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A Case Study of Availability of Juki MF-7524 Flatlock Machine Based on Maintenance Schedule

Ananya Agnihotri*, Himanshu Kumar*, Sarita Kumari*, Sweta Megha*, Vinoth Rengaraj**
**Student, Department of Fashion Technology, National Institute of Fashion Technology, Patna, Bihar, India*
***Assistant Professor, Department of Fashion Technology, National Institute of Fashion Technology, Patna, Bihar, India*
Email: [sk7036985@gmail.com]

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Abstract:

In the apparel manufacturing industry, sewing machines play an important role in maintaining production efficiency and garment quality. The performance of sewing equipment depends on proper operation, regular maintenance, and timely identification of machine abnormalities. A flatlock sewing machine is widely used for knitted and stretchable fabrics because it produces flat, flexible seams suitable for garment hems, neck areas, panel joining, and decorative purposes. This study focuses on the maintenance management and downtime analysis of the JUKI MF-7524 flatlock sewing machine. The study examines the major machine components, lubrication system, different types of maintenance, and maintenance activities performed at daily, weekly, monthly, six-monthly, and yearly intervals. Common machine abnormalities and major breakdowns, including thread slipping, needle breakage, and uneven covering, are also considered.

Keywords — **Flatlock machine, Juki MF-7524, Preventive maintenance, Planned maintenance, Downtime, Availability.**

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I. INTRODUCTION

A flatlock machine is a specialised sewing machine that makes a flat, flexible seam with very little bulk. It is mostly used on knitted, stretchable and jersey fabrics, because the seam can stretch along with the garment instead of snapping or puckering. In everyday garment making it turns up at hems, neck areas and panel joins, and sometimes purely as a design feature, where a contrast-coloured flatlock seam becomes part of the look [1].

The machine studied in this paper is the Juki MF-7524 (Fig. 1). Its main specifications are listed in Table I.

TABLE I
SPECIFICATIONS OF JUKI MF-7524

S. No.	Parameter	Specification
1	Company	Juki
2	Machine type	High-speed, flat-bed coverstitch machine
3	Maximum sewing speed	4,200 stitches/min (3,500 stitches/min at delivery)
4	Dimensions	Height 451 mm × Width 515 mm × Length 263 mm
5	Weight	46 kg
6	Stitch type	ISO 607
7	Needle gauge	4-needle, 6.0 mm
8	Stitch length	1.2 mm to 3.6 mm, adjustable up to 4.4 mm
9	Needle	SM1014B
10	Lubricating oil	Juki Genuine Oil 18
11	Oil reservoir capacity	600 cc (lower line) to 900 cc (upper line)

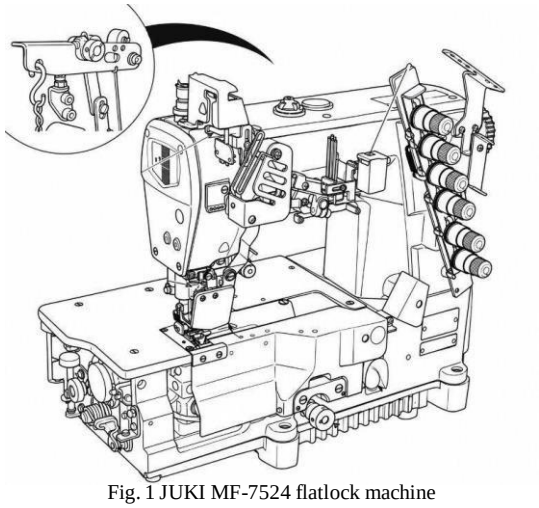


Fig. 1 JUKI MF-7524 flatlock machine

A. *Working Principle*

The sewing cycle follows a fixed order. First, the machine is threaded along its prescribed path, with every needle and looper thread placed correctly and the tension set so that stitches form properly. The fabric layers are then placed under the presser foot, which holds them down while the feed mechanism pushes them forward. The needles move down through the fabric and the needle threads form loops. The loopers travel around these loops and interlock with them, and this repeated interlocking builds the stitch (Fig. 2). Because the cycle repeats at high speed, a uniform flat seam runs along the garment edge. When the seam is finished, the operator stops sewing, the thread chain is secured or trimmed, and the part is taken off the machine [2].

