"TRAINCRAFT©"

explains in simple terms

The Safe Operation of
Miniature Passenger Hauling Railways

Ground level or raised tracks
Up to 200 mm (7.25" - 7.5") gauge

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I Introduction and Purpose

This CODE OF OPERATION for miniature railway operation has been compiled from observations and experiences learned from being involved for more than 50 years in the Miniature Live Steam Railway hobby.
The authors have visited tracks in many countries around the world and have observed and noted the good and bad features of them all.
These operating guidelines are to help newer members to the hobby to operate a miniature railway in a safe and enjoyable manner.
It may also help some of the more experienced members to hone their procedures.
TRAINCRAFT is to be used in harmony with the MEANZ codes of operation.
Each individual track may have additional rules to suit their particular conditions.
With locomotives getting larger and more public riding on the larger heavier trains it is essential for the locomotive driver to have a good working knowledge of the overall railway operation. Once a new driver has studied ***TRAINCRAFT*** and been taught the correct skills in locomotive preparation, driving and train handling a provisional licence may be issued. This will allow the student driver to operate a locomotive under the supervision of the club driver-training officer/s. (DTO)
A full licence will be issued once the student driver has satisfied the DTO that he/she is competent in the safe operation of the type of locomotive being used.

REMEMBER –

IT IS THE LOCOMOTIVE DRIVERS RESPONSIBILITY AT ALL TIMES TO ENSURE THE SAFETY OF THE PASSENGERS AND THAT THE EQUIPMENT IN HIS CONTROL IS BEING USED SAFELY ON THE RAILWAY AT ALL TIMES.

2 Railway Operation

2.1 The Operator or "*Manager*"

The ***MANAGER*** is defined as the person in charge on the day.
The ***MANAGER*** for the day must be at least 18 years old.
This is an NZ Department of Labour requirement. DoL. He / she must have read and fully understood all the rules and any local club extra safety rules. He / she is responsible for liaising with other club members present to ensure that the railway is operated in a safe manner at all times.

2.2 Logbooks

2.2.1 Day Running Logbook

It is recommended that a Daily Logbook be kept by the club, the *MANAGER* is to record all locos running and drivers / members present on running days. This logbook should also record members present on working bees and a brief description of the task being undertaken. If a member enters the club rooms at any time throughout the week he/ she should record the visit and purpose in the log book.

2.2.2 Passenger Car / Rolling Stock Logbook

Each item of rolling stock used on the railway should be given a mechanical safety WOF check to ensure that it is in safe working order. This check should be completed at least once per 12month period.

This inspection should be recorded in the passenger ride car / rolling stock logbook. An inspection date sticker should be attached to the car.

2.2.3 Locomotive Register / Boiler Serial Number Logbook

A logbook should be kept recording each locomotive owned by members of the club. It should contain the type of locomotive, the boiler serial number, or other method of ID, name of the builder and name of the owner. This register should also record non-steam Locos.

A photograph of the locomotive should also be attached.

This record is also useful in the event that a locomotive is stolen.

2.3 Track Inspection before Running Trains

2.3.1 Track

Before running trains for the day the entire track must be inspected for damage, stones or other debris which may be present. All loose stones etc must be removed or swept from the rails on any road crossings.

2.3.2 Signals

If the railway has operating signals these must be checked for damage and correct operation before trains run for the day.

2.3.3 Points and Operating Mechanisms

The point blades must be free from stones and other debris, which may prevent their correct operation. Moving components need to be oiled.

2.3.4 Turntable or Traverser Operation

If the railway has a Turntable or traverser or any mechanical device for transferring locos, the moving components must be checked for damage, oiled or greased before being used on the day of operation.

2.3.5 Tunnel Doors or Bridge gates (if fitted)

Tunnel doors or gates need to be secured and or locked in the open position to ensure that they cannot be closed while trains are running.

2.3.6 Faults

Any fault or damage to the track should be repaired before the MANAGER allows trains to haul members of the public.

Only when the track has been inspected and reported 'all clear' to the MANAGER, can trains hauling the public commence running for the day. This should be recorded in the day running logbook

2.4 Drivers Responsibilities

The Driver is responsible for the operation and safety of the train at all times.

- The Driver must ensure the following:-
- The passengers have been told of the safety requirement before the train depart the station.
- Abide by all safety requirements for the track that the train is running on.
- Ensure the passengers remain seated and facing forward throughout the entire journey.
- Look back at the passengers at every opportunity to ensure they are behaving.
- In the case of a derailment/accident to ensure the train is made safe, a passenger or guard if one is on board must been sent back to stop the following train. Only then assist with fixing the derailment / accident.
- It is desirable to have a guard at the rear of trains of four or more passenger carriages. This is at the discretion of the driver.
- It is desirable that the guard has a means of alerting the driver if there is a need to stop the train. i.e.: Whistle and red flag.
- If any passenger will not abide by the safety rules the driver has the right to stop the train and have the passenger make his or her own way back to the station on foot.

2.4.1 Drivers Ability (or lack of)

If any driver is seen to be operating any train in an inconsiderate or dangerous or manner they will be asked to immediately remove their equipment from the railway track.

The MANAGER will note details of the violation and advise the safety committee to investigate further if this is deemed necessary.

The driver may be asked to explain his version of the incident and a period of re-training for the offender may be required.

