

CLAIMS

- 1 A composition comprising:
 - (a) carbon dioxide (R-744, CO₂);
 - (b) difluoromethane (R-32); and
 - (c) a third component selected from 1,1,1,2-tetrafluoroethane (R-134a), *trans*-1,3,3,3-tetrafluoropropene (R-1234ze(E)), 2,3,3,3-tetrafluoropropene (R-1234yf), 1,1,1,2,3,3,3-heptafluoropropane (R-227ea) and mixtures thereof.
- 2 A composition according to claim 1, wherein the third component is R-134a and one or more of R-1234yf, R-1234ze(E) and R-227ea.
- 3 A composition according to claim 1, wherein the third component is R-134a, provided that the composition does not comprise 86 weight % CO₂ ±1 weight %, 7 weight % R-32 ±1 weight % and 7 weight % R-134a ±1 weight %.
- 4 A composition according to claim 1, wherein the third component is one or more of R-1234yf or R-1234ze(E).
- 5 A composition according to claim 1, wherein the third component is one or more of R-1234yf, R-1234ze(E) and R-227ea.
- 6 A composition according to any of the preceding claims comprising from about 62 or about 65 to about 98 weight % CO₂, such as from about 69 or about 71 to about 97 weight %, for example from about 74 or about 77 to about 96 weight % or from about 81 to about 96 weight %, optionally from about 81 or about 84 to about 95 weight %.
- 7 A composition according to any of the preceding claims comprising from about 1 to about 25 weight % R-32, such as from about 2 to about 22 weight %, for example from about 3 to about 19 weight %, optionally from about 4 weight % to about 15 or about 13 weight % or from about 5 weight % to about 11 weight %.
- 8 A composition according to any of the preceding claims comprising from about 1 to about 20 weight % of the third component, such as from about 2 or about 3 to about 15 weight %, for example from about 4 to about 13 weight %, optionally from about 5 to about 11 weight %.

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9. A composition according to claim 3 comprising, optionally consisting essentially of, from about 65 to about 95 weight % CO₂, from about 5 to about 15 weight % R-32 and from about 2 to about 20 weight % R-134a.
10. A composition according to claim 9 wherein the CO₂ is present in amount of from about 70 to about 91 weight %, the R-32 is present in an amount of from about 6 to about 14 weight % and the R-134a is present in an amount of from about 3 to about 16 weight %; preferably wherein the CO₂ is present in amount of from about 72 to about 88 weight %, the R-32 is present in an amount of from about 8 to about 13 weight % and the R-134a is present in an amount of from about 4 to about 15 weight %.
11. A composition according to any of the preceding claims, wherein the composition additionally comprises 1,1-difluoroethylene (R-1132a).
12. A composition according to claim 11 comprising from about 1 to about 20 weight % R-1132a, such as from about 2 to about 15 weight %, for example from about 3 to about 12 weight % or from about 4 or about 5 to about 10 weight %.
13. A composition according to any of the preceding claims, wherein the composition comprises substantially no 1,1,2-trifluoroethylene (R-1123).
14. A composition according to any of the preceding claims consisting essentially of the stated components.
15. A composition according to any of the preceding claims, wherein the composition is non-flammable as formulated, such as wherein the composition is not flammable as determined in accordance with ASHRAE Standard 34:2019
16. A composition according to any of the preceding claims having a Global Warming Potential (GWP) of less than about 300, such as less than about 240, such as less than about 200, for example less than about 160 or less than about 150, preferably less than about 145.
17. A composition according to any of the preceding claims having a critical temperature which is about equal to or higher than the critical temperature of CO₂, for example higher than about 40° C.

18. A composition according to any of the preceding claims, wherein the composition has a volumetric refrigeration capacity that is within at least about 75% of that of CO₂, such as within at least about 80%, for example within at least about 90%.
19. A composition according to any of the preceding claims, wherein the composition has a coefficient of performance (COP) that is about equal to or higher than that of CO₂.
20. A composition according to any of the preceding claims, wherein the composition has an operating pressure in a gas cooler or evaporator that is lower than that of CO₂.
21. A composition according to claims any of the preceding claims, wherein the composition has a temperature glide in an evaporator or condenser which is less than about 12K, such as less than about 10K, for example less than about 8K, preferably less than about 6K.
22. A composition comprising a lubricant and a composition according to any of the preceding claims, preferably wherein the lubricant is selected from mineral oil, silicon oil, polyalkyl benzenes (PABs), polyol esters (POEs), polyalkylene glycols (PAGs), polyalkylene glycol esters (PAG esters), polyvinyl ethers (PVEs), poly (alpha-olefins) and combinations thereof.
23. A composition according to claim 22, wherein the lubricant is selected from PAGs, POEs, PVEs and combinations thereof.
24. Use of a composition according to any of the preceding claims as a working fluid in a heat transfer system, such as a refrigeration, heat pump or air-conditioning system.
25. The use of claim 24, wherein the refrigeration system comprises a commercial refrigeration system, such as a supermarket display refrigeration system, beverage cooler refrigeration system, warehouse refrigeration system or a cold-room refrigeration system.
26. The use of claim 24, wherein the refrigeration system comprises a transportation refrigeration system, such as a refrigeration system fitted to a refrigerating shipping container or a refrigeration system fitted to a vehicle.
27. The use of claim 24, wherein the heat pump system comprises a water heater heat pump system.

28. The use of claim 24 wherein the air-conditioning system comprises a mobile or transportation air-conditioning system, such as a bus, car, train or truck air-conditioning system.
29. The use of any of claims 24 to 28, wherein the heat transfer system operates as a transcritical heat transfer system for at least part of the year.
30. A heat transfer device comprising a composition as defined in any of claims 1 to 23.
31. A heat transfer device according to claim 30, wherein the heat transfer device is a transcritical heat transfer device, such as a transcritical refrigeration, heat pump or air-conditioning device.
32. Use of a composition according to any of claims 1 to 23 as an alternative for an existing working fluid in a heat transfer system.
33. The use according to claim 32, wherein the existing working fluid is R-410A or R-407C.
34. A method for cooling an article which comprises condensing a composition defined in any of claims 1 to 23 and thereafter evaporating the composition in the vicinity of the article to be cooled.
35. A method for heating an article which comprises condensing a composition as defined in any one of claims 1 to 23 in the vicinity of the article to be heated and thereafter evaporating the composition.