NARCOA

CUSTOM-BUILT & HIGHLY- MODIFIED MOTORCAR GUIDELINES

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INTRODUCTION and INTENT -

This handbook was developed to create a set of guidelines that provides inspectors, excursion coordinators and custom motorcar builders a common reference source that will aid in building and inspecting custom built or highly modified factory-built motorcars. It is not the intention of this handbook to aid in the prohibition or banning of motorcars from NARCOA insured excursions. It was developed to help assure that motorcars which are custom built or highly modified are done so in a proper and safe manner and that they can operate safely along with factory built motorcars.

SCOPE -

These guidelines have been written to apply to all existing custom-build or highly modified factory-built motorcars and to all vehicles that are being custom-built or highly modified at the present time or in the future.

DESCRIPTIONS -

CUSTOM-BUILT MOTORCARS CAN BE DESCRIBED AS FOLLOWS:

A motorcar that has not been built by a commercial motorcar manufacturer whose vehicles have been proven in a professional railroad or motorcar hobby environments. Or, a motorcar that has been built using technology other than that used in the manufacture of factory-built motorcars. Or, a motorcar that has been built by an individual from the frame up. In most cases one or more of the following items may be other than standard factory-built motorcar components or designs: the frame, engine, transmission, drivetrain, braking system or a radical new design in body style.

HIGHLY MODIFIED FACTORY-BUILT MOTORCAR CAN BE DESCRIBED AS FOLLOWS:

Any factory-built motorcar that has had one or more of the following modification performed to it:

a] An engine has been installed that is physically much larger or much smaller in size and/or weight when compared to the standard engine for a factory-built motorcar of it's same size and weight class.

b] A different engine has been installed that is 15 horsepower or more or 10 horsepower or less than the standard engine it replaced. Or, for heavy weight motorcars (Fairmont "A" type cars), when the replacement engine horsepower has been increased by 50 horsepower or more.

c] The factory installed power source (engine) has been removed and replaced with something other than a conventional internal combustion engine.

d] The frame has been replaced with a frame of an unconventional design, Or, the frame has been shortened, lengthened, raised or lowered radically for it's standard factory dimensions.

e] Radical modifications have put the motorcar into a weight and size class other than it's original size and class.

f] The drivetrain has been radically changed to an unconventional type of drive system.

MECHANICAL STANDARDS-

In addition to meeting all of the "NARCOA MECHANICAL STANDARDS" that are printed in the latest version of the NARCOA BOOK of RULES, a custom-built or highly modified factory-built motorcar should meet the following criteria:

a) APPEARANCE - Overall size, proportion, seating and appearance of the vehicle should be comparable to that of a factory-built motorcar of comparable size and weight.

b) AXLES - Axles should be aligned to insure that they are parallel with each other and not skewed. Axles should be set to proper gauge. Hubs and axles should run true without wobble or vibration.

c) AXLES - Except on four wheel drive cars, the front axle should be a differential type. The differential sleeve or bearing should be equipped with a grease fitting to allow for proper lubrication. Cars that are turned manually should have a differential axle on the wheel set that remains on the ground.

d) BATTERY - Battery(s) should be mounted in a secure fashion in a way that also helps prevent damage or problems caused by vibration.

e) BRAKES - The vehicle's braking system should be cable of operating equivalent to, or exceeding the performance of a factory-built motorcar braking system of the same size and weight class.

f) CONTROLS - All controls should be solidly mounted, clearly labeled, easily accessible and not positioned in a way that interferes with the operator's visibility.

g) DRIVETRAIN - The drivetrain should be readily capable of being shifted into neutral and be able to be towed forward or reverse at a safe speed.

h) ENGINE - The vehicle's engine should be an appropriate size, with and horsepower for the vehicle's size and weight class. The engine should be mounted in a location that provides proper weight distribution. The weight ratio should be similar to that of a factory built vehicle that is in the same size and weight class.

i) EXHAUST SYSTEM - The vehicle should have an exhaust system that directs all heat and exhaust gases away from the operator and all passengers. The system should have a sound level that is un-offensive and comparable to that of a factory-built motorcar of the vehicle's same size, weight and engine type. The system should be located so it will cause no adverse temperature rise in any other part of the vehicle.

j) FASTENERS - All frame, structural and suspension components that are mounted with bolts should use fasteners that are a minimum of grade 5 or metric grade 8.8. All wheel mounting bolts and nuts should be fine thread grade 8 or metric grade 10.9 and be installed with lock washers. All other bolted assemblies should use lock washers or a self-locking type nut. Use of a removable thread locking fluid is recommended. [Please refer to the bolt head grade chart on page 4]

k) FENDERS - Fenders, flooring and/or running boards should be designed to a sufficient width in order to cover the entire width of each wheel. The top of all wheels should be covered and cannot be left open or exposed to the operator or passengers.

