

# 2004 Metrology Market Survey



*Quality Digest examines what kinds of metrology equipment companies are buying and why.*

by Dirk Dusharme

**M**ost *Quality Digest* readers depend on measurement equipment to help them ensure the quality of the products they produce. Whether it's a \$100 hand-held volt/ohm/amp meter or a \$1 million coordinate measuring machine, measurement equipment provides the data that let production or inspection personnel know whether their processes are performing as intended and keeps quality products rolling off the line.

As a result, those responsible for selecting test equipment are picky about what they buy. Some are brand-conscious, sticking with what they know, some look strictly at price/performance, and others (you know who you are) buy the newest gizmos with all the bells and whistles, regardless of price or manufacturer.

In this, our first metrology market survey, *Quality Digest* examines some of the buying characteristics of those who purchase metrology equipment as well as the measurement issues they're faced with. For instance, do they need portable equipment? Are their measurements done in a controlled environment or on the shop floor? Who handles equipment calibration? All of these characteristics influence the type of equipment a company will purchase.

The survey was conducted in July with assistance from metrology equipment manufacturers Brown & Sharpe, Mitutoyo, Optical Gaging Products and others. Surveys were e-mailed to 14,094 *Quality Digest* readers, 580 of whom responded. The survey was conducted online using SurveyGold by Golden Hills Software. Not all of the survey results are presented in this article.

## **Metrology on the go**

Hand-held dimensional tools, such as micrometers and calipers, are the predominant inspection tools, with 37 percent of respondents indicating these as among the tools most used for their inspection needs. Bench top dimensional equipment came next with 22 percent reporting their use. A little more than one-third of respondents use either 2-D or 3-D inspection equipment such as CMMs, trackers, optical comparators, vision systems and photogrammetry.

Nearly two-thirds of respondents indicated that equipment portability was important to them. The value of hand-held metrology tools is, of course, that they are portable. Although not always as accurate as their bench top counterparts, portable measuring tools and equipment of all types—dimensional, hardness, color and subsurface analysis, for instance—allow the user to perform measurements on parts without having to bring them into the inspection lab. Although not portable, more shop-hardened, traditionally lab-based equipment is making its way to the shop floor. Both portable and shop-hardened machines allow users to pursue in-process or near-process inspection.

The downside of shop floor equipment is that it must give accurate and repeatable results not only in controlled environments but in unfriendly ones, too. The table at the top of page 25 shows the types of environmental conditions under which respondents say their measurement equipment must function.

Although these issues are difficult enough for manufacturers of hand-held devices, the problems are much tougher for manufacturers of high-precision 2-D or 3-D measurement equipment,

where high accuracy and precision compete with the physics of temperature expansion, vibration and other environmental issues.

### Environmental Concerns for Equipment Selection

In response to the question: If your measurement equipment is normally used outside a lab environment, which of the following environmental issues exist that affect measurement or equipment selection?

Dust/airborne contaminants	20%
High humidity	16%
Widely varying temperature	14%
High temperature	12%
Vibration	12%
Water/oil/liquid contaminants	11%
Low temperature	5%
Electrical noise	4%
Outdoor setting	3%
Flammable gases (explosion hazard)	1%
Other	3%

During the past years, CMM manufacturers have worked to shop-harden their machines. For example, Hexagon Metrology uses ACTIV temperature compensation, a proprietary system that uses multiple temperature sensors installed throughout the CMM structure to monitor changes in machine geometry due to extreme temperature fluctuations. Using temperature models of these structural changes, their products make the appropriate corrections using CMM software.

Carl Zeiss IMT Corp. has also released a new line of shop-hardened products that maintain accuracy despite harsh conditions. “Our new line of machines manage the two key challenges of shop floor operation: contaminants and temperature,” says Walter Pettigrew, manager of strategic business development for Carl Zeiss. “Our new Max line of machines performs on the shop floor comparably to what could previously only be achieved in a controlled environment.”

Even technologies that don’t endure the same environmental issues as CMMs have their own set of problems. For example, photogrammetry suffers less from temperature and vibration. “This is really one of the main selling points of photogrammetry over other in-place 3-D measurement systems like trackers, arms, etc.,” says John Brown, president of Geodetic Systems Inc. Geodetic uses a high-speed

flash to expose targets, freezing the object for both measurement and a stable reference field of target points that provides the orientation of the cameras instantaneously on each measurement.

