Servohydraulic Testing Machines for Dynamic Testing
UFIB Series

Capacity: 10 - 250 kN or more
Dynamic Testing Machines

**UFIB series**

Universal Servo hydraulic Dynamic Testing Machines, UFIB series.

Designed for the configuration and performing of static and dynamic tests on a wide range of materials (specimens, subassemblies or finished parts) by incorporating the appropriate tools for each application.

**Typical applications**

- Dynamic tests on all type of materials
- Fatigue tests on finished parts or subassemblies.
- Lifespan tests on elastic elements and lift.
- Tests on springs and set of dampers.
- Pre-cracking tests for mechanics fracture.

**Testing frame**

With high structural stiffness, 2 columns, a mobile crosshead and a lower steel plate, which function as a base and closure of the testing frame.

The baseplate is perforated to allow the hydraulic piston movement.

The upper mobile crosshead is steel manufactured, precision machining, which allows a linear movement along the columns with adequate thickness to guarantee the specified rigidity value.

Furthermore the crosshead can be positioned to the desired height: raised or lowered by the simultaneous action of two synchronized lateral hydraulic actuators. The position of the crosshead is adjustable via a screen of movements in WinTest32 testing software or via the remote control.

Load cell is mounted under the upper crosshead, specially designed for fatigue testing with a nominal capacity equal to the testing frame capacity. Over the load cell in series, is the assembly which allows the interchangeability of testing devices using clamping bolts.

These testing devices can be gripping heads, compression plates, bending device, etc.

The lower steel plate is mounted over a metallic frame composed by UPN steel profiles.

The double effect hydraulic servo cylinder and double piston rod with symmetric chambers is mounted under the plate.

The entire testing frame is resting over the metallic frame which contains the hydraulic piston and sleeves of lateral lifting jacks, making it possible to work at a comfortable height.

The testing frame has been designed to have less than 1 mm deformation when the machine operates at maximum load.

The mechanical design of testing frame is made with finite elements analysis using the design ANSYS software to determine, in addition to the analysis that guarantee the specified rigidity, those important parameters for the correct operation of the machine without resonance under dynamic conditions.
Hydraulic systems for the application of dynamic loads.

To apply the load on the specimen a set of servo cylinder, servo valve and hydraulic group is used, as detailed below.

**Servo cylinder**

The servo cylinders are mounted below the bottom plate of the testing frame, using a standard fastening flange. The piston sleeve crosses through the plate (front flange).

The servo cylinders for dynamic applications have the following main specifications:

- Double effect and dual rod with symmetric chambers to ensure an accurate dynamic response when operating at high frequencies.
- High rigidity design, with grounded and chromed piston and rods.
- Joints, slides and bearings with low friction and minimum wear. According to the application, the cylinder can be equipped with polymer, hydrostatic (pressurized oil joint) or semi-hydrostatic joints.

The servo cylinders for dynamic applications can also include accumulators (high and low pressure), if necessary, to ensure accurate dynamic response when working at high frequencies.

**Servo valve.**

The servo valve is the element which regulates the piston movement, adjusting the hydraulic flow (input-output) in the servocylinder chambers.

The selection of the appropriate servo valve depends on the flow to adjust, which can be calculated according to:

- Work pressure of the hydraulic group
- Speed of the piston
- Amplitude of movement

The servo valve must be selected with a rated flow higher than the estimated value.

The servo valves for dynamic applications have the following main specifications.

- High response pilot signal.
- Flow controlled by a high speed spool.
- The spool is moved by a permanent magnet motor. This type of motor acts on the spool with a force 2 times greater than a conventional solenoid.
- Integrated electronics, with emergency failsafe positioning: in case of voltage drop or emergency stop, the main spool will move to its central position with a default and safe flow condition.
Hydraulic systems

Their function is to provide pressure and hydraulic flow required for the movement of the actuators. The electric drive motor pump generates pressure in the hydraulic system and flow is regulated by a servo valve or a high performance servo distributor. The oil flow in the circuit is restricted through the manifold and the servovalve, increasing oil temperature. In order to maintain an ideal temperature of oil and to avoid problems of low viscosity or lamination, the group must have an adequate cooling system. The most common systems are heat exchangers water-oil or air-oil. The temperature is monitored by a thermostat which activates the system if necessary. It is also necessary to use clean oil free of water and particles. To achieve this, the circuit incorporates oil filters with interchangeable cartridge for necessary replacements. Other common elements are the pressure switches, inlet flow regulators, pressure accumulators, return pumps, monitoring elements, etc.
Determination of dynamic performance

The performances of the hydraulic group are always calculated according to the needs and indications of the customer. For static and quasi-static tests, the use of high pressure motor pump units with slightly elevated constant flow is enough (up to 10 l/min).

