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8 vehicles unsprung masses damping characterisation

Validity: 1 month

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1. Object of the work

- To characterise full vehicle damping characteristics of eight vehicles using IDIADA's MTS 4-post test rig
- To rent a workshop beside the 4 poster rig during the testing process

2. Description of the work

2.1. Vehicles and configurations

The vehicles and its configurations are summarised as follows:

- Vehicle 1 with 4 vehicle configurations which do not imply to remove the vehicle from the rig.
- Vehicle 2 with 4 vehicle configurations which do not imply to remove the vehicle from the rig.
- Vehicle 3 with 3 vehicle configurations which do not imply to remove the vehicle from the rig
- Vehicle 4 with 1 vehicle configuration
- Vehicle 5 with 1 vehicle configuration
- Vehicle 6 with 1 vehicle configuration
- Vehicle 7 with 1 vehicle configuration
- Vehicle 8 with 1 vehicle configuration

2.2. Full vehicle damping characterisation tests

The project consists of analysing the unsprung mass' response to a swept frequency sinusoidal input, using our MTS 320 4-post rig of 8 vehicles (16 configurations in total).

The vehicle will be installed on the test bench with the following sensors:

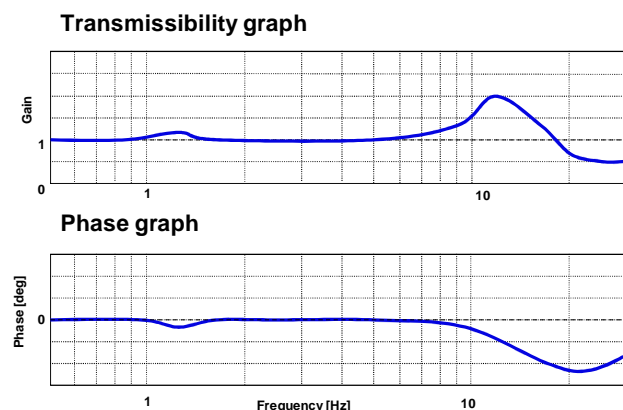
- 4 accelerometers at the wheel centre position
- 4 accelerometers at the 4-post wheel pans

The test mode and outputs will be:

- In-phase left-right sinusoidal input (frequency sweep from **3 Hz to 25 Hz**) for front and rear axle independently and simultaneously.

The output will be:

- Bounce natural frequencies of the front and rear unsprung masses.
- Damping of the front and rear unsprung masses.
- Transmissibility graphs between Unsprung mass vs Platform: Related with wheel road copy

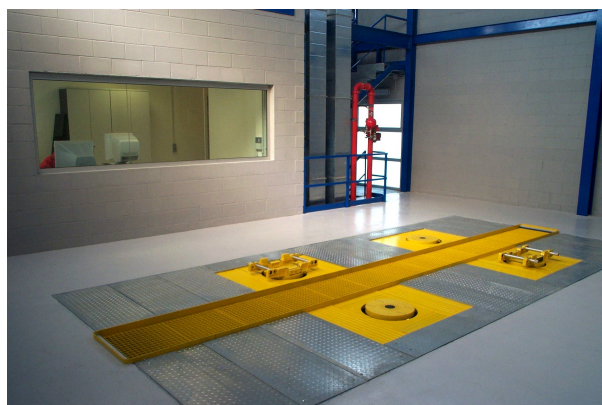


3. 4-Post characteristics

The Four Channel Road Simulator Laboratory MTS® Model 320 (4-post) offers the possibility to study the suspension damping characteristics of a vehicle. The 4-post test rig is able to perform durability and NVH studies

This rig applies precisely controlled displacements up to high frequency values to the vehicle tires through independent platforms.

The resulting wheel movements can be recorded by means of accelerometers, offering natural frequency and damping analysis possibilities for the deep understanding of the vehicle damping performance and being able to perform damper tuning if the dampers can be adjusted.



The main technical characteristics of the 4-post are summarised below:

Item	Characteristics
Max. Force	35 kN
Max. displacement	±125 mm
Max. velocity	4 m/s
Max. acceleration	30g @ 40kg unsprung (500kg sprung)
Seismic mass natural frequency	1.4 Hz
Seismic mass air-spring Damping system	6 units GRB 2480
Wheelbase range	1800 – 3200 mm
Track Width	1200 – 1800 mm
Linear Hydraulic Actuator MTS Model 248.04	Hydrostatic bearings (low friction and high side load capability)
Hydraulic Servovalve MTS Model 256.09	Flow rating at 6.9 MPa drop, 340 lpm, Three stage, four way operation
Differential Pressure Cell MTS Model 660.22	20.7 MPa fatigue rated
Wheelpans	432 mm diameter (Nat. frequency greater than 200 Hz)
FlexTest IICTC Digital Control System	4 Control Channels, 16 Digital Input 16 Digital Output, 12 Analog Input
FlexTest IICTC Software MTS Software 793.00	<ul style="list-style-type: none"> - MultiPurpose TestWare® (MPT), MTS Model 793.10 - Time History Playout and Data Acquisition Software & Hardware for RPCIII playout - Amplitude Phase Control (APC) adaptive control for sinusoidal waveforms - Adaptive Inverse Control (AIC) adaptive control for linear systems

