

GUM OPTIMISATION Value Validation

September 2022

OVERVIEW

IN DECEMBER '21, WE RAN A “VALUE DISCOVERY LITE” CONSISTING OF 2 WORKSHOPS TO ASCERTAIN THE DESIRABILITY, SCALABILITY AND FEASIBILITY OF THE USE CASES

VALUE DISCOVERY “LITE” ACTIVITIES

WORKSHOP #1



Objectives:

- Determine value to be targeted with use case at Gainesville and potential scalability

Activities:

- Working session to model potential savings based on site data (use case dependent – use case shared in advance as per pre-requisite)

Attendees:

- Process owners at site
- Site finance
- Process lead in other relevant regions

WORKSHOP #2



Objectives:

- Detail use case to enough granularity to allow MVP scoping

Activities:

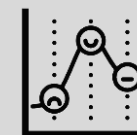
- Define manufacturing process to be targeted - Process mapping as is and to be
- Identify intervention points that the solution will use
- Determine data sources and complexity of integration
- Overlay key opportunity areas, value drivers and data sources

Attendees:

- Process owner at site
- Technical Lead at site

VALUE DISCOVERY ACTIVITIES DURING MVP

Detailed As-Is and To-Be Journey Mapping



Value Validation and Expected Realisation



Roadmap for roll-out and associated benefits



Detailed user requirements for build



POTENTIAL USE CASES

WE ARRIVED AT THREE POTENTIAL USE CASES THAT COULD BE APPLICABLE TO YORKVILLE AND GAINESVILLE AND DECIDED TO TAKE TWO OF THESE FORWARD INTO MVP.

1

BATCH MANAGEMENT

Automated batch reporting system for visibility of unknown issues resulting in higher quality and more consistent gum.

Out of scope

2

GUM MEASUREMENTS

Use visual inspection to measure circular LAND settings that eliminates operator subjectivity **to improve the regularity of gum measurements, score depths** and **reduce short stops downstream** in the wrapping process.

YRV

3

GUM DEFECTS

Use visual inspection to **identify holes/spots & trim abnormalities** to improve gum quality and **reduce short stops** further downstream in the wrapping process.

YRV + GNV

OBJECTIVE

WE WILL BE FOCUSING ON THE FOLLOWING OUTCOMES FROM THE GUM OPTIMISATION VALUE CASE

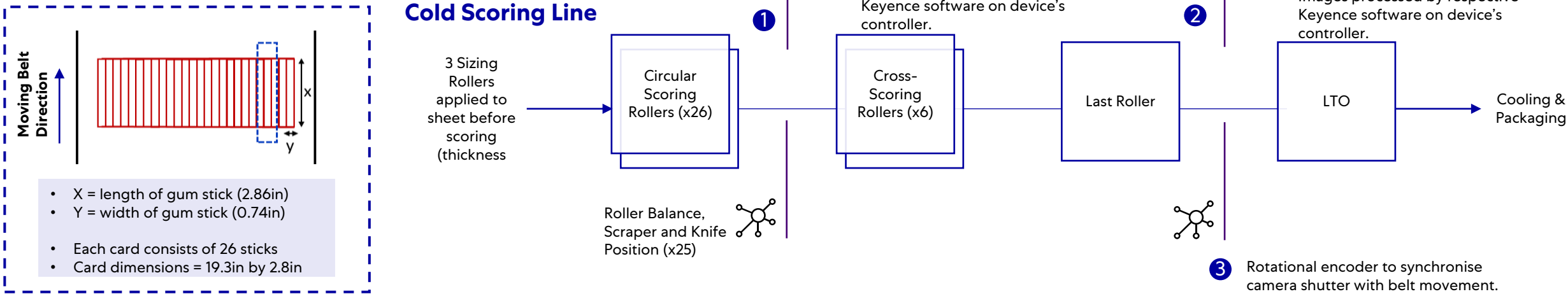
- Validate the value case for Gum Optimisation at YRV and GNV (Data not available as solution is not in use)
- Validate the scalability and value opportunity for Gum Optimisation at other Gum Sites
- Explore tangential use cases and technologies where the same technology can be applied
- Complete Data Validation for YRV to determine any gaps in the data and adjustments required to the data model (Data not available as solution is not in use)

SOLUTION OVERVIEW

Gum Measurement

YRV Solution Overview

The Challenge: To eliminate regularity of gum parameters to reduce short stops further downstream in the wrapping process. The aim is to alert operators when gum measurements are out of a defined threshold and make adjustments based on the level of error, to create product in spec.



- 1** The laser profiler continuously measures the width of the gum sticks as well as circular land score depth. The camera is placed after the Circular Scoring Rollers **above and centre of the cards**.

Scanning Area = 39mm (2 Circular Land Scores)

Width : Distance between score lines

Depth: Roller balance and knife + scraper settings
- 2** The line scanner is placed above and perpendicular to the moving belt. The camera's shutter is synchronized to the belt movement by using a rotational encoder. When a signal from the encoder is received, the camera takes a picture.

A strobe light illuminates the back of the cards.
- 3** The line scanner take a series of line images and combines these to form a 3 x 2" 'Field of View'.

Power BI Dashboard Analytics

Real-Time

- Users are able to see if the length, width and land score depth of the gum stick is within a **maximum and minimum threshold across a 30 minute time period**.
- Users can view the **total number of errors** above or below threshold of each type of measurement within a 30 minute time period.

Historic

Users can view the average length, width and land score depth across a **selected shift or SKU**. They can also drill down into the **total number of errors** in each run as well the **median of the hours during which an error has occurred**.

Predictive

Users can see if a measurement will be **above or below threshold in the next 20 minutes**.

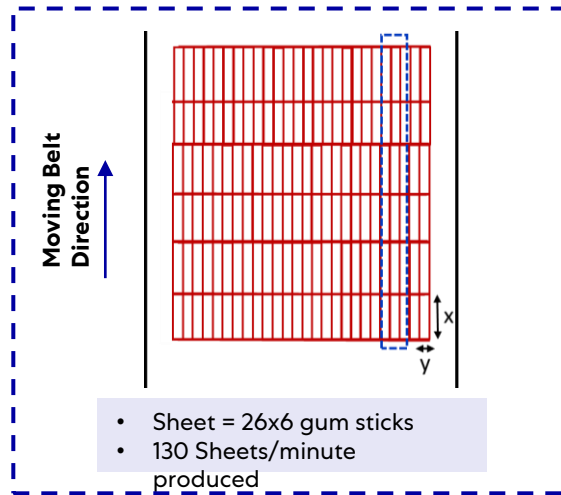
Alerts

An alert is provided when gum measurements are +/- their ideal threshold. Users can **accept and reject these alerts**. A reject indicates that the operator believes an error is not significant. Chosen actions are displayed on the dashboard. Alerts are considered expired after 15 mins.

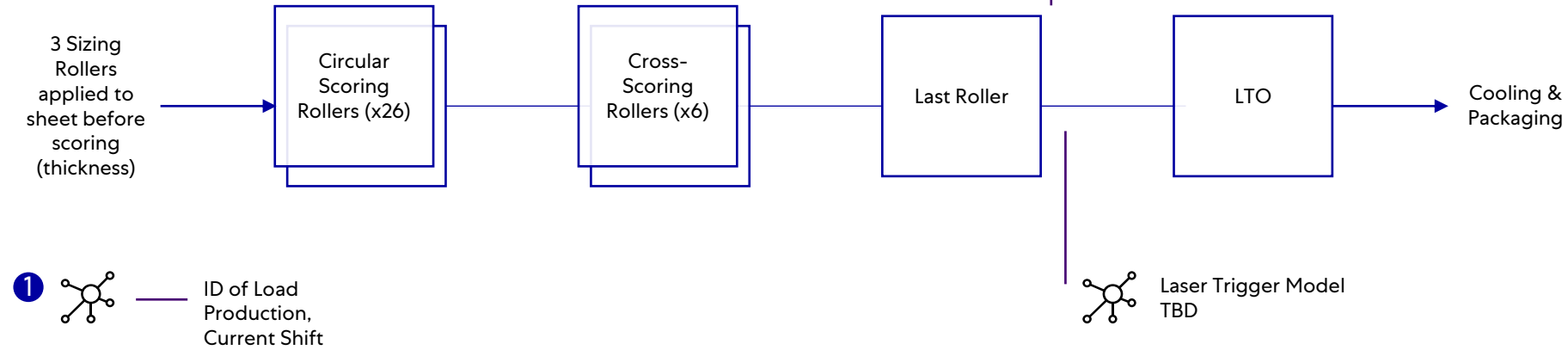
Gum Defects

GNV Solution Overview

The Challenge: To identify holes/spots & trim abnormalities to improve regularity of gum parameters and prevent short stops downstream in the wrapping process. The aim is to identify which sheets have defects so that they can be removed before reaching the packaging area and causing delays.



