2. Construction of modules

Valid from November 5th 2005

The modules should be lightweight, easy to handle and strong enough to withstand regular transport and changes in temperature and humidity. This calls for the use of materials that are easy to work with, affordable and still are lightweight and not prone to warping and other problems. The modules should also be at a defined height from the floor, and need suitable legs to support them.

2.1 Woodwork

The woodwork is relatively straightforward. No real standards are given, apart from the module sizes and the end boards, which should have holes to let the connecting bolts pass through. Basically a module is made up of two long sides, two shorter ends and a module top sheet. The ends and sides should at least be 100 mm deep, but 120 mm depth is highly recommended. It is recommended to have the top sheet sunken between the sides and ends, to protect the edges.
All modules should be **strong, square and easy to handle**, please bear this in mind when you start to design one or more modules.

Suitable materials for the sides and ends are plywood and MDF (medium density fibreboard), chipboard is not suitable, it is heavy and too likely to warp under changing climate conditions. Otherwise, it can easily be damaged during transport and storage. Plywood and MDF are different materials, both are used for making modern furniture. Plywood should be of a good quality and have a fine grain. When you can get it, use birch plywood, often used for making loudspeaker cabinets. Do not use plywood that has a very coarse grain or large 'knots'. These are low-quality plywoods, only suitable to make moulds for pouring concrete.

MDF is cheaper than plywood, but heavier. It is often used for making modern furniture and has a very smooth surface. It is also often used for making loudspeaker cabinets, as it has good acoustic qualities. MDF consists of fine wood fibres (just like sawdust) which are pressed together with a binding agent and some resin-like material. The resulting sheets are strong and smooth. MDF is suitable for the sides and ends of a model railway module. Please be careful with the very fine sawdust, take care of good ventilation and use the proper protective gear.

Sides of a 'J-Module' should be at least be 9 mm thick and be made of plywood or MDF.

Ends should be at least 12 mm thick and be made of plywood or MDF.
Module ends should have 2 holes of 10 mm diameter at the following position: 75 mm under the module top surface, at the position of the tracks and 150 mm on either side of the centreline. The holes are needed for the M8 or M6 bolts and wingnuts that are used to connect the modules. M8 bolts are recommended.

The top sheet can be made of plywood, or with suitable support made of hard insulation foam. These insulation foam sheets are sold under trade names like 'Styrodur', 'Styrofoam' or 'Isofoam'. Other brand names do exist. White 'Styropor' , also known as 'bubbleboard' or 'beadboard' is **not** suitable as it is not strong enough. The other foam sheet materials are not really cheap, but they are very lightweight and all have a destinctive colour and cell structure. They are available at D-I-Y stores. All need some form of support, and more than a plywood top sheet. This is basically due to the lesser strength of the foam. When you use Tomix track, only small holes are needed to let the wires pass trough, no big holes for point motors (Peco!) or point motor actuating rods are needed.

2.1.1 Module shapes and sizes, grouping of modules

The J-Module project knows several standard sizes of modules, which fit into a 'grid' to create a system that is a bit like 'Lego'. Basic grid size is 300 mm, with a minimum of 600 mm. Module width is to be **500 mm at the module ends**. Modules may be built wider or narrower, but only if this is required to depict a certain

scene, so please use this possibilty with care. The following table gives an overview of all J-Module lengths. Pleas note that you use the longer module lenghts only if you have suitable transportation and storage for them and that these longer modules are a lot harder to handle, often requiring two people to lift the module and move it from its storage to your car. The 'ends' column shows how much space is there to be left for the connecting track pieces. More on this in the section 'Trackwork' (paragraph 2.2.1) The column 'Track length' shows the numbers of Tomix track pieces and how many you need for a certain length of module. Please note that the numbers given are for a single track. For a standard 2-track module you need to double the number of track pieces. Very useful when ordering track!

