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# The Nuts and Bolts of Zinc-Nickel

OEM Zinc Nickel Implementation on Fasteners – Getting It Into Production

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# Report Documentation Page

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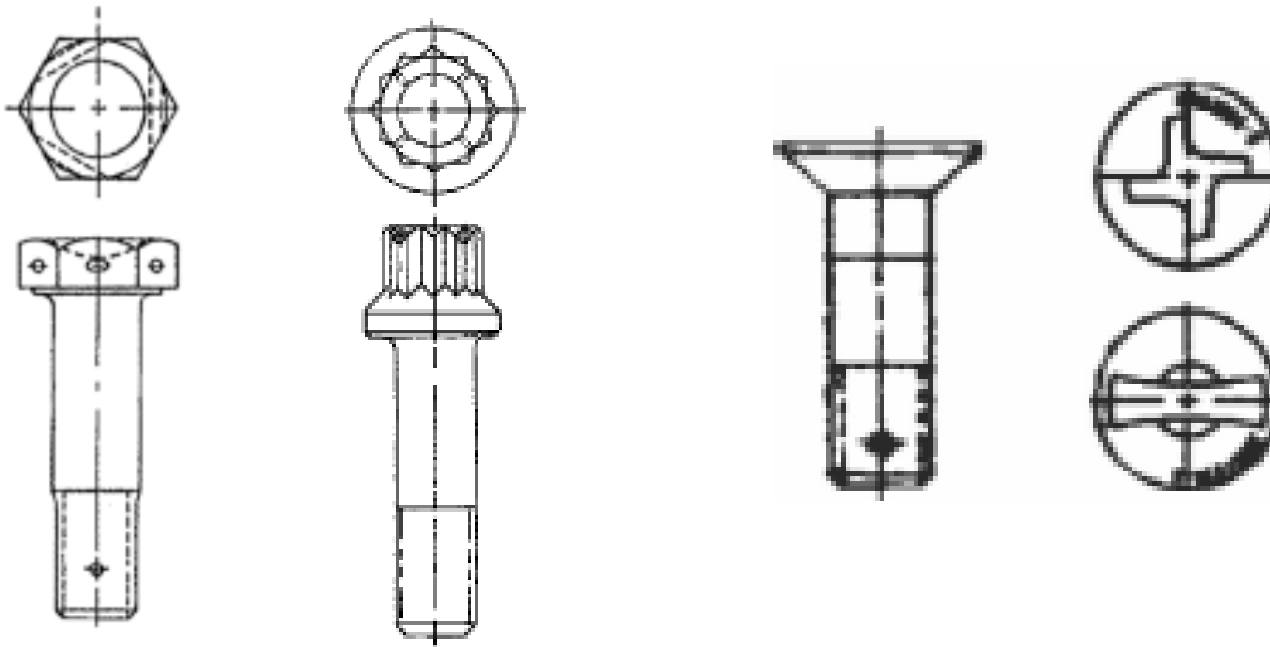
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# Agenda

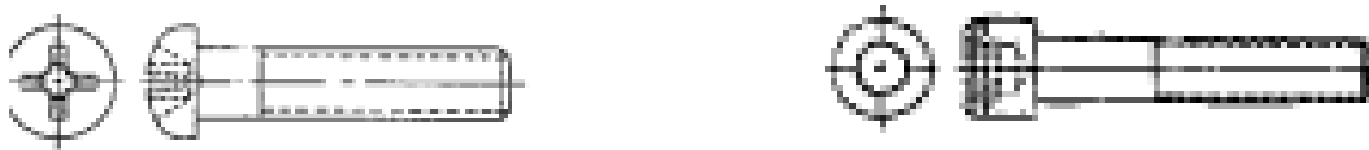
- 1. Cadmium Plated Fasteners currently in production**
- 2. Problem at Hand – Hexavalent Chromates**
- 3. Transition to Zinc-Nickel**
- 4. Preliminary Testing**
- 5. Plan moving forward for Qualifications and Implementation**

