

AVL



AVL Advanced Simulation Technologies








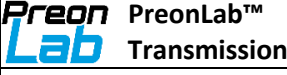
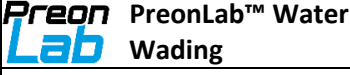



# Customer Services Catalog

## Software Related Services

Training and Support | Knowledge Transfer | Project Work

[www.avl.com](http://www.avl.com)

## Overview of Basic Training courses in AST Trainings Center Austria Graz, year 2024

 <b>AVL CRUISE™ M</b>	 <b>AVL CRUISE™ M Engineering Enhanced EAS</b>	 <b>AVL EXCITE™ Desinger</b>
January 15-17	February 05-07	February 13-14 July 17-18
 <b>AVL EXCITE™ M</b>	 <b>AVL EXCITE™ Piston&amp;Rings</b>	 <b>AVL EXCITE™ Power Unit</b>
April 03-04 October 07-08	January 30-31 September 17-18	February 26-27 September 30 - October 01
 <b>AVL FIRE™ M</b>	 <b>Preon PreonLab™ Transmission</b>	 <b>Preon PreonLab™ Water Wading</b>
February 20-22 July 08-10	February 15 July 11	April 25 November 19
 <b>Model.CONNECT™</b>	 <b>AVL VSM™</b>	 <b>AVL Scenario Designer™</b>
February 01-02 July 02-03	January 22-24 July 15-17	March 21 October 09

### PRICING:

- For scheduled training courses held in Graz, the price is:
  - a) 500 euro per day and participant
  - b) 250 euro per day and participant for universities
- For training on request, the total price for one AST engineer for 1 full day training is:
  - a) In Graz: 1520 euro for max. 4 participants
  - b) In Europe: 2200 euro for max. 6 participants at the customer location, including travel and accommodation
  - c) The rest of the world: 6300 euro for 2 days training, including travel and accommodation  
For each additional day, 1520 euro
- Additional cost for cloud training (max. 8 users):
  - 610 euro for setting up the cloud and the introduction
  - + 68 euro per day for running the cloud
  - Software-Support costs extra

Register online: [Explore our Trainings Portfolio](#) | [AVL Experience Cloud](#)

## Table of Content

<b>1. Introduction</b>	<b>4</b>
<b>2. Overview of AST Customer Services</b>	<b>5</b>
2.1 Validity of Prices and Training Content	6
2.2 AST Training Center	6
<b>3. Training &amp; Software Support</b>	<b>7</b>
3.1 Installation Support	7
3.2 Standard Software Training	8
3.2.1 Basic Software Training	9
3.2.2 Application Software Training	10
3.2.3 Premium Software Training Package	11
3.2.4 E-Learning	12
3.2.5 Online Video Training	15
3.2.6 Electrification Training	16
3.2.7 AVL BOOST™ Training Courses	22
3.2.8 AVL CRUISE™ Training Courses	24
3.2.9 AVL CRUISE™ M Training Courses	25
3.2.10 AVL EXCITE™ Designer Training Course	29
3.2.11 AVL EXCITE™ Piston&Rings Training Courses	29
3.2.12 AVL EXCITE™ Power Unit Training Courses	31
3.2.13 AVL EXCITE™ Timing Drive Training Courses	36
3.2.14 AVL EXCITE™ M Training Courses	37
3.2.15 AVL FIRE™ Training Courses	38
3.2.16 AVL FIRE™ M Training Courses	41
3.2.17 AVL SAMOS™ Training Course	45
3.2.18 AVL SPA™ Training Course	46
3.2.19 Model.CONNECT™ Training Course	46
3.2.20 AVL Scenario Designer™ Training Course	47
3.2.21 PreonLab™ Training Course	48
3.2.22 Python™ Training Course	49
3.2.23 AVL VSM™ Training Courses	49
3.3 Non-Standard Software Training	50
3.4 Software Support	51
<b>4. Know-How Transfer &amp; Engineering Support</b>	<b>52</b>
4.1 Technology Seminars	52
4.2 Engineering Support	53
4.2.1 Start-up Support	54
4.2.2 Enhancement Support	55
4.2.3 Consulting	56
4.2.4 Software Customization and Specific Software Development	57
<b>5. Project Work</b>	<b>58</b>
<b>6. Model Identification</b>	<b>59</b>
<b>7. Validated Powertrain Models</b>	<b>59</b>
<b>8. Appendix</b>	<b>60</b>
8.1 AST Global Customer Support Process (GCSP)	60
8.1.1 Local Point of Contact	60
8.1.2 Level Concept	60
8.1.3 Escalation Model	61

## 1. Introduction

This document describes all AVL AST software product-related services offered by the customer services group (AST / CC Methodology Development & Services).



### ➤ From a Software Provider to a Solution Provider

Beside the development of easy-to-use software products, AVL AST provides the development of methods and advanced simulation solutions. The transfer of engineering and application know-how is important for an efficient use of advanced simulation technologies in daily work, in addition to training in the usage of a software tool.

### ➤ Create Values for Customers

AST offers various services in different levels to support our customers in the best way to shorten the initial phase from the first contact with our products to the effective integration and usage in the development process.

In addition, we provide services for improvement of the applied methods and for development of new simulation methods in close cooperation with the customer, up to complex project work, including simulation-measurement comparison for validation of methods, problem solving with root-cause analysis or taking over design responsibility.

### ➤ From Engineer to Engineer

All our engineers participate in method development and advanced simulation work, software training and support. This is a challenging task for all the engineers involved, but for the customer it offers the significant benefit that by getting in contact with our service group he/she is in contact with highly experienced engineers, who know their tools and their application, work in close contact with software development and can link their engineering experience with the information coming from software support of various customers.

➤ Our message to the customers is: **"We assist our customers in developing advanced simulation excellence"**

Graz, January 2022

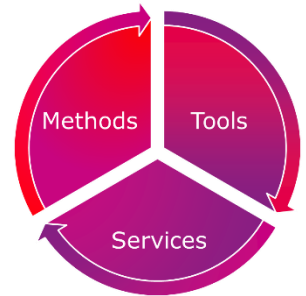
Thomas Resch (AST CC / Head of Methodology Development & Services)

Christian Vock (AST CCSP / Customer Support Manager)

## 2. Overview of AST Customer Services

### MORE THAN JUST A TOOL - Our Solution Approach

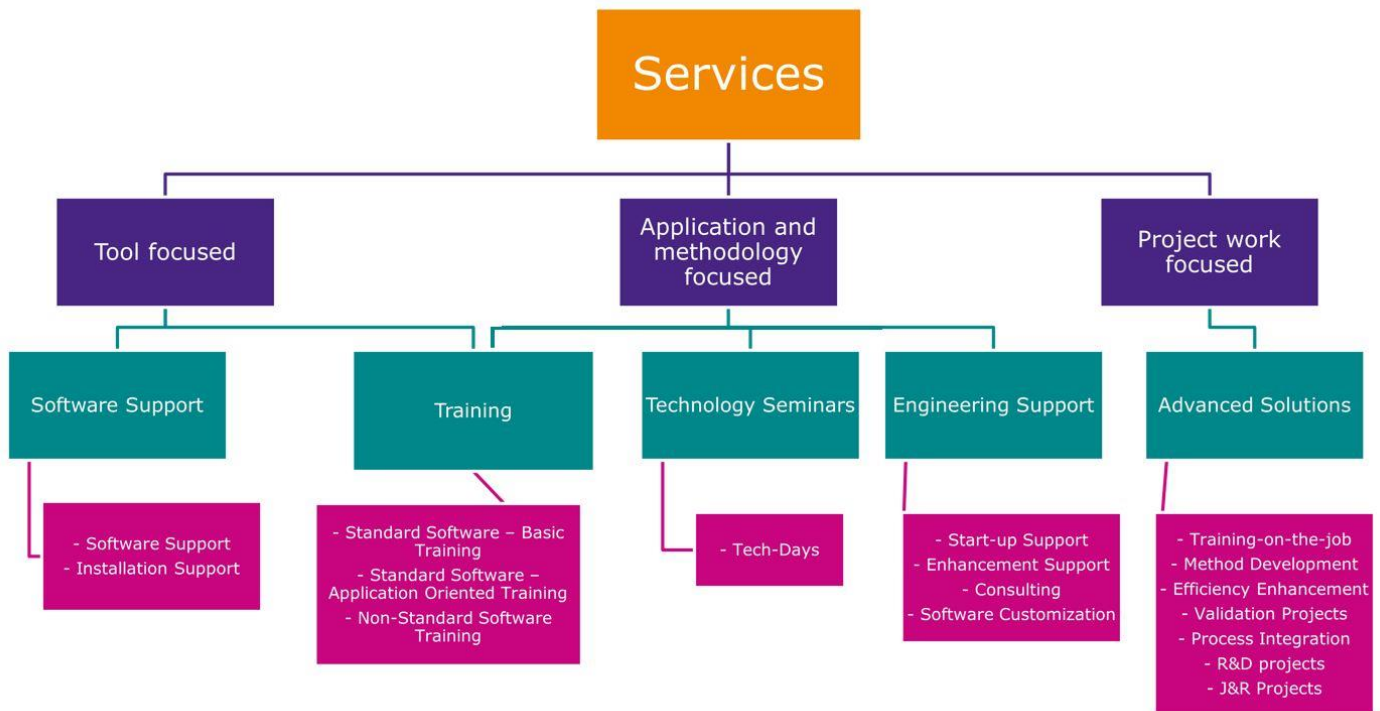
Our **methods** are grounded in the understanding of using cases. This understanding is our basis for choosing the right solution approach and defining the best workflow. The embedded functionality in the pre-processor, solver and post-processor is the physical evidence. You can experience this in all our **tools**. We provide **services** to train and support you, to enable you to use our solution independently and successfully with the help of validation, documentation, and training.



The customer services group comprises three modules:

- **Tool focused** – Standard Training & Software Support
- **Application and methodology focused** – Non-Standard Training, Technology Seminars & Engineering Support
- **Project work focused** – Advanced Solutions

An overview of the entire chain from basic training and standard software support via enhanced know-how transfer by technology seminars and specific engineering support up to specific advanced solutions, performed as project work, is shown in the following figure. These services are valid for AST worldwide.



## 2.1 Validity of Prices and Training Content

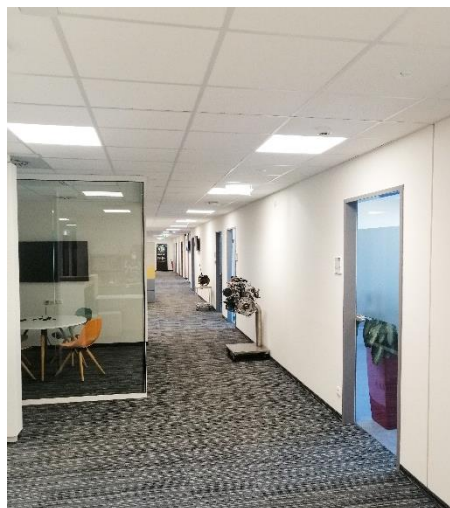
\* All **prices** given in this document, as well as the **training content**, are related to activities done by AVL AST Graz and can differ for local affiliates.

For more details, contact your local support and sales organization.

## 2.2 AST Training Center

Part of the AVL Training Center in cooperation with the AVL Skill Center and Academy at the Smart City (Graz, Austria)

- Modern-equipped and air-conditioned training rooms
- Face2face (F2F), remote and hybrid trainings
- Cloud support
- Greenroom
- Training by support and application engineers
- Hardware examples for demonstration purpose



Training at AST Training Center Graz



### 3. Training & Software Support

This module focuses mainly on the usage and installation of the AVL AST software tools:

- AST offers support for the *installation of software tools* in a customer-specific environment.
- AST offers for all its software products *standardized software training and customer-specific non-standard training*.
- For software-related questions, AST offers *software support* according to the AST Global Customer Support Process (CSP).

#### 3.1 Installation Support

This module deals with the installation of our software in a customer-specific environment.

ID	Service
CC_31	Installation Support
<p><b>Purpose:</b> The basic step is the installation of the software on a single computer or on a file server. The second step is valid for more complex installations, such as multi-processor environment on clusters.</p> <p><b>Validity:</b> Basic installation is valid for all AST tools. It includes multi-processor and connection with a queuing system for the tools, which support these options.</p> <p><b>Content:</b></p> <ul style="list-style-type: none"> <li>• Software installation from the network store ready to work</li> <li>• Installation performed by an AST engineer</li> <li>• Customization of software interfaces according to the requirements of the queuing system</li> </ul> <p><b>Requirements:</b></p> <ul style="list-style-type: none"> <li>• Basic requirements for the system are given by AVL in advance and have to be fulfilled.</li> <li>• The AVL engineer has to get administration privileges during the installation phase.</li> </ul> <p><b>Customer Benefit:</b></p> <ul style="list-style-type: none"> <li>• A fast start-up to get a valid installation running</li> <li>• The best opportunity to enable the usage of all features of the software</li> </ul> <p><b>Duration:</b></p> <ul style="list-style-type: none"> <li>• Half a day for basic installation.</li> <li>• The connection with a queuing system depends highly on the complexity of this system and has to be done in close cooperation between AST and system administration on the customer side. For LSF system installation, it will take approximately 1 day, for other systems around 3 days.</li> </ul> <p><b>Price (excl. Tax):</b> * see chapter 2.1</p> <p>Installation will be done on the customer side. The price for installation by one AST engineer is:</p> <ul style="list-style-type: none"> <li>• Basic installation: <b>610 euro</b> * see chapter 2.1</li> <li>• Installation in a complex system environment and the connection with a queuing system: <b>1520 euro per day</b> * see chapter 2.1</li> </ul> <p>Travel and accommodation will be charged separately.</p>	
<b>Contact</b>	
<b>Additional Information</b>	Responsible Sales Manager
<b>Proposal</b>	Responsible Sales Manager

## 3.2 Standard Software Training

Standard training courses are provided and performed by AST using standard training material and calculation models. AST offers **basic software training** and **application-oriented training** modules.

Training courses are available for each AVL AST software product and are provided in Graz, at AVL affiliates, or at the customer location.

The general training language is English or a local language at AVL affiliates.

Register at the [AVL Homepage](#) using the **AVL AST Training Center** to search for a course and submit an inquiry, after which you will receive a Confirmation E-Mail.

Cancellations must be made in written form 1 week before the start of the course.

### Training at AVL Graz

- Training courses will take place at AST Headquarters, “Smart City” Waagner-Biro-Straße 108, A-8020 Graz, Austria.
- AST will organize accommodation for customers, if requested.
- At AVL affiliates, arrangements are to be made with the affiliates.
- Training courses held in Graz have the additional benefit for customers to get in contact with various application engineers from AVL.

### Training at the Customer Location

- On-site training will be held by one engineer from AST. The customer is asked to secure a training room with equipment and necessary hardware.
- Software should be pre-installed by the customer. Additional licenses during the training can be provided by AST.

### Online Training – refer to [e-Learning](#) services

- All training courses can also be held online on request.
- Software should be pre-installed by the customer. Additional licenses during the training can be provided by AST.
- Or software and licenses are used via Cloud.

<b>Contact</b>	
<b>Training Content</b>	<a href="#">Link to Experience Cloud</a>
<b>Training Schedule</b>	<a href="#">Experience Cloud</a>
<b>Training Registration</b>	<a href="#">Experience Cloud</a>



## 3.2.1 Basic Software Training

An overview of the handling and usage of the product is given, as well as a general introduction to the main applications. A standard model for the simulation is presented and possible applications with this model are discussed.

ID	Service
CC_321	Basic Software Training
<p><b>Purpose:</b></p> <ul style="list-style-type: none"> <li>• Overview on the software tool</li> <li>• Enables the user to build up and run calculation models, prepared by AVL</li> </ul> <p><b>Validity:</b> Basic training courses are offered for all AVL AST software products.</p> <p><b>Content:</b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>• Introduction, theory, primer examples, modeling, simulation, and post-processing</li> </ul> <p><b>Goals:</b></p> <ul style="list-style-type: none"> <li>• Basic knowledge</li> <li>• Capability of software handling</li> </ul> <p><b>Customer Benefit:</b></p> <ul style="list-style-type: none"> <li>• A fast and efficient way to start using the software tool</li> </ul> <p><b>Duration:</b></p> <ul style="list-style-type: none"> <li>• Depending on training (see subsequent product listing)</li> </ul> <p><b>Price (excl. Tax):</b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>• For scheduled training courses held in Graz, the price is:             <ol style="list-style-type: none"> <li>a) 500 euro per day and participant</li> <li>b) 250 euro per day and participant for universities</li> </ol> <p>AVL offers fixed dates for <b>scheduled training courses</b>, typically one training course per quarter of the year. At these training courses, engineers from different companies can participate (max. 12 people).</p> </li> <li>• Alternatively, training can be held on request. For <b>training on request</b>, the total price for one AST engineer for 1 full day training is:             <ul style="list-style-type: none"> <li>▪ In Graz: 1520 euro for max. 4 participants</li> <li>▪ In Europe: 2200 euro for max. 6 participants at the customer location, including travel and accommodation</li> <li>▪ The rest of the world: 6300 euro for 2 days training, including travel and accommodation. For each additional day, 1520 euro.</li> </ul> </li> </ul>	
<b>Contact</b>	
<b>Information &amp; Organization</b>	Training Organization – Petra Pintaric ( <a href="mailto:ast_training@avl.com">ast_training@avl.com</a> )
<b>Registration</b>	<a href="#">Experience Cloud</a>
<b>Training Schedule</b>	<a href="#">Experience Cloud</a>

## 3.2.2 Application Software Training

Application training courses are also standard training courses, but focus on specific applications and are based on the knowledge given by standard basic training.

For some products, various parts of the course for different applications are offered. They can be combined individually according to the customer's requirements.

ID Service

CC_322	Application Software Training
<p><b>Purpose:</b> Application software training will improve the knowledge of the software tool and will train the user in the methodology of special application methods.</p> <p><b>Validity:</b> Application training courses are offered for all AVL AST software products.</p> <p><b>Content:</b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>• Application method, special theory, application examples</li> <li>• Special modeling, post-processing technology</li> <li>• Result evaluation and integration</li> </ul> <p><b>Goals:</b></p> <ul style="list-style-type: none"> <li>• Special application oriented knowledge</li> </ul> <p><b>Customer Benefit:</b></p> <ul style="list-style-type: none"> <li>• A fast and efficient way to learn a new software application field</li> </ul> <p><b>Duration:</b></p> <ul style="list-style-type: none"> <li>• Depending on training (see subsequent product listing)</li> </ul> <p><b>Price (excl. Tax):</b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>• For scheduled training courses held in Graz, the price is: <ul style="list-style-type: none"> <li>c) 500 euro per day and participant</li> <li>d) 250 euro per day and participant for universities</li> </ul> <p>AVL offers fixed dates for <b>scheduled training courses</b>, typically one training course per quarter of the year. At these training courses, engineers from different companies can participate (max. 12 people).</p> </li> <li>• Alternatively, training can be held on request. For <b>training on request</b>, the total price for one AST engineer for 1 full day training is: <ul style="list-style-type: none"> <li>▪ In Graz: 1520 euro for max. 4 participants</li> <li>▪ In Europe: 2200 euro for max. 6 participants at the customer location, including travel and accommodation</li> <li>▪ The rest of the world: 6300 euro for 2 days training, including travel and accommodation. For each additional day, 1520 euro.</li> </ul> </li> </ul>	
<b>Contact</b>	
<b>Information &amp; Organization</b>	Training Organization – Petra Pintaric ( <a href="mailto:ast_training@avl.com">ast_training@avl.com</a> )
<b>Registration</b>	<a href="#">Experience Cloud</a>
<b>Training Schedule</b>	<a href="#">Experience Cloud</a>

### Further information:

- Application training courses are on request after completing the basic training.
- Pre-requisites: Completing the related Basic Training Course.