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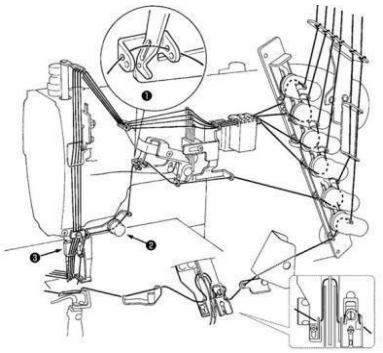


Fig. 2 Needle and looper movement

B. Role of differential feed

Knitted fabric stretches easily, so feeding it evenly is the real challenge. The differential feed deals with this by controlling the relative speed of the front and rear feed dogs. A ratio of 1:1 feeds the fabric normally. A ratio above 1:1 pushes more fabric through at the front, which helps create a gathered effect or stops the fabric from stretching. The ratio can be changed to suit the fabric and the sewing job, and it is one of the main reasons the machine copes so well with knits.

C. Types of Flatlock Stitches

Flatlock seams are classified by the number of threads used, and each configuration changes how the needles and loopers work together (Table II). The Juki MF-7524 is a four-needle, six-thread machine, so it works in the six-thread configuration.

TABLE II
TYPES OF FLATLOCK STITCHES

S. No.	Type	Threads	Needles	Loopers	Stitch Formation
1	Six-thread flatlock	6	4	2	Four needles form needle-thread loops, and two loopers interlock with them underneath
2	Four-thread flatlock	4	2	2	Two needles form two rows of stitches, and two loopers interlock from the underside
3	Three-thread flatlock	3	2	1	The needle thread is interlooped with the looper thread to form the flat seam

II. MAJOR COMPONENTS

A well-coordinated set of components lies behind the seemingly plain seam. They are outlined below since the maintenance plan revolves around them.

A. Needle, Needle Bar and Needle Clamp

The needles take the upper threads and feed them through the fabric down to the needle holes on the throat plate, where the loops are created. The needle used in this machine is known as SM1014B. The needle bar provides the vertical movement of the needles, while the needle clamp ensures that all four needles are secured on the 6.0 mm gauge (Fig. 3). The throat plate offers a hard sewing surface, which has slots for the feed dogs and needle holes for the needles.

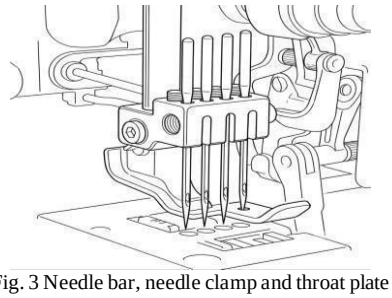


Fig. 3 Needle bar, needle clamp and throat plate

B. Presser Foot and Presser Spring Regulator

The purpose of the presser foot is to hold the fabric down while the sewing machine operates. The presser spring regulator controls how much pressure the presser foot applies on the fabric by the feed dogs (Fig. 4). If one turns it clockwise, it will increase the pressure for heavy fabrics, while counterclockwise decreases the pressure.

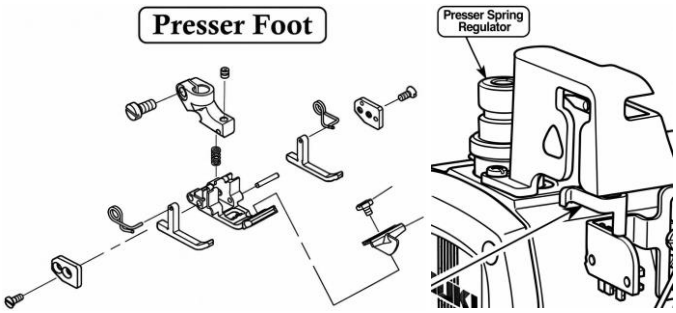


Fig. 4 Presser foot and presser spring regulator

C. Looper and Spreader

The looper uses the needle thread to create the bottom half of the stitch. The spreader is a guide arm that helps in guiding the thread loops during the creation of the stitch (Fig. 5). The rear needle guard is found behind the needles, helping to guide the needles to prevent deflection by the looper, whereas the front needle guard guides the needle thread loops.

