

GTR - DEVELOPMENT GUIDELINES

Adapted from the approach suggested by AC.3.

Requires definition of the **Objective of the GTR** including problems to be faced.

The GTR format must be proposed with appropriate Test Procedures included.

The guidelines refer to a '**Compendium of Candidates**' ie. other Regulations in Braking which should be consulted.

Thus the preliminary work must:

Identify the significant Braking Regulations in current use and:

Identify any existing voluntary International Standards in Braking which might contribute to this GTR.

Preparation for the GTR should:

Generate the case for a GTR in passenger car braking which deals with the questions: **Is there a sufficient problem?**

If so, what is the nature and extent ?

Outline **OPTIONS** available for the **GTR structure** and consider their merits

Consider the other Braking Regulations listed in the Compendium

Agree the approach to the development of a GTR

Describe any additional research necessary and list any contentious issues.

**The Chairman has to request that a GTR-Working Group
be allowed to begin work on the draft.**

FORMAT of a GTR for BRAKING

Statement of the Technical Rationale and a justification.

Technical and economic feasibility and the anticipated benefits are to be set down.

Potential cost effectiveness has to be predicted.

General arrangement of the Text of the Regulation

Scope and Purpose Application vehicle range

Definitions General Requirements

Performance Requirements 1/ Test Conditions 1/ Test Procedures 1

Performance Requirements 2/ Test Conditions 2/ Test Procedures 2

Performance Requirements 3/ Test Conditions 3/ Test Procedures 3

and so on.

Which is not unlike Braking Regulations 13/13-H.

AN OVERVIEW OF ECE REG.13-H AND FMVSS 135 PHILOSOPHIES.

Reg.13-H appears the more formal document in which the concepts used in braking systems are detailed in the Regulation text. Construction requirements covering all parts of the of a passenger car braking system are set out in a way which shows a concern that manufacturers may otherwise be tempted to opt for provision shortcuts which could prejudice safe operation.

FMVSS 135 on the other hand is a smaller down-to-earth practical document which appears to accept that manufacturers can be trusted to supply braking systems of adequate design to be safe and effective or alternatively face a product liability disaster.

Reg.13-H has a directive approach which demands many detailed requirements but, gives these prescriptions in the expectations that conforming systems will have long-term effective and safe operation.

FMVSS 135 makes no long term prescriptions but checks that, during a short term testing sequence, there is no appearance of any impending durability problem.

Reg.13-H gives a guide to the performance tests which have to be made and an outline of how these need to be conducted. Interpretation of the detail and extent of the range of tests to be made is left to the Technical Services which have individual discretion over test order, test detail and all considerations of non-performance related checking of provisions.

FMVSS 135 provides a very precise specification of the test order, conditions and the actual processes to be followed when checking vehicle braking performance.

Reg.13-H requires a split braking system as the norm whereas FMVSS 135 accepts a non-split system.

For power braking systems, Reg.13-H defines the constructional requirements whereas FMVSS 135 introduces the philosophy of 'back-up' but only infers a failsafe operation from the required performance being achieved in the specific failure test.

FMVSS 135 does not set down basic terms such as Service, Secondary and Parking Braking and system elements such as Control, Transmission, Response and Energy Source/Reserve.

Therefore the prescriptions which are provided, cannot use these terms to ease the text. However, the performance tests are quite rigidly specified in order and procedure with stopping distance as the measure of results.

The philosophy on RBS is quite different as Reg.13-H, being concerned about pedal feel with variable RBS effectiveness, requires automatic compensation. This does not appear in FMVSS 135 so that the ruling must be more suited to systems having low levels of RGB.

Both rules require FAILURE WARNING but the requirements are stated to reflect different systems:

Reg.13-H, for conventional systems, deals with a main hydraulic failure through one of two detection means and accepts that this may use the Park Brake Applied warning. For more complex systems, the substantially increased warning requirements are set in widely spaced sections of the text and the two-level warning means are defined separately from the sources of failure detection.

