

Operating and Service  
**INSTRUCTION MANUAL**  
FOR

**STEAM STERILIZER**

Model HS-4085

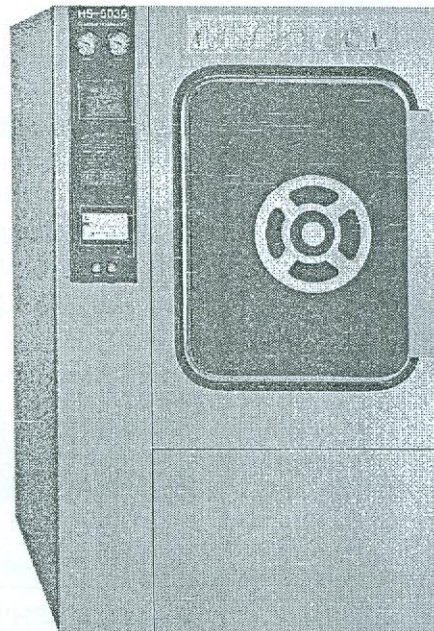
HS-5020

**HS-5025**

HS-5035



**HS-4085/5020**



**HS-5025/5035**



SINCE 1975

**한신메디칼주식회사**  
HANSHIN MEDICAL CO., LTD.

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## SAFETY INSTRUCTIONS

The following instructions should be strictly observed to ensure the safety of life and property when operating, inspecting, and repairing this sterilizer. The manufacturer shall not be held liable for damages caused by failure to correctly follow these safety instructions, as well as the operating instructions detailed in this manual.

01. The operator should carefully read this manual, and should have a good working knowledge and experience in sterilization. This sterilizer should be used in accordance with the methods specified herein.
02. The area where the sterilizer would be installed should be ventilated at least ten times an hour.
03. Do not sterilize the loads that may deteriorate, discolor, and/or deform. Also, do not sterilize loads that are explosive or toxic, and that malfunction when exposed to high-pressure and high-temperature steam.
04. In sterilizing goods or materials whose physical and chemical properties have not been confirmed, please apply the sterilization methods specified in the literature provided by their respective manufacturers.
05. Observe the following pointers in loading the items to be sterilized:
  - ① Place the item to be sterilized in the tray supplied by the manufacturer, and put the tray on the rack.
  - ② Do not put the tray containing the item to be sterilized directly on the chamber floor or on the heater's cover, and avoid bringing the tray in contact with these parts.
  - ③ Do not bring the package of the item to be sterilized in contact with the chamber wall.
06. When sterilizing liquids, please observe the following:
  - ① Use only vented closures. Do not use a screw cap or rubber stopper.
  - ② Use only borosilicate glass bottles (type 1). Do not use ordinary glass bottles or containers that are not designed for sterilization purposes.
  - ③ Avoid opening the door immediately after completing the sterilization cycles. Instead, slightly open the door and let it cool for about ten minutes.
  - ④ Do not shake or move the hot bottle, as doing so may lead it to burst.
07. Do not sterilize saline solutions.
08. Use the sterilizer only when it is properly grounded to earth.
09. During sterilization, the operator should be near enough to be able to watch over it and hear any warning or unusual sounds that may indicate equipment failure. Also, make sure that sterilization has been completed and that the sterilizer has been turned off before leaving.
10. Only technically qualified and experienced personnel should inspect, adjust, and repair the sterilizer:
  - ① Always wear protective gloves when operating the sterilizer.
  - ② Disconnect the power plug and let the sterilizer cool down before conducting inspection and maintenance.
  - ③ Use only those spare parts designated by the manufacturer.
11. When cleaning the door or chamber, do not use a wire brush, steel wool, abrasives, or materials containing chlorides.

## 3.2 FUNCTION OF CONTROL

### (1) Message Center

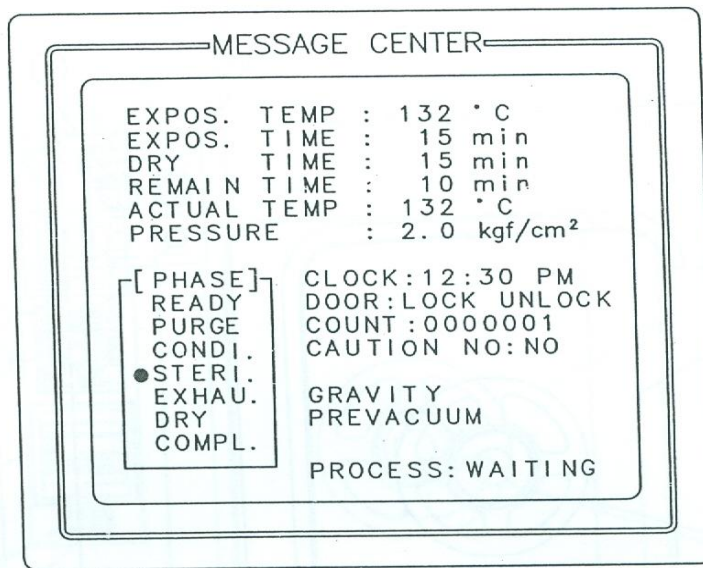


Figure 3-4. Message Center

EXPOS. TEMP: Displays the exposure temperature in grades Celsius set to each cycle program.

EXPOS. TIME: Displays the exposure time in minutes set to each cycle program.

DRY TIME: Displays the drying time in minutes set to each cycle program.

REMAIN TIME: Displays the remaining time during Heat, Sterilization, and Dry mode.

ACTUAL TEMP: Displays the actual temperature of the chamber during operation.

PRESSURE: Displays the actual pressure of the chamber during operation

[PHASE]: Displays the present phase as follows,

READY: Ready for operation

PURGE: Initial air removal

CONDI.: Air removal by Pulsing

STERI.: Sterilizing

EXHAU.: Venting

DRY: Drying

COMPL.: Completion of the cycle

CLOCK: Displays the present time.

DOOR: Displays the present door status, LOCK or UNLOCK

COUNT: Displays the number of operated cycles.

CAUTION NO: Displays the caution code when caution state occurs.



GRAVITY: Displays reversely if you select gravity cycle.

PREVACUUM: Displays reversely if you select prevacuum cycle.

PROCESS: Displays reversely a process in progress that PREHEAT, WAITING, STEAM IN, VACUUM, AIR IN, COOLING, DWELL, LEAK TEST.

## (2) Control Keyboard

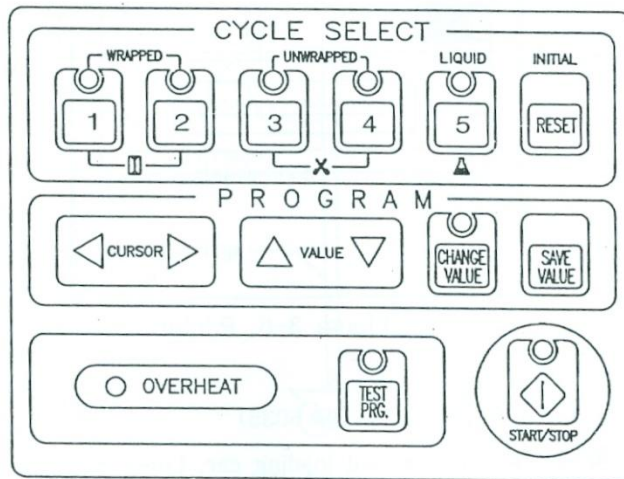


Figure 3-5. Control Keyboard

<CYCLE SELECT>: You can choose between 5 basic programs, numbered 1 ~ 5.

