

New Capabilities / Development

- Advanced Photometry and Optics Laboratory, ARAI-HTC, Chakan
- ARAI's MARG 2.0: GIS based Tool for Vehicle Development through Road Condition Analysis
- India Specific Traffic Data Generation for Development of ADAS and AV Systems for India
- Automotive Cybersecurity and Software Update Certification of E/E Systems and Vehicles
- Digital Key for Cars: A Seamless Future
- Technical Support Cell
- Work Process Management Software (SHL-WPMS) for Component Certification
- PLI – AUTO ARAI PORTAL: For Production Linked Incentive Scheme (PLI) Applications of Advanced Automotive Technology (AAT) Products

Advanced Photometry and Optics Laboratory, ARAI-HTC, Chakan

In our pursuit towards becoming the leading Global Automotive Certification, Testing and Evaluation Organization, ARAI has established state-of-the-art facility, viz. "Advanced Photometry & Optics Laboratory" at ARAI-Homologation and Technology Centre (ARAI-HTC), Chakan, to cater to the certification and evaluation requirements of all types of lighting devices used in automobiles as well as general lighting assemblies.

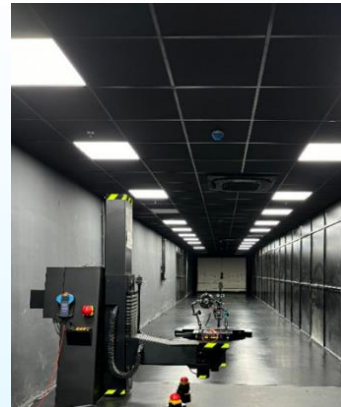
This facility is equipped to measure parameters such as Illuminance (lux)/ Luminous Intensity (cd)/ Luminance (cd/m²)/Colour Coordinate (x, y)/ Colour Temperature (CCT) / Colour Rendering Index (CRI) / Dominant Wavelength / Coefficient of Luminous Intensity (mcd/lx) / Coefficient of reflection (cd/m²/lx)/ Transmission (τ) & Diffusion (σ) / UV radiation (k_1, k_2)

This facility will provide homologation services as per various national and international standards, such as AIS, IS, UN Regulations, FMVSS, CMVSS, ADR, SANS, etc.

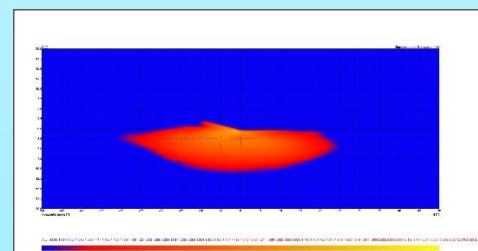
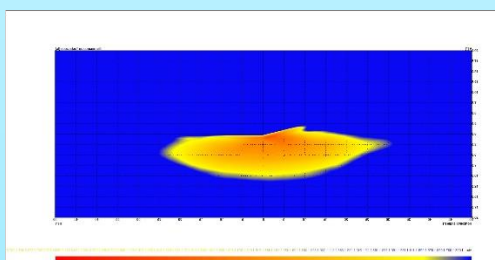
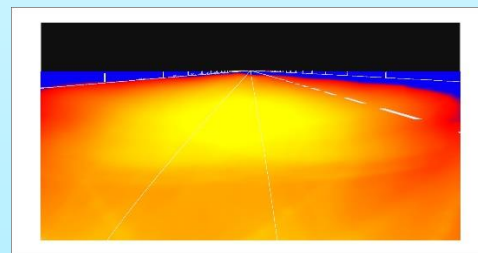
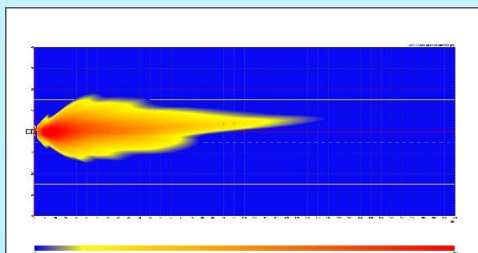


a. Automotive Lighting and Signaling Devices:

State-of-the-art Type A multiple Goniophotometers are used for testing and certification of all types of light and light signaling devices, viz. headlamp, including AFS and ADB technologies; stop lamps; direction indicator lamps; retro reflectors; etc. installed on the vehicles. The Lab is also equipped to perform testing of various light sources, viz. incandescent, Xenon, LEDs, replaceable LEDs, etc.



Additionally, this facility provides lamp light distribution data in the form of ISOLUX plots, ISO-candela diagram, bird's eye view plots and in the form of .IES files for analysis.



