



Xi'an HL Petroleum Equipment Co., Ltd.

Drilling Fluid Shale shaker HZS604

Operation Manual

XI' AN HL Petroleum Equipment Co.,Ltd.

Contents

Instruction on operation

1. Summary

2. Technical parameters

3 . Safety instructions

- 1). Installation
- 2). Operation
- 3). Maintenance

4. Structural and dimensions

5. Working Principle

6. Installation and debugging

- 1). Installation
- 2). Debugging

7. Operation steps and precautions

1. Preparation before starting
2. Start-up steps
3. Shutdown steps
4. Deck adjustment
5. Operation precautions

8. Lubrication and maintenance

1. Lubrication
2. Inspection and maintenance
3. Electrical maintenance

9. Transportation and storage

1. Transportation
2. Storage

10. Common faults and troubleshooting methods

11. Figures

Attached Figures 1 to 4

Instruction on operation

- ★ All persons concerned must read through this manual and relevant instructions for operation and use carefully.
- ★ Designate the trained personnel as safety managers of the mud shale shaker.
- ★ Make sure all operators are educated on relevant safety precautions.
- ★ Only the trained personnel designated are allowed for operation and maintenance.
- ★ Electrical and mechanical maintenance must be performed by professional engineers under the guide of relevant documentations or other means.
- ★ Adjustment of electrical system parameters must be authorized by the manufacturer and performed by electrical engineers.
- ★ It is recommended that guides of safe operation and equipment maintenance be hung on the site.
- ★ It is recommended that an equipment use record and a maintenance record be created.
- ★ Sufficient light should be provided for night work.
- ★ No access to the equipment is allowed for any person not concerned.

1. Summary

The drilling fluid shale shaker is suitable for the drilling fluid solid control system of oil and gas drilling, and is the first-level equipment for solid-liquid separation of drilling fluid.

The HZS604 drilling fluid solid control linear shale shaker uses two vibrating motors of equal mass and diameter to achieve linear motion of the screen box in a certain direction based on the self-synchronization principle, achieving the purpose of screening and discharging cuttings particles in the drilling fluid.

2. Technical parameters

1). List of technical parameters

Vibrating motion: Linear motion

Screen size and type: 4×1165×585 frame screen (40-210 mesh)

Screen area : 2.7 m²

Motor power : 2×2.3 kW

Speed : 1500 r/min

Vibration frequency : 25 Hz

Vibration Amplitude : ≥5.5 mm

Vibration strength : ≥6 g

Deck angle adjustment : -1° ~ +3°

Capacity : ≥40 L/s

Voltage/Frequency : AC380 V , 50 Hz

Dimension : 2935 × 1945 × 1422 mm (L×W×H)

Weight : 1658 kg

2). Environmental conditions

Ambient temperature: -20°C ~ +40°C

Ambient relative humidity: no more than 95%

Degree of explosion-proof: ExdⅡBT4

Corrosive environment: No corrosive gas or vapor that may damage metal and insulation

Degree of electrical protection: IP66

3 . Safety instructions

1). Installation

- A. Use appropriate lifting equipment and slings;
- B. It is strictly forbidden to lift the equipment at any location other than the designated lifting point;
- C. Make sure that the installation table is strong and can bear sufficient weight;
- D. The equipment should be placed stably and securely fixed on the tank surface.

2). Operation

- A. Before starting the machine, make sure that the screen box fixing block has been removed and reversely fixed;
- B. Do not touch the screen box and compression spring during equipment operation;
- C. If there is abnormal sound or vibration after starting, stop the machine immediately, find the cause, and eliminate the fault;
- D. Please cut off the main power after stopping the machine.

3). Maintenance

- A. The explosion-proof electric control box can only be opened after the main power supply is cut off;
- B. It is strictly forbidden to adjust the eccentric block of the vibration motor at will;
- C. It is strictly forbidden to drill, cut or weld on the screen box.

4. Structural and dimensions

The HZS604 linear shale shaker is mainly composed of the base assembly, screen box assembly, deck angle adjustment device assembly, anti-splash device assembly, mud box assembly, electrical control system assembly and other parts.

The screen box assembly is supported on the left and right beams of the screen box inclination adjustment device assembly through four compression springs, forming a typical "spring-mass" vibration system.

The appearance and installation dimensions of the vibrating screen are shown in Figure 1, the exploded view of the whole machine is shown in Figure 2, the exploded view of the screen box assembly is shown in Figure 3, and the electrical schematic diagram is shown in Figure 4.