Module lenghts				
Length	***Track lengths (1 track)***	***Ends (each)***	***Tomix ref. (Fine Track)***	***Tomix ref. (grey)***
600 mm	**280 + 99 + 70 + 70 insulating**	**40.5 mm**	**1022 + 1025 + 1024 + 1671**	**1032 + 1034 + 1035 + 1681**
900 mm	**280 + 158.5 + 99 + 70 + 70 insulating**	**41.25 mm**	**1022 + 1026 + 1025 + 1024 + 1671**	**1032 + 1036 + 1035 + 1034 + 1681**
1200 mm	**3 x 280 + 140 + 70 + 70 insulating**	**40 mm**	**3 x 1022 + 1021 + 1024 + 1671**	**3 x 1032 + 1031 + 1034 + 1681**
Additional module sizes				
1500 mm	**3 x 280 + 3 x 99 + 140 + 70 + 70 insulating**	**41.5 mm**	**3 x 1022 + 3 x 1025 + 1021 + 1024 + 1671**	**3 x 1032 + 3 x 1035 + 1031 + 1034 + 1681**
1800 mm	**4 x 280 + 2 x 158.5 + 140 + 70 + 70 insulating**	**41.5 mm**	**4 x 1022 + 2 x 1026 + 1021 + 1024 + 1671**	**4 x 1032 + 2 x 1036 + 1031 + 1034 + 1681**

The insulating track piece (ref. 1671, 1681) is very important, it provides electrical insulating between the modules. Electrical connections are made with cables. This provides the possibilty to create seperate electrical sections or 'power districts', which is very important for larger setups. The insulating track should be the first track piece on the module as seen in the normal direction of travel (mind the left-hand traffic!). An exclusion is made for the small radius corner modules, on wich there is no room to fit a 70mm track piece.

As an alternative you can use insulating track joiners (Tomix ref. 0110) and replace the 'gap track' (1671) and the 70mm track piece with a 140 mm long track piece.

Curved Modules

To “get around the corner” you will need curved modules. I designed two different combinations of curve radii, both on the same module size. The table shows the basic dimensions. Both use the same module size, basically a 760 x 760 mm square, but with end boards of 500 mm wide and the corners on the inside and outside of the curve 'chopped off'.

Small Radius Corner Module		***Tomix ref. (Fine Track)***	***Tomix ref. (grey)***
Inner Radius	317 mm	**1122**	**1132**
Outer Radius	354 mm	**1126**	**1136**
Straight on end of curve	140 mm	**1021**	**1031**
'End Zone'	34.5 mm		

Large Radius Corner Module		*Tomix ref. (Fine Track)*	*Tomix ref. (grey)*
Inner Radius	354 mm	**1126**	**1163***
Outer Radius	391 mm	**1128**	**1128 (Fine Track)**
Straight on end of curve	99 mm	**1025**	**1035**
'End Zone'	38.5 mm		

- Tomix ref # 1163 is a 2-track viaduct section that could be used without the piers.

Again, as an alternative, the insulating rail joiners could be used (Tomix ref. 0110), leaving the need for gapped track pieces (Tomix ref. 1671), which could be replaced by 70 mm long track pieces (Tomix ref. 1024). Use of insulating joiners saves money too.

A short note on older corner modules

Some older corner modules are built on a grid size of 730 x 730 mm. These modules could still be used with some restrictions. They should always be used in pairs, fours etc. At the moment of writing (2-11-2005) the author knows of only four of these older corner modules existing.

Grouping of modules

To depict scenes that do not fit a single module, modules may be grouped into larger scenes. Connections between modules within a group need not to confirm to the standards, but it is recommended strongly to have at least the main lines laid to the full standards, to allow the modules to be used as a single module.

2.2 Trackwork

Always important for any railway, and model railways make no exception. Without proper track no proper railway! The J-Module project team has chosen Tomix track as the basic track system for the J-Modules, at least for the design where we will start with. An upgraded standards may use other trackwork, but nothing has been defined for this upgraded standards, so we will concentrade on the basic standards first.

Tomix offer a wide range of sectional track, including several radii of curves. Full advantage has been taken of the extendable track section (ref. 1522, new 'Fine Track' range) to connect the tracks between two modules. The tracks fixed on the module should always end with a piece of Tomix track, just to accept the connector track without problems. Track should **always** be laid without kinks and bumps to ensure smooth running. Please check often during construction. Although most N-scale models are quite forgiving, it does not look prototypical to have trains running with a highly visible 'wiggle'.

Railtop level

A key factor in the design of a modular model railway. Railtop level is defined at **1100 mm** from the floor, the legs of the module should be able to compensate at **least 25 mm up and down**. This compensation is an absolute necessity to compensate for the always uneven floors at exhibition halls. When using J-Modules at home or small shows or get togethers other layout heights could be used, it's then up to you to decide which will suit you best.

