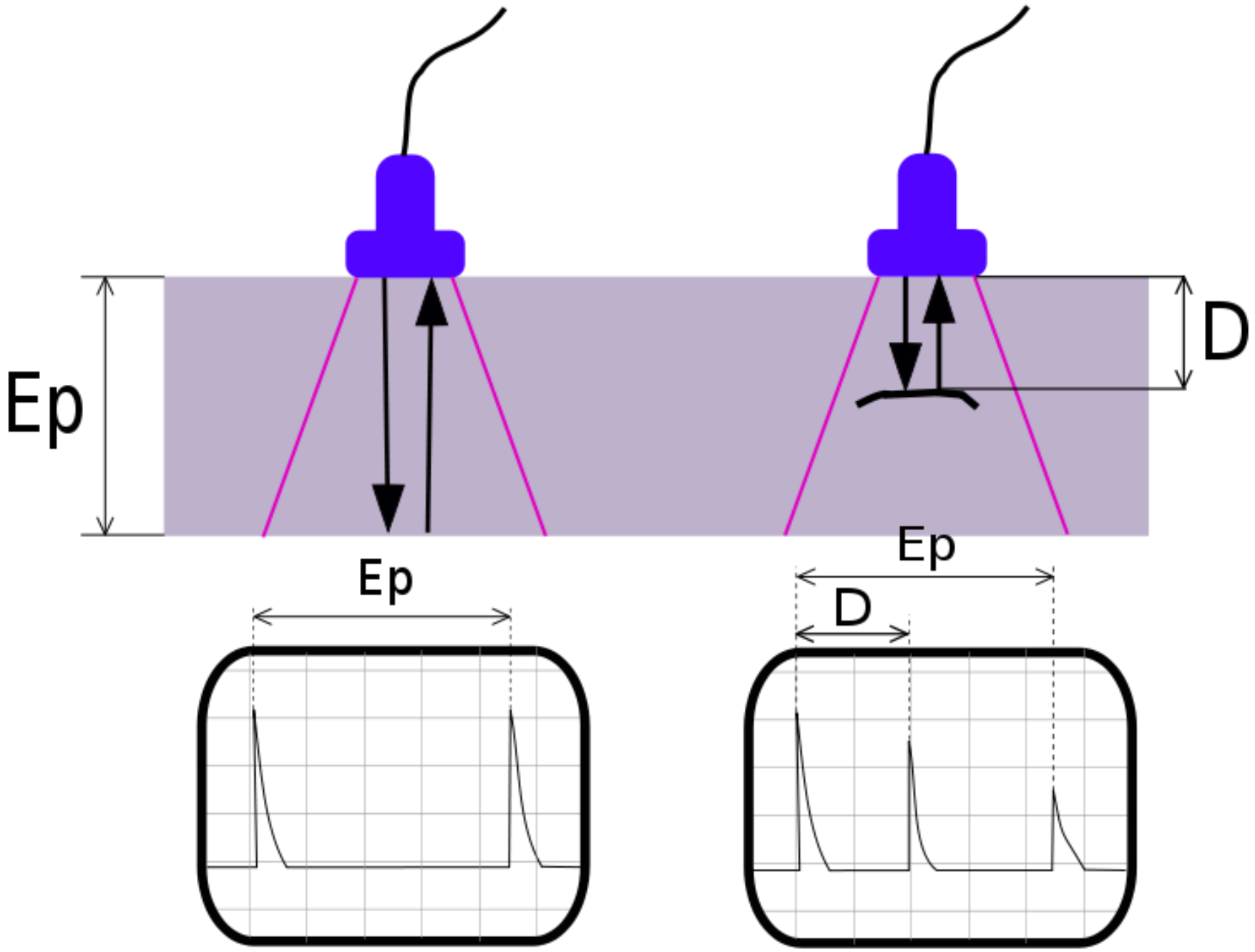
5. Ultrasonic Testing (UT)

- High frequency sound wave (1.0 – 10.0 MHz) introduced through coupling agent into the material completely or partially bounces back on discontinuities or areas of different acoustic impedance

- Knowing speed of sound in the material and time the signal travels the discontinuity distance from the surface can be calculated in real time

- Techniques: straight beam, angle beam, immersion, through transmission, phased array (many small transducer in one probe), time of flight diffraction (TOFD)