2.4.2 Locomotives and Rolling Stock Safety Checks / WOF

The driver is responsible to check for the correct operation of all items on the locomotive. i.e.: Steam loco - water sight glass, blow down on the sight glass, safety valves and the various water feed systems and brakes must all be tested before the loco leaves the steaming bay.

The rolling stock should also be given a visual WOF check to ensure that the wheels, bogies, brakes, passenger foot supports etc are all in safe working order before the ride car is used for passenger hauling. Each item of rolling stock should be fully inspected on a yearly basis or more often if a fault has been reported on that particular item.
These details should be a “current WOF sticker with date of inspection” affixed to the ride car.

3 Station Duties

3.1 Stationmaster

The MANAGER can also be the Stationmaster
The Stationmaster is responsible for all activities around the station regarding the running of the railway on the day.
This includes crowd control. At busy times safety ropes or barriers may be required to keep the public back from the track.

3.2 Signage

The Stationmaster will ensure that any necessary safety information or warning signs be put out on display before passengers arrive. These signs also need to be collected and stored at the conclusion of the day's operation.

3.3 Water & Fuel

On busy running days a person should be dedicated to help the locomotive drivers' coal and water their locos.

Suggestion: *- Drinking water should also be available nearby for drivers.*

3.4 Ticket Seller

An adult club member should be present in the ticket office at all times when trains are operating. A good working knowledge of the railway is also required as some customers have many questions to be answered.

3.5 Train Loading

The train must be completely stopped before passengers board the train.
The best method to board the sit astride passenger ride cars on ground level track is to **step right over the seat and then sit down**.
An alternative method is to sit on the seat side-saddle and then swing a leg over the seat. This method can also be used on raised tracks.
High-sided Gondola cars are difficult to board and even more difficult to alight from. They are best suited for small to medium size children.
All passengers should be facing forward at all times.

If only one passenger is on a ride car he / she should be in the centre of the ride car to keep the car in balance.

3.6 Ticket Clipping & Train Dispatch

The station master or his / her assistant must take the ticket from the passenger, clip it and return the ticket to the passenger – This prevents finger nails being clipped in error

Once all the passengers are seated and their tickets clipped the following instruction should be given - (or something along similar lines):

▪ Please remain seated at all times while the train is in motion - ▪ Do not jump around, lean out, or grab any items beside the train –
▪ Keep your feet on the footrests, and hands in at all times while the train is in motion - ▪ Enjoy your ride on our miniature railway.
▪ When the train and passengers are ready to leave, the dispatcher will give the driver the *ALL CLEAR* to proceed.

3.7 The Journey

- The driver must abide by any speed restriction of the track, usually 4 Km / hour approaching stations, yards and crossing. 8 km per hour maximum on minimum radii curves such as the MLS mountain spiral track and maximum top speed of 12 Km / hr on long straight sections or sections with large radii curves.
- Note there are different speed rules for different tracks. Make sure you know these rules before driving on the track
- The driver should check on the passengers' behaviour by looking back as often as possible. This is easiest done when going around curves.

3.8 Unload the Train

The train must have come to a complete stop before any passengers are allowed to de-train.

4 Locomotive Preparation

4.1 General Safety Check

Locomotives must have all safety devices checked before entering service for the day. All moving parts need a **drop of oil**. Do not over oil as this can contaminate the track and cause traction and braking problems.
Train brakes must be tested before commencing each trip.

A safety chain must be connected between the locomotive and the tender/drivers ride car to eliminate any chance of a runaway locomotive.

4.2 Steam Locomotive Boiler Certificates

Steam locomotives must have a current boiler test certificate. A copy of this should be available at all times. The loco driver must be prepared to show this certificate when requested by a club boiler inspector or the *MANAGER.*
A *laminated copy attached under the driver's seat is a good idea)*

4.3 Battery Electric Locomotives

Check couplings and safety chains and test the braking system.
Operate the speed control in a smooth manner both accelerating and slowing. Avoid harsh acceleration to extend the battery life between recharges.
The batteries should be recharged straight after use to prevent sulphating of the plates. Check the electrolyte levels in the cells and if necessary just cover the plates with deionised battery water: available from battery retailers.
Any spillage of battery acid must be diluted with water and cleaned up.

4.4 Refuelling Petrol/Diesel Locos

Refuelling Petrol and diesel locos must be done well away from locos that are in steam or any other naked lights.
The ground in the refuelling area must be dry to prevent any spilt fuel floating on top of the water towards any nearby ignition source.

4.5 Boilers

4.5.1 Raising steam

- Before lighting the fire in a steam loco, the boiler must be filled with water to $^1/_2$ way on the sight glass. This is the normal operating level.
- Check that both top and bottom sight-glass stopcocks if fitted are open.
- Check that the sight-glass blowdown cock is closed.
- The locomotive should then be rocked slightly forward and aft.
- The water level must rise and fall in the glass.
- This rocking water level check ensures that both top and bottom passages are clear from the boiler to the sight glass and that the sight glass is giving a true water level reading in the boiler.
- Ensure the fire grate and ash pan are located in the correct position.
- Light the fire and turn on the external 'blower' to draw the fire.
- Once steam is raised, the various boiler water-feed devices must be checked for correct operation. Steam Locos must have two completely separate operating methods for feeding water into the boiler.
- Care must be taken not to touch the sight glass with the shovel, poker, or any other cold object when the loco is in steam.
- It will almost certainly fail & spray out very hot water & steam.
- The boiler pressure must be raised to full working pressure and the safety valves tested to blow off at the working pressure. (Max 7 bar)
- The maximum working pressure is normally marked with a red line on the face of the pressure gauge and should not exceed 7 bar (or 100 PSI).

