**Meeting Notes**

***47th PMP Meeting 16 - 17 May 2018***

**Joint Research Centre, Ispra**

**Via Enrico Fermi 2749, Ispra (VA) 21027, Italy**

**Day 1 : 16th May 2018 @ 10:00H : Exhaust Particles**

**Day 2 : 17th May 2018 @ 09:00H : Non -Exhaust Particles**

**Day 1 : 16th May 2018 @ 10:00H : Exhaust Particles**

1. **Welcome & Introduction – Chair - Giorgio Martini**

* Noted that in GRPE session we are asked to think about fuel quality on PN which is not on our current mandate
* Noted on NEPE that UK requested how to consider technologies to reduce brake emissions can be taken into account
* Minutes of last 2 meetings uploaded on the website.

1. **Calibration**

* **Update on PNC round robin results**

Postponed to next meeting due to unforeseen circumstances

* **Update on PNC calibration sub-group**
* **Presentation from AVL –Thanasis Mamakos**

K factor – reg allows k factor of 0.91-1.11% efficiency – flow rate vs particle counter – individual CPC flow rate or ‘typical flow rate’ for type of CPC. When should k factor be applied ? Examples for best / worst efficiency curves shown. AVL indicated +/- 12% at 23nm for lab compliant with ISO 17025 lab and using emery oil is rather wide. This is not the case for CAST as CAST particles (unlike emery oil) are not spherical. This could also be important at the 10nm size too. K factor is dependant on flow rate so makes not so much difference if flow rate individually measured per CPC

**Discussion Points**

* Uncertainty band could not be reproduced with soot (like emission of car) then if can’t reproduce with another material - this is academic and not real.
* Is it possible to establish the ‘golden soot particles’ ?
* Goal of calibration is reproducibility – soots are different (Gdi, diesel, NRMM diesel etc) – however k-factor impact will be reduced if you start from soot and measurement programs show soot produces very reasonable results
* Differing view points on soot / uncertainty and k-factor throughout the group. Also difference whether necessary to calibrate individual parts of the system (eg VPR and CPC) or the system as a whole (eg for RDE).
* NIST DSL possible at 100 or 50 nm, but not at 23nm. Significant discussion on whether expanded uncertainty comes on top of calibration tolerances – no consensus within the group.
* OICA – how do me move forward ? we see - 20% difference in the field with CPCs available for PN. Both calibrated like ISO etc. One manufacturer comented they have 50 systems and all seen within 10%, and now with new system seeing wider tolerances.
* Ricardo-AEA noted there was a tolerance originally applied for DPFs but now when same limit applied to gasoline which is slightly smaller mean size distribution, errors have bigger effect.
* Chair summary : calibration of CPC (academic calibration exercise at lab level emery oil or soot) but does this help for real life in the field – soot is different under diff engines /operating conditions. Better calibrated CPC might reduce uncertainty. Another point is the fundamental decision on emery oil vs CAST – if soot well defined then makes not so much difference, but emery oil doesn’t suit RDE systems, therefore we have to continues to investigate soot. Tolerances might lead to +/- 20% differences and we might need to relook at that. AVL final comment is that will need to keep in mind if going the direction of soot, that tolerances need to be reviewed but may not be able to be reduced.
* RR CPC with soot aerosol uncertainty can be similar to emery oil – draft report uploaded on the website (Barouch Giechaskiel). Objective in one year time we can develop some suggestions on improving calibration procedure.
* Question what we could prepare to GPRE ?

Technical Secretary proposed to develop a roadmap and discussion of the priorities – improve today, prepare for sub-23nm or do both ?

Group agreed to the proposal and to discover which is more work

Chair – agreed we will inform GRPE we will develop a roadmap and will discuss and develop the roadmap at the next PMP

