SECTION 5.

Can Seam Evaluation and Can Coding

In previous sections, problems associated with swollen and/or decomposed cans of pasteurized crabmeat were attributed to inadequate heating, cooling, or storage. A fourth potential problem area is defective can seams. During the past few years, there have been several incidences of swollen cans and decomposed crabmeat due to defective can seams. Although only recently recognized as a potentially significant problem, defective can seams are not new to the crabmeat industry.

Some state regulatory agencies that have responsibility for the crabmeat industry have neither inspected can seams nor required processors to inspect them. There are several reasons: first, the significance of the problem was not widely recognized until recent years; second, some agencies did not have staff members trained in can seam evaluation; and, third, the processing plants did not have employees trained in can seam evaluation. Both industry and the regulatory agencies are now aware of the problem, and many are training their personnel in can seam evaluation. Unfortunately, in some cases, the seafood industry was too slow in accepting the importance of the seaming operation until the cost of negligence became prohibitive despite the availability of training schools and reminders mailed by can companies.

Unlike low-acid canned foods, pasteurized crabmeat must be refrigerated; therefore, the crabmeat industry has been exempt from the strict inspection, process control, and record keeping requirements imposed on the low-acid can food (LACF) industry. One requirement of the LACF industry, which may become applicable to the pasteurized crabmeat industry in the future, is the periodic inspection and teardown of can seams.

What happens when a can seam is defective? Nothing may happen, in some cases, or "leaks" may develop. Even when leaks do not develop at first, this is probably a temporary situation, unless the problem causing the defect is corrected. When leaks occur, bacteria in the environment can be drawn into the container through the leaks; thus spoilage of the product is hastened. The leaks may be extremely small "micro-leaks," but the bacterial load introduced into the container by just one small drop of water can be enough to cause major contamination. The presence of micro-leaks can be detected using a specifically designed detector (Fig. 33).

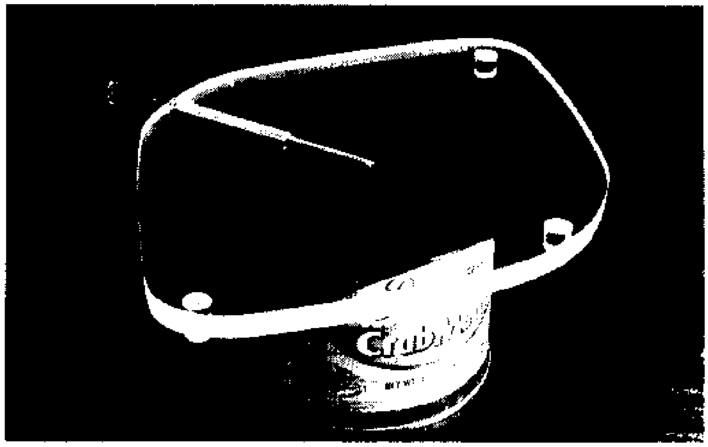

Figure 33. A can leak detector which uses vacuum to draw air out of the suspect can. Leaks are identified by bubbles viewed through the transparent plate as they rise through water previously poured into the can.

Usually, air or water droplets gain entry through micro-leaks in the can seams during the cooling phase of the pasteurization process. A leaking seam allows air to escape when the container is heated and the internal pressure increases. When the container is cooled, the pressure is relieved, and a vacuum occurs because of this loss of air. Outside air or water then enters through the leak to relieve the vacuum.

Defective can seams can create serious problems for the industry. What is in question, however, is the extent of the problem. Some processors in the pasteurized crabmeat industry do not know how to evaluate can seams. Although some of the major suppliers of pasteurization cans provide a can seam evaluation service, discussions with company officials indicate that only a portion of those buying cans make routine use of the service. The NBCIA Standards Committee has recommended that all companies pasteurizing crabmeat have at least one employee who has been trained in can seam evaluation. That employee is responsible for can teardown examinations every four hours of operation. The NBCIA also recommends that a record of these evaluations be kept and filed for future reference.

Can Coding

The proper coding of cans is a significant protection device not only for the consumer but also for the processor. The more refined the coding system, the easier it is for the processor to locate and recall the product. According to the Handbook of Product Recalls and Package Coding and Equipment, a product code at a minimum should include:

1. Product should be coded for easy identification and at frequent enough intervals to keep the lots small.

2. Codes should be related to processing records so that lots that may need to be recalled because of a process deviation or other problem may be identified quickly and completely.
3. Keeping of raw product and quality-control records should be kept in such a way that the product in any batch can be identified.*

It is to the processor's advantage to keep each lot small. If lots are kept small, only the lots in question can be recalled instead of an entire day's production. Several coding systems and methods can be used, according to the requirements of the plant, and the choice should be left to the individual processor. Special attention should be given to the clarity of the code mark. In the case of recalls, illegible codes could create serious problems.

Double Seam Evaluation: Determining Proper Formation

Double Seam Defined

The double seam consists of five thicknesses of plate interlocked or folded and pressed firmly together. It is formed in two operations. A first operation roll tucks the curled edge of the cover underneath the flange on the can body, as illustrated in Figure 34. The seam is then completed by the second operation roll, which presses the folds of metal tightly together, squeezing the compound lining into the spaces between the metal to effect a hermetic seal (Fig. 35).

The names of the various parts of the double seam are shown in the cross section views of first and second operation seams. The juncture of the double seam and the side seam of the can is referred to as the crossover or lap.

Visual Inspection of External Seam Formation

Cans leaving from the closing machine should be examined visually. Carefully inspect the entire periphery to detect any seam malformation or defects such as pronounced cut overs, cut seams, droop, lips, false seams, spinners (skids), cracked plate, or any evidence of seam looseness. Rotating the seam between the thumb and forefinger is very helpful in detecting certain types of seam defects.

The frequency of these examinations will depend on the speed at which the closing machine operates. At a minimum, visual external seam inspection of cans from each seaming head must be made every thirty minutes of machine operation and recorded.

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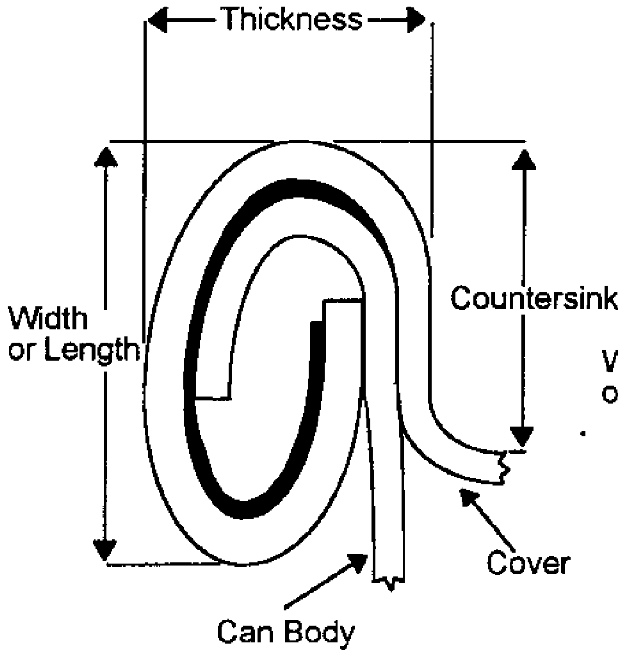
*This requirement may have less application to the pasteurized crab industry than do items 1 and 2.



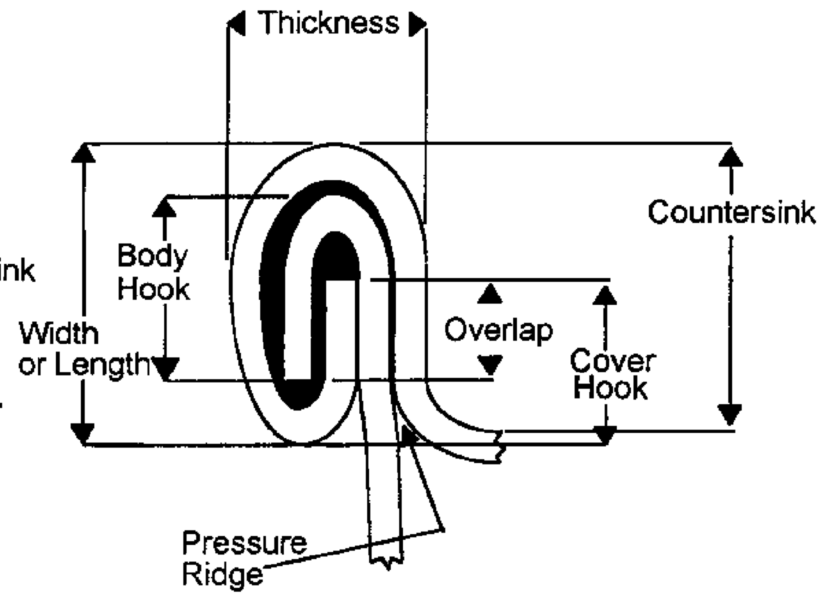


Figure 34. Cross sectional view of seam following first operation.

Figure 35. Fully formed seam following second operation

Cut Over: A cut over is a sharp fin of the cover formed over the top of the seaming chuck flange during the seaming operation (Fig. 36). This condition usually occurs at the body lap of soldered cans, but may occur all the way around the end. A slight sharpness, best noted by running a finger around the inside of the seam, is not indicative of a defective seam, but when pronounced could result in a more serious cut over. A severe cut-over condition is dangerous, leading to a possible fracture known as a cut-through cut over. Correction is mandatory when severe cut overs are encountered.

Possible Causes of Cut Overs:

1. Incorrect vertical alignment of the first operation seaming roll groove relative to the seaming chuck. The seaming chuck and first operation seaming roll groove should be set to maintain .001 inch to .002 inch vertical running clearance between the top of the chuck flange and the lead-in angle of the seaming roll groove (Fig. 37).

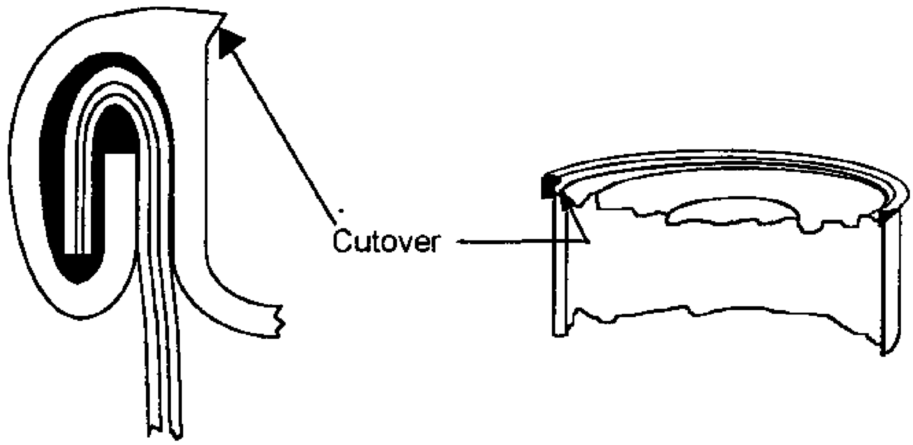


Figure 36. Seam cross-section at the crossover (lap), soldered cans.

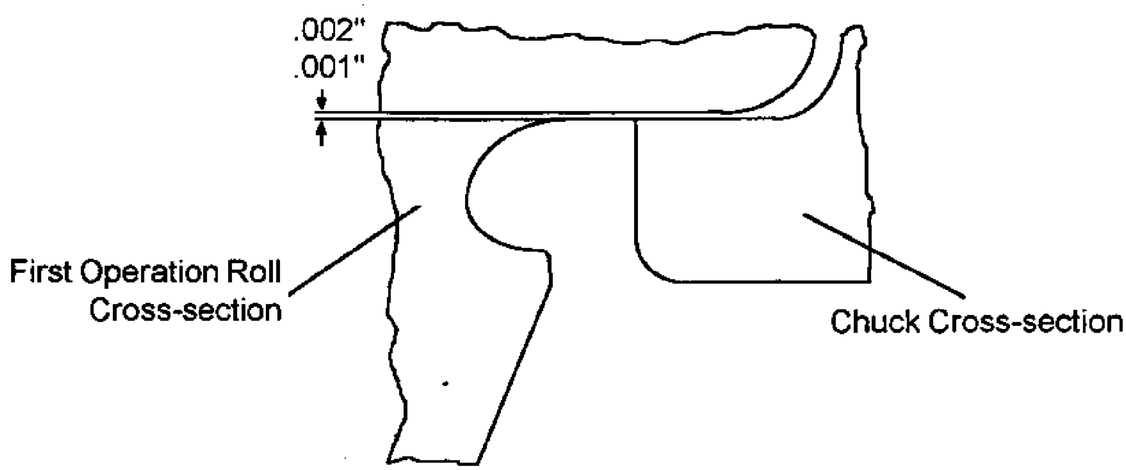


Figure 37. Roll & chuck alignment on seamer (closing machine).

