SOCIETY OF AUTOMOTIVE ENGINEERS, INC. • TWO PENNSYLVANIA PLAZA • NEW YORK, NEW YORK 10001

LAND SEA AIR SPACE

TECHNICAL REPORT J972

MOVING BARRIER COLLISION TESTS—SAE J972a

SAE Recommended Practice

Report of the Automotive Safety Committee approved November 1966 and last revised March 1973.

1. Scope and Purpose—Collision tests are conducted on automotive vehicles to obtain information of value in evaluation of structural integrity and in reducing occupant injuries. The deformation resulting from a moving barrier impact is more severe at a given speed than that produced by using a crushable vehicle, but is more readily reproducible than that occurring during impacts of two vehicles. The purpose of this recommended practice is to establish sufficient standardization of moving barriers and moving barrier collision methods so that results of tests conducted at different facilities may be compared.

Background information and a rationale for the test procedures described in this recommended practice are provided in the Appendix.

2. Objectives—The primary objective of this recommended practice is to define test procedures for impacts which will result in a simulation of forces and deformations experienced during a vehicle crash. Standardized procedures allow proper evaluation of vehicle structural loads and deflections, occupant loads and dynamics, and photographic and postcollision observations of pertinent areas or events which are useful in establishing design criteria.

3. Crash Test Facility

3.1 Test Site General—The test site shall be of sufficient area to provide accommodations for the test vehicle, various photographic equipment, a protected observer area, and provisions for accelerating the moving barrier to the desired velocity.

3.1.1 The immediate crash site shall be level.

3.1.2 The approach road and the surface at the immediate crash site shall be paved.

3.1.3 Allowances for proper positioning of photographic equipment should be made.

3.1.4 Allowances should be made for after-impact skidding of both the test vehicle and the moving barrier.

3.2 Approach—The type of approach required depends upon the technique employed to obtain the desired impact velocity of the moving barrier. A practical approach is level, straight, and of sufficient length to permit the moving barrier to be towed along a rail guidance system with the impact occurring after the moving barrier is released from the tow force and released from guidance at the end of the rail.

3.3 Barrier—Two impact surfaces are used: the flat surface described in paragraph 3.3.2 for rear impact tests and the contoured surface described in paragraph 3.3.3 for side impact tests. These two surfaces are attachable to the front end of a common carriage as shown in Fig. 1.

3.3.1 General—With either impact surface attached to the common carriage, the moving barrier assembly shall have the following characteristics:

3.3.1.1 The moving barrier shall be rigid construction, symmetrical about a longitudinal-vertical plane, with a solid nonsteerable front axle and fixed rear axle attached directly to the frame rails with no spring nor other type suspension system on any wheel.

3.3.1.2 The total weight shall be 4000 ±50 lb (1818 ±22.8 kg). Weight distribution shall be 900 ±25 lb (409 ±11.4 kg) at each rear wheel and 1100 lb ±25 lb (500 ±11.4 kg) at each front wheel.

3.3.1.3 It shall have a braking device capable of stopping it.

3.3.1.4 Tread width of 60 ±1 in (1524 ±25 mm), front and rear tires.

3.3.1.5 Wheelbase of 120 ±2 in (3048 ±51 mm).

3.3.1.6 Pneumatic tires on all wheels, G78-15 or equivalent, inflated to 24 psi (165 kPa) minimum.

3.3.1.7 The center of gravity shall be located at:

$\overline{X}$=54.0 ±1.5 in (1372 ±38 mm) rearward of the front wheel axis

$\overline{Y}$=at the longitudinal-vertical plane of symmetry

$\overline{Z}$=15.8 ±0.5 in (401 ±13 mm) above ground

3.3.2 Rear Impact Testing—A flat impact surface 30 in (762 mm) high and 96 in (2438 mm) wide shall be used. It may be attached to the carriage as shown in Fig. 2. The impact surface is covered with 0.75 in (19 mm) thick plywood. Ground clearance to the lower edge of the impact surface shall be 7 ±1 in (178 ±25 mm).

