



# Autoclave Operation & Safety

Jason Hartman, Phillips Enterprises Inc.



# Learning objectives

- ▶ Understand what steam sterilization is
- ▶ Learn what types of cycles are available to use on CCOM autoclaves
- ▶ Understand which cycle fits the needs of the load you are going to sterilize
- ▶ Learn and use all safety precautions associated with steam sterilizers
- ▶ Learn the basic autoclave use procedures for CCOM sterilizers



# Principles of steam sterilization

▶The basic principle of steam sterilization, as accomplished in an autoclave, is to expose each item to direct steam contact at the required temperature and pressure for the specified time. Thus, there are four parameters of steam sterilization: steam, pressure, temperature, and time.



# CCOM autoclave cycles

- ▶ The CCOM autoclaves available for your use are all gravity displacement autoclaves
- ▶ On these units there are 3 cycles you may choose from:
  - ▶ Gravity and Dry
  - ▶ Gravity and No Dry
  - ▶ Liquid



# Gravity Cycles

- ▶The traditional “Gravity Cycle” is the most common and simplest steam sterilization cycle. During a Gravity Cycle, steam is pumped into a chamber containing ambient air. Because steam has a lower density than air, it rises to the top of the chamber and eventually displaces all the air. As steam fills the chamber, the air is forced out through a drain vent. By pushing the air out, the steam is able to directly contact the load and begin to sterilize it.
- ▶At the end of the cycle, the steam is discharged through the drain vent. However, the load can still be hot and possibly wet. To address this issue, you may select the gravity and dry function. After complete sterilization, filtered air is introduced into the chamber allowing the load to cool and dry for the time selected.



# Gravity Cycles

▶ Gravity Cycles are commonly used on loads like glassware, bio-hazardous waste (red bag waste), vented containers, and certain types of unwrapped instruments.



# Liquid Cycles

- ▶ Just about every lab must sterilize some type of liquid solution, such as lysogeny broth (otherwise known as LB Broth), media, agar, buffer, saline, and water. And as such, sterilization of a liquid in a vented container requires a special type and the proper application of a cycle known as the Liquids Cycle.
- ▶ Liquids rely on the Liquids Cycle to avoid a phenomenon known as “boil-over.” Boil-over is simply a liquid boiling so violently that it spills over the top of its container. Boil-over will occur if the pressure in your autoclave chamber is released too quickly during the exhaust phase of the cycle. Significant liquid volume can be lost to boil-over, and this can result in unwanted spills on the bottom of your chamber and subsequent cleanup.

