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Original

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**Specific sub-system requirements (traction, braking, etc.) for
EMU/DMU, locomotives and driving coaches
(Rolling stock sub-system requirements, requirements for
economic purposes, requirements for railway
standardisation)**

*Exigences spécifiques vis-à-vis des sous-systèmes (sous-systèmes de traction, freinage, etc.), des rames automotrices électriques et diesel, des locomotives et des cabines de réversibilité
(Exigences vis-à-vis des sous-système du matériel roulant, exigences liées à des motifs économiques, exigences de standardisation ferroviaire)
Spezifische Teilsystemanforderungen (Traktion, Bremswesen usw.) für Elektro- bzw. Dieseltriebwagen, Lokomotiven und Steuerwagen (Anforderungen an Teilsysteme des Rollmaterials, Anforderungen an Wirtschaftlichkeit, Anforderungen an die Standardisierung der Bahnfahrzeuge)*



UNION INTERNATIONALE DES CHEMINS DE FER
INTERNATIONALER EISENBAHNVERBAND
INTERNATIONAL UNION OF RAILWAYS

Leaflet to be classified in Volume:

VI - Traction

Application:

With effect from 1st October 2009

All members of the International Union of Railways

This leaflet applies to all lines and rolling stock in the scope of this leaflet.

The provisions in this Leaflet are applicable to the rolling stock concerned.

This leaflet does not replace European legislation (TSIs, including specific/national cases).

Record of updates

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First issue

The person responsible for this leaflet is named in the UIC Code

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Summary

This leaflet:

- specifies requirements for main sub-systems, especially for traction and braking, for EMU/DMU, locomotives and related driving coach driver cabs.
- specifies requirements to increase economic performance and ensure standardisation of rolling stock.

1 - General

This specification describes rolling stock sub-system requirements especially regarding economical impacts and standardisation of the rolling stock in the railway system.

Aim of this leaflet	Use	Verification
Define the target condition in order to avoid project specific engineering of common rolling stock functions.	Minimise the scope of interpretation for solutions that meet the requirements, identify deviations/non-compliance of functional requirements.	Comparison between target/actual "specification ↔ manufacturer's solution".
Provide precise definition of functional requirements to avoid or minimise functional changes or restrictions due to technical changes/innovations. Functional changes are acceptable if there are proven cost-effective LCC advantages (e.g. fault reduction and training expenditure) or in the case of mandatory regulations (i.e. TSI including specific cases). Provide comprehensive physical interface specifications to ensure interchangeability, irrespective of the supplier.	Clear definition of consistent functional interfaces (standardisation) enabling innovative design at module level: old components can easily be replaced with new ones.	- Costs of • spare parts • maintenance • repair - Compliance with regulations and directives.
Retain known operational driver procedures, while at the same time trying to simplify them	Reduce training expenditure.	Training costs.
Avoid operational errors by using self-explanatory and fault-tolerant functions, greater automation and diagnostics.	Increase reliability.	- MTBF - Experience and User Feedback.

