



**2017** **ASBC Annual Meeting**  
June 4-7 ■ Fort Myers, Florida  
*See what SCIENCE can brew for you*



**Quality**  
Jamie Wenham  
Sierra Nevada Brewing Co.

# About Me

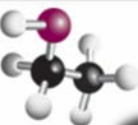
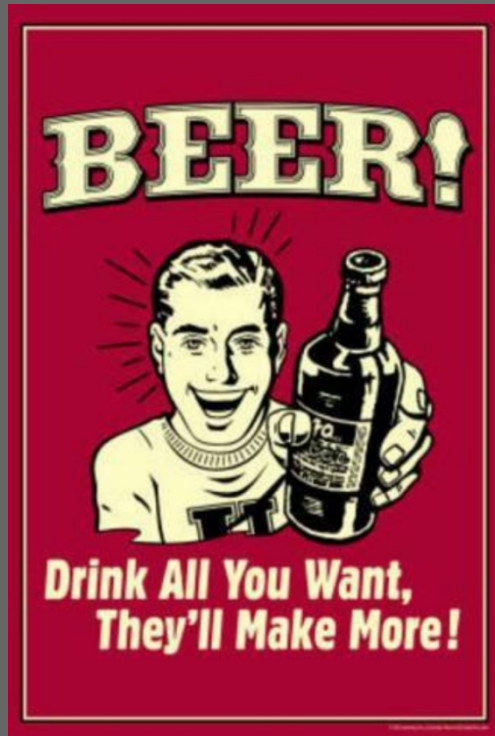
B.S. Professional Chemistry from CSU Chico

Analytical Quality Technician for two years at SNBCo.

Analytical Quality Supervisor at SNBC for the past two years

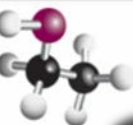
# What is Quality?

- To a consumer:
- Consistent Product that is drinkable...
- To an employee at Sierra Nevada:
- Product meeting certain specifications in various analyses
- Flavor Stability
- Meeting Consumers expectations



# Quality Control vs Quality Assurance

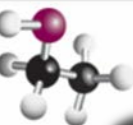
- What is the difference between Quality Control (QC) and Quality Assurance (QA)?
  - QC involves testing a product to verify it is within certain specifications and detecting any defects. QC is a reactionary or corrective process.
  - QA involves testing current processes/ standards/ procedures to verify the testing we are conducting is the correct way to do it. We have a certain level of confidence to the results we are producing. QA is a planned preventive process.



# Quality Control

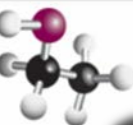
- Quality Control includes the routine analyses or checks on beer production for example:
  - Bitterness Units
  - Alcohol
  - Extract
  - CO<sub>2</sub>
  - DO

Although product not within specifications can still be corrected before the package, these tests are done on something that has already happened and are considered quality control measurements



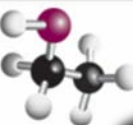
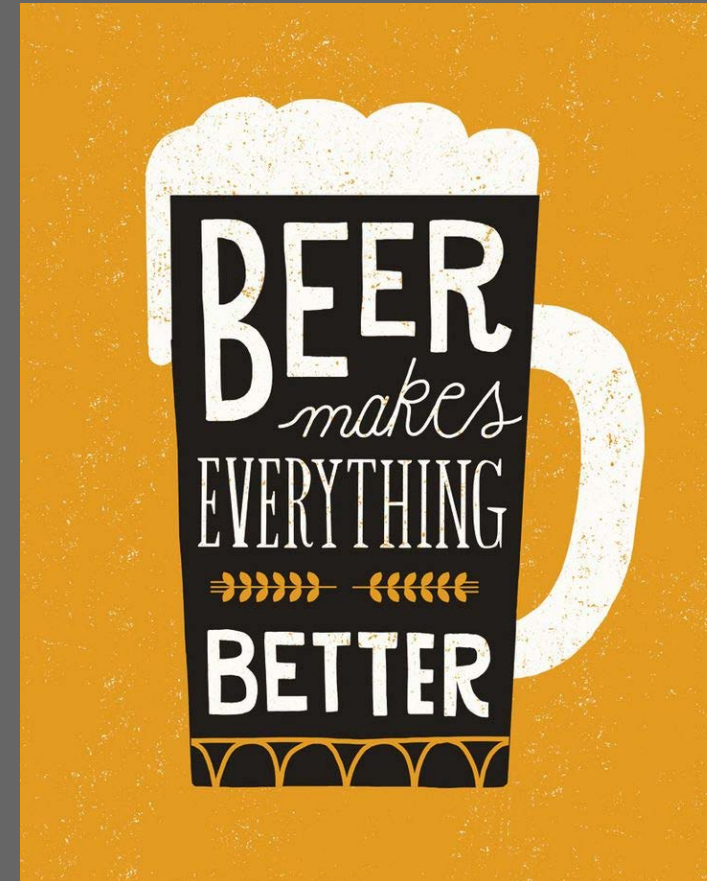
# Quality Assurance

- Quality Assurance starts before production begins.
  - For the lab, we need to determine what equipment or processes we need in order to keep our product within set specifications.
    - Preventative and scheduled maintenance
    - Calibration of equipment
    - Audits
    - SOP's



