Most Improved Award

Application

German Space Education Institute
Moonbuggy Team 2008

www.spacepass.de

1. Damage – analyses - causation – adjustment

We analyzed the total Moonbuggy, all detriments and did nominations for the adjustment. The best nominations were discussed by the team. After that, we did some modifications and A few re-designs on our Moonbuggy. We worked in two different directions:

-the adjustment of damage
-new constructions based on experience from last year

Most important Modifications 2008

- The progress of a “Freewheel-Differential Gear”
- Assembled the new pneumatically shock absorber
- Usage fiber glassed springs
- Four completely new gears (the best on market at the moment)

We modified 26 sub-assemblies. The Moonbuggy 2008 will be a test vehicle and is called Ganymede 1b. We are going to test some new constructions with Ganymede 1b, which can be used on Ganymede 2, which will be driven in 2009 (40 years landing on moon).

2. Discussions – Suggestions

During the total process of finding errors, analyzing, adjustment and redesigns, we had new ideas for improvement. They were discussed and we made notes on a cheat of paper or on the computer.

At first we solved the easy problems; the complicated sub-assemblies were taken on a separate table. That way, we could look on them every time, when we had an idea. These sub-assemblies would take a longer time.

To take part in the world cup 2008 successfully, we had to adhere three principals:

1. Only the best materials
2. Only the best assemblies
3. Only the most precise work

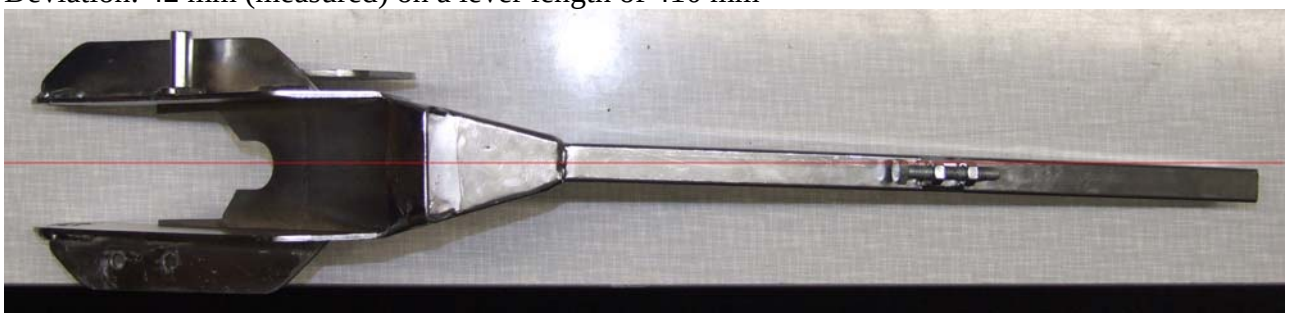
Directs to to the objective.

The most important weak points are fastly located and it can begin the researches in the internet after better units. At the simplest one it goes with standard parts out of the trade. It becomes more complicated with the self-constructions, which go beyond that.

3. The changes / improvements in detail

1. pillar for pedals

Damage: strong deflection of the box profile to the right
Deviation: 42 mm (measured) on a lever length of 410 mm



Possible Cause: tensile forces due to the leverage effect of the drive chain, additional pressure burden of leg strength
Remedial proposal: Raise the forces encountered by simulation (Materials Testing), calculating an appropriate cross-section / profile

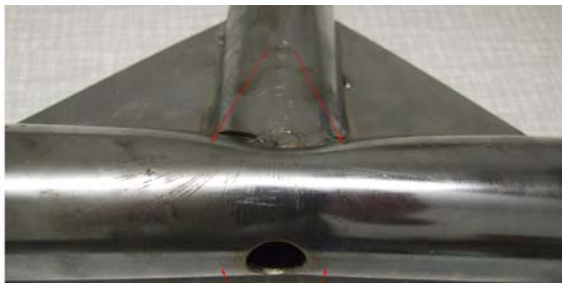
Fixes grind slots in twisted appointment
Holm-to measure precisely bent
Slot-welded (TIG)
- Strive to strengthen welded on

2. Rear axle

Damage: complex deformation:

1st Three squeezing in the transverse axis
2nd Twisting the frame approach
3rd the flaring of hole the chassis tilting mechanism
4th cancel a seat fastening bolt

Deviations: 1a. The middle of axle has been set at 12 mm
1b / C. Seat cushions have been set at 10 mm
2nd 41 mm to a length of 100 mm below (10 °)
3rd 1.8 mm in the direction of travel



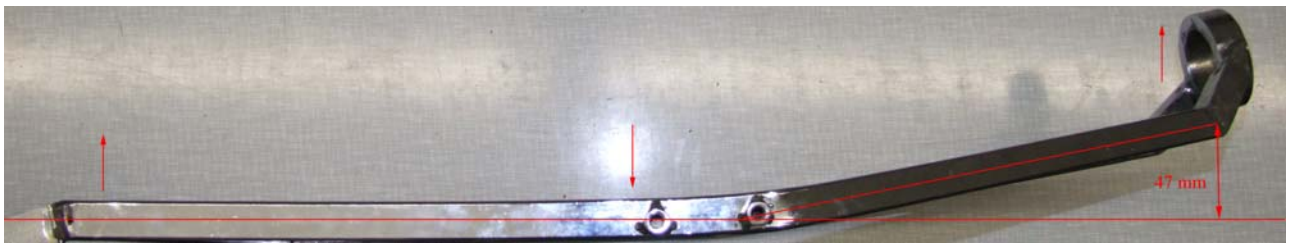
Possible causes: 1a-c. Too high dynamic loads by weight of the copilots
2nd Leverage through the leg work of the copilots or for the poorer people greater emphasis behind axis (seat)
3rd By driving dynamics (length of the vehicle between the axles)
4th Inadequate welding connection

Remedial proposal: 1-2. Collect the forces who caused these deformations, recalculation of the axis (possibly new profile or striving to strengthen)
3rd Installation of a hole amplification (more material)
4th Better control of work execution

Fix: This module has been completely re-designed and stable.
It now includes:
- spring independent suspension
- Leaf springs from S-Ply (glass fiber)
- elastically supported triangular wings

3. Rear support frame

Damage: strong deflection to the top
Deviation: 47 mm to 300 mm length



Possible causes: lack of seat suspension and rear axle, too weak component designed to vehicle dynamics, seat position copilot's footwork
Fix proposal: Structural review, possibly from plate out composite finished with honeycomb

Fix: This module was removed. There are aluminum rails on the rear frames.

