THE HARSH DESIGN

The HARSH design seen today is based on two basic requirements for tipping vehicles which are Stability and Reliability.

The principle of the HARSH design is an underfloor tipping gear operating within a purpose built stabiliser – an integral system.

Each HARSH stabiliser frame is designed to lock the body and payload squarely to the chassis whilst the rams solely provide lift in an even plane without incurring side loading.

Diagram 1.
Therefore the centre of gravity of the load and body whilst in the tipping cycle is held within the chassis rails which keeps the vehicle rigid and stable. The strength of the stabiliser to hold the body and payload square to the chassis whilst on uneven ground or when discharging uneven loads means the rams are not subjected to side loading, therefore they are protected and remain straight and reliable.

Effectively what HARSH adds to a tipping vehicle is an independent second hinge which works through each degree of inclination. Working with the rear hinge the HARSH system evenly distributes the loads and stresses effectively eliminating the misalignment between body and chassis seen with vehicles tilted with front mount or twin underbed unsupported rams. Therefore the HARSH system considerably reduces the possibility of a turnover, and protecting the complete truck and driver.

Diagram 2.
HARSH gears work very much like a weight-lifter would lift a weight. HARSH gear picks up the body by the width of the body runners and mounts across the width of the chassis rails. This wide base enables control of uneven loads and ground conditions even in extreme circumstances.

Tests carried out have proven the HARSH stabilised design to be 5 times stronger than a front end ram proving the efficiency of the design to withstand side loading, Later in this paper reference is made to tests carried out on the HARSH design.

"HARSH" IN HOUSE TESTING PROCEDURES.

THE "JAWS" TEST.

Harsh's objective is to improve tipping stability and safety, with absolute mechanical reliability. A tipping gear that can work in the real world, therefore to ensure the strength of the design to cope with the potential extreme working conditions of a tipper HARSH designed a stringent test. The test is carried out by 'Jaws'. An RSJ structure in which the HARSH gears are mounted and put through 20,000 cycles before it is produced and added to the HARSH line.

Diagram 3: "Jaws"
The test is essentially the same for each and every model in the HARSH line of gear with the exception of actual testing pressure as that is a function of the capacity. Each and every model that is designed is mounted into 'Jaws' which generally duplicates a frame and body arrangement. A testing pressure is selected which is the actual operating pressure that each of the gear is designed to perform with. The gear is then cycled to an opening of approximately 8" (this is all that we feel is necessary as the 'Lift-off' is the most difficult portion of the dumping cycle) and the 'resistance' pressure is set. Resistance is achieved by the gear's efforts to open.

Each gear is cycled as follows :

500 cycles at 2" eccentric loading [A] (2" off the centre to the left)
1000 cycles at the centre
500 cycles at 2" eccentric loading [B] (2" off the centre to the right)
(They can be seen diagramatically, see figure 1.)

This sequence is continued until a total of 20,000 cycles are completed without failure of the gears' frame. Any frame failure experienced results in a redesign and re-test. Upon successful completion, the tested unit becomes a new member of the HARSH line.

To further explain the significance of this test, I will use the K110 gear as an example.

By taking the area of each of the two rams (4" x 2 = 8" x 3.1419) and multiplying that by the operating pressure (3600 PSI) we realise a force of 90,400# or 90.4K when centred on the cross section if the K110 results in '0' torque, but a substantial force to be overcome by the gear as it is pressured to open (this is equivalent to 23.5 UK tonnes or 47.0 OK in the 'Jaws' configuration. Bear in mind that the difference between the 90.4K cylinder force and the 37.0 OK is the result of geometry within the gear and 'Jaws').

The 2" eccentric loading on each side of the centre ([A] , [B]) results in a torsion force of 108,810IN#'S. This is of particular significance when you consider that because the cylinders are plumbed together, any offset load results in effectively placing total lifting force on one ram. The only factor opposing the massive torsion forces is the rigid design of the HARSH gear's frame.

The testing cycle is we believe the hardest test that can be placed on a gear and is unique to HARSH, imitating, real life tipping situations.

Diagram 4: HARSH 'Jaws' testing; procedure.