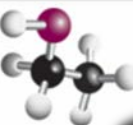
# Topics Covered

- Analytical, Packaging and Microbiology Analyses
- Audits
- Sierra Nevada's QC Beer Program
- SPC Charts
- Standard Operating Procedures



# Analytical Quality Analyses

- Sierra Nevada's Analytical Quality Lab analyses include:
  - Using an Anton Paar Alcolyzer/  
DMA 5000
  - Using a UV-VIS Spectrophotometer for Bitterness Units and Color

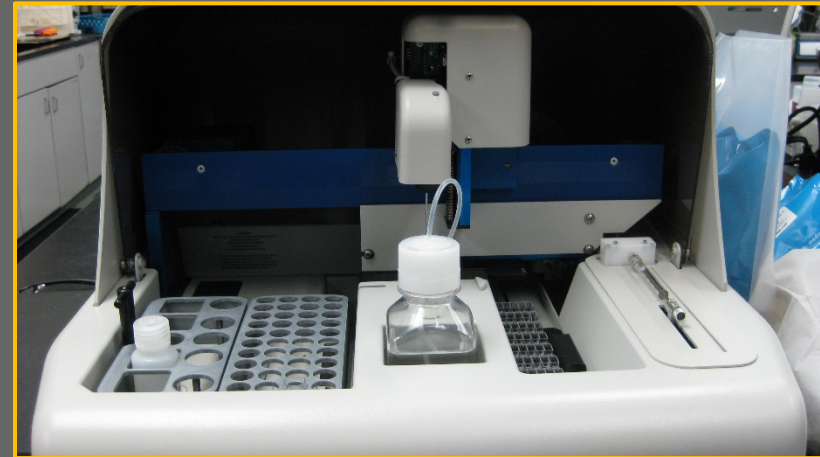




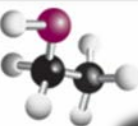
# Analytical Quality Analyses



- Discrete Analyzer
  - SO<sub>2</sub> and Acetaldehyde

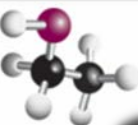


- GC-MS
  - Vicinal Diketones
  - Every Lager Fermentation Tank is measured for VDK and SO<sub>2</sub> before package



# Packaging Quality Analyses

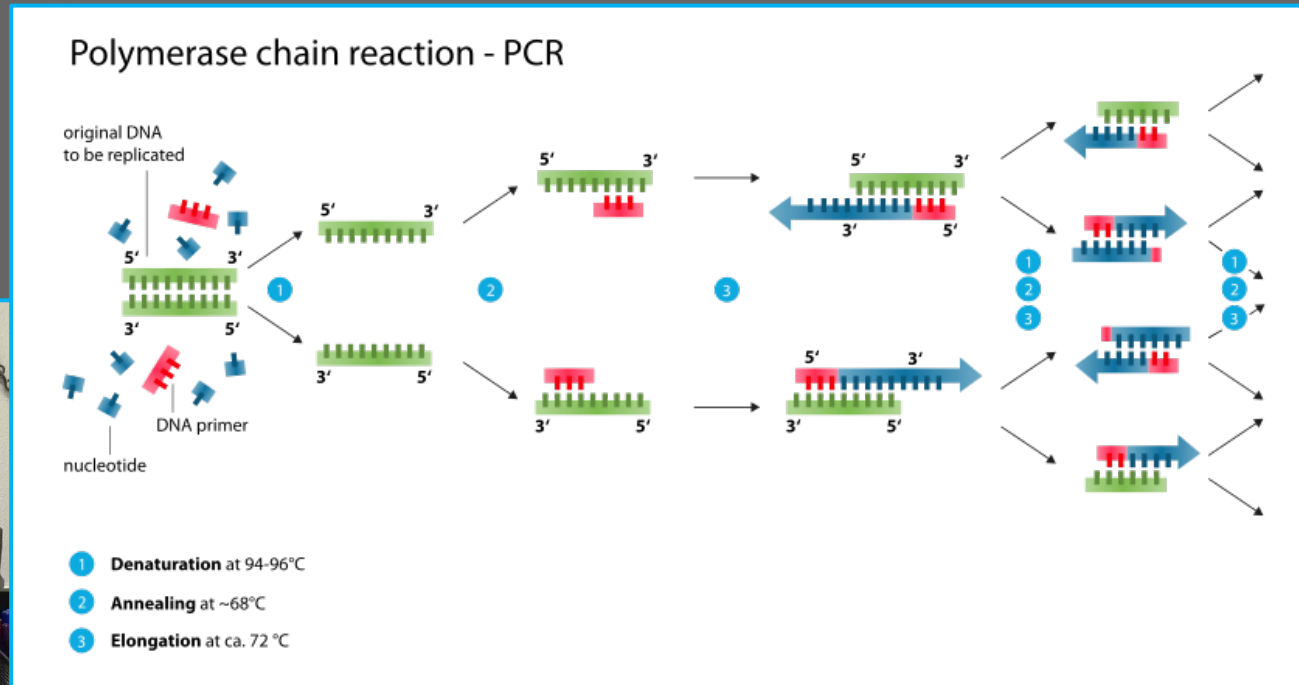
- Sierra Nevada's Packaging Lab analyses includes:
  - CO<sub>2</sub>, DO, TPO using an Orbisphere 3625 and Hach 6610
  - Seam and crimper checks
  - Secure Seal Tests (SST)
  - ABV, Extract and pH