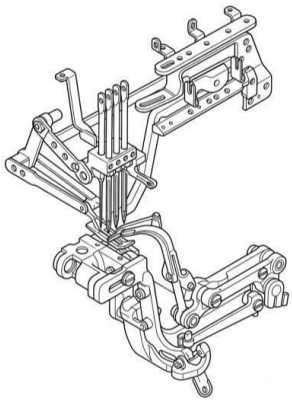


Fig. 5 Needle bar, looper and spreader drive mechanism

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D. Feed Dog and Micro Lifter

The feed dog pulls the material through the sewing machine. At its highest point, its rear teeth are supposed to be 1 mm above the throat plate. The micro lifter lifts the presser foot off the material a little, thus allowing for any puckering or stretching on elastic knits to be removed. This component is set by a collar and screw; when it is not active, the marker on the collar should point vertically upwards.

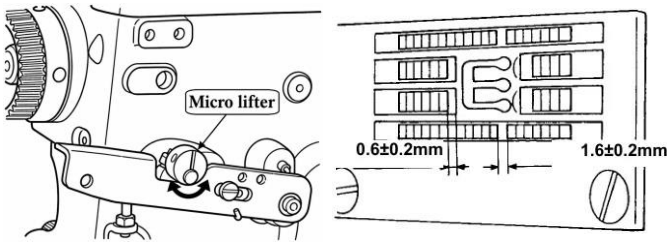


Fig.6 *Feed Dog area and Micro Lifter*

E. Hand-wheel, Feed Regulating Knob and Thread Guides

The hand wheel or the upper pulley is manually rotated to set the motion of the needles and looper during the setup procedure. It should rotate in a clockwise direction when viewed from the side of the pulley in order for the oil pump to function properly. The feed regulating knob is a rotating knob in the front arm which is used to set the stitch length between 1.2 mm to 3.6 mm, and the setting could go to 4.4 mm by adjusting the screw and pin. The thread guides are an upper bracket which holds the thread from the spool stand and aligns it with the tension disc assembly.

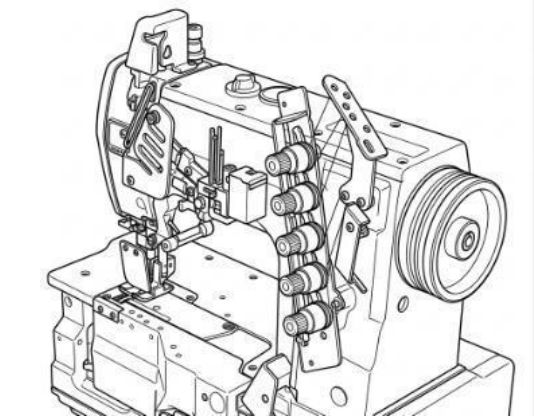


Fig.7 Hand-wheel, Feed regulating and Thread guides

F. Safety Parts

The eye shield is made up of a clear plastic shield located above the needle bar section. The shield prevents any pieces from the broken needle from entering the eye of the operator. The cover for the belt covers the motion pulley and the belt to prevent anything from being pulled into the belt.

