

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

**ADAPTER, COMPRESSED AIR BREATHING APPARATUS, M4
(End Item Code 201) AND DETECTOR KIT, CARBON MONOXIDE,
COLORIMETRIC, M23 (End Item Code 573)**

Refs: TM 3-4240-224-12; SM 3-4-6665-A37

Headquarters, Department of the Army, Washington 25, D. C.
1 June 1962

SAFETY PRECAUTIONS

Never stand in the way of the escaping air from the hose of the compressor or from the cylinders of the breathing apparatus.

Before disconnecting the adapter, make certain that both the valve on the high-pressure air hose and the on-off valve on the breathing apparatus carefully closed. Also open the needle valve on the adapter.

Do not use an indicating tube after the expiration date or more than 2 years after the date of manufacture.

Do not attempt to sample the air in the cylinders until the temperature of the apparatus has reached room temperature.

Do not use an indicating tube if the color of the indicating gel is other than yellow.

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the M23 colorimetric carbon monoxide detector kit and directions for the use of these items in conjunction with the ABC-M15A1 compressed air breathing apparatus (TM 3-4240-224-12).

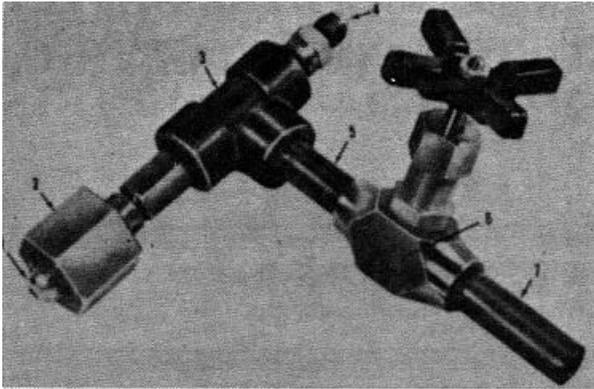
2. Use. a. The M4 compressed air breathing apparatus adapter provides a means for coupling the compressed air breathing apparatus to a high-pressure hose from an approved air compressor (TM 3-4240-224-12) and, at the same time, provides a chamber for sampling air during normal charging operations.

b. The M23 colorimetric carbon monoxide detector kit serves as a means for detecting the presence of carbon monoxide in the air supplied by the compressor and for measuring the concentration of carbon monoxide.

1. Scope. This bulletin contains a description of the M4 compressed air breathing apparatus adapter and

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3. Description. a. *Adapter, Compressed Air Breathing Apparatus Air* (fig. 1). The adapter has a heavy duty 1/4-inch pipe tee (3) with a heavy-duty inlet nipple (4) at its inlet end, a coupling nipple (1) and a coupling nut (2) at the outlet end, and a heavy-duty 1/4-inch pipe nipple (5) screwed into the side leg of the tee. A needle valve (6) fitted with a standard-weight 1/4-inch nipple (7) is screwed to the heavy-duty pipe nipple.



- | | |
|------------------------|--------------------------------|
| 1. Coupling nipple | 4. Heavy-duty inlet nipple |
| 2. Coupling nut | 5. Heavy-duty pipe nipple |
| 3. Heavy-duty pipe tee | 6. Needle valve |
| | 7. Standard-weight pipe nipple |

Figure 1. M4 compressed air breathing apparatus adapter.

b. *Detector kit, Carbon Monoxide, Colorimetric, M23.*

(1) *General.* An M23 colorimetric carbon monoxide detector kit (fig. 2) is issued with each M4 compressed air breathing apparatus adapter.

(2) *Components.* The components of the M23: colorimetric carbon monoxide detector kit (fig. 3) are an indicating tube seal breaker (2), a sampling bulb unit (3), a box (4) containing twelve C3 carbon monoxide indicating tubes, a calibration chart (5), and an instruction sheet (6) packed in a carrying case (1).

(a) *Carrying case* (fig. 3). The carrying case is a black metal box, approximately 3 inches wide, 39 inches deep, and 6 inches high, with a hinged top. (The carrying case in some kits is cylindrical.) It is equipped with a stud for holding the sampling bulb unit, a clip for holding an indicating tube seal breaker, a holder for a box of indicating tubes, and a

retaining spring for holding the calibration chart and instruction sheet.

