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Qualification of Autosampler Dissolution Test Apparatus Type I & Type II

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Abstract

Historically, the dissolution testing has been used primarily as a quality control (QC) test for solid oral drug products performance. Dissolution testing is a basic technique used as a qualitative test to provide the measurement of the bioavailability of a drug as well as to demonstrate bioequivalence from batch-to-batch. The bioavailability and bioequivalence data obtained as a result of dissolution testing can be used in the development of a new formulation and product development processes toward product optimization, as well as to ensure continuing product quality and performance of the manufacturing process. In addition, dissolution is a requirement for regulatory approval for product marketing and is a vital component of the overall quality control program. Dissolution testing is conducted using a dissolution apparatus that conforms to the specifications outlined in the United States Pharmacopeia. In order to have a high degree of assurance that the dissolution apparatus is consistent and accurate in its performance, validation is required.

Validation is defined as documented evidence that provides a high degree of assurance that a specific instrument performs consistently according to manufacturer's specifications, user requirements meeting Good manufacturing practices (GMP) and Good laboratory practices (GLP). Validation is achieved by performing a series of validation activities; for a newly installed dissolution apparatus, validation is obtained through installation qualification (IQ), operational qualification (OQ) and performance qualification (PQ) through respective stages protocols. During different stages of qualification, it is ensured that dissolution tester was effectively installed, operated as per user manual & performed according to given programmed operation as per feeding instructions. During performance qualification the calibration results of installed dissolution tester were obtained within limit. Various physical parameters were tested like Spirit level test, Rotation per minute test, Temperature of water bath & each jar, Timer, Wobbling test & in Chemical test performance verification test with Prednisone tablet.

Keywords: Qualification, Autosampler, Dissolution Apparatus.

Introduction

Pharmaceutically dissolution is defined as the process by which the known amount of the solid drug substance transfer into the dissolution medium under specified standardized conditions. Dissolution testing is a critical analytical research parameter that helps in measuring the stability of the investigational product, which achieves uniformity during production batches and determining the in-vivo availability. Thus dissolution testing is a prime requirement for the development, performance, quality control & registration of different dosage forms.

Qualification is a basic step for equipment/ instrument validation to demonstrate that respective equipment/ instrument performance is suitable for its intended use. The various steps of qualification are design, installation, operational and performance qualification which are done in order to qualify the equipment/ instrument.

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Qualification

It refers to activities undertaken to demonstrate that utilities and equipment/ instrument properly installed, suitable for their intended use and perform properly as per predefined specifications.

Design Qualification (DQ)

It is documented evidence that the proposed design of the facilities, systems and equipment/ instrument is suitable for the intended purpose. It provides the assurance that the machine/ instrument is manufactured as per the URS and it complies with the scope of supply.

Installation Qualification (IQ)

It is documented evidence that the premises, supporting utilities, the equipment/ instrument have been built and installed in compliance with design specifications. Installation qualification consists of documented verification that all key aspects of the dissolution apparatus are in working condition and have been properly installed in accordance with manufacturer's recommendation in the proper operating environment.

Operational Qualification(OQ)

It is documented evidence that the equipment/ instrument operates as intended and is capable of consistent operation within established specifications. In this phase tests are done to assure that product meets all defined requirements under all anticipated conditions of manufacturing, i.e. worst case testing.

Qualification (PQ)

It is documented evidence that the equipment/ instrument operates as intended and is capable of consistently perform the operation within established specifications. Objective of performance qualification is to collect sufficient data to establish that dissolution apparatus performs to meet the desired Product Quality in consistent manner, when operated as per Standard Operating Procedure. Performance Qualification protocol provide the methodology of qualification studies, formats for recording the observation, criteria of Qualification and guideline for documentation of the study.

This qualification procedure was done according to User requirement specification (URS), Good manufacturing practices (GMP) and Good Laboratory Practices (GLP). The dissolution tester was effectively installed, operated as per user manual & performed according to the given programed operation as per feeding instructions of the instrument.

Material and Methods

Machine description

Dissolution apparatus, the unit has been designed for user friendly operation and supports a menu driven 20 x 4 character backlit LCD display. The EDT-14LX is provided with a microcontroller based stepper motor drive which gives precise RPM.

