

## The Application of Eddy Current Transducer for Testing Movement Locus of Shaker Screen

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**Abstract:** Shaker screen is one of important equipments in the industry of oil, metallurgy, coal and timbering. The movement locus of shaker screen affects the capacity and efficiency of shaker screen to split the solid particle from crude ore directly. To test movement of shaker locus, two eddy current transducers are employed. A discussion of the usage of these eddy current transducer to test and acceleration sensors will be made. The experiment results from a real elliptic shaker screen have good agree with the design requirements.

**Key words:** shaker screen; movement locus; test; eddy current transducer

### 1 Introduction

The drilling-well-fluid-shaker is one of important equipment in drilling well of oil & natural gas, used to eliminate harmful solid state in drilling-well-fluid<sup>[1]</sup>. Shaker screen can meet the critical screening requirements of virtually every processing industry. They are ideally suited for dry separations, wet or dry classifications or liquids solids separation. It will meet users high volume specifications efficiently, reliably and economically. In national standard of "drilling-well-fluid-shaker" GB/T11648 — 89<sup>[2]</sup>, every shaker is asked to have dynamic parameters test before leaving factory. These dynamic parameters can reflect shaker handling capacity and internal quality. They must be tested before leaving factory. The ellipse-equal-deep shaker is one of large-scale filter equipments, which is often used for material filtering in many industries, such as metallurgy, mine, coal, timbering etc. TDS and TDLS are a series of elliptical equithickness screens, which are much better in capacity and efficiency than other ordinary shaker screens. These shaker screens are fit for filtering flux and cold sinter in metallurgy, the grading ore in mine, the grading and dehydration in coal, which are ideal replacement products for large-scale

shaker screen introduced from foreign countries. TDS shaker screen is applied to filter flux; TDLS is designed to filter cold sinter. For the effects of the movement locus of shaker screen to its treating ability<sup>[3,4]</sup>, two types of dynamic testing are needed for these shaker screens before leaving factory. The shaker often has a resonance range while starting and stopping, acute vibration generally results in the departure even falling of acceleration sensors from the surface of the fixed place. Many of movement loci of shaker screen testing made today are preformed using acceleration transducers. This paper provides a new method to testing movement locus of shaker screen of some large-scale ellipse shaker using the no contact large-scale eddy current transducers. Some experimental results are given.

### 2 Principle and Approach of Testing

Elliptical equithickness screen is constituted of shaker-box, exciter, vibration isolator, transmission device etc. Eccentric block of exciter drives by synchronous transmission device with the principle of three-axial device and forced synchronous vibration, which can produce a stable motion. Movement locus of shaker screen will be a ellipse, whose ellipticity and direction angle can be adjusted according to the requirements of

customers<sup>[5,6]</sup>. The surface shaker screen has been spray-painted before leaving factory, which made it is not convenient to burnish the surface to place acceleration transducers. After that, the obtained signals have to be integrated first to transfer original vibration signal to displacement. Generally speaking, the test has been down under a condition of unloading. So the vibration amplitude of shaker screen would be larger than loading condition, especially more seriously during getting across the resonance area. That will be very dangerous when it works with a side-shaker<sup>[7]</sup>. This paper provides a new method to test movement locus of shaker screen using non-contact eddy current transducers considering above dangerous conditions. The linear range of the common eddy current transducer is limited, which is often from 1~5 mm. But the displacement of locus of shaker screen usually is up to 15 mm. The large-scale eddy current transducer is needed<sup>[8-10]</sup>. The principle of testing is shown in Fig.1. Two large-scale eddy current transducers are fixed along vertical and horizontal directions separately. The signals are put into the computer with data acquisition card after being pre-processed. The software of data acquiring and processing must be made<sup>[11,12]</sup>. According to different shaker, selecting a short bar as a tested surface, which has an appropriate end-face area matching with operating size of eddy current transducer, shown in Fig.2. One screw hole is manufactured to install the short bar to the bolt on shaker screen. A special supporting frame is also made to fix two eddy current transducers, shown in Fig.3. The distance between end-face of eddy current transducer and the end-face of short bar should be adjusted to right location to guarantee valid data acquiring and void the damage of eddy current transducer. The support frame is shown in Fig. 3.