5. Working Principle

HZS604 vibrating sieve is a kind of inertia linear vibrating screen with double shafts in self-synchronization and two inversely rotating vibrating motors equal in mass-radius product that are mounted slantways. According to the theory of self-synchronization, the two motors in rotation will follow each other when certain requirements being satisfied, thus realizing synchronous reverse rotation with zero phase difference within a short time, as shown in Diagram 1.

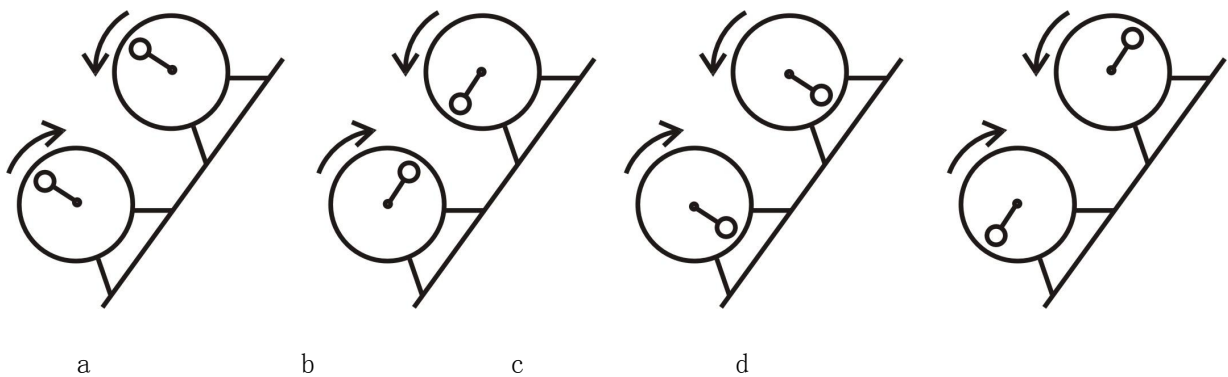


Diagram 1

At positions a and c, the two centrifugal forces overlap to get a maximum excitation force; at positions b and d, the two centrifugal forces counteract to reduce the excitation force to zero. It follows that the centrifugal forces created by the two motors overlap to form a resultant force, direction of which is always vertical to the installation platform of motors and the strength of which varies in a sinusoidal curve.

As the resultant force passes through mass center of the screen box, the sinusoidal excitation force will drive the whole screen box into a vibrating motion along a periodically varying linear path vertical to the installation platform of motors, with all vibrating points of the box identical in direction and intensity.

6. Installation and debugging

1). Installation

1.1. Preparation

- A. Check whether the product nameplate is consistent with the order requirements or operation requirements;
- B. Check whether the on-site power supply is consistent with the requirements.
- C. Check whether the tools and accessories are complete and properly stored.
- D. Clean and check the installation surface.

1.2. Lifting

Lifting must be performed at the designated point, as shown in Diagram 2.

When lifting, place thick cardboard or cloth where the steel rope contacts the equipment to avoid damaging the paint coating.

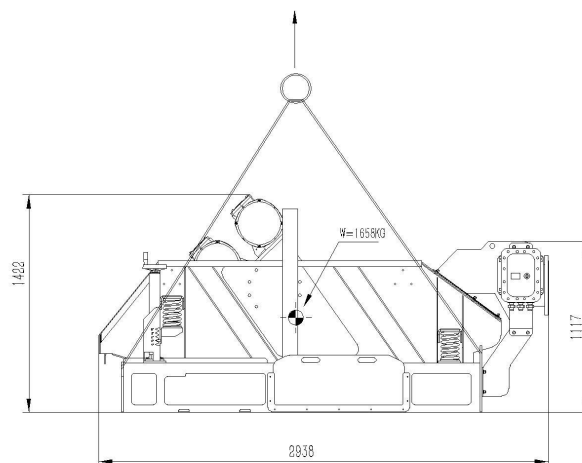


Diagram 2

1.3. Under ordinary conditions, two to three shale shakers are installed on the tank level transversely in a row and the base is clamped with bolts or a pressure plate. A properly enough space is reserved around each shale shaker for operation and maintenance. Customers can choose base to connect two shale shakers directly. The whole can be lifted when transiting.

1.4. Feeding

There is a DN200, PN10 flange interface at the rear of the mud box. The user can drill a hole on the blind plate and directly weld a steel pipe \leq DN200 to the DN200 flange, and then bolt the flange together with the steel pipe to the flange interface.

