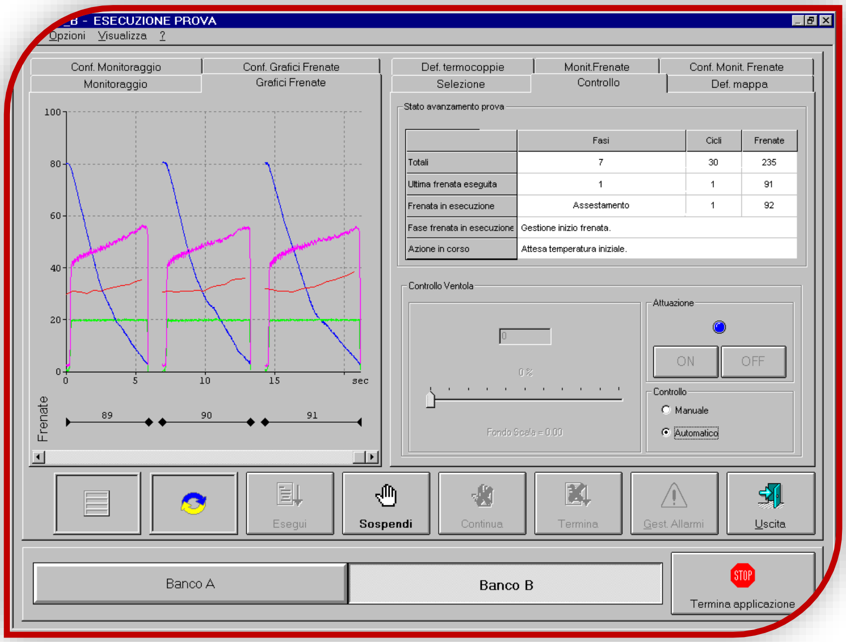
TECSA bench

TECSA INNOVATIVE TEST SOLUTIONS

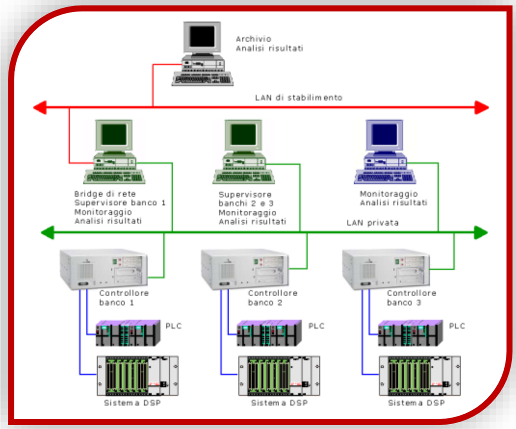


AUTOMATION AND SOFTWARE

ARCHITECTURE OF COMPUTER SYSTEM

The architecture of the computer system which controls the bench is divided into three levels

- ☑ *First level* (optional): centralized management of the data archives and analysis of the results.
- ☑ *Second level*: supervision of the dynamometer benches, monitoring and analysis of the results. The supervision level is composed of one or more PCs linked to a LAN. Each PC supervises one or more benches or carries out monitoring. The PCs allow the operator to manage the activity of the benches. For security reasons, they should be positioned in an area from which the benches are visible. There can be any number of PCs with monitoring duties and they can be located in different offices. In no case do these systems allow for commands to be sent to the PCs which control the benches.



- ☑ *Third level*: control of the dynamometer benches. The control level is composed of several systems linked to the LAN. Every system provides for managing the activity of a single bench and is composed of a PC to which a PLC (to manage the security logics) and a system based on a DSP micro controller (which manages the Real Time activity) are connected.

REAL-TIME SYSTEM

The real-time control system is composed by:

- ☑ National Instruments cRio with CPU real-time;
- ☑ An expansion chassis.

The whole rea-time control (acquisition, filters, PID elaboration and output) is managed at 1 kHz frequency.

The real-time system gives high performance:

- ☑ hardware filter to the analogue input channels, give an average of four consecutive readings for each channel.
- ☑ programmable digital filters on the single analogue channels (decimations, averages, FIR, etc.) with the possibility of creating more channels with different damping levels depending on the type of use: monitoring, time history, control loops.
- ☑ derivations from the counting channels of the following channels (within an input frequency range between 1 Hz and 50 Hz);
  - space (UP/DOWN impulse count and zero signal)
  - speed (first derivative)
  - acceleration/deceleration (second derivative)
- ☑ on line computed channel obtained by putting into relation different physical quantities, as in the case of the "friction coefficient channel", for example;
- ☑ precise detection of the instant of signal transition, of thresholds exceeding, of safety values reaching or alarms triggering, with corrective action or block occurring within one hundredth of a second;
- ☑ digital PID functions, by transformed Z, with the possibility of instant exchange of the control quantity, such as Force/Position for example.

