

# 1 Technical Specification IM10T-20

## 1-1 System

Drop height	Range 50mm to 2000mm Resolution 1mm Accuracy $\pm 2$ mm
Drop mass	Range 8kg to 30kg (excludes strikers & adapters) Increments 1.0kg Accuracy $\pm 0.5\%$ Wide range of standard and custom interchangeable strikers
Mass arrest	By pair of self compensating shock absorbers
Mass arrest SIPS option	Secondary specimen impacts prevented by second impact prevention system Rebounding impact mass detected by laser photo-switch and arrested using pneumatically activated buffers
Velocity range	1.0m/s to 6.26m/s
Velocity range HV option	1.0m/s to 20m/s
High Velocity option	Impact carriage accelerated using elastomer cord Impact velocity predicted by measuring tension in cord and integrating with respect to winch displacement to calculate stored energy Velocity repeatability better than 2%
Energy range	4.0J to 588 J
Energy range HV option	4.0J to 2000 J
Base	Free standing on isolation mounts T-slotted M12, with datum location Width 1420mm, Depth 760mm, Thickness 100mm
Tower assembly	Manufactured from 3mm walled box section steel Enclosed by panels with electro-mechanical interlocked front access door
Specimen area	Versatile specimen support chamber with internal dimensions Width 1200mm, Depth 700mm, Height 650mm
Access	Impact resistance polycarbonate doors front and rear with electro-mechanical interlocks
Drop parameter control	Height or velocity or energy, controlled by software
Gross Weight	2200kg approximately
Overall dimensions	Width 1420mm, Depth 760mm, Height 4500mm
Control systems	Servo controller (winch) Imatek C3008 (machine interface) ImpAcqt V3 control software (on PC for impact test sequencing)

Winch	<p>AC brushless servo motor fitted with brake, driving simplex chain via precision gearbox.</p> <p>Resolver attached to motor provides position feedback.</p> <p>Dual circuit mechanical limit switches to detect</p> <ul style="list-style-type: none"><li>(a) top of travel (fixed position)</li><li>(b) winch chain gone slack (any position)</li></ul> <p>Secondary over-run limit switches provide back-up.</p>
Release	<p>Release of mass by rotation of hook on bottom of catcher.</p> <p>Activation of both release cylinder and interlock cylinder required for release.</p> <p>Anti-recoil brakes minimise mechanical shock for high velocity testing</p>
Safety	<p>Safety is compliant with the European CE machinery safety directive (89/392/EEC &amp; 91/368/EEC - machinery safety EN60204-1:1992).</p> <p>Access to specimen area protected by solenoid-locked doors when the catcher or impact mass are in an unsafe position.</p> <p>Winch drive and release mechanism electrically isolated when access doors are open.</p> <p>Emergency stop function electrically isolates winch drive and release.</p> <p>All safety systems dual circuit and fail-safe.</p> <p>No unsafe release of the impact mass possible under any of the following conditions:</p> <ul style="list-style-type: none"><li>(a) failure of mains power supply</li><li>(b) failure of compressed air supply</li><li>(c) failure of control software</li></ul>
Instrumentation – Force	<p>Impact force measured by Kistler force link, mounted immediately behind striker</p> <p>Dynamic rated capacity: <math>\pm 60\text{kN}</math>.</p> <p>Linearity: <math>&lt;0.5\%</math> of rated output.</p> <p>Hysteresis: <math>&lt;0.5\%</math> of rated output.</p> <p>Operating temperature range: <math>-20^{\circ}\text{C}</math> to <math>+120^{\circ}\text{C}</math>.</p> <p>Safe overload: <math>\pm 150\%</math>.</p>
Signal conditioning – Force	<p>By matched charge amplifier</p> <p>Bandwidth: DC – 50KHz, <math>-3\text{dB}</math></p> <p>Range: <math>\pm 100</math> to <math>999,000\text{pC}</math></p> <p>Output voltage: <math>\pm 10\text{V}</math></p> <p>Linearity: <math>&lt;\pm 0.1\%</math></p> <p>Accuracy: <math>\pm 0.5\%</math></p> <p>Auto-zero function: automatic zero of force signal output applied as part of test cycle</p>
Data acquisition – Force	<p>Sample rate: 3,000,000 samples per second.</p> <p>Resolution: 16 bits</p> <p>Data points captured per impact: 32,000</p>



