

Pendant

Batch galvanizing is a process in which a workpiece is immersed in a zinc bath in batches to obtain a hot-dip galvanized layer. Due to the wide variety of steel structural parts that need to be galvanized and the shape are diverse, how to carry out the operation of each process of various workpieces safely, efficiently and orderly is the first problem that needs to be solved for hot-dip galvanizing operation. In the early days, hot-dip galvanizing enterprises often used pickling slings to hoist the workpieces into the pre-plating process pools, and then carry out secondary pendants after the pre-plating treatment was completed. This operation often affects the galvanizing efficiency. Nowadays, due to the higher and higher environmental protection requirements of hot-dip galvanizing, more and more enterprises have carried out fully enclosed collection and treatment of acid mist and water vapor generated in the pre-treatment area, as well as galvanized soot generated in the galvanized area, which puts forward higher requirements for the pendant process before plating.

The pendant is to hang the workpiece neatly on the beam one by one, and then transport them to each galvanizing process pool by crane. The use of pendant method for galvanizing operation can ensure the safety of operators and instruments, and obtain higher galvanizing efficiency, greater production output and better galvanizing quality.

1.1 Pendant device

As an important part of the hot-dip galvanizing operation process, a special pendant area should be set up to pendant the parts. Corresponding pendant devices should be set up in the pendant area, such as brackets and hanging beams, as shown in Figure 3-2.

1.Brackets and hanging beams

Brackets are steel structure supports used to support hanging beams and workpieces, which can be fixed height brackets or adjustable height brackets. The fixed height bracket has a simple structure and is easy to make, and several commonly used bracket heights can be determined according to the main type of workpiece. The height-adjustable bracket can be adjusted according to the height required by the pendant, which can adapt to the pendant requirements of a variety of workpieces, and can also reduce the strength of the worker's pendant, but the production is more

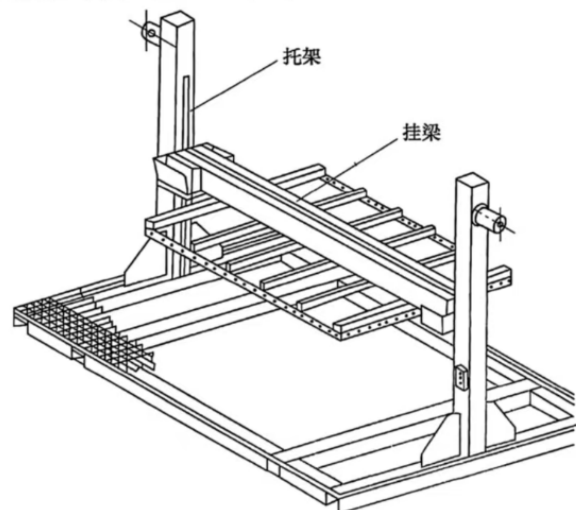
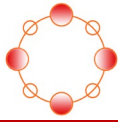


图 3-2 托架和挂梁



complex and the cost is high. Adjustable height brackets can be adjusted by electric, pneumatic, hydraulic or screw drive. On the one hand, the production of the bracket should ensure that the steel structure supporting the pendant has sufficient strength; On the other hand, it is necessary to ensure that the foundation of the bracket is stable to avoid potential safety hazards.

The hanging beam is used to hang the workpiece, so it needs a certain design rigidity, otherwise it is easy to cause bending deformation. The size of the hanging beam should fully consider the size of the zinc pot and the length and width required by the pendant.

2. Hanging device

When steel structural parts are pendants, suitable and safe hangers are generally used according to their types, sizes and weights, including steel wires, hooks and chains, special hangers or nylon slings, etc. These hangers can be used individually or in combination. However, special attention should be paid to nylon slings that cannot be used in the hot-dip galvanizing process.

(1) Steel wire: As the most common hanging method, steel wire is widely used in hot-dip galvanizing enterprises. The use of steel wire pendant can be applied to the pendant requirements of various workpieces; At the same time, the wire takes relatively less zinc liquid when lifting the workpiece from the zinc bath compared to chains and hooks. However, the use of steel wire pendants requires workers to tie and tie knots by hand, which is easy to scratch workers in the process, and the labor intensity of workers is also greater. In addition, for safety reasons, steel wires are usually discarded after being used once, which also increases the cost of use.

The use of steel wire pendants is not as thick as possible, which not only needs to ensure sufficient tensile strength, but also allows workers to bundle more conveniently. According to a survey report by the American Galvanizers Association (AGA), the most commonly used by hot-dip galvanizing companies in North America is No. 9 annealed steel wire (diameter 3.658mm). According to ASTM A853, the tensile strength of this steel wire is 413MPa, and the annealed texture state makes this steel wire relatively soft, making it easy for workers to hang the workpiece on the hanging beam with the steel wire and tie it firmly.

