POWER SUPPLY and PRINTER-SCANNER-COPIER-FAX and LCD TELEVISION investigated to draft IEC 62368-1

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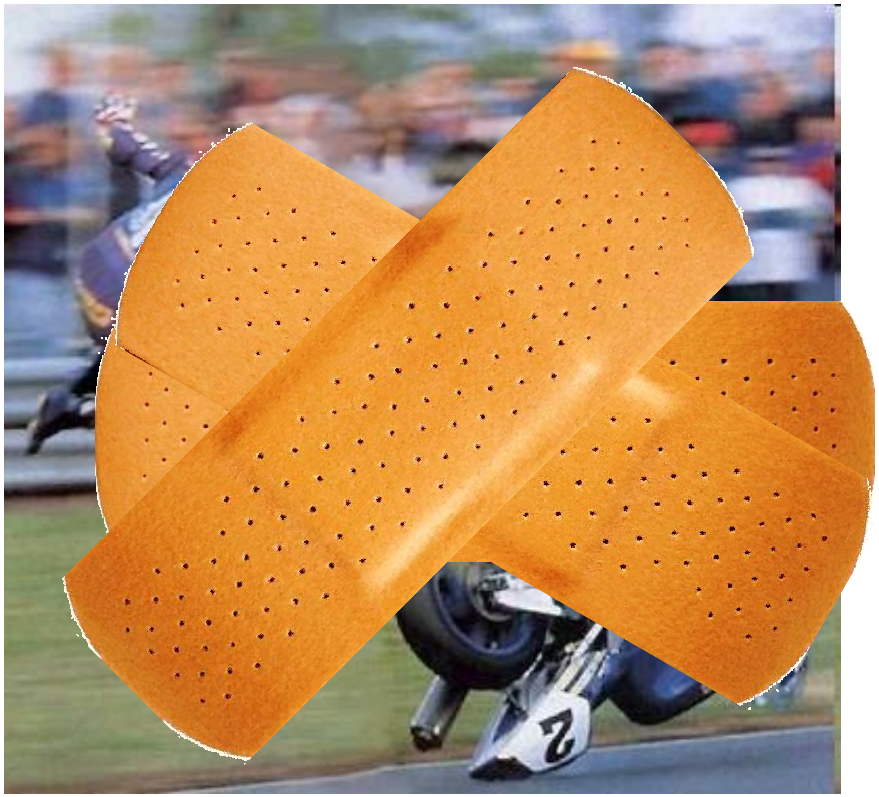
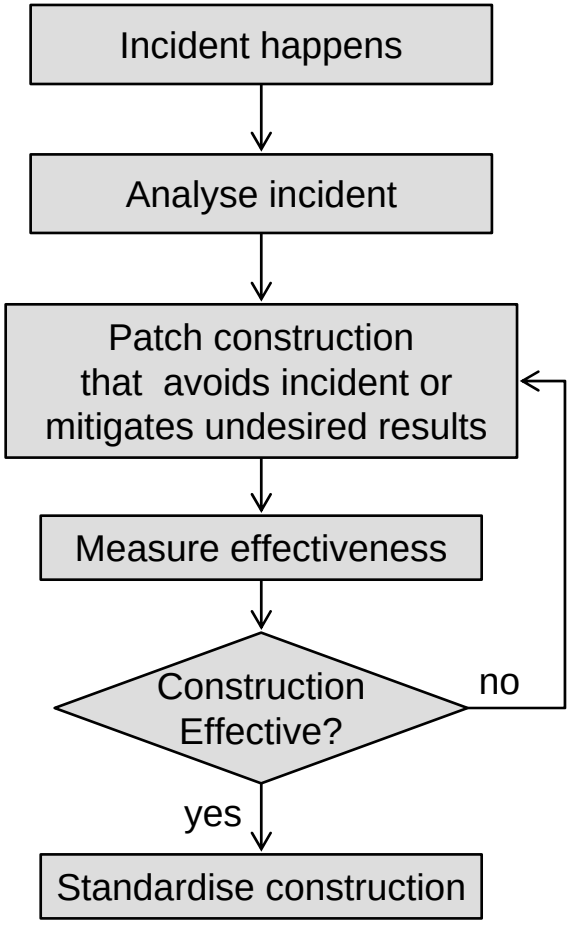
IEC 60950-1 versus IEC 62368-1

- **IEC 60950-1**
  - Incident-based
  - Product-specific
  - Construction based
  - Reactive
- **IEC 62368-1**
  - Hazard-based
  - Technology independent
  - Performance based
  - Proactive

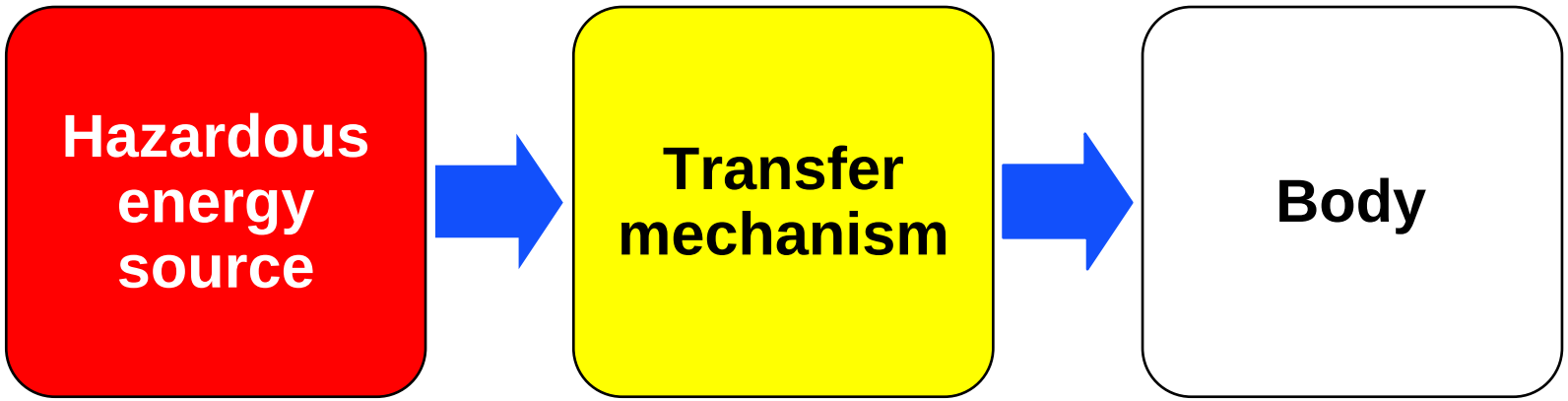
INCIDENT BASED SAFETY ENGINEERING





MODEL FOR INJURY

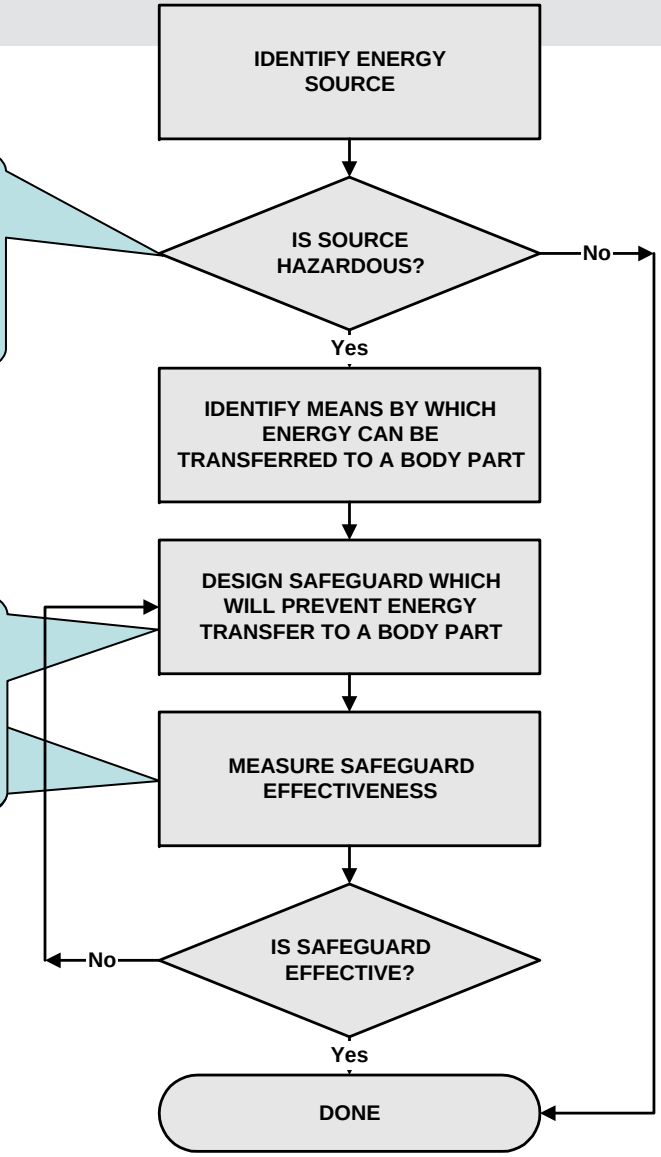
If there was no safety standard, how would you make a safe product?



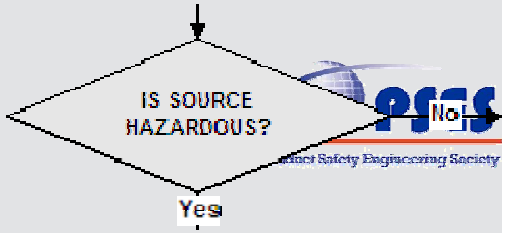
SAFETY EVALUATION PROCESS

The limit values for determining whether or not an energy source is hazardous are based on IEC Basic and Group safety publications.

The safeguard tests and parameters are based on IEC Basic and Group safety publications.

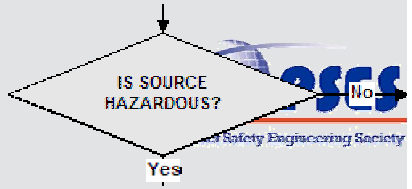


IS THE SOURCE HAZARDOUS?



Class 1 energy source	Class 2 energy source	Class 3 energy source
May be detectable, but is not painful nor is it likely to cause an injury. Ignition not likely.	May be painful, but is not likely to cause an injury. Ignition possible, but limited growth and spread of fire.	Capable of causing an injury. Ignition likely; rapid growth and spread of fire.

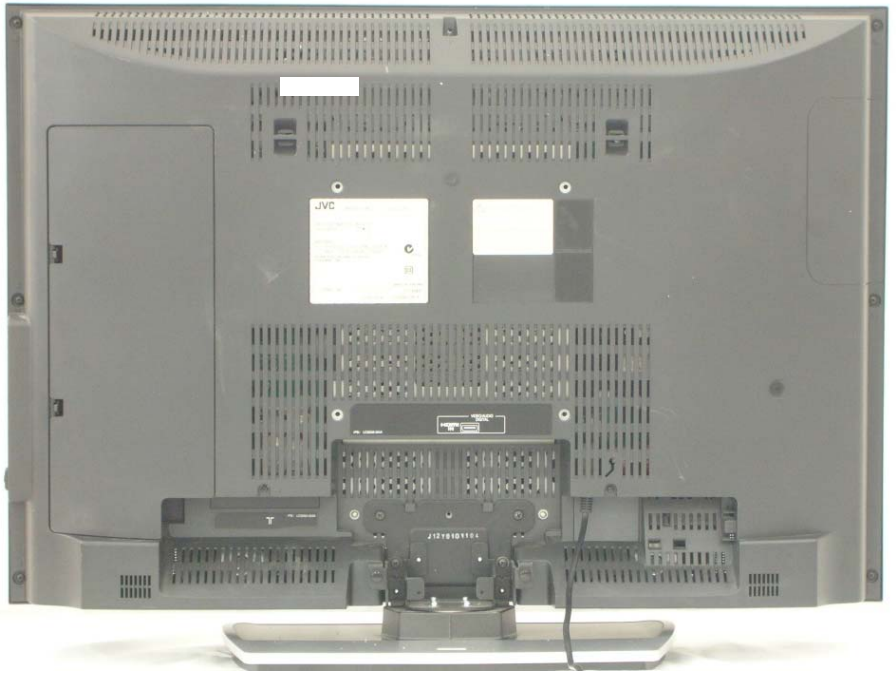
EXAMPLES OF ENERGY SOURCES



	Class 1 energy source	Class 2 energy source	Class 3 energy source
Electric shock injury, energy source class ES-	< 30 V rms or < 0.5 mA	< 50 V rms or < 5 mA	> 50 V rms and > 5 mA
Electrically-caused fire, power source class PS-	< 15 watts	< 100 watts	> 100 watts
Mechanical injury, energy source class MS-	< 7 kg mass	< 25 kg mass	> 25 kg mass
Thermal injury, energy source class TS-	< 48 °C	< 58 °C	> 58 °C

PRINTER-SCANNER-FAX OVERVIEW

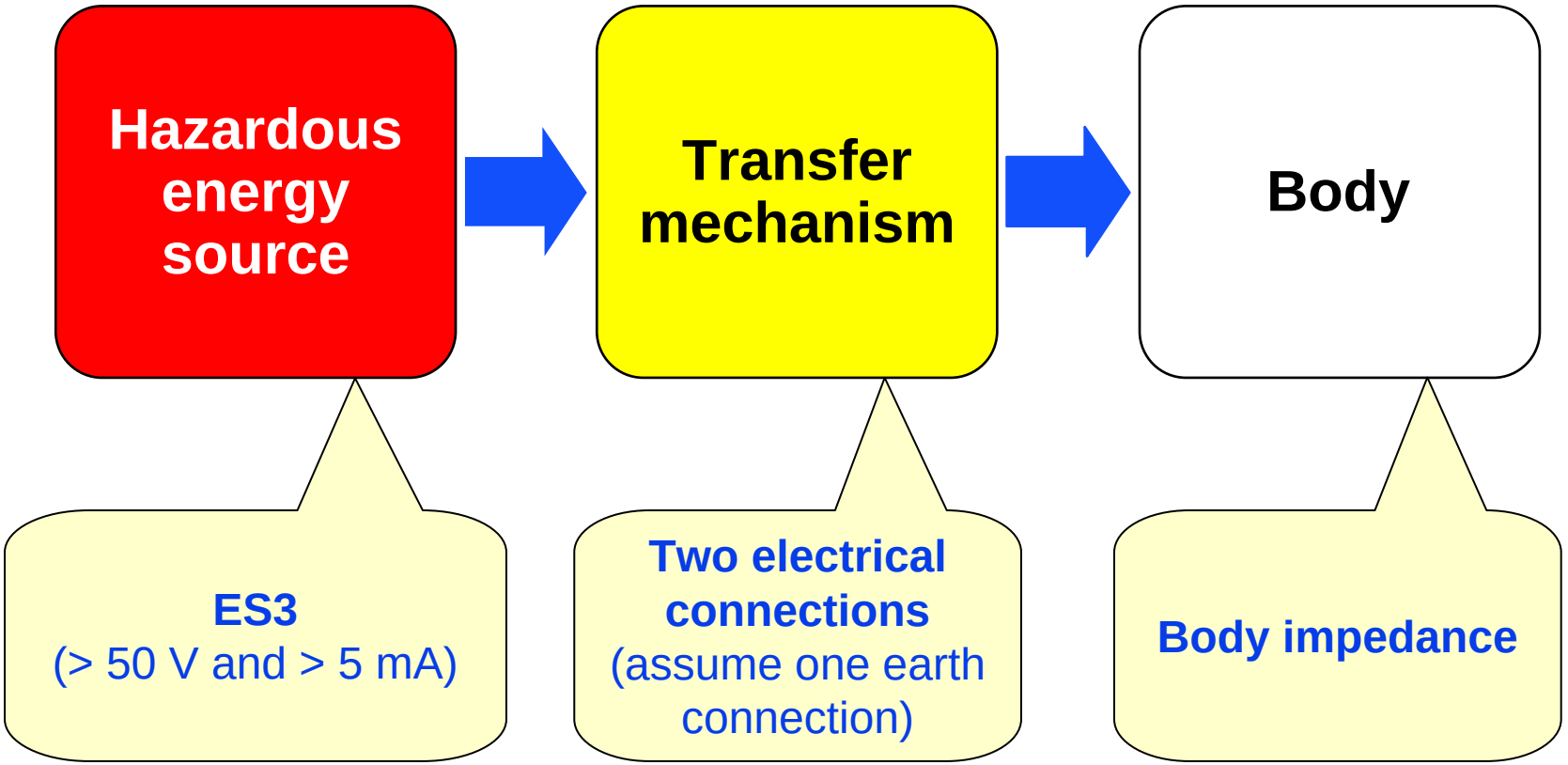
LCD TELEVISION OVERVIEW



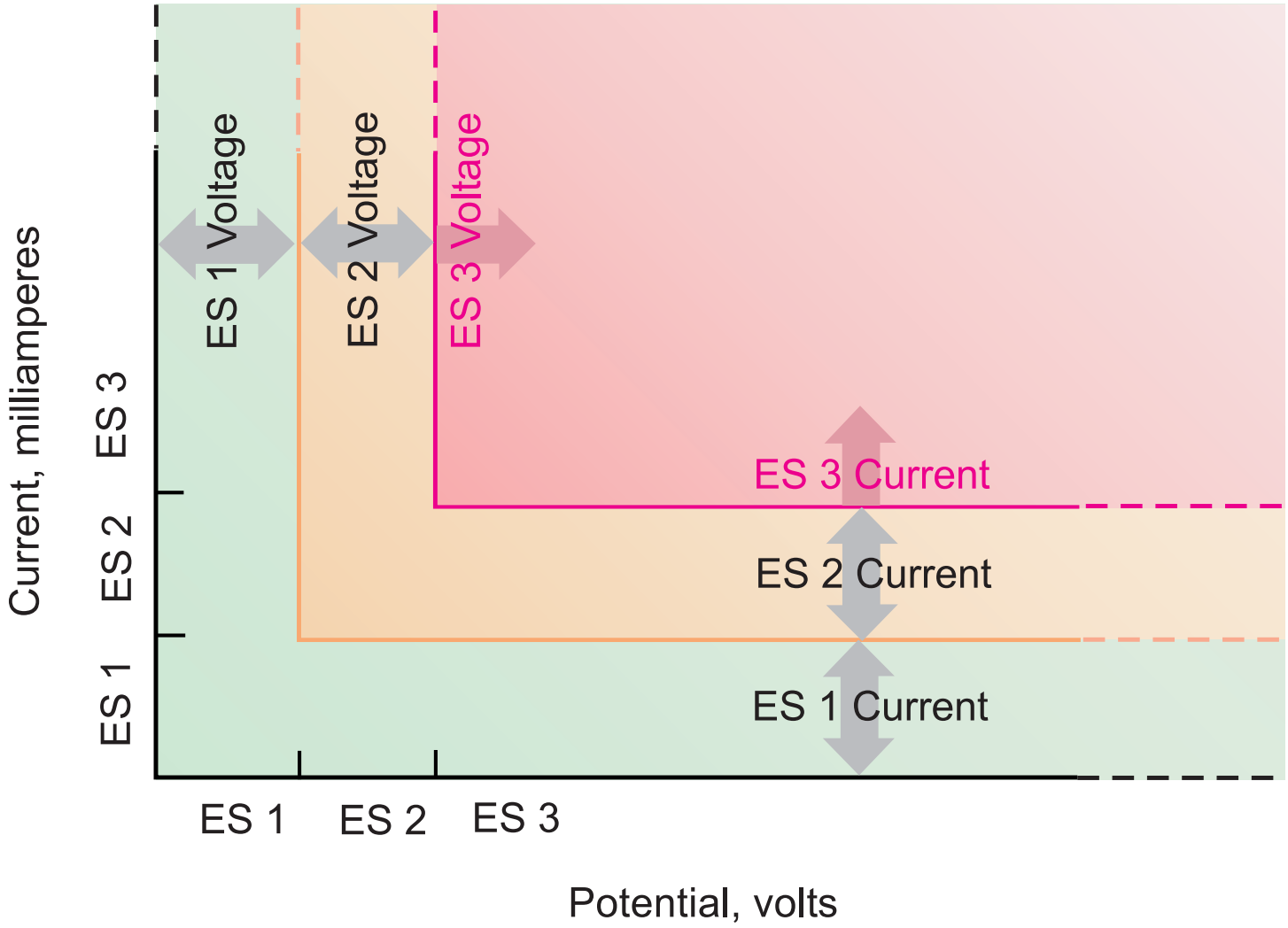
PRODUCT INVESTIGATION

1. Identify the ES1, ES2 and ES3 parts and circuits and their respective safeguards.
2. Identify the PS1, PS2, and PS3 circuits and the fire safeguard methods.
3. Identify the MS1, MS2, and MS3 parts and circuits and their respective safeguards.
4. Identify the TS1, TS2, and TS3 parts and circuits and their respective safeguards.

