GOBIERNO DE ESPAÑA | MINISTERIO DE FOMENTO | MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE | CEDEX CENTRO DE ESTUDIOS Y EXPERIMENTACIÓN DE OBRAS PÚBLICAS | UIC

24th January 2018
T&S–TTI common meeting

UPDATE OF UIC LEAFLET 719 & 722 INTO IRS

Dr. José Estaire (*Head of CEDEX Track Box – CEDEX)*
David Villalmanzo (*Infra Senior Advisor Rail System Dept. – UIC)*

Summary

1. Main Objective
2. Meetings-Members
3. Working Groups
4. IRS Design
5. IRS Maintenance

1. Main Objective

Technical and Format Update of

UIC Leaflet 719

"Earthworks and Track bed construction for Railway Lines"

&

UIC Leaflet 722

"Methods of improving the track formation of existing lines"

Into

International Railway Solution (IRS)

IRS Design of Earthworks and Track Bed for Railway Lines

&

IRS Maintenance and Improvement of Earthworks and Track Bed of Existing Railway Lines

2. Meetings-Members

1st meeting – Paris – May-2016
2nd meeting – Madrid – September-2016
3rd meeting – Paris – October-2016
4th meeting – Madrid – March-2017
5th meeting – Madrid – October-2017
6th meeting – Madrid – March-2018

(Presentation of the final draft of IRS Design)

2. Meetings-Members

- UIC
- CEDEX
- ADIF
- Deutsche Bahn
- Infrabel
- IP Engenharia
- MÁV
- SZDC
- TRAFIKVERKET
- NETWORK RAIL
- RFI
- SBB
- SNCF
- SYSTRA

+ China Railway Corp./CARS

3. Working Groups

(and corresponding Work Packages)

- **WG#1: Soil classification and materials**
- **WG#2: Transition zones**
- **WG#3: Design criteria**
- **WG#4: Asphalt & bituminous layers**
- **WG#5: Soil treatment**
- **WG#6: Hydraulic sensitivity, drainage, flood risk, soil liquefaction,…**

4. IRS Design comes from UIC Leaflet 719 *Earthworks and Track bed construction for Railway Lines*

Current UIC Leaflet 719

Contents

Chapters 1.1.4. and 3. will go into IRS Maintenance Contents

4. IRS Design New proposal for TABLE OF CONTENTS

4. IRS Design New proposal for TABLE OF CONTENTS detailed

4. IRS Design

1. Introduction and scope
2. Definition of the cross section of a railway structure
   - 2.1 Ballasted track
   - 2.2 Slab track (Ballastless track)

- Definition of railway track section
- Superstructure/understructure
- Track bed layer: Ballast+Subballast

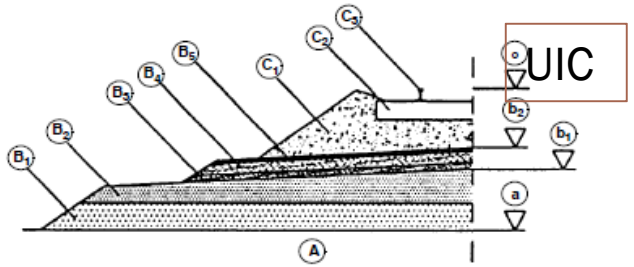
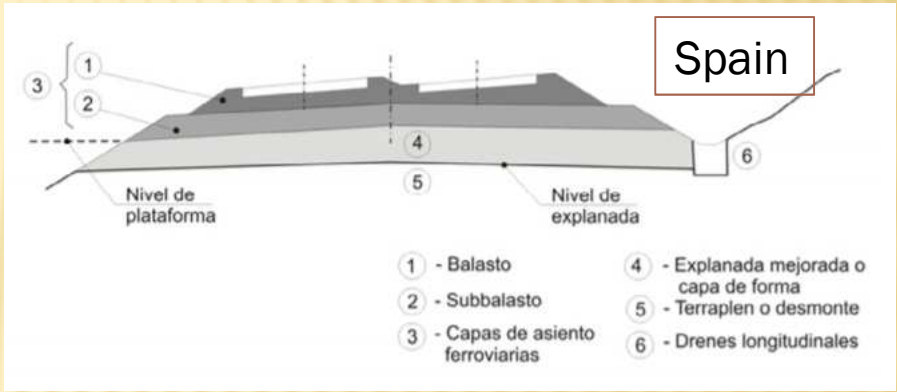
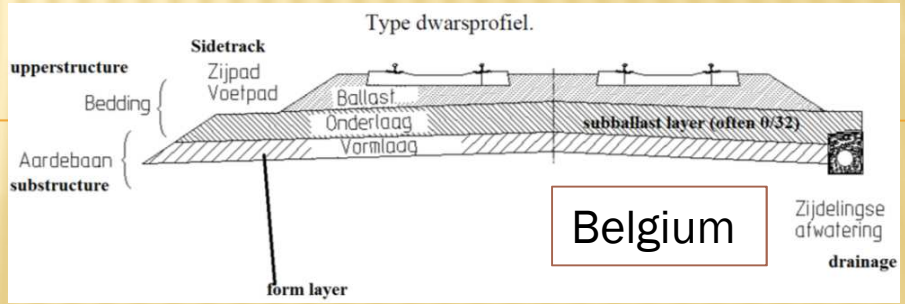