"HARSH" RIGIDITY TESTING.

HARSH rigidity testing is carried out in the following way :

A HARSH gear is placed in the following position, [diagram 5], on one side of the gear the upper and lower mounts are clamped shut. (See A).

On the other side there is a hydraulic jack fitted between the upper and lower mounts. A force is then applied, and the rigidity figure is taken at the point when the mounts have been opened 1 degree in relation to the stabiliser hinge.

Diagram 6.

This test is specifically designed to determine the frames resistance to remain 'square' and rigid even with extreme off set loading applied.

Diagram 7: Rigidity test results graph.

Problems associated with tipper vehicles when discharging.

Traditionally tipper hauliers throughout the world have accepted problems associated with front end gear mounted tippers of leaking hydraulics, scored stages due to bending, and the possibilities of turnovers as 'part of the job' due to the general arduous nature of tipping work.

In the UK the Health and Safety Executive (HSE) commissioned research into the operation of tipping vehicles to determine the major factors involved during the discharging of loads. Increasing numbers of roll over incidents were being reported to the HSE and the safety implications for both drivers of tippers and people working in the vicinity of tippers when discharging were of great concern.

The research project titled "Investigation into safe use of tipper lorries" was carried out by Messers. Keen, Savage and Lowe of the Bristol Polytechnic.

Their research looked at incidents of rollovers and at that time in the UK they estimated some 900 tipper turnovers per year.

The research looked specifically at 60 of those incidents, interviewing operators and drivers to determine the main factors which caused the incident. The research highlighted two main areas which affected the discharge of vehicles which are :

1.) Vehicle factors

and

2.) Outside factors

The vehicle factors included:-

a.) Tipping gear deflection.
b.) Chassis deflection.
c.) Body deflection.
d.) Rear hinge deflection.
e.) Suspension and tyre deflection.

Diagram 8.

2.) The outside factors.

The vehicle factors are effected directly by the outside factors :-

a.) Uneven, sloping or soft ground.
b.) Wind forces.
c.) Force due to uneven, shifting or sticking load.
d.) Freezing conditions.

Diagram 9

With reference to point c.) of uneven, shifting and sticking loads in house research by HARSH has shown that because of the fast tipping cycles offered by high pressured low volume hydraulics combined with tipping angles of up to 60 degrees permissible with HARSH this ensures the load does not have time to stick and cause problems. Whereas with high volume low pressure front end hydraulics the slower tipping cycles allow loads to stick with the obvious consequences.

FACTORS THAT LEAD TO VEHICLE DAMAGE AND THE POSSIBILITY OF A TURNOVER.

The research showed that when a vehicle was in a normal working environment outside factors act on the tipper to create a 'snowball' effect. For example a tipper loaded with soil from site is likely not to have a symmetrical load. As it travels down the road it will encounter road vibration that cause the heavier parts of the load to congregate at the bottom of the body and braking forces cause the load to stick to the front of the body as the load shifts forward sticking to the head board and in the body corners. This sticking was found to increase with recessed (doghoused) rams as there is a greater surface area for the load to stick to.

When the Vehicle is then tipped it is likely the ground surface will not be level. A common road camber will give a slope of two to three degrees. As the body is raised the 'snowball' effect begins. See diagram 8.

The chassis is leaning, therefore the suspension and tyre deflection on one side of the chassis will be greater. As the body is raised it will begin to lean to one side, and the weight deflects in the body switch to the rear of the chassis causing rear hinge deflection and chassis twist which in turn twists the body further out of line, as such the ram continues to bend. This result is that all the major components of the tipper are put under stress which results in worn parts and component failure. Ultimately if the conditions are sufficient and the deflection is great enough then the centre of gravity of the load moves outside the line of the chassis and the vehicle will roll over.

Keen, Savage and Lowes' research found that of the 900 turnovers reported the majority of these happen on level firm ground, and were ultimately caused by shifting uneven loads and inadequate component strengths to withstand those forces.

The research also undertook practical research testing articulated and 8 x 4 tippers with front end gears all on tilt tables. They also tested front end rams by attaching them to strongwalls, applying a load to the end of the ram to measure deflection.

