INTRODUCTION

TO

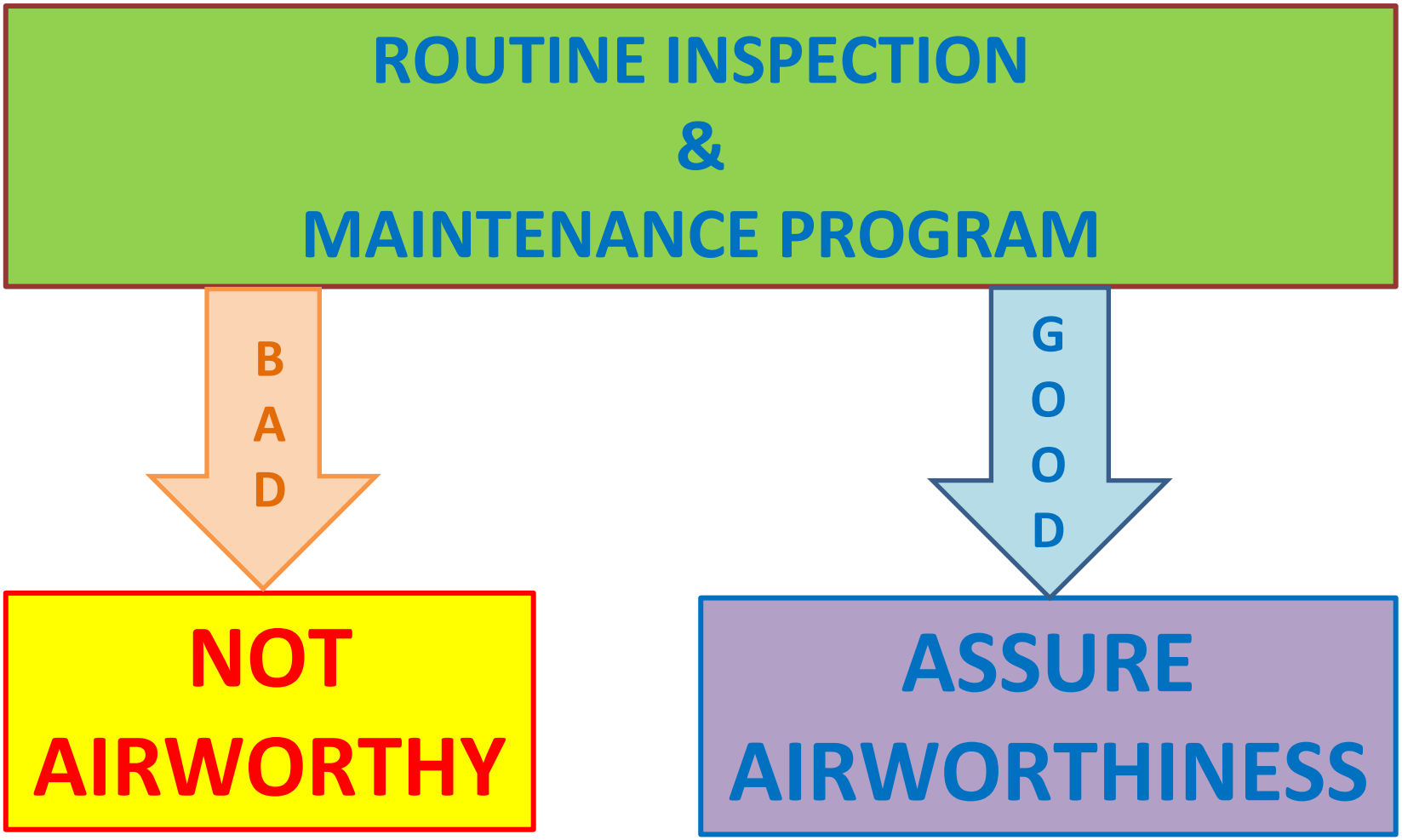
INSPECTION TECHNIQUE

INSPECTION TECHNIQUE

INSPECTIONS:

- ✓ is designed to maintain an aircraft in the best possible condition.
- ✓ are a visual examinations and manual checks to determine the condition of an aircraft or component.
- ✓ range from a casual walk-around to a detailed inspection involving complete disassembly and the use of complex inspection aids.
- ✓ references, including:
  - reports made by mechanics
  - reports made by the pilot or crew flying an aircraft, and
  - regularly scheduled inspections of an aircraft.

INSPECTION TECHNIQUE



MAINTENANCE PROGRAM

- **What is a "routine inspection and maintenance program".**
  - ✓ is a thorough and repeated inspections.
  - ✓ is a regularly scheduled inspections and preventive maintenance.

AIRFRAME & ENGINE INSPECTIONS

- range from preflight inspections to detailed inspections.
- time intervals for the inspection periods:
  - ✓ vary with the models of aircraft involved and
  - ✓ the types of operations being conducted.
- establishing inspection intervals:
  - ✓ consult the airframe and engine manufacturer's instructions.
  - ✓ basis for scheduling:
    - may be using flight hours, or
    - on a calendar time.

INSPECTION TECHNIQUE

PREPARATION & REFERENCES

INSPECTION TECHNIQUE

- **PREPARATION BEFORE AIRCRAFT INSPECTION:**
  - ✓ all plates, access doors, fairings, and cowling have been opened or removed and the structure cleaned.
  - ✓ take note of any oil or other evidence of fluid leakage.
  - ✓ paperwork and/or reference information must be accessed and studied.
  - ✓ aircraft logbooks must be reviewed to provide background information and a maintenance history of the particular aircraft.
  - ✓ appropriate checklists must be utilized to ensure that no items will be forgotten or overlooked.
  - ✓ additional publications must be available, (hard copy or electronic format) to assist in the inspections:
    - aircraft and engine manufacturers,
    - appliance manufacturers,
    - parts venders, and
    - the Regulator (FAA, DGCA).

AIRCRAFT LOGBOOK

- is the record in which all data concerning the aircraft is recorded.
- determine the aircraft condition, date of inspections, time on airframe, engines and propellers.
- to understand the aircraft's maintenance history:
  - ✓ reflects all significant events occurring to the aircraft, its components, and accessories, and provides a place for indicating compliance with FAA/DGCA airworthiness directives or manufacturers' service bulletins.
- when the inspections are completed:
  - ✓ appropriate entries must be made in the aircraft logbook certifying that the aircraft is in an airworthy condition and may be returned to service.(use good penmanship and write legibly)

CHECKLIST

NOTE: Always use a checklist when performing an inspection.

- **WHO MAKE THE CHEKLIST:**
  - ✓ **may be of your own design by referring:**
    - **to the manufacturer's documents of the equipment being inspected, or**
    - **obtained from some other source.**

CHECKLIST

- **What should be included:**
  1. Fuselage and hull group.
  2. Cabin and cockpit group.
  3. Engine and nacelle group.
  4. Landing gear group.
  5. Wing and center section.
  6. Empennage group.
  7. Propeller group.
  8. Communication and navigation group.
  9. Miscellaneous.

CHECKLIST

(Fuselage and hull group)

- **Fabric and skin**
  - Inspect for deterioration, distortion, other evidence of failure, and defective or insecure attachment of fittings.
- **Systems and components**
  - Inspect for proper installation, apparent defects, and satisfactory operation.
- **Inspet condition of envelope gas bags, ballast tanks, and related parts.**

CHECKLIST

(Cabin and Cockpit group)

- **Generally**
  - for cleanliness and loose equipment that should be secured.
- **Seats and safety belts**
  - for condition and security.
- **Windows and windshields**
  - for deterioration and breakage.
- **Instruments**
  - for condition, mounting, marking, and (where practicable) for proper operation.
- **Flight and engine controls**
  - for proper installation and operation.
- **Batteries**
  - for proper installation and charge.
- **All systems**
  - for proper installation, general condition, apparent defects, and security of attachment.

CHECKLIST

Engine and Nacelle group

- **Engine section**
  - for visual evidence of excessive oil, fuel, or hydraulic leaks, and sources of such leaks.
- **Studs and nuts**
  - for proper torque and obvious defects.
- **Internal engine**
  - for cylinder compression and for metal particles or foreign matter on screens and sump drain plugs. If cylinder compression is weak, check for improper internal condition and improper internal tolerances.
- **Engine mount**
  - for cracks, looseness of mounting, and looseness of engine to mount.
- **Flexible vibration dampeners**
  - for condition and deterioration.
- **Engine controls**
  - for defects, proper travel, and proper safetying.

CHECKLIST

Engine and Nacelle group (Cont'd)

- **Lines, hoses, and clamps**
  - for leaks, condition, and looseness.
- **Exhaust stacks**
  - for cracks, defects, and proper attachment.
- **Accessories**
  - for apparent defects in security of mounting.
- **All systems**
  - for proper installation, general condition defects, and secure attachment.
- **Cowling**
  - for cracks and defects.
- **Ground run-up and functional check**
  - check all powerplant controls and systems for correct response, all instruments for proper operation and indication.

CHECKLIST

Landing Gear group

- **All units**
  - for condition and security of attachment.
- **Shock absorbing devices**
  - for proper oleo fluid level.
- **Linkage, trusses, and members**
  - for undue or excessive wear, fatigue, and distortion.
- **Retracting and locking mechanism**
  - for proper operation.
- **Hydraulic lines**
  - for leakage.

CHECKLIST

Landing Gear group (Cont'd)

- **Electrical system**
  - for chafing (isolasi yang tergores/sobek/lecet) and proper operation of switches.
- **Wheels**
  - for cracks, defects, and condition of bearings.
- **Tires**
  - for wear (keausan) and cuts.
- **Brakes**
  - for proper adjustment.
- **Floats and skis**
  - for security of attachment and obvious defects (defect yang terlihat kasat mata).

CHECKLIST

Wing and center section

- **All components**
  - for condition and security.
- **Fabric and skin**
  - for deterioration, distortion, other evidence of failure, and security of attachment.
- **Internal structure (spars, ribs compression members)**
  - for cracks, bends, and security.
- **Movable surfaces**
  - for damage or obvious defects, unsatisfactory fabric or skin attachment and proper travel.
- **Control mechanism**
  - for freedom of movement, alignment, and security.
- **Control cables**
  - for proper tension, fraying (sobek), wear and proper routing through fairleads and pulleys.

CHECKLIST

Empennage group

- **Fixed surfaces**
  - for damage or obvious defects, loose fasteners, and security of attachment.
- **Movable control surfaces**
  - for damage or obvious defects, loose fasteners, loose fabric, or skin distortion.
- **Fabric or skin**
  - for abrasion, tears, cuts or defects, distortion, and deterioration.

CHECKLIST

Propeller group

- **Propeller assembly**
  - for cracks, nicks, bends, and oil leakage.
- **Bolts**
  - for proper torquing and safetying.
- **Anti-icing devices**
  - for proper operation and obvious defects.
- **Control mechanisms**
  - for proper operation, secure mounting, and travel.

CHECKLIST

Communication and navigation group

- **Radio and electronic equipment**
  - for proper installation and secure mounting.
- **Wiring and conduits**
  - for proper routing, secure mounting, and obvious defects.
- **Bonding and shielding**
  - for proper installation and condition.
- **Antennas**
  - for condition, secure mounting, and proper operation.

CHECKLIST
Miscellaneous

- **Emergency and first aid equipment**
  - for general condition and proper stowage.
- **Parachutes, life rafts, flares, and so forth**
  - inspect in accordance with the manufacturer's recommendations.
- **Autopilot system**
  - for general condition, security of attachment, and proper operation.

AERONAUTICAL

PUBLICATION

USED FOR

INSPECTIONS

AERONAUTICAL PUBLICATION

- **are the sources of information for:**
  - **guiding aviation mechanics in the operation and maintenance of aircraft and related equipment.**
- **aid in the efficient operation and maintenance of all aircraft.**
- **include:**
  - **manufacturers' service bulletins, manuals, and catalogs;**
  - **DGCA/FAA regulations; airworthiness directives; advisory circulars; and**
  - **aircraft, engine and propeller specifications.**

Manufacturer's Service Bulletins/Instructions

- **issued by:**
  - airframe, engine, and component manufacturers.
- **may include:**
  - purpose for issuing the publication,
  - name of the applicable airframe, engine, or component,
  - detailed instructions for service, adjustment, modification or inspection, and source of parts, if required, and
  - estimated number of man-hours required to accomplish the job.

Maintenance Manual

Manufacturer's Aircraft Maintenance Manual:

- **Contains:**
  - complete instructions for maintenance of all systems and components installed in the aircraft.
  - information for the mechanic who normally works on components, assemblies, and systems while they are installed in the aircraft.
- **Does not contain information for the overhaul mechanic.**

Aircraft Maintenance Manual (AMM)

- A description of the systems (i.e., electrical, hydraulic, fuel, control)
- Lubrication instructions setting forth the frequency and the lubricants and fluids which are to be used in the various systems,
- Pressures and electrical loads applicable to the various systems,
- Tolerances and adjustments necessary to proper functioning of the airplane,
- Methods of leveling, raising, and towing,
- Methods of balancing control surfaces,
- Identification of primary and secondary structures,
- Frequency and extent of inspections necessary to the proper operation of the airplane,
- Special repair methods applicable to the airplane,
- Special inspection techniques requiring x-ray, ultrasonic, or magnetic particle inspection, and
- A list of special tools.

Overhaul Manual

- **Contains:**
  - **brief descriptive information**
  - **detailed step by step instructions**

  covering work normally performed on a unit that has been removed from the aircraft.
- **Simple / inexpensive items, (such as switches and relays), are not covered in the overhaul manual.**

Structural Repair Manual

- **Contains:**
  - ✓ **manufacturer's information and specific instructions for repairing primary, and secondary structures:**
    - **skin, frame, rib, and stringer including material and fastener substitutions, and**
    - **special repair techniques.**

Illustrated Parts Catalog (IPC)

- **Presents:**
  - ✓ component breakdowns of structure and equipment in disassembly sequence.
  - ✓ exploded views or cutaway illustrations for all parts and equipment manufactured by the aircraft manufacturer.

Code of Regulations (CASRs/FARs)

- **provide:**
  - ✓ for the safe and orderly conduct of flight operations, and
  - ✓ to prescribe airmen privileges and limitations.

Airworthiness Directives

- correction of unsafe conditions found in an aircraft, aircraft engine, propeller, or appliance because of:
  - ✓ a design defect, maintenance, or other causes.
- published to:
  - ✓ notify aircraft owners and other interested persons of unsafe conditions, and
  - ✓ prescribe the conditions under which the product may continue to be operated.
- divided into two categories:
  - ✓ those of an emergency nature requiring immediate compliance upon receipt and
  - ✓ those of a less urgent nature requiring compliance within a relatively longer period of time.

Type Certificate Data Sheets (TCDS)

- describes the type design and sets forth the limitations prescribed by the applicable CASR/CFR part.
- contains information regarding:
  1. Model designation of all engines for which the aircraft manufacturer obtained approval for use with this model aircraft.
  2. Minimum fuel grade to be used.
  3. Maximum continuous and takeoff ratings of the approved engines, including manifold pressure (when used), rpm, and horsepower (hp).
  4. Name of the manufacturer and model designation for each propeller for which the aircraft manufacturer obtained approval will be shown together with the propeller limits and any operating restrictions peculiar to the propeller or propeller engine combination.
  5. Airspeed limits in both mph and knots.
  6. Center of gravity range for the extreme loading conditions of the aircraft is given in inches from the datum. The range may also be stated in percent of MAC (Mean Aerodynamic Chord) for transport category aircraft.

Type Certificate Data Sheets (Cont'd)

7. Empty weight center of gravity (CG) range (when established) will be given as fore and aft limits in inches from the datum. If no range exists, the word "none" will be shown following the heading on the data sheet.
8. Location of the datum.
9. Means provided for leveling the aircraft.
10. All pertinent maximum weights.
11. Number of seats and their moment arms.
12. Oil and fuel capacity.
13. Control surface movements.
14. Required equipment.
15. Additional or special equipment found necessary for certification.
16. Information concerning required placards.

DEPARTMENT OF TRANSPORTATION
FEDERAL AVIATION ADMINISTRATION

A25CE
Revision 11
CESSNA
404
406
June 15, 1995

TYPE CERTIFICATE DATA SHEET NO. A25CE

This data sheet which is part of Type Certificate No. A25CE prescribes conditions and limitations under which the product for which the type certificate was issued meets the airworthiness requirements of the Federal Aviation Regulations.

Type Certificate Holder — Cessna Aircraft Company
P. O. Box 7704
Wichita, Kansas 67277

I - Model 404, Titan, (Normal Category), Approved July 21, 1976

Engines — Two Teledyne Continental GTSIO-520-M
Reduction gear ratio .667:1

Fuel — 100/130 or 100 low-lead minimum grade aviation gasoline
See NOTE 3 for optional anti-icing additive

Engine Limits — For all operations, 2235 propeller r.p.m. (375 hp.)
40.0 in. Hg. mp. up to critical altitude of 16,000 feet in standard atmosphere. Above 16,000 feet the following maximum mp. applies for maximum r.p.m.

Altitude (ft.)	Max. Allowable Mp. (in. Hg)
16,000	40.0
18,000	37.5
20,000	35.0
22,000	32.0
24,000	29.2
26,000	26.0
28,000	23.0
30,000	20.0

Propeller and Propeller Limits — Two McCauley full-feathering three-bladed propeller installations
(a) McCauley hub 3FF32C501 with 90UMB-0 blades
Diameter: not over 90.0 in., not under 88.5 in.
No further reduction permitted
Pitch settings at 30.0 in. sta.:
low 16.6°, ±0.2°, feathering 84.6°, ±0.3°
S/N 404-0001 through 404-0600
(b) Hydraulic governor McCauley DCF290D2/T6, DCFU290D2/T6, DCFS290D2/T6, DCFUS290D2/T6, DCF290D7/T6, DCFU290D7/T6 or DCFU290D13/T6, DCFS290D7/T6, DCFUS290D7/T6 or DCFUS290D13/T6
S/N 404-0601 and up
(b) Hydraulic governor McCauley DCF290D7/T6, DCFU290D7/T6 or DCFU290D13/T6, DCFS290D9/T6, DCFUS290D9/T6

(c) Propeller spinner and bulkhead assembly, McCauley D3534/D-4506

Airspeed Limits (IAS)

Maneuvering	160 KIAS
Maximum structural cruising	212 KIAS
Never exceed	241 KIAS
Landing gear operating	182 KIAS
Landing gear extended	182 KIAS
Flaps extended - takeoff	182 KIAS
Flaps extended - landing	152 KIAS
Minimum control	78 KIAS

C.G. Range (Landing Gear Extended)

(+170.31) to (+179.08) at 8400 lb.
(+165.6) at 6100 lb. or less
Straight line variation between points given
Landing gear retracted moment change: +1113 in./lb.

Empty Wt. C.G. Range

None

Leveling Means

Two screws located on W.L. 93.80 @ sta. 248.25 and sta. 272.65

Maximum Weight

S/N 404-0001 through 404-0200
Landing 8100 lb., takeoff 8400 lb.

S/N 404-0201 and up
Landing 8100 lb., ramp 8450 lb., takeoff 8400 lb.

No. of Seats

One through eleven
(2 at +137.0, 2 at +171.0, 2 at +199.0, 2 at +227.0, 1 at +255.0 and 2 at +296.0)
See manufacturer's equipment list for other seating arrangements

Maximum Baggage

250 lb. (+32.0), 350 lb. (+71.0), 400 lb. (+211.0), 400 lb. (+301.0) and 100 lb. (+317.0)

Fuel Capacity

S/N 404-0001 through 404-0200
348.0 gallons (2 wing tanks, 174.0 gallons each, 170.0 gallons usable at +181.2)

S/N 404-0201 and up
348.0 gallons (2 wing tanks, 174.0 gallons each, 172.0 gallons usable at +181.2)

See NOTE 1 for data on unusable fuel

Oil Capacity

26 quarts (13 quarts in each engine at +129.0; usable 7.0 quarts per engine)
See NOTE 1 for data on undrainable oil.

Maximum Operating Altitude

30,000 feet

Control Surface Movements

Wing flaps			Down 35°, ±1° (Inboard) Down 23°, +0°, -1° (Outboard)
Main surfaces			
Aileron	Up	25°, +1°, -0°	Down 15°, +1°, -0°
Elevator	Up	24°, +1°, -0°	Down 15°, +1°, -0°
Rudder	Right	32°, +1°, -0°	Left 32°, +1°, -0°
(Read degrees normal to rudder hinge line)			
Tab (main surface in neutral)			
Aileron	Up	15°, +1°, -0°	Down 15°, +1°, -0°
Elevator	Up	4°, +0.5°, -0.0°	Down 14°, +0.0°, -0.5°
Rudder	Right	9°, +0.0°, -0.5°	Left 9°, +1°, -0°
(Read degrees normal to rudder hinge line)			

Serial Nos. Eligible

404-0001 through 404-0859

II - Model 406, Caravan II, (Normal Category), Approved June 27, 1986

Engines

Two Pratt and Whitney Aircraft of Canada, Ltd., PT6A-112 turboprops

Fuel

Aviation turbine fuel ASTM D-1655, Jet A, Jet A-1, or Jet B; MIL-T-5624, JP-4, JP-5; MIL-T-83133, JP-8. Anti-icing additive per MIL-I-27686D, MIL-I-27686E, or Phillips PFA55MB must be blended into the aircraft fuel in concentrations not less than 0.060% or more than 0.15% by volume. For emergency use of aviation gasoline and fueling procedures, refer to approved Airplane Flight Manual.

Engine Limits

	Operating Limits				
	Shaft Horsepower	Ng Gas Generator Speed (% r.p.m.)	Indicated Torque (ft.-lbs.)	Prop Shaft Speed (r.p.m.)	Maximum Permissible Interturbine Temp. (°C)
Takeoff static and max. continous	500	101.6	1382	1900	725
Starting (2 seconds)	-	-	-	-	1090
Maximum reverse	480	101.6	1382	1815	725

Propeller and Propeller Limits

Two McCauley three-bladed, full-feathering, reversible
Hub: 3GFR34C701
Blade: 93KB-0
Diameter: Not over 93 inches, not under 90-5/8 inches; no further reduction permitted
Pitch at 30-inch station:
Low pitch 18.5°, feathered 85.5°, reverse -13.5°

Airspeed Limits (IAS)

V_{MO} (Maximum operating)	
Sea level to 21,500 ft.	229 knots
M_{MO} Above 21,500 ft.	.52 mach
V_A (Maneuvering)	162 knots
V_{FE} (Flaps extended)	
30° (Landing)	180 knots
20° (Approach)	200 knots
10° (Takeoff)	200 knots
V_{MCA} (Air minimum control speed)	90 knots
V_{LO} (Landing gear operating)	180 knots
V_{LE} (Landing gear extended)	180 knots

C.G. Range (Landing Gear Extended)

(+166.99 in.) to (+180.28 in.) at 6,500 lb. or less (11% to 32% MAC)
(+172.42 in.) to (+180.28 in.) at 9,360 lb. (19.6% to 32% MAC)
Variation is linear between points
Landing gear retracting moment (+1346 in.-lb.)

Empty Wt. C.G. Range

None

Leveling Means

Two screws located on W.L. 93.80 @ sta. 248.25 and sta. 272.65

Maximum Weight

Takeoff	9,360 lb.
Landing	9,360 lb.
Zero fuel (with zero wing locker payload)	8,500 lb.
Ramp	9,435 lb.

Number of Seats

One through fourteen
(2 at +137.0, 2 at +166.0, 2 at +192.0, 2 at +218.0, 2 at +244.0, 2 at +270.0, and 2 at +296.0)
See manufacturer's equipment list for other seating arrangements

Maximum Baggage	250 lb. (+32.0), 350 lb. (+71.0), 400 lb (+211.0), 400 lb. (+301.0), and 100 lb. (+317.0)				
Fuel Capacity	3227 lb. (481.5 gal.) total in two wing tanks, 1613.5 lb. (240.75 gal.) each 3183 lb. (475 gal.) usable total, 1591.5 lb. (237.5 gal.) in each tank at sta. +181.9 Fuel weight based on 6.70 lb./gal. See NOTE 1 for data on unusable fuel				
Oil Capacity	5.28 gal. total, 3.00 gal. usable (2.3 gal. in each engine-mounted tank at +142.1) See NOTE 1 for data on undrainable oil				
Maximum Operating Altitude	30,000 ft.				
Control Surface Movements	Elevator (horn faired)	Up	14°, +1°, -0°	Down	17°, +1°, -0°
	Elevator trim tabs	Up	8°, +1°, -0°	Down	10°, +2°, -0°
	Rudder (perpendicular to hinge 0° faired with fin)	Right	32°, +1°, -0°	Left	32°, +1°, -0°
	Rudder trim tab (perpendicular to hinge)	Right	11°, +1°, -0°	Left	16°, +1°, -0°
	Aileron	Up	25°, +1°, -0°	Down	14°, +1°, -0°
	Aileron trim tab	Up	19°, +1°, -0°	Down	19°, +1°, -0°
	Wing flap (inboard)			Down	30°, +1°, -0°
	Wing flap (outboard)			Down	20°, +1°, -0°
Serial Nos. Eligible	406-0001 and on				

Data Pertinent to All Models

Datum: 100.0 inches forward of forward face of fuselage bulkhead forward of rudder pedals.

