Foreword

The formulation of this national standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled "Enhancing the Implementation of AFMA Through Improved Agricultural Engineering Standards" which was funded by the Bureau of Agricultural Research (BAR) of the Department of Agriculture (DA).

This standard has been technically prepared in accordance with PNS 01-4:1998 (ISO/IEC Directives Part 3:1997) – Rules for the Structure and Drafting of International Standards.

The word "shall" is used to indicate requirements strictly to be followed in order to conform to the standard and from which no deviation is permitted.

The word "should" is used to indicate that among several possibilities one is recommended as particularly suitable, without mentioning or excluding others, or that certain course of action is preferred but not necessarily required.

In the preparation of this standard, the following documents/publications were considered:

AMTEC Test Reports on Sprinkler Head

International Organization for Standardization (ISO) 7749-1:1986 (new 1995) – Agricultural Irrigation Equipment – Rotating Sprinklers – Part 1: Design and Operational Requirements

ASAE S398T:1980 – Procedure for Sprinkler Testing and Performance Reporting

Republic Act No. 7394 otherwise known as "The Consumer Act of the Philippines" enacted on July 22, 1991.

Agricultural Machinery – Rotating Sprinkler Head – Methods of Test

1 Scope

This standard specifies the methods of test and inspection for rotating sprinkler head. Specifically, it shall be used to:

1.1 verify the dimensions, weight and materials of construction of sprinkler head and the list of specifications submitted by the manufacturer; and

1.2 determine the performance of the device by measuring the discharge capacity, radius of throw and distribution pattern at different base pressures.

2 References

The following normative document contains provisions, which, through reference in this text, constitute provisions of this National Standard:

PAES 125:2002, Agricultural Machinery – Sprinkler Head – Specifications
Part 1: Rotating Impact-Driven Type

PAES 103:2000, Agricultural Machinery – Method of Sampling

PAES 316:2002, Engineering Materials – Metal Bars, Pipes and Tubes – Specifications

3 Definitions

For the purpose of this standard, the following definitions shall apply:

3.1
base pressure
pressure measured at a point on the riser with a distance of at least five times the nominal sprinkler inlet diameter from the last upstream direction change or change in pipe cross-sectional area

3.2
nozzle
aperture of the sprinkler through which the liquid is discharged

3.3
radius of throw
farthest distance measured from the sprinkler head centerline to a point at which liquid is deposited

3.4
rotating sprinkler head
rotating sprinkler
device which by its rotating motion around its vertical axis distributes liquid over an area

4 General Conditions for Test and Inspection

4.1 Sprinkler head on test

In the case of commercially manufactured sprinkler head, the sprinkler head submitted for test shall be taken from production model or series of production and shall be sampled in accordance with PAES 103.

4.2 Role of the manufacturer/dealer

The manufacturer/dealer shall submit to the official testing agency the performance specifications and other relevant information on the sprinkler head. An official representative shall be appointed to conduct minor repair, handle, adjust and witness the test. It shall be the duty of the representative to make all decisions on matters of adjustment and preparation of the device for testing. The manufacturer/dealer shall abide with the terms and conditions set forth by the official testing agency.

4.3 Site conditions and test equipment

4.3.1 Sprinkler site

The sprinkler shall be located in an area where the surface is smooth or where vegetative growth is less than 8 mm in height. The land shall have a maximum slope of 2 percent. A map showing location and heights of windbreaks (trees, shrubs, and other obstructions) shall be included on the test report. Tests shall not be run when these conditions are not satisfied.

4.3.2 Sprinkler mounting

4.3.2.1 The sprinkler nozzle height above the nearest collector(s) for test purposes is defined in Table 1.

Table 1. Sprinkler Nozzle Height Above Collectors

Sprinkler Type	Sprinkler Inlet Size (Nominal Pipe Diameter)	Maximum Nozzle Height Above Collector
Riser mounted; rotating	32 mm or smaller	915 mm
Riser mounted; rotating	38 mm or larger	1830 mm
Riser mounted; non-rotating	All	460 mm

4.3.2.2 The sprinkler shall remain vertical (within 1 degree) throughout the duration of the test.

4.3.2.3 The sprinkler riser shall be made from Schedule 40 steel pipe. The riser nominal pipe size shall be the same size as the sprinkler inlet connection. The base pressure measurement location shall be defined as a point with a distance of at least five times the nominal sprinkler inlet diameter from the last upstream direction change or change in pipe cross-sectional area. The pressure tap shall be perpendicular to the riser and shall not extend into the inside diameter of the riser. Riser stream straightening vanes may be used when data are collected if such vanes are supplied as standard equipment with the sprinkler.