4.5.2 Water Level Sight Glass

The sight glass blow down valve (at the bottom of the fitting) must be opened for a few seconds to ensure the sight glass is clear and that the water level returns to normal as soon as it is closed. This should be done hourly or more often if the glass is dirty and the water level is hard to read.
The normal water level in a boiler is 1/2 way up the glass when level.
This will be 1/2 to 3/4 - full when going uphill. It will drop to ½ to 1/4 when going downhill. The variation in gauge glass water level is due to the boiler angle changing due to the gradient of the track.

4.5.3 Boiler Water Treatment

Many clubs have some form of water softening treatment in the lines used to fill loco boilers. It is normal when using locos with steel boilers to use additional boiler treatment to remove oxygen and slow corrosion. Check with the boiler committee in your area for details.

5 Rolling Stock Preparation

5.1 Making up Trains

Once your locomotive is ready to run you need to attach some rolling stock.
Choose passenger cars or other rolling stock that is in scale with your locomotive. Ensure that the passenger ride cars have working brakes, a seat back rest and front grab handle to prevent passengers sliding off the seat.

5.2 Couplings Brakes & Safety chains

5.2.1 Couplings

The NZR type with a solid kidney link is the most common type.
It is easy to make and it is very reliable.
It gives vertical and lateral movement.
Nearly all the NZ clubs have adopted this type of coupling for their 185 mm gauge (7.25") passenger hauling ride cars.
The couplers / kidney link holes used are 10mm dia and the coupling pins used are 3/8" or 9.5mm dia for ease of assembly.
To retain the pins use 2 mm 'R' clips, Nyloc nuts or drop links.
The flat bar and vertical pin is also used on many smaller locomotives and is also very satisfactory.
The vertical pin is normally 6 mm dia.
The automatic knuckle coupler type is not in common use in NZ.
This type must have a safety chain between cars as these couplers have a nasty tendency to come uncoupled at the most inconvenient time leaving part of the train behind.

5.2.2 Brakes

Over the years we have established that to be safe, at least half of the wheels on a train should be fitted with brakes under direct control of the loco driver.
A small ejector on a steam locomotive generates the 12 - 15"of vacuum required to operate the train vacuum brakes.
On multi cylinder petrol powered locos the vacuum can be taken from the inlet manifold via a one way valve, vacuum receiver tank and a three-way brake control valve.
The most common system is - Vacuum to train = brakes applied.
The connection between ride cars uses 6mm internal dia (7.32") vacuum hose onto 6.3 mm hose tails. (Available from Repco stores)
Another system in use **on locomotives** is compressed air.
Air on = brakes applied.
This is a very effective method of operating the brakes on the larger locomotives. It is however much more difficult to set up on the locomotive. Usually only the larger scale locos use this system.

5.2.3 Testing Brakes for the First Time

When testing your new loco for the first time start off with one or two ride cars until you have mastered the operation of your locomotive and tested the effectiveness of your braking system.
It is essential for you to know how long it takes your train to stop.

5.2.4 Safety Chains

Safety Chains must be fitted between the locomotive, tender and the drivers ride car to prevent a run-away locomotive if the coupling comes detached.
Safety chains must be fitted between all ride cars if the automatic knuckle type couplers are used.
Recommended - that safety chains be used between all ride cars.

6 Running Trains

6.1 Speed

The speed limit through any station or yard area is not to exceed 4 km per hr.
The speed when going around sharp / tight or minimum radius curves such as on the Manukau mountain spiral track shall not exceed 8 km / hr.

A maximum speed of 10 Km / hr may be OK on long straight sections and large radii curves such as the Manukau prairie / park track when pulling the public. Some clubs may impose a lower speed limit than this to suit local conditions. There may be tunnels, bridges or sections of track with a lower speed limit.

The driver must keep watch for any speed restriction signs.

6.2 Signals

All signals, warning signs and flags must be always obeyed.
Individual clubs may have special rules regarding their signal system.
Each driver must be familiar with these before running his/her locomotive.

6.3 Following Distances

As a rule, a minimum spacing of 30 metres between trains should be considered satisfactory. The distance to stop varies with the track gradient.
Trains running downhill will take twice the distance to stop from the same operating speed as the same train running uphill.
The driver must be vigilant and always keep a look out ahead. **DRIVERS**
there is no excuse for tail ending the train in front.

6.4 Derailments

Stop the train behind you
If any train should derail or have an unscheduled stop for any reason, the first thing to do is to protect the rear of your train from the train following you.
If there is a guard on board this is his first job. If no guard is aboard, a passenger can be sent back to warn the following train there is a stoppage. Once the train following has been advised of the stoppage the cause of the stoppage can be attended to.

6.5 Night Running

6.5.1 Lights in the Dark.

All trains running in the dark must have a white light showing to the front and have a RED light indicating the tail of the train (a bicycle tail light is suitable).
An additional torch should also be carried to check boiler water levels and to warn a following train of any unscheduled stoppage.
It is essential to have a torch available for the driver when When operating at night.

6.6 Guards Duties

6.6.1 Before Train Departs

The driver and guard if one is being used must ensure that all passengers are correctly seated and their feet are on the footrest boards.