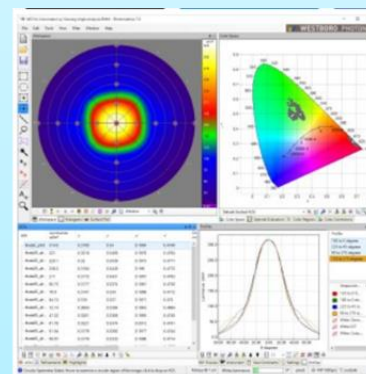
b. Road Furniture Devices and other Lights:

Additionally, with this facility we can do testing and evaluation of road furniture devices, such as road studs, road delineators, retro reflective tapes as per various standards, such as ASTM, AIS, IS, etc.



c. Imaging Colorimeter – Camera-based luminance meter

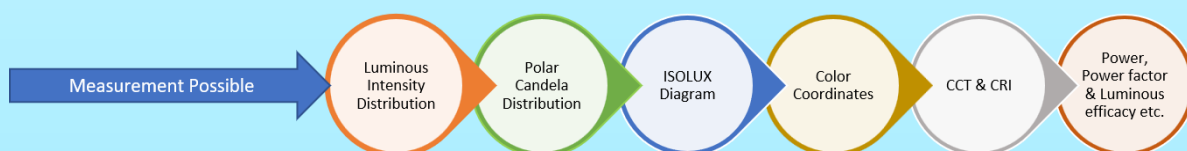
- High accuracy CCD based system provides precise measurements of luminance (cd/m^2) and colour characteristics such as x, y co-ordinates, colour temperature, wave length, etc.
- Evaluation of vehicle instrument clusters, head-up displays, flat panel displays, avionics - aircraft and aerospace, illuminated products such as integrated displays, flight controls and indicators, cabin lighting, signage, wing position lights, etc.





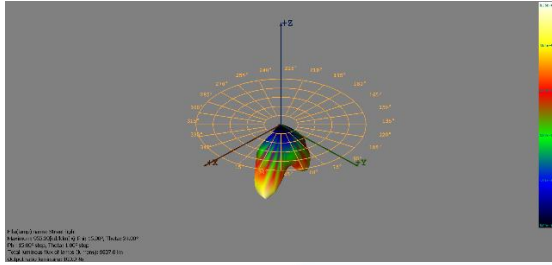
d. Testing & Certification of various Light sources & Luminaires under the gamut of General Lighting:

- State-of-the-art Type C Mirror Goniometer with Spectroradiometer in accordance with LM 79-19, LM 75-01, EN 13032-1, CIE Publication No. 70
- Integrating sphere (2m dia and 1m dia) for testing of light sources
- Evaluation all types of indoor and outdoor lights, streetlights, flood lights, portable luminaires, etc. as per LM 79 as well as various IS and IEC standards.

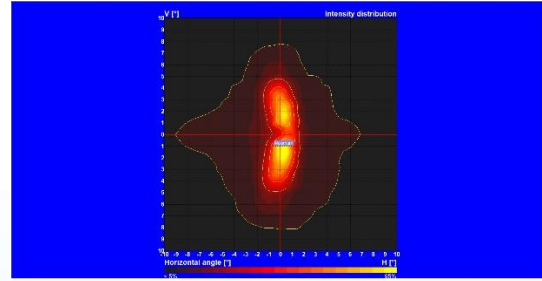


• Compliance Testing as per following Standards

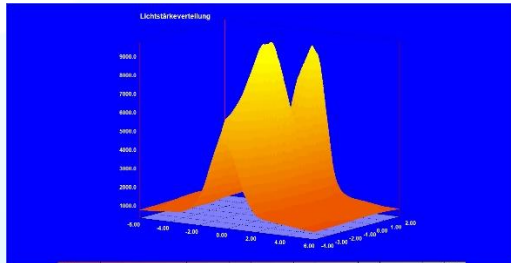
LM 79-2019, LM 79-08, IS 16106, IS 16102 (Part 2), IS 16103 (Part 2), IS 16107 (Part 2/Sec 1), IS 16107 (Part 2/Sec 2), IS 10322 (Part 5/Sec 1), IS 10322 (Part 5/Sec 2), IS 10322 (Part 5/Sec 3), IS 10322 (Part 5/Sec 4), IS 10322 (Part 5/Sec 5), IS 13383 (Part 1), IS 13383 (Part 2), IS 15111 (Part 2), IEC 62612, IEC 62717, IEC 62722-2-1, etc.



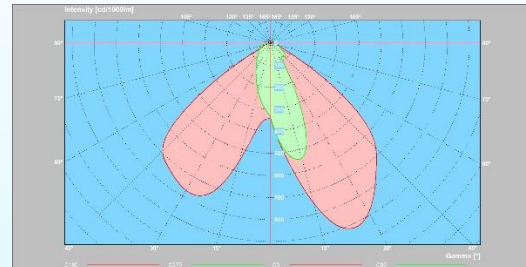
Graphical view of C plane measurement



Isoline diagram



3D Isoline diagram



Polar diagram

ARAI is the trusted partner of Indian lamp manufacturers for development, design validation, quality assessment and product conformity of their products.

ARAI has planned establishment of Optical Calibration Laboratory in near future.

❑ **ARAI's MARG 2.0: GIS based Tool for Vehicle Development through Road Condition Analysis**

Vehicle manufacturers always look for cost effective solutions to speed up development of new vehicles. Some of the major challenges are accurate measurement of vehicle performance and vehicle-reliability on different types of roads. This involves over-utilization of time, effort and money, especially when trying to understand how customers use their vehicles on various road conditions. Traditionally, the methods used to gather this information have been subjective and inconsistent.

