Applied Failure Analysis
Service Training Meeting Guide 002 SESV8002
August 2000

CATERPILLAR

TECHNICAL PRESENTATION

APPLIED FAILURE ANALYSIS

THREADED FASTENERS

THREADED FASTENERS FAILURE ANALYSIS

MEETING GUIDE SLIDES AND SCRIPT

AUDIENCE

Service, service support and administrative staff personnel who understand the principles of engine and machine operation, and who are or may be involved in determining root causes of failures of threaded fasteners.

CONTENT

This presentation describes function, structure, manufacturing, installation, operation and and some root causes of failures of threaded fasteners.

OBJECTIVES

After learning the information in this presentation, the student will be able to:

1. describe functions, structure and the manufacturing process used to produce fasteners;
2. identify road signs of fastener failure due to fatigue fracture, ductile fracture, impact shearing, fretting, fretting corrosion and stress corrosion cracking and list possible root causes;
3. identify common fastener problems that may occur in the fastener material, or during forming, hardening or threading;
4. identify the road signs of fastener failure due to a nut backing off and list possible root causes.

REFERENCES

Threaded Fasteners Applied Failure Analysis Reference Book	SEBV0545
Threaded Fasteners Applied Failure Analysis Self-Paced Instruction CD-ROM	SEGV8002

PREREQUISITES

AFA STMG 013 Failure Analysis Management
AFA STMG 017 Basic Metallurgy
AFA STMG 014 Principles of Fractures
AFA STMG 015 Principles of Wear

Estimated Time: 3 1/2 Hours
Visuals: 89 electronic images
Student Handout: 1 - Lab Worksheet
Form: SESV8002
Date: 8/2000

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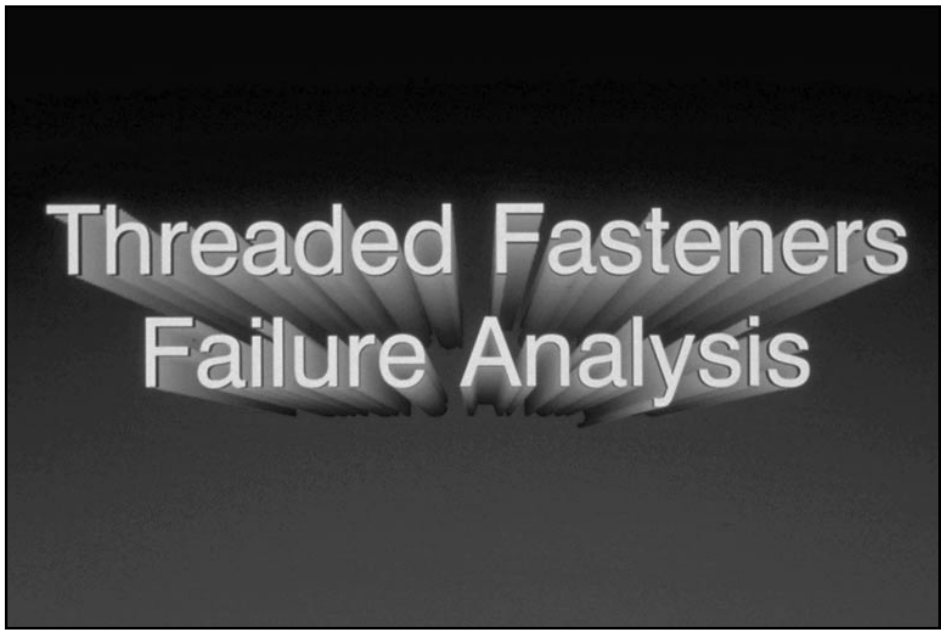
INSTRUCTOR NOTES



