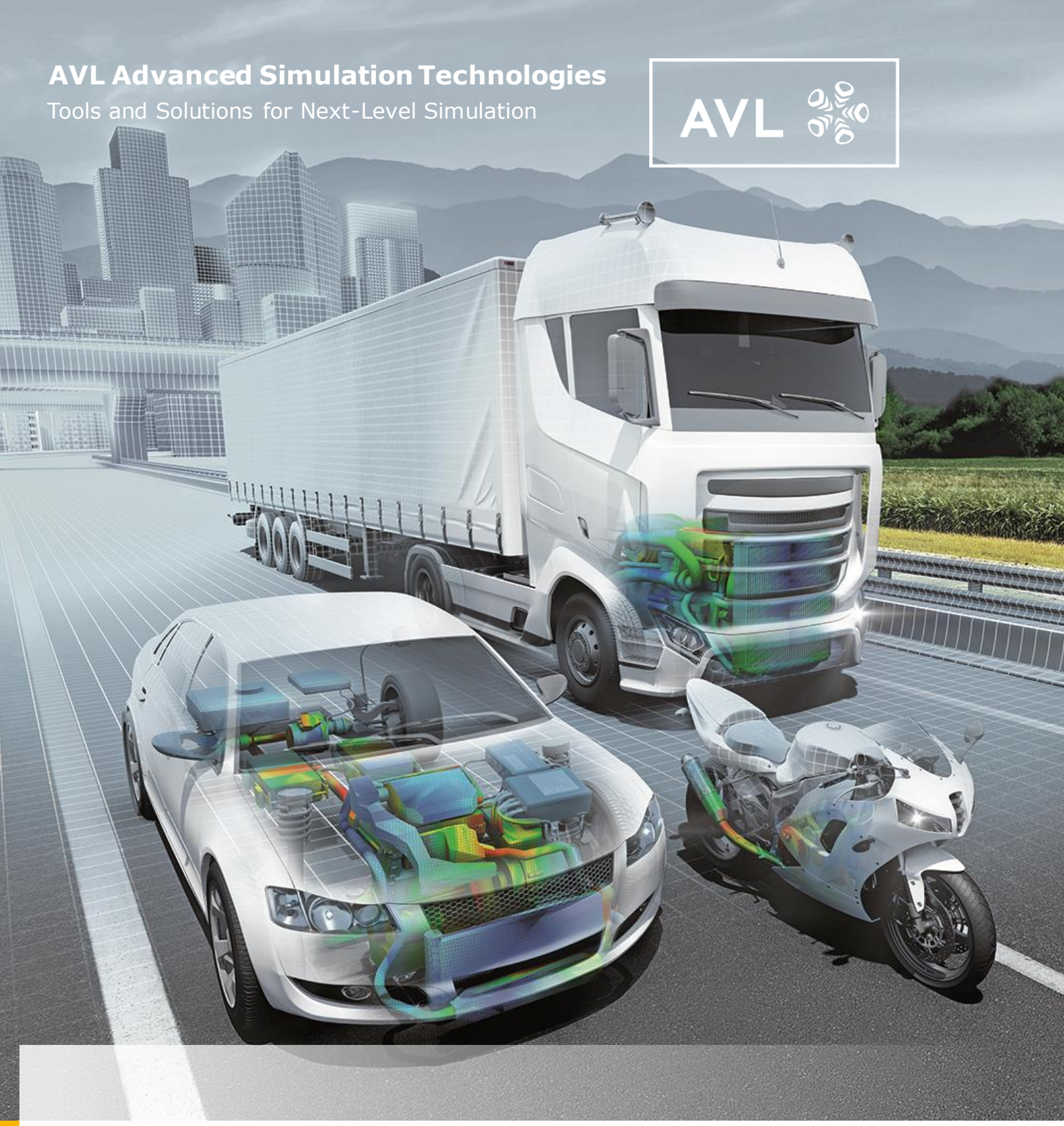
AVL Advanced Simulation Technologies

Tools and Solutions for Next-Level Simulation



Customer Services Catalogue

Software Related Services

Training and Support | Knowledge Transfer | Project Work

www.avl.com

Overview of Training courses in Graz 2022

BOOST™	CRUISE™	CRUISE™ M
March 22-24	February 09-10	January 17-19
	September 05-06	May 16-18
		August 23-25
		November 23-25
CRUISE™ M MOBEO EAS	**CRUISE™ M VTMS**	**EXCITE™ Designer**
June 21-24	March 23-25	February 02-03
		June 16-17
		September 21-23
EXCITE™ Piston&Rings	**EXCITE™ Power Unit**	**EXCITE™ Timing Drive**
February 23-24	January 25-26	April 12-13
May 10-11	April 20-21	September 13-14
October 12-13	September 07-08	
	November 03-04	
FIRE™	**FIRE™ - SAMOS**	**FIRE™ M**
January 18-20	March 21-22	February 16-17
April 05-07	September 28-29	May 17-18
August 30 - September 01		September 08-09
November 07-09		November 29 – 30
Model.CONNECT™	**PreonLab**	**AVL VSM™**
February 10-11	April 14	March 15-17
May 03-04	October 20	June 13-15
August 31 – September 01		September 12-14
November 10-11		November 23-25

PRICES:

- For scheduled training courses held in Graz, the price is:
  - a) 400 euro per day and participant
  - b) 200 euro per day and participant for Universities
- For training on request, the total price for one AST engineer for one full day training is:
  - a) In Graz: 1200 euro for max. 4 participants
  - b) In Europe: 1850 euro for max. 6 participants at the customer location, including travel and accommodation
  - c) Rest of World: 5200 euro for 2 days training, including travel and accommodation. For each additional day 1200 euro.
- Additional cost for cloud training (max. 8 users):
  - 500 euro for setting up the cloud and introduction
  - + 50 euro per day for running the cloud
  - Software-Support is extra

Register online: www.avl.com

Table of Contents

1. Introduction

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

- **From a Software Provider to a Solution Provider**

Besides the development of easy-to-use software products, AVL AST provides development of methods and advanced simulation solutions. The transfer of engineering and application know-how is necessary for an extensive 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 first contact with our products to the effective 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 co-operation with the customer up to complex project work including simulation-measurement comparison for validation of methods 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 definitely a challenging task for all engineers involved, but for the customer it offers the significant benefit that by each contact with our service group he is in contact with highly experienced engineers, who know their tools and the application, work in close contact to the software development and can link their engineering experience with the information coming from software support of various customers.

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

Graz, April 2020

Thomas Resch (AST CC / Head of Customer Services)

Christian Vock (AST CCS / Customer Support Manager)

2. Overview of AST Customer Services

The customer services group comprises the three modules

- Tool focused - Training & Software Support
- Application and methodology focused – 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 up by technology seminars and specific engineering support up to specific advanced solutions, performed as project work, is shown in following figure. These services are valid for AST worldwide.

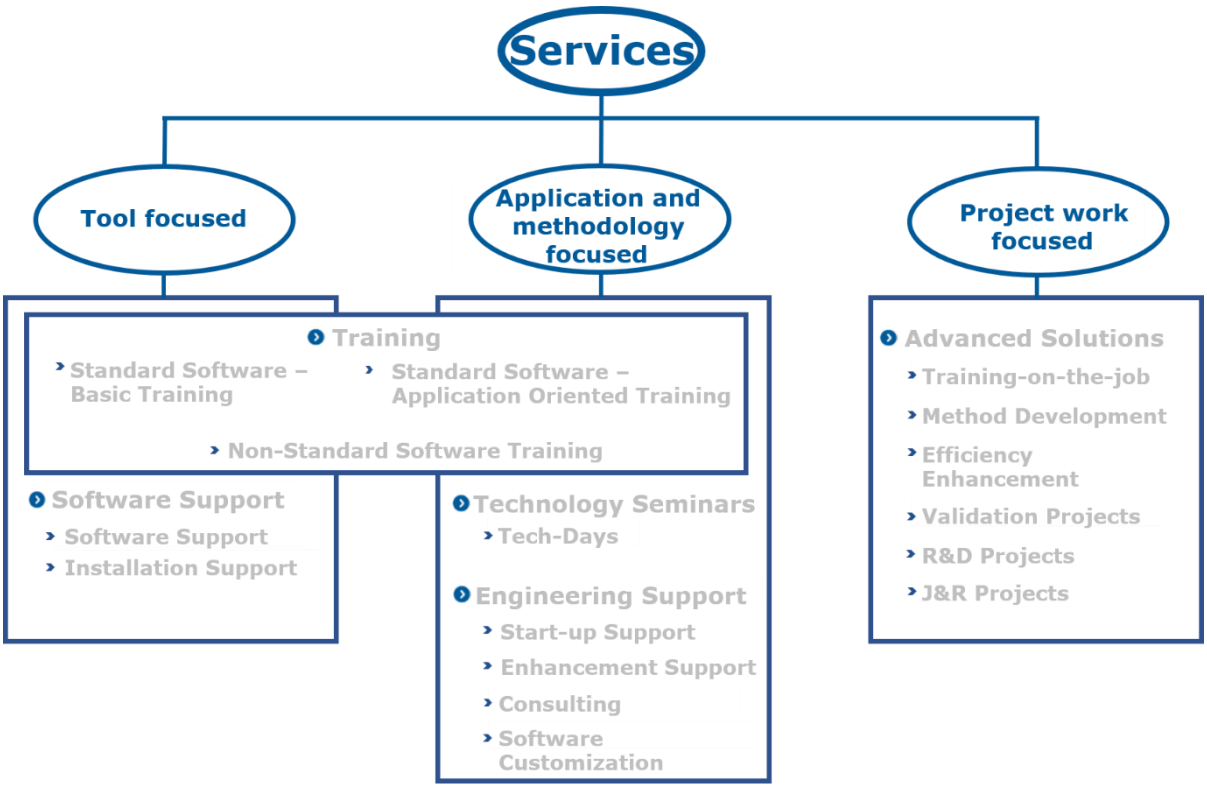


Figure 1: Overview of AST Customer Services

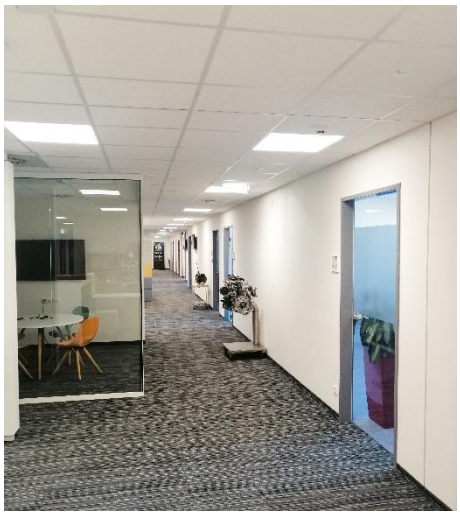
2.1 Validity of Prices and Training Content

* All **prices** given in this document as well as **training content** is 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 Trainingscenter in cooperation with the
ALV Skill Center and Academy at the Smart City



- Modern-equipped and air-conditioned training rooms
- Greenroom
- Training by support and application engineers
- Hardware examples for demonstration purpose

Training at AST Trainings 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 *installation of software tools* at customer specific environment.
- AST offers for all its software products *standardized software training* for getting started.
- For software related questions AST offers *software support* according to the AST customer support process.

3.1 Installation Support

This module deals with the installation of our software at customer specific environment.

ID	Service
CC_31	Installation Support

Purpose:

Basic step is the installation of the software on a single computer or on a file server. Second step is valid for more complex installations as multi-processor environment on clusters or the connection of AVL AST software with a queuing system such as LSF or another customer specific queuing system.

Validity:

Basic installation is valid for all AST tools, multi-processor option for FIRE and connection with a queuing system is valid for AWS software and FIRE.

Content:

- Software installation from CD / DVD, ready to work.
- Installation performed by AST engineer.
- Customization of AWS interfaces according to the requirements of the queuing system.

Requirements:

- Basic requirements to the system are given by AVL in advance and have to be fulfilled.
- AVL engineer has to get administration privileges during the installation phase.

Customer Benefit:

- Fast start-up to get a valid installation running.
- Best possibility to enable the usage of all features of the software.

Duration:

- Half a day for basic installation.
- Connection with queuing system depends highly on the complexity of this system and has to be done in close co-operation between AST and system administration on customer side. For LSF system installation will take approximately one day, for other systems around 3 days.

Price (excl. Tax): * see chapter 2.1

Installation will be done at customer side. Price for installation by one AST engineer is:

- Basic installation: **500 euro** * see chapter 2.1
- Installation in complex system environment and connection to queuing system: **1200 euro per day** * see chapter 2.1

Travel and accommodation will be charged separately.

Contact	
Additional Information	Responsible Sales Manager
Proposal	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 and application training modules.

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

General training language is English or local language at AVL affiliates.

Register at the AVL Homepage using the **AVL AST Trainingcenter** 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, 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 Customer's Site

- On-site training will be held by one engineer from AST. The customer is asked to provide 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

- All training courses can also be held online with Webex 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

Contact	
Training Content	Link to Homepage
Training Schedule	AVL Training Calendars
Training Registration	AVL Homepage

3.2.1 Basic Software Training

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

ID	Service
CC_321	Basic Software Training

Purpose:

- Overview about the software tool
- Enables the user to build up and run calculation models, prepared by AVL

Validity:

Basic training courses are offered for all AVL AST software products.

Content: * see chapter 2.1

- Introduction, theory, primer examples, modeling, simulation and post-processing

Goals:

- Basic knowledge
- Capability of software handling

Customer Benefit:

- Fast and efficient way to start using the software tool

Duration:

- Depending on training (see subsequent product listing)

Price (excl. Tax): * see chapter 2.1

- For scheduled training courses held in Graz, the price is:
  a) 400 euro per day and participant
  b) 200 euro per day and participant for Universities

  AVL offers fixed dates for scheduled training courses, typically one training per quarter of the year. At these training courses engineers from different companies can participate (max. 12 people).