Ep
D
Ep
Ep
D


OLYMPUS
EPOCH 600
NEXT GROUP
F1
F2
F3
F4
F5
P1
P2
P3
P4
P5
P6
P7
dB
RANGE
GATES
PEAK MEM
2ND F
FREEZE

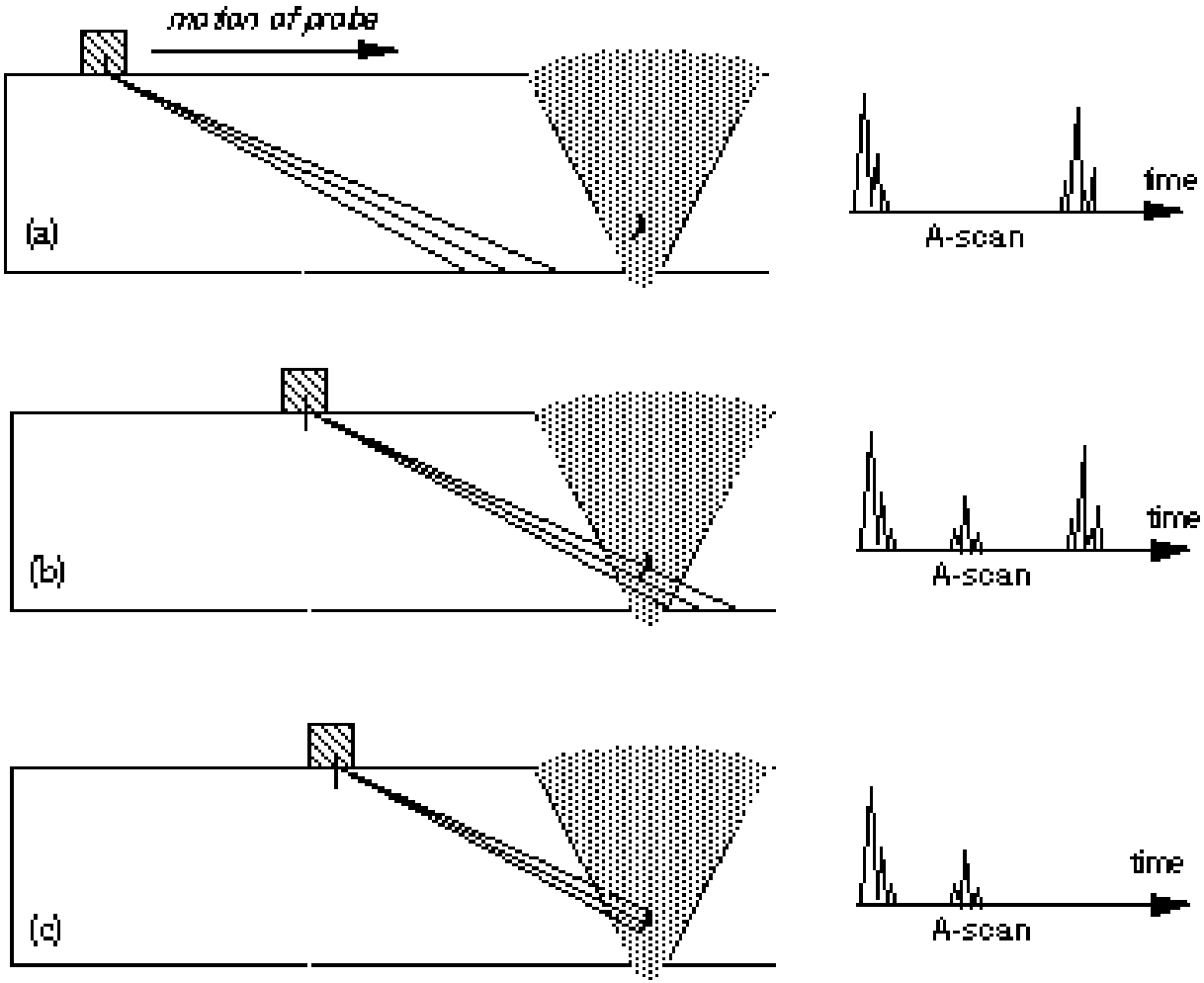
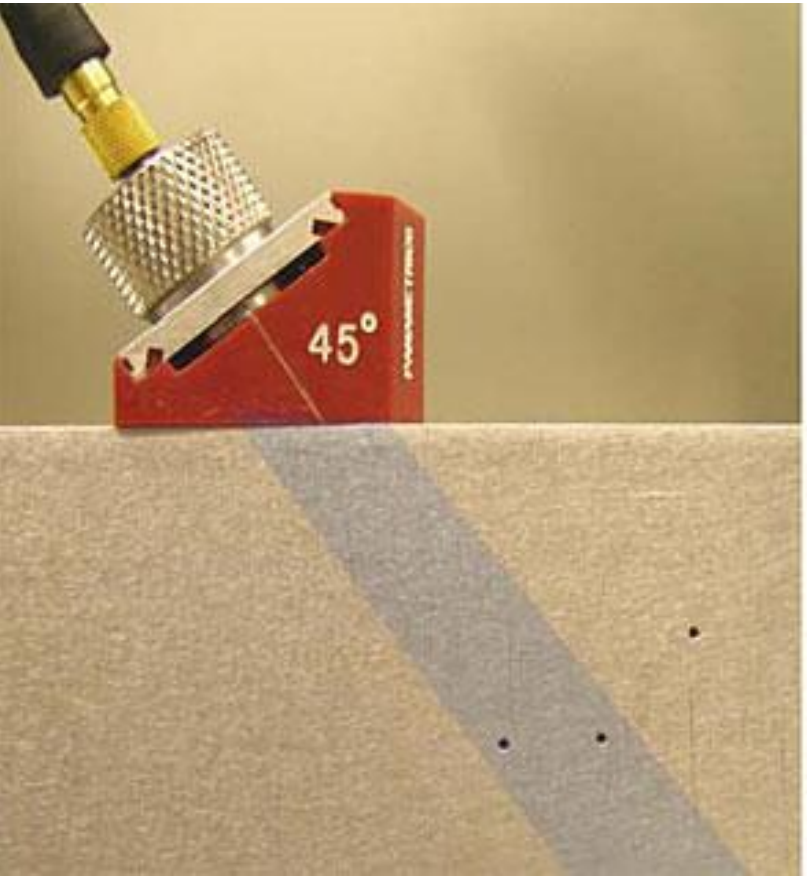
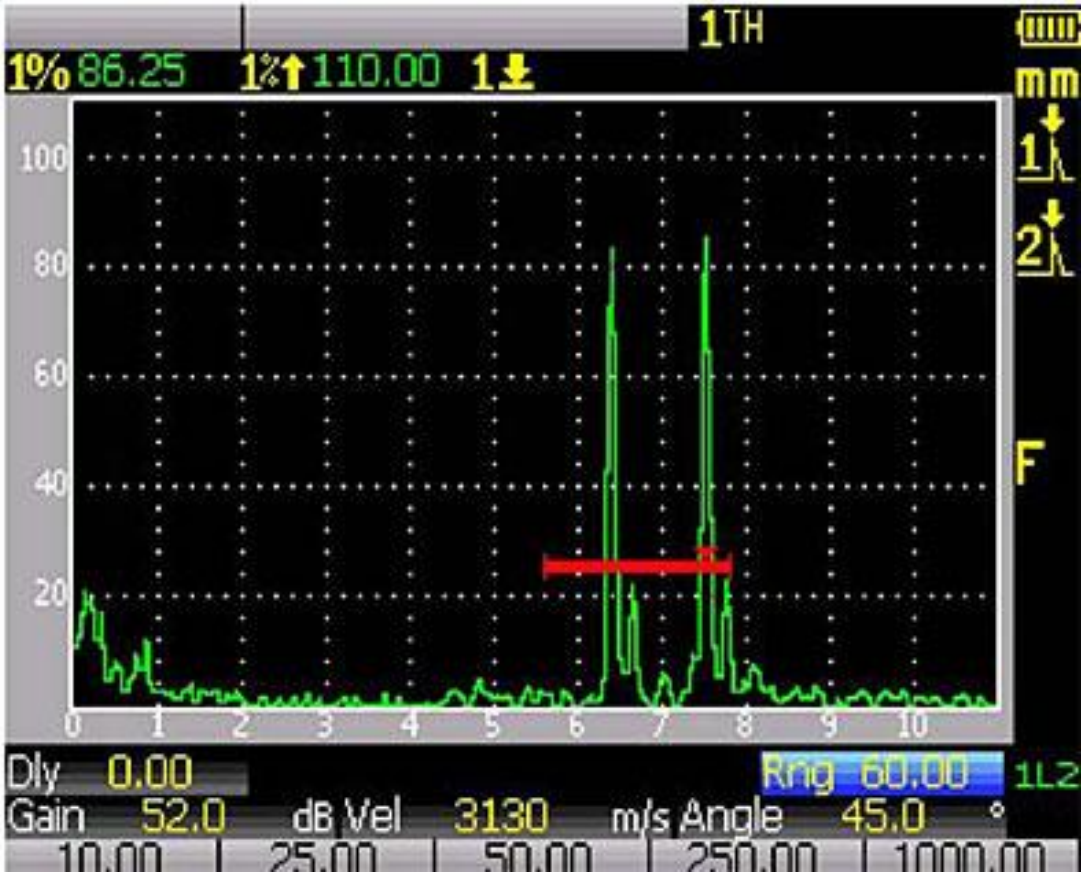
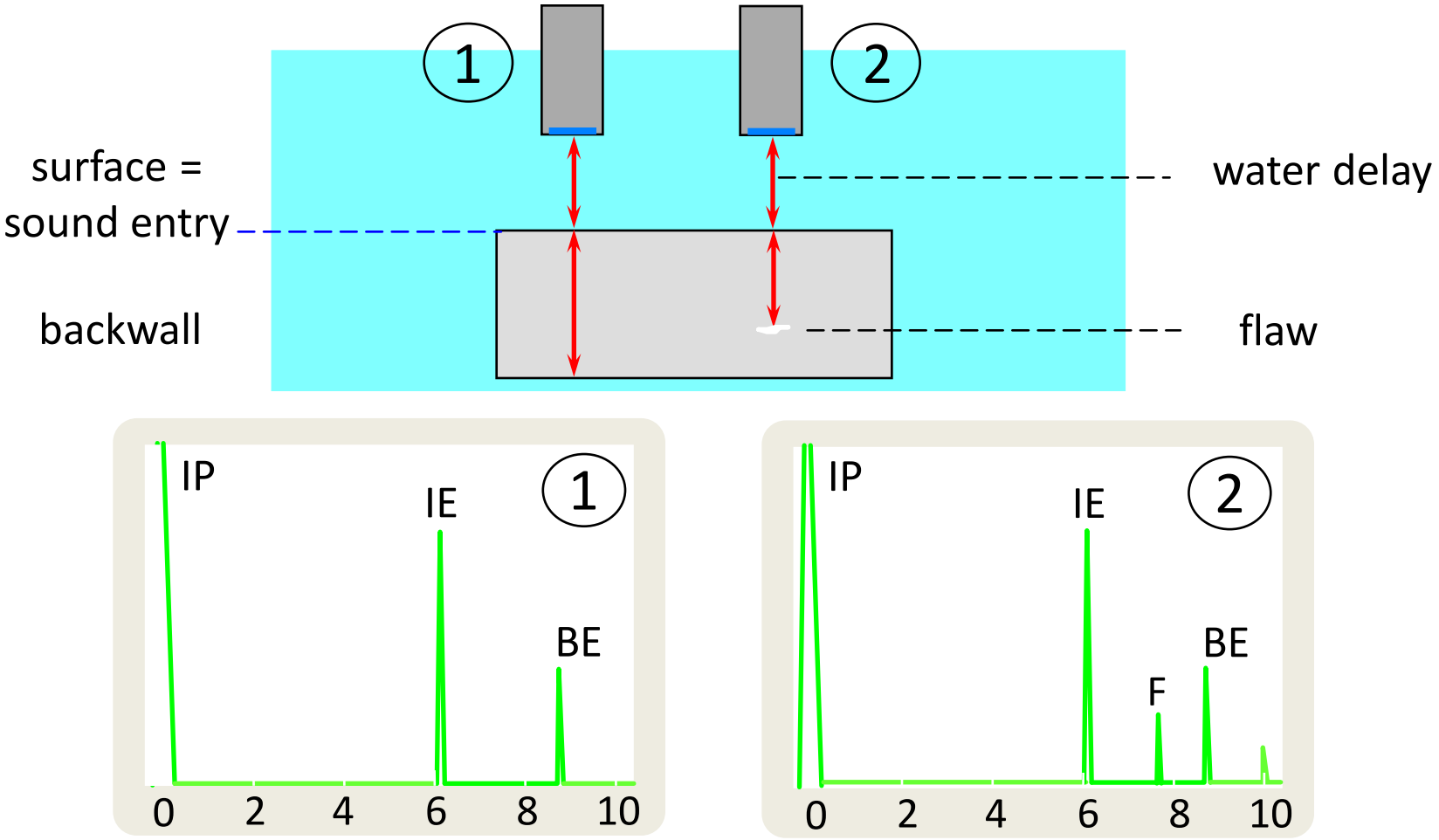