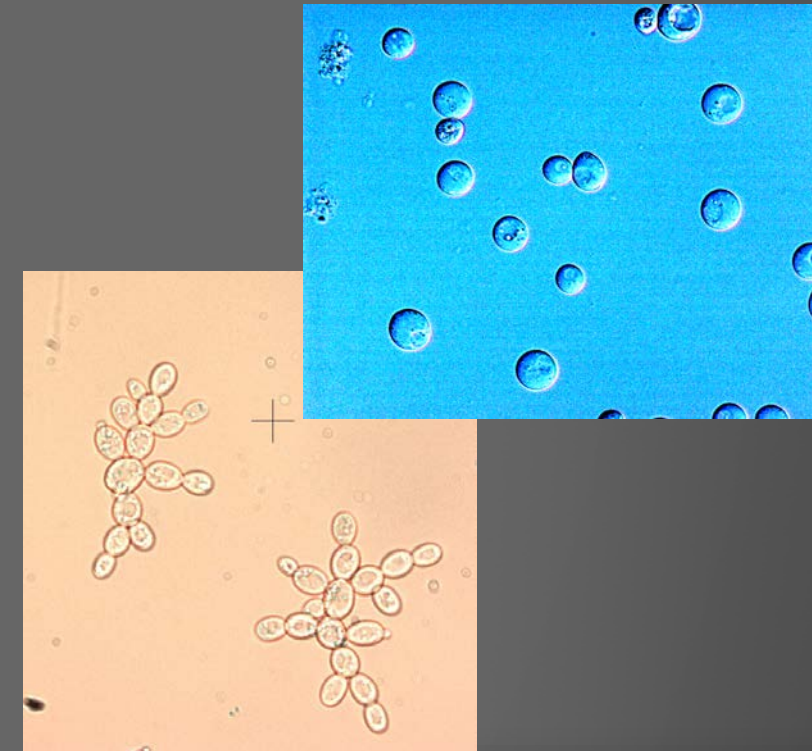
# Microbiology Quality Analyses

Sierra Nevada's Micro Lab follows wort all the way through to packaging, methods/ Instrumentation include:

## Polymerase Chain Reaction (PCR)



## Microscopy

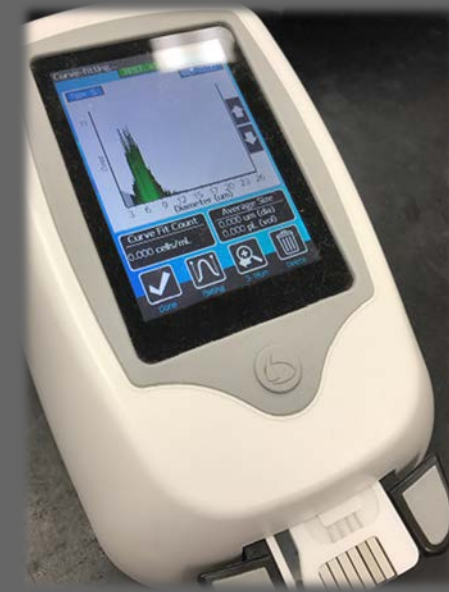


# Microbiology Quality Analyses

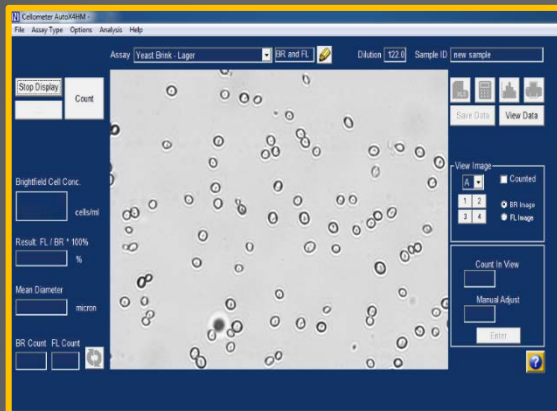
- Membrane Filtration



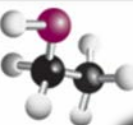
- Bright Beer Tank Cell Counts



- Yeast Brink Cell Counts



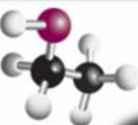
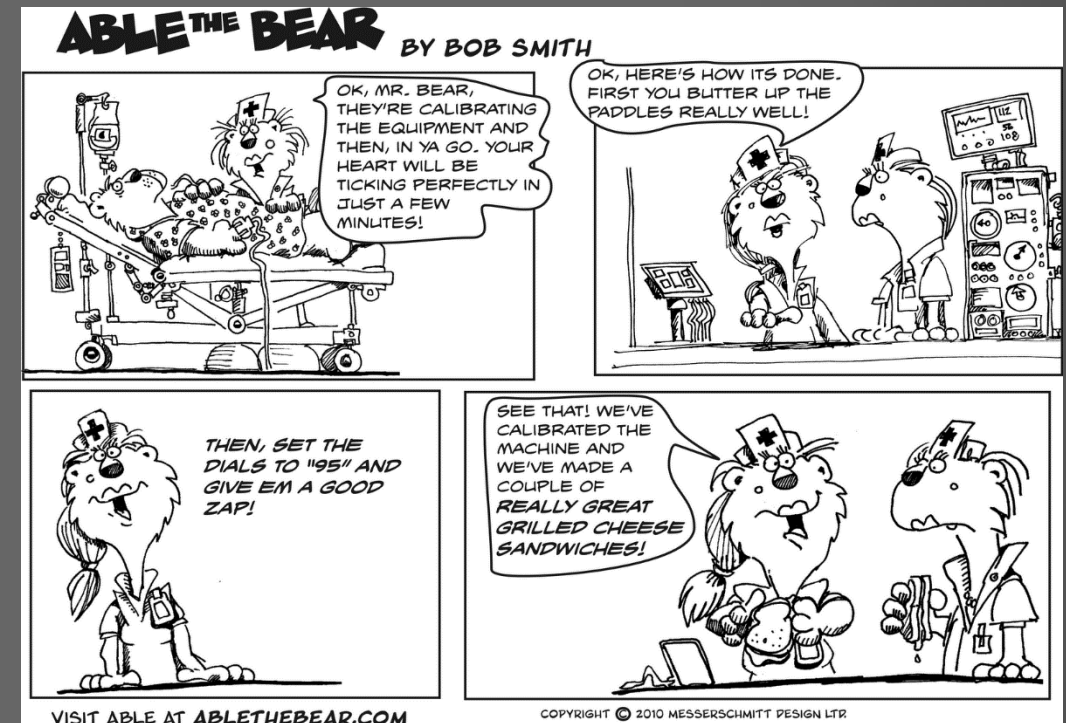
- Propagations



# Instrument Calibrations

Sierra Nevada's QA Labs have quite a few instruments that require regular calibration. Why is it important to calibrate these instruments?

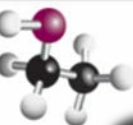
- Maintains Instrument Accuracy
- Minimizes error with values between calibration points



# Instrument Calibrations

Different instruments call for different calibration timelines for example:

- GC-MS: Once a week
- pH Meter: Once a day
- Anton Paar AlcoLyzer/DMA: Once to twice a week  
depending on water check drift
- UV-VIS: Once a month



# Documentation

It is very important to document when instruments were calibrated. Here are a couple of examples:

- Anton Paar AlcoLyzer

- pH Meter

pH CALIBRATION LOG

DATE	CALIBRATED	NEW SOAKING SOLUTION	PROBE TOPPED OFF	BUFFER CHANGED	SLOPE	INITIALS	COMMENTS
4/20	Y	Y	Y	Y	99.7	JMC	
4/21	Y	Y	Y	Y	99.8	JMC	
4/22	Y	Y	Y	Y	100.0	JP	
4/23	Y	Y	Y	Y	100.0	Seth	
4/24	Y	Y	Y	Y	99.8	JMC	
4/25	Y	Y	Y	Y	99.7	JMC	
4/26	Y	Y	Y	Y	99.7	JMC	
4/27	Y	Y	Y	Y	99.7	JMC	
4/28	Y	Y	Y	Y	99.7	JMC	

Daily Density Check

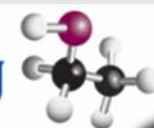
Density of H<sub>2</sub>O should be: 0.998203 +/- 0.00005 or between (0.998153 to 0.998253)  
Recalibrate if density deviation is 0.00005 or greater

Date	Squishy-Squishy? Y or N	Density Check # (ie. 0.00005)	Density of double di H <sub>2</sub> O	Std Value	Alcohol Reading	
					AlcoLyzer alc	DMA alc
4/30	N	0.000008	0.998211	997	992	9.915
5/1	N	0.000009	0.998212	997	992	9.924
5/2	N	0.000018	0.998221	997	995	9.952

# Documentation

- This is an example of a Sign-in sheet we use for all yeast harvests. Each harvest is analyzed at least twice before being used in brewing.
- Data is not only written on this log but entered into a database for traceability purposes.

