WER'WOLF MKII
Mine Protected Vehicle

India Trial Report
January – June 2000

Deployment in the Jammu Region

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CONTENT LIST

Section A: Introduction and Background.

1. With the acquisition of Windhoeker Maschinenfabrik 1998 Pty Ltd (WMF 1998) by the Namibian Government during the first half of 1998, a new impetus was given to the organization in terms of becoming more export driven and orientated.
2. With this new focus came a strategic business alliance between WMF 1998 and Military International Limited (MIL) of Canada, whereby MIL would provide an international business network and marketing infrastructure to launch the WMF 1998 product range into the international arena.
3. After extensive mutual evaluation of the Wer'wolf MKI Vehicle to determine it's suitability for the export market, it was decided not to try and improve on the MKI but to develop a brand new Mine Protected Vehicle (MPV) that would not only be 100% suitable for export, but also of a superior mine protection design as well as technologically current.
4. MIL provided the User Specification to suit the International market requirements and WMF 1998 provided the design and development expertise as well as resources to develop the Wer'wolf MKII MPV in a record-breaking 8 weeks during 1999. Extensive evaluation of the vehicle was undertaken in Namibia during August 1999 during which the vehicle proved itself to be of superior automotive design and performance.

The outstanding development team of WMF 1998 on the day the vehicle was introduced to the WMF 1998 Board Members.

5. With the vehicle qualified and signed off by MAN of Germany it was decided to launch the vehicle into the international market during the DEFEXPO India '99 Defence Exhibition which was held in New Delhi during October 1999.

6. In February 1999 submissions were made to the Indian Army whereby the MKII was offered to them. In follow up, Johan Dippenaar travelled to India in July 1999 and made a detailed product presentation to Gen. PSK Choudary (and his Staff) as ADG-WE in his capacity as Procurement Chief of the Army. Gen. Choudary confirmed the Indian Army requirement for Mine Protected Vehicles in view of their protracted conflict in Jammu and Kashmir where mine and ballistic attacks were a significant problem.
7. In view of this important potential market for the MKII, the vehicle was shipped to India and was indeed very favourably received at the show.

Wer'wolf MKII on exhibit at DEFEXPO India '99.

The Indian Director Infantry, Gen. Shankar Prasad, receiving a product briefing during DEFEXPO '99 with the Namibian High Commissioner to India, HE Mr. Kapaanda, attending the proceedings.

The Indian Secretary of Defence, Mr. TR Prasad, receiving a product briefing during DEFEXPO '99 with the Exhibition Manager, Col. SS Dahiya, attending to the right.

8. To benefit on the vehicle being in India, we requested the Indian Army to submit the vehicle for official trials. This is a necessary step in having any product considered for procurement by the Indian Army. No product is purchased without it being properly evaluated first.
9. Whilst Gen. Choudary agreed, during the July 1999 product briefing, to trial the Wer'wolf after DEFEXPO; we could not secure his official permission to do so during the show. This meant that in accordance with the exhibition rules we were forced to re-export the vehicle within five days of the closure of the show. This was obviously potentially disastrous for us.
10. To resolve this crisis, the Namibian High Commissioner and myself made a personal submission to the Secretary of Defence, Mr. Prasad. Since Mr. Prasad knew the product we were favourably received and we were granted permission to retain the vehicle in India to give us an opportunity to lobby the decision makers to have the vehicle trial evaluated by the Indian Army.
11. The next few months proved to be a very difficult time for us. The whole project was continuously hanging by a thread due to the very strong efforts from our competitors to keep us out of this market. Vickers OMC from South Africa already had 2 contracts to supply refurbished Casspirs to the Indian Army and it was abundantly clear that they were not going to give us a fair opportunity to even offer our vehicle to this customer.
12. Weeks of very extensive lobbying and petitioning followed and eventually we received an instruction early in December 1999 to report for a meeting with Gen. Choudary within a few days. During this meeting I was informed that the Wer'wolf MKII trial was approved and would commence on 5th January 2000. I was given an outline of the trial program, which would be completed by the end of March 2000.

Section B: Pre-trial events and Preparation.

1. Urgent preparations in terms of personal logistics were concluded for the trials and Amos van Jaarsveld and myself left for India on 2nd January 2000 to arrive in Delhi on the 3rd January.
2. **5th January – 15h00**: Meeting with Col AP Singh (Trial Director). Discuss the scope of the trial and agree on the schedule as well as the assistance required from the Indian Army in respect of maintenance facilities, diesel, messing and accommodation for our personnel etc. The trial will commence on 10th January with driver training in Delhi. The discussions are followed up with a confirmation letter from ourselves.
3. **6th January – 15h00**: meeting held with the MAN India Representatives. They are briefed on the scope of the trials and we agree on an action plan for in-country technical assistance, should this become necessary.
4. **7th January – 10h00**: meeting held with the Namibian High Commissioner, HE Mr. Kapaanda. Discussion regarding the current project status and trial schedule.
5. **4th January – 8th January**: vehicle preparations for trials. Procured and fitted fog lamps, fire extinguishers and a cold starting device. Some minor technical problems are fixed such as the fuel pump cutting out when the starter kicks in. This is due to an electrical installation problem. The brake lights are also not working due to an electrical installation fault. This problem could not be rectified and persisted throughout the trials.
6. **10th January – 26th January**: the trials are delayed by the ADG: WE. Several letters are written and numerous phone calls are made without success. We were to learn later that the Government owned Medak Ordnance Factory caused the delay. They were building their own MPV, which turned out to be a copy of a hybrid between a Casspir and an RG31. This vehicle was entered as a competitor for the MKII and was to be trial evaluated alongside the MKII. We had to wait for Medak to finish their vehicle first before the trial could commence. This was only accomplished by the 24th January.

First parade maintenance checks before training commence.

7. **27th January – 10h00**: three drivers arrive in Delhi for training. They are Rifleman Mohammed Zaman, Lance Corporal ML Sharma and Lance Corporal DS Nikam.


Completion of driver training on the Army Parade Ground in Delhi

8. **28th January – 2nd February**: driver training. Rifleman Zaman is taken off the course on the 31st January. He is not trainable and will definitely damage the vehicle should he be allowed to continue. The other two drivers do somewhat better with Nikam turning out to be the best. He was the only driver allowed to assist Amos with the driving during the trials. Sharma turned out to be average as a driver but he was very useful for assisting with the vehicle routine maintenance.

Section C: Phase 1: User Evaluation – Jammu Region.

1. Deployment for this phase starts on the 3rd February 2000 and is originally scheduled by the ADG: WE for completion by the end of March 2000.
2. The vehicle is to move under own power for deployment between Phases, as this would be part of the endurance testing under actual Indian road conditions.
3. The trial is scheduled over 5 Phases as follows:
    a. Phase 1: User Evaluation in the operational area of Jammu.
    b. Phase 2: Blast Trial at the Terminal Ballistics Research Laboratory (TBRL) at Chandigargh.
    c. Phase 3: Blast and Ballistic Tests at the Military Academy for the History of War (MHOW) near Indore.
    d. Phase 4: Automotive Trials at the Vehicle Research and Development Establishment (VRDE) at Ahmed Nagar.
    e. Phase 5: Maintenance evaluation at the Maintenance Action Group 12 (MAG 12) at Ahmed Nagar.

India: Trial Venues marked X

4. **3rd February – 7th February**: road movement from Delhi to Thanna Mandi where Phase 1 is executed. This trip is indicative of the road traffic conditions

throughout India. It takes 5 days to cover a distance of 786 kilometres. Thus an average distance of 157 kilometres per day, spending at least 8 hours a day on the road.

5. The Medak vehicle develops several technical problems along the way and they are plagued with vehicle breakdowns. It is patently clear that the vehicle is not of sound automotive design since it is built on a hotchpotch of components. The build quality is also very poor. Typical problems they encounter are a transfer gearbox that packs up with the loss off 4x4 selection, chronic overheating, continuous fuel and hydraulic fluid leaks, etc.
6. **8th February - morning**: briefing by Col. Varinder Singh, VrC. Col. Singh is the Commanding Officer of 4 Jammu & Kashmir Light Infantry (4 JAKLI). This is the Unit that will execute the User Trials. 4 JAKLI is part of the 39th Division and they are deployed at a village called Thanna Mandi, situated close to the border with Pakistan in the operational area. Operational soldiers therefore do Phase 1 trials under operational conditions. We are impressed with the professionalism and dedicated approach of the Trial Team. It is clear that this phase will be executed to the highest standards.

