

ENGINEERING STANDARD  
PENETRANT ACCEPTANCE CRITERIA  
ES 2012

Prepared by: H. HOPKINSON Date: 12-21-90

Reviewed by: J. MOELLER Date: 12-27-90

Approved by: J. D. MOELLER Date: 12-27-90  
John D. Moeller  
Director of Engineering

2

**1.0 SCOPE**

This procedure, when called out on the engineering drawing, routing or purchase order, is intended for use by Tactair and/or its suppliers as acceptance criteria when performing penetrant inspection per ASTM-E1417 on in-process, finished components and assemblies.

**2.0 PENETRANT SYSTEM:**

The penetrant system used shall be TYPE I (Fluorescent dye) with high or ultra high sensitivity levels unless otherwise specified on the component drawing or purchase order.

**3.0 WRITTEN PROCEDURE**

3.1 Penetrant inspections shall be performed to a specific written procedure, that implements the requirements of ASTM-E1417 for the components under test.

**4.0 INSPECTION OF PARTS:**

4.1 The following Tables I, II and III list the maximum size and distribution of discontinuities in castings, wrought products and weldments when ES 2012 is the specified acceptance criteria:

TABLE I CASTINGS: MAXIMUM ALLOWABLE DISCONTINUITY SIZES (IN INCHES)  
AND DISTRIBUTION

TYPE DISCONTINUITY	GRADE A	GRADE B	GRADE C	GRADE D
Nonmetallic inclusion, rounded: surface	0.031 Dia D-3*	0.047 Dia D-3*	0.063 Dia D-3*	0.125 D-2*
Gas hole porosity/discrete Shrinkage cavities: surface	0.031 Dia** D-3*	0.047 Dia** D-3*	0.063 Dia** D-3*	0.125**,*** D-2*
Cracks, hot tears, or Cold shuts	0	0	0	0.25 Long***
Shrinkage sponge areas (May include small cavities, cavity stringers)	0.250	0.375	0.625	1.25 Dia***
Micro shrinkage (micro porosity) Maximum cluster diameter:	0.063 D-3*	0.188 D-3*	0.313 D-3*	0.375 D-3*
Alloy or metallic phase Segregation				
Surface:	0.125	0.375	1.5	1.5
Subsurface:	0.25	0.5	1.5	1.5
<p>* Distribution designations signify the following:</p> <p style="padding-left: 40px;">D-2 Discontinuities no closer to each other than two times the maximum size.</p> <p style="padding-left: 40px;">D-3 Discontinuities no closer to each other than three times the maximum size.</p> <p>** The limits for gas hole porosity for the individual grades do not apply if the voids are less than one half the maximum sizes specified and are well dispersed.</p> <p>*** Shrinkage discontinuities are not allowed if within 0.5 inch of an outer edge of a casting section.</p>				

TABLE II WROUGHT PRODUCTS: MAXIMUM ALLOWABLE DISCONTINUITY SIZES  
(IN INCHES) AND DISTRIBUTION (EXCLUDING  
WELDMENTS)

TYPE DISCONTINUITY	GRADE A	GRADE B	GRADE C
Inclusions, rounded: Surface:	0.031 Dia DD-2*	0.047 Dia D-3*	0.063 Dia D-3*
Inclusions, stringers: Surface	0.125 Long DD-1*	0.375 Long DD-1*	0.75 Long DD-1*
Seams or laps (Unmachined surfaces)	0.5 Long DD-1*	1 Long DD-1*	1.5 Long DD-1*
Seams or laps (Machine surfaces)	0	0	0.25 Long DD-1*
Propagating discontinuities (Cracks, flakes, laminations, etc.)	0	0	0
<p>* Distribution designations signify the following:</p> <p>D-3 Discontinuities no closer to each other than three times the maximum size.</p> <p>DD-1 Discontinuities no closer to each other than 0.5 inch linearly and 0.25 inch in a parallel direction.</p> <p>DD-2 No more than two indications</p>			

TABLE III WELDMENTS: MAXIMUM ALLOWABLE DISCONTINUITY SIZES  
(IN INCHES) AND DISTRIBUTION

TYPE DISCONTINUITY	GRADE A	GRADE B	GRADE C
Cracks, weld or base metal (longitudinal, transverse, star or crater, underbead, underside, etc.)	0	0	0
Weld undercutting or lack of bead-edge fusion: Base metal less than 0.188 inch thick	0.016 Deep 0.125 Long D-5*	0.016 Deep 0.250 Long D-5*	0.031 Deep 0.250 Long D-5*
Base metal 0.188 inch thick and over	0.031 Deep 0.125 Long D-5*	0.031 Deep 0.250 Long D-5*	0.047 Deep 0.375 Long D-5*
Weld metal voids or inclusions, rounded: Base metal less than 0.188 inch thick:	0.016 Dia D-5*	0.031 Dia D-5*	0.063 Dia D-5*
Base metal 0.188 inch thick and over:	0.031 Dia D-5*	0.063 Dia D-5*	0.125 Dia D-5*
Weld metal voids or inclusions, elongated: Base metal less than 0.188 inch thick:	0.063 Long D-5*	0.125 Long D-5*	0.188 Long D-5*
Base metal 0.188 inch thick and over:	0.125 Long D-5*	0.250 Long D-5*	0.375 Long D-5*
<p>* Distribution designations signify the following: D-5 Discontinuities no closer to each other than five times the maximum dimension.</p>			

## 5.0 ACCEPT/REJECT CRITERIA

- 5.1 Within the specified grade, discontinuities exceeding the limits in Tables I, II and III shall be rejected.
- 5.2 Discontinuities in as-cast and as-forged surfaces that were previously inspected may be held to the original acceptance criteria utilized at the time of the previous inspection. In these cases the criteria to be used will be identified on the drawing, router, technique sheet or purchase order.

For example: A finish machined part is inspected to Grade A but the forging/casting it is machined from was inspected to Grade C at the forging/casting level. As-forged and as-cast surfaces will be inspected but will meet the Grade criteria originally specified at a minimum.

- 5.3 When penetrant inspection is specified without the acceptance criteria being defined, the minimum grade shall be "C" from Tables I, II and III.

## 6.0 CLEANING AFTER PENETRANT INSPECTION

- 6.1 Penetrant and developer residues may interfere with subsequent manufacturing and inspection operations on parts and may require removal prior to any further processing. When required this will be detailed on the router, technique sheet or purchase order. In some cases post-cleaning may be performed at a subsequent operation (for example, anodizing).