



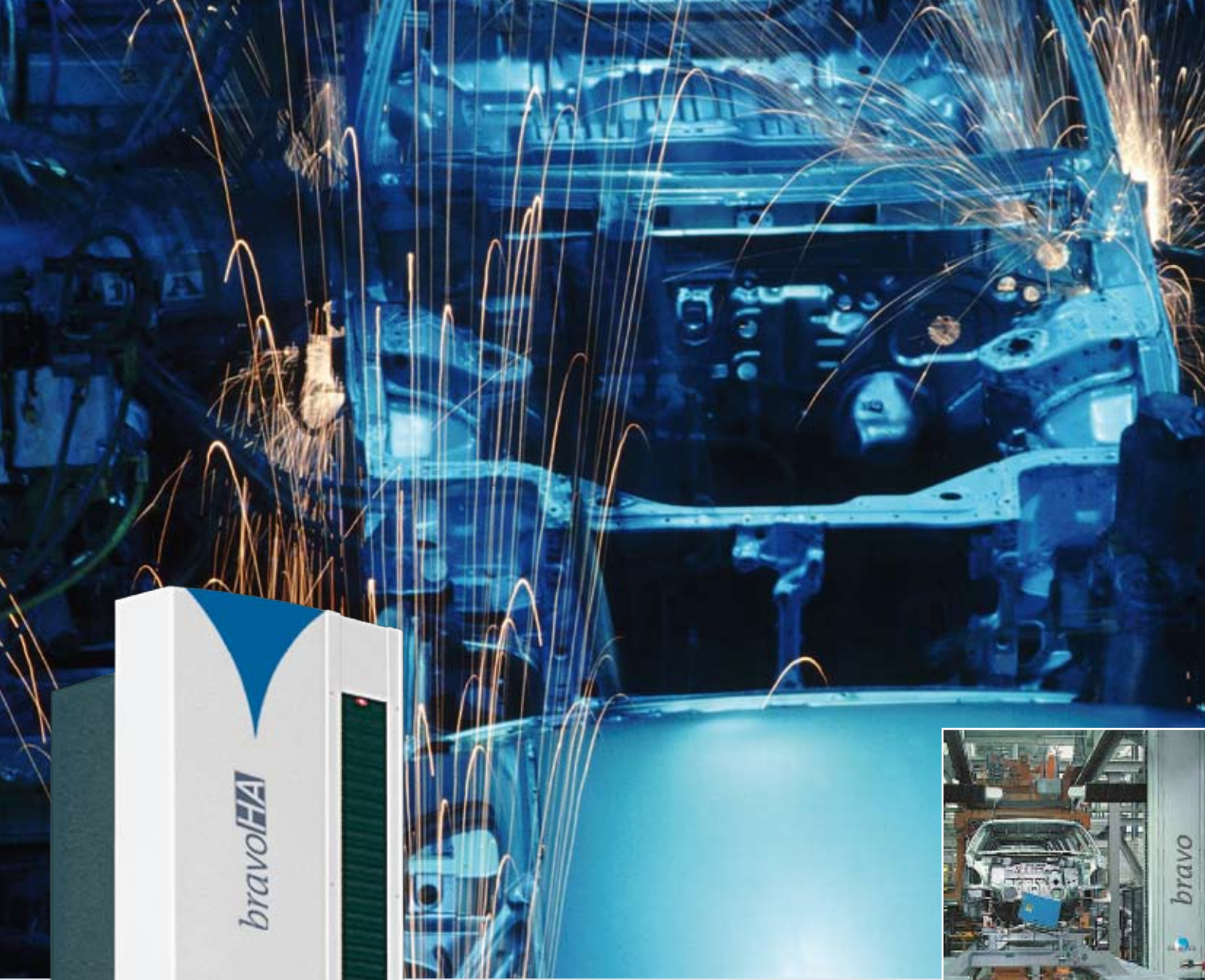
BRAVO HA
Horizontal-Arm
Coordinate Measuring Machines



Serving Metrology Worldwide



 **HEXAGON**
METROLOGY



bravoHA



An abridged list of BRAVO system users

- ACTIVE INDUSTRIES
- AUDI
- AUTOEUROPA
- ALCOA
- ALFA ROMEO
- ARACO
- BERTONE
- BMW
- CENTRAL AUTOMOBILE
- CITROEN
- CHRYSLER
- DAIHATSU
- DAIMLER CHRYSLER
- FERRARI
- FIAT
- FORD
- GENERAL MOTORS
- HINO AUTOMOBILES
- HYUNDAI
- HONDA
- IVECO
- KANTO AUTOMOBILES
- KARMANN
- KOUZUI MOTORS
- A. LAEPPLE
- MAZDA
- MIYAZU
- NEDCAR
- NISSAN
- NUMNI
- PEUGEOT
- PININFARINA
- PORSCHE
- RENAULT
- SAMSUNG
- SANYO KOGYO
- SATA
- SEAT
- SEVEL
- SEVERSTAL
- SKODA
- SOGEDAG
- TOFAS
- TOYOTA
- VOLKSWAGEN
- VOLVO
- YMOS



The evolution of sheetmetal inspection

BRAVO is a family of horizontal-arm measuring machines that has made a mark in dimensional inspection of automotive bodies and subassemblies with over 600 installations at the major carmakers throughout the world.