Traditional Line



1 The solution will aim to detect the following defects:

1. Holes
2. Ingredient Spots
3. Ragged Edges

and match these to the production run so that individual defected sheets can be identified.

2 The cameras are placed after the last roller with an additional light source.

The camera's shutter speed will be synchronised with the belt's movement to capture a single sheet of gum. The camera will capture 130 images per minute.

3 The machine learning model for automatic defect detection is to be determined depending on accuracy, complexity and time to train the model.

The model will aim to count the number of good sheets produced and identify the number of defects as they arise.

4 With time, a Power BI dashboard will be able to alert operators of gum defects before they enter packaging and reduce detection time by up to 2-3 days.

MVP VALUE CASE

Gum Optimisation Value Case - GNV

ASSUMPTIONS ARE FROM **ORIGINAL VALUE CASE** AND HAVE NOT BEEN VALIDATED IN COMPARISON TO THE EXISTING SOLUTION AS IT IS NOT CURRENTLY LIVE.

	TOTAL LOSS	ADDRESSABLE LOSS	
Non Quality Cost Avoidance	\$86,203	\$47,411	Avoidance of edge trim waste and waste at the cutting and packaging process.
Downtime Cost Avoidance	\$324,272	\$178,350	Avoidance of short stops and downtime in the packaging process.
Capacity	\$383,500	\$210,925	Avoidance of short stops and downtime based on 80% utilisation rate at GNV
		\$436,686	

Gum Optimisation Value Case - YRV

	TOTAL LOSS	ADDRESSABLE LOSS	
Non Quality Cost Avoidance	\$144,000	\$79,200	Avoidance of edge trim waste and waste at the cutting and packaging process.
Downtime Cost Avoidance	\$555,234	\$305,378	Avoidance of short stops and downtime in the packaging process.
Capacity	TBC	TBC	Avoidance of short stops and downtime
		\$384,578	

Gum Optimisation Value Case - GNV

ASSUMPTIONS ARE FROM **ORIGINAL VALUE CASE** AND HAVE NOT BEEN VALIDATED IN COMPARISON TO THE EXISTING SOLUTION AS IT IS NOT CURRENTLY LIVE.

	TOTAL LOSS	ADDRESSABLE LOSS	
Non Quality Cost Avoidance	\$86,203	\$47,411	Avoidance of edge trim waste and rework losses at the cutting and packaging process. Estimated value of gum waste is \$30.50/kg which includes cost associated with raw materials and labour. Addressability is assumed at 55% based on site estimates of % of gum waste being avoidable if identified earlier.
Downtime Cost Avoidance	\$324,272	\$178,350	Avoidance of short stops and downtime in the packaging process due to Gum Quality (includes Gum Measurement + Gum Defects). Addressability is assumed at 55% based on site estimates of % of downtime being avoidable if identified earlier.
Capacity	\$383,500	\$210,925	Improvement in yield due to avoidance of short stops and downtime . Estimate given from the site that \$267k - \$500k can be attributed to gum quality/ gum measurement. \$383,500 is the midpoint. Calculation is based on MAC Value of yield loss. Addressability is assumed 55% based on assumptions for previous value levers.
		\$436,686	

Gum Optimisation Value Case - YRV

	TOTAL LOSS	ADDRESSABLE LOSS	
Non Quality Cost Avoidance	\$144,000	\$79,200	Avoidance of edge trim waste and rework losses at the cutting and packaging process. Estimated value of gum waste is \$30.50/kg which includes cost associated with raw materials and labour. Addressability is assumed at 55% based on site estimates of % of gum waste being avoidable if identified earlier.
Downtime Cost Avoidance	\$555,234	\$305,378	Avoidance of short stops and downtime in the packaging process due to Gum Quality (includes Gum Measurement + Gum Defects). Addressability is assumed at 55% based on GNV site estimates of % of downtime being avoidable if identified earlier.
Capacity	TBC	TBC	MAC Value of yield loss to be determined.
		\$384,578	

TANGENTIAL OPPORTUNITIES WITHIN GUM

OPPORTUNITIES WITHIN GUM

WE FOUND THAT THE USE CASES WITHIN GUM MEASUREMENTS AND GUM DEFECTS CAN BE SCALED ACROSS THE GUM NETWORK

		Applicable Format						Primary Inspection Location					
		Stick (CS)	Tab (CS)	Stick (Conv)	Tab (Conv)	Pellet	Soft Chew	Post-Forming (Online)	Post-Forming (Offline)	Accumulation (Tray/Magazine)	WIP Storage	Decumulation	Post-Coating
Gum Measurements	Gum Height*	X	X	X	X		X	X					
	Gum Width	X	X	X	X		X	X					
	Gum Length*	X	X	X	X		X	X					
	Score Depth	X	X	X	X		X		X				
Gum Defects	Ragged Edge	X	X	X	X		X		X				
	Holes	X	X	X	X		X		X				

*not currently available in solution

TANGENTIAL OPPORTUNITIES OUTSIDE GUM

TANGENTIAL OPPORTUNITIES BEYOND GUM

<div><div>1</div><div>Chocolate Quality Vision Inspection</div></div> <p>Reduce NQC by using vision to assess the tempering of quality and the associated gloss of the finished product.</p> <p>Intervention: Adjust the tempering process to optimise for chocolate quality.</p> <p>Medium Value</p>	<div><div>2</div><div>Filled Bar Height Optimisation</div></div> <p>Reduce Giveaway and inefficiencies in Packaging due to inconsistencies in the slab height across the height for Filled Bar. Applicable to Nougat and Caramel</p> <p>Intervention: Adjust the amount of product applied -may need to make adjustments to one side of the slab.</p> <p>High Value</p>	<div><div>3</div><div>Chocolate: Caramel: Nougat Ratio</div></div> <p>Reduce Giveaway due to higher proportion of chocolate being applied to the bars and reducing rejects</p> <p>Intervention: Adjust the amount of chocolate/caramel applied to the slab.</p> <p>Medium Value</p>	<div><div>4</div><div>Edge Trim Defect Detection</div></div> <p>Reduce rework, waste and inefficiencies in packaging by identifying issues with the edge trim and guillotine failures</p> <p>Intervention: Adjust guillotine settings and/or process components</p> <p>High Value</p>
<div><div>5</div><div>Barrier Cream Application</div></div> <p>Reduce rework and waste by ensuring that barrier cream is applied to the right place on the cookie.</p> <p>Intervention: Make adjustments in the application of the barrier cream to reduce defects</p> <p>Medium Value</p>	<div><div>6</div><div>Broken Cookie Detection</div></div> <p>Reduce waste and line blockages through early identification of broken cookies on the line.</p> <p>Intervention: Intervene early to remove broken cookies on the line.</p> <p>Medium Value</p>	<div><div>7</div><div>Chocolate Addition Giveaway Reduction</div></div> <p>Reduce chocolate giveaway by monitoring the amount of chocolate applied to the uncoated bar and reduce tails</p> <p>Intervention: Intervene early to reduce the amount of chocolate coated and early detection of defects such as tails on bars.</p> <p>High Value</p>	<div><div>8</div><div>Slab Heights for Soft Centres</div></div> <p>Reduce NQC and downstream issues with final coat or chocolate spray by standardising the height of slabs for soft centres (M&Ms and Skittles).</p> <p>Intervention: Adjust the parameters which determine the slab height of the soft centre</p> <p>Medium Value</p>

APPENDIX

Line #1

8	32	Thu	8/12/2021	1	Circular scoring out of spec on Classic load 1 (several loads hard to run)	Operational	No
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Line #4

5	19	Mon	5/10/2021	1	#231 for scoring on Spr-lds 32,48,50,52,53 trim (.035")	Operational	No	
5	19	Mon	5/10/2021	3	#234 for Peppermint breaking off center	Operational	No	
7	26	Fri	7/2/2021	1	#327 Extra Spearmint holes and spots/ tough scores loads 35 & 36	Operational	No	2
10	40	Tue	10/5/2021	1	#448 Five Rain-circular scoring off lds 138-151	Operational	No	6
10	40	Thu	10/7/2021	3	#450 Holes and spots in WF Circulars at top end of spec	Operational	No	29

Line #5

5	19	Mon	5/10/2021	1	NCR #235 for tough scores on load 121 Polar Ice	Operational	No	1
6	24	Tue	6/15/2021	3	NCR #299 for WF tough scores/holes/spots lds 4,15,16	Operational	No	1
13	49	Thu	12/9/2021	3	#508, Polar Ice loads 1-6 tough circular scores. Measured .025"		No	1