The water bath is attached to an isolated water circulating pump with a temperature controller to ensure a Uniform set temperature in the bath. The pump is isolated from the water bath to eliminate vibration. The water bath is molded to prevent leakage and shaped for easy cleaning to comply with GLP. It is provided with quick release couplings for ease ofoperation.

A sturdy top plate is provided to support the 14 vessels. The vessel is precisely aligned in the center with respect to the paddle by the self-centering ring and can be interchanged without disturbing the centering thus eliminating routine validation.

The instrument is provided with a sturdy telescopic motorized lift mechanism. This mechanism uses non-contact sensors for precise height positioning to meet USP requirements. Adjustable legs have been provided to level the instrument perfectly.

Method for Execution of Design Qualification:

Completing and documenting design reviews to illustrate that all quality aspects have been fully considered at the design stage. The purpose of DQ is to ensure that proposed design is suitable for the intended purpose as all the requirements for the final equipment/ instrument have been clearly defined at the start of qualification. Through DQ protocol it has been documented and verified that design of the instrument/ equipment fulfills the requirement of the user and manufacturer as per GMP and GLP.

Method for Execution of Installation Qualification

To ensure that there is sufficient information available to verify the installation of the equipment/ instrument safety, effectively and consistently. To verify the installation attributes of the Dissolution test apparatus critical to serve the intended purpose of the equipment. Prepare a

installation checklist and verify the appropriate installation of all the components and parts, including the spare parts according to the purchase order and manufacturer's specifications. Record the information for each component, spare parts, auxiliary equipment, supporting facilities/ utilities and compare to manufacturer's specifications. Installation should be done as per the instructions provided in the user manual.

Method for Execution of Operational Qualification

To ensure that there is sufficient information available to enable the equipment/ instrument to be operated and maintained safety, effectively and consistently. Draft SOPs of operation, cleaning and maintenance should be prepared on the basis of supplier guide/manual for operation before the qualification testing. Prior to the qualification test, the personnel shall be trained by the Engineer from the supplier on the operational features of the equipment/ instrument. This training shall be recorded in the respective section of the qualification document. The trained personnel shall carry out the operational qualification of the equipment/ instrument. Record the observations of qualification test in the observation test data table. Operate the equipment/ instrument as per the draft operational SOP. Record the changes if any and confirm the SOP. Report the confirmation of SOP in the observation section of OQ protocol. Identify and check all the displayed key functionality of the operating panel. Turn on the electrical power from the electrical panel. Set the controlling parameters on the panel. Perform the no load run with the help of RPM controller against set RPM and temperature using respective controller functionality set parameter key. Verify functionality of each component on the control panel against it specified functions set parameters. Observe and record the results in the Test Data sheet/ table.

Method for Execution of Performance Qualification

To ensure the performance of the equipment/ instrument shall fulfill the user requirements and meets the GLP and GMP requirements. Performance of the dissolution test apparatus shall be verified through physical and chemical verification methods in loaded condition.

Physical performance of the dissolution apparatus with load run shall be verified by checking the Head plate coplanarity, dissolution solution temperature, stirrer RPM, stirrer timer, stirrer wobbling, Stirrer basket/ paddle depth, Integrity and mesh size of basket, Jar centering, Stirrer vibration, Rinsing Volume, Sampling Volume and Replenishing Volume.

Chemical performance of the dissolution apparatus with load run shall be verified chemically by two dissolution test parameters of Geometric mean and Percentage of coefficient variance (%CV).

Results and Discussion

Physical Performance Qualification Tests:

Temperature Check:

Dissolution medium added in each jar is 900 ml and Set temperature = 37.0 °C.

Table 1: Temperature check of Dissolution apparatus

Time (Min.)	Observed Temperature (°C) (Acceptance limit: ± 0.5°C of set temperature)														
	Temp. of water bath	Calibrated Thermometer													
		Jar No.													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
10	37.2	37.1	37.2	37.2	37.2	37.2	37.1	37.1	37.1	37.2	37.2	37.1	37.1	37.1	37.1
20	37.2	37.1	37.1	37.3	37.1	37.0	37.1	37.1	37.0	37.1	37.1	37.0	37.2	37.1	37.0
30	37.3	37.0	37.1	37.2	37.2	37.0	37.1	37.0	37.1	37.0	37.2	37.0	37.2	37.0	37.1
40	37.2	37.0	37.1	37.2	37.2	37.0	37.0	37.1	37.2	37.1	37.2	37.1	37.0	37.1	37.1
50	37.3	37.1	37.2	37.2	37.2	37.0	37.2	37.0	37.1	37.2	37.1	37.0	37.2	37.0	37.1
60	37.3	37.1	37.2	37.2	37.1	37.2	37.1	37.1	37.0	37.0	37.1	37.1	37.1	37.0	37.0

