Research on the method for compiling operating procedures for rubber machinery and equipment

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Abstract: This article briefly outlines the purpose, basis, scope of application, and normative references for the compilation of equipment operation procedures. It also introduces the main structure, technical performance parameters, working principle, and usage of the equipment, as well as the management responsibilities of the procedures, equipment lubrication regulations, and common fault handling methods. Furthermore, it provides detailed explanations on the requirements for equipment operators, pre-operation inspections, operation specifications, safety precautions, equipment lubrication, and operation status checks.

Key words: equipment inspection; equipment operation; equipment operating status; safety precautions

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The equipment operation procedures are formulated to standardize the operational skills required for equipment, provide correct guidance for equipment operation, prevent personal safety and equipment accidents, and ensure the safe, economical, and reliable operation of equipment while maintaining good working conditions. These procedures are based on the operational characteristics of equipment structure and requirements for safe operation, and stipulate the procedures, actions, and safety precautions that production or maintenance personnel must adhere to during equipment operation.

1 General provisions

The general principles outline the purpose, basis, scope of application, and normative references for the compilation of equipment operation procedures. The purpose of compiling various equipment operation procedures is the same, while the basis and scope of application vary with the type of equipment. The scope of application is determined by the level of detail in the equipment operation procedures. Generally, compiling procedures based on equipment type can meet the needs of on-site use.

1.1 Purpose

This regulation is formulated to standardize the operational skills required for equipment, provide correct guidance on equipment operation, prevent personal safety and equipment accidents, and ensure the safe, economical, and reliable operation of equipment while maintaining good working conditions.

1.2 Basis for preparation

It is usually based on the equipment maintenance manual, the requirements of the production process for the equipment, the actual situation of equipment operation, the on-site work experience of equipment management personnel, as well as the operating procedures of similar equipment at home and abroad.

1.3 Scope of application

In an enterprise, there exist equipment models from the same manufacturer with different structural forms, as well as equipment models from different manufacturers with different

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structural forms but possessing the same functionality. To compile operating procedures for similar equipment, multiple equipment units with the same structure should be used as the benchmark model for compilation. Subsequently, the operating procedures or regulations for different structures of other models should be incorporated into the corresponding entries. Finally, the benchmark model for compiling the procedures and the scope of other applicable models should be stated.

1.4 Normative references

In the process of preparing equipment operation procedures, it is common to refer to the "Production Safety Law of the People's Republic of China"; current national laws, regulations, standards, and industry technical specifications; equipment maintenance manuals and design and manufacturing documentation; actual use and maintenance practices of similar or related equipment; operational and operational experience of personnel, as well as experiences and lessons learned from practical operations; safety management system documents, and other relevant materials.

2 Equipment overview

2.1 Main structure

For simple equipment, the main structure is described directly in the order of the prime mover part → transmission part → execution part → control (manipulation) system → auxiliary system (such as lubrication, hydraulic, medium supply, etc.). For complex equipment or production lines, the main line is raw material input → product output, and each structure is described one by one in the same way as simple equipment. Finally, the control (manipulation) system and auxiliary system (such as lubrication system, hydraulic system, medium supply, etc.) are described. If the lubrication or hydraulic system belongs to a local structure, it needs to be included in the corresponding structure part.

2.2 Main technical parameters

The main technical parameters include the production capacity of the equipment, the design parameters of each device, the required medium supply system, the power supply and distribution requirements, as well as the equipment's external dimensions and product quality standards. For production lines with relatively complex structures, further introduction can be made to the design parameters of the main devices.

2.3 Operating principle

For simple equipment, describe the overall working principle. For complex equipment or production lines, first summarize the working principle, then describe the working principles of each structure separately, and finally introduce the control principle of the automatic control system. If the working principle is introduced in the "Equipment Maintenance and Operation Manual", you can quote the entire or partial working principle described in the manual; if it is not introduced in the "Equipment Maintenance and Operation Manual", the compiler shall prepare it based on equipment management experience, combined with the operational requirements of the equipment and its auxiliary facilities, as well as the production process.

2.4 Purpose

Briefly introduce the role of this equipment in the production process of enterprise products and the types of products it can produce.

