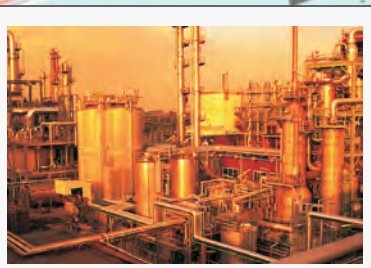
BenchMark
Control Valve Diagnostics

Your Independent and Complete Control Valve Diagnostics Solution



BenchMark
Control Valve Diagnostics™

Independent

BenchMark Tests Air-Operated Control Valves From ALL Manufacturers

Air-Operated Control Valve Problems

For years, the process, power, petroleum and paper industries have recognized the potential value of effective preventative and predictive maintenance programs. Very significant time and cost savings can be realized if control valve problems are detected and corrected early. And yet, recent published studies by control valve manufacturers conclude that as many as ***60+ percent of installed air-operated control valves have serious performance problems****.*

Blindly pulling and overhauling control valves not only costs you time and money, but may actually make the situation worse.

Critical valve accessories, often causing or contributing to the performance problem, don't always accompany the valve to the repair shop. The repair vendor generally receives no specific information on the valve's deficiencies and therefore, is limited to a generalized rebuilding process which may not correct the original problem. To compound matters further, the problems associated with removal, re-installation and setup may actually cause more problems than are solved.

Accepting control valves without incoming performance testing is risky and expensive.

Implement an effective incoming control valve performance testing program to keep deficient control valves from entering your plant / mill and delaying your outages, reducing productivity, damaging quality and costing you money.

BenchMark attaches simply and quickly to the control valve.

Shown with Protective Doors Open and Accessories Partially Removed for Illustration.

The standard test system platform is an ultra-rugged, industrial grade, portable computer featuring the latest computer technology.

BenchMark
Control Valve Diagnostics™

Features . . .

- **Tests ALL Manufacturers' AOVs**
- **Test Analog, HART and Digital Control Valves**
- **Integrated Digital Valve Tagging (BD MIT)**
- **Pass / Fail Performance Standards**
- **Automatic Multi-page PDF Reports**
- **Complete Data Management**
- **Easy to Learn, Easy to Use**
- **Latest Transducer / Computer Technology**
- **Readily Accessible Data Tables**
- **Minimal Clerical Work**
- **Easily Interpreted Test Results**
- **Field Portable, Battery Powered**
- **WindowsXP$_{tm,}$ Windows 7, Whatever's Next**
- **Ultra Rugged NEMA Rated Computer**
- **Multiple Computer Platforms Available**

and Complete Solution

Powerful Tools Support
BenchMark Control Valve Diagnostics™

BenchMark Data MGR™

Place the valve record, performance standards and test record management tools of the world's most advanced Control Valve Diagnostics System on your ***desktop!*** *This powerful engineering tool takes the same practical "no nonsense" approach to the review, trending, graph overlay and engineering evaluation of valve diagnostics data. Automatically produce multi-page pdf (portable document format) reports and distribute them directly from your desk.*

BenchMark Link MGR™

The unit turn-around is concern enough. Why worry about managing and archiving the test data produced by all of the test systems working on the outage? This powerful data handling tool automatically manages the upload of all test data (archive) or just the latest tests from any test system to the plant network (intranet) or internet site of your choice. Makes the management of multiple test systems or multiple service vendors a snap.

<bd mit/>

"Metal valve tags are an obsolete way of storing valve configuration information"

Digital Valve Tags

Imagine walking up to any valve in your facility and within seconds view a detailed configuration, inspection and maintenance history. All at the cost of little more than a typical industrial vinyl tag?