Certification Basis:

Model 404:

Part 23 of the Federal Aviation Regulations effective February 1, 1965, as amended by 23-1 through 23-13 except Subpart B as amended through 23-14; and FAR 23.1385(c) as amended through 23-21; and 23.1327 as amended through 23-23. Findings of equivalent level of safety were made for FAR 23.1189(a), 23.1545, and 23.1583(a). In addition, effective S/N 404-0601, FAR 36 dated December 1, 1969, as amended by 36-1 through 36-4.

In addition to the above certification basis, compliance with ice protection has been demonstrated in accordance with FAR 23.1419 of Amendment 23-14 effective December 20, 1973, when ice protection equipment is installed in accordance with Cessna Drawing S114400, Factory Kit (FK) No. 194, and Pilot's Operating Handbook and FAA Approved Airplane Flight Manual. Aircraft which have been modified in compliance with Accessory Kit (AK) No. 421-106 are considered to be equivalent to those with Factory Kit (FK) No. 194.

Model 406:

Part 23 of the Federal Aviation Regulations effective February 1, 1965, as amended by 23-1 through 23-13 except Subpart B as amended through 23-14; and 23.427, 23.929, 23.979, 23.1017, 23.1027, 23.1163, 23.1182, 23.1189, 23.1192 as amended through 23-14; 23.951, 23.997, 23.1013, 23.1015, 23.1019(a)(1), 23.1019(a)(2), 23.1019(a)(4), 23.1019(a)(5), 23.1019(b), 23.1183 as amended through 23-15; 23.933, 23.971, 23.977, 23.999, 23.1111, 23.1125, 23.1143, 23.1165, 23.1303 (a through d), 23.1385(c), 23.1549 as amended through 23-17; 23.901, 23.939, 23.943, 23.959, 23.967, 23.973, 23.975, 23.995, 23.1093, 23.1121, 23.1141, 23.1145, 23.1193, 23.1203, 23.1305 (a through u and w), 23.1337 as amended through 23-18; 23.1323, 23.1325, 23.1327, 23.1351, 23.1357, 23.1547 as amended through 23-20; 23.45, 23.49, 23.65, 23.67, 23.77, 23.161, 23.1043, 23.1353, 23.1521 as amended through 23-21; 23.1545 as amended through 23-23; 23.903, 23.1529 as amended through 23-26; SFAR 27 as amended by 27-1 through 27-4; Part 36 as amended by 36-1 through 36-12; SFAR 41C; and Exemption No. 4661 from exact compliance with the requirements of Section 23.207(c). Findings of equivalent level of safety were made for FAR 23.1189(a), and that design of

the elevator tab control system provides the level of safety intended by the requirements of FAR 21.21(b)(2) by preventing an unsafe condition. Therefore, FAR 23.629(f), as amended by Amendment 23-23, is applicable to the elevator tab control system, in addition to other requirements in the cited certification basis.

In addition to the above certification basis, compliance with ice protection has been demonstrated in accordance with FAR 23.773 and 23.1419 of Amendment 23-14, FAR 23.1309 as amended through Amendment 23-17, and FAR 23.1416 of Amendment 23-23 when ice protection equipment is installed in accordance with Cessna Drawing 6015006, Factory Kit (FK) No. 194, and Pilot's Operating Handbook and FAA Approved Airplane Flight Manual. Aircraft which have been modified in accordance with Accessory Kit (AK) No. 421-106 are considered to be equivalent to those with Factory Kit (FK) No. 194.
Application for type certificate dated October 9, 1973. Type Certificate No. A25CE issued July 21, 1976, obtained by the manufacturer under delegation option procedures.

Production Basis — Production Certificate No. 312 issued and Delegation Option Manufacturer No. CE-3 authorized to issue airworthiness certificates under delegation option provisions of Part 21 of the Federal Aviation Regulations. Effective February 15, 1985, and on, Production Certificate No. 4 is applicable to all spares production for the Model 404 and to all production on the Model 406.

Equipment — The basic required equipment as prescribed in the applicable airworthiness regulations (see Certification Basis) must be installed in the aircraft for certification. In addition, the following item of equipment is required:

Stall Warning Indicator - Cessna Dwg. 5818008 (404), 5718030 (406) or
Angle-of-Attack Indicator System - Cessna Dwg. 0800302 (404)

NOTE 1. Current weight and balance report together with list of equipment included in certificated empty weight and loading instructions when necessary must be provided for each aircraft at the time of original certification.

The certified empty weight and corresponding center of gravity location must include undrainable oil (not included in Oil Capacity) and unusable fuel as follows:

(a) S/N 404-0001 through 404-0200
Fuel 48 lb. at (+177.6)

S/N 404-0201 and up
Fuel 28 lb. at (+177.6)

S/N 406-0001 and up
Fuel 44 lb. (6.5 gal.) at (+186.7)

(b) Oil 0.0 lb.

NOTE 2. The placards specified in the FAA Approved Airplane Flight Manual must be displayed.

NOTE 3. (404-0001 and up)
1%, by volume, isopropyl alcohol approved for use as fuel anti-icing additive when used as outlined in Cessna Service Letter ME73-25 dated November 2, 1973, or subsequent revisions.

NOTE 4. (S/N 404-0201 and up), (406-0001 and up)
An optional cargo configuration is available which excludes the passenger air distribution and seating. Such airplanes may be operated with passenger seats installed provided the operating rules for supplemental oxygen are complied with.

NOTE 5. Aircraft operators must observe limitations and placards shown in the applicable Pilot's Operating Manual and FAA Approved Airplane Flight Manual, or later approved revisions as listed below:

Cessna P/N D1540-3-13:	Model 404 Serial 404-0001 through 404-0136 (1977 Model)
Cessna P/N D1563-1-13:	Model 404 Serial 404-0201 through 404-0246 (1978 Model)
Cessna P/N D1572-2-13PH:	Model 404 Serial 404-0401 through 404-0460 (1979 Model)
Cessna P/N D1583-3-13PH:	Model 404 Serial 404-0601 through 404-0695 (1980 Model)
Cessna P/N D1593-1-13PH:	Model 404 Serial 404-0801 through 404-0859 (1981 Model)
Cessna P/N D1624-13PH:	Model 406 Serial 406-0001 and on

NOTE 6. The Model 406 type design has been duplicated as Model F406 in Type Certificate No. A54EU. The type design file is common between Models 406 and F406 and duplicates of the type design file are maintained by the respective type certificate holders.

....END....

TYPES

OF

INSPECTION

ROUTINE/REQUIRED INSPECTIONS

➢ AIRWORTHINESS REGULATION BASIS:

✓ Responsibility of the pilot in command:

- inspect the aircraft before each flight to determine whether the aircraft is in condition for safe flight.

✓ Responsibility of maintenance technicians:

- conduct more detailed inspections at least once each 12 calendar months,
- conduct other required inspection after each 100 hours of flight.
- inspect the aircraft in accordance with a system set up to provide for total inspection of the aircraft over a calendar or flight time period.

PREFLIGHT/POSTFLIGHT INSPECTIONS

- when operating aircraft, pilots are required to follow a checklist contained within the Pilot's Operating Handbook (POH), which includes:
  - ✓ Preflight Inspection:
    - "walk-around" visually check. (such as fuel, oil and other items required for flight)
    - review the airworthiness certificate, maintenance records, and other required paperwork to verify that the aircraft is indeed airworthy.
  - ✓ Postflight Inspection:
    - recomended to be conducted by pilot or mechanic after each flight (to detect any problems that might require repair or servicing before the next flight).

ANNUAL/100-HOUR INSPECTIONS

- **Basic requirements for annual and 100-hour inspections:**
  - ✓ **FAR/CASR part 91**
- **Scope and detail of items:**
  - ✓ **Appendix D of FAR/CASR part 43:**
    - **to be conducted by a certified airframe and powerplant maintenance technician.**
    - **overflight condition:**

      an aircraft may only be flown up to 10 hours beyond the 100-hour limit if necessary to fly to a destination where the inspection is to be conducted.

Appendix D to Part 43—Scope and Detail of Items (as Applicable to the Particular Aircraft) To Be Included in Annual and 100-Hour Inspections

(a) Each person performing an annual or 100-hour inspection shall, before that inspection, remove or open all necessary inspection plates, access doors, fairing, and cowling. He shall thoroughly clean the aircraft and aircraft engine.

(b) Each person performing an annual or 100-hour inspection shall inspect (where applicable) the following components of the fuselage and hull group:

(1) Fabric and skin—for deterioration, distortion, other evidence of failure, and defective or insecure attachment of fittings.

(2) Systems and components—for improper installation, apparent defects, and unsatisfactory operation.

(3) Envelope, gas bags, ballast tanks, and related parts—for poor condition.

(c) Each person performing an annual or 100-hour inspection shall inspect (where applicable) the following components of the cabin and cockpit group:

(1) Generally—for uncleanliness and loose equipment that might foul the controls.

(2) Seats and safety belts—for poor condition and apparent defects.

(3) Windows and windshields—for deterioration and breakage.

(4) Instruments—for poor condition, mounting, marking, and (where practicable) improper operation.

(5) Flight and engine controls—for improper installation and improper operation.

(6) Batteries—for improper installation and improper charge.

(7) All systems—for improper installation, poor general condition, apparent and obvious defects, and insecurity of attachment.

(d) Each person performing an annual or 100-hour inspection shall inspect (where applicable) components of the engine and nacelle group as follows:

(1) Engine section—for visual evidence of excessive oil, fuel, or hydraulic leaks, and sources of such leaks.

(2) Studs and nuts—for improper torquing and obvious defects.

(3) Internal engine—for cylinder compression and for metal particles or foreign matter on screens and sump drain plugs. If there is

weak cylinder compression, for improper internal condition and improper internal tolerances.

(4) Engine mount—for cracks, looseness of mounting, and looseness of engine to mount.

(5) Flexible vibration dampeners—for poor condition and deterioration.

(6) Engine controls—for defects, improper travel, and improper safetying.

(7) Lines, hoses, and clamps—for leaks, improper condition, and looseness.

(8) Exhaust stacks—for cracks, defects, and improper attachment.

(9) Accessories—for apparent defects in security of mounting.

(10) All systems—for improper installation, poor general condition, defects, and insecure attachment.

(11) Cowling—for cracks and defects.

(e) Each person performing an annual or 100-hour inspection shall inspect (where applicable) the following components of the landing gear group:

(1) All units—for poor condition and insecurity of attachment.

(2) Shock absorbing devices—for improper oleo fluid level.

(3) Linkages, trusses, and members—for undue or excessive wear fatigue, and distortion.

(4) Retracting and locking mechanism—for improper operation.

(5) Hydraulic lines—for leakage.

(6) Electrical system—for chafing and improper operation of switches.

(7) Wheels—for cracks, defects, and condition of bearings.

(8) Tires—for wear and cuts.

(9) Brakes—for improper adjustment.

(10) Floats and skis—for insecure attachment and obvious or apparent defects.

(f) Each person performing an annual or 100-hour inspection shall inspect (where applicable) all components of the wing and center section assembly for poor general condition, fabric or skin deterioration, distortion, evidence of failure, and insecurity of attachment.

(g) Each person performing an annual or 100-hour inspection shall inspect (where applicable) all components and systems that make up the complete empennage assembly for poor general condition, fabric or skin deterioration, distortion, evidence of failure, insecure attachment, improper component installation, and improper component operation.

(h) Each person performing an annual or 100-hour inspection shall inspect (where applicable) the following components of the propeller group:

(1) Propeller assembly—for cracks, nicks, binds, and oil leakage.

(2) Bolts—for improper torquing and lack of safetying.

(3) Anti-icing devices—for improper operations and obvious defects.

(4) Control mechanisms—for improper operation, insecure mounting, and restricted travel.

(i) Each person performing an annual or 100-hour inspection shall inspect (where applicable) the following components of the radio group:

(1) Radio and electronic equipment—for improper installation and insecure mounting.

(2) Wiring and conduits—for improper routing, insecure mounting, and obvious defects.

(3) Bonding and shielding—for improper installation and poor condition.

(4) Antenna including trailing antenna—for poor condition, insecure mounting, and improper operation.

(j) Each person performing an annual or 100-hour inspection shall inspect (where applicable) each installed miscellaneous item that is not otherwise covered by this listing for improper installation and improper operation.

PROGRESSIVE INSPECTIONS

- A progressive inspection program allows an aircraft to be inspected progressively.
- Require approval by the DGCA/FAA Administrator.
- Each owner or operator of an aircraft must submit a written request to the FAA/DGCA. CASR/FAR part 91, 91.409(d) establishes procedures to be followed for progressive inspections.
- Designed to minimize down time (because the scope and detail of an annual inspection is very extensive and could keep an aircraft out of service for a considerable length of time):
  - ✓ The scope and detail of an annual inspection is essentially divided into segments or phases.
  - ✓ Completion of all the phases completes a cycle (that satisfies the requirements of an annual inspection).

PROGRESSIVE INSPECTIONS (Cont'd)

- **A cycle must be completed within 12 months:**
  - ✓ If all required phases are not completed within 12 months:
    - the remaining phase must be conducted before the end of the 12th month from when the first phase was completed.
- **Include:**
  - ✓ routine items (such as engine oil changes):
    - accomplished each time the aircraft comes in for a phase inspection.

    and
  - ✓ detailed items (such as flight control cable inspection):
    - typically done once each cycle.
- **The advantage:**
  - ✓ enable the aircraft to fly daily without missing any revenue earning potential. (any required segment may be completed overnight)

§91.409 Inspections.

(d) **Progressive inspection.** Each registered owner or operator of an aircraft desiring to use a progressive inspection program must submit a written request to the FAA Flight Standards district office having jurisdiction over the area in which the applicant is located, and shall provide—

(1) A certificated mechanic holding an inspection authorization, a certificated airframe repair station, or the manufacturer of the aircraft to supervise or conduct the progressive inspection;

(2) A current inspection procedures manual available and readily understandable to pilot and maintenance personnel containing, in detail—

(i) An explanation of the progressive inspection, including the continuity of inspection responsibility, the making of reports, and the keeping of records and technical reference material;

(ii) An inspection schedule, specifying the intervals in hours or days when routine and detailed inspections will be performed and including instructions for exceeding an inspection interval by not more than 10 hours while en route and for changing an inspection interval because of service experience;

(iii) Sample routine and detailed inspection forms and instructions for their use; and

(iv) Sample reports and records and instructions for their use;

(3) Enough housing and equipment for necessary disassembly and proper inspection of the aircraft; and

(4) Appropriate current technical information for the aircraft.

The frequency and detail of the progressive inspection shall provide for the complete inspection of the aircraft within each 12 calendar months and be consistent with the manufacturer's recommendations, field service experience, and the kind of operation in which the aircraft is engaged. The progressive inspection schedule must ensure that the aircraft, at all times, will be airworthy and will conform to all applicable FAA aircraft specifications, type certificate data sheets, airworthiness directives, and other approved data. If the progressive inspection is discontinued, the owner or operator shall immediately notify the local FAA Flight Standards district office, in writing, of the discontinuance. After the discontinuance, the first annual inspection under §91.409(a)(1) is due within 12 calendar months after the last complete inspection of the aircraft under the progressive inspection. The 100-hour inspection under §91.409(b) is due within 100 hours after that complete inspection. A complete inspection of the aircraft, for the purpose of determining when the annual and 100-hour inspections are due, requires a detailed inspection of the aircraft and all its components in accordance with the progressive inspection. A routine inspection of the aircraft and a detailed inspection of several components is not considered to be a complete inspection.

CONTINUOUS INSPECTIONS

- Similar to progressive inspection programs, except that they apply to large or turbine-powered aircraft.
- Require approval by the DGCA/FAA Administrator.
- must be detailed in the approved operations specifications (OpSpecs) of the commercial certificate holder.
- includes both routine and detailed inspections.
  - ✓ detailed inspections may include different levels of detail. Often referred to as "checks," the A-check, B-check, C-check, and D-checks involve increasing levels of detail.
  - ✓ A-checks are the least comprehensive and occur frequently.
  - ✓ D-checks, are extremely comprehensive, involving:
    - major disassembly, removal, overhaul, and inspection of systems and components.
    - might occur only three to six times during the service life of an aircraft.

MAINTENANCE

PROGRAM & SCHEDULE

SCHEDULED MAINTENANCE

- **Daily check:**
  - ✓ several common names:
    - post-flight, maintenance pre-flight, service check, and overnight check.
  - ✓ is the lowest scheduled check.
  - ✓ is a cursory inspection to look for obvious damage and deterioration.
  - ✓ for "general condition and security" and reviews the aircraft log for discrepancies and corrective action.
  - ✓ accomplished every 24 to 60 hours of accumulated flight time.
  - ✓ requires specific equipment, tools, or facilities.
  - ✓ Examples of check items include:
    - Visually inspect tail skid shock strut pop-up indicator
    - Check fluid levels
    - Check general security and cleanliness of the flight deck
    - Check that emergency equipment is installed

SCHEDULED MAINTENANCE

➢'A' check:

- ✓ is the next higher level of scheduled maintenance.
- ✓ is normally accomplished at a designated maintenance station in the route structure and includes the opening of access panels to check and service certain items.
- ✓ requires limited special tooling, servicing, and test equipment.
- ✓ check includes the lower check (i.e. Daily check).
- ✓ performed every 500 hours or monthly, whichever is sooner.
- ✓ Examples of 'A' check items include:
  - General external visual inspection of aircraft structure for evidence of damage, deformation, corrosion, missing parts
  - Check crew oxygen system pressure
  - Operationally check emergency lights
  - Lubricate nose gear retract actuator
  - Check parking brake accumulator pressure
  - Perform Built-in Test Equipment (BITE) test of Flap/Slat Electronics Unit

SCHEDULED MAINTENANCE

- 'B' check:
  - ✓ is a slightly more detailed check of components and systems.
  - ✓ Special equipment and tests may be required.
  - ✓ does not involve, detailed disassembly or removal of components.
  - ✓ not as common these days.
  - ✓ not use on contemporary maintenance programs. (The tasks have been distributed between the 'A' and 'C' check).

SCHEDULED MAINTENANCE

- **HEAVY CHECKS:**
  - **normally accomplished at the main maintenance base of the airline where specialized manpower, materials, tooling, and hangar facilities are available:**
  - **Include:**
    - ✓ **'C' check, and**
    - ✓ **'D' checks**

SCHEDULED MAINTENANCE

➢'C' check:

- ✓ is an extensive check of individual systems and components for serviceability and function.
- ✓ requires a thorough visual inspection of specified areas, components and systems as well as operational or functional checks.
- ✓ is a high-level check that involves extensive tooling, test equipment, and special skill levels.
- ✓ requires 3 to 5 days to remove the aircraft from its revenue schedule.
- ✓ includes the lower checks (i.e. 'A,' 'B,' and Daily checks).
- ✓ Examples of 'C' check items:
  - Visually check flight compartment escape ropes for condition and security
  - Check operation of DC bus tie control unit
  - Visually check the condition of entry door seals
  - Operationally check flap asymmetry system
  - Pressure decay check APU fuel line shroud
  - Inspect engine inlet ducting for cracks
  - Operationally check RAT deployment

SCHEDULED MAINTENANCE

➢'D' check:

- ✓ referred to as the Structural check.
- ✓ includes detailed visual and other non-destructive test inspections of the aircraft structure.
- ✓ is an intense inspection of the structure for evidence of corrosion, structural deformation, cracking, and other signs of deterioration or distress and involves extensive disassembly to gain access for inspection.
- ✓ Special equipment and techniques are used.
- ✓ Structural checks are man-hour and calendar-time intensive.
- ✓ includes the lower checks, i.e. 'A,' 'B,' 'C,' and Daily checks.
- ✓ can take 20 or more days include all aspects of the lower checks.
- ✓ Examples of 'D' check items include:
  - Inspect stabilizer attach bolts
  - Inspect floor beams
  - Detailed inspection of wing box structure

ALTIMETER & TRANSPONDER INSPECTIONS

- **Required for:**
  - ✓ **Aircraft operated in controlled airspace under instrument flight rules (IFR):**
    - each altimeter and static system must be tested in accordance with procedures described in CASR/FAR part 43, appendix E, within the preceding 24 calendar months.
    - each air traffic control (ATC) transponder must be checked within the preceding 24 months.
- **All Altimeter & Transponder checks must be conducted by appropriately certified individuals.**

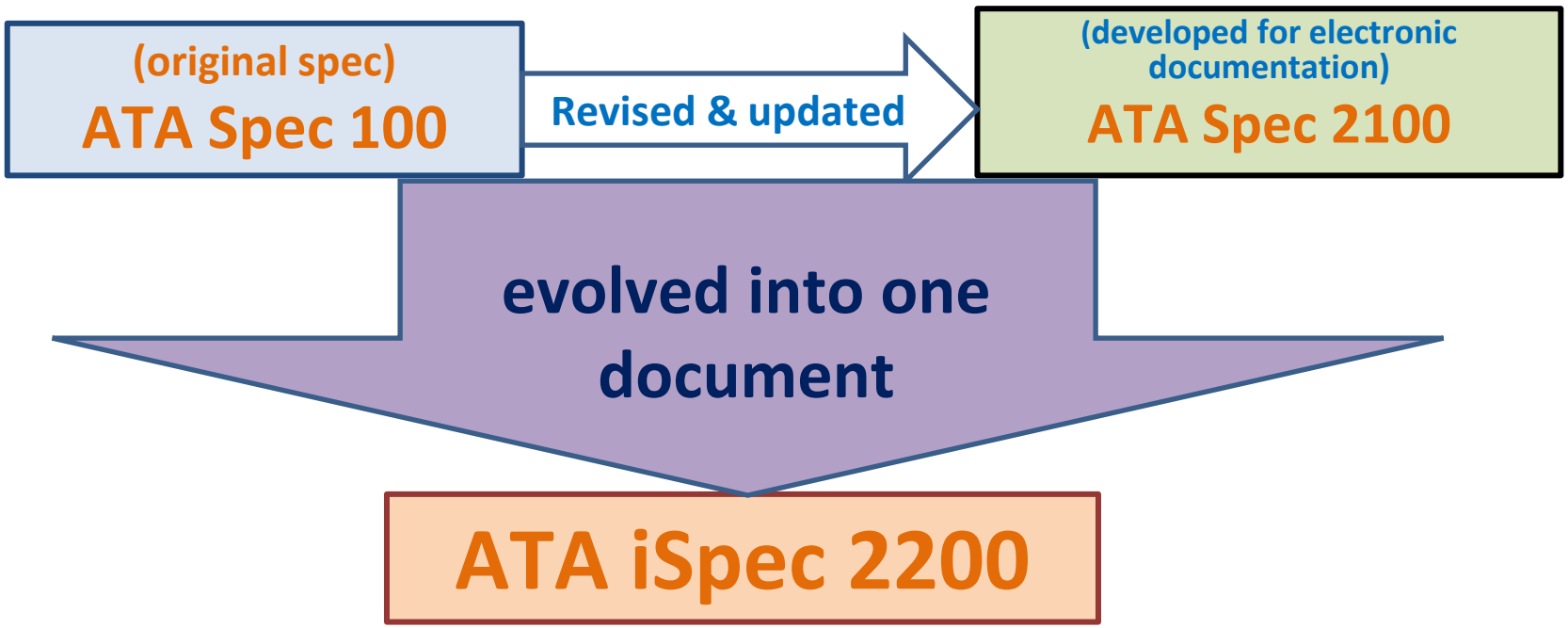
ATA

(Air Transport Association)

SPECIFICATION

ATA Spec

Air Transport Association of America (ATA) issued specifications for Manufacturers Technical Data.



