FREMO - N Gauge Modules

N-RE Guideline For Construction And Operation
with
Great-britN amendments

Don't Panic!

Table of Contents

Created: July 29, 2012
Updated: October 14, 2012
Author: Matthias Keil

Remarks For The English Version of the N-RE Guidelines

During the last years FREMO (Circle of **Fr**iends of **E**uropean Railway **Mo**dellers) developed to a really European federation with many groups in several countries. FREMO conventions in Germany have an international flair and German modellers travel to foreign countries for such conventions. 2008 saw a large international convention for N-gauge, an anniversary for 20 years N-gauge, in Naumburg/Germany.

On the other hand, the basics of cooperation, the published guidelines, only exist in German. FREMO-Members in "the rest" of Europe are struggling with the complicated German language to extract the necessary information, and sometimes misunderstand parts of the text.

Today we can find a growing number of people for those English is a comprehensible language, even in Germany. It is time to provide the N-RE community with an English version of the N-RE guideline.

So, here it is. This translation may serve as a base for translations in other languages. It should be declared as the base version of the guideline in general. Changes, developments and corrections should be made in the English version first, and after this taken to other languages, even into German.

This English version does not intend to improve, correct or extend the German text, at least not yet, but to give a translation as accurately as possible. If somebody is interested in the original text, he/she can inspect the HTML code. The German text remains as a HTML comment in each paragraph.

The translation has been done by Germans! Some terms and phrases may make native English speakers smile. Well, you are welcome to help to bring the wording of this documentation in a good shape.

Some links in the text refer to other German web-pages. These links remain in the English text, even if the destination pages may not be comprehensible for visitors who don't understand German.

Find below a list of terms used and their translation:

German	**English**
Betrieb	operation
Bau	construction
rangieren	shunting
Regelspur	standard gauge
Baugrösse	gauge
Spur N	N gauge
Maßstab	scale
Norm	standard
Epoche	era
Empfehlung	recommendation
Vorbild	prototype
Modulkasten	frame
Vorschrift	regulation
Aufbau	assembly
Einfahrsignal	home signal (stop signal protecting the entry into a station)
Ausfahrsignal	starter signal (stop signal protecting the exit out of a station)
Blocksignal	block signal, section signal
Vorsignal	distant signal
Schattenbahnhof	fiddle yard

German	English
Zugbildung	marshalling of a train
Modularrangement	layout
Triebfahrzeug	locomotive
Schienenoberkante (SOK)	rail's head
Weiche	turnout, points
Spurkranzauflauf	to direct the wheel by raising its flange
DKW	double slip
EKW	single slip
Bogenweiche	curved turnout
Herzstück	frog
Leiterplattenmaterial	conductor board, PCB
Gleisüberhöhung	banking, super elevation
Dehnfuge	expansions joint
Kleineisen	fixings, chairs
lichter Raum	clearance
Schwelle	sleeper
Blindleitung	feeder cable, wire bus
Wagengattung	wagon category, wagon type
Nebengattungszeichen	secondary category
Bahnverwaltung	railway company, train operating company, freight operating company

About Great-britN

Great-britN is the name of a group of railway enthusiasts modelling British outline 1:148 scale railways with track gauge of 9 mm. You can contact the authors via Britische Bahn Forum (**http://75355.homepagemodules.de/**) in German language or N-Gauge-Forum **http://www.ngaugeforum.co.uk/SMFN/index.php** in English language.

British railway modelling is part of FREMO since 2009. Most aspects of this modular system are derived from the N-RE guidelines. The Great-britN guidelines were originally developed in German language and published as a separate document. The original intention was to have an add-on to the N-RE guidelines. But this had the drawback that the Great-britN guidelines were never complete and interested modellers would need to read both documents. Additionally, confusion could arise over some rules. The current version was prepared by the Great-britN modellers with the goal to give modellers a complete set of rules to the hand and to clearly identify rules that only belong to one or the other standard.

The Great-britN guideline is still in development and content will be added and refined according to experiences from the first meetings.

This translation to english language was done by Germans, too. In this document some statements of the original N-RE guideline were rephrased. You can compare this version with the original english version at **http://blauthermik-rostock.de/nre-norm/nre-norm.htm**. However, you are welcome to help to improve the text and add to the content.

The Great-britN standard has no restrictions regarding the prototype, region or era. At our meetings we normally use rolling stock from a specific era. If we have enough modules and rolling stock it might be possible to build layouts resembling a more specific region with matching rolling stock and railway companies in the future.

In addition to the list of goals given in the guidelines, we have put pairs of the individual goals in relation to each other, pretty much as the Agile Manifesto, to communicate our views as Great-britN Manifesto:

We are uncovering better ways of building and operating
modular layouts by doing it and helping others do it.
Through this we have come to value:

Individuals and interaction over processes and tools

Working modules over comprehensive landscape modelling and detailing

Coherent reflection of prototype operation over fine scale modelling

That is, while there is value in the items on
the right, we value the items on the left more.

It are individual persons that volunteer to build modules, organise meetings, plan the operation and bring their rolling stock along. Modellers are encouraged to model their favourite prototype, to seek help and to discuss their approach and solutions within the community. This keeps us all open minded. The few processes and tools we have are there to support the people in doing this.

Whilst we really appreciate and love to see the whole modular layout with uniform great landscape modelling and a high level of detail, there is nothing more annoying than unreliable running, sporadic uncoupling, stalling at points or points not throwing at all, derailments and short-circuits. Modellers are encouraged to bring their modules to meetings early to find and solve running and electric problems that otherwise would be difficult to tackle if the modules were already ballasted and highly detailed. However, if the same module stays as plywood desert for to long, you will be frowned upon.

All the fun is about running trains, shunting and re-marshalling them on their route and trying to keep everything on time. With a large modular layout there is no longer one single person controlling everything but a bunch of people with specific tasks who have to communicate with each other and do their best to keeping to the timetable. No one can predict how this turns out in the end and every session is different to the other. True fine scale modelling to FS160 and 2mm however

introduces an additional level of dedication to fineness of wheels and rail tolerances and couplings as well as work and details on the models, which some modellers interested in railway operation are not prepared to follow. That said, fine scale modellers show us what can be achieved and everyone should try to do hers/his best within the rules of this guidelines. This by no means tears all the bridges down between the different systems. FS160 rolling stock runs perfectly on plain NEM track and NEM rolling stock can be run on plain 2mm Easitrac with 9.42 mm gauge. N-RE and Great-britN set for code 40 track or code 55 track with tolerances to NEM, which is actually a lot finer than currently available industrial products and is a compromise to enable as many as possible modellers to get interested in not only building modular layouts but operating them.

Preamble

N-RE is the name of a fraction of enthusiasts of the N-gauge (scale 1:160) in FREMO. The R in the name stands for "standard gauge" (German: "Regelspur") and the E for "Europe", to indicate the main focus; but this does not mean an exclusion.

Goals

N-RE has developed this **"Guidelines"**. It intends to encourage the construction and operation of modular model railway layouts of N-gauge in terms where operation and appearance of the "real railways" are being reflected the best way possible.

Therefor the **aims** we try to achieve are worded as (with decreasing importance):

- Ensure safe operation.
- Ensure free combination of easy movable modules for quick assembly of layouts.
- Observe NEM (and other general standards of model railroading if necessary).

Great-britN

- Observe recommendations for clearances of the N Gauge Society (see handbook)

- Coherent reflection of the prototype.
- Possible usage of industrial products to lower costs and thresholds for beginners.
- Best possible compatibility to standards of other N-fractions and FREMO groups.
- Encourage for progresses in operation and in construction of modules, tracks and vehicles. *Continuance: Progresses will be introduced in the way that existing equipment can still be used without reconstruction. Only small extensions can be expected.*
- In general open for concepts of operation, era, country, region and season.
- Common platform for everybody who is interested in the operation of the European or British railway.

Conventions

The largest part of the current version of the guideline covers the part "construction". The part "operation" should be extended quickly, and (because of better handling) perhaps in a separate document which may be developed continuously.

Especially the part "construction" consists mostly in the categories

- Rule:

  Must be observed.
- Recommendation:

  Should be observed.
- Best practice:

  Can be chosen without doubts because this solution is practicable due to previous experiences.
- If necessary, warning for improper solutions are provided.

This guideline does not want to repeat things that are already well described elsewhere (and that's a lot), but to list differences and innovations. But for a better understanding it intends to be complete for the rules and recommendations (in short terms).

The content shows additional, relative or miscellaneous information, without validation.

Great-britN Rules, recommendations and statements regarding Great-britN only will be set in a box with “Great-britN” on the left hand side border.

N-RE Same for stuff that applies to N-RE only.

General terms and conditions

- Author and editor of this document strictly refuse any responsibility for its content, for damage resulting using its content and for the content of linked pages.
- Private usage of the content of this document is permitted without restrictions, transmission only unchanged. Commercial usage is permitted after a notification.
- Author and editor included data and established processes known inside and outside of FREMO in this document without asking for authorship. Gladly an author will be named who announces it and names a source.

Great-britN
- The editor of this document, **Matthias Keil**, is looking forward for opinions, remarks, proposals, criticism and commendation.

N-RE
- The editor of the N-RE guidelines is, **Dietrich Alker**, who is also looking forward for opinions, remarks, proposals, criticism and commendation.

References

Preliminary remark

On this page references are listed which may provide the user of the N-RE-Guideline with additional information. In the text they are stated for instance as [E.2]. Author and editor of this guideline have to refuse any responsibility for its content because they are not able to affect it or to check it periodically. References published in the web (just like this guideline) are preferred but not all are available that way. Web-links can get unusable or – sometimes hopelessly – out of date. If this happens please give a notification! Fortunately railway modelling standards mostly last long.

Further standards in FREMO

1. The Module Manual of **Ulf Mahrt**, Version 4.2 of 2006-10-01:
   A summary of several N-standards.
   Its 8 chapters can be downloaded separately as PDF-files.
2. The "MODULNORM N-03" of the "Arbeitsgruppe Vorbild&Modell", Version 1.1:
   Booklet with approximately 31 pages, available at nominal charge from Jürgen Dill (see FREMO member list).
3. The standard of the group **"americaN"**:
   N layouts with American or Canadian prototypes.
4. The front profile of the frame by **Edward von Flottwell**:
   Original reference of the published drawings in the section about module frames with additional information as a collection of files with different formats for easy download.

Other N-standards

1. The "Modulbau-Info" of **N-Club International (NCI)**, Release 2005-01:
   Can be download as PDF-file.

Related standards in FREMO

1. **Standards of the gauge H0e**. *"*
   Modulnormen" (Standards of modules) and "Modulbauhandbuch" (Manual for construction of modules) provide very comprehensive information. Each part can be downloaded as PDF-file.