But even that technology must cope with environmental issues. “We can handle the temperature and vibration, but establishing and maintaining our reference targets—applying them to the fixture and keeping them clean—is a challenge in many situations, especially in the automotive industry,” Brown explains. “We are trying to develop more rugged targets and ways to maintain them but have nothing ready yet.”

### Can’t touch this

Noncontact inspection was important to respondents, with 43 percent reporting that they require or are interested in it.

Particularly for aerospace and automotive customers, noncontact measurement

using photogrammetry, laser trackers, radar trackers and similar noncontact 3-D technologies is the only way to quickly gather 3-D data on large structures such as airframes.

The “don’t touch” aspect of noncontact equipment isn’t always the reason customers are interested in the technology for 2-D or 3-D measurement, points out Bill Fetter, director of marketing and communications for Hexagon. “We have a lot of customers interested in various noncontact technologies now, many of whom are looking at it for the first time,” he says. “However, it’s not necessarily the noncontact aspect that’s driving it—it’s the need for speed. The probing technology is a means to an end. Producers need accurate results—fast.”

In addition to the ability to nondestructively measure and the increased speed of data gathering, there is a third benefit that noncontact inspection brings

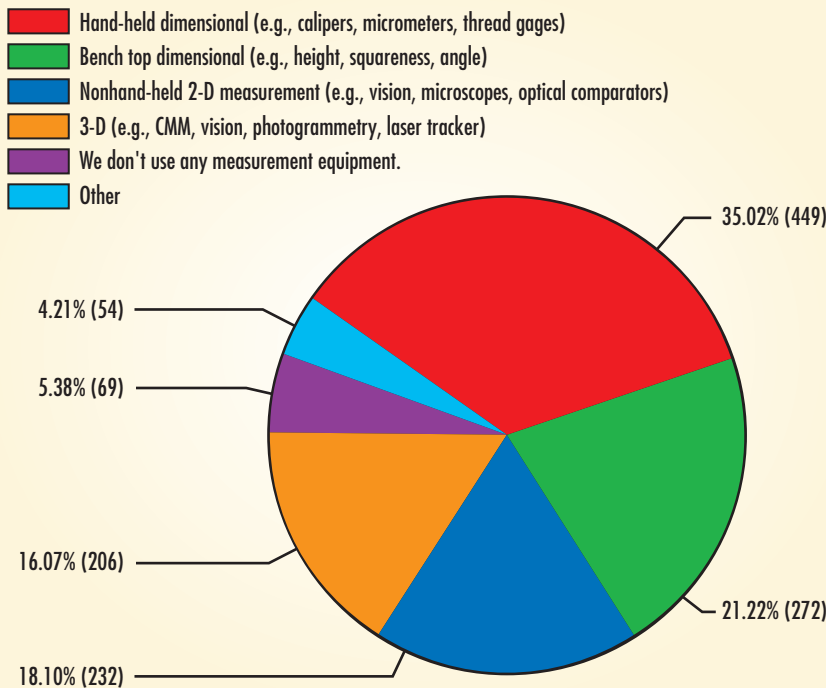
### Percent of Measurements Performed on Shop Floor Vs. Controlled (Lab) Environment

% of measurements	% respondents all measurements		% respondents only 2-D/3-D measurements
	Shop floor	Lab	Lab
0–10%	39%	16%	9%
11–25%	15%	11%	7%
26–50%	16%	15%	13%
51–75%	9%	14%	5%
76–90%	11%	21%	11%
91–100%	10%	22%	56%

### Equipment Purchasing History and Plans

	Have purchased in last 12 months	Plan to purchase in next 12 months
None	7%	13%
Bench top dimensional	10%	8%
Coating thickness	3%	3%
Color analysis	3%	2%
Chemical properties (e.g., pH)	4%	3%
2-D	6%	7%
3-D	5%	7%
Electrical properties (e.g., amps)	8%	6%
Environmental properties (e.g., temperature)	6%	6%
Fluid properties (e.g., viscosity)	1%	2%
Force/torque/tension	9%	9%
Gap/flush	2%	1%
Hand-held dimensional (e.g., micrometers)	21%	18%
Pressure/vacuum	5%	4%
Profile	2%	1%
Subsurface inspection (e.g., X-ray)	1%	1%
Surface properties (e.g., roughness)	4%	4%
Other	3%	4%

## What Are the Predominant Types of Dimensional Metrology Equipment Your Company Uses?



to the table: versatility. "Video-based systems use zoom optics to make it easy to find a feature and then zoom in for detailed inspection," explains Mark Glowacky, president of RAM Optical Instrumentation. "Good optics, pure white illumination and color monitors make it easy to do detailed inspections. It's the versatility of [noncontact] inspection systems for a broad variety of applications that makes them so popular."

