

1.7.14. GALS-1 AE SYSTEM APPLICATION FOR HOISTING MACHINES DIAGNOSTICS

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Application of the acoustic emission (AE) method for general technical state evaluation of high risk objects have become a standard practice long ago. This method attracts inspectors first of all with its convenience and cost-effectiveness – we get information about technical state of the whole object using just few probes and without any scanning (and so with no need to prepare the entire surface) – quickly and relatively cheaply. In addition AE method qualifies defects not according to their size (as conventional methods do), but rather according to their tendency to develop at working stresses – i.e. according to their risk level.

There are a huge number of codes describing AE inspection of different types of pipelines (gas and oil main pipelines, ammonia lines, industrial pipelines, etc), cisterns, tanks, cylinders and other pressure vessels. Many AE instruments implementing those codes have been developed and are widely used.

But only few companies tried to make AE diagnostics of hoisting machines until recently. While as for normative documents – they up to the authors were absent. According to known codes the hoisting machines diagnostics is made using conventional methods (visual, ultrasonic, penetrants testing etc). Performing of all those procedures (and also object preparation for them) made hoisting machines diagnostics very durational and expensive. As a result – frequently testing was not done in full scale and experts had to make their decisions basing on insufficient information about objects technical state.

For solving of this situation – lowering of the labor input of hoisting machines diagnostics and boost of its effectiveness – the Center for Technical Expertise of Southern Railway of Ukrainian Railways (CTE SR) and Ukrainian Scientific Research Institute for NDT have developed a technique of AE diagnostics of hoisting machines.

Technique allows examining of following types of hoisting machines:

- Single-girder and double-girder overhead cranes;
- Portal bridge cranes with elements of tubular, box-type and truss-type structure;
- Arm cranes;
- Railway cranes;
- Lorry-mounted cranes;
- Tower cranes.

Other types of hoisting machines can also be inspected according to this technique provided appropriate appendices to it will be developed. According to this technique an AE method can be used as:

- Separate preliminary integral method providing detection of developing defects in all structure including welded joints;
- Additional method (to conventional ones) providing reliable evaluation and qualification of defects (as those which tend to develop and those which don't develop);
- Basic method for prognostication of possibility of safe operation of hoisting machines with cracks in metalware.

Acoustic emission method can be used for periodical or permanent evaluation of the hoisting machines technical state.

The technique describes application of three location levels according to information value and interference immunity grade:

- Zone location – the least information valuable (location is made accurate within zone around each sensor) and has very pure interference immunity, but on the other hand uses minimal number of AE system channels possible;

- Linear location – allows to estimate a cross section in which the source of AE activity is situated; has interference immunity better zone location has; uses approximately twice as more AE system channels than zone location does;

- Planar, cylindrical and grid location – these types of location allow to determine the concrete place (ideally point) in which the AE activity source is situated (e.g. in which truss diagonal and at what distance from its end), have the highest grade of interference immunity, but unfortunately require maximal number of AE system channels (3 to 4 times as many as needed for zone location).

The technique describes both combined and successive ways of application of these location methods. In the issue possibility of large hoisting machines inspection by AE systems with relatively small number of channels without loss of quality is provided.

GALS-1 AE system (manufactured by the PROMPRYLAD Company) was chosen to implement this technique. The main argument in favor of choice of this very system was an exclusive presence in GALS-1 software of algorithm of location on truss structures (grid location). This is very important since there are many truss structures in hoisting machines. In addition this system has already shown itself to advantage for bridges metalware inspection to the time of the technique development start [1]. And at last it was very important that GALS-1 developers are open to development of systems software according to clients (in this case – technique authors) needs.

The technique authors together with CTE SR experts and representatives of GALS-1 company-manufacturer have been inspecting cranes of each type both in process and after finish of technique development. Developing defects (cracks) were detected at some of the cranes and their risk level was estimated. Corresponding experts' reports were written basing on AE testing results. AE testing was repeated after repair and has proven the repair quality.

The proofing of the technique using GALS-1 AE system has shown its technical strength and high cost-effectiveness. Authors look forward to further development of the technique to test also other types of hoisting machines.

References:

1. **Bridge** construction spans examination using GALS-1 AE complex. – http://www.ndt.com.ua/eng/technology_2_article.html.