2.2.1 Mark 1 Module trackwork, joining of modules.

On a Mk1 J-Module the track and module geometry is chosen in such a way that you can use Tomix sectional track on the module, encouraging novices to start building a module. The track to be used is the new Tomix **'Fine Track'** range, available from November 2002 and still growing in terms of available track pieces. Track is to be laid perpendicular (at 90º) to the module ends, to prevent kinks in the track and reduce the risk of derailment. Tracks should be in the center of the module for at least 70 mm from the module ends. Tracks on the module should end with a piece of Tomix 'Fine Track' track to make joining with other modules easier. Distance between track centres is **37 mm**, as per the Tomix track geometry. The use of Tomix 'Fine Track' is strongly recommended, it assures more or less correct track spacing and is ideal for those who are less experienced. Older Tomix track with brown or grey roadbed may also be used, as long as you can provide 'Fine Track' extending track pieces to join your modules with other modules.

As mentioned above, nominal railtop level is 1100 mm from floor to railtop. Module supporting legs should be able to compensate at least 25 mm up and down. Connecting the supports for stability is recommended, this canbe achieved by using diagonal struts and horizontal planks connecting the legs. If placed carefully, the horizontal planks can carry a handy storage shelve.
When setting up the layout, the first module set up will function as a 'master' to align the other modules in the layout. Modules should be placed level, so that the Japanese-manufactured free-rolling trains will not roll away when parked. A spirit level is very useful to ensure this.

For connecting the tracks there should be a space without any track, to leave room for the Tomix extending track pieces that are used to connect the modules. This space varies a little in length, depending on the length of the module, see the tables for the correct space. The tracks should always end with a piece of Tomix track, just for easy fitting the connecting track pieces.

Electrical

The track on which a train enters the module (left hand) should be fitted with gapped rails within the first 150 mm of fixed track. Both rails need to be gapped to provide electrical insulation. This is necessary to group modules into electrical sections, that are powered by a single controller. On all modules except for the small radius curve, these gaps can be made by using the Tomix insulator track piece (ref. 1671). On all modules you can replace the metal joiners by plastic (insulating) joiners from Fleischmann. More information on the electrical system can be found in chapter 3, that deals with all electrical matter.

In the appendixes you can find CAD drawings of several modules, complete with measurements.

2.3 Loading gauge

The loading gauge can best be seen as an imaginary tunnel in which a train and its load should fit. No part of the train should protrude outside the loading gauge. For modellers, the loading gauge gets important when building tunnels, placing platforms and other buildings in close proximity to the tracks. Kato makes a useful gauge that comes with their re-railer (Kato ref. 24-000) A different gauge is offered by the NMRA, this gauge can also be used as a track gauge when handlaying your track (I know, this is beyond the skills of most of our members).If you do not have one of these gauges you can roughly use the measurements listed below. I strongly recommend the purchase of a Kato or NMRA gauge, preferably both. The loading gauge for electric trains should be applied to all double-track modules. Single track branches could be built to the lower 'steam and diesel' loading gauge, but the clearance for electric trains is preferred. Please indicate any track that is made to this lower loading gauge. Do not place catenary supports next to these tracks!

Basic loading gauge dimensions	
Width	27.5 mm
Height for steam and diesel trains	34 mm
Height for electric trains	45 mm
All heights are measured from railtop level	

Kato *gauge for checking loading gauge, catenary height, platform heigth, also functions as 'Unijoiner' remover to remove joiners from Kato 'Unitrack'. Comes together with a rerailer ramp.*

For reliable operation it is important that you use this values and regularly check them during contruction, modules with objects protruding into the loading gauge **will be excluded from exhibitions and operating sessions** until the problem is fixed. Remember that the given values are **only valid for straight track**, in curves the loading gauge should be considerably wider.(See RP-11 of the NMRA standards, or NEM 103), how much wider depends on both the radius of the curve and the length of the rolling stock used. Longest Japanese railway vehicles are 25 metres (Shinkansen) or 23 metres (conventional lines) long. The NMRA recommended practice RP11 classifies Shinkansen trains as type 'H' and conventional trains as type 'G'. This will affect the minimum curve radius and clearances.
Fortunately, the Tomix track system has a generous **37mm** track spacing, allowing long vehicles to take tight curves. I recommend to use the widest curve possible if only for aestethics. Distance between tracks is 37 mm as per the Tomix track system.

NMRA *mkIV standards gauge, checks loading gauge, platform height and RP25 rail and wheel standards.*