3.3.3 Side Impact Testing—A contoured impact surface 24.75 in (629 mm) high and 78 in (1981 mm) wide shall be attached to the carriage as shown in Fig. 3. The impact surface is not covered with plywood. Ground clearance to the lower edge of the impact surface shall be 12.25 ±0.5 in (311 ±13 mm). This side impact moving barrier assembly shall also have a moment of inertia about the center of gravity as follows:

I_x=271 ±13.6 slug·ft² (367 ±18.4 kg·m²)

I_z=3475 ±174 slug·ft² (4711 ±236 kg·m²)

4. Methodology

4.1 General—Even when simplified by using moving barriers, vehicle collisions are very complex and careful control of impact parameters must be exercised. Paragraphs 4.1.1-4.1.5 shall be followed for every moving barrier test, with the addition of those in paragraph 4.2 or 4.3 for the specific type of test under consideration.

4.1.1 The moving barrier shall impact the test vehicle while moving at essentially a constant velocity. The impact velocity chosen will depend upon the object of the test or the specific energy levels desired.

4.1.2 The moving barrier shall be braked following an initial separation from the impacted vehicle to preclude subsequent impacts.

4.1.3 The test vehicle shall be stationary, with its parking brake off and the transmission in neutral.

4.1.4 All doors on the test vehicle shall be closed and locked.

4.1.5 Position of windows during test is contingent on test objectives.

4.2 Rear Impact Tests—The flat impact surface shall be used.

4.2.1 The longitudinal-vertical plane of the moving barrier shall be at a 0 ±3 deg angle relative to the longitudinal-vertical plane of the test vehicle.

4.2.2 The longitudinal-vertical plane at the centerline of the test vehicle and the moving barrier shall be in line within ±3 in (±76 mm) at the time of initial impact.

4.3 Side Impact Tests—The contoured impact surface shall be used.

4.3.1 All standard side components and door system components which may affect the strength or rigidity of the vehicle shall be installed. Steering wheel and seats shall be installed and in mid-position, if adjustable. After impacting one side of a vehicle, tests shall not be performed on the other side unless the frame, floor, and door opening remain essentially undistorted on that side.

4.3.2 The test shall be conducted with the moving barrier approaching from the left front or right front of the stationary test vehicle with the longitudinal-vertical plane of symmetry of the moving barrier at a 45 ±3 deg angle relative to the longitudinal-vertical plane at the centerline of the test vehicle.