## 3.2.3 Premium Software Training Package

Premium software training packages are extensions of the basic or application software training. They offer additional contact with the trainer beyond the training days.

ID	Service
CC_323	Premium Software Training Package
<p><b>Purpose:</b> The premium software training package will help the users learn how to use the software faster by offering extended contact with the trainer with regular meetings after the basic or application software training. Meetings and additional training days are always held individually for each customer.</p> <p><b>Validity:</b> Premium software training packages are offered for all AVL AST software products.</p> <p><b>Content:</b></p> <ul style="list-style-type: none"> <li>• Discussion about user experience</li> <li>• Review of user generated models</li> </ul> <p><b>Goals:</b></p> <ul style="list-style-type: none"> <li>• Increase experience and application of the software at the customer location</li> </ul> <p><b>Customer Benefit:</b></p> <ul style="list-style-type: none"> <li>• A faster way to get information and a speed-up of profitable work with software</li> </ul> <p><b>Duration:</b></p> <ul style="list-style-type: none"> <li>• Weekly online meetings, approx. 2 hours each for 4 weeks following the basic or application training</li> <li>• Additional training day after 4 weeks</li> <li>• Biweekly online meetings, approx. 2 hours each for 8 weeks following the additional training day</li> </ul> <p><b>Price (excl. Tax):</b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>• With an additional training day done at an AVL affiliate or via web-service: 3850 euro for max. 4 participants</li> <li>• With an additional training day done at the customer location with a local trainer from an affiliate: 5580 euro for max. 4 participants at the customer location, including travel and accommodation</li> <li>• With an additional training day done at the customer location requiring experts from other affiliates: 6700 euro for max. 4 participants, including travel and accommodation</li> </ul>	
<b>Contact</b>	
<b>Information &amp; Organization</b>	Training Organization – Petra Pintaric ( <a href="mailto:ast_training@avl.com">ast_training@avl.com</a> )
<b>Registration</b>	<a href="#">Experience Cloud</a>
<b>Training Schedule</b>	<a href="#">Experience Cloud</a>

### Further information:

- Premium training packages can only be purchased in combination with basic or application training.
- Premium training packages can also be purchased following a standard scheduled training course, but meetings and additional training days are always held individually for each customer.
- Pre-requisites: Completing the Basic or Application Training Course.

### 3.2.4 E-Learning

In addition to the face2face training courses, AST also offers various online training courses. E-Learning (or electric learning) includes all forms of learning in which electronic or digital media are used as the learning material.



#### 3.2.4.1 Remote/ Online Training

Remote training courses are “real-time” training courses with the trainer and the trainees doing the training online, regardless of the country. For better communication, the trainer uses a headset with a microphone and a webcam with different view options.

ID [Service](#)

CC_324	Remote/ Online Training
<p><b><u>Purpose:</u></b></p> <ul style="list-style-type: none"> <li>Training courses are done online.</li> </ul> <p><b><u>Validity:</u></b></p> <p>Remote/ online training courses are offered for all AVL AST software products.</p> <p><b><u>Requirement:</u></b></p> <ul style="list-style-type: none"> <li>Local software and license installation at the customer location</li> </ul> <p><b><u>Content:</u></b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>Introduction, theory, primer examples, modeling, simulation, and post-processing or</li> <li>Application method, special theory, application examples,</li> <li>Special modeling, post-processing technology</li> </ul> <p><b><u>Goals:</u></b></p> <ul style="list-style-type: none"> <li>Basic knowledge,</li> <li>Capability of software handling or</li> <li>Special application-oriented knowledge</li> </ul> <p><b><u>Customer Benefit:</u></b></p> <ul style="list-style-type: none"> <li>A fast and efficient way to learn a new software application field</li> <li>No travel costs</li> </ul> <p><b><u>Duration:</u></b></p> <ul style="list-style-type: none"> <li>Depending on training (see subsequent product listing)</li> </ul> <p><b><u>Price (excl. Tax):</u></b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>For scheduled training courses, the price is:                         <ul style="list-style-type: none"> <li>500 euro per day and participant</li> <li>250 euro per day and participant for universities</li> </ul> <p>AVL offers fixed dates for scheduled training courses, typically one training course per quarter of the year. At these training courses, engineers from different companies can participate (max. 9 people).</p> </li> <li>Alternatively, training can be held on request. For training on request, the total price for one AST engineer for 1 full day training is:                         <ul style="list-style-type: none"> <li>1520 euro for max. 4 participants</li> </ul> </li> </ul>	
<b>Contact</b>	
<b>Information &amp; Organization</b>	Training Organization – Petra Pintaric ( <a href="mailto:ast_training@avl.com">ast_training@avl.com</a> )
<b>Registration</b>	<a href="#">Experience Cloud</a>
<b>Training Schedule</b>	<a href="#">Experience Cloud</a>

## 3.2.4.1 Hybrid Training

Hybrid training, also known as blended learning or mixed-mode instruction, is an education approach that combines online education materials and opportunities for online interaction with traditional location-based classroom methods. Hybrid training is a combination of “live” F2F training courses with participants at the Training Center in Graz and trainees participating online.

**ID**                      **Service**

<b>CC_324</b>	<b>Hybrid Training</b>
<p><b>Purpose:</b></p> <ul style="list-style-type: none"> <li>Depending on the possibilities and preferences, the participants join the training either F2F or online.</li> </ul> <p><b>Requirement:</b></p> <ul style="list-style-type: none"> <li>The participants who join the training online need to install software and licenses on their computers.</li> </ul> <p><b>Content:</b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>Introduction, theory, primer examples, modeling, simulation, and post-processing or</li> <li>Application method, special theory, application examples,</li> <li>Special modeling, post-processing technology</li> </ul> <p><b>Goals:</b></p> <ul style="list-style-type: none"> <li>Basic knowledge,</li> <li>Capability of software handling or</li> <li>Special application-oriented knowledge</li> </ul> <p><b>Customer Benefit:</b></p> <ul style="list-style-type: none"> <li>A fast and efficient way to learn a new software application field</li> <li>A flexible arrangement for different customer needs</li> </ul> <p><b>Duration:</b></p> <ul style="list-style-type: none"> <li>Depending on training (see subsequent product listing)</li> </ul> <p><b>Price (excl. Tax):</b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>For scheduled training courses, the price is:                             <ul style="list-style-type: none"> <li>500 euro per day and participant</li> <li>250 euro per day and participant for universities</li> </ul> <p style="margin-left: 40px;">AVL offers fixed dates for scheduled training courses, typically one training course per quarter of the year. At these training courses, engineers from different companies can participate (max. 9 people).</p> </li> <li>Alternatively, training can be held on request. For training on request, the total price for one AST engineer for 1 full day training is:                             <ul style="list-style-type: none"> <li>1520 euro for max. 4 participants</li> </ul> </li> </ul>	
<b>Contact</b>	
<b>Information &amp; Organization</b>	Training Organization – Petra Pintaric ( <a href="mailto:ast_training@avl.com">ast_training@avl.com</a> )
<b>Registration</b>	<a href="#">Experience Cloud</a>
<b>Training Schedule</b>	<a href="#">Experience Cloud</a>

## 3.2.4.2 Remote or Hybrid Training in the Cloud



Trainees can use our software on MS Azure cloud – the trainer can log on to the cloud and support the trainee. Depending on the location, different virtual machines (e.g. US/Europe) are used.

Additionally, the specification is done according to the software (SW) package and CPU power used. Cloud Training is offered for all SDT- and AWS-based tools and for VSM.

**ID**                      **Service**

<b>CC_324</b>	<b>Remote or Hybrid Training in the Cloud</b>
<p><b>Purpose:</b></p> <ul style="list-style-type: none"> <li>The participants do not need to install the license on their computer for the training.</li> </ul> <p><b>Requirement:</b></p> <ul style="list-style-type: none"> <li>Strong internet connection</li> </ul> <p><b>Content:</b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>Introduction, theory, primer examples, modeling, simulation, and post-processing or</li> <li>Application method, special theory, application examples,</li> <li>Special modeling, post-processing technology</li> </ul> <p><b>Goals:</b></p> <ul style="list-style-type: none"> <li>Basic knowledge,</li> <li>Capability of software handling or</li> <li>Special application-oriented knowledge</li> </ul> <p><b>Customer Benefit:</b></p> <ul style="list-style-type: none"> <li>A fast and efficient way to learn a new software application field</li> <li>Deeper interaction between the trainer and the trainee due to screen sharing in both directions</li> <li>No local installations necessary on the customer side</li> <li>No travel costs</li> </ul> <p><b>Duration:</b></p> <ul style="list-style-type: none"> <li>Depending on training (see subsequent product listing)</li> </ul> <p><b>Price (excl. Tax):</b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>For scheduled training courses, the price is:                         <ul style="list-style-type: none"> <li>500 euro per day and participant</li> <li>250 euro per day and participant for Universities</li> </ul> </li> <li>Alternatively, training can be held on request. For training on request, the total price for one AST engineer for 1 full day training is:                         <ul style="list-style-type: none"> <li>1520 euro for max. 4 participants</li> </ul> </li> <li>Additional cost for cloud training (max. 8 users):                         <ul style="list-style-type: none"> <li>610 euro for setting up the cloud and the introduction</li> <li>+ 68 euro per day for running the cloud</li> <li>Software-Support costs extra</li> </ul> </li> </ul>	
<b>Contact</b>	
<b>Information &amp; Organization</b>	Training Organization – Petra Pintaric ( <a href="mailto:ast_training@avl.com">ast_training@avl.com</a> )
<b>Registration</b>	<a href="#">Experience Cloud</a>
<b>Training Schedule</b>	<a href="#">Experience Cloud</a>



## 3.2.5 Online Video Training

All customers with a valid license can get access to our video training. To get access, please contact [ast\\_training@avl.com](mailto:ast_training@avl.com). You will get a pdf file with valid links for about 1 month of the ordered training.

Please note that these video training courses are not a full substitute for a complete standard training!

The following video training courses are available:

<b>Basic Training</b>	
• <b>TCSS-01</b>	AVL CRUISE™ Basic
• <b>TCMF-01</b>	AVL CRUISE™ M Flow Basic
• <b>TCM-01</b>	AVL CRUISE™ M Basic GUI
• <b>TCM-02</b>	AVL CRUISE™ M Basic Intro
• <b>TCME-02</b>	AVL CRUISE™ M Physical Engine / DIESEL
• <b>TCMV-01</b>	AVL CRUISE™ M Engineering Enhanced - Software Training for VTB / Gasoline
• <b>TCMV-02</b>	AVL CRUISE™ M Engineering Enhanced - Software Training for VTB / Diesel
• <b>TCOM-01</b>	AVL COMPOSE™ Basic
• <b>TEPR-01</b>	AVL EXCITE™ Piston & Rings Basic – Piston Dynamics
• <b>TEPR-02</b>	AVL EXCITE™ Ring Dynamics
• <b>TEPR-03</b>	AVL EXCITE™ Piston & Rings Lube Oil Consumption
• <b>TEPU-01</b>	AVL EXCITE™ PowerUnit Basic
• <b>TEPU-04</b>	AVL EXCITE™ PUMain Bearing and Conrod Bearing Analysis
• <b>TEPU-15</b>	AVL EXCITE™ Power Unit Acoustic
• <b>TEDE-01</b>	AVL EXCITE™ Designer Basic
• <b>TFME-01</b>	AVL FIRE™ M Engine
• <b>TFIM-01</b>	AVL FIRE™ M Basic
• <b>TMCO-01</b>	Model.CONNECT™ Office Basic
• <b>TPREO-01</b>	PreonLab™ Basic
• <b>TSPA-01</b>	AVL SPA™ Basic
<b>Electrification Training</b>	
• <b>TELV-01</b>	AVL CRUISE™ M Battery and Range Extended Electric Vehicle
• <b>TELV-02</b>	AVL CRUISE™ M Fuel Cell Electric Vehicle
• <b>TELV-03</b>	AVL CRUISE™ M Hybrid Electric Vehicle
• <b>TELA-01</b>	AVL EXCITE™ E-Axle NVH and Durability Analysis (AWS based)
• <b>TELM-03</b>	AVL EXCITE™ Electric Machine Rotor-Dynamics
• <b>TELB-01</b>	AVL FIRE™ M Battery Thermal and Hazard Investigation
• <b>TELF-01</b>	AVL FIRE™ M PEM Fuel Cell Module Performance Analysis
• <b>TELM-01</b>	AVL FIRE™ M PMSM E-Machine Electromagnetics and Thermal Investigation

We are continuously working on recordings for new training courses. Please contact us for more information.

### 3.2.6 Electrification Training

#### 3.2.6.1 Electrification Training Vehicle

##### TELV-01 / Battery and Range Extended Electric Vehicle Concept Finding & Layout

**Models:**

C04036\_Basic\_Circuits.proj  
 C04042\_DCDC\_Converter.proj  
 C04044\_Power\_Consumer.proj  
 C04050\_Lowpass\_Filter.proj  
 C11013\_Mechanical\_Consumer.proj  
 C04048\_EM\_Speed\_Control.proj  
 C04004\_BEV\_DoE.proj  
 C04002\_BEV.proj  
 C04032\_Range\_Extended\_EV.proj



**Module 1\***  
Basic

1 Day

**Introduction**

- CRUISE M GUI, Pre- and Post-processing
- Control domain in CRUISE M
- Electric domain in CRUISE M
- Mechanical domain in CRUISE M
- Basic model setup with calculation tasks
- Simple powertrain

**Module 2**  
Application

1 Day

**BEV powertrain model**

- Simple powertrain
- Advanced powertrain
- Introduction to BMS
- E-motor current control
- Model analysis

**Module 3**  
Application

1 Day

**Applications & REEV powertrain model**

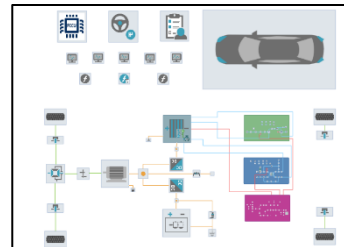
- Cycle run & FLA
- Parameters, scenarios and DoE
- REEV & controller
- Simple thermal model
- Model analysis

##### TELV-02 / Fuel Cell Electric Vehicle Concept Finding & Layout

**Models:**

C04063\_FC\_Testbed  
 C04069\_Water\_Separator  
 C04078\_PEMFC\_Cold\_start  
 C04060\_Anode  
 C04062\_Therm\_Mgmt\_FCEV\_BoP  
 C04014\_Powertrain\_FCEV  
 C04016\_Powertrain\_Mech\_FCEV  
 C04093\_FCEV\_BoP\_RedDim\_PEMFC

C04064\_Humidifier  
 C04072\_PEMFC\_Reduced\_Dim  
 C04075\_BoP\_Component\_Sizing\_Cathode  
 C04061\_Cathode  
 C04013\_FCEV\_BoP\_Analytical\_PEMFC  
 C04015\_Powertrain\_EI\_FCEV  
 C04017\_FCEV\_EIChem\_FC



**Module 1\***  
Basic

1 Day

**Introduction**

- CRUISE M GUI, Pre- and Post-processing
- Control domain in CRUISE M
- Electric domain in CRUISE M
- Mechanical domain in CRUISE M
- Basic model setup with calculation tasks
- Simple powertrain

**Module 2**  
Application

1 Day

**FCEV powertrain model**

- BOP intro
- Gas path domain in CRUISE M
- Anode
- Cathode
- Liquid domain in CRUISE M
- Thermal domain in CRUISE M

**Module 3**  
Application

1 Day

**Applications & FCEV powertrain model**

- Reduced dimensionality Fuel Cell
- Advanced powertrain
- Degradation
- Q&A

\* Module 1 (Basic Training for TELV-01, TELV-02 & TELV-03) only has to be done once



### TELV-03 / Hybrid Electric Vehicle Concept Finding & Layout

**Models:**

C04024\_HEV\_P2\_AMT\_FWD.proj  
 C04032\_Range\_Extended\_EV.proj  
 C11027\_Man\_FWD.proj  
 C04030\_MHEV\_P3\_AMT\_FWD.projEV\_P2\_AMT\_FWD.proj  
 Series\_Hybrid\_RE\_Basic\_Model.proj  
 Man\_FWD.proj  
 PX\_PMG\_AMT\_FWD.proj



<b>Module 1*</b> Basic	<b>Module 2</b> Application	<b>Module 3</b> Application
<b>1 Day</b>	<b>1 Day</b>	<b>1 Day</b>
<p><b>Introduction</b></p> <ul style="list-style-type: none"> <li>CRUISE M GUI, Pre- and Post-processing</li> <li>Mechanical domain in CRUISE M</li> <li>Electric domain in CRUISE M</li> <li>Basic model setup with calculation tasks</li> <li>Simple powertrain</li> </ul>	<p><b>HEV powertrain model</b></p> <ul style="list-style-type: none"> <li>Run basic vehicle model with post-processing</li> <li>Overview on hybrid concepts Px</li> <li>Modify basic vehicle to a hybrid configuration P0+P2</li> <li>Simple control function implementation</li> </ul>	<p><b>HEV powertrain model</b></p> <ul style="list-style-type: none"> <li>Simple control function implementation</li> <li>Introduction to BMS</li> <li>E-motor current control</li> <li>Simple thermal model</li> </ul>

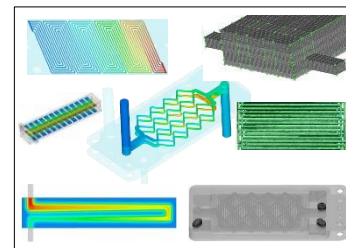
\* Module 1 (Basic Training for TELV-01, TELV-02 & TELV-03 ) only has to be done once

### 3.2.6.2. Electrification Training Fuel Cell (PEM)

#### TELF-01 / PEM Fuel Cell Module Performance Analysis

**Models:**

9106\_LTPeM\_FC\_Straight\_Channel  
 9335\_LTPeM\_FC\_Cooling  
 9336\_LTPeM\_FC\_Discretized\_ZBT\_50  
 9337\_LTPeM\_FC\_Discretized\_Homogenized\_ZBT\_50  
 9507\_LTPeM\_FC\_CAD\_Workflow

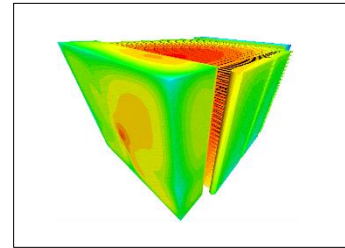


<b>Module 1*</b> Basic	<b>Module 2</b> Application	<b>Module 3</b> Application
<b>1 Day</b>	<b>1 Day</b>	<b>1 Day</b>
<p><b>Introduction</b></p> <ul style="list-style-type: none"> <li>FIRE M introduction</li> <li>SDT GUI, Pre- and Post-processing</li> <li>Case definition, parameters and job submission</li> <li>Basic model set-up</li> </ul>	<p><b>PEM FC Basic Training</b></p> <ul style="list-style-type: none"> <li>PEM FC surface preparation</li> <li>Interactive meshing (Single Serpentine Flow Channel PEM FC)</li> <li>Automatic meshing (FC Diamond)</li> <li>Basic simulation setup for fuel cell module</li> </ul>	<p><b>PEM FC Application Training</b></p> <ul style="list-style-type: none"> <li>Advanced surface repair (ZBT PEM FC)</li> <li>Specific oriented simulation setup for fuel cell module</li> <li>Analysis of FC specific results (Post-processing and discussion)</li> </ul>

\* Module 1 (Basic Training for TELF-01,TELF-02, TELB-01 & TELM-01, TELP-01) only has to be done once