Fig. 1 - pulse echo examination of a weld using a 60° probe. In (a) only the surface and backwall echoes are present in the A-scan. As the defect is reached in (b) the defect signal also becomes apparent, registering between the two component echoes. For a short period the defect may even block access to the backwall as shown in (c).


45°


1TH
1% 86.25
1% 110.00
1
mm
1
2
F
100
80
60
40
20
0 1 2 3 4 5 6 7 8 9 10
Dly 0.00
Rng 60.00
1L2
Gain 52.0 dB Vel 3130 m/s Angle 45.0 °
10.00 25.00 50.00 250.00 1000.00


EPOCH 1000
OLYMPUS
1 2 3
REF dB
dB
SAVE
AUTO XX%
GATE
DELAY
RANGE
PK HOLD
ANGLE
PEAK MEM
PRINT
2ND F
RECALL SETUP
1% 13.00
2% 2.50
G2-1 LOS
Angle
Gain
55.1 dB
Range
4.600
Delay
0.000
Basic
Pulser
Receiver
TRIG
Auto CAL
F1
F2
F3
F4
F5
P1
P2
P3
P4
P5
P6
PANAMETRICS
NDT
ABWS-8
45° STEEL


1
2
surface =
sound entry
water delay
backwall
flaw
IP
IE
BE
1
0
2
4
6
8
10
IP
IE
F
BE
2
0
2
4
6
8
10


Tektronix
FRAGILE


WinS


NDT
JAMES INSTRUMENTS


D5
ZETEC


Sperry
© Michael Taylor

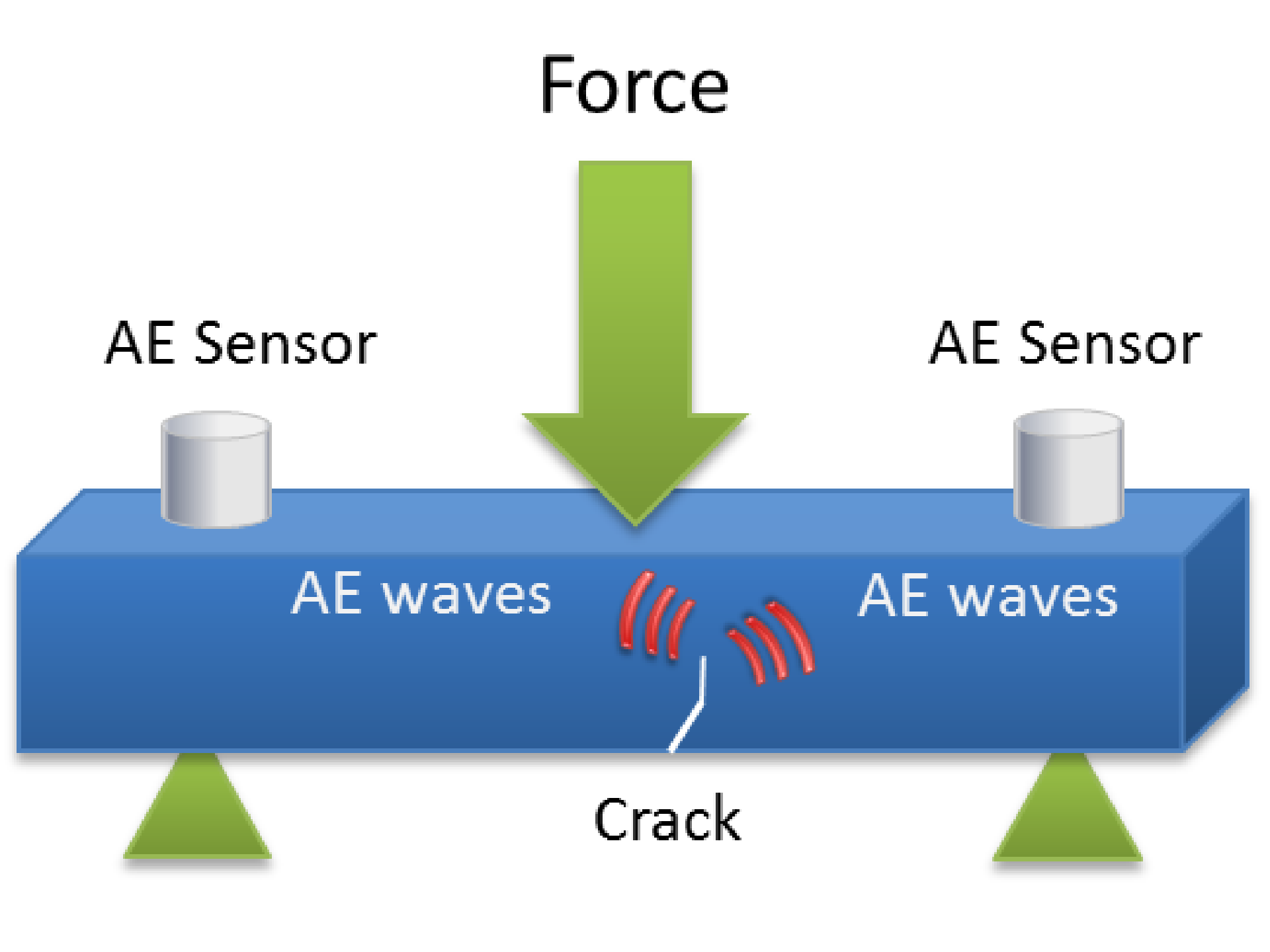
5. Ultrasonic Testing (UT)