NOTE For more detailed specification of steel pipe (Schedule 40), refer to PAES 316.

4.3.3 Collector description and location

4.3.3.1 All collectors used to measure distribution shall be identical. They shall be such that the water does not splash out and such that evaporation is kept to a minimum. The type of collector shall be identified and recorded on the data sheet. If an evaporation suppressant is used, its type and method of application shall be identified and recorded on the data sheet.

4.3.3.2 A square grid pattern of collectors shall be used, with the spacing between collectors being any whole number. The sprinkler shall be located in the center of a grid square (midway between 4 adjacent collectors). A minimum of 80 collectors shall be maintained such that the tops are level at all times. The maximum spacing of collectors for a pre-determined radius of throw is shown in Table 2. (see Annex A)

Table 2. Maximum Spacing of Collectors for Pre-determined Sprinkler Radius of Throw

Sprinkler Radius of Throw (m)	**Maximum Collector Spacing Center to Center (m)**
< 3	0.30
3 – 6	0.60
6 – 12	0.75
> 12	1.50

4.3.3.3 The average above ground height of the tops of the 4 collectors near the sprinkler shall either be 0.9 m or 0.3 m above the ground. This measurement shall be reported as collector height. Collectors shall be placed such that the vertical change in height between successive collectors shall not exceed a grade of 2 percent.

4.3.4 Wind measuring equipment and location for outdoor tests

4.3.4.1 Wind velocity during the test period shall be determined with a rotating cup anemometer or device of equal or better accuracy. The wind direction shall be determined with a wind vane on the basis of 8 points of the compass (N, S, E, W, NE, NW, SE, SW).

4.3.4.2 Wind velocity sensing equipment shall be located at a minimum height of 4 m. For sprinklers with trajectory height of more than 4 m, the sensor height shall be equal to the highest point of the main stream $\pm$ 10 percent.

4.3.4.3 The wind sensing equipment shall be located outside the wetted area and at a location that is representative of the wind conditions at the sprinkler location. The maximum distance of the sensor location shall not exceed 45 m from the wetted area of the sprinkler under test.

5 Test and Inspection

5.1 Verification of the Manufacturer's Technical Data and Information

5.1.1 This inspection is carried out to verify the main dimensions, weight and materials of construction of sprinkler head in comparison with the list of manufacturer's technical data and information.

5.1.2 A plain and level surface shall be used as reference plane for verification of dimensional sprinkler head specifications.

5.1.3 The items to be inspected and verified shall be recorded in Annex B.

5.2 Field Performance Test

5.2.1 This test is carried out to obtain the discharge capacity, speed of sprinkler rotation and radius of throw and sprinkler distribution pattern at base pressures ranging from 170 kPa up to 485 kPa at increments of 35 kPa. The base pressure shall not vary by more than $\pm$ 3 percent during the test period. Pressure shall be measured and recorded at a point on the riser using pressure measuring devices accurate within $\pm$ 3 percent of the sprinkler test pressure.

5.2.2 Discharge Capacity Determination

5.2.2.1 The test shall be conducted by operating the sprinkler at base pressures indicated in 5.2.1.

5.2.2.2 The discharge capacity shall be measured using volumetric method. The rotating sprinkler head is kept stationary by restraining the impact arm from swinging. A hose is then connected to the sprinkler nozzle while a container is placed on the other end of the hose opening. The container shall have sufficient capacity to prevent the liquid from overflowing during measurement, and it shall be sufficiently rigid to prevent deformation when it is filled with liquid. The liquid shall be obtained in a container of known volume for a definite time usually one minute. The discharge capacity or sprinkler flow rate shall be computed using the following formula:

$$Q = \frac{V}{t}$$

where: Q is the discharge, L/s

V is the volume of liquid introduced into container in t seconds, L

t is the time required to introduce liquid of volume V, s

The flow through the sprinkler shall be measured to an accuracy of $\pm$ 3 percent of the sprinkler flow rate.

5.2.3 Radius of Throw Determination and Sprinkler's Speed of Rotation

5.2.3.1 The test shall be conducted by operating the sprinkler at base pressures indicated in 5.2.1.

5.2.3.2 The radius of throw shall be taken by computing the average of two measurements (r_1 and r_2) made when the sprinkler base is rotated a quarter revolution (90°) about its axis. See Figure 1. Three test trials shall be conducted.

