



DEA BRAVO C/C HS/HD/HP
Horizontal-Arm
Coordinate Measuring Machines



Serving Metrology Worldwide

www.dea.it





The Evolution of Sheetmetal Inspection

DEA 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.

DEA BRAVO C and **DEA BRAVO C HS** are technically advanced and cost-effective solutions for flexible and accurate dimensional inspection of thin-walled components, ideal for mid-size parts in industrial environments.

DEA BRAVO HD and **DEA BRAVO HP** are automatic horizontal-arm systems characterized by high performance, designed to optimally tackle a wide variety of metrology applications.

They are advanced systems offering a consistent and efficient approach to car-body inspection and integrate innovative industrial measurement technologies into single- and double-arm horizontal structures.



An abridged list of DEA 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



R-evolutionary through the years since the '80s

These are the features that make DEA BRAVO systems the state-of-the-art for the dimensional inspection of body-in-white, and allow to implement a truly automatic, flexible inspection process:

INTEGRABILITY – The open architecture of electronic control and software as well as the Runway mechanical structure of the DEA BRAVO line allow the effective integration of the measurement cell in manufacturing environments. Hexagon Metrology uses an experienced team of systems engineers and project managers that facilitate and guarantee the success of the integrated solutions.

PERFORMANCE – They make a direct contribution to reducing measuring cycle times, which is essential to keeping the production process under control in real time. The traditional dynamic performance of DEA BRAVO systems is present in the DEA BRAVO HP (High Performance) series, while maximum flexibility also in a control room is offered by the DEA BRAVO HD (Heavy Duty) series.

The DEA BRAVO Console line is a cost-effective solution, fully made of steel, ensuring high structural stability in all environments. Two versions are available: DEA BRAVO C and DEA BRAVO C^{HS} (High Speed) with dynamic and accuracy performances at the top of its class.

FLEXIBILITY – Inspection of several components with a single measurement cell. Possibility to use a broad range of indexable or continuous motorized heads, probe extensions and contact as well non-contact sensors.

ACCURACY – Generation of accurate, significant data capable of ensuring the best preventive measurements, both in the control room and on the assembly line. All DEA BRAVO HD and DEA BRAVO HP systems use an innovative compensation algorithm for mutual alignments in dual opposing arms systems.

DEPENDABILITY – Efficient operation under the same environment conditions of the production process – no need for special

operating conditions. The most sophisticated proven technologies allow the DEA BRAVO systems to operate with maximum accuracy even in environments with sudden temperature changes.

DEA BRAVO HD and DEA BRAVO HP can operate in a temperature range of 16-32 °C, while DEA BRAVO C and DEA BRAVO C^{HS} are metrologically tested in a temperature range of 16 – 24 °C.

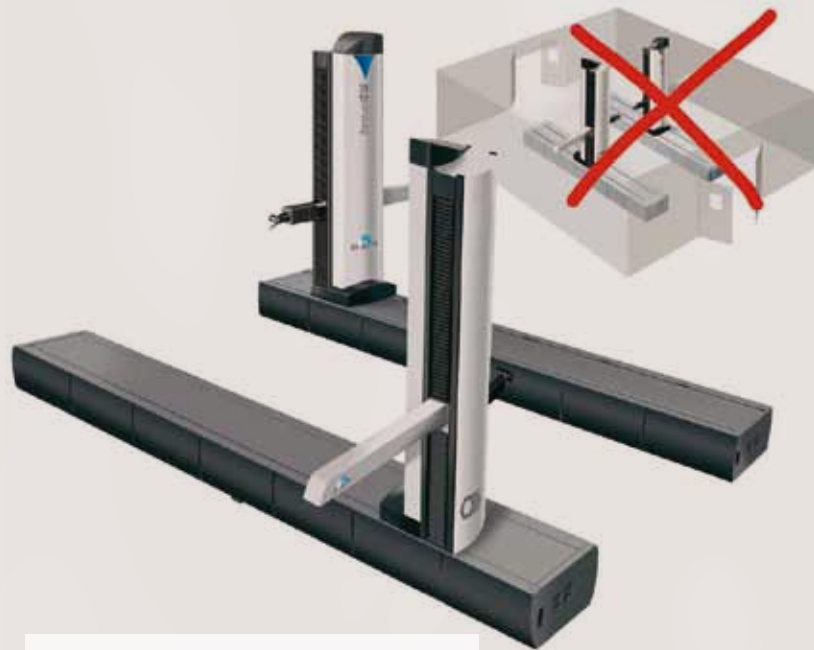
MODULARITY – Configuration of the measurement cell to the specific requirements of the manufacturing process. The DEA BRAVO series is available with the widest range of useful measuring travels.

