

## Klea® 407A Engineers Tables – SI Units

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### 1. Introduction

The following tables provide practical information to help you design or set up refrigeration systems using Klea® 407A. We've tried to make the layout as easy as possible to use; where possible we've followed the existing conventions used in standard reference works.

These tables are supplementary to the Physical Property Datasheet for Klea® 407A and the booklets of Thermodynamic Property Data for Klea® 407A.

### 2. Temperature-Pressure Tables for Klea® 407A

#### 2.1 Evaporator and Condenser Tables

The temperature glide need cause no problems so long as you know the correct relationship between pressure and temperature for the evaporator and the condenser. If you are unsure about the basic behaviour of blended refrigerants, refer to the Klea® Technical Note Introduction to Mixed Refrigerants for further guidance. Bear in mind:

- When specifying the evaporating and condensing temperatures we set mean temperatures in these exchangers.
- When setting evaporator superheat we calculate it from the saturated vapour or dew point temperature in the evaporator.
- When setting subcool we calculate it from the saturated liquid or bubble point temperature in the condenser.

The following simple guidelines explain which tables to use to obtain the relationships between the saturated liquid and vapour pressures and temperatures. We have tabulated the following data for you:

Table 1: Evaporator pressure from condenser liquid temperature and evaporator mean temperature.

Table 2: Evaporator temperature from condenser liquid temperature and evaporator pressure.

Table 3: Evaporator saturated vapour temperature from pressure (dew point).

Table 4: Condenser pressure from mean temperature.

Table 5-7: Maximum recommended suction line capacities for varying suction gas conditions.

Table 8: Discharge line capacities

Table 9: Liquid line capacities

Table 10: Recommended minimum capacities for oil entrainment in suction lines

Table 11: Correction factors for use with the capacity tables at other conditions

Refrigerant Flowrate: A graphical correlation of refrigerant flowrate per unit capacity.

## 2.2 Using the Tables

- In setting up a system to give a specified mean evaporating temperature, you simply look up the pressure you need in the evaporator using the temperature of liquid at the expansion valve and the mean temperature you want in Table I.
- The liquid temperature at the valve has only a slight effect on the mean temperature but we have tabulated it nonetheless. For practical purposes the evaporator pressure will not vary significantly even if the liquid temperature at the valve changes.
- To set the mean temperature for the condenser just look up the mean condensing pressure in Table 2.
- To calculate the superheat for a given pressure, use the table of saturated vapour temperatures (dew points) to give you the saturation temperature for the vapour leaving the evaporator.
- To calculate the subcooling for a given pressure, use the table of saturated liquid temperature (bubble point) as a function of pressure.
- You can also readily estimate the mean temperatures from pressure readings using these tables.
- The capacity tables follow the standard layouts used in other reference sources.

## 2.3 Worked examples for mean pressure/ temperature tables:

### (i) Setting the evaporator pressure

Problem:

Liquid temperature at valve: 40°C.

Desired evaporating temperature: -25°C.

What is the evaporator pressure to use?

What is the effect of a liquid temperature of 30°C?

Solution:

For Klea® 407A, with a liquid temperature at the valve of 40 °C and a desired mean evaporating temperature of -25°C, read Table I to get an evaporator pressure of 2.07 bara. A liquid temperature of 30°C gives an evaporator pressure of 2.09 bara...a change of 1 %.

### (ii) Finding the evaporator temperature from a gauge reading:

Problem:

Evaporator pressure gauge reads 2.5 bara.

Measured exit temperature (from thermometer) is -15.5 °C.

What is the mean evaporator temperature?

What is the superheat in the evaporator?

Solution:

For Klea® 407A, we have a measured evaporator pressure of 2.5 bara and a measured exit temperature of  $-15.5^{\circ}\text{C}$ ; we want to check superheat and evaporating temperature. The liquid temperature is  $40^{\circ}\text{C}$ . Table 2 shows that the mean evaporating temperature is  $-20.4^{\circ}\text{C}$ . The superheat is calculated from the dewpoint, given in Table 3 as  $-18.7^{\circ}\text{C}$ ; hence we have a working superheat of  $3.2^{\circ}\text{C}$ , obtained by subtracting the dew point temperature from the measured exit temperature.

(iii) Setting up the condenser pressure and subcool:

Problem:

Target mean condenser temperature is  $40^{\circ}\text{C}$ . The liquid temperature at the valve will be  $30^{\circ}\text{C}$ . What is the condensing pressure? What degree of subcooling will be required?

Solution:

Table 3 supplies the condenser pressure of 17.5 bara for a mean condenser of  $40^{\circ}\text{C}$ . Then the subcooling is obtained by subtracting the liquid temperature of  $30^{\circ}\text{C}$  from the bubble point of  $37.8^{\circ}\text{C}$ , giving a subcool of  $7.8^{\circ}\text{C}$ .

### 3. Refrigerant Line Capacity Tables

#### 3.1 Methods used to generate the tables

The tables presented here have been developed using the methodology described in the ASHRAE Handbook: Refrigeration Systems and Applications (1994). The physical property data used to generate these tables are correlated in the Klea® datasheets and thermodynamic tables. Pressure drop has been estimated using the Colebrook equation to obtain friction factors and the Darcy-Weisbach equation for pressure drop.

#### Gas Compressibility Effects

In calculating the maximum capacity (flowrate) it has been assumed that the gas is incompressible. This is in line with the tables published in the ASHRAE Handbook and for most systems this is perfectly adequate.

The assumption of incompressibility may however over-predict capacity if the total pressure drop is appreciable compared to the static pressure. The likely over-prediction will be in the region of 5-10% depending on the evaporator pressure and total line loss (including fittings loss).

Mexichem recommends that the pressure drop obtained for a line using these tables should be compared to the total pressure available; if it is greater than 5% of the static pressure then the compressibility may have some effect, and sizing should be made on that basis.

### 3.2 Suction Line Capacity Tables

These tables give capacities for cycles operating under the following conditions:

Condenser mean temperature 40°C. Zero subcooling (i.e. liquid at bubble point) Vapour leaving evaporator (i) saturated i.e. at dew point or (ii) superheated (superheat quoted in the table) Evaporator temperatures quoted are true mean values.

The capacity for other liquid temperatures may be found using the tabulated correction factors given in Table 11. Note that the tables are referenced to a mean condenser of 40 °C; the liquid temperature (bubble point) corresponding to this condition is quoted in the tables.

The tables quote capacity for pressure drops in the mean evaporating pressure equivalent to a drop in saturation temperature of 0.01, 0.02 and 0.04 Kelvin for every metre of suction line. Data are presented for copper tubing, Type L, and Schedule 40 steel pipe with dimensions as given in the ASHRAE Handbook HVAC Systems and Equipment (1992).

The mass flowrate of refrigerant is also presented graphically as the flow in kg/hr required for a duty of 1 kW refrigeration over a range of evaporating temperatures and liquid temperatures.

### 3.3 Discharge Line Capacity Tables

These have been calculated on the following basis: Condenser mean temperature of 40°C. Zero subcooling i.e. liquid at bubble point. Vapour leaves evaporator at dew point i.e. zero useful superheat. Superheat at compressor discharge is (i) 45 or (ii) 60°C. Evaporator temperatures are true mean values.

### 3.4 Liquid Line Capacity Tables

These are quoted for conditions of (i) 0.5 m/s maximum velocity or (ii) 0.02 K/m drop in saturation temperature. Use the velocity criterion for sizing self-venting lines.

### 3.5 Correcting for other Temperature Drops or Line Lengths

The suction capacity tables reference according to saturation temperature losses of 0.01, 0.02 and 0.04 K in one metre length. In order to correct the capacities for different values of temperature drop or line length, use the following equation:

$$\text{Capacity} = \text{Table Capacity} \times \left( \frac{\text{Required } \Delta T_e \times \text{Table } L_e}{\text{Table } \Delta T_e \text{ Required } L_e} \right)^{0.54}$$

where:

$\Delta T_e$  is the change in evaporating temperature

$\Delta L_e$  is the length of suction line

To evaluate the change in saturation temperature for differing capacities or line lengths, use the equation :

$$\text{Actual } \Delta T_e = \text{Table } \Delta T_e \times \left( \frac{\text{Actual } L_e \times \text{Actual Capacity}}{\text{Table } L_e \times \text{Table Capacity}} \right)^{1.8}$$

#### 4. What's New In This Edition

This is version 1.1 of the Tables. The updates from version 1.0 are as follows:

Tables 5-9: A revision of the physical property routines and calculation methods has occurred so that all physical properties used in the calculation are now obtained from the most recent physical property datasheets for each refrigerant.

Tables 5-9: The nomenclature in the tables has been changed slightly to make it more readable.

Tables 5-11: The number of significant figures in the tables is revised to three to better reflect the accuracy limits of the calculations.

Tables 10: The oil-refrigerant calculations have been carried out using new data for the solubility of Klea® 407A in Uniqema's EMKARATE RL32S and RL68S lubricants.

Table 11: The changes in physical property calculations have resulted in some changes to the correction factors displayed in this table.

Table 1: Evaporator pressure from liquid temperature and mean evaporating temperature - Klea® 407A Pressure in bara

| Temperature mean °C | Temperature liquid °C |      |      | Temperature mean °C | Temperature liquid °C |      |      |
|---------------------|-----------------------|------|------|---------------------|-----------------------|------|------|
|                     | 30                    | 40   | 50   |                     | 30                    | 40   | 50   |
| 5                   | 6.37                  | 6.33 | 6.27 | -33                 | 1.47                  | 1.45 | 1.43 |
| 4                   | 6.17                  | 6.12 | 6.07 | -34                 | 1.40                  | 1.39 | 1.37 |
| 3                   | 5.97                  | 5.92 | 5.87 | -35                 | 1.34                  | 1.32 | 1.31 |
| 2                   | 5.77                  | 5.73 | 5.68 | -36                 | 1.28                  | 1.26 | 1.25 |
| 1                   | 5.58                  | 5.54 | 5.49 | -37                 | 1.22                  | 1.20 | 1.19 |
| 0                   | 5.40                  | 5.35 | 5.31 | -38                 | 1.16                  | 1.15 | 1.13 |
| -1                  | 5.21                  | 5.17 | 5.13 | -39                 | 1.10                  | 1.09 | 1.08 |
| -2                  | 5.04                  | 5.00 | 4.95 | -40                 | 1.05                  | 1.04 | 1.03 |
| -3                  | 4.87                  | 4.83 | 4.78 |                     |                       |      |      |
| -4                  | 4.70                  | 4.66 | 4.62 |                     |                       |      |      |
| -5                  | 4.53                  | 4.50 | 4.46 |                     |                       |      |      |
| -6                  | 4.38                  | 4.34 | 4.30 |                     |                       |      |      |
| -7                  | 4.22                  | 4.19 | 4.15 |                     |                       |      |      |
| -8                  | 4.07                  | 4.04 | 4.00 |                     |                       |      |      |
| -9                  | 3.93                  | 3.89 | 3.86 |                     |                       |      |      |
| -10                 | 3.78                  | 3.75 | 3.72 |                     |                       |      |      |
| -11                 | 3.65                  | 3.61 | 3.58 |                     |                       |      |      |
| -12                 | 3.51                  | 3.48 | 3.45 |                     |                       |      |      |
| -13                 | 3.38                  | 3.35 | 3.32 |                     |                       |      |      |
| -14                 | 3.25                  | 3.23 | 3.19 |                     |                       |      |      |
| -15                 | 3.13                  | 3.10 | 3.07 |                     |                       |      |      |
| -16                 | 3.01                  | 2.98 | 2.96 |                     |                       |      |      |
| -17                 | 2.90                  | 2.87 | 2.84 |                     |                       |      |      |
| -18                 | 2.78                  | 2.76 | 2.73 |                     |                       |      |      |
| -19                 | 2.67                  | 2.65 | 2.62 |                     |                       |      |      |
| -20                 | 2.57                  | 2.55 | 2.52 |                     |                       |      |      |
| -21                 | 2.47                  | 2.44 | 2.42 |                     |                       |      |      |
| -22                 | 2.37                  | 2.35 | 2.32 |                     |                       |      |      |
| -23                 | 2.27                  | 2.25 | 2.23 |                     |                       |      |      |
| -24                 | 2.18                  | 2.16 | 2.13 |                     |                       |      |      |
| -25                 | 2.09                  | 2.07 | 2.05 |                     |                       |      |      |
| -26                 | 2.00                  | 1.98 | 1.96 |                     |                       |      |      |
| -27                 | 1.92                  | 1.90 | 1.88 |                     |                       |      |      |
| -28                 | 1.83                  | 1.82 | 1.80 |                     |                       |      |      |
| -29                 | 1.76                  | 1.74 | 1.72 |                     |                       |      |      |
| -30                 | 1.68                  | 1.66 | 1.64 |                     |                       |      |      |
| -31                 | 1.61                  | 1.59 | 1.57 |                     |                       |      |      |
| -32                 | 1.54                  | 1.52 | 1.50 |                     |                       |      |      |

Table 2: Mean evaporator temperature from pressure and liquid temperature Klea® 407A

| Pressure<br>bara | Temperature liquid °C |        |        | Temp<br>Dew °C |
|------------------|-----------------------|--------|--------|----------------|
|                  | 30                    | 40     | 50     |                |
| 1                | -41.00                | -40.78 | -40.53 | -39.18         |
| 1.1              | -39.08                | -38.85 | -38.60 | -37.24         |
| 1.2              | -37.28                | -37.05 | -36.80 | -35.43         |
| 1.3              | -35.59                | -35.37 | -35.12 | -33.73         |
| 1.4              | -34.01                | -33.78 | -33.53 | -32.14         |
| 1.5              | -32.51                | -32.28 | -32.04 | -30.63         |
| 1.6              | -31.09                | -30.86 | -30.61 | -29.19         |
| 1.7              | -29.73                | -29.51 | -29.26 | -27.83         |
| 1.8              | -28.44                | -28.21 | -27.96 | -26.52         |
| 1.9              | -27.20                | -26.97 | -26.72 | -25.27         |
| 2                | -26.01                | -25.78 | -25.53 | -24.07         |
| 2.1              | -24.86                | -24.64 | -24.39 | -22.92         |
| 2.2              | -23.76                | -23.53 | -23.29 | -21.80         |
| 2.3              | -22.70                | -22.47 | -22.22 | -20.73         |
| 2.4              | -21.67                | -21.44 | -21.19 | -19.69         |
| 2.5              | -20.67                | -20.44 | -20.19 | -18.68         |
| 2.6              | -19.70                | -19.47 | -19.23 | -17.70         |
| 2.7              | -18.76                | -18.54 | -18.29 | -16.76         |
| 2.8              | -17.85                | -17.62 | -17.37 | -15.84         |
| 2.9              | -16.96                | -16.74 | -16.49 | -14.94         |
| 3                | -16.10                | -15.87 | -15.62 | -14.07         |
| 3.1              | -15.26                | -15.03 | -14.78 | -13.22         |
| 3.2              | -14.44                | -14.21 | -13.96 | -12.39         |
| 3.3              | -13.63                | -13.40 | -13.15 | -11.58         |
| 3.4              | -12.85                | -12.62 | -12.37 | -10.78         |
| 3.5              | -12.08                | -11.85 | -11.60 | -10.01         |
| 3.6              | -11.33                | -11.10 | -10.85 | -9.25          |
| 3.7              | -10.60                | -10.37 | -10.12 | -8.51          |
| 3.8              | -9.88                 | -9.65  | -9.40  | -7.79          |
| 3.9              | -9.18                 | -8.95  | -8.69  | -7.07          |
| 4                | -8.48                 | -8.25  | -8.00  | -6.38          |
| 4.1              | -7.81                 | -7.58  | -7.33  | -5.69          |
| 4.2              | -7.14                 | -6.91  | -6.66  | -5.02          |
| 4.3              | -6.49                 | -6.26  | -6.01  | -4.36          |
| 4.4              | -5.85                 | -5.62  | -5.36  | -3.71          |
| 4.5              | -5.22                 | -4.98  | -4.73  | -3.08          |
| 4.6              | -4.60                 | -4.36  | -4.11  | -2.45          |
| 4.7              | -3.99                 | -3.75  | -3.50  | -1.84          |
| 4.8              | -3.39                 | -3.15  | -2.90  | -1.23          |

