AIS-181

AUTOMOTIVE INDUSTRY STANDARD

Approval of Tank Vehicles with regard to Rollover Stability

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ON BEHALF OF
AUTOMOTIVE INDUSTRY STANDARDS COMMITTEE

UNDER
CENTRAL MOTOR VEHICLE RULES – TECHNICAL STANDING COMMITTEE

SET-UP BY
MINISTRY OF ROAD TRANSPORT and HIGHWAYS
GOVERNMENT OF INDIA

March 2025

INTRODUCTION

The Government of India felt the need for a permanent agency to expedite the publication of standards and development of test facilities in parallel when the work on the preparation of the standards is going on, as the development of improved safety critical parts can be undertaken only after the publication of the standard and commissioning of test facilities. To this end, the erstwhile Ministry of Surface Transport (MoST) has constituted a permanent Automotive Industry Standards Committee (AISC) vide order No. RT-11028/11/97-MVL dated September 15, 1997. The standards prepared by AISC will be approved by the permanent CMVR Technical Standing Committee (CTSC). After approval, the Automotive Research Association of India (ARAI), Pune, being the secretariat of the AIS Committee, has published this standard. For better dissemination of this information ARAI may publish this document on their Web site.

Based on the discussion in the 66th AISC meeting held on 14th July 2021, it was decided to review the alignment status of AIS standards with corresponding UN Regulations under various GR groups. Committee agreed in principle to formulate an Automotive Industry Standard (AIS) for "Approval of Tank Vehicles with regard to Rollover Stability". Currently Section 7 of AIS 093 Rev1: 2015 (Code of Practice for Construction and Approval of Truck Cabs & Truck Bodies) specifies only tank rollover stability requirements. Based on 66th AISC direction, there was a need to have comprehensive requirements for tank vehicles in line with UN Regulation 111 (Uniform provisions concerning the Approval of Tank vehicles of Categories N and O with regard to Rollover Stability) and European ADR Rules 2021 (for International Carriage of Dangerous Goods by Roads).

The AISC panel and the Automotive Industry Standards Committee (AISC) responsible for preparation of this standard are given in Annexure-VI and Annexure-VII respectively.

Approval of Tank Vehicles with regard to Rollover Stability

CONTENTS

Approval of Tank Vehicles with regard to Rollover Stability

1. SCOPE

1.1 This Standard applies to the rollover stability of tank vehicles of category N2, N3, T3 and T4 intended for the carriage of dangerous and hazardous goods by Road.

2. REFERENCES

2.1 UN R 111 Uniform provisions concerning the Approval of Tank vehicles of Categories N and O with regard to Rollover Stability.

2.2 ADR 2021: Agreement Concerning the International Carriage of Dangerous Goods by Road - Part 9 Requirements concerning the construction and approval of vehicles.

3. DEFINITIONS

3.1 **"Approval of a vehicle"** means approval of a vehicle type with regard to rollover stability.

3.2 **"Vehicle type"** means a category of vehicle, which does not differ in such essential respects as:

3.2.1 Vehicle category as per IS 14272: 2011 amended from time to time and type (truck, prime mover/tractor, full trailer, semi-trailer, centre-axle trailer etc.).

3.2.2 Maximum mass as defined in Clause No. 3.4 below

3.2.3 Cross-section profile of the tank (circular, elliptical, maxi-volume)

3.2.4 Maximum height of the centre of gravity of the unladen vehicle

3.2.5 Distribution of mass among the axles (including fifth wheel)

3.2.6 Number and arrangement of the axles (including axle spacing)

3.2.7 Suspension arrangements in relation to roll characteristics

3.2.8 Tyre size and structure (radial ply, diagonal ply or bias belted)

3.2.9 Track width

3.2.10 Wheel base

3.3 **"Laden vehicle"** except where otherwise stated, means a vehicle so laden as to attain its "maximum mass".

3.4 **"Maximum mass"** means the technically permissible maximum mass stated by the vehicle manufacturer.

3.5 **"The distribution of mass among the axles"** means the proportion of the maximum permissible mass borne by each axle, as declared by the vehicle manufacturer.