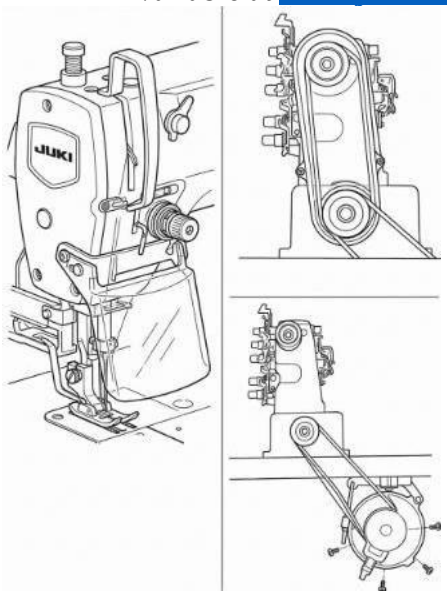


Fig.8 Eye shield and Cover belt cover

G. Motor and Arm Shaft

The motor is the 3-phase, 2-pole, 400 W (1/2 HP) clutch motor placed under the table. It operates the machine head by an M-type V-belt, which needs to be adjusted to the deflection of 15-20 mm. The rotation of the motor should be in the clockwise direction when observed from the pulley side in order to operate the internal gear pump to supply oil. Sewing speed varies according to the pulley diameter of the motor and may be up to 4,200 stitches per minute. The arm shaft is the major horizontal steel shaft of the upper arm.

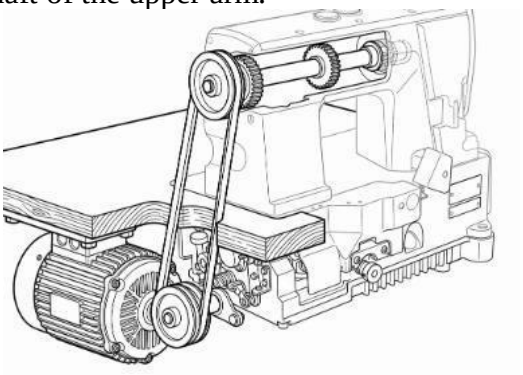


Fig. 9 Motor and Arm Shaft

H. Lubrication System

Lubrication reduces friction, heat, and wear of the moving parts. The machine has a forced oil gear pump for circulating oil to all bearings and shafts. There are lower and upper limit lines in the oil pan while there is an inspection window with flow sight nozzle, which allows the operator to see whether the oil is circulating. The machine requires Juki Genuine Oil 18 with oil pan capacity of 600 to 900 cc. The oil should be changed after the first month of operation and then every six months thereafter while the oil filter should be inspected and cleaned or replaced every six months. There is a silicone oil lubricating unit, which is standard and designed for use during

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high-speed sewing to reduce thread breaks and skips. [3].

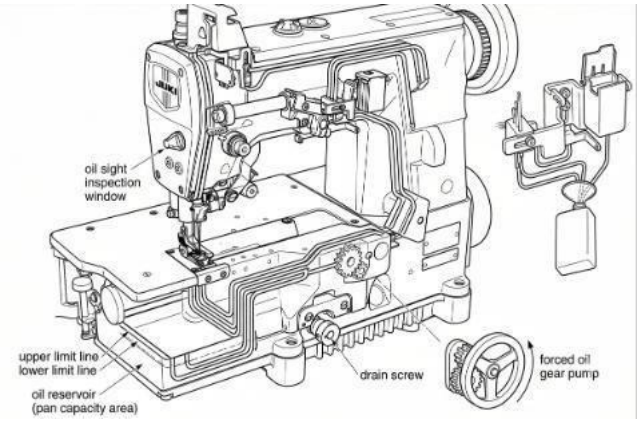


Fig. 10 Lubrication System

III. MAINTENANCE

- Maintenance refers to the deliberate attempt to maintain equipment in proper working order, minimize downtime and manage repair costs. There are several types of maintenance that can be employed in a garment unit:
- Routine maintenance: basic inspection and cleaning done regularly by the operator.
- Preventive maintenance: planned inspection, lubrication, adjustment, and replacement before breakdown occurs.
- Corrective maintenance: maintenance that is carried out once a fault or defect is detected.
- Breakdown maintenance: maintenance done after the equipment fails or breaks down.
- Predictive or condition-based maintenance: maintenance performed depending on the condition of the equipment.[4].