Fig. 31 - Schematic cross-section

Table 2 : Terms and examples

	Layers		Surfaces		Examples of materials used
Super-structure	C3	Rail surface	c	Running	(rail top) - Rail steel
	C2	Sleeper			- Timber - Steel - Concrete
	C1	Ballast			- Crushed hard stone
Infra-structure	B5	Sub-ballast layer	b2	Blanket layer	- Bitumen cover - Mineral aggregate
	B4	Foundation layer			- Sandy gravel I, II, 100, 120 - Sandy gravel CFF
	B3	Filter layer			- Sand - Geotextile
	B2	Prepared subgrade	b1	Prepared subgrade	- Compacted - Replacement fill - Stabilisation
	B1	Embankment			
	A	Natural subgrade	a	Surface of natural subgrade	



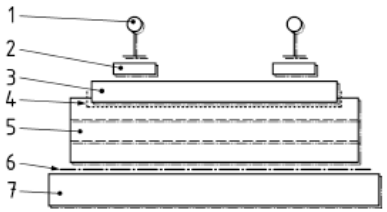


4. IRS Design

1. Introduction and scope
2. Definition of the cross section of a railway structure
   - 2.1 Ballasted track
   - 2.2 Slab track (Ballastless track)

5.1 Ballastless track system, subsystems and components

A ballastless track system may consist of (but is not limited to) following levels of subsystems and components shown in Figure 1.



Key	Item	Type
1	**Rail/switch and crossing**	**Subsystem**
2	**Fastening system /system for embedded rail**	**Subsystem**
-	Clip, clamp, rail pad etc.	Component
-	Adhesive	Component
3	**Prefabricated element**	**Subsystem**
-	Sleeper, block	Component
-	Slab, frame	Component
4	**Intermediate layer, boot, fixation**	**Subsystem**
-	Concrete filling layer	Component
5	**Pavement**	**Subsystem**
-	Single-, multi-layered pavement	Component
-	Base layer	Component
6	**Intermediate layer**	**Subsystem**
-	Foil, sheeting	Component
-	Compensation layer	Component
7	**Substructure**	**System**

Figure 1 — Ballastless track system - subsystems and components

- ✓ Use of Slab Track section from

EN 16432-2:
Railway applications - Ballastless track systems - Part 2: System design, subsystems and components

- ✓ Include “angular distortion” and “settlements” as slab track design criteria.

4. IRS Design

3. Classification of materials for railway structures
   3.1 Materials for subgrade or infrastructure
      3.1.1 Definitions
      3.1.2 Classification of soils and rocks

PRINCIPLES

- ✓ Concepts for UIC Materials groups (QSi) are kept
- ✓ Classification according to **EN 16907-2 "Earthworks. Classification of materials"**
- ✓ Classification based on test results

4. IRS Design

3. Classification of materials for railway structures
  3.1 Materials for subgrade or infrastructure
    3.1.1 Definitions
    3.1.2 Classification of soils and rocks

- ✓ According to EN 16907 "Earthworks"
- ✓ By Tests:
  - Particle size distribution
  - Plasticity
  - Organic Material Content test
  - Soluble Sulphate Content test
  - Soluble Salt Content test
  - Proctor test
  - CBR
  - Swelling test
  - Collapse test