1. **Update on raw exhaust sampling**

* ACEA/JRC presentation on *“****PN Counting from Raw Exhaust via Fixed Dilution and round robin project”. Hua Lu Karlsson.***
* ACEA HD members decided to run a project with JRC. Japan HD members of OICA also supported this concept. On-highway engine.
* 01 Series Reg 132 includes raw exhaust as a possibility but procedure not defined
* New testing program – uncertainty vs CVS or PFDS, robustness, tech specification and equations and how this links to developments on Sub-23nm.
* Starting with existing commercial systems and existing technical requirements for PFDS /PMP or PN-PEMS (eg distance to tailpipe) and include influence of heavy biofuels
* Additional consideration is that crankcase emissions on HD have to be included and connected to the tailpipe
* RR with golden instruments (no golden engine to circulate) as more efficient to circulate instruments than engine. Want to start as soon as LD golden instruments available (eg end Sept 2018)
* Will include 10 and 23 nm CPCs at various locations and VPR / CS, WHTC cold+hot, pressure cycle etc . Presentation contains details about protocol, experimental investigations eg on PCRF, sampling line length etc.
* OEM1 and OEM2 will look at PFDS / CVS respectively, final protocol decisions with JRC after OEM2.
* Timing – start Oct 2018. In june ACEA members will respond with number of engines and test cell availability. Japan is assuming currently not to participate directly. Will confirm decision as program becomes more concrete.
* JRC is strongly committed to this program.

1. **Update on particles from gasoline direct injection**

* SWRI presentation on the ***“Relationships Among Various Particle Metrics Using 12 GDI Vehicles and 8 Fuels”*** by Imad A. Khalek
* US only uses PM2.5. Some wish to have more size differentiation and to get more information.
* Consideration / discussion in US EPA on whether GPF (reduction of black carbon) could get credits for GHG reduction – PN reduction would be a side benefit
* This study – 12 different GDI without GPF. Fuel impacts. Octane number has no significant impact, PN index has significant impact, ethanol content in fuels increased PN (match vs splash)
* Soot mass measurements and PM measurements and EC/OC correlated very well. Micro-soot sensor is absorption co-efficient device and can react differently to different soots but actually all measurement techniques responded very well and correlate well to elemental carbon (EC). This may not apply to 2-stroke engines though.
* PN vs mass : solid PN with total mass – shows correlation but this is dominated by high soot (slope dominated high mass with large GNMD / less PN). The R2 correlation slope increased for number vs soot as PM mass decreased.
* Expect good correlation solid particles to soot mass. Solid particles to total particles only correlates if have soot.
* Derived mass (using EEPS) vs measured mass – strong correlation but EEPS underestimated by approx. 35%. Due to default curves in EEPS and corrected when used soot curve instead.
* Good correlation observed between the 3 mass measurements, typically soot mass 10-20% lower than PM mass
* JA noted PMP saw same results at low levels 1mg/km but fell apart below that – this is consistent despite new generation of vehicles and differences in PM measurement EU Vs US filter papers
* Japan NTSEL performed similar work and presented in 2016 and have very similar results 10+12 PN equivalent to 1 mg/mile

1. **Sub-23nm**

* Update on Horizon 2020 projects on sub-23 nm particles (projects’ presentations)
* Projects workshop 9-10 Oct 2018 (PMP should be updated at next PMP f2f meeting)

**Downtoten – jon Anderson,**

WP2 composition of GDI particles and to understand downtoten system vs commercially available systems today

Recommending use of optimised CS size with cooling porous tube diluters to avoid recondensation (minimising thermophoresis) about 3nm (some sulphates below that)

Now WP3 prototype set up equipment and sampling (slide 13) and a wide range of measurements / technologies

Reviewing exceedance zone : on average PN10 is approx. 40% more than PN23 –shows there are no independent modes of particle generation that are being missed with PN23. One LNT diesel and several GDIs without GPFs were above 6E+11#/km. Need chemical analysis too. No LPG or CNG done yet. JRC will test a CNG.

Where do we generate sub23 nm solid particles ?

* + With GDI without GPF on a very hard accel (foot to the floor) where a bimodal distribution is seen for 3-4 seconds
  + Major <23nm particle prodicuton event taking place after disel post injection starts, particles 10-100 times those in >23 range for 2-3minutes along with short duration of the event are not high enough to influence pass/fail at Euro 6c PN limit once Ki factor is included.
  + Important to keep the fundamental level of particle generation in mind when talking about increases.

Next steps :

* + WP4 starting now which is looking into PEMS
  + May also look into high FAME containing fuels

**PEMS4Nano –presented by Les Hill (Horiba) on behalf of the consortium**

Running a single cylinder diesel engine as a particle generator, many analysis techniques to develop a model for the evolution of particles in engine and measurement system. LII on line technique to give soot vol fraction and mean soot diameter. Experimental set up (slide 7) so real time LII data can be compared to SMPS/EEPS/SPCS. Using eg nano MOUDI to determine size related particle morphology (aluminium substrate). Moving now into model guided application (MGA) to simulate formation/evolution of particulate emissions in IC engine driven vehicles

**SURREAL-23**

* Complement / extend existing instrumentation < 23nm
* Characterise particles < 23nm
* Support future emissions compliance through technical developments in RDE

Questions from the group about whether CS with and without sulphur trap Included.

