



# ***Health-Ready Components and Systems***

Peter H. Grau  
Program Manager

July 17, 2019



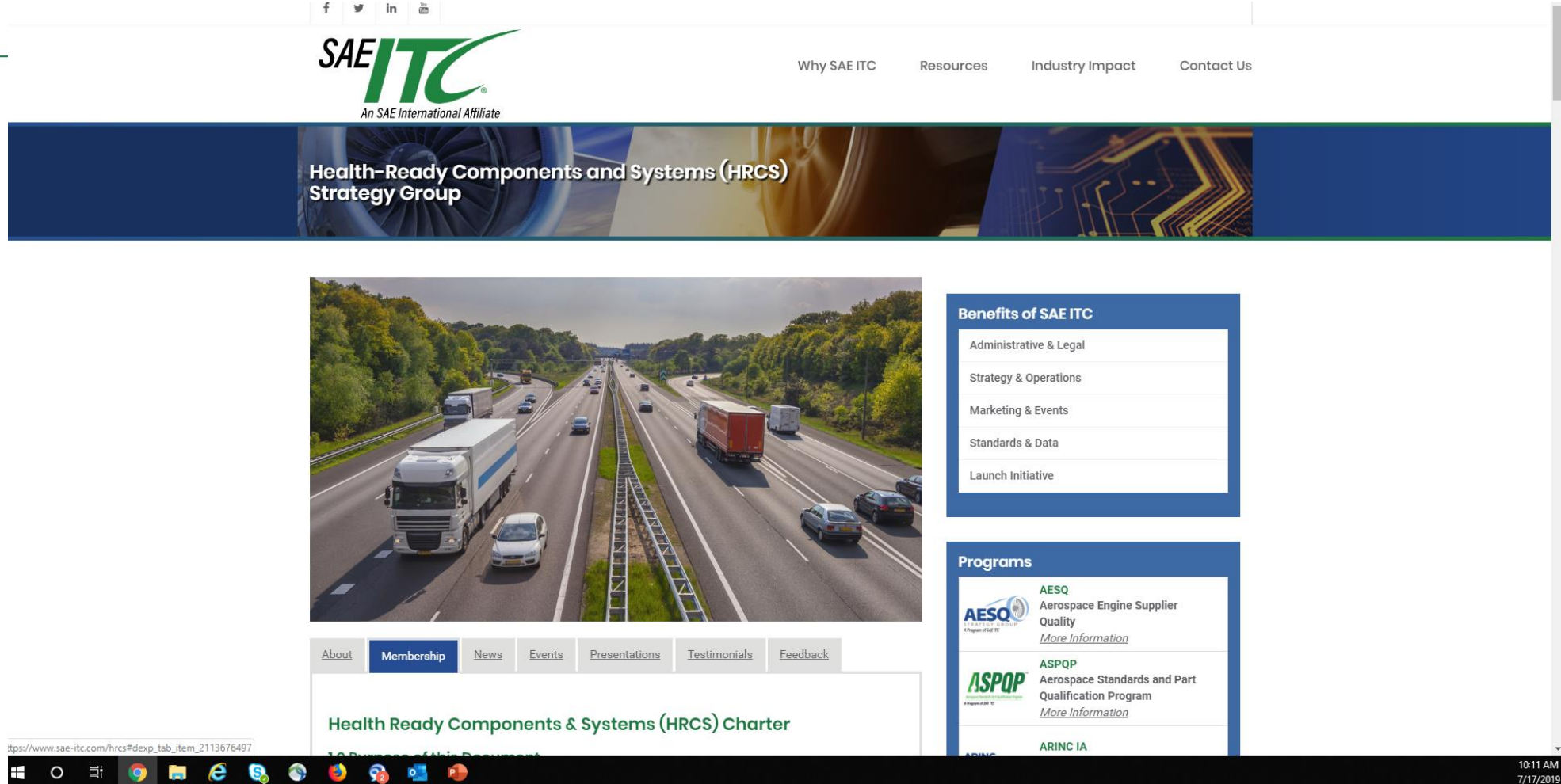
***Collaborative Innovation.  
Trusted Implementation.***

# PRESENTATIONS AT UPCOMING CONFERENCES

---

- PHM Asia-Pacific Conference July 23-25, 2019 (Beijing, China)
- HM-1 Committee September 17-19, 2019 (Paris, France)
- PHM Society Annual Conference September 21-26, 2019 (Scottsdale, AZ)
- Advanced Automotive Diagnostic Systems October 15-17, 2019 (Berlin, Germany)
- IIM Innovations In Mobility October 29-31, 2019 (Novi, MI)

# WEBSITE DEVELOPMENT



[www.sae-itc.com/hracs](http://www.sae-itc.com/hracs)

# IVHM CAPABILITY (**VEHICLE LEVEL**) (SOURCE: SAE JA6268™)

Illustrating industry evolution in use of diagnosis & prognosis for vehicle maintenance

SAE Level	Vehicle Health Capability	Narrative Description	Participation in Repair Actions	Key Data Resources	Availability of Logged &/or Real-Time Data	Use of Supporting Models	IVHM System Characteristics
<b>Manual Diagnosis &amp; Repair Process performed by Technician</b>							
<b>0</b>	Limited On-Vehicle Warning Indicators	Service actions for scheduled maintenance or when Operator notices problems or is alerted by indicator lights or simple gages.	<b>Operator/Driver &amp; Service Tech</b>	On-Vehicle Measurements & Observation	N/A	Paper-based Manuals	Only Manual Diagnostic Tools & No Condition-Based Services
<b>1</b>	Enhanced Diagnostics Using Scan Tools	Service techs gain added diagnostic insight using automated scanners to extract vehicle operating parameters & diagnostic codes.	Operator/Driver & Service Tech	<b>On-Vehicle &amp; Service Bay/ Depot Tools</b>	Logged Diagnostic Codes & Parameters available to Service Tech	Paper-based Manuals	On-Board Diagnostics Available
<b>2</b>	Telematics Providing Real-Time Data	Service techs gain real-time vehicle data via remote monitoring of vehicle to more completely capture issues.	Operator/Driver, Service Tech & Remote Support Center Advisor	On-Vehicle, Service Bay / Depot & Cloud Data	<b>Telematic Data Available to Service Tech with Diagnostics Info</b>	Paper-based Manuals	On-Board & Remote Data Available
<b>Diagnosis &amp; Repair Augmented by Prognosis &amp; Predictive Analytics</b>							
<b>3</b>	Component Level Proactive Alerts	Operator and service techs are provided with component health status (R/Y/G) before problem occurs . Limited condition-based maintenance.	Operator/Driver, Service Tech & Cloud-Based Services	On-Vehicle, Service Bay & Cloud Data	Telematic Data Available to Service Tech with Diagnostics Info	<b>Addition of Component-Level Health Models</b>	Component-Level Health Predictions
<b>4</b>	Integrated Vehicle Health Mgmt.	Operator and service techs are provided with system or vehicle level health indicators before problems occur with remaining useful life estimated. Condition-based maintenance.	Operator/Driver, Service Tech & Cloud-Based Services	On-Vehicle, Service Bay & Cloud Data	Telematic Data Available to Service Tech with Diagnostics Info	Addition of Vehicle-Level Health Models	<b>Vehicle-Level Health Management</b>
<b>5</b>	Self-Adaptive Health Mgmt.	Self-adaptive control and optimization to extend vehicle operation and enhance safety in presence of potential or actual failures.	Operator/Driver, Service Tech & Cloud-Based Services	On-Vehicle, Service Bay & Cloud Data	Telematic Data Available to Service Tech with Diagnostics Info	Addition of Vehicle-Level Health Models	<b>IVHM Capability Integrated into Vehicle Controls</b>

