Analytical Method Validation (AMV) in pharmaceuticals is the process of proving, through laboratory studies, that an analytical method (such as HPLC, GC, UV, etc.) is **suitable for its intended purpose**—typically for testing the identity, strength, quality, purity, or potency of a drug substance or drug product.

✅ Purpose of Method Validation

To ensure that the method consistently produces reliable and accurate results, which are:

- **Reproducible**
- **Accurate**
- **Specific**
- **Robust**
- **Compliant** with regulatory requirements (like ICH, FDA, EMA, WHO, etc.)

🔬 When is Method Validation Required?

- During **drug development** (especially before Phase III clinical trials)
- Before **commercial manufacturing**
- For **routine quality control** testing
- When a method is **transferred** between labs
- After **changes** in method parameters, instruments, or formulations

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📋 Key Validation Parameters *(Based on ICH Q2(R2))*

Parameter	Description
Accuracy	Closeness of the test results to the true value
Precision	Repeatability (same conditions) and intermediate precision (different days/analysts)

Specificity	Ability to measure analyte accurately in presence of other components
Linearity	Ability to obtain test results proportional to the concentration
Range	Interval between upper and lower concentration levels with acceptable accuracy
LOD (Limit of Detection)	Lowest amount of analyte that can be detected, not necessarily quantified
LOQ (Limit of Quantitation)	Lowest amount of analyte that can be quantitatively measured
Robustness	Ability to remain unaffected by small variations in method parameters
System Suitability	To ensure the system (instrument + method) is performing correctly

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🧪 Example:

For **Ceftriaxone Injection USP 500 mg**, an HPLC method used for *assay* would be validated for:

- Specificity (no interference from excipients)
- Linearity (e.g., 80% to 120% of label claim)
- Accuracy (recovery studies)
- Precision (repeatability across multiple runs)
- Robustness (e.g., slight changes in pH or temperature)
- System suitability (e.g., retention time, tailing factor, %RSD)

📑 Regulatory Guidelines for Method Validation

- **ICH Q2(R2) –** *Validation of Analytical Procedures*
- **USP <1225>**

- **FDA Guidance –** *Analytical Procedures and Methods Validation for Drugs and Biologics*
- **WHO TRS 1025 Annex 3**
- **EMA Guideline on Bioanalytical Method Validation** (for bioanalytical methods)

💡 Summary

Analytical Method Validation is a **critical quality assurance process** in pharmaceutical manufacturing and regulatory compliance. It ensures that the analytical test methods used are scientifically sound, reliable, and suitable for their intended use throughout the drug's lifecycle.

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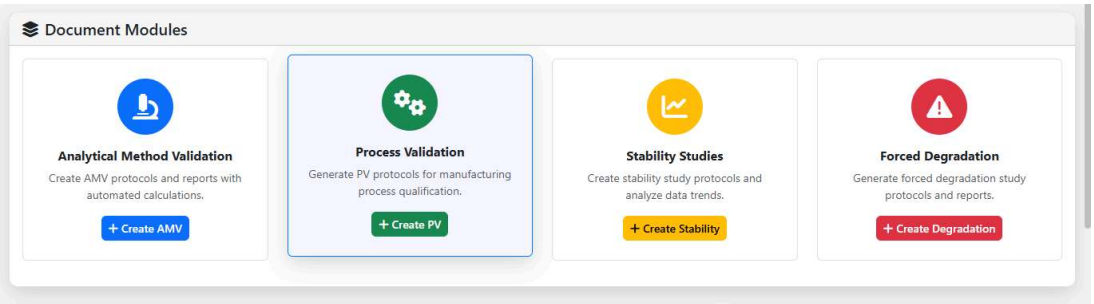
Dashboard View    Analytical Method Validation, Process Validation, Stability, Forced Degradation, Drug Excipient Compatibility Study