- Alternatively training can be held on request. For training on request, the total price for one AST engineer for one full day training is:
  - In Graz: 1200 euro for max. 4 participants
  - In Europe: 1850 euro for max. 6 participants at the customer location, including travel and accommodation
  - Rest of World: 5200 euro for 2 days training, including travel and accommodation. For each additional day 1200 euro.

Contact	
Information & Organization	Training Organization – Petra Pintaric (petra.pintaric@avl.com)
Registration	link to registration (inquiry) on the AVL Homepage
Training Schedule	AVL Training Calendars

3.2.2 Application Software Training

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

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

ID	Service
CC_322	Application Software Training

Purpose:

The application software training will improve the knowledge about the software tool and will train the user the methodology of special application methods.

Validity:

Application training courses are offered for all AVL AST software products.

Content: * see chapter 2.1

- Application method, special theory, application examples
- Special modeling, post-processing technology

Goals:

- Special application oriented knowledge

Customer Benefit:

- Fast and efficient way to learn a new software application field

Duration:

- Depending on training (see subsequent product listing)

Price (excl. Tax): * see chapter 2.1

- For scheduled training courses held in Graz, the price is:
  - 400 euro per day and participant
  - 200 euro per day and participant for Universities

  AVL offers fixed dates for scheduled training courses, typically one training per quarter of the year. At these training courses engineers from different companies can participate (max. 12 people).
- Alternatively training can be held on request. For training on request, the total price for one AST engineer for one full day training is:
  - In Graz: 1200 euro for max. 4 participants
  - In Europe: 1850 euro for max. 6 participants at the customer location, including travel and accommodation
  - Rest of World: 5200 euro for 2 days training, including travel and accommodation. For each additional day 1200 euro.

Contact	
Information & Organization	Training Organization – Petra Pintaric (petra.pintaric@avl.com)
Registration	link to registration (inquiry) on the AVL Homepage
Training Schedule	AVL Training Calendars

Further information:

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

3.2.3 Premium Software Training Package

Premium software training packages are extensions for basic or application software trainings. They offer additional contact to the trainer beyond the training days.

ID	Service
CC_323	Premium Software Training Package

Purpose:

The premium software training package will help the users to speed up in using the software by offering extended contact to the trainer with regular meetings after the basic or application software training. Meetings and additional training day are always held individually for each customer

Validity:

Premium software training packages are offered for all AVL AST software products.

Content:

- Discussion about user experience
- Review of user generated models

Goals:

- Increase experience and application of the software at the customer

Customer Benefit:

- Faster way to get information and speed up of profitable work with software

Duration:

- Weekly Skype/Webex for approx. 2 hours each for 4 weeks following the basic or application training
- Additional training day after 4 weeks
- Bi-weekly Skype/Webex for approx. 2 hours each for 8 weeks following the additional training day

Price (excl. Tax): * see chapter 2.1

- With additional training day done at AVL affiliate or via Skype/Webex: 3200 euro for max. 4 participants
- With additional training day done at customer with local trainer from affiliate: 4500 euro for max. 4 participants at the customer location, including travel and accommodation
- With additional training day done at customer requiring experts from other affiliates: 5500 euro for max. 4 participants including travel and accommodation.

Contact	
Information & Organization	Training Organization – Petra Pintaric (petra.pintaric@avl.com)
Registration	link to registration (inquiry) on the AVL Homepage
Training Schedule	AVL Training Calendars

Further information:

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

3.2.4 E-Learning

Additional to our face2face training courses, we also offer various online training courses. E-Learning (or electric learning) includes all forms of learning where electronic or digital media are used for the Learning Material.

3.2.4.1 Remote/ Online Training

Remote trainings are "live" trainings with trainer and trainees attending the training online independent from the country.
For a better communication the trainer is using a head set with microphone and a webcam with different view options.

ID	Service
CC_324	Remote/ Online Training

Purpose:

- Trainings are carried out online

Validity:

Remote/ Online training courses are offered for all AVL AST software products.

Requirement:

- Local software and license installation at customer

Content: * see chapter 2.1

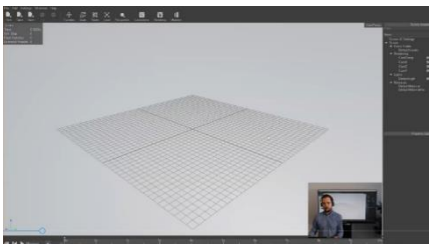
- Introduction, theory, primer examples, modeling, simulation and post-processing or
- Application method, special theory, application examples,
- Special modeling, post-processing technology

Goals:

- Basic knowledge,
- Capability of software handling or
- Special application oriented knowledge

Customer Benefit:

- Fast and efficient way to learn a new software application field
- No travel costs



Duration:

- Depending on training (see subsequent product listing)

Price (excl. Tax): * see chapter 2.1

- For scheduled training courses , the price is:
  - 400 euro per day and participant
  - 200 euro per day and participant for Universities

  AVL offers fixed dates for scheduled training courses, typically one training per quarter of the year. At these training courses engineers from different companies can participate (max. 9 people).
- Alternatively training can be held on request. For training on request, the total price for one AST engineer for one full day training is:
  - 1200 euro for max. 4 participants

Contact	
Information & Organization	Training Organization – Petra Pintaric (petra.pintaric@avl.com)
Registration	link to registration (inquiry) on the AVL Homepage
Training Schedule	AVL Training Calendars

3.2.4.1 Hybrid Training

Hybrid trainings are "live" trainings with participants at the Trainingcenter in Graz and online.

ID	Service
CC_324	Hybdrid Training

Purpose:

- If for some reason its not possible for a participant to join the training face2face, they can also join the training online.

Requirement:

- Participants that join the training online needs to install software and license on his/her computer

Content: * see chapter 2.1

- Introduction, theory, primer examples, modeling, simulation and post-processing or
- Application method, special theory, application examples,
- Special modeling, post-processing technology

Goals:

- Basic knowledge,
- Capability of software handling or
- Special application oriented knowledge

Customer Benefit:

- Fast and efficient way to learn a new software application field
- Flexible arrangemend for different customer needs

Duration:

- Depending on training (see subsequent product listing)

Price (excl. Tax): * see chapter 2.1

- For scheduled training courses , the price is:
  - 400 euro per day and participant
  - 200 euro per day and participant for Universities

  AVL offers fixed dates for scheduled training courses, typically one training per quarter of the year. At these training courses engineers from different companies can participate (max. 9 people).
- Alternatively training can be held on request. For training on request, the total price for one AST engineer for one full day training is:
  - 1200 euro for max. 4 participants

Contact	
Information & Organization	Training Organization – Petra Pintaric (petra.pintaric@avl.com)
Registration	link to registration (inquiry) on the AVL Homepage
Training Schedule	AVL Training Calendars

3.2.4.2 Remote or Hybrid Training in the Cloud

Trainees can use our software on MS Accure 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.
Additional to that the specification is done according to the SW package and used CPU power.
Cloud Trainings are offered for all SDT and AWS based tools and VSM.

ID	Service
CC_324	Remote or Hybrid Training in the Cloud

Purpose:

- The Training participants do not need to install the license on theyre computer for the training.

Requirement:

- Good internet connection

Content: * see chapter 2.1

- Introduction, theory, primer examples, modeling, simulation and post-processing or
- Application method, special theory, application examples,
- Special modeling, post-processing technology

Goals:

- Basic knowledge,
- Capability of software handling or
- Special application oriented knowledge

Customer Benefit:

- Fast and efficient way to learn a new software application field
- Deeper interaction between trainer and trainee, due to screen sharing in both directions
- No local installations necessary at customer side
- No travel costs

Duration:

- Depending on training (see subsequent product listing)

Price (excl. Tax): * see chapter 2.1

- For scheduled training courses , the price is:
  - 400 euro per day and participant
  - 200 euro per day and participant for Universities
- Alternatively training can be held on request. For training on request, the total price for one AST engineer for one full day training is:
  - 1200 euro for max. 4 participants
- Additional cost for cloud (max. 8 users):
  - 500 euro for setting up the cloud and introduction
  - + 50 euro per day for running the cloud
  - Software-Support is extra

Contact	
Information & Organization	Training Organization – Petra Pintaric (petra.pintaric@avl.com)
Registration	link to registration (inquiry) on the AVL Homepage
Training Schedule	AVL Training Calendars

3.2.5 Online Videotrainings

All customers with a valid license can get access to our Video trainings. To get access, please contact petra.pintaric@avl.com
You will get a pdf file with valid links for about one month of the ordered training.

Please note that these video trainings are not a full substitute for an f2f training!

Following Videotrainings are available.

Basic Trainings	
• TCSS-01	CRUISE Basic
• TEPR-01	EXCITE Piston & Rings Basic – Piston Dynamics
• TEPR-02	EXCITE Ring Dynamics
• TEPR-03	EXCITE Piston & Rings Lupe Oil Consumption
• TEPR-03	PreonLab Basic
• TEPU-01	EXCITE PowerUnit Basic
• TMCO-01	Model.CONNECT Office Basic
• TSPA-01	SPA Basic
• TCOM-01	COMPOSE Basic
• TCMF-01	CRUISE M Flow Basic
• TCM-01	CRUISE M Basic GUI
• TCM-02	CRUISE M Basic Intro
• TCME-02	CRUISE M Physical Engine / DIESEL
Electrification Trainings	
• TELA-01	E-Axle NVH and Durability Analyis
• TELA-02	E-Axle NVH and Durability
• TELB-01	Battery Thermal and Hazard Investigation
• TELF-01	PEM Fuel Cell Module Performance Analysis
• TELM-01	PMSM E-Machine Electromagnetics and Thermal Investigation
• TELM-03	Electric Machine Rotor-Dynamics
• TELV-01	Battery and Range Extender Electric Vehicle
• TELV-02	Fuel Cell Electric Vehicle
• TELV-03	Hybrid Electric Vehicle
Other Trainings	
• TEPU-04	Main Bearing and Conrod Bearing Analysis
• TCMV-01	CRUISE M Engineering Enhanced -Software Training for VTB / Gasoline
• TCMV-02	CRUISE M Engineering Enhanced - Software Training for VTB / Diesel
• EPW	Engine Parametrization Wizard
• VSS	Vehicle Simulation Solution
• PEM_FuelCell	PEM Fuel Cell Calibration Workflow
• CM_FuelCell	CRUISE M simulation capabilities FCEV
• Wizards	Wizards and Generators
• Impress M	Postprocessing Impress M
• CRUISE M	GUI Basic

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

3.2.6 Electrification Trainings

3.2.5.1 Electrification Trainings Vehicle

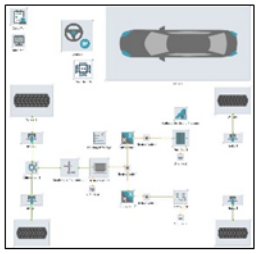
TELV-01 / Battery and Range Extended Electric Vehicle Concept Finding & Layout

Models:
Basic_Electronic_Circuits.proj
DCDC_example.proj
El_Consumer_Modeling.proj
lowpass_filter.proj
Mech_Consumer_Modeling.proj
E-Machine_Speed_Control.proj
Battery_Electric_Vehicle_DoE_03.proj
Battery_Electric_Vehicle_OP.proj
Range_Extended_Electric_Vehicle_02.proj

Module 1* Basic	Module 2** Application	Module 3** Application
1 Day	1 Day	1 Day
Introduction ▪ CRUISE M GUI, Pre- and Post-processing ▪ Mechanical domain in CRUISE M ▪ Electric domain in CRUISE M ▪ Basic model setup with calculation tasks	**BEV powertrain model** ▪ Simple powertrain ▪ Advanced powertrain ▪ Introduction to BMS ▪ E-motor current control ▪ Model analysis	**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:
FC_testbed.proj
Basic_Electronic_Circuits.proj
DCDC_converter_basics.proj
Battery_parametrization.proj
Aut_FWD.proj
HeatFlow_QuasiSteady.proj
WaterSeparator.proj
Humidifier.proj
PEMFC_basic_interactive.proj
FCEV_BoP_Anode.proj
FCEV_BoP_Cathode_part1.proj
FCEV_BoP_Cathode.proj
FCEV_BoP_Anode.proj
FCEV_BoP_Thermal_management_part1.proj
FCEV_BoP_Thermal_management_part2.proj
FCEV_BoP_Thermal_management.proj
FCEV_BoP_Assembly.proj



Module 1* Basic	Module 2** Application	Module 3** Application
1 Day	1 Day	1 Day
Introduction ▪ CRUISE M GUI, Pre- and Post-processing ▪ Control domain in CRUISE M ▪ Mechanical domain in CRUISE M ▪ Electric domain in CRUISE M ▪ Basic model setup with calculation tasks ▪ Simple powertrain	**BEV powertrain model** ▪ Gas path domain in CRUISE M ▪ Liquid domain in CRUISE M ▪ Thermal domain in CRUISE M ▪ FC Control ▪ E-motor current control ▪ Model analysis	**Applications & REEV powertrain model** ▪ Advanced powertrain ▪ Cycle run & FLA ▪ Parameters, scenarios & BoP ▪ FCEV & controller ▪ Model analysis ▪ Energy Management ▪ Electrochemical Fuel Cell

* Module 1 (Basic Training for CRUISE M) only has to be done once | Duration: 1 Day
** Module 2 and 3 (Application Training) can only be done together | Duration: 1 Day

TELV-03 / Hybrid Electric Vehicle Concept Finding & Layout

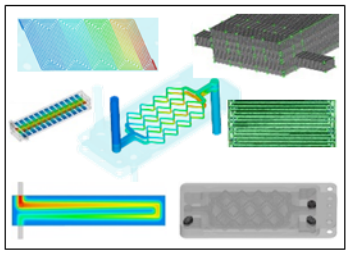
Models:
HEV_P2_AMT_FWD.proj
Series_Hybrid_RE_Basic_Model.proj
Man_FWD.proj
PX_PMG_AMT_FWD.proj