Tools of the N-domain

1. The **data base FreDL**:
   The calendar of events is accessible for everybody. For an access to all other features, especially to the equipment management, ask Dirk Jahnke or Klaus Killinger (see FREMO member list).

Standards of European model railroading (NEM)

1. From the reference, the **European Federation MOROP**.
2. From the publishing company of the **journal "Miba"**.
   Each single part can be downloaded as PDF-file.

Foreign model railroading standards

1. **The American National Model Railroad Association (NMRA)**.

Web-pages of the fraction N-RE

1. **German friends**.
   References to other groups and fractions, reports of events, technical expertises and many more.
2. **Czech friends**.
3. **Danish friends**.
   Amongst a lot of others a Danish translation of the N-RE guideline (still under construction).

Regulations of the German Association for Electrical, Electronic & Information Technologies (VDE)

1. DIN EN 61558-2-7/A11 (VDE 0570-2-7/A11):2003-05 (price 2007: 9.39 €) Safety of transformers, power supplies and suchlike – part 2-7: Special requirements for transformers for toys.
2. DIN EN 62115 (VDE 0700-210):2006-01 (price 2007: 54.12 €) Electrical toys – safety.

*These regulations can be found in technical libraries of many companies on the "DIN-CD" or as printed handouts by the publisher **VDE-Verlag**. For model railroaders the important part is [H.1].*

Modules

In general

Introduction

Let's turn to the base of common operation: the modules. A module is a piece of model railway, designed according to the creator's own wishes, which can be connected via standardised ends with other modules. In general, the required length of a module is not defined, but the owner should consider his/her personal limit of transportation. A length between 750 and 1100 mm is considered as viable. If the chosen theme is to long, it can be separated in several segments. For the width see chapter Modules, section Frame, for the height see the section about Legs.

Types of modules

Route/track section:

This is the simplest but also most important type of modules: Between two ends a "normal" track without turnouts is created, shaped either strait or bend or in some other way.

Signal module:

A track module with a stop signal or distant signal. Universal usable signal modules are proven to be flexible and allow for compact design of stations. Signal modules and signals can be placed at the appropriate locations in the approach to a station.

Great-britN

For Great-britN adhere to british signalling practice. This is quite different to German signalling.

Station and stop:

All connections with industrial plants, junctions and stations.

Fiddle yard:

This is the terminus of a series of modules. It serves mostly for marshalling. Furthermore fiddle yards simulate the "big, wide world", ergo that part of the line which can not be illustrated with the layout anymore. A fiddle yard has to have an appropriate number of tracks, connected to one end of the layout. There must be a possibility to change over locomotives (transfer table, turn table), to avoid damage on vehicles by the "five-finger-crane". It does not need to have a scenery.

Great-britN

Classification of Line Types

For Great-britN three classes of line type are considered. The purpose is to enable the planning of consistent looking layouts.

Mainline

Double track and four track mainlines. These are characterised by heavy engines and long trains. Stations should be able to accommodate trains with a minimum of 9 Mk1 coaches. But a double headed train with 15 Mk1 coaches or full 8 car HST or 11 car Pendolino should be considered too.

Secondary Line

Single track line. Imagined are lines like the Far North lines or Cambrian Coast Line. Rather long trains were used. Express trains with restaurant cars can be used. The stations should be able to accommodate trains with at least 6 Mk1 coaches.

Branch Line

Single track branch lines and light railways characterised by small engines and short trains. Passenger trains have a maximum length of 3 Mk1 coaches. Goods trains can be composed to a length equivalent to 12x short wheelbase wagons.

Frame

Module end plates

Rules:

1. Three different profiles ("end plates") can be chosen for both single-track and double-track lines, and a fourth with limitations (because of different location of the holes).
2. Two holes with 8 (-0/+2) mm diameter act as a connection between the modules; they are located 58 mm below the rail's head, 120 mm right and left of the middle of the track.
3. No fixtures on or near the inside of the profile to give room for c-clamps.

Recommendations:

N-RE

1. The flat profile is the standard.
2. Because of the different location of the connecting holes, the profile "Embankment" should be used with a couple of adaptor modules.
3. For a consistent appearance, all modules should have a width of 400 mm. Stations which need more room can be wider, but should narrow to the end to 400 mm. (see also "best practices".)
4. The exterior colour of the frame should be a matt grey (to prefer "dust grey RAL 7037").

Best practices

Width of the module

If somebody – especially on track modules – wants to save width, choose 300 mm. First, to be worthwhile. Second, because narrower modules cannot be bolted the standard way.

Double-track modules

Get, advantageously, two additional couples of holes in the end faces, symmetrically to both tracks. Such modules can be bolt with single track modules, although that will hardly produce a convincing overall appearance.

They can (unlike the drawings) be built with a width of 425 mm, because, if combined such-like, at least one of the longitudinal edges is align.

Great-britN

For Great-britN modules the colour of the frame should be dark brown.

In contrast to N-RE the standard shape for the end plate for Great-britN modules is the “Slope”-profile H1 for single-track. Currently for Great-britN only single-track modules have been built. For double track modules no standard has been established, as no modules have been built yet.

Single Track

For single-track the following end profiles are available:

1. H1 “Slope”-profile as the standard
2. F1 “Flat”-profile (adaptors to the slope profile are recommended)
3. E1 “Cutting”-profile (adaptors to the slope profile are recommended)
4. D1 “Embankment”-profile (adaptors to the slope profile are mandatory)

Double Track

For double-track following profiles are available:

1. H2 “Slope”-profile
2. F2 “Flat”-profile
3. E1 “Cutting”-profile
4. D1 “Embankment”-profile

Additional holes symmetrically to one or both tracks, would allow for such a module to be bolted to single-track modules.

Quad-Track Mainline

For 4-track main lines there are no readily made end plates available. If such a line is considered, the profile should be derived of one of the existing double-track endplates. The following recommendations should be considered when designing 4-track endplates.

As there currently no quad-track modules have been built, we will only accept such modules for meetings, if the length of the quad-track is at least 2.5 meters and junctions to double track profile are provided. This allows quad-track modules to be used as loops.

Quad-track mainlines fall in one of two types of track layout, when putting it simple.

West Coast Main Line / Great Western Main Line

1. The first type of track layout is the track separation by class. Examples for this are parts of the Great Western Mainline and West Coast Mainline. Here Up and Down are paired for Slow and Fast lines. This looks like two double track lines run side by side with a larger gap between both pairs. The gap in the middle is required to place signals near to the line they belong to.

To model such a line at least the following measurements shall be considered:

1. The distance between Up and Down lines for each class of track should be 25 mm. This is derived from the double-track end plates.
2. The distance between both pairs of track, i.e. the gap in the middle, should be 33 mm.
3. An additional pair of holes should be added to allow on pair to be used in combination with double-track modules.

East Coast Main Line

2. The second type of track layout is the separation by direction. Examples for this type can be found on the East Coast Mainline outside of London. Here the slow lines for Up and Down are put to the outside of the double-track Fast line. Up and Down are paired for the same direction. This looks like the Slow lines are very long loops of a double-track line. There is usually a larger gap between the slow line and the fast lines. Again, this space is required to place the signals to the left of the track they belong to.

To model such a line at least the following measurements shall be considered:

1. The distance between Up and Down Fast lines should be 25 mm. This is derived from the double-track end plates.
2. The distance between Fast and Slow line should be 33 mm.
3. The Fast lines should be positioned at the end plate, that without further modification the module can be used in combination with a double-track module.

Advices

The making of the basic construction - the frame - must be done very accurate:

- Head and side parts have to be assembled on a plain surface, in order that the frame becomes straight.
- The base for the track must be mounted absolutely plain, to get the ideal position of the track. The plank must be reinforced with a beam to prevent long term distortion.
- The frame gets additional strength by transversal ribs.
- During the work with the wooden parts you should consider the cables to install and should see to the necessary openings.
- Also, space and openings for the turnout motors / mechanism should be left free by now. It is also recommendable to see to the fitting of the legs by now.
- There must be enough space provided for the connecting bolts at the ends of the module.
- High quality plywood or cross-banded lumber veneered board (CLV), not below 10 mm thickness, is suitable for the building material. Beyond repair is chipboard and suchlike.
- After the assembling all wooden parts should be painted inside and outside, to protect the wood from getting wet (and by this from distortion). A light coloured inside helps during an error detection if the module is already placed in a layout, because cables and parts of the mechanic are better visible.
- The holes for the bolts at the end plates should not be drilled until the tracks are mounted, because they fit better that way.
- Also, openings for cables to the next module should be installed as shown in the drawings. This openings can be used as grip holes when carrying.

Legs

Rules:

N-RE

1. The legs hold the rail's head at a height of (usually average) 1300 mm above the floor.
2. The length of a leg can be adjusted by at least ± 20 mm (better ± 30 mm) to compensate uneven floors.
3. The legs are fixed to the frame – but not to the profile ends – in a way that they cannot jiggle or fall out if the module is moved, lifted or tilted.
4. Cross-Beams between the legs (or other appropriate) prevent the layout to wag across.
5. The feet are designed (for example covered with soft caps or pasted with disks of felt) not to damage sensitive floors.

Great-bitN

In contrast to the N-RE-Guideline **the top of the rail is defined as 1100 mm above floor** level. To enable interoperation with N-RE modules at 1300 mm height a second pair of legs can be used.

Digest of FREMO-Leg-Lore

The decision for one leg-system or a mixed form will always depend from individually requirements. As time goes by several constructions raised, only some of them can be described here as an example.

1. Double-legs: They mostly consist in a construct, similarly to a ladder, with adjustable screws at the lower end. + Very robust, clipboards can be inserted easily.
   – Needs a lot of space during the transport.
2. Single-legs: Here are fittings mounted at the frame, which hold wooden or metal legs by an attachment screw. + Adjustment can be done by a single person, needs lesser space than double-legs. – Modules can wag easily because of missing cross-beams.
3. Universal legs: They consist in a board, with approximately 80 cm length, which has fittings for two short legs and the necessary attachment screws. + Adjustment can be done by a

single person, transport can be done in or at the module, clipboards and more can be integrated easily, a height for other module systems can be established easily.

4. Legs, made from protection housings: The housings will be fitted vertically under the module. Fine-tuning is done with feet of adjustable screws . + The module is best protected during the transport. – Module and box must match.
5. Racks: Sometimes stations are put on racks, whereby especially groups of segments can be assembled easier.

How many legs?

Many:

No doubts, a layout can be assembled easier – especially during try and error – if every module can stand for itself.

Less:

Some assembled layout attest by dangling legs that less legs would do. This would benefit the space under the modules, which is badly required for "dive through", for clipboards or for storage of equipment.

Compromise:

A couple of legs is installed at every meter of the layout.

