2018 TCR TECHNICAL BULLETIN N° 11

NEWS del 3 luglio 2018 - Decisione n° 11/2018 (rivisto)

Il Balance of Performance adottato per la manifestazione del Mugello del 15/7, come previsto dall'articolo 7.1 del Regolamento Sportivo del TCR Italy Touring Car Championship, è quello definito dalla WSC TCR International Series (vedi bollettino TCR n° 10 allegato) ad eccezione del Compensation Weight, riportato di seguito, che sostituisce integralmente quello riportato nel bollettino WSC.

TCR Car Models	Target Racing Weight [kg]	BoP Compensation Weight[1] [kg]	BoP Ballast [kg]	Tot Min. Racing Weight TCR Italy [kg]	Tot Min. Racing Weight [kg]
Alfa Romeo Giulietta TCR	1265	30	-40	1255	~~1285~~
Audi RS 3 LMS SEQ	1265	0	-10	1255	~~1315~~
Audi RS 3 LMS DSG	1230	0	-10	1220	~~1280~~
Cupra TCR	1265	50	-20	1295	~~1305~~
Cupra TCR DSG	1230	0	-20	1210	~~1270~~
Honda Civic FK7 TCR (2018) (2)	1265	20	0	1285	~~1325~~
Honda Civic FK2 TCR (2017) (2)	1265	40	-20	1285	~~1305~~
Hyundai I30 N TCR	1265	60	0	1325	~~1325~~
KIA Cee'd TCR	1265	60	-20	1305	~~1305~~
Lada Vesta TCR	1265	60	-30	1295	~~1295~~
Opel Astra TCR	1265	30	-10	1285	~~1315~~
Peugeot 308 TCR	1265	60	-40	1285	~~1285~~
Peugeot 308 Racing Cup	1225	0	-60	1165	~~1225~~
Renault Mégane TCR	1265	60	-30	1295	~~1295~~
SEAT TCR SEQ	1265	50	-20	1295	~~1305~~
SEAT TCR DSG	1230	0	-20	1210	~~1270~~
Subaru STi TCR	1265	60	-20	1305	~~1305~~
VW Golf GTI TCR SEQ	1265	0	-10	1255	~~1315~~
VW Golf GTI TCR DSG	1230	60	-10	1280	~~1280~~

(1) 2018 TCR Italy BOP Compensation Weight Automatic Formula post Misano 17/06/2018
(2) Rivisto a causa di un errore nella attribuzione del Compensation Weight

Si ricorda, a tutti i partecipanti, che le vetture, in qualunque momento dell'evento, dovranno rispettare tutti i requisiti di sicurezza previsti dall'All. J e dovranno essere conformi integralmente al 2018 TCR Technical Regulations.
In particolare si rammenta che, in ottemperanza agli art. 3.3 e 3.6 del TCR Technical Regulations vigente (vedi stralcio riportato di seguito), è obbligo di ogni Concorrente assicurare ai Commissari Tecnici il pieno utilizzo del sistema Data Logging; sistema che dovrà fornire tra l'altro, in maniera chiara ed identificabile, il valore delle pressioni di sovralimentazione.

2018 TCR Technical Regulations

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Art. 3.3 Compliance with the regulations
All vehicles musi be conformed lo these regulations, TCR Technical Form, TCR Technical Passport and lo all WSC Notification and Technical Bulletins.
All parts noi mentioned in these regulations have lo remain those from the basic production car or another production model of the same manufacturer and correspond lo the Manufacturer's Parts Catalogue for the produced model and may noi be modified in any way.
In case of doubt about the conformity of any part the Technical Delegate may ask the opinion of the car's manufacturer or request the replacement with a reference part without any further explanation. All cosi of such operations will be covered by the Competitor.
Teams will deliver on request lo the TCR technical staff following information regarding TCR cars:

- **Data from team's data logger**
- **Video footage from team's camera**
- **Any other technical documentation**

Upon request, manufacturers will deliver lo the TCR technical staff any technical information regarding TCR cars.
WSC has the right lo archive all information regarding TCR cars.
It is the duly of each competitor to assure the Scrutineers and the Stewards of the competition that his car complies with these regulations in their entirety at all times during a competition.
All costs of the technical checks will be supported by competitors.
A car, the construction of which is deemed to be dangerous, may be excluded by the Stewards.