ATA Specification 100 Systems

Sys.	*Title*
01	GENERAL
02	MAINTENANCE POLICY
03	OPERATIONS
04	SUPPORT
05	AIRWORTHINESS LIMITATIONS
06	TIME LIMITS/MAINTENANCE CHECKS
07	DIMENSIONS AND AREAS
08	LEVELING AND WEIGHING
09	TOWING AND TAXIING
10	PARKING, MOORING, STORAGE AND RETURN TO SERVICE

ATA Specification 100 Systems (Cont'd)

Sys.	*Title*
11	PLACARDS AND MARKINGS
12	SERVICING
13	HARDWARE AND GENERAL TOOLS
15	AIRCREW INFORMATION
16	CHANGE OF ROLE
18	LEVELING AND WEIGHING
20	STANDAR PRACTICE AIRFRAME

ATA Specification 100 Systems (Cont'd)

Sys.	*Sub.*	*Title*
21		AIR CONDITIONING
21	00	General
21	10	Compression
21	20	Distribution
21	30	Pressurization Control
21	40	Heating
21	50	Cooling
21	60	Temperature Control
21	70	Moisture/Air Contaminate Control

ATA Specification 100 Systems (Cont'd)

Sys.	*Title*
22	AUTO FLIGHT
23	COMMUNICATIONS
24	ELECTRICAL POWER
25	EQUIPMENT/FURNISHINGS
26	FIRE PROTECTION
27	FLIGHT CONTROLS
28	FUEL
29	HYDRAULIC POWER
30	ICE AND RAIN PROTECTION
31	INDICATING/RECORDING SYSTEMS
32	LANDING GEAR
33	LIGHTS
34	NAVIGATION

ATA Specification 100 Systems (Cont'd)

Sys.	*Title*
35	OXYGEN
36	PNEUMATIC
37	VACUUM/PRESSURE
38	WATER/WASTE
39	ELECTRICAL/ELECTRONIC PANELS AND MULTIPURPOSE COMPONENTS
49	AIRBORNE AUXILIARY POWER
51	STRUCTURES
52	DOORS
53	FUSELAGE
54	NACELLES/PYLONS
55	STABILIZERS
56	WINDOWS
57	WINGS
61	PROPELLERS
65	ROTORS

ATA Specification 100 Systems (Cont'd)

Sys.	*Title*
71	POWERPLANT
72	(T)TURBINE/TURBOPROP
72	(R) ENGINE RECIPROCATING
73	ENGINE FUEL AND CONTROL
74	IGNITION
75	BLEED AIR
76	ENGINE CONTROLS
77	ENGINE INDICATING
78	ENGINE EXHAUST
79	ENGINE OIL
80	STARTING
81	TURBINES (RECIPROCATING ENG)
82	WATER INJECTION
83	REMOTE GEAR BOXES (ENG DR)

ATA Specification 100 Systems (Cont'd)

Sys.	*Title*
84	PROPULSION AUGMENTATION
85	FUEL CELL SYSTEMS
91	CHARTS
97	WIRING REPORTING
92	ELECTRICAL POWER MULTIPLEXING
93	SURVEILLANCE
94	WEAPON SYSTEM
95	CREW ESCAPE AND SAFETY
96	MISSILES, DRONES AND TELEMETRY
98	METEOROLOGICAL AND ATMOSPHERIC RESEARCH
99	ELECTRONIC WARFARE SYSTEM

SPECIAL INSPECTIONS

SPECIAL INSPECTIONS

- **Conducted when out of the ordinary care and use of an aircraft might happen, such as:**
  - ✓ Hard or Overweight Landing Inspection.
  - ✓ Severe Turbulence Inspection/Over “G”.
  - ✓ Lightning Strike.
  - ✓ Fire Damage.
  - ✓ Flood Damage.
  - ✓ Seaplanes.
  - ✓ Aerial Application Aircraft.

SPECIAL INSPECTIONS

➢ Severe Turbulence Inspection/Over "G":

an aircraft encounters **a gust condition.**

→ **airload on the wings exceeds normal wingload** supporting the aircraft weight.

→
- gust tends to **accelerate the aircraft** while
- its **inertia acts to resist this change.**

If **combination of gust velocity and airspeed is too severe.**

→ the **induced stress** can cause **structural damage.**

Severe Turbulence Inspection/Over "G"

- **inspect the critical areas, such as:**
  - ✓ the upper and lower wing surfaces for excessive buckles or wrinkles with permanent set.
    - Where wrinkles have occurred:
      - remove a few rivets and examine the rivet shanks to determine if the rivets have sheared or were highly loaded in shear.
  - ✓ all spar webs from the fuselage to the tip:
    - check for buckling, wrinkles, and sheared attachments.
    - buckling in the area around the nacelles and in the nacelle skin, particularly at the wing leading edge.
    - check for fuel leaks.
  - ✓ the surface of the empennage for wrinkles, buckling, or sheared attachments (the area of attachment of the empennage to the fuselage).

- **If the landing gear was lowered during, inspect:**
  - ✓ the surrounding surfaces carefully for loose rivets, cracks, or buckling.
  - ✓ interior of the wheel well may give further indications of excessive gust conditions.
  - ✓ the top and bottom fuselage skin. (excessive bending moment may have left wrinkles of a diagonal nature in these areas).

Lightning Strike

- **After striked by lightning, the following visual inspection is required:**
  - ✓ **For metallic structures:**
    - **the aircraft's static discharge wicks, or on more sophisticated aircraft, null field dischargers.**
  - ✓ **For non-metallic structures:**
    - **such as a fiberglass radome, engine cowl or fairing, glass or plastic window, or a composite structure that does not have built-in electrical bonding, burning and more serious damage to the structure could occur.**
      (Look for evidence of degradation, burning or erosion of the composite resin at all affected structures, electrical bonding straps, static discharge wicks and null field dischargers)

Fire Damage

- **METALIC STRUCTURE** (that have undergone some sort of heat treatment process during manufacture):
  - ✓ If exposure to high heat could severely degrade the design strength of the structure.
  - ✓ The strength of an aluminum structure, that passes a visual inspection but is still suspect can be further determined by use of a conductivity tester (uses eddy current).
  - ✓ Strength of metals is related to hardness, (therefor might be determined by use of a hardness tester such as a Rockwell C hardness tester).

Flood Damage

- Can range from minor to severe, depending on
  - ✓ the level of the flood water,
  - ✓ Was it fresh or salt water, and
  - ✓ the elapsed time between the flood occurrence and when repairs were initiated.
- Any parts that were totally submerged should be completely disassembled, thoroughly cleaned, dried and treated with a corrosion inhibitor.
- Parts might have to be replaced:
  - ✓ particularly interior carpeting, seats, side panels, and instruments.
- Since water serves as an electrolyte that promotes corrosion, all traces of water and salt must be removed before the aircraft can again be considered airworthy.

Seaplanes

- Must be carefully inspected for corrosion and conditions that promote corrosion.
- Inspect bilge areas for waste hydraulic fluids, water, dirt, drill chips, and other debris.
- Seaplanes often encounter excessive stress from the pounding of rough water at high speeds:
  - ✓ inspect for loose rivets and other fasteners; stretched, bent or cracked skins; damage to the float attach fitting; and general wear and tear on the entire structure.

Aerial Application Aircraft

- **Consider two primary important factors:**
  - ✓ the corrosive nature, and
  - ✓ the typical flight profile.
- **Metal aircraft may need to have the paint stripped, cleaned, and repainted and corrosion treated annually.**
- **Leading edges of wings and other areas may require protective coatings or tapes.**
- **can greatly accelerate the failure of normal fatigue items. (because fly up to 50 cycles or more in a day, most likely from an unimproved or grass runway):**
  - ✓ Landing gear and related items require frequent inspections.
- **Because operate almost continuously at very low altitudes:**
  - ✓ air filters tend to become obstructed more rapidly.

SPECIAL FLIGHT PERMITS

- referred to as ferry permits
- May be issued to:
  - ✓ aircraft that does not currently meet airworthiness requirements because:
    - of an overdue inspection, damage, expired replacement times for time-limited parts or other reasons, but is capable of safe flight.
- Ferry Permits may be issued for the following purposes:
  - Flying the aircraft to a base where repairs, alterations, or maintenance are to be performed, or to a point of storage.
  - Delivering or exporting the aircraft.
  - Production flight testing new production aircraft.
  - Evacuating aircraft from areas of impending danger.
  - Conducting customer demonstration flights in new production aircraft that have satisfactorily completed production flight tests.

NDI / NDT

(NONDESTRUCTIVE INSPECTION / TESTING)

NONDESTRUCTIVE INSPECTION / TESTING

- Refer as **NDI** (nondestructive inspection) or **NDT** (nondestructive testing)
- **Definition:**
  - ✓ The use of noninvasive techniques to determine the integrity of a material, component or structure, or
  - ✓ quantitatively measure some characteristic of an object.
- **The objective:**
  - ✓ to determine the airworthiness of a component without damaging it.
- **Methods:**
  - ✓ Simple method. (requiring little additional expertise).
  - ✓ High sophisticated method. (requires highly trained and specially certified technician).
- **References Information on NDI:**
  - ✓ chapter 5 of Advisory Circular (AC) 43.13-1B, Acceptable Methods, Techniques, and Practices—Aircraft Inspection.
  - ✓ Advisory Circular (AC) 65-31A, information regarding training, qualifications, and certification of NDI personnel.

NDI / NDT ON AIRCRAFT INSPECTION

➢ NDT is used:

extensively during the aircraft manufacturing.

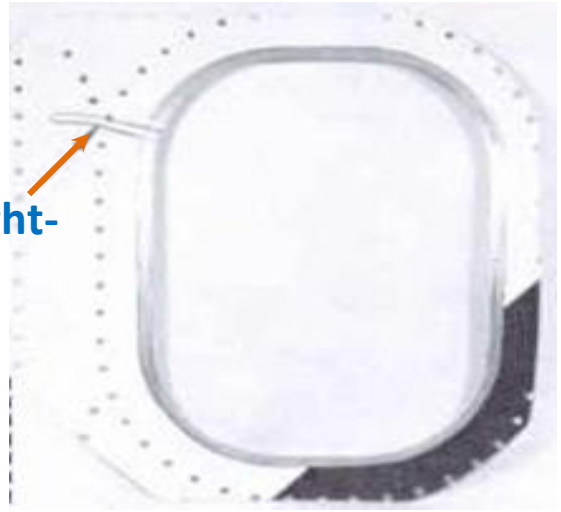
to find cracks and corrosion damage during operation of the aircraft.

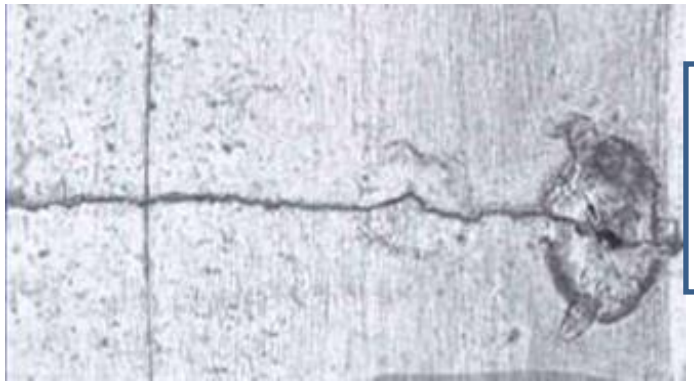
Aircraft Jet Engine Inspection:

- overhauled engines after being in service for a period of time.
- the engines are completely disassembled, cleaned, inspected and then reassembled.

NDI / NDT ON AIRCRAFT INSPECTION

Example of a fatigue crack that started at the site of a lightning strike is shown below.





sound proof blanket inside the hitted skin

NONDESTRUCTIVE INSPECTION / TESTING

Most Common NDT Methods:

- ✓ Visual (including boroscope)
- ✓ Liquid Penetrant
- ✓ Eddy Current
- ✓ Ultrasonic
- ✓ Magnetic
- ✓ Radiography (X-ray)

NONDESTRUCTIVE INSPECTION / TESTING (Cont'd)

- **Consist of:**
  - ✓ General Techniques
  - ✓ Visual Inspection
  - ✓ Borescope
  - ✓ Liquid Penetrant Inspection
  - ✓ Eddy Current Inspection
  - ✓ Ultrasonic Inspection
  - ✓ Acoustic Emission Inspection
  - ✓ Magnetic Particle Inspection
  - ✓ Magnetizing Equipment
  - ✓ Radiographic Inspection

General Techniques

- **Preparatory steps before conducting NDI:**
  - ✓ Generally, the parts or areas to be inspected must be thoroughly cleaned.
  - ✓ Some parts may have to be removed from the aircraft or engine.
  - ✓ Other parts might need to have any paint or protective coating stripped.
  - ✓ Calibration and inspection of the equipment must be current.
  - ✓ A complete knowledge of the equipment and procedures is essential.

Visual Inspection

- **Is the most basic and common inspection method.**
- **Tools to be used for the inspection:**
  - ✓ Bright light,
  - ✓ Boroscopes,
  - ✓ Magnifying glass, and
  - ✓ Mirror (when required).
- **Considerations:**
  - ✓ Some defects could not be detected visually.
    (defects that lie beneath the surface or too small)
  - ✓ lack of visible defects may require further inspection.

Borescope

- is categorized a visual inspection.
- is a device used to see inside areas that could not otherwise be inspected without disassembly.
  - ✓ Examples:
    - the inside of a reciprocating engine cylinder. (borescope can be inserted into an open spark plug hole)
    - the hot section of a turbine engine. (access could be gained through the hole of a removed igniter or removed access plugs)
- includes a light to illuminate the area being viewed.
- available in two basic configurations:
  - ✓ The rigid type, consist of a small diameter telescope with a tiny mirror at the end that enables the user to see around corners.
  - ✓ The flexible type uses fiber optics that enables greater flexibility.
- Many borescopes provide displayed image (on a computer or video monitor) for:
  - ✓ better interpretation of what is being viewed, and
  - ✓ to record images for future reference.

LIQUID PENETRANT

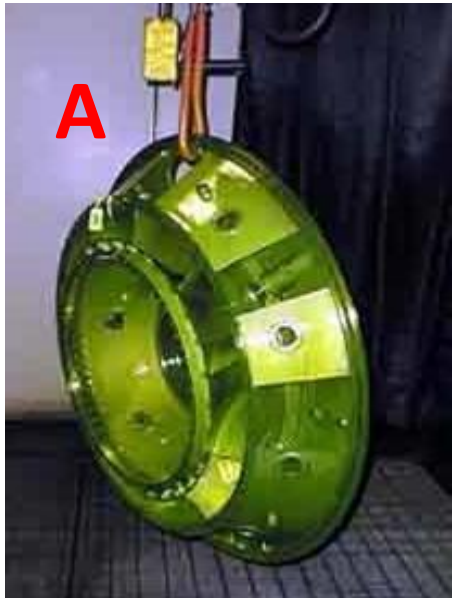
INSPECTION

Liquid Penetrant Inspection

- Is a nondestructive test for open defects surface of any nonporous material.
- Used for:
  - ✓ metal: aluminum, magnesium, brass, copper, cast iron, stainless steel, and titanium.
  - ✓ non metal: ceramics, plastics, molded rubber, and glass.
- Detect such defects as surface cracks or porosity caused by:
  - ✓ fatigue cracks, shrinkage cracks, shrinkage porosity, cold shuts, grinding and heat treat cracks, seams, forging laps, and bursts.
- Also indicate a lack of bond between joined metals.
- The tools / materials generally used for this inspection are:
  - ✓ Dye penetrant (to increase visibility), and
  - ✓ Light assembly (to illuminate the inspected area)
- The penetrating liquid is used to increase visibility of the defect because the liquid enters the opened surface and remains there.

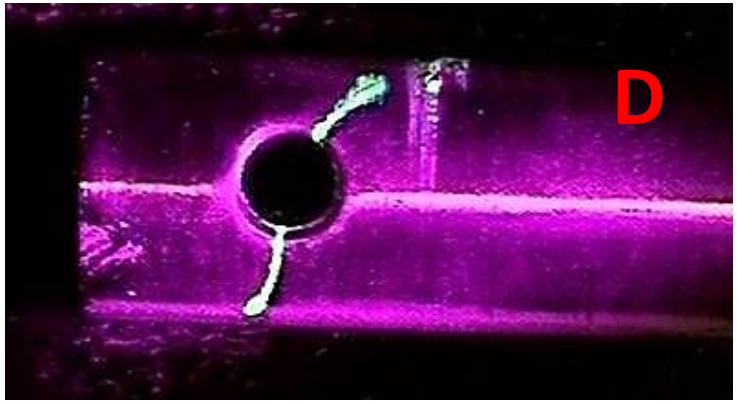
Liquid Penetrant Inspection (Cont'd)

- **BASIC PRINCIPLES:**
  - A. A liquid with high surface wetting characteristics is applied to the surface of the part and allowed time to seep into surface breaking defects.
  - B. The excess liquid is removed from the surface of the part.
  - C. A developer is applied to pull the trapped penetrant out the defect and spread it on the surface where it can be seen.



Liquid Penetrant Inspection (Cont'd)

- **BASIC PRINCIPLES (Cont,d):**
  - D. Visual inspection is the final step in the process. The penetrant used is often loaded with a fluorescent dye and the inspection is done under UV light to increase test sensitivity.



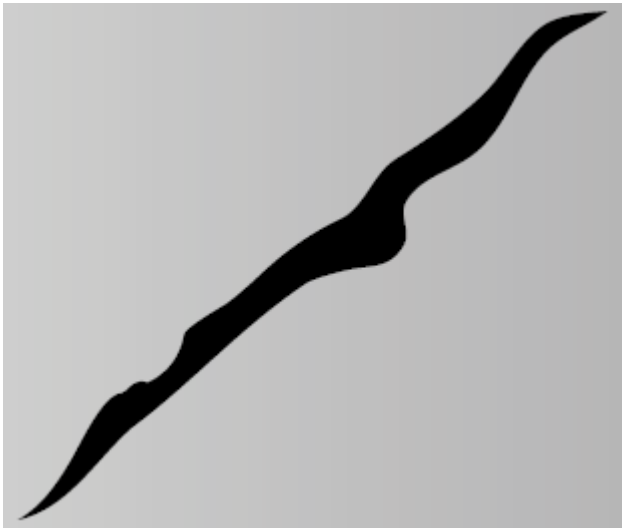
Liquid Penetrant Inspection (Cont'd)

- **Visibility of the penetrating material can be increased by the addition of:**
  - ✓ visible dye type, or
  - ✓ fluorescent dye type.
- **Main disadvantage:**
  - ✓ the defect must be open to the surface in order to let the penetrant get into the defect. (if the part is made of magnetic material, it is recomended to use magnetic particle inspection)
- **Visible Penetrant Kit consists of:**
  - ✓ dye penetrant, dye remover emulsifier, and developer.
- **Fluorescent Penetrant Inspection Kit contains of:**
  - ✓ a black light assembly, as well as spray cans of penetrant, cleaner, and developer.
- **Light Assembly consists of:**
  - ✓ a power transformer, a flexible power cable, and a hand-held lamp.

Liquid Penetrant Inspection (Cont'd)

Types of defects

Pits of porosity



Crack or similar opening

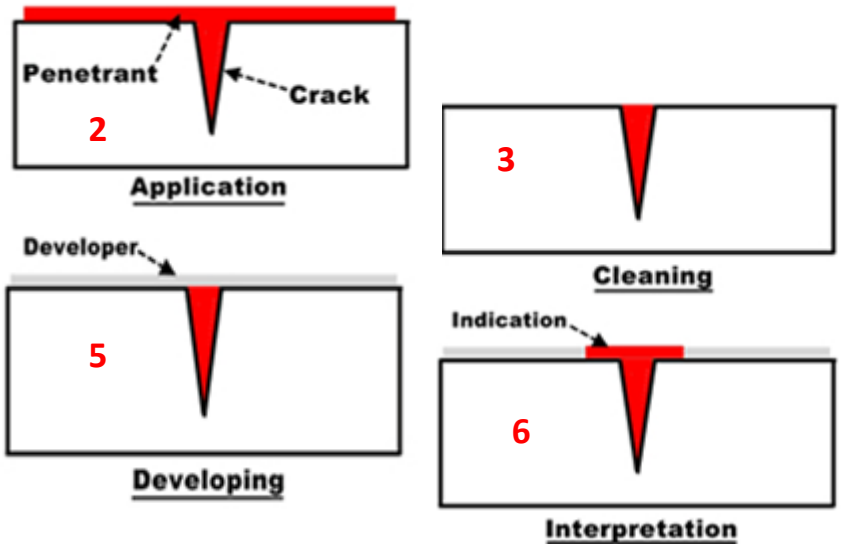
Tight crack or partially welded lap

Liquid Penetrant Inspection (Cont'd)

Fluorescence Dye Type

- **Fluorescence** is the emission of light by a substance that has absorbed light or other electromagnetic radiation.

- **Steps** for performing a penetrant inspection:
  1. Thorough cleaning of the metal surface.
  2. Applying penetrant.
  3. Removing penetrant with remover emulsifier or cleaner.
  4. Drying the part.
  5. Applying the developer.
  6. Inspecting and interpreting results.



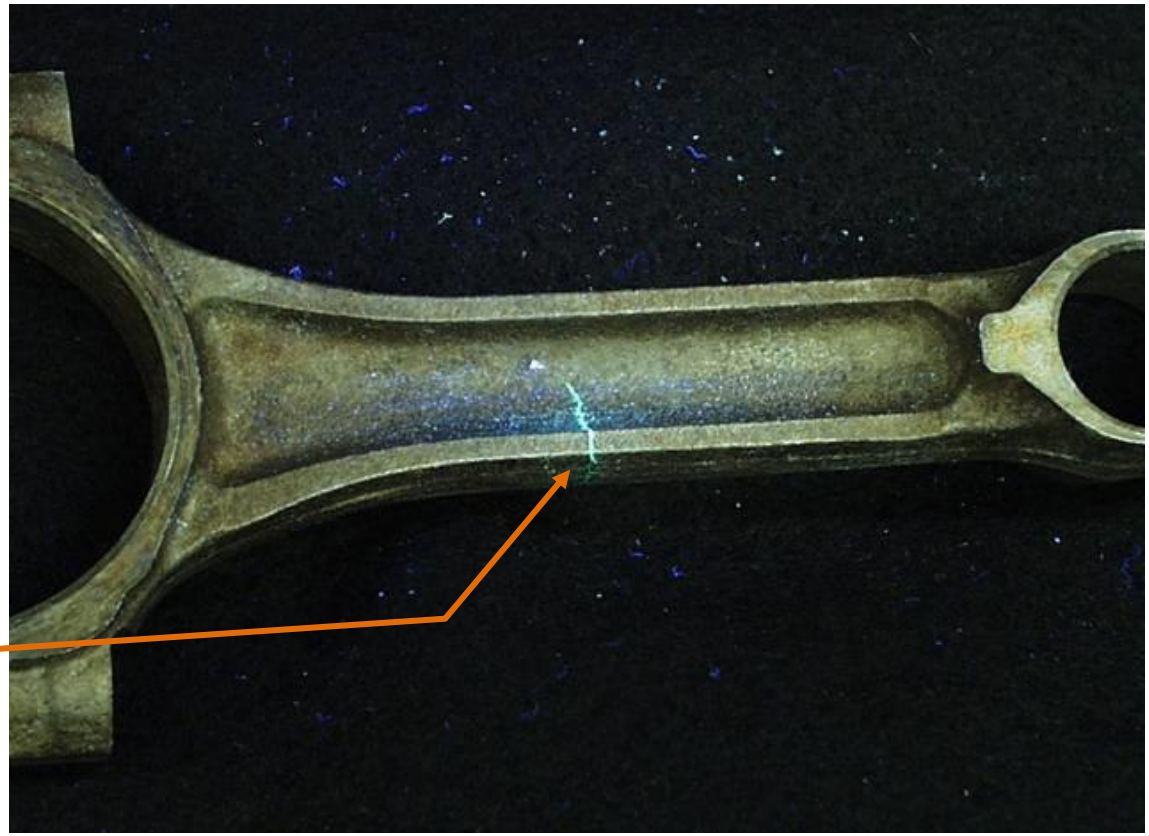
- **NOTE:**

  success and reliability of a penetrant inspection depends upon the thoroughness with which the part was prepared.

Liquid Penetrant Inspection (Cont'd)

Fluorescence Dye Type

Fluorescent penetrant indication on a connecting rod of a piston engine



Liquid Penetrant Inspection (Cont'd)

- ***Interpretation of Results***
  - ✓ **basic principles:**
    1. The penetrant must be free to enter and fill the defect.
       (the defect must be clean and free of contaminating materials).
    2. If all penetrant is washed out of a defect, an indication cannot be formed.
       (During the washing or rinsing operation, prior to development, it is possible that the penetrant will be removed from within the defect, as well as from the surface)
    3. Clean cracks are usually easy to detect.
    4. The smaller the defect, the longer the penetrating time.
    5. If part to be inspected is susceptible to magnetism, it should be inspected by a MPI method.
    6. When using visible penetrant-type developer. As the developer dries, bright red indication appears on the defects.
    7. When using fluorescent penetrant-type inspection. The defects will show up (under black light) as a brilliant yellow-green color and the sound areas will appear deep blue-violet.
    8. Examine the indication of all defect and determine its cause as well as its extent.

NOTE:

Deep cracks will hold more penetrant and will be broader and more brilliant.

Liquid Penetrant Inspection (Cont'd

False Indications:

- no false indications (as occurs in MPI).
- there are two conditions in which caused by accumulations of penetrant that are sometimes confused with true surface cracks and discontinuities:
  - ✓ False indications caused by poor washing:
    - the part should be completely reprocessed.
    - Degreasing is recommended for removal of all traces of the penetrant.
  - ✓ False Indications created where parts press fit to each other:
    - Example: If a wheel is press fit onto a shaft, penetrant will show an indication at the fit line.
    - this type of false indication are easy to identify. (because they are regular in form and shape)

EDDY CURRENT

INSPECTION

Eddy Current Inspection

- The process involves electric fields made to explore a test piece for various conditions, involves the transmission of energy through the specimen much like the transmission of x-rays, heat, or ultrasound.
- can be performed without removing the surface coatings (such as primer, paint, and anodized films).
- effective in detecting surface and subsurface corrosion, pots and heat treat condition.