However, for dynamic tests the group requires higher flow rates.

To assess approximately, the hydraulic flow required for a dynamic solicitation with a determined frequency and amplitude, the following relation can be used:

\[ Q \text{ (l/min)} = 3.7 \cdot 10^{-2} \cdot a_0 \cdot A \]

Where
- \( a_0 \) = amplitude (mm)
- \( A \) = piston active cross section area (cm²)

**Note:**
The formula is an approximation to the real needs, since it does not take into account factors such as oil compressibility of oil, the pressure drop in the pipes or the servo valve, the beneficial effect of hydraulic accumulators, etc.

For a more realistic calculation, graphics as the figure below are usually used, in which the necessary flow is extrapolated according to the test frequency and amplitude of the motion. These graphs are made for each particular type of actuator.

**Example:** Calculation of the flow required for a double effect actuator of ± 100 kN nominal load
- \( a_0 \): Amplitude: ± 2 mm
- \( f \): Frequency of solicitation: 20 Hz
- \( a_0 \cdot f \): Piston speed: 40 mm/second
- \( Q \): Flow required: 74 litres/minute
LOAD TRANSDUCER: Load cells for dynamic applications

High performance load cells for the measurement of tensile and compression static and dynamic loads:

› Universal application: for tension and compression, suitable for static and dynamic tests.

› Low profile robust measuring body: strictly symmetrical design with multi-shear network technology.

› Individual compensation of bending moment: thanks to a special electrical adjustment procedure, the interference of parasitic loads is minimized, even in the double bridge version.

› Load cell with measuring system based on full bridge strain gauges.

› High resistance to fatigue tests, even with extreme oscillation amplitudes of up to 200 %.

› Manufactured in materials highly resistant to corrosion.

› Connection and coupling flanges highly resistant to corrosion, with the possibility of integrated cable for difficult environments (climate chambers).

Example: Load cell ±250 kN

<table>
<thead>
<tr>
<th>HBM U10M</th>
<th>250 kN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominal force</td>
<td>( F_{\text{nom}} )</td>
</tr>
<tr>
<td>Rated characteristic value</td>
<td>( C_{\text{nom}} )</td>
</tr>
<tr>
<td>Accuracy class</td>
<td>0.05</td>
</tr>
<tr>
<td>Relative repeatability without modification of position</td>
<td>( b_p )</td>
</tr>
<tr>
<td>Zero signal relative error</td>
<td>( d_0 )</td>
</tr>
<tr>
<td>Linearity relative error</td>
<td>( d_l )</td>
</tr>
<tr>
<td>Temperature effect on characteristic value / 10 K</td>
<td>( T_{K_C} )</td>
</tr>
<tr>
<td>Effect of temperature on the zero signal / 10 K</td>
<td>( T_{K_0} )</td>
</tr>
<tr>
<td>Influence of bending moment (at 10% · ( F_{\text{nom}} ) · 10 mm)</td>
<td>( d_Q )</td>
</tr>
<tr>
<td>Reference temperature</td>
<td>( T_{\text{ref}} )</td>
</tr>
<tr>
<td>Nominal temperature range</td>
<td>( B_{T_{\text{nom}}} )</td>
</tr>
<tr>
<td>Operating temperature range</td>
<td>( B_{T_{\text{G}}} )</td>
</tr>
<tr>
<td>Maximum operating force</td>
<td>( (F_p) )</td>
</tr>
<tr>
<td>Breaking force</td>
<td>( (F_b) )</td>
</tr>
<tr>
<td>Lateral force limit (relative to the center of the cell)</td>
<td>( (F_Q) )</td>
</tr>
<tr>
<td>Limit bending moment</td>
<td>( M_{p_{\text{perm}}} )</td>
</tr>
<tr>
<td>Torque limit</td>
<td>( M_\tau )</td>
</tr>
<tr>
<td>Nominal displacement</td>
<td>( S_{\text{nom}} )</td>
</tr>
<tr>
<td>Fundamental resonance frequency</td>
<td>( f_\omega )</td>
</tr>
<tr>
<td>Rigidity</td>
<td>( F/S )</td>
</tr>
<tr>
<td>Relative permissible oscillatory stress (oscillation amplitude DIN 50100)</td>
<td>( F_{\text{rb}} )</td>
</tr>
<tr>
<td>Weight (without cable)</td>
<td>60</td>
</tr>
<tr>
<td>· With adapter</td>
<td>kg</td>
</tr>
<tr>
<td>· Without adapter</td>
<td>28</td>
</tr>
</tbody>
</table>
DISPLACEMENT TRANSDUCER

Magnetostrictive, digital transducer.

