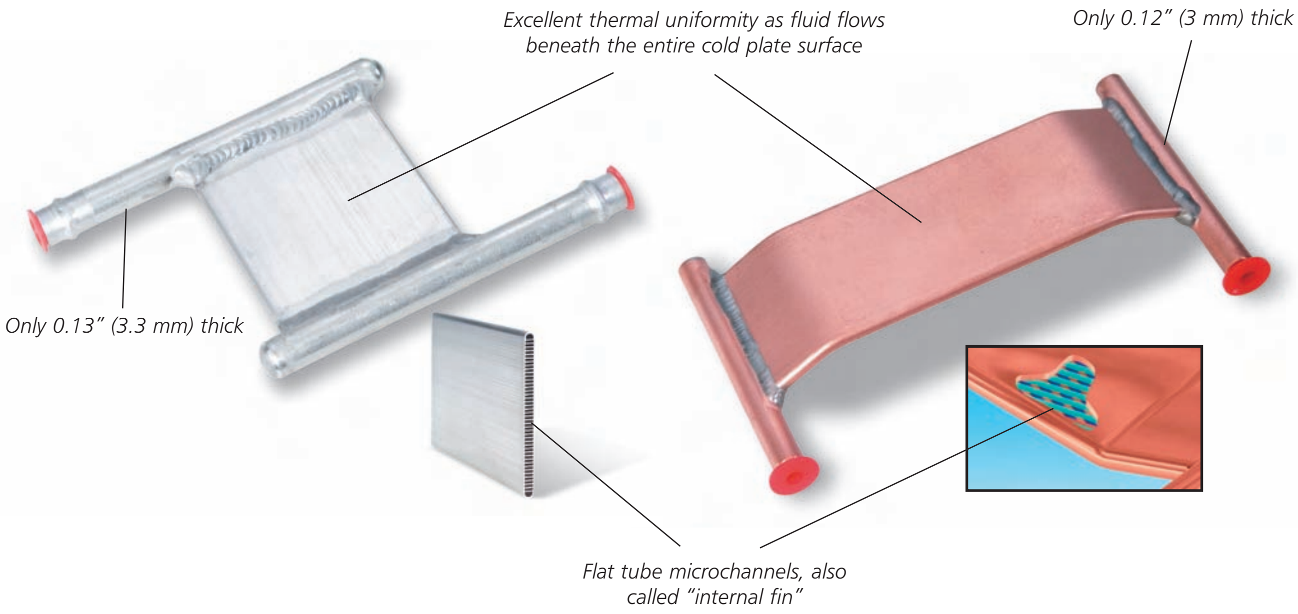


Flat tube cold plates are compact cold plates that offer extremely low thermal resistance. They contain internal fin to increase performance and offer excellent thermal uniformity as coolant flows below the entire surface. They are ideal for cooling small, high watt-density components such as thermoelectric modules. We offer both an aluminum solution (the CP20) and a copper solution (the CP25, or Ascent™).

- **Extremely high performance and thermal uniformity:** The CP20 and CP25 cold plates' extremely low thermal resistance is achieved by thin mounting surfaces and internal fin, which create a large surface area for heat transfer. Coolant flows below the entire cold plate surface, offering excellent thermal uniformity. The CP25's thermal resistance at 1 gpm (3.8 lpm) is just 0.05°C-in²/W (0.33°C-cm²/W), which is achieved by using an all-copper construction with a unique criss-crossed fin structure. The internal micro-channels create turbulence, which minimizes the fluid boundary layer and reduces thermal resistance. The CP20's thermal resistance is also very low – just 0.13°C-in²/W (0.84°C-cm²/W) at 1 gpm (3.8 lpm).

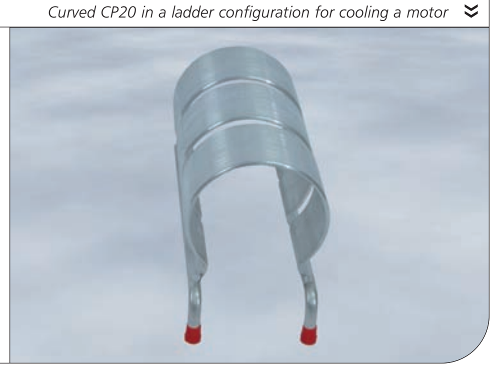
- **Very thin, compact, and lightweight:** The CP20 is only 0.13" (3.3 mm) thick and 0.1 lbs (0.05 kg) and the CP25 is only 0.12˝ (3 mm) thick and 0.2 lbs (0.09 kg), making them ideal for applications where space is limited.

