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BUREAU OF INDIAN STANDARDS

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भारतीय मानक मसौदा

कृषि ट्रैक्टरों और पावर टिलर के लिए स्पार्क अरेस्टर — परीक्षण पद्धतियां

(आइ एस 11822 *का पहला पुनरीक्षण*)

Draft ***Indian Standard***

SPARK ARRESTER FOR AGRICULTURAL TRACTORS AND POWER TILLERS — TEST METHODS

(*First Revision of* IS 11822*)*

ICS 65.060.01

Agricultural Machinery and Equipment Sectional Committee, FAD 11

Last date for Comments: **20 May 2024**

FOREWORD

(*Formal clause will be added later*)

While using the tractors for harvesting, threshing and transportation of dry agricultural material, it has been observed that glowing carbon particles coming out from the exhaust silencer, create fire hazards. In order to arrest these glowing carbon particles, spark arresters are used in tractors and power tillers. To streamline methods for evaluation of these spark arresters, the standard was published in 1986 based on SAE J350.1980 'Spark arrester test procedure for medium size engine' published by Society of Automotive Engineers' USA. In formulation of the standard, assistance was also derived from Central Farm Machinery Training and Testing Institute, Budni and Northern Region Farm Machinery Training and 'resting Institute, Hissar.

The standard primarily covers the methods of test for evaluation of spark arrester for agricultural tractors and power tillers, however the methods may also be used for other powered equipment like combine harvester.

The first revision of the standard has been brought out to incorporate the amendment issued to the earlier version with necessary editorial corrections and to bring it in the latest style and format of Indian Standards. Reference to Indian Standards wherever applicable have also been updated.

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 2022 'Rules for rounding off numerical values (*second revision*)'.

Draft ***Indian Standard***

SPARK ARRESTER FOR AGRICULTURAL TRACTORS AND POWER TILLERS — TEST METHODS

(*First Revision of* IS 11822*)*

1 SCOPE

This standard covers methods of tests for spark arresters fitted on engines used for agricultural tractors and power tillers.

2 REFERENCES

The following standard contain provision which, through reference in this text, constitute provisions of this standard. At the time of publication, the edition indicated was valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent edition of the standards indicated below:

IS No.	*Title*
IS 4905 : 2015/ ISO 24153 : 2009	Random sampling and randomization procedures (*first revision*)

3 TERMINOLOGY

3.1 For the purpose of this standard, the following definitions shall apply.

3.2 Agricultural Tractors — A self-propelled wheeled vehicle having two axles, or a track-laying or semi-track-laying machine, more particularly designed to pull, push, carry and operate implements and machines used for agricultural work (including forestry work).

3.3 Spark Arrester — A device fitted with the exhaust system of an engine to arrest the glowing carbon particles.

4 SELECTION AND GENERAL REQUIREMENTS

4.1 Selection — The spark arrester shall be selected at random (*see* IS 4905) from the production lot by a representative of testing authority. However, in case of prototype, the sample shall be submitted directly to the testing authority. The spark arrester shall be complete in all respects.

4.2 Specification — The applicant manufacturer shall supply specifications of the spark arrester as per Annex A as well as any further technical details as may be required to carry out the test. A line sketch should be provided by the manufacturer/applicant giving the details of the specification.

5 RUNNING IN AND CHECKING OF SPECIFICATION

5.1 Running in

The spark arrester shall be run-in as per schedule and duration specified by the applicant/manufacturer.

