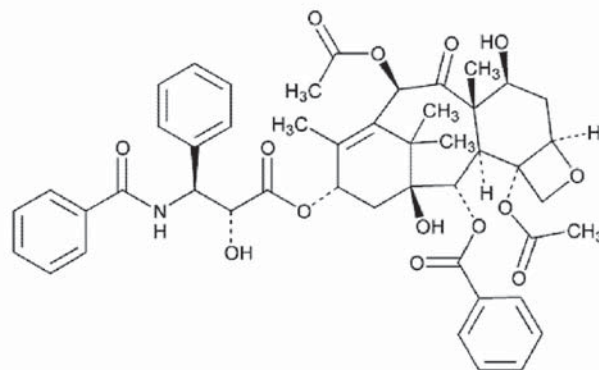


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Paclitaxel



$C_{47}H_{51}NO_{14}$ 853.91

Benzenepropanoic acid, β -(benzoylamino)- α -hydroxy-, 6,12b-bis(acetyloxy)-12-(benzoyloxy)-2a,3,4,4a,5,6,9,10,11,12,12a,12b-dodecahydro-4,11-dihydroxy-4a,8,13,13-tetramethyl-5-oxo-7,11-methano-1*H*-cyclodeca[3,4]benz[1,2-*b*]oxet-9-yl ester, [2a*R*-[2a α ,4 β ,4a β ,6 β ,9 α (α *R**, β *S**),11 α ,12 α ,12a α ,12b α]]-(2a*R*,4*S*,4a*S*,6*R*,9*S*,11*S*,12*S*,12a*R*,12b*S*)-1,2a,3,4,4a,6,9,10,11,12,12a,12b-Dodecahydro-4,6,9,11,12,12b-hexahydroxy-4a,8,13,13-tetramethyl-7,11-methano-5*H*-cyclodeca[3,4]-benz[1,2-*b*]oxet-5-one 6,12b-diacetate, 12-benzoate, 9-ester with (2*R*,3*S*)-*N*-benzoyl-3-phenylisoserine [33069-62-4].

» Paclitaxel contains not less than 97.0 percent and not more than 102.0 percent of $C_{47}H_{51}NO_{14}$, calculated on the anhydrous, solvent-free basis.

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Caution—Paclitaxel is cytotoxic. Great care should be taken to prevent inhaling particles of Paclitaxel and exposing the skin to it.

Packaging and storage— Preserve in tight, light-resistant containers, and store at controlled room temperature.

Labeling— The labeling indicates the type of process used to produce the material and the *Related compounds* test with which the material complies.

USP Reference standards [〈 11 〉](#) — [USP Endotoxin RS.](#) [USP Paclitaxel RS.](#) [USP Paclitaxel Related Compound A RS.](#) [USP Paclitaxel Related Compound B RS.](#)

Identification—

A: [Infrared Absorption](#) [〈 197K 〉](#).

B: The retention time of the major peak in the chromatogram of the *Assay preparation* corresponds to that in the chromatogram of the *Standard preparation*, as obtained in the *Assay*.

Specific rotation [〈 781S 〉](#): between -49.0° and -55.0° at 20° , calculated on the anhydrous, solvent-free basis.

Test solution: 10 mg per mL, in methanol.

Microbial limits [〈 61 〉](#) — The total aerobic microbial count does not exceed 100 cfu per g. It meets the requirements of the tests for the absence of *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Salmonella* species, and *Escherichia coli*.

Bacterial endotoxins [〈 85 〉](#) — It contains not more than 0.4 USP Endotoxin Unit per mg of paclitaxel.

Water, Method Ic [〈 921 〉](#): not more than 4.0%.

Residue on ignition [〈 281 〉](#): not more than 0.2%.

Heavy metals, Method II [〈 231 〉](#): 0.002%.

Related compounds—

TEST 1 (*for material labeled as isolated from natural sources*)— If the material complies with this test, the labeling indicates that it meets *USP Related compounds Test 1*.

Diluent— Prepare as directed in the *Assay*.

Solution A— Prepare filtered and degassed acetonitrile.

Solution B— Prepare filtered and degassed water.

Mobile phase— Use variable mixtures of *Solution A* and *Solution B* as directed for *Chromatographic system*. Make adjustments if necessary (see *System Suitability* under [Chromatography](#) [〈 621 〉](#)).

System suitability solution— Dissolve accurately weighed quantities of [USP Paclitaxel Related Compound A RS](#) and [USP Paclitaxel Related Compound B RS](#) in methanol to obtain a solution having known concentrations of about 10 µg of each per mL. Transfer 5.0 mL of this solution to a 50-mL volumetric flask, dilute with *Diluent* to volume, and mix.

Standard solution— Dissolve, with the aid of sonication, an accurately weighed quantity of [USP Paclitaxel RS](#) in *Diluent*, and dilute quantitatively, and stepwise if necessary, with *Diluent* to obtain a solution having a known concentration of about 5 µg per mL.

Test solution— Use the *Assay preparation*.

Chromatographic system (see [Chromatography](#) (621))— The liquid chromatograph is equipped with a 227-nm detector and a 4.6-mm × 25-cm column that contains 5-µm packing L43. The flow rate is about 2.6 mL per minute. The column temperature is maintained at 30°. The chromatograph is programmed as follows.

Time (minutes)	Solution A (%)	Solution B (%)	Elution
0–35	35	65	isocratic
35–60	35→80	65→20	linear gradient
60–70	80→35	20→65	linear gradient
70–80	35	65	isocratic

Chromatograph the *System suitability solution*, and record the peak responses as directed for *Procedure*: the relative retention times are about 0.78 for paclitaxel related compound A and 0.86 for paclitaxel related compound B (relative to the retention time for paclitaxel obtained from the *Test solution*); and the resolution, *R*, between paclitaxel related compound A and paclitaxel related compound B is not less than 1.0. Chromatograph the *Standard solution*, and record the peak responses as directed for *Procedure*: the relative standard deviation for replicate injections is not more than 2.0%.