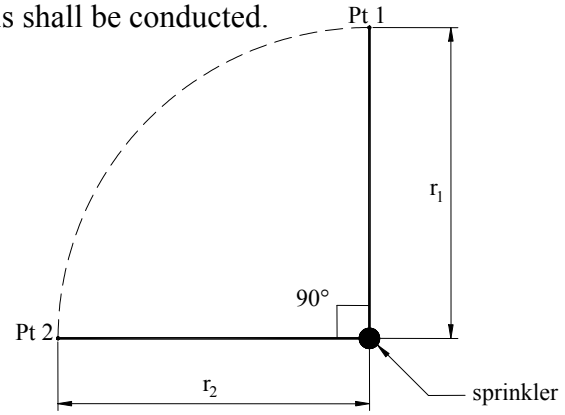


Figure 1 – Measurement of Radius of Throw

5.2.3.3 The sprinkler's speed of rotation shall be measured only while the sprinkler is rotating from its own drive mechanism.

5.2.4 Distribution Pattern

5.2.4.1 The conditions for testing shall be in accordance with subclause 4.3.

5.2.4.2 The test shall be conducted by operating the sprinkler at base pressures indicated in 5.2.1.

5.2.4.3 The depth of application in each collector shall be determined to an accuracy of $\pm$ 2 percent of the average application depth and recorded in a table showing the location of the collector relative to the sprinkler.

5.2.5 Items to be measured shall be recorded in Annex C.

6 Test Report

6.1 Name of testing agency

6.2 Test report number

6.3 Title

6.4 Summary

6.5 Purpose and scope of test

6.6 Methods of test

6.7 Table 1 – Machine Specifications

6.8 Table 2 – Field Performance Test Data

6.9 Observations

6.10 Name and signature of test engineer

Annex A
(Informative)

Sample Distribution of Collectors in a Square Grid Pattern

For a predetermined 3 m radius of throw, the collectors' location in a square grid pattern with a minimum of 80 collectors is illustrated in the following figure.