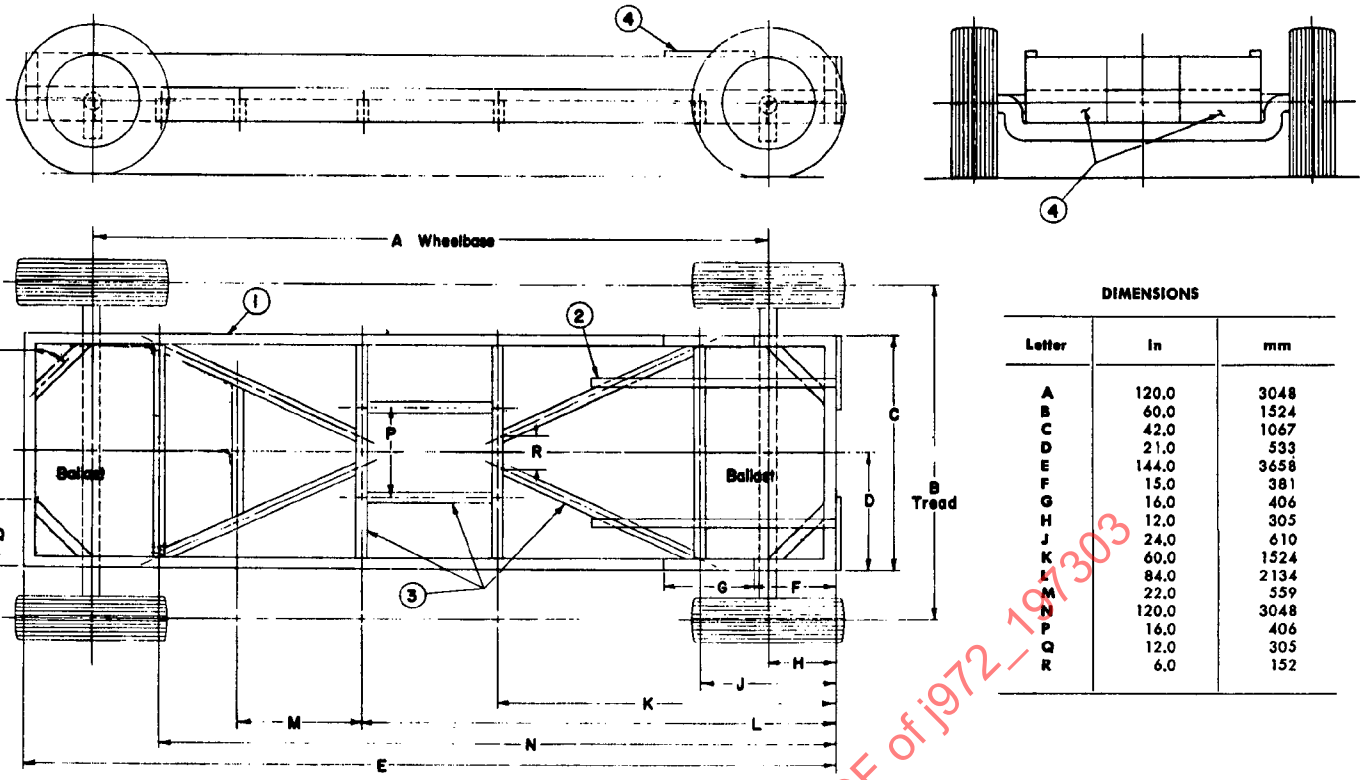
4.3.3 The moving barrier alignment shall be such that the lateral extremity of the contoured impact surface, when projected along a line parallel to the longitudinal-vertical plane of the moving barrier, is within 0-3 in (0-76 mm) of the "door opening reference" (DOR) point of the front door opening (Fig. 4). The DOR point is defined to be located at the front of the door opening and:

(a) In a plane 4 in (100 mm) above the highest point on the door sill (Figs. 5 and 6).

(b) At that point on the rear edge of the hinge pillar where the hinge pillar structure is tangent to the 45 deg direction of impact (Fig. 7).

(The DOR point will typically be located on the hinge pillar, but not necessarily if the front door is not hinged forward of the door. The DOR point is then defined at the point of tangency to the 45 deg direction made by that door frame structure which is forward of the door. In either case, outer sheet metal is not used to define the DOR point location.)