FMVSS 135 introduces a warning indicator section which certainly facilitates a multiple indicator arrangement and lists all the sources of failure which have to activate the warning(s).

Labeling and warning function checking are dealt with in detail.

GTR BRAKING. - Preparation – Critique of existing Regulations.

Reg.13-H Paragraphs which might be amended to make requirements more easily and widely understood.

- 2.3. Braking Equipment - so basic as to be unnecessary.
- 2.6. Brake - for cars this is so basic as to be unnecessary.

- 5.1.1.6. 10ms interruption of the 'failure signal'
- 5.2.3. Failure of Warning means - must not cause loss of brakes. (Text change?)
- 5.2.4.1. Half system – Devices activated automatically or when **STATIONARY**?
- 5.2.8.1.2. Braking compensation - leave only transverse compensation.
- 5.2.14.1. Stored energy warning signal - easily mis-understood (Minor text change?)
- 5.2.15. Servo Park brake - only likely on trucks.
- 5.2.17. Provisions for electrically braked trailers - **Needed still ?**

- 5.2.20.2. Single Temporary Failure. - Related to 11992 CAN link only.

- Ax 3 1.4.1.2.1. Vehicle load patterns - Heavy duty vehicle applications.

- 2.3.5. Parking brake with several actuations – Not on light vehicles.

- 5.1.14.2./Ax 4.1.3. Possible rewording to make more easily understood in a Global text.

FMVSS 135 - Selected Comments.

This regulation appears to assume a 'Standard Braking System' with fundamental characteristics taken for granted. **Should this approach be adopted ?**

RGB rules appear to be written for Electric vehicles with motors connected directly to the wheels and this is not the likely arrangement with Hybrids and perhaps not with Fuel Cell powered vehicles. This creates disconnection difficulties.

However 135 does not include the following braking system requirements:

- 1 Power system charging time.
 - 2 Necessity for a Split Braking system.
 - 3 Redundant element rule
 - 4 Phasing of multiple braking sources.
 - 5 Response time and mfdd.
 - 6 Parking Brake dynamic performance.
 - 7 Unbraked trailer tests
 - 8 ABS performance.
 - 9 Rules covering EPB.
 - 10 Rules covering EHB.
 - 11 Compensation rules.
 - 12 Safety Concept of electronic control systems.
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Terms and Fundamentals in Reg.13-H which are considered useful.

Transmission: Energy and Control.

Graduated braking: Control.

Application: - of the Control.

Actuation: - of the brakes.

Service Braking System. (Used but not defined in 135)

Secondary braking System. Only 1 fault at a time (**which appears to be a satisfactory concept**).

Statement about parts not considered likely to fail.

Energy source drive: to be as safe as possible.

Split Service Braking system is not a term used but is inferred in 5.2.2.6.(Used in 135)

Full Power system: 2 energy reserves / transmissions - **Secondary performance on each.**

No redundant elements: lying 'permanently' dormant.

Symmetrical Distribution: - Compensation.

Electric Control Transmission.

EPB and EHB

Braking (surfaces) sources disconnection ?

Dual sources of braking: - Friction braking + RBS - Phased Blending.

Low Energy warning. (used in 135 also)

Braking Rate (135: Braking ratio - Confusion with front/rear ratio?)

Response time

Dynamic Parking brake performance.

POINTS OF AGREEMENT in Braking Equipment Requirements:

Service Braking: Acts on all wheels.
Control underfoot.

Independent controls for Service and Parking.

Brakes have automatic wear adjustment.

Wear checking and/or warning facilitated.

Regenerative Braking as part of Service Braking system.

If ABS is installed – No manual disable allowed.
ABS must also control RBS.

Master Cylinder Reservoir Section for each half system.

Reservoir Capacity defined for master cylinder or power system. (with a slight difference)

Reservoir labels. (except for a slight difference)

Fluid level indication: Transparent or level detector.

Main Warning: Low fluid level or differential pressure.

Warning given: when fault is present and IGN is ON.

