

SURFACE VEHICLE INFORMATION REPORT

Submitted for recognition as an American National Standard

SAE J810

REV.
MAR96

Issued 1956-04
Revised 1996-03

Superseding J810 MAR87

(R) CLASSIFICATION OF COMMON IMPERFECTIONS IN SHEET STEEL

Foreword—This Document has also changed to comply with the new SAE Technical Standards Board format.

1. **Scope**—Common or obvious surface imperfections, which sometimes occur in sheet steel, are normally visible to the naked eye before or after fabrication.

Illustrations and definitions of these imperfections are contained in this SAE Information Report. The identifying names are those commonly used throughout the steel industry. The imperfections identified include the major and most often encountered imperfections known to exist at this time. These imperfections are variable in appearance and severity. Extreme conditions have been selected in some instances in order to obtain suitable photographs.

Photographs are courtesy of the American Iron and Steel Institute, Kaiser Aluminum, LTV Steel, National Steel, The Budd Company.

2. **References**—There are no referenced publications specified herein.

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-8512 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS <http://www.sae.org>

3. *Most Common Imperfections*—(See Table 1.)

TABLE 1—COMMON IMPERFECTIONS ENCOUNTERED IN SHEET STEEL

Imperfections	Origin Steelmaking	Origin Rolling	Origin Processing	Origin Coating	Page No.
Blisters	X				3
Buckles		X			10
Camber			X		20
Chatter Marks		X			11
Coil Welds			X		21
Crown		X			12
Dross Stringers				X	30
Edge Breaks		X			13
Friction Digs			X		22
Ghost Lines	X				4
Healed-Over-Scratch		X			14
Holes	X				5
Line-Stop				X	31
Lüder Lines			X		23
Orange Peel			X		24
Oscillation			X		25
Pinchers		X			15
Pipe Lamination	X				6
Pits		X			16
Ragged-Edges	X		X		7
Reel-Breaks		X			14
Rolled-In Scale		X			18
Sliver	X				8
Speckled Rust			X		26
Sticker Breaks			X		27
Telescoping			X		28

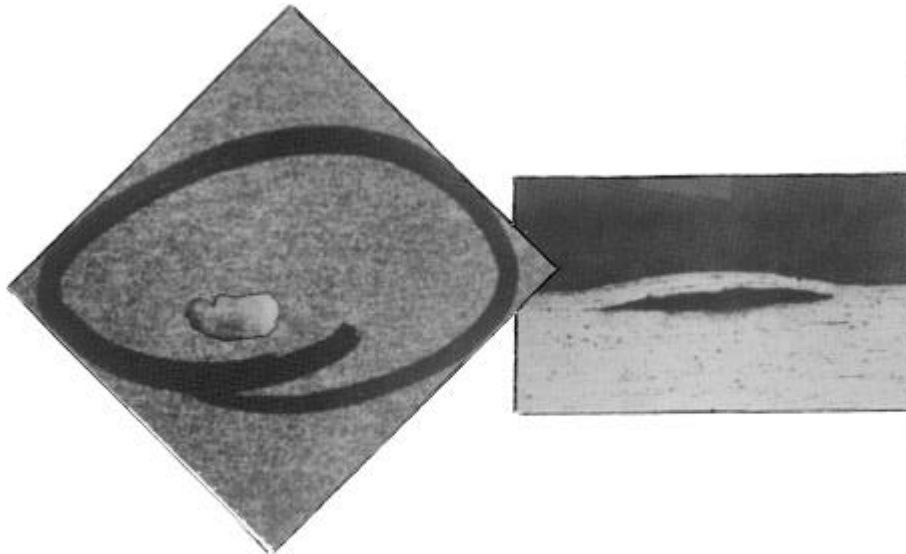
This table lists alphabetically the most common imperfections encountered in sheet steel. They are classified according to the various manufacturing processes. The appropriate descriptions can be found in the following sections under:

- a. Section 4—Steelmaking
- b. Section 5—Rolling
- c. Section 6—Processing
- d. Section 7—Coating

4. *Steelmaking Imperfections*—(See Table 2 and Figures 1 to 6.)

TABLE 2—STEELMAKING IMPERFECTIONS

Steelmaking Imperfections	Similar Imperfections
Blisters	Pinhead Stringers
Ghost Lines	
Holes	
Pipe Lamination	Laminations
Ragged-Edges	Sawtooth Edges, Damaged Edges
Sliver	Scabs, Skin Laminations



Description:	Blister is a small raised area on the steel surface. It may be an isolated spot or it may occur as longitudinal streaks.
Cause:	Blisters are caused by the expansion of gas concentrated at a subsurface inclusion.
Similar Imperfection:	Pinhead, Stringers

