

# Refrigerant Charge Calculation

## Technical Bulletin

Products: Solstice® N40 (R-448A), Solstice N13 (R-450A),

Genetron Performax® LT (R-407F)

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Application: Refrigeration



## Background

When designing refrigeration systems for supermarkets or other large commercial projects it is helpful to include the expected refrigerant charge in the construction documents. This allows for accurate competitive bidding and assurance of ample refrigerant during startup.

## Problem

Calculating refrigerant charge by experience or rule-of-thumb can be inaccurate.

## Resolution

A series of charts have been developed to assist in calculating system charge.

The total charge will be the sum of the refrigerant in the piping to the fixtures (circuits), the receiver charge, the condenser charge and the evaporator charges. Table 5 can be used to combine all charges for a total charge.

**Solstice N40 (R-448A) charges per 100ft of piping**  
**Charge Calculation Table 1**

| Line<br>Size OD<br>(inches) | Weight per 100ft of piping (lbs) |                                  |                                              |       |       |       |
|-----------------------------|----------------------------------|----------------------------------|----------------------------------------------|-------|-------|-------|
|                             | Liquid<br>Line                   | Discharge/<br>Hot Gas<br>Defrost | Suction Line @ Select Evaporator Temperature |       |       |       |
|                             |                                  |                                  | -25°F                                        | -15°F | +15°F | +25°F |
| 3/8                         | 3.5                              | 0.20                             | 0.02                                         | 0.03  | 0.06  | 0.07  |
| 1/2                         | 6.6                              | 0.37                             | 0.05                                         | 0.06  | 0.11  | 0.13  |
| 5/8                         | 10.6                             | 0.59                             | 0.07                                         | 0.09  | 0.17  | 0.21  |
| 3/4                         | 15.9                             | 0.88                             | 0.11                                         | 0.14  | 0.25  | 0.31  |
| 7/8                         | 22.0                             | 1.2                              | 0.15                                         | 0.19  | 0.35  | 0.43  |
| 1-1/8                       | 37.6                             | 2.1                              | 0.26                                         | 0.33  | 0.60  | 0.73  |
| 1-3/8                       | 57.2                             | 3.2                              | 0.40                                         | 0.50  | 0.92  | 1.1   |
| 1-5/8                       | 81.0                             | 4.5                              | 0.57                                         | 0.70  | 1.3   | 1.6   |
| 2-1/8                       | 140.9                            | 7.8                              | 0.99                                         | 1.2   | 2.3   | 2.7   |
| 2-5/8                       | 217.3                            | 12.1                             | 1.5                                          | 1.9   | 3.5   | 4.2   |
| 3-1/8                       | 310.2                            | 17.2                             | 2.2                                          | 2.7   | 5.0   | 6.0   |
| 3-5/8                       | 419.6                            | 23.3                             | 2.9                                          | 3.6   | 6.7   | 8.1   |
| 4-1/8                       | 543.2                            | 30.2                             | 3.8                                          | 4.7   | 8.7   | 10.5  |

*Conditions: 105°F condensing, 5°F sub cooling, 0°F evaporator for discharge calculations*

## Condenser Refrigerant Charge

Condensers have varying charges based on manufacturer, model, and the condenser. Manufacturers' data sheets will supply charge values based on the condenser selected.

*Note:*

A condenser can also have up to a four times greater charge if holdback valves are used for winter head pressure control.

## Evaporator Charges

Evaporators will have varying charges based on fixture type, manufacturer, and model. Manufacturers' data sheets will supply charge values based on the equipment selected.

### Solstice N13 (R-450A) charges per 100ft of piping

Charge Calculation Table 2

| Line Size OD<br>(inches) | Weight per 100ft of piping (lbs) |           |                                              |       |
|--------------------------|----------------------------------|-----------|----------------------------------------------|-------|
|                          | Liquid Line                      | Discharge | Suction Line @ Select Evaporator Temperature |       |
|                          |                                  |           | +15°F                                        | +25°F |
| 3/8                      | 3.8                              | 0.14      | 0.03                                         | 0.04  |
| 1/2                      | 7.1                              | 0.26      | 0.06                                         | 0.07  |
| 5/8                      | 11.4                             | 0.41      | 0.09                                         | 0.11  |
| 3/4                      | 17.1                             | 0.62      | 0.14                                         | 0.17  |
| 7/8                      | 23.8                             | 0.86      | 0.19                                         | 0.23  |
| 1-1/8                    | 40.5                             | 1.5       | 0.32                                         | 0.40  |
| 1- 3/8                   | 61.7                             | 2.2       | 0.49                                         | 0.60  |
| 1- 5/8                   | 87.3                             | 3.2       | 0.69                                         | 0.85  |
| 2-1/8                    | 151.9                            | 5.5       | 1.2                                          | 1.5   |
| 2-5/8                    | 234.2                            | 8.5       | 1.9                                          | 2.3   |
| 3-1/8                    | 334.3                            | 12.1      | 2.6                                          | 3.3   |
| 3-5/8                    | 452.2                            | 16.3      | 3.6                                          | 4.4   |
| 4-1/8                    | 585.4                            | 21.1      | 4.6                                          | 5.7   |

