CLAIMS

1. A transport refrigeration system comprising:

a compressor, a heat rejection heat exchanger, a flash tank, an expansion device and a heat absorption heat exchanger arranged in a serial refrigerant flow order to circulate a refrigerant;

a controller configured to:

determine a presence of at least one condition of the transport refrigeration system; and

initiate a low refrigerant charge detection process in response to detecting the presence of the at least one condition of the transport refrigeration system,

wherein the at least one condition comprises a relationship of an ambient air temperature to a critical point of the refrigerant and wherein the controller initiates a dynamic test as part of the low refrigerant charge detection process when the ambient air temperature is less than the critical point of the refrigerant.

2. The transport refrigeration system of claim 1, wherein the controller initiates a standstill test as part of the low refrigerant charge detection process when the ambient air temperature is greater than the critical point of the refrigerant.

3. The transport refrigeration system of claim 2, wherein the standstill test is performed with the compressor powered off.

4. The transport refrigeration system of claim 3, wherein the standstill test comprises determining a pressure and a temperature of the transport refrigeration system.

5. The transport refrigeration system of claim 4, wherein the standstill test comprises determining a density of the refrigerant in response to the pressure and the temperature.

6. The transport refrigeration system of claim 5, wherein the standstill test comprises determining a refrigerant charge in response to the density of the refrigerant and a volume of the transport refrigeration system.

7. The transport refrigeration system of claim 6, wherein the standstill test comprises comparing the refrigerant charge to a threshold to detect a low refrigerant charge.

8. The transport refrigeration system of claim 2, wherein the controller initiates the standstill test when the ambient air temperature is greater than the critical point of the refrigerant by a margin.

9 The transport refrigeration system of claim 1, wherein the dynamic test is performed with the compressor powered on.

10. The transport refrigeration system of claim 9, wherein the dynamic test comprises determining an ambient air temperature.

11. The transport refrigeration system of claim 10, wherein the dynamic test comprises determining a flash tank pressure in the flash tank.

12. The transport refrigeration system of claim 11, wherein the dynamic test comprises determining a refrigerant charge in response to the ambient air temperature and the flash tank pressure.

13. The transport refrigeration system of claim 12, wherein the dynamic test comprises comparing the refrigerant charge to a threshold to detect a low refrigerant charge.

14. A transport refrigeration system comprising:

a compressor, a heat rejection heat exchanger, a flash tank, an expansion device and a heat absorption heat exchanger arranged in a serial refrigerant flow order to circulate a refrigerant;

a controller configured to:

determine a presence of at least one condition of the transport refrigeration system; and

initiate a low refrigerant charge detection process in response to detecting the presence of the at least one condition of the transport refrigeration system,

wherein the at least one condition comprises a relationship of an ambient air temperature to a critical point of the refrigerant, and wherein the controller initiates a dynamic test as part of the low refrigerant charge detection process when the ambient air temperature is not greater than the critical point of the refrigerant by a margin.

15. The transport refrigeration system of claim 1 wherein the refrigerant is carbon dioxide.

16. A method of detecting a low refrigerant charge in transport refrigeration system including a compressor, the method comprising:

determining an ambient air temperature;

comparing the ambient air temperature to a critical point of the refrigerant;

initiating a standstill test with the compressor powered off when the ambient air temperature is greater than the critical point of the refrigerant;

initiating a dynamic test with the compressor powered on when at least one of (i) the ambient air temperature is less than the critical point of the refrigerant or (ii) the ambient air temperature is not greater than the critical point of the refrigerant by a margin.

17. A computer program product for detecting a low refrigerant charge in transport refrigeration system including a compressor, the computer program product comprising a non-transitory computer readable storage medium having program instructions embodied therewith, the program instructions executable by a processor to cause the processor to implement operations comprising:

determining an ambient air temperature;

comparing the ambient air temperature to a critical point of the refrigerant;

initiating a standstill test with the compressor powered off when the ambient air temperature is greater than the critical point of the refrigerant;

initiating a dynamic test with the compressor powered on when at least one of (i) the ambient air temperature is less than the critical point of the refrigerant or (ii) the ambient air temperature is not greater than the critical point of the refrigerant by a margin.