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**ENGINEERING STANDARD
ES 2013 REV A
MAGNETIC PARTICLE INSPECTION PROCEDURE**

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ES 2013

**MAGNETIC PARTICLE
INSPECTION PROCEDURE**

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Date:

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1.0 Scope

This procedure is intended for use by Young & Franklin and/or its suppliers when performing magnetic particle inspection per ASTM-E1444 on products to be used in hydraulic actuator and valve assemblies.

2.0 Magnetic Particle System

The magnetic particle system shall be as defined in ASTM-E1444 unless otherwise stated on the component drawing or purchase order.

3.0 Written Procedure

- 3.1 The supplier shall perform all magnetic particle inspections to a specific written procedure, prepared by the supplier and approved by Young & Franklin, that implements the requirements of ASTM-E1444 for the components under test.
- 3.2 The written procedure (s) shall contain the process information required by Sections 5.4 of ASTM-E1444.

4.0 Inspection Of Parts

- 4.1 Inspection of all component parts under this procedure shall be done in accordance with the approved written procedure and ASTM-E1444.
- 4.2 Examine all surfaces of parts except small openings that could entrap or remain contaminated with inspection media unless otherwise specified on the drawing. These areas shall be masked or plugged prior to inspection. Establish definite inspection patterns, particularly when inspecting quantities of the same or similar parts, to ensure examination of internal and external surfaces. Unless otherwise specified, 100 percent of lot shall be inspected. All indications shall be identified with a marking pencil for further review.
- 4.3 The following Tables I, II and III list the maximum size and distribution of discontinuities in castings, wrought products and weldments:



**Table I Castings
Maximum Allowable Discontinuity Sizes (In Inches) And Distribution**

TYPE DISCONTINUITY	GRADE A	GRADE B	GRADE C
Nonmetallic inclusion, rounded: Surface	0.031 Dia D-3*	0.047 Dia D-3*	0.063 Dia D-3*
Subsurface	0.047 Dia D-3*	0.063 Dia D-3*	0.094 Dia D-3*
Gas hole porosity/discrete Shrinkage cavities: Surface	0.031 Dia** D-3*	0.047 Dia** D-3*	0.063 Dia** D-3*
Subsurface	0.047 Dia** D-3*	0.063 Dia** D-3*	0.094 Dia** D-3*
Cracks, hot tears, or Cold shuts	0	0	0
Shrinkage sponge areas (May include small cavities, cavity stringers)	0.250	0.375	0.625
Micro shrinkage (micro porosity) Maximum cluster diameter:	0.063 D-3*	0.188 D-3*	0.313 D-3*
Alloy or metallic phase segregation Surface:	0.125	0.375	1.5
Subsurface:	0.25	0.5	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>			



**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*
Subsurface	0.047 Dia DD-2*	0.063 Dia D-3*	0.094 Dia D-3*
Inclusions, stringers: Surface	0.125 Long DD-1*	0.375 Long DD-1*	0.75 Long DD-1*
Subsurface	0.187 Long DD-1*	0.5 Long DD-1*	1.125 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*
Propagation discontinuities (Cracks, flakes, laminations, etc.)	0	0	0

* Distribution designations signify the following:

- D-3 Discontinuities no closer to each other than three times the maximum size.
- DD-1 Discontinuities no closer to each other than 0.5 inch linearly and 0.25 inch in a parallel direction.
- DD-2 No more than two indications



**Table III Welded Wrought Products
 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*

* Distribution designations signify the following:

D-5 Discontinuities no closer to each other than five times the maximum dimension.



5.0 Accept/Reject Criteria

- 5.1 Within the specified grade, discontinuities exceeding the limits in Tables I, II and III shall be rejected. Parts that have indications which are obviously rejectable shall be rejected, tagged and dispositioned as appropriate. Parts that have questionable indications shall be separated, tagged and processed for further evaluation. Discontinuities that are defects which will be removed by subsequent processing will not be rejected.
- 5.2 When magnetic particle inspection is specified without the acceptance criteria being defined, the minimum grade shall be "C" from Tables I, II and III.
- 5.3 Nonrelevant indications. Parts shall not be rejected because of incidental concentrations of magnetic particles in areas that are not defective. Nonrelevant indications may appear on fillets, weld beads, or other areas, particularly if there is surface roughness.
- 5.4 The appearance of indications due to micro segregations shall not be cause for rejection. Micro segregations are extremely narrow lines, usually long and straight, on surfaces of highly finished parts made of wrought metals. These indications are not considered harmful when there are no physical indications i.e. cracks, stringer, etc...visible under 5X magnification.

6.0 Cleaning After Penetrant Inspection

- 6.1 Final cleaning after inspection shall be performed to remove all residues. Pay close attention to internal cavities i.e.: drilled passages.