### TELF-02 / SOFC Module Performance Analysis

**Models:**  
 9344\_SOFC\_Straight\_Channel  
 9345\_SOFC\_Single\_Cell  
 9346\_SOFC\_Stack



**Module 1\***  
Basic

1 Day

- Introduction**
- FIRE M introduction
  - SDT GUI, Pre- and Post-processing
  - Case definition, parameters and job submission
  - Basic model setup FIRE M introduction
  - SDT GUI, Pre- and Post-processing
  - Case definition, parameters and job submission
  - Basic model setup (straight channel geometry)

**Module 2**  
Application

1 Day

- SOFC Basic Training**
- SOFC surface preparation
  - Discretized modeling approach
  - Homogenized modeling approach
  - Basic simulation setup for fuel cell module

**Module 3**  
Application

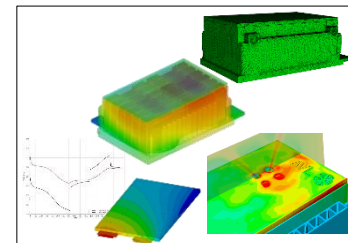
1 Day

- SOFC Application Training**
- Introduction stack modeling
  - Detailed simulation setup
  - Analysis of stack-specific results (Post-processing and discussion)

### 3.2.6.3 Electrification Training Battery

#### TELB-01 / Battery Thermal and Hazard Investigation

**Models:**  
 9107\_Battery\_Cooling  
 9320\_ET\_Battery  
 9322\_Battery\_Thermal\_Runaway



**Module 1\***  
Basic

1 Day

- Introduction**
- FIRE M introduction
  - SDT GUI, Pre- and Post-processing
  - Case definition, parameters and job submission
  - Basic model set-up

**Module 2**  
Application

1 Day

- Thermal analysis**
- Introduction to battery technology and simulation
  - Preparation of CAD data and meshing
  - Basic model setup for Battery Cooling

**Module 3**  
Application

1 Day

- Hazard investigation**
- Introduction to battery thermal runaway
  - Setup for thermal runaway simulations
  - Analysis of results (Propagation times, flammability)

**Module 4**  
Application

1/2 Day

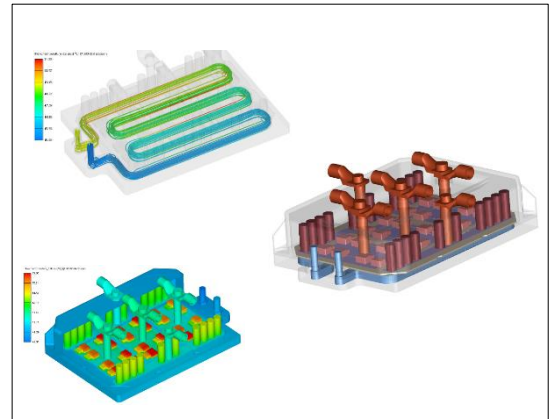
- Electrothermal battery models**
- Introduction to ET battery models
  - Data requirements and processing for ET models
  - Setup of ET simulations

\* Module 1 (Basic Training for TELF-01,TELF-02, TELB-01 & TELM-01, TELP-01) only has to be done once

### 3.2.6.4 Electrification Training Power Electronics

#### TELP-01 / FIRE M Power Electronics

**Models:**  
 9107\_Battery\_Cooling  
 9505\_Power\_Inverter\_Cooling\_Workflow



**Module 1\***  
Basic

1/2 Day

**Introduction**

- FIRE M introduction
- SDT GUI, Pre- and Post-processing
- Case definition, parameters and job submission
- Basic model set-up

**Module 2**  
Application

1/2 Day

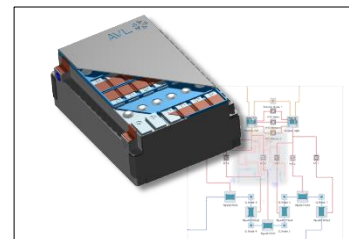
**Power electronics**

- Introduction to power electronics simulation
- Preparation of CAD data and meshin
- Basic model setup for Power inverter

\* Module 1 (Basic Training for TELF-01, TELB-01 & TELM-01, TELP-01) only has to be done once

#### TCFM-01 / CRUISE M/FIRE M Battery 3D-1D

**Models:**  
 C04002\_BEV.proj  
 C04037\_Battery\_SoC\_Balancing.proj



**Module 1**  
Application

1 Day

**CRUISE M Introduction/BEV Powertrain Model**

- Overview and Introduction
- 1D Basics
- 1D Application

**Module 2**  
Application

1 Day

**FIRE M Introduction/ Thermal Analysis**

- 3D Basics
- 3D Application

**Module 3**  
Application

1 Day

**CRUISE M & FIRE M**

- Recap and Combination of AVL CRUISE™ M and FIRE™ M

**Module 4**  
Application

1 Day

**Theory behind Electrothermal/Electrochemical Model**

- ET/EC Model
- ET/EC Simulation

**Module 5**  
Application

1 Day

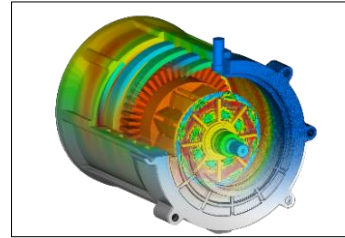
**FIRE M Thermal Runaway**

- 3D Application
- Recap and Discussion

### 3.2.6.4 Electrification Training Electric Motor

#### TELM-01 / PMSM E-Machine Electromagnetics and Thermal Investigation

**Models:**  
9504\_E-Motor Cooling Workflow



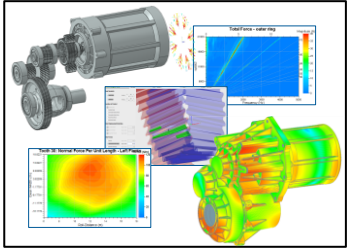
<b>Module 1*</b> Basic	<b>Module 2</b> Application	<b>Module 3</b> Application
<b>1 Day</b>	<b>1 Day</b>	<b>1 Day</b>
<p><b>Introduction</b></p> <ul style="list-style-type: none"> <li>▪ FIRE M introduction</li> <li>▪ SDT GUI, Pre- and Post-processing</li> <li>▪ Case definition, parameters and job submission</li> <li>▪ Basic model set-up</li> </ul>	<p><b>E-machine electro-magnetic analysis</b></p> <ul style="list-style-type: none"> <li>▪ Intro of 2.5D electro-magnetic capabilities and modeling appr.</li> <li>▪ E-machine modeling using EMT*** and from CAD import</li> <li>▪ Setup of EM simulation</li> <li>▪ Results evaluation</li> <li>▪ Export results for further analyses</li> <li>▪ Modify the model</li> </ul>	<p><b>E-machine thermal analysis</b></p> <ul style="list-style-type: none"> <li>▪ Intro of thermal capabilities and 3D modeling approaches</li> <li>▪ Calculation of losses</li> <li>▪ CAD preparation and meshing</li> <li>▪ Model setup with combined liquid and air cooling</li> <li>▪ Analysis of temperatures</li> </ul>

\* Module 1 (Basic Training for TELF-01, TELB-01 & TELM-01, TELP-01) only has to be done once

### 3.2.6.5 Electrification Training E-Axle

#### TELA-01 / E-Axle NVH and Durability Analysis ( AWS based)

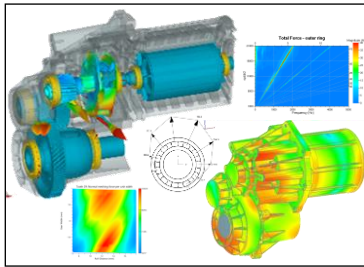
Models:  
502\_E\_Axle

<b>Module 1*</b> Basic	<b>Module 2</b> Application	
<b>1 Day</b>	<b>1 Day</b>	
<p><b>Advanced simulation</b></p> <ul style="list-style-type: none"> <li>▪ Introduction of EXCITE Power Unit capabilities and modeling approaches to simulate eAxles with cylindrical and planetary gear stages</li> <li>▪ Creating an advanced eAxle model</li> <li>▪ Results evaluation using Impress Chart and Impress 3D (Data Recovery), gear mesh evaluation</li> </ul>	<p><b>Extended simulation</b></p> <ul style="list-style-type: none"> <li>▪ Modeling extensions:                             <ul style="list-style-type: none"> <li>▪ Microgeometry – contact plots</li> <li>▪ FlexGear – retained nodes</li> <li>▪ Stator – teeth forces</li> <li>▪ RCA (Root Cause Analysis)</li> <li>▪ MA (Modal Analysis)</li> <li>▪ NTPA (Numerical Transfer Path Analysis)</li> <li>▪ TF (Transfer Functions)</li> </ul> </li> </ul>	

\* Module 1 (Basic Training for TELA-01 & TELA-02) only has to be done once

#### TELA-02 / E-Axle NVH and Durability (SDT based)

Models:  
502\_E\_Axle

<b>Module 1*</b> Basic	<b>Module 2</b> Application	
<b>1 Day</b>	<b>1 Day</b>	
<p><b>Advanced simulation</b></p> <ul style="list-style-type: none"> <li>▪ Introduction of EXCITE for eAxle (SDT) capabilities and modeling approaches to simulate e-axles with cylindrical and planetary gear stages</li> <li>▪ Creating e-Axle model in BASIC modeling level</li> <li>▪ Results evaluation in IMPRESSTM M, gear mesh evaluation, report generation</li> </ul>	<p><b>Extended simulation</b></p> <ul style="list-style-type: none"> <li>▪ Model extensions in EXPERT modeling level                             <ul style="list-style-type: none"> <li>▪ Stator – teeth forces</li> <li>▪ Component Modeler</li> <li>▪ FlexGear – retained nodes</li> <li>▪ RCA (Root Cause Analysis)</li> <li>▪ MA (Modal Analysis)</li> <li>▪ NTPA (Numerical Transfer Path Analysis)</li> <li>▪ TF (Transfer Functions)</li> </ul> </li> </ul>	

\* Module 1 (Basic Training for TELA-01 & TELA-02) only has to be done once

### 3.2.7 AVL BOOST™ Training Courses

#### TBCS-01 / BOOST Basic Training Course

**Models:**  
 4t1.bwf  
 ottocalc\_short.bwf  
 TCI\_short.bwf  
 4t1\_gasoline\_transient\_ECU\_driv.bwf

**Module 1**  
Basic

1 Day

**Introduction**

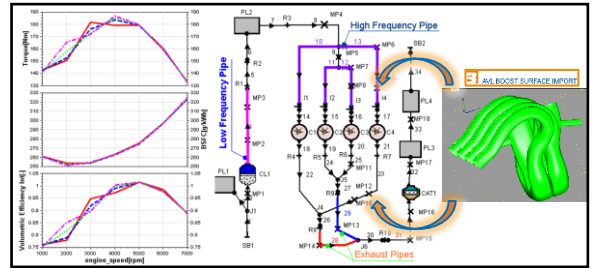
- Introduction and Theory
- Create a Model of a 4-stroke Gasoline or Diesel Engine (1 cylinder gasoline model optional - aimed for customers dealing with the motorcycle engines)
- Series Calculation
- Post-processing
- Control Elements
- MATLAB Interfaces
- BURN module: combustion - rate of heat release evaluation based on measurement data

**Module 1**  
Basic

1/2 Day

**Calculation**

- Transient Calculation (on request as additional 1/2 day)



#### TBCS-02 / BOOST Aftertreatment

Required pre-requisites: TBCS-01

**Models:**  
 DOC\_LightOff.bwf  
 SCRT\_AdDesorbtion.bwf  
 SCRT\_Parameter\_Sets.bwf  
 DPF\_Loading.bwf  
 DPF\_BackDiffusion.bwf  
 EHC\_DOC\_ECE\_Cycle.bwf  
 OxiCat\_LightOff.bwf  
 SCR\_WCL\_AdDesorbtion.bwf  
 DPF\_BareTrapRegen.bwf  
 DPF\_Filtration\_Soot\_Classes.bwf  
 WHTC\_400s\_EAS.bwf  
 WHTC\_600s\_EAS\_Controlled.bwf

**Module 2**  
Application

1 Day

**Introduction**

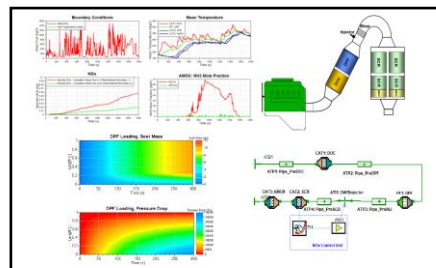
- Introduction and Theory
- Examples: DOC Light Off and DPF Regeneration
- Kinetic Parameters Calibration Using Optimization Tool
- Introduction to AST User Coding Interface

**Module 2**  
Application

1/2 Day

**Simulation**

- Complete EAS System modeling using test bed data
- Control functions



## TBCS-04 / BOOST Turbocharger

### Models:

TCl\_calc.bwf  
TCl\_calc\_short.bwf  
TCl\_calc\_TC\_match.bwf  
first.bwf

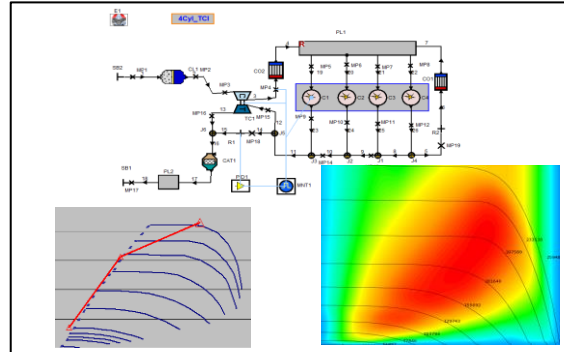
### Module 2

Application

1/2 Day

### Introduction and Theory

- BOOST Simplified Turbocharger Model
- Turbocharger Matching and Full Turbocharger Model

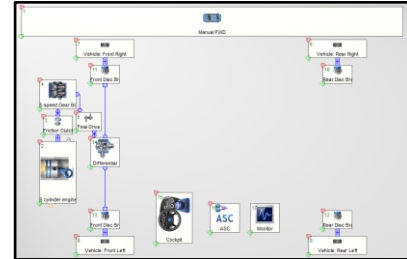


### 3.2.8 AVL CRUISE™ Training Courses

#### TCSS-01 / CRUISE Basic Training Course

Models:  
Man\_FWD ver\_0001  
Aut\_FWD ver\_0001

<b>Module 1</b> Basic	<b>Module 1</b> Basic
<b>1 Day</b>	<b>1 Day</b>
<p><b>Introduction</b></p> <ul style="list-style-type: none"> <li>Introduction</li> <li>Creating a basic vehicle model</li> <li>Setting up the Cycle Run Calculation Task</li> <li>Running a simulation</li> <li>Post-processing</li> </ul>	<p><b>Calculation</b></p> <ul style="list-style-type: none"> <li>Overview of other calculation tasks (e.g. Full load acceleration, max. velocity, etc.)</li> <li>Modifying a manual transmission vehicle to an automatic transmission vehicle</li> <li>Explanation of different calculation types (variations) with post-processing</li> </ul>

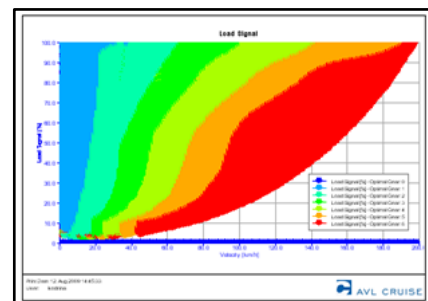


#### TCSS-04 / CRUISE GSP

Required pre-requisites: TCSS-01

Models:  
GSP Wizard AMT ver\_0001  
GSP AMT ver\_0001

<b>Module 2</b> Application	<b>Module 2</b> Application
<b>1 Day</b>	<b>1/2 Day</b>
<p><b>Introduction</b></p> <ul style="list-style-type: none"> <li>Introduction and overview</li> <li>GSP Wizard</li> <li>GSP Generation</li> </ul>	<p><b>GSP Optimisation</b></p> <ul style="list-style-type: none"> <li>GSP Optimisation</li> </ul>

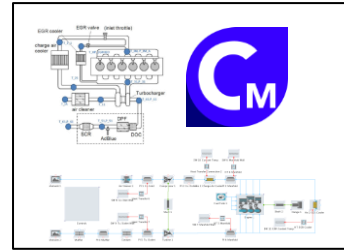




### 3.2.9 AVL CRUISE™ M Training Courses

CRUISE M Physical Engine Basic Training Courses  
**TCME-01** / CRUISE M Physical Engine / GASOLINE  
**TCME-02** / CRUISE M Physical Engine / DIESEL

Models:  
 C06111\_EPW\_CAR\_Gasoline  
 C06107\_EPW\_CAR\_Diesel



**Module 1**  
Basic

1 Day

**Introduction**

- Basic GUI Functionality
- Basic components
- Simulation Settings
- CRUISE M GUI, Pre- and Post-processing
- Basic model setup with calculation tasks
- Online Monitoring

**Module 1**  
Basic

1 Day

**Engine model**

- Generators
- Parameterization and Wizards
- Steady State Engine mode
- Transient, HiL, Soft ECU modes
- Turbocharger
- Control Strategies

**Module 1**  
Basic

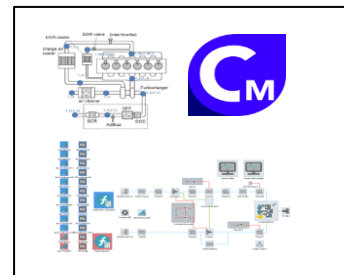
1 Day

**Engine model**

- Generators
- Parameterization and Wizards
- Steady State Engine mode
- Transient, HiL, Soft ECU modes
- Turbocharger
- Control Strategies

CRUISE M Engineering Enhanced Engine Basic Training  
**TCME-03** / CRUISE M Engineering Enhanced - Engine Basic / GASOLINE  
**TCME-04** / CRUISE M Engineering Enhanced - Engine Basic / DIESEL

Models:  
 C06056\_Gasoline\_EE\_Calibration



**Module 1**  
Basic

1 Day

**Introduction**

- CRUISE M GUI, Pre- and Post-processing
- Engineering Enhanced Cylinder
- Gaseous domain in CRUISE M
- Basic model setup with calculation tasks

**Module 1**  
Basic

1 Day

**Engineering Enhanced Engine model**

- Steady State model
- Transient model

**Module 1**  
Basic

1 Day

**Engineering Enhanced Engine model**

- Turbocharger
- Transient control
- Peripheral models

CRUISE M Engineering Enhanced EAS Basic Training  
**TCME-05** / CRUISE M Engineering Enhanced EAS / GASOLINE  
**TCME-06** / CRUISE M Engineering Enhanced EAS / DIESEL

**Models:**  
**TCME-05:** C06049\_Gasoline\_EAS\_Demo.proj  
**TCME-06:** C06039\_Diesel\_EAS\_ASC\_Wizard\_Demo.proj  
 C06040\_Diesel\_EAS\_Demo.proj  
 C06041\_Diesel\_EAS\_SCR\_Wizard\_Demo.proj  
 C06042\_Diesel\_EAS\_sDPF\_Wizard\_Demo.proj

**Module 1**  
Basic

1 Day

**Introduction and Basic Modeling**

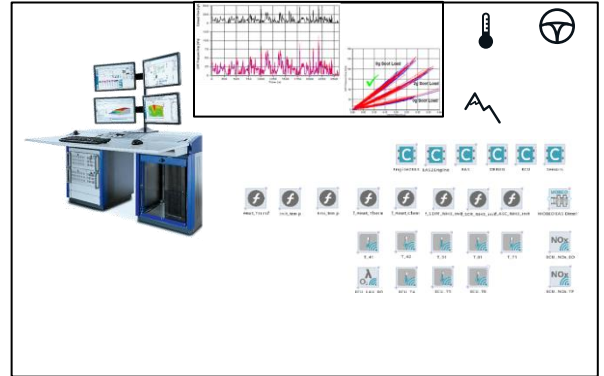
- Engineering Enhanced EAS Gasoline/Diesel block
- EAS model setup (simple and advanced model)