6.6.2 Flags

It is recommended that the guard has a green 'Keep going' and a red warning flag to STOP.
This is to be used as a stop signal as required.
It is also desirable to have a green flag to signal the driver that all is well.
Suggestion: - this flag could be double ended red on one end green on the other end of the handle.

GUARD Duties during trip

Keep a constant watch over the passenger's behaviour and stop the train in the event of any misconduct. Protect the rear of the train.
On very long trains it is recommended that the guard be in contact with the driver by 2-way radio or a loud audible device (Whistle)

7 Problems Which May Happen

7.1 Duties if there are Problems

In the event of any serious misconduct by a passenger the driver or guard will stop the train. The offending passenger will be asked to leave the train.

7.2 Locomotive Failure

In the event of a locomotive failing to operate, firstly stop the following train - Send a messenger for assistance and if possible push or tow the dead loco **in the normal direction of travel** back to the depot or steaming bays.

7.3 Rolling Stock Derailment

The driver should be aware of the normal noise the train makes when all is running normally. In the event of any abnormal noise or additional drag from the train the driver should stop the train and check that all the train wheels are on the rails. The passengers should be removed from the derailed ride car before re-railing takes place.

7.4 Track Problems or Faults

If a track fault is located it should be reported to the manager.
The track may need to have a slow order placed on the faulty section or be closed until the fault is repaired.

7.5 Incidents / Accidents

- All incidents / accidents must be reported to the Manager.
- Details are to be entered in the incident / accident register.
- If medical treatment is required the Manager or another suitably trained person will arrange this.
- If the accident is caused by any faulty mechanical equipment operated at, or by the club it must also be reported to MEANZ so they can deal with any ongoing consequences.

8 Drivers Licences & Membership Cards

Members, who wish to partake in running the railway, performing guard duties and driving miniature locomotives with fare paying passengers will need to study for and obtain a club issued licence.

The licence details are recorded on the club membership card. This is issued once the member has paid his yearly club membership fees.

8.1 Driver Training

8.1.1 Guard / Electric / Diesel loco drivers licence

Before driving trains with fare paying passengers a new 'Student' should be involved with helping around the station, loading trains and clipping tickets. This leads to Guard duties on longer trains and learning the 'Train craft' that is necessary before driving a locomotive.

The next step is to learn to operate an electric or diesel loco under the direct supervision of the driver training officer or senior committee member. (Supervisor to be on the train with the student)

A provisional 'Guard, electric or diesel licence' may be issued at this stage once the DTO is satisfied that the student has acquired the necessary skills in train handling. After a further practice period the Student will be allowed to haul passengers under supervision. (The supervisor present in the general operating area)

A full electric / diesel / guards licence will be issued once the Student has satisfied the DTO that he/she has reached the required standard and answered the relevant questions correctly.

8.2 Steam Locomotive Licence

To obtain a Steam loco licence a student would first have to have passed a guard / electric / diesel licence.

The student would have to spend several track running days helping a steam loco owner prepare and light up a loco from cold.

Lessons would be given under direct supervision at first in the correct preparation and handling of the locomotive, its accessories and rolling stock.

Blowing down the boiler and cleaning out the tubes and cleaning the loco at the end of the days running would also need to be included.

After a few days satisfactory operating under direct supervision the student may be issued a provisional licence.

After a few more days operating under supervision and answering relevant questions a full steam locomotive licence may be issued.

8.3 Retesting

The *MANAGER* / DTO must be confident at all times that all drivers are able to operate the locomotives and trains in complete safety. If any driver has had a major incident, a rear end collision or any other “near misses” the Safety Committee reserves the right to ask the driver to study and re-sit the licence test.

8.4 Driver Training Officer/s DTO

The person/s appointed by a club to oversee the driver-training program should have a past history of satisfactory building and operating miniature trains over a period of many years.

Driver's Licence Application Form

for the operation of MINIATURE LOCOMOTIVES
operating under the MEANZ Code of Operations
on miniature railway tracks in New Zealand

Applicant First Names: _____

Applicant Surname: _____

Postal Address: _____

Street *(if different from above*): _____

_____

Suburb: _____ City: _____

Phone Number: _____ Date of Birth:: _____

Email: _____

MEANZ associated club you are a member of : _____

_____

Type of Licence required – strike out those that don't apply:

Guard Duties	Diesel – Electric	Steam

By signing this application you are stating that you have read and fully understand the Code of Operation for Miniature Railways and agree to comply with its contents.

Signature _____ Date _____

FOR CLUB USE ONLY

Date Received: _____

Date of Section One Testing: _____ DTO Signature: _____

DTO Comments: _____

_____

Date of Practical Test: _____ DTO Signature: _____

DTO Comments: _____

_____

Retesting Recommended _____

The testing club must keep all details in their drivers licence register

Driver's Licence Test

The questions 1 to 16 are compulsory and must be answered correctly before a driving test can take place

	Compulsory Questions	
1	What is the minimum age for the operator of the day?	
2	When visiting another club with your loco should you ask to read their additional rules and why?	
3	Name some of the items that must be checked on the track before public running starts.	
4	Who gives the all clear to allow public running for the day to commence?	
5	How often should rolling stock be checked and be issues with a WOF?	
6	If you find that a piece of rolling stock has a fault who must you inform?	
7	Which direction should all passengers be facing?	
8	If a loco is over oiled, what is likely to happen to the track?	
9	After a train is made up what must be checked before the train can be put into service for the public?	
10	Do all drivers have to obey all signals?	
11	What is the recommended speed through stations and yard areas?	
12	In general what spacing should be between trains?	
13	Under what circumstances is it permitted to tail end the train in front?	
14	What precaution must be taken when refuelling petrol or gas powered loco?	
15	Between what components of a train must safety chains be fitted?	
16	What procedure must be followed if there is an accident? Name at least three.	