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Art. 3.6 Data logging
The car must be fitted with the scrutineering data logging system (memotec) providing following data (Certification):

- Speed of the 4 wheels
- Engine revs & timing
- Longitudinal acceleration
- Laleral acceleration
- Throttle pedal position
- Throttle valve position and of any other contrai element
- Engine load target & delivered Engine load (if the Throttle Valve doesn't follow the Throttle Pedal Position)
- Engine Water Temperature
- Inlet air temperature in the manifold
- Boost pressure (monitored by an additional sensor)
- Front & Rear Brake Calliper pressure
- Lap trigger
- Lambda-signal
- Ignition angle timing
- Injection duration, start & end
- injection fuel pressure
- camshafts timing & positions
- GPS
- Steering wheel angle
- Lau nch-contral button

WSC will decide and communicate the list of stand-alone sensors or of other independent monitoring systems for each model. (Certification)
The Scrutineering Data Logger system consisting of an "memotec" evo4 or evo5 box and a TCR kit (specific bracket, sensors and loom) must be installed corresponding to the instructions.
Contaci to: memotec GmbH: Bauwaldstrasse 1, 75031 Eppingen, Germany Phone: +49.7260.920440; Fax: +49.7260.920444 Mail: info@me-mo-tec.de; Web: www.me-mo-tec.de

Manufacturers will offer for sale race cars equipped with scrutineering data logging system.
The collected data remain at WSC disposal.
The scrutineering data logger may not be used as Team Data Logger and may not be accessed by the team. On request, competitors receive recorded data of their own scrutineering data logger, to verify own sensor values.
The use ofTeam Data Logger is allowed. The Team will allow access to the TCR Technical Delegate to the data ofTeam Data Logger at any time.
Team Data Logger with removable memory devices are allowed.
The use of following sensors is not allowed:

- **Pitot tube**
- **Tire pressure**
- **Tire internal and external temperature including the running surface Ride height**
- **Inertial platform**
- **Turbine speed**
- **Combustion pressure**
- **Sensors using wireless data transmission**
- **Engine torque sensors**
- **Load celi on power train, running gear and suspension mounting points.**

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Si allega inoltre il bollettino n° 14/2017 relativo al “"Metodo di controllo della pressione del turbocompressore (vedi le pagine da 2 a 6 bollettino)".

2018 TCR TECHNICAL BULLETIN no. 10

Date: 2018, June, 6th

This decision is with immediate application and valid until further notice.

TCR BoP & Eligible Cars:

TCR Car Models	Engine Power Level [%]	Target Racing Weight [kg]	BoP Compensation Weight* [kg]	BoP Ballast [kg]	Tot. Min. Racing Weight [kg]	Ride Height [mm]
Alfa Romeo Giulietta TCR	102.5	1265	60	-40	1285	70
Audi RS 3 LMS SEQ	100	1265	60	-10	1315	70
Audi RS 3 LMS DSG	102,5	1230	60	-10	1280	60
Cupra TCR	100	1265	60	-20	1305	70
Cupra TCR DSG	102.5	1230	60	-20	1270	60
Honda Civic FK7 TCR	97.5	1265	60	0	1325	80
Honda Civic FK2 TCR	97.5	1265	60	-20	1305	70
Hyundai I30 N TCR	97.5	1265	60	0	1325	**90**
KIA Cee'd TCR	100	1265	60	-20	1305	70
Lada Vesta TCR	100	1265	60	-30	1295	70
Opel Astra TCR	100	1265	60	-10	1315	70
Peugeot 308 TCR	102.5	1265	60	-40	1285	70
Peugeot 308 Racing Cup	100	1225	60	-60	1225	70
Renault Mégane TCR	100	1265	60	-30	1295	70
SEAT TCR SEQ	100	1265	60	-20	1305	70
SEAT TCR DSG	102.5	1230	60	-20	1270	60
Subaru STi TCR	100	1265	60	-20	1305	70
VW Golf GTI TCR SEQ	100	1265	60	-10	1315	70
VW Golf GTI TCR DSG	102.5	1230	60	-10	1280	60