Because of better flexibility more fittings are installed:

- one at modules from a length of 40 cm,
- two at modules from a length of 70 cm,
- three at modules from a length of 100 cm,

The modules will be bolted to groups with two couples of legs before they are set up.

Track / Radiuses

In general

Rules:

1. All tracks must be accessible with wheels after NEM 310.
2. The clearance after NEM 102/103 must be kept free.
3. Visible tracks have a rail profile not higher than 1.4 mm (code 55).
4. The radius of bended tracks is nowhere lesser than 0.457 m.
5. Frogs of turnouts and slips must not be designed to direct the wheel by raising its flange.

Recommendations:

1. Visible rails are preferably 1.0 mm (code 40) high.
2. The radius of route tracks is at least 1.2 m.
3. The radius of throughout main tracks of stations is at least 0.9 m.
4. Every 0.5 m an expansions joint is installed.

Wide radiuses and long points don't just look good, but also improve the operating safety and lessen the train resistance. Scale radiuses and points are doomed, even in N-gauge, by the required space. The table below illustrates this fact.

Radius of the prototype	Radius in N-gauge	Remark
73 m	0.457 m	Available radius for a two track line of industrial products
112 m	0.7 m	Minimum radius for a double track model railway line without the need to increase the standard distance of 25 mm between the tracks
145 m	0.9 m	Lowest radius of the German prototype without special permit
190 m	1.2 m	Turnout radius of the German prototype for a driving speed of 40 km/h
300 m	1.9 m	Turnout radius of the German prototype for a driving speed of 50 km/h
5000 m	31 m	Minimum radius for new high-speed lines of the German ICE

This means that it is already a painful compromise to allow a radius of 0.9 m for mainline tracks.

Scale rails are 1.0 mm (code 40) high. For wheels after NEM 310 the track cannot have chairs. Purchasable track material of this type does not hearten yet. Currently the best approach is to build your own track (Key technology: Solder rails to sleepers made from conductor board). This allows the construction of all types of crossings, turnouts and slips either straight or within a radius and with curved frogs and the like. However, we accept that this is not everybody's piece of cake.

Fortunately, there is at least one manufacturer, who offers rails with 1.4 mm height (code 55), which has the attempt of chairs, promises usability with NEM-310 wheels, uses electrofrogs (allows switching of the polarity of the crossing Vee) which do not direct the wheel by raising its flange, and obtains a quite good stability due to a special shape of the rail. Who accepts tight curves (see table above), also gets curved turnouts. (We advise against the usage of the double slip and single slip of that manufacturer.) In doing so, look and operational safety – matched driving speed assumed – suffer only below average, because geometry and kinematics of model junctions differ from the original. For wiring of turnouts see the section about Electric.

Other manufactures of appropriate track material may exist. Anyway, there is no good reason to use higher rails, for example the usual products of the large-scale production with 2.0 mm height (code 80). Only for fiddle yards this material can be used.

To avoid damage by dilatation or drying, an expansions joint in the track should be installed on every module; but it must not be wider than 0.5 mm.

Great-britN

For British outline modelling the flawless propelling of trains over crossovers is very important, as most points were laid trailing to the normal running direction in steam days and shunting movements could require reversing the full train into sidings clear of the main line.

For Great-britN there is currently no limitation of the types of points that can be used, as long as the radius of the diverging route is greater than 457 mm and the rail is code 55 or code 40. If serious running problems come to light that are clearly linked to the type of point a restriction could be made in the future not to use this type of point.

Smaller radiuses than 457 mm can only be used for sections of track that are limited to certain locomotives and wagons that do not expose running problems on it. However this could easily exclude other modellers from running their machines who prefer to fit the larger wheels and the bits from the bag supplied with the models these days and who try to reduce the gap between locomotive and tender.

Recommended Radius

For Great-britN we recommend the following radiuses:

	Recommended Minimum	Recommended
Main Line	0.9 m	1.9 m
Secondary Line	0.9 m	1.2 m
Branch Line	0.75 m	1.1 m

The recommendations for the radiuses are made with the overall appearance in mind. However, there are modules built already with radiuses down to 500 mm which do not look out of place.

Recommended Track lengths in stations

The recommended usable length of tracks in a station should be as follows:

Length of	Recommended Minimum
Loop for a Main Line	**2.50 m** (ca. 45 4-wheel 10 ft wagons or 16 HHA hoppers)
Loop for a Secondary Line	**1.5 m** (ca. 25 4-wheel 10 ft wagons or 13 ICA silver bullet)
Loop for a Branch Line	**0.7 m** (ca. 10 4-wheel 10 ft wagons or 8 PCA cement wagons)
Main Line Platform	**1.3 m** (ca. 9 Mark I without locomotive, still to short for an 8-car HST)
Secondary Line Platform	**0.85 m** (ca. 6 Mark I without locomotive)
Branch Line Platform	**0.43 m** (ca. 3 Mark I without locomotive)

For the platform length add the length of the locomotive as appropriate.

If a prototype station is modelled with scale lengths shorter than the recommended ones, then the scale length should be used of course.

At the profile ends

Rules:

1. The tracks meet the profile ends perpendicular (top view and side view!). That can easily be checked with a mirror.
2. Super elevation of the outside rail in a curve is not permitted.
3. The ends of the rails are fixed as good as possible so they cannot be damaged. Neither during transport nor at the assembling of the layout. For example, they can be soldered to cut brass screws at the edge of the module.
4. The rail ends approximately 0.2 mm before the edge of the module, in order that they are safely electrically disconnected and do not suffer a longitudinal force.

Electric

At the module

Rules:

1. Cables (bus wires), parallel to the track, at least with 0.75 mm² cross section.
2. No electronic devices in the track's electric system at all, except boosters and occupancy detectors.
3. No automatic train control (ergo, no automatic train stop due to signals showing danger).
4. Do not burden the digital voltage for secondary aim.
5. For security reasons: No power supply voltage (230 V AC) at the module!

Recommendations:

1. Additional consumer of power (example: free usable signal modules) have their own power supply of 12..15 V DC.
2. Signals on free usable signal modules get a connection cable of 5 m to it's control box. This is fixed (for example with a c-clamp) at the assigned station.
3. For a future occupancy detection (track circuit) one rail is divided into a sufficient number of registration sections, each of them wired dividable; long sections get it's own parallel cable.

Best practices and illustrations:

Parallel cables:

Close leads, ergo, no loops, keep the inductivity small, so that the steep flanks of the digital signal are kept, and interferences stay small.

It is sufficient to connect that cable approximately each 0.5 m with the rails.

Thin blank wires droppers are appropriate as connection to the rail, soldered to a blank part of the bus wire and to the rail's foot (or a rail joiner).

Security:

All power plugs, multiple sockets, transformers etc. belong at a separate clip board (not at the floor because of danger by tapping on it); transformers, at least in order the waste head does not damage the module.

No electronically devices, which alter the digital signal, must be added in the power supply of the tracks, and therefore may interfere the operation. (Does not apply to boosters and proved vehicle detectors.)

No automatic train control:

Stop by "voltage-off" contradicts to DCC. Breaking at DC and Lenz ABC are also not standardised by NMRA.

Digital voltage:

Although it is a great temptation: The digital voltage is for driving only! All other consumers have to be powered by own electrical sources, in order to avoid an overload of the digital boosters.

Junctions (Turnouts)

should be build and wired, so that the point blade and stock rail that belong together, have the same electrical polarity. Otherwise bad adjusted pair of wheels (as well as long wheelbase 4-wheel cars) may short-circuit.

The frog has to be powered by a double-throw switch, because contact made by the tapered blades, is not reliable enough, as they gather dirt after some time and would often require mid-session servicing.

At the profile ends

Rules:

1. No contact of the rails (ergo, safe electrical disconnection).
2. Connection cables for the digital voltage (interface cable):
    - double flexible wire,
    - cross section at least 0.75 mm²,
    - for the right rail (looking from the middle of the module to one end) a 4 mm banana plug, favourably with additional hole at the end,
    - for the left rail a 4 mm banana jack,
    - long enough so they can be extract to 0.3 m over the edge of the module's end,
    - at multiple tracks interface cables have to be provided separately for each track (because of occupancy detectors).
3. For safety reasons: No connection for AC, just not for low voltage.

Best practices and illustrations:

Connection cables for the digital voltage (interface cable):

The connection method introduced here is the record holder for fast assembling and low error rate. For the first time it should have been described from the section H0e.

In fact, the interface cables and the parallel bus cable (see above) may be the same unit. It is better, to install it as three pieces, and to connect them with chocolate blocks at the inside of the end plate. They work as protective predetermined breaking point, and support the replacement of defective "pigtails".

Preferable cable colour are brown or red/black; white and black are reserved for other usage. The plugs should be red, but in no case blue (see below "feeder cable").

An additional hole at the plugs makes it easier to connect a booster or an extension cable (more comfortable if in the interface cable, but sufficient in the additional cables). Plugs with holes at the end are more expensive than plugs with transversal, put are a better protection against short-circuits.

Needless long "pigtails" increase the cable chaos. Who places connection jacks deep inside the module, also has to provide the necessary cables!

No connection for AC:

Such connections lead to – mostly unknowingly – parallel circuit of the secondary winding of the transformers. If one of the transformers is unplugged from the main power, the full main power voltage applies at it's blank contacts, even sometimes more. Therefore, power additional consumer with DC if possible(see above)!

Feeder cable:

This is a two-core passing cable without electrical connection to the module, the same connection technique as for the connection cable is used (brown or red/black cable, blue plugs). It makes a simple track module, designed for digital operation, usable for analog operation ("W-Circuit").

Scenery

Recommendations:

1. Scenery of the late summer and preferably, foothills.
2. Keep the thickness of the scenery's skin very low at the module's ends.
3. The scenery is the "food for the eyes", therefore, an arrangement of modules should look quite uniform. Because we are talking about "Standard Gauge Europe", the suggestions for the design are restricted to the necessary minimum.
4. Concerning the season, the design should be conform to the late summertime in the foothills or low mountain range of Central Europe, that is green meadows, leafy trees, harvested fields. Research groups may design themes, different in region and season.
5. The transition between modules should be designed as inconspicuously as possible, to avoid optical breaks in the scenery. Therefore, the skin of the scenery at the module's ends should be kept thin. Furthermore, it has been tried to paint the upper part of the module's ends in a colour similar to the scenery. Small edges regresses that way.
6. Roads, ditches or such structures should never run over the module's ends. How does it look like, if our own lane ends in the pond of the neighbour's module? If you design a closed group of segments then, of course, everybody can create his/her own transitions.