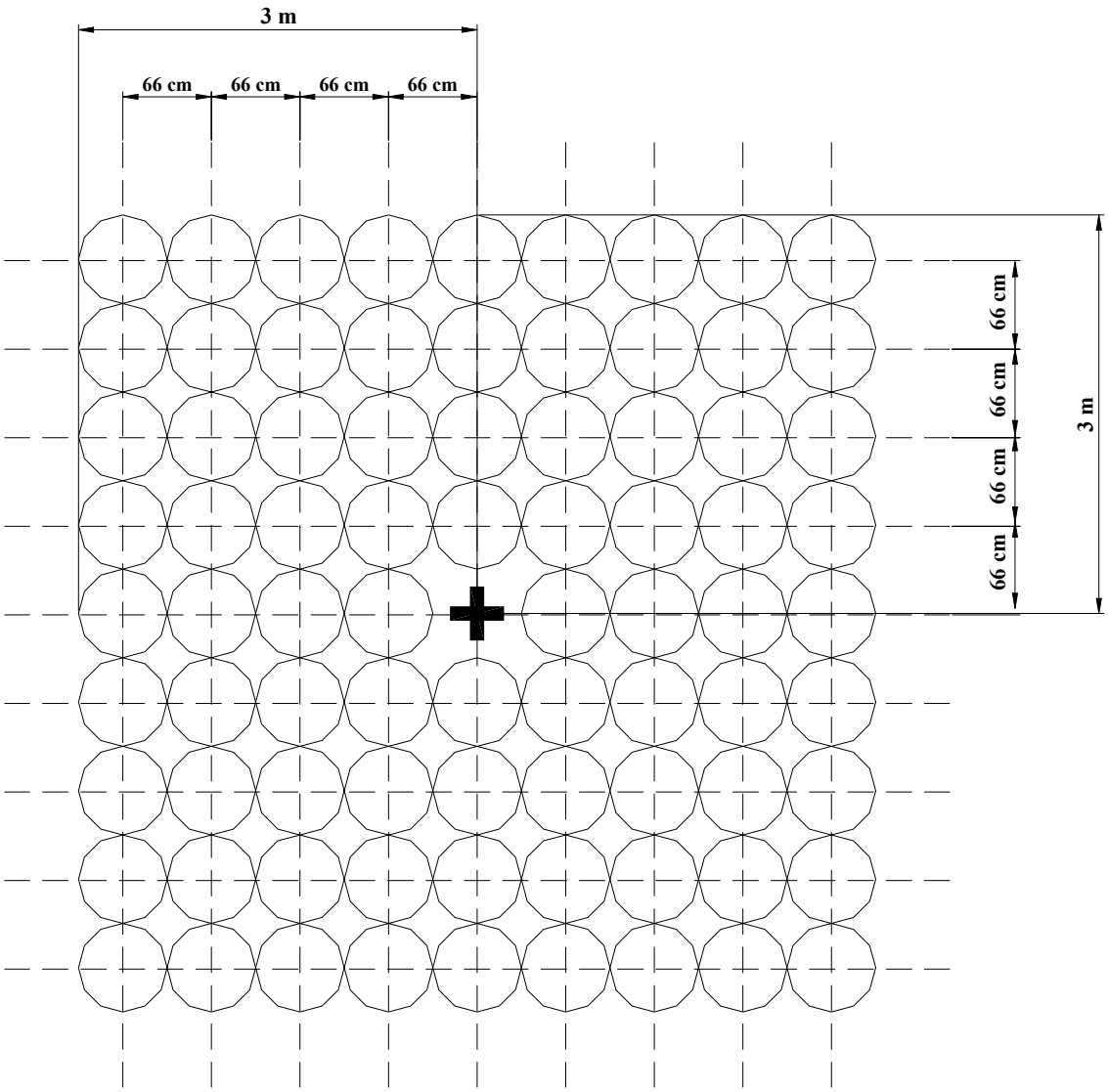


Figure A1 – Square Grid Pattern of 80 Collectors for a 3 m Radius of Throw

Annex B

Inspection Sheet for Sprinkler Head

Name of Applicant : _____

Address : _____

Telephone No. : _____

Name of Distributor : _____

Address : _____

Name of Manufacturer : _____

Factory Address : _____

General Information

Brand :_____Model :_____

Type : _____

Production date of sprinkler head to be tested (if available) : _____

ITEMS TO BE INSPECTED

ITEMS	Manufacturer's Specification	Verification by Testing Agency
B1 Dimensions and weight of the sprinkler		
B1.1 Overall length, mm		
B1.2 Overall width, mm		
B1.3 Overall height, mm		
B1.4 Weight, kg		
B2 Specifications		
B2.1 Sprinkler Head		
B2.1.1 Type		
B2.2 Nozzle		
B2.2.1 Type		
B2.2.2 Size, mm		
B2.2.3 Material		
B2.2.4 Mode of Attachment		

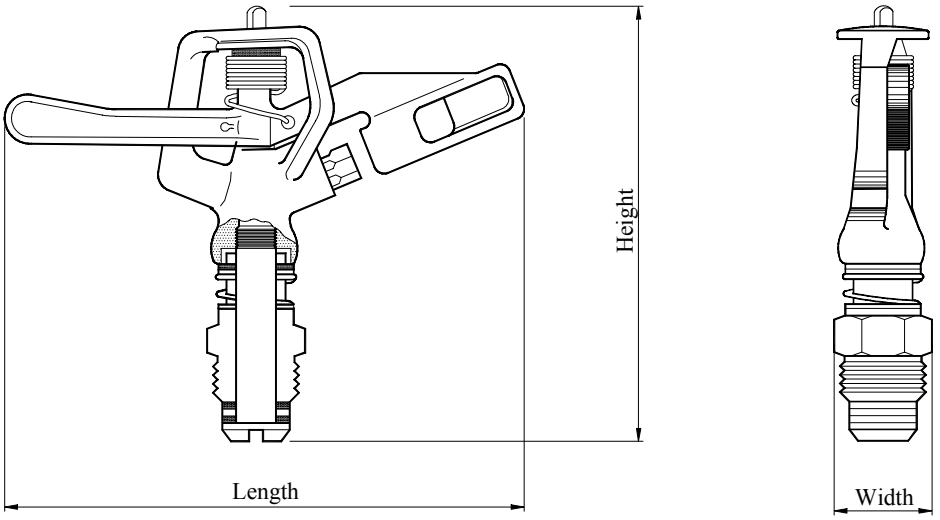


Figure B1 – Measurement of Length, Width and Height of Sprinkler Head

Annex C

Field Performance Test Data Sheet

C1 Sprinkler Head on Test

Brand : _____
Model : _____
Date of test : _____

C2 Test Conditions

Ambient temperature

Dry bulb, ºC : _____
Wet bulb, ºC : _____

Relative Humidity, % : _____
Atmospheric Pressure, mb : _____
Wind speed at 4 m elev., kph : _____

C3 Discharge Capacity, Sprinkler's Speed of Rotation and Radius of Throw Data Sheet

Base Pressure kPa	Discharge Capacity* L/s			Radius of Throw* m		Time for one rotation* s
	Nozzle 1	Nozzle 2	Total	300 mm riser	1000 mm riser	
170						
205						
240						
275						
310						
345						
380						
415						
450						
485						

* Average of three test trials

C4 Sprinkler Distribution Test Data Sheet

C4.1 Collector height : _____

C4.2 Collector entrance diameter : _____

C4.3 Sketch of test area (sample sketch shown in Figure C1)

