RESEARCH ARTICLE OPEN ACCESS

# Maintenance Scheduling and Availability of Case Study in JUKI LBH-1790AN Computer-Controlled Buttonholing Machine

Hemasri S[1*], Gopika M[1], Harikrishnan R[1], Akash G[1], Vinoth Rengaraj[2]
[1]Student, Department of Fashion Technology, National Institute of Fashion Technology, Patna, Bihar
[2]Assistant Professor, Department of Fashion Technology, National Institute of Fashion Technology, Patna, Bihar
Corresponding author mail Id: hemasri.s@nift.ac.in

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## Abstract:

The JUKI LBH-1790AN is a high-speed, computer-controlled lockstitch buttonholing machine widely used in the garment industry for precise and efficient production of buttonholes on shirts, blouses, uniforms and similar apparel. This paper presents a systematic study of its technical specifications, working principle, key components and, most importantly, a structured maintenance scheduling framework aimed at maximizing machine availability. Emphasis is placed on preventive maintenance practices, lubrication requirements, common operational issues and the integration of Internet of Things (IoT) features such as Near Field Communication (NFC) and USB-based data management. A practical maintenance schedule covering daily, weekly, monthly and periodic activities is proposed. The study highlights how proper maintenance scheduling reduces downtime, improves stitch quality and extends machine life, thereby supporting higher productivity in industrial sewing environments. The paper is intended to serve as a practical reference for engineering and fashion technology students as well as maintenance personnel.

*Keywords* - **Buttonholing machine, JUKI LBH-1790AN, Maintenance schedule, Planned Maintenance, Downtime, Availability, Internet of Things (IoT)**

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## I. INTRODUCTION

Buttonholing is a key operation in garment manufacturing because the quality of a buttonhole affects the strength, durability and appearance of the finished garment [1], [2]. Modern computer-controlled machines such as the JUKI LBH-1790AN series combine high sewing speed, programmable buttonhole patterns, electronic thread tension control and digital data management [3].

The LBH-1790AN is driven by a compact AC servomotor, while stepping motors control needle throwing, cloth feeding, cloth cutting and work clamp lifting [3]. It also has active electronic thread tension, a multiple knife-dropping function, inbuilt Near Field Communication (NFC) and a USB port. Sewing data can be transferred to an Android tablet or a USB drive, which helps keep stitch quality consistent and reduces setup time [3].

These benefits last only if the machine is properly maintained. Only the hook section needs lubrication, but it must be oiled correctly. Parts such as needles, bobbins, knives and trimmer parts are marked as consumable in the manufacturer's parts list [4], and the manufacturer requires regular cleaning, power-off before maintenance and repairs by trained technicians [5]. Unplanned downtime caused by poor lubrication, neglected adjustments or worn components reduces the time the machine is available for production [6], [7].

This paper focuses on the maintenance management and availability of the JUKI LBH-1790AN. It presents the technical specifications, explains the working principle, describes the key components and safety precautions, and proposes a

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structured maintenance schedule. The machine availability is then calculated from the planned maintenance time and the estimated failure, administrative and external delays, following the total productive maintenance (TPM) principle [8] and the availability method used in [9]. The aim is to give students and industry practitioners a clear, practical guide that links the machine's design features to effective maintenance practice.



Fig. 1 JUKI LBH-1790AN buttonholing machine head

## II. MATERIALS AND METHODS

### *A. Machine Specifications*

The machine head of the JUKI LBH-1790AN is shown in Fig. 1. Its principal specifications (standard model) are given in Table I. These values are the basis for planning lubrication, adjustments and spare parts.