**Update on sub-23 nm monitoring (Tero Lahde – PMP-47-13)**

* LD GDI circulated to 6 labs, two to come.
* PN10 and PN23 data with heated evap tupbe and CS from all labs
* Only results from PMP vehicle to date
* CO2 variability cold 1% and hot 2% (mainly one lab is different, still under investigation)
* PMP (heated tube) PN23 variability – no absolute values being given as mid way in exercise. Variability 19% cold start, hot start 12% (emissions normalised to mean)
* CS1 cold start 16% and hot start 12% 23nm, 10nm cold start 18% and 8% hot start
* CO2 varied also on steady speed checks – group also commented speed looked rather variable too for a steady state.
* PN variability between labs on steady speeds very low on 23nm systems, higher on 10nm systems
* See summary slide. There are some size distribution measurements to come too.
* Questions about within same lab chassis dyno to chassis dyno and how to eliminate vehicle variability vs measurement variability.
* Industry raised some questions on the steady speed if this was actually steady speed
* Japan round robin is still under discussion but plan is to start in September 2018
* Heavy duty asked for clear timing on Japan because of need of their program too – maybe a different golden instrument.

**PTI NRMM PN (Giovanni D’Urbano, Switzerland)**

Swiss 2009 construction machinery 1E+12/kWh and adopted in Stage V NRMM from 2019.

Retrofitting of construction machinery (97% particles must be retained between 20-300nm)

Opacimeters weren’t suitable for testing. Investigation alternative devices. Some equipment specifications are added. Devices have to be type approved and a declaration of conformity and only body is METAS-CERT, annual equipment verification (only METAS currently)

Measurement procedure: engine must be warmed, coolant and oil at normal op temp, PN at high idle (engine cut off speed), 40 second duration for 3 off 5 second measurements

Reference value of 2.5E+5 #/cm3 compared to TA value 1E+12#/kWh. Not looking for 1-2% above limit but really looking for malfunctions or removed filters.

Allowed to do this technique since 2016 in Switzerland for NRMM on construction sites. Opacity method is also in place. In future will only be PN after a transition time for more devices. Self inspection every 24 months and every 60 months to a station.

Most of the inspections are in a workshop so temperature +5 to + 30 deg C is the mandatory range, outdoor range -10 to +40 deg - equipment has to have a clear specified range

Only TSI system has been certified to date.

1. **Presentation on *"Estimation of transport efficiency for brake emissions testing"* from LINK and TSI (Carlos AGUDELO – LINK Engineering). Brief feedback on measurement requested from exhaust measurement experts**

Brakes – 6nm to 10um – huge size range (if smallest one in a coffee cup, largest like London Eye). Tendancy of larger particles to move to walls and adhere etc. Transport losses from brake particles – humidity important / lab elevation etc, sampling vacuum, particle density – exising models CDC, Max Planck and SAE don’t include. Initial approach to use bulk density – but not representative of brake pad – need skeletal density (as in including porosity) Looked at models on other losses. Model is not yet complete but gives a good early idea before going ahead to test.

Questions:

* How did the sampling impact the disk temperatures ? with or without ?

No measurements done but building on work done by Ford and others with an inflection point around 120 deg C where PN picks up.

* Does model take account of residence time in sample chamber and ducts ?

Not taken into account – would need a coagulation model to handle particle size shift. Unimodal distribution is covered but a bimodal coagulation model doesn’t exist

Losses in enclosure not yet taken into account.

Model details will be presented at REbRAKE next week and the paper will be presented.

Model will be freely available to industry.

1. **Update on the status of the participation of Marie Curie PhD Students to the PMP Face-to-Face Meetings –**

This activity is on hold for a year

**Any other business : Questions raised by GRPE June 2018 session to PMP:**

*Fuel quality on PN emissions and biofuel – especially heavier fractions*

Fuel quality impact is not included in the mandate of PMP and PMP will update GRPE June 2018 with a proposal. Imad Khalek has study on fuel quality, Japan for RDE GDI PN and others may have presentations eg India etc.

PMP proposes to start with a literature survey – what is already available and if / what gaps there are and PMP can review if / how to close knowledge gaps.

