



SPECIAL GAGING

## SPECIAL GAGING

### THE STARRETT SPECIAL GAGE DIVISION

Even with our extremely broad catalog of products, some application measurement requirements can not be met with a standard tool – they require a custom solution.

One way Starrett stands out from other precision tool providers is our willingness to work directly with our customers to develop custom tools and gages. Established over 50 years ago, our Special Gage Division is an independent group within the Company that devotes its total effort to developing and building special gages.

Once we determine that no "off-the-shelf" product is applicable, our engineers begin a dialog with the customer to develop a custom tool for the specific task.

Together, we discover what you want and need. Then, we design and build a special tool or gage that will perform to your expectations – with rugged construction, easy and intuitive operation, Starrett quality and guaranteed to meet your specifications for accurate, reliable part measurement.

Design work is treated in a strictly confidential manner. Design-and-build prices are quoted at no charge. Prices are fixed at order entry.

### SINGLE-SOURCE RELIABILITY

We make and use electronic indicators, AGD dial, electronic and mechanical micrometer heads, and all of the other tools or gages that provide the output from the custom gage.

We also make DataSure® Wireless Data Collection Systems, which we have integrated into an increasing number of special gages so measurement data can be gathered and recorded with 100% reliability.

Simply put, our service and expertise are second to none – we control the entire process from concept through design, manufacture, inspection and delivery.

We offer the resources of this unique problem-solving division to innovate, design, and build the equipment you need to control product quality and reduce dimensional gaging costs.

The following pages show some examples of gages we have developed and built.



Custom designed and built  
Area Flow Gage

### SPECIAL GAGE DIVISION MISSION

We design and build dimensional measuring instruments that provide guaranteed performance to meet our customers' specifications. We are in the business of solving measuring problems when standard gages cannot be used.

Find out more about Starrett Custom Solutions at: [starrett.com/custom](http://starrett.com/custom)

### CONTACT US

We encourage you to contact us directly to discuss your application.

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The L. S. Starrett Company  
Special Gage Division  
121 Crescent Street  
Athol, MA 01331-1915



Custom Height Gage with a  
78.7" (2000mm) range and  
resolution of .0005"





# SPECIAL GAGING

## MEASURING HOT STEEL DURING ROLLING, FORGING OR EXTRUDING

Starrett Special Gage was asked by a customer to develop a new gage for measuring hot steel flat stock during the rolling process.

The old measuring device utilized a gage with a crude fractional dial that did not provide accurate or repeatable results. In addition, it often stuck to the hot steel and ruined the piece being measured. Even worse, on several occasions, the old process caused burn injuries to the operator.

The customer needed a new solution that provided precise and reliable results, a much lower scrap rate, and ensured operator safety.

The application presented some unique challenges. Any operation that requires contact with hot steel is dangerous and must be of very brief duration.

## FROM PROBLEM TO SOLUTION

After collaboration between the engineering staffs of our customer and the Starrett Special Gage group, a radically different gage was developed that met all of the design criteria.

## THE HOT STEEL GAGE

- Takes measurements quickly, with only two seconds of contact
- Uses an electronic indicator with a hold feature to lock the reading so it can be safely read away from the dangerous area, and in better light conditions
- Nickel plated to minimize radiant heat transfer
- The operator's hand stays 12" away from the hot steel
- The gage is very accurate, measuring to  $\pm .003$ "

## A FAMILY OF GAGES

A number of satisfied companies are now using the Hot Steel Gage. Starrett has developed a family of related products with capacities up to 12" (in 1" or 3" increments) and 2' or 3' in-reach capacity. Other variations have modified jaws for measuring round stock.



The Hot Steel Gage is now a family of products with capacities up to 12"



Hot Steel Gage with a DataSure® End Node



Variation on a theme: A large caliper with long reach for web thickness of train tracks hot or cold.

## DATA SURE® WIRELESS DATA COLLECTION

Starrett introduced the DataSure® Wireless Data Collection System several years after the hot steel gage was developed and it was a perfect fit for this application.

With DataSure®, the measurement data can be recorded and sent to a data collection application with 100% reliability immediately after it is recorded by the indicator.

Many manufacturers now include DataSure when they order these gages, and existing gages have been field-retrofitted.