## Calibration and service

It should come as good news to calibration service providers that more than half of respondents (54%) indicated that they outsource their equipment calibration and service to third-party labs. About one-third (34%) perform the calibration and service in-house and only about 10 percent have the factory do it. As seen in the table on page 27, although small shops of one to 10 employees are more likely to outsource, large companies also prefer to outsource rather than use in-house services or the original equipment manufacturer. Even where the equipment is much more complex, such as with CMMs or vision systems, the trend is still toward outsourcing or using in-house labs.

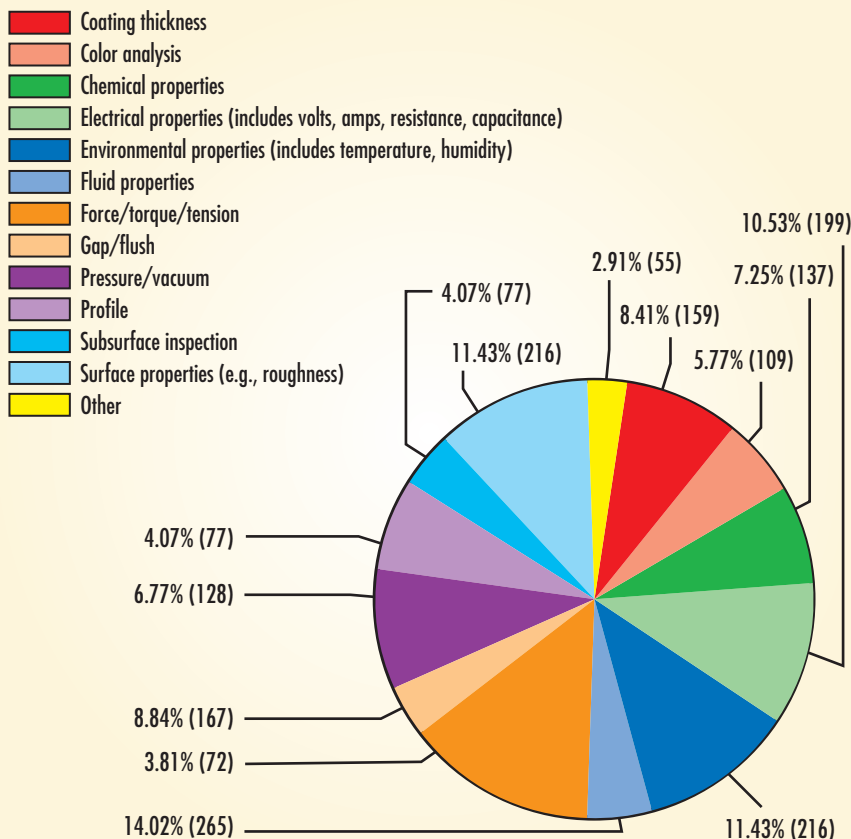
Asked their reasons for outsourcing, most respondents said it is easier, more cost-effective, and more timely.

"One of the reasons companies come to us is because they don't have the proper equipment to perform the calibrations or the staff trained to do it," says B.J. Hangartner, vice president of Quality Calibration Service Inc. "Another reason may be that they have an inefficient operation or are overloaded and don't have the resources to do their own calibrations."

In addition, the cost to set up an in-house calibration lab can be huge, explains James Kratzer of Arizona Calibration and Electronics Inc. "A company may purchase a \$40 voltmeter, but if ISO requires that it be calibrated, they may not be able to afford the \$40,000 calibration instrument," he explains.

The cost of accreditation can be a real show stopper as well, Kratzer adds. "Especially with A2LA and NVLAP, the audits for companies to keep up their [lab] accreditation is so expensive and time-consuming that it's just easier to send it to a third-party lab," says Kratzer. "Especially when you start getting into the auto industry, which

## What Other Types of Inspection Equipment Does Your Company Use on a Regular Basis?





requires that calibrations be done by a lab that's ISO 17025-accredited. That registration can cost \$10,000 to \$20,000 in itself."