7. We are introduced to the Trial Team, which are:
    a. Col. Varinder Singh, VrC.
    b. Maj. Das, 2IC.
    c. Lt. Col. JP Sharma, Engineering Corps.
    d. Maj. Biju, EME.

8. After confirmation of the trial schedule we are given the opportunity to give the Trial Team a full on-site briefing on our vehicle and its capabilities.
9. **8th February – afternoon**: mountain trail to test the ability of the vehicle to ascend mountain passes in the operational area. The test is done from Thanna Mandi to an outpost called DKG. This is an ascent of 5,000 feet within a distance of 10 kilometres. The ascent takes you above the snowline of the surrounding mountains. The Wer'wolf performs faultlessly. We are instructed to stop and pull away on several steep inclines. We experience no problems at all. The Medak vehicle makes it to the top but they burn the clutch in the process and they spring a pneumatic leak as well.

View from the Thanna Mandi Camp.

10. The DKG ascent is a very important part of the User Trials. Capt. Jadhav, the Unit Quartermaster, informs us that Casspir could not complete this ascent. There are several Casspirs located at the Division HQ in the village of Rajouri, some 30 kilometres down the valley from Thanna Mandi. They can however not be used by the Unit in the mountains. They tried the ascent once but midway up the Casspir did not have enough engine power and torque to continue, and the clutch burnt out in the process. The Casspir could also not negotiate the tightly winding bends, as its turning circle was far too wide. The broken down Casspir had to be left in the mountain overnight and subsequently recovered the next day. The ascent was not attempted with a Casspir again. This test therefore also summarizes the operational failure of Casspir in India. It cannot operate in the mountains, which is where the entire operational area is located.
11. It is the outstanding manoeuvrability of Wer'wolf in the mountains, which endears it most to the Operational User. Not only can he get the best possible protection, but in Wer'wolf he also has a vehicle with outstanding automotive performance, even through the worst possible terrain.

The DKG mountain ranges.

The mountain trial summit point at DKG.

12. **9th February – morning**: road trial from the Unit down the valley to Rajouri and back. On the way back we turn off the village road onto a dirt track that leads to one of the Unit's outposts. The Colonel wants to use the opportunity to visit this post. About 1 kilometre along the dirt track we find a Casspir that had rolled down a 6-metre embankment. The Casspir could not negotiate the

tight bend in the road and whilst manoeuvring backwards and forwards to get around the bend, it rolled down the mountainside. We negotiate this track with ease and without having to manoeuvre around any bends. The MKII performs so well that when disembarking at the outpost, the Colonel remarks: “Super, excellent performance”. By contrast the Medak vehicle cannot negotiate the tight bends either. On no less than 6 occasions they have to stop and manoeuvre their way around the bends.

13. Back at Base we receive a visit from Brig. Nikam, The Brigade Commander. I get the opportunity to give him a full briefing on the MKII.
14. **9th February – afternoon**: the mountain trial of the previous day is repeated. This time we are loaded to full combat mass with soldiers and equipment. Amos does the driving himself. From about ▪ up the mountain the road is covered by 12 inches of snow. Amos engages 4x4 to get a 50:50 differential split between the front and rear axles. We are still in high range and without any differential locks selected. We have perfect traction up and down the mountain. Fuel consumption for the day comes to 3,47 km/litre, which is very good given the terrain.
15. **10th February – 07h00**: a heavy snowfall starts at around 04h30 during the night, which by now leaves 8 inches of snow on the ground in the camp. The ambient temperature is 1,1 degrees centigrade and we do a cold starting test. The MKII starts first crank without the use of any cold starting aids.

Thanna Mandi camp at dawn on the morning of 10th February.

Cold starting test successfully completed.

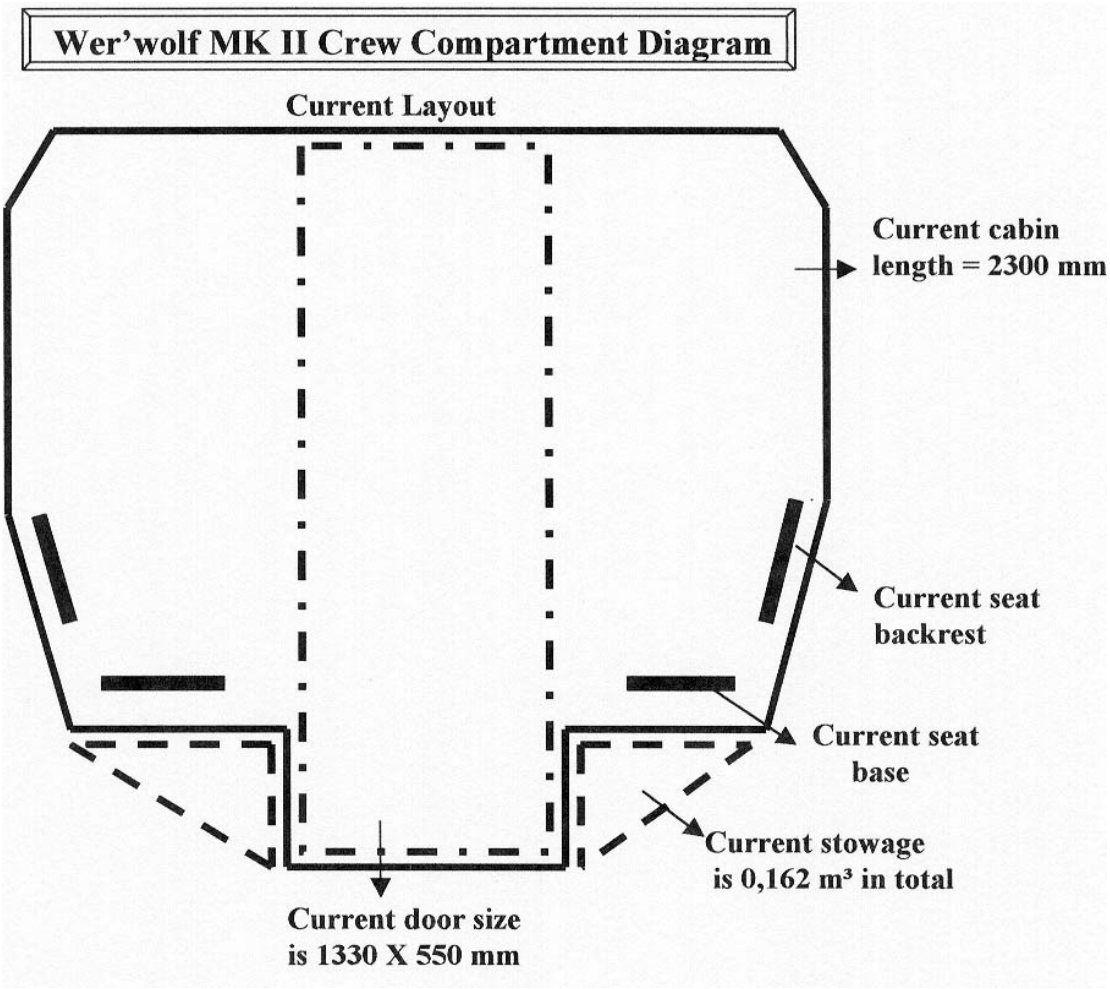
16. At 10h00 we leave for a snow-mobility test. The ambient temperature is now minus 2 degrees centigrade with 12 inches of snow on the ground. It is still snowing heavily and the visibility is very poor. The mountain road is very narrow with steep gorges on either side. It is difficult to negotiate even in good conditions. Now the road is not even visible under the snow, which makes for a hair-raising experience. Amos engages 4x4 for a 50:50 differential split and he also engages low range for optimum traction. We do not have snow chains on the wheels but the Michelin XZL tyres cope very well with the terrain and adverse weather conditions. We experience no problems at all and the test is concluded successfully. Significantly, the Medak crew does not pitch up for the test and we leave without them. They do not trust their own vehicle in these conditions.
17. Whilst out on this test the Colonel decides to do a river-crossing test. The water is not deep enough for it to be classified as a fording test. The crossing is about 50 – 60 metres long through water varying in depth from 300 – 600mm. The riverbed is rocky with round boulders of varying size.
18. The current is fast flowing and the water is quite murky and turbulent. The test is concluded without incident and is a success.
19. **10th February – afternoon**: the entire afternoon is spent test firing the crew weapons from the vehicle using the firing ports. The test is done with the AK47 and INSAS Assault Rifles as well as the LMG and with a full crew compliment on board. The Colonel is not too happy with the firing ports. He wants them larger and mounted higher up the sidewall. This is due to the AK 47 and INSAS rifles having a large front sight assembly, which tends to get stuck in the firing port when the weapon is retrieved back inside the crew compartment.
20. There is virtually no noise inside the crew compartment and the smoke levels inside are also acceptable, even when firing with all the hatches closed down.