+ portable, inexpensive, sensitive to small discontinuities, immediate results, wide range of materials and thicknesses can be inspected

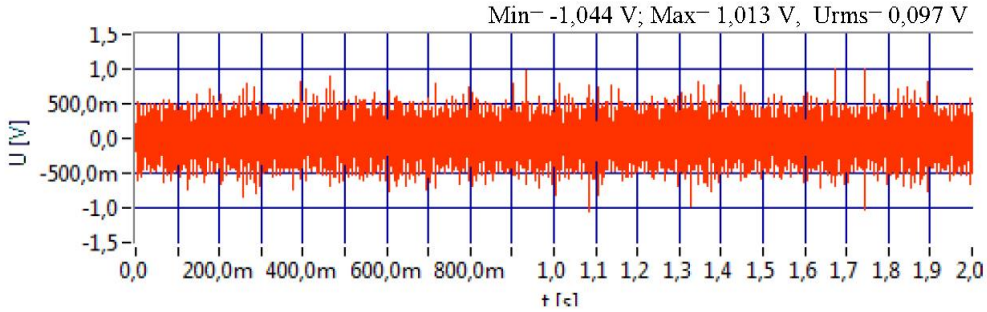
- surface must be accessible to probe, surface texture may interfere with the test, high degree of skill required to setup and interpret

6. Acoustic Emission Testing (AE)

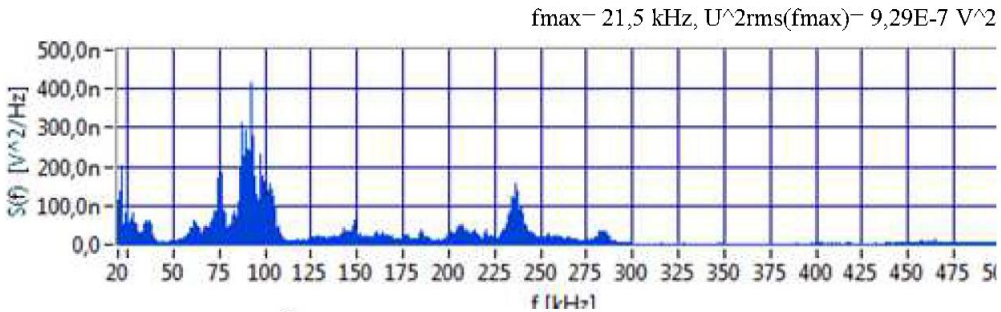
- phenomenon of sound and ultrasound wave radiation in materials subjected to mechanical stress exposure (crack propagation, deformation, faying surfaces shift, etc.)


Force
AE Sensor
AE Sensor
AE waves
AE waves
Crack

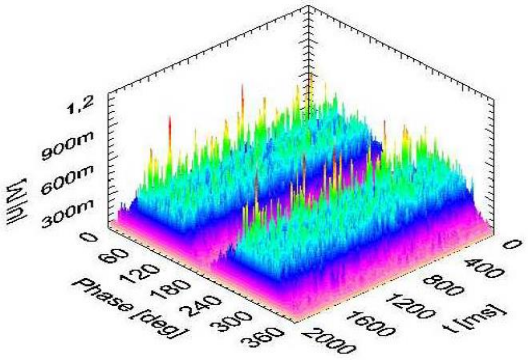
a)


Min= -1,044 V; Max= 1,013 V, Urms= 0,097 V
U [V]
t [s]

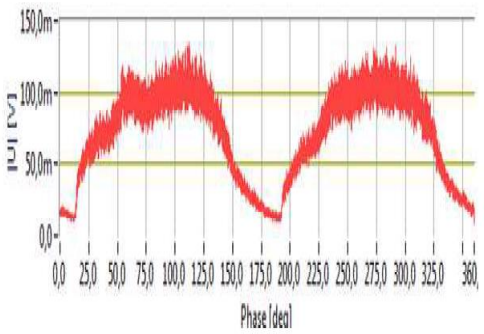
b)


fmax= 21,5 kHz, U^2rms(fmax)= 9,29E-7 V^2
S(f) [V^2/Hz]
f [kHz]

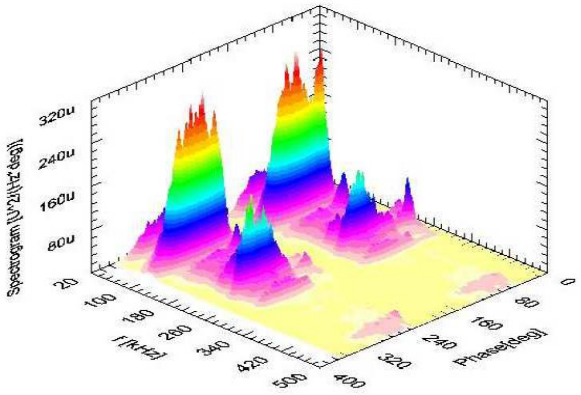
c)


Phase [deg]
t [ms]

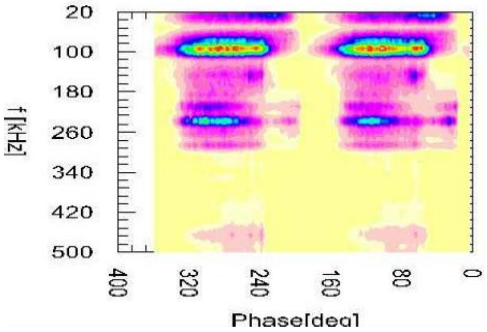
d)