2. Vertical play of first operation roll. Roll should revolve freely but vertical play in excess of .002 inch should be avoided.
3. Vertical play in seaming head assembly.

4. Worn seaming chuck flange. Usually caused when the lead-in angle of the first operation seaming roll groove rides the chuck flange. Not sufficient vertical running clearance.
5. First or second operation seaming rolls set too tight. When either operation roll is set too tight, the seam formation can be forced beyond the ideal limits of the seaming roll groove profile to produce a cut over.
6. Worn seaming roll grooves. All first and second operation roll groove profiles were developed to produce good seam formations and maximize the life of the groove. Incorrect setting of seaming rolls, even though the seam formation produced is acceptable, should be avoided as the life of the roll grooves will be reduced and the development of seam defects hastened. Any seaming roll, when suspected of creating cut overs because of possible worn groove conditions, should be replaced only after determining that the roll is set correctly.
7. Solid or semi-solid product trapped in seam.
8. When excessively long body hooks force too much metal into the seam, sharpness all around the seam as well as at the crossover often results.

Cut Seam: A double seam, wherein the outer layer of the seam is fractured (Fig. 38), is known as a cut seam. Immediate correction must be made when this condition exists.

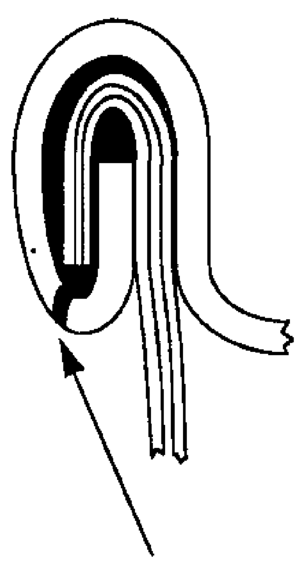


Figure 38. Cut or fractured seam.

Possible Causes of Cut Seam:

1. Seam too tight.
2. Defective end plate.
3. Excess sealing compound.
4. Long body hook.

Droop: A smooth projection of double seam below the bottom of a normal seam is identified as a droop. While droops may occur at any point of the seam, they usually are evident at the side seam lap (Fig. 39). A slight droop at the side seam lap or crossover may be considered normal because of additional plate thicknesses incorporated in the seam structure of soldered cans.

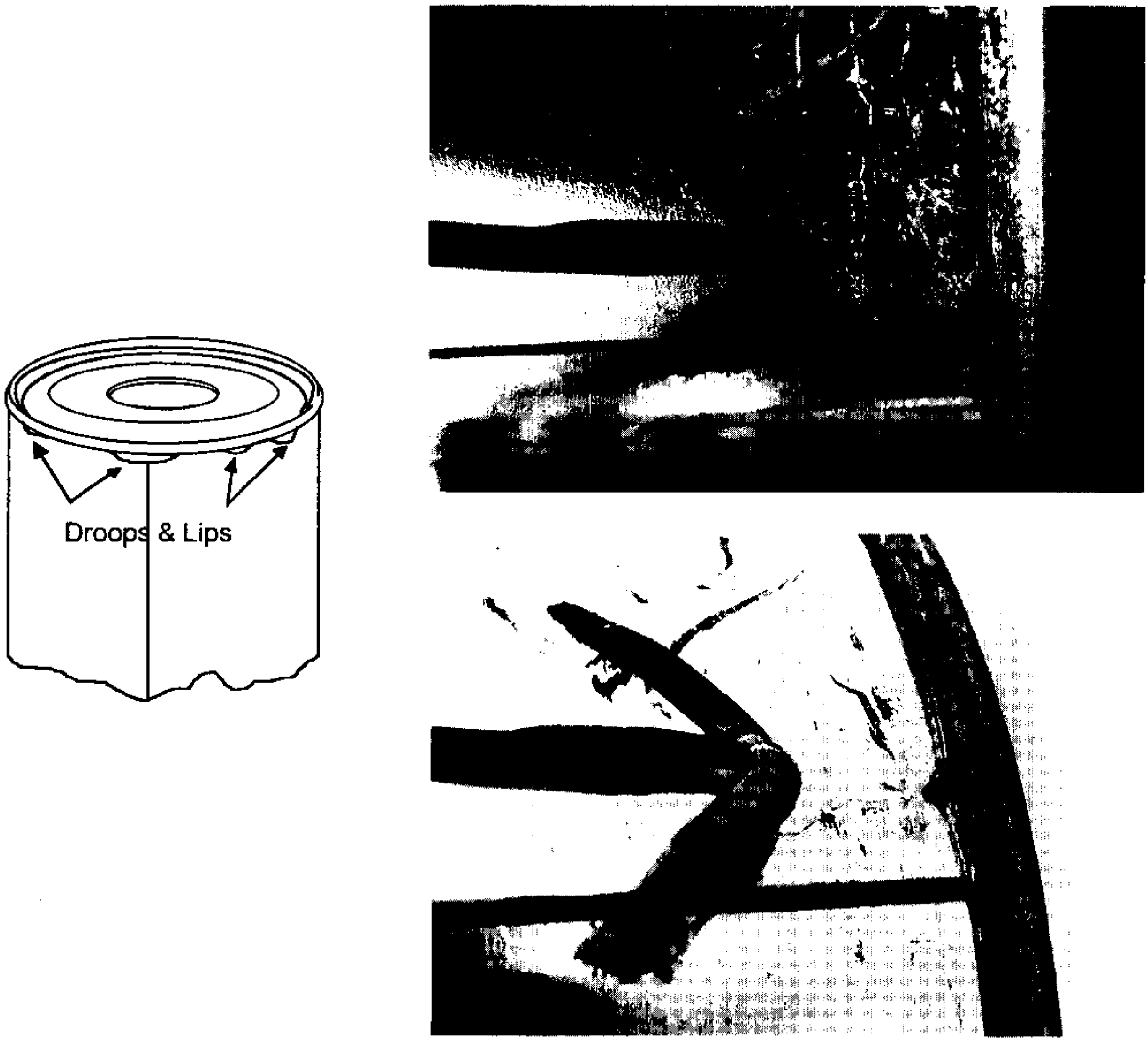


Figure 39. Seam Defects.

A droop at the crossover exceeding ½ the cover hook length should not be tolerated, immediate correction is mandatory. Similarly, slight droops in the seam at points away from the lap are undesirable, and corrections should be made to eliminate them.

Lip: An irregularity in a double seam showing as a sharp "V" projection below the normal seam (Fig. 39) is called a lip, or a "V" droop. If lips are observed during the inspection of double seams, the cause should be determined and corrections made.

Possible Causes of Droops and Lips:
1. First operation seam too loose.
2. Worn first operation roll groove.
3. Body hook too long.
4. Product trapped in seam.
5. Formation of can body out of shape.
6. Excessive amount or unequal distribution of end lining compound.

False Seam: A false seam is a seam or portion of a seam that is entirely unhooked and in which the folded cover hook is compressed against the folded body hook (Fig. 40). This is a serious defect that will cause leakage, and if it is repetitive must be corrected immediately. Sometimes the folded body hook does not project below the seam, and the false seam can then be detected only by very close inspection.

Possible Causes of False Seam:
1. Mushroomed can flange.
2. Bent can flange.
3. Damaged or bent cover curl.
4. Misassembly of can and cover.
5. Can not properly aligned at assembly.
6. Improperly filled can. Product extending over can flange.

Spinner (Slip, Skid, Dead Head): An incompletely rolled finished seam (Fig. 41) is known as a spinner, slip, skid, or dead head. Correction must be made immediately.

Possible Causes of Spinners:
1. Insufficient lifter pressure.
2. Improper end fit with chuck.
3. Worn seaming chuck.
4. Incorrect pin height setting. Chuck set too high in relation to lifter plate.
5. Seaming rolls binding.

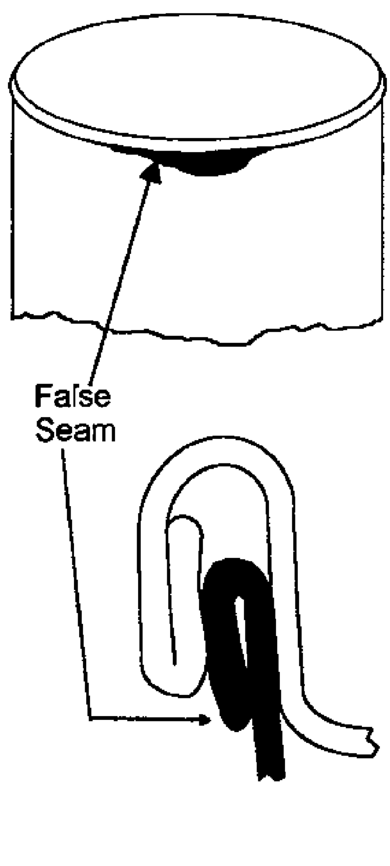


Figure 40. Seam Defects.

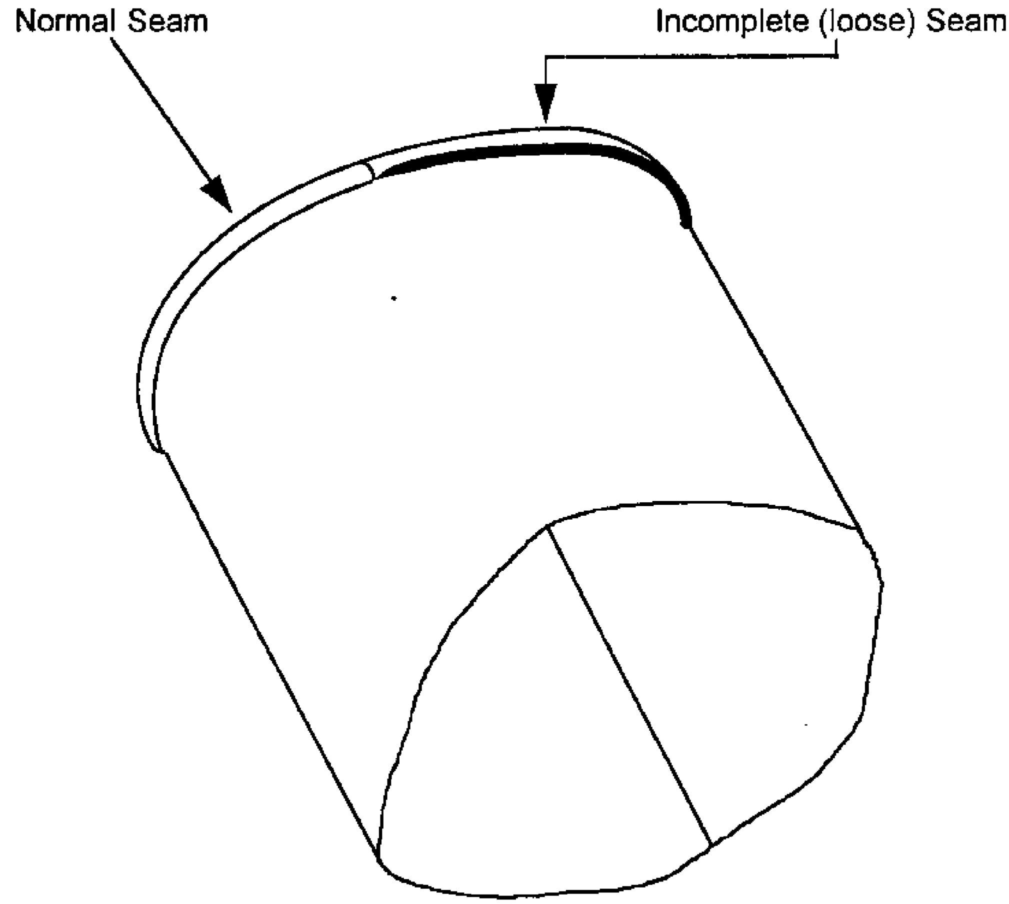


Figure 41. Seam Defects.

6. Oil or grease on seaming chuck or lifter.
7. Excessive vertical play of seaming chuck spindle.

Checklist: Recommended Daily Seamer Operating Procedures

Start-up:

1. Inspect seamer for extraneous debris or loose items in or around seamer.
2. Inspect cans and lids for damage.
3. Run seamer fully engaged for ten minutes prior to beginning production.
4. Run two sample cans for teardown, for vacuum or pressure micro-leak test, and to remove excess grease from header.