4. Main Frame 2

Damage: bending piece of pipe down
Deviation: 16.5 mm to 400 mm

Possible causes: Follow appearances from the burden of the support frame (leg work of the copilots, weight and dynamic driving charges in throats and holes)
Remedial proposal: collect the forces who caused these deformations, recalculation of the component (possibly new profile or striving to strengthen)

Fixes From this assembly has been removed and the rear pipe approach on the torsion built joints.

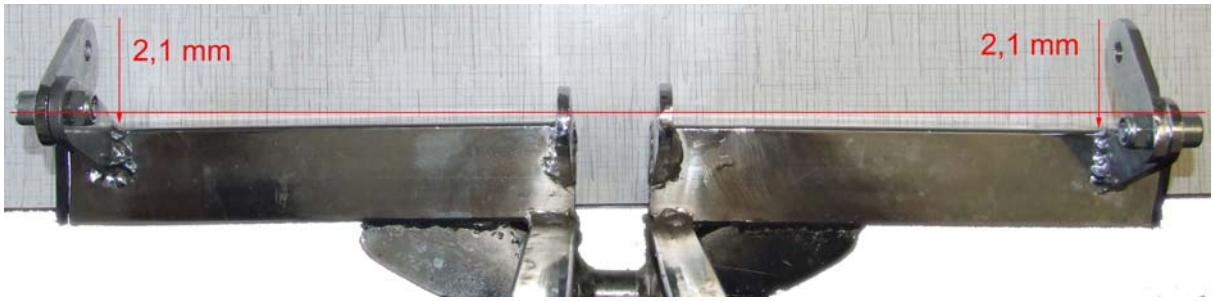
Possible Cause: weight of the driver, excessive leverage, suspension in the middle not used
Fix proposal: here: suspension in the middle use (distance ridges produce)
Later: construct new headquarters suspension (this was a solution for time)

Fixes the seat was also in the middle Screwed

5. Main frame 1 / fixing seat

Damage: squashed
Deviation per page to 2.1 mm (depending on a lever length of 220 mm)

Fixes from this assembly have been removed and the rear pipe approach on the torsion built joints.

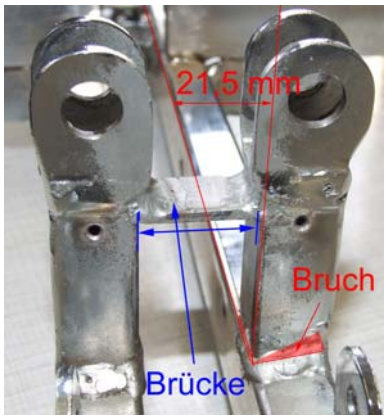


Possible Cause: weight of the driver, excessive leverage, suspension in the middle not used
Fix proposal: here: suspension in the middle use (distance ridges produce)
Later: construct new headquarters suspension (this was a solution for time)

Fixes the seat was also in the middle Screwed

6. Main frame 1 / shock absorber bracket

Damage: suspension broke while driving
Deviation: no longer a connection, suspension leaned on the neighbor (21.5 mm)

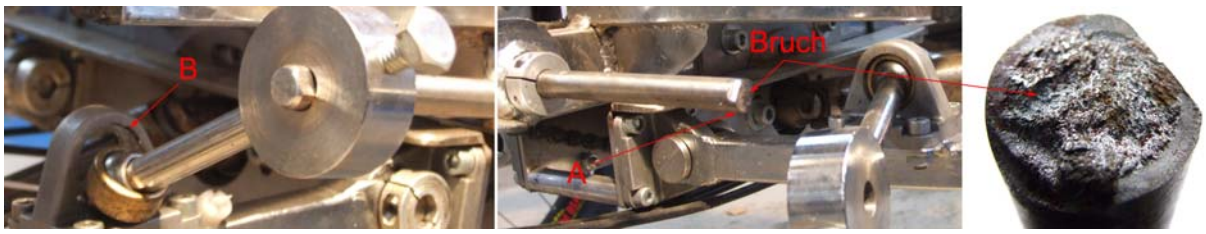


Possible Cause: lateral shock absorbers burden of progressive leverage
Remedial proposal: Polywrapping a bridge, TIG process (already incurred, blue)

Fix: This assembly was eliminated, and now serves only as a holder of a liaison element of the new spring legs.

7. Cross stabilizer

Damage: A broken right Dorn, torsion fractures
B: joint head left from the bracket glide
Deviations: A: Part destroyed
B: Part destroyed

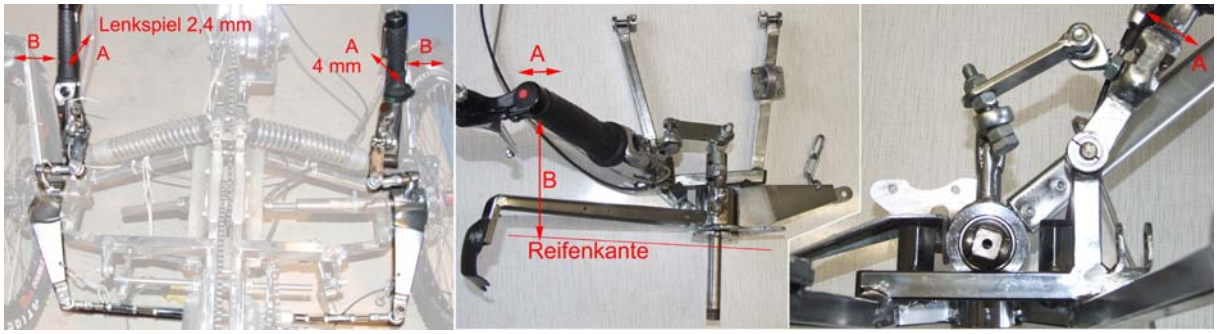


Possible Cause: A little too much elasticity and torsion forces (too much carbon)
B: agile thorn jammed
Proposed remedy: A: spring steel or other elastic materials (laboratory!)
B: dust caps or other construction (not unparalleled!)