TABLE I
SPECIFICATIONS OF THE JUKI LBH-1790AN

| Parameter | Specification |
|---|---|
| Sewing speed | Max. 4,200 sti/min; normal 3,600 sti/min; 3,300 sti/min with non-lubricated hook [3] |
| Buttonhole length | Max. 41 mm (optional parts for 70 mm and 120 mm) [3] |
| Bartacking width | Max. 5.0 mm [3] |
| Cloth-cutting knife size | 6.4–31.8 mm [3] |
| Needle | DP×5, #11J–#14J [3] |
| Hook | DP-type full-rotary hook; non-lubricated hook optional [3] |
| Needle-bar stroke | 34.6 mm [3] |
| Work-clamp lift | 14 mm (17 mm with reverse-rotation needle-up function) [3] |
| Needle-throwing precision | 0.05 mm [3] |
| Stitch patterns | 31 standard; up to 99 can be stored [3] |
| Machine head drive | Compact AC servomotor (direct drive) [3] |
| Power requirement | Single-phase 220–240 V, or 3-phase 200–240 V / single-phase 100–120 V, depending on control box; 250 VA [3] |
| Operating temperature | 5 °C to 35 °C [5] |
| Operating humidity | 35 % to 85 %, without condensation [5] |
| Voltage tolerance | Within ±10 % of rated voltage [5] |
| Lubricating oil | JUKI New Defrix Oil No. 1 (ISO VG 7), hook only [3] |
| Weight | Machine head (with motor) 55 kg; control box 6 kg [3] |

### *B. Working Principle*

The machine forms lockstitch buttonholes through the following coordinated actions [1]–[3]:

1. The needle bar moves the needle up and down, while the needle-throwing mechanism moves it sideways according to the selected pattern [3].
2. As the needle rises, it leaves a loop of needle thread, which the rotating full-rotary hook catches.
3. The hook carries this loop around the bobbin thread, interlocking the two threads.
4. The thread take-up lever pulls the stitch tight.
5. The cloth is advanced in small steps by intermittent feed [3].
6. The cloth-cutting knife, driven by a stepping motor, is lowered to cut the buttonhole opening. The number of knife drops is set automatically from the buttonhole size [3].

The main shaft is driven by the AC servomotor, while needle throwing, cloth feeding,

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cloth cutting and work-clamp lifting are each driven by a separate stepping motor [3]. This gives accurate, repeatable pattern control.

### *C. Key Components and Functions*

The machine consists of the machine head, operation panel, control box (MC602N), pedal, thread stand and power switch [3], [4]. The major assemblies of the machine head are shown in Fig. 2. Each key component group is described below together with its link to maintenance.

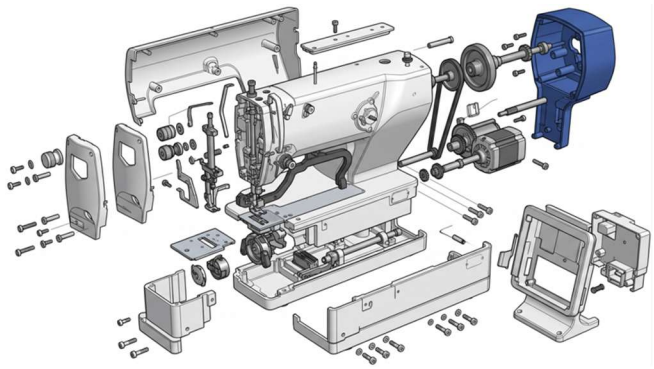


Fig. 2 Components of the JUKI LBH-1790AN machine head

***1) Needle Bar and Needle-Throwing Mechanism:*** The needle bar carries a DP×5 needle (#11J–#14J) through a stroke of 34.6 mm, while a stepping motor throws the needle sideways with a precision of 0.05 mm. A bent or blunt needle can cause thread breakage and poor stitches, so the needle is checked daily. It is also a consumable part [4].

***2) Full-Rotary Hook and Bobbin Case:*** The DP-type full-rotary hook catches the needle-thread loop and interlocks it with the bobbin thread [3] (Fig. 3). It is the only part that needs lubrication. A minute quantity of JUKI New Defrix Oil No. 1 is fed from an oil tank, and the amount is set with the hook-oil adjustment screw, which is reached by opening the hook cover [3]. Lint and oil in this area are cleaned daily. The hook, bobbin case, bobbin and oil filter appear in the parts list [4].




