ABB MEASUREMENT & ANALYTICS | APPLICATION DESCRIPTION

Monitoring the autoclaving process in the pharmaceutical industry

Provides independent verification and validation monitoring of the autoclaving process

Enables compliance with the latest regulations and GAMP guidelines

Eliminates unauthorized adjustment of recorded data

Measurement made easy

Monitoring the autoclaving process in the pharmaceutical industry

Introduction

The conditions under which pharmaceutical products are sterilized are subject to stringent standards. Satisfying these requirements is essential for companies wishing to prove that their products have been safely produced and are suitable for sale both at home and overseas.

When it comes to the use of electronic equipment in sterilization, the de facto standards are set by the International Society of Pharmaceutical Engineers' (ISPE) Good Automated Manufacturing Practice (GAMP) guidelines. Adopted by countries worldwide, these guidelines set down the main requirements that need to be considered when planning and implementing computerized systems in pharmaceutical applications. Figure 1 on the next page shows the standard drivers associated with the current GAMP guidelines.

As the world's largest market for pharmaceutical products, the US has led the way in developing its own interpretation of these guidelines, with the Food & Drug Administration's (FDA's) good practice rules setting the standard for companies worldwide.

Particularly important are the FDA's Predicate Rules, which set stringent requirements for the manufacture, processing, packing and storage of pharmaceutical products.

The specific predicate rules relating to pharmaceutical manufacturing are:

- 21 CFR Part 210, stipulating current good manufacturing practice in the manufacture, processing, packing and storage of pharmaceutical products; and
- 21 CFR Part 211, setting current good manufacturing practice for finished products

These rules include guidance on which aspects of pharmaceutical production need to be recorded, including any process control settings, details on checking recorded data and specific requirements relating to the collection of batch production and control records.

Where these records are collected electronically, then 21 CFR Part 11 also applies, which aims to give electronic records and signatures the same weight and trustworthiness as their paper-based counterparts. A key aspect of 21 CFR Part 11 is its focus on security, particularly relating to the prevention of data tampering and the ability to identify specific individuals and events involved in the production and /or data management processes.

The application

Sterilization permits the re-use of pharmaceutical equipment such as instruments, utensils, lab equipment and media preparation, and is necessary to eliminate transmissible agents such as spores, bacteria and viruses. It is possible to kill some microorganisms with chemicals, irradiation, and dry heat but the most effective and inexpensive method is with saturated steam.

The most popular piece of equipment for use in steam sterilization processes is the autoclave. An autoclave is a pressurized vessel that that uses steam to apply pressure and heat to a load placed inside. The advantage of using an autoclave is that it can reach temperatures higher than boiling water alone, so it can kill not only bacteria but also bacterial spores, which tend to be resistant.

Autoclaves commonly use steam heated to 115–134°C (250–273°F). To achieve sterility, a holding time of at least 30 minutes at 115°C, 15 minutes at 121°C (250°F) or 3 minutes at 134°C (273°F) is required.

