1 DWT40-100 Technical Information

1·1 System

Drop height	Range 1300mm to 4200mm Resolution 1mm Accuracy ± 2mm
Drop mass	Fixed 2500kg Accuracy ± 1.0%
Mass guidance	By pair of 80mm diameter hard chromed guide bars Induction hardened and fixed at regular intervals over entire length
Velocity range	5.0m/s to 9.0m/s
Energy range	31,250J to 101,250J
Mass arrest	By six self-compensating hydraulic shock absorbers with piston return monitor, operation inhibited in the event of non-return
Striker	Radius of curvature 25.4mm ±0.1mm Centreline with respect to centre of anvil supports: 0mm ±1.0mm Complies with API 5L3, ASTM E436, EN 10274 Material of contact parts – H13 (BS-3BH13)
Anvil	Radius of curvature 15.0mm ±0.1mm Span 254.0mm ±1.0mm Complies with API 5L3, ASTM 436, EN 10274 Material of contact parts – H13 (BS-3BH13)
Specimen size	Width 76.0mm ±3.0mm Length 305mm±50.0mm Thickness 6mm to 50mm Weight up to 12Kg Notch depth 5.1mm±0.51mm. Notch angle 45°±2° Notch radius 0mm to 0.05mm Planarity ≤5mm Can accommodate specimens prepared according to standards API 5L3, ASTM 436, EN 10274
Overall dimensions	2975mm width, 2700mm depth, 8150mm height
Weight	9000kg approximately
Foundation (recommended)	Piling as required by underlying soil to suit static load of 10 metric tons, dynamic load of 150 metric tons Deep trench foundations filled with low-Q concrete Concrete topped by Imatek-supplied interface plate, levelled to 0.5 mm over 1000mm
Base	1520mm x 1200mm x 300mm solid cast steel Hole in base underneath specimen area allows retrieval of specimens (presented to front of machine)

Tower assembly	Manufactured from thick-walled box section steel Part enclosed by squared mesh panels secured to framework
Control systems	Control for specimen autoloader Intelligent servo controller (winch) Imatek C3008 machine interface (proprietary) ImpAcqt V3 control software (on PC, impact test sequencing)
Winch	AC brushless servo motor fitted with brake, driving 2-plex chain via precision gearbox. Resolver attached to motor provides position feedback. Dual circuit mechanical limit switches to detect (a) top of travel (fixed position) (b) winch chain gone slack (any position) Secondary over-run limit switches provide back-up.
Specimen loading	By pneumatically operated pick and place system Load cycle time < 10s Placement of specimen within ± 0.5mm (X & Y axes)
Release	Release of mass by rotation of hook on bottom of catcher. Activation of both release cylinder and interlock cylinder required for release.
Safety	Safety is compliant with the European CE machinery safety directive (89/392/EEC & 91/368/EEC – machinery safety). Access to specimen area protected by solenoid-locked doors when the catcher or impact mass are in an unsafe position. Winch drive and release mechanism electrically isolated when access doors are open. Emergency stop function electrically isolates winch drive and release. All safety systems dual circuit and fail-safe. No unsafe release of the impact mass possible under any of the following conditions: (a) failure of mains power supply (b) failure of compressed air supply (c) failure of control software
Instrumentation-force	Impact force measured by force load cell, mounted immediately behind hammer. Dynamic rated capacity: ±1500kN. Non-Linearity: <0.05% of rated output. Repeatability: <0.05% of rated output. Hysteresis: <0.05% of rated output. Zero balance: <1.0% of rated output (zero offset compensation by amplifier) Operating temperature range: -20°C to +80°C. Safe overload: ±125%.