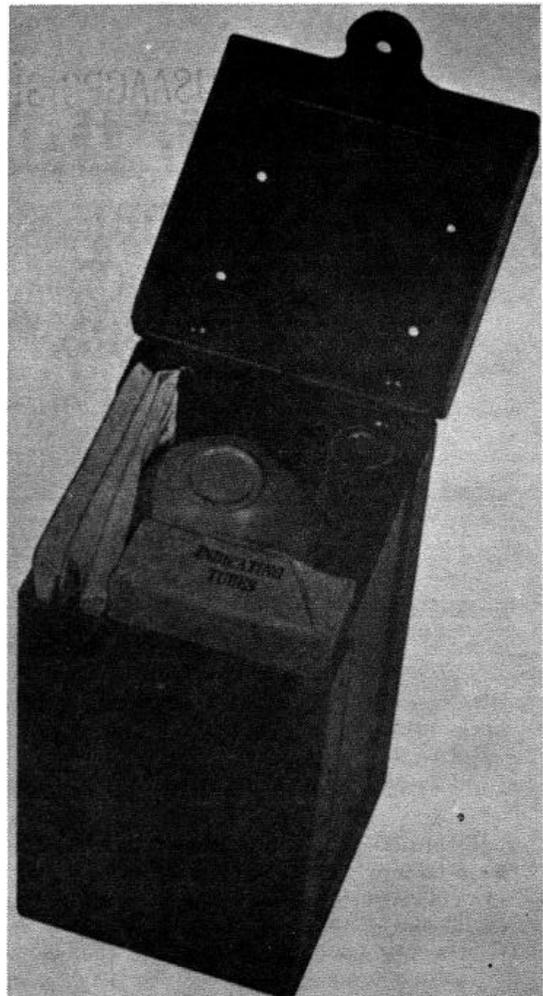
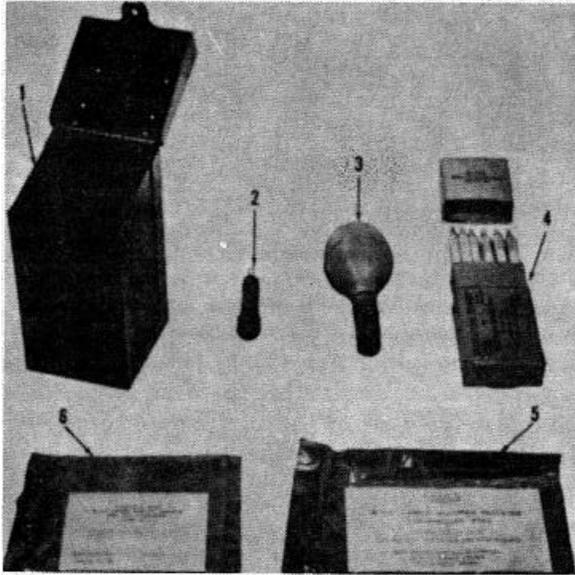


Figure 2. M23 colorimetric carbon monoxide detector kit in carrying case.

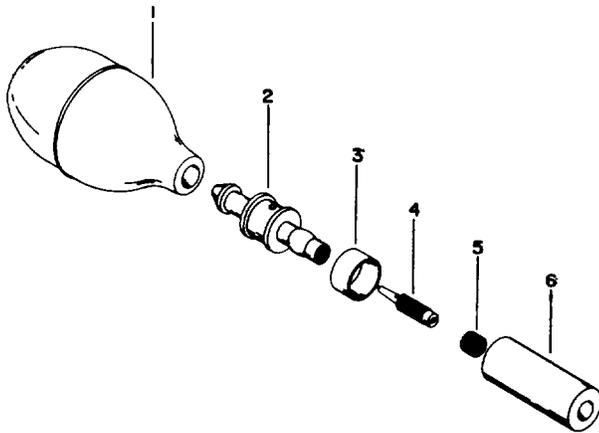
(b) *Indicating tube seal breaker.* The seal breaker (2) is a metal tube with a cap screwed to one end and a short screwdriver attached to the other end. It is used to break the fused ends of the glass indicating tube just prior to use. A hole in the cap receives the tip of an indicating tube; sidewise pressure on the tube causes the tip to break and drop into the interior of the seal breaker. Broken-off tips can be emptied from the seal breaker by unscrewing the cap. The screwdriver is also used to adjust the metering valve (par. 7a) in the sampling bulb unit.