Fig. 3 Full-rotary hook and bobbin case

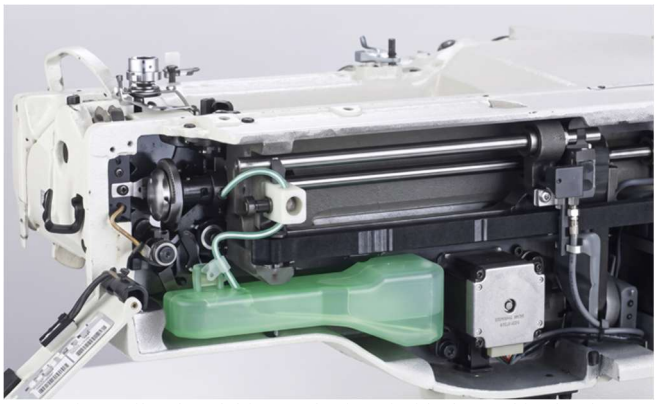


Fig. 4 Oil tank and drive mechanisms inside the machine head

***3) Thread Take-Up Lever and Active Tension:*** The take-up lever supplies needle thread and tightens the stitch. The active tension system controls needle-thread tension electronically. Tension for the parallel and bartacking sections can be set separately on the operation panel and stored in memory [3] (Fig. 5). The take-up spring is a consumable part [4], and the tension setting is checked monthly.



Fig. 5 Lever and linkage assembly of the buttonholing machine

***4) Needle-Thread and Bobbin-Thread Trimmers:*** Needle-thread trimming and bobbin-thread trimming are electronically controlled, and each has its own trimming

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motor [3], [4] (Fig. 6). The trimmer, clamp and puller parts are marked as consumable in the parts list [4], so they are inspected weekly and serviced half-yearly.

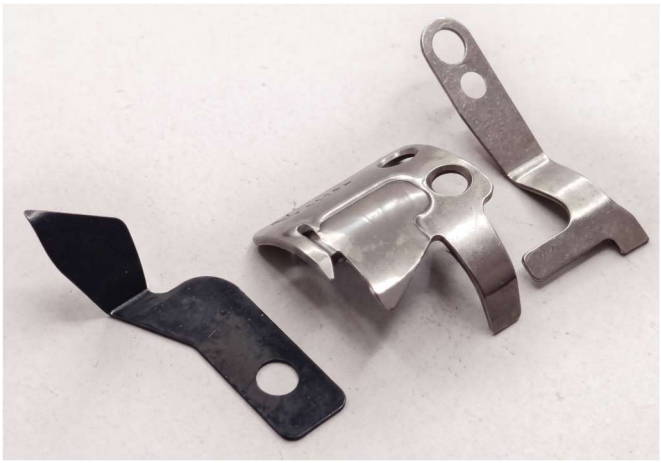


Fig. 6 Thread trimmer parts of the buttonholing machine

***5) Cloth-Cutting Knife:*** The knife is driven by a stepping motor and supports buttonhole lengths up to 41 mm. The multiple knife-dropping function sets the number of cuts from the buttonhole size, so the knife need not be changed when the size changes [3] (Fig. 7). A dull or wrongly set knife gives an incomplete cut, so the knife is checked daily and replaced when worn [4].



Fig. 7 Cloth-cutting knives of the buttonholing machine

***6) Work Clamp, Feed and Auto-Lifter:*** The work clamp holds the fabric while stepping motors feed it intermittently and lift the clamp (14 mm, or 17 mm with the reverse-rotation needle-up function). The stepping-motor auto-lifter reduces operator fatigue [3] (Fig. 8). After a pattern change, the needle entry point must be checked against the work clamp foot to avoid needle breakage [5].



Fig. 8 Work clamp of the buttonholing machine

***7) Control Box, Operation Panel, Motors and Sensors:*** The MC602N control box is connected to the motors, photo sensors and operation panel [4]. The panel selects patterns and settings and carries the USB port and NFC function [3]. The fuses are consumable parts [4]. The fan air vent and wiring must be cleaned and inspected periodically [5].

