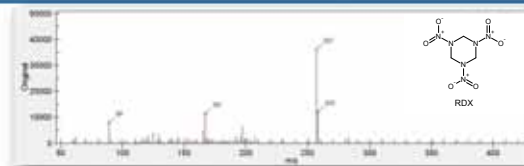
9/18/2013

Page 21

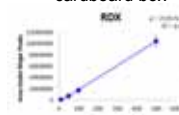
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Griffin AI-MS



Atmospheric pressure chemical ionization-based AI-MS using IR lamp desorption & neutral transfer line for 50 ng RDX on cardboard box



9/18/2013

Page 22

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9/18/2013

Page 23

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