

ELEVATOR MOTOR SIZING ESTIMATE			
HYDRAULIC PUSH LIFT			
2 - 3 STORY	4 - 5 STORY	6 - 8 STORY	-
25HP	50HP	125HP	-
CABLE PULL LIFT			
2 - 3 STORY	4 - 5 STORY	6 - 8 STORY	-
??HP	??HP	??HP	-
EMERGENCY POWER IF AVAILABLE AND SHUNT TRIP.			

TAP RULE  
 NEC 240.21(B) - READ TO MEET ALL CONDITIONS  
 (1) NOT OVER 10' - AMPACITY NOT LESS THAN COMBINED CALCULATED LOAD  
 (2) NOT OVER 25' - AMPACITY NOT LESS THAN 1/3 OF OVERCURRENT DEVICE  
 (3) TRANSFORMER - AMPACITY NOT LESS THAN 1/3 OF OVERCURRENT DEVICE  
 (4) OVER 25' - AMPACITY NOT LESS THAN 1/3 OF OVERCURRENT DEVICE  
 (5) UNLIMITED LENGTH -

UNDERVOLTAGE -VS- SHUNT TRIP FOR RECEPTACLES LOCATED UNDER A KITCHEN HOOD  
 UNDERVOLTAGE IS MORE FAIL SAFE IN THAT IT REQUIRES A 35% TO 70% OF CONTROL VOLTAGE TO STAY ON. IF USING AN ANSUL FIRE SUPPRESSION CONTROL, IT WOULD REQUIRE A N.C. CONTACT.  
 SHUNT TRIP REQUIRES A 120V SOURCE TO CLOSE THE BREAKER.  
 UNDERVOLTAGE TRIP IS WAS REQUIRED BY SC OFFICE OF SCHOOL FACILITIES (OSF). MEMO FROM OSF DATED OCT. 29 2003 SHOWED THIS SHORT COMING. 2010.3 IN 2012 CODE.

MCA - SIZE WIRE  $KW = \frac{V}{1000} \times V \times \sqrt{3} \times MCA$   
 MOP - SIZE BREAKER  
 MOP (ONLY KNOWN) - SIZE WIRE & BREAKER  
 A TYPICAL GOLF COURSE IS 180 TO 220 ACRES

GE: A Series lighting panels were introduced in the late 1980's. The lineup of A Series panels includes all of the following:  
 AQ, AL, AE, AD, and our newest is AS  
 The previous version panels were:  
 NLTO, NLAB, NAB, and NHB  
 The power panels were changed in the same timeframe as well. The current model is Spectra, and the previous version is CCB.

TEMPERATURE			
	KELVIN	CELSIUS	FAHRENHEIT
ABSOLUTE ZERO	OK	273.16°C	459.7°F
WATER FREEZES	273.16K	0°C	32°F
WATER BOILS	373.16K	100°C	212°F

$K = C + 273.16$   
 $F = (9/5)C + 32$

Energy Comparison	
1 pound of wood	6,401 BTUs = 1.9 KWH
1 pound of coal	13,000 BTUs = 3.8 KWH
1,000 cubic feet of natural gas	1,000,021 BTUs = 299 KWH
1 gallon of oil	138,095 BTUs = 40.5 KWH
1 gallon of propane	91,500 BTUs 26.8 KWH

National Comparison Mix of Electric Generation Sources	
Coal	52%
Nuclear	19%
Gas & Fuel Oil	18%
Hydro	7%
Wood/Biomass, Wind, Solar	4%

US Department of Energy, September, 2005  
 National average cost of Electricity 8.83 cents per kilowatt hour

Power Plant Type	Cost \$/KW-hr
Coal	\$0.10-0.14
Natural Gas	\$0.07-0.13
Nuclear	\$0.10
Wind	\$0.08-0.20
Solar PV	\$0.13
Solar Thermal	\$0.24
Geothermal	\$0.05
Biomass	\$0.10
Hydro	\$0.08

Fuel Energy Efficiency	
Wood	1.9 KWH per pound
Coal	3.8 KWH per pound
Natural Gas	6.9 KWH per pound (liquid and gas measures are calculated at 6.3 pounds per gallon)
Oil	6.4 KWH per pound
Propane	4.3 KWH per pound

