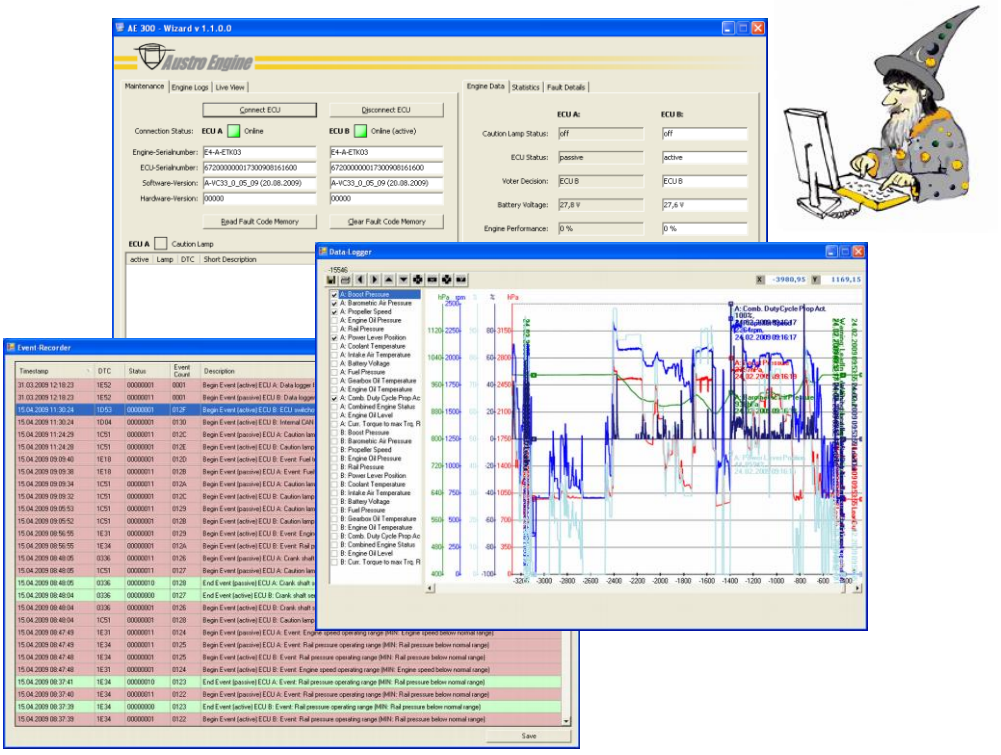
AE300-Wizard
Training Exercises



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Revision History

Change Description	Author of Change	Date	Revi-sion
Initial document	Mannsberger	2010-05-04	00.Draft
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Abbreviations

Item	Definition
AE	**A**ustro **E**ngine
AR	**A**uthorization **R**equest
Atmos.	**Atmos**pheric
bin	**bin**ary
BATT	**Batt**ery
BPA	**B**oost **P**ressure **A**ctuator
CAN	**C**ontroller **A**rea **N**etwork; CAN bus is a message-based protocol, designed specifically for automotive applications.
CR	**C**ommon **R**ail
Cyl.	**Cyl**inder
DatRec	Data Logger
DTC	**D**iagnostic **T**rouble **C**ode
E4	Internal project name (**E**ngine **4**)
ECU	**E**ngine **C**ontrol **U**nit (in this manual used synonymously to EECU)
EECU	**E**lectronic **E**ngine **C**ontrol **U**nit
EECS	**E**lectronic **E**ngine **C**ontrol **S**ystem
Eng.	**Eng**ine
EvRec	**Ev**ent **Rec**ord also **Ev**en**t Rec**order
FCM	**F**ault **C**ode **M**emory
FCT	**F**lash **C**on**t**ainer (a file containing the ECU-SW)
GND	**G**rou**nd**
GUI	**G**raphical **U**ser **I**nterface
HW	**H**ard**w**are
ICM	**I**nter**c**onnection **M**odule
ID	**Id**entification
IE	MS **I**nternet **E**xplorer
IQA	**I**njector **Q**uantity **A**djustment (*german*: IMA Injektor Mengen Abgleich)
ISO	The **I**nternational **S**tandardization **O**rganization known as ISO, is an international standard-setting body composed of representatives from various national standards organizations.
KI	Contact, Terminal
KI15	Switched battery plus through ignition switch ("engine master" switch)
KI30	Battery plus ("electric master" switch)
KI31	Engine ground
KI50	Starter control
KWP2000	**K**ey**w**ord **P**rotocol **2000** (Diagnostic Protocol)
KWPonCAN	**KWP**2000 **on** the **CAN** Bus
MAX	Value above **max**imum allowed value (overflow)