- **Compatible with a range of coolants:** The CP20 cold plate's large internal surface area combined with its low pressure drop makes it ideal for use with viscous and poor heat transfer fluids such as EGW, oils, Fluorinert®, and Polyalphaolefin (PAO), while the CP25's all-copper construction makes it compatible with untreated water and other common coolants.

Please see our specifications table on page 39 to review the cold plate options, including configurations and fittings.

Standard Cold Plates
DWG 38
GRAPHS 39
SPECS 39
SELECT 40

Curved CP20 in a ladder configuration for cooling a motor



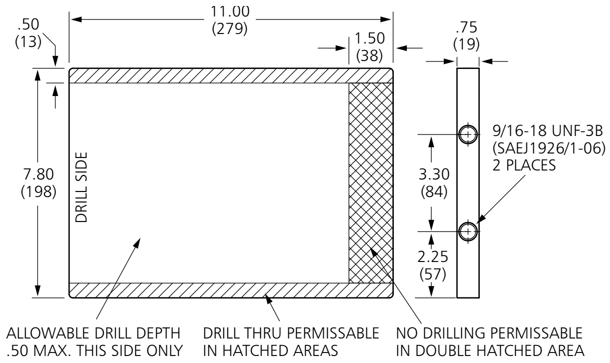
Customization Options:

The CP20 and CP25 are easily customized for OEM applications. The length can be varied and several pieces of flat tube can be assembled in a ladder configuration with a common header. The CP20 can also be curved for cooling cylindrical objects. For large area cooling applications, the flat tube can be integrated into larger assemblies.

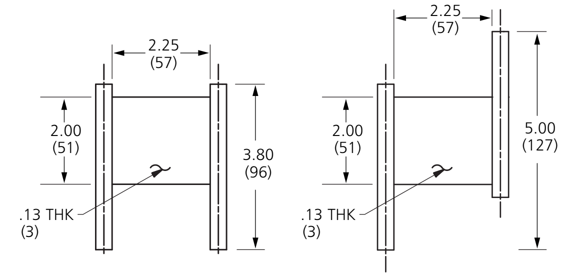
See page 30 for more custom cold plates.

Standard Cold Plates
DWG 38
GRAPHS 39
SPECS 39
SELECT 40

CP30

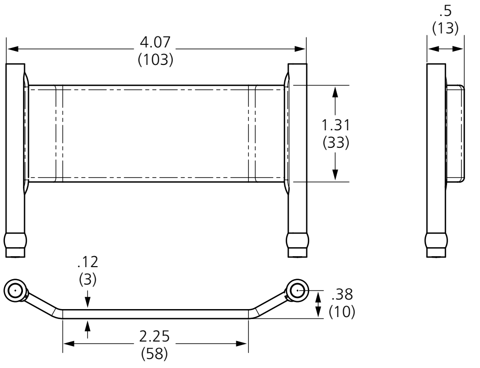


CP20

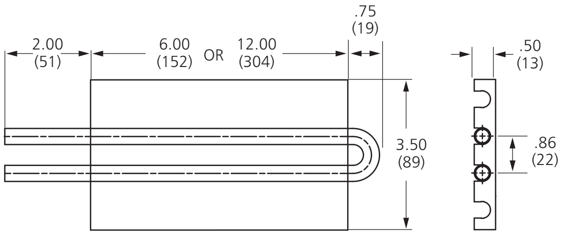


Actual mounting surface 2˝ x 2˝ (50 mm x 50 mm)