Great-bitN

Recommendations for Great-britN:

1. Paint the sides of the rails and weather the trackbed. Preferably this will result in a uniform appearance although there is no standard colour defined. Painted rails will however make a big difference.
2. Points and slips need to be controlled remotely by either a point motor or wire in tube or a push-pull mechanism. The exception to this rule are fiddle yards.
3. The track on the “big” railway needs to be protected against unintended trespassing. Therefore fences, hedges or stone walls run along the line. Within an flight of modules the fences can be modelled as appropriate. Apart from that Peco “Flexible Fencing” is the recommended standard. The fence shall be placed 25 mm from the centre of the track on both sides.
4. Level crossings should have gates or barriers. Working ones would be great. For level crossings additional stop signals should be considered. Ideally these can be added or removed depending on the location of the module in relation to a station.
5. Stations should have stop signals at the entry of the station and at the end of each road where trains usually leave a station. The signal shall reflect the possible routes if applicable. However, british signalling practice is quite complex and there is no easy rule to achieve correct signalling arrangements for a modular layout, where no builder of a module knows what the next module would contain in the actual layout. So signalling currently remains a compromise.
6. At the module ends the following foliage should be used:
    - Woodland Scenics – Blended green T1349
    - Noch Foliage – Wiese no. 95005
7. At the module ends the following ballast should be used:
    - Noch Ballast – grey blend fine no. 95760

Equipment

Besides the module itself, a few more implements are needed, to ensure the first meeting will become a pleasure.

For each player:

1. An uncoupler tool.

For each module:

1. A sufficient number of thumb screws, butterfly nuts and washers (preferably large diameter washer), for the mechanical connection to the neighbour's modules,
2. suitable cables 0.75 mm² with 4-mm-plugs for the electrical connection to the neighbour's modules (if not already attached),
3. at least one LocoNet cable 3 m and a LocoNet box (if not integrated).
4. One for each module's owner: track cleaner (only to be used for your own modules!), for example a peace of felt with suitable fluid, rubber etc.

For stations and fiddle yards additionally:

1. Clipboard for documents,
2. clipboard for handheld throttles (FREDs),
3. holder for waybills,
4. holder for schedules,
5. mobile phone, accumulators or batteries,
6. station sign with holder for a clock,
7. cable for the clock's pulse 10 m white, 0.75 mm², bifilar, 4-mm-plug/coupler,
8. at least two additional LocoNet boxes and suitable cables,
9. container for freight orders,
10. container for freights.
11. For fiddle yards only: Coloured flags with holder.

Vehicles

In general

Rules:

1. Proper technical condition and smooth running.
2. Wheels according to NEM 310. Lower flanges are permitted as long as a save operation is not harmed. (see also: "Best practices")
3. Operational standard-N-coupler (see also: NEM 356) on both sides (This does not apply to secondary vehicles and vehicles, which are equipped with another coupler in origin also.)
4. All vehicles can, also as a train set, pass curved tracks with minimum 0.457 m radius.
5. The clearance is conform to NEM 302.
6. Lights – and other additional equipment – is applicable for 14.5V (Top value equals to effective value)
7. Visible owner label, in order that all vehicles will "find home" at the end of the meeting.

Recommendations:

1. To improve the safety against derailing, especially of inhomogeneous, long or pushed trains, the mass of all cars is increased to unified 7.5 g per a axis. Removable loads are allowed to add additional 30 %.
2. Lights and electrical head and tail-lights preferably can be digitally switched off.
3. Cards for cars and locomotives (see the following pages) are created with unified tools, preferably with FreDL (see also: "Best practices").

Great-britN

4. Rolling stock should be weathered. This is important for a realistic flair. Different grades of signs of usage are prototypical and thus welcome.
5. Wheel sets need a back-to-back measurement of 7.54 mm.
6. All wheels should be metal, as plastic wheels can easily distribute dirt.
7. For Great-britN currently only the Rapido coupler is used. Tests with the new Dapol “easi-shunt” coupler are under way. Fixed rakes of wagons and coaches that will not be shunted can use other types of couplers.

Best practices:

Lower flanges:

Vehicles with bogies or with 3-point-bearing or comparable construction get along with 0.5 mm flange's height on accurate laid track; any lower flanges are not advised.

Stuttgart-Coupling ("Stuttgarter Kupplung"):

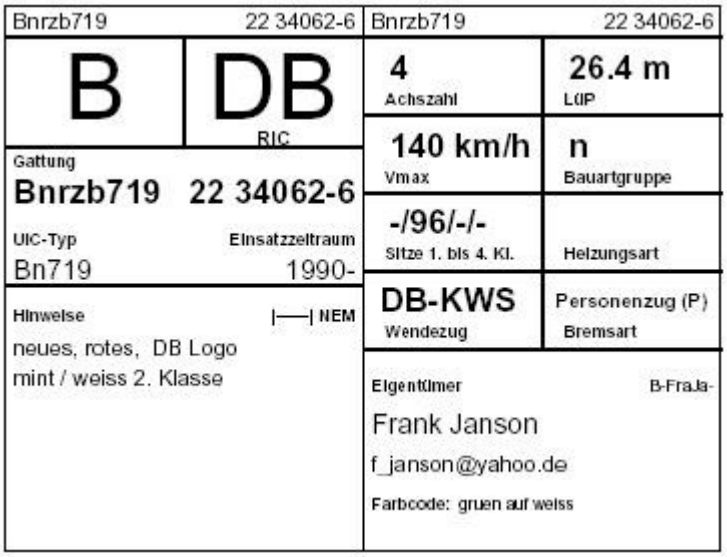
Originally, a spring holds the clamp of the N-coupler in horizontal position. Vehicles couple smoother if the clamp falls back only by the force of gravitation because the spring was disabled. Longer test showed no disadvantages on proper laid tracks. The modification of newer vehicles (with NEM slot, or such like) is easy, modifications of older vehicles may be more complicated. Compatibility rules apply.

FreDL

is not only appropriate for creating car cards, but also especially for the administration of the whole rolling stock (and a lot of other equipment) and therefor makes the organization of meetings more easy.

Passenger cars

1. This card was introduced for passenger cars, baggage cars, coach carriers and mail cars:



Great-bitN For Great-britN currently no cards are required for coaches and NPCC stock.

Freight wagons / cars

Rules:

1. Each freight wagon/car requires a car card in panel format 46 x 70 mm ...
2. ... with at least this data at the front face:
   - UIC type
   - Category with secondary category
   - Railway company
   - Car number without checking number
   - Characteristics
   - Utilisation time (optional)
3. ... with at least this data at the backside:
   - Permitted maximum speed.
   - Length over buffers
   - Loading length
   - Cargo area
   - Storage space
   - Maximum weight
   - Owner
4. … with a transparent slot on the backside, which can keep a "freight card" of the size of the car card.

Recommendations

1. Freights should not be fixed on the cars, so that it can be loaded and unloaded as the prototype.
2. Wagon cards as shown in Annex B shall be used. However, some N-RE-teams and Great-britN use plain white cards because they are easier to produce and better readable.

Great-bitN

Example:

<table>
<tr><td>TOPS-code</td><td>number</td><td>TOPS-code</td><td colspan="3">number</td></tr>
<tr><td rowspan="2">UIC</td><td rowspan="2">FOC</td><td>A</td><td>B</td><td>C</td><td>D</td></tr>
<tr><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="2">TOPS</td><td colspan="2">Weight</td><td colspan="2"></td></tr>
<tr><td colspan="2">TOPS-code</td><td colspan="2">Load space</td><td colspan="2"></td></tr>
<tr><td colspan="2">number</td><td colspan="2">Stowage</td><td colspan="2"></td></tr>
<tr><td colspan="2" rowspan="3">NEM wheels
Rapido coupling

- Load, usage
- properties</td><td colspan="2">Load length</td><td colspan="2"></td></tr>
<tr><td colspan="2">Vmax</td><td colspan="2"></td></tr>
<tr><td colspan="4">Your Name</td></tr>
<tr><td colspan="2"></td><td colspan="4">contact@e.mail</td></tr>
</table>

UIC	First letter of UIC classification
FOC	Owner of the wagon or Freight Operating Company, e. g., BR petrol, BR metal, EWS, NACCO, VTG, etc.
TOPS	TOPS code or pre-TOPS letter code of the wagon
number	Number as written on the wagon

Great-britN

Guide to UIC classification

The following table gives a quick overview of the UIC classes and also tries to give examples for typical British wagons. The letter in the first column shall be used to fill the UIC fild in the wagon card.

UIC class	Wagon type	Examples
E	Ordinary open high-sided wagon	MEA, POA, MBA
F	Special open high-sided wagon	HAA, HEA, PGA, HHA, HTA, JGA
G	Ordinary covered wagon	Fruit D
H	Special covered wagon	VGA, CargoWaggon, livestock
I	Refrigerated van	
K	Ordinary flat wagon with separate axles	OCA, OTA
L	Special flat wagon with separate axles	4-wheel container flats
O	Open multi-purpose wagon	
R	Ordinary flat wagon with bogies	Bogie bolster
S	Special flat wagon with bogies	Bogie container flats, KFA-GERS timber wagon, Bogie steel carrier
T	Goods wagon with opening roof	
U	Special wagons	PCA, Polybulk, Silver Bullets, Presflo, CDA, CEA
Z	Tank wagon for liquids or gases	TTA, TEA

Locomotives

Rules:

1. DCC decoder with 4-digit-address
2. Card for the locomotive
3. Hand controller with a LocoNet connector.

Because we want to operate our vehicles like the prototype, the extensively standardised control system NMRA-DCC is used. This system provides an individual control of locomotives, whereas it's even possible to escort your own train on its journey.

The locomotives must be equipped with a DCC-decoder in order to "understand" the commands. Today, adequate small decoders are available on the market, some local dealers even offer an installation service.The decoder must be able to work with "long addresses" (up to 9999). For the management of addresses a central database is used.

Great-bitN

The addresses for Great-britN are managed in a different database. Upon request a block of addresses can be reserved, usually a block of ten. If you want to obtain a block for your locomotives please contact the author for details.

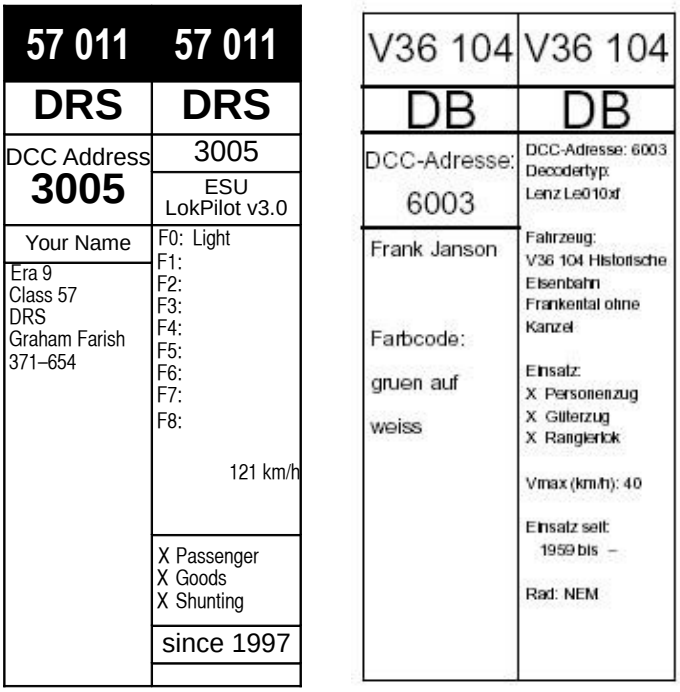
This central address management has been set-up to avoid conflicting DCC addresses and lengthy reprogramming sessions of half of the stock at a meeting.

