4. CAN EXAMINATION AND EVALUATION PROCEDURES

4.1 Double Seam Examination and Measurement Procedures

The process of assessing the double seam embodies three aspects, each of which provides varying amounts of qualitative and quantitative information:

1) visual inspection and external measurements to provide an initial assessment of double seam integrity;
2) seam teardown to provide an assessment of tightness by conducting a tightness rating and pressure ridge evaluation; and
3) seam cross sectioning to provide an assessment of optical overlap at the point of sectioning (where optical methods are used).

4.1.1 Visual Inspection

A careful external visual examination of the can and its seams is the primary means of detecting container and seam defects:

1) Remove the label from the can.
2) Grasp the can body with one hand and rotate the double seam between the thumb and forefinger of the other hand and carefully examine the seam around the entire perimeter of both can ends.
3) Check for any double seam defects as described in Chapter 7.
4) Ensure that the can ends, body and side seam are also inspected for possible defects. See Section 4.2.

4.1.2 External Seam Measurements

(a) Points of Seam Measurements

All measurements should be recorded and the can marked in such a way that these external measurements can be directly related to the corresponding internal (teardown) measurements when the body hook and end hook are no longer engaged. It is most useful to take seam measurements at the points which indicate possible problems, such as sharp seams or excessive thickness. Averaging of double seam dimensions must not be done. Measurements are not usually taken at the crossover.

Round Cans

Seam measurements on round cans should be made at three points around the circumference of the can. Record the measurements which are approximately 120 degrees apart and at least one-half inch away from the side seam crossover of a three piece can.

Non-round Cans

Seam dimensions of non-round cans are measured using the same method as for round cans; however, due to the irregular shapes of non-round cans, measurements should be taken at additional points as indicated in figure 4.1.2.a. (Individual can makers publish guidelines which may specify alternate points which provide equivalent assurances of seam quality.) Additional points may also be cut, especially where irregularities are noted. Cans having a key tab must also have measurements taken at the centre of, and immediately adjacent to, the tab.

Most 'hidden' defects (those that are not immediately obvious during visual examination of the double seam) manifest themselves by an increased thickness measurement at the defect. Therefore, after visually examining a double seam for obvious defects, a seam micrometer should be guided around the entire periphery of the can to determine excessively thick measurements. These points should be marked, the length and thickness measurements recorded, and a seam section cut (Section 4.1.4.c) to show the seam profile. In this manner, a number of sections/measurements could be obtained from the points of concern. 'Routine' measurements could then be obtained from the remaining portion of the double seam. It is imperative (when this initial examination method is employed) that diagrams, demonstrating where the sections/measurements were taken, be constructed in order that common problem locations can be identified.

In cases where this initial examination reveals no seam thickness profile anomalies, the points for suggested routine length and thickness measurements for the various non-round shaped cans are illustrated in Figure 4.1.2.a.

Key-open non-round cans have an extra metal thickness at the tab. Specific can seam dimensional guidelines obtainable from the manufacturer should be used to evaluate this part of the seam. Measure in the same way as any other can.

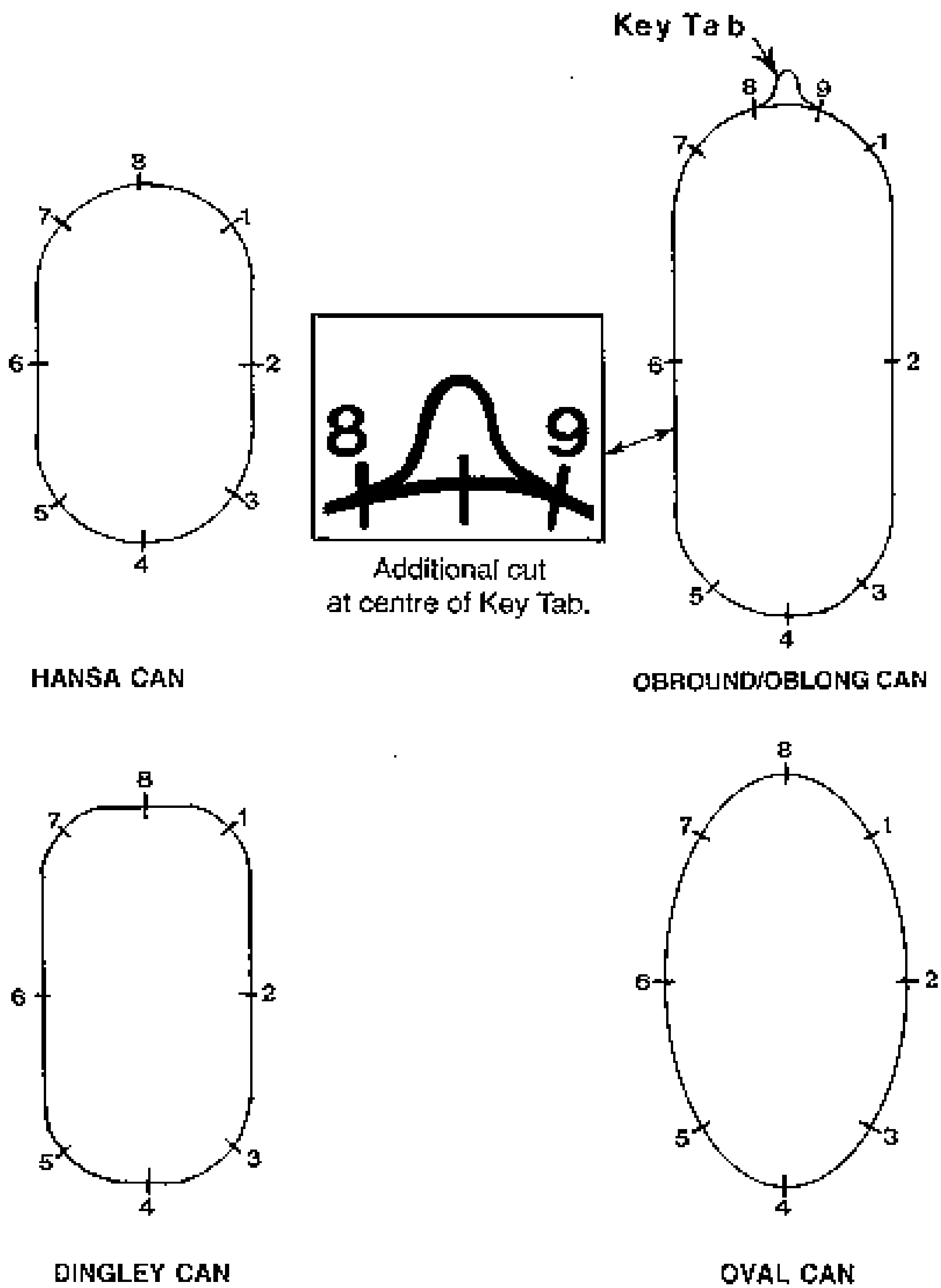
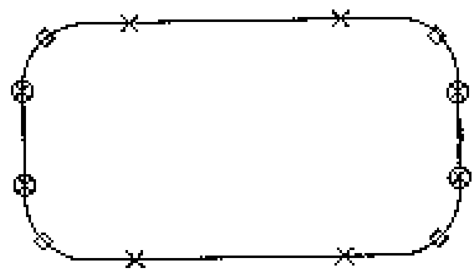


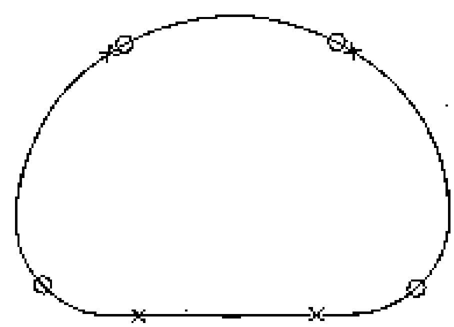
Figure 4.1.2.a - Suggested Points of Routine Measurement on Non-round Cans

Note: Measurements should be taken as identified in published can maker's guidelines. These guidelines may specify alternate points and frequencies which provide equivalent assurance of the seam quality.



