Stichting

Wind Energie Events

Addendum to the rules for Racing Aeolus 2018

Version: 18.1

December 2017

WIND ENERGY EVENTS

Introduction

The rules for Racing Aeolus are designed to be comprehensive but brief and to the point. They provide no room for the ideas behind them and even though rules in general should not need reasoning this addendum will provide some explanations to the story behind certain rules. It will also give you some insights on certain procedures in dealing with the rules.

Contents

1. Technical Report – concerning rule 2 (from November 2016)

The technical report is an important part of the safety assessment. It must be handed in at least one month prior to the race. Handing it in late may result in a longer technical inspection. Handing it in incomplete will lead to a longer technical inspection. If you hand it in very early you might get a feedback weeks before the race which might reveal design flaws early and give you a chance to fix them in time. If your design report is late teams that were on time will get a higher priority for the technical inspection.

2. Rotor brake – concerning rule 6.1 (from November 2016)

It is no longer allowed to have the rotor brake anywhere but on the rotor axis. This rule used to be phrased "...or via proven technology..." but a tower shaft failure in 2016 showed that even a "proven technology" can easily fail if the person that designed the part is not present during the race.

3. Brakes – concerning rule 6.2 (from November 2016)

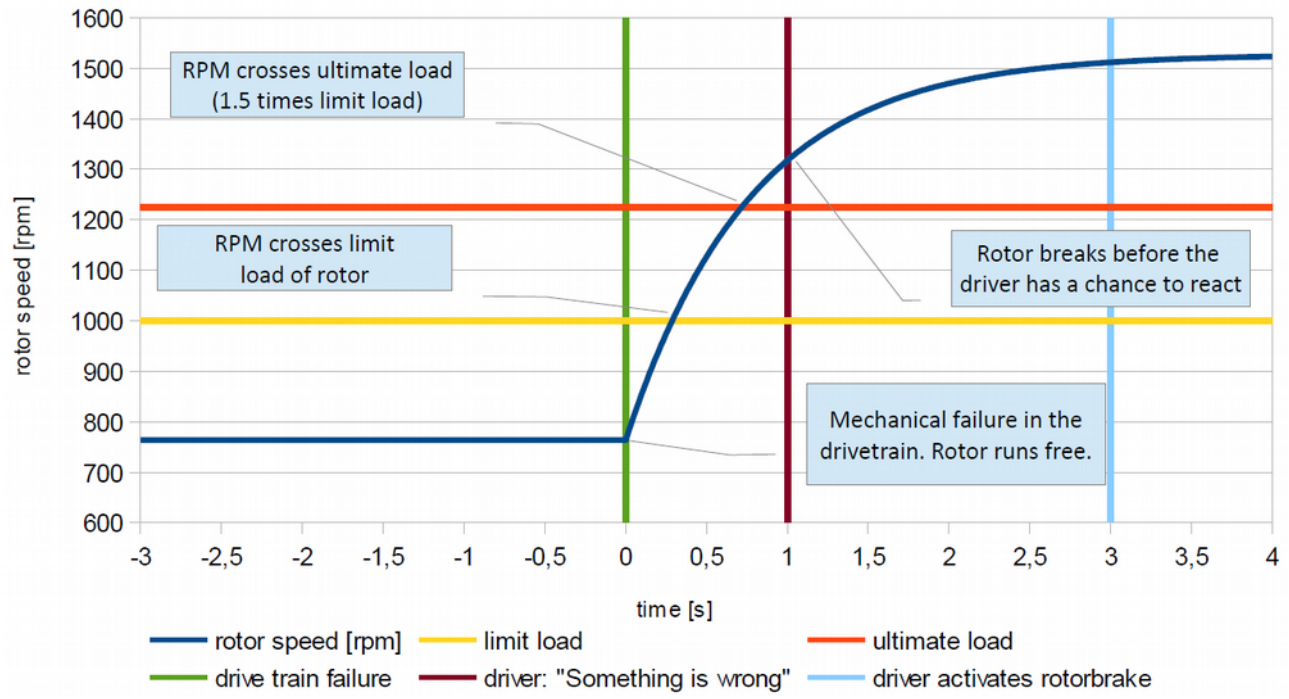
An incident during the 2016 race showed that the way the vehicle brakes were tested was not rigorous enough. We were lucky that nothing happened but we are not willing to rely on our luck any longer. That is why the rules meeting agreed on a minimum deceleration that the vehicle brakes must be capable of. The testing procedure for this is described in test 9.4. This test is much more challenging than the old test. Make sure your brakes are strong enough and test them before you leave for Den Helder. If you show up with weak brakes and fail the test you will not be allowed to participate at all (as stated in rule 10.1). Since this is a safety rule you won't even be allowed to race in category D.

