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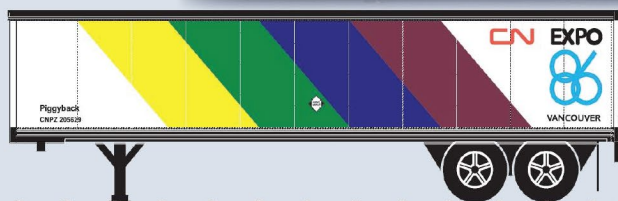
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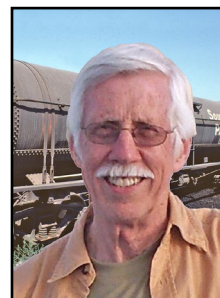
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Model Railroad Hobbyist | February 2016 | #72

# GETTING REAL

column



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## TANK CAR BASICS: PART 1

### ACCURATE TANK CAR MODELING REQUIRES PROTOTYPE UNDERSTANDING

FOR A NUMBER OF YEARS, I HAVE PRESENTED talks and clinics about the basics of tank car construction and operation, and continue to be surprised how often these topics are understood poorly by significant parts of the audience. Accordingly, I am presenting a summary of that material here.

Understanding how tank cars were built, as late as the 1950s, as well as how they were operated, is essential to accurate modeling. Not only the selection of appropriate car models, and the correct lettering of tank cars, but also the realistic assignment of them in model operation, is essential to "getting it right" with tank cars.

► **MODELING REAL RAILROADS AND WHAT THEY DO**

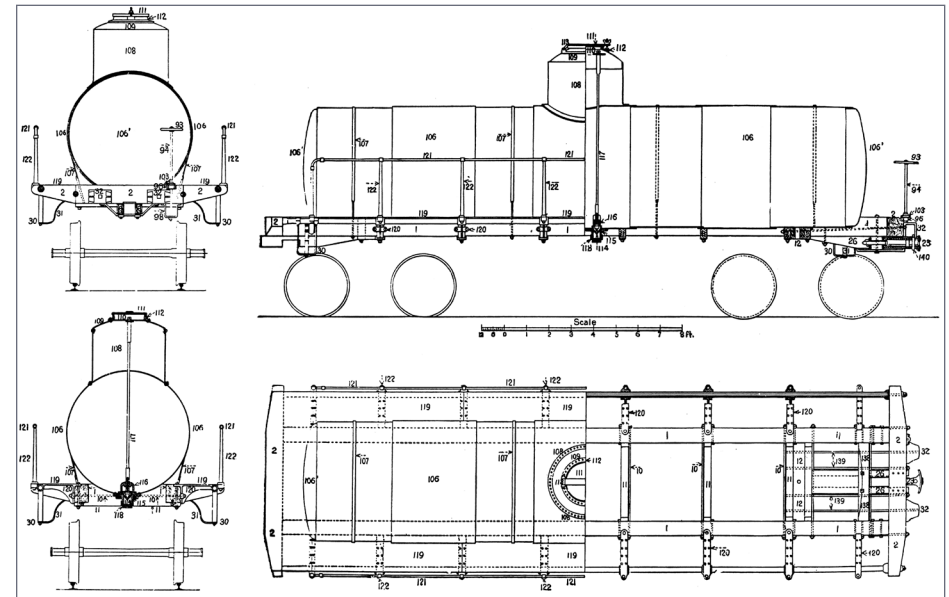
## Early tank car construction

Hoary legend assigns the invention of the railroad tank car to the Densmore brothers in the Pennsylvania oil fields in 1865. Their design, a pair of vertical wooden tubs on a flat car, was not particularly sophisticated, and indeed very similar tubs had been in use for many years, not only to haul water on wagons, both in the U.S. and in Europe, but to store water, vinegar, wine, and other common liquids. John White's extensively detailed and referenced book covers this topic well (see Bibliography).

At the same time, other inventors were patenting designs for cars with horizontal iron tanks, also hardly an innovation, since riveted locomotive boilers became an established technology in prior decades. Soon oil and its byproducts were being hauled in cars with horizontal iron tanks. These were built to whatever standards a builder or a purchaser might choose.

In-service performance of all freight cars, including tank cars, was greatly affected toward the end of the 19th century, because of the rapidly growing introduction and use of knuckle couplers and air brakes. Those changes made possible considerable increases in train lengths, and those increases in turn caused very large increases in the forces experienced by cars in trains. One common result was damage to, or destruction of, wood underframes, which had particular importance for tank cars.

The early tank cars had iron or steel cylindrical tanks, but they also had wood underframes, and often these were arranged with widely separated center sills. That arrangement permitted the tank to sit lower on the underframe, lowering the center of gravity of the car, but it meant that greater stresses and bending forces were present in these underframes. Damage in accidents or even in hard switching was often severe.



**1. The tank car design shown here received patent No. 100,058, granted to Samuel S. Murray in 1870 for Murray, Dougal & Company, a predecessor company of American Car & Foundry. (1879 *Car Builders Dictionary*).**

To be more specific, a drawing for a late 19th-century tank car is shown in [1], and in the plan view, the wide spacing of the center sills, and the corresponding need for cross pieces between the sills for attachment of draft gear, are clearly seen. This drawing closely follows the 1870 patent for a tank car, assigned to Samuel W. Murray of Murray, Dougal & Company, located in Milton, Pennsylvania, and a predecessor of American Car & Foundry.

Let's look at this drawing for a moment. The car has several modern features. The metal sheets making up the tank have joints that run around the circumference of the tank, and the

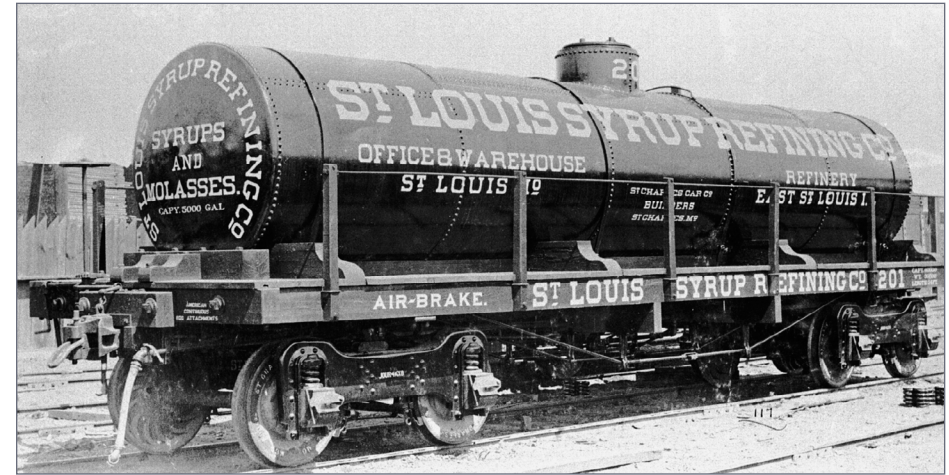


end of the tank, called the tank head, is pressed to shape. There are four bands around the tank, securing it to the underframe. Note in the sectional view that the bottom outlet valve is operated through a long shaft and a handwheel in the dome, which has a manway opening at the top. A walkway and railing are provided along each side of the car, a common arrangement in 19th-century tank cars.

The 1879 drawing also shows, with the benefit of hindsight, some weaknesses. The center sills, as mentioned, are widely spaced and thus cannot transfer pulling (draft) and pushing (buff) forces without also exerting bending forces at the body bolster and draft gear crosspieces. No safety valve is provided to relieve a build-up of pressure from volatile cargoes. Lastly, the tank is not significantly restrained longitudinally, nor prevented from rotating about the long axis of the tank. In impacts from an accident or hard switching, the tank can rotate or move along the underframe, both of which, among other things, endanger the projecting bottom outlet. These features would gradually be improved after 1903, as described below.

An example of a somewhat later 19th-century tank car is shown in [2]. Though most tank cars of the time were used for petroleum products, this example shows that tank cars had other uses then too. Its tank only has four hold-down bands, and no yoke around the dome, but does sit above its wooden underframe, and it has a large head block. The head block restrained tank motion, preventing longitudinal movement. This had some disadvantages in very hot weather, as the tank could not expand lengthwise, and might bow upward at the center. In violent derailments, the head block restraint could be responsible for tank penetration.

Safety valves to relieve pressure build-up with volatile cargoes were also needed, but were at the discretion of car purchasers



2. This tank car was built by St. Charles Car Company (an AC&F predecessor) about 1890. It has a 5,000-gallon tank on a wooden underframe, with 30-ton pressed-steel trucks. Car no. 201 shows common features of construction at that time. The underframe has head blocks to restrain longitudinal movement of the tank; it also has four hold-down bands. There is no bottom sheet, nor a ladder to access the dome. (AC&F photo, Edward S. Kaminski collection)

until regulation began. Early in the 20th century, regulation would begin to dictate that tank cars be much better-designed, better-built, and safer.

## Tank car standards introduced

After several dramatic railroad accidents in which tank car contents caught fire, an especially dangerous event in the days of wooden cars, the Master Car Builders' Association (MCB) was called upon by the American Railway Association or ARA in 1903 to assess the state of tank car design and make

recommendations for changes. This was evidently not a surprise to the MCB, for they submitted a full report within months, and the recommendations were soon adopted by ballot as Recommended Practice. Citations for the 1903 MCB report, and a 1903 editorial about it, are in the Bibliography.

These recommendations were revised several times before 1910, and in that year were advanced to Standard. There were two parts to these standards: first, changes to older cars if they were to stay in service; second, improved construction practices for new cars.

For older tank cars to continue in operation required the following: certain minimum strengths for center sills, both as to sill dimensions and for 18-inch maximum separation; direct attachment of draft gear to center sills; and at least three, and preferably five, tank bands holding the tank to the underframe; one had to be a yoke around the dome to prevent tank rotation around the long axis. It was also recommended that wood bolsters, body or truck, be replaced with steel ones.

An additional requirement was that the tank had to pass a 40-pound-per-square inch (psi) pressurization test with cold water “without distress,” meaning without distortion or leakage, and the test had to be repeated every five years. For volatile cargoes, safety valves were also required. The cars were then designated as Class I cars, meaning that they had been built before 1903, but conformed to minimum standards.