Item	Definition
MIN	Value below **min**imum allowed value (underrun)
MS	**M**icro**s**oft (as in MS Windows, MS Internet Explorer)
.NET	.NET Framework is a software framework developed by Microsoft that runs primarily on Microsoft Windows.
NPL	Value is **n**ot **pl**ausible
OEM	**O**riginal **E**quipment **M**anufacturer
pas.	**Pas**sive
PCAN	**P**EAK-System **CAN** hardware
PCV	**P**ressure **C**ontrol **V**alve
PDF	**P**ortable **D**ocument **F**ormat. PDF is a file format, which enables presentation and exchange of documents independent of the original software, hardware or operating system. Originally developed by Adobe, PDF is now an open standard of ISO.
Press.	**Press**ure
RAM	**R**andom **A**ccess **M**emory
RecMng	**Rec**ord **M**a**n**a**g**er
ROM	**R**ead **O**nly **M**emory
rpm	**r**evolutions **p**er **m**inute (engine or propeller speed)
RS-232	In telecommunications, RS-232 is a standard for serial communication transmission of data.
RTC	**R**eal **T**ime **C**lock
SIG	**Sig**nal disconnected or broken
SW	**S**oft**w**are
Temp.	**Temp**erature
Trq.	**T**o**rq**ue
Ubatt	Battery voltage
USB	**U**niversal **S**erial **B**us
UTC	**U**niversal **T**ime **C**oordinated (Greenwich Mean Time)
Vcc	**V**oltage of the **c**ommon **c**ollector (positive power supply)
XML	e**X**tensible **M**arkup **L**anguage

Table 1 Definitions and Abbreviations

1 Preface

1.1 Subject

The AE300-Wizard is a diagnostic tool required to perform maintenance and serial production tasks on the Austro Engine AE 300 engine (E4) and its electronic engine control system (EECS).

1.2 Objective

The exercises described in this document are designed to develop and exercise troubleshooting techniques for the AE 300 engine using the functionality provided by the AE 300 Wizard.

1.3 Scope

Although it provides hints and recommendations on how to employ the Wizard for maintenance and production tasks it does not replace nor supersede the approved maintenance and build manuals.

1.4 Intended Audience

This document is intended as a learning aid to be used by mechanics and engineers attending AE 300 training classes required as a prerequisite for qualified maintenance organizations.

2 Requirements

A working environment meeting the following requirements has to be provided for students attempting the training exercises defined in this manual.

2.1 Software

2.1.1 Operating System

Tool	bit	SP	Version	Manufacturer	Remark
MS Windows XP	32	2	5.1.2600.2180	Microsoft	
MS Windows XP	32	3	5.1.2600	Microsoft	
MS Windows 7	32/64	1	6.1.7601	Microsoft	Only with service pack 1
MS Windows 10	32/64	-	10.0.10240	Microsoft	

Table 2 Supported Operating Systems

Note: Installation requires (local) administrator privileges. Ongoing Wizard operation does not require administrator privileges.

2.1.2 .NET Environment

The minimum requirement for MS .Net Framework is version 4.0 with Service Pack 2 German or English language version (dotNetFx40_Full_x86_x64.exe). This version is supplied on the AE300-Wizard distribution CD.