BenchMark *Control Valve Diagnostics™ interfaces seamlessly with* ***Black Diamond MIT™*** *digital equipment tags and provides a full set of tools for creating, reading, editing and updating the stainless steel, hermetically sealed tags.*

Simply connect to the valve tag and ***BenchMark*** *will automatically locate the valve and/or load the configuration information needed to test the valve. This completely eliminates any clerical data entry work and minimizes the potential of errors.*

Up to 32 kb of information is stored on the tag and is not dependent on an expensive, hard to get deployed plant-wide information system. This means you can deploy this system right away and start saving time and money. The XML data format is easily exchanged with other computer applications.

For more information, please visit our Black Diamond Maintenance Information Tool website, ***www.bdmit.com***

These software tools are offered in addition to BenchMark Control Valve Diagnostics system and are not required for basic system operation. End-users seeking engineering tools to assist in organizing and evaluating test data for maintenance trends will find them particularly useful. Windows XP or Windows 7 operating systems. Multiple seat discounts and site licensing options are available by quotation; please contact us for more details.

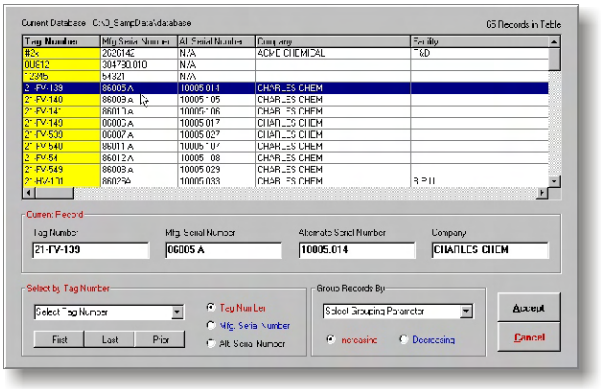
benchmarkvalvediagnostics.com

Black Diamond Engineering™

1- (800) 847- 5088

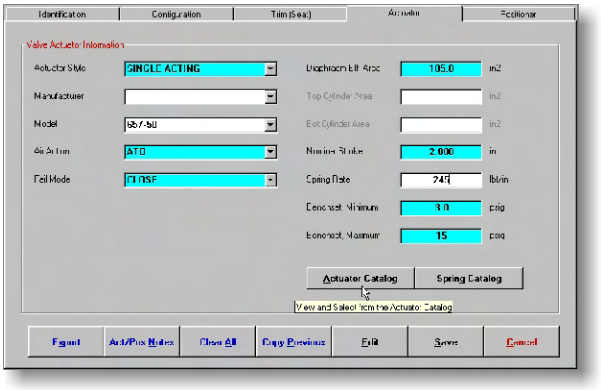
Valve Record Management

Valve data can be stored in any path accessible to the computer and can be efficiently organized by plant, unit, or customer. Individual valve records are quickly and intuitively located by tagnumber, manufacturer serial number or by a user-defined number of up to 15 characters, numbers or symbols. Scan and select directly from the Identification data table, or select from the drop down list. Once a record is made current, all other program functions have access to the valve's detailed identification, configuration, application and test history.



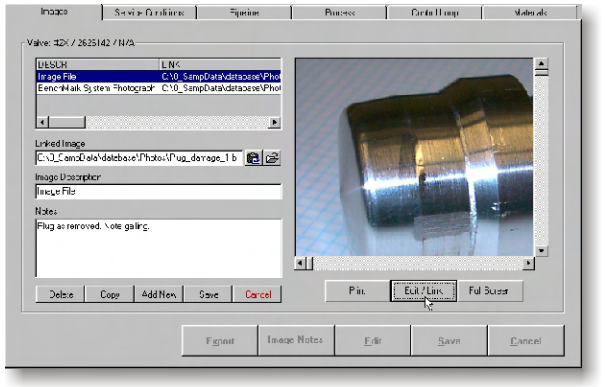
Valve Configuration

Detailed configuration records are easily accessible for the current valve record. Fields are logically organized by Identification, Configuration, Trim, Actuator and Positioning System. Data can be entered, reviewed and modified in easy-to-use software folders with customizable drop-down grids containing detailed catalog data. One-click places the catalog data in the appropriate fields eliminating clerical work. The menu items listed in the drop-down lists can be readily customized by the user to reflect the unique inventory of valves in your facility.