The integration of industrial metrology in fast, modern production lines for measuring car bodies and complex contoured shapes requires dynamic, accurate and robust systems that are capable of optimizing the dimensional inspection process.



R-evolutionary through the years since the '80s

One of the most critical and complex phases of the car manufacturing process is undoubtedly the production of the car body. The style of a car and the quality of body assembly may severely affect its success on the market.

Furthermore, automation of the manufacturing process alone does not ensure the final quality of the product.

Quality standards are getting higher and higher and integration with flexible control systems is fundamental to keep the production process under constant control and to prevent defective parts.

Flexible measuring cells based on BRAVO HA systems specifically developed for the

dimensional control of car bodies throughout the production process are the concrete answer to this requirement. Here are the characteristics that make of BRAVO HA a state-of-the-art system for body-in-white inspection, and make it ideal for automatic flexible manufacturing processes:

INTEGRABILITY – The open architectures of the electronic control, the software and of the mechanical structure of the BRAVO line, allow for an effective integration of the measurement cell in production environments. Hexagon Metrology uses an experienced team of systems engineers and project managers that facilitate and guarantee the success of the integrated solutions.

SPEED – A direct contribution to shorter measurement cycle times. An essential issue to keep production process under close permanent control.

FLEXIBILITY – Inspection of different kinds of parts with a single measurement cell.

ACCURACY – Accurate and reliable measurement data to ensure the best preventive actions.

RELIABILITY – Part inspection is carried out under the environmental conditions of the manufacturing process.

No special working conditions required.

MODULARITY – The measurement cell is customized to meet the specific requirements of the production process.

SOFTWARE – Tailored applications based on real car body inspection requirements.