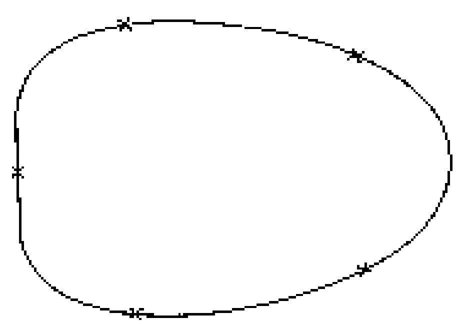
a) X = seam thickness, length and end hook (measure adjacent to corner radius).
b) ☐ = body hook and countersink
c) ⊗ = at set-up or when problem is noted, thickness, length and end hook should also be measured on the side seam side and side opposite.
d) Overlap - measure at maximum measured seam length away from corners.

Rectangular and Square Meat Cans



a) X = seam thickness, length, body hook and end hook.
b) ○ = Countersink
c) Overlap - measure at maximum measured seam length away from corners

"D" Shaped Meat Cans



a) X = seam thickness, length, body hook, end hook and countersink
b) Overlap - measure at maximum measured seam length away from corners

Irregular Shaped Meat Cans

Figure 4.1.2.b - Suggested Points of Measurement on Non-round Meat Cans

Note: Measurements should be taken as identified in the can maker's guidelines. These guidelines may specify alternate points and frequencies which provide equivalent assurance of the seam quality.

(b) Seam Length Measurement - Hold the flat surface of the micrometer against the can body as shown in Figure 4.1.2.c.

When using the micrometer, remember to:

1) Make sure it is zeroed. This is done by closing the moveable shaft onto the stationary anvil (zero position). The zero gradation mark on the rotatable barrel should match exactly with the index line on the stationary body member. If the zero gradation mark is more than one-half a division of the smallest graduations from the index line, an adjustment to the micrometer is required.
2) Hold at a right angle to the seam.
3) Do not overtighten.

Figure 4.1.2.c - Seam Length Measurement

(c) Seam Thickness Measurement - Balance the micrometer with the index finger immediately above the seam until the anvil assumes the same angle as the taper of the countersink wall as shown in Figure 4.1.2.d.

Figure 4.1.2.d - Seam Thickness Measurement

(d) Countersink Depth Measurement - Prior to using the countersink gauge, ensure that the point is tightly screwed onto the shaft. Place the bar of the gauge on a flat surface, preferably a block of machined steel large enough to detect warps in the bar (the bar of a second countersink gauge is useful for this purpose). In this position the point of the gauge is at the zero position and the dial of the gauge should also read zero. To adjust the "zero" on the dial, loosen the knurled screw near the top of the dial, rotate the outer scale until the zero and the indicator coincide, and tighten the screw to lock the gauge at the zero position.

Rest the bar of the depth gauge on top of the seam across the top of the can as shown in Figure 4.1.2.e. Position the point of the depth gauge pin (shaft) at the lowest point adjacent to the countersink wall (but away from the crossover of three piece cans) as shown in Figure 4.1.2.f.

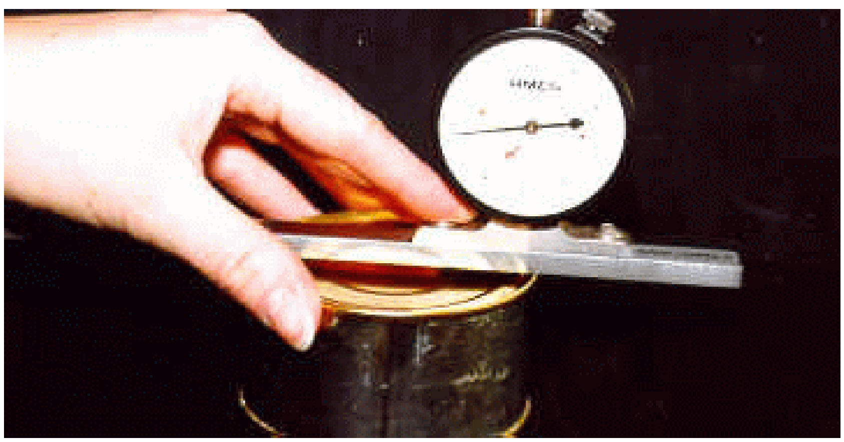


Figure 4.1.2.e - Countersink Gauge

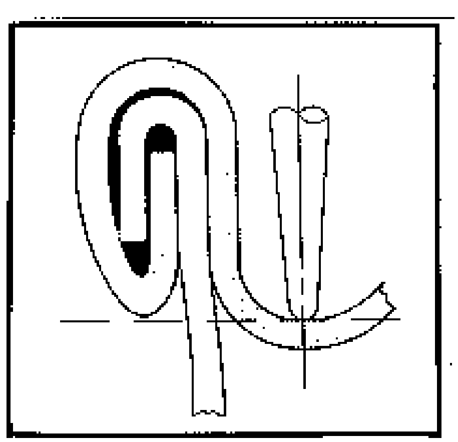


Figure 4.1.2.f - Position of Countersink Gauge Point

4.1.3 Seam Teardown and Internal Measurements

By tearing down the double seam, the following internal parameters may be measured and evaluated: tightness rating, body hook, end hook, internal droop, pressure ridge, crossover rating and jumped seam. These internal measurements must correspond to their respective external measurements (length, width, etc.), thus it is necessary to mark the can appropriately prior to teardown.

It is extremely important to recognize and understand that the quality of the double seams cannot always be judged on measured dimensions alone. Visual inspection for tightness and visible abnormalities are equally important. Dimensions outside the can maker's guidelines do not necessarily mean that seam integrity is compromised. It means that the seam should be carefully evaluated. Final judgement must be based on the amount of deviation along with all of the other measurements and observations.

Can makers supply guidelines to their customers and indicate frequency of tests as well as points of measurement. These can makers' guidelines recognize the need to check certain attributes at certain points on the can. Not all tests need to be performed at every check.

(a) Cut out the centre section of the can end (with either a sanitary type can opener or with tin snips) approximately 1 cm (3/8") from the double seam as shown in Figure 4.1.3.a. In the case of the FPEO pull tab can, the hole cutting/trimming is eliminated by simply pulling the tab and removing the can end.

Figure 4.1.3.a - Removing Centre of Can End

(b) Remove the remainder of the can end using nippers as shown in Figure 4.1.3.b.

Figure 4.1.3.b - Removing Can End

(c) Cut through the double seam at least one inch from the side seam lap using the nippers as shown in Figure 4.1.3.c.