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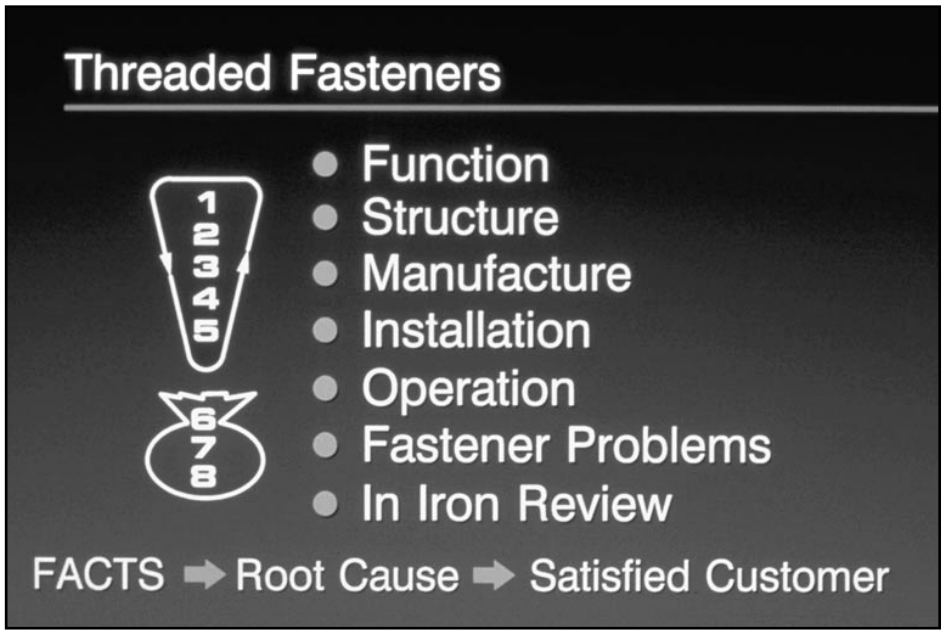
- **Failure Analysis of Threaded Fasteners**

INTRODUCTION

The threaded fastener failure analysis module explains how to apply failure analysis principles when examining worn and fractured threaded fasteners.



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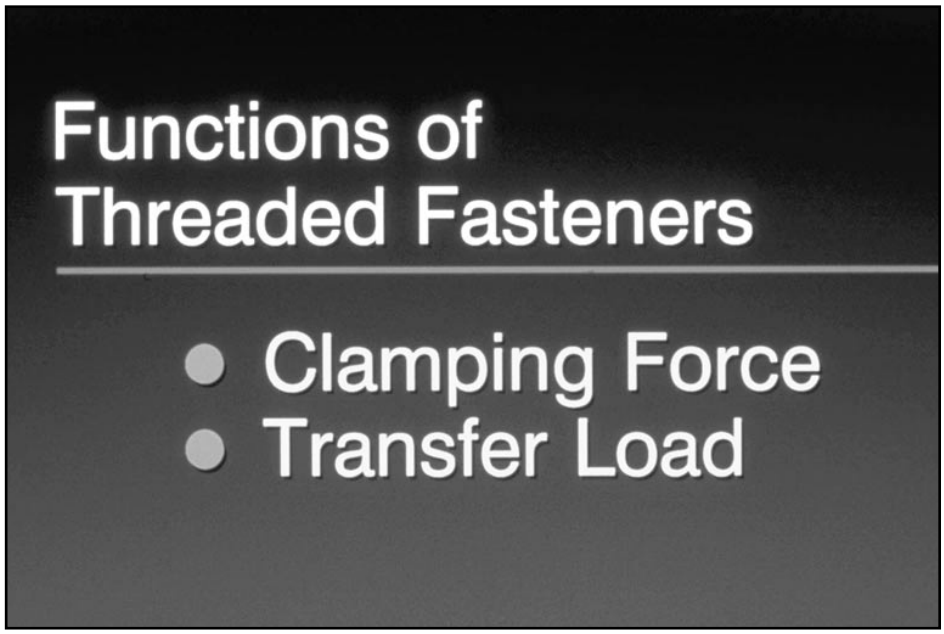
- **Threaded Fasteners presentation**
  - **Functions**
  - **Structure**
  - **Manufacturing**
  - **Installation**
  - **Operation**
  - **Failure analysis**

Topics that will be covered in the threaded fastener failure analysis module include the function, structure and manufacture of bolts. This is followed by a review of fastener installation, operation, and possible fastener problems. The final section in this module covers threaded fastener failure analysis using the eight step method along with the proper visual examination procedure to discover road signs that lead to the root cause of failure. The payoff steps (6, 7, and 8) need to be completed to get the full benefit of finding the root cause of a failure and to ensure customer satisfaction.