1.5. Slurry discharge

The slurry is discharged from the bottom of the shale shaker base.

1.6. Slag discharge

Users can make their own chutes and install them at the slag discharge port of the vibrating screen. If necessary, users can also make their own shields and install them at the slag discharge port to prevent mud from splashing out.

1.7. Electrical installation

The power cables of the two vibration motors pass through two low-temperature-resistant flexible connecting pipes, enter the exposed section of the threading pipe installed on the base, then enter the embedded section of the threading pipe on the base, and finally connect to the explosion-proof electric control box installed on the mud box body through two low-temperature-resistant flexible connecting pipes. The external power cable is connected to the explosion-proof electric control box by the user.

External power cable is connected to the explosion-proof terminal box on the base holder.

When AC380V power is supplied, the vibrating motor is wired with Y connection, as specified in the manual for vibrating motors.

Motors and the control box should be grounded as specified.

1.8. Installation and removal of frame screen

Installation

First, clean the dirt on the installation surface and mesh surface of the frame screen and then clean the dirt on the surface of each pad on the screen support frame welded to the bottom of the screen box and the two inner surfaces of the screen box. Place the mesh surface of the frame screen upward on the screen support frame at the innermost end of the screen box (close to the mud box body). Insert the small end of the screen fixing wedge outward into the gap between the frame screen and the screen fixing plates on both sides. Use a rubber hammer to hit the large end of the screen fixing wedge to press the frame screen against the pads of the screen support frame. Install the frame screen in the middle and outermost end of the screen box (close to the slag discharge end) in turn according to the above method. The mesh size of the four screens can be the same or different. The size of the mesh size is determined by the on-site mud engineer according to the requirements of the drilling process.

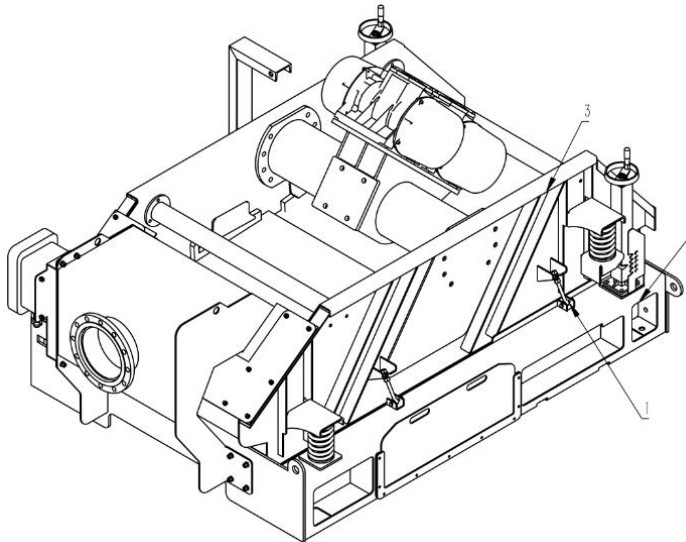
Disassembly

Clean the dirt attached to the inside of the screen box and the surface of the screen. Use a rubber hammer to hit the small ends of the screen fixing wedges on both sides of the frame screen to loosen the screen fixing wedges, and then remove the screen fixing wedges. Remove the frame screen from the outermost end of the screen box to the innermost end.

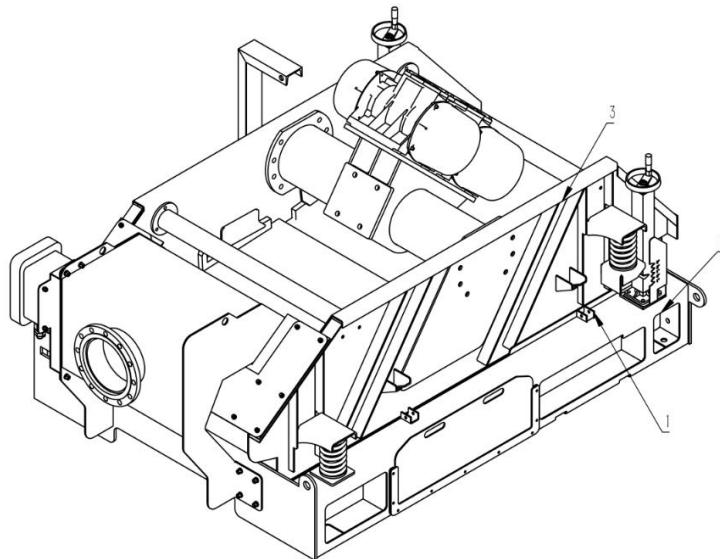
2. Debugging

2.1. Check the following items and handle any abnormalities promptly and properly:

- A. Check the integrity of the equipment to see if there are any missing or mis-installed parts;
- B. Check whether the equipment is reliably grounded and measure the grounding resistance if necessary;
- C. Check whether all bolts are tightened;
- D. Check whether the screen box inclination adjustment device can be raised and lowered normally;



