

# PRODUCT LINE OVERVIEW

Quick Couplings and Fittings  
for Plastic Tubing



Controlled  
Performance  
Connections

# Colder Products Company

Colder Products Company — a world leader in the design of plastic, quick disconnects for flexible tubing — has combined innovative engineering with highly advanced manufacturing to provide a diverse range of fluid management solutions worldwide. For over 25 years, CPC® has been providing controlled performance connections to industrial, biopharmaceutical, medical, and packaging markets.

## Product Line Overview

This Product Line Overview is designed to show the range and diversity of CPC's extensive product line. For complete product information, including configurations, specifications, part numbers, and more on any of the couplings shown here, please refer to CPC's full line catalogs.

## Interactive Web Site

CPC supports its product lines and literature with an interactive Web site. The site showcases new product innovations and technologies and provides easy, immediate access to product and industry information, application tools and more.

- Free catalogs and other literature on CPC product lines
  - Industrial
  - Medical Device & Equipment
  - Bioprocessing
  - High Purity & Chemical Management
  - Smart Technology
  - Food & Beverage Service
- Information on custom applications
- Online tools and selector guides
- Downloadable CAD drawings
- Distributor locations
- Direct connections to CPC engineers

## On-line Catalogs and Literature



Industrial



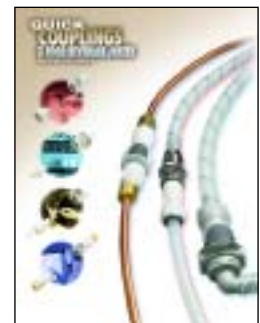
Medical



Chemical Management



Smart Technology



Food, Beverage and Water

# Things to Consider when Selecting a Coupling

## Temperatures and Pressures

CPC couplings are available in many different designs and materials. Each has its own distinct tolerance range for exposure to temperature and pressure. Standard couplings are available for use with temperatures ranging from -40°F to 300°F (-40°C to 149°C) and pressures ranging from vacuum to 250 psi (17.2 bar).

## Materials

CPC offers a variety of material options to suit your application. Depending on the application's media, you may choose from aluminum, chrome-plated brass, acetal, polypropylene, polysulfone, PVDF, PTFE, and others. Be sure to consider the media the coupling will be exposed to internally and externally. The o-ring seals and any internal springs must also be considered.

## Shutoff Valve Options

Colder couplings are available with or without integral shutoff valves. These valves automatically stop the flow when the coupling is disconnected. Coupling configurations include straight thru (no valves), single-sided, double-sided, or non-spill.

## Flow

CPC's couplings provide high flow within a compact size. Internal shutoff valves and tubing size are factors to consider in flow performance.

## Configurations and Tubing Options

Many options are available for mounting configurations and terminations. CPC couplings are available as in-line, panel mount or mounted using a pipe thread. Many couplings also offer an elbow configuration option. Tubing options include hose barb for 1/16" to 3/4" tubing, compression terminations for semi-rigid tubing, pipe thread (1/8" to 3/4"), and others.

| Product Line    | Material      | O-ring*    | Temperature                      | Pressure†                               |
|-----------------|---------------|------------|----------------------------------|-----------------------------------------|
| NS4             | Polypropylene | EPDM       | 32° to 160° F<br>0° to 71° C     | Vacuum to 120 psi<br>Vacuum to 8.3 bar  |
| NS6             | Polypropylene | EPDM       | 32° to 160° F<br>0° to 71° C     | Vacuum to 120 psi<br>Vacuum to 8.3 bar  |
| NSH             | Polypropylene | EPDM       | 32° to 120° F<br>0° to 49° C     | Vacuum to 120 psi<br>Vacuum to 8.3 bar  |
| RPN             | Aluminum      | EPDM       | -40° to 185° F<br>-40° to 85° C  | Vacuum to 100 psi<br>Vacuum to 6.9 bar  |
| SMC/PTC/TT/SX   | See page 7    | BUNA-N     | -40° to 180° F<br>-40° to 82° C  | Vacuum to 100 psi<br>Vacuum to 6.9 bar  |
| PMC/PLC/APC     | Acetal        | BUNA-N     | -40° to 180° F<br>-40° to 82° C  | Vacuum to 120 psi<br>Vacuum to 8.3 bar  |
| PMC12/PLC12     | Polypropylene | EPDM       | 32° to 160° F<br>0° to 71° C     | Vacuum to 120 psi<br>Vacuum to 8.3 bar  |
| HFC12           | Polypropylene | EPDM       | 32° to 160° F<br>0° to 71° C     | Vacuum to 60 psi<br>Vacuum to 4.1 bar   |
| EFC             | Polypropylene | EPDM       | 32° to 160° F<br>0° to 71° C     | Vacuum to 105 psi<br>Vacuum to 7.2 bar  |
| HFC35/HFC57/FFC | Polysulfone   | EPDM       | -40° to 280° F<br>-40° to 138° C | Vacuum to 125 PSI<br>Vacuum to 8.6 bar  |
| MC/LC           | Brass         | BUNA-N     | -40° to 180° F<br>-40° to 82° C  | Vacuum to 250 psi<br>Vacuum to 17.2 bar |
| 3FL/5FL         | Aluminum      | FKM        | -40° to 300° F<br>-40° to 149° C | Vacuum to 120 psi<br>Vacuum to 8.3 bar  |
| CQG             | Polypropylene | Viton® FKM | 0° to 150° F<br>-18° to 66° C    | Vacuum to 80 psi<br>Vacuum to 5.5 bar   |
| CQH             | Polypropylene | Viton® FKM | 32° to 225° F<br>0° to 107° C    | Vacuum to 80 psi<br>Vacuum to 5.5 bar   |
| CQV             | PVDF          | Chemraz®   | 0° to 225° F<br>-18° to 107° C   | Vacuum to 80 psi<br>Vacuum to 5.5 bar   |
| CQN             | PTFE          | Chemraz®   | 0° to 150° F<br>-18° to 66° C    | Vacuum to 80 psi<br>Vacuum to 5.5 bar   |

\*Standard o-ring shown – other materials available.

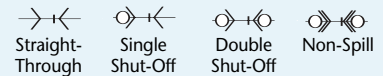
†Note: contact the factory for vacuum ratings.

Chemraz® is a registered trademark of Greene, Tweed & Co.

Viton® is a registered trademark of DuPont Dow Elastomers.



# Product Line Overview



Couplings connected and shown actual size (approximate).

For additional terminations and configurations, see full line Industrial Catalog.

Cv values are expressed in English based on GPM and PSI and in metric (shown in parentheses) based on LPM and Bar.

**NEW!**

## Non-Spill Couplings

### NS4 Series

NS4D22002 & NS4D17006



**Material:** Polypropylene  
**Tubing Range:** 1/8" to 3/8" (3.2mm to 9.5mm)  
**Feature:** Plastic non-spill with soft-touch overmold  
 Cv~0.6 (8.65) max

### NS6 Series

NS6D22006 & NS6D17008



**Material:** Polypropylene  
**Tubing Range:** 3/8" and 1/2" (9.5mm to 12.7mm)  
**Feature:** Same as NS4 with higher flow  
 Cv~2.2 (31.70) max

### NSH Series

NSHD22006 & NSHD17012



**Material:** Polypropylene  
**Tubing Range:** 3/8" to 3/4" (9.5mm to 19.0mm)  
**Feature:** Spring-free flow path and highest flow non-spill  
 Cv~3.0 (43.23) max

### RPN Series

RPN30006 & RPN46006



**Material:** Anodized aluminum  
**Termination:** SAE-06  
**Feature:** Clipless design for rack and panel systems  
 Cv~2.5 (36.02) max

## Subminiature Couplings

### SMC Series

SMM01 & SMF02



**Material:** Acetal, Polypropylene, Polycarbonate, Chrome-Plated Brass

**Tubing Range:** 1/16" to 1/8" (1.6mm to 3.2mm)

**Feature:** Smallest CPC coupling; twist to connect

$C_v \sim 0.19$  (2.74) max  
 $C_v \sim 0.08$  (1.15) max

## General Purpose Couplings/Plastic

### PMC Series

PMC2201 & PMC1704



**Material:** Acetal

**Tubing Range:** 1/16" to 1/4" (1.6mm to 6.4mm)

**Feature:** General purpose coupling

$C_v \sim 0.51$  (7.35) max  
 $C_v \sim 0.26$  (3.75) max  
 $C_v \sim 0.24$  (3.46) max

### PMC12 Series

PMCD220112 & PMCD170412



**Material:** Polypropylene

**Tubing Range:** 1/16" to 1/4" (1.6mm to 6.4mm)

**Feature:** Chemically resistant for corrosive applications

$C_v \sim 0.44$  (6.34) max  
 $C_v \sim 0.26$  (3.75) max  
 $C_v \sim 0.24$  (3.46) max

### PLC Series

PLC22004 & PLC17006



**Material:** Acetal

**Tubing Range:** 1/4" to 3/8" (6.4mm to 9.5mm)

**Feature:** General purpose coupling

$C_v \sim 1.40$  (20.17) max  
 $C_v \sim 0.82$  (11.82) max  
 $C_v \sim 0.51$  (7.35) max

### PLC12 Series

PLCD2200412 & PLCD1700612



**Material:** Polypropylene

**Tubing Range:** 1/4" and 3/8" (6.4mm to 9.5mm)

**Feature:** Chemically resistant for corrosive applications

$C_v \sim 1.40$  (20.17) max  
 $C_v \sim 0.82$  (11.82) max  
 $C_v \sim 0.51$  (7.35) max

### APC Series

APC22004 & APC17006SH



**Material:** Acetal

**Tubing Range:** 1/4" to 3/8" (6.4mm to 9.5mm)

**Feature:** Plastic-latched coupling

$C_v \sim 1.28$  (18.44) max  
 $C_v \sim 0.80$  (11.53) max  
 $C_v \sim 0.70$  (10.09) max

### EFC12 Series

EFCD22412 & EFCD17612



**Material:** Polypropylene

**Tubing Range:** 1/4" and 3/8" (6.4mm to 9.5mm)

**Feature:** Extra flow; chemically resistant for corrosive applications

$C_v \sim 1.13$  (16.28) max  
 $C_v \sim 0.72$  (10.37) max

# Product Line Overview



Straight-Through



Single Shut-Off



Double Shut-Off



Non-Spill

Couplings connected and shown actual size (approximate).

For additional terminations and configurations, see full line Industrial Catalog.

Cv values are expressed in English based on GPM and PSI and in metric (shown in parentheses) based on LPM and Bar.