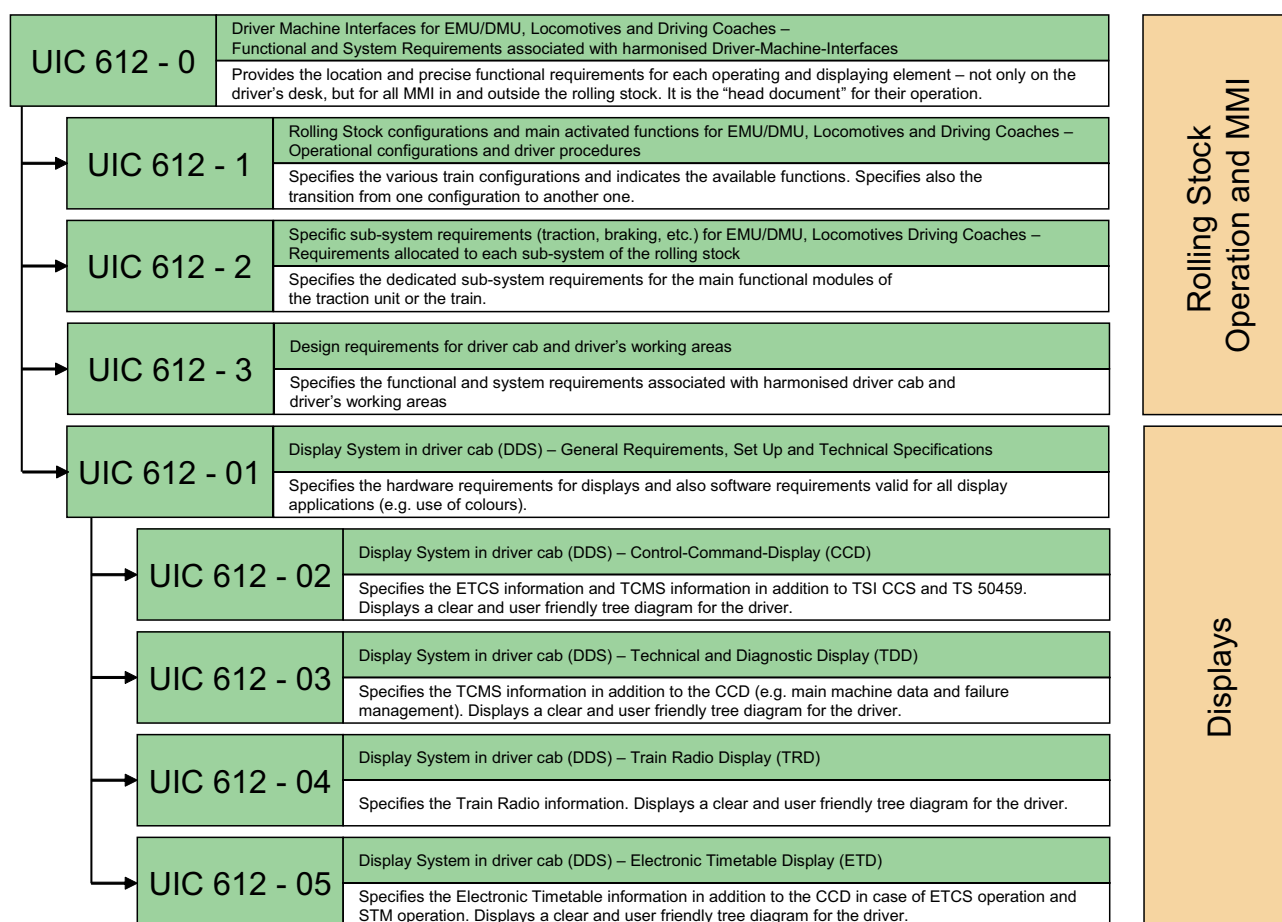


Fig. 1 - Hierarchy of UIC Leaflet 612 series

2 - Definitions

See *UIC Leaflet 612-0* (see Bibliography - page 36)

3 - Traction and electrical equipment

3.1 - General

Limit values depend on the network's operating provisions, routes (sections) and specific operating conditions. TCMS (see [List of abbreviations - page 34](#)) shall apply those limits related to the selected network, if the requested data is available.

Generally, special attention must be paid to limit values in multiple traction operations. All automatic limitation options - especially in multiple traction - should be applied to EMU/DMU (see [List of abbreviations - page 34](#)) and locomotives. However, in specific cases the driver shall be able to cancel a predefined limit value and intentionally select or set an alternative limit value in the TDD (see *UIC Leaflet 612-03*). This action taken by the driver action shall be stored in the TCMS memory. In case of predictable constraints due to this driver action, TCMS shall notify such constraints to the driver via TDD (see *UIC Leaflet 612-03*). The driver is then responsible for complying with the new limit value and any pursuant constraint due to this choice.

3.2 - Maximum traction force (T)

The following requirements apply to conventional trains in flexible formation.

The train's traction force shall be limited according to the mechanical strength of the coupler and the risk of derailment or track shifting resulting from compressive forces (see also point [4.3 - page 22](#)).

The limit value for any single EMU/DMU or locomotive in the train shall depend on the amount and position of all EMU/DMU and locomotives in the train, if train-wide communication is in use.

Limits due to mechanical strength of the coupler:

UIC screw coupling	T	< 450 kN
Strengthened UIC screw coupling ("white point carriage")	T	< 550 kN
Auto coupler ("UIC uni coupler") traction/compressive force	T	< 600 kN

Reason: risk of train separation

The above mentioned mechanical limit values for specific types of couplers already include a safety margin for preventing the coupler from breaking . The limitation of traction forces stretching the train may partially encroach on these safety margins depending on driving rules and line characteristics. Consequently, network or operator specific limits on traction forces in a train still exist.