a). During transportation, install the screen box locking device



b). Before operation, remove the locking device

1— Locking device 2— Base 3— Screen box

E. Remove the screen box locking device (1) to release the screen box. At the same time, remove the screen box locking device and put it in the base tool box to prevent loss and prepare it for use when the well team moves.

2.2. Start the equipment and check the direction of motor rotation.

Start the two motors one after another, and observe that the movement trajectory of the screen box should be an inclined straight line, and observe that the objects placed on the screen bed (such as gloves, cardboard, etc.) can be transported to the slag discharge port. Otherwise, please change the phase line of one motor at will.

The method of observing the vibration motion: draw a small dot mark on the side of the screen box. When the screen box vibrates normally, observe the shape of the small dot during the vibration movement. If it is a small straight line tilted forward and upward, it is normal. If it is a circle, ellipse, etc., it is abnormal.

Before leaving the factory, the vibrating screen has been tested in the factory and the motor rotation direction has been adjusted. When installing a new machine, there is no need to change the motor phase line. Only when the user rewires due to reasons such as changing the motor, it is necessary to check the motor rotation direction.

Another reason for abnormal vibration is that one of the motors is not working.

2.3. No-load operation

Start the shale shaker according to the operating steps, check whether the vibrating screen has any abnormal sound and shaking, whether the vibration motion is normal, and whether the frame screen is installed properly.

7. Operation steps and precautions

1. Preparation before startup

1.1. Before using for the first time or after reinstallation, the equipment should be properly installed in accordance with the requirements of Chapter 6 "Installation and Debugging", and detailed inspection and debugging should be performed.

1.2. Preparation and inspection before daily startup:

- A. Clean the surrounding environment of the site. No tools, parts or other debris should be placed on the vibrating screen;
- B. Check whether the screen box fixing block is removed;
- C. Check whether the frame screen is damaged or has a large area of dry knots or sticky screens;
- D. Check whether the frame screen is firmly fixed;
- E. Check whether the mesh size of the frame screen meets the operating requirements;
- F. Check whether the screen box inclination is adjusted appropriately.

2. Start-up steps

- A. Connect the external main power supply;
- B. Start the two vibration motors in sequence;
- C. Adjust the inclination of the screen box so that the mud submerged surface of the screen bed accounts for about 2/3 to 3/4 of the length of the screen bed.

3. Shutdown steps

- A. Close the feed valve;
- B. Stop the two vibration motors one after another;
- C. Disconnect the external main power supply.

4. Deck adjustment

The screen box of this machine is supported on the screen box inclination adjustment device on both sides of the base through four compression springs. The left and right beams of the screen box inclination adjustment device are installed on the base through hinge supports and can rotate around the rotating shaft of the hinge support.

When adjusting the screen box inclination angle, turn the corrugated handwheel by hand to adjust the inclination angle.

The screen box inclination angle can be adjusted when the vibrating screen is in working or not working, but it must be noted that the lifting screw rod is always in contact with the top plate plane on the fixed fork.

The screen box inclination angle should be adjusted on both sides of the vibrating screen at the same time, and always pay attention to whether the scales on both sides are consistent. Avoid adjusting the inclination angle of only one side without adjusting the inclination angle of the other side, or the inclination adjustment of both sides is inconsistent.

5. Operation precautions

- A. After starting, observe whether there are any abnormal phenomena, and feed only after confirming that it is normal;
- B. When stopping and passing through the resonance zone, the screen box will shake greatly, which is normal;
- C. When stopping to replace the screen, be sure to clean the soil adhering to the screen bed, and rinse the screen bed with clean water if necessary.

8. Lubrication and maintenance

1. Lubrication

1.1. Lubrication of vibration motor bearings

The lubrication cycle of the vibration motor bearings is 2000 hours, and 40 grams of grease is added to each location each time.

Kluber NB52 grease must be used. The grease can be purchased directly from Kluber or from our company.

The grease gun used for the vibrating screen must be dedicated to ensure that the grease is not mixed with other types of grease.