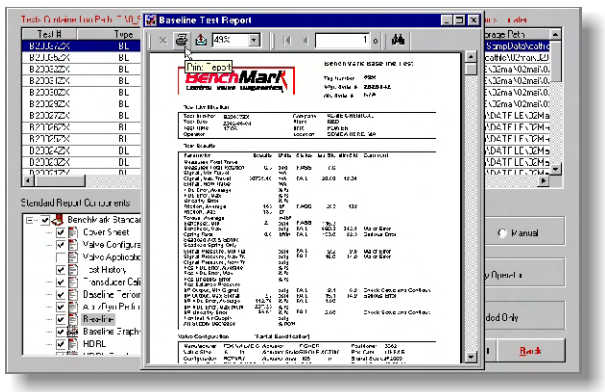
Valve Application

Detailed records describing the valve's service and application are organized by Images, Service Conditions, Pipeline, Process, Control Loop and Materials. Data can be entered, reviewed and modified in intuitive, easy-to-use software folders. Simply click on the folder tab and the data fields are brought into view. Drop-down menus are used wherever possible to reduce the clerical entry work. Clear, readable reports can be reviewed, printed or exported detailing application, installation and control requirements.

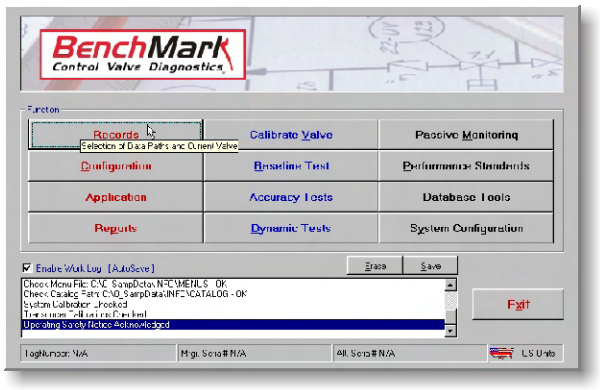


Automatic Report Generation

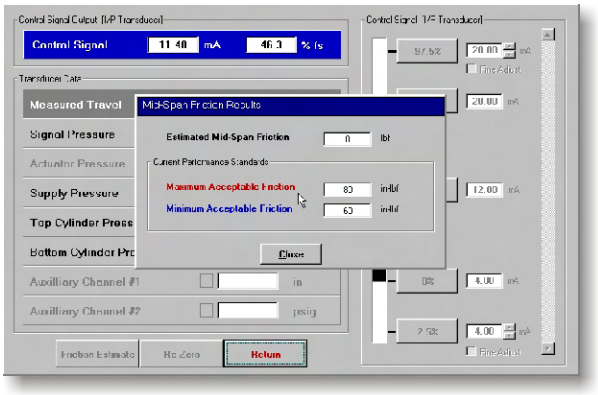
Whether your customers are plant managers, maintenance supervisors or control systems engineers, they will appreciate getting important problem-solving information without being buried in a pile of confusing reports, charts and graphs. BenchMark's report generator lets you select the exact report elements to be printed or converted to multi-page "pdf" format (portable document format - ideal for e-mail communications). Documents can be previewed with a simple click of the mouse. Double-click any test to present test results and graphs for review, export or print.



