

# Our Top 10

Most Commonly Found  
Non-Compliant Items in Industrial  
Equipment Examinations



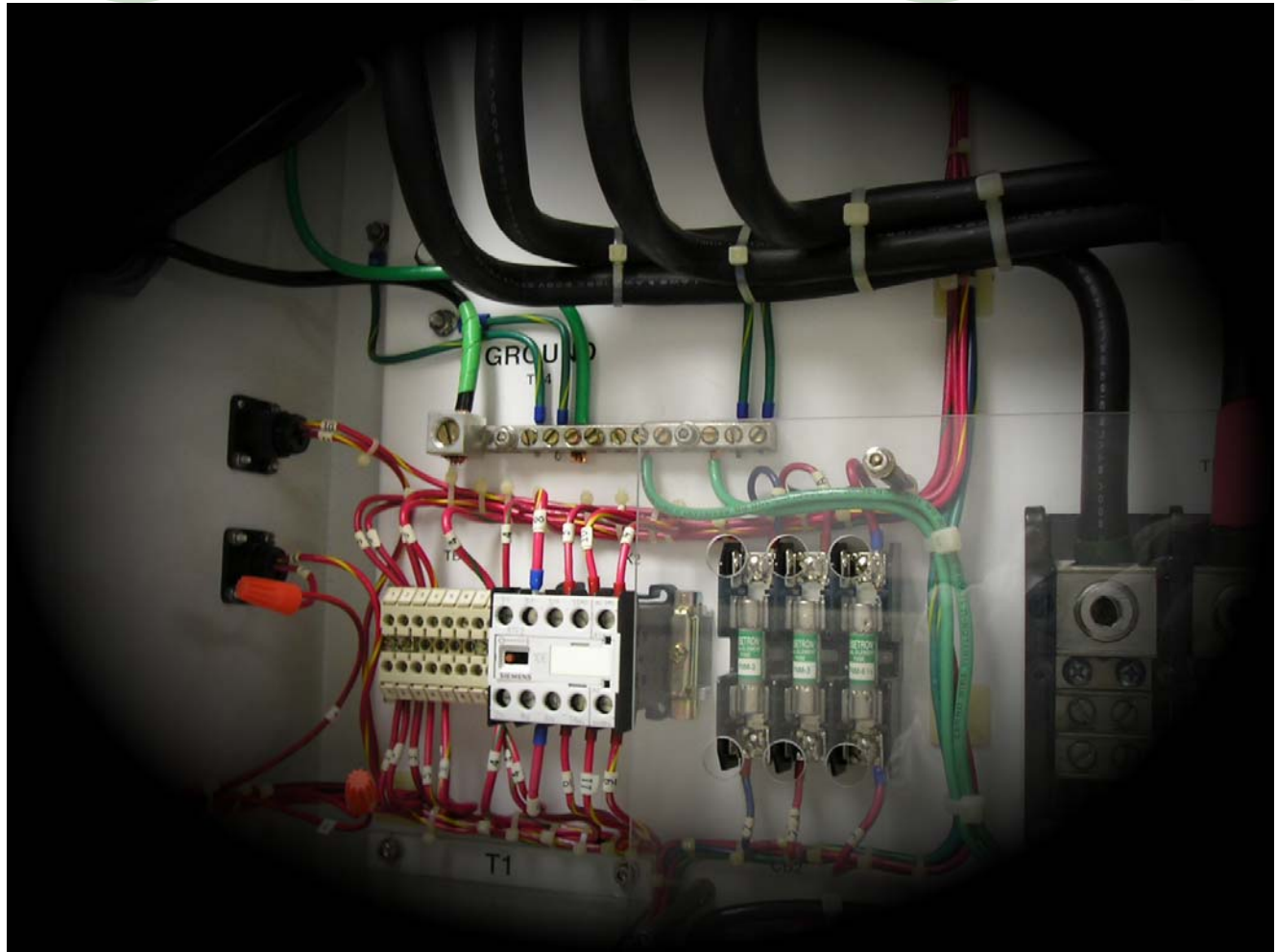
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# Top 10 Trouble Areas