Grease must be added according to the specified amount. If the amount is too much, it may cause the bearing to heat up and shorten the bearing life.

Other greases are not allowed to be used, otherwise it may cause damage to the motor. Use a 3/16" Allen wrench to disassemble and install the lubricating oil hole screw of the vibration motor.

Regarding the lubrication of the vibration motor, please read the "Vibration Motor Operation Manual" that comes with the machine in detail.

1.2. Lubrication of the inclination adjustment screw and nut

The inclination adjustment screw and nut can be lubricated with low-temperature resistant lubricating oil or grease, and refuel once a week.

2. Inspection and maintenance

2.1. Routine inspection contents for each shift:

- A. Check whether the noise of the vibrating screen is abnormal during operation;
- B. Check whether the temperature of the vibration motor housing is too high, usually the temperature is $\leq 90^{\circ}\text{C}$. If it exceeds 90°C , please handle it according to the instructions of the vibration motor;
- C. Check whether the motor fastening bolts are loose;
- D. Check whether the bolts, nuts, pins, locks, etc. on the screen box inclination adjustment mechanism are loose or fall off.

If there is any abnormality in the above inspection, the machine should be stopped immediately and restarted after handling.

2.2. Regular inspection contents:

- A. Check all threaded connections weekly for looseness or falling off;
- B. Check the screen fixing wedge and the screen fixing plate on the screen box for obvious deformation every time the screen is replaced;
- C. Check the four compression springs weekly for obvious permanent deformation or cracks;
- D. Check the equipment weekly for obvious rust or damage. If the equipment is rusted, especially the surface in contact with the mud, the user should promptly apply anti-rust paint.

2.3. Daily maintenance

- A. Clean the mud on the screen bed every time the machine is stopped, and rinse with water if necessary;
- B. When replacing the frame screen, thoroughly clean the mud and dirt on the installation surface to ensure the correct installation of the frame screen;
- C. Clean the mud accumulated in the mud box and base every week to avoid blockage of the channel after long-term accumulation.

3. Electrical maintenance

- A. Electrical maintenance must be performed by professional electrical technicians;
- B. Before opening the explosion-proof electric control box, the external main power supply should be cut off;

- C. When closing the cover of the explosion-proof electric control box, attention should be paid to the cleanliness of the explosion-proof surface, and there should be no bumps, scratches, or damage to the sealing ring. At the same time, isolation grease should be applied to the explosion-proof surface;
- D. The cables and rubber sealing rings in the inlet and outlet must be pressed tightly to achieve the purpose of isolation and explosion-proof;
- E. The thermal relay is set to about 5.4A, which should not be too large or too small.

9. Transportation and storage

1. Transportation

- A. Before transportation, adjust the screen box inclination to 0 degrees and use a special screen box connecting plate to fix the screen box.
- B. When loading and unloading the whole machine, it should be lifted at the specified lifting position. See Diagram 2;
- C. During transportation, the equipment should be securely fixed in the carriage or cabin to prevent collision. A sealed cargo hold or a protective canvas should also be used to prevent the impact of bad weather on the equipment.

2. Storage

- A. It should be placed in a warehouse with good air circulation and relative humidity not exceeding 60%;
- B. The storage environment should not contain highly corrosive gases that damage the metal and wire insulation layer;
- C. When stored for a long time, anti-rust grease should be applied to the parts or components that may rust;
- D. The explosion-proof electric control box should be powered on once every six months to prevent the electrical components from becoming damp and failing.

10. Common faults and troubleshooting methods

No.	Failure	Cause	Troubleshooting
1	The motor cannot be started.	1 Power failure.	1 Designate a professional electrician to examine whether peripheral power supplies are in good condition.
		2 Certain element of the control cabinet was damaged.	2 Designate a profession electrician to check control cabinet elements.
		3 Motor damaged.	3 Designate a profession electrician to check whether motors are in good condition.