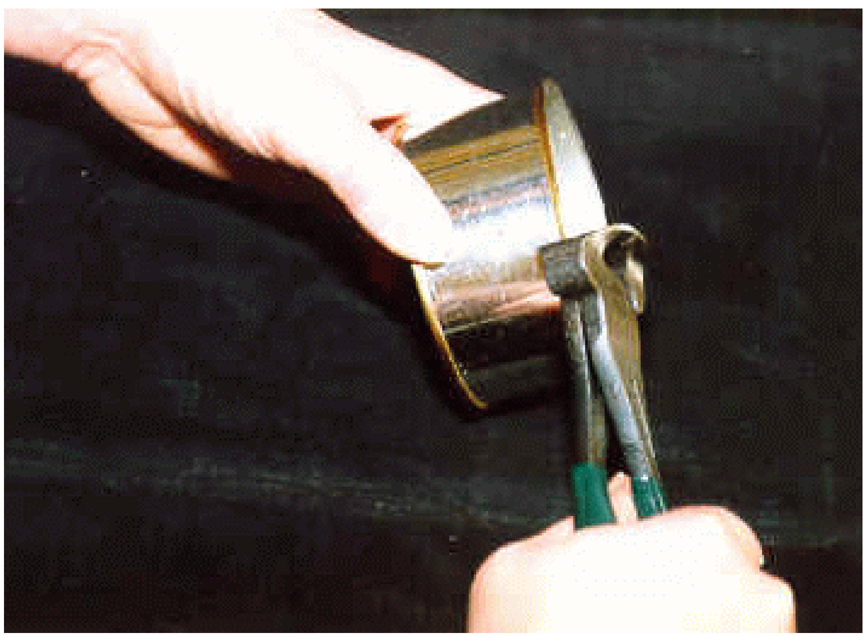
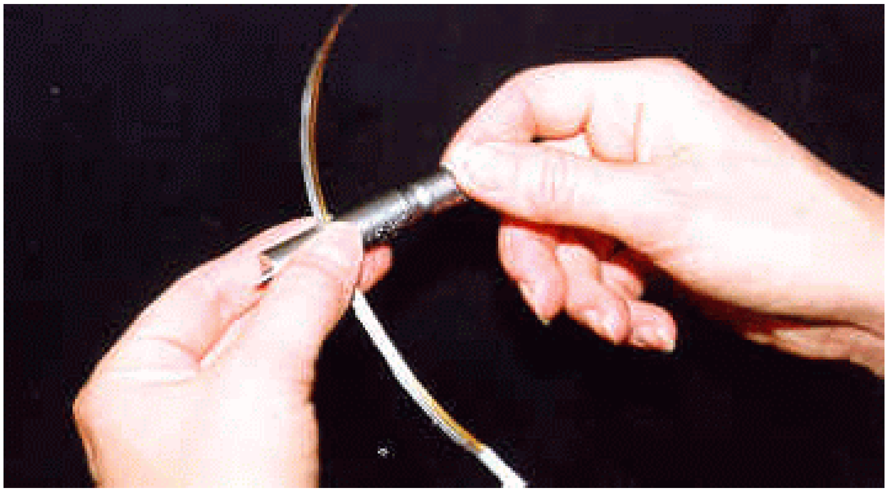


Figure 4.1.3.c - Double Seam Cutting

(d) Remove the stripped part of the end by gently tapping with the nippers as shown in Figure 4.1.3.d. Take care not to distort the can body hook.

Figure 4.1.3.d - Removing Stripped Part of End

(e) Measure the end hook length using the seam micrometer as shown in Figure 4.1.3.e.



\ **Figure 4.1.3.e - End Hook Measurement**

(f) Measure the body hook length using the seam micrometer as shown in Figure 4.1.3.f.

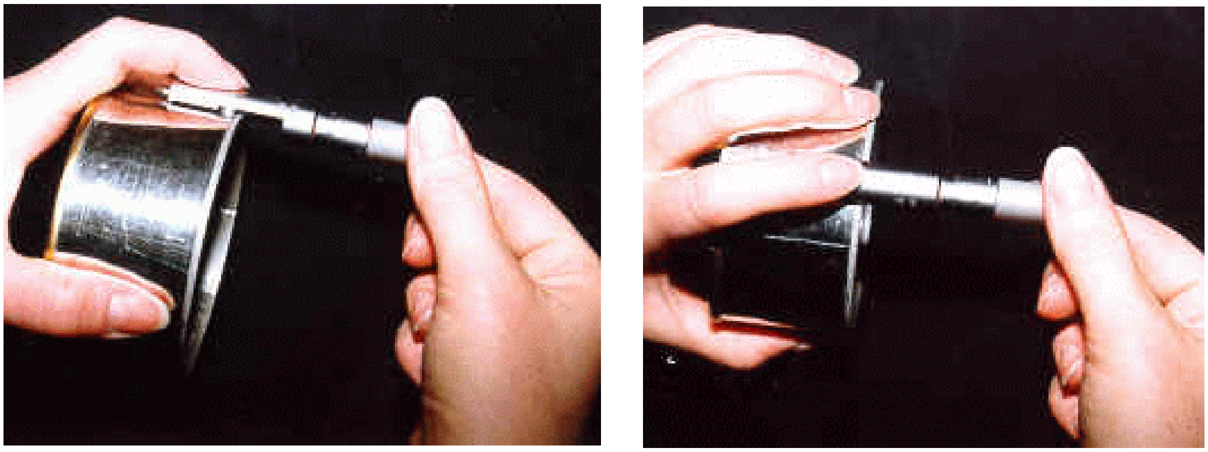


Figure 4.1.3.f - Body Hook Measurement

(g) Inspect the pressure area on the inside of the can body near the bottom of the double seam as shown in Figure 4.1.3.g. The pressure ridge should appear as a continuous and visible impression (but not excessively deep) around the inside periphery of the can body (see section 3.5.2 for further information on pressure ridge).

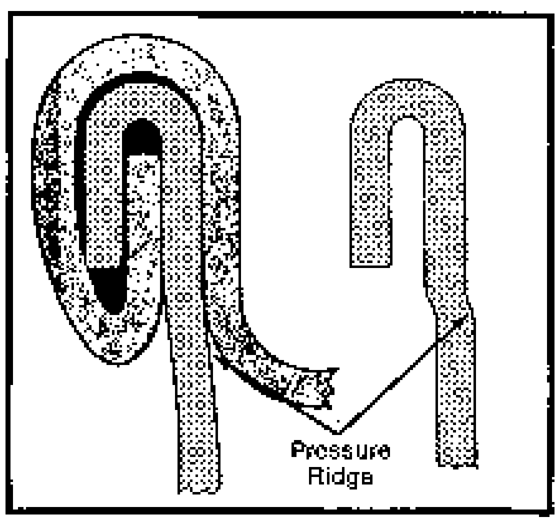


Figure 4.1.3.g - Pressure Ridge/Area

(h) Inspect the inside of the end hook and assess the wrinkles in terms of the tightness rating.

Due to the nature of the seaming process, wrinkle formation on the end hook during the first operation seaming process is unavoidable especially in the case of non-round cans where there is a sharp change in the radius of the seam. These wrinkles should be ironed out during the second operation.

The wrinkles remaining at the end of the second operation may be either LOOSENESS WRINKLES or GHOST WRINKLES. The ability to differentiate between these two wrinkles is required in order to estimate tightness, as only looseness wrinkles are assessed.

Looseness Wrinkles

The presence of looseness wrinkles indicates incomplete tightness in the double seam.

These wrinkles have three dimensions:

1) length - the distance the wrinkle extends from the edge of the end hook to where it fades out toward the end hook radius;
2) depth - the distance the wrinkle projects from the face of the end hook toward the can body; and
3) width - the distance the wrinkle extends along the cut edge of the end hook, i.e., its circumferential length.

As the double seam becomes tighter these dimensions decrease. The length of any looseness wrinkles remaining after the second operation may be visually estimated and used as an indication of the double seam tightness provided that other seam parameters are within the double seam guidelines. By grading residual wrinkles in a normally formed seam, a reliable method of estimating seam tightness has been established.

There are various ways of expressing the tightness rating (see Figure 4.1.3.h and Table 4.1.3). The most commonly used North American system is % Tightness which is the estimated ratio of the length of smooth (unwrinkled) portion of end hook compared to the end hook length, expressed as a percent. The tightness rating is based on the length of the longest looseness wrinkle on the entire end hook. Looseness is the opposite of the tightness rating (e.g., 60% tightness rating is equivalent to 40% looseness).

$$\% \text{ Tightness} = \frac{\text{Length of Unwrinkled End Hook (A)} \times 100}{\text{End Hook Length (B)}}$$

Since a looseness wrinkle has three dimensions, the classification of the tightness should not be based only on the length of the wrinkle. It should also take into account the depth and width of the wrinkle. One of the ways of overcoming the problem of evaluating the double seam tightness would be to also evaluate the free-space and the percent compactness, according to the specifications provided by the can maker.

$$\% \text{ compactness} = \frac{3 \text{ x end plate thickness} + 2 \text{ x body plate thickness}}{\text{double seam thickness}} \text{ x } 100$$

The minimum acceptable percent compactness is 75% in the prime sealing area.

