DIY Investigation History

2016
• Initial Market Investigation
• Identify and Review Available DIY Systems
• Field Test 4 Systems

2017
• Quick Connectors Investigation

2018
• Revisit Field Test Systems
  • Performance
  • Refrigerant charge
Outline

• Initial Investigation
  • Products
  • Field Test
  • Recommendations

• Quick Connector Due Diligence
  • Cascade Engineering Lab
  • Field Test Revisit (1-year later)

• Summary & Question
Initial Investigation
Contractor Assisted Install (CAI)

Everything You Need For A Successful Installation

When you receive our Do-It-Yourself Ductless Heat Pump Package, it includes everything you need to perform a streamlined installation.

- Top-Shelf Equipment
- Professional Installation Matei

DIY WITH ASSISTANCE

TheHeatPumpStore.com
Do-It-Yourself (DIY)

MRCOOL DIY Ductless 24000 BTU Air Conditioner and Heat Pump with Quick Connect

Item #: DIY-24-HP-230A
Email to a Friend

Be the first to review this product

Your Price: $1,646.00
Availability: In Stock
Shipping: In stock items ship within 24 hours

View Full Product Details
### 2017 Available Systems ---- HUGE TABLE

<table>
<thead>
<tr>
<th>Model</th>
<th>Capacity</th>
<th>Rating</th>
<th>Features</th>
<th>Price</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>EA118M1C</td>
<td>12,000 BTU</td>
<td>11.1 SEER</td>
<td>Auto Fan, Programmable Thermostat, Remote Control</td>
<td>$1,275.00</td>
<td>Available at Amazon</td>
</tr>
<tr>
<td>KSID012</td>
<td>14,870 BTU</td>
<td>18.4 SEER</td>
<td>Inverter Driven, Twin Rotary</td>
<td>$2,298.95</td>
<td>Available at Newegg</td>
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<tr>
<td>KSID022</td>
<td>15,900 BTU</td>
<td>20.0 SEER</td>
<td>Inverter Driven, Twin Rotary</td>
<td>$2,699.00</td>
<td>Available at Amazon</td>
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<tr>
<td>WMAH</td>
<td>18,000 BTU</td>
<td>19.5 SEER</td>
<td>Inverter Driven, Twin Rotary</td>
<td>$2,899.00</td>
<td>Available at Amazon</td>
</tr>
</tbody>
</table>

#### Additional Information
- **Brands:** Unionaire, AmericAire, Evolution, and others.
- **Price range:** $1,099 to $3,151.
- **Energy Efficiency:** SEER ratings vary from 11.1 to 20.0.
- **Installation:** DIY available, with installation guides provided.

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**Note:** More details and specifications can be found on the manufacturer websites linked in the table.
## 2017 Available DIY Systems - RANKING

<table>
<thead>
<tr>
<th>Brand</th>
<th>Currently Available</th>
<th>Vacuum Pump Not required</th>
<th>Warranty Includes DIY Installs</th>
<th>Warranty Score</th>
<th>Homeowner Support Score</th>
<th>Total Score</th>
<th>Overall Rank</th>
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<tbody>
<tr>
<td>Caribou</td>
<td>Discontinued</td>
<td></td>
<td></td>
<td></td>
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<td>Friedrich</td>
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<tr>
<td>Klimare</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Ramsund</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Mirage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utopian</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>American Aire</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aura Systems</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Ideal Air</td>
<td></td>
<td></td>
<td></td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Mr Cool</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>4</td>
<td>9</td>
<td>1</td>
</tr>
</tbody>
</table>
Identify Products

- Ideal Air
- Mr. Cool
- Aura Systems
- Mirage
- Utopian
- Klimaire
- Friedrich
- AmericAire
- Caribou
- Ramsond
Identify Products

- Ideal Air
- Mr. Cool
- Aura Systems
- Mirage
- Utopian
- Klimaire
- Friedrich
- AmericAire
- Caribou
- Ramsond
Field Test Four Systems
Field Test Four Systems
Installation Process