Week 19

3,330 kgs of Extra Peppermint Trim from wrapping

2,970 kgs of Extra Polar Ice Trim from wrapping

1,215 kgs of Extra Spearmint Trim from wrapping

Week 24

2,025 kgs of Extra Winterfresh Trim from wrapping

Week 26

4,500 kgs of Extra Spearmint Trim from wrapping

Week 32

90 kgs of Extra Classic BBG Trim from wrapping

Week 40

3,551 kgs Extra Winterfresh Trim from wrapping

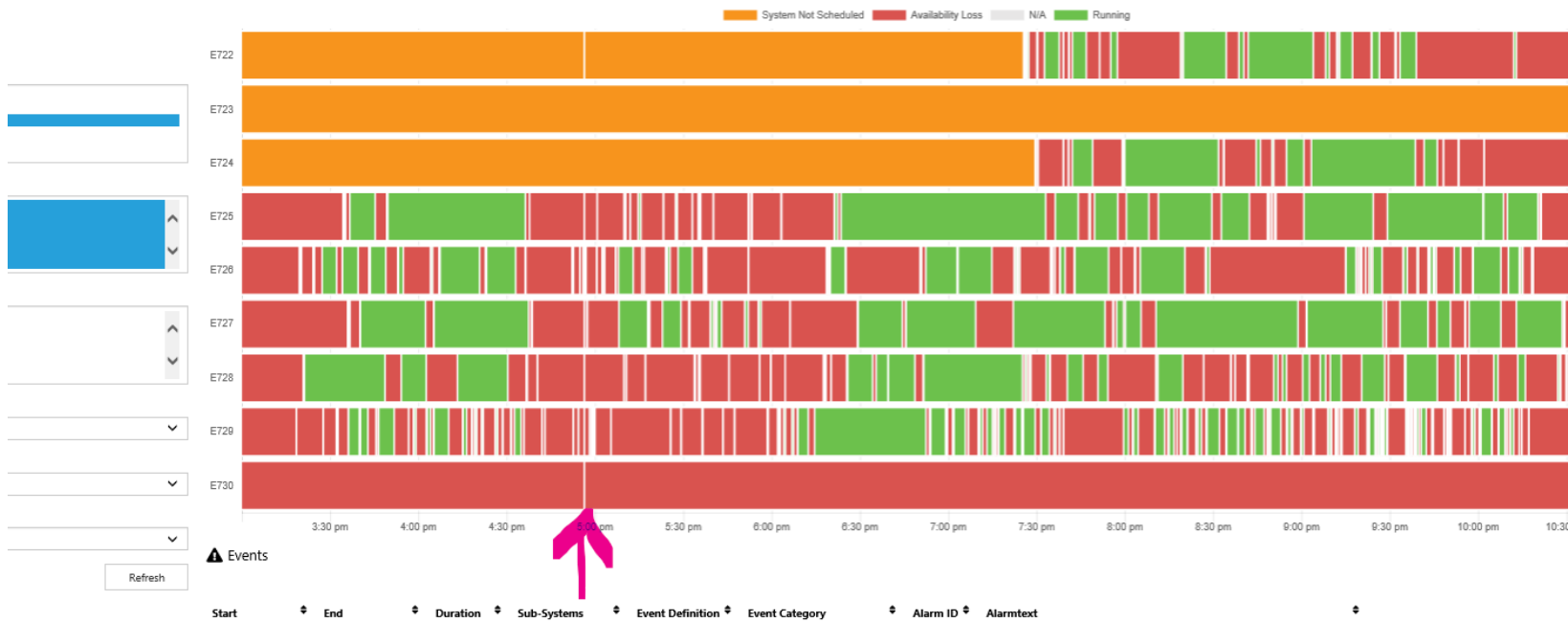
5,895 kgs 5 Rain Trim from wrapping

Week 49

1,845 kgs Extra Polar Ice Trim from wrapping

\$88,973 In Rework Losses

Event Data



ent Data



Escalation #448 Line 4_Five Rain E
line night shift trying to run out gum,
7am Changeover to peppermint.



#450 Line 4_ Winterfresh holes and spots circular at top end of spec

1	EndDateTimeOffset	Duratio	EventIn	AreaNa	System	SubSys	EventD	EventC	EventC	EventCategory02Name	EventC	EventC	ProductName	Produ
07	10/7/2021 7:24	1321	1	Line D	D714	Line D - D	ModuleSt	Gum Qual Unplanner	Gum Quality				EXTRA WINTERFRESH	1019
13	10/7/2021 7:13	17	1	Line D	D719	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality					
17	10/7/2021 7:21	178	1	Line D	D720	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality					
	10/7/2021 7:24	147	1	Line D	D720	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality					
	10/7/2021 7:33	337	1	Line D	D720	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality					
	10/7/2021 7:34	334	1	Line D	D715	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality				EXTRA WINTERFRESH	1019
	10/7/2021 8:09	1949	1	Line D	D720	Line D - D	ModuleSt	Gum Qual Unplanner	Gum Quality					
	10/7/2021 7:53	649	1	Line D	D714	Line D - D	ModuleSt	Gum Qual Unplanner	Gum Quality				EXTRA WINTERFRESH	1019
	10/7/2021 8:10	1030	1	Line D	D714	Line D - D	ModuleSt	Gum Qual Unplanner	Gum Quality				EXTRA WINTERFRESH	1019
	10/7/2021 8:10	125	1	Line D	D719	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality					
	10/7/2021 9:38	5318	1	Line D	D720	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality					
	10/7/2021 8:15	158	1	Line D	D716	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality					
	10/7/2021 8:23	259	1	Line D	D716	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality					
	10/7/2021 8:26	382	1	Line D	D715	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality				EXTRA WINTERFRESH	1019
	10/7/2021 8:27	252	1	Line D	D714	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality				EXTRA WINTERFRESH	1019
	10/7/2021 8:34	65	1	Line D	D716	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality					
17	10/7/2021 8:46	695	1	Line D	D719	Line D - D	ModuleSt	Gum Qual Unplanner	Gum Quality					
28	10/7/2021 8:42	151	1	Line D	D716	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality					
29	10/7/2021 8:42	9	1	Line D	D714	Line D - D	OperatorS	Gum Qual Unplanner	Gum Quality				EXTRA WINTERFRESH	1019

Factory > Reports > Historical Shift Event Data

Historical Shift Event Data

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Filters

Select Line(s)

Line C

Line D

Line ELine MTPFlowpack Line

Select Module(s)

D714D715D716D717D718D719

Select Sub Module(s)

MSSSE [D714] [Line D]LTM [D714] [Line D]WKM [D714] [Line D]MSSSE [D715] [Line D]LTM [D715] [Line D]WKM [D715] [Line D]

Day

2021-10-07

Shift

[All]



5_ Winterfresh
tough scores, holes,
spots, Loads
4,15,16.
Changed over @
5pm.

StartDateTimeOffset	EndDat	Duratio	EventIn	AreaNa	System	SubSys	EventD	EventCate	EventCi	EventCategory02Name	EventCi	EventCi	ProductName
6/15/2021 17:17	#####	8276	1	Line MTP	G733	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 17:20	#####	246	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 17:30	#####	554	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 18:04	#####	428	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 18:12	#####	8	1	Line MTP	G734	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 18:14	#####	273	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 18:20	#####	299	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 18:27	#####	199	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 18:30	#####	350	1	Line MTP	G734	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 18:35	#####	519	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 18:57	#####	338	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 19:17	#####	378	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 19:35	#####	432	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 19:43	#####	13	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 19:48	#####	112	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 19:51	#####	417	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 20:00	#####	47	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 20:15	#####	24	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 20:20	#####	458	1	Line MTP	H731	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP
6/15/2021 20:21	#####	17	1	Line MTP	G733	Line MTP	OperatorS	Gum Quality	Unplanne	Gum Quality			EXTRA WINTERFRESH MTP

Factory > Reports > Historical Shift Event Data

Historical Shift Event Data



Historical Shift Event Data

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Filters

Select Line(s)

Line C
Line D
Line E
Line MTP
Flowpack Line

Select Module(s)

E722
E723
E724
E725
E726
E727

Select Sub Module(s)

MSSSE [E722] [Line E]
LTM [E722] [Line E]
WKM [E722] [Line E]
MSSSE [E723] [Line E]
LTM [E723] [Line E]
WKM [E723] [Line E]