	<p>Calibrated accuracy: <math>\pm 0.1\%</math>  Timebase accuracy: <math>\pm 0.01\%</math>  Triggering: from force signal, laser/photodiode detector or external trigger</p>
Data acquisition – Auxiliary	Three additional channels with the same specification, simultaneously sampled
Instrumentation – Velocity	<p>Impact velocity measured immediately prior to impact  Method: time of flight of target through laser/photo-diode detector  Timing resolution: 25ns  Target dimensions accuracy <math>&lt; 0.1\%</math>  Overall accuracy: <math>\pm 0.1\%</math></p>
Performance	<p>Overall accuracy of force measurement: <math>\pm 0.75\%</math>  Overall accuracy of absorbed energy: <math>\pm 1.5\%</math></p>
Supplies	<p>Electricity: 230VAC <math>\pm 10\%</math>, 16Amp, 50/60Hz <math>\pm 1\%</math>, 1-phase, Neutral and Protective Earth.  Air: 0.7Mpa to 0.8Mpa clean non-lubricated air</p>
Emissions	<p>Noise: site dependent  Vibration: site dependent  Dust: none  Radiation: none</p>
Operating environment	<p>Temperature: <math>+5\text{C}</math> to <math>+30\text{C}</math>  Humidity: 0% to 90% non-condensing  Electrical immunity: to EN 50 082  All main electrical control systems rated at, or housed in enclosures, with protection category IP65 (to EN 60 529/10.91)</p>

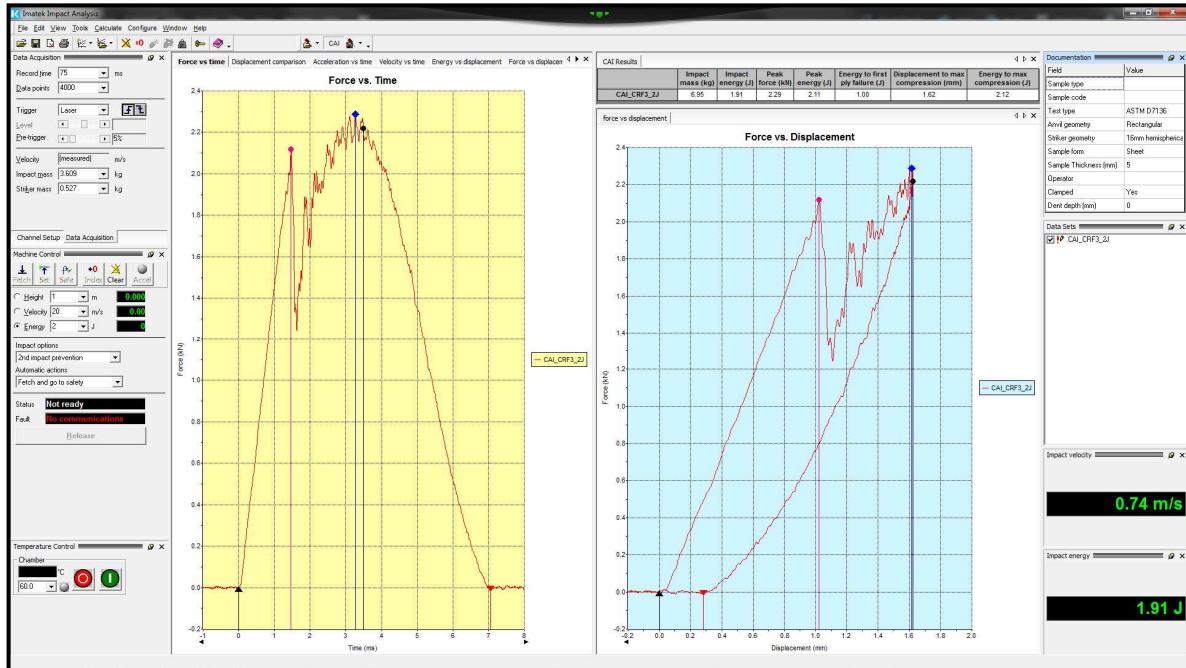
## 1-2 Software specification

Platform	PC running Microsoft Windows OS
Environment	Compatible with MS Office (supports export in native Excel format files, and Windows MetaFiles for graphics)
Purpose	Control of impact testing sequence and analysis of impact data
Access control	<p>Three, password protected levels:</p> <ul style="list-style-type: none"> <li>(a) limited access, to perform pre-defined impact tests</li> <li>(b) supervisor access, to control the type of test performed and the required documentation information etc</li> <li>(c) engineering access, for sensitive configuration and calibration functions</li> </ul> <p>Access is controlled by passwords. The user ID forms part of the test information that has to be entered</p>
Data security	<p>All calibration and configuration information is held as data files on the hard drive of the control PC</p> <p>Password protection of the configuration mechanism provides protection from accidental or malicious modification</p> <p>Standard operating system features provide integrity checking (CRC checksum)</p>

Test information

As standard, the Impact software allows for configuration of what information is stored with each test

### 1-3 Graphical user interface



The GUI provides both control of the impact test (drop parameters and data acquisition parameters) and analysis of the resulting data.