5.2 Checking of Specifications

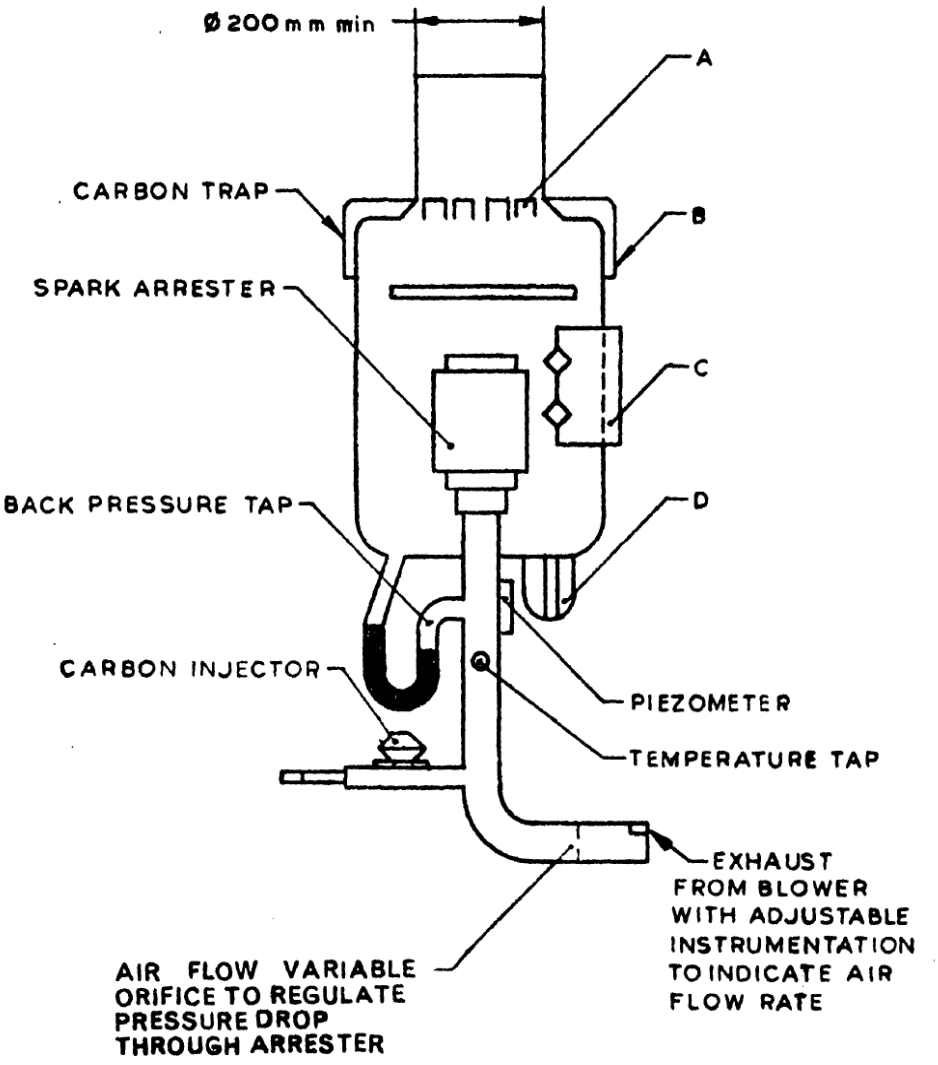
The information given by the manufacturer/applicant in the specification sheet as per Annex A shall be verified by the testing authority and reported.

6 TESTS

6.1 General

6.1.1 The tests shall be conducted under laboratory conditions with air. The spark arrester shall be tested at flows creating back pressure up to 6.8 kPa. If the spark arrester is considered for back pressure above 6.8 kPa, additional testing may be carried out at the higher flow rate necessary to develop the actual maximum back pressure.

6.1.2 *Test Equipment* — The test unit consists of a suitable blower with air directed through the metering instruments, spark arrester, and a positive trap for collecting particles. The apparatus shall permit mounting of arresters in all positions in which they may be used and shall discharge into the positive trap in a manner similar to that shown in Fig. 1.



A — Diameter should be large enough to ensure negligible back pressure at maximum air flow screen (IS Sieve 600 micron opening).

B — Soft target (optional), plywood or equivalent, to be used when necessary to prevent carbon from being pulverized through the screen and shall be capable of being thoroughly cleansed, if used.

C — Air tight access hatch to permit clean sweep down of all material collected (optional).

D — Trap for removal of carbon passed through arrester.