## SPECIAL GAGING

### CONTAINER FIT MEASUREMENT FOR THE FOOD AND PLASTICS INDUSTRIES

#### PI-GAGES FOR I.D. AND O.D.

Starrett PI-Gages protect product quality by maintaining critical diameter tolerances of plastic lids and containers where shrinkage, temperature and mold affect parts manufacturing. The diameter of these parts is critical to the sealing integrity between lids and containers.

We have developed a wide variety of hand held and fixture gages for many related applications. Starrett PI-Gages measure most diameters accurately to within  $\pm 0.001$ .

Designed to measure any flexible circular part, variations of these gages have been in use for over 25 years, and have become the standard of the industry.



#### FIXTURES FOR LARGE O.D. OR I.D. MEASUREMENT



Metal band I.D. fixture for 1/2-gallon container



Master in position to set indicator to zero



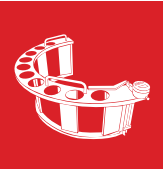
Top of 1/2-gallon container in measuring position



#### PI-PLATE GAGE FOR O.D.

This gage ensures container quality requirements with an easy-to-use gage system. With either electronic indicators (and data collection), or dial indicators, this gage measures most product diameters to  $\pm 0.001$  accuracy.

Each gage from the 2" to 4" range through the 10" to 12" range is set with the master. Push the button on the indicator to insert a part and release the button to gage a part within  $\pm 0.025$ " diameter range from the master size. They provide quick changes from size-to-size, ease of use, and  $\pm 0.001$  accuracy on most diameters will ensure process control.





### PNEUMATIC FOOD TRAY MEASUREMENT

This gage measures width, length, and height of food trays. Full part length contacts ensure the correct dimensions for every measured parameter.

The gage employs a system of pneumatics to withdraw probes for quick, easy loading and unloading of trays.

A steel master is used to replicate a perfect part. The electronic indicators are then set to their mean values.

The result is a reliable and accurate system with fast throughput to measure a specialized, complex part.

### MEASUREMENT OF THE INTERFACE OF A COFFEE CUP AND LID

Most of us have heard the story – a large fast food chain is sued because the lid came off of a Styrofoam coffee cup and scalded a customer. The company lost the suit and the word went down to find a way to make sure that the lid stays on and the cup does not leak – a specialized, difficult measurement that required a custom solution.

The hand held gage pictured provides the perfect solution to this application. The cup and lid are both measured with the same gage, with a simple sensor change to go from one to the other.

Each are measured to within  $\pm .001$ ".

The result is a reliable and accurate system that keeps the lid on the cup and prevents leaks. The fast food customer is safe from hot coffee and our customer is safe from costly lawsuits.



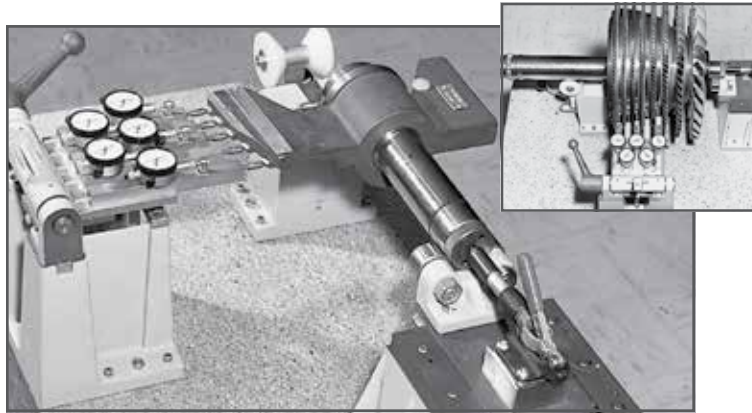


## SPECIAL GAGING

### TURBINE COMPRESSOR ROTOR SPACERS

This inspection fixture checks gas turbine engine compressor rotor spacers for radial size and runout at five stages.

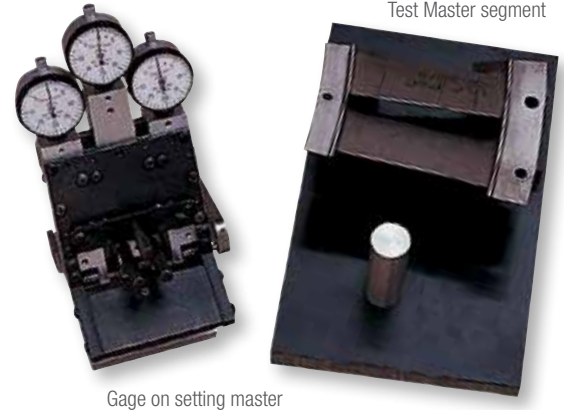
It represents a specific Starrett special gage capability — the designing and building of large, ultra-precise fixture gages mounted on Starrett precision granite surface plates which meet or exceed U.S. Federal Specification GGG-P-463C.



