Government Presentation of Phase 1 Testbed and Results

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Office of the Director of National Intelligence

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Phase 1 Performer Technology

Bring the best minds to bear:

Full and open competition to the greatest possible extent

World-class, rotational, Program Managers

Define and Execute Research Programs that:

Have goals that are clear, measurable, ambitious and credible

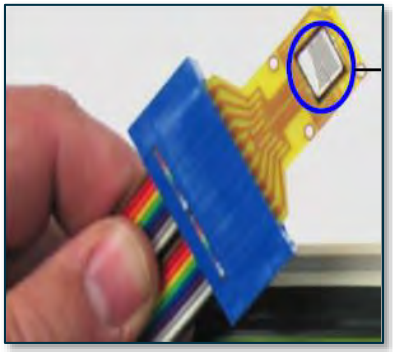
Employ independent and rigorous Test & Evaluation

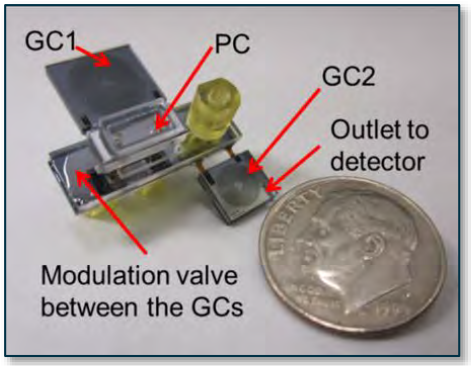
Involve IC partners from inception to finish

Run less than 5 years

Government Furnished Equipment

IARPA programs include independent 3rd party T&E on all research. For MAEGLIN, this includes comparing "best of breed" COTS/GOTS components to MAEGLIN devices using a single, comprehensive test protocol developed at NRL.





U.S. NAVAL RESEARCH LABORATORY

908devices

smiths detection

Sandia National Laboratories

Phase 1 T&E Schedule

Program Status:

December 2017/January 2018 – Month 11 performer benchmark tests

February 2018 – Sandia National Lab benchmark test

April 2018 – Month 15 benchmark tests

May 2018 – 908 Devices benchmark test

June/July 2018 – Final evaluations

	Month		FEB 17	MAR 17	APR 17	MAY 17	JUN 17	JUL 17	AUG 17	SEP 17	OCT 17	NOV 17	DEC 17	JAN 18	FEB 18	MAR 18	APR 18	MAY 18	JUN 18	JUL 18
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
PERFORMERS	Kickoff																			
	DC TIM																			
	Site Visit																			
	Workshop																			
	Integration Report																			
GFI	Library List																			
	Benchmark Test																			
TEST	Final Test																			
	Government Eval																			

Collection Thrust Area

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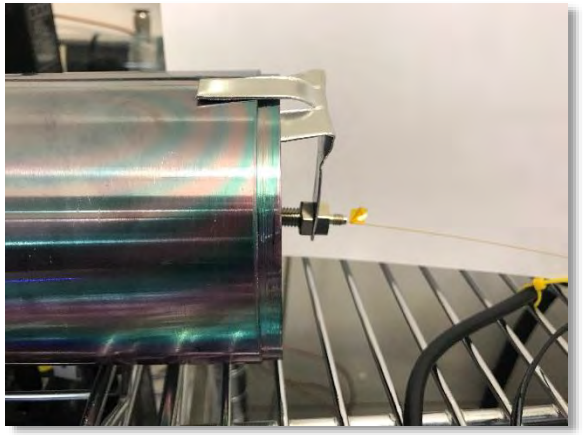
Collection – Metrics and Test Plan

