

TECHNICAL ASSISTANCE BULLETIN



TOPIC: PLASTIC CLOSURE QUALITY CHECKS

NUMBER: 0014 REVISION: A ISSUED: June 30th, 2021

Purpose

This bulletin is intended to define the important quality checks for our plastic closures, as well as to describe the procedures for completing the quality checks. For our TPE lined closures, pull-up, removal torque, security, and touch-off should be used together to properly gage closure application. For our linerless, plug style closures, pull-up and removal torque should be used together to properly gauge closure application. Bottle pull-up mark verification should be checked before starting to ensure you are using the correct recommended range. Touch-offs should be completed before running any new TPE lined closure and bottle finish combinations. Band break torque is an optional test that can be completed to gauge the package tamper evidence function.

Sequential Order

Quality checks should be completed in a sequential order on each package. For example, for TPE lined closures, sample 1 should be measured for Pull-up → Removal Torque → Band Break Torque (Optional) → Security before moving on to sample 2.

Sample Collection

Hot fill:

Measurements taken after capping should be completed within 1 minute. Measurements after cooling should be made immediately after packages exit the cooler provided product temperatures are no greater than 80°F (27°C).

Cold/ESL/Aseptic Fill:

Measurements should be completed at least 10 minutes after capping for accurate removal torque readings.

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Bottle Pull-up Mark Degree Verification

Bottle finishes can have different pull-up index mark positions. Index marks are measured in degrees from a fully formed thread on the bottle finish. There are three most common pull-up mark degrees, 0°, 42°, 78°. It is important to note the angle before starting your measurements as the pull-up range will change depending on the mark position.

Equipment: Correct diameter pull-up gauge, marker

Procedure:

1. With a marker, draw a line through the first fully developed portion of the thread start. See example below
2. Align the 0 point of the gauge on the fully formed thread section and record the pull-up marks between the fully formed thread and the bottle index mark (Figure 1).
 - a. A 0° bottle will be about 0, a 42° will be about 10, and a 78° will be about 16 (Figures 2-4).

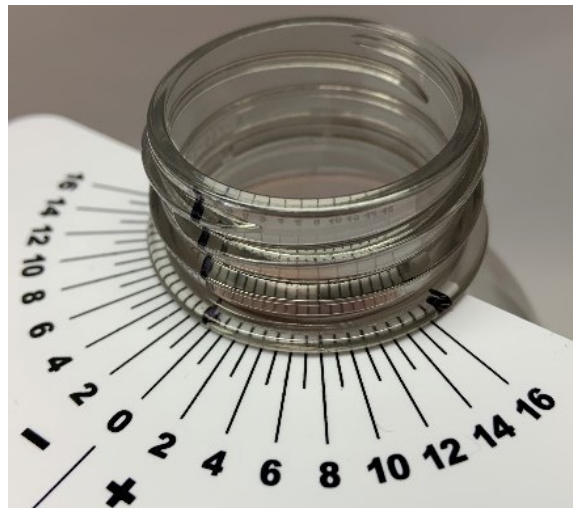


Figure 1: Proper bottle finish pull-up mark degree check on a 78° bottle finish.

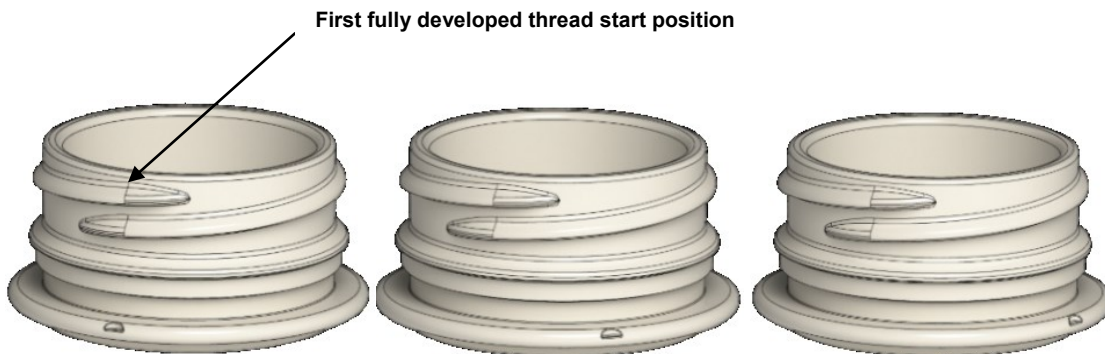


Figure 2: 0° pull-up mark bottle finish example.

Figure 3: 42° pull-up mark bottle finish example.

Figure 4: 78° pull-up mark bottle finish example.

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Pull-up

Purpose: Pull-up is the mechanical relationship of cap thread to bottle thread. It is a non-destructive test reference of closure application.

Equipment: Correct diameter pull-up gauge (Figure 5), marker.