Module 1* Basic	Module 2** Application	Module 3** Application
1 Day	1 Day	1 Day
Introduction ▪ CRUISE M GUI, Pre- and Post-processing ▪ Mechanical domain in CRUISE M ▪ Electric domain in CRUISE M ▪ Basic model setup with calculation tasks	**HEV powertrain model** ▪ Run basic vehicle model with post-processing ▪ Overview on hybrid concepts Px ▪ Modify basic vehicle to a hybrid configuration P0+P2 ▪ Simple control function implementation	**HEV powertrain model** ▪ Simple control function implementation ▪ Introduction to BMS ▪ E-motor current control ▪ Simple thermal model

3.2.5.2. 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



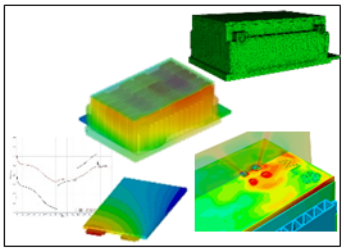
Module 1* Basic	Module 2** Application	Module 3** Application
1 Day	1 Day	1 Day
Introduction ▪ FIRE M introduction ▪ SDT GUI, Pre- and Post-processing ▪ Case definition, parameters and job submission ▪ Basic model set-up	**PEM FC Basic Training** ▪ PEM FC surface preparation ▪ Interactive meshing (Single Serpentine Flow Channel PEM FC) ▪ Automatic meshing (FC Diamond) ▪ Basic simulation setup for fuel cell module	**PEM FC Application Training** ▪ Advanced surface repair (ZBT PEM FC) ▪ Specific oriented simulation setup for fuel cell module ▪ Analysis of FC specific results (Post-processing and discussion)

* Module 1 (Basic Training for CRUISE M) only has to be done once | Duration: 1 Day
** Module 2 and 3 (Application Training) can only be done together | Duration: 1 Day

3.2.5.3 Electrification Training Battery

TELB-01 / Battery Thermal and Hazard Investigation

Models:
9107_Battery_Cooling
9320_ET_Battery
9321_EC_Battery (existing model)
9322_Battery_Thermal_Runaway
9106_LTPEM_FC_Straight_Channel



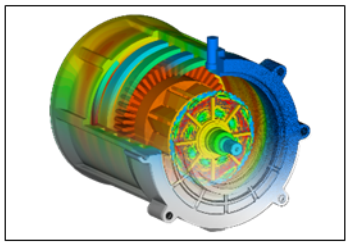
Module 1* Basic	Module 2** Application	Module 3** Application	Module 4** Application
1 Day	1 Day	1 Day	1/2 Day
Introduction ▪ FIRE M introduction ▪ SDT GUI, Pre- and Post-processing ▪ Case definition, parameters and job submission ▪ Basic model set-up	**Thermal analysis** ▪ Introduction to battery technology and simulation ▪ Preparation of CAD data and meshing ▪ Basic model setup for Battery Cooling	**Hazard investigation** ▪ Introduction to battery thermal runaway ▪ Setup for thermal runaway simulations ▪ Analysis of results (Propagation times, flammability)	**Electrothermal & -chemical models** ▪ Introduction to ET & EC battery models ▪ Data requirements and processing for ET & EC models ▪ Setup of ET & EC simulations

* Module 1 (Basic Training for FIRE M) only has to be done once | Duration: 1 Day
** Module 2, 3 and 4 (Application Training) can only be done together | Duration: 1 Day for Module 2 and 3; 1/2 Day for Module 4

3.2.5.4 Electrification Trainings Electric Motor

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

Models:
9504_E-Motor Cooling Workflow (existing model)
2 new e-motor EM analysis installation examples
(ready for 2020.1 release)



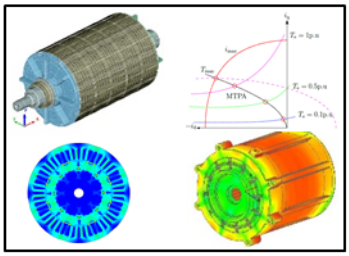
Module 1* Basic	**Module 2**** Application	**Module 3**** Application
1 Day	1 Day	1 Day
Introduction ▪ FIRE M introduction ▪ SDT GUI, Pre- and Post-processing ▪ Case definition, parameters and job submission ▪ Basic model set-up	**E-machine electro-magnetic analysis** ▪ Intro of 2.5D electro-magnetic capabilities and modelling appr. ▪ E-machine modeling using EMT*** and from CAD import ▪ Setup of EM simulation ▪ Results evaluation ▪ Export results for further analyses ▪ Modify model	**E-machine thermal analysis** ▪ Intro of thermal capabilities and 3D modelling approaches ▪ Calculation of losses ▪ CAD preparation and meshing ▪ Model setup with combined liquid and air cooling ▪ Analysis of temperatures

* Module 1 (Basic Training for FIRE M) only has to be done once | Duration: 1 Day
** Module 2 and 3 (Application Training) can only be done together | Duration: 1 Day

TELM-02 / E-Machine NVH Analysis with Electrical Network

Models:
EMC0 + Stator Forces
EMC1

Module 1* Basic	**Module 2**** Application
1/2 Day	1 Day
Introduction ▪ FIRE M introduction ▪ SDT GUI, Pre- and Post-processing ▪ Case definition, parameters and job submission ▪ Basic model set-up	**Model Set-up** ▪ Data generation with EMT (Electric Machine Tool) ▪ Set-up of Models for NVH task (frequency domain/time domain) – EMC0 & stator forces + post processing ▪ Set-up of model for higher electrical order effects and (low speed) rotor dynamics– EMC1 ▪ Data check with property assistant

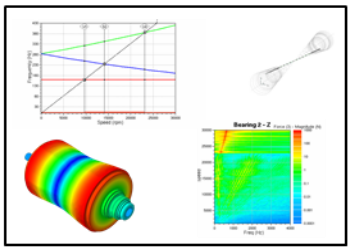


* Module 1 (Basic Training for FIRE M) only has to be done once | Duration: 1/2 Day
** Module 2 (Application Training) | Duration: 1 Day

TELM-03 / Electric Machine Rotor-Dynamics

Models:
RotDyn.ex
RotDynBearingStiffness.ex
RotorDyn_3D.ex

Module 1* Basic	Module 2** Application	Module 3** Application
1/4 Day	1/4 Day	1/2 Day
Rotor-dynamics Theory Introduction ▪ Introduction to Rotor-dynamics theory ▪ Basics about critical speeds, upward and backward whirling modes	**Complex Modal Analysis** ▪ Introduction to Shaft Modeler tool ▪ Setup of the Shaft Modeler Rotor ▪ Bearing Stiffness calculation ▪ Complex Modal Analysis of the rotor	**Transient Dynamic Analysis** ▪ Setup of the E machine Excite model for Rotor-dynamics ▪ Introduction to the EMC joint in Excite ▪ Results Evaluation



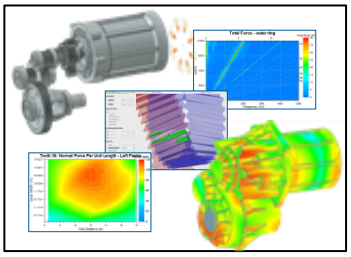
* Module 1 (Basic Training for FIRE M) only has to be done once | Duration: 1/4 Day
** Module 2 and 3 (Application Training) can only be done together | Duration: 1/4 Day for Module 2; 1/2 Day for Module 3

3.2.5.5 Electrification Training E-Axle

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

Models:
eAxle_PGS.ex
eAxle_PGS_flex.ex

Module 1 Basic	Module 2 Application
1 Day	1 Day
Advanced simulation ▪ Introduction of EXCITETM Power Unit capabilities and modelling approaches to simulate eAxles with cylindrical and planetary gear stages ▪ Creating an advanced eAxle model ▪ Results evaluation using Impress Chart and Impress 3D (Data Recovery), gear mesh evaluation	**Extended simulation** ▪ Modelling extensions: ▪ Microgeometry – contact plots ▪ FlexGear - retained nodes ▪ Stator – teeth forces ▪ RCA (Root Cause Analysis) ▪ MA (Modal Analysis) ▪ NTPA (Numerical Transfer Path Analysis) ▪ TF (Transfer Functions)



* Module 1 (Basic Training for FIRE M) only has to be done once | Duration: 1 Day
** Module 2 (Application Training) | Duration: 1 Day

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

Module 1
Basic

1 Day

Advanced simulation

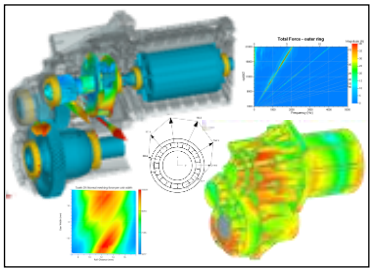
- Introduction of EXCITETM for eAxle (SDT) capabilities and modelling approaches to simulate e-axles with cylindrical and planetary gear stages
- Creating e-Axle model in BASIC modeling level
- Results evaluation in IMPRESSTM M, gear mesh evaluation, report generation

Module 2
Application

1 Day

Extended simulation

- Model extensions in EXPERT modeling level
- Stator – teeth forces
- Component Modeler
- FlexGear - retained nodes
- RCA (Root Cause Analysis)
- MA (Modal Analysis)
- NTPA (Numerical Transfer Path Analysis)
- TF (Transfer Functions)



* Module 1 (Basic Training for FIRE M) only has to be done once | Duration: 1 Day
** Module 2 (Application Training) | Duration: 1 Day

3.2.7 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

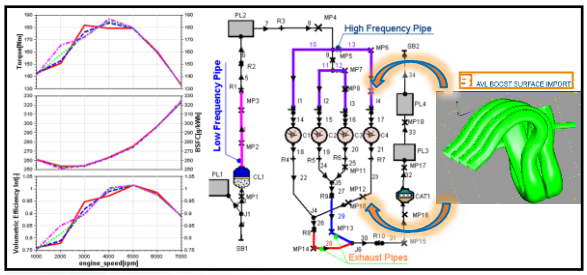
1 Day

- Introduction 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 Day

- Transient Calculation (on request as additional ½ day)



* Module 1 (Basic Training for BOOST) only has to be done once | Duration: 2 Days

TBCS-02 / BOOST Aftertreatment

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

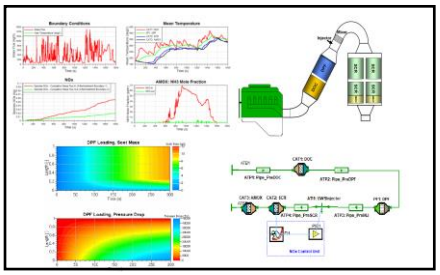
1 Day

- Introduction 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

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

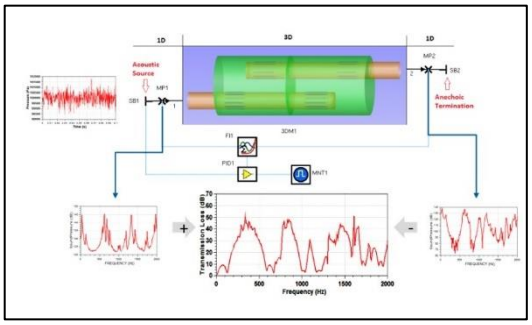


TBCS-03 / BOOST Linear and Non-Linear Acoustics

Module 2
Application

1 Day

- Introduction and Theory
- Example: Exhaust Muffler Model (Rockdrill)
- Advantages/Disadvantages of Linear vs. Non-linear Solution
- Transmission Loss Adjustment Using Optimization Tool



TBCS-04 / BOOST Turbocharger

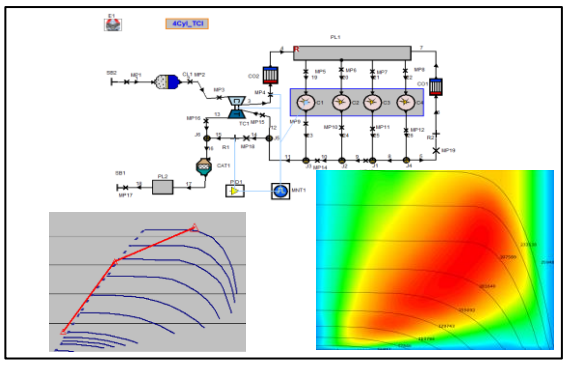
Models:

TCI_calc.bwf
TCI_calc_short.bwf
TCI_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 CRUISE Training Courses

TCSS-01 / CRUISE Basic Training Course

Models:
Man_FWD ver_0001
Aut_FWD ver_0001

Module 1*
Basic

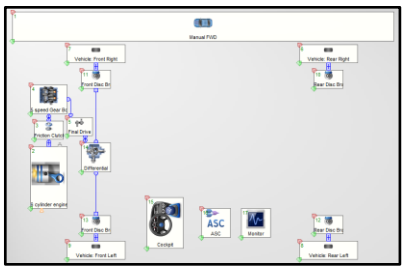
1 Day

- Introduction
- Creating a basic vehicle model
- Setting up the Cycle Run Calculation Task
- Running a simulation
- Post-processing

Module 1*
Basic

1 Day

- Overview of other calculation tasks (e.g. Full load acceleration, max. velocity, etc.)
- Modifying a manual transmission vehicle to an automatic transmission vehicle
- Explanation of different calculation types (variations) with post-processing



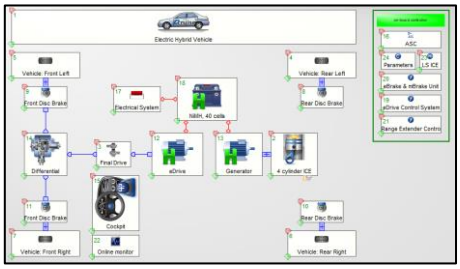
TCSS-02 / CRUISE HEV and EV Modeling

Models:
Electric_Vehicle ver_0001
Range_Extender ver_0001
Hybrid_2 ver_0002
Mild_Hybrid ver_0001

