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Enidine

**ENIDINE STANDARD  
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<b>Standard Number:</b>	<b>WS-001</b>
<b>Standard Title:</b>	<b>Workmanship Standards</b>

**SIGNATURES OF APPROVAL**

Approved Electronically in Q-Pulse

**REVISION HISTORY**

<b>Date:</b>	<b>Revision:</b>	<b>Description:</b>	<b>By:</b>
1/25/1999	None	Original Issue	
-	A-D	See Q-Pulse for revision history A-D	-
12/28/2005	E	Added section 1.5 (Passivation of Stainless Steel)	T. Bukowski
1/17/2008	F	Updated outdated Mil-Spec (MIL-C-5541 to MIL-DTL-5541F Pg 6/8. updated block for signatures of approval to electronically approved	L. Brooks
10/23/2009	G	Added sections 1.7, 1.8, 1.9	J. Kelly
11/17/2010	H	Updated inspection and packaging requirements for piston rod, 1.4.6, 2.1, 2.2.1, 2.2.2, 2.3.5, 2.4, 7.1.3. Added Jarret requirement 4.1.3, 7.1.4 Added WS-005 ITT ENIDINE WORKMANSHIP STANDARD FOR ELASTOMERIC PRODUCTS	G. Zuefle L. Brooks
03/17/2011	J	Added uniform, free from delamination, pits, nodules, blisters to 1.4.1, added Nodules photos	J. Kelly
10/5/2012	K	Added WI-003 to related documents	L. Brooks
10/14/2013	L	Added statement about checking Revisions for Standards and Specifications Section 1. Added Section 5.7. Thread acceptance	A. Skeldon P. Kowalewski
06/24/2014	M	Added paragraph 1.6.2 For Color uniformity of Plastic Molded Parts.	T. Daul
10/12/2016	N	Updated section 1.4.6 to include temperature.	T. Daul
11/19/2018	P	Update 1.6.1, change from, lot to lot to, within a lot. Added lot to lot variation rules. Add 7.1.5, VCI packaging required for un-plated carbon steel, and black oxide components.	R. Goodemote
5/20/2024	Q	Updated Scope to reference drawings and Part-Specific Supplemental Inspection Instructions. Updated Section 1.2 to include notes on surface finish, gates, and flash. Added back in from revision M: 1.6.2 & 1.6.2.1 was created as a resolution to multiple CAR's.	L. Jones A. Skeldon



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**Workmanship Standard**

**PURPOSE:**

To establish the acceptable workmanship criteria for the manufacture of and assembly of ENIDINE Products. These standards will determine the workmanship requirement not normally covered in subsidiary specifications or drawings. Unless otherwise noted, where there is any discrepancy between this document and the part drawings, the part drawings shall govern. Where there is any discrepancy between this document and Part-Specific Supplemental Inspection Instructions, the Part-Specific Supplemental Inspection Instructions shall govern.

**SCOPE:**

These standards apply to all ENIDINE Products.

**DEFINITIONS:**

**RELATED DOCUMENTS:**

**WS-005** ITT ENIDINE WORKMANSHIP STANDARD FOR ELASTOMERIC PRODUCTS

**WS-003** PART CLEANLINESS AND DEBURRING

**ENCOMPASSING  
PERSONNEL:**

It is the responsibility of the ENIDINE Engineering, Purchasing and Quality to define the Workmanship Standards contained within this specification.

The Quality Department shall be responsible for assuring the requirements are met for components and finished goods.

The Purchasing Department shall be responsible for relaying the requirements to our vendors.

The Assembly Supervisors shall be responsible for assuring the requirements that pertain to the assembly of the Product are met.

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## 1. STANDARDS:

If the Standard or Specification revision is not called out by Contract or Order, the latest Revision shall be used. If the Standard or Specification Revision is not called out on a drawing, the latest revision shall be used.

All standards apply unless otherwise specified on the drawing, specification, or purchase order.