The tilt table tests produced the following results :-

Vehicle tested :- 8 x 4 Leyland; Edbro DE 16 tipping gear; Edbro steel body.

The vehicle was loaded with seven tonnes of blocks offset to one side and placed on a three degree side slope.

The test was stopped after ten degrees of body elevation as the ram had bent considerably and the suspension tube on the tipping gear was touching the ram stage. Continuation of the test would have damaged the ram. Even though the vehicle was of heavy construction considerable deflection was also seen in the rear hinge, chassis and body.

Effectively the test proved that the front and ram is not capable of controlling sideloading and holding the centre of gravity in the body within the stability limits of the vehicle. Further research which will be discussed later in this paper is that the front end ram is shown to have little or no ability to transmit any torque produced by a leaning body into the chassis, therefore all torque produced by a body twisting out of line are transmitted into the rear hinge which increases the twist and probability of a turnover.

It should be pointed out that this statement applies to all front of body telescopic cylinders. Manufacturers of this type of tipping gear state quite clearly that the hoist is a lifting device and should not be used or considered as a stabiliser.

The articulated trailer was tested as per the Leyland 8 x 4 with a seven tonne offset load on a three degree side slope. In this test the body reached full elevation. However the vehicle had reached its' 'limit of stability' shown by the rear wheels of the upside of the chassis transmitting no load into load sensors and one of the wheels being visibly off the ground.

The testing of front end gears by attaching them to a strongwall and applying a load to the end of the ram to measure deflection brought the following results.

Leading UK manufacturers trailer ram was extended and a load was gradually extended and a load was gradually exerted at the end of the ram to test resistance to the side load. At three tonnes side load the base tube split. This would have effectively caused a turnover. With a 5.9 load applied the ram had deflected 47 inches (1194 mm) from the centre line.

When a side load of three tonnes is considered in light of the practical loads this ram would be subject to at 38 tonnes GVW in the UK it is not surprising that 60% of turnovers are articulated trailers and of those the major of them were working on level ground.

The research of Keen, Savage and Lowe concluded by recommending further research into the design and construction of tippers and investigation into further products that could improve stability. It was also recommended that guidelines be established and test procedures be devised to determine the stability of tipper vehicles.

DEPARTMENT OF TRADE AND INDUSTRY RESEARCH "INVESTIGATION OF THE STABILITY OF TIPPING VEHICLES"

HARSH v Front End Design.

In 1991 following the research of Keen, Savage and Lowe further research was commissioned by the British Department of Trade and Industry into tipper stability. Titled "Investigation of the Stability of Tipping Vehicles" the university of Western England (formally Bristol Polytechnic) continued the research by looking specifically at an alternative to the previously tested front end tipping gears.

The research was opened up to the whole industry as recommended by Keen, Savage and Lowe to create a collaboration between manufacturers concerned in the industry to develop better and safer tipping vehicles. The result was only three companies were willing to be involved in the research, these were K and J Withey (a UK bodybuilder), Telehoist the ram manufacturer, and HARSH Ltd.

The aim of the research was to further investigate the cause of vehicle turnovers, develop a model and testing procedure to evaluate tipper stability and determine the performance of a stabilised tipping gear in comparison to the front end technology available.

The research mirrored that of Keen, Savage and Lowe, by looking at the tipping Vehicle as it discharged and the reaction of that vehicle. But importantly it did this practically to a certain degree and compared the performance of the two types of tipping systems using an 8 x 4 30 tonne GVW tipper as the example.

Chassis Performance,

Firstly the DTI research looked at chassis performance and found that when tipping with a front end gear when the body and payload is raised 90% of the load is transmitted into the rear of the chassis, a situation that increases if the vehicle is working on uneven ground or has an uneven load. This is shown in diagram 10.

Initially the chassis research looked at the tipper and the initial lift of the body at the start of the tipping cycle. The loading affects on the chassis can be seen in diagram 11.

It must be stressed that these are calculated results and do not take into consideration the strength of the stabiliser, these calculations are based on point loadings.

