# The STAS ASIS$^{3D}$ – The automated anode stub inspection system

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**Abstract**

Currently, anode stub inspection is done manually by visually assessing the stub assembly as it travels on the conveyor. Stubs can be worn, leading to current imbalances and hot spots, and some stubs may even be missing. Worn, crooked or tapered stubs increase voltage-drop which, in today's ultra long potlines, can result in important energy losses. STAS has developed a new Anode Stub Inspection System, the ASIS$^{3D}$, which can handle both single-row or double-row distributed stub (hexapod) assemblies. The system precisely evaluates every anode assembly and can automatically issue work orders for the ones deemed to be in need of repair. This also allows users to get statistically significant data to allow for intelligent decision-making using Six Sigma and Lean Manufacturing techniques. And ultimately, it can result in lowered voltage-drop, which can potentially save the plant millions of dollars annually.



**Keywords:** Anode stub; Inspection; Anode rod tracking; Process monitoring.

## 1. Introduction

STAS has developed and designed a novel equipment to perform the inspection of anode stubs: the ASIS$^{3D}$ (Anode Stub Inspection System). It has the capability of inspecting anode rods fitted with a single (bipods, tripods) or a double (tetrapods, hexapods) row of stubs. In this paper, we will use the term "hexapod" to refer to any kind of stub arrangement.

### 1.1. Anode rod inspection – current practice

Currently, anode rod inspection is done by operators using manual gauges. A visual check determines whether a rod has to be tested with the manual gauges or sent to be rodded with a new anode.

Manual inspection, performed using gauges and visual standards, is somewhat limited when more complex measurements have to be taken. And with manual inspection, records of the rod fleet condition are not kept. This practice relies on the operator's skills, for not every single anode is verified but only the ones that 'look' off, which makes the method very subjective. In addition, the data collected is seldom retained for further statistical analysis, depriving the plant of a huge opportunity for process optimization.

### 1.2. Impact of crooked, broken or worn stubs

In recent years, many studies related to performance penalties associated with the condition of the anode stubs have been published [1] [2] [3] [4] [5].

A fleet of anode rods of poor quality can easily consume an *additional 50-70 mV* over its designed voltage drop, which could result in *millions of dollars annually* in additional direct energy costs for an average size smelter. For mega smelters like the ones in the Middle-East where capacities are approaching and even surpassing a million tonnes per year, the cost associated with increased voltages due to bad stub alignment is commensurately higher! In addition, costs related to rodding line stoppage, offline anode handling, greater probability of anode-related problems in the cells could also be associated to less-than-perfect inspection.

## 2. Automated inspection - statistical process control in the rod shop

Automatic inspection is not subjective. All measurements are taken in the same manner and using the same references, and the system never gets “tired” or “bored” of doing the same task year after year. Moreover, there is more of an advantage in the use of an automated measuring system:

- Repeatability, independent of human perception.
- Capacity of taking measurements not possible for an operator, such as the stub lengths relative to a reference plane.
- Possibility to create a precise work order for each anode rod that requires repair. Online stub repair equipment can be automatically fed with precise information.
- Capacity of building a database that records the condition of the entire fleet of rods.
- When used in parallel with unique rod IDs, ability to follow each rod individually and monitor its evolution in time.
- After data has been recorded for a while, the database will allow the anode rod repair shop to forecast the work load weeks in advance.
- Using the database and knowledge from the many studies on the factors affecting the stub-carbon connection, one could probably choose the repairs that have the greatest positive impact from an economic point of view.
- Using the same database and knowledge base, one could possibly evaluate the average anode-rod-related mV penalty associated to the average condition of a fleet of anode rods.

## 3. Presentation of ASIS$^{3D}$

Working with Alcoa and the Quebec Industrial Research Organization (CRIQ), STAS has developed the ASIS$^{3D}$. The ASIS$^{3D}$ scanning unit is built around four 3D sensors. The 3D sensor assemblies are designed for a long stand-off and a deep field of view. The sensors allow to configure the digitizer so that they never get in the path of or between the stubs of the hexapods. There is no sensor placed under the path of the hexapod, either. This prevents damage to the system if some cast iron falls or if a clad gives up during the measurement. Figure 1 shows a typical hexapod scanned using the ASIS$^{3D}$.

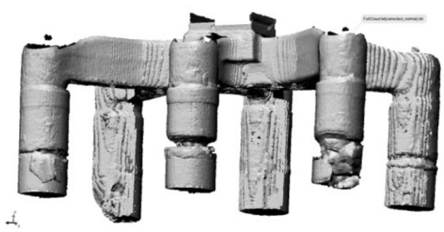

**Figure 1. Typical scanner output of ASIS$^{3D}$.**

The system uses class 3 lasers installed in a fully opaque enclosure (Figure 2). Access to the scanning area is restricted by interlocked doors that prevent the operators to enter the machine while it is in operation. With all the security systems in operation, the equipment becomes a class 1 laser product, which means it is safe under all conditions.

In addition, and some may argue most importantly, the automatic measurement and data acquisition can yield great process analysis power that can significantly impact the cost if acted upon. The system can generate the necessary data to allow for process engineers to see how their process is robust. Unacceptable stubs can be identified automatically and rerouted from the conveyor, with a work order issued to repair the stub with the appropriate configuration.

Also, an automated inspection system can supply all the necessary data to allow a rodding shop to pinpoint the most critical repairs on each rod and perform only the required maintenance. After a few months of operation, the information stored in the database will allow the planners to forecast the workload of the rod repair shop.

With ever increasing energy costs and the efforts of the industry to make the refining process more efficient, the need to lower the power loss from the rods, stubs and anodes has become a necessity. Thanks to an automated inspection system, the data necessary for a plant to evaluate the mV penalty at plant level can be supplied to help determine the repairs that represent the best return on investment.

The STAS ASIS$^{3D}$ / Automated Stub Inspection System does more than replace manual inspection. It is a very powerful tool for planning the operations and forecasting the needs of a rodding plant.

## 6. References

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