Procedure:

1. On a fully applied closure, locate the pull-up index marks on the closure and bottle (Figure 6).
2. Make a mark from the closure to the bottle finish for TPE lined closure security checks.
3. Measure the distance between the index marks on the bottle and closure using the Pull-up gauge. The 0 point on the gauge should correspond with the index mark on the bottle transfer flange (Figure 7).
4. Record your pull-up reading. A positive pull-up will be one with the closure pull-up index mark to the right of the bottle index mark. A negative value, the closure pull-up index mark to the left of the bottle index mark.

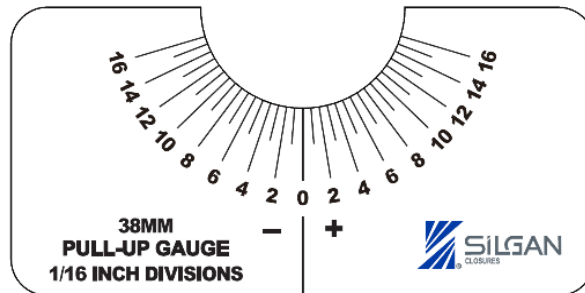


Figure 5: 38mm Pull-up Gauge to complete Pull-up checks on 38mm closures.

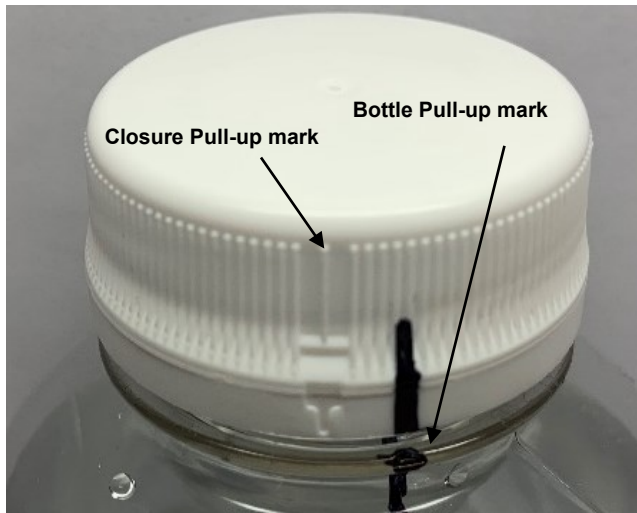


Figure 6: Closure and bottle Pull-up index mark examples.

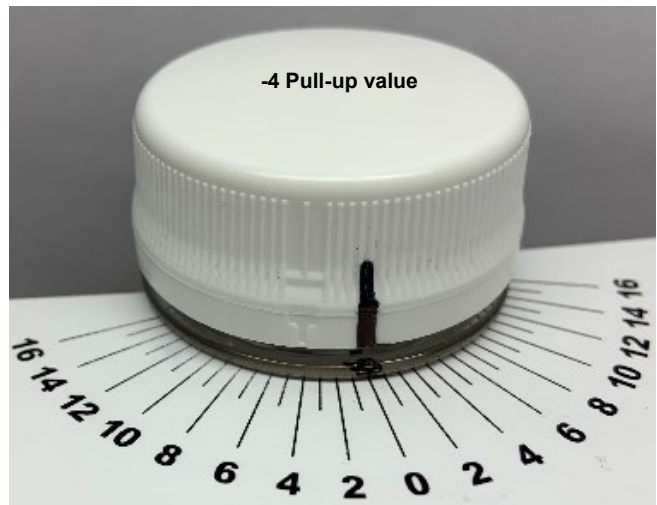


Figure 7: Proper Pull-up measurement technique

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Removal Torque

Purpose: Removal Torque, or Torque 1, is used to determine proper closure application and measure the initial torque required to rotate the closure on the bottle finish prior to breaking the Tamper Evident (TE) band.

Equipment: Removal torque meter

Procedure:

1. Tightly secure the package in a torque meter device (Figure 8). The bottle should not move when completing the opening.
2. Open the package by rotating the closure in a counter clockwise direction in a smooth, continuous motion. Only the initial torque required to move the closure on the container finish should be recorded.



Figure 8: Proper hand removal torque setup

*Recommended removal torque ranges are based on data collected by hand removal. If removal torques are going to be completed via automated removal torque opening devices, a gauge R+R study should be conducted between both methods to amend the recommended torque ranges in the closure TDS.

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Band Break Torque (Optional)

Purpose: Band Break Torque, or Torque 2, measures the peak torque required to break the bridges between the TE Band and the shell of the closure.

Equipment: Removal torque meter

Procedure:

1. After completing the Torque 1 zero the removal torque meter.
2. Open the package by rotating the closure in a counter clockwise direction in a smooth, continuous motion, until bridges break and record the peak torque (Figure 9).



Figure 9: Closure rotated until all TE band bridges are broken.

