

Table 15.... Comparative Refrigerant Performance Per Ton  
Based on 5 F Evaporation and 86 F Condensation\*

| Refrigerant | No.                            | Name  | Evaporator pressure, psig | Condensing pressure, psig | Compression Ratio | Net refrigerating effect, Btu/lb | Refrigerant circulated, lb/min | Liquid circulated, cu in./min | Specific volume of suction gas, cu ft/lb | Compressor displacement, cfm | Horsepower | Coefficient of performance | Comp. discharge Temp, F |
|-------------|--------------------------------|-------|---------------------------|---------------------------|-------------------|----------------------------------|--------------------------------|-------------------------------|------------------------------------------|------------------------------|------------|----------------------------|-------------------------|
| 170         | Ethane                         | 221.3 | 661.1                     | 2.86                      | 58.6              | 3.41                             | 342.9                          | 0.53                          | 1.82                                     | 1.953                        | 2.41       | 122                        |                         |
| 744A        | Nitrous Oxide                  | 294.3 | 922.3                     | 3.03                      | 85.2              | 2.35                             | 71.2                           | 0.28                          | 0.66                                     | 1.310                        | 3.60       |                            |                         |
| 744         | Carbon Dioxide                 | 317.5 | 1031.0                    | 3.15                      | 55.5              | 3.62                             | 167.1                          | 0.27                          | 0.96                                     | 1.840                        | 2.56       | 151                        |                         |
| 13B1        | Monobromotrifluoromethane      | 63.2  | 247.1                     | 3.36                      | 29.3              | 6.86                             | 123.8                          | 0.38                          | 2.63                                     | 1.030                        | 4.25       | 124                        |                         |
| 1270        | Propylene                      | 37.0  | 167.0                     | 3.51                      | 173.0             | 1.1                              | 61.5                           | 2.61                          | 3.03                                     | 1.046                        | 4.51       | 108                        |                         |
| 290         | Propane                        | 27.2  | 140.5                     | 3.70                      | 121.0             | 1.65                             | 94.0                           | 2.48                          | 4.09                                     | 1.030                        | 4.58       | 97                         |                         |
| 502         | 22/115 Azeotrope <sup>b</sup>  | 36.0  | 175.1                     | 3.75                      | 45.7              | 4.38                             | 99.4                           | 0.82                          | 3.61                                     | 1.079                        | 4.37       | 99                         |                         |
| 22          | Monochlorodifluoromethane      | 28.2  | 158.2                     | 4.03                      | 70.0              | 2.86                             | 67.4                           | 1.24                          | 3.55                                     | 1.011                        | 4.66       | 128                        |                         |
| 115         | Chloropentafluoroethane        | 23.3  | 134.2                     | 3.92                      | 29.1              | 6.87                             | 150.2                          | 0.82                          | 5.61                                     | 1.254                        | 3.76       | 86                         |                         |
| 717         | Ammonia                        | 19.6  | 154.5                     | 4.94                      | 474.4             | 0.422                            | 19.6                           | 8.15                          | 3.44                                     | 0.989                        | 4.76       | 210                        |                         |
| 500         | 12/152a Azeotrope <sup>b</sup> | 16.4  | 113.4                     | 4.12                      | 61.1              | 3.27                             | 79.3                           | 1.52                          | 3.97                                     | 1.022                        | 4.61       | 105                        |                         |
| 12          | Dichlorodifluoromethane        | 11.8  | 93.3                      | 4.08                      | 50.0              | 4.00                             | 85.6                           | 1.46                          | 5.83                                     | 1.002                        | 4.70       | 101                        |                         |
| 40          | Methyl Chloride                | 6.5   | 80.0                      | 4.48                      | 150.2             | 1.33                             | 40.9                           | 4.47                          | 5.95                                     | 0.962                        | 4.90       | 172                        |                         |
