

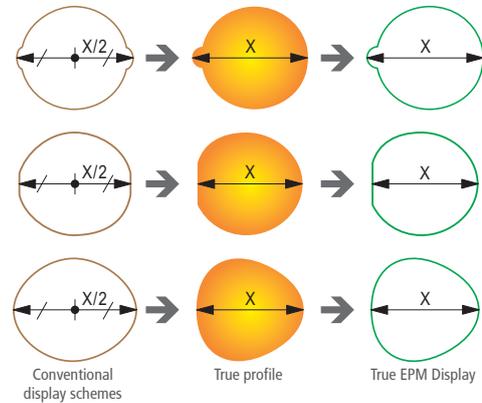
# Zumbach Technical Note

EPM "Enhanced Profile Measurement" (pat. pend.) for Dynamic Capture of the Real Profile (Cross Section) During In-Line Measurements on Rolling Mills. Special Version FPS for 3-Roll Technology.

## Background

Most in-line measuring systems equipped with laser or CCD technology (shadow) show the captured values in symmetrical fashion (halved) as polar coordinates to a virtual center. This is the most simple and commonly used method, which often renders an interpretation of the display and subsequent process corrections difficult.

ZUMBACH's EPM method allows the capture and quasi 1:1 display of the real profile dynamically on-line. Depending on product and rolling process, the EPM principle can be used on various models (static SMS, oscillating SMO or rotating SMR).

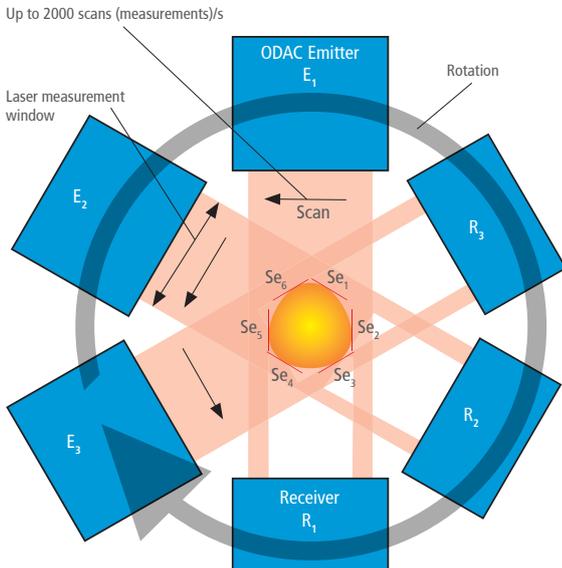


## The Operating Principle of EPM

Below is a simplified explanation of the operating principle relative to the rolling mill:

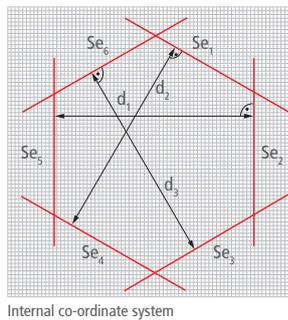
### Step 1: Scanning

Three (3) or more ODAC® Laser Scanners generate tangential and fully synchronized scans, each providing up to 2000 measurements/s. The product position within the measurement window is largely immaterial.



### Step 2: Data Capturing

The 3 synchronized scans yield an "instant picture" of the position of 6 shadow edges ( $Se_1 - Se_6$ ) of the product, related to an internal coordinate system and 3 precise diameters  $d_1, d_2$  and  $d_3$ .



The high measurement rate of up to 2000/s, coupled with powerful computing, allows for processing of numerous "instant pictures". High accuracy and stability are achieved, even as the product is vibrating and swaying while passing through the gauge at high speed.

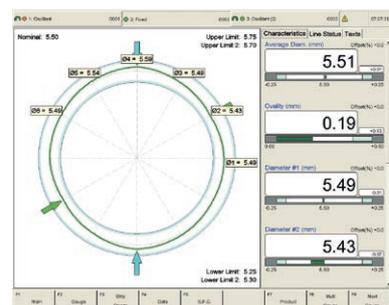
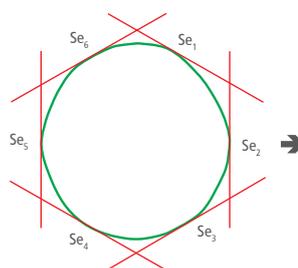
### CSS (Calibrated Single Scan)

The new CSS Technology is of top importance as each scan produces a calibrated measurement value. Averaging of measurement results, coupled with "blurring" time and location of the single measurements is largely eliminated.

### Step 3: Completing the Profile

The entire circumference of the profile is completed, based on the 6 shadow edges and application of specially adapted algorithms. The relevant product and process related parameters are then derived and calculated.

In case of round products, like pipe or bars with inherently "oval" deviations of their shape, a practically realistic profile is determined, regardless of product orientation.



## Alternative Gauge Versions

The EPM technology can be used with various gauge versions. With static SMS gauges, typically with 6 axes, the diameter, roundness and polygonality can be captured at high rates (number of profiles/s). However, longitudinal faults such as seams, flat spots and similar, remain undetected if they are located between 2 measurement axes.

Oscillating SMO and rotating SMR gauges capture the full circumference, i.e. also longitudinal faults, independent of their radial location. SMR gauges are faster than SMO, however practically with the same principle.

### Advantages and Key Dimensions:

- Highly accurate diameter measurement values (2 point); same as with all STEELMASTER models.
- 2-point diameter measurement values (min., max., average)  
The EPM values render the profile shapes truthfully and with accuracy, especially in case of polygonal shapes with 3 or 6 lobes, even if distributed asymmetrically.
- True out of round condition  $RON_t$  as per ISO/TS 12181-1 (previously DIN 4291/92) based on LSCI (reference circle of smallest deviational squares).
- Circumscribed circle MCCI
- Inscribed circle MICI

## Use in Cold Processes and for Quality Control Applications

For cold processes like peeling, grinding as well as for quality control (NDT) calling for tight tolerances, and also for roundness or polygonality, systems with up to 6 axes equipped with EPM evaluation are the ideal solution.

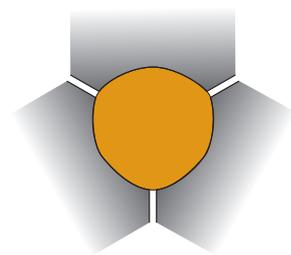


SMS 100-B6 gauge in a NDT line for cold bars

## Special Version FPS (Full Profile Synthesis) for 3-Roll Technology

In case of 3-roll blocks, especially when the "free sizing" feature is used, the product often shows polygonal shape aberrations, 3 or 6 lobes (under adverse circumstances these could be distributed asymmetrically). Here the FPS Synthesis offers decisive advantages, since the actual shape of the profile can always be used to determine the dimensions which are relevant for process and quality.

A special function allows to determine dynamically the twist angle and to "turn back" the measured values accordingly.



### Additional Important Parameters

- 3-point diameter values (min., max., average)
- Reference diameter DT (touch) and GT (gap), corrected with twist angle. These two values are instrumental for fast optimization of the 3-roll cassettes.
- Left and right shoulder



SMO 151 after KOCKS block

### Note:

FPS reproduces and enhances the 3-point micrometer or analog methods, which often provide approximated values only.

- All technical data are subject to change without notice.

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