Correct: It was spring steel. The mandrels were longer
Replaced.

8. Steering lever assembly

Damage: no damage to assembly, however:
A: Lack of less instability of the steering transmission, steering game
B: security (driver injured slightly on the wheel)
C: Total construction plump and immature (as adjusted)
Deviations: A: Right: 2.4 mm, links: 4 mm driving game
B: minimum distance between the front wheel steering lever and 7 cm

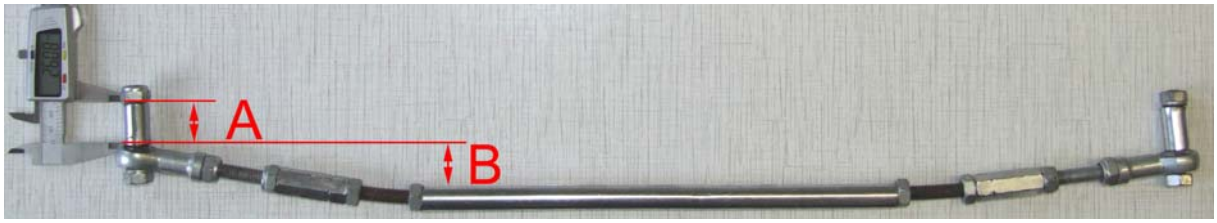


Possible Cause: A lack of precision, too much leverage and joints in flux
B: an almost constructed
C: lack of time during the construction (16 h of the idea to
For the completion of this game without leverage drawings)

Fix proposal: re-do the AC construction on the paper
Fixes have been given new joint heads and stronger materials

9. Track rod

Damage: bent
Deviations: A piece distance of 26 mm length had after first race
B: bilateral crank by 27 mm to leverage length of 180 mm



Possible Cause: Deflection of the front axle, while immersing was part of the axis
in the way
Fix proposal: 1: driving deeper build leg (saving the distance)
2: crank, track rod build stable, perhaps from composite
Construct
3: Total construction, or otherwise completely rethink

Fixes By using a new chassis, could also be deep immersion of the vehicle frame prevented.

The track rod was treated and again with new joint heads. It is now just built and is not in conflict with other components. A component change was not necessary.

10. Suspension assembly and storage front

Damage: no visible external damage, but too heavy

Possible reason: to find the complicated design, oversized
Fix proposal: less material, lighter materials / other construction

Solution: No special modifications.

Damage: strong rust appearances inside the warehouse keeper and the parts

Possible Cause: not-sealed borehole, no fat, condensation and Splash residues could not dry

Remedial proposal: seal holes; spaces fill with fat

Rust also on the ball bearings on the inner side (left), Outside is not (right)

Damage: Ball bearings are hard to dismantle

Possible Cause: too small a hole between the ball bearings
Proposed remedy: wider hole

Fix: No changes, new ball bearings used

Damage Pictures: A strong rust appearances between the camps
B: the corrosion of that axle to cross joints
C: scratch at the camp headquarters
D: Corrosion image at the camp headquarters

loupe crosses joint connection (the corrosion of that axle)

Possible Cause: A: Not sealed hole
B: Not yet sophisticated power transmission
C: ball bearings are too tight, turned on the shaft
D: water could corrode ball bearing seat

Proposed remedy: A + D: seal holes, bearings with grease
B: other construction (e.g. hexagonal)
C: the installation of the ball bearing to ease the eighth

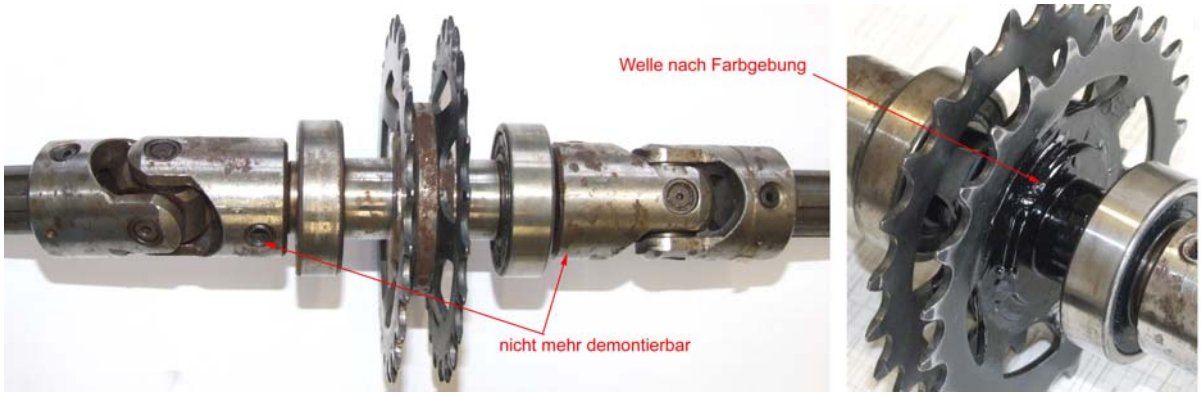
Fixes holes filled with grease, thread instead of using hexagonal

Damage Image: Cross joints broken
Possible Cause: missing differential gear overload
Remedial suggestion: use differential gear

Fixes assembly completely new designs
Cross-smaller joints used
Wave from several parts
Thread as a port (right / left)

11. Drive Shaft

Damage: A: bad form closure, it is impossible to dismantle
B: wave corroded
Deviation: A: “H-fit” (german technical standard DIN) eaten (range hundredths of a millimeter)

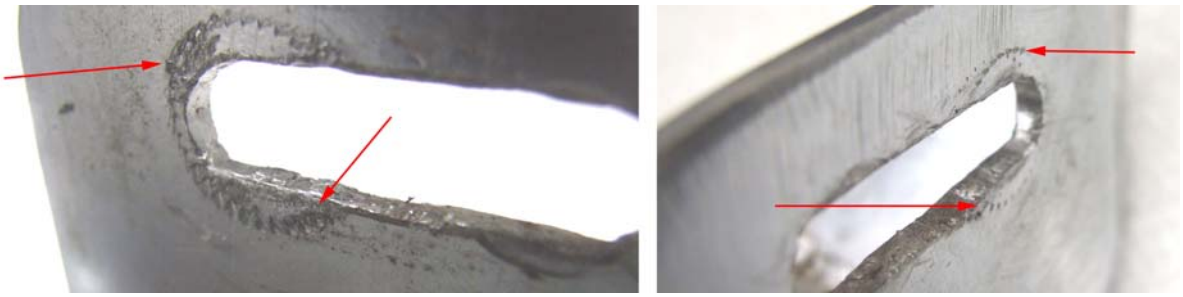


Possible Cause: A: applied final form not suitable
B: wave after welding of the pinion with corrosion protection treatment
proposed remedy: A: Use square
B: painting, coloring

