

**KANSAS DEPARTMENT OF TRANSPORTATION  
 SPECIAL PROVISION TO THE  
 STANDARD SPECIFICATIONS, EDITION 2007**

**METRIC CONVERSION**

Because not all the Contract Documents provided on metric unit contracts are available with metric units, manual conversion of English units to metric units will be required on metric unit contracts. The Contractor shall be responsible for the conversion of units.

The following tables provide a soft conversion to metric, common metric units and symbols, prefixes and conversions.

<b>ENGLISH TO METRIC CONVERSION FACTORS</b>		
<b>Multiply</b>	<b>By</b>	<b>To Obtain</b>
acres	0.4047	hectares (10,000 sq m)
acres	4047	square meters
cubic feet	0.0283	cubic meters
cubic yards	0.7646	cubic meters
Fahrenheit	$(^{\circ}\text{F}-32)5/9$	Celsius
feet	0.3048	meters
feet	304.8	millimeters
foot-candles	10.764	lux
foot-pounds	1.356	joules
gallons (U.S. liquid)	0.0038	cubic meters
gallons (U.S. liquid)	3.785	liters
gallons/cubic yard	4.950	liters/cubic meter
gallons/minute	3.785	liters/minute
gallons/square yard	4527	milliliters/square meter
gallons/square yard	4.527	liters/square meter
horsepower (550 ft lb/s)	745.7	watts
inches	25.4	millimeters
inches	0.0254	meters
inches/10 feet	8.333	millimeters/meter
inches/foot	83.33	millimeters/meter
inches/second	0.0254	meters/second
kips (1000 lb)	453.6	kilograms (force)
kips (1000 lb)	4.448	kilonewtons
kips (1000 lb)	0.4536	metric tons
mils	25.4	micron
miles	1.609	kilometers
ounces(wt.)	28.35	grams
ounces(liq.)	29.57	milliliters
pints(dry)	0.5506	liters
pints(liq.)	0.4732	liters
pounds(wt.)	0.4536	kilograms
pounds(force)	4.448	newtons
pounds/cubic foot	16.02	kilograms/cubic meter

<b>ENGLISH TO METRIC CONVERSION FACTORS (cont.)</b>		
pounds/cubic yard	0.5933	kilograms/cubic meter
pounds/square inch	0.00689	MPa
pounds/inch	0.0179	kilograms/millimeter
pounds/square foot/hour	4.883	kilograms/ square meter/hour
quarts(liq.)	0.9463	liters
square feet	0.0929	square meters
square inches	645.2	square millimeters
square inches/foot	2117	square millimeters/meter
square miles	2.590	square kilometers
square yards	0.8361	square meters
Stations	30.48	meters
tons(short, 2000 lb)	907.18	kilograms
tons(short, 2000 lb)	8.896	kilonewtons
tons(short, 2000 lb)	0.9072	metric tons
yards	0.9144	meters

<b>METRIC TO ENGLISH CONVERSION FACTORS</b>		
<b>Multiply</b>	<b>By</b>	<b>To Obtain</b>
cubic meters	35.3149	cubic feet
cubic meters	1.308	cubic yards
cubic meters	264.17	gallons (U.S. liquid)
hectares (10,000 sq m)	2.471	acres
grams	0.0353	ounces(wt.)
joules	0.7376	foot-pounds
kilograms	2.2046	pounds(wt.)
kilograms	0.0011	tons(short, 2000 lb)
kilograms (force)	0.0022	kips (1000 lb)
kilograms/ square meter/hour	0.2048	pounds/square foot/hour
kilograms/cubic meter	0.0624	pounds/cubic foot
kilograms/cubic meter	1.6855	pounds/cubic yard
kilograms/millimeter	55.9543	pounds/inch
kilometers	0.6214	miles
kilonewtons	0.2248	kips (1000 lb)
kilonewtons	0.1124	tons(short, 2000 lb)
liters	0.2642	gallons (U.S. liquid)
liters	1.8162	pints(dry)
liters	2.1134	pints(liq.)
liters	1.0567	quarts(liq.)
liters/cubic meter	0.0202	gallons/cubic yard
liters/minute	0.2642	gallons/minute
liters/square meter	0.2209	gallons/square yard
lux	0.0929	foot-candles
meters	3.2808	feet
meters	39.3701	inches
meters	0.0328	Stations
meters	1.0936	yards

<b>METRIC TO ENGLISH CONVERSION FACTORS (cont.)</b>		
meters/second	39.3701	inches/second
metric tons	2.2046	kips (1000 lb)
metric tons	1.1023	tons (short, 2000 lb)
micron	0.0394	mils
milliliters	0.0338	ounces(liq.)
milliliters/square meter	0.0002209	gallons/square yard
millimeters	0.0033	feet
millimeters	0.0394	inches
millimeters/meter	0.1200	inches/10 feet
millimeters/meter	0.0120	inches/foot
MPa	145.0377	pounds/square inch
newtons	0.2248	pounds(force)
Celsius	$[(9/5)(^{\circ}\text{C})]+32$	Fahrenheit
square kilometers	0.3861	square miles
square meters	0.0002471	acres
square meters	10.7639	square feet
square meters	1.1960	square yards
square millimeters	0.001550	square inches
square millimeters/meter	0.000472	square inches/foot
watts	0.0013	horsepower (550 ft lb/s)