Warning signal checking defined and quite similar.

Failure in Transmission: remaining section to give 'secondary' performance.

<u>Braking Performance:</u>	
Cold effectiveness/Type 0 in neutral	6.43 m/s ²
High speed effectiveness/Type 0 in-gear	5.76 m/s ²
Energy source – sudden failure	6.43 m/s ²
Failed ABS	5.15 m/s ²
Failed proportioning	3.86 m/s ²
Hydraulic circuit failure laden/unladen	2.44 m/s ²
Energy failure	2.44 m/s ²
Park brake static - holding gradient (in either up/down direction)	20 %

POINTS of CLEAR DISAGREEMENT	
FMVSS 135	Regulation 13-H
<p><u>Test explanation.</u> Includes clear and detailed definition and a strict sequence of tests.</p> <p><u>Checking.</u> None required</p> <p><u>Burnish</u> Lengthy procedure defined precisely.</p> <p><u>Warning Signals.</u> 1 level only (RED) could be multiple signals Constant or Flashing allowed Messages defined if multiple signals.</p> <p><u>Warning signal test.</u> Automatic function or Manual on demand.</p> <p><u>RBS as part of Service Braking system</u> Disconnection not allowed. (Is this Practical ?)</p> <p><u>Fade and Hot tests with RBS.</u> Use auxiliary means to accelerate to set speed.</p> <p><u>Tests in Neutral.</u> These have to include RBS component but this is often impractical.</p> <p><u>Braking Distribution.</u> Calculation is not allowed. Must be tested.</p> <p><u>Torque Wheel Tests.</u> Rear utilization to lie below $z = 0.9k$.</p> <p><u>ABS:</u> Only failed performance defined.</p> <p><u>Park Brake dynamic.</u> Not required Only static hill hold required.</p>	<p><u>Test explanation.</u> Technical Services decide individually how to make the tests. ISO 6597 may be an explanation for others.</p> <p><u>Checking.</u> Required but not given</p> <p><u>Bedding</u> left to manufacturer to accomplish before submission for test.</p> <p><u>Warning Signals.</u> 2 levels: yellow (care), RED (Stop). Constant only allowed. No definition of source mandated but this would be an option.</p> <p><u>Warning signal test.</u> Automatic start-up test only. Fault memory required for sensor faults</p> <p><u>RBS of Category B.</u> Disconnection is allowed but loss of RBS must be compensated using friction braking.</p> <p><u>Type 1 and Hot tests with RBS_B.</u> Use attainable speed after first cycle as specified.</p> <p><u>Tests in Neutral.</u> These do not have to have RBS component but the lack of RBS has to be compensated.</p> <p><u>Braking Distribution.</u> Calculation allowed. May be tested (optional).</p> <p><u>Torque Wheel Tests.</u> Rear utilization must lie below fronts. Same as 135 for Conformance checks.</p> <p><u>ABS:</u> Performance defined in detail.</p> <p><u>Park Brake dynamic.</u> Test from 30 km/h and performance defined.</p>

POINTS of MINOR DISAGREEMENT	
FMVSS 135	Regulation 13-H
Fluid min. level Detected at 25%.	Min. level not specified. Manufacturer allowed to decide
Fluid capacity - Defined on max. fluid usage over full lining wear range.	Capacity same but relaxed if Fluid Level warning is fitted.
Full Power Systems - pressure fall: Warning to be given at 50% of normal pressure.	Warning based on No of applications remaining
Tests - at v_{max} Test at nearest multiple of 5 km/h below the speed attainable in 3.2 km.	Test at v_{max} if the higher specified figure is not attainable.
Tests - steering correction Permitted during each stop	Tests - steering correction Specifically allowed only on low adhesion ABS and RBS stops
Hot Performance Control Force allowed: Specified as no greater than that used in the shortest 'Type 0' test. Number of stops required/allowed: 2 stops are required: – 1 st to achieve 60% and 2 nd at full force to achieve 75% criteria.	Control Force allowed: Specified as no greater than the mean force used in the Type 0 test. 1 stop is accepted if the criteria is reached but 2 nd at full force if needed to achieve 75%.
Wheel locking order 2 surfaces are specified for the tests.	2 surfaces have to be inferred as they are not stated.
Park Brake Holding test Initial brake temperature: 65 –100°C	Any level below 100°C is accepted