Ghost Wrinkles

Ghost wrinkles have length and width but no depth. The face of the hook is smooth indicating that the double seam has been suitably compressed or ironed out. These "wrinkles" are usually the remains, i.e., shadows of second operation wrinkles that have been completely ironed out. They may also be indicative that compound between the body hook and cover hook was highly compressed. In either event, since the end hook is smooth, ghost wrinkles are not indicative of looseness.

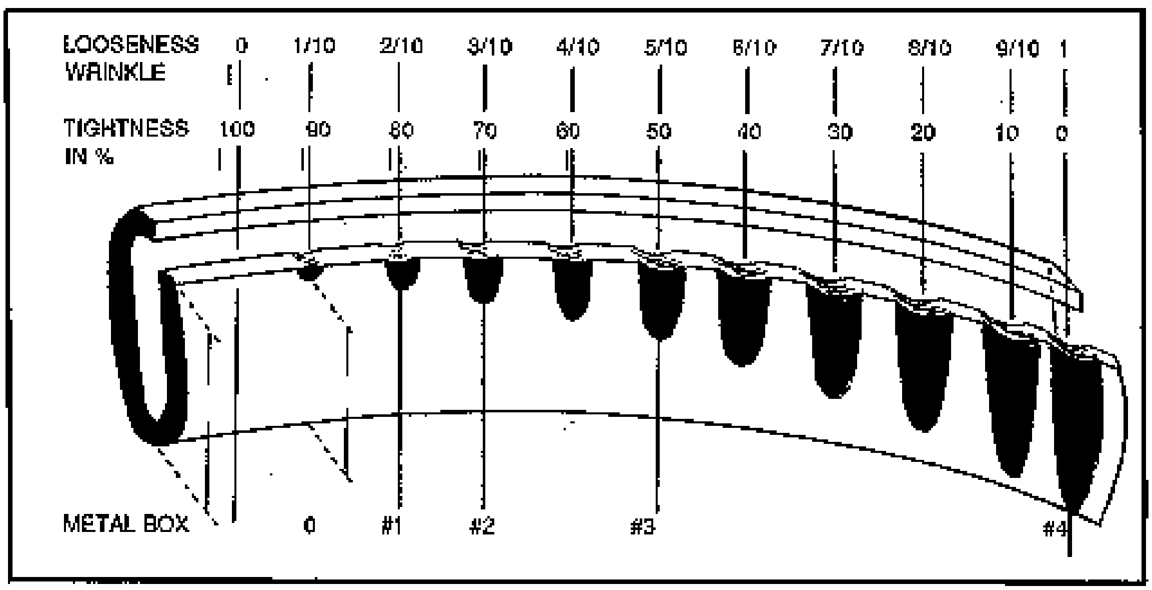


Figure 4.1.3.h - Tightness Rating

LOOSENESS WRINKLE	TIGHTNESS RATING	
	% TIGHTNESS	METAL BOX CO.
ZERO	100	0
1/10	90	0
1/8	-	1
2/10	80	1
1/4	75	2
3/10	70	2
3/8	-	3
4/10	60	3
1/2	50	3
6/10	40	4
7/10	30	4
8/10	20	4
9/10	10	4
FULL LENGTH	0	4

* Looseness wrinkle length expressed as a fraction of the end hook length

Table 4.1.3 - Different Methods For Expressing Tightness Rating

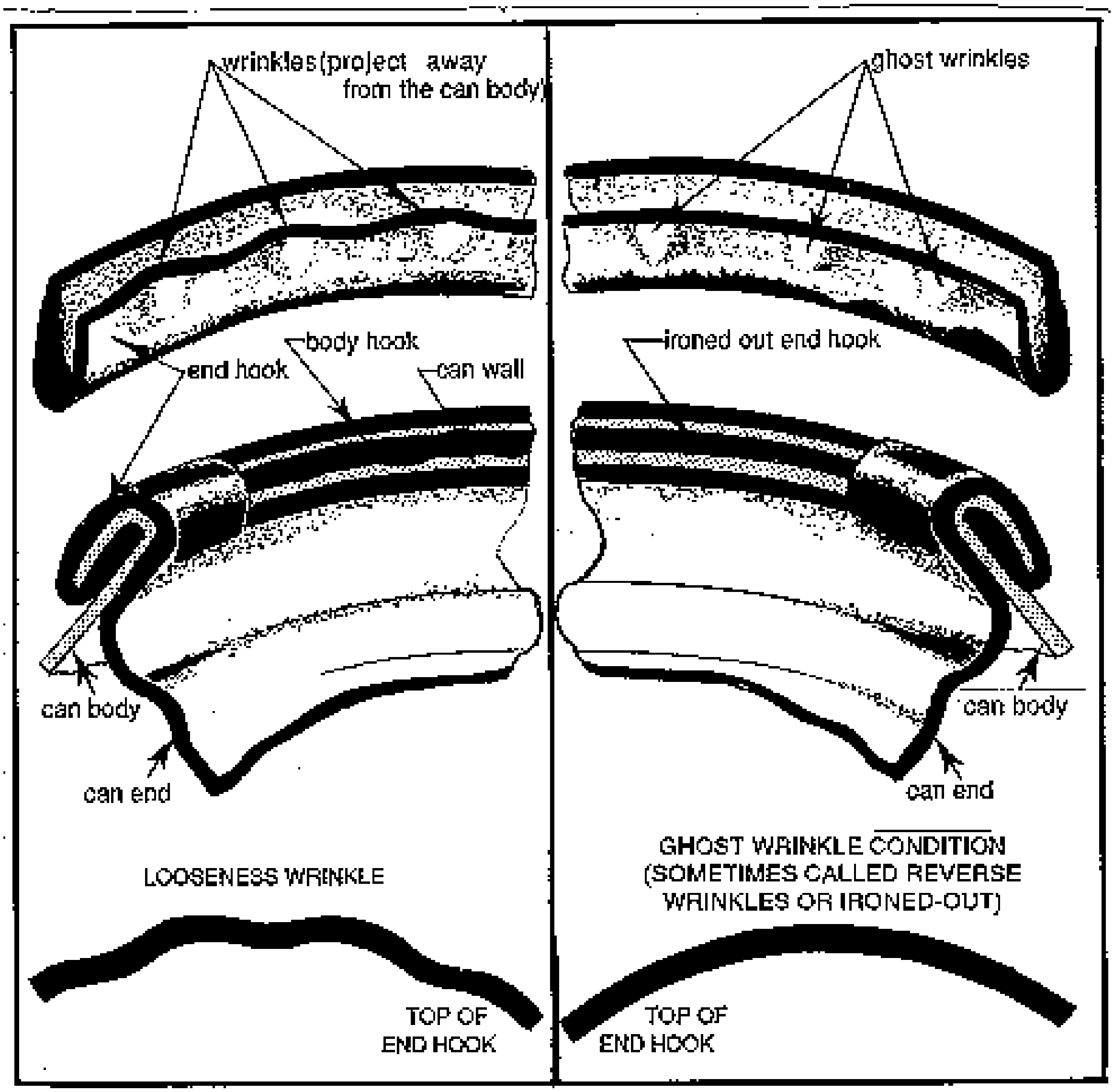


Figure 4.1.3.i - End Hook Tightness

Tightness Rating - Non-Round Cans

In the case of non-round cans, there will be differences in the tightness rating at different points on the seam perimeter. In areas of the seam where the perimeter is straight, the tightness can be expected to be similar to that found in round cans. However, where there is a sharp change in seam radius at corners, there is necessarily less tightness as the curve radius is quite small and a relatively large amount of metal must be bent and accommodated in this radius. The setup aim must result in a tightness rating which will meet the accepted can manufacturer's guidelines for the specific can and can end; efforts to improve this are apt to lead to seam defects such as vees or cutovers. When cans are encountered with loose seams (see LOOSE SEAMS 7.5.15), several considerations must be taken into account:

1) The quality and tightness of the seam at the straight profile areas; if the seam at this portion of the profile is of low quality, the significance of extensive wrinkles at a corner is greater than with a good quality straight seam, as this indicates that the producer has little control over the overall seam quality, and the wrinkles may not be solely the result of the small radius.