<b>SI PREFIXES</b>		
<b>Multiplication Factor</b>	<b>Prefix</b>	<b>Symbol</b>
1 000 000 000 = $10^9$	giga	G
1 000 000 = $10^6$	mega	M
1 000 = $10^3$	kilo	k
100 = $10^2$	hecto	h
10 = $10^1$	deka	da
0.1 = $10^{-1}$	deci	d
0.01 = $10^{-2}$	centi	c
0.001 = $10^{-3}$	milli	m
0.000001 = $10^{-6}$	micro	$\mu$
0.000000001 = $10^{-9}$	nano	n

<b>CONCRETE MIX DESIGNATIONS</b>	
<b>English</b>	<b>Metric</b>
Grade 2.5	Grade 17
Grade 2.5(AE)	Grade 17(AE)
Grade 3.0	Grade 21
Grade 3.0(AE)	Grade 21(AE)
Grade 3.5	Grade 24
Grade 3.5(AE)	Grade 24(AE)
Grade 4.0	Grade 28
Grade 4.0(AE)	Grade 28(AE)
Grade 4.5	Grade 31
Grade 4.5(AE)	Grade 31(AE)
Grade 5.0	Grade 35
Grade 5.0(AE)	Grade 35(AE)

SIEVES						
English	metric	Nominal Sieve Opening (in.)	Permissible Variation of Average Opening from the Standard Sieve Designation (y) + or	Intermediate Tolerance (x)	Maximum Individual Opening (x)	Nominal Wire Diameter (mm)
5 in.	125 mm	5	3.70 mm	130.0 mm	130.9 mm	8
4 in.	100 mm	4	3.00 mm	104.0 mm	104.8 mm	6.3
3 in.	75 mm	3	2.20 mm	78.1 mm	78.7 mm	5.8
2 ½ in.	63 mm	2.5	1.90 mm	65.6 mm	66.2 mm	5.5
2 in.	50 mm	2	1.50 mm	52.1 mm	52.6 mm	5.05
1 ½ in.	37.5 mm	1.5	1.10 mm	39.1 mm	39.5 mm	4.59
1 in.	25.0 mm	1	0.80 mm	26.1 mm	26.4 mm	3.8
¾ in.	19.0 mm	0.75	0.60 mm	19.9 mm	20.1 mm	3.3
½ in.	12.5 mm	0.5	0.39 mm	13.10 mm	13.31 mm	2.67
No. 4	4.75 mm	0.187	0.15 mm	5.02 mm	5.14 mm	1.54
No. 8	2.36 mm	0.0937	0.080 mm	2.515 mm	2.600 mm	1
No. 10	2.00 mm	0.0787	0.070 mm	2.135 mm	2.215 mm	0.9
No. 12	1.70 mm	0.0661	0.060 mm	1.820 mm	1.890 mm	0.81
No. 14	1.40 mm	0.0555	0.050 mm	1.505 mm	1.565 mm	0.725
No. 16	1.18 mm	0.0469	0.045 mm	1.270 mm	1.330 mm	0.65
No. 18	1.00 mm	0.0394	0.040 mm	1.080 mm	1.135 mm	0.58
No. 20	850 µm	0.0331	0.035 mm	0.925 mm	0.970 mm	0.51
No. 30	600 µm	0.0234	0.025 mm	0.660 mm	0.695 mm	0.39
No. 40	425 µm	0.0165	0.019 mm	0.471 mm	0.502 mm	0.29
No. 50	300 µm	0.0117	0.014 mm	0.337 mm	0.363 mm	0.215
No. 60	250 µm	0.0098	0.012 mm	0.283 mm	0.306 mm	0.18
No. 100	150 µm	0.0059	0.008 mm	0.174 mm	0.192 mm	0.11
No. 200	075 µm	0.0029	0.005 mm	0.091 mm	0.103 mm	0.053
No. 325	045 µm	0.0017	0.003 mm	0.057 mm	0.066 mm	0.03

METRIC PILE FORMULAS		
Hammer	Pile Type	Formula
Gravity	Steel Steel Shell Steel Sheet	$P = \frac{2450 \ W \ H}{S + 9} \left( \frac{W}{(W + X)} \right)$
Air/Steam (Single Acting)	All Types	$P = \frac{1635 \ W \ H}{S + 3}$
Air/Steam (Double Acting)	All Types	$P = \frac{166.7 \ E}{S + 3}$
Delmag and McKierman-Terry*	All Types	$P = \frac{1308 \ W \ H}{S + 2.5 \ \left( \frac{X^{**}}{W} \right)}$
Link-Belt*	All Types	$P = \frac{133.3 \ E}{S + 2.5 \ \left( \frac{X^{**}}{W} \right)}$

\*diesel hammers

\*\* For diesel hammers, drop the quantity X/W from the formula if less than 1

P = safe bearing power in newtons

W = mass, in kilograms, of striking part of hammer

H = height of fall in meters

E = energy of ram in joules per blow

S = the average penetration in millimeters per blow for the last five blows for gravity hammers and the last 20 blows for steam or diesel hammers

X = mass, in kilograms of the pile plus the mass of any cap and/or anvil used on the pile during driving