	A Selection of the following Questions will be asked	
17	What details should be recorded in the day running logbook?	
18	Can the stationmaster be the operator for the day?	
19	If the rolling stock has a current WOF can you presume it is safe to use or should the driver give the train a further check before using it?	
20	What must be checked on all rolling stock before they are put into service for the day?	
21	Who is responsible for ensuring signage is displayed for the day?	
22	Who gives the driver the all clear to depart from the station?	
23	What are some of the things the dispatcher should say to the passengers before the train is given the all clear to proceed?	
24	What causes the water level in a steam loco to vary when going up and down hills?	
25	What is the maximum speed a train can travel when pulling in the public?	
26	Can a club have a lower speed than the maximum shown in the code and if so where would you find this limit?	
27	When a train is derailed or a train stops for any reason, what is the first thing that must be done?	
28	What lights are required for night running?	
29	When is a guard required on a train?	
30	What colour flag should a guard have available and what it this flag used for?	
31	When there is a track fault or problem who must be informed or this?	
32	Can a driver's licence retest be called for and if so, for what reasons?	

	Steam Loco Operating Procedures	
33	What MUST be done before the fire is lit in a steam loco?	
34	What duties can be performed while steam is being raised?	
35	Why does the driver check the safety valves are working correctly?	
36	How many operating ways of putting water into the boiler of a steam loco are required before a steam loco can be used to haul the public?	
37	When your loco has a full head of steam and the train is made up, what is the procedure to observe before putting your train into service for the day?	
38	What must a steam loco have before it can be operated for the public?	
39	If you are in doubt if a boiler has any water what can be done to check for water?	
40	When a mechanical water pump is fitted how could you tell if it is functioning?	
41	If the water level is hard to read in the sight glass how can you clear this?	
42	If all means of putting water into the boiler fail and the boiler water is out of sight in the glass, what would you do next?	

43	When a steam loco is in motion what must be checked before you add fuel to the fire?	
44	How can you tell if the cylinders are receiving oil?	
45	How do you stop the train?	
46	What is the reason for notching up the valve gear once the loco is working?	
47	When the loco is stationary why is it necessary to have the blower on?	
48	What is one reason for always using clean boiler feed water?	
49	What is meant by “PRIMING” of the boiler?	
50	In the event that you prime a boiler what is the next thing to do?	
51	In the event of a Water Gauge Glass breaking, what would you do?	
52	If the boiler water level was low and the ash suddenly blew out from the ash pan, what has happened, and what would you do next?	
53	What is the normal water level in a steam locomotive sight glass?	
54	When taking over a loco which is in steam from another driver, what checks would you make?	
55	If the blower is on and the safety valves are howling off what procedures should you do to rectify this situation?	
56	In the event that the reversing lever is jumping back and forward when you are notching up the valve gear, what could this indicate?	
57	What is the normal procedure for shutting down a loco at the end of a day’s running?	

9.0 Dimensions for Track & Coupling Standards for Rolling Stock

DIMENSIONS FOR MINIATURE RAILWAY TRACK AND WHEEL STANDARDS

TRACK GAUGE		ACTUAL WHEEL STANDARD DIMENSIONS						COUPLER HEIGHT
Nominal track gauge - inches	Actual track dimensions - mm	G	B	T	W	F	R	C
3.5 inch	90 mm	87.5 mm	83 . mm	8.6mm	2.4 mm	3 mm	1 mm	
5 inch	128 mm	125.5 mm	119 mm	13 mm	3 mm	4 mm	2 mm	75 mm
7.25 inch	186 mm	182 mm	172 mm	19 mm	5 mm	6 mm	3 mm	125 mm

9.2 Guidelines for Retesting Used Miniature Steam Boilers

As steam locomotive boiler tickets come due for renewal we follow the guidelines set down in the Australian Rules Pt.1 Copper boilers & Pt. 2 Steel boilers.

Copper boilers, Retests are due at 1 year and then at 4 yearly intervals.
Steel boilers, Retests are due at 1year and then at 4 yearly including internal inspection each time.

The wash out plugs on the sight glass fittings need to be removed and both the water passages into the boiler checked to ensure they are both completely clear.

The safety valves need to be removed and the seats on the steam dome need to be plugged.

The safety valves should be dismantled, cleaned and the springs inspected for corrosion at this time. The firebox and the smokebox also need to be cleaned out so all the internals are clearly visible

If a fusible plug is fitted to the firebox crown sheet this needs to be removed, cleaned and refitted. All inspection plugs need to be removed to check the interior state of the boiler.

The MLS boiler committee has purchased a miniature digital camera which can pass through an 8 mm dia hole and give sharp images in colour of the general internal condition and the state of the crown sheet. These images are stored in the corresponding boiler # file in our computer.

After the internal inspection the owner needs to assemble the necessary fittings on to the boiler to accept the club hydraulic boiler test outfit.

The MLS test outfit has both 1/8" BSP and 1/4" BSP male fittings so the boiler will need to be fitted with a suitable female socket of either 1/8 or 1/4 BSP. Some ME thread adaptors in the smaller sizes are also available -

If the boiler inspector is familiar with the boilers past history the retest may be done with the cladding in place. If a boiler is presented 'out of the blue' without any past history available the cladding must be removed so a more detailed inspection of the overall condition can be made.