Auto Industry (especially heavy duty manufacturers)– support the above approach

Question whether covers LD, HD, NRMM, etc – Jon Anderson suggested to go back to EPEFE study for impact of aromatics etc. The more critical question is how does FQ impact a GDI GPF vehicle ?

Commented that Oxygenated content impacts nature of particles – at 7-10% very small impacts. Recommended to focus on impact of reducing sulphur rather than on impacts of bio-feedstock.

Conclusion : Request to GRPE to better guide us. The wider scope will take more time. What are the priorities for different technologies.

**Return to the mornings questions**

Discuss and agree a roadmap on the calibration side. All the members of the group should meantime consider the different approaches.

* Existing calibration procedure for 23nm – not perfect – but works to a certain extent
* But, recently EU Com and stakeholders about potential measures for post Euro 6 – DG-GROW is keen on shift to 10nm emissions. This means PMP might not need to concentrate on 23nm calibration but should focus on the move to 10nm ? Also if we touch calibration materials then we have to discuss reviewing the emission values. So now, please think about best way forward. Maybe small cal improvements today eg on how to use k factor but without changing fundamentals, and instead develop roadmap for calibration and 10 nm method – including the H2020 projects. We need to keep in mind how to handle the RDE activity (soot vs emery oil) also.
* Deeper discussion next F2F meeting
* BMW supports roadmap idea. Horiba suggested to go for 10nm

**End of Day 1**

**Day 2 : 17th May 2018 @ 09:00H : Non -Exhaust Particles**

**Theo – tf2 brake task force – looking into development of suitable sampling methodology and selection of most suitable measurement methods – merged into one step because sampling set ups impact what is finally being measured.**

1. **Welcome & Introduction**

Chair updated the group on the GRPE request for PMP to consider the impact of the new technologies on the braking particle emissions.

1. **Step 1 – Adoption/development of a braking test cycle**

**Update on the work done by the dedicated Task Force and presentation on the current status of the *“New Real-World Braking Cycle for Studying Brake Particle Emissions”* (Ford – JRC – Heinz Steven) – presented by Theo Grigoratos**

* Development of the cycle : Ford / Heinz Steven have concluded the work, technical details to REBRAKE, available to all after publication in the WEAR Journal in June
* Round Robin completion foreseen April 2018 is postponed until Dec 2018.
* Study on brake cooling (horizontal cooling) had significant impact on brake temperatures – essential to take care of this to replicate real world.
* Parasitic drag (on average 15% of kinetic energy by parasitic drag on road) needed to be accounted for in cycle development as the temperatures would otherwise be quite different on the higher speed braking events
* Open issues
  + Low flow dyno testing leads to higher max temps than observed in field – how to replicate correct temps
  + Other vehicle classes (temps / adapting cycle)
  + Consideration of speed proportional fans will come in future – very few labs have this available currently – and will be difficult to maintain isokinetic sampling- may not be recommended.

1. **Steps 2&3 – Selection of the most suitable sampling method and the most suitable methodology for Brake Wear Particles Measurement and Characterization**

Theo Grigoratos (JRC) noted that the original brake task force activies looking into development of suitable sampling methodology and selection of most suitable measurement methods have merged because sampling set ups impact what is finally being measured.

* **Presentation on *“Comparison of the run-in and emission behaviour of different friction materials”* from the on-going measurement campaign on a common project from AVL and TU Ilmenau (David HESSE – TU Ilmenau)**

Sampling system CVS with CPC sub-23nm

Influence of preconditioning (test run-in procedure)

* Investigation of run in behaviour for green friction partners according to following methodology – 50 times WLTC
* AK-Master section 3 (400 times) + 3 times WLTP
* 50 WLTP 1163 km / 2400 brake events. Compared cast iron disc and coated disc with anti corrosion coating.
* Preconditioning is very important as high thermal loads lead to lower particle emissions. Experts recommend continue to test until the corrosion coating is removed and emissions are stable – maybe 4 repeats of the new test procedure. Alternatives were proposed such as preconditioning with WLTP+20%, or to measure corrosion coating emissions and assign it a lifetime value (like PN regeneration).
* Some experts indicated friction co-efficient twice as high as expected on the graphs in the presentation.
* **Presentation on *"Influence of sampling flow on PN and PM measurements as well as comparison of macroscopic (weighting) and airborne results of measurements for PM”* from Horiba (Dmytro LUGOVYY) and (Sebastian GRAMSTAT) – AUDI**
* Horiba data obtained using AK master cycle. Sample flow has no influence on PN or PM measurements. Isokinetic conditions not needed.
* inlet air – PN per test drops with decreasing inlet air flow but PM decreases with increasing air flow.
* Transition temperature is 135 to 140 deg C for formation of nano-PN
* Particle size distribution is shifted smaller with increasing air flow (coagulation mechanism)
* Note – caution using particle loss calculations as showed differently predicted results from actual results even different in trends
* Sub-23nm exist at all parts of AK-Master cycle, are real solid state
* 90% of PM measured within PM2.5
* By turbulence only <1% of mass due to losses can be counted – content of airborne PM <1% in comparison weight losses of pads and discs
* Under laminar conditions < 30% can be counted