B	F	New Yeast Code brink/date/tank/gen/brand	Taken by	Time brought to Lab	Ck. Date	Count x 10 <sup>9</sup>	% Dead	pH	Comr
X	X	02W05131781908A PAL	WD	4 AM	5/16	1.43	3.9	4.68	
X	X	04W05161781608A PAL	DB	7:20A	5/16	1.27	2.4	4.43	
X	X	04W05161781608A PAL	WD	4 AM	5/17	1.52	3.1	4.60	Rev 1.5L
X	X	03W05191782109A PAL	DB	7:30A	5/19	1.44	2	4.43	
X	X	02W05211782609A PAL	JMC	6:25	5-21	1.35	3.8	4.42	
X	X	02W05211782609A PAL	PA	3:53A	5/22	1.47	4.3	4.51	Rev 1.5
X	X	09E.052217.534.01A.OKT		7:15A	5/22	1.14	3.4	4.33	rev pH
X	X	06W05221780409A PAL	DB	8:15A	5/22	1.37	3.2	4.47	
X	X	02W05211782609A PAL	PA	4:08A	5/23	1.46	3.9	4.61	
X	X	01W05231783209A PAL	SE	12:17p	5/23	1.36	3.2	4.20	
X	X	01W05231783209A PAL	PA	4:05A	5/24	1.38	3.8	4.48	
X	X	04W03241781409A PAL	DB	7:40A	5/24	1.43	3.1	4.37	



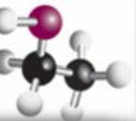




# How do we keep brands consistent with multiple facilities?



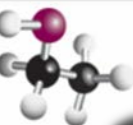
2017 ASBC Meeting



# SOP's

Standard Operating Procedures (SOP's) are crucial when the same instrument or procedure are used at different facilities

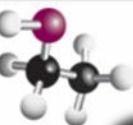
- Helps maintain alignment between labs
- Helps to reduce errors or variability between technicians or facilities
- Increases efficiency by keeping technicians up-to-date on current procedures



# Audits!

Auditing processes fall under Quality Assurance and a couple reasons why are:

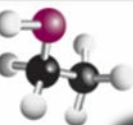
- Ensures the lab is generating data of integrity and quality
- Ensures the lab is following good laboratory practices (GLP)
- Will help to determine when it is time to calibrate an instrument



# Analytical Audits

Analytical lab audits include:

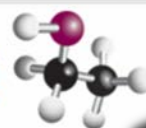
- Brewhouse Inline Gravity Meter- Weekly
- Filtration Color Meter- Weekly
- Brewhouse Dissolved Oxygen Meter- Monthly
- Brewery-wide pH probes- Monthly
- Hand Held DMA's- Quarterly



# Packaging Audits

The Packaging Lab Audits include:

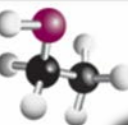
- CO2 audits on Orbisphere 3625 and Hach 6110
- Oxygen Sensor audit on Orbisphere Hach 6110- Weekly
- Anton Paar Carbo QC audit- Monthly
- Rinser Survey/Audit- Quarterly



# Packaging Audits

## Bottle Bursts

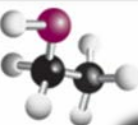
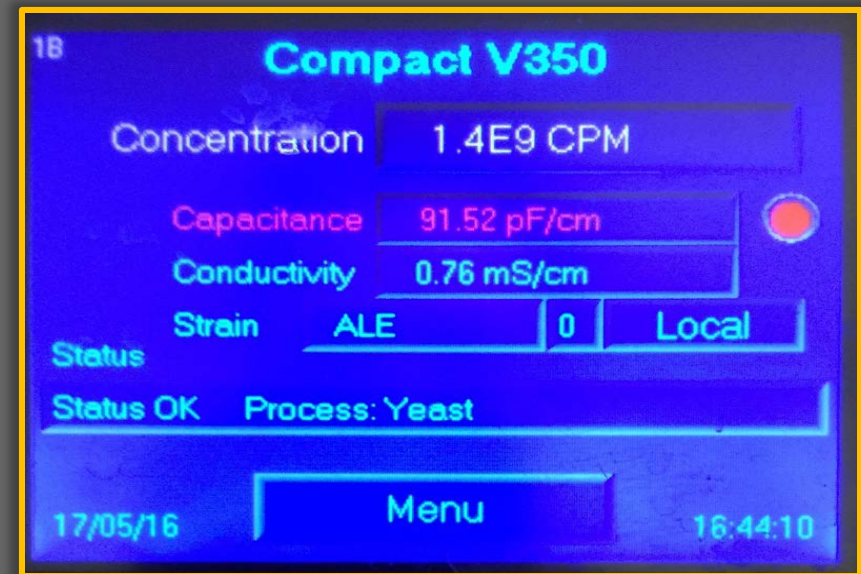
- First Revolution
- Second Revolution
- Third Revolution



# Microbiology Audits

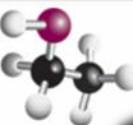
The Micro Lab audits include:

- Inline Aber on ale yeast- monthly
- Wort- weekly
- Lightning swabbing- daily
- Swabbing can and glass line- weekly
- Water tanks- weekly