3.6 **"Suspension trim height"** means the distance between the wheel centre and a fixed point on the chassis as declared by the vehicle manufacturer.

3.7 **"Rollover threshold"** means the instant when all the wheels of one side of a vehicle have lost contact with the supporting surface (tilt table platform).

3.7.1 The inclination angle of the tilt table surface is represented by the symbol "β".

3.8 **"Tank vehicle"** means a vehicle built to carry liquids, gases or powdery or granular substances and comprising one or more fixed tanks.

4. APPLICATION FOR TYPE APPROVAL

The type approval application shall be accompanied by the following:

4.1 The application for approval of a vehicle type with regard to rollover stability shall be submitted by the vehicle manufacturer / body builder or his duly accredited representative.

4.2 A detailed description of the vehicle type with regard to the items specified Classes.

4.3 Photographs and/or diagrams and drawings of the vehicle showing the vehicle type in front, side, and rear elevation.

4.4 Particulars of the vehicle's mass as defined in Clause No. 3.4 above.

4.5 A vehicle, representative of the vehicle type to be approved, shall be submitted to the test agency conducting the approval tests.

5. APPROVAL

5.1 If the vehicle type submitted for approval pursuant to this Standard meets the requirements of Paragraph 6 below, approval of that vehicle type shall be granted by the authorized test agencies.

6. APPROVAL TEST AND SPECIFICATIONS

6.1 The vehicle shall undergo a tilt table test in accordance with Annexure-I or Annexure-II to this Standard, which simulates a non-vibratory steady-state turn. As an alternative a calculation method in accordance with Annexure-III to this Standard may be used to prove the stability. If there is any doubt or dispute a tilt table test shall be used.

6.2 The result of the tilt table test or the calculation method shall be considered satisfactory if the conditions set out in Paragraph 7 below are satisfied.

7. STABILITY CRITERIA

7.1 The criteria, using corresponding Annexure-I or Annexure-II or Annexure-III, must fulfill one of the following conditions, subject to paragraph 6.1.

7.1.1 **Tilt table test:**

The static rollover stability of the vehicle is considered to be passed, if overturning does not occur up to tilt table angle of $\beta_c = 23°$ for all tests in both (Left and Right) tilt directions. One consecutive retest is allowed if the vehicle fails in one of the three tests for a specific direction.

7.1.2 **Calculation method:** The rollover stability of the vehicle shall be such that the point at which overturning occurs would not be passed if a lateral acceleration of 4 m/s^2 has been reached.

7.1.3 **Particular requirements:** No contact between parts of the vehicle shall occur which are not intended to come into contact during normal use.

8. MODIFICATION OF THE VEHICLE TYPE AND EXTENSION OF APPROVAL

8.1 Every modification which affects the vehicle type as defined in Paragraph 3.2 above (for instance the chassis, body, suspension, axle configuration, etc.) shall be notified to the testing agency which approved the vehicle type. The testing agency may then either:

8.1.1 Consider that the modifications made are unlikely to have an appreciable adverse effect and that in any case the vehicle still complies with the requirements, or

8.1.2 Require a further test report from the testing agency responsible for conducting the tests.

8.2 In case of 8.1.2, tests shall be carried out for only those parameters which are affected by the modifications

8.3 In case of fulfilment of criteria of Para. 8.1.1 or after successful results of further verification as per para 8.1.2 the approval of compliance shall be extended for the changes carried out.

8.4 Approvals issued for corresponding tests as per Section 7 of AIS-093 (Rev. 1) shall be construed for compliance to this standard.

ANNEXURE I

ROLL OVER STABILITY / TILT TABLE TEST PROCEDURE (OPTION A)

A GENERAL CONDITIONS

A 1 The Tilt Table

A rigid surface should be used. The tyres may rest against a safety block or step during the test to prevent sideways slipping, provided that the safety block does not influence the test result. The vehicle shall be subjected to test on a tilt test rig. Height of step used to prevent the vehicle from slipping sideways on the test rig shall not be greater than two third of the distance between the surface on which the vehicle stands and part of the rim of the wheel which is nearest to the surface in the untilted position.