| 601         | Isobutane                      | 3.3*  | 44.8                      | 4.54                      | 111.5             | 1.79                             | 91.0                           | 6.41                          | 11.50                                    | 1.083                        | 4.36       | 80                         |                         |
| 764         | Sulfur Dioxide                 | 5.9*  | 51.8                      | 5.63                      | 141.4             | 1.41                             | 26.6                           | 6.42                          | 9.09                                     | 0.958                        | 4.87       | 191                        |                         |
| 630         | Methylamine                    | 9.9*  | 46.8                      | 6.13                      | 304.0             | 0.66                             | 28.2                           | 15.54                         | 10.23                                    | 0.978                        | 4.81       |                            |                         |
| 600         | Butane                         | 13.2* | 26.9                      | 5.07                      | 128.6             | 1.56                             | 75.9                           | 9.98                          | 15.52                                    | 0.953                        | 4.95       | 88                         |                         |
| 114         | Dichlorotetrafluoroethane      | 16.1* | 22.0                      | 5.42                      | 43.1              | 4.64                             | 89.2                           | 4.34                          | 20.14                                    | 1.049                        | 4.49       | 86                         |                         |
| 21          | Dichloromono-fluoroethane      | 19.2* | 16.5                      | 5.96                      | 89.4              | 2.24                             | 45.7                           | 9.13                          | 20.43                                    | 0.941                        | 5.01       | 142                        |                         |
| 180         | Ethyl Chloride                 | 20.5* | 12.4                      | 5.83                      | 142.3             | 1.45                             | 45.8                           | 17.06                         | 24.82                                    | 0.906                        | 5.21       | 106                        |                         |
| 631         | Ethylamine                     | 23.1* | 10.0                      | 7.40                      | 225.5             | 0.89                             | 349.0                          | 32.32                         | 38.67                                    | 0.855                        | 5.52       |                            |                         |
| 11          | Trichloromono-fluoroethane     | 24.0* | 3.6                       | 6.24                      | 67.3              | 2.98                             | 56.2                           | 12.27                         | 36.46                                    | 0.933                        | 5.05       | 109                        |                         |
| 611         | Methyl Formate                 | 26.3* | 1.6*                      | 7.74                      | 189.2             | 1.06                             | 29.9                           | 48.25                         | 51.00                                    |                              |            |                            |                         |
| 610         | Ethyl Ether                    | 26.9* | 4.9*                      | 8.20                      | 126.3             | 1.58                             | 62.9                           | 35.90                         | 55.40                                    | 0.822                        | 5.74       |                            |                         |
| 30          | Methylene Chloride             | 27.6* | 9.5*                      | 8.60                      | 134.6             | 1.49                             | 30.9                           | 49.90                         | 74.30                                    | 0.963                        | 4.90       |                            |                         |
| 113         | Trichlorotrifluoroethane       | 27.9* | 13.9*                     | 8.02                      | 53.7              | 3.73                             | 66.5                           | 27.38                         | 102.03                                   | 0.973                        | 4.84       | 205                        |                         |
| 1130        | Dichloroethylene               | 28.3* | 15.8*                     | 8.42                      | 114.3             | 1.75                             | 38.3                           | 63.60                         | 111.20                                   | 0.973                        | 4.83       | 86                         |                         |
| 1120        | Trichloroethylene              | 29.6* | 26.2*                     | 11.65                     | 91.7              | 2.18                             | 41.6                           | 229.40                        | 502.00                                   | 0.980                        | 4.82       |                            |                         |

\* Saturated suction vapor except for Refrigerants 113, 114, and 115. In these cases, enough suction superheat was assumed to give saturated discharge vapor.  
<sup>b</sup> See Table 1 for composition.  
<sup>c</sup> Inches of mercury vacuum.