Fixes: A: threaded processed (right / left)
B: Painting

12. Gear brackets

Damage pattern: Bruising of long hole for gear axle holder, surface damaged,
Deviation: up to 0,5 mm

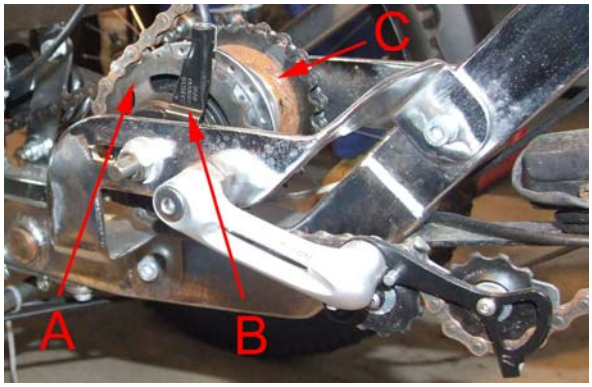


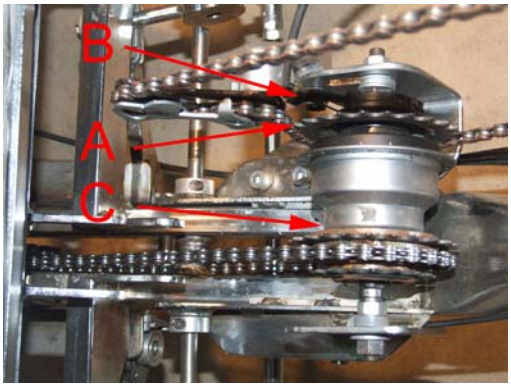
Possible cause: Base of the gear slipped into the brackets, excessive force despite form closure and high torque of fine threaded nuts
Repair proposal: Construct spanner to lock in either direction (similar to chain)

Repair: construct new brackets for Rohloff gear

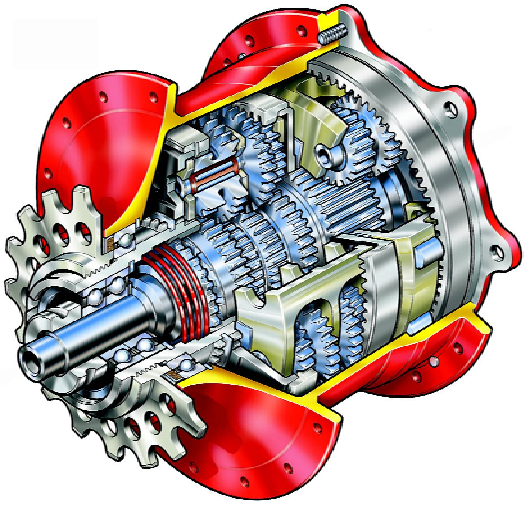
13. Hub gear

Damage pattern:	A: Drive pinion broke several times during test drives B: Total loss during the 2nd Race (front gear) C: rusty spacer ring
Deviation:	A-B lead to complete loss of the assemblies