# Cadmium Plated Fasteners

- **Bolts**

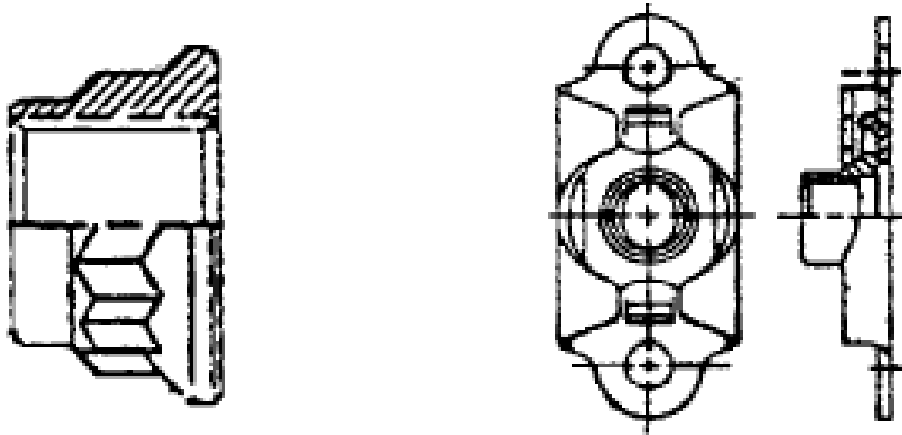


- **Screws**

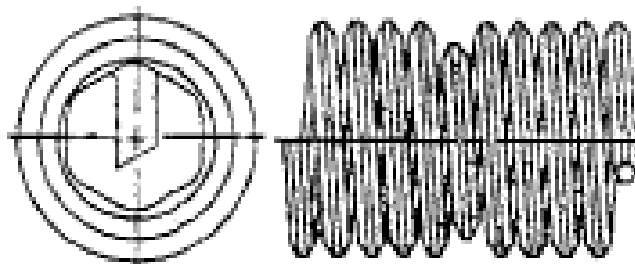


# Cadmium Plated Fasteners

- **Nuts/Nut Plates**

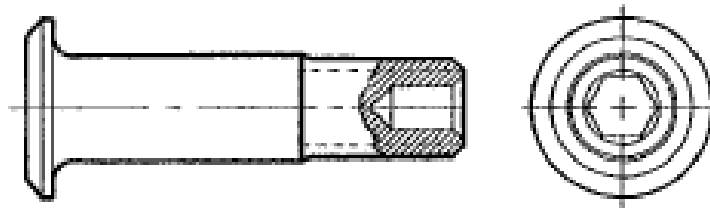


- **Inserts**

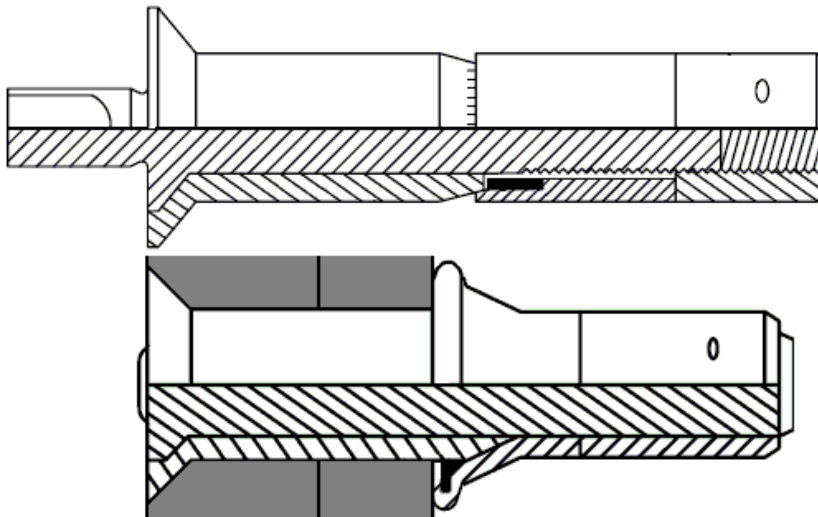


# Cadmium Plated Fasteners

- **Hi-Loks**



- **Blind Fasteners**



# *Problem At Hand*

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## **REACH Initiative: Eliminate Hexavalent chromates**

**Cadmium Plating: September 21, 2017**



# Solution for Fasteners

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# Zinc-Nickel Plating



# Where is Zinc-Nickel used today?

- **Low Strength Steel – just about everywhere**
  - Rod
  - Brackets
  - Baskets of Nut plates
- **High Strength Steel**
  - Landing gear
  - Flap tracks on wings

# So why not fasteners?

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# Threads

# What has Boeing done in preparation?

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**Goal: Zinc-Nickel Plated Fasteners to be a drop-in replacement for CAD Plated Fasteners**



*Boeing Research and Technology conducted 6 phases of testing before moving into qualification and implementation phase of Zinc-Nickel plating of threaded fasteners.*