A 2 Wind Conditions

If the tilt table test rig is placed outside, the lateral wind velocity shall not exceed 3 m/s and the total wind velocity shall not exceed 5 m/s.

A 3 Tyres

The tyres shall be inflated to pressures as specified by the vehicle manufacturer for the test vehicle at the laden condition. The tolerance for the inflation pressure in a cold state is ± 2 %.

A 4 Operating Components

A 4.1 All operating components likely to influence the results of this test (e.g. condition and setting of springs and other suspension components and suspension geometry) shall be as specified by the manufacturer.

A 4.2 Height-leveling systems should be deactivated (held at static values) during the actual tilt to avoid inflation/deflation of suspension during the tilt. Cross-coupling from side to side may need to be deactivated. An exception can be made for levelling systems with very short response time of less than one second.

B MEASURING ACCURACY

B 1 The tilt table angle shall be measured with an accuracy of better than 0.3°.

C NON-POWER-DRIVEN VEHICLES

C 1 If the vehicle is a centre-axle trailer, the vehicle may be tested with a power-driven vehicle. Any power-driven vehicle, substitute or support which has the appropriate coupling system and height may be used, as this will not influence the results.

C 2 If the vehicle is a semi-trailer, the vehicle shall be tested with a tractor or a substitute. The tractor/substitute will influence the results and therefore a reference tractor/substitute shall be used.

D VEHICLE LOADING CONDITION

D 1 The standard test condition is the maximum loaded condition; the laden vehicle. In this maximum loading condition, the tank vehicle shall be fully loaded, without exceeding the maximum authorised mass and maximum authorised axle loads.

D 2 If the normal load to be carried by the tank vehicle is classified as being of a dangerous type, it may be replaced by water or another non-dangerous test load. If the standard test conditions, (a) fully laden or (b) maximum mass, cannot be fulfilled with this test load then:

(a) a filling factor of the tank between 100% and 70% is acceptable. If at the minimum filling factor of 70% the total mass and/or axle loads still exceed the maximum authorised mass and maximum authorised axle loads, a test load with a lower density shall be used. The distribution of mass of the tank (including the test load) among the axles shall be proportional to the maximum loaded condition. Tanks provided with compartments shall be differentially loaded so that the centre of gravity height at each axle or axle group is as close as possible to the real centre of gravity height.

(b) a calculation shall be issued by the vehicle manufacturer (1) to provide a new required maximum tilt table angle for the lighter test load.

E SAFETY

E 1 Restraints shall be used to prevent final rollover but these shall be arranged so as not to interfere with the test.

F TEST PROCEDURE

F 1 The vehicle shall be aligned with all units in a straight line parallel to the tilt table axis such that no axle longitudinal centre line is off line by more than 25 mm. The vehicle shall be fixed in the longitudinal direction to prevent forward and rearward movement, provided that the method of fixing does not influence the test result. All steerable axles of the vehicle shall be locked to prevent axle lateral movement and/or turning of the wheels in a steering direction. The vehicle shall be tilted at very low rates of 0.25 °/s or less. This procedure consists of a very gradual increase in the tilt table angle up to the required maximum angle or the rollover threshold. The vehicle shall be gradually tilted three times each to the right and left of the vehicle longitudinal centre line. Due to the influences of stick-slip in the vehicle's suspension systems and coupling components, the vehicle shall be removed from the table between the tests and driven around to "randomize" and "equalize" the influences of stick-slip and hysteresis.

F 2 Without prejudice to paragraph D of this Annexure., if the vehicle fails to achieve the minimum tilt table angle specified in paragraph 7.1.1 of this Standard when tested with a partially filled tank in the maximum mass condition then, subject to the agreement of the test agency and appropriate safety considerations being taken into account, the manufacturer or applicant may request that a further test be undertaken with alternative loading conditions as described in paragraphs F 2.1 and F 2.2 of this Annexure. Where the vehicle manufacturer or applicant chooses not to test in accordance with the alternative loading conditions in paragraphs F 2.1 and F 2.2 of this Annexure, the first test result will constitute the final result.