Located inside the dynamic servo cylinder, it is aimed to control at any moment the piston position enabling to obtain the set parameter when the machine works with “displacement” servo control.

- Maximum stroke: 200 mm (+ 100 mm)
- Resolution: 0,001 mm.
- Linearity: + 0,05% full scale.
- Repeatability: + 0,01% full scale.
- Hysteresis: < 0,07 mm.
- Operating temperature: from -10° C to +70° C.
- Estimated lifespan: More than 4 million hours.
- Communication protocol: SSI (digital)

DEFORMATION TRANSDUCERS (Extensometers)

They allow for the measurement of deformation of the specimen while it is under dynamic solicitation.

For dynamic tests, the most usual types of extensometers are as follows:

A: Axial, clip-on, extensometer.

The extensometer can be clipped on the specimen by means of a system of adjustable springs.

Appropriate for performing tensile and compression dynamic tests, with or without zero crossing.

Its excellent design and strength ensure a high level of reliability and long lifespan.

B: Measurement of crack propagation, clip-on type, for fracture mechanics.

Used for the measurement of crack propagation in fracture mechanics of metallic materials, on metallic materials with CT (Compact Tension) type or SEB (three point bending) specimens.

Used to perform tests with constant strain speed (crack opening: CMOD), to determine the tenacity of composite materials such as, for example, fiber reinforced concrete
**MD5 Electronic system for control and data acquisition**

System fully automatic and independent from the computer used for dynamic testing with test frequencies up to 50 Hz.

This high performance modular system MD5, enables closed loop control of IBERTEST hydraulic machines (with servo valve) or electromechanical (with servomotor), performing static, dynamic or fatigue tests.

The unit manages the acquisition and synchronization of data from each of the transducers (force, stroke, deformation channels, etc.) as well as the interpretation and correction of the control signal according to the specified set point (closed loop servo control).

The control can be done by closing the loop against any channel (force, stroke or deformation control).

The MD5 electronic unit can operate in standalone mode or in remote mode (connected to a computer).

To work in standalone mode, the front side of the unit has an LCD screen to display the different menus of parameter setting, a "Digi-poti" digital control to browse the menu and alphanumeric keyboard to enter data.

These elements are embedded in the UCRD-7 remote control therefore, in case of purchase, the MD5 control unit would be delivered without these elements (blind front).

In the remote mode, the control unit is connected to a computer via USB or Ethernet, using application software for configuration, presentation and process of test results. In this case the MD5 unit is also supplied with blind front.

The user can then operate in standalone mode even if the computer does not work, recording the basic parameters of the test in the MD5 unit (force and stroke max and min values, number of cycles, etc.), without waiting to repair the computer or application software.

The MD5 control unit includes advanced technology using digital feedback via a 32-bit DSP, able to control the system in real-time at 5 KHz data acquisition and control frequency (simultaneous channel), which enables to follow highly accurately the control function imposed by the operator to carry out the tests.

The use of an appropriate digital signal processing enables total control, thus obtaining characteristics of highly effective work which are the best technical solution to ensure obtaining reliable, comparable and reproducible results.

The system has the possibility of PID adjustment in high and low pressure modes. The system automatically adjusts the PID according to the working pressure, chosen depending on the type of test (low or high dynamic range).
Specifications of MD5 control system

› Digital output for servo valve command through an internal amplifier with rated current up to 300 mA.
› Adjustable “dither” signal
› It supports incremental type position measurement (SSI digital protocol).
› It has eight slots to connect data acquisition cards, which amplify and condition the transducer signal, allowing reading load cells, encoders, extensometers, etc.
› The data acquisition cards vary according to the type of transducers (strain gauges, potentiometers, magneto restrictive, LVDT, digital incremental, digital SSI, etc.).
› System for recognition and automatic adjustment of the transducers connected in each channel by means of "sensor-plug" connectors with EEPROM memory chip, which store the calibration and linearization data of the transducer. This enables to connect alternatively same type transducers on the same channel. The system recognizes the connected transducer and adjusts automatically the reading channel depending on the characteristics of the transducer (measure unit, zero, maximum, minimum, linearization, etc.)
› Sampling frequency: up to 5 kHz (5000 readings per second) in each channel
› Resolution in measurement (conversion A/D) per channel
    › ± 180,000 points with an integration time of 20 ms
    › ± 2,250,000 points with an integration time of 250 ms (resolution > 21 bits).
› All channels are synchronous and simultaneous
› Control close loop time: 0.2 ms (the control loop closes 5000 times per second)
› Connexions to PC: USB 2.0 or Ethernet 10/100
› Up to 8 (slots) for data acquisition of transducers