The river crossing is successfully completed.

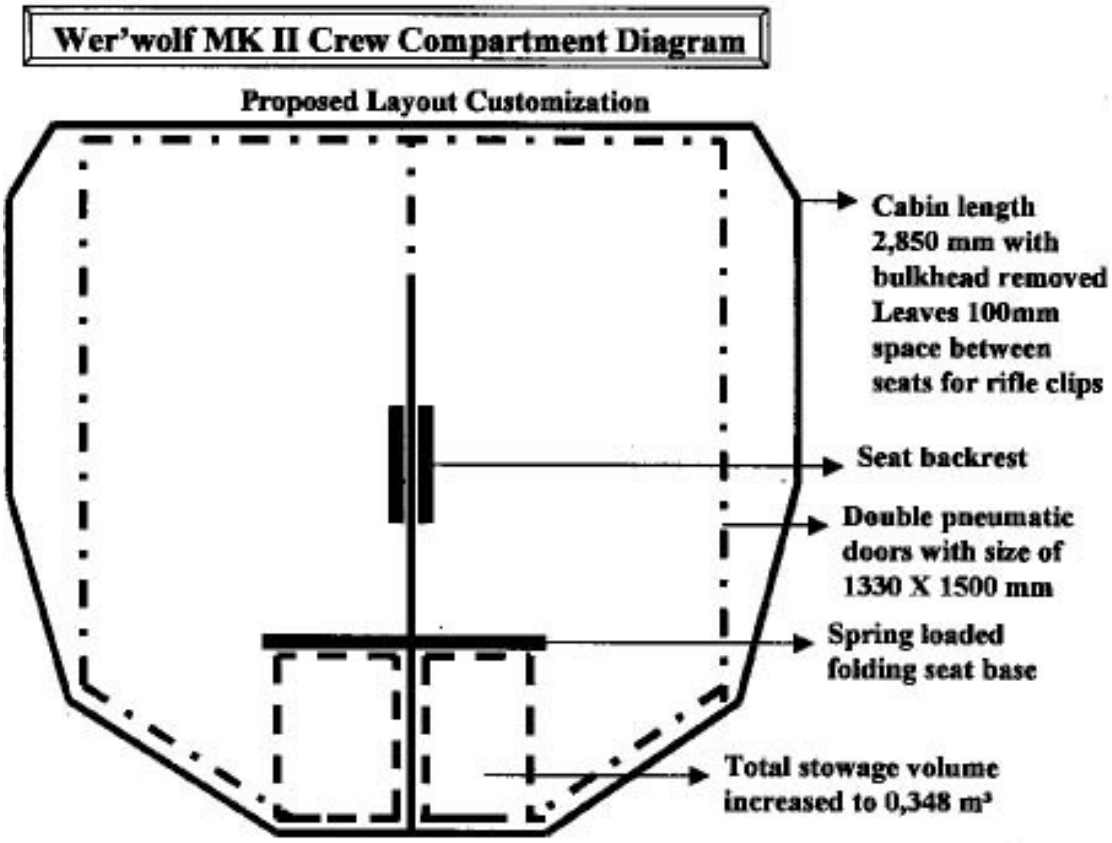
21. **11th February – morning**: the entire morning is spent putting the vehicle through a photography and video session. This is done to complement the Trial Report that will be submitted from 4 JAKLI. The ease of access into, and de-bussing from the vehicle is also evaluated. A full crew complement with all their combat gear is instructed in and out of the vehicle ad nauseum.
22. **11th February – afternoon**: Colonel Singh calls a meeting with the Medak representative and myself to discuss the problems they have with the vehicles as well as the changes they want affected.
23. The following points are noted in terms of Wer'wolf:
    a. They don't want a modular vehicle with a removable crew compartment. The configuration must be fixed APC with the bulkhead between the compartments removed. They want a back-to-back seat layout for a section size of 2+10 soldiers. The gap between the seats must be stretched for better ease of firing personal weapons.
    b. They want a 2-piece rear door, as large as possible, which opens pneumatically, a la Casspir.
    c. They don't want a fold down rear step. They want a permanent exterior step, as wide as the rear doors, and with 2 raisers equally spaced between the ground and the vehicle floor.
    d. The firing ports must be enlarged.
    e. The water leaks into the crew compartment must be stopped.
    f. We must mount their radio set and antenna.
    g. They want a PA system between the Commander and the crew.
    h. They want a fresh air ventilation system and demister for the windscreen.
    i. A pneumatic bonnet jack must be fitted.
    j. The vehicle must be issued with snow chains.
    k. They want an exhaust brake fitted to compliment the pneumatic braking system for deployment in mountainous areas. They feel the

brake drums get too hot during extended mountain descents. This is a subjective observation however.

24. The list of comments has to be seen in perspective. These points are not noted as failures, but as user-preferred changes. The vehicle does not attract a single critical technical comment. The points they raise are all modifications or customisations, which they request as a result of their own doctrine or operational experience.
25. By contrast the Medak vehicle is severely criticized because of technical failures. These include a new engine, transmission, steering system etc.
26. Below is a schematic layout of the current crew compartment as well as a proposed new crew compartment layout that contains the changes requested by the Trial Team. These proposed changes are discussed with Col. Singh and he is satisfied that it represents their wishes. He requests copies of these layout drawings, which we believe are included in his Trial Report.



Current crew compartment layout.



Proposed new crew compartment layout.

27. **12th February – full day**: endurance trial for vehicle and crew. The Medak vehicle cannot start this trial since their steering pump packed up. They stay in the Base. The trial is done on a mountain pass, travelling from Thanna Mandi down the valley through Rajouri and on to a village called Sunderbani. This trip takes 4 hours of non-stop driving. At Sunderbani we halt for 30 minutes before we complete the trek back to Thanna Mandi. The entire trial takes 7 hours to complete and we travel a distance of 188 kilometres at an average speed of 26,85 km/hour. This is no mean feat given the appalling road conditions. This entire route is nothing more than a dirt track carved out the side of the mountain. The vehicle performs very well throughout the trial. At one stage the entire crew was nodding off at the back, so I guess the crew comfort level on long distance marches must be adequate!
28. The Medak vehicle is allowed to complete their endurance trial the next day after they fix their steering pump. Colonel Singh does not accompany them however. Major Das tells me he does not feel comfortable travelling in their vehicle.
29. **13TH February**: rest day which we spend doing routine vehicle maintenance.
30. **14th February**: Colonel Singh asks me to accompany him to the Casspir, which rolled down the embankment. He wants me to give him a detailed briefing on the deficiencies of the Casspir as well as a first hand comparison between MKII and the Casspir. The main focus of my comparison is the fact that Casspir is old technology with no growth opportunities. It is

underpowered with poor manoeuvrability, both in terms of steering as well as tractive effort. To top it all, the Casspir is not maintenance friendly and neither is it reliable. The Colonel concurs and I follow up my presentation with a letter confirming the points discussed.