SOFTWARE – The system can be adapted to reflect the real application requirements. Broad selection of platforms and computers customizable to suit the customers' needs.

Factors that Affect Accuracy

DEA BRAVO HP: Environment Temperature

Environment temperature variation is one of the factors affecting the metrologic performance of measurement equipment. To limit unwanted effects, the most common solution consists in simulating the ideal temperature conditions in enclosures or rooms. This solution is the simplest on a technical basis, but it is the most expensive one, particularly for large-sized measuring machines. In most cases, the DEA BRAVO HP series requires no air-conditioned machine enclosure since it is designed to work efficiently in a shop-floor environment. The technological solutions adopted are the outcome of many years of experience in the application of measurement systems in industrial environments.



All DEA BRAVO models offer:

- Easy access to the feature

The inspection of body-in-white requires both long probe extensions (to get access to critical points) and special angles of approach. The latter requirement is even more important when non-contact probes are used. The angle of approach may considerably affect probing accuracy. The DEA BRAVO series is available both with the CW43L-mw continuous wrist and with the TESASTAR-m motorized indexable probe head.

- CW43L-mw

This continuous rotary wrist allows full access to the part being measured and the automatic change of extensions (up to 570 mm) and adapters. The CW43L-mw is available in 3rd continuous axis configuration for the correct application of non-contact sensors, such as the laser sensor CMS106.

- TESASTAR-m

Motorized articulating probe head capable of rotating about two axes in 5° increments, which translates to a total of 2,952 possible positions. The robust aluminum construction permits extension rods with lengths over 300 mm.

- CMS106

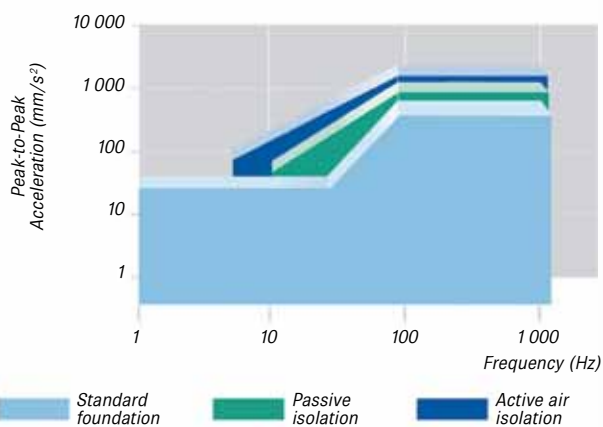
The CMS106 is a laser line scanning sensor with two unique features:

- three level zoom offering a 24, 60 or 124 mm laser line
- automatic, real-time laser power adjustment

The sensor offers rapid non-contact metrology for three key application areas: free form surface inspection, sheet metal feature inspection and reverse engineering.



Environment Vibrations



DEA BRAVO HP: Environment Vibrations

The vibrations present in a shop-floor environment are a determining factor affecting the metrologic performance.

The foundation on which the measuring machine is installed plays two significant roles: it stabilizes the geometric rigidity of dual-arm systems and it insulates vibrations.

Depending on the nature (frequency and intensity) of vibrations, further insulating elements may be added to the foundation -both passive, and, in the most critical cases, active elements. In all cases, the rigidity of the X beam of the DEA BRAVO HP systems helps ensure that the initial performance is kept over time.

The Measurement Software



PC-DMIS® is the measurement software for the analysis and inspection of simple prismatic parts, complex geometric features and 3D surfaces. Available in three versions (PRO, CAD, CAD++), PC-DMIS performs most application tasks required by the modern industry.

PC-DMIS allows the user to create customized, intuitive inspection reports. With its CAD and CAD++ modules, PC-DMIS can import directly the CAD model of the part, thus simplifying the programming task. In addition, the CAD++ module offers several useful functions for measuring form errors of complex contoured components, like turbine blades, dies, models, sheetmetal components and other curved shapes.