Module 2
Application

1 Day

- Introduction of Electrical Components
- Model Setup
- Basic Controller Usage (No Controller Development)
- Example of using a Matlab based controller (No Matlab usage)



* Module 1 (Basic Training for CRUISE) only has to be done once | Duration: 2 Days

TCSS-04 / CRUISE GSP

Models:
GSP Wizard AMT ver_0001
GSP AMT ver_0001

Module 2
Application

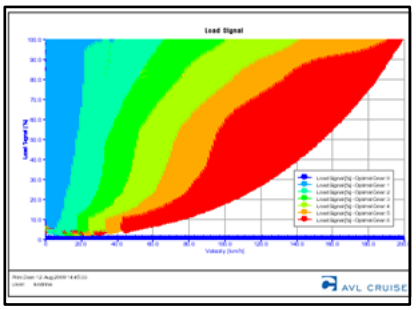
1 Day

- Introduction and overview
- GSP Wizard
- GSP Generation

Module 2
Application

1 Day

- GSP Optimisation



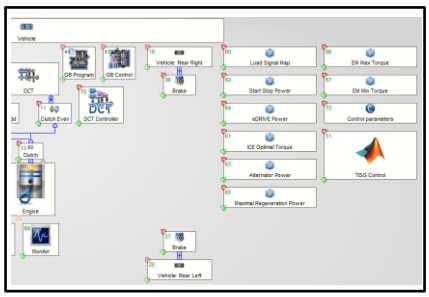
TCSS-03 / CRUISE Interfaces

Models:
Matlab API ver_0001
Matlab DLL ver_0001
Function C ver_0001
Function RPN ver_0001
Map ver_0001

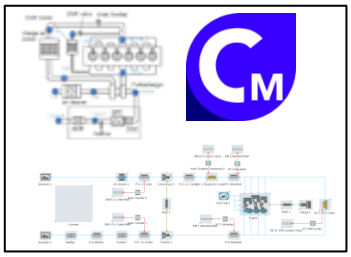
Module 2
Application

1 Day

- Introduction and overview
- Matlab API
- Matlab DLL
- Function
- Map



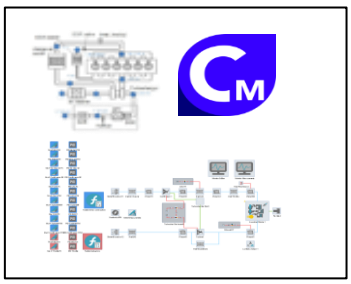
3.2.9 CRUISE M Training Courses



CRUISE M 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	Module 1* Basic	Module 1* Basic
1 Day	1 Day	1 Day
Introduction ▪ CRUISE M GUI, Pre- and Post-processing ▪ Gaseous domain in CRUISE M ▪ Basic model setup with calculation tasks	**Engine model** ▪ Steady State Engine model ▪ Transient Engine model	**Engine model** ▪ Turbocharger ▪ Transient control



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	Module 1* Basic	Module 1* Basic
1 Day	1 Day	1 Day
Introduction ▪ CRUISE M GUI, Pre- and Post-processing ▪ Engineering Enhanced Cylinder ▪ Gaseous domain in CRUISE M ▪ Basic model setup with calculation tasks	**Engineering Enhanced Engine model** ▪ Steady State model ▪ Transient model	**Engineering Enhanced Engine model** ▪ Turbocharger ▪ Transient control ▪ Peripheral models

* Module 1 (Basic Training for CRUISE M) only has to be done once

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

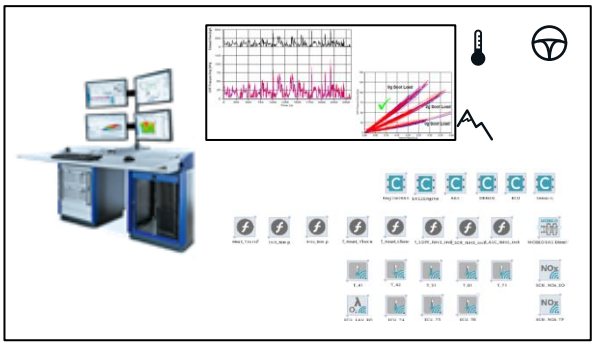
1 Day

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

Module 1*
Basic

1 Day

- 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 Modelling

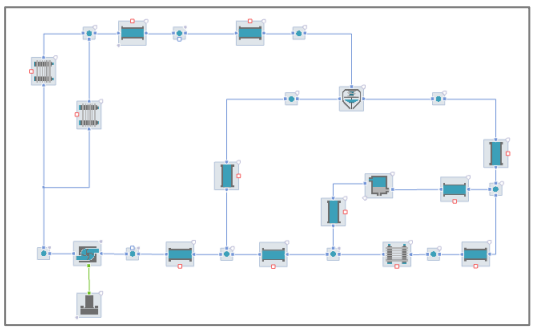
- Thermal management Introduction
- Liquid Flow Domain in CRUISE™ M
- Hydraulic Calibration
- Underhood Modeling
-

Module 1*
Basic

1 Day

Basic Modelling and Circuits

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



* Module 1 (Basic Training for CRUISE M) only has to be done once | Duration: 2 Days

TCMA-01 / CRUISE M Physical Engine VTMS Training / GASOLINE
TCMA-02 / CRUISE M Physical Engine VTMS Training / DIESEL

Models:
Same as in TCMF-01
C09002_1_4L_PFI_FTC_Gasoline_VTMS
C09009_1_5L_4Cyl_FTC_VTMS

Module 2
Application

1 Day

Introduction and Basic Modelling

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

Module 2
Application

1 Day

Basic Modelling and Circuits

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

Module 2
Application

1 Day

VTMS Modelling

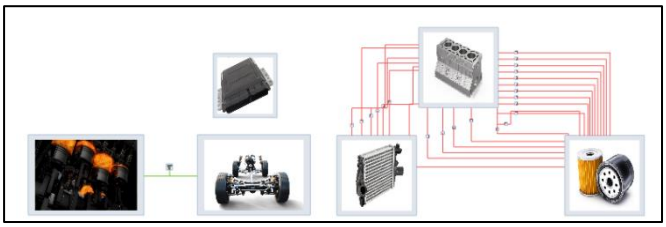
- Thermal network modelling
- Coupling of engine and driveline models

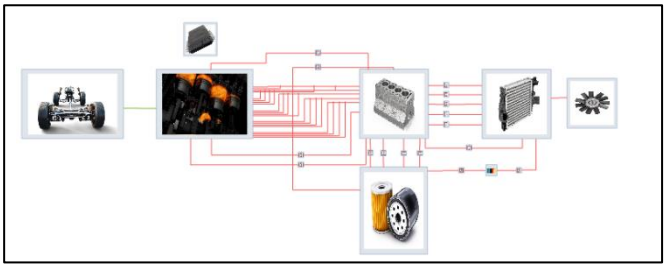
Module 2
Application

1 Day

VTMS Modelling

- Coupling of the flow circuits
- Drive cycle simulation set-up
-

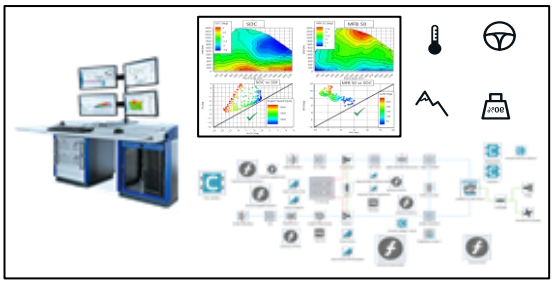




TCMV-01 / CRUISE M Engineering Enhanced Software Training for VTB / Gasoline
TCMV-02 / CRUISE M Engineering Enhanced Software Training for VTB / DIESEL

Required Prerequisites: Customer order of VTB (Virtual TestBed) from AVL ITS

Models:
C06056_Gasoline_EE_Calibration



Module 2
Application

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 2
Application

1 Day

Engineering Enhanced Engine model
- Steady State model
- Transient model
- Turbocharger
- Transient control
- Peripheral models

Module 2
Application

1 Day

Engineering Enhanced Engine model
- Steady State model
- Transient model
- Turbocharger
- Transient control
- Peripheral models

Module 2
Application

1 Day

VTB application extensions
- Measurement data evaluation
- Data visualization
- Engine Calibration
- Engine extensions (sensors, robustness, non-standard conditions)
- HiL usage

Module 2
Application

1 Day

VTB application extensions
- Measurement data evaluation
- Data visualization
- Engine Calibration
- Engine extensions (sensors, robustness, non-standard conditions)
- HiL usage

Module 2
Application

1 Day

VTB application extensions
- Measurement data evaluation
- Data visualization
- Engine Calibration
- Engine extensions (sensors, robustness, non-standard conditions)
- HiL usage

Module 2
Application

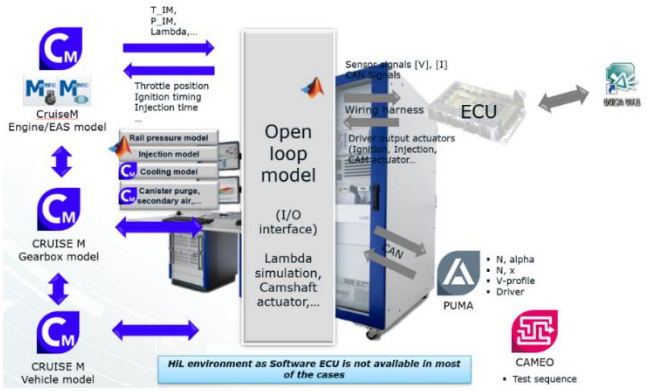
1 Day

Engineering Enhanced EAS model
- Engineering Enhanced EAS Gasoline/Diesel block
- EAS model setup (simple and advanced model)
- EAS model parameterization (kinetics, heat transfer and pressure loss refinement)
- EAS model export (preparation for HiL usage)

Module 2
Application

1 Day

Engineering Enhanced EAS model
- Engineering Enhanced EAS Gasoline/Diesel block
- EAS model setup (simple and advanced model)
- EAS model parameterization (kinetics, heat transfer and pressure loss refinement)
- EAS model export (preparation for HiL usage)



TCMH-01 / CRUISE M Mobile A/C Basic

Models:
C01001_AC_Circuit_EV
C01002_Heat_Pump_Cycle_Internal_HE
C01008_Single_Stage_Controlled

Module 2
Application
1 Day

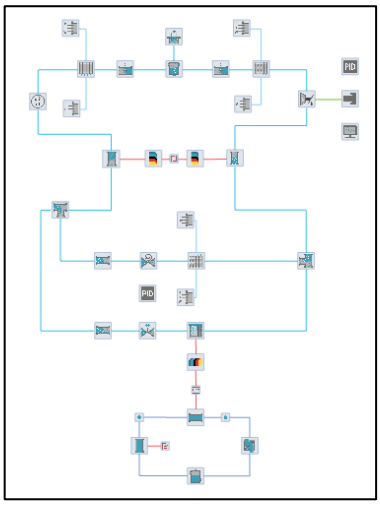
Introduction

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

Module 2
Application
1 Day

Basic Modelling and Circuits

- Air-conditioning modelling
- Heat pump modelling



TCMH-02 / CRUISE M BEV with HVAC

Models:
C01001_AC_Circuit_EV
C05058_Cabin_Air_ReCirc_Sys_GF

Module 2
Application
1 Day

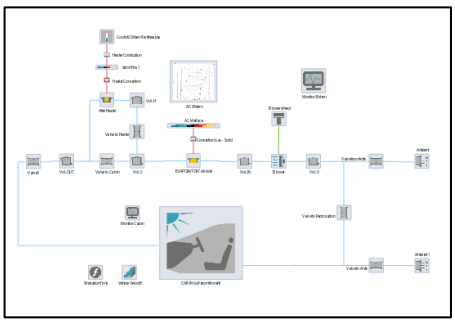
TELV-01

- The entige TELV-01 Training

Module 2
Application
1 Day

TELV-01

- The entige TELV-01 Training



Module 2
Application
1 Day

TELV-01

- The entige TELV-01 Training

Module 2
Application
1 Day

HVAC in BEVs

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

Module 2
Application
1 Day

HVAC in BEVs

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

TCMH-03 / CRUISE M BEV VTMS and HVAC
Recommended pre-requisites: TELV-01, TCMF-01, TCMH-01

Models:
C01001_AC_Circuit_EV
C05058_Cabin_Air_ReCirc_Sys_GF

Module 2
Application

1 Day

Vehicle and Flow Introduction
- Summary of TELV-01, vehicle modelling overview
- CRUISE M basic workflow
- Usage of vehicle model for drive cycle simulation
- Cooling circuit modelling
- Pressure drop and heat transfer calibration

Module 2
Application

1 Day

Flow and A/C Modelling
- Pump and valve modelling
- Circuit formation and calibration
- Air conditioning system modelling
- Extension of A/C model with a chiller

Module 2
Application

1 Day

Vehicle and Flow Introduction
- Battery modelling – discretization of battery module
- Electric machine thermal modelling
- Vehicle cabin modelling

Module 2
Application

1 Day

Integration of Vehicle and Thermal Models
- Integration of vehicle model and battery thermal model
- Integration of electric motor thermal model
- Integration of A/C and cabin model
- Drive cycle simulation and model variation