## 10. Improper Grounding



# Grounding



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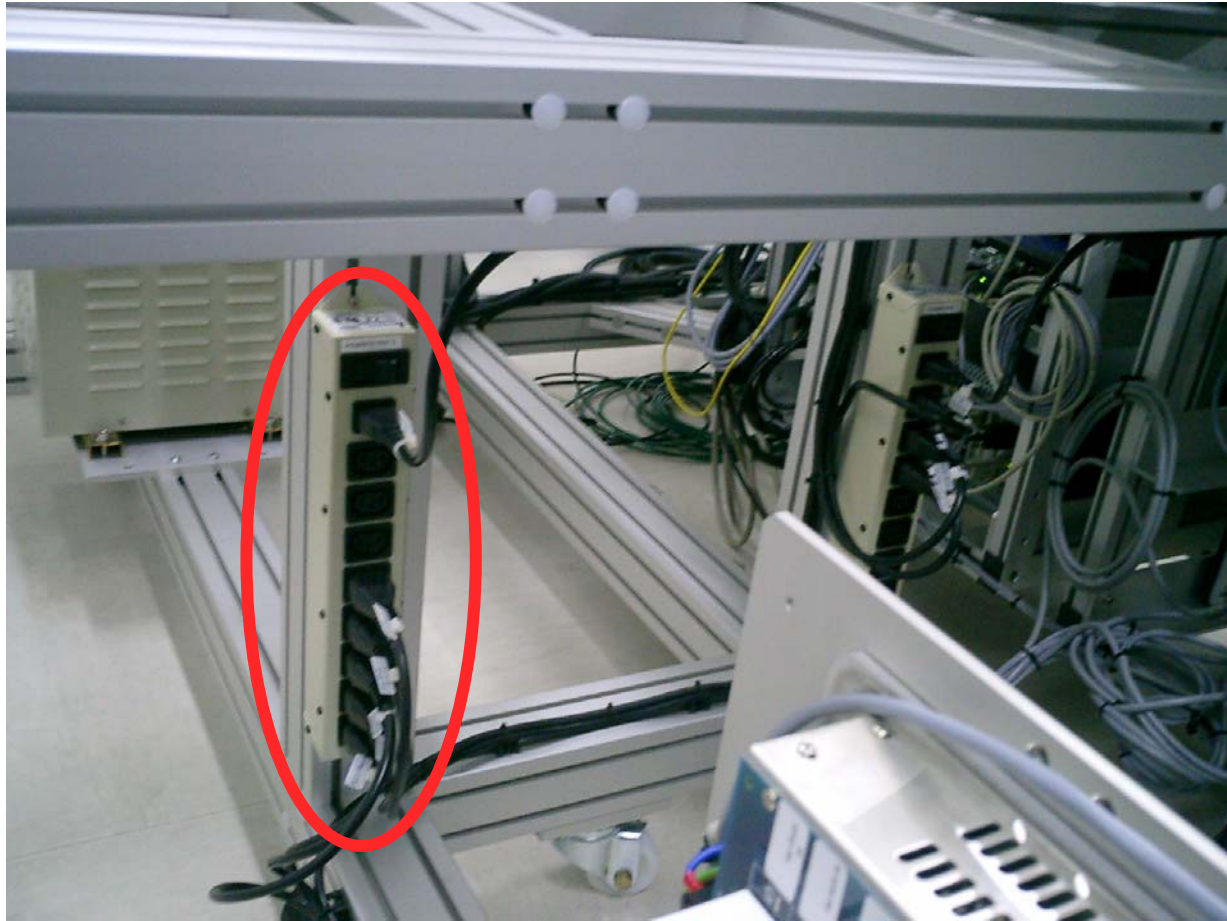
# Top 10 Trouble Areas

10. Improper Grounding

9. Flexible cord (type SO) used as permanent wiring



# Use of Flexible Cords



# Top 10 Trouble Areas

10. Improper Grounding
9. Flexible cord (type SO) used as permanent wiring
8. Incorrect EMO circuit function



# EMO (Emergency OFF)

- Requirements

- All equipment *shall* be equipped with a “Category 0” stop. (USA, CE)
- Switches *shall* be self latching & NC
  - Must be PUSH to operate button
  - Actuators *shall* be colored **RED**
  - Background *shall* be colored **YELLOW**
  - Actuators *shall* be mushroom-head or palm type
- Resetting of switch *shall not* restart equipment
  - Requires three step operation:
    1. Activate EMO switch
    2. Reset EMO switch
    3. Restart equipment



# Top 10 Trouble Areas

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8. Incorrect EMO circuit function
7. Improper transformer & motor protection



# Transformer & Motor Protection

NEC table 430.52 sets the over current protection as a % of full load current:

Motor Type	Non-Time Delay Fuse	Time Delay Fuse	Instantaneous Trip Breaker	Inverse Time Breaker
Single phase	300%	175%	800%	250%
Squirrel cage	300%	175%	800%	250%
Energy efficient	300%	175%	1100%	250%
Synchronous	300%	175%	800%	250%
Wound rotor	150%	150%	800%	150%
Direct current	150%	150%	250%	150%