## General Purpose Couplings/Plastic

### HFC12; HFC35 and HFC57 Series

HFCD22612 & HFC171212



**Material:** Polypropylene (*as shown*)  
Polysulfone (*white*)  
UV Polysulfone (*black*)

**Tubing Range:** 3/8" to 3/4" (9.5mm to 19.0mm)

**Feature:** High flow family of couplings

→+← Cv~3.94 (56.77) max

○+← Cv~2.50 (36.02) max

○+○ Cv~2.04 (29.39) max

### FFC35 Series

FFC221235 & FFC171235



**Material:** Polysulfone

**Tubing Range:** 3/4" (19.0mm)

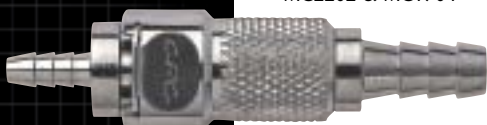
**Feature:** Unobstructed flow path (no valves)

→+← Cv~13.00 (187.31) max

## General Purpose Couplings/Metallic

### MC Series

MC2202 & MC1704



**Material:** Chrome-Plated Brass

**Tubing Range:** 1/8" to 1/4" (3.2mm to 6.4mm)

**Feature:** General purpose coupling

→+← Cv~0.51 (7.35) max

○+← Cv~0.26 (3.75) max

○+○ Cv~0.24 (3.46) max

### LC Series

LCD22004 & LC17006



**Material:** Chrome-Plated Brass

**Tubing Range:** 1/4" to 3/8" (3.2mm to 9.5mm)

**Feature:** Same as MC with higher flow

→+← Cv~1.40 (20.17) max

○+← Cv~0.82 (11.82) max

○+○ Cv~0.51 (7.35) max

### FL Series

3FLD6061228 & 3FLD60611710



**Material:** Aluminum

**Tubing Range:** 1/2" to 3/4" (12.7mm to 19.0mm)

**Feature:** Lightweight, anodized industrial coupling

○+○ Cv~1.5 (21.61) max for 3FL

○+○ Cv~3.8 (54.75) max for 5FL

## Multiple Line Couplings

### PTC Twin Tube™ Series

PTC1602096 & PTC202096

**Material:** Acetal, ABS  
**Tubing Range:** 1/16" to 1/8" (1.6mm to 3.2mm)  
**Feature:** One connection for two separate lines  


### SX Sixtube™ Series

SXM1702 & SXF4202

**Material:** Acetal (housing), Acetal or Polypropylene (fitting inserts)  
**Tubing Range:** 1/16" to 1/8" (1.6mm to 3.2mm)  
**Feature:** One connection for six separate lines  
  
  
 $C_v \sim 0.19$  per line (2.74) max  
 $C_v \sim 0.08$  (1.15) max

### TT Tentube® Series

TT1002

**Material:** Nylon (housing), Acetal or Polypropylene (fitting inserts)  
**Tubing Range:** 1/16" to 1/8" (1.6mm to 3.2mm)  
**Feature:** One connection for ten separate lines  
  
  
 $C_v \sim 0.19$  per line (2.74) max  
 $C_v \sim 0.08$  (1.15) max

### Multi-Mount Series

Various LC & PLC

**Material:** Acetal, Chrome-Plated Brass  
**Tubing Range:** 1/8" to 3/8" (3.2mm to 9.5mm)  
**Feature:** One connection for three to five lines  
  
  
  
 $C_v \sim 1.4$  per line (20.17) max  
 $C_v \sim 0.82$  (11.82) max  
 $C_v \sim 0.51$  (7.35) max

## Liquid Dispensing Couplings

### Puncture Seal Dispensing System

PSD1700612 & PSC38MM

**Material:** Polypropylene (body), LPDE (closure)  
**Tubing Range:** 1/4" to 3/8" (6.4mm to 9.5mm)  
**Feature:** Safe liquid dispensing for bag-in-box or other flexible packaging  
  


### Universal Dispensing Series

97600 & 96400

**Material:** Polypropylene (body), Acetal (cap)  
**Tubing Range:** 3/8" to 3/4" (9.5mm to 19.0mm)  
**Feature:** Universal connection for a 38 mm fitment neck  


## Smart Technology Couplings

### Smart Technology

- Smart Technology FAQ
- Why Use a Smart Coupling
- Smart Markets
- Smart Products

## Custom Solutions

### Special Application Capabilities

See page 10 of this Product Overview or the full line Industrial Catalog for more information.

# Product Line Overview



Straight-Through



Single Shut-Off



Double Shut-Off



Non-Spill

Couplings connected and shown actual size (approximate). For additional terminations and configurations, see full line Chemical Management Catalog.

Cv values are expressed in English based on GPM and PSI and in metric (shown in parentheses) based on LPM and Bar.

## High Purity ChemQuik® and DrumQuik® Series

### CQG06 Series

CQGD06200108 & CQGD06100108

**Material:** Virgin Polypropylene

**Tubing Range:** 3/8 to 3/4 flare; 1/2" to 3/4" NPT (other options available)

**Feature:** Spring-free flow path; pressure-balanced

 Cv~3.2 (46.11) max



### CQH06 Series

CQHD06200106 & CQHD06100106

**Material:** Virgin Polypropylene

**Tubing Range:** 1/4 to 3/4 flare; 3/8" to 3/4" NPT (other options available)

**Feature:** All plastic; non-lube construction

 Cv~1.6 (23.05) max



### CQV06 Series

CQVD06200108 & CQVD06100106

**Material:** Virgin PVDF

**Tubing Range:** 1/4 to 3/4 flare; 3/8" to 3/4" NPT (other options available)

**Feature:** All plastic; non-lube construction

 Cv~1.6 (23.05) max



## CQN06 Series

CQND06200108 & CQND06100108

**Material:** Virgin Dyneon™ TFM™ PTFE  
**Tubing Range:** 1/4 to 3/4 flare  
(other options available)  
**Feature:** Spring-free flow path;  
pressure-balanced  
 Cv~3.1 (44.67) max



## CQN08 Series

CQND0820011205 & CQND0810011605

**Material:** Virgin Dyneon™ TFM™ PTFE  
**Tubing Range:** 3/4 to 1 flare  
(other options available)  
**Feature:** Spring-free flow path;  
pressure-balanced  
 Cv~7.3 (105.18) max



## DrumQuik® Series

Various part options

**Material:** Virgin Polypropylene or PTFE  
**Feature:** Designed specifically for drums  
and IBC containers; works with  
HFC12, NSH, CQH06, CQG06,  
and CQN couplings



DrumQuik® photo not to scale

Dyneon™ TFM™ are trademarks of 3M-Hoechst.

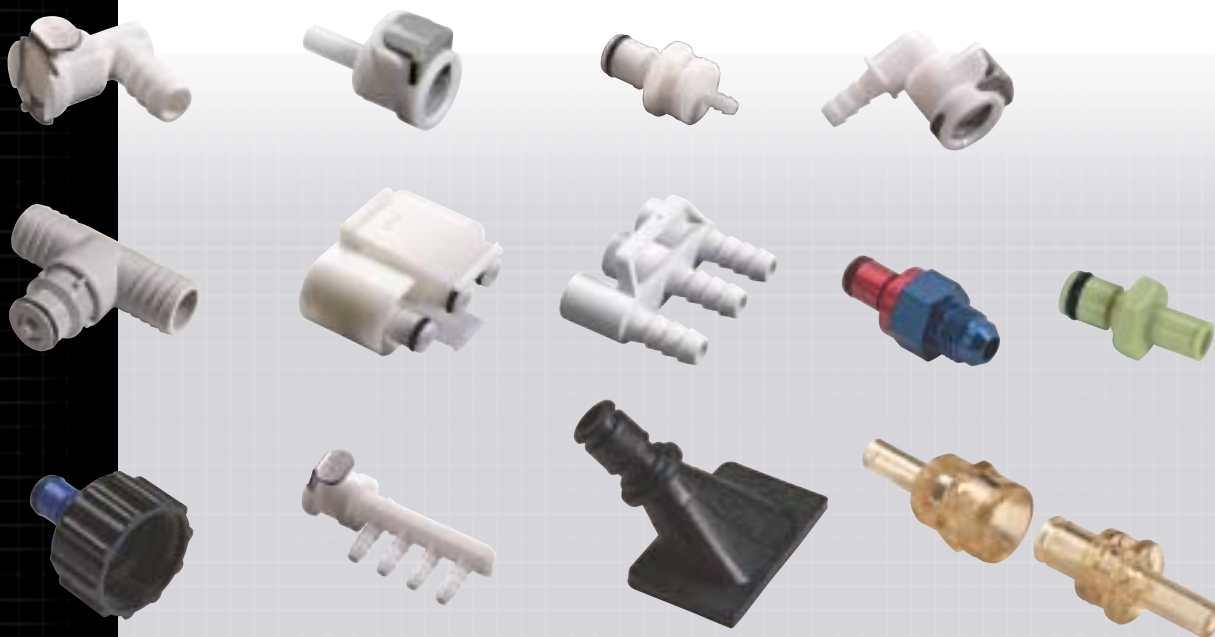
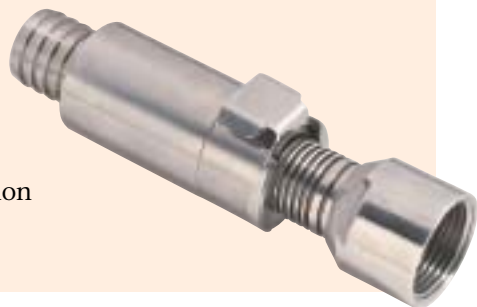
# Still Looking for That Perfect Solution?

Even with thousands of standard quick disconnect couplings available, we know you still may not have found the precise part you need. That's why, for more than 25 years, CPC's Application Engineering Team has worked with customers around the world to design custom coupling solutions to solve their specific problems and improve their products' performance. CPC has solid modeling capabilities, prototype equipment, an expansive test lab, and thousands of solutions. Combine that with our years of experience and a "can do" attitude, and there is no need for you to design your solution alone.

## Consider a Custom-Designed Connector When:

- A quick disconnect will add value to your product, making it easier to use and more reliable
- Your requirements cannot be met by an existing standard CPC product
- Unique requirements, budgets or timing warrant your designer's collaboration with CPC's Application Engineering Team

Remember, standard catalog items generally have the advantage of quick availability and many times, lower cost, with no initial investment of time or money. However, depending on your volumes and technical requirements, it may make sense to work with our Application Engineering Team to design a unique solution tailored for your needs.

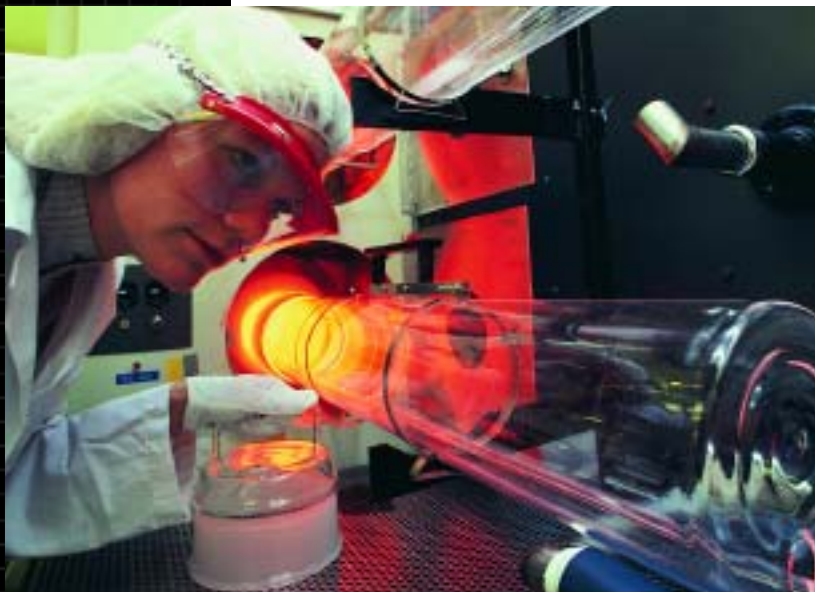


*Custom designed products are exclusively produced for a specific customer. These proprietary products might not be for sale. Contact your local distributor for special application couplings.*



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# Colder Case Studies



## Semco Corporation

When Semco Corporation, a California-based OEM of chemical management systems for the semiconductor and pharmaceutical industries, specified a PTFE ChemQuik™ CQN08 non-spill quick disconnect coupler to incorporate into their SmartCart – they had a list of tough requirements.

Aggressive chemicals, including sulfuric acid, hydrofluoric acid, hydrogen peroxide, and de-ionized water, are dangerous if not handled correctly. From chemical cart to process tool, a one-hand, push-button quick disconnect coupling was needed, with the ability to connect and disconnect under pressure, with no spill. Couplings with traditional poppet-style designs spill a significant amount when disconnected.

In addition, high purity process fluids can be contaminated by the metallic springs in the flow path of ordinary couplers or the lubricants that are used for seal lubrication. CPC's ChemQuik™ CQN couplings use no lubricants, and the springs, which are hermetically encapsulated in fluoropolymer plastic, are located outside the flow path, away from corrosive and ultra pure fluids, eliminating the expensive risk of contamination.

Finally, CPC's unique rugged keying system prevents accidental line misconnection with an almost infinite number of key codes. Challenge met, problem solved, customer satisfied.