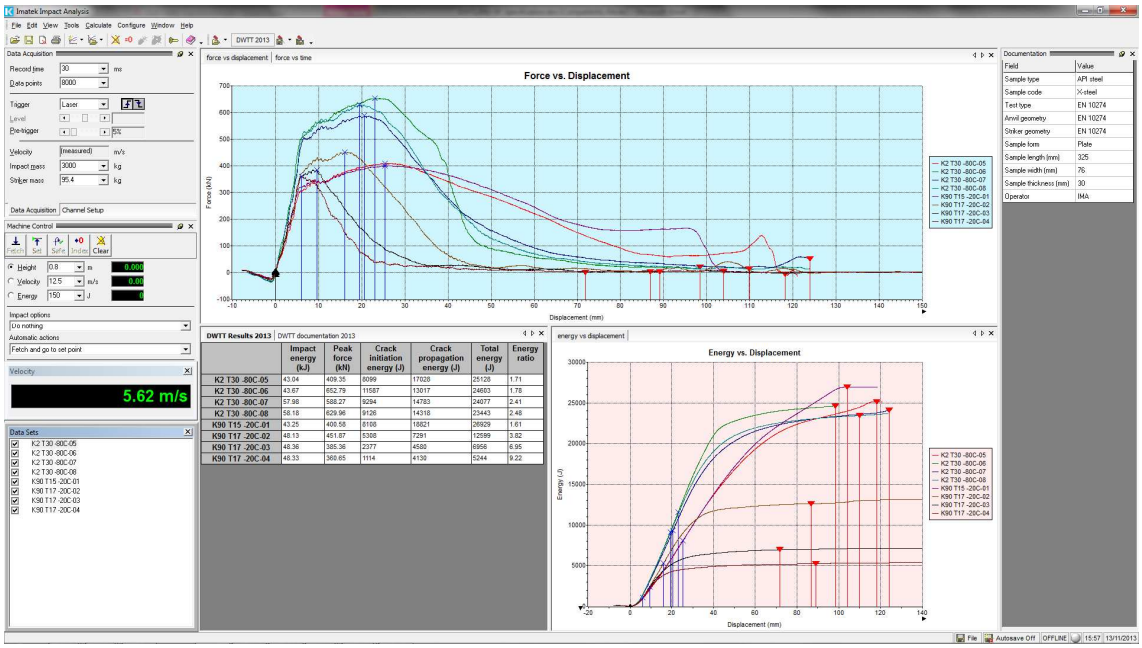
Signal conditioning	By strain-gauge amplifier Bandwidth: DC - 50KHz, –3dB. Sensitivity: 100mV Linearity: <0.02% Accuracy: ±0.5% Stability: 0.02% - 12 months Auto-zero function: automatic zero of load cell output applied as part of test cycle
Data acquisition	Sample rate: 3,000,000 samples per second. Resolution: 16 bits Data points captured per impact: 32,000 Calibrated accuracy: ±0.1% Timebase accuracy: ±0.01% Triggering: from force signal, laser/photodiode detector or external trigger
Data acquisition auxiliary channels	Three additional channels with the same specification, simultaneously sampled
Velocity measurement	Impact velocity measured immediately prior to impact Method: time of flight of target through laser/photo-diode detector Timing resolution: 25ns Target dimensions accuracy <0.1% Overall accuracy: ±0.1%
Performance	Overall accuracy of force measurement: ±0.75% Overall accuracy of absorbed energy: ±1.5% Cycle time (specimen to specimen): < 2 min Cycle time (specimen leaving cooling bath to impact): <= 10sec Specimen placement accuracy (notch relative to hammer centreline): ±1.0mm Specimen placement accuracy (notch relative to anvil midpoint): ±1.0mm Duty cycle: 30 tests/hour
Maintenance	Replacement of contact parts dependent on specimen type: Anvil bars every 2,000 to 4,000 tests Striker bar: every 4,000 to 8,000 tests Replacement of clamp contact parts every 5,000 tests Initial periodic service of shock absorber at 10,000 cycles (exchanged with spare set provided)
Supplies	Electricity: 230VAC ±10%, 32Amp, 50/60Hz ±1%, three-phase, Neutral and Protective Earth Active usage: 7.5KVA Standby usage: 1KVA Air: 0.6Mpa to 0.8Mpa clean air

Operating environment	Temperature: +5C to +30ºC. 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). The system is designed for operation in dusty environments.

1·2 Software

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	Three, password protected levels: (a) limited access, to perform pre-defined impact tests (b) supervisor access, to control the type of test performed and the required documentation information etc (c) engineering access, for sensitive configuration and calibration functions Access is controlled by passwords. The user ID forms part of the test information that has to be entered
Data security	All calibration and configuration information is held as data files on the hard drive of the control PC. Password protection of the configuration mechanism provides protection from accidental or malicious modification. Standard operating system features provide integrity checking (CRC checksum).

1·3 Graphical user interface



The GUI runs under Microsoft Windows. It provides both control of the system, the cooling baths, the impact test (drop parameters and data acquisition parameters), the analysis of the resulting data and the recovery of the fractured specimen pieces.

Control	Temperature conditioning bath Impact parameter (height, velocity or energy) Data acquisition parameters (sample rate, sweep length) Impact sequence
Indication	Machine status Temperature conditioning bath actual Current impact mass position (height, velocity, energy)
Data capture	Force vs time Initial impact velocity
Calculations	Acceleration Velocity Displacement Energy User-defined curves User-defined numerical results Crack initiation energy Crack propagation energy Total energy Energy ratio % Shear (uses operator entered values)
Units	Fully configurable units for any requirements Default units: SI, cgs and US
Markers	Configurable system of markers to identify specific points on curve, including: start of impact yield load maximum load initiation of crack propagation end of crack propagation
Data presentation	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
Other features	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 powerful digital filtering (multiple notch 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” file.

2 Functional Specification

2·1 Operator functions

Winch pendant	Manual winch control: up, down. Multi-stage speed control
Machine panel	Laser trigger position set Specimen door unlock Access door unlock Emergency stop
Software – impact control	Set release height Set release velocity Set release energy Arm release system Set action after impact (none, fetch, fetch & go to release height)
Software – data acquisition	Set acquisition time Set acquisition resolution Set trigger source Set trigger level Set pre-trigger length
Software – temperature	Set soak temperature Set ramp speed Set ramp time Set soak time
Specimen loading	• The operator starts the release sequence via the software. • The operator opens the specimen door. • The operator takes a specimen from the cooling bath and places it on the alignment table. • The operator closes the specimen door. • The rest of the sequence is automatic: the autoloader picks the specimen up, places it on the anvil, the clamp is applied and the autoloader returns to the home position. The drop mass is then released and the broken pieces of the specimen recovered

2·2 Specimen auto-extraction and sorting (option)

Function	Conveyor system recovers specimen after fracture Selects as ‘pass’ or ‘fail’ based on operator entered parameters ‘Pass’ specimens transferred to scrap bin for re-cycling ‘Fail’ specimens transferred to secondary holding conveyor for investigation, holds up to 10 specimens
Construction	Stainless steel and stoved enamel panel work
Safety	Drive motor with overload trip, requires manual re-set

2·3 System limits

The apparatus is designed to operate with specimen sizes specified above.

Specimens with dimensions outside these limits are not testable.

The apparatus is designed for a maximum force of 1500KN. There is 25% over-capacity in the load cell and supporting structures. Forces above 1875KN will cause damage.

The apparatus is designed for impact energies between 31,250 J and 101,250J. It has sufficient capacity to arrest the falling mass when the impact energy is 101,250J even if the specimen absorbs no energy.

The system is designed for a minimum cycle time of 2 minutes. Cycle times less than 2 minutes might result in over heating of the shock absorbers, and consequently to increased wear or damage to the shock absorbers and apparatus.