Furthermore, each locomotive needs a handheld/walk-around controller with a LocoNet connector. These walk-around controllers can be home-made or purchased from specialised traders. In order to know, which locomotive is associated with which walk-around controller, each walk-around controller gets a locomotive card attached in a plug-in-pocket.

A locomotive card is illustrated below and should contain the following information:

1. Type and number of the locomotive
2. DCC-address
3. Owner
4. Optional information of special functions (sound, light ...)

The card is folded longitudinally.



Operation

In general

We conceive "operation" as a copy, as close as possible to the prototype operation on a given railway network. Including:

- Information about the economic structure of the chosen (or made up) prototype,
- Usage of the regulations for operation of the prototype,
- Usage of a timetable,
- Use of a common (model-)time,
- Control of freight flows with appropriate tools,
- and some additional issues.

Operating procedures of the prototype are used in an adapted way in model operation too. In the DB that are:

- Train reporting procedures with staffed stations,
- Train direct procedures with more or less un-staffed stations.

Great-britN

Great-britN tries to resemble British operational practises, however this can only be a generic representation as there were at least as many sets of regulations as there were railway companies in the history of UKs railways.

- Single track lines are considered to be fully fitted with Track Circuit Block. For other systems like Electric Token Block or RETB additional equipment would be required that is currently not available and would not be practical for our purposes.
- Instead of bell codes to communicate with the next signalbox we use the telephone with standardised phrases.

For the operation to function properly following roles must be filled with a responsible person:

- Several train guards and train drivers, possibly with one person for both roles,
- Station master for staffed stations,
- Train director (for train direct procedures); that role can be taken by one of the station masters,
- Chief operating officer and dispatcher respectively for larger layouts for the central control of the operation and the freight traffic.

The model time runs faster than the real time; approved is from 2 to 6 times faster.

Timetable

The timetable shall consider the operational features of the individual modules used to built the layout as well as distances between stations and the sequence of stations.

For the development of a timetable the fast clock and the real time of travel of the trains with the assumed driving speed has to be considered. Shunting times should not be too short.

Timetable documents:

Train graph

is the base for the planning of the operation; it shows, in a graphically way, planned train movements and track occupation in the stations. During an meeting especially important for station masters and fiddle yards.

Timetable book / Train workbook

for the train crew, it contains the route of the train, where it's calling, times of arrival and departure, driving speeds etc. listed as a table. For each train a separate workbook is necessary.

Regulations for marshalling

contains information about the composition of trains and are essential for the correct marshalling of freight trains and for this reason for the circulation of goods. They define the order of wagons for the several stations and loading points.

Circulation plans

regulate the operation of locomotives and passenger coaches.

Freight system

The freight traffic has to follow the requirements of the stations, its goods, loading points and the types of wagons, for that purpose a list should be available at the station modules.

Before freight wagons are marshalled to trains they get a "load" (provided that they don't run "empty"). That can be "real" load, e.g. on flat wagons with side stakes or open wagons, or imaginary, e.g. for vans. There are freight cards for each load that will be attached to the car card of the wagon that is carrying the load. The freight card will be removed from the car card if the wagon gets unloaded. Freight cards have a size of 66 x 42 mm and contain information about type and weight of the load, sender, destination and receiver.

This system as been chosen to make the movements of freight wagons sensible. Otherwise the wagons would run about randomly. Freight cards are usually provided by owners/operators of a station module, as they know what goods the local industry requires. To “order” goods for a station the freight card will be put to a fiddle yard or to another station that can deliver that load. The station master or Yard master of that station is responsible to find or order a suitable empty wagon, shunt it to the loading spot, get the wagon loaded (attach the freight car to the car card) and sending it out to its destination with the next possible train.

Starting point *or* endpoint are usually fiddle yards. Except, if there are precise traffic connections within the layout, e.g. wood from a sawmill from station A to a furniture factory at station B. All other goods go to the fiddle yard and from there to a imaginary destination somewhere in Europe.

N-RE

Fiddle yards get a colour to mark this imaginary destination. This makes it possible to use identical freight cards on different layouts (with different fiddle yards).

Proposals for suitable freights can be found on www.fremo.org.

The colours of the fiddle yards and their definition:

Red	East
Yellow	South
Green	West
Blue	North, coasts and seaports
Black	Heavy industry
Brown	industry in general

Defective vehicles

Inoperable vehicles will be excluded, in order not to jeopardize the overall operation.

Defective locomotives will be immediately (best in a station, danger of short circuit!) taken from the track and will be replaced by hand or with a shunting move. Defective cars will, if possible, be taken to the next fiddle yard and removed there.

The defective vehicle gets a bad order card, which gets information about the kind of defect, possibly proposal solution for fixes and the name of the person who detected the defect (for further enquiry). After that, it will be put to a predefined place, including car card, hand controller etc.; the owner will be informed as soon as possible, at least at the end of the session.

Module maintenance

Modules will be assembled and disassembled, electrically connected and checked by their owners. Also, the track cleaning is the owners's business.

Do not put things on modules! For hand controller, car cards, timetables etc. use clipboards at or under the module.

In case of system malfunctions the owner has to be informed; manipulations (installation, soldering, reconstruction, track cleaning) at modules belonging to other persons are not permitted.

To comply with that rules, all modules should be marked with name and owner on both longitudinal sides.

Meetings

Organisation

Invitation

The organiser has to provide the following information for a meeting with the invitation:

- Time/ place (including begin of the assembling) and location of the meeting
- Theme of the layout (era, operation mode, etc.)
- Information about accommodation and catering
- Deadline for registration

Registration

Until the deadline, interested party can register with the meeting organiser. They offer thereby what they can contribute to the layout:

- Modules (with draft or CAD-drawing) and a station data sheet
- Locomotives (type, number, DCC address)
- Cars/Wagons/Vans (at least number of cars per type, if possible car numbers)
- DCC equipment (command stations, booster, other LocoNet equipment like controllers, cables or hubs)
- Telephone system / telephones
- Clock-pulse generator / secondary clocks
- With the registration the participant states the time of his/her presence (assembling and disassembling!).

Organisation

Depending on the size of the meeting the meeting organiser gets or names assistants:

- Layout designer
- Timetable creator

The layout designer, timetable creator and meeting organiser decide, with consideration of theme's and operation's guidelines as well as the location's circumstances, which modules can be used.

Furthermore, they check, on the basis of the registered equipment (clocks, telephones, DCC, etc.), whether the layout can be operated suchlike.Layout designer and meeting organiser publish the assembling plan for the layout at an early stage and at the same time announcing the beginning of the assembling.

Furthermore, they would inform participants, if offered modules are not planned to be used, in order to spare space of transportation. The timetable creator creates the train graph, using the information about the requested amount of traffic of the involved stations, the layout plan, as well as the registered stock of vehicles. On that basis, after consultation with all involved station owners, the timetable books (station workbook, train workbook), regulations for marshalling etc. will be generated.

The meeting organiser sees to accommodations, soft drinks, catering, lectures, excursions etc. Furthermore, he names someone, who takes care of:

- Clocks
- Telephone
- DCC command stations

Assembling

All **module owners** look after their modules being placed according to the assembling plan, and are connected mechanically and electrically to the neighbour modules, in order to provide a smooth assembling. Furthermore, they install – as far as intended in the plan – LocoNet and, if necessary, booster to their modules; they advise the DCC assistant to inbuilt LocoNet-jacks. At last all tracks are cleaned. Contact person for questions is the layout designer.

The **DCC assistant** checks the LocoNet (also, whether all inbuilt LocoNet-jacks are connected), installs the DCC central unit, takes it in service operation, checks the polarity of the booster sections and sees to test runs. If there is enough equipment at hand, it is recommended to install a secondary DCC central unit including a programming track for test runs and programming of locomotives.

The **clock assistant** installs the clock-pulse generator and the clocks, connect them, and sees to it that all clocks run synchronously. He adjusts the clocks to the start time (information from the timetable creator).

The **telephone assistant** takes the telephone devices in service operation and distributes telephone directories to all stations.

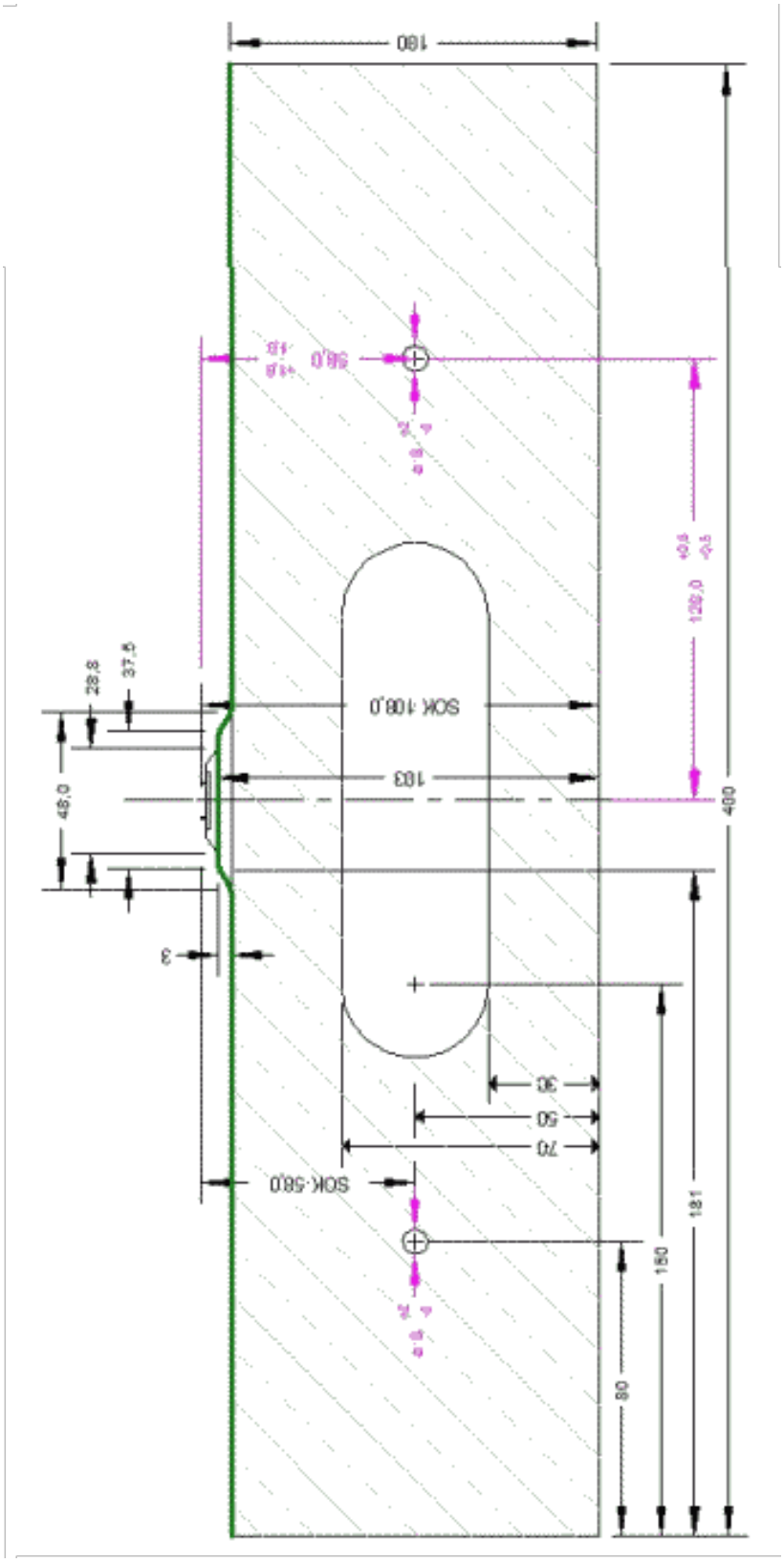
The **timetable creator** distributes timetable documents to the station owners, who install them clearly visible. Furthermore, he ensures that an initial set of wagons is distributed across the layout.