Procedure— Inject a volume (about 15 µL) of the *Test solution* into the chromatograph, record the chromatogram, and measure the areas for the major peaks. Calculate the percentage of each impurity in the portion of Paclitaxel taken by the formula:

$$100(Fr_i / r_U),$$

in which *F* is the relative response factor for each impurity peak (see [Table 1](#) for values); *r_i* is the peak area for each individual impurity; and *r_U* is the peak area for paclitaxel.

Table 1

Relative Retention Time	Relative Response Factor (<i>F</i>)	Name	Limit (%)
0.24	1.29	Baccatin III	0.2
0.53	1.00	10-Deacetylpaclitaxel	0.5
0.57	1.00	7-Xylosylpaclitaxel	0.2
0.78	1.26	Cephalomannine (paclitaxel related compound A)	a ₁ ¹

Relative Retention Time	Relative Response Factor (<i>F</i>)	Name	Limit (%)
0.78	1.26	2'',3''-Dihydrocephalomannine	a ₂ ¹
0.86	1.00	10-Deacetyl-7-epipaclitaxel (paclitaxel related compound B)	0.5
1.10	1.00	Benzyl analog ³	b ₁ ²
1.10	1.00	3'',4''-Dehydropaclitaxel C	b ₂ ²
1.40	1.00	7-Epicephalomannine	0.3
1.85	1.00	7-Epipaclitaxel	0.5

¹ Resolution may be incomplete for these peaks, depending upon the relative amounts present; the sum of a₁ and a₂ is not more than 0.5%.

² Resolution may be incomplete for these peaks depending upon the relative amounts present; the sum of b₁ and b₂ is not more than 0.5%.

³ The following chemical name is assigned to the related compound, benzyl analog: Baccatin III 13-ester with (2*R*,3*S*)-2-hydroxy-3-phenyl-3-(2-phenylacetylamino)propanoic acid.

In addition to not exceeding the limits for paclitaxel related impurities in [Table 1](#), not more than 0.1% of any other single impurity is found; and not more than 2.0% of total impurities is found.

TEST 2 (for material labeled as produced by a semisynthetic process)— If the material complies with this test, the labeling indicates that it meets *USP Related compounds Test 2*.

Diluent— Use acetonitrile.

Solution A— Use a filtered and degassed mixture of water and acetonitrile (3:2).

Solution B— Use filtered and degassed acetonitrile.

Mobile phase— Use variable mixtures of *Solution A* and *Solution B* as directed for *Chromatographic system*. Make adjustments if necessary (see *System Suitability* under [Chromatography](#) (621)).

System suitability solution— Dissolve accurately weighed quantities of *USP Paclitaxel RS* and *USP Paclitaxel Related Compound B RS* in *Diluent*, using shaking and sonication if necessary, to obtain a solution having known concentrations of about 0.96 mg and 0.008 mg per mL, respectively.

Test solution— Transfer about 10 mg of Paclitaxel, accurately weighed, to a 10-mL volumetric flask; dissolve in and dilute with *Diluent* to volume, using shaking and sonication if necessary; and mix.

Chromatographic system (see [Chromatography](#), § 621) — The liquid chromatograph is equipped with a 227-nm detector and a 4.6-mm × 15-cm column that contains 3-μm packing L1. The flow rate is about 1.2 mL per minute. The column temperature is maintained at 35°. The chromatograph is programmed as follows.

Time (minutes)	Solution A (%)	Solution B (%)	Elution
0–20	100	0	isocratic
20–60	100→10	0→90	linear gradient
60–62	10→100	90→0	linear gradient
62–70	100	0	isocratic

Chromatograph the *System suitability solution*, and record the peak responses as directed for *Procedure*: the relative retention times are about 0.94 for paclitaxel related compound B and 1.0 for paclitaxel; the resolution, *R*, between paclitaxel related compound B and paclitaxel is not less than 1.2; and the relative standard deviation for replicate injections is not more than 2.0%.

Procedure— Separately inject equal volumes (about 15 μL) of the *Diluent* and the *Test solution* into the chromatograph, record the chromatograms, and measure the areas for all the peaks. Disregard any peaks due to the *Diluent*. Calculate the percentage of each impurity in the portion of Paclitaxel taken by the formula:

$$100(F_i / r_s),$$

in which *F* is the relative response factor for each impurity (see [Table 2](#) for values); *r_i* is the peak area for each impurity obtained from the *Test solution*; and *r_s* is the sum of the areas of all the peaks obtained from the *Test solution*.

Table 2

Relative Retention Time	Relative Response factor (<i>F</i>)	Name	Limit (%)
0.11	1.24	10-Deacetylbaaccatin III	0.1
0.20	1.29	Baccatin III	0.2
0.42	1.39	Photodegradant ²	0.1
0.47	1.00	10-Deacetylpacitaxel	0.5
0.80	1.00	2-Debenzoypacitaxel-2-pentenoate	0.7
0.92 ¹	1.00	Oxetane ring opened, acetyl and benzoyl ²	<i>x</i> ₁
0.92 ¹	1.00	10-Acetoacetylpacitaxel	<i>x</i> ₂
0.94 ¹	1.00	10-Deacetyl-7-epipacitaxel (pacitaxel related compound B)	<i>x</i> ₃
1.37	1.00	7-Epipacitaxel	0.4
1.45	1.00	10,13-Bissidechainpacitaxel ²	0.5
1.54	1.00	7-Acetylpacitaxel	0.6

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