Regional Variation in Levelized Costs of New Generation Resources, 2019			
Plant type	Total System Levelized Costs (2010 USD/MWh)		
	Minimum	Average	Maximum
Conventional Coal	87.0	95.6	114.4
IGCC	106.4	112.2	131.5
IGCC with CCS	137.3	147.4	163.3
Natural Gas Fired			
Conventional Combined Cycle	61.1	66.3	75.8
Advanced Combined Cycle	59.6	64.4	73.6
Advanced CC with CCS	85.5	91.3	105.0
Conventional Combustion Turbine	106.0	128.4	149.4
Advanced Combustion Turbine	96.9	103.8	119.8
Advanced Nuclear	92.6	96.1	102.0
Geothermal	46.2	47.9	50.3
Biomass	92.3	102.6	122.9
Wind	71.3	80.3	90.3
Wind-Offshore	168.7	204.1	271.0
Solar PV	101.4	130.0	200.9
Solar Thermal	176.8	243.1	368.0
	61.6	84.5	137.7

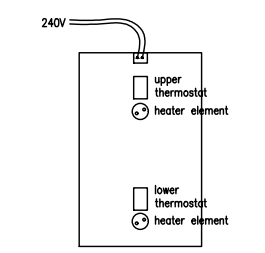
O&M = operation and maintenance.  
 CC = combined cycle.  
 CCS = carbon capture and sequestration.  
 PV = photovoltaics.  
 GHG = greenhouse gas.

When used as a unit of power for heating and cooling systems, BTU per hour (BTU/h) is the correct unit, though this is often abbreviated to just "BTU"  
 1 watt is approximately 3.412142 BTU/h [10]  
 1000 BTU/h is approximately 293.071 W  
 1 horsepower is approximately 2544 BTU/h

HEAT FROM LIGHTING SYSTEM = KW x 3.412142\* x DUTY HOURS  
 \* - MBtu/kWh

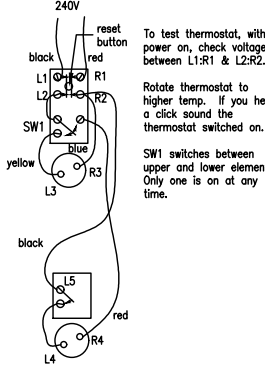
Covert 5000 watts to BTU per hour:  
 3.412142 x 5000 = 17060.71 BTU/hr.

ONLY QUALIFIED ELECTRICIANS SHOULD TROUBLESHOOT WATER HEATERS.



To check heater elements -  
 Make sure power is off and wires are removed before working with connections.  
 Remove at least one wire on element before proceeding. Check resistance from both terminals of the heater element. There should be between 8 to 25 ohms. If it reads differently then replace the element.

The top element heats first so make the bottom element hotter than the top, especially for taller water heaters. There may be a short instance of hot water if it is not tuned correctly.



To test thermostat, with power on, check voltage between L1:R1 & L2:R2.  
 Rotate thermostat to higher temp. If you hear a click sound the thermostat switched on.  
 SW1 switches between upper and lower element. Only one is on at any time.

Prefix	Symbol	10 <sup>n</sup>
yotta	Y	10 <sup>24</sup>
zetta	Z	10 <sup>21</sup>
exa	E	10 <sup>18</sup>
peta	P	10 <sup>15</sup>
tera	T	10 <sup>12</sup>
giga	G	10 <sup>9</sup>
mega	M	10 <sup>6</sup>
kilo	k	10 <sup>3</sup>
hecto	h	10 <sup>2</sup>
deca	da	10 <sup>1</sup>
		10 <sup>0</sup>
deci	d	10 <sup>-1</sup>
centi	c	10 <sup>-2</sup>
milli	m	10 <sup>-3</sup>
micro	μ	10 <sup>-6</sup>
nano	n	10 <sup>-9</sup>
pico	p	10 <sup>-12</sup>
femto	f	10 <sup>-15</sup>
atto	a	10 <sup>-18</sup>
zepto	z	10 <sup>-21</sup>
yocto	y	10 <sup>-24</sup>