**Module 1**  
Basic

1 Day

**Basic Modeling EAS**

- EAS model parameterization (kinetics, heat transfer and pressure loss refinement)
- EAS model export (preparation for HiL usage)



**TCMF-01** / CRUISE M Flow Basic

**Models:**  
 Several simple models, not part of the installation

**Module 1**  
Basic

1 Day

**Introduction and Basic Modeling**

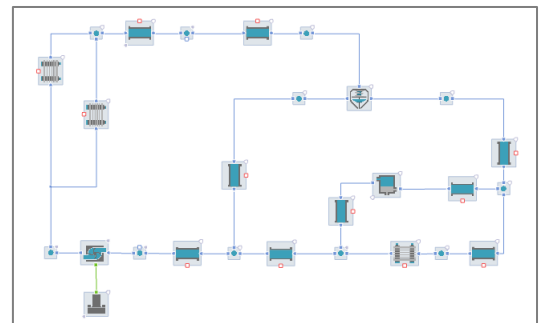
- Thermal management Introduction
- Liquid Flow Domain in CRUISE™ M
- Hydraulic Calibration
- Underhood Modeling

**Module 1**  
Basic

1 Day

**Basic Modeling and Circuits**

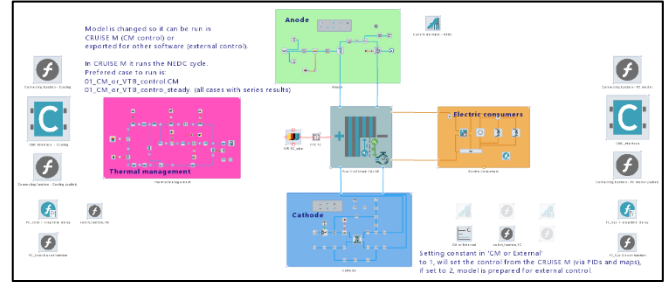
- Heat Exchangers and Heat Transfer
- Pumps
- Valves
- Building and Calibrating Circuits



## TCMV-03 / CRUISE M for VTB / Fuel Cell

Required pre-requisites: TELV-02

Models:  
 C04072\_PEMFC\_Stack  
 C04129\_FC\_System\_VTB  
 C04073\_PEMFC\_System



### Module 2 Application

1 Day

- Introduction**
- CRUISE M GUI
  - VTB introduction
  - Basic model setup
  - Fuel Cell System plant model

### Module 2 Application

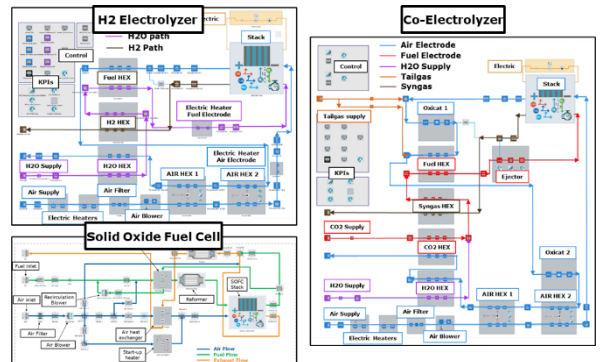
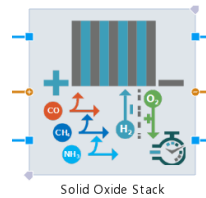
1 Day

- VTB application extension**
- Steady state simulation
  - Transient simulation
  - Exporting the model
  - Testing the exported model

## TCMS-01 / CRUISE M SOFC & SOEC

Only available from September 2024

Models:  
 C04152\_SOFC\_System\_Demo.proj  
 C04174\_SOEC\_System\_Demo.proj



### Module 1 Application

1 Day

- Introduction**
- Basic GUI Functionality
  - Postprocessing
  - Simulation Settings
  - Online Monitoring
  - Basic components
  - Hydrogen storage and

### Module 2 Application

1 Day

- Standalone Model**
- 1D Heat Exchangers
  - Solid Oxide Stack component and Wizard Parameterization
  - Oxidation Catalysis
  - Reformer / Heat Exchangers

### Module 2 Application

1 Day

- Complete Model**
- Solid Oxide Fuel Cell (SOFC) System
  - Solid Oxide Cell Electrolyzer (SOEC) for H2 production
  - Solid Oxide Cell Electrolyzer (SOEC) for Syngas production

## TCMH-01 / CRUISE M Mobile A/C Basic

Required pre-requisites: TCMF-01

**Models:**

- C01001\_AC\_Circuit\_EV
- C01002\_Heat\_Pump\_Cycle\_Internal\_HE
- C01008\_Single\_Stage\_Controlled

**Module 2**  
Application

**1 Day**

**Introduction**

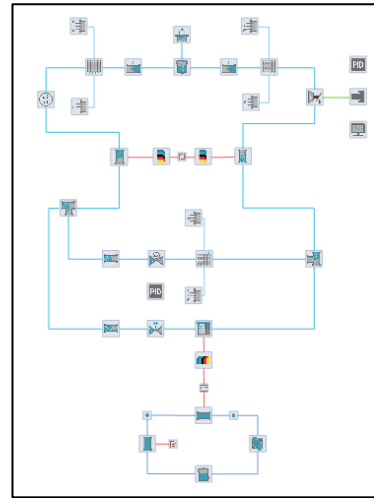
- Introduction to CRUISE M
- AC/WHR domain introduction
- Refrigeration system modeling basics

**Module 2**  
Application

**1 Day**

**Basic Modeling and Circuits**

- Air-conditioning modeling
- Heat pump modeling



## TCMH-02 / CRUISE M BEV with HVAC

Required pre-requisites: TELV-01 and TCMH-01

**Models:**

- C01001\_AC\_Circuit\_EV
- C05058\_Cabin\_Air\_ReCirc\_Sys\_GF

**Module 2**  
Application

**1 Day**

**HVAC in BEVs**

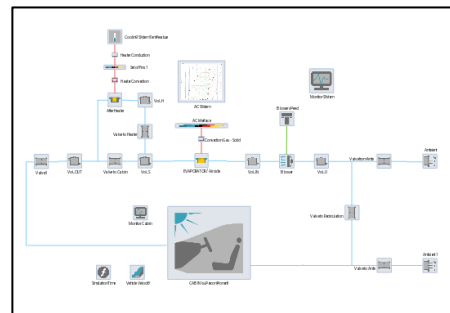
- Refrigeration modeling basics
- AC modeling
- Cabin modeling
- Integration with BEV model

**Module 2**  
Application

**1 Day**

**HVAC in BEVs**

- Refrigeration modeling basics
- AC modeling
- Cabin modeling
- Integration with BEV model



### 3.2.10 AVL EXCITE™ Designer Training Course

#### TEDE-01 / EXCITE Designer Basic

Models:  
121\_Designer\_I4\excite\I4

**Module 1**  
Basic

1 Day

##### Introduction and Basic Modeling

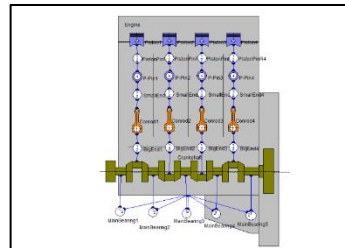
- Introduction and Theory
- Bearing, Torsion and Strength Application
- Create a Model of an 4 Cylinder Engine

**Module 1**  
Basic

1 Day

##### Basic Modeling

- Post-Processing
- Crankshaft Pre-Processing using Au-toSHAFT approach



### 3.2.11 AVL EXCITE™ Piston&Rings Training Courses

#### TEPR-01 / EXCITE Piston Basic

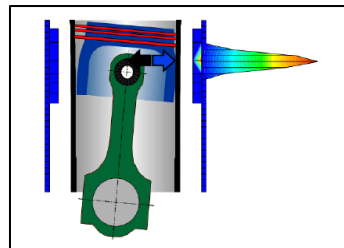
Models:  
202\_GasolineEngine\excite\_pr\1\_4L-Gasoline  
203\_I4\_Demo\_Diesel\excite\_pr\I4\_demo\_diesel

**Module 1**  
Basic

1 Day

##### Introduction and Basic Modeling

- Piston Dynamics – Theory
- General information
- Calculation assumptions
- Modeling Guidelines
- Build up and run a model



#### TEPR-02 / EXCITE Rings Basic

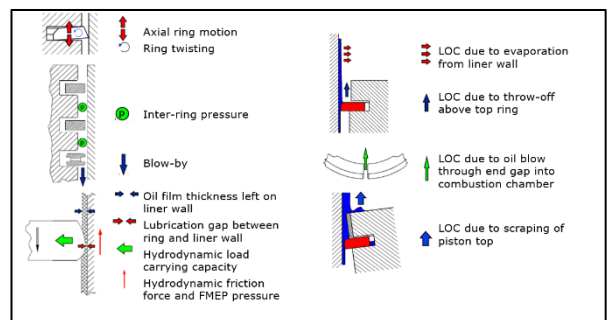
Models:  
202\_GasolineEngine\excite\_pr\1\_4L-Gasoline  
203\_I4\_Demo\_Diesel\excite\_pr\I4\_demo\_diesel

**Module 1**  
Basic

1 Day

##### Introduction and Basic Modeling

- Ring Dynamics - Theory
- General Information
- Ring Dynamics Modeling Approaches
- Lube Oil Consumption - Theory
- Build up and run a model



## TEPR-03 / EXCITE Piston & Rings Lube Oil Consumption

### Models:

202\_GasolineEngine\excite\_pr\1\_4L-Gasoline  
203\_I4\_Demo\_Diesel\excite\_pr\I4\_demo\_diesel

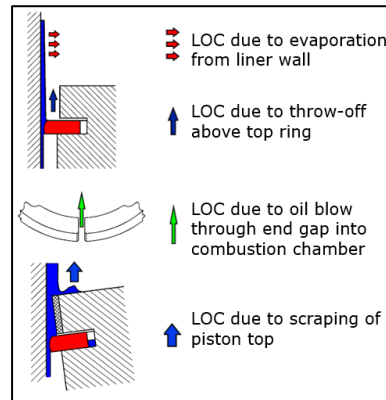
### Module 1

Basic

1 Day

#### Introduction and Basic Modeling

- Lube Oil Consumption - Theory
- General Information
- Lube Oil Consumption Modeling Approaches
- Build up and run a model



## 3.2.12 AVL EXCITE™ Power Unit Training Courses

### TEPU-01 / EXCITE Power Unit Basic

**Models:**

100\_General\excite\General\_Example3\_extended  
101\_Primer\excite\Primer\_FEM\_NONL\_abq

**Module 1**  
Basic

1 Day

**Introduction and Basic Modeling**

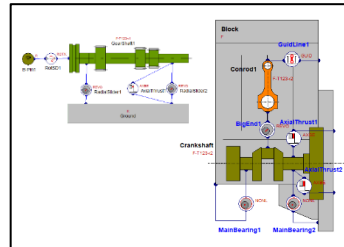
- Introduction and Theory
- Bodies and Joints
- Loads and Initial Conditions
- Crank Train Globals
- Matrix Reduction of Simple Structured Bodies
- Set-up of Analysis Cases and Simulation Control
- Create a Simple Multi-Body Dynamics Model

**Module 1**  
Basic

1 Day

**Basic Modeling**

- Matrix Reduction of Volumetric Models
- Create a Model of a Single Cylinder
- 2D and 3D Post-processing
- Internal Data Recovery



### TEPU-02 / EXCITE Power Unit Crankshaft Dynamics

Required pre-requisites: TEPU-01

**Models:**

102\_I4\_Demo\excite\i4\_demo\_CS\_SHM\_abq\_enhd\_sweep.ex  
102\_I4\_Demo\excite\i4\_demo\_CS\_FEM\_abq\_enhd\_sweep.ex

**Module 2**  
Application

1 Day

**Introduction and Modeling**

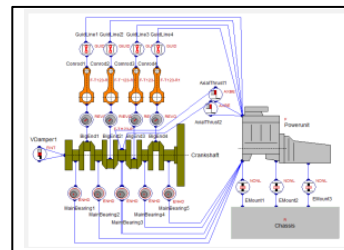
- Introduction and Theory
- Modeling Guidelines
- AutoSHAFT Approach
- Setup of I4 Demo Model (Structured Model)

**Module 2**  
Application

1 Day

**Modeling**

- Setup of I4 Demo Model (Volumetric Model)
- Postprocessing



## TEPU-03 / EXCITE Power Unit Crankshaft Stress Analysis

Required pre-requisites: TEPU-01 and 02

**Models:**

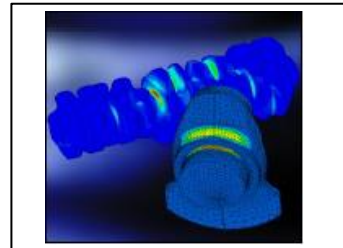
102\_I4\_Demo\excite\I4\_demo\_CS\_SHM\_abq\_enhd\_sweep.ex  
 102\_I4\_Demo\excite\I4\_demo\_CS\_FEM\_abq\_enhd\_sweep.ex

**Module 2**  
Application

1 Day

**Introduction and Theory**

- Overview of the Strength Analysis based on the MBD Stress Analysis using FEA and Fillet Modeler approaches based on the In-line 4-cylinder Example

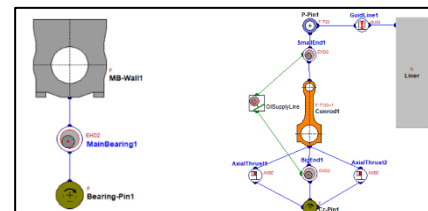


## TEPU-04 / EXCITE Power Unit Main Bearing and Conrod Bearing Analysis

Required pre-requisites: TEPU-01

**Models: installation examples**

103\_Bearing\excite\MainBearing\_EHD\_abq.ex  
 104\_Conrod\excite\Conrod\_abaqus\_OSL.ex



**Module 2**  
Application

1/4 Day

**Introduction and Theory**

- Agenda
- Introduction
- Features and Applications
- Theory (EHD joint)
- Friction
- Surface Roughness and Micro-contact Analysis

**Module 2**  
Application

1/4 Day

**Modeling Guidelines (FE and EXCITE)**

- FE Model Requirements, retained nodes and condensation
- EXCITE PU modeling
- Thermal Analysis
- Wear Analysis
- Oil Supply Lines

**Module 2**  
Application

1/4 Day

**MB and Conrod Bearing Models – Practice**

- Overview of EHD Definitions in GUI
- Body definitions
- Joint definitions
- Loads
- Create Model, Simulation, Create Results

**Module 2**  
Application

1/4 Day

**Post-processing**

- 2D post-processing, IMPRESS Chart
- 3D post-processing, IMPRESS 3D

## TEPU-05 / EXCITE Power Unit Main Bearing Wall and Conrod Stress Analysis

Required pre-requisites: TEPU-01

**Models:**

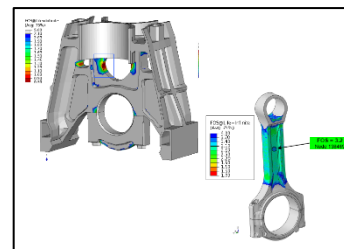
103\_Bearing\excite\MainBearing\_EHD\_abq.ex  
 104\_Conrod\excite\Conrod\_abaqus.ex

**Module 2**  
Application

1 Day

**Introduction and Theory**

- Introduction and theory
- FEModeling Guidelines for MB Wall and Conrod
- High Cycle Fatigue (only presentation)
- Thermal Analysis
- Fretting





## TEPU-06 / EXCITE Power Unit 3D Piston Dynamics

Required pre-requisites: TEPU-01

**Models:**

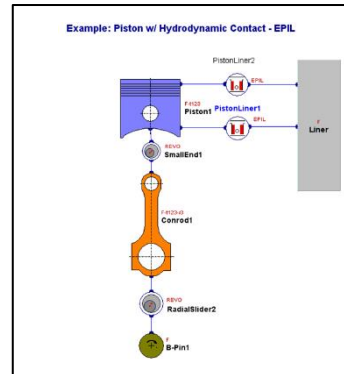
105\_Piston\excite\Piston\_hydro\_ABQ.ex

**Module 2**  
Application

1 Day

**Introduction and Modeling**

- Introduction and Theory
- Modeling Guidelines
- Create Piston-Liner Analysis Model
- Post-processing



## TEPU-07 / EXCITE Power Unit Noise, Vibration & Harshness Structural

Required pre-requisites: TEPU-01 and 02

**Models:**

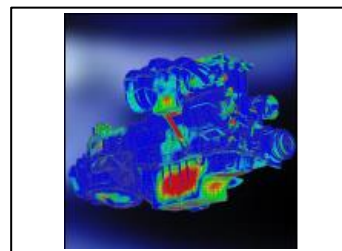
102\_I4\_Demo\excite\I4\_demo\_PU\_FEM\_abq\_nonl\_sweep.ex

**Module 2**  
Application

1 Day

**Introduction and Modeling**

- Introduction and Theory
- Modeling Guidelines
- Data Recovery
- NVH Example based on the Inline 4-Cylinder Example
- Post-processing



## TEPU-08 / EXCITE Power Unit Transmission MT or AT

Required pre-requisites: TEPU-01

**Models:**

107\_I4\_Demo\_TransmissionManual\excite\I4\_demo\_transmission\_rigid.ex  
107\_I4\_Demo\_TransmissionManual\excite\I4\_demo\_transmission\_NVH.ex or  
107a\_I4\_Demo\_TransmissionAutomatic\excite\I4\_demo\_automatic\_transmission.ex

**Module 2**  
Application

1 Day

**Introduction and Modeling**

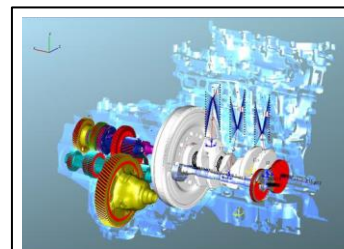
- Introduction
- Gear rattle, gear whine, heartbeat noise
- Gear joints
- Single gear pair model
- Create simple transmission model

**Module 2**  
Application

1 Day

**Modeling**

- Create Standalone Automotive gearbox model
- Assembly of engine, gearbox and driveline
- Dual Mass Flywheel and Clutch modeling



## TEPU-12 / EXCITE Power Unit Micro-contact Analysis

Required pre-requisites: TEPU-01 and 04 or 06

**Models:**

103\_Bearing\excite\MainBearing\_EHD\_abq.ex

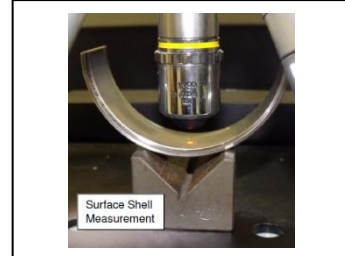
### Module 2

Application

1/2 Day

#### Introduction and Theory

- Roughness Data Import
- Contact Data Evaluation
- Contact Data Selection in EXCITE



## TEPU-15 / EXCITE Power Unit Acoustics (Air Born Noise)

**Models:**

4001\_I4\_Demo\I4\_demo\_full\_workflow.proj

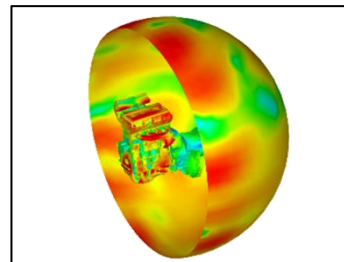
### Module 1

Basic

1 Day

#### Introduction and Basic Modeling

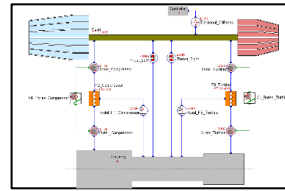
- Introduction and Theory of EXCITE Acoustics
- Generation of acoustic and filed point mesh
- Boundary condition settings and simulation run
- Excite Acoustics 2D Post-processing
- Excite Acoustics 3D Post-processing



