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Continuing Education Course #056
Forensic Engineering Part A
Conducting Failure Analyses of Metallic Materials

1. When conducting a RCFA the recommended procedure is analogous to this process?
- a. A good mechanical design process
- b. Completing engineering economic cost analysis
- c. The scientific method
- d. Evaluating a fracture surface with an SEM

2. Valuable physical evidence from a material failure may be destroyed early in the RCFA process if?
- a. Used oil samples containing wear debris are collected for analysis
- b. Fracture surfaces are “fitted” together
- c. Corrosion products are not immediately cleaned off of corroded surfaces
- d. Failed components are packaged securely for transport to a lab

3. There may be several alternative recommendations that could be made at the conclusion of an industrial RCFA to prevent a reoccurrence. The best alternative that can be recommended will?
- a. Have the lowest initial cost
- b. Have a significant effect in preventing a reoccurrence and will actually be implemented
- c. Provide the ultimate technical solution to the problem
- d. Allow management to save face for past decisions regarding the issue

4. The term material “defect” as used in litigation involving a RCFA is a material characteristic that?
- a. May have had a partial role in the failure
- b. Describes an imperfection that rarely is found in commercially produced materials
- c. Describes a feature that directly contributed to the specific failure mechanism
- d. Always is the responsibility of the party that specified the particular material

5. Which of the following organizations commonly provides many types of useful test procedures that are widely accepted and used in conducting RCFA’s?
- a. API
- b. ASTM
- c. ASME
- d. ASCE

6. Use of a soft metal, e.g., copper, in an abrasive wear application or use of a low fracture toughness alloy at a very low service temperature are examples of this generic class of problems that may cause failures?
- a. Design defects
- b. Unexpected service conditions
- c. Incorrect material selection
- d. Material defects due to processing or fabrication

7. A “designated” expert witness in a legal action who completes a RCFA for his or her retaining attorney has which one of the following characteristics?

○ a. Typically will receive a higher rate of compensation than an “undesignated” individual
○ b. Will not be subject to giving sworn testimony at deposition and trial
○ c. Will typically write a formal report of his analysis and conclusions that must be shared with opposing counsel
○ d. Can have privileged and protected communications with his or her retaining attorney and know that those communications do not have to be disclosed to the opposing counsel

8. One use of the X-ray diffraction (XRD) technique for materials characterization is to?

○ a. Provide semi-quantitative indications of most potential elements that may be on a fracture surface
○ b. Provide a clear display of the microstructure of a prepared section of the failed metal
○ c. Indicate the hardness of the material examined
○ d. Indicate the residual stress level in the metal sample examined

9. In the process of conducting a RCFA all of the following actions are recommended except?

○ a. Gathering all applicable documents, e.g., drawings or specifications
○ b. Interviewing all knowledgeable individuals simultaneously, as a group
○ c. Obtaining an exemplar
○ d. Proceeding in the analysis of physical evidence in a sequence of non-destructive examinations to the most destructive tasks

10. Which of the following is a semi-quantitative, materials characterization technique used for identifying a wide range of elements that might be present on a metal surface?

○ a. Metallography
○ b. Optical emission spectroscopy (OES)
○ c. Inductively coupled plasma spectrometer (ICP)
○ d. Energy-dispersive spectroscopy (EDS)

11. Not specifying a requirement to remove machining marks on a rotating shaft so that the marks can then become initiation sites for fatigue failure is an example of this generic class of failures?

○ a. Unexpected service conditions
○ b. Design defects
○ c. Incorrect material selection
○ d. Material defects due to processing or fabrication

12. All of the following characteristics may be determined or estimated by use of hardness measurements of a metal except this feature?

○ a. Wear resistance
○ b. Ultimate tensile strength
○ c. Thermal conductivity
○ d. Approximate heat treatment that has been applied

13. Failure to attain the correctly specified strength or ductility of a metal for the given application because of improper heat treatment is an example of which generic class of causes of metallic failures?

○ a. Unexpected service conditions
○ b. Design defects
○ c. Material defects due to processing or fabrication
○ d. Incorrect material selection and use

14. Certain laboratory techniques can provide accurate values of the percentages of chemical elements present in an alloyed metal that has failed. Which of the following techniques can serve this function (1) at least cost but (2) will require a greater quantity of material for the analysis as compared to these other alternatives noted in the course?

- a. Optical emission spectroscopy (OES)
- b. Atomic absorption (AA)
- c. Metallography
- d. Inductively coupled spectrometer (ICP)

15. Which of the following sequences of activities is most probable for a P.E. acting as a designated expert witness in a civil law case to experience?

- a. Complete the RCFA, complete privileged communications with his retaining attorney, settlement
- b. Complete the RCFA, write the report, deposition, trial
- c. Complete the RCFA, write the report, deposition, settlement
- d. Complete the RCFA, assist in preparation of evidence for use at trial, trial