Parameter	QS0 Unsuitable material	QS1 Poor material	QS2 Average material	QS3 Good material
Geotechnical classification (Soil group symbol according to Tables 3a-3e)	CIV – CIE MOSa – MOSi MOCi - PE	ISL – ISH SIL – CIL SIM – CIM CIH – LOSa LOSi – LOCi	GrN – SaN CGrW - CGrN CSaW - CSaN	GrW-SaW
Organic material content (%)	>6	<6	<2	<1
Sulphate content (SO_3%) (Tabla 4d pr 16907)	>10	<10	<1	<0.1
Soluble salt content(%)	>1	<1	<0.5	<0.2
CBR	<3	>3	>5	>17
Free swelling (%)	>3.0	<3.0	<2.0	<1.0
Collapse (%)	>2.0	<2.0	<1.0	<0.5

Classification of Soils

4. IRS Design

Parameter	QS1 Poor material	QS2 Average material	QS3 Good material
Fragmentability (NF P 94-66)	FR ≥ 7 %	FR < 7 %	FR < 7%
Degradability UNE 146510	DR > 2% *DR > 20%	DR ≥ 2% 5 ≤ DR ≤ 20%	DR < 2% DR < 5%
Micro Deval (EN 1097-1)	MD >40	25 < MD ≤40	MD ≤25
Los Angeles Index test (EN 1097-2)	LA >40	30 < LA ≤40	LA ≤30
Slake Durability Test		>70% (ADIF)	
Soluble Sulphate Content (%)			<1%
Soluble Salt Content (%)			
Organic Material content (%)			<2%
Density (EN 1097-6)	<1,7 t/m^3	≥1,7 t/m^3	≥1,7 t/m^3
Unixial Compression Strength	< 5 MPa	5-50 MPa	>50MPa

- ✓ According to **EN 16907 "Earthworks"**
- ✓ By Tests:
  - Particle requirements
    - Fragmentability (NF P 94-66)
    - Degradability (UNE 146510≈ASTM D 4644, and NF P 94-67)
    - Micro Deval (EN 1097-1)
    - Los Angeles Index (LA) (EN 1097-2)
    - Slake Durability Test (¿?)
  - Chemistry requirements
    - Soluble Sulphate Content test
    - Soluble Salt Content test
    - Organic Material Content test
  - Strength requirements
    - Density (EN 1097-6)
    - Uniaxial compression test

Classification of Rocks for filling purposes

4. IRS Design

- ✓ According to **EN 16907 "Earthworks"**

3. Classification of materials for railway structures
- 3.1 Materials for subgrade or infrastructure
  - 3.1.1 Definitions
  - 3.1.2 Classification of soils and rocks

- ✓ By Tests:
  - Chemistry requirements
    - Soluble Sulphate Content test
    - Soluble Salt Content test
    - Organic Material Content test
  - Strength requirements
    - Density (EN 1097-6)
    - Uniaxial compression test
    - Deformation modulus in static plate test (Ev2)

Parameter	QS0 Unsuitable material	QS1 Poor material	QS2 Average material	QS3 Good material
Soluble Sulphate Content (%)	--	--	--	<1%
Soluble Salt Content (%)				
Organic Material content (%)	--	--	--	<2%
Density (EN 1097-6) (¿?)	--	<1,7 t/m^3	≥1,7 t/m^3	≥1,7 t/m^3
Unixial Compression Strength	--	< 5 MPa	5-50 MPa	>50MPa
Deformation modulus in static plate test (Ev_2 - MPa)	<12,5	12,5<E_{v2}< 25	25< E_{v2} <80	E_{v2}>80

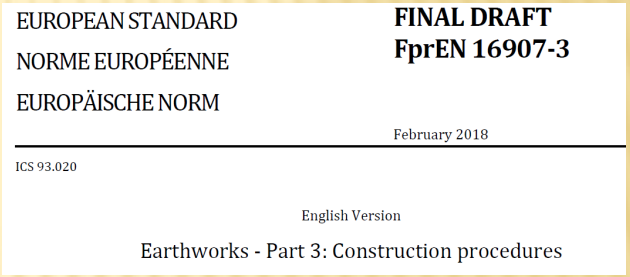
Classification of Rocks as railway structure support

4. IRS Design

4. Earthworks and track bed layers for new lines

PRINCIPLES BASED ON

- ✓ Material coming from current UIC 719
- ✓ Ideas coming from **EN 16907**
  - ✓ Part 3 " Construction procedures"
  - ✓ Part 4 "Soil treatment with …"
  - ✓ Part 5 "Quality control"