Time (Min.)	Observed Temperature (°C) (Acceptance limit: ± 0.5°C of set temperature)	
	Temp. of	Instrument display temperature probe
		Jar No.

	water bath	1	2	3	4	5	6	7	8	9	10	11	12	13	14
10	37.3	37.2	37.2	37.1	37.1	37.2	37.2	37.1	37.1	37.2	37.2	37.1	37.2	37.2	37.0
20	37.2	37.2	37.1	37.2	37.2	37.1	37.1	37.1	37.1	37.1	37.1	37.0	37.2	37.1	37.1
30	37.2	37.1	37.2	37.3	37.1	37.1	37.2	37.1	37.2	37.1	37.2	37.1	37.0	37.0	37.2
40	37.3	37.1	37.1	37.2	37.2	37.1	37.1	37.1	37.2	37.1	37.0	37.2	37.1	37.1	37.1
50	37.2	37.0	37.1	37.1	37.2	37.0	37.2	37.2	37.1	37.1	37.2	37.0	37.1	37.0	37.2
60	37.2	37.2	37.2	37.2	37.2	37.2	37.2	37.1	37.1	37.2	37.2	37.1	37.2	37.1	37.2

Rotational Speed: Instrument: Tachometer

Table 2: Rotational speed check of Equipment

Set RPM	Observed RPM on Tachometer Acceptance limit: ± 4% of set RPM													
	RPM verification of stirring element - Paddle													
	Jar No.													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
20	20.1	20.1	20.1	20.1	20.1	20.1	20.0	20.0	20.1	20.1	20.1	20.0	20.0	20.0
25	25.1	25.1	24.9	24.9	24.8	24.9	24.9	24.9	24.9	25.1	25.0	25.1	24.9	25.0
50	49.9	50.1	49.9	50.0	49.9	49.8	49.8	49.9	50.1	50.0	49.9	50.1	50.0	50.1
100	99.9	99.8	99.9	99.9	100.0	99.9	99.8	99.9	99.9	99.8	100.0	99.9	99.8	99.9
150	149.8	149.9	149.8	150.0	150.0	150.1	149.8	149.9	150.0	149.8	150.1	150.0	149.9	149.9
200	199.8	199.9	199.9	201.0	201.0	199.8	199.9	199.8	199.9	199.9	199.8	200.1	200.0	199.9
250	249.9	249.8	249.7	249.8	249.6	249.9	249.6	249.9	250.0	249.8	249.9	249.8	249.8	249.7

Set RPM	Observed RPM on Tachometer Acceptance limit: ± 4% of set RPM													
	RPM verification of stirring element - Basket													
	Jar No.													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
20	20.2	20.1	20.2	20.2	20.1	20.1	20.0	20.1	20.1	20.2	20.1	20.1	20.0	20.1
25	25.2	25.1	24.9	24.8	24.8	24.8	24.8	24.7	24.8	25.0	25.1	25.1	24.8	25.1
50	49.8	50.2	49.8	50.1	49.8	49.9	49.9	49.8	50.1	50.1	49.8	50.2	50.1	50.0
100	99.8	99.9	99.8	99.9	100.1	99.8	99.7	99.8	99.8	99.7	100.1	99.8	99.7	99.8
150	149.7	149.8	149.7	150.1	150.1	150.2	149.7	149.5	150.2	149.8	150.3	150.4	149.8	149.8
200	199.7	199.8	199.7	201.3	201.4	199.5	199.4	199.6	199.8	199.2	199.4	200.8	201.2	199.2
250	249.2	249.2	249.0	249.2	249.4	249.2	248.6	247.8	248.0	248.4	247.6	248.8	247.8	248.7