FIGURE 1—BLISTERS

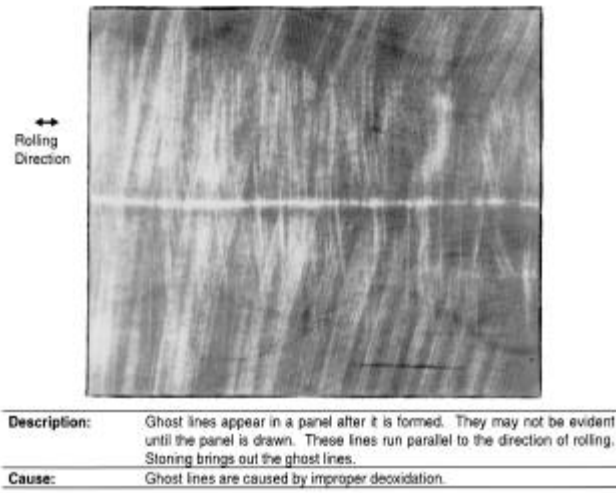


FIGURE 2—GHOST LINES

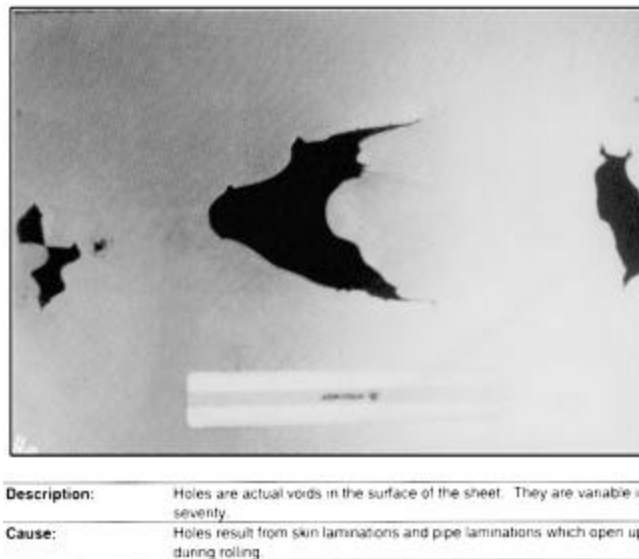


FIGURE 3—HOLES

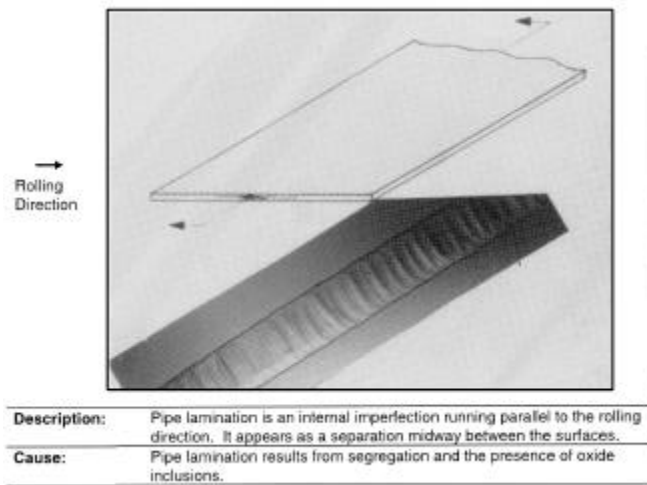
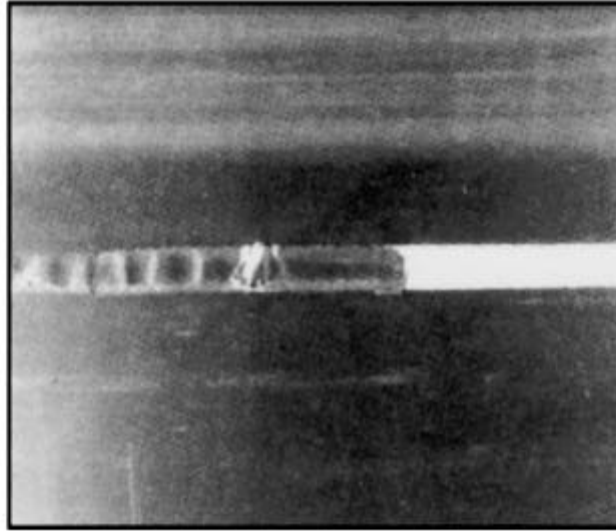


FIGURE 4—PIPE LAMINATION



FIGURE 5—RAGGED EDGES



Description:	A sliver is a prominent surface rupture consisting of a very thin elongated piece of metal attached only by one end to the parent steel into whose surface it has been rolled. Slivers will vary in severity and frequency.
Cause:	• Improper composition (overoxidized, high sulfur) • Improper teeming (scabs) • Improper heating (burning) • Tearing of corners in early stages of rolling • Inadequate conditioning Slivers can also be generated mechanically.
Similar Imperfection:	Scab, Seam, Skin Lamination

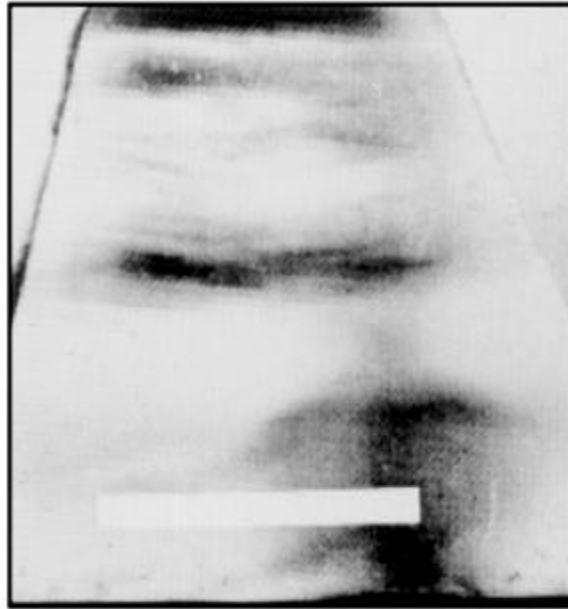
FIGURE 6—SLIVER

5. **Rolling Imperfections**—(See Table 3 and Figures 7 to 15.)

TABLE 3—ROLLING IMPERFECTIONS

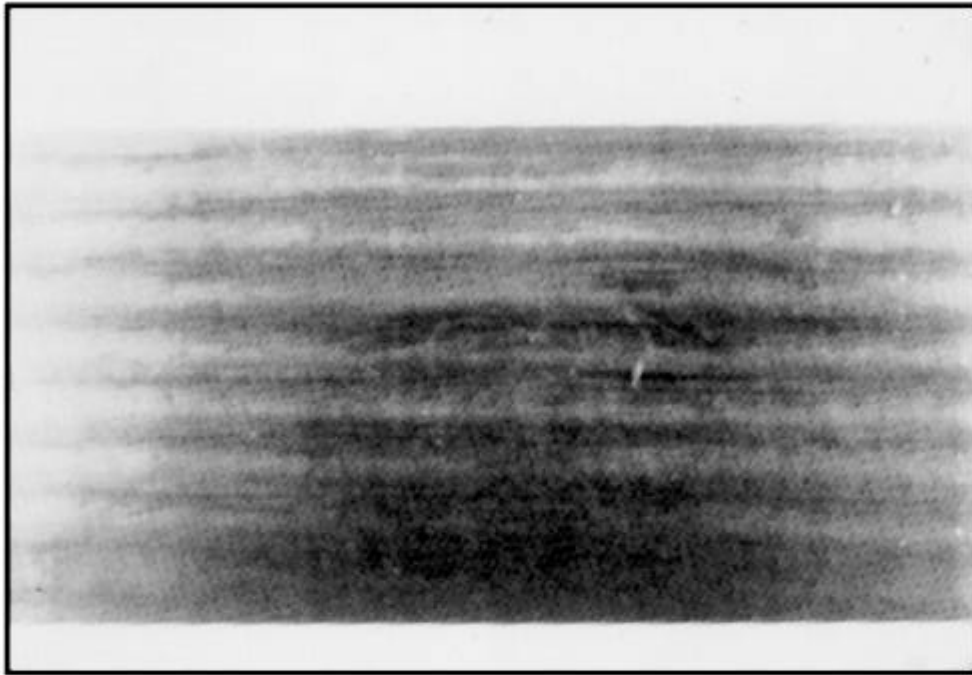
Rolling Imperfections	Similar Imperfections
Buckles	Full Center, Edge Wave
Chatter Marks	
Crown	
Edge Breaks	Sticker Breaks
Healed-Over-Scratch	Black Streak, Seam
Pinchers	
Pits	Pick-up, Rolled-in Dirt
Reel-Breaks	Breaks, Mandrel Breaks, Reel Kink
Rolled-In Scale	Rolled-in Dirt

↑
↓
Rolling
Direction



Description:	Buckles are a series of waves transverse to the direction of rolling. This condition varies in severity and frequency. The imperfection is called Center Buckle when it is located in the middle of the sheet, or Side Buckle (also called Quarter Buckle) when it is located near, but off, center.
Cause:	Buckles are caused by hardness variations of the hot rolled sheet due to uneven cooling of the steel or mill rolls, build-up, or poor rolling practice.
Similar Imperfection:	Full Center, Edge Wave