## TEPU-16 / EXCITE Power Unit Turbo Charger

Models:

111\_Turbo\_Charger\excite\111\_Turbocharger.ex



**Module 1**  
Basic

1 Day

### Introduction and Modeling

- Theory introduction and FE model requirements for EXCITE
- Turbocharger rotor modeling and rotor modal analysis in Shaftmodeler
- Create a turbocharger model

**Module 1**  
Basic

1 Day

### Bearing modeling and running the simulation

- Oil film modeling
- Roller bearing modeling
- Simulation and results parameter definition
- Running simulation for different speed cases

**Module 1**  
Basic

1 Day

### Results Evaluation

- Introduction in AVL Impress Chart post-processing tool.
- Turbocharger results evaluations.
- Q & A

## TEPU-17 / EXCITE Power Unit Power Unit Valve Train

Models:

4001\_i4\_Demo\i4\_demo\_full\_workflow.proj

**Module 1**  
Application

1/4 Day

### Introduction and Components

- Introduction
- Valve Train Module
- Components, Configurations
- Hydraulic Lash Adjuster Bodies, Joints

**Module 2**  
Application

1/2 Day

### Assembly and FE-Modelling

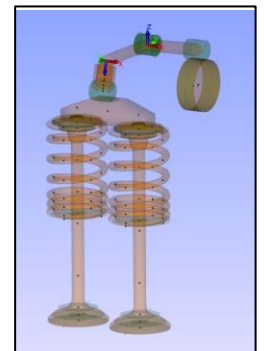
- Valve Train Assembly
- Assembly Examples
- Modelling Guide Lines
- Working Session

**Module 2**  
Application

1/2 Day

### EHD/EHL Contacts

- EHL Cam Contact
- Bearing EHD
- Working Session
- Summing Up and Discussion



## TEPU-18 / EXCITE Power Unit Power Unit Valve Wear Analysis

Models:

4001\_i4\_Demo\i4\_demo\_full\_workflow.proj

**Module 1**  
Application

1/4 Day

### Intro, Approach, Modelling

- Introduction
- Approach/Features
- Modelling
- Thermal Profile

**Module 2**  
Application

1/2 Day

### Wear Analysis

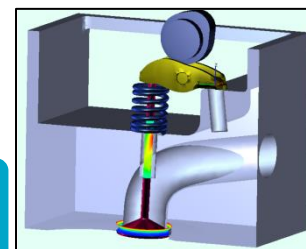
- Wear Workflow
- Wear Evaluation
- Guidelines
- Simplified Model
- Working Session

**Module 2**  
Application

1/2 Day

### COMPOSETM Apps

- COMPOSETM Profile Generator App
- COMPOSETM Wear App
- Working Session
- Summing Up and Discussion



## 3.2.13 AVL EXCITE™ Timing Drive Training Courses

### TETD-01 / EXCITE Timing Drive Basic Dynamics Calculation

**Models:**

01\_SVT-Intake\_OHC-Flat-Tappet.etc  
 03\_Intake-Camshaft.etc  
 05\_Timing-Gear-Train.etc  
 07\_Exhaust-Valve-Train-System.etc  
 09\_Chain-Drive.etc

02\_SVT-Exhaust\_OHC-Finger-Follower.etc  
 04\_Exhaust-Camshaft.etc  
 06\_Intake-Valve-Train-System.etc  
 08\_Timing-Drive\_w-Gear-Train.etc  
 10\_Timing-Drive\_w-Chain-Drive.etc

**Module 1**  
Basic

1 Day

**Introduction**

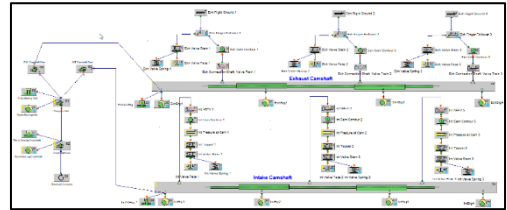
- Introduction and Theory
- Single Valve Train Dynamics Shaft Systems

**Module 1**  
Basic

1 Day

**Theory**

- Gear Train Dynamics
- Timing Drive Dynamics
- Chain & Belt Drives
- Result Analysis



### TETD-05 / EXCITE Timing Drive Chain & Belt Drives

Required pre-requisites: TETD-01

**Models:**

09\_Chain-Drive.etc  
 10\_Timing-Drive\_w-Chain-Drive.etc

**Module 2**  
Application

1 Day

**Introduction and Modeling**

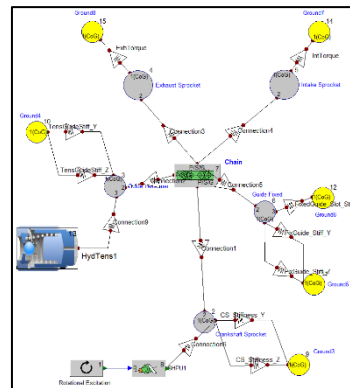
- Modeling General Mechanical Systems
- Overview of Macro Elements for Chains and Belts

**Module 2**  
Application

1 Day

**Modeling**

- Setting up of Application Example
- Result Analysis
- Modeling General Hydraulic Systems



### 3.2.14 AVL EXCITE™ M Training Courses

#### TEXM-01 / EXCITE M Basic

Models:  
561\_I3\_IC

#### Module 1 Basic

1 Day

##### Introduction

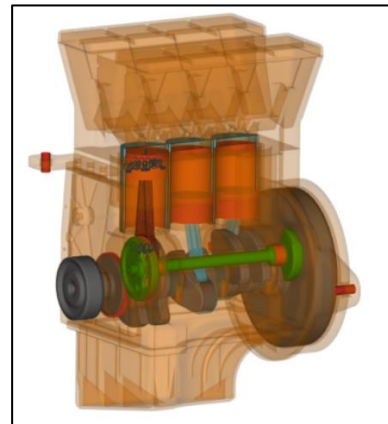
- Introduction and Theory
- Joints & Bodies
- ICE Assembly
- Engine configuration & Globals
- Initial Conditions and Loads & EXCITETM M
- FE Modelling and Condensation
- Simulation and Results Control
- Analysis cases setup

#### Module 1 Basic

1 Day

##### Model setup & Simulation

- Create a Multi-Body Dynamics Model
- IMPRESS™ M general
- Internal Data Recovery
- 2D and 3D Postprocessing



#### TEXM-02 / EXCITE M - Large Scale DOE and Robust Optimization using CAMEO™

Required pre-requisites: TEXM-01

#### Module 1 Basic

1/2 Day

##### CAMEO Basic

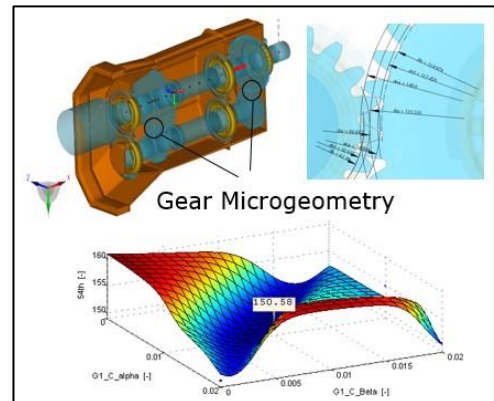
- Introduction
- CAMEO Basics
- Software usage
- Model building
- Optimization

#### Module 1 Basic

1/2 Day

##### EXCITE M for DOE

- Introduction
- Excite M for DOE
- Working Example
- CAMEO + Excite M DOE
- Evaluation
- Robust Optimization



#### TEXM-03 / EMT™ - Large Scale DOE and Robust Optimization using CAMEO™

#### Module 1 Basic

1/2 Day

##### CAMEO Basic

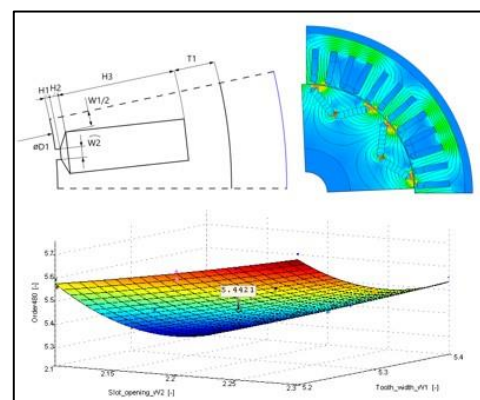
- Introduction
- CAMEO Basics
- Software usage
- Model building
- Optimization

#### Module 1 Basic

1/2 Day

##### EMT for DOE

- Introduction
- EMT for DOE
- Working Example
- CAMEO + EMT DOE
- Evaluation
- Robust Optimization

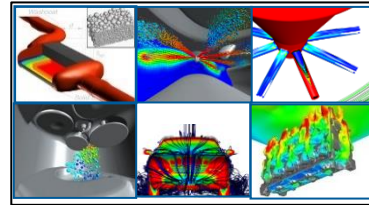


### 3.2.15 AVL FIRE™ Training Courses

#### TFGP-01 / FIRE Basic (General Purpose)

**Models:**

- 900\_Intake Manifold
- 952\_Sliding Grid Interface: Rotating Object
- 901\_FAME™ Hexa: Cooling Jacket



**Module 1**  
Basic

**1 Day**

**Introduction**

- Introduction to AVL FIRE
- Basic Model Generation
- Mesh generation (for non-moving, steady geometries)
- Simulation setup – basics
- Postprocessing – basics

**Module 1**  
Basic

**1 Day**

**Main features**

- Computational volume domain in FAME HEXA
- Advanced features, such as Sliding, MRF
- Basic model setup FIRE WM
- Post-processing in FIRE WM
- Self-working on example

**Module 1**  
Basic

**1 Day**

**Other tools/features**

- Moving mesh concept
- Sliding, MRF
- Advanced simulation setup
- Optimization formulas
- Impress chart post-processing

## TFEN-03 / FIRE IC Engine – GDI Nozzle

Required pre-requisites: TFEN-01

Models:  
979\_GDI\_Flash\_Boiling

### Module 2 Application

1 Day

#### Introduction

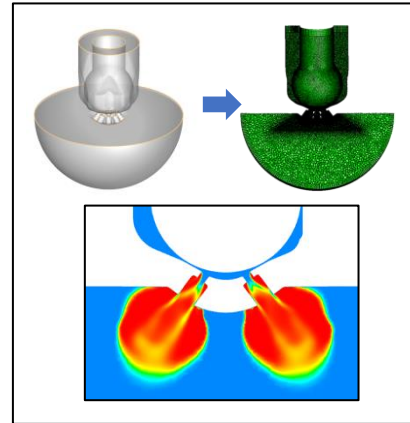
- FIRE™ M Nozzle flow Pre-processing capabilities
- Interactive meshing basics and modeling
- Block structured and automated meshing solution
- Mesh movement; moving mesh or movement by formula

### Module 2 Application

1 Day

#### Multi-phase module

- GDI Nozzle flow simulation setup
- Performance Parameter: discharge rate, flow uniformity at the outlet, erosion probability, adhesion force model, flash boiling cavitation model
- Eulerian Multiphase Models, cavitation model, erosion model, nozzle interface
- Running and monitoring of the simulation
- Post-processing and Application specific 2D result analysis
- Optional demo: LaGrange spray coupling using the nozzle file as input on a simple spray-box geometry



## TFEN-04 / FIRE IC Engine – Piston cooling Analysis

Required pre-requisites: TFEN-01

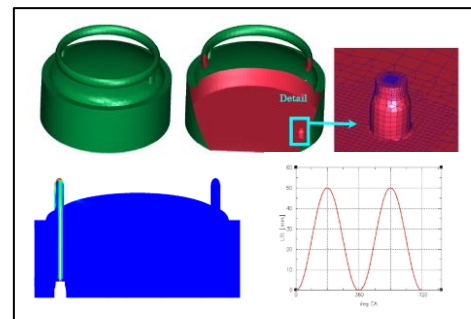
Models:  
9400 Automatic Optimization Example

### Module 2 Application

1 Day

#### Introduction and Simulation

- FIRE GUI basics, Pre- and Post-processing
- Calculation domain definition and generation
- Calculation preconditions, setup and initial calculation
- Simulation result analysis



## TFEN-18 / FIRE IC Engine - Aftertreatment - SCR & DPF

Required pre-requisites: TFEN-01

### Models:

909\_Part particulate\_Filter  
 911\_Diesel\_Exhaust\_System  
 924\_Damaged\_Part particulate\_Filter  
 932\_Selective\_Catalytic\_Reactor

### Module 2 Application

1 Day

#### Introduction and Simulation

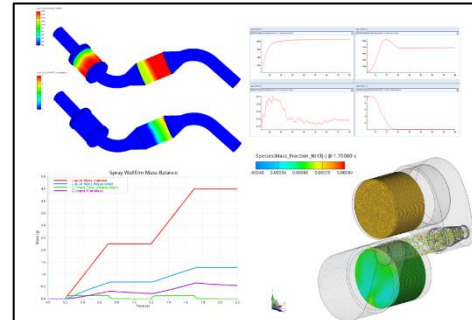
- Introduction to Aftertreatment Simulation (BOOST / CM / FIRE)
- SCR Simulation workflow: steady – transient, speed up
- Performance Parameter: AdBlue Injection, Uniformity of Ammonia, Wall film, Species Conversion, Deposits
- Model Generation (HD example approach)
- Exhaust Gas Aftertreatment Module, Lagrangian Multiphase Module
- Setup of Simulation Control File
- Result Analysis

### Module 2 Application

1 Day

#### Aftertreatment module

- DPF Simulation workflow
- Performance Parameter: Pressure Drop, Loading / Regeneration of Soot, Temperature Gradients, Crack Risk
- Model Generation (DPF example approach)
- Exhaust Gas Aftertreatment Module
- Setup of Simulation Control File
- Result Analysis



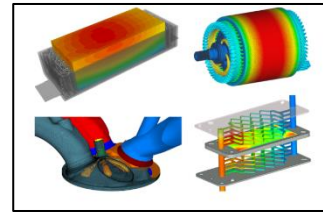


### 3.2.16 AVL FIRE™ M Training Courses

#### TFIM-01 / FIRE M Basic

**Models:**

- 9102\_Cooling Jacket.proj
- 9104\_Parameters and Scenarios
- 9301\_Cylinder Head
- 9303\_Porosity
- 9103\_Interactive Meshing



**Module 1**  
Basic

**1 Day**

**Introduction**

- FIRE M GUI - Pre-processing
- Computational volume domain in FIRE M
- Basic model setup FIRE M
- Post-processing in IMPRESS M

**Module 2**  
Basic

**1 Day**

**Advanced features – Embedded body**

- Simple setup of each user
- Advanced features as embedded body
- Introduction to Interactive meshing
- Embedding control with multiple meshes
- Model analysis

**Module 3**  
Basic

**1 Day**

**Advanced features - Multi-domain**

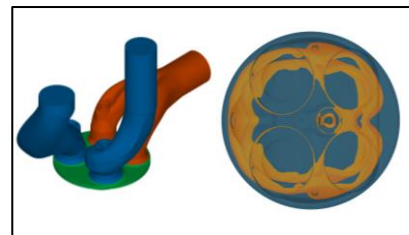
- Multi-material approach
- Multi-material setup, sliding moving mesh
- Checking simulation parameters and scenarios
- Advanced reporting in IMPRESS M
- Activating modules in FIRE M GUI

#### TFME-01 / FIRE M Engine (GDI/ PFI/ Diesel Engine Related)

Required pre-requisites: TFIM-01, Module 1

**Models:**

- 9600\_In-cylinder flow
- 9601\_Fame Engine Pre-processing
- 9602\_Fame Engine Post-processing
- 9603\_Engine Automated workflow
- 9604\_PFI Engine Automated workflow



**Module 1**  
Application

**1 Day**

**Pre-processing**

- Model preparation
- Surface preparation
- Selection definition
- Movement prescription
- Mesh generation

**Simulation Setup**

- Template definition
- Boundary conditions
- Initial conditions
- Convergence criteria
- Underrelaxation
- Differencing schemes
- Turbulence modeling

**Module 2**  
Application

**1 Day**

**Physical Models**

- Species transport
- Spray model
- Combustion / reaction model
- Emission model
- Knocking model
- Post-processing
- Result analysis

**Post-processing**

- Running simulations
- Simulation monitoring
- Post-processing
- Result analysis

**TFME-02 / FIRE M IC Engine - Diesel Injection Nozzle**

Required pre-requisites: TFME-01

**Models:**

- 9103\_Interactive\_Meshing.proj
- 9310\_Diesel\_Injector.proj
- 9312\_Automated\_Injector.proj

**Module 2**  
Application

**1 Day**

**Introduction**

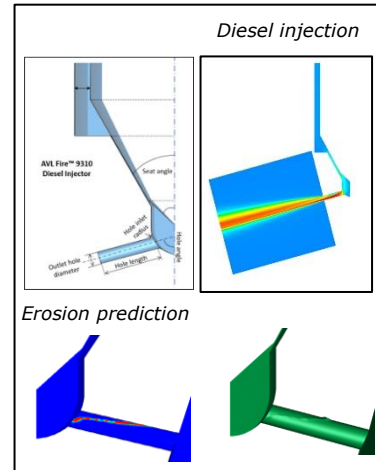
- FIRE™ M Nozzle flow Pre-processing capabilities
- Interactive meshing basic and modeling
- Block structured and automated meshing solution
- Mesh movement; moving mesh or movement by formula

**Module 2**  
Application

**1 Day**

**Multi-phase module**

- Nozzle flow simulation setup
- Performance Parameter: discharge rate, flow uniformity at the outlet, cavitation intensity, erosion probability
- Eulerian Multiphase Models, cavitation model, erosion model, nozzle interface
- Running and monitoring of the simulation
- Post-processing and Application-specific 2D result analysis
- Optional demo: Lagrangian spray coupling using the nozzle file as input on a simple spray-box geometry

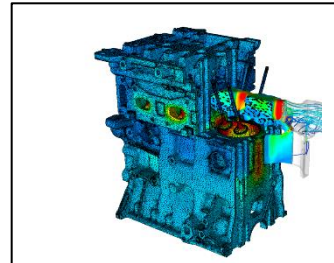


**TFME-04 / FIRE M Head Block Compound**

Required pre-requisites: TFME-01

**Models:**

- 9301\_Cylinder\_Head.proj
- Internal training material: Foton GDI Engine
- 9520\_HBC\_Thermal\_Load\_Management.proj
- Internal training material: Foton GDI Engine



**Module 2**  
Application

**1 Day**

**Introduction**

- Introduction of the HBC application and simulation specifics
- Heat transfer model parameters and influence on the results
- FIRE M GUI, Pre- and Post-processing
- Basic model setup with calculation tasks

**Module 2**  
Application

**1 Day**

**Modeling**

- Preparation of HBC input model (CAD data)
- Multi-domain model generation
- Setup of the simulation
- Starting and monitoring
- Result analysis

**Module 2**  
Application

**1 Day**

**HBC module**

- Introduction of the HBC transient operation and simulation specifics
- Preparation of input data (System level VTMS – 1D simulation)
- Preparation of input data (Cylinder Inner flow – 3D simulation)
- Setup of the HBC simulation
- Transient simulation-specific parameters
- Starting and monitoring of the simulation
- Result analysis
- Mapping of 3D AVL FIRE results to the FEM mesh

## TFME-05 / FIRE M Liner Cavitation

Required pre-requisites: TFME-01

### Models:

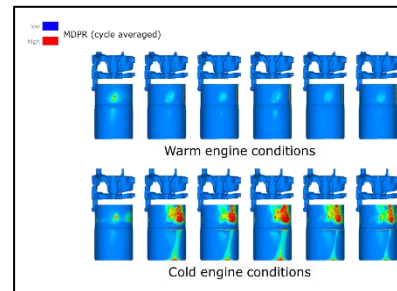
9506\_Liner\_Cavitation.proj

### Module 2 Application

1 Day

#### Introduction and Simulation

- Introduction of the Liner Cavitation application and simulation specifics
- Preparation of excitation data (obtained with EX-CITE simulation)
- Setup of the simulation
- Simulation-specific parameters and their influence on the results
- Starting and monitoring of the simulation
- Result analysis