← For some, this could be on-board recording



# SAE JA6268™ THREE REGISTRATION STAGES (NOTE: NOW AT COMPONENT/SUBSYSTEM LEVEL)

---

Ladder-like structured Stage Registrations for easy entry and upgrades when ready. No proprietary information will be requested or listed.

Stage 1: *Functional Self Assessment*

Stage 2: *Failure Modes Assessment*

Stage 3: *Detailed Design Assessment*

## Note:

- *Stage 1 is a low barrier to entry provisional registration. All Stage 1 information will be recorded in online HRCS Registry.*
- *Stages 2 & 3 are enhanced by seeking an OEM/ integrator to validate the more detailed supplier-provided assessments. Stage 2 & 3 completion will be noted in HRCS Registry. **This additional (potentially proprietary) data will not be loaded into the registry.***

# SAE HRCS HEALTH-READY COMPONENTS REGISTRY

---

## Stage 1

\*All examples and associated numbers in this presentation are for illustrative purposes only.

# STAGE 1 REGISTRATION: QUICK, EASY WAY TO GET COMPONENTS LISTED

---

- Provide assurance that a consistent process was followed and that the information is correct.
- Enable participants to find information they are seeking in a cost-effective manner.
- Ensure a neutral, unbiased approach.
- Provide contacts for more information or issue resolution.
- Leverage shared knowledge and technology

# SAE HRCS HEALTH-READY COMPONENTS REGISTRY

---

## Stage 2

\*All examples and associated numbers in this presentation are for illustrative purposes only.



# STAGE 2: FAILURE MODES ASSESSMENT

Failure Mode Description	% Field Failures	Severity of Failure (5-1)	Avg Cost of Repairs (CPV) \$	Health Indicators ID'd (describe)	Relationships / Models ID'd (describe)	Machine Readable Information Exchange? (Y/N)	Machine Readable Conv of Raw Inputs to Eng Units? (Y/N)	Data Acquisition & Manipulation (DA & DM) % Coverage for Given Failure Mode	State Detection & Health Assessment (SD & HA) % Coverage for Given Failure Mode	Prognostics Assessment & Advisory Generation (PA & AG) % Coverage for Given Failure Mode
						<select>	<select>	0.0%	0.0%	0.0%
						<select>	<select>	0.0%	0.0%	0.0%
						<select>	<select>	0.0%	0.0%	0.0%
						<select>	<select>	0.0%	0.0%	0.0%
						<select>	<select>	0.0%	0.0%	0.0%



### Stated RUL Units:

- Hours
- Days
- Weeks
- Months
- Cycles (flights/trips/starts)
- Engine Hrs
- Operation Hrs
- Other: \_\_\_\_\_

# SAE HRCS HEALTH-READY COMPONENTS REGISTRY

---

## Stage 3

\*All examples and associated numbers in this presentation are for illustrative purposes only.

# STAGE 3: DETAILED DESIGN ASSESSMENT (~16 RELATIONAL TABLES)

Stage 3 is the most complete, providing design data. Stage 3 still under development.

ISO 13374 (OSA-CBM) Implementation Level / SAE JA6268™ Interface Name		Data Acquisition (DA)	Data Manipulation (DM)	State Detection (SD)	Health Assessment (HA)	Prognostic Assessment (PA)	Advisory Generation (AG)
Design-Time Interfaces	1	Table of Corrective Actions	X	X	X	X	X
	2	Table of Interfaces	X	X	X	X	
	3	Table of Parameters	X				
	4	Table of Failure Modes	X	X	X		
	5	Table of Condition Indicators		X	X		
	6	Table of Health Indicators			X	X	
	7	Table of Predictive Indicators				X	X
	8	Table of Reported State/Mode Indicators	X	X	X	X	
	9	Table of Loadable Software and Data Files	X	X	X	X	X
	10	Table of Automatically Reported Configuration Indicators			X	X	X
	11	Table of Internally Managed Data Recordings			X	X	X
	12	Table of Suggested, Externally Managed, Data Recordings	X	X			
	13	Table of Suggested, Externally Executed Algorithms	X	X			
	14	Table of Corrective Actions to Health Indicator Relationships	X	X	X	X	X
	15	Table of Corrective Actions to Interface Anomaly Relationships	X	X	X		
	16	Table of Indicator to State/Mode Validity Relationships	X	X	X		

\*All examples and associated numbers in this presentation are for illustrative purposes only.

# STAGE 3 REGISTRATION

---

Registry ***WILL NOT*** contain any proprietary information (only Stage 1 information will be included and displayed regardless of the Stage completed.)