FIGURE 7—BUCKLES

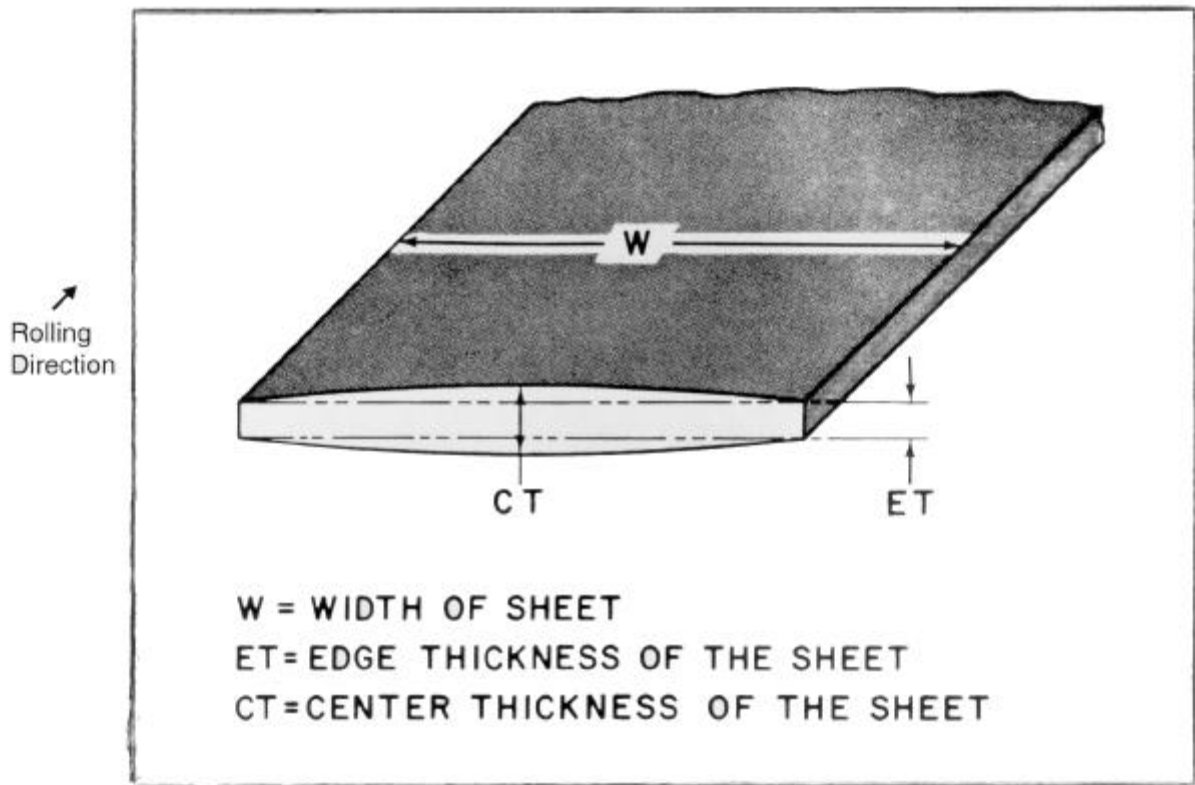


Description: Intermittent surface distortion perpendicular to the direction of rolling (across the width). They may or may not be perceptible to the touch. They may appear as alternate bright and dull streaks. They can be highlighted by stoning.

Cause:

- Vibration during rolling
- Lubricant failure causing fluctuation in the coefficient of friction between the roll face and the sheet surface
- Improper tension between stands during rolling

FIGURE 8—CHATTER MARKS

**Description:**

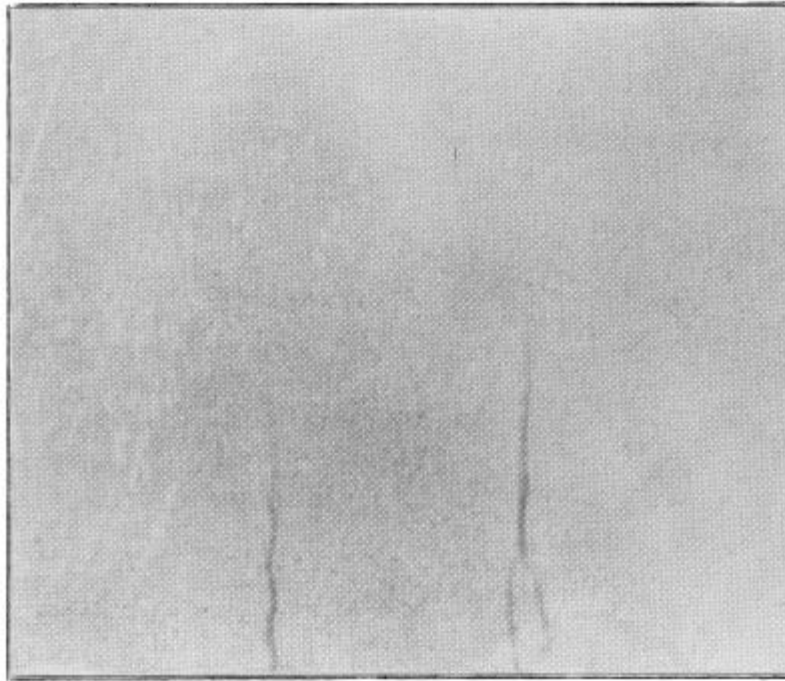
Crown exists when the thickness at the center of the sheet is greater than at the edges. Under normal conditions a flat rolled product will exhibit a crown. This condition is classified as an imperfection when the center thickness of the sheet exceeds the published thickness tolerances.

Cause:

Crown can be caused by the bending of the rolls, worn rolls, improperly ground rolls, or rolling practices.

