dba **HARCO LLC**
Visual Inspection
Standard

VIS-01 Rev F
Issued: October 20, 2000
Revised: September 5, 2017

Visual Inspection Standard - 01

1. **Scope:** This Standard provides inspection methods and acceptance limits for imperfections permitted on all parts, unless otherwise specified by purchase order, engineering drawing or other Inspection Standard.

2. **Policy:** Visual Inspection Standards (VIS) provide relaxations from the surface condition (normally flawless) implied by engineering drawings. Only those relaxations (called imperfections) allowed by this VIS, or the engineering drawing are permitted on parts to which this VIS is assigned.

3. **Application:** This VIS applies when specified by purchase order, drawing, or by an approved or manufacturing or inspection document. This VIS also applies by default to all HARCO final inspection operations, unless otherwise specified by engineering drawing or manufacturing instruction.

   3.1. If there is a conflict between this VIS-01 and an engineering drawing, the engineering drawing has precedence.
   3.2. This VIS applies to all areas of a part unless otherwise specified by an approved document.
   3.3. When this VIS-01 is applied to assemblies and its acceptance limits, as defined in the engineering drawing conflict with the visual inspection applied to a detail, the engineering drawing detail acceptance limits prevail.

4. **Instructions to Inspectors**

   4.1. Parts shall be visually inspected to acceptance to the limits of the assigned VIS.
   4.2. Unless otherwise specified, visual inspection sampling is to be 100%.
   4.3. Any observed conditions not addressed by this VIS or engineering drawing shall be considered as nonconforming. Examples of nonconforming conditions not addressed by this VIS are cracks, chips, burrs, and missed operations.
   4.4. Parts shall be cosmetically representative of quality workmanship based on such factors as inspection history with parts previously returned from customer and/or unusual variation from normal appearance.
   4.5. Inspection shall be performed under 100 FT/CANDLE lighting minimum.
   4.6. Inspectors shall possess normal or corrected near vision.
   4.7. Unless otherwise specified, parts shall be inspected without magnification. However, up to 4X magnification may be used as an aid to evaluate an observed condition.

4.8. **Stylus** Definition: A metallic stylus having a nose radius .025 inch may be used to evaluate imperfections which appear to penetrate the surface finish texture in accordance with the following paragraph of this Standard.

4.9. **General Stylus Use:** The stylus should be lightly held near the top, between the thumb and forefinger, inclined at 60 degrees toward the imperfection, and be pushed forward over the surface without applying pressure other than the weight of the stylus itself, in a direction approximately 90 degrees to the general lay of the imperfection. If the point of the stylus does not hesitate (catch) in the surface imperfection being judged, the imperfection is acceptable.

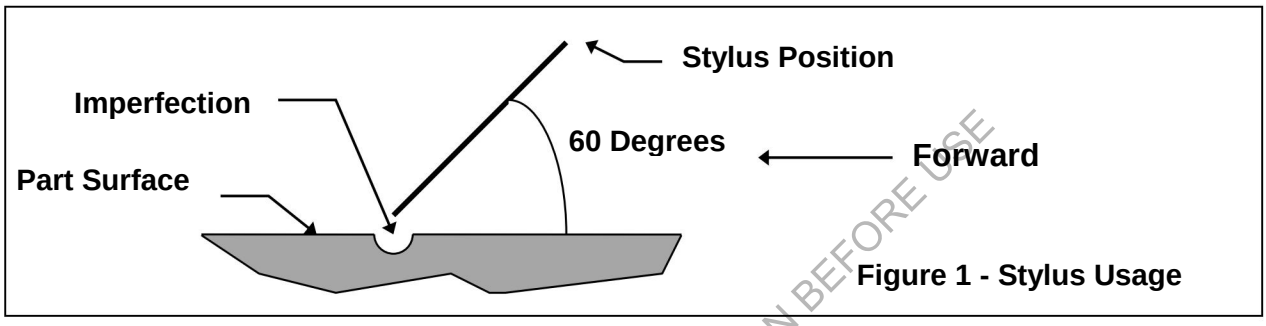


Figure 1

5. Acceptance Limits

5.1. ***Allowable Imperfections for All Parts***

The following imperfections are allowable unless otherwise specified. Parts containing imperfections other than those allowed herein are cause for rejection.