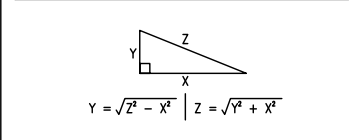
25% of 80 is 20  
 $25\% = 25/100$   
 $(25/100) \times 80 = 20$

15% of 200 apples were bad. How many apples were bad?  
 $(15/100) \times 200 = 15 \times 2 = 30$  apples

If only 10 of the 200 apples were bad, what percent is that?  
 $(10/200) = .05$  (5%)

A Skateboard is reduced 25% in price in a sale.  
 The old price was \$120.  
 $(25/100) \times \$120 = \$30$   
 $\$120 - \$30 = \$90$

BREAKERS IN A PANEL MAY HAVE DIFFERENT SIZED AIC RATING BUT LOWEST RATED SHALL DESIGNATE SIZE FOR PROTECTION OF PANEL IE: IF MOST ALL BREAKERS ARE 65K AND ONE IS RATED FOR 42K, THE PANEL SHALL BE DESIGNATED 42K AIC. ONLY WHEN ALL RATINGS ARE OVER 65KA DOES THE SIZE OF THE BOX START TO BE CONSIDERED BECAUSE OF THE EXTRA SUPPORT REQUIRED TO MOUNT BREAKERS.



American	mm	mm (rounded)
8"	230	200
2'	610	600
4'	1220	1200
6'	1830	1800
8'	2438	2400
10'	3048	3000
12'	3658	3600

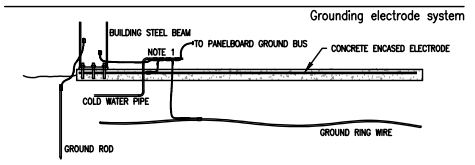
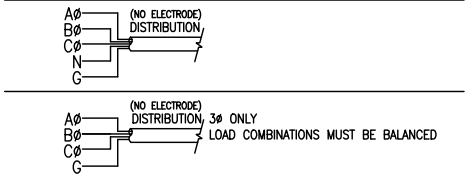
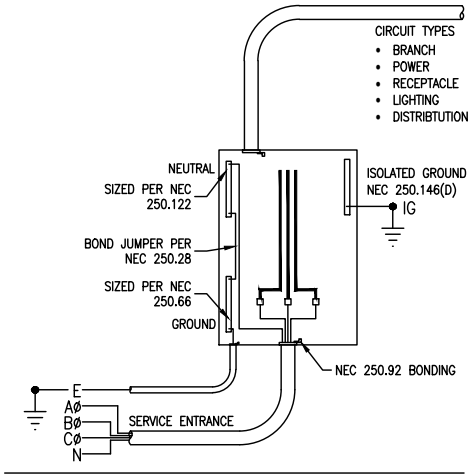
$1" \times 25.4 = \text{mm}$   
 $\text{mm} \times .03937 = \text{in}$

OHM'S LAW

based on 2014 NEC edited: APR 2016  
 MISC  
 REFER TO NATIONAL, STATE, LOCAL AND AHJ CODES AND EXISTING REQUIREMENTS.  
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CURRENT CARRIERS IN CONDUIT RUNS				
#	N	G	IG	NO. OF CCC* PER CONDUIT GROUP
12	12	12	12	(3)
12	12	12	12	(3)
12	12	12	12	(2)
12	12	12	12	(6)**
12	--	12	12	(3)
12	--	12	12	(3)
12	12	12	12	(6)**
12	12	12	12	(6)**

\*CURRENT CARRYING CONDUCTORS  
 \*\*TABLE 310-15(B)(2)(a) ADJUSTMENT FACTORS FOR MORE THAN 3 CURRENT CARRYING CONDUCTORS IN A RACEWAY OR CABLE



NOTE 1: NEC 250.52(A)(1), CONNECTIONS SHALL BE MADE WITHIN 5 FEET OF POINT OF ENTRY OF WATER PIPE.  
 FOR INFORMATION ONLY. REFER TO NATIONAL, REGIONAL LOCAL & AHJ CODES FOR EXACT REQUIREMENTS OF GROUNDING, BONDING AND SERVICE CONNECTIONS.