F 2.1 The first alternative condition is the vehicle loaded to its maximum mass and with the tank fully or partially filled with a fluid for which the tank is designed to carry in normal use.

F 2.2 The second alternative condition is the vehicle loaded in excess of its normal maximum mass and with the tank fully filled with a substitute fluid.

F 2.3 If the tank vehicle manufacturer does not agree with overloading required for additional test, the vehicle is considered as not having passed the test.

F 3 In the case where the vehicle is tested in the fully filled condition, the recorded values of the test tilt table inclination angle β_f shall be corrected using the following formulae:

$$\tan \beta_p = \tan \beta_f \cdot \frac{A_T \cdot H_f}{A_f \cdot H_g} + \frac{T_T}{2 H_g}\left(1 - \frac{A_T}{A_f}\right)$$

The value of β_p shall be higher than, or equal to, the minimum rollover threshold inclination angle required by this Standard (β_c).

In the formulae:

A_T = vehicle mass in case of loading by normal fluid;

A_f = vehicle mass in case of loading by a substitute fluid.

$$A_f = A_T + V_l \cdot (\rho_f - \rho_T)$$

H_g, H_f = height of the vehicle centre of gravity in case of loading with normal fluid and a substitute fluid, respectively;

$$H_f = H_g - V_l \cdot (\rho_f - \rho_T) / C_{ST}$$

T_T = theoretical wheel track at the vehicle cross section at the centre-of-gravity point;

β_p = corrected tilt table inclination angle for the fluid which the vehicle is intended to carry;

β_f = the recorded tilt table inclination angle achieved using the substitute fluid;

V_t = effective tank volume;

$$C_{ST} = \frac{A_g}{H_g - H_l}$$

C_{ST} = vertical stiffness of suspension at the centre of gravity point;

A_g = mass of payload;

ρ_T = density of normal fluid;

ρ_f = density of the substitute fluid;

H_l = height of the centre of gravity of the vehicle in running order.

F 4 If, in the case of filling a tank with a substitute fluid, the total vehicle mass is less than the maximum permissible mass of a vehicle and the vehicle is intended to carry a fluid having a higher density than that of the test fluid, the recorded value of the rollover threshold inclination angle shall be corrected using the formula given in paragraph F 2 of this annexure. Alternatively, the manufacturer may arrange to provide facilities for the vehicle to be tested using the fluid which it is intended to carry, taking into account any incurred safety risks.

ANNEXURE II

ROLL OVER STABILITY / TILT TABLE TEST PROCEDURE (OPTION B)

A C.G. DETERMINATION OF VEHICLE IN UNLADEN CONDITION

A 1 The Center of Gravity of vehicle shall be measured as per IS 11849:1986 or ISO 19380: 2019 (E), as amended from time to time.

B C.G. DETERMINATION OF VEHICLE IN LADEN CONDITION BY SIMULATION

B 1 Input Required

B 1.1 Representative/Schematic 3D CAD/FE model of cab, chassis and tanker envelope.

B 1.2 Vehicle kerb mass and GVW

B 1.3 Type of liquid to be carried and its mass density

B 1.4 C.G. of vehicle in unladen condition obtained in step A 1 of this procedure

B 2 Simulation Procedure

B 2.1 From the variant list, worst case for stability to be decided based on vehicle kerb weight, gross vehicle weight and capacity of tanker.

B 2.2 In the representative tanker model, adjust the mass and center of gravity of the vehicle in unladen condition as per corresponding measured values obtained in step A 1 of this procedure.

B 2.3 In the above tanker model, distribute the mass of liquid in the volume of tanker envelope to demonstrate the laden condition.

B 2.4 Calculate the Center of Gravity (longitudinal, lateral and vertical position) of tanker under this laden condition.

B 2.5 The Center of Gravity so obtained can be used for determining stability of tanker and stability ratio as defined below.

B 2.5.1 **Stability of tank-vehicles:**

The height of the centre of gravity of the laden vehicle shall not exceed 90% of the overall width of the ground level bearing surface (distance between the outer points of contact with the ground of the right hand tyre and the left hand tyre of the same axle.