Inset: Rotor turns 360° on its axis to determine runout and radial deviation.

### TURBINE NOZZLE DIAPHRAGM OPENING GAGE

This gage checks three critical dimensions in the nozzle. This is an older and less complex design than the gage above, and it does not measure the radial height dimension.



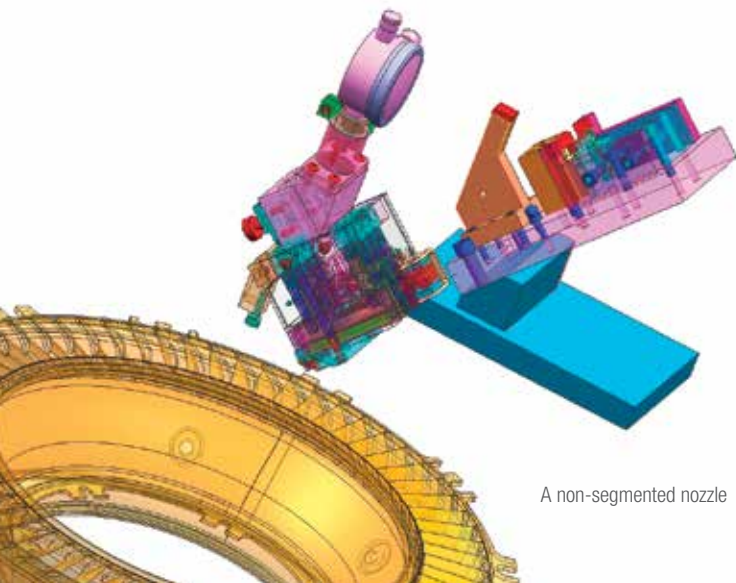
Gage on setting master

Test Master segment

## AEROSPACE

### AREA FLOW GAGE

Area Flow Gages measure the minimum area openings of turbine engine nozzles. Area readings are in .001 square inch resolution. It uses eight or more contacts that reach into the throat of the turbine nozzle openings. The recorded measurements are transferred via hydraulic cylinders to a dial indicator. Using mechanical linkage and hydraulics the algebraic area is transferred to the indicator or electronic probe at the top of the gage. Openings of segments are matched and located opposite one another on the engine circumference to provide a balanced air flow. These gages are custom designed for each stage of the turbine and are critical to proper engine performance and operation.



A non-segmented nozzle



# SPECIAL GAGING

## HIGH PRECISION CYLINDER MEASUREMENT

We offer a full range of snap gages that utilize highly polished carbide contacts to measure cylindrical parts to as close as  $\pm .0001$ ".

The gage has an insulated handle with a thumb activated contact lift and a bump stop.

Each gage with optional master can measure a 1" range with exceptional accuracy.

They are available as bench or handheld gages.

## ADJUSTABLE RANGE SNAP GAGES

These snap gages have a lightweight aluminum frame and low-friction ball bushing motion transfer.

The indicator can be rotated and locked for easy viewing in any position.

Ball contacts or contacts for grooves are also available. They are also available with electronic indicators.

They have simple and rugged construction including sturdy dovetail slides for range adjustment. This is a proven low maintenance gage with a long trouble-free life.

Three standard size ranges are available: 6-10", 10-14", and 14-18".



Measuring a turbine component.



## SPECIAL GAGING

### OUTSIDE AND INSIDE DIAMETER GAGES

Individually designed and built for each application, these gages have a low-friction bushing direct-transfer mechanism and will repeat within one graduation.

It is made of aluminum for light weight and to preserve the proper "feel". Gage contacts and rest feet are carbide for long wear.

The steel tube master has carbide rests and pads for accuracy and wear control.

Shown here is an angled outside diameter gage in position on the setting master to set the indicator to zero.