Production:

1. Fully evaluate the seam of one can every four operating hours.
2. Routinely monitor visual parameters, including external seam measurements and potential defects.
3. Seamer operator should continuously confirm that product does not lay over the top of body flanges.
4. Seamer operator should continually confirm that no damaged cans (especially dented flanges) are seamed.

End of day:

1. With machine running, hose down the interior and exterior of seamer.
2. Shut off seaming machine including main switch and grease with appropriate food grade lubricant.

External Seam Measurements

Following visual inspection of the external seam formation, the seam width, thickness, and countersink depth should be measured. These measurements and complete internal seam inspection should be made at least once every four operating hours. Complete inspection of the double seam should also be made on start-up, after a prolonged shut down, after a severe closing machine jam, and after a change in can size or body or end material. It is recommended that the width and thickness of the first operation seam be checked at least every forty operating hours or whenever an adjustment of the seaming rolls is required.

Seam measurements should be made at three points around the periphery of the can, at least ½ inch away from the crossover. The highest and lowest readings should be recorded. Average dimensions derived from two or more individual measurements should **not** be used.

A micrometer especially made for measuring double seams is shown in Figure 42. Care should be exercised that the micrometer is in proper adjustment. When the micrometer is set at zero position, the zero graduation on the moveable barrel should match exactly with the Index Line on the stationary member. If, for any reason, the zero adjustment is more than half a space from the Index Line at this setting, an adjustment should be made.

Seam Width (Height, Length)

To measure the seam width, hold the flat surface of the micrometer against the can body as shown in Figure 43 and turn the barrel until the entire seam is lightly trapped between the calipers.

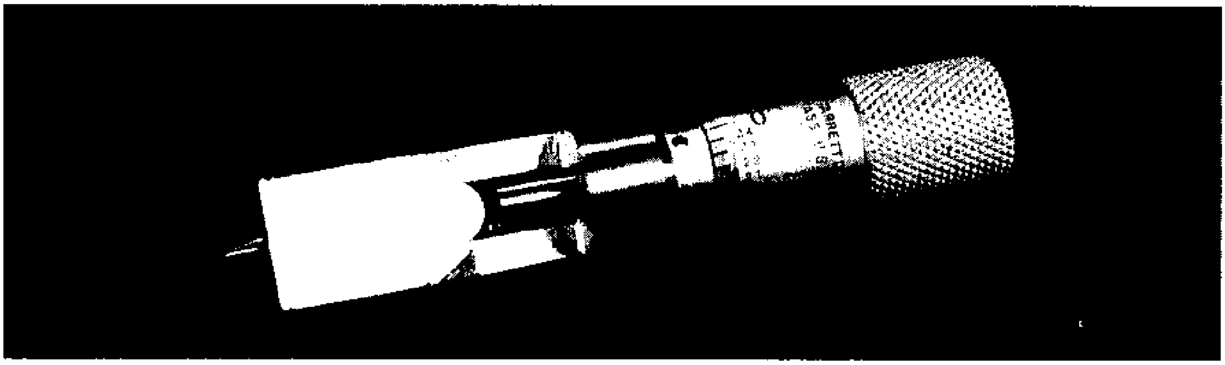


Figure 42.

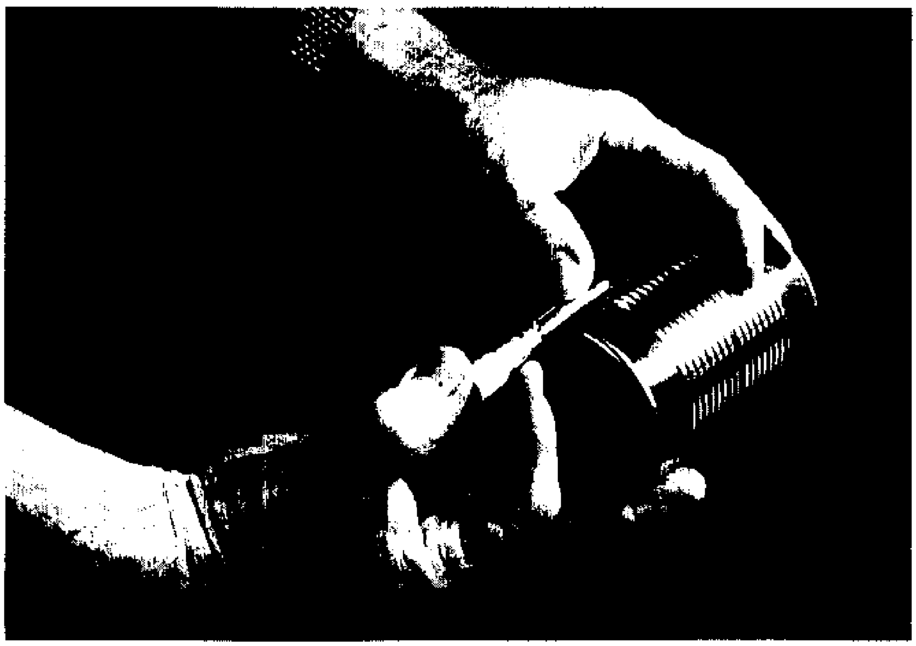


Figure 43.

Seam Thickness

The thickness of the seam should be measured as illustrated in Figure 44. When taking the measurement, balance the micrometer with a finger immediately above the seam and turn the barrel until the anvil assumes the same angle as the taper of the countersink, when the calipers grip the seam.

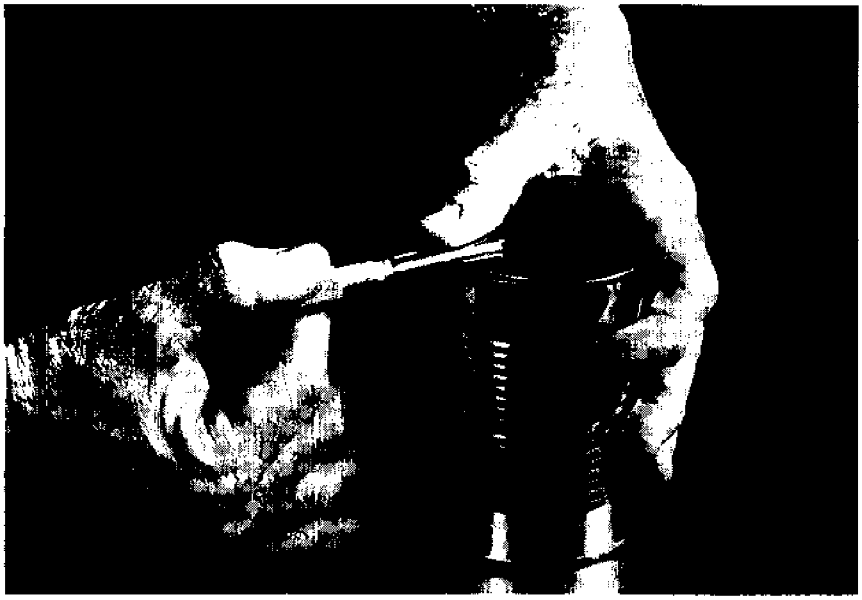


Figure 44.

Countersink

The countersink or drop from top of the seam to the lid surface is an optional measurement but is useful and easily performed (Fig. 45).

Figure 45.

Inspection of Internal Seam

Judging the quality of the double seam formation involves both visual inspection of the torn-down seam as well as consideration of the dimensions of the various parts of the seam.

Allowances must be made for the variations due to normal differences in plate thickness and temper as well as in sealing compound weight and placement.

Internal seam evaluation and recording of seam measurements should be done at a minimum of once every four operating hours. As indicated in the preceding section, complete inspection of the double seam should always be made after prolonged shut downs, after severe closing machine jams, and after changes in can size or body or end materials.

First Operation Seam Formation

Figure 46 shows the appearance of a correct first operation seam in cross section away from the lap. Notice that the cover hook curves around against the inside of the body hook and the body hook is in contact with the flange of the end. The seam should be rounded at the bottom and in contact with the body of the can. Due to extra material in the seam at the lap of soldered cans, however, the first operation seam will be somewhat tighter at this point only and will show a slight flat at the bottom, as indicated in Figure 47.

If the first operation is too tight, the bottom of the seam will be slightly flattened through its length, as shown in Figure 48. If the seam is too loose, the cover hook will not be in contact with the can body, as shown in Figure 49.

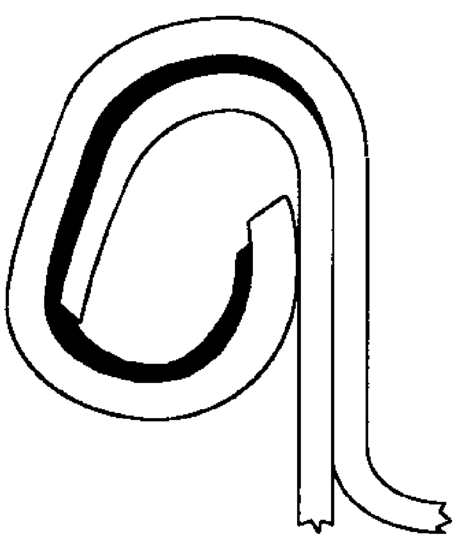


Figure 46. Correct First Operation.

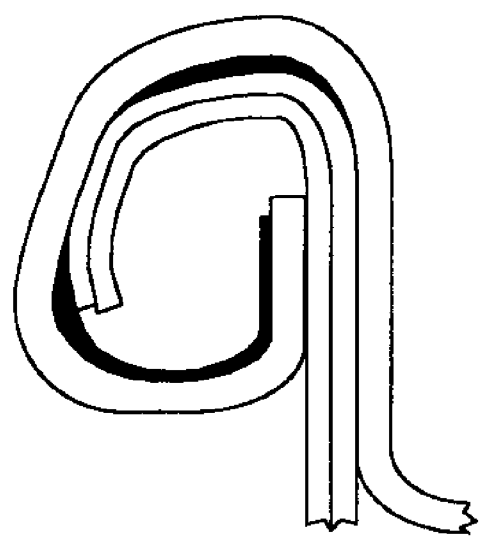
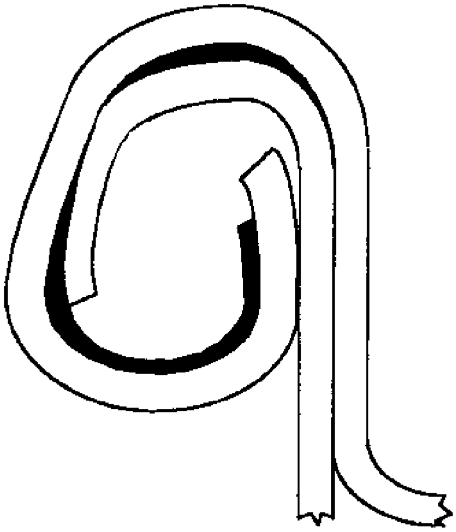


Figure 47. Correct First Operation at Crossover.



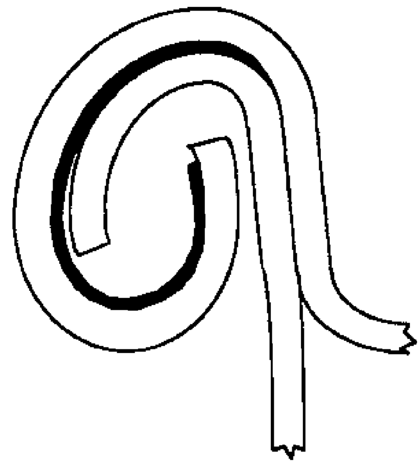


Figure 48. Tight First Operation.

Figure 49. Loose First Operation.

Due to possible variations in end curl configurations, first operation thickness may vary. The ideal first operation thickness should be determined by sectioning the seam so the portion of the cover hook relative to the body hook may be noted (Figs. 46 and 47). The seam may be sectioned either by filing radially across the seam or by use of a seam saw.

Second Operation Seam Formation

The second operation roll groove flattens the seam and presses the folds together tightly enough to compress the sealing compound and cause it to fill the parts of the seam not occupied by metal. This compressed sealing compound is illustrated by the solid black area around the body and cover hooks in the well-formed seams shown in Figures 35 and 50.

