White Paper: Hydraulic Press Calculations

Calculating pressure on a hydraulic press used for laminating panels (hot or cold) can be very tedious and confusing when multiple units are being used.

There are two major systems of measurement (English and Metric), both of which have numerous units to express length, area, force and pressure. In order to simplify these calculations all measurements should be converted into either all metric or English units shown below:

	Metric (SI)	**English**
Length	cm	inch
Area	cm²	in²
Force	kg	lb
Pressure	kg/cm²	psi (lb/in²)

Trying to use two different measurement systems and alternate units for length, area, pressure not only causes confusion but greatly increases the chance for calculation errors.

A hydraulic press is designed so that a very large force is applied to a panel. This force is then applied evenly to the panels in the press. It is important to know three of the four values in the following equation.

Hydraulic Line Pressure **X** Total Cylinder Area = Glue Line Pressure **X** Total Panel Area

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Hydraulic Gauge (Line) Pressure: This is the value seen on the machine's pressure gauge. The pressure unit is typically measured in bars (metric) or psi (English). On most presses, the maximum pressure will be no more than 200 bar or 3,000 psi.
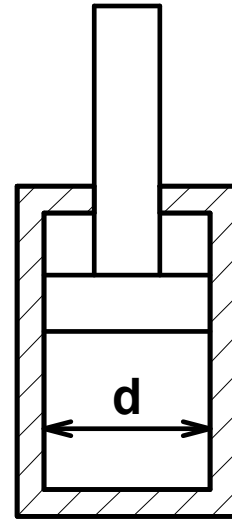
Conversion Factors

To Convert from	To	Multiply by
bar	kg/cm²	1.02
kg/cm²	bar	0.98
bar	psi	14.5
kg/cm²	psi	14.22
psi	kg/cm²	0.0703

Cylinder Area: To calculate the area of a pressure cylinder, the diameter of the cylinder must be known. This diameter is the internal diameter of the cylinder, not the outside case diameter or the ram diameter. On most cylinders it is about 90 percent of the outside diameter. Convert the diameter to either *inches* or *centimeters* and calculate the area using this formula:

$$Area = \frac{\pi d^2}{4}$$

Area = Cylinder area
π = 3.1416
d² = Cylinder diameter squared

Multiply this value by the number of cylinders to obtain the total cylinder area.

Cylinder

Conversion Factors

To Convert from	To	Multiply by
mm	cm	0.1
mm	inch	0.0394
cm	inch	0.3937
inch	cm	2.54
in²	cm²	6.45
cm²	in²	0.155

Glue Line Pressure: This is the pressure being exerted on the panel. The recommended pressure depends on the substrates being pressed. Most glue line pressures will be between 100 psi (7 kg/cm²) and 250 psi (17.6 kg/cm²).

Total Panel Area: This area of a panel is the Length x Width. The total panel area will be the sum of the area of all panels that are positioned on the lower platen. Make sure that the length and width values are in either *inches* or *centimeters*.

To determine the *Glue Line Pressure*, multiply the *Cylinder Area* and the *Hydraulic Gauge Pressure* together and divide this number by the *Total Panel Area*. To determine the proper *Hydraulic Gauge Pressure*, multiply the *Total Panel Area* by the *Glue Line Pressure* and divide this value by the *Cylinder Area*.

EXAMPLE: A customer would like to press a plywood panel that is 30" x 24" and a panel that is 18" x 36'. The panels will be pressed side by side. The desired pressure is 125 psi. The press has six (6) 150mm pressure cylinders. What is the correct hydraulic line pressure?

The press is designed around metric cylinders and most likely has a pressure gauge that reads bars. It is recommended that all values in this example be expressed in metric units.

TOTAL PANEL AREA. The panel dimensions are in inches. The first panel is 30" X 24" = 720 in²; the second panel is 18" X 36" = 648 in². The total area of the two panels is 720 in² + 648 in² = 1368 in². This value is multiplied by 6.45 to convert 1368 in² to **8824 cm²**.

GLUE LINE PRESSURE. The desired glue line pressure is 125 psi which is multiplied by 0.0703 to equal **8.79 kg/cm²**.

CYLINDER AREA. The diameter of each cylinder is 150mm which is equal to 15cm. The area of one cylinder is π x 15² ÷ 4 = 176.7 cm²; the area of all 6 cylinders is **1060 cm²**.

HYDRAULIC GAUGE PRESSURE. The total force on the panel is the Total Panel Area (8824 cm²) X the Glue Line Pressure (8.79 kg/cm²) = 77563 kg. Divide this value by the Total Cylinder Area (1060 cm²) to obtain a hydraulic line pressure of 73.2 kg/cm². The pressure gauge is most likely graduated in bars. 73.2 kg/cm² x 0.98 = **71.7 bar**.

You can also find Franklin's Web-based hydraulic pressure calculator at
http://www.franklinadhesives.com/Wood-Adhesives-US/Wood-Adhesives/Wood-Pressure-Calculators/Hydraulic-Press-Pressure-Calculator.aspx

For additional assistance or questions, please contact Franklin technical support at 1.800.877.4583.