### 1.1. Machined and Stamped Components

- 1.1.1. All machined and stamped components shall be free of cracks, laps, pits, porosity, and corrosion.
- 1.1.2. All components shall be free of burrs and supplied to ENIDINE suitably protected from damage or corrosion during shipment. Finishes of threads, ports, orifices, and intersecting bores shall be free of chips, tumbling (deburring media), and loose or hanging burrs.
- 1.1.3. Areas having a designated surface finish shall be free of irregularities beyond specific acceptance limits. Additionally, sealing surfaces (32√ or better) shall exhibit a uniform finish and be free of nicks, scratches, gouges, tool marks, or other imperfections that would provide a leak path.
  - 1.1.3.1. On visual tool marks that meet surface finish requirements, ENIDINE's method for acceptance of this visual tool mark is running along the surface a 0.5mm lead pencil to feel for the discontinuity. If the tool mark can be felt in this manner then it would be considered a defect.

### 1.2. Molded and Die-Cast Components

- 1.2.1. All molded and die-cast components shall exhibit complete fill and be free of voids, cracks, porosity, tears and excessive flash or mismatch.
- 1.2.2. Sealing surfaces shall exhibit a uniform finish and be free of nicks, scratches, gouges, flash, or other imperfections that would provide a leak path.
- 1.2.3. Surface finish shall be consistent and free from defects like sink marks or warping.
- 1.2.4. All gates, sprues, and flash shall be trimmed to a maximum protrusion of .005 in. Any component with a gate, sprue, or flash that is below flush is not acceptable.
- 1.2.5. Any changes or reworking of dies require that ENIDINE purchasing department be notified of such actions. Additionally, arrangements for first article inspection documentation are to be provided with the actual sample for verification by ENIDINE.

**1.3. Welded Components**

1.3.1. All welded components shall be inspected for poor appearance, excessive splatter, poor fusion, undercutting, porosity, slag inclusion, incomplete penetration, and cracked welds.

**1.3.2. PROCESS:**

1.3.2.1. Welding Preparation - Components to be welded shall be free of rust, scale, paint, grease, or any other foreign material or impurities that will adversely affect weld quality. Metal shall be ground, sanded, and washed with mineral spirits prior to welding.

1.3.2.2. Weld fusion and penetration shall be sufficient to provide for a mechanically strong joint. The size of the weld fillet shall be as specified on the appropriate drawing. A fillet gage or appropriate measuring device shall be used to verify the weld size

1.3.2.3. Post Heat Treatment - Shall be done only if specified on drawing by an approved heat-treating facility.

1.3.2.4. Post Cleaning - The completed weld joint shall be cleaned of slag and weld splatter by means of chipping, sanding or grinding.

1.3.2.5. The weld joint shall be visually inspected for the following conditions, which shall be cause for rejection of the weld.

- 1.3.2.5.1. Poor Appearance
- 1.3.2.5.2. Excessive Spatter
- 1.3.2.5.3. Poor Fusion
- 1.3.2.5.4. Undercutting
- 1.3.2.5.5. Porosity
- 1.3.2.5.6. Slag Inclusion
- 1.3.2.5.7. Incomplete Penetration
- 1.3.2.5.8. Cracked Welds

1.3.2.6. Welds requiring pressure testing shall be tested as specified on the drawing.

1.3.2.7. Welds subjected to the weld integrity requirements of acceptance test procedures (TD-10185 and TD-10186) shall be visually inspected and be subjected to liquid dye penetrant inspection.

**1.4. Plating**

1.4.1. All plating shall be smooth, adherent, continuous, uniform, free from delamination, pits, nodules, blisters, and cosmetically bright unless otherwise specified on the drawing or purchase order.

1.4.2. Anodized and black-oxide surfaces shall be smooth, adherent and continuous in color.

1.4.3. Electroplating shall be performed in accordance with ASTM B-633, "Electro-Deposited Coatings of Zinc on Iron & Steel" unless otherwise specified.