31. **15th February**: I assist colonel Singh with the preparation of his Trial Report to the GOC 39th Division, Maj. Gen. GS Negi, which is scheduled for the next day.
32. Two new potential customers for the Wer'wolf arrive at the Base. They are Commandant Bhangu of the Indo Tibetan Border Police (ITBP) and Commandant Ravi Deep of the Central Reserve Police Force (CRPF). I give them both a full product briefing and Colonel Singh also briefs them with regard to his findings.
33. **16th February**: Gen. Negi arrives and I am given the opportunity of giving him a full product briefing, during which he also inspects the vehicle. He is then presented with the Trial Report by Colonel Singh, which we are not allowed to attend. After his briefing the General emerges from the tent, walks straight to me and makes the following 3 comments:
    a. "Congratulations, you have an outstanding product, clearly you have distinctly better features".
    b. Then he wants to know why the MKII was not offered to them when they decided to buy the Casspir. I tell him that the MKII was not available on the market when they made their decision. They contracted Casspir in 1998 and we only launched MKII in 1999.
    c. Lastly he wants to know how long it would take to develop the customized changes. I tell him that it shouldn't take more than 8-10 weeks for the initial development.
34. Over lunch Colonel Singh tells me that the General accepted his Trial Report without any reservation. He also tells me that the General was a member of the Trial Team that evaluated and selected the Casspir for service. This explains the General's Casspir related question to me. Since we have developed a good report with Colonel Singh, I ask him what the crux of his Trial Report was. He tells me that the conclusion of his report was that Casspir was not suitable for operational deployment in the Northern Command Sector. The Medak vehicle is also not recommended for service since they needed at least another 5-7 years of development work to mature the design. Wer'wolf is the vehicle of choice for him, which is exactly what he recommended.
35. This concludes Phase 1: User Evaluation. We are satisfied with the outcome in spite of the difficult circumstances in respect of the severe weather, very basic amenities and the very real threat to one's personal safety.
36. **18th February**: I leave for Jammu to rendezvous with our Liaison Officer, Colonel Kumar, for preparation of the next Phase. Amos stays behind with the vehicle to await official clearance from the ADG: WE in Delhi to proceed to the next station.
37. **19th – 21st February**: waiting for clearance from Delhi.
38. **22nd February**: Amos arrives in Jammu with the vehicle. Clearance is received from the ADG: WE to proceed to Chandigargh for Phase 2.
39. **23rd February**: we depart for Chandigargh. Just outside of Jammu we first have to do a cross-country mobility test. This we do in an old riverbed over a 10 kilometre stretch and the purpose of the test is to establish how well the

vehicle copes on the plains as against deployment in the mountains. All goes well and the Trial Team is satisfied.

Section D: Phase 2: Blast Trial – Chandigargh.

1. **23rd – 24th February**: travel from Jammu to Chandigargh with a night stop in Jalander.
2. Upon arrival in Chandigargh we proceed directly to the TBRL facilities where we are directed to take the vehicle out to the test range located some 20 kilometres out of town.
3. At the test range we are informed by the Director of the TBRL, Dr. Sethi, that the test can not proceed since they have not received any test instructions from the ADG: WE. Once the test instruction is issued the TBRL will need some 14 days to set up the test. We mutually agree to postpone the test until the 21st March. Since there is nothing to be done about this development, Amos and myself will fly back home for a break. The vehicle is handed over into the care of the TBRL where it is locked away in a secure area and we depart for Delhi.
4. **25th February – 19th March**: break in the trial schedule to allow for preparation of the blast test.
5. **20th March**: Amos van Jaarsveld, Hannes Kögl and myself depart for Delhi via Bombay.
6. **21st March**: we arrive in Delhi where we meet up with Colonel Kumar to proceed directly to Chandigargh. Once in Chandigargh we move directly out to the test range where we prepare the vehicle for the blast test.
7. **22nd March**: blast test done by the TBRL personnel at the Chandigargh test range.
8. **Blast Test set-up**: the vehicle is in a fully functional condition, with the exception of a dummy axle, which is fitted in lieu of the normal, running rear axle. The vehicle is fully instrumented to record the blast results and the entire test is captured on high-speed film. Unfortunately, due to the classified status of the test, none of the data or film is made available to us. We are also not permitted to record the test ourselves. The only record we have is therefore our own observations.
    a. The charge comprises 10kg of RDX boosted with 300 grams of plastic explosives as an ignition charge.
    b. The charge is positioned in a hole, with the top of the charge flush with ground level, and located 1,785 mm from the rear end of the vehicle. This puts the point of detonation centrally, about midway between the transfer case and the rear axle.
    c. The vehicle is loaded with 20 sand bags inside the crew compartment to simulate combat mass.
    d. A live pig is placed inside the crew compartment directly above the point of detonation. The pig is not sedated and is not strapped in with the seatbelts, as would be the case for soldiers travelling inside the vehicle.
    e. The charge is detonated remotely at 13h09, whilst observed from inside the bunkered control room.
9. **Blast test results**: are recorded as follows:

a. The vehicle front end is lifted off the ground by 300mm and the rear end by 500mm. There is no forward or sideways movement of the vehicle.
b. The vehicle comes to rest after the blast, directly over the blast crater, which measures 2 metres in diameter and 1 metre in depth.
c. The rear door is open after the detonation, but there is no pressure or heat intrusion into the crew compartment.
d. The pig is unscathed and is only taken away hours later by the test personnel, to be slaughtered and eaten.
e. The rear axle is damaged but repairable, as expected and designed. The bolts on the front set of suspension hanger brackets on the rear axle, shear off as designed. The rear bolts stay intact and the spring pack merely swivels to the rear.
f. All the suspension components are virtually undamaged and all are re-fitted and used during field repair of the vehicle afterwards.
g. Two of the windows crack due to mechanical shock when the vehicle drops back onto the ground.
h. The hull is unmarked by the explosion and the hull integrity is perfect.
i. Only one tyre is damaged and deflated as a result of the blast.
j. There is no damage to the automotive system and the engine and driveline components are all fully functional. The transfer case housing is undamaged.
k. The only components that are detached from the vehicle during the blast are the 2 spacer blocks from the rear spring packs and these are picked up inside the blast crater under the vehicle.

10. **Blast test conclusion:** The blast test is a complete success. It is proven that the crew will survive a double anti-tank mine detonation positioned centrally under the crew compartment and the collateral vehicle damage is proven to be limited and field repairable. The modular design concept is also proven to be fully mine resistant, since the rear module does not move during the detonation. The 4 turnbuckles prove more than adequate in securing the crew compartment in place. The new stepped v-shaped hull design is proven to be highly effective with superior protective qualities. The result is therefore predictable and in accordance with the design expectations.
11. **23rd March**: the vehicle is field repaired by Hannes and Amos within 5 hours. All repair work is done in-situ over the blast crater. A local roadside blacksmith repairs the damaged u-bolts and spring packs.
12. **24th March**: the Medak vehicle is blast tested. The result is however somewhat different. Their pig is bleeding heavily from the nose, indicating severe brain haemorrhage. All the windows on the left side of the vehicle are blown completely out of their mountings and the floor plates are severely bent, indicating complete blast pressure intrusion into the cabin. This pressure also causes the injuries to the pig. The hull cracks open on the bottom wedge and the suspension hanger brackets are picked up some 80 metres away. The transfer case housing is blown away completely. The rear axle is blown out completely from under the vehicle and is destroyed.
13. The Medak vehicle fails the blast test in all respects. An ITBP Colonel comments the following whilst inspecting the blast results: “Anyone inside this vehicle would have been killed”. He is absolutely right. It is clear that the Medak factory has no experience in designing mine resistant vehicles.