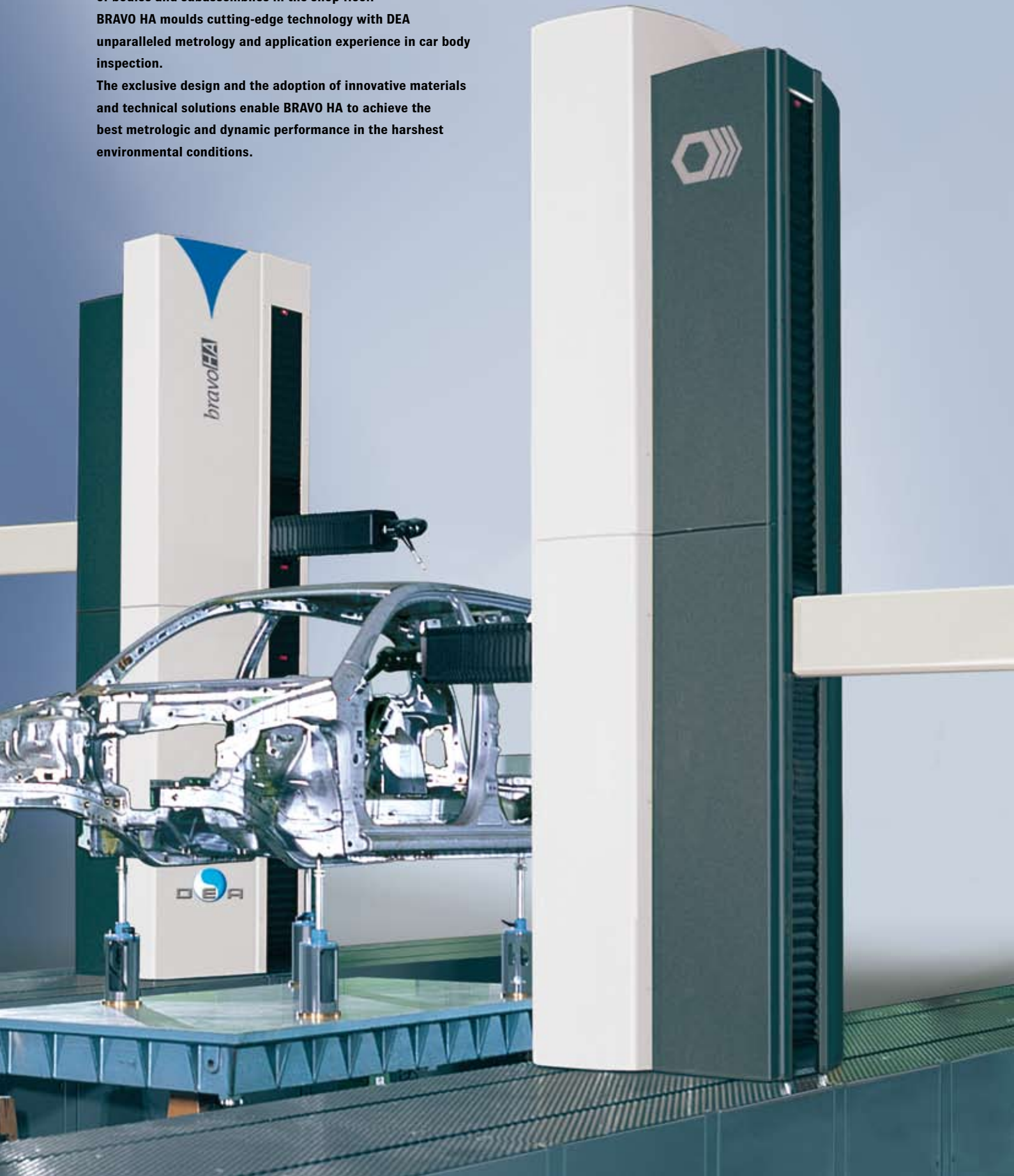


bravo HA

Designed to operate in an industrial environment, the BRAVO HA constitutes the optimized answer to the dimensional inspection of bodies and subassemblies in the shop floor.

BRAVO HA moulds cutting-edge technology with DEA unparalleled metrology and application experience in car body inspection.

The exclusive design and the adoption of innovative materials and technical solutions enable BRAVO HA to achieve the best metrologic and dynamic performance in the harshest environmental conditions.



Enhanced Flexibility

In its standard configuration, BRAVO HA is equipped with the sturdy high-performance multi-axis DEA CW43L continuous wrist. The CW43L handles a series of probe extensions (up to 570 mm) thus allowing full accessibility to all part features.

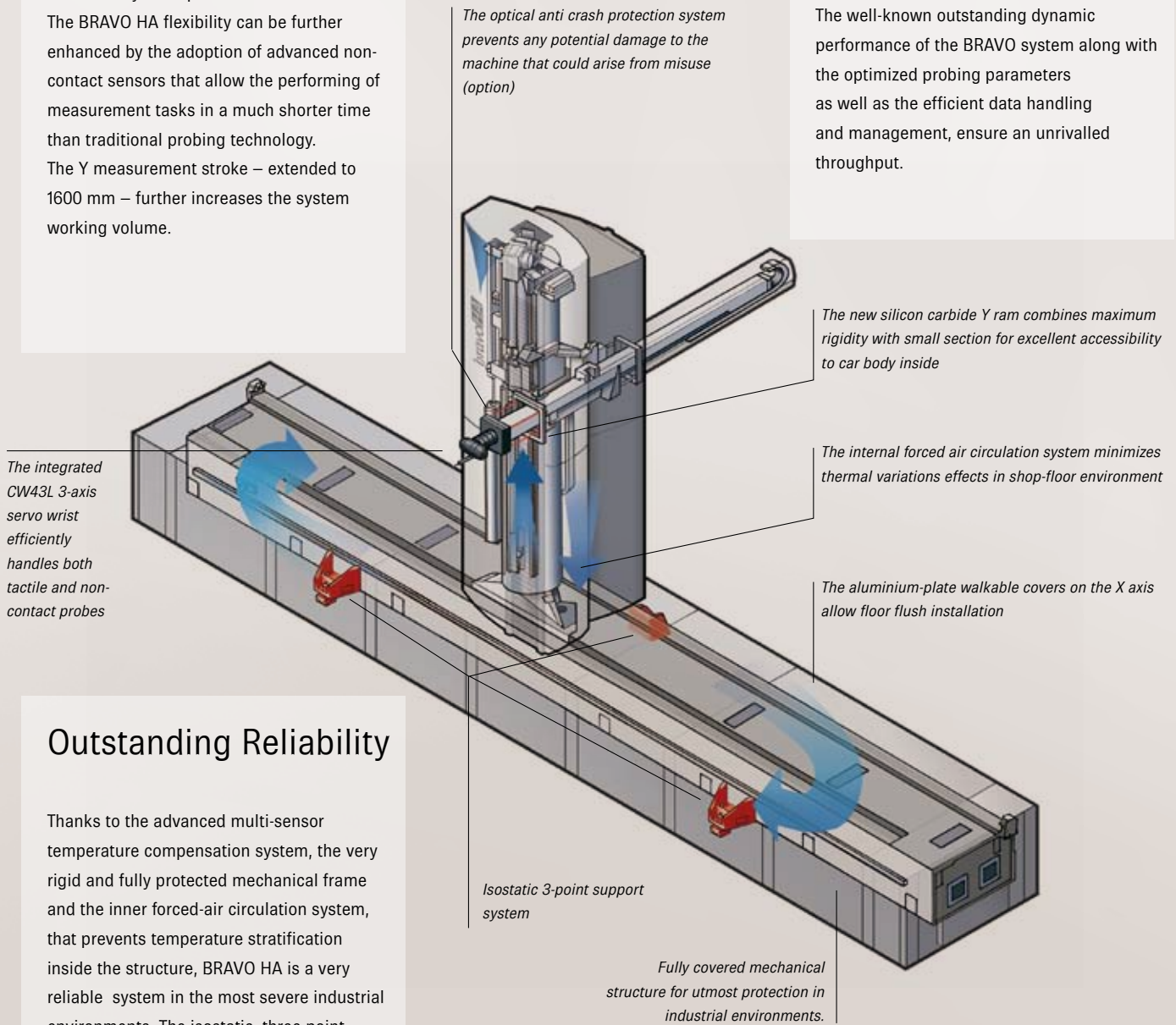
The BRAVO HA flexibility can be further enhanced by the adoption of advanced non-contact sensors that allow the performing of measurement tasks in a much shorter time than traditional probing technology.