Standard TCMS settings limiting the maximum traction force in a train (nominal limits for pull-operation with a standard coupler):

DB	450 kN (The driver may select deviating limits in the TDD, see <i>UIC Leaflet 612-03</i>)
SNCF	500 kN
SBB/BLS	550 kN
TI	600 kN

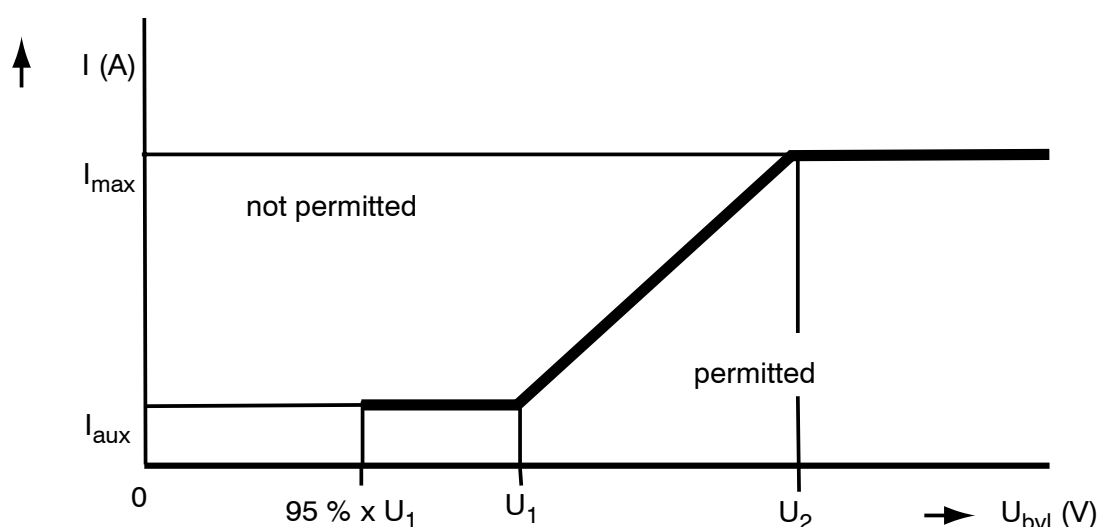
Such limits shall be managed by the master unit in the case of train-wide communication between all working EMU/DMU and locomotives in the train, e. g. based on *UIC Leaflets 556 and 647*.

3.3 - Maximum overhead current (contact wire current - I_F)

Basic TCMS settings limiting the maximum total overhead current for a train:

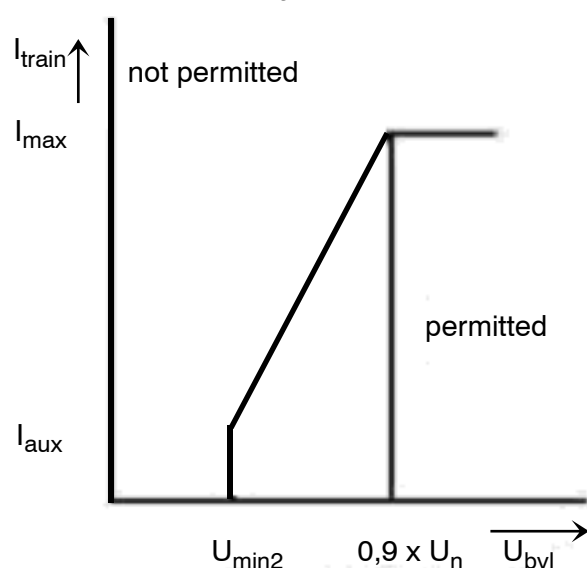
- DB: 600 A
- Trenitalia (for 540 mm² catenary, DC 3 kV): 3000 A
- NS (1,5 kV): 4000 A up to 1350 V, linear current limit between 1350 and 1000 V and zero current below 950 V
- NS (25 kV): 800 A up to 22,5 kV, then linear decrease to 0 from 22,5 kV to 17,5 kV.