B 2.5.2 **Stability ratio:**

Stability ratio should never be more than one. The usual recommended stability ratio is 0.7 to 0.9. The stability ratio can be calculated as below: (Under normal spring deflection of 80 mm).

Stability ratio	=	2h x Tan 23° / b
h	=	CG ht. Under laden condition
b	=	Rear outer tyres center distance in m
Stability ratio	=	moment W.R.T. ground / b

C DETERMINATION OF OVERTURNING ANGLE

C 1 Rotate tanker model till the C.G. of tanker in laden condition lies in vertical plane passing tire outer surface.

C 2 Measure the angle of rotation.

ANNEXURE III

LATERAL STABILITY CALCULATION

A GENERAL

A 1 The lateral stability of tank vehicles is calculated by simulation of a steady state circular test (constant radius, constant speed and consequently constant lateral acceleration). The calculation method takes into account the main factors which influence the stability, such as the height of the centre of gravity, the track width and all factors which result in a lateral shift of the centre of gravity (axle roll stiffness, suspension roll stiffness, etc.). In case of semi-trailers, the tractor will be simulated with a reference kingpin roll stiffness.

A 2 The specifications of the calculation method are:

1. axle roll centre is at ground level;
2. vehicle structure is assumed to be rigid;
3. vehicle is symmetrical about its center line;
4. tyre and suspension deflections are linear;
5. lateral deflection of suspensions is zero.

B DEFINITIONS

B 1 For the purposes of this calculation:

"Bogie" means an axle group with compensatory load distribution, in which zero load is attained on all wheels on a given side simultaneously.

C SYMBOLS (See also Figure 1 below)

i (-)	Axle/bogie index (i = 1 - n, front to - axle/bogie;
i	T, all axles/bogies;
i	M, stiffest axle/bogie; and for semi-trailers only i = K, kingpin)
mi	Nominal suspension roll axis height
Ai (kN)	Axle/bogie load
C_{DGi} (kNm/rad)	Suspension roll stiffness at axle roll axis
C_{DGMi} (kNm/rad)	Equivalent suspension roll stiffness at ground level C
DRi (kNm/rad)	Axle/bogie roll stiffness
C_{DRESi} (kNm/rad)	Resolved combined suspension roll stiffness at ground level
F_{RVi} (kN/m)	Vertical tyre rate for each axle/bogie (inclusive the double effect of twin tyres)

Ui (kN)	Unsprung weight
T_{Ni} (m)	Nominal track width
Ti (m)	Theoretical track width for axle/bogie with twin tyres
F_E (-)	Effective mass factor of stiffest axle/bogie
H_G (m)	Centre of gravity height of complete vehicle
H_N (m)	Centre of gravity height of sprung mass
M_A (m)	Twin tyre width
q_c g	Corrected lateral acceleration at overturn
q_M g	Lateral acceleration at first wheel lift
q_T g	Maximum optimal lateral acceleration at overturn
g (m/s^2)	Acceleration due to gravity;
g	9.81 m/s^2
θ_i (rad)	Vehicle pseudo-roll angle at wheel lift
ß (deg)	Equivalent tilt table angle