These systems do not have operator interfaces, since this function is carried out by supervisor PCs.

The private LAN which connects the supervisor and/or monitoring PCs and the control PCs may be with optical fibres or with RJ45 (and relative HUBs).

Based on our twenty years' experience in the sector, we have been able to perfect the software in order to carry out all the tests that our customers have suggested. Just to give a few examples, some of the tests that the system can carry out are listed below:

- ☑ AK Master (performance and fade test);
- ☑ AK Noise Matrix (in the case of the Tec-NAS option);
- ☑ SAE J 2521 (in the case of the Tec-NAS option);
- ☑ AMS Fade (Auto Motor Sport Fade Test);
- ☑ VW TL 110 (performance test);
- ☑ ECE-R90.

Types of brakes application

Thanks to the **Real Time RT** control system, braking can be performed:

- ☑ in torque;
- ☑ in pressure;
- ☑ in deceleration;
- ☑ in torque, with a set limit on the maximum value of pressure applied;
- ☑ in torque, pressure and deceleration, with the possibility to change of the control value during the brake application;
- ☑ in torque, pressure and deceleration, with the possibility to apply trigonometric functions to the abovementioned braking modes;
- ☑ with fixed or variable inertia in function of the deceleration for the simulation of the load shifting from back to front.
- ☑ braking with an external hand brake
- ☑ static friction test, hill hold, creep groan and sticking

Thanks to special software functions, included in this present offer, it is possible to perform:

- ☑ Road profile simulation/WLTP. Starting from acquired time histories that have been opportunely modified with creation of CSV files, it is possible to carry out braking that are reproducing road behaviors on the dynamometer bench by execution of speed and brake control profile (M/C stroke, pressure or braking torque). The single braking can be managed by standard description file parameters or by the profiles.
- ☑ **Regenerative/Blending** Braking. Hybrid and electrical vehicles apply the hydraulic brake in combination with the electrical brake. Emergency brake applications (i.e. with high deceleration and/or starting from high speed) are performed only with the hydraulic brake. Usually, the braking is performed with both the brake systems. At the beginning of the brake application, at moderate speed, only the electrical brake is used (wheel motor is used as a generator). As far as the speed decreases, the capacities of the electric brake decrease as well and the hydraulic brake is applied. At the end of the braking, only the hydraulic brake is applied. Vehicle manufacturers shall provide the repartition of the braking (application of electrical brake/application of hydraulic brake) as a family of profiles, according to speed and deceleration. The dynamometer bench reproduces the same conditions of the vehicle. The main motor of the dyno is used to simulate the electrical (regenerative) part of the braking torque and at the same tame the hydraulic torque is applied according to the repartition provided by the profile.

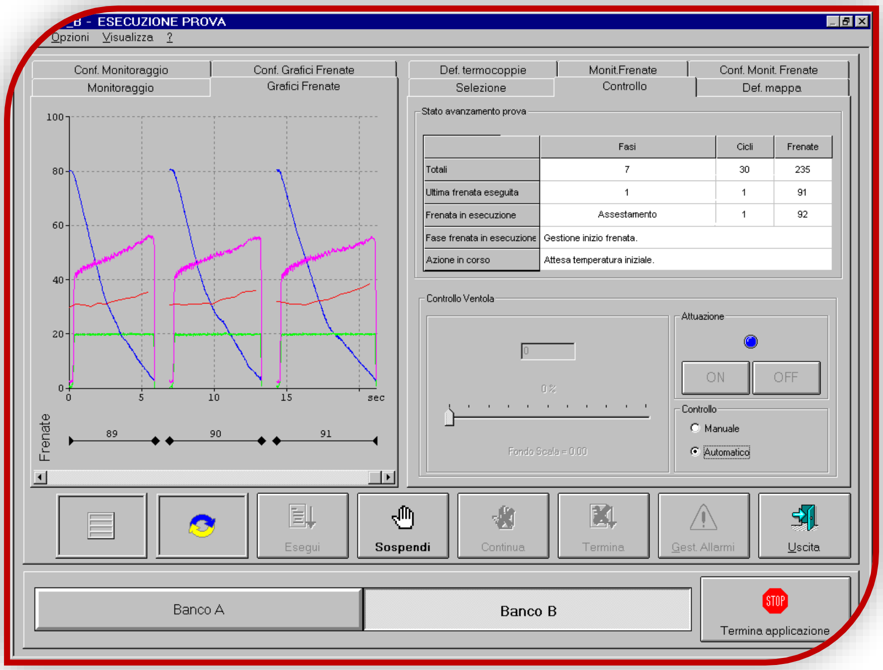
DYNAMOMETER MANAGEMENT SYSTEM

Description of tests

The test brake applications are described individually with the possibility of specifying over 200 parameters for each. The “copy and paste” technique, together with the possibility of specifying repetitions of individual brake applications or of groups of these at several levels, promote particularly simple fast programming.

