**SI (Metric) Award**
sponsored by the
**US Metric Association (USMA)**
**https://usma.org**

# Judging Guide

(revised 2019)

ELIGIBILITY: All students competing in the fair are eligible.

THE PROJECT: The project should involve quantitative measures and should use units of the SI metric system for those measures. The subject of the project should not be the SI system itself.

THE USE OF SI UNITS: Measures reported in the project, including all calculations, results, graphs, etc. should be expressed completely and correctly in units of the International System of Units (SI) also called the metric system. It is preferable that equivalents in other units not be given at all (and if given, should be secondary to the SI expression). Measurements should actually be obtained in metric units, not obtained in US customary units and then mathematically converted to metric.

CRITERIA: Any project that involves measures and expresses those measures consistently and correctly in SI metric would be a good choice to win the metric award. A project which uses a variety of metric units for different kinds of measures (such as force in newtons, pressure in kilopascals, energy in joules, power in watts, etc.) would be a better choice than one which only uses centimeters to measure lengths or liters for volumes. A project in which the measures were integrally important to the research would be a better choice than one in which measures were only used to describe the sizes of containers or the amounts of substances tested (or the size of the display board!). Units of older (non-SI) metric systems are NOT acceptable. Examples of such non-acceptable units are: mmHg, cmHg or millibars for pressure; calories, kilocalories or ergs for energy or heat; dynes, grams or kilograms for force or weight. (Grams and kilograms are mass.) The table on the following page gives the name and correct symbol for some of the units of the SI system, those for measures that are most likely to be encountered. Also shown are a few non-SI units that are officially considered acceptable for use with SI.

COMMON ERRORS: A common error is the incorrect use of unit symbols. Capital letters are not correct where lower case is prescribed and vice versa. For kilowatts, kW is right while Kw, kw and KW are wrong. The symbols are never followed by an "s" to form a plural. It is not good usage to use multiple slashes for division. Use $m/s^2$, not m/s/s. The product of units is formed by a raised dot or a space between the separate symbols; e.g., the symbol for the newton–second is N·s or N s, but not Ns. Symbols should not be mixed with words. Write the symbol km/h or spell out kilometers per hour; do not use kilometers/hour. The symbols are not considered abbreviations so they should not end with a period. The symbols should be used, not abbreviations. Use s rather than sec. and use $cm^3$, not cc or c.c. and use h not hr. etc.

THANK YOU! The members of the US Metric Association thank you for assisting us by serving as a judge for the metric award.

USMA: The US Metric Association is a national non-profit organization that was founded in 1916. USMA advocates completing the US conversion to the International System of Units. For more information see https://usma.org, and for USMA's Science Fair information see https://usma.org/science-fair-award-program.

(See the table on the following page for Judging Criteria)

# Some Units of The International System of Units (SI)

(revised 2019)

| **Measurable Quantity** | **Basic Unit** | **Examples of Some Acceptable Multiples and Submultiples** | **Units Not Part of SI but Acceptable for Use with the SI** |
|---|---|---|---|
| Length, Distance | meter (m) | millimeter (mm)<br>kilometer (km) | astronomical unit (ua) |
| Mass<br>(not weight) | kilogram (kg) | gram (g)<br>milligram (mg)<br>microgram (µg) | tonne (t) (metric ton)<br>atomic mass unit (u) or<br>Dalton (Da) |
| Time | second (s) | millisecond (ms)<br>microsecond (µs) | minute (min)<br>hour (h)<br>day (d) |
| Speed, Velocity | meter per second<br>(m/s) | kilometer per second<br>(km/s) | kilometer per hour<br>(km/h) |
| Acceleration | meter per second squared<br>($m/s^2$) | centimeter per second squared<br>($cm/s^2$) | ----- |
| Force (including weight) | newton (N) | kilonewton (kN) | ----- |
| Energy (all forms,<br>including heat) | joule (J) | kilojoule (kJ)<br>megajoule (MJ) | electron-volt (eV)<br>kilowatt-hour (kW·h) |
| Power | watt (W) | kilowatt (kW)<br>megawatt (MW) | ----- |
| Pressure,<br>also Stress | pascal (Pa) or<br>newton per square meter<br>($N/m^2$) | megapascal (MPa)<br>kilonewton per square meter<br>($kN/m^2$) | ----- |
| Area | square meter ($m^2$) | square kilometer ($km^2$) | hectare (ha) |
| Volume or Capacity | cubic meter ($m^3$) | cubic centimeter ($cm^3$) | liter ( l or L ) milliliter<br>( ml or mL ) |
| Angle | radian (rad) | milliradian (mrad) | degree ( ° ), minute ( ' ),<br>second ( " ) |
| Potential, Emf<br>(voltage) | volt (V) | millivolt (mV)<br>kilovolt (kV) | ----- |
| Current | ampere (A) | milliampere (mA) | ----- |
| Resistance | ohm (Ω) | kilohm (kΩ)<br>megohm (MΩ) | ----- |
| Capacitance | farad (F) | microfarad (µF)<br>picofarad (pF) | ----- |
| Inductance | henry (H) | millihenry (mH) | ----- |
| Temperature | kelvin (K),<br>also degree Celsius (°C) | millikelvin (mK)<br>(prefixes are not used with °C) | ----- |

Columns 1 and 2 of this list do <u>not</u> contain <u>all</u> the quantities and basic units in SI. It includes <u>most</u> of the quantities and basic units that might be expected in the work of good high school science students. Column 3 contains only a couple examples of acceptable multiples and submultiples formed by adding the SI prefixes to the basic unit. There are many others. Any of the prefixes below is correct. Each is shown followed by the power of 10 it represents and its symbol; e.g. tera represents $10^{+12}$ and its symbol is T, as in one terawatt (1 TW) equals one trillion watts ($10^{+12}$ W).

| Multiples | | | | | | Submultiples | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| deka | ($10^{+1}$) | da | tera | ($10^{+12}$) | T | deci | ($10^{-1}$) | d | pico | ($10^{-12}$) | p |
| hecto | ($10^{+2}$) | h | peta | ($10^{+15}$) | P | centi | ($10^{-2}$) | c | femto | ($10^{-15}$) | f |
| kilo | ($10^{+3}$) | k | exa | ($10^{+18}$) | E | milli | ($10^{-3}$) | m | atto | ($10^{-18}$) | a |
| mega | ($10^{+6}$) | M | zetta | ($10^{+21}$) | Z | micro | ($10^{-6}$) | µ | zepto | ($10^{-21}$) | z |
| giga | ($10^{+9}$) | G | yotta | ($10^{+24}$) | Y | nano | ($10^{-9}$) | n | yocto | ($10^{-24}$) | y |