	Primary Protection			Secondary Protection	
	Current $\geq 9$	Current $< 9$	Current $< 2$	Current $\geq 9$	Current $< 9$
Only the primary is protected	125%	167%	300%	does not apply	does not apply
Both primary and secondary are protected	250%	250%	250%	125%	167%

**Note:** See NEC table 450.3(B) notes #1-3 for more detail.

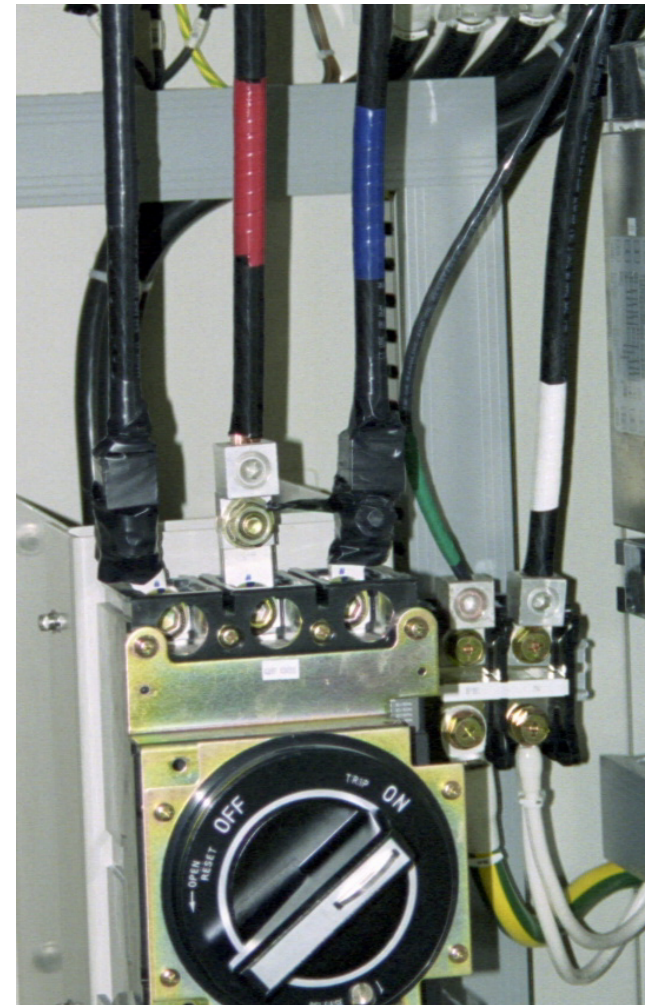
# Top 10 Trouble Areas

10. Improper Grounding
9. Flexible cord (type SO) used as permanent wiring
8. Incorrect EMO circuit function
7. Improper transformer & motor protection
6. Improper wire size & marking



# Wire Size & Marking

Size AWG or kcmil	60°C (140°F)	75°C (167°F)	90°C (194°F)
		Types TW, UF	Types RHW, THHW, THW, THWN, XHHW, USE, ZW
COPPER			
18	—	—	14
16	—	—	18
14*	20	20	25
12*	25	25	30
10*	30	35	40
8	40	50	55
<b>6</b>	55	65	<b>75</b>
4	70	85	95
3	85	100	110
2	95	115	130
1	110	130	150



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7. Improper transformer & motor protection
6. Improper wire size & marking
5. Nameplate or Nameplate Information Missing



# Nameplate

<b>MANUFACTURER</b>	<b>MODEL</b>
	<b>SERIAL</b>
<b>INPUT</b>	
<input type="text"/> <b>VOLTS</b>	<input type="text"/> Ø <input type="text"/> <b>HZ</b>
<input type="text"/> <b>AMPS</b>	
<input type="text"/> <b># WIRES</b>	<input type="text"/> <b>AMPERES</b>
<b>INPUT BREAKER</b>	<b>LARGEST LOAD</b>
<input type="text"/> <b>AMPS</b>	<input type="text"/> <b>A.I.C.</b>
<b>SCHEMATIC</b>	<input type="text"/>
Supply conductor and machine overcurrent protection provided at machine supply terminals.	
	<input type="text"/>

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7. Improper transformer & motor protection
6. Improper wire size & marking
5. Nameplate or Nameplate Information Missing
4. Oversize mains & branch breakers



# Oversize Mains & Branch Breakers

- If system input is: 208V, 3Ø, and
- If branch breakers are:
  - 50A, 3Ø, 3 or 4 pole
  - 25A, 3Ø, 3 or 4 pole
  - 20A, 2 pole
  - 15A, 1 pole (six total)
- What is the size of the main breaker (disconnect)?