3 Management responsibilities

It mainly clarifies the responsibilities of management departments, production units, as well as operation and maintenance personnel related to the preparation, review, approval, operation, supervision, revision, and management of equipment operation procedures.

3.1 Responsibilities of the equipment management department

The responsibilities of the equipment management department mainly include four aspects: Firstly, before equipment is put into use, it is responsible for organizing management personnel with senior equipment management experience, experienced equipment operators, process technicians, safety management personnel, etc. to compile operating procedures. Secondly, it is responsible for the distribution, control, revision, and abolition of operating procedures that have been reviewed and approved. Thirdly, it is responsible for training operators on operating procedures and supervising and managing the implementation of operating procedures. Fourthly, it is required to confirm the adaptability and effectiveness of operating procedures annually, and to review and revise operating procedures at least once every three years; when there are significant changes in process

technology and equipment, it is necessary to promptly revise operating procedures and other requirements.

3.2 Responsibilities of equipment user units

The responsibilities of equipment users mainly include three aspects: Firstly, they are responsible for managing the operators' compliance with equipment operation procedures. Secondly, they should maintain good environmental and equipment hygiene according to on-site working conditions, creating a clean and unobstructed environment for equipment operation. Thirdly, they should promptly report changes in equipment safety production information, safety requirements, and precautions to the equipment management department.

3.3 Responsibilities of equipment operators

The responsibilities of equipment operators primarily encompass three aspects: Firstly, proficiency in the technical specifications of equipment operation skills. Secondly, adherence to regulations concerning items, procedures, and actions during operation. Thirdly, focusing on operating the equipment, observing equipment operation, and immediately stopping the machine for inspection if any abnormalities are detected. Production can only resume after the issues have been addressed.

3.4 Responsibilities of maintenance personnel

The responsibilities of equipment maintenance personnel mainly encompass five aspects: Firstly, they are responsible for conducting routine maintenance and upkeep of equipment in accordance with the daily inspection management system and regular equipment maintenance schedule, aiming to minimize potential hazards and rectify defects. Secondly, they must strictly adhere to the "Eight Fixations and Three Filtrations" principle and equipment lubrication regulations, performing periodic lubrication on equipment and maintaining detailed lubrication records. Thirdly, they must strictly comply with the requirements for checking equipment operating status, conducting routine and regular inspections on equipment. Fourthly, they must promptly address any equipment malfunctions, nipping potential hazards in the bud and ensuring the equipment's availability. Fifthly, they are responsible for conducting equipment debugging work, provided that they strictly adhere to the inspection and operational procedure requirements for equipment startup, operation, and shutdown as stipulated in this procedure.

4 Equipment operation specifications

4.1 Requirements for equipment operators

The main focus is on the requirements for the abilities and qualifications needed by personnel who operate or run special equipment, power supply and distribution facilities, or power system equipment. Generally, no special requirements are imposed on production process equipment.

4.1.1 Requirements for operators of special equipment

The requirements for special equipment operators mainly include seven aspects: First, operators must be at least 18 years old and not exceed the statutory retirement age. Second, operators should have a junior high school degree or above. Safety administrators need to have a high school degree or above. Safety valve calibration requires a college degree or above. Third, operators must have internship experience in related work for at least three months. Fourth, operators must undergo professional training and possess corresponding safety technical knowledge and operational skills. Fifth, operators must be in good health and free from diseases and physical defects that hinder their work in the position. Sixth, employers should provide safety education and training to operators, equip them with necessary knowledge and skills for safe operation of special equipment, and update their knowledge in a timely manner. Seventh, special equipment operators must hold a valid "Special Equipment Operator Certificate" to engage in corresponding level of operations.

4.1.2 Requirements for operation personnel of power supply and distribution facilities

The requirements for personnel operating power supply and distribution facilities mainly encompass six aspects: Firstly, they should possess certain professional knowledge and skills, and only be allowed to work after passing relevant training. Secondly, they must strictly adhere to the operating procedures of power supply and distribution equipment, obey the instructions of superiors, and operate in accordance with operational norms, eliminating any illegal operations. Thirdly, they should be familiar with the "Safety Work Regulations for the Electric Power Industry" and the "Technical Guidelines for Live Working on Distribution Lines", and master emergency

rescue methods, electrocution rescue methods, and artificial respiration. Fourthly, the person in charge of the work (including the safety supervisor) should have over three years of practical experience in live distribution line work, be familiar with equipment conditions, and possess certain organizational and accident handling abilities. Fifthly, they should obey the arrangements of the operation management department, carry out routine equipment maintenance and repair work, ensure the safe and reliable operation of equipment, and guarantee the quality of power supply from the power system. Sixthly, in daily work, they need to closely monitor the operating status of equipment, promptly identify and address issues, to ensure the stable operation of the power supply and distribution system.