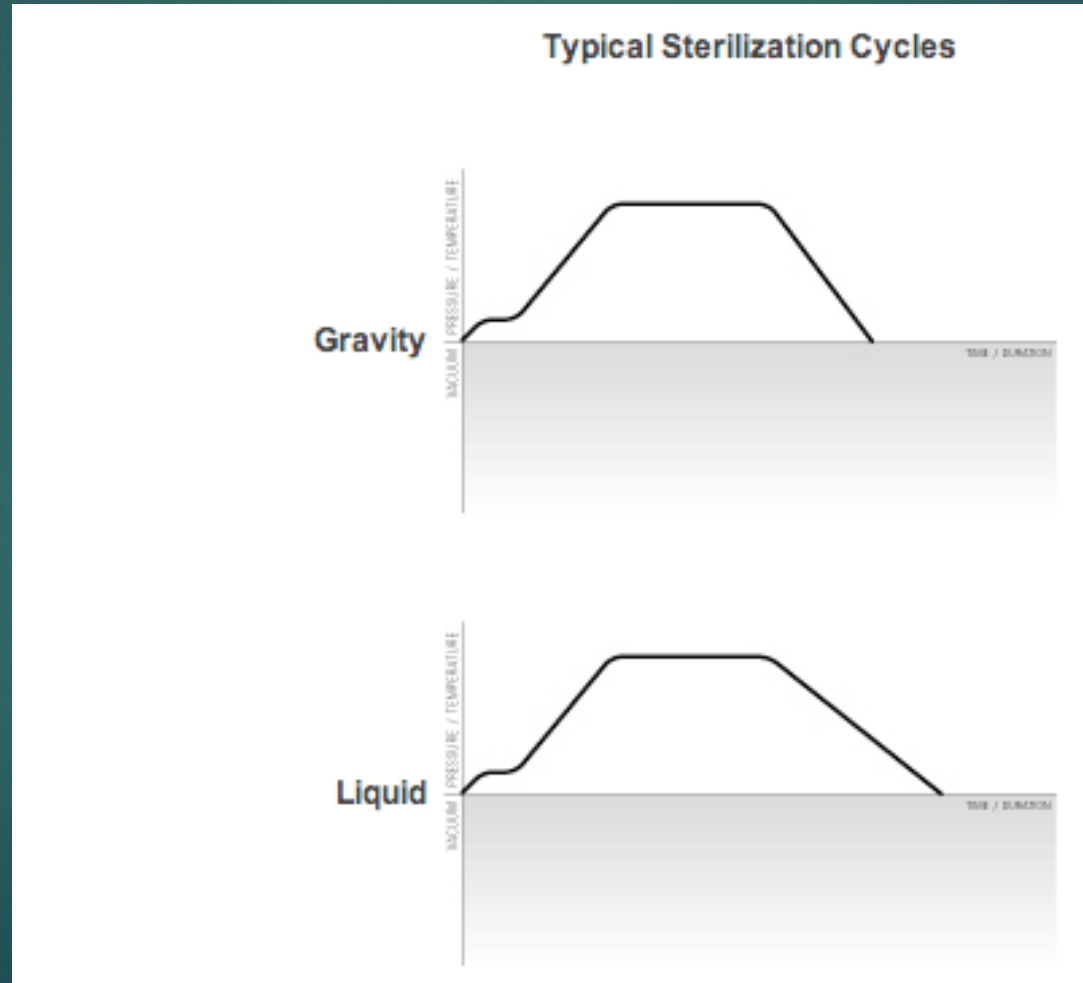


# Liquid Cycles

- ▶ To help prevent boil-over during the exhaust phase, the chamber pressure must be released slowly. This process is controlled by the sterilizer's control system. Controlling the exhaust rate allows the liquid load to cool off as the surrounding chamber pressure is decreased.
- ▶ It is important to recognize that larger liquid loads will take longer to both heat up and cool down. You should keep this in mind, especially for large beakers or carboys. For instance, a 30-minute Liquids Cycle for a 500mL flask won't necessarily achieve the same results if sterilizing a 5 L flask.



# Gravity & Liquid Cycles





# Safety

- ▶ Prevent injuries by:

- ▶ Wearing appropriate Personal Protective Equipment (PPE) including a lab coat, heat resistant gloves, closed toed shoes and eye protection, especially when unloading the autoclave.
- ▶ Never sealing containers; under pressure they pose an explosion risk.
- ▶ Never opening the door to the autoclave if there is water running out the bottom. Clogged steam lines, equipment malfunction, or plugged drains may cause a buildup of scalding water.
- ▶ Waiting for the pressure to reach zero and the temperature is at or below 121°C before opening the door at the end of a cycle to avoid steam burns and shattered glassware. Do not stand directly in front of the door.



# Safety

▶ Allow materials inside the autoclave to cool for at least 10 minutes with the door open before unloading the autoclave. Removing contents too soon may cause heat stress and fracturing of materials, especially glass.