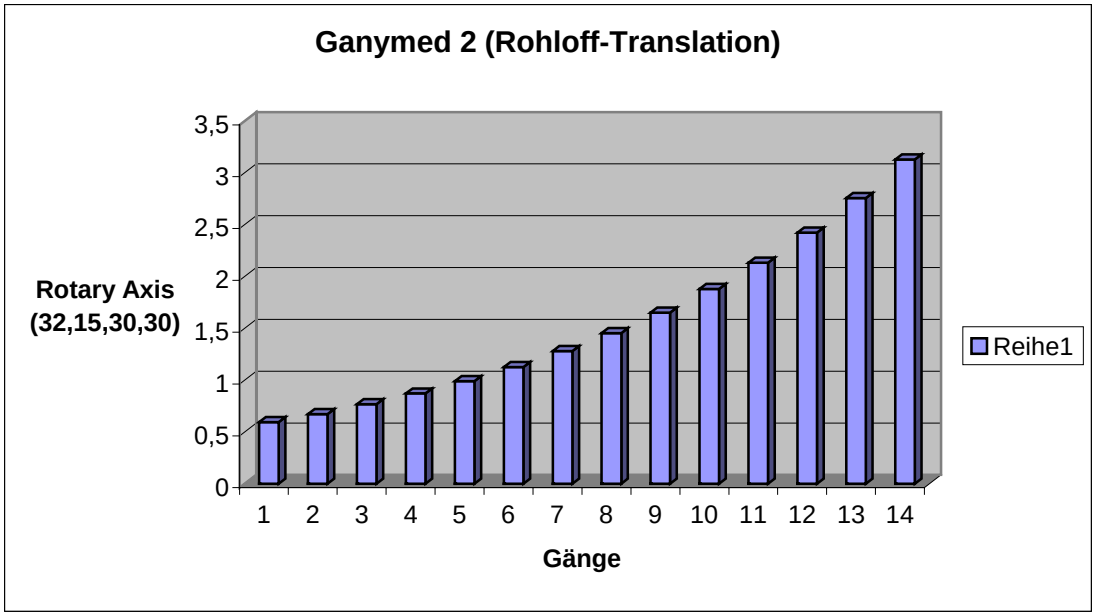




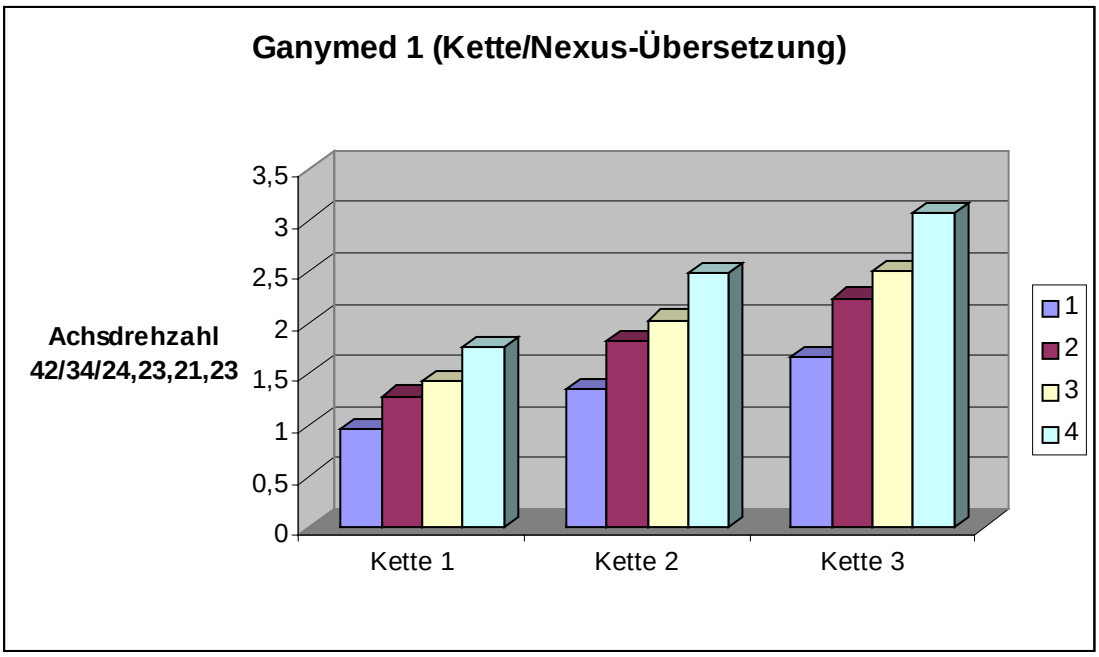
Possible cause:	A: Form closure with spring too small B: consequential damage to gear after failure of the transmission chain in the front C: missing corrosion protection
Repair proposal:	A: fixated with welding points – in fact a different gear is required B: save chain gear– needs another hub gear C: Paint, Color coat



New Gear box: 14-gear Speed hub from Rohloff



Gearbox table new

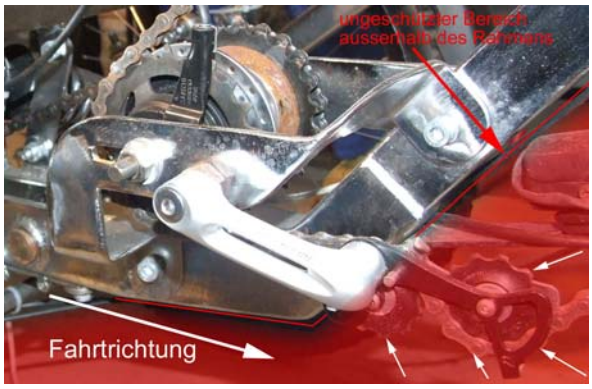


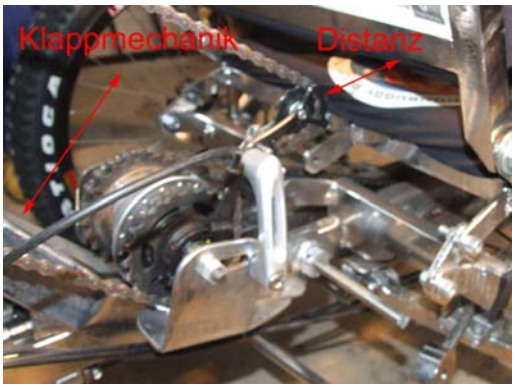
Gearbox table old

It is visible that the choice of the gear is now clearly arranged. This saves time.

14. Chain gear

Damage pattern: A: in front: gear completely destroyed
B: at the back: chain pops out of the pinion
Deviation: A-B lead to complete loss of the assemblies

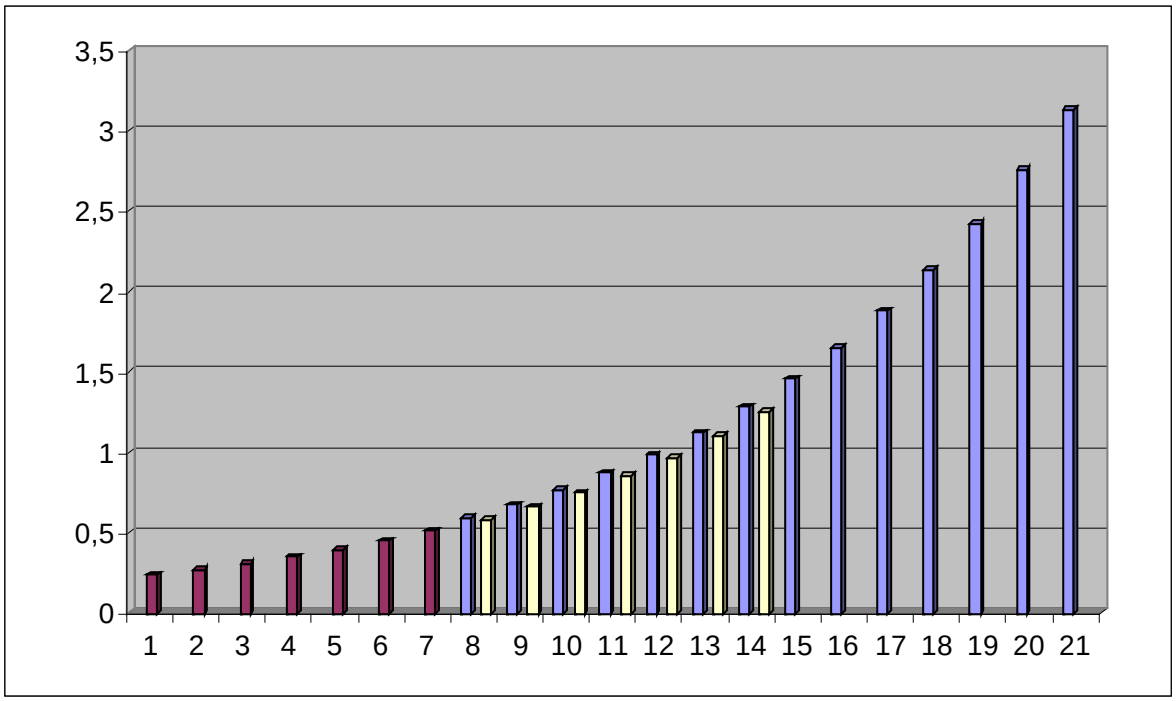




Possible cause: A: Chain lies in the unprotected area outside (left)
B: Chain stretcher collides with the seat (right) when collapsed due to very small distance
Repair proposal: A: save chain gear– needs another hub gear
B: save chain gear– needs another hub gear

