NEW ZEALAND AGRICULTURAL ENGINEERING INSTITUTE

Lincoln College

PUBLIC TEST REPORT No. T/4

SAFE "T" SAFETY FRAME FOR FORD 4000 AND FORD 5000 TRACTORS

SEPTEMBER, 1966

Lincoln College

University of Canterbury

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SAFE "T" SAFETY FRAME FOR FORD 4000 and 5000 TRACTORS: STRENGTH CHARACTERISTICS

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SAFE "T" SAFETY FRAME FOR FORD 4000 AND 5000 TRACTORS: STRENGTH CHARACTERISTICS

ENTRANT: Sockburn Motors Ltd, Christchurch, New Zealand

MANUFACTURER: Cyclone Industries Ltd, Christchurch, New Zealand

SUMMARY

Strength tests were made using testing apparatus similar to that used by the National Swedish Testing Institute for Agricultural Machinery and the National Institute of Agricultural Engineering, Silsoe, England, to establish whether or not the frame is of adequate strength to prevent excessive deformation in the event of an overturning accident. The deflections of the frame during impact and crushing tests were within satisfactory limits.

The frame did not unduly affect accessibility, visibility or maintenance, and no change in the noise level to which the driver was subjected was noticed when the frame was fitted.

BRIEF DESCRIPTION

The frame consists of two uprights ex 3 in nominal bore 0·192 in (6 s.w.g.) tube welded at their bottom ends to mounting pads which are in turn bolted to the rear axle housings. A further length of 3 in nominal bore 0·192 in (6 s.w.g.) tube is welded parallel to the rear axle, across the top of the uprights. A rear roll bar ex $1\frac{1}{2}$ in nominal bore 0·160 in (8 s.w.g.) tube in the shape of a D is welded to the top cross member and projects rearwards from it by 2 ft. No weather cladding was fitted during the tests. Further details and measurements of the safety frame are given in Appendix I. During the tests the frame was fitted to a Ford 5000 serial number B003177A5 with 16·9/14-30 rear tires set at a track of 62 in.

SCOPE OF TEST

The primary object of the test was to establish whether or not the safety frame is strong enough to prevent excessive deformation during an overturning accident. Observations of the strength of the frame and attaching brackets were based on impact and crushing tests using a special test rig.

It should be noted that this test procedure makes no attempt to assess any anti-roll characteristics which the frame may possess.

TEST RESULTS

Impact and Crushing Tests - For these tests the frame was fitted to the tractor and the tractor was anchored to a concrete base. The frame was subjected to two impact tests, the first from the rear and the second from the side. In each case the blow was imparted by a pendulum of mass 4410 lb swinging so that the arc traced out by its centre of gravity was tangential to the horizontal plane containing the rear roll bar and the top cross member respectively. The energy applied by the blow was calculated in accordance with the procedure used by

the National Swedish Testing Institute for Agricultural Machinery as detailed in Appendix II. The weight of a Ford 5000 tractor with water ballast in the rear tires - 6800 lbf - was used to calculate the impact energy, which was 2694 ft lbf for the blow from the rear and 8610 ft lbf for the blow from the side. The blows from rear and side were directed to the centre of the rear roll bar and the end of the top cross member, respectively.

A crushing load equal to twice the weight of the tractor - 13 600 lbf - was applied vertically to the top of the frame using hydraulic rams and a beam placed on top of and parallel to the top cross member.

Measurements were made before and after the tests to establish the deformation of the frame. The following figures are the average deformations measured at a height of $37\frac{1}{2}$ in above the loaded tractor seat at the completion of each phase of the test, and indicate the deflection of the frame in the direction of the loading.

(a) Impact from rear - $3\frac{7}{8}$ in forwards

(b) Impact from side - $7\frac{7}{8}$ in sideways

(c) Static loading - negligible deformation

No failure of welds, joints, or mounting attachments took place.

These deformations are considered to be within acceptable limits as detailed in Appendix III, and the results of the test can be considered to apply to this frame only when fitted to Ford 4000 and 5000 tractors.