FIG. 1 TEST APPARATUS FOR MEASURING SPARK ARRESTER EFFICIENCY

6.1.2.1 The measuring apparatus shall be such that the following items have the tolerances within the limits shown against each:

a)	Rotational speed, r/min	± 0.5 percent
b)	Time, s	± 0.2 s
c)	Distance, m or mm	± 0.5 percent
d)	Force, N and torque, Nm	± 1.0 percent
e)	Mass, kg	± 0.5 percent
f)	Atmospheric pressure, kPa	± 0.2 kPa
g)	Hydraulic pressure, kPa	± 2.0 percent
h)	Temperature of fuels, etc., °C	± 2 °C
j)	Temperature readings of wet and dry bulb thermometers, °C	± 0.5 °C

6.1.3 *Test Carbon* — The test carbon used shall conform to the following specifications:

Type of Carbon	*IS Sieve No.*	*Percent Retained*
Fine Carbon	1.40 mm	0 to 5
	1.18 mm	10 to 30
	850 mm	50 to 70
	600 mm	0 to 25
Coarse Carbon	2.36 mm	0 to 10
	1.70 mm	40 to 60
	1.18 mm	30 to 40
	850 mm	0 to 10

6.1.3.1 The test carbon shall be petroleum coke and once used may not be used for further tests.

6.1.4 *Carbon Injection Mechanism* — The test carbon shall be injected by a feeder mechanism that shall not crush or grind the material, nor shall it unduly affect the normal flow of air through the apparatus. It shall be located approximately as shown in Fig. 1.

6.1.5 *Differential Pressure* — The test equipment as shown in Fig. 1 shall be equipped with a piezometer ring or other device for monitoring pressure to the arrester. The differential pressure shall be measured with a manometer between the piezometer and the pressure tap on the discharge side of the arrester. A piezometer calibration run should be made over the anticipated airflow range with no spark arrester in place. The indicated pressure recorded should be plotted and the resulting calibration curve should be used to correct data recorded during subsequent tests on the same spark arrester. At each test point, the flow rate through the arrester shall be held constant during the carbon feed cycle.

6.2 Test Procedure

6.2.1 The test equipment shall be arranged in a general configuration similar to that shown in Fig. 1. The inlet duct shall be of proper size to fit the arrester as in normal installation.

6.2.2 The following checks can be made with no spark arrester by using a straight pipe equal in length and inlet diameter to that of the test arrester:

a) System pressure with maximum expected air delivery down to 10 percent of flow which occurs at 6.8 kPa.
b) Pulverization caused by injection and/or positive test trap for the highest flow point.

NOTE — The outlet screen shall ~~be of~~ have sufficient cross-sectional area to maintain minimum back pressure in the test apparatus discharge.

6.2.3 The amount of test carbon to be used at each test condition shall be 6 times the flow rate in l/min at 6.8 kPa back pressure with a minimum test sample of 25 g and a maximum test sample of 200 g. The flow rate shall be determined with the test arrester in place.

6.2.4 The test carbon shall be fed into the air stream at a uniform rate over a period of 15 min. A tolerance of 5 min may be allowed.

6.2.5 The observations shall be recorded separately for each size of test carbon, that is, fine and coarse at five evenly spaced air flow rates from the flow at which the spark arrester creates a differential pressure of 6.8 kPa and down to 10 percent of this flow. The observation may be recorded at higher f1ow rate also if the spark arrester applications indicate a need for it.

6.2.6 Following observations shall be recorded for each flow rate:

a) Mass of test sample carbon (W_s) for both coarse carbon and fine test carbon.
b) Mass of carbon in the positive trap that is retained on a 600-micron IS Sieve (W_t) for each individual run both for coarse and fine test carbon.
c) Air flow at the test conditions.
d) Air temperature at spark arrester inlet.
e) Pressure in the system without the spark arrester installed at air flow rates specified under **6.2.5** (P_1)
f) Pressure in the system with the spark arrester installed (P_2) and
g) Differential pressure induced by the spark arrester $P_a = (P_2 – P_1)$.

7 COMPUTATIONS OF TEST RESULTS

7.1 Spark Arresting Efficiency

$$\mu = \frac{W_s \times W_t}{W_s} \times 100$$

where

μ = spark arresting efficiency, percent; and
W_s and W_t = as defined under in **6.2.6**.

7.2 Gas Flow — The gas flow can be computed by the formula given below:

$$Q = W_m \times \frac{1}{V} = W_m \times \frac{T}{3.49 \times P}$$

where

Q = flow, dm^3/s
W_m = rate of air flow determined by standard laboratory instrumentation or as specified by the manufacturer, g/s;
V = specific mass, g/m^3
P = gas pressure to the spark arrester, kPa; and
T = gas temperature to spark arrester, °K.