The Y measurement stroke – extended to 1600 mm – further increases the system working volume.

Top Class Performance

Exclusive design, patented solutions, selected components, innovative materials, and refined geometric compensation maps allow BRAVO HA to achieve top measuring accuracy in a wide operating temperature range.

The well-known outstanding dynamic performance of the BRAVO system along with the optimized probing parameters as well as the efficient data handling and management, ensure an unrivalled throughput.



Outstanding Reliability

Thanks to the advanced multi-sensor temperature compensation system, the very rigid and fully protected mechanical frame and the inner forced-air circulation system, that prevents temperature stratification inside the structure, BRAVO HA is a very reliable system in the most severe industrial environments. The isostatic, three-point support X guideways (up to 6 m net stroke available) eliminates the need for dedicated foundations in most cases, and guarantees metrologic performance over time.

The Y ram is made of silicon carbide, a material ensuring an optimal structural behaviour and avoiding bending deformations. The aluminium walkable covers protect the longitudinal guideways and allow easy access to working volume in floor flush installations.

BRAVO HA

Models	Strokes (single arm models)			Strokes (double arm models)			
	X	Y	Z	X	Y	YT	Z
	mm	mm	mm	mm	mm	mm	mm
60.14.20	6000	1400	2000	6000	1400	2750	2000
70.14.20	7000	1400	2000	7000	1400	2750	2000
60.16.20	6000	1600	2000	6000	1600	3150	2000
70.16.20	7000	1600	2000	7000	1600	3150	2000
60.14.24	6000	1400	2400	6000	1400	2750	2400
70.14.24	7000	1400	2400	7000	1400	2750	2400
60.16.24	6000	1600	2400	6000	1600	3150	2400
70.16.24	7000	1600	2400	7000	1600	3150	2400

Longer X-axis strokes are available on request



1 Non-contact probing drastically reduces inspection cycle time.

2 CW43L long probe extensions (up to 570 mm) allow to reach all inside body details

Precise Probe Head Orientation

Performance and efficiency of BRAVO HA are enhanced by the exclusive DEA CW43L multi-axis continuous wrist.