A very important point in wire pendants is that it is necessary to ensure that sufficient strength is used to carry the workpiece. Using too few wires can be dangerous, and using too much is a waste. The most dangerous time for steel wires to carry workpieces is when the workpiece is lifted after hot-dip galvanizing. At this time, the steel wire is close to the temperature of the zinc bath, and its own strength decreases, and at the same time, because the workpiece contains liquid zinc, it needs to bear a greater load than the hanging workpiece. Therefore, the working load limit that the steel wire can withstand should be much less than the tensile strength of the steel wire itself.

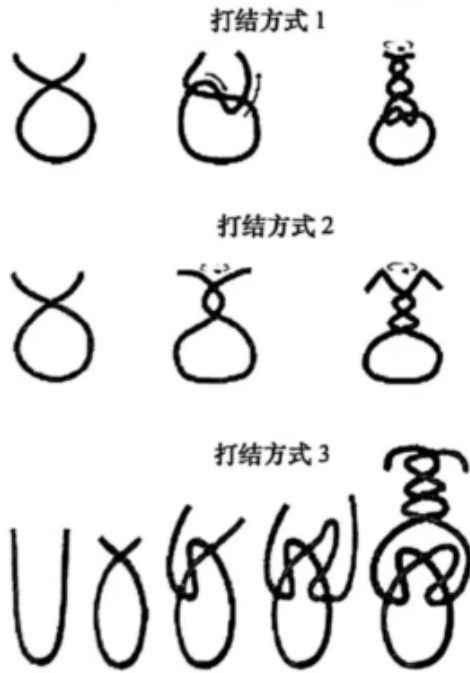
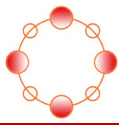


图 3-3 钢丝打结方式

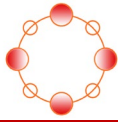
表 3-1 热浸镀锌用 9 号钢丝 (ASTM A853) 的工作载荷参考值

钢丝打结方式 (见图 3-1)	钢丝股数 /根	钢丝工作载荷 /(N/根)
打结方式 1	1	450
打结方式 2	1	450
打结方式 1 和 2	<4	450
打结方式 1 和 2	≥4	350
打结方式 3	1	1350
打结方式 3	<4	1350
打结方式 3	≥4	1000

According to the results of the AGA2003 wire test project, the working load limit of the wire depends on the type of wire and the knot method. The project recommends three commonly used wire knotting methods, as shown in Figure 3-3. Through the actual test in the enterprise, it is found that the bearing value of the steel wire changes greatly when the knotting methods 1 and 2 in Figure 3-3 are used, which is closely related to the proficiency of the workers in knotting. The third knotting method is used, and the bearing value of the steel wire is relatively stable and has little to do with the operation of workers. If the tensile strength of the steel wire itself and the use of high temperature are considered, the knotting methods 1 and 2 are used, and the working load limit of the steel wire is usually only 10% of the tensile load of the steel wire at room temperature; while using knotting method 3, the working load limit of the steel wire is 30% of the tensile load of the steel wire at room temperature. The working load reference value of No. 9 steel wire for hot-dip galvanizing (ASTM A853) is shown in Table 3-1.

It should be noted that when using multi-strand steel wire to bundle the workpiece, the workpiece load should be evenly distributed on each steel wire as much as possible to avoid stress on only one or several steel wires. After tying the wire to the workpiece and twisting it a few times, remember to fold the end of the wire back to prevent the wire from slipping off.

(2) Hooks and chains: For large workpieces, hooks and chains are usually used for hanging. This is due to the fact that the hook and chain can withstand greater loads, and the hanging is convenient and simple, and can be used many times. However, it is also necessary to pay special attention to the use of hooks and chains for hot-dip galvanizing production, which can be damaged by liquid metal corrosion, hydrogen embrittlement, chemical reagent corrosion, impact load, uneven



bearing capacity, stress corrosion, hanging shear and thermal effects.

It is important to note that high-strength alloy chains are not suitable for hot-dip galvanizing pre-treatment processes. This is due to the potential for hydrogen produced during the pickling process to be adsorbed within the alloy chain, resulting in hydrogen embrittlement. In addition, it has been studied that when the chain is at hot-dip galvanizing temperature, its strength will be reduced by more than 30%.

Before the pendant, the chain or hook needs to be inspected for wear and corrosion. Before using the chain and hook again, make sure that all the zinc on it has been removed to avoid contaminating the pickling tank. For this purpose, a separate dezinc tank needs to be set up to clear.

(3) Special pendants: For some large batches of workpieces of the same specification, it is recommended to design special pendants to pend, which can greatly improve the efficiency and safety of pendants, and ensure the quality of galvanization. Figure 3-4 shows some examples of special hangers.

