COMPONENTS TESTING

TURBO CHARGER TEST RIG

BRIEF INTRODUCTION INTO THE SYSTEM

CO_2 REDUCTION AND ENERGY EFFICIENCY ARE THE MAJOR TECHNOLOGY DRIVERS IN AUTOMOTIVE INDUSTRY AT THIS STAGE

THE NEED FOR ACCURATE AND EASY TO USE TURBO CHARGER TEST SYSTEMS IS EVIDENT ON THE MARKET. INTUITIVE USE, UPGRADEABILITY AND HIGH PRODUCTIVITY IN DAILY TESTING BUSINESS ARE CRUTIAL

Main Item Description

AVL Turbo Charger testing equipment for TC mapping and thermodynamic characterization purposes.
The turbo charger test rig loads turbo chargers with steady state or slow transient loads on both gas paths. It is suitable for all marketable turbo chargers out of the field of actual and future passenger car engines up to most of the current heavy duty on road engine chargers.

The system mainly will be used for the following investigation and testing programs:

- Fully automated measurements of complete Isentropic compressor and turbine maps
- Manual control and measurement of single operating points
- Bearing behavior comparison under different, specific oil conditions
- Slow transient endurance testing, CoP testing
- Burst containment testing of compressor and turbine housing, over speed testing.[1])[1]

[1] *additional equipment might be required*

System Description

The completely integrated system is divided in 4 logical sections which are denominated as turbine circuit and compressor circuit, media conditioning and electrical equipment.

Automation System:
Puma Open Components combined with the Application package Turbo Charger testing. The operation and control of the test rack is executed by Puma Open.
The test runs will be operated either manually, partly or fully automatic by Puma Open.

Turbine circuit:
The turbo charger turbine side is charged with hot gas. The pressurized air comes from an industrial compressor feeding the the test rig burner, contained within the burner chamber.

Compressor circuit:
The compressor side of the turbo charger is loaded with a throttle valve. Pressure and temperatures and gas flow are precisely measured in this gas path.

Media Conditioning:
The oil and coolant conditioning system control the inlet temperature and the volumetric flow through the charger, oil feed pressure can be controlled alternatively.

Electrical Equipment:
The two integrated electric cabinets contain all required electrical components including the safety system PLC and the measurement I/O.

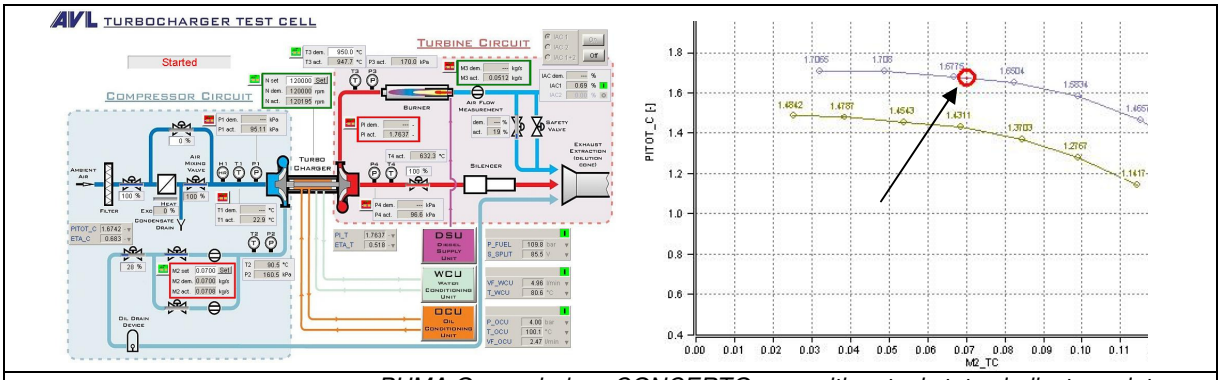
Application Description

The system will be used for the following investigation and testing programs among others:

- Manual and fully automated measurements of complete isentropic turbine and compressors maps including automated compressor surge detection
- Bearing behavior validation with different oil conditions.
- High temperature VTG investigation, high temperature creep testing
- Slow transient massflow and pressure ratio variations, endurance test runs

Start of the test rig

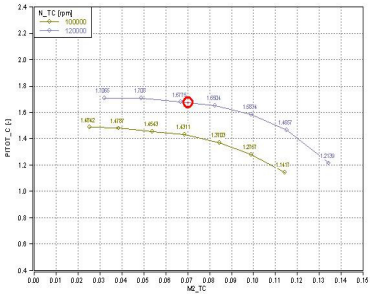
The test rig is started fully automatically by a defined start up routine executed by Puma Open. This ensures the safe start up and warming of the charger without danger of hazards or damages.
The actual operation point of the charger is indicated online in the maps. This helps the operator to have a clear picture of the chargers operating conditions (see example below).