THREE-BLOCK MODEL FOR ELECTRICALLY-CAUSED INJURY



ES CLASS IS BOTH VOLTAGE AND CURRENT



PRODUCT INVESTIGATION: ELECTRIC SHOCK

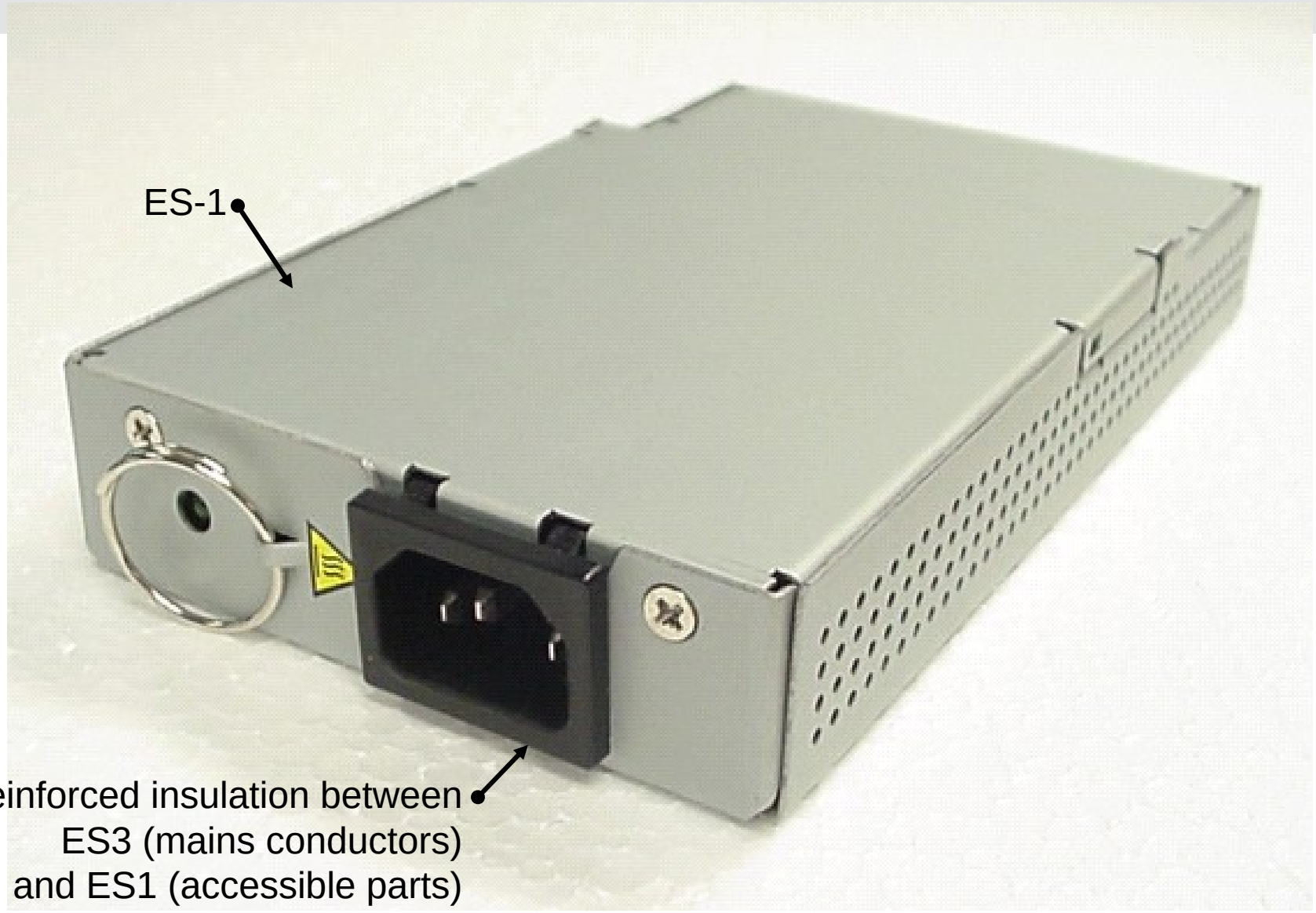
- **What are the ES1, ES2, and ES3 parts and circuits?**

Electric shock injury, energy source class ES-	ES-1	ES-2	ES-3
	< 30 V rms or < 0.5 mA	< 50 V rms or < 5 mA	> 50 V rms and > 5 mA

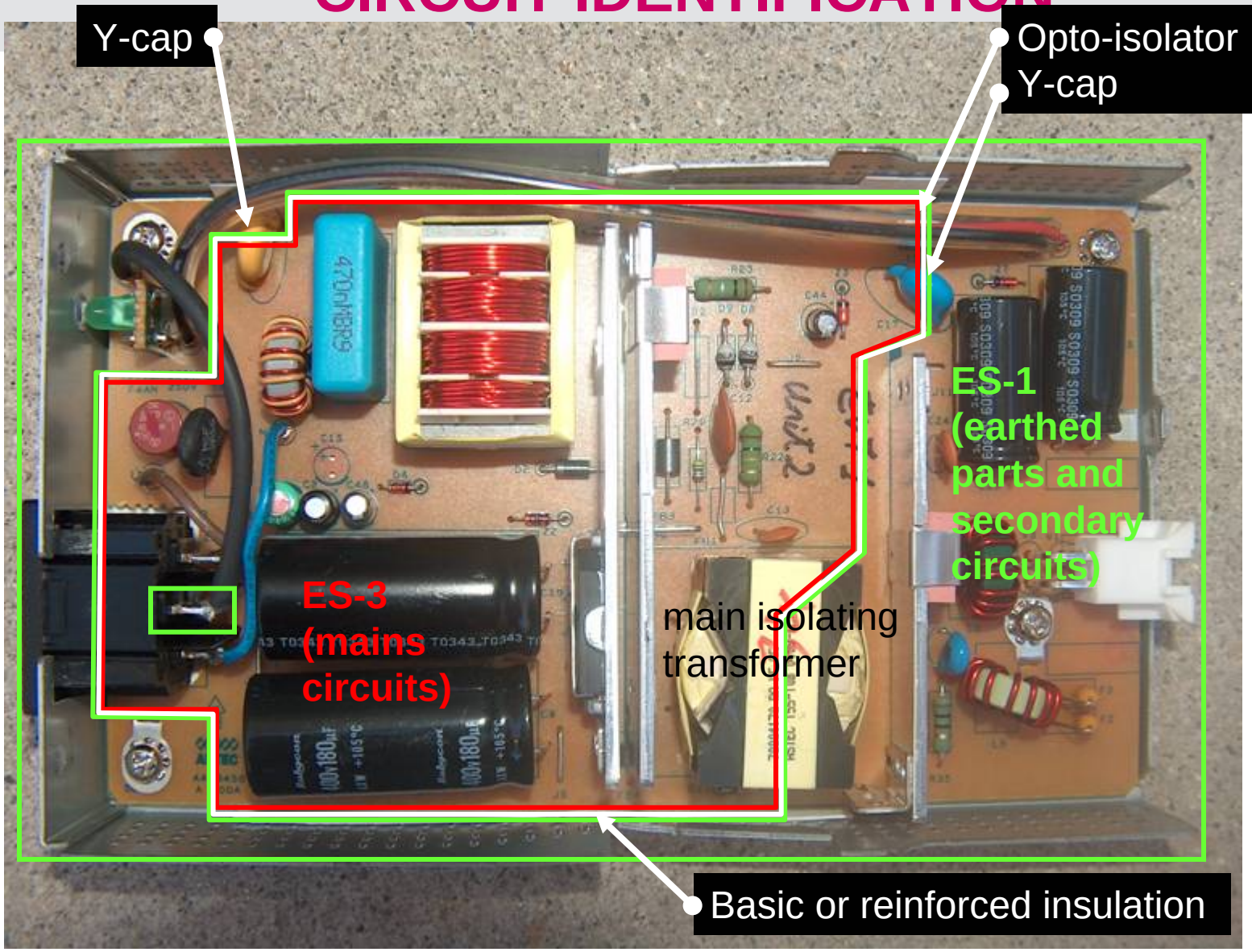
- **What are the product safeguards against electric shock?**

Electric shock injury, energy source class ES-	ES-1	ES-2	ES-3
	None	Basic insulation	Double or reinforced insulation