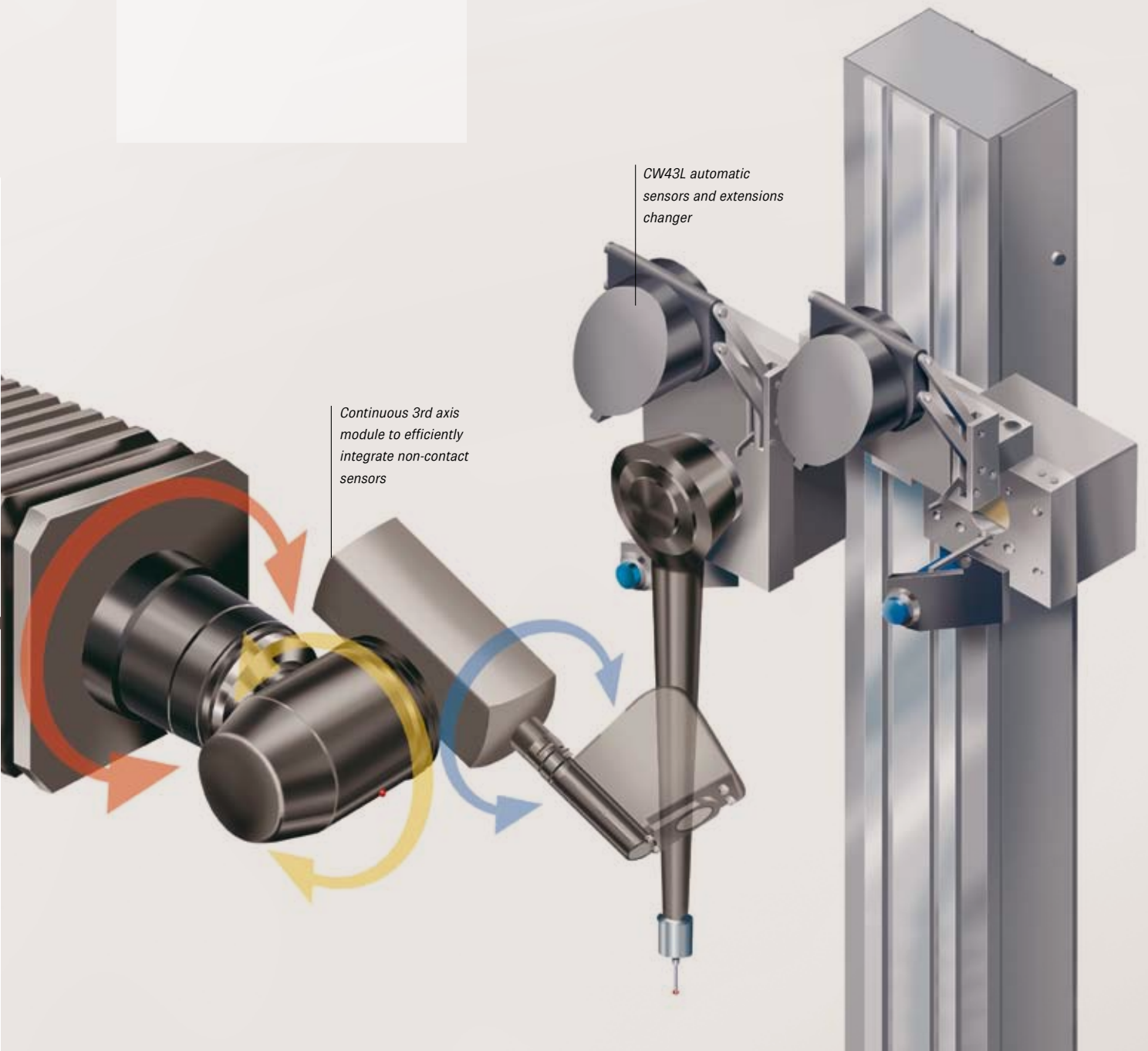
Its ability of orienting the probe as needed in space (virtually infinite angular positions) along with the possibility to handle exceptionally long probe extensions, allow full access to the part to be measured.

The CW43L is available also in the configuration with integrated 3rd continuous axis developed for the optimized use of non-contact sensors.

The CW43L wrist is compatible with the most widespread Renishaw probes and tip/tool changers, thus enabling to measure both in point-to-point and in scanning mode.

Specifications

	Roll Axis	Pitch Axis	Yaw Axis
Useful Angular Stroke	+/-180°	+/-170°	+/-180°
Rotation Speed	1 (rad/s)		1 (rad/s)
Acceleration	10 (rad/s ²)		10 (rad/s ²)
Resolution	0.14 (arc")		3.16 (arc")
Positioning Repeatability	1 x 10 ⁻⁵ (rad)		7 x 10 ⁻⁵ (rad)
Weight	3.5 (kg)		1.7 (kg)
Max. Tool Weight	1.5 (kg)		1 (kg)
Max. Applied Torque	2 (Nm)		1.5 (Nm)
Extensions	up to 570 mm		
Probes	TP6, TP2, TP20		Non-Contact Probes
Probe Changer	ACR1, CW43L AC		CW43L AC