# Water Quality

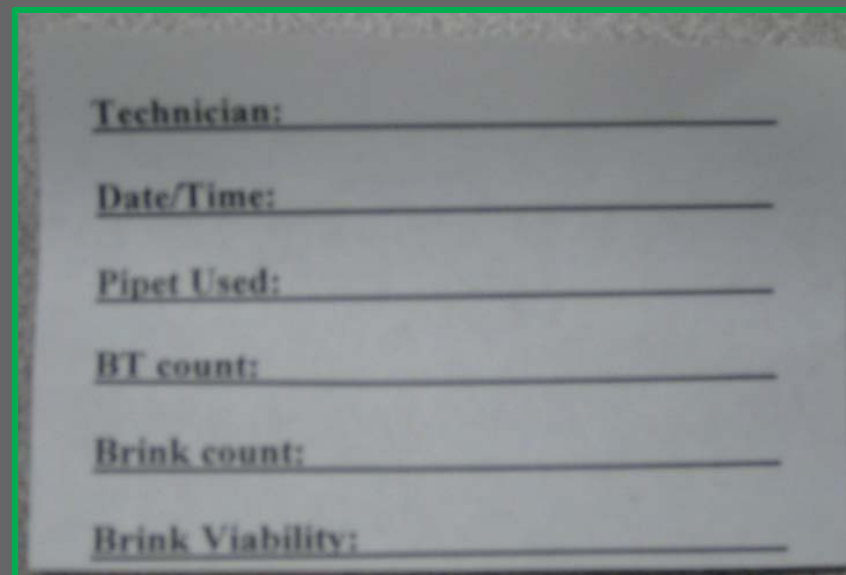
- Our brewing water must go through a few processes before being used:
- A 5  $\mu\text{m}$  sediment filter to take out any solids
- Water is then sent through Ultra-Violet light to be sterilized and some chlorine is stripped.
- Next, water is sent through a Carbon filter to take out any Chlorine compounds left along with VOC's
- The water is then acidified for brewing using food grade phosphoric acid.





# Internal Performance Audit

- Every Quarter the micro lab conducts an audit on all technicians that perform yeast cell counts on brinks, Bright Beer Tanks, and packages
- Our goal is to have all technicians within a 10% deviation.



Technician: \_\_\_\_\_

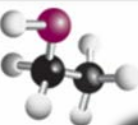
Date/Time: \_\_\_\_\_

Pipet Used: \_\_\_\_\_

BT count: \_\_\_\_\_

Brink count: \_\_\_\_\_

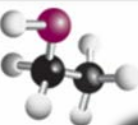
Brink Viability: \_\_\_\_\_



# QC Beer Audit Program

Sierra Nevada has an internal check sample that is measured each day before production samples are measured

- Same beer is used between both breweries
  - Tested on Anton Paar Alcolyzer/DMA for ABV and Extract
  - Tested on UV-VIS for Bitterness Units and Color
  - Tested on pH meter
  - Tested on Orbisphere 3625 and Hach 6110 for CO<sub>2</sub>
- 
- Measured by TTB Certified Third Party Lab



# Specifications

## Specs

Brand

Department

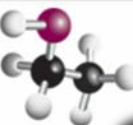
Search Spec Description

EHA

<ALL>

Export

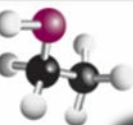
BRANDID	Department	SpecDesc	Low	Target	High	L Update
EHA	Brewhouse	East Last Runnings	3.2	3.7	4.5	
EHA	Brewhouse	First Runnings	18.5	20	21.5	
EHA	Brewhouse	Last Runnings	3.2	3.7	4.5	
EHA	Brewhouse	Mash pH	5.3	5.38	5.46	
EHA	Brewhouse	OG	16.4	16.6	16.8	
EHA	Brewhouse	pH Last Runnings	5.25	5.5	5.75	
EHA	Brewhouse	Wort BU	81	85	88	
EHA	Brewhouse	Wort Color	20	22	24	
EHA	Brewhouse	Wort pH	5.08	5.14	5.2	
EHA	Fermentation	Alcohol	6.5	6.7	6.9	2016-01-05
EHA	Fermentation	BU	62	67	72	
EHA	Fermentation	CO2	2.65	2.7	2.75	
EHA	Fermentation	Color	22	24	26	
EHA	Fermentation	Day 13 CO2	2.6	2.65	2.7	
EHA	Fermentation	Day 5 BU	62	67	72	
EHA	Fermentation	Day 5 Color	22	24	26	
EHA	Fermentation	Last CO2	2.6	2.65	2.7	
EHA	Fermentation	SO2	0	4	10	
EHA	Fermentation	TA	3.8	4	4.2	
EHA	Fermentation	TA pH	4.4	4.49	4.59	
EHA	Fermentation	Tank Cell/ml	6,640,000	8,300,000	9,960,0...	
EHA	Fermentation	Total Diacetyl (Dia + Aca)	0	40	100	
EHA	Filtration	AE BBT	3.8	4	4.2	
EHA	Filtration	AE BL	3.8	4	4.2	
EHA	Filtration	Alcohol BBT	6.4	6.7	7	
EHA	Filtration	Alcohol BL	6.4	6.7	7	
EHA	Filtration	Alcohol PR	6.4	6.7	7	
EHA	Filtration	BBT Keg CO2	2.55	2.6	2.65	
EHA	Filtration	CO2	2.6	2.65	2.7	
EHA	Filtration	DO	0	25	50	
EHA	Filtration	pH BBT	4.41	4.5	4.6	
EHA	Filtration	pH BL	4.41	4.5	4.6	
EHA	Filtration	pH PR	4.41	4.5	4.6	
EHA	Packaging	Bottle DO	0	25	50	
EHA	Packaging	Color	21	23	25	