COMMENTS ON GENERAL FEATURES

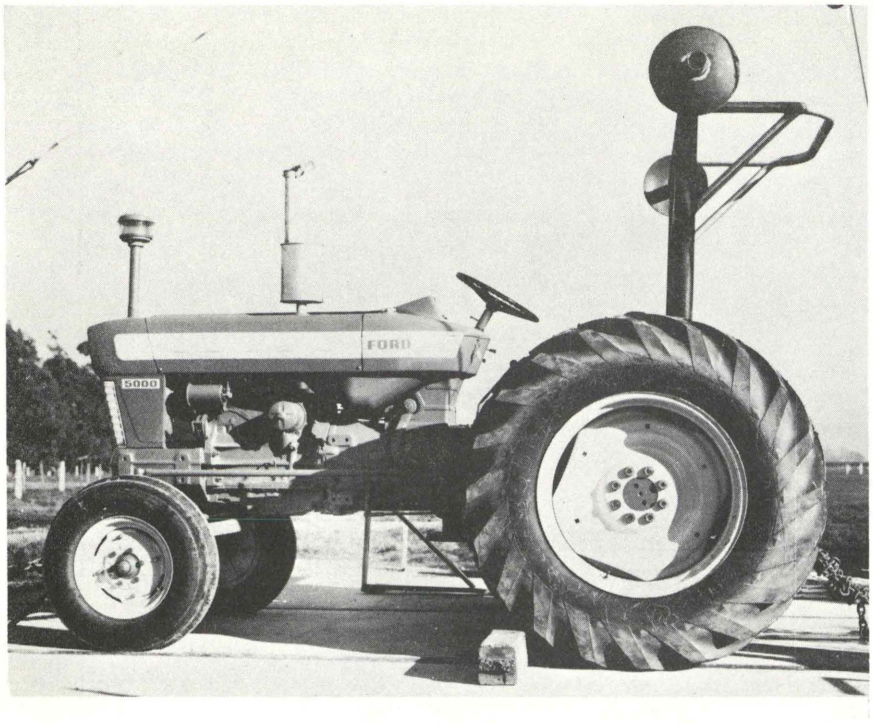
The tractor was driven for short periods with the frame fitted. Visibility was not unduly affected by the frame, and the frame and mountings did not interfere with the general maintenance of the tractor. The level of noise experienced by the operator was not significantly

altered by the addition of the frame to the tractor.

JOHN R. BURTON
Director.

G.M. GARDEN
Testing Officer.

September 1966.



Safe "T" safety frame before impact from rear.

Safe "T" safety frame after impact from rear.

Safe "T" safety
frame before
sideways impact.

Safe "T" safety
frame after
sideways impact.

APPENDIX I

BRIEF SPECIFICATION OF FRAME AS TESTED WHEN FITTED TO A FORD 5000 TRACTOR

The frame consists of two parallel uprights 67½ in long ex 3 in nominal bore 0·192 in (6 s.w.g.) tube spaced 36½ in apart, (centre to cnetre) and a cross member 72 in long ex 3 in nominal bore 0·192 in (6 s.w.g.) tube which is welded across one end of the two uprights. A 16 in long stay ex 1½ in nominal bore 0·160 in (8 s.w.g.) tube, is welded to the inside of each upright and the underside of the top member. Mounting plates as described below are welded to the lower end of each upright in such a manner that when these plates are bolted to the rear axle housing, the uprights and cross member lie in a vertical plane parallel to, and 6½ in behind, the rear axle. The ends of the cross member, which have an 11/16 in diameter hole drilled in them 3 in from each end for attaching extras, project 12½ in beyond the uprights.

The two ends of a rear roll bar which is bent in the shape of a flattened D are welded symmetrically on 38 in centres to the top member. This roll bar ex 1½ in in nominal bore 0·160 in (8 s.w.g.) tube projects in a horizontal plane, 24 in behind the top member, and is braced to each upright by a length of 1¼ in nominal bore 0·128 in (10 s.w.g.) tube.

To each upright are welded, 6¼ in apart, two mounting plates ex ⅜ in mild steel plate which fit over the rear axle housings. Each plate is suitably drilled to take four ⅜ in diameter black hexagon bolts which each pass through the top and bottom mounting plates and the locating grooves provided in the rear axle housings. A triangular gusset, ex ⅜ in mild steel plate, 21 in high and with a 7 in base is welded to the top mounting plate and the front of each upright. To

strengthen the uprights against crushing, a 2 in wide, $\frac{1}{4}$ in thick band is welded to each upright under the top of the gusset.