2	The motor automatically shut down shortly after being started.	1. Thermal relay current was set with a too low value.	1. Properly adjust the current value to 5.4A around.
		2. Motor wiring error.	2. Y connection is recommended for 380V power, but not shaped connection.
3	The whole set vibrates obviously and sounds abnormally after start-up.	The fixing blocks were not dismantled.	Stop the machine immediately and dismantle the four screen box fixing blocks thoroughly.
4	Vibrating path abnormal, failure in slag discharge or very slow discharging.	1. Only one of the two motors was started.	1. Start the other motor or ask a professional electrician to check the control cabinet or motor in case of failure in start-up.
		2. The two motors rotate to a same direction.	2. Reverse the rotation direction of one of the motors after changing the phase line.
5	Abnormal vibration	1. The eccentric block setting of the vibration motor does not meet the requirements	1. Re-set or tighten the eccentric block according to regulations, requiring the setting size of the two motors to be the same and the setting direction of the two ends of the same motor to be the same
		2. The eccentric block of the vibration motor is loose	
		3. The whole machine is not installed stably and is not fixed properly.	3. Install the whole machine stably and firmly.
		4. Compression spring failure	4. Replace the compression spring
6	The sound is mixed with abnormal noise	The screwed connection was loose.	Thoroughly check each screwed connection according to judgment of the abnormal position.
7	Slurry spillage	1. Screen box dip was too low.	1. Increase the dip of screen box.
		2. Settlement capacity was too high.	2. Decrease the settlement capacity.
8	Settlement capacity is too low.	1 Screen openings were blocked largely.	1 Clean or replace the screen.
		2 Density and viscosity of the drilling fluid were too high.	2 Capacity decrease caused by high density and viscosity is just normal.
9	Short service time of screen.	1 Screen tension was too loose, too tight or uneven.	1 Tension the screen as required.
		2 The rubber strip was damaged or aged.	2 Replace all the rubber strips.
		3 The drilling fluid was too high in solid content.	3 Short service time of screen caused by drilling fluid high in solid content is just normal.

If any failure mentioned above cannot be eliminated through the suggested means, consult the manufacturer for settlement.

11. Figures

Fig 1 Overall dimension

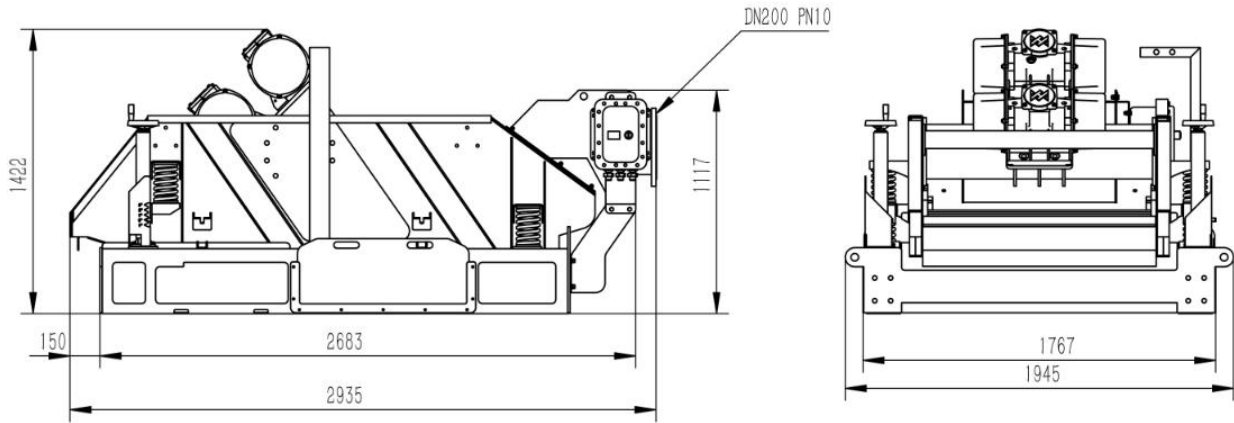
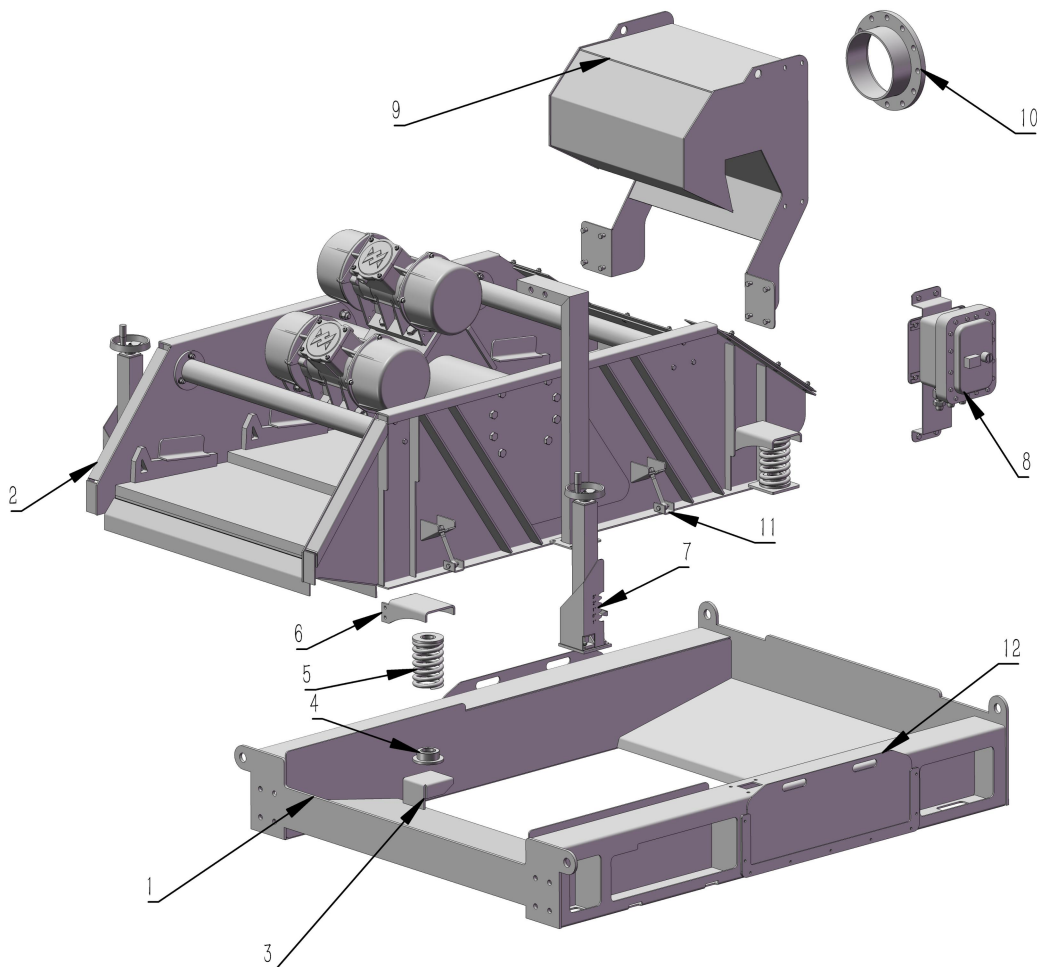