# Oversize Mains & Branch Breakers

- The ampere rating (*of the main breaker, if used as a disconnect*) shall be at least **115 percent** of the sum of the full-load currents required for all equipment that may be in operation at the same time under normal conditions of use.
- If the branch circuit supplies a single non-motor operated load rated at 16.7 amperes or more, the overcurrent device rating shall not exceed **150 percent** of the load rating.

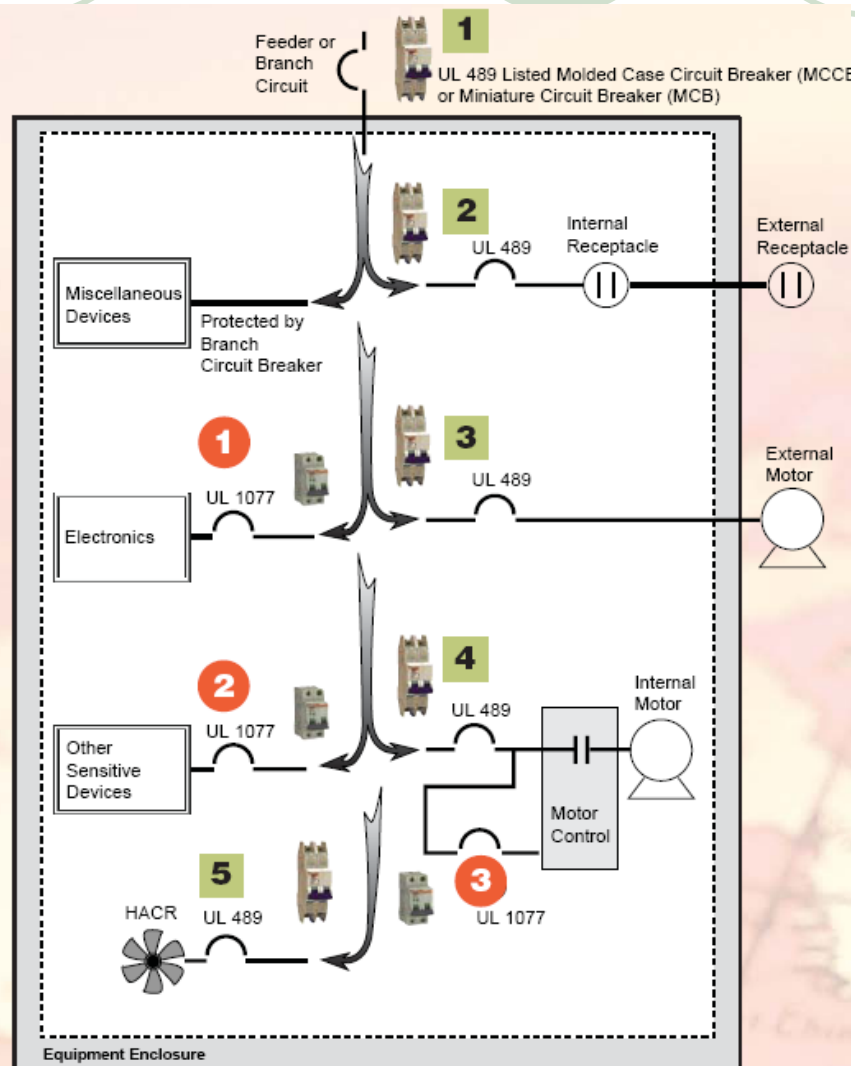


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4. Oversize mains & branch breakers
3. Main CB (disconnect) not listed (UL489)



# Use of Listed Breakers



**Example of applicable UL 489 Circuit Breakers and UL 1077 Supplementary Protectors**

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6. Improper wire size & marking
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4. Oversize mains & branch breakers
3. Main CB (disconnect) not listed (UL489)
2. No GFCI on utility & convenience outlets