4.1.3 Requirements for operators of the power supply system

The requirements for personnel operating the power supply system mainly encompass seven aspects: First, during daily use, operators should strictly adhere to operating procedures, pay attention to observing the system's operating status, especially key parameters such as temperature, pressure, and current. If there are any abnormalities, the system should be shut down immediately for inspection to prevent the problem from escalating. Second, regular inspections of the power system should be conducted, including checks on the wear of mechanical components, the insulation of electrical components, and the quality of lubricating oil, to ensure that the system operates in good condition. Third, preventive measures such as regular inspections, replacements, and cleanings should be taken to prevent malfunctions. For example, lubricating oil should be replaced regularly, and radiators should be cleaned. Fourth, when the power system malfunctions, timely maintenance is required. This usually involves diagnosing the faulty part, replacing damaged components, and adjusting equipment parameters. During maintenance, safety operating procedures should be followed to prevent maintenance personnel from being injured. Fifth, records of the maintenance process should be kept, including the time, content, and results of maintenance, to facilitate tracking of the system's performance and status. Sixth, for special operations, a system of employment with certificates must be strictly enforced, and the validity and scope of work of the certificates should be reviewed. The requirements of "understanding the structure, understanding the principle, understanding the performance, understanding the use; being able to operate, being able to maintain, being able to inspect, being able to clean, and being able to troubleshoot simple faults" must be met. Seventh, equipment operation records should be kept: the entries should be true, complete, and accurate.

4.2 Inspection before operation

The pre-operation inspection is conducted in accordance with the equipment management system and the three-level maintenance and care system. It is a major task in daily equipment maintenance and care, and also one of the tasks required for equipment operation. When the equipment is at a standstill, a comprehensive inspection is conducted on the integrity, condition, effectiveness, and safety of the equipment based on the equipment spot inspection standards, grease supply standards, and intactness standards. Any issues identified during the inspection are promptly repaired in accordance with the equipment maintenance technical standards to prevent equipment from operating with defects or potential safety hazards. Special attention should be paid to the inspection of key monitoring parts, quality control points, and equipment safety devices or facilities, which must not be overlooked. The inspection content includes but is not limited to the following aspects.

First, inspect the appearance of the equipment: check whether the equipment foundation has any settlement, whether the anchor bolts are loose or rusted, and whether the equipment appearance is intact, without any defects such as damage, deformation, or cracking. Inspect the metal structural components for any welding defects, deformation, or cracks, and check the connecting bolts for any looseness or rusting. Inspect the parts for any signs of loosening or scattering. Second, inspect the equipment functions: check whether the equipment meets the basic and auxiliary functions required for the production process and product quality, as well as the safety guarantee functions ensuring stable operation and safe use of the equipment. Third, inspect the safety facilities: check whether protective covers, protective nets, protective railings, safety plugs, walking ladders, platforms, locking devices, and other mechanical safety protection devices are complete, intact, securely installed, and meet the strength requirements for use. Check whether emergency stop switches, alarms, buzzers (for