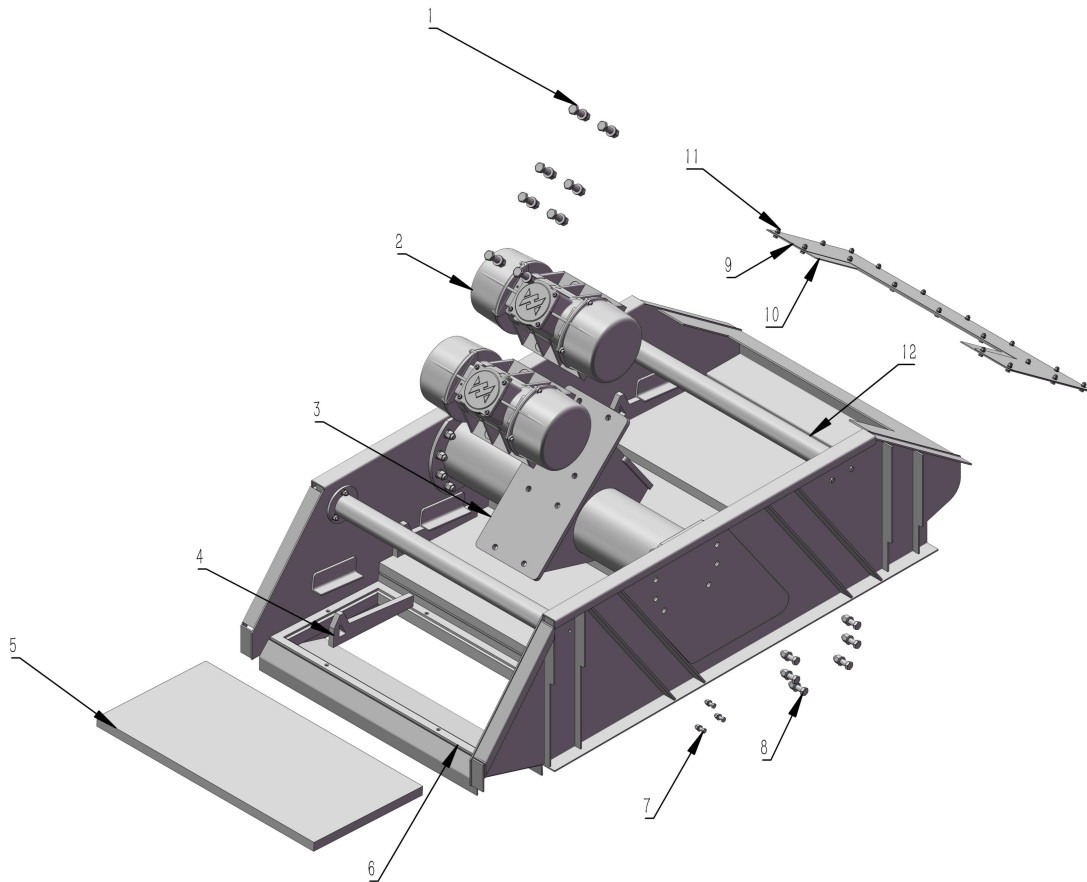
Fig 2 Exploded figure of shale shaker assembly