Excessive pressure does not produce a good seam and may even produce a defective seam. Extreme tightness of the second operation roll will stretch the metal and cause an increase in the width and outside diameter of the seam. This tightness is also likely to produce slippage between the hooks, commonly called "unhooking," especially if the first operation rolls are set too loose or if they are excessively worn. Therefore, a seam which is rolled too tight is more likely to leak than is one made with proper pressure. Figure 51 illustrates an incorrect second operation seam, which could be partially unhooked at some points.

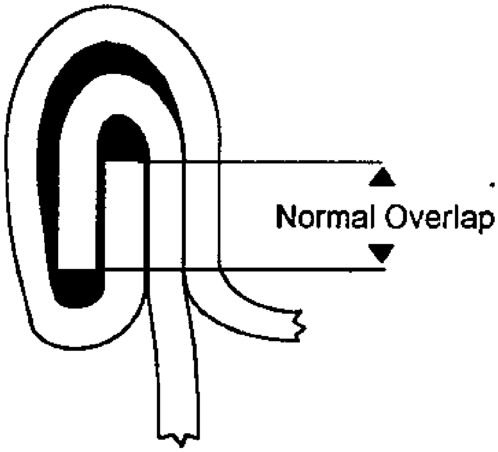


Figure 50. Normal double seam and overlap.

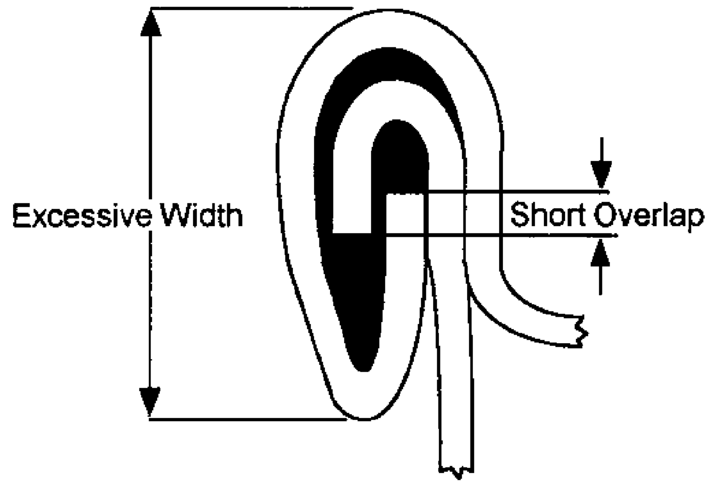


Figure 51. Wide or long double seam, short overlap.

The degree of interlock of the cover hook and the body hook is known as overlap (Fig. 50). The integrity of the double seam is dependent in large measure on the length of this overlap. Insufficient overlap may result in leakage, particularly at the crossover of a malformed seam, if the cover is then distorted due to internal pressure during filled can processing or when the double seam is disturbed due to rough handling.

Tearing Down the Double Seam for Inspection:

The method preferred by most evaluators is to separate the body and cover hook of the finished seam in the following manner:

1. Use can opener to cut out center section of cover approximately 3/8" from double seam (Fig. 52).
2. Use a nipper to remove remainder of the center cover (Fig. 53).
3. Cut through double seam about 1" from lap, as shown in Figure 54.
4. Remove stripped part of cover by gently tapping with nippers, taking care not to distort can body hook (Fig. 55).

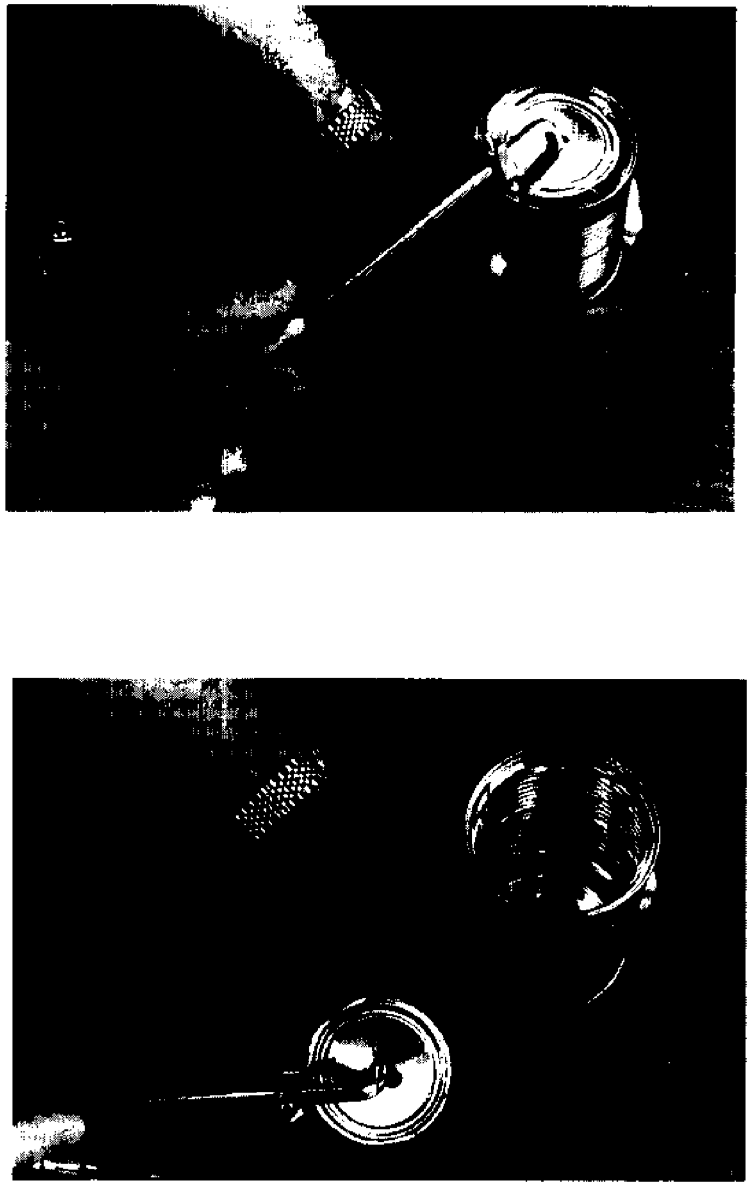


Figure 52. Use special seam evaluation opener to remove end of can.

Figure 53. Tear remaining center cover with nippers without distorting seam.

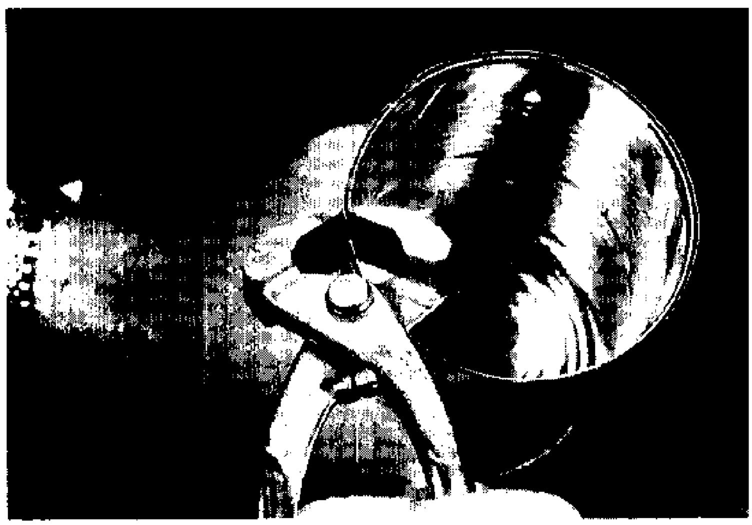


Figure 54. Cut through seam and can body.

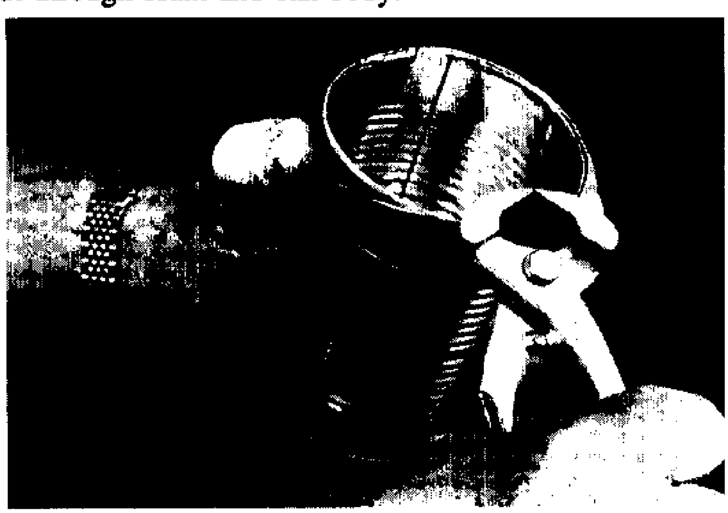


Figure 55. Gently tap down stripped cover to unhook cover from body.

Visual Inspection of Internal Seam

Visual inspection of internal seam formation should include examination for such seam defects as insufficient cover hook tightness, lack of evidence of a pressure ridge, jumped seam, excessive droop of the cover hook at the crossover, and body or end fractures. See Table 9 for causes of seam defects and likely solutions.

Cover Hook Tightness (Wrinkle) Rating

Seam tightness is judged primarily by seam thickness and the smoothness of the cover hook. Percent tightness is expressed in terms of how far the waves or wrinkles extend from the top edge of the cover hook toward the base of the cover hook. The percent tightness is determined by the largest wrinkles present.

Wrinkles or waves have three basic dimensions. **Height**, the distance the wrinkle extends from the top edge of the cover hook to where it fades out towards the base; **depth**, the amount the wrinkle projects out from the face of the cover hook; and **length**, the width or distance the wrinkle extends around the top edge of the cover hook. Since a wrinkle or wave is graded only by its height, it is important to note that a true looseness wrinkle has height, depth, and length. Often the profile of an ironed-out, first-operation wave with no depth will show on the face of the cover hook; this is incorrectly graded as a looseness wave.

When a wrinkle extends one-fourth of the length of the cover hook, the seam is rated 75% tight; when the wrinkle extends halfway, the seam is rated 50% tight; etc.

In hemming a straight edge of plate, no wrinkles are formed. On curved edges, wrinkling increases as the radius of curvature decreases. For this reason, different wrinkle ratings are specified for small diameter cans as compared to large diameter cans.

In small round cans, 300 diameter and under, it is important to note that ironed-out, first-operation folds should not be confused with true seam wrinkles. The ironed-out folds will be apparent only in tightly rolled seams.

Excessive sealing compound will sometimes cause impressions on the face of the cover hook, which cannot be ironed out. These should not be confused with looseness wrinkles. The presence of an unusual amount of compound on the face of the cover hook is usually evidence of heavy compound.

A heavy enamel coating on the cover hook may interfere with judging the tightness. If this occurs, the enamel may be removed to facilitate judgment.

Determining Tightness (Wrinkle) Rating

The tightness of a double seam is graded according to percentage figures. Figure 56 shows the cover hook with 0 to 100% tightness, with the formerly used "wrinkle number" shown below.

An experienced double seam inspector can tell a good deal about tightness by the flatness of the cover hook; that is, there should not be a rounded appearance to the cover hook. This observation can be made on a cover hook removed from a seam that has been sectioned with a seam saw (Fig. 57), or by observing cover hooks torndown by hand. Notice the heavily wrinkled and rounded cover hook at the top of Figure 58.

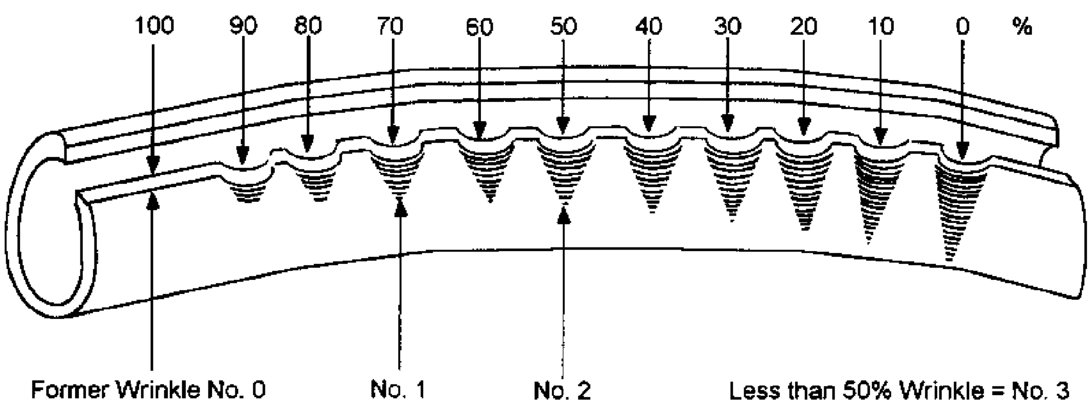


Figure 56. Tightness (wrinkle) rating in percent.