signal prompts), electrical interlocking devices, and other electrical safety protection and warning devices are complete, intact, and securely and reliably installed. Fourth, inspect the power medium system: check whether the system delivery pipelines and accessories (valves, metering instruments, etc.) have any leaks, damage, or rust, and whether the installation is reliable. Check whether the pressure, temperature, and flow of the supplied medium meet the process indicators. Fifth, inspect the power supply and electrical circuits: check whether the power supply voltage is within the error range, whether the power switches and electrical circuits are normal, and whether there are any hidden safety hazards such as illegal parallel connection, burnout, or interface leakage. Check whether the voltage and current meters display normally, and whether the power indicator light is on. Sixth, inspect the mechanical transmission device: check whether the appearance, installation connection, and performance of the prime mover (such as motor), transmission device (coupling, reducer/gearbox, chain drive, V-belt drive, etc.), and actuator (such as roller, flat belt, rotating body, etc.) meet the technical standard requirements. Seventh, inspect the hydraulic system: check whether the hydraulic components and accessories are intact, whether the pipelines have any leaks, whether the oil quality meets the quality requirements, whether the oil level reaches the standard height, and whether the cooling device meets the operating requirements. Eighth, inspect the pneumatic system: check whether the system delivery pipelines and accessories (valves, metering instruments, safety valves, etc.) have any leaks, damage, or rust, whether the safety valve operates reliably, and whether the air pressure and cleanliness meet the standards. Ninth, inspect the cooling system: check whether the cooling water pipeline is unblocked, whether the pressure, flow rate, and temperature meet the standards, and whether the control valves, pipelines, and usage parts have any leaks. Tenth, inspect the control system: check whether the appearance is intact and the markings are correct. Check the interior of the cabinet for integrity, sealing, environment, markings, and cable status. Check the components inside the cabinet for tightness, no damage, firm and reliable wiring, flexible action, no abnormal smell, and reliable grounding. Eleven, check the lubrication system: check whether the storage volume in the oil tank of the automatic thin oil lubrication system and the oil barrel of the automatic grease lubrication system meets the periodic lubrication consumption standard. The manual lubrication parts are well lubricated. Twelve, check the cleanliness and hygiene: check whether there are foreign objects and dust inside the equipment to avoid affecting the normal use of the equipment, ensuring the health of the operating personnel and the long service life of the equipment. Thirteen, check the operating environment: check whether there are obstacles and flammable materials around the equipment, whether there are foreign objects between the relative rotating parts of the equipment, and whether there are foreign objects inside the machine body. Check whether there are obstacles and covering items within the travel range of the moving parts. Fourteen, conduct a trial operation check. Mainly check the stability of the equipment, whether the operation is normal, and whether there are abnormal noises, faults, and other adverse conditions.

4.3 Equipment operation requirements

4.3.1 Preparations for power-on

The preparation work for startup involves setting or adjusting various structures, devices, functions, and parameters of the equipment to their operational states before the equipment inspection is completed and the equipment is allowed to be turned on for operation. This preparation work includes, but is not limited to, the following aspects: First, adjust electromechanical control devices such as operating handles, locking devices, interlocking devices, safety pins, and manual/automatic switchers to place them in a standby state before operation. Second, turn on the power supply system first and then the power supply. When supplying power, operate in the order of the distribution cabinet, control cabinet, and operation cabinet. Third, power on the computer, start it to enter the operating system, run the production program, and check whether signal communication, data transmission, and automatic control are normal. Fourth, start the lubrication system, check the operation status of the oil pump, and ensure that the oil supply pressure and flow rate are normal. The oil dispenser and lubrication oil circuit should be free of blockages, all parts should be well lubricated, and there should be no oil leakage. Fifth, start the hydraulic system, check the operation status of the oil pump, and ensure that there are no noises or howls. The oil supply pressure and flow rate should meet operational requirements. The oil pump, control valve,

oil pipe, oil cylinder, and accessories should be free of leaks, and the detection and metering instruments should display normally. Sixth, check the sensitivity and reliability of electrical safety protection devices such as emergency stop switches, alarms, buzzers (indication signals), and safety interlock devices, and adjust or repair them if necessary. Seventh, check the sensitivity, effectiveness, and accuracy of electrical limit devices such as travel switches and proximity switches, and adjust or repair them if necessary. Eighth, check the "zero drift" of detection devices, metering devices, or weighing systems, and calibrate them if necessary. Ninth, verify the equipment operating parameters and production process parameters, and adjust them if necessary to meet production needs. Tenth, conduct a no-load test run before load operation to check for abnormalities such as vibration, abnormal noise, jamming, and leakage. Any existing problems should be repaired in time before load operation can be carried out.