Eddy Current Inspection (Cont'd)

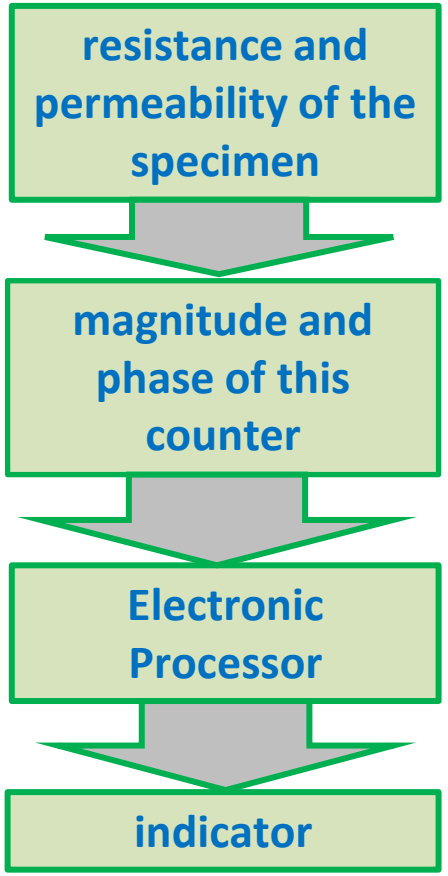
- is a broad spectrum of electronic test methods involving the intersection of magnetic fields and circulatory currents.
- Eddy currents are composed of free electrons under the influence of an induced electromagnetic field which are made to "drift" through metal.
- used to inspect:
  - ✓ jet engine turbine shafts and vanes,
  - ✓ wing skins, wheels, bolt holes, and
  - ✓ spark plug bores

  for cracks, heat or frame damage.
  - ✓ in aircraft manufacturing plants:
    - used to inspect castings, stampings, machine parts, forgings, and extrusions.
- Measuring principle:
  - ✓ A difference in readings indicates a difference in the hardness state of the affected area. (Different meter readings will be seen when the same metal is in different hardness states. Readings in the affected area are compared with identical materials in known unaffected areas for comparison)

Eddy Current Inspection (Cont'd)

Basic Principles of Measurement

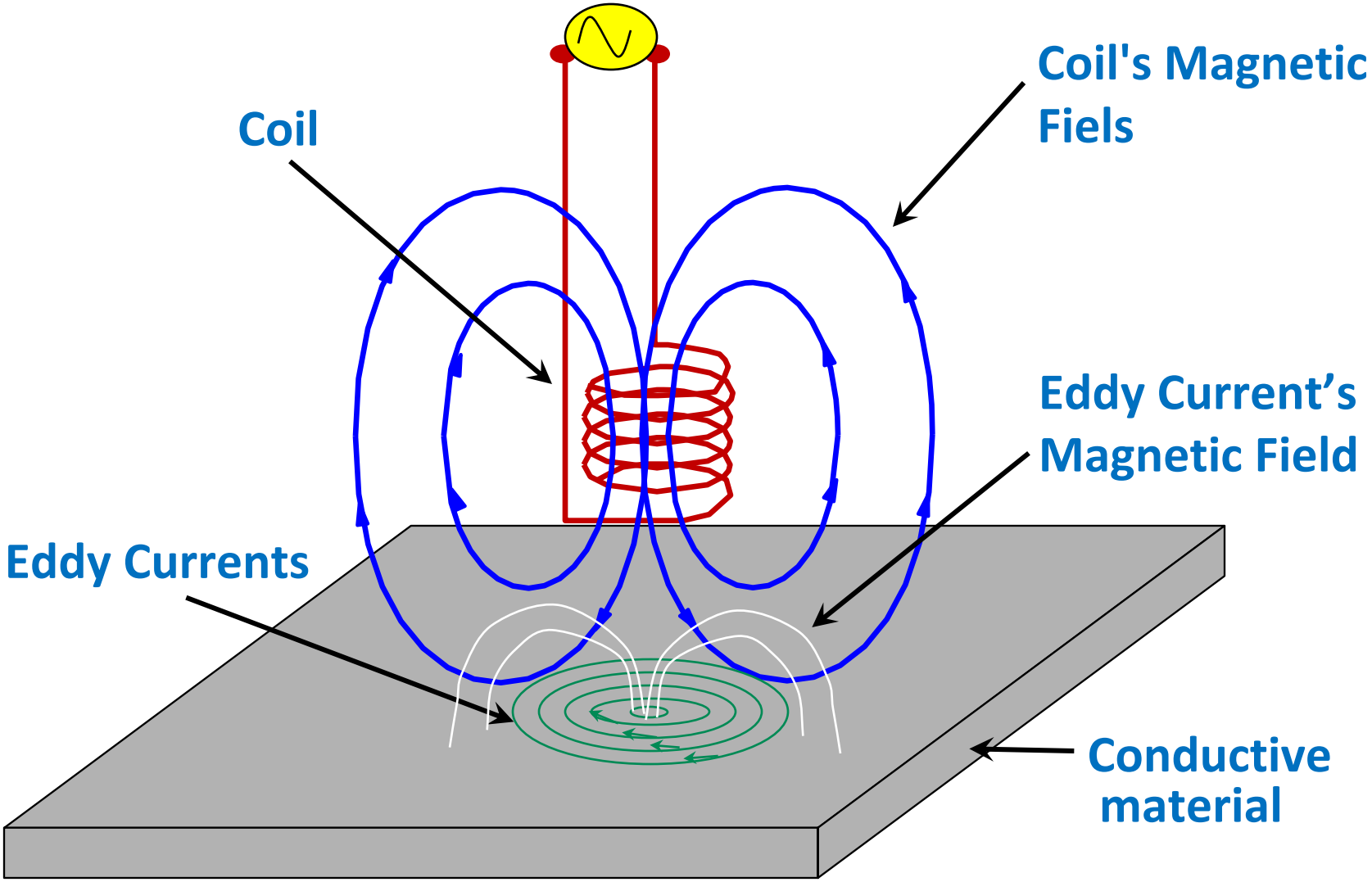
- ✓When an alternating current is passed through a coil, it develops a magnetic field around the coil, which in turn induces a voltage of opposite polarity in the coil and opposes the flow of original current.
- ✓If the coil is placed so that the magnetic field passes through an electrically conducting specimen, eddy currents will be induced into the specimen.
- ✓The eddy currents create their own field which varies the original field's opposition.
- ✓The eddy current depends on the specimen's susceptibility and determines the current flow through the coil.



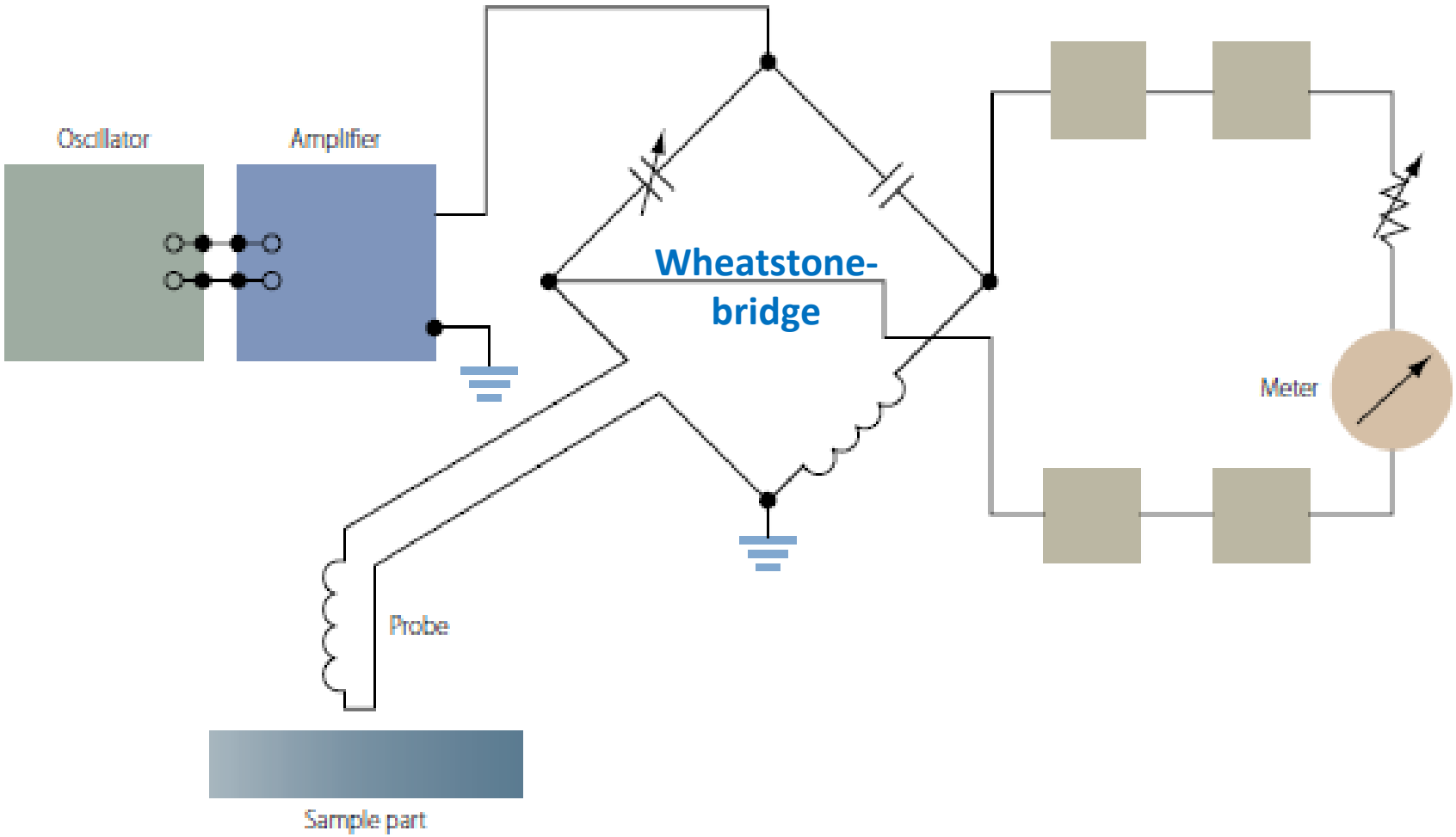
Interaction of the eddy current field with the original field results is a power change that can be measured by utilizing electronic circuitry similar to a Wheatstone bridge.

Eddy Current Inspection (Cont'd)

Eddy Current Testing



Eddy Current Inspection Circuit

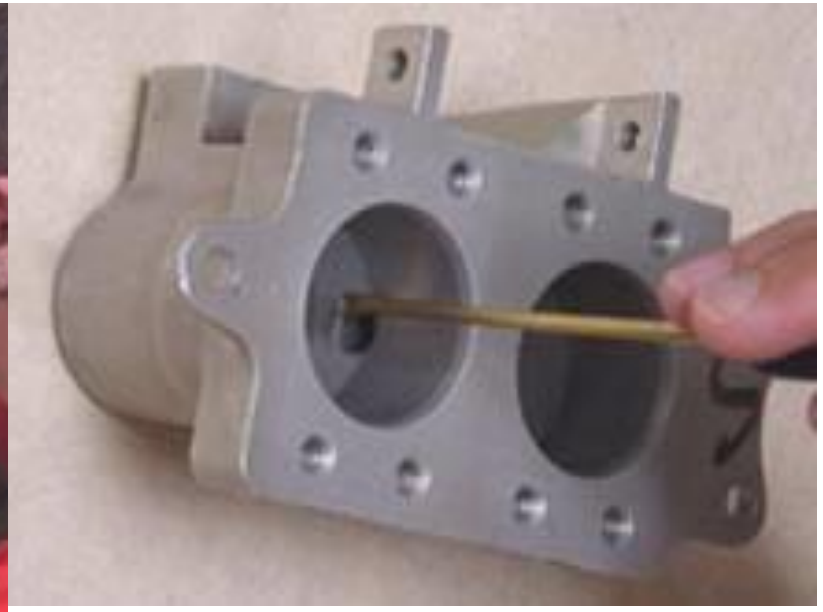


Eddy current inspection circuit.

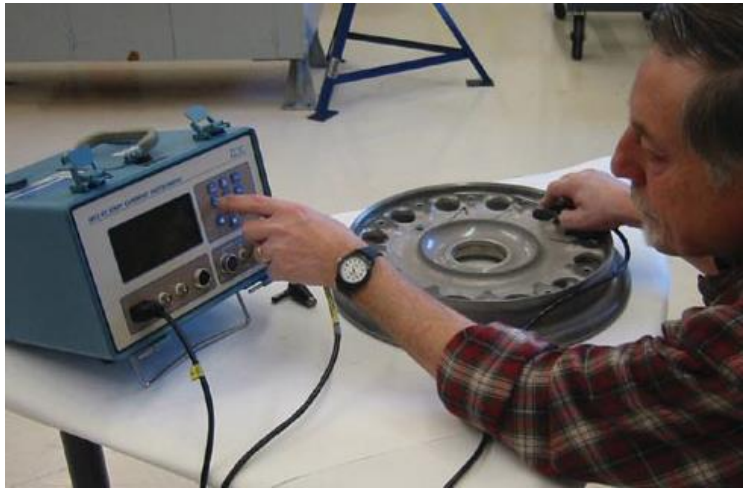
Eddy Current Inspection

technicians performing eddy current inspection.

a small surface probe is scanned over the part surface in an attempt to detect a crack.



on a cylinder of a piston compressor



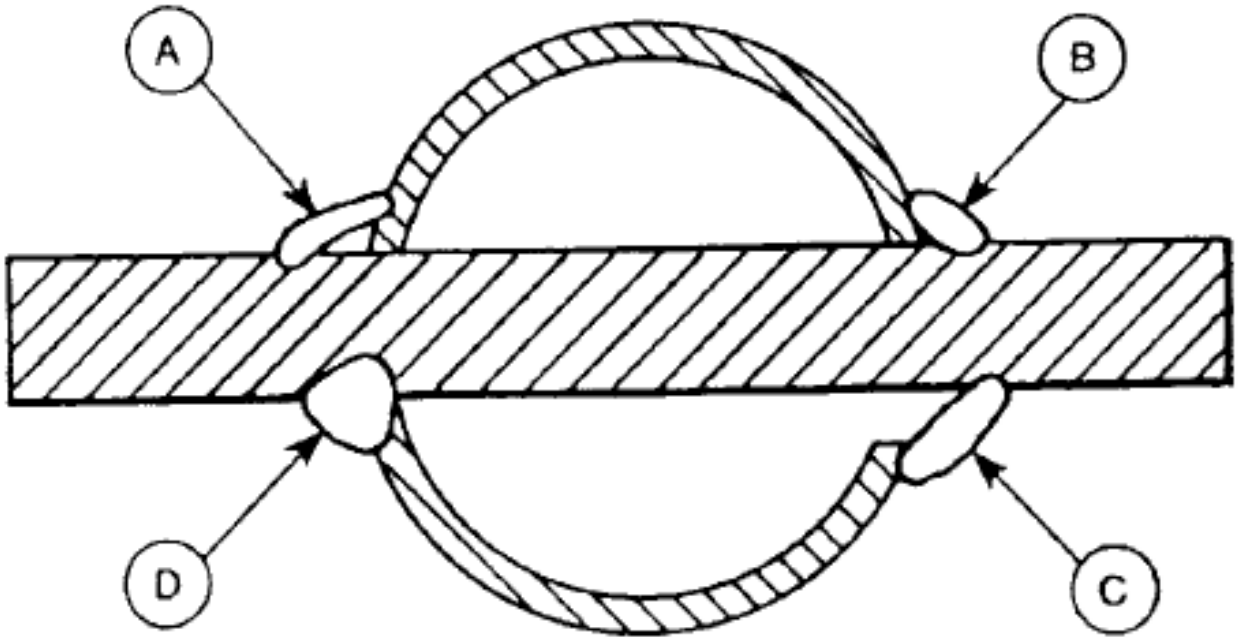
on an aluminum wheel half

ULTRASONIC

INSPECTION

EXAMPLE of DEFECTS on WELDED JOINTS

Common defects to avoid when fitting and welding aircraft certification cluster.



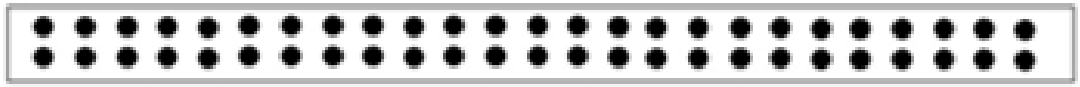
A. – INCOMPLETE ROOT PENETRATION
B. – INSUFFICIENT PENETRATION ON THICK PLATE
C. – POOR TUBE FIT AND POOR PENETRATION
D. – SATISFACTORY WELD

ULTRASONIC INSPECTION

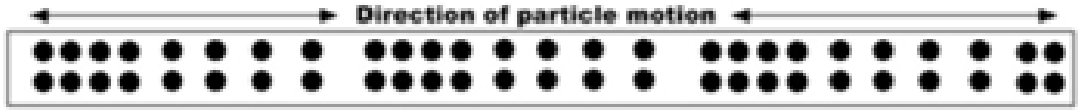
- Uses the same principle as is used in naval SONAR and fish finders.
- common sound frequencies are between 1.0 and 10.0 MHz, (could not be heard and do not travel through air):
  - ✓ The lower frequencies have greater penetrating power but less sensitivity (the ability to "see" small indications),
  - ✓ the higher frequencies don't penetrate as deeply but can detect smaller indications.
- Two commonly used types of sound waves are:
  - ✓ the compression (longitudinal) wave (causes the atoms in a part to vibrate back and forth parallel to the sound direction), and
  - ✓ the shear (transverse) wave (cause the atoms to vibrate perpendicularly (from side to side) to the direction of the sound).

ULTRASONIC INSPECTION (Cont'd)

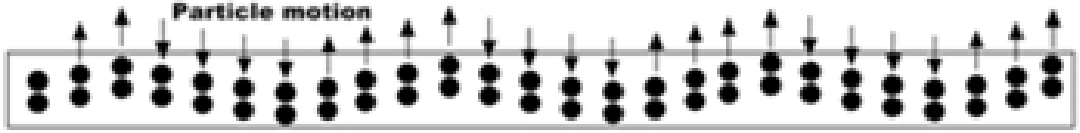
- Compression waves cause the atoms in a part to vibrate back and forth parallel to the sound direction.
- Shear waves cause the atoms to vibrate perpendicularly (from side to side) to the direction of the sound.
- Shear waves travel at approximately half the speed of longitudinal waves.



Material (particles) at Rest



Compressional (Longitudinal) motion



Shear (Transverse) motion

ULTRASONIC INSPECTION (Cont'd)

- Sound is introduced into the part using an ultrasonic transducer ("probe").
- the probe converts electrical impulses from the ultrasonic test machine into sound waves, then converts returning sound back into electric impulses that can be displayed as a visual representation on a digital or LCD screen (on older machines, a CRT screen).

ULTRASONIC INSPECTION (Cont'd)

- **Basic Principle:**
  - ✓ **By knowing:**
    - **the speed of the sound through the part (the acoustic velocity),and**
    - **the time required for the sound to return to the sending unit,**

    the distance to the reflector (the indication with the different acoustic impedance) can be determined.
- **Ultrasonic detection equipment is used to locate defects in all types of materials.**
- **Used to check defects which are too small to be seen by x-ray.**
- **Ultrasonic test instrument:**
  - ✓ **can be used with either straight line or angle beam testing technique.**
  - ✓ **requires access to only one surface of the material to be inspected.**

ULTRASONIC INSPECTION (Cont'd)

- **Two methods are used:**

immersion testing method.

the part under examination and the search unit are totally immersed in a liquid couplant. (which may be water or any other suitable fluid)

and

contact testing method.

the part under examination and the search unit are coupled with a viscous material, liquid or a paste, which wets both the face of the search unit and the material under examination.

- **There are three basic ultrasonic inspection methods:**

1. **pulse echo;**
2. **through transmission; and**
3. **resonance.**

ULTRASONIC INSPECTION (Cont'd)

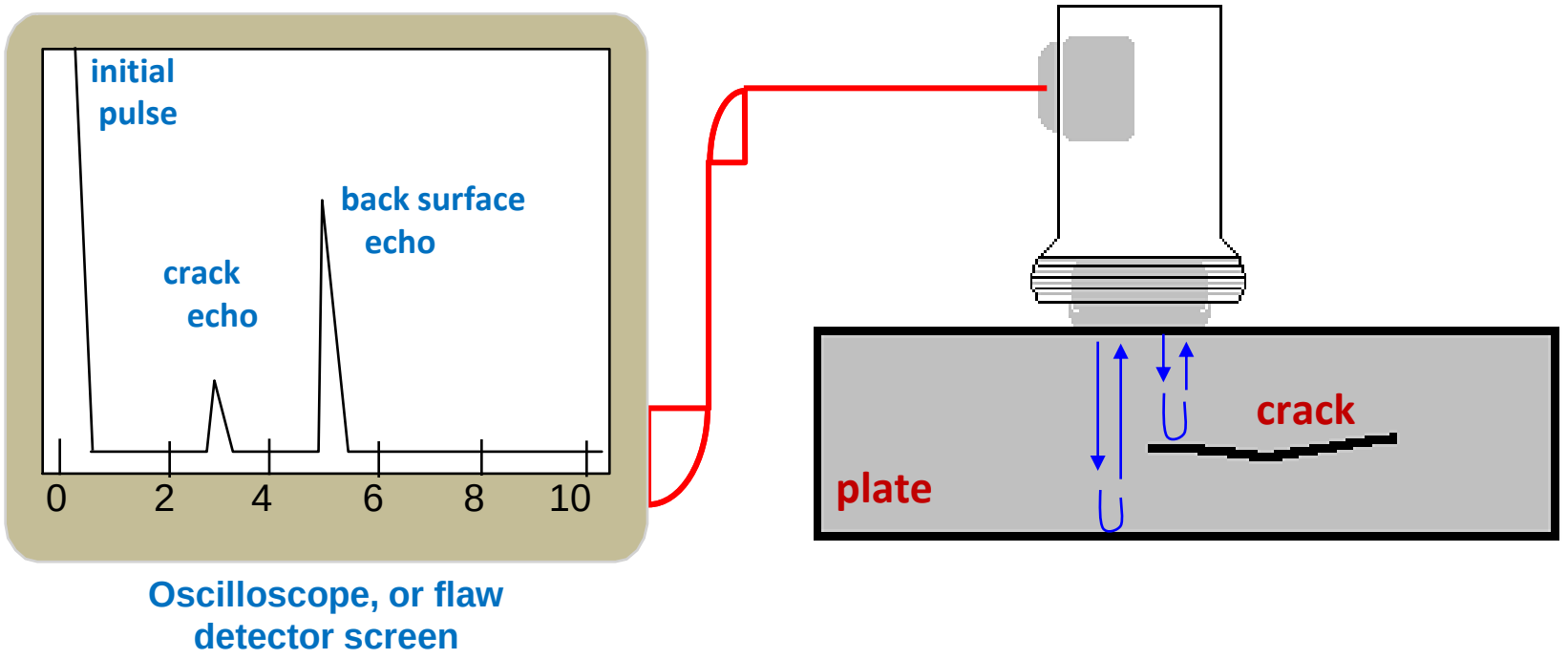
PULSE METHOD

- **Pulse Echo Method:**
  - ✓ **detected by measuring:**
    - **the amplitude of signals reflected, and**
    - **the time required for these signals to travel between specific surfaces.**
  - ✓ **the frequency of transmission is constant.**

ULTRASONIC INSPECTION (Cont'd)

PULSE ECHO METHOD

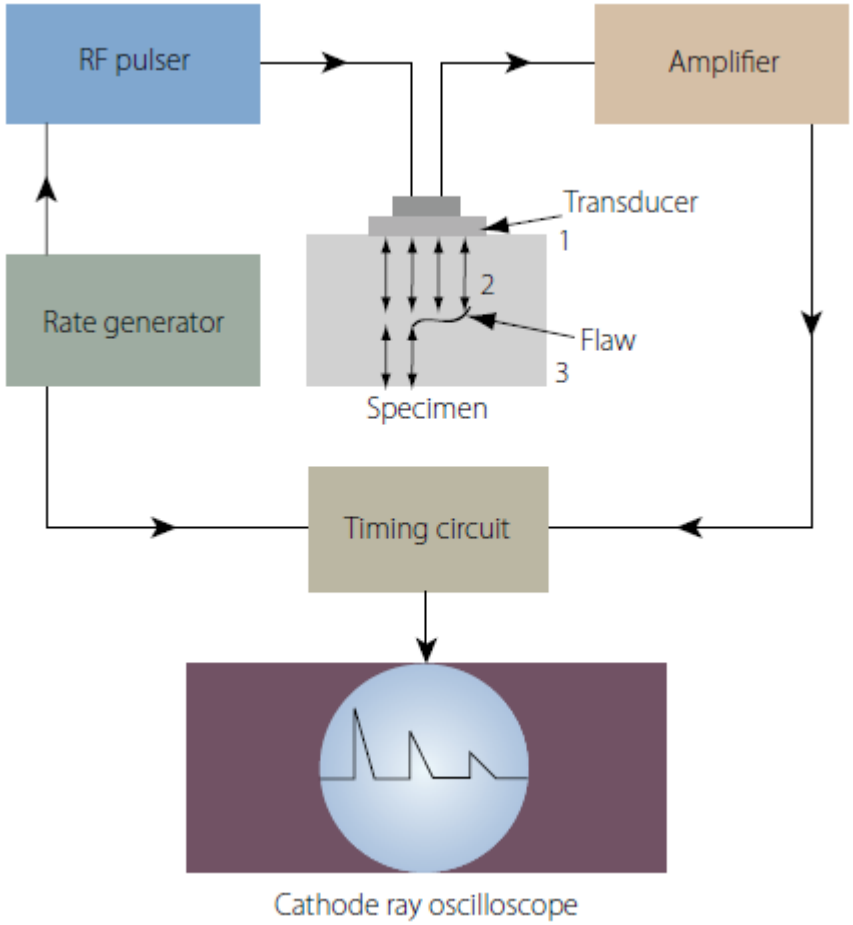
- **BASIC PRINCIPLES:**
  - ✓ High frequency sound waves are introduced into a material and they are reflected back from surfaces or flaws.
  - ✓ Reflected sound energy is displayed versus time, and inspector can visualize a cross section of the specimen showing the depth of features that reflect sound.