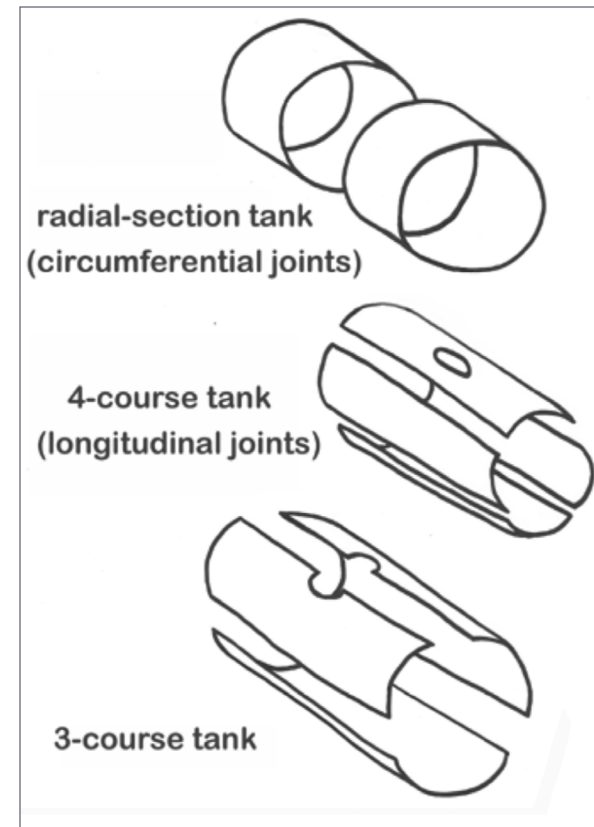
Cars built after 1903 were designated Class II, and had to meet these core requirements: steel tanks and underframe members; application of safety valves, friction draft gear, and certain combinations of tank hold-down fixtures, head blocks, or both; and tanks had to be designed to meet a 240-psi bursting pressure.

The test pressure for new cars was 60 psi, which tanks had to withstand without distress, and which would not only be certified for that tank, but would have to be periodically re-tested.

Quite a few tanks built before 1903 were permitted to continue in operation, designated as Class I cars, though most had to undergo modifications to qualify. The newer cars, conforming to the Recommended Practice or, later, the 1910 Standard, were designated Class II.

Tank cars at this time were built with circumferential joints between tank sheets [2], as sketched in [3]. Having the seams

between tank sheets run under the bottom of the tank created a location prone to leakage, and presently a bottom sheet was introduced, running the length



**3. Shown here are sketches of three types of tank car construction: top, all circumferential joints; below, all longitudinal joints, in either three or four courses.**

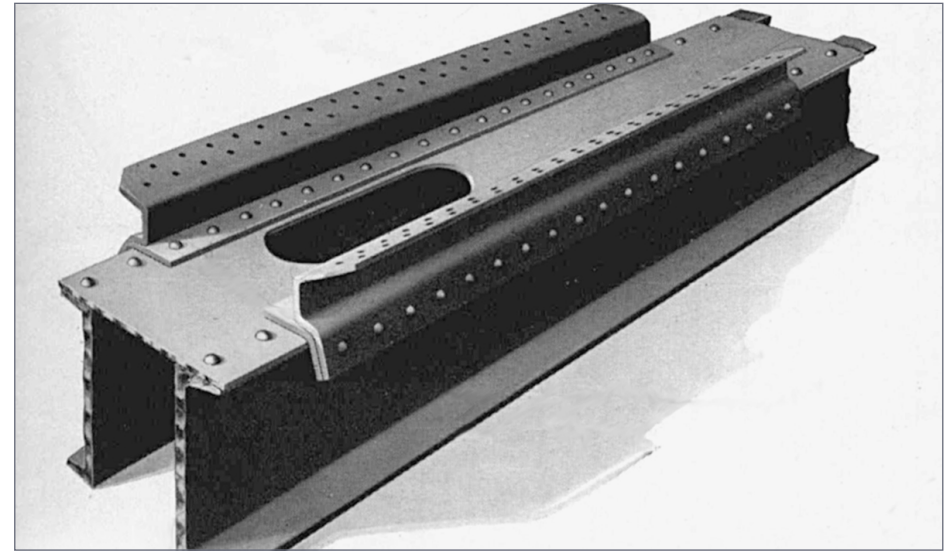


of the car, and avoiding these under-tank seams. This is visible in the AC&F “Type 7” tank car shown in [4]. (Eventually all circumferential joints would be eliminated in favor of longitudinal ones, as shown in [3].) Also visible in [4] is a new arrangement of tank hold-down, the center anchorage.

The problem of tank hold-down, anchorage, and restraint was a lively challenge in tank car design at that time. Not only the vertical tank bands of the 1903 MCB recommendations, but other appliances such as diagonal tie rod hold-downs and head blocks, were also in use to restrain tanks. Coincidentally, in that year of 1903 John Van Dyke at Union Tank Line was inventing



4. This 8,000-gallon Class II tank car was built in January, 1911 by American Car & Foundry. It was designated “Type 7” for the year of its underframe design, 1907. Longitudinal tank seams are double riveted. Note the white band on the car end, lettered “MCB CONSTRUCTION,” as was required until about 1918. (ACF photo, Edward S. Kaminski collection)



5. A view of a center anchorage. It can be regarded as simply a cradle, riveted to the center sills and their cover plate, and also riveted by means of its upper flanges to the tank, which would be on top of the part shown. This admirably simple design was a major advance in tank car technology. (American Car & Foundry)

a new, superior tank attachment, the center anchorage, which would eventually become universal on tank cars. With this anchorage, tanks were attached to the underframe only at the center, and were free to expand and contract longitudinally inside the tank bands [5]. In addition, a dome yoke was not needed. Before long, Class II tank car standards recommended center anchorages and discouraged use of head blocks.

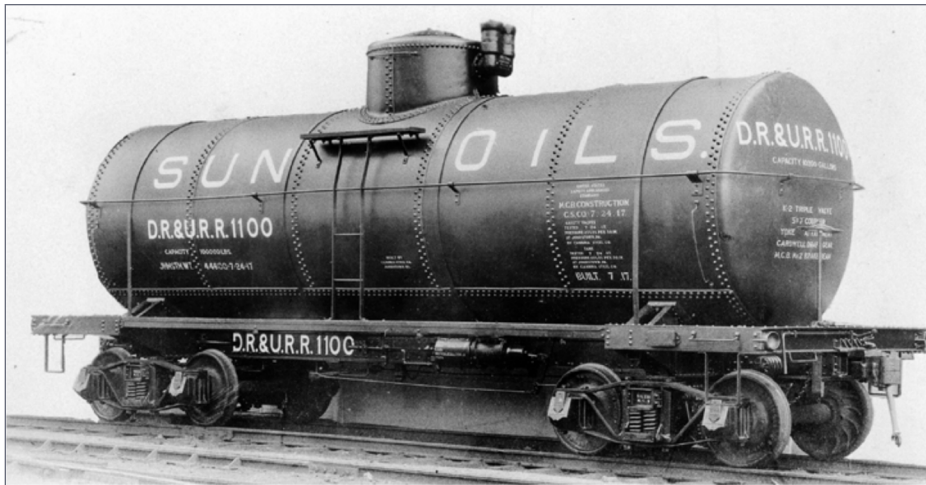
Design of safety valves also received attention. About a year after the 1903 MCB report, an additional MCB report discussed safety valves in some detail, and a preliminary design was

## GETTING REAL | 10

shown (see Bibliography). A slightly different design was soon adopted, in the form of an elbow to be applied to the dome. This kind of design is visible in [4].

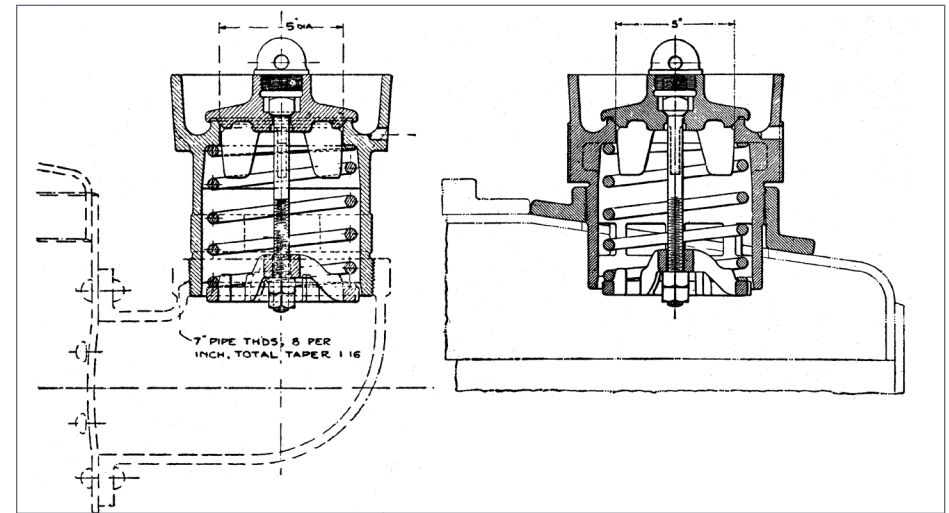
Soon afterward, it was decided that a five-inch diameter valve such as this was adequate for tanks (or tank compartments) of up to 6,500 gallons; tanks larger than that would require additional valves, one for each 6,500 gallons. Those values continued in force for decades thereafter.

In the years after adoption of the 1910 standard, several modifications to Class II requirements were made, until 1916, when it was decided that a new standard design was needed. Cars built after May 1, 1917 had to conform to a new Class III standard. Required draft attachment capacity was increased (though the center sill



**6. New Class III tank car, built by Cambria Steel Car Company in July 1917. Capacity is 10,200 gallons. All seams are now double-riveted, and a center anchorage is used. Reporting marks DR&URR = Delaware River & Union Railroad. (*Car Builders Dictionary*, 1919)**

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**7. These two drawings are to the same scale, and show clearly that the elbow and dome-top safety valve designs are internally identical, and have the same five-inch outlet diameter. (*Car Builders Cyclopedia*, 1922)**

requirement remained at 30 square inches effective area), and the design requirement for tank bursting pressure was raised to 300 psi. Expansion domes were regulated to have no less than 2 percent of the tank capacity, and all seams had to be double-riveted. An example of a new Class III car is shown in [6].