- Shopped for best retail price
- Highly qualified team
- Documented process
- Drafted user recommendations
- Performed follow up QA visits at 15, 45 and 75 days
Install Costs

<table>
<thead>
<tr>
<th></th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
<th>Site 4</th>
<th>Regional Average</th>
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</thead>
<tbody>
<tr>
<td>Unit</td>
<td>220v</td>
<td>110v</td>
<td>220v</td>
<td>220v</td>
<td>1:1</td>
</tr>
<tr>
<td>Ideal Air</td>
<td>Ideal Air</td>
<td>Ideal Air</td>
<td>Mr. Cool</td>
<td>Mr. Cool</td>
<td></td>
</tr>
<tr>
<td>Unit Capacity</td>
<td>24K BTU</td>
<td>12K BTU</td>
<td>18K BTU</td>
<td>18K BTU</td>
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<tr>
<td>Unit Cost</td>
<td>$2,400</td>
<td>$1,450</td>
<td>$1,457</td>
<td>$1,457</td>
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<tr>
<td>Mechanical Permit</td>
<td>$106</td>
<td>$106</td>
<td>$120</td>
<td>$106</td>
<td></td>
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<tr>
<td>Additional Components</td>
<td>$278</td>
<td>$278</td>
<td>$278</td>
<td>$278</td>
<td></td>
</tr>
<tr>
<td>Electrician (including electrical permit)</td>
<td>$783</td>
<td>$793</td>
<td>$748</td>
<td>$688</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>$3,566</td>
<td>$2,626</td>
<td>$2,602</td>
<td>$2,529</td>
<td>$4,462</td>
</tr>
</tbody>
</table>
Field Test Findings

• Wall template was really helpful
• Some “out of box” components incomplete
• Indoor unit is pre-wired eliminating need for separate electrical connection
• Instruction manuals confusing
• Fixed line-set length created obstacles
• BUT - line sets were kink resistant
• Connection lines and fittings differed across systems
• Better control features needed (all)
• Fan noise continuous (Ideal Air)
• Constant air blowing even when not heating (Ideal Air)
Field Test Site Revisits

- All still working satisfactorily
- Some minor issues
  - One is noisy
  - One does a poor job of mixing air
  - One is rarely used for heating
  - One has possible factory connection leak

<table>
<thead>
<tr>
<th>Site #</th>
<th>Equipment</th>
<th>Location</th>
<th>60-Day Revisit</th>
<th>1-Year Revisit</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Coil ΔT °F</td>
<td>OAT °F</td>
</tr>
<tr>
<td>#1</td>
<td>Idealaire 24Kbtu 220V</td>
<td>Family room</td>
<td>21</td>
<td>38</td>
</tr>
<tr>
<td>#2</td>
<td>Idealaire 12Kbtu 110V</td>
<td>ADU</td>
<td>43</td>
<td>58</td>
</tr>
<tr>
<td>#3</td>
<td>Mr Cool 18Kbtu 220V</td>
<td>Entryway</td>
<td>58</td>
<td>48</td>
</tr>
<tr>
<td>#4</td>
<td>Mr Cool 18Kbtu 220V</td>
<td>Baby’s room</td>
<td>50</td>
<td>45</td>
</tr>
</tbody>
</table>
Recommendations

Manufacturer Improvements Needed

- Include indoor head template
- Increase line set length flexibility
- Improve fan control
- Clarify instructions

Program Issues

- Conduct Due Diligence on Quick Connectors
- Utility QPL or Buyer Beware
Quick Connector Due Diligence
Quick Connectors
Quick Connect Questions

• What kinds of connectors exist?
• Can they be installed by untrained?
• Do they leak? / Are they reliable?
• What standards and testing have been done?
• Should utilities support/allow DIY quick connectors
Due Diligence - Fittings
Due Diligence

