



Use of Hexane (mixed isomers), N-hexane, Cyclohexane, Heptane, Potassium Hydroxide, Distilled Lime Oil (*Citrus aurantifolia*), Lemon Oil (*Citrus limonium*), and Cornmint Oil (*Mentha arvensis* and *Mentha canadensis*) as Denaturants

*The Alcohol and Tobacco Tax and Trade Bureau (TTB) authorizes hexane (mixed isomers), n-hexane, cyclohexane, heptane, potassium hydroxide, distilled lime oil (*Citrus aurantifolia*), lemon oil (*Citrus limonium*), and cornmint oil (*Mentha arvensis* and *Mentha canadensis*) as substitute denaturants.*

TTB RUL. 2010-3

Introduction

TTB has been asked whether hexane (mixed isomers), n-hexane, cyclohexane, heptane, potassium hydroxide, distilled lime oil (*Citrus aurantifolia*), lemon oil (*Citrus limonium*), and cornmint oil (*Mentha arvensis* and *Mentha canadensis*) may be used as substitute denaturants in specially denatured alcohol (SDA).

Background

Pursuant to 26 U.S.C. 5242, TTB regulates materials that are suitable to denature distilled spirits. The regulations in 27 CFR Part 21, Formulas for Denatured Alcohol and Rum, identify materials suitable for denaturing distilled spirits. Under the authority of 27 CFR 21.91, the appropriate TTB officer may authorize the use of substitute denaturants where the substitution will not jeopardize the revenue.

To approve a material as a denaturant for an SDA formula, TTB must determine:

1. That the proposed material, when added to spirits (ethanol), makes the ethanol "unfit for beverage or internal human medicinal use" (26 U.S.C. 5242 and 27 CFR 21.11),
2. That the use of the proposed material as a substitute denaturant will be adequate to protect the Federal excise tax revenue (27 CFR 21.91), and
3. That the proposed material is suitable for the intended use (26 U.S.C. 5242).

TTB makes these determinations for each proposed material on a case-by-case basis. To determine whether a material renders ethanol unfit for beverage purposes, TTB considers whether a reasonable person would not be inclined to drink it as an alcohol beverage, either because it would be disagreeable to the

senses or harmful to one's health. In the latter case, TTB considers whether the mixture has a warning taste and odor.

In making the determination that the proposed material will be adequate to protect the revenue, TTB considers whether the mixture of the proposed material and the ethanol is likely to be diverted for beverage purposes. One factor that TTB weighs when considering the possibility of diversion is the complexity and expense of equipment or processes that would be needed to obtain a significant quantity of potable alcohol from ethanol mixed with the proposed material. Other factors TTB considers are whether the material has a boiling point similar to ethanol and whether it forms an azeotropic mixture with ethanol, because these factors indicate that no more than a small amount of pure ethanol would be recoverable.

TTB Determinations

General

As provided below, TTB is authorizing the use of hexane (mixed isomers), n-hexane, cyclohexane, heptane, potassium hydroxide, distilled lime oil (*Citrus aurantifolia*), lemon oil (*Citrus limonium*), and cornmint oil (*Mentha arvensis* and *Mentha canadensis*) as substitute denaturants in the SDA formulas specified. In accordance with 27 CFR 20.93, users who wish to change to the newly authorized denaturants must submit new TTB Form 5150.19—Formula and/or Process for Article Made with Specially Denatured Spirits.

Hexane (mixed isomers) as a substitute denaturant in SDA Formula No. 2-B

Examination of hexane (mixed isomers) shows that it is an appropriate substitute denaturant for benzene, rubber hydrocarbon solvent, toluene, or heptane in SDA Formula No. 2-B (27 CFR 21.33). TTB has determined that the use of hexane (mixed isomers) as a denaturant in SDA Formula No. 2-B renders the spirits unfit for beverage or internal human medicinal use, is adequate to protect the Federal excise tax revenue, and is suitable for the intended use.

Held: Hexane (mixed isomers) may be used as a substitute denaturant on an equal volume basis for benzene, rubber hydrocarbon solvent, toluene, or heptane in SDA 2-B.

Held further: Hexane (mixed isomers) must meet the following specifications:

- Minimum 55% n-hexane.
- Distillation Range: No distillate should come over below 150°F and none above 160°F.
- Odor: Characteristic odor.

N-hexane as a substitute denaturant in SDA Formula No. 2-B

Examination of n-hexane shows that it is an appropriate substitute denaturant for benzene, rubber hydrocarbon solvent, toluene, or heptane in SDA Formula No. 2-B (27 CFR 21.33). TTB has determined that the use of n-hexane as a denaturant in SDA Formula No. 2-B renders the spirits unfit for beverage or internal human medicinal use, is adequate to protect the Federal excise tax revenue, and is suitable for the intended use.

Held: N-hexane may be used as a substitute denaturant on an equal volume basis for benzene, rubber hydrocarbon solvent, toluene, or heptane in SDA 2-B.

Held further: N-hexane must meet the following specifications:

- Minimum 97% purity.
- Distillation Range: No distillate should come over below 150°F and none above 160°F.
- Odor: Characteristic odor.

Cyclohexane as a substitute denaturant in SDA Formula No. 3-A

Examination of cyclohexane shows that it is an appropriate substitute denaturant for methyl alcohol in SDA Formula No. 3-A (27 CFR 21.35). TTB has determined that the use of cyclohexane as a denaturant in SDA Formula No. 3-A renders the spirits unfit for beverage or internal human medicinal use, is adequate to protect the Federal excise tax revenue, and is suitable for the intended use.