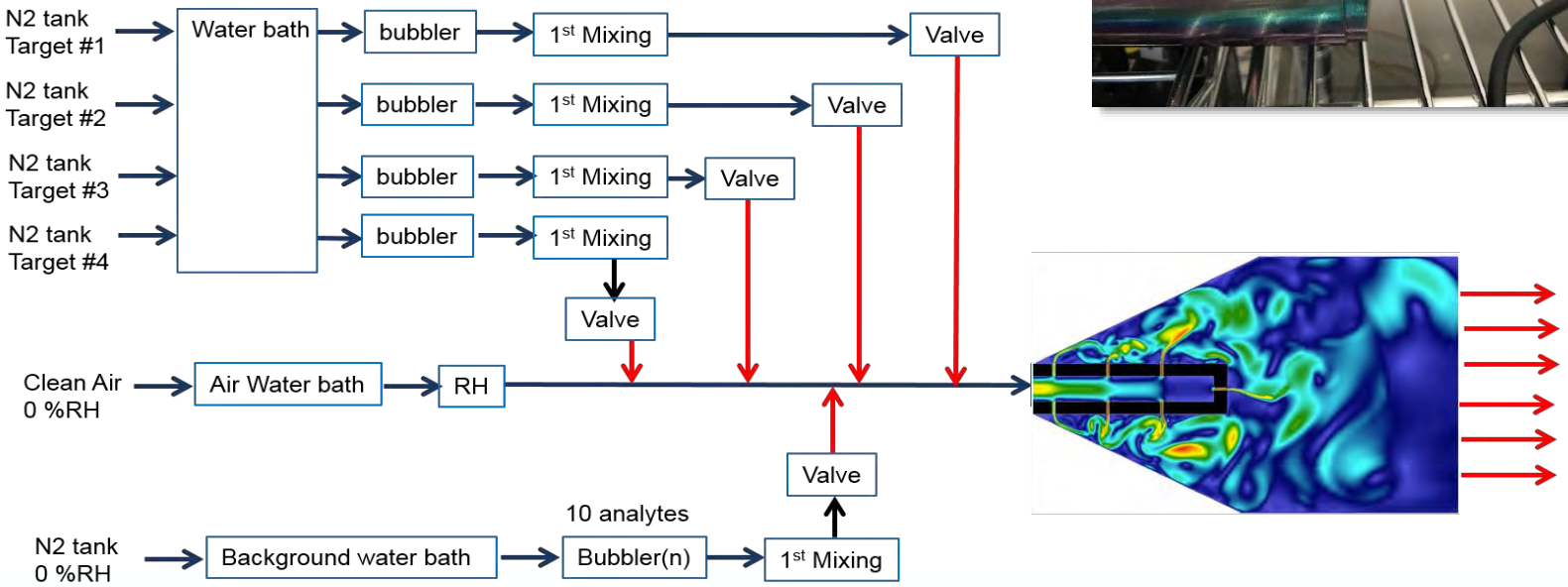
- **Collection Metrics:**
  - Pressure drop at specified flow rates
  - Power consumption (if any)
  - Collection efficiency neat and in mixtures
  - Sorbent type to match target chemicals
  - Resistance to sample bleed
- **Desorption Metrics:**
  - Power consumption to thermally release bolus
  - Thermal control
  - Fluidic design coupling to GC inlet
  - Residual analyte

Chemical Test #	Time	T amb/C	RH%	Analyte	Conc mg/m^3	Background chemicals #	Conc mg/m^3	Bolus temporal profile	Bolus chemical profile	Quantify analyte in bolus	Enhanced signal (real-time)	Breakthrough	Sample bleed	Residual Analyte
Day 1								Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6	Metric 7
0	9:00	25	Low	None	N/A	0	N/A	N/A	Yes	No	No	No	No	No
1	10:00	25	Low	High VP	Low	0	N/A	Yes	No	Yes	Yes	No	No	Yes
2	11:00	25	High	High VP	Low	0	N/A	Yes	Yes	Yes	Yes	No	No	Yes
3	12:00	25	Low	High VP	High	0	N/A	Yes	No	Yes	Yes	Yes	Yes	Yes
4	13:00	25	High	High VP	High	0	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes
5	14:00	25	Low	Med VP	Low	0	N/A	Yes	Yes	Yes	Yes	No	No	Yes
6	15:00	25	High	Med VP	Low	0	N/A	Yes	Yes	Yes	Yes	No	No	Yes
7	16:00	25	Low	Low VP	Low	0	N/A	Yes	Yes	Yes	Yes	No	No	Yes
8	17:00	25	High	Low VP	Low	0	N/A	Yes	Yes	Yes	Yes	No	No	Yes
Day2								Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6	Metric 7
9	8:00	25	Med	Med VP	Low	0	Med	No	Yes	Yes	No	No	No	Yes
10	9:00	25	Med	Med VP	High	≤10	Med	No	Yes	Yes	No	No	No	Yes
11	10:00	25	Med	Low VP	Low	0	Med	No	Yes	Yes	No	No	No	Yes
12	11:00	25	Med	Low VP	Low	≤10	Med	No	Yes	Yes	No	No	No	Yes
13	12:00	25	Med	Low VP	Low	≤10	Med	No	Yes	Yes	No	No	No	Yes
14	13:00	25	Med	Low VP	Low	≤10	Med	No	Yes	Yes	No	No	No	Yes
15	14:00	25	Med	V Low VP	Low	0	Med	Yes	Yes	Yes	Yes	No	No	Yes
16	15:00	Non Chem Tests												
	16:00													

Collection – Test Bed Apparatus

- **NRL constructed chamber for vapor challenge**
  - Incorporates low flow vapor generation and exposure to collector elements (to mimic real world)
  - Accommodates all of the unique MAEGLIN systems
  - Downstream analysis protocols were drafted prior to testing – executed seamlessly.
  - Multi-flow controller built





Collection – Chemicals

Concentration Ranges for Example Chemicals:

DMMP			Main air	Vapor flow	1st dilution	Vapor out	Final Concentration		
	T (oC)	Sat ppm	L/min	mL/min	L/min	ml/min	ppm	mg/m3	ppb
Minimum	-15	34.90183	20	10	2	50	0.000433	0.002196	0.433019872
Maximum	20	736.7232	20	50	0	50	1.837215	9.317573	1837.214949

Acetone			Main air	Vapor flow	1st dilution	Vapor out		Final Conc.	
	T (oC)	Sat ppm	L/min	mL/min	L/min	ml/min	ppm	mg/m3	ppb
Minimum	-15	39656.17	20	10	2	50	0.492006	1.16874	492.0058878
Maximum	20	241184.4	20	50	0	50	601.46	1428.74	601457.30

Separation Thrust Area

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Separation – Metrics

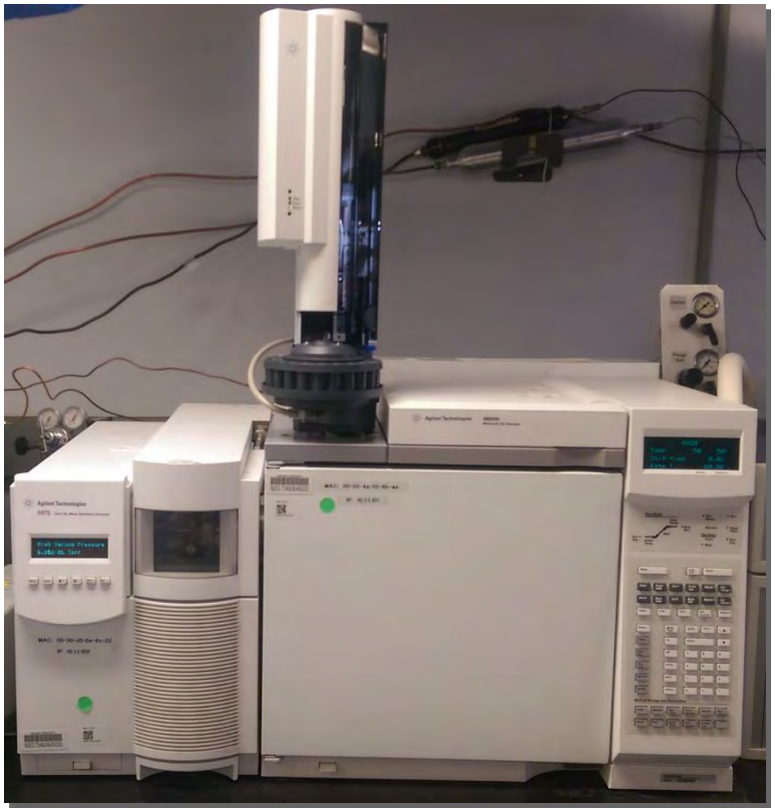
- **Physical Metrics:**
  - Column configuration – wall coated, open, tubular, etc.
  - Column geometry – aspect ratio, length, radius, cross section, shape, etc.
  - Physical parameters - column structural material, uniformity, stationary phase, etc.
  - Stationary phase deposition/packing technique
  - Stationary phase film thickness and uniformity
  - Isothermal or ramped temperature profile required for successful separation and associated energy consumed.
  - HETP at optimum flow rate (Golay or van Deemter plot)
  - Flow rate
  - Column pressure drop
  - Phase ratio, β
- **Chemical Metrics:**
  - Un-retained gas peak width
  - Separation number, SN or TZ
  - Peak characteristics - peak resolution, peak shape, time for complete chromatogram
  - Chromatography performance as a function of sample load size
  - Chromatography robustness as a function of 100 – 730 repeat analysis

Separation – Test Plan

Chemical Test #	Time	Chemicals	Conc mg/m^3	Peak temporal profile	Chemical retention time	# Theoretical plates	Polar separability	nonpolar separability SN/TZ	Carryover
Day 1				Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6
1	9:00	n-alkane mix	low	Yes	Yes	Yes	No	Yes	No
2	10:00	n-alkane mix	high	Yes	Yes	Yes	No	Yes	Yes
3	11:00	polar mix	low	Yes	Yes	Yes	Yes	No	No
4	12:00	polar mix	high	Yes	Yes	Yes	Yes	No	Yes
5	13:00	Kovats Test mix	low	Yes	Yes	Yes	Yes	Yes	No
6	14:00	Kovats Test mix	high	Yes	Yes	Yes	Yes	Yes	Yes
7	15:00	Grobs Test mix	low	Yes	Yes	Yes	Yes	Yes	No
8	16:00	Grobs Test mix	high	Yes	Yes	Yes	Yes	Yes	Yes
Day2				Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6
9	9:00	Kovats Test mix	high	Yes	Yes	Yes	Yes	Yes	Yes
10	10:00	NRL test mix 1	Med	Yes	Yes	No	No	Yes	Yes
11	11:00	NRL test mix 2	Med	Yes	Yes	No	No	Yes	Yes
12	12:00	NRL test mix 3	Med	Yes	Yes	No	Yes	No	Yes
13	13:00	NRL test mix 4	Med	Yes	Yes	No	Yes	No	Yes
14	14:00	low v. pressure	low	Yes	Yes	No	No	No	Yes
15	15:00	low v. pressure	high	Yes	Yes	No	No	No	Yes