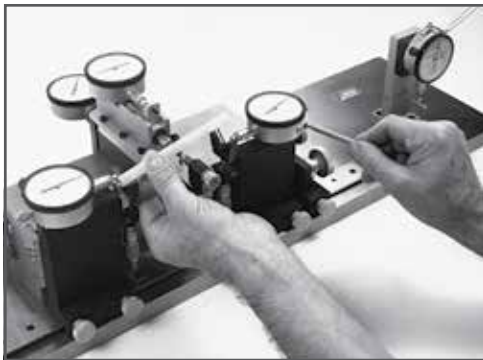
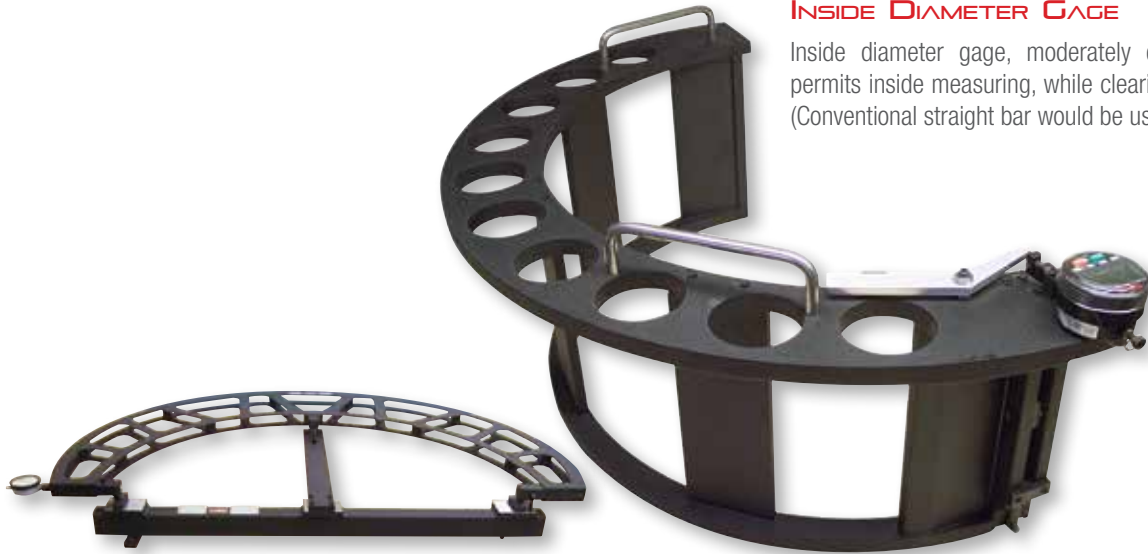
This specific gage was designed to measure the diameter on conical parts.



Angled outside Diameter Gage with Setting Master

### INSIDE DIAMETER GAGE

Inside diameter gage, moderately deep reach. Design permits inside measuring, while clearing hub obstructions. (Conventional straight bar would be used otherwise).



Inserting ceramic cylinder in gage to check squareness and parallelism of ends, longitudinal bow and out-of-roundness

### MULTI-READOUT AND SPECIAL PURPOSE GAGES

This complex five-station fixture gage checks critical dimensions and geometry of precision cylinders.

This single fixture checks overall length to  $\pm .010$ ", squareness and parallelism of the ends to within  $.002$ ", longitudinal bow to within  $.005$ ", out-of-roundness to within  $.003$ " T.I.R, and wall thickness to within  $\pm .003$ ".

The gage includes micrometer head height adjustment of the work-staging V-rests. It has precision ball slide mounts for dial indicators at two of the stations and wear-resisting carbide contacts at all gaging stations.







### ULTRA-LIGHT HONEYCOMB DEEP THROAT AND LARGE DIAMETER GAGES

A large diameter or deep-throated gage no longer has to be heavy and hard to handle. Starrett special gage engineers have studied the physical and structural properties of honeycomb aluminum, establishing standards covering the selection and use of this lightweight material.

The results were long-range measurement to close tolerances in hand-held gages of many configurations, all combining great rigidity with light weight and ease of handling.

It measures diameters to 72" (180cm) and throat depths to 24" (60cm).

### ULTRA-LIGHT DEEP THROAT GAGE

This deep throat indicating micrometer gage solves the problem of checking the .281" ( $\pm .005$ ") thickness of a fan rotor shaft at a point nearly 15" from its edge.