<INITIAL RESET>: Switch back to pre-set programs from user-defined programs.

<PROGRAM>: For saving the user cycle programs.

CURSORS: Moves the cursor.

VALUE: Insert values.

CHANGE: Change modes.

SAVE: Save.

(OVERHEAT): Warning light in case of chamber overheating.

<TEST PRG.>: Use for test cycle (#1: Bowie-Dick Test, #2: Vacuum Leak Test).

<START/STOP>: Start/stop button for cycle operation.

## (3) Interlock

Interlock system is one of safety system, and perform functions as follows.

- ① Turn <POWER> switch on firstly, or else the chamber door will not open.
- ② In spite of pressing the <START/STOP> key, the cycle would not start unless the chamber door is locked.
- ③ It is impossible to open the chamber door during cycle.
- ④ It is unable to open the chamber door if the cycle ceased due to power failure.

#### (4) Printer

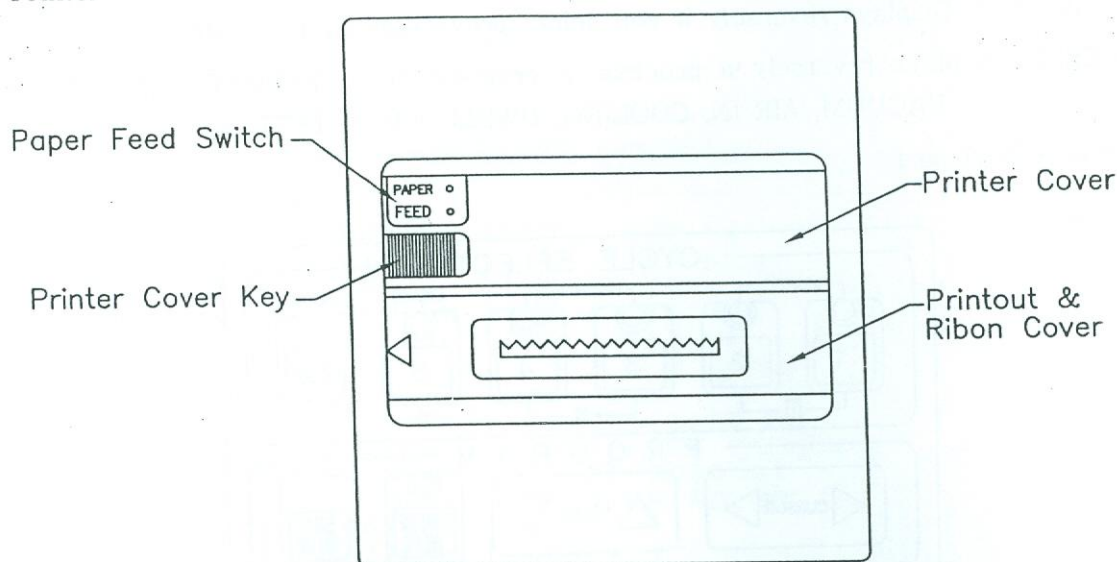


Figure 3-6. Printer

### 3.3 LOADING (Available for only HS-5025, HS-5035)

Loading system is consist of carriage and loading car. Loading car is mounted on the rail of carriage and is fixed with each other by latch. The loads be put on the shelf of loading car and the loading car is placed into the chamber. The carriage rail should be leveled with chamber rail so as to move the loading car into chamber. If necessary, you can adjust height of carriage with four casters.

- (1) Loading: Firstly open the chamber door widely, push the carriage with loading car against entrance of the chamber in order to make two rails one line, then linking hook will be inserted into the groove of chamber door frame, and the rail of carriage and chamber will be connected in one line. As you push the loading car raising the release knob of the carriage, it will go into the chamber along the rail. After the loading car entered the chamber, pull the carriage pushing the release knob of carriage, it will be separated from the sterilizer.
- (2) Unloading: After connecting the carriage to the chamber in the same method as in loading, draw out the loading car with the unloading hook, it will be engaged with the latch on the rail of carriage. Pull the carriage pushing the release knob of the carriage, it will be separated from the sterilizer.



### 3.4 OPERATION

This unit can sterilize metal instruments, synthetic resin products, rubber products, glass products, fiber products for medical applications, as well as the liquids in a glass container or any other receptacle. The unit features a "resume" function, which saves present operating data in case of a power failure or power switch off and continues the program when electrical power is available again.

Run the Vacuum Leak Test cycle daily before use, to check the operating condition of the unit.

**CAUTION:** This unit is not suitable for sterilizing of toxic materials or products which can be damaged under heat or high humidity. If in doubt, please contact the manufacturer for information on materials, which can be sterilized with this unit.

**NOTE:** ① The whole sterilization process is computer-controlled.

② This unit does not operate when the door is open.

③ In case of error messages the unit will automatically stop operation by self-diagnosis function and the chamber pressure will be released.

④ In case of termination by pressing the <START/STOP> button, error code will be displayed. However, the "RESUME" function will save operating parameters in case of a power failure or power switch off and continue the program after electrical power is available again.

⑤ This unit displays cycle phases and error codes, and print out respective processing results.

#### WARNING

① Do not shut off the power when the unit is operating.

② Do not open the chamber door when the unit is operating.

The pre-set cycle programs are as follows:

Table 3-1. Cycle Program

ITEM	BASIC STERILIZATION CYCLE					TEST CYCLE	
CYCLE NO.	1	2	3	4	5	Bowie-Dick Test	Vacuum Leak Test
EXPOSURE TEMPERATURE	132℃	132℃	132℃	121℃	121℃	134℃	132℃
AIR REMOVAL	Vacuum	Gravity	Gravity	Gravity	Gravity	Vacuum	Vacuum
LOADS TYPE	Wrapped	Wrapped	Unwrapped	Unwrapped	Liquid	Test Pack	N/A
EXPOSURE TIME	5min	15min	15min	30min	30min	3.5min	3min
DRY TIME	5min	15min	—	—	—	5min	15min
COOLING TIME	—	—	—	—	30min	—	—
DWELL TIME	—	—	—	—	—	—	5min
TEST TIME	—	—	—	—	—	—	30min

### 3.4.1 Cycle Programs for Wrapped and Unwrapped Loads (#1, #2, #3, #4)

- (1) Turn on the <POWER> switch. The latest cycle program will be selected automatically. The message center will display the settings of selected cycle program.
- (2) Check the printer ribbon and paper and replace it if necessary.
- (3) Load the wrapped or unwrapped material to be sterilized and lock the door. The LOCK on the message center will be displayed in reverse image (refer to above 3.3 LOADING).