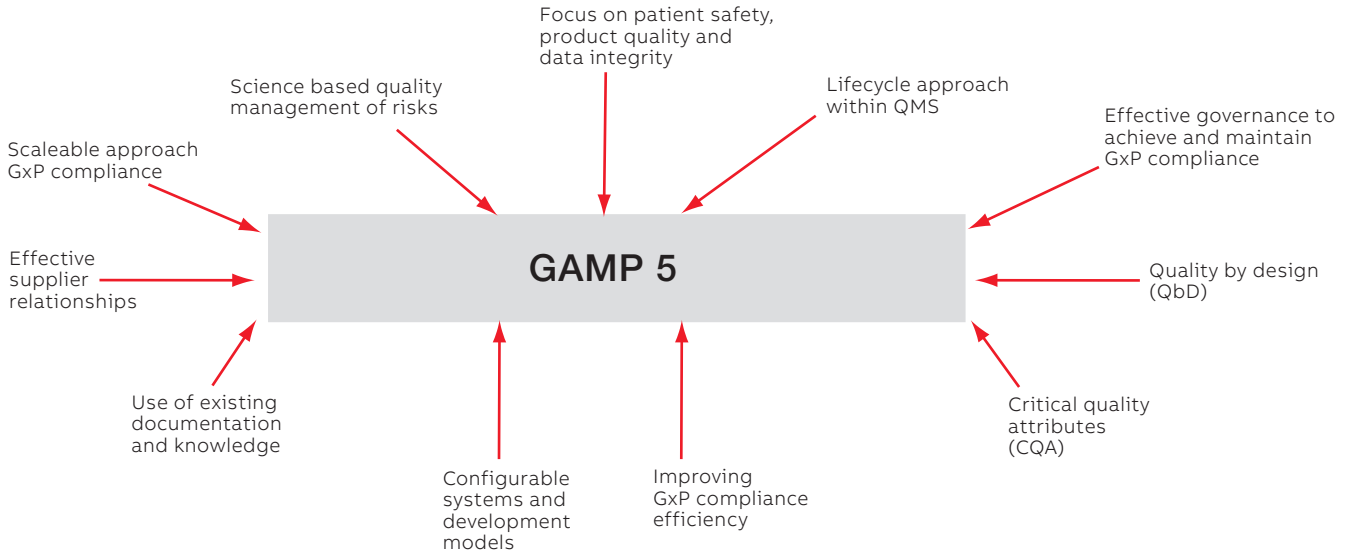

Figure 1 GAMP 5 sets the main requirements for the use of computerized systems in pharmaceutical applications.

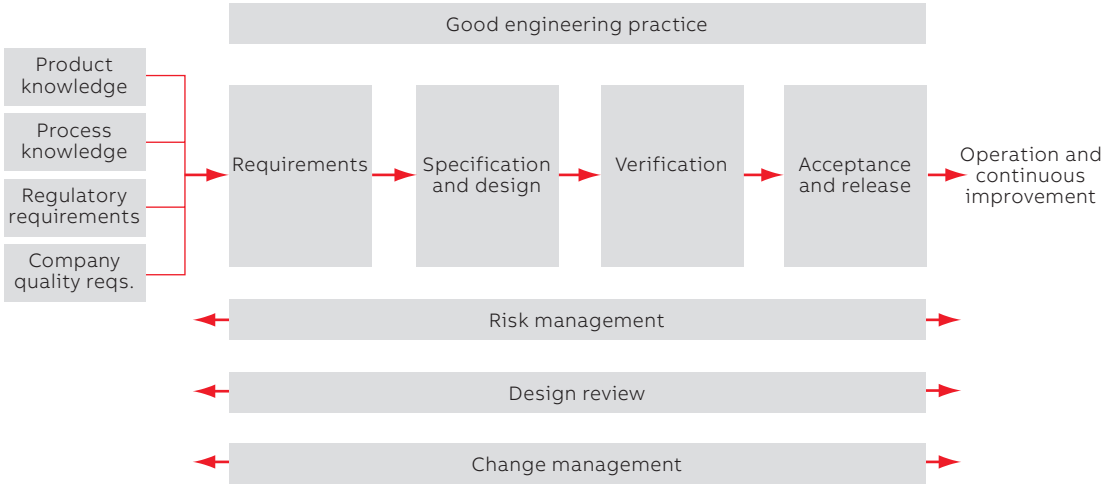

Figure 2 GAMP 5 illustrates the specification, design, and verification process.

The challenge

The validation and verification of the sterilization process is well monitored in the pharmaceutical industry and operators must ensure that autoclaves comply with various guidance and regulations from the UK and abroad. These include the NHS guidance on sterilization HTM 2010, the industry's own Good Automated Manufacturing Practice (GAMP), and the FDA's 21 CFR Part 11, which sets the standard for paperless recorders during the sterilization process.

There are two main issues that need to be addressed in order to verify the sterilization process:

1. Ensure the control system is independently monitored and record the correct functioning of the autoclave, in compliance with GAMP and 21 CFR Part 11.
2. Ensure the system is validated and verified according to the GAMP guidelines.

The solution

Verification of the process is usually recorded on chart or paperless recorders, though the latter is becoming more widespread. These recorders will need to be validated to GAMP guidelines, according to the FDA and other authorizing bodies.

The control functions of an autoclave are normally performed using an integrated control system from the manufacturer. However, it is usual that key parameters are independently recorded against time, including temperature and pressure. The number of temperature and pressure points that are independently recorded varies by the size of the autoclave to ensure that a representative record is retained. Typically three temperature and one pressure signals are used. These are totally independent sensors from the control system.