Separation – Test Bed Apparatus

- **Test-Bed Features:**
  - Standardized performance tests for capillary GC columns. Using an adapted procedure of the well known Grob test.
  - Microfabricated GC columns, provided with short pigtailed lengths of conventional capillary tubing, are evaluated with conventional injector (if required) and COTS MS detector in a bench top COTS gas chromatographic system.
  - Automated repeat tests to examine column performance endurance.
  - Traditional HETP, TZ, McReynolds type outputs.



Agilent GCMS system used to interface and test performer separator modules

Identification Thrust Area

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Identification – Metrics

Five components of identification:

- Ion source
- Mass or mobility analyzer/separator
- Detector
- Vacuum or carrier stream
- Data interpretation

Performance criteria:

- Resolution (mass or drift time)
- Efficiency
- Background
- Abundance sensitivity
- Fragmentation pattern reproducibility
- Operational factors
- Temperature, humidity
- Vacuum or carrier gas
- SWaP specifications

Evaluation:

- Overall goal of unique identification
  - Single compound
  - Overlapping mixtures
- Discrimination capability
- Limits of Detection
- Reliability
- Reproducibility
- Sensitivity to operating conditions
- SWaP expectations
- Identify critical limiting factors

Recommendations:

- Describe strength and weakness of approach
- Suggest modifications to improve performance
- Indicate if improved testing needed

Identification – Test Plan

Chemical Test #	Start Time	T amb/C	Analyte	Conc mg/m^3	Background chemicals #	Conc mg/m^3	Mass Range	Duration of scan(s)	Triplicate Precision	Identification	LOD	LOI	Carryover
Day 0							Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6	Metric 7
	1:00		Equipment set up, SWAP evaluation										
Day 1							Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6	Metric 7
0	8:00		blank		0	N/A	Yes	Yes	Yes	No	No	No	No
1	8:30	30	calibrant	Low (L)	0	N/A	Yes	Yes	Yes	Yes	Yes	Yes	No
2	9:15	30	calibrant	Med Low (ML)	0	N/A	Yes	Yes	No	Yes	Yes	Yes	No
3	9:45	30	calibrant	Med (M)	0	N/A	Yes	Yes	No	Yes	Yes	Yes	No
4	10:15	30	calibrant	Med High (MH)	0	N/A	Yes	Yes	No	Yes	Yes	Yes	No
5	10:45	30	calibrant	High (H)	0	N/A	Yes	Yes	Yes	Yes	Yes	Yes	Yes
6	11:30	30	Low Mass	ML, M, MH	0	N/A	Yes	Yes	No	Yes	Yes	Yes	Yes
7	12:30	30	Med Mass	ML, M, MH	0	N/A	Yes	Yes	No	Yes	Yes	Yes	Yes
8	13:30	30	Hi Mass	ML, M, MH	0	N/A	Yes	Yes	No	Yes	Yes	Yes	Yes
9	14:30	30	few peaks	ML, M, MH	0	N/A	Yes	Yes	No	Yes	Yes	Yes	Yes
10	15:30	30	many peaks	ML, M, MH	0	N/A	Yes	Yes	No	Yes	Yes	Yes	Yes
	16:30		Exchange GC column, put instrument into rest mode										
Day2							Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6	Metric 7
	8:00	30	Bring equipment out of rest mode										
11	8:30	30	Low Mass	ML, M, MH	≤2	MH	Yes	Yes	No	Yes	Yes	Yes	Yes
12	9:30	30	Low Mass	ML, M, MH	≤2	M	Yes	Yes	No	Yes	Yes	Yes	Yes
13	10:30	30	Med Mass	ML, M, MH	≤2	M	Yes	Yes	No	Yes	Yes	Yes	Yes
14	11:30	30	Hi Mass	ML, M, MH	≤2	M	Yes	Yes	No	Yes	Yes	Yes	Yes
15	12:30	30	few peaks	ML, M, MH	≤2	M	Yes	Yes	No	Yes	Yes	Yes	Yes
16	13:30	30	med peaks	ML, M, MH	≤2	M	Yes	Yes	No	Yes	Yes	Yes	Yes
17	14:30	30	many peaks	ML, M, MH	≤2	MH	Yes	Yes	No	Yes	Yes	Yes	Yes
18	15:30	30	many peaks	ML, M, MH	≤2	M	Yes	Yes	No	Yes	Yes	Yes	Yes
	16:30		Full data download, Equipment breakdown, Closeout discussions										