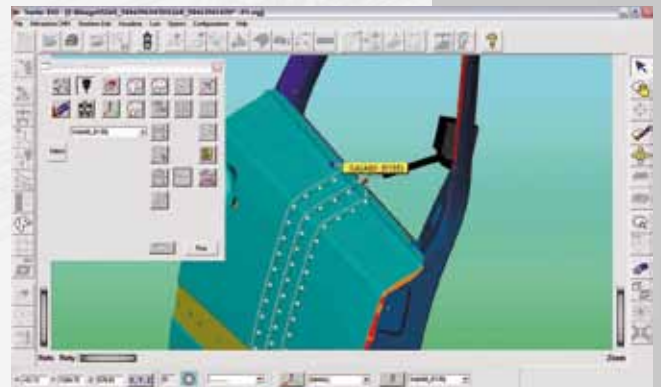
Automatic Procedures for Measuring Sheetmetal Components

The CAD++ module of PC-DMIS includes a series of automatic procedures for measuring the characteristic features of sheetmetal components. These procedures improve the efficiency of the measurement system, and they simplify and speed up programming tasks. The operator only needs to enter key data. The system will automatically generate the measurement program, complete with positional moves and measurement instructions. While the cycle is being executed, automatic feature search functions prevent part positional errors or the lack of the characteristics required from causing system collisions or accidental program blocks.



Surfer EVO is a powerful and flexible solution offering a large number of software modules to meet all requirements in connection with inspection, quality control, dimensional analysis, process control, and reverse engineering with tactile and non-contact sensors.

Surfer EVO offers dedicated tools for the offline analysis, the generation of customized measurement graphic reports, the creation of optimized alignment systems between part and CAD model (Best-Fitting or R.P.S.), GD&T analysis of details characterized by 3D surfaces (tolerances of profiles on surfaces and curves).



Surfer EVO includes specific solutions for measuring and inspecting profiles and thickness dimensions that are typical of sheetmetal parts (sheetmetal applications). The availability of a wide selection of CAD interfaces allows you to import all major CAD 3D formats (such as UNIGRAPHICS, CATIA, PROE, SOLIDWORKS, IDEAS, ACIS) and export them into IGES format.

Surfer EVO also allows performing metrology analysis of the part starting from the scanning data. Using an advanced graphic environment, Surfer EVO compares the mathematical model with the scanning data, including alignment systems, color mapping, automatic detection of the feature, as well as advanced and flexible reporting.

The DEA BRAVO Family

DEA BRAVO systems stand out for their exceptional dynamic and metrology performance, the excellent dependability of operation in harsh industrial environments and the ability to withstand being subjected to sudden differences in temperature.

DEA BRAVO HD, DEA BRAVO HP

The open structure can be embedded in the walkable area. Walkable covers along the longitudinal axes ensure the maximum ease of access to the measurement area, thus simplifying the part loading/unloading operations, programming and automatic dimensional inspection.

DEA BRAVO HP and DEA BRAVO HD are designed to ensure maximum protection to the operator and the parts being measured, in compliance with the strictest international safety regulations.

Main Features:

- Rigid steel structure for maximum dimensional stability in a wide range of operating conditions
- Axis sliding through high-accuracy recirculating ball pads (compressed air is not required)
- Rigid ram with 80 x 100 mm section, prewired to accept the anticrash protection option.
- Fully covered mechanical structure (DEA BRAVO HP)
- Forced air circulation inside the main beam for leveling structure temperature
- Multisensor temperature compensation – ensures optimum measurement accuracy even with significant temperature variations (up to 16-32 °C)
- Axis motion with sturdy reliable motors coupled with rack & pinion systems for the X axis and timing belts on the Y and Z axes
- Innovative adjustable slack-free arm counterbalance
- X sliding having a provision for installation flush to the floor
- Linear optical scales with 0.5 µm resolution
- Compatibility with CW43L-mw continuous rotary wrist (up to 3 axes), efficient control of non-contact sensors and probe extensions up to 570 mm

DEA BRAVO C, DEA BRAVO C HS

The DEA BRAVO Console line is a technically advanced and cost-effective solution for flexible and accurate dimensional inspection of thin-walled components, ideal for mid-size parts in industrial environments. The guideways located on the side of the machine base (Console architecture) allow the arm to be moved fully outside of the working area. This allows for optimal access to the work area for simple part loading/unloading operations. The cast iron machine table features the exclusive three-point support system, which eliminates the need for costly dedicated foundations, and makes the installation on vibration dampers easier. Just like the HP and HD series, the DEA BRAVO Console line is fully made of steel, ensuring high structural stability in all environments.

Two versions are available: DEA BRAVO C and DEA BRAVO C HS (High Speed).

