

Analysis on the Common Quality Problems and Production Methods of Jeans Belt Loop Knot

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Abstract: The belt loop is an important part of a standard five-pocket jeans, integrating functionality and aesthetics. Because of common problems such as skewed belt loop, unequal lengths, improper slackness, double lines at the front pocket of the belt loop cover, exposed bottom of the belt loop, asymmetry, too low or too high position of the belt loop, and no light in the back, we tracked the sewing of the belt loop in the jeans production line, analyzed the causes of the problems, and came out with targeted solutions. We analyzed the operation steps of knotting jeans belt loops and then develop daily maintenance measures for knotting machines, provide technical guidance for seamstresses/seamsters and team leaders to enhance the maintenance ability to knot machines, enhance the ability of knotting machines to run well, ensure the stability of jeans belt loops quality, and provide technical reference for quality control of belt loops in the same type of jeans production lines.

Keywords: Belt loops; Jeans; Knotting machine; Routine maintenance

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1. Introduction

The jeans production industry is currently in a crucial period of transformation and upgrading. In the face of the new pattern of industry development, continuous improvement of the knot method of the belt loop, the improvement is the quality of jeans is imperative. Lv and Zhang concluded that the most classic denim clothing is workwear jeans, which have continuously evolved into various trouser types, such as suspender jeans, flared jeans, and hot pants^[1]. Liang et al. pointed out that the production of denim clothing presents a development pattern of multiple types in small batches^[2]. Liu and Zhu concluded that China is both a significant consumer and producer of denim garments^[3]. Ge pointed out that the latest report from the China Business Industry Research Institute states that the global market size of ready-made denim garments is expected to exceed the threshold of 2 billion pieces by 2023^[4]. Belt loops are small loops that hold the belt on jeans and are sewn into 1.2 cm wide, 4 cm long strips of cloth, also known as trouser lugs, tabs, trouser noses, or belt tabs, which play the role of fixing and decorating the belt. The belt loop knotting is an essential part of the finished jeans and is also prone to quality problems. The equipment used in the knotting process is the knotting machine, which is the most widely used machine in the jeans production line. The knotting machine is one of the most commonly used special equipment in garment production, which is used for stitch reinforcement and decoration. Ding and Chang found that exploring the common quality problems and process operation points when knotting waistband loops in jeans can help improve quality control and efficiency of the production line^[5].

2. Literature review

Zhang and Wang found that the main differences in the waist style of jeans are mainly in the workmanship and design, which can directly affect consumers' overall impression of jeans ^[6]. Liang et al. pointed out that the main reason workers fail to follow the standard procedure in the making of mass-produced jeans was that there is no systematic training, hence their technical knowledge is lacking ^[7]. He concluded that the overlock machine is special sewing equipment, which is usually used at the pocket, trouser toss, back strap, and other tensioned parts, which not only reinforces the tensioned parts but also act as a decoration ^[8]. Feng pointed out that the overlocking machine is mainly used for reinforcing particular parts of garments and decorative sewing stitches, which makes it an indispensable machine in garment production ^[9]. Wang pointed out that quality control is fundamental to achieving high-quality enterprise management, and quality management is the key to the stable development of the enterprise, thus strict quality control and quality management needs to be practiced ^[10]. Cheng pointed out that quality management is the root of the enterprise's foundation. A sound quality management system allows the enterprise run more smoothly and improve its core competitiveness ^[11]. Shen pointed out that quality is an enterprise's lifeline and determines its survival and development ^[12]. Pan pointed out that the appearance of high-quality finished jeans must have a flat surface with symmetrical and firm pockets. However, due to factors such as operating skills and proficiency, various quality problems occur during the sewing process ^[13]. Wang pointed out that most of the quality problems in the manufacturing process are caused by human errors and that analysis and research on human factors, and development and implementation of effective measures can reduce quality problems caused by human error ^[14]. Zhou pointed out that for a company to have good quality products, frontline employees should have professional operational skills and strict quality awareness ^[15]. Yuan pointed out that the process of taking apart and re-sewing should be avoided. This is because with more sewing, the frequency of machine needles piercing the fabric also increases, which can easily cause needle holes ^[16]. Liu pointed out that the employees' work quality and the optimization of quality management is essential for a company ^[17]. Cheng pointed out that quality management and control should not only include the product itself but also the manufacturing process, gradually improve the stability of the process in order to ensure the consistency of the products' quality ^[18]. Jin pointed out that ex-ante management is conducted to predict possible quality problems and provide reliable solutions based on analysis and diagnosis, thus improving product quality ^[19]. Wang pointed out that strict standards, requirements, and assessment should be applied in quality management, and the efficiency and professional skills of employees should be continuously improved to control the quality, and only in this way can the market competitiveness of enterprise products be continuously improved ^[20]. Chang pointed out that equipment management is needed to maintain equipment in the best state of reliability and improve equipment productivity through scientific and practical means ^[21].