Identification – Test Bed Apparatus

Agilent GC + Gerstel System used to interface to and test performer identification modules

Test-Bed Features:

1. Conventional GC and capillary column interfaces to performer identification module
2. Gerstel system allows removal of most of the solvent before injection to avoid MS solvent issues
3. Prefer identification module provided with short pigtail length of conventional capillary tubing for ease of interface
4. Present systems with relevant test chemicals
5. Validate MS and ion mobility performance

Multiple Thrust Area Test Plans

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Collection/Separation –Test Plan

Chemical Test #	Time	T amb/C	RH%	Analyte	Conc mg/m^3	Background chemicals #	Conc mg/m^3	Bolus temporal profile	Bolus chemical profile	Quantify analyte in bolus	Enhanced signal (real-time)	Breakthrough	Sample bleed	Residual Analyte
Day 1								Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6	Metric 7
0	8:00	25	Low	N/A	N/A	0	N/A	N/A	Yes	Yes	N/A	No	No	No
1	9:00	25	Low	High VP	Low	0	N/A	N/A	No	Yes	N/A	No	No	Yes
2	10:00	25	High	High VP	Low	0	N/A	N/A	Yes	Yes	N/A	No	No	Yes
3	11:00	25	High	High VP	High	0	N/A	N/A	No	Yes	N/A	Yes	Yes	Yes
4	12:00	25	High	Low VP	Low	0	N/A	N/A	No	Yes	N/A	No	No	Yes
5	13:00	25	Med	Med VP	Low	0	N/A	N/A	Yes	Yes	No	No	No	Yes
6	14:00	25	Med	Med VP	Low	≤10	Med	N/A	Yes	Yes	No	No	No	Yes
7	15:00	25	Med	Low VP	Low	0	N/A	N/A	Yes	Yes	No	No	No	Yes
8	16:00	25	Med	Low VP	Low	≤10	Med	N/A	Yes	Yes	No	No	No	Yes
9	17:00	25	Med	V Low VP	Low	0	N/A	N/A	Yes	Yes	No	No	No	Yes

Chemical Test #	Time	Chemicals	Conc mg/m^3	Peak temporal profile	Chemical retention time	# Theoretical plates	Polar separability	nonpolar separability SN/TZ	Carryover
Day 2				Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6
10	8:00	n-alk mix	low	Yes	Yes	Yes	No	Yes	No
11	9:00	n-alk mix	high	Yes	Yes	Yes	No	Yes	Yes
12	10:00	polar mix	low	Yes	Yes	Yes	Yes	No	No
13	11:00	polar mix	high	Yes	Yes	Yes	Yes	No	Yes
14	12:00	Kovats mix	low	Yes	Yes	Yes	Yes	Yes	No
15	13:00	Kovats mix	high	Yes	Yes	Yes	Yes	Yes	Yes
16	14:00	Grobs mix	low	Yes	Yes	Yes	Yes	Yes	No
17	15:00	Grobs mix	high	Yes	Yes	Yes	Yes	Yes	Yes

Separation/Identification – Test Plan

Chemical Test #	Start Time	T amb/C	Analyte	Conc mg/m^3	Peak temporal profile	Chemical retention time	# Theoretical plates	Polar separability	nonpolar separability SN/TZ	Carryover	Mass Range	Duration of scan(s)	Triplicate Precision	Identification	LOD	LOI
Day 1a					Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6	Metric 7	Metric 8	Metric 9	Metric 10	Metric 11	Metric 12
	8:00		Equipment set up, SWAP evaluation													
Day 1b					Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6	Metric 7	Metric 8	Metric 9	Metric 10	Metric 11	Metric 12
0	11:00		blank	N/A	No	No	No	No	No	No	No	Yes	Yes	No	Yes	No
1	11:45	30	calibrant	Low (L)	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
2	12:30	30	calibrant	Med (M)	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
3	13:15	30	calibrant	High (H)	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
4	14:00	30	Low Mass	ML, M, MH	Yes	Yes	Yes	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes
5	15:00	30	few peaks	ML, M, MH	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes
	16:00		Put instrument into rest mode													
Day2	Start Time	T amb/C	Analyte	Conc mg/m^3	Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6	Metric 7	Metric 8	Metric 9	Metric 10	Metric 11	Metric 12
	8:00	30	Bring equipment out of rest mode													
6	8:30	30	n-alkane mix	M	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	No	No
7	9:30	30	Kovats Test mix	L	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	No
8	10:30	30	Grobs Test mix	L	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	No	No
9	11:30	30	Kovats Test mix	high	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No
10	12:30	30	NRL test mix 1	Med	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	No	No
11	13:30	30	NRL test mix 2	Med	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	No	No
12	14:30	30	NRL test mix 3	Med	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	No	No
13	15:30	30	NRL test mix 4	Med	Yes	Yes	No	Yes	No	Yes	Yes	Yes	No	Yes	No	No
	16:30		Put instrument into rest mode													
Day3	Start Time	T amb/C	Analyte	Conc mg/m^3	Metric 1	Metric 2	Metric 3	Metric 4	Metric 5	Metric 6	Metric 7	Metric 8	Metric 9	Metric 10	Metric 11	Metric 12
	8:00	30	Bring equipment out of rest mode													
14	8:30	30	low v. pressure	low	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	No	No
15	9:30	30	low v. pressure	high	Yes	Yes	No	No	No	Yes	Yes	Yes	No	Yes	No	No
16	10:30	30	many peaks	ML, M, MH	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes
	11:30		Full data download, Equipment breakdown, Closeout discussions													