Table 16.... Comparative Refrigerant Performance Per Ton at Various Evaporating and Condensing Temperatures\*

| Refrigerant                             | No.                        | Name | Suction Gas Temperature, F | Evaporating Pressure, psig | Condensing Pressure, psig | Compression Ratio | Net Refrigerating Effect, Btu/lb | Refrigerant Circulated, lb/min | Specific Volume of Vapor, cu ft/lb | Compressor Displacement, cfm | Horsepower |
|-----------------------------------------|----------------------------|------|----------------------------|----------------------------|---------------------------|-------------------|----------------------------------|--------------------------------|------------------------------------|------------------------------|------------|
| A. -130 F Evaporating, -40 F Condensing |                            |      |                            |                            |                           |                   |                                  |                                |                                    |                              |            |
| 1150                                    | Ethylene                   | -130 | 16.18                      | 196.7                      | 6.8                       | 141.4             | 1.42                             | 3.72                           | 5.27                               |                              |            |
| 744A                                    | Nitrous Oxide              | -130 | 1.00*                      | 122.3                      | 9.6                       | 130.5             | 1.53                             | 5.80                           | 8.57                               |                              |            |
| 170                                     | Ethane                     | -130 | 2.24*                      | 98.2                       | 8.3                       | 155.1             | 1.29                             | 8.16                           | 10.52                              |                              |            |
| 13                                      | Monochlorotrifluoromethane | -130 | 11.43*                     | 72.7                       | 9.6                       | 45.8              | 4.366                            | 3.605                          | 15.74                              | 1.63                         |            |
| B. -100 F Evaporating, -30 F Condensing |                            |      |                            |                            |                           |                   |                                  |                                |                                    |                              |            |
| 170                                     | Ethane                     | -100 | 16.6                       | 120.2                      | 4.3                       | 153.8             | 1.30                             | 3.87                           | 5.03                               | 1.13                         |            |
| 13                                      | Monochlorotrifluoromethane | -100 | 7.6                        | 90.9                       | 4.8                       | 46.4              | 4.31                             | 1.56                           | 6.74                               | 1.13                         |            |
| 22                                      | Monochlorodifluoromethane  | -100 | 25.04*                     | 4.9                        | 8.2                       | 90.8              | 2.20                             | 18.43                          | 40.59                              | 1.07                         |            |
| C. -76 F Evaporating, 5 F Condensing    |                            |      |                            |                            |                           |                   |                                  |                                |                                    |                              |            |
| 1150                                    | Ethylene                   | -76  | 95.00                      | 399.8                      | 3.8                       | 115.2             | 1.74                             | 1.14                           | 1.98                               |                              |            |
| 744A                                    | Nitrous Oxide              | -76  | 49.70                      | 294.3                      | 4.8                       | 116.4             | 1.72                             | 1.32                           | 2.27                               | 1.6                          |            |
| 170                                     | Ethane                     | -76  | 40.40                      | 221.3                      | 4.3                       | 131.1             | 1.53                             | 2.30                           | 3.51                               | 1.3                          |            |
| 13                                      | Monochlorotrifluoromethane | -76  | 26.16                      | 177.1                      | 4.7                       | 39.6              | 5.05                             | 0.89                           | 4.50                               | 1.34                         |            |
| 13B1                                    | Monobromotrifluoromethane  | -76  | 3.66*                      | 63.2                       | 6.0                       | 47.0              | 4.25                             | 1.93*                          | 8.20                               |                              |            |
| 290                                     | Propane                    | -76  | 17.40*                     | 27.2                       | 6.8                       | 146.4             | 1.37                             | 14.80                          | 20.22                              | 1.11                         |            |
| 22                                      | Monochlorodifluoromethane  | -76  | 18.85*                     | 28.2                       | 7.9                       | 84.4              | 2.37                             | 8.60                           | 20.38                              | 1.18                         |            |
| 717                                     | Ammonia                    | -76  | 23.40*                     | 19.6                       | 10.7                      | 533.5             | 0.37                             | 75.30                          | 28.24                              | 1.24                         |            |
| 12                                      | Dichlorodifluoromethane    | -76  | 23.24*                     | 11.8                       | 8.1                       | 59.3              | 3.37                             | 10.22                          | 34.46                              | 1.17                         |            |

\* Data on fluorinated refrigerants (except 11 and 500) from E. I. du Pont de Nemours & Co., Inc. Used by permission. Data on Refrigerant 11 from General Chemical Division, Allied Chemical Corp. Used by permission. Data on Refrigerant 600 from Carrier Corp. Used by permission. Data on other refrigerants from Reference 1.