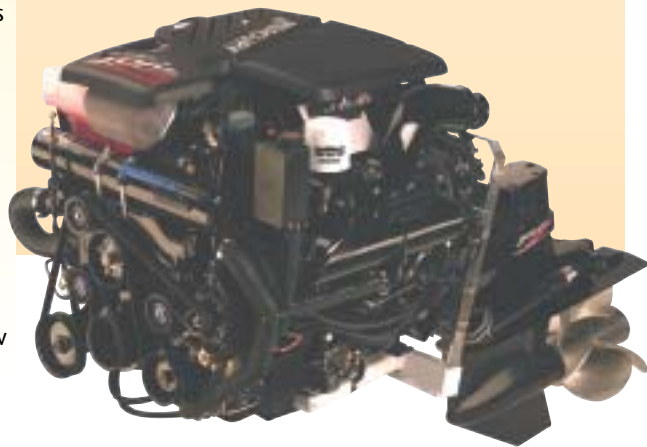
## Mercury MerCruiser

Mercury Marine, the industry-leading provider of Mercury MerCruiser sterndrive engines and inboards, was looking for ways to help boat manufacturers improve productivity by reducing engine installation time. They turned to Colder Products to help them accomplish their goal of making out-of-water processes as quick and convenient as possible.

CPC suggested their APC series couplings as a way to enable quick, one-step connections between sterndrives and both the speedometer and gear lube reservoir on boats. These advanced couplings replace rubber hoses and hose clamps or push-and-turn devices that made assembly laborious and time consuming.

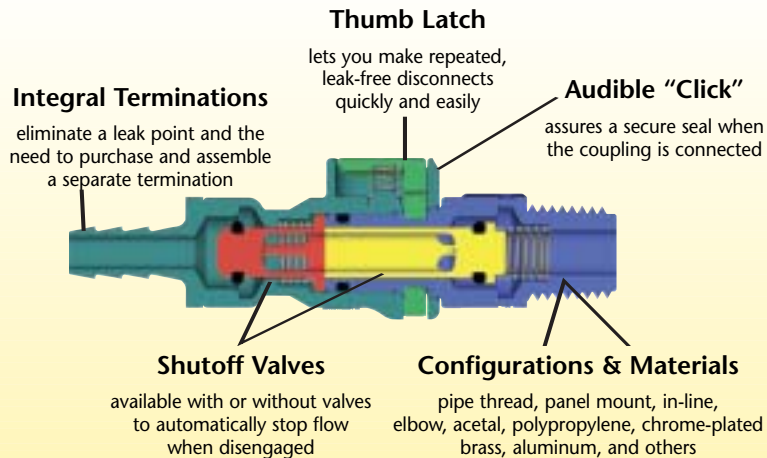
Eliminating the use of hose clamps and screws on Mercury MerCruiser sterndrives allowed boat manufacturers to save up to five minutes of installation time per engine. Overall, localized engine production assembly time has been reduced by 45-70%. The CPC couplings also allow service personnel to easily drain water from the engine cooling system.

Working as part of Mercury MerCruiser's team, CPC was able to help them make the right connection to accelerate boat manufacturing times and simplify service.



# Why use a CPC coupling?

- **Flexibility:** allows quick connection of subassemblies
- **Utility:** makes equipment replacement and upgrades fast and easy
- **Safety:** eliminates dangerous and messy spills
- **Serviceability:** no tools needed to disconnect for maintenance and repairs
- **Modularity:** allows quick connection of attachments and accessories
- **Convenience:** they're easy to use and economical



**Colder Products®**  
*Quick Couplings & Fittings for Plastic Tubing*



#### CPC Patent Statement:

Colder Products Company takes pride in its innovative quick disconnect coupling solutions, many of which have been awarded United States and International patents. Colder Products Company has a strong tradition of leadership in the quick disconnect market, and aggressively pursues and protects its proprietary information and intellectual property. In cases where it is practical and as a benefit to its customers, Colder Products Company has licensed its proprietary technology. Please contact Colder Products to discuss your unique needs.

**CPC Warranty Statement:** Colder Products Company warrants its products against defects in workmanship and materials a period of 12 months from the date of sale by Colder Products Company to its initial customer (regardless of any subsequent sale of the products). This warranty is void if the product is misused, altered, tampered with or is installed or used in a manner that is inconsistent with Colder Product Company's written recommendations, specifications and/or instructions, or fails to perform due to normal wear and tear. Colder Products Company does not warrant the suitability of the product for any particular application. Determining product application suitability is solely the customer's responsibility. Colder Products Company is not liable for special, indirect, incidental, consequential or other damages including, but not limited to, loss, damage, personal injury, or any other expense directly or indirectly arising from the use of or inability to use its products either separately or in combination with other products. ALL OTHER WARRANTIES EXPRESS OR IMPLIED, WHETHER ORAL, WRITTEN OR IN ANY OTHER FORM, INCLUDING BUT NOT LIMITED TO WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, ARE EXPRESSLY EXCLUDED.

The sole and exclusive remedy under this warranty is limited, at the option of Colder Products Company, to replacement of the defective product or an account credit in the amount of the original selling price. All allegedly defective Colder Products Company products must be returned prepaid transportation to Colder Products Company, together with information describing the product's application and performance, unless otherwise authorized in writing by Colder Products Company.

# High Performance QUICK DISCONNECT COUPLINGS

## Why Use a Coupling?

Quick disconnect couplings save time and money

**Maintenance:** Service and maintenance become quick and easy.

**Convenience:** One-hand operation with an audible "click" that signals a secure connection.

**Modularity:** Attachments and accessories are easily connected or disconnected.

**Safety:** Couplings reduce or eliminate the potential for dangerous or messy spills.

**Flexibility:** Colder offers an extensive selection of materials and sizes.

Colder has designed thousands of solutions for unique coupling and fitting applications. We have a coupling to fit virtually any engine systems application and we're ready to work with you to solve your most critical fluid management problems.

## Why Use a Colder Quick Disconnect Coupling?

Controlled performance connections

Traditional fittings used in engine systems can interfere with tubing mobility, and they have no shutoff valve, so they spill when disconnected. But, fluid line connection problems are now a thing of the past with Colder quick disconnect couplings.

Colder couplings lock into place with an audible "click," creating a secure, leak-free seal every time. Colder couplings also allow quick and easy one-handed disconnections by simply pressing the thumb latch. Colder quick disconnect couplings are the fastest and easiest way to service fluid lines in any engine system.

**Tubing range:** 1/16" to 3/4"

### Push button thumb latch

One hand disconnect. Press thumb latch to disconnect coupling.

### O-ring

Seals bubble tight in pressure or vacuum.

### Integral terminations for bodies or inserts include:

Pipe threads, hose barbs, push-to-connect fittings and ferruleless compression fittings for easy connection to semi-rigid plastic tubing from 1/16" to 3/4" and 3 mm to 19 mm ID.

### Shutoff options:

Straight thru – open flow path with no valve

Single shutoff – valve in either the coupling insert or the coupling body

Double shutoff – valves in both the insert and the body of the coupling

### Mounting options:

Colder couplings are available in pipe thread, panel mount, in-line or elbow configurations.

### Markets:

- ATV
- Motorcycle
- Marine
- Fluid Recovery Recycling
- Construction
- Off-highway
- Motor Homes
- Lawn and Garden
- Portable Generators
- Snowmobiles
- Personal Watercraft
- Fuel Cells
- Removable Fuel Tanks

Cooling Lines

Oil Lines

Marine Washdown Systems

Flush Systems  
(coolant & water)

Water  
Lines

Windshield  
Washer Systems

Tire Inflation

Fuel Lines

Gear Lube Lines

Flush and  
Fill Lines



Motorcycles



Marine



Fluid Recovery/Recycling



ATVs



Personal Watercraft



Motor Homes



Lawn and Garden



Portable Generators



Construction/Off-Highway



Snowmobiles



 BMW motorcycle  
engineers use  
Colder couplings to  
simplify fuel systems

BMW Motorcycle design engineers in Berlin needed to simplify fuel tank installation and routine service. The solution came from replacing traditional fittings and hose clamps with Colder PLC quick disconnect couplings that contain an integral double shutoff valve. The lightweight black plastic couplings are easy to use, provide assembly flexibility, enhance serviceability and help prevent the loss of fuel pressure in the Bosch electronic fuel injection system when disconnected. Fluorocarbon (FKM) o-rings ensure chemical compatibility and leak-free performance. Today, BMW motorcycle owners and service technicians all over the world appreciate the convenience and serviceability of Colder's one-hand, push button operated couplings.

**MERCRUISER** MerCruiser  
"connects" with Colder  
to speed manufacturing  
and servicing

Mercury MerCruiser, the industry-leading provider of marine sterndrive engines and inboards, turned to Colder's APC series of couplings to help reduce engine installation time. APC couplings enable quick, one-step connections between sterndrives and boat speedometers and gear tube reservoirs. The couplings replaced rubber hoses and clamps that made assembly laborious and time consuming. In addition, servicing personnel were able to easily drain seawater from the engine-cooling system before boat storage. Mercury MerCruiser's production staff also benefited from the Colder couplings because employees responsible for localized portions of engine assembly were able to reduce production time by 45 to 70 percent.

This is just a sample of couplings. Colder has over 4,000 products available, plus custom options. Contact us for more detail.

# Custom Couplings

Colder's Application Engineering Group is dedicated to developing the highest quality custom coupling solutions for specific application needs. Colder's diverse product line is a great base for custom couplings, providing great flexibility and quality unmatched in the industry.

Colder offers the fastest turnaround time with its modular product design, on-site test lab and unique prototyping capabilities. Colder understands the importance of making the coupling operational as soon as possible for the manufacturer.

Manufacturers seek Colder custom couplings to lower production costs and allow their parts as well as the end product to run more efficiently. For example, Colder created one custom quick disconnect coupling to replace three separate parts that had combined to make one component for a motorcycle gas line. The single Colder custom coupling resulted in fewer leak points, reduced assembly time and lower cost. The new Colder coupling also reduced the overall weight of the vehicle, which was a key customer goal.



## Colder custom couplings are the perfect fit when:

- Quick disconnect couplings make the product more useful.
- Specific coupling configurations outside standard offerings are needed.
- Unique requirements warrant custom solutions.



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**WARRANTY:** All sales are subject to Colder Products Company's limited express warranty set forth in the Colder catalog. Contact your local distributor or Colder Customer Service for warranty provisions.

# QUICK DISCONNECT COUPLINGS

## for Fuel Cell Systems

### Why Use a Colder Quick Disconnect Coupling?

Colder couplings lock into place with an audible "click," creating a secure, leak-free seal every time. They also allow quick and easy one-hand disconnections by simply pressing the thumb latch. Colder quick disconnect couplings are the fastest and easiest way to connect and disconnect fluid lines in any fuel cell system.



**Tubing range:** 1/16" to 3/4"

#### Push button thumb latch

One-hand disconnect. Press thumb latch to disconnect coupling.

#### O-ring

Seals bubble tight in pressure or vacuum.

#### Integral terminations for bodies or inserts include:

Pipe threads, hose barbs, push-to-connect fittings and ferrules for easy connection to semi-rigid plastic tubing from 1/16" to 3/4" and 3mm to 19mm ID.

#### Shutoff options:

Straight thru – open flow path with no valve

Single shutoff – valve in either the coupling insert or the coupling body

Double shutoff – valves in both the insert and the body of the coupling

Non-spill – double shutoff with virtually no spillage upon disconnect

#### Mounting options:

Colder couplings are available in pipe thread, panel mount, in-line or elbow configurations.

