INDIANA

DEPARTMENT OF TRANSPORTATION

STANDARD SPECIFICATIONS

EFFECTIVE FOR LETTINGS
ON OR AFTER
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1999

For copies of these Standard Specifications contact:

Contract Engineer
Indiana Department of Transportation
Room N855, Indiana Government Center North
100 North Senate Avenue
Indianapolis, Indiana 46204-2218

Price $15.00

A supplemented version of these standard specifications is located on the internet at the following address:

http://www.state.in.us/dot/TS/standard/sp_book/std_spec.htm

A copy of the supplemental specifications only is located on the internet at the following address:

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METRICS

The first two paragraphs of 109.01, Measurement of Quantities reads as follows:

(a) General Requirements. All work completed under the contract will be measured according to the metric system, now known as the International System of Units, or SI, unless otherwise specified.

The standard measures shown in this publication are mostly in the International System of Units such as meters, kilograms, liters, and hectares. The Department is converting to the International System. In this text where the standard measure is given in the International System, the English, or inch pound system, equivalents are shown in parentheses. The measures shown in parentheses are intended only for those contracts in which they are specified. No guarantee is provided, explicit or implicit, that the units are accurate conversions. Work included in the contract will be accepted on the basis of measures shown in parentheses only when such measures are specified.

In addition to the English equivalents shown in the text, the following general notes and table are provided to assist you in becoming familiar with the metric system.

SI UNITS AND CONVERSION FACTORS

MEASUREMENT	ENGLISH UNIT	ENGLISH UNIT SYMBOL	MULTIPLIER FOR CONVERSION FROM ENGLISH UNIT TO SI UNIT (*)	SI UNIT	SI SYMBOL
Acceleration	foot per second squared	ft/sec^2	0.304 8 exactly	meter per second squared	m/s^2
	mile per hour squared	mi/h^2	1.060 93	kilometer per hour squared	km/h^2
Area	square inch	in^2	645.16 exactly	square millimeter	mm^2
	square foot	ft^2	0.092 9	square meter	m^2
	square yard	yd^2	0.836 1	square meter	m^2
	acre	ac	0.404 7	hectare	ha
	square mile	mi^2	2.59	square kilometer	km^2
Density	pound per cubic foot	lb/ft^3	16.018 46	kilogram per cubic meter	kg/m^3
Energy	foot·pound force	ft lbf	1.355 8	joule	J
	kilowatt hour	kW h	3 600 000. exactly	joule	J
Force/Weight (Gravity of Force)	pound force	lbf	4.448 2	newton	N
	kilopound force	kip	4.448 2	kilonewton	kN
	ton	t	8.896 4	kilonewton	kN
Length	inch	in.	25.4 exactly	millimeter	mm
	foot	ft	0.304 8 exactly	meter	m
	yard	yd	0.914 4 exactly	meter	m
	mile	mi	1.609 3	kilometer	km

MEASUREMENT	ENGLISH UNIT	ENGLISH UNIT SYMBOL	MULTIPLIER FOR CONVERSION FROM ENGLISH UNIT TO SI UNIT (*)	SI UNIT	SI SYMBOL
Mass	ounce	oz	28.349 5	gram	g
	pound mass	lbm	0.453 6	kilogram	kg
	ton mass	t	0.907 2	megagram	Mg
Power	horsepower (550 ft·lbf/s)	hp	745.699 9	watt	W
Pressure/Stress	pound per square inch	lb/in^2	6.894 8	kilopascal	kPa
	pound per square foot	lb/ft^2	0.047 88	kilopascal	kPa
	kilopound per square inch	kip/in^2	6.894 8	megapascal	MPa
Speed/Velocity	foot per second	ft/s	0.304 8 exactly	meter per second	m/s
	mile per hour	mi/h	1.609 3	kilometer per hour	km/h
Temperature	degree Fahrenheit	°F	(°F - 32)/1.8(**) exactly	degree Celsius	°C
Volume, Fluid	cubic inch	in^3	16.387 1	milliliter	mL
	fluid ounce	fl oz	29.573 4	milliliter	mL
	gallon	gal.	3.785 4	liter	L
	1000 gallons	M.G.	3.785 4	kiloliter	kL
Volume, Solid	cubic inch	in^3	16 387.06 exactly	cubic millimeter	mm^3
	cubic foot	ft^3	0.028 32	cubic meter	m^3
	bushel	bu	0.035 24	cubic meter	m^3
	cubic yard	yd^3	0.764 6	cubic meter	m^3
	1000 feet board measure	MFBM	2.359 7	cubic meter	m^3