The difference between preventive and breakdown maintenance is mainly one of timing. Preventive work is planned in advance and can be fitted into gaps in production. Breakdown work arrives without warning and brings urgent stoppages, lost production time and pressure on the maintenance staff. Preventive maintenance cannot remove every breakdown, but it reduces the avoidable ones. Checking the belt condition every month is preventive, for example, while replacing a belt after it snaps in the middle of production is breakdown maintenance. Breakdown records are valuable too, because they show where the preventive plan needs to be improved.

A. Abnormalities Normally Observed

The abnormalities normally observed during the check-up of the machine included; corrosion of the threads, play of looper, missing screw of the throat plate, low oil, missing tension screw, missing needle guard in front of needle, oil leakage and discoloration, play in the thread stand, wrong use of thread sizes and dust accumulation in the looper. All these are minor problems which will be noticed during normal check up way before they cause machine breakdowns.

PLANNED MAINTENANCE

B. Basis of the Schedule

The below schedule has been formulated keeping into consideration the machine Juki MF-7524 operating for six days a week and eight hours daily. Each task time period has been converted into minutes per week to calculate total time per week for all tasks. The task times in Tables III to VII are the revised times.

C. Daily Maintenance

TABLE III
DAILY MAINTENANCE

S. No.	Component	Maintenance activity	Freq.	Revised time
1	Machine cleaning	Remove lint, dust and thread waste	3×/week	2 min 55 sec
2	Needle condition	Check for bent, blunt or damaged needle	1×/week	27 sec
3	Threading and tension	Check correct threading and thread tension	2×/week	58 sec
4	Oil level	Check oil level and visible leakage	1×/week	35 sec
5	Presser foot	Check presser-foot condition	1×/week	25 sec
6	Feed area	Check feed-dog movement	1×/week	33 sec
7	Loose parts	Check nuts, screws and fittings	1×/week	1 min 27 sec
			Total	**7 min 18 sec**

Weekly equivalent = 7 min 18 sec × 6 days = 43 min 48 sec/week.

D. Weekly Maintenance

TABLE IV
WEEKLY MAINTENANCE

S. No.	Component	Maintenance activity	Freq.	Revised time
1	Needle bar / needle head	Check movement, alignment and fixing screws	1×/week	9 min 39 sec
2	Looper	Check condition and secure mounting	1×/week	5 min 47 sec
3	Main and differential feed dogs	Check movement and feed action	1×/week	3 min 52 sec
4	Presser-foot assembly	Check hinge, spring, guide and movement	1×/week	9 min 39 sec
5	Thread tension assembly	Check tension discs and springs	1×/week	3 min 52 sec

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S. No.	Component	Maintenance activity	Freq.	Revised time
6	Thread guides/ take-up parts	Check guides, screws and thread-contact surfaces	1×/week	11 min 35 sec
			Total	**44 min 24 sec**

Weekly equivalent = 44 min 24 sec/week.

E. Monthly Maintenance

TABLE V
MONTHLY MAINTENANCE

S. No.	Component	Monthly maintenance activity	Freq.	Revised time
1	Complete cleaning	Clean machine and accessible internal areas	1×/month	20 min
2	Looper	Check condition, clearance and mounting	1×/month	12 min
3	Needle guard	Inspect position and damage	1×/month	12 min
4	Spreader	Check condition, position and thread-guide clearance	1×/month	9 min
5	Feed mechanism	Check alignment, movement and operation	1×/month	11 min
6	Presser-foot mechanism	Check lift and micro-lifter operation	1×/month	7 min
			Total	**63 min**

Weekly equivalent = 71 / 4 = 17 min 45 sec/week.