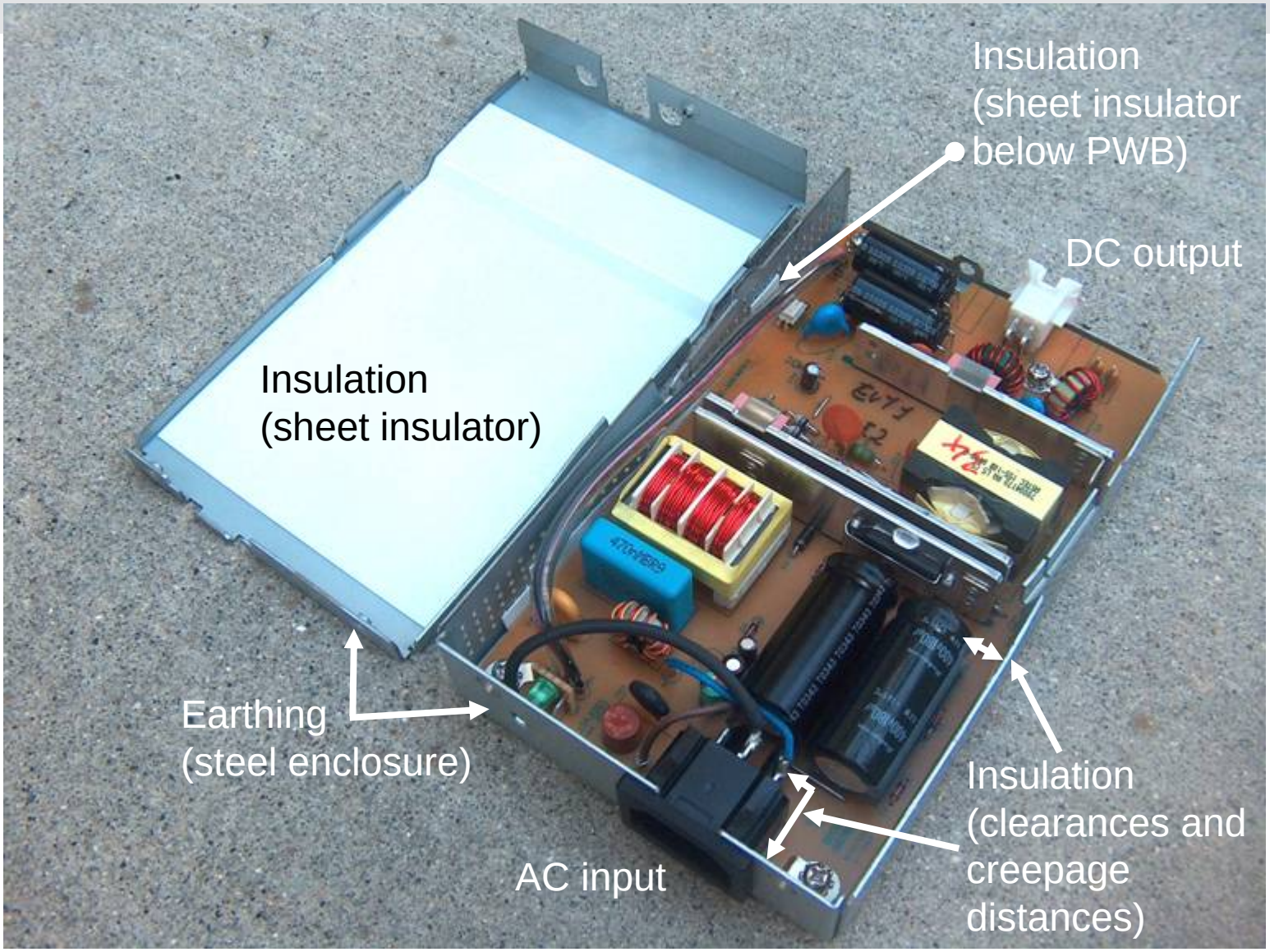
ES1 PARTS EXAMPLE: POWER SUPPLY



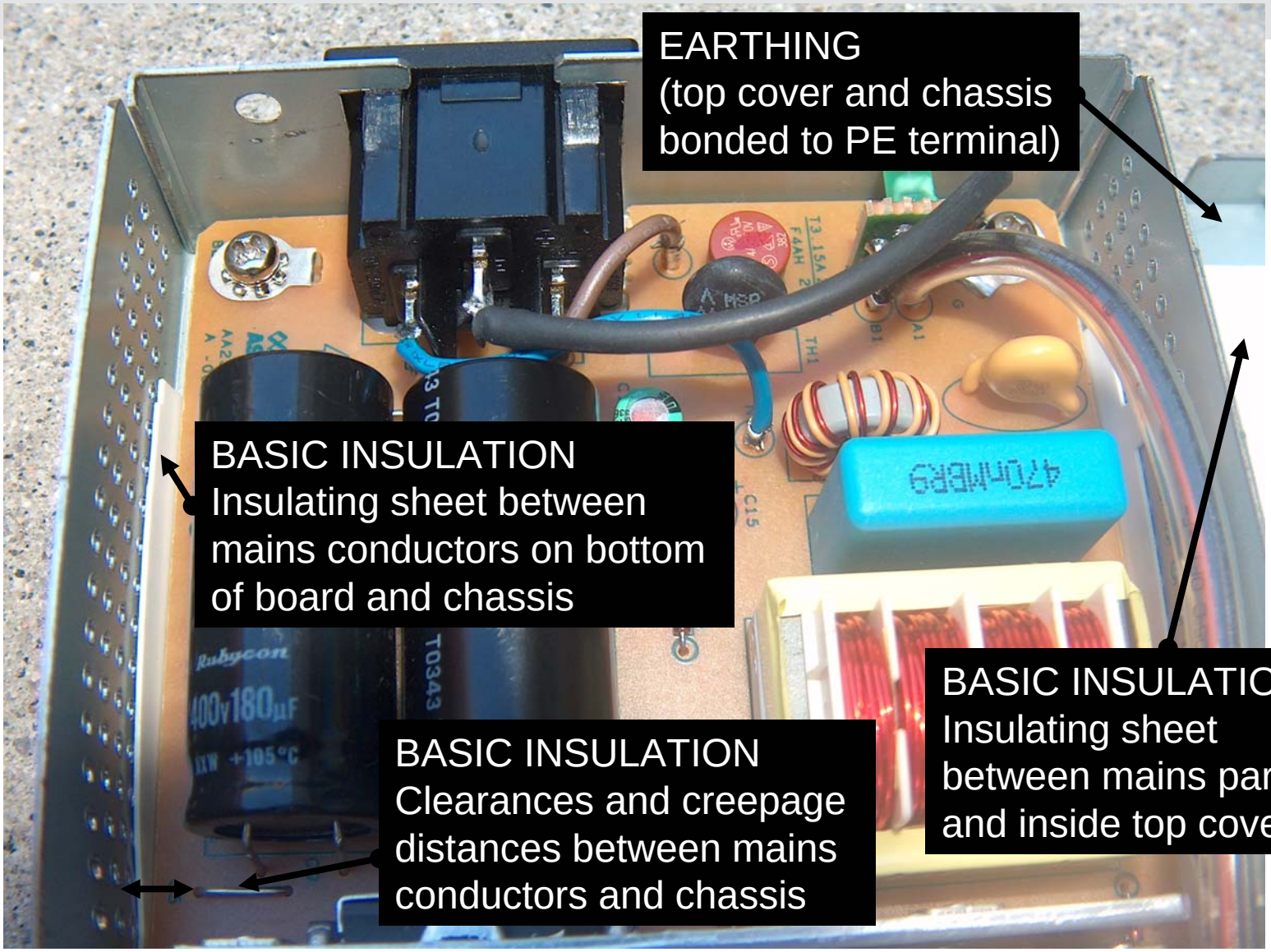
ES1 and ES3 CIRCUIT IDENTIFICATION



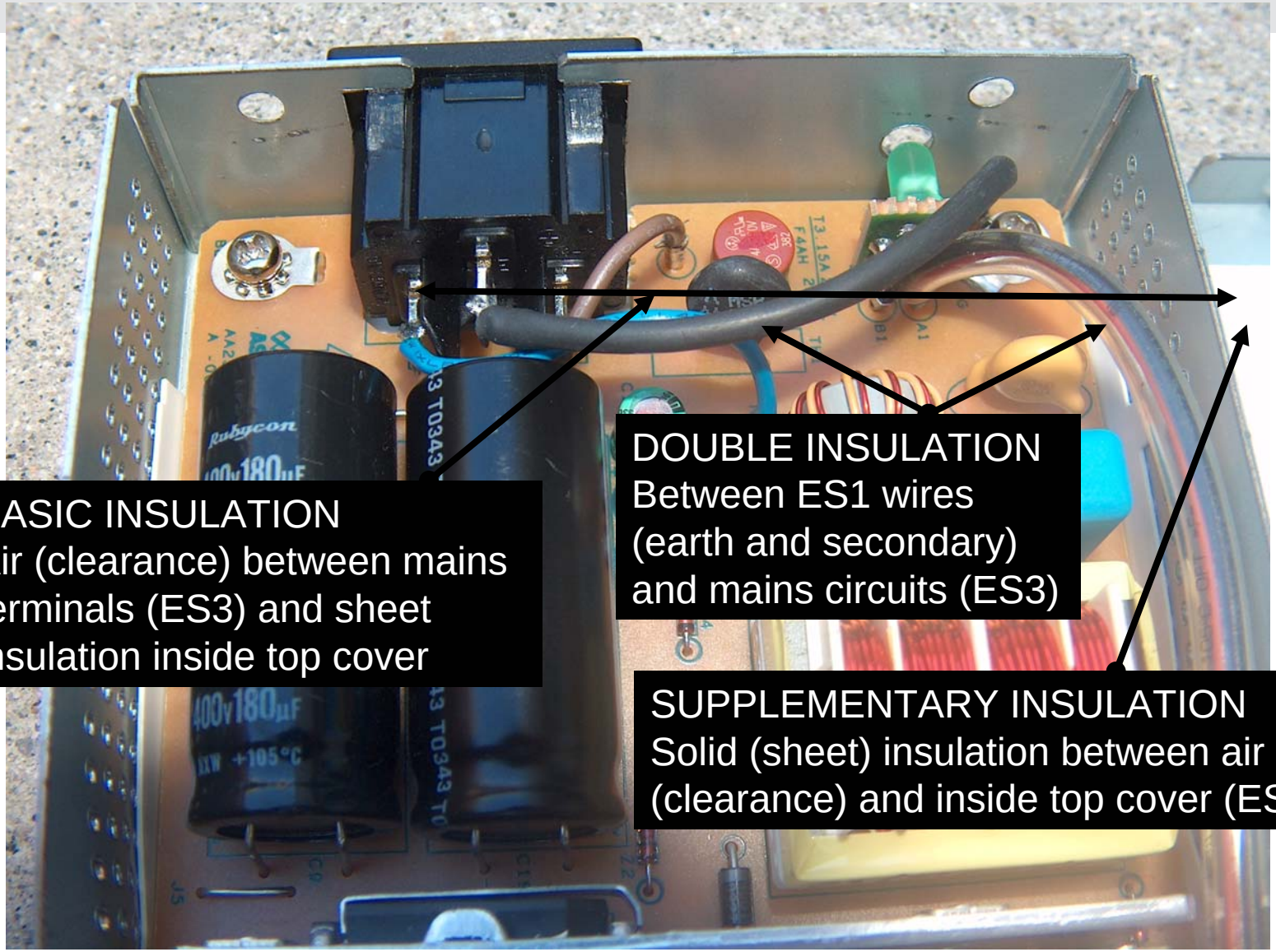
VARIOUS INSULATIONS



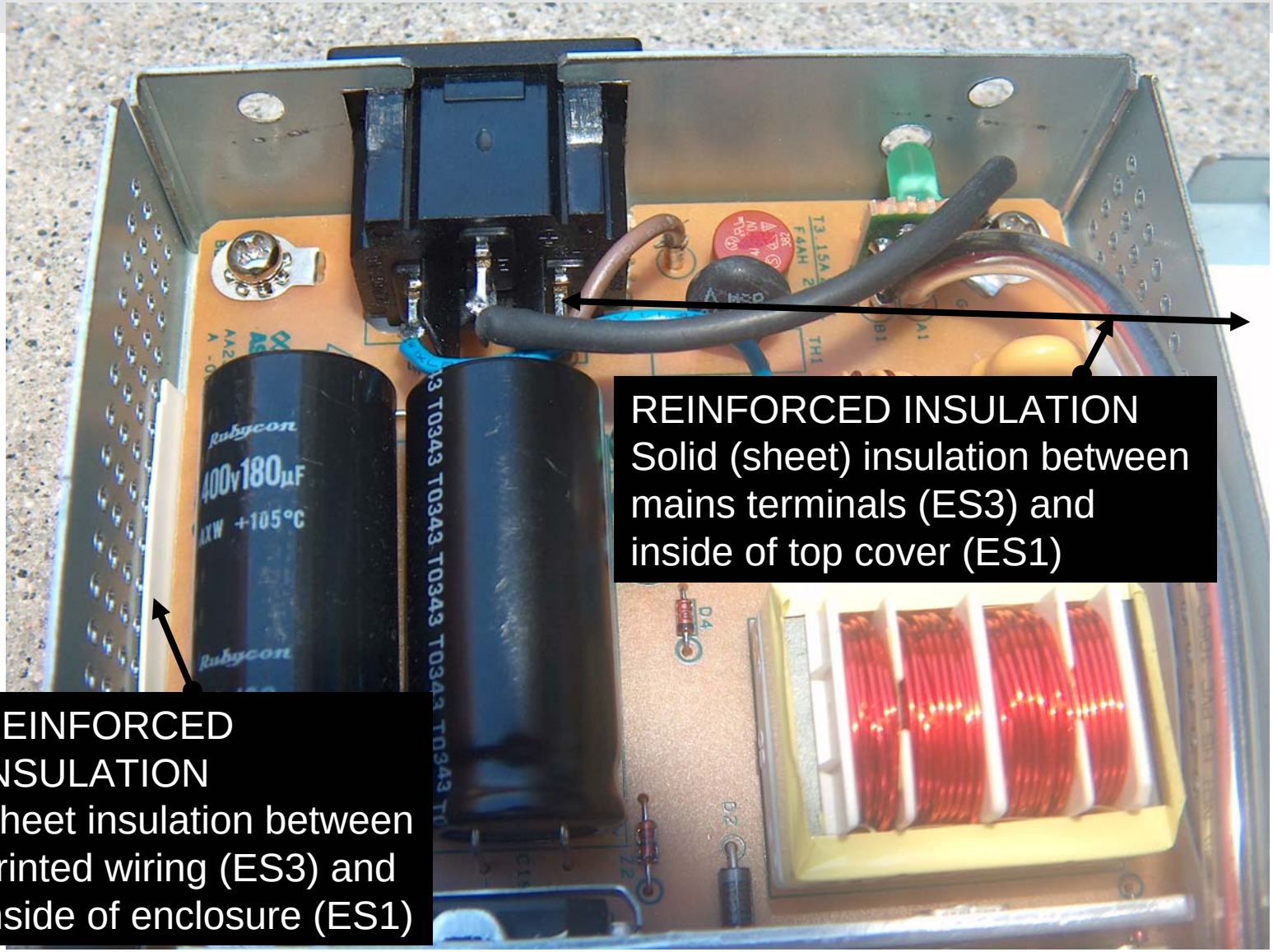
CLASS I SAFEGUARDS: BASIC INSULATION AND EARTHING



CLASS II SAFEGUARDS: DOUBLE INSULATION



CLASS II SAFEGUARDS: REINFORCED INSULATION



PRINTER-FAX-SCANNER-COPIER - 1

PRINTER-FAX-SCANNER-COPIER - 2

PRINTER-FAX-SCANNER-COPIER - 3

PRODUCT INVESTIGATION: ELECTRIC SHOCK

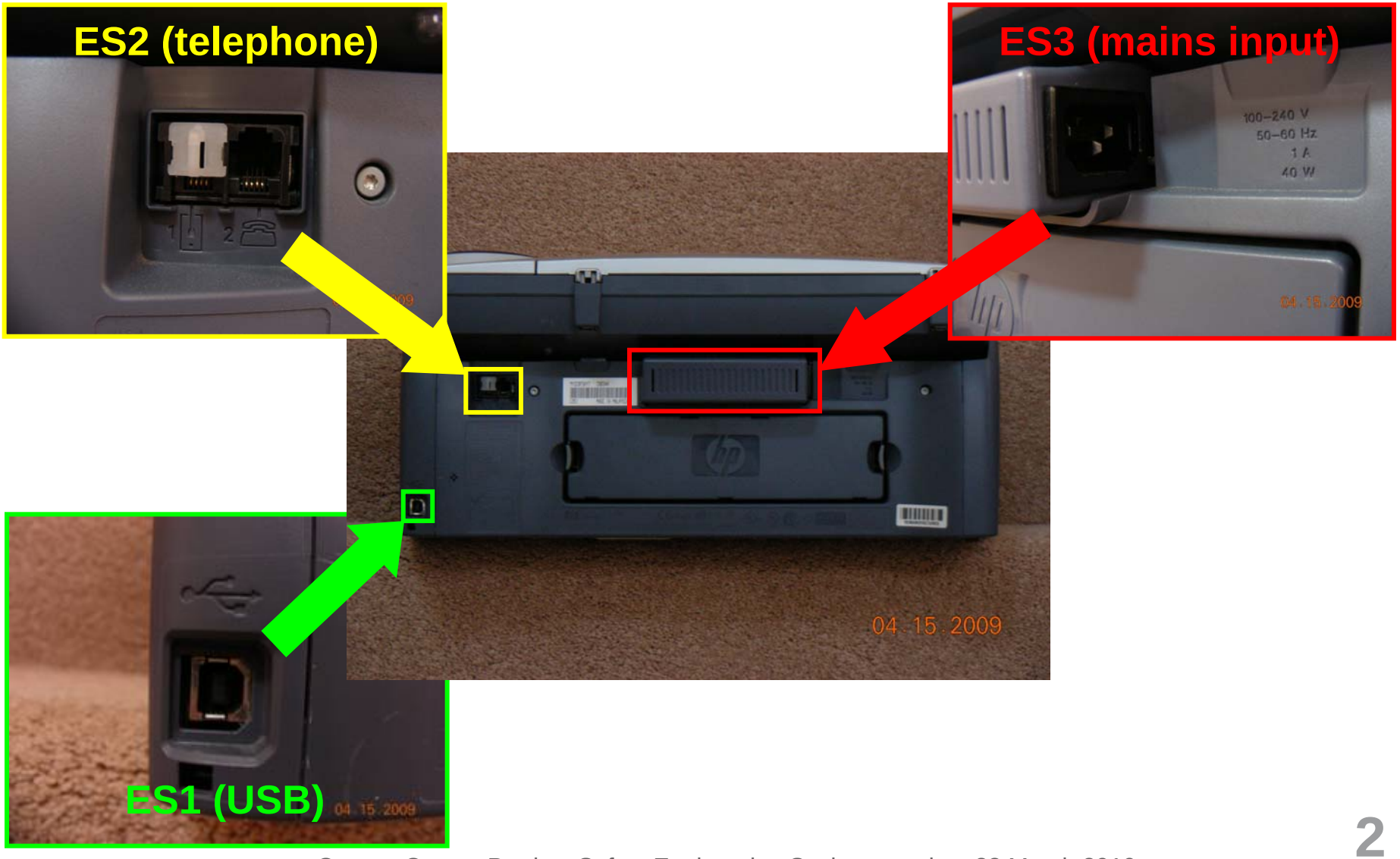
- **What are the ES1, ES2, and ES3 parts and circuits?**

Electric shock injury, energy source class ES-	ES-1	ES-2	ES-3
	< 30 V rms or < 0.5 mA	< 50 V rms or < 5 mA	> 50 V rms and > 5 mA

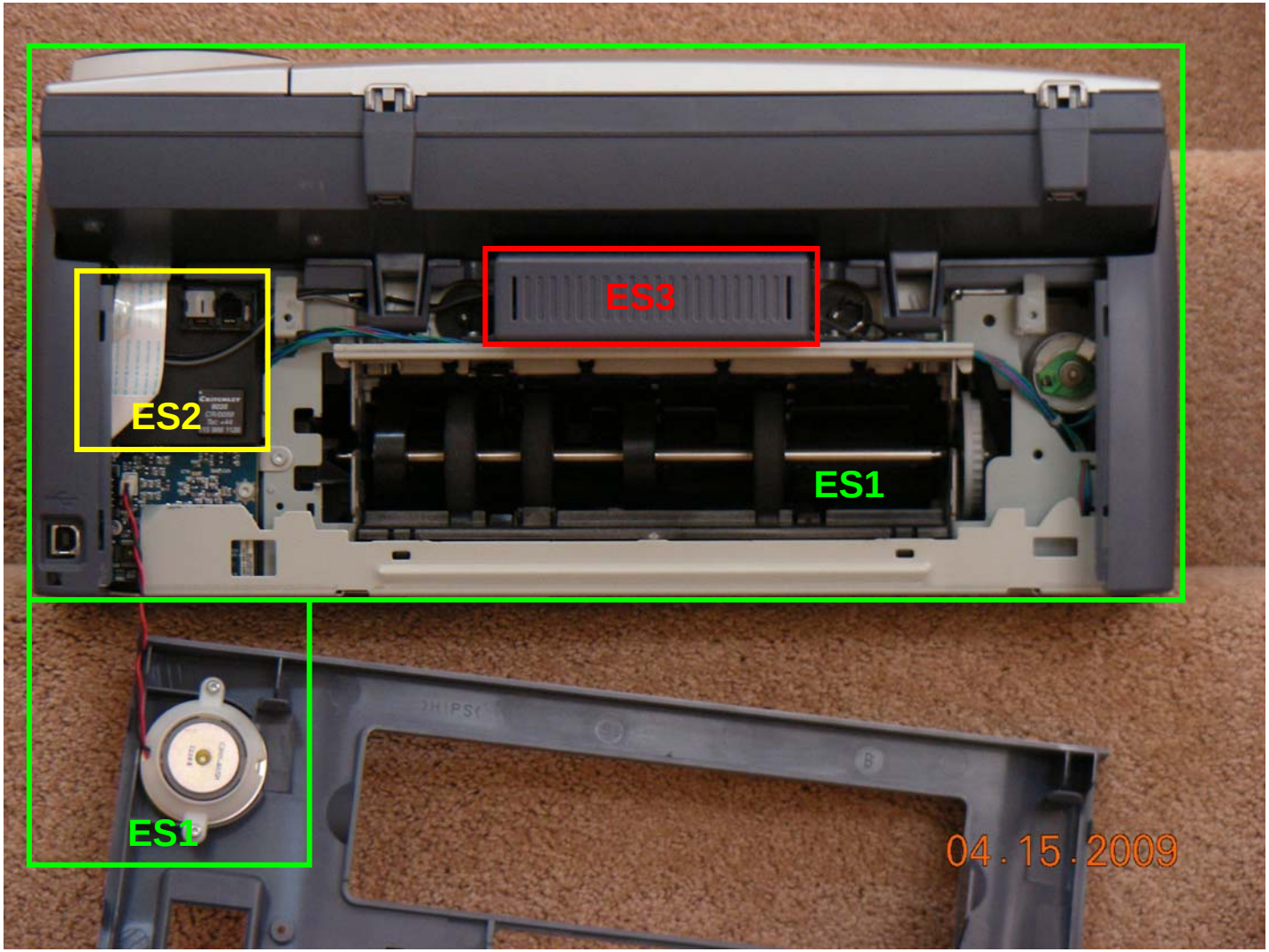
- **What are the product safeguards against electric shock?**

Electric shock injury, energy source class ES-	ES-1	ES-2	ES-3
	None	Basic insulation	Double or reinforced insulation

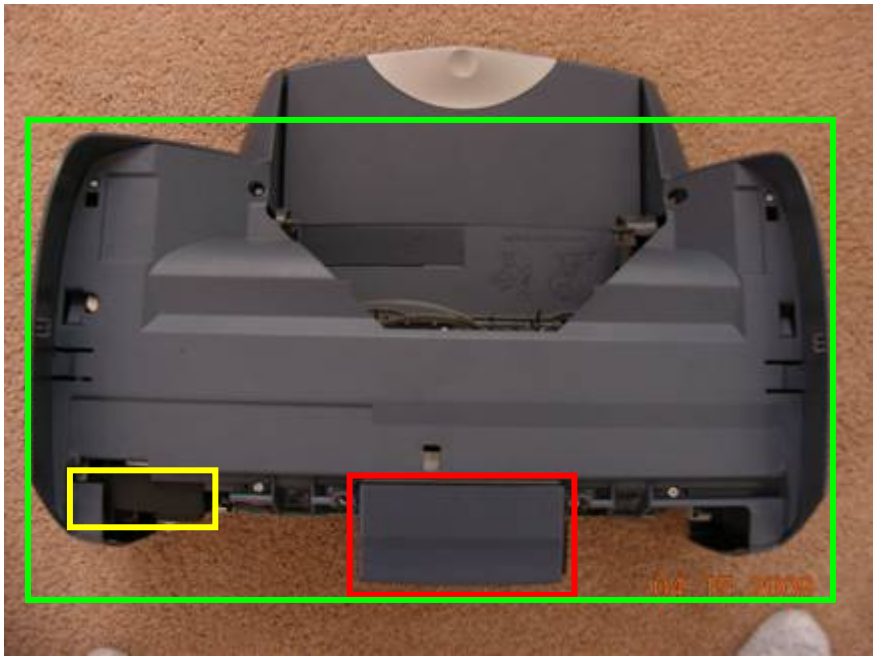
ES1, ES2, and ES3 parts

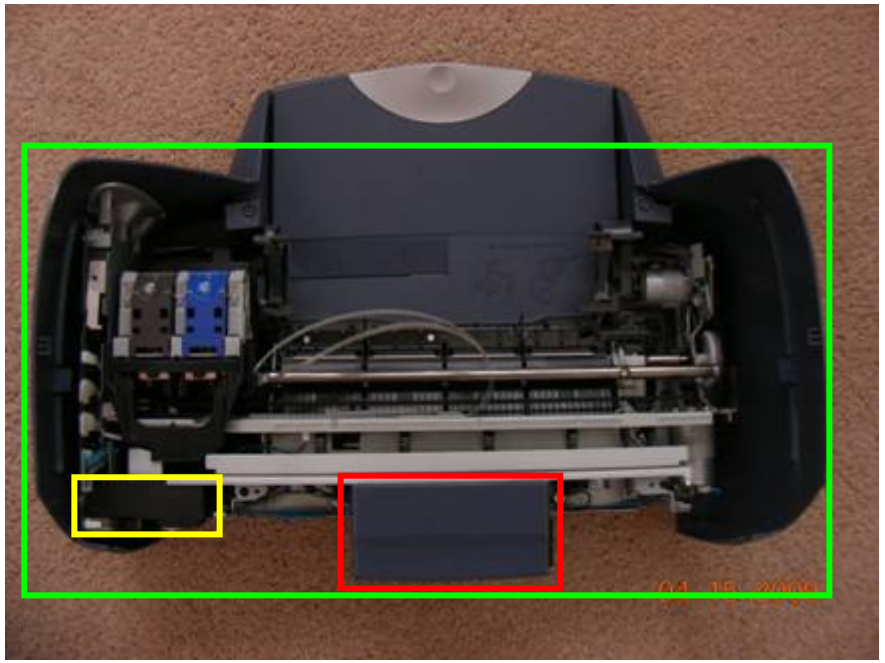


ES1, ES2, and ES3 parts

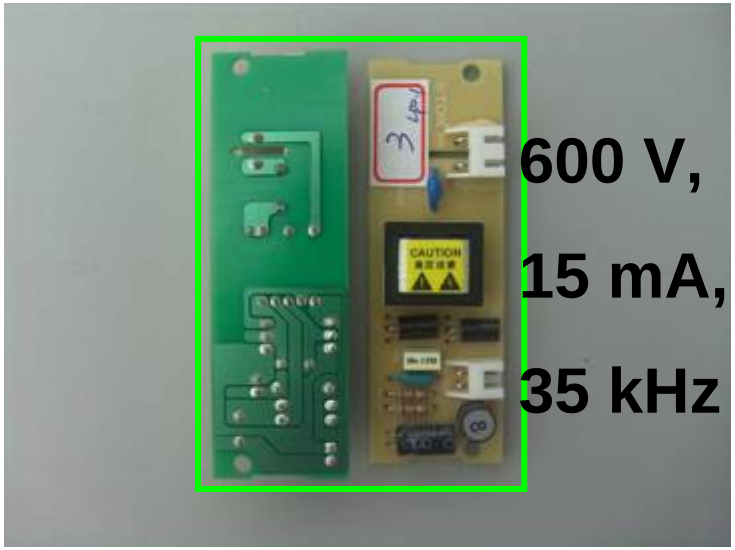


ES1, ES2, and ES3 parts





SAFEGUARD BLOCK DIAGRAM



Energy Source		ES1	ES2	ES3
1 kHz up to 100 kHz	Voltage	30 V r.m.s. + 0,4 x *f*	50 V r.m.s. + 0,9 x *f*	Greater than ES2 limit
	Current	0,5 mA r.m.s. × *f*	5 mA r.m.s. + 0,5 x *f*	
f is in kHz.				

	Allowed:	Circuit:
Voltage:	30 + 0,4 x 35 = 44 V r.m.s.	600 V
Current:	0,5 x 35 = 17,5 mA	15 mA

ES1 (600 V, 15 mA, 35 kHz)

ES3 (mains) → **Double or Reinforced Safeguard** → **ES1** (31 V dc) ← **Basic Safeguard** ← **ES2** (telephone)

SAFEGUARDS AGAINST ES3

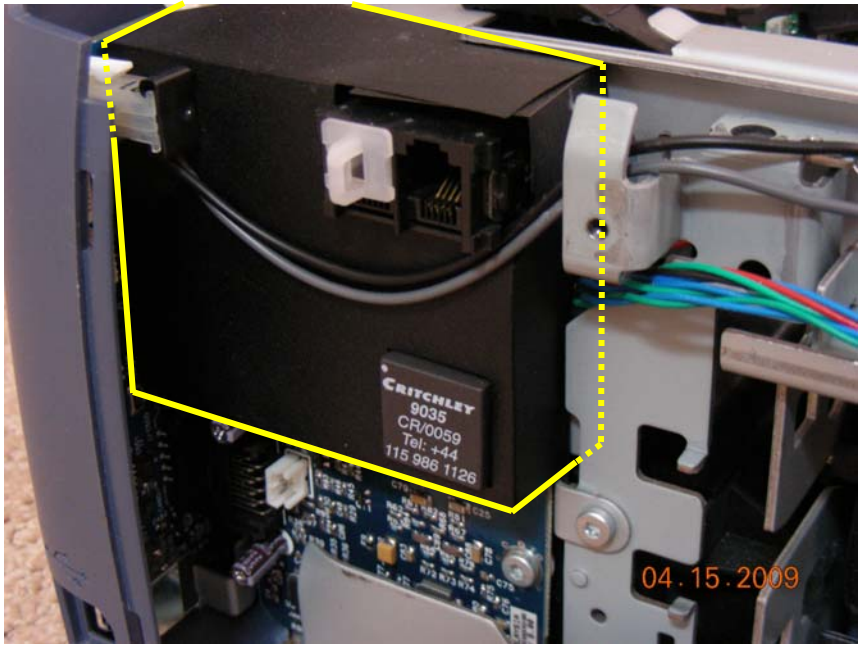
Reinforced insulation (Between ES3 and ES1)