(*) Conversion from SI unit to English unit may be made by dividing the SI unit by the conversion factor shown in this column.

(**) This is a formula, and not a multiplier. The Fahrenheit temperature is substituted for °F in the formula to attain the Celsius temperature. Conversion from Celsius temperature to Fahrenheit temperature may be made by substituting the Celsius temperature for °C in the formula (1.8 x °C) +32. This is an exact conversion.

Angles will continue to be measured in degrees, minutes, and seconds instead of radians.

GENERAL NOTES

1. **The SI unit of millimeter should be used to covert inches to millimeters.**

2. **The SI unit of Mass is the Kilogram (Kg) which should be used for smaller masses expressed in pounds. The megagram (Mg) should be used for larger masses expressed in tons.**

3. **All units peculiar to the various cgs systems (measurement systems constructed by using the centimeter, gram and second as base units) are to be avoided.**

4. **In commercial and everyday use, the term weight nearly always means mass; thus, when one speaks of a person's weight, the quantity referred to is mass. In Science and Technology, the term weight of a body has usually meant the force that, if applied to the body, would give it an acceleration equal to the local acceleration of free fall g (acceleration of gravity). When the term is used, it is important to know whether mass or force is intended and to use SI Units properly, by using Kilograms for Mass or Newtons for Force. The use of force of gravity (mass times acceleration of gravity) instead of weight with this meaning is recommended. Because of the dual use of the term weight as a quantity, this term should be avoided in technical practice except under circumstances in which its meaning is completely clear.**

5. **The term load means either mass or force, depending on its use. A load that produces a vertically downward force because of the influence of gravity acting on a mass may be expressed in mass units. Any other load is expressed in force units.**

6. **A quantity stated as limits, such as "not more than" or "maximum", must be handled so that the stated limit is not violated.**

7. **Conversion of quantities should be handled with careful regard to the implied correspondence between the accuracy of the data and the given number of digits. In all conversions, the number of significant digits retained should be such that accuracy is neither sacrificed nor exaggerated. For example, a length of 125 ft converts exactly to 38.1 m. If however, the 125-ft length has been obtained by rounding to the nearest 5 ft, the conversion should be given as 38 m. The proper conversion procedure is to multiply a value by a conversion factor that is more accurate than is required, the result is then rounded to the appropriate number of significant digits.**

8. **The rule for addition and subtraction is that the answer shall contain no significant digits farther to the right than occur in the least precise number. The rule for multiplication and division is that the product or quotient shall contain no more significant digits than are contained in the number with the fewest significant digits used in the multiplication.**

9. **When a figure is to be rounded to fewer digits than the total number available, the procedure should be as follows: a. When the first digit discarded is less than 5, the last digit retained should not be changed. For example, 3.46325, if rounded to four digits, would be 3.463; if rounded to three digits, 3.46. b. When the first digit discarded is greater than 5, or if it is a 5 followed by at least one digit other than 0, the last digit retained should be increased by one unit. For example, 8.37652, if rounded to four digits, would be 8.377; if rounded to three digits, 8.38. c. When the first digit discarded is exactly 5 followed by zeros, the last digit retained should be rounded upward if it is an odd number, but no adjustment made if it is an even number. For example, 4.365 when rounded to three digits, becomes 4.36. The number 4.355 would also round to the same value, 4.36, if rounded to three digits.**

10. **Refer to ASTM E 380 Standard Practice For Use of International System of Units (SI) for other conversion factors.**