To address these challenges, Structural Dynamics Laboratory (SDL) of ARAI has introduced MARG (Measurement Analysis of Road Geometry) 2.0, a ground-breaking Geographic Information System (GIS) based software tool, designed to provide precise and objective road roughness data across India.

MARG 2.0 represents significant advancement in how vehicle OEs/Tire OEs/Tier 1 manufacturers can approach the challenges faced by them to accommodate diverse Indian conditions during design, testing and validation phases of product development.

ARAI is supporting Automotive industry for transformation from traditional subjective decision making to scientific objective data driven decision making by providing advanced GIS based data in the form of road conditions / roughness [International Roughness Index (IRI)], i.e. MARG 2.0.

This innovative tool not only streamlines vehicle development process, but also helps in enhancing safety and reliability of vehicles on road. It includes geo referenced road roughness data from all across the country for different categories of typical indian roads, viz. city, national highway, state highway, expressway, etc.

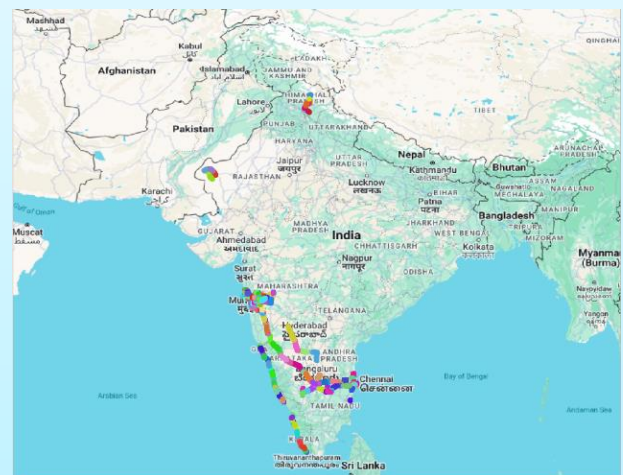
Highlights of ARAI MARG Tool

- MARG 2.0 comprises geo referenced road roughness (IRI) database of total 35,000 km, spread across 18 different states of India for different road categories, viz. city, national highway, expressway, state highway, village, sub-urban, etc. collected over the years. It provides detailed measurements of road roughness using IRI for every 100 meters of road.
- ARAI's MARG 2.0, a login-based software, offers several key features that make it an invaluable tool for vehicle and tire designers, durability and reliability engineers, quality engineers as well as manufacturers for target setting and understanding Indian road conditions.
- The tool includes geotagged photos of roads, allowing engineers to visualize the conditions they are analyzing while sitting at users' desk.
- Engineers can track changes in road conditions year-after-year on MAP to take decision on durability targets.
- MARG has in-built statistical analysis and data display tools, which help to identify the best representative test roads nearby OEM's facility / location that reflect diverse Indian road conditions.
- The tool provides insights into common road obstacles, like potholes and speed bumps, which are crucial for optimizing vehicle designs, particularly for electric vehicles (EVs).
- ARAI MARG 2.0 database is regularly updated and available for subscription.

MARG 2.0 Key Highlights : Software Interface and Applications



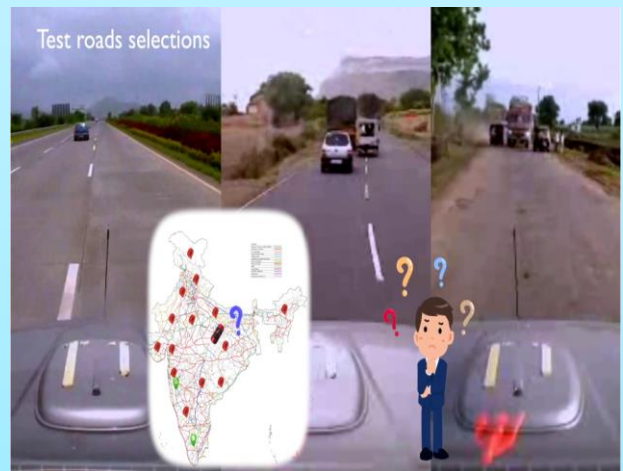
MARG 2.0 Software Interface



MARG 2.0 – Sample Road Roughness Heat MAP for selected Roads



MARG 2.0 Application – Road Roughness data along with Geo Tagged Photograph



MARG 2.0 Application – Test Route Selection

India customer usage: 35,000 km database:

Road Types	IRI	IRI-L	IRI-S	IRI-M	IRI-H
City	41.8 %	%	%	%	6.9 %
Sub urban	12.8 %	%	%	%	%
National Highway	11.8 %	%	%	%	%
State Highway	38.3 %	%	%	%	%
Expressway	25.2 %	%	%	%	%
Mountain Pass	24.2 %	%	%	%	%
Village road	21.2 %	%	%	%	25.6 %



Road Severity Distribution as per IRI

MARG 2.0 Application – Analysis of Statistical Distribution of Road Condition (International Roughness Index)

India customer usage: 35,000 km database:

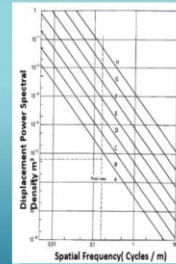


Table. Percentage distribution of road sections according to road Class as per ISO 8608