Day

2021-12-08

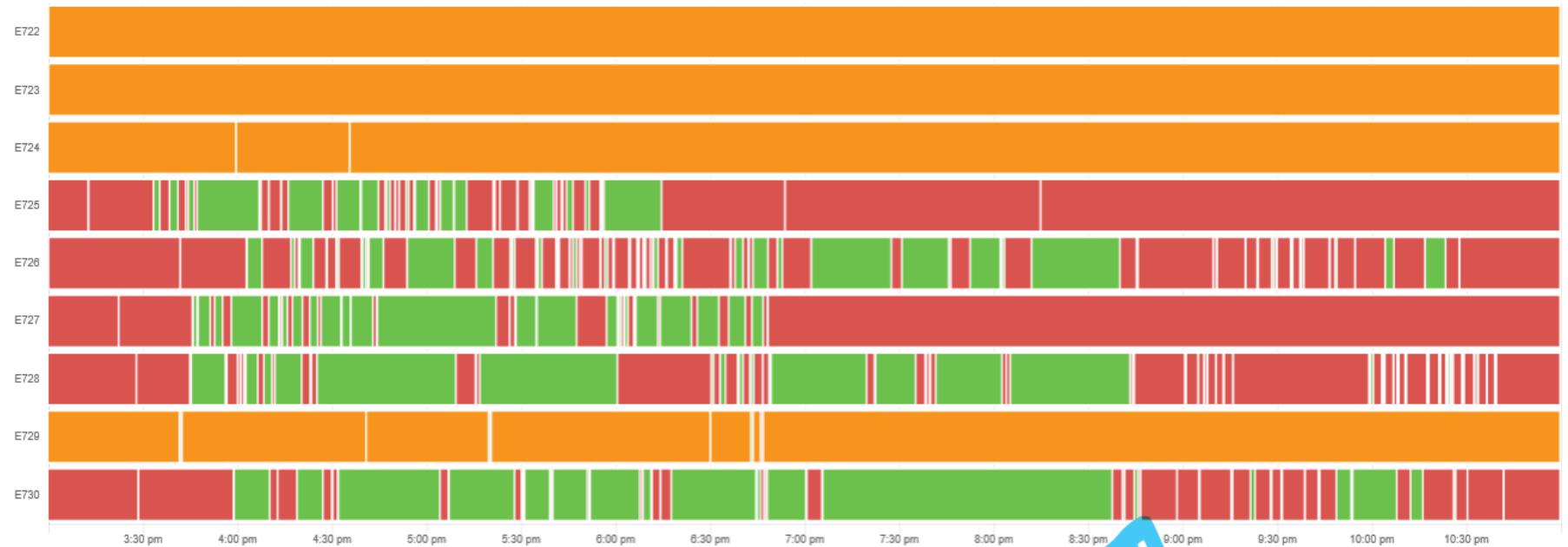
Shift

C Shift

Team

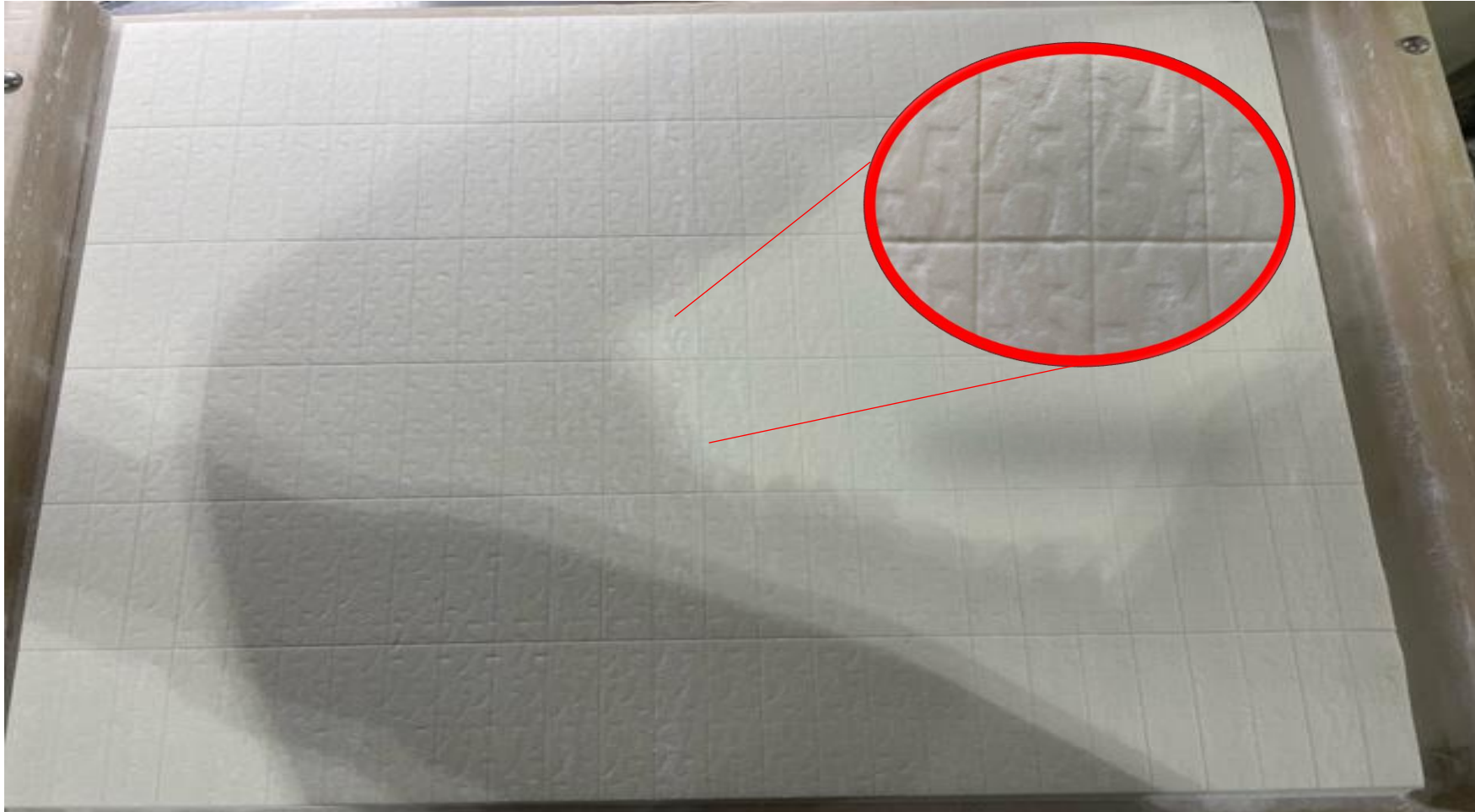
[All]