### 3 Test Results and Analysis

In this paper, CWY-D0-813604-speical-50-02 large-scale eddy current transducer and YD-22 three-axial piezoelectric acceleration sensors to be

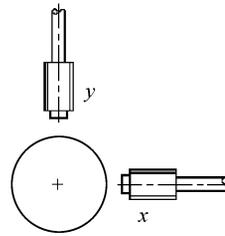


Fig.1 Principle of testing

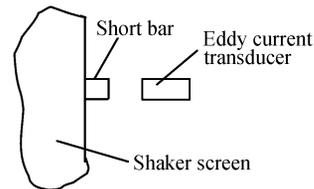


Fig.2 The diagram of support frame

employed to test movement locus of shaker screen of ellipse shaker screen before it leave factory. The layout of test points is shown in Fig. 4. Three-axial acceleration sensors are placed at test points 1,2,3,4 and I respectively. The vibration signals from different coordinate axis can be selected according to the number of channel of instrument and acquirements of designer. During the test, the signals from test point I and II go into the after being integrated by an integrator. Two large-scale eddy current transducers are installed at point III, whose signals go into the computer and are processed by special analysis software. Movement locus tested point can be drawn. The pictures directly from the oscilloscope of movement locus are shown in Fig. 5 and Fig. 6.

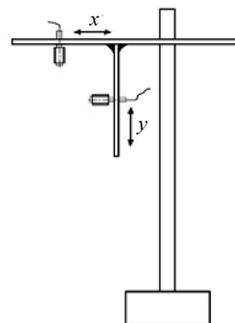
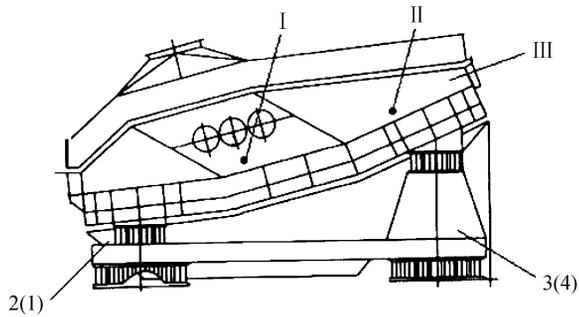


Fig.3 The disposal sketch of test point

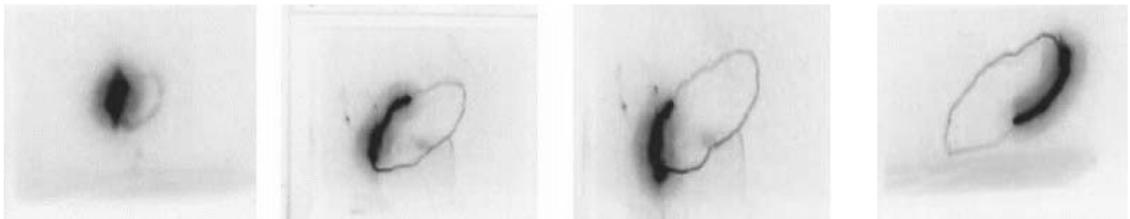
The change process of movement locus of



**Fig. 4 The disposal sketch of test point**

shaker screen at point I when shaker screen starts to work is shown in Fig. 5a. At the beginning,

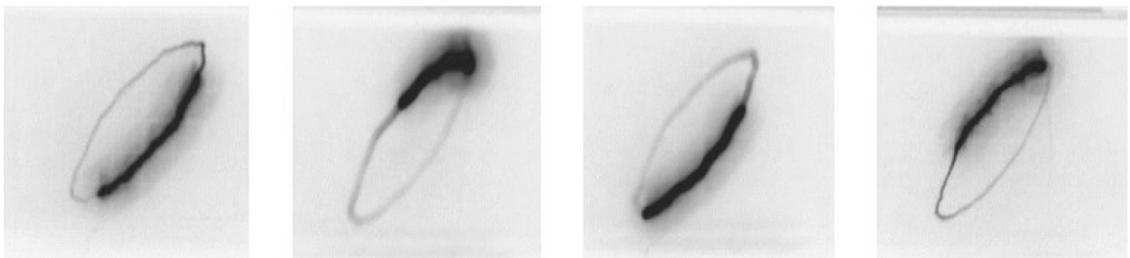
the long and short axis of the ellipse, which is movement locus of shaker screen formed from two perpendicular displacement signals, are small. They will increase gradually when shaker screen runs to a stable condition. The testing results at point I during that status are shown in Fig. 5b. The results at point II are shown in Fig. 5c at the same condition. Fig. 5d shows the change process of movement locus at test point II when stopping, the ellipse last becomes a small dot. Movement locus of shaker screen is drawn according to test data from eddy current transducer using special software, shown in Fig. 6.