5. Instrumentation and Equipment—To obtain meaningful informa-

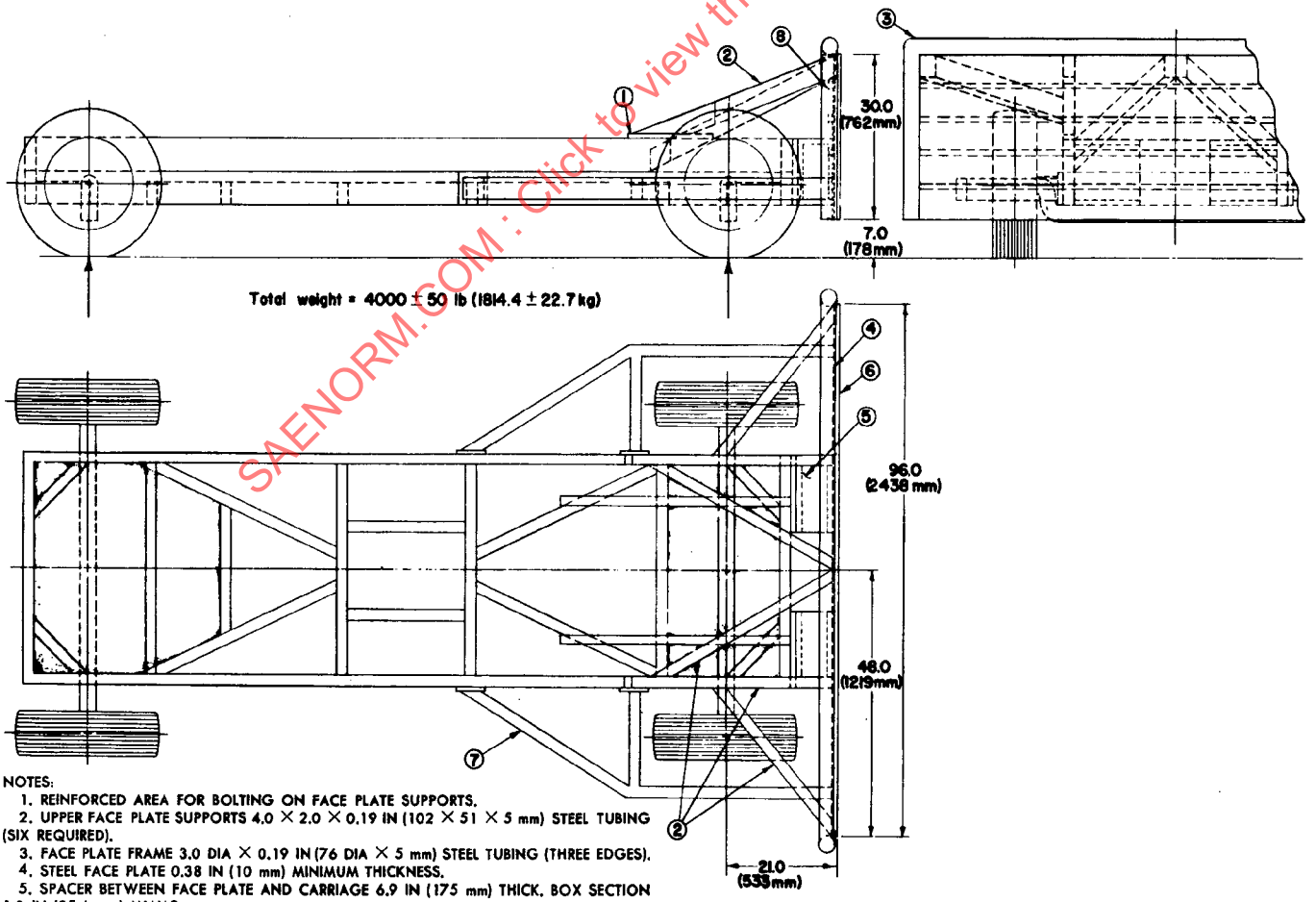


DIMENSIONS

Letter	In	mm
A	120.0	3048
B	60.0	1524
C	42.0	1067
D	21.0	533
E	144.0	3658
F	15.0	381
G	16.0	406
H	12.0	305
J	24.0	610
K	60.0	1524
L	84.0	2134
M	22.0	559
N	120.0	3048
P	16.0	406
Q	12.0	305
R	6.0	152

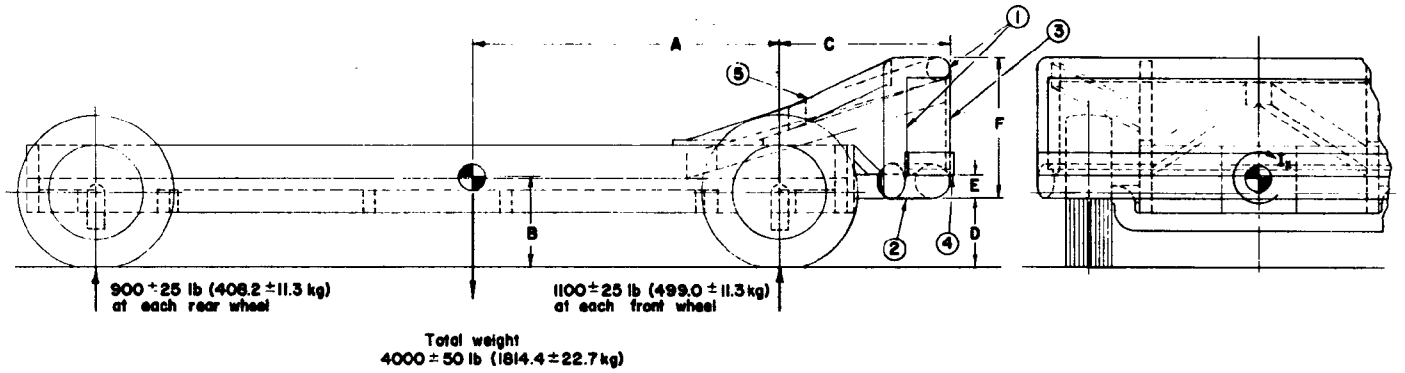
NOTES:
1. OUTER FRAME 6.0 × 2.0 × 0.19 IN (152 × 51 × 5 mm) STEEL TUBING, TWO PIECES WELDED TOGETHER FOR A 12.0 IN (305 mm) HEIGHT.
2. BALLAST TIE DOWNS.
3. ALL INNER REINFORCEMENTS AND FRAME GUSSETS OF 4.0 × 2.0 × 0.19 IN (102 × 51 × 5 mm) STEEL TUBING.
4. REINFORCED AREAS FOR BOLTING ON FACE PLATES.