* The "BoP Compensation Weight" of 60kg applies at the 1st event of a model in a TCR Series and will be corrected during the season using the particular Compensation Weight Automatic Formula.

Modifications in **bold writing**

Imposed parameters for boost pressure and engine ECU software remain unchanged.
(See TCR Technical Bulletin no. 9 from 2018, May, 17th).

Andreas Bellu / TCR Technical Director

WSC Ltd, 22 Eastcheap, 2nd Floor, London EC3M 1EU, UK

Date: 2017, June, 15th

Technical Bulletin No. 14

1. Turbocharger Boost Pressure Monitoring Method (see pages 2 to 6 of the present bulletin)

The method refers to the Checking Algorithm of the Maximum Absolute Supercharging Pressures published in the TCR TB no. 12 from 14.06.2017.

Eventual question to the “TCR Turbocharger Boost Pressure Monitoring Method” can be answered by the authors.

2. Errata for VW Golf GTI TCR SEQ and DSG for following articles of the TCR Technical Form 2017:

- Art. 202.a) Overall Length: 4597mm (instead of 4564mm)
- Art. 209.b) Overhang Rear: 1035mm (instead of 1002mm)

Andreas Bellu / TCR Technical Director

TCR Turbocharger Boost Pressure Monitoring Method

Markus Krug*
Electrics/Electronis
markus.krug@tcr-series.com

Florian Eich
Electrics/Electronics
eletronic@tcr-series.com

1 Introduction

Turbocharger boost pressure is an important Balance of Performance (BoP) parameter and must therefore be monitored adequately. In this paper, we present the monitoring method we have developed on the basis of the monitoring method described by the *LED boost control strategy* by the FIA GT Committee [1]. It is currently used by technical delegates to check the legality of cars in TCR International. Our implementation provides to the technical delegate the information of

- when (outing, lap, minute, second, millisecond) the boost limit was violated
- duration of boost limit violation
- engine speed (RPM) at the beginning and end of the violation
- throttle position (%) at the beginning and end of the violation
- amount of boost limit violation (mbar) at the beginning and end of the violation

if a boost limit violation occurred.

The conditions which must be met for the boost pressure monitoring method to be applicable are described in section 2. The boost pressure monitoring method itself is described in section 3. For a summary of all parameters, see section 4.

2 Conditions

First of all, there are two conditions introduced to discard meaningless results and exclude unnecessary edge cases from the analysis using the monitoring method.

- Engine speed is 2000 RPM.
- Throttle pedal position is at least at 25% of its total travel.

The following condition has been defined in order to fairly treat the physical properties of different technical solutions used in TCR vehicles.

- No gearshift window (described in section 2.1) is currently active.

IF AND ONLY IF all of these conditions are met the boost pressure monitoring method is applied.

2.1 Gearshift Window

Due to the physical properties of a turbocharger, overshoots of the boost pressure after a gear upshift are common in some systems. The beginning and the length of the overshoot vary between different systems. Therefore we define the *gearshift window* as follows.

A gearshift window is detected *IF AND ONLY IF*

- a gear upshift (described in section 2.2) has been completed within the last 1000 ms.
- the beginning of an overboost event (i.e. the rolling average of the boost pressure being over the permitted limit) has been detected withing the last 300 ms.
- a gearshift window has not already been detected since the last gear upshift has been completed, i.e. only one gearshift window can be detected per gear upshift.