3.2.10 EXCITE Designer Training Course

TEDE-01 / EXCITE Designer Basic

Module 1*
Basic

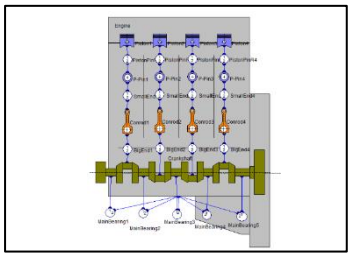
1 Day

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

Module 1*
Basic

1 Day

- Post-Processing
- Crankshaft Pre-Processing using AutoSHAFT approach



* Module 1 (Basic Training for EXCITE Designer) only has to be done once | Duration: 2 Days

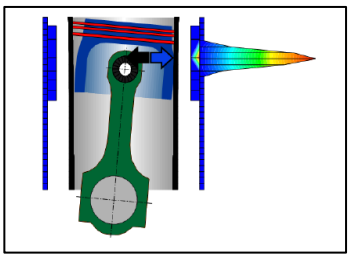
3.2.11 EXCITE Piston&Rings Training Courses

TEPR-01 / EXCITE Piston Basic

Module 1*
Basic

1 Day

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

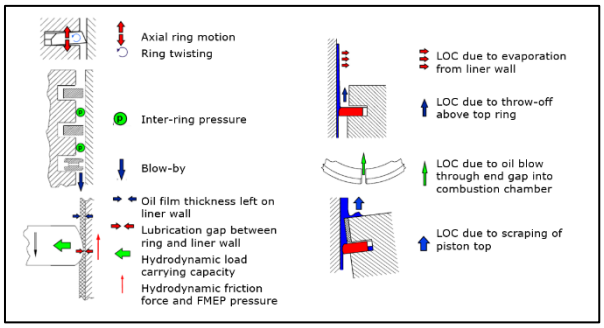


TEPR-02 / EXCITE Ring Basic

Module 1*
Basic

1 Day

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



* Module 1 (Basic Training for EXCITE Piston & Rings) only has to be done once | Duration: 1 Day

3.2.12

3.2.12EXCITE Power Unit Training Courses

TEPU-01 / EXCITE Power Unit Basic

Module 1*
Basic

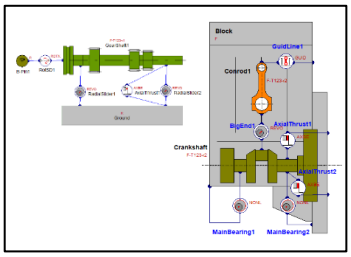
1 Day

- 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

- 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

Module 2
Application

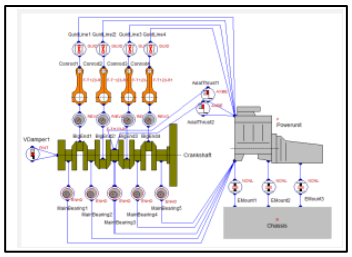
1 Day

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

Module 2
Application

1 Day

- Set-up of I4 Demo Model (Volumetric Model)
- Postprocessing



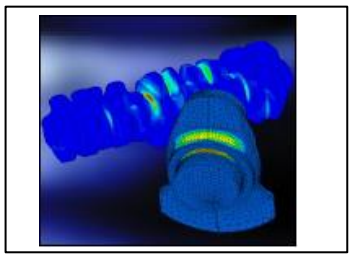
* Module 1 (Basic Training for EXCITE Power Unit) only has to be done once | Duration: 2 Days

TEPU-03 / EXCITE Power Unit Crankshaft Stress Analysis

Module 2
Application

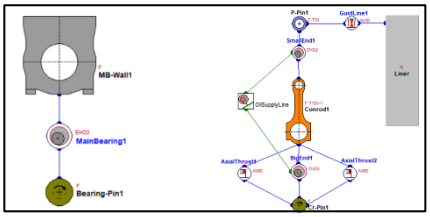
1 Day

- Overview on Strength Analysis based on MBDStress Analysis using FEA and Fillet Modeler approach based on Inline
- 4-cylinder Example



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

Models: installation examples
103_Bearing.ex
104_Conrod.ex



Module 2
Application

1/4 Day

Intro 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

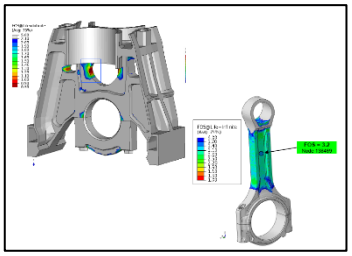
Post-processing
- 2D post-processing, IMPRESS Chart
- 3D post-processing, IMPRESS 3D

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

Module 2
Application

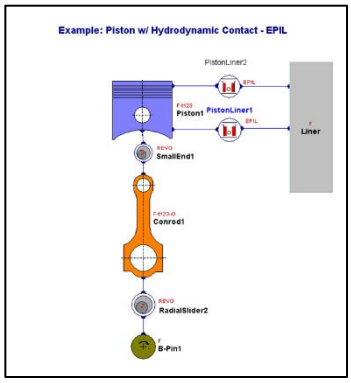
1 Day

- 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

Models:
Installation example
105_Piston/Piston_hydro_.ex

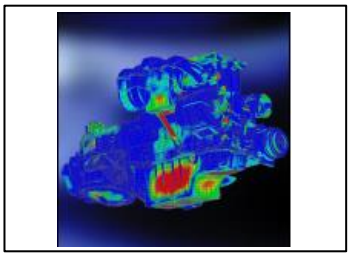


Module 2
Application

1 Day

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

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

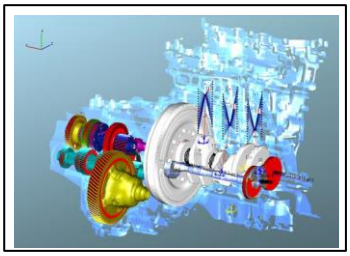


Module 2
Application

1 Day

- 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



Module 2
Application

1 Day

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

Module 2
Application

1 Day

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

TEPU-09 / EXCITE Power Unit Driveline Vehicle Integration

Module 2
Application

1 Day

- Driveline NVH Phenomena
- Modeling approach and Driveline Components
- From 1D Pure Torsional to 3D Approach

Module 2
Application

1 Day

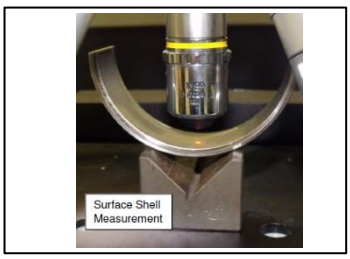
- Create a Model of a Front Wheel Drive
- Shuffle and Clonk Investigation
- Post-processing

TEPU-12 / EXCITE Power Unit Micro-contact Analysis

Module 2
Application

1/2 Day

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



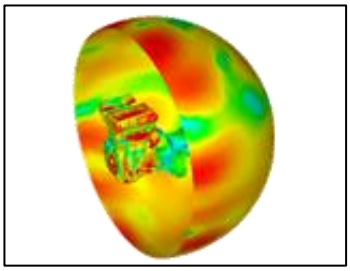
TEPU-15 / EXCITE Power Unit Acoustics (Air Born Noise)

Models:
I4_Demo_Transmission_Acoustic_Model.proj

Module 2
Application

1 Day

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

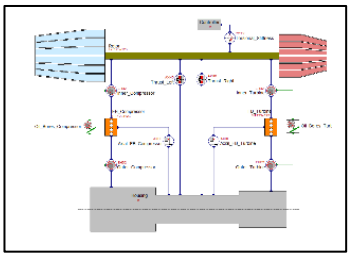


TEPU-16 / EXCITE Power Unit Turbo Charger

Module 2
Application

1 Day

- FE model requirements for EXCITE
- Modelling of Turbocharger Rotor
- Rotor Modal Analysis
- Create Turbocharger model
- Post-Processing



3.2.13 EXCITE Timing Drive Training Courses

TETD-01 / EXCITE Timing Drive Basic Dynamics Calculation

Models:

01_SVT-Intake_OHC-Flat-Tappet.etd
03_Intake-Camshaft.etd
05_Timing-Gear-Train.etd
07_Exhaust-Valve-Train-System.etd
09_Chain-Drive.etd
02_SVT-Exhaust_OHC-Finger-Follower.etd
04_Exhaust-Camshaft.etd
06_Intake-Valve-Train-System.etd
08_Timing-Drive_w-Gear-Train.etd
10_Timing-Drive_w-Chain-Drive.etd

Module 1* Basic

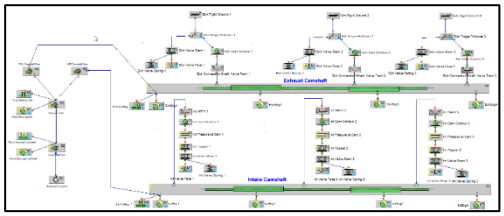
1 Day

- Introduction and Theory
- Single Valve Train Dynamics
  Shaft Systems

Module 1* Basic

1 Day

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



TETD-02/ EXCITE Timing Drive Cam Design

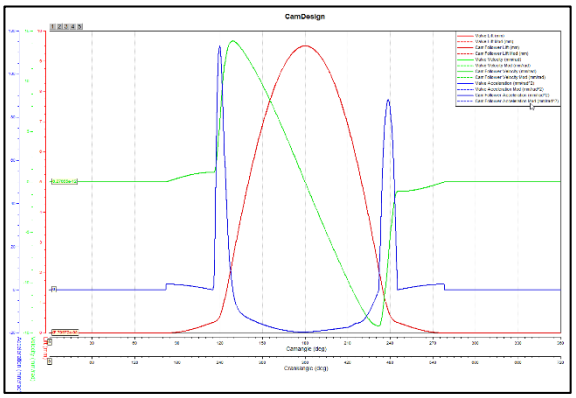
Models:

301-01_CD_flat_tappet.etd
301-01_CD_flat_tappet_1.vtc
301-01_CD_flat_tappet_modification_1.vtc

Module 2 Application

1 Day

- Introduction and Theory
- Setting up of Application Example
  Result Analysis



* Module 1 (Basic Training for EXCITE Timing Drive) only has to be done once | Duration: 2 Days

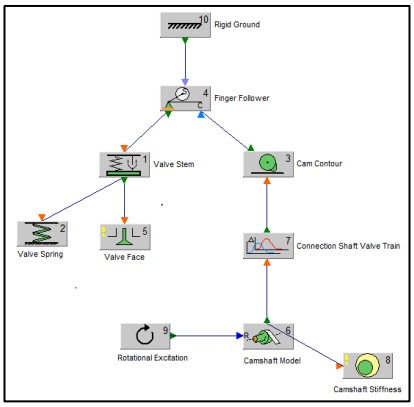
TETD-03 / EXCITE Timing Drive Single Valve Train

Models:
01_SVT-Intake_OHC-Flat-Tappet.etd
02_SVT-Exhaust_OHC-Finger-Follower.etd

Module 2
Application

1 Day

- Introduction and Theory
- Single Valve Train Dynamics
- Setting up of Application Example
- Result Analysis



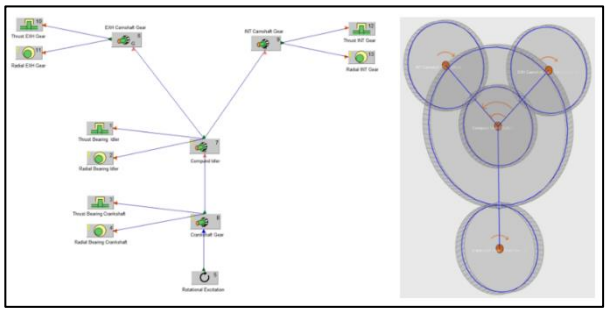
TETD-04 / EXCITE Timing Drive Gear Train

Models: 05_Timing-Gear-Train.etd

Module 2
Application

1 Day

- Introduction and Theory
- Gear Train Modeling
- Setting up of Application Example Result Analysis



TETD-05 / EXCITE Timing Drive Chain & Belt Drives

Models:
09_Chain-Drive.etd
10_Timing-Drive_w-Chain-Drive.etd

Module 2
Application

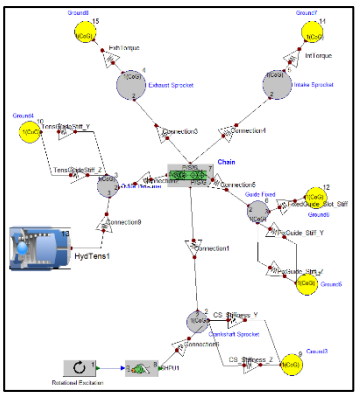
1 Day

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

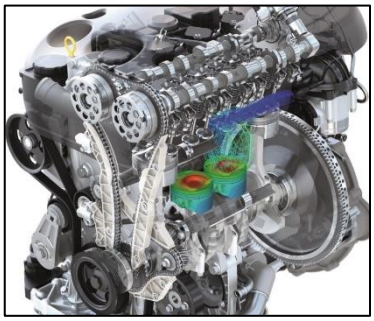
Module 2
Application

1 Day

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



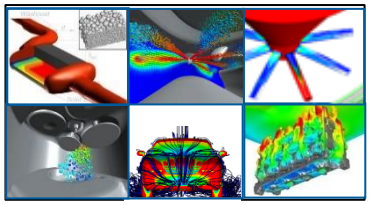
3.2.14 FIRE Training Courses



TFEN-01 / FIRE Basic (Engine Related)

Models:
900_Intake_Manifold
923_ICE_FAME_Engine_Plus

Module 1* Basic	Module 1* Basic	Module 1* Basic
1 Day	1 Day	1 Day
▪ Introduction to AVL FIRE ▪ Basic Model Generation ▪ Mesh generation (for non-moving, steady geometries) ▪ Simulation setup – basics ▪ Postprocessing – basics **Working Session: Examples** ▪ 900_Intake_Manifold	▪ Extended Simulation Setup ▪ Typical boundary conditions, turbulence modeling, numerics ▪ Basic modeling generation for moving boundaries ▪ Mesh generation concepts for moving boundaries (especially engine-related) **Working Session: Examples** ▪ 923 ICE FAME Engine Plus	▪ Continuation of topics from Day 2 ▪ Simulation setup and result analysis ▪ Open issues, answering questions, etc. ▪ **Working Session: Examples** ▪ 923_ICE_FAME_Engine_Plus ▪