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Table 16.... Comparative Refrigerant Performance Per Ton\* (Concluded)

| Refrigerant                                               |                            | Suction Gas Temp. F | Evap. Pressure psig | Cond. Pressure psig | Compression Ratio | Net Refrig. Effect Btu/lb | Refrig. Circ. lb/min | Spec. Vol. of Vapor cu ft/min | Comp. Displ. cfm | Horsepower |
|-----------------------------------------------------------|----------------------------|---------------------|---------------------|---------------------|-------------------|---------------------------|----------------------|-------------------------------|------------------|------------|
| No.                                                       | Name                       |                     |                     |                     |                   |                           |                      |                               |                  |            |
| D. -40 F Evaporating, 68 F Condensing                     |                            |                     |                     |                     |                   |                           |                      |                               |                  |            |
| 744                                                       | Carbon Dioxide             | -40                 | 131.2               | 815.9               | 5.7               | 75.9                      | 2.64                 | 0.61                          | 1.61             |            |
| 13B1                                                      | Monobromotrifluoromethane  | -40                 | 17.7                | 193.3               | 6.5               | 30.3                      | 6.60                 | 0.88                          | 5.81             |            |
| 290                                                       | Propane                    | -40                 | 1.5                 | 109.0               | 7.6               | 119.7                     | 1.67                 | 6.13                          | 10.24            |            |
| 717                                                       | Monochlorodifluoromethane  | -40                 | 0.5                 | 117.3               | 8.7               | 70.7                      | 2.53                 | 3.30                          | 9.32             | 1.57       |
| 500                                                       | Ammonia                    | -40                 | 8.7*                | 109.5               | 11.9              | 479.3                     | 0.42                 | 24.86                         | 10.38            | 1.60       |
| 12                                                        | Dichlorodifluoromethane    | -40                 | 7.9*                | 82.7                | 9.0               | 60.4                      | 3.31                 | 4.08                          | 13.50            | 1.57       |
|                                                           |                            | -40                 | 11.0*               | 67.6                | 8.8               | 49.3                      | 4.06                 | 3.88                          | 15.71            | 1.56       |
| E. -10 F Evaporating, 100 F Condensing                    |                            |                     |                     |                     |                   |                           |                      |                               |                  |            |
| 11                                                        | Trichloromono-fluoroethane | -10                 | 26.0*               | 8.9                 | 12.3              | 62.4                      | 3.20                 | 18.19                         | 58.21            | 1.39       |
| 21                                                        | Dichloromono-fluoroethane  | -10                 | 22.9*               | 25.3                | 11.6              | 84.0                      | 2.38                 | 13.43                         | 31.96            | 1.40       |
| 114                                                       | Dichlorotetrafluoroethane  | -10                 | 20.6*               | 31.7                | 10.2              | 37.6                      | 5.31                 | 6.31                          | 33.52            | 1.65       |
| 717                                                       | Ammonia                    | -10                 | 4.5                 | 117.2               | 6.9               | 45.1                      | 4.43                 | 1.97                          | 8.74             | 1.53       |
| 115                                                       | Chloropentafluoroethane    | -10                 | 9.0                 | 197.2               | 8.9               | 453.3                     | 0.44                 | 11.50                         | 5.07             | 1.49       |
| 22                                                        | Monochlorodifluoromethane  | -10                 | 13.2                | 166.3               | 6.5               | 22.9                      | 8.73                 | 1.11                          | 9.69             | 2.20       |
| 502                                                       | ...                        | -10                 | 16.5                | 195.9               | 6.8               | 64.2                      | 3.12                 | 1.68                          | 5.24             | 1.54       |
|                                                           |                            | -10                 | 22.8                | 214.4               | 6.1               | 39.6                      | 5.06                 | 1.10                          | 5.56             | 1.72       |
| F. -10 F Evaporating, 100 F Condensing                    |                            |                     |                     |                     |                   |                           |                      |                               |                  |            |