Road Types	0.1m to 100m (@10 m)				
	A	B	C	D	E
City	23%	%	%	1%	%
Sub urban	21%	%	%	6%	%
National Highway	61%	%	%	0%	%
State Highway	13%	%	%	2%	%
Express Way	100%	%	%	0%	%
Mountain Pass	0%	%	%	5%	%
Village Road	0%	%	%	24%	%

Road Severity Distribution as per ISO 8608

MARG 2.0 Application – Analysis of Statistical Distribution of Road Condition as per ISO 8608 Classes

Use Cases

MARG tool is beneficial in various scenarios:

- ❖ For Vehicle & Tire OEM:
 - MARG 2.0 is useful for target setting, design and validation of vehicles / tires that are better suited to Indian roads, which can lead to improved durability and performance.
 - MARG 2.0 will be the beneficial tool for vehicle validation and market target setting. Organizations conducting vehicle durability tests can select appropriate roads based on the detailed analysis of objective Geo referenced road roughness data provided in MARG 2.0. It will help to ensure that finalized vehicle test targets / schedules are effective and relevant to customer duty cycle. On road durability test routes representative to any market roads can be decided using statistical analysis tools provided in MARG 2.0.
- ❖ For Urban Planners:
 - The insights gained from MARG 2.0 can help in planning road maintenance and upgrades, leading to safer driving conditions.
- ❖ For Researchers:
 - Academics studying vehicle dynamics and road safety can utilize data from MARG to support their research.

In totality, ARAI's MARG 2.0 is a GIS based Mathematical tool that simplifies complexities of vehicle development by offering precise understanding of Indian road conditions and insights into road geometry. This advancement will ultimately lead to creation of safer and reliable vehicles to meet the needs of Indian consumers, towards safer and more efficient transportation system.

❑ India Specific Traffic Data Generation for Development of ADAS and AV Systems for India

Technology

Synchronously acquired multi-sensor India specific traffic dataset for development of ADAS and AV functionalities, specifically for India environment.

Properties/ Features

- India-specific conditions are covered:
 - Multiple states and major cities, covering expressways, state highways, rural roads and ghat sections
 - India-specific vehicles – auto-rickshaws, tempos, trucks, buses, bikes, etc.
 - Seasonal variations: rain, winter, summer
 - Time: dawn, day, noon, afternoon, twilight
- The generated dataset consists of synchronous data from the following sensors:
 - Camera sensors: 8
 - Lidar sensor: 64 channels
 - Mid-range radar sensor
 - Inertial Navigation Sensor – IMU + GPS
 - Vehicle CAN
- Captured raw data is in-time sync with each of the sensors.

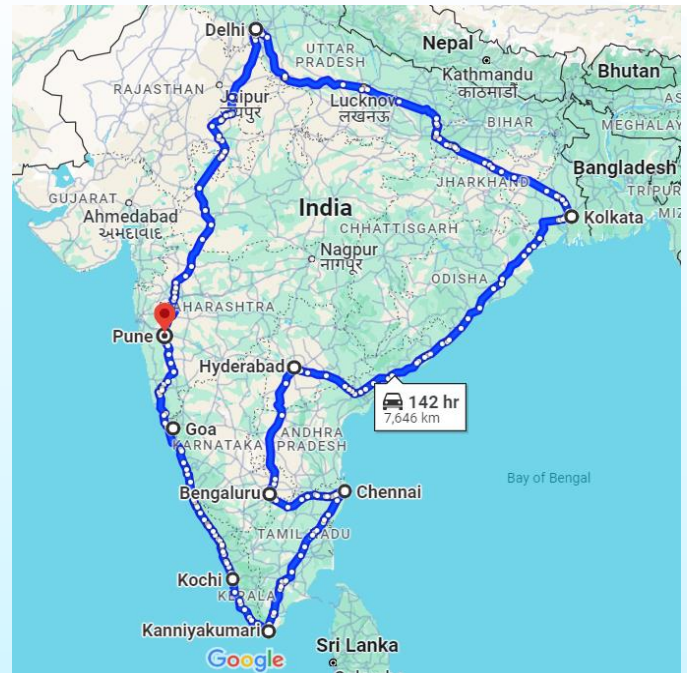


Figure 1 – Data Acquisition Route

Application

The generated synchronous data can be used for:

- Training and validation of AI models for ADAS functions and autonomous vehicles
- Sensor fusion research
- India specific traffic events extraction
- India specific traffic analysis and understanding
- Development of India-specific autonomous driving algorithms
- Testing and evaluation of autonomous driving systems for Indian cases
- Data-driven decision-making for urban planning
- Research in computer vision and machine learning
- Development of safety features for human-driven vehicles
- Creation of synthetic datasets

Abstract

Now-a-days Advanced Driver-Assistance Systems (ADAS) is equipping cars and drivers with advanced information and technology to make them aware of the environment and handle potential situations effectively, semi-autonomously. High-quality training and test data are essential in development and validation of ADAS systems, which lay foundation for autonomous driving technology.