2.1.3 Visual C++ Runtime Library

MS VC++ 2010 redistributable runtime library. This library is supplied on the AE300-Wizard distribution CD as part of the AE300-Wizard software.

2.1.4 Driver for USB/CAN Adapter

PEAK System HW driver for the high speed CAN-to-USB adapter. This driver is supplied on the AE300-Wizard distribution CD.

2.1.5 AE300-Wizard

Use at least version 1.3.0.xxx of the AE300-Wizard software.

2.2 Hardware

2.2.1 Computer System

The requirements for the PC HW are:

Characteristic	Minimum	Recommended
PC System	Standard x86 desktop PC or laptop system	
No. of CPU Cores	2	2 or more
Clock Frequency [GHz]	2	at least 2.8
RAM [GByte]	2	at least 4
HD Space (free) [MByte]	100 for a full Wizard installation (including .NET Framework, VC++ redistributable library and HW drivers)	
Additional HD Space [MByte]	~100 (will be a good starting point) for log files and aircraft data	

Table 3 Supported Operating Systems

2.2.2 USB/CAN Adapter

A special USB/CAN adapter (provided with the AE300-Wizard) is required to physically connect to the CAN bus of the EECU. It connects to a USB port (at least USB 2.0) of the PC system on one end and provides a CAN bus male connector on the other. Additionally this adapter also acts as a license dongle to enable the AE300-Wizard in one of two operating modes defined by the license:

- AE-order number "IPEH-002021-M CAN-USB Adapter M" to unlock "Maintenance mode"
- AE-order number "IPEH-002021-QM CAN-USB Adapter QM" to unlock "Qualified maintenance mode"

2.2.3 USB DataMatrix Scanner

A specially programmed DataMatrix scanner is optionally available from Austro Engine to support scanning of IQA codes from injectors (see chapter "**Fehler! Verweisquelle konnte nicht gefunden werden. Fehler! Verweisquelle konnte nicht gefunden werden.**" on page **Fehler! Textmarke nicht definiert.**). This is not a required item, but a recommended one to prevent misreading of IQA codes:

- Part#"TBD" hand held IQA scanner

2.2.4 CAN Extension Cable

It is recommended to use an RS-232 extension cable (female to male connectors) of about 2m (7ft) length for a convenient connection from the USB/CAN adapter of the PC/laptop to the diagnostic plug in the aircraft cockpit.

2.3 Aircraft

2.3.1 Ground Power Supply

For diagnostic sessions to be performed while the engine is NOT running it is important to avoid draining the aircraft battery.

Therefore it is recommended to connect external ground power to the aircraft when performing diagnosis for more than 15 minutes.

Details for the setup of the aircraft are provided in the "AE300-Wizard – User Guide".

3 Installation

Austro Engine provides a distribution CD of the AE300-Wizard for initial installation of the tool, the required runtime libraries and device drivers. This CD also includes the folder "Documentation" which contains the AE300-Wizard User Guide and a Power Point presentation as well as predefined practical exercises for self-study purposes.

For automatic installation simply right-click on "`setup.bat`" and select the menu item "`Run as administrator`" (*German:* "`Als Administrator ausführen`") to execute the sequence of required steps.

3.1 .NET Environment

Attention: Close all applications before installing the .NET environment. Otherwise data loss can result!

The installation of .NET Framework depends on the language environment and the architecture. Install the version of the .NET Framework mentioned in chapter "2.1.2 .NET Environment" on page 10. You can find the supported version on the distribution CD:

`Data\DotNetFX40\dotNetFx40_Full_x86_x64.exe`

Double clicking on the files initiates the installation which will guide the user through the process.

Note: After installation of the .NET environment the PC usually reboots!