The MD5 unit is delivered with the standard following configuration:

› Slot 1: Card for reading of the load transducer (load cell)
› Slot 2: Card for reading of the position transducer (SSI displacement transducer)
› Slot 3: For data acquisition cards of strain gauge transducers
› Slots 4 to 8 free, for the future possible installation of other transducers data acquisition cards
IBERTEST uses the following criteria:

› Positive force: tensile load
› Negative force: compression load.

EXAMPLES OF APPLICATIONS IN UFIB MACHINES:

Tensile tests
› For these tests gripping heads are used, with lateral clamping jaws and mechanical fastening, pneumatic and hydraulic, or wedge clamping jaws with hydraulic clamping.
› Typically testing are performed on fastening elements such as bolts and screws, weldings, elastomers, adhesives, rebars, etc.

Compression tests
› Compression plates are used for these tests. If the compression plates are jointed, the joint must be locked in a position in order to prevent that the specimen can leave the plate during the movement.
› Typically tested elements are dampers, elastomers, rubber-metal elements, silent-blocks, etc.
› If the purpose of the test is to verify the behavior of springs, the compression plates must have a restraint system.

Bending tests.
› Bending tests consist in the application of force by one or two loading points while the specimen is resting on two supports.
› Fracture mechanics tests on metals and fiber reinforced concrete, and tests for welding homologation are typical applications.
## General specifications for testing frames UFIB-50 - 100 - 200 - 250

<table>
<thead>
<tr>
<th>MODEL</th>
<th>UFIB-50</th>
<th>UFIB-100</th>
<th>UFIB-200</th>
<th>UFIB-250</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum load tensile-compression</td>
<td>± 50 kN</td>
<td>± 100 kN</td>
<td>± 200 kN</td>
<td>± 250 kN</td>
</tr>
<tr>
<td>Load measurement</td>
<td>Strain gauge load cell, with capacity for dynamic tests.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Measuring calibrated range</td>
<td>1 % to 100 % of the load cell nominal capacity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Precision: class according to ISO 7500</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
<td>0,5</td>
</tr>
<tr>
<td>Resolución en fuerza</td>
<td>5 digits with floating coma</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Columns</td>
<td>2 chromed plated and grounded columns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mobile Crosshead</td>
<td>Can be freely positioned in height by means of side jacks. Guided by columns. With hydraulic stop.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free horizontal distance (distance between columns)</td>
<td>420 mm</td>
<td>420 mm</td>
<td>520 mm</td>
<td>520 mm</td>
</tr>
<tr>
<td>Free vertical distance without devices (distance between clamping points)</td>
<td>0-1000 mm</td>
<td>0-1000 mm</td>
<td>0-1200 mm</td>
<td>0-1200 mm</td>
</tr>
<tr>
<td>Measurement of piston position.</td>
<td>Magnetostrictive displacement transducer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Displacement resolution, shown in software WinTest32</td>
<td>5 digits (3 integers and 2 decimals)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piston stroke</td>
<td>± 100 mm (total 200 mm)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Power supply</td>
<td>Three-phase 380 V + N + T, 50/60 Hz (Power to define according to hydraulic group)¹</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimensions: testing frame (mm)</td>
<td>Width x Depth x Height: 1000 x 900 x 2375</td>
<td>1000 x 900 x 2375</td>
<td>1250 x 900 x 2800</td>
<td>1250 x 900 x 2800</td>
</tr>
<tr>
<td>Approx. weight without testing devices</td>
<td>1400 kg</td>
<td>1400 kg</td>
<td>1800 kg</td>
<td>1800 kg</td>
</tr>
</tbody>
</table>

**NOTES:**

1. The characteristics of the hydraulic group are specific according to the application and the requirements of each customer.
2. IBERTEST can design and manufacture testing frames with higher dimensions, according to your testing requirements.

Please contact our sales department.

S.A.E. IBERTEST reserves the right to modify the present technical information without prior notice