Repair: Assembly removed and replaced with Schlumpf-gearbox

Schlumpf Innovations GmbH (Swizterland) offers very interesting planetary gearboxes. This is part of the bottom brackets und can be switched in 2 gears. While a gear always gives a 1:1 ratio, the intermediary planetary gear provides following outputs: 1: 2.5, 1: 1.65, 1: 0.4.



Speed behavior of Ganymed 1B with double Schlumpf- + 14-times Rohloff-Switch,
(Rohloff-gears in blue, in red are low-speed-gear reductions with help of Schlumpf-planetary gear brackets, overlapping gears in yellow, Total: 21 real gears)
Engine speed volume: from 0.23 to 3.12

15. Seats

Damage pattern:	no damage but too bulky
Possible cause:	Material is too heavy
Repair proposal:	different Material (e.g. Composit, textile, Aluminium)
Repair:	no changes

16. Control console

Damage pattern:	no damage but too heavy and too little protection for switch and display
Possible cause:	too heavy and too strong material used, no safety bar
Repair proposal:	better solved elsewhere
Repair:	Assemblies replaced by telemetry case made of aluminum

17. cable laying

Damage pattern:	Laying the cables and the bowden cables is very complicated
Possible cause:	No devices available to mount
Repair proposal:	Consideration of cable channels in the planning
Repair:	Cable tree with connectors prepared

18. Bumper

Damage pattern:	broken and feet space of the pilots restricted
Possible cause:	suspension units too flexible, spring deflection too big
Repair proposal:	Alternative solution for Suspension, shape as "icebreaker"
Repair:	Omit assembly

19. Shock absorber

Damage pattern:	too soft (despite strengthening)
Possible cause:	spring deflection too long, suspension units too flexible
Repair proposal:	shorten spring deflection, more Progression
Repair:	Installation of Hasebite-shock absorbers (short, Air suspension, Oil damped)

20. Front lock

Damage pattern:	collides with Alternate angle mechanism
Possible cause:	Construction failure
Repair proposal:	better review, take more time
Repair:	no changes

21. Corrosion

Damage model:	different parts corrode (mainly turned parts)
Possible cause:	No chromium plating, welded after chromium plating, water in turned parts
Repair proposal:	While processing pay attention to the sequence of steps
Repair:	Use Corrosion Protection (Stainless steel spray or Gloss paint)

22. Whole

Damage model:	too much weight (95 kg)
Possible cause:	used to much steel, many units too big
Repair proposal:	usage of lighter material (e.g. Aluminum, Composit)
Repair:	partially use less drill holes and lighter construction parts

23. Transport brackets

Damage model:	poor transportation options of the Buggy
Possible cause:	It lacks flaps for fixing on the roof and for carrying during transportation
Repair proposal:	fasten flaps and handles on the buggy
Repair:	handles affixed

24. Release

Damage model:	Difficult unlocking of the folding mechanism
Possible cause:	Mechanism too complicated
Repair proposal:	the unlocking of the folding mechanism should be eased through use of some mechanical solution
Repair:	Ring affixed

25. Folding brackets

Damage model:	unsafe footing in folded state
Possible cause:	Missing folding brackets to fixate in folded state
Repair proposal:	mount folding brackets
Repair:	affix safety rope made of steel