NOTE: Press <POWER> switch first, you can open door after a clicking sound of the door interlock.

NOTE: If the automatically selected program values was a user cycle program;

- ① If you want to employ the selected user cycle program, skip paragraph (4) and proceed to paragraph (5).
- ② If you want any other user cycle program, change the values with <CHANGE VALUE> key (refer to 3.4.3 User Cycle Program).
- ③ If you want to employ the basic cycle program, press the <INITIAL RESET> key and then proceed to paragraph (4).

CAUTION: Do not attempt to sterilize liquids with the wrapped and unwrapped materials program.

- (4) Select the desired cycle program using the <SELECT> key. The values of the selected program will be displayed.
- (5) Press <START/STOP> key.

The cycle will start. The unit will operate automatically (purge, conditioning, sterilization, venting, drying, and completion). The display will show present phases, pressure, temperature, and remaining time. The data of pressure, temperature, and time will be printed out continuously during the process.

NOTE: In case of a power failure or power switch off: the unit has a "RESUME" and "RESTART" function, which automatically saves the present operating cycle and resumes operation after power is restored. If actual readings for temperature and pressure during the period of termination deviate too much from the saved values, some error may be occurred.

- (6) After completion the process, there is an 0.1 second alarm sound for 30 seconds at 0.1 second interval and the printer will print all process informations.
- (7) The unit will be restored in original state when you open the door or press the <START/STOP> key during and after the alarm.
- (8) Open the door and unload. In case of double door unit, it should be unloaded rear door, and in case of single door unit, it should be unloaded front door pulling out loading car (refer to 3.3 LOADING).
- (9) In case the unit is no longer used, turn off the power.

### 3.4.2 Cycle program for liquids (#5)

This process is similar to the cycle for wrapped and unwrapped materials (1).



- (1) Select the cycle for liquids by pressing the #5.

**CAUTION:** ① The liquid contents of a container should not exceed 70% of the container capacity.

② Leave containers open or use porous lid. Don't use screw-on or rubber lids.

③ Only borosilicate glass containers (Type I) should be used. Do not try to use ordinary glass containers or containers which are not suitable for the sterilization process.

④ Do pay attention to handling the hot glass container. Moving the container with boiling liquids may lead to burst.

⑤ Sterilization of chlorine solution may be harmful to the chamber.

⑥ Sterilization time depends on container capacity. Bigger containers require longer sterilization (see Table 3-2 for recommended sterilizing time).

- (2) Load the liquid material, and lock the door.

**CAUTION:** Do not attempt to sterilize wrapped and unwrapped materials with the program for liquids.

- (3) When you press the <START/STOP> key the unit will be operated in the order of process: PURGE, CONDITION, STERILIZATION, SLOW EXHAUST, COOLING (CONDENSING), and COMPLETION.

**NOTE:** In case of the liquid cycle, exhaust slowly when terminates the sterilization phase. The chamber is cooled down to condense vapor and then the chamber pressure is gradually dropped. This will prevent overflow or burst due to a rapid change in pressure.

### 3.4.3 User Cycle Program

It is prepared for setting a program different to the 5 basic cycle program.

- (1) Select the cycle according to the material to be sterilized.

① If you want to sterilize wrapped or unwrapped materials, select one out of #1, #2, #3, or #4.

② If you want to sterilize liquids, select #5.

- (2) Change values as desired:

① If you press the <CHANGE VALUE> key, the display shows the cursor at "EXPOS. TEMP".

② Whenever you press the cursor key <▶>, the cursor will move to the next value field. Change values using the value keys <▲, ▼>. The cursor key <◀> will move the cursor backwards.

③ After changing, press the <SAVE VALUE> key to save and exit from change mode.

- (3) Press <INITIAL RESET> key for return to the original cycle program.

**NOTE:** If you do not reset, the saved user cycle program will be selected successively.

- (4) Operation of user cycle program is the same as basic cycle.

Table 3-2. Recommended Exposure Time

Material to be Sterilized vs Minimum Time in Minutes	Gravity		Vacuum
	121 °C	132 °C	132 °C
INSTRUMENTS, metal only, in perforated tray, unwrapped	15	3	4
INSTRUMENTS, metal, unwrapped, combined with sutures, tubing or other porous materials	20	10	4
INSTRUMENTS, metal only, in lightly covered or padded tray	20	10	4
INSTRUMENTS, metal, combined with other porous materials, in lightly covered or padded tray	30	15	4
INSTRUMENTS, wrapped in muslin -4 thicknesses- for storage	30	15	4
GLASSWARE, empty, inverted	15	3	4
DRESSINGS, wrapped in paper or muslin	30	15	4
DRESSINGS, loosely packed, in canisters (on sides)	30	15	4
LINEN, packs, maximal size (12"x12"x20") and weight (12 lbs)	30	-	4
SYRINGES and NEEDLES, disassembled, lumen moist, individually packaged in muslin or paper	30	15	4
RUBBER GLOVES, wrapped in muslin or paper	20	-	4
RUBBER CATHETERS, DRAINS, TUBING (lumen moist), unwrapped	20	10	4
RUBBER CATHETERS, DRAINS, TUBING (lumen moist), individually packaged in muslin or paper	30	15	4
TREATMENT TRAYS, wrapped in muslin or paper	30	-	4
SOLUTIONS (square-pak bottles)			
75 ml ~ 250 ml	20	-	-
500 ml ~ 1,000 ml	30	-	-
1,500 ml ~ 2,000 ml	40	-	-
UTENSILS, on edge, unwrapped	15	3	4
UTENSILS, on edge, wrapped in muslin or paper	20	10	4
REFERENCE: Perkins, J. J. : Principles and Methods of Sterilization in Health Sciences, 2nd ed. Springfield, IL., Thomas, 1983, p. 165, 166.			

#### 3.4.4 Test Cycle Program

When using the vacuum cycle, make sure that the air in the chamber as well as in the loads is completely evacuated. Before operating the vacuum cycle, run the Vacuum Leak Test to make sure the vacuum sealing is intact. If the vacuum leak is observed, the sterilizer should be checked and repaired.

##### (1) Vacuum Leak Test Cycle

- ① Lock the door of the empty chamber and select basic cycle #1.
- ② Press <TEST PRG.> key.

NOTE: In case of the cycle #3, #4 or #5 are selected, the cycle will not convert to the test cycle program.

- ③ Press <START/STOP> key, the cycle will start.

● Message Center display as follows.



- ⑤ Immediately unload and evaluate the test pack after completion.
- ⑥ If the pattern colour of test sheet is changed deep and evenly, the test shall be deemed acceptable.
- ⑦ Press <TEST PRG> to return to the basic cycle #2.

### 3.4.5 Cycle Performance Record

The printer will print the Cycle Performance Record during cycle (refer to Table 3-3).