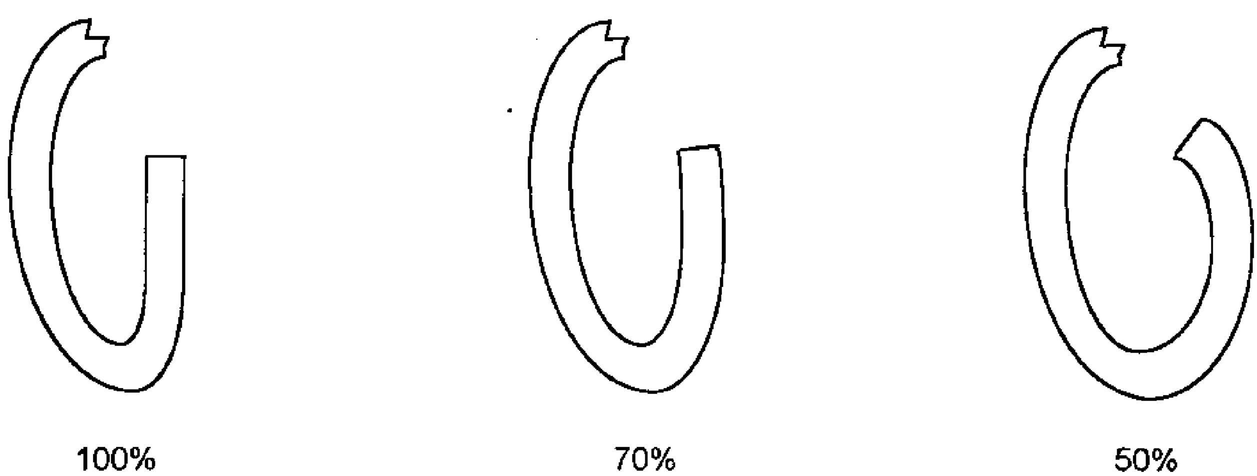


Figure 57. Cross-sectional appearance of cover hook corresponding to three wrinkle ratings.

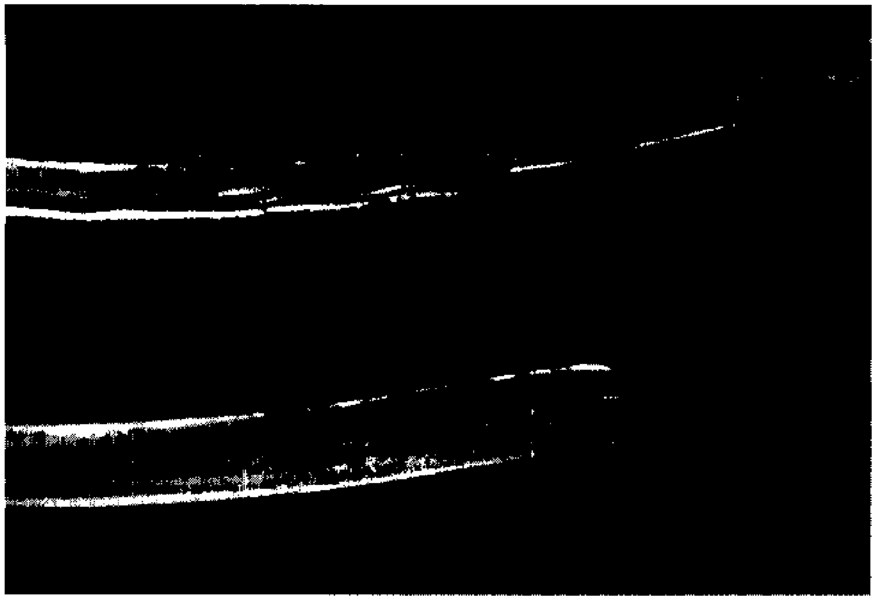


Figure 58. Stripped cover hooks from loose seam (top) and normal seam.

Pressure Ridge: The pressure ridge is formed on the inside of the can body in the double seam area as the result of the pressure applied by the seaming rolls during the seaming operation. The practice of visually inspecting this point in the torn-down can serves as an additional check on the tightness of the finished seam. The pressure ridge should appear as an impression around the complete inside periphery of the can body. An excessively deep pressure ridge should be avoided, particularly on inside enameled cans and cans with aluminum ends. It should, however, be present and visible.

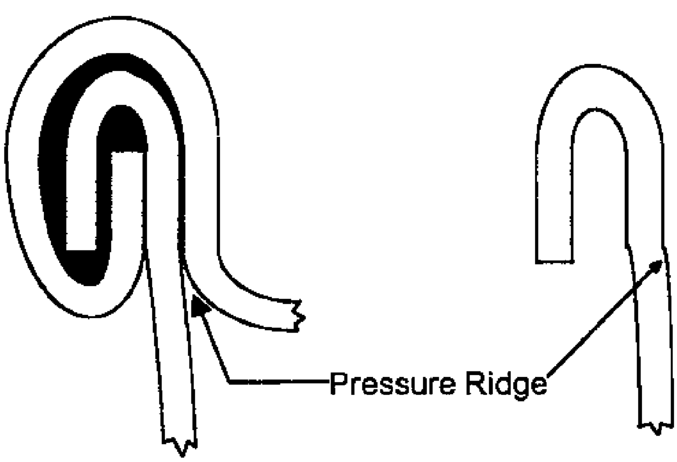


Figure 59. Location of pressure ridge.

Figure 59 shows a cross-section of the finished double seam and a cross-section of a stripped seam, illustrating the pressure ridge produced in making a good commercial seam.

Crossover Droops: The extra thickness at the lap of the side seam of a soldered can causes a normal slight deformation of the cover hook at this point.

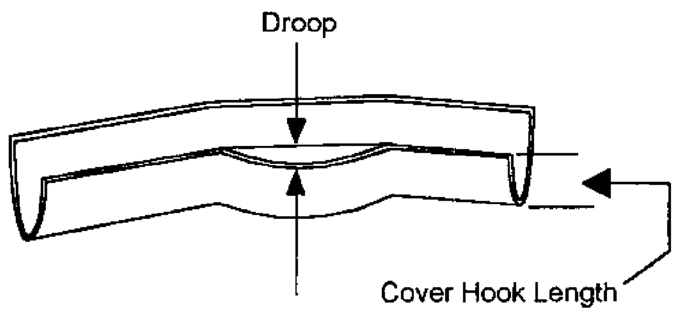


Figure 60. A droop on the cover hook.

Excessive droop at this point, exceeding ½ the cover hook length (Fig. 60), requires immediate correction.

Jumped Seam: For soldered cans, the most critical portion of the double seam is at the crossover, the juncture with the side seam. The cover hook immediately to either side of the crossover should be examined for looseness indicative of a jumped seam (Fig. 61). A jumped seam is a double seam that is not rolled tight enough adjacent to the crossover; it is caused by jumping of the seaming rolls after passing over the lap. Thus, the location of a jumped seam wrinkle in relation to the crossover will depend on the direction of rotation of the seaming rolls.

Possible Causes of Jumped Seam

1. Operation of closing machine at excessive speed.
2. Sluggish-acting, second-operation seaming-roll cushion spring.
3. Second operation seaming roll cushioning too weak.
4. Broken cushion spring.
5. Can lap too thick at double seam area.

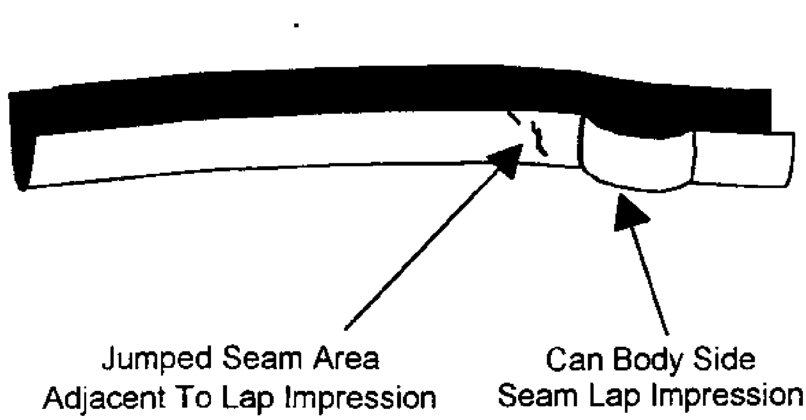


Figure 61. View of coverhook at the crossover (lap) of soldered can.

Internal Seam Measurements

The cans that have been previously measured for external seam dimensions, torn down, and visually inspected should be measured for body hook length and cover hook length. Optical projection and inspection of a cross-section of the seam at one point cannot be substituted for measurement of the body and cover hooks at several points around the seam. As indicated under "External Seam Measurements," measurements should be made at a minimum of three points around the periphery of the can, at least ½ inch away from the crossover. The highest and lowest readings should be recorded. Average dimensions, derived from two or more individual measurements, should not be used. This topic is discussed in more detail in the following section.

Double Seam Evaluation: Daily Testing and Records

Good double seams are essential in insuring against spoilage from leakage and the ingress of oxygen, which result in internal corrosion and product deterioration. The best safeguards against improperly constructed double seams are

1. regular inspections by a qualified person using approved methods, and
2. the operation of the closing machines without deviation from the instructions given by the can companies.

Examination of Cans Prior to Use

Metal-can seam evaluation involves more than tear-down inspection of final seams. It includes careful handling and inspection of cans and lids prior to closing. Make certain that lid and body flanges are undamaged, that no sharp burrs are present on body flange edges, and that lids delivered from the manufacturer contain uniform distribution of sealing compound in the seam area. Bent or burr-edged body flanges are particularly serious defects when a tinplate can body is fitted with an aluminum lid, since the body hook may crack the more brittle cover hook. Dented body flanges can sometimes be straightened with a special crimping tool designed for this purpose.

When lids are stored, the sealing compound tends to become hard over time and is less likely to compensate for slightly malformed double seams. This compound is the glue that keeps out bacteria. When cans are closed with lids containing good, fresh sealing compound, the compound will look and feel tacky (gummy) during manual seam tear-down inspection. Store lids in cool, dry storage.

Double Seam Evaluation

When significant seam defects are noted, closing machine adjustments should be made immediately, and all corrective actions recorded. The following is a recommended schedule for the examination of can seams:

1. **Visual Examination:** During regular production runs, a constant watch should be maintained for gross maladjustments such as deadheads, cut-overs, and other similar double seam defects. Maintaining this constant check may be accomplished in several ways, depending on the type of closing machine, line speeds, and general equipment layout. It may best be performed by training the closing machine operator to recognize irregularities by visual examination. However, an adequate check program can be maintained through use of other trained personnel. The operator, can closure supervisor, or other qualified person should visually examine, at intervals of not more than 30 minutes of operation, the top seam of a randomly selected can from each seaming station, and should record his/her observations. Additional visual seam inspections should be made immediately after a can-jam in a closing machine, or after startup of a machine following a prolonged shutdown. If irregularities are found, the action taken should be noted.

2. **Tear-Down Examination:** Tear-down examinations should be made at a frequency of at least 1 can per seaming station every 4 hours of operation or each major fraction thereof. Such examinations should be made as soon as possible after starting up following a shutdown, waiting only long enough for the machine to "warm-up." Cans for visual inspection should be taken during this warm-up period. The results of the tear-down examinations should be recorded.

3. **General Observations:** Following are some of the many factors that influence double seam quality:
   a. condition of the seaming equipment: whether or not the mechanical operation and adjustment of the closing machine give the proper seam contours.
   b. can materials: variations in tinplate thickness.
   c. can size: roll contours change with can size to accommodate variations in plate thickness.

Other pertinent observations should be recorded, indicating the presence or absence of such defects as cut-overs, droops, etc.

Regardless of whether or not a seam scope or seam projector is used, the double seam should be torn down for examination. Tools required for seam examinations are available from the can suppliers as well as from other sources.

Two measurements should be made for each double seam characteristic if a seam scope or seam projector is used. If a micrometer is used, 3 measurements should be made at points approximately 120° apart, beginning 1/2 inch from the side seam. The high and low measurements must fall within limits considered to be normal for the conditions.

