

Draft Guidance on Fluticasone Propionate and Salmeterol Xinafoate

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Active Ingredient: Fluticasone propionate; Salmeterol xinafoate

Dosage Form; Route: Powder; inhalation

Strength: 0.055 mg/Inh; EQ 0.014 mg Base/Inh
0.113 mg/Inh; EQ 0.014 mg Base/Inh
0.232 mg/Inh; EQ 0.014 mg Base/Inh

Recommended Studies: In vitro and in vivo studies

FDA recommends the following in vitro and in vivo studies to establish bioequivalence (BE) of the test (T) and reference (R) dry powder inhalers (DPIs) containing fluticasone propionate and salmeterol xinafoate.

In Vitro Studies:

FDA recommends that applicants conduct the following in vitro BE studies for all strengths of the T and R products. For each strength, use at least three batches each of the T and R products, with no fewer than 10 units from each batch. FDA recommends that three primary stability batches be also used to demonstrate in vitro BE. The three batches of T product should be manufactured from, at minimum, three different batches of drug substance(s), excipient(s), and device components. The T product should consist of the final device constituent part and final drug constituent formulation intended to be marketed.

1. **Type of study:** Single actuation content (SAC)
Design: The SAC test should be performed at the beginning (B), middle (M), and end (E) lifestages¹ of the product, using a flow rate of 30 L/min, 60 L/min and 90 L/min. U.S. Pharmacopoeia (USP) <601> Apparatus B or another appropriate apparatus may be used to determine the SAC using a validated assay. The number of actuations per determination should be one. The volume of air drawn through the delivery system should be 2 L.

Equivalence based on: Population bioequivalence (PBE) analysis of SAC. Refer to the product-specific guidance for *Budesonide Inhalation Suspension* for additional information regarding PBE analysis procedures.

¹ Based on the labeled number of actuations, the terms, B lifestage, M lifestage, and E lifestage represent the first actuation(s) following the priming, the actuation(s) corresponding to 50 percent of the labeled number of actuations, and the actuation(s) corresponding to the labeled number of actuations, respectively.

2. Type of study: Aerodynamic particle size distribution (APSD)

Design: The APSD test should be performed at the B and E lifestages of the product using flow rates of 30 L/min, 60 L/min and 90 L/min. The USP <601> Apparatus 3, Apparatus 5, or another appropriate method may be used to determine APSD using a validated assay. The APSD determination of each unit should be performed with a minimum number of inhalations justified by the sensitivity of the validated assay. The volume of air drawn through the delivery system should be 4 L.

Additional comments: Drug deposition on individual sites, including the mouthpiece adapter, the induction port, the pre-separator, and each stage of the cascade impactor (CI) and the filter, is requested. Mass balance accountability should be reported based on the sum of all deposition sites. For electronic submission of the individual CI data for the T and R products, provide a table using the format in the appendix, and send them as part of the abbreviated new drug application (ANDA) submission for BE evaluation.

Equivalence based on: PBE analysis of impactor-sized mass (ISM).² The CI profiles representing drug deposition on the individual stages of the CI along with the mass median aerodynamic diameter (MMAD), geometric standard deviation (GSD) and fine particle mass (FPM) should be submitted as supportive evidence for equivalent APSD.

Pharmacokinetic Study

FDA recommends that applicants conduct the following pharmacokinetic (PK) BE study for all strengths of the T and R products.

3. Type of study: Fasting

Design: Single-dose, two-way crossover

Dose: Minimum number of inhalations that is sufficient to characterize a PK profile by using a sensitive analytical method

Subjects: Adult males and non-pregnant females, general population

Additional comments: (1) Subjects enrolled for in vivo studies should be trained in the use of the inhalation powders in a standard fashion, prior to each treatment session, to assure a relatively consistent inspiratory flow rate and inspiratory duration. (2) The subjects should adhere to labeling as follows: “Rinse your mouth with water without swallowing after each inhalation.” (3) A Bio-IND is required prior to conduct of the PK study if the dose exceeds the maximum labeled single dose.

Analyte(s) to measure (in appropriate biological fluid): Fluticasone propionate and salmeterol in plasma

² ISM is defined as a sum of the drug mass on all stages of the CI plus the terminal filter, but excluding the top CI stage because of its lack of a specified upper cutoff size limit.

Equivalence based on: AUC and C_{max} for fluticasone propionate and salmeterol. The 90% confidence intervals for the geometric mean T/R ratios of AUC and C_{max} should fall within the limits of 80.00-125.00%.

Comparative Clinical Endpoint BE Study

FDA recommends that applicants conduct the following comparative clinical endpoint BE study for the lowest strength of the T and R products.