1. Carrying case
2. Indicating tube seal breaker
3. Sampling bulb unit
4. C3 carbon monoxide indicating tubes
5. Calibration chart
6. Instruction sheet

Figure 3. Components of M23 colorimetric carbon monoxide detector kit.

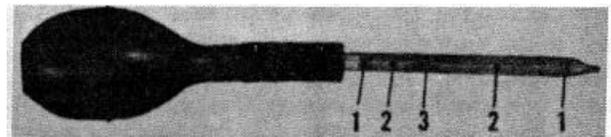
(c) *Sampling bulb unit* (fig. 4). The sampling bulb unit consists of a synthetic rubber bulb (1) of approximately 3.7 cubic inch (60 ml.) capacity, a metal nipple (2), a rubber check valve (3), an adjustable metering valve (4), a filter screen (5), and an adapter (6).



1. Bulb
2. Nipple
3. Check valve
4. Metering valve
5. Filter screen
6. Adapter

Figure 4. Sampling bulb unit, exploded view.

(d) *Indicating Tube, Carbon Monoxide, C3* (fig. 5). The C3 carbon monoxide indicating tube is a sealed glass tube containing a yellow-colored indicating gel (3) with a layer of white silica gel (2) at each side. A plug of glass wool (1) at each end of the tube holds the gels in place. The indicating, gel changes color in the presence of carbon monoxide (par. 7e); the silica gel absorbs water and oil vapor and prevents them from interfering with the action of the indicating gel. One layer of silica gel is approximately twice as thick as the other; in use, air is drawn into the tube through the thicker layer (par. 7b). The tubes are packed 12 to a box (4, fig. 3). The box is marked with an expiration date or the date of manufacture



1. Glass wool
2. White silica Gel
3. Yellow implicating gel

Figure 5. C3 carbon monoxide indicating tube inserted in sampling bulb.

(e) *Calibration chart*. The calibration chart (5) serves as a color comparator and provides a table of correction factors. The color comparator portion of the chart has five color blocks graduated in color. The color block at the extreme left is yellow, which is the color of the indicating gel in an unused indicating tube; the center block is a yellow green; and the block at the extreme right is a blue green. The concentration of carbon monoxide in an air sample is measured by matching the color in the indicating tube through which the air sample was drawn with a color block on the chart. The table of correction factors lists factors to be applied when more than one bulb full of air is drawn through an indicating tube, or when the sample is taken at different altitudes.

- (f) *Instruction sheet.* The instruction sheet (6) provides operating and maintenance instructions. A manufacturer's parts list printed on the sheet is not for military use. Replacement components for military use are authorized in SM 3-6665-437.

4. Functioning. *a. M4 Compressed Air Breathing Apparatus Adapter.* When the adapter is connected to a compressor (par. 5), air from the compressor enters the inlet nipple (4, fig. 1) and passes through the pipe tee (3) and coupling nipple (1) into the cylinders of the ABC-M15A1 compressed air breathing apparatus. When the needle valve (6) is partially opened, some of the air from the compressor is bled into the nipple (7) which serves as an air-sampling chamber.

b. M23 Colorimetric Carbon Monoxide Detector Kit. When a C3 carbon monoxide indicating tube (4, fig. 3) attached to a sampling bulb unit (3) is inserted in the air-sampling chamber (a, above), air is drawn through the indicating tube into the bulb (fig. 5). The yellow indicating gel in the tube changes color if carbon monoxide is present in the air sampling. The color change is a measurement of the carbon monoxide concentration in the air sample. The color can vary from yellow, which indicates that there is no carbon monoxide in the sample, to shades of yellow, green, or blue for increasing concentrations of carbon monoxide.

5. Connecting Adapter. *a.* Immediately before coupling the M4 adapter to the high-pressure air hose, blow out any dust or dirt in the hose by opening the valve on the hose for an instant. Hold the free end of the hose to keep it from whipping about.

b. Open the on-off valve on the breathing apparatus and the valve on the air hose from the compressor slowly and fully each time that compressed air is transferred from the compressor to the cylinders. Keep these valves closed except when charging the cylinders.

Warning.

