FLAW MANUFACTURING
TECHNOLOGY

THE OLD
THE NEW
THE FUTURE
Introduction

- FlawTech, Inc. has been in the flaw manufacturing business since 1982.

- The founder of FlawTech was Dr. George Pherigo.

- Dr. Pherigo recognized the need for reliable flawed specimens designed for specific NDE methods, training and testing applications.
Introduction

- This presentation will briefly review the different flaw types that have been established over the years as well as newer alternative flaw implant processes.

- We will also touch on some of the driving forces that are necessitating the newer alternative flaw types.
History of Flawed Specimens

- “Field Removed”
  - Numerous Limitations

- “Buddy Made”
  - Everybody knows a welder - Good Luck!

- Manufactured Flawed Specimens
  - Professionally made Custom Specimens
The Old *Machined Indications*

- **Machined Indications – Notches, Side Drilled Holes & End-Drilled Holes**
  - Great for basic training and calibration
  - Relatively inexpensive and lead times normally not too long
  - Fine for most all metals / alloys
  - Repeatable
  - Geometry can be an issue

- **EDM Indications – Notches, Micro Holes**
  - Great for basic training and calibration
  - Great for small surface breaking indications
  - There is a depth-to-width issue
  - Fine for most all metals / alloys
  - Geometry is not as much of an issue as with normal machining
  - Good control of the notch shape and repeatable
  - A little more expensive than normal machined indications and longer lead time
Machined Indication
Machined Indication
The New **Real Flaws**

- **The Demand for Real Flaws** is driven by:
  - Code Changes (new developments / incidents)
  - Utilities & Other Industries
  - NDT Equipment Manufacturers (new systems and equipment)
  - In-service Inspection Groups
  - Training & Qualification Facilities

- **Flaw Requirements:**
  - Flaws must be realistic.
  - Flaws must be repeatable and meet tolerance requirements.
  - Flaws must fit the purpose of inspection – detection, sizing, training or testing
  - Flaw specimen cost must fit the client’s budget and delivery requirements
  - Flaw manufacturing process must not affect the inspection process and must have the “Mutual Approval” of buyer and/or governing bodies
What are Real Flaws?

- They are not notches or side drilled holes.

- They are manufactured replicas of service-induced flaws or weld indications.

- They can be manufactured for most any method of NDT.

- They can be held to strict tolerances that range from +/- 0.003” to +/-0.040” depending on flaw type.
Real Flaws

- **Flaw Types:**
  - **Fatigue Cracks:** HAZ, Centerline, Toe, Root, Branched, Surface-breaking and Sub-surface
  - **Corrosion:** Chemical, Erosion and Service Wear
  - **Weld Indications:** Porosity, LOF, Slag, etc.
  - **Geometric Conditions:** LOP, Excess Penetration, Root Concavity, Overlap, Misalignment, etc.
Real Flaw Manufacturing
Real Flaw Manufacturing
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Real Flaw Manufacturing
Real Flaw Manufacturing
Newer Real Flaw Manufacturing
Newer Real Flaw Manufacturing

ANFI (Alternative Non-thermal Fatigue Indication)

Indication Tip shown against 0.0008" EDM Notch Gauge
Newer Real Flaw Manufacturing

Indication Tip shown against 0.0017” EDM Notch Gauge
Newer Real Flaw *Manufacturing*

Process Caused Geometry
Newer Real Flaw Manufacturing

Indication With No Spacer

Indication Transition With Spacer To No Spacer
Newer Real Flaw Manufacturing

Mechanical Break – No Heat

Manufactured Surface Breaking Crack In 304 S/S

0.0017” EDM Gauge

x400
Newer Real Flaw Manufacturing

Surface Breaking Stress Corrosion Cracking

Surface Corrosion / Pitting (OD or ID)

Manufactured Surface Breaking Crack In 304 S/S
Newer Real Flaw Manufacturing

Surface Hydrogen Damage with Fishers

Acid Phosphate Corrosion

Manufactured Surface Breaking Crack In 304 S/S
The Future

- In years past, the technology did not exist to inspect some unique or complex geometries and designer alloys.

- As NDE technology has improved and code requirements changed so has the refinement of the flaw manufacturing process in order to produce new, smaller or alternative flaws.

- The Future of Flaw Manufacturing is upon us and requires a cooperative effort between client and manufacturer.

- Technical Cooperation is the Key  The flaw manufacturer and client must work together as “we” consider new approaches in the develop of indications that are fit for purpose.

- Therefore when you come upon on a new requirement or a new material, such as High Density Polyethylene Piping, do not panic; we might be able to help one another.
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