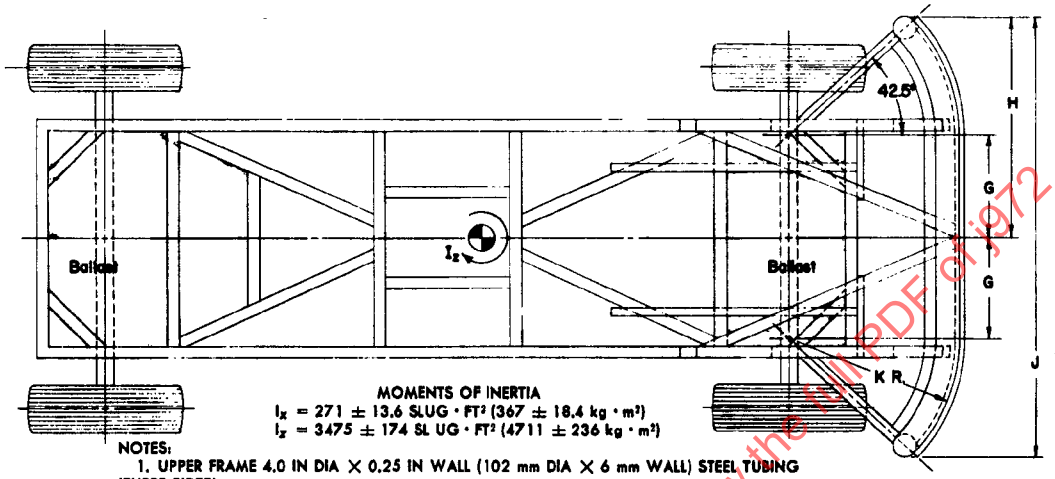
FIG. 1—COMMON CARRIAGE FOR MOVING BARRIERS



NOTES:
1. REINFORCED AREA FOR BOLTING ON FACE PLATE SUPPORTS.
2. UPPER FACE PLATE SUPPORTS 4.0 × 2.0 × 0.19 IN (102 × 51 × 5 mm) STEEL TUBING (SIX REQUIRED).
3. FACE PLATE FRAME 3.0 DIA × 0.19 IN (76 DIA × 5 mm) STEEL TUBING (THREE EDGES).
4. STEEL FACE PLATE 0.38 IN (10 mm) MINIMUM THICKNESS.
5. SPACER BETWEEN FACE PLATE AND CARRIAGE 6.9 IN (175 mm) THICK, BOX SECTION 1.0 IN (25.4 mm) WALLS.
6. PLYWOOD FACE 0.75 IN (19 mm) THICK, BOLTED TO FACE PLATE.
7. LOWER CORNER SUPPORTS FOR FACE PLATE, 4.0 × 2.0 × 0.19 IN (102 × 51 × 5 mm) STEEL TUBING.
8. FACE PLATE REINFORCEMENTS 5 × 15 × 0.25 IN (127 × 38 × 6.5 mm), STEEL U-CHANNEL, FIVE REQUIRED.