2) For non-round cans exhibiting marginal seam tightness on the corners, the presence of a pressure ridge should be a major factor in determining acceptability of the seam. In combination with excessive wrinkle length and bowed seams, the lack of a pressure ridge may indicate insufficient seam tightness.

3) The presence of seam defects or out of specification seam dimensions; as in all seams, the presence of defects or dimensions outside specifications should be heavily weighed when judging the acceptability of seam tightness in non-round cans. The combination of excessive wrinkle length and dimensions outside of specifications (especially thickness) or seam defects will normally result in an unacceptably loose seam.

4) The flatness of the end and body hooks; curved or bowed end hooks or body hooks may produce an unacceptably loose seam while still producing an acceptable pressure ridge and an acceptable wrinkle length (this will usually result in the thickness of the seam being out of specification).

(i) Inspect the inside of the end hook on either side of the crossover of three piece cans for looseness indicative of a jumped seam, as shown in Figure 4.1.3.j. (See section 7.5.8 - JUMPED SEAM.)

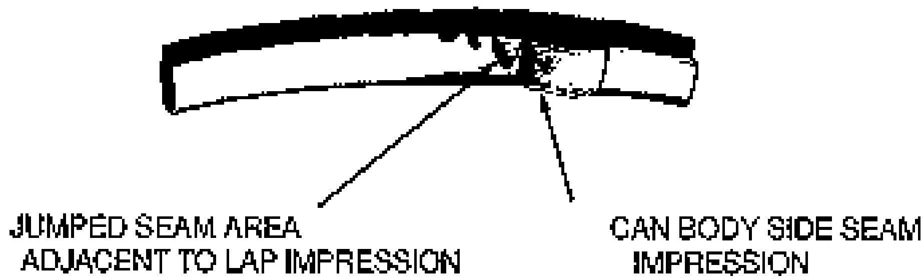


Figure 4.1.3.j - Jumped Seam

(j) Inspect the inside of the end hook at the crossover of three piece cans for the amount of internal crossover droop (juncture rating) as shown in Figure 4.1.3.k. The amount of internal droop at this point should not exceed accepted can maker's guidelines.

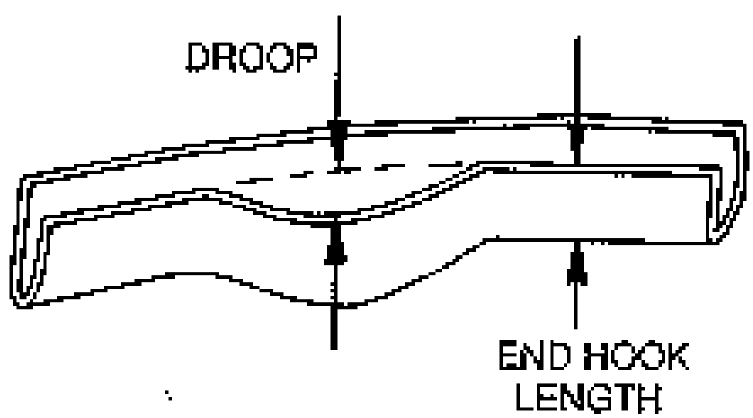


Figure 4.1.3.k - Internal Crossover Droop

(k) Determine the plate gauge thickness by removing the enamel coatings of a section of end plate; methyl ethyl ketone or steel wool may be used. Measure the end plate thickness using a micrometer with a domed anvil. DO NOT USE THE DOUBLE SEAM MICROMETER.

(l) Optical (Actual) Overlap - Optical overlap measurements using a seam saw and seam projector will provide the actual overlap at the point of cross sectioning (see Section 4.1.4).

$$\% \text{ OVERLAP} = \frac{\text{OPTICAL OVERLAP}}{\text{INTERNAL SEAM LENGTH}} \times 100$$

TECHNICAL NOTE:

The presence of the key tab adds an extra layer of metal to the double seam in the tab area. This will result in a corresponding reduction in overlap. The overlap in the key tab area must comply with the minimum length in the accepted can maker's guidelines.

(m) Calculation of Theoretical Overlap - It should be noted that use of the calculation for theoretical overlap has more variability and has been demonstrated to both overestimate and underestimate the actual overlap as measured optically. There is no accurate substitute for optical measurement. For those who wish to include this factor in their records, a theoretical overlap may be calculated as follows:

Calculated Overlap = Body hook
+ End hook
+ End plate thickness
- Seam length

To determine the theoretical overlap, an adjustment factor is added to the calculated overlap. The following table of adjustment factors used by the B.C. Salmon Canning Industry is included as an example.

CALCULATED OVERLAP		ADJUSTMENT FACTOR	
Imperial	Metric	Imperial	Metric
under 0.030"	0.76 mm	0.008"	0.20 mm
0.030" to 0.039	0.76 to 0.99	0.007"	0.18 mm
0.040" to 0.049	1.00 to 1.24	0.005"	0.13 mm
Over 0.050"	1.27 mm	0.002"	0.05 mm

4.1.4 Seam Cross Sectioning And Direct Internal Measurements

In routine teardown examinations of a double seam, both teardown and optical methods may be used for routine measurements. In routine destructive examinations of a double seam, either method, teardown or cross section, is acceptable to determine seam tightness and overlap/seam profile respectively.

The use of theoretical overlap is not an accurate substitute for optical overlap. Teardowns or cross sections are carried out individually on different sample units or alternatively may be carried out on the same unit utilizing more than 1 unit if needed to attain the suggested number of measurement points.

(a) Cross Sectioning - The preparation of double seam cross sections provides direct measurement of the seam dimensions and integrity factors such as actual overlap and percent body hook butting. Cross sections can be prepared by either filing, sawing with a hand-held jeweller's saw, or sawing using a double or single blade seam saw.

The type, size and location of defect, as well as whether the inspection is being carried out in the field or lab will determine which method(s) is/are best suited. For example, a file would be useful for field inspections, and where a saw (hand held or electric), is not readily available. A jeweller's saw would be useful for field inspections and where use of an electric seam saw might totally obliterate the defect; that is, a cut made by the seam saw is wider than the total width of the defect at the point of occurrence.

Filing - Cut across the double seam by filing at right angles to the seam using a flat file having a safe edge. Hold the file so that the safe edge is against the proposed cross section which will minimize the tendency to produce a burr on the can.

Jeweller's Saw - Cut sections of the seam using a jeweller's saw, from points on the seam appropriate to the type of container, or from seam defects which have tentatively been identified/rated visually. Use the jeweller's saw so that the cutting motion is only made in the direction of the teeth and not with a back and forth motion. The blade must be tight in the saw frame and the blade moved through the cutting motion with a light but steady downward pressure. Proficient use of the jeweller's saw will come with practice. Make two cuts into the can body and end, one of which passes through the center of the defective area. Once the seam cuts have been completed, remove the seam section by snipping the body and end plate with a pair of snippers.