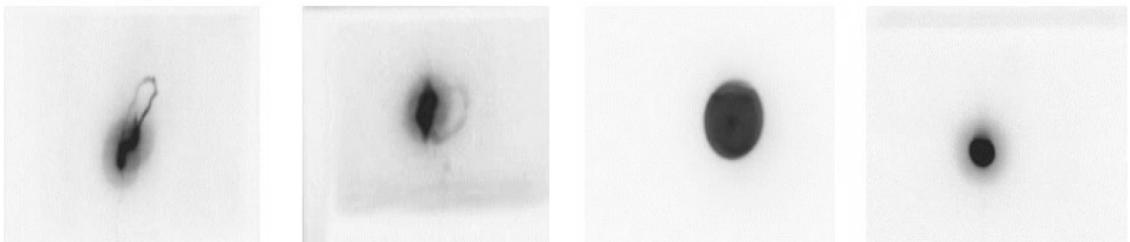
(a) Change process of movement locus when shaker screen begins to run (test point I)



(b) Movement locus during stable status of shaker screen (test point I)

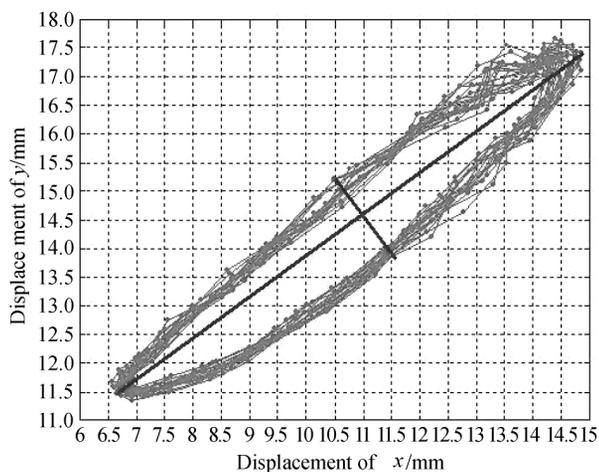


(c) Movement locus during stable status of shaker screen (test point II)



(d) Change process of movement locus when shaker screen begins to stop (test point II)

**Fig. 5 Movement locus of shaker screen (from the oscilloscope)**



**Fig. 6 Movement locus of shaker screen**  
(data from eddy current transducers)

The integrator can be omitted in the test of displacement from eddy current transducers in the direction of  $x$ ,  $y$ . The movement locus can be obtained easily by synthetic signals in the direction

of  $x$ ,  $y$  as well as the long and short axis of ellipse. For this shaker screen, they are 9~13 mm and 3~5mm. The vibration direction angle is  $36^\circ$ , which satisfies requirements of designer.

## 4 Conclusion

Movement locus of shaker screen is one of dynamic characteristic parameters. The experiment is successful with the help of large-scale eddy current transducers. This testing system is simple but valid, which can avoid some testing errors from integrator during processing the data from acceleration transducer. The testing system can provide reliable testing data. It is helpful to seek optimizing data combination for developing new type of shaker screen. This system is also can be used to research the running principle of large-scale components.

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temperature heat treatment at the penetration hole area of the collectors;

Safety systems employ 4 trains instead of 3 trains, greatly enhancing the redundancy of the safety systems and the reliability of their functioning;

The new reversed U shape 55-strand steel cables for containment pre-stressing system;

Four sets of 100% capacity emergency diesel generators for each unit.

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