Table 7. Essential and Optional Seam Measurements

Measurement	Method
<u>**Essential**</u>	
Body Hook	Scope or Micrometer (preferred)
Cover Hook	Scope or Micrometer (preferred)
Overlap	Scope
Length (Width)	Scope or Micrometer
Thickness	Micrometer
Tightness / Wrinkle	Visual Observation
<u>**Optional**</u>	
Overlap (by calculation)	Micrometer
Countersink	Micrometer

With regard to measurements, the canner should follow the specifications recommended by the can supplier.

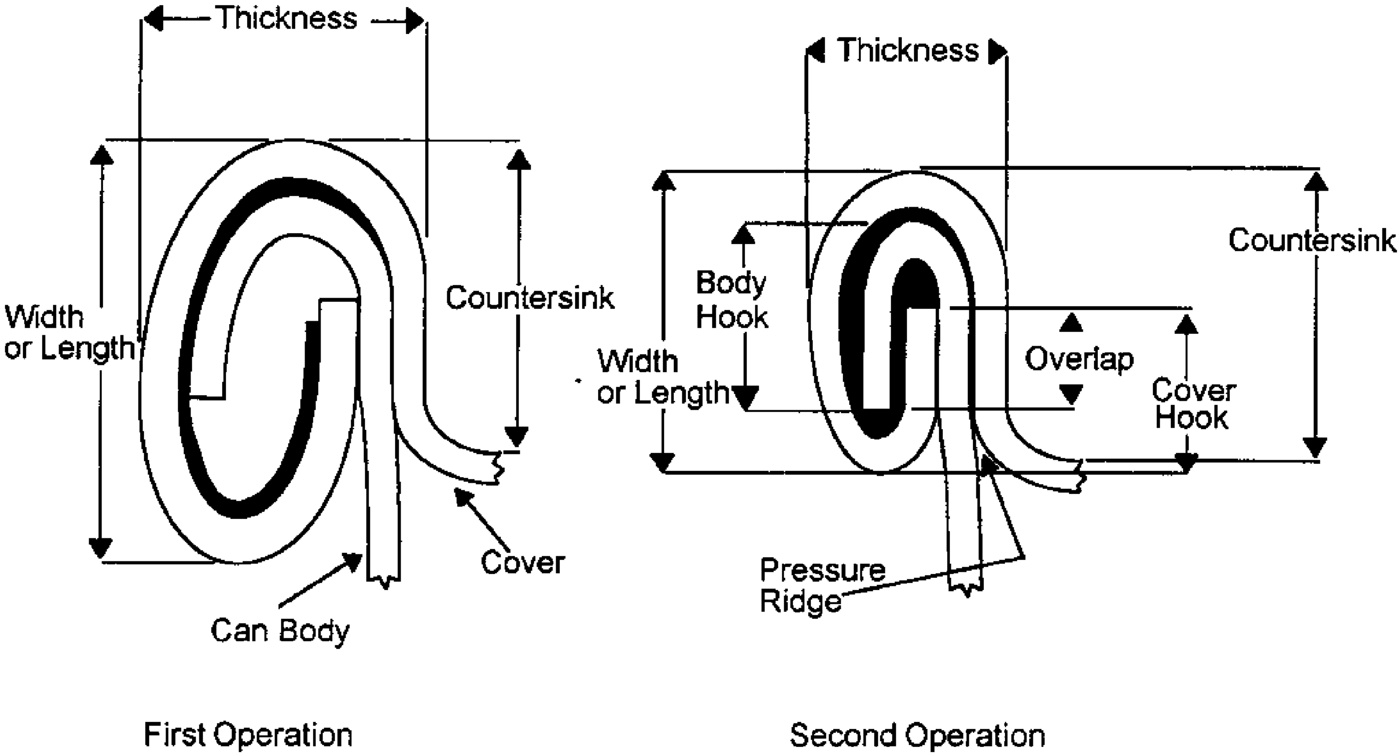
Overlap length (Fig. 62) can be calculated by the following formula when a scope is not available:

$$\text{Theoretical Overlap length} = CH + BH + T - W$$

Where CH = cover hook
BH = body hook
T** = cover thickness, and
W = seam width
(These are micrometer measurements, usually)

Figure 62 is a cutaway diagram of a double seam, showing the measurements to be made and the terminology for the measurements. The completed seam (second operation) diagram should be displayed in the plant area where seams are to be examined. The formula for calculating the overlap length is listed as well.

**In general practice .012 may be used for the aluminum thickness and .010 for tinplate.



Minimum Measurements

Width* (not essential if overlap is measured optically)
Thickness (desirable but not essential)
Countersink (desirable but not essential)
Body hook*
Cover hook* (required if micrometer is used)
Overlap* (essential if optical system is used)
Tightness* or wrinkle

*Essential Requirements

Calculation of Overlap Length

Overlap length = CH + BH + T - W
Where CH = cover hook
BH = body hook
T** = cover thickness, and
W = seam width

** In general practice 0.010 may be used for tin plate thickness and 0.012 when aluminum lids are used.

Figure 62. Seam features commonly measured.

An example of a recommended form is shown in Figure 63. It should meet recognized recordkeeping requirements. Such forms should be modified as necessary to meet the needs of individual companies and must be appropriate for each container used.

Stripping Seams for Inspection and Measurement

Some examiners strip the entire seam, while others find it preferable to leave about one inch of the double seam opposite the side seam undisturbed. In the latter case, the cover is left hinged to the unstripped portion of the double seam. This method of stripping has the following advantages:

1. The coded top and cover hook portion of the seam stay fixed to the can, assuring accurate identification of the entire container in case it is to be inspected by the can company servicemen or interested cannery personnel.
2. It permits measurement of both hooks four points apart (90°), or at three points (120°) apart, either of which is usually considered satisfactory.
3. It permits good visual inspection of the cover hook.
4. It permits inspection and measurement of the undisturbed outside portion of the double seam.
5. It permits filing a notch through the undisturbed portion of the double seam to see if can and cover hook are properly abutted.

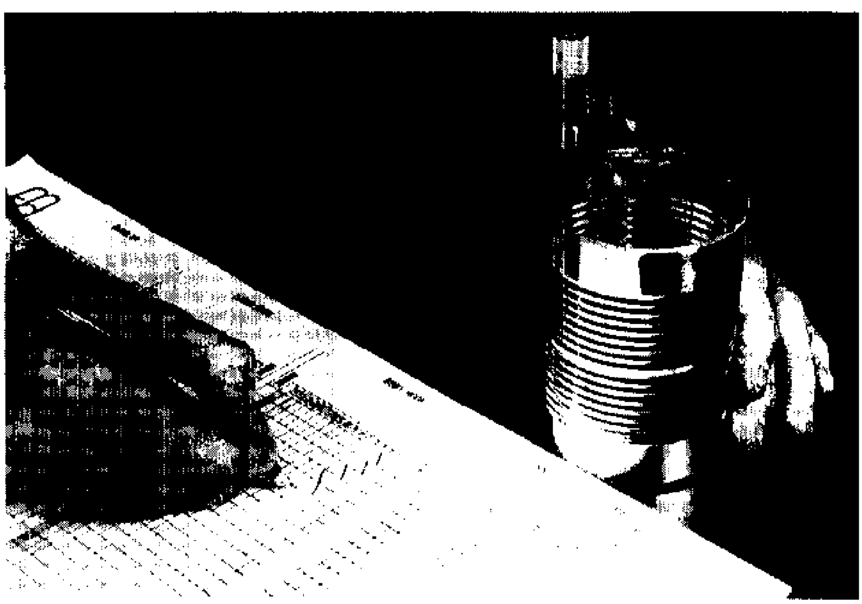


Figure 63. Recording seam measurements on a form.

The most convenient tools for stripping seams are:

1. a can opener (Fig. 64) with a point on the end to pierce the center of the cover and act as a fulcrum, equipped with an adjustable slide cutter to make a circular cut in the cover leaving 3/8 to 1/2 inch strip attached to the seam; or a set of "Airplane" left-hand snips (for example, the Wiss 8 in.) which are easily handled when cutting the top out of the can
2. a pair of 6-inch end nippers for tearing the seam apart (Fig. 64)
3. a hook gauge (or can seam micrometer) for measuring the can hooks (Fig. 65)
4. a pocket size magnifying glass or seam scope (projector) for close inspection of seams (Fig. 66)
5. a seam saw for use with seam projectors (Fig. 67)

Seam specifications differ depending on the can size and the manufacturer. It is not possible, therefore, to list measurements that would apply in all cases and for all sizes of cans. For this reason it is recommended that double seam specifications be obtained from the can supplier. There are, however, the following fundamental characteristics of a double seam:

1. There should be little or no "cut-over," which may cause cans to leak (caused by tinplate being rolled over the chuck).
2. Double seams should not be rolled so tightly that they become distorted and stretched. An otherwise good double seam can be destroyed by rolling it too tightly.
3. Body and cover hooks should be about the same height and kept within a specified tolerance range.
4. A good seam is one in which the first operation has been rolled just tightly enough to produce the desired length of body and cover hooks, and the second operation tightly enough to iron out the wrinkles in the cover hook without stretching the metal. A wrinkle is the degree of waviness occurring in a cover hook. Wrinkles are classified either by percent tightness or by number as follows (Fig. 56):

   Smooth, no wrinkles.

   Slight wrinkle. Wrinkles up to 1/3 distance from edge.

   Somewhat heavier wrinkle. Wrinkles up to 1/2 distance from edge.

   Large wrinkle. Wrinkles more than 1/2 distance from edge.

Figure 64. Tools commonly used to tear-down and measure double seams.

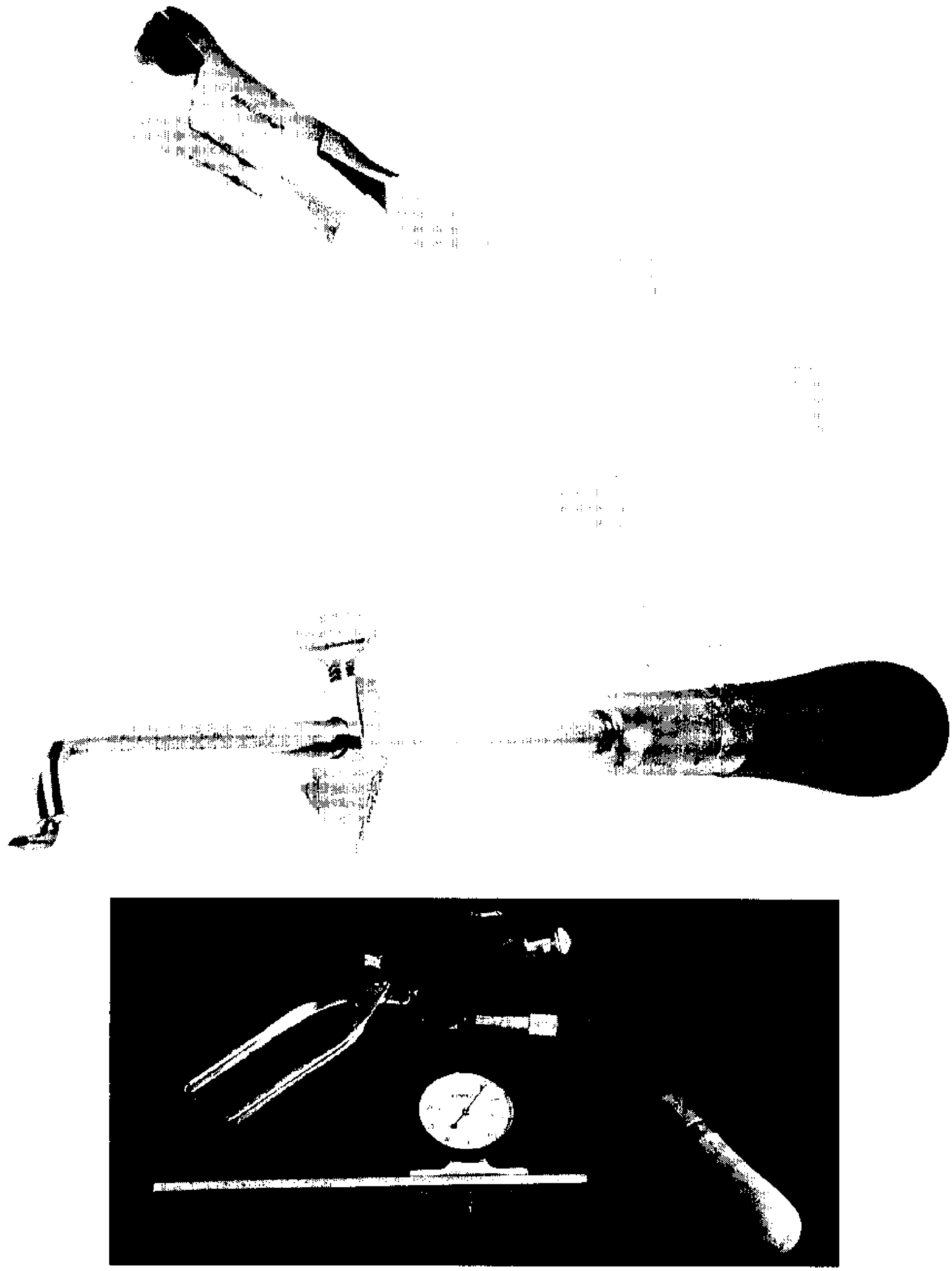
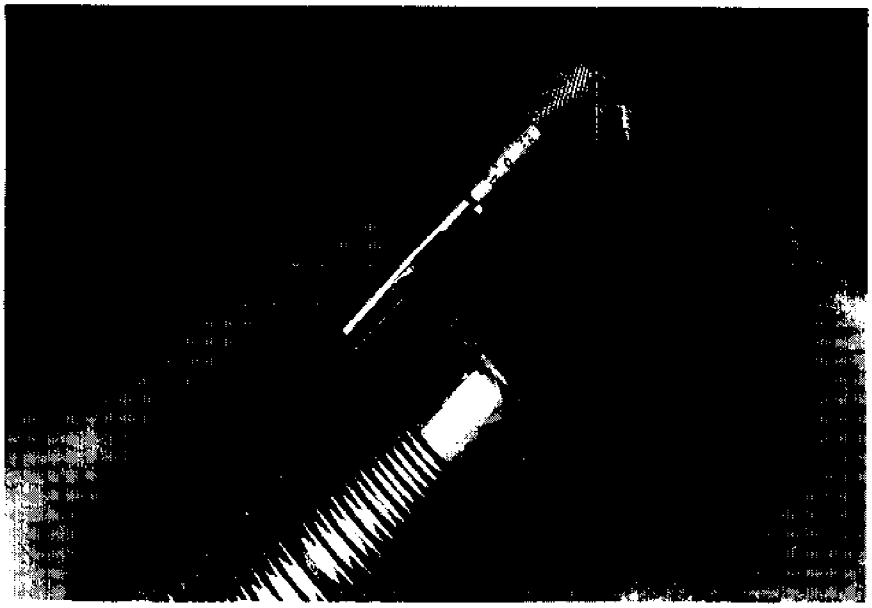