BenchMark Main Menu



Calibration / Valve Setup

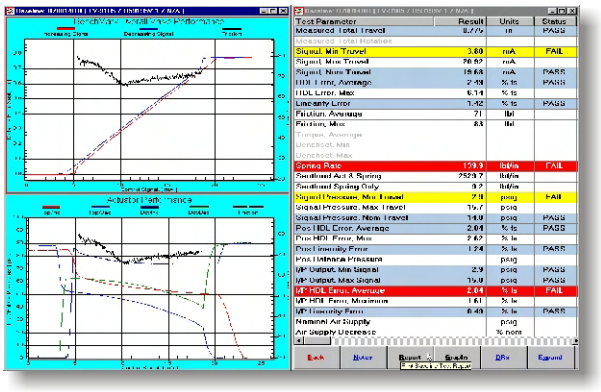


A functional, intuitive calibration tool provides accurate and efficient setup of the control valve. BenchMark communicates with either analog or digital valves. Friction can be quickly evaluated at mid-span for the proper adjustment of packing pre-

Standard Test Parameters

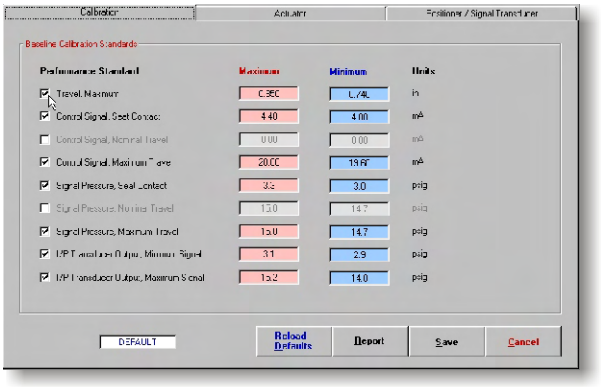
Travel, Rotation
Signal, Seat
Signal, Nominal
Signal, Full Open
HDL Error
Linearity Error
Friction, Avg
Friction, Max
Benchset, Min
Benchset, Max
Springrate
Seatload
Press, Seat
Press, Nominal
Press, Full Open
Pos HDL Error
Pos Linearity
Pos Balance Press
I/P Output, Min
I/P Output, Max
I/P HDL Error
I/P Linearity Error
Air Press, Nom
Air Press Drop
Hysteresis + Deadband
Repeatability Error
Linearity Error
Dead Time
Response Time
Rise Time
Total Time
Settling Time
Overshoot
Step Sensitivity
Step Resolution
Attenuation

(Partial List)



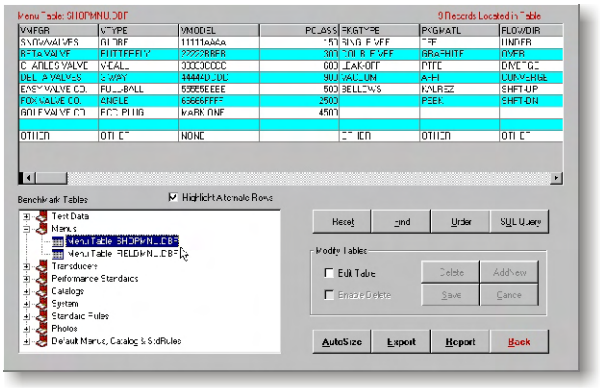
Performance Tests

BenchMark includes all key tests to evaluate the "health" of an air operated control valve. During each test, real-time graphs keep you informed of test status and valve performance. At test completion, engineering parameters with "Pass / Fail" comparisons are clearly presented. Automatically formatted graphs are used to clarify test results where appropriate. Test reports and full page graphs are immediately available for print, preview or export. All graphs can be enlarged, customized, zoomed and exported. Results link directly to BenchMark Diagnostic Reference.