FIGURE 9—CROWN

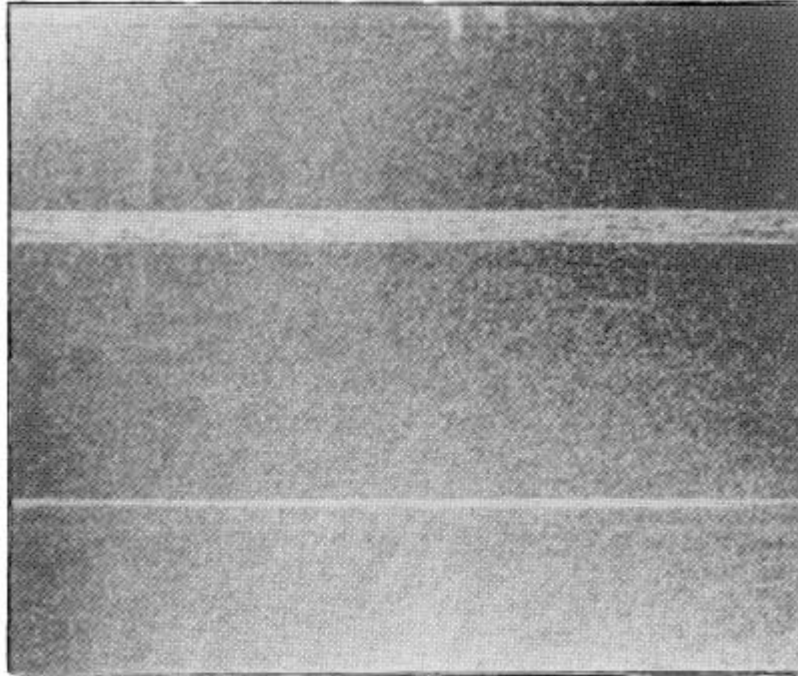
↔
Rolling
Direction



Description:	Edge breaks are short creases which extend in from the side edge of the temper rolled sheet.
Cause:	Edge breaks are found in steel where the extreme sheet edges are substantially thinner than the rest of the sheet and, therefore, are placed in tension during the temper rolling process.
Similar Imperfection:	Sticker Breaks

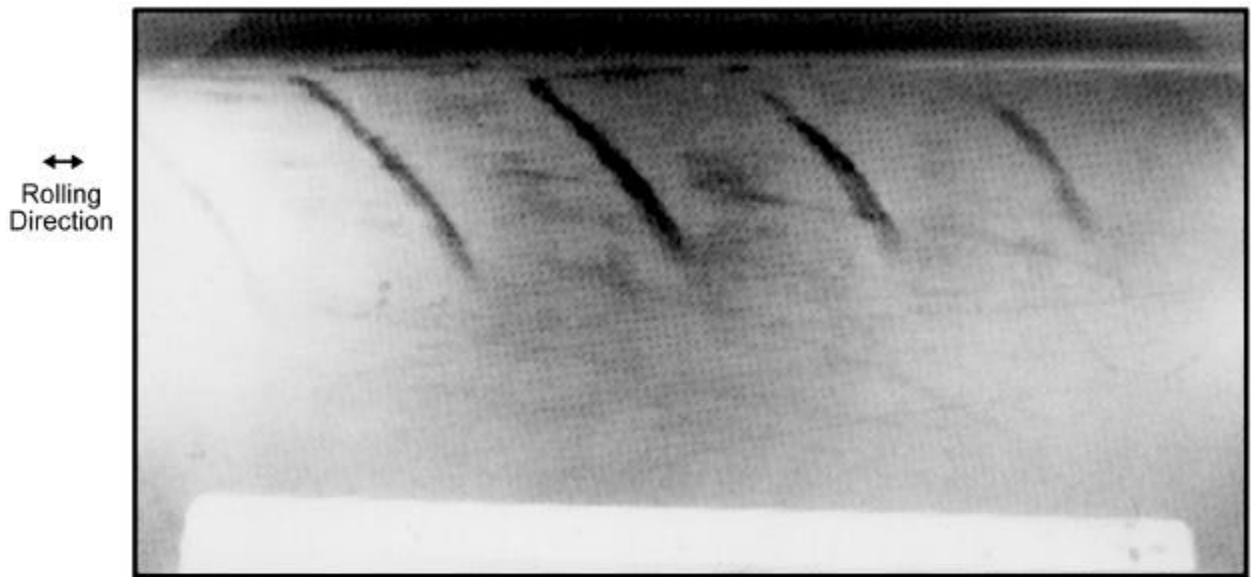
FIGURE 10—EDGE BREAKS

↔
Rolling
Direction



Description:	A healed-over scratch, also known as "rolled-over scratch," is a scratch which may open up during rolling and is sometimes indistinguishable from a seam.
Cause:	A scratch which originated in a previous mill operation and it has been partially masked in subsequent rolling.

FIGURE 11—HEALED-OVER SCRATCH



Description:	Pinchers (feathering) occur during temper rolling. They can be observed with the naked eye and usually they run diagonal to the direction of rolling.
Cause:	Pinchers may occur locally or across the width of the sheet. They are caused when the profile of the ingoing strip does not coincide with that of the "roll gap" during temper rolling (Ex: wavy strip).