Figure 65. Use of a can seam micrometer to measure hooks.



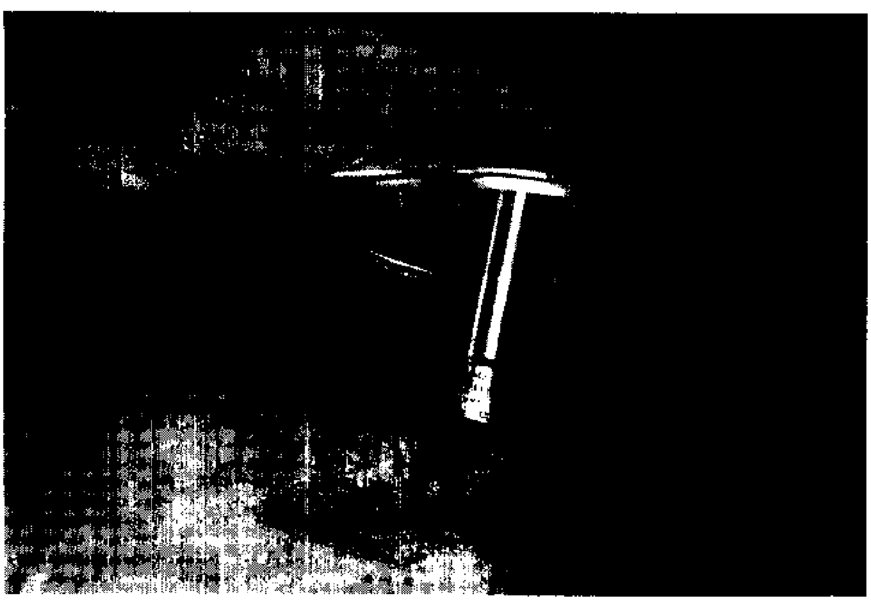
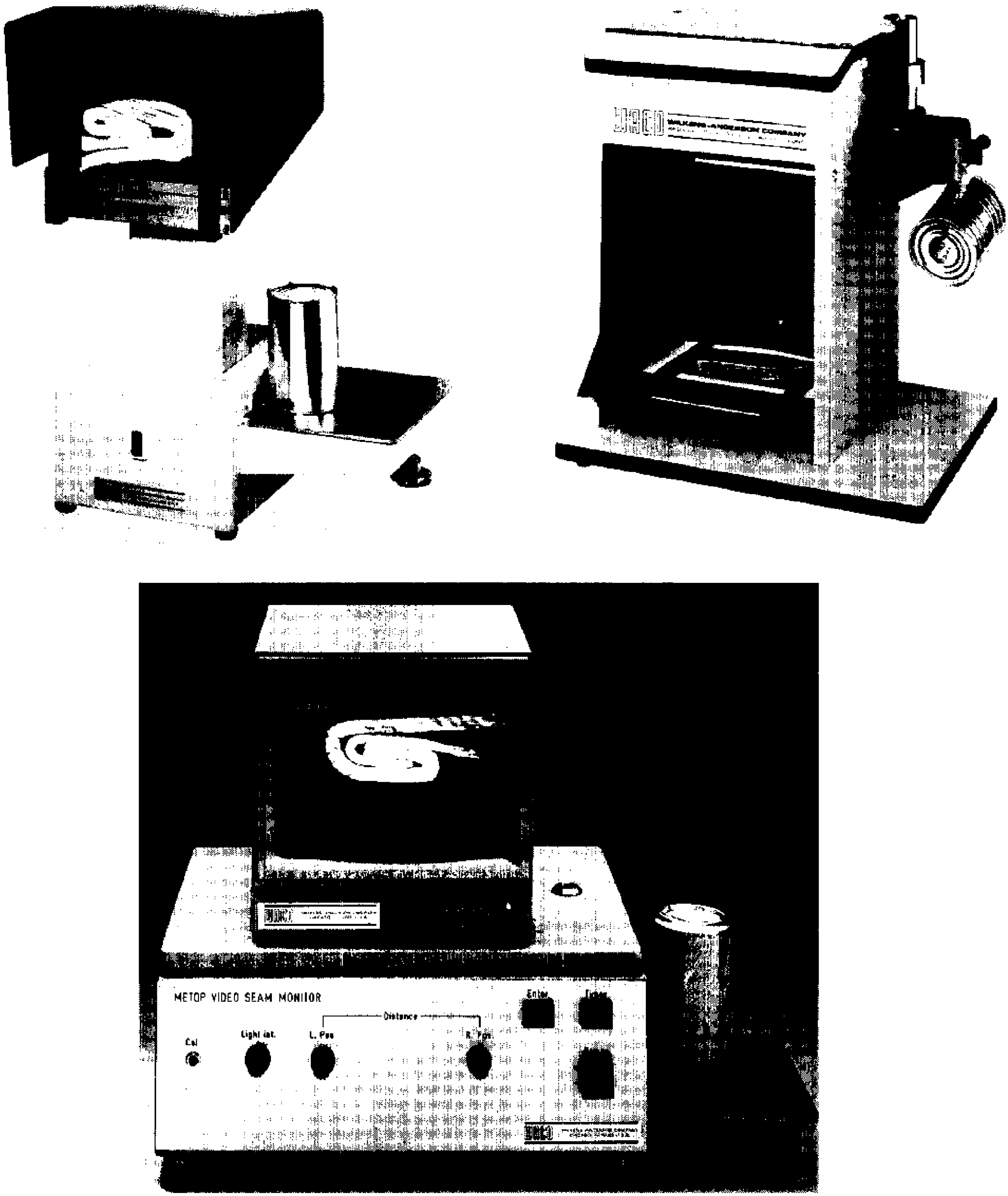


Figure 66. Seam Scopes.



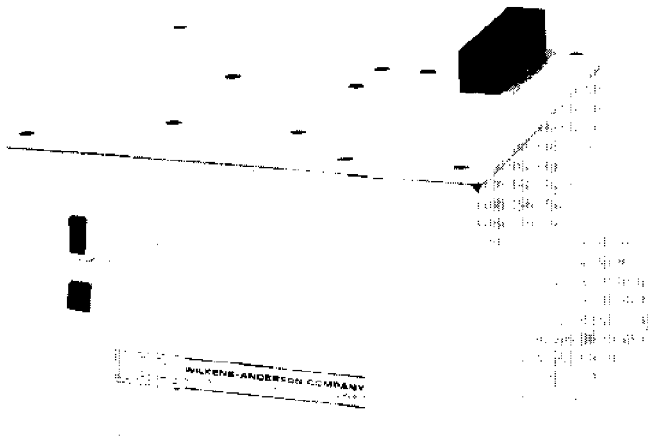


Figure 67. Seam saw used for sectioning double seams.

In 307 diameter cans having wet seams, consistent No. 0 wrinkles indicate that the seams are on the tight side and should be adjusted to produce wrinkles not greater than No. 1. No. 2 wrinkle is the borderline between a satisfactory and unsatisfactory seam, and when the wrinkles in the double seam approach this point the seam should be tightened. No. 3 wrinkles indicate a loose seam likely to give trouble.

It is important to note that, in small cans under 307 diameter, ironed-out first-operation folds should not be confused with the normal wrinkle. Typical seam specifications for 401 x 301 cans are given in Table 8.

Table 8. Example Seam Dimensions for Steel 401 x 301 Can

(Dimensions in Inches)

	Aluminum End	Tinplate End 85 lb.
Thickness	.060 +- .002	.056 - .058
Width / Length	.125 max.	.115 - .125
Body Hook	.080 +- .008	.080 +- .008
Cover Hook	.080 +- .008	.080 +- .008
Overlap	.045 MIN	.045 MIN
Tightness	80 - 100%	75 - 100%

Testing Cans for Leakage

Detection of can leaks is an important, but often difficult, task in the study of spoilage. The pressure test is the method most generally used, although others have been suggested. Pressure is applied by various means.

One apparatus consists of two metal plates faced with rubber and held together by screw clamps. One plate has a pipe connection to the center for the admission of air. With this equipment the opened can should be against the gasket to which the air line is connected. This assembly is then immersed in water and the air turned on. Leaks are detected by air bubbles. Care should be taken to obtain a good seal against the rubber, especially if the double seam is at all irregular, because air leaks between the rubber and the double seam make it difficult to see seam leaks.

Another method for pressure testing cans is to cut a small hole in the end of the can just large enough to remove the contents using an adjustable slide opener. Remove the can contents, wash out the can, and dry in an incubator or warm oven. Solder a piece of metal over the hole. Puncture the can and make a hole just large enough to insert a piece of metal tubing. Solder the metal tube into the can and connect to an air pressure line. (An alternative is to solder over the hole a solderhemmed cap, and, through the center of this, attach a special apparatus having a hollow triangular spur, a sealing clamp, and attached pressure gauge.) Immerse the can in water and turn on the air pressure. A maximum pressure of 20 psi is recommended. The pressure should be increased from zero in stages and the can observed for leaks at each stage. A leak will be indicated by the formation of air bubbles. This procedure cannot be used when the entire can end has been removed.

One objection to these methods is that can leakage normally occurs from the outside in, and the use of internal pressure may produce or indicate leaks that would not occur in a normal can under slight vacuum. On the other hand, leaks that would occur under vacuum may be obscured. To obtain results more comparable to those that may occur naturally, a leak detector employing vacuum has been developed by Bee and Denny, similar to that shown in Figure 33.

Alternative Packaging: Special Considerations

Flexible Pouches and Bags

Some seafood processors pasteurize in pouches, bags, or tubes (casing) designed to withstand the temperatures and stresses encountered in a heat processed, refrigerated, or frozen product. By definition, a pouch possesses seals on all four sides when closed: three side seals formed by the pouch manufacturer and a head seal formed by the processor after filling. Bags usually possess only one distinct seal: the head seal. Tube casing materials and certain bags are closed with a clip.

Pouches may consist of a foil and plastic film laminate (these are opaque) or contain two or more types of plastic film, e.g. polyethylene and polypropylene formulations. Bags may be composed of several plastic materials coextruded into a single film layer. These materials provide numerous properties, including durability, puncture and stretch resistance, shrink control, seal strength, and the barrier levels desired for transmission of water vapor, oxygen, and other gases.