When preparing for hydro testing, the boiler must be filled to brim with water and all air bubbles eliminated. The boiler hydraulic retest requires working pressure X 1.25
It is strongly recommend that a new sight glass be installed before conducting each hydraulic pressure test. Sight glass tubing does wear very thin after a few years in service.
During this time the inspectors look for any leaks or other abnormalities.
The pressure gauge fitted to the boiler is also checked against the club master gauge at this time.

If all is well the hydraulic test details are completed in the club boiler register.

STEAM TEST
The water glass is checked for correct operation
The boiler is steamed and the operation of both / all water feed systems checked.
The accumulation test is next.
With park brakes applied or driving wheels spragged, drain cocks open and the throttle just cracked, a good fire, blower on, the safety valves are allowed to pop. Safety valves must not allow the boiler pressure to exceed operating pressure by more than 10 %

Auxiliary items such as the sight glass blow down valve, boiler blow down valves, brakes, whistle etc should also be checked for correct operation at this time.

If all the above items are found to be in good working order the boiler register is to be completed and the new boiler ticket complete with new expiry date will be issued by the boiler committee.

GENERAL SAFETY CHECK
A general check on brakes, couplings and safety chains should also be completed at this time.

MLS Boiler Committee – 30/8/15

9.3 Tips on Care of your Miniature Steam Boiler

Report by Dave Giles MLS

The Guest speaker at the MLS general meeting in July was Mike Bouwmeester from SPIRAX SARCO Ltd, a company that specialises in care of large boilers.

Mike showed us a very interesting power point presentation of the various things that need to be kept in order inside large boilers that are in steam 24 hours a day 7 days per week. He also explained the challenges that occur when operating large boilers 24/7 are totally different, compared to the short periods that we have our miniature boilers in steam.

SOME POINTS WE SHOULD BE AWARE OF –

Find out what the Ph levels are in the water supply that we use in our boilers. This can vary from club to club so it is a good idea to purchase a PH level kit.
A suitable test kit is available from JAYCAR -

The ideal Ph of the feed water for full copper boilers and Steel shell boilers with copper tubes should be around 9.5. This is slightly alkaline. This will ensure the copper tubes don't collect deposits such calcium, silica, lime etc which form an insulation barrier on the tubes.

Steel boilers with steel tubes can tolerate a slightly higher Ph level of between Ph
10 to Ph 11.

It is desirable for club with low PH (acid water) to install a water softener.

Mike mentioned that there is a small percentage of non-soluble solids, calcium, Silica, lime etc in every litre of water that our boilers evaporate into steam.
When our boilers are in steam the solids are left behind and these collect at the lowest point; this is usually around the firebox foundation ring.

Mike strongly recommends that we should be doing a short blowdown for a few seconds every hour the boiler is in steam to dump the solids before they have time to accumulate and solidify. We have traditionally done a blowdown at the end of the days run. He says this is not sufficient to discharge the solids from the boiler.

STORING YOUR STEEL BOILER –

When a steel boiler is not going to be steamed for a while, the safety valves should be removed from the dome, the blow down cocks left open and a 75 watt light bulb or low wattage heater unit be left burning inside the firebox. This will allow the boiler to completely dry out inside.

We have observed that several Live Steamers in the USA and Canada have a control lever in the loco cab connected to the blow down cocks on their loco.
They regularly do a short blowdown when crossing a bridge or viaduct well away from the public to ensure the escaping steam will not burn any bystanders.

MBM model supplies have stock of boiler treatment for a steel boilers.

9.4 Batteries

FREQUENTLY ASKED QUESTIONS ABOUT CHOOSING AND CARING FOR BATTERIES ON MINIATURE LOCOMOTIVES

Q1 **How do I decide on the correct size battery for my battery powered locomotive?**

A1 Most DC motors that are suitable for powering miniature locomotives operate on 24 volts and have permanent field magnets. Let us assume that the motors are 24 Volt. This requires two 12-volt batteries in series to make up a 24-volt system. Four six volt batteries in series can also be used. A typical battery electric locomotive with 2 - 600-watt DC motors (3/4HP ea.) geared to a maximum speed of 12 km / hour will haul 10 adults on grades of 1.5% - 2% with ease.

The total current draw from the batteries on a typical journey will be about 20 amps on the level sections and about 60 amps on the gradients. Most miniature railway tracks are a loop so the uphill section cannot be more than 50% of the journey. On the downhill section there is virtually no power being consumed and in some cases a very small amount of power is returned to the batteries from the dynamic braking effect of making the motors into generators.

While passengers are being loaded the loco is usually stopped for about the same time as the trip takes so the average current draw per hour is only about 1/3 of the maximum amps being consumed on the upgrade section of the trip.

The average current usage in this example would equate to 20 amps.

If 80 amp/hour batteries in series are powering the locomotive you could expect to run the locomotive for 4 hours before the power would start to drop off. *i.e.: total battery voltage down to 23 volts.*

e.g.: 80 amp/hour battery divided by 20 amps = 4 hr expected running time.

If 100 amp/hour batteries were being used, 5 hours running time could be expected.

The general rule with batteries is 'Bigger is always best' if they will fit in the available space.