DIMENSIONS

Interior width	33 in
Height to underside of frame cross member from loaded seat (165 lbf)	$43\frac{1}{2}$ in
Height to underside of frame roof from footplates	$62\frac{1}{4}$ in
Overall height of tractor and frame	$91\frac{1}{2}$ in
Maximum width of frame	72 in
Maximum distance frame projects behind rear axle	$30\frac{1}{2}$ in

APPENDIX II

INTERIM SCHEME OF TEST FOR TRACTOR SAFETY FRAMES (D.ST 65/1).

1. PURPOSE OF TEST

This Scheme of Test is primarily intended for the purpose of measuring the strength characteristics of a tractor safety frame and its mountings. It also provides for an evaluation of the effects of the frame on the operation of the tractor to which it is mounted. This Scheme of Test does not include any evaluation of the anti-rolling characteristics of a safety frame.

2. VALIDITY OF TEST RESULTS

The results of this test are considered to apply only to the tractor/safety frame combination on which it was carried out and to identical tractor/safety frame combinations in which the frame has been fitted strictly in accordance with the manufacturer's specification. It might also, subject to the written opinion of the Director of the Institute, be considered to apply to combinations of an identical safety frame with tractors of the same manufacturer's range having identical mounting points and a lower all-up weight than the tractor tested.

3. TEST PROCEDURE

The following tests will be conducted:-

(i) Strength tests

(ii) Noise test

(iii) General evaluation

Details of these tests are as follows:-

3.1 Strength Tests

The strength of the safety frame and its mountings will be determined by conducting the three tests detailed below, which will be carried out on one and the same cab in the order given. No repairs or adjustments will be allowed between successive tests.

a. Rearwards impact test: The rearwards impact test will be applied by causing a pendulum of mass 4410 lb to strike the frame from the rear at a position and in a direction appropriate to the manner in which the frame can be expected to contact the ground in the event of overturning rearwards.

The impact energy applied will be equivalent to 1810 + 0·13 W ft lbf where W is the weight of the tractor in pounds force. During the test the tractor will be firmly fixed to the ground.

b. Sideways impact test: The sideways impact test will be applied by causing a pendulum of mass 4410 lb to strike the frame from the side at a position and in a direction appropriate to the manner in which the frame can be expected to contact the ground in the event of the tractor overturning sideways.

The impact energy applied will be equivalent to 1810 + 1·0 W ft lbf where W is the weight of the tractor in pounds force. During the test the tractor will be firmly fixed to the ground.

c. Compression test: A static compression test will be applied vertically to the frame over that part of it which is most likely to support the tractor if it rolls through 180°. A load of 2·0 W lbf will be applied, where W is the weight of the tractor in pounds force. During the test the tractor will be supported from beneath in such a way that the load is not transmitted to its wheels.

The points at which the impact and compression tests will be applied to the frame and the manner of fixing or supporting the tractor will be decided by agreement between the testing officer and the test entrant. In the event of any disagreement the ruling of the Director of the Institute shall be final.

3.2 Noise Test

Noise level measurements will be made on the same tractor both with and without the safety frame or cab under identical working conditions, as agreed between the Director and the test entrant.

3.3 General Evaluation

The tractor/safety frame combination will be operated by staff of the Institute under selected conditions. The following points will be commented upon in the test report:-

a. Convenience of access
b. Visibility
c. Roominess and convenience of operation
d. Effect on operation of tractor controls
e. Effect on operation of trailed or mounted implements
f. Effect on maintenance of tractor
g. Noise, heat, fumes and driver fatigue.

4. PUBLICATION AND USE OF TEST RESULTS

Attention is drawn to Clauses 12, 13, 14, 15, 17, 18, and 19 of the Institute's Interim Testing Regulations for Test of Production Safety Devices for Agricultural Machinery.

APPENDIX III

Interpretation of Strength Tests

At the date of publication of this report no specific limits on the allowable deformation of safety frames subjected to the impact and compression tests described in this report have been laid down for New Zealand conditions.

Following an exhaustive analysis of all available overseas data and a careful evaluation of experience with safety frame testing at Lincoln College, the Institute holds the view that a safety frame cannot be considered to have satisfactory strength characteristics if the deformation measured after each impact described in Appendix II exceeds,

(a) Impact from rear - four (4·0) inches forwards

(b) Impact from side - ten (10·0) inches sideways