At about this same time, a modified safety valve design was introduced, intended to fit atop the expansion dome of a tank car. It is shown in [7]. The dome-top design had the advantage that expanding cargo was less likely to submerge it, and it came to be universally used after the mid-1920s. But the elbow arrangement continued in use through the 1950s on older cars.

In addition to Class III, new classes IV and V were introduced in 1916 and 1917. The Class IV car was essentially a Class III car with



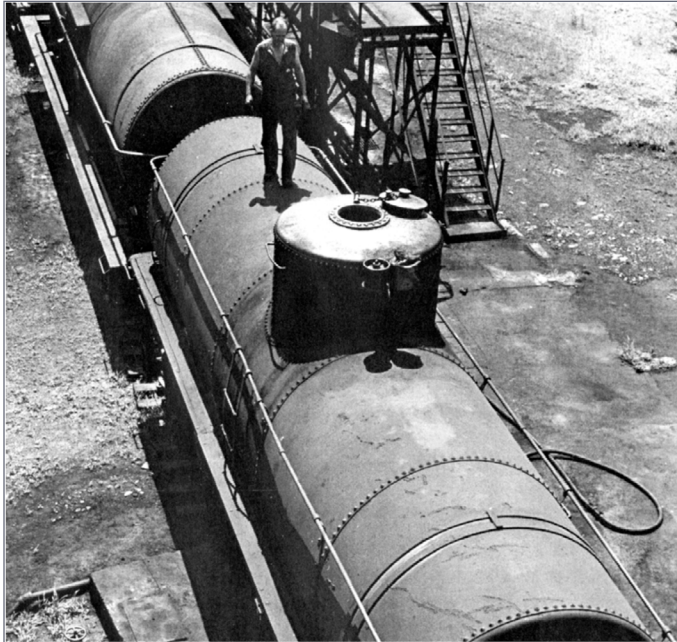
## GETTING REAL | 12

two inches of insulation, making it suitable for volatile and flammable commodities, but the Class V was a true high-pressure car. At that time, such cars had to be fabricated by forge welding, as fusion welding was not yet sufficiently developed for this use.

In 1919, the MCB became “Division V–Mechanical” of the ARA, and thereafter the MCB classes became ARA classes; moreover, the class number was subsequently required to be stenciled on tanks, a new requirement.

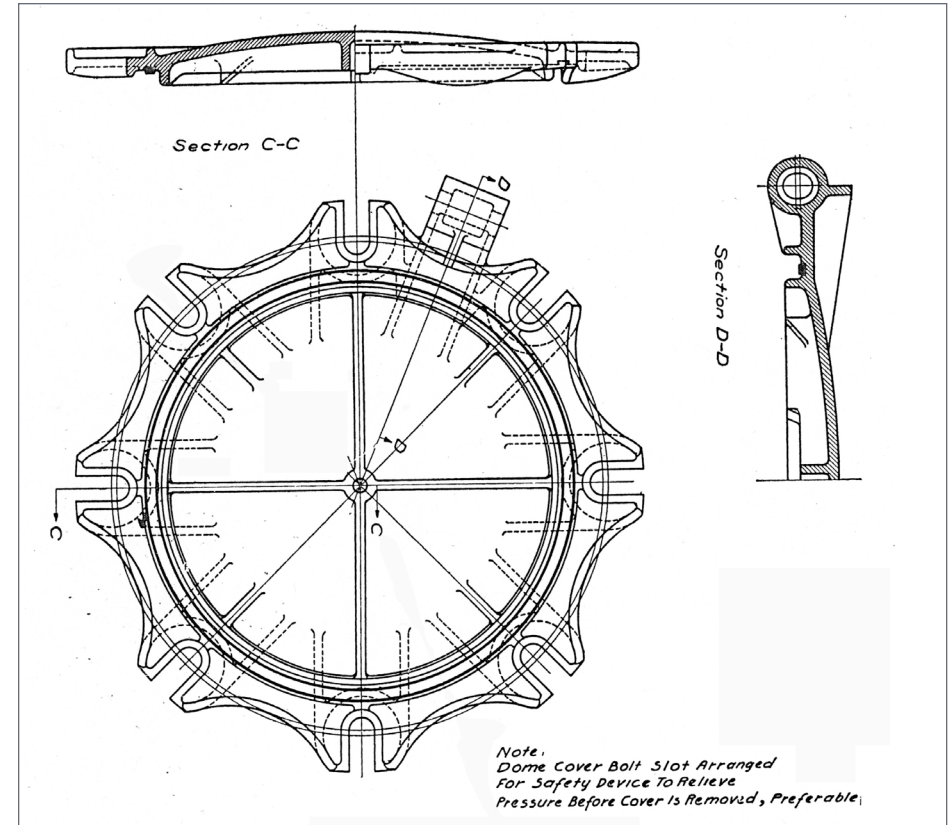
From early days, manway closures atop domes, also called dome covers, had usually been a flat, threaded plate arrangement,

with a short safety chain [8], but there were repeated accidents in which internal tank pressure blew this cover into the workman who was opening it. In 1922, an “approved”



**8. An overhead view of a tank car with a screw-top manway cover. The cover simply screws into the threaded opening, and is secured by a chain. Note that there are no dome walkways on this particular car. (Standard Oil of New Jersey photo, courtesy Ted Culotta)**

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**9. The ARA “approved” bolted manway cover was adopted in 1922, and thereafter widely used, except for cargoes that developed no pressure, such as vegetable oils, wine, or other unregulated commodities. (Car Builders Cyclopedia, 1931)**

bolted manway, with a special design of bolt-secured cover which was much safer, was adopted. This is shown in [9] and [10], in both drawing and photograph. A small diamond could be stenciled on the side of the dome to indicate the presence of an approved bolted manway, but such stenciling was entirely at the option of the car owner.



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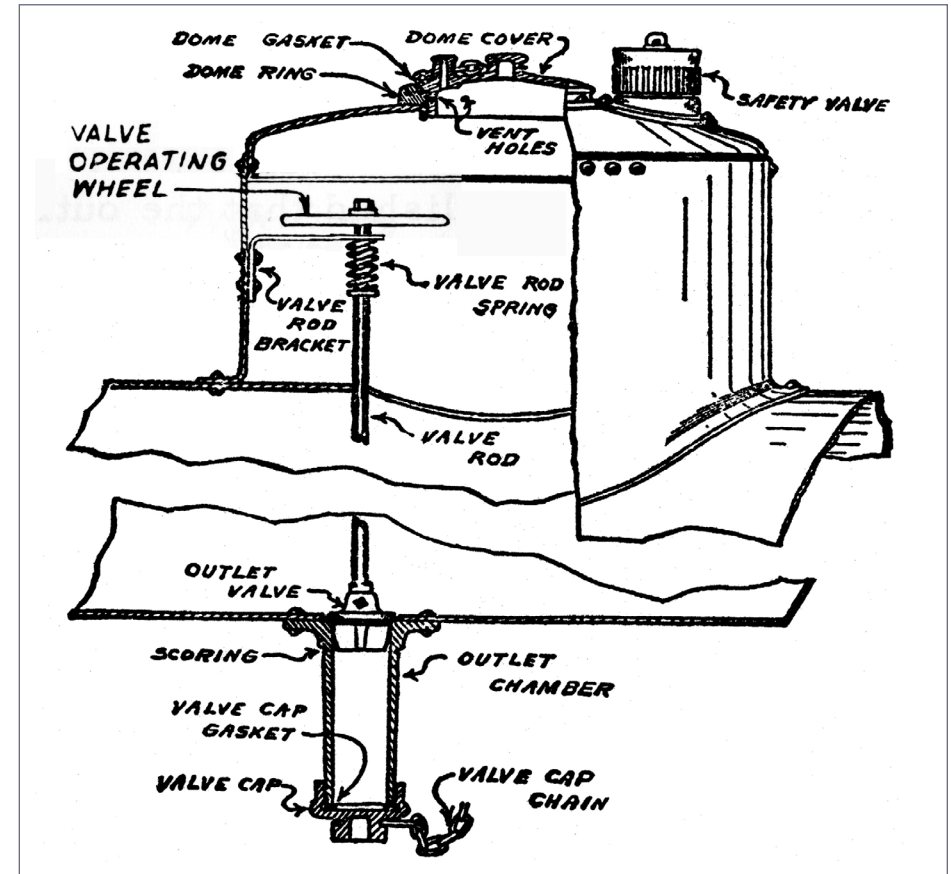
The outlet valves at tank bottoms had been recognized as vulnerable in accidents from the earliest days of tank cars, and as early as the Class I standards, it had been recommended that the valve itself be located inside the tank, with an external tube called an “outlet chamber” below it. This chamber was scored around its circumference near the tank shell, so that in



10. A clear photograph of an “approved” bolted manway in the open position, with restraining bolts pivoted away from their working position. (American Car & Foundry)

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an accident the outlet chamber would fracture cleanly at that point, and not exert bending forces on the shell itself. These features are shown in [11].



11. This cutaway drawing shows the arrangement of the valve operating wheel inside the dome of the car, the valve at the bottom of the tank, and the exterior outlet pipe, scored just below the bottom of the tank. Note that safety valves are located on the opposite side of the dome center line from the outlet. (AAR Manual, Section K)

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Note also in this drawing that the control wheel for the outlet valve is located inside the dome, accessible through the dome cover. This arrangement had been used since the 19th century (compare [1]). The outlet valve then permitted gravity unloading through the bottom outlet [12].

In 1927, the ICC took over regulation of tank cars, and the existing ARA classes III through VI were renamed as ICC classes 103 through 106, while the older cars surviving in classes I and II remained stenciled as ARA (not ICC) Class I or Class II cars. Moreover, all cars built as ARA Class III tank cars remained so-stenciled, even though that specification had become an ICC specification after the cars were built.



12. Gravity unloading of a tank car, by attaching a hose to the bottom outlet. Photo at the diesel fuel spot in Alturas, California. (SP photo, Shasta Division Archives)

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13. Typical tank car construction by 1930. All tank sheets are longitudinal, safety valves are atop dome, tank proportions are relatively long and slender (compare [6]). This nominally 8,000-gallon car, owned by leasing company California Dispatch Line, has 40-ton trucks and shows characteristic American Car & Foundry construction, having end sills as well as stub side sills from bolster to end sill. The photo date is April 19, 1930. (AC&F photo, Richard Hendrickson collection)

The Appendix contains an abbreviated list of landmark dates in tank car development and regulation.