4.3.2 Operational requirements

The operational requirements are formulated based on the equipment management system and the three-level maintenance and care system. During equipment operation, a comprehensive inspection of the integrity, effectiveness, and safety of the equipment's operating status is conducted according to the equipment spot inspection standards, grease supply standards, and intactness standards. Any issues identified during the inspection should be promptly addressed by shutting down the equipment to identify the cause and repairing it according to the equipment maintenance technical standards. It is prohibited to operate the equipment with defects or potential safety hazards.

Firstly, propose equipment operation procedures and requirements based on the production process. According to the product production process, compile operation procedures, regulations, and requirements for each process node, starting from the raw material end and ending at the product output end. Secondly, regularly check whether the pressure, flow rate, temperature, etc. of the compressed air, normal water, and cooling water systems meet the process technical requirements and whether there are any leaks. Thirdly, regularly check whether the pressure, flow rate, and temperature of the lubrication system meet the standards. In case of oil circuit blockage, oil pressure reduction, insufficient oil volume, abnormal temperature rise at the lubrication part, oil pipe leakage, oil and gas evaporation, etc., immediately shut down the machine for inspection and handling. Fourthly, regularly check whether the pressure and temperature of the hydraulic system are within the specified range. In case of oil circuit blockage, pipeline leakage, oil temperature exceeding the standard, oil and gas evaporation, etc., immediately shut down the machine for inspection and handling. Fifthly, regularly check whether the pressure, flow rate, and temperature of the temperature control system meet the process technical requirements and whether there are any leaks. Sixthly, regularly check the lubrication condition of manual lubrication parts and timely replenish lubricating oil and grease. Seventhly, inspect metal structural parts, components, connectors, etc. for any abnormalities such as looseness, vibration, abnormal noise, fracture, deformation, wear, and detachment. Eighthly, check whether the current of the main motor exceeds the rated current, whether the temperature of the motor and its bearing positions exceeds the standard, and in case of obvious vibration, smoke, and burnt smell, immediately shut down the machine for inspection and handling. Ninthly, inspect whether there are oil leakage and oil seepage phenomena in the high-speed input shaft, low-speed output shaft, box (housing), bearing gland, sealing surface, oil pipe, etc. of the reduction gearbox; in case of abnormal noise, local heating (especially at the bearing position) during operation, shut down the machine for inspection and handling when necessary. Tenthly, inspect whether there are oil leakage, oil seepage, oil shortage, base cracking, loosening, etc. in the reducer, transmission, etc. Eleventhly, in case of mechanical limit and buffer device failure, electrical safety protection device and limit switch malfunction, automatic detection device failure, emergency brake device failure, immediately shut down the machine for inspection and handling. The equipment can only be operated after restoring its normal performance. Twelfthly, immediately shut down the machine for inspection and handling when there is a burnt smell emitted from the distribution cabinet, control cabinet, and operation cabinet. Thirteenthly, pay attention to observe whether there are abnormalities in the voltage, current, temperature, pressure, flow rate, etc. on the operation panel during operation. Fourteenthly, it is strictly prohibited for operators to set parameters that control the operating state of

the equipment. Based on the equipment operating conditions, professional technicians should adjust the equipment parameters (such as speed, temperature, pressure, etc.) in a timely manner to ensure that the equipment performance reaches its optimal state. The fifteenth rule is to immediately shut down the equipment when it malfunctions. It is strictly prohibited to alter the working state or change the operating parameters. Report to the maintenance personnel the operation actions before the malfunction and the phenomena that occurred during the malfunction, so as to identify the cause and handle it in a timely manner. The sixteenth rule is to inspect the lubrication status of the equipment according to the equipment lubrication regulations, ensuring normal lubrication of all parts. The seventeenth rule is to inspect the operating status of the equipment according to the inspection requirements for equipment operating status, ensuring that all parts are free of hidden dangers or malfunctions. If there are hidden dangers or defects in operation, promptly report to the management or maintenance personnel and take necessary measures to control them.

4.3.3 Production downtime requirements

The shutdown operation requirements refer to the specifications for cutting off the power medium, turning off the power supply, and cleaning the equipment after production ends. The main contents include but are not limited to the following aspects.