3.2 Driver for USB/CAN-Adapter

Before connecting the USB/CAN adapter to the PC/laptop system for the very first time the following HW driver has to be installed:

`Data\PeakOemDrv.exe`

Double clicking on the file initiates the installation which will guide the user through the process:

- Accept license agreement
- Select/accept installation folder
- Select "PCAN-USB Driver"
- Click on "Next" to continue with the installation

After the HW driver installation is complete:

- Connect your USB/CAN adapter to a free USB port on your PC
- The new HW will be recognized by Windows XP and a message box will show up asking you for instructions on how to continue.
- Select automatic installation of PCAN USB driver

3.3 AE300-Wizard and Visual C++ Runtime Library

The AE300-Wizard is provided as an MS-Installer package:

`Data\AE_Wizard.msi`

Double clicking on the file initiates the installation which will guide the user through the process:

- Select a target folder (e.g. "`C:\Programs\Austro Engine\AE300-Wizard`")

After the installation has finished it is also recommended to

- install a shortcut on your desktop pointing to your personal folder (e.g. "`My Documents\Austro Engine\AE300-Wizard`" in standard installations). This allows easy access to stored log files and folders created during diagnostic sessions.

4 Exercise 1 (Engine Log, Offline Analysis)

Extract identification, statistical and failure information from the EECU.

4.1 Identification

Load engine log: `Engine_Log_(Exercise_1).xml`

Answer the following questions:

- Engine serial number? _____
- Software version?_____
- Total engine runtime (in seconds)?_____
- How is the engine run time split between ECU-A and ECU-B?
  _____
- Is there a significant difference between ECU power-on time and engine runtime?
  _____

4.2 Engine Statistics

Load engine log: `Engine_Log_(Exercise_1).xml`

Answer the following questions:

- For ECU-A, what percentage of engine runtime was spent at full power setting (propeller speed around 2300 rpm)? _____
- For ECU-B, at which engine oil temperature range has the engine spent most of its runtime?_____

4.3 Fault Code Memory

Load engine log: `Engine_Log_(Exercise_1).xml`

Answer the following questions:

- What is the diagnostic trouble code (DTC) of the reported common rail problem?____
- How often was the common rail problem logged? _____
- Is the common rail problem currently active?_____
- When was the common rail problem logged the first time?_____
- What was the error type of the first occurrence? _____
- Was the engine running during the first occurrence?_____
- When was the common rail problem logged the last time? _____
- What was the error type of the last occurrence? _____
- Was the engine running (rpm?) during the last occurrence? _____
- Which ECU logged the common rail problem? _____
- Was the common rail problem reported to the pilot (visible in the cockpit)?_____

5 Exercise 2 (Engine Log, Offline Analysis)

Analyze detailed failure information from the Fault Code Memory.

5.1 Boost Pressure Sensor Failure

Load engine log: `Engine_Log_(Exercise_1).xml`

Answer the following questions:

- What is the DTC of the reported boost pressure problem? _____
- How often was the boost pressure problem logged? _____
- Was the boost pressure problem logged on one or both ECUs?_____
- If the problem was logged on both ECUs, was it logged at the same or at different times?_____
- What was the error type logged? _____
- Was the engine running?_____
- Why was the error logged (what kind of check failed)? _____
- What is the component which has most likely failed?_____

5.2 Pressure Control Valve (PCV) Failure

Load engine log: `Engine_Log_(Exercise_2).xml`

Answer the following questions for ECU-A:

- What is the DTC of the reported PCV problem? _____
- When did this failure occur? _____
- Was the failure detected first by ECU-A or ECU-B?_____
- What was the error type of the PCV failure?_____
- What does this error type mean (what values have been checked and have been found to deviate too much)? _____

5.3 Metering Unit (MU) Failure

Load engine log: `Engine_Log_(Exercise_2).xml`

Answer the following questions for ECU-B:

- What is the DTC of the reported MU problem?_____
- When did this failure occur? _____
- What was the error type of the MU failure? _____
- Approximately at what power setting (in terms of "take off", "max continuous", "idle", etc.) was the engine running when the MU problem occurred?_____
- Was the aircraft on the ground or in the air? _____
- Was the common rail problem reported to the pilot (visible in the cockpit)?_____

6 Exercise 3 (Event Recorder, Offline Analysis)

Analyze detailed failure information from downloaded event recorder data.