# Safety

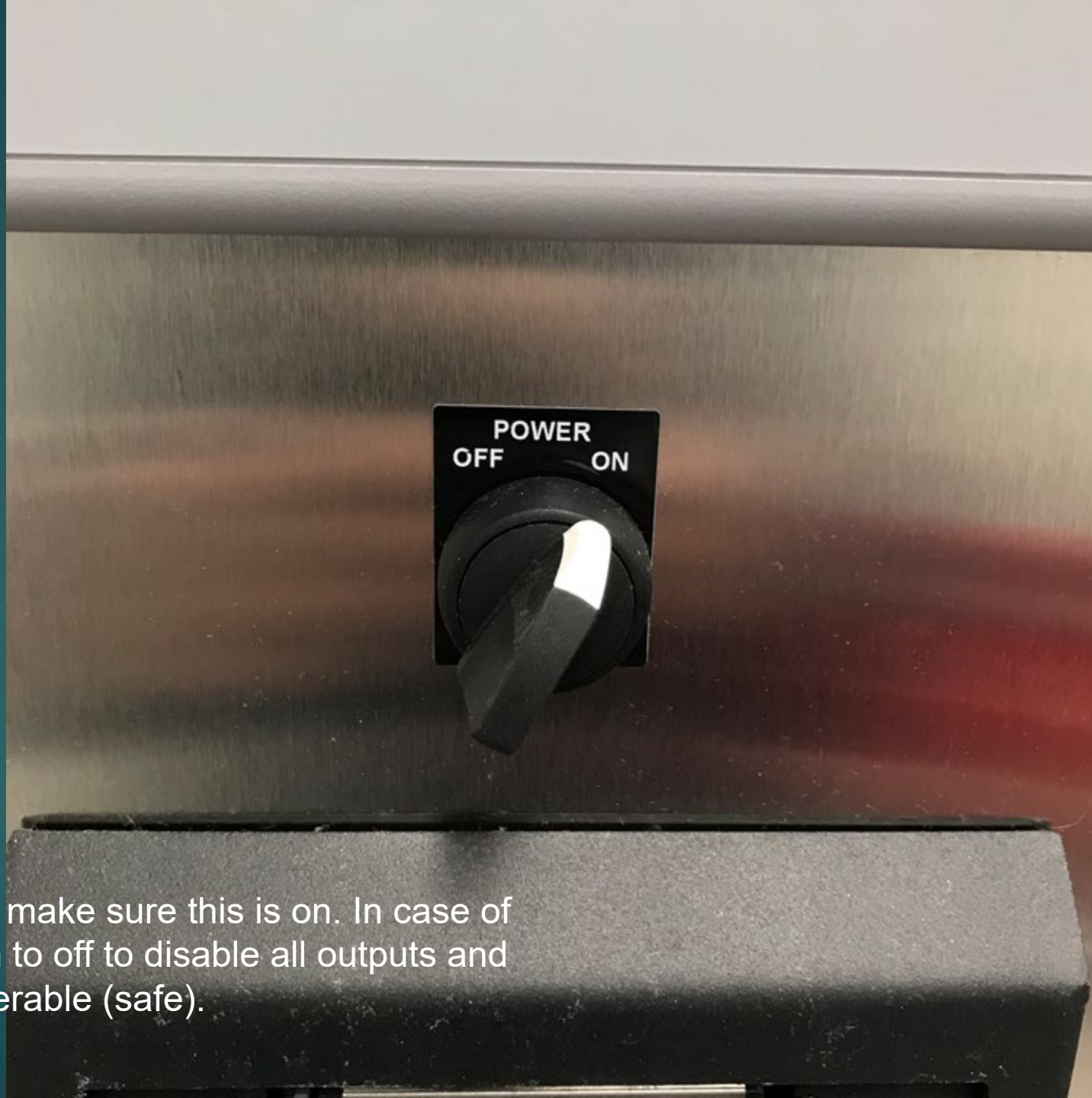
- ▶ In the event of a steam leak:
  - ▶ If you can approach the machine without injury:
    - ▶ Turn the main power switch off or press ABORT
    - ▶ Allow the chamber pressure to drop to zero
    - ▶ Open the door, re-close it and tighten it further and try again
  - ▶ If its too hot/ no visibility or otherwise unsafe to approach the unit:
    - ▶ Close the door to the autoclave room
    - ▶ Call CCOM Facilities (335-8061)
    - ▶ Wait for the fire department and/or facilities