PUMA Open window, CONCERTO map with actual status indicator point

Application group of map measurements:

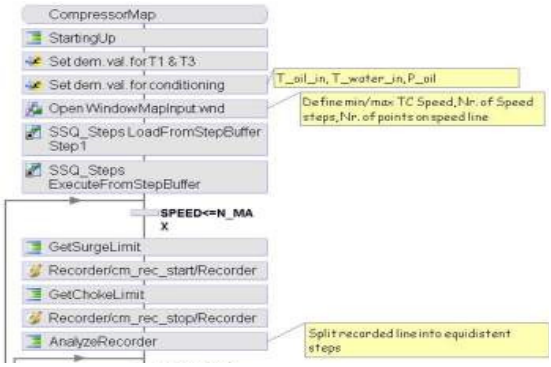
The test rig runs under steady state conditions.
Steady state measurement points will be logged, when stability criteria like band width and gradient limits criteria are reached, preferably at 600 °C turbine inlet and 20 °C compressor inlet temperature the measurements are taken.
Oil pressure, alternatively oil flow and oil temperature are kept constant within tight limits for repeatable results. Coolant the same if the UUT requires this.
The maps to be measured will be predefined automatically after having run a “master-speed line” from surge to the choke limit (predefined efficiency value between 0,2 and 0,3).



The operating points change stepwise, the system targeting every predefined point, stabilizes and takes the measurements, which will be put to the map (see left).
This will be repeated fully automated for every specified speed line, then the turbocharger speed will be increased to the next higher speed line.

Application group of endurance and transient testing:

The test rig runs under steady state or slow transient conditions.



Gas flow, TC speed, turbine or compressor pressure ratios are ramped up and down in cycles.
The test cycles easily can be designed in Puma Open via drag and drop.
(See defined example left, mapping test run).
For some tests the charger temperature needs to change very quickly, which will be realized with additional thermo shock equipment.

Manual Operation:

Manual operation means, that the operator types in all set points or gradients manually on the Puma screen of the test system.
This mode is mainly used to identify interesting operating points upfront of an automated test or for a specific type of “offline” investigation during the automated test, once specific charger behavior has been detected.

Benefits

Main Benefit to Customers

- Affordable fuel facilities due to Diesel burner (CNG compressor is not required)
- Dual Fuel burner enables unlimited testing with all available state of the art burner fuels
- Safe and reliable VTG testing without stuck TC components with diesel burner in use
- Unbeatable Application Know How due to Cooperation with TC experts of Swissauto and in-house know-how of Dr. Schrick in Germany
- Reliable and fully automated test execution by the well established Automation System Puma Open
- Direct interchangeability of testing results to all other Puma Open users, “data hosting” prepared
- Experienced users can give start up support and application background information beyond just equipments delivery
- World wide service and market presence of AVL ensures global support with local experts

Technical Insight

Hot Gas Generator

diesel burner capacity approx.	400	[kW]
turbine min flow [kg/s]	**0,005**	**[kg/s]**
turbine max. flow	0,6	[kg/s]
turbine min. inlet temp	*200*	*[°C]**
turbine max inlet temp	*1100*	*[°C]**
max. rated hot gas path pressure (relative pressure)	*500*	*[kPa]*

Turbine circuit

temperature stability after stabilization time at unit´s exit	± 1	[°C]
pressure operation & control range	100 to 600	[kPa] abs
pressure stability(stationary)	+/- 100	[Pa]

Compressor circuit

pressure operation & control range (abs.)	100 to 600	8kPa]
pressure Stability Compressor circuit (stationary)	± 100	[Pa]
speed control stability	± 200	[rpm]