Seam Saw - For round cans, cut sections of the seam using a double blade seam saw (Figure 4.1.4.a), from three points which are approximately 120 degrees apart and approximately one inch away from the side seam crossover. For non-round cans, the seam sections would be cut at the points identified in Figure 4.1.2.a.

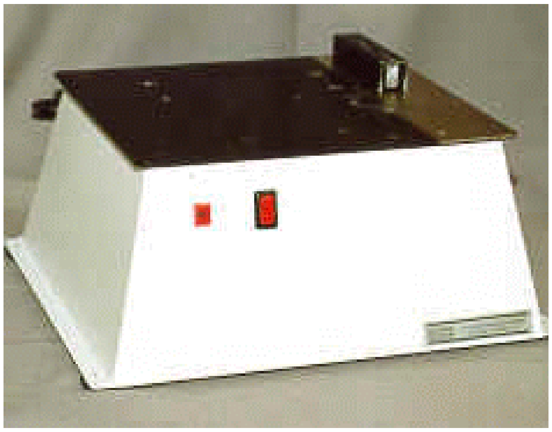


Figure 4.1.4.a - Seam Saw

(b) Seam Projection - Clean/polish the seam section with either a fine stone or emery cloth.

Seam Projector - Ensure that the machine is properly calibrated as per manufacturer's instructions. Clamp the section in position on the seam projector, Figure 4.1.4.b. Project the double seam image and use the calipers in the instrument to directly measure the overlap, the body hook, end hook, and internal seam length as shown in Figure 4.1.4.c.

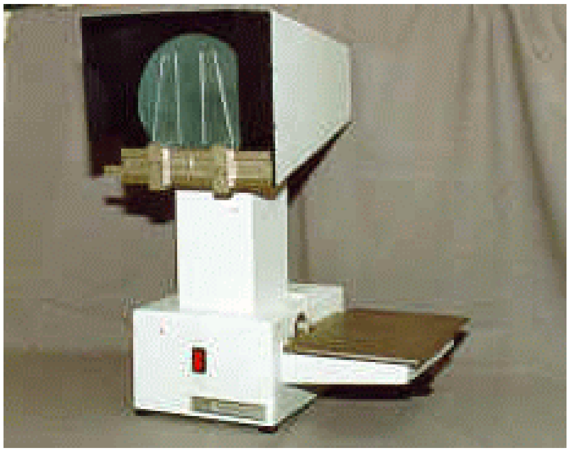


Figure 4.1.4.b - Seam Projector

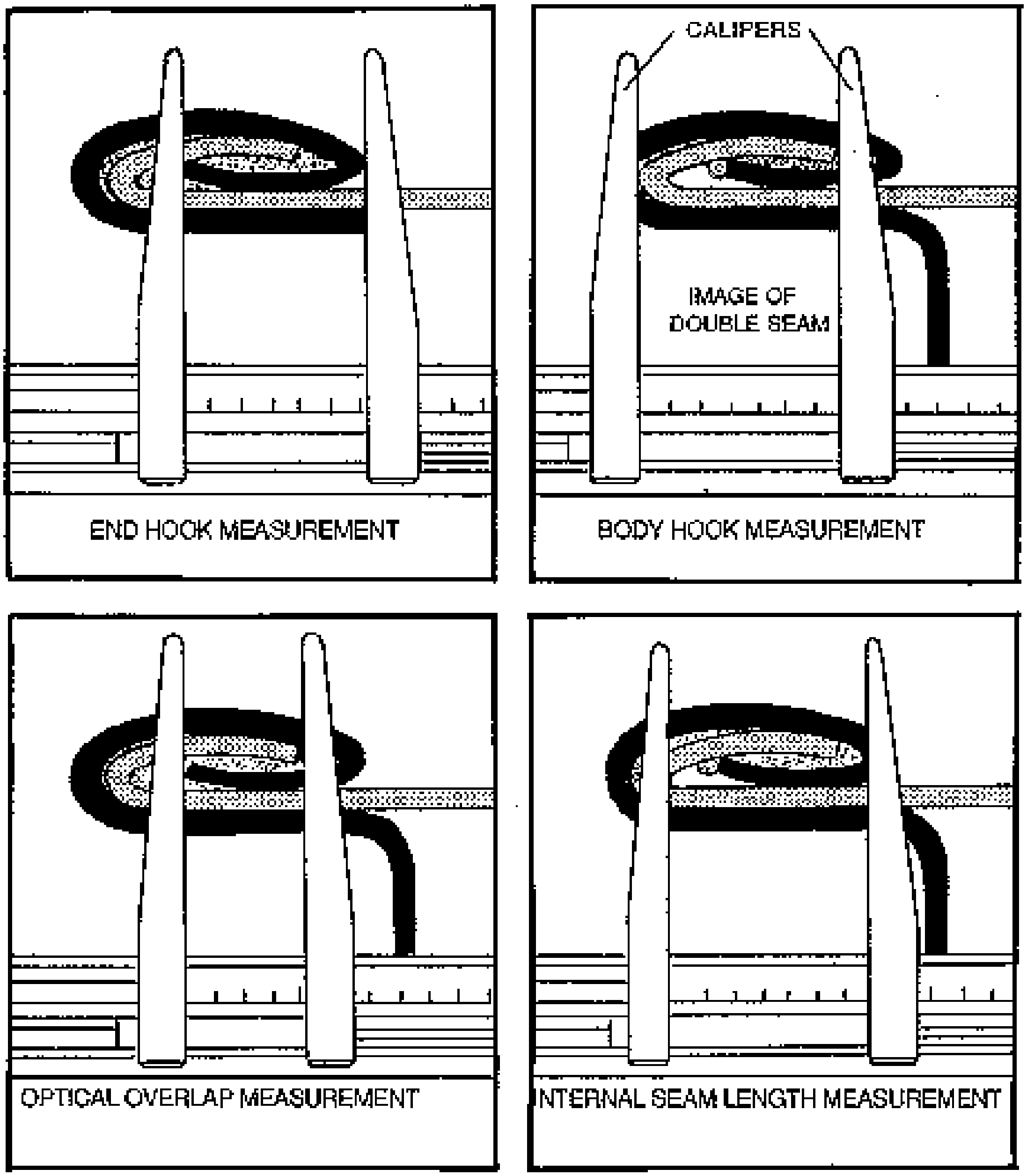
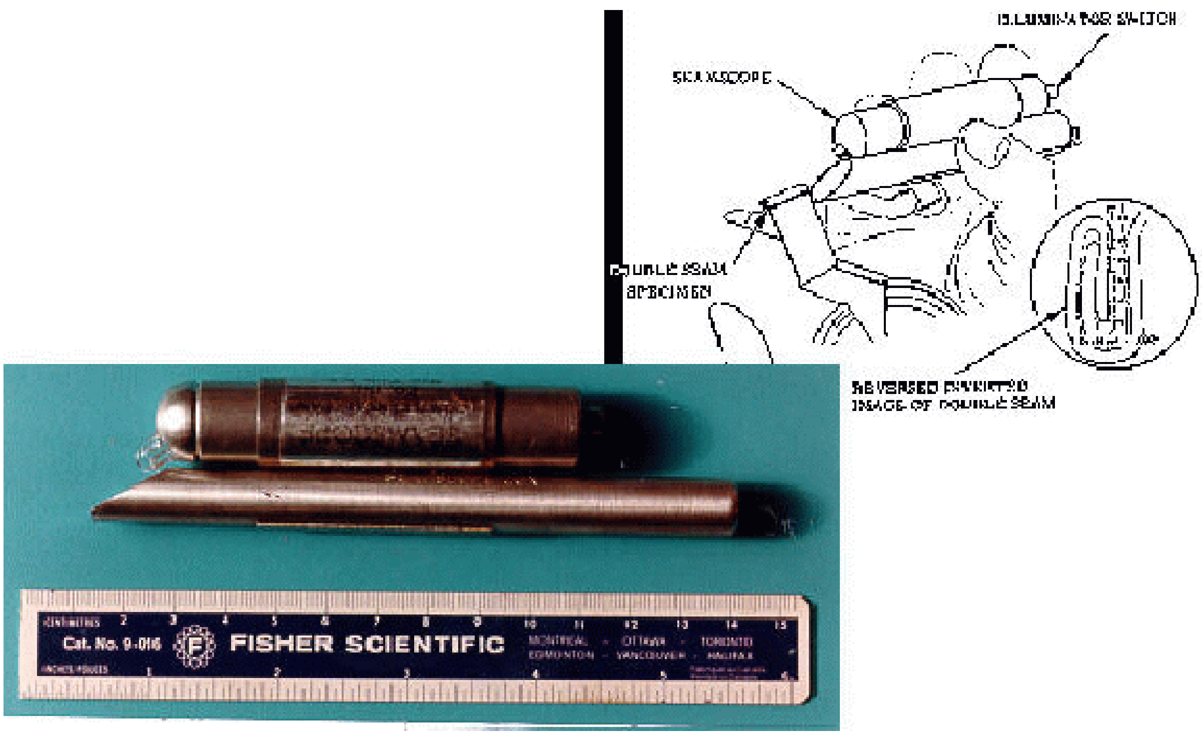