# HRCS DATABASE REGISTRATION BADGES



# GARRETT TURBOCHARGER STAGE 1 REGISTRATION

SAE HRCS JA6268™ Registration	HRCS Stage Being Submitted	1		
Core Info Required for All Submissions (Stages 1, 2 or 3)		Fill in Grey Boxes		
Field	Description / Examples	Response		
Component Name	Antilock Brake System	Turbocharger with Variable Nozzle Turbine		
Known Aliases	ABS	eTurbo		
Supplier Name	XYZ Company	Garrett		
Sector	Automotive	Automotive		
Catalog Reference Number(s)	12 3456 7890	830323-5003S		
Supplier Contact Name	John Doe	Tim Felke		
Supplier Contact email	<a href="mailto:john.doe@xyz.com">john.doe@xyz.com</a>	<a href="mailto:tim.felke@garrettmotion.com">tim.felke@garrettmotion.com</a>		
Supplier Contact Phone	+1 (888) 123-4567	+1 (602) 510-3518		
Supplier Contact Address		La Piece 16, 1180 Rolle, Switzerland		
Supplier Website	xyz.com	<a href="https://www.garrettmotion.com/">https://www.garrettmotion.com/</a>		
DUNS Number (if applicable)				
CAGE Code (if applicable)				
Other Industry Standard Supplier Identifier (if applicable)			<select>	<select>
Primary Validation Approach	Combined Design & Run-Time Info	Combined Design & Run-Time Info	Design-Time Info Only	Aerospace
OEM or Integrator Name	Giant Motors Company		Run-Time Info Only	Automotive
OEM/Integrator Contact Name	Jane Doe		Combined Design & Run-Time Info	Commercial
OEM/Integrator Contact email	<a href="mailto:jane.doe@giant.com">jane.doe@giant.com</a>			Off-Highway
OEM/Integrator Contact Phone	+1 (888) 123-4567		<select>	Marine
OEM/Integrator Contact Address			1	Defense
OEM/integrator Website	giant.com		2	Rail
OEM/Integrator DUNS Number (if applicable)			3	
OEM/Integrator CAGE Code (if applicable)				
OEM/Integrator Other Industry Standard Supplier Identifier (if applicable)				
Date Validation Certified	5/1/2019	7/1/2019		
Date Validation Expires	5/1/2022	7/1/2022		

**SAE HRCS HEALTH-READY COMPONENTS REGISTRY (CORE INFO)  
APPLIES TO STAGE 1, 2 & 3** (SAE JA6268™ Chapter 9)

- Component Name (and known aliases)
  - Supplier Name & Sector(s) (e.g., Aero, Auto, ...)
  - Supplier's catalog reference number (or numbers)
  - Suppliers contact information and DUNS number, CAGE Code or other industry standard supplier identifier (if applicable)
  - Validation approach can be based upon (a) design-time information, (b) run time information or (c) both design-time and run-time information
  - Format of Health Ready info which provides a mathematical model (or mathematical relationships) in a machine-readable format to allow for a proper interpretation and use of specific component parameters
  - Integrator/OEM name providing the validation along with their contact information and DUNS number (if applicable)
  - Dates validation was completed and date which the validation expires (if applicable)
- + Other items to be determined by HRCS SG (all non-proprietary)



# GARRETT TURBOCHARGER STAGE 1 REGISTRATION

IVHM Functional	Common IVHM Function or Process	General Description	% Coverage of Field Failures (if not provided, enter 0)
Data Acquisition (DA)	Data Management	System function and process to control, protect, manage, deliver and enhance the value of health state data and information for the user community.	85
	Data Transfer Interface	System function or system to download or communicate raw data, health state indicators and information for consumption by downstream systems.	
	Data Capture	System function may be a specialized data acquisition module that has analog feeds from sensors, collects processed data from a data bus or provides the software interface to a smart sensor.	
Data Manipulation (DM)	Feature Extraction	System function to manipulate data and compute certain statistical indicators from degradation (predictor) parameters.	80
	Data Normalization	System function to manipulate data and compute a limited range of values within a norm.	
	Data Processing	System function to manipulate data to compute health state indicator(s) or extract information for down stream systems.	
State Detection (SD)	Parametric Data Analysis	System function to process degradation parameter data streams captured in a predefined event, anomaly condition or using external equipment.	80
	Onboard Diagnostics	A dedicated system function for self-diagnostics and reporting of system failures.	
	Built-in-test (BIT)	The integrated system function that monitors and controls system self-tests to detect and report system failures to downstream systems.	
Health Assessment (HA)	BIT Filtering & Correlation	System function and process to manage false alarms, fault persistence and correlate primary and secondary diagnostic trouble (BIT) codes to operational capabilities.	75
	Fault Isolation Analysis	System function and process to resolve reported failure ambiguities using model-based diagnostics or multiple data observations.	
Prognostics Assessment (PA)	Time-to-fail Assessment	System function to monitor, record, assess and report equipment degradation parameter data and produce predicted performance life remaining estimates.	65
	Usage Monitoring & Assessment	System function to monitor, record, assess and report equipment life usage parameter data and produce predicted remaining useful life estimates.	
Advisory Generation (AG)	Decision Support Analysis	System function and process for the transformation and analysis of health state data and information to produce prescriptive actions for the user community.	80
	Health Reporting	System function to monitor, record and report health state data and information for consumption by downstream systems.	
	Caution Warning Indicators	System function to monitor, record, assess and report safety critical equipment failures and produce caution and warning indications for operators.	

# GARRETT TURBOCHARGER STAGE 1 REGISTRATION

SAE HRCS JA6268™ Registration		
Function Self-Assessment, Stage 1, Part B Worksheet		
Field	Description / Examples	Response
<b>For Data Acquisition and Manipulation</b>		
Machine Readable Info Exchange? (select)	XLS templated form	XLS templated form
Machine Readable Conv of Raw Inputs to Eng Units? (select)	source code	XLS templated form
Severity of Failures? (Range: 5-1)	5-3	5-3
<b>For State Detection &amp; Health Assessment</b>		
Health Indicators ID'd? (Y/N)	Y	Y
Relationships/Models ID'd? (Y/N)	Y	N
Diagnostic Metrics 1? (specify range & type)	30-40%	20-30%
Type for Above	NTF (NFF)	NTF (NFF)
Diagnostic Metrics 2? (specify range & type)		2
Type for Above		Ambiguity Group Size
<b>For Prognostics Assessment &amp; Advisory Generation</b>		
Typical RUL Notice?	14.0	60.0
Units for Above	Days	Days
Typical Std Dev for RUL? (specify units if applicable)	4.0	10.0
Units for Above	Days	Days
Prognostic Metrics 1? (specify range & type if applicable)	99%	85%
Type for Above	TPR	TPR
Prognostic Metrics 2? (specify range & type if applicable)	90%	0.15%
Type for Above	FPR	FPR

## STAGE 1: FUNCTIONAL SELF-ASSESSMENT, PART B WORKSHEET

Part B asks 9 Supplemental Questions for Covered Failure Modes Identified in Part A to assess sophistication

- **For Data Acquisition and Manipulation**
  - Machine Readable Info Exchange? (Y/N)
  - Machine Readable Conv of Raw Inputs to Eng Units? (Y/N)
  - Severity of Failures? (Range: 5-1)
- **For State Detection & Health Assessment**
  - Health Indicators ID'd? (Y/N)
  - Relationships/Models ID'd? (Y/N)
  - Diagnostic Metrics? (specify range & type)
- **For Prognostics Assessment & Advisory Generation**
  - Typical RUL Notice? (specify units if applicable)
  - Typical Std Dev for RUL? (specify units if applicable)
  - Prognostic Metrics? (specify range & type if applicable)

SAE ITC Collaborative Innovation. Trusted Implementation. SAE Industry Technologies Consortia (SAE ITC) | 1/8/19 | Copyright © SAE ITC. Further use or distribution is not permitted without permission from SAE ITC. 24