Running of the tests

Once started, a test is completed by the dynamometer in complete safety, also without surveillance by an operator.



The front-end system of the dynamometer provides the operator with several monitoring environments during the test. These return information on the status of the test both at general level (number of brake applications performed, result of the last brake application performed, phase of the current brake application, etc.), and at detail level (graphic display of the trend of one or more analogue values during the last brake applications performed, monitoring of the logic and analogue I/O channels, etc.).

The system allows the analysis of the brake applications stored with the possibility of full-screen display, of variation in scale and activation or de-activation of the individual curves.

As already mentioned, the dynamometer is able to manage running of a test also in unattended mode. This means that the operator can use the front-end computer of the system for other purposes, such as filing and/or processing of results or description of new tests. In this case, a specific function (Bench Alerter) performed at “service” level by the operating system, continuous to inform the operator of changes in test rig status. These are, for example, alarms, programmed pauses, and completion of the current test.

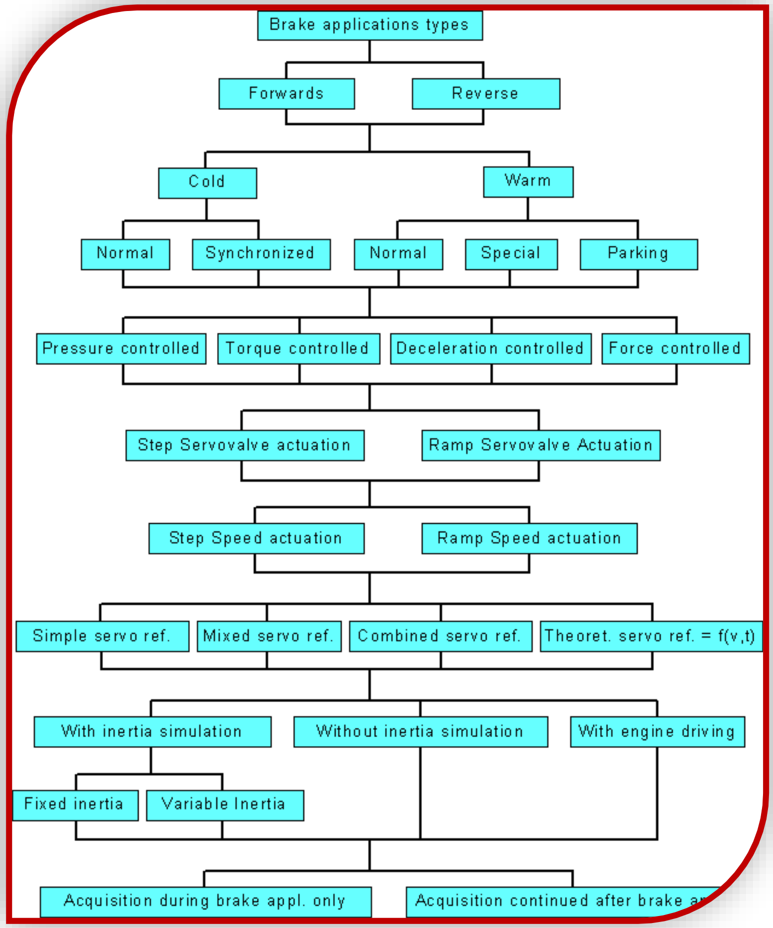
The network connection of the control system permits remote monitoring of test rig activities and transfer of results to centralized databases.

Types of brake applications

Brake applications may differ according to various parameters that can be combined in a vast number of different ways.

A simplified explanatory diagram is provided below. From the top down, combining the various boxes, an overview of possible types of brake applications is obtained.