- 4 types of connectors being examined
  - Standard flare fittings
  - Vulkan Lokring
  - Ebrilsmart
  - Smartlock
  - ??? All in one connector ???
- Test standards, test results, product samples
- Literature review
- Cascade Engineering Services review
Example Refrigerant Tubing Connectors

Field fabricated 45-degree flare

Mfr supplied

Ebrilsmart

Smartlock

All-in-one connector

Lokring
Operating Conditions

Operating condition ranges for a DHP connector
- Pressure range: 0.01 psig to 450 psig
- Ambient Temperature: -20 C to +40 C
  - 1 cycle per day
- Working Temp (lines get hotter and colder) -42 C to + 80 C
  - 10-50 cycles per day
- Vibration: inverter driven scroll or rotary
- Compressor RPM: 30 to 120 RPM
- Other?
- Interior fluid 410a refrigerant + poly Ester oil (POE - which is highly hygroscopic)
DIY Quick Connectors

- Extensive literature search found limited public domain reliability information
- Equipment manufacturers of DIY systems did not provide connector data – they may not have an established evaluation criteria for quick connectors
- Observed systems relied on metal to plastic connections which may have additional failure modes or complexity
- User operation impacts may add additional evaluation criteria

Non-DIY “Quick” Connectors

(some require tools and are not any quicker)

- Test data from a few non-precharged line connector types was found
- These data covered the primary failure modes that should be examined
### Applicable Test Standards Identified

Several IEC 60068 standards can be used to evaluate quick connectors.

<table>
<thead>
<tr>
<th>Environmental</th>
<th>IEC Test Spec</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature, Operational</td>
<td>-40°C for 500 Hours 100°C for 500 Hours</td>
<td>IEC60068-2-1 (Low)  IEC60068-2-2 (High)  IEC60068-2-14 (Cycle)</td>
</tr>
<tr>
<td>Temperature, Cycling</td>
<td>Thermal Cycling -40°C to 85°C, 15 minute dwells, 5000 cycles</td>
<td>IEC60068-2-14</td>
</tr>
<tr>
<td>Accelerated Frost/Defrost Cycling</td>
<td>50°F/-40°F in humid environment for 5000 Cycles</td>
<td></td>
</tr>
<tr>
<td>Salt Environment</td>
<td>5% Salt Solution, pH 6.5-7.2, 35°C, 2000 Hours</td>
<td>IEC60068-2-11</td>
</tr>
<tr>
<td>Shock, survival</td>
<td>Half Sine 10g, 11ms, 3 shocks, 6 directions (Table 1)</td>
<td>IEC60068-2-27</td>
</tr>
<tr>
<td>Vibration, survival</td>
<td>Sine Sweep: 10-500 Hz, 2g, 1 Octave/min for 5 sweeps Random Vibe: Table A2, Category 1 for 1 hour each in all three axes</td>
<td>IEC60068-2-59  IEC60068-2-64</td>
</tr>
<tr>
<td>Torque Test</td>
<td>Test to failure to determine product limits</td>
<td>Inna</td>
</tr>
<tr>
<td>Leak and Pressure Test with and without refrigerant</td>
<td>Upto 450 psig without any leaks or bursting. Test to failure to determine margins; Typical leak tests use Nitrogen, Helium or refrigerant</td>
<td>Inna</td>
</tr>
</tbody>
</table>
1. Identify Product Usage and Specification Metrics
   - Loads: Temperature, Pressure, Leak, Vibration Salt Fog, Torque
   - Define Tests
     - Pressure Burst
     - Thermal Cycling
     - Corrosion of Metal Surfaces
     - Torque Tests
     - Vibration

2. Reliability Test Investigation
   - Explore range of product types
   - Random sample products
   - Sample size would be needed large
     (30 for 90% reliability w/95% confidence)