F. Half-Yearly Maintenance

TABLE VI
HALF-YEARLY MAINTENANCE

S. No.	Component / system	Half-yearly maintenance activity	Freq.	Revised time
1	Complete machine cleaning	Remove accumulated contamination	1×/6 months	29 min
2	Lubrication system	Drain and replace lubricating oil	1×/6 months	35 min
3	Oil filter	Inspect and replace if clogged	1×/6 months	19 min
4	Looper mechanism	Inspect condition, clearance and mounting	1×/6 months	14 min
5	Feed mechanism	Inspect and adjust feed mechanism	1×/6 months	31 min
6	Needle / guard / spreader system	Inspect and check alignment	1×/6 months	27 min
7	Main shaft and take-up mechanism	Inspect movement, play and wear	1×/6 months	15 min
8	Final test	Verify stitch formation, feeding and lubrication	1×/6 months	31 min
9	Machine interior	Deep clean accessible internal areas	1×/6 months	29 min
			Total	**230 min**

Weekly equivalent = 8 min 48 sec/week.

G. Yearly Maintenance

TABLE VII
YEARLY MAINTENANCE

S. No.	Component / system	Yearly maintenance activity	Freq.	Revised time
1	Complete machine inspection	Review overall machine condition	1×/year	37 min
2	Main shaft and drive mechanism	Check shaft play, rotation and wear	1×/year	52 min
3	Looper drive	Inspect drive mechanism and wear	1×/year	35 min
4	Feed drive	Inspect feed cams, levers and movement	1×/year	22 min
5	Needle bar mechanism	Check movement, clamp and alignment	1×/year	34 min
6	Thread take-up mechanism	Inspect shaft and thread-contact components	1×/year	19 min
7	Belt and pulley	Inspect belt condition and tension	1×/year	34 min
8	Electrical / motor connection	Inspect wiring and operating condition	1×/year	15 min
9	Machine setting	Verify timing, feeding and stitch quality	1×/year	28 min
			Total	**276 min**

Weekly equivalent = 276 / 52 = 5 min 18 sec/week.

IV. DOWNTIME

Machine down time is described as all the periods where the machine does not perform its work, resulting in production halt. Downtime could be scheduled but unpredictable in some form or other like administrative lag. The remaining form is unpredictable and varies from week to week [5]. In this experiment, downtime is assumed as:

Downtime = Planned maintenance + Unplanned maintenance + Administrative delay + External factors

All values are stated per week.

A. Planned Maintenance

Table VIII brings the daily, weekly, monthly, six-monthly and yearly tasks together in weekly units.

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TABLE VIII
PLANNED MAINTENANCE (WEEKLY UNITS)

S. No.	Maintenance Type	Time (min/week)
1	Daily	43 min 48 sec
2	Weekly	44 min 24 sec
3	Monthly	17 min 45 sec
4	Half-yearly	8 min 48 sec
5	Yearly	5 min 18 sec
	Total	**120 min 3 sec**

B. Unplanned Maintenance

Unplanned maintenance is the corrective work carried out when a fault stops the machine during production. The failures and the corrective action taken are listed in Table IX and amount to 66 min/week.

TABLE IX
UNPLANNED MAINTENANCE

S. No.	Component / Failure	Corrective maintenance activity	Time (min/week)
1	Needle breakage or damage	Replace needle and check alignment	8
2	Thread tension failure	Adjust tension and test stitching	10
3	Looper malfunction	Inspect, adjust and reset looper	12
4	Feed mechanism problem	Check feed dogs and correct feeding	10
5	Oil leakage or lubrication issue	Identify leakage and correct lubrication	8
6	Belt or motor problem	Inspect drive and restore operation	18
		Total	**66 min/week**

C. Administrative Delay

This is the lost time during waiting for the mechanic to reply, including communication time, spare-parts approval, and operator skill issues. This is a total of 48 min per week (Table X).

TABLE X
ADMINISTRATIVE DELAY

S. No.	Factor	Example of delay	Time (min/week)
1	Mechanic response time	Waiting for maintenance staff	10
2	Communication delay	Calling and reporting the fault	6
3	Spare parts approval	Waiting for permission or parts	7
4	Operator skill issue	Time required to explain the problem	5
5	Material availability	Waiting for fabric or thread	12
6	Production coordination	Waiting for instructions or line clearance	8
		Total	**48 min/week**

D. External Factors

These refer to the external factors which influence the machine's operation. These include power, air supply, material and production conditions, and amount to 25 min/week (Table XI).