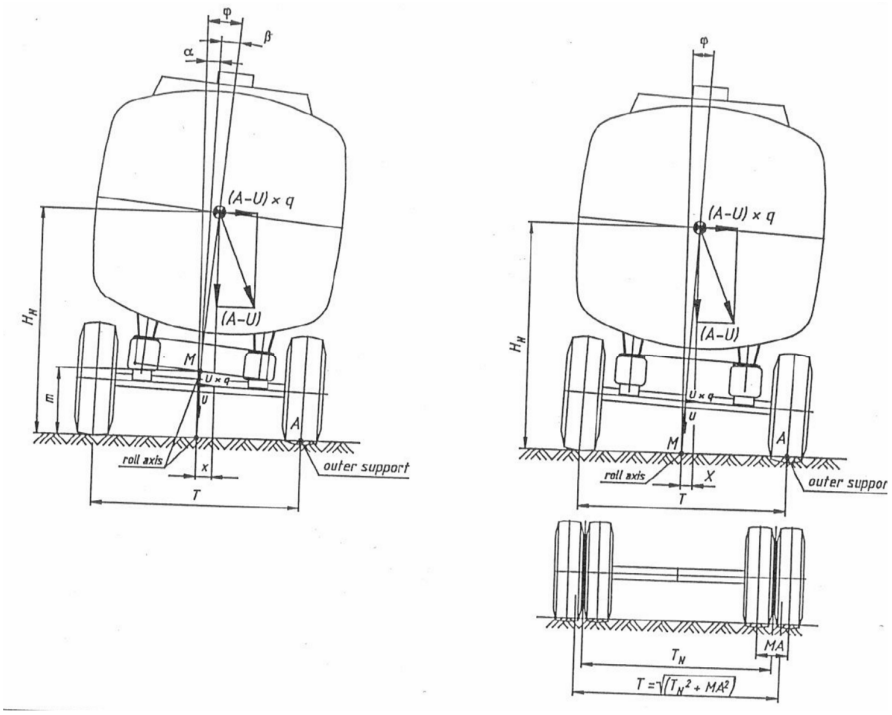

Figure 1
Cross-section of a tank vehicle

D GENERAL CONDITIONS

D 1 Height-leveling systems are not taken into account (held at static values).

E TRAILERS

E 1 If the trailer is a full trailer or a central axle trailer the calculation does not have to include the coupling with the towing vehicle.

E 2 If the trailer is a semi-trailer, the tractor will be simulated with a reference kingpin roll stiffness, which represents the tractor suspension, tyres, chassis & fifth wheel flexibility at ground level.

F VEHICLE LOADING CONDITION

F 1 The test condition is the maximum loaded condition; laden vehicle. In this maximum loading condition, the tank vehicle shall be fully loaded, without exceeding the maximum authorized mass and maximum authorized wheel loads.

G CALCULATION METHOD

G 1 Calculation of the combined roll stiffness and the pseudo vehicle roll angle at wheel lift of each axle/bogie with the formulae:

G 1.1 Axles/bogie with single tyres:

axle/bogie roll stiffness:

$$C_{DRi} = \frac{F_{RVi} \times T_{Ni}^2}{2}$$

equivalent suspension roll stiffness ground level:

$$C_{DGMi} = C_{DGi} \times \left[\frac{H_N}{H_N - m}\right]^2$$

combined roll stiffness to simulate lateral CG shift:

$$C_{DRESi} = \frac{C_{DGMi} \times C_{DRi}}{C_{DGMi} + C_{DRi}}$$

pseudo vehicle roll angle at wheel lift

$$\Theta_i = \frac{A_i \times T_{Ni}}{2 \times C_{DRESi}}$$

G 1.2 Axles/bogie with twin tyres:

Theoretical track width for twin tyres:

$$T_i = \sqrt{T_{Ni}^2 + MA^2}$$

axle/bogie roll stiffness:

$$C_{DRi} = \frac{F_{RVi} \times T_i^2}{2}$$

equivalent suspension roll stiffness ground level

$$C_{DGMi} = C_{DGi} \times \left[\frac{H_N}{H_N - m}\right]^2$$

combined roll stiffness to simulate lateral CG shift

$$C_{DRESi} = \frac{C_{DGMi} \times C_{DRi}}{C_{DGMi} + C_{DRi}}$$

vehicle pseudo roll angle at wheel lift

$$\Theta_i = \frac{A_i \times T_i}{2 \times C_{DRESi}}$$

G 2 In case of semi-trailers separated from tractors, kingpin effects are calculated by using the following formula:

Kingpin trace width:

$$T_K = \frac{\sum_{i=1}^{n} T_i}{n}$$

The kingpin roll stiffness, which is the roll stiffness of the tractor at the longitudinal position of the fifth wheel/kingpin, will be calculated by using a reference load dependent roll stiffness factor of 4 kN-m/rad:

$$C_{DRESK} = A_K \cdot 4$$

G 3 After the resolved combined stiffness and pseudo roll angle for each axle/bogie are calculated the totals for the complete vehicle are determined:

total vehicle weight

$$A_T = \sum_{i=1}^{n} A_i + A_K$$

total unsprung weight

$$U_T = \sum_{i=1}^{n} U_i$$

effective track width

$$T_T = \frac{\sum_{i=1}^{n} (T_i \times A_i)}{A_T} + \frac{T_K \times A_K}{A_T}$$

total roll stiffness

$$C_{DREST} = \sum_{i=1}^{n} C_{DRESi} + C_{DRESK}$$

G 4 Select the axle/bogie with the lowest value of θ, for this indicates that first wheel lift will occur. To distinguish this axle/bogie from the other axles/bogies, allocate the following:

A_M = Axle load of axle/bogie with lowest θ.

U_M = Unsprung weight of axle/bogie with lowest θ.

T_M = Track width of axle/bogie with lowest θ.

C_{DRESM} = Roll stiffness axle of axle/bogie with lowest θ.

G 5 Lateral Stability Calculation

G 5.1 The effective mass factor of the stiffest axle/bogie F_E

$$F_E = \frac{C_{DRESM}}{C_{DREST}}$$

G 5.2 The lateral acceleration at first wheel lift q_M:

$$q_M = \frac{A_M \times T_M}{2 \times \left[(F_E \times A_T \times H_G) + \frac{((A_T - U_T) \times F_E \times H_N)^2}{C_{DRESM} - (A_T \times F_E \times H_N)} \right]}$$

G 5.3 The maximum optimal theoretical lateral acceleration at overturn q_T:

$$q_T = \frac{A_T \times T_T}{2 \times \left[(A_T \times H_G) + \frac{((A_T - U_T) \times H_N)^2}{C_{DREST} - (A_T \times H_N)} \right]}$$

G 5.4 Linear interpolation between the lateral acceleration at first wheel lift and the Maximum theoretical lateral acceleration gives the correlated lateral acceleration at overturn qc:

$$q_C = q_T - (q_T - q_M) \times \frac{A_M}{A_T}$$

ANNEXURE IV
MODEL CALCULATION REPORT

1	Trade name or mark of the vehicle
2	Vehicle type
3	Manufacturer
4	Height of the centre of gravity of the spring mass
5	Unsprung weight of all axles
6	Nominal suspension roll axis height of all axles
7	Suspension roll stiffness of all axles
8	Vertical tyre rate (inclusive double effect of twin tyres)
9	In case of twin tyres, the twin tyre width
10	Calculation results, q_c =
11	Testing agency which carried out the calculation
12	Date
13	Signature

ANNEXURE V

TECHNICAL SPECIFICATION TO BE SUBMITTED BY VEHICLE MANUFACTURER

1. 0	Details of Vehicle Manufacturer	
	1.1	Name & address of the vehicle manufacturer
	1.2	Telephone / Mobile No.
	1.3	Fax. No.
	1.4	E-mail address
	1.5	Contact person
	1.6	Plant(s)of manufacture
2.0	Details of Truck Body / Tanker Builder	
	2.1	Name & address of the body builder
	2.2	Telephone / Mobile No.
	2.3	Fax. No.
	2.4	E-mail address
	2.5	Contact person
3.0	Name of model and variants (if any)	
	3.1	CMVR certificate reference(s)
	3.2	Type and General commercial description (s)
4.0	Mass of vehicle:	
	4.1	maximum mass of vehicle
	4.2	mass of laden tank
	4.3	distribution of the maximum mass among the axles
	4.4	in case of a semi-trailer or centre-axle trailer, the static load on the fifth wheel/front coupling
5.0	Cross-section of the tank: circular/elliptical/maxi-volume	
6.0	Centre of gravity height of the laden vehicle	
7.0	Axles:	
	7.1	number and arrangement of the axles (including axle spacing)
	7.2	suspension arrangements in relation to roll characteristics
	7.3	suspension trim height and datum location

