WHAT IS CLAIMED IS:

1. A process for making a base oil, which is useful for making a heavy base oil having a viscosity of at least 12.7 cSt, or at least 13 cSt, or at least 13.3 cSt at 100°C, comprising

contacting a base oil feedstream comprising an atmospheric resid feedstock, and, optionally, a base oil feedstock, with a hydrocracking catalyst under hydrocracking conditions to form a hydrocracked product;

separating the hydrocracked product into a gaseous fraction and a liquid fraction;

contacting the liquid fraction with a dewaxing catalyst under hydroisomerization conditions, to produce a dewaxed product; and

optionally, contacting the dewaxed product with a hydrofinishing catalyst under hydrofinishing conditions to produce a hydrofinished dewaxed product;

wherein the base oil feedstream does not contain a deasphalted oil and wherein the process produces at least one base oil product comprising a heavy base oil product having a viscosity of at least 12.7 cSt, or at least 13 cSt, or at least 13.3 cSt at 100°C.

2. A process for making a heavy base oil having a viscosity of at least 12.7 cSt, or at least 13 cSt, or at least 13.3 cSt at 100°C from a base oil feedstream, or a fraction thereof, according to claim 1, the process comprising

providing a base oil feedstream comprising an atmospheric resid feedstock, and, optionally, a base oil feedstock;

separating the base oil feedstream, or a fraction thereof, into a vacuum gas oil fraction having a front end cut point of 700°F (371°C) or greater and a back end cut point of 900°F (482 °C) or less to form a medium vacuum gas oil MVGO fraction and a heavy vacuum gas oil HVGO fraction; and

using the HVGO fraction as the atmospheric resid feedstock in the process of claim 1.

3. The process of any one of claims 1-2, wherein the base oil feedstream includes a base oil feedstock.

4. The process of any one of claims 1-3, wherein the atmospheric resid feedstock meets one or more of the following conditions:

API gravity in the range of 20-60 or 20-45 or 25-45, or at least 20, or at least 22, or, optionally, greater than the API of the base oil feedstock;

VI in the range of 50-200, or 70-190, or 90-180, or at least 80, or, optionally, greater than the VI of the base oil feedstock;

viscosity at 100°C in the range of 3-30 cSt, or 3-25 cSt, or 3-20 cSt, or 3-10 cSt, or at least 3 cSt, or at least 4 cSt, or less than 10 cSt;

viscosity at 70°C in the range of 5-50 cSt or 5-30 cSt, or 5-20 cSt, or 5-15 cSt, or at least 5cSt, or at least 6 cSt;

hot $C_7$ asphaltene content in the range of 0.01-0.3 wt.% or 0.01-0.2 wt.% or 0.02-0.15 wt.%, or less than 0.3 wt. %, or less than 0.2 wt.%, or less than 0.1 wt.%;

wax content in the range of 5-90 wt.%, or 5-80 wt.%, or 5-70 wt.%, or 5-60 wt.%, or 5-50 wt.%, or 5-40 wt.%, or 5-30 wt.%, or 10-25 wt.%, or at least 5 wt.%, or at least 10 wt.%, or at least 15 wt.%, or, optionally, greater than the wax content of the base oil feedstock;

nitrogen content of less than 2500 ppm, or less than 2000 ppm, or less than 1500 ppm, or less than 1000 ppm, or less than 800 ppm, or less than 500 ppm, or less than 200 ppm, or less than 100 ppm;

sulfur content of less than 8000 ppm, or less than 6000 ppm, or less than 4000 ppm, or less than 3000 ppm, or less than 2000 ppm, or less than 1000 ppm, or less than 500 ppm, or less than 200 ppm, or in the range of 100-8000 ppm, or 100-6000 ppm, or 100-4000 ppm, or 100-2000 ppm, or 100-1000 ppm, or 100-500 ppm, or 100-200 ppm; and/or

1050+°F (566+°C)content in the range of 2-50 wt.%, 2-40 wt.%, or 4-50 wt.%, or 4-40 wt.%, or 8-50 wt.%, or 8-40 wt.%, or up to 50 wt.%, or up to 40 wt.%, or up to 30 wt.%, or up to 20 wt.%, or up to 10 wt.%, optionally, greater than the 1050+°F (566+°C) content of the base oil feedstock.