1.4.4. Unless otherwise specified on the drawing Chrome plating shall be performed in accordance with AMS 2460.



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- 1.4.5. Unless otherwise specified on the drawing Electroless Nickel shall be performed in accordance with ASTM B733.
- 1.4.6. Any post plating baking/heat treating over 475° F shall be performed in an inert atmosphere.

### **1.5. Passivation of Stainless Steel**

- 1.5.1 Cleaning: All stainless-steel components shall be cleaned and de-scaled prior to passivation. The cleaning process shall be such that no heat-treat tint, oxide film, scale, rust, oil, grease and/or other foreign matter exists after cleaning. Cleaning by chemical or mechanical means, as described in ASTM A380 shall be used.
- 1.5.2 Passivation: Passivation shall be done per the applicable specifications defined on the drawing, with the following exceptions:
  - 1.5.2.1 Where no specification is defined, ASTM A380 shall be used.
  - 1.5.2.2 Where QQ-P-35 is defined, it has been superseded by ASTM A967.
- 1.5.3 Appearance of passivated components: All passivated components shall exhibit a chemically clean surface and shall on visual inspection, show no discoloration, etching, pitting, or frosting resulting from the passivation process.

### **1.6. Color / Finish**

- 1.6.1. Unless specified on the Purchase Order or drawing, all components supplied to ENIDINE shall be uniform in color and finish. Large variations in color and finish within a lot are not acceptable. Color variation between lots is permissible provided parts are still in compliance with any material or process specification.
- 1.6.2. For plastic molded parts when specified on drawings, or specs. Color code call outs (components and finished goods) shall be consistently uniform in color and finish from part to part and batch to batch. Uniformity and conformity can be measured using a Color Difference Meter, CR-10, by Konica Minolta (or ENIDINE approved equivalent equipment).
  - 1.6.2.1. A Delta E (also called dE,  $\Delta E^*$ ,  $\Delta E^*_{ab}$ ) value of less than 3.0 is acceptable (CIE76)

### **1.7. Springs**

#### **1.7.1. Compression Springs**

- 1.7.1.1. Squared and ground ends: Unless otherwise specified on the drawing, squared and ground ends of compression springs shall have a bearing surface of not less than three-quarters of the mean circumference of the spring. The ends shall be squared by closing down the last coil and subsequently grinding to obtain the bearing surface. The thickness of the tip of the end coil after grinding shall not exceed one-half of the original diameter of the material. Unless otherwise specified, the thickness of the tip shall not be reduced to less than one-eighth of the wire diameter. The sides and corners of the tip shall be broken with all sharp edges removed.

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- 1.7.1.2. Squareness of ends: Unless otherwise specified on the drawing, squared and ground ends shall be square with the spring axis within 3 degrees.
- 1.7.1.3. Spring Rate. When specified as a requirement, the spring rate shall be tested at 20 and 60 percent of the total theoretical deflection, by establishing two test lengths and recording the load at these lengths. The spring rate shall be determined by dividing the difference between these loads (in pounds) by the difference (in inches) between the test lengths.
- 1.7.1.4. Preservation: Application of a preservative is required only for alloy and carbon steel springs which do not have a permanent type coating such as paint, epoxy or plating, but includes phosphate or black oxide. Preservatives shall be per MIL-PRF-16173, Grade 3, MIL-L-3150 or equivalent.
- 1.7.1.5. Workmanship: Workmanship shall be such as to produce springs free from grit, scale, sharp edges, fins, burrs, nicks or other defects that would impair the usefulness of the spring.
- 1.7.1.6. End Coils: The edges of the last coils on both ends shall not protrude beyond the outside or inside diameter of the preceding coil.

**1.8 Sealants, Adhesives and Thread Locking Compounds**

- 1.8.1 Surface preparation, application, fixture time and cure time shall be per manufacturer's recommendations. Refer to specific manufacturer's technical data sheet for proper application and cure times.
- 1.8.2 Loctite branded thread locking products used on the following inactive metals require the use of appropriate Loctite branded primers: Plated Parts, Anodized Aluminum, Titanium, Stainless Steel, Galvanized Steel, Zinc, Cadmium, Magnesium, Black Oxide, Inconel, Silver and Gold. For other manufacturers' products, refer to their specific technical data sheet for proper surface preparation, application, fixture time and cure time.