# Autoclave use procedures

- ▶ Turn main power switch on
- ▶ Swipe access card
- ▶ Press jacket ON button to allow unit to warm up
- ▶ Load chamber
- ▶ Close the door and ensure tightness
  - ▶ For the crank handled doors, tighten until snug and then half a turn more.
- ▶ Select cycle
- ▶ Select time
- ▶ Press start
- ▶ **Watch unit for 30 seconds to ensure no steam is leaking from door**





Main Power Switch – make sure this is on. In case of leaks, turn this switch to off to disable all outputs and makes machine inoperable (safe).



Allen-Bradley

PanelView Plus 1000

**C**  
**SS** **CONSOLIDATED**  
**STERILIZER SYSTEMS** PH: 1-617-782-6072  
www.consteril.com

DATE / TIME: DATE:11/6/2017 TIME:02:13:40PM

PREPARED FOR: UNIVERSITY OF IOWA

STERILIZER SER. NO.: 111213

STERILIZER TYPE: SSR-3A-ADVPRO

PLEASE SWIPE CARD TO ACCESS MENU

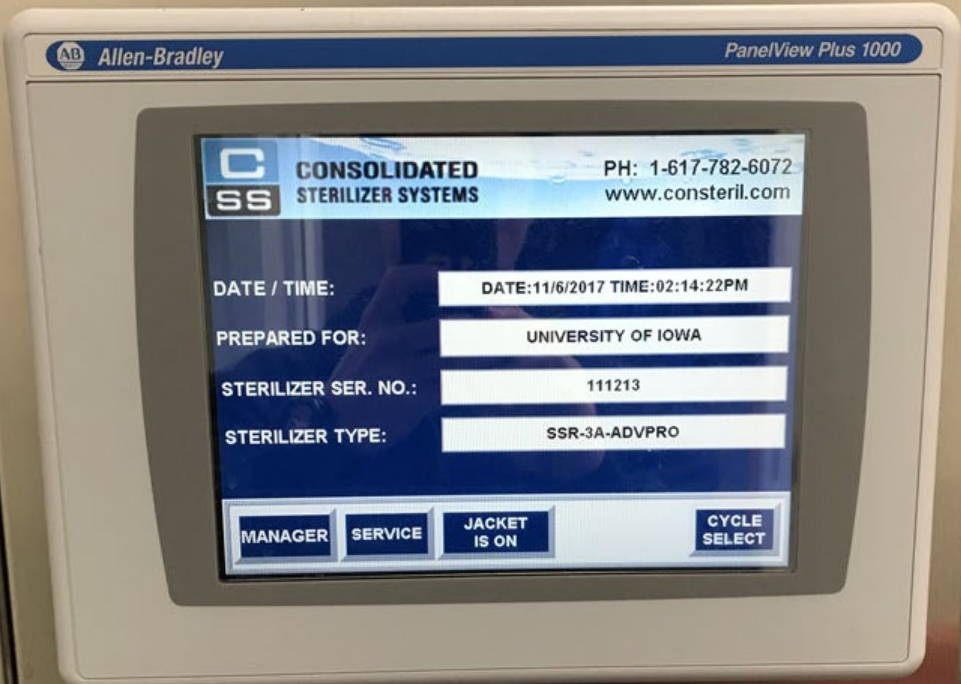
Standby screen. This screen requires the user to scan their badge in order to run a cycle.











Standby screen after a badge is scanned. (You'll now see buttons on the bottom of the display screen.)





The door of a Consolidated autoclave in the open position.  
Note the retracted “bars” along the edges of the door.



The door of a Consolidated autoclave in a closed position. Tighten handle to “snug”. Add another partial turn for a full seal. The bars should now be extended into the frame to secure the door for safe operation.