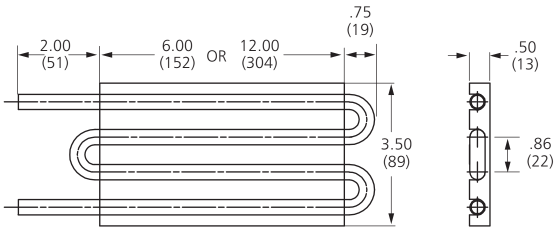
CP25



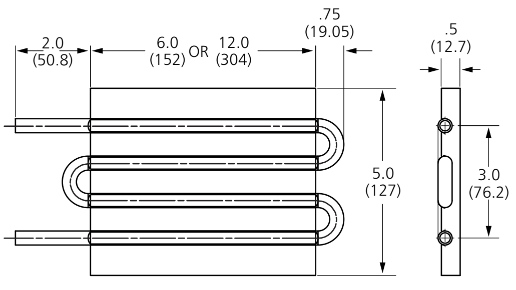
CP10 2-pass



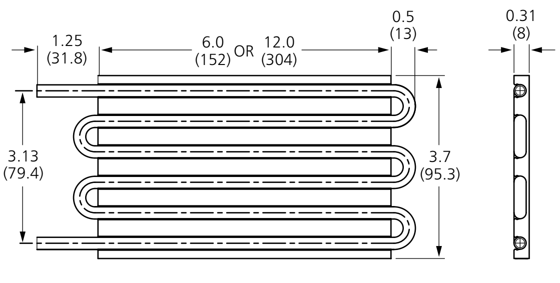
CP10 4-pass



CP12



CP15



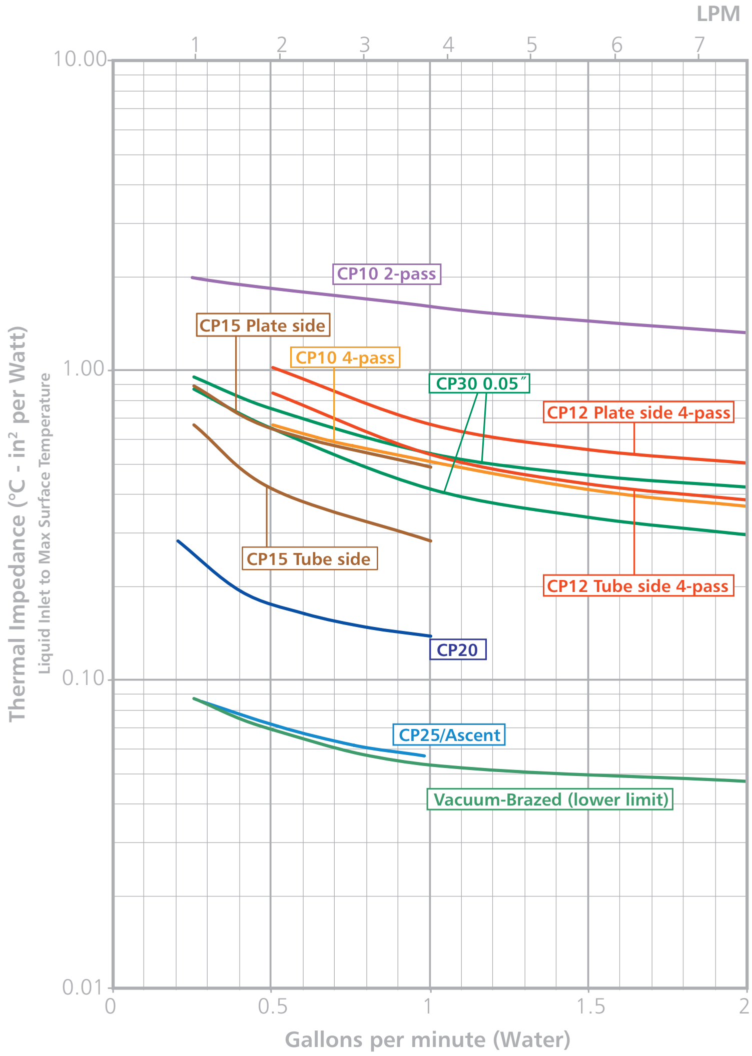
PDFs, IGS files, and eDrawings of standard cold plates are available at www.Lytron.com. Main dimensional label is inches. Dimension in parentheses is mm.

Thermal resistance is normally expressed as °C per Watt. Thermal resistance describes how much hotter the surface of a cold plate is relative to the temperature of the fluid flowing through the cold plate, under a given thermal load. Our performance curves show the local thermal resistance—the surface temperature versus the local liquid temperature. Full details on thermal resistance calculations and how to select a cold plate technology are on page 40.