As can be clearly seen the HARSH gear in this situation reduces at point, stress imposed on the chassis by at least 40%. In practical terms the effects of stresses imposed here by a front end gear result in cracking in front of the rear bogie and also around the mounting brackets of the front end gear down forces acting against the upward forces form the spring hanger brackets causing sheer forces.

It is commonly assumed that underfloor tipping gear impose excess loadings into the chassis at lift off. The fact remains with the HARSH system – this is not the case. It is accepted that the HARSH system does not have the mechanical efficiency at lift off of a front end cylinder and uses increased pressure to begin lift off and to loads Imposed is slightly higher. In the case of this example an additional 4940 kgs of force. However engineers at Mercedes Bent UK confirmed that the 14840 kg downforce at lift off is insignificant in terms of a vehicle chassis of this GVW as the chassis is designed to take loads downwards. The problems of chassis cracking are predominantly caused by the chassis flexing upwards, known as "hog backing" caused by the front end gear imposing a load at the front of the chassis, while the rest of the weight is put through the rear hinge and rear of the chassis.

Furthermore the HARSH gear mounts mid chassis as such it does not encounter any sheer forces with springhanger brackets.

It must also be noted that in practical application the mounting plates of the HARSH system reduce point load by approximately 10%.

When the vehicle is fully tipped with no discharge as can be seen in diagram 13. The weight distribution of the HARSH system is much better, reducing the loading of the rear hinge. Again at point HARSH reduces the stresses in the rear of the chassis by 20%. A practical example of this situation is the spreading of tarmac, or blowing agricultural products when bodies must be raised and discharge delayed.

What proves more significant is when the body is tipped on a side stop and the effect the loads have on the chassis. Diagram 14 shows the loading effects of a body raised with 21 tonnes load and the distribution of those loadings on the chassis. It must be noted that the angle of tilt donated by X degrees for the front end gear and X degrees + 4/ 5 degrees is the angle at which it was estimated the tipping vehicle would reach its' limit of stability with the tipping gear fitted. (It will be shown later that the HARSH system improves the stability of a vehicle by 6/ 7 degrees over a front end ram).

It should be noted then that at the higher angle of tilt the loadings in the HARSH equipped vehicle will be higher. However it can be seen that the distribution of those loadings is significantly better, and the loading on the rear hinge significantly reduced over those seen in the front end gear vehicle at a significantly lower angle of tilt.

The effect on the chassis at point is a reduction in stresses of 40%.

The practical result of this analysis is that when a vehicle fitted with a front end gear reaches an angle where the stresses are high and turnover is a high probability. A vehicle fitted with a HARSH gear will remain stable and reduce significantly the stresses imposed on the chassis.

The final part of the chassis analysis is the effect on the rear hinge and chassis. This DTI research put great emphasis on the rear hinge deflection as the rear hinge as shown by Keen, Savage and Lowe to be the strongest link between the body and chassis, and the area where the greatest loading occurs, because of the front end rams inability to control sideloading and transfer torque from the body to the chassis.

Diagram 5. clearly shows the reduced bending seen in the chassis when a HARSH gear is fitted. The HARSH gear acts in a number of ways. Firstly the rigidity of the stabiliser prevents the twist associated with vehicles fitted with front end gears, as such the loading in the rear corners of the chassis is reduced. Secondly the mid chassis mounting position of the HARSH gear reduces the length of the unsupported / fix chassis rails reducing chassis 'hog backing' and also transferring loads evenly throughout the chassis. Thirdly the HARSH gear by its' design adds a significant crossmember to the chassis by means of its' mounting bracketry and lower cross tube of the stabiliser frame thereby strengthening the chassis.

The total effect on the chassis is the HARSH gear reduces rear hinge deflection from its lateral line by 100% over the deflection seen in a front end gear fitted vehicle.

What is significant about rear hinge deflection is that as the strongest link between body and chassis, should the rear hinge deflect through 3 degrees then this means the body is also immediately out of line from the chassis. Therefore once the front end ram bends there comes a point when it is not pushing upwards but rather pushing out which results in a turnover.

BODY PERFORMANCE.

At the same time as the reaction and deflections in the chassis were analysed the corresponding body reaction wa recorded and analysed.