The **station owner** puts freight requests for her/his station and, if applicable, wagon loads at the fiddle yards or stations that will deliver them.

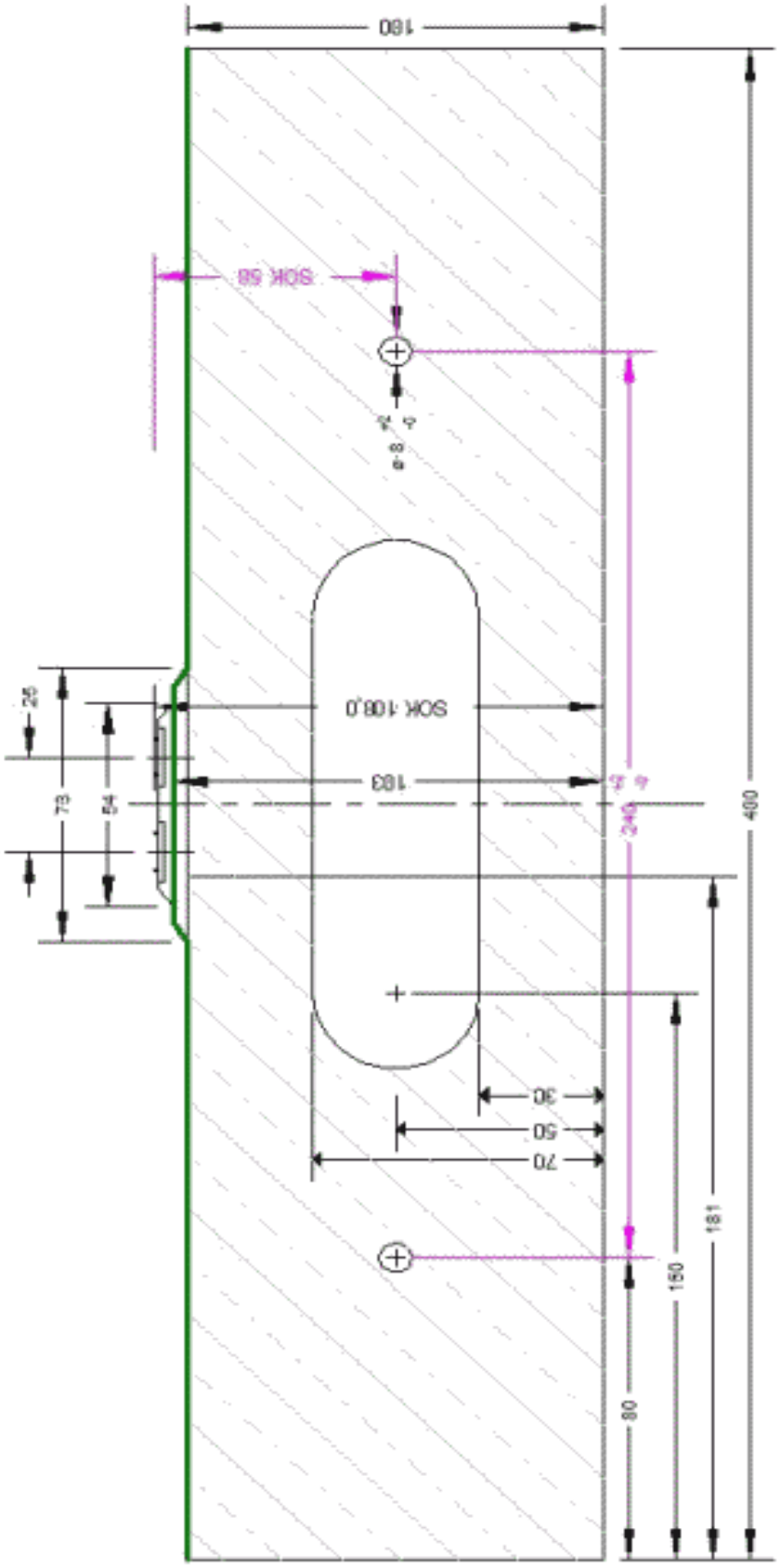
At last a recommendation: The **FREMO name tag** should be worn from the beginning. It makes communication easier – last but not least with non-members – and serves as a passport.

Annex A – Standardised module end profiles

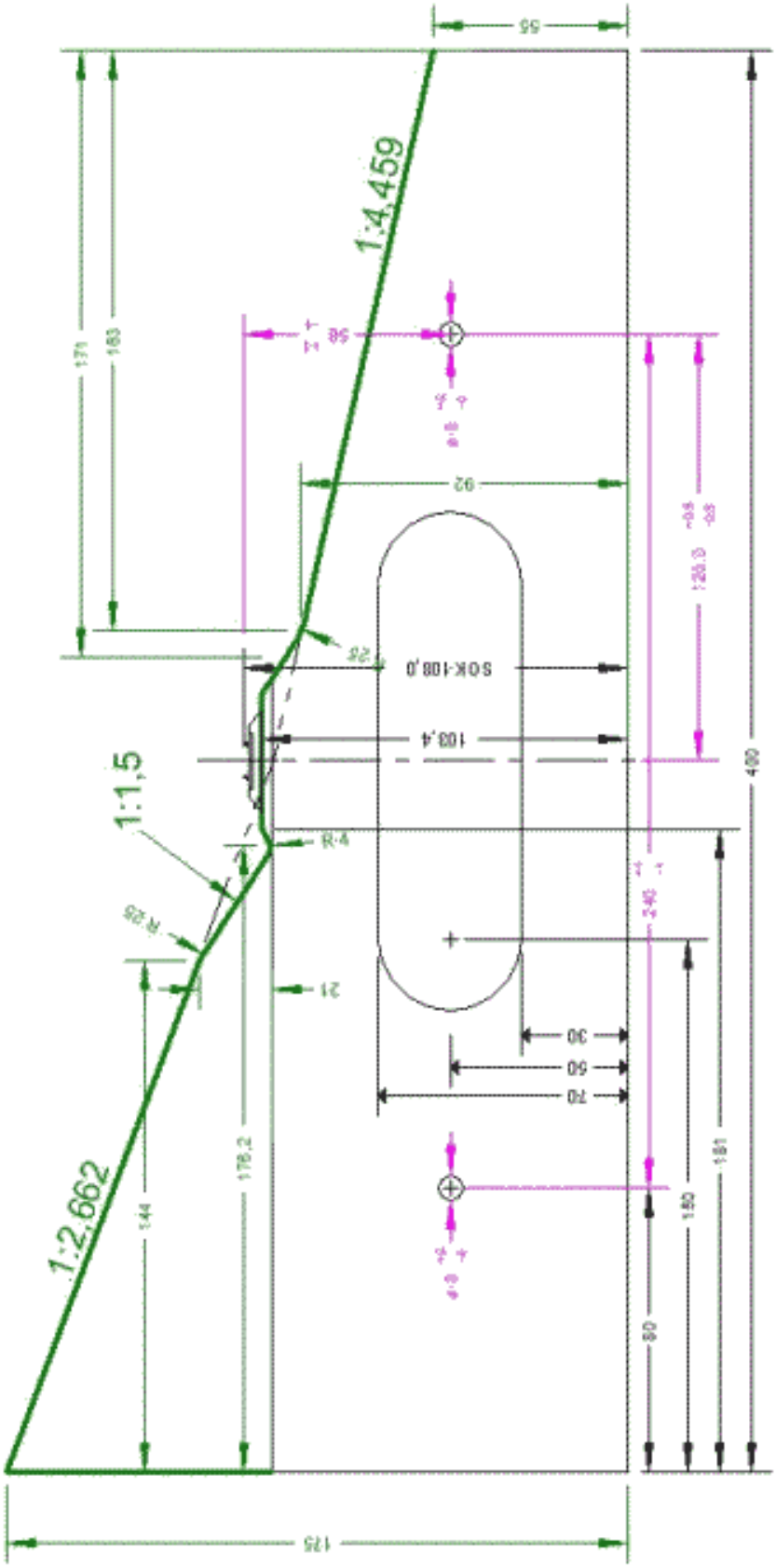
F1: Flat single track profile, similarly to FREMO "N90"