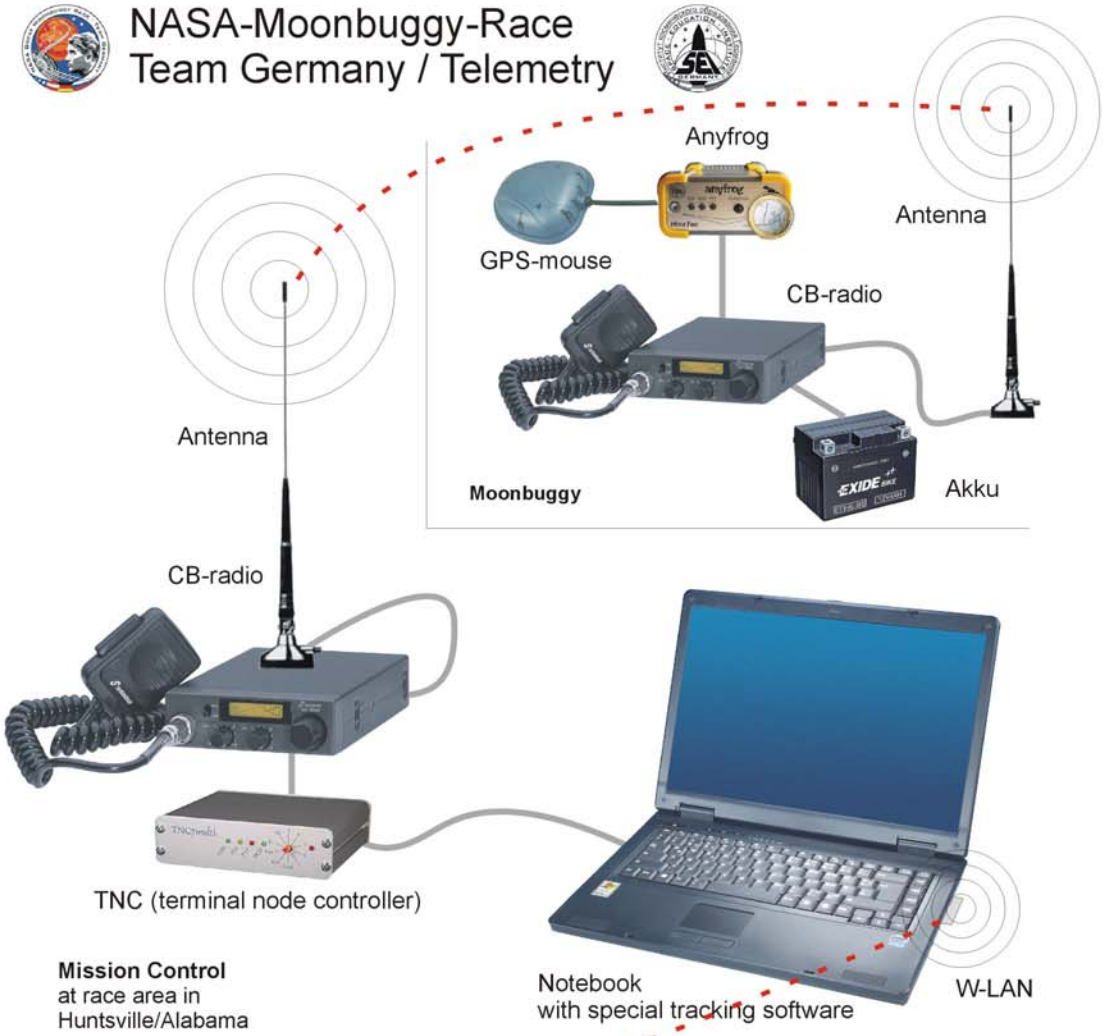
26. Differential gear

Damage model:	see point 10 – cross joints broken
Possible cause:	known, was a timing problem
Repair proposal:	Installation of a Freewheel-Differential
Repair:	New construction of a Freewheel-Differential

27. Telemetry

The automatic sending of current measuring GPS-data via 2-way-radio from the Moonbuggy till a Mission Control Center near the race, extend the potential of safety of the Moonbuggy. The conductor of the Mission Control Center (a student) can observe the position of the Moonbuggy in the real time. It’s like a camera would be fixed in an altitude of one mile above the race track. Additionally from transaction data the speed, direction and height of the vehicle are determined. In the case of an accident or a stop, the conductor of the Mission Control Center can inform immediately via voice transmission (Walkie Talkie) its team colleagues. These can immediately appropriate accordant supporting measures in a before specified order. There is thereby no disorder.

NASA-Moonbuggy-Race
Team Germany / Telemetry



World Wide Web with connection to educational websites

Sponsors

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FÜR GUTE VERBINDUNG

Hnz tec

German Space Education Institute
Wurzner Str. 4
04315 Leipzig

28. Planned long-term employment to the Moonbuggy Regatta

To publish further the idea of the Moonbuggy race, we have the vision of the Moonbuggy Regatta. Our objective is it to orbit with the Moonbuggy the world. The residences of the Moonbuggy teams must be interconnected with the stations of space travel (space center, manufacturing plants, universities). At the same time , we imagine that one or also several Moonbuggys drive together. The vehicles can be tested at the same time on their load capacity.

We will do a first test travel in summer 2008 from Berlin to Moscow (approx. 1200 miles). In Moscow is planned a large receipt meeting. Therefore the telemetry is also so important. The GPS-data sent by the Moonbuggy are received from the escort vehicle. In it is the intermediate station of the Mission Control Center. From there, the data are transferred to the internet and evaluated in the running center. So each Moonbuggy fan can along-pursue world-wide the movements of the Moonbuggy. Also it is possible for the escort team to be immediately to place in case of emergency (accident or repair).

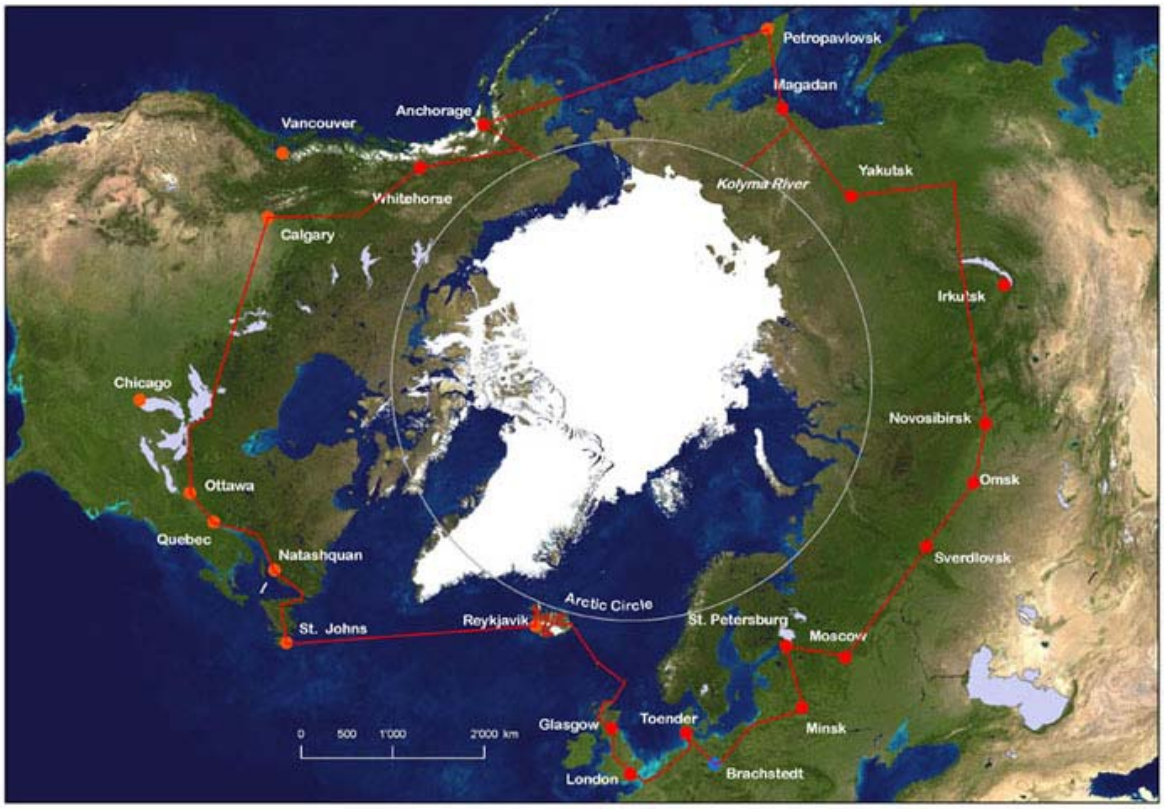
Unser Team wurde von einem professionellen Trainer (Kieser Training) für solche körperlichen Belastungen trainiert.