Phase 1 T&E Results and Plans

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Overview/Highlights

Round 1 Benchmark Tests:

- Tests were conducted at NRL in December 2017 and January 2018
- Each performer team had 2.5 days – 0.5 days for setup, 2 days for testing

Lessons Learned:

- Press-Fit connectors do not produce a good seal with metal capillaries.
- The original test plans were very ambitious – estimated time for set up and take down (1 hour) was more like 2-3 hours (in some cases) when calibration was included.
- Leaks – issue for virtually all performers. Finding solutions is a major focus before next round of benchmark tests.

Round 2 Benchmark Tests:

- Tests will be conducted at NRL in April 2018
- Each performer team will have 2 days total – no half day for setup
- Test plans will cover the same metrics as Round 1, while challenging the performers further.

Plans for MAEGLIN Phase 2

Detection Track:

- Round 1: Advanced component level testing. Emphasis will be on collection, separation, and detection metrics.
- Round 2: Integrated prototype testing. Emphasis will be on integrated design and accuracy of detection.

Identification Track:

- Round 1: Advanced component level testing. Emphasis will be on collection, separation, and identification metrics.
- Round 2: Integrated prototype testing. Emphasis will be on integrated design and accuracy of identification.

Month	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Kickoff	■																		
WMA Review								■						■				■	
Site Visits					■							■							
WMA Workshop														■					
Library List	■																		
Benchmark Test										■					■				
Final Test																		■	
Independent Gov. Eval.																	■	■	■

Other T&E Endeavors

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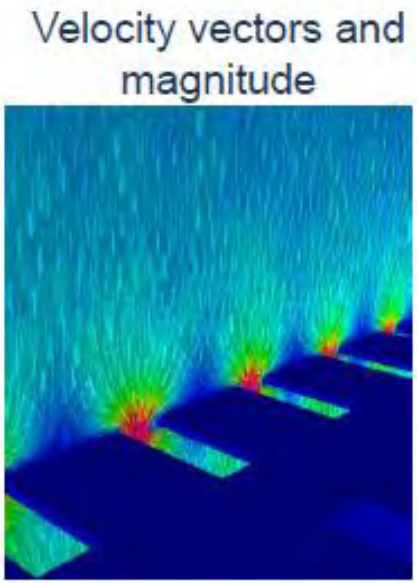
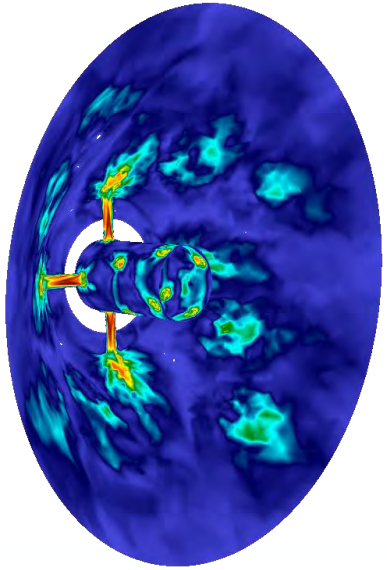
CFD Measurements

- **NRL Computational Fluid Dynamics Calculations (CFD)**
  - Calculation runs to inform performers on expected performance of chemical flow paths
  - CFD was used to develop vapor generator for the NRL testbed. First, 2-D modeling was developed and then used to develop 3-D model (shown below). Apparatus has worked ideally and is experimentally verified.

- **Performer Participation**
  - Calculation runs to inform performers on expected performance of chemical flow paths
  - CFD was used to develop vapor generator for the NRL testbed. First, 2-D modeling was developed and then used to develop 3-D model (shown below). Apparatus has worked ideally and is experimentally verified.

