

Welding Guard 3.0 : the TIG welding smart vision system

Non-Destructive Testing (NDT) is a widely accepted standard to improve process quality and reduce scrap.

In-line and off-line machines are deployed to respectively have a constant quality monitoring or a spot checking especially on big products. Table 1 reports a list of the most common NDT and their limits.

In last few years the improving of vision systems and CMOS/CCD sensors allowed a high quality vision of the scene and the adoption of computer vision provided parametric objective measures of the quality of the welding pool in real time.

Technology	Integration	Limits
Eddy current	Usually in-line control	<ul style="list-style-type: none"> • difficult to set • small cracks or close metal not welded borders are not easy to detect
Ultrasound	Usually off-line control	<ul style="list-style-type: none"> • multiple probes required, in accordance to the dimension and thickness of the production • better results using gel/liquid between the probe and the inspection section • not easy to integrate in a continuous production
Laser inspection	In-line control	<ul style="list-style-type: none"> • seem parameterization allows good after welding monitoring from outside, no information available on bubbles, cracks • complementary to ultrasound or eddy current checks
Vision systems	In-line control	<ul style="list-style-type: none"> • the weld pool must be visible, arranging at least a 10 mm circular window even in a closed welding chamber

Table 1: Common NDT comparison

Let's improve quality keeping the eyes on your process.

For a long time welding has been a clever mix of practice and knowledge: factory line operators and certified welders use their eyes and experience to achieve the best possible result. This high level knowledge essentially comes from the welding pool observation: here the experience of Video Systems has been used to develop a tool that helps the operator to have a better magnified direct vision, supported by a

parametric evaluation of the weld pool quality. In Figure 1 you can see a typical tube mill TIG image captured before



Figure 1: Magnified vision of welding pool

the welding process, where you can observe electrode and welding pool shapes are visible, as well as the distance

between the two metal strip edges. This information can be elaborated by visual processing to obtain precise and useful information parameters like:

- alignment between electrode and gap [$\pm 10\mu\text{m}^1$]
- gap width [$\pm 10\mu\text{m}^1$]
- Smart Energy Index of welding pool (SEI) [relative measure]

The first two measures refer to geometrical properties and can be converted directly

¹ Field Of View dependant, typical FOV 15 mm.

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from the image to real numbers by a initial calibration process, the third index, the SEI, is a relative index, comes from costumer requirements, that takes care of:

- welding pool width (W)
 - welding pool height (H)
 - welding pool intensity (I)
- and calculated as:

$$SEI = W \times H \times I$$

this will be a relative index proportional to geometry and intensity of the process, allowing a fast comparison of process evolution within the same production or a reference index

across discontinuous product types over time.

Thanks to this, index degradation of electrode or derives of the process can be detected and monitored during the whole production. Furthermore, operator's work can be improved by giving a measure proportional to voltage and current sets of the welder controller, giving a

reference to be respected for future similar productions. Video systems Welding Guard 3.0 displays this information in real time, directly on a line-side screen or broadcasting it over the company network infrastructure as a web streaming. Figure 2 shows a screenshot captured from a standard and freely available streaming player, like VLC.

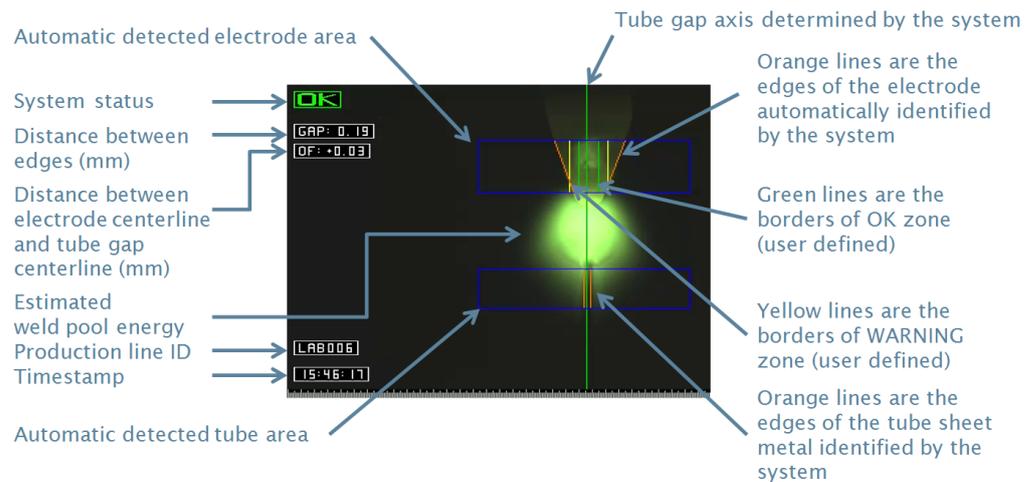


Figure 2: Superimposed information to the sampled image.

Understand the process and make the information available for your company.

The systems is thought either for the line side operations, allowing a magnified vision of the weld pool for the operator, or for the quality department, or for a full control of the lines from a unique position that can be located near the lines as well as anywhere in the world, using a remote internet connection.

Process parameterization and data collection is a big part of the **Industry 4.0** paradigm, in

this way Video Systems helps your company supplying all necessary information collected by two widely accepted standards:

- a web page where a smart data collection, with trends and daily, weekly, monthly and yearly charts are directly available from any browser.

- an active and flexible data source that can feed your company database or a MQTT broker on a cloud structure, for your own processing.

The effort of Video Systems during the development of every product is being fully compatible with standards, so that all the data configurations can be managed by a web browser, while the stream is a light-weight H264 format and can be played with any video player on desktops, tablets, as well as mobile platforms like smart phones.

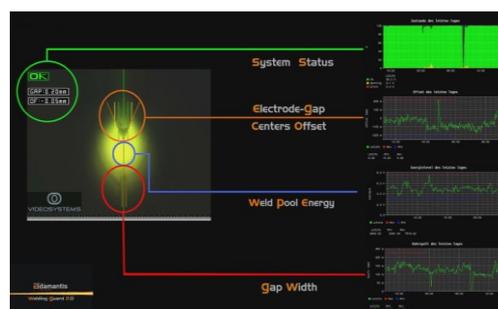


Figure 3: System status and data logging.