Heating and cooling rates (and corresponding process lethalities) of product in flexible packaging is very sensitive to package thickness and vacuum level. See Appendix III for a brief example operations protocol for moderate thermal processing in pouches.

Testing Methods for Plastic Packaging

The National Food Processors Association established a national committee of industry leaders to develop standards for the evaluation of flexible packaging. The Flexible Package Integrity Committee sets guidelines for the production and testing of:

1. paperboard packages
2. flexible pouch packages
3. plastic cans with heat sealed lids
4. plastic cans with double seamed metal ends.

For a copy of their complete set of guidelines or for an informative color poster (prepared jointly with FDA) contact:

National Food Processors Association
1401 New York Avenue, N.W.
Washington, D.C. 20005
202-639-5900

(Request publication 41-L, Flexible Package Integrity Bulletin)

Refer to Appendix III for examples of in-plant test procedures for pouch integrity. Inexpensive hand pump-up devices are also available for strength testing of plastics. The manufacturers of flexible and semi-rigid containers establish seamer/sealer set-up specifications for their packaging. These procedures should be incorporated into each plant's quality assurance and record-keeping programs.

Table 9. Causes and Solutions to Common Double Seam Defects

Possible Causes	Possible Solutions
DROOPS	
1. Baseplate pressure too great.	Decrease baseplate pressure. Check number of spacers needed for can size.
2. First seam roll operation too loose.	Tighten first seam roll operation.
3. Food trapped in seam.	Clean can edge carefully before seaming.
4. Defective cans (bent or dented).	Inspect cans for damage before using.
5. First seam roll worn.	Replace seam roll.
VEE	
1. Baseplate pressure too great.	Decrease baseplate pressure. Check number of spacers needed
2. First Seam roll operation too loose.	Tighten first seam roll operation.
3. Food trapped in seam.	Clean can edge carefully before seaming.
4. First seam roll operation too tight.	Loosen first seam roll operation.
5. First seam roll worn.	Replace seam roll.
SHARP SEAM AND CUTOVER	
1. First or second seam roll operation too tight.	Loosen first and/or second seam roll operations.
2. Food trapped in seam.	Clean can edge carefully before seaming.
3. Baseplate pressure too great.	Decrease baseplate pressure. Check number of spacers needed for can size.
4. Worn seam rolls and/or chuck.	Replace seam rolls and/or chuck.
CUT SEAM	
1. First and second seam roll operations too tight.	Loosen first and second seam roll operations.
INCOMPLETE SEAM	
1. Baseplate pressure too high or too low.	Check sealer instructions for number of spacers needed for can size.
2. Worn seaming chuck.	Replace chuck.
Seam rollers not rotating freely.	Clean, oil, or repair seam rollers so they rotate freely.

3. Oil or grease on seaming chuck turntable.	Clean seaming chuck and/or turntable.
FALSE SEAM	
1. Bent or damaged lid or can edges.	Inspect cans and lids for damage before using.
2. Food trapped in seam and/or can overfilled.	Clean can edge carefully before seaming. Check fill of can.
3. First seam roll operation loose.	Tighten first seam roll operations.
4. Second seam roll operation too tight.	Loosen second seam roll operation.
LOOSE THICKNESS (seam too loose)	
1. Second seam roll operation too loose.	Tighten second seam roll operation.
TIGHT THICKNESS (seam too tight)	
1. Second seam roll operation too tight.	Loosen second seam roll operation.
LONG SEAM WIDTH	
1. First seam roll operation too loose.	Tighten first seam roll operation.
2. Second seam roll operation too tight.	Loosen second seam roll operation.
3. Worn seam rolls.	Replace seam rolls.
SHORT SEAM WIDTH	
1. Second seam roll operation too loose.	Tighten second seam operation.
2. Baseplate pressure too great.	Decrease baseplate pressure. Check number of spacers needed for can size.
DEEP COUNTERSINK	
1. Baseplate pressure too great.	Decrease baseplate pressure. Check number of spacers needed for can size.
2. Incorrect chuck for can size being sealed.	Check sealer instructions for correct chuck size.

SHALLOW COUNTERSINK

1. Baseplate pressure too low.	Increase turntable pressure. Check number of spacers needed for can size.
2. Chuck worn.	Replace chuck.

LONG BODY HOOK (Fig. 68)

1. Baseplate pressure too great.	Decrease baseplate pressure.
2. Incorrect pin height setting.	Check number of spacers or pin height needed for can size.
3. Seaming chuck too low in relation to baseplate.	
4. Mushroomed can flange (misshapen curl).	Check can flanges for uniform shape prior to filling.

SHORT BODY HOOK (Fig. 69)

1. Baseplate pressure too low.	Increase baseplate pressure. Check number of spacers or pin height needed for can size.
2. Incorrect pin height setting.	
3. Seaming chuck too high in relation to baseplate.	
4. First seam roll operation too tight.	Loosen first seam roll operation.
5. Second seam roll operation too loose.	Tighten second seam roll operation.
6. Improperly formed can flange.	Check can flanges for uniform shape prior to filling.

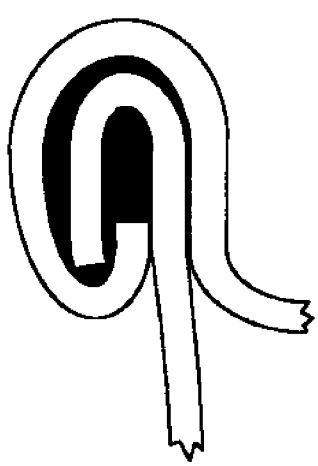


Figure 68. Long body hook.

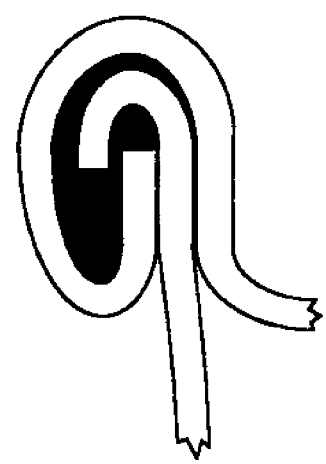


Figure 69. Short body hook.

LONG COVER HOOK (Fig. 70)

1. First seam roll operation too tight.	Loosen first operation seam roll.
2. Baseplate pressure too low.	Increase baseplate pressure. Check number of spacers needed for can size.

SHORT COVER HOOK (Fig. 71)

1. First seam roll operation too loose.	Tighten first operation seam roll.
2. Baseplate pressure too great.	Decrease baseplate pressure. Check number of spacers needed for can size.
3. First seam roll worn.	Replace seam rolls.

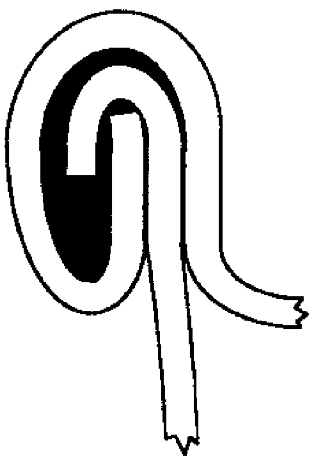


Figure 70. Long coverhook.

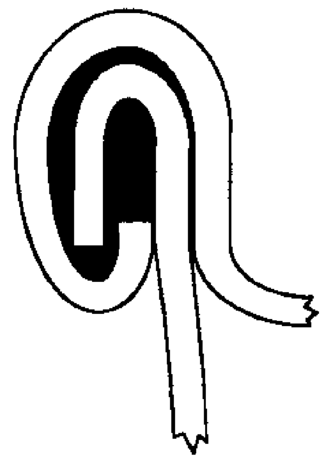


Figure 71. Short coverhook.

SHORT OVERLAP (Fig. 51)

1. Damaged can or lid edges.	Inspect cans and lids for damage before use.
2. First seam roll operation too tight.	Loosen first operation seam roll.
3. Baseplate pressure too low.	Increase baseplate pressure. Check number of spacers needed for can size.

LOOSE (pronounced) WRINKLE

1. Second seam roll too loose.	Tighten second operation seam roll.

TIGHT (no) WRINKLE

1. Second seam roll too tight.	Loosen second operation seam roll.

PRESSURE RIDGE NOT PRESENT	
1. Second seam roll operation too loose.	Tighten second seam roll operation.
2. Baseplate pressure too low.	Increase baseplate pressure. Check number of spacers needed for can size.

LOW VACUUM	
1. Cans not exhausted or food is cold before attaching lid.	Check canning instructions for exhausting and hot packing methods used with cans.
2. Incipient microbial growth.	Pasteurize soon after seaming.
3. Too little headspace in filled can (rare in crabmeat).	Check canning instructions for correct amount of headspace.

HIGH VACUUM	
1. Too much headspace in filled can.	Check canning instructions for correct amount of headspace.

Can Handling

The condition of a metal can or glass food container is of concern both when it is empty and when it is filled and sealed. In the case of the empty container, the principal concerns are the prevention of contamination with extraneous material and physical damage that may interfere with container integrity.

Empty Can Handling

Tin and glass containers are usually purchased, although a few of the larger canners manufacture their own cans. Glass containers are delivered to the cannery in boxes or, less frequently, palletized. Cans are received either loose, bagged, or palletized. Loose cans usually arrive at the cannery in freight cars or trucks. At every step of can off-loading, transfer, storage, washing, etc., employees should be instructed in the importance of careful handling procedures. Damaged containers, particularly dented body flanges, may not seal properly. Scratched can enamels may lead to crabmeat bluing problems or be unsightly.

Cans are transferred to the cannery on runways which lead directly to the fillers or to the storage loft. The runways outside the factory should be covered to prevent foreign objects from falling, being thrown, or kicked into the open cans. Inside the factory the can runways should be covered at any point where they pass under catwalks, dripping pipe lines, unprotected light fixtures, and so forth. Where the runways pass through floors, a protective metal collar should be placed around the runways at floor level to keep out floor dirt. When empty cans are stored in lofts, the tiers of cans closest to the floor should be protected with paper or cardboard to prevent objects from being kicked or swept into the cans.

When cans are received bagged, care should be exercised to prevent breaking of the bags prior to use. Bags of cans should be opened only as needed, and partial bags should be covered until the next use. Some canners use plastic covers for this purpose. Where cans are bright palletized and fed automatically into the can liners, cardboard separators should be left over the top of the open cans until they are fed into the distributing unit. Some canners also use plastic covers for palletized cans awaiting use. At the end of the day's operation all cans beyond the can washer or invertor should be removed from the can track, to prevent can contamination during the clean-up and shut-down period.

Cans should be used for food and food only. This must be a hard and fast rule if product contamination is to be avoided. Occasionally, maintenance men use cans as containers for nails, bolts, electrical supplies, and cleaning compounds, and workers on canning lines have been known to make them repositories for watches, jewelry, and other personal belongings. In addition, cans have been used for measuring ingredients, oils, and other materials. The possibility exists that these dirty cans may find their way into the packing lines without being emptied or washed. In one case several dollars in cash allegedly were found in a can with the product.

Container Washing

Some, though not all, canners have units installed in the empty-can handling lines that are referred to as can washers. These are either commercial or homemade and of various designs. All of them have their faults, and canners do not regard them as completely satisfactory. Some state regulatory agents have recommended steam injection of the empty container as a cleaning procedure.

The National Food Processors Association employed an experimental procedure in an attempt to evaluate in the laboratory the efficiencies of can washing methods. In brief, the procedure consisted of dying a mixed microbial contaminant and adding a measured quantity of the dyed contamination to the cans to be tested. The intensity of the dye was measured before and after the can washer as an index of remaining contamination. The amount of dye reduction is a rough measure of the efficiency of the washing procedure. The results indicated that only one living spore remained for each 100 grams of food. The time to reduce the survivors by 90% (the decimal reduction time [D-value]) was $D_{240}=1$ minute.

Preliminary tests indicate that hot water cleans more efficiently than cold water, cold water more efficiently than steam, and steam more efficiently than air blast. However, steam has a tendency to paste larger particles of contamination to the can rather than remove them.

While water at 170-180°F under 60 to 70 pounds of nozzle pressure will do a good cleaning job under laboratory conditions, the commercial application of this procedure presents serious economic and engineering problems.

In the case of glass containers, suitable jar washers are available especially for baby food jars. Alternate air blasts and vacuum have been used successfully in cleaning glass containers. Glass containers also have the advantage that they can be observed as they pass an inspection point and defects or extraneous material can be detected.

Containers should be rinsed or dipped with an approved sanitizer (most often chlorine) and drained immediately prior to filling with product.