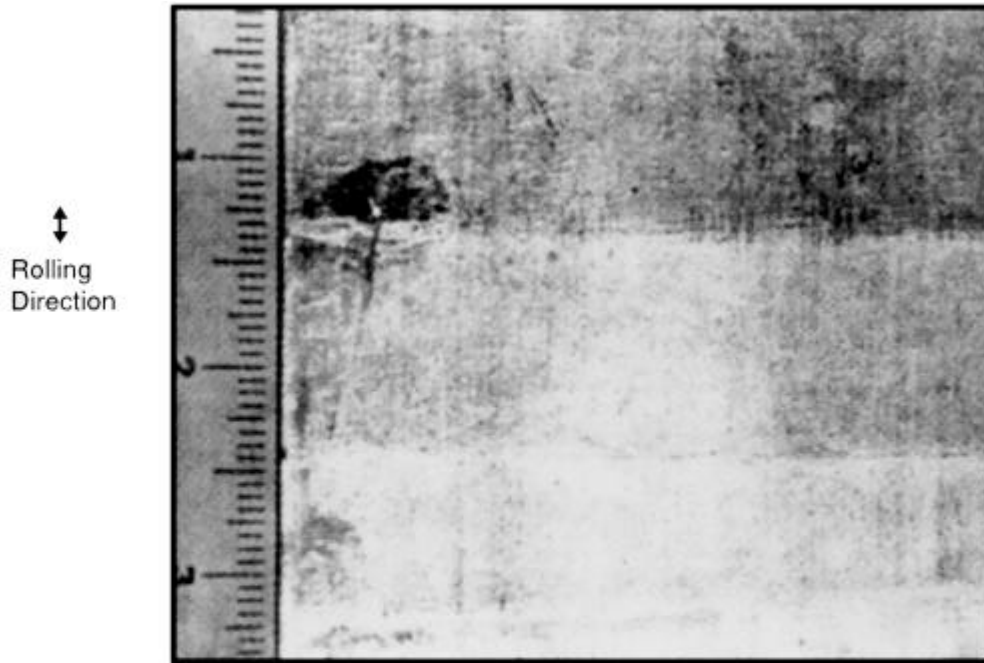
FIGURE 12—PINCHERS

↔
Rolling
Direction



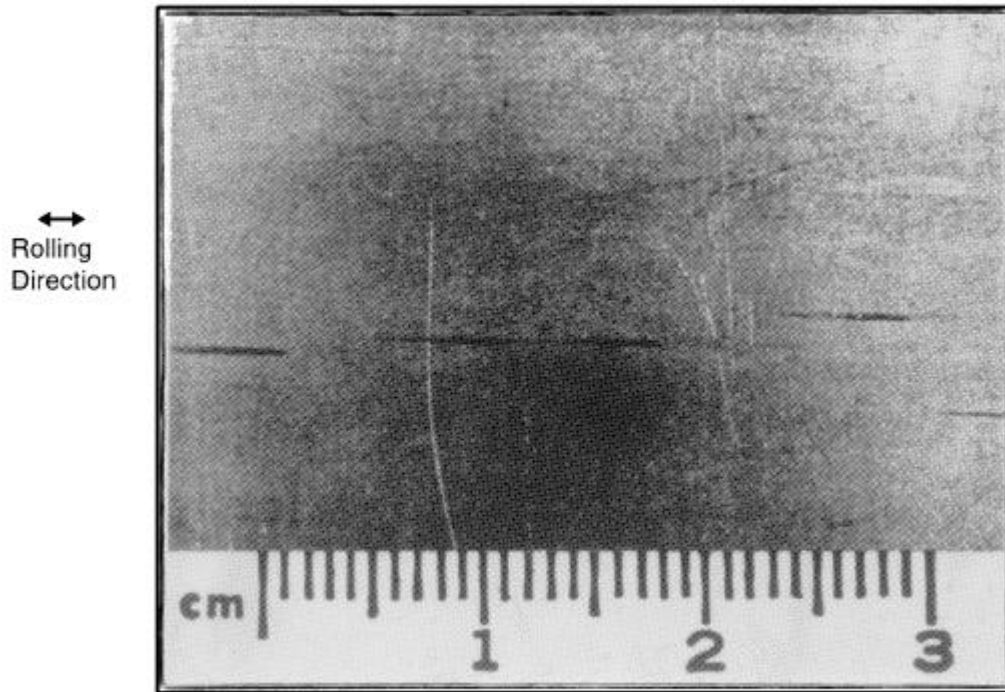
Description:	Pits are small cavities in the surface of the steel. Pits are randomly distributed indentations.
Cause:	• Pits can be caused by the temper mill rolls. Pits that repeat periodically are called Grease Pits. • Pits can be caused by picked-up sand from the box-type annealing furnaces. The sand is rolled into the surfaces and they appear as multiple small pits about 12 in from the edge; they are Sand Pits. • Pits can be caused by rolled-in scale which has been removed by pickling; they are called Scale Pits. • Pits can be caused by foreign particles or metal flakes, which are rolled into and fall out of the surface of the steel, they are called: Slug Pits.
Similar Imperfection:	Pick-Up, Rolled-In Dirt, Rolled-In Scale

FIGURE 13—PITS



Description:	Reel breaks are transverse breaks or ridges on successive inner laps of a coil.
Cause:	Reel breaks originate when the lead end of the coil may not have been properly entered into the clamp. They are also caused by excessive tension during coiling.
Similar Imperfection:	Breaks, Mandrel Breaks, Reel Kink

FIGURE 14—REEL BREAKS

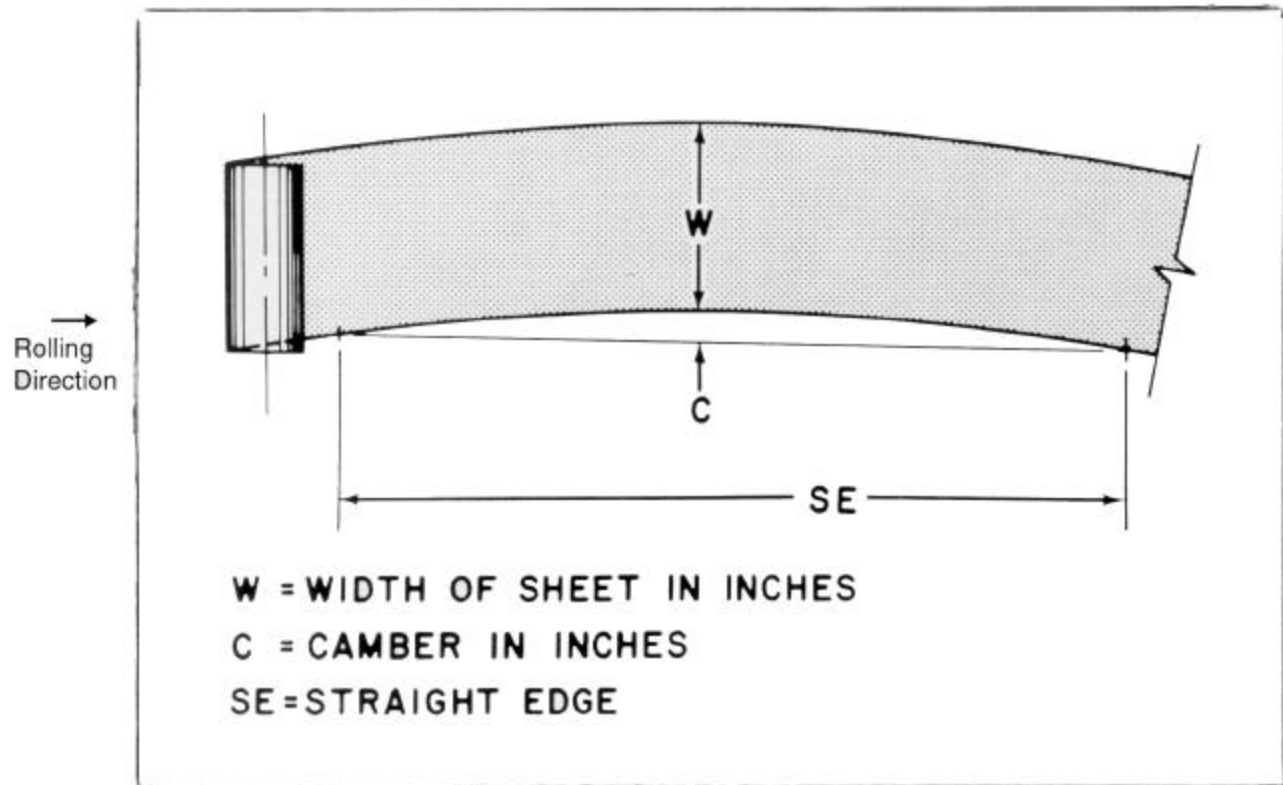


Description:	Rolled-in scale appears as dark streaks in the rolling direction.
Cause:	Rolled-in scale results when scale is partially rolled into the surface of the sheet. This condition can cause holes in certain products.

FIGURE 15—ROLLED-IN SCALE

6. Processing Imperfections—(See Table 4 and Figures 16 to 24.)**TABLE 4—PROCESSING IMPERFECTIONS**

Processing Imperfections	Similar Imperfections
Camber	
Coil Welds	
Friction Digs	Gouges, Coil Digs
Lüder Lines	Stretcher Strains
Orange Peel	Alligator Skin
Oscillation	
Speckled Rust	Rust Patches, Pinpoint Rust
Sticker Breaks	Coil Breaks, Edge Breaks
Telescoping	



Description:	Camber is the deviation of a sheet edge from a straight line. It is measured as the greatest deviation of the concave edge of the sheet from a straight line.
Cause:	Camber is the result of bad slitting or is caused when the mill is off level when the sheet is rolled. Camber can also be caused by edge wave and center buckle.