Table 3-3. Cycle Performance Record (Example)

RECORD				DESCRIPTIONS
ERROR CODE : NO				
CYCLE COUNT = 0000003				
TOTAL CYCLE = 00:41:31				
AIR IN	=	00:00:25	OK	
DRY	=	00:05:00	OK	
EXHAUST	=	00:01:16	OK	
STERILIZE	=	00:05:00	OK	
CONDITION	=	00:27:49	OK	
PURGE	=	00:02:01	OK	
PRES MAX	:	2.0 kgf/cm <sup>2</sup>		
PRES MIN	:	1.9 kgf/cm <sup>2</sup>		
TEMP MAX	:	133 °C		
TEMP MIN	:	132 °C		
Z	11:51:33A	75	-0.1V	First Column: P= PURGE, C= CONDITION, S= STERILIZE, E= EXHAUST, D= DRY, A= AIR IN, Z= COMPLETE, D= DWELL, T= TEST Second Column A = am, P = pm Third Column: Temperature Forth Column: Pressure P = Pressure, V = Vacuum
A	11:51:08A	76	-0.9V	
D	11:46:08A	104	0.0P	
E	11:44:51A	32	2.0P	
S	11:39:51A	133	2.0P	
C	11:26:59A	87	-0.7V	
C	11:25:39A	117	1.0P	
C	11:24:22A	94	-0.7V	
C	11:22:24A	118	1.0P	
C	11:19:59A	93	-0.4V	
C	11:16:19A	116	1.0P	
C	11:12:02A	82	0.7P	
P	11:11:01A	18	0.0P	
TIME	T=°C	P=kgf/cm <sup>2</sup>		
DRY	TIME =	5 min		
EXPOSURE	TIME =	5 min		
CONTROL	TEMP =	133 °C		
EXPOSURE	TEMP =	132 °C		
CYCEL NO : #1 (WRAPPED)				
DATE: 1998/11/06				
CYCLE START TIME : 11:11:01 AM				
STERILIZER NO : 9811006				
MODEL NO : HS-5020				
FULL AUTOMATIC STERILIZER				
HANSHIN MEDICAL CO., LTD.				

### 3.5 TECHNIQUES OF STERILIZATION

The information in this section is intended as a guide to steam sterilization techniques for the most common types of steam sterilizable articles and materials. Prior to sterilization, all materials and articles must be thoroughly cleaned. After sterilization, most goods should be stored for no longer than 30 days, depending on wrapping materials. For sterilization of articles or materials not covered in this section, contact the manufacturer of the article for the recommended procedure.

## (2) Cleaning of Loads

**Instruments:** Cleaning the instruments immediately after use is most effective. Disassemble that assembled devices and unlock that locked devices and wash with water. At this time, every debris of dirt should be removed completely. Then, wash out cleanly with warm water and an appropriate detergent and apply water-soluble instrument lubricants, specifically designed for sterilization. **Lumens:** Catheter, syringe needle, and tube should be washed cleanly and remove moisture, then soak with distilled water. Pack it with moisture remained in the tube and sterilize immediately (at least within 24 hours) for achieving effective sterilization and prevention of pyrogen generation. **Textiles:** Wash out cleanly immediately after use and dry completely before sterilize.

## (3) Wrapping Fabrics and Hard Goods

Wrapping of packs, instrument sets, and other porous materials provides protection against recontamination when the items are removed from the sterilizer.

The protective wrapping also serves as protection against contact contamination in handling, guards against the entry of insects, etc., and serves as a dust filter for normal storage of sterilized goods. Use steam-sterilization wrappers for surgical supplies to provide protection after sterilization.

**NOTE:** Muslin of 140 thread count is the present standard for steam sterilization. The manufacturers of other materials should show data that indicates their product is equivalent to or better than the muslin profile in steam sterilization, drying and sterility maintenance.

Use of freshly laundered 140 thread count muslin (or equivalent) helps prevent superheating and provides longer life of the textiles. You may also use nonwoven wrap, self-seal and heat-seal pouches.

All fabric packs should be placed on edge, and arranged in chamber to allow for maximum exposure (i.e., minimal resistance for steam passage through the load).

Also place utensils and treatment trays on edge so they will be sterilized and dried properly.

Instrument sets should be placed flat in tray having perforated bottom (or equivalent).

When processing mixed loads combining fabrics and hard goods, place the hard goods on the lower tray or rack. This prevents wetting of muslin packs from condensate dripping from hard goods load.

Remove any caps from and invert empty jars, canisters and all other nonporous containers to facilitate sterilization and drying.

**CAUTION:** DO NOT OVERLOAD STERILIZER. Allow for steam penetration between packs. Avoid contact of load components with the walls of the chamber.

## (4) Avoiding Wet Packs

A major factor governing the sterility of supplies is a "state of dryness." Wet materials may transmit bacteria, therefore a "state of wetness" could compromise the sterility of processed packs and instruments.

No single factor stands out as the primary cause of wet packs, but rather several factors



should be considered. Wet pack conditions occur in various:

- types of loads (i.e., instrument sets, utensil sets, textile packs, and steam-sterilized plastic, paper, or all-plastic peel pouches).
- types and sizes of wrappers (i.e., reusable textiles of all thread counts, disposable cellulose-based, and disposable polypropylene-based).
- pack preparation and sterilizer loading techniques.

Following are some guidelines for evaluating packs for acceptable drying.

- ① External droplets or visible moisture on the exterior of the pack, or on the tape, are unacceptable unless that wrap is completely impermeable to water (e.g., plastic film).
- ② Water droplets on the interior of a wrap (unless it is completely water impermeable), or on the items within the pack are unacceptable.
- ③ A pack is unacceptable if the pack is damp or wet when opened for use. A general guideline is that the pack be completely dry after cooling at room temperature (i.e., 21°C and 50% relative humidity) for a minimum of one hour following removal from the sterilizer. (If the room temperature and relative humidity vary from these recommendations, a longer drying time and increased cooling time may be necessary before the packs are handled or stored).

These guidelines are not intended to be the final word in establishment of wet pack criteria, but serve as a basis for evaluating sterilized packs to assure an acceptable "state of dryness".

#### (5) Sterilizing of Liquids

This sterilizer is designed to process liquids only when borosilicate flasks with vented closures are used. Sterilization of liquids in any other flask or with the use of non-vented closures requires a sterilizer specially designed for that purpose.

Borosilicate glass is recommended because it is a superior glass capable of containing higher pressure, of resisting thermal shock (such as cold air striking the hot glass), and of withstanding repeated handling.

Vented closures are required because, by design, they will relieve excess pressure by automatically venting a flask.

If other types of glass (such as flint glass) and non-venting (sealed) closures are used to sterilize liquids in the sterilizer, dangerous condition, capable of causing personal injury and property damage, is created. As the liquid and residual air in a sealed flask are heated, they expand and create an internal pressure greater than the external pressure of the steam. With the weaker glass, a greater potential for bursting exists. After the sterilization exposure, the chamber is exhausted slowly but it still exhausts more rapidly than the pressure within a sealed flask.