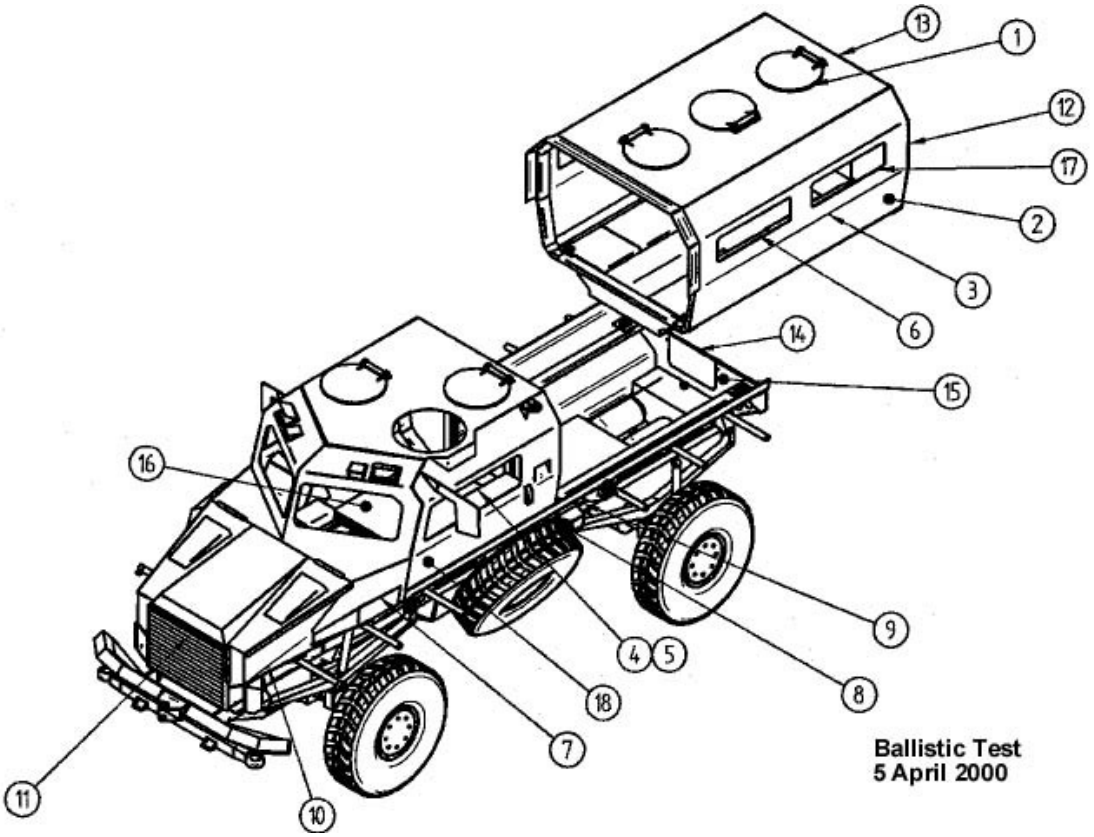
14. **25th March**: rest day while we wait for the Medak vehicle to be repaired.
15. **26th March**: travel by road to Delhi for deployment to MHOW where Phase 3 of the trials will be executed. The vehicle runs perfectly and without incident after the blast test.

Section E: Phase 3: Blast and Ballistic Tests – MHOW

1. **27th March – 31st March**: travel by road from Delhi to MHOW, located near Indore. The route is via the towns of Agra and Shivpuri. The total distance from Chandigargh to MHOW is around 1,108 kilometres. No problems or mechanical failures are experienced. The Medak vehicle cannot cover this march on its own and is transported on the back of a truck from Chandigargh to MHOW.
2. **1st April**: report to the Infantry School at MHOW. The tests will be carried out by a dedicated Trial Section under the command of Colonel Aithani, assisted by his 2IC, Lt. Col. Ganesh. Instructions are given for the next few days and we are dismissed.
3. **3rd April**: meeting at Infantry School with briefing by Col. Ganesh. Also I attendance is Major Kalyan Singh of the Assam Rifles Regiment. The schedule for the test is discussed and conveyed.
4. **4th April**: Hannes delivers a full product briefing to the Trial Team. The briefing is also attended by representatives from the CRPF, ITBP, BSF as well as Colonel Varinder Singh from 4 JAKLI, who travelled all the way from Jammu to attend the tests. The briefing is well received. The following points are raised as requirements or as part of a wish list during question time:
    a. Interior cooling fan.
    b. Back-to-back seat layout.
    c. Double rear pneumatic doors.
    d. Communications and an intercom system.
    e. Self-recovering system.
    f. Cupola assembly for weapon mounts.
    g. Run-flat inserts for the tyres.
    h. Fire extinguishers for the cabin.
    i. Modification to the firing ports.
    j. No modular layout but fixed configuration only.
    k. Bonnet pneumatic jack for power assisted opening.

5th April - Ballistic Penetration Test:

5. **Test preparation**: the following actions are taken in preparation for the test:
    a. Tests are done on the left hand side of the vehicle only.
    b. Front and rear mudguards are removed.
    c. Front and rear shock absorbers are removed.
    d. The spare wheel and winch assembly is removed.
    e. The mirror bracket assembly is removed.
    f. The Michelin tyres are exchanged for the Dunlop mock-up tyres.
    g. The rear light box assembly is removed.



6. **Ballistic tests executed**: all tests are done at a point blank standoff distance of 10 metres with 7,62x39mm AK47, 5,56X45mm INSAS, 7,62X51mm SLR and 7,62X51mm LMG rifles and machine guns using ball rounds.
7. The following tests are done – see the corresponding number on the drawing above for the exact location:
    1. 7,62 SLR single shot: roof hatch - shot penetrates fully.
    2. LMG burst of 3 rounds – no penetration.
    3. LMG single shot: firing port cover – no penetration.
    4. AK 47 single shot: no penetration.
    5. LMG burst of 3 rounds: side window – cavity forms but no penetration occurs and no bullets are found inside the cabin.
    6. AK 47 burst of 3 rounds: side window surface shatters only.
    7. LMG single shot: no penetration.
    8. LMG single shot: no penetration.
    9. LMG single shot: no penetration.
    10. INSAS single shot: no penetration.
    11. 7,62 SLR single shot: bullet fragments on impact and 9 shrapnel pinholes are observed in the radiator with another 5 pinholes in the intercooler assembly.
    12. INSAS single shot: rear window – no penetration.
    13. INSAS single shot: RH rear door – no penetration.
    14. INSAS single shot: NDF number plate – no penetration.
    15. 7,62 SLR single shot: RH below number plate – no penetration.
    16. 7,62 SLR single shot: LH windscreen – no penetration.
    17. AK 47 burst: rear window blast reflective mounting buckets – penetration into the mild steel buckets but not into the cabin.
    18. LMG burst of 3 rounds: no penetration.

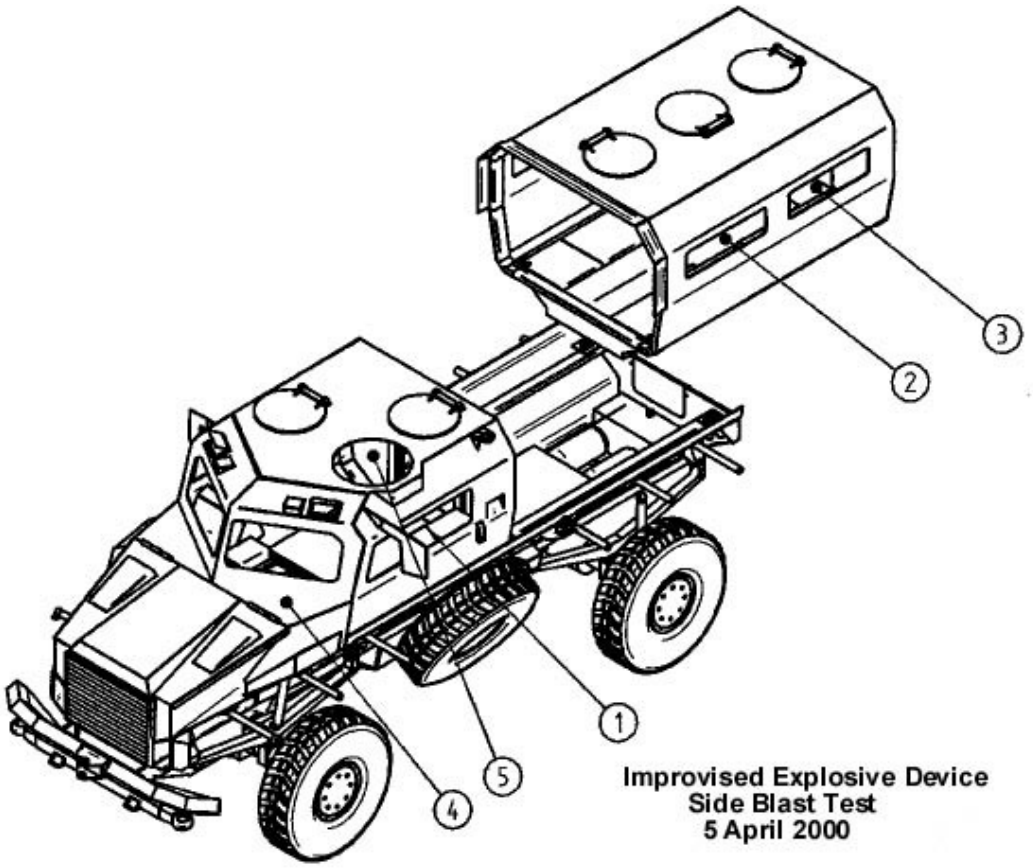
INSAS single shot on left side window.

AK 47 burst on hull side.

LMG burst on hull side.