FIGURE 16—CAMBER

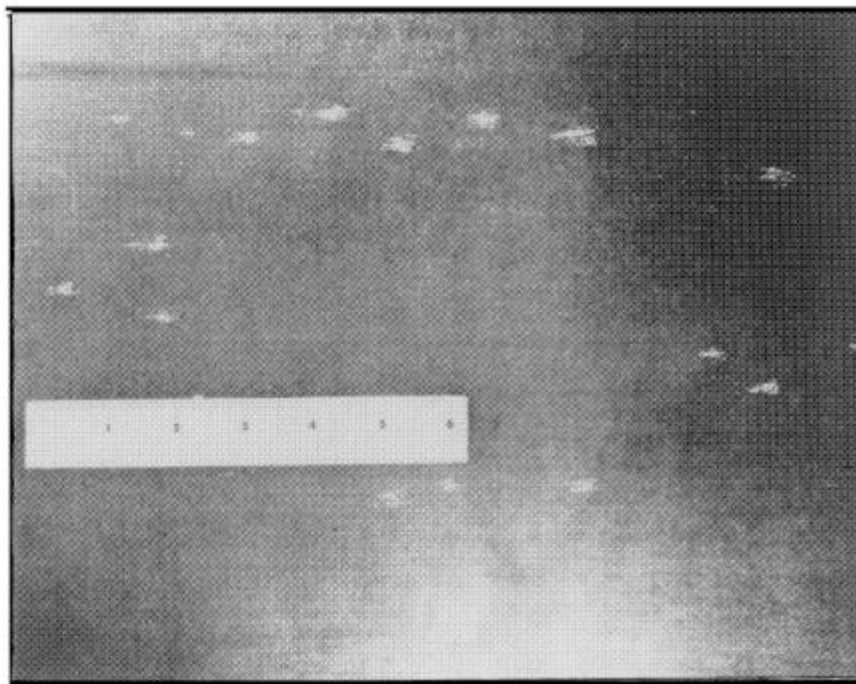

 Rolling
 Direction



Description:	A coil weld is the area where two coils have been joined together to go through pickling, rolling, or coating lines for continuous processing. Small coils are welded together to make larger coils.
Cause:	Two coils are joined or fused together by heat. The types of coil welds are: • "Butt weld" or "cold reduced weld." It should be undetectable in the cold rolled or coated stage. This is acceptable. • "Lap weld," when two coils are joined by overlapping the coil ends. This is not acceptable.

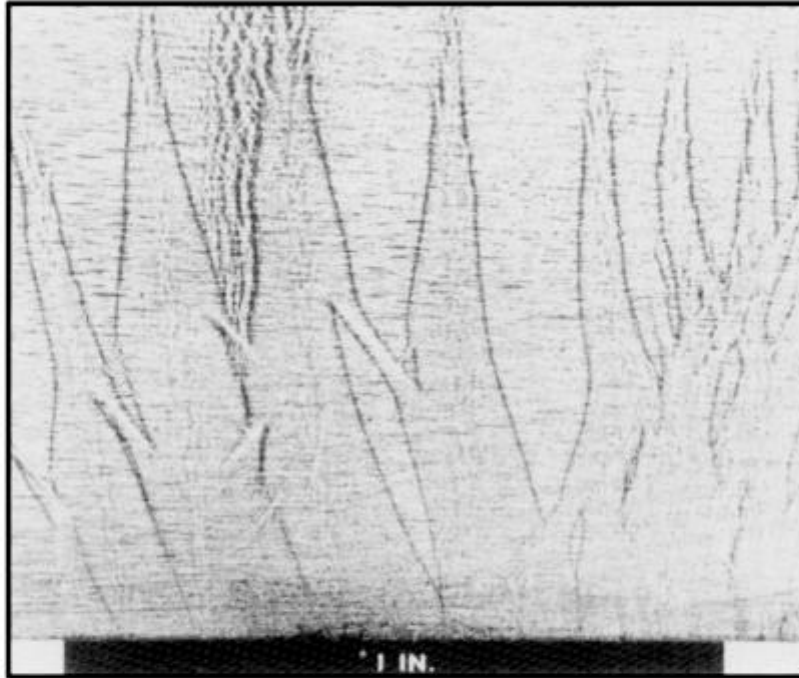
FIGURE 17—COIL WELD

↔
Rolling
Direction



Description:	Friction digs are short scratches running in the longitudinal or diagonal direction. They are usually deeper than handling or mechanical scratches.
Cause:	Friction digs are caused by slippage of adjacent laps of a coil during uncoiling and coiling.

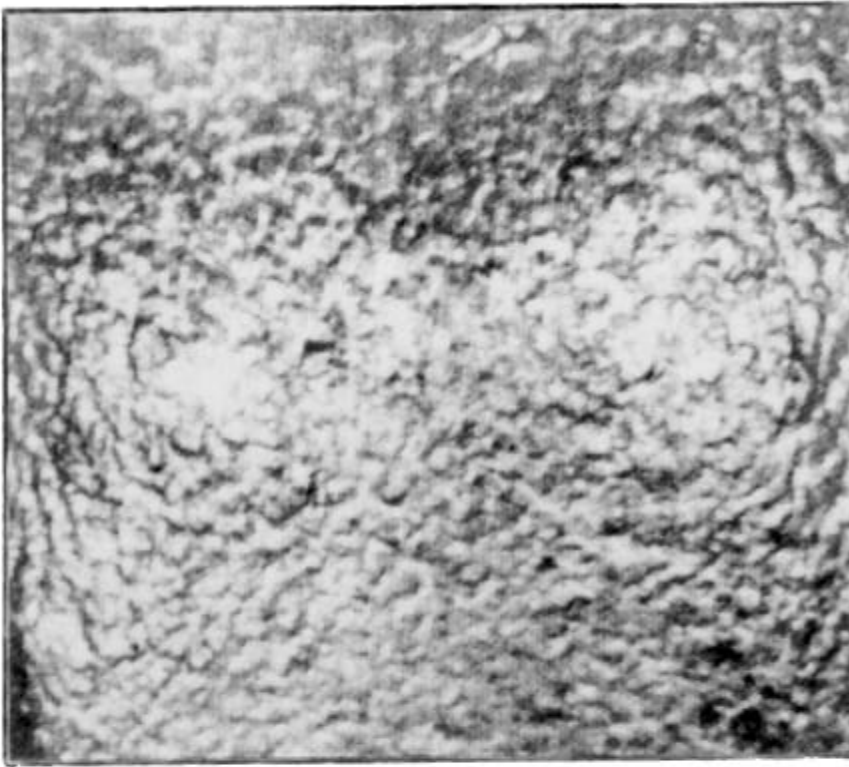
FIGURE 18—FRICTION DIGS



Description: Lüder lines, also called stretcher strains, are lines which occur during forming. For exposed applications, they are objectionable, since they cause uneven, undulating surfaces.