*Primary Contact

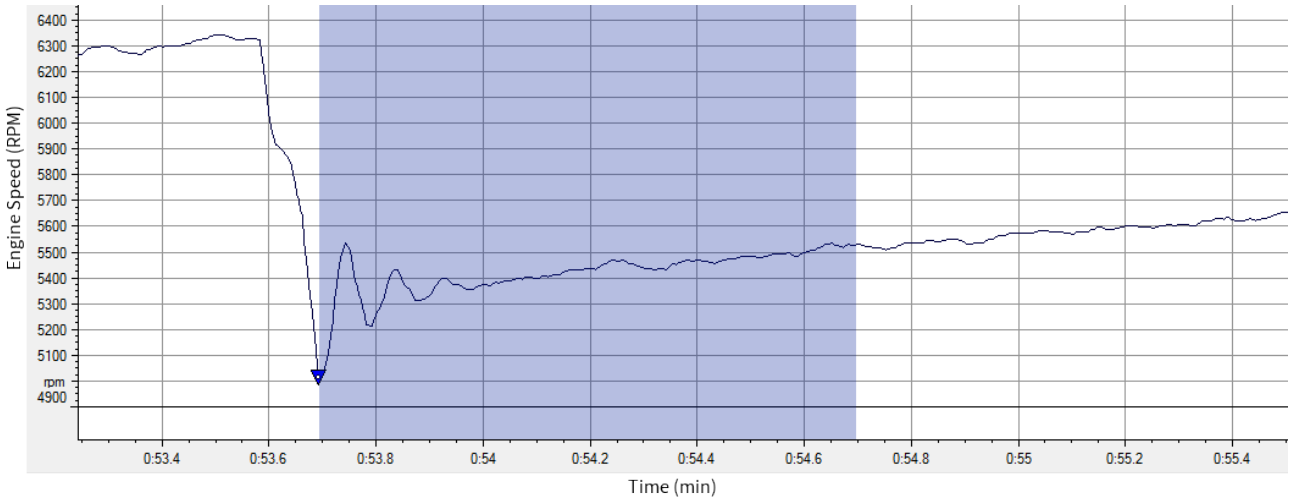

Figure 1: Time range where the gearshift window can be activated

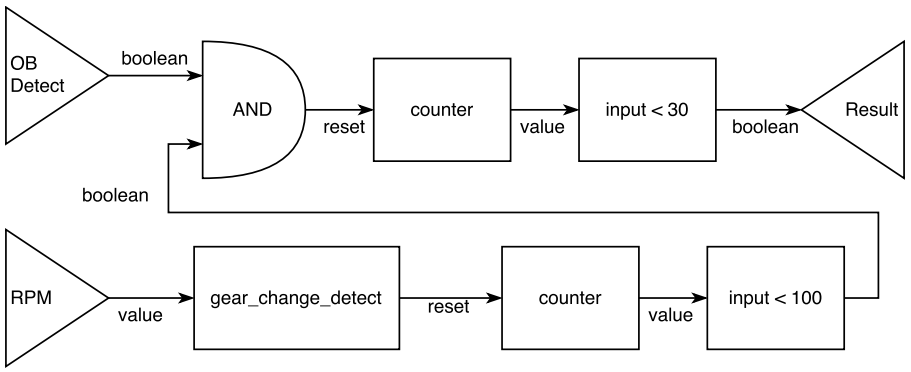

Figure 2: Gearshift Window Detection

See figure 1 for an illustration of the time range when a gearshift window can be detected. If during this time range an overboost event is detected, the boost pressure monitoring method is suspended for 300 ms. We define this as the *gearshift window*. The gearshift window detection is shown in figure 2.

2.2 Gear Upshift Detection

To detect a gear upshift, the end of the falling edge of the engine speed must be detected (see figure 1). The falling edge is detected by calculating the drop of the engine speed as follows:

$$drop(t) = rpm(t - 20) - rpm(t) \tag{1}$$

where t is measured in ms. If $drop(t)$ is greater than 200 RPM, the falling edge is detected. The end of the falling edge is then found by determining the point in time when $drop(t)$ is again less than 200 RPM. Figure 3 shows the method by which the gear upshift is detected.