3. Research methodology

This paper adopts site investigation and analysis as the research method. We visited the production lines of different jeans enterprises, summarized the methods of belt loop knotting and common quality problems in the production process, conducted field data collection and analysis. A famous jeans enterprise was visited, hence this paper explains the belt loop sewing process, pre-production preparation, and production quality control of this jeans manufacturing enterprise. On-site production analysis was conducted to understand the existing belt loop problems and to communicate with the seamster/seamstresses.

4. Research findings

4.1. Common quality problems of jeans belt loops

4.1.1. Belt loop skew, length difference, and slackness

(1) Skewed belt loop

If the knot of the belt loop is not tied according the positioning line, there will be a skew. This can be caused unclear positioning line or a sewing speed that is too high. As a result, there is no accurate alignment when piecing the semi-finished products together, causing a skew. When the skew amount exceeds 0.3 cm, it is a severe defect and needs to be reworked.

(1) Belt loop length

In standard five-pocket jeans of the same size, the belt loop length is usually the same, if the ironing is not following the amount of sewing ironing, or when the belt loop is not cut according to the required length, it will cause an asymmetry between the belt loops. When the difference between the length of the belt loops in the same jeans is 0.5 cm and above, it is considered a severe defect; when the difference in length is between 0.3 and 0.5, it is considered a minor defect and can be reworked before the next process.

(2) Belt loop slackness

The slackness of the belt loop is set to meet the capacity of the belt, so the slackness should be executed according to the order standard. When the sewing workers do not leave the slackness according to the standard, or do not sew according to the alignment point, or trim the belt ring inaccurately, the slackness will change. When the difference between the slackness of the belt loop and the required slackness exceeds 0.3 cm, it will be classified as a severe defect and needs to be reworked.

The solutions to a crooked belt loop include clear powder marks, reasonable reduction of sewing speed, prioritizing quality over quantity, and precise alignment when placing the presser foot. As shown in **Table 1**, the solution to the belt loop length problem requires ironing with the help of a template during ironing to ensure the accuracy of the sewn portion. After the belt loop is turned and sewn in the cutting phase, the sewing worker can choose to draw a positioning line on the cutting table as a standard to ensure the accuracy of the cutting length. As for the problem of belt loop slackness, sewing should be done strictly following the alignment point, and the belt loop length should not be trimmed randomly.

Table 1. Belt loop skew, length, and slackness problems and countermeasures

| Quality problem points | Cause analysis | Solution |
|------------------------|---|---|
| Skewed belt loops | The positioning line is not clear, causing inaccurate positioning | The sweeping powder should be clear |
| | Overly fast sewing speed | Reduce the speed of sewing, prioritizing quality over quantity. |
| | The needle is not aligned with the stop | Timely adjustment of alignment when placed under the presser foot |
| Belt loop length | Sewing and ironing errors | Iron in place according to the template slip edge |
| | The front channel belt loop is incorrectly cut | Sewing workers should check the length of the belt loops that have been cut |
| Belt loop slackness | Amount of slack is not according to the standard | The amount of slack should be consistent and performed according to the standard. |
| | Not sewn according to the alignment point | Sew strictly according to the alignment point |
| | Belt loop secondary trimming | Do not trim belt loops randomly |

4.1.2. Belt loop covers the front pocket double line, exposed bottom, and asymmetry

(1) Belt loops cover the two decorative lines of the front pocket

The belt loop at the curved front pocket is close to the crescent pocket, and if the alignment point is not sewn, it will easily cause the problem of double lines at the front pocket of the belt loop cover. However, if there is a double line problem in the front pocket of the belt loop cover, it is a severe defect and needs to be removed and reworked.