Current limits for NS 1500 V DC system



in which: $U_1 = 1000$ V; $U_2 = 1350$ V; I_{aux} = current for train auxiliaries; $I_{max} = 4000$ A;

Current limits for NS 25 kV AC system



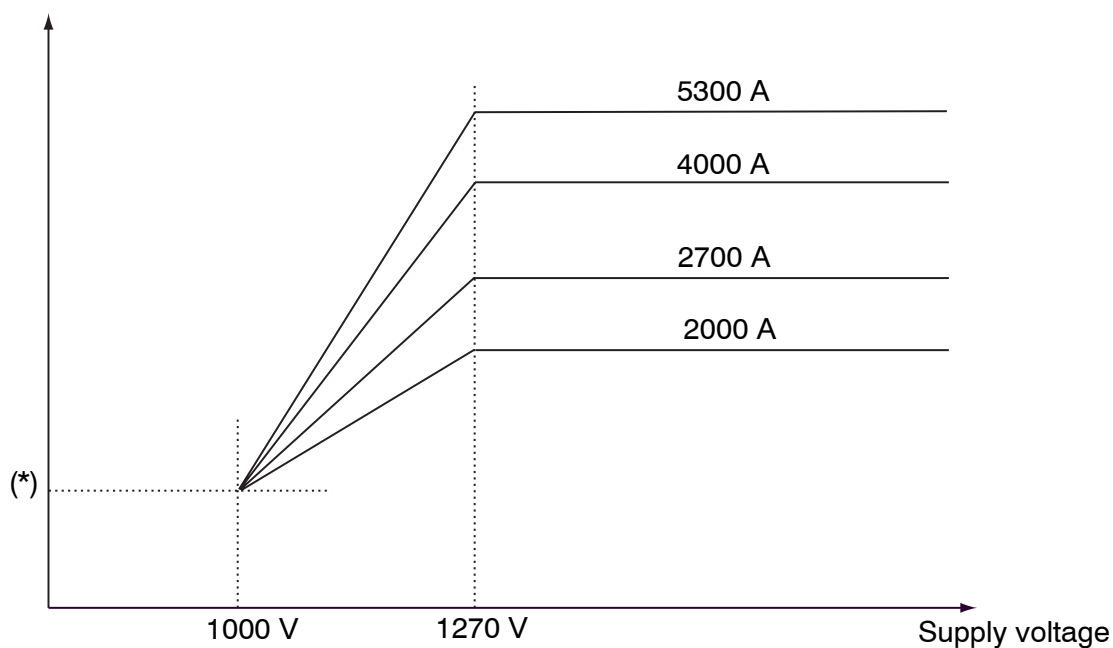
in which: $U_{min2} = 17,5$ kV; $U_n = 25$ kV, I_{aux} = current for train auxiliaries; $I_{max} = 800$ A;

Fig. 2 - Overhead current limits (NS)

SNCF:

1500 V DC supply

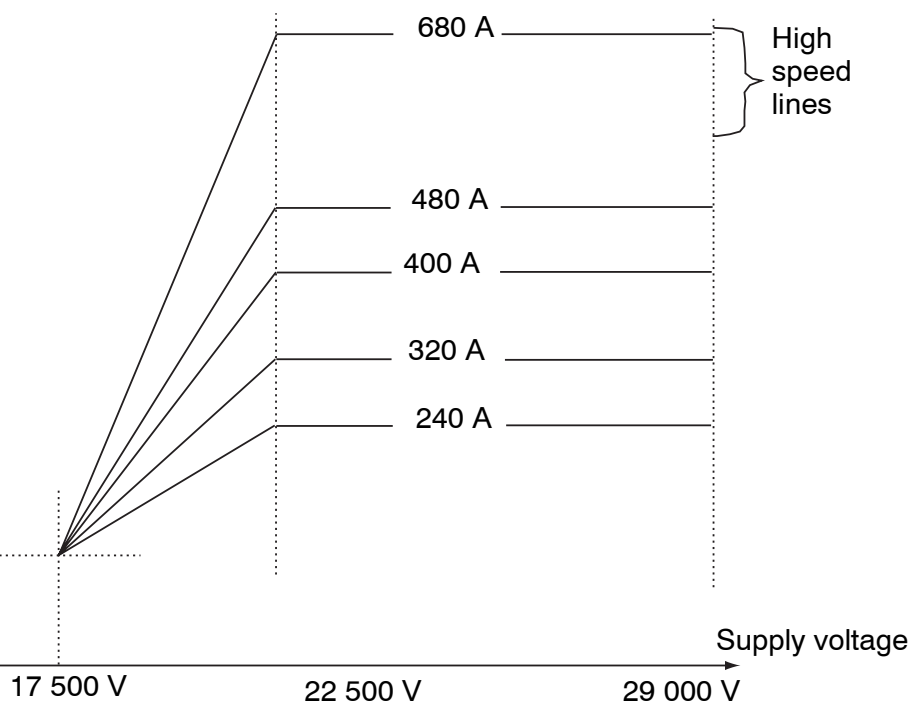
Total current at
pantograph (A)



25 kV AC supply

Total current at pantograph

(*)



(*) Minimum consumption (auxiliaries without traction)

Fig. 3 - Overhead current limits (SNCF)

3.4 - Pantograph

3.4.1 - Prerequisites for raising the pantograph

All the stated criteria must be met at the same time!