## TFME-06 / FIRE M IC Engine - Intake Port Flow

Required pre-requisites: TFIM-01

### Models:

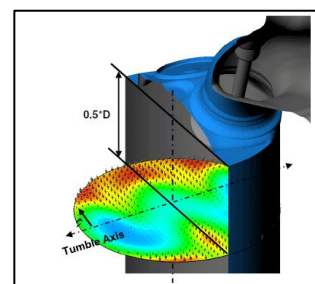
9502\_Port Workflow

### Module 2 Application

1 Day

#### Introduction and Modeling

- Introduction to port flow simulation
- Flow evaluation - parameters (discharge rate, swirl/tumble)
- Formulas
- Single model generation (Reference TFIM-01)
- Series of model generation
- Single and series simulation setup and running
- Result analysis



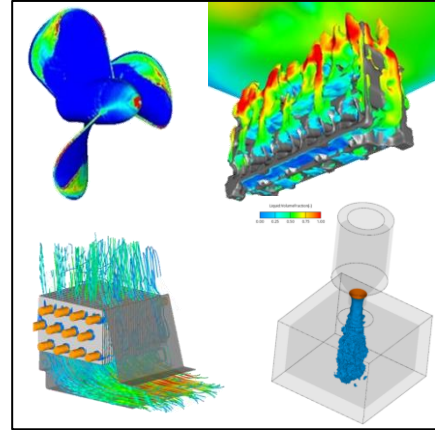
## TFME-07 / FIRE M (Module-Specific) Eulerian Multiphase Module

Required pre-requisites: TFIM-01

**Models:**

- 9356\_Tank\_Filling.proj
- 9384\_Embedded\_Body\_Gearbox.proj
- 9310\_Diesel\_Injector.proj

<b>Module 2</b> Application	<b>Module 2</b> Application
<b>1 Day</b>	<b>1 Day</b>
<p><b>Introduction</b></p> <ul style="list-style-type: none"> <li>Theory on Eulerian multi-phase module</li> <li>Available multi-phase specific modeling approaches in FIRE M</li> <li>Cavitation/Erosion model</li> <li>Quenching model</li> <li>Eulerian spray</li> <li>Melting/Solidification</li> <li>Basic example preparation</li> </ul>	<p><b>Simulation</b></p> <ul style="list-style-type: none"> <li>Used example Pre-processing</li> <li>Calculation domain definition and generation</li> <li>Calculation preconditions, setup and initial calculation</li> <li>Simulation result analysis</li> </ul>



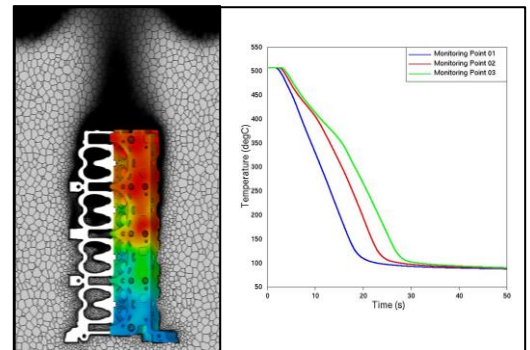
## TFME-08 / FIRE M (Module-Specific) Quenching

Required pre-requisites: TFIM-01

**Models:**

- 9307\_Steel\_Quenching.proj
- 9308\_Quenching.proj
- 9309\_RPI\_Wall\_Boiling.proj

<b>Module 2</b> Application	<b>Module 2</b> Application
<b>1 Day</b>	<b>1 Day</b>
<p><b>Introduction</b></p> <ul style="list-style-type: none"> <li>Theory on Eulerian multi-phase module</li> <li>Available multi-phase specific modeling approaches in FIRE™ M</li> <li>Introduction into Quenching module</li> <li>Model preparation and Mesh generation</li> <li>Basic example preparation</li> </ul>	<p><b>Simulation</b></p> <ul style="list-style-type: none"> <li>Used example Pre-processing</li> <li>Calculation domain definition and generation</li> <li>Calculation preconditions, setup and initial calculation</li> <li>Simulation result analysis</li> </ul>



## TFME-09 / FIRE M IC Engine - Aftertreatment - SCR

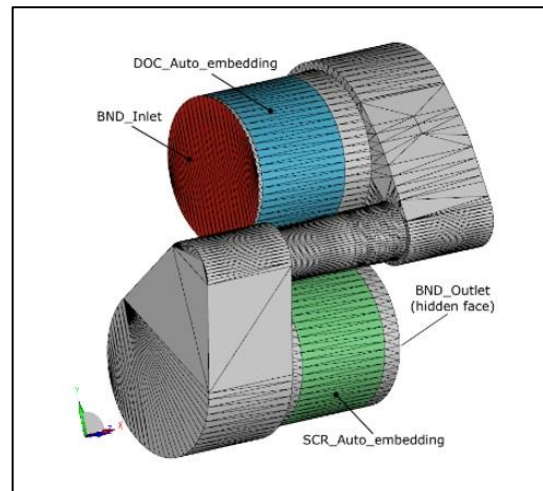
Models:  
9305\_Aftertreatment\_AdBlue\_SCR

### Module 2 Application

1 Day

#### Introduction and Modeling

- Workflow Overview
- Preprocessing – Selection Creation
- Simulation Setup (Steady Case)
- Sim Postprocessing and Discussion ulation Setup (Transient Case)



## 3.2.17 AVL SAMOSTM Training Course

### TSAM-01 / SAMOS Basic

Models:  
Included in SAMOS-AT SW-Package: madlein.e00

### Module 1 Basic

1 Day

#### Introduction and Theory

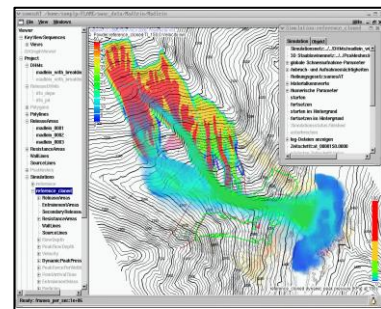
- Laws of Conservation and Fluid Mechanics
- Theory of Dense Flow Avalanches
- Theory of Powder Snow Avalanches
- Numerical Models

### Module 1 Basic

1 Day

#### Theory

- General Software Handling
- Digital Terrain Models
- Release and Entrainment Area Definitions
- Dense Flow Simulation and Postprocessing
- Powder Snow Simulation and Postprocessing



### 3.2.18 AVL SPA™ Training Course

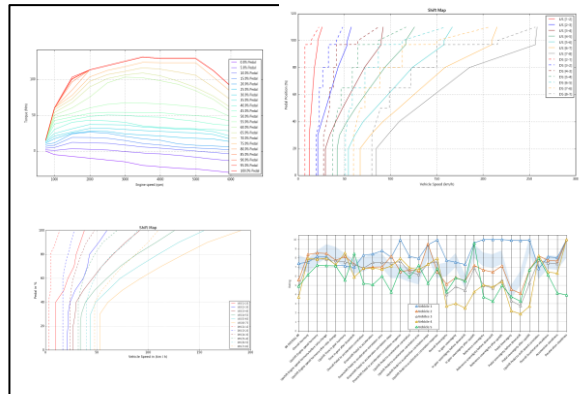
TSPA-01 / SPA Basic

**Module 1**  
Basic

1 Day

**Introduction an application**

- What is AVL SPA
- SPA GUI
- Basic model setup
- Criteria Introduction
- Rating Improvement
- Report Generation



### 3.2.19 Model.CONNECT™ Training Course

TCMO-01 / Model.CONNECT Basic

**Models:**  
Primer.proj  
CRUISE\_M.proj  
MATLAB.proj

**Module 1**  
Basic

1 Day

**Introduction**

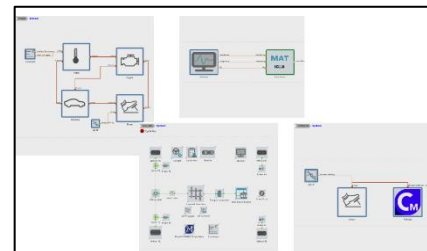
- Model.Connect presentation
- Model.Connect Basic and overview
- Inserting components
- Component properties
- Connecting components
- Simulation properties
- Online monitoring
- Run the simulation
- Results tab
- Debugging
- Case generation

**Module 1**  
Basic

1 Day

**Interfacing**

- CruiseM interface
- MATLAB interfaces fmi.LAB



### 3.2.20 AVL Scenario Designer™ Training Course

#### TSDB-01 / Scenario Designer Basic

**Models:**

Cut-in.proj  
 OpenSCENARIO\_BASICS\_Trajectories.proj  
 OpenSCENARIO\_BASICS\_Synchronize.proj

#### Module 1 Basic

1 Day

**Introduction**

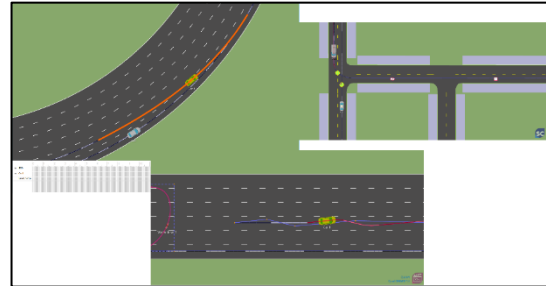
- Scenario Designer presentation
- Scenario Designer Basic and overview

**Create Cut in scenario**

- Inserting components
- Component properties
- Defining events
- Run the verification of the Scenario
- Export Scenario
- Define Parameters
- Export Scenario with set of Parameters

**Create more scenarios**

- Define routes
- Define trajectories
- Set up synchronize action



### 3.2.21 AVL Scenario Simulator™ Training Course

#### TSSB-01 / Scenario Simulator Basic

**Models:**

ACC.proj  
 ALKS.proj  
 LKA.proj

#### Module 1 Basic

1 Day

**Introduction**

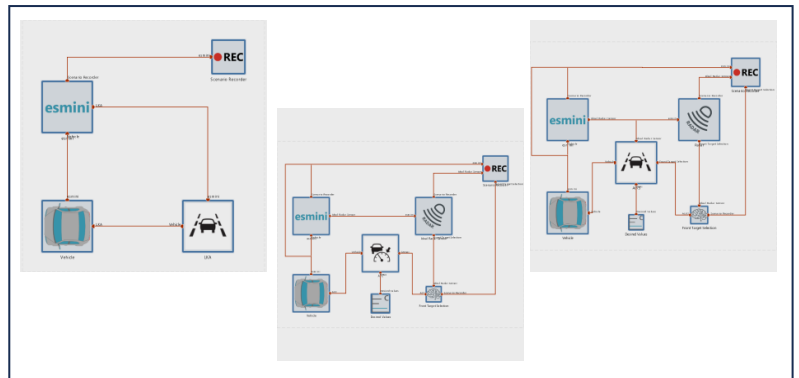
- General Knowledge

**Integration Phase**

- Tool overview
- Integration Phase

**Automated testing Phase**

- Automated testing Phase
- Q&A



### 3.2.22 PreonLab™ Training Course

#### TPREO-02 / PreonLab Basic Transmission

Models:  
GearBox\_RBS Geometries

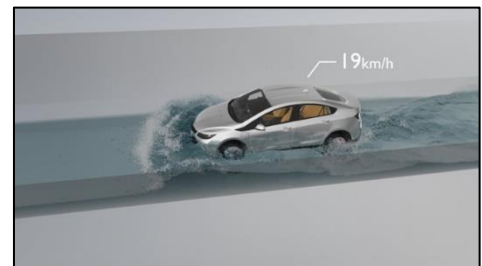
<div style="background-color: #0056b3; color: white; padding: 10px; border-radius: 10px; margin-bottom: 5px;"> <b>Module 1</b> Basic             </div> <div style="text-align: center; font-weight: bold; color: #0056b3;">1 Day</div> <div style="background-color: #e0e0e0; padding: 10px; border-radius: 10px; margin-top: 5px;"> <p><b>Basic Introduction</b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Solver</li> <li>▪ Boundary handling</li> <li>▪ PreonLab basic usage</li> <li>▪ Sources</li> <li>▪ Connections</li> <li>▪ Keyframes</li> <li>▪ Visualizations</li> <li>▪ Force fields</li> <li>▪ Sensors</li> <li>▪ Rigid body GearBox</li> </ul> </div>	<div style="background-color: #0056b3; color: white; padding: 10px; border-radius: 10px; margin-bottom: 5px;"> <b>Module 1</b> Basic             </div> <div style="text-align: center; font-weight: bold; color: #0056b3;">1 Day</div> <div style="background-color: #e0e0e0; padding: 10px; border-radius: 10px; margin-top: 5px;"> <p><b>Transmission</b></p> <ul style="list-style-type: none"> <li>▪ Gearbox example</li> </ul> </div>
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#### TPREO-03 / PreonLab Basic Water Management

Models:  
RainWaterManagement  
Airflow.prscene  
Drain.prscene

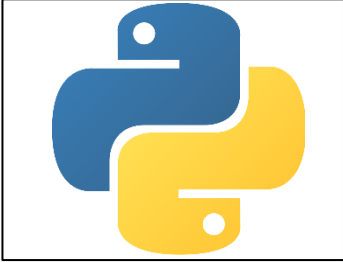
<div style="background-color: #0056b3; color: white; padding: 10px; border-radius: 10px; margin-bottom: 5px;"> <b>Module 1</b> Basic             </div> <div style="text-align: center; font-weight: bold; color: #0056b3;">1 Day</div> <div style="background-color: #e0e0e0; padding: 10px; border-radius: 10px; margin-top: 5px;"> <p><b>Basic Introduction</b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Solver</li> <li>▪ Boundary handling</li> <li>▪ PreonLab basic usage</li> <li>▪ Sources</li> <li>▪ Connections</li> <li>▪ Keyframes</li> <li>▪ Visualizations</li> <li>▪ Force fields</li> <li>▪ Sensors</li> <li>▪ Rigid body GearBox</li> </ul> </div>	<div style="background-color: #0056b3; color: white; padding: 10px; border-radius: 10px; margin-bottom: 5px;"> <b>Module 1</b> Basic             </div> <div style="text-align: center; font-weight: bold; color: #0056b3;">1 Day</div> <div style="background-color: #e0e0e0; padding: 10px; border-radius: 10px; margin-top: 5px;"> <p><b>Water Wading</b></p> <ul style="list-style-type: none"> <li>▪ Water Wading example</li> </ul> </div>
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### 3.2.23 Python™ Training Course

TPYT-01 / Python Basic

<div style="background-color: #0056b3; color: white; padding: 10px; border-radius: 5px;"> <p><b>Module 1</b> Basic</p> </div> <p><b>1 Day</b></p> <div style="background-color: #e6e6e6; padding: 10px; border-radius: 5px;"> <p><b>Introduction</b></p> <ul style="list-style-type: none"> <li>▪ Introduction</li> <li>▪ Overview of the Language</li> <li>▪ Python Data Types</li> <li>▪ Control Statements</li> </ul> </div>	<div style="background-color: #0056b3; color: white; padding: 10px; border-radius: 5px;"> <p><b>Module 1</b> Basic</p> </div> <p><b>1 Day</b></p> <div style="background-color: #e6e6e6; padding: 10px; border-radius: 5px;"> <p><b>Theory</b></p> <ul style="list-style-type: none"> <li>▪ Input/Output Facilities</li> <li>▪ Functions and Modules</li> <li>▪ Object Oriented Programming</li> <li>▪ Working Session</li> </ul> </div>	
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### 3.2.24 AVL VSM™ Training Courses

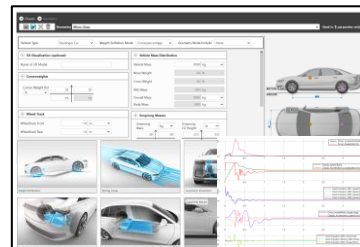
TVSM-01 / VSM Basic

**Models:**

Template VSM models (various)  
 Manage\_Simulink\_Parameters.zip  
 Battery.zip  
 KnC\_Neutral\_Example.zip  
 Simulink\_implementation.zip  
 HV\_Battery\_Example\_Extended.zip

**RDE**

Vehicle\_Model\_Factory\_Example.zip  
 Hydro\_Engine\_Mounts.7z  
 Sequence\_and\_Simbook.7z  
 HV\_Battery\_Example\_Base.zip



<div style="background-color: #0056b3; color: white; padding: 10px; border-radius: 5px;"> <p><b>Module 1</b> Basic</p> </div> <p><b>1 Day</b></p> <div style="background-color: #e6e6e6; padding: 10px; border-radius: 5px;"> <p><b>Introduction &amp; Setups</b></p> <ul style="list-style-type: none"> <li>▪ Introduction to Applications</li> <li>▪ VSM Basics/Workflow</li> <li>▪ Setups: Vehicle Geometry &amp; Aerodynamics</li> <li>▪ Setups: Suspension &amp; Compliance</li> <li>▪ Setups: Tyre &amp; Tyre Plotter</li> </ul> </div>	<div style="background-color: #0056b3; color: white; padding: 10px; border-radius: 5px;"> <p><b>Module 1</b> Basic</p> </div> <p><b>1 Day</b></p> <div style="background-color: #e6e6e6; padding: 10px; border-radius: 5px;"> <p><b>Setups (cont.) &amp; Track Generation</b></p> <ul style="list-style-type: none"> <li>▪ Setups: Spring &amp; Damper &amp; Anti-Roll Bar</li> <li>▪ Setups: Bumpstop &amp; Rebound Limiter</li> <li>▪ Setups: Drivetrain &amp; Engine</li> <li>▪ Setups: Hybrid &amp; Electric Motor, Electric Controller, Battery</li> <li>▪ Track Generation</li> <li>▪ 3D Viewer</li> </ul> </div>	<div style="background-color: #0056b3; color: white; padding: 10px; border-radius: 5px;"> <p><b>Module 1</b> Basic</p> </div> <p><b>1 Day</b></p> <div style="background-color: #e6e6e6; padding: 10px; border-radius: 5px;"> <p><b>Applications</b></p> <ul style="list-style-type: none"> <li>▪ Driver Setup</li> <li>▪ Variation</li> <li>▪ Results &amp; Postprocessing</li> <li>▪ VSM Matlab Simulink</li> <li>▪ VSM Vehicle Model Factory</li> </ul> </div>
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## 3.3 Non-Standard Software Training

Beside the standard training courses, AVL AST offers non-standard training courses for specific customer interests that are based on customer models as on-the-job training.

Such training courses are treated as separate projects. Content, duration, and price will be defined individually according to the specific needs and requests. A separate project proposal will be given by AVL AST (refer also to **chapter 5**).

Non-standard training is offered for advanced simulation solutions for virtual development and for the following solution areas:



For further information or a specific project proposal, contact your responsible AST Sales Manager.

<b>Contact</b>	
<b>Additional Information</b>	Responsible Sales Manager
<b>Proposal</b>	Responsible Sales Manager

## 3.4 Software Support

Software support at AST is organized according to the AST Global Customer Support Process (GCSP).

The GCSP defines the process steps for answering all regular customer questions and requests related to AVL AST software products. The defined process does not cover customer contact which takes place within project work or joint research developments.

The GCSP includes a level concept:

- 1<sup>st</sup> level support is done by local AST affiliates (if no local affiliate is available, 1<sup>st</sup> level support is done by AST in Graz)
- 2<sup>nd</sup> level support by AST headquarters in Graz

AST offers support by email. Telephone support is offered for 1<sup>st</sup> level support at some AST affiliates. Telephone support is not given by AST in Graz or for 2<sup>nd</sup> level support generally.