This pressure within the flask will exist until the residual air and the liquid have cooled (unlike a flask with a vented closure that relieves this excess pressure). Thus, potential exists for the flask to burst and cause personal injury or property damage.

## 4. PRINCIPLES of OPERATION

The following explanation will focus on the cycle graph.

References: Figures 4-1-1. to 4-1-7. Cycle Graphs

Figures 4-2-1. to 4-2-5. Wiring Diagrams

Figures 4-3-1. to 4-3-5. Piping Diagrams

### .1 INITIAL

Turning POWER switch on, initial phase begins. Message center will light and initial state will be displayed. The Message Center will be operated until off the power. In case of the built-in boiler, turn on the power switch of boiler.

The jacket steam supply (SV6) and drain cooling valve (SV4) begins operation, and the fast exhaust (SV2) and filtered air (SV3), vacuum water (SV5) and boiler water supply valve (SV7) begins controlling. Steam pressure and temperature of the jacket rise.

### .2 READY

If steam temperature of the jacket reaches setting value (+3°C of sterilizing temperature setting value), will proceed to READY phase by temperature transducer (TT2) controls.

According to control of temperature transducer (TT2), the jacket steam supply valve (SV6) operates in controlling to maintain setting jacket temperature (+3°C of sterilizing temperature setting value). Fast exhaust (SV2) and filtered air (SV3) and vacuum water valve (SV5) remains in controlling. Drain cooling valve (SV4) continues operation.

Boiler operation convert to controlling and boiler water supply valve (SV7) maintains controlling.

The sterilizer should be loaded during initial or ready phase since if condition phase begins, you can't open door. If you lock door, 'LOCK' will flash on the message center.

### .3 PURGE

If you press the <START/STOP> key on, PURGE phase begins. 'PURGE' will flash on the message center. The chamber steam supply (SV1) and fast exhaust valve (SV2) begins to operating. The filtered air (SV3) and drain cooling valve (SV4) will close. The jacket steam supply valve (SV6) maintains controlling.

Vacuum water valve (SV5) opens and pump supply water to ejector. Passing the ejector in high speed the water build up a vacuum status in the ejector, therefore it will suck out the air from chamber through fast exhaust valve (SV2). Pressure transducer (PT1) controls chamber steam supply valve (SV1) and fast exhaust valve (SV2) to maintain chamber pressure 0.7 kgf/cm<sup>2</sup>. Purge time is programmed by 2 minutes.

Boiler water supply valve (SV7) maintains controlling and printer begins printing the cycle performance record.

### .4 CONDITION

When PURGE terminates, the CYCLE proceeds to CONDITION. the vacuum cycle consists of Pulse and Heat-Up steps, and gravity cycle have a Heat-Up step only.

#### ● Pulse Step:

According to the control of pressure transducer (PT1), perform pulse operation that



chamber steam supply valve (SV1) and drain cooling valve (SV4), fast exhaust valve (SV2) and vacuum water valve (SV5) open three times and close three times alternately. The upper limit steam pressure of pulse is programmed as  $1.0 \text{ kg/cm}^2$  and the lower limit steam pressure of pulse is programmed as  $-0.4 \text{ kg/cm}^2$  at first time and as  $-0.7 \text{ kg/cm}^2$  at 2nd ~ 3rd time.

This step is designed to remove remained air in chamber completely, and when the third lower limit pressure is reached, pulse terminates and then proceeds to Heat-Up step automatically.

Jacket steam supply valve (SV6) and boiler water supply valve (SV7) maintains controlling.

Printer continues printing the cycle performance record.

#### ● Heat-Up Step:

Jacket steam supply valve (SV6) maintains controlling.

Printer continues to print the cycle performance record.

According to chamber temperature transducer (TT2) control, chamber steam valve (SV1) and drain cooling valve (SV4) open. When chamber steam temperature reaches setting value, the cycle proceeds to sterilize phase automatically.

### 4.5 STERILIZE

Chamber steam supply valve (SV1) controls setting chamber temperature according to chamber temperature transducer (TT1) controls. Drain cooling valve (SV4) continues operation.

Jacket steam supply valve (SV6) continues to controlling.

Boiler water supply valve (SV7) maintains controlling and printer continues printing the cycle performance record.

If setting sterilize time passes, the cycle proceeds to exhaust phase according to the program.

### 4.6 EXHAUST

Exhaust is classified by two types as follows.

Boiler water supply valve (SV7) maintains controlling and printer continues printing the cycle performance record.

#### ● Fast Exhaust: Applied to cycles such as #1, #2, #3 and #4.

Chamber steam valve (SV1) and drain cooling valve (SV4) close by the program. When fast exhaust valve (SV2) and vacuum water valve (SV5) open by the program, chamber steam exhausts quickly. Jacket steam supply valve (SV6) maintains controlling.

When chamber pressure drops into atmospheric pressure, Exhaust Phase terminate by sensing of pressure transducer (PT1).

#### ● Slow Exhaust: Applied to Liquid Cycle.

Drain cooling valve (SV4) continues operating. Chamber steam supply valve (SV1) and Jacket steam supply valve (SV6) stops controlling. Fast exhaust valve (SV2) and vacuum water valve (SV5) close.

Chamber steam is exhausted through needle valve (NV1) slowly. Exhaust time is appropriate between 15 and 30 minutes. As the chamber pressure drops to atmospheric pressure, exhaust terminates through sensing of pressure transducer (PT1).

#### 4.7 DRY

DRY Phase is consist of Vacuum and Air In step. Especially, in vacuum leak test cycle, there are Dwell and Test step between vacuum and air in. But, this phase is excluded since it is not required in cycles such as unwrapped instruments and liquids.

Jacket steam supply valve (SV6) maintains controlling.

Boiler water supply valve (SV7) maintains controlling and printer continues printing the cycle performance record.

##### ● Vacuum Formation and Maintenance:

According to the program, fast exhaust valve (SV2) and vacuum water valve (SV5) operates continuously to exhaust chamber steam. Chamber pressure maintains vacuum of  $\leq -0.7$  kgf/cm<sup>2</sup>.

##### ● Dwell and Test: This is applicable to Leak Test Cycle only.

During the time of Dwell (5 minutes) and Test (15 minutes), fast exhaust valve (SV2) and vacuum water valve (SV5) stops operation and test the performance of maintaining vacuum state in vacuum leak test cycle.

##### ● Air In:

Fast exhaust valve (SV2) and vacuum water valve (SV5) stops operation.

According to the program, filtered air valve (SV3) opens and the air enters into the chamber. At the same time, drain cooling valve (SV4) will operate.

As the chamber pressure is recovered to the atmospheric pressure, it proceeds to Complete Phase.

#### 4.8 COMPLETE

Boiler continues operating.

This phase is consists of completive signal and final printing.

##### ● Signal Sound:

Fast exhaust valve (SV2) starts operation and filtered air valve (SV3) and drain cooling valve (SV4) operates continuously. But, in liquid cycle, fast exhaust valve (SV2) will not operate.

Jacket steam supply valve (SV6) maintains controlling.