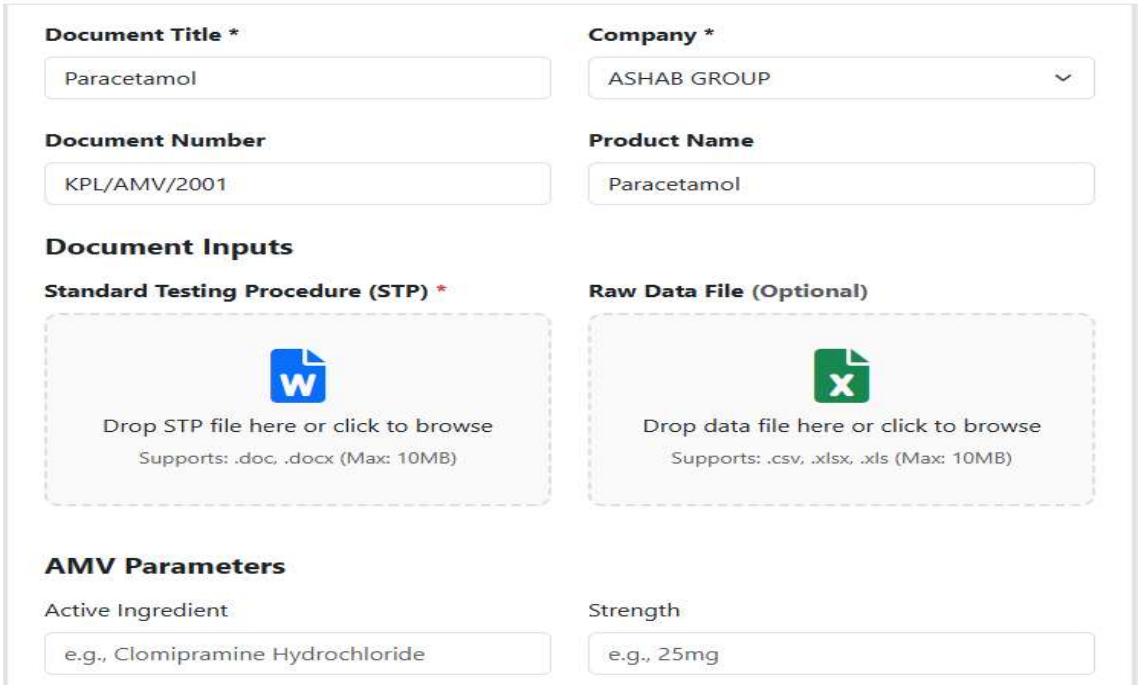
1. Analytical Method Validation Button

Analytical Method Validation	Analytical Method Verification

Analytical Method Verification Part is Missing,

Arrange following image content as per followed:-

1. Name of Document
2. Name of Product
3. Label Claim
4. Document Number



Select Instrument used for Method of Analysis

Ultraviolet Spectrophotometer (UV) □

Titration □ Missing

HPLC/UPLC □

Gas Chromatography (GC) □

Infrared Spectrophotometer(IR) □ Missing

Atomic Absorption Spectrophotometer (AAS) Missing

Select Parameter to Validate/Verify

Assay □

Dissolution □

Identification Test □

Related Substances □

Organic Impurities □

Residual Solvents □

If UV / AAS is selected

Add Parameters

Reference Absorbance of Standard

Weight of Standard (mg)

Weight of Sample (mg)

Final Concentration of Standard (mg/ml)

Final Concentration of Sample (mg/ml)

Potency %

Average Weight (mg)

Weight per ml (mg)

Wavelength (nm)

Add Method of Analysis in PDF Format

AI will extract the analytical method from the uploaded file and modify it as required

Example:-

Procedure: Mix the content of five vials and make pooled sample. Transfer accurately pooled sample equivalent to 75 mg of Fluorouracil into 200 ml volumetric flask, add 20 ml 1M hydrochloric acid, mix and dilute to 200 ml with water. Dilute 3 ml of this solution to 100 ml with 0.1M hydrochloric acid. Measure the absorbance of the resulting solution at 266nm.

Calculate the content of Fluorouracil, taking 552 as the value of A (1%, 1cm) at the maximum at 266nm.