The reaction of a fully loaded body with a front end gear very much mirrored the reaching in the chassis which is shown in diagram 6. As the body is tipped the C of G of the load moves back over the rear bogie, where the greatest loads are experienced.

What also can be seen is the actual reaction of the body as a separate component. The load in side the body causes the floor of the body to go into a tension, as the floor is unsupported. In consequence the top rail of the body goes into compression . As such the top rail may bend, and needs a sizeable top rail to hold the shape of the body. The effect of this is the rear of the body will suffer cracking especially around the rear hinge area. In time bodies can be seen to 'banana' and the front of the body when not loaded will ride off the chassis. The effect of this body reaction on stability is that because of the body is not rigid and flexes and twists it adds to the other individually small deflections in the tyres, suspension, chassis and tipping gear to create further potential for component failure and ultimately turnover.

The same vehicle and body specification fitted with the HARSH tipping gear reacts completely opposite to that of a front end geared truck. Because the gear lifts from under the body this puts the bottom rail into compression, while the top rail is put into tension.

The compression effect of the floor construction of the body is illuminated by full length runners that act as a spine while the top rail holds its' shape through being in tension.

The effect on stresses seen in the body is shown in diagram 17. where the stresses are reduced by half.

The HARSH gear ensures that the vehicles body and load are controlled and prevented from deflecting through each degree of lift. By picking the body up by the two longitudinal runners and linking that directly to the width of the chassis, the torsional forces created by uneven loading or uneven sites are transferred proportionally to the chassis at the HARSH mounting point and rear hinge preventing extreme loading and potentially dangerous levels of deflection.

The position of mounting the HARSH gear in the chassis shown in diagram 18. shows the close position of the gear to the greatest mass of the load where it occurs in the tipped body. This enables the HARSH gear to control the load, even when uneven or sudden movements happen, for example an unevenly breaking load. Thereby holding the body square to the chassis at all times eliminating twisting, ensuring the retention of the body and loads' C of G inside the chassis rails, ensuring maximum stability.

DTI Stability Test 1993 Volvo 8x4.

Essentially all the research and data on the reaction of chassis, bodies and tipping gears has been collated from simple tests as shown in diagram 19 without taking vehicles to any extreme. We at HARSH although very happy that our products were proven by independent test to offer significant benefits over a front end ram, at no time had the strength of the stabiliser been taken into consideration therefore we knew that the real performance of our range of gears was not being taken into consideration. Therefore in light of the previous front end gear stability tests we made vehicles available to the DTI for test. This also enabled them to have an accurate check on the performance of the vehicles in extreme situations and cross check their extrapolated results against the practical result.

Test Procedure

Using a Volvo FL10 8 x 4 5.1 metre wheelbase the body is portioned to retain the load as shown in photograph 1. The test was performed by the Ministry of Defence Research Agency and on arrival to the MOD test station the Vehicle was handed over to them and they checked, monitored and carried out the test.

The vehicle was loaded to its maximum GVW of 32000 kgs. The vehicle was weigh checked both for total weight and separate axle loadings to ensure legal axle loadings throughout.

Then each individual component is checked e.g. tyre pressure, spring wear, mountings, etc. to ensure the vehicle is to the manufacturers' recommendation.

The Vehicle is then placed on the tilt platform and chains fastened around the axles and a safety chain fastened to the gear. These chains are used as a precaution, however they are not tight and do not effect the results of the test.

The DTI researchers at this stage then placed load sensors around the vehicle to measure deflections and the angles of tilt.

The body was fully tipped to 48 degrees and the tilt platform was raised.

Firstly the tilt platform was tilted to 3 degrees to allow a comparison of results to the front end gear test performed by Keen, Savage and Lowe. The tilt table was then raised to 5 degrees for compliance with Category B standard for the IRTE code of practise. Then to 7 degrees to comply with Category A.

The test was continued to a sideways tilt of 9 degrees at which point all wheels were still in contact with the ground and transmitting load.

The DTI researchers were very happy with the information collated and the tilt angles were confirmed by the MOD.

The test results were :-

Ground tilt 9 degrees
Chassis tilt 14 degrees front of chassis.
Body tilt 17 degrees rear of body.