ULTRASONIC INSPECTION (Cont'd)

PULSE METHOD

Block diagram of basic pulse-echo system

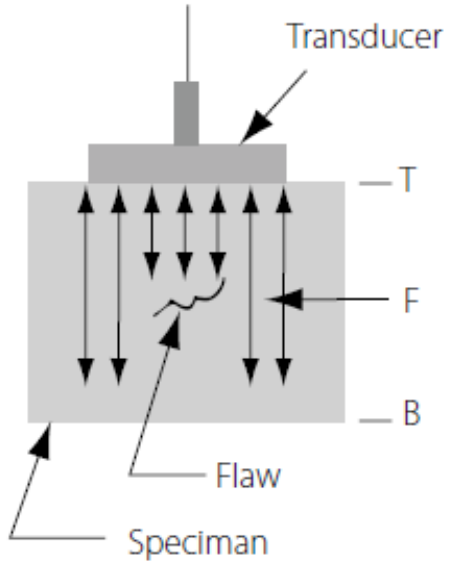


ULTRASONIC INSPECTION (Cont'd)

PULSE METHOD

Pulse Echo System (Straight Beam)

- ✓ The reflected pulse received by the transducer is amplified, then transmitted to and displayed on the instrument screen.
- ✓ The pulse is displayed in the same relationship to the front and back pulses as the flaw is in relation to the front and back surfaces of the specimen.
- ✓ the horizontal distance on the screen between the initial pulse and the first back reflection represents the thickness of the piece

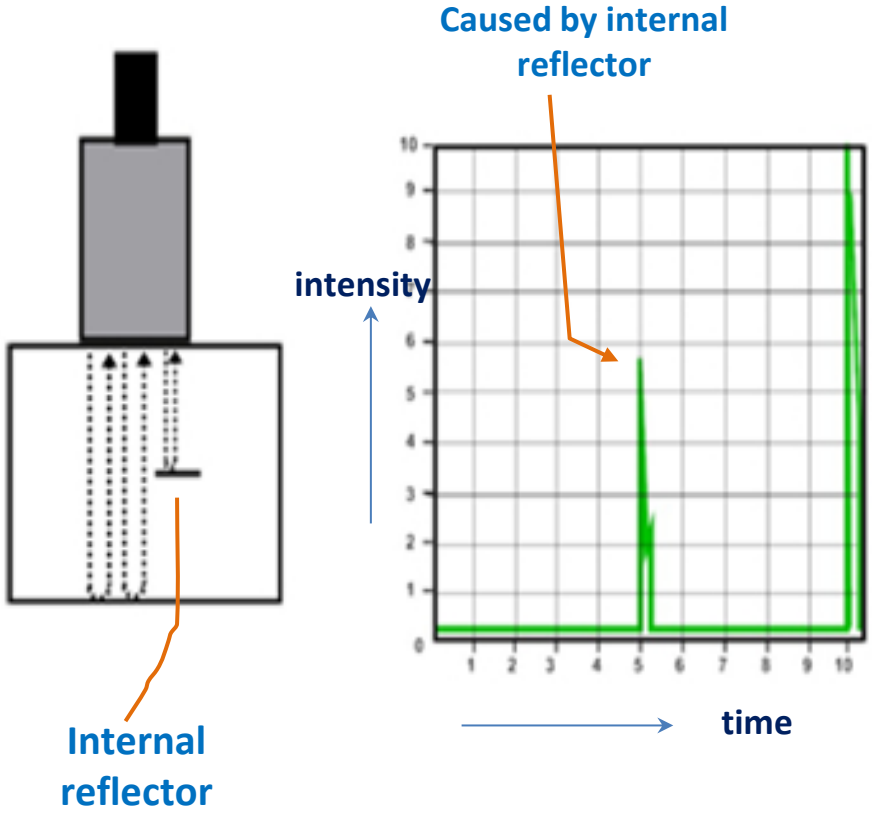


Pulse-echo display in relationship to flaw detection.

ULTRASONIC INSPECTION (Cont'd)

PULSE METHOD

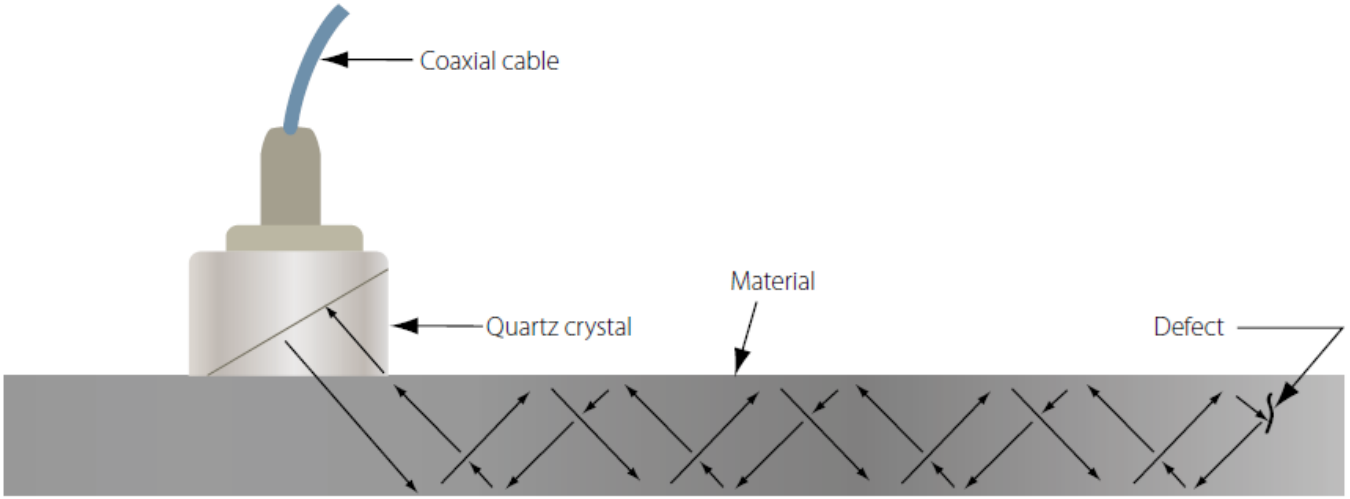
- If the sound hits an internal reflector, the sound from that reflector will reflect to the transducer faster than the sound coming back from the back-wall of the part due to the shorter distance from the transducer.
- The results in a screen display would be like that shown at the right in the following figure:



ULTRASONIC INSPECTION (Cont'd)

PULSE METHOD

Pulse Echo System (Angle beam)



Pulse-echo angle beam testing

- ✓ differs from straight beam testing only in the manner in which the ultrasonic waves pass through the material being tested.
- ✓ the horizontal distance on the screen between the initial pulse and the first back reflection represents the width of the material between the searching unit and the opposite edge of the piece.

ULTRASONIC INSPECTION (Cont'd)

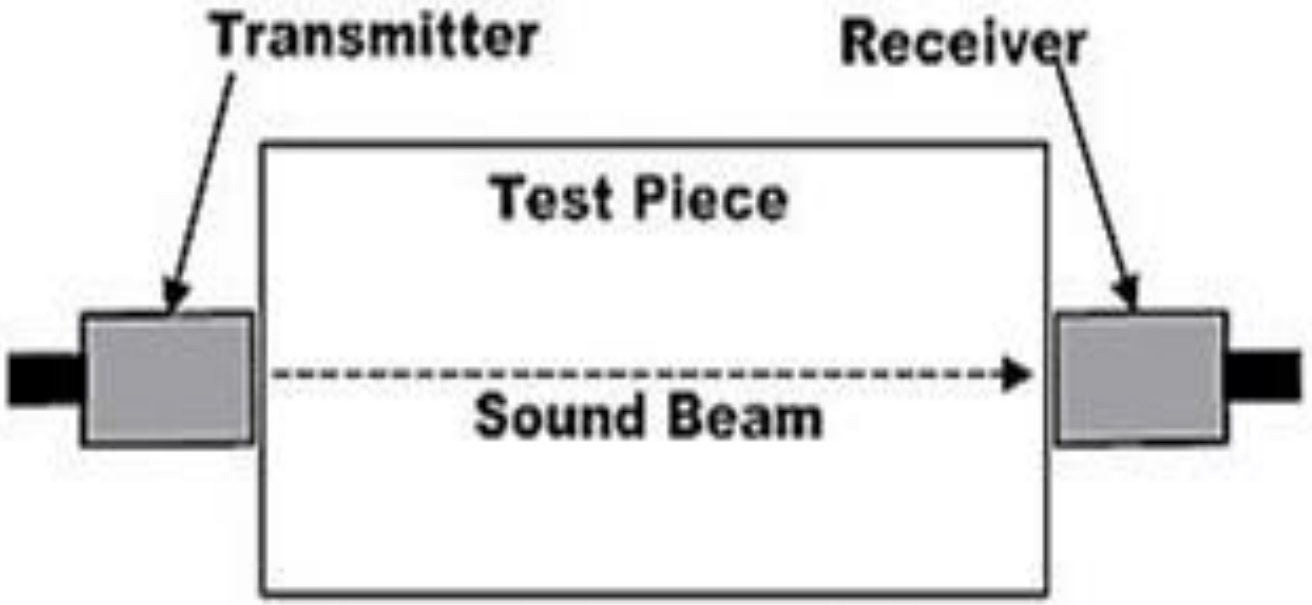
THROUGH TRANSMISSION METHOD

Through Transmission:

- ✓ uses two transducers:
  - one to generate the pulse, and
  - another to receive it. (placed on the opposite surface)
- ✓ a disruption in the sound path will indicate a flaw and be displayed on the instrument screen.
- ✓ is less sensitive to small defects than the pulse-echo method.

ULTRASONIC INSPECTION (Cont'd)

THROUGH TRANSMISSION METHOD



Through Transmission

ULTRASONIC INSPECTION (Cont'd)

RESONANCE METHOD

➢ Resonance method:

- ✓ the frequency of transmission may be continuously varied. (differs from the pulse method in that)
- ✓ used principally for thickness measurements when the two sides of the material being tested are smooth and parallel and the backside is inaccessible.
- ✓ the thickness of the material being tested is determined by the frequency matches the resonance point.
- ✓ the observer/user of this instrument must clearly understand the characteristic of resonance, phase, and fundamental & its harmonic frequencies.
- ✓ to change the oscillator frequency, there are two instrument types:
  - some instruments use a motor driven capacitor.
  - other instruments use electronic means.
- ✓ the change in frequency is synchronized with the horizontal sweep of a CRT. (the horizontal axis thus represents a frequency range). The electronic circuit is designed to present if the frequency range contains resonances.

ULTRASONIC INSPECTION (Cont'd)

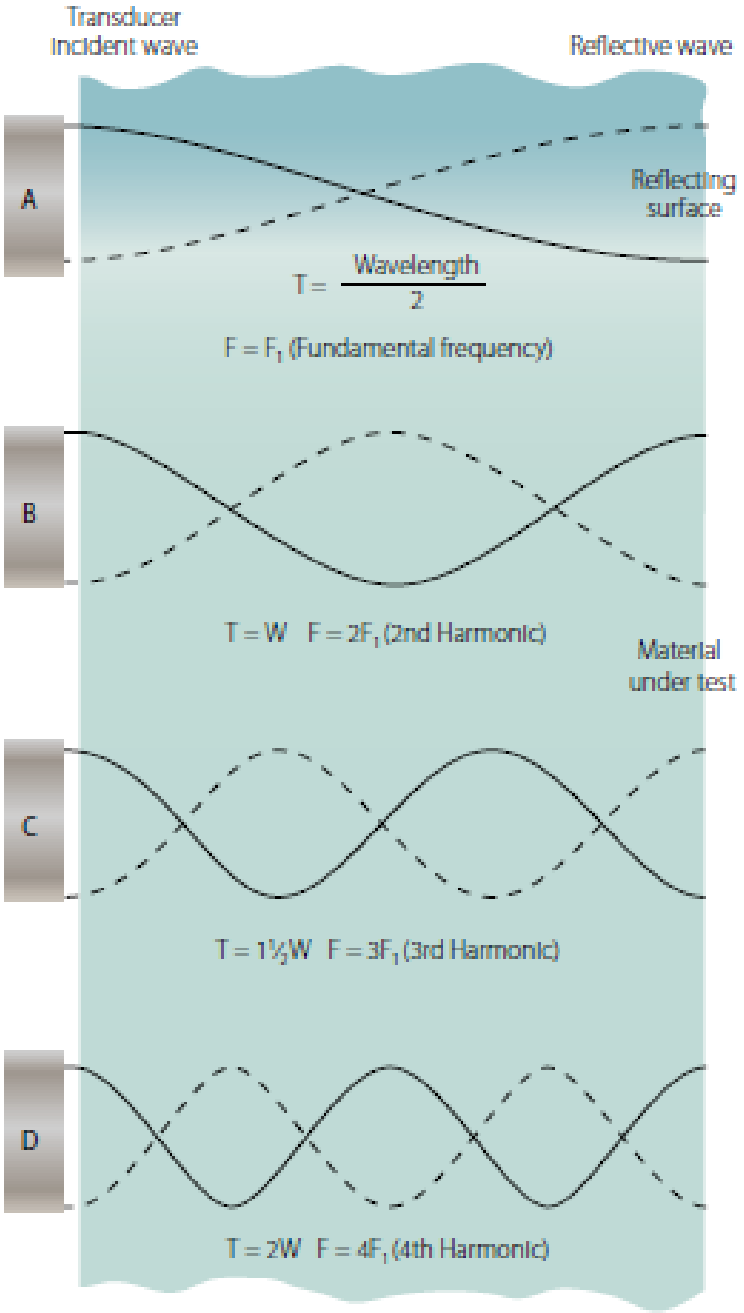
RESONANCE METHOD

- ✓ calibrated transparent scales,placed in front of the tube, is used to read the thickness.
- ✓ the instruments normally operate between 0.25 millicycle (mc) and 10 mc in four or five bands.
- ✓ can be used to test the thickness of such metals as steel, cast iron, brass, nickel, copper, silver, lead, aluminum, and magnesium.
- ✓ also used to locate and evaluate corrosion or wear on tanks, tubing, airplane wing skins, and other structures or products .
- ✓ also available direct reading dial-operated units that measure thickness between 0.025 inch and 3 inches with an accuracy of better than ±1 percent.
- ✓ requires a skilled operator who is familiar with the equipment being used as well as the inspection method to be used for the many different parts being tested.

ULTRASONIC INSPECTION (Cont'd)

RESONANCE METHOD

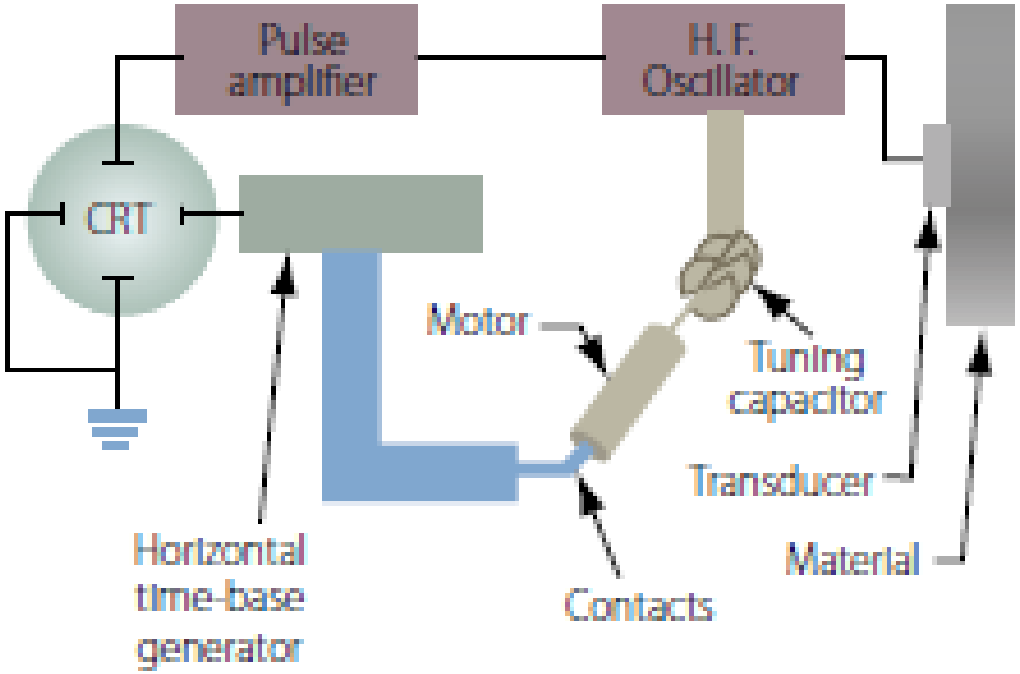
the observer/user of this instrument **must clearly understand the characteristic** of resonance, phase, and fundamental & its harmonic frequencies.



Conditions of ultrasonic resonance in a metal plate.

ULTRASONIC INSPECTION (Cont'd)

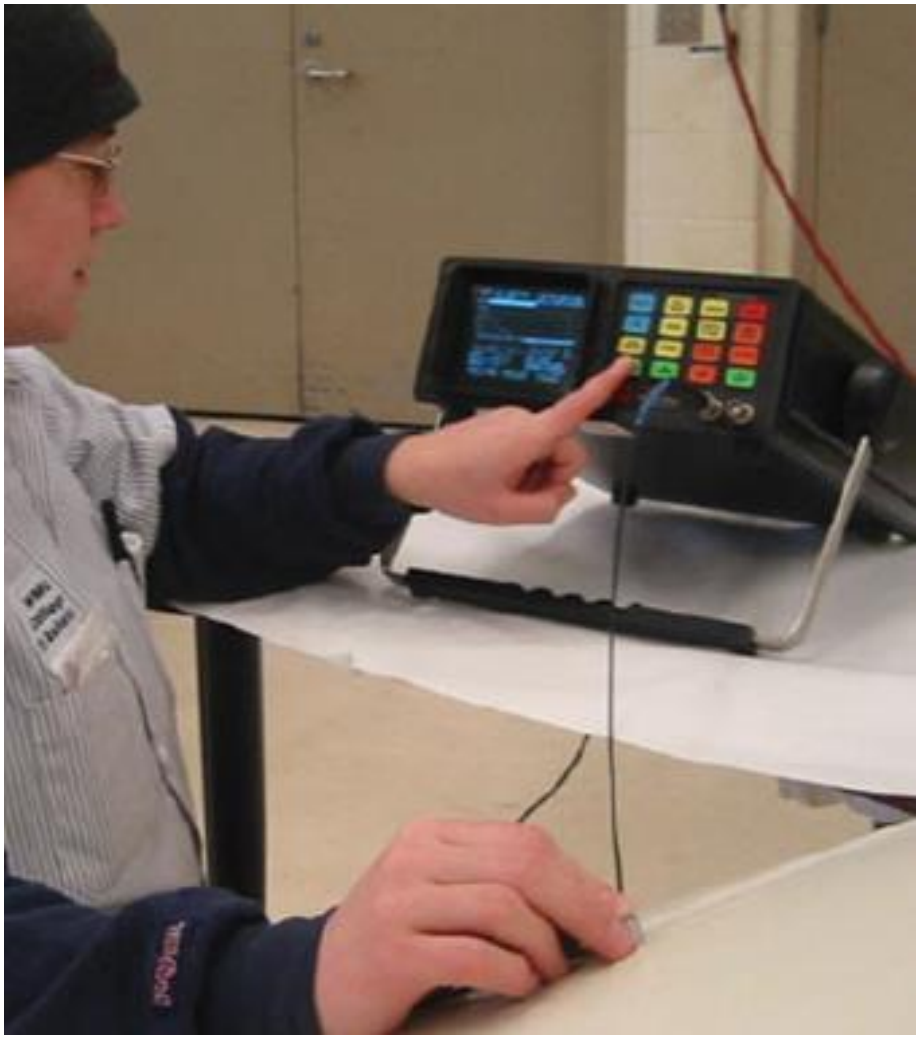
RESONANCE METHOD



Block diagram of resonance thickness measuring system

ULTRASONIC INSPECTION (Cont'd)

RESONANCE METHOD



Ultrasonic inspection of a composite structure

ULTRASONIC INSPECTION (Cont'd)

TOFD

➢ TOFD (Time of Flight Diffraction):

- ✓ Uses for inspection on weld.
- ✓ Uses two transducers located on opposite sides of a weld and set at a specified distance from each other. (One transducer transmits sound waves and the other transducer acting as a receiver)
- ✓ The transducers are travelled along the length of the weld with the transducers remaining at the same distance from the weld. (Unlike other angle beam inspections)
- ✓ Two sound waves are generated:
  - one travelling along the part surface between the transducers, and
  - the other one travelling down through the weld at an angle then back up to the receiver.
- ✓ When a crack is encountered:
  - some of the sound is diffracted from the tips of the crack, generating a low strength sound wave that can be picked up by the receiving unit. By amplifying and running these signals through a computer, defect size and location can be determined with much greater accuracy than by conventional UT methods.

Acoustic Emission Inspection (AEI)

➢ Acoustic Emission Inspection:

- ✓ is an NDI technique:
  - ❑ that involves the placing of acoustic emission sensors at various locations on an aircraft structure and then applying a load or stress.
  - ❑ The materials emit sound and stress waves that take the form of ultrasonic pulses.
    - (Note: Cracks and areas of corrosion in the stressed airframe structure emit sound waves which are registered by the sensors)
  - ❑ These acoustic emission bursts can be used to locate flaws and to evaluate their rate of growth as a function of applied stress.
- ✓ has an advantage over other NDI methods. (that it can detect and locate all of the activated flaws in a structure in one test)
- ✓ application of acoustic emission testing to aircraft has required a new level of sophistication in testing technique and data interpretation. (Because of the complexity of aircraft structures)

MAGNETIC PARTICLE INSPECTION

Magnetic Particle Inspection

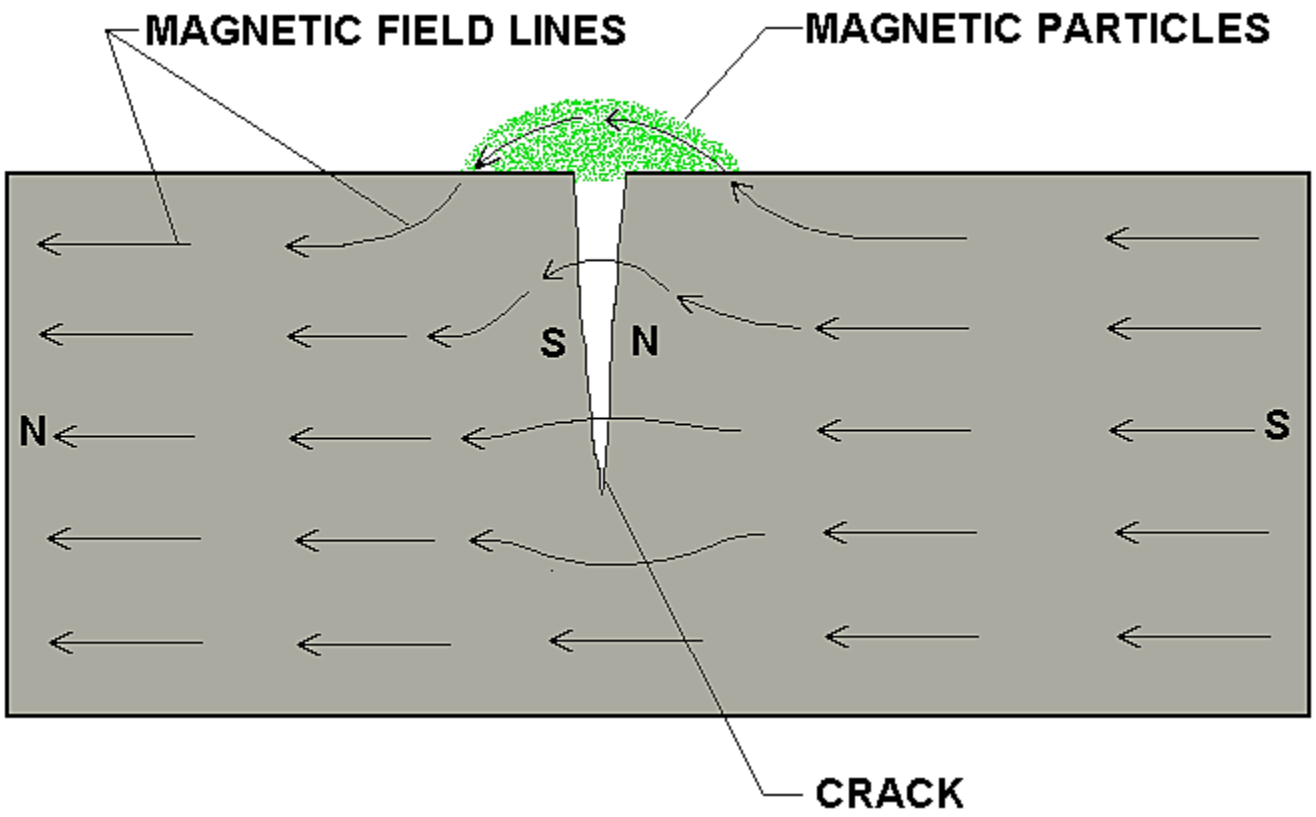
- a method of detecting invisible cracks and other defects in ferromagnetic materials (such as iron and steel).
- not applicable to nonmagnetic materials.
- used for the rapid detection of defects located on or near the surface.
- The process to conduct MPI consists of:
  - ✓ magnetizing the part, and
  - ✓ then applying ferromagnetic particles

} to the surface area to be inspected

Magnetic Particle Inspection (Cont'd)

- **Types of the process:**
  - ✓ **The wet process:**
    - commonly used in the inspection of aircraft parts.
    - ferromagnetic particles (indicating medium) may be held in suspension in a liquid that is flushed over the part.
  - ✓ **The dry process:**
    - The ferromagnetic particles in dry powder form, may be dusted over the surface of the part.