### ULTRA-LIGHT LARGE DIAMETER GAGE

This gage is used as an indicating snap gage by setting the indicator to zero with the set master and then reading the part size variations on the indicator.

The setting master is a Starrett 234 End Measuring Rod with insulated grips and saddle-centering mounts.

Sizes are available from 18" to 24" through 84" to 90".

This gage can be made into an adjustable snap gage by fitting one end with a micrometer and the other end with an indicator. They are available with dial or electronic indicators.

Other concepts are available to suit specific requirements.



## SPECIAL GAGING

### SPECIAL GEOMETRIES

#### THICKNESS GAGES

We have fulfilled many requests for special purpose gages to measure material thickness in hard to reach areas.



#### QUICK-ADJUSTING MICROMETER HEAD

We have developed a number of custom gages utilizing a Starrett 30380 Quick Adjusting Micrometer Head. It greatly increases the speed with which measurements can be taken.

Pressing a button on the thimble allows the spindle to slide along its axis to any position within its range. Releasing the button re-engages the spindle threads, and thimble rotation is then used for final size adjustment.

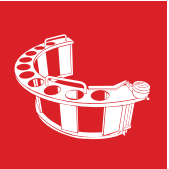
Gages with these micrometer heads can save a lot of time when taking precise measurements in hard to access areas



#### DIAL PROTRACTOR HEADS

Starrett Dial Protractor Heads for special applications permit rapid angular measurements. With 90° range and graduations of 5' they will assure accurate measurements.

Specifications – Bezel diameter is 2-1/4"; case thickness is 1.34" from crystal to back; .25" dia. input shaft projects .63" from back of case. Main dial reading to customer specification; graduation – specify 0°5', 0°10' or 0°15'. Also available with balanced dials and with counterclockwise figures in red.



## SPECIAL GAGING

### UNIVERSAL BENCH GAGE

Sizes from 0 to 4" are rapidly checked to .0001" accuracy with a dial or electronic indicator. The gage range is  $\pm .100$ " from the zero set point on a master. A rugged ball bushing motion transfer provides accuracy for many maintenance-free years.

With optional contacts, this gage can be quickly set up to check inside and outside diameters, slot and groove widths, length or thickness, and splines or gear pitch diameters.

Move the lockable slide to reverse this gaging direction. Attach the required contacts and set the indicator to zero with a master. You are ready to gage a different part in less than five minutes.

The gage is also available with a digital indicator that will hold the reading from one sweep over the part to eliminate errors.



Contacts are available for numerous applications. Optional 2- or 3-point contact sets are available with flat or rounded faces, conical points, steel or carbide balls, and pins for over-roll dimensions.

### DATA COLLECTION

SPC requires accurate input of product dimensions. Speed and accuracy are the demands met by this special gage and the 776 Gage -Chek™.

One special gage and one 776 displays and stores up to eight dimensions. As shown, the larger diameter, small diameter, concentricity and length are checked in one step. It takes less than ten seconds to take and store all four dimensions.

The actual sizes are entered into the 776 display. Both the variance from nominal size plus actual size can be displayed.