3. Develop Test Specification
EPA 608 certification is now required
Does this Apply to DIY systems?

- R-410a is a regulated refrigerant
- Applies to anybody installing, servicing, repairing or maintaining a DHP
- Includes record keeping requirements
- Process
  - Take a 1-2 day class
  - Take a test (once, unless rules change)
  - Keep records in case you are audited
DIY DHP Summary

Market
- Small potential market ~ not likely more than 5-10%
- Mostly sold for supplemental cooling
- Only a few (2) offer warrantees if not professionally installed

Installation
- Not difficult, but unrefined manuals and variable support
- Decent performance
- New federal certification requirements may make DIY impossible

Hardware
- Small companies that rebrand or distribute generic systems
- Not state of the art controls – some idiosyncrasies

Quick Connectors
- No clear standard or assurances by equipment suppliers
Questions

If we had a DIY qualified products list . . .

1. Would utilities offer incentives for these products?
2. Would manufacturers conduct required testing?
3. Would retailers sell them?
4. Would this be sufficient to influence the market?
5. Would contractors be okay with DIY? (i.e. not complain to EPA)

Is there any additional investigation needed?
Supplemental Slides
Photos
Smart Lock

Reliability Test Report
for New Ferrule SmartLock Fitting

Puukyong National University
Department of Refrigeration and Air-Conditioning Engineering
Alternative Energy Laboratory

TECHNOLOGY

METAL TO METAL SEALING

POWERCUL APPLICATION

High Temperature
-40°C to 150°C (-40°F ~ 302°F)
Working Pressure
110 bar (1,595 psi)
Refrigerant
R-717 (Ammonia)
R-410A (R-32 50%, R-125 50%)
R-22 (Chlorodifluoromethane)
R-134a (1,1,1,2-Tetrafluoroethane)
R-744 (Carbon dioxide)

TUBE MATERIAL COMPATIBILITY

Applicable for Copper & Aluminum tubing. Other materials tube available

- AL + CU
- AL + AL
- CU + CU
# Leak & Pressure Test

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Acceptance criteria</th>
<th>Number of samples</th>
<th>Period</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nitrogen gas 60.0 kgf/cm² leakage test</td>
<td>No Leakage</td>
<td>Each size 500 set</td>
<td>2017-06-05 ~ 2017-07-15</td>
<td>Pass</td>
</tr>
<tr>
<td>Leak test</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water 200.0 kgf/cm² pressing pressure</td>
<td>No Leakage, No deformation</td>
<td>Each size 500 set</td>
<td>2017-06-13 ~ 2017-07-15</td>
<td>Pass</td>
</tr>
<tr>
<td>Pressure</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Add pressure when pipe burst out</td>
<td>Over 200kgf/cm² Not be eliminated</td>
<td>Each size 500 set</td>
<td>2017-06-13 ~ 2017-07-15</td>
<td>Pass</td>
</tr>
<tr>
<td>Burst</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Leak test at 60.0 kgf/cm²**

**Pressure test at 200.0 kgf/cm²**

**Burst test**

1/4" 360bar (5221psi)

3/8" 270bar (3916psi)

1/2" 250bar (3625psi)

5/8" 240bar (3480psi)
# Smartlock

## Corrosion

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Acceptance criteria</th>
<th>Number of samples</th>
<th>Period</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salt water Spray</td>
<td>Solution (NaCl 5%, pH 6.5 ~ 7.2) / 960 hr Continuous spray @ 35 °C</td>
<td>No leakage when pressurized 60 kgf/cm²</td>
<td>Each size 10 set</td>
<td>2017-06-05 ~ 2017-07-15</td>
</tr>
<tr>
<td>SWAAT</td>
<td>Solution (NaCl 5% pH 2.8 ~ 3.0 with acetic acid) 960hr continuous spray @ 49 °C</td>
<td>No leakage when pressurized 60 kgf/cm²</td>
<td>Each size 10 set</td>
<td>2017-06-13 ~ 2017-07-15</td>
</tr>
</tbody>
</table>