### Standard car designs emerge

During the 1920s, the arrangement of tank sheets gradually changed to one in which all sheets were joined with longitudinal joints [3], instead of upper sections all having circumferential joints, as in [6]. By the end of the 1920s, most ICC 103 cars had the general appearance of the California Dispatch Line car shown in [13].



The onset of the Great Depression in the early 1930s was the final blow to many of the smaller tank car companies shown in Table 1, and by 1935 there were only two in the United States: American Car & Foundry and General American. Typical car construction for each builder is shown in [13] and [14].

With all the changes of the 1920s, overall car appearance had become similar from purchaser to purchaser, though many lesser features and details of cars were in fact chosen by the buyer. The tank construction, dome arrangements and walkways, even location of brake equipment, was subject to choice by the buyer. Both General American and American Car & Foundry had essentially standard underframe designs, from before World War I into the 1950s, but the kind and



14. This 8,053-gallon Tidewater Associated Oil Co. tank car, built by General American in 1925, has 40-ton trucks and was photographed in lighting that clearly shows its absence of side or end sills, typical General American features. The walkways are supported entirely from the center sill. Photo at Kansas City, 1954. (George Sisk photo, Charles Winters collection)

Table 1

## Builders of tank cars in two time periods

### Before 1920

American Car & Foundry  
General American  
Canadian Car & Foundry  
Standard Tank Car  
Pennsylvania Tank Car  
Pressed Steel Car  
Cambria Steel  
Keith Railway Equipment  
Chicago Steel Car  
McGuire-Cummings Manufacturing

### After 1935

American Car & Foundry  
General American  
Canadian Car & Foundry  
(after 1949: Union Tank Car)

arrangement of tank and specialties mounted on that underframe could be quite variable.

There were ARA classifications for tank cars (which in 1934 became AAR classes), separate from ICC classes, which gradually shifted over time. As with these kinds of classes for other freight cars, the intent was only to identify broad categories of use. Table 2 lists the AAR classes as of 1950. More details may be found in various issues of the *Official Railway Equipment Register*. Note in particular the “TA” class, because the use of the “A” suffix carried over to ICC classes to designate cars with no bottom outlet.

The ICC classes, mentioned above, were a somewhat parallel but differently directed set of tank car classifications, aimed

Table 2

### AAR classes of tank cars

**TM** = “merchandise” or general service

**TA** = “acid service,” no bottom outlet

**TP** = high-pressure cars

**TG** = cars with glass lining

**TL** = cars with lining other than glass

**TW** = cars with wood tanks

suffix “I” for insulated cars, e.g. TPI

more at car capability. A list of the major ones of these is shown in Table 3, and more information about each of them can be found at the beginning of the chapters on tank cars in various volumes of the *Car Builders Cyclopedia*. Since any car would be assigned classes in both of these systems, such as an ICC-103 car which was AAR Class TM, a complete description would have to cite both classifications.

As mentioned above, the ICC-104 cars [15] can almost be described as insulated ICC-103 cars (the standard safety valve setting is 25 psi for ICC-103, 30 psi for ICC-104), often with distinctive fittings [16]. On the other hand, the high-pressure cars, ICC-105, are very different in design and construction. For one thing, they by definition have no bottom outlets for gravity unloading, and are thus always described as ICC-105A (the “A” indicates the lack of that outlet). The car interior is accessed by a pipe, as can be seen in [17].

Table 3

### ICC tank car classifications

**103** = low-pressure general service car

**103A** = modified 103, no bottom outlet

**103B** = rubber-lined 103 car

**104** = similar to 103 but insulated and jacketed, used for flammable products

**105A** = welded tank, heavily insulated, pressurized and suitable for dangerous cargo. A 105A tank has a suffix number for rated pressure in pounds per square inch, e.g. 300 psi: 105A300

**107A** = seamless tanks, 3350 psi pressure

**108** = wooden tank

**AAR 201, 203** = “not covered by regulations for transportation of dangerous articles”

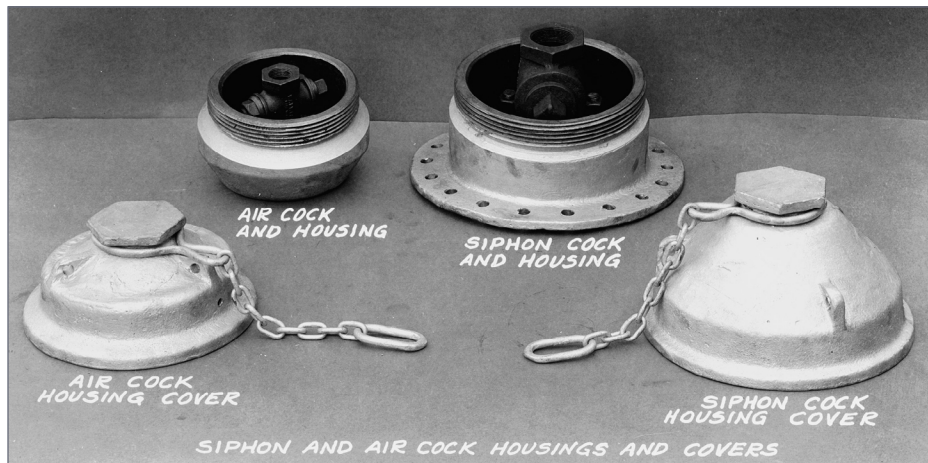
Second, as they are by definition cars rated for some elevated pressure, the pressure rating became part of the ICC car class. For example, a car rated at 300 psi maximum pressure would be designated as ICC-105A300 and its safety valves would be set at 225 psi.

And third, the loading and unloading of cargo in these cars requires entirely different forms of piping and valving, compared to ICC-103 or -104 cars. This equipment is housed in a “valve bonnet” atop the tank (shown in drawing [17]), which should not be called a “dome,” as it serves no expansion purpose (although railroaders certainly refer to valve bonnets as “domes” on occasion, just as a simplification).





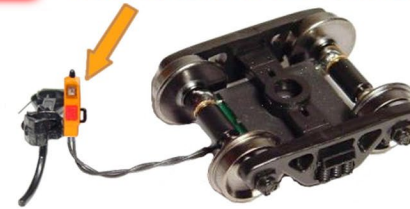
15. This Warren Petroleum car is a good example of an ICC-104 class of car. It's an 8,074-gallon insulated car built in 1948 by AC&F with 40-ton trucks. Atop the dome is visible one of the safety valves, but also visible are some stubby conical appliances. These are the covers for air vents (during unloading) and siphon valves for sampling. A close-up view of these parts is presented in [16]. (ACF photo, courtesy Edward S. Kaminski)



16. These tank car parts, similar to those visible on the dome of WRNX 204, shown in [15], are clearly labeled as to function. (AC&F photo, courtesy Edward S. Kaminski)

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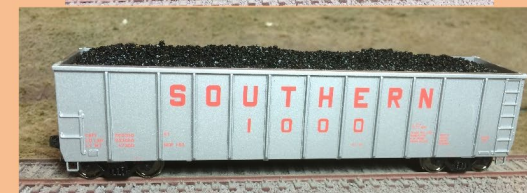
↓ Car without Load ↓