For each product or product group, a Support Master is defined. He/she is responsible for all related support requests and distributes the support requests to the different support engineers.

**To receive software support, it is mandatory to have a valid maintenance contract and to have participated in a related training course held by AVL. Within the partnership programs UPP (“university partnership program”) and RPP (“research partnership program”), a dedicated person is defined. He/she acts as a contact person to our support organization.**

**ID**                      **Service**

<b>CC_33</b>	<b>Software Support</b>
<p><b><u>Purpose:</u></b> Software support via email is the single point of contact for customers regarding software-related issues (beside sales information). AST support engineers are highly experienced calculation engineers, who also perform software training and project work in simulation projects within AVL’s engine development process or separate pilot, validation, or method development projects for customers.</p> <p><b><u>Validity:</u></b> The CSP is defined worldwide and is valid for all AVL AST software tools.</p> <p><b><u>Content:</u></b></p> <ul style="list-style-type: none"> <li>• Answer software-related questions</li> <li>• Take over change requests or enhancement requests from customers and transfer them to development and product management</li> </ul> <p><b><u>Goals:</u></b></p> <ul style="list-style-type: none"> <li>• Help the customer with daily problems</li> <li>• Improve product quality and customer satisfaction</li> <li>• Support development with information about customer needs and recommendations</li> <li>• Improve the relationship with the customer</li> </ul> <p><b><u>Customer Benefit:</u></b></p> <ul style="list-style-type: none"> <li>• One contact for all software-related questions</li> <li>• Application know-how of all AST support engineers</li> </ul> <p><b><u>Duration:</u></b></p> <ul style="list-style-type: none"> <li>• 30 hours per year of software support is included with each license.</li> <li>• If this limit is exceeded, it will be charged separately and treated as consulting or project work.</li> </ul> <p><b><u>Price (excl. Tax):</u></b> Software support via email is free of charge for every customer of AST products.</p>	
<b>Contact</b>	
<b><u>About the Process</u></b>	Customer Support Manager – Christian Vock ( <a href="mailto:christian.vock@avl.com">christian.vock@avl.com</a> )
<b><u>Who is my Local Support?</u></b>	Please contact your local sales manager or <a href="#">local support</a> via email.

**Further information:**

- Customer Support Process --> An overview of the GCSP is given in Appendix [7.1](#).

## 4. Know-How Transfer & Engineering Support

This service group sets its focus on engineering know-how and its transfer to the customer.

<b>Contact</b>	
<b>Additional Information</b>	Responsible Sales Manager
<b>Proposal</b>	Responsible Sales Manager

### 4.1 Technology Seminars

Technology seminars are organized as TechDays by AST Graz or a local affiliate. They can be performed for a specific customer and at the customer location, or as a corporate event where different customers can participate.

ID	Service
CC_41	Technology Seminars / TechDays
<p><b><u>Purpose:</u></b>                      Within the frame of a technology seminar, a specific engineering topic and application field is discussed, including theoretical background, application field, problems, and solutions. The focus is set on simulation-related problems and solutions.</p> <p><b><u>Validity:</u></b>                      All engineering topics, which are connected to AST software products, can be addressed. Although the seminar content is kept more general and not focused on AST products, AST-specific solutions and benefits are presented as AST know-how is based on those methods and tools.</p> <p><b><u>Content:</u></b></p> <ul style="list-style-type: none"> <li>• Definition of the entire topic</li> <li>• Theoretical background</li> <li>• Components and functionality</li> <li>• Problems and engineering tasks, which have to be solved</li> <li>• Technical solutions and applied methods</li> </ul> <p><b><u>Goals:</u></b></p> <ul style="list-style-type: none"> <li>• Generate understanding of the engineering topic</li> <li>• Transfer of application know-how for the specific topic</li> <li>• Understanding of cross effects</li> </ul> <p><b><u>Customer Benefit:</u></b></p> <ul style="list-style-type: none"> <li>• Compressed know-how transfer of cutting-edge technology for a specific application field</li> </ul> <p><b><u>Duration:</u></b></p> <ul style="list-style-type: none"> <li>• The duration depends on the specific topic, but it is typically between 1 and 3 days.</li> </ul> <p><b><u>Price (excl. Tax):</u></b> * see chapter 2.1</p> <ul style="list-style-type: none"> <li>◆ Seminar fee for a TechDay starts from <b>390 euro</b> per participant and it may vary..</li> </ul>	

### 4.2 Engineering Support

This module focuses mainly on the usage of AVL AST software products in daily life and real development projects, including the interpretation of results and dealing with variants (*application-oriented*).

Specific services are:

- Start-up support
- Enhancement support
- Consulting
- Software customization and specific software development

## 4.2.1 Start-up Support

ID                      Service

CC\_421                Start-up Support

**Purpose:**

Start-up support is on-the-job training for a standard application using a specific customer model. It is organized as a separate project for a defined period of time. The target is to get started with a real application example. Start-up support can be performed at AST in Graz, entirely or partly at the customer location. Typically, AST performs the main steps of the investigation and afterwards re-performs each step on site together with the customer. AST makes use of these models and results for a detailed explanation of each work step.

**Validity:**

Start-up support is offered for all standard applications and all AST products. Standard applications refer to the standard training courses offered by AST.

An input sheet defining all required data and models is sent to the customer in advance.

**Content:**

- Explanation of the workflow and all work steps
- Setup of necessary models, performing analysis, evaluation and interpretation of results
- Explanation of the introduction of modifications
- Hints and significant information about the application
- The workflow and the entire work performed will be documented in a report.

**Goals:**

- The entire workflow performed
- The customer can perform the specific application by him/herself.

**Customer Benefit:**

- Knowledge transfer from AVL for standard application
- Usage of customer models
- The customer becoming skilled with the new tool and application in a short time
- Maximum training effect

**Duration:**

- The duration of start-up support is **8 to 10 weeks**.
- 3 weeks of this period are defined as the customer and the AVL engineers working together. This can be either held at AVL in Graz or at the customer location.
- The specific customer model should be sent to AST about 2 weeks in advance to ensure that the AST engineer gets familiar with the model and performs all the necessary modifications to the model or defines these modifications.
- The main work steps are done by AVL separately to keep the on-site period at maximum efficiency. All work performed is documented and explained.

**Price (excl. Tax):**

The total cost is in the range of **24450 to 61250 euro** (depending on the application and the complexity of work). Travel and accommodation for the AVL engineer are charged separately.

## 4.2.2 Enhancement Support

Enhancement support is offered to experienced users of AVL AST software tools. Within this module, know-how about very specific new features or methods is investigated, transferred to the customer, and implemented into the specific development process.

Enhancement support is guided by a specific model and application using customer-specific data. A comparison to the previous methods and validation by measurements could be part of this work.

**ID**      **Service**

**CC\_422**      **Enhancement Support**

Enhancement support is on-the-job training for the usage of a new feature or method, offered by AST software, using a specific customer model. It is organized as a separate project for a defined period of time. The target is to integrate this feature or method into the customer-specific application work.

Enhancement support can be performed at AST in Graz or at the customer location.

The specific customer model should be sent to AST about 2 weeks in advance to ensure that the AST engineer gets familiar with the model and performs all the necessary modifications to the model or defines these modifications. Model requirements are sent to the customer in advance.

**Validity:**

Enhancement support is offered for all AST products.

**Content:**

- Explanation about functionality of the feature and the method
- Update of the customer-specific methodology and workflow
- Application on a customer model
- Comparison of the old and new workflow, model changes and results
- Hints and significant information

**Goals:**

- Detailed know-how transfer of new features and methods
- The customer can perform the specific application by himself/herself.

**Customer Benefit:**

- Knowledge transfer from AVL for new features and methods
- Usage of customer models
- The customer becoming skilled with the new features and methods in a short time
- Maximum training effect

**Duration:**

- The duration of enhancement support is **1 to 5 weeks**.
- The entire period is defined as the customer and the AVL engineer working together. This can be either held at AVL in Graz or at the customer location.

**Price (excl. Tax):** \* see chapter 2.1

The price for one AST engineer for 1 week (5 full working days) at the customer location and the preparation phase is:

- ◆ Preparation phase: **3850 euro**\* see chapter 2.1
- ◆ **7770 euro per week**; excl. travel and accommodation\* see chapter 2.1

Travel and accommodation for the AVL engineer are charged separately.

## 4.2.3 Consulting

This module describes the possibility to book highly skilled and experienced engineers from AST for a defined period of time for work at the customer location.

**ID**                      **Service**

**CC\_423**                **Consulting**

**Purpose:**

AST offers on-site work of highly skilled and experienced engineers for various advanced applications using AST tools.

Any specific material, such as the models or results for the on-site work, should be sent to AST at least 2 weeks in advance so that the AST engineer can be well prepared to increase the efficiency of the on-site work.

**Validity:**

Consulting work is valid for all applications where AST tools are the main simulation tools and which are covered by training and support activities from AST.

**Content:**

- AST engineers can be booked for a period of days, weeks or longer.
- The customer also has the possibility to book a contingent of hours or days, which is valid for a period of 1 year. Within this year, the agreed amount of time can be used whenever it is required. On-site work has to be purchased at least 2 weeks before the trip.

**Goals:**

- AST engineers work at the customer location in close cooperation with local engineers.

**Customer Benefit:**

- Problem investigation by experienced AST engineers
- Usage of the latest methodology and features of AST software
- Know-how transfer to customer engineers; integration of methods into a specific development process
- A fast solution of pending problems; direct contact to software developers
- Extends capacity on the customer side

**Duration:**

Depending on the definition.

**Price (excl. Tax): \* see chapter 2.1**

The total price for one AST engineer for 1 full day at the customer location is:

- ◆ **1520 euro**; excl. travel and accommodation \* see chapter 2.1
- ◆ **2200 euro** (in Europe), including travel and accommodation \* see chapter 2.1

Preparation work is included in the given price.



## 4.2.4 Software Customization and Specific Software Development

AST offers the possibility to customize its software according to the specific needs and requirements of the customer. AVL AST software offers various options for **customization** (depending on the features and interfaces of the specific software tool), such as:

- Creation of template models
- User functions
- Macros
- APPs and Workflows using COMPOSE
- Python scripts (i.e. for post-processing)
- MATLAB models, using existing interfaces
- FMU models, using existing interfaces
- EXCEL templates (e.g. for pre-processing)

Update of the general GUI and kernel is not part of this service, although this service can be offered as **customer-specific software development**. In such cases, a separate agreement has to be made. The new features and enhancements will be implemented in subsequent releases of the standard AST release. AVL grants the customer an exclusive use of the developed features for a period of 6 months after receiving a written approval of the extension from the customer. AST will also guarantee the compatibility of the developed feature for subsequent releases if it is part of the standard AST release.

ID	Service
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CC_424	<p><b>Software Customization</b></p> <p><u>Purpose:</u> AST offers the possibility to customize its software according to the specific needs and requirements of the customer. Work is typically done at AST. A training on the usage and implementation of the customized part is included.</p> <p><u>Validity:</u> Software customization is valid for all features developed for customization, offered for a specific AST tool (see above). Customer-specific software development is treated separately.</p> <p><u>Content:</u></p> <ul style="list-style-type: none"> <li>• A setup of customer-specific functionality</li> <li>• Testing of the new functionality using a standard model or a customer model</li> <li>• Training about the usage and implementation of the new functionality</li> </ul> <p><u>Goals:</u></p> <ul style="list-style-type: none"> <li>• Customized functionality ready to use</li> <li>• Know-how transfer of the usage, modification, and implementation of the functionality</li> </ul> <p><u>Customer Benefit:</u></p> <ul style="list-style-type: none"> <li>• Implement customer-specific solutions</li> <li>• Independent from the regular release cycle</li> </ul> <p><u>Duration:</u></p> <ul style="list-style-type: none"> <li>• This depends on the complexity of the requirement. Minimum effort is in the range of 1 week.</li> </ul> <p><u>Price (excl. Tax):</u> * see chapter 2.1</p> <p>The total price for one AST engineer for 1 full day is:</p> <ul style="list-style-type: none"> <li>◆ <b>1520 euro (at AVL AST in Graz)</b> * see chapter 2.1</li> </ul> <p>The total price of the final training and know-how transfer (1 day) is:</p> <ul style="list-style-type: none"> <li>◆ <b>2200 euro</b> (in Europe), including travel and accommodation * see chapter 2.1</li> </ul>
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## 5. Project Work

In addition to the services described in the previous chapters, we provide services for the improvement of the applied methods and for the development of new simulation methods in close cooperation with the customer, up to complex project work, including simulation-measurement comparison for validation of methods or taking over design responsibility.

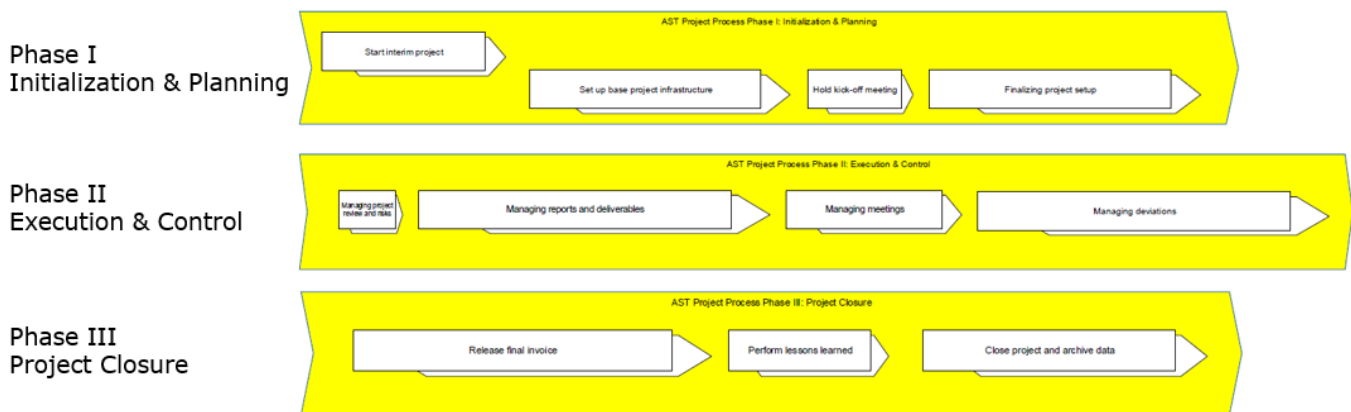
AST offers a wide range of simulation project work using analytical and numerical methods in the field of mobility and non-mobility industry. Applications use software products, serviced by AST, as well as different third-party tools.

Simulation work is offered for:

- Structural mechanics and dynamics applications
- Thermo-fluid dynamics in 0D/1D and 3D
- 3D CFD applications using FV and SPH approaches
- 2D and 3D electro-magnetic and electro-chemical applications
- Multi-body dynamics for durability and NVH
- 0D/1D mechanical, electrical, and hydraulic system simulation
- MiL / SiL applications in office and on RT-platforms
- HiL integration with xCUs
- Multiphysics applications and co-simulations between different domains and approaches

The project can cover the entire simulation, including model setup, definition of boundary conditions, analysis and result evaluation and interpretation. AST will give clear conclusions and recommendations on the analysis performed and the investigated design.

Each project is performed according to the **AST project process (PP)**, guided by continuous documentation and finalized by a report describing all steps, the models used, and the results obtained. Optionally, know-how transfer is done at the end of the project.



Typical project definitions are:

- Development of new methodologies
- Increase of efficiency and advanced solutions
- Validation projects, including comparison to measurements
- Implementation of new methods into the development process (process integration)
- Research and development (R&D) projects
- Dedicated projects or joint and research (J&R) projects

**Measurements for validation** can be performed at AVL, at the customer location, or by a third-party supplier.

Projects can be performed by AST alone or together with the customer (sharing the work) as joint and research projects (J&R).

For further information or a specific project proposal, contact your responsible AST Sales Manager.

## 6. Model Identification

Within this service, AST takes care of specific measurements and the generation of fully parameterized and validated simulation models. Measurements are either done at and by AVL, or by selected partners.

Examples for possible measurements:

- ◆ **Surface Measurement** and Contact Data Extraction - EXCITE Micro-slide Analysis (EXCITE Power Unit EHD or EPIL joints; EXCITE Piston & Rings contact models)
- ◆ **Belt Characteristics Measurement** of a Poly-V Belt (EXCITE Timing Drive)
- ◆ **Engine or Transmission Mount Characteristics** – static (0-50Hz) and dynamic mount characteristic (50~1-2kHz) (EXCITE Power Unit)
- ◆ **Dual Mass Flywheel Characteristics** - DMF’s parameters like basic hysteresis, quasi-static characteristics, and dynamic stiffness characteristics (EXCITE Power Unit or Timing Drive)

## 7. Validated Powertrain Models

AVL offers different **validated CRUISE M powertrain models**, based on benchmarking data, or creates such models, based on the data provided by the customer.

### Validated Powertrain Models

The image illustrates the process of validated powertrain modeling. On the left, a blue sports car is shown on a test rig. In the center, a software interface displays a 'Model Validation - Test Cycles' graph with multiple data series. On the right, two detailed powertrain block diagrams are shown: one for 'Audi E-tron quattro' and another for 'Porsche Taycan Turbo S'. A green box highlights the benefits of this approach:

- + Benchmarking of powertrains or components
- + Easily see impact of design variations
- + Realistic environment for component development
- + Rely on a true digital twin

Below the diagrams, it is noted: "... latest xEV models."

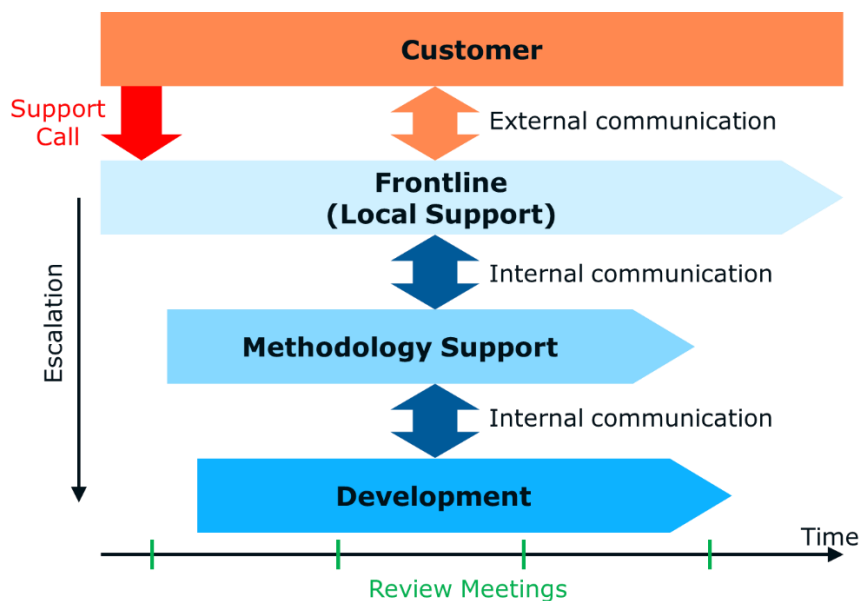
For further information or a specific project proposal, contact your responsible AST Sales Manager.

## 8. Appendix

### 8.1 AST Global Customer Support Process (GCSP)

- ◆ The GCSP defines the process steps for handling all customer questions and requests related to the usage of the software products maintained by AVL AST.
- ◆ It describes all interactions between the customer, the frontline team (local affiliate support team), the methodology support team at the service base, and the development team during the handling of support cases.
- ◆ The GCSP defines when and how a development request is generated out of a support case.

These main functions are summarized in the following figure:



GCSP: Basic Process

#### 8.1.1 Local Point of Contact

The local support teams at the affiliates collect all customer requests. They are also responsible for the entire communication between the customer and the AVL support. Information about the contacts within our service organization can be found in chapter 3.4 or on the AVL homepage <http://www.avl.com/hotlines>.