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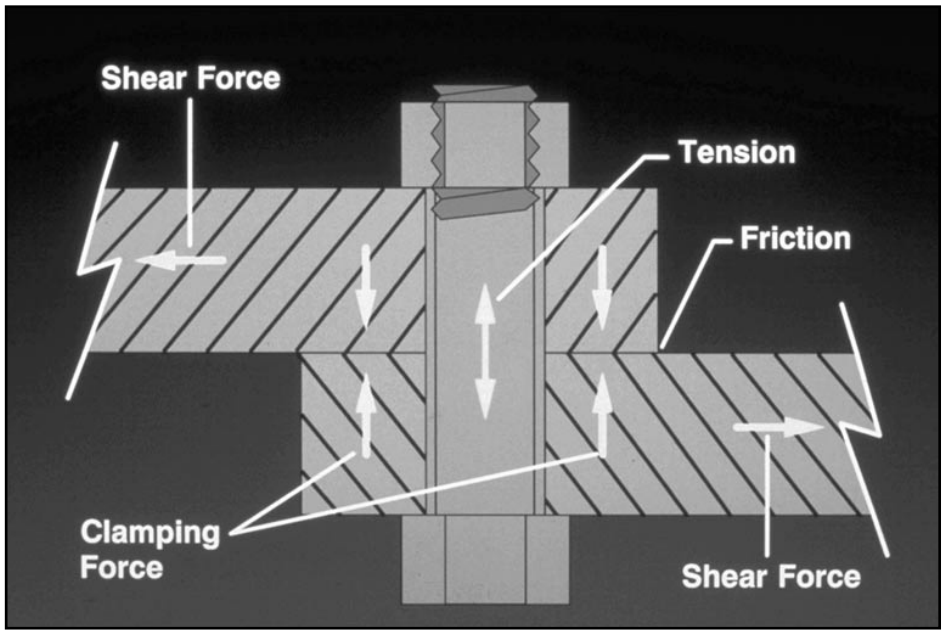
- **Functions**
  - **Clamping force**
  - **Transfer load**

FUNCTIONS

Threaded fasteners perform two major functions:

First, threaded fasteners provide the clamping force that holds a bolted joint together. Second, threaded fasteners transfer load from one part to another.



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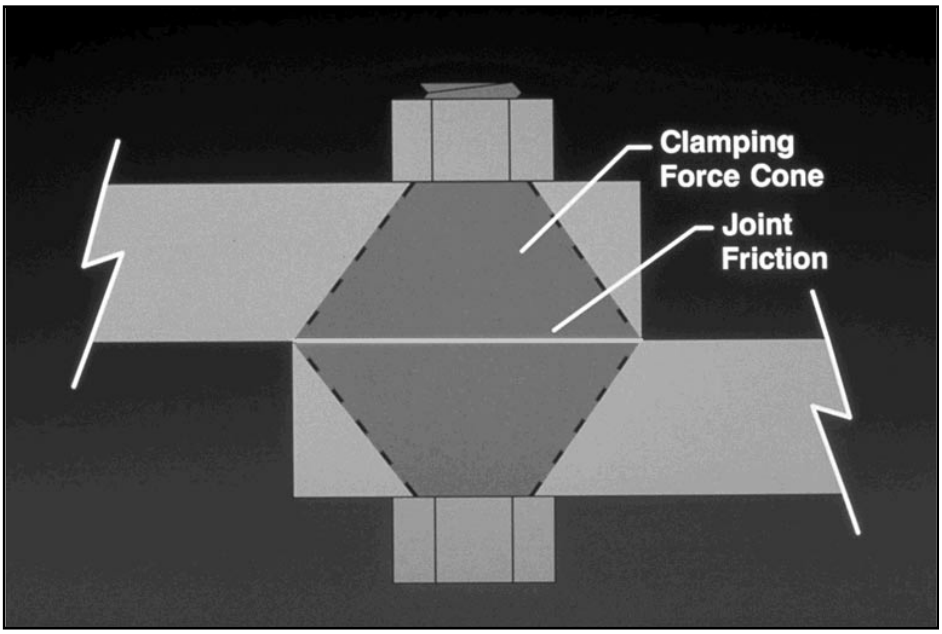
- **Properly tightened fasteners**
  - **Allow no relative movement**
  - **Bolt sees only tension loads**
  - **Shear or bending loads carried by joint face friction**
- **Some bolted joints are designed to slide**

If a bolt is properly tightened or torqued and joint loads are normal, there should be no relative movement between the two joined parts. Therefore, the only load on the bolt is tension.

Any shear or bending forces present in the joint should be carried by joint face friction created by the clamping force that is due to bolt tension.

Note: There are certain bolted joints that are designed to slide. These are exceptions to the above and are used in areas where thermal expansion and contraction is necessary. Examples are exhaust manifold and aftercooler to block joints.



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- **Cone of effective clamping force**

Clamping force and joint friction work together to transfer load from one part to the other.

In each bolted joint there is a cone of effective clamping force felt by the two joined parts. The transfer of load takes place at the surface area of the parting faces included in the cone (shown in red on this view). The effect is as if the two parts are welded together in this area.