Normalized performance graphs

This graph shows the **normalized** thermal resistance for our standard cold plate products (i.e. thermal impedance per square inch). It enables cold plate technologies to be compared independently of individual part geometries. The lower the thermal impedance, the better the performance of the cold plate.

1. *Thermal resistance is inversely proportional to area. To find the thermal resistance of a 25 inch² (161 cm²) cold plate, divide the normalized performance by 25.*
2. *Our CP30 standard cold plate is designed for prototyping purposes, so it has a thick surface plate for machining. We show two traces—before (0.5″/13 mm) and after (0.05″/1.3 mm) machining. The performance of a custom vacuum-brazed cold plate is usually significantly better than the standard part.*
3. *For comparison purposes, the performance of all cold plates is shown using water as the coolant. Treated water is recommended with aluminum (CP20 & CP30) cold plates.*
4. *Please visit www.Lytron.com for individual cold plates' thermal performance, pressure drop graphs, weight, and fluid volume.*



Cold Plate Specifications & Fittings*

Model	Tubed Material	Tube Diameter	Configuration	Fitting	Mounting Surface
CP30G01	Aluminum	NA	Square	9/16-18 UNF-3B	7.8" x 11" (19.81 cm x 27.94 cm)
CP20G01/G02	Aluminum	⅜" (9.5 mm)	U	Straight or Beaded*	2" x 2" (5.08 cm x 5.08 cm)
CP20G03/G04	Aluminum	⅜" (9.5 mm)	Z	Straight or Beaded*	2" x 2" (5.08 cm x 5.08 cm)
CP25G01/G02	Copper	¼" (6.4 mm)	U	Straight or Beaded*	2.25" x 1.3" (5.72 cm x 3.30 cm)
CP10G01/G02	Copper	⅜" (9.5 mm)	2-Pass	Straight or Beaded*	6" x 3.5" (15.24 cm x 8.89 cm)
CP10G03/G04	Stainless Steel	⅜" (9.5 mm)	2-Pass	Straight or Beaded*	6" x 3.5" (15.24 cm x 8.89 cm)
CP10G05/G06	Copper	⅜" (9.5 mm)	2-Pass	Straight or Beaded*	12" x 3.5" (30.48 cm x 8.89 cm)
CP10G07/G08	Stainless Steel	⅜" (9.5 mm)	2-Pass	Straight or Beaded*	12" x 3.5" (30.48 cm x 8.89 cm)
CP10G14/G15	Copper	⅜" (9.5 mm)	4-Pass	Straight or Beaded*	6" x 3.5" (15.24 cm x 8.89 cm)
CP10G16/G17	Stainless Steel	⅜" (9.5 mm)	4-Pass	Straight or Beaded*	6" x 3.5" (15.24 cm x 8.89 cm)
CP10G18/G19	Copper	⅜" (9.5 mm)	4-Pass	Straight or Beaded*	12" x 3.5" (30.48 cm x 8.89 cm)
CP10G20/G21	Stainless Steel	⅜" (9.5 mm)	4-Pass	Straight or Beaded*	12" x 3.5" (30.48 cm x 8.89 cm)
CP12G01/G02	Copper	⅜" (9.5 mm)	4-Pass	Straight or Beaded*	6" x 5" (15.24 cm x 12.70 cm)
CP12G05/G06	Copper	⅜" (9.5 mm)	4-Pass	Straight or Beaded*	12" x 5" (30.48 cm x 12.70 cm)
CP15G01/G02	Copper	¼" (6.4 mm)	6-pass	Straight or Beaded*	6" x 3.75" (15.24 cm x 9.53 cm)
CP15G05/G06	Copper	¼" (6.4 mm)	6-pass	Straight or Beaded*	12" x 3.75" (30.48 cm x 9.53 cm)

* Letter G followed by an odd number indicates straight fittings and letter G followed by an even number indicates beaded fittings. For example, part number CP20G01 has a straight fitting and CP20G02 has a beaded fitting.