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|--------------|---|
| Control      | Impact parameter (height, velocity or energy)<br>Data acquisition parameters (sample rate, sweep length)<br>Impact sequence   |
| Indication   | Machine status<br>Current impact mass position (height, velocity, energy)   |
| Data capture | Force vs time<br>Initial impact velocity  |
| Calculations | Acceleration<br>Velocity<br>Displacement<br>Energy<br>User-defined curves<br>User-defined numerical results   |
| Units        | Fully configurable units for any requirements<br>Default units: SI, cgs and US  |
| Markers      | Configurable system of markers to identify specific points on curve, including: <ul style="list-style-type: none"> <li>▪ start of impact</li> <li>▪ yield load</li> <li>▪ maximum load</li> <li>▪ initiation of crack propagation</li> <li>▪ end of crack propagation/test</li> </ul> |



Data presentation	<p>Graphs of any standard calculated or measured quantity against any other, including user-defined curves.          Appearance of graphs very flexible          Tables of numerical results and documentation information          Hard copy of graphs and tables          User-definable report layout</p>
Other features	<p>Test results database          Automatic save of test results          Three configurable levels of user access          User-configurable documentation fields          Frequency analysis of captured data (FFT) and very flexible filtering (Butterworth, Bessel and FFT filter types)          Configuration back-up restore mechanism for securing apparatus configuration and calibration information          Configurable screen layout          Export of test data to Microsoft Excel, Windows Metafile and "comma separated value" (.CSV) file.</p>

## 1-4 Standard options

Standard Anvil	General purpose variable height anvil stack
Low Variable Mass	<p>Range 2kg to 8kg          Increments 0.5kg          Accuracy <math>\pm 0.5\%</math>          Energy range 1J to 117J</p>
High Variable Mass	<p>Range 50kg to 100kg          Increments 5.0kg          Accuracy <math>\pm 0.5\%</math>          Energy range 25J to 1468J</p>
Extended T-slots	Additional base T-slot sections for larger specimen support
Force transducer	Options with dynamic rated capacity from $\pm 2\text{kN}$ up to $\pm 120\text{kN}$
Plaque Test set	<p>Includes striker, anvil and clamping system          Complies with EN ISO6603-2 or ASTM D3763</p>
Flexible Film Test	Complies with EN ISO 7763 or ASTM D7192 & D1709
CAI fixture	<p>Compression After Impact testing, for example to requirements of ASTM7136 &amp; ASTM 7137          Striker and support fixture as defined by standard</p>
Charpy	<p>Charpy testing of standard polymer and metallic specimens.          Complies with geometries of EN ISO179, ASTM E23.</p>
Izod	<p>Izod testing of standard polymer and metallic specimens.          Complies with geometries of EN ISO180, ASTM E23.</p>
Energy absorption	Energy absorption testing for aluminium honeycombs, and polymeric foams to EN ISO4651 and ASTM D4168
Cushioning performance	
Cylinder Crush Test	Analysis of flow stress properties of metallic specimens. Strain rates up to $1500\text{s}^{-1}$

High Rate Tensile	Polymer and metallic specimens. Strain rates up to 1500 <sup>s-1</sup>
Dynamic Displacement	Specimen deformation measured directly during impact.
Temperature Conditioning	Removable temperature chamber for pre-conditioning of specimens. Surrounds specimen anvil area. Slides to rear of impact chamber when not required Range -70°C to 200°C. Internal dimensions Width 400mm, Depth 400mm, Height 400mm
Additional DAQ Channels	Additional DAQ channels, up to 16 in total, with synchronous sampling at 5ms/s
Integrated High Speed Video	Visual recording of impact event. Full control using systems software. Captured images linked to graph markers. Measurements can be taken direct from images.
Motion analysis	Automatic 2-D tracking of unlimited number of points Automatic 1-D tracking of edges Extraction of velocity, angular and displacement data Lens calibration Data export in Excel, DIAdem, Matlab