**1.9 Primers and Paints**

- 1.9.1 Surface preparation, application and cure time shall be per manufacturer's technical data sheet.
- 1.9.2 Painted components or final assemblies shall not be packed and shipped until after proper cure time has been achieved.

**2. PISTON ROD INSPECTION PROCEDURE**

2.1. This applies to all piston rods that currently have the surface finish defined as 12 Ra or below.

2.2. To specify a procedure and standards for inspection of the surface finish of piston rods used in hydraulic shock absorbers. Obtaining the correct surface finish free of surface imperfections is critical to the reliability of the shock absorber. Dynamic elastomeric seals are used to seal a finite amount of hydraulic fluid in the shock absorber. Surface imperfections such as nicks and scratches can create a leak path or prematurely wear the dynamic seal, thus shortening the life of the shock absorber.

2.2.1 **For piston rods manufactured from raw stock** all dimensional and finish requirements apply after all manufacturing processes and plating. Typically the required surface finish is 6-12 Ra after plating. Piston rods shall also meet Rz70.

2.2.1.1 After plating, check surface finish of the piston rod diameter with a profilometer to identify actual finish range.

2.2.1.2 Surface finishes below 4Ra shall be circumferentially roughed to obtain a minimum measured surface finish of 6Ra, Rz70.

2.2.2 **For plated shaft material** that measures below component drawing specified surface finishes (typically specified as 6 to 12 Ra, Rz70).

2.2.2.1 Check surface finish of the piston rod diameter with a profilometer to identify actual finish range.

2.2.2.2 Surface finishes below 4Ra shall be circumferentially roughed to obtain a minimum measured surface finish of 6Ra, Rz70.

**2.3. INSPECTION PROCESS FOR SURFACE FINISH**

2.3.1. Check surface finish of piston rod with profilometer.

2.3.2. Perform visual inspection of piston rods.

2.3.3. Run fingernail along piston rods.

2.3.4. Make sure that piston rods inspected by the above process conform to the quality standards set forth in (2.4.1) below.

2.3.5. The direction of lay of finish is to be perpendicular to the axis of the piston rod.

**2.4. QUALITY STANDARDS**

2.4.1. As long as the required surface finish is met in the critical region, as defined on the drawing, inherent surface discontinuities are acceptable, including hairline scratches that do not run into critical region, circumferential scratches, minor blemishes, and slight nicks. If a critical region is not defined on the drawing the entire length of the surface is considered critical. If you cannot feel the surface discontinuity by fingernail touch or use of a 0.5mm lead pencil, it is acceptable. The plating process must not result in any raised or etched area. Consistency of surface finish in the critical region is important.