The deflection between front of chassis and rear of body effectively was made up of the twist in the chassis which is shown quite clearly in photograph 1. also suspension deflection and tyre deflection are also noticeable.

Photograph 2. shows that the HARSH gear remained straight and rigid throughout this extreme test, and an inspection following the test showed there was no damage to any part of the tipping gear, chassis or body.

It should noted that the Volvo FL10 was one of Volvo GB's demonstration fleet that had been on the road for just under 12 months and had completed 47,000 kilometres and this test was performed with their kind permission.

The results gained from this test proved beyond doubt the strength and stability performance of the HARSH system producing proven levels of stability way beyond those achieved by any front end gear in previous tests.

ARTICULATED TRAILER AND 6 X 4 STABILITY TESTS

HARSH have also performed stability tests on articulated trailers and 6 x 4 rigids to comply with UK Health and Safety and European legislation.

These were also conducted by the Ministry of Defence and they were performed in the same way as the 8 x 4 test only differing by payload. The articulated trailer load to 38 tonnes GVW. Payload and body weights were approximately 29 and 19 tonnes respectively.

Results Articulated Trailer Test :

Ground tilt 12 degrees.
Chassis tilt 18½ degrees.
Body tilt 19 degrees.

Trailer specification : 33'6" triaxle stepframe trailer 55 cyard capacity
tipping angle 48 degrees.

Please see the photograph of the Articulated trailer test.

This result had duel importance. Firstly this was the highest tilt ever recorded for a fully loaded articulated trailer surpassing the previous tests done using front end geared trailers by 35% while incurring no product damage. Previous front end gear tests while seeming to give good stability results resulted in seriously damaged rams and chassis. Secondly the 1/2 deflection between chassis and body highlighted the strength of the HARSH M130 tipping gear to hold a body and payload of approximately 30 tonnes squarely to the chassis at such an extreme angle of tilt.

6 H 4 Stability Test Results

Ground tilt 9 degrees.
Chassis tilt 12 degrees.
Body tilt 15 degrees.

Please see photograph of this 6 x 4 test.

Truck Specification.

Leyland DAF 6 x 4 26000 kgs GVW.
18 ft alloy body.
Tipping gear HARSH J100.
Payload 17 tonnes.

Again the HARSH equipped vehicle surpassed the IRTE Stability Code of Practice A Category of 7 degrees by 30%.

The 6 x 4 stability test completed the testing needed to cover the UK's heavy tipping markets which suffer turnover problems of over 2000 per year as estimated by the Commercial Motor in 1988. Industry statistics puts the average turnover cost at £7500 in the UK, which equates to a loss of £15 million per year. This figure only relates to acute repair costs and dues not include loss of earnings, downtime, increasing insurance premiums and injury compensation.

Conclusions of the DTI research.

Dr. George Trmal, the Co-ordinator of the DTI research programme concludes this by stating

"From our research over 4 years it can be concluded that the HARSH stabilised tipping gear offers significant advantages over traditional front end rams. HARSH offers greater stability and safety and reduces stresses in both the chassis and the body thereby improving vehicle specification and performance"

The DTI research proved HARSH gear to :

- offer significant reductions in chassis and body stresses and torsion deflections.
- significantly reduced rear hinge deflection.
- lock the body squarely to the chassis in extreme conditions.
- offer significantly greater levels of stability over the front end ram.
- meet and surpass the LKTE Stability Code of Practice Category A.
- meet the requirements of UK Health and Safety legislation.
- meet the EC Machinery Directive.

Most importantly the DTI stability research proved that regardless of the inherent strengths and weaknesses of all the relevant Vehicle components such as chassis, body suspension, etc. the single greatest contribution to a vehicle's stability is the HARSH stability .

RIGIDITY TEST OF THE HARSH STABILISED GEAR.

The final part of the DTI research was the actual specific determining of the rigidity of the HARSH design in to the lateral strength of the front end gear.

To do this test the HARSH gear was turned through 90 degrees and connected to a strongwall, fully extended and subjected to both a direct loading at the end of the fully extended stabiliser and also a load was applied at 2m from the end of the stabiliser to create a torsional load. Diagram 20. shows how the test was performed.