	7.4.	tyre size and structure: radial ply/diagonal ply/bias belted	
	7.5.	track width of each axle	
8.0	Wheel base		
9.0	Test conditions		
	9.1	mass of vehicle when tested:	
		Axle No.	**Load (Kg)**
		Total	
	9.2	load imposed on towing vehicle fifth wheel coupling or centre axle trailer coupling	
	9.3	filling factor of the test load (% fill of the tank)	
	9.4	test load (water, etc.)	
10.0	Tilt table test / calculation method		
11.0	Approval granted / refused / extended / withdrawn		

ANNEXURE VI

(See Introduction)

Composition of AISC Panel on Tank Vehicles Rollover Stability *

Panel convener	**Representing**
Mr. D. Balakrishnan	SIAM (Ashok Leyland Ltd.)
Members	
Mr. B. S. Yamgar	The Automotive Research Association of India
Mr. Vishal P. Rawal	The Automotive Research Association of India
Mr. Nachiket A. Kulkarni	The Automotive Research Association of India
Mr. Sajal Praveen	The Automotive Research Association of India
Ms. Shubhangi Dalvi	Central Institute of Road Transport
Mr. Ravi M	Global Automotive Research Centre
Mr. S. Nagarajan	Global Automotive Research Centre
Mr. S. Perumal	Global Automotive Research Centre
Mr. V M Dhanasekkar	Global Automotive Research Centre
Mr. Suhail	Global Automotive Research Centre
Mr. Amit Karwal	International Centre for Automotive Technology
Ms. Vijayanta Ahuja	International Centre for Automotive Technology
Mr. Tarun Sharma	International Centre for Automotive Technology
Mr. V. Faustino	SIAM (Ashok Leyland Ltd.)
Mr. Ved Prakash Gautam	SIAM (Ashok Leyland Ltd.)
Mr. N. Muthukumar	SIAM (Ashok Leyland Ltd.)
Mr. Girish S. Kodolikar	SIAM (Force Motors Ltd.)
Mr. V. G. Kulkarni	SIAM (Mahindra Truck & Bus Div.)
Mr. P. S. Gowrishankar	SIAM (Tata Motors Ltd.)
Mr. Pratyush Khare	SIAM (Tata Motors Ltd.)
Mr. Sharad S. Bhole	SIAM (Tata Motors Ltd.)
Ms. Namrata Deb	SIAM (Tata Motors Ltd.)
Mr. D. S. Patil	SIAM (Tata Motors Ltd.)
Mr. Rahul Jain	SIAM (VE Commercial Vehicles Ltd.)
Mr. T Suresh Kumar	SIAM (VE Commercial Vehicles Ltd.)
Mr. Vigknesh V. Rajan	SIAM (Volvo Trucks India)

Mr. Uday Harite	ACMA
Mr. Hirdesh Singh Thakur	ACMA (Pinnacle Industries)
Mr. Prabhakar Chaurasia	AutoApps Gas Solution Pvt. Ltd.
Dr. Shabana Shaikh	H2E Power

***** At the time of approval of this Automotive Industry Standard (AIS)

ANNEXURE VII

(See Introduction)

COMMITTEE COMPOSITION *

Automotive Industry Standards Committee

Chairperson	
Dr. Reji Mathai	Director, The Automotive Research Association of India
Members	**Representing**
Representative from	Ministry of Road Transport and Highways, New Delhi
Representative from	Ministry of Heavy Industries, New Delhi
Representative from	Office of the Development Commissioner, MSME, Ministry of Micro, Small and Medium Enterprises, New Delhi
Shri Shrikant R. Marathe	Former Chairman, AISC
Shri P. V. Srikanth	Bureau of Indian Standards
Director	Central Institute of Road Transport
Director	Global Automotive Research Centre
Director	International Centre for Automotive Technology
Director	Indian Institute of Petroleum
Director	Vehicles Research and Development Establishment
Director	Indian Rubber Manufacturers Research Association
Representatives from	Society of Indian Automobile Manufacturers
Representative from	Tractor and Mechanization Association
Representative from	Automotive Components Manufacturers Association of India
Representative from	Indian Construction Equipment Manufactures' Association
Member Secretary	
Shri Vikram Tandon	The Automotive Research Association of India

* At the time of approval of this Automotive Industry Standard (AIS)