Held: Cyclohexane may be used as a substitute denaturant on an equal volume basis for methyl alcohol in SDA Formula No. 3-A.

Held further: Cyclohexane must meet the following specifications:

- Specific Gravity at 20°C: 0.75 to 0.80.
- Odor: Characteristic odor.

Heptane as a substitute denaturant in SDA Formula No. 12-A

Examination of heptane shows that it is an appropriate substitute denaturant for toluene or benzene in SDA Formula No. 12-A (27 CFR 21.40). TTB has

determined that the use of heptane as a denaturant in SDA Formula No. 12-A renders the spirits unfit for beverage or internal human medicinal use, is adequate to protect the Federal excise tax revenue, and is suitable for the intended use.

Held: Heptane may be used as a substitute denaturant on an equal volume basis for toluene and benzene in SDA Formula No. 12-A.

Held further: Heptane shall have the following specifications, as stated in 27 CFR 21.112:

- Distillation Range: No distillate shall come over below 200°F and none above 211°F.
- Odor: Characteristic odor.

Potassium Hydroxide as a substitute denaturant in SDA Formula No. 36

Examination of potassium hydroxide (also called “caustic potash,” “lye,” or “potassium hydrate”) shows that it is a satisfactory substitute denaturant for use in SDA Formula No. 36 (27 CFR 21.63). TTB has determined that the use of potassium hydroxide as a denaturant in SDA Formula No. 36 renders the spirits unfit for beverage or internal human medicinal use, is adequate to protect the Federal excise tax revenue, and is suitable for the intended use.

Held: Potassium hydroxide may be used as a denaturant in SDA Formula No. 36. The amount of potassium hydroxide used shall be such that each 100 gallons of alcohol will contain not less than 8.75 pounds of potassium hydroxide, on an anhydrous basis. For instance, 19.45 pounds of caustic potash, liquid grade, containing 45 percent potassium hydroxide by weight may be used, or 17.5 pounds of caustic potash, liquid grade, containing 50 percent potassium hydroxide by weight may be used.

Held further: Potassium hydroxide must meet the following specifications:

- Color: white or yellow.
- Specific Gravity at 20°C: 1.95 to 2.10.
- Melting Point: 360°C.
- Boiling Point: 1320°C.
- pH (0.1M solution): 13.5.

Distilled Lime Oil as a substitute denaturant in SDA Formula No. 38-B

Examination of Distilled Lime Oil (*Citrus aurantifolia*) shows that it is an appropriate substitute denaturant for use in SDA Formula No. 38-B (27 CFR 21.65). TTB has determined that the use of Distilled Lime Oil as a denaturant in SDA Formula No. 38-B renders the spirits unfit for beverage or internal human

medicinal use, is adequate to protect the Federal excise tax revenue, and is suitable for the intended use.

Held: Distilled Lime Oil may be used as a denaturant in SDA Formula No. 38-B in the same manner as the other denaturants listed in 27 CFR 21.65.

Held further: Distilled Lime Oil must meet the following specifications:

- Specific Gravity at 25°C: 0.850 - 0.870.
- Refractive Index at 20°C: 1.4740 - 1.4780.
- Optical Rotation at 20°C: +30° to +50°.
- Aldehyde Content (as citral): 0.5% - 3.0%.
- Terpene Content (as limonene): 45% minimum.

Lemon Oil as a substitute denaturant in SDA Formula No. 38-B

Examination of Lemon Oil (Citrus limonium) shows that it is an appropriate substitute denaturant for use in SDA Formula No. 38-B (27 CFR 21.65). TTB has determined that the use of Lemon Oil as a denaturant in SDA Formula No. 38-B renders the spirits unfit for beverage or internal human medicinal use, is adequate to protect the Federal excise tax revenue, and is suitable for the intended use.

Held: Lemon Oil may be used as a denaturant in SDA Formula No. 38-B in the same manner as the other denaturants listed in 27 CFR 21.65.

Held further: Lemon Oil meets the following specifications:

- Specific Gravity at 25°C: 0.850 – 0.860.
- Refractive Index at 20°C: 1.4570 – 1.4580.
- Optical Rotation at 20°C: +55° to +65°.
- Terpene Content (as limonene): 65% minimum.

Cornmint Oil as a substitute denaturant in SDA Formula No. 38-B

Examination of Cornmint Oil (Mentha arvensis and Mentha canadensis) shows that it is an appropriate substitute denaturant for use in SDA Formula No. 38-B (27 CFR 21.65). TTB has determined that the use of Cornmint Oil as a denaturant in SDA Formula No. 38-B renders the spirits unfit for beverage or internal human medicinal use, is adequate to protect the Federal excise tax revenue, and is suitable for the intended use.

Held: Cornmint Oil may be used as a denaturant in SDA Formula No. 38-B in the same manner as the other denaturants listed in 27 CFR 21.65.

Held further: Cornmint Oil must meet the following specifications:

- Specific Gravity at 25°C: 0.895 – 0.905.
- Refractive Index at 20°C: 1.4580 – 1.4590.
- Optical Rotation at 20°C: -18° to -36°.
- Alcohol Content (as menthol): 65% minimum.
- Ketone Content (as menthone): 5% minimum.

Date signed: April 27, 2010.

Signed by John J. Manfreda,

John J. Manfreda
Administrator
Alcohol and Tobacco Tax and Trade Bureau