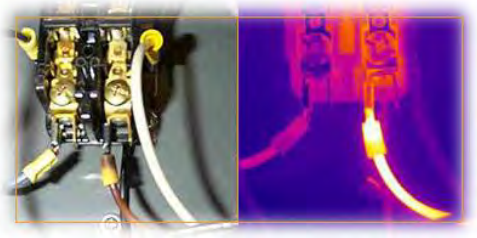




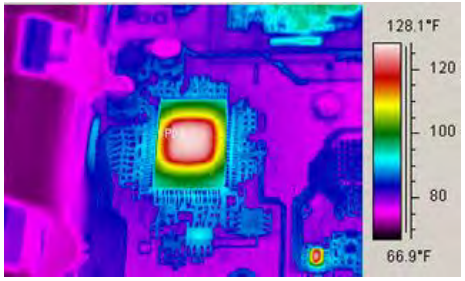
Non-Contact Thermography

- **<u>Challenge</u>: Non-contact (*in situ*) determination of heat/energy performance as a function of:**
  - Position
  - Time
  - Flow
- **<u>Solution</u>: Infrared Thermal Imaging**
  - Imaging offers position information about hot/cold spots
  - Fast (up to 9600 frames/second) camera frame rates offer dynamic information about temperature profiles
  - Non-contact imaging measures in native flow environment
- **<u>Advantages</u>:**
  - Value-added diagnostics on desorption properties
  - Spatial/temporal profiling of Joule heating
  - Can inform thermal/flow interface between MAEGLIN system components

NRL high speed IR camera



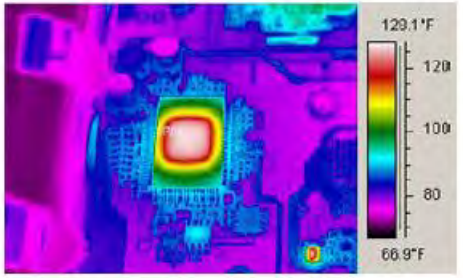
Example: Electrical wiring

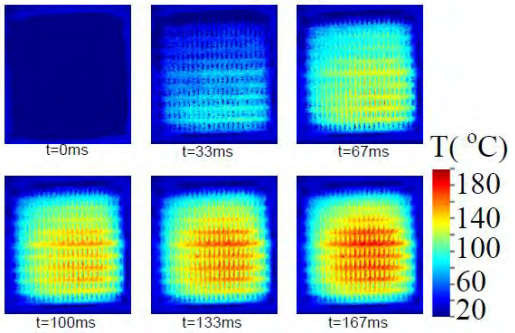


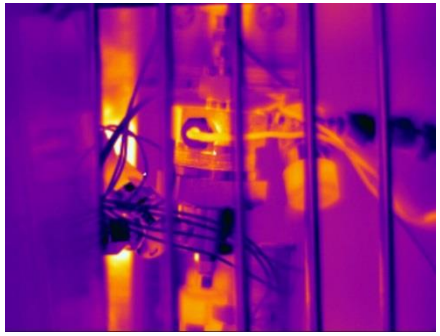
Example: PC board thermal profile

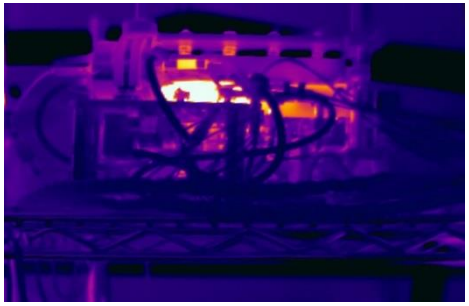
Thermography Measurements

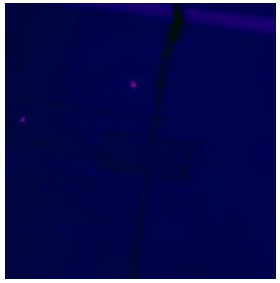
- **Macro Scale Thermography**
  - The NRL thermography test bed was utilized in Month 11 testing for 3 performer teams.
  - Test results help locate non uniform heating for desorption or heat management issues
  - Thermography measurements are voluntarily option during testing, based on suitability of device configuration
  - Micro-thermography is available and currently multiple performer teams are in discussions with NRL to utilize this system for more detailed measurements in the coming months.