Allen-Bradley

PanelView Plus 1000

CHAMBER TEMP. 134.2 °F	CHAMBER PRESSURE 0.0 PSI	JACKET TEMP. 251.9 °F
---------------------------	-----------------------------	--------------------------

GRAVITY  
VACUUM

LIQUIDS

THIS DOOR IS CLOSED

MANAGER SERVICE JACKET IS ON

SS

POWER  
OFF ON

Choose a load cycle.

FEED  
REPRINT



CHAMBER TEMP.  
134.3 °F

CHAMBER PRESSURE  
0.0 PSI

JACKET TEMP.  
251.7 °F

**GRAVITY CYCLES**

CYCLE NAME	CHAMB. TEMP	STERIL. TIME	DRY TIME	SELECT CYCLE
GRAVITY 1	250.0 °F	20 MIN	15 MIN	SELECT
GRAVITY 2	250.0 °F	40 MIN	40 MIN	SELECT
GRAVITY 3	250.0 °F	3 MIN	1 MIN	SELECT

THIS DOOR IS CLOSED

CYCLE  
SELECT MENU



Advanced cycle selection for customization to your needs.



CHAMBER TEMP.  
134.2 °F

JACKET TEMP.  
251.4 °F

20

0 ~ 299

- CYCLE  
NAME
- GRAVITY 1
  - GRAVITY 2
  - GRAVITY 3

7	8	9
4	5	6
1	2	3
.	0	-
ESC	←	↵

- Y  
E
- SELECT  
CYCLE
- MIN SELECT
  - MIN SELECT
  - MIN SELECT

THIS DOOR IS CLOSED

CYCLE  
SELECT MENU

C SS

This screen appears when selecting times or temperature.  
Select the desired number and press enter.



CONTINUE WITH THIS CYCLE?

GRAVITY

CYCLE NAME

GRAVITY 3

CYCLE TEMP

250.0 °F

STERILIZE TIME

3 MIN

DRY TIME

1 MIN

THIS DOOR IS CLOSED

YES

NO

PREVIOUS



Confirm parameters are correct.



CHAMBER TEMP. 134.3 °F	CHAMBER PRESSURE 0.1 PSI	JACKET TEMP. 252.9 °F
<b>GRAVITY CYCLE RUN</b>		
250.0 °F CYCLE TEMP	615 CYCLE - COUNT	GRAVITY 3 CYCLE NAME
3 MIN STERILIZE TIME		1 MIN DRY TIME
THIS DOOR IS CLOSED		
ABORT		