5.1.1. **Superficial imperfections, burnish marks**, and **water discoloration** light gray or light brown.

5.1.2. Any imperfection, which appears to penetrate the surface finish, does not have a dark bottom (ie: bottom not visible without magnification) and does not cause a stylus (per the above definition) to hesitate (catch) when passed over it.

5.1.3. **Chatter marks**, provided surface texture requirements are met.

5.1.4. **Drilled Holes:** Circumferential tool marks, up to .003 inch deep are permitted in the bore of drilled holes, provided they do not affect an area in excess of 10% of the part thickness (or hole depth), are free of raised metal, are not within 10% of part thickness dimension from either end of the hole and do not break into the radius at either end of the hole.

5.1.5. **Counterbored Holes**: Steps in the counter bore diameter up to .003 inch deep are acceptable provide they are smooth and do not affect an area in excess of 10% of the counterbored area.

5.1.6. **Scallops:** Circumferential tool marks, up to .003 inch deep, are permitted on the surfaces of scallops, provided they are free from raised material, do not break an edge and do not extend from one scallop to an adjacent scallop in a single line.

5.1.7. Surfaces containing drilled holes: **False drill starts**, up to .005 inch deep or 10% of thickness, whichever is less, are acceptable provided they are free from raised material or sharp edges and are at least .100 inch away from the nearest edge.

5.2. Allowable Imperfections on Die-Stamped Parts

The following acceptance criteria apply for die-stamped features on sheet metal hardware parts (e.g. brackets, clamps, etc.) that fall into one of the following categories:

Thick Parts: Parts where the minimum sheet thickness on drawing is .085 inch or less. Either of the following die-stamped features on these parts:

Holes or slots, if the tolerance is +/- .010 inch or more
Contour, if the drawing shows contour tolerance of +/- .010 or more (per edge).

Thin Parts: Parts where minimum sheet thickness on drawing is less than .085 inch (regardless of magnitude of contour, slot and hole tolerances).

The following imperfections are allowable unless otherwise specified. Parts not meeting these requirements are cause for rejection. Parts containing imperfections other than those allowed herein are cause for rejection.

5.2.1. **Die break** occurring on sheared edges is acceptable provided there are no sharp edges or hanging burrs. Raised edges around holes in perforated parts are acceptable provided the edge height is .003 inch or less and are free of jagged or loose metal fragments.

5.2.2. **Rollover:** Blanked, punched or sheared parts shall be allowed a rolled edge on the punch side for up to 1/6 of the material thickness and extending back from the edge for up to 1/3 of the material thickness (Ref. Figure 2).

5.2.3. Exclusive of dimensional tolerances, **shear or bellmouth** shall be permitted provided the amount of taper is no greater than 1/4 of the material thickness (Ref. Figure 2).

5.2.4. Unless otherwise specified, the following tolerances in excess of the perfect form thickness tolerance is permitted:

5.2.4.1. Thick parts (.085 inch or greater) a tolerance of .010 inch shall be applied.

5.2.4.2. Thin parts (less than .085 inch) a tolerance of .020 shall be applied.

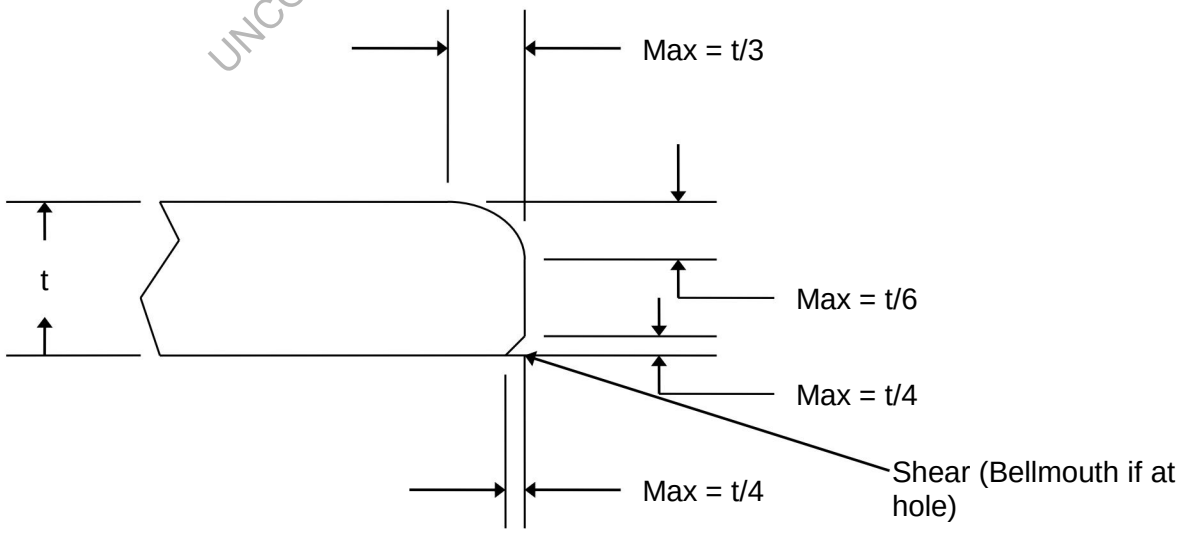


Figure 2

5.3. ***Allowable Imperfections on Die-Formed Sheet Metal Parts***

5.3.1. **Scratches** are acceptable provided they do not cause a stylus (per paragraph 5.9) to hesitate (catch) when passed over it.

5.3.2. **Formed depressions** are acceptable provided they do not exceed .005 inch in depth or height and they blend with adjacent surfaces without exhibiting sharp creasing of material. The minimum ratio of width to depth or height of depression shall be 10 to 1.

5.3.3. **Wrinkles** in areas of sharp contour changes are acceptable provided the depth or height does not exceed .008 inches.

5.3.4. **Wavy Surface Appearance:** Surfaces may have contour changes which are within the drawing limit ranges (limit dimension/profile). These contour changes are acceptable provided they have a smooth transition.

5.3.5. AMS 5536 Material (Hastelloy) and Thermocouple Alloys (Chromel, Alumel): **Orange peel** is acceptable provided drawing surface texture does not exceed 250 AA.

5.4. ***Hot Formed Sheet Metal Parts***

In addition to the above conditions for Die-Formed Sheet Metal Parts, the following are allowed:

5.4.1. **Draw marks** are acceptable provided:

5.4.1.1. They are in the direction of the draw operation

5.4.1.2. The width is .015 inch or less and the length is .500 inch or less

5.4.1.3. The associated raised metal is .002 inch or less

5.4.2. **Pits** are acceptable provided they are .031 inch or less across the longest dimension and there are no more than ten (10) in one inch square.

5.4.3. **General surface texture** of hot formed parts shall be at least as smooth as 90 AA except on bend radii where the finish may be 125 AA maximum.

5.5. ***Allowable Imperfections for Thermocouple Probe Assemblies***

The following acceptance criteria apply for thermocouple assemblies at all stages of production up to and including final inspection and acceptance:

5.5.1. Thermocouple Probes Containing Multiple, Independently Sheathed Elements with Supporting Spacers

5.5.1.1. Probe elements may be bent in the area between spacers provided the thermocouple does not exceed the envelope provided by the spacer(s), and

5.5.1.2. the thermocouple element does not diverge from perfect form at a rate greater than .008 inches per .100 inch of length.

5.5.2. Thermocouple probes tested at elevated temperatures.

5.5.2.1. When there is a requirement to test thermocouple probes at elevated temperatures as part of manufacturing or inspection, heat discoloring of the portion heated is acceptable, cleaning of heat stain is unnecessary unless otherwise specified.

WIRE BUNDLE IS WRAPPED WITH SUFFICIENT AMOUNT OF SILICONE TAPE: A MINIMUM OF 1 ½ TURNS, TO PROVIDE FIRM GRIPPING ACTION BY THE CLAMP ASSEMBLY.

ACCEPTABLE

REJECTABLE

COMPONENT NOT INSTALLED:

NO SILICONE TAPE UNDER STRAIN RELIEF CLAMP.

REJECTABLE

COMPONENT INSTALLED IMPROPERLY:

INSUFFICIENT BUILDUP OF SILICONE TAPE UNDER CLAMP – DOES NOT PROVIDE GRIPPING ACTION ON WIRE BUNDLE.