| 11                                                        | Trichloromono-fluoroethane | 65                  | 26.0*               | 8.9                 | 12.3              | 62.4                      | 3.20                 | 21.33                         | 68.28            | 1.61       |
| 21                                                        | Dichloromono-fluoroethane  | 65                  | 22.9*               | 25.3                | 11.6              | 84.0                      | 2.38                 | 7.16                          | 38.03            | 1.64       |
| 114                                                       | Dichlorotetrafluoroethane  | 65                  | 20.6*               | 31.7                | 10.2              | 37.6                      | 5.31                 | 6.31                          | 33.53            | 1.86       |
| 717                                                       | Ammonia                    | 65                  | 4.5                 | 117.2               | 6.9               | 45.1                      | 4.43                 | 2.36                          | 10.44            | 1.80       |
| 115                                                       | Chloropentafluoroethane    | 65                  | 9.0                 | 197.2               | 8.9               | 453.3                     | 0.44                 | 13.68                         | 6.02             | 1.75       |
| 22                                                        | Monochlorodifluoromethane  | 65                  | 13.2                | 166.3               | 6.5               | 22.9                      | 8.73                 | 1.26                          | 10.95            | 2.53       |
| 502                                                       | ...                        | 65                  | 16.5                | 195.9               | 6.8               | 64.2                      | 3.12                 | 2.02                          | 6.29             | 1.85       |
|                                                           |                            | 65                  | 22.8                | 214.4               | 6.1               | 39.6                      | 5.06                 | 1.32                          | 6.66             | 2.11       |
| G. -10 F Evap. + Refrig. Effect to 65 F, 100 F Condensing |                            |                     |                     |                     |                   |                           |                      |                               |                  |            |
| 11                                                        | Trichloromono-fluoroethane | 65                  | 26.0*               | 8.9                 | 12.3              | 72.3                      | 2.77                 | 21.33                         | 59.10            | 1.39       |
| 21                                                        | Dichloromono-fluoroethane  | 65                  | 22.9*               | 25.3                | 11.6              | 93.8                      | 2.13                 | 15.71                         | 33.55            | 1.46       |
| 114                                                       | Dichlorotetrafluoroethane  | 65                  | 20.6*               | 31.7                | 10.2              | 48.9                      | 4.09                 | 7.16                          | 29.24            | 1.44       |
| 717                                                       | Ammonia                    | 65                  | 4.5                 | 117.2               | 6.9               | 55.9                      | 3.58                 | 2.36                          | 8.44             | 1.49       |
| 115                                                       | Chloropentafluoroethane    | 65                  | 9.0                 | 197.2               | 8.9               | 494.2                     | 0.40                 | 13.68                         | 5.54             | 1.61       |
| 22                                                        | Monochlorodifluoromethane  | 65                  | 13.2                | 166.3               | 6.5               | 35.9                      | 5.58                 | 1.26                          | 7.00             | 1.62       |
| 502                                                       | ...                        | 65                  | 16.5                | 195.9               | 6.8               | 75.9                      | 2.63                 | 2.02                          | 5.31             | 1.56       |
|                                                           |                            | 65                  | 22.8                | 214.4               | 6.1               | 51.6                      | 3.87                 | 1.32                          | 5.10             | 1.61       |
| H. 20 F Evaporating, 80 F Condensing                      |                            |                     |                     |                     |                   |                           |                      |                               |                  |            |
| 290                                                       | Propane                    | 20                  | 40.8                | 128.1               | 2.6               | 129.1                     | 1.55                 | 1.90                          | 2.94             |            |
| 220                                                       | Monochlorodifluoromethane  | 20                  | 43.0                | 143.6               | 2.7               | 73.3                      | 2.73                 | 0.94                          | 2.56             | 0.69       |
| 717                                                       | Ammonia                    | 20                  | 33.5                | 138.3               | 3.2               | 485.8                     | 0.41                 | 5.91                          | 2.43             |            |
| 500                                                       | ...                        | 20                  | 27.3                | 102.5               | 2.8               | 64.9                      | 3.08                 | 1.44                          | 3.52             | 0.69       |