# Statistical Process Chart

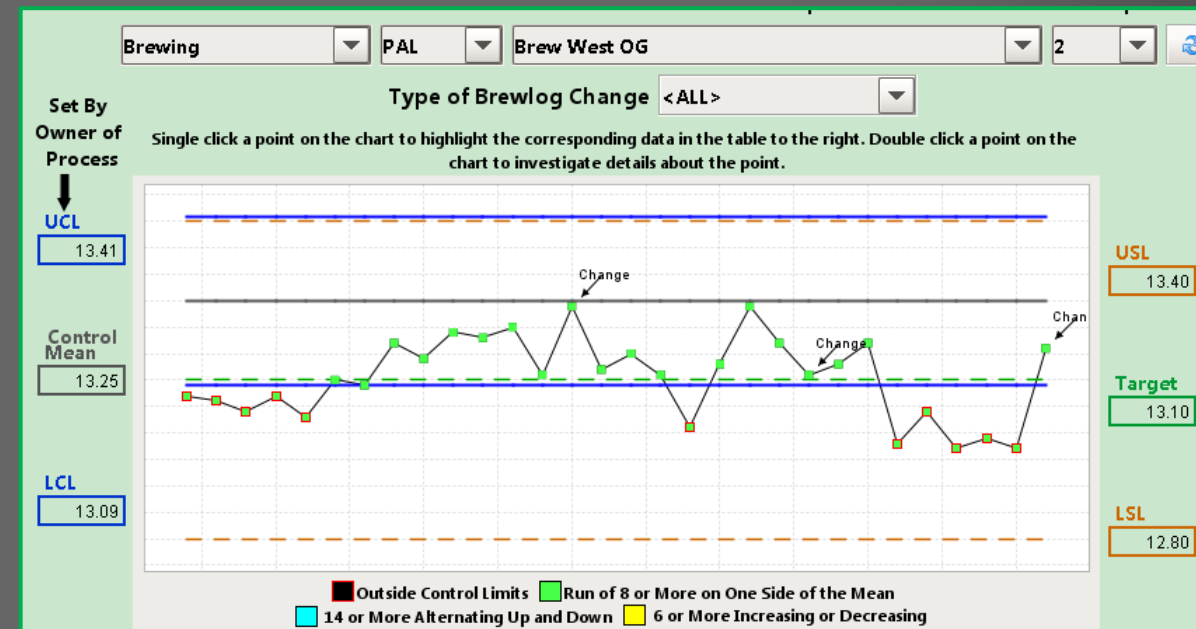
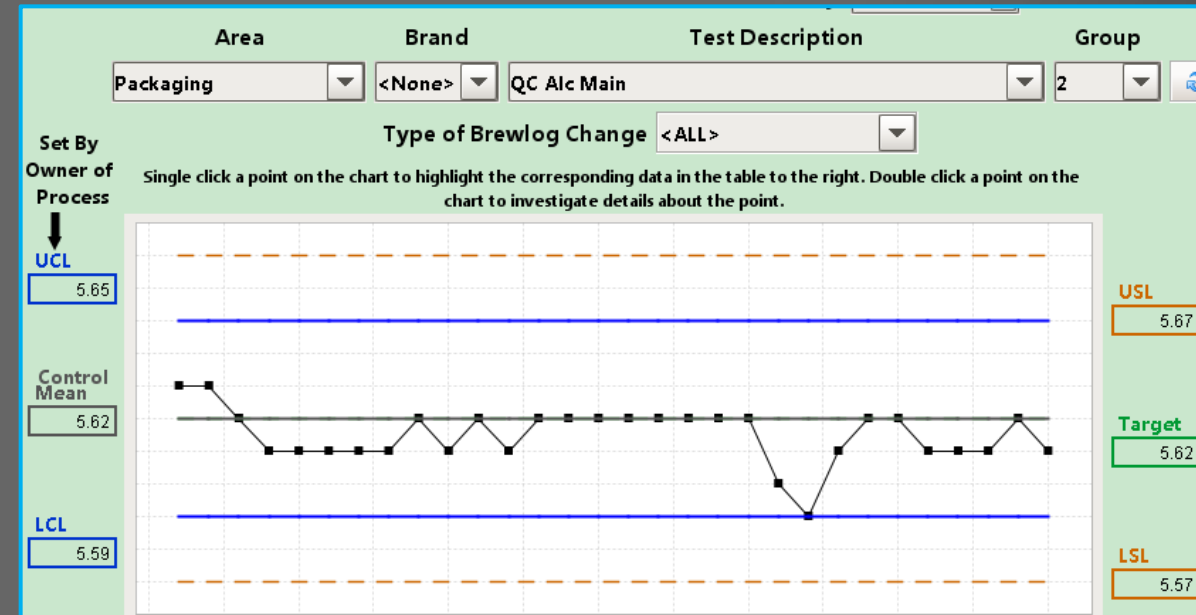
Statistical Process Charts (SPC) are beneficial for analyzing how well processes are performing

- Allow us to determine if a process is out of control
- Can help to determine if process variation is due to common or special causes
- One example to use an SPC chart is for our QC Beer, we can assess how well all four Anton Paar Alcolyzers/DMAAs are performing