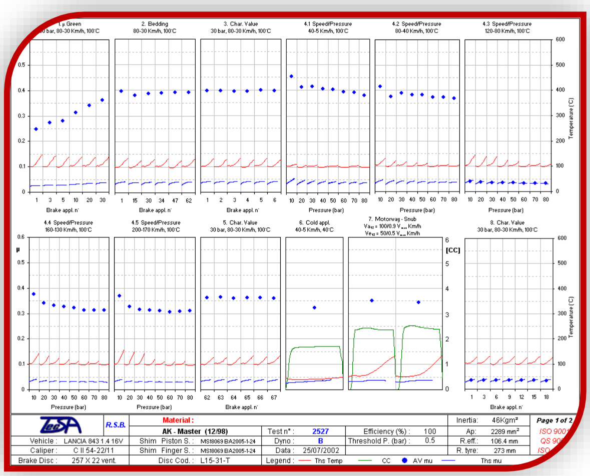
Further then brake application defined in the following diagram, the automation system can manage completely in automatic handbrake control, static friction tests, water sprinkling, simulation of vehicle load transfer.



Results of the tests

The results of the tests are divided into numeric results and Time History data.

Numeric results

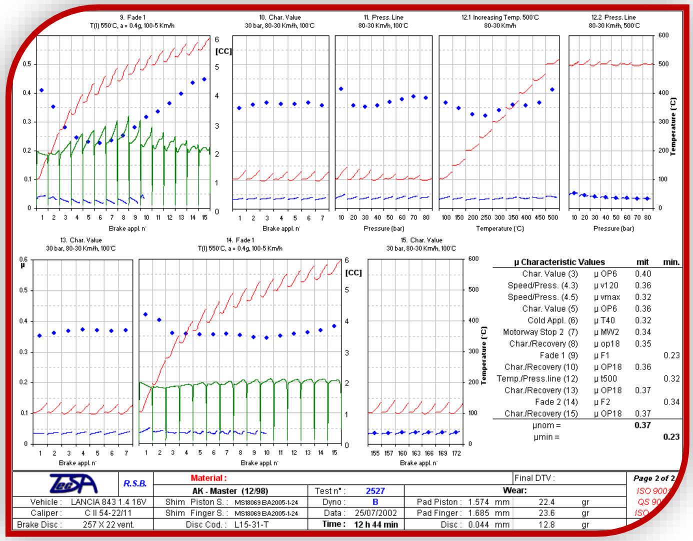


The numeric results, organized in tables in which each line provides the results of a brake application, are typically average, maximum, minimum values of the dimensions acquired, the friction coefficient, etc.

The operator can choose the results required from the vast set available and can specify the type of sorting of the columns.

Calculation formulas applied to the set of predefined results can also be included in the results of a test.

Time History data

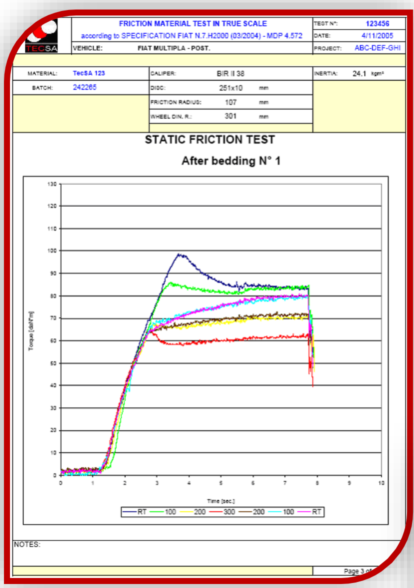


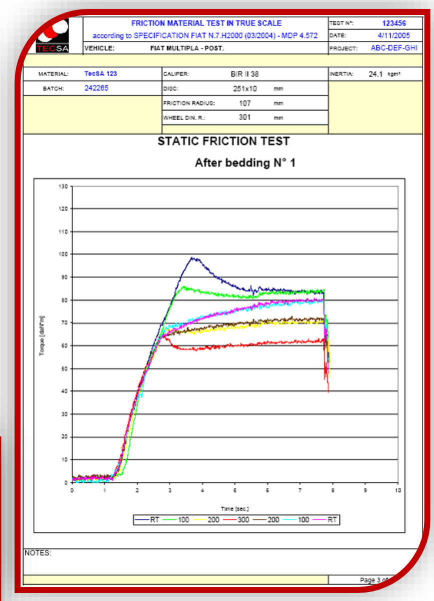
Regardless of the type of monitoring performed by the operator to check the trend of the test, Time History storage of the values acquired for the various channels can be selected during description of this.

For each channel, it is possible to specify the acquisition frequency, application of any filters and the observation period (all or part of the brake application).

Also in the case of Time History data, calculation formulas applicable to the dimensions acquired can also be specified. In this way, processed channels are obtained; a typical example of which is the channel of the instantaneous friction coefficient.

The Time History file is generated in a standard format CSV recognized by all electronic spreadsheets or database managers.





Example of DTV test report