↓ Car with Load ↓

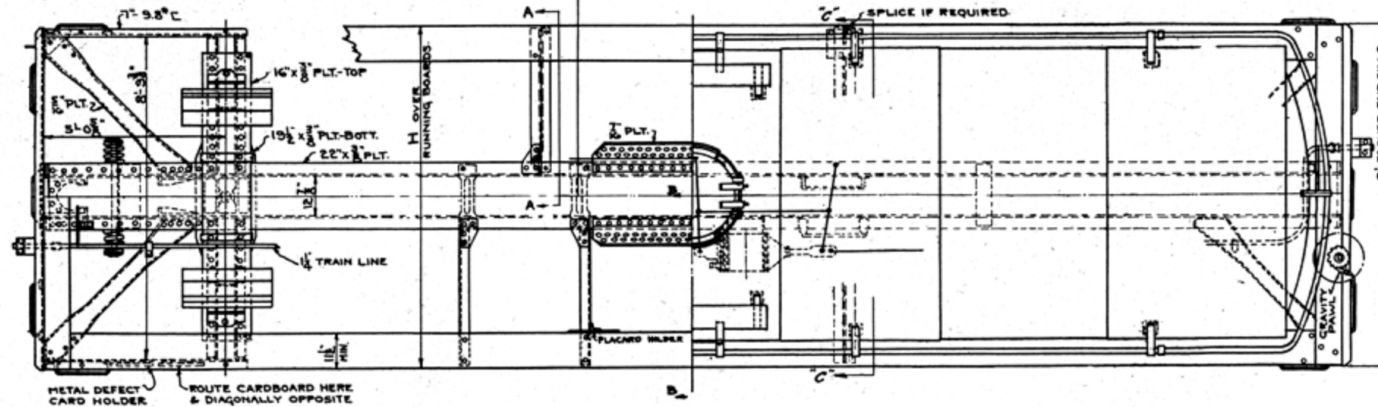


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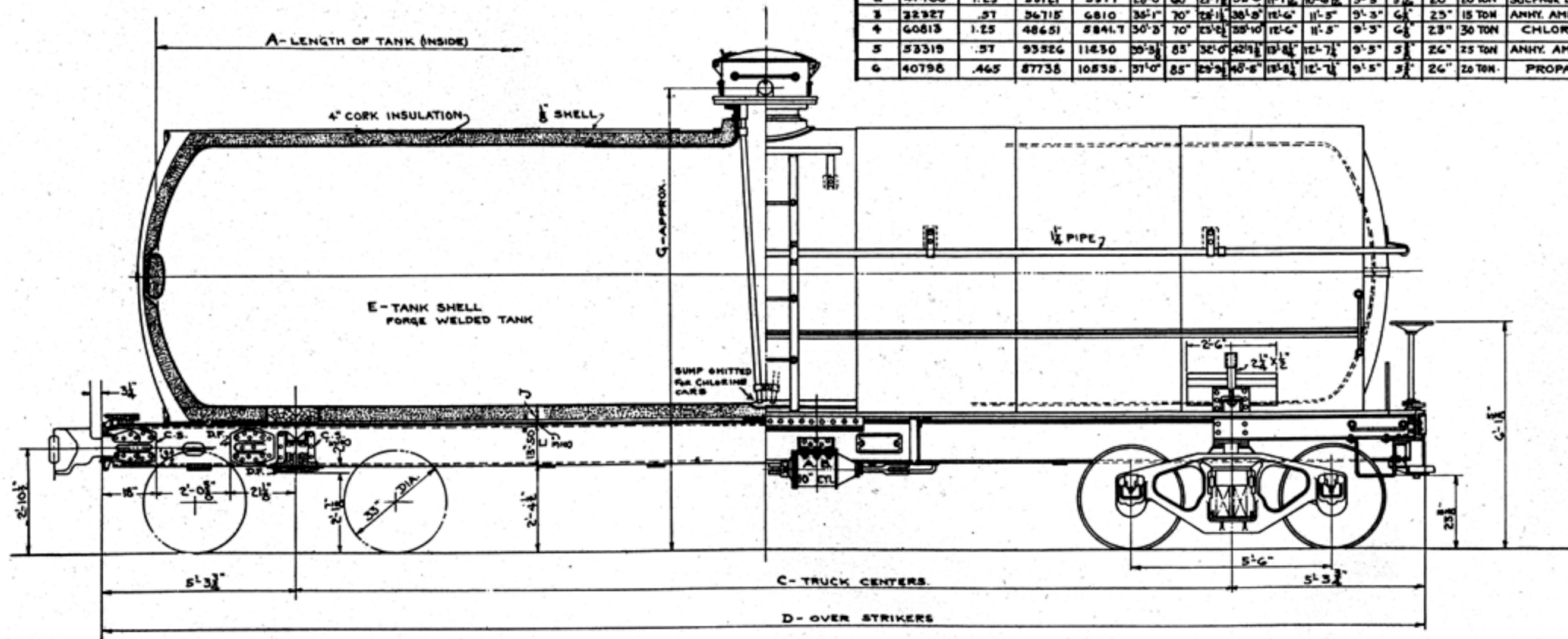


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|----------|------------------|-----------------------|----------------------|-----------------------|--------|-----|---------|---------|---------|---------|-------|-------|-----|---------------|-----------------|-----------------|
| 1        | 35365            | 1.25                  | 25892                | 3108                  | 28'-6" | 32" | 24 1/2" | 32'-7"  | 10'-11" | 9'-10"  | 9'-5" | 5'-3" | 20" | 15 TON        | CHLORINE        | 1"              |
| 2        | 41400            | 1.25                  | 33121                | 3977                  | 28'-0" | 40" | 25 1/2" | 32'-3"  | 11'-7"  | 10'-6"  | 9'-5" | 5'-3" | 20" | 20 TON        | SULPHUR DIOXIDE | 1"              |
| 3        | 32927            | .5T                   | 34715                | 3977                  | 38'-1" | 70" | 28 1/2" | 38'-8"  | 11'-6"  | 11'-8"  | 9'-5" | 5'-3" | 24" | 15 TON        | ANHY. AMMONIA.  | 1"              |
| 4        | 40813            | 1.25                  | 48651                | 5841.7                | 30'-3" | 70" | 25 1/2" | 38'-10" | 12'-6"  | 11'-5"  | 9'-5" | 5'-3" | 24" | 30 TON        | CHLORINE.       | 1"              |
| 5        | 53319            | .5T                   | 93326                | 11430                 | 30'-3" | 85" | 32'-0"  | 42'-11" | 13'-8"  | 12'-7"  | 9'-5" | 5'-3" | 26" | 25 TON        | ANHY. AMMONIA.  | 1"              |
| 6        | 40795            | .465                  | 87735                | 10835                 | 31'-0" | 85" | 29 1/2" | 40'-5"  | 13'-8"  | 12'-11" | 9'-5" | 5'-3" | 26" | 20 TON        | PROPANE.        | 1"              |



17. Drawing of an ICC 105A tank car, showing insulation thickness and valve bonnet, together with the eduction pipe by which cargo can be pumped out of the car, and the small sump located below that pipe to permit effective emptying of the car.

The table shows dimensions for cars of varying capacities sized for cargoes such as chlorine, anhydrous ammonia, and propane. (American Car & Foundry, courtesy Edward S. Kaminski)



When a valve bonnet is opened, one of course does not see the cargo inside, as would be the case with an ICC-103 car. Instead, the operating valves and piping are located there. This is shown in [18] for a chlorine car such as that shown in [19]. When in use, there are typically multiple connections to this internal valving [20].

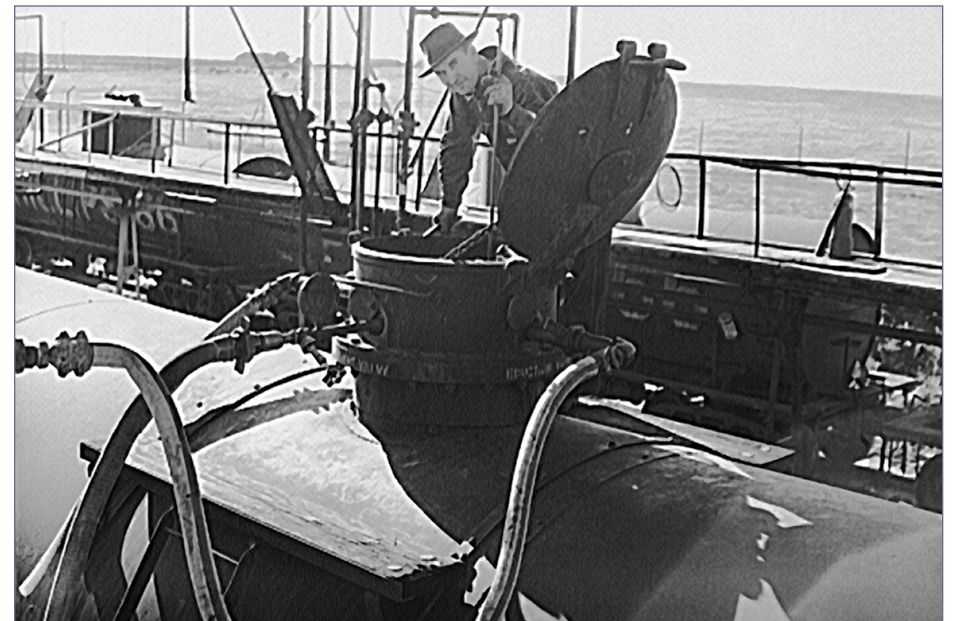
Fourth, the ICC-105A cars are always insulated, since their cargoes of liquified gasses can experience large pressure changes with temperature. A wide range of insulation material has been



18. Interior of a valve bonnet for a chlorine car. Valve handles control openings for sampling, temperature measurement, and venting, as well as loading and unloading. The shell of the bonnet has openings for hose connections, for example nearest the camera, just below the grab iron. (AC&F photo, courtesy Edward S. Kaminski)



19. A typical high-pressure tank car, in this case a Hooker Electrochemical car carrying chlorine. It is a 5,907-gallon car, a common size for chlorine, and has 40-ton trucks. Photographed on the Santa Fe in the Los Angeles area in 1959. (Morris Abowitz)



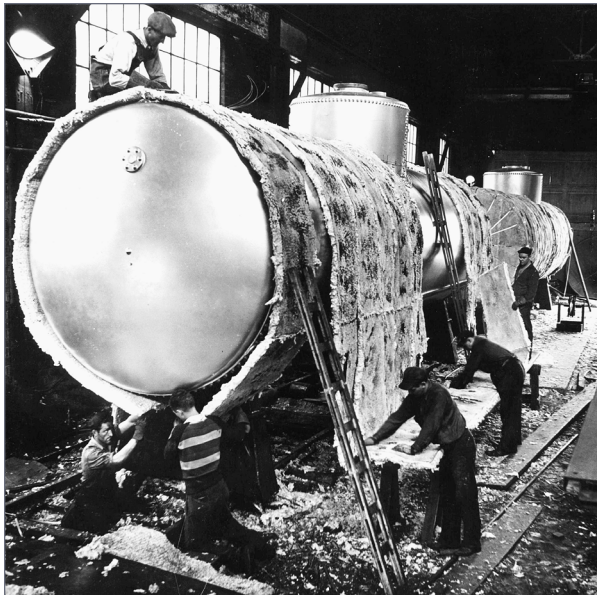
20. Unloading view of a high-pressure car. Pipe connections on sides of valve bonnet are evident. John Vachon photograph, 1943. (Library of Congress, negative LC-USW3-010341-D)



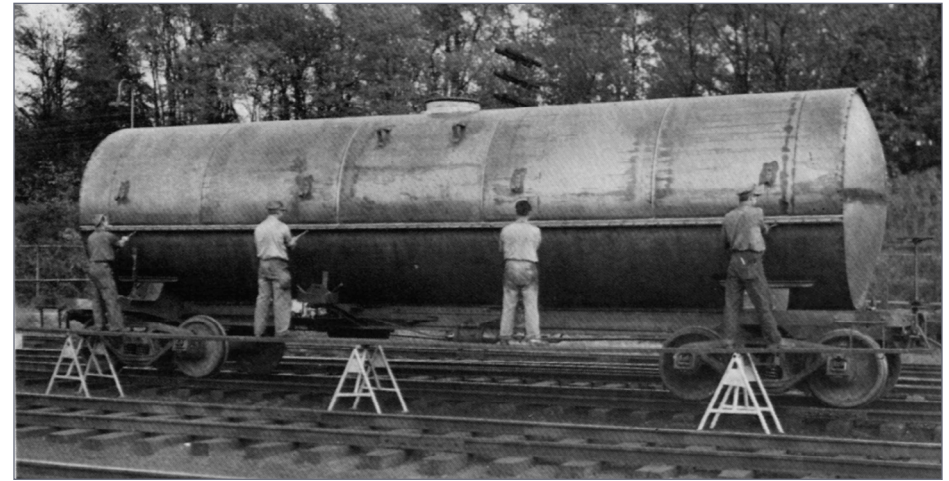
used, as specified by the purchaser of the car, from cork and magnesite, to products such as mineral wool and fiberglass. (Mineral wool is a fiber spun or drawn from molten minerals, in much the same way that fiberglass is made from glass). The insulation blanket is then covered with a jacket of thin sheet steel, which may be bolted together to permit removal, or may be welded, in which case removal would be destructive and would require a new jacket.

Application of insulation was labor-intensive with some insulating materials [21], but some of them, such as sheet cork, were simpler to apply. The final step was the enclosure with the jacket. The example shown is being bolted along the longitudinal flange [22].