6.1 Checking Oil Pressure Problems (e.g. Routine Maintenance)

Load event recorder data: `HexDump_EvRec_(Exercise_3).xml`

Answer the following questions:

- At what date was the first (oldest) EventRec entry made?_____
- At what date was the last (newest) EventRec entry made? _____
- During this time frame, did any low oil pressure events occur (***Hint:*** DTC=1E4E)? ___
- If there were oil pressure problems logged,
  when did they occur? _____
  how long did they last?_____

6.2 Checking a Reported Problem at a Specific Date 04.09.2009 11:06:44 (European date/time format) 09/04/2009 11:06:44 am (US date/time format)

Load engine log: `HexDump_EvRec_(Exercise_3).xml`

Answer the following questions for ECU-A:

- What happened at this date?_____
- What is the DTC of the reported problem? _____
- What is the error type of the reported problem? _____
- How long did the problem last?_____
- Was the failure detected by ECU-A or ECU-B? _____
- Which ECU was actively controlling the engine when the failure occurred? _____
- Will the engine continue to run, if this problem occurs?_____
- What could cause this problem? _____
- Which engine component could be replaced pro-actively? _____

7 Exercise 4 (Data Logger, Offline Analysis)

Analyze detailed information from downloaded data logger files.

7.1 Reviewing a Flight Cycle at a Specific Date 30.10.2009 11:24:20 (European date/time format) 10/30/2009 11: 24:20 am (US date/time format)

Load data logger file: `HexDump_DataLog_(Exercise_4).xml`

Answer the following questions:

- At what date/time was the self-test started? _____
- What was the gearbox oil temperature when the self-test started?_____
- When did the take-off run start? _____
- What percentage of power/load was reached during take-off? _____
- Did a propeller over speed occur when full power was applied? _____
- How much time did the take-off run take? _____
- When was take-off power reduced to max continuous power? _____
- What was the maximum engine oil temperature reached during flight? _____
- What was the lowest barometric air pressure (= highest altitude)? _____
- When did the aircraft land (touch down) again?_____
- What was the flight time from take-off to touch down?_____
- Which ECU was controlling the engine during this flight cycle? _____

8 Online Exercises

Online exercises to be performed on the LabCar.

8.1 Save Engine Log

8.2 Read FCM, clear RCM

8.3 Save Event Recorder

8.4 Save Data Logger

8.5 Save IQA-Data

8.6 Replace EECU

8.7 Replace Injector

8.8 LiveView, Predefined Measurement

8.9 LiveView, Import User Defined Measurement

8.10 LiveView, Define and Save Own Test Configuration

8.11 Send Files to AE

9 Appendices

9.1 Error Messages of the AE300-Wizard

List TBD

9.2 Details – Freeze Frame

9.2.1 Combined Engine Status

Bit	Description
0	1 = engine status "afterrun"
1	1 = engine status "start"
2	1 = engine status "normal"
3	1 = rail pressure governing via metering unit
4	1 = squat switch depressed ("weight on wheels") → aircraft on ground
5	Proposed active ECU (0 = ECU A, 1 = ECU B)
6	Voter decision (0 = ECU A, 1 = ECU B)
7	1 = ECU is passive 0 = ECU is active

Table 4 Combined Engine Status

Note:

1) bit 0 is the least significant bit or the right most position of the bit mask
2) If bit 5 and 6 do not agree (e.g. bit 5 = 1, bit 6 = 0) the pilot has overruled the voter and manually selected ECU-A to become active.

9.3 Details – Event Recorder

9.3.1 Event Status

Bit	Description
0	1 = start of event 0 = end of event
1	1 = ECU is passive 0 = ECU is active
2	1 = RAM queue overflow when previous event was appended 0 = RAM queue was OK when previous event was appended
3-7	Not used

Table 5 Event Status

Note: bit 0 is the least significant bit or the right most position of the bit mask