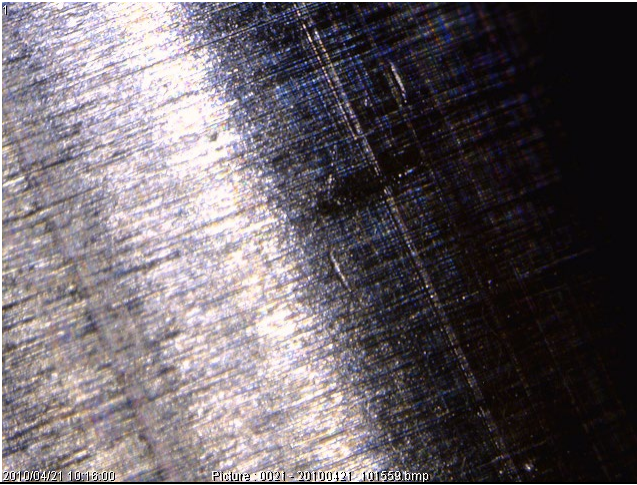
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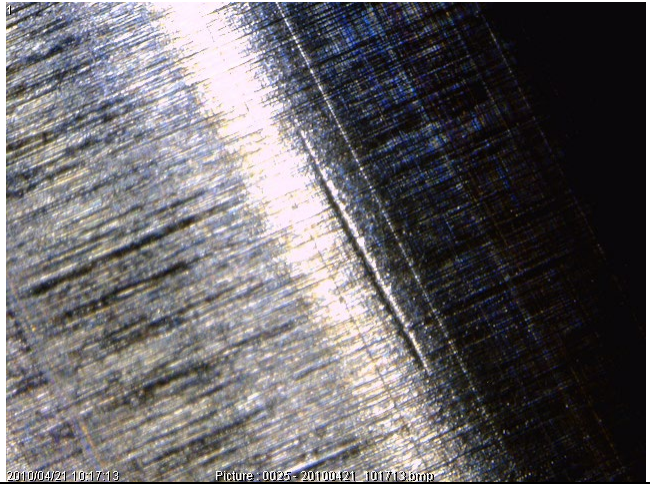
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Example of surface defects that are **not permissible**.

**Scratch**



**Scratch**



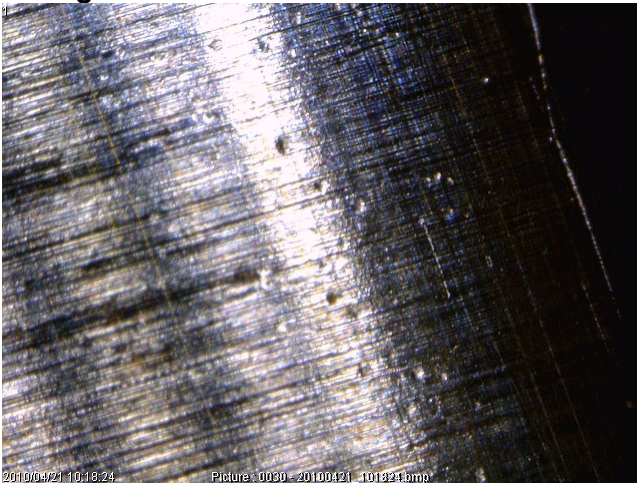
**Nodules**



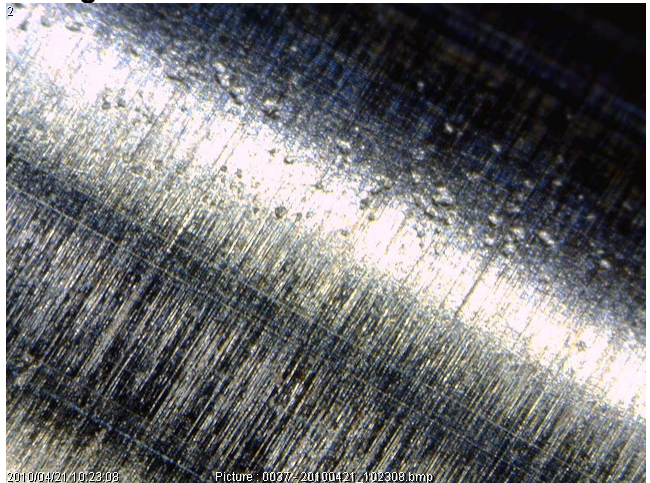
**Nodules**



**Pitting**



**Pitting**







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## 3. MOUNT BAR INSPECTION PROCEDURE

3.1.1. This applies to all aluminum wire rope and compact wire rope mount bars that require chemical conversion coating per military specification MIL-DTL-5541F. To inspect for acceptable chemical film color use ENIDINE Chemical Film Color Verification Chips. To obtain a copy please contact your ENIDINE representative.