Another category of car entirely is the helium car, assigned to ICC-107A class. The helium is highly compressed for shipment,



**21. In this 1930s view, a four-inch blanket of mineral wool insulation is being applied to a tank car body. It would then be covered with a thin steel jacket. (AC&F photo, courtesy Edward S. Kaminski)**



**22. Here workmen are bolting together the top and bottom sections of a steel jacket, along the prominent flange on the car side. (AC&F photo, courtesy Edward S. Kaminski)**

to 2000 psi or more, and the cars have very heavy-walled tanks, making the cars themselves quite heavy, in excess of 235,000 pounds gross weight. Until the mid-1950s, these cars were owned and operated by the U.S. Navy, but gradually all were transferred to ownership by the U.S. Bureau of Mines, reporting marks MHAX (for Mines Helium Activity). An example is shown in [23].

Major changes in tank car regulations were adopted by the ICC in 1957, both in softening the requirements for certain specific design features such as expansion domes, and also in a growth of the long-standing list of ICC classes. These new categories were for welded tank cars (class suffix “W”) in the several subclasses of ICC classes 109, 110, 111 and 112. These were usually built with only small manway housings, instead of the 2 percent expansion domes of earlier designs. One example is a car leased by Union Carbide from Shippers Car Line and shown in [24].



23. This is a helium tank car, ICC-107A, photographed about 1975. Loading and unloading is accomplished with fittings inside the end doors of the car. Note the empty placards on the car. (Richard Hendrickson collection)



24. The late 1950s changes in ICC requirements led to major changes in tank car appearance. This large car, SHPX 12831, is ICC Class 111A100-W-1, has 20,000 gallons nominal capacity. Photo at Los Angeles in 1960. (Morris Abowitz)

## Service assignments

It is important to remember that, unusual among North American freight cars, tank cars were almost entirely privately owned and operated. About 95 percent of all tank cars in service in 1950 had owners other than railroads. That privately owned fleet was dominated by a few large leasing companies, as shown in Table 4, along with petroleum companies. The major exception was the U.S. Department of the Army.

Table 4 shows that the largest fleet was that of Union Tank Line, one of the many corporations spun off in the breakup of Standard Oil in 1911. Though independent after that date,

**Table 4**

### Principal private owners of tank cars in 1950s

|                                                   |        |
|---------------------------------------------------|--------|
| Union Tank Line (UTLX) .....                      | 38,700 |
| General American Tank Line (GATX) .....           | 37,500 |
| Shippers' Car Line (SHPX) .....                   | 7,500  |
| Sinclair Oil (SDRX) .....                         | 6,400  |
| North American Car (NATX) .....                   | 4,500  |
| Shell Oil (SCCX, RPX) .....                       | 3,700  |
| U.S. Army (USAX, USQX, USOX) .....                | 3,300  |
| Phillips Petroleum (PSPX, SWLX) .....             | 2,700  |
| Canadian General Transit (CGTX) .....             | 2,300  |
| Warren Petroleum (WRNX) .....                     | 2,200  |
| Mid-Continent Petroleum (COSX) .....              | 2,100  |
| Tide Water Associated Oil (AOX, TIDX, TWOX) ..... | 1,500  |
| Gulf Oil (GRLX) .....                             | 1,500  |



Union retained its friendly connections with all the Standard entities, and continued into the 1950s as the primary supplier of tank cars to Standard companies across the U.S. This is amply documented in Albert Carr's book (see Bibliography).

In contrast to the private owners, most railroads owned only a handful of tank cars, retained for company service. There were three exceptions of note, as shown in Table 5, the western railroads Santa Fe, Southern Pacific and Union Pacific. Together, they owned nearly two-thirds of all railroad-owned tank cars in the United States. The Santa Fe and UP cars were heavily devoted to company fuel and water service, but two-thirds of the SP cars were in revenue service, an unusual railroad ownership situation for tank cars.

The tank car fleet in North America was heavily tilted toward ICC-103 type cars, that is, general service cars suitable for a wide variety of cargoes. To choose one specific year, in 1930 about 90 percent of all tank cars were ICC-103 type, with only 10 percent assigned to carry various special commodities.

Another important point to recognize is that cars were sized according to the cargo they were expected to carry. Densities of cargoes vary considerably. For non-pressure tanks, cargo densities range from gasoline at about six pounds per gallon, to nitric acid and sulfuric acid at 13 and 15.3 pounds per gallon,

**Table 5**

## Principal railroad owners of tank cars in 1950

|                 |      |
|-----------------|------|
| ATSF .....      | 3575 |
| SP + T&NO ..... | 2520 |
| UP .....        | 860  |



**25. A typical acid tank car, Class ICC-103A, with its distinctive dome shape and appliances. The car was built in 1927 and has 50-ton trucks and 7045 gallons capacity, typical for cars carrying dense acids. (AC&F photo, courtesy Edward S. Kaminski)**

respectively. Many common liquids are not greatly different from the density of water (water is 8.34 pounds per gallon), so that water capacity in pounds is often stenciled on tanks.

An entire group of tank cars was designed to carry acids. This type is much like an ICC-103 but with no bottom outlet, thus its designation as ICC-103A, and will have an eduction pipe for withdrawal of the cargo. Also, dome fittings are elevated farther above the cargo space to minimize any contact with the acid. As there is usually little danger of pressure build-up, these cars may have frangible disk vents rather than safety valves. These disks are designed to break at a specified pressure, and if that happens, the device would have to be disassembled to insert a new disk for further use. These differences give their domes a distinctive look, as in [25].

An acid tank car of 7,000 gallons nominal capacity, as in [25], would have a cargo weight of around 100,000 pounds for either nitric or sulfuric acid, which is the nominal capacity with 50-ton trucks. However, even 12,500 gallons of gasoline would weigh only about 75,000 pounds, and could be shipped in an ICC-103 car of 12,500 gallons capacity with 40-ton trucks, though 50-ton trucks were more usual.

Pressurized cargoes also vary in density. Among the liquified gasses shipped in ICC-105A cars, densities range from propane and anhydrous ammonia, at 4.24 and 5.14 pounds per gallon, respectively, to liquid chlorine at 12.26 pounds per gallon. And liquid bromine weighs in at 26 pounds per gallon. So an 11,000-gallon car would be suitable for a cargo like propane, while chlorine would normally not be shipped in a car larger than 8,000 gallons, and even 4,000 gallons of liquid bromine weighs more than 100,000 pounds.

These widely varying cargo densities are one reason why gallonage capacity of tank cars is usually not well related to pounds capacity of the car, unless the specific cargo is known. Capacity of trucks can also play a role, because car capacity in pounds can be set entirely by truck journal size, as noted above in discussing the relation of cargo weights and car capacity. When that is the case, tank size for such a car is normally chosen so that the maximum loads will be well below the truck capacity.

A second factor in car size for some consignees is the amount needed to be shipped. Thus a bulk oil dealer might need 6,000, 8,000 or 10,000 gallons of kerosene and would request a shipment accordingly. But many chemical cargoes are shipped in only one size of car.

In addition, service assignments must take into account the character of the cargo, for example, whether it develops



**26. This tank car, General American-built GATX 66674, is an 8,093-gallon car of ICC-104 classification. Its insulation jacket is thicker than the normal two inches, likely intended for a specific cargo and specified by the buyer for a particular lessee. This undated photograph was taken at Milwaukee. (Richard Hendrickson collection)**

pressure when warmed in the normal ambient range, in which case an insulated car is specified [26]. Much higher pressures are applied if it is a liquified gas. Liquified gasses typically have far greater density than the same gas would have at ambient pressure, and are thus far more efficient to ship.

Many specialized commodities are restricted to certain types of cars or cars with specific equipment. This applies to a number of dangerous or flammable organic compounds. These commodities generally also have required warning placards which the car must carry. Placards will be discussed in Part 2 of this work.



At the other extreme, there are a number of liquids not subject to ICC oversight, designated “non-regulated commodities,” which can be shipped in more simply equipped cars. Commodities which would be rarely if ever expected to develop excess pressure in transit can move in cars without safety valves, with a frangible disk safety vent instead. Such disk safeties are often visible on wine cars, for example, as seen in [27].

The wine tank car shown in [27] raises the complex and interesting subject of multi-compartment tank cars, but that topic has been thoroughly and knowledgeably explored by Richard Hendrickson in his recent article in *Model Railroad Hobbyist* (see Bibliography), and will not be further discussed here. These types of cars were a minority of the total tank car fleet.



27. This GATX tank car, built in 1926 and leased to the Roma Wine Company, is Class AAR-203 and has 6,600-gallon capacity, divided into six compartments of about 1,100 gallons each. The individual domes all have approved manways, and their frangible-disk safety vents are on an elbow off of each dome. (General American photo, author’s collection)



28. Tank cars were used for a variety of foodstuffs, as this 8,111-gallon car shows. It is an ICC-103 built in 1929. (AC&F photo, courtesy Edward S. Kaminski)

It is difficult to generalize about the interaction of commodity requirements, placards, and permitted or preferred types of tank cars. A very helpful table, giving many such details, forms the Appendix of Edward Kaminski’s 2003 book on tank cars (see Bibliography). These cargoes range from the exotic to the mundane [28]. Kaminski’s table is one issued by American Car & Foundry. A similar table issued by General American can be found in the 1961 *Tank Car Manual* (see Bibliography). I have put this table onto Google Drive, at this link: [drive.google.com/file/d/0Bz\\_ctrHrDz4wbE81TFRybKFMUk0/view?usp=sharing](https://drive.google.com/file/d/0Bz_ctrHrDz4wbE81TFRybKFMUk0/view?usp=sharing).

### Tank cars in service

The great majority of tank cars are leased, many from the big companies like General American and Shippers Car Line, but the existence of other reporting marks may not indicate ownership. For example, The Texas Company (Texaco) sold all its tank cars to General American in 1936 and then leased them back, keeping its existing TCX reporting mark.

The lessee usually has an agreement to be able to direct its leased cars as it wishes, for example, repeating a cycle between a refinery and one or more bulk oil dealers. But in some situations, such as when cars from a general pool are used instead of individually leased, the cars are directed instead by the lessor, with movement directives provided to the railroads on which the cars are made empty.