Q2 **What voltage is a fully charged battery?**

A2 For a 24 volt system this is 25.6 - 25.8 volts when the batteries are not connected to the battery charger.

Q3 **How far can I draw the battery voltage down before I start to permanently damage the cells?**

A3 23 volts is considered the minimum voltage that the batteries should be drawn down to if permanent damage to the cells is to be avoided. Note – this must be measured when there is no load on the batteries.

Q4 **Can a battery be left in a discharged condition for a few days without damaging it?**

A4 No, after your run for the day put your batteries on charge as soon as you can. Chemical changes take place when batteries are left in a discharged state for any length of time. This may mean that the plates start to sulphate and they will never fully return to a 'fully charged' state.

Q5 **Are sealed *GELL CELLS* better than *WET CELLS? (with removable top up caps)***

A5 In general the sealed type of *GELL CELLS* do not last as long on cyclic use as the wet cells that you can top up with electrolyte.

The ***GELL CELLS*** do have certain safety advantages in that they do not vent explosive hydrogen fumes when being charged or spill acid in the event of a roll over.

Q6 **Are *TRACTION* or *DEEP CYCLE BATTERIES* of different construction than the sealed *GELL CELL* type of battery.**

A6 Yes, Traction batteries have thicker plates, the plates are fastened in the case more securely to cope with vibration. The battery case is also deeper which allows more space at the bottom of each cell for debris to collect before it starts to short across the bottom of the positive and negative plates causing the cell to fail.

Q7 **Are there any viable alternatives to *LEAD ACID* type batteries?**

A7 Yes there are several different types but the cost of the exotic types is out of all proportion to the cost and performance of a conventional Lead Acid battery.
The Lead acid battery is still the only viable choice at present.

Q8 What is the best type of battery charger, Single-stage or Two-stage?

A8 The single-stage battery charger gives a compromise charge. If left on for too long after the batteries reach their fully charged state the cells can overheat and boil the electrolyte, which then evaporates.
The single-stage charger is reasonably cheap to purchase and it is best suited to supervise use. *i.e.: It must be turned off as soon as the battery comes up to full float voltage*.
The two-stage charger -CTEK 1400 is easily the best for batteries that are on intermittent use. This charger starts charging on a boost voltage of 29 - 30 volts for two or three hours and gets things moving inside the cells. It then cuts off and comes in on a much lower float maintenance charge voltage level of 27.2 - 27.4 volts. This type of charger can be left turned on without overcharging or heating the batteries and shortening their life. It is the type recommended for the sealed types of GELL CELL batteries as it does not cause the electrolyte to 'gas'. The CTEK 1400 costs more than the single stage charger but the batteries have a much longer useful life.

Q9 How do I know what amperage battery charger to use for my 80 amp/hour batteries?

A9 The battery manufacturers recommend that to obtain the longest life from your batteries the charger should be sized to give a full charge over a period of 10 - 12 hours.
The **maximum charging** amps that a battery can accept is its rated Amp/hours divided by 4.
In this example the maximum charge rate that a 80 amp/hour battery could accept is 20 amps.
This is not recommended as the high charge rate severely overheats the plates and they buckle and start to disintegrate. The battery life will be very short if it is charged at this high rate.
If your loco has 80 amp/hour batteries, an 8 amp charger will take 10 hours to fully recharge them. *i.e.: 8 amp X 10 hr = 80 amp hour. An 8 amp charger is perfect for 80 /100 amp/hour batteries.*

Q10 Can parallel / series / parallel stacks of batteries be charged together or does each bank have to be charged separately?

A10 The industry opinion is that it is not satisfactory to charge strings of series / parallel batteries with a common charger. The variation in resistance between batteries in parallel causes uneven current flows. If this lash up has to be used, it is better to charge the series strings separately.

Q11 Does the Amp/Hour capacity of a battery reduce with short heavy usage and then long periods of inactivity?

A11 As long as the batteries are stored fully charged they last fairly well. This however needs to be taken in context that the life of a battery is never more than 4 years even if it is properly charged and cared for. The internal plates 'sulphate' over time and they eventually fail at around 3 - 4 years.
If a single stage charger is used the batteries should be put on charge for two hours every month to keep them fully charged. If a CTEK 1400 charger is used they can be left on float charge.

Q12 How long do you expect batteries last in a miniature locomotive?

A12 Makers of the Sealed types claim a cycle life of 300 - 350 cycles. i.e.: full - flat - recharged.
The makers of the Trojan Deep Cycle wet batteries that are often used in Golf Karts claim a typical battery life of 600 cycles. These cycle / life predictions are assuming the battery is used and charged on a daily basis.
To obtain the best life from a battery it must never be discharged below 11.5 volts on a 12 Volt system, or never discharged below 23 volts on a 24 V system.

The information on batteries and chargers has been gained from practical experience gained from many years of building more than 800 battery electric vehicles ranging from single seat Mobility scooters weighing 100 kg up to 48 seat people movers weighing up to 5000 kg. Many variations of battery electric railway locomotives, two battery electric trains that operate inside the Auckland Harbour Bridge and two race winning solar/ battery powered racing cars have also been designed and manufactured by the author over the past 35 years.

9.5 MLS Passenger Ride Car

We are including a copy of our MLS Passenger Ride Car checklist for your information so you can check all of the following items on your own passenger ride car before the MLS safety committee give it the regular safety WOF inspection.
This should save us a lot of time as we hope that you will have attended to any faults found before presenting it to the safety committee for its regular WOF inspection.