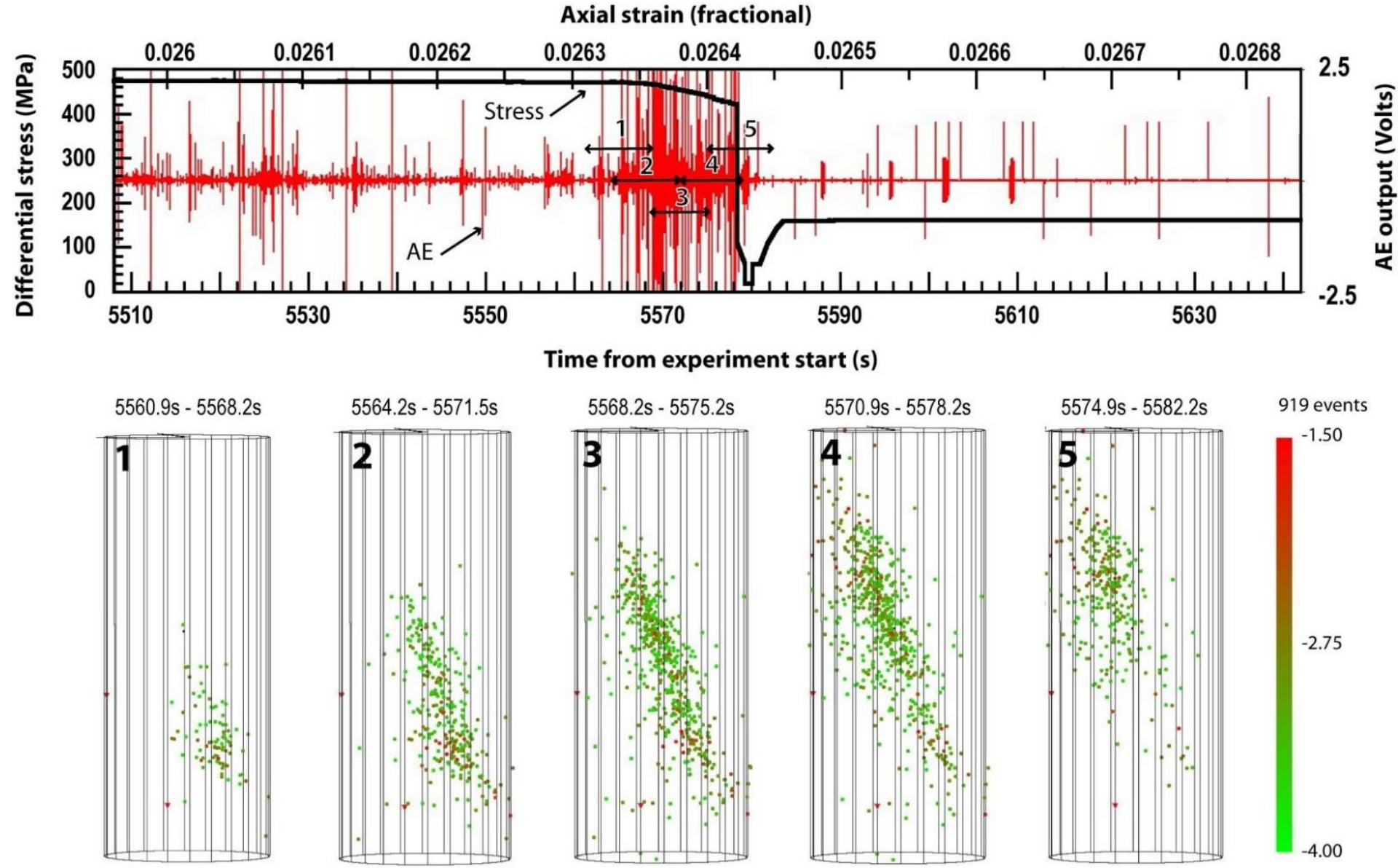

Phase [deg]

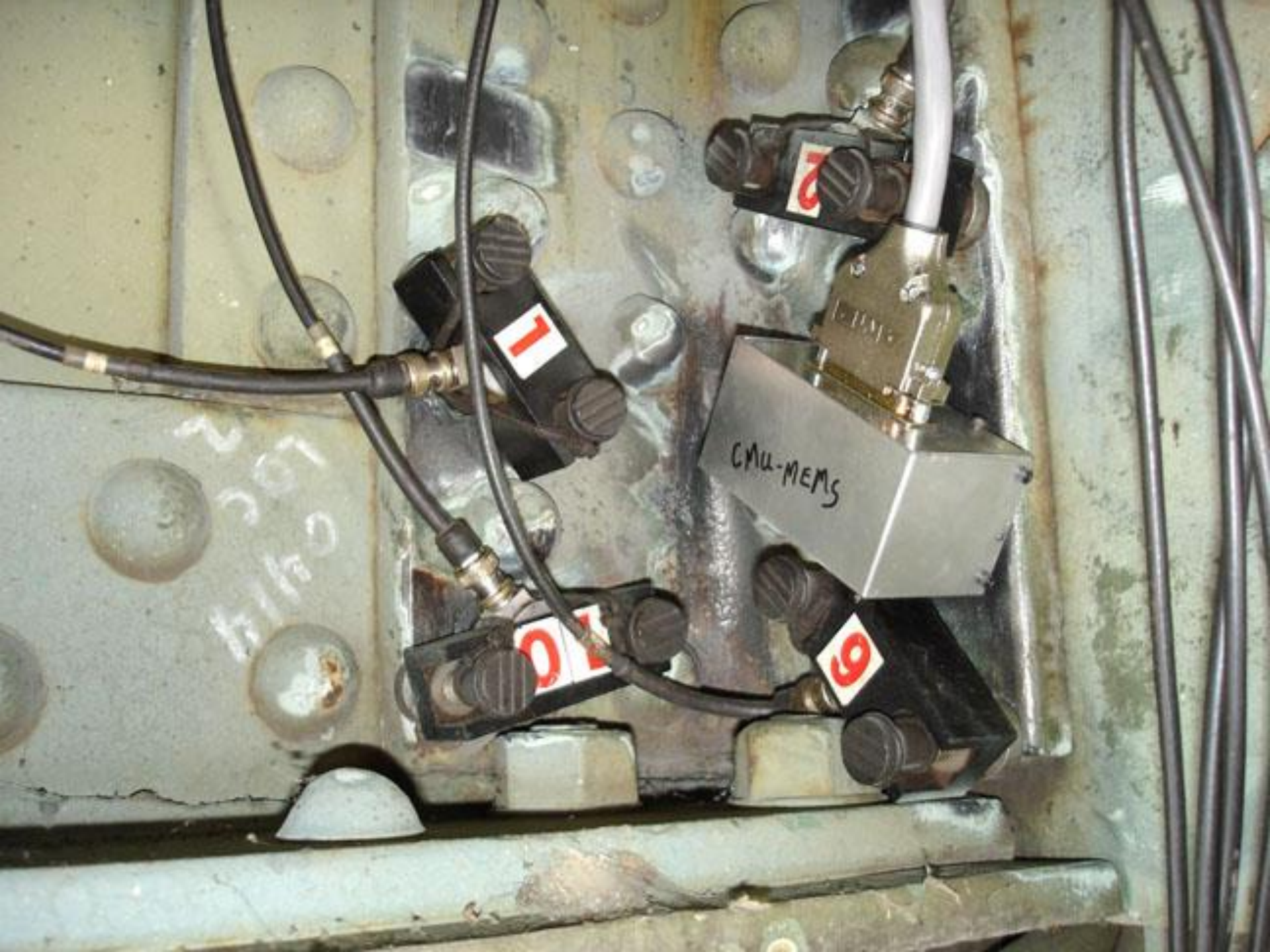
e)