System Not Scheduled Availability Loss N/A Running



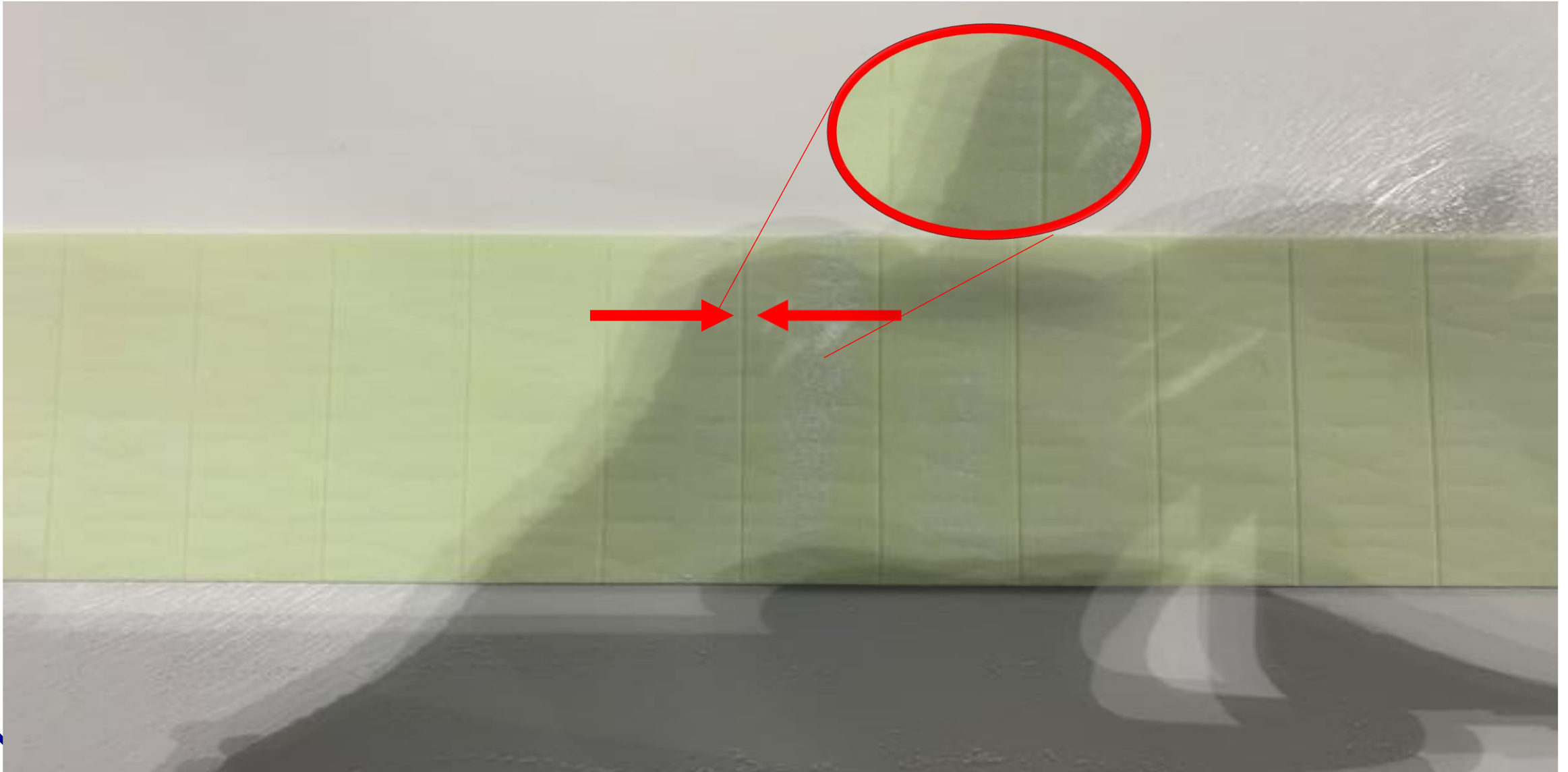
Events

Photo of full sheet of gum
26 circular land
6 cross land

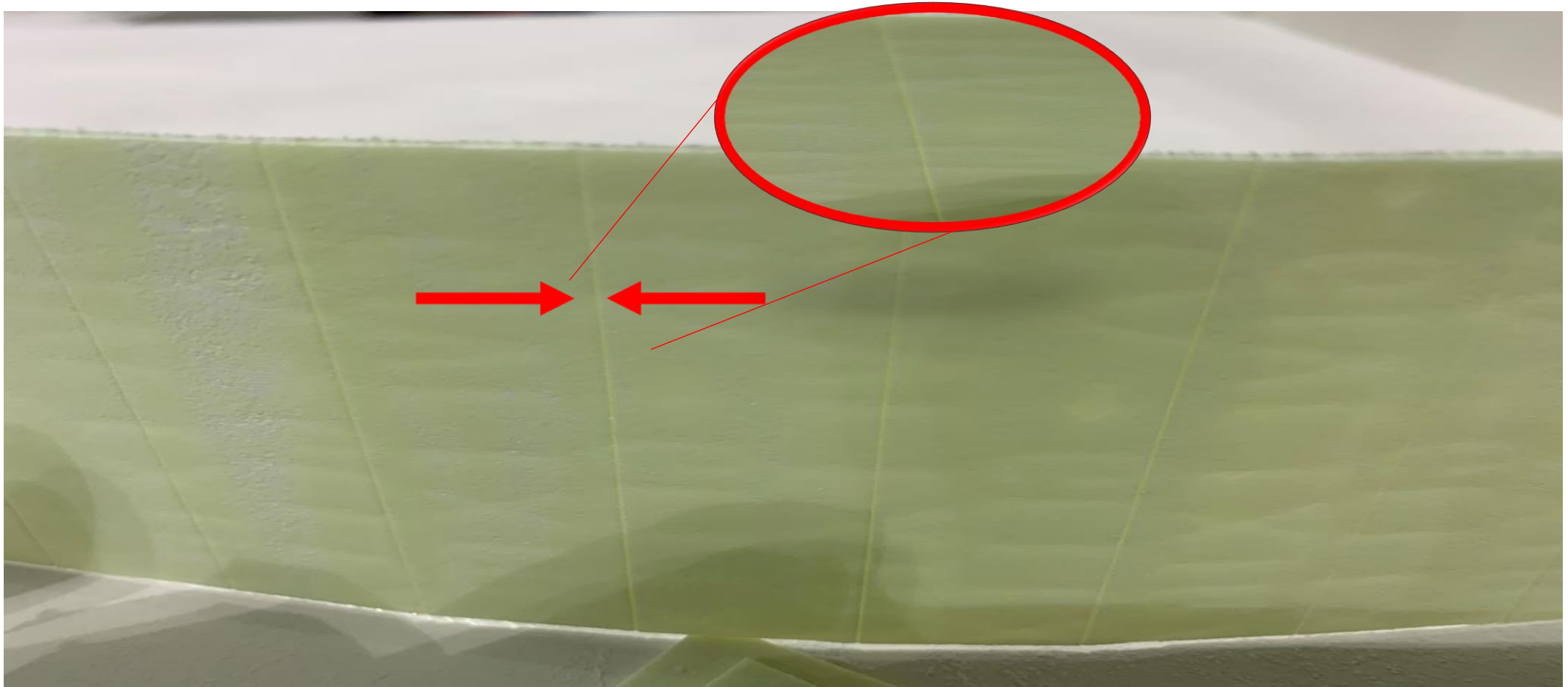


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Top view of finished land score on final product



Side view of finished land score on final product



Tool used to measure land score in Micrometer

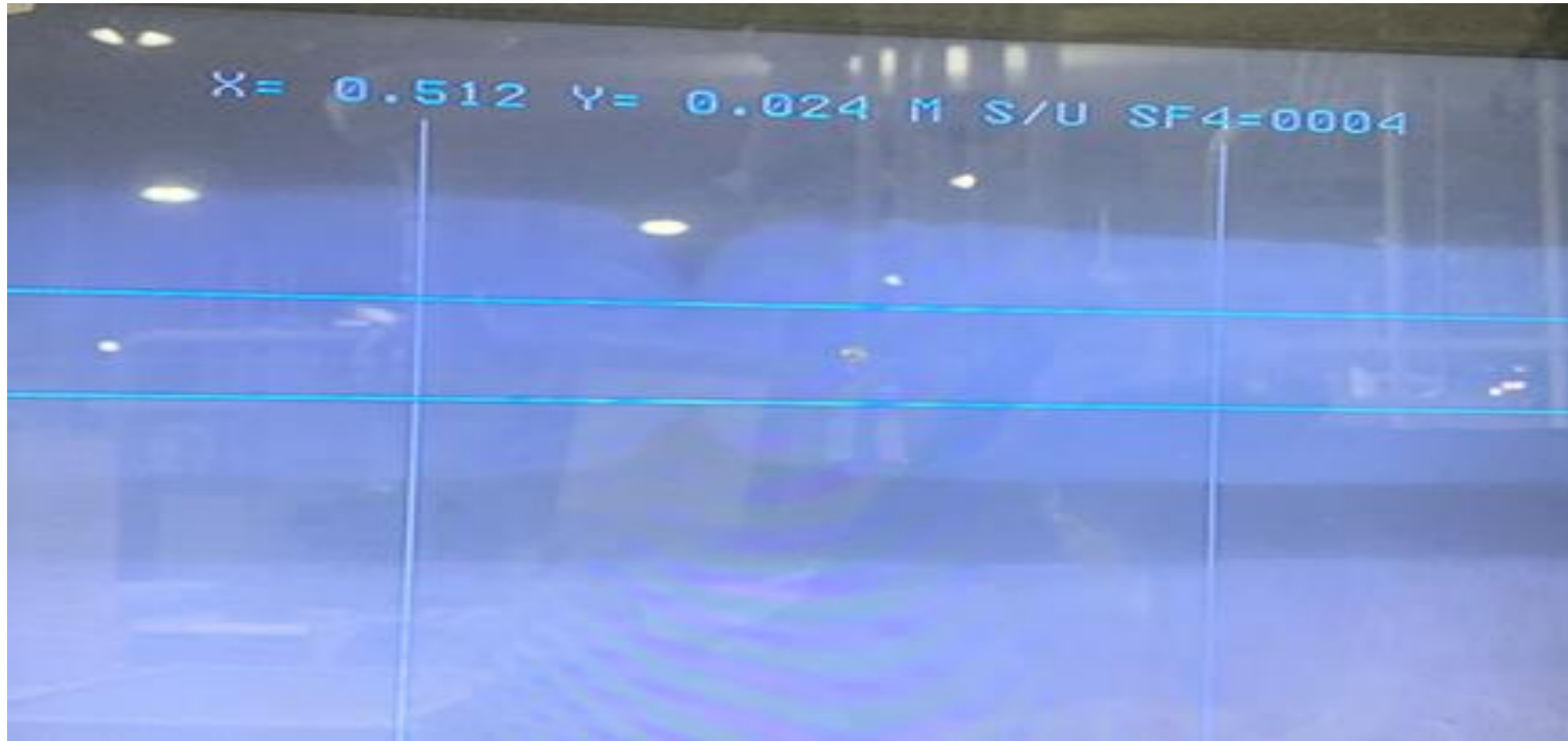


Side view of land score in Micrometer

Each flavor have different specs i.e.