Buzzer generates signal sound of 0.1 second for 30 seconds at intervals of 0.1 second.

##### ● Cycle performance record printing:

Fast exhaust valve (SV2) starts operation and filtered air valve (SV3) and drain cooling valve (SV4) operates continuously. But, in liquid cycle, fast exhaust valve (SV2) will not operate.

Jacket steam supply valve (SV6) maintains controlling.

But, in liquid cycle, Jacket steam supply valve (SV6) will not operate.

When completion signal sound terminate, printing of cycle performance record begins.



and then if printing terminates, door interlock will be released.

When the cycle is completed, it will be returned to READY phase. But in case of liquid cycle, it will be return to INITIAL phase.

#### 4.9 COOLING

The cooling phase is applicable to the liquid cycle program only for safety of glass bottles.

If you unlock and turn the door handwheel counterclockwise until display 「UNLOCK」 reversely on the message center, the cooling phase is performed for 30 minutes.

Drain cooling valve (SV4) continues operating.

Chamber steam supply valve (SV1) and Jacket steam supply valve (SV6) stops controlling.

Filtered air valve (SV3), fast exhaust valve (SV2) and vacuum water valve (SV5) will close.

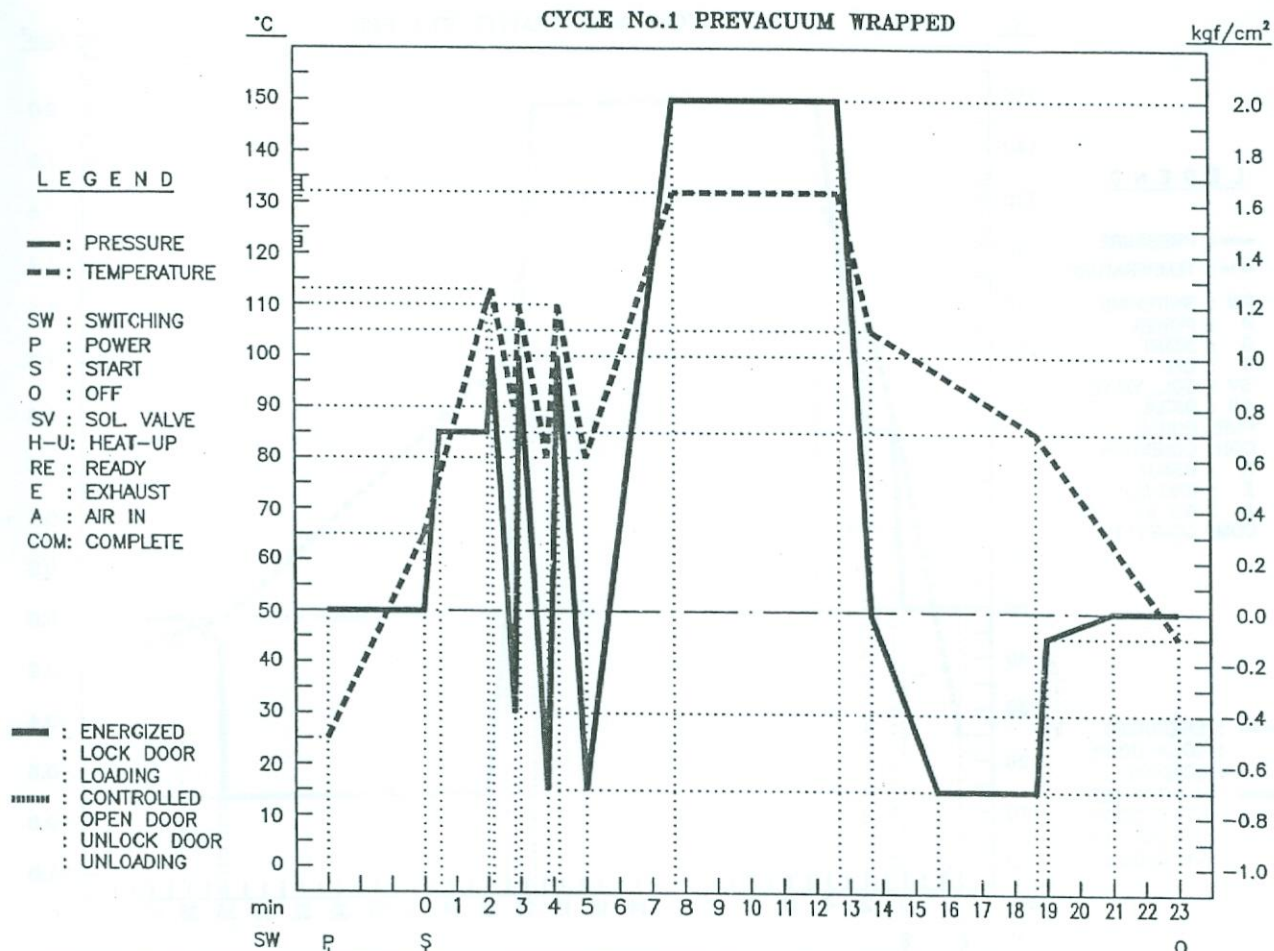
When preset time of 30 minutes is over, cooling phase terminates and buzzer generates signal sound of 0.1 second for 30 seconds at intervals of 0.1 second.

Remove the sterilized liquids from chamber, and then if you close and lock door, the unit will return to the INITIAL phase.

#### 4.10 READY PHASE for SUCCESSIVE CYCLE

When Complete Phase terminates, one cycle is completed and the number of cycle counter increases by one, and then automatically returns to the Ready Phase of the selected cycle program lastly. Purpose of this phase is to maintain continuity with the next cycle.

