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Australian spark arrester tests. Test no. SPA-5 : Caterpillar 3B-2655

Department of Agriculture, Western Australia

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FORMAL tests on spark arresters are conducted by The Tractor Testing Committee* at the Testing Station, Werribee, on behalf of those companies concerned with tractors, engines or spark arresters who wish to have these equipments tested. The arrester is tested on the engine for which it is specially designed or if this is not convenient (as in this instance) it is tested on an engine having the characteristics and power for which the spark arrester is intended.

1.—Test Procedure.

The method of test is based on a procedure standardised by the Society of Automotive Engineers (U.S.A.); this consists of feeding a weighed quantity of carbon particles of given size into the exhaust of the working engine, and then catching in a trap, and weighing, the particles that the arrester allows to pass through. Separate runs are conducted with particles of larger and smaller size; in some runs the engine is working at full load, in others at fast idle under no load.

According to the S.A.E. standard, no particles of the larger size should escape the arrester, and not more than 10 per cent, of the smaller size. At the same time the extra back pressure imposed on the exhaust system by the presence of the arrester should be no more than 10 inches in a water barometer.

2.—Name and Type of Arrester.

Caterpillar 3B 2655. (Aust. Pattern—see Note (a) below.)

Submitted by: Caterpillar of Australia Pty. Ltd.

For Particular Engine: Caterpillar D.311 Diesel Engine.

3.—Brief Specification of Arrester.

Operating Principle: Centrifugal separator.

Arrester fabricated of steel sheet. Aluminium painted finish.

Copper dish with swirling vanes formed around rim

Slots filled by welding – B

% Supports

2" Brass plug socket

*The Australian Tractor Testing Committee is a joint body established by agreement between the Commonwealth, the States, and the University of Melbourne; under this agreement the tests are carried out by the University of Melbourne. The address of the Tractor Testing Committee is: c/o Department of Primary Industry, 301 Flinders Lane, Melbourne.
Declared Maximum Horse-power: 50.

Dimensions: Exhaust pipe, diameter 2½ inches. Tall pipe, diameter 2¼ inches, length 2 inches. Arrester, outside diameter 10 inches, length 7½ inches, weight 10 lb. (approx.).

Mounting: Vertical.

Relation to Operator: No comment since arrester was not tested on a Caterpillar tractor.

Details of Test Engine: International AW-7 Diesel (Tractor): 49 horse-power maximum; 264 cubic inches; rated speed 1,450 r.p.m.

4.—Summary of Test Results.

(a) Effectiveness of Spark Arrester: See Notes (a), (b) below.

Particles injected at rate of 100 gms. in 13 to 15 mins.

<table>
<thead>
<tr>
<th>Particle Size</th>
<th>Engine Load Condition</th>
<th>Carbon Passing Arrester (Percentage)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>High</td>
<td>Less than 0.1*</td>
<td>Average of two tests</td>
</tr>
<tr>
<td>Large</td>
<td>Low</td>
<td>Less than 0.1*</td>
<td>Average of two tests</td>
</tr>
<tr>
<td>Small</td>
<td>High</td>
<td>0.2</td>
<td>Average of two tests</td>
</tr>
<tr>
<td>Small</td>
<td>Low</td>
<td>Less than 0.1*</td>
<td>Average of two tests</td>
</tr>
</tbody>
</table>

* 0.1 gm. being the limit of accuracy of the scales.

(b) Back Pressure: At high load 4.0 inches water. Changes during test 3.8 to 4.1 inches.

(c) Temperatures (°F.): Air (in region between arrester and manifold) 90° F. approx. Outlet (surface temperature of outlet pipe) 550° F. approx.

(d) Noise Levels: Not taken.

Note:

(a) The arrester tested was a prototype based on the former United States pattern stock model for Caterpillar D-311 engines. On a randomly-chosen Australian-made stock model, earlier tests had shown 1.4 per cent. large carbon passing at high load. Caterpillar of Australia Pty. Ltd. asked the Committee to carry out a series of developmental tests, as a result of which the modified design shown in the accompanying sketch and reported in this test was adopted as the Australian stock model. The modifications consist of the interposition of the baffle, A (see sketch), between the swirling vanes and the outlet, and the closing of the slots B, by welding.

(b) This report makes no promise about the likely performance of this spark arrester other than in the new condition for which it was supplied for test.

5.—Comments.

- Cleaning: The position and design of the cleaning plug are such that it is not possible to empty the arrester merely by removing the plug.

- Life: The arrester is of the type not able to be dismantled for inspecting and replacing the internal elements. Its expected life, according to the draft specification, should, therefore, be equal to the life of the engine for which it is intended.

We doubt whether the gauge of metal, approximately 24-gauge steel in the top section, would meet this requirement. Copper for the swirling vane element must also be regarded with some suspicion in a situation where it is subject to repeated heating and cooling, and exposed to the full heat of the exhaust gases.

A heat-resisting non-ferrous alloy or a heat-resisting stainless steel would be preferred. It is understood that arrangements are being made to use a stainless-steel element in future production according to the Australian pattern.

On the samples inspected some of the internal welds appeared to be not sufficiently secure.

W. F. BAILEY, G. H. VASEY,
Testing Officer, Officer in Charge
Tractor Testing.
University of Melbourne, 5th December, 1957.
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