Dropdown field definitions:

<select>	<select>	<select>	<select>
Y	Hours	TPR	N/A
N	Days	FPR	XLS templated form
	Weeks	TNR	ACCDB templated form
	Months	FNR	MS Word templated tables
	Cycles	PPV	XML templated form
	Engine Hrs.	NPV	source code
	Cycles	FDR	pseudo code
	Engine Hrs.	FOR	
	Operation Hrs.	Cd Coverage	
	Other	NTF (NFF)	
		Ambiguity Group Size	
		RUL Std Dev	

# HRCS DATABASE- ACTUAL LISTINGS\*

## Health-Ready Components Registry

SHOW 25 ENTRIES FILTER BY: SEARCH:

Part Name	Supplier Name	Sector	Certification Stage	Machine Readable Info Exchange	Machine Readable Conv of Inputs to Eng Units	Criticality of Failures	Data Acquisition & Manipulation Coverage	Health Indicators ID'd	Relationships/ Models ID'd	Diagnostic Metrics	State Detection & Health Assessment Coverage	Typical RUL Notice	Typical RUL Std Dev	Prognostic Metrics	Prognostics Assessment & Advisory Generation Coverage
Electric Power Steering (EPS)	Nexteer Automotive	Automotive	2	✓	✓	① ② ③ ④ ⑤		✓	✓	70% - 80% CdC				99% TPR 90% FPR	
Turbocharger with Electric Boost (eTurbo)	Garrett	Automotive	1	✓	✓	① ② ③ ④ ⑤		✓	✗	10% - 20% NTF (NFF) AMBIGUITY GROUP SIZE 1.7		30 Days	10.0 Days	91% TPR 0.10% FPR	
Turbocharger with Variable Nozzle Turbine- 5001S	Garrett	Automotive	1	✓	✓	① ② ③ ④ ⑤		✓	✗	20% - 30% NTF (NFF) AMBIGUITY GROUP SIZE 2.0		60 Days	10.0 Days	85% TPR 0.15% FPR	
Turbocharger with Variable Nozzle Turbine - 5003S	Garrett	Automotive	1	✓	✓	① ② ③ ④ ⑤		✓	✗	20% - 30% NTF (NFF) AMBIGUITY GROUP SIZE 2.0		60 Days	10.0 Days	85% TPR 0.15% FPR	
Turbocharger with Variable Nozzle Turbine - 5006S	Garrett	Automotive	1	✓	✓	① ② ③ ④ ⑤		✓	✗	20% - 30% NTF (NFF) AMBIGUITY GROUP SIZE 2.0		60 Days	10.0 Days	85% TPR 0.15% FPR	

Previous 1 Next



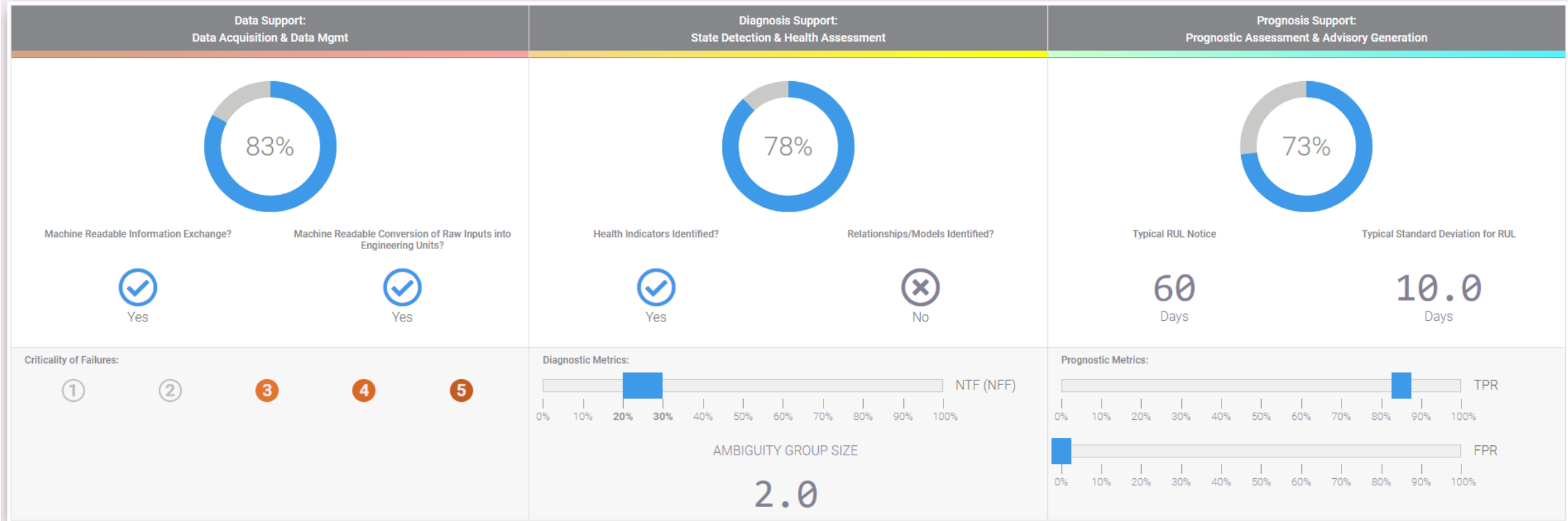
# HRCS DATABASE- STAGE 1 LISTING DETAIL

SAE ITC Health-Ready Components & Systems (HRCS) Registry (Beta)

Health-Ready Components Registry > Turbocharger with Variable Nozzle Turbine

Turbocharger with Electric Boost Garrett

STAGE 1



# HRCS DATABASE- LISTING CORE INFORMATION



Health-Ready Components & Systems (HRCS) Registry (Beta)

Health-Ready Components Registry > Turbocharger with Variable Nozzle Turbine

Turbocharger with Electric Boost Garrett STAGE 1

Data Support: Data Acquisition & Data Mgmt	Diagnosis Support: State Detection & Health Assessment	Prognosis Support: Prognostic Assessment & Advisory Generation
---	---	---

**Assembly Details** X

<b>Component Name</b> Turbocharger with Variable Nozzle Turbine		<b>HRCS Certification Stage</b> STAGE 1	
<b>Known Aliases</b> eTurbo	<b>Catalog Reference Number(s)</b> 830323-5003S	<b>Primary Validation Approach</b> Combined Design & Run-Time Info	<b>Format of Health-Ready Information</b> XLS templated form
<b>Supplier Name</b> Garrett	<b>Sector</b> Automotive	<b>Date Validation Certified</b> 7/1/2019	<b>Date Validation Expires</b> 7/1/2022
<b>DUNS Number</b> n/a	<b>CAGE Number</b> n/a		

**Supplier Contact**

Tim Felke [@tim.felke@garrettmotion.com](mailto:tim.felke@garrettmotion.com)  
[+1 \(602\) 510-3518](tel:+16025103518)

La Piece 16,  
1180 Rolle,  
Switzerland

Machine Readable Information Exchange? Machine Readable Information Exchange?