5. The process of any one of claims 1-4, wherein the atmospheric resid feedstock:

a. has a hot $C_7$ asphaltene content in the range of less than 0.3 wt. %, or less than 0.2 wt.%, or less than 0.1 wt.%; and a nitrogen content of less than 2500 ppm, or less than 2000 ppm, or less than 1500 ppm, or less than 1000 ppm, or less than 800 ppm, or less than 500 ppm, or less than 200 ppm, or less than 100 ppm; and/or

b. has a hot $C_7$ asphaltene content in the range of less than 0.3 wt. %, or less than 0.2 wt.%, or less than 0.1 wt.%; a nitrogen content of less than 2500 ppm, or less than 2000 ppm, or less than 1500, ppm or less than 1000 ppm, or less than 800 ppm, or less than 500 ppm, or less than 200 ppm, or less than 100 ppm; and a metals content of: less than 5 ppm Nickel, or less than 3 ppm Vanadium, or less than 4 ppm Iron, or a combination thereof; and/or

c. the feedstock meets the following conditions:

viscosity at 100°C of less than 10cSt, or in the range of 3-10 cSt;

hot $C_7$ asphaltene content of less than 0.1 wt.%, or in the range of 0.01-0.1 wt.%;

MCRT of less than 2 wt.%;

nitrogen content of less than 800 ppm;

sulfur content of less than 3000 ppm;

Nickel content of less than 5 ppm;

Vanadium content of less than 3 ppm; and

Iron content of less than 4 ppm.

6. The process of any one of claims 1-5, wherein the base oil feedstock:

a. meets one or more of the following conditions:

API gravity in the range of 15-40 or 15-30 or 15-25, or at least 15, or at least 17, optionally, less than the atmospheric resid feedstock;

VI in the range of 30-90 or 40-90 or 50-90 or 50-80, optionally, less than the VI of the atmospheric resid feedstock;

viscosity at 100°C in the range of 3-30 cSt or 3-25 cSt or 3-20 cSt, or at least 3 cSt, or at least 4 cSt;

viscosity at 70°C in the range of 5-50 cSt or 5-80 wt.% or 5-70 wt.% or 5-60 wt.% or 5-50 wt.% or 5-40 wt.% or 5-30 wt.% or 5-20 cSt or 5-15 cSt, or at least 5cSt, or at least 6 cSt;

hot $C_7$ asphaltene content in the range of 0.01-0.3 wt.% or 0.01-0.2 wt.% or 0.02-0.15 wt.%, or less than 0.3 wt. %, or less than 0.2 wt.%;

wax content in the range of 5-90 wt.% or 5-80 wt.% or 5-70 wt.% or 5-60 wt.% or 5-50 wt.% or 5-40 wt.% or 5-30 wt.% or 10-25 wt.%, or at least 5 wt.% or at least 10 wt.%, or at least 15 wt.%, or, optionally, less than the wax content of the atmospheric resid feedstock;

nitrogen content of less than 2500 ppm or less than 2000 ppm or less than 1500 ppm or less than 1000 ppm, or in the range of 1000-5000 ppm, or 2000-5000 ppm, or 1000-4000 ppm, or 1000-3000 ppm;

sulfur content of less than 40000 ppm, or less than 35000 ppm, or less than 30000 ppm, or less than 25000 ppm, or less than 20000 ppm, or less than 15000 ppm, or less than 10000 ppm, or in the range of 1000-40000 ppm or 1000-35000 ppm or 1000-30000 ppm or 1000-25000 ppm or 1000-15000 ppm or 1000-10000 ppm; and/or

1050+°F (566+°C) content of less than 10 wt.%, or less than 8 wt.%, or less than 7 wt.%, or less than 6 wt.%, or less than 5 wt.%, or less than 4 wt.%, or less than 3 wt.%, or less than 2 wt.%, or in the range of 2-15 wt.% or 2-10 wt.% or 1-7 wt.%, optionally, less than the 1050+°F (566+°C) content of the atmospheric resid feedstock, and/or

b. has a nitrogen content of less than 2500 ppm or less than 2000 ppm or less than 1500 ppm or less than 1000 ppm, or in the range of 1000-5000 ppm, or 2000-5000 ppm, or 1000-4000 ppm, or

1000-3000 ppm; or a sulfur content of less than 40000 ppm, or less than 35000 ppm, or less than 30000 ppm, or less than 25000 ppm, or less than 20000 ppm, or less than 15000 ppm, or less than 10000 ppm, or in the range of 1000-40000 ppm or 1000-35000 ppm or 1000-30000 ppm or 1000-25000 ppm or 1000-15000 ppm or 1000-10000 ppm; or a 1050+°F content of less than 10 wt.%, or less than 8 wt.%, or less than 7 wt.%, or less than 6 wt.%, or less than 5 wt.%, or less than 4 wt.%, or less than 3 wt.%, or less than 2 wt.%, or in the range of 2-15 wt.% or 2-10 wt.% or 1-7 wt.%, optionally, less than the 1050+°F content of the atmospheric resid feedstock, or a combination thereof.