Calibration Timer: Instrument: Stopwatch

Table 3: Calibration Timer check of Equipment

Set time on instrument (Minute)	Observation (Acceptance limit : ± 6 Seconds)	
	Time observed on Stopwatch (Minute)	Time displayed on Dissolution Apparatus (Minute)
30	30:00	000:30
45	45:00	000:45
60	60:00	001:00

Wobble Check: Instrument: Wobblemeter

Table 4: Wobble check of Equipment

Stirring Element	Observed Wobbling (mm)														
	Set RPM	Jar No.													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Paddle (Acceptance limit: NMT 0.5 mm)	**25**	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1
	50	0.1	0.1	0.1	0.2	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2
	100	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1
	150	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1
	200	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2	0.1	0.2	0.1
	250	0.2	0.1	0.2	0.1	0.2	0.1	0.2	0.2	0.3	0.1	0.2	0.2	0.1	0.3
Basket (Acceptance limit: NMT 1.0 mm)	**25**	0.1	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	50	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.2	0.1
	100	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.2	0.2	0.2
	150	0.2	0.1	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.2	0.2	0.2	0.3	0.2
	200	0.2	0.3	0.3	0.4	0.2	0.4	0.4	0.2	0.5	0.3	0.3	0.4	0.3	0.4
	250	0.3	0.3	0.4	0.4	0.5	0.4	0.3	0.5	0.4	0.5	0.3	0.5	0.4	0.5

Distance from paddle bottom and basket bottom to the bottom of the jars:
Instrument: Depth gauge

Table 5: Depth of jars check of Equipment

Jar No.	Observation (mm) (Acceptance Limit – 23 mm to 27 mm)	
	Distance D1	Distance D2
1	25.4	25.5
2	25.2	25.0
3	25.3	25.0
4	25.0	24.5
5	25.0	24.6
6	25.0	25.0
7	25.5	25.5
8	25.8	25.8
9	25.6	25.6
10	25.7	25.8
11	25.9	25.9
12	25.8	25.7
13	25.6	25.6
14	25.6	25.8

D1= Distance between bottom edge of paddle to lowest inner surface of the jar (in mm).
D2= Distance between bottom edge of basket to lowest inner surface of the jar (in mm).

Integrity check and mesh size of basket: Equipment: LensSlot

Table 6: Integrity check of Equipment

Basket No.	Integrity of mesh of the Basket	Observation (No. of opening per linear inch)		
		Vertical Position	Horizontal Position	
			1	2
Acceptance Criteria: Integrity of mesh of the Basket should be Ok as mesh size of basket should be 40 opening in per linear inch.				
1	OK	40	40	40
2	OK	40	40	40
3	OK	40	40	40
4	OK	40	40	40
5	OK	40	40	40
6	OK	40	40	40
7	OK	40	40	40

Basket No.	Integrity of mesh of the Basket	Observation (No. of opening per linear inch)		
		Vertical Position	Horizontal Position	
			1	2
Acceptance Criteria: Integrity of mesh of the Basket should be Ok as mesh size of basket should be 40 opening in per linear inch.				
8	OK	40	40	40
9	OK	40	40	40
10	OK	40	40	40
11	OK	40	40	40
12	OK	40	40	40

Distance between the shaft axis and vertical axis of the jar is calculated by formula: Instrument: Vernier Caliper

Table 7: Centering of jars check

Jar No.	Observation (mm) Acceptance Limit – NMT 2.0 mm						
	Measured Dimensions (mm)				$\Delta X=(X1-X2)^2$	$\Delta Y=(Y1-Y2)^2$	Centering (Z)
	X1	X2	Y1	Y2			
1	47.39	46.73	46.32	47.66	0.4356	1.7956	0.7
2	46.45	47.04	46.51	46.98	0.3481	0.2209	0.4
3	47.46	47.97	47.32	48.12	0.26.1	0.6400	0.5
4	47.21	47.10	47.19	47.92	0.0121	0.5329	0.4
5	48.45	47.78	47.32	48.51	0.4489	1.4161	0.7
6	47.50	47.73	46.92	47.58	0.0529	0.4356	0.3
7	46.75	47.35	47.48	46.81	0.3600	0.4489	0.4
8	46.52	46.61	46.22	47.05	0.0081	0.6889	0.4
9	47.87	47.10	47.58	46.83	0.5929	0.5625	0.5
10	46.95	47.48	46.76	47.39	0.2809	0.3969	0.4
11	46.39	47.82	47.24	46.88	2.0449	0.1296	0.7
12	45.31	44.92	44.91	44.46	0.1521	0.2025	0.3