Cause: These lines are associated with the yield point. When the yield point is exceeded, nonuniform plastic deformation occurs. With increased stretching, these zones multiply and intersect each other, until the entire surface is covered with these type of lines.

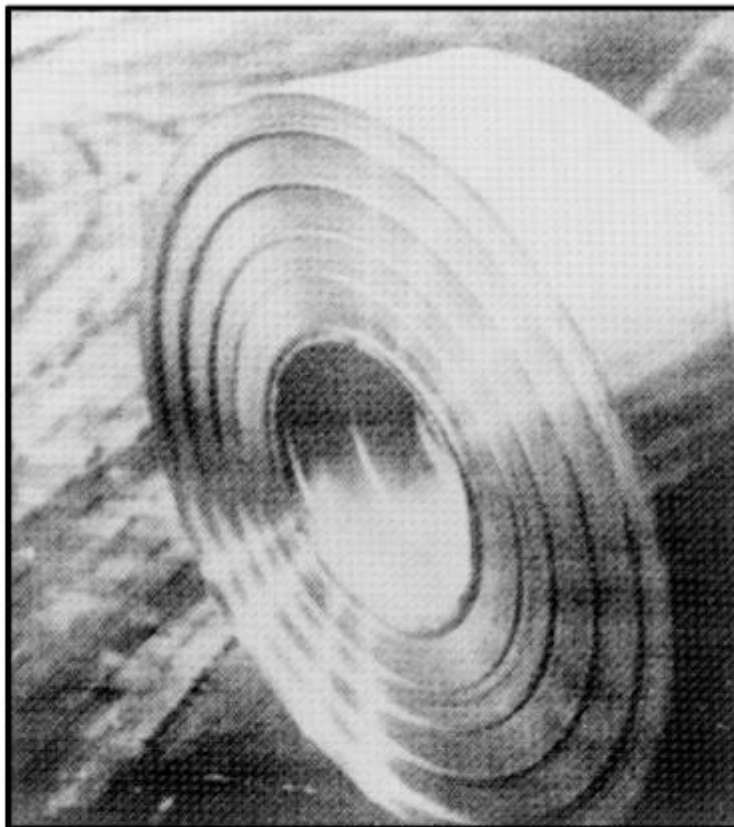
FIGURE 19—LÜDER LINES



Description: Orange peel is a rough surface in the form of a pebbly-grained pattern produced during forming (drawing operation) when the metal has a very coarse grain size and is stressed beyond its elastic limit. Also called alligator skin.

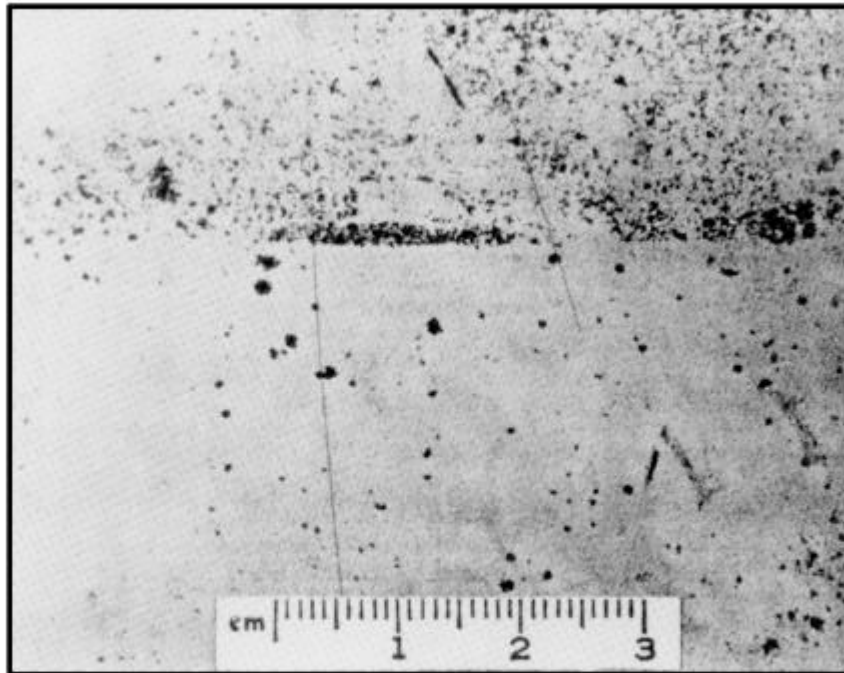
Cause: Coarse grain structure occurs because of secondary recrystallization after deformation when annealing at high temperatures.

FIGURE 20—ORANGE PEEL



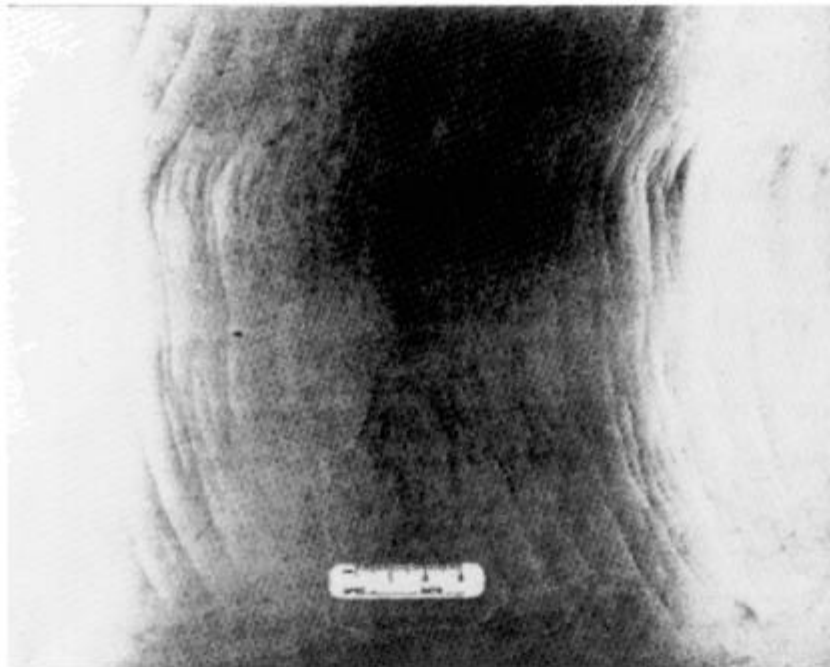
Description:	The wraps of the oscillated coil are wound unevenly, resulting in an intermittent telescoping condition throughout the coil.
Cause:	• Temporary loss of tension during coiling