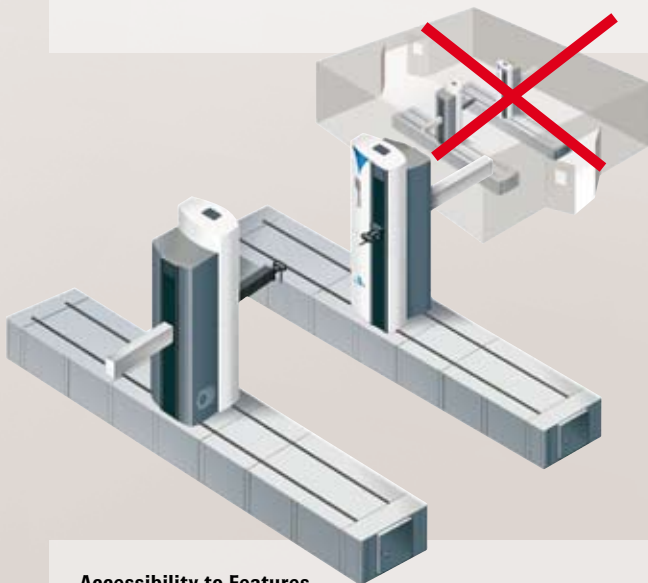


Overcoming Influence on Accuracy

Ambient Temperature

Ambient temperature variations have always been one of the factors affecting the performance of all measuring tools. To curb negative effects, the most common solution consists in using enclosures that reproduce the ideal temperature environment. Technically, this is the simplest solution but it is also the most expensive one, in particular for large-sized measuring machines.

BRAVO HA eliminates the need for enclosures because it has been designed to work efficiently in a shop floor environment. The technological solutions adopted (multisensor compensation, full covering of the structure, inner forced-air circulation system, appropriate motors positioning) are the outcome of many years' experience in the application of measuring systems in shopfloor environments.



Accessibility to Features

In particular, in the dimensional inspection of car bodies the need for very long tool extensions (to gain access to critically positioned features) and the need for specific approach angles are felt.

These requirements become even more significant – at times imperative - when non-contact probes are used. In these cases, the approach angle may significantly affect probing accuracy and it is therefore fundamental to adopt a continuous multi-axis probe head. The CW43L continuous rotary wrist therefore combines the automatic management of long probe extensions with the control of three continuous rotary axes for optimal operation with non contact sensors.