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Security (For Lined Closures Only)

Purpose: To measure the amount of liner compression and seal pressure from application.

Equipment: Pull-up Gauge, marker

Procedure:

1. Ensure that the TE Band has been completely disengaged from the closure shell.
2. Reapply the closure to 2 in-lbs.
3. Measure the distance between the closure and bottle mark made prior to completing the Pull-up check (Figure 10). This reading should always be positive. If negative, it means the package was not properly sealed.

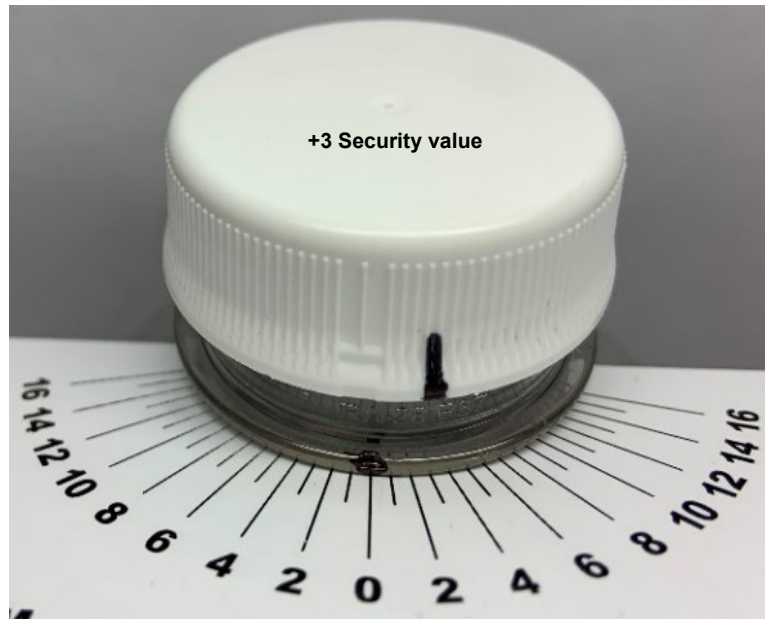


Figure 10: Proper Security measurement

Touch-Off (TPE Lined Closures Only)

Purpose: To define the recommended pull-up range for a closure and bottle combination.

Definition: A Touch-Off is the pull-up value at 2 in-lbs application on an unused closure and bottle finish combination before any liner compression occurs.

Equipment: Pull-up gauge, marker, removal torque meter

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Procedure:

1. Collect 6 unused bottles and closures, preferably bottles from different mold cavities and closures with different liner mold numbers.
2. Label the bottles and closures 1 through 6, and remove the TE bands from the closures.
3. Secure bottle 1 in the removal torque meter, and manually apply closures 1 through 6 to 2 in-lbs, recording the pull-up value for each touch off performed.
4. Next, repeat this test for bottles 2 through 6 building a 6x6 matrix with 36 total touch-offs (Figure 11).
5. Next, locate the minimum recorded touch off value in the 6x6 matrix. The minimum recommended pull-up value will be 5 pull-up marks deeper or more negative than the minimum touch off value recorded. For example, if the lowest pull-up noted in the touch off is a +1 then the minimum application pull-up value would be $1 - 5 = -4$. If the minimum touch off is +6 then the minimum application pull-up value would be $6 - 5 = +1$.
6. Next, determine the full revised pull-up range. If the original recommended pull-up range was -3 to -12 in our example above, the entire pull-up range would shift negative by 1 pull-up mark for a new pull-up range of -4 to -13. If the original range was -1 to -10, then our range would shift negative by 3 pull-up marks for a new pull-up range of -4 to -13 (Figure 12).

		Caps					
		1	2	3	4	5	6
Bottles	1	1	1	1	2	1	2
	2	1	1	1	1	1	2
	3	1	1	1	1	1	2
	4	2	2	1	2	2	3
	5	2	1	1	2	2	3
	6	2	1	1	1	2	3

Figure 11: 6x6 touch-off matrix example.

Minimum Finger Tight Pull-up	1
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Target Pull-Up Range Chart		
Minimum Finger Tight Pull-up	Minimum Application Pull-up	Maximum Application Pull-up
4	-1	-10
3	-2	-11
2	-3	-12
1	-4	-13
0	-5	-14
-1	-6	-15
-2	-7	-16
-3	-8	-17
-4	-9	-18

Figure 12: Target pull-up range calculation chart.

*For a 6x6 touch-off matrix, if the pull-up difference between minimum and maximum touch-off values exceeds 4, further investigations should be taken as this could be an indication of high closure or bottle dimensional variability.

Please contact your Silgan Sales or Technical Service Representative for additional resources on quality checks or additional closure operating guidelines. You can also visit our website @<https://silgancls.com/locations/#contacts> to submit an Information Request Form or call us at 630.515.8383.

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