Discussions / Questions

One of the key TF2 decisions was for isokinetics – so it is very surprising to see a presentation coming back showing isokinetics not needed.

Imad Khalek - SwRI emphasised the importance of isokinetic sampling for large particles. Wondered if the large particles were being lost in all cases e.g. 2.5 um particles might not make it to the CPC. Range needs to be properly specified maybe only up to 1 um.

Needs size dependent loss analysis, then can decide on appropriate range

Dmytro Lugovyy stated that Isokinetics for mass needed but Particle number does not need isokinetic sampling.

Recommendation not to solely rely on mass loss as might measure nothing after even a week.

* **Presentation on *"Estimation of transport efficiency for brake emissions testing"* from LINK and TSI (Carlos AGUDELO – LINK Engineering)**
* **see notes from day 1**

Macro is available on request. PMP experts recommended to start using the macro to evaluate existing systems. Brake Task force will take this up to use and review. Carlos Agudelo offered to run a workshop if needed.

* **Presentation on *"PM emissions from brakes – some first insights"* from AVL and TU Ilmenau (Thanasis MAMAKOS – AVL)**
* 3 types tested – 2 from ECE market, 1 Non-Asbestos Organic (NAO) from US market (also EU aftermarket). One ECE was copper free.
* WLTC, different segments of AK-Master (U-green, fade, pressure row)
* Focus on chemical analysis (not so much on repeatability)
* Large differences in PM emissions between pads
* ECE 6 mg/km for 2 front brakes, ECE Cu-free 10 mg/km, NAO 2.2 mg/km.
* Emissions not so stable during AK-Master sections – chemistry of particle may have been changing. Light absorbing fraction of PM ranged between 7-15%
* EC/OC analysis complicated due to large Cu/Fe metallic backgrounds. For all pads tested, majority of carbonaceous compounds seems to be volatile. More work required to establish EC/OC procedures for brake dust
* PM2.5 emissions relatively high (compared to current and exhaust PM standards)
* Now in WLTP-brake cycle have to decide solid or all particles – there are organics. For ECE it is not so critical, for NAO it is important – this is however a global project. Decision needed on volatile particles. Large fraction of OC released below 400 deg C - do they condense? More study needed. Also need to think about common approaches to other methodologies like exhaust emissions.
* Is proposed to go forward with both solid and total particles and determine future based on data, repeatable, reproducibility.

1. **Presentation on the *“Estimated impact of future vehicle technologies on brake particle emissions”* and follow-up discussion (Florian Guckeisen – AUDI on behalf of the VDA Group)**

Note this question of how to deal with future vehicle technologies for brake particle emission reduction was raised at the request of the GRPE Jan 2018.

Mega-trends – digitalisation (connectivity), electrification of powertrains, autonomous driving – how might these impact brake particle emissions ?

Outlook for combinations of predictive efficiency, adaptive cruise control, C2X communications, regen braking (electric generator and friction brake in combo) – using friction brakes less means reduced temperatures, reduced brake pressure level and reduced brake particle emissions.

However

* A friction brake on todays’ technology might not reach bedded in conditions – effect of increased Brake Particle emissions
* Current brake disc pads do suffer on non-usage. Rusted surfaces could correspond to bad bedding in conditions and higher brake particle emissions.

How to take into account for the brake methodology ? One approach could be by using eco-innovation methodology.

Discussion on impact of regen braking and whether it works when battery 100% full also. Mass and number might reduce by different amounts because mass might be saved during low temp braking events, but PN might not reduce so much due to PN emissions as these come from higher pressure braking events. LiNK will follow up with info to TF1 as they are trying to replicate WLTC for blended regen / friction braking.