FIG. 2—COMMON CARRIAGE WITH FLAT IMPACT SURFACE ATTACHED





NOTES:
1. UPPER FRAME 4.0 IN DIA × 0.25 IN WALL (102 mm DIA × 6 mm WALL) STEEL TUBING (THREE SIDES).
2. LOWER FRAME 6.0 IN DIA × 0.50 IN WALL (152 mm DIA × 13 mm WALL) STEEL TUBING.
3. FACE PLATE 0.75 IN (19 mm) THICK COLD ROLLED STEEL.
4. LEADING EDGE 1.0 × 4.0 IN (25 × 102 mm) STEEL BAND, SHARP EDGES BROKEN.
5. ALL INNER REINFORCEMENTS 4.0 × 2.0 × 0.19 IN (102 × 51 × 5 mm) STEEL TUBING.

DIMENSIONS		
Letter	in	mm
A	54.0	1372
B	15.8	401
C	30.0	762
D	12.25	311
E	3.75	95
F	24.75	629
G	18.0	457
H	39.0	991
J	78.0	1981
K	30.0	762

FIG. 3—COMMON CARRIAGE WITH CONTOURED IMPACT SURFACE ATTACHED

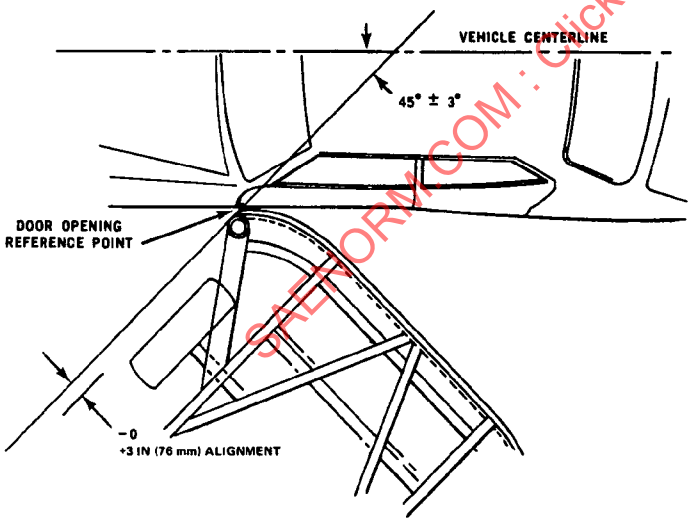


FIG. 4—ALIGNMENT AT IMPACT

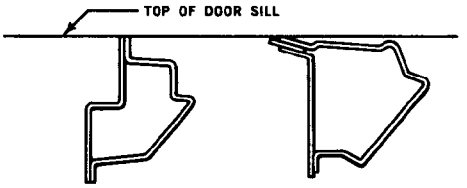


FIG. 6—TYPICAL CROSS SECTIONS OF ROCKER PANELS

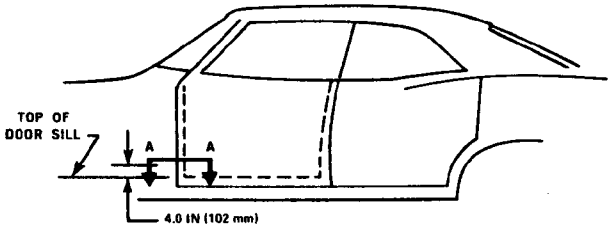


FIG. 5—LOCATION OF AREA OF DOR POINT

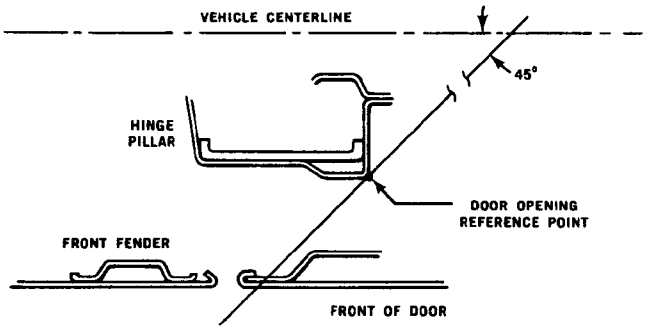


FIG. 7—TYPICAL SECTION A-A SHOWING DOR POINT WITH HINGE PILLAR TANGENT TO 45 DEG LINE