Winter fresh $Y=0.024 \pm 0.002$

Peppermint $Y= 0.026 \pm 0.002$

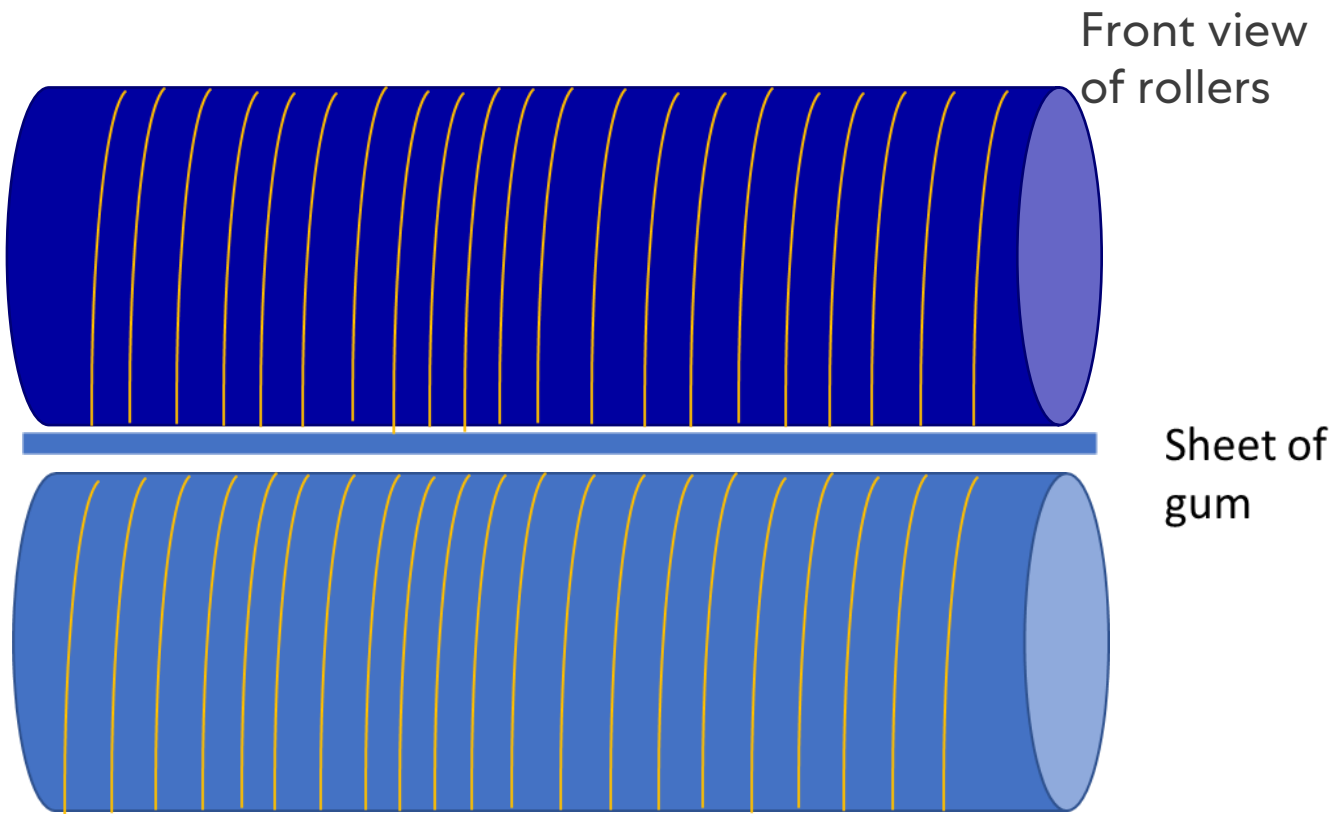
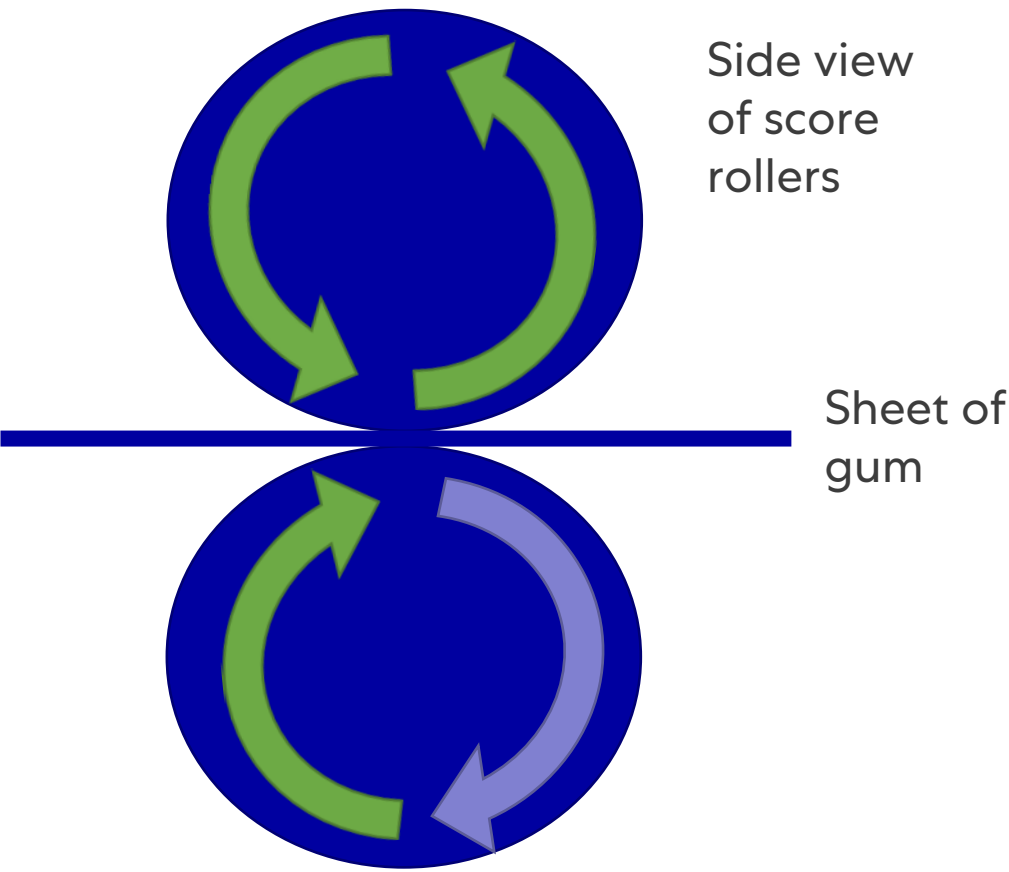


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Circular land score cutting rollers



Circular land score cutting rollers

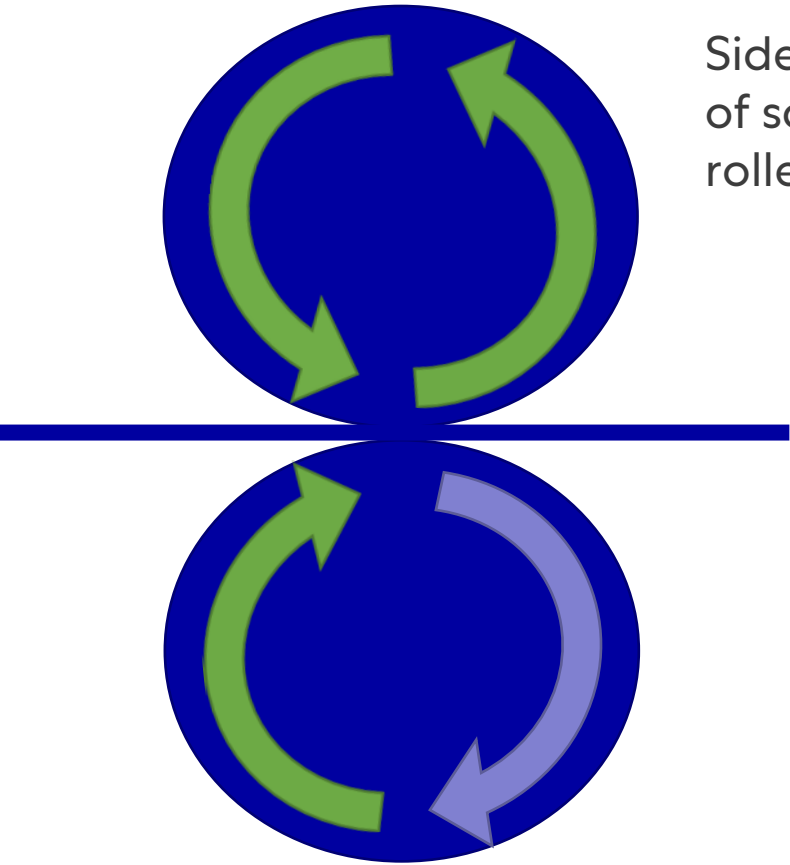


Cross land score cutting rollers



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Cross land score cutting rollers