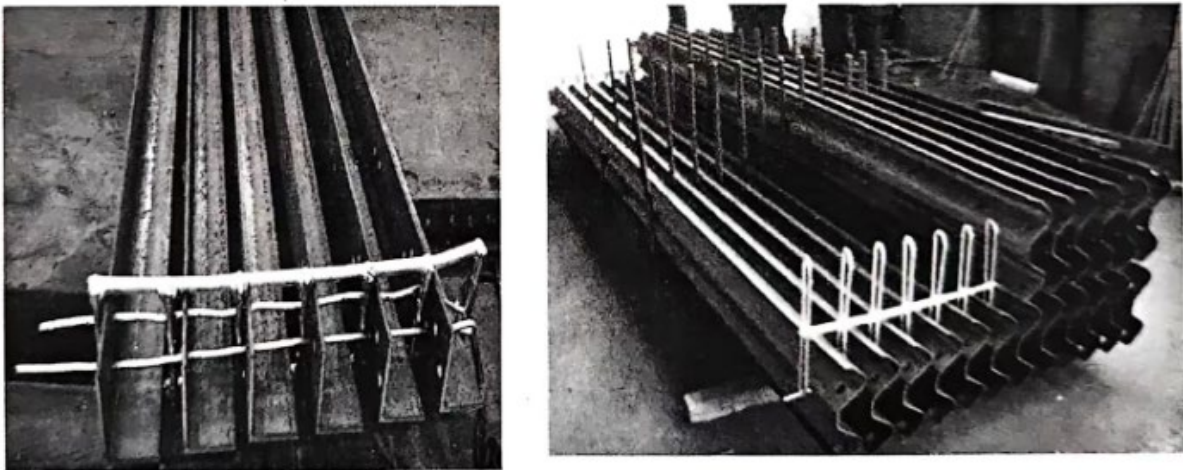


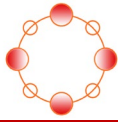
图 3-4 特殊挂具的示例

1.2 Pendant steps

To ensure high galvanizing productivity, it is generally always necessary to prepare the next batch of finished pendant parts waiting for pre-treatment, while in the galvanizing area, ensure that at least one batch of pre-treated workpieces is waiting for galvanizing. The pendant steps are as follows:

(1) Inspection before the pendant: Before the pendant, check the surface condition of the workpiece to see if there is paint, serious rust, surface defects, etc. that cannot be removed by the subsequent process; Check whether the workpiece meets the design requirements of hot-dip galvanizing, such as whether the exhaust vent hole is sufficient and whether the workpiece structure is easy to deform.

(2) Classified discharge: Under normal circumstances, the size, shape and weight of the



workpiece are different, there are solid and hollow. It can usually be classified as follows:

1) Separate small and lighter workpieces from large and heavy workpieces.

2) Separate the solid workpiece from the hollow workpiece.

3) Separate the severely corroded workpiece from the lightly corroded workpiece.

4) Workpieces that are easy to deform in zinc bath, such as flat thin steel plates with large areas, long pipes welded, corrugated steel plates, etc. are classified as one category.

If possible, pendant together with workpieces of the same material composition, the same shape and weight, and the same surface condition as possible.

(3) Choose suitable and safe hangers: According to the different conditions of the workpiece, flexibly choose hangers for pendants, or several types of hangers can be combined to form pendants. When pending, the contact traces of the hanger on the workpiece should be minimized.

(4) Hang the pendant firmly on the hanging beam: choose the correct hanging position. For symmetrical workpieces, such as steel pipes and closed hollow workpieces, lifting points or suspension points are generally prepared at 1/4 of the length of both ends of the workpiece to prevent deformation of the workpiece during the hot-dip galvanizing process.

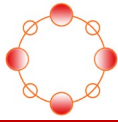
When pending, attention should be paid to the position of the exhaust hole and drain hole of the workpiece, which are usually opened diagonally. When pending, ensure that the workpiece exhaust hole is suspended at the highest position and the liquid discharge hole is in the lowest position.

The larger the hanging angle of the workpiece, the better, and vertical dipping is the best, which is conducive to the discharge of the pretreatment liquid and zinc liquid in the workpiece. Of course, for active steel galvanizing, if it is necessary to reduce the time of the workpiece immersed in the zinc bath as much as possible, the workpiece can also be hung horizontally and the angle can be increased by operating the driving pull-up. In this way, the workpiece can achieve "first in, first out" when leaving the zinc bath.

When pending, the weight of the workpiece must be strictly controlled for each dipping and not exceeding the maximum load value of the hanging beam. The number of pendants per dip is also affected by the size of the zinc pot (width, height, length). When the workpiece is immersed in the zinc bath, make sure that the workpiece does not touch the walls and bottom of the zinc pot after expansion. Maintain a minimum spacing of 100mm between the workpiece and the side wall and end of the zinc pot.

There must be a certain distance between the hanging workpieces to prevent them from sticking to each other or scratching during galvanizing. But the spacing between the workpieces should not be too large to avoid wasting hanging space.

When pending, it is necessary to take into account whether the workpiece can be adequately



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vented and drained when hot-dip galvanized. If there are no drain and vent holes on the hollow or closed workpiece, hot-dip galvanizing cannot be performed. Otherwise, the residual liquid on the workpiece may vaporize during hot-dip galvanizing and produce a strong explosion. The exhaust holes and liquid drain holes on the workpiece are referred to by the steel structure parts manufacturer.