3 Boost Pressure Monitoring Method

The boost pressure is measured with a resolution of 1 mbar and a sampling rate of 100 Hz.

The boost pressure monitoring method is composed of several steps, each of which is described in the sections below. It is loosely modeled after the monitoring method described by the *LED boost control strategy* by the FIA GT Committee [1].

3.1 Rolling Average

- Static set of 50 values.
- Setting at check start: set is filled with zeroes. This means that the result of the algorithm is only meaningful after 50 measurements have been captured.
- Implemented as circular buffer [2], i.e. the values in the set are overwritten from the beginning to end of the set again and again.
- The average is always calculated by building the sum of the values in the set and dividing it by 50.
- The set is never emptied, i.e. when the conditions (see section 2) are not met the set remains static and when the conditions are again met the overwriting process restarts from where it was stopped.

3.2 Overboost Condition

The overboost is detected by subtracting the maximum permitted boost pressure from the result of the rolling average calculation.

$$\mathbf{OB} = \mathbf{P}_{\text{rolling average}} - \mathbf{P}_{\text{limit}} \tag{2}$$

IF AND ONLY IF OB is greater than 0, the result is forwarded.

3.3 High and Low Overboost Detection

The value resulting from the overboost condition described in section 3.2 is evaluated. Two thresholds are used for this evaluation:

- High Overboost Threshold: 100 mbar
- Low Overboost Threshold: 30 mbar

These thresholds are used for the evaluation of the monitoring method, which is executed at 100 Hz. The car is legal *IF AND ONLY IF*

- the High Overboost Threshold never surpassed, i.e. the overboost value has always been less than 100 mbar.
- the Low Overboost Threshold is surpassed at most 5 times, i.e. the overboost value is higher than 30 mbar at most 5 times per outing.

3.4 Monitoring Method

Figure 4 shows the entire boost pressure monitoring method including all condition verifications. If all conditions are met, the conditional pass through forwards the boost pressure value from the sensor to the rolling average, after which the boost limit as per BoP is subtracted. If the resulting value is greater than 30 mbar, a counter is incremented. As long as the counter is below or equal to 5 and the value after subtraction is below 100 mbar, the monitoring method evaluates to `true`, meaning that the car is legal.

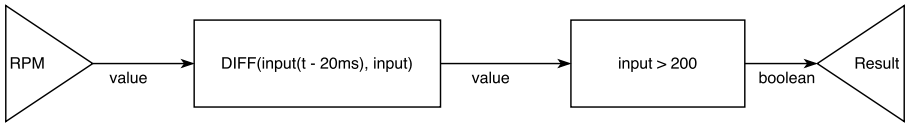

Figure 3: Gear Upshift Detection

4 Summary

In this paper, a monitoring method for the turbocharger boost pressure has been presented. It enables monitoring a vehicle's legality during a race (online), given suitable electronic hardware is available, or after the race (offline) using logged data, albeit with much greater effort.

The key parameters are:

- The monitoring method is viable whenever the throttle pedal is at least at 25% travel and the engine is operating at more than 2000 RPMoutside a gearshift window.
- A gearshift window can be detected for up to 1000 msafter a gear upshift has been completed and lasts for 300 ms.
- A gear upshift is detected if the engine speed drops by 200 RPM or more within 20 ms.
- The boost pressure is averaged over 50 measurements which are stored in a circular buffer and never lost.
- If the difference between the boost pressure limit according to the BoP and the averaged boost pressure goes
  - over a threshold of 30 mbar a counter is incremented. If the counter is bigger than 5, the car is illegal.
  - over a threshold of 100 mbar the car is illegal.

We believe this monitoring method is fair to all vehicles homologated according to TCR technical regulations [3].