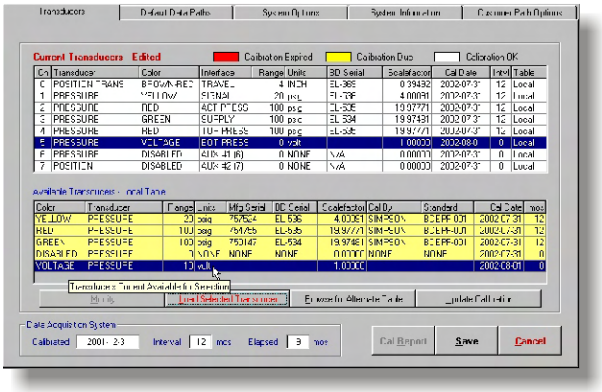
Performance Standards

*BenchMark automatically establishes unique performance standards, based on customizable rules, for each valve tested. These default standards can be easily modified to meet the special requirements of **each** customer and **each** valve. At the conclusion of each test, results are compared to appropriate performance standards and "Pass" or "Fail" is reported for each parameter. No more guessing about whether a result is too high or too low. Individual standards are easily switched on/off or the entire function can be enabled or disabled.*



Database Access / Export

BenchMark uses the power and flexibility of data tables to store valve information and test data. For normal testing, access to these tables is conveniently managed for you. For the end-user with custom data requirements, a powerful database access function is provided. Tools are included to retrieve test data by Standard Query Language (SQL), sort, filter, print or export the data in most popular formats. Since BenchMark data tables are in a popular public, PC format, test data are very accessible and portable.



System Setup

BenchMark uses the latest technology to increase operator productivity. No difficult transducer setup or complicated scalefactor calculations are required to use this state-of-the-art data acquisition system. Simply identify the colors of the transducers in use and test. A complete data table of calibration dates, scalefactors, serial numbers and more transducer data is just a click of the mouse away. Test data storage paths are managed automatically, but can also be manually set. Similarly, BenchMark sets test duration and stabilization times automatically.

Improved Valve Repair Cycle

Step 1: Documented Performance

Valves returned from the repair vendor have been tested and meet the plant's requirements. New and replacement valves are tested on the bench when received from the manufacturer and prior to installation; deficient valves are returned to manufacturer with no wasted installation or setup effort. Only "healthy" valves are placed in-line, setup and then tested to document proper installed function.

Step 2: In-Plant Testing

By a simple file transfer, the plant provides copies of valve records and performance standards to all repair vendors participating in the turn-around. Everyone works from the "same page" with a minimum of clerical work. Target valves and relevant accessories are tested at the start of turn-around. Only "unhealthy" valves that cannot be fixed in line are pulled. A detailed test report accompanies all valves sent for repair.

Step 3: Shared Data, Shared Expectations

Valves arrive at the repair shop with "as-found" test records including detailed technical notes. Since the repair vendor has access to the plant's performance standards for each valve, the expectations for the repairs are clearly defined. Repair efforts can then be focused to ensure an efficient and effective resolution to the documented performance problem.

Step 4: Documented Repair Quality

Valves are tested following repair. Satisfactory performance is documented prior to returning the valve to service. Maintenance histories are updated and test data is passed back to the plant for trending and archival.

Maintenance Benefits

If valve problems and performance expectations are defined when the valve arrives at the repair shop, maintenance labor is used efficiently. Rework and fault finding are kept to a minimum. Post-repair testing ensures proper valve function and documents repair quality. The more subtle valve repair procedures, such as adjusting packing pre-load and actuator leak checking are simplified, standardized and documented. Valve data is consolidated into one easily accessed database.

Production Unit Benefits

Properly setup and maintained valves result in more unit uptime and therefore more product. Valve problems can be isolated faster, saving wasted hours tuning and troubleshooting control problems. Properly operating control valves throttle better and are less prone to hunting type instability. Improved control leads to better yields and higher efficiencies. The actual dynamic response and control capabilities of the various air-operated control valves can be clearly and efficiently defined and appropriate control strategies can be devised.

Plant Productivity Benefits

The name of the game is efficiency. Fewer valves pulled results in shorter turn-around times and therefore more plant uptime. Less money and time are wasted on unnecessary repairs. Maintenance efforts are focused more effectively. BenchMark provides an efficient and economic means of collecting data for the development of a predictive maintenance program. Future maintenance decisions and control valve purchases can be based on engineering facts.