1. **Presentation on the activities of the SAE Brake Materials Environmental Task Force (Matt Robere – GM – Chairman of the TF)**

* USA phase out of copper
* SAE brake task force focus shifts to brake particle emissions, intention is to support PMP to develop one global set of brake emission measurement standards
* In the event of future NA regulation in this area, the TF will engage the full group to mechanise how to comply

PMP group welcomed Matt Robere’s participation in the meeting and the participation in harmonisation activities.

1. **Presentation on *“Preliminary investigations of morphology and composition of brake wear particles”* from a research project organized by Empa in collaboration with Horiba and Audi (Dr. Panayotis Dimopoulos Eggenschwiler – Empa)**

Brake materials (pads and discs) – cascade LPI for size separation of particles with 13 stages, then analysis by SEM / TEM. Smaller size particles appear to be agglomerates which are spherical containing calcium (Ca) – surprising. Above 100nm start to see non-spherical particles and more elements like iron, magnesium, zinc etc. increasing size class – aggregates with more irregular shapes and 330nm upwards see also F, Al, Sn, Mg, Cr W and smaller amounds of Ti, Ni and Ca (Note W= Tungsten)

1. **Presentation on the “Experimental investigation of tread wear and particle emission from tyres with different treadwear marking” from the measurement campaign conducted at the VTI, Sweden. Preliminary exchange of views on next steps in preparation for a full discussion at the next session. (Theo Grigoratos – JRC)**

Objective to explore relevance of expected tyre durability expressed as treadwear rating (TWR) for total tyre wear, as well as PM and PN from the interaction between the tyre and road surface. VTI road simulator – 5.3m diameter where any type of pavement can be applied.

Tested 5 tyres, on typical Nordic road surface, 20 deg C at constant 70 kmph.

* First 210 km for investigating total wear
* 3 days testing PM10, PM2.5(TEOM, dustTrak) and PN (APS, SMS)

Key findings:

* Mass loss does not correlate to TWR
* PM10 also does not correlate to TWR (by observation but not statistically significant) - opposite effect than expected
* PM2.5 10-15 ug/m3 – approx. 50% of the emitted particles PM2.5 (i.e. not only in coarse fraction) – due to low level of PM2.5, cannot use TWR to predict PM2.5 emissions
* PN concentrations were very low but from the complex day to day patterns, no conclusions can be drawn
* Bi-modal mass size distribution – with very wide peak at coarser size range 4-7um and another smaller at 1um. TWR does not appear to have any correlation.
* PN very low, unimodal distribution, peak at 20-30nm
* There is no general relation between TWR and measured tread mass loss or PM10 pm2.5 or PN concentration.
* Approx. 50% by mass of emitted PM10 fall within size range of fine particles
* Particle mass size bimodal distribution– coarse and fine peaks.
* Particle number size distribution is unimodal and is dominated by ultrafine particles

**Next steps Discussion:**

Need to update GRPE Jan 2019 on next steps re tyre / road wear particle investigations. There are still fundamental questions which have not been answered. PMP can not contain a full scale investigation. Most of the information comes from the TIP project because not many groups are covering this activity.

Suggested to Develop definition of tyre abrasion and methodology to measure it

* Could allow rating and need to confirm relationship between amount of released material and impact on AQ. Might be useful for EU Com work on microplastic emissions
* Development of methodology has been mandated at EU CO level in the iA accompanying the proposal – although unclear to whom the mandate is directed currently
* ETRMO indicated some feasibility considerations and said they were working internally and that a common definition of abrasion is available now. PMP requested this common definition from ETRMO.
* PMP also asked whether ETRMO could present a roadmap to next PMP.
* ETRMO noted that they have made a commitment to work internally and to keep the PMP group updated but will need further internal discussions on the scope of the collaboration with PMP etc.
* Michelin – noted that theoretic analysis should show why no correlation. TWR represents mileage you can drive on the tyre which is also based on total tread thickness not to particle emission. PMP will look into recalculating this.
* One participant mentioned very complicated to make abrasion loss tests because of driving style etc. weather – wet / dry. The Chair responded we are not far from that with measuring fuel consumption and this is done under a defined standard set of conditions.

1. **Update on the status of the participation of Marie Curie PhD Students to the PMP Face-to-Face Meetings.**

Postponed - Project will be resubmitted in 2019

1. **Arrangements for the next meeting**

* GRPE 07 June – PMP will summarise activities
* Next F2F ISPRA or Brussels depending on meeting rooms. Proposed 2 days during Nov 13-14-15. Subsequently date revised due to meeting rooms availability.

**End of Day 2**