TABLE XI
EXTERNAL FACTORS

S. No.	Factor	Example of delay	Time (min/week)
1	Power interruption	Temporary loss of electrical supply	15
2	Compressed air supply	Low or interrupted air pressure	10
		Total	**25 min/week**

E. Downtime Analysis

Table XII combines the four downtime categories into the total weekly downtime.

TABLE XII
DOWNTIME ANALYSIS

S. No.	Downtime category	Factors	Time (weekly)
1	Scheduled maintenance	Operator checklist, mechanic checklist, periodic checks, six-month overhaul	120 min 3 sec
2	Unplanned maintenance	Needle breakage or damage, looper malfunction and other factors	66 min
3	Administrative delay	Mechanic response, communication/calling, availability of maintenance support, training/skill issues	48 min
4	External factors	Production/environmental conditions and other factors affecting machine operation	25 min
		Total	**259 min 3 sec**

V. RESULT AND DISCUSSION

A. Availability Calculation

Availability = (Up time / Total time) × 100

Total time = 1 week = 6 days × 8 hours × 60 = 2,880 min

Downtime = 259 min 3 sec = 259.05 min

Up time = 2,880 − 259.05 = 2,620.95 min

Availability = 2,620.95 / 2,880 × 100 = 91.01%

B. Major Flatlock Breakdowns

Three issues occur most frequently in flatlock sewing machines. The time required to diagnose these problems is shown in Table XIII. These are

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the diagnosis times for individual incidents, and therefore do not constitute part of the fixed weekly downtime.

TABLE XIII
MAJOR FLATLOCK BREAKDOWNS

S. No.	Problem	Checks Carried Out	Time
1	Thread slipping	Machine timing (5 min), damaged machine parts (5 min), blunt or bent needle (3 min)	13 min
2	Needle breakage	Correct needle (1 min), machine timing (5 min), operator sewing method (1 min)	7 min
3	Uneven covering	Machine setting (5 min), operator instructions (1 min)	6 min

VI. CONCLUSIONS

With this maintenance strategy, the Juki MF-7524 flatlock sewing machine becomes available about 91% of the time per week. Out of the total 259.05 minutes lost per week, 120.05 minutes are used for scheduled maintenance (4.17% of the week's work), 66 minutes for unplanned maintenance (2.29%), 25 minutes due to external influences (0.87%) and 48 minutes due to administrative delays (1.67%), adding up to about 9%.

There are two notable aspects. First, scheduled maintenance is the largest single part of the downtime (about 46%), yet it is planned, fitted into production gaps, and most of it is quick daily and weekly checks performed by the operators (about 88 of the 120 minutes). Second, the remaining 139 minutes (about 54%) are lost to unplanned maintenance, external factors and administrative delays, and these can be reduced. Belt or motor problems (18 min) and looper malfunction (12 min) are the largest unplanned items. The combination of proper threading, correct differential-feed setting and maintenance will maintain seam quality, identify any defects timely, prevent break downs and increase the machine's life span

VII. FUTURE WORK

Availability can be increased by reducing the amount of downtime which is unplanned. It can be done by minimizing the administrative delays. This would involve having an in-house mechanic who is trained, keeping spare parts readily available and providing an easy mechanism for calling for help. External factors like dust, humidity and power supply can be controlled through housekeeping and stable electrical supply.

Maintenance records can be maintained properly and analyzed so that problems like thread slipping, needle breakage and uneven covering could be correlated with the respective activity in the preventive plan. With time, the study can also be expanded from fixed interval maintenance to condition-based and predictive maintenance, where oil condition, belt wear and needle replacement can be monitored with respect to usage. Lastly, the same methodology can be applied to other machines on the knit line as well as to different types of machine models.

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