CLAIMS

1. A multi-grade lubricating oil composition achieving SAE J300 certifications for at least 0W-16, 0W-20, and 5W-20 grade oils with increased amounts of heavier base oils, the multi-grade lubricating oil composition comprising:

a blend of base oils including at least one lighter base oil having a KV100 of 4.5 cSt or less and at least one heavier base oil having a KV100 of 5.5 cSt or higher, the blend of base oils including at least about 20 weight percent of the at least one heavier base oil based on the total weight of base oils in the blend; and

about 1 weight percent or less, based on polymer solids, of a (meth)acrylate copolymer having a hydrocarbyl group in the monomer ester moiety, the (meth)acrylate copolymer having as polymerized monomer units (i) (meth)acrylate monomer units with an intermediate molecular weight hydrocarbyl group in the monomer ester moiety of about 500 to about 700 and (ii) (meth)acrylate monomer units with a high molecular weight hydrocarbyl group in the monomer ester moiety of about 6,000 to about 10,000.

2. The multi-grade lubricating oil composition of claim 1, wherein the multi-grade lubricating oil composition exhibits a kinematic viscosity at 100°C of about 9.3 mm2/s or less and a CCS at -35°C of about 6200 mPa or less.

3. The multi-grade lubricating oil composition of claim 1 or 2, comprising a blend of two or more lighter base oils, wherein the blend of two or more lighter base oils are selected from API Group II base oils, API Group III base oils, API Group IV base oils, or combinations thereof, or wherein the at least one heavier base oil is selected from API Group III base oils, API Group IV base oils, or combinations thereof; and/or wherein the blend of base oils includes at least about 40 weight percent of the heavier base oil.

4. The multi-grade lubricating oil composition of any previous claim, wherein a weight ratio of the lighter base oils to the heavier base oils is 1.55 or less; and/or wherein the blend of base oils includes about 40 to about 60 weight percent of the heavier base oil; and/or wherein the at least one lighter base oil is a blend of two or more base oils each having a KV100 of 4.5 cSt or less.

5. The multi-grade lubricating oil composition of any previous claim, wherein the (meth)acrylate copolymer has a number average molecular weight of about 140,000 or more; and/or wherein the (meth)acrylate copolymer has a number average molecular weight of about 500,000 or less.

6. The multi-grade lubricating oil composition of any previous claim, wherein the (meth)acrylate copolymer further includes as a polymerized monomer unit (iii) (meth)acrylate monomer units with a low molecular weight hydrocarbyl group in the monomer ester moiety of about 400 or less.

7. The multi-grade lubricating oil composition of claim 6, wherein the (meth)acrylate copolymer is derived from (meth)acrylate monomers having a hydrocarbyl moiety of 12 to 16 carbons and (meth)acrylate monomers having a hydrocarbyl moiety derived from macromonomers of alkenes or alkadienes including ethylene, propylene, butene, butadiene, isoprene, or combinations thereof and having a molecular weight of about 10,000 or less.

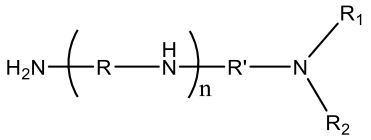
8. The multi-grade lubricating oil composition of any previous claim, wherein a molecular weight ratio of the high molecular weight hydrocarbyl group to the low molecular weight hydrocarbyl group in the (meth)acrylate monomer ester moieties of the copolymer is about 1.5:1 to about 50:1.

9. The multi-grade lubricating oil composition of any previous claim, further comprising a hydrocarbyl substituted succinamide or succinimide dispersant; and/or wherein the multi-grade lubricating oil composition includes about 1 to about 8 weight percent of the hydrocarbyl substituted succinamide or succinimide dispersant.

10. The multi-grade lubricating oil composition of claim 9, wherein the hydrocarbyl substituted succinamide or succinimide dispersant is derived from a hydrocarbyl substituted acylating agent reacted with a polyalkylene polyamine and wherein the hydrocarbyl substituent of the succinamide or the succinimide dispersant is a linear or branched hydrocarbyl group

having a number average molecular weight of about 250 to about 5,000 as measured by GPC using polystyrene as a calibration reference.

11. The multi-grade lubricating oil composition of claim 10, wherein the polyalkylene polyamine has the formula



wherein each R and R', independently, is a divalent C1 to C6 alkylene linker, each R_1 and R_2, independently, is hydrogen, a C1 to C6 alkyl group, or together with the nitrogen atom to which they are attached form a 5- or 6-membered ring optionally fused with one or more aromatic or non-aromatic rings, and n is an integer from 0 to 8.

12. The multi-grade lubricating oil composition of claim 11, wherein the polyalkylene polyamine is selected from the group consisting of a mixture of polyethylene polyamines having an average of 5 to 7 nitrogen atoms, triethylenetetramine, tetraethylenepentaamine, and combinations thereof.

13. A method of formulating a multi-grade lubricating oil composition achieving SAE J300 certifications for at least 0W-16, 0W-20, and 5W-20 grade oils with increased amounts of heavier base oils, the method comprising:

blending an amount of base oil with about 1 weight percent or less, based on polymer solids, of a (meth)acrylate copolymer to form a multi-grade lubricating oil composition that exhibits a kinematic viscosity at 100°C of about 9.3 mm^2/s or less and a CCS viscosity at -35°C of about 6200 mPa or less and exhibits a kinematic viscosity at 100°C up to about 1 mm^2/s lower at a target CCS viscosity as compared to a multi-grade lubricating oil composition without the (meth)acrylate copolymer;

wherein the base oil include a blend of at least one lighter base oil having a KV100 of 4.5 cSt or less and at least one heavier base oil having a KV100 of 5.5 cSt or higher and the blend of base oils has at least about 20 weight percent of the at least one heavier base oil based on the total weight of base oils in the blend; and

the (meth)acrylate copolymer includes as polymerized monomer units (i) (meth)acrylate monomer units with an intermediate molecular weight hydrocarbyl group in the monomer ester moiety of about 500 to about 700 and (ii) (meth)acrylate monomer units with a high molecular weight hydrocarbyl group in the monomer ester moiety of about 6,000 to about 10,000.

14. The method of claim 13, wherein the blend of base oils includes a weight ratio of the lighter base oils to the heavier base oils of about 1.55 or less and wherein the blend of base oils includes about 40 to about 60 weight percent of the heavier base oil.

15. The method of claim 13 or claim 14, wherein the multi-grade lubricating oil composition includes about 1 to about 8 weight percent of the hydrocarbyl substituted succinamide or succinimide dispersant.