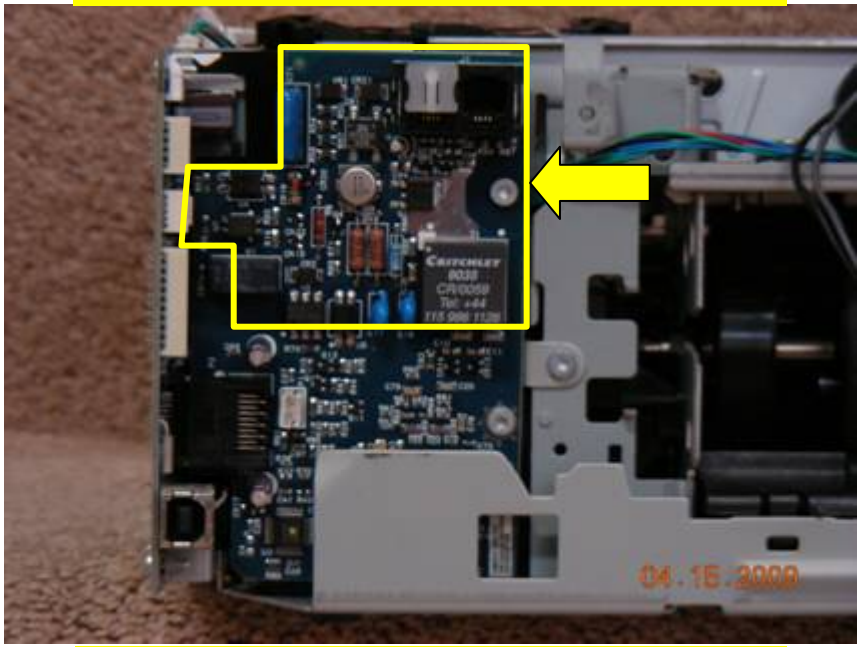
Functional earthing (Sleeved earthing wire between ES1 and ES3)

Reinforced creepage and clearance (Between ES3 and ES1)

SAFEGUARDS AGAINST ES2

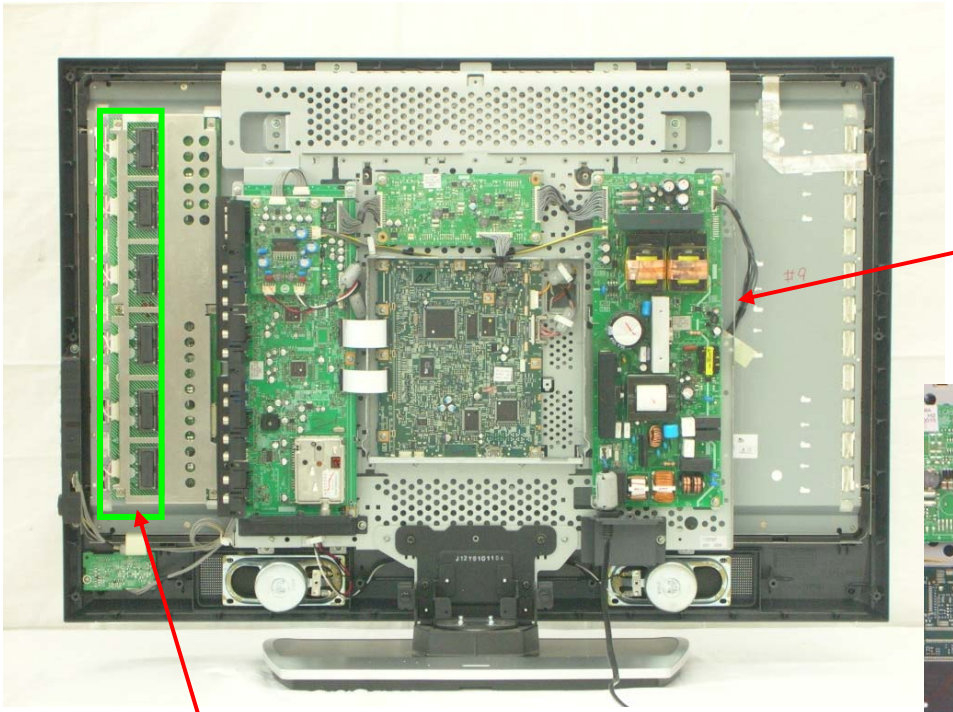
Solid insulation behind board
Air insulation between board and barrier (enclosure)
(Between ES2 and ES1)





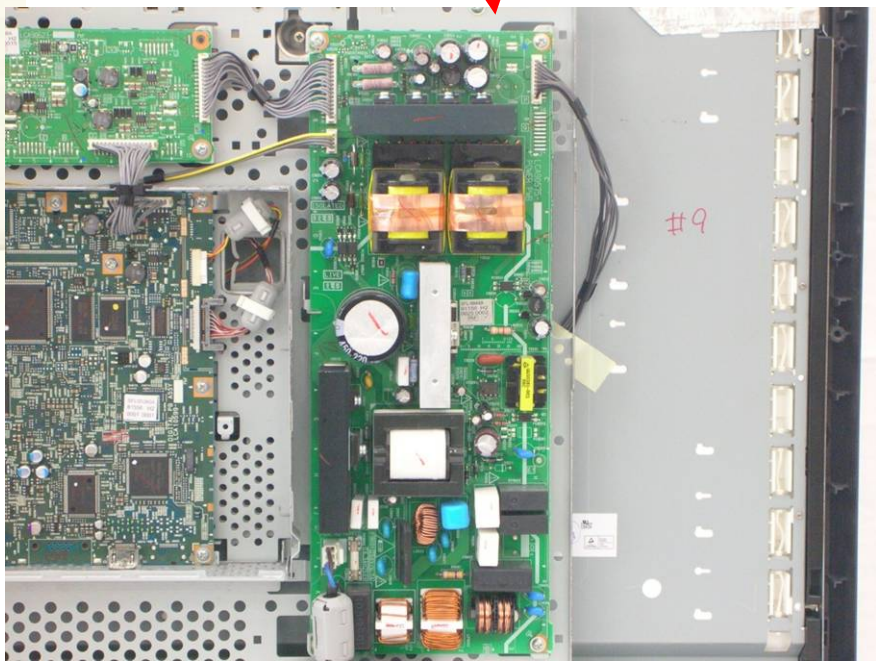
Creepage and clearance
(Between ES2 and ES1)

LCD TELEVISION – inside views

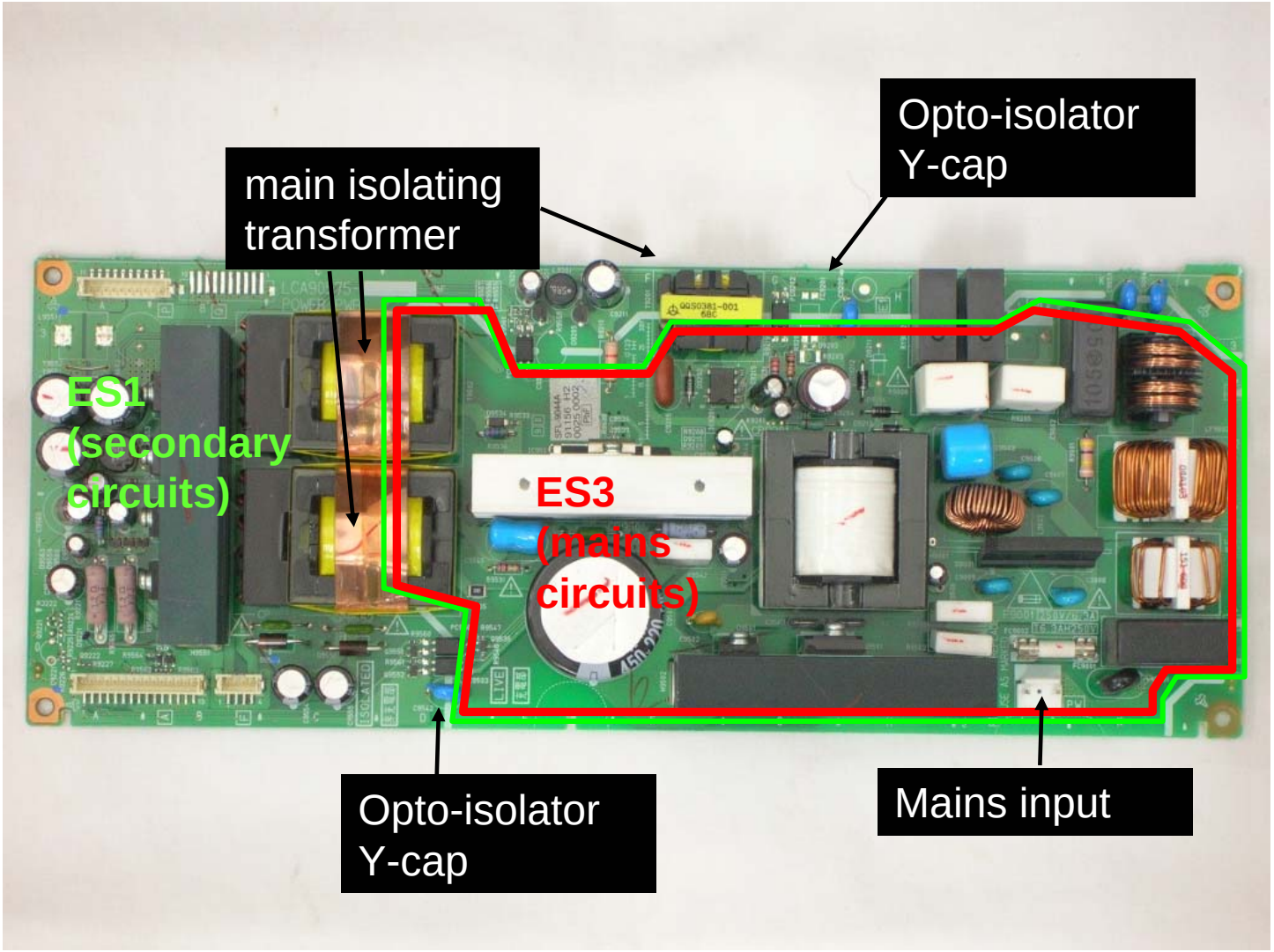


Output of inverter circuit (backlight): ES1

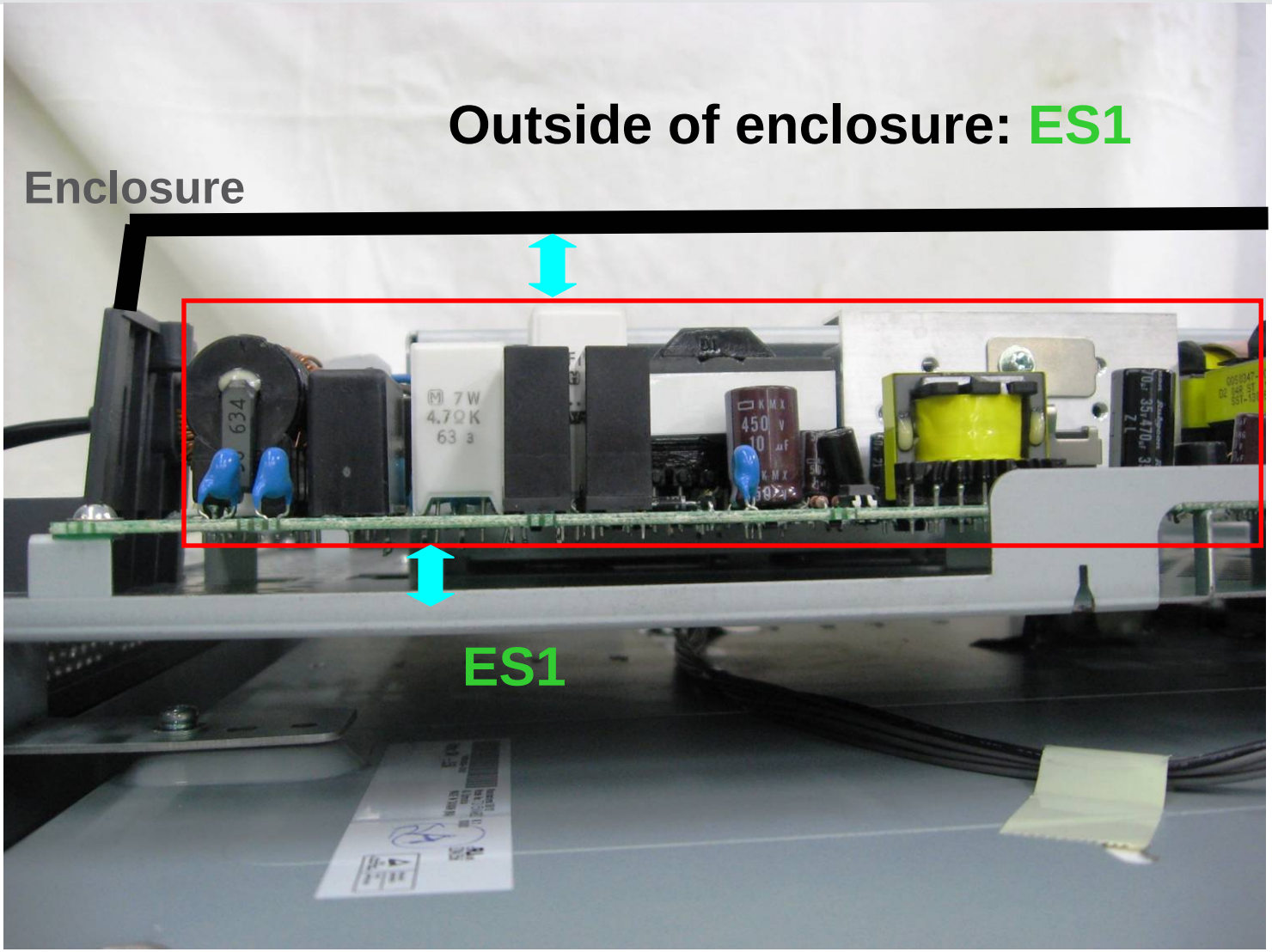
Power supply board: ES3



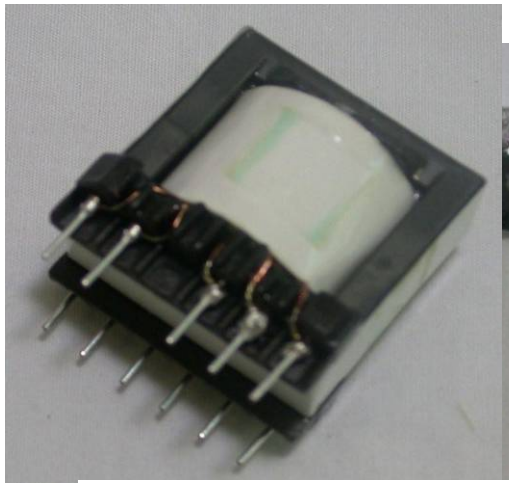
LCD TV -- Power supply board

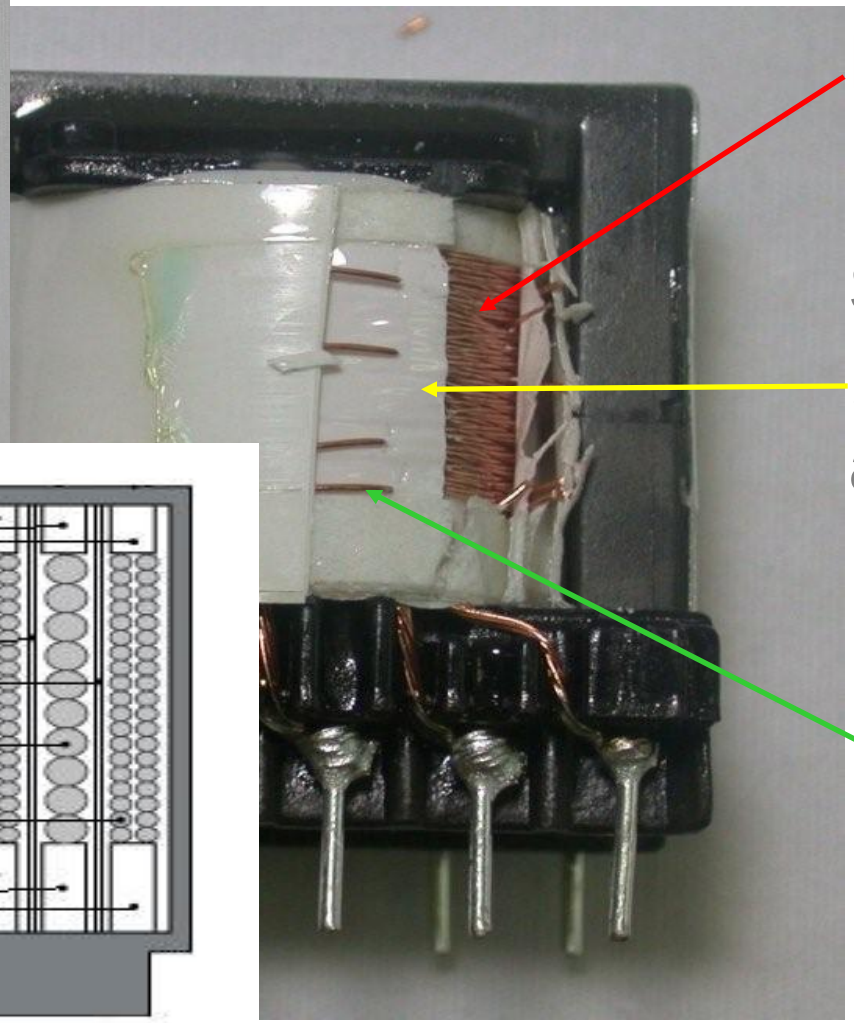


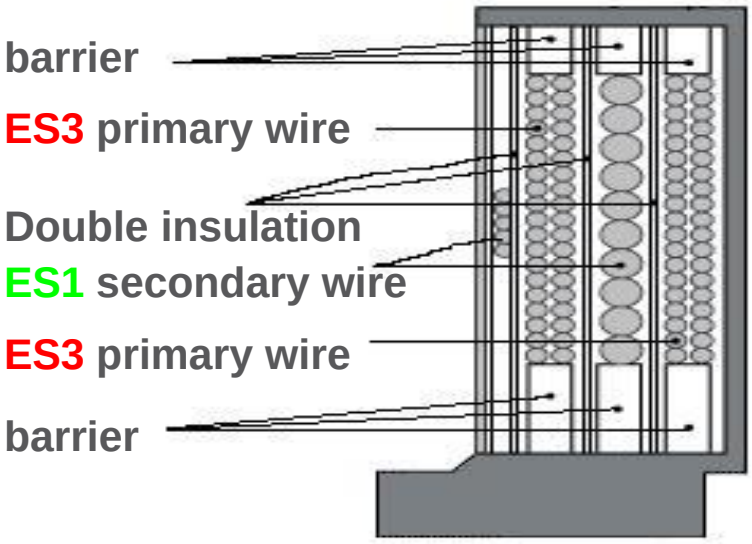
LCD TV:
Power supply board -- bottom side