- Driver's ID inserted (see *UIC Leaflet 612-0, pos. 036*) (see Bibliography - page 36) and Direction of Travel set to "F", "R" or "N" (see *UIC Leaflet 612-0, pos. 033 - 035*).
- Main circuit breaker is switched off.
- "Connecting to earth" device (*UIC Leaflet 612-0, pos. 510*) in "I"-position.
- Compressed air of 4,5 bars provided by the BP in a degraded situation (in order to obtain external air-supply just by coupling the BP until the pantograph has been lifted).
- No condition for lowering is pending (see point 3.4.2).
- LSS for pantograph control is switched on.
- In case of manual current selection or degraded mode: right pantograph selected.

3.4.2 - Automatic lowering of the pantograph

One criterion alone is sufficient!

- Set operating element "Pantograph" (see *UIC Leaflet 612-0, pos. 016*) to "down" position.
- Only in certain networks (triggered by TCMS): Operate the "Emergency stop valve" (*UIC Leaflet 612-0, pos. 010*).
- Switch off the operating element "preparation / shut-down" (*UIC Leaflet 612-0, pos. 508*).
- Turn the "connecting to earth" device (see *UIC Leaflet 612-0, pos. 510*) to "0" position.
- Command "Pantograph down" by TCMS.
- Change of pantograph if the newly selected configuration for the pantograph does not contain the previously raised pantograph anymore (reason: to avoid an arc if the new pantograph cannot be raised, e.g. due to freezing).
- Pressure level less than 4,0 bars in the "pantograph" separate compressed-air reservoir.
- LSS for pantograph control is switched off.
- **Only for slave EMU/DMU and locomotives:** maximum duration for interruption of train-wide communication > 1,5 s.
- **Only for radio remote control:** Radio control active **and** BP < 2,5 bars **and** interrupted radio contact.
- **Optional:** A contact strip defect has been detected (see below).

3.4.3 - Contact strip defect monitoring (see also *EN 50206* - see Bibliography - [page 36](#))

When the contact strip defect monitoring function is activated by the breakdown of a pantograph contact strip, it must automatically

- lower all pantographs in the train, if train-wide communication is available, and
- request a full service brake performed by the master unit, which can be released by filling the stroke position of the driver's automatic brake controller (see *UIC Leaflet 612-0, pos. 032*) or by a soft key indicated by the help text in the TDD (see *UIC Leaflet 612-03* - see Bibliography - [page 36](#)) in the activated cab of the master unit and
- send a fault message specifying the affected pantograph in the TDD (see *UIC Leaflet 612-03*).

The pantograph is not affected (= no contact strip defect has been detected) and can be raised again immediately.

3.5 - Main circuit breaker

3.5.1 - Prerequisites for switching on the main circuit breaker

All the stated criteria must be met at the same time!

- Driver's ID inserted (see *UIC Leaflet 612-0, pos. 036*) and Direction of Travel set to "F", "R" or "N" (see *UIC Leaflet 612-0, pos. 033 - 035*).
- Traction / dynamic brake controller on the activated main or auxiliary driver's desk has been set to "OFF" / "0" position (see *UIC Leaflet 612-0, pos. 020* ("OFF"), 032b ("0") → "zero position acknowledgement").
- "connecting to earth" device (*UIC Leaflet 612-0, pos. 510*) in "I"-position.
- If the design of the main circuit breaker needs air to be switched on: Compressed air of 4,5 bars provided by the BP in a degraded situation (in order to obtain external air-supply just by coupling the BP to switch on the main circuit breaker).
- No criterion for automatic lowering of the pantograph (see point [3.4.2 - page 8](#)) is pending.
- LSS for main circuit breaker is switched on.
- At least one pantograph is raised.
- Overhead line voltage is energised within specified limits.
- Contactors for electrical Train Heating / Power supply are switched off.
- Main circuit breaker is switched off.
- Switching on the main circuit breaker is permitted by TCMS.
- For multi-system EMU/DMU and locomotives: AC/DC selector switch is in the correct position.
- Permission by certain automatic train control systems (e. g. KVB, RPS, ATSS, SCMT, ETCS - see List of abbreviations - [page 34](#)).