

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 including 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

Improve quality focusing our smart eye 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. Their high level of 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 the welding process, where you can observe electrode



Figure 1: Magnified vision of welding pool and welding pool shapes, 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, referring to geometrical properties, can be directly converted from images to real numbers thanks to an initial calibration process. The third index, SEI, is a relative index which comes from welding experts requirement.

¹ Field Of View dependant, typical FOV 15 mm.

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It analyzes:

- welding pool width (W)
- welding pool height (H)
- welding pool intensity (I)

Calculation is:

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

As a relative index proportional to the geometry and intensity of the process, it allows a fast comparison between process evolution of the same production or as a referring index in discontinuous types of product. 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 defining a measure proportional to voltage and current settings 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.

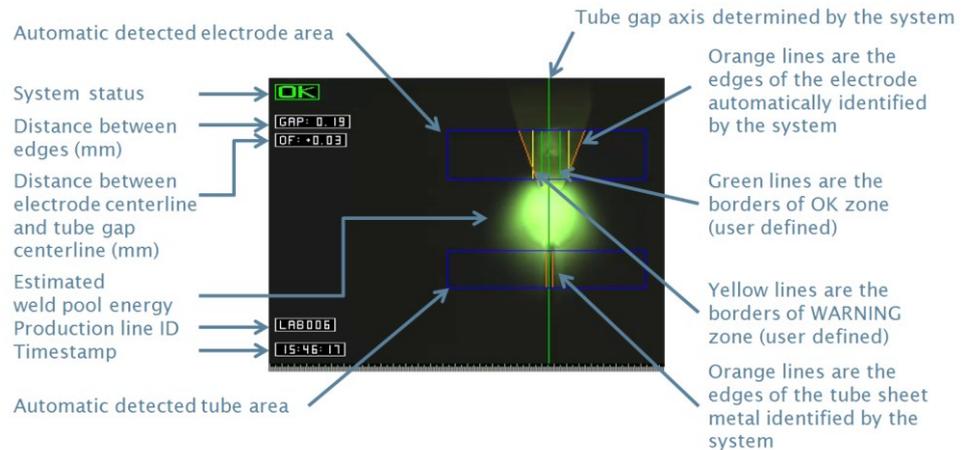


Figure 2: Superimposed information on the sampled image.

Log the process and broadcast the information to your company

The system works along the line side operations assuring not only a magnified vision of the weld pool to the operator and to the quality department, but also it assures a full control of the lines from a unique position located near the lines or anywhere in the world using a remote internet connection. Process parameterization and data collection are a big part of the **Industry 4.0** paradigm. 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.

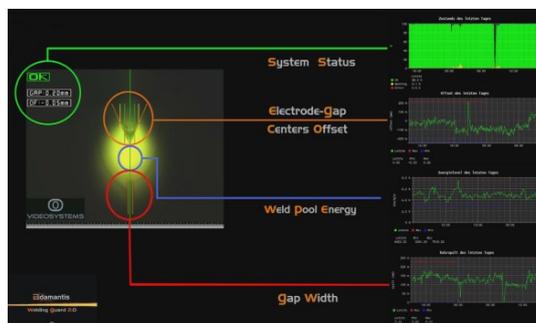


Figure 3: System status and data logging.