This is a method of analysis

AI will read this and make dilution as per method for all selected parameters

Select Validation Parameters to include

1. Specificity
2. System Suitability
3. System Precision
4. Method Precision
5. Intermediate Precision
6. Linearity
7. LOD and LOQ
8. LOD and LOQ Precision
9. Range
10. Recovery
11. Robustness

AI will start preparing Protocol and Report by Using inputs

If HPLC/UPLC/GC is selected

Add Parameters

Reference Area of Standard

Weight of Standard (mg)

Weight of Sample (mg)

Final Concentration of Standard (mg/ml)

Final Concentration of Sample (mg/ml)

Potency %

Average Weight (mg)

Weight per ml (mg)

Flow Rate ml/min

Injection Volume micro Ltr

Wavelength (nm)

Add Method of Analysis in PDF Format

AI will extract the analytical method from the uploaded file and modify it as required

Example:-

Procedure:

Chromatographic system:

Column: A stainless steel column having (Length: 30cm x Diameter: 3.9mm)

Stationary phase: Packed with Octadecylsilyl silica gel for chromatography, (3-10 µm) L1

Flow rate: 1.0 ml per minute

Detection wavelength: 254 nm

Injection volume: 10 µl

Solution A:

Transfer an accurately weighed 2.75gm of sodium 1-heptanesulfonate in 50ml volumetric flask and dissolve in 25ml of distilled water (50% of flask volume) with the help of sonication and dilute with glacial acetic acid to 50ml.

Mobile phase:

Transfer an accurately measured 20ml of Solution A and 2ml of Triethylamine to a 500ml beaker, and dilute with water to 500ml. Transfer this solution to a 1000ml beaker and dilute with water to 1000ml, adjust with phosphoric acid to a pH of 3.2 ± 0.1.

Transfer an accurately measured 500 ml of buffer solution and 500 ml of acetonitrile in 1000 ml beaker.

Standard Solution:

Transfer an accurately weighed 100mg of Clomipramine hydrochloride RS/WS in 100ml volumetric flask and dissolve in 50ml of methanol with the help of sonication and dilute with methanol to 100ml. Further transfer an accurately measured 5ml of this solution in a 50ml volumetric flask and dilute with methanol to 50ml, mix to obtain a concentration of 100 mcg per ml of Clomipramine hydrochloride RS/WS.

Sample Solution:

Take not less than 20 tablets and crush them to make a fine powder. Transfer accurately weighed powdered tablets containing 25mg of Clomipramine hydrochloride in 250ml volumetric flask and dissolve in 165ml of methanol by mechanical shaking for 1 hour and dilute with methanol to 250ml, mix, filter through ordinary filter paper and Use the filtrate directly to obtain a concentration of 100 mcg per ml of Clomipramine hydrochloride.

Relative standard deviation: Not more than 2.0 percent

Procedure: Separately inject equal volumes (about 10 µL) of the each solution into the chromatograph, record the chromatograms, and measure the responses for the major peaks.

Analysis

Samples: Standard solution and Sample solution

Calculate the percentage of the labelled amount of Clomipramine hydrochloride in the portion of tablet taken:

Result= (Sample area)/(Std.area) X (Std.wt.)/100 X 5/50 X 250/25 X P/100 X Average weight=…%age

P = potency of working standard /RS

This is a method of analysis

AI will read this and make dilution as per method for all selected parameters

Select Validation Parameters to include

12. Specificity
13. System Suitability
14. System Precision
15. Method Precision
16. Intermediate Precision
17. Linearity
18. LOD and LOQ
19. LOD and LOQ Precision
20. Range
21. Recovery
22. Robustness

AI will start preparing Protocol and Report by Using inputs

If Titration is selected

Add Parameters

Reference Volume

Weight of Sample (gm)

Standard Factor (gm)

Average Weight (mg)

Weight per ml (mg)

Add Method of Analysis in PDF Format

AI will extract the analytical method from the uploaded file and modify it as required

Example:-

Procedure:

Weigh and powder 20tablets. Add a quantity of the powder containing 1 g of Lithium carbonate to100ml of water, add 50ml of 1M hydrochloric acid VS and boil for 1 minute to remove the carbondioxide. Cool and titrate the excess of acid with 1M sodium hydroxide VS using methyl orangesolution as indicator. Each ml of 1M hydrochloric acid VS is equivalent to 36.95mg of LithiumCarbonate

This is a method of analysis

AI will read this and make dilution as per method for all selected parameters

Select Validation Parameters to include

23. Specificity
24. System Suitability
25. System Precision
26. Method Precision
27. Intermediate Precision
28. Linearity
29. LOD and LOQ
30. LOD and LOQ Precision
31. Range
32. Recovery
33. Robustness

AI will start preparing Protocol and Report by Using inputs