TFGP-01 / FIRE Basic (General Purpose)

Models:
Getting Started: Intake Manifold (900)
Sliding Grid Interface: Rotating Object (952)
FAME™ Hexa: Cooling Jacket (901)
FAME™ Engine: IC Engine (902)

Module 1* Basic	Module 1* Basic	Module 1* Basic
1 Day	1 Day	1 Day
Introduction ▪ FIRE WM GUI - Pre-processing ▪ Computational volume domain in FAME HEXA ▪ Basic model setup FIRE WM ▪ Post-processing in FIRE WM	**Advanced features** ▪ Simple setup of each user ▪ Advanced features as Sliding, MRF ▪ Introduction to module setup ▪ Model analysis	**Multi-material approach** ▪ Moving mesh concept ▪ Advanced simulation setup ▪ Impress chart post-processing

* Module 1 (Basic Training for FIRE) only has to be done once

TFEN-02 / FIRE IC Engine – Diesel Injection Nozzle

Models:
9103_Interactive_Meshing.proj
9310_Diesel_Injector.proj
9312_Automated_Injector.proj

Module 2
Application

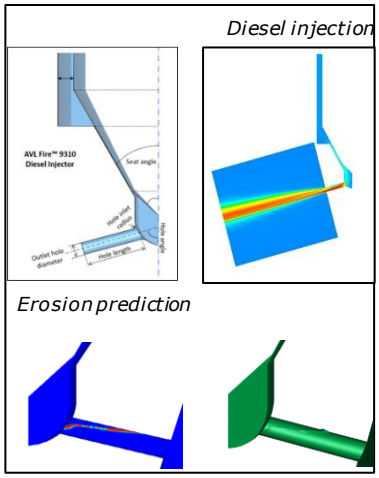
1 Day

- 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

- 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



TFEN-03 / FIRE IC Engine – GDI Nozzle

Models:
979_GDI_Flash_Boiling

Module 2
Application

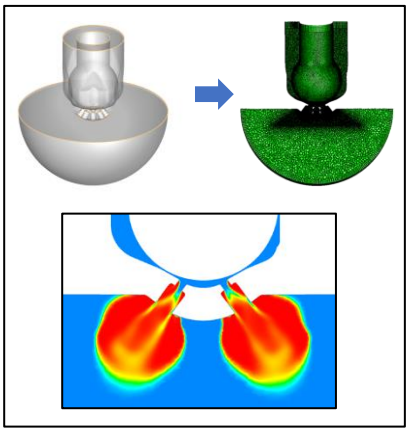
1 Day

- 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

- 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



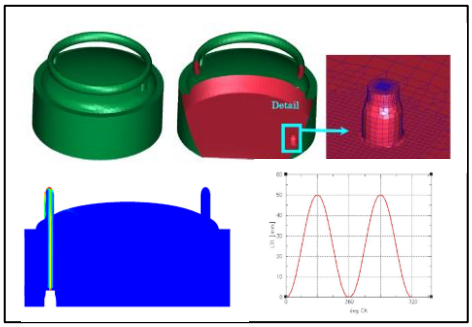
TFEN-04 / FIRE IC Engine – Piston cooling Analysis

Models:
9400 Automatic Optimization Example

Module 2
Application

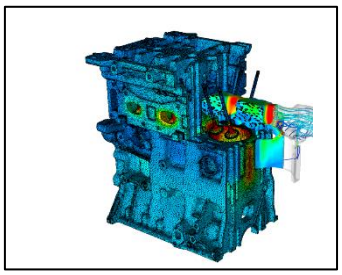
1 Day

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



TFEN-06 / FIRE Head Block Compound

Models:
9301_Cylinder_Head.proj
Internal training material: Foton GDI Engine
9520_HBC_Thermal_Load_Management.proj (will be released in R2022.1)
Internal training material: Foton GDI Engine



Module 2
Application

1 Day

- Introduction of the HBC application and simulation's 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

- Preparation of HBC input model (CAD data)
- Multi-domain model generation
- Set-up of the simulation
- Starting and monitoring of the simulation
- Result analysis
- Mapping of 3D AVL FIRE

Module 2
Application

1 Day

- Introduction of the HBC transient operation and simulation's specifics
- Preparation of input data (System level VTMS – 1D simulation)
- Preparation of input data (Cylinder Inner flow – 3D simulation)
- Set-up 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

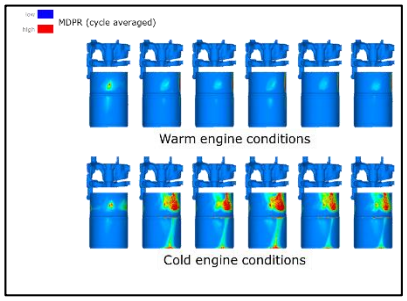
TFEN-08 / FIRE Liner Cavitation

Models:
9506_Liner_Cavitation.proj

Module 2
Application

1 Day

- Introduction of the Liner Cavitation application and simulation's specifics
- Preparation of excitation data (obtained with EXCITE simulation)
- Set-up of the simulation
- Simulation specific parameters and their influence on the results
- Starting and monitoring of the simulation
- Result analysis



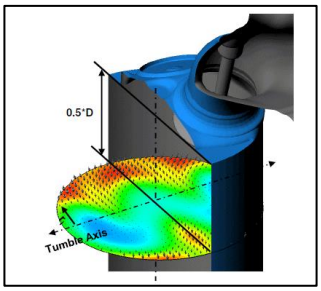
TFEN-15 / FIRE IC Engine Intake Port Flow

Models:
4-stroke Diesel engine intake port
4-stroke Gasoline engine intake port

Module 2
Application

1 Day

- Introduction to port flow simulation
- Flow evaluation - parameters (discharge rate, swirl/tumble)
- Model generation (reference TFGP-01)
- Formulas
- Simulation setup
- Result analysis

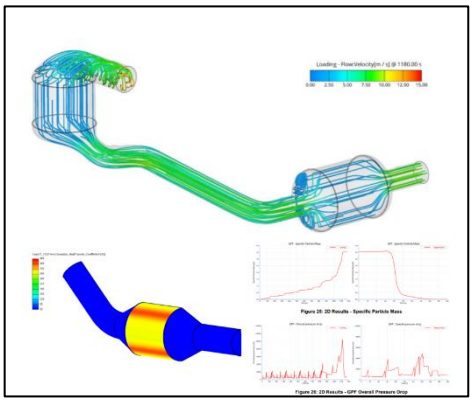


TFEN-17 / FIRE Application IC Engine - Aftertreatment - TWC & GPF
Required Training: TFEN-01 or TFGP-01

Module 2
Application

1 Day

- Introduction to Aftertreatment Simulation (BOOST / CM / FIRE)
- Performance Parameter: Uniformity, Species Conversion, Soot Loading/Regeneration
- Introduction to Automatic Kinetic parametrization
- Model Generation (general approach)
- Exhaust Gas Aftertreatment Module
- Setup of Simulation Control File
- Result Analysis



TFEN-18 / FIRE IC Engine Aftertreatment - SCR & DPF
Required Training: TFEN-01 or TFGP-01

Module 2
Application

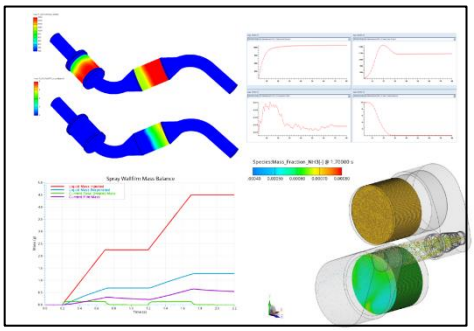
1 Day

- 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 Multphase Module
- Setup of Simulation Control File
- Result Analysis

Module 2
Application

1 Day

- 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



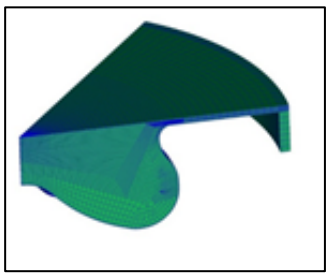
TFEE-01 / FIRE (Module Specific) ESE Diesel GUI

Models:
Diesel segment

Module 2
Application

1 Day

- Introduction to IC engine simulations
- Segment specification
- Model generation using ESE Diesel
- Geometry description
- Mesh generation options
- Compression volume, compensation volume
- Modelling centric/ eccentric combustion chamber/ injection nozzle
- Simulation setup
- Post-processing



TFEE-04 / FIRE (Module Specific) Eulerian Multiphase Module

Models:
9356_Tank_Filling.proj
9384_Embedded_Body_Gearbox.proj
9310_Diesel_Injector.proj

Module 2
Application

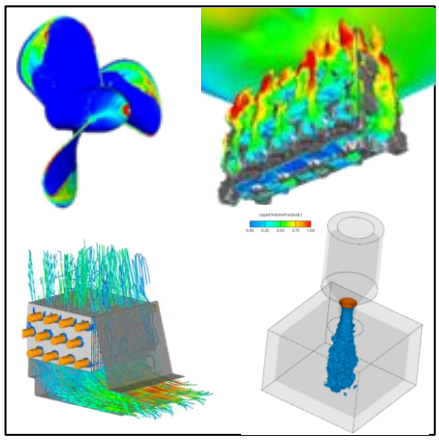
1 Day

- Theory on Eulerian multi-phase module
- Available multi-phase specific modeling approaches in FIRE
- Cavitation/Erosion model
- Quenching model
- Eulerian spray
- Melting/Solidification
- Basic example preparation

Module 2
Application

1 Day

- Used example Pre-processing
- Calculation domain definition and generation
- Calculation preconditions, setup and initial calculation
- Simulation result analysis



TFEE-06 / FIRE (Module Specific) Quenching

Models:
9307_Steel_Quenching.proj
9308_Quenching.proj
9309_RPI_Wall_Boiling.proj

Module 2
Application

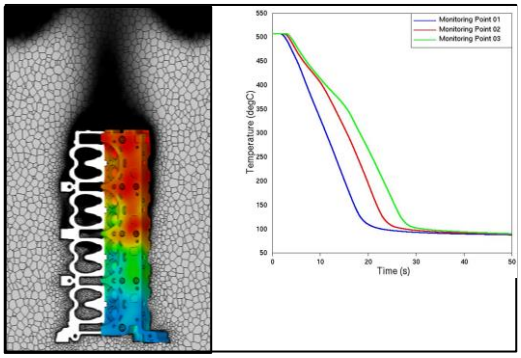
1 Day

- Theory on Eulerian multi-phase module
- Available multi-phase specific modeling approaches in FIRE™ M
- Introduction into Quenching module
- Model preparation and Mesh generation
- Basic example preparation

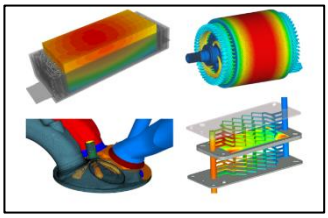
Module 2
Application

1 Day

- Used example Pre-processing
- Calculation domain definition and generation
- Calculation preconditions, setup and initial calculation
- Simulation result analysis



3.2.15 FIRE M Training Courses



TFIM-01 / FIRE M Basic

Models:
Cooling Jacket (9102).proj
Parameters and Scenarios (9104)
Cylinder Head (9301)
Porosity (9303)
Interactive Meshing (9103)

Module 1* Basic	Module 1* Basic	Module 1* Basic
1 Day	1 Day	1 Day
Introduction ▪ FIRE M GUI - Pre-processing ▪ Computational volume domain in FIRE M ▪ Basic model setup FIRE M ▪ Post-processing in IMPRESS M	**Advanced features** ▪ Simple setup of each user ▪ Advanced features as embedded body ▪ Introduction to Interactive meshing ▪ Embedding control with multiple meshes ▪ Model analysis	▪ **Multi-material approach** ▪ Multi-material setup, sliding moving mesh ▪ Checking simulation parameters and scenarios ▪ Advanced reporting in IMPRESS M ▪ Activating modules in FIREM GUI

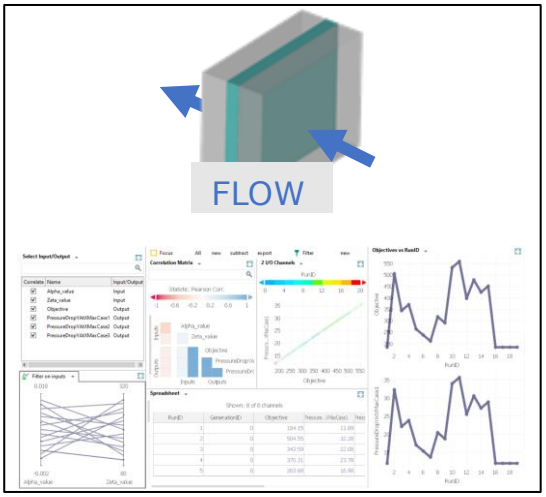
TFMA-01 / FIRE M Automatic Optimization

Models:
9400 Automatic Optimization Example

Module 2
Application

1 Day

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



* Module 1 (Basic Training for FIRE M) only has to be done once | Duration: 3 Days

3.2.16 SAMOS Training Course

TSAM-01 / Samos Basic

Models:
Included in SAMOS-ATSW-Package: madlein.e00

Module 1*
Basic

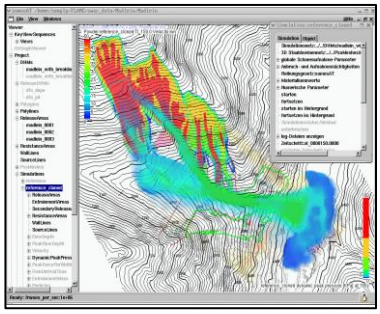
1 Day

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

Module 1*
Basic

1 Day

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



3.2.17 Model.CONNECT Training Course

TCMO-01 / Model.CONNECT Basic

Models:
2. COMPOSE Examples
2.1. IDE installation and initial setup
2.2. Data model
2.3. Custom editors
2.4. Forms
2.5. Connection between apps
2.6. Other useful asi funcionalities