4. Timing schedule

The test vehicle will follow the time schedule below:

Activities	Timing schedule
- Vehicles preparation away from the 4-post rig before and after the testing activities	2 day
- Unsprung masses damping characterisation of 16 vehicle configurations (spread on eight vehicles) with one sinusoidal inputs heave test on 4-post rig	3 day
Total project	5 days (1 shift per day)

Remarks:

- Each configuration change is considered to last 10 minutes and will be carried out on the 4-post rig.
- The vehicle is supplied by the client ready to be tested. No adjustment of the suspension alignment or repairing of the vehicle is included in the timing schedule.
- The final report will be delivered one week after completion of the tests (draft excel results can be delivered just after the test execution).
- Booking of the 4-post rig must be confirmed at least 1 week in advance by e-mail or fax

5. Quotation and payment terms

5.1. Quotation

The prices for the described activities are:

Activities	Price (Euros)
- Vehicles preparation away from the 4-post rig before and after the testing activities	1.430,00
- Unsprung masses damping characterisation of 16 vehicle configurations (spread on eight vehicles) with one sinusoidal inputs heave test on 4-post rig (3 days usage with instrumentation)	8.580,00
- Box rental (5 days usage))	1.470,00
Total project	11.480,00

Remarks:

- The vehicle is supplied by the client ready to be tested. No adjustment of the suspension alignment or repairing of the vehicle is included in the quotation.
- The prices stated in this quotation are net amounts.

5.2. Payment terms

At the end of the project, 30 days from date of invoice.

6. General conditions

The general conditions of sale (please read them carefully) described in the annex will be applied provided that they do not contradict the terms of this quotation.

On behalf of IDIADA AUTOMOTIVE TECHNOLOGY SA:



Joan Puig
Vehicle Dynamics

Annex I. General conditions of sale

1. All service contracts signed with IDIADA AUTOMOTIVE TECHNOLOGY SA shall be governed by their specific provisions and, additionally, by these general conditions, which shall apply in so far as they do not contradict the specific provisions.
2. A client's acceptance of an offer is understood to be a firm order and a contractual commitment between the parties.
3. All taxes due and payable on any payment to IDIADA are the sole responsibility of the client. Thus, any payment received by IDIADA shall correspond to the total net amount stipulated in the corresponding quotation or agreement, after any deduction has been made. If the client is required by its applicable domestic law to withhold any tax on any payment to IDIADA, the client shall assume and settle all such taxes and provide official evidence that such payment has been made. The client shall timely request from IDIADA any documentation reasonably necessary to ensure reduction or exemption of taxes imposed on any payment and shall provide corresponding official evidence of payment of the said taxes.
4. Invoices shall be issued upon termination of the work or following achievement of the stages stipulated in each case. The fact that requirements such as the indication of an order number, acknowledgement of delivery notes, etc., which are the responsibility of the client, have not been fulfilled shall not preclude the right of IDIADA AUTOMOTIVE TECHNOLOGY SA to issue invoices for work contracted and performed.
5. The standard term of payment is 30 days from the date of invoice and, unless otherwise stated, prices are quoted for payment under these terms. Notwithstanding, on the client's request, offers can be issued with other terms of payment. In such cases, the agreed terms shall be expressly stipulated in the service contract.
6. Invoices that are not paid on the due date shall accrue a monthly interest of 1% of their amount until the date of settlement, whenever the non-payment is attributable to the client.
7. Fuel, lubricants, spare parts and other consumables not foreseen in the offer and which are supplied upon the client's request shall be invoiced at market price, plus 12% to cover financial and administration costs.
8. Transport and accommodation costs that are incurred to meet a client's request shall be invoiced at cost price, plus 12% to cover financial and administration costs. Journeys made using company vehicles shall be invoiced at the tariff per kilometre in force. Human resources involved in journeys shall also be invoiced in accordance with the corresponding tariffs. When appropriate, the client shall be duly informed about all these tariffs.
9. All equipment, materials or vehicles belonging to the client must be delivered to IDIADA AUTOMOTIVE TECHNOLOGY SA with transport charges, customs duties and taxes paid and complying with international regulations for the interpretation of trading terms established in the Incoterm *Delivery Duty Paid* (Incoterm DDP), in accordance with the definitions of the standard rules of trade published by the International Chamber of Commerce. If, as a result of the non-fulfilment of this condition, IDIADA AUTOMOTIVE TECHNOLOGY SA incurs expenses which were not foreseen in the offer, these shall be invoiced at their cost price, plus 12% to cover financial and administration costs.
10. Any modifications to the scope of the contracted services, performance time, prices, payment terms or other conditions agreed upon shall be stipulated in an appendix to the contract and signed by persons authorised to represent both parties.
11. Should the client wish to terminate a signed service contract unilaterally, the client shall pay for services rendered until the date of termination and also any demonstrable additional expenses that IDIADA AUTOMOTIVE TECHNOLOGY SA has incurred as a result of the client's order.
12. Vehicles and other test samples deposited in IDIADA AUTOMOTIVE TECHNOLOGY SA's premises shall be subject to the standard measures of confidentiality in force, about which the client shall be duly informed upon request. If the client wishes additional confidentiality measures to be taken, notice must be given in advance, in which case the measures agreed upon shall be expressly stipulated in the service contract.
13. Individuals who have to enter IDIADA AUTOMOTIVE TECHNOLOGY SA's premises must have previously signed the document in force concerning the commitment to secrecy, and must obey the rules of confidentiality stipulated in the said document.