#### 8.1.2 Level Concept

The AST GCSP has different levels.

- Frontline support (1<sup>st</sup> level) is done by local AST affiliates (if no local affiliate is available, 1<sup>st</sup> level support is done by AST Service Base)
- Methodology support (2<sup>nd</sup> level) is done by AST Service Base

For each Support Team (individual for different products/ product groups and locations), a Support Master is defined. He/she is responsible for all related support requests and distributes the support requests to the different support engineers.

### 8.1.3 Escalation Model
























































The escalation depends on the time scale and the category of the support case.

The escalation model defines the treatment of critical support cases, which require special effort and extended capacity. The escalation is done based on regular review meetings by the review team, which includes the support masters, local and global support managers, and the people responsible for a specific application area.

**Main Target:**

- ◆ Identify possible high importance problems in an early phase of the support chain in order to define the necessary measures before the problem escalates between the customer and AVL.
- ◆ Possible measures are providing the necessary capacity and shifting priority between other tasks.

# Training courses 2024 - Graz

January		February		March		April		May		June	
1	M National Holiday 1	1	T  Model.CONNECT	1	F	1	M National Holiday 14	1	W National Holiday	1	S
2	T	2	F  Model.CONNECT	2	S	2	T	2	T	2	S
3	W	3	S	3	S	3	W  EXCITE M	3	F	3	M 23
4	T	4	S	4	M 10	4	T  EXCITE M	4	S	4	T  BEV with HVAC
5	F	5	M  CRUISE M Engineering Enhanced 6	5	T  E-Machine NVH Analysis with Electrical Network	5	F	5	S	5	W  BEV with HVAC
6	S National Holiday	6	T  CRUISE M Engineering Enhanced	6	W  E-Machine NVH Analysis with Electrical Network	6	S	6	M 19	6	T
7	S	7	W  CRUISE M Engineering Enhanced	7	T  CRUISE M Mobile A/C Basic	7	S	7	T	7	F
8	M 2	8	T	8	F  CRUISE M Mobile A/C Basic	8	M  Hybrid Electric Vehicle Concept Finding & Layout 15	8	W	8	S
9	T	9	F	9	S	9	T  Hybrid Electric Vehicle Concept Finding & Layout	9	T National Holiday	9	S
10	W	10	S	10	S	10	W  Hybrid Electric Vehicle Concept Finding & Layout	10	F	10	M 24
11	T	11	S	11	M  Fuel Cell Electric Vehicle 11	11	T	11	S	11	T
12	F	12	M 7	12	T  Fuel Cell Electric Vehicle	12	F	12	S	12	W
13	S	13	T  EXCITE Designer	13	W  Fuel Cell Electric Vehicle	13	S	13	M 20	13	T
14	S	14	W  EXCITE Designer	14	T	14	S	14	T  PEM Fuel Cell Module	14	F
15	M  CRUISE M Engine 3	15	T  PreonLab Basic Transmission	15	F	15	M  Battery Thermal and Hazard Investigation 16	15	W  PEM Fuel Cell Module	15	S
16	T  CRUISE M Engine	16	F  PreonLab Basic Transmission	16	S	16	T  Battery Thermal and Hazard Investigation	16	T  PEM Fuel Cell Module	16	S
17	W  CRUISE M Engine	17	S	17	S	17	W  Battery Thermal and Hazard Investigation	17	F	17	M 25
18	T	18	S	18	M  PMSM E-Machine Electromagnetics and Thermal Investigation 12	18	T  Battery Thermal and Hazard Investigation	18	S	18	T
19	F	19	M 8	19	T  PMSM E-Machine Electromagnetics and Thermal Investigation	19	F	19	S National Holiday	19	W  E-Axle NVH and Durability (AWS based)
20	S	20	T  FIRE M	20	W  PMSM E-Machine Electromagnetics and Thermal Investigation	20	S	20	M National Holiday 21	20	T  E-Axle NVH and Durability (AWS based)
21	S	21	W  FIRE M	21	T  Scenario Designer	21	S	21	T	21	F
22	M  VSM 4	22	T  FIRE M	22	F	22	M 17	22	W	22	S
23	T  VSM	23	F	23	S	23	T  Electric Machine Rotor-Dynamics	23	T	23	S
24	W  VSM	24	S	24	S	24	W	24	F	24	M 26
25	T	25	S	25	M 13	25	T  PreonLab Basic Water Wading	25	S	25	T
26	F	26	M  Battery and Range Extended Electric Vehicle 9	26	T  EXCITE Power Unit	26	F  PreonLab Basic Water Wading	26	S	26	W
27	S	27	T  Battery and Range Extended Electric Vehicle	27	W  EXCITE Power Unit	27	S	27	M 22	27	T
28	S	28	W  Battery and Range Extended Electric Vehicle	28	T	28	S	28	T	28	F
29	M 5	29	T	29	F	29	M 18	29	W	29	S
30	T  EXCITE Piston Basic			30	S	30	T	30	T National Holiday	30	S
31	W  EXCITE Rings Basic			31	S National Holiday			31	F		

# Training courses 2024 –Graz

July		August		September		October		November		December																		
1	M	27	1	T	1	S	1	T	E	EXCITE Power Unit	1	F	National Holiday	1	S													
2	T		2	F	2	M	36	2	W		2	S		2	M	E	E-Machine NVH Analysis with Electrical Network	49										
3	W		3	S	3	T		3	T		3	S		3	T	E	E-Machine NVH Analysis with Electrical Network											
4	T		4	S	4	W		4	F		4	M	45	4	W													
5	F		5	M	32	5	T	F <sub>M</sub>	PEM Fuel Cell Module	5	S		5	T		5	T											
6	S		6	T		6	F			6	S		6	W		6	F											
7	S		7	W		7	S			7	M	E <sub>M</sub>	EXCITE M	41	7	T		7	S									
8	M	F <sub>M</sub>	FIRE M	28	8	T		8	T	E <sub>M</sub>	EXCITE M		8	F		8	S	National Holiday										
9	T	F <sub>M</sub>	FIRE M		9	F		9	M			37	9	W		9	S											
10	W	F <sub>M</sub>	FIRE M		10	S		10	T	C <sub>M</sub>	CRUISE M SOFC & SOEC		10	T		10	S											
11	T	Preon Lab	PreonLab Basic Transmission		11	S		11	W	C <sub>M</sub>	CRUISE M SOFC & SOEC		11	F		11	M		46	11	W	C <sub>M</sub>	Fuel Cell Electric Vehicle					
12	F	Preon Lab	PreonLab Basic Transmission	33	12	M		12	T	C <sub>M</sub>	CRUISE M SOFC & SOEC		12	T	E	E-Axle NVH and Durability (AWS based)	12	T										
13	S				13	F		13	F				13	W	E	E-Axle NVH and Durability (AWS based)	13	F										
14	S				14	W		14	S				14	M	C <sub>M</sub>	Battery and Range Extended Electric Vehicle	42	14	T		14	S						
15	M	VSM		29	15	T	National Holiday	15	S				15	T	C <sub>M</sub>	Battery and Range Extended Electric Vehicle		15	F		15	S						
16	T	VSM			16	F		16	M			38	16	W	C <sub>M</sub>	Battery and Range Extended Electric Vehicle		16	S		16	M	C <sub>M</sub>	Hybrid Electric Vehicle Concept Finding & Layout	51			
17	W	VSM	E	EXCITE Designer	17	S		17	T	E	EXCITE Piston Basic		17	T		17	S		17	T		17	T	C <sub>M</sub>	Hybrid Electric Vehicle Concept Finding & Layout			
18	T	E	EXCITE Designer		18	S		18	W	E	EXCITE Rings Basic		18	F		18	M		47	18	W		18	W	C <sub>M</sub>	Hybrid Electric Vehicle Concept Finding & Layout		
19	F			34	19	M		19	T				19	T	Preon Lab	PreonLab Basic Water Wading		19	T									
20	S				20	T		20	F				20	W	Preon Lab	PreonLab Basic Water Wading		20	F									
21	S				21	W		21	S				21	M	F <sub>M</sub>	Battery Thermal and Hazard Investigation	43	21	T		21	T		21	S			
22	M			30	22	T		22	T	F <sub>M</sub>	Battery Thermal and Hazard Investigation		22	F		22	F		22	F		22	F		22	S		
23	T				23	F		23	M	F <sub>M</sub>	PMSM E-Machine Electromagnetics and Thermal Investigation	39	23	W	F <sub>M</sub>	Battery Thermal and Hazard Investigation		23	S		23	S		23	M		52	
24	W				24	S		24	T	F <sub>M</sub>	PMSM E-Machine Electromagnetics and Thermal Investigation		24	T	F <sub>M</sub>	Battery Thermal and Hazard Investigation		24	S		24	S		24	T			
25	T				25	S		25	W	F <sub>M</sub>	PMSM E-Machine Electromagnetics and Thermal Investigation		25	F		25	F		48	25	M		25	W	National Holiday			
26	F			35	26	M		26	T				26	T		26	T			26	T		26	T	National Holiday			
27	S				27	T		27	F				27	W		27	W			27	W		27	F				
28	S				28	W		28	S				28	M		44	28	M		28	T		28	T		28	S	
29	M			31	29	T		29	S				29	T	E	Electric Machine Rotor-Dynamics		29	F		29	F		29	F		29	S
30	T				30	F		30	M	E	EXCITE Power Unit	40	30	W		30	W			30	S		30	M		1		
31	W				31	S							31	T			31	T			31	T		31	T	National Holiday		

# Training courses 2024 - France

January	February	March	April	May	June	July	August	September	October	November	December
1 M National Holiday 1	1 T CRUISE M C <sub>M</sub>	1 F	1 M National Holiday 14	1 W National Holiday	1 S	1 M 27	1 T	1 S	1 T	1 F National Holiday	1 S
2 T	2 F	2 S	2 T	2 T	2 S	2 T	2 F	2 M 36	2 W Preon Lab PREONLAB Basic Transmission	2 S	2 M 49
3 W	3 S	3 S	3 W	3 F	3 M 23	3 W	3 S	3 T	3 T Preon Lab PREONLAB Basic Transmission	3 S	3 T
4 T	4 S	4 M 10	4 T	4 S	4 T	4 T	4 S	4 W	4 F	4 M 45	4 W
5 F	5 M 6	5 T	5 F	5 S	5 W	5 F	5 M 32	5 T	5 S	5 T	5 T
6 S National Holiday	6 T	6 W	6 S	6 M 19	6 T	6 S	6 T	6 F	6 S	6 W	6 F
7 S	7 W Preon Lab PREONLAB Basic Transmission	7 T	7 S	7 T	7 F	7 S	7 W	7 S	7 M 41	7 T	7 S
8 M 2	8 T Preon Lab PREONLAB Basic Transmission	8 F	8 M 15	8 W	8 S	8 M 28	8 T	8 S	8 T	8 F	8 S National Holiday
9 T	9 F	9 S	9 T	9 T National Holiday	9 S	9 T	9 F	9 M 37	9 W	9 S	9 M 50
10 W	10 S	10 S	10 W	10 F	10 M 24	10 W	10 S	10 T	10 T	10 S	10 T
11 T	11 S	11 M 11	11 T	11 S	11 T	11 T	11 S	11 W EXCITE M E <sub>M</sub>	11 F	11 M 46	11 W
12 F	12 M 7	12 T	12 F	12 S	12 W	12 F	12 M 33	12 T EXCITE M E <sub>M</sub>	12 S	12 T	12 T
13 S	13 T	13 W	13 S	13 M 20	13 T	13 S	11 T	13 F	13 S	13 W	13 F
14 S	14 W	14 T	14 S	14 T	14 F	14 S	14 W	14 S	14 M 42	14 T	14 S
15 M 3	15 T	15 F	15 M 16	15 W	15 S	15 M 29	15 T National Holiday	15 S	15 T	15 F	15 S
16 T	16 F	16 S	16 T	16 T	16 S	16 T	16 F	16 M 38	16 W	16 S	16 M 51
17 W EXCITE M E <sub>M</sub>	17 S	17 S	17 W	17 F	17 M 25	17 W	17 S	17 T	17 T	17 S	17 T
18 T EXCITE M E <sub>M</sub>	18 S	18 M 12	18 T	18 S	18 T	18 T	18 S	18 W FIRE M F <sub>M</sub>	18 F	18 M 47	18 W
19 F	19 M 8	19 T	19 F	19 S National Holiday	19 W	19 F	19 M 34	19 T FIRE M F <sub>M</sub>	19 S	19 T	19 T
20 S	20 T	20 W	20 S	20 M National Holiday 21	20 T	20 S	20 T	20 F	20 S	20 W	20 F
21 S	21 W	21 T	21 S	21 T	21 F	21 S	21 W	21 S	21 M 43	21 T	21 S
22 M 4	22 T	22 F	22 M 17	22 W	22 S	22 M 30	22 T	22 S	22 T	22 F	22 S
23 T	23 F	23 S	23 T	23 T	23 S	23 T	23 F	23 M 39	23 W	23 S	23 M 52
24 W FIRE M F <sub>M</sub>	24 S	24 S	24 W	24 F	24 M 26	24 W	24 S	24 T	24 T	24 S	24 T
25 T FIRE M F <sub>M</sub>	25 S	25 M 13	25 T	25 S	25 T	25 T	25 S	25 W CRUISE M C <sub>M</sub>	25 F	25 M 48	25 W National Holiday
26 F	26 M 9	26 T	26 F	26 S	26 W	26 F	26 M 35	26 T CRUISE M C <sub>M</sub>	26 S National Holiday	26 T	26 T National Holiday
27 S	27 T	27 W	27 S	27 M 22	27 T	27 S	27 T	27 F	27 S	27 W	27 F
28 S	28 W	28 T	28 S	28 T	28 F	28 S	28 W	28 S	28 M 44	28 T	28 S
29 M 5	29 T	29 F	29 M 18	29 W	29 S	29 M 31	29 T	29 S	29 T	29 F	29 S
30 T		30 S	30 T	30 T National Holiday	30 S	30 T	30 F	30 M 40	30 W	30 S	30 M 1
31 W CRUISE M C <sub>M</sub>		31 S National Holiday		31 F		31 W	31 S		31 T		31 T National Holiday



# Training courses 2024 –USA

January	February	March	April	May	June	July	August	September	October	November	December
1 M National Holiday 1	1 T	1 F	1 M National Holiday 14	1 W	1 S	1 M 27	1 T	1 S	1 T	1 F	1 S
2 T	2 F	2 S	2 T	2 T	2 S	2 T	2 F	2 M National Holiday 36	2 W	2 S	2 M 49
3 W	3 S	3 S	3 W	3 F	3 M 23	3 W	3 S	3 T	3 T	3 S	3 T
4 T	4 S	4 M 10	4 T	4 S	4 T	4 T National Holiday	4 S	4 W	4 F	4 M 45	4 W
5 F	5 M 6	5 T	5 F	5 S	5 W	5 F National Holiday	5 M 32	5 T	5 S	5 T PreonLab Transmission	5 T
6 S	6 T PreonLab Water Wading	6 W	6 S	6 M 19	6 T	6 S	6 T PreonLab Water Wading	6 F	6 S	6 W PreonLab Transmission	6 F
7 S	7 W PreonLab Water Wading	7 T	7 S	7 T PreonLab Transmission	7 F	7 S	7 W PreonLab Water Wading	7 S	7 M 41	7 T	7 S
8 M 2	8 T	8 F	8 M 15	8 W PreonLab Transmission	8 S	8 M 28	8 T	8 S	8 T PreonLab Water Wading	8 F	8 S
9 T PreonLab Transmission	9 F	9 S	9 T PreonLab Water Wading	9 T	9 S	9 T PreonLab Transmission	9 F	9 M 37	9 W PreonLab Water Wading	9 S	9 M 50
10 W PreonLab Transmission	10 S	10 S	10 W PreonLab Water Wading	10 F	10 M 24	10 W PreonLab Transmission	10 S	10 T PreonLab Transmission	10 T	10 S	10 T PreonLab Water Wading
11 T	11 S	11 M 11	11 T	11 S	11 T PreonLab Water Wading	11 T	11 S	11 W PreonLab Transmission	11 F	11 M 46	11 W PreonLab Water Wading
12 F	12 M 7	12 T PreonLab Transmission	12 F	12 S	12 W PreonLab Water Wading	12 F	12 M 33	12 T	12 S	12 T AVL FIRE M	12 T
13 S	13 T AVL FIRE M	13 W PreonLab Transmission	13 S	13 M 20	13 T	13 S	13 T AVL FIRE M	13 F	13 S	13 W AVL FIRE M	13 F
14 S	14 W AVL FIRE M	14 T	14 S	14 T AVL FIRE M	14 F	14 S	14 W AVL FIRE M	14 S	14 M 42	14 T AVL FIRE M	14 S
15 M National Holiday 3	15 F AVL FIRE M	15 F	15 M 16	15 W AVL FIRE M	15 S	15 M 29	15 T AVL FIRE M	15 S	15 T	15 F	15 S
16 T	16 F	16 S	16 T	16 T AVL FIRE M	16 S	16 T	16 F	16 M 38	16 W E-Axle NVH and Durability (SDT based)	16 S	16 M 51
17 W E-Axle NVH and Durability (SDT based)	17 S	17 S 12	17 W E-Axle NVH and Durability (SDT based)	17 F	17 M 25	17 W E-Axle NVH and Durability (SDT based)	17 S	17 T AVL ModelCONNECT	17 T E-Axle NVH and Durability (SDT based)	17 S	17 T
18 T E-Axle NVH and Durability (SDT based)	18 S	18 M	18 T E-Axle NVH and Durability (SDT based)	18 S	18 T AVL ModelCONNECT	18 T E-Axle NVH and Durability (SDT based)	18 S	18 W AVL ModelCONNECT	18 F	18 M 47	18 W
19 F	19 M 8	19 T AVL ModelCONNECT	19 F	19 S	19 W AVL ModelCONNECT	19 F	19 M 34	19 T	19 S	19 T AVL VSM	19 T
20 S	20 T AVL VSM	20 W AVL ModelCONNECT	20 S	20 M 21	20 T	20 S	20 T AVL VSM	20 F	20 S	20 W AVL VSM	20 F
21 S	21 W AVL VSM	21 T	21 S	21 T AVL VSM	21 F	21 S	21 W AVL VSM	21 S	21 M 43	21 T	21 S
22 M 4	22 T	22 F	22 M 17	22 W AVL VSM	22 S	22 M 30	22 T	22 S	22 T AVL CRUISE™ M	22 F	22 S
23 T AVL CRUISE™ M	23 F	23 S	23 T AVL CRUISE™ M	23 T	23 S	23 T AVL CRUISE™ M	23 F	23 M 39	23 W AVL CRUISE™ M	23 S	23 M 52
24 W AVL CRUISE™ M	24 S	24 S	24 W AVL CRUISE™ M	24 F	24 M 26	24 W AVL CRUISE™ M	24 S	24 T	24 T	24 S	24 T National Holiday
25 T	25 S	25 M 13	25 T	25 S	25 T	25 T	25 S	25 W	25 F	25 M 48	25 W National Holiday
26 F	26 M 9	26 T	26 F	26 S	26 W	26 F	26 M 35	26 T	26 S	26 T	26 T
27 S	27 T	27 W	27 S	27 M National Holiday 22	27 T	27 S	27 T	27 F	27 S	27 W	27 F
28 S	28 W	28 T	28 S	28 T	28 F	28 S	28 W	28 S	28 M 44	28 T National Holiday	28 S
29 M 5	29 T	29 F National Holiday	29 M 18	29 W	29 S	29 M 31	29 T	29 S	29 T	29 F National Holiday	29 S
30 T		30 S	30 T	30 T	30 S	30 T	30 F	30 M 40	30 W	30 S	30 M 1
31 W		31 S		31 F		31 W	31 S		31 T		31 T National Holiday