Main Features:

- Rigid ram with 80 x 100 mm section
- Axes slide on high-accuracy recirculating ball pads
- Innovative adjustable slack-free arm counterbalance system
- Linear optical scales with 0.5 µm resolution
- Compatibility with CW43L-mw continuous wrist (compressed air is required); efficient control of non-contact sensors and probes extensions up to 570 mm
- Isostatic three-point support system only for X stroke = 3000 mm
- Protection bellows on the X and Y axes (available as an option)
- Axis motion with sturdy reliable motors coupled with rack & pinion systems for the X axis and timing belts on the Y and Z axes
- Work plate made in cast iron, available as options with tapered M8 x 1.25 holes pattern, T-slot, high load bearing capacity and FIVE U-nique plane



DEA BRAVO HP Fast, Accurate, Integrated

Applications

- Dimensional inspection of car body components, body-in-white, chassis, subassemblies, panels, and also for process control along assembly lines
- High-speed reverse engineering of complex surfaces creating CAD models

Operating Environment

- Shop-floor environment, adjacent to or directly integrated into the assembly lines or car body welding
- Metrologic temperature ranges: 18-22 °C, 16-26 °C, 16-32 °C
- Dynamics optimized for maximum speed and throughput

Probe Heads

- Standard: CW43L-mw (two or three axes)
Optional: TESASTAR-m



DEA BRAVO HD/HP standard X axis measuring strokes: 4 000, 6 000, 7 000, 9 000 mm.

All DEA BRAVO HD/HP models are available in both single and double arm configuration.

The specified strokes, dimensions, and weights refer to the single arm configuration.

Series	Strokes (mm)			Overall Dimension (mm)			Weight (kg)
	X	Y	Z	Length	Width	Height	
60.16.21	6000	1600	2100	6997	4144	3594	4665
60.16.25	6000	1600	2500	6997	4144	3994	4715
60.16.30	6000	1600	3000	6997	4144	4494	4775



DEA BRAVO HD Versatile, Accurate, Robust



Applications

- Dimensional inspection of thin-walled components, bodyshells, chassis, subassemblies, panels, car doors, glasses, dashboards
- Dimensional inspection of castings, structural aircraft, ship and railway components
- Metrology support to die and mould manufacturing
- Reverse engineering of complex contoured shapes creating CAD models

Operating Environment

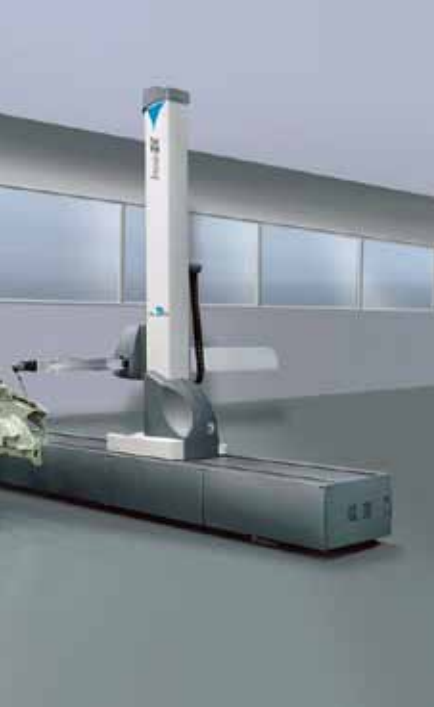
- Quality control room, "Meisterbock" room
- Metrologic temperature range: 18-22 °C; 16-24 °C; 16-32 °C
- Dynamics optimized for maximum versatility

Probe Heads

Standard: TESASTAR-m

Optional: CW43L-mw (two or three axes)

Series	Strokes (mm)			Overall Dimension (mm)			Weight (kg)
	X	Y	Z	Length	Width	Height	
60.16.21	6000	1600	2100	6997	4148	3547	4640
60.16.25	6000	1600	2500	6997	4148	3947	4690
60.16.30	6000	1600	3000	6997	4148	4447	4750