Magnetic Particle Inspection (Cont'd)



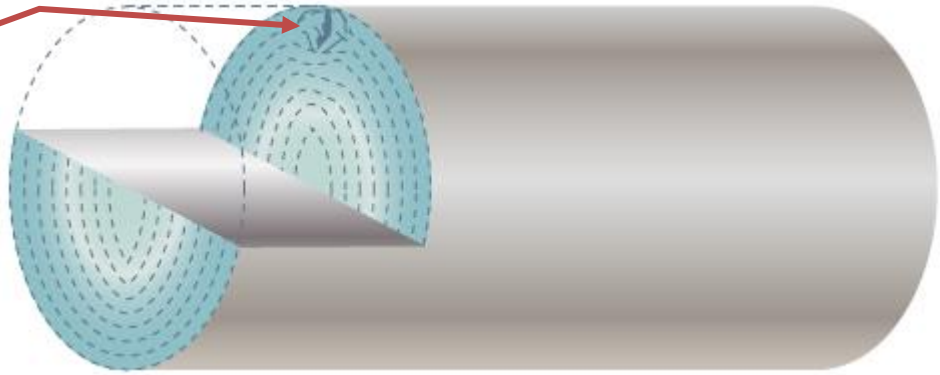
Magnetic Particle Inspection (Cont'd)

- **INDICATIONS OF DEFECT:**
  - ✓ **If a discontinuity is present:**
    - the magnetic lines of force will be disturbed, and
    - opposite poles will exist on either side of the discontinuity.
  - ✓ **A discontinuity may be defined as:**
    - an interruption in the normal physical structure or configuration of a part, such as a crack, forging lap, seam, inclusion, porosity, and the like.

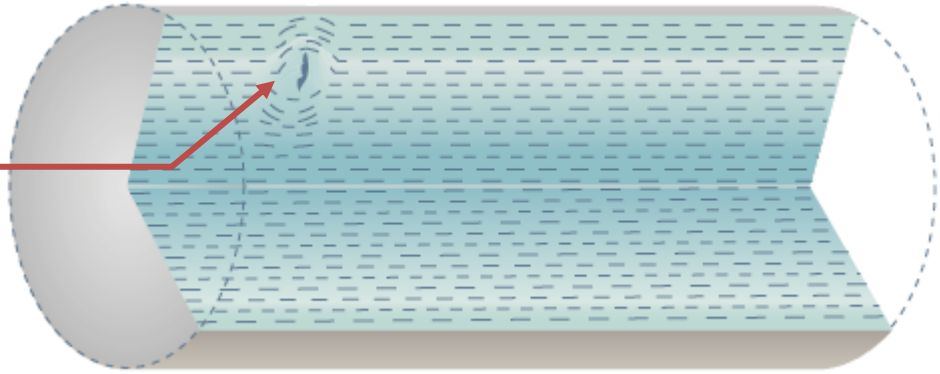
Magnetic Particle Inspection (Cont'd)

➢ Development of Indications:

Flux leakage at transverse discontinuity.



Flux leakage at longitudinal discontinuity.



Magnetic Particle Inspection (Cont'd)

- **types of discontinuities detected:**
  - ✓ **Cracks, splits, bursts, tears, seams, voids are formed by an actual parting or rupture of the solid metal.**
  - ✓ **Cold shuts and laps are folds that have been formed in the metal, interrupting its continuity.**

Magnetic Particle Inspection (Cont'd)

➢ Preparation of Parts for Testing:

- ✓ Grease, oil, and dirt must be cleaned before tested.
- ✓ All small openings and oil holes leading to internal passages or cavities should be plugged with paraffin or other suitable nonabrasive material.

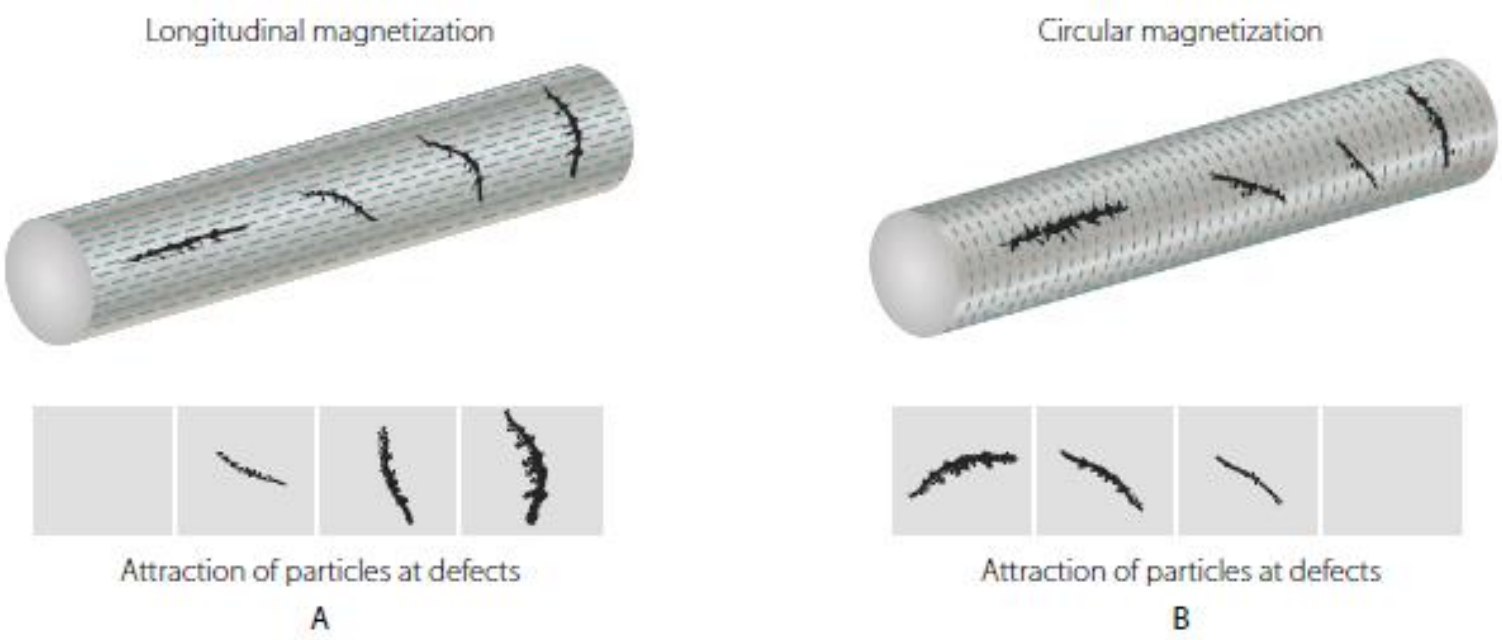
Note:

- Coatings of cadmium, copper, tin, and zinc do not interfere with the satisfactory performance of magnetic particle inspection.
- Chromium and nickel plating generally will not interfere with indications of cracks open to the surface of the base metal but will prevent indications of fine discontinuities, such as inclusions.
- Nickel plating is more effective than chromium plating in preventing the formation of indications. (because nickel is more strongly magnetic)

Magnetic Particle Inspection (Cont'd)

Effect of Flux Direction:

- It is necessary to induce magnetic flux in more than one direction. (defects are likely to exist at any angle to the major axis of the part):
  - ✓ requires two separate magnetizing operations, referred to as:
    - A. Longitudinal magnetization, and
    - B. Circular magnetization.

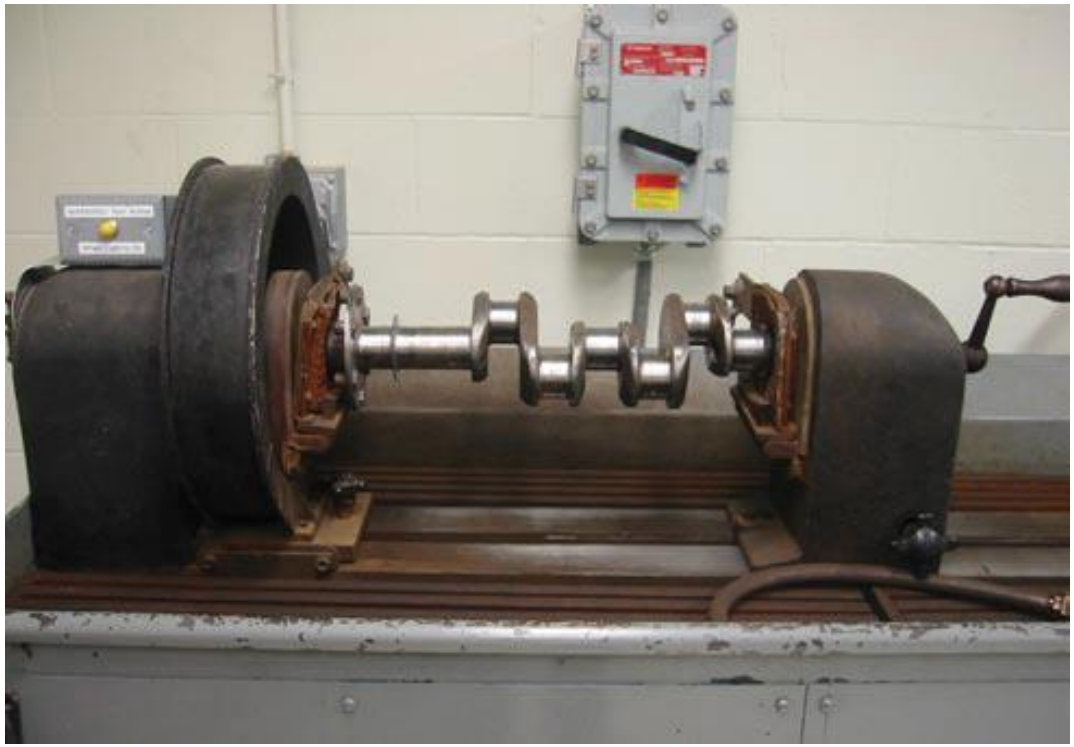


Effect of flux direction on strength of indication

Magnetic Particle Inspection (Cont'd)

➢ Circular magnetization:

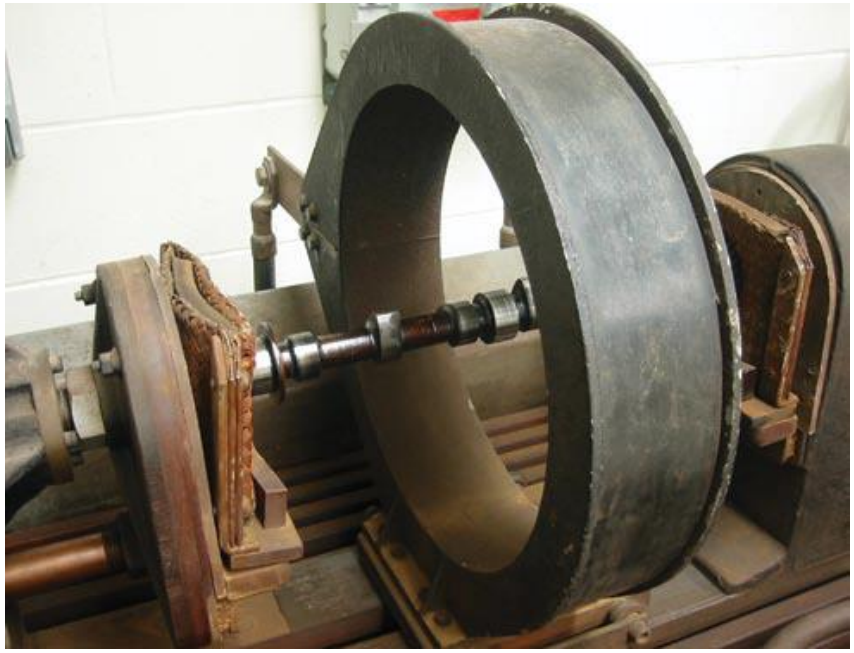
- ✓ is the induction consisting of concentric circles of force about and within the part.(achieved by passing electric current through the part).
- ✓ will locate defects running approximately parallel to the axis of the part.



Circular magnetization of a camshaft.

Magnetic Particle Inspection (Cont'd)

- **Longitudinal magnetization:**
  - ✓ the magnetic field is produced in a direction parallel to the long axis of the part. (by placing the part in a solenoid excited by electric current and the metal part then becomes the core of the solenoid).
  - ✓ For long parts, the solenoid must be moved along the part in order to magnetize it. (to ensure adequate field strength throughout the entire length of the part).
  - ✓ Accomodating parts or sections approximately 30 inches in length. (because solenoids produce effective magnetization for approximately 12 inches from each end of the coil).



Longitudinal magnetization of crankshaft (solenoid method)

  - ✓ Has advantage in producing more uniform magnetization. (the coils conform more closely to the shape of the part)
  - ✓ Is useful for large or irregularly shaped parts for which standard solenoids are not available.

Magnetic Particle Inspection (Cont'd)

- **Effectiveness of the MPI depends on:**
  - ✓ the **flux density** or **field strength** at the surface of the part:

To be awared when using field strength:

- If the flux density in the part is increased, the sensitivity of the test increases.
- Excessively high flux densities may form nonrelevant indications. (for example, patterns of the grain flow in the material)

therefore

1. use a field strength high enough. (to reveal all possible harmful discontinuities),
2. but not strong enough. (to produce confusing nonrelevant indications)

Magnetic Particle Inspection (Cont'd)

➢ Magnetizing Methods:

✓ Continuous method:

- may be used in all circular and longitudinal magnetization procedures.
- provides greater sensitivity than the residual procedure. (particularly in locating subsurface discontinuities)
- will reveal more nonsignificant discontinuities than the residual procedure,

and

✓ Residual method:

- Involves magnetization of the part and application of the indicating medium after the magnetizing force has been removed.
- When the magnetizing force is removed, the field strength decreases to a lower residual value depending on the magnetic properties of the material and the shape of the part.
- Relies on the residual or permanent magnetism in the part.
- Is more practical than the continuous procedure when magnetization is accomplished by flexible coils wrapped around the part.
- is used only with steels which have been heat treated for stressed applications.

Magnetic Particle Inspection (Cont'd)

➢ Identification of Indications:

- ✓ **principal features** of indications are:
  - shape, buildup, width, and sharpness of outline.
- ✓ The **most readily indications** are those produced by cracks open to the surface, include:
  - fatigue cracks, heat treat cracks, shrink cracks in welds and castings, and grinding cracks.

Fatigue crack in a landing gear.

Magnetic Particle Inspection (Cont'd)

➢ Magnaglo Inspection:

- ✓ is similar to the preceding method but used a fluorescent particle solution, and the inspection is made under black light.
- ✓ used reddish brown liquid spray or bath which consists of Magnaglo paste mixed with a light oil. (the ratio of 0.10 to 0.25 ounce of paste per gallon of oil)
- ✓ Used neon-like glow to increase efficiency of inspection.(the defects allowing smaller flaw indications to be seen)
- ✓ This method is very effective for use on gears, threaded parts, and aircraft engine components.

Magnetic Particle Inspection (Cont'd)

NOTE AFTER CONDUCTING MPI

- **After inspection:**

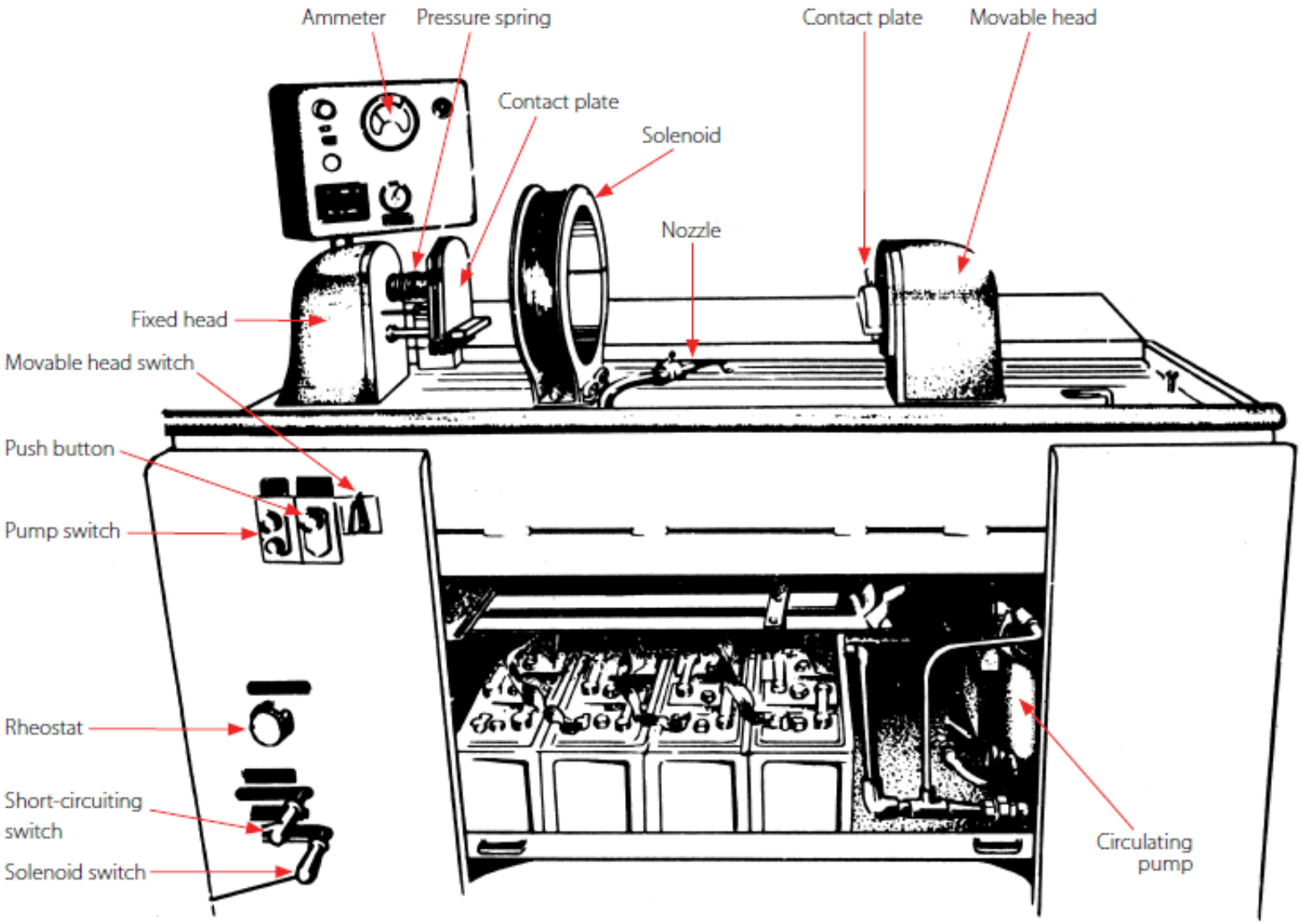
  - ✓ **the part must be demagnetized, and**

  - ✓ **rinsed with a cleaning solvent.**

Magnetizing Equipment

- **Fixed (Nonportable) General Purpose Unit:**
  - ✓ provides direct current (dc) for wet continuous or residual magnetization procedures.
  - ✓ may be used for circular or longitudinal magnetization and it may be powered with rectified alternating current (ac), as well as direct current (dc).
  - ✓ the contact heads provide the electrical terminals for circular magnetization:
    - one head is fixed in position with its contact plate mounted on a shaft surrounded by a pressure spring, so that the plate may be moved longitudinally.
  - ✓ the motor driven movable head slides horizontally in longitudinal guides and is controlled by a switch.
  - ✓ the strength of the magnetizing current may be set manually to the desired value by means of the rheostat or increased to the capacity of the unit by the rheostat short circuiting switch. (the current utilized is indicated on the ammeter)
  - ✓ longitudinal magnetization is produced by the solenoid, which moves in the same guide rail as the movable head and is connected in the electrical circuit by means of a switch.

Magnetizing Equipment (Cont'd)



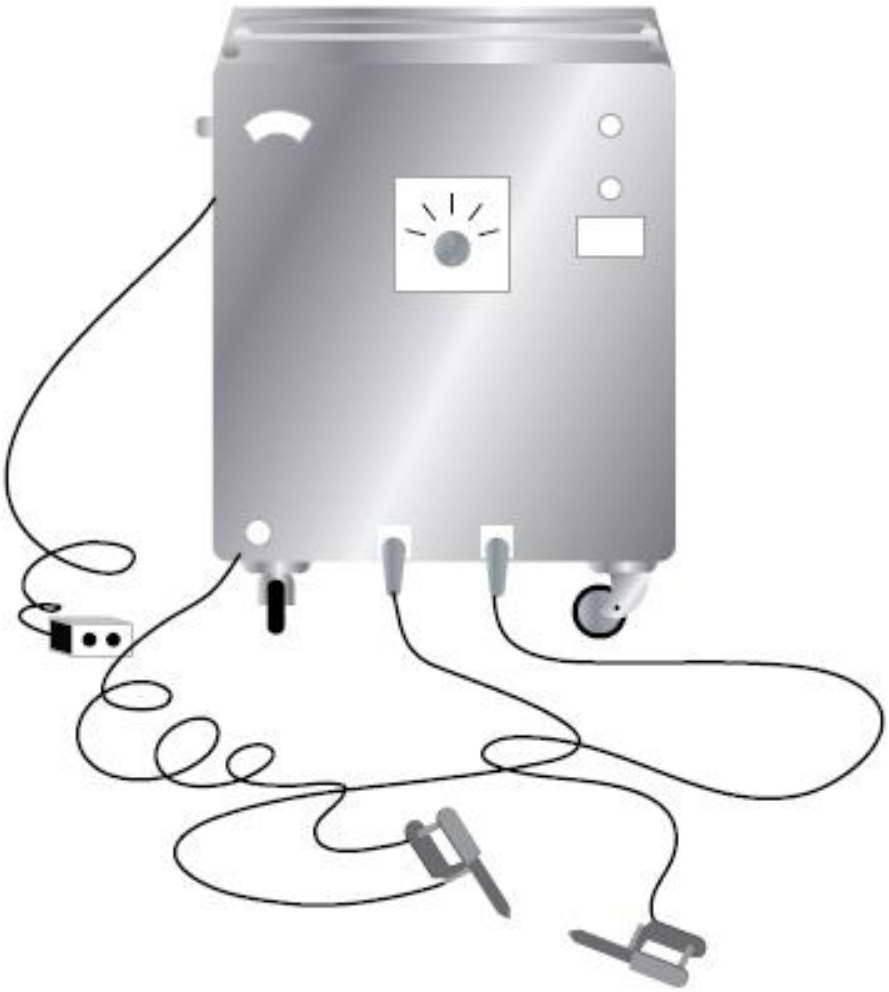
Fixed general-purpose magnetizing unit

Magnetizing Equipment (Cont'd)

➢ Portable General Purpose Unit:

- ✓ used at locations where:
  - fixed general purpose equipment is not available, or
  - to perform an inspection on members of aircraft structures without removing them from the aircraft.
- ✓ useful for inspecting:
  - landing gear and engine mounts. (suspected of having developed cracks in service)
- ✓ supply both alternating current and direct current magnetization.
- ✓ only a source of magnetizing and demagnetizing current and does not provide a means for supporting the work or applying the suspension.
- ✓ Circular magnetization may be developed by using either the prods or clamps.
- ✓ Longitudinal magnetization is developed by wrapping the cable around the part.
- ✓ unit also serves as a demagnetizer and supplies high amperage low voltage alternating current for this purpose.
- ✓ prods should be held firmly against the surface being tested. (there is a tendency for a high amperage current to cause burning at contact areas)

Magnetizing Equipment (Cont'd)



Portable general purpose unit

Magnetizing Equipment (Cont'd)

Indicating Mediums:

✓ basic requirement is:

- produce acceptable indications of discontinuities in parts.

✓ two general material types:

- wet and dry.