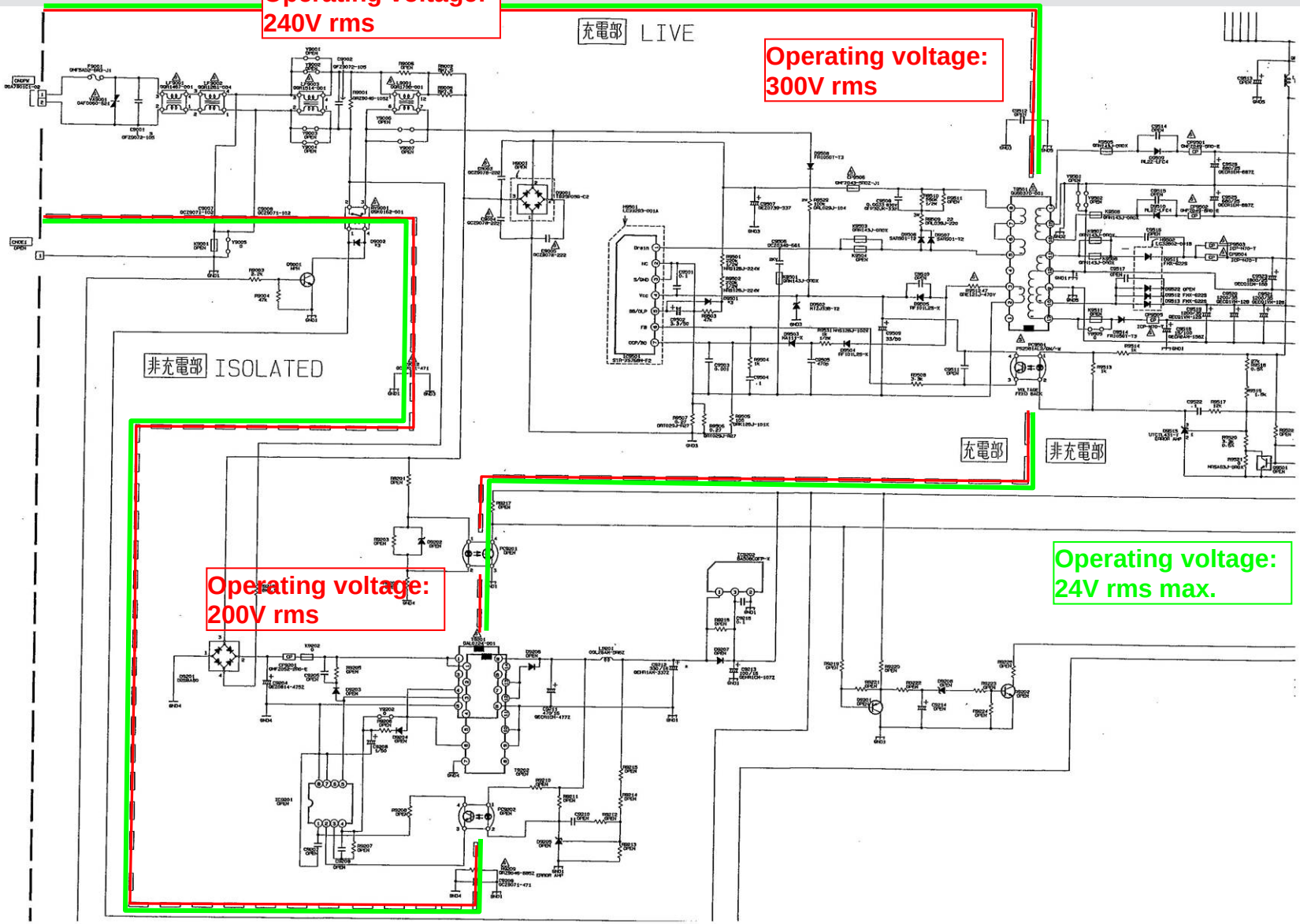


Inside of transformer

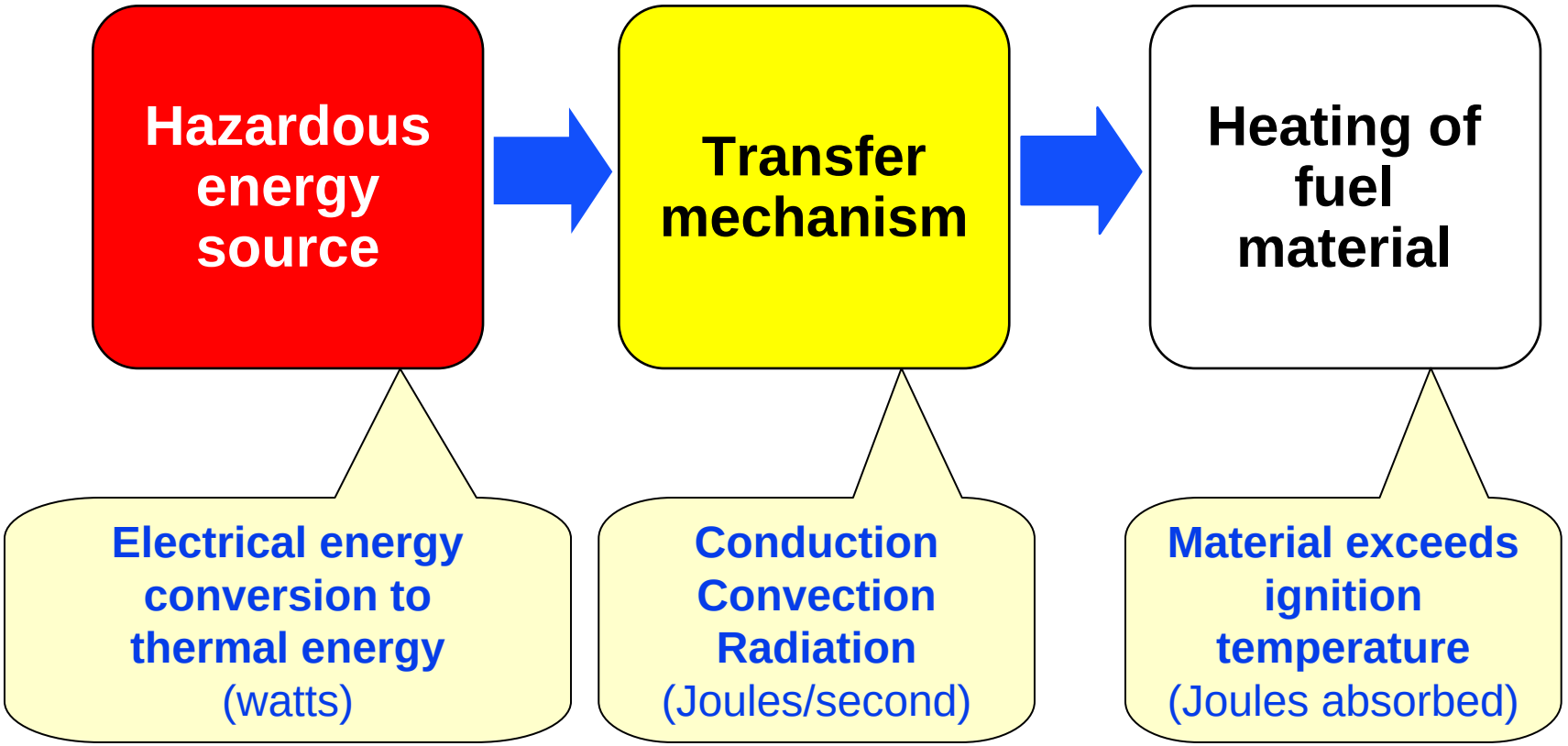




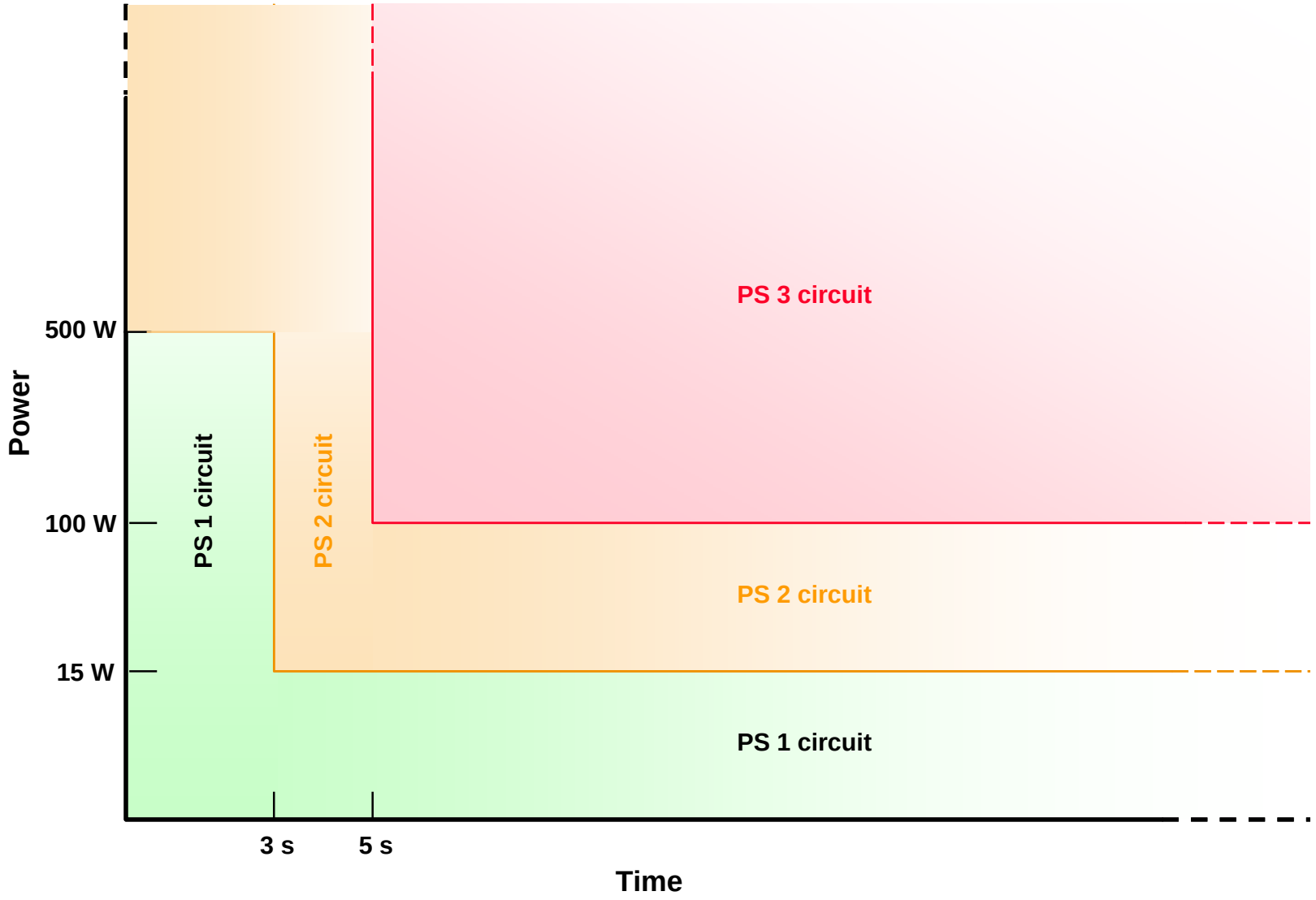



Operating voltage:
240V rms
充電部 LIVE
Operating voltage:
300V rms
非充電部 ISOLATED
充電部
非充電部
Operating voltage:
200V rms
Operating voltage:
24V rms max.

THREE-BLOCK MODEL FOR ELECTRICALLY-CAUSED FIRE



ELECTRICAL HEATING IS A FUNCTION OF BOTH POWER DISSIPATION AND TIME



PRODUCT INVESTIGATION: FIRE

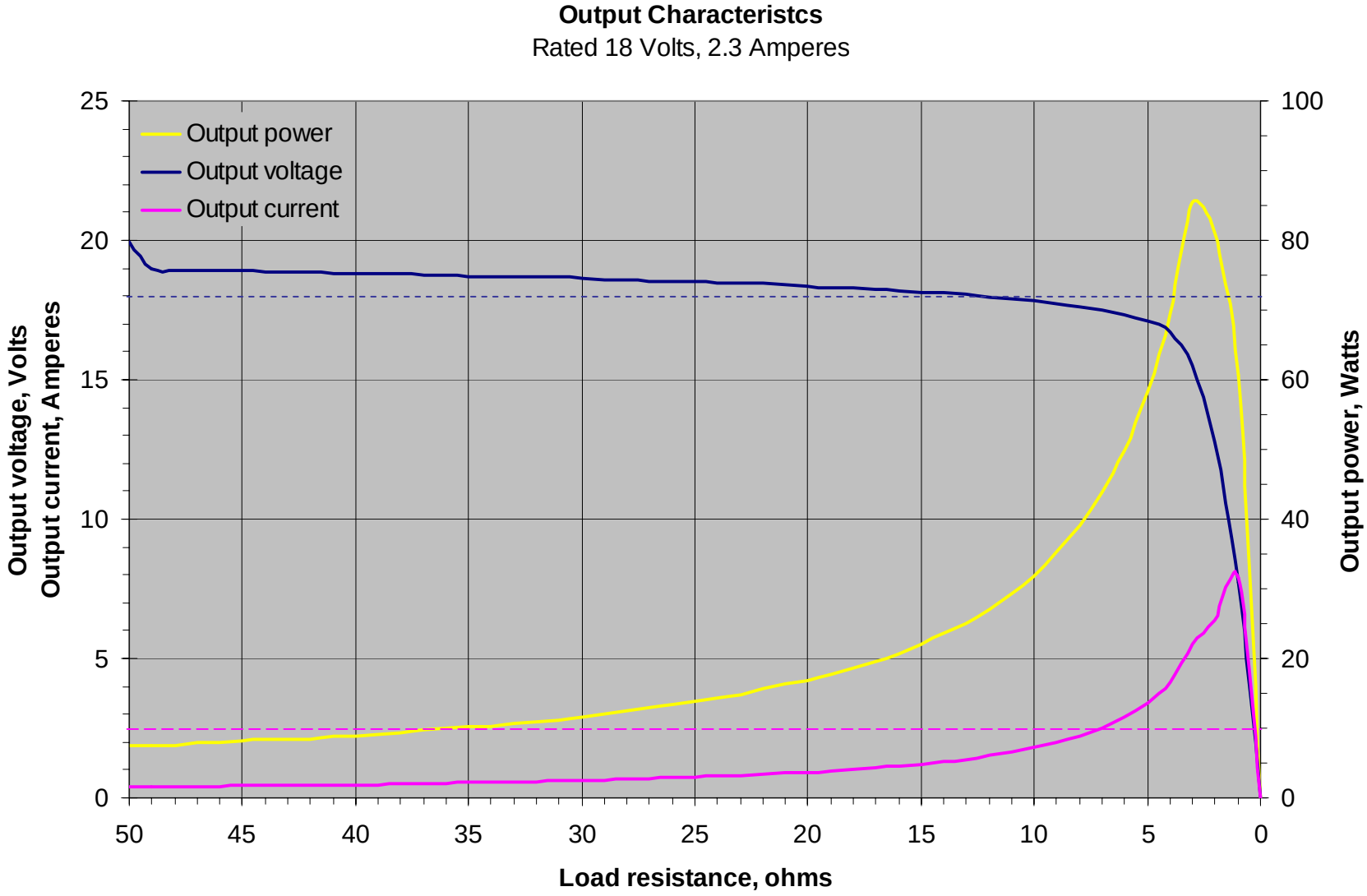
- **What are the PS1, PS2, and PS3 circuits?**

Electrically-caused fire, power source class PS-	PS1 < 15 watts	PS2 < 100 watts	PS3 > 100 watts

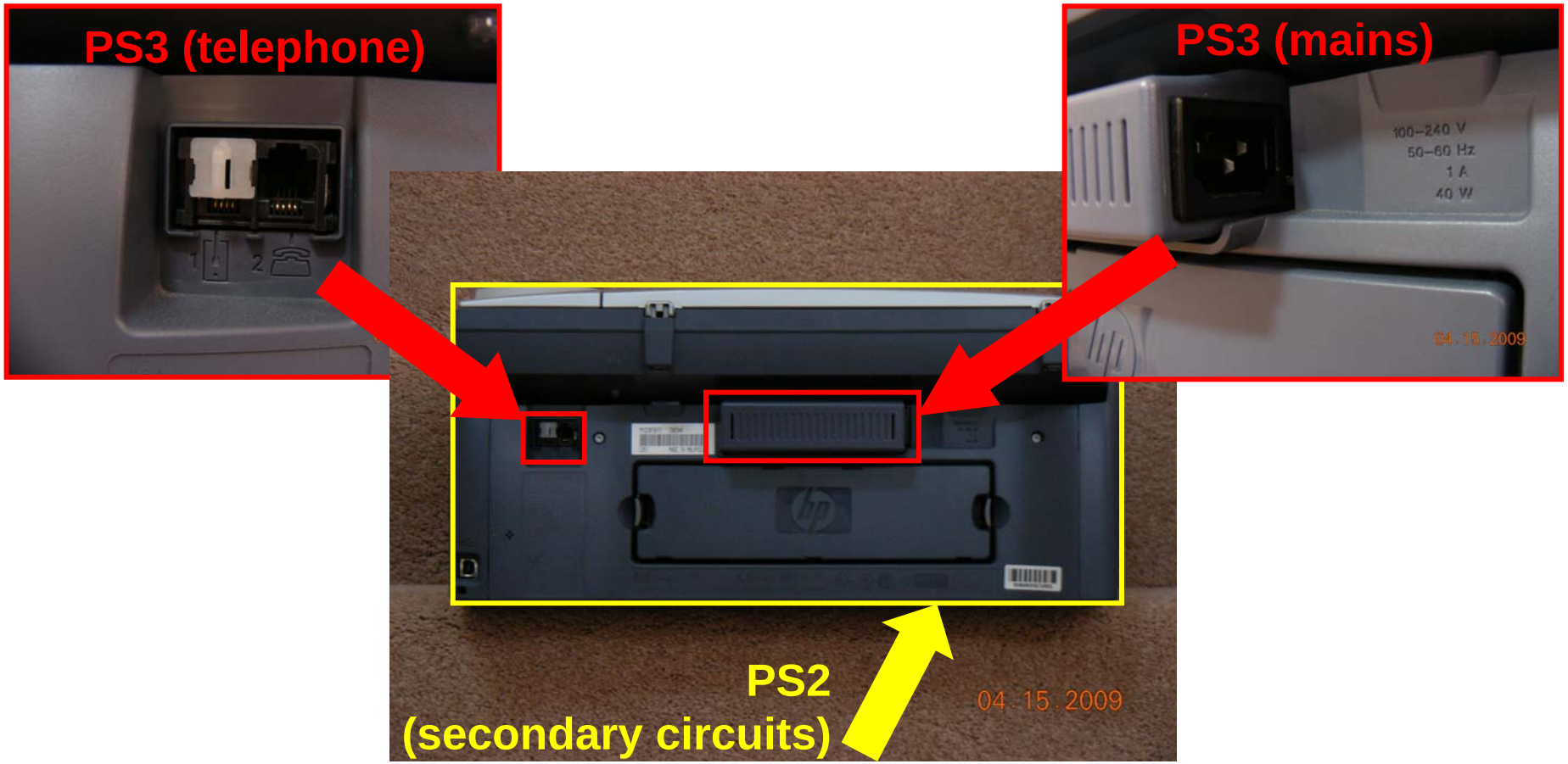
- **What are the product safeguards against fire?**

Electrically-caused fire, power source class PS-	None	Keep out volume	Fire enclosure

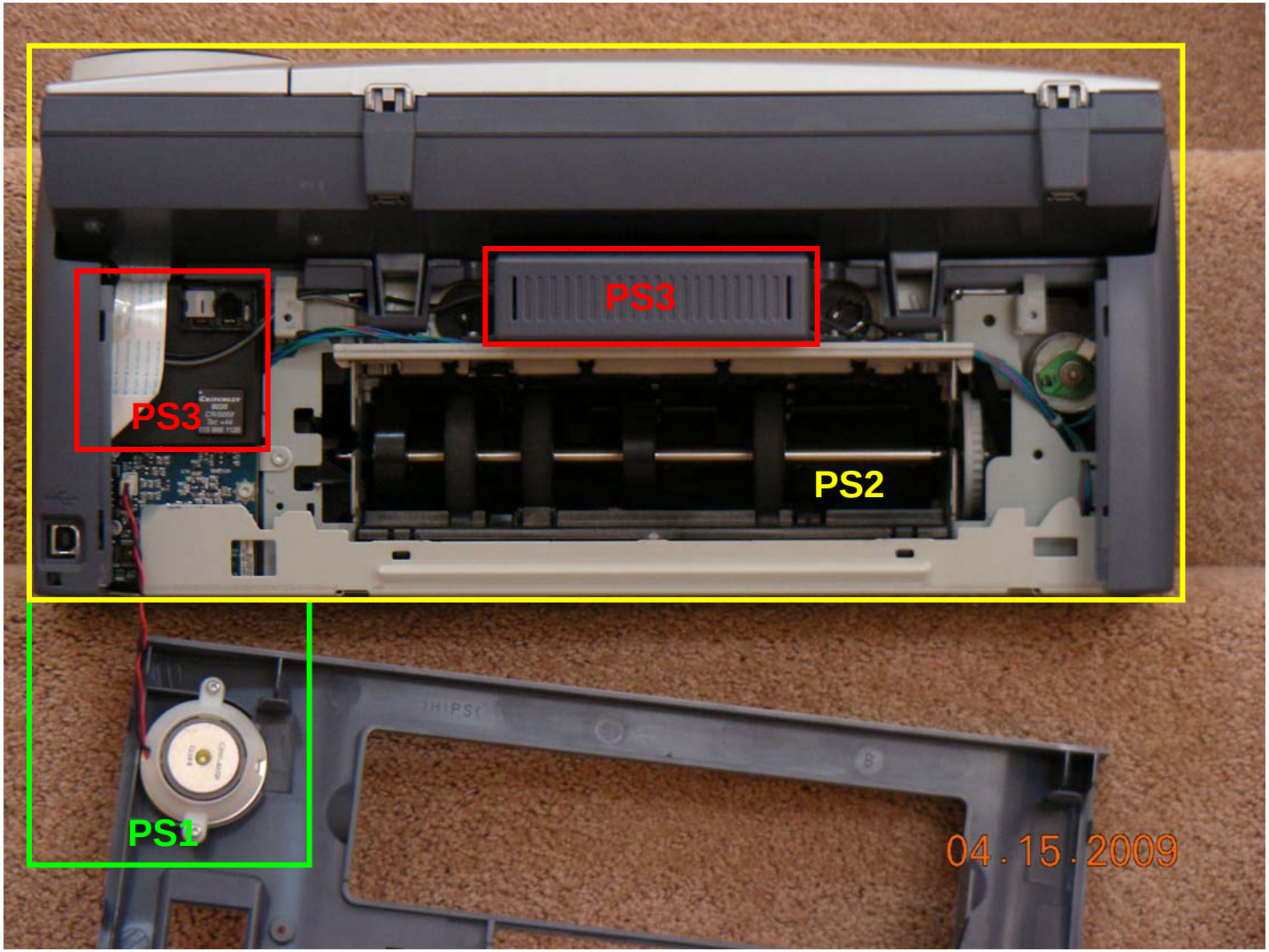
DETERMINATION OF PS1, PS2, or PS3



PS1, PS2, and PS3 circuits



PS1, PS2, and PS3 circuits



FIRE SAFEGUARDS

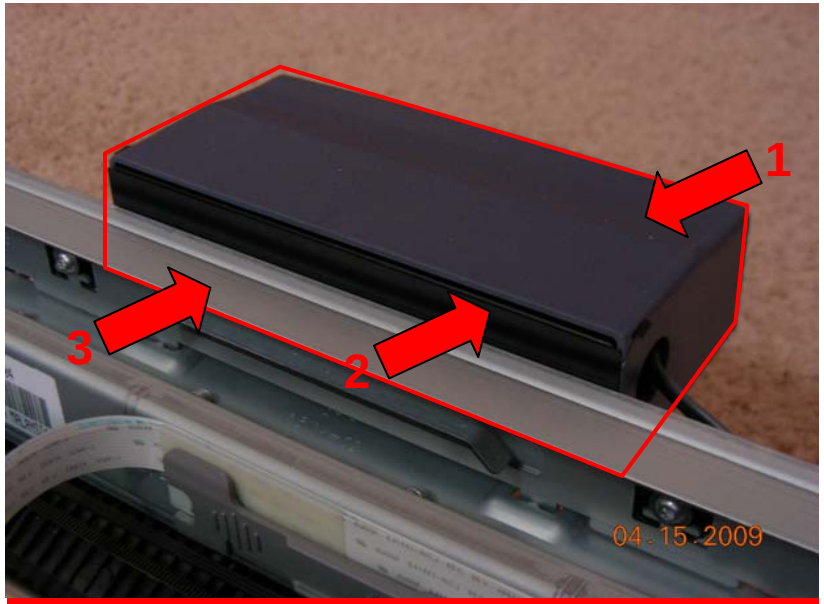
Ignition Prevention Safeguards
(applicable to PS2 circuits)