Note: Superheat should be set from dew point

| Pressure<br>bara | Temperature liquid °C |       |       | Temp<br>Dew °C |
|------------------|-----------------------|-------|-------|----------------|
|                  | 30                    | 40    | 50    |                |
| 4.9              | -2.79                 | -2.56 | -2.31 | -0.63          |
| 5                | -2.21                 | -1.98 | -1.73 | -0.05          |
| 5.1              | -1.64                 | -1.41 | -1.16 | 0.53           |
| 5.2              | -1.08                 | -0.85 | -0.59 | 1.10           |
| 5.3              | -0.52                 | -0.29 | -0.04 | 1.66           |
| 5.4              | 0.03                  | 0.26  | 0.51  | 2.21           |
| 5.5              | 0.57                  | 0.80  | 1.05  | 2.76           |
| 5.6              | 1.10                  | 1.33  | 1.58  | 3.30           |
| 5.7              | 1.63                  | 1.86  | 2.11  | 3.83           |
| 5.8              | 2.14                  | 2.38  | 2.63  | 4.35           |
| 5.9              | 2.66                  | 2.89  | 3.14  | 4.87           |
| 6.1              | 3.66                  | 3.89  | 4.14  | 5.88           |
| 6.2              | 4.15                  | 4.38  | 4.64  | 6.37           |
| 6.3              | 4.64                  | 4.87  | 5.12  | 6.87           |
| 6.4              | 5.12                  | 5.35  | 5.60  | 7.35           |
| 6.5              | 5.60                  | 5.83  | 6.08  | 7.83           |
| 6.6              | 6.06                  | 6.30  | 6.55  | 8.30           |
| 6.7              | 6.53                  | 6.76  | 7.01  | 8.77           |
| 6.8              | 6.99                  | 7.22  | 7.47  | 9.23           |
| 6.9              | 7.44                  | 7.67  | 7.93  | 9.69           |
| 7                | 7.89                  | 8.12  | 8.38  | 10.14          |
| 7.1              | 8.33                  | 8.57  | 8.82  | 10.59          |
| 7.2              | 8.77                  | 9.01  | 9.26  | 11.03          |
| 7.3              | 9.21                  | 9.44  | 9.69  | 11.47          |
| 7.4              | 9.64                  | 9.87  | 10.12 | 11.90          |
| 7.5              | 10.06                 | 10.30 | 10.55 | 12.33          |
| 7.6              | 10.49                 | 10.72 | 10.97 | 12.76          |
| 7.7              | 10.90                 | 11.13 | 11.39 | 13.18          |
| 7.8              | 11.32                 | 11.55 | 11.80 | 13.59          |
| 7.9              | 11.72                 | 11.96 | 12.21 | 14.00          |
| 8                | 12.13                 | 12.36 | 12.61 | 14.41          |
| 8.1              | 12.53                 | 12.76 | 13.02 | 14.81          |
| 8.2              | 12.93                 | 13.16 | 13.41 | 15.22          |
| 8.3              | 13.32                 | 13.55 | 13.81 | 15.61          |
| 8.4              | 13.71                 | 13.94 | 14.20 | 16.00          |
| 8.5              | 14.10                 | 14.33 | 14.58 | 16.39          |
| 8.6              | 14.48                 | 14.71 | 14.97 | 16.78          |
| 8.7              | 14.86                 | 15.09 | 15.35 | 17.16          |
| 8.8              | 15.24                 | 15.47 | 15.72 | 17.54          |

Note: Superheat should be set from dew point



| Pressure<br>bara | Temperature liquid °C |       |       | Temp<br>Dew °C |
|------------------|-----------------------|-------|-------|----------------|
|                  | 30                    | 40    | 50    |                |
| 8.9              | 15.61                 | 15.84 | 16.10 | 17.92          |
| 9                | 15.98                 | 16.21 | 16.47 | 18.29          |
| 9.1              | 16.35                 | 16.58 | 16.83 | 18.66          |
| 9.2              | 16.71                 | 16.94 | 17.20 | 19.02          |
| 9.3              | 17.07                 | 17.31 | 17.56 | 19.39          |
| 9.4              | 17.43                 | 17.66 | 17.92 | 19.75          |
| 9.5              | 17.79                 | 18.02 | 18.27 | 20.10          |
| 9.6              | 18.14                 | 18.37 | 18.62 | 20.46          |
| 9.7              | 18.49                 | 18.72 | 18.97 | 20.81          |
| 9.8              | 18.83                 | 19.07 | 19.32 | 21.16          |
| 9.9              | 19.18                 | 19.41 | 19.66 | 21.50          |
| 10               | 19.52                 | 19.75 | 20.00 | 21.85          |

Note: Superheat should be set from dew point

Table 3: Condenser mean pressure, dew and bubble points, from the mean temperature Klea® 407A

| Mean temp °C | Pressure bara | Bubble/liquid Temp °C | Dew temp °C |
|--------------|---------------|-----------------------|-------------|
| 10           | 7.60          | 7.24                  | 12.75       |
| 11           | 7.84          | 8.26                  | 13.74       |
| 12           | 8.08          | 9.27                  | 14.72       |
| 13           | 8.33          | 10.29                 | 15.71       |
| 14           | 8.58          | 11.30                 | 16.70       |
| 15           | 8.84          | 12.32                 | 17.68       |
| 16           | 9.10          | 13.33                 | 18.66       |
| 17           | 9.37          | 14.35                 | 19.65       |
| 18           | 9.65          | 15.36                 | 20.63       |
| 19           | 9.93          | 16.38                 | 21.62       |
| 20           | 10.22         | 17.39                 | 22.60       |
| 21           | 10.52         | 18.41                 | 23.58       |
| 22           | 10.82         | 19.43                 | 24.57       |
| 23           | 11.13         | 20.44                 | 25.55       |
| 24           | 11.44         | 21.46                 | 26.53       |
| 25           | 11.77         | 22.48                 | 27.51       |
| 26           | 12.10         | 23.50                 | 28.49       |
| 27           | 12.43         | 24.52                 | 29.47       |
| 28           | 12.77         | 25.53                 | 30.45       |
| 29           | 13.12         | 26.55                 | 31.43       |
| 30           | 13.48         | 27.57                 | 32.41       |
| 31           | 13.85         | 28.59                 | 33.39       |
| 32           | 14.22         | 29.61                 | 34.37       |
| 33           | 14.60         | 30.63                 | 35.35       |
| 34           | 14.99         | 31.65                 | 36.33       |
| 35           | 15.38         | 32.67                 | 37.31       |
| 36           | 15.78         | 33.69                 | 38.29       |
| 37           | 16.19         | 34.71                 | 39.26       |
| 38           | 16.61         | 35.73                 | 40.24       |
| 39           | 17.04         | 36.76                 | 41.22       |
| 40           | 17.48         | 37.78                 | 42.20       |
| 41           | 17.92         | 38.80                 | 43.17       |
| 42           | 18.37         | 39.82                 | 44.15       |
| 43           | 18.83         | 40.85                 | 45.12       |
| 44           | 19.30         | 41.87                 | 46.10       |
| 45           | 19.78         | 42.89                 | 47.08       |
| 46           | 20.27         | 43.92                 | 48.05       |
| 47           | 20.77         | 44.94                 | 49.03       |
| 48           | 21.28         | 45.97                 | 50.00       |
| 49           | 21.79         | 46.99                 | 50.97       |
| 50           | 22.32         | 48.02                 | 51.95       |
| 51           | 22.85         | 49.05                 | 52.92       |
| 52           | 23.40         | 50.07                 | 53.90       |
| 53           | 23.95         | 51.10                 | 54.87       |
| 54           | 24.52         | 52.13                 | 55.84       |
| 55           | 25.09         | 53.16                 | 56.82       |
| 56           | 25.68         | 54.18                 | 57.79       |
| 57           | 26.28         | 55.21                 | 58.76       |
| 58           | 26.88         | 56.24                 | 59.74       |
| 59           | 27.50         | 57.27                 | 60.71       |
| 60           | 28.13         | 58.30                 | 61.68       |

Table 4: Condenser bubble, dew and mean temperatures from condenser pressure Klea® 407A

| Pressure bara | Bubble liquid | Temperatures °C |       |
|---------------|---------------|-----------------|-------|
|               |               | Mean            | Dew   |
| 10            | 16.61         | 19.23           | 21.85 |
| 10.2          | 17.32         | 19.92           | 22.52 |
| 10.4          | 18.01         | 20.60           | 23.19 |
| 10.6          | 18.69         | 21.27           | 23.85 |
| 10.8          | 19.36         | 21.93           | 24.50 |
| 11            | 20.02         | 22.58           | 25.14 |
| 11.2          | 20.67         | 23.22           | 25.77 |
| 11.4          | 21.32         | 23.86           | 26.39 |
| 11.6          | 21.96         | 24.48           | 27.01 |
| 11.8          | 22.58         | 25.10           | 27.61 |
| 12            | 23.20         | 25.71           | 28.21 |
| 12.2          | 23.82         | 26.31           | 28.80 |
| 12.4          | 24.42         | 26.90           | 29.38 |
| 12.6          | 25.02         | 27.49           | 29.96 |
| 12.8          | 25.61         | 28.07           | 30.53 |
| 13            | 26.19         | 28.64           | 31.09 |
| 13.2          | 26.77         | 29.21           | 31.64 |
| 13.4          | 27.34         | 29.77           | 32.19 |
| 13.6          | 27.90         | 30.32           | 32.73 |
| 13.8          | 28.46         | 30.87           | 33.27 |
| 14            | 29.01         | 31.41           | 33.80 |
| 14.2          | 29.56         | 31.94           | 34.33 |
| 14.4          | 30.10         | 32.47           | 34.84 |
| 14.6          | 30.64         | 33.00           | 35.36 |
| 14.8          | 31.17         | 33.52           | 35.87 |
| 15            | 31.69         | 34.03           | 36.37 |
| 15.2          | 32.21         | 34.54           | 36.87 |
| 15.4          | 32.72         | 35.04           | 37.36 |
| 15.6          | 33.23         | 35.54           | 37.84 |
| 15.8          | 33.73         | 36.03           | 38.33 |
| 16            | 34.23         | 36.52           | 38.81 |
| 16.2          | 34.73         | 37.00           | 39.28 |
| 16.4          | 35.22         | 37.48           | 39.75 |
| 16.6          | 35.70         | 37.96           | 40.21 |
| 16.8          | 36.18         | 38.43           | 40.67 |
| 17            | 36.66         | 38.89           | 41.13 |
| 17.2          | 37.13         | 39.36           | 41.58 |
| 17.4          | 37.60         | 39.81           | 42.03 |
| 17.6          | 38.07         | 40.27           | 42.47 |
| 17.8          | 38.53         | 40.72           | 42.91 |
| 18            | 38.98         | 41.16           | 43.35 |
| 18.2          | 39.44         | 41.61           | 43.78 |
| 18.4          | 39.88         | 42.05           | 44.21 |
| 18.6          | 40.33         | 42.48           | 44.63 |
| 18.8          | 40.77         | 42.91           | 45.05 |
| 19            | 41.21         | 43.34           | 45.47 |
| 19.2          | 41.65         | 43.77           | 45.89 |
| 19.4          | 42.08         | 44.19           | 46.30 |
| 19.6          | 42.50         | 44.60           | 46.70 |
| 19.8          | 42.93         | 45.02           | 47.11 |
| 20            | 43.35         | 45.43           | 47.51 |

| Pressure bara | Bubble liquid | Temperatures °C |       |
|---------------|---------------|-----------------|-------|
|               |               | Mean            | Dew   |
| 20.2          | 43.77         | 45.84           | 47.91 |
| 20.4          | 44.19         | 46.24           | 48.30 |
| 20.6          | 44.60         | 46.65           | 48.70 |
| 20.8          | 45.01         | 47.05           | 49.09 |
| 21            | 45.41         | 47.44           | 49.47 |
| 21.2          | 45.82         | 47.84           | 49.86 |
| 21.4          | 46.22         | 48.23           | 50.24 |
| 21.6          | 46.62         | 48.61           | 50.61 |
| 21.8          | 47.01         | 49.00           | 50.99 |
| 22            | 47.40         | 49.38           | 51.36 |
| 22.2          | 47.79         | 49.76           | 51.73 |
| 22.4          | 48.18         | 50.14           | 52.10 |
| 22.6          | 48.56         | 50.51           | 52.47 |
| 22.8          | 48.95         | 50.89           | 52.83 |
| 23            | 49.33         | 51.26           | 53.19 |
| 23.2          | 49.70         | 51.62           | 53.55 |
| 23.4          | 50.08         | 51.99           | 53.90 |
| 23.6          | 50.45         | 52.35           | 54.25 |
| 23.8          | 50.82         | 52.71           | 54.60 |
| 24            | 51.19         | 53.07           | 54.95 |
| 24.2          | 51.55         | 53.42           | 55.30 |
| 24.4          | 51.91         | 53.78           | 55.64 |
| 24.6          | 52.27         | 54.13           | 55.98 |
| 24.8          | 52.63         | 54.48           | 56.32 |
| 25            | 52.99         | 54.82           | 56.66 |
| 25.2          | 53.34         | 55.17           | 56.99 |
| 25.4          | 53.69         | 55.51           | 57.33 |
| 25.6          | 54.04         | 55.85           | 57.66 |
| 25.8          | 54.39         | 56.19           | 57.99 |
| 26            | 54.74         | 56.53           | 58.31 |
| 26.2          | 55.08         | 56.86           | 58.64 |
| 26.4          | 55.42         | 57.19           | 58.96 |
| 26.6          | 55.76         | 57.52           | 59.28 |
| 26.8          | 56.10         | 57.85           | 59.60 |
| 27            | 56.44         | 58.18           | 59.92 |
| 27.2          | 56.77         | 58.50           | 60.24 |
| 27.4          | 57.10         | 58.83           | 60.55 |
| 27.6          | 57.43         | 59.15           | 60.86 |
| 27.8          | 57.76         | 59.47           | 61.17 |
| 28            | 58.09         | 59.79           | 61.48 |
| 28.2          | 58.42         | 60.10           | 61.79 |
| 28.4          | 58.74         | 60.42           | 62.09 |
| 28.6          | 59.06         | 60.73           | 62.40 |
| 28.8          | 59.38         | 61.04           | 62.70 |
| 29            | 59.70         | 61.35           | 63.00 |
| 29.2          | 60.02         | 61.66           | 63.30 |
| 29.4          | 60.33         | 61.96           | 63.59 |
| 29.6          | 60.64         | 62.27           | 63.89 |
| 29.8          | 60.96         | 62.57           | 64.18 |
| 30            | 61.27         | 62.87           | 64.48 |