### *D. IoT and Digital Features*

The LBH-1790AN has built-in NFC and a USB port on its operation panel [3]. NFC is a short-range wireless technology that works when two devices are brought close together [10]. With it, sewing-adjustment data can be sent contactlessly to a commercially available Android tablet running the JUKI Smart App, simply by holding the tablet over the machine.

This allows a quick check that settings are uniform across the machines on a sewing line [3]. The USB port is used for data management and software updates with a USB flash drive [3]. Such digital features are typical of Industry 4.0 manufacturing [11]. Because sewing data are managed numerically, stitch quality stays stable and setup changes take less time [3].

### *E. Safety Devices and Precautions*

Maintenance work is done close to moving parts, so the manufacturer fits several safety devices: a thread take-up lever cover, an eye protection cover against broken needles, a finger guard near the needle, a motor cover, warning labels and a power switch.

The EU-type switch also serves as the emergency stop [5]. The manufacturer specifies an IEC 60204-1-compliant power switch [5], [12], and

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the machine must never be operated with the safety devices removed [5].

The manufacturer gives the following precautions for maintenance [5]:

- Switch the power off and remove the plug before threading, changing the needle or bobbin, oiling, cleaning or inspecting.
- Do not assume the machine is off when it is silent, because the servomotor makes no noise at rest.
- Wait at least five minutes after power-off before opening the control box. Electrical work must be done by a qualified technician.
- Wear safety goggles, and keep fingers away from the needle, take-up lever, cloth presser and knife.
- Use only JUKI genuine oil and parts, and wash oil off the eyes or skin immediately.
- After any repair or adjustment, check that screws and nuts are tight. If a fuse blows, find the cause before replacing it.

## III. RESULTS AND DISCUSSION

### *A. Importance of Maintenance for Availability*

Machine availability is the share of the scheduled time in which the machine is able to perform as required [13]. On a high-speed buttonholing machine, even short stoppages from thread breakage, tension problems, knife faults or poor lubrication add up to large production losses.

Maintenance is commonly divided into preventive and corrective work, and planned preventive maintenance aims to reduce failures before they occur [14]. Availability is one of the main indicators used to judge maintenance performance [15], and reducing downtime is a core goal of TPM [16]. Planned maintenance also takes machine time, so the schedule has to balance the two.

In this study, one machine is assumed to work 8 hours a day for 6 days a week, so the total time is 2,880 min per week. All maintenance and delay times are estimates made by the authors, and each is converted to a weekly value: daily tasks × 6 days, monthly ÷ 4 weeks, half-yearly ÷ 26 weeks and yearly ÷ 52 weeks.

### *B. Planned Maintenance Schedule*

The daily, weekly, monthly, half-yearly and yearly tasks are given in Tables II to VI. They are grouped by frequency, as is usual in maintenance planning and scheduling [17]. The tasks follow the manufacturer's requirements to clean the machine regularly, switch the power off before cleaning or maintenance, and use only genuine oil and parts [5]. The only lubrication point is the hook [3].

**TABLE II**
**DAILY MAINTENANCE**

| S.No | Activity | Time (min) |
|---|---|---|
| 1 | Checking oil level | 0.17 |
| 2 | Checking needle condition and installation | 0.08 |
| 3 | Cleaning lint and thread waste from hook, bobbin area and accessible surfaces | 0.75 |
| 4 | Inspecting threading and thread path | 1.00 |
| 5 | Visual check of cloth-cutting knife | 0.17 |
| 6 | Trial stitching (buttonhole quality check) | 1.00 |
| 7 | End-of-shift cleaning | 1.00 |
| **Total** | | **4.17** |

Daily maintenance per week = 4.17 × 6 = 25.0 min.

**TABLE III**
**WEEKLY MAINTENANCE**

| S.No | Activity | Time (min) |
|---|---|---|
| 1 | Thorough cleaning of hook and bobbin area | 2.0 |
| 2 | Inspection of thread trimmers and knife condition | 3.0 |
| 3 | Checking work clamp and fasteners | 2.5 |
| 4 | Stitch and trim quality verification | 2.0 |
| 5 | Oil flow observation and refill if needed | 1.5 |
| **Total** | | **11.0** |

Weekly maintenance per week = 11.0 min.