C4.3.1 Location of sprinkler

C4.3.2 Location of climatic measuring equipment

C4.3.3 Wind direction during test period

C4.3.4 Distance from sprinkler to all windbreaks (upwind, downwind, and to side)

C4.3.5 Heights of all windbreaks

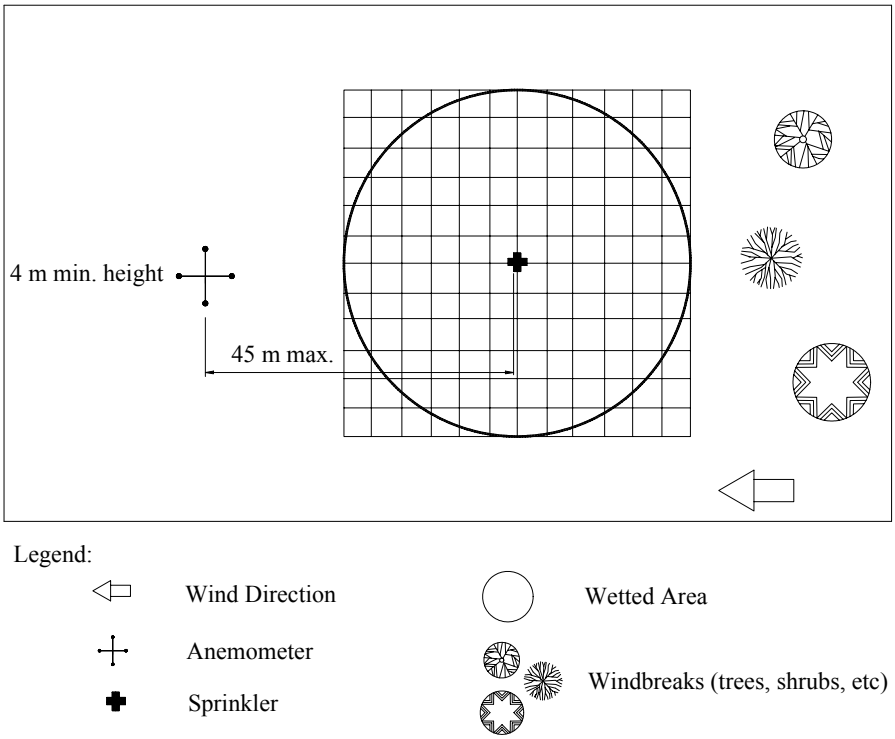
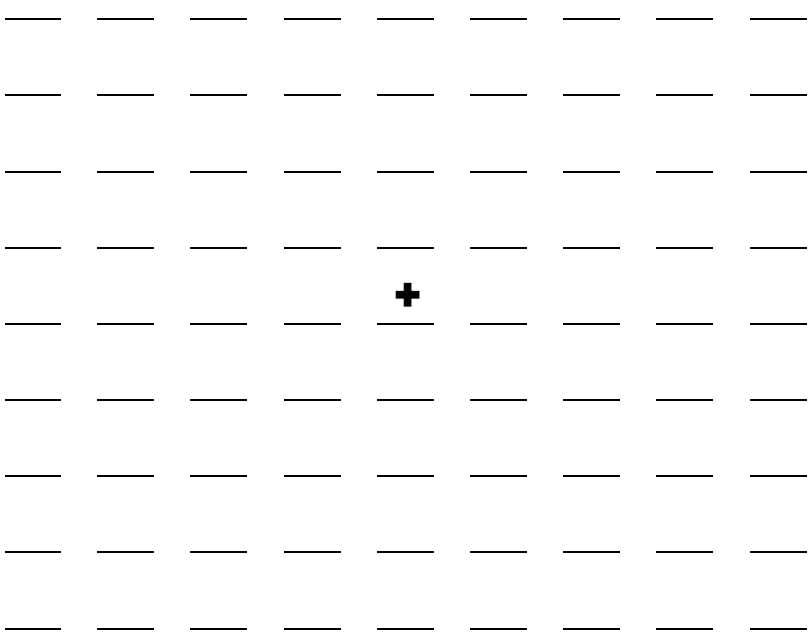


Figure C1 – Sketch of Test Area

C4.4 Map of sprinkler distribution pattern



Note: Indicated above are the depths of application in millimeter.
Mark location of sprinkler with plus (+) sign.
Indicate prevailing wind direction by an arrow and give its least angle of deviation from a line parallel to one of the principal axes of this sheet.
Grid spacing is _____mm.

Figure C2 – Map of Sprinkler Distribution Pattern