Table 5a: Suction line capacities in kW for Klea® 407A Saturated vapour leaving evaporator

| Nominal line size mm | Saturation temperature change 1.0 K in 100 m<br>Mean evaporating temperature °C at corresponding pressure drop, Pa/m |       |       |       |       |       |       |       |       |       |
|----------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                      | -40  | -35   | -30   | -25   | -20   | -15   | -10   | -5    | 0     | 5     |
| T                    |  |       |       |       |       |       |       |       |       |       |
| $\Delta P/\Delta L$  | 52   | 63    | 75    | 89    | 104   | 121   | 139   | 160   | 183   | 208   |
| Type L Copper        |  |       |       |       |       |       |       |       |       |       |
| 10                   | 0.069  | 0.088 | 0.112 | 0.142 | 0.177 | 0.218 | 0.267 | 0.324 | 0.391 | 0.467 |
| 12                   | 0.160  | 0.204 | 0.261 | 0.329 | 0.410 | 0.506 | 0.618 | 0.749 | 0.901 | 1.08  |
| 15                   | 0.304  | 0.388 | 0.494 | 0.623 | 0.775 | 0.956 | 1.17  | 1.41  | 1.70  | 2.03  |
| 19                   | 0.522  | 0.666 | 0.849 | 1.07  | 1.33  | 1.64  | 2.00  | 2.42  | 2.91  | 3.47  |
| 22                   | 0.813  | 1.04  | 1.32  | 1.66  | 2.06  | 2.54  | 3.10  | 3.75  | 4.50  | 5.37  |
| 28                   | 1.66   | 2.12  | 2.70  | 3.39  | 4.21  | 5.18  | 6.31  | 7.63  | 9.15  | 10.9  |
| 35                   | 2.92   | 3.72  | 4.73  | 5.93  | 7.36  | 9.05  | 11.0  | 13.3  | 16.0  | 19.0  |
| 42                   | 4.64   | 5.91  | 7.51  | 9.42  | 11.7  | 14.4  | 17.5  | 21.1  | 25.3  | 30.1  |
| 54                   | 9.69   | 12.4  | 15.7  | 19.6  | 24.3  | 29.9  | 36.4  | 43.9  | 52.5  | 62.5  |
| 67                   | 17.2   | 21.9  | 27.8  | 34.9  | 43.2  | 53.0  | 64.4  | 77.6  | 93.0  | 111   |
| 79                   | 27.6   | 35.2  | 44.6  | 55.8  | 69.1  | 84.7  | 103   | 124   | 148   | 176   |
| 92                   | 41.1   | 52.4  | 66.4  | 83.1  | 103   | 126   | 153   | 185   | 221   | 262   |
| 105                  | 58.2   | 74.2  | 93.9  | 117   | 145   | 178   | 216   | 260   | 311   | 370   |
| Schedule 40 steel    |  |       |       |       |       |       |       |       |       |       |
| 10                   | 0.206  | 0.262 | 0.33  | 0.411 | 0.506 | 0.617 | 0.746 | 0.894 | 1.06  | 1.26  |
| 15                   | 0.384  | 0.489 | 0.615 | 0.766 | 0.942 | 1.15  | 1.39  | 1.66  | 1.98  | 2.34  |
| 20                   | 0.815  | 1.04  | 1.30  | 1.62  | 1.99  | 2.42  | 2.93  | 3.50  | 4.17  | 4.92  |
| 25                   | 1.55   | 1.97  | 2.48  | 3.07  | 3.78  | 4.60  | 5.54  | 6.63  | 7.89  | 9.32  |
| 32                   | 3.21   | 4.08  | 5.13  | 6.36  | 7.81  | 9.49  | 11.4  | 13.7  | 16.3  | 19.2  |
| 40                   | 4.84   | 6.14  | 7.71  | 9.56  | 11.7  | 14.3  | 17.2  | 20.6  | 24.4  | 28.8  |
| 50                   | 9.37   | 11.9  | 14.9  | 18.5  | 22.7  | 27.5  | 33.2  | 39.7  | 47.1  | 55.6  |
| 65                   | 15.0   | 19.0  | 23.8  | 29.5  | 36.2  | 43.9  | 52.9  | 63.3  | 75.1  | 88.7  |
| 80                   | 26.6   | 33.7  | 42.2  | 52.2  | 64.0  | 77.7  | 93.6  | 112   | 133   | 157   |
| 100                  | 54.2   | 68.7  | 86.1  | 107   | 131   | 158   | 191   | 228   | 271   | 319   |

## Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C

Table 5b: Suction line capacities in kW for Klea® 407A Saturated vapour leaving evaporator

| Nominal<br>line size<br>mm | Saturation temperature change 2.0 K in 100 m<br>Mean evaporating temperature °C at corresponding pressure drop, Pa/m |       |       |       |       |       |       |       |       |       |
|----------------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                            | -40  | -35   | -30   | -25   | -20   | -15   | -10   | -5    | 0     | 5     |
| T                          |  |       |       |       |       |       |       |       |       |       |
| $\Delta P/\Delta L$        | 104  | 126   | 150   | 177   | 208   | 241   | 279   | 320   | 366   | 416   |
| Type L Copper              |  |       |       |       |       |       |       |       |       |       |
| 10                         | 0.102  | 0.130 | 0.166 | 0.210 | 0.261 | 0.323 | 0.394 | 0.478 | 0.575 | 0.687 |
| 12                         | 0.238  | 0.302 | 0.385 | 0.485 | 0.604 | 0.745 | 0.909 | 1.10  | 1.32  | 1.58  |
| 15                         | 0.450  | 0.573 | 0.729 | 0.917 | 1.14  | 1.40  | 1.71  | 2.07  | 2.49  | 2.97  |
| 19                         | 0.772  | 0.983 | 1.25  | 1.57  | 1.95  | 2.40  | 2.93  | 3.54  | 4.25  | 5.07  |
| 22                         | 1.20   | 1.53  | 1.94  | 2.44  | 3.03  | 3.72  | 4.54  | 5.48  | 6.57  | 7.83  |
| 28                         | 2.45   | 3.11  | 3.96  | 4.96  | 6.16  | 7.57  | 9.21  | 11.1  | 13.3  | 15.9  |
| 35                         | 4.29   | 5.45  | 6.92  | 8.68  | 10.8  | 13.2  | 16.1  | 19.4  | 23.2  | 27.7  |
| 42                         | 6.81   | 8.66  | 11.0  | 13.8  | 17.1  | 20.9  | 25.5  | 30.7  | 36.8  | 43.7  |
| 54                         | 14.2   | 18.1  | 22.9  | 28.6  | 35.5  | 43.5  | 52.9  | 63.7  | 76.2  | 90.6  |
| 67                         | 25.2   | 32.0  | 40.6  | 50.8  | 62.8  | 77.0  | 93.5  | 113   | 135   | 160   |
| 79                         | 40.3   | 51.3  | 64.9  | 81.1  | 100   | 123   | 149   | 180   | 215   | 255   |
| 92                         | 60.0   | 76.4  | 96.6  | 121   | 149   | 183   | 222   | 267   | 319   | 379   |
| 105                        | 84.8   | 108   | 137   | 171   | 211   | 258   | 313   | 377   | 450   | 534   |
| Schedule 40 steel          |  |       |       |       |       |       |       |       |       |       |
| 10                         | 0.297  | 0.378 | 0.475 | 0.59  | 0.726 | 0.883 | 1.07  | 1.28  | 1.52  | 1.79  |
| 15                         | 0.554  | 0.703 | 0.884 | 1.10  | 1.35  | 1.64  | 1.98  | 2.37  | 2.82  | 3.33  |
| 20                         | 1.17   | 1.49  | 1.87  | 2.32  | 2.85  | 3.46  | 4.17  | 4.99  | 5.93  | 7.00  |
| 25                         | 2.23   | 2.82  | 3.54  | 4.39  | 5.39  | 6.55  | 7.90  | 9.44  | 11.2  | 13.2  |
| 32                         | 4.61   | 5.84  | 7.32  | 9.08  | 11.1  | 13.5  | 16.3  | 19.5  | 23.1  | 27.3  |
| 40                         | 6.92   | 8.78  | 11.0  | 13.6  | 16.7  | 20.3  | 24.4  | 29.2  | 34.7  | 40.9  |
| 50                         | 13.4   | 17.0  | 21.3  | 26.3  | 32.3  | 39.2  | 47.2  | 56.4  | 66.9  | 78.9  |
| 65                         | 21.4   | 27.1  | 33.9  | 42.0  | 51.5  | 62.5  | 75.2  | 89.8  | 107   | 126   |
| 80                         | 37.9   | 48.0  | 60.0  | 74.3  | 91.0  | 110   | 133   | 159   | 188   | 222   |
| 100                        | 77.3   | 97.9  | 122   | 151   | 185   | 225   | 271   | 323   | 384   | 453   |

## Note:

(i) Capacity based on saturated vapour (no useful superheat)

(ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8 °C

Table 5c: Suction line capacities in kW for Klea® 407A Saturated vapour leaving evaporator

| Nominal line size mm | Saturation temperature change 4.0 K in 100 m<br>Mean evaporating temperature °C at corresponding pressure drop, Pa/m |       |       |       |       |       |       |       |       |      |
|----------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|------|
| T                    | -40  | -35   | -30   | -25   | -20   | -15   | -10   | -5    | 0     | 5    |
| $\Delta P/\Delta L$  | 209  | 252   | 300   | 354   | 415   | 483   | 558   | 640   | 731   | 831  |
| Type L Copper        |  |       |       |       |       |       |       |       |       |      |
| 10                   | 0.152  | 0.193 | 0.246 | 0.310 | 0.386 | 0.475 | 0.580 | 0.702 | 0.844 | 1.01 |
| 12                   | 0.351  | 0.446 | 0.568 | 0.715 | 0.889 | 1.09  | 1.33  | 1.61  | 1.94  | 2.31 |
| 15                   | 0.663  | 0.844 | 1.07  | 1.35  | 1.67  | 2.06  | 2.51  | 3.03  | 3.64  | 4.33 |
| 19                   | 1.14   | 1.44  | 1.84  | 2.30  | 2.86  | 3.52  | 4.28  | 5.17  | 6.20  | 7.38 |
| 22                   | 1.76   | 2.24  | 2.85  | 3.57  | 4.43  | 5.44  | 6.62  | 7.99  | 9.57  | 11.4 |
| 28                   | 3.59   | 4.56  | 5.79  | 7.26  | 8.99  | 11.0  | 13.4  | 16.2  | 19.4  | 23.1 |
| 35                   | 6.27   | 7.98  | 10.1  | 12.7  | 15.7  | 19.2  | 23.4  | 28.2  | 33.7  | 40.1 |
| 42                   | 9.95   | 12.7  | 16.0  | 20.1  | 24.8  | 30.4  | 37.0  | 44.6  | 53.3  | 63.3 |
| 54                   | 20.7   | 26.3  | 33.3  | 41.7  | 51.6  | 63.1  | 76.6  | 92.3  | 110   | 131  |
| 67                   | 36.7   | 46.7  | 59.0  | 73.8  | 91.2  | 112   | 135   | 163   | 195   | 231  |
| 79                   | 58.6   | 74.6  | 94.3  | 118   | 146   | 178   | 216   | 260   | 310   | 368  |
| 92                   | 87.3   | 111   | 140   | 175   | 216   | 265   | 321   | 386   | 460   | 546  |
| 105                  | 123  | 157   | 198   | 247   | 305   | 373   | 452   | 543   | 648   | 769  |
| Schedule 40 steel    |  |       |       |       |       |       |       |       |       |      |
| 10                   | 0.427  | 0.542 | 0.681 | 0.845 | 1.04  | 1.26  | 1.52  | 1.82  | 2.16  | 2.55 |
| 15                   | 0.795  | 1.01  | 1.27  | 1.57  | 1.93  | 2.34  | 2.82  | 3.37  | 4.01  | 4.73 |
| 20                   | 1.68   | 2.13  | 2.67  | 3.31  | 4.06  | 4.93  | 5.94  | 7.10  | 8.43  | 9.95 |
| 25                   | 3.18   | 4.04  | 5.06  | 6.26  | 7.68  | 9.32  | 11.2  | 13.4  | 15.9  | 18.8 |
| 32                   | 6.58   | 8.34  | 10.4  | 12.9  | 15.8  | 19.2  | 23.1  | 27.6  | 32.8  | 38.7 |
| 40                   | 9.88   | 12.5  | 15.7  | 19.4  | 23.8  | 28.8  | 34.7  | 41.5  | 49.2  | 58.1 |
| 50                   | 19.1   | 24.2  | 30.3  | 37.4  | 45.8  | 55.6  | 66.9  | 80.0  | 94.9  | 112  |
| 65                   | 30.5   | 38.6  | 48.3  | 59.7  | 73.1  | 88.7  | 107   | 127   | 151   | 178  |
| 80                   | 53.9   | 68.2  | 85.3  | 106   | 129   | 157   | 189   | 225   | 267   | 315  |
| 100                  | 110  | 139   | 174   | 215   | 263   | 319   | 384   | 458   | 544   | 641  |

## Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C

Table 6a: Suction line capacities in kW for Klea® 407A Suction line vapour with 5°C of superheat

| Nominal line size mm | Saturation temperature change 1.0 K in 100 m<br>Mean evaporating temperature °C at corresponding pressure drop, Pa/m |       |       |       |       |       |       |       |       |       |
|----------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                      | -40  | -35   | -30   | -25   | -20   | -15   | -10   | -5    | 0     | 5     |
| T                    | 52   | 63    | 75    | 89    | 104   | 121   | 139   | 160   | 183   | 208   |
| $\Delta P/\Delta L$  |  |       |       |       |       |       |       |       |       |       |
| Type L Copper        |  |       |       |       |       |       |       |       |       |       |
| 10                   | 0.070  | 0.089 | 0.113 | 0.143 | 0.179 | 0.221 | 0.271 | 0.329 | 0.396 | 0.473 |
| 12                   | 0.163  | 0.207 | 0.264 | 0.333 | 0.415 | 0.512 | 0.626 | 0.759 | 0.913 | 1.09  |
| 15                   | 0.309  | 0.393 | 0.501 | 0.631 | 0.786 | 0.969 | 1.18  | 1.43  | 1.72  | 2.06  |
| 19                   | 0.531  | 0.675 | 0.86  | 1.08  | 1.35  | 1.66  | 2.03  | 2.45  | 2.95  | 3.51  |
| 22                   | 0.826  | 1.05  | 1.34  | 1.68  | 2.09  | 2.58  | 3.14  | 3.80  | 4.56  | 5.44  |
| 28                   | 1.69   | 2.15  | 2.73  | 3.43  | 4.27  | 5.25  | 6.40  | 7.73  | 9.28  | 11.1  |
| 35                   | 2.96   | 3.77  | 4.79  | 6.02  | 7.47  | 9.18  | 11.2  | 13.5  | 16.2  | 19.3  |
| 42                   | 4.71   | 6.00  | 7.62  | 9.55  | 11.9  | 14.6  | 17.7  | 21.4  | 25.7  | 30.5  |
| 54                   | 9.84   | 12.5  | 15.9  | 19.9  | 24.7  | 30.3  | 36.9  | 44.5  | 53.3  | 63.4  |
| 67                   | 17.5   | 22.3  | 28.2  | 35.4  | 43.8  | 53.7  | 65.3  | 78.8  | 94.3  | 112   |
| 79                   | 28.0   | 35.7  | 45.2  | 56.6  | 70.1  | 85.9  | 104   | 126   | 151   | 179   |
| 92                   | 41.8   | 53.2  | 67.4  | 84.3  | 104   | 128   | 155   | 187   | 224   | 266   |
| 105                  | 59.1   | 75.2  | 95.3  | 119   | 147   | 181   | 219   | 264   | 316   | 375   |
| Schedule 40 steel    |  |       |       |       |       |       |       |       |       |       |
| 10                   | 0.209  | 0.266 | 0.335 | 0.417 | 0.514 | 0.627 | 0.757 | 0.908 | 1.08  | 1.28  |
| 15                   | 0.390  | 0.496 | 0.625 | 0.778 | 0.957 | 1.17  | 1.41  | 1.69  | 2.01  | 2.37  |
| 20                   | 0.828  | 1.05  | 1.32  | 1.65  | 2.02  | 2.46  | 2.97  | 3.56  | 4.23  | 5.00  |
| 25                   | 1.58   | 2.00  | 2.52  | 3.12  | 3.84  | 4.67  | 5.63  | 6.74  | 8.01  | 9.47  |
| 32                   | 3.27   | 4.15  | 5.21  | 6.46  | 7.93  | 9.65  | 11.6  | 13.9  | 16.5  | 19.5  |
| 40                   | 4.92   | 6.24  | 7.83  | 9.71  | 11.9  | 14.5  | 17.5  | 20.9  | 24.8  | 29.3  |
| 50                   | 9.52   | 12.1  | 15.2  | 18.8  | 23.0  | 28.0  | 33.7  | 40.3  | 47.9  | 56.5  |
| 65                   | 15.2   | 19.3  | 24.2  | 30.0  | 36.8  | 44.7  | 53.8  | 64.3  | 76.4  | 90.1  |
| 80                   | 27.0   | 34.2  | 42.9  | 53.1  | 65.1  | 79.0  | 95.2  | 114   | 135   | 159   |
| 100                  | 55.2   | 69.9  | 87.5  | 108   | 133   | 161   | 194   | 232   | 275   | 325   |

Note:

- (i) Capacity based on superheated vapour (superheat assumed useful)
- (ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C



Table 6b: Suction line capacities in kW for Klea® 407A Suction line vapour with 5°C of superheat

| Nominal line size mm | Saturation temperature change 2.0 K in 100 m<br>Mean evaporating temperature °C at corresponding pressure drop, Pa/m |       |       |       |       |       |       |       |       |       |
|----------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| T                    | -40  | -35   | -30   | -25   | -20   | -15   | -10   | -5    | 0     | 5     |
| $\Delta P/\Delta L$  | 104  | 126   | 150   | 177   | 208   | 241   | 279   | 320   | 366   | 416   |
| Type L Copper        |  |       |       |       |       |       |       |       |       |       |
| 10                   | 0.104  | 0.132 | 0.168 | 0.212 | 0.265 | 0.327 | 0.400 | 0.484 | 0.583 | 0.696 |
| 12                   | 0.241  | 0.306 | 0.391 | 0.492 | 0.612 | 0.755 | 0.921 | 1.12  | 1.34  | 1.60  |
| 15                   | 0.456  | 0.580 | 0.739 | 0.93  | 1.16  | 1.42  | 1.74  | 2.10  | 2.52  | 3.01  |
| 19                   | 0.782  | 0.996 | 1.27  | 1.59  | 1.98  | 2.44  | 2.97  | 3.59  | 4.31  | 5.14  |
| 22                   | 1.22   | 1.55  | 1.97  | 2.47  | 3.07  | 3.77  | 4.60  | 5.56  | 6.66  | 7.94  |
| 28                   | 2.48   | 3.16  | 4.01  | 5.03  | 6.25  | 7.68  | 9.34  | 11.3  | 13.5  | 16.1  |
| 35                   | 4.35   | 5.53  | 7.02  | 8.80  | 10.9  | 13.4  | 16.3  | 19.7  | 23.6  | 28.1  |
| 42                   | 6.90   | 8.78  | 11.1  | 14.0  | 17.3  | 21.2  | 25.8  | 31.2  | 37.3  | 44.4  |
| 54                   | 14.4   | 18.3  | 23.2  | 29.1  | 36.0  | 44.1  | 53.6  | 64.6  | 77.3  | 91.9  |
| 67                   | 25.5   | 32.5  | 41.2  | 51.5  | 63.7  | 78.1  | 94.9  | 114   | 137   | 162   |
| 79                   | 40.9   | 52.0  | 65.8  | 82.3  | 102   | 125   | 151   | 182   | 218   | 259   |
| 92                   | 60.9   | 77.5  | 98.1  | 123   | 152   | 186   | 225   | 271   | 324   | 385   |
| 105                  | 86.1   | 110   | 139   | 173   | 214   | 262   | 318   | 382   | 457   | 542   |
| Schedule 40 steel    |  |       |       |       |       |       |       |       |       |       |
| 10                   | 0.302  | 0.383 | 0.483 | 0.600 | 0.737 | 0.898 | 1.08  | 1.30  | 1.54  | 1.82  |
| 15                   | 0.563  | 0.715 | 0.898 | 1.12  | 1.37  | 1.67  | 2.01  | 2.41  | 2.86  | 3.38  |
| 20                   | 1.19   | 1.51  | 1.90  | 2.36  | 2.89  | 3.52  | 4.24  | 5.07  | 6.03  | 7.12  |
| 25                   | 2.26   | 2.87  | 3.60  | 4.47  | 5.48  | 6.66  | 8.03  | 9.60  | 11.4  | 13.5  |
| 32                   | 4.68   | 5.94  | 7.45  | 9.23  | 11.3  | 13.7  | 16.6  | 19.8  | 23.5  | 27.7  |
| 40                   | 7.04   | 8.92  | 11.2  | 13.9  | 17.0  | 20.6  | 24.8  | 29.7  | 35.3  | 41.6  |
| 50                   | 13.6   | 17.3  | 21.6  | 26.8  | 32.8  | 39.8  | 47.9  | 57.3  | 68.0  | 80.2  |
| 65                   | 21.7   | 27.6  | 34.5  | 42.7  | 52.3  | 63.5  | 76.5  | 91.3  | 108   | 128   |
| 80                   | 38.5   | 48.8  | 61.1  | 75.6  | 92.5  | 112   | 135   | 161   | 192   | 226   |
| 100                  | 78.6   | 99.5  | 125   | 154   | 189   | 229   | 275   | 329   | 390   | 460   |

Note:

- (i) Capacity based on superheated vapour (superheat assumed useful)
- (ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C

Table 6c: Suction line capacities in kW for Klea® 407A Suction line vapour with 5°C of superheat

| Nominal line size mm | Saturation temperature change 2.0 K in 100 m<br>Mean evaporating temperature °C at corresponding pressure drop, Pa/m |       |       |       |       |       |       |       |       |      |
|----------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|------|
| T                    | -40  | -35   | -30   | -25   | -20   | -15   | -10   | -5    | 0     | 5    |
| $\Delta P/\Delta L$  | 209  | 252   | 300   | 354   | 415   | 483   | 558   | 640   | 731   | 831  |
| Type L Copper        |  |       |       |       |       |       |       |       |       |      |
| 10                   | 0.154  | 0.195 | 0.249 | 0.314 | 0.391 | 0.482 | 0.588 | 0.712 | 0.855 | 1.02 |
| 12                   | 0.355  | 0.452 | 0.576 | 0.724 | 0.901 | 1.11  | 1.35  | 1.63  | 1.96  | 2.34 |
| 15                   | 0.672  | 0.855 | 1.09  | 1.37  | 1.70  | 2.09  | 2.54  | 3.07  | 3.69  | 4.39 |
| 19                   | 1.15   | 1.46  | 1.86  | 2.34  | 2.90  | 3.56  | 4.34  | 5.24  | 6.28  | 7.48 |
| 22                   | 1.78   | 2.27  | 2.89  | 3.62  | 4.49  | 5.52  | 6.71  | 8.10  | 9.71  | 11.6 |
| 28                   | 3.64   | 4.63  | 5.87  | 7.36  | 9.12  | 11.2  | 13.6  | 16.4  | 19.7  | 23.4 |
| 35                   | 6.36   | 8.09  | 10.3  | 12.9  | 15.9  | 19.5  | 23.7  | 28.6  | 34.2  | 40.7 |
| 42                   | 10.1   | 12.8  | 16.3  | 20.4  | 25.2  | 30.9  | 37.5  | 45.2  | 54.1  | 64.3 |
| 54                   | 21.0   | 26.7  | 33.8  | 42.3  | 52.3  | 64.1  | 77.8  | 93.6  | 112   | 133  |
| 67                   | 37.2   | 47.3  | 59.9  | 74.9  | 92.5  | 113   | 137   | 165   | 197   | 234  |
| 79                   | 59.5   | 75.7  | 95.7  | 120   | 148   | 181   | 219   | 264   | 315   | 373  |
| 92                   | 88.6   | 113   | 142   | 178   | 220   | 269   | 326   | 391   | 467   | 554  |
| 105                  | 125  | 159   | 201   | 251   | 310   | 379   | 459   | 552   | 658   | 780  |
| Schedule 40 steel    |  |       |       |       |       |       |       |       |       |      |
| 10                   | 0.434  | 0.551 | 0.692 | 0.859 | 1.05  | 1.28  | 1.55  | 1.85  | 2.20  | 2.59 |
| 15                   | 0.808  | 1.03  | 1.29  | 1.60  | 1.96  | 2.38  | 2.87  | 3.43  | 4.07  | 4.81 |
| 20                   | 1.71   | 2.17  | 2.71  | 3.36  | 4.12  | 5.01  | 6.04  | 7.22  | 8.57  | 10.1 |
| 25                   | 3.24   | 4.10  | 5.14  | 6.37  | 7.81  | 9.48  | 11.4  | 13.6  | 16.2  | 19.1 |
| 32                   | 6.69   | 8.48  | 10.6  | 13.1  | 16.1  | 19.5  | 23.5  | 28.1  | 33.4  | 39.4 |
| 40                   | 10.0   | 12.7  | 15.9  | 19.7  | 24.2  | 29.3  | 35.3  | 42.2  | 50.0  | 59.0 |
| 50                   | 19.4   | 24.6  | 30.8  | 38.1  | 46.6  | 56.6  | 68.1  | 81.3  | 96.5  | 114  |
| 65                   | 31.0   | 39.2  | 49.1  | 60.7  | 74.3  | 90.2  | 108   | 130   | 154   | 181  |
| 80                   | 54.8   | 69.4  | 86.8  | 107   | 131   | 159   | 192   | 229   | 272   | 320  |
| 100                  | 112  | 141   | 177   | 219   | 268   | 324   | 390   | 466   | 553   | 652  |

Note:

- (i) Capacity based on superheated vapour (superheat assumed useful)
- (ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C

Table 7a: Suction line capacities in kW for Klea® 407A Suction line vapour at 20°C

| Nominal line size mm | Saturation temperature change 1.0 K in 100 m<br>Mean evaporating temperature °C at corresponding pressure drop, Pa/m |       |       |       |       |       |       |       |       |       |
|----------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                      | -40  | -35   | -30   | -25   | -20   | -15   | -10   | -5    | 0     | 5     |
| T                    | 52   | 63    | 75    | 89    | 104   | 121   | 139   | 160   | 183   | 208   |
| $\Delta P/\Delta L$  |  |       |       |       |       |       |       |       |       |       |
| Type L Copper        |  |       |       |       |       |       |       |       |       |       |
| 10                   | 0.058  | 0.075 | 0.097 | 0.124 | 0.158 | 0.197 | 0.245 | 0.302 | 0.369 | 0.448 |
| 12                   | 0.136  | 0.174 | 0.226 | 0.290 | 0.366 | 0.458 | 0.568 | 0.698 | 0.852 | 1.03  |
| 15                   | 0.258  | 0.332 | 0.430 | 0.550 | 0.694 | 0.868 | 1.07  | 1.32  | 1.61  | 1.95  |
| 19                   | 0.444  | 0.572 | 0.740 | 0.945 | 1.19  | 1.49  | 1.84  | 2.26  | 2.75  | 3.33  |
| 22                   | 0.692  | 0.891 | 1.15  | 1.47  | 1.85  | 2.31  | 2.86  | 3.50  | 4.26  | 5.16  |
| 28                   | 1.42   | 1.83  | 2.36  | 3.00  | 3.78  | 4.71  | 5.82  | 7.13  | 8.67  | 10.5  |
| 35                   | 2.49   | 3.21  | 4.14  | 5.27  | 6.63  | 8.25  | 10.2  | 12.5  | 15.1  | 18.3  |
| 42                   | 3.97   | 5.11  | 6.58  | 8.37  | 10.5  | 13.1  | 16.2  | 19.8  | 24.0  | 29.0  |
| 54                   | 8.30   | 10.7  | 13.8  | 17.5  | 22.0  | 27.3  | 33.6  | 41.1  | 49.9  | 60.1  |
| 67                   | 14.8   | 19.0  | 24.5  | 31.1  | 39.0  | 48.4  | 59.6  | 72.8  | 88.3  | 106   |
| 79                   | 23.7   | 30.5  | 39.2  | 49.7  | 62.4  | 77.5  | 95.3  | 116   | 141   | 170   |
| 92                   | 35.4   | 45.6  | 58.5  | 74.2  | 93.0  | 115   | 142   | 173   | 210   | 253   |
| 105                  | 50.1   | 64.5  | 82.8  | 105   | 131   | 163   | 200   | 244   | 296   | 356   |
| Schedule 40 steel    |  |       |       |       |       |       |       |       |       |       |
| 10                   | 0.178  | 0.229 | 0.293 | 0.370 | 0.461 | 0.569 | 0.696 | 0.844 | 1.02  | 1.22  |
| 15                   | 0.333  | 0.429 | 0.547 | 0.690 | 0.860 | 1.06  | 1.29  | 1.57  | 1.89  | 2.26  |
| 20                   | 0.708  | 0.911 | 1.16  | 1.46  | 1.82  | 2.24  | 2.73  | 3.31  | 3.98  | 4.76  |
| 25                   | 1.35   | 1.74  | 2.21  | 2.78  | 3.46  | 4.25  | 5.18  | 6.27  | 7.54  | 9.01  |
| 32                   | 2.81   | 3.61  | 4.59  | 5.76  | 7.15  | 8.79  | 10.7  | 13.0  | 15.6  | 18.6  |
| 40                   | 4.23   | 5.43  | 6.90  | 8.66  | 10.7  | 13.2  | 16.1  | 19.5  | 23.4  | 27.9  |
| 50                   | 8.20   | 10.5  | 13.4  | 16.8  | 20.8  | 25.5  | 31.1  | 37.6  | 45.1  | 53.8  |
| 65                   | 13.1   | 16.8  | 21.4  | 26.8  | 33.2  | 40.8  | 49.6  | 59.9  | 71.9  | 85.8  |
| 80                   | 23.3   | 29.9  | 37.9  | 47.5  | 58.8  | 72.1  | 87.8  | 106   | 127   | 152   |
| 10                   | 0.178  | 0.229 | 0.293 | 0.370 | 0.461 | 0.569 | 0.696 | 0.844 | 1.02  | 1.22  |