REJECTABLE

COMPONENT INSTALLED INCORRECTLY:

WIRE IS PULLED TIGHT BY STRAIN RELIEF CLAMP, OR STRING TIES.

HARDWARE SUPPLIED WITH BACKSHELL IS INSTALLED IN PROPER LOCATION. STRAIN RELIEF CLAMP AND SILICONE TAPE PROVIDES SECURE GRIP ON WIRE BUNDLE.

NOTE: AN EQUAL GAP IS PERMISSIBLE ON BOTH SIDES OF CLAMP AS LONG AS LOCKWASHERS ARE FULLY COMPRESSED.

ACCEPTABLE

REJECTABLE

COMPONENT NOT INSTALLED:

WASHER IS MISSING.

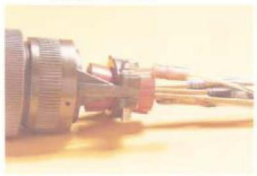
REJECTABLE

HARDWARE STACKED IMPROPERLY:

WASHER LOCATED BETWEEN SADDLE CLAMP AND TAB ON COUPLING NUT.

HARDWARE SUPPLIED WITH BACKSHELL IS CORRECTLY STACKED ON GROUND TERMINAL LUG.

ACCEPTABLE



REJECTABLE

COMPONENT NOT INSTALLED:

LOCKWASHER MISSING FROM STACKUP ON GROUND TERMINAL LUG.

REJECTABLE

HARDWARE STACKED IMPROPERLY:

LOCKWASHER NOT LOCATED DIRECTLY UNDER SCREW HEAD.

Cable Markers

All marking tags should be secure and free of damage. Shrink sleeves can split if any nicks or cuts are present when heat is applied. Metal ID tags shall be formed to the contour of the cable with no sharp corners exposed. Wrap around tags shall be held securely in place by wire ties.

5.6.3 Connectors and Protective Caps

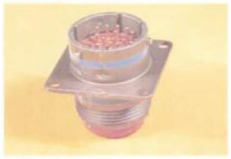
Threads are to be checked for damage such as nicks or any foreign material such as potting. Protective caps should be applied when transporting cables from work-stations and when shipping product to the customer. Caps must fit secure on the connector to prevent handling damage.

PART IS FREE OF NICKS OR DENTS:

NOTE: THIS APPLIES TO ALL PARTS – NOT LIMITED TO CONNECTORS.

ACCEPTABLE

REJECTABLE



COMPONENT IS DAMAGED:

PART HAS NICKS OR DENTS, BARE METAL IS EXPOSED.

MINUTE SCRATCHES ARE PRESENT ON PART BUT NO BARE METAL IS EXPOSED.

NOTE: THIS APPLIES TO ALL CADMIUM PLATED PARTS – NOT LIMITED TO BACKSHELLS.

ACCEPTABLE

REJECTABLE

COMPONENT IS DAMAGED:

PART IS CORRODED.

REJECTABLE

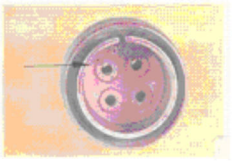
COMPONENT IS DAMAGED:

LARGE SCRATCHES ARE PRESENT ON PART OR BARE METAL IS EXPOSED.

CONNECTOR FACE IS FREE OF CRACKS AND NICKS, AND REQUIRED CONTACT LOCATIONS ARE LEGIBLE.

ACCEPTABLE

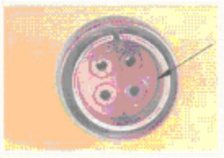
REJECTABLE



COMPONENT IS DAMAGED:

CONNECTOR FACE IS CRACKED OR NICKED. RAISED SECTION OF INTERFACIAL SEAL (DONUT) NOT INTACT.

REJECTABLE



COMPONENT IS DAMAGED:

CONNECTOR FACE CAVITY LOCATIONS ARE NOT LEGIBLE.

CONNECTOR GROMMET IS FREE OF VISIBLE TEARS, GOUGES AND CUTS.

NOTE: DO NOT SPREAD OPEN GROMMET HOLES.

NOTE: THIS APPLIES TO ALL PARTS USING CONTACTS – NOT LIMITED TO CONNECTORS.