- Standby power
- Portable electronics
- Miniature fuel cells
- Transportation
- Fuel lines
- Filling lines
- Drain lines
- Cooling lines

**Flexibility:** Colder offers an extensive selection of materials and sizes.

**Modularity:** Fuel sources are easily connected or disconnected.

**Safety:** Couplings reduce or eliminate the potential for spills.

**Maintenance:** Service and maintenance become quick and easy.

**Convenience:** One-hand operation with an audible "click" that signals a secure connection.

Colder has designed thousands of solutions for unique coupling and fitting applications. We have a coupling to fit virtually any fuel cell systems application and we're ready to work with you to solve your most critical fluid connection problems.

# Fluid Connections for

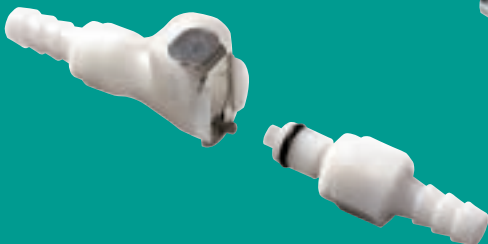
**FUEL** *supply*



*Fuel Lines • Filling Lines • Drain Lines • Cooling*

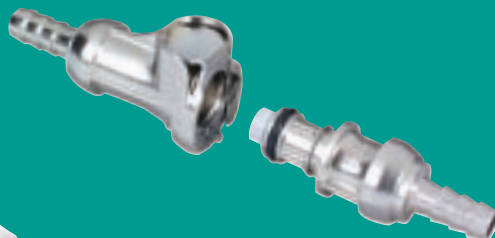
## PMC Series

Material: Acetal  
Flow: 1/8"



## ZLC Series

Material: Die-cast, nickel-plated zinc  
Flow: 1/4"



## NS4 Series

Material: Polypropylene  
Flow: 1/4"



# or Fuel Cells

Colder also has a wide range of couplings for balance of plant applications.

Lines

FUEL cell

## RPN Series

Material: Anodized Aluminum  
Flow: 3/8"



## MicroConnector (for portable electronics)

Flow: 1mm



## Case Studies

### ReliOn

ReliOn is the only hydrogen fuel cell developer using a patented hot-swappable, modular cartridge architecture. This modularity differentiates ReliOn's highly efficient, environmentally friendly fuel cells and makes them far more reliable than other architectures, say company officials.

The critical plug-and-play ability to disconnect and reconnect fuel cell cartridges while power is still being created—key to the high operational reliability of ReliOn's fuel cells—is afforded by Colder couplings.

"Colder's hot-swappable coupling design is low maintenance and leak free, ensuring continuous power transmission," says ReliOn's engineering manager Scott Spink. "The company's willingness to work with us to design a custom component has aided our mission to provide customers with an extremely dependable power supply."

### Tekion

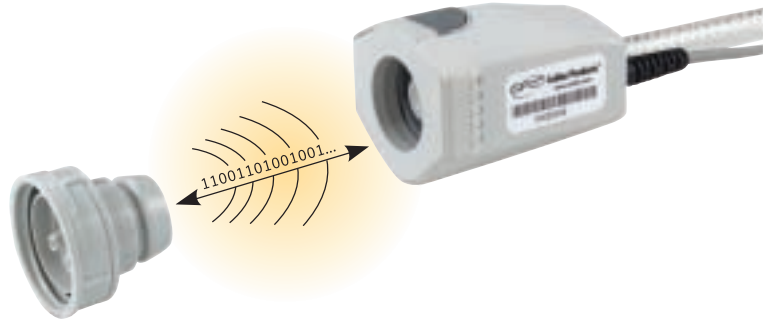
Tekion is commercializing a miniature power pack that fits inside mobile devices. The Formira Power Pack™, which is a micro fuel cell/battery hybrid, will allow users to power their mobile devices continuously without re-charging on the electricity grid.

The micro fuel cell is integrated with a miniature liquid fuel cartridge. When the liquid fuel is consumed, the user quickly inserts a new fuel cartridge while the device remains operating. One key component of the fuel cartridge concept is a miniaturized coupling from Colder Products Company that connects the fuel cartridge to the power pack. This easy-to-use connection product enables the cartridge to be quickly snapped in and out of the device in one simple motion.

"Colder immediately took an active role in the development process and produced a custom-designed coupling prototype that not only addresses our size requirements, but also provides operational and safety benefits," says Malcolm Man, director of programs and strategic planning at Tekion. "To meet required safety standards for the applications we are pursuing, we need to ensure that our liquid fuel systems are virtually leak free. Colder's connections offer this critical fluid-control safeguard."

# IdentiQuik™ Series Couplings

Colder's **IdentiQuik™** series of Smart Couplings utilizes RFID technology to automatically identify fluid products and their characteristics and capture data from point-of-origin through point-of-use. Data stored on the package insert or fluid delivery line is transferred across the coupling before the two halves are connected. Your control system obtains this data via RS-232 communications and uses it to improve safety, prevent misconnections, avoid dangerous combinations, verify processes, protect your brand, and capture important process data.



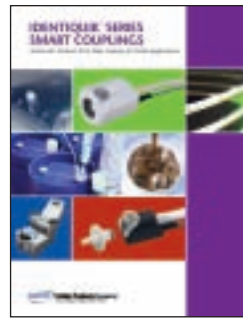
Industrial



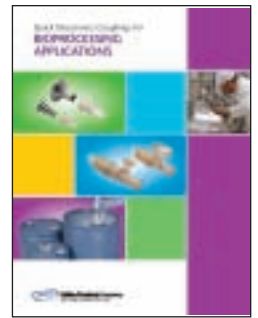
Medical Device



Chemical Management



Smart Technology



Bioprocessing

**CPC®** **Colder Products Company®**  
*Quick Couplings & Fittings for Plastic Tubing*

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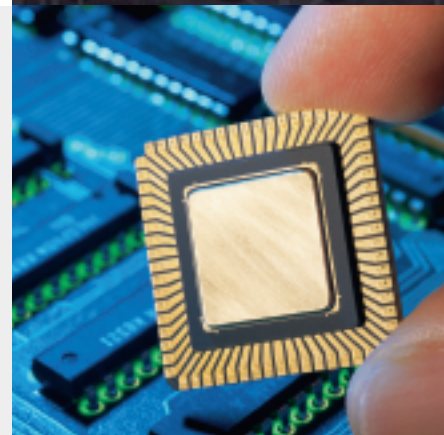
**WARRANTY:** All sales are subject to Colder Products Company's limited express warranty set forth in the Colder catalog. Contact your local distributor or Colder Customer Service for warranty provisions.

# Quick Disconnect Couplings for **LIQUID COOLING**

## Why Use a Coupling for Liquid Cooling?

Colder Products couplings are designed with a variety of features to help provide safe and secure connections for critical fluid applications:

- Non-spill valves help to keep expensive electronics safe
- Robust materials for compatibility with a variety of chemicals and fluids
- One-handed operation – no tools needed to connect or disconnect
- An audible “click” assures your connection is secure
- High flow valve design for maximum flow in a compact coupling
- Custom capabilities for special needs



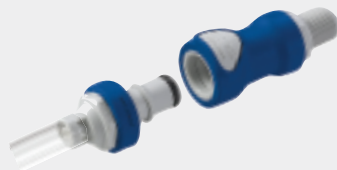
Controlled  
Performance  
Connections

## A Variety of Connection Options from CPC

CPC has thousands of parts designed to fit a wide range of needs, requirements and specifications. Here are just a few samples of the options available for liquid cooling applications:



**RPN:** A non-spill coupling for rack-and-panel systems



**NS4:** A plastic non-spill coupling with an easy-to-use thumb latch (*shown with optional blue overmold*)



**LC:** A durable, chrome-plated brass coupling with stainless steel components

Applications may include:

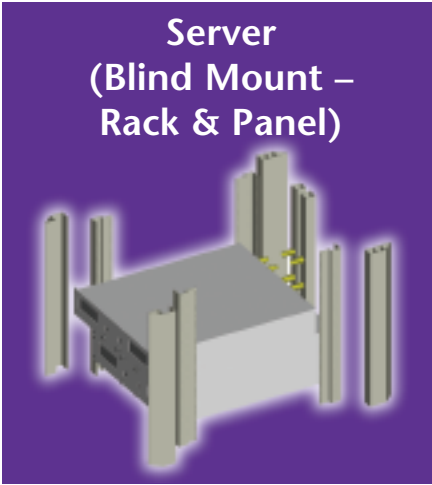
- PCs
- Servers
- Chillers
- Chip Testing
- Lasers
- Medical Equipment
- Other

In addition, CPC's Application Engineering Group is dedicated to developing the highest quality custom coupling solutions for specific application needs. Their diverse product line is a great base for custom couplings, providing great flexibility and quality unmatched in the industry. CPC offers some of the fastest turnaround times in the industry with its modular product design, on-site test lab and unique prototyping capabilities. CPC understands the importance of making the coupling operational as soon as possible.

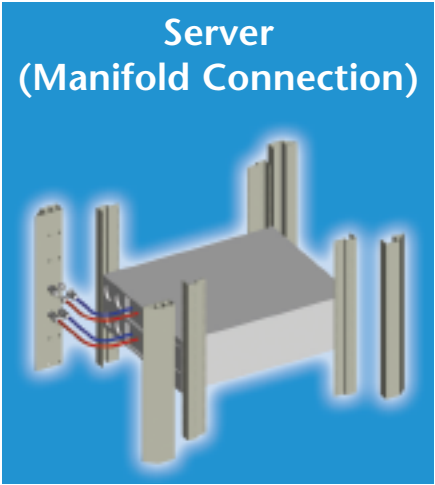
# CPC Couplings for a Variety of Liquid Cooling Connections



Product Series: NS6, HFC, Others



Product Series: RPN & custom non-latched products



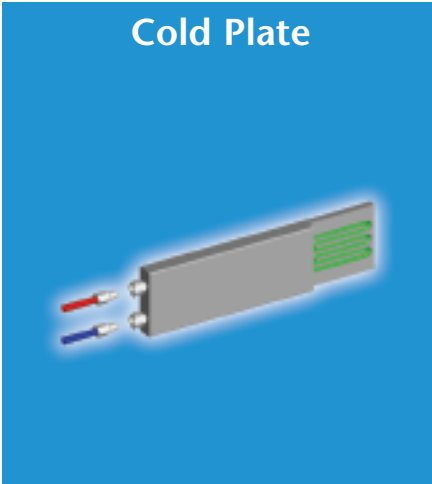
Product Series: NS4, NS6, LC, PLC, APC, Custom



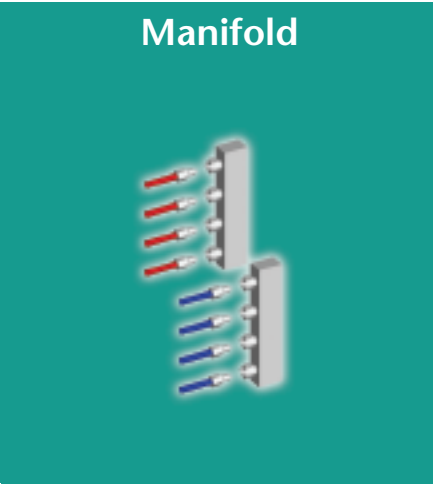
Product Series: PMC, PLC, MC, LC, APC, Custom



Product Series: NS4, NS6, PMC, PLC, APC, HFC



Product Series: NS4, NS6, PMC, PLC, MC, LC, APC, HFC and Custom



Product Series: NS4, NS6, MC, LC, PMC, PLC, APC, HFC, Custom



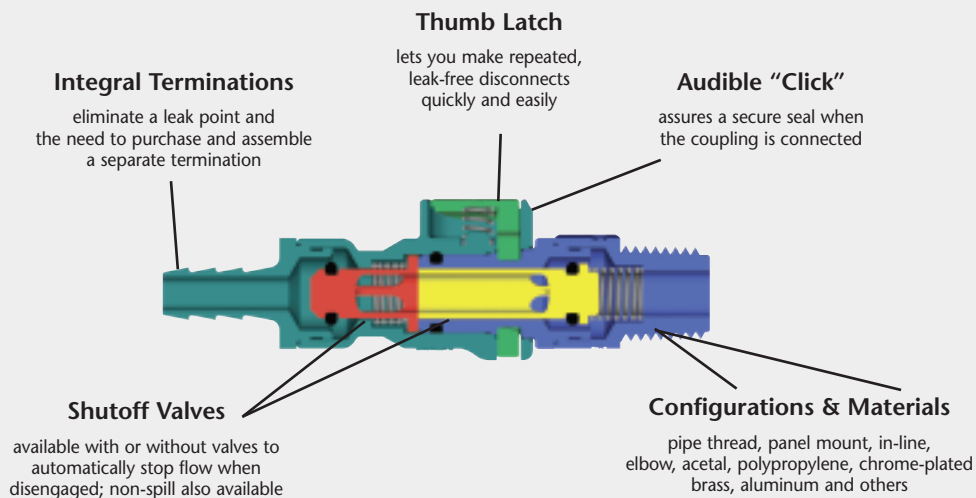
## Other Applications

CPC has worked with customers to help find solutions for their specific liquid cooling applications. Please contact our Applications Engineering Team to discuss your unique application.