Rollingstock Checklist

Date: _____ Item # _____ Checked By:

Item Checked	Pass	Fail	Comments
Carriage Body#			
Check Couplings for damage			
Couplings & Pivot pins both ends			
Safety chain & hooks			
Front handgrip			
Rear seat backrest			
Seat covering for damage			
Seats sits correctly on carriage			
Vacuum brake hoses intact			
Vacuum brake lines (full length)			
Carriage body general condition			
Paintwork needs attention			
Front Bogie#			
Frame for square			
Wheels/Axle back to back 172mm			
Brake shoes for wear			
Handbrake Operation (if fitted)			
Bogie bolsters & centrebolt			
Check for bolster/carriage play			

Rear Bogie#			
Frame for square			
Wheels/Axle back to back 172mm			
Brake shoes for wear			
Handbrake Operation (if fitted)			
Bogie bolsters & centrebolt			
Check for bolster/carriage play			

9.6 NZ Suppliers of Tools & Materials for Model Locomotive Building

ALLOY & BRONZE CASTINGS
Montrose foundry – 5 Southdown lane - Penrose – Ph 5794230 (Contact John)

BOLTS & FASTENINGS – Blacks Fasteners – 930 C Great South Rd Penrose ph 09 5891036

BOILER AND MODEL ENGINEERING COMPONENTS
MBM model supplies - Water pumps, rustless balls, clack valves, water sight glasses, injectors, BA taps and dies, BA bolts and nuts, boiler treatment for steel boilers etc SILVER SOLDER with Cadmium 1.5dia SB 45 - Check out the range in the MBM website - mbmmodelengineering.com

BRONZE, Solid & Cored - various off cuts and Modeller friendly –
CORUS METALS - 7 Bruce Roderick Dv - East Tamaki Ph 09 271 8781

CASTINGS - NON FERROS
Progressive Castings Ltd – 86 C Patiki Road Avondale – Jobbing work
Ph Joe Crowther 8289668

CERTIFIED STEEL BOILER PLATE
Fletcher Easy Steel – Suppliers of certified steel boiler plate with manufacturers' certificates –
Computer cut to exact shape and size you require – Fletcher Easy Steel Ph 525 9400

CERTIFIED STEEL BOILER WELDING
Weld Trade Engineering Ltd – 30 Tui Street - Otahuhu Auckland (Contact Duncan)

COPPER SHEET SUPPLIERS – 600 mm wide X 3 mm thick – Kimberly Tool and Design
60 Ford Road Waihi…Ph 07 8638008
Contact Brian Parker

COPPER TUBE & SOLID ROD for boiler stays –5.5m & 3.6 m lengths MICO –
306 Nielson St Onehunga Ph 09 6330301

CURTIS 200 amp 24 volt DC speed controllers –
With regen braking – DNC Systems Sydney

FLAME CUT LOCO FRAMES
Fletcher Easy Steel – Give them your cad drawing and they can cut out your exact requirements from any thickness steel plate with their computer controlled oxy acetylene torch. Ph 5259400

HOLLOW BAR FOR LOCO WHEEL TYRES Fletcher Easy Steel - Medium tensile hollow steel
Ph 5259400

LATHES – MILLING MACHINES - BAND SAWS – HAND TOOLS – ETC
Chevpac Machinery – 131 B Pilkington Road – Panmure – Ph 570 1134

Machinery House – Hybrook drive East Tamaki

MILLING CUTTERS – LATHE TOOLS – TAPS & DIES - DRILLS
Trade Tools 23 Olive Road Penrose ph 525 8900

PASSENGER RIDE CAR WHEELS 90mm dia
Fully machined from 1045 steel to correct profile
With bearings – Ikon Engineering – 2 Canon Place Pakuranga
Ph 09 5767162

PLASTICS - Engineering grades – all types Mulford Engineering Plastics – 12 Henderson Pl
Onehunga Ph 09 6362900

SEALS AND TEFLON PACKING
Seal House – oil seals -square & round Teflon gland packing

STAINLESS STEEL FASTENINGS etc – 3 mm dia upwards, hex head, CSK, Pan head, capscrews, nuts, nyloc nuts, SS piano hinge, SS threaded rod, SS ball valves, SS flexible wire cable –
ANZOR Fasteners –
Trugood drive – East Tamaki –2121

STEAM BALL VALVES FOR REGULATORS
Brass & SS pipe fittings – Steam related fittings
Taylors Transmark 4 C George Bourke Drive
Mt Wellington Ph 0508 829567

TITON BRASS FITTINGS – copper steam and brake lines –
Rocol cutting fluids -
ENCO Engineering supplies – 45 Springs Road – East Tamaki
– Ph 2744125

9.7 Driver's Licence Application Form – Tear out Copy for your own use

Driver's Licence Application Form

for the operation of MINIATURE LOCOMOTIVES operating under the MEANZ Code of Operations on miniature railway tracks in New Zealand

Applicant First Names: _____

Applicant Surname: _____

Postal Address: _____

Street *(if different from above*): _____

_____

Suburb: _____ City: _____

Phone Number: _____ Date of Birth:: _____

Email: _____

MEANZ associated club you are a member of: _____

_____

Type of Licence required – strike out those that don't apply:

Guard Duties	Diesel – Electric	Steam

By signing this application you are stating that you have read and fully understand the Code of Operation for Miniature Railways and agree to comply with its contents.

Testing officer ……..