First, there are requirements for clearing materials inside the machine or on the production line. Second, there are requirements for the cooling process of the equipment. Third, there are requirements for the shutdown sequence of the equipment. Fourth, there are requirements for the shutdown sequence of the automatic control system. Fifth, there are requirements for the sequence of cutting off the power medium, shutting down the hydraulic system, lubrication system, and turning off the power supply. Sixth, there are requirements for the fixed placement of production tools and equipment, as well as the cleanliness of the machine. Seventh, there are requirements for the shutdown operation of supporting special equipment and other process production equipment. Eighth, there are requirements for equipment operation records and shift handover. Ninth, there are other shutdown operation procedures and requirements that need to be mentioned.

4.4 Safety precautions

This content is formulated based on equipment operation procedures, requirements, and relevant safety regulations. In addition to strictly following the inspection, startup, operation, and shutdown requirements of the equipment, it is also important to pay attention to the safety of both the equipment and personnel.

4.4.1 Safety precautions for startup

After supplying the power medium and connecting the power supply, if the devices are not in standby mode, it will inevitably cause certain devices or mechanisms to operate. If these are not checked or cleaned properly at this time, damage or injury may occur. Therefore, when starting up, attention should be paid to the following aspects, including but not limited to.

First, there are safety requirements for the sequence of activating the power system and connecting the power supply, concerning the activation of the power system and the connection of power supply. Second, there are electrical safety requirements for distribution cabinets, control cabinets, operation cabinets (boxes), as well as distribution boxes and operation boxes installed on equipment, power supply and distribution facilities, lines, production equipment, and their ancillary facilities. Third, there are safety requirements for the preheating process of equipment. Fourth, there are requirements for the integrity of mechanical safety protection devices such as incomplete parts, mechanical limit and buffer devices, and protective covers. Fifth, there are safety requirements for electrical safety protection devices such as emergency stop switches, pull cord safety switches, limit devices such as travel switches and proximity switches, and emergency braking devices. Sixth, there are safety requirements for the working positions of various mechanisms and devices of the equipment. Seventh, there are safety requirements for parts that rotate relatively, equipment feed inlets, and other areas prone to debris entry. Eighth, there are safety requirements for the quality and installation tightness of cutting and trimming tools used in production. Ninth, there are safety requirements for the quality, quantity, and lubrication status of grease in automatic lubrication systems. Tenth, there are safety requirements for the use of various safety warnings, early warning signals, and monitoring systems of equipment. Eleventh, there are safety precautions for starting up supporting special equipment and

other process production equipment. Twelfth, there are other safety precautions that need to be mentioned for startup.

4.4.2 Precautions for operational safety

During equipment operation, phenomena such as vibration, heating, and wear often cause some devices, mechanisms, or components to loosen, fall off, leak, or exhibit abnormal movements, which can further develop into hidden dangers, malfunctions, or accidents. Therefore, attention should be paid to the following aspects during equipment operation, including but not limited to.

First, there are safety requirements for equipment startup speed, no-load running time, capacity load, power, and current. Second, there are operational safety requirements for the pressure, flow rate, and temperature of the power supply system, lubrication system, hydraulic system, and temperature control system. Third, there are operational safety requirements for the integrity of power supply and distribution facilities, the effectiveness of mechanical limit and buffer devices, the sensitivity of electrical safety protection devices, the effectiveness of detection devices, and braking effects. Fourth, there are safety requirements for the use of lifting tools and equipment. Fifth, there are safety requirements for the placement of production tools and equipment. Sixth, there are operational safety requirements for parts such as relative rotation, transmission, sliding, swinging, and cutting devices. Seventh, there are safety requirements for the location of production employees. Eighth, there are safety protection requirements for electrical equipment and facilities. Ninth, there are operational safety requirements for handling material blockages and accumulations. Tenth, there are safety handling requirements for equipment fault alarms. Eleventh, there are operational safety precautions for supporting special equipment and other process production equipment, which should be implemented according to their operating procedures. Twelfth, there are other operational safety precautions that need to be mentioned.

4.4.3 Safety precautions for shutdown

After production is completed, some equipment requires material cleaning, some need to cool down at low speed, and some need to be shut down in sequence. Therefore, when shutting down equipment, attention should be paid to the following aspects, including but not limited to.