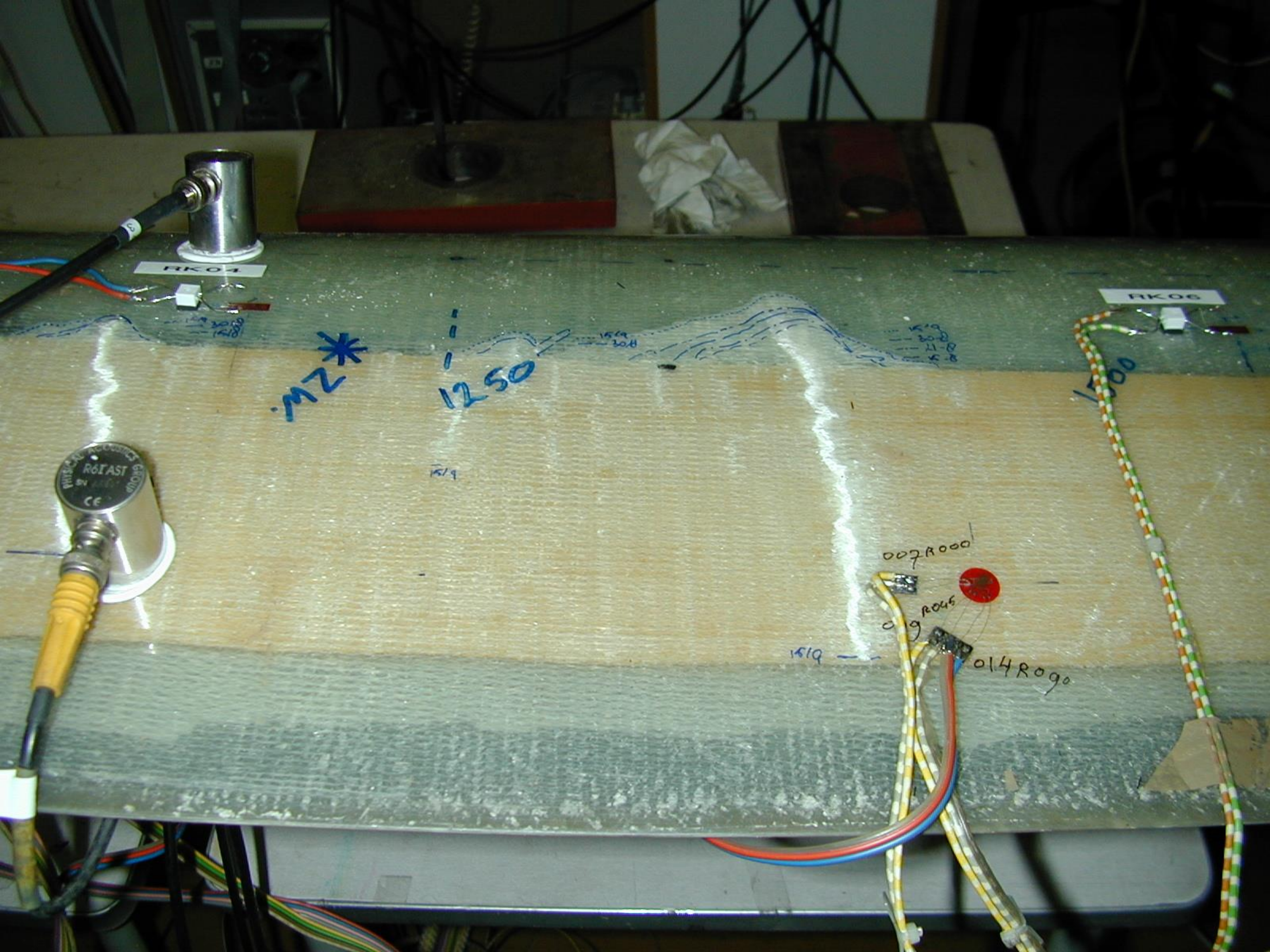

f [kHz]
Phase[deg]

f)


f [kHz]
Phase[deg]


Axial strain (fractional)
0.026
0.0261
0.0262
0.0263
0.0264
0.0265
0.0266
0.0267
0.0268
Differential stress (MPa)
500
400
300
200
100
0
Stress
AE
1
2
3
4
5
2.5
-2.5
AE output (Volts)
5510
5530
5550
5570
5590
5610
5630
Time from experiment start (s)
5560.9s - 5568.2s
5564.2s - 5571.5s
5568.2s - 5575.2s
5570.9s - 5578.2s
5574.9s - 5582.2s
919 events
-1.50
-2.75
-4.00