The important point is that the cars tend to remain in a particular lease, sometimes for years, and to carry the same cargo again and again. If nothing else, this avoids the necessity to clean the cars between loads. Such cleaning certainly could be and was done (the car leasing companies, as well as private contractors, maintained cleaning and repair facilities around the country), but is an expense all concerned would prefer to avoid.

Note that a tank car made empty at a particular consignee does not become an empty car which can be confiscated for other loading. Instead, directives for its empty movement will have already been specified, and normally it then moves on a regular freight waybill to return it in reverse, back over the route it followed when loaded. The previous cargo, which might easily be dangerous, poisonous, or flammable even as residue in the unloaded car, is indicated on that waybill. (There are commodities, such as gasoline, which pose a bigger danger of explosion and fire when in the form of vapor in an empty car, compared to the same car filled with liquid.)

Another point worth emphasizing is that as late as the transition era, most tank car loads were billed by gallonage, not by weight. That has two important implications: first, the requirement for all other types of freight cars, that they be periodically reweighed to validate their light or empty weight, did not apply to tank cars, and often the weigh date on the car could be decades old.

Second, knowing the exact gallonage of a “full” car became an important simplification in loading and billing. This gallonage was measured when the car was built, and was lettered on the end of the car. Then the car was loaded “shell full,” that is, with liquid level just at the top of the horizontal tank, readily verified through the manway, and that level corresponded to the stenciled gallonage.

As indicated above, after 1960 many aspects of tank car construction were considerably altered, not only the prevalence of welded construction but substantial increases in car size and appearance. These changes are beyond the scope of the present account.

### Concluding remarks

Tank cars are different in many ways from other freight cars, not all of which differences may be recognized by modelers. Understanding their construction, specialty appliances, and usage can help, which was the purpose of the general and historical background information contained in this column. In Part 2 of this work, modeling aspects and placards will be presented. ☒



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Pre-Production Sample Shown

*Baltimore & Ohio  
Canadian National (Delivery)  
Canadian National (New herald)  
Canadian Pacific (Block)  
Canadian Pacific (Script)  
Erie*

*Great Northern  
Lehigh Valley  
New York Central  
Pennsylvania  
Undecorated*

Roadname-specific details - Accurate body contours - Heavy, die-cast chassis - 5-pole, skew-wound motor with excellent slow-speed performance - Operating number boards, headlights and two-color class lights - Dynamic brakes - Etched-metal grilles (Farr or chicken wire, as appropriate) - Full underbody piping and conduits - Correct, roadname-specific FA-2 and FPA-2 fuel tanks - Separate grab irons and handrails installed at the factory - Full cab interior - Accurate sounds

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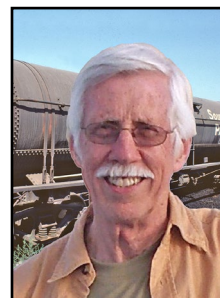
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# GETTING REAL

column



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## TANK CAR BASICS: PART 2

### | ACCURATE TANK CAR MODELING FOLLOWS THE PROTOTYPE

**PART 1 SUMMARIZED THE HISTORY OF** tank car construction and regulation for the period up to and including the 1950s. It showed details of car appliances, along with a description of tank cars in service. In Part 2, the intent is to show examples of modeling approaches that take advantage of the prototype information in Part 1, with emphasis on HO scale, my own modeling scale. These are not descriptions of modeling projects as such, just indications of what models may be possible, and ways to address them.

It is useful to begin by reminding modelers that though there have been many commercial tank car models down through the years, before about 1990 these were usually rather generic. They often did not match any specific car exactly; they were also often oversize, perhaps reflecting a desire by manufacturers

► **MODELING REAL RAILROADS AND WHAT THEY DO**



that these models would have bulk “comparable” to house and other larger freight car models. In more recent years, a number of outstanding accurate models have arrived on the market. But all of them have their place in developing a model tank car fleet, as described below.

There have been a great many articles in the model press about tank car modeling, and in more recent years, some have provided excellent guidance toward prototype accuracy. It is of course impossible to review all of these, but some of the landmark articles are listed in the Bibliography, and are mentioned in the text of this column.

### Basic modeling approaches

The simplest approach, of course, is to identify an accurate model, with accurate paint and lettering, as produced by the manufacturer. This may or may not be a ready-to-run car. Many brass tank car models, especially an excellent series produced by Overland Models, have been highly accurate. Styrene kits and ready-to-run cars from Proto2000 (now Walthers), modeling the AC&F Type 21, and InterMountain, modeling the AC&F Type 27, are dependable car bodies, even if every paint scheme may not be accurate. The recent Tangent models are quite accurate in construction and decoration.

Resin kits from Sunshine Models, Southern Car & Foundry, Resin Car Works, and others, are also in most cases very faithful to prototype [1]. Painting and lettering these models may call for access to resources of the kind provided in the Bibliography of Part 1.

But for many potential prototype cars you might wish to model, it is necessary to do more. My preference is to try and use an existing kit underframe, and an existing kit tank, or both, whether or



1. One of the Southern Car & Foundry tank car models, a superbly designed and executed resin kit, modeling a car which has had two end compartments added after the car was built, thus the smaller domes at each end. Moreover, it is a Standard Tank Car Company design, with its distinctive STC bolsters. Paint scheme exactly follows a prototype photo, including Du Pont’s typical light gray paint (rendered incorrectly on some models as silver).

not those parts were made to go together. And if really necessary, one can, with surprising ease, scratchbuild a tank or an underframe to be combined, or to mix with kit underframes or tanks. I describe each approach below.

### Upgrading models

This may mean upgrading details (especially brake gear, a highly visible part of tank cars and thus worth upgrading), or perhaps

## GETTING REAL | 4

correcting a deficiency. One good example of that is conversion of the Athearn 12,500-gallon tank car to the Southern Pacific out-line. The SP car is almost certainly the prototype of the Athearn model but as manufactured, it has some shortcomings. I will explain these briefly below, though a full article on this conversion, entitled “Modeling SP tank cars,” has been published (see Bibliography), and it should be consulted for details. An updated version is online at: [modelingthesp.blogspot.com/2011/05/modeling-sp-tank-cars.htm](http://modelingthesp.blogspot.com/2011/05/modeling-sp-tank-cars.htm).

The most glaring deficiency of this model is its dome height, an artifact of Athearn’s production of three-compartment cars with lower dome heights. This is evident when comparing a corrected dome with an uncorrected one [2].

The way to correct this was first suggested by Richard Hendrickson, slightly modified by me, as shown in [3]. I use sacrifice bodies to obtain the extra domes; three-dome Athearn bodies are still available as parts.

Slicing off a dome from the sacrifice body, filing its bottom flat, and scraping a taper on the inside of that dome, allows gluing it onto the working body [3]. The equilateral arrangement of three

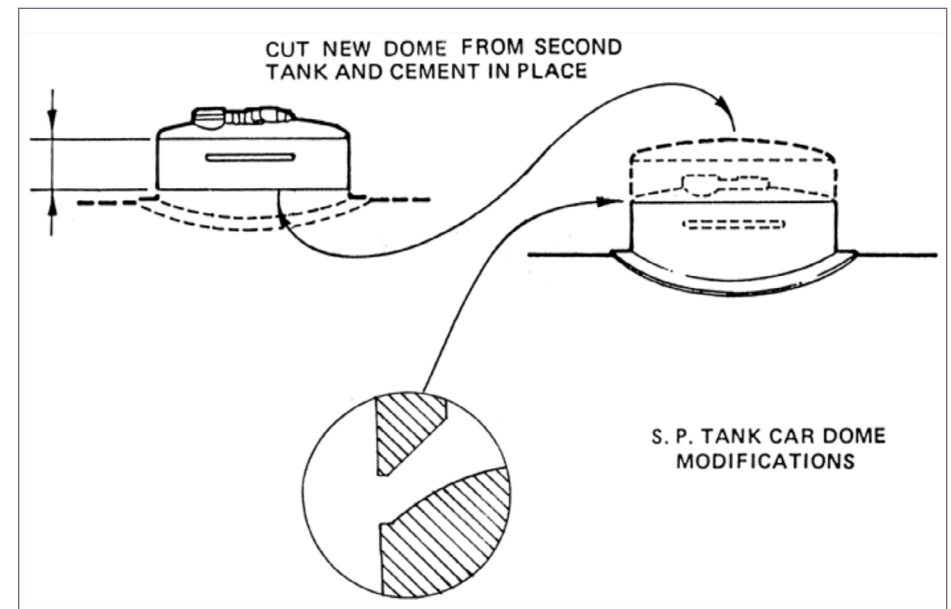
2. (Next page, top) The foreground model is an Athearn tank car with unmodified dome and incorrect paint, though a vertical-staff handbrake has been added. Behind it is a car with dome height corrected. The three safety valves on the uncorrected dome are also incorrect, and they need to be repositioned.

3. (Next page, bottom) The method for correcting the height of the Athearn dome, using a dome from a sacrifice body, filed to have an interior taper (shown at bottom) so it can be glued directly onto the dome being corrected. The basic idea came from Richard Hendrickson.

## GETTING REAL | 5

safety valves is also incorrect, and these can be removed. There should be just two of them, paired toward the B end of the car.

The double rivet rows on either side of the Athearn dome are also artifacts of the three-dome model and should be removed for the





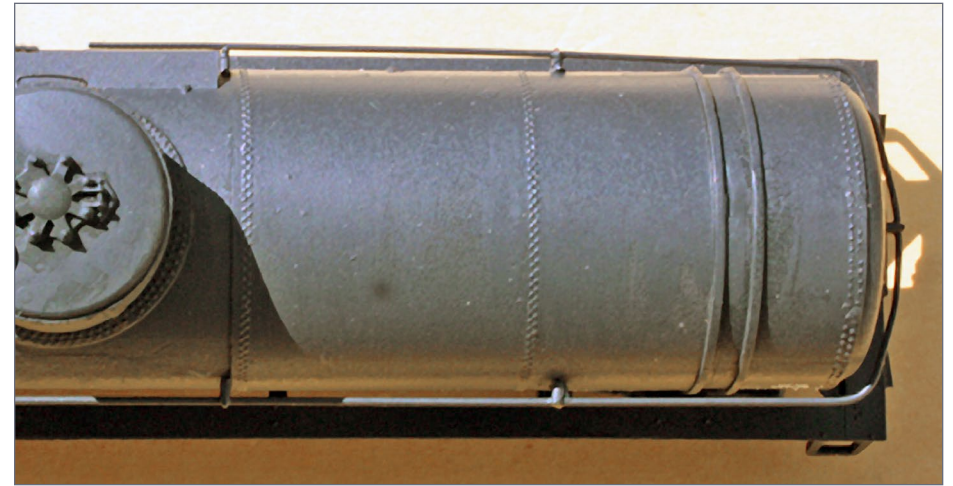
SP car or any single-compartment car, as should the outboard bottom outlets. And the dome walkway and ladder on the right side of the car should be removed.