Yes

Criticality of Failures: ① ② ③

2.0

AMBIGUITY GROUP SIZE

Typical Standard Deviation for RUL

10.0

Days

TPR

FPR

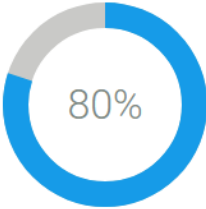
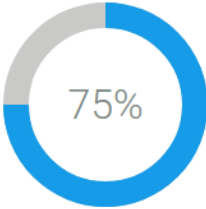
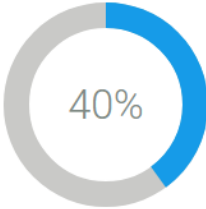
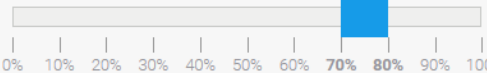
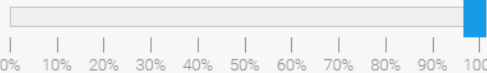
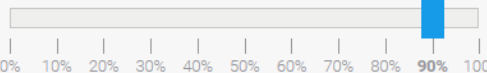
# HRCS DATABASE- STAGE 2 LISTING DETAIL



SAE ITC Health-Ready Components & Systems (HRCS) Registry (Beta)

Health-Ready Components Registry > Electric Power Steering (EPS)

Electric Power Steering (EPS) Nexteer STAGE 2

Data Support: Data Acquisition & Data Mgmt	Diagnosis Support: State Detection & Health Assessment	Prognosis Support: Prognostic Assessment & Advisory Generation
 <p>80%</p>	 <p>75%</p>	 <p>40%</p>
<p>Machine Readable Information Exchange? <input checked="" type="checkbox"/> Yes</p> <p>Machine Readable Conversion of Raw Inputs into Engineering Units? <input checked="" type="checkbox"/> Yes</p>	<p>Health Indicators Identified? <input checked="" type="checkbox"/> Yes</p> <p>Relationships/Models Identified? <input checked="" type="checkbox"/> Yes</p>	<p>Typical RUL Notice</p> <p>Typical Standard Deviation for RUL</p>
<p>Criticality of Failures:</p> <p>① ② ③ ④ ⑤</p>	<p>Diagnostic Metrics:</p> <p>CdC:  70% - 80%</p>	<p>Prognostic Metrics:</p> <p>TPR:  90% - 100%</p> <p>FPR:  90% - 100%</p>



# HRCS DATABASE- LISTING CORE INFORMATION



SAE ITC Health-Ready Components & Systems (HRCS) Registry (Beta)

Health-Ready Components Registry > Electric Power Steering (EPS)

Electric Power Steering (EPS)

STAGE **2**

**Assembly Details** ✕

<b>Component Name</b> <b>Electric Power Steering</b>		<b>HRCS Certification Stage</b> <b>STAGE 2</b>	
<b>Known Aliases</b> EPS	<b>Catalog Reference Number(s)</b>	<b>Primary Validation Approach</b> Combined Design & Run-Time Info	<b>Format of Health-Ready Information</b> MS Word templated tables
<b>Supplier Name</b> Nexteer Automotive	<b>Sector</b> Automotive	<b>Validating OEM/Integrator/Operator</b> <b>General Motors Company</b>	
<b>DUNS Number</b> 00-025-7923	<b>CAGE Number</b>	Yat-Chung Tang      @ Yat-chung.tang@gm.com +1 (586) 907-3059	
<b>Supplier Contact</b>		29755 Louis Chevrolet Rd. Warren, MI 48093	
Matt Tompkins      @ matthew.tompkins@nexteer.com +1 (989) 757-4992		<b>Date Validation Certified</b> 3/25/2019	<b>Date Validation Expires</b> 3/25/2024

Machine Readable Info Exchange?  Yes

Criticality of Failures: ① ② ③ ④ ⑤

CdC: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

TPR: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

FPR: 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

# HRCS CONSORTIUM AND OTHER ACTIVITIES

---

- Listings:
  - All new listings during calendar 2019 free of charge through year-end 2020
  - Discounted listing fees thereafter commensurate with membership level
  - SAE Badges by Stage (registration level) for improved product branding
- Members signing by August 31<sup>st</sup> will be **Charter Members** who determine initial projects and goals
- Conference with HRCS Session and exhibition: Innovations In Mobility October 29-31, 2019