j) FRAME DESIGN - The frame should be designed and fabricated in a way that it has sufficient strength to not only support the vehicle and it's operator, but it also should exceed the strength necessary to support the maximum number of riders the vehicle can seat. It should also be able to support the weight of any additional tools, luggage or equipment the vehicle is capable of holding. No components should project from the vehicle lower than 2.5 inches above the rail head.

m) FRAME GEOMETRY - The frame should be designed and fabricated in a way that it is flexible enough and have proper weight distribution to allow all four wheels to be in constant contact with the rails even under severe changes in track geometry. The vehicle should be designed and fabricated to be “front heavy” with a front to rear weight ration that is similar to that of a factory built car that is in the same size and weight class. [Please refer to “Frame Design Choices on page 4.]

n) FRAME RAILS - Each frame rail should be fabricated from one continuous piece of material. Bolting or welding in order to extend or modify frame rails is prohibited. Frame rails should be fabricated from material with sufficient enough thickness and width to supply proper frame rail strength. Care should be taken when choosing the proper alloy for frame rail applications. Care should also be taken when choosing the structural configuration of the frame rails. Material such as square tubing has a greater resistance to flex than channels or angle configurations. So square tubing would be a poor choice for a flexible chassis design. [Please refer to “Materials Hint” on pg. 4]

o) FUEL TANK - The fuel tank should have adequate capacity in order to prevent premature or frequent re-filling on an excursion of average NARCOA length. The tank should be mounted securely and in a location that eliminates fire hazard from spilling, overflow, or draining of fuel. The tank should be mounted in a location that would help prevent puncture in the event of an accident.

p) MATERIALS - All materials used during fabrication or modification of the vehicle should be suitable for and used for their intended application. When selecting materials, care should be taken that the materials selected are able to withstand the stress they will be subjected to. {Please refer to “Materials Hint” on page 4]

q) PARKING BRAKE - Every car should be equipped with a parking brake capable of holding the car in place. If the brakes are pneumatic or hydraulic in operation, a separate and independent mechanical brake linkage should be provided for emergency/parking brake use.

r) RUNNING GEAR - All hubs, axles, bearings and additional running gear should meet or exceed factory motorcar design, strength, composition and manufacture specs. All hubs, axles, bearings and additional running gear should be of the proper size and strength for the vehicle’s size and weight class.

s) SEATING - Operator and passenger seating should be mounted securely. Seats should be mounted and positioned in such a manner that no occupant of the vehicle is ever put in danger of falling out of the vehicle or being put in contact with any moving parts.

t) TOP SPEED - The vehicle should be capable of operating at speeds comparable to a factory-built motorcar of the same size and weight class.

u) TURNING - The operator should be able to turn the motorcar at a road crossing in a reasonable amount of time by means of lift handles or a turntable. Note! Cars that can not be turned easily can disrupt the timely running of excursions.

v) TRANSMISSION - The transmission should be such that it allows for full speed operation in forward or reverse and can easily be shifted into neutral.

w) WHEELBASE - The vehicle’s wheel base (axle center to axle center measurement) should be not less than 32" and not greater than 98".

x) WHEELS - All vehicles should have four OEM (factory-made) wheels.

y) WHEEL SPECS - All wheels should be a minimum of 14 inches in diameter and manufactured from a steel alloy. Vehicles that weigh more than 4,000 lbs should use four heavy-duty cast wheels.

z) WORKMANSHIP - Each vehicle should be free from defects such as incomplete or improper welds, heavy rust, cracks or other defects that could impair it’s operation and integrity.

Frame Design Choices -

There are two choices that a builder has when designing a motorcar frame. The frame can be designed to be flexible enough to keep all wheels on the rails as best as possible by allowing the frame to flex during changes in track geometry. Or the second choice the frame could be built rigidly and an equalizing pivot joint or joints must be added in order to keep all the wheels in contact with the rails. The rigid frame with pivots design can be bulky, heavy, and complex to design and work properly. So the flexible, "Fairmont type" frame design would be the wise choice for a custom motorcar frame.

Materials Hint -

Many alloys of steel or aluminum do not have the same properties. For example; some aluminum alloys should not be welded while other alloys are totally suitable for the welding process. Many heat treated aluminum alloys tend to crack when bent, but they do a great job when used in unbent applications. Other alloys bend more easily, but that flexibility may come at the cost of the alloy having a lower tensile strength.