### SST Test Results

- Salt water Spray
- SWAAT
## Temperature

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Acceptance criteria</th>
<th>Number of samples</th>
<th>Period</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>No leakage when pressurized 60 kgf/cm²</td>
<td>Each size 10 set</td>
<td>2017-06-05 ~ 2017-07-15</td>
<td>Pass</td>
</tr>
<tr>
<td>Cooling</td>
<td>No leakage when pressurized 60 kgf/cm²</td>
<td>Each size 10 set</td>
<td>2017-06-13 ~ 2017-07-15</td>
<td>Pass</td>
</tr>
<tr>
<td>Temperature Cycle</td>
<td>No leakage when pressurized 60 kgf/cm²</td>
<td>Each size 10 set</td>
<td>2017-06-19 ~ 2017-07-15</td>
<td>Pass</td>
</tr>
</tbody>
</table>
# Destruction Torque

<table>
<thead>
<tr>
<th>Test Condition</th>
<th>Acceptance criteria</th>
<th>Number of samples</th>
<th>Period</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Destruction torque</td>
<td>Tightening until the destruction of the union or connector</td>
<td>No deformation at thread at 2.5 times of normal torque.</td>
<td>Each size 100 set</td>
<td>2017-06-05 - 2017-07-07</td>
</tr>
</tbody>
</table>

## Rated Torque

<table>
<thead>
<tr>
<th>Outside diameter</th>
<th>Torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>mm</td>
<td>kgf.cm</td>
</tr>
<tr>
<td>Ø6.35</td>
<td>200-300</td>
</tr>
<tr>
<td>Ø9.52</td>
<td>300-400</td>
</tr>
<tr>
<td>Ø12.7</td>
<td>400-500</td>
</tr>
<tr>
<td>Ø15.88</td>
<td>450-550</td>
</tr>
<tr>
<td>Ø19.05</td>
<td>600-600</td>
</tr>
</tbody>
</table>

No deformation at thread at 2.5 times of normal torque. (5/8 inch & 3/4 inch)
Ebrilsmart
**Ebrilsmart**

- **EBRILSMART technical characteristics:**
  - Working temperature: -45°C to 150°C
  - Maximum operating pressure: 45 bar
  - Suitable for all refrigerants HCFC, HFC, HC
  - Triple metallic seal
  - Compatible with traditional 45° flare fittings
  - It is not required the use of a torque wrench for the installation
  - To be used exclusively on R220 annealed copper tubes and OH111 aluminium tubes

- **EBRILSMART certification:**
  - Conformity with European Directives (PED, RoHS and REACH)
  - Superior performance than the traditional 45° flare fittings
Installation

Insert the tube, previously cut and deburred, into the nut and the insert the sleeve. Bevel of sleeve toward nut. Lubricate the inner surface of the nut. Apply pressure to hold tube against male flare body while hand tightening. Mark pipe-nut location then follow wrench tightening directions. If necessary maintain pressure on tube until nut tightening prevents tube drift. Mark the starting point and make a complete turn and a half with the aid of a common wrench. In the event that the nut needs to be unscrewed for inspection the following installation requires that half a turn is made via a common wrench (after manual screwing is done).
Products

EURO flare-fittings

Description

- Pre-pressed copper seal for safe assembly without the seal slipping.
- Connecting piece: stainless steel
- Flare nut: brass
- Can be used with all LOKRING type 50 brass connectors.