# SPC Charts

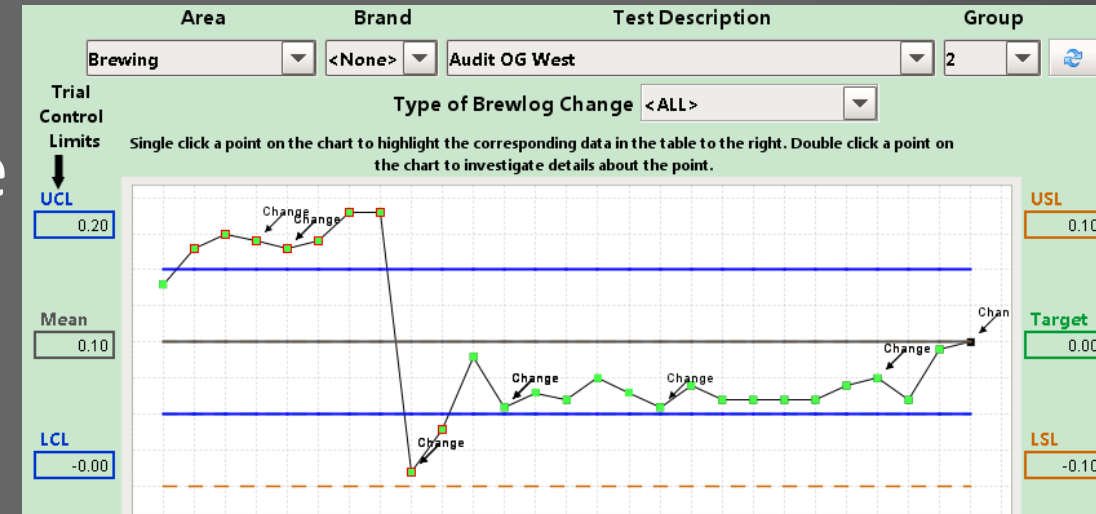
- The top chart is used to display our QC ABV results from day to day.
- The second graph displays our West Brewhouse Original Gravity for Pale.
- Upper and lower control limits are calculated and if a process is in control all data points will be within these points.
- If points are outside then process is out of control and need to determine what the special cause is.
- Just because a process is in control does not mean a product is within specification



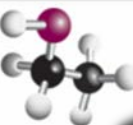
# SPC Charts

- The Chart to the right displays the percent difference between the inline Densitometer vs an Anton Paar Densitometer

Date	Label	Value	Assignabl
02/22/2017 03:38 PM	0457W 2-22	0.23	
03/01/2017 12:06 PM	0524W 3-1	0.25	
03/08/2017 09:20 AM	0577W 3-8	0.24	
03/15/2017 07:19 AM	0626W 3-15	0.23	
03/15/2017 07:39 AM	0627W 3-15	0.24	
03/15/2017 09:22 AM	0628W 3-15	0.28	
03/15/2017 11:42 AM	0629W 3-15	0.28	
03/22/2017 08:58 AM	0686W 3-22	-0.08	Calibration of Inlin
03/29/2017 12:28 PM	0734W 3-29	-0.02	
04/12/2017 05:06 AM	0819W 4-12	0.08	
04/12/2017 02:48 PM	0823W 4-12	0.01	
04/12/2017 02:48 PM	0824W 4-12	0.03	
04/12/2017 03:52 PM	0825W 4-12	0.02	
04/12/2017 05:24 PM	0826W 4-12	0.05	
04/12/2017 07:28 PM	0826W 4-12	0.03	
04/12/2017 09:45 PM	0828W 4-13	0.01	
04/13/2017 07:34 AM	0829W 4-13	0.04	
04/13/2017 07:42 AM	0830W 4-13	0.02	
04/13/2017 07:50 AM	0832W 4-13	0.02	
04/13/2017 07:58 AM	0833W 4-13	0.02	
04/19/2017 10:01 AM	0878W 4-19	0.02	
04/26/2017 10:21 AM	0929W 4-26	0.04	
05/03/2017 08:45 AM	0984W 5-3	0.05	
05/10/2017 10:25 AM	1041W 5-10	0.02	
05/17/2017 12:24 PM	1097W 5-17	0.09	
05/24/2017 08:44 AM	1139W 5-24	0.1	

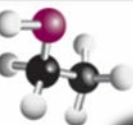


- We set the specifications to be +/- 0.10. Once we see two consecutive weeks of greater than a 10% difference between the two instruments, the Wort way inline densitometer will be calibrated.



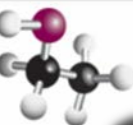
# ASBC Check Sample

- Great way to evaluate alternative methods or instrumentation
  - Flow Analyzer vs Discrete Analyzer
- Not only compare results between Sierra Nevada facilities but other labs within the industry



# Quality Maintenance

- A good quality assurance program will limit the need for excessive measurements in quality control. A well operated process does not require to be analyzed as often as an out of control process





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# Lab Technician



What my mother thinks I do



What my friends think I do



What society thinks I do



What my boss thinks I do



What I think I do



What I really do