The results of the test were that the stiffness of the HARSH stabiliser at full extension is 345 knm/m in comparison to a front end gear of approximately 70 knm/m.

It should be noted that the test was of the stabiliser alone, where as the front end ram test figure is for a pressured ram. Even though in side loading conditions the rams do not 'feel' any of the side loading. When pressurised – the cylinders do add additional rigidity to the stabiliser. However purely on the performance of the stabiliser alone t HARSH system is five times as strong as a pressurised front end ram, thereby able to control loading conditions which are five times greater than those that will cause serious damage or failure to a front end ram.

The actual test procedure is exactly the same as the method used when testing the Volvo 8 x 4 a previous section.

The practical reality in the UK is that only vehicles equipped with HARSH underfloor tipping gears have practically passed the IRTE category A tests for 6 x 4, 8 x 4, and articulated trailers.

In 1994 following completion of these tests much was written in the UK press concerning tipper stability and the obvious advantage of the HARSH system. This caused a backlash from front end gear manufacturers as could be expected as they tried to defend their technology. In response Commercial Motor offered a head to head between all tipping gear manufacturers to bring vehicles to the Ministry of Defence tilt table to finally prove which system was the safest.

The result was that only HARSH agreed to this test and still today no front end gear manufacturers have proven their equipment can meet the minimum five degrees Category B standard.

THE HARSH TIPPING GEAR RANGE AND THEIR BENEFITS.

HARSH offer a complete range of tipping gears for Vehicles requiring lifting capacity from one to forty tonnes that are suitable for both rigids and articulated trailers.

All the HARSH range are underfloor tipping gears, with the cylinder(s) incorporated in a stabiliser frame. By being located underfloor HARSH tipping gears offer the greatest flexibility to the operator. Whether the truck is specified as a straight tipper or with ancillary equipment such as a crane in addition to the optimum safety, stability and reliability afforded by the HARSH design, HARSH allows the greatest versatility of final vehicle specification for optimum operating efficiency and productivity.

Vehicle / Body versatility.

Because there is no tipping gear behind the cab, HARSH offer you the ability to maximise bodylengths on short wheelbase vehicles. Trucks specified with crew or sleeper cabs can retain standard bodylengths without the need for extended Wheelbases.

For bulk applications such as feed bodies, HARSH enables operators to increase overall volume and the number of body compartments – without increasing body height.

Double Acting Cylinders.

Power up and down is standard on the HARSH range from 1.5 – 20 tonnes GVW, enabling efficient, safe and controlled tipping of full and part loads.

Crane Applications.

Complete compatibility of flows and pressures between HARSH tipping gears and cranes means just one hydraulic system works for both operations – selectable at the flick of a switch. The ability to mount HARSH direct to the truck chassis with only a short sub-frame is a unique benefit – saving you cost, weight and height.

Speed and angle of Tip.

HARSH provides for much faster tipping cycles which, combined with options for greatly improved angles of tip, ensure that even the most difficult load is discharged quickly and safely, whatever the situation.

Small high pressure HARSH cylinders provide fast tipping cycles, which combined with the ability to gain tipping angles of up to 60 degrees ensure that even the most difficult loads are discharged quickly and safely.

Chrome Cylinders.

Hard chrome rams are standard throughout the HARSH range. They protect against corrosion thereby extending ram and seal life to ensure utmost reliability.

Conclusion - HARSH v Front End Gears.

The HARSH gear is proven to provide the following significant benefits over the traditional front end ram.

- The HARSH stabiliser is five times as strong as a pressurised front end ram.
- A vehicle fitted with a HARSH gear is twice as stable as one fitted with a front end ram.
- HARSH significantly reduces the stresses and loadings incurred by a chassis.
- HARSH increases rear hinge stiffness by 100%.
- HARSH significantly reduces the stresses and loads incurred by a body by controlling the load and preventing misalignment.
- HARSH provides an independent second hinge to the vehicle.

HARSH provide a tested proven, acceptable and immediately available range of tipping gears which represent the single greatest contribution to the stability of a tipping vehicle.