One temperature sensor is typically located in the 'drain' or the coolest location; one in the load of the product being sterilized; and one in the 'free space' (typically the hottest location). The pressure signal is there to cross correlate the temperature, as pressure is directly proportional to temperature for saturated steam.

Some installations look to have the mathematical calculation for F_0. This takes the temperature and uses an exponential calculation to give 'killing points' for any temperature below the required sterilization temperature. The higher the temperature the faster the 'killing points' accrue. The result is an equivalent time at the sterilization temperature. This can shorten total autoclave cycle times by taking into account the killing temperatures prior to the required sterilization temperature being reached.

It is important to perform a regular calibration check and to be able to perform full calibration adjustment for the system inputs as it is important to verify that the measurements made are reliable.

The system that records the data also independently triggers warning and active alarms should the accepted process parameters be exceeded. In this instance it is usual for a 134°C sterilizing temperature to have a high alarm at 137°C. A recorder that has Ethernet connectivity allows for the provision of historical recorded data and alarm and audit trail information to be retrieved automatically to a central database where archiving and analysis, if required, can take place.

The use of independent recorders for monitoring the autoclave gives confidence that the process has performed as required and is usually part of the product release documentation.

How can ABB help?

ABB offers a full range of products and expertise that can help operators make sure that they comply with the requirements for verification and validation of the autoclaving process.

ABB offers GAMP validation templates with its SM series of videographic recorders, compliant with 21 CFR Part 11, that will follow the unit's life through delivery, calibration, production and can even extend to its end of life disposal. ABB offers a range of validation documentation services in accordance with the required application, such as instrument configuration sheets to help document the User Requirement Specification (URS) and aid the production of the Functional Specification (FS), as well as Installation Qualification (IQ) and Operational Qualification (OQ) documentation.

SM500F

The world's first field-mountable videographic data recorder, the SM500F can be part of a fully compliant 21CFR11 system - the FDA's (Food and Drug Administration) regulations concerning electronic process data collection. Process data is displayed clearly to the local operator through a variety of display formats, including chart, bargraph and digital indicator displays.

The SM500F offers up to seven analogue inputs, enabling multiple sensors to be connected. This is accompanied by 12 recording channels that can each record process and communications inputs, math block results, digital signals and other values, providing additional detail and functionality.

The SM500F comes with a choice of Ethernet or RS485 communications. The Ethernet allows link enabled historical data to be remotely downloaded to a PC for subsequent analysis via ABB's DataManager software. It also allows a web browser view and connection to a SCADA or PLC system using the Modbus TCP protocol. The RS485 option gives Modbus RTU in either three or five wire configurations. These protocols gives the ideal opportunity for integration of third party equipment into the display and recording systems by OEMs.

For sterilizer, autoclave and retort applications, the SM500F now incorporates the efficiency boosting F0 calculation on each recording channel. When compared to purely time based systems, the calculation of F0 enables a sterilizer operator to reduce the cycle time of their process, boosting efficiency whilst still ensuring required sterilization levels are met.

The SM500F can send email notifications whenever an alarm occurs to ensure that any potential problems are promptly addressed. Users can also choose to receive email status reports at any time.

The SM500F now also provides users with greater functionality for batch recording processes. When a new batch is initiated on the control system, the SM500F will automatically start to record the batch, including any associated batch information. This eliminates the need for the operator to duplicate the data entry process on both the recorder and the PLC, saving time and reducing the chance of any potential errors.

SM1000

Now with an added batch control function, the SM1000 is a state-of-the-art solution to recording and data storage. It provides 12 recording channels and up to 12 universal analog inputs which can be viewed in a variety of display formats: chart, bargraph, digital indicator and process summary. Historical logs are provided for recording alarms, operator and system events and totalizer values.

DataManager Pro

ABB's new DataManager Pro analysis software offers a powerful tool for reviewing recorded data. Using the software, operators can review data from multiple recorders. Functions include the ability to compile graphical charts comparing multiple parameters, plus a dual cursor function enabling operators to review data for specific periods of time and specific recorders.

ABB's ScreenMaster series videographic recorders feature Ethernet communications, allowing users to access the recorders from any web browser. Information can be automatically retrieved and placed in DataManagerPro for further analysis.

DataManager Pro also offers a range of presentation possibilities, including the ability to annotate specific alarms and present recorded data as a combined graph accompanied by tables and statistics.

For advice on how ABB can help with independently monitoring the manufacture, production and storage of pharmaceutical products email:
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