Generation of synchronous multi-sensor datasets for India specific traffic conditions represents a crucial milestone in development of accurate and reliable autonomous driving systems tailored to India's unique urban landscape. This comprehensive dataset combines data from various sensors, such as cameras, lidars, radars, and GPS units, all synchronized to capture dynamic and often chaotic nature of Indian roads. By incorporating multiple sensor modalities, this dataset provides holistic view of traffic scenarios, including pedestrian behavior, vehicle interactions, road infrastructure and environmental factors, peculiarly to Indian cities. The synchronous nature of dataset ensures that all sensor inputs correspond to the precise moment, allowing precise correlation and analysis of different data streams. This rich, multi-dimensional dataset serves as a valuable resource for training and validating AI models designed to navigate India's complex traffic environments, ultimately contributing to safer and more efficient autonomous vehicles adapted to local conditions.

Beneficiary Industry

- Vehicle Manufacturers, Tier 1 suppliers
- Engineering Institutes working in AI / ML
- Developers and service providers working in ADAS / V areas
- Research Institutes and Startups developing algorithms for ADAS functionalities

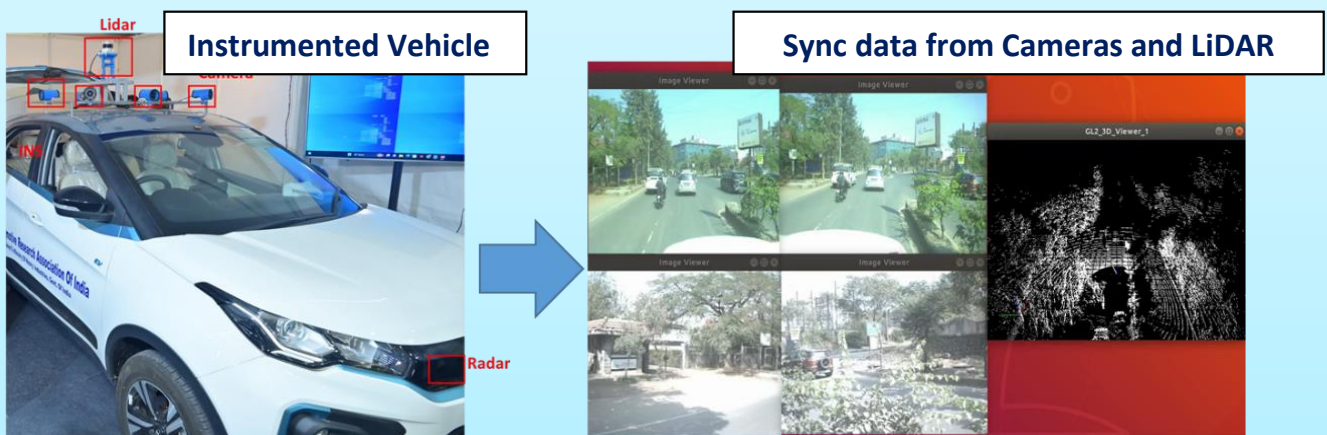


Figure 2 – Generation of synchronous India specific dataset from Instrumented Vehicle



Modern vehicles have become totally connected objects and require communication to support a wide range of scenarios from information and entertainment purposes to new ways of operating the vehicle such as driver assistance, connected fleet and autonomous driving modes. This fast-paced functional evolution has significantly increased the attack surface of the connected car.

These advanced cars consist of several Electronic Control Units (ECUs) to support various safety-critical functionalities. The underlying systems are susceptible to safety and cyber-attacks as the involved ECUs are interconnected. Security attacks can lead to disrupting safety operations of component and vehicle while causing injury to passengers. As a result, large variety of defensive mechanisms is needed to prevent the hackers.

Europe has already started implementation of Cyber Security Management System (UN R155) and Software Update Management System (UN R156) from June 2022. Automotive Industry Standards Committee (AISC) and CMVR - Technical Standing Committee (CMVR-TSC) has recently finalized AIS 189 for approval of vehicles for Cyber Security and Management Systems (CSMS) and AIS 190 for approval of vehicles for Software Update and Management System (SUMS). In future, scope of these standards will be expanded to cover L category vehicles also. Many electric vehicles, especially 2-Wheelers, are coming with telematics connectivity and Over-The-Air (OTA) software update features.

Traditionally, the security team performs Threat Analysis and Risk Assessment (TARA) in evaluating the risk associated with security incidents. Real Penetration and Fuzz testing depends on the result of TARA.

In order to face this challenge, there is a need to establish tools required for various cyber analysis and testing of automotive electronic components and entire vehicle. ARAI is in the process of establishing cyber security testing laboratory to cater to homologation and testing requirements.

This Testing Laboratory will consist of following state-of-the-art facilities:

- 1. Tools for threat and risk analysis**
- 2. Fuzz Testing Lab**
- 3. Penetration Testing Lab**
- 4. Side channel attacks**
- 5. Static and dynamic code analysis**
- 6. Vulnerability scanning tools**

This will help OE and component manufacturers to carry out development and certification activities in cyber security and software update with a view of ensuring safety and security of modern vehicles.