**NOTE:** CPC offers many different coupling materials and configurations. Be sure to test CPC couplings for compatibility in your application. Contact CPC for more information on your particular requirements.

# Why Use a CPC Quick Disconnect Coupling?

CPC couplings lock into place with an audible "click," creating a secure, leak-free seal every time. They also allow quick and easy one-handed disconnections by simply pressing the thumb latch. CPC quick disconnect couplings provide a fast, easy and safe way to incorporate liquid cooling into your system.



Industrial



Medical Device



Chemical  
Management



Smart Technology



Bioprocessing



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# Quick Disconnect Couplings for **PRINTING AND INK MANAGEMENT**

## Why Use a Coupling?

Colder Products couplings are designed with a variety of features to help provide safe and secure connections for printing and ink management applications:

- Robust materials for compatibility with a most inks and solvents
- High flow valve design for maximum flow in a compact coupling
- Non-spill valves help prevent messy spills, downtime and loss of expensive inks
- One-handed operation – no tools needed to connect or disconnect
- An audible “click” assures your connection is secure
- Custom capabilities for special needs



Controlled  
Performance  
Connections

## A Variety of Connection Options from CPC

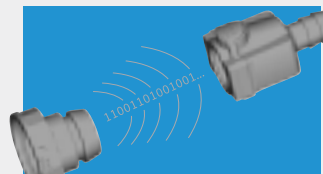
CPC has thousands of parts designed to fit a wide range of requirements and specifications. Many are available with alternative o-ring materials including EPDM and FKM. Here are a few samples of the options available for printing and ink management applications:



**NS4:** A plastic non-spill coupling with an easy-to-use thumb latch (shown with optional blue overmold)



**LC:** A durable, chrome-plated brass coupling with stainless steel components



**Smart Technology:** built-in RFID tags assure the correct ink is used and prevent print head or system damage

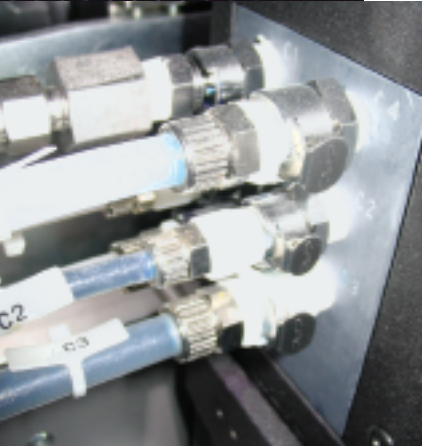
In addition, CPC's Application Engineering Group is dedicated to developing the highest quality custom coupling solutions for specific application needs. CPC offers some of the fastest turnaround times in the industry with its modular product design, on-site test lab and unique prototyping capabilities.

**CPC provides couplings in materials for use with:**

- Water-based inks
- UV inks
- Soy inks
- Solvents
- Cleaners

# CPC Couplings for a Variety of Printing and Ink Connections

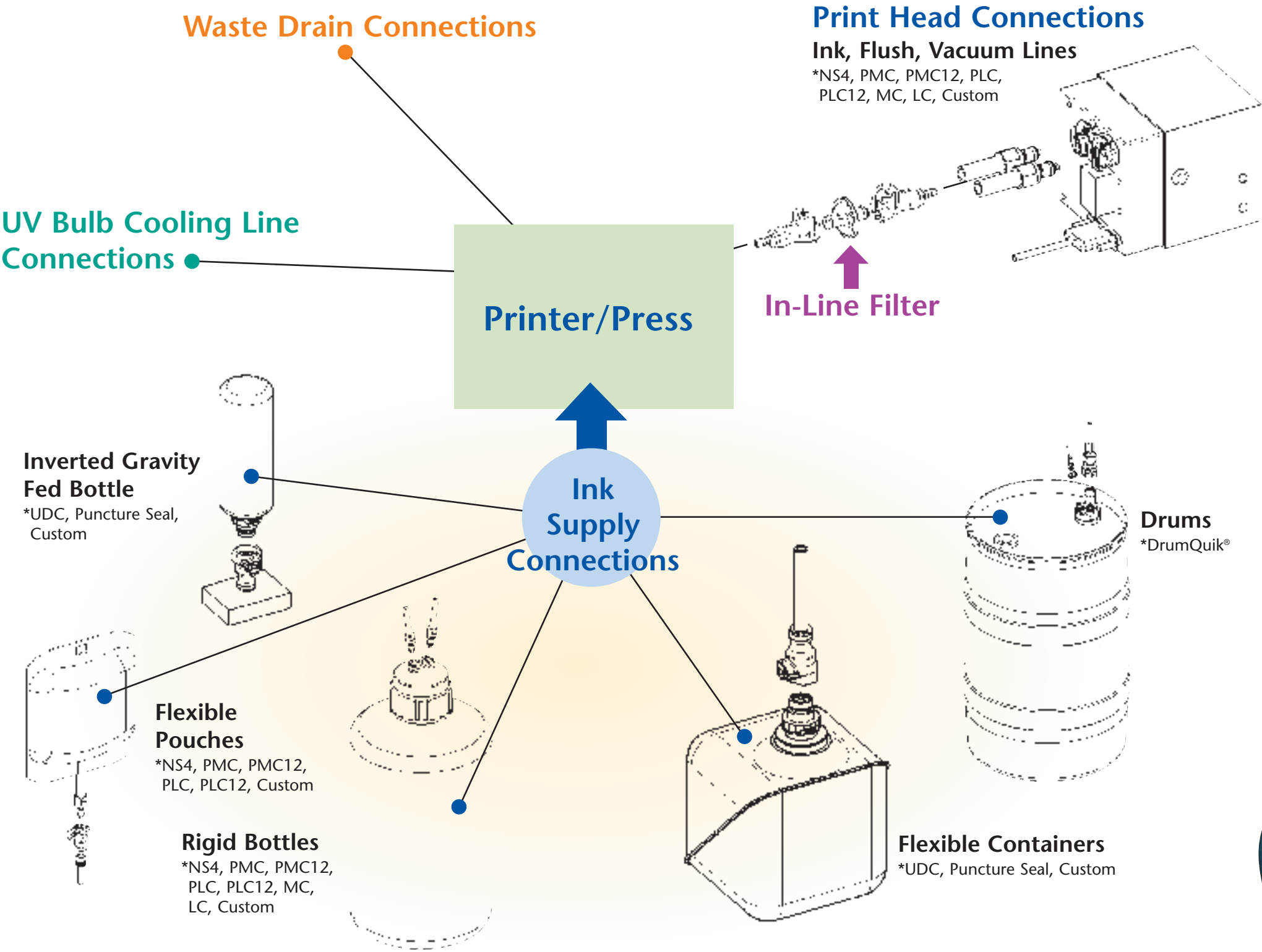
Print head



Ink refill systems



Heating lines on wax ink tanks

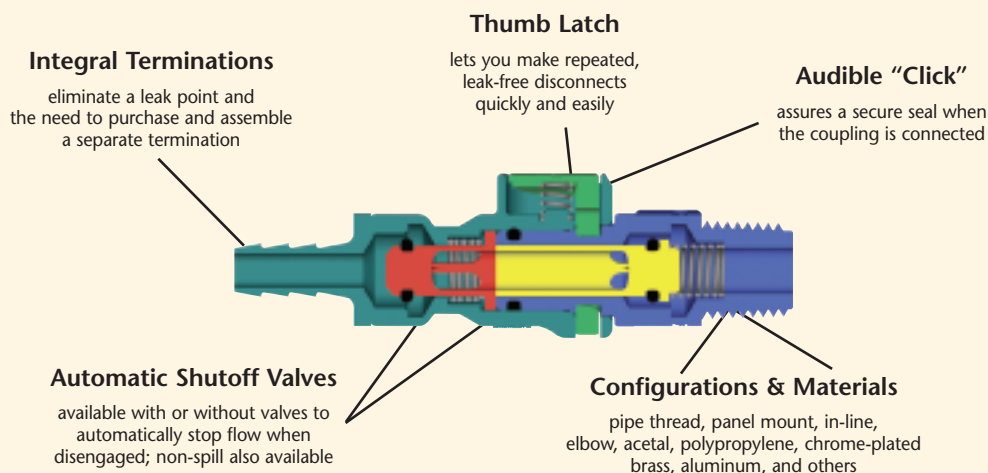


\*Indicates CPC couplings commonly used in these applications.

**NOTE:** Due to the many formulations of inks, CPC offers many o-ring materials. Be sure to test o-rings for compatibility in your application. Contact CPC for more information on your particular requirements.

# Why Use a CPC Quick Disconnect Coupling?

CPC quick disconnect couplings provide fast, easy and safe connections for printing and ink applications.



Industrial



Medical Device



Chemical Management



Smart Technology



Bioprocessing

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**CPC Patent Statement:** Colder Products Company takes pride in its innovative quick disconnect coupling solutions, many of which have been awarded United States and International patents. Colder Products Company has a strong tradition of leadership in the quick disconnect market, and aggressively pursues and protects its proprietary information and intellectual property. In cases where it is practical and as a benefit to its customers, Colder Products Company has licensed its proprietary technology. Please contact Colder Products to discuss your unique needs.



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Quick Couplings & Fittings for Plastic Tubing



# ZLC SERIES

## Die-Cast, Nickel-Plated Zinc Quick Disconnect Couplings

Colder Products' new ZLC Series die-cast, nickel-plated zinc couplings provide a durable and economical solution for meeting price expectations in high volume (500+ pieces) metal applications. The ZLC is streamlined, lightweight (about 20% less than comparable brass couplings) and aesthetically appealing. They can be used for a variety of diverse applications and are interchangeable with many of Colder's existing coupling lines, including the popular acetal PLC Series, the polypropylene PLC12 Series and the chrome-plated brass LC Series. As with all Colder couplings in this series, the ZLC incorporates an easy-to-use thumb latch, integral shutoff valves and terminations, and an audible "click" to indicate a secure connection.

### FEATURES

Die-cast zinc material

Nickel-plated finish

High temperature capability

Colder thumb latch

Integral terminations

### BENEFITS

Durable, lightweight construction withstands higher pressure and temperature

Attractive appearance and chemical resistance

Versions rated to 400° F (204° C)

One-hand connection and disconnection

Eliminate additional components and assembly; reduce coupling size

## ZLC Series Specifications

### Materials:

**Main components:** Die-cast zinc

**Finish:** Nickel-plated

**Thumb latch:** Stainless steel

**Valves:** Acetal

**Valve springs:** 316 stainless steel

**External springs and pin:** Stainless steel

**O-ring:** Buna-N, others available

**Color:** Bright nickel

**Pressure:** Vacuum to 250 psi, 17.3 bar

### Temperature:

-10° F to 150° F continuous, -23° C to 66° C continuous  
(High temperature versions available)

### Tubing Range:

1/4" to 3/8", 6.4mm to 9.5mm

**WARNING:** Pressure, temperature, chemicals, and operating environment can affect the performance of couplings. It is the customer's responsibility to test the suitability of Colder's products in their own application conditions.