| 12                                                        | Dichlorodifluoromethane    | 20                  | 21.0                | 84.2                | 2.8               | 53.0                      | 3.77                 | 1.10                          | 4.15             | 0.68       |
| 40                                                        | Methyl Chloride            | 20                  | 14.5                | 71.6                | 3.0               | 154.5                     | 1.29                 | 3.31                          | 4.29             | 0.66       |
| 601                                                       | Isobutane                  | 20                  | 3.5                 | 39.9                | 3.0               | 114.5                     | 1.67                 | 4.68                          | 7.53             |            |
| 764                                                       | Sulfur Dioxide             | 20                  | 2.5                 | 45.0                | 3.5               | 149.4                     | 1.28                 | 3.49                          | 6.21             |            |
| 600                                                       | Butane                     | 20                  | 5.3*                | 22.9                | 3.2               | 136.6                     | 1.46                 | 4.77                          | 10.59            |            |
| 114                                                       | Dichlorotetrafluoroethane  | 30                  | 10.1*               | 18.3                | 3.4               | 46.6                      | 4.29                 | 3.08                          | 13.19            | 0.70       |
| I. 40 F Evaporating, 100 F Condensing                     |                            |                     |                     |                     |                   |                           |                      |                               |                  |            |
| 290                                                       | Propane                    | 40                  | 63.3                | 172.0               | 2.4               | 121.5                     | 1.65                 | 1.37                          | 2.25             |            |
| 220                                                       | Monochlorodifluoromethane  | 40                  | 68.5                | 195.9               | 2.5               | 49.9                      | 2.90                 | 0.66                          | 1.91             | 0.68       |
| 717                                                       | Ammonia                    | 40                  | 56.8                | 197.2               | 2.9               | 467.8                     | 0.43                 | 3.97                          | 1.70             | 0.65       |
| 500                                                       | ...                        | 40                  | 46.2                | 141.9               | 2.6               | 61.4                      | 3.26                 | 0.80                          | 2.61             | 0.67       |
| 12                                                        | Dichlorodifluoromethane    | 40                  | 37.0                | 117.2               | 2.6               | 50.3                      | 3.97                 | 0.77                          | 3.07             | 0.66       |
| 40                                                        | Methyl Chloride            | 40                  | 28.6                | 102.0               | 2.7               | 149.1                     | 1.34                 | 2.29                          | 3.07             | 0.63       |
| 601                                                       | Isobutane                  | 40                  | 12.2                | 3.7                 | 111.0             | 1.80                      | 3.22                 | 6.80                          |                  |            |
| 764                                                       | Sulfur Dioxide             | 40                  | 12.0                | 69.8                | 3.1               | 135.5                     | 1.48                 | 2.89                          | 4.26             |            |
| 600                                                       | Butane                     | 40                  | 3.0                 | 37.5                | 2.9               | 131.8                     | 1.52                 | 4.77                          | 7.24             |            |
| 114                                                       | Dichlorotetrafluoroethane  | 52                  | 0.5                 | 31.7                | 3.0               | 44.7                      | 4.48                 | 2.04                          | 9.15             | 0.90       |
| 21                                                        | Dichloromono-fluoroethane  | 40                  | 4.8*                | 25.3                | 3.2               | 90.0                      | 2.22                 | 4.13                          | 9.17             | 0.63       |
| 30                                                        | Trichloromono-fluoroethane | 40                  | 16.8*               | 8.9                 | 3.4               | 68.6                      | 2.92                 | 5.45                          | 15.89            | 0.62       |
| 40                                                        | Methyl Chloride            | 40                  | 23.0*               | 3.0*                | 3.9               | 134.0                     | 1.49                 | 18.60                         | 27.78            |            |
| 713                                                       | Trichlorotrifluoroethane   | 47                  | 24.6*               | 8.6*                | 4.0               | 55.7                      | 3.59                 | 10.85                         | 38.95            | 0.65       |
| 118                                                       | Water                      | 40                  | 29.7*               | 28.0*               | 7.8               | 1010.7                    | 0.20                 | 2445.0*                       | 483.80           |            |