Our team was trained for such somatic stresses and strains of a professional trainer (Kieser Training).

We want to make our experiences and cognitions of this first moonbuggy-regatta available for the NASA-Moonbuggy Race, so they can reproduce them and call other teams out for joining in.

Our dream is a complete America-regatta (all NASA Space Centers + all Moonbuggy-Schools) in year 2009 at the 40th anniversary of the lunar landing of Apollo 11.

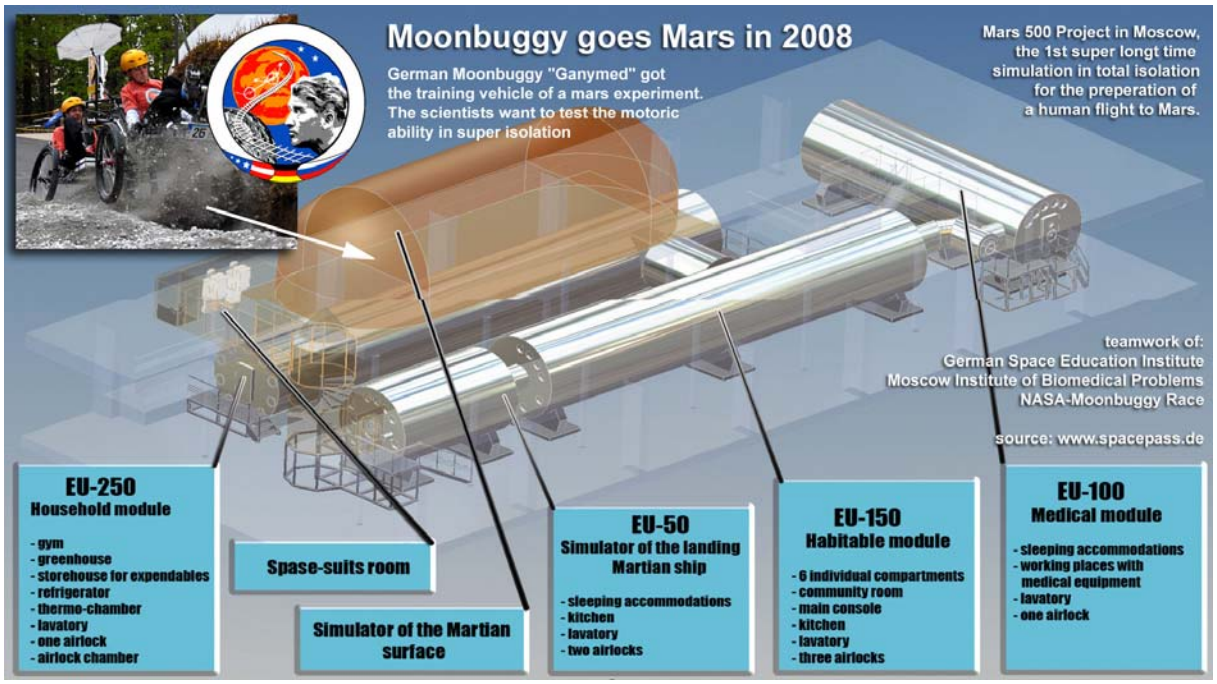
Join all in – it will suffice sections, too. We come with the moonbuggy from Moscow. Later we would go with it around the world. We already have interested people at www.terracirca.de. They drove this course with a bicycle:



29. German Moonbuggy "Ganymed" has got a licence for the Mars 500 Project

The german moonbuggy “Ganymed” was licensed from the Moscow Aviation Institute and the institute for biomedical problems in Moscow as a trainingapparat in the Mars 500 project. The Mars 500 project is composed of three biomedical super longtime experiments in the super isolation. In each case are six crew members tested during a time by 500 days on all abilities of the life and working in a Mars spaceship simulator. The German Moonbuggy functions thereby as trainingapparat for the motor abilities on an after-arranged Mars surface for two crew members. It is used only, if EVA's are planned.

Our Moonbuggy existed as the only applicant for such an important mission under nearly real conditions all safety-relevant examinations.The Mars 500 experiment will be accomplished under international participation and ends in the year 2016. It is a component of the Russian space exploration under the national space travel agency ROSCOSMOS.


Moonbuggy goes Mars in 2008
German Moonbuggy "Ganymed" got the training vehicle of a mars experiment. The scientists want to test the motoric ability in super isolation
Mars 500 Project in Moscow, the 1st super longt time simulation in total isolation for the preperation of a human flight to Mars.
teamwork of:
German Space Education Institute
Moscow Institute of Biomedical Problems
NASA-Moonbuggy Race
source: www.spacepass.de
EU-250
Household module
- gym
- greenhouse
- storehouse for expendables
- refrigerator
- thermo-chamber
- lavatory
- one airlock
- airlock chamber
Spase-suits room
Simulator of the Martian surface
EU-50
Simulator of the landing Martian ship
- sleeping accommodations
- kitchen
- lavatory
- two airlocks
EU-150
Habitable module
- 6 individual compartments
- community room
- main console
- kitchen
- lavatory
- three airlocks
EU-100
Medical module
- sleeping accommodations
- working places with medical equipment
- lavatory
- one airlock

School:
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Teamleaders:
Ralf und Yvonne Heckel, Space Camp Ambassadors

Members of team:
Reshma Anwar (16)
Andriy Garkavyy (17)
Philipp Hanstein (16)
Markus Reichelt (16)
Alexander Uth (15)
Peggy Zinsmeyer (14)

Sideboard of all award applications 2008, Team Germany:

Best-Design-Award	www.spacepass.de/mbr08/best-design-award-en.pdf
Most-Improved-Award	www.spacepass.de/mbr08/most-improved-award-en.pdf
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System-Safety-Award	www.spacepass.de/mbr08/system-safety-award-en.pdf
Team-Spirit-Award	www.spacepass.de/mbr08/team-spirit-award-en.pdf