Patent Pending

### Applications:

- Fuel systems
- Engine systems
- Instrumentation
- Cooling lines
- Ink, water, coffee, and beverage lines

# ZLC Series Couplings

## Coupling Bodies

### Die-Cast Zinc



|                                | THREAD SIZE | STRAIGHT THRU | SHUTOFF       | X-BODY*<br>(SHUTOFF VALVE REMOVED) |
|--------------------------------|-------------|---------------|---------------|------------------------------------|
| <b>Pipe Thread<sup>1</sup></b> | 1/4" NPT    | ZLC10004      | ZLCD10004     | ZLCX10004                          |
|                                | 1/4" BSPT   | ZLC10004BSPT  | ZLCD10004BSPT | ZLCX10004BST                       |

|                                          | THREAD SIZE | METRIC EQ. | STRAIGHT THRU | SHUTOFF   | X-BODY*<br>(SHUTOFF VALVE REMOVED) |
|------------------------------------------|-------------|------------|---------------|-----------|------------------------------------|
| <b>In-Line<br/>Hose Barb<sup>2</sup></b> | 1/4" ID     | 6.4mm ID   | ZLC17004      | ZLCD17004 | ZLCX17004                          |
|                                          | 5/16" ID    | 7.9mm ID   | ZLC17005      | ZLCD17005 | ZLCX17005                          |
|                                          | 3/8" ID     | 9.5mm ID   | ZLC17006      | ZLCD17006 | ZLCX17006                          |

|                                              | THREAD SIZE | METRIC EQ. | STRAIGHT THRU | SHUTOFF   | X-BODY*<br>(SHUTOFF VALVE REMOVED) |
|----------------------------------------------|-------------|------------|---------------|-----------|------------------------------------|
| <b>Panel Mount<br/>Hose Barb<sup>2</sup></b> | 1/4" ID     | 6.4mm ID   | ZLC16004      | ZLCD16004 | ZLCX16004                          |
|                                              | 5/16" ID    | 7.9mm ID   | ZLC16005      | ZLCD16005 | ZLCX16005                          |
|                                              | 3/8" ID     | 9.5mm ID   | ZLC16006      | ZLCD16006 | ZLCX16006                          |

## Coupling Inserts

### Die-Cast Zinc



|                                          | THREAD SIZE | METRIC EQ. | SHUTOFF   |
|------------------------------------------|-------------|------------|-----------|
| <b>In-Line<br/>Hose Barb<sup>1</sup></b> | 1/4" ID     | 6.4mm ID   | ZLCD22004 |
|                                          | 5/16" ID    | 7.9mm ID   | ZLCD22005 |
|                                          | 3/8" ID     | 9.5mm ID   | ZLCD22006 |

## Accessories

|                                           |                                             | MATERIAL | PART NO. |
|-------------------------------------------|---------------------------------------------|----------|----------|
| <b>Panel Mount<br/>Gasket<sup>2</sup></b> | For sealing panel mount bodies listed above | Buna-N   | 1830300  |

<sup>1</sup>As with all tapered pipe threads, it is typical to use a thread sealant (tape or paste). <sup>2</sup>Due to the manufacturing process, the hose barbs on ZLC couplings have less "bite" on the tubing than typical Colder hose barbs. To ensure tubing retention, Colder recommends the use of a hose clamp.

ZLC couplings are intended for high volume applications (500 piece minimum). ZLC samples are available for testing. For lower volume applications, please consider Colder's LC, PLC or PLC-12 Series couplings.



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Quick Couplings & Fittings for Plastic Tubing

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## New Generation Non-Spill Quick Disconnect Technology

**Abstract:** *Traditionally, non-spill quick disconnect couplings have served the high pressure, industrial hydraulic market. Existing commercial designs are characterized by minimal air inclusion at connection and low spillage at disconnect. Common coupler package materials include machined brass, zinc-coated steel and stainless steel. Recent design innovations and improvements include advances in valve design, optimized flow area calculations and isolation of the valve actuation springs from the fluid flow path. These developments have led to new low pressure, thermoplastic quick disconnect couplings incorporating flush face non-spill valve technology.*

For the purpose of this white paper and non-spill technology discussions, the following terminology is frequently used. As with any technical subject matter, it is important to understand and use common reference terminology.

**Spillage:** The volume of liquid between the valve faces that is released every time the coupler is disconnected. One drop of water = 5 ml. A traditional valved 3/8" coupler has ~ 1-2 ml spillage per connection cycle; Colder Products Company non-spill technology reduces this volume to .01-.15 ml spillage per connection cycle with the same 3/8" flow area.

**Inclusion:** The volume of air that is put into a system every time the coupler is connected. A traditional valved 3/8" coupler has ~ 2 ml inclusion per connection cycle; Colder Products Company non-spill technology reduces this volume to ~ 0.4 ml spillage per connection cycle with the same 3/8" flow area.

**Leakage:** Media that leaks out of the coupler while connected or disconnected.

**Flow Area:** The areas through which the fluid or gas media travel. Used to specify coupling size to meet requirements of tubing size, pressure drop, flow rate, etc.

### Traditional Non-Spill Couplings

Traditional non-spill quick disconnect couplings are used in high pressure, hydraulic applications. This has been accomplished through designs which utilize brass, zinc-plated steel and stainless steel. While these couplers and associated design technologies serve industrial hydraulic applications, there are other applications and markets that are better served by quick disconnect couplers, utilizing modern materials and new design strategies. In particular, the use of engineering polymers as a construction material extends the boundaries of usefulness to these new applications.



High-pressure non-spill coupling.

### Engineering Polymers

Anyone who has recently looked under the hood of a new car has seen the extensive use of engineering polymers. Weight reduction and improved strength and rigidity, as well as reduced cost, make modern polymers a natural fit for many industrial applications. In quick disconnect coupler design, the use of advanced engineering polymers makes it possible to achieve complex part geometries, meet required chemical compatibilities, and reduce cost when compared to traditional machined components. Additionally, the use of reinforcing additives can further improve the strength, rigidity and operating temperature range of thermoplastics.

### Expanding Fluid Handling Parameters

In fluid handling applications, systems typically operate in the pressure range of vacuum to 120 psi. The use of a non-spill quick disconnect designed for 10,000 psi is overkill. In typical low pressure fluid handling applications, the specifier of non-spill quick disconnects may be limited in the available selection of weight, package size, flow performance, and cost in the process of selecting a traditional industrial non-spill quick disconnect. While non-spill valve technology is not



Patent-pending NS6, shown in standard gray.

new, recent design innovations and cost improvements bring flush face non-spill quick disconnect technology to applications whose budgetary restrictions prevented the use of a non-spill quick disconnect coupling.

### Molded vs. Machined Couplings



Molded non-spill valve (left) and machined conventional valve (right).

A critical design decision is the selection of molded vs. machined components. This is true for several reasons: First, the geometries of the valve and housing components are designed to optimize flow performance through the non-spill coupling. Second, complex geometry requirements can be produced through high-tolerance injection molding for a fraction of the price of machining the same components. Another benefit of the molded components is the integral terminations (i.e., NPT, hose barb, elbows, compression, etc.) that eliminate a potential leak point found in other couplings with secondary adapters. An additional advantage is the superior aesthetics and easy-to-use, ergonomic function offered by the molded shape of the plastic coupling. One example of this is the application of soft-touch overmold material to the exterior of the coupling. The benefits of this include improved impact resistance, a more ergonomic shape, and color keying.



Patent-pending NS4, shown in available colors.

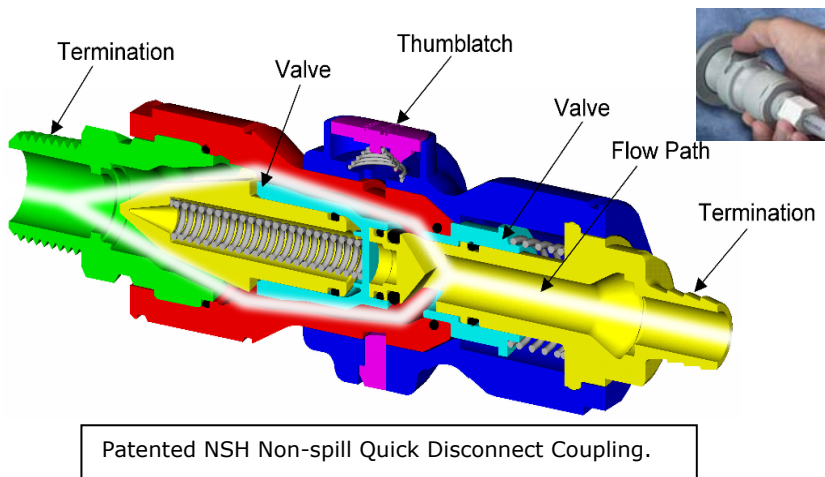
### Design Process and Results

A review of existing non-spill coupler designs indicated little was available in the way of compact, chemically resistant, non-spill couplers for low-pressure fluid handling and transfer. Based on identified industrial market needs, two valve technologies were designed and developed. Differences between the valve technologies developed have to do with the valve design and actuation springs.

The first valve design includes the valve springs in the flow path, which yields a compact package size with exceptional fluid flow characteristics. The second design utilizes valve technology which isolates the springs from the flow path through the use of o-rings. This design results in the metal-free flow path required in specific chemical handling applications where metal can act as a system contaminant.

## Chemical Handling Applications

Recently designed non-spill couplings (models NSH, CQG and CQN) offer a patented non-spill valve design. This design isolates the valve actuation springs from the fluid flow path. The new couplings for chemical handling applications feature one degree of separation between the fluid and any metal. The o-ring seals separate fluid flow from the



valve actuation springs. The benefit of this design feature is a chemically inert, high purity flow path. The result is a flush-face non-spill coupling that is well-suited to high purity and chemical handling applications.

Additionally, the CQN coupling is designed for ultra high purity applications, such as semiconductor manufacturing. With materials of construction including PTFE, perfluoroelastomeric o-rings and PTFE-jacketed springs, the CQN offers the same metal-free flow path with two degrees of separation between the fluid and any metals. The benefit of this second degree of separation between the fluid and any metal is peace of mind that the flow path maintains exceptional purity for the most demanding applications.

## Industrial Applications

The Colder Products Company Industrial Non-Spill Couplings (models NS4, NS6 and NSH) are designed for low pressure fluid transfer applications up to 120 psi. In addition to offering extremely low spillage, the molded valves have balanced flow areas to achieve high flow performance in a compact size. When combined with a familiar and easy-to-use thumb latch, the non-spills offer users many new coupling options. Some of the many applications identified to benefit from the non-spill quick disconnect technology described in this white paper include:

### Chemical Handling and Transfer – *Personal Safety*

The handling of hazardous chemicals is made safer through the use of a non-spill coupling instead of a traditional coupling or fitting. By keeping the often-dangerous and costly media inside the system, personal safety

can be improved and costs reduced. Applications include: semiconductor manufacturing, institutional cleaning solutions, photo processing chemicals, plating solutions, and bulk chemical transfer.

#### Liquid Cooling of Electronics – *System Safety*

The heat density of electronics has risen to the point that traditional forced convection cooling is no longer sufficient. Liquid cooling is becoming the method of choice as cooling technology increases in efficiency and decreases in size. Cooler operating temperatures can also translate into significantly lower failure rates among electrical components. Applications include: Cooling PCs, servers, chillers, lasers, medical equipment, and chip testing equipment.

#### Ink Management – *Convenience & Cleanliness*

Whether ink is water-based, solvent-based or UV curable, spillage is always a problem. Like water-based inks, solvent-based inks leave a mess but can also have noxious fumes. Because UV inks only dry under exposure to UV light, small spills wiped up by rags continue to stay wet long after cleanup. By keeping the ink in the system, the media never gets into contact with users and eliminates the mess at the source. Applications include: Labeling equipment, wide format printing, high speed digital, and many more ink handling and transfer applications.