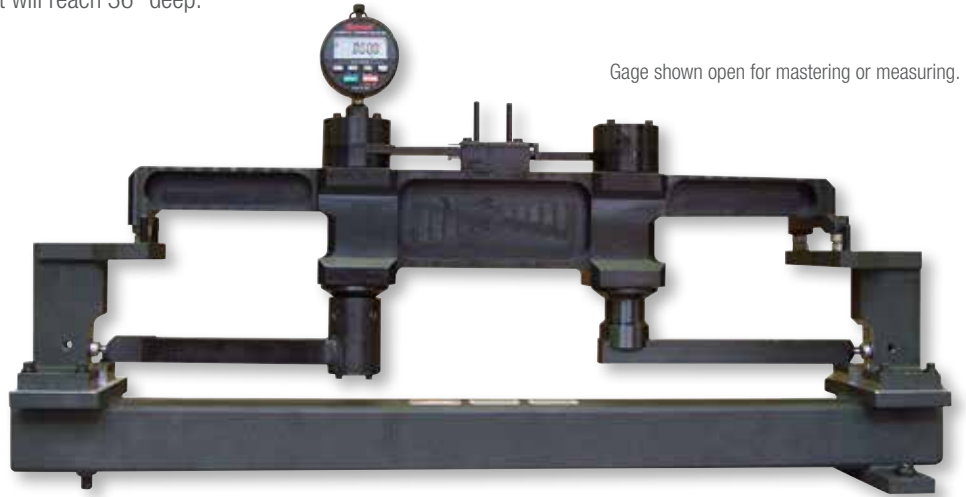


## SPECIAL GAGING

### INSIDE DIAMETER DOUBLE-TURRET GAGES

This gage was designed to fit through a diameter much smaller than the one to be gaged. A double-turret gage can check an I.D. up to two times larger than the hole it will pass through. Single-turret gages can be designed for I.D.s up to one and one-half times larger than the hole it will pass through. Accurate gages have been supplied that will reach 36" deep.

Gage shown open for mastering or measuring.



Gage folded for insertion or removal.



Turrent gage shown open for inspecting parts.



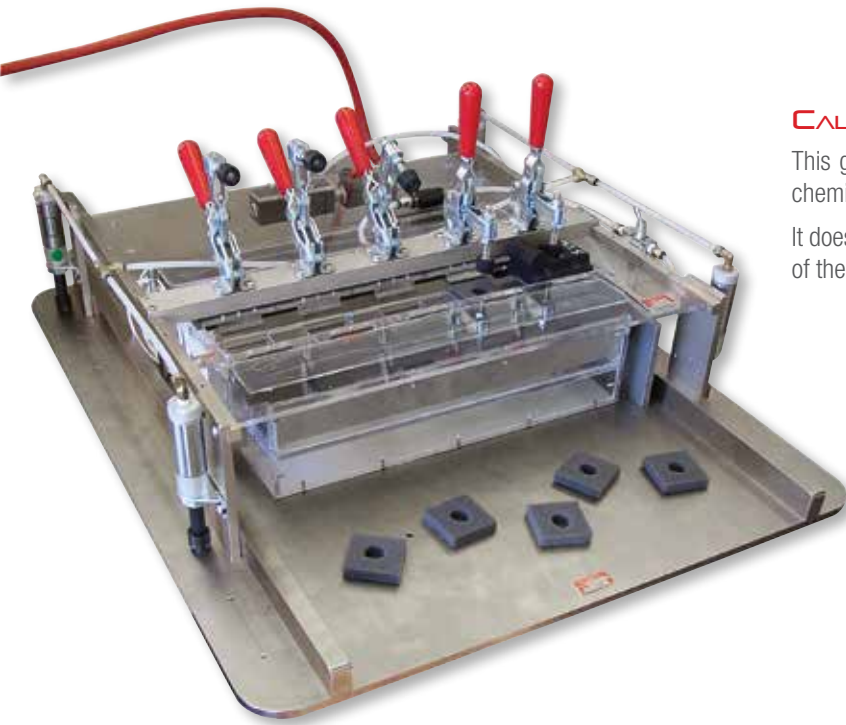
# SPECIAL GAGING

## VARIABLE HEIGHT DIAMETER RADIUS GAGE

Diameters, radii and lengths (from known "bump stops") can be measured using this long gaging range, electronic indicator assembly.

It is capable of locking into position at specific heights and moved up or down as needed.

Gage (right) shown on top of master (below and left)



## CALIBRATION GAGE WITH PNEUMATIC ADJUSTMENT

This gage is used to check the equipment that detects the level of a chemical in two tanks.

It does not do the actual measuring, but verifies the validity/compliance of the detectors.



## PERFORMANCE RACING

### STAGGER PRO 1000

The Stagger Pro 1000 utilizes electronic caliper technology to quickly and accurately record front and rear stagger for oval track car setup. The Stagger Pro is simple to use and eliminates potential errors that could result in costly setup mistakes. With simple button presses the Stagger Pro quickly measures each tire and calculates the front and rear stagger. Adjustable to accommodate a variety of tire sizes.



### RIDE HEIGHT GAGE

Controlling the ride-height of a car is one of the most strict rules in racing. Starrett developed a custom-engineered Ride Height Gage that provides easier, more precise measurement before and after the race.



### CYLINDER BORE GAGE

The design of the cylinder gage is to access the engine's piston cylinder cavity through the spark plug opening. The design allows a quick check of racing specifications of the cylinder cavity diameter, especially modifications beyond what's acceptable, without the need to dismantle the engine block for access.