✓ the colors used are:

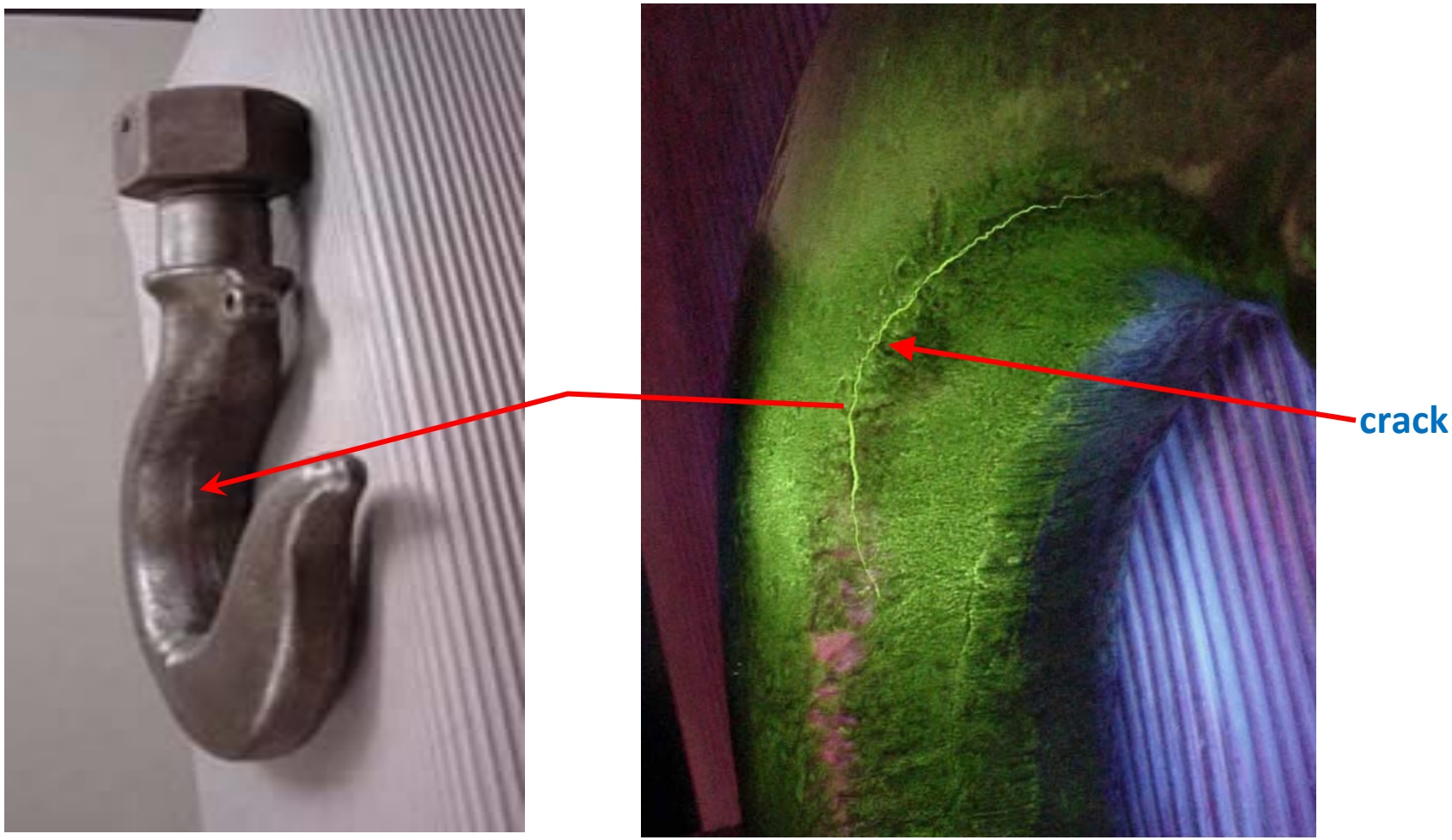
- black and red for the wet procedure, and
- black, red, and gray for the dry procedure.

✓ the indicating medium must be of

- high permeability (to ensure that a minimum of magnetic energy will be required), and
- low retentivity. (to ensure that the mobility of the magnetic particles will not be hindered by the particles themselves becoming magnetized and attracting one another)

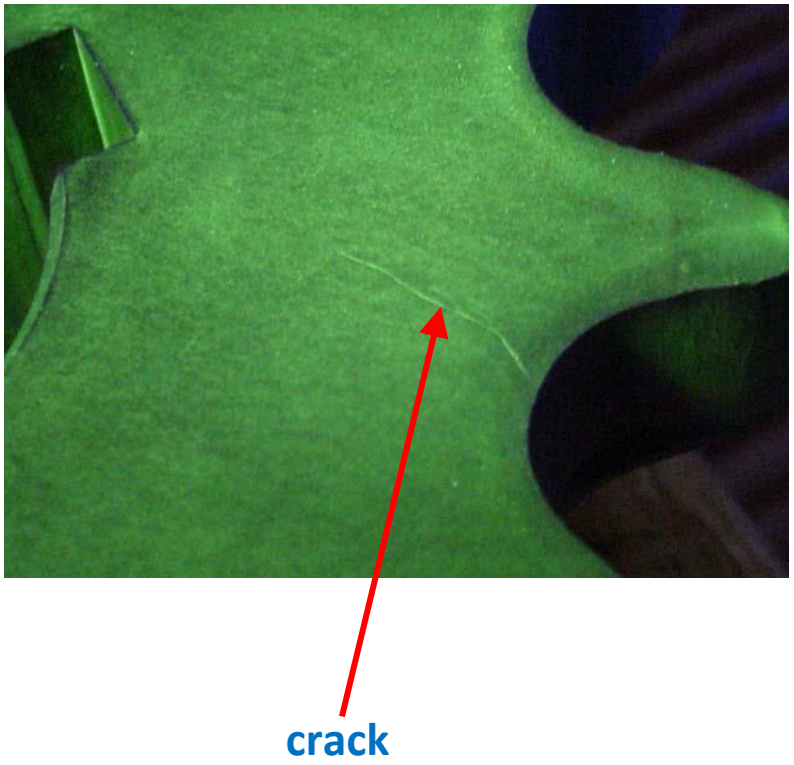
Magnetic Particle Inspection (Cont'd)

Magnetic Particle Crack Indications



Magnetic Particle Inspection (Cont'd)

Magnetic Particle Crack Indications



Magnetizing Equipment (Cont'd)

Demagnetizing:

- after NDI using MPI, the permanent magnetism will remain permanent in the object. The part must be demagnetized before the returned to service.
- Parts of the airframe must be demagnetized so they will not affect instruments.
- An accumulation of such particles on a magnetized part may cause scoring of bearings or other working parts.

Standard Demagnetizing Practices

- use of a solenoid coil energized by alternating current.
- Procedure:
  - ✓ by moving the part away from the alternating field of a solenoid, the magnetism in the part gradually decreases:
    - for small parts:

      should be held as close to the inner wall of the coil as possible.
    - parts that do not readily lose their magnetism:

      should be passed slowly in and out of the demagnetizer several times and, at the same time, tumbled or rotated in various directions.
    - for portable units:

      pass alternating current through the part being demagnetized, while gradually reducing the current to zero.

RADIOGRAPHIC INSPECTION

RADIOGRAPHIC INSPECTION

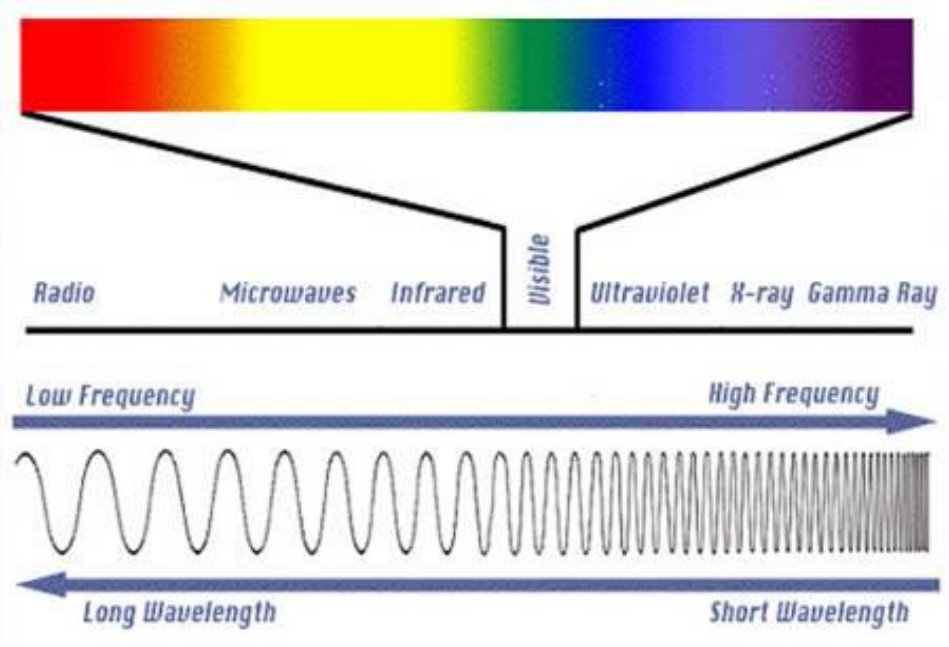
RADIOGRAPHIC:

✓ **Uses:**
X and gamma radiations

✓ **Applied to the radiographic (x-ray) inspection of:**
- **metal fabrications, and**
- **nonmetallic products.**

✓ **The penetrating radiation is projected through the part to be inspected and produces an invisible or latent image in the film.**
- **The film becomes a radiograph or shadow picture of the object.**

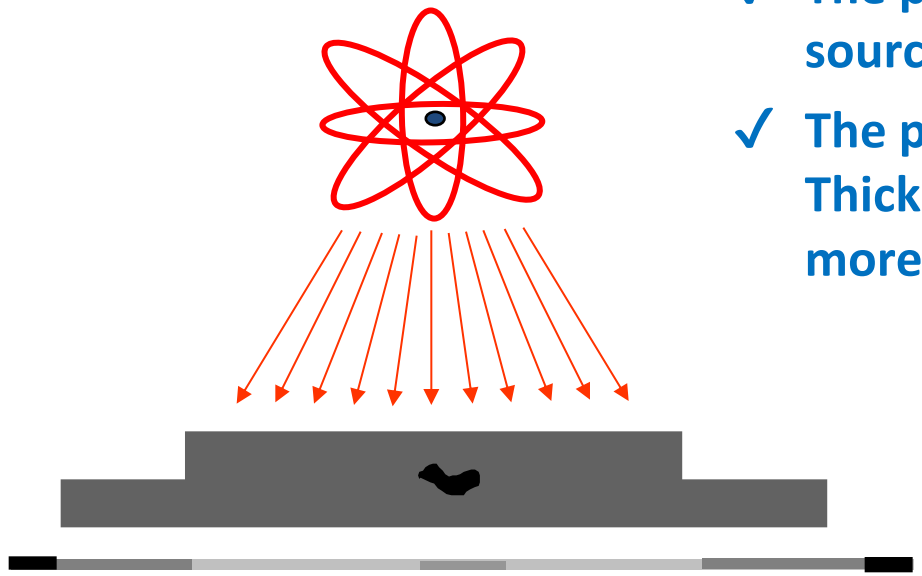
a higher energy, shorter wavelength radiation



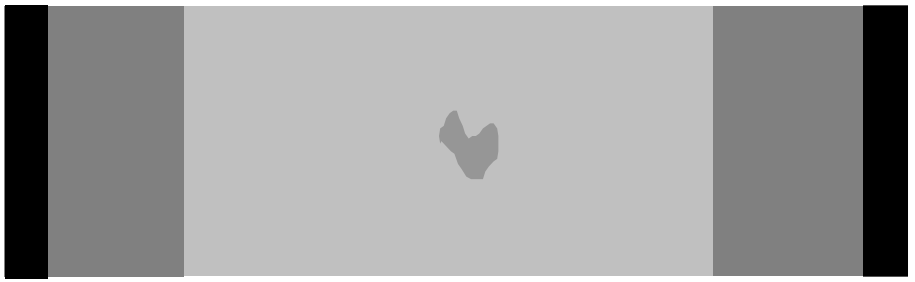
✓ **This inspection medium and portable unit provides a fast and reliable means for checking the integrity of airframe structures and engines.**

RADIOGRAPHIC INSPECTION (Cont'd)

FILM RADIOGRAPHY



X-ray film



Top view of developed film

- ✓ The part is placed between the radiation source and a piece of film.
- ✓ The part will stop some of the radiation. Thicker and more dense area will stop more of the radiation.

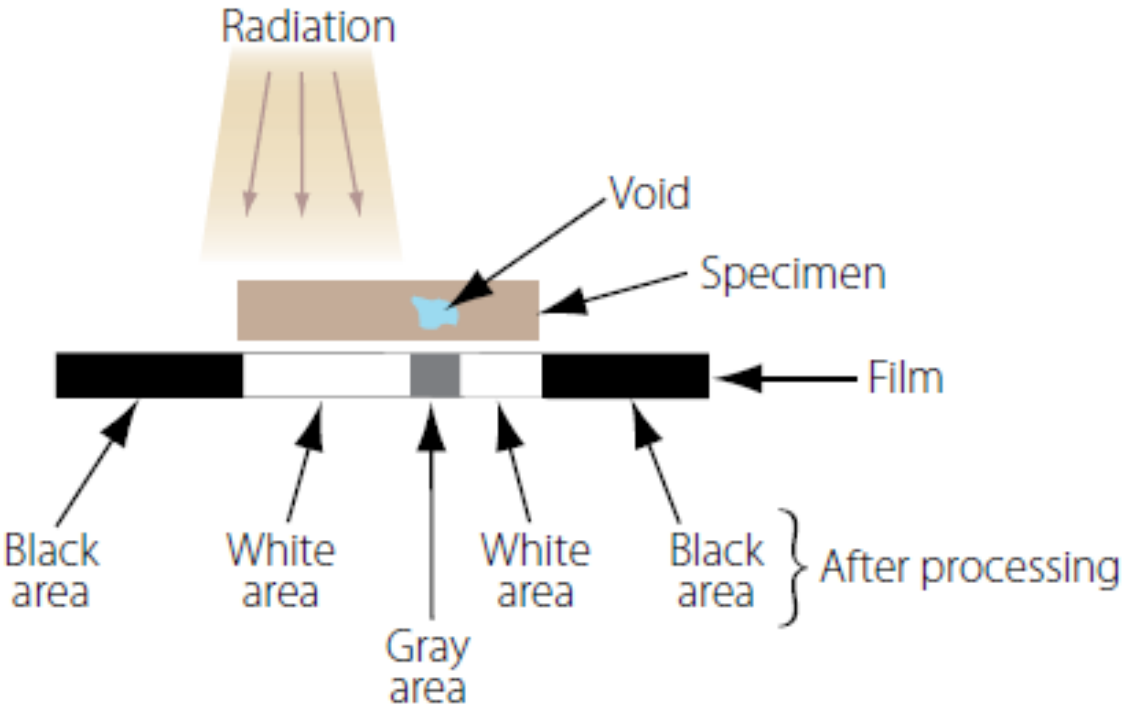
The film darkness (density) will vary with the amount of radiation reaching the film through the test object.

= less exposure

= more exposure

RADIOGRAPHIC INSPECTION (Cont'd)

- **RADIATION PENETRATION THROUGH THE PART BEING INSPECTED:**



RADIOGRAPHIC INSPECTION (Cont'd)

- used to locate defects or flaws in airframe structures or engines with little or no disassembly.
- extensive training is required to become a qualified radiographer (due to the radiation risks associated with x-ray).
- only qualified radiographers are allowed to operate the x-ray units.

RADIOGRAPHIC INSPECTION (Cont'd)

- **Three major steps in the x-ray process:**
  1. **exposure** to radiation, including preparation,
  2. **processing** of film, and
  3. **interpretation** of the radiograph.

RADIOGRAPHIC INSPECTION (Cont'd)

Preparation and Exposure

- **Factors to be considered:**
  - Material thickness and density
  - Shape and size of the object
  - Type of defect to be detected
  - Characteristics of x-ray machine used
  - The exposure distance
  - The exposure angle
  - Film characteristics
  - Types of intensifying screen (if used)
- **The following should be thoroughly understood:**
  - the unit rating in kilovoltage,
  - the size,
  - portability,
  - ease of manipulation, and
  - exposure particulars

  of the available equipment.
- **A log or record of previous exposures will provide specific data as a guide for future radiographs.**

RADIOGRAPHIC INSPECTION (Cont'd)

Film Processing

- To make the visibility of the latent image on the film permanent:
  - ✓ It must be processed through a developer chemical solution, an acid bath, and a fixing bath, followed by a clear water wash.

RADIOGRAPHIC INSPECTION (Cont'd)

Radiographic Interpretation

- Is the most important phase in radiographic inspection.
- The following present several factors which must be considered when analyzing a radiograph:
- An improper interpretation may cause a false sense of security imparted by the acceptance of a part or structure based. This is a particular danger. This is one of the reasons why only qualified persons are allowed for radiographic inspection.

NOTE:
The subject of interpretation is so varied and complex that it cannot be covered adequately in this presentation. Instead, we will give only a brief review of basic requirements for radiographic interpretation, including some descriptions of common defects.

RADIOGRAPHIC INSPECTION (Cont'd)

Radiographic Interpretation (Cont'd)

- **The three basic categories of flaws:**
  - voids,
  - inclusions, and

    } the forms ranges from a two-dimensional plane to a three-dimensional sphere.
  - dimensional irregularities (will not be discussed because its prime factor is one of degree, and radiography is not exact).
- **Examples of flaws:**
  - ✓ Two-dimensional plane:
    - crack, tear, or cold shut
  - ✓ Three-dimensional plane:
    - Cavity
  - ✓ Other types of flaws (between two and three dimensional):
    - shrink, oxide inclusions, porosity, and so forth.

RADIOGRAPHIC INSPECTION (Cont'd)

Radiographic Interpretation (Cont'd)

factors which must be considered when analyzing a radiograph:

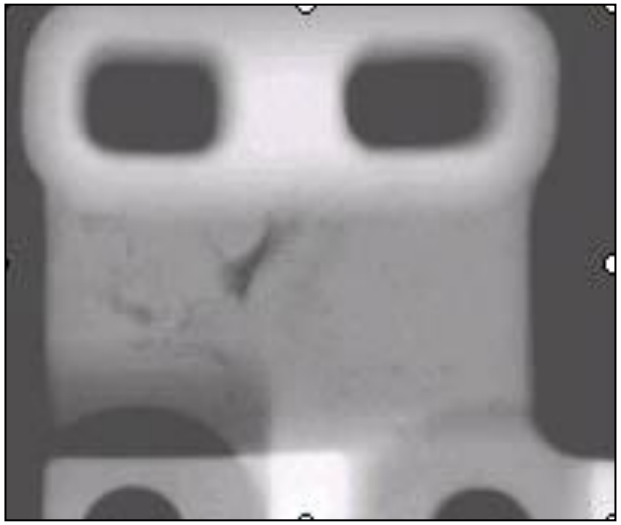
1. A flaw having sharp points could establish a source of localized stress concentration.
2. Spherical flaws affect material strength to a far lesser degree than do sharp pointed flaws.
3. Specifications and reference standards:
   - ✓ Flaws cause for rejection:
     - cracks, cold shuts.
4. Material strength is also affected by flaw size. A metallic component of a given area is designed to carry a certain load plus a safety factor. Reducing this area by including a large flaw weakens the part and reduces the safety factor.
5. the interpreter must determine the degree of tolerance or imperfection specified by the design engineer.

RADIOGRAPHIC INSPECTION (Cont'd)

Radiographic Interpretation (Cont'd)

6. small flaws with sharp points can be just as bad as large flaws with no sharp points.
7. Flaw location:
   - metallic components are subjected to numerous and varied forces during their effective service life.
   - distribution of these forces is not equal in the component or part, and certain critical areas may be rather highly stressed.
   - another aspect of flaw location is that certain types of discontinuities close to one another may potentially serve as a source of stress concentrations. (creating a situation that should be closely scrutinized)
8. An inclusion is a type of flaw which contains entrapped material:
   - a flaw containing foreign material could become a source of corrosion.

Radiographic Images



RADIOGRAPHIC INSPECTION (Cont'd)

Radiation Hazards

- Radiation from x-ray units and radioisotope sources is destructive to living tissue. (Adequate protection must be provided)
- Personnel must keep outside the primary x-ray beam at all times:
  - ✓ When radiation strikes the molecules of the body, the effect may be no more than to dislodge a few electrons, but an excess of these changes could cause irreparable harm. When a complex organism is exposed to radiation, the degree of damage, if any, depends on which of its body cells have been changed.
  - ✓ Vital organs in the center of the body that are penetrated by radiation are likely to be harmed the most. The skin usually absorbs most of the radiation and reacts earliest to radiation.
  - ✓ If the whole body is exposed to a very large dose of radiation, death could result. In general, the type and severity of the pathological effects of radiation depend on the amount of radiation received at one time and the percentage of the total body exposed. Smaller doses of radiation could cause blood and intestinal disorders in a short period of time. The more delayed effects are leukemia and other cancers. Skin damage and loss of hair are also possible results of exposure to radiation.

INSPECTION
OF
COMPOSITES

INSPECTION OF COMPOSITES

- inspected for:
  - ✓ delamination, which is separation of the various plies,
  - ✓ debonding of the skin from the core, and
  - ✓ evidence of moisture and corrosion.
- ultrasonic, acoustic emission, and radiographic inspections may be used. (as recommended by the aircraft manufacturer)
- The simplest method used in testing composite structures is the tap test.

INSPECTION OF COMPOSITES (Cont'd)

- **Tap Testing:**
  - ✓ also referred to as the ring test or coin test,
  - ✓ is widely used as a quick evaluation of any accessible surface to detect the presence of delamination or debonding.
  - ✓ testing procedure:
    - consists of lightly tapping the surface with a light hammer (max weight of 2 ounces), a coin or other suitable device.
    - the acoustic response or "ring" is compared to that of a known good area.
    - a "flat" or "dead" response indicates an area of concern.
    - limited to finding defects in relatively thin skins, less than 0.080" thick.
    - Tap testing on only one side would not detect debonding on the opposite side. Therefor, on honeycomb structures, both sides need to be tested.

INSPECTION OF COMPOSITES (Cont'd)

➢ Electrical Conductivity

- ✓ Composite structures are not inherently electrically conductive. However some aircraft, such as highspeed high-performance jets, are required to utilize various methods of incorporating aluminum into their structures to make them conductive.
- ✓ Aluminum is imbedded within the plies of the lay-ups either as a thin wire mesh, screen, foil, or spray. When damaged sections of the structure are repaired, care must be taken to ensure that the conductive path be restored.
- ✓ the continuity of the electrical path from the original conductive material to the replacement conductor and back to the original must be maintained.
- ✓ Electrical conductivity may be checked by use of an ohmmeter.
- ✓ Specific manufacturer's instructions must be carefully followed.

INSPECTION
of
WELDS

Inspection of Welds

➢ INTRODUCTION:

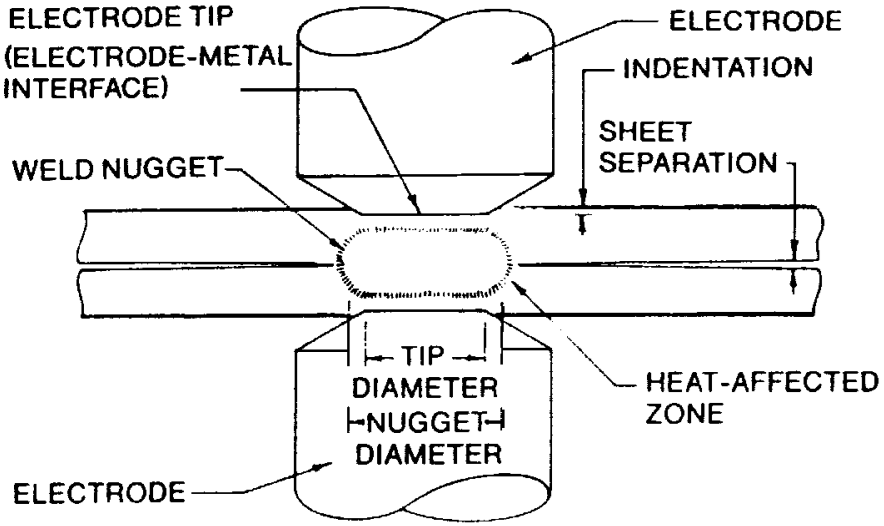
✓ Types of Welding

- ❑ Gas Welding.
- ❑ Shielded Metal Arc Welding (SMAW).
- ❑ Gas Metal Arc Welding (GMAW).
- ❑ Gas Tungsten Arc Welding (GTAW).
- ❑ Electric-Resistance Welding:
  - Spot Welding.
  - Seam Welding.

