TECH TIP # 21

HARDI
HEATING, AIRCONDITIONING & REFRIGERATION DISTRIBUTORS INTERNATIONAL

One of a series of dealer contractor technical advisories prepared by HARDI wholesalers as a customer service.

GOING METRIC IN HEATING & COOLING

Metric measurement was legalized (permitted) in the United States in 1866. Metric weights were established for U.S. coinage in 1876. Science and research, especially in the aerospace, nuclear physics and theoretical chemistry fields are in metric units. Electric energy and illumination are defined in metric terms. Some army ordnance and maps are metric. Optical, ball bearing and photographic industries are largely metric. Medical and pharmaceutical professions are entirely metric. And the popularity of foreign cars and bicycles has introduced a common supply of metric nuts, bolts and wrenches.

After an initial attempt to "go metric" in the 1970's, the construction industry is once again going to switch to the metric system of measurement. The Construction Metrication Council of the National Institute of Building Sciences is spearheading the change. ASHRAE will shortly cease to publish its Handbook in Inch-Pound units and ARI has a project to use metric units in their standards and guidelines.

Thus, the days of BTU, CFM, FAHRENHEIT TEMPERATURE, 6-INCH DUCT and INCHES OF WATER PRESSURE may soon be numbered.

The metric system originated in France late in the 17^{th} century. In 1960, the International General Conference of Weights and Measures developed a modernized metric system now termed "SI" for Le Systeme International d' Unites. All countries who adopt SI units -- even so-called metric countries -- must make adjustments.

The fact that there is "more logic" behind SI units than the traditional "English" system is little comfort to the person who must learn to "think" metric -- to appreciate the significance of the numbers attached to a strange term.

For example: How would you dress to work outside if the weather report over the radio stated the temperature was 35 degrees Celsius with the wind out of the North at 6.7 meters per second? Heavy coat and gloves? Light jacket? In units that have practical meaning to you, the numbers would be 95° F with a 15 miles per hour wind.

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Suppose a duct system was to be designed to handle 378 liters of air per second (L/s) at a pressure of 49.8 Pascal's (Pa). Do you have a "feel" for the size of the system and the required fan? Converted to more familiar numbers and units, this turns out to be 800 cfm at a pressure of 0.2 inches of water --- residential size components.

Here are a few additional common heating and cooling "numbers" in both SI and English units.

(Note: k = kilo = 1,000)

28.3 Btu/lb heat content of air (75º F, 50% humidity)	65.9 kilojoules per kilogram (kJ/kg)
80º F design temperature difference	44.4º Celsius (or Kelvin)
Glass U factor 1.13 Btuh/sq ft F	6.42 watts/square meter/degree C ($W/m^2/ºC$)
3.5 inches of insulation (R-12)	(R-3.26)
1,000 Btu/cu ft natural gas	37 kilojoules per liter (kJ/L)
7 gpm of water flow	0.44 liters per second (L/s)
600 fpm duct velocity	3.05 meters per second (m/s)
8 ft ceiling height	2.44 meters (m)
1500 sq ft floor area	139.4 square meters (m^2)
2-ton cooling unit	7.02 kilowatts (kW)
150,000 Btuh furnace	43.96 kilowatts (kW)
278 psig condensing pressure	1915 kilopascals (kPa)
6-inch diameter duct	0.15 meter (m)

How in the world can someone ever learn the "meaning" of these new numbers in practical terms? The same way you originally learned what a two-ton cooling unit translates into physically in terms of machinery -- by experience.

How long will it take? Not as long as it did for you to learn the meaning of numbers in English units because your industry experience is now an asset. Think of the individual who knows neither metrics nor the heating-cooling industry.

How do you started? By working with the numbers. Using the conversions factors that follow, convert the numbers you are encountering now in your work into SI values. You'll soon begin to have the same "feel" for 24º C as you do for 75º F.

TO CONVERT:

Fahrenheit (F) temperature to Celsius (C)

ºC = (ºF - 32) x (5/9)

Velocity (feet per minute) to meters per second

Fpm x 0.0051 = m/s

Pressure (pounds per square inch) to kilopascals

psi x 6.89 = kPa

Air flow (cubic feet per minute) to liters per second

Cfm x 0.472 = L/s

Water flow (gallons per minute) to liters per second

Gpm x 0.0631 = L/s

British Thermal units to Joules

Btu x 1055 = J

British Thermal Units per hour to Watts

Btuh x 0.0293 = Watts

Btuh per square foot per degree Fahrenheit to Watts per square meter per degree Celsius

U value x 5.68 = W/m^2 x ºC

Feet to meters

Ft x 0.305 = m

Inches to meters

In x 0.0254 = m

Square feet to square meters

Sq ft x 0.093 = m^2