IMPORTANT:
Stabilisation inserts must not be used within the stainless steel tube of a EURO flare fitting.

| Article number | Article name              | For tube outer φ [ mm | " ] | Thread   | Wrench size | Tig Torc [ Nm] |
|----------------|--------------------------|-------------------------|----------|------------|---------------|
| L13004846      | LOKRING LR-EURO-08,35-EB | 8.35 | 1/4     | 1/4" SAE  | 17            | 14 -          |
| L13004344      | LOKRING LR-EURO-09,53-EB | 9.53 | 3/8     | 3/8" SAE  | 22            | 33 -          |
| L13004847      | LOKRING LR-EURO-12,7-EB  | 12.7 | 1/2     | 1/2" SAE  | 24            | 50 -          |
| L13004347      | LOKRING LR-EURO-16-EB    | 16   | 5/8     | 5/8" SAE  | 27            | 63 -          |
| L13004368      | LOKRING LR-EURO-19-EB    | 19   | 3/4     | 3/4" SAE  | 36            | 90 -          |
Field Flared Copper Pipe
Pre-Manufactured Flare Fittings
Perdue University Testing – Water Pipes

Existing Press Fittings for Water

- Bell & Spigot Fitting Design
- Adjoining Tube
- EPDM O-ring for Water
- Jaw for Crimping
  - Fitting Compressed for Pressure Resistance
- O-ring Compressed to Seal Fluid

July 17, 2014

Paper 2564: Design of Accelerated Fatigue Tests for Flame Free Refrigeration Fittings
Chapter 3 Working with Copper Tubing

Other than making sure tubing ends are cut square and burrs are removed, no special preparation is needed when using compression fittings. Simply slip the nut and compression ring over the tubing, then insert the tubing into the fitting until it meets against a shoulder. Slide the compression ring into position and tighten the nut. If too much pressure is applied, the compression ring will collapse and prevent proper seating of the nut.

Compression fittings are used to connect tubing to fittings, valves, and other components in a refrigeration system. They are easy to install and provide a secure connection. The fitting is inserted into the end of the tubing, and the nut is tightened until the shoulder on the fitting makes contact with the tubing. This ensures a tight seal and prevents leaks.

Flared connections are commonly used in refrigeration systems to ensure a secure seal. The tubing is flared at an angle of 45 degrees, and the fitting is designed to fit over the flared end. This provides a watertight connection that resists vibrations and pressures.

Compression fittings are used in a variety of applications, including HVAC systems, industrial refrigeration, and automotive air conditioning. They are durable, reliable, and easy to install, making them a popular choice for professional technicians and homeowners who work on refrigeration systems.
Parker Hannifin Corp – Major Supplier

45° Flare Fittings

Parker’s Flare Fittings is an economical choice for a metal-to-metal seal that resists mechanical pullout. Meets functional requirements of SAE J512 and SAE J513.

Product Features:
- All brass construction
- Resists vibration with use of lock nut
- UL, listing
- Functional requirements of SAE J512 and J513

Markets:
- Refrigeration
- Heavy Duty Truck
- Medium Duty Truck
- Industrial
- Heating
- Air Conditioning

Applications:
- Refrigerant Lines
- Propane
- Fluids
- Natural Gas

Specifications:

<table>
<thead>
<tr>
<th>Pressure Range</th>
<th>Temperature Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/16 1900 psi</td>
<td>-40°F to +180°F</td>
</tr>
<tr>
<td>1/4 1400 psi</td>
<td></td>
</tr>
<tr>
<td>5/16 1200 psi</td>
<td></td>
</tr>
</tbody>
</table>

Compatible Tubing:
- Copper
- Brass
- Aluminum
- Stainless Steel Hydraulic Tubing

Access Valves

Parker’s Access Valves are designed to offer convenient, low cost access ports for refrigeration service. Access valves may be installed in any position on either high or low side for quick testing, pressure checking, purging or charging.

Product Features:
- All brass construction
- 1/4" SAE male flare access ports
- Finger tight quick seal caps
- Access valves with pipe connections have internal OEG seal cap

Markets:
- Refrigeration
- Air Conditioning

Applications:
- Pressure Testing
- Purging
- Charging Refrigeration Lines

Specifications:

<table>
<thead>
<tr>
<th>Pressure Range</th>
<th>Temperature Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 500 psi</td>
<td>-30°C to +226°F</td>
</tr>
</tbody>
</table>

Compatible Tubing:
- Copper