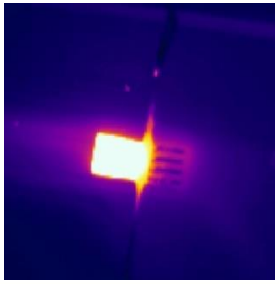




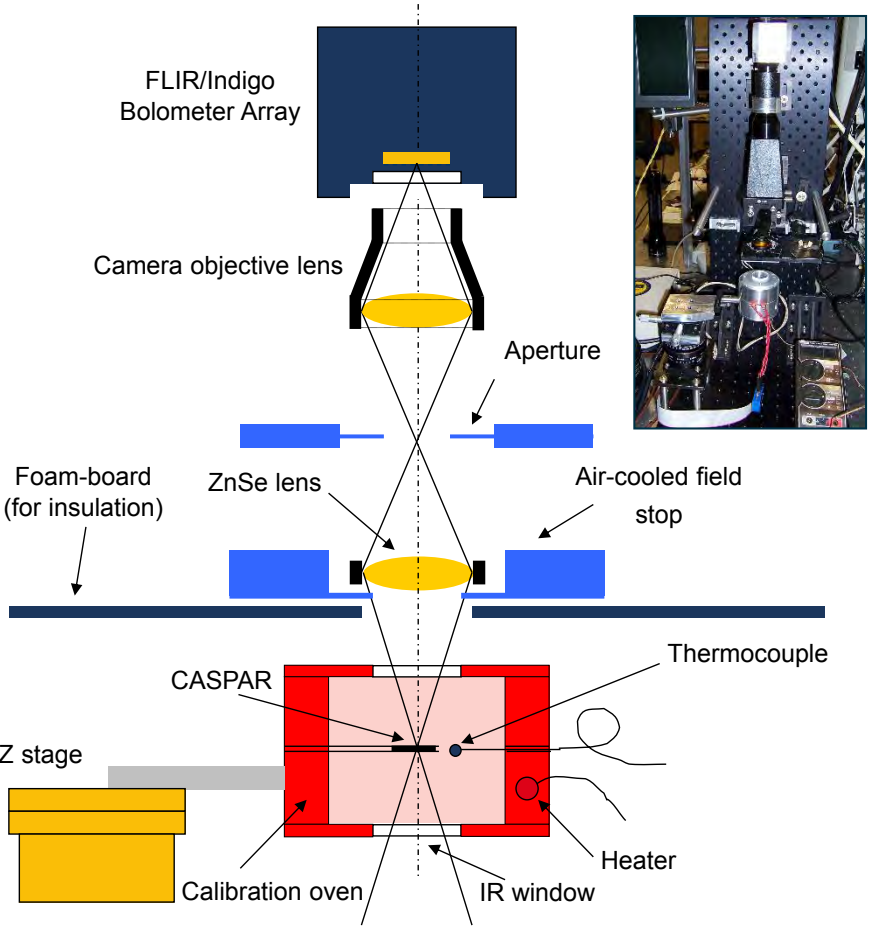








Infrared micro-Thermography Testbed



R. Furstenberg et al, *Rev. Sci. Inst.*, Jun 2007, 78

NRL test-bed provides:

- Calibrated thermal characteristics of collector, injector or micro GC column modules.
- Thermal uniformity mapping with or w/o flows.
- Platform to evaluate different device design variants.
- Device under test line of sight (or through IR window) testing.

Test Conditions:

- Microfabricated device electrically heated
- With and without active airflow
- Sorbent coated or uncoated device

Test-Bed Features:

- Oven calibration
- Thermal dynamics
- Thermal mapping
- Conduits for electrical and pneumatic fittings
- Active airflow testing
- Adaptable for device size variants
- Oven free option for larger device studies

Time	Topic	Speaker
7:30 - 8:00	Arrival, Badging	
8:00-8:15	Logistics, Proposer's Day Goals	Dr. Kristy DeWitt Program Manager
8:15-8:30	IARPA Overview and Remarks	Marianne Kramer Chief of Technology Transition
8:30-9:00	MAEGLIN Techical Overview	Dr. Kristy DeWitt
9:00-9:30	Government Presentation of Phase 1 Testbed and Results	Dr. Kristy DeWitt
9:30-9:45	Break	
9:45-10:45	MAEGLIN BAA Overview	Dr. Kristy DeWitt
10:15-10:45	Doing Businness w/ IARPA	Dr. Kristy DeWitt
10:45-11:00	Break	
11:00-11:30	Q&A Session	Dr. Kristy DeWitt
11:30-1:00	Lunch - Posters/Demos/Teaming Discussions	No Government
1:00-2:45	"Lightning Round" Presentations	No Government
1:00-1:10	*BAE Systems*	
1:10-1:20	*Signature Science*	
1:20-1:30	*U.M. - Zellers*	
1:30-1:40	*U.M. - Gianchandani*	
1:40-1:50	*U. M. - Fan*	
1:50-2:05	Break	
2:05-2:15	*MassTech*	
2:15-2:25	*Leidos*	
2:25-2:35	*SRI International*	
2:35-2:45	*UTAS*	
2:45-3:00	Break	
3:00-4:00	5 Minute Capability Briefs (No Government)	No Government