Parts list of exploded figure of shale shaker assembly

No.	Part number	Specification	Quantity	No.	Part number	Specification	Quantity
1	HZS604-2	Base	1	7	HZS604-4	Lifting device	2
2	HZS604-1	Screen box assembly	1	8	HZS604-5	Explosion proof control panel	1
3	HZS604-3-1	Lower spring seat	2	9	HZS604-6	Hopper	1
4	HZS604-3-2	Spring rubber sleeve	8	10	HZS604-7	DN200Flange	1
5	HZS604-3-3	Spring	4	11	HZS604-8	Locking device	4
6	HZS604-3-4	Spring upper seat plate	4	12	HZS604-9	Toolbox	1

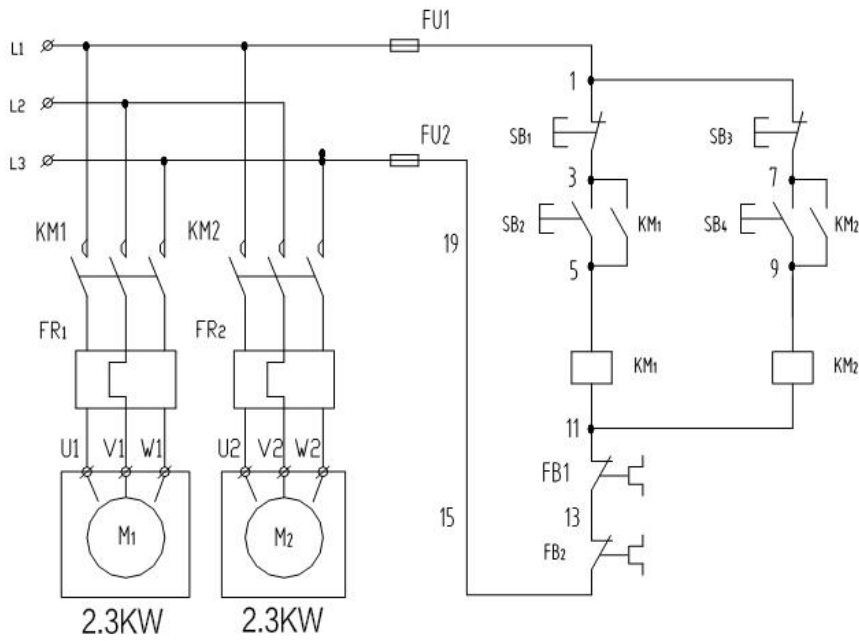
Fig 3 Exploded view of screen box assembly



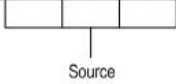
Part list of exploded view of screen box assembly

No.	Part number	Specification	Quantity	No.	Part number	Specification	Quantity
1	GB/T70.1-2000	High strength bolt M22*95	8	7	GB/T819.1-2000	Hexagonal bolt M12*40	12
2	HZS604-1-1	Vibrating motor	2	8	GB/T819.1-2000	Hexagonal bolt M20*70	16
3	HZS604-1-2	Vibration motor beam	1	9	HZS604-1-6	Pressure plate	1
4	HZS604-1-3	Screen fixing wedge	8	10	HZS604-1-7	Rubber Sheet	1
5	HZS604-1-4	Screen (585×1165)	4	11	GB/T819.1-2000	Hexagonal bolt M10*30	18
6	HZS604-1-5	Protector	4	12	HZS604-1-8	Screen box support pipe	2

Fig 4 Electrical schematic



Terminal	1	2	3	4	5	6	7	8	9	10
	L1	L2	L3	PE	15	17	17	19		





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