**TABLE IV**
**MONTHLY MAINTENANCE**

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| S.No | Activity | Time (min) |
|---|---|---|
| 1 | Inspecting lubrication system for blockage or leakage | 5 |
| 2 | Checking thread take-up spring and tension setting | 5 |
| 3 | Cloth-cutting knife assessment | 5 |
| 4 | Checking presser bar and work clamp movement | 8 |
| 5 | Checking operation panel and pattern settings | 2 |
| 6 | Inspecting accessible electrical cables and control box exterior | 5 |
| | **Total** | **30** |

Monthly maintenance per week = 30 ÷ 4 = 7.5 min.

TABLE V
HALF-YEARLY MAINTENANCE

| S.No | Activity | Time (min) |
|---|---|---|
| 1 | Inspecting main shaft, bearings and drive mechanisms | 12 |
| 2 | Inspecting hook assembly and needle-bar mechanism | 9 |
| 3 | Inspecting cloth-cutting knife and throat plate | 6 |
| 4 | Servicing needle- and bobbin-thread trimmers | 8 |
| 5 | Inspecting oil filter, wick and oil tubes | 10 |
| 6 | Inspecting electrical connections and control box | 8 |
| 7 | Verifying timing, thread tension and presser settings | 10 |
| | **Total** | **6** |

Half-yearly maintenance per week = 63 ÷ 26 = 2.42 min.

TABLE VI
YEARLY MAINTENANCE

| S.No | Activity | Time (min) |
|---|---|---|
| 1 | Comprehensive mechanical inspection and servicing | 25 |
| 2 | Inspecting shafts, bearings, hook and drive components | 12 |
| 3 | Inspecting and replacing worn trimmer and knife parts if needed | 15 |
| 4 | Servicing lubrication system as per manual | 10 |
| 5 | Inspecting motor, wiring, fuses and control box | 16 |
| 6 | Final performance test and verification of programmed settings | 10 |
| 7 | Updating maintenance records and replacement history | 6 |
| | **Total** | **94** |

Yearly maintenance per week = 94 ÷ 52 = 1.81 min.

TABLE VII
SUMMARY OF PLANNED MAINTENANCE TIME

| Frequency | Time per machine (min) | Converted to weekly (min) |
|---|---|---|
| Daily | 4.17 | 25.00 |
| Weekly | 11.00 | 11.00 |
| Monthly | 30.00 | 7.50 |
| Half-yearly | 63.00 | 2.42 |
| Yearly | 94.00 | 1.81 |
| | **Total** | **47.73** |

### *C. Unplanned maintenance*

Downtime that cannot be scheduled is grouped into Unplanned maintenance, administrative delay and external factors [9], [18] (Tables VIII to X). Failures are usually studied by their causes and effects so that preventive actions can be planned [19]. Consumable parts such as needles, bobbins, knives and trimmer parts are listed in the parts list [4], so keeping spares in stock directly reduces delays caused by part shortages.

TABLE VIII
UNPLANNED MAINTENANCE

| S.No | Activity | Time (min) |
|---|---|---|
| 1 | Needle breakage and replacement | 5 |
| 2 | Thread breakage troubleshooting and | 7 |

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| S.No | Activity | Time (min) |
|---|---|---|
| | correction | |
| 3 | Hook timing adjustment due to skipped stitches | 10 |
| 4 | Thread trimmer or knife malfunction repair | 15 |
| 5 | Bobbin case jamming and correction | 12 |
| 6 | Electrical fault diagnosis and repair | 20 |
| | **Total** | **69** |