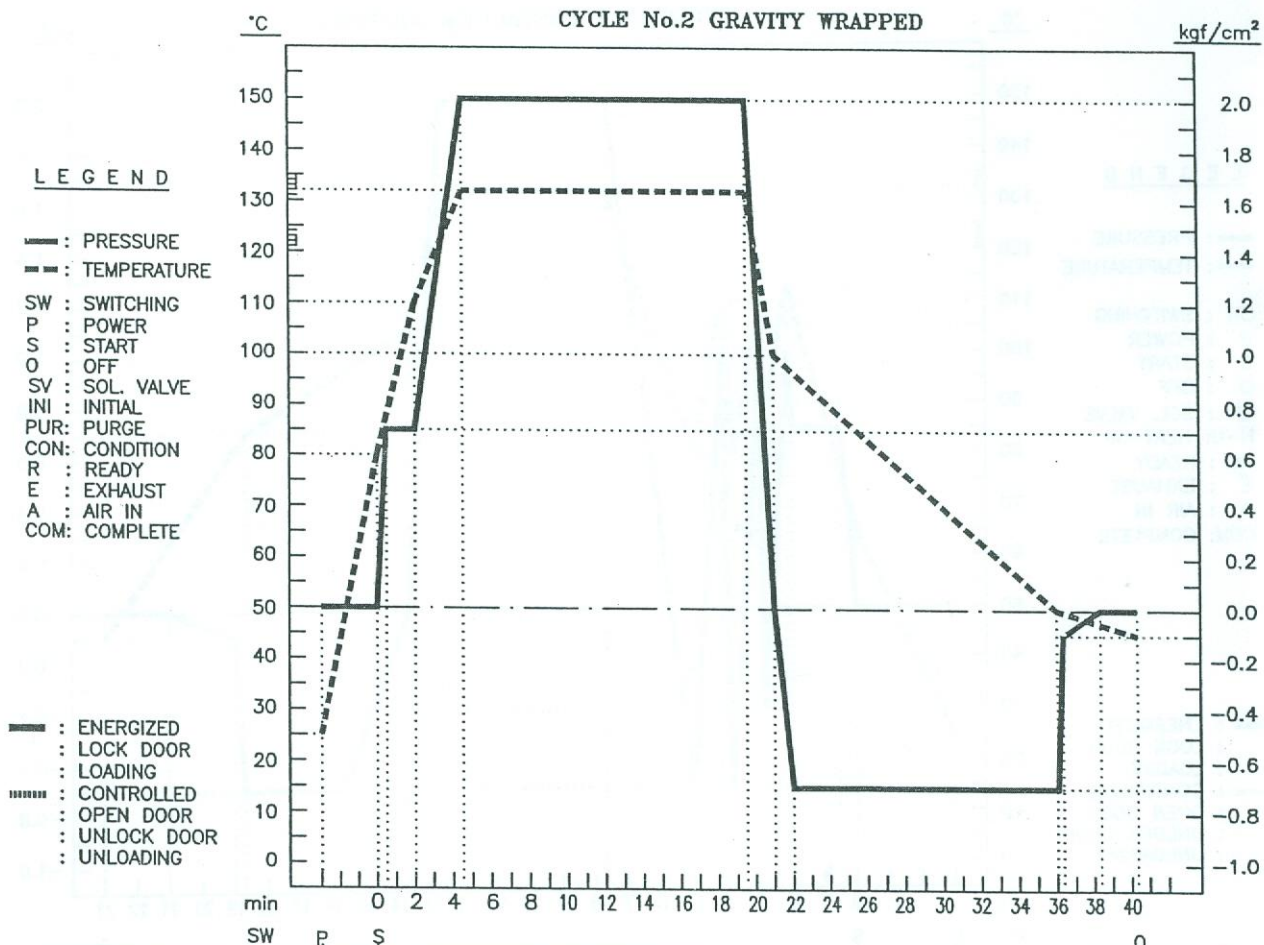
Fast exhaust valve (SV2) and filtered air valve (SV3) change to controlling and continues operation. Drain cooling valve (SV4) continues to operate. Jacket steam supply valve (SV6) continues to operate controlling. In this condition, the next successive cycle can be started by just loading and pressing <START/STOP> key.



CYCLE PHASE	INITIAL	RE	CONDITION		STERILIZE	E	DRY		COM	READY	O
			PULSE	H-U			VACUUM	A			
MESSAGE CENTER	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
SV1 (steam to cham)	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
SV2 (fast exhaust)	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
SV3 (filtered air)	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
SV4 (drain cooling)	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
SV5 (vacuum water)	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
SV6 (steam to jacket)	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
SV7 (boiler water supply)	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
STEAM GENERATOR	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
PRINTER	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
BUZZER	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
DOOR	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■
LOADS	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■	■■■■■

Figure 4-1-1. Basic Cycle Graph (#1)





CYCLE PHASE	P		S		PUR		CON		STERILIZE		E		DRY		VACUUM		COM		R		O	
	INI	R	PUR	CON	STERILIZE	E	DRY	VACUUM	COM	R	O	INI	R	PUR	CON	STERILIZE	E	DRY	VACUUM	COM	R	O
MESSAGE CENTER																						
SV1 (steam to cham)																						
SV2 (fast exhaust)																						
SV3 (filtered air)																						
SV4 (drain cooling)																						
SV5 (vacuum water)																						
SV6 (steam to jacket)																						
SV7 (boiler water supply)																						
STEAM GENERATOR																						
PRINTER																						
BUZZER																						
DOOR																						
LOADS																						

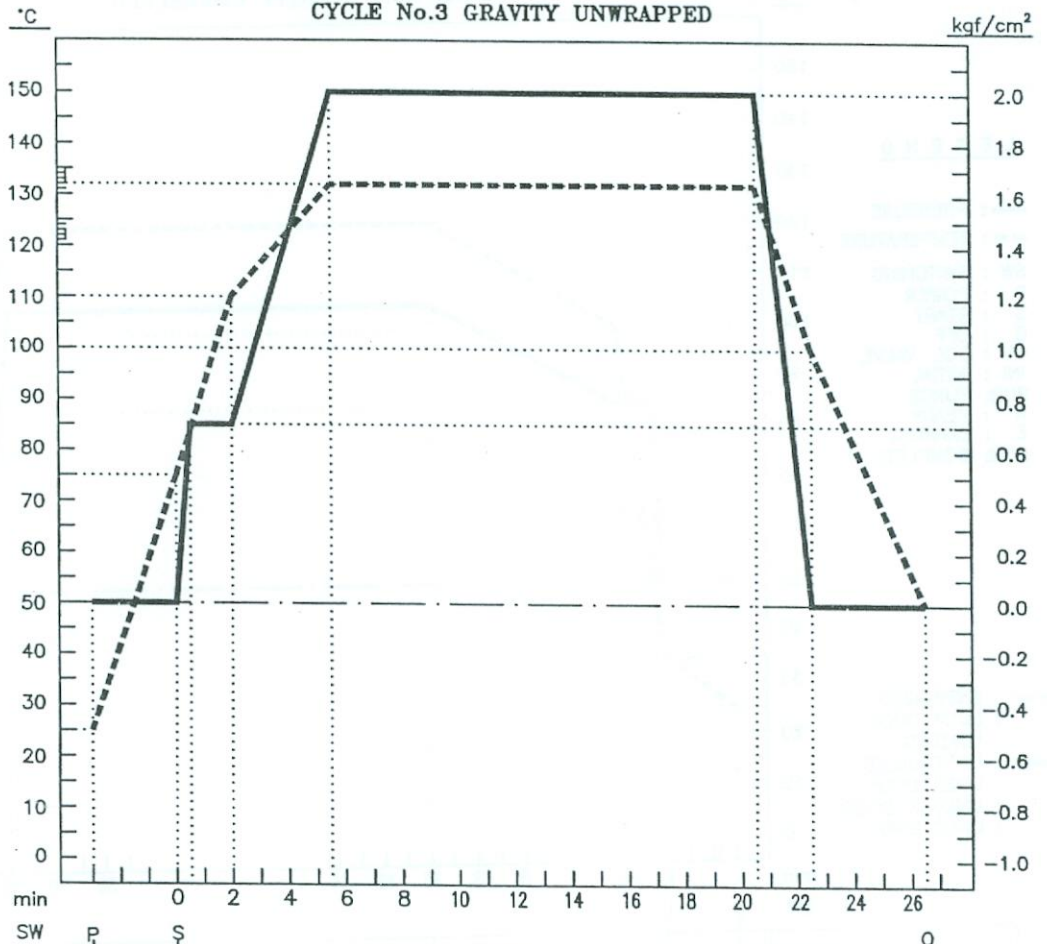
Figure 4-1-2. Basic Cycle Graph (#2)