RADIOACTIVE DECAY			
ISOTOPE	HALF-LIFE	DECAY PRODUCT	HALF-LIFE
<b>A. FISSIONABLE MATERIAL</b>			
URANIUM-235	7.1 x 10 <sup>8</sup> yr.	THORIUM-231*	25.2 hr
URANIUM-238	4.5 x 10 <sup>9</sup> yr.	THORIUM-234*	24 days
URANIUM-239	2.4 x 10 <sup>4</sup> yr.	URANIUM-235*	7.1 x 10 <sup>8</sup> yr.
<b>B. FISSION PRODUCTS</b>			
LANTHANUM-140	40 hr.	CERIUM-140	STABLE
IODINE-131	8 days	XENON 131m	11.9 days
STONTIUM-90	28.9 yr.	YTRIUM-90	64 hr
CESIUM-137	30.0 yr.	BARIUM-137m	2.5 min
<b>C. OTHER RADIOISOTOPES</b>			
RADON-222	3.8 days	PLONONIUM-218*	3 min
POTASSIUM-40	1.3 x 10 <sup>9</sup> yr.	CESIUM-40	STABLE
		OR ARGON-40	STABLE
		MAGNESIUM-24	STABLE
SODIUM-24	15 hr.		
HYDROGEN-3 (TRITIUM)	12.3 yr.	HELIUM-3	STABLE

\* INCLUDES OTHER DAUGHTER RADIONUCLIDES.

Product	1 Gallon Pounds
Ale	8.33
Acid, Nitric	10.58
Acid, Sulphuric	15.42
Acid, Muratic	10
Alcohol, Commerce	6.74
Alcohol, Proof Spirit	7.9375
Naphtha	7.08
Oil, Linseed	7.75
Oil of Turpentine	7.25
Oil, Whole	7.25
Petroleum	7.35
Vinegar	8.43
SaltWater	8.59
Tar	8.43
Distilled Water	8.33

Boiling Points and Heat of Vaporization				
Substance	Boiling point °K	Boiling point °C	Heat of vaporization (103 J/kg)	Heat of vaporization (103 J/kg)
Helium	4.216	-268.93	20.9	
Hydrogen	20.26	-252.89	452	
Nitrogen	77.34	-195.81	201	
Oxygen	90.18	-182.97	213	
Ethyl alcohol	351	78	854	
Mercury	630	357	272	
Water	373.15	100.00	2256	
Sulfur	717.75	444.60	326	
Lead	2023	1750	871	
Antimony	1713	1440	561	
Silver	2466	2193	2336	
Gold	2933	2660	1578	
Copper	2840	2567	5069	

FIGURE 25.3 (IESNA) CONVERSION FACTORS FOR VARIOUS FUELS				
FUEL	FUEL EFFICIENCY	UNIT ENERGY	FUEL TO OBTAIN 1 MBtu	FUEL TO OBTAIN 1 MBtu
	1.0	0.0034 MBtu/kWh	293 kWh	283 kWh
ELECTRIC HEAT	0.85	30 MBtu/TON	0.05 TON	0.05 TON
NO. 2 FUEL OIL	0.70	0.14 MBtu/GAL	10 GAL	10 GAL
NATURAL GAS	0.70	1.0 MBtu/mCF	1.4 mCF/MBtu	1.4 mCF/MBtu

MBtu - 1 THOUSAND BTU (1,000)

Specific Resistance  
 The Specific Resistance (K) of a material is the resistance offered by a wire of this material which is one foot long with a diameter of one MIL.

The resistance of a wire is directly proportional to the specific resistance of the material.

Material	"K"	Material	"K"
Brass	43.0	Aluminum	17.0
Constantan	295	Monel	253
Copper	10.8	Nichrome	600
German Silver 18 %	200	Nickel	947
Gold	14.7	Tantalum	93.3
Iron (Pure)	60.0	Tin	69.0
Magnesium	276	Tungsten	34.0
Manganin	265	Silver	9.7

WARNING SYMBOLS

SHOCK HAZARD

DANGER HIGH VOLTAGE