(2) Exposed insides of belt loop bottoms

The problem of exposed bottom occurs when sewing workers do not iron the belt loops properly or randomly adjust their sewing gesture. When the length of exposed bottom is more than 0.3 cm, it will be considered as a serious defect; if the length of exposed bottom is 0.2 cm to 0.3 cm, it will be considered as a minor defect, which can be reworked timely.

(3) Asymmetry of belt loops

If the side seams are not sewn properly, or there is misalignment between the seams, or if the sewer did not pay attention to the symmetry of the seams, it will cause the problem of asymmetry of the belt loops. When the difference between the position of the belt loops is 1 cm or more, it is considered a severe defect. When the misalignment of the belt loops is between 0.5 cm and 0.9 cm, it is considered a slight defect and can be reworked in time before the next stage.

The solution to the double line at the front pocket of the belt loop cover is to sew according to the alignment points, adjust the machine needle positioning in time when placing the semi-finished product under the presser foot, and reasonably adjust the sewing speed. As shown in **Table 2**, when sewing the belt loops, the workers ensure that no quality problems occur in the process they are responsible for, and products with quality problems at any stage shall be rejected in time.

Table 2. Belt loops conceal the two decorative lines on the front pocket, exposed bottom, asymmetry problems, and countermeasures.

| Quality problem | Cause analysis | Solution |
|---|---|---|
| Belt loops conceal the two decorative lines on the front pocket | Not sewn according to the alignment point | Stitching in strict accordance with alignment point positioning |
| | The needle is not aligned with the top edge. | Timely adjustment of needle positioning when placed under the presser foot. |
| | Overly fast sewing speed | Moderate reduction of sewing speed |
| The inside of the belt loop bottom exposed | Belt loop ironing is not in place | Ironing after aligning strictly with the edges of the template |
| | Sewing gesture problem | Do not adjust the gesture at will to ensure consistency of the gesture. |
| Belt loop symmetry | Not sewn following the side seam allowance | Precise sewing according to the reserved seam allowance |
| | Not sewn according to the alignment point on the waistband of the pants | Stitching in strict accordance to the alignment points |
| | No sense of symmetry in sewing workers | Cultivate self-inspection awareness among sewers |

4.1.3. Improper height of the belt loop on the waistline

(1) Incorrect belt loop position

When the waistline of the pants is knotted with the belt loop, if the sewing gesture is adjusted frequently, the belt loop is not knotted according to the alignment mark, or if the sewing speed is too fast when the belt loop is placed, or the machine needle and the stop edge are misaligned, it will result in the position of the belt loop being too high or too low and not aligned with the waistline of the jeans. If the misalignment is severe, rework needs to be done and causes losses.

(2) The belt loop is not aligned with the stitching at the back of the pants

The alignment of the middle belt loop at the back of the waistline is an integral part of the quality inspection. If the spacing between the two parallel stitching lines of the belt loop is uneven and the upper end of the belt ring is misaligned, directly tying the set knot without accurate alignment in the back center will directly lead to the misalignment of the two parallel stitching lines in the back center and affect the beauty of the garment.

To avoid the problem of low or high belt loops, the turners and sewing workers operate with consistency and stability of hand gestures as shown in **Table 3**, operate in strict accordance with the alignment points, control the speed of the machine while maintaining the quality, and determine the precise positioning before tying the set knot after the belt loops are placed under the presser foot. As for the problem of not shining the line in back middle belt loop, when turning and sewing the belt loop, the unevenly spaced belt ring cannot flow into the production line. the upper end of the belt ring should be accurately aligned before inserting the needle, and when placing the belt loop, the two parallel stitching lines in the back middle should be accurately aligned, which can effectively avoid the problem of misalignment of the two parallel decorative lines in the back middle.