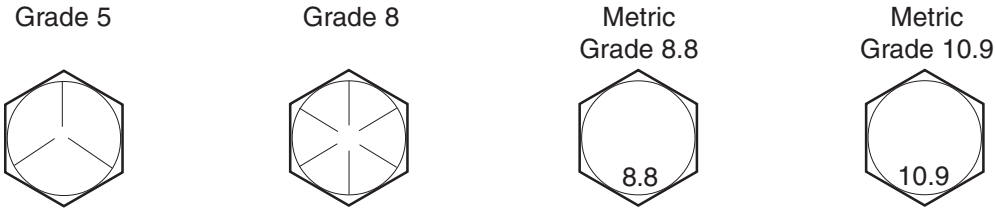
The improper choice of steels or stainless steels could also have detrimental results. Some alloys of stainless steel should not be welded, some have low tensile strength, yet others are way too brittle to use. Caution must be used when selecting stainless steel bolts and nuts. Many stainless fasteners, although being corrosion resistant, do not even have the tensile strength of grade 5 fasteners.

During the alloy steel manufacturing process various elements including carbon are added to give the steel it's required properties. Some grades of steel may appear to weld properly, but the weld area may crack readily. This is due to the steel being made up of a combination of elements that develop an improper grain structure when that steel is subjected to a welding process.

A heat-treated or hardened piece of steel may be perfect for certain high wear applications but when used in conjunction with the wrong mating material excessive and premature wear will result on the mating piece.

The entire point of the above paragraphs is to show that all materials are not "created equal". Be sure that you know what you are buying the next time you purchase materials for your motorcar building project!

Bolt Head Reference Chart:



*** THE VEHICLE SHOULD BE GIVEN STATIC AND ON-TRACK INSPECTIONS***

The static inspection -

Overall vehicle appearance is a very good key to determining if the car builder has done a proper job. If a car builder takes the time to make sure every little detail has been taken care of, it is a good indication that the car has been assembled properly. For example; poor looking welds could mean that the person doing the welding didn't know how to perform this operation. Crude looking welds aren't always weak welds, but if the car builder compromises on the integrity of the car's welds, then short cuts could have been taken in other areas. This "attention to detail' concept of inspection can be carried over into other area too.

STATIC INSPECTION CHECKLIST:

a] Is the wiring neat and properly secured?

b] Does the car present a professional appearance?

c] Were all the NARCOA Rulebook Mechanical Standards met?

d] Were all the Mechanical Standards listed in this handbook met?

e] Were fasteners and locking devices of the proper size and strength used?

f] Was attention given to the vehicle's undercarriage and parts that are out of direct view?

The on-track, test ride inspection -

It is impossible to determine the tracking, stopping, balance or the overall performance of a motorcar without operating it on the rails. Final determination as to whether a car can be approved should not be done until the vehicle has been taken for a test ride. When taking the car for the test ride, the operator should start out in a very slow and cautious manner. Then eventually work up to track speed after the vehicle has proven to be stable and safe to operate at lower speeds.

TEST RIDE INSPECTION CHECKLIST:

a] Does the vehicle have sufficient power to move it's loaded weight at average NARCOA motorcar excursion speeds?

b] Does the vehicle operate as if it is geared or over-powered so that it is capable of excessively high unsafe speeds?

c] Does the vehicle operate as if it were under-powered or geared to prevent reaching top speed?

d] Do the brakes feel as if they are adequate for a vehicle of this size and weight?

e] Can the braking system lock-up all four wheels at once and slide on dry rail?

f] Does the parking brake perform properly?

g] Are all important controls (i.e.: brake lever, throttle, shifter, clutch, horn, ignition kill) within easy access of the operator? Can all these controls be selected and reached quickly during emergency situations?

h] Are there any moving parts or "nip points" close to the operator or any of the passengers?

i] When seated in the operator's seat or in any passenger seats, does the rider feel safe, secure and comfortable during vehicle operation?

j] Does the vehicle run straight and true at all speeds? Does it give an overall feeling of adhesion to the rail when operating over all types of track geometry on tangent or curved track at all operating speeds?

k] Does the vehicle have adequate operator visibility for forward or reverse moves? Does the vehicle have adequate side visibility? If the vehicle were loaded with passengers, would the operator still have adequate visibility?

l] Can the vehicle be put in neutral and towed or pushed easily in either direction?

m] Does any excessive wheel vibration, wobble or eccentric action take place when the vehicle is operating in it's intended speed range?

n] Does the vehicle tend to "hunt" back and forth on the rails?

Inspection Hint - A factory-built motorcar of similar size, weight and power can be used as a reference vehicle. For instance the reference motorcar could be used to compare performance of the braking system or to get the general "feel" of a car that size. The reference motorcar could also be used to compare frame rail thickness or to compare any other aspects of material composition, strength or size.