## 4. CYLINDER INSPECTION PROCEDURE

4.1.1. This applies to all cylinders that require Electroless Nickel Plating.

4.1.1.1. To inspect for acceptable plating adherence use ENIDINE standard (Verifying Electroless Nickel Plating Adherence) number WS002. To obtain a copy please contact your ENIDINE representative

4.1.2. This applies to all cylinders that designate a **metric** thread form for the external thread.

4.1.2.1. To inspect for acceptable thread form, all external metric threads on cylinder components will be verified using GO and NO GO **solid** (fixed) screw ring gauges manufactured in accordance with International Standard ISO 1502 (ISO general purpose metric screw threads – Gauges and Gauging). All pass/fail criteria will apply to the finished component after plating if applicable.

4.1.3. Jarret product reservoirs shall be inspected per Enidine WI-00087-00.

## 5. USE OF THREAD GAGES

### 5.1. Forcing of Gages

5.1.1. It is extremely important that the force or torque applied to "GO" gages should not be greater than that which can be easily exerted, by hand, on the gage handle. Excessive force applied to "GO" gages will result in the acceptance of oversize products that should be rejected. Thread gages are precision equipment and should be used accordingly. Hand torque is adequate to insure proper inspection. Under no circumstances should a wrench or lever be used to force a thread gage in or on a product. It is well to remember that thread gages are "comparators"; that is, they compare the dimensions of the setting gage with the dimension of the product being inspected. The force applied to these gages when inspecting parts should in no case exceed, and preferably be less than, the force applied when setting the gages.

### 5.2. "GO" Thread Plug Gages

5.2.1. "GO" thread plug gages should check simultaneously as many elements as possible; therefore, the gage is designed to have a full form thread and to check pitch diameter, major diameter, thread angle, and lead. "GO" thread plug gages control the extent of the product tolerance in the direction of the limit of maximum-metal, and represent the minimum diameter of the tapped hole. The gages should not be used when worn beyond the product limit. The gage should enter the full threaded length of the product freely, with no more force than can be applied by the fingers; excessive force should never be applied. When "GO" plug gages do not go, the tapped hole is too small or thread lead is improper. A "GO" thread plug should never be forced into a "GO" thread ring gage, and an adjustable "GO" tread ring gage should never be set with either a working or inspection "GO" thread plug gage, but with a proper setting plug.

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**5.3. "NO GO" or "HI" Thread Plug Gages**

5.3.1. "NO GO" or "HI" thread plug gages are made as nearly as practicable to check pitch diameter only. This is accomplished by reducing both the length of the thread flank and the length of the thread. The thread flank is shortened by removing a portion of the thread crest and by a greater width of relief at the thread root. "NO GO" thread plug gages control the extent of the product tolerance in the direction of the limit of minimum-metal and represent the maximum diameter of the tapped hole. In use, "NO GO" or "HI" gages should not enter the product in excess of the limitations contained in applicable thread specifications. (A definite drag on or before the third turn of entry.) If the "NO GO" plug gage enters the tap more than three turns, the hole is too large.

**5.4. "GO" Thread Ring Gages**

5.4.1. "GO" thread ring gages, like "GO" thread plug gages, are designed to check as many elements as possible. They are used to check pitch diameter, minor diameter, thread angle and lead, control the extent of the product tolerance in the direction of the limit of maximum-metal and represent the maximum diameter of the thread shaft. In use, "GO" thread ring gages should pass over the entire threaded portion of the product and with no more force than can normally be applied with the fingers. If the "GO" ring gage does not go, the threaded item is too large or the lead is improper.

**5.5. "NO GO" or "LO" Thread Ring Gages**

5.5.1. "NO GO" or "LO" thread ring gages, like "NO GO" thread plug gages, are made to check pitch diameter only. Increasing the minor diameter and the width of the thread relief at the major diameter reduces the length of the thread flank. The "LO" thread ring gage controls the extent of the product tolerance in the direction of minimum-metal, and represents the minimum diameter of the threaded shaft. In use, the product should not enter the gage in excess of the limitations contained in applicable thread specifications. (A definite drag on or before the third turn of entry.) If the "NO GO" ring gage threads on more than three turns, the threaded item is too small.