October 29-31, 2019 | Novi, MI

# Innovations in Mobility

A REVOLUTIONARY TRANSFORMATION

<https://www.sae.org/attend/innovationsinmobility>

# Event-at-a-Glance

## October 29 TUESDAY

**7:00 a.m. - 4:00 p.m.**  
Registration Hours  
Exhibit Hall

**8:30 a.m. - 9:30 a.m.**  
Technical Sessions  
Session Rooms

**9:30 - 10:00 a.m.**  
Coffee / Networking Break  
Exhibit Hall

**9:30 a.m. - 6:00 p.m.**  
Exhibit Open  
Exhibit Hall

**10:00 a.m. - 11:30 a.m.**  
Technical Sessions  
Session Rooms

**11:30 a.m. - 1:00 p.m.**  
Luncheon  
Exhibit Hall

**1:00 - 2:30 p.m.**  
Technical Sessions  
Session Rooms

**2:30 - 3:00 p.m.**  
Coffee / Networking Break  
Exhibit Hall

**3:00 - 4:30 p.m.**  
Technical Sessions  
Session Rooms

**4:30 - 6:00 p.m.**  
Networking Reception  
Exhibit Hall

## October 30 WEDNESDAY

**7:00 a.m. - 4:00 p.m.**  
Registration Hours  
Exhibit Hall

**8:30 a.m. - 9:30 a.m.**  
Technical Sessions  
Session Rooms

**9:30 - 10:00 a.m.**  
Coffee / Networking Break  
Exhibit Hall

**9:30 a.m. - 3:00 p.m.**  
Exhibit Open  
Exhibit Hall

**10:00 a.m. - 11:30 a.m.**  
Technical Sessions  
Session Rooms

**11:30 a.m. - 1:00 p.m.**  
Luncheon  
Exhibit Hall

**1:00 - 2:30 p.m.**  
Technical Sessions  
Session Rooms

**2:30 - 3:00 p.m.**  
Coffee / Networking Break  
Exhibit Hall

**3:00 - 4:30 p.m.**  
Technical Sessions  
Session Rooms

## October 31 THURSDAY

**7:00 a.m. - 1:00 p.m.**  
Registration Hours  
Exhibit Hall

**8:30 a.m. - 9:30 a.m.**  
Technical Sessions  
Session Rooms

**9:30 - 10:00 a.m.**  
Coffee / Networking Break  
Exhibit Hall

**9:30 a.m. - 3:00 p.m.**  
Exhibit Opens  
Exhibit Hall

**10:00 a.m. - 11:30 a.m.**  
Technical Sessions  
Session Rooms

**11:30 a.m. - 1:00 p.m.**  
Luncheon  
Exhibit Hall

**1:00 - 2:30 p.m.**  
Technical Sessions  
Session Rooms

**2:30 - 3:00 p.m.**  
Coffee / Networking Break  
Exhibit Hall

**3:00 - 4:30 p.m.**  
Technical Sessions  
Session Rooms

**TECHNICAL  
SESSION**

**NETWORKING  
OPPORTUNITY**



### Co-located SAE International events:

- ADAS to Automated Driving Symposium
- Co-Optimization of Fuels and Engines Symposium
- Additive Manufacturing Symposium
- Augmented and Virtual Reality Symposium
- Engine and Materials Convergence Conference
- Range Extenders Symposium
- Automated and Connected Vehicle Systems Testing Symposium
- Transmission and Driveline Technologies Symposium

### Innovations in Mobility's Tracks:

- Automated & Unmanned Mobility
- Advanced Propulsion
- Smart Mobility and Infrastructure
- Smart Manufacturing
- Next Gen Materials



## Automated & Unmanned Mobility

The Automated and Unmanned Mobility track will explore the automated vehicle market, new business concepts such as mobility as a service, technology development in the area of sensor fusion and data collection, data management/blockchain, the internet of things (IoT), artificial intelligence, machine learning, occupant protection, health ready components/IVHM and much more.



## Advanced Propulsion

The Advanced Propulsion track will explore future technology development in the areas of transmission, driveline, all-wheel drive, range extenders, hybrid/electric transmission and driveline, batteries, battery charging, fuel cells, fuel and engine co-optimization, net zero carbon fuels, natural gas, and engine materials.





## Smart Mobility and Infrastructure

The Smart Mobility and Infrastructure track will address current and future initiatives by state, urban and city planners to meet the future needs of automated vehicles and their passengers.



## Smart Manufacturing

The Smart Manufacturing track at Innovations in Mobility explores the next generation factory floor with technologies such as additive manufacturing, industrial internet of things (IoT), the digital thread, extended reality (XR), machine learning, artificial intelligence, blockchain, and robotics.



## Next Gen Materials

The Next Gen Materials track will provide useful insight into many of the high priority challenges that the materials community is currently addressing related to new generation vehicles while also taking a look into the near and long-term future.

# Five Program Tracks:

Date	Smart Manufacturing	Next Gen Materials	Advanced Propulsion			Automated & Unmanned Mobility				Smart Mobility and Infrastructure
			Engine and Materials Convergence		Transmission & Driveline	Deployment	Sensors	Intelligence	Safety	
10/29	Additive Manufacturing		Natural Gas	Hybrid & Electric Powertrain	Transmission & Driveline	Wireless Communication	Sensor Fusion, Integration, and Data Collection	Internet of Things	Occupant Protection	Smart Cities
10/30	Smart Manufacturing (IIOT, Blockchain)	Metals & Non-Metallics	Fuels and Engines Interactions and Co-Optimization Opportunities	Hybrid/Electric Transmission & Driveline		Market Analysis & Deployment Strategies	Sensor Fusion, Integration, and Data Collection	Artificial Intelligence	Validation Certification and Testing	Urban Mobility
10/31	Augmented & Virtual Reality for Manufacturing	Powertrain Materials	Net Zero Carbon Fuels	Range Extenders	All Wheel Drive	HD Mapping		Machine Learning	Health Ready Components/IVHM	Infrastructure & Research

Exhibits &  
Sponsorships  
Contact:

**Megan McCoy**  
Event Sales

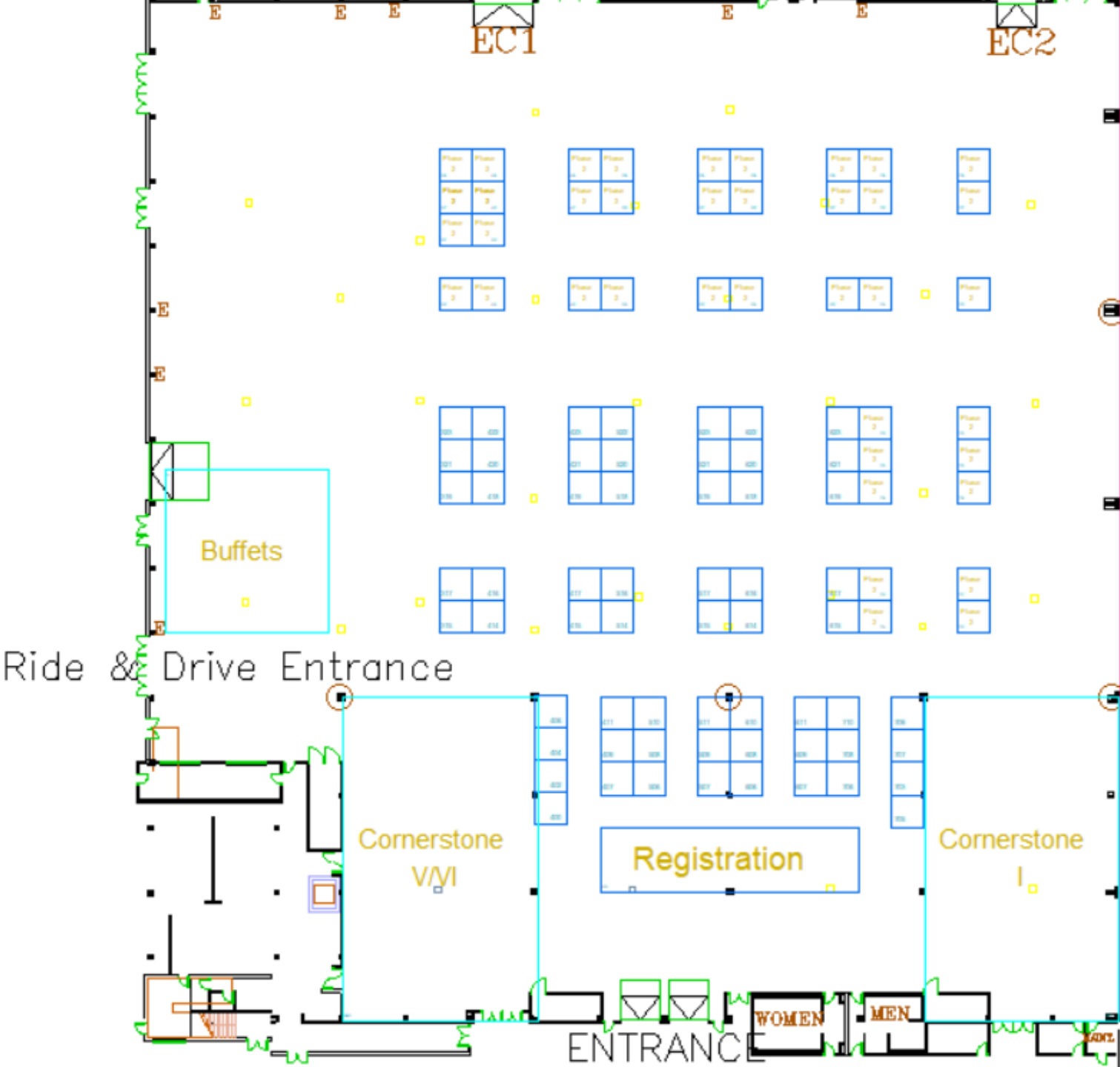
**SAE INTERNATIONAL**  
400 Commonwealth Drive  
Warrendale, PA 15096