❑ Digital Key for Cars: A Seamless Future

Amendment No. 3 To AIS-076:2007: “Approval of Vehicle Alarm Systems (VAS) for M1 and N1 category of vehicles with regard to their Alarm Systems (AS)” describes new features of digital key unit used in modern vehicles.

The concept of a digital key is revolutionizing the automotive industry. Digital key allows users to unlock, start and share access to their vehicle using a smart device, like smartphone. The digital key system is being developed to provide more convenient, secure and user-friendly alternative to traditional keys.



Key Features

Digital keys offer numerous use-cases:

Unlocking the vehicle: When smartphone is in close proximity, the system, through proximity sensors, can unlock or lock the car without requiring any user interaction. This is commonly referred to as passive entry.

Engine start: Engine can be started when the device is detected inside the vehicle, simplifying the process by just pressing START button.

Key sharing: Temporary either in-person or remote access can be granted to others, such as family members or service providers.

Security Standards: Given the sensitive nature of automotive security, development of digital key technology adheres to stringent safety requirements outlined by industry standard, viz. AIS 076. The key aspects include:

- **Trustworthiness:** Digital key exchanges must come from verified devices to prevent malicious attacks.
- **Freshness and Binding:** Messages between the device and vehicle must ensure they are current and tied to the proper user, safeguarding against replay attacks or unauthorized access.

The technology behind digital keys relies on Secure Elements (SEs), Trusted Execution Environments (TEEs), and secure communication protocols, like Bluetooth, NFC and Global Platform, ensuring that the user experience is smooth and reliable.

Testing and Validation of digital key according to AIS 076 is augmented at ARAI. AIS 076 standard emphasizes robust security validation.

Cyber Security related threats are important for digital key. Automotive digital key is connected to vehicles through smartphone that is enrolled with the software and connects both on cloud server. Manufacturers are thus involved in developing advanced cyber security systems to provide better security against hacking.

Car Connectivity Consortium (CCC) is an industry-wide collaboration aimed at developing global standards for smart device and vehicle connectivity. Comprising of leading automotive manufacturers, smart device companies and technology providers, CCC plays crucial role in driving interoperability between different brands and platforms. Its focus includes creating unified digital key eco-system that allows seamless communication between cars and mobile devices. By promoting these standards, CCC ensures enhanced security, user convenience and consistency across the automotive industry.

As the automotive industry moves towards connected vehicles, adoption of digital keys offers consumers greater flexibility and convenience. Standards, like AIS 076 ensure that this transition happens securely, making digital keys a safe and efficient solution for the future of mobility.

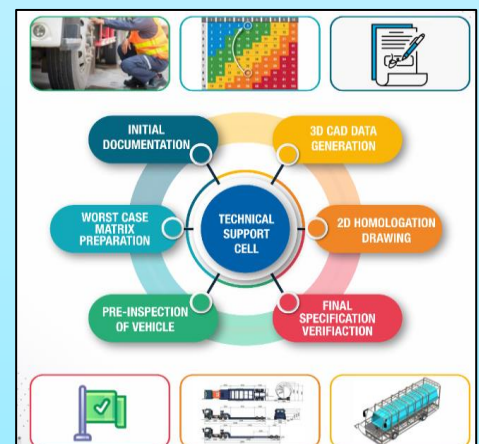
❑ Technical Support Cell

ARAI has launched Technical Support Cell (TSC) to provide homologation technical support, guiding clients through type approval process as per Central Motor Vehicles Rules (CMVR), with initial documentation and detailed guidance for necessary documentation and drawings. This Cell is dedicated to serve diverse market sectors, including EV start-ups, MSME component manufacturers and the unorganized sector of bus, truck and trailer body builders.

As Government of India and various state Governments have initiated schemes for startups and incentive for local manufacturing to boost electric mobility and promote development of electric vehicles, we have seen sudden rise in EV startups in last few years. These new entrants require special support for CMVR Type approval, which is mandatory in order to register new vehicles, technical requirements, type approved components, Conformity of Production (COP) and whole homologation process, to avoid hindrances in their launching phase. Additionally, the unorganized sector, viz. bus body builders, truck body builders and trailer body builders, which are usually run by families, need guidance for compliance process.

To address these issues and cater to homologation support service to start-ups- EVs, MSMEs and unorganised sector, ARAI Technical Support Cell (TSC) offers following services:

1. Understand customer requirement and connect them with respective Departments
2. In case of Homologation technical support requirement:
 - a. Understand customer product and brief them about relevant CMVR type approval process
 - b. Support for initial documentation
 - c. Guidance for documentation and drawings. (different annexures, various checklists as per different tests, etc. specified in CMVR).
 - d. Co-ordination of test schedules in consultation with testing Departments
 - e. Guidance for mock-up required for different tests
 - f. Pre-inspection and gap analysis of proto vehicle