**5.6. Control of Wear**

5.6.1. The principal cause of gage wear is the abrasive action between the gage and the part. Inspectors should not apply gages to parts from which dirt, machine chips, loose scale, or abrasives have not been removed. Failure to clean parts will damage gages and result in inaccurate inspection. Inspectors should become familiar with wear rates and characteristics. Application of such information will result in much greater useful life of gages. When doubt exists as to the extent of wear on a gage, it should be forwarded to the appropriate gage checking facility for a complete inspection. A gage wears most rapidly at the entering end. Wear at this point may be disregarded, or the gage can be corrected by removal of the work portion provided that the remaining portion of the gage will still function satisfactorily. Only qualified personnel, such as the gage manufacturer or an outside lab shall make repairs.

**5.7 Thread acceptance Criteria for Imperial and Metric thread configurations**

5.7.1. ITT Enidine designs and has manufactured thread configurations based on the ANSI standards B1.1, Unified Inch Screw threads, and B1.1.3M, Metric Screw threads-M profile.

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- 5.7.2. ITT Enidine also, uses acceptability criteria that has been established and based on the ANSI standard B1.3, Screw thread gaging systems.
- 5.7.3. Thread acceptance issues are known with the use of thread, GO/NOGO, ring gages whether split if solid gaging. For that reason and to avoid conflicts caused by thread ring gaging.
- 5.7.4. ITT Enidine chooses to use variable thread gaging as its means of acceptance criteria. Variable thread gaging determines thread acceptability based on Product Thread Limits, giving you a direct thread reading on the indicator of the variable gage.

Example: When measuring an M10 X 1.5-6g threaded product with variable gaging and the indicator reading is between the pitch diameter requirements (8.994 and 8.862) then the thread is considered conforming. If the gage indicates the thread is outside those limits, the product is considered nonconforming.

## 6. Assembly

- 6.1.1. Workmanship Standards for the assembly of ENIDINE Products shall be defined in the assembly manuals and assembly procedures.

## 7. Identification / Marking / Packaging

- 7.1.1. All components shall be supplied to ENIDINE with clearly marked packaging. All completed units shall be clearly marked per the Engineering drawings. The identification applied to the units shall be legible.
- 7.1.2. Packaging of items supplied to ENIDINE, unless otherwise specified, are to be supplied in accordance with good commercial practices and provide adequate protection against corrosion and damage.
- 7.1.3. Packaging of piston rods supplied to ENIDINE shall be packaged such that the piston rods do not contact each other during shipping. Adequate protection must be provided to avoid damage. The protection method must not cause damage to the piston rods. See example of surface defects that are **not permissible**. All non-plated surfaces shall be protected against corrosion by applying rust preventative per MIL-PRF-16173 class II, grade 3 (MIL-C-16173 class II, grade 3) or equivalent coating.
- 7.1.4. Jarret product reservoirs shall be packaged to prevent rust corrosion by means of vapor corrosion inhibitor technology. After the internal bore is made, each reservoir shall be stored and transported inside a VCI zip top bag or units longer than 1meter may have ends covered with VCI bags (tape bag to seal on outside diameter). VCI bag suppliers include Cortec, KPR Adcor, Zerust or equivalent MIL-PRF-22019 film.
- 7.1.5. Carbon based steel components, and black oxide components, shall be packaged to prevent rust corrosion by means of vapor corrosion inhibitor (VCI) technology. After processing components shall be stored and transported inside a VCI zip top bag or units longer than 1meter may have ends covered with VCI bags (tape bag to seal on outside diameter). VCI bag suppliers include Cortec, KPR Adcor, Zerust or equivalent MIL-PRF-22019 film.

**NOTE: IF THERE IS A QUESTION CONCERNING THE INTERPRETATION OF THE INFORMATION CONTAINED WITHIN THIS DOCUMENT, "PLEASE ASK!"**