DWG 38
GRAPHS 39
SPECS 39
SELECT 40

To select the best cold plate for your application, you need to know the cooling fluid flow rate, the fluid inlet temperature, the heat load of the devices attached to the cold plate, and the maximum desired cold plate surface temperature, T_{max}. From these you can determine the maximum allowable thermal resistance of the cold plate.

First, calculate the maximum temperature of the fluid when it leaves the cold plate, T_{out}. This is important because if T_{out} is greater than T_{max}, there is no solution to the problem.

T_{out} can be calculated by solving the heat capacity equation:

$$T_{out} = T_{in} + \frac{Q}{\rho \cdot \dot{v} \cdot C_p}$$

T_{out} = temperature of fluid leaving cold plate
T_{in} = inlet temperature of fluid
Q = heat load of devices
ρ = density of the fluid
$\dot{v}$ = cooling fluid flow rate
C_p = specific heat of the fluid

Alternatively, you can use the heat capacity graphs found on www.Lytron.com. These graphs describe the change in temperature, ΔT, that occurs along the fluid path. To find T_{out}, add ΔT to the inlet temperature, T_{in}.

Assuming T_{out} is less than T_{max}, the next step is to determine the required normalized thermal resistance (θ) for the cold plate using this equation:

$$\theta = (T_{max} - T_{out}) \cdot (A/Q)$$

θ = thermal impedance
T_{max} = maximum desired cold plate surface temperature
T_{out} = temperature of fluid leaving cold plate
A = area being cooled
Q = heat load of devices

Any cold plate technology that provides a normalized thermal impedance less than or equal to the calculated value will be a suitable solution.

Example:
A cold plate is used to cool a 2″ x 4″ (5.08 cm x 10.16 cm) IGBT that generates 500 W of heat. It is cooled with 20°C water at a 0.5 gpm flow rate. The surface of the cold plate must not exceed 55°C.

We know:
T_{in}: 20°C T_{max}: 55°C   Q: 500 Watts   A: 8 in²

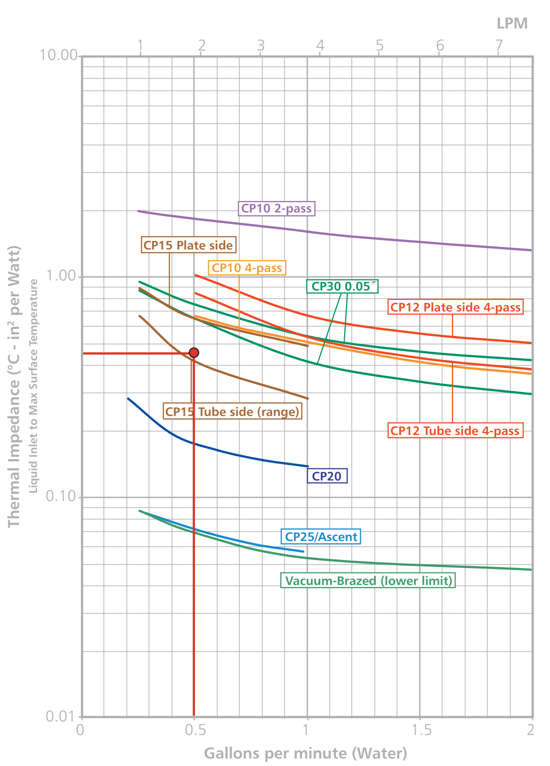
We need to calculate T_{out} and θ.
First calculate T_{out}. Using the heat capacity graphs on www.Lytron.com, we find that the temperature change for 500 W at a 0.5 gpm flow rate is 4°C. Therefore T_{out} = 20°C + 4°C = 24°C.

T_{out} is less than T_{max} so we can proceed to the second part of the problem. The required thermal impedance is given by this equation:

$$\theta = (T_{max} - T_{out}) \cdot (A/Q)$$

$\theta = (55°C - 24°C) \cdot (8\ in^2/500\ W)$
$\theta = 0.5°C\text{-}in^2/W$ at 0.5 gpm

We then plot this point on the normalized thermal impedance graph. Any technology below this point will meet the thermal requirement. The CP15, CP20, CP25, and CP30 provide the necessary thermal impedance. However, because the cooling fluid is water, you should only consider the CP15 and CP25 cold plates.



Standard Cold Plates

DWG 38
GRAPHS 39
SPECS 39
SELECT 40