5th April – Improvised Explosive Device (IED) Side Blast Test:

9. After the ballistic penetration test it only takes 35 minutes to have the vehicle fully mobile. Corrective action is focused on plugging the pinhole penetrations in the radiator. This is done using normal Pratley Putty and without replacing the radiator. The vehicle continues to complete the entire trial programme, including automotive performance trials with this repaired radiator.
10. **Test preparation**: the following steps are taken in preparation for the IED side blast test:
    a. Drive from the ballistic test site to the blast test site.
    b. Remove the front and rear prop shafts.
    c. Remove the diesel tank filler cap and replace it with a locally procured galvanised cap.
    d. Remove and replace the co-driver side window.



11. **IED side blast test set-up**: the test is set up by the Trial Team as follows:
    a. The charge comprises 9,5 kg of H.E.F plastic explosives, laced with 500 grams of shrapnel (bolts, nuts, nails, etc.)
    b. The charge is buried in the side of a rocky gully at a height of approximately 1,5 metres off ground level. The backstop for the detonation is thus solid with the rocks becoming secondary shrapnel.
    c. The vehicle is parked 3 metres from the charge with the LH side facing the charge. The GSQR specifies a 5 metre standoff distance.

12. **IED side blast results**: the following test results are recorded in respect of the IED side blast test. Please refer to the corresponding number on the drawing above for the exact location of the damage description.
    1. Co driver window surface shatters and cracks, but with no penetration or blast intrusion.
    2. Crew compartment side window – as above.
    3. Crew compartment side window – as above.
    4. Air intake duct bends.
    5. Two cupola windows are surface shattered.
    6. Complete sandblasting occurs on the left vehicle flank.
13. The vehicle is fully repaired within 30 minutes and is started and driven out of the kill zone. No automotive damage occurs, not even the tyres are damaged or deflated. This test is witnessed by the ADG: WE Trial Director, Colonel AP Singh, who came down from Delhi for the event. Colonel Singh drives with Amos out of the kill zone for an impromptu mobility trial on the test range. The test is a resounding success.

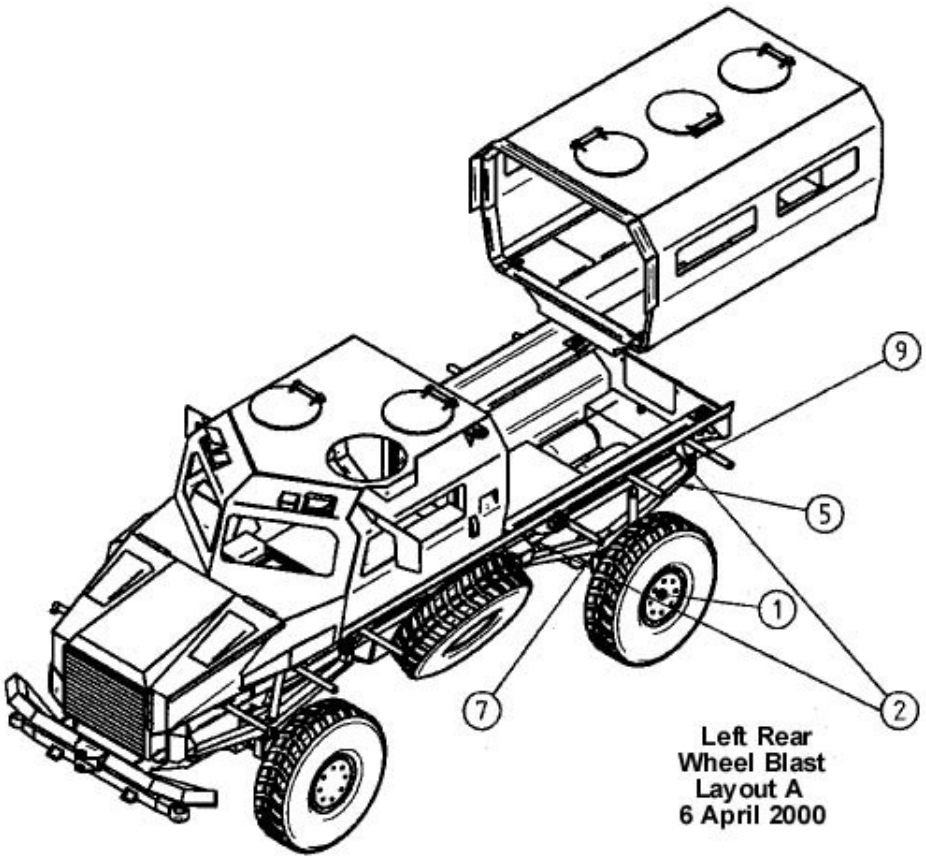
Damage after the MKII IED side blast. No pressure intrusion occurred.

The Medak vehicle after its side blast test. The side windows are completely blown into the cabin. With the resulting pressure intrusion it is doubtful if anyone would have survived this blast.

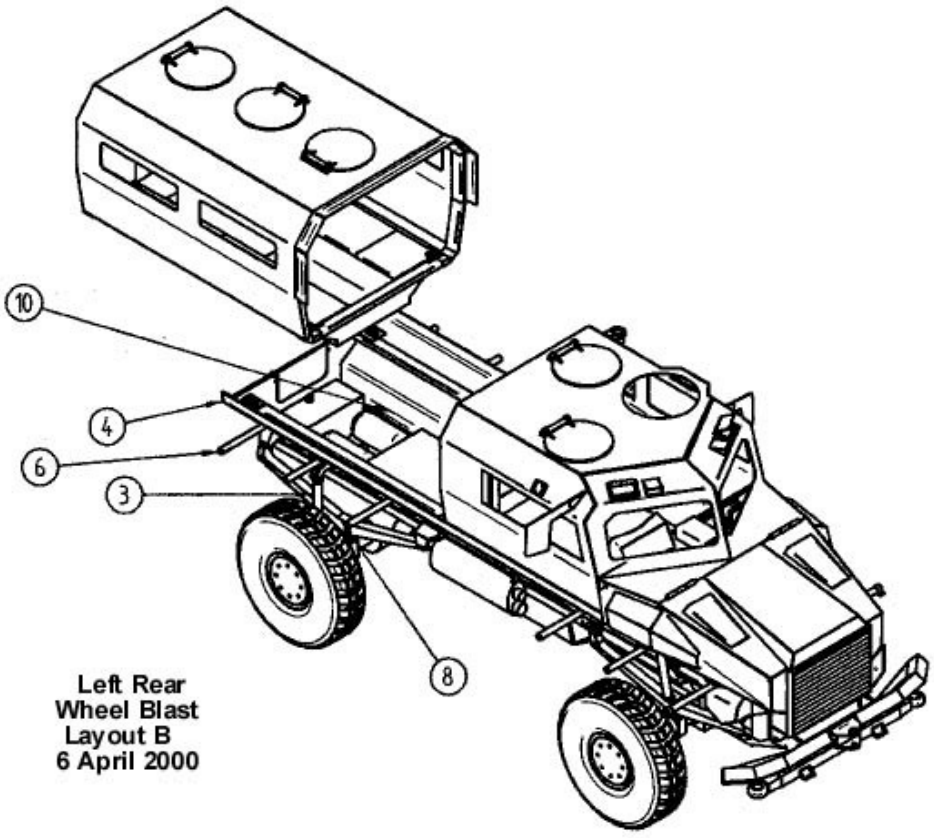
The side blast surface-cracked the windows, but no penetration occurred.

6th April – Left Rear Wheel Blast Test:

14. **Test preparation**: the following actions are taken in preparation for the blast test on the left rear wheel.
    a. The vehicle is driven from the side blast test site to the designated test site for the wheel detonation.
    b. The rear prop shaft is removed.
    c. The left rear brake booster is removed.
15. It is important to note that we decide to do the wheel blast test with the live running axle of the vehicle. We do not fit a dummy axle as a substitute. Under pressure from the Trial Team to continue with the blast tests, we are forced to continue with the tests despite the delay in the shipment of our additional spares. As can be seen from the schedule we do 2 blast tests and a series of ballistic tests within 2 days. This is extremely demanding given the difficult circumstances under which we have to repair the vehicle and prepare it for the next tests. Repairs are done in the veldt with no shade available and with ambient temperatures of around 45 degrees centigrade. We only use an electrical drill and an angle grinder, which we power from a portable generator set. No other power tools or facilities are available.
16. **Left rear wheel blast test set-up**: the Trial Team sets up the test as follows.
    a. The charge comprises 14 kg of H.E.F plastic explosives.
    b. The charge is buried into rocky soil, flush with ground level.
    c. The charge is positioned directly under the centre point of the left rear wheel.
    d. Detonation is done remotely.
17. **Left rear wheel blast results**: the results are recorded as follows. Please refer to the drawings below for the exact location of the damage description. Of note is the fact that the vehicle is not thrown over. It is lifted up and the rear end is rotated by about 30 degrees to the right. The rear axle is ripped out and positioned next to the rear end. The blast crater size is 2,700mm in diameter and 700mm deep. The hull integrity stays intact and there is no pressure intrusion into the cabin. The test is successful.