o +1.724.772.4037  
m +1 412.992.6518  
e [megan.mccoy@sae.org](mailto:megan.mccoy@sae.org)

**Nicole Gize**  
Event Sales & Development

**SAE INTERNATIONAL**  
755 West Big Beaver, Suite 1600  
Troy, MI 48084

o +1.248.273.2466  
m +1.248.765.7937  
e [nicole.gize@sae.org](mailto:nicole.gize@sae.org)



# CONSORTIUM DEVELOPMENT



## Mission

*SAE Industry Technologies Consortia (ITC) enables organizations to connect, collaborate and positively impact global industries by empowering implementation of precompetitive solutions and innovative technologies.*

## Vision

*We are a trusted global leader in consortia-based collaborative tools and services for highly technical industries' operations and supply chain, especially automotive and aerospace.*

***Collaborative Innovation. Trusted Implementation.***

# HRCS MEMBERSHIP AGREEMENT



## Health-Ready Components & Systems™ (HRCS™) A Program of SAE ITC® MEMBERSHIP AGREEMENT

This Health-Ready Components and Systems Membership Agreement (the “Agreement”) is made by and between SAE Industry Technologies Consortia®, a Pennsylvania not-for-profit corporation, having a principal place at 400 Commonwealth Drive, Warrendale, PA 15096 (“SAE ITC”) and [Company Name], a \_\_\_\_\_ corporation, having an address at \_\_\_\_\_ (“Member”).

### Health-Ready Components & Systems™ (HRCS™) A Program of SAE ITC® MEMBERSHIP AGREEMENT

This Health-Ready Components and Systems Membership Agreement (the “Agreement”) is made by and between SAE Industry Technologies Consortia®, a Pennsylvania not-for-profit corporation, having a principal place at 400 Commonwealth Drive, Warrendale, PA 15096 (“SAE ITC”) and [Company Name], a \_\_\_\_\_ corporation, having an address at \_\_\_\_\_ (“Member”).

#### WITNESSETH

WHEREAS, SAE ITC® is organized and operated for the development of industry standards, requirements, documents and guidelines, for research and development, and the development of Programs for certification and conformance with standards, accreditation, and education, and undertakes such Programs and activities in support of its industry consortia and participant groups pursuant to Section 501(c)(6) of the Internal Revenue Code of 1986.

WHEREAS, the Health-Ready Components and Systems™ (“HRCS” or “Program”) has been organized as an industry program of SAE ITC to establish a global community to establish best practices and uniform information sharing methods between OEMs and their supplier base. This will facilitate industry-wide application of Integrated Vehicle Health Management (IVHM) technology to improve asset operational availability, sustainment, and logistical efficiencies.

WHEREAS, SAE ITC and the Member are independent entities and desire to engage into a business relationship to support the activities of the HRCS.

NOW, THEREFORE, in consideration of the mutual promises contained herein and intending to be legally bound hereby, the parties agree as follows:

**1.0 Membership**  
Member agrees to participate in and provide support to the HRCS. Membership is contingent upon approval by the Program Executive Committee, and payment of applicable fees.

Member agrees to abide by the terms and conditions of this Agreement, the HRCS Charter Agreement (“Charter”), the HRCS Operating Rules (the “Operating Rules”), as may from time to time be amended, and SAE ITC policies and procedures including SAE ITC Antitrust Compliance Guidelines which are incorporated into this Agreement by this reference. In the

[Click for full document](#)



# HRCS FEE SCHEDULE



## Health-Ready Components & Systems™ (HRCS™) A Program of SAE ITC ®

### MEMBERSHIP FEE SCHEDULE

Revision History	
Approved Date	Description
Date	Original Version

Membership Level	Eligible Participants	Annual Membership Fee	Project and Part Registration Fees	Payment Terms
Bronze	ALL	\$3,000	As needed	Net 60 days
Silver	ALL	\$6,000	As needed	Net 60 days
Gold	ALL	\$9,000	As needed	Net 60 days
Strategic Partner	By Invitation	In-kind services	As needed	Net 60 days



## Health-Ready Components & Systems™ (HRCS™) A Program of SAE ITC ® MEMBERSHIP FEE SCHEDULE

Revision History	
Approved Date	Description
Date	Original Version

Membership Level	Eligible Participants	Annual Membership Fee	Project and Part Registration Fees	Payment Terms
Bronze	ALL	\$3,000	As needed	Net 60 days
Silver	ALL	\$6,000	As needed	Net 60 days
Gold	ALL	\$9,000	As needed	Net 60 days
Strategic Partner	By Invitation	In-kind services	As needed	Net 60 days

[Click for full document](#)

# HRCS OPERATING RULES

---



**Health-Ready Components & Systems™ (HRCS™)**  
A Program of SAE ITC®

**OPERATING RULES**  
Click for full document

**Health-Ready Components & Systems™ (HRCS™)**  
A Program of SAE ITC®

## OPERATING RULES

# SAE ITC ANTITRUST

---



## ANTITRUST COMPLIANCE GUIDELINES INTRODUCTION

The SAE Industry Technology Consortia ("Consortia") Antitrust Compliance Guidelines (the "**Guidelines**") are intended to assist the members of the Consortia in complying with the antitrust laws and rules of conduct that may apply to the Consortia's activities. These Guidelines are intended to accomplish two objectives:

# HRCS APPLICATION FORM

---



## Application for Membership

Company / Organization	
Address Where Incorporated or Registered	
Primary Contact Name	
Primary Contact Email	
Primary Contact Phone	

# HRCS CHARTER AGREEMENT



Health-Ready Components & Systems™ (HRCS™)  
A Program of SAE ITC®

## Charter Agreement

# Health-Ready Components & Systems™ (HRCS™) A Program of SAE ITC®

## Charter Agreement

### 1.0 Purpose of this Document

SAE Industry Technologies Consortia® (“SAE ITC”) provides a neutral, legal framework for industry entities to convene and solve key technical challenges on a pre-competitive basis. The Health-Ready Components and Systems (“HRCS”) consortium has been organized as an industry Program of SAE ITC to establish best practices and uniform information sharing methods between OEMs and their supplier base. This will facilitate industry-wide application of Integrated Vehicle Health Management (“IVHM”) technology to improve asset operational availability, sustainment, and logistical efficiencies.