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14. IDIADA AUTOMOTIVE TECHNOLOGY SA's own emergency services will attend injured test-track users in the event of an accident. These services consist of a qualified nurse, an ambulance and first-aid equipment, plus a person trained in fire extinction, equipped with a fire engine; these services shall attend the injured until outside help arrives. Should the client require additional emergency measures, notice must be given in advance, in which case the measures agreed upon shall be expressly stipulated in the service contract.
15. Any property left in IDIADA AUTOMOTIVE TECHNOLOGY SA shall be the responsibility of the client, unless otherwise specified in the special conditions stated in each contract. If this clause is inapplicable, IDIADA AUTOMOTIVE TECHNOLOGY SA shall respond up to the limit of the general insurance cover contracted, this being three-hundred thousand euros. If the client wishes special cover to be contracted, notice must be given in advance, in which case the agreed terms shall be expressly stipulated in the service contract.
16. The client shall notify IDIADA AUTOMOTIVE TECHNOLOGY SA in advance of the value of property that forms part of a test or that remains in IDIADA AUTOMOTIVE TECHNOLOGY SA's custody for whatever reason, whenever the value of the property exceeds three-hundred thousand euros or when, although the value is lower than this amount, it is higher than would be apparent at first sight owing to hidden values. In such cases, the value of the property must be specified in the service contract and may involve an increase in service prices, owing to the higher risk. If this is not the case, IDIADA AUTOMOTIVE TECHNOLOGY SA's liability for damages to property left in its custody is doubly limited: on the one hand, to the apparent value of the property at first sight and, on the other hand, to the maximum of three-hundred thousand euros. The limit of the evident value of the property at first sight shall in particular apply to prototype vehicles, whose value shall be considered as the same as that of equivalent conventional vehicles that can be found on the market. Notwithstanding, property that is to be tested in a destructive manner (such as vehicles for crash tests) is not liable to compensation for damages owing to incorrect execution of tests when the test is carried out following the obligatory rules for its performance, or those agreed with the client for each test. In these cases, the client expressly renounces any right to claim compensation for property damaged or destroyed by mistake during the tests.
17. The client is responsible for the professional qualifications of the technicians, drivers, operators, etc. that are sent to carry out tests at IDIADA AUTOMOTIVE TECHNOLOGY SA and that these workers are duly insured and up to date on their Social Security payments. However, IDIADA AUTOMOTIVE TECHNOLOGY SA shall be responsible for these requirements when it provides these workers.
18. The driving of vehicles on the test tracks is subject to the traffic regulations in force at the time; the updated version of the document that details these regulations shall be given to all people who have to drive on the test tracks, and acknowledgement of receipt shall be required.
19. Reports issued to the client are for the client's own use and are not to be disseminated. If the information they contain is to be included in articles, publicity, reports etc., the prior express authorisation of IDIADA AUTOMOTIVE TECHNOLOGY SA shall be required if it can be identified as the originator of the aforementioned information.
20. It is the responsibility of the client that samples, plans, technical documentation, patents, models or any documentation brought to IDIADA AUTOMOTIVE TECHNOLOGY SA for the realisation of the tests, experiments or studies are his property or in his possession as legal title holder, according to the legality in force.
21. All disagreements arising in connection with the present contract shall be finally settled under the Rules of Conciliation and Arbitration of the International Chamber of Commerce by one or more arbitrators appointed in accordance with the said Rules.
22. Should cases of disagreement arise for which arbitration is not legally applicable, the parties shall submit themselves to the jurisdiction of the Courts of El Vendrell (Tarragona, Spain) and shall renounce the jurisdiction that may have applied to them.

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Annex II. Acceptance of the quotation

To accept this quotation please return this form duly signed and completed.

Order number:

Tax no.: .

On behalf of: VEHICLE TESTING EQUIPMENT, S.L.

(signature, company stamp and date)