Side view
of score
rollers

Sheet of
gum

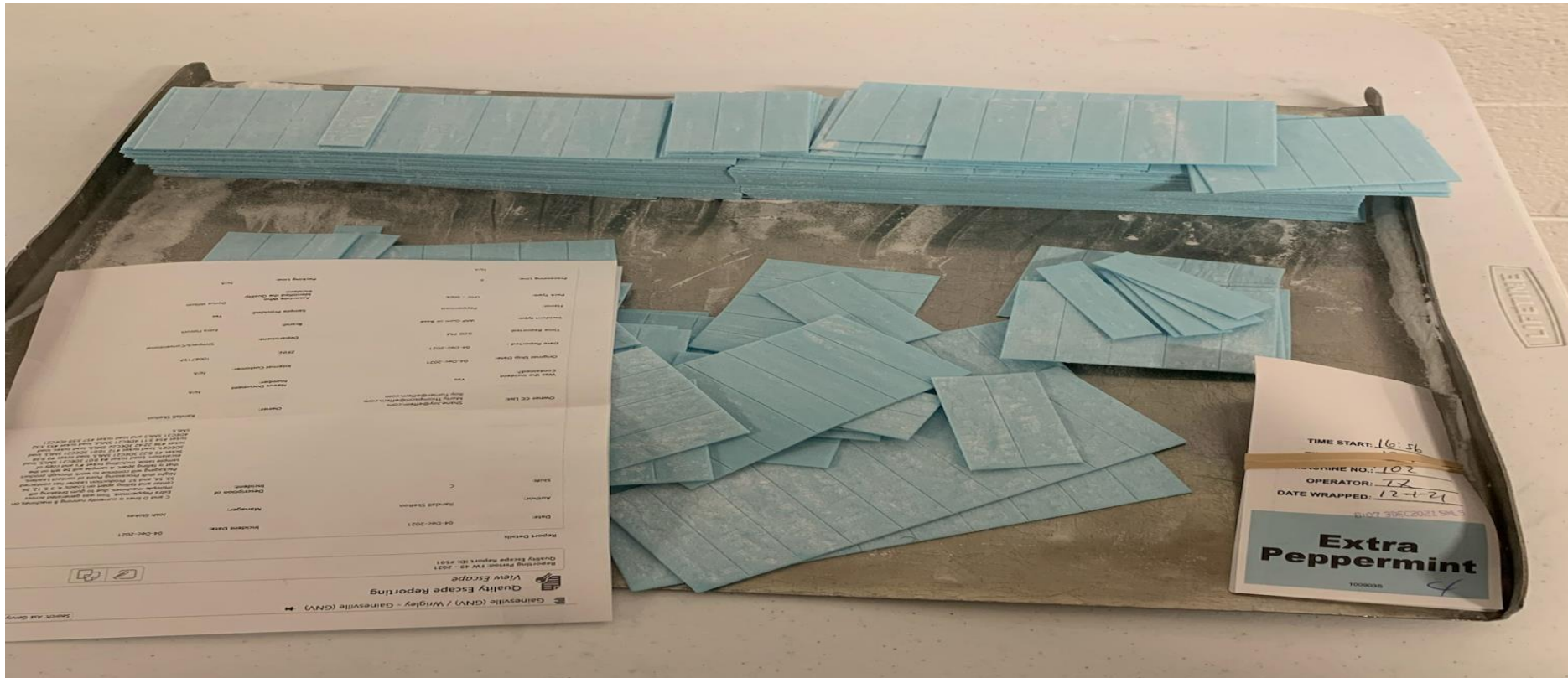


Front view
of rollers

Sheet of
gum

Possible defect from deep land scores

- Gum breaking off center
- Gum having multiple breaks

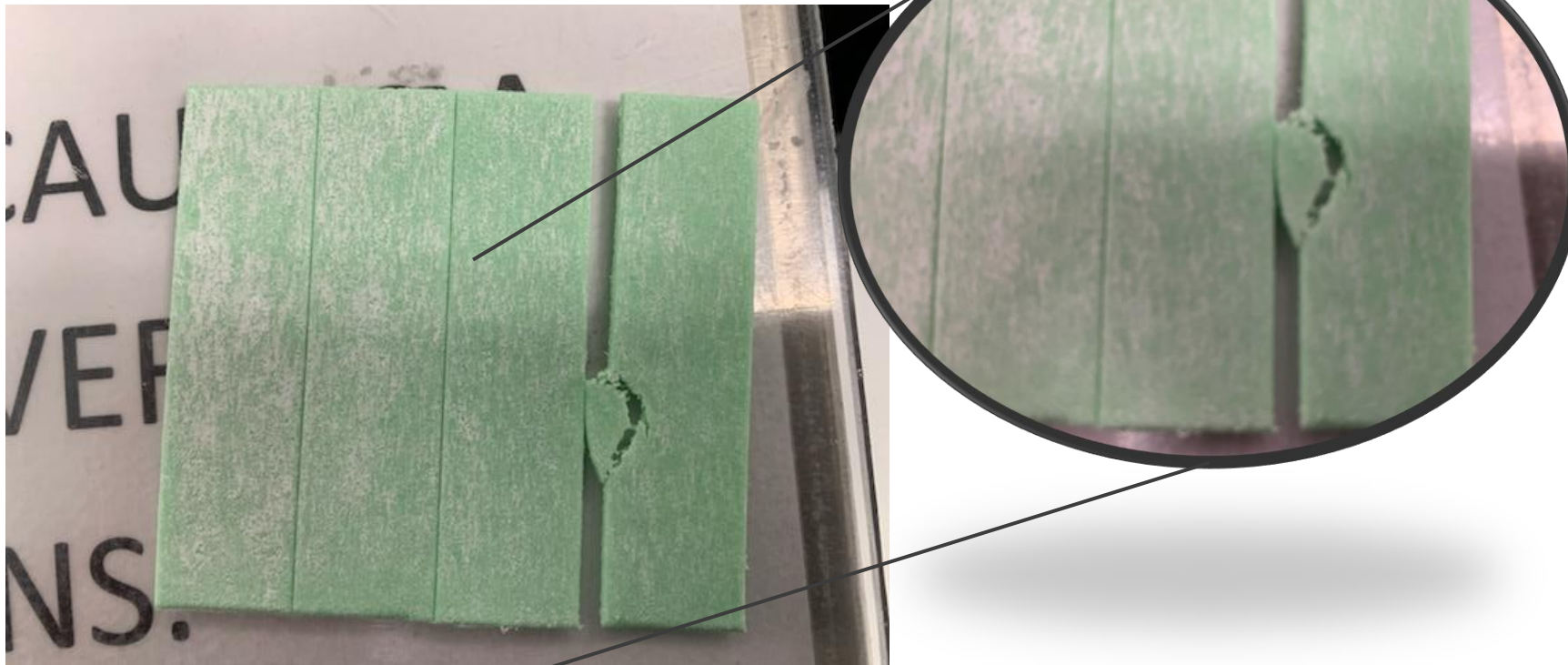


Possible defect from shallow land scores

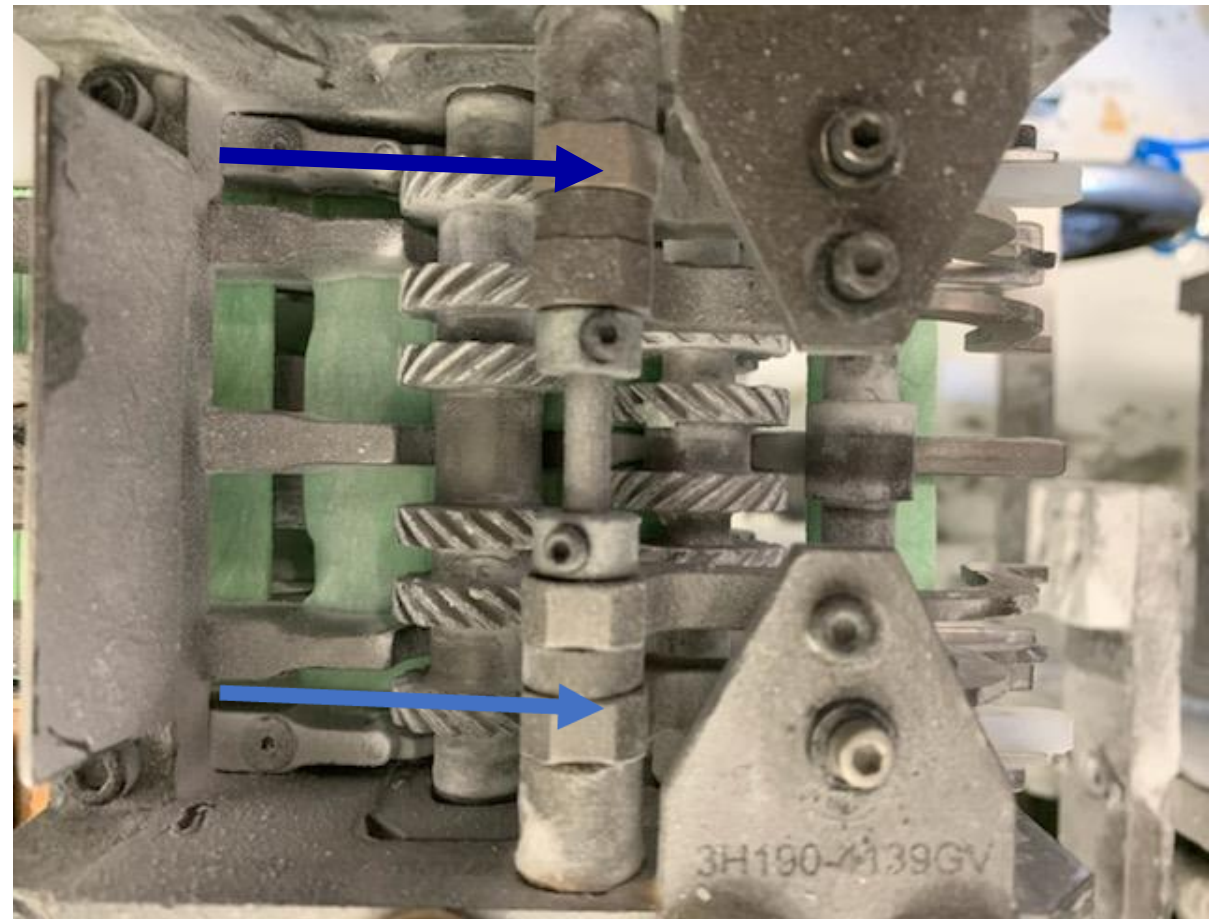
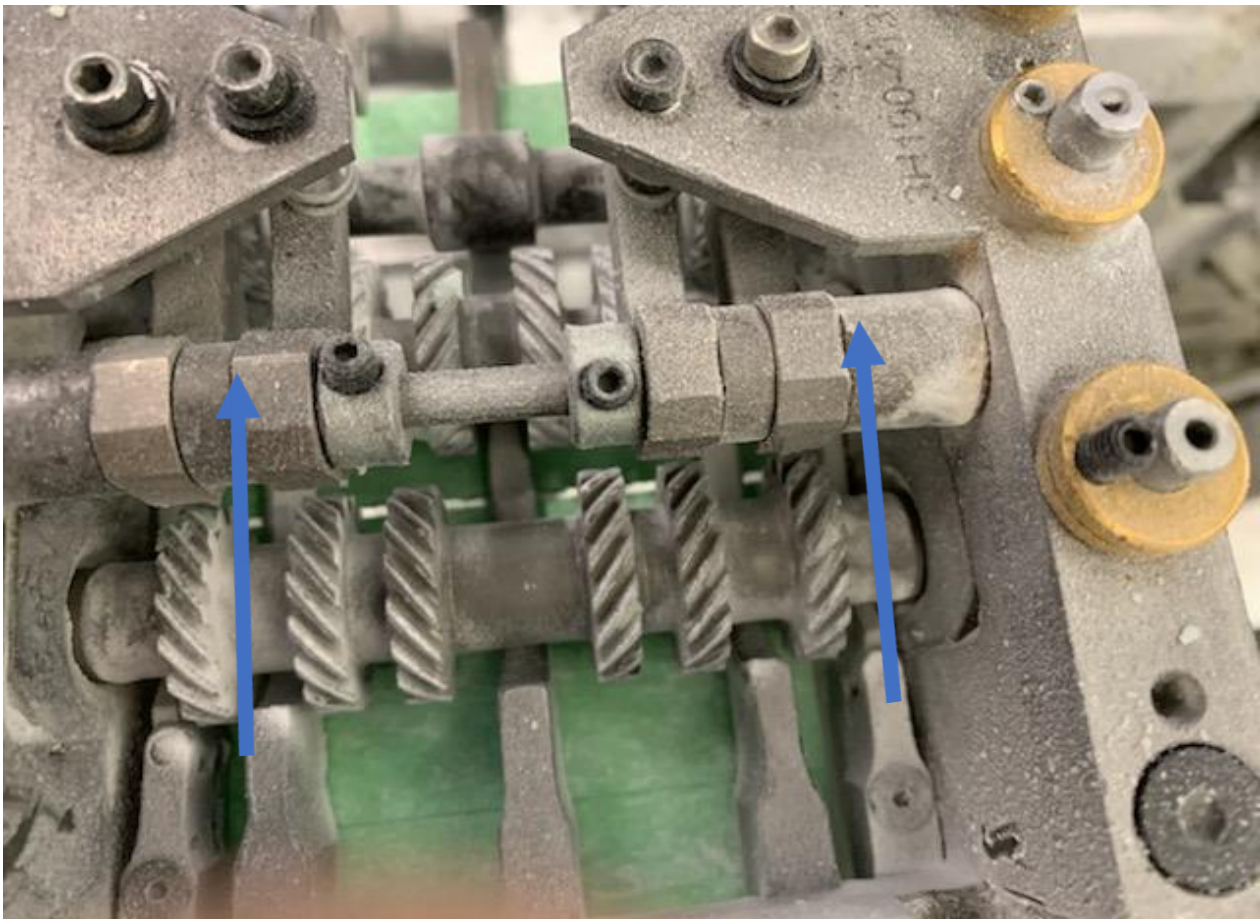
Gum no separating in parting rolls leading to short stops

Gum tough to break for operators

Gum tearing



Parting roller on MSS7S



Parting rollers 1 are rotating at 5 rotation per sec
Parting rollers 2 are rotating at 7 rotation per sec

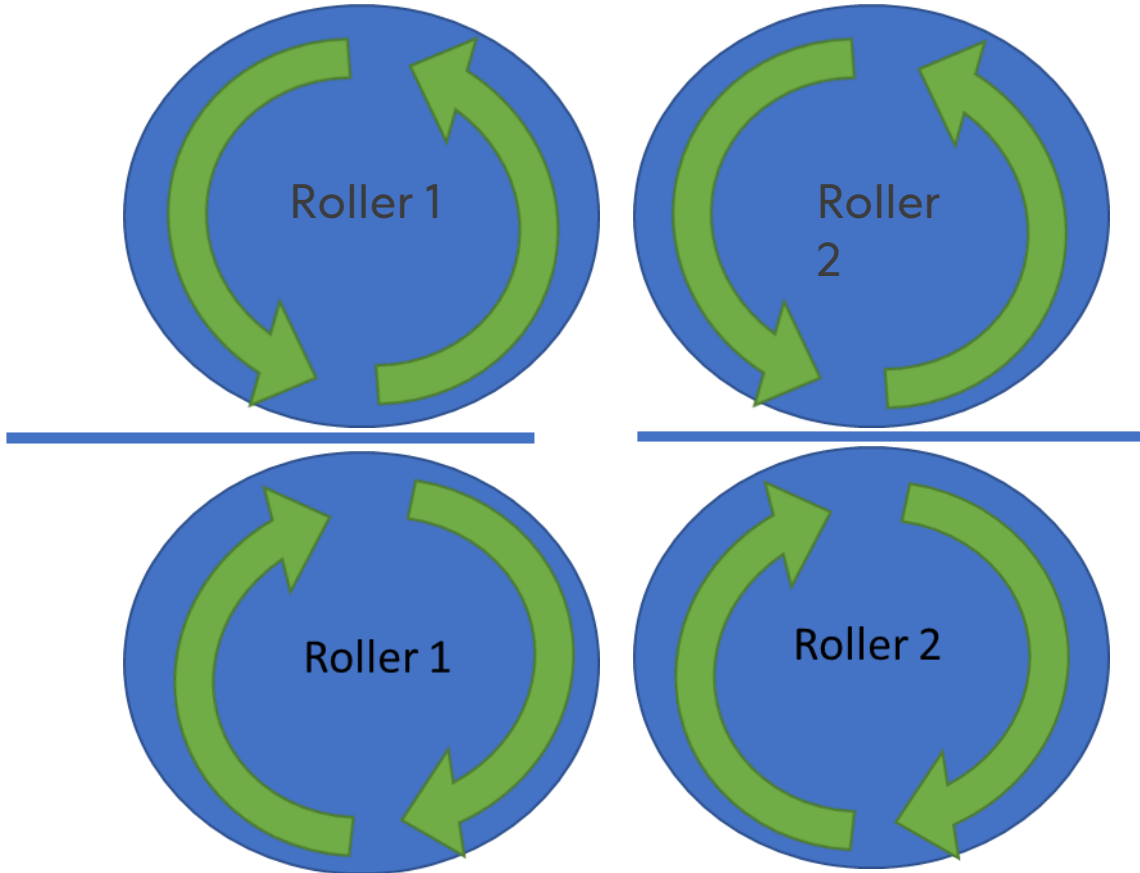


Photo of short stops caused by shallow land scores



Quality control bi-hourly checks

Operators check land scores twice per hour and record results

Leaders Initials															
Time															
						CROSS	CIRCULAR	CROSS	CIRCULAR	CROSS	CIRCULAR	CROSS	CIRCULAR	CROSS	CIRCULAR
Sheet Location															
Top row operator side															
Top row middle of sheet															
Top row gear side															
LAND STANDARD:															
Cross - 0.021 +/- 0.002															
Circular - 0.028 +/- 0.002															
Verify Video Micrometer															
Bottom row operator side															
Bottom row middle of sheet															
Bottom row gear side															
LAK000620023- 6/10/2021															