Table 3. The problem of the improper height of belt loops and the problem of not illuminating the line in the back and countermeasures.

| Quality problem points | Cause analysis | Solution |
|---|---|---|
| The belt ring is too low/too high | Sewing hand gesture error | Maintain consistency and stability of hand gestures |
| | Knotted belt loops are not aligned | Knotted belt loops in strict accordance with the position of the alignment points |
| | Overly fast sewing speed | The speed of the machine should be controlled |
| The belt ring after the center does not illuminate the line | Misalignment of the machine needle and stop edge when placing the belt loop | After putting the belt loop under the presser foot, determine the precise positioning and tie the knot. |
| | Belt loop two parallel stitching line spacing is uneven | When sewing belt loops, unevenly spaced belt loops shall be rejected before proceeding to the next production stage |
| | Misalignment of the upper end of the belt loop | The upper end of the belt loop should be accurately aligned. |
| | No alignment in the back center, directly tying the set knot | When placing the belt loops, the rear and middle double stitching lines should be precisely aligned |

4.2. Routine maintenance of nesting machines

In order to ensure the smooth operation of the production line, the daily maintenance of the knotting machine should be implemented, as shown in **Table 4**. The aspects needing maintenance include the working table, the thread frame, the surface of the machine head, the thread clamp, the oil window, the

working light, the frame, the computer central processing unit (CPU), the bobbin, the bobbin bed, the dynamic and static knives, the presser foot paper, the stitches. The sewers and sewing machine operators will perform daily maintenance on the knotting machine according to the requirements.

Table 4. Schedule of routine maintenance of the casing machine

| Spot-check serial number | Spot check parts | Spot check requirements | Use of tools | Remarks |
|--------------------------|--|---|-------------------------------|-----------------------------|
| 1 | Workbench board, wireframe | The body is cleaned, and no objects are placed in a mess | Towel | Three times/day |
| 2 | Head surface, strainer, oil window, work light | Clean and dust-free | Towel | Three times/day |
| 3 | Rack, computer CPU | Clean surface | Towel | One time/day |
| 4 | Pendulum shuttle | No dust accumulation | Small brushes, small tweezers | In the evening, before work |
| 5 | Shuttle bed, dynamic and static knife | No dust accumulation | Small brushes, small tweezers | |
| 6 | Pad with presser foot paper | Machine pin inserted | / | |
| 7 | Take out the presser foot paper | No oil leakage | / | In the morning, before work |
| 8 | Power-on spot check | Standard oil supply to the equipment The machine is running correctly. | / | |
| 9 | Pinning | Normal stitching | Clothes piece | All day |

The sewer cleans the workbench and thread frame three times a day to prevent all kinds of debris on the table, and cleans the surface of the machine head, the thread clamp, the oil window, and the work light with a towel to keep them dust-free. The sewing workers need to use a small brush and small tweezers to clean the accumulated dust on the swing shuttle, bobbin bed, and dynamic and static knives before they leave work every night, and lift the presser foot, pad it with presser foot paper and insert the machine needle down to avoid the presser foot paper falling off. When working, make sure the stitching is standard.

4.3. Procedure of belt loop knot

In the first step, smooth out the fabric surface where the belt loops are knotted. Align the pressure foot with the alignment point at the semi-finished belt loops, press the jeans with the left hand and take the belt loops with the right hand.

The second step is precise alignment, before tying the knot, the machine needle is usually on the left side, and the machine needle and the left stop of the belt ring are aligned to tie the knot; the knot will be equal to the belt loop, the middle seam of the presser foot is aligned with the width of the belt ring, and the knot is tied in the middle; usually the knot will be in the middle of the belt loop.

In the third step, the belt loop ironing upper stop needs to be aligned with the trouser waist stop position and cannot be skewed. In contrast, the upper and lower belt ring stop need to be aligned. If the upper stop is skewed, no adjustment will be tied to the set of knots, and it will cause the entire belt ring to be skewed.

The lower stop is difficult to correct, easy to appear belt ring length, and inconsistent problems.

In the fourth step, the left hand is placed 2 cm from the lower stop of the belt loop, the hand is then moved to the back of the presser foot. Next the presser foot is pressed against the belt loop, and the cutting piece is held with the right hand to prevent the jeans from being skewed and finish the process of tying the knot of the belt loop.

5. Conclusions

In this paper, we analyzed the most common problems in sewing jeans belt loops and formulated corresponding measures to solve the problems. We also summarized the operation steps of belt loop knotting from the front line of jeans production and points of maintenance of the knotting machine to ensure proper operation of the knotting machine. Besides, we have also provided theoretical support for sewers and security workers to troubleshoot and maintain the equipment quickly, help shorten maintenance time, improve work efficiency, and ensure the quality consistency of the belt loop link in jeans.

Disclosure statement

The author declares no conflict of interest.

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