7. The process of any one of claims 1-6, wherein the base oil feedstream:

   a. comprises 5-95 wt.% atmospheric resid feedstock and 95-5 wt.% base oil feedstock, or 10-90 wt.% atmospheric resid feedstock and 90-10 wt.% base oil feedstock, or 10-80 wt.% atmospheric resid feedstock and 90-20 wt.% base oil feedstock, or 10-60 wt.% atmospheric resid feedstock and 90-40 wt.% base oil feedstock, or 10-50 wt.% atmospheric resid feedstock and 50-90 wt.% base oil feedstock, or 10-40 wt.% atmospheric resid feedstock and 90-60 wt.% base oil feedstock, or 10-30 wt.% atmospheric resid feedstock and 90-70 wt.% base oil feedstock, or 30-60 wt.% atmospheric resid feedstock and 70-40 wt.% base oil feedstock, or 40-60 wt.% atmospheric resid feedstock and 60-40 wt.% base oil feedstock, and/or

   b. does not contain an added whole crude oil feedstock, or wherein the base oil feedstream does not contain a vacuum residue feedstock, or wherein the base oil feedstream contains only atmospheric resid feedstock and, optionally, a base oil feedstock.

8. The process of any one of claims 1-7, wherein the process does not include recycle of a liquid feedstock as part of the base oil feedstream or as either or both of the atmospheric resid feedstock and the base oil feedstock.

9. The process of any one of claims 1-13, wherein the atmospheric resid feedstock and the base oil feedstock are not the same, optionally wherein wherein the atmospheric resid feedstock and the base oil feedstock differ in nitrogen content, sulfur content, 1050+°F content (566+°C), or a combination thereof.

10. The process of any one of claims 1-9, wherein the base oil feedstock comprises vacuum gas oil or is vacuum gas oil, or consists essentially of vacuum gas oil, or consists of vacuum gas oil.

11. The process of any one of claims 1-10, wherein the vacuum gas oil is a heavy vacuum gas oil obtained from vacuum gas oil that is cut into a light fraction and a heavy fraction, with the heavy fraction having a cut point temperature range of 950-1050℉ (510-566°C).

12. The process of any one of claims 1-11, wherein the dewaxed product and/or the hydrofinished dewaxed product is obtained as a light base oil product and a heavy base oil product, optionally wherein:

a. the light base oil product has a nominal viscosity in the range of 3-9 cSt, or 4-8 cSt or 5-7 cSt at 100°C and/or the heavy base oil product has a nominal viscosity in the range of 13-24 cSt, or 13-21 cSt, or 13-18 cSt at 100°C, or

b. the yield of the heavy base oil product relative to the light base oil product is increased by at least 0.5 Lvol.%, or at least 1 Lvol.% or at least 2 Lvol% or at least 5 Lvol% compared with the same process that does not include the atmospheric resid feedstock in the base oil feedstream, or

c. the total waxy base oil yield is increased by at least 0.5 Lvol.%, or at least 1 Lvol.% or at least 2 Lvol% or at least 5 Lvol% compared with the same process that does not include the atmospheric resid feedstock in the base oil feedstream.

13. The process of any one of claims 1-12, wherein the dewaxed product is further separated into at least a lighter product having a nominal viscosity in the range of 5.5 to 7.5 cSt at 100°C or at least a heavier product having a nominal viscosity of 13 cSt or greater at 100°C, or 13-16.5 cSt at 100°C, or 18-23 cSt at 100°C, or a combination thereof.

14. The process of claim 2, further comprising

contacting the MVGO fraction with a hydrocracking catalyst under hydrocracking conditions to form a hydrocracked product;

separating the hydrocracked product into a gaseous fraction and a liquid fraction;

contacting the liquid fraction with a dewaxing catalyst under hydroisomerization conditions, to produce a dewaxed product; and

optionally, contacting the dewaxed product with a hydrofinishing catalyst under hydrofinishing conditions to produce a hydrofinished dewaxed product;

wherein, the dewaxed product and/or the hydrofinished dewaxed product comprises a Group III or Group III+ base oil product having a viscosity index of 120 or greater after dewaxing, optionally wherein:

a. the dewaxed product and/or the hydrofinished dewaxed product comprises a Group III or Group III+ base oil product having a viscosity index of 130 or greater after dewaxing, or 135 or greater after dewaxing, or 140 or greater after dewaxing, or

b. the dewaxed product and/or the hydrofinished dewaxed product comprises a Group III or Group III+ base oil product, or

c. the hydrocracked product has a viscosity index of at least 135, or 140, or 145, or 150.

15. The process of any one of claims 1-14, wherein the base oil feedstock comprises tight oil, or a fraction thereof and/or the atmospheric resid feedstock is derived from a tight oil, or a fraction thereof.

16. A Group II base oil product having a nominal viscosity at 100°C in the range of 13-16.5 cSt.

17. The Group II base oil product of claim 16, where in product is a Grade 800 base oil.

18. A Group II base oil product having a nominal viscosity at 100°C in the range of 18-23 cSt.

19. The Group II base oil product of claim 18, wherein the product is a Grade 900 base oil.