4. About the ROPS – concerning rule 6.4 (from October 2014)

Since the dawn of Racing Aeolus in 2007 the rules included a device that should prevent the rotor from overspeeding. Over the years this device has been heavily debated and only halfheartedly implemented. We, the Racing Aeolus committee, came to the conclusion that an automatic system limiting the rotor speed is very important and should be part of every car participating in the 2015 Racing Aeolus. On these pages we want to give an explanation why we think this way and provide some help to those teams who find the implementation of such a system challenging.

Why?
In 2013 we saw what happens when the connection of a rotor blade fails. Luckily nobody was seriously injured. But everybody realized the potential risk the event of a rotor failure poses. So we asked ourselves: “How can we prevent this from happening again?”

Firstly, make sure that the rotor blade connection is designed properly.
Every team must present their calculation of the rotor blade connection in the design report. Hereby we ensure that the rotor will not fail as long as the rotor speed is below the limit load speed.
But what happens if the rotor speed crosses the limit load speed? In normal operation the driver monitors the rotor speed and can apply the rotor break if the rotor speed gets too high. But is there any chance that the rotor accelerates so fast that the driver has no chance to apply the rotor brake in time? What happens if a part in the drivetrain fails? We did some calculations which resulted in the diagram below.



Rotor speed after a drivetrain failure.

Evidently the driver has no chance to apply the rotor brake in time to prevent the rotor from crossing the ultimate load speed. This extreme case will only happen in very high windspeeds; the calculation was done at 18m/s wind. But since the event will take place in winds up to 18 m/s even higher inflow velocities can easily be achieved.
It takes just one second for the rotor to accelerate from well below the limit load speed to above the ultimate load speed. That is the time the driver needs to realize that there is some kind of problem. At that point the rotor connection will fail, if it didn't already do so.
This shows that only a fully automatic rotor overspeed protection system (ROPS) can prevent the rotor from breaking in case of a drive train failure.

How?
There are several ways to implement a ROPS. We'd like to highlight four of them to give you an idea how a ROPS can be done:

- Centrifugal brake
  - In a centrifugal brake the brake shoes rotate inside a cylinder and are kept from the walls by tension springs. If the rotational speed increases the centrifugal force will push the brake shoes against the wall and thereby limit the rotational speed. This is a very simple but effective ROPS and can be tuned to keep the rotor at a very precise speed.
  - These brakes can be bought off the shelf from a number of manufacturers like Suco (http://www.suco-tech.com/product/wtb/)
- Electrical monitoring
  - An electrical system monitoring the rotor speed and automatically applying the rotor brake.
- Aerodynamic runaway speed design with automatic pitch
  - It is possible to design the rotor in such a way that makes it impossible for the rotor to cross a certain speed because it's rotational resistance is as great as the force driving the rotor. If this speed is below the limit load speed, the rotor can not cross the limit load speed even in a runaway situation. Since the runaway speed depends on the inflow velocity there has to be an automatic pitch to adjust the runaway TSR for high inflow velocities.

5. Rotor net – concerning rule 6.5 (from November 2016)

Over the last years a habit of relying on the manufacturer data was developed. Tests showed that some manufacturers do not state the correct maximum tension on their product. We will test every teams rotor net material in 2017 so make sure yours is strong enough.

6. Derating maximum windspeed – concerning rule 6.14 (from November 2016)

There were some changes to the technical inspection for the 2015 race and to account for the new situation some teams were allowed to race even though they did not pass the flipping test. The safe maximum windspeed for their car was calculated and the teams had to leave the dyke if the windspeed rose above their maximum windspeed. Since this might result in an unfair advantage this procedure was abandoned in 2016 and those teams that had a too lightweight car had to pack extra weight to meet the requirements. Cars that do not pass the fipping test in 2017 will have to increase their weight until they meet the requirements. Like in 2016 there will be no derating of the windspeed in 2017. If you are unsure whether your car will pass test 9.2 bring some extra weights to be on the safe side.

7. Radio – concerning rule 7.9 (from November 2016)

The rules state that the driver and at least one team member (at the start line) must have a radio so that the start marshal can contact the driver during a race. In 2016 some teams tried using an app for this which didn't work well, partly due to the bad cellular internet on the dyke. Therefore we will not accept apps as replacement for radios in 2017.

8. Excemption from rules (from November 2016)

Over the last years some teams were granted excemptions from certain rules. In general, this is possible upon request by the team. Excemptions will only be granted for safety rules and only if the team proves that they took measures that lead to the same result as following the rule they wish to be excempt from would. If a team whishes to be excempt from a non-safety rule it also has to prove that this will not lead to an unfair advantage. Excemptions from safety rules may be granted by the Stichting member responsible for the rules. Excemptions from non-safety rules will also be run by the Racing Aeolus Community.
For example one team was excempt from rule 6.11 (helmet) because they used a certified aviation canopy and had a very thick carbon fibre safety element directly above the drivers head covering every place the head could be. They were only allowed to drive with the canopy closed.
Because your car passed a test last year and was not changed since is no reason to be excempt from a rule. If the rules change, you car has to be modified to meet the new criterias.