GTR DEVELOPMENT

A PROBLEM which should be ADDRESSED BEFORE STARTING

The set of rules must be acceptable to all users of Federal Regulations.
This raises the question:

What is it about Reg.13-H which is preventing USA signing up to the current Harmonized Standard ?

A GTR needs to have means for accommodating:

- a) Type Approval
- b) Self Certification

Essential characteristics for such a GTR servicing a Global Market

Complete statement of Constructional & Operational requirements.

Precise specification of checking and testing procedures.

A GTR adequately covering these requirements will clearly be a sizeable document.

Possible structure for a GTR – Braking for Passenger Cars

- A A modified version of Regulation 13-H
- B An extended version of FMVSS 135
- C A combination of these Regulations - Several possibilities exist.

A Modified version of Reg.13-H

- 1 Definitions – a composite list but only those necessary.
Approval arrangements - Not included in the GTR.
- 2 Specification - of an up-to-date passenger car system.
Equipment and functional requirements
- 3 System Characteristics - specified in detail
- 4 Preferred layout - Regulation and a series of Annexes ?

Annex – Braking tests and Performance requirements (as current).
General test conditions set out and sequence specified.
Procedure for each test explained in detail.

Annex – Energy system requirements and tests – procedures.

Annex – Braking distribution requirements and tests

Wheel lock sequence tests

Torque wheel tests

Annex – ABS tests with more explanation (e-motor energy only ?)

Annex – Tests for EPB and EHB systems.

Annex – Complex electronic vehicle control systems requirements.

[Is the current Annex 7 needed in a passenger car Braking GTR?]

B Extended version of FMVSS 135

- 1 Definitions extended
- 2 Constructional and operational requirements extended.
- 3 Failure warnings – increased to 2 levels.
- 4 General test conditions - ambient, road and vehicle
conditions + instrumentation.
- 5 Procedural conditions for the tests.
- 6 Test sequence – extended to include ABS and Park brake dynamic.
- 7 Safety concept (as Annex 8) added.
- 8 Approval procedure added.

This will be simpler – but would it be adequate ?

C An example based on the COMBINATION of R.13-H & FMVSS 135.

Principles embodied:

Keep all the requirements together? - Should we now ask why are energy sources, braking distribution and ABS treated separately in R13-H.

Is this due to historical development? **Should this now be changed?**

Detailed test procedures must be included.

Is it advisable to keep all such test procedures grouped together or **should these and the prescriptions be in sections?**

Proposal - Use Appendices only for special test instructions.

Content

- 1 List of definitions including ABS/EBS.**
- 2 Braking system specification:
Equipment, ground rules and functions.**
- 3 Characteristics Required:
as R.13-H with: energy provisions and response timing
distribution rules
ABS, EPB and EHB requirements
Annex 8 safety concept declaration.**
- 4 Test sequence list + performance requirements.**
- 5 Testing method fundamentals.**
- 6 Detailed test methods – following a set sequence.**
- 7 Appendices:
Brake temperature measurement
Battery SoC assessment
Park brake force apply point?
Adhesion utilisation and selection of low adhesion surface.**

DECISIONS NOW NEEDED to SHAPE the GTR

Scope of the GTR in terms of vehicle type and weight range

Level of construction/operation prescription (as 135 or 13-H)

Inclusion of precise checking & testing procedures.

Preference for following the pattern of 13-H or 135.

**Influence of Braking Regulations other than 13-H & 135.
(Those having a contribution which will be usefully included in a GTR)**

Layout of the GTR Braking.

How to include the Annex 8 Safety Concept declaration.