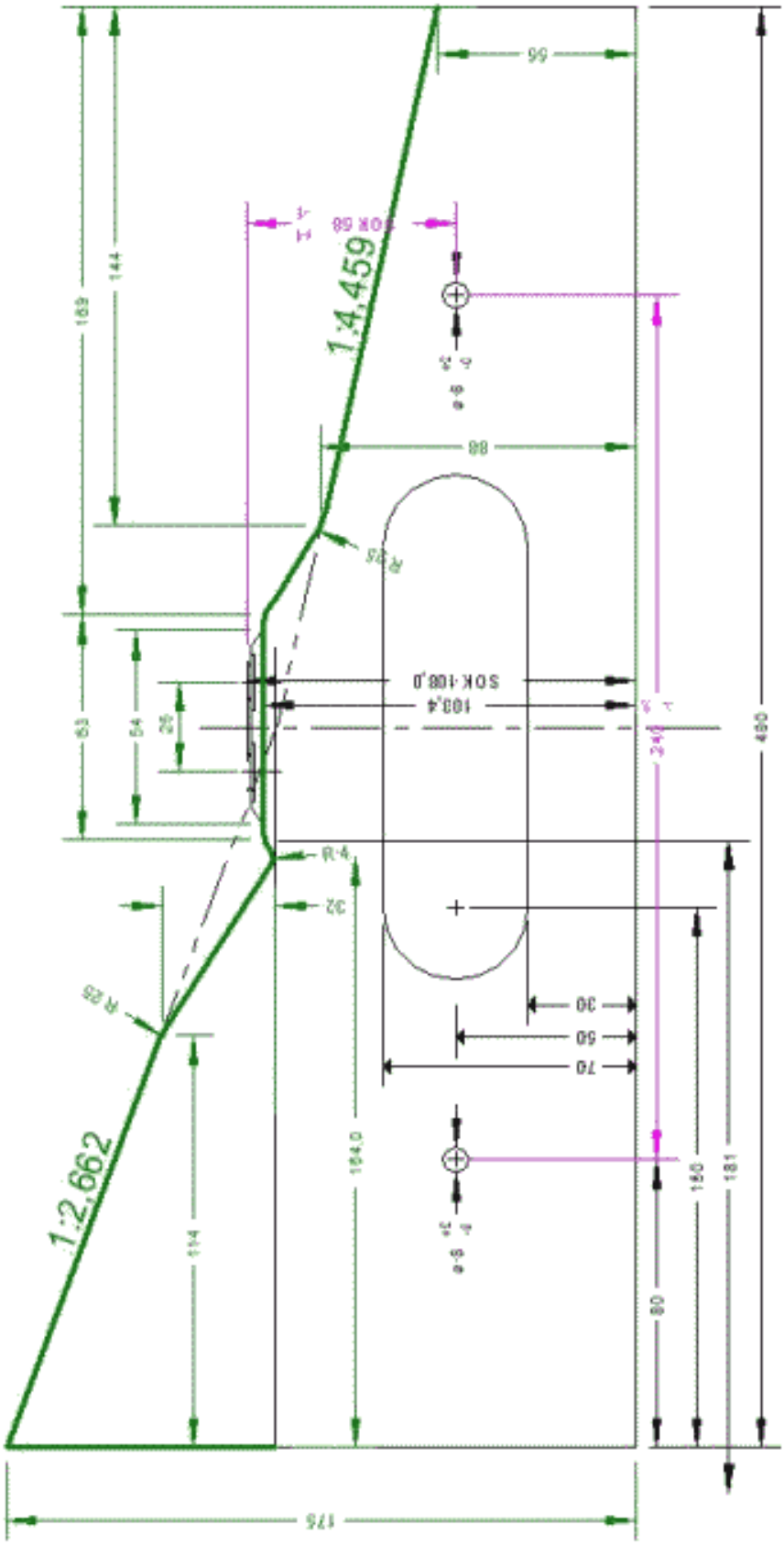
F2: Flat double track profile, similarly to FREMO "N90"