7.3 Presentation of Test Results

The test results shall be presented in a form as given in Annex B. The results shall also be presented graphically as shown in Fig. 2. In general, all tests will be carried out to a flow at which the differential

pressure induced is 6.8 kPa. However, the tests can be carried out to greater flows if the necessity arises. Curves of arresting efficiency and differential pressure will be presented as shown in Fig. 2.

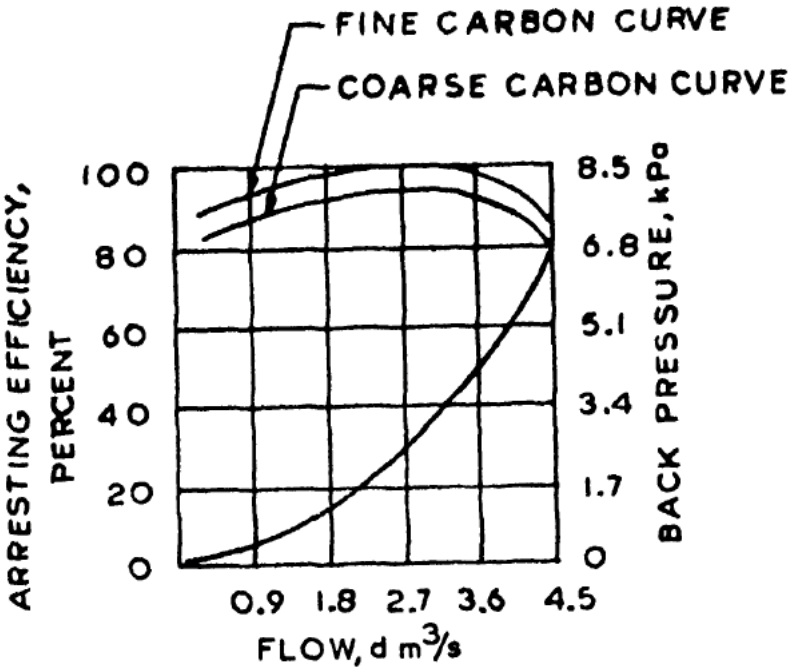


FIG. 2 PERFORMANCE OF SPARK ARRESTER UNDER LABORATORY TEST WITH AIR

ANNEX A
(*Clauses* 4.2 and 5.2)
SPECIFICATION SHEET

To be Filled in by

Manufacturer | Testing Institute

A-1 GENERAL

a) Make
b) Model
c) Type

A-2 DRUM

a) Construction
b) Inner diameter, mm
c) Thickness of sheet, mm
d) Height, mm

A-3 SEPARATOR

a) Construction
b) Number of slots
c) Length of slot (radial), mm
d) Opening of slots, mm
    1) At inner end
    2) At outer end

A-4 INLET

a) Construction
b) Inner diameter, mm
c) Thickness of sheet, rom

A-5 OUTLET

a) Construction
b) Inner diameter, mm
c) Length, mm
d) Thickness of sheet, mm

A-6 OVERALL DIMENSIONS

a) Height, mm
b) Diameter, rnm

A-7 MASS, kg

NOTE — A 1ine sketch shall be provided by the manufacturer/applicant detailing the specification.

ANNEX B
(*Clause* 7.3)
DATA SHEET FOR LABORATORY TEST WITH AIR

B-1 DATE OF TEST

B-2 PLACE OF TEST

B-3 DURATION OF TEST

B-4 ATMOSPHERIC CONDITIONS

a) Temperature °C
b) Pressure, kPa
c) Relative humidity, percent

B-5 TEST DATA

Sl. No.	**Air Flow, dm^3/s (Q)**	**Air Temperature, °K (T)**	**Test carbon size**		**Differential back pressure induced by the spark arrester, kPa**			**Spark arresting efficiency, percent**			**Remark**
			Designation	Average particle size, mm	Pressure without spark arrester (P_1)	Pressure with spark arrester (P_2)	Induced pressure ($P_a = P_2$-P_1)	Mass of test sample (W_s)	Mass of carbon in the positive trap (W_t)	Efficiency (μ)= $\frac{(Ws-W_t)}{W_s} \times 100$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
			Fine								
			Coarse								