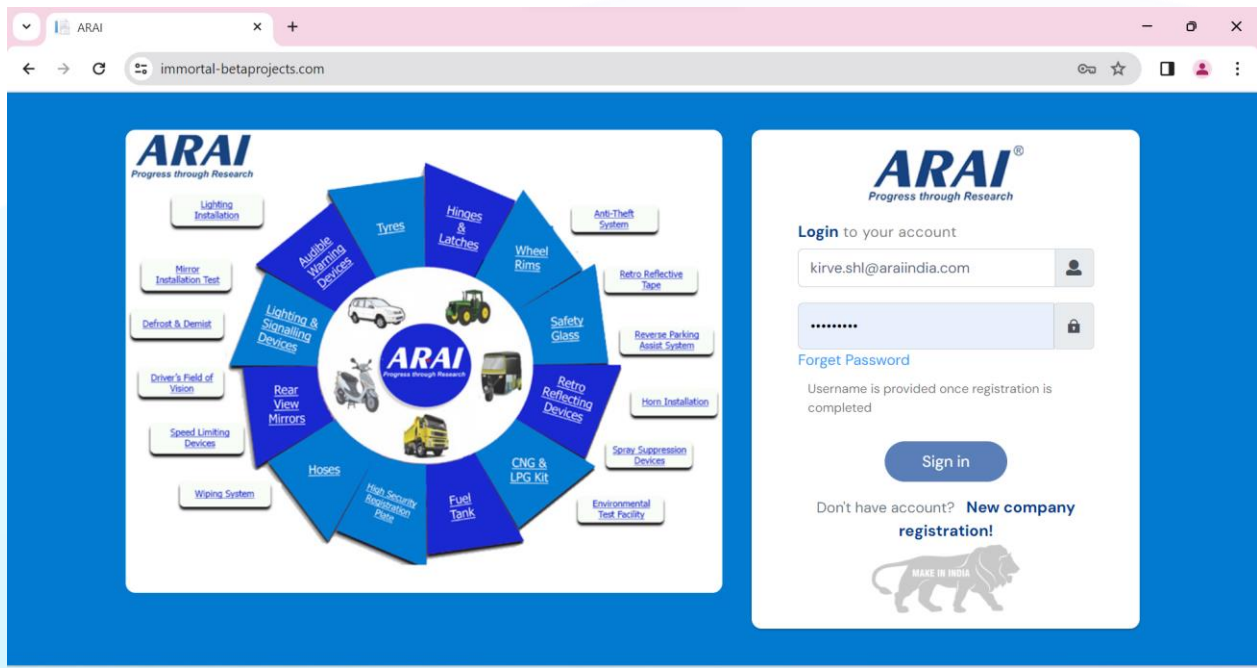


ARAI Technical Support Cell is headquartered in Pune and currently has Regional Centre in Chennai. Plans of expansion are underway to ensure enhanced network support.

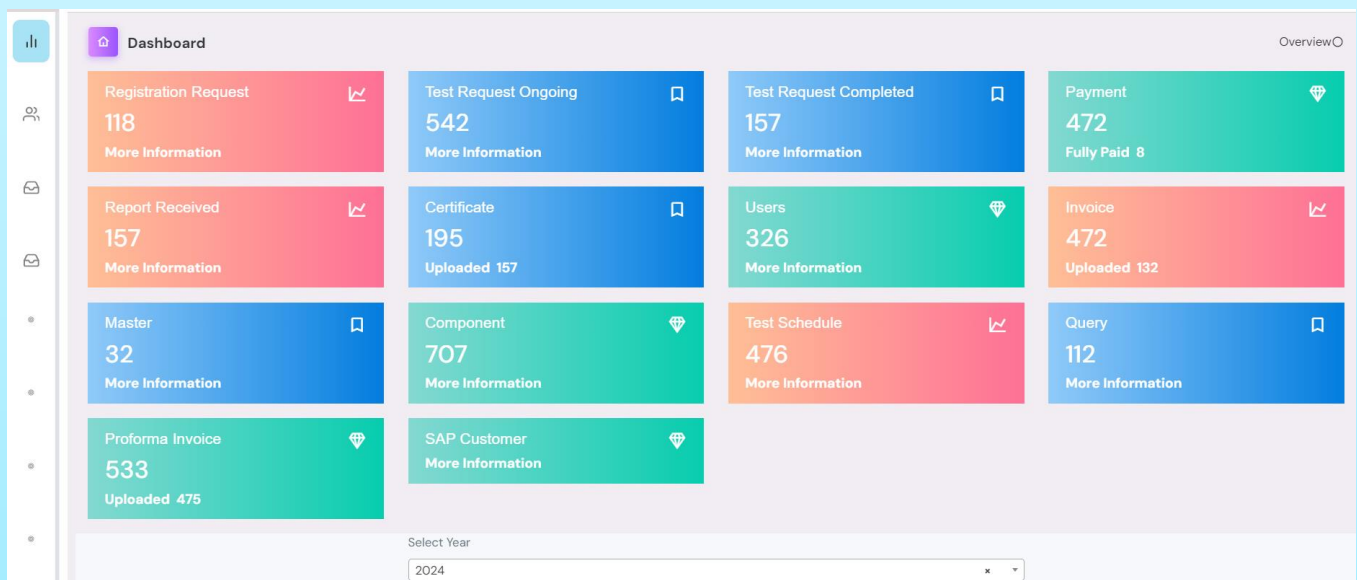
❑ Work Process Management Software (SHL-WPMS) for Component Certification

ARAI's Safety & Homologation Laboratory (SHL) has launched Work Process Management System portal to offer digital services to the automotive and component industry for testing and certification of their products.