### Genetron LT (R-407F) charges per 100ft of piping

Charge Calculation Table 3

| Line Size OD<br>(inches) | Weight per 100ft of piping (lbs) |                                  |                                              |       |       |       |
|--------------------------|----------------------------------|----------------------------------|----------------------------------------------|-------|-------|-------|
|                          | Liquid Line                      | Discharge/<br>Hot Gas<br>Defrost | Suction Line @ Select Evaporator Temperature |       |       |       |
|                          |                                  |                                  | -25°F                                        | -15°F | +15°F | +25°F |
| 3/8                      | 3.6                              | 0.19                             | 0.02                                         | 0.03  | 0.05  | 0.07  |
| 1/2                      | 6.7                              | 0.35                             | 0.04                                         | 0.05  | 0.10  | 0.12  |
| 5/8                      | 10.8                             | 0.56                             | 0.07                                         | 0.09  | 0.16  | 0.20  |
| 3/4                      | 16.1                             | 0.83                             | 0.10                                         | 0.13  | 0.24  | 0.30  |
| 7/8                      | 22.4                             | 1.15                             | 0.14                                         | 0.18  | 0.34  | 0.41  |
| 1-1/8                    | 38.2                             | 1.97                             | 0.25                                         | 0.31  | 0.58  | 0.70  |
| 1- 3/8                   | 58.2                             | 2.99                             | 0.38                                         | 0.47  | 0.88  | 1.1   |
| 1- 5/8                   | 82.4                             | 4.24                             | 0.53                                         | 0.67  | 1.2   | 1.5   |
| 2-1/8                    | 143.3                            | 7.37                             | 0.92                                         | 1.2   | 2.2   | 2.6   |
| 2-5/8                    | 221.0                            | 11.37                            | 1.4                                          | 1.8   | 3.3   | 4.0   |
| 3-1/8                    | 315.5                            | 16.23                            | 2.0                                          | 2.6   | 4.8   | 5.8   |
| 3-5/8                    | 426.8                            | 21.95                            | 2.8                                          | 3.5   | 6.5   | 7.8   |
| 4-1/8                    | 552.5                            | 28.41                            | 3.6                                          | 4.5   | 8.4   | 10.1  |

Conditions: 105°F condensing, 5°F sub cooling, 0°F evaporator for discharge calculations

**Receiver Charge:**

If the receiver dimensions or volume is known, the charge can be calculated from Table 4.

For example:

An 18-inch diameter, 6 ft long receiver would have a volume of length (ft) x area (ft<sup>2</sup>).

Volume =  
(6ft) x (3.14 x 1.5ft<sup>2</sup> ÷ 4) = 10.6 ft<sup>3</sup>  
(end bell volume is considered negligible)  
With a common fill percentage of 30%,  
the total charge for R-448A will be:  
65.6 x 10.6 x 0.3 = 208 lb.

**Table 4**  
**Receiver Charge**

| Refrigerant                    | Refrigerant Density (lb/ft <sup>3</sup> ) | Receiver Volume* (ft <sup>3</sup> ) | Fill %** (in decimal i.e., 0.3) | Refrigerant Charge (lb) |
|--------------------------------|-------------------------------------------|-------------------------------------|---------------------------------|-------------------------|
| Solstice N40 (R-448A)          | (65.6                                     | x _____                             | x _____)                        | = _____                 |
| Genetron Performax LT (R-407F) | (66.7                                     | x _____                             | x _____)                        | = _____                 |
| Solstice N13 (R-450A)          | (70.5                                     | x _____                             | x _____)                        | = _____                 |

\* Receivers are rarely filled to full level. 30% full is a common level.  
\*\*Receivers are typically sized at 80% of expected refrigerant charge.

**Total Charge:**

Use the table below to combine the charges to determine the total charge.

| Item                          | Refrigerant Charges (lbs)               |             |             |                   |   | Sum |
|-------------------------------|-----------------------------------------|-------------|-------------|-------------------|---|-----|
|                               | Liquid                                  | Suction     | Discharge   | Hot Gas           |   |     |
| Calculation ->                | Value from chart x length in feet ÷ 100 |             |             |                   |   |     |
| Circuit 1                     | _____ lbs                               | + _____ lbs | + _____ lbs | + _____ lbs       | = |     |
| Circuit 2                     | _____ lbs                               | + _____ lbs | + _____ lbs | + _____ lbs       | = |     |
| Circuit 2                     | _____ lbs                               | + _____ lbs | + _____ lbs | + _____ lbs       | = |     |
| Circuit 2                     | _____ lbs                               | + _____ lbs | + _____ lbs | + _____ lbs       | = |     |
| Circuit 2                     | _____ lbs                               | + _____ lbs | + _____ lbs | + _____ lbs       | = |     |
| Additional Circuits as needed |                                         |             |             |                   |   |     |
|                               |                                         |             |             |                   |   |     |
|                               |                                         |             |             |                   |   |     |
|                               |                                         |             |             | Condenser Charge  | = |     |
|                               |                                         |             |             | Evaporator Charge | = |     |
|                               |                                         |             |             | Receiver Charge   | = |     |
|                               |                                         |             |             | Sum:              | = |     |

**For more information:**  
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