- **Fault condition testing to determine if ignition will occur**
- **Distances from potential ignition source (PIS) to ignitable materials**

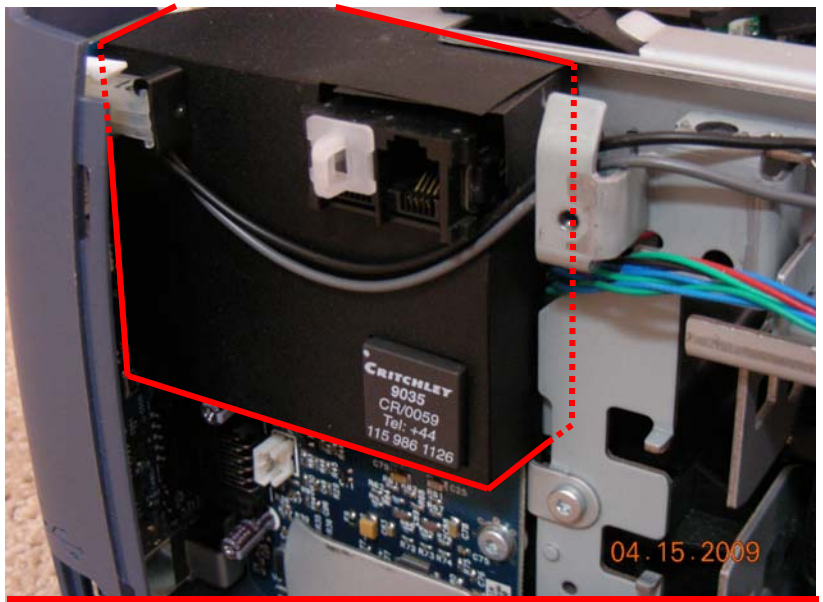
Spread of Fire Safeguards
(applicable to PS2 and PS3)

- **Flame-retardant material**
- **Fire-containing enclosure**

SAFEGUARDS AGAINST PS3



Fire enclosure
(encloses mains)
1 Flame-retardant molded plastic
2 Flame-retardant sheet
3 Metal

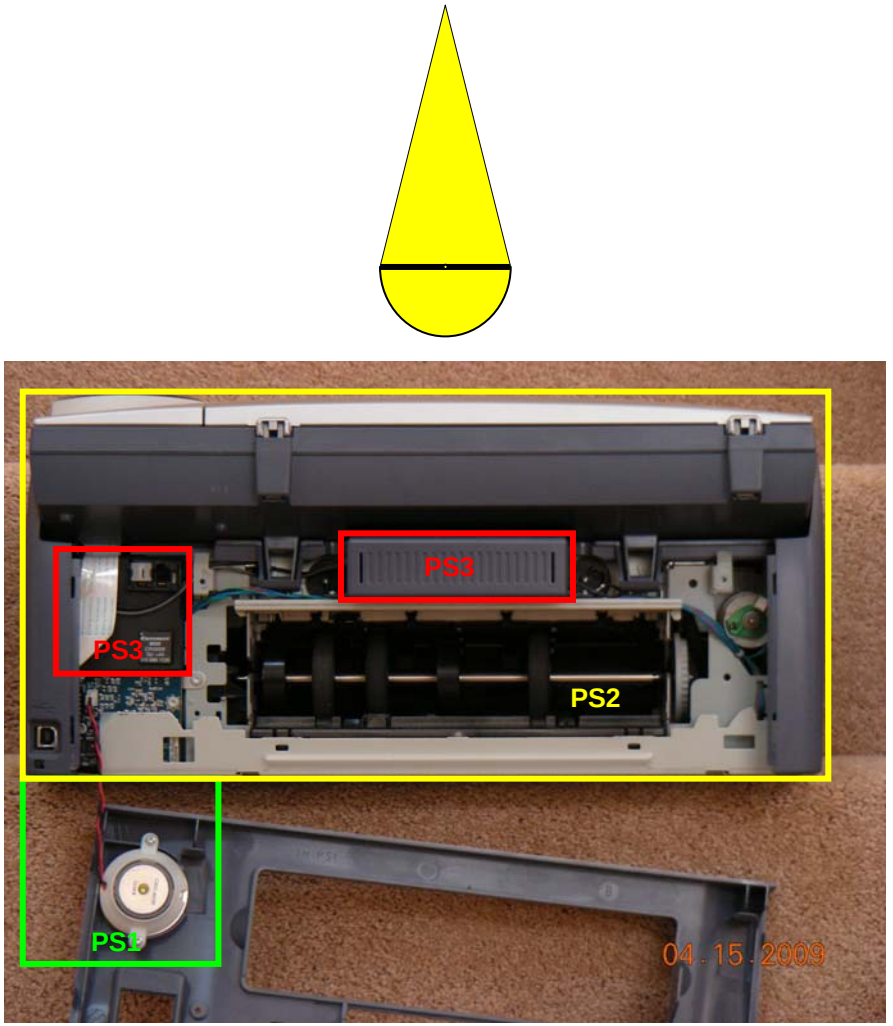


Fire enclosure
(encloses telephone circuits)
Flame-retardant sheet

SAFEGUARDS AGAINST PS2

Ignition Prevention Safeguards
(applicable to PS2 circuits)

- **Fault condition testing to determine if ignition will occur**
- **Distances from potential ignition source (PIS) to ignitable materials**



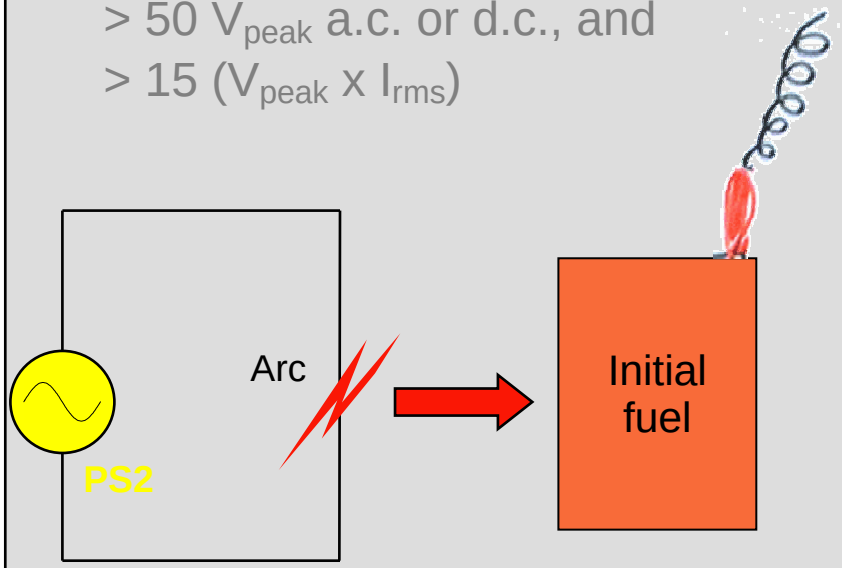
POTENTIAL IGNITION SOURCES (PIS)

Arcing PIS

where an arc may occur due to the opening of a conductor or a contact

> 50 V_{peak} a.c. or d.c., and

> 15 (V_{peak} x I_{rms})



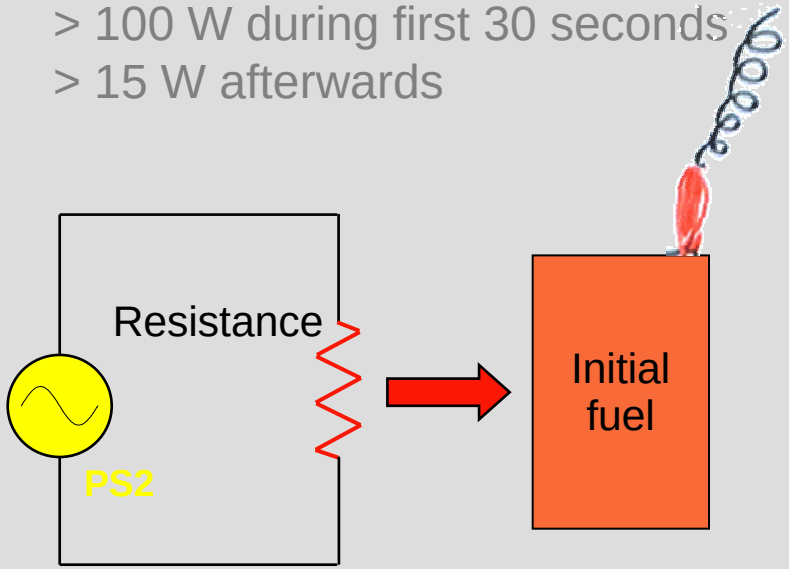
Power converted to thermal energy → Conduction, convection, radiation → Fuel heated to ignition temperature

Resistive PIS

where power may be dissipated in a resistance

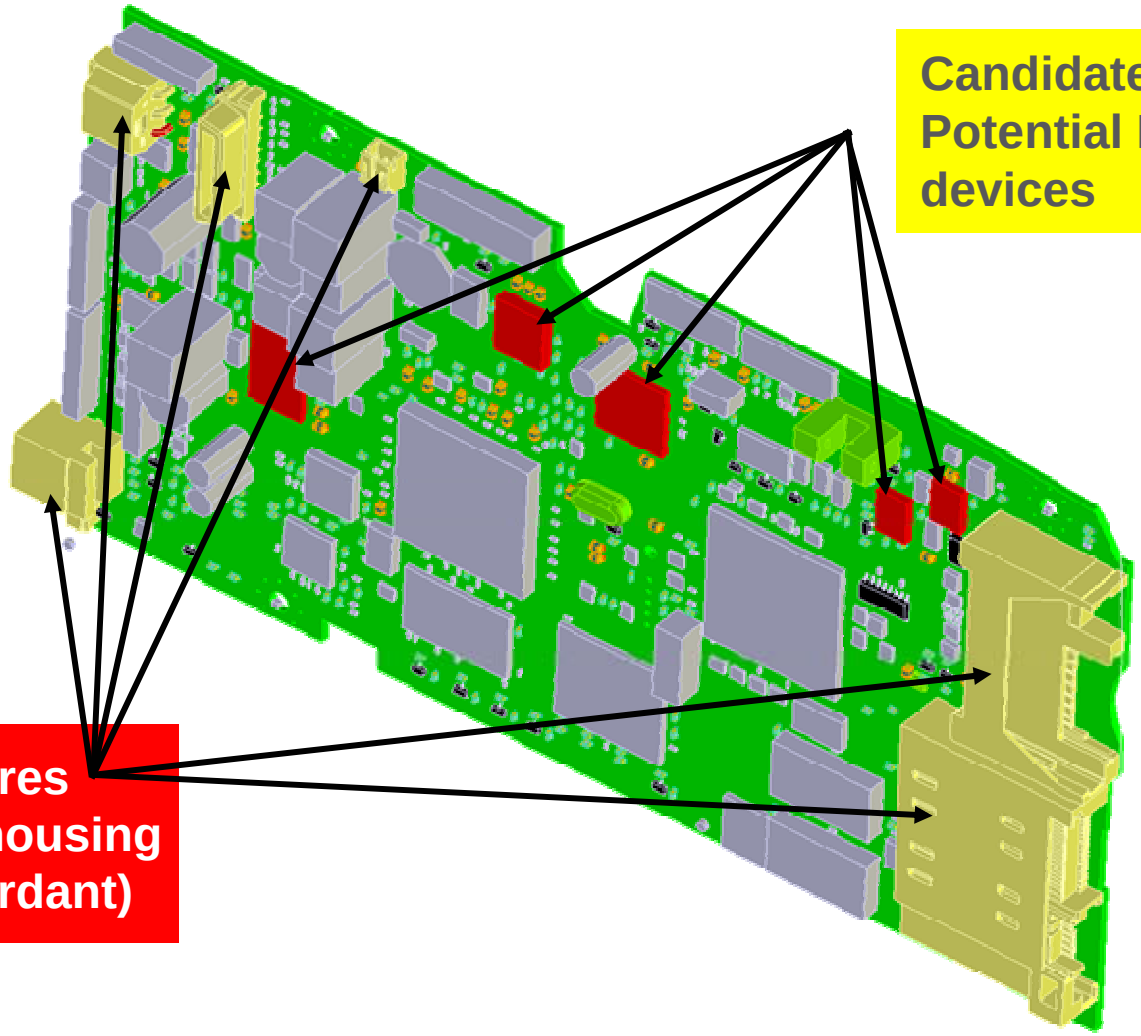
> 100 W during first 30 seconds

> 15 W afterwards



Power converted to thermal energy → Conduction, convection, radiation → Fuel heated to ignition temperature

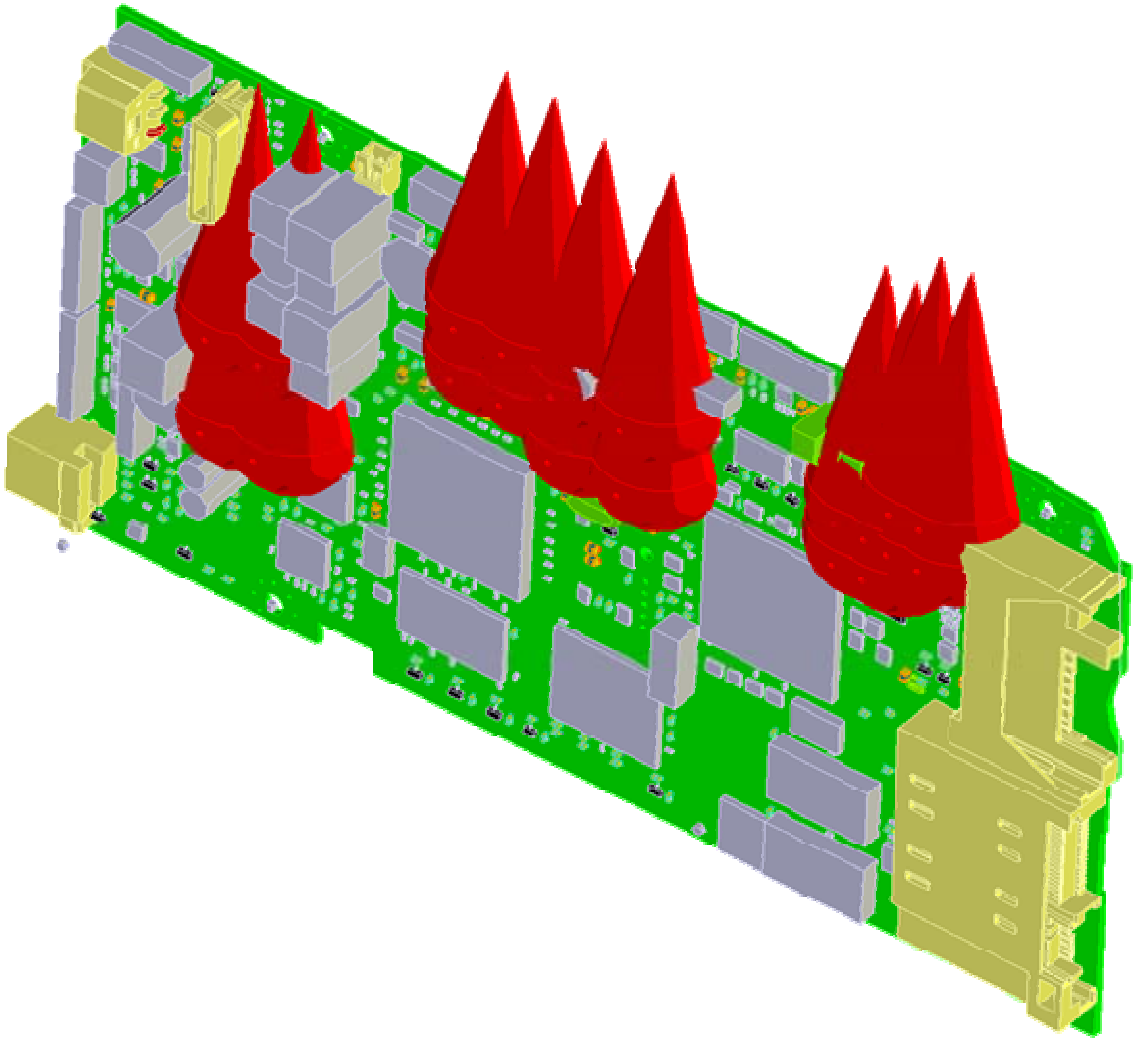
CANDIDATE PIS DEVICES IN PS2 CIRCUITS



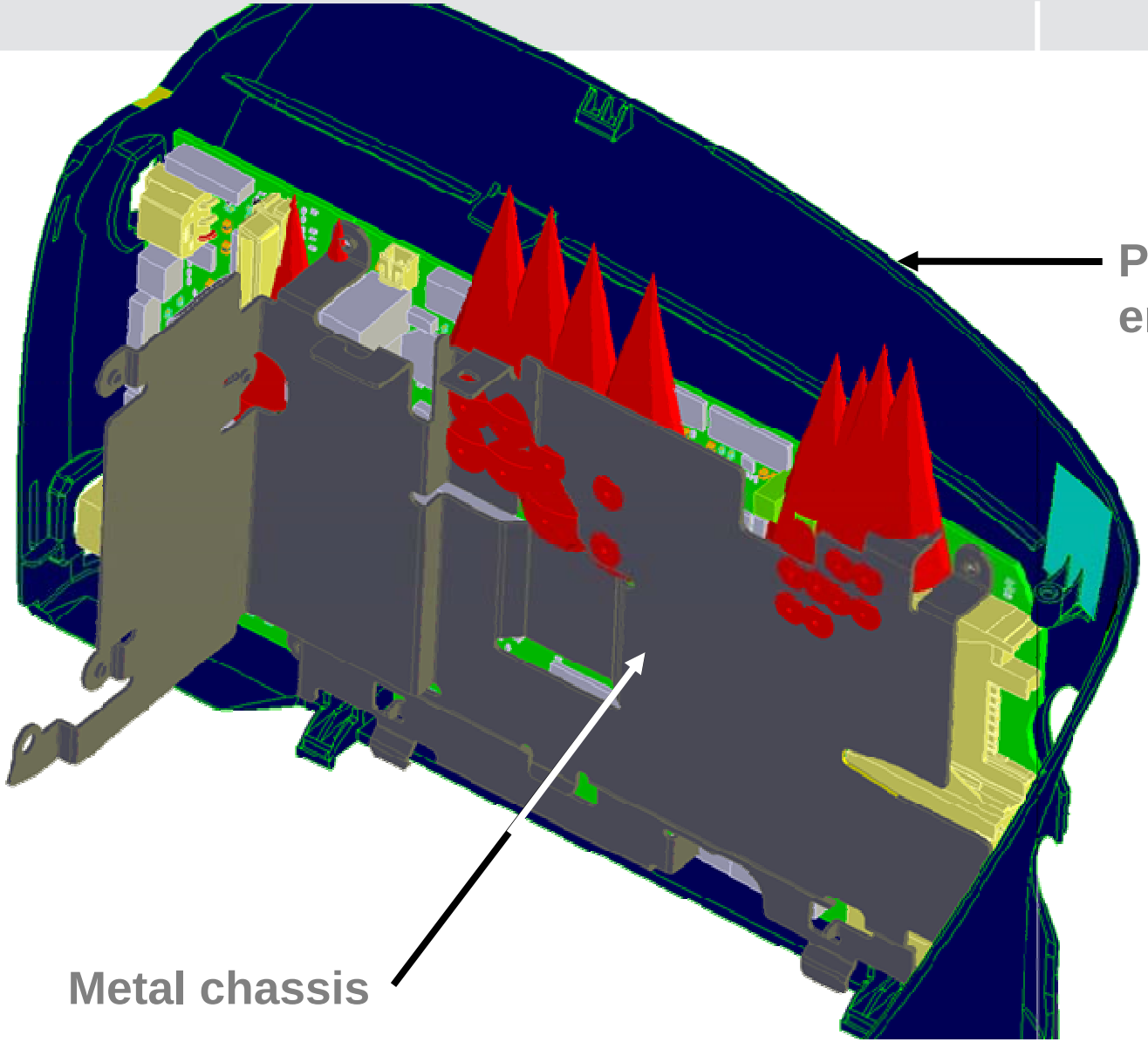
Candidate Potential Ignition Source devices