1
2
CMU-MEMS
9



RK04
RK06
1250
007R000
014R090

6. Acoustic Emission Testing (AE)

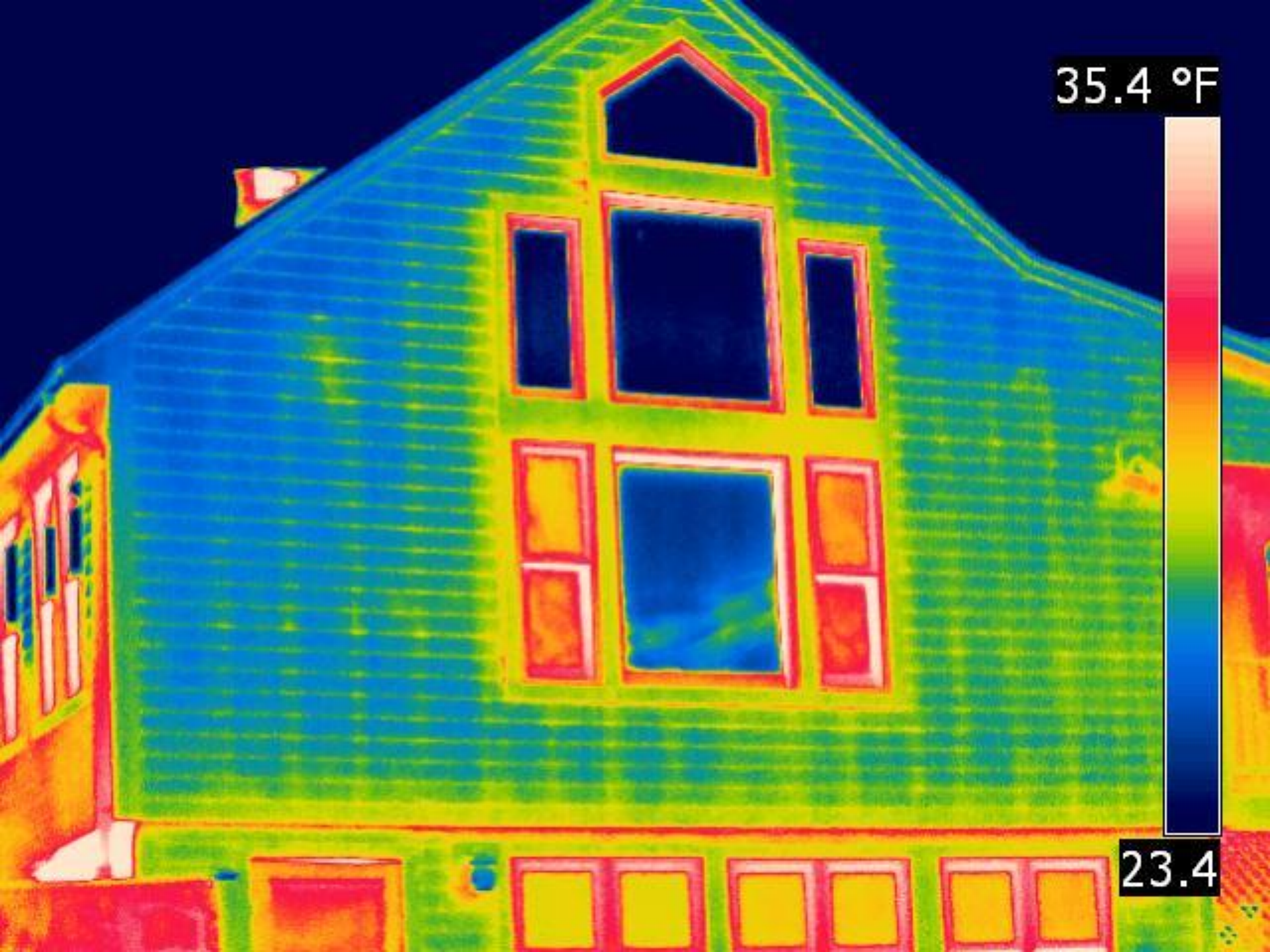
+ can be used on most materials, detects dynamic processes, provides fast and complete volumetric inspection, permanent process control
- more qualitative than quantitative, background noise affects test, may be very difficult to interpret

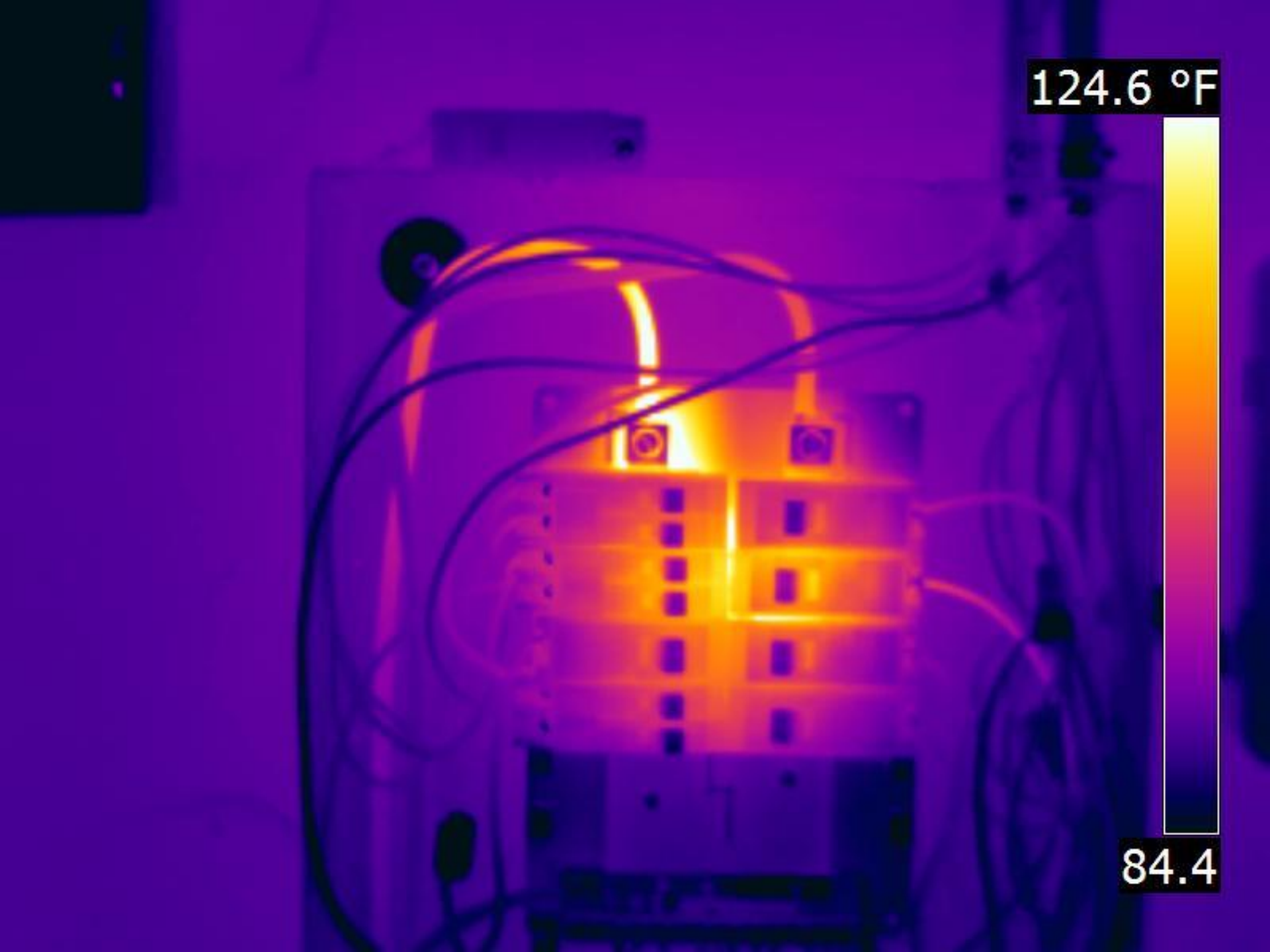
7. Infrared Testing (IR)