FIGURE 21—OSCILLATION



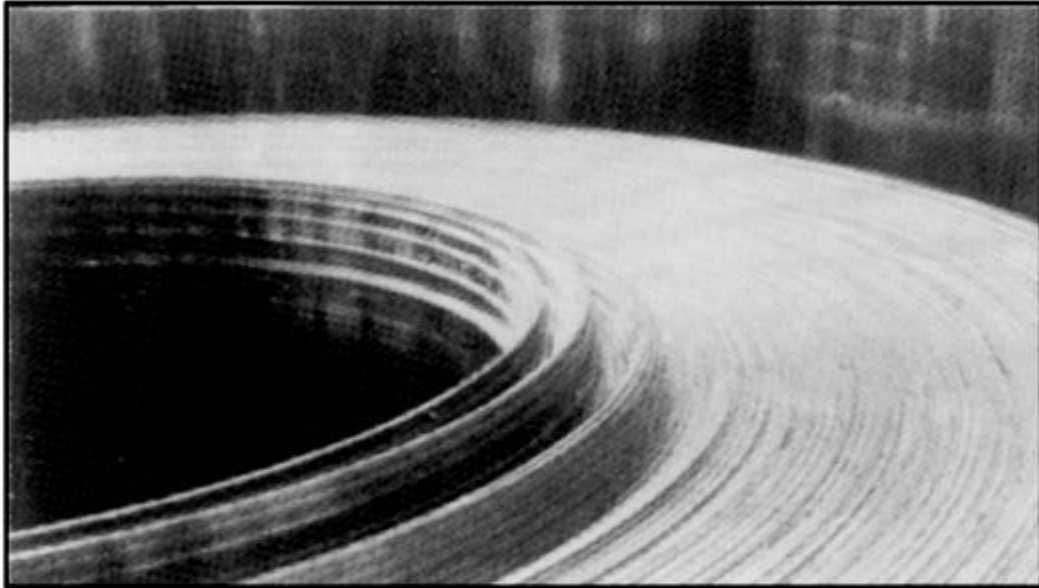
Description:	Speckled rust appears as round dark specks randomly distributed on the surface of the coil.
Cause:	Speckled rust is caused by high humidity or moisture spray.
Similar Imperfection:	Lineal Rust, Pin Point Rust, Rust Patches

FIGURE 22—SPECKLED RUST



Description:	Sticker breaks are creases or ridges which appear as roughly arc-shaped lines running transverse to the direction of rolling and usually near the middle of the sheet.
Cause:	Sticker breaks are formed as a result of coil laps sticking together during uncoiling, because of: • Coils being too tightly wound prior to annealing • Surface too smooth • Annealing temperature too high • Damaged coils (bumped) prior to annealing
Similar Imperfection:	Coil Breaks, Edge Breaks

FIGURE 23—STICKER BREAKS



Description:	Telescoped coils are formed when transverse slipping of successive inner wraps of the coil occurred giving the formation of a cone between the inner wraps and the OD.
Cause:	• Wrap to wrap slippage during coiling • Uneven wrap in coiling and lateral travel during winding • Wrap too loosely

FIGURE 24—TELESCOPING

7. Coating Imperfections—(See Table 5 and Figures 25 and 26.)**TABLE 5—COATING IMPERFECTIONS**

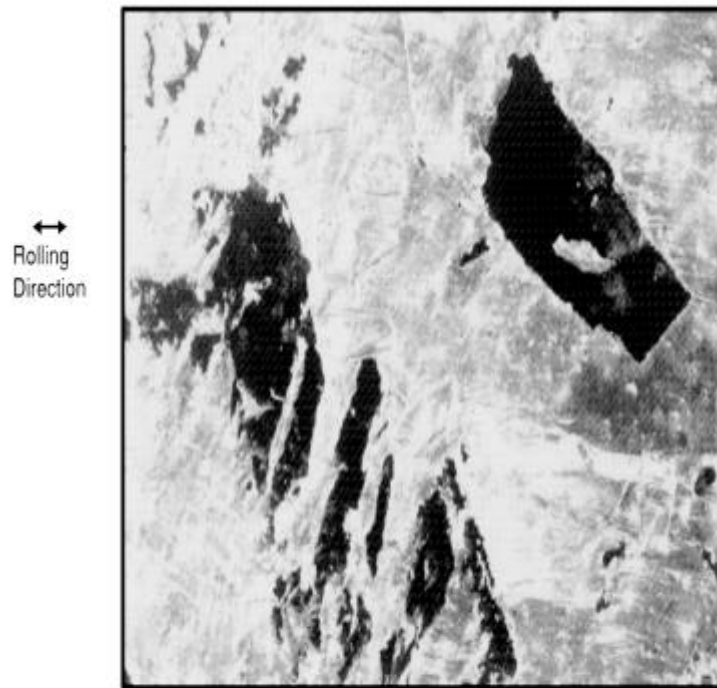
Coating Imperfections	Similar Imperfections
Dross Stringers	Seam Line
Line-Stop	Bare Spots

↔
Rolling
Direction



Description:	Dross stringers appear as raised lines in the rolling direction on the surface of "hot-dipped" galvanize andterne plate.
Cause:	Dross stringers are caused when the scum that floats on the surface of the molten metal is picked up by the steel strip and streaked onto the coating by the control knives as the strip exits from the bath.
Similar Imperfection:	Seam Line

FIGURE 25—DROSS STRINGERS



Description:	A line stop is an area on the surface of the steel where there is no coating (bare spots).
Cause:	A line stop is caused when the metal and fluxing agent are burned due to the operational shutdown of the "hot-dipped" coating line.

FIGURE 26—LINE STOP (HD COATED PRODUCTS)

8. Notes

- 8.1 Marginal Indicia**—The change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions have been made to the previous issue of the report. An (R) symbol to the left of the document title indicates a complete revision of the report.

PREPARED BY THE SAE IRON AND STEEL TECHNICAL COMMITTEE DIVISION 32—
SHEET & STRIP STEEL OF THE SAE IRON AND STEEL TECHNICAL COMMITTEE

SAE J810 Revised MAR96

Rationale—Not applicable.

Relationship of SAE Standard to ISO Standard—Not applicable.

Application—Common or obvious surface imperfections, which sometimes occur in sheet steel, are normally visible to the naked eye before or after fabrication.

Illustrations and definitions of these imperfections are contained in this SAE Information Report. The identifying names are those commonly used throughout the steel industry. The imperfections identified include the major and most often encountered imperfections known to exist at this time. These imperfections are variable in appearance and severity. Extreme conditions have been selected in some instances in order to obtain suitable photographs.

Photographs are courtesy of the American Iron and Steel Institute, Kaiser Aluminum, LTV Steel, National Steel, The Budd Company.

Reference Section—There are no referenced publications specified herein.

Developed by the SAE Iron and Steel Technical Committee Division 32—Sheet & Strip Steel

Sponsored by the SAE Iron & Steel Technical Committee