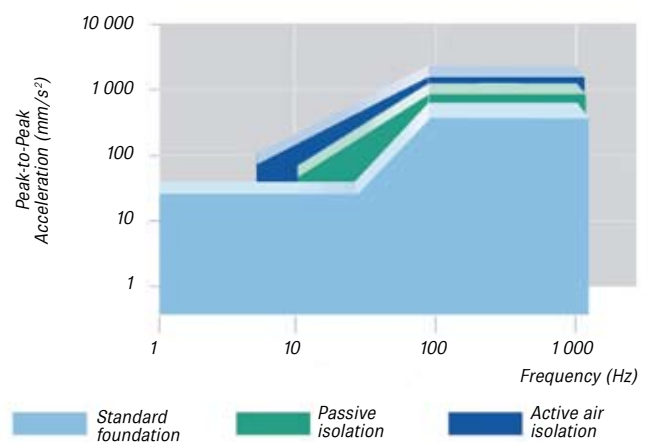
Environmental Vibrations

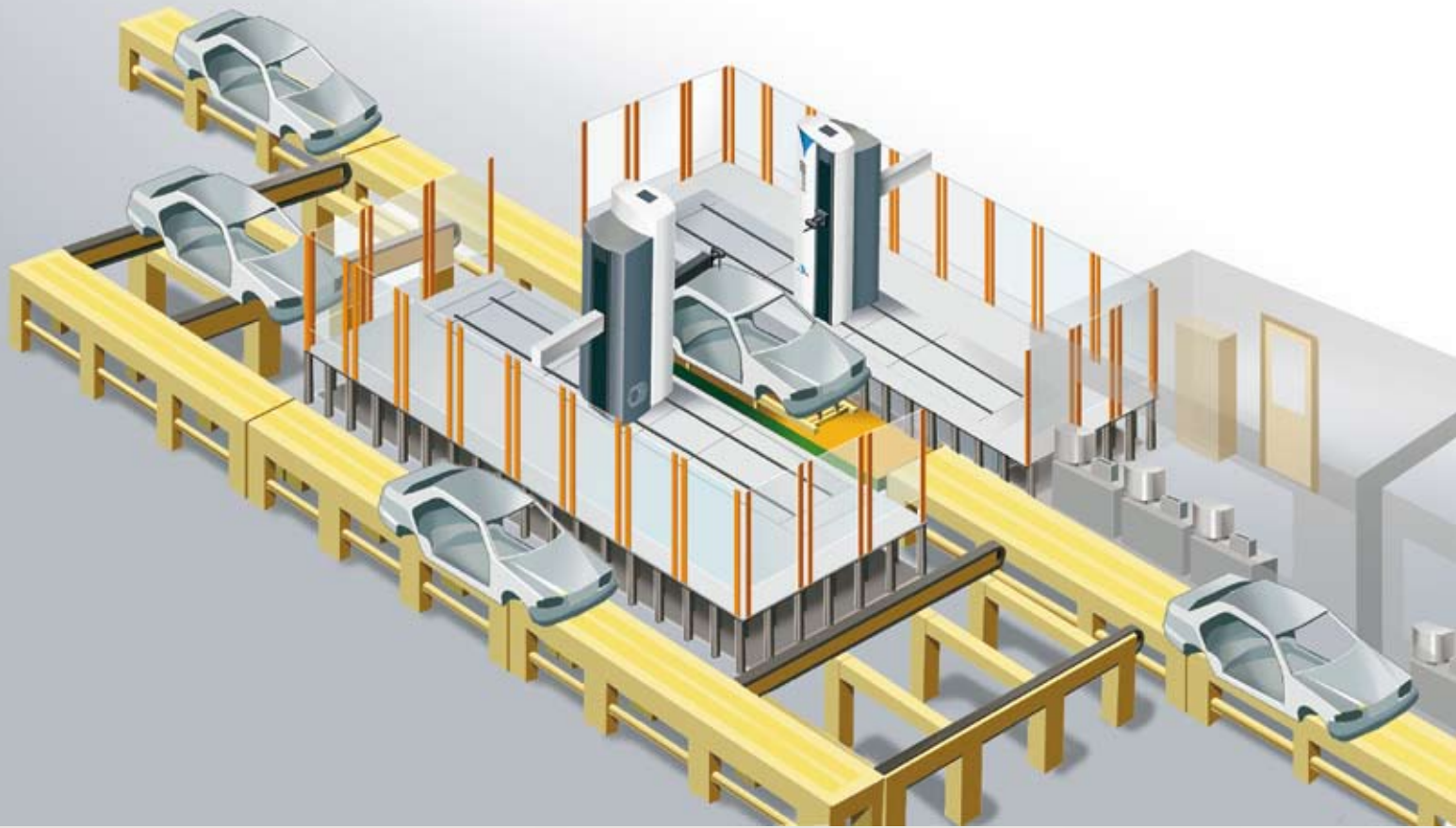
The vibrations present in a shopfloor environment have a decisive influence on metrologic performance.

The foundation on which the measuring machine is installed plays not only the important role of stabilizing the geometric rigidity of dual arm systems but also the role of damping vibrations. Depending on the nature (frequency and intensity) of vibrations, the foundation may be supplemented with further isolating units both of the passive type (isolating pads) and of the active type (electronically controlled pneumatic dampers) in the most critical cases.

In all cases, the in-built rigidity of the main X beam of the BRAVO HA adds to ensuring that the nominal performance is maintained over time.

Environment vibrations





Turnkey Solutions to In-Process Sheetmetal Gaging Problems

For easy and efficient integration into the production line, BRAVO is capable of being automated with the same part loading or transfer devices as other equipment in the manufacturing process and can be remotely managed by a supervisory computer system. The possibility of installing the robot flush to the floor and its robust walk-on covers that protect the longitudinal ways simplify part loading and unloading operations.

Additional hardware, such as pallet transfer systems, handling robots, indexing tables, as well as operator safety and part recognition devices can be supplied with BRAVO to configure integrated car body inspection cells that help maximizing manufacturing productivity.

A full time staff of system engineers studies and analyses customers application requirements and defines the software and hardware configurations of possible special systems to address specific car body manufacturing situations, for one machine or an entire system.

They have an outstanding familiarity with the characteristics and the use of BRAVO, complemented by an excellent knowledge of multiprocessing and computer network technologies, OEM system components, as well as mechanical and construction engineering techniques.

Stand-alone units, inspection cells, integrated system stations - every one of them is intended to provide the user with control over production. On line. In real time.