Vibration check: Instrument: Vibration Meter

Table 8: Vibration check

Position	Bench Top with Acceptance Limit – NMT 10µ							
	Paddle				Basket			
	1	2	3	4	1	2	3	4
Observation (µ)	8	4	3	4	6	2	4	3
	2	3	2	3	4	6	3	2
	1	2	1	2	2	2	2	3
	2	1	2	1	2	2	2	2
	2	1	1	2	1	2	2	2
	3	2	2	1	3	2	1	2
	3	2	1	1	2	2	1	1
	2	2	2	1	2	1	2	1
	2	3	2	2	2	2	2	1
	4	4	3	3	4	3	3	2
	3	4	3	2	4	4	2	2
	3	3	2	2	3	2	1	1
Maximum value for each position	8	4	3	4	6	6	4	3
Maximum value among each position	8							

Position	Top plate with Acceptance Limit – NMT 10µ							
	Paddle				Basket			
	1	2	3	4	1	2	3	4
Observation (µ)	6	4	6	2	3	9	3	3
	4	4	3	2	2	4	2	3
	3	4	3	2	2	3	3	2
	3	3	2	2	8	3	8	2
	2	3	2	2	5	2	6	2
	6	4	5	2	8	9	6	4
	8	6	4	4	6	4	5	2
	4	5	4	3	5	3	3	4
	6	4	5	4	6	4	3	3
	8	4	6	5	4	4	3	4
	5	6	4	4	8	3	2	4
	7	3	5	4	6	4	2	3
Maximum value for each position	8	6	6	5	8	9	8	4
Maximum value among each position	9							

Position	Stirrer Unit with Acceptance Limit – NMT 10µ							
	Paddle				Basket			
	1	2	3	4	1	2	3	4
Observation (µ)	6	1	2	2	2	2	2	2
	3	1	1	1	1	1	2	1
	3	1	2	2	1	2	2	2
	2	2	2	1	1	2	2	1
	2	2	1	2	2	1	1	2
	6	4	5	2	8	6	6	4
	8	6	4	4	6	4	5	2
	4	5	4	3	5	3	3	4
	6	4	5	4	6	4	2	3
	4	5	4	3	5	3	3	4
	5	6	5	4	8	5	2	4
	7	3	5	4	6	8	3	3
Maximum value for each position	8	6	5	4	8	8	6	4
Maximum value among each position	8							

Verification of Rinsing Volume: Instrument: Analytical Weighing Balance

Table 9: Rinsing Volume check

Sr. No.	Observation Acceptance Limit: ± 0.5 ml			
	Wt. of dry empty vials/ test tubes (g)	Wt. of filled vials / test tubes (g)	Difference in weights (g)	Rinsing Volume (ml) = Difference in weight / 0.099602 (specific gravity at 25°C)
1	13.2191	16.2432	3.0241	3.0
2	13.3932	16.4537	3.0605	3.1
3	13.3633	16.4153	3.0520	3.1
4	13.2959	16.3524	3.0565	3.1
5	13.4501	16.4948	3.0447	3.1
6	13.5745	16.5759	3.0014	3.0
7	13.2690	16.2136	2.9446	3.0
8	13.3686	16.4267	3.0581	3.1
9	13.4733	16.5349	3.0616	3.1
10	13.5440	16.5972	3.0532	3.1
11	13.5057	16.5676	3.0619	3.1
12	13.5021	16.5490	3.0469	3.1

Verification of Sampling Volume: Instrument: Analytical Weighing Balance

Table 10: Sampling Volume check

Sr. No.	Observation Acceptance Limit: ± 0.5 ml			
	Wt. of dry empty vials / test tubes (g)	Wt. of filled vials / test tubes (g)	Difference in weights (g)	Sampling Volume (ml) = Difference in weight / 0.099602 (specific gravity at 25°C)
1	13.3174	23.2822	9.9648	10.0
2	13.2191	23.1839	9.9648	10.0
3	13.3699	23.3275	9.9576	10.0
4	13.3047	23.3057	10.0010	10.0
5	13.4581	23.4388	9.9807	10.0
6	13.4375	23.3812	9.9437	10.0
7	13.3799	23.2543	9.8744	9.9
8	13.4190	23.3442	9.9252	10.0
9	13.4661	23.3843	9.9182	10.0
10	13.4131	23.3296	9.9165	10.0
11	13.3034	23.2169	9.9135	10.0
12	13.3892	23.2876	9.8984	9.9