Never stand in the way of the escaping air from the hose of the compressor or from the cylinders of the breathing apparatus.

c. Fully close the valve on the high-pressure air hose from the compressor; then remove the bayonet fitting from the outlet end of the hose.

d. While holding the air hose, couple the high

pressure air hose to the inlet nipple (4, fig. 1) on the M4 adapter with a wrench and tighten with a second wrench using light pressure.

e. Make certain that the on-off valve on the breathing apparatus is in the closed position. Place the apparatus on a flat surface. Unscrew and remove the cap from the adapter on the breathing apparatus using the wrench provided with the equipment.

f. Insert the coupling nipple (1) of the M4 adapter in the adapter on the breathing apparatus. Screw the coupling nut (2) to the adapter and tighten with a wrench while holding the hexagonal nut at the base of the adapter with a second wrench.

6. Charging Air Cylinders in Temperatures Above 65° F. *a.* Before charging cylinders, be sure that the air pressure from the compressor is at least 3,000 pounds per square inch.

b. Fully open the valve on the high-pressure air hose of the compressor and the on-off valve on the breathing apparatus, allowing compressed air to flow into the cylinders.

c. Watch the pressure gage on the dummy head of the apparatus and when the indicator on the gage appears in the black sector of the dial (approx. 1 1/2 to 2 min.), the cylinders are fully charged. Close the valve on the high-pressure air hose and the on-off valve on the breathing apparatus.

7. Air-Sampling in Temperatures Above 65° F. Each time that the compressor is put in operation to charge the cylinders, sample the air during the first charging and every 10 minutes thereafter if a number of cylinders are being charged consecutively. If there is a time lapse of as much as 10 minutes between each charging operation, sample the air supplied to each apparatus. If any air sampling shows a harmful concentration of carbon monoxide, empty the cylinders being charged and sample the air in the cylinders which were charged subsequent to the last previous air sampling. Empty all cylinders showing harmful carbon monoxide concentration.

a. Before charging cylinders, check the time required to fill the sampling bulb with air. When properly adjusted, the bulb should fill with air in 22 to 28 seconds. To check the time, squeeze the bulb to exhaust as much air as possible; release the bulb and measure the time required for the bulb to fill with air. If the time required is less than 22 seconds, remove the adapter (6, fig. 4) and

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turn the metering valve (4) clockwise. If the time required is more than 28 seconds, turn the metering valve counterclockwise. Use the screwdriver on the end of the indicating tube seal breaker to turn the metering valve. Recheck the filling time after the adjustment and readjust if necessary.

Note.

Some sampling bulb units may be assembled incorrectly with the metering valve (4) instead of the nipple (2) inserted in the bulb (1). These assembled sampling bulb units must be disassembled and reassembled correctly as shown in figure 4 before the metering valve can be adjusted.

b. Remove a carbon monoxide indicating tube from the carrying case. Break off both tips of the indicating tube with the seal bracket (par. 3b). Insert the end of the indicating tube that has the thinner layer of silica gel in the adapter on the sampling bulb.

Warning.

Do not use an indicating tube after the expiration date or more than 2 years after the date of manufacture. Do not use an indicating tube if the color of the indicating gel is other than yellow.

c. Open the needle valve on the adapter enough to allow air to bleed slowly into the nipple (7, fig. 1).

d. Squeeze the sampling bulb to exhaust as much of the air as possible. Insert the free end of the indicating tube into the nipple of the adapter. Release the bulb and allow it to fill with a sample of air. After the bulb has filled completely, squeeze the bulb again and allow it to fill with another sample of air. After the bulb has filled completely for the second time, remove the tube from the nipple and close the needle valve on the adapter.

e. Compare the color of indicating gel in the indicating tube with the color blocks on the calibration chart (par. 3b) and compute the percent of concentration using the table of correction factors.

Note.

The number that appears directly under the color block on the calibration chart does not represent percent of carbon monoxide concentration, but rather a number that is multiplied with one of the factors on the calibration chart depending upon the altitude and number of squeezes. For example: Assume that the two squeezes of the sampling bulb have been taken at sea level and the color of the indicating gel matches the color of the center block on the calibration chart.

Find the percent of carbon monoxide concentration, multiplying the .01 found directly under the center block by 0.5 which is the factor for two squeezes at sea level. $0.1 \times$

$0.5 = .005$ percent. The maximum allowable concentration of carbon monoxide in air supplied for breathing is 0.005 percent which is equivalent to 50 parts per million (PPM).