4. Type of study: Comparative clinical endpoint BE study
Design: A randomized, multiple-dose, placebo-controlled, parallel-group design, at minimum consisting of a 2-week run-in period followed by a 4-week treatment period of the placebo, T or R product.
Strength: 0.055 mg/Inh; EQ 0.014 mg Base/Inh
Dose: 0.055 mg/Inh; EQ 0.014 mg Base/Inh, one inhalation twice daily

Inclusion and exclusion criteria:

Inclusion criteria should, at minimum, include:

- a. Adult male or female subjects of non-child bearing potential or of child bearing potential committing to consistent and correct use of an acceptable method of birth control.
- b. Diagnosis of asthma, as defined by the National Asthma Education and Prevention Program (NAEPP)³ at least 12 months prior to screening.
- c. Pre-bronchodilator FEV₁ of $\geq 45\%$ and $\leq 85\%$ of the predicted normal value during the screening visit and on the first day of treatment.
- d. Patients should be stable on their chronic asthma treatment regimen for at least 4 weeks prior to enrollment.
- e. Currently non-smoking; had not used tobacco products (i.e., cigarettes, cigars, pipe tobacco) within the past year, and had ≤ 10 pack years of historical use.
- f. $\geq 15\%$ reversibility and ≥ 0.2 L increase from baseline FEV₁ within 30 minutes following 180 – 360 mcg of albuterol inhalation (pMDI).
- g. Ability to discontinue their asthma medication (inhaled corticosteroids and long acting β agonist) during the run-in period and for remainder of the study.
- h. Ability to replace current short-acting β agonists (SABAs) with salbutamol/albuterol inhaler for use as needed for the duration of the study (subjects should be able to withhold all inhaled SABAs for at least 6 hours prior to lung function assessments on study visits).
- i. Willingness to give their written informed consent to participate in the study.

Exclusion criteria should, at minimum, include:

³ Guidelines for the Diagnosis and Management of Asthma: Expert Panel Report 3. National Asthma Education and Prevention Program; National Institute of Health; National Heart, Lung, and Blood Institute. 2007, Publication No. 07-4051.

- a. Life-threatening asthma, defined as a history of asthma episode(s) requiring intubation, and/or was associated with hypercapnia; respiratory arrest or hypoxic seizures, asthma related syncopal episode(s), or hospitalization within the past year to the screening or during the run-in period.
- b. Significant respiratory disease other than asthma (COPD, interstitial lung disease, chronic bronchitis, emphysema, etc.).
- c. Evidence or history of clinically significant disease or abnormality including congestive heart failure, uncontrolled hypertension, uncontrolled coronary artery disease, myocardial infarction, or cardiac dysrhythmia. In addition, historical or current evidence of significant hematologic, hepatic, neurologic, psychiatric, renal, cardiovascular, endocrine, or other diseases that, in the opinion of the investigator, would put the patient at risk through study participation, or would affect the study analyses if the disease exacerbates during the study.
- d. Hypersensitivity to any sympathomimetic drug (e.g., salmeterol/albuterol) or to any inhaled, intranasal, or systemic corticosteroid therapy, or to excipients in the DPI.
- e. Patients receiving B₂-blockers, anti-arrhythmics, anti-depressants, and/or monoamine oxidase inhibitors within 4 weeks prior to the screening.
- f. Viral or bacterial, upper or lower respiratory tract infection, or sinus, or middle ear infection within 4 weeks prior to the screening visit, during the run-in period, or on the day of treatment.
- g. Patients receiving systemic, oral, parenteral, or depot corticosteroids, or other immunosuppressive medications within 4 weeks prior to screening and during the study.

Additional Recommendations:

- The study may enroll all asthma patients who meet the inclusion and exclusion criteria, or may be enriched by using a subpopulation of patients predicted to respond well to the study treatment (appropriate justification should be included for the population chosen for study).
- Subjects who discontinue from the study early should be identified, and the protocol should clearly, prospectively state how missing data will be handled in the statistical analysis and provide appropriate justification for the method chosen. The protocol should also include subject retention strategies and other plans to minimize missing data. If there are missing data, adequate justification should be provided that the missing data do not lead to biased equivalence determination. Detailed information for all subjects who are discontinued from the study should be provided.
- All spirometry should be conducted in accordance with American Thoracic Society Standards.
- The study should begin with a placebo run-in period at least two weeks in duration to wash out any pre-study corticosteroids and/or long-acting bronchodilators and to establish FEV₁ baseline values.
- The study protocol should include pre-specified definitions of asthma exacerbation, as well as pre-specified and appropriate escape criteria with consideration to patient safety.