Verification of Replenishing Vol.: Instrument: Analytical Weighing Balance

Table 11: Replenishing Volume check

Sr. No.	Observation Acceptance Limit: ± 0.5 ml			
	Wt. of dry empty vials / test tubes (g)	Wt. of filled vials / test tubes (g)	Difference in weights (g)	Replenishing Volume (ml) = Difference in weight / 0.099602 (specific gravity at 25°C)
1	16.6977	29.7294	13.0317	13.1
2	16.8212	29.8883	13.0671	13.1
3	16.4846	29.4074	12.9228	13.0
4	16.9155	30.0029	13.0874	13.1
5	16.5725	29.5173	12.9448	13.0
6	16.5930	29.5048	12.9118	13.0
7	16.5801	29.6052	13.0251	13.1
8	16.6197	29.6708	12.0511	13.1
9	16.6145	29.5692	12.9547	13.0
10	16.5358	29.5224	12.9866	13.0
11	16.5622	29.5024	12.9402	13.0
12	16.6436	29.6430	12.9994	13.1

Chemical Performance Qualification Tests

Perform chemical test using USP Prednisone Tablet Reference Standard for preparing the Standard Solution and Sample solution with Dissolution Medium as follows:

Preparation of Dissolution medium

Heated 14000 ml water to 45°c filter under vacuum through 0.45 µm porosity membrane filter & apply vacuum for additional 5min. with continuous stirring. Doesn't allow temperature to fall below 37°C prior to initiate the test.

Preparation of standard solution

Weighed 40.79 mg USP reference standard of Prednisone & transferred into 200 ml volumetric flask. Added approximately 10 ml of ethanol & sonicated to dissolve. Diluted to volume upto 200 ml with dissolution medium & mixed. Further diluted the 10 ml of stock solution in 100 ml volumetric flask with dissolution medium & mixed.

Preparation of samplesolution

One tablet subjected to each 500 ml of dissolution medium for dissolution and filtered. Carried out dissolution on 12 tablets.

Procedure for determination of % dissolution of standard and sample

Maintain the temperature of bath 37±0.5°C. Set the pump RPM and measure this by Tachometer. Load one tablet of USP Prednisone Tablet Reference Standard into each basket/ paddle jar. Set the assembly such that baskets/ paddles are immersed into the dissolution jar at appropriate height. Carried out dissolution on all 12 tablets. After the end of 30 min dissolution, withdraw 10 ml of the test solution from all 12 dissolution jars. Measure the absorbance of the standard solution and test solution on a UV-VIS Spectrometer at the maximum 242 nm against deaerated purified water as blank. After withdraw of the samples at regular intervals. Again replace with equal amount of dissolution medium to maintain the volume of jar as 500ml.

Calculate the percentage of each individual dissolved Prednisolone tablet in 30 minutes as follows:

Absorbance of standard solution at 242 nm = 0.885.

$$\text{Factor (K)} = \frac{1}{\text{Absorbance of Std. Sol.}} \times \frac{\text{Wt. of Std.}}{\text{200 ml of dissolution medium}} \times \frac{\text{10 ml of Stock Solution}}{\text{100 ml diluted standard solution}} \times \frac{\text{500 ml of dissolution jar sample volume}}{\text{10 ml of withdrawal sample}} \times \text{Std. purity}$$

For Dissolution Apparatus - I: USP Type I - Basket**:**

Duration : 30 min.
Speed : 50 rpm
Temperature : 37°c
Dissolution medium : 500 ml of deaerated purified water

For 1st stage calibration out of two stage (Run-1):

$$\text{Factor K} = \frac{1}{0.885} \times \frac{40.79}{200} \times \frac{10}{100} \times \frac{500}{10} \times 99.6 = 114.765$$