From the OEM's perspective, outsourcing, particularly for complex equipment, may not be a wise move, says Vince Brennan, president of Quality Vision Services, a division of Quality Vision International Inc. "With advances in technology, the quality of the service technician is now a major factor in the quality of the measurement," Brennan explains. "Two important technician quality factors are training and experience with the machine. As machine capabilities, numbers of sensors, and measurement accuracies increase, training and experience of the service technicians must keep stride."

Third-party service companies might have experience with many systems, but because they may service a large variety of manufacturers, they may not learn all of them thoroughly, as Brennan points out: "Only technicians with repeated experience with the latest measurement systems have the expertise to keep those systems in peak operating condition."

### Software

The problem has been around since PC first hit the shop floor. It seems you can have easy-to-learn software that performs just the functions you need, or you can have software that does everything except knot your tie but requires a Ph.D. in advanced logic to figure out. As the functionality of software increases, so does the difficulty in learning it. This is of particular importance to shops where operator turnover is high. What managers want, of course, is software that can be learned in minutes or hours, not days or weeks.

According to the survey, when given the choice between easy-to-learn software with basic functionality or more difficult programs with a lot of extra functionality, 89 percent would give up functionality for ease of use. This is reflected in respondent comments as well. When asked to list the most desirable software features, words like "ease of use," "simplicity," and "user-friendly" made up the majority of the list.

### The big O

As discussed in an April 2002 *Quality Digest* article ([www.qualitydigest.com/april02/html/outsource.html](http://www.qualitydigest.com/april02/html/outsource.html)), outsourcing

## Who Performs Equipment Calibration/Service by Company Size

Company size	All equipment		2-D/3-D equipment only	
	In-house	Cal lab	In-house	Cal lab
1-10	16%	60%	18%	53%
11-25	32%	47%	6%	50%
26-50	22%	73%	13%	63%
51-100	39%	52%	16%	59%
101-500	36%	51%	13%	54%
>500	41%	46%	36%	40%

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inspection is an option many companies are considering. Equipment costs, calibration costs and operator knowledge all become the problem of the third-party inspection house. With that said, survey respondents don't seem to be seeing much overall change in that regard. Although 23 percent say they have seen an increase in the amount of inspection being outsourced, 15 percent say it has decreased. Just under half (48%) say inspection outsourcing has stayed the same.

There are two big reasons for outsourcing, explains Fetter. First, departments are lean and may not be able to accommodate a fluctuating workload. Second, some respondents see existing equipment being more than 75 percent utilized.

"Economists normally say that when plant capacity exceeds 80 percent, manufacturers tend to invest in new plants and equipment," says Fetter. "However, we all know that economic times have been difficult in the past couple of years, and many companies have been reluctant to invest in capital projects. So if the demand for inspection exceeds capacity, it would spill over into outsourcing. One of our jobs as a manufacturer in economic times such as this is to find innovative ways to help customers who find themselves in this predicament: more work than they can handle and no money to expand."

## The big race

Parts get smaller, tolerances get tighter and the push for zero defects increases. All this keeps metrology manufacturers on their toes.

Less than half of respondents (48%) believe that metrology technology is keeping up with required tolerances. About 31 percent believe that technology is just barely keeping up and 7 percent believe that technology isn't keeping up with tolerances. The group you side with largely depends on your industry. But there is no doubt product specs are tightening and that measurement equipment must follow suit.

As required tolerances tighten at an exponential rate, metrology manufacturers struggle to keep designing tools that will provide more accuracy than the parts they are supposed to measure. As one metrology company put it, the pursuit is never-ending: Improved inspection technology allows parts to be made to tighter tolerances which, in turn, lead to more advanced inspection equipment, which then helps in manufacturing new parts to even tighter tolerances.

But there is a limit, either a point of diminishing returns where it will cost more to add an extra decimal than the customer is willing to pay or where physics puts up a roadblock.

"It requires a great deal of R&D funds to push ahead of the tolerance curve and manage price pressures," says Pettigrew. "Each step brings us closer to barriers of physical properties. It will require innovation, not just muscle, to stay in this race."

## About the author

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## Comments

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