Left Rear
Wheel Blast
Layout A
6 April 2000



Left Rear
Wheel Blast
Layout B
6 April 2000

18. **Left rear wheel blast damage**: is recorded as follows:
    1. Left rear wheel hub and stub axle assembly blows off. The side shaft is intact. The rim and tyre is destroyed. The LH axle tube assembly is severely damaged.
    2. All the spring pack hanger mountings on both rear sides shear off, as designed.
    3. RH rear shock absorber is destroyed and is replaced.
    4. RH rear light bracket bends, but is repairable.
    5. LH spring main blade mounting eye is mildly damaged and is repaired by a roadside blacksmith.
    6. RH mudguard bottom mounting caps slide to the outside.
    7. LH lower shock absorber mounting bracket is damaged, but repairable.
    8. U-bolts that fasten the axle bend, but are fully repairable.
    9. LH rear swivel hanger plates bends.
    10. 4 – way protection valve housing is damaged and is replaced.

The vehicle is set up and ready for the rear wheel blast test.

The axle is ripped out to the right rear by the blast force. The vehicle remains field repairable and there is no blast intrusion into the cabin.

The vehicle is not thrown over by the wheel blast, nor is it moved forward. The rear end is rotated by 30 degrees to the right. Note the blast crater.

Blast results of an equivalent triple anti tank mine hit.

19TH April - Front Axle Centre Blast Test:

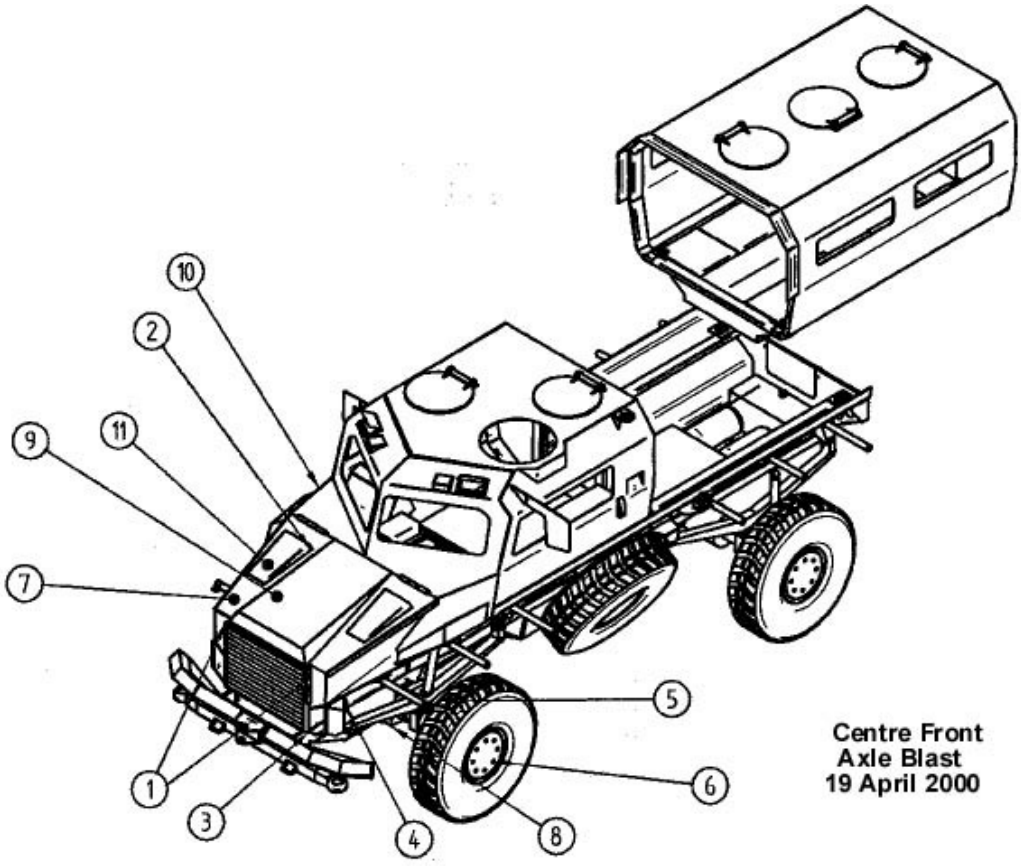
19. After the rear wheel blast test we are unable to continue with the last blast test due to the delay in the inbound shipment of our additional spare parts. We agree with the Trial Team to hold the last test over until arrival of the spares. The vehicle is now immobile as a result of the rear axle damage. We have no more spare axles to continue with the trials. The vehicle is recovered into the Infantry School compound with a recovery vehicle where it is kept, pending repair.
20. The delay in arrival of the spares is extended and we are pressurised by the Trial Team to complete the last blast test by setting the vehicle up on stands instead of a rear axle.

21. We improvise however, and we repair the damaged rear axle by welding a flange onto the axle as a dummy hub. The vehicle is still immobile but it cam be set up for the last test without the use of any stands.

The static axle repair.

22. **Test preparation**: the following preparations are carried out for the front axle blast.
    a. Removal of the front prop shaft.
    b. Removal of the LH & RH brake boosters.
    c. Removal of the steering drag link.
    d. Removal of the front LH & RH brake pipes.
    e. Removal of the front mudguards.
    f. Removal of the drawbar.
    g. Removal of the front tow pin.
    h. Removal of the power steering reservoir.
    i. Removal of the exhaust silencer box.
    j. Removal of the spare wheel and winch assembly.
    k. Removal of the headlamps.
    l. Removal of the indicator lamps.
    m. Removal of both windscreen wiper blades.
    n. Removal of both batteries.
    o. Removal of the front shock absorbers and replacement of same with substitutes for test purposes.
    p. Fabrication of protection bracket for exhaust opening in hull.
    q. Securing the 2 bonnet catches with bolts and nuts.
    r. Weld all the roof hatch mounting brackets to ensure proper integrity.
    s. Replace sump cover mounting bolts with new ones.
    t. Removal of the mirrors and their brackets.
    u. Check and secure all engine mounting bolts & sledge mounting bolts.
    v. Weld plate on the inside of the fuse box cover.
    w. Replace left front tyre with a Samil demo tyre.
    x. Place sand bags around the tyres for protection.

23. **Front axle centre blast test set-up**: the Trial Team sets up the test as follows.
    a. The charge comprises 10kg of H.E.F plastic explosives.
    b. The charge is positioned centrally under the vehicle directly under the front axle centre portion.
    c. The charge is buried flush with ground level into rocky soil.
    d. Detonation is done remotely.
24. **Front axle centre blast test results**: the vehicle is not thrown away from the point of detonation. It comes to rest directly over the blast crater, which measures 2,400mm in diameter and is 700mm deep. Both front wheels are blown off with the wheel hubs bolted onto the rims, as designed. There is some damage to the centre portion of the axle but it remains entirely repairable. There is no blast pressure intrusion into the cabin. The automotive system is undamaged and the engine starts with the vehicle lying on the crater rim. The vehicle is field repaired and the test is a complete success.



25. **Front axle centre blast damage**: is recorded as the following. Please refer to the drawing above for an exact location of the damage description.
    1. Both bonnet catches are bent.
    2. There is a welding crack on top of the bonnet.
    3. One cap screw is sheared off.
    4. The LH front spring hanger mounting and one bolt shear off.
    5. The tie-rod is bent.
    6. Both front wheels are blown off with the hubs bolted on inside. The tyres, rims and hubs are undamaged and are fitted back.
    7. Two bolts shear off from the power steering bracket.