Inspection of Welds (Cont'd)

➢ INTRODUCTION (Cont'd):

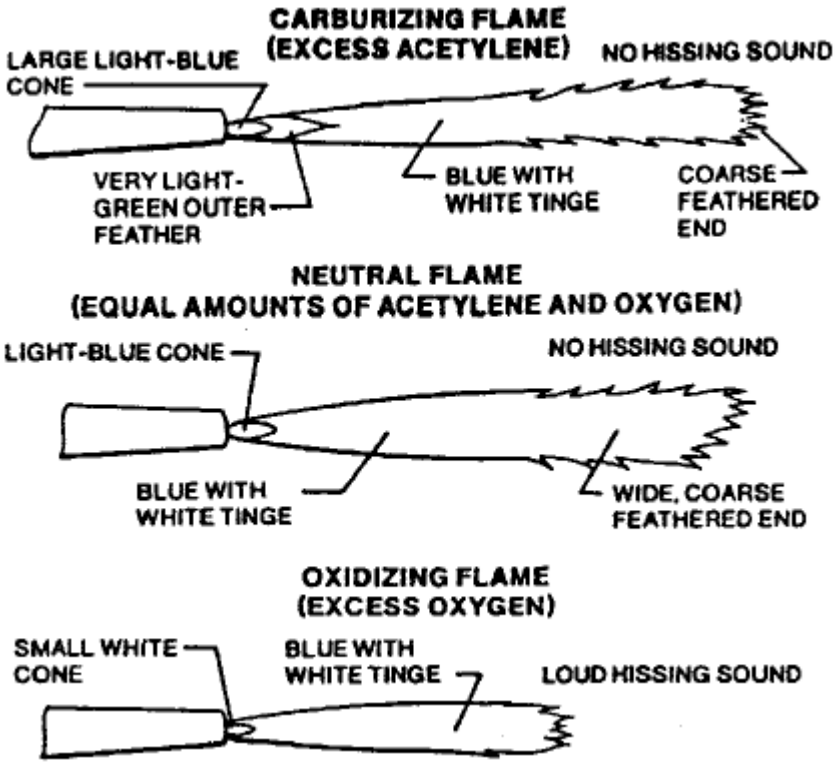
- ✓ In spot welding, heat is produced by electrical resistance between copper electrodes.
- ✓ Pressure is simultaneously applied to electrode tips to force metal together to complete fusing process.
- ✓ Spot-weld-nugget size is directly related to tip size.



Inspection of Welds (Cont'd)

INTRODUCTION (Cont'd):

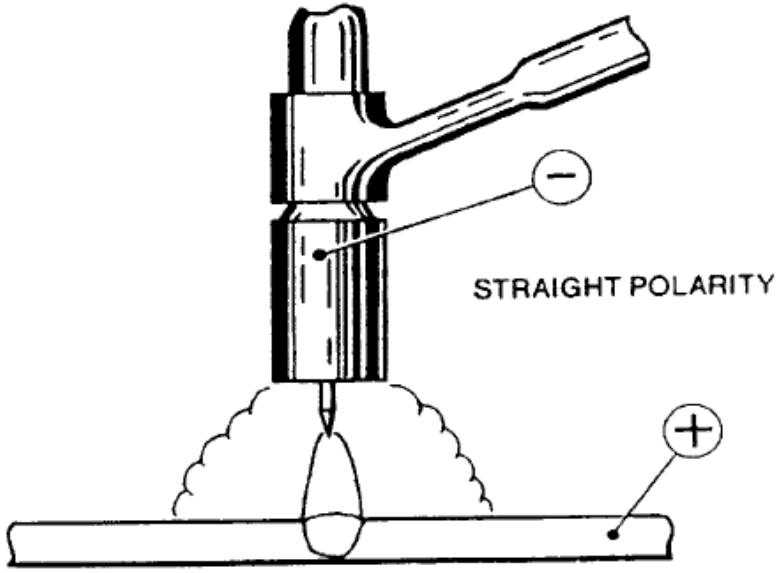
- **Basic gas-welding flames:**
  - **Each has distinctive:**
    - shape, color and sound.
  - **Neutral flame is the most used.**



Inspection of Welds (Cont'd)

INTRODUCTION (Cont'd):

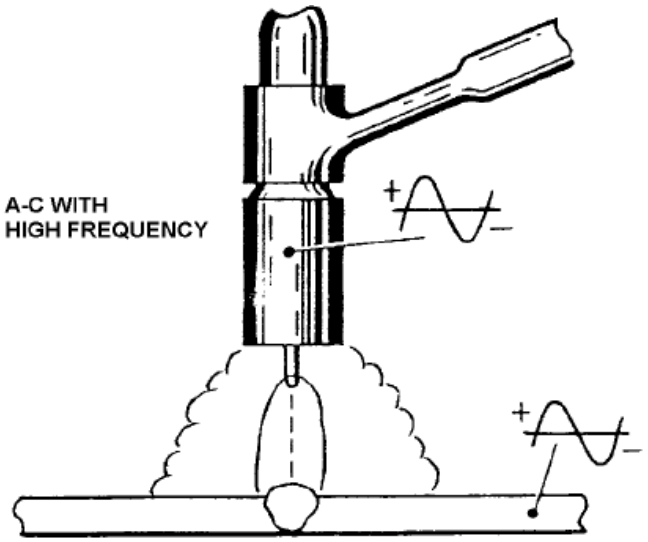
- **Set TIG welder to DC current straight polarity for welding:**
  - **mild steel, stainless steel and titanium.**



Inspection of Welds (Cont'd)

INTRODUCTION (Cont'd):

- **Set TIG to AC current for welding:**
  - **aluminum and magnesium.**

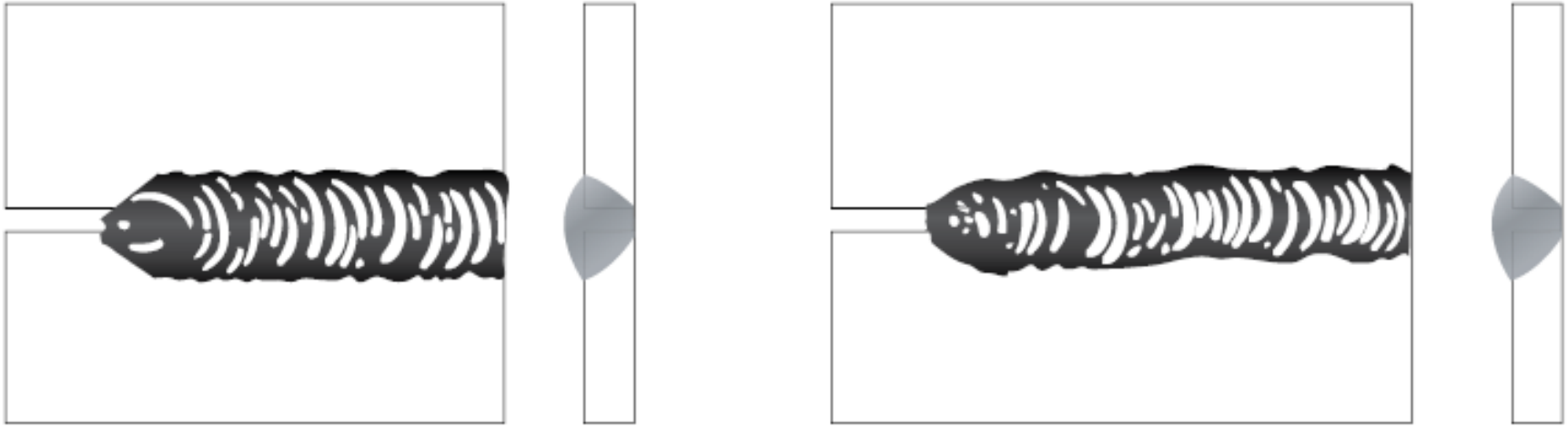


Inspection of Welds (Cont'd)

- the appearance of the completed weld is not a positive indication of quality, it provides a good clue about the care used in making it.
- properly designed joint weld is stronger than the base metal which it joins.
- characteristics of a properly welded joint:
  - ✓ uniform in width;
  - ✓ the ripples are even and well feathered into the base metal. (which shows no burn due to overheating)
  - ✓ good penetration and is free of gas pockets, porosity, or inclusions.

Inspection of Welds (Cont'd)

Examples of good welds



A B

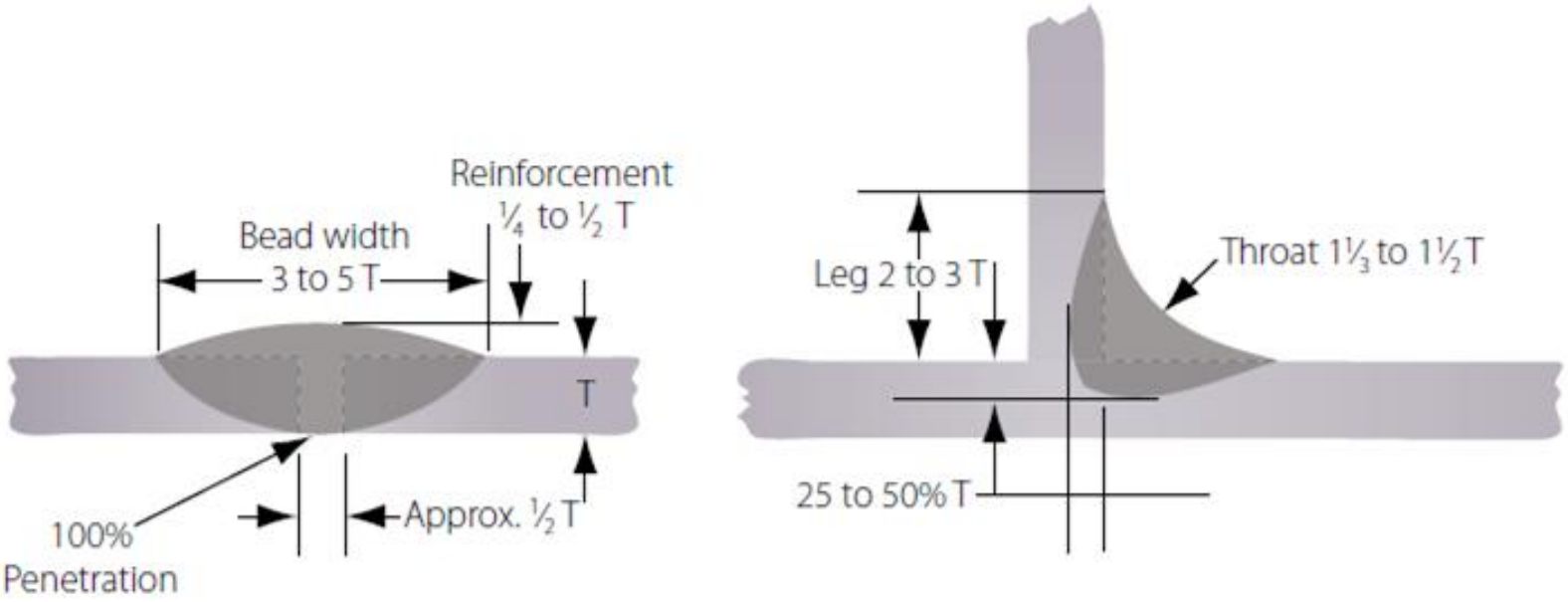
The edges of the bead illustrated in Figure (B) are not in a straight line, yet the weld is good since penetration is excellent.

Inspection of Welds (Cont'd)

- **Penetration of the filler rod:**
  - ✓ Penetration is the depth of fusion in a weld and is affected by:
    - the thickness of the material to be joined,
    - the size of the filler rod, and
    - how is the filler rod added.
  - ✓ In a butt weld, the penetration should be 100 percent of the thickness of the base metal.
  - ✓ On a fillet weld, the penetration requirements are 25 to 50 percent of the thickness of the base metal.

Inspection of Welds (Cont'd)

- The width and depth of bead for a butt weld and fillet weld are shown in the following figure.



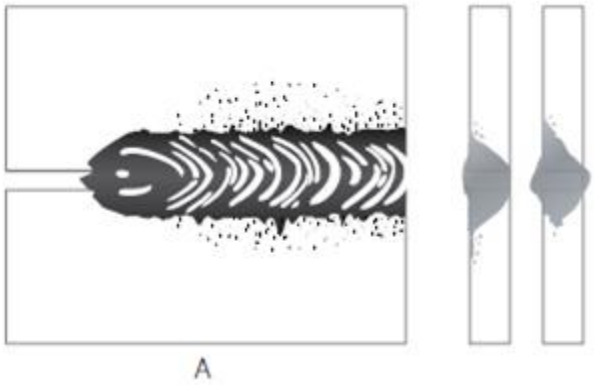
A. Butt weld

B. Fillet weld

Inspection of Welds (Cont'd)

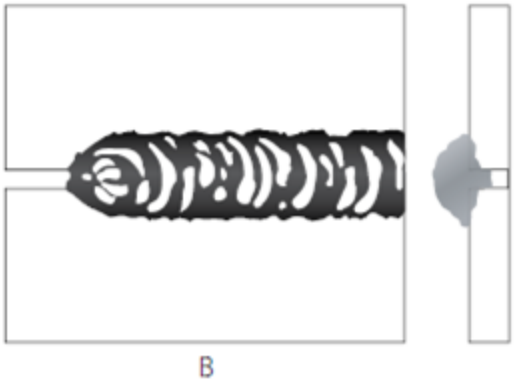
➢ Examples of incorrect welds:

A. The weld was made too rapidly:



- The long and pointed appearance of the ripples was caused by an excessive amount of heat or an oxidizing flame.
- If the weld were cross-sectioned, it would probably disclose gas pockets, porosity, and slag inclusions.

B. The weld caused by insufficient heat:

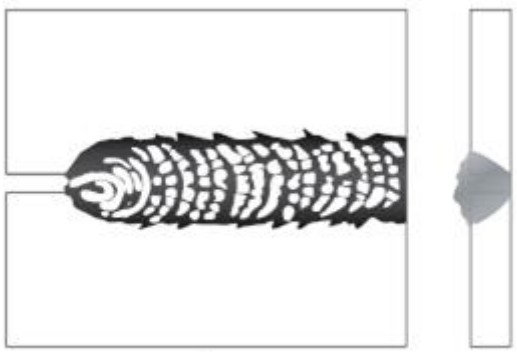


- weld that has improper penetration and cold laps.
- appears rough and irregular, and its edges are not feathered into the base metal.

Inspection of Welds (Cont'd)

➢ Examples of incorrect welds (Cont'd):

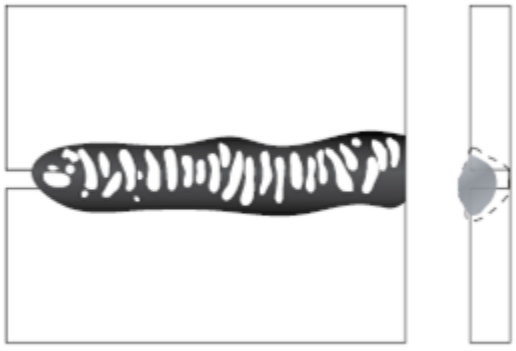
C. The weld caused by insufficient heat (cont'd)



C

- the puddle has a tendency to boil during the welding operation if an excessive amount of acetylene is used.
- this often leaves slight bumps along the center and craters at the finish of the weld.
- if the weld were cross-sectioned, pockets and porosity would be visible.

D. A weld with irregular edges and considerable variation in the depth of penetration.

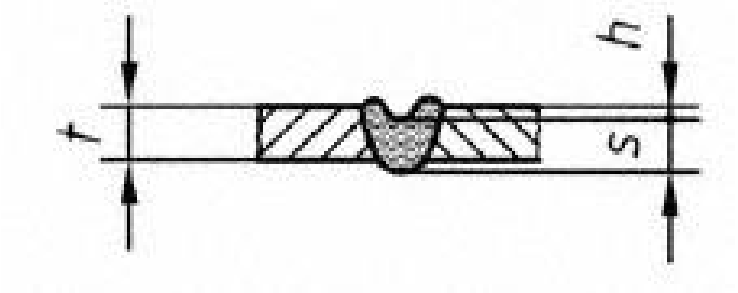


D

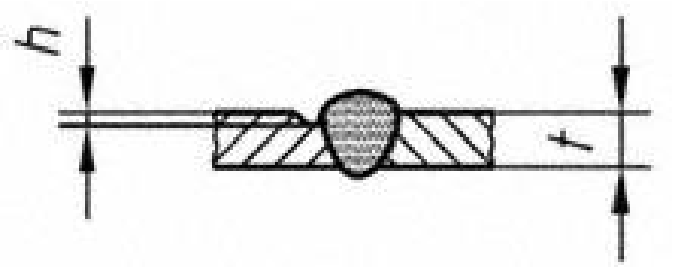
- It often has the appearance of a cold weld.

Inspection of Welds (Cont'd)

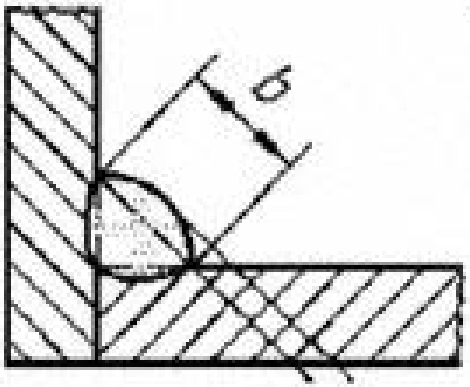
Examples of Welding Flaw:



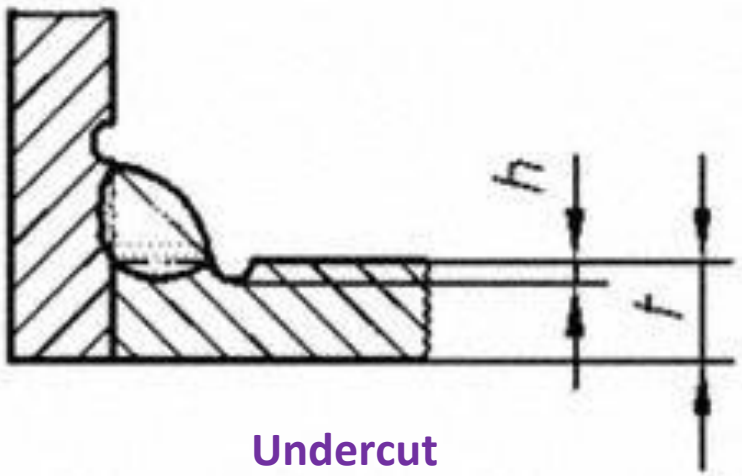
Joint incompletely filled



Mismatching edges



Inspection Dimension



Undercut

TYPES of FLAWS

➢ Corrosion.

is the electrochemical deterioration of a metal resulting from chemical reaction with the surrounding environment.

➢ Inherent Flaws:

is present in metal as the result of its initial solidification from the molten state, before any of the operations to forge or roll it into useful sizes and shapes have begun.

- **Primary pipe**
  - is a shrinkage cavity that forms at the top of an ingot during metal solidification,
  - shows up as irregular voids in finished products
- **Blowholes**
  - are secondary pipe holes in metal that can occur when gas bubbles are trapped as the molten metal in an ingot mold solidifies
- **Segregation**
  - is a nonuniform distribution of various chemical constituents that can occur in a metal when an ingot or casting solidifies
- **Porosity**
  - is holes in a material's surface or scattered throughout the material, caused by gases being liberated and trapped as the material solidifies
- **Inclusions**
  - are impurities, such as slag, oxides, sulfides, etc., that occur in ingots and castings.
  - caused by incomplete refining of the metal ore or the incomplete mixing of deoxidizing materials added to the molten metal in the furnace.
- **Shrinkage cracks**
  - occur in castings due to stresses caused by the metal contracting as it cools and solidifies.

TYPES of FLAWS (Cont'd)

➢ Primary Processing Flaws:

- Seams
  - are surface flaws, generally long, straight, and parallel to the longitudinal axis of the material
  - introduced by drawing or rolling processes
- Laminations
  - are formed in rolled plate, sheet, or strip when blowholes or internal fissures are not welded tight during the rolling process and are enlarged and flattened into areas of horizontal discontinuities.
- Cupping
  - is a series of internal metal ruptures created when the interior metal does not flow as rapidly as the surface metal during drawing or extruding processes.
- Cooling cracks
  - occur in casting due to stresses resulting from cooling, and are often associated with changes in cross sections of the part, or
  - occur when alloy and tool steel bars are rolled and subsequently cooled.

TYPES of FLAWS (Cont'd)

➢ Primary Processing Flaws (Cont'd):

- **Flakes**
  - are internal ruptures that can occur in metal as a result of cooling too rapidly.
- **Forging laps**
  - result of metal being folded over and forced into the surface, but not welded to form a single piece.
- **Forging bursts**
  - are internal or external ruptures that occur when forging operations are started before the material to be forged reaches the proper temperature throughout.
- **hot tear**
  - is a pulling apart of the metal that can occur in castings when the metal contracts as it solidifies.
- **cold shut**
  - is a failure of metal to fuse.
  - occur in castings when part of the metal being poured into the mold cools and does not fuse with the rest of the metal into a solid piece.

TYPES of FLAWS (Cont'd)

➢ Primary Processing Flaws (Cont'd):

- Incomplete weld penetration
  - is a failure of the weld metal to penetrate completely through a joint before solidifying.
- Incomplete weld fusion
  - occurs in welds where the temperature has not been high enough to melt the parent metal adjacent to the weld.
- Weld undercutting
  - is a decrease in the thickness of the parent material at the toe of the weld caused by welding at too high a temperature.
- Cracks in the weld metal
  - caused by the contraction of a thin section of the metal cooling faster than a heavier section, or
  - incorrect heat or type of filler rod.
- Weld crater cracks
  - are star shaped cracks that can occur at the end of a weld run.
- Cracks in the weld heat-affected zone
  - occur because of stress induced in the material adjacent to the weld by its expansion and contraction from thermal changes.
- slag inclusion is a nonmetallic solid material
  - is a nonmetallic solid material that becomes trapped in the weld metal or between the weld metal and the base metal.
- Scale is an oxide formed on metal
  - is an oxide formed on metal by the chemical action of the surface metal with oxygen from the air.

TYPES of FLAWS (Cont'd)

➢ Secondary Processing or Finishing Flaws:

- **Machining tears**
  - occur when working a part with a dull cutting tool or by cutting to a depth that is too great for the material being worked.
- **Heat treating cracks**
  - occur where a part has a sudden change of section that could cause an uneven cooling rate, or at fillets and notches that act as stress concentration points
  - are caused by stresses setup by unequal heating or cooling of portions of a part during heat treating operations.
- **Grinding cracks**
  - are thermal type cracks similar to heat treating cracks and can occur when hardened surfaces are ground.
- **Etching cracks**
  - occur when hardened surfaces containing internal residual stresses are etched in acid.
- **Plating cracks**
  - Generally, found in areas where high residual stresses remain from some previous operation involving the part.
  - occur when hardened surfaces are electroplated.

TYPES of FLAWS (Cont'd)

- **In-Service Flaws:**
  - Stress corrosion cracks
  - Overstress cracks
  - Fatigue cracks
  - Unbonds, or disbonds
  - Delamination

NDT LEVELS

NDT LEVELS

- **Reference:**

  Air Transport Association (ATA) Specification 105-Guidelines. (For Training and Qualifying Personnel In Nondestructive Testing Methods)

NDT LEVELS (Cont'd)

- **Level I Special:**
  - ✓ individual must be able to pass a vision and color perception examination,
  - ✓ a general exam dealing with standards and NDT procedures, and
  - ✓ a practical exam conducted by a qualified Level II or Level III certificated person.

NDT LEVELS (Cont'd)

- **Level I/Level II:**
  - ✓ the individual shall have an Airframe and Powerplant Mechanic Certificate,
  - ✓ complete the required number of formal classroom hours, and
  - ✓ complete an examination.

NDT LEVELS (Cont'd)

- **Level III:**
  1. The individual must have graduated from a 4 year college or university with a degree in engineering or science, plus 1 year of minimum experience in NDT in an assignment comparable to that of a Level II in the applicable NDT methods: or
  2. The individual must have 2 years of engineering or science study at a university, college, or technical school, plus 2 years of experience as a Level II in the applicable NDT methods: or
  3. The individual must have 4 years of experience working as a Level II in the applicable NDT methods and complete an examination.

TRAINING, QUALIFICATION, AND CERTIFICATION

NDI method and procedure

✓knowledge,
✓skill, and
✓experience

} success

TRAINING, QUALIFICATION, AND CERTIFICATION (Cont'd)

- **knowledge, skill, and experience:**
  - ✓ familiar with the test method,
  - ✓ know the potential types of discontinuities peculiar to the material, and
  - ✓ familiar with their effect on the structural integrity of the part.

TRAINING, QUALIFICATION, AND CERTIFICATION (Cont'd)

- **person(s) qualification standards:**
  - ✓ certified to specific CASR / FAA's standard
  - ✓ acceptable government or industry standards:
    - MIL-STD-410, (Nondestructive Testing Personnel Qualification and Certification)
    - ATA Specification 105 (Guidelines for Training and Qualifying Personnel in Nondestructive Testing Methods)

SUMMARY

Before starting an inspection

- Clean structure
- Open or remove all :
  - ✓ plates,
  - ✓ access doors,
  - ✓ fairings, and
  - ✓ cowling

Preparation

- **paperwork and/or reference information must be accessed and studied:**
  - ✓ **review aircraft logbooks to provide background information and a maintenance history of the aircraft.**
  - ✓ **utilize appropriate checklist to ensure that no items will be forgotten or overlooked during the inspection.**
  - ✓ **additional publications must be available, (either in hard copy or in electronic format) to assist in the inspections which include:**
    - **information provided by the aircraft and engine manufacturers, appliance manufacturers, parts venders, and the CASR / FAA.**