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## Pipe Thread Types and Designations

**Overview:** Different types of screw threads have evolved for fastening, and hydraulic systems. Of special concern are plastic-to-metal, taper/parallel threaded joints in hydraulic circuits. A discussion and recommendations are provided to create an awareness of different types of threads and how they are used.

Over time many different types of screw threads have been developed. Applications include fastening components, and hydraulic and pneumatic circuits. In the nineteenth century, manufacturers needing fasteners would devise their own systems. This resulted in compatibility problems. The English mechanical engineer and inventor, Sir Joseph Whitworth devised a uniform threading system in 1841 to deal with these difficulties. The Whitworth thread form is based on a 55 degree thread angle with rounded roots and crests.

In America, William Sellers set the standard for nuts, bolts, and screws which became the National Pipe Tapered Thread (NPT) in 1864. His 60 degree thread angle, in common use by early American clockmakers, enabled the American Industrial Revolution. These thread forms later became the American National Standard.

The Whitworth thread form was selected as a connecting thread for pipes, which was made self sealing by cutting at least one of the threads on a taper. This became known as the British Standard Pipe thread (BSP Taper or BSP Parallel thread). The Whitworth thread is now used internationally as a standard thread for jointing low carbon steel pipes.

The best known and most widely used connection where the pipe thread provides both the mechanical joint and the hydraulic seal is the American National Pipe Tapered Thread, or NPT. NPT has a tapered male and female thread which seals with Teflon tape or jointing compound.

Pipe threads used in hydraulic circuits can be divided into two types:

- a) **Jointing threads** – are pipe threads for joints made pressure tight by sealing on the threads and are taper external and parallel or taper internal threads. The sealing effect is improved by using a jointing compound.
- b) **Fastening threads** – are pipe threads where pressure tight joints are not made on the threads. Both threads are parallel and sealing is affected by compression of a soft material onto the external thread, or a flat gasket.



## Sizes

Pipe thread sizes are based on an inside diameter (ID) or flow size. For example, "1/2-14 NPT" identifies a pipe thread with a nominal inside diameter of 1/2 inch and 14 threads to the inch, made according to the NPT standard. If "LH" is added, the pipe has a left hand thread. The most common global pipe thread forms are:

|      |                                                   |
|------|---------------------------------------------------|
| NPT  | American Standard Pipe Taper Thread               |
| NPSC | American Standard Straight Coupling Pipe Thread   |
| NPTR | American Standard Taper Railing Pipe Thread       |
| NPSM | American Standard Straight Mechanical Pipe Thread |
| NPSL | American Standard Straight Locknut Pipe Thread    |
| NPTF | American Standard Pipe Thread Tapered (Dryseal)   |
| BSPP | British Standard Pipe Thread Parallel             |
| BSPT | British Standard Pipe Thread Tapered              |

Plastic injection molded thread forms are manufactured to ANSI B2.1 and SAE J476 standards.

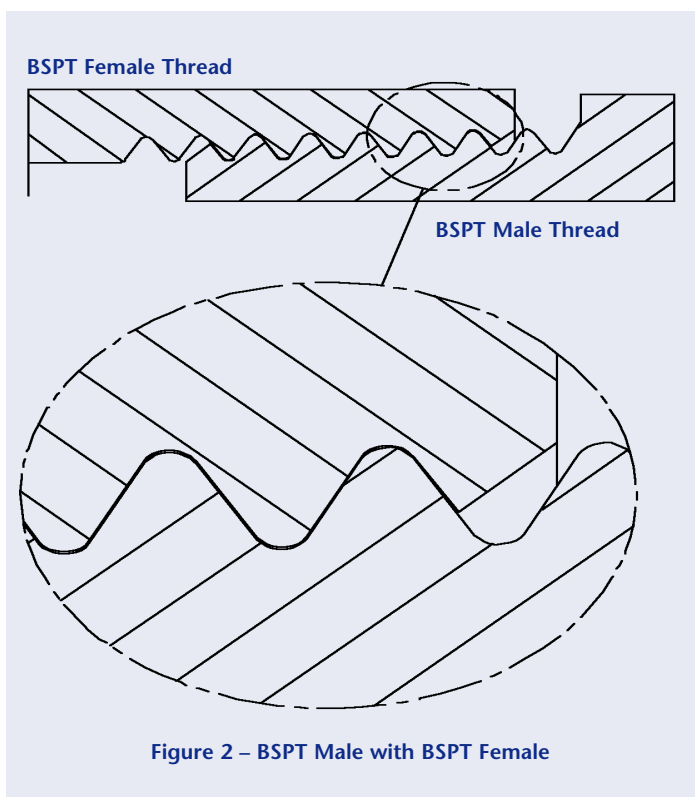
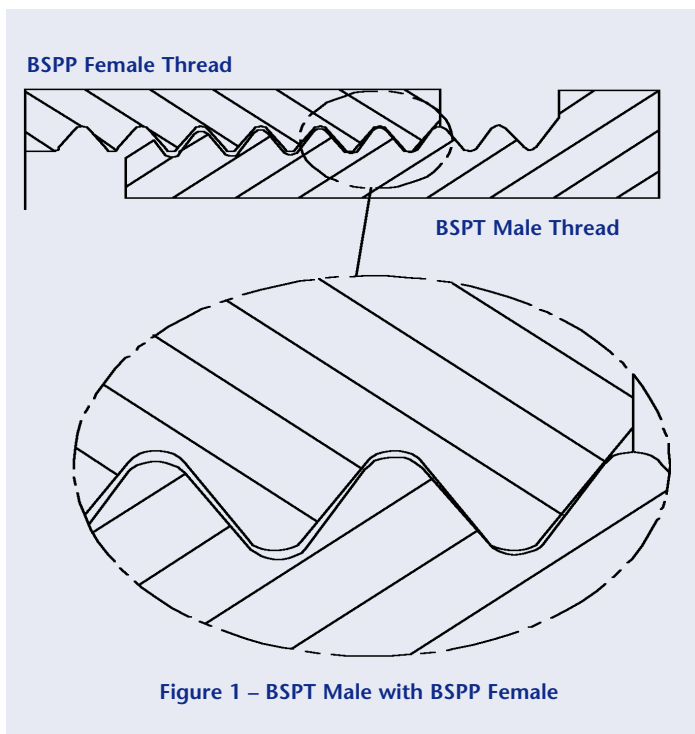
The word "tapered" in several of the above names points to the big difference between many pipe threads and those on bolts and screws. Many pipe threads must make not only a mechanical joint but also a leakproof hydraulic seal. This is accomplished by the tapered thread form of the male matching the thread form of the female tapered thread and the use of pipe sealant to fill any voids between the two threads which could cause a spiral leak. The bottoms of the threads aren't on a cylinder, but a cone; they taper. The taper is 1/16 inch in an inch, which is the same as 3/4 inch in a foot.

Because of the taper, a pipe thread can only screw into a fitting a certain distance before it jams. The standard specifies this distance as the length of hand tight engagement, the distance the pipe thread can be screwed in by hand. It also specifies another distance – the effective thread, this is the length of the thread which makes the seal on a conventional machined pipe thread. For workers, instead of these distances, it is more convenient to know how many turns to make by hand and how many with a wrench. A simple rule of thumb for installing tapered pipe threads, both metal and plastic, is finger tight plus one to two turns with a wrench. Torque installation values can be determined per application, but due to the variations involved in pipe joints such as dissimilar materials of male and female threads, type of sealants used, and internal variations in product wall thickness, a standard torque specification cannot be generically applied.

This table shows the distances and number of turns called for in the standard. A tolerance of plus or minus one turn is allowed, and in practice threads are often routinely cut shorter than the standard specifies. All dimensions are in inches.

### American Standard Taper Pipe External Thread

| Nominal size | Actual OD | Threads per inch | Length of engagement (tightened by hand) | Length of effective thread |
|--------------|-----------|------------------|------------------------------------------|----------------------------|
| 1/8          | 0.407     | 27               | 0.124 ≈ 3.3 turns                        | 0.260                      |
| 1/4          | 0.546     | 18               | 0.172 ≈ 3.1 turns                        | 0.401                      |
| 3/8          | 0.681     | 18               | 0.184 ≈ 3.3 turns                        | 0.408                      |
| 1/2          | 0.850     | 14               | 0.248 ≈ 3.4 turns                        | 0.534                      |
| 3/4          | 1.060     | 14               | 0.267 ≈ 3.7 turns                        | 0.546                      |
| 1            | 1.327     | 11.5             | 0.313 ≈ 3.6 turns                        | 0.682                      |



## Taper/Parallel Threaded Joints

Despite the standards created to maintain uniform fittings, tapered pipe threads are inexact and during the course of use and repair the threads can become damaged and susceptible to leakage. The area where the crest and the root of the thread meet can form a spiral leak path no amount of tightening will eliminate.

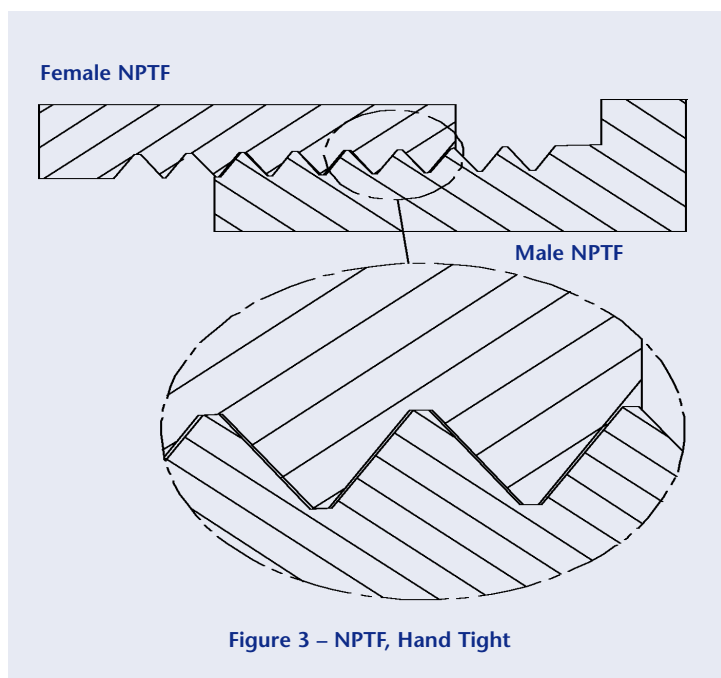
A pressure tight joint is achieved by the compression in the threads resulting from tightening. This compression and sealing occurs in the first few turns of the internal thread. As wrenching takes place, material from both the male and female threads deform into each other. This ensures full thread contact which minimizes spiral leakages. Variations between injection-molded plastic and machined metal thread forms can occur due to different manufacturing processes.

Pipe threads were originally designed as machined thread forms. With the use of thermoplastics and plastic injection molding in the manufacture of plastic pipe thread forms, mold shrinkage and plastic sink make it difficult to insure leak free joints. For this reason, the use of a Teflon based sealant is recommended on all plastic pipe threads. The most common form of sealant is Teflon tape wrapped 2 to 3 turns around the male thread before assembly. Liquid Teflon based sealants are also used successfully to ensure a pressure tight seal. It is always important to use care when applying sealants to avoid introducing the sealant material into the system flow path.

The following sections show examples of how different threads are used and issues that can arise in attempting to create a leak free connection.

When a BSPT tapered male thread is tightened into a straight female thread (BSPP) the seal can only be made at the base of the female port with 1 or 2 threads. See figure 1. Sealing is compromised by the lack of thread form control in BSP specifications. Variation in crests and roots may cause a mismatch in the thread and create a spiral leak. Thread sealant is required to seal this combination.

Using both tapered male and female BSPT threads would offer a better chance of sealing since you are now matching the taper of the male and female thread. See figure 2. This offers more threads a



chance of sealing against spiral leakage. Crest and root control is still missing, but with thread sealant, a pressure tight joint would be easier to accomplish.