ACCEPTABLE

REJECTABLE

COMPONENT IS DAMAGED:

CONNECTOR GROMMET IS TORN, GOUGED OR CUT.

6. Glossary of Terms

Unless otherwise specified, imperfections described in this glossary are acceptable only to the extent allowed in this VIS.

Term	Definition
Bellmouth	Taper condition formed on ID of hole at the opposite end of the hole from which a punch or blanking die enters.
Blending	An operation which removes an irregularity from a surface, resulting in a shallow, smooth depression.
Blister	A localized lifting of coating, plating, fiberglass, or paint, appearing as a bulge that may break when probed.
Bottomed Imperfection	Pit, cavity or hole in which the bottom can be seen.
Burnish	A shiny area resulting from rubbing against a hard, smooth surface; may contain scratches of no apparent depth.
Burr	A fragment of metal which remains attached to the surface after a machining or riveting operation.
Chatter Mark	Recurring undulations or irregularities that result from vibratory interactions of the tool and a typical machined surface.
Crack	Linear imperfection in the form of a narrow break or fissure of the surface.
Dent	A surface depression normally having rounded edges, corners, and bottom, caused by the impact of some object.
Depressed Imperfection	One that is below the general surface of the part; may have either smooth or irregular (sharp) edges or bottom (see Dent or Pit)
Die Break (Breakaway or Fracture Marks)	A rough surface caused by breaking away of metal by a punch or blade during a blanking or shearing operation.
Draw Mark	Linear, trough-like grooves which result from the action of die imperfections or foreign material on the drawn material.
Formed Depression	A change in surface level caused by mismatch of adjoining die segments.

Term	Definition
Heat Discoloration	Staining, ranging from straw color (low temperature effects) to purple (high temperature effects)
Imperfection	An interruption (non-uniformity) in the normal surface condition of a part configuration which must be evaluated for acceptance to an assigned standard.
Nick	A small surface imperfection having sharp edges, corners or bottom caused by impact of a sharp object.
Non-bottomed Imperfection	A depressed imperfection in which the bottom cannot be seen.
Orange Peel	A dimpled or grainy surface texture resembling an orange peel.
Pit	Small irregular cavity in a surface, usually dark bottomed.
Raised Edge	A narrow ridge of material along an edge raised above the general contour of the part.
Rollover	A rounded edge formed on the side of a part from which a punch or blanking die enters.
Scratch	A linear depression with a sharp bottom caused by movement of a sharp object or particle across the surface.
Shallow Imperfection	An imperfection which appears to penetrate the surface finish, does not have a dark bottom and which would not cause a stylus (ref. paragraph 5.9) to hesitate (catch) when passed over it.
Shear Mark (Die Break)	A rough surface caused by breaking away of metal during die-forming operations.
Smooth	A surface that is continuously even, free of irregularities, presenting no resistance to the sliding of a finger or tool. Can be applicable to one plane surface or transition surfaces between planes.
Stain	Surface discoloration due to liquids drying on the part.
Surface Texture (Finish)	The texture of a surface, be it forged, case or machined. Also, this term applies to the numerical value assigned to the surface roughness of machined surfaces.
Tool Mark	Imperfection, usually depressed, caused by machining tools.
Wrinkle	A ripple surface that occurs in areas of sharp contour changes (e.g. transition areas between circular and flat surfaces).

Rev	Date	Engineer	Description of Change
-	20-Oct-2000		Initial release
A	22-Jul-2002		Added section 5.5 to provide allowable imperfections in TC assemblies.
B	04-Aug-2009	A. Hicks	Added section 5.6 to include workmanship details for Cable Harnesses.
C	5/3/12	G. Williams	Revised section 2, 3.1, 3.3, 4.4, 4.5, 5.1.2, 5.6.1, 5.6.1.1 & 5.6.1.4, added images to 5.6
D	5/22/15	John Dutra/ Mercedes Lamas	Added section 5.5.2 to include acceptable heat stain inspection criteria
E	8/24/16	M. Wheway	Replaced the old Harco logo with the new HarcoSemco logo; added “dba” and “LLC” to Harco

F	6/5/17	Mercedes Lamas	Section 4.8 tolerance revised