Note: (i) Capacity based on saturated vapour (no useful superheat)

(ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C

Table 7b: Suction line capacities in kW for Klea® 407A Suction line vapour at 20°C

| Nominal<br>line size<br>mm | Saturation temperature change 2.0 K in 100 m<br>Mean evaporating temperature °C at corresponding pressure drop, Pa/m |       |       |       |       |       |       |       |       |       |
|----------------------------|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|                            | -40  | -35   | -30   | -25   | -20   | -15   | -10   | -5    | 0     | 5     |
| T                          | 104  | 126   | 150   | 177   | 208   | 241   | 279   | 320   | 366   | 416   |
| $\Delta P/\Delta L$        |  |       |       |       |       |       |       |       |       |       |
| Type L Copper              |  |       |       |       |       |       |       |       |       |       |
| 10                         | 0.086  | 0.111 | 0.144 | 0.185 | 0.234 | 0.292 | 0.362 | 0.445 | 0.544 | 0.659 |
| 12                         | 0.201  | 0.259 | 0.335 | 0.429 | 0.541 | 0.676 | 0.837 | 1.03  | 1.25  | 1.52  |
| 15                         | 0.382  | 0.492 | 0.636 | 0.812 | 1.02  | 1.28  | 1.58  | 1.94  | 2.36  | 2.85  |
| 19                         | 0.656  | 0.846 | 1.09  | 1.39  | 1.75  | 2.19  | 2.70  | 3.31  | 4.03  | 4.87  |
| 22                         | 1.02   | 1.32  | 1.70  | 2.16  | 2.72  | 3.39  | 4.19  | 5.13  | 6.23  | 7.53  |
| 28                         | 2.09   | 2.69  | 3.47  | 4.41  | 5.55  | 6.90  | 8.51  | 10.4  | 12.6  | 15.3  |
| 35                         | 3.66   | 4.72  | 6.08  | 7.72  | 9.70  | 12.1  | 14.9  | 18.2  | 22.1  | 26.6  |
| 42                         | 5.82   | 7.50  | 9.65  | 12.3  | 15.4  | 19.1  | 23.6  | 28.8  | 34.9  | 42.1  |
| 54                         | 12.2   | 15.7  | 20.1  | 25.6  | 32.0  | 39.8  | 49.0  | 59.8  | 72.4  | 87.2  |
| 67                         | 21.6   | 27.8  | 35.8  | 45.3  | 56.8  | 70.5  | 86.7  | 106   | 128   | 154   |
| 79                         | 34.6   | 44.6  | 57.2  | 72.5  | 90.8  | 113   | 138   | 169   | 204   | 246   |
| 92                         | 51.7   | 66.5  | 85.3  | 108   | 135   | 168   | 206   | 251   | 304   | 365   |
| 105                        | 73.1   | 94.1  | 121   | 153   | 191   | 237   | 291   | 354   | 428   | 515   |
| Schedule 40 steel          |  |       |       |       |       |       |       |       |       |       |
| 10                         | 0.258  | 0.332 | 0.423 | 0.533 | 0.663 | 0.817 | 0.997 | 1.21  | 1.45  | 1.73  |
| 15                         | 0.482  | 0.620 | 0.790 | 0.993 | 1.23  | 1.52  | 1.85  | 2.24  | 2.69  | 3.22  |
| 20                         | 1.02   | 1.31  | 1.67  | 2.10  | 2.61  | 3.20  | 3.91  | 4.72  | 5.67  | 6.78  |
| 25                         | 1.95   | 2.50  | 3.18  | 3.98  | 4.94  | 6.07  | 7.40  | 8.94  | 10.7  | 12.8  |
| 32                         | 4.04   | 5.18  | 6.57  | 8.24  | 10.2  | 12.5  | 15.3  | 18.4  | 22.1  | 26.4  |
| 40                         | 6.07   | 7.79  | 9.88  | 12.4  | 15.3  | 18.8  | 22.9  | 27.7  | 33.2  | 39.6  |
| 50                         | 11.8   | 15.1  | 19.1  | 23.9  | 29.6  | 36.3  | 44.2  | 53.4  | 64.0  | 76.4  |
| 65                         | 18.8   | 24.1  | 30.5  | 38.2  | 47.3  | 58.0  | 70.5  | 85.1  | 102   | 122   |
| 80                         | 33.3   | 42.7  | 54.1  | 67.6  | 83.7  | 103   | 125   | 150   | 180   | 215   |
| 100                        | 68.1   | 87.2  | 110   | 138   | 171   | 209   | 254   | 307   | 368   | 438   |

## Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C

Table 7c: Suction line capacities in kW for Klea® 407A Suction line vapour at 20°C

| Nominal line size mm | Saturation temperature change 4.0 K in 100 m<br>Mean evaporating temperature °C at corresponding pressure drop, Pa/m |       |       |       |       |       |      |       |       |       |
|----------------------|--|-------|-------|-------|-------|-------|------|-------|-------|-------|
|                      | -40  | -35   | -30   | -25   | -20   | -15   | -10  | -5    | 0     | 5     |
| T                    | 209  | 252   | 300   | 354   | 415   | 483   | 558  | 640   | 731   | 831   |
| $\Delta P/\Delta L$  | 209  | 252   | 300   | 354   | 415   | 483   | 558  | 640   | 731   | 831   |
| Type L Copper        |  |       |       |       |       |       |      |       |       |       |
| 10                   | 0.128  | 0.165 | 0.214 | 0.273 | 0.345 | 0.43  | 1    | 0.534 | 0.655 | 0.798 |
| 12                   | 0.298  | 0.384 | 0.496 | 0.633 | 0.797 | 0.995 | 1.23 | 1.51  | 1.83  | 2.22  |
| 15                   | 0.564  | 0.727 | 0.938 | 1.19  | 1.50  | 1.88  | 2.32 | 2.83  | 3.45  | 4.16  |
| 19                   | 0.968  | 1.25  | 1.61  | 2.05  | 2.57  | 3.21  | 3.95 | 4.84  | 5.88  | 7.09  |
| 22                   | 1.50   | 1.94  | 2.49  | 3.17  | 3.99  | 4.96  | 6.12 | 7.48  | 9.08  | 11.0  |
| 28                   | 3.07   | 3.95  | 5.09  | 6.46  | 8.11  | 10.1  | 12.4 | 15.2  | 18.4  | 22.2  |
| 35                   | 5.37   | 6.92  | 8.90  | 11.3  | 14.2  | 17.6  | 21.7 | 26.4  | 32.0  | 38.6  |
| 42                   | 8.53   | 11.0  | 14.1  | 17.9  | 22.5  | 27.9  | 34.3 | 41.8  | 50.7  | 61.0  |
| 54                   | 17.8   | 22.9  | 29.4  | 37.3  | 46.7  | 57.9  | 71.1 | 86.7  | 105   | 126   |
| 67                   | 31.6   | 40.7  | 52.1  | 66.0  | 82.6  | 102   | 126  | 153   | 185   | 223   |
| 79                   | 50.5   | 65.1  | 83.4  | 105   | 132   | 163   | 201  | 244   | 295   | 355   |
| 92                   | 75.3   | 96.9  | 124   | 157   | 196   | 243   | 298  | 363   | 438   | 526   |
| 105                  | 106  | 137   | 175   | 222   | 277   | 343   | 420  | 511   | 617   | 741   |
| Schedule 40 steel    |  |       |       |       |       |       |      |       |       |       |
| 10                   | 0.373  | 0.479 | 0.609 | 0.765 | 0.950 | 1.17  | 1.42 | 1.72  | 2.07  | 2.47  |
| 15                   | 0.695  | 0.893 | 1.13  | 1.42  | 1.77  | 2.17  | 2.64 | 3.19  | 3.83  | 4.58  |
| 20                   | 1.47   | 1.89  | 2.40  | 3.00  | 3.72  | 4.57  | 5.56 | 6.72  | 8.07  | 9.63  |
| 25                   | 2.79   | 3.58  | 4.54  | 5.69  | 7.05  | 8.65  | 10.5 | 12.7  | 15.3  | 18.2  |
| 32                   | 5.78   | 7.41  | 9.39  | 11.8  | 14.5  | 17.8  | 21.7 | 26.2  | 31.4  | 37.5  |
| 40                   | 8.69   | 11.1  | 14.1  | 17.6  | 21.8  | 26.8  | 32.6 | 39.3  | 47.1  | 56.2  |
| 50                   | 16.8   | 21.5  | 27.3  | 34.1  | 42.2  | 51.7  | 62.8 | 75.8  | 90.9  | 108   |
| 65                   | 26.9   | 34.4  | 43.5  | 54.4  | 67.2  | 82.4  | 100  | 121   | 145   | 173   |
| 80                   | 47.6   | 60.9  | 77    | 96.2  | 119   | 146   | 177  | 213   | 256   | 305   |
| 100                  | 97.1   | 124   | 157   | 196   | 242   | 297   | 360  | 435   | 521   | 621   |

## Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 C (no subcooling) i.e. liquid temperature of 37.8°C

Table 8a: Discharge line capacities in kW for Klea® 407A

| Nominal<br>line size<br>mm | Condenser Saturation temperature change 2.0 K in 100 m Pressure gradient of 880 Pa/m<br>Mean evaporating temperature °C Discharge line superheat of 45.0K |       |       |       |       |       |       |      |      |      |
|----------------------------|---|-------|-------|-------|-------|-------|-------|------|------|------|
|                            | -40.0   | -35.0 | -30.0 | -25.0 | -20.0 | -15.0 | -10.0 | -5.0 | 0.0  | 5.0  |
| T                          |   |       |       |       |       |       |       |      |      |      |
| Type L Copper              |   |       |       |       |       |       |       |      |      |      |
| 10                         | 1.24  | 1.28  | 1.31  | 1.34  | 1.37  | 1.40  | 1.43  | 1.46 | 1.49 | 1.52 |
| 12                         | 2.85  | 2.92  | 3.00  | 3.07  | 3.15  | 3.22  | 3.29  | 3.36 | 3.42 | 3.49 |
| 15                         | 5.35  | 5.49  | 5.63  | 5.77  | 5.91  | 6.04  | 6.18  | 6.30 | 6.43 | 6.55 |
| 19                         | 9.11  | 9.36  | 9.60  | 9.84  | 10.1  | 10.3  | 10.5  | 10.7 | 11.0 | 11.2 |
| 22                         | 14.1  | 14.5  | 14.8  | 15.2  | 15.6  | 15.9  | 16.3  | 16.6 | 16.9 | 17.2 |
| 28                         | 28.5  | 29.3  | 30.0  | 30.8  | 31.5  | 32.2  | 32.9  | 33.6 | 34.2 | 34.9 |
| 35                         | 49.6  | 50.9  | 52.2  | 53.5  | 54.8  | 56.0  | 57.3  | 58.5 | 59.6 | 60.7 |
| 42                         | 78.4  | 80.5  | 82.5  | 84.6  | 86.6  | 88.6  | 90.5  | 92.4 | 94.2 | 95.9 |
| 54                         | 162   | 166   | 171   | 175   | 179   | 183   | 187   | 191  | 195  | 198  |
| 67                         | 286   | 294   | 301   | 309   | 316   | 323   | 330   | 337  | 344  | 350  |
| 79                         | 456   | 468   | 480   | 492   | 504   | 515   | 526   | 537  | 548  | 558  |
| 92                         | 676   | 695   | 712   | 730   | 747   | 764   | 781   | 797  | 813  | 828  |
| 105                        | 953   | 978   | 1003  | 1028  | 1053  | 1077  | 1100  | 1123 | 1145 | 1166 |
| Schedule 40 steel          |   |       |       |       |       |       |       |      |      |      |
| 10                         | 3.17  | 3.26  | 3.34  | 3.43  | 3.51  | 3.59  | 3.66  | 3.74 | 3.81 | 3.88 |
| 15                         | 5.88  | 6.04  | 6.20  | 6.35  | 6.50  | 6.65  | 6.79  | 6.93 | 7.07 | 7.20 |
| 20                         | 12.4  | 12.7  | 13.0  | 13.4  | 13.7  | 14.0  | 14.3  | 14.6 | 14.9 | 15.1 |
| 25                         | 23.4  | 24.0  | 24.6  | 25.2  | 25.8  | 26.4  | 27.0  | 27.6 | 28.1 | 28.6 |
| 32                         | 48.2  | 49.5  | 50.7  | 52.0  | 53.2  | 54.4  | 55.6  | 56.8 | 57.9 | 59.0 |
| 40                         | 72.3  | 74.2  | 76.1  | 78.0  | 79.8  | 81.7  | 83.4  | 85.2 | 86.8 | 88.4 |
| 50                         | 139   | 143   | 147   | 150   | 154   | 157   | 161   | 164  | 167  | 170  |
| 65                         | 222   | 228   | 234   | 240   | 245   | 251   | 256   | 262  | 267  | 272  |
| 80                         | 392   | 403   | 413   | 423   | 433   | 443   | 453   | 462  | 471  | 480  |
| 100                        | 798   | 820   | 841   | 861   | 882   | 902   | 922   | 941  | 959  | 977  |