First, there are safety disposal requirements for the materials remaining in the equipment and on the conveyor line before shutdown. Second, there are safety requirements for the cooling speed, time, and lubrication status of rotating parts of the equipment. Third, there are safety requirements for the position of the electromechanical control device after shutdown. Fourth, there are safety requirements for the shutdown sequence of the automatic control system. Fifth, there are safety requirements for the sequence of closing the medium and cutting off the power supply. Sixth, there are safety requirements for cleaning the machine and maintaining hygiene. Seventh, there are safety precautions for the shutdown of supporting special equipment and other process production equipment, which should be implemented according to their operating procedures. Eighth, there are other safety precautions for shutdown that need to be mentioned.

4.4.4 Emergency shutdown in case of emergency

During the startup, operation, and shutdown of equipment, occasional abnormalities may occur. To prevent personal safety and equipment accidents, emergency shutdown measures must be taken. Emergency shutdown measures can be taken in the following situations.

First, when foreign objects enter between the relatively rotating parts of the equipment or inside the equipment. Second, when the equipment exhibits abnormal vibrations, temperature rises, fractures, friction, impacts, or other phenomena or sounds. Third, when the mechanical safety protection devices fail, or the electrical safety protection devices and emergency braking devices malfunction. Fourth, when the power supply and distribution system emits a burnt smell or experiences electric leakage. Fifth, when the power medium supply system, lubrication system, hydraulic system, temperature control system, and pipelines suddenly burst or leak. Sixth, when personal safety is endangered or equipment accidents occur. Seventh, when emergency shutdown of supporting special equipment and other process production equipment is required, it should be executed according to their operating procedures. Eighth, other emergency shutdown matters that need to be raised.

4.5 Safety protection device

Equipment safety protection devices are crucial measures for ensuring the safe operation of equipment and

protecting personal safety. In production equipment, there are primarily mechanical safety protection devices, electrical safety protection devices, and electromechanical hybrid safety protection devices. Widely used devices include protective covers, protective railings, protective nets, emergency stop buttons, emergency stop switches, emergency stop pull cord switches, locking devices, emergency braking devices, buffers, limiters, load limiters, safety plates, monitoring systems, audible and visual alarms, safety light curtains, safety light barriers, safety doors, and so on. Different safety protection devices are selected for equipment based on its structural type and operating state. In the operating procedures, listing the safety protection devices of the equipment helps operators and maintenance personnel understand and properly use the safety protection devices. This part is usually compiled in a tabular format, with the header defined as a safety protection device list. The items mainly include: name of safety device, installation location, control part, safety function, and integrity standard. The format of the safety protection device list is shown in table 1.

Table 1 List of Safety Protection Devices

Name of safety device	Installation location	Control part	Safety function	Intact standard

5 Equipment lubrication regulations

The equipment lubrication regulations are distilled from the equipment lubrication management system and embody the specific requirements for equipment lubrication. With the development of modern equipment management technology, the lubrication management rules have been upgraded, requiring the implementation of "eight fixations and three filtrations". The "eight fixations" include fixation of position, fixation of point, fixation of quality, fixation of quantity, fixation of time, fixation of personnel, fixation of method, and fixation of table. The "three filtrations" include oil receiving filtration, transfer barrel filtration, and refueling filtration. The specific content of the "eight fixations" is as follows:

Positioning - Identify the lubrication points of each unit and provide clear guidance for locating these points. Locating - Determine the specific lubrication points within the lubrication areas of the equipment, which is a fundamental requirement for equipment lubrication management. Quality - Ensure the variety and quality of lubrication materials, as this is a prerequisite for ensuring effective equipment lubrication. Quantity - Apply, replenish, or change lubrication oil according to the specified quantity. Timing - Refuel or change oil according to the specified oil change times indicated on the lubrication cards and charts. Personnel - Clarify the responsibilities of relevant personnel for equipment lubrication work. Method - Define the methods for refueling, changing oil, and cleaning oil tanks by relevant personnel. Table - Develop lubrication charts, lubrication record sheets, and lubrication oil change record sheets for each unit. The prescribed format for equipment lubrication is shown in table 2.

Table 2 Equipment Lubrication Regulations

Part/Lubrication Point	Oil products	Quantitative standard		Cycle		Person in charge
	Name	Brand No		Come on	Replace	

6 Equipment operation status inspection

The equipment inspection standards specify the requirements for both static and dynamic inspections of equipment. The inspection before operation mentioned earlier is actually the static inspection requirement for equipment, while the inspection of equipment operating status is the dynamic inspection requirement. The inspection of equipment operating status mainly includes two aspects: the inspection of equipment lubrication status and the inspection of equipment operating status.