Figure 4.1.4.c - Double Seam Image Measurements

<u>Hand Held (Pocket) Seam Scope</u> - Position the seam section in an inverted position on the tip of your thumb and forefinger, then position the bevelled end of the pocket seam scope next to the seam piece in such a manner that the seam piece is within the field of vision and in focus. If measurements are to be taken of any of the seam parameters, position the graduated scale so that the scale and seam piece are in focus and the particular parameter being measured is incorporated within the scale range (1 Division on the scale = .002"). Good illumination of the seam section is required when using the pocket seam scope.

<u>TECHNICAL NOTE</u>:

If the seam parameter being measured indicates a borderline accept/reject situation, the observations made with the pocket seam scope should be confirmed through use of the more accurate seam projector.



<u>Figure 4.1.4.d - Pocket Seam Scope</u>

(c) <u>Seam Evaluation</u> - Remove the end hook from the balance of the double seam and check the pressure ridge, evidence of jumped seam, juncture rating, and tightness rating as per Section 4.1.3(g) to (j).

4.1.5 Double Seam Guidelines

The can manufacturer provides a guideline for each can size and style outlining the seam measurements and tolerances for which the double seam was designed to ensure an hermetic container. Inspection procedures must be implemented which enable the can manufacturer or the cannery to hold for investigation (HFI), any product which does not comply with accepted guidelines.

These can maker's guidelines will vary according to whether the cans are steel or aluminum, two or three piece, soldered or welded, and round or non-round. An example of HFI guidelines for three piece round sanitary cans is included in Table 4.1.5. These tentative double seam dimensional guidelines provide HFI limits for round sanitary food cans used by North American manufacturers. These guidelines are not necessarily applicable to cans of other shapes or manufacture.

It is extremely important to remember that the quality of double seams cannot be judged on dimensions alone. Visual inspection for tightness and for any visible abnormalities is equally important.

When one or more measurements fall outside the adjustment limits, check another sample immediately. If it too is outside the limits, take whatever corrective action is indicated.

Dimensions outside of the adjustment limits do not necessarily mean that the seam is unacceptable. This means that you must decide if the seam is adequate. Final judgement must be based on the amount of deviation along with all of the other measurements and observations.

In making your determination, the prime considerations are overlap and tightness. The seam may be considered satisfactory when overlap and tightness are within adjustment limits and other dimensions are within hold for investigate limits with no serious defects and the seam is properly formed.

When the total seam evaluation indicates questionable performance, the cans should be held for further investigation such as sorting, leakage tests, incubation for spoilage, or simply holding to determine whether any spoilage develops. The type of action required depends upon the circumstances.

EXAMPLE OF RECOMMENDED DOUBLE SEAM MEASUREMENT

STANDARDS FOR THREE-PIECE SANITARY CANS
English Dimensions

EVALUATING DOUBLE SEAM TIGHTNESS

ITEM	NOMINAL DIAMETER	SET UP AIM	OPERATING LIMIT	HOLD FOR INVESTIGATION STEEL ENDS	ALUM.ENDS
Body hook	202	.075 - .080	.075 ± .008	n/a	n/a
Length	207.5-401	.080 - .085	.080 ± .008	n/a	n/a
(note 1)	404-603	.082 - .087	.082 ± .010	n/a	n/a
End hook	202-211	-	.65 Min.	n/a	n/a
Length	300-401	-	.070 Min.	n/a	n/a
(note 2)	404-603	-	.075 Min.	n/a	n/a
Optical	202	-	.035 Min.	.030 Min.	.030 Min.
Overlap	207.5-211	-	.040 Min.	.030 Min.	.030 Min.
	300-303	-	.040 Min.	.035 Min.	[not developed]
	307-401	-	.045 Min.	.035 Min.	.035 Min.
	404	-	.045 Min.	.035 Min.	.035 Min.
	502-610	-	.050 Min.	.035 Min.	[not developed]
%	202-401	80-100%	70-100%	60% or less	70% or less
Tightness	404	90-100%	80-100%	60% or less	70% or less
	502	90-100%	80-100%	70% or less	[not developed]
	603-610	90-100%	90-100%	70% or less	[not developed]

note 1: Based on the highest and lowest readings obtained on a can sample.
note 2: Based on the lowest reading obtained on a can.

Information source: Can Manufacturers Institute - Voluntary Industry Can Standards

TABLE 4.1.5 An Example of Double Seam Measurement Guidelines for Hold for Investigation Levels in Three Piece Round Sanitary Food Cans

4.2 Can Examination & Evaluation Procedures

4.2.1 Filled Can Inspection

After the double seams are inspected as per section 4.1.1, the rest of the can should be inspected prior to teardown. The following points provide a checklist.

a) Inspect the metal plate for flaws or damage. Areas susceptible to metal fracture include scorelines, pull tab rivet, embossing, and panel steps.

b) Inspect the side seam of welded or soldered cans.

c) Ensure the ends are not distended. For vacuum-packed products, under constant conditions of fill and closure, the end deflection or centre panel depth may be used as an indicator of internal vacuum. It should be recognized that end deflections of empty cans vary considerably and may influence the end deflection of the closed can. Temperature also affects the end deflection.

End deflection is a measure from the top edge of the double seam to the geometric centre of the end. A calibrated gauge, similar to the countersink gauge, is used by resting the bar along the top of the seam and away from the crossover. The point of the gauge is positioned at the approximate centre of the can end. Ensure that the embossed coding does not interfere with the measurement.

d) Check that the can does not feel light, hollow, or dry. The weight of the can in comparison to an average weight can will provide an indication of whether or not the can may have leaked.

4.2.2 Pressure Testing

Pressure testing may be used as part of a container integrity examination. This is a test by which a standard pressure of air is forced into the can by means of a special instrument used specifically for this purpose.

This test is most commonly applied to emptied cans. The can bodies must be completely dry and the compound lining free from oil and water before and during pressure testing. The can is then placed right side up in the pressure testing instrument and submerged in water. By placing the can right side up, all the critical areas of the can are exposed to the pressure including the scoreline, the double seam, and the pull tab rivet. Pressure must be increased slowly and the cans must show no sign of leakage below 69 kPa (10 psig). If a can leaks below 69 kPa (10 psig) pressure, a serious defect is considered to exist and further investigations must be conducted to determine the source of that defect. For cans which are not intended to hold vacuum, non-round or cans with easy-open scoreline features, a maximum pressure of 48 kPa (7 psig) should be used.