## Note:

(i) Capacity based on saturated vapour (no useful superheat)

(ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C

Table 8b: Discharge line capacities in kW for Klea® 407A

| Nominal<br>line size<br>mm | Condenser Saturation temperature change 2.0 K in 100 m Pressure gradient of 880 Pa/m<br>Mean evaporating temperature °C Discharge line superheat of 60.0K |       |       |       |       |       |       |      |      |      |
|----------------------------|---|-------|-------|-------|-------|-------|-------|------|------|------|
|                            | -40.0   | -35.0 | -30.0 | -25.0 | -20.0 | -15.0 | -10.0 | -5.0 | 0.0  | 5.0  |
| T                          |   |       |       |       |       |       |       |      |      |      |
| Type L Copper              |   |       |       |       |       |       |       |      |      |      |
| 10                         | 1.18  | 1.21  | 1.24  | 1.27  | 1.30  | 1.33  | 1.36  | 1.39 | 1.42 | 1.44 |
| 12                         | 2.71  | 2.78  | 2.86  | 2.93  | 3.00  | 3.06  | 3.13  | 3.19 | 3.26 | 3.32 |
| 15                         | 5.10  | 5.23  | 5.37  | 5.50  | 5.63  | 5.76  | 5.88  | 6.01 | 6.12 | 6.24 |
| 19                         | 8.69  | 8.92  | 9.15  | 9.38  | 9.60  | 9.82  | 10.0  | 10.2 | 10.4 | 10.6 |
| 22                         | 13.4  | 13.8  | 14.1  | 14.5  | 14.8  | 15.2  | 15.5  | 15.8 | 16.1 | 16.4 |
| 28                         | 27.2  | 27.9  | 28.7  | 29.4  | 30.1  | 30.8  | 31.4  | 32.1 | 32.7 | 33.3 |
| 35                         | 47.4  | 48.7  | 49.9  | 51.2  | 52.4  | 53.6  | 54.7  | 55.9 | 57.0 | 58.0 |
| 42                         | 74.9  | 76.9  | 78.9  | 80.9  | 82.8  | 84.7  | 86.5  | 88.3 | 90.0 | 91.7 |
| 54                         | 155   | 159   | 163   | 167   | 171   | 175   | 179   | 183  | 186  | 190  |
| 67                         | 274   | 281   | 288   | 296   | 303   | 310   | 316   | 323  | 329  | 335  |
| 79                         | 437   | 448   | 460   | 471   | 482   | 493   | 504   | 515  | 525  | 534  |
| 92                         | 648   | 666   | 683   | 700   | 716   | 733   | 749   | 764  | 779  | 794  |
| 105                        | 914   | 938   | 962   | 986   | 1010  | 1032  | 1055  | 1077 | 1098 | 1118 |
| Schedule 40 steel          |   |       |       |       |       |       |       |      |      |      |
| 10                         | 3.06  | 3.14  | 3.22  | 3.30  | 3.38  | 3.46  | 3.53  | 3.61 | 3.68 | 3.75 |
| 15                         | 5.68  | 5.83  | 5.98  | 6.13  | 6.27  | 6.41  | 6.55  | 6.69 | 6.82 | 6.95 |
| 20                         | 11.9  | 12.3  | 12.6  | 12.9  | 13.2  | 13.5  | 13.8  | 14.1 | 14.4 | 14.6 |
| 25                         | 22.6  | 23.2  | 23.8  | 24.4  | 25.0  | 25.5  | 26.1  | 26.6 | 27.1 | 27.6 |
| 32                         | 46.5  | 47.8  | 49.0  | 50.2  | 51.4  | 52.6  | 53.7  | 54.8 | 55.9 | 57.0 |
| 40                         | 69.8  | 71.7  | 73.5  | 75.3  | 77.1  | 78.9  | 80.6  | 82.3 | 83.9 | 85.4 |
| 50                         | 135   | 138   | 142   | 145   | 149   | 152   | 155   | 159  | 162  | 165  |
| 65                         | 214   | 220   | 226   | 232   | 237   | 242   | 248   | 253  | 258  | 263  |
| 80                         | 379   | 389   | 399   | 409   | 419   | 428   | 438   | 447  | 455  | 464  |
| 100                        | 771   | 792   | 813   | 833   | 852   | 872   | 891   | 909  | 927  | 944  |

## Note:

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C

Table 9a: Liquid line capacities in kW for Klea® 407A

| Nominal<br>line size<br>mm | Liquid line velocity 0.5 m/s<br>Mean evaporating temperature °C |       |       |       |       |       |       |       |      |      |     |
|----------------------------|---|-------|-------|-------|-------|-------|-------|-------|------|------|-----|
|                            | T   | -40.0 | -35.0 | -30.0 | -25.0 | -20.0 | -15.0 | -10.0 | -5.0 | 0.0  | 5.0 |
| Type L Copper              |   |       |       |       |       |       |       |       |      |      |     |
| 10                         | 3.21  | 3.30  | 3.39  | 3.47  | 3.55  | 3.63  | 3.71  | 3.79  | 3.86 | 3.93 |     |
| 12                         | 5.99  | 6.15  | 6.31  | 6.47  | 6.62  | 6.77  | 6.92  | 7.06  | 7.20 | 7.33 |     |
| 15                         | 9.62  | 9.88  | 10.1  | 10.4  | 10.6  | 10.9  | 11.1  | 11.3  | 11.6 | 11.8 |     |
| 19                         | 14.4  | 14.8  | 15.1  | 15.5  | 15.9  | 16.3  | 16.6  | 16.9  | 17.3 | 17.6 |     |
| 22                         | 20.0  | 20.5  | 21.0  | 21.6  | 22.1  | 22.6  | 23.1  | 23.5  | 24.0 | 24.4 |     |
| 28                         | 34.1  | 35.0  | 35.9  | 36.8  | 37.6  | 38.5  | 39.3  | 40.1  | 40.9 | 41.7 |     |
| 35                         | 51.9  | 53.2  | 54.6  | 56.0  | 57.3  | 58.6  | 59.9  | 61.1  | 62.3 | 63.5 |     |
| 42                         | 73.4  | 75.4  | 77.3  | 79.2  | 81.1  | 83.0  | 84.8  | 86.5  | 88.2 | 89.9 |     |
| 54                         | 128   | 131   | 135   | 138   | 141   | 144   | 147   | 151   | 153  | 156  |     |
| 67                         | 197   | 202   | 207   | 213   | 218   | 223   | 227   | 232   | 237  | 241  |     |
| 79                         | 281   | 289   | 296   | 303   | 311   | 318   | 325   | 331   | 338  | 344  |     |
| 92                         | 380   | 390   | 400   | 410   | 420   | 430   | 439   | 448   | 457  | 465  |     |
| 105                        | 494   | 507   | 521   | 533   | 546   | 559   | 571   | 582   | 594  | 605  |     |
| Schedule 40 steel          |   |       |       |       |       |       |       |       |      |      |     |
| 10                         | 7.87  | 8.09  | 8.29  | 8.50  | 8.70  | 8.90  | 9.09  | 9.28  | 9.46 | 9.64 |     |
| 15                         | 12.5  | 12.9  | 13.2  | 13.5  | 13.9  | 14.2  | 14.5  | 14.8  | 15.1 | 15.3 |     |
| 20                         | 22.0  | 22.6  | 23.2  | 23.8  | 24.3  | 24.9  | 25.4  | 25.9  | 26.4 | 26.9 |     |
| 25                         | 35.6  | 36.6  | 37.5  | 38.5  | 39.4  | 40.3  | 41.2  | 42.0  | 42.8 | 43.6 |     |
| 32                         | 61.7  | 63.4  | 65.0  | 66.6  | 68.2  | 69.7  | 71.3  | 111   | 74.2 | 75.5 |     |
| 40                         | 84.0  | 86.2  | 88.5  | 90.7  | 92.8  | 94.9  | 97    | 99    | 101  | 103  |     |
| 50                         | 138   | 142   | 146   | 149   | 153   | 156   | 160   | 163   | 166  | 169  |     |
| 65                         | 198   | 203   | 208   | 213   | 218   | 223   | 228   | 233   | 237  | 242  |     |
| 80                         | 305   | 313   | 321   | 329   | 337   | 345   | 352   | 360   | 367  | 373  |     |
| 100                        | 525   | 539   | 553   | 567   | 580   | 594   | 607   | 619   | 631  | 643  |     |

**Note:**

(i) Capacity based on saturated vapour (no useful superheat)

(ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C



Table 9b: Liquid line capacities in kW for Klea® 407A

| Nominal<br>line size<br>mm | Condenser saturation temperature change 2.0k in 100m Pressure gradient of 880 Pa/m<br>Mean evaporating temperature °C |       |       |       |       |       |       |       |      |      |     |
|----------------------------|---|-------|-------|-------|-------|-------|-------|-------|------|------|-----|
|                            | T   | -40.0 | -35.0 | -30.0 | -25.0 | -20.0 | -15.0 | -10.0 | -5.0 | 0.0  | 5.0 |
| Type L Copper              |   |       |       |       |       |       |       |       |      |      |     |
| 10                         | 5.03  | 5.16  | 5.29  | 5.42  | 5.55  | 5.68  | 5.80  | 5.92  | 6.04 | 6.15 |     |
| 12                         | 11.6  | 11.9  | 12.2  | 12.5  | 12.8  | 13.1  | 13.3  | 13.6  | 13.9 | 14.1 |     |
| 15                         | 21.7  | 22.3  | 22.9  | 23.5  | 24.0  | 24.6  | 25.1  | 25.6  | 26.1 | 26.6 |     |
| 19                         | 37.1  | 38.1  | 39.1  | 40.1  | 41.0  | 41.9  | 42.9  | 43.7  | 44.6 | 45.4 |     |
| 22                         | 57.4  | 58.9  | 60.5  | 62.0  | 63.4  | 64.9  | 66.3  | 67.7  | 69.0 | 70.3 |     |
| 28                         | 116   | 120   | 123   | 126   | 129   | 132   | 134   | 137   | 140  | 143  |     |
| 35                         | 203   | 208   | 214   | 219   | 224   | 229   | 234   | 239   | 244  | 248  |     |
| 42                         | 321   | 330   | 338   | 346   | 355   | 363   | 371   | 378   | 386  | 393  |     |
| 54                         | 665   | 683   | 701   | 718   | 735   | 752   | 768   | 784   | 800  | 814  |     |
| 67                         | 1175  | 1207  | 1238  | 1269  | 1299  | 1328  | 1357  | 1385  | 1412 | 1439 |     |
| 79                         | 1874  | 1925  | 1974  | 2023  | 2071  | 2118  | 2164  | 2209  | 2253 | 2294 |     |
| 92                         | 2785  | 2860  | 2934  | 3006  | 3078  | 3148  | 3216  | 3282  | 3347 | 3409 |     |
| 105                        | 3926  | 4031  | 4135  | 4237  | 4338  | 4437  | 4533  | 4627  | 4718 | 4805 |     |
| Schedule 40 steel          |   |       |       |       |       |       |       |       |      |      |     |
| 10                         | 13.2  | 13.6  | 13.9  | 14.3  | 14.6  | 15.0  | 15.3  | 15.6  | 15.9 | 16.2 |     |
| 15                         | 24.5  | 25.2  | 25.9  | 26.5  | 27.1  | 27.7  | 28.3  | 28.9  | 29.5 | 30.0 |     |
| 20                         | 51.7  | 53.1  | 54.5  | 55.8  | 57.1  | 58.4  | 59.7  | 60.9  | 62.1 | 63.3 |     |
| 25                         | 97.8  | 100   | 103   | 106   | 108   | 110   | 113   | 115   | 117  | 120  |     |
| 32                         | 202   | 207   | 212   | 218   | 223   | 228   | 233   | 238   | 242  | 247  |     |
| 40                         | 302   | 310   | 318   | 326   | 334   | 342   | 349   | 356   | 363  | 370  |     |
| 50                         | 583   | 599   | 614   | 629   | 644   | 659   | 673   | 687   | 701  | 714  |     |
| 65                         | 929   | 954   | 979   | 1003  | 1027  | 1050  | 1073  | 1095  | 1117 | 1138 |     |
| 80                         | 1642  | 1686  | 1730  | 1773  | 1815  | 1856  | 1897  | 1936  | 1974 | 2010 |     |
| 100                        | 3344  | 3434  | 3522  | 3609  | 3695  | 3779  | 3861  | 3941  | 4018 | 4093 |     |

**Note:**

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C

Table 10a: Minimum refrigeration capacities in kW for Klea® 407A Lubricant is EMKARATE RL32S - Type L Copper Tubing