Table 12: Performance verification test for Apparatus Type I

Tablet No. (Jar No.)	Observation				
	Acceptance Criteria for USP Prednisone Tablets RS, R072M1: % Dissolution: 60 to 88 i.e. Combined GM of %Dissolution. %CV: NMT 11 i.e. %Coefficient of variation.				
	Wt. of Tablet (mg)	Absorbance at 242 nm	% Dissolution (K Factor x Absorbance)	Test Results	
				Combined Geometric Mean	%CV
1	220.53	0.596	114.765 x 0.596 = 68.400	69	1
2	220.93	0.609	114.765 x 0.609 = 69.892		
3	218.63	0.601	114.765 x 0.601 = 68.974		
4	219.30	0.599	114.765 x 0.599 = 68.744		
5	221.14	0.597	114.765 x 0.597 = 68.515		
6	221.08	0.591	114.765 x 0.591 = 67.826		
7	225.48	0.604	114.765 x 0.604 = 69.318		
8	225.20	0.595	114.765 x 0.595 = 68.285		
9	225.86	0.604	114.765 x 0.604 = 69.318		
10	223.61	0.600	114.765 x 0.600 = 68.859		

11	220.40	0.606	114.765 x 0.606 = 69.548		
12	219.10	0.599	114.765 x 0.599 = 68.744		

For 2nd stage calibration out of two stage (Run-2): Not applicable

(If calibration fails in 1st stage out of two stages then perform 2nd stage/ run)

For Dissolution Apparatus - II: USP Type II - Paddle**:**

Duration : 30 min.

Speed : 50 rpm

Temperature : 37°c

Dissolution medium : 500 ml of deaerated purified water

For 1st stage calibration out of two stage (Run-1):

$$\text{Factor K} = \frac{1}{0.885} \times \frac{40.79}{200} \times \frac{10}{100} \times \frac{500}{10} \times 99.6 = 114.765$$

Table 13: Performance verification test for Apparatus Type II

Tablet No. (Jar No.)	Observation				
	Acceptance Criteria for USP Prednisone Tablets RS, R072M1: % Dissolution: 26 to 40 i.e. Combined GM of %Dissolution. %CV: NMT 6.8 i.e. %Coefficient of variation.				
	Wt. of Tablet (mg)	Absorbance at 242 nm	% Dissolution (K Factor x Absorbance)	Test Results	
				Combined Geometric Mean	%CV
1	219.78	0.306	114.765 x 0.306 = 35.118	35	1.9
2	223.32	0.296	114.765 x 0.296 = 33.970		
3	220.19	0.310	114.765 x 0.310 = 35.577		
4	221.81	0.309	114.765 x 0.309 = 35.462		
5	220.60	0.298	114.765 x 0.298 = 34.200		
6	226.03	0.311	114.765 x 0.311 = 35.692		
7	219.71	0.303	114.765 x 0.303 = 34.774		
8	223.14	0.298	114.765 x 0.298 = 34.200		
9	227.66	0.304	114.765 x 0.304 = 34.889		
10	226.04	0.299	114.765 x 0.299 = 34.315		
11	224.58	0.298	114.765 x 0.298 = 34.200		
12	221.67	0.311	114.765 x 0.311 = 35.692		

For 2nd stage calibration out of two stage (Run-2): Not applicable

(If calibration fails in 1st stage out of two stages then perform 2nd stage/ run)

Conclusion

The Dissolution Test Apparatus was successfully installed as per the design qualification of standard laboratory instrument model. Operational qualifications test results were found to be within the predefined acceptable limits. The system suitability tests should be performed after any significant equipment/ instrumental change e.g., a change from a basket apparatus to a paddle apparatus, unless multiple apparatus are qualified at the time of qualification or relocation of the dissolution apparatus e.g., to another laboratory/ position. Barring any significant change, the system suitability tests should be conducted at least twice a year as part of a robust preventive maintenance program. Final outcome of the work was that the dissolution test apparatus operated as per user manual & performed the given programed or operation as per feeding instructions of SOP. Thus dissolution apparatus is considered qualified and acceptable for its intended use to perform desire dissolution testing. Asperformance qualification/ calibration results of newly installed dissolution tester obtained within its pre-defined acceptance limit and satisfactory performance when operated.

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