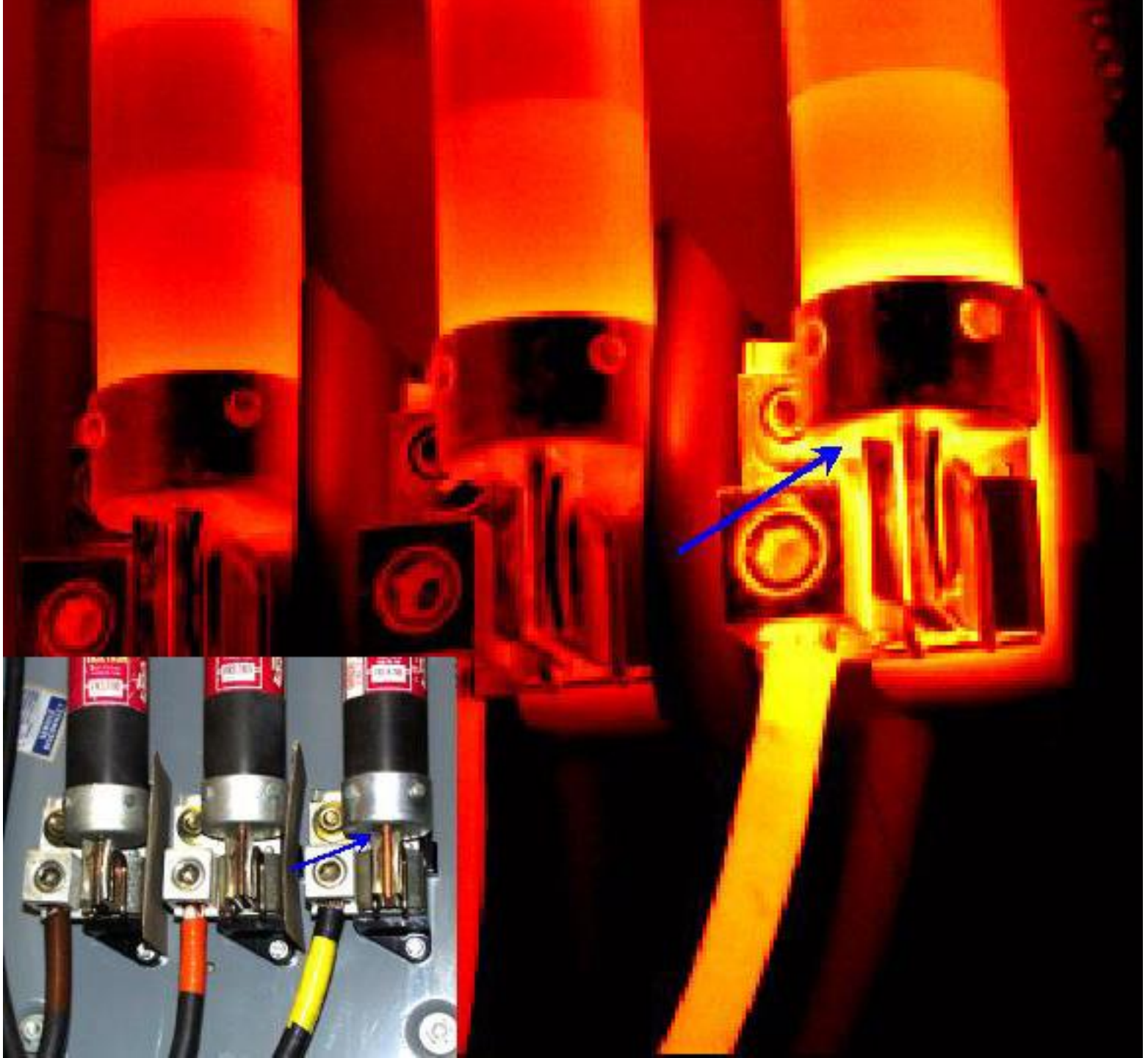
- infrared thermography, is used to measure or map surface temperatures based on the infrared radiation given off by an object as heat flows through, to or from that object

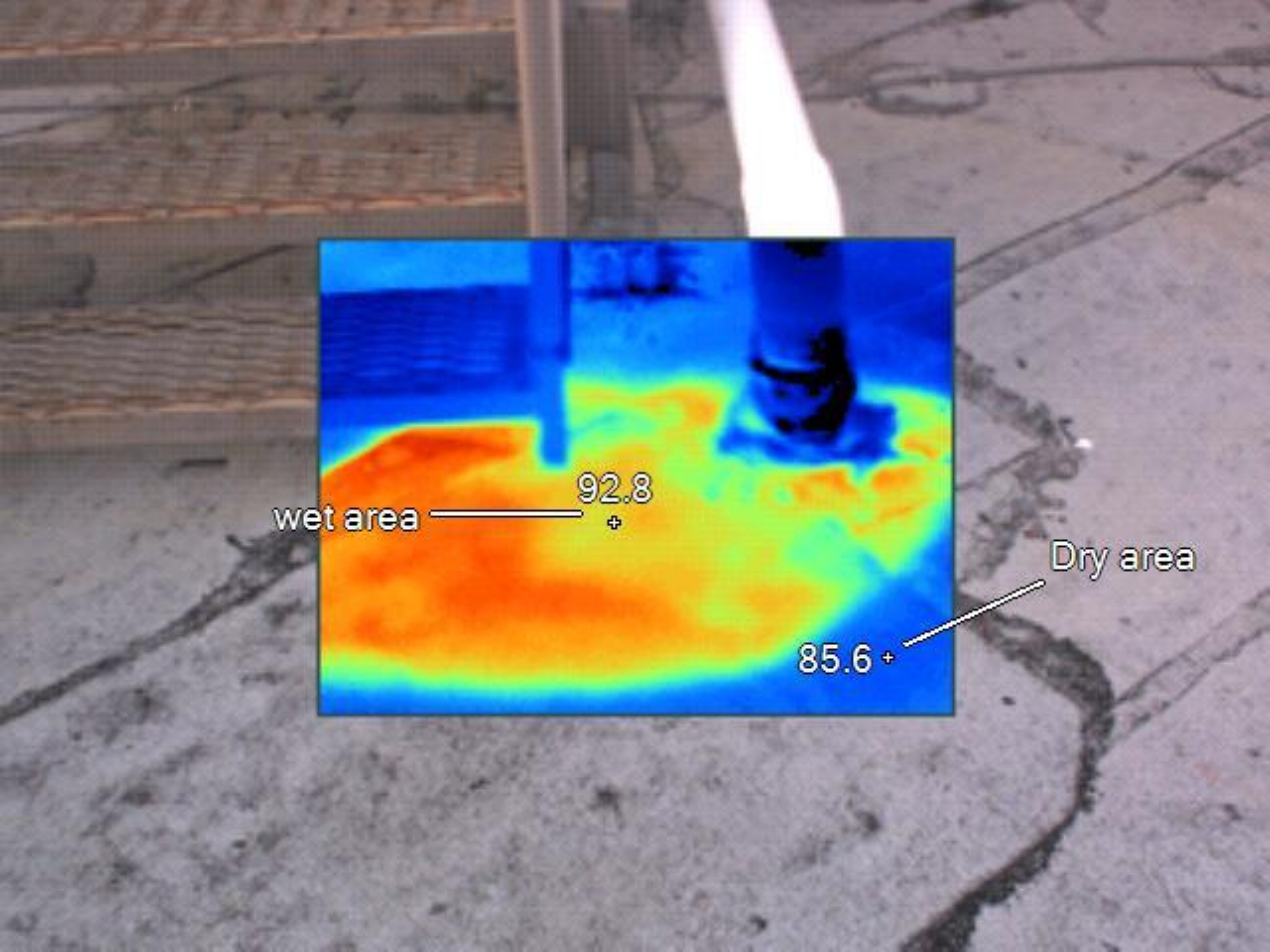

FLIR


FLUKE
THERMAL IMAGER
58.4°C
Manual 1
63.1
22.9
E=0.95
BG=72.5
T=100%
7/23/13 11:10:33 AM
F1
F2
F3


35.4 °F
23.4


124.6 °F
84.4




92.8
wet area
Dry area
85.6