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

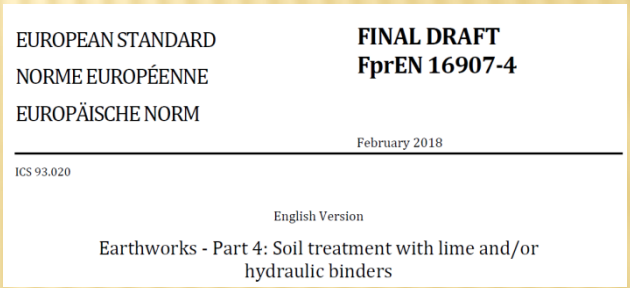
FINAL DRAFT
FprEN 16907-3

February 2018

ICS 93.020

English Version

Earthworks - Part 3: Construction procedures



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

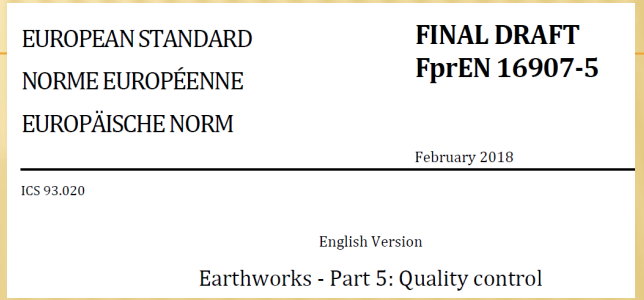
FINAL DRAFT
FprEN 16907-4

February 2018

ICS 93.020

English Version

Earthworks - Part 4: Soil treatment with lime and/or hydraulic binders



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

FINAL DRAFT
FprEN 16907-5

February 2018

ICS 93.020

English Version

Earthworks - Part 5: Quality control

4. IRS Design

5. Transition zones

- ✓ Mainly material coming from current UIC 719
- ✓ No great changes

6. Ballastless track (Slab track)

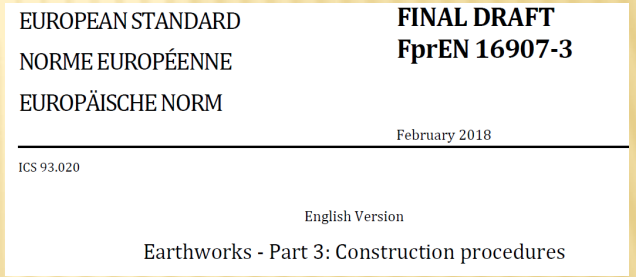
- ✓ Material coming from current UIC 719
- ✓ Some ideas coming from **EN 16432-2:** Railway applications - Ballastless track systems - Part 2: System design, subsystems and components

4. IRS Design

7. Construction requirements

PRINCIPLES BASED ON

- ✓ Material coming from current UIC 719
- ✓ Ideas coming from **EN 16907**
  - ✓ Part 3 " Construction procedures"
  - ✓ Part 5 "Quality control"



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

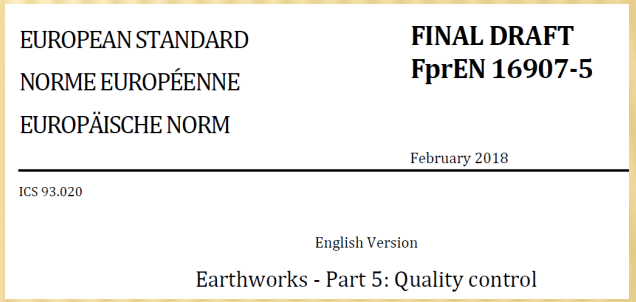
FINAL DRAFT
FprEN 16907-3

February 2018

ICS 93.020

English Version

Earthworks - Part 3: Construction procedures



EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

FINAL DRAFT
FprEN 16907-5

February 2018

ICS 93.020

English Version

Earthworks - Part 5: Quality control

5. IRS Maintenance and Improvement of Earthworks and Track Bed of Existing Railway Lines comes from UIC Leaflet 722

(Methods of improving the track formation of existing lines)

UIC Leaflet 722

UIC 719 Chapters 1.1.4. and 3. are included in this new IRS

4. IRS Maintenance Proposal for New TABLE OF CONTENTS

GOBIERNO DE ESPAÑA | MINISTERIO DE FOMENTO | MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE | CEDEX CENTRO DE ESTUDIOS Y EXPERIMENTACIÓN DE OBRAS PÚBLICAS

UPDATE OF UIC LEAFLET 719 & 722 INTO IRS

Dr. José Estaire (*Head of CEDEX Track Box – CEDEX*)
David Villalmanzo (*Infra Senior Advisor Rail System Dept. – UIC*)