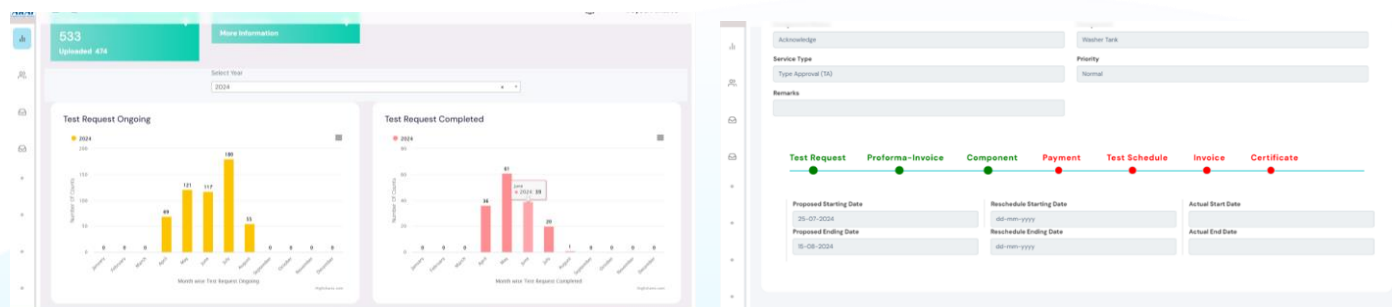
This customer-centric portal provides digital experience to the industry for their applications.



This portal facilitates customer registration as well as online application by providing requisite information and uploading of documents, such as ARAI Checklists, Drawings, E-certificates, etc., required for testing and certification of customer products. The user-friendly system flow guides customers in selection of critical safety components. Options for selection of different types of services, such as Type Approval Certification (TAC), Conformity of Production (CoP), Developmental Testing, Extension Testing, any Specific Performance Testing, etc. are available on the portal.



One of the important features of the portal is provision for uploading information regarding dispatch of test samples as well as payment details by the customers. On uploading of data on the portal, it is easy to track the details in the system and keep it accessible on the portal for future reference.



Additional advantage of online tracking of test request is available for ARAI users and customers. Using this facility, customer can view and track progress of ongoing testing and also receive updated status upon completion of testing and uploading of Report or Certificate.

Auto mail alerts to customers have been set at various stages, such as Proforma Invoice upload, Receipt of Components at ARAI, Probable date of completion of test, Final invoice upload, Certificate upload, etc.

Customer can view and download Proforma Invoice, Final Invoice and Certificate directly on the portal.

Test Engineers will find this portal useful because all the information related to testing can be organized online. This will reduce tracking as well as resultant testing time. Users will also receive auto periodic mail alerts communicating progress of testing. This facility can be extended to other type of services the Lab would like to offer in future as well. The portal will facilitate monitoring of complete test process, reduce testing time, thereby increasing overall efficiency.

❑ **PLI – AUTO ARAI PORTAL: For Production Linked Incentive Scheme (PLI) Applications of Advanced Automotive Technology (AAT) Products**

ARAI has recently launched its own PLI – Auto Portal to facilitate Domestic Value Addition (DVA) certification for Advanced Automotive Technology (AAT) products under the Production Linked Incentive (PLI) Scheme. This portal offers user-friendly interface for submission of application and uploading of documents, enabling efficient processing and transparency with online tracking and auto mail alerts for applicants. New users can register and manage their applications ensuring seamless interaction and timely updates throughout the certification process.



ARAI launches **PLI - AUTO PORTAL,**

simplifying DVA certification with seamless online tracking and efficient application processing for Advanced Automotive Technology products

Using the login credentials, applicant can create request for DVA certification on this web portal, post the application is uploaded on MHI's PLI – Auto Scheme Portal. The user-friendly flow of the system is designed in reference to MHI-SOP dated 27th April 2023 that it can better guide the applicant to process their Applications in seamless and efficient way.

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ARAI
Progress through Research

PLI-AUTO ARAI PORTAL

(For Production Linked Incentive Scheme (PLI) Applications of Advanced Automotive Technology (AAT) Products)

Ministry of Heavy Industries
Government of India
भारत उद्योग मंत्रालय, भारत सरकार





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Next

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Key Features:

1. Secured login with OTP.
2. Facility of New Applicant Registration.
3. Auto email for major stages and Notifications for every status change.
4. Calendar indicating major tasks as a part of Application tracking
5. Role-wise Dashboard design
6. Document upload and process facility designed in reference to MHI-SOP dated 27th April 2023.
7. Process-friendly with easy click on notifications
8. Multiple Document upload facility against each head of Annexure VIII of SOP, e.g. Annexure IV undertakings up to 200 documents upload facility.
9. System for sharing remarks against each uploaded file by applicants. Version control for each document upload.
10. Quotation and Invoice uploads.
11. Download facility for Certificate and Reports.
12. Techno-Commercial Audit (TCA) reminders with TCA request creation for applicants in reference to its original Application.
13. Periodic Surveillance Assessment Reminders with Application request creation for applicants.

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