DEA BRAVO C, DEA BRAVO C HS Compact, Flexible, Robust

Applications

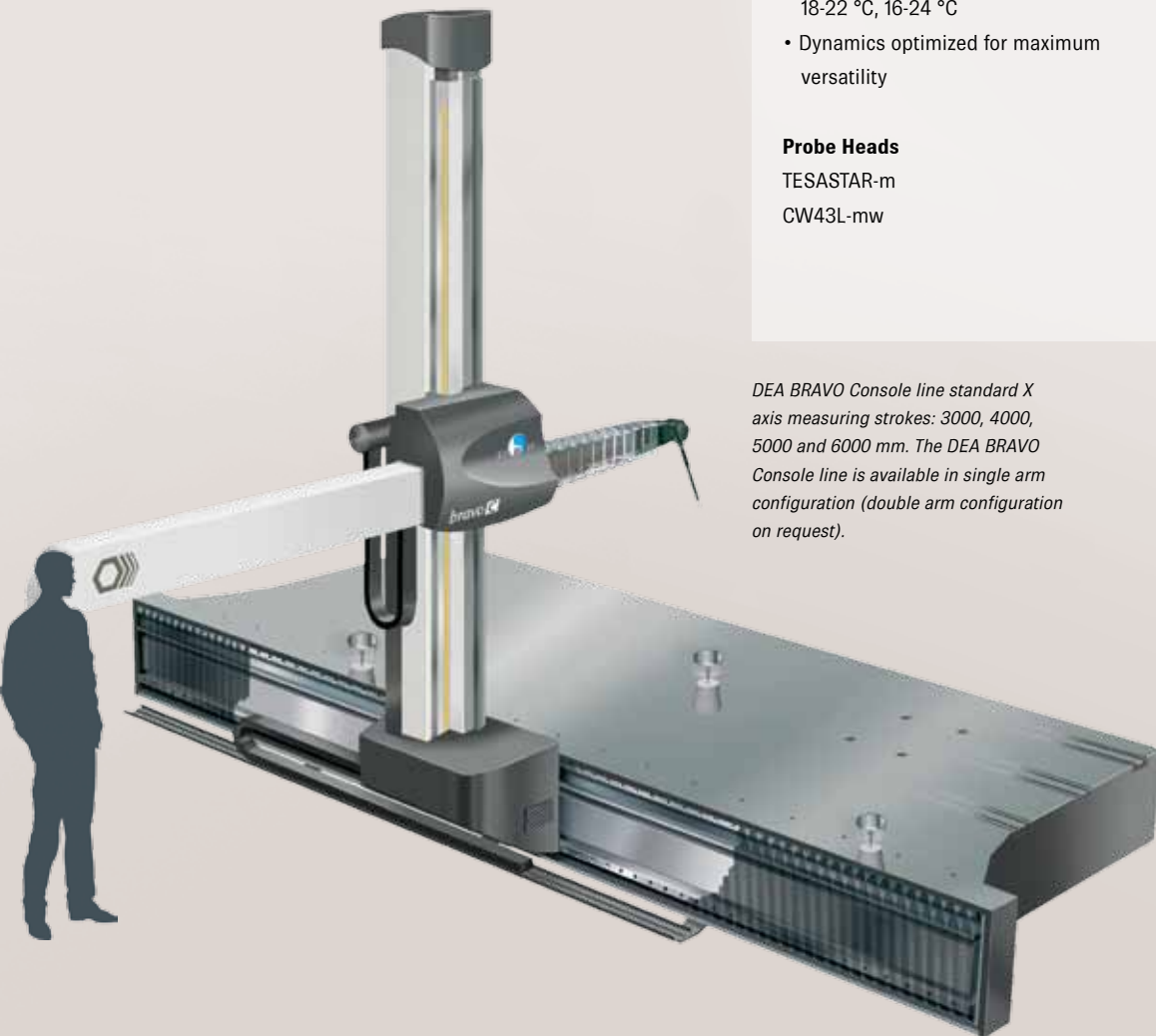
- Dimensional inspection of thin-walled components, ideal for mid-size parts in industrial environments
- Reverse engineering of complex contoured shapes creating CAD models with non-contact probes

Operating Environment

- Quality control rooms, clean workshop
- Measurement temperature range: 18-22 °C, 16-24 °C
- Dynamics optimized for maximum versatility

Probe Heads

TESASTAR-m
CW43L-mw



DEA BRAVO Console line standard X axis measuring strokes: 3000, 4000, 5000 and 6000 mm. The DEA BRAVO Console line is available in single arm configuration (double arm configuration on request).

Series	Strokes (mm)			Overall Dimension (mm)			Weight (kg)
	X	Y	Z	Length	Width	Height	
30.14.16	3000	1400	1600	3750	3698	2983	4600
40.16.16	4000	1600	1600	4750	4098	2983	6600
50.16.21	5000	1600	2100	5750	4098	3483	8200
60.16.25	6000	1600	2500	6750	4098	3883	9800



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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