References

[1] FIA GT Committee, *LED Boost Control Strategy 20.01.2017*, `http://www.fia.com/file/53189/download?token=KQCDQIP5`

[2] Wikipedia, *Circular Buffer*, `https://en.wikipedia.org/wiki/Circular_buffer`

[3] TCR International Technical Department, *TCR Technical Regulations 2017*, `http://tcr-series.com/pdf/2017_TCR_International_Series_Tecnical_Regulations-2017_01_28.pdf`, 2017

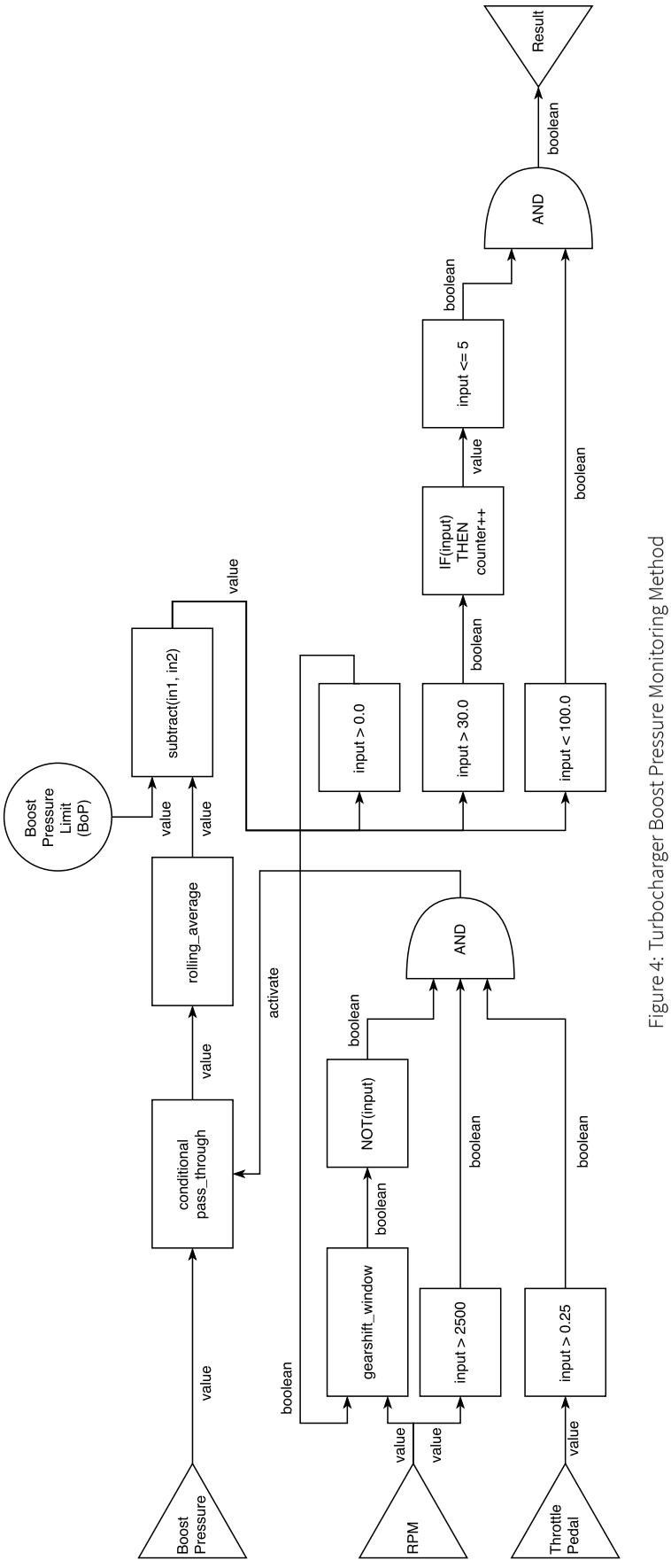

Figure 4: Turbocharger Boost Pressure Monitoring Method