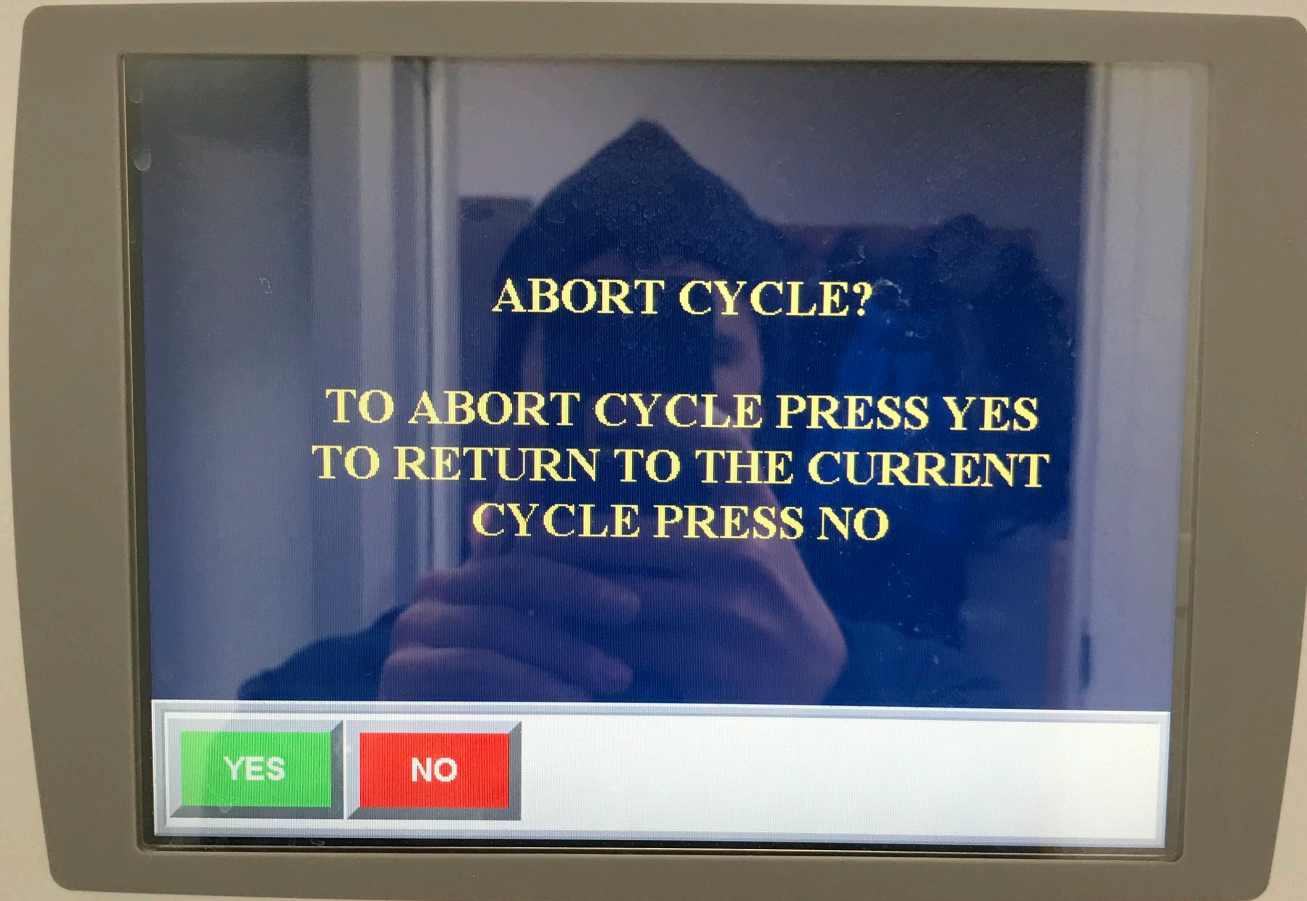
This screen displays while a cycle is running.



<b>CHAMBER TEMP.</b> 149.1 °F	<b>CHAMBER PRESSURE</b> 6.6 PSI	<b>JACKET TEMP.</b> 252.6 °F
<b>GRAVITY CYCLE RUN</b>		
250.0 °F CYCLE TEMP	615 CYCLE - COUNT	GRAVITY 3 CYCLE NAME
3 MIN STERILIZE TIME	REMAINING PHASE TIME <b>0:56</b>	1 MIN DRY TIME
CONDITIONING		
THIS DOOR IS CLOSED		
<b>ABORT</b>		

The remaining phase time is displayed in the center. The abort button is in the lower left corner.





If a user decides to abort a cycle, this is the confirmation screen.





Aborting cycle confirmation.



Once the chamber pressure has reached zero, you can open the door. Attempts to open the door before the pressure has sufficiently decreased will result in the safety mechanisms to engage and the door will be “locked down”. To release the safety mechanisms, tighten the door slightly. The user should hear an audible “clanking” sound before proceeding to open the door normally.

**\*\*ABORT COMPLETE\*\***

0.4 PSI

**CYCLE HAS BEEN ABORTED.  
PLEASE OPEN DOOR.**

**THIS DOOR IS CLOSED**



# Sources

- ▶ Consolidated Stills & Sterilizers
- ▶ CDC
- ▶ University of Stanford EHS: Autoclave Safety

# Disclaimer

This presentation was written and assembled by Jason Hartman, Phillips Enterprises Inc. Please do not alter this presentation in any way without the expressed consent of Phillips Enterprises Inc.