- (1) If the color matches that of the first block (yellow), the air in the cylinders is breathable and free of carbon monoxide.

Note.

If there is no color change in the indicating gel, the indicating tube may be used for the next air sampling provided that the next sample is taken within the hour after the indicating tube seals are broken. (This instruction differs from that on the calibration chart which states that a new tube must be used for each sampling.) If there is a color change, remove the indicating tube and discard it. Use a new indicating tube for the next air sampling.

- (2) If the color matches or is lighter than the middle color block, the air is breathable even though it contains a small amount of carbon monoxide.
- (3) If the color is darker than the middle color block or green or blue green similar to that of the blocks to the right of the middle block, the carbon monoxide concentration in the air is greater than 0.005 percent which is too high for breathing purposes. If this occurs, empty the cylinders being enlarged.

8. Disconnecting the Adapter.

Warning.

Before disconnecting the adapter, make certain that both the valve on the high-pressure air hose and the on-off valve on the breathing apparatus are fully closed. Also open the needle valve on the adapter.

a. Uncouple the M4 adapter from the adapter on the breathing apparatus. Loosen the coupling nut (2), fig. 1) with a wrench while holding the hexagonal nut at the base of the adapter with a second wrench. Separate the M4 adapter from the breathing apparatus.

b. Replace the cap on the adapter and tighten it on the wrench supplied with the apparatus.

c. Uncouple the M4 adapter from the high-pressure air hose on the compressor. Loosen the inlet nipple (4) with a wrench while holding the fitting of the high-pressure air hose with a second wrench. Separate the M4 adapter from the high-pressure air hose.

d. Replace the bayonet fitting on the high-pressure air hose.

9. Charging Air Cylinders in Temperatures Below 65° F. a. When several cylinders are to be charged, number each one and charge them in consecutive order.

b. Follow instructions in paragraphs 5, 6, and 8.

c. Carry the charged cylinders into a heated building where the temperature is above 65° F.

10. Air-Sampling Cylinders Charged in Temperatures Below 65° F.

Warning.

Do not attempt to sample the air in the cylinders until the temperature of the apparatus has reached room temperature.

a. Check the time required to fill the sampling bulb with air (par. 7a).

b. Remove the cap from the adapter using the wrench provided with the breathing apparatus.

c. Remove a carbon monoxide indicating tube from the carrying case. Break off both tips of the indicating tube with the seal breaker (par. 3b).

Insert the end of the indicating tube that has the smaller amount of silica gel into the adapter (6, fig. 4) on the sampling bulb.

Warning.

Do not use an indicating tube after the expiration date or more than 2 years after date of manufacture.

Do not use an indicating tube if the color of the indicating gel is other than yellow.

d. When more than one breathing apparatus has been charged, sample the air in the air cylinders according to the chart below.

Number of apparatus charged	Test the following:
1	Test No. 1
2	Test No. 2
3	Test No. 3
4	Test No. 4
5	Test No. 3 and No. 5
6	Test No. 3 and No. 6
7	Test No. 4 and No. 7
8	Test No. 4 and No. 8

e. Open the on-off valve of the breathing apparatus and allow a small amount of air to flow out of the adapter.

f. Cup one hand around the adapter and insert the free end of the indicating tube in the adapter while a small amount of air is flowing out of the adapter.

g. Sample the air (par. 7 d and e).

h. Close the on-off valve.

i. If more than one breathing apparatus has been charged and the sampled air from one of the cylinders is found to be contaminated, sample the air in each apparatus charged.

j. If air sampling shows the air to be breathable, replace the cap on the adapter and tighten with the wrench supplied with the apparatus.

k. If the air sample indicates that the air in the cylinders is not breathable, carefully open the on-off valve on the breathing apparatus and allow the air to escape from the cylinders until the pressure gage on the breathing apparatus shows that the cylinders are empty.

Warning.

Never stand in the way of the escaping air from the hose of the compressor or from the cylinders of the breathing apparatus.

l. Recharge emptied cylinders with breathable air.