6.1 Equipment lubrication status inspection

According to the equipment lubrication standard requirements, it is necessary to specify the parts, contents, standards, and methods for operators to check the lubrication status of various parts of the equipment to prevent equipment wear and tear. The equipment lubrication inspection parts include but are not limited to the following aspects. First, the working status inspection of the automatic lubrication system. Second, the inspection of mechanical transmission parts, such as gear transmission, chain transmission, worm gear and worm transmission, gear and rack transmission, cam mechanism, ratchet mechanism, crank and connecting rod mechanism,

etc. Third, the inspection of rotating parts, such as T-shaped screws, ball screws, shaft sleeves, and other relative rotating parts. Fourth, the inspection of relative sliding parts, such as linear guides, guide rods and guides, sliding surfaces, etc. Fifth, the inspection of the lubrication and oil supply status of air source processing components. Sixth, the inspection of sliding bearings, rolling bearings, hinge points, and other parts of various locations. Seventh, the lubrication status inspection requirements for supporting special equipment and other process production equipment should be carried out according to their operating procedures. Eighth, other lubrication status inspection requirements that need to be proposed.

The status inspection of the automatic equipment lubrication system typically includes checking the integrity and condition of the lubrication device; ensuring that the oil quality meets the equipment requirements and the oil quantity is adequate without excess or deficiency, thereby guaranteeing lubrication efficiency; verifying that the oil circuit is unblocked, free from leaks, and flows smoothly to all lubrication points; confirming that the oil temperature and pressure are within normal ranges, without overheating or overcooling; and verifying that the lubricating oil cooling device is functioning properly, ensuring that the temperature of the lubricating oil is controlled within an appropriate range.

6.2 Equipment operation status inspection

It is necessary to specify the parts, contents, standards, and methods that production employees need to inspect for various devices and mechanisms of equipment under operating conditions, in order to prevent malfunctions or accidents. The inspection parts of equipment operating conditions mainly include, but are not limited to, the following aspects. First, the inspection of the connection and fastening, as well as the intactness, of the equipment foundation and body structure. Second, the inspection of the supply status of the power medium system. Third, the inspection of the working conditions of equipment driving, transmission, braking, and speed change. Fourth, the inspection of the operating status of the automatic lubrication system. Fifth, the inspection of electromechanical safety protection and warning devices. Sixth, the inspection of the operating status of power supply and distribution equipment and facilities. Seventh, the inspection of equipment detection devices, metering, and weighing systems. Eighth, the inspection of the operating status of automatic control systems. Ninth, the inspection of loads such as voltage, current, pressure, temperature, and flow during equipment operation. Tenth, the inspection requirements for the operating status of supporting special equipment and other process production equipment should be carried out according to their operating procedures. Eleventh, other operating status inspection requirements that need to be proposed.

7 Common faults and troubleshooting methods

This content typically includes fault symptoms, causes, and solutions. The table format can be adjusted according to the equipment structure and management needs. The commonly used format is shown in table 3.

Table 3 Common faults and troubleshooting methods

Fault phenomenon	Cause of failure	Treatment method

8 Supplementary provisions

The supplementary provisions typically outline the departments responsible for the compilation, revision, interpretation, and management of procedures; require joint review by units and departments related to the procedures, which must be approved by the company leaders in charge of the equipment; and finally specify the implementation date and inform of the cancellation of previous similar procedures.

9 Conclusion

The article "Method for Preparing Equipment Operation Procedures" combines modern equipment management concepts and summarizes the methods, content composition, and preparation requirements for equipment operation procedures. It serves as a guiding document for the preparation of various types of equipment operation procedures. The two parts of the article, namely "Equipment Lubrication Regulations" and "Common Faults and Troubleshooting Methods," should be reflected in equipment maintenance and repair procedures. This article is included to enable operators to directly conduct equipment lubrication status checks, fault analysis, judgment, and troubleshooting based on the standards. Given the author's level, it is inevitable that there may be some shortcomings. Readers are welcome to provide criticism and corrections.