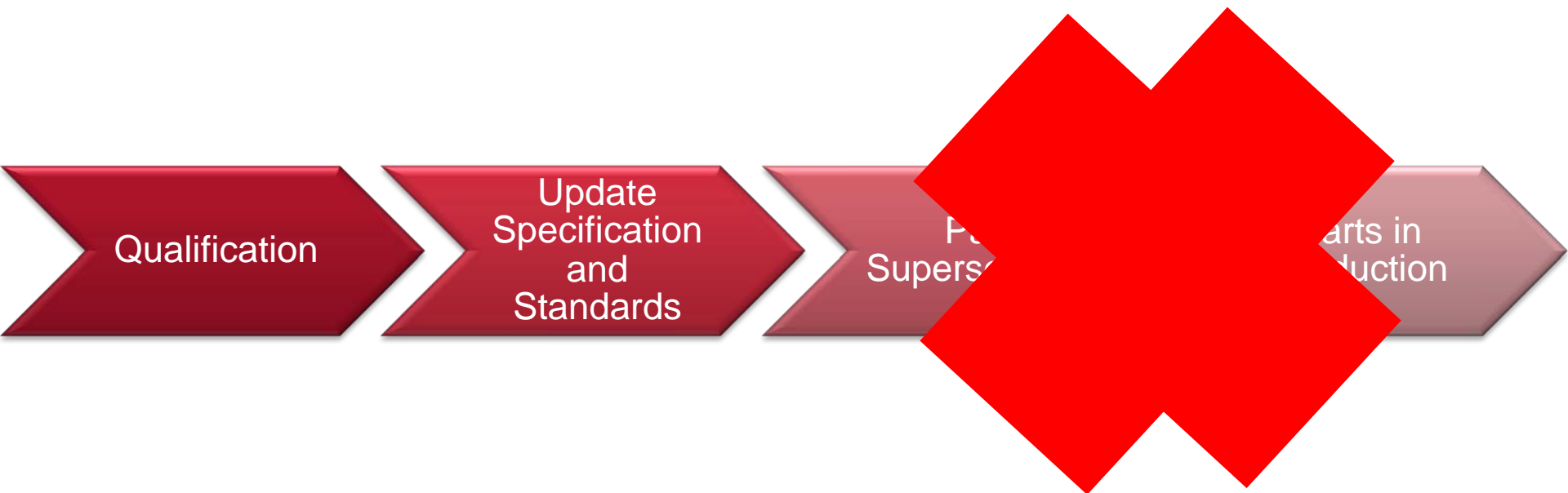
# 6 Phases of Testing

- **Phase I – Failed, Acid based Zinc-Nickel, Fasteners were not representative of fasteners used in production**
- **Phase II – Failed, Acid based Zinc-Nickel, Results were not acceptable. Switch to Alkaline based Zinc-Nickel**
- **Phase III – Failed, Alkaline based Zinc-Nickel, Results Unacceptable**
- **Phase IV – Failed, Alkaline based Zinc-Nickel, Coating too thick**
- **Phase V – Failed, Alkaline based Zinc-Nickel, parts were stripped and re-plated (altered data)**

# Phase VI

1. **Metallurgical Testing - thickness check**    **Comparable**
2. **Torque Tension – NASM1312-15**    **Comparable, need more data**
  - 3 sizes, 6 tests configurations
3. **High RPM Installation – galling check**    **Comparable**
4. **Torque Effectively and Reusability – BPS-N-70**    **Crimp Optimization needed**
5. **Salt Spray – NASM1312-1**    **Comparable**
6. **Installation Force – BMS10-85**    **Further investigation needed with interference fit fasteners**

# What is the plan?



## Qualification is not equal to Implementation

1. Structures and design community risk adverse
2. Immature supply chain

# Where are we?

## Qualifications in-process

### 1) Bolts

- Thickness
- Appearance
- Dimensions
- Corrosion

### 2) Nuts

- Thickness
- Appearance
- Dimensions
- Torque Effectivity and Resuability – Adjust crimp factors
- Additional Torque Tension to complete data set

# Next Steps

- **Continue qualifying fasteners (hi-loks, collars, blinds, nut plates, inserts)**
- **Complete specification changes**
- **Complete torque tension data package during the qualifications**
- **Slowly get parts into production (Start with low risk parts and increase confidence) and build the supply chain**



# Questions???

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**Fasteners and Bearings Engineering**