Fire enclosures (connector housing is flame-retardant)

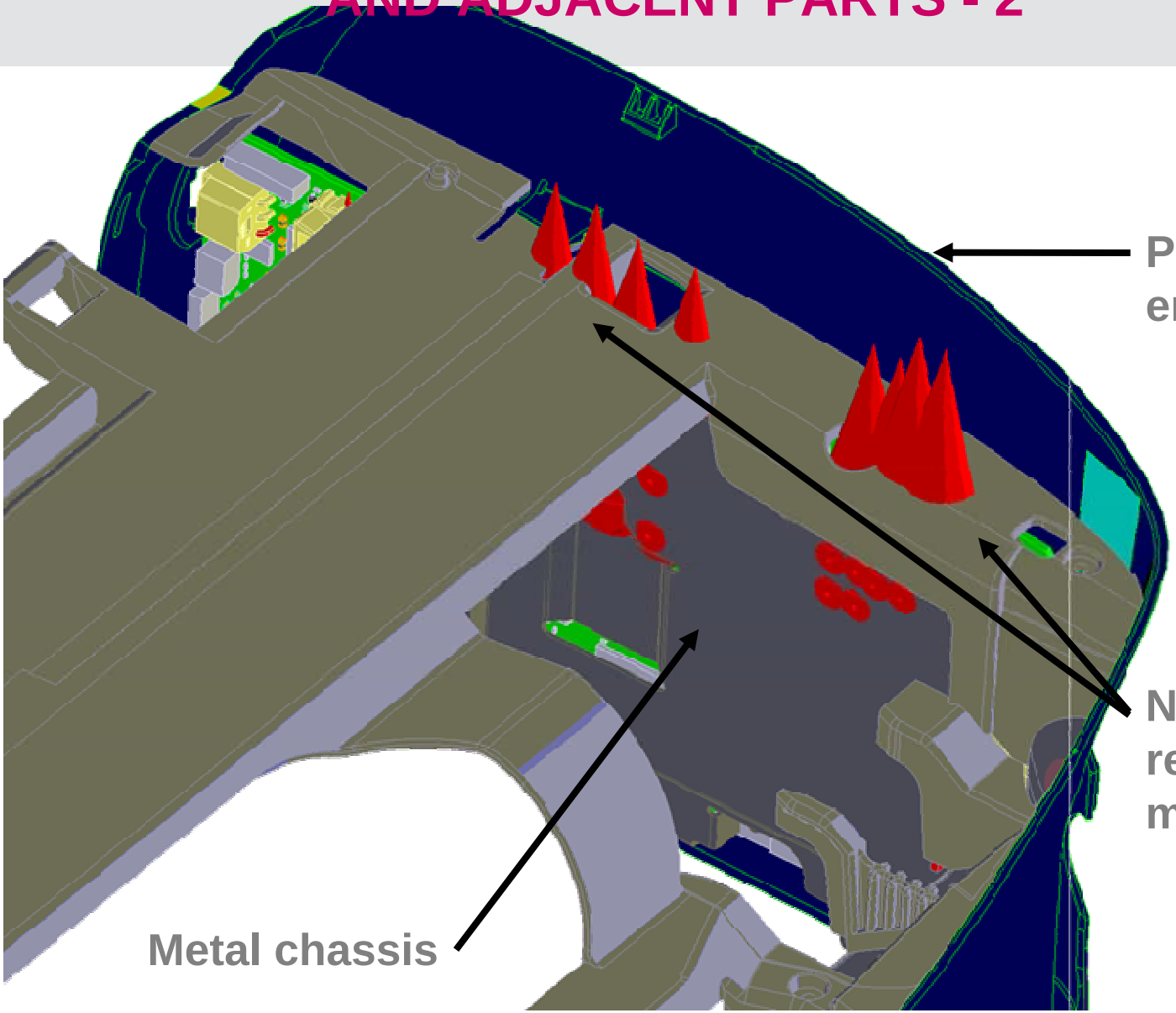
PIS WITH FLAME CONES



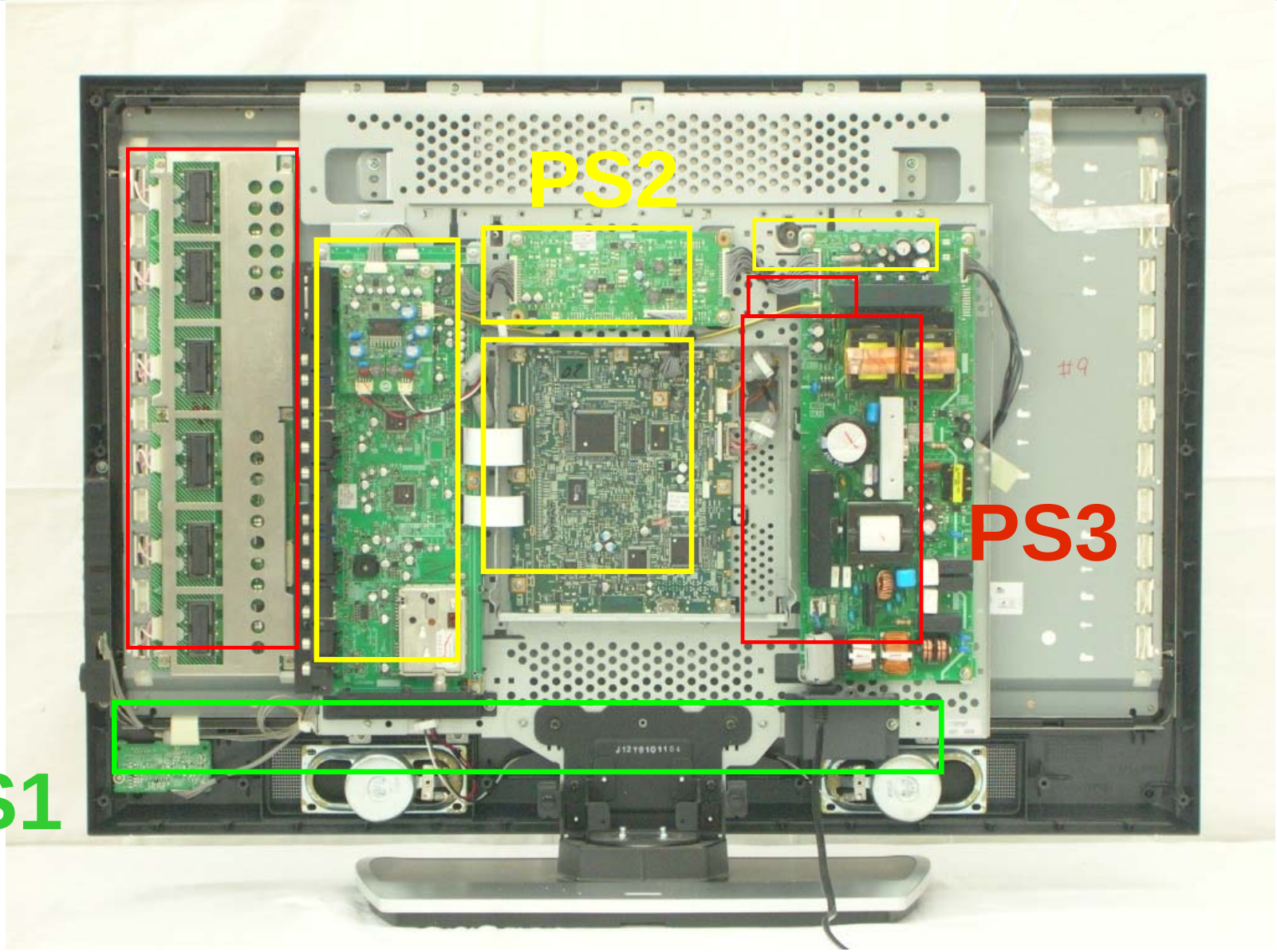
PIS WITH FLAME CONE AND ADJACENT PARTS - 1



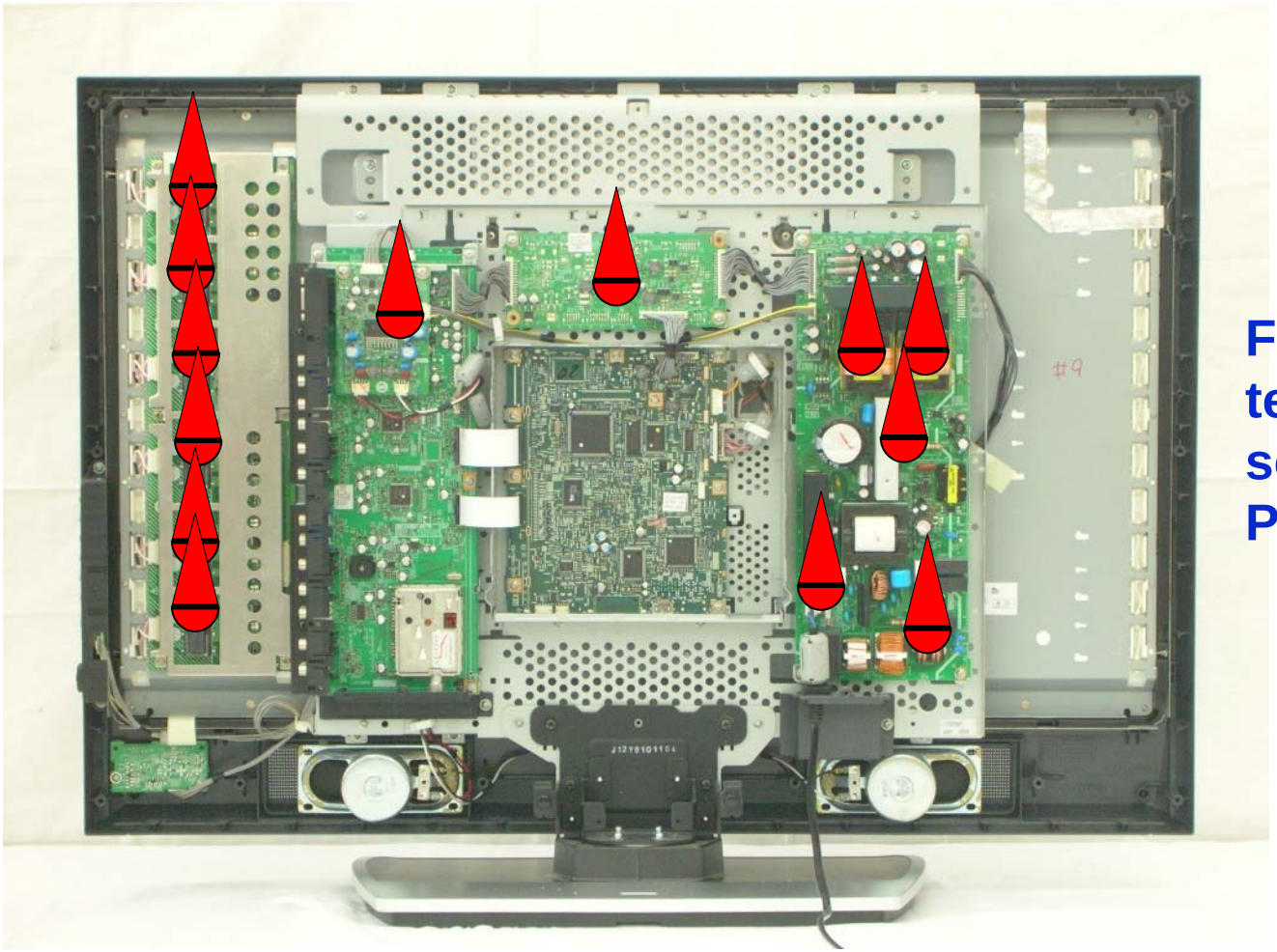
PIS WITH FLAME CONE AND ADJACENT PARTS - 2



LCD TELEVISION
PS1, PS2, and PS3 circuit identification



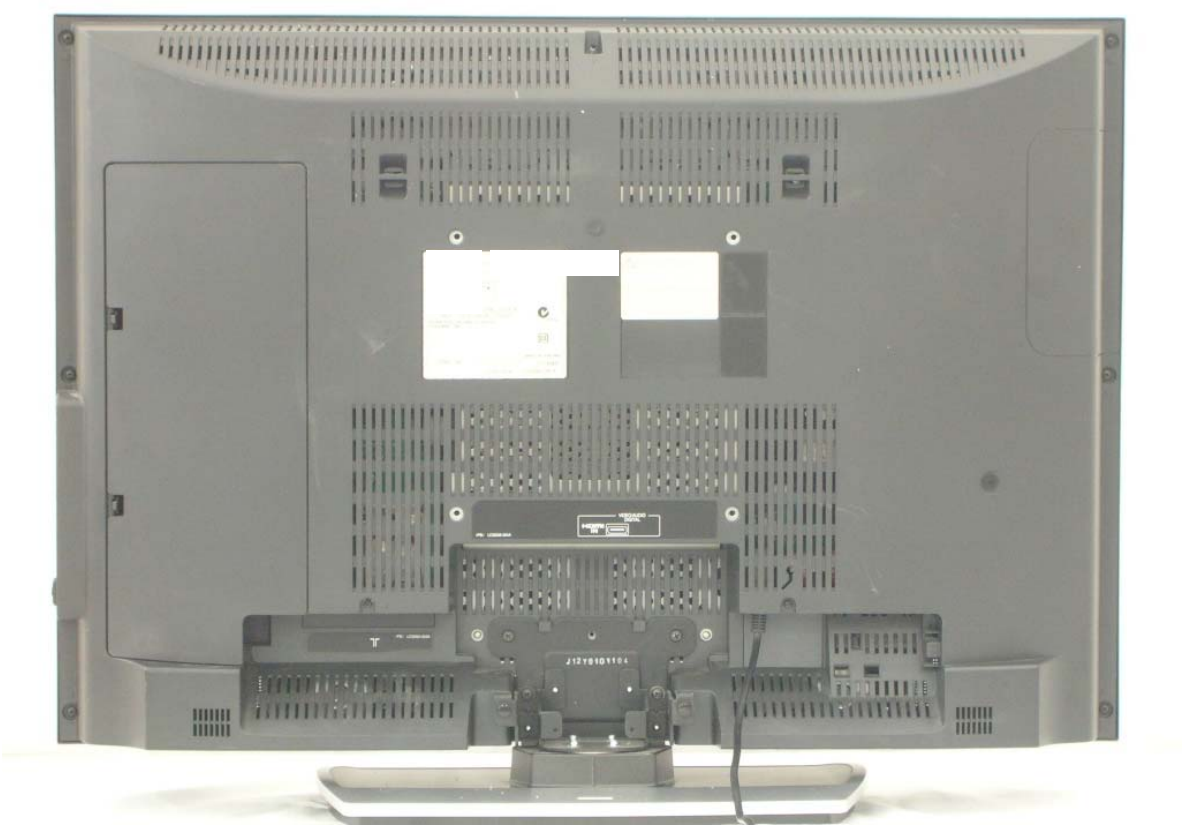
Prevent ignition



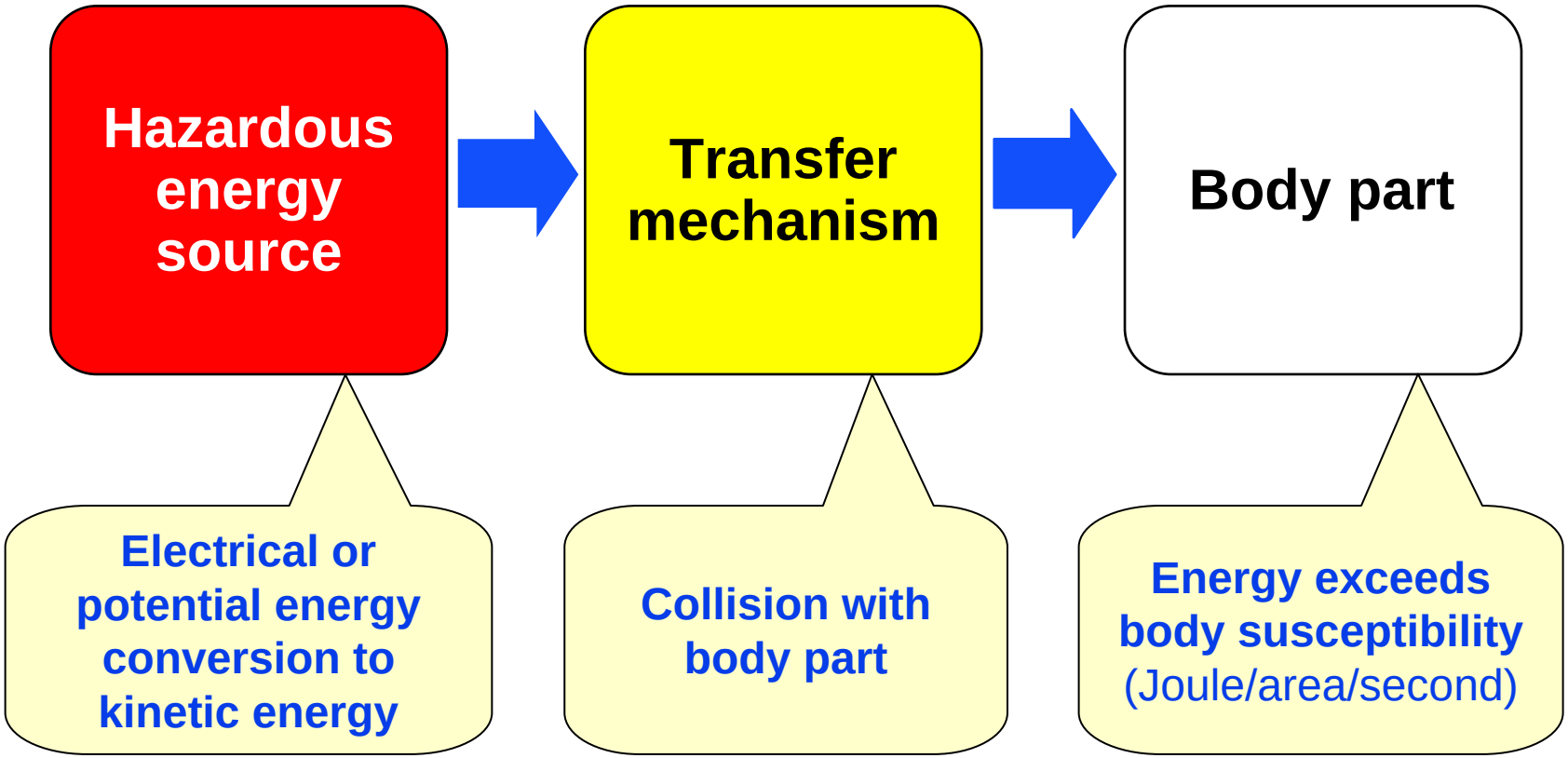
Fault condition test and separation from PIS