11. Maintenance. a. *M4 Compressed Air Breathing Apparatus Adapter.* Keep the adapter clean. If any of the threaded connections become loose, tighten the connections. Replace the adapter if it becomes damaged or defective.

b. *M23 Colorimetric Carbon Monoxide Detector Kit.* The C3 carbon monoxide indicating tubes are expendable and should be replaced as needed. The sampling bulb should fill in 22 to 28 seconds after being compressed. Adjust the metering valve (par. 7a) if the bulb fills too quickly or too slowly. Replace the sampling bulb unit if proper adjustment cannot be made or if the bulb is damaged. Replace any lost or damaged components of the kit (SM 3-4-6665-A37).

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3-117 (1)	44-544 (1)
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44-102 (3)	44-548 (1)

NG: None.

USAR: Same as Active Army except allowance is one copy to each unit.

For explanation of Abbreviations used, see AR 320 50.

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The Metric System and Equivalents

Linear Measure

1 centimeter = 10 millimeters = .39 inch
 1 decimeter = 10 centimeters = 3.94 inches
 1 meter = 10 decimeters = 39.37 inches
 1 dekameter = 10 meters = 32.8 feet
 1 hectometer = 10 dekameters = 328.08 feet
 1 kilometer = 10 hectometers = 3,280.8 feet

Weights

1 centigram = 10 milligrams = .15 grain
 1 decigram = 10 centigrams = 1.54 grains
 1 gram = 10 decigrams = .035 ounce
 1 decagram = 10 grams = .35 ounce
 1 hectogram = 10 decagrams = 3.52 ounces
 1 kilogram = 10 hectograms = 2.2 pounds
 1 quintal = 100 kilograms = 220.46 pounds
 1 metric ton = 10 quintals = 1.1 short tons

Liquid Measure

1 centiliter = 10 milliliters = .34 fl. ounce
 1 deciliter = 10 centiliters = 3.38 fl. ounces
 1 liter = 10 deciliters = 33.81 fl. ounces
 1 dekaliter = 10 liters = 2.64 gallons
 1 hectoliter = 10 dekaliters = 26.42 gallons
 1 kiloliter = 10 hectoliters = 264.18 gallons

Square Measure

1 sq. centimeter = 100 sq. millimeters = .155 sq. inch
 1 sq. decimeter = 100 sq. centimeters = 15.5 sq. inches
 1 sq. meter (centare) = 100 sq. decimeters = 10.76 sq. feet
 1 sq. dekameter (are) = 100 sq. meters = 1,076.4 sq. feet
 1 sq. hectometer (hectare) = 100 sq. dekameters = 2.47 acres
 1 sq. kilometer = 100 sq. hectometers = .386 sq. mile

Cubic Measure

1 cu. centimeter = 1000 cu. millimeters = .06 cu. inch
 1 cu. decimeter = 1000 cu. centimeters = 61.02 cu. inches
 1 cu. meter = 1000 cu. decimeters = 35.31 cu. feet

Approximate Conversion Factors

<i>To change</i>	<i>To</i>	<i>Multiply by</i>	<i>To change</i>	<i>To</i>	<i>Multiply by</i>
inches	centimeters	2.540	ounce-inches	Newton-meters	.007062
feet	meters	.305	centimeters	inches	.394
yards	meters	.914	meters	feet	3.280
miles	kilometers	1.609	meters	yards	1.094
square inches	square centimeters	6.451	kilometers	miles	.621
square feet	square meters	.093	square centimeters	square inches	.155
square yards	square meters	.836	square meters	square feet	10.764
square miles	square kilometers	2.590	square meters	square yards	1.196
acres	square hectometers	.405	square kilometers	square miles	.386
cubic feet	cubic meters	.028	square hectometers	acres	2.471
cubic yards	cubic meters	.765	cubic meters	cubic feet	35.315
fluid ounces	milliliters	29.573	cubic meters	cubic yards	1.308
pints	liters	.473	milliliters	fluid ounces	.034
quarts	liters	.946	liters	pints	2.113
gallons	liters	3.785	liters	quarts	1.057
ounces	grams	28.349	liters	gallons	.264
pounds	kilograms	.454	grams	ounces	.035
short tons	metric tons	.907	kilograms	pounds	2.205
pound-feet	Newton-meters	1.356	metric tons	short tons	1.102
pound-inches	Newton-meters	.11296			

Temperature (Exact)

°F	Fahrenheit temperature	5/9 (after subtracting 32)	Celsius temperature	°C
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