| Evap<br>Temp °C | Suction<br>Temp °C | Nominal line size mm |       |       |       |       |      |      |      |      |      |      |      |      |
|-----------------|--------------------|----------------------|-------|-------|-------|-------|------|------|------|------|------|------|------|------|
|                 |                    | 10                   | 12    | 15    | 19    | 22    | 28   | 35   | 42   | 54   | 67   | 79   | 92   | 105  |
| 5               | 10                 | 0.267                | 0.580 | 1.05  | 1.73  | 2.62  | 5.10 | 8.62 | 13.3 | 26.6 | 45.7 | 71.3 | 104  | 144  |
|                 | 15                 | 0.263                | 0.572 | 1.03  | 1.71  | 2.58  | 5.02 | 8.49 | 13.1 | 26.2 | 45.0 | 70.2 | 102  | 142  |
|                 | 20                 | 0.259                | 0.564 | 1.02  | 1.69  | 2.54  | 4.95 | 8.38 | 12.9 | 25.8 | 44.4 | 69.3 | 101  | 140  |
| 0               | 5                  | 0.243                | 0.528 | 0.956 | 1.58  | 2.38  | 4.64 | 7.85 | 12.1 | 24.2 | 41.6 | 64.9 | 94.7 | 131  |
|                 | 10                 | 0.239                | 0.521 | 0.942 | 1.56  | 2.35  | 4.58 | 7.74 | 11.9 | 23.9 | 41.0 | 64.0 | 93.4 | 130  |
|                 | 15                 | 0.236                | 0.514 | 0.929 | 1.54  | 2.32  | 4.51 | 7.63 | 11.8 | 23.5 | 40.5 | 63.1 | 92.1 | 128  |
| -5              | 0                  | 0.220                | 0.479 | 0.867 | 1.43  | 2.16  | 4.21 | 7.12 | 11.0 | 22.0 | 37.7 | 58.9 | 85.9 | 119  |
|                 | 5                  | 0.217                | 0.473 | 0.855 | 1.41  | 2.13  | 4.15 | 7.02 | 10.8 | 21.7 | 37.2 | 58.1 | 84.7 | 118  |
|                 | 10                 | 0.214                | 0.467 | 0.844 | 1.39  | 2.10  | 4.10 | 6.93 | 10.7 | 21.4 | 36.7 | 57.3 | 83.6 | 116  |
| -10             | -5                 | 0.199                | 0.433 | 0.784 | 1.29  | 1.95  | 3.80 | 6.43 | 9.94 | 19.8 | 34.1 | 53.2 | 77.6 | 108  |
|                 | 0                  | 0.196                | 0.427 | 0.773 | 1.28  | 1.93  | 3.75 | 6.35 | 9.80 | 19.6 | 33.6 | 52.5 | 76.6 | 106  |
|                 | 5                  | 0.194                | 0.422 | 0.763 | 1.26  | 1.90  | 3.70 | 6.26 | 9.67 | 19.3 | 33.2 | 51.8 | 75.6 | 105  |
| -15             | -10                | 0.179                | 0.390 | 0.705 | 1.17  | 1.76  | 3.42 | 5.79 | 8.94 | 17.9 | 30.7 | 47.9 | 69.9 | 97.0 |
|                 | -5                 | 0.177                | 0.385 | 0.696 | 1.15  | 1.73  | 3.38 | 5.71 | 8.82 | 17.6 | 30.3 | 47.2 | 68.9 | 95.7 |
|                 | 0                  | 0.174                | 0.380 | 0.686 | 1.13  | 1.71  | 3.33 | 5.64 | 8.71 | 17.4 | 29.9 | 46.6 | 68.0 | 94.4 |
| -20             | -15                | 0.160                | 0.349 | 0.632 | 1.04  | 1.57  | 3.07 | 5.19 | 8.01 | 16.0 | 27.5 | 42.9 | 62.6 | 86.8 |
|                 | -10                | 0.158                | 0.345 | 0.623 | 1.03  | 1.55  | 3.03 | 5.12 | 7.90 | 15.8 | 27.1 | 42.3 | 61.7 | 85.7 |
|                 | -5                 | 0.156                | 0.340 | 0.615 | 1.02  | 1.53  | 2.99 | 5.05 | 7.80 | 15.6 | 26.8 | 41.8 | 60.9 | 84.6 |
| -25             | -20                | 0.143                | 0.311 | 0.563 | 0.930 | 1.40  | 2.73 | 4.62 | 7.14 | 14.3 | 24.5 | 38.2 | 55.8 | 77.4 |
|                 | -15                | 0.141                | 0.307 | 0.555 | 0.918 | 1.38  | 2.70 | 4.56 | 7.04 | 14.1 | 24.2 | 37.7 | 55.0 | 76.4 |
|                 | -10                | 0.139                | 0.303 | 0.548 | 0.906 | 1.37  | 2.66 | 4.50 | 6.95 | 13.9 | 23.9 | 37.2 | 54.3 | 75.4 |
| -30             | -25                | 0.127                | 0.276 | 0.499 | 0.824 | 1.24  | 2.42 | 4.10 | 6.33 | 12.6 | 21.7 | 33.9 | 49.4 | 68.6 |
|                 | -20                | 0.125                | 0.272 | 0.492 | 0.813 | 1.23  | 2.39 | 4.04 | 6.24 | 12.5 | 21.4 | 33.4 | 48.8 | 67.7 |
|                 | -15                | 0.123                | 0.269 | 0.486 | 0.803 | 1.21  | 2.36 | 3.99 | 6.16 | 12.3 | 21.1 | 33.0 | 48.1 | 66.8 |
| -35             | -30                | 0.112                | 0.243 | 0.439 | 0.726 | 1.09  | 2.13 | 3.61 | 5.57 | 11.1 | 19.1 | 29.8 | 43.5 | 60.4 |
|                 | -25                | 0.110                | 0.240 | 0.434 | 0.717 | 1.08  | 2.11 | 3.56 | 5.50 | 11.0 | 18.9 | 29.4 | 43.0 | 59.6 |
|                 | -20                | 0.109                | 0.237 | 0.428 | 0.707 | 1.07  | 2.08 | 3.52 | 5.43 | 10.8 | 18.6 | 29.1 | 42.4 | 58.9 |
| -40             | -35                | 0.098                | 0.213 | 0.385 | 0.636 | 0.958 | 1.87 | 3.16 | 4.88 | 9.74 | 16.7 | 26.1 | 38.1 | 52.9 |
|                 | -30                | 0.096                | 0.210 | 0.380 | 0.627 | 0.946 | 1.84 | 3.12 | 4.81 | 9.62 | 16.5 | 25.8 | 37.6 | 52.2 |
|                 | -20                | 0.095                | 0.207 | 0.375 | 0.619 | 0.934 | 1.82 | 3.08 | 4.75 | 9.49 | 16.3 | 25.4 | 37.1 | 51.5 |

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C
- (iii) Content of refrigerant in lubricant estimated from solubility data at suction gas temperature and pressure

Table 10b: Minimum refrigeration capacities in kW for Klea® 407A Lubricant is EMKARATE RL32S - Type L Copper Tubing

| Evap<br>Temp °C | Suction<br>Temp °C | Nominal line size mm |       |      |      |      |      |      |      |      |      |
|-----------------|--------------------|----------------------|-------|------|------|------|------|------|------|------|------|
|                 |                    | 10                   | 15    | 20   | 25   | 32   | 40   | 50   | 65   | 80   | 100  |
| 5               | 10                 | 0.817                | 1.46  | 2.95 | 5.40 | 10.7 | 15.7 | 29.4 | 45.9 | 79.0 | 156  |
|                 | 15                 | 0.805                | 1.44  | 2.91 | 5.32 | 10.6 | 15.5 | 29.0 | 45.2 | 77.8 | 154  |
|                 | 20                 | 0.794                | 1.42  | 2.87 | 5.24 | 10.4 | 15.3 | 28.6 | 44.6 | 76.7 | 151  |
| 0               | 5                  | 0.744                | 1.33  | 2.69 | 4.91 | 9.75 | 14.3 | 26.8 | 41.8 | 71.9 | 142  |
|                 | 10                 | 0.733                | 1.31  | 2.65 | 4.84 | 9.62 | 14.1 | 26.4 | 41.2 | 70.9 | 140  |
|                 | 15                 | 0.723                | 1.29  | 2.61 | 4.78 | 9.49 | 13.9 | 26.0 | 40.6 | 69.9 | 138  |
| -5              | 0                  | 0.675                | 1.21  | 2.44 | 4.46 | 8.85 | 13.0 | 24.3 | 37.9 | 65.2 | 129  |
|                 | 5                  | 0.666                | 1.19  | 2.40 | 4.40 | 8.73 | 12.8 | 24.0 | 37.4 | 64.3 | 127  |
|                 | 10                 | 0.657                | 1.17  | 2.37 | 4.34 | 8.61 | 12.7 | 23.6 | 36.9 | 63.5 | 125  |
| -10             | -5                 | 0.610                | 1.09  | 2.20 | 4.03 | 8.00 | 11.8 | 22.0 | 34.2 | 59.0 | 116  |
|                 | 0                  | 0.602                | 1.08  | 2.17 | 3.97 | 7.89 | 11.6 | 21.7 | 33.8 | 58.1 | 115  |
|                 | 5                  | 0.594                | 1.06  | 2.14 | 3.92 | 7.78 | 11.4 | 21.4 | 33.3 | 57.4 | 113  |
| -15             | -10                | 0.549                | 0.982 | 1.98 | 3.62 | 7.20 | 10.6 | 19.8 | 30.8 | 53.0 | 105  |
|                 | -5                 | 0.541                | 0.969 | 1.96 | 3.58 | 7.10 | 10.4 | 19.5 | 30.4 | 52.3 | 103  |
|                 | 0                  | 0.534                | 0.956 | 1.93 | 3.53 | 7.01 | 10.3 | 19.2 | 30.0 | 51.6 | 102  |
| -20             | -15                | 0.492                | 0.879 | 1.78 | 3.25 | 6.45 | 9.48 | 17.7 | 27.6 | 47.5 | 93.7 |
|                 | -10                | 0.485                | 0.868 | 1.75 | 3.20 | 6.36 | 9.35 | 17.5 | 27.2 | 46.9 | 92.5 |
|                 | -5                 | 0.479                | 0.856 | 1.73 | 3.16 | 6.28 | 9.23 | 17.2 | 26.9 | 46.3 | 91.3 |
| -25             | -20                | 0.438                | 0.784 | 1.58 | 2.89 | 5.74 | 8.44 | 15.8 | 24.6 | 42.3 | 83.5 |
|                 | -15                | 0.432                | 0.773 | 1.56 | 2.85 | 5.67 | 8.33 | 15.6 | 24.3 | 41.8 | 82.4 |
|                 | -10                | 0.427                | 0.763 | 1.54 | 2.82 | 5.59 | 8.22 | 15.4 | 24.0 | 41.2 | 81.3 |
| -30             | -25                | 0.388                | 0.695 | 1.40 | 2.56 | 5.09 | 7.48 | 14.0 | 21.8 | 37.5 | 74.0 |
|                 | -20                | 0.383                | 0.685 | 1.38 | 2.53 | 5.02 | 7.39 | 13.8 | 21.5 | 37.0 | 73.0 |
|                 | -15                | 0.378                | 0.677 | 1.37 | 2.50 | 4.96 | 7.29 | 13.6 | 21.2 | 36.6 | 72.1 |
| -35             | -30                | 0.342                | 0.612 | 1.24 | 2.26 | 4.49 | 6.59 | 12.3 | 19.2 | 33.1 | 65.2 |
|                 | -25                | 0.338                | 0.604 | 1.22 | 2.23 | 4.43 | 6.51 | 12.2 | 19.0 | 32.6 | 64.4 |
|                 | -20                | 0.333                | 0.596 | 1.20 | 2.20 | 4.37 | 6.42 | 12.0 | 18.7 | 32.2 | 63.5 |
| -40             | -35                | 0.299                | 0.536 | 1.08 | 1.98 | 3.93 | 5.77 | 10.8 | 16.8 | 28.9 | 57.1 |
|                 | -30                | 0.295                | 0.529 | 1.07 | 1.95 | 3.87 | 5.70 | 10.6 | 16.6 | 28.6 | 56.3 |
|                 | -20                | 0.292                | 0.522 | 1.05 | 1.93 | 3.82 | 5.62 | 10.5 | 16.4 | 28.2 | 55.6 |

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40°C (no subcooling) i.e. liquid temperature of 37.8°C
- (iii) Content of refrigerant in lubricant estimated from solubility data at suction gas temperature and pressure

Table 10c: Minimum refrigeration capacities in kW for Klea® 407A Lubricant is EMKARATE RL68S - Type L Copper Tubing

| Evap<br>Temp °C | Suction<br>Temp °C | Nominal line size mm |       |       |       |       |      |      |      |      |      |      |       |      |
|-----------------|--------------------|----------------------|-------|-------|-------|-------|------|------|------|------|------|------|-------|------|
|                 |                    | 10                   | 12    | 15    | 19    | 22    | 28   | 35   | 42   | 54   | 67   | 79   | 92    | 105  |
| 5               | 10                 | 0.268                | 0.583 | 1.05  | 1.74  | 2.63  | 5.12 | 8.66 | 13.4 | 26.7 | 45.9 | 71.6 | 104.0 | 145  |
|                 | 15                 | 0.264                | 0.575 | 1.04  | 1.72  | 2.59  | 5.05 | 8.53 | 13.2 | 26.3 | 45.2 | 70.6 | 103.0 | 143  |
|                 | 20                 | 0.260                | 0.567 | 1.02  | 1.69  | 2.55  | 4.98 | 8.42 | 13.0 | 26.0 | 44.6 | 69.6 | 102.0 | 141  |
| 0               | 5                  | 0.244                | 0.531 | 0.960 | 1.59  | 2.39  | 4.66 | 7.88 | 12.2 | 24.3 | 41.8 | 65.2 | 95.1  | 132  |
|                 | 10                 | 0.240                | 0.523 | 0.946 | 1.56  | 2.36  | 4.60 | 7.81 | 12.0 | 24.0 | 41.2 | 64.3 | 93.8  | 130  |
|                 | 15                 | 0.237                | 0.516 | 0.934 | 1.54  | 2.33  | 4.53 | 7.67 | 11.8 | 23.7 | 40.6 | 63.4 | 92.5  | 128  |
| -5              | 0                  | 0.221                | 0.482 | 0.871 | 1.44  | 2.17  | 4.23 | 7.15 | 11.0 | 22.1 | 37.9 | 59.1 | 86.3  | 120  |
|                 | 5                  | 0.218                | 0.475 | 0.859 | 1.42  | 2.14  | 4.17 | 7.05 | 10.9 | 21.8 | 37.4 | 58.3 | 85.1  | 118  |
|                 | 10                 | 0.215                | 0.469 | 0.847 | 1.40  | 2.11  | 4.11 | 6.96 | 10.7 | 21.5 | 36.9 | 57.5 | 83.9  | 117  |
| -10             | -5                 | 0.200                | 0.435 | 0.787 | 1.30  | 1.96  | 3.82 | 6.46 | 9.98 | 19.9 | 34.2 | 53.4 | 77.9  | 108  |
|                 | 0                  | 0.197                | 0.429 | 0.776 | 1.28  | 1.93  | 3.77 | 6.37 | 9.84 | 19.7 | 33.8 | 52.7 | 76.9  | 107  |
|                 | 5                  | 0.195                | 0.424 | 0.766 | 1.27  | 1.91  | 3.72 | 6.29 | 9.71 | 19.4 | 33.3 | 52.0 | 75.9  | 105  |
| -15             | -10                | 0.180                | 0.391 | 0.708 | 1.17  | 1.76  | 3.44 | 5.81 | 8.98 | 17.9 | 30.8 | 48.1 | 70.1  | 97.3 |
|                 | -5                 | 0.177                | 0.386 | 0.698 | 1.15  | 1.74  | 3.39 | 5.74 | 8.86 | 17.7 | 30.4 | 47.4 | 69.2  | 96.0 |
|                 | 0                  | 0.175                | 0.381 | 0.689 | 1.14  | 1.72  | 3.35 | 5.66 | 8.74 | 17.5 | 30.0 | 46.8 | 68.3  | 94.8 |
| -20             | -15                | 0.161                | 0.351 | 0.634 | 1.05  | 1.58  | 3.08 | 5.21 | 8.04 | 16.1 | 27.6 | 43.1 | 62.8  | 87.2 |
|                 | -10                | 0.159                | 0.346 | 0.626 | 1.03  | 1.56  | 3.04 | 5.14 | 7.93 | 15.8 | 27.2 | 42.5 | 62.0  | 86.0 |
|                 | -5                 | 0.157                | 0.341 | 0.617 | 1.02  | 1.54  | 3.00 | 5.07 | 7.83 | 15.6 | 26.9 | 41.9 | 61.2  | 84.9 |
| -25             | -20                | 0.144                | 0.312 | 0.565 | 0.934 | 1.41  | 2.74 | 4.64 | 7.16 | 14.3 | 24.6 | 38.4 | 56.0  | 77.7 |
|                 | -15                | 0.142                | 0.308 | 0.557 | 0.921 | 1.39  | 2.71 | 4.58 | 7.07 | 14.1 | 24.3 | 37.9 | 55.2  | 76.7 |
|                 | -10                | 0.140                | 0.304 | 0.550 | 0.909 | 1.37  | 2.67 | 4.52 | 6.98 | 13.9 | 24.0 | 37.4 | 54.5  | 75.7 |
| -30             | -25                | 0.127                | 0.277 | 0.501 | 0.827 | 1.25  | 2.43 | 4.11 | 6.35 | 12.7 | 21.8 | 34.0 | 49.6  | 68.8 |
|                 | -20                | 0.126                | 0.273 | 0.494 | 0.817 | 1.23  | 2.40 | 4.06 | 6.27 | 12.5 | 21.5 | 33.6 | 49.0  | 67.9 |
|                 | -15                | 0.124                | 0.270 | 0.488 | 0.806 | 1.22  | 2.37 | 4.01 | 6.19 | 12.4 | 21.2 | 33.1 | 48.3  | 67.1 |
| -35             | -30                | 0.112                | 0.244 | 0.441 | 0.729 | 1.10  | 2.14 | 3.62 | 5.59 | 11.2 | 19.2 | 30.0 | 43.7  | 60.6 |
|                 | -25                | 0.111                | 0.241 | 0.435 | 0.719 | 1.08  | 2.11 | 3.57 | 5.52 | 11.0 | 18.9 | 29.6 | 43.1  | 59.9 |
|                 | -20                | 0.109                | 0.238 | 0.430 | 0.710 | 1.07  | 2.09 | 3.53 | 5.45 | 10.9 | 18.7 | 29.2 | 42.6  | 59.1 |
| -40             | -35                | 0.098                | 0.213 | 0.386 | 0.638 | 0.962 | 1.87 | 3.17 | 4.90 | 9.78 | 16.8 | 26.2 | 38.2  | 53.1 |
|                 | -30                | 0.097                | 0.211 | 0.381 | 0.630 | 0.949 | 1.85 | 3.13 | 4.83 | 9.65 | 16.6 | 25.9 | 37.7  | 52.4 |
|                 | -20                | 0.096                | 0.208 | 0.376 | 0.621 | 0.937 | 1.83 | 3.09 | 4.77 | 9.53 | 16.4 | 25.5 | 37.3  | 51.7 |

- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 37.8 °C
- (iii) Content of refrigerant in lubricant estimated from solubility data at suction gas temperature and pressure

Table 10d: Minimum refrigeration capacities in kW for Klea® 407A Lubricant is EMKARATE RL68S - Schedule 40 Steel Pipe

| Evap<br>Temp °C | Suction<br>Temp °C | Nominal line size mm |       |      |      |       |      |      |      |      |      |
|-----------------|--------------------|----------------------|-------|------|------|-------|------|------|------|------|------|
|                 |                    | 10                   | 15    | 20   | 25   | 32    | 40   | 50   | 65   | 80   | 100  |
| 5               | 10                 | 0.821                | 1.47  | 2.97 | 5.42 | 10.80 | 15.8 | 29.5 | 46.1 | 79.3 | 156  |
|                 | 15                 | 0.809                | 1.45  | 2.92 | 5.34 | 10.60 | 15.6 | 29.1 | 45.4 | 78.2 | 154  |
|                 | 20                 | 0.798                | 1.43  | 2.88 | 5.27 | 10.50 | 15.4 | 28.7 | 44.8 | 77.1 | 152  |
| 0               | 5                  | 0.747                | 1.34  | 2.70 | 4.93 | 9.80  | 14.4 | 26.9 | 41.9 | 72.2 | 142  |
|                 | 10                 | 0.737                | 1.32  | 2.66 | 4.87 | 9.66  | 14.2 | 26.5 | 41.4 | 71.2 | 140  |
|                 | 15                 | 0.727                | 1.30  | 2.63 | 4.80 | 9.53  | 14.0 | 26.2 | 40.8 | 70.2 | 139  |
| -5              | 0                  | 0.678                | 1.21  | 2.45 | 4.48 | 8.89  | 13.1 | 24.4 | 38.1 | 65.5 | 129  |
|                 | 5                  | 0.668                | 1.20  | 2.42 | 4.41 | 8.77  | 12.9 | 24.1 | 37.5 | 64.6 | 127  |
|                 | 10                 | 0.660                | 1.18  | 2.38 | 4.36 | 8.65  | 12.7 | 23.7 | 37.0 | 63.7 | 126  |
| -10             | -5                 | 0.612                | 1.10  | 2.21 | 4.04 | 8.03  | 11.8 | 22.1 | 34.4 | 59.2 | 117  |
|                 | 0                  | 0.604                | 1.08  | 2.18 | 3.99 | 7.92  | 11.6 | 21.8 | 33.9 | 58.4 | 115  |
|                 | 5                  | 0.596                | 1.07  | 2.15 | 3.94 | 7.82  | 11.5 | 21.5 | 33.5 | 57.6 | 114  |
| -15             | -10                | 0.551                | 0.986 | 1.99 | 3.64 | 7.23  | 10.6 | 19.8 | 30.9 | 53.3 | 105  |
|                 | -5                 | 0.544                | 0.973 | 1.96 | 3.59 | 7.13  | 10.5 | 19.6 | 30.5 | 52.5 | 104  |
|                 | 0                  | 0.537                | 0.960 | 1.94 | 3.54 | 7.04  | 10.3 | 19.3 | 30.1 | 51.9 | 102  |
| -20             | -15                | 0.493                | 0.883 | 1.78 | 3.26 | 6.47  | 9.51 | 17.8 | 27.7 | 47.7 | 94.1 |
|                 | -10                | 0.487                | 0.871 | 1.76 | 3.22 | 6.39  | 9.39 | 17.5 | 27.3 | 47.1 | 92.8 |
|                 | -5                 | 0.481                | 0.860 | 1.74 | 3.17 | 6.30  | 9.26 | 17.3 | 27.0 | 46.5 | 91.6 |
| -25             | -20                | 0.440                | 0.787 | 1.59 | 2.90 | 5.77  | 8.48 | 15.8 | 24.7 | 42.5 | 83.8 |
|                 | -15                | 0.434                | 0.776 | 1.57 | 2.87 | 5.69  | 8.36 | 15.6 | 24.4 | 41.9 | 82.7 |
|                 | -10                | 0.428                | 0.766 | 1.55 | 2.83 | 5.62  | 8.26 | 15.4 | 24.1 | 41.4 | 81.7 |
| -30             | -25                | 0.390                | 0.697 | 1.41 | 2.57 | 5.11  | 7.51 | 14.0 | 21.9 | 37.7 | 74.3 |
|                 | -20                | 0.385                | 0.688 | 1.39 | 2.54 | 5.04  | 7.41 | 13.8 | 21.6 | 37.2 | 73.3 |
|                 | -15                | 0.380                | 0.679 | 1.37 | 2.51 | 4.98  | 7.32 | 13.7 | 21.3 | 36.7 | 72.4 |
| -35             | -30                | 0.343                | 0.614 | 1.24 | 2.27 | 4.50  | 6.62 | 12.4 | 19.3 | 33.2 | 65.5 |
|                 | -25                | 0.339                | 0.606 | 1.22 | 2.24 | 4.44  | 6.53 | 12.2 | 19.0 | 32.7 | 64.6 |
|                 | -20                | 0.334                | 0.598 | 1.21 | 2.21 | 4.39  | 6.45 | 12.0 | 18.8 | 32.3 | 63.8 |
| -40             | -35                | 0.300                | 0.538 | 1.09 | 1.98 | 3.94  | 5.79 | 10.8 | 16.9 | 29.0 | 57.3 |
|                 | -30                | 0.297                | 0.530 | 1.07 | 1.96 | 3.89  | 5.72 | 10.7 | 16.6 | 28.7 | 56.5 |
|                 | -20                | 0.293                | 0.524 | 1.06 | 1.93 | 3.84  | 5.64 | 10.5 | 16.4 | 28.3 | 55.8 |



- (i) Capacity based on saturated vapour (no useful superheat)
- (ii) Mean condenser temperature 40 °C (no subcooling) i.e. liquid temperature of 37.8 °C
- (iii) Content of refrigerant in lubricant estimated from solubility data at suction gas temperature and pressure

Table 11a: Suction line capacity correction factors for Klea® 407A

| Evap.<br>Temp. °C | Temperature liquid °C |       |       |       |       |       |       |       |
|-------------------|-----------------------|-------|-------|-------|-------|-------|-------|-------|
|                   | 20                    | 25    | 30    | 35    | 37.8  | 40    | 45    | 50    |
| 5                 | 1.195                 | 1.142 | 1.088 | 1.032 | 1.000 | 0.974 | 0.913 | 0.850 |
| 0                 | 1.199                 | 1.145 | 1.090 | 1.033 | 1.000 | 0.973 | 0.912 | 0.847 |
| -5                | 1.203                 | 1.148 | 1.091 | 1.033 | 1.000 | 0.973 | 0.910 | 0.844 |
| -10               | 1.207                 | 1.151 | 1.093 | 1.034 | 1.000 | 0.972 | 0.908 | 0.841 |
| -15               | 1.212                 | 1.154 | 1.095 | 1.035 | 1.000 | 0.972 | 0.906 | 0.837 |
| -20               | 1.217                 | 1.158 | 1.098 | 1.035 | 1.000 | 0.971 | 0.904 | 0.833 |
| -25               | 1.222                 | 1.162 | 1.100 | 1.036 | 1.000 | 0.970 | 0.902 | 0.829 |
| -30               | 1.227                 | 1.166 | 1.102 | 1.037 | 1.000 | 0.970 | 0.899 | 0.825 |
| -35               | 1.233                 | 1.170 | 1.105 | 1.038 | 1.000 | 0.969 | 0.897 | 0.820 |
| -40               | 1.240                 | 1.175 | 1.108 | 1.039 | 1.000 | 0.968 | 0.894 | 0.816 |

To convert from tabulated values at a mean condenser temperature of 40°C to the desired value, multiply by the appropriate factor.

Note: liquid temperature at a mean condensing temperature of 40.0 °C is 37.8 °C hence table is referenced to a liquid temperature of 37.8 °C

Table 11b: Discharge line capacity correction factors for Klea® 407A

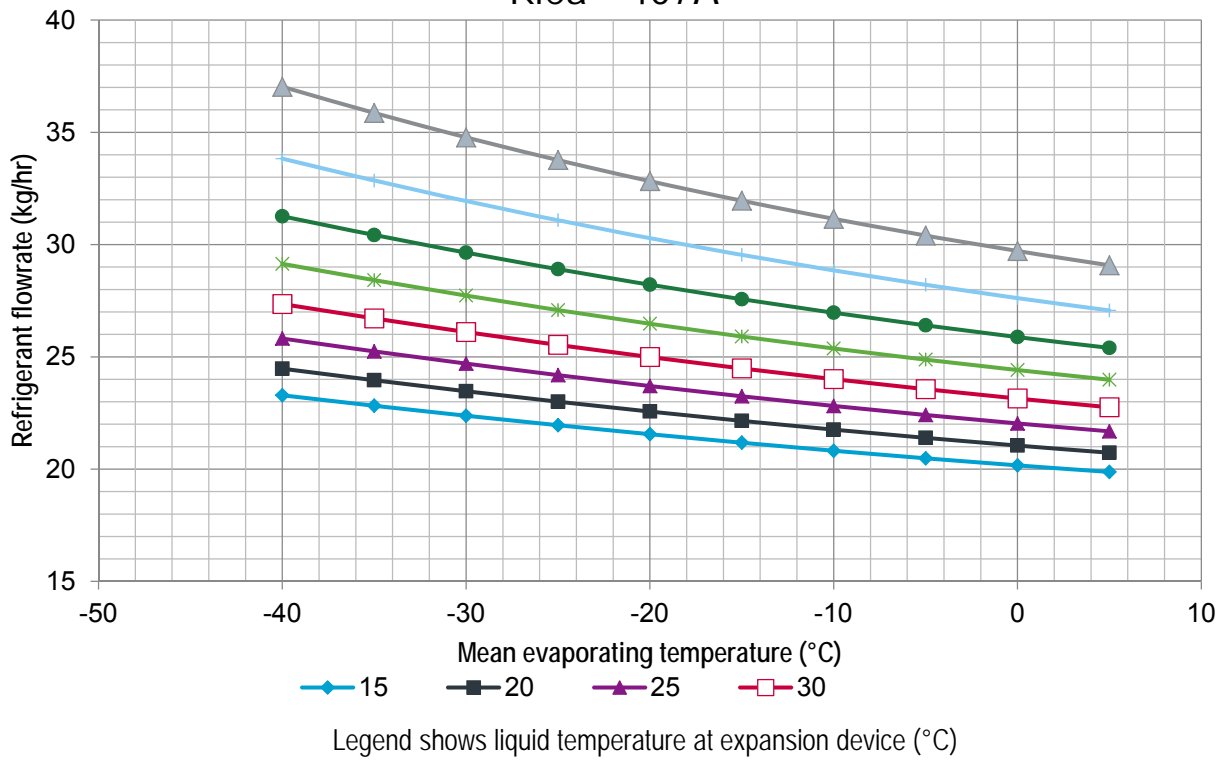
To convert tabulated values to values for true mean condenser temperature multiply by the appropriate factor from this table.

| Evap. Temp. °C | Condenser Temperature °C |     |       |
|----------------|--------------------------|-----|-------|
|                | 30                       | 40  | 50    |
| 5              | 0.878                    | 1.0 | 1.097 |
| 0              | 0.880                    | 1.0 | 1.094 |
| -5             | 0.882                    | 1.0 | 1.091 |
| -10            | 0.884                    | 1.0 | 1.088 |
| -15            | 0.886                    | 1.0 | 1.084 |
| -20            | 0.888                    | 1.0 | 1.080 |
| -25            | 0.891                    | 1.0 | 1.075 |
| -30            | 0.893                    | 1.0 | 1.071 |
| -35            | 0.896                    | 1.0 | 1.066 |
| -40            | 0.900                    | 1.0 | 1.062 |

Note:

- (i) Condenser temperatures refer to true mean temperature
- (ii) Capacities based on saturated vapour leaving evaporator

### Refrigerant Flowrate for 1 kW refrigeration Klea® 407A



**Mexichem.**  
Refrigerants

**Mexichem UK Limited, The Heath Business & Technical Park, Runcorn, Cheshire, WA7 4QX**  
**Tel: +44 (0)1928 518880 E-mail: [info@mexichem.com](mailto:info@mexichem.com) [www.mexichemfluor.com](http://www.mexichemfluor.com)**

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