8. The axle centre portion is damaged but repairable.
9. One bolt is missing from the engine mounting rail.
10. The flexible portion of the exhaust pipe shear off.
11. The flange of the turbo housing cracks. This is welded up and re-fitted without any negative effect.

Wer'wolf MKII after the front axle centre blast.

The Medak vehicle after the front axle centre blast.

Wer'wolf MKKII lying in the blast crater after the front axle blast test.

The Medak vehicle lying in the blast crater after the same test.

Detail of damage to right front wheel station after front axle centre blast test. The wheel with hub is blown off, but the axle is repairable.

Left front view of damage after the front axle centre blast test. Note virtually no damage to the springs, hanger brackets and shock absorbers.

26. This concludes all the blast and ballistic tests the ADG: WE executes as part of the Wer'wolf MKII trials. In summary, the vehicle is blast tested with the equivalent of 9 anti-tank mines detonated next to and under the vehicle in four separate detonations. These tests are far more extensive and severe than the tests done during the trials of Casspir. To the best of our knowledge Casspir only did 2 blast tests, (the TBRL test at Chandigargh and a side blast test at MHOW).
27. Wer'wolf MKII not only survives all these tests but the vehicle remains field repairable, where after it completes gruelling automotive trials at VRDE. Remarkably the automotive system suffers no damage at all, and the vehicle completes its VRDE trials with ease. Casspir could not manage this since the manufacturer did not do the VRDE trials with the same Casspir that was blast tested. He shipped a separate, new vehicle in for this purpose.

Wer'wolf MKII, field repaired after 9 anti-tank mines were detonated under the vehicle during trials. The vehicle is now ready to proceed for automotive performance evaluation.

Section F: Phase 4: Automotive Trials – VRDE

1. **23 April**: movement by road from MHOW to VRDE, located at Ahmed Nagar. The distance covered is approximately 550km. No problems are experienced en route.
2. **24 April – 22nd May**: the vehicle is comprehensively measured, driven and tested by a team of scientists and other personnel to establish its automotive performance parameters and endurance. VRDE is equipped with a good test track comprising scientifically designed tracks to measure automotive performance. The personnel are well trained and they have good, calibrated equipment with which to do the job.

3. These trials take a lot longer to complete than originally estimated and committed to by the Test Director. This is basically due to the work pace that is maintained by the personnel.
4. The following tests are done and the results recorded as indicated below.

Serial	Test characteristic	Recorded result
1.	Unladen weight	9800 kg
2.	Overall dimensions:	
	Length	5860 mm
	Width	2335 mm
	Height	2650 mm – without cupola
		2830 mm with cupola
3.	Wheelbase	3560 mm
4.	Pass by noise – outside @ 50 km/h, 6th gear	74,0 dB (max permissible = 84 dB)
	Pass by noise – inside @ 50 km/h, 6th gear	90,6 dB (max permissible = 90 dB)
5.	Overturning angle	37 degrees
6.	Combat mass	12000 kg
7.	Front axle load	5500 kg
8.	Rear axle load	6500 kg
9.	Ground clearance	355 mm
10.	Approach angle – front	33 degrees
	Approach angle – rear	42 degrees
11.	Turning circle	15 m
12.	Speedo / ODO calibration	
	Trip counter	V.006
	Speedo reading	V+. 6
13.	Maximum speed	125 km/h @ 43 degrees C ambient
14.	Acceleration: 0 – 90 km/h	47,63 sec over 755,7 metres
15.	Brake test @ 60 km/h in neutral with pedal force of 70 kg.	
	All four wheels braking	31m (max permissible = 36,67m)
	Front wheels only braking	46m (max permissible = 64m)
	Rear wheels only braking	66m (max permissible = 64m)
16.	Handling test – serpentine track	100% - max controllable speed is 50 – 65 km/h
17.	Step climbing	400mm (requirement = 350mm)
18.	Articulation	
	Left front wheel	400mm (requirement = 200mm)
	Right rear wheel	400mm (requirement = 200mm)
19.	Steering pad	60m dia @ 55 km/h LH – no side drag
		50m dia @ 50 km/h LH – no side drag
		45m dia @ 40 km/h LH – no side drag
		60m dia @ 50 km/h RH – no side drag
		50m dia @ 45 km/h RH – no side drag
		45m dia @ 40 km/h RH – no side drag

20.	Steering torque	
	Power assisted	3kg (max permissible = 7kg)
	Non – power assisted	Beyond 10kg (max permissible = 10kg)
21.	Mud crossing	
	10m	Depth of 355mm
	50m	Depth of 300mm
22.	Fording – 100m	Depth of 1200mm
23.	Gradeability	70%
24.	Cross – country fuel consumption	5,4 km/l @ 50 – 70 km/h for 50 km
25.	Endurance testing	
	Paved track	75 laps, with 1 lap = 400km max controllable speed = 55 – 60 km/h
	Cross – country	250 km with max controllable speed of 60 – 70 km/h
	Corrugated track 50mm	4 passes of 500m @ 15 km/h
	Corrugated track 100mm	4 passes of 500m @ 15 km/h
	Pothole track	4 passes of 500m @ 60 km/h
26.	Fuel consumption	
	90 km/h on paved road	4,52 km/litre
	50 km/h at convoy speed	8,50 km/litre

5. The vehicle performs exceptionally well during these tests. No failures are experienced of any kind. It is remarkable that the vehicle should perform so well after receiving such severe punishment during the blast trials. To put the Wer'wolf MKII performance into proper perspective one should note that Casspir (the 2nd new one) could only complete 26 laps on the paved endurance track before the entire rear axle fell out from under the vehicle ending up in the bush with the vehicle lying on its belly.

Section G: Phase 5: Maintenance Evaluation – MAG 12

1. **23rd May – 6th June**: is spent evaluating the logistic support elements of the vehicle and assessing its maintainability.
2. The MAG 12 Group accomplished this, firstly by studying the following technical literature, which we submitted;
    a. Executive summary and product overview.
    b. Complete technical specification.
    c. Summary of removal sequence of main vehicle assemblies.
    d. Lubricant list.
    e. MET accessibility schedule.
    f. Adequacy of tools and CEF items.
    g. Maintenance schedule.
    h. Recommended spares list.
    i. Operators and maintenance manual.
    j. 4th Line workshop repair manual.
    k. Lubrication and servicing instructions.
    l. Technical inspection document.

m. Partial illustrated parts catalogue as an example.
n. Recommended master record spares list, duly priced.
o. Recommended special maintenance tool list, duly priced.
p. Recommended illustrated spare parts list, duly priced.
q. Ballistic protection specification.
r. Mine protection specification.
s. Maintenance schedule with lubricant list, including full lubricant specifications.
t. Technical procedure for use when power steering hydraulic system fails.
u. Euro II compliant certificate and specification.

3. The second phase of the maintenance evaluation entails Amos van Jaarsveld working with the MAG 12 team on a daily basis to do the following.
    a. Working through all the technical literature and explaining all questions and queries.
    b. Physically executing all the maintenance tasks on the actual vehicle. This work is done by the MAG 12 personnel in their own workshops. This task is actually done twice over.
    c. Physically executing the removal and replacement of all the main vehicle aggregates including engine, transmission, transfer gearbox, front and rear axles as well as all the suspension components.
4. On the 6th June Colonel Khuttan of MAG 12 is satisfied that all maintenance aspects are adequately covered and evaluated. He then releases the vehicle from trials and gives permission for it to be moved back to Delhi for re-export back to Namibia, thereby also concluding the trial evaluation of the Wer'wolf MKII MPV by the Indian Army.
5. The Indian Army will compile and circulate their own trial report in due course. We will never be privy to this report. We can state, without fear of contradiction however, that Wer'wolf MKII proved itself conclusively as the best mine protected vehicle in series production today. The Indian Army is renowned for the gruelling way in which they trial evaluate the equipment of manufacturers. It is also widely accepted that only the best equipment survives the Indian Army trials.
6. Reflecting on the extensive trials, which we endured and lived through from January – June 2000, one is inclined to agree with the above contention. WMF 1998 and the Wer'wolf MKII Development Team can rightly be proud of the MKII. It was tested and measured to the extreme, and it sailed through with ease and dignity. Wer'wolf MKII proved itself as the best. This was proven on more than one occasion when members of the Indian Trial Team just shook their heads in amazement and walked off after Wer'wolf survived tests that was intended to destroy it.