Prevent spread of fire

Fire enclosure required



THREE-BLOCK MODEL FOR MECHANICAL INJURY



PRODUCT INVESTIGATION – MECHANICAL INJURY

- **What are the MS1, MS2, and MS3 parts?**

Mechanical injury, energy source class MS-	MS1 < 7 kg mass	MS2 < 25 kg mass	MS3 > 25 kg mass

- **What are the product safeguards against mechanical injury?**

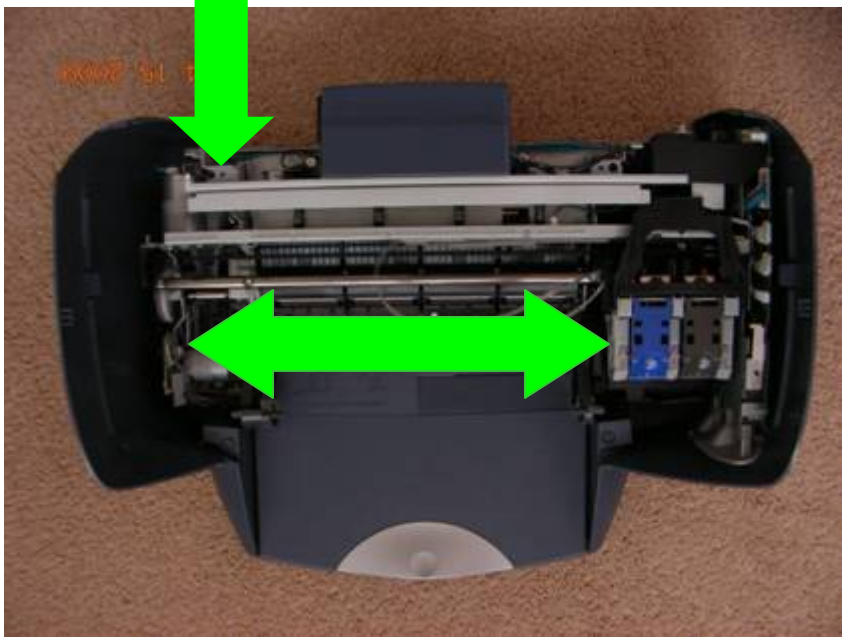
Mechanical injury, energy source class MS-	None	No overbalance	Floor-standing or fastened in place

MS1 PARTS -- EXAMPLE

MS1, MS2, MS3
PART IDENTIFICATION

MS1 (moving carriage)

MS1 (rotating gear)



MS1 (moving carriage)

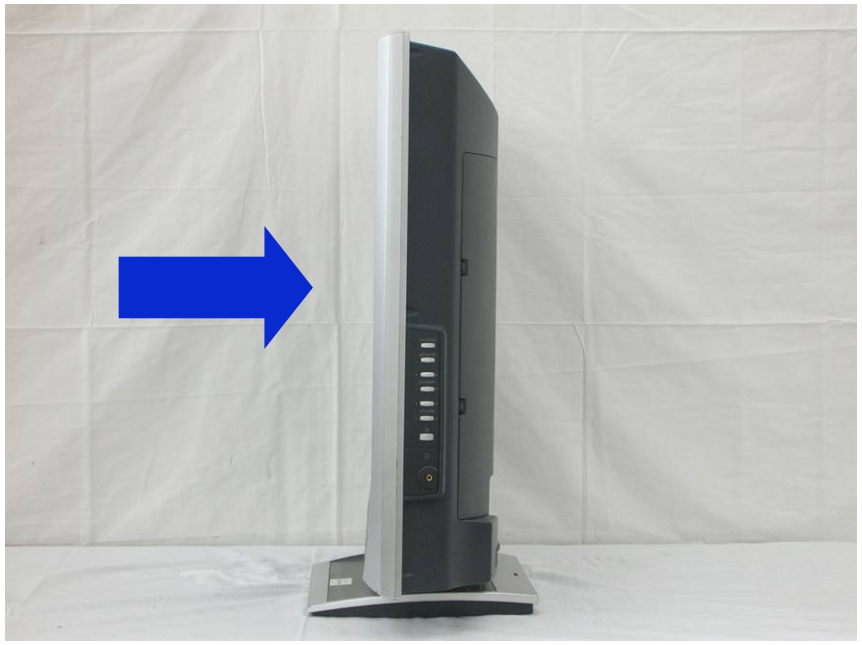
MS1, MS2, MS3
PART IDENTIFICATION

No moving parts ➡ MS1

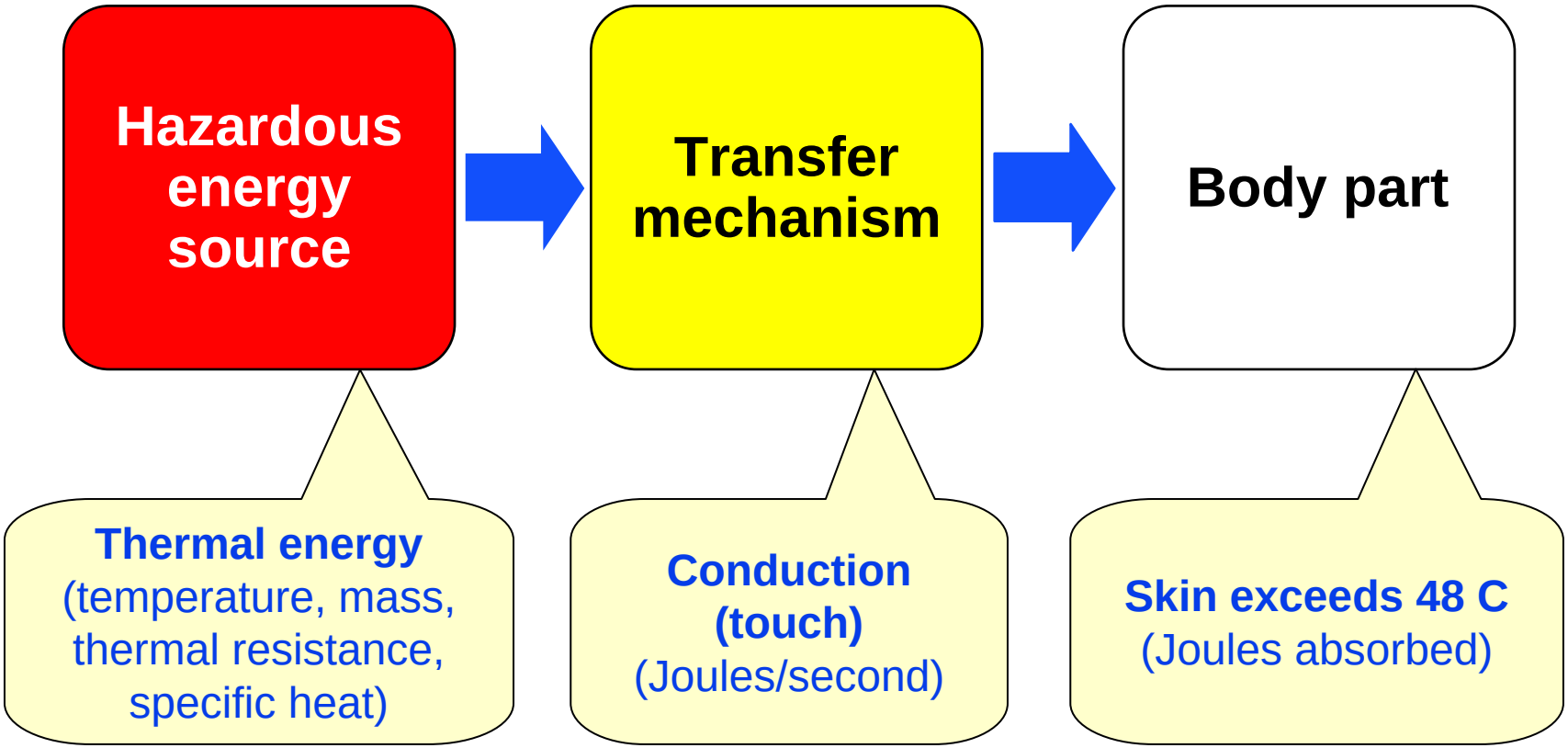
Mass: >25Kg

⬇

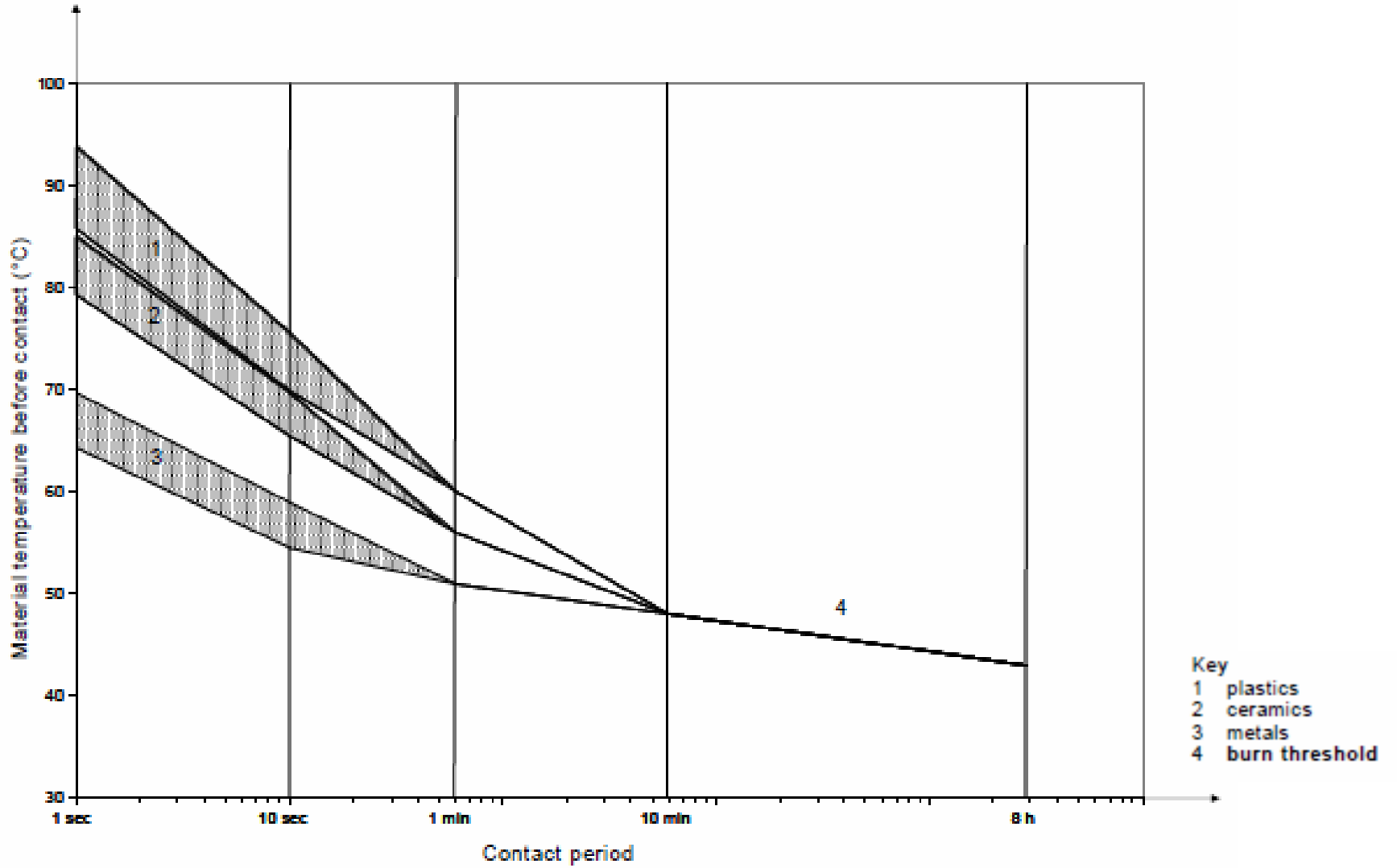
MS3



THREE-BLOCK MODEL FOR THERMAL INJURY



MATERIAL TEMPERATURE AND CONTACT TIME



PRODUCT INVESTIGATION – THERMAL INJURY

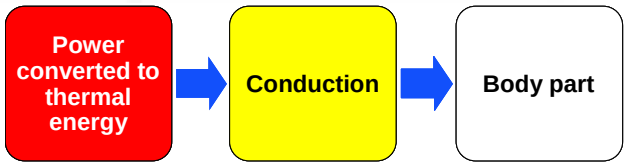
- **What are the TS1, TS2, and TS3 parts?**

Thermal injury, energy source class TS-	< 48 °C	< 58 °C	> 58 °C

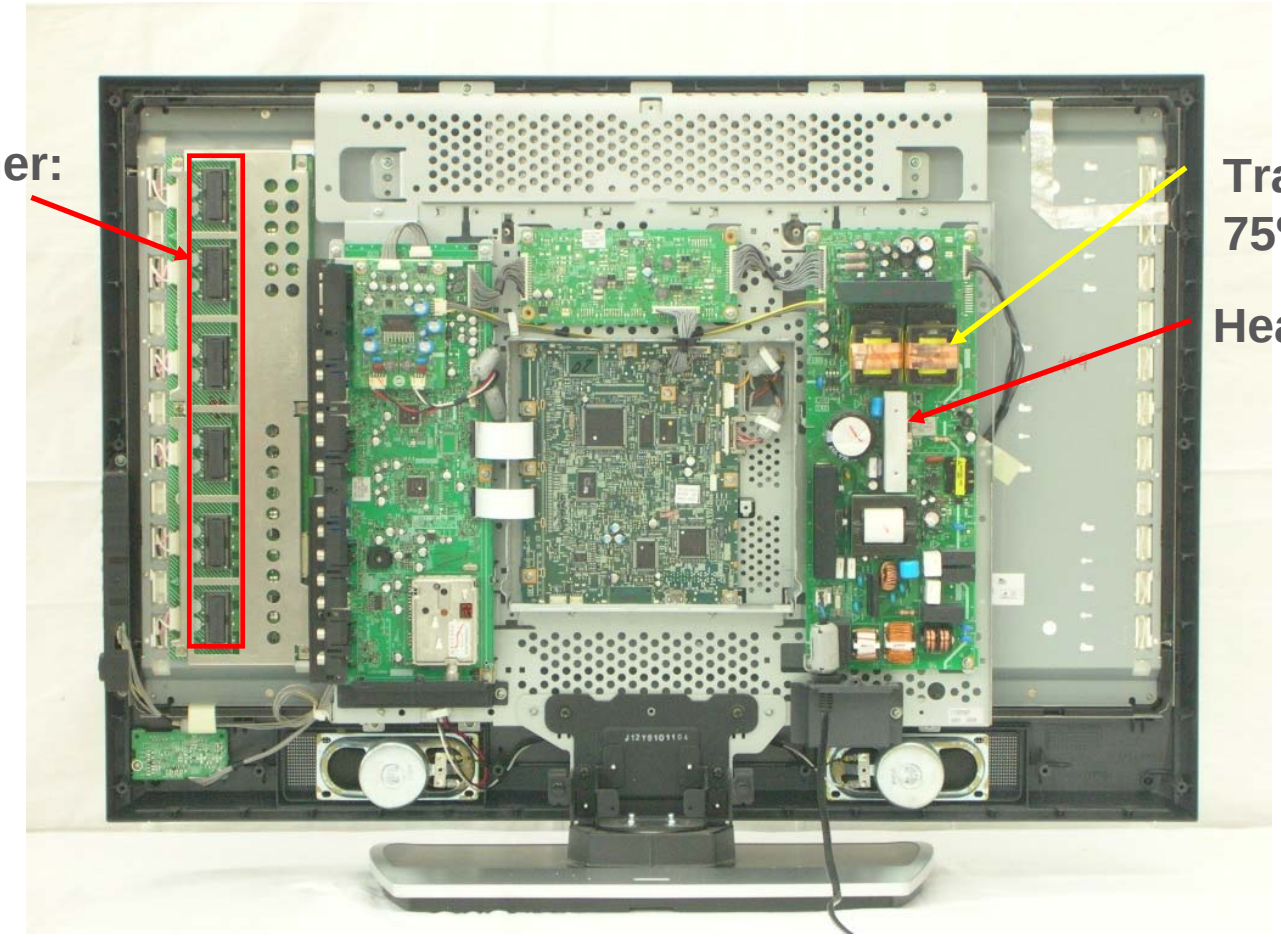
- **What are the product safeguards against thermal injury?**

Thermal injury, energy source class TS-	None	Warning (Instructional safeguard)	Not accessible (Equipment safeguard)

EXAMPLE OF THERMAL INJURY and THERMAL SAFEGUARD

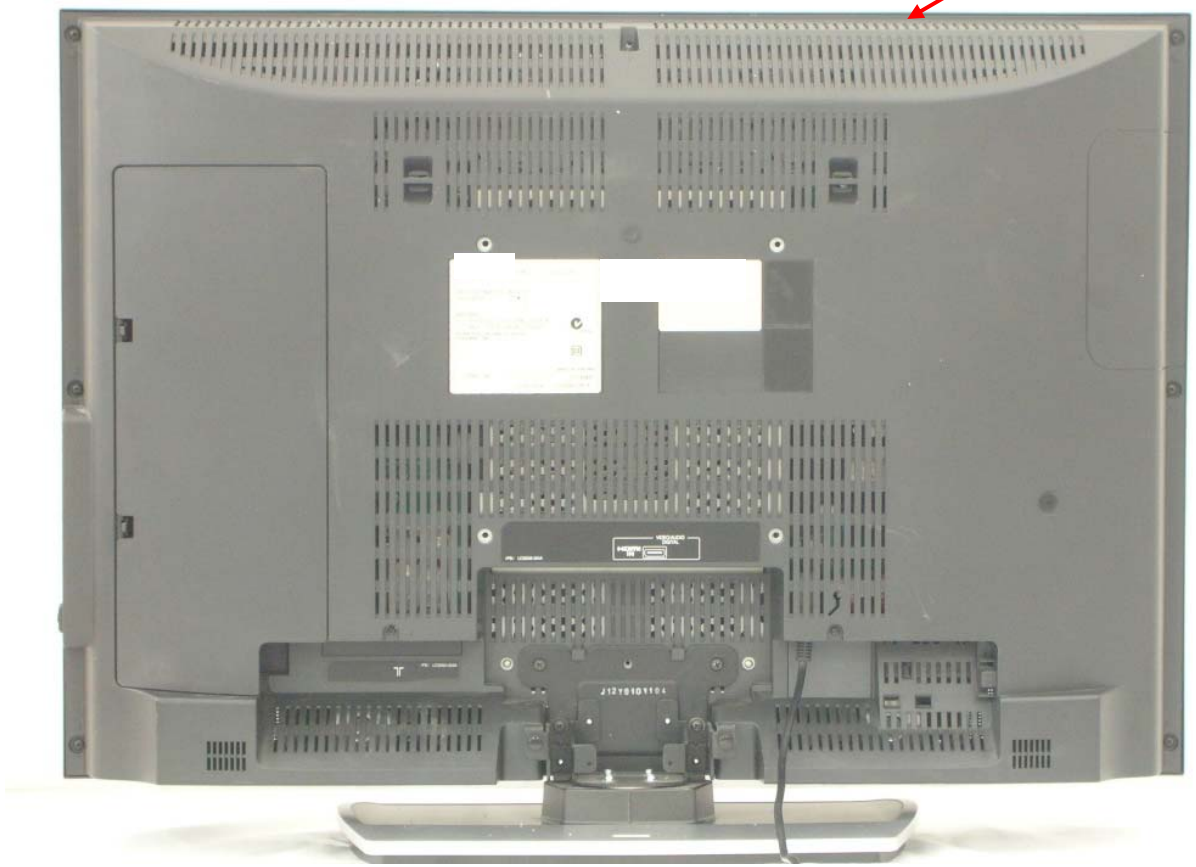


TS1, TS2, TS3
PART IDENTIFICATION



TS1, TS2, TS3
PART IDENTIFICATION

Outside of enclosure :
36ºC max



TS1


IEEE
PSES
Product Safety Engineering Society
END
power supply
and
printer-scanner-copier-fax
and
LCD television
t. shiota and t. kondo
japan quality assurance organization (jqa)
osaka and tokyo, japan
richard nute
hb engineering expert, tc 108/hbsdt
san diego, california, u.s.a.