**TABLE IX**
**ADMINISTRATIVE DELAY**

| S.No | Activity | Time (min) |
|---|---|---|
| 1 | Waiting for maintenance technician availability | 10 |
| 2 | Delay in approval for repair or replacement | 10 |
| 3 | Waiting for maintenance records or job instructions | 5 |
| 4 | Delay in production-line coordination | 15 |
| 5 | Waiting for spare-parts issue authorization | 10 |
| 6 | Poor communication with the spare-parts supplier | 5 |
| | **Total** | **55** |

**TABLE X**
**EXTERNAL FACTORS**

| S.No | Activity | Time (min) |
|---|---|---|
| 1 | Power failure or voltage fluctuation | 5 |
| 2 | Compressed-air supply | 3 |
| | interruption, if applicable | |
| | **Total** | **8** |

***D. Availability Calculation***

Availability is calculated as

**Availability = (Up time / Total time) × 100**

Total time = 6 × 8 × 60 = 2,880 min per week

Down time =Unplanned maintenance + Planned maintenance + Administrative delay + External factors

Down time = 69 + 47.73 + 55 + 8 = 179.73 min

Up time = 2,880 − 179.73 = 2,700.27 min

Availability = (2,700.27 / 2,880) × 100 = **93.76 %**

**TABLE XI**
**WEEKLY DOWNTIME SUMMARY**

| Cause | Time (min) | Share of total downtime (%) |
|---|---|---|
| Unplanned maintenance | 69.00 | 38.39 |
| Administrative delay | 55.00 | 30.60 |
| Planned maintenance | 47.73 | 26.56 |
| External factors | 8.00 | 4.45 |
| **Total** | **179.73** | **100.00** |

The machine is available for about 93.8 % of the scheduled time. Planned maintenance takes only 1.66 % of the time, while unplanned causes take 4.58 %. Unplanned maintenance is the largest single cause (2.40 %). Administrative delay (1.91 %) is almost as large, and it can be reduced without touching the machine, for example by stocking consumable spares, giving technicians approval to carry out routine repairs, and agreeing delivery times with the supplier. If administrative delay were removed completely, availability would rise to about 95.7 %.

***E. Contribution of IoT Features to Maintenance***

Because the NFC and USB features store the sewing settings in numerical form, a machine can be returned to its correct settings quickly after

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an adjustment or repair, and the settings of all machines on a line can be compared [3]. This shortens setup time and helps reduce the time lost to adjustment-related failures. Condition-based maintenance uses monitored machine data to decide when maintenance is needed [20], [21]. The manufacturer does not describe condition monitoring, so using machine data in this way remains a possible future step.

## IV.CONCLUSION

The JUKI LBH-1790AN combines high sewing speed, electronic control and NFC/USB data management, but these features give full benefit only when the machine is maintained on a planned schedule. This study described the key components, explained the safety precautions, and proposed daily, weekly, monthly, half-yearly and yearly maintenance activities with estimated times. For a six-day, 8-hour working week, planned maintenance takes about 47.7 min. With estimated failure time (69 min), administrative delay (55 min) and external factors (8 min), the total weekly downtime is about 179.7 min, giving a weekly availability of about 93.8 %.

Unplanned maintenance is the largest cause of downtime, followed closely by administrative delay. Keeping spares of consumable parts, giving clear approval routes for routine repairs and using the stored numerical settings to restore a machine after repair can reduce these losses. The results rest on estimated times, so they are a planning guide and not measured data.

## V. FUTURE WORK

The first step is to replace the estimated times with measured ones. Recording the start and end of every stoppage on a working LBH-1790AN for several weeks would give real downtime data, from which the mean time between failures and the mean time to repair can be calculated. Availability before and after the proposed schedule is applied can then be compared to show its real benefit.

The largest unplanned losses, and administrative delay, can be targeted next. The effect of stocking consumable spares and giving technicians approval for routine repairs can be measured. Availability can also be extended to overall equipment effectiveness by adding machine performance and stitch quality. Finally, the sewing settings stored through NFC and USB could be combined with a digital maintenance log. If enough failure data are collected, condition-based maintenance can be studied.

## ACKNOWLEDGMENT

The authors sincerely thank the Department of Fashion Technology, NIFT Patna, for providing the necessary resources.

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