- The study protocol should provide a definition of compliant subjects (e.g., used at least 75% and no more than 125% of study drug doses) and specify how compliance will be verified (e.g., by the use of subject diaries).
- To ensure study sensitivity, the T and R products should both be statistically superior to placebo ($p < 0.05$) with regard to the BE study primary endpoints.
- It is the sponsor's responsibility to enroll a sufficient number of subjects for the study to demonstrate BE of the T to the R product.
- A clear list of permitted and restricted medications should be provided, including justification for use (or restriction) of certain classes of respiratory therapies, that considers the current standard of care for asthma.
- The start and stop date of concomitant medication use during the study should be provided in the data set in addition to the reason for the medication use. The sponsor should clearly explain whether the medication was used prior to baseline visit, during the study or both.
- All adverse events (AEs) should be reported, whether or not they are considered to be related to the treatment. The report of each AE should include the date of onset, description of AE, severity, relation to study medication, action taken, outcome, and date of resolution. The information will assist FDA in determining whether the incidence and severity of adverse reactions is different between the T and R products.

BE study endpoint: (1) Area under the serial FEV₁-time curve calculated from time zero to 12 hours (AUC_{0-12h}) on the first day of treatment, and (2) FEV₁ measured in the morning prior to the dosing of inhaled medications on the last day of the 4-week treatment.

The above primary endpoints should be baseline adjusted (change from baseline). An FEV₁ baseline is defined as the average of pre-dose FEV₁ values of at least two time points measured in the morning of the first day of a 4-week treatment period. Sampling is recommended to correspond to the same time of day as used on the last day of a 4-week treatment.

On the first day of treatment, serial FEV₁ should be determined at 0, 0.25, 0.5, 1, 2, 3, 4, 6, 8, 10, and 12 hour post-dose.

Equivalence based on: T/R ratio for the primary endpoints. The 90% confidence intervals for the T/R ratio for the primary endpoint should fall within the limits of 80.00 - 125.00%.

Additional Information

Formulation:

FDA recommends that the T formulation be qualitatively (Q1)⁴ and quantitatively (Q2)⁵ the same as the R formulation.

⁴ Q1 (qualitative sameness) means that the T formulation uses the same inactive ingredient(s) as the R formulation.

If a sponsor uses a Q2-different formulation for its T product, the sponsor should explain the reason(s) for not using a T formulation that is Q2 the same as the R formulation. In addition, the sponsor should provide pharmaceutical development data, involving in vitro testing of multiple drug-to-excipient ratios that encompass combinations below and above the ratios used in the T and R products.

Device:

Sponsors should refer to the FDA guidance for industry entitled, *Comparative Analyses and Related Comparative Use Human Factors Studies for a Drug-Device Combination Product Submitted in an ANDA*, which, when finalized, will provide the Agency's current thinking on the identification and assessment of any differences in the design of the user interface for a proposed generic drug-device combination product when compared to its RLD.

FDA recommends that applicants consider the following characteristics of the R product when designing the T product:

- Passive (breath-actuated) device
- Device-metered multi-dose format
- Number of doses of the R product
- External operating principles and external critical design attributes of the R product
- Size and shape of the R product
- Device resistance of the R product
- Dose indicator/counter

In addition, in vitro and in use studies should be conducted to support the functionality, accuracy and robustness of the proposed T product.⁶

⁵ Q2 (quantitative sameness) means that concentration of the inactive ingredient(s) used in the T formulation are within $\pm 5\%$ of those used in the R formulation.

⁶ Refer to the Guidance for Industry, *Metered Dose Inhaler (MDI) and Dry Powder Inhaler (DPI) Products – Quality Considerations*, for relevant principles regarding studies to support dry powder inhaler devices.

APPENDIX

Variable Name	Variable Type	Content	Notes
Product Name	Character	TEST or REF	Identifier for product
LOT Number	Alphanumeric/Numeric	Alphanumeric/Numeric	Identifier for product lot
UNIT Number	Numeric	Numeric values	Identifier for unit must be unique for each product (e.g. #1-30 for test and #31-60 for ref).
Stage 1	Numeric	Numeric Values	S1
Stage 2	Numeric	Numeric Values	S2
Stage 3	Numeric	Numeric Values	S3
Stage 4	Numeric	Numeric Values	S4
Stage 5	Numeric	Numeric Values	S5
Stage 6	Numeric	Numeric Values	S6
Stage 7	Numeric	Numeric Values	S7
Stage 8 or Filter	Numeric	Numeric Values	S8
ISM	Numeric	Numeric Values	ISM
MMAD	Numeric	Numeric Values	MMAD
GSD	Numeric	Numeric Values	GSD
FPM	Numeric	Numeric Values	FRM

Example

PRODUCT	LOT	Unit	S1	S2	S3	S4	S5	S6	S7	S8 or Filter	ISM	MMAD	GSD	FPM
TEST	1234	1												
		2												
		3												
		4												
		5												
		6												
		7												
		8												
		9												
		10												