A number of variations of the NPT thread have been introduced to overcome the problem of spiral leakage and are known as Dryseal threads (See SAE standard J476). The best known is the NPTF (F for Fuel). With this thread design, there are controls on the crests and roots of both the male and the female threads to ensure the crest crushes or displaces material into the root of the mating thread. The interference fit between the crest of one thread and the root of the other, along with the thread flanks matching, seals against spiral leakage.

Figure 3 shows an NPTF male tightened into an NPTF female hand tight. You can see the crests of both the male and female thread come into contact with the root before the thread flanks meet.

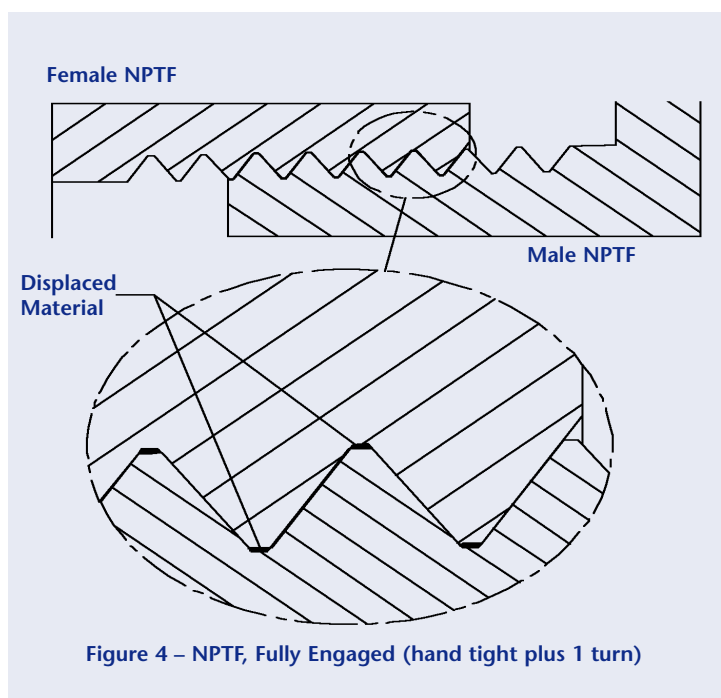
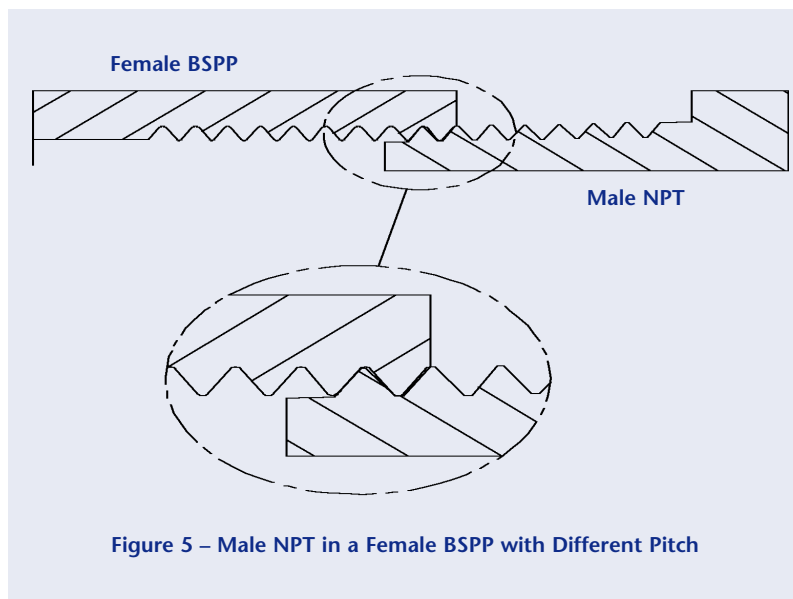


Figure 4 shows the NPTF male and female threads tightened approximately 1 turn past hand tight, and you can see the flanks meet and the crests are displaced into the roots. Although these threads are considered Dryseal, a Teflon tape or liquid is still recommended to aid in the assembly process. The Teflon works as a lubricant to avoid galling of the material when tightening the two threads together and also fills any voids that may cause leakage.

A variation of the Dryseal thread is the NPSF (National Pipe Straight Fuel). It is used for internal threads and a NPTF external thread can be screwed into it to provide a satisfactory mechanical connection and a hydraulic seal. The combination of a parallel and tapered thread is not regarded as ideal but is widely used. High-quality plastic quick disconnect couplings typically use NPT threads.



Another tapered thread is the British Standard Pipe taper, or BSP, covered by British Standard 21. BSP thread is commonly used for low pressure plumbing, but is not recommended for medium and high pressure hydraulic systems. This form uses the Whitworth thread with an angle of  $55^\circ$  and a 1 in 16 taper. It is not interchangeable with the American NPT thread, though at the  $1/2"$  and  $3/4"$  size, they both have 14 threads per inch.

Problems arise when threading a NPT male thread form into a BSP female straight thread form. The  $1/16"$ ,  $1/8"$ ,  $1/4"$ , and  $3/8"$  sizes have a dissimilar pitch, which causes a misalignment of the threads. The flank angles of the threads are also different between NPT and BSP. NPT has a  $60^\circ$  thread where the BSP has a  $55^\circ$  thread.

Figure 5 shows a male NPT tightened into a BSPP. Because of the smaller size of the BSPP and the pitch difference, the NPT tightens with only a few turns.

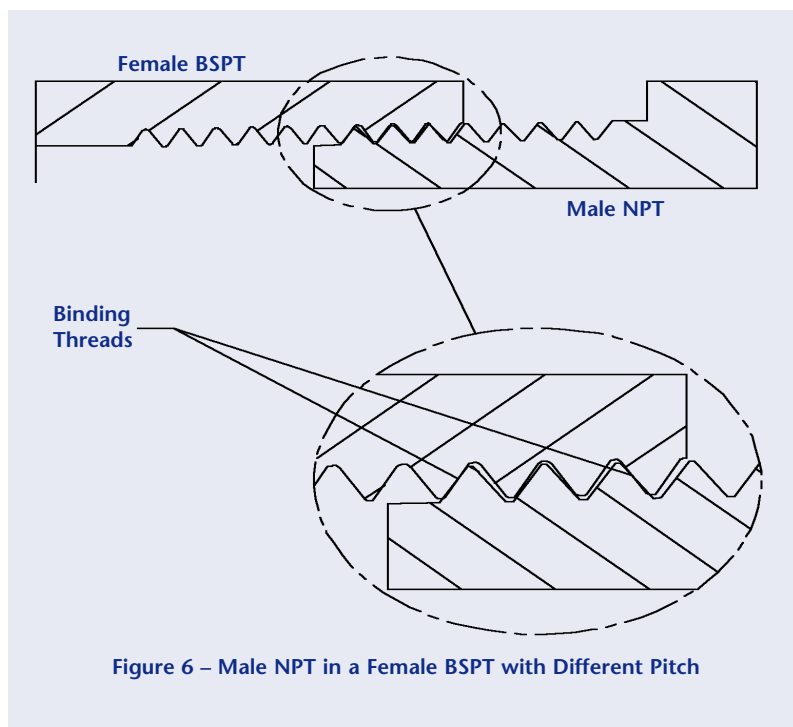
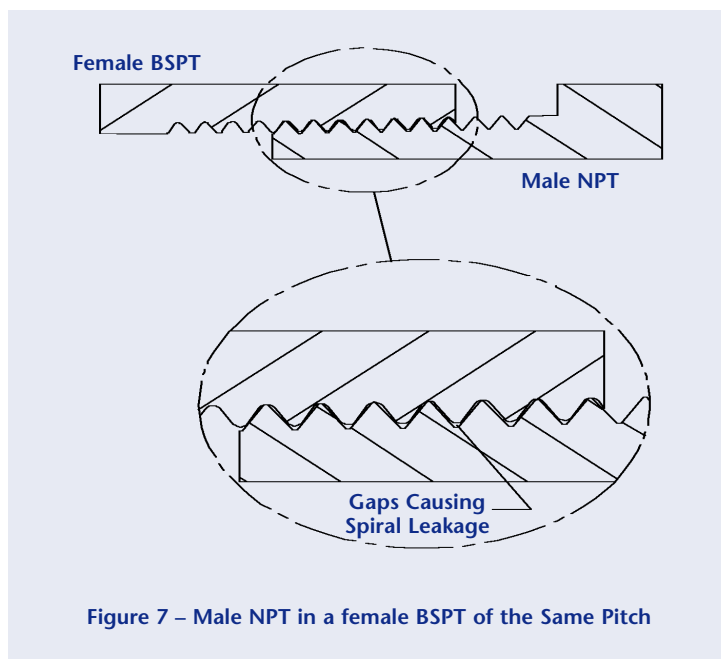


Figure 6 shows an NPT tightened into a BSPT. The BSPT being wider at the opening will allow the NPT thread to engage further, but pitch difference eventually causes a binding of the threads. Pitch and thread angle differences will allow spiral leakage.

The  $1/2"$  and  $3/4"$  sizes in the NPT and BSP are all 14 threads per inch, and the NPT will engage the BSP fairly well.

Although these threads are the same pitch and engage well there are still issues with the thread form. The thread angles and the crest and root tolerances being different will allow spiral leakage as shown in figure 7. These threads might be used effectively together if an appropriate thread sealant is incorporated.

Many issues arise when plastic quick disconnect couplings, with their corresponding injection-molded pipe thread forms are plumbed into metal-piped hydraulic systems. Leaks and plastic thread form failures may occur if care is not taken. When investigating a metal-to-plastic pipe joint failure, two factors, chemical attack and over tightening, need to be considered.



Chemical attack can occur when improper thread sealants are used. Thread sealing is an attempt to block the spiral leak path which occurs when the crests and roots of the thread forms do not match. Anaerobic thread sealants should be avoided when sealing plastic thread forms. These sealants contain chemicals which may attack plastics. Use of a Teflon-based pipe thread sealant is a better choice for plastic threads.

Over tightening of any plastic pipe thread will have adverse affects on the function of the joint. The major difference between plastics and metals is the behavior of polymers. Injection-molded plastic parts continue to deform if they are held under a constant load e.g. creep. Creep is the continued extension or deformation of a plastic part under continuous load. Typically the plastic material in an injection-molded plastic pipe thread form will creep from being over tightened into a female tapered port. The deformation of the part's internal features can lead to part failure.

### Standard Pipe Thread forms Colder Products Company produces

| NPT (National Pipe Taper)<br>Sizes: | BSPT (British Standard Pipe Taper)<br>Sizes: |
|-------------------------------------|----------------------------------------------|
| 1/16 – 27NPT                        |                                              |
| 1/8 – 27NPT                         | 1/8 – 28BSPT                                 |
| 1/4 – 18NPT                         | 1/4 – 19BSPT                                 |
| 3/8 – 18NPT                         | 3/8 – 19BSPT                                 |
| 1/2 – 14NPT                         | 1/2 – 14BSPT                                 |
| 3/4 – 14NPT                         | 3/4 – 14BSPT                                 |
| 1 – 11-1/2 NPT                      |                                              |

Virtually any thread configuration can be incorporated into a CPC coupler on a custom basis. Some examples of custom applications are NPSM (National Pipe Straight Mechanical), BSPP (British Standard Pipe Parallel), SAE flare fittings, and a variety of ISO (Metric) and American Unified screw threads.

With over 20 years experience in the design and manufacture of injection-molded plastic quick disconnect couplings, Colder Products Company knows about the shrink and sink of molded plastic parts and how they can affect the seal ability of pipe threads. Our NPT thread has been engineered to add more control to the plastic thread form to ensure a leak-proof seal.

This paper was researched, organized and written by Mark Schmidt, CPC Product Control Engineering. Mark works at Colder Products Company in St. Paul, MN.