Frequently Asked Questions

How will BenchMark benefit my plant?

First, don't bolt in problems. Keep deficient control valves from being accepted on your loading dock. With BenchMark you can implement an effective incoming control valve performance inspection program. Secondly, if your control valves are not working properly, the plant, product quality and safety are all being affected. No matter which maintenance philosophy you practice, identifying control valve problems quickly and resolving them efficiently, improves quality, plant efficiency and safety.

I own a valve service company that has been doing business for years without this type of equipment. We are doing all right. Why do I need it now?

For some of your customers, you don't. However, many of your larger customers are taking a very hard look at their plants and processes trying to maintain quality and competitiveness. Others are carefully examining their plants for safe operation. These customers will soon ask you to document the quality of your work. Will you be able to meet their needs?

Ok, So I test my valves. How do I know when they are operating properly?

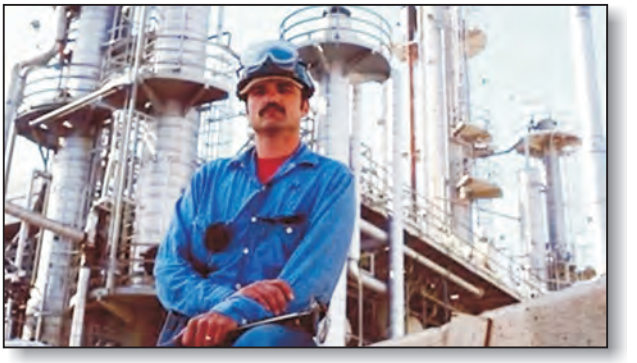
BenchMark provides Pass/Fail comparisons to Performance Standards maintained for ***each*** *valve. You can customize both the standards and the rules used to develop them to meet the needs of your facility or customer. Turn them on or off, individually or collectively, as you see fit.*

I work in Maintenance. We are constantly pressed to reduce our budget and costs. Why would I want to spend our limited resources on this tool?

There are several very good reasons. First, if you can test the valve prior to removal, you just might find out it doesn't need to come out of line. In many cases, one hour of testing can save between twenty-five to forty hours of maintenance time. Secondly, by not accepting deficient valves from your valve oem or repair vendor, you don't waste your resources on bolting in a problem. All of the costs associated with accepting a bad control valve are paid for by the valve owner.

Is the testing time consuming? Will it slow us down?

Connecting to a typical valve and performing a Baseline test takes less than one-half hour. Many maintenance hours can be saved by not installing and uninstalling a "sick" valve. Keep in mind, the general overhaul procedure may not have corrected the original performance problem.



Isn't this just another way for valve repair companies to increase sales? Does this really help me?

A few important points here. First, with BenchMark there is no need to "send the data off" for analysis. With our training and analysis tools, you will be the one "calling the shots". We believe in "demystifying" the process of control valve data analysis for repair shop and end-user alike. Second, with BenchMark you set the performance standards that are ***important to you****. Third, the repair vendor wants your business. By investing in this technology they are able to document their quality and deliver only performance checked valves. Your risk goes down, their rework goes down and everybody benefits. True, in-plant testing will return them some additional revenue, but the larger benefit to the repair vendor comes from establishing a long-term business relationship based on* ***documented*** *quality and service.*

I'm not a computer expert and can't afford to hire one. Can my valve technicians really learn this?

Unlike other diagnostic systems, BenchMark is a "no nonsense" industrial tool with a very successful industrial track record of over 16 years. It is designed for use in the real world and has been designed for operators with all computer skill levels. We support you with a full program of training. You'll find it really is ***easy to learn and easy to use****.*

We have lots of test data from another valve diagnostic system, is it compatible with BenchMark?

We know your previous data represents a significant investment to your company and its lack of portability can lock you into a particular vendor's technology. This limits your ability to stay current and can be very frustrating. With specifics, we can help you assess your situation and in most cases economically convert your data to a BenchMark compatible format. By the way, BenchMark's data is stored in public formats and can be fully integrated into your asset management or business information system.