The purpose of this Charter Agreement (“Charter”) is to establish the terms and conditions under which participants (“Members”) will meet and function as an industry consortium Program (“Program”) of SAE ITC to develop a Health-Ready Components and Systems Program.

This document establishes HRCS as a Program of the SAE ITC and outlines the scope, objectives, vision, and mission of HRCS, as well as the relationship between HRCS and the SAE ITC and its policies, including the Antitrust Guidelines, Confidentiality and Intellectual Property Policy, and the general operation of HRCS. This document refers to and is supported by the following attachments:

- **Attachment 1: Membership Agreement** between Member organizations and HRCS which outlines the basic terms and obligations of membership, Program support, use and ownership of intellectual property and funding. By signing the Member Agreement, Members agree to the terms and conditions outlined in this Charter including all appendices, schedules and addendums, policies of SAE ITC and Program policies as established or updated by HRCS.
- **Attachment 2: Fee Schedule** to support the work of HRCS. The fees may increase or decrease due to changes in the scope, timing and nature of the work and operational costs (e.g. inflation).

### 1.0 Purpose of this Document

SAE Industry Technologies Consortia® (“SAE ITC”) provides a neutral, legal framework for industry entities to convene and solve key technical challenges on a pre-competitive basis. The Health-Ready Components and Systems (“HRCS”) consortium has been organized as an industry Program of SAE ITC to establish best practices and uniform information sharing methods between OEMs and their supplier base. This will facilitate industry-wide application of Integrated Vehicle Health Management (“IVHM”) technology to improve asset operational availability, sustainment, and logistical efficiencies.

[Click for full document](#)

# HRCS MEMBERSHIP BENEFITS AND PRICING

Membership Category	Leadership Voting	Corporate Member Voting	Complimentary Parts Listing	Webpage/Promotion	Program Documents	Online/ WebEx Training	Event Promotion/ Recognition	Registry Electronic Access	HRCS Events	Sponsorship rates	Annual Fee
<b>Bronze</b>	No	Yes	3	Listing	10% discount	10% discount	Yes	10% discount	10% discount	10% discount	\$3K
<b>Silver</b>	No	Yes	6	Listing +Link	25% discount	25% discount	Yes	25% discount	25% discount	25% discount	\$6K
<b>Gold</b>	Yes	Yes	9	Logo + Listing +2 links	50% discount	50% discount	Yes	50% discount	50% discount	50% discount	\$9K

**Membership term will be a calendar year, but 2019 will be prorated from date of entry.**



# HRCS DATABASE COMPONENT PRICING

Membership Category	Initial Setup Fee	2019-2020 Listing	3yr Listing Fee	3yr Listing Bundle (10)
Non-member	\$200	Complimentary	\$300	\$2,500
Bronze	\$100	Complimentary	\$270	\$2,250
Silver	\$50	Complimentary	\$225	\$1,875
Gold	Complimentary	Complimentary	\$150	\$1,250

# WHY JOIN THESE EFFORTS IN THE HRCS SG?

---

- Ensure **interoperable** instead of proprietary solutions
- Protection of operating in a legal, pre-competitive environment
- **Health-Ready Component Registry** gives visibility to SAE JA6268™ health-ready components and creates a cross-industry movement to implement IVHM
- Subcommittees agree on **specific document interchange content and format descriptions** building on existing documents (like GM's ICD component description file and ARINC standards) that can be augmented to better support for health-ready components
- Agreed upon **actions to put SAE JA6268™ into practice** by going down a level from the high-level content captured in JA6268™
- Subcommittees to tackle **terminology/lexicon/vocabulary** in important industry domains

# HOW CAN YOU GET INVOLVED NOW?

---

- Sign and return the **Membership Agreement**. **Those who sign by August 31, 2019 will be Charter Members**
- Submit components for listing in the database. **Note: Stage 1 is easy and all listings are complimentary through December 31, 2020.**
- Volunteer to participate in consortium development
- Submit pilot program recommendations
- Share membership benefits and low-cost entry with appropriate individuals in your company for action and signature
- Please return suggestions to Peter Grau at: [peter.grau@sae-itc.org](mailto:peter.grau@sae-itc.org)

# QUESTIONS?



# THANK YOU!





# HRCS STRATEGY GROUP POTENTIAL ACTIVITIES

---

## HRCS Activities and Objectives Roadmap

1. Strategy (Communications, Prioritization, Deployment, Standards, Trial Use Pilot Projects, etc.)
2. Communication, branding, and marketing actions (e.g., websites, press releases, social media, certification badges to use in ads, etc.)
3. Development of an HRCS database. The database will list components, their capabilities, and certification stage
4. Establishing a voting and membership policy, meeting cadence, and rules
5. Liaison with SAE committees (e.g., SAE HM-1, OBD-II, E-32, and ARINC Industry Activities, etc.) and other standards organizations
6. Liaison with government organizations and regulatory bodies to review requirements relating to the flow down of Health-Ready Component requirements to the supply chain
7. Development and coordination of HRCS characterization training, certification training, JA6268™ training, liaison/endorsement of providers
8. Guidance for applicable tool development to support implementation (e.g., registries, databases, data exchange tools, training, etc.)
9. Deployment actions (timing, execution)
10. Management of third-party service providers
11. Program Participant Agreement Appendix (HRCS Strategy Group contracted work)
12. Funding/finances - budget & invoicing and what it supports/limitations



# ADDITIONAL BENEFITS OF MEMBERSHIP

---

- Protection of operating in a legally protected environment
- Establish key relationships and trusted networks
- Voting privileges for all Consortium activities
- Discounted listing fees for HRCs in the registry
- Discounted event attendance
- Professional training courses and development
- Implement strategic business improvements and innovative technologies
- Co-develop, publish, and gain access to standards, tools, products, programs, and services