These tests may be used to aid in the detection of hidden defects, but a successful leakage test (i.e., the can does not leak) does not in any way lessen the seriousness of any other defect which may be present. There may be instances when this factor becomes of paramount importance and should be included in a risk assessment.

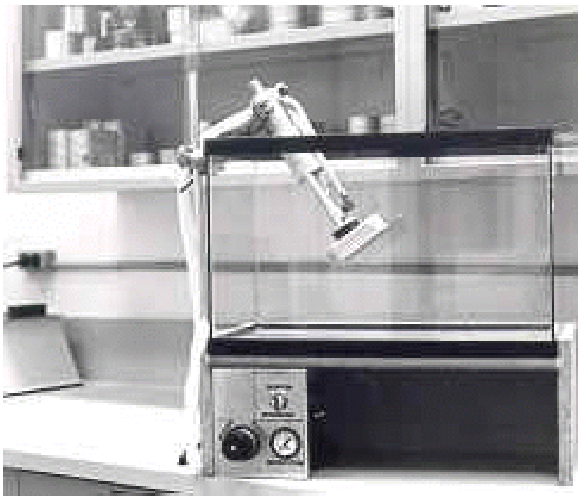


Figure 4.2.2 - Pressure Testing Device

4.2.3 Vacuum Testing

Leakage testing can also be conducted by drawing a vacuum on a clean empty can, utilizing appropriate equipment and conditions to ensure that any leakage can be easily identified. The vacuum test is recommended for non-round cans. The vacuum (in inches of water gauge) will depend on the can size and shape and is normally specified by the can maker.

4.2.4 Dye Testing

The dye test using a water-based or mostly water-based dye such as Zylox is the preferred laboratory diagnostic testing method for any can size or shape for testing for leakage paths. Solvent-based dyes are best used for scorelines, side seams and plate fracture testing. Water-based dyes, such as Zyglo, are recommended for double seam testing.

The dye test(s) should be performed as suggested by the dye manufacturer, or can manufacturer. Government inspections will follow the official procedures.

Easy open ends can be tested for leakage paths in the score, rivet or embossed areas using a penetrating dye. Either a fluorescent dye or a dye requiring a developer may be used to detect a loss of hermetic seal. This procedure can be conducted on unused ends and on cans which have been emptied and thoroughly washed and dried.

4.2.5 Pull Tab Testing

Pull tabs and scorelines should be tested using the dye test method. It is not necessary for these tests to use the water-based dye. A solvent-based dye would be acceptable.

4.3 Hold For Investigation Protocol

This section defines the Hold For Investigation Protocol (HFI) and the defect types that are eligible. The HFI is an option for an owner of a lot by which they may assess the actual risk of some defect types (as the defect appears in the lot) which would result in unsafe containers. The HFI protocol is only an option for lots where sufficient representative samples are available in order to be able to conduct a statistically valid evaluation. The HFI is not a mandatory requirement.

For some defects, such as pin holes and false seams, where the integrity of the container has been compromised, there is no provision for an HFI assessment. Section 4.3.1.4 lists the defects which are not eligible for the HFI protocol.

There are other defect types, such as droops, where under certain circumstances and taking all the container integrity parameters into consideration, container integrity may still be maintained. It is for these types of defects that a HFI protocol may be followed in order to determine whether the defect may be deemed serious or minor.

4.3.1 HFI sampling and assessment

The objective of the HFI is to gain additional information on the types and range of defect severity that can be expected to be present in the lot, through a sampling and assessment protocol. The owner of the lot is responsible to develop and submit for CFIA review a "Hold for Investigation Plan", including the sampling and assessment criteria. This "Hold for Investigation Plan" must be developed by a person with extensive relevant container integrity experience and knowledge.

4.3.1.1 Sampling

For the HFI protocol, sample size is 1250 cans and every effort should be taken to use the most effective sample selection method for discovering defects in a given lot.

The owner of the lot must determine whether the HFI defects are randomly distributed, stratified or clustered and develop the appropriate sampling instructions to obtain representative samples of the defective cans.

The Agriculture Canada publication, Statistical Methods for Food Quality Management, Chapter 3, Sampling Methods, provides guidance on the method of collecting the samples, in the following sections: 3.2.1.-Sampling Priority; 3.4.-Sample selection Methods; 3.4.1.-Simple random sampling; 3.4.2-Stratified Random Sampling; 3.4.3- Systematic sampling; 3.4.4-Cluster Sampling; 3.5.-Bulk sampling; 3.5.1-Selecting Samples of Segregated Material.

4.3.1.2 Assessment

The assessment will include a determination of the:

- prevalence of HFI defects in the lot, i.e., the frequency of occurrence or percentage of HFI defects in the lot;
- variance of HFI defects in the lot, i.e. the range of the severity of the defect; and
- appropriate testing of the HFI defects, as required.

4.3.1.2.1 Serious Defect

When a serious defect is found, and is not eligible for HFI, the defect is automatically deemed a serious defect.

4.3.1.2.2 HFI Defects

For HFI defects, the owner is responsible to provide CFIA with an assessment and the appropriate technical analysis/test results, which must be done by a person with extensive relevant container integrity experience and knowledge.

The assessment must include:

- an evaluation of the defective cans, including an explanation for the cause of the defect;

- where multiple cans with the same HFI defects are found, an assessment as to the range of the severity of the defects that can be expected in the lot;

- where appropriate, cannery quality control data to support the decision; and

- an analysis of the potential for the defects to pose a significant risk of container failure.

If the risk of container failure is assessed as insignificant, the HFI defect that led to the HFI protocol is deemed to be minor.

4.3.1.3 CFIA assesssment of the HFI sampling and assessment report

The owner is to submit to the CFIA a report of the results of the HFI sampling and assessment. The CFIA will review the assessment report and will provide the owner with a written decision.

4.3.1.4 HFI Protocol - List of Eligible and Non-eligible Can Defects

4.3.1.4.1 List of Can Defects NOT ELIGIBLE for the HFI Protocol

Broken Chuck	False Seam	No Second Operation
Burned Weld (Burned Through)	Fractured Bottom Profile	Open Weld
Clinched Only	Fractured Seam	Pin-Hole
Cut-Down Flange	Key Tab Seamed To Inside	Pull Tab Rivet Fracture
Cut Seam	Knocked-Down Curl	Punctured
Cutover	Knocked-Down End	Seam Inclusion
Double Body	Knocked-Down Flange	Turned Back Corner
Double End	Laminated Plate	Weld Joint

4.3.1.4.2 List of Can Defects ELIGIBLE for the HFI Protocol

Acid Salts Corrosion	Fluted Body	Off-register Body Blank Coating
Burrs on Curl	Incomplete Curl	Open or Weak Lap
Coating Drip	Incomplete Flange	Out-of-square body
Coating Inside Out	Insufficient Overlap	Overfill, Flipper, Springer, and Swell
Coating Skips	Insufficient Solder	Panelling
Cold Solder	Inverted Inside Coating	Peaked Can
Corrosion	Jumped Seam	Pleats
Damage to Scoreline/ Pull Tab	Key Tab not Properly Tucked	Pucker
Damaged Curl/Flange	Loose Seams	Scrap-in-die Marks
Distorted Reform Ridge	Malformed Abuse Bead	Side Seam Droop
Double Seam Dent	Mis-locked Side Seam	Spinner
Droop	Mis-notch	Turned Back Lap
Excessive Solder	Misembossing	Vee
Excessively Weak or Deep Scoreline	Necked-in-can	Wrinkled Curl
Faulty Sealing Compound	Notcher Trim Still Attached	Wrinkled Flange
Flange Burrs		

Note that those defects that have only a minor defect classification, e.g., plate stain, are not included in the above table.

4.3.1.5 HOLD FOR INVESTIGATION (HFI) PROTOCOL FLOW CHART