More questions and answers on our website: www.benchmarkvalvediagnostics.com

BenchMark
Control Valve Diagnostics

Standard Tests

Baseline	Travel (Rotation) Stroking Anomalies Valve Calibration Valve Accuracy Errors, HD+L Positioner Calibration Positioner Accuracy Errors I/P Calibration I/P Accuracy Errors Bench Set / Spring Rate Friction / Torque Seat Load Balance Pressure Air Supply Pressure
Sensitivity / Resolution	Step Sensitivity (Control Test) Step Resolution
HDRL / Deadband	Hysteresis and Deadband Error Repeatability Error Linearity Error Deadband Error
Step Response	Dead Time Response Time Rise Time Step Time Velocity Overshoot Settling Time
Frequency Response	Attenuation Ratio Phase Lag
With Optional Equipment	Hydro Test Monitor Seat Leak Testing (Mass Flowmeter)

Test procedures are based on accepted industry standards where available.

Technical Specifications

Control Signal	0 - 24 ma, 0 - 60 ma, 0 - 10 vdc 14 bit D/A, 1 part in 16,394
Input Resolution and Accuracy	14 bit A/D, 1 part in 16,384 0.01% of Measurement
Travel Ranges and Accuracy	2", 5", 15", 20", 30", 0-360 degs ± 0.1% fs (0.05% fs opt.)
Pressure Ranges and Accuracy	0 - 30 , 0 - 100 , 0 - 300 psig ± 0.1% fs (0.05% fs opt.)

For more information, please contact:

www.benchmarkvalvediagnostics.com

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Black Diamond Engineering

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Computer Configuration

This section describes our most popular and most rugged portable platform. BenchMark can be operated from this configuration, rugged tablets, rugged notebooks, standard notebooks and shop computers. Contact us for details.

Processor	Intel Core Duo Processor L2400 1.66GHz 667 MHz FSB, 3MB L2 Cache Mobile Intel 945GM Chipset
Memory	1 GB DDR Expandable to 4GB
O/S	Windows XP, Windows 7 or later
Storage	160 GB SATA HDD, 320 GB Optional, Removable
Display	14.1" TFT LCD XGA (1024x768) Optional QuadraClear Sunlight Readable with Touchscreen
Keyboard	Shower-proof and Dust-proof Keyboard Touch Sensitive Control Pad Optional LED Back-lit Rubber Keyboard
Expansion	PCMCIA Port, (2Type II or 1Type III)
I/O Ports	Serial Port, 9 Pin, D-sub USB Port, Type 2.0, Two Parallel Port, 25 Pin, D-sub External VGA Port, 15 Pin, D-sub Microphone, Mini-jack Audio Output, Mini-jack Modem, RJ11 LAN, RJ45 Docking Connector Ir DA Port IEEE 1394 Port External Power Supply Port
Interface	10/100/1000 base-T Ethernet 56K ITU v.92 Modem
Accessories	Li-Ion Battery, Smart Battery, 7800mAh 90 Watt Universal AC Adapter (100-240v, 50/60 Hz) Custom, Hard Sided, Transport Case
Options	Second Battery (Bay 1) Third Battery (Bay2) CD-ROM, CD-RW 10-20 vdc Car Power Cable Docking Tray and Connector Adobe Acrobat™ Microsoft Office Professional™ Custom Software Installations

Physical and Environmental

Dimensions	13"W x 11"D x 3.37"H
Weight	Computer (with battery) 13 lbs Standard Hardware Kit < 7 lbs
Temperature	Operating 0 to + 55 C Transport -40 to + 70 C
Rugged	Ultra Rugged Full Magnesium Alloy Case Shock Protected Removable HDD Vibration and Drop Resistant Mil-STD-810G Certified and IP65 Compliance