Module 1*
Basic

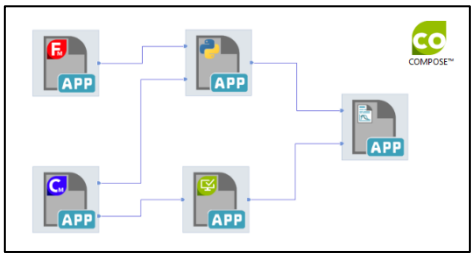
1 Day

- IDE installation and initial setup
- Data model
- Custom editors
- Forms
- Connection between apps
- Other useful asi funcionalities

Module 1*
Basic

1 Day

- COMPOSE Workflow development
- First app: Importing data
- Second app: Data analysis
- Third app: Exporting data
- Making app and workflow components



* Module 1 (Basic Training for SAMOS or Model.CONNECT) only has to be done once

3.2.18 PreonLab Training Course

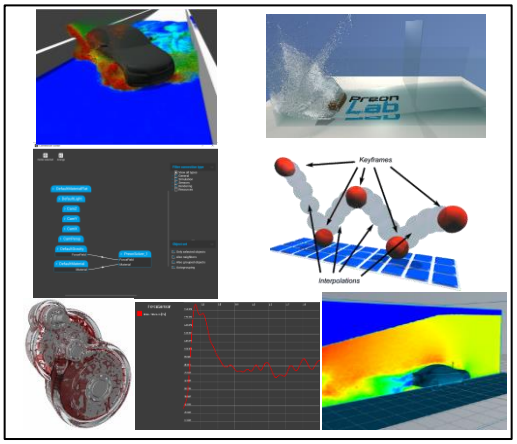
TPREO-01 / PreonLab Basic

Models:
RainWaterManagement
Airflow.prscene
Drain.prscene
GearBox_RBS Geometries

Module 1*
Basic

1 Day

- Introduction
- Solver
- Boundary handling
- PreonLab basic usage
- Sources
- Connections
- Keyframes
- Visualizations
- Force fields
- Sensors
- Rigid body GearBox



TPYT-01 / Python Basic

Module 1*
Basic

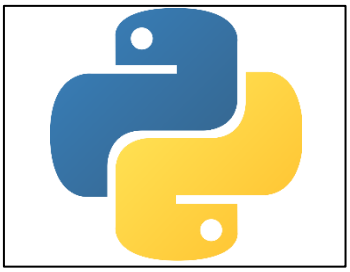
1 Day

- Introduction
- Overview of the Language
- Python Data Types
- Control Statements

Module 1*
Basic

1 Day

- Input/Output Facilities
- Functions and Modules
- Object Oriented Programming
- Working Session



* Module 1 (Basic Training for PreonLab or Python) only has to be done once

3.2.19 Software Conception

TCOM-01 / COMPOSE Basic

Module 1*
Basic

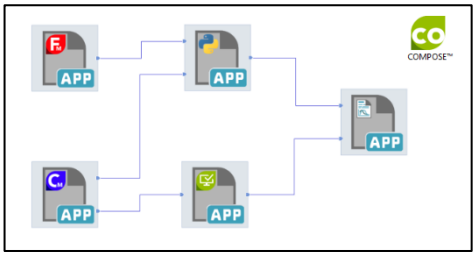
1 Day

COMPOSE Examples
- DE installation and initial setup
- Data model
- Custom editors
- Forms
- Connection between apps
- Other useful asi funcionalities

Module 1*
Basic

1 Day

COMPOSE App and workflow development
- COMPOSE Workflow development
- First app: Importing data
- Second app: Data analysis
- Third app: Exporting data
- Making app and workflow components

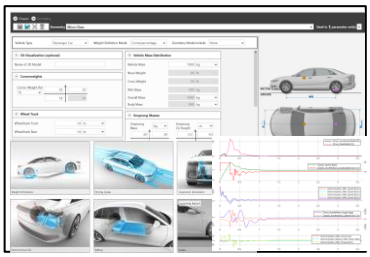


3.2.20 VSM Training Courses

TVSM-01 / VSM Basic

Models:
Template VSM models (various)
Manage_Simulink_Parameters.zip
Battery.zip
KnC_Neutral_Example.zip
Simulink_inplementation.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



Module 1*
Basic

1 Day

Introduction & Setups
- Introduction to Applications
- VSM Basics/Workflow
- Setups: Vehicle Geometry & Aerodynamics
- Setups: Suspension & Compliance
- Setups: Tyre & Tyre Plotter

Module 1*
Basic

1 Day

Setups (cont.) & Track Generation
- Setups: Spring & Damper & Anti-Roll Bar
- Setups: Bumpstop & Rebound Limiter
- Setups: Drivetrain & Engine
- Setups: Hybrid & Electric Motor, Electric Controller, Battery
- Track Generation
- 3D Viever

Module 1*
Basic

1 Day

Applications
- Driver Setup
- Variation
- Results & Postprocessing
- VSM Matlab Simulink
- VSM Vehicle Model Factory

* Module 1 (Basic Training for COMPOSE or VSM) only has to be done once

3.2.21

3.2.21 SPA Training Courses

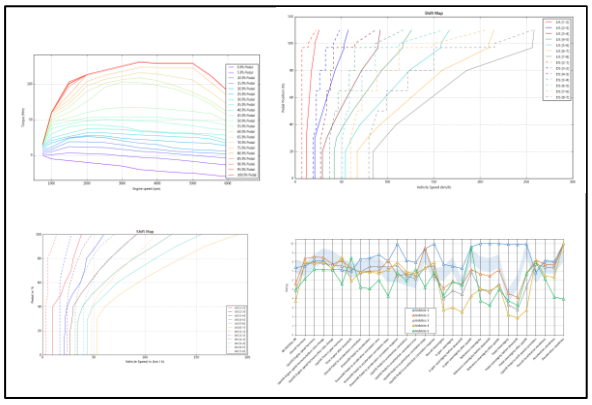
TSPA-01 / Spa Basic

Module 1*
Basic

1 Day

Introduction an application

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



* Module 1 (Basic Training for SPA) only has to be done once | Duration: 1 Day

3.3 Non-Standard Software Training

AVL AST offers also non-standard training courses for specific customer interest and based on customer models as training-on-the-job.

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**).

For FIRE possible application topics for such non-standard training courses are as follows:

FIRE Engine Related Application

Content:

- Integrated Diesel Injector Flow, Spray & Combustion Simulation and ESE Diesel
- Engine Cooling Systems (Water Cooling Jacket)
- Engine Thermal Analysis
- Aftertreatment Suite
- Injector Flow & Spray Simulation
- 1D/3D Intake System Design
- Intake Port Analysis
- Two-stroke Engine Simulation
- Spark Ignited Gasoline Injection Engine – Mixture Formation
- Spark Ignited Gasoline Injection Engine – Flame Propagation & Knock Offset
- HCCI Combustion
- Parametric Optimization using external optimization tool

FIRE General Purpose CFD Application

Content:

- Meshing Complex Geometries (2 days)
  - Complex non-moving and sliding geometries
- Multi-Fluid Approach (2 days)
  - Filling processes,
  - Hydraulic engineering examples
- Steady Combustion & Radiation (2 days)
  - Basic examples for radiation and combustion
- Examples of Automotive and Aerospace Applications

Contact	
Additional Information	Responsible Sales Manager
Proposal	Responsible Sales Manager

3.4 Software Support

The software support at AST is organized according to the AST Customer Support Process (CSP).

The CSP 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 CSP includes a level concept:

- 1st level support is done by local AST affiliates (if no local affiliate is available, 1st level support is done by AST in Graz)
- 2nd level support by AST in Graz headquarter

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

For each product or product group a Support Master is defined, who 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 "university partnership program" (UPP) a dedicated person is defined who acts as contact person to our support organization.

ID	Service
CC_33	Software Support

Purpose:

The software support via email is the single point of contact for customers regarding software related issues (besides 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.

Validity:

The CSP is defined worldwide and is valid for all AVL AST software tools.

Content:

- Answer software related questions
- Take over change requests or enhancement requests from customers and transfer to development and product management.

Goals:

- Help the customer with daily problems
- Improve product quality and customer satisfaction
- Support development with information about customer needs and recommendations
- Improve customer relationship

Customer Benefit:

- One contact for all software related questions
- Application know-how of all AST support engineers

Duration:

- 30 hr per year software support is included with each license.
- If this limit is exceeded, it will be charged separately and treated as consulting or project work.

Price (excl. Tax):

The software support via email is free of charge for every customer of AST products.

Contact	
About the Process	Customer Support Manager – Christian Vock (christian.vock@avl.com)
Who is my local support?	Please contact your local sales manager or local support via email.

Further information:

- Customer Support Process --> An overview of the CSP is given in Appendix 7.1.

4. Know How Transfer & Engineering Support

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

Contact	
Additional Information	Responsible Sales Manager
Proposal	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 and at a specific customer or as a corporate event where different customers can participate.

The seminars are partly done in co-operation with AVL business unit PTE.

ID	Service
CC_41	Technology Seminars / TechDays

Purpose:

Within a technology seminar a specific engineering topic and application field is discussed, including theoretical background, application field, problems and solutions. Focus is set on simulation related problems and solutions.

Validity:

All engineering topics, which are connected to AST software products, can be addressed. Although the seminar content is kept more general and not focusing on AST products, AST specific solutions and benefits are presented as AST know-how is based on those methods and tools.

Content:

- Definition of the entire topic
- Theoretical background
- Components and functionality
- Problems and engineering tasks, which have to be solved
- Technical solutions and applied methods

Goals:

- Generate understanding on the engineering topic
- Transfer of application know-how for the specific topic
- Understanding of cross effects

Customer Benefit:

- Compressed know-how transfer of state-of-the-art technology for a specific application field.

Duration:

- The duration depends on the specific topic, but typically is between 1 and 3 days.

Price (excl. Tax): * see chapter 2.1

- Seminar fee for a TechDay starts from **300 euro** per participant and may diversify.

Actually available seminar topics are:

- Engine Development Process (Concept, Layout and Design Phases)
- Chain & Belt Drive
- NVH & Durability / From Engine via Transmission to Entire Drive Line
- Vehicle NVH and Power Unit Mount Vibration Analysis
- Efficiency Enhancement
- Marine Engine & Drive Line System Modeling and Analysis
- HEV&EV Development and SW Application Seminar
- DoE, Optimization and Robust Design

4.2 Engineering Support

This module focuses mainly on the usage of AVL AST software products in daily life and real development projects including 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:

A start-up support is a training-on-the-job 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. The start-up support can be performed at AST in Graz, on-site or partly on-site at the customer. Typically AST performs the main steps of the investigation and afterwards re-performs each step on-site together with the customer and makes use of these models and results for detailed explanation of each working step.

Validity:

Start-up support is offered for all standard applications and all AST products. The 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 workflow and all working steps
- Set-up of necessary models, perform analysis and evaluation and interpretation of results
- Explanation of introduction of modifications
- Hints and significant information about the application
- Workflow and entire work performed will be documented in a report

Goals:

- Entire workflow performed
- Customer can perform the specific application by himself

Customer Benefit:

- Knowledge transfer from AVL for standard application
- Usage of customer models
- Short time for customer to get efficient with new tool and application
- Maximum training effect

Duration:

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

Price (excl. Tax):

Total costs are in the range of **20,000 to 50,000 euro** (depending on the application and complexity of work). Travel and accommodation for AVL engineer are charged separately.

4.2.2 Enhancement Support

The 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.

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

ID	Service
CC_422	Enhancement Support

Purpose:

Enhancement support is a training-on-the-job 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 in the customer specific application work.

The enhancement support can be performed at AST in Graz, on-site at the customer.

The specific customer model should be sent to AST about 2 weeks before to ensure that the AST engineer gets familiar with the model and performs all necessary modifications in the model or defines these modifications. Requirements to the model 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 customer specific methodology and workflow
- Application on a customer model
- Comparison of old and new workflow, model changes and results
- Hints and significant information

Goals:

- Detailed know-how transfer about new features and methods
- Customer can perform the specific application by himself

Customer Benefit:

- Knowledge transfer from AVL for new features and method
- Usage of customer models
- Short time for customer to get efficient with new feature and method
- Maximum training effect

Duration:

- Total duration of an enhancement support is **1 to 5 weeks**.
- Entire period is defined as customer and AVL engineer working together. This can be either held at AVL in Graz or on-site at customer.

Price (excl. Tax): * see chapter 2.1

Price for one AST engineer for one week (5 full working days) at customer and preparation phase is:

- Preparation phase: **3000 euro*** see chapter 2.1
- **6000 euro per week**; excl. travel and accommodation* see chapter 2.1

Travel and accommodation for AVL engineer are charged separately.

4.2.3 Consulting

This module describes the possibility to book highly skilled and experienced engineers from AST for defined period of time for on-site work at customers.

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 models or results for the on-site work should be sent to AST in advance, minimum 2 weeks before in order to be well prepared to increase 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 single days, weeks or longer duration.
- The customer also has the possibility to book a contingent of hours or days, which is valid for a period of one year. Within this year the agreed amount of time can be used whenever it is required. Purchase of on-site work has to be given at least 2 weeks before the trip.

Goals:

- AST engineers work in the customer environment in close co-operation with local engineers

Customer Benefit:

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

Duration:

Depending on definition.