# CYCLE No.3 GRAVITY UNWRAPPED

## LEGEND

— : PRESSURE  
 - - : TEMPERATURE  
 SW : SWITCHING  
 P : POWER  
 S : START  
 O : OFF  
 SV : SOL. VALVE  
 INI : INITIAL  
 RE : READY  
 PUR : PURGE  
 EX : EXHAUST  
 COM : COMPLETE

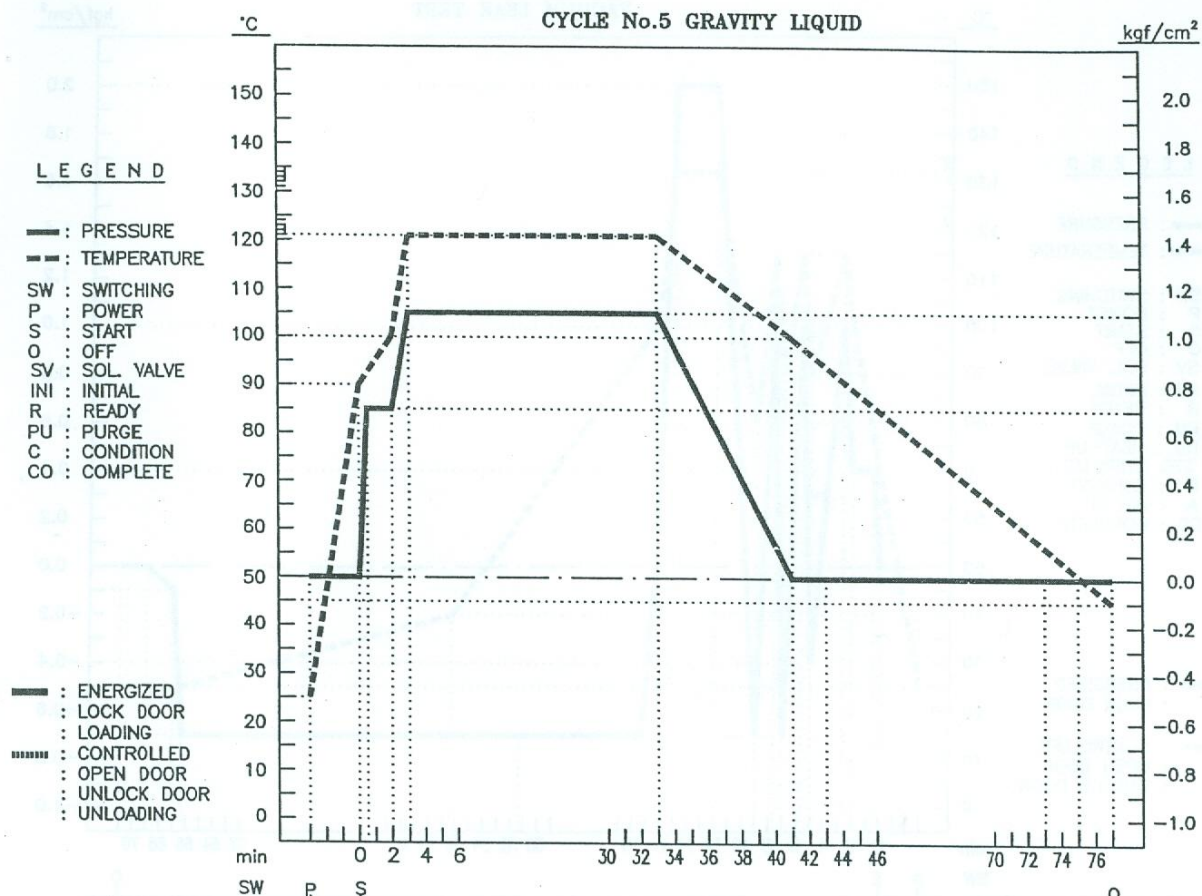
— : ENERGIZED  
 : LOCK DOOR  
 : LOADING  
 : CONTROLLED  
 : OPEN DOOR  
 : UNLOCK DOOR  
 : UNLOADING



CYCLE PHASE	INI	RE	PUR	CONDITION	STERILIZE	EX	COM	RE
MESSAGE CENTER	ENERGIZED	ENERGIZED	ENERGIZED	ENERGIZED	ENERGIZED	ENERGIZED	ENERGIZED	ENERGIZED
SV1 (steam to cham)	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
SV2 (fast exhaust)	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
SV3 (filtered air)	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
SV4 (drain cooling)	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
SV5 (vacuum water)	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
SV6 (steam to jacket)	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
SV7 (boiler water supply)	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
STEAM GENERATOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
PRINTER	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
BUZZER	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR
LOADS	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR	LOCK DOOR

Figure 4-1-3. Basic Cycle Graph (#3)





CYCLE PHASE	SW	P	S	INI	R	PU	C	STERILIZE	EXHAUST	CO	COOLING	INI	R	O
MESSAGE CENTER														
SV1 (steam to cham)														
SV2 (fast exhaust)														
SV3 (filtered air)														
SV4 (drain cooling)														
SV5 (vacuum water)														
SV6 (steam to jacket)														
SV7 (boiler water supply)														
STEAM GENERATOR														
PRINTER														
BUZZER														
DOOR														
LOADS														

Figure 4-1-5. Basic Cycle Graph (#5)

## 6. MAINTENANCE

### 6.1 CHAMBER

- (1) Clean daily and as frequently as necessary. Spills must be cleaned immediately to prevent accumulation and consequent staining and coagulation. Wash all interior surfaces with a mild detergent solution followed by a through rinsing with plain water. Clean the shelves in the same manner.
- (2) It is recommended that the chamber be inspected daily for broken glassware, stoppers, etc., and any debris removed before operating the equipment. The chamber drain screen should be lifted out, inspected and cleaned prior to heating the unit.
- (3) After sterilizing liquids, wipe the chamber as soon as the sterilizer is cooled.
- (4) Weekly, lift out the chamber drain screen insert a suitable funnel into the drain opening and pour in one liter of hot trisodium phosphate solution (containing about 28 gram of trisodium phosphate) follow this step by flushing the line with one liter of hot tap water.

### 6.2 DOOR GASKET

The gasket should be inserted into the groove on the inside of door plate accurately because it is very important device so as to keep airtightness of the chamber. In order to maintain the original elasticity, the gasket should be checked and cleaned daily. The defective gasket should be removed with a suitable tool promptly and clean the gasket groove up. Spread the greaselike silicone rubber into the gasket groove and then insert a new gasket. The gasket shall be put evenly without strain or contraction partially.

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