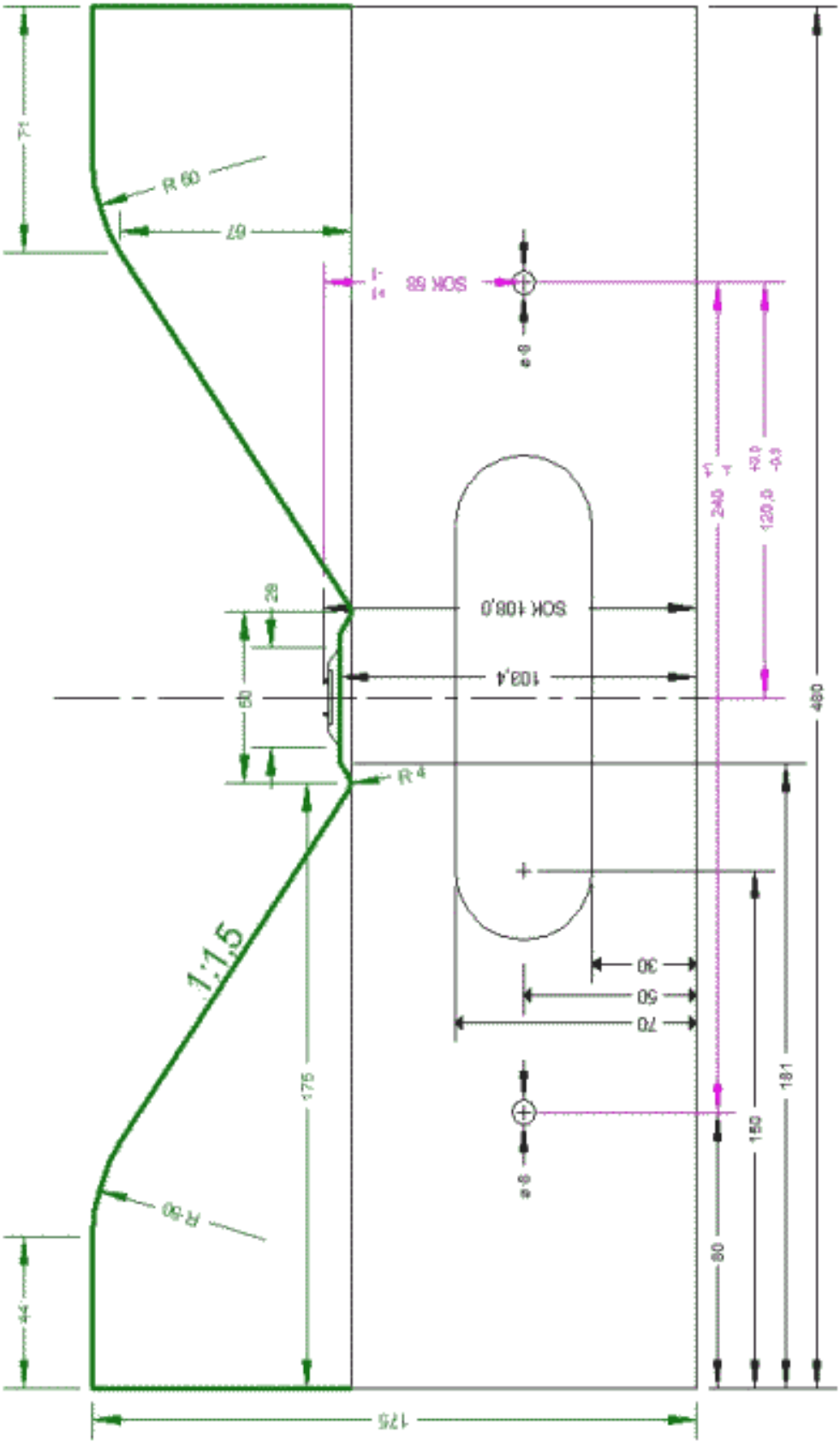
H1: Slope single track profile



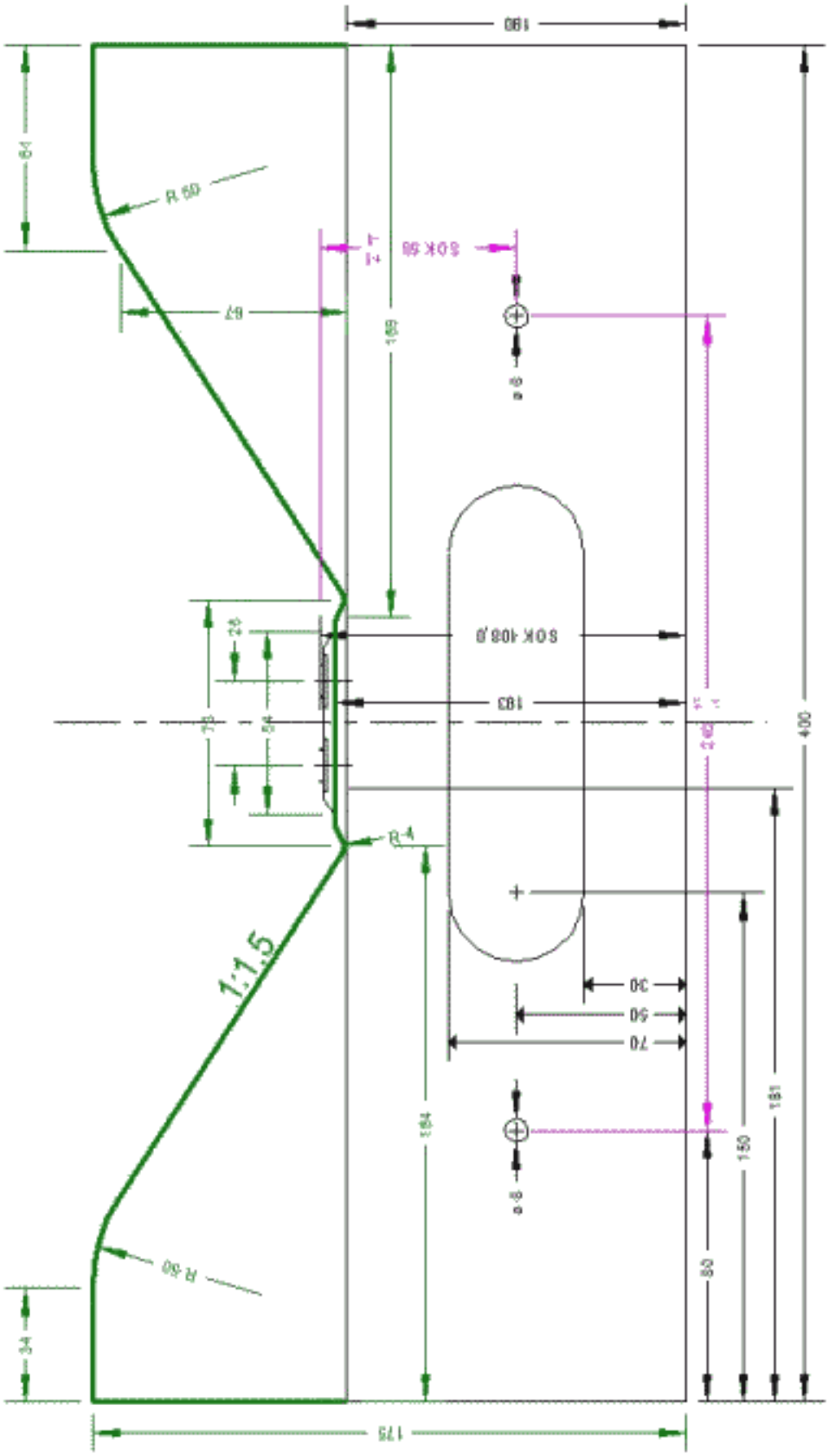
H2: Slope double track profile



E1: Cutting single track profile

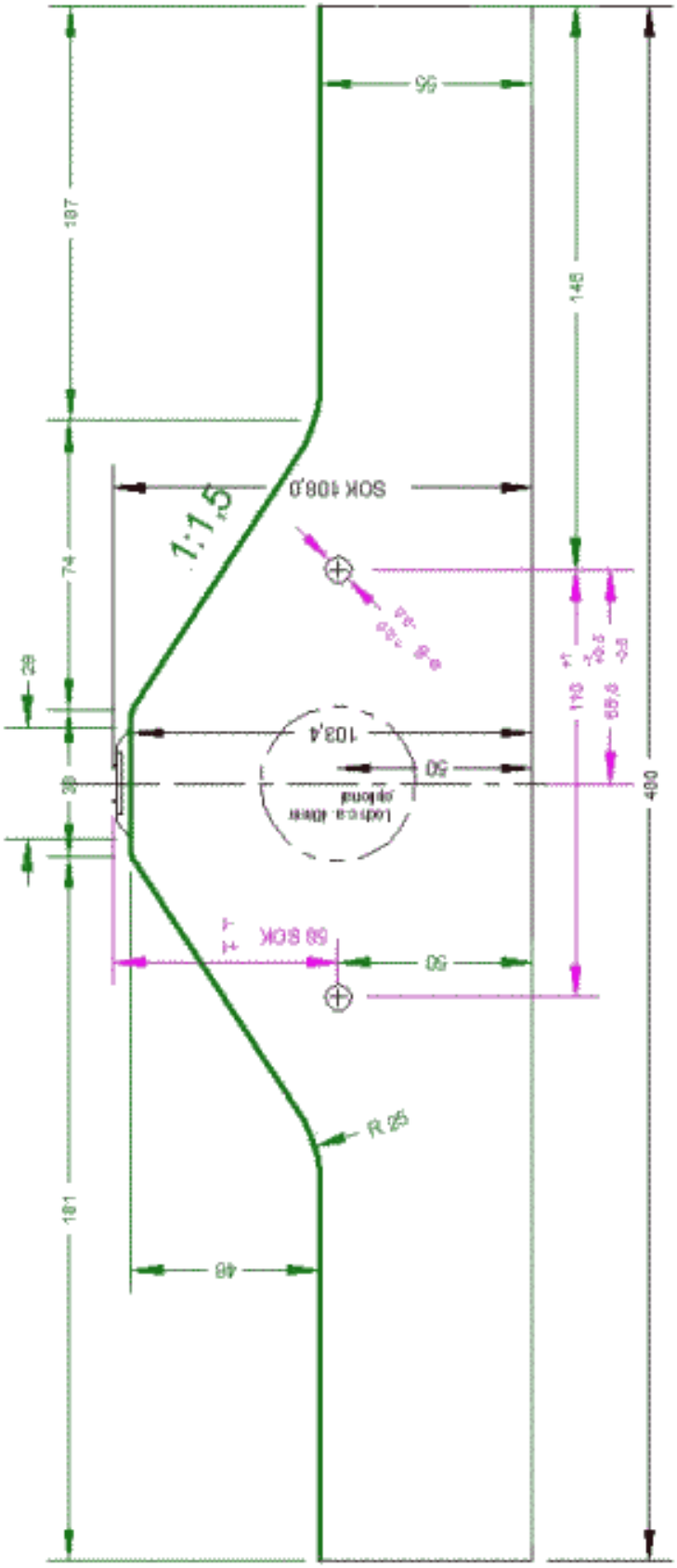


E2: Cutting double track profile



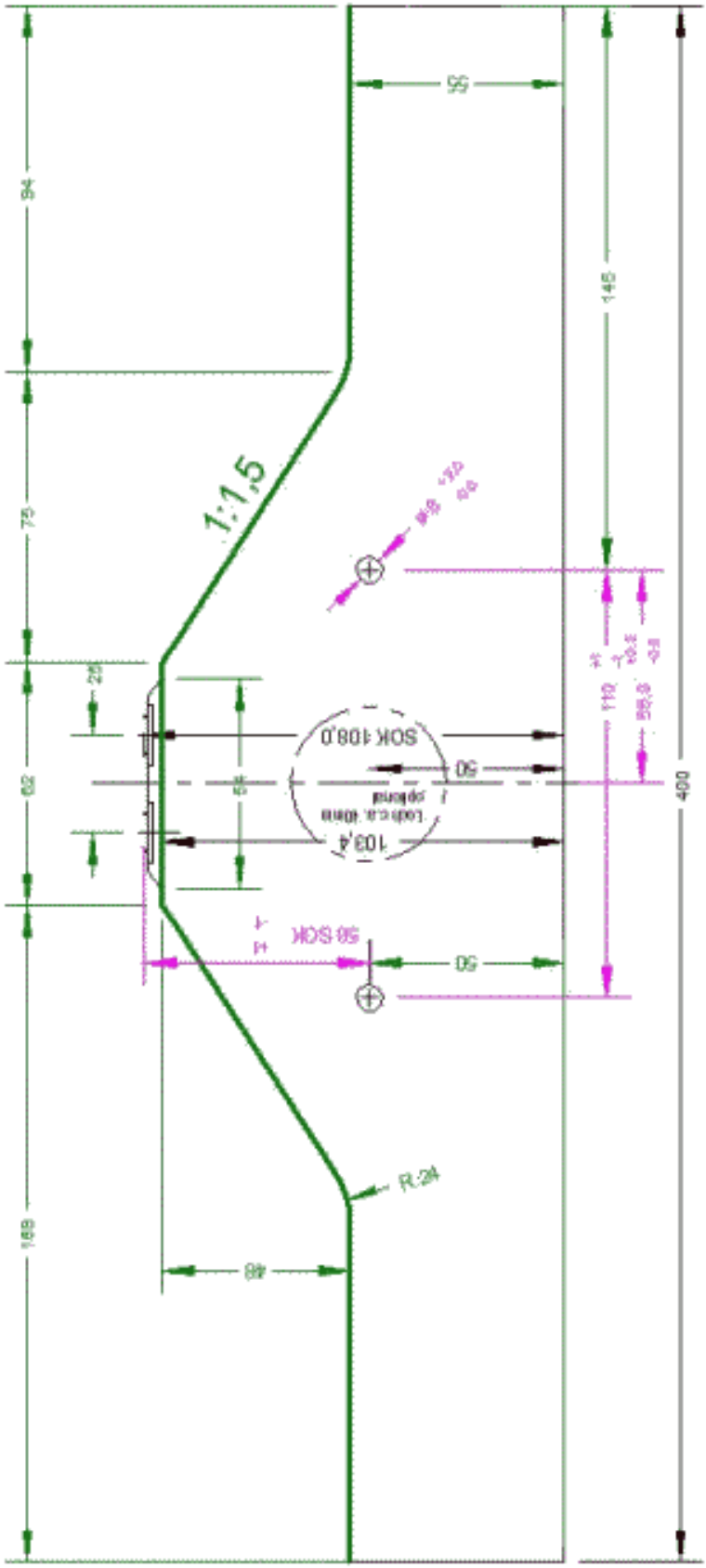
D1: Embankment single track profile

(Limited usage; Location of the holes!)



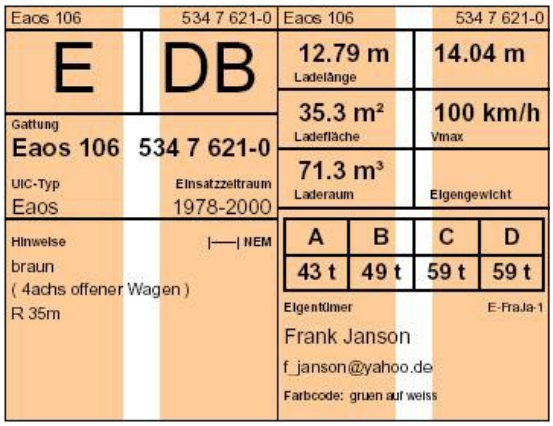
D2: Embankment double track profile

(Limited usage; Location of the holes!)



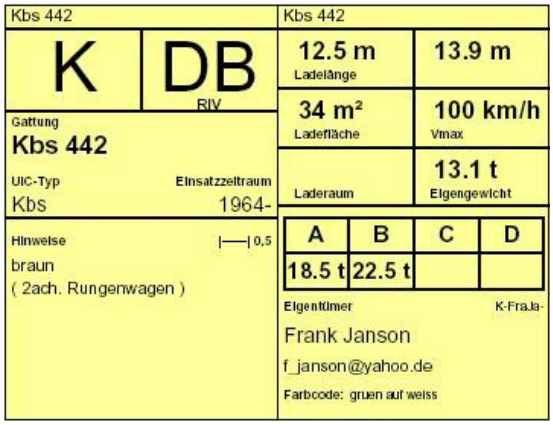
Annex B – Car cards for freight wagons (N-RE only)

UIC Types E and F

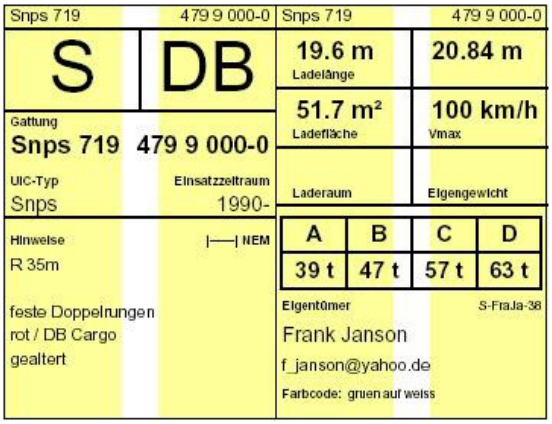


UIC Types G and H

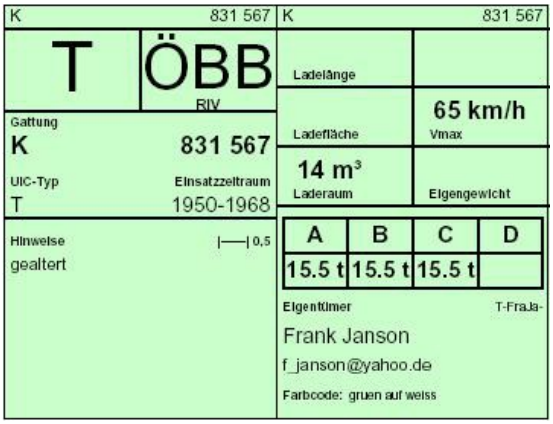
UIC Types K and L



UIC Types R and S



UIC Type T



UIC Type Z