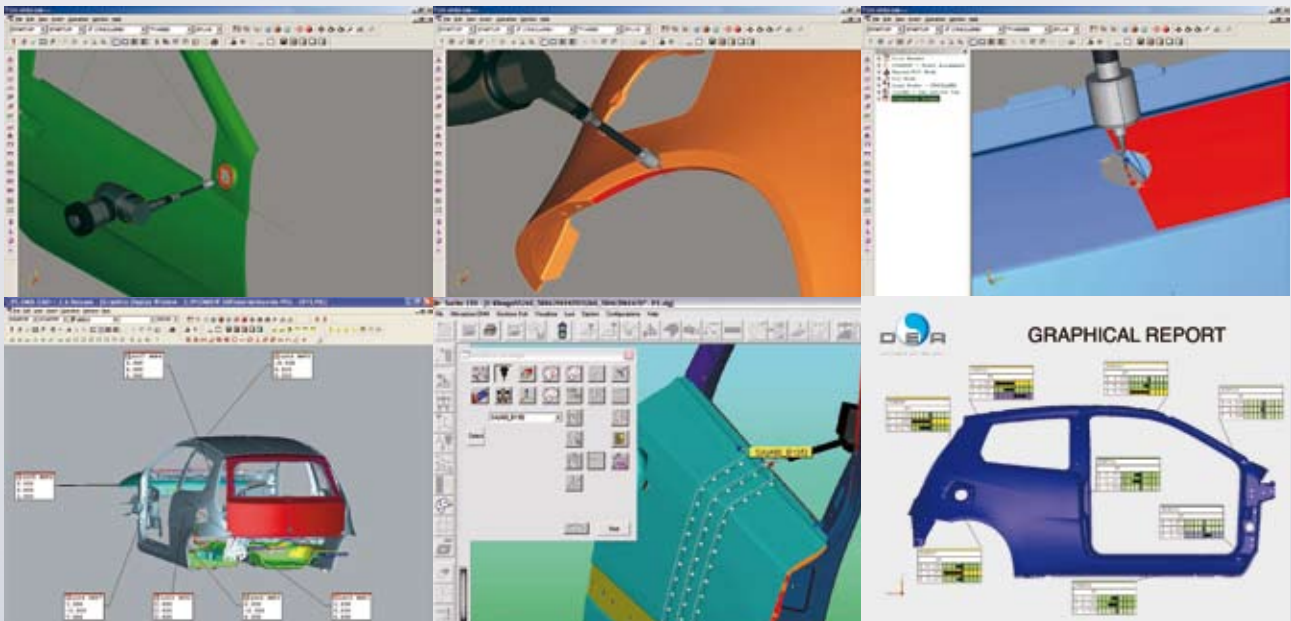
The Intelligent Software for All CMMs



BRAVO HA is equipped with PC-DMIS®, the industrial grade measuring software that provides a multi-tasking multi-user environment to inspection operations.

Main Features

- User-friendly Windows operating system
- Customizable 3D graphics-based operator interface
- Direct CAD Interface (DCI)
- IN/OUT DMIS
- Direct part measurement using original CAD data
- Direct measurement without a CAD model, with automatic recognition of part shapes and features
- Management of non-contact measuring probes
- DCC program-driven measurement
- Reverse engineering functionality
- Management of continuous scanning probes
- Off-line part programming supported by original CAD design data and graphical simulations
- On-line part programming (Self-Teach)
- Advanced tools for program proofing, fine tuning, and debugging
- Flexible graphical and analytical reporting
- Advanced SPC and process monitoring options
- Management of multi-arm measuring systems
- Management of FIVE and FIVE U-nique flexible fixturing system options



Power Sheet Metal Routines Optimize System Performance

PC-DMIS includes powerful point-and-click sheet metal measuring routines for the automatic inspection of thin-walled components, and the presentation of results for intuitive interpretation. The sheet metal routines are efficient software tools that simplify and speed up part programming. They only need the operator to enter data.

The system automatically generates the part program containing the necessary positioning and probing instructions. At run time, automatic and self-adaptive search routines overcome element mispositioning. If the element is not present, automatic skip cycles allow the machine to continue part program execution.

Accessories

Remote Terminals

To improve efficiency, the BRAVO HA system can be equipped with optional operator terminal and wireless jogbox.

The operator terminal performs the task to remote the main PC (screen, mouse and keyboard) allowing the user to work as close as possible to the CMM measuring volume.

The wireless jogbox (available as an option) is particularly useful for operations with such a large CMM, i.e. during self-teach part programming, when cables may be a hindrance to the operator.

Flexible Fixturing System

The systems commonly used for fixturing thin-walled components, both fixed and modular ones, are effective devices but they are definitely costly – from the building of fixtures to their maintenance and handling, and all that by the high number of elements required to fixture whole product lines.

FIVE system – DEA exclusive patent – offers the users a revolutionary alternative to fixturing systems. It is characterized by an extremely flexible use and reasonable costs. A set of columns can be positioned by the CMM on the surface plate and the rod lifted at the requested height. The columns' position is determined based on the design data of the part. The fixture is then completed with supporting, clamping or reference modules for the part to be measured.



Remote wireless joystick and operator terminal on a trolley





DEA

Since 1963, DEA has been one of the world's premier brands in Coordinate Measuring Machine technology. The main facilities are located in the Torino area (Italy), where highly skilled teams of mechanical, electronic and software engineers are committed to the continuous development of state-of-the-art solutions for dimensional quality inspection. DEA products are used by virtually every industry in every geographical market throughout the world.

Hexagon Metrology

Hexagon Metrology is part of the Hexagon group and brings leading brands from the field of industrial metrology under one roof.

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