# Effects of Electric Shock,

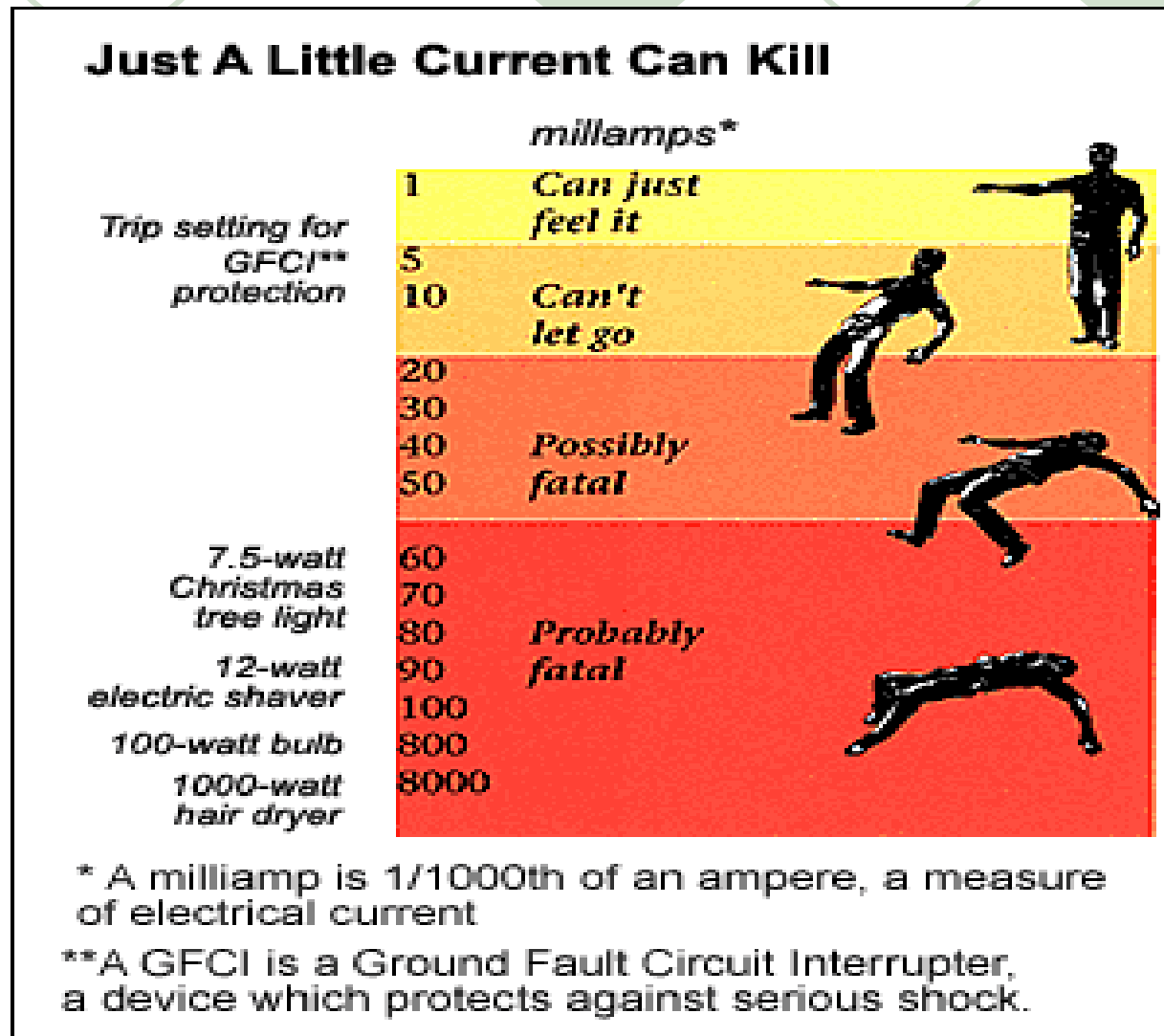
Charles F. Dalziel, 1956

<b><i>Bodily Effect</i></b>	<b><i>Gender</i></b>	<b><i>DC (ma)</i></b>	<b><i>60 Hz (ma)</i></b>	<b><i>10kHz (ma)</i></b>
Slight sensation at point(s) of contact	Men	1	0.4	7
	Women	0.6	0.3	5
Threshold of bodily perception	Men	5.2	1.1	12
	Women	3.5	0.7	8
Pain, w/ voluntary muscle control maintained	Men	62	9	55
	Women	41	6	37
Pain, w/ loss of voluntary muscle control	Men	76	16	75
	Women	51	10.5	50
Severe pain, difficulty breathing	Men	90	23	94
	Women	60	15	63
Possible heart fibrillation after three (3) seconds	Men	500	100	ND
	Women	500	100	ND





# Effects of Electric Shock



AND, #1

Manuals and Schematics  
are  
Non-existent  
or  
Incomplete



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