Price (excl. Tax): * see chapter 2.1

Total price for one AST engineer for 1 full day at customer is:

- **1200 euro**; excl. travel and accommodation* see chapter 2.1
- **1850 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 specific software tool) such as:

- User defined joints
- Python scripts (i.e. for post-processing)
- User functions
- Macros
- Apps and Workflows using COMPOSE
- MATLAB models, using existing interfaces

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 time period of 6 months after receiving a written approval of the extension from the customer. AST will also guarantee compatibility of the developed feature for subsequent releases, if it is part of the standard AST release.

ID	Service
CC_424	Software Customization

Purpose:

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 usage and implementation of the customized part is included.

Validity:

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.

Content:

- Set-up of customer specific functionality
- Testing of the new functionality using a standard model or a customer model.
- Training on usage and implementation of the new functionality

Goals:

- Customized functionality ready to use
- Know-how transfer on usage, modification and implementation of the functionality

Customer Benefit:

- Implement customer specific solutions
- Independent from release cycle

Duration:

- This depends on the complexity of the requirement. Minimum effort is in the range of 1 week.

Price (excl. Tax): * see chapter 2.1

Total price for one AST engineer for 1 full day is:

- **1200 euro (at AVL AST in Graz)** * see chapter 2.1

Total price of the final training and know-how transfer (1 day) is:

- **1850 euro** (in Europe) ; including travel and accommodation* see chapter 2.1

5. Project Work

In addition to the services described in the previous chapters, we provide services for improvement of the applied methods and for development of new simulation methods in close co-operation 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 as FEM, BEM (for noise radiation) and CFD in the field of automotive and non-automotive industry.

Simulation work is offered for

- Mechanical applications
- Thermo-fluid dynamics in 1D or 3D
- Multi-body dynamics
- System simulation
- Combined applications

And is typically, but not necessarily done using AVL AST software products.

The project can cover the entire simulation including model set-up, 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, guided by continuous documentation and finalized by a report describing all steps, the models used and the results obtained. Typically 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
- Research and development (R&D) projects
- Dedicated projects or joint and research (J&R) projects

Measurements could be performed at AVL or at customer side.

Projects could be performed by AST alone or together with 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. Identification of Material Properties for Simulation Model Input

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

Available for:

- **Surface Measurement** and Contact Data Extraction - EXCITE Micro-slide Analysis (EXCITE Power Unit EHD or EPIL joints)
- **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)

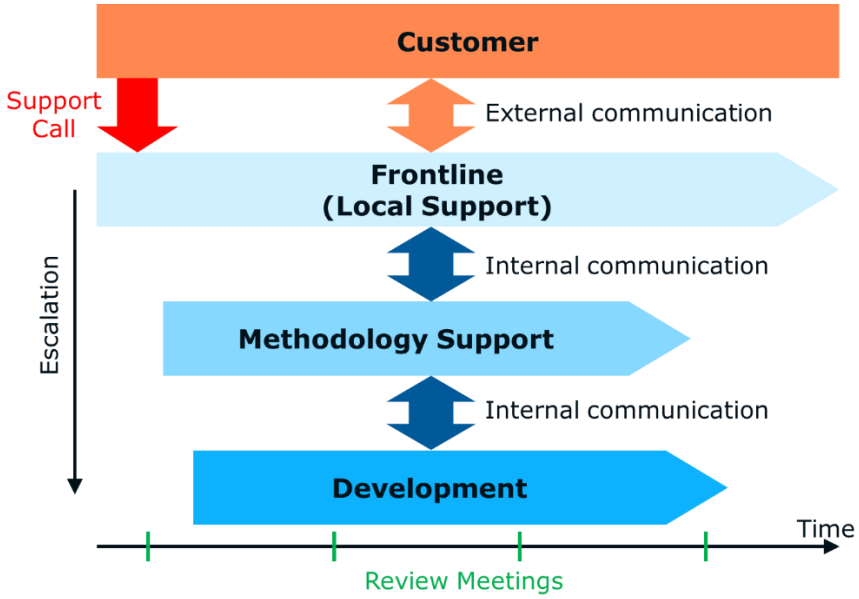
For the price, see standard proposals (ask your sales contact)

7. Appendix

7.1 AST Global Customer Support Process (GCSP)

- GCSP defines the process steps for handling all customer questions and requests related to the usage software products maintanined 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 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

7.1.1 Local Point of Contact

The local support teams at the affiliates collect all customer requests and they are also responsible for the entire communication between customer and AVL support. Information about contacts within our service organization can be found in chapter **3.4** or on the AVL homepage (http://www.avl.com ➔ Customer Services ➔ Simulation Technologies).

7.1.2 Level Concept

The AST GCSP has different levels.

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

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

7.1.3 Escalation Model

The escalation depends on the time scale and 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 involving support masters, local and global support managers, and application responsibles.

Main Target:

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

Training courses 2022 – Graz

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

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Training courses 2022 - Graz

July	August	September	October	November	December
1 F	1 M	1 T Model.CONNECT; FIRE	1 S	1 T National Holiday	1 T CRUISE M Engineering Enhanced
2 S	2 T 31	2 F	2 S	2 W	2 F
3 S	3 W	3 S	3 M Battery Thermal and Hazard Investigation 40	3 T EXCITE Power Unit	3 S
4 M 27	4 T	4 S	4 T Battery Thermal and Hazard Investigation	4 F EXCITE Power Unit	4 S
5 T	5 F	5 M CRUISE 36	5 W Battery Thermal and Hazard Investigation	5 S	5 M PMSM E-Machine Electromagnetics and Thermal Investigation
6 W	6 S	6 T CRUISE	6 T Battery Thermal and Hazard Investigation	6 S	6 T PMSM E-Machine Electromagnetics and Thermal Investigation
7 T	7 S	7 W EXCITE Power Unit	7 F	7 M FIRE 45	7 W PMSM E-Machine Electromagnetics and Thermal
8 F	8 M 32	8 T EXCITE Power Unit; FIRE M	8 S	8 T E-Machine NVH Analysis with Electrical Network; FIRE	8 T National Holiday
9 S	9 T	9 F FIRE M	9 S	9 W E-Machine NVH Analysis with Electrical Network; FIRE	9 F
10 S	10 W	10 S	10 M 41	10 T Model.CONNECT	10 S
11 M	11 T	11 S	11 T	11 F Model.CONNECT	11 S
12 T 28	12 F	12 M VSM 37	12 W EXCITE Piston & Rings	12 S	12 M 50
13 W	11 S	13 T EXCITE Timing Drive; VSM	13 T EXCITE Piston & Rings	13 S	13 T CRUISE M Mobile A/C Basic
14 T	14 S	14 W EXCITE Timing Drive; VSM	14 F	14 M Electric Machine Rotor-Dynamics 46	14 W CRUISE M Mobile A/C Basic
15 F	15 M National Holiday 33	15 T CRUISE M Aftertreatment	15 S	15 T Electric Machine Rotor-Dynamics; Hybrid Electric Vehicle Concept Finding & Layout	15 T
16 S	16 T	16 F CRUISE M Aftertreatment	16 S	16 W Hybrid Electric Vehicle Concept Finding & Layout	16 F
17 S	17 W	17 S	17 M Fuel Cell Electric Vehicle 42	17 T Hybrid Electric Vehicle Concept Finding & Layout	17 S
18 M	18 T	18 S	18 T Fuel Cell Electric Vehicle	18 F	18 S
19 T 29	19 F	19 M 38	19 W Fuel Cell Electric Vehicle	19 S	19 M 51
20 W	20 S	20 T EXCITE Designer	20 T PreonLab	20 S	20 T
21 T	21 S	21 W EXCITE Designer; E-Axle NVH and Durability (AWS	21 F	21 M CRUISE M Engine 47	21 W
22 F	22 M PEM Fuel Cell Module 34	22 T E-Axle NVH and Durability (AWS based)	22 S	22 T CRUISE M Engine	22 T
23 S	23 T CRUISE M Engine; PEM Fuel Cell Module	23 F	23 S	23 W CRUISE M Engine; VSM	23 F
24 S	24 W CRUISE M Engine; PEM Fuel Cell Module	24 S	24 M 43	24 T VSM	24 S National Holiday
25 M	25 T CRUISE M Engine	25 S	25 T	25 F VSM	25 S National Holiday
26 T 30	26 F	26 M Battery and Range Extended Electric Vehicle 39	26 W National Holiday	26 S	26 M National Holiday 52
27 W	27 S	27 T Battery and Range Extended Electric Vehicle	27 T	27 S	27 T
28 T	28 S	28 W Battery and Range Extended Electric Vehicle; FIRE SAMOS	28 F	28 M 48	28 W
29 F	29 M 35	29 T FIRE SAMOS	29 S	29 T FIRE M; CRUISE M Engineering Enhanced	29 T
30 S	30 T FIRE	30 F	30 S	30 W FIRE M; CRUISE M Engineering Enhanced	30 F
31 S	31 W Model.CONNECT; FIRE		31 M 44		31 S National Holiday

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Training courses 2022 – North America

January	February	March	April	May	June	July	August	September	October	November	December
1 S National Holiday	1 T EXCITE PU	1 T EXCITE P&R	1 F	1 S National Holiday	1 W PreonLab	1 F	1 M	1 T	1 S	1 T FIRE	1 T PreonLab
2 S	2 W EXCITE PU	2 W EXCITE P&R	2 S	2 M 18	2 T	2 S	2 T 31	2 F	2 S	2 W FIRE	2 F
3 M 1	3 T	3 T	3 S	3 T EXCITE PU	3 F	3 S	3 W PreonLab	3 S	3 M 40	3 T	3 S
4 T	4 F	4 F	4 M 14	4 W EXCITE PU	4 S	4 M	4 T	4 S	4 T CRUISE M	4 F	4 S
5 W	5 S	5 S	5 T	5 T	5 S	5 T	5 F	5 M	5 W CRUISE M	5 S	5 M 49
6 T National Holiday	6 S	6 S	6 W	6 F	6 M National Holiday 23	6 W	6 S	6 T	6 T CRUISE M	6 S	6 T CRUISE
7 F	7 M 6	7 M 10	7 T	7 S	7 T EXCITE Designer	7 T	7 S	7 W	7 F	7 M 45	7 W CRUISE
8 S	8 T	8 T CRUISE	8 F	8 S	8 W EXCITE Designer	8 F	8 M 32	8 T	8 S	8 T	8 T National Holiday
9 S	9 W PreonLab	9 W CRUISE	9 S	9 M 19	9 T	9 S	9 T	9 F	9 S	9 W	9 F
10 M 2	10 T	10 T	10 S	10 T FIRE	10 F	10 S	10 W	10 S	10 M 41	10 T	10 S
11 T	11 F	11 F	11 M 15	11 W FIRE	11 S	11 M	11 T	11 S	11 T BOOST	11 F	11 S
12 W	12 S	12 S	12 T BOOST	12 T	12 S	12 T BOOST	12 F	12 M 37	12 W BOOST	12 S	12 M 50
13 T	13 S	13 S	13 W BOOST	13 F	13 M 24	13 W BOOST	11 S	13 T EXCITE PU	13 T PreonLab	13 S	13 T CRUISE M
14 F	14 M 7	14 M 11	14 T	14 S	14 T CRUISE	14 T	14 S	14 W EXCITE PU	14 F	14 M 46	14 W CRUISE M
15 S	15 T EXCITE Designe	15 T CRUISE M	15 F	15 S	15 W CRUISE	15 F	15 M National Holiday 33	15 T	15 S	15 T EXCITE PU	15 T CRUISE M
16 S	16 W EXCITE Designe	16 W CRUISE M	16 S	16 M 20	16 T National Holiday	16 S	16 T	16 F	16 S	16 W EXCITE PU	16 F
17 M 3	17 T	17 T CRUISE M	17 S	17 T EXCITE P&R	17 F	17 S	17 W	17 S	17 M 42	17 T	17 S
18 T BOOST	18 F	18 F	18 M National Holiday 16	18 W EXCITE P&R	18 S	18 M	18 T	18 S	18 T EXCITE Designe	18 F	18 S
19 W BOOST	19 S	19 S	19 T EXCITE TD	19 T	19 S	19 T 29	19 F	19 M 38	19 W EXCITE Designe	19 S	19 M 51
20 T	20 S	20 S	20 W EXCITE TD	20 F	20 M 25	20 W	20 S	20 T EXCITE TD	20 T	20 S	20 T
21 T	21 M	21 M	21 T	21 S	21 T CRUISE M	21 T	21 S	21 W EXCITE TD	21 F	21 M 47	21 W
22 S	22 F FIRE	22 Model.Connect	22 F	22 S	22 W CRUISE M	22 F	22 M 34	22 T	22 S	22 T	22 T
23 S	23 W FIRE	23 Model.Connect	23 S	23 M 21	23 T CRUISE M	23 S	23 T FIRE	23 F	23 S	23 W	23 F
24 M 4	24 T	24 T	24 S	24 T	24 F	24 S	24 W FIRE	24 S	24 M 43	24 T	24 S National Holiday
25 T	25 F	25 F	25 M 17	25 W	25 S	25 M	25 T	25 S	25 T EXCITE P&R	25 F	25 S National Holiday
26 W	26 S	26 S	26 T	26 T National Holiday	26 S	26 T 30	26 F	26 M 39	26 W EXCITE P&R	26 S	26 M National Holiday 52
27 T	27 S	27 S	27 W	27 F	27 M 26	27 W	27 S	27 T CRUISE	27 T	27 S	27 T
28 T	28 M 9	28 M 13	28 T	28 S	28 T Model.Connect	28 T	28 S	28 W CRUISE	28 F	28 M 48	28 W
29 S		29 T	29 F	29 S	29 W Model.Connect	29 F	29 M 35	29 T	29 S	29 T	29 T
30 S		30 W PreonLab	30 S	30 M	30 T	30 S	30 T	30 F	30 S	30 W	30 F
31 M 5		31 T		31 T		31 S	31 W		31 M 44		31 S National Holiday

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Training courses 2022 - France

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

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