Other upgrades include a vertical-staff handbrake, brake rigging, and perhaps a corrected tank handrail, as the Athearn one is oversize in diameter. When completed, a variety of paint schemes can be applied, as shown in [4].

For SP and other cars built before the mid-1920s, there were a number of construction differences, as described in Part 1. Circumferential riveted joints in the top of the car were one such difference. These are not difficult to reproduce using such resources as Archer rivets (see Parts List), as shown in [5]. Safety valves were usually mounted on elbows at the side of the dome (as shown in Part 1). An excellent lost-wax brass part is now



4. Here are five completed SP tank cars, five different paint schemes (the front and back cars are diesel fuel schemes of different eras, the yellow car is a gasoline scheme, the car with the "S" in the diamond on the dome is equipped for liquid sugar service, and the plain black one is in general service). Most are converted from Athearn plastic models.



5. The top of an Athearn tank car, converted to circumferential double-row rivets using Archer set AR 88031. That set was designed to reproduce exactly this kind of double-row rivets.

available from Owl Mountain Models (see Parts List) for these elbow valves [6], along with frangible-disc safety vents.

Another kind of simple upgrade for some cars is the substitution of a screw-top manway for the bolted manway on most models (see Part 1 for illustration of this appliance). The Tichy tank car detail set, no. 3007, contains crisp versions of both manway covers. This part set, and others mentioned in these modeling approaches, are included here in a Parts List. I allude below to sources of detail parts, both to complete some models, and also to upgrade kit parts, in a few cases.

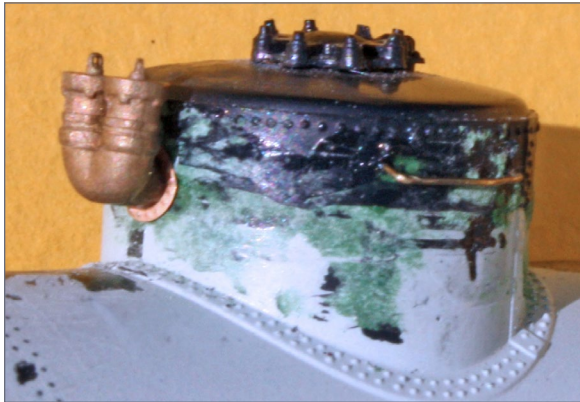
## Model conversions

To inter-convert parts of tank car kits, for example swapping tanks and underframes, it is useful to know the size (in gallons) of what you are working with. The first problem, at least with older

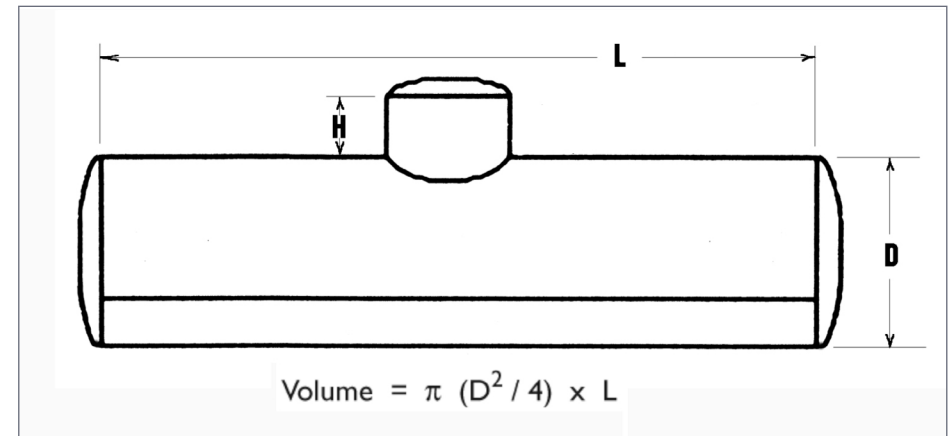
models, is to determine how big the tank actually is. The second problem is to determine what the prototype car you are modeling might have contained in gallons.

A way to do this is shown in [7]. The idea here is to simplify measuring a tank, by choosing easily located end points, and then to juggle the conversion factor to compensate for what is ignored. Measure, in scale inches, the cylindrical or barrel dimensions of tank or dome, ignoring tank heads and crown of dome. Then use the equation shown (merely the equation for the volume of a cylinder) to calculate volume in cubic inches. Next divide by 225 to get the gallons (in other words, assume there are 225 cubic inches per gallon). This conversion factor allows for shell thickness and curvature of tank heads. (For the technically inclined, the “hand-book” conversion factor is 231 cubic inches per gallon; the overestimate of roughly 2 percent compensates for head shape, etc.)

One of the simpler conversions, if the volume of your target prototype is right, is to correct the Athearn “chemical” tank car. Athearn somehow created a car with an immensely oversize valve bonnet (see Part 1 for discussion of what this is for) and a correspondingly oversize dome platform. You can get a sense of this if you put an HO scale man on the Athearn platform.



**6. The Owl Mountain double safety valve on an elbow mount. The dome height of the Athearn car has been corrected.**



**7. Computing the volume of a tank car or its dome, using the formula shown (see text for details). Measurements should be in scale inches.**

Correction is easy: replace the Athearn bonnet with Precision Scale’s part [8,9]. Both size and appearance are now much better. The only remaining problem is to add either a correct-size dome platform, or, as was quite common, simply add dome walkways. Prototype photos are essential to determine which one is correct.

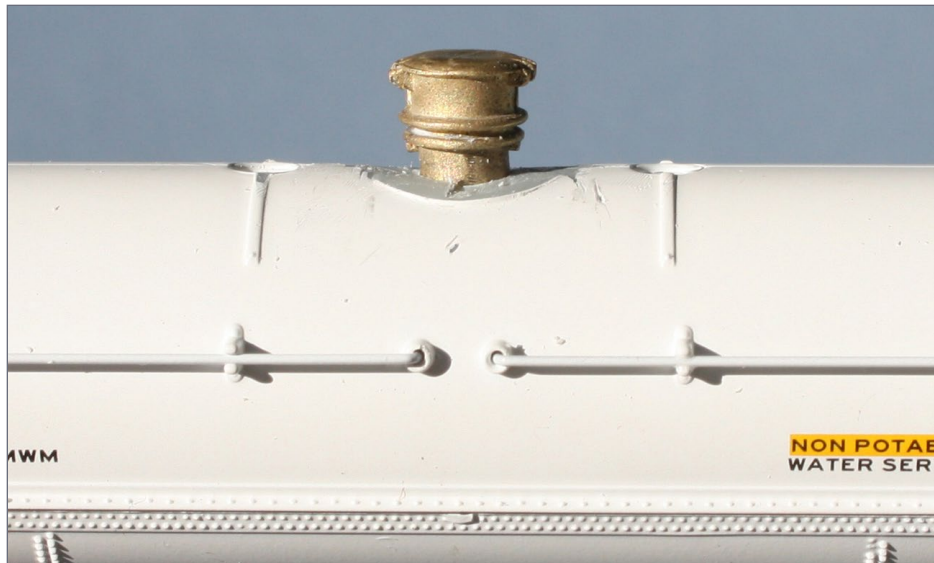
One example of making a new dome platform is to cut down an Atlas kaolin tank car part to make a scale-size platform [10]. I have described this project in a blog post, at: [modelingthesp.blogspot.com/2015/05/another-approach-to-tank-car-platforms.html](http://modelingthesp.blogspot.com/2015/05/another-approach-to-tank-car-platforms.html).

Another approach is to simply add dome walkways, as shown in [11]. This too is an Athearn “chemical” tank car with a replaced valve bonnet. This particular prototype, leased to Brea Chemicals, had a very short walkway at the top of the ladder, just as modeled here. The grid walkway is also taken from the Atlas tank car platform described above.





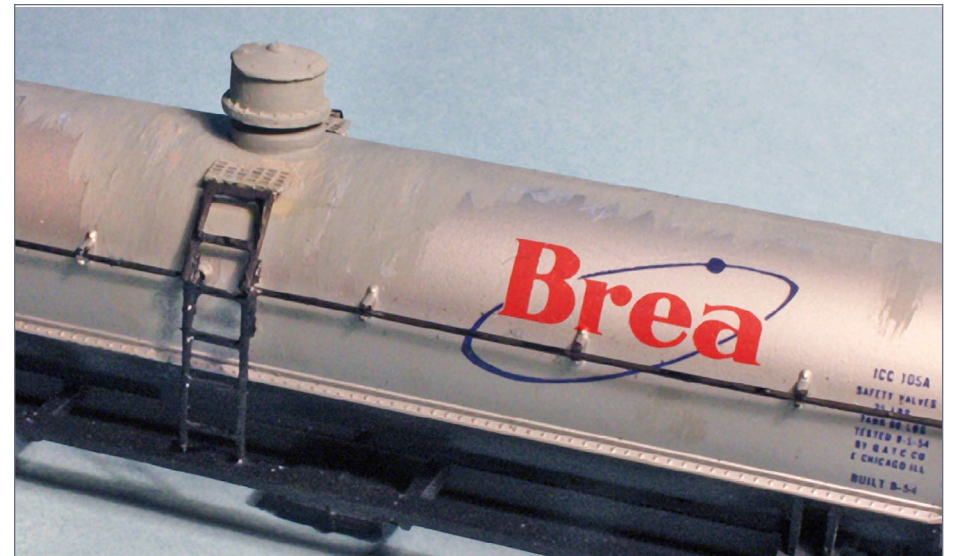
8. The stock Athearn valve bonnet on the “chemical” tank car. It’s seriously oversize, as is the platform which goes with it.



9. With the Athearn bonnet removed, the Precision Scale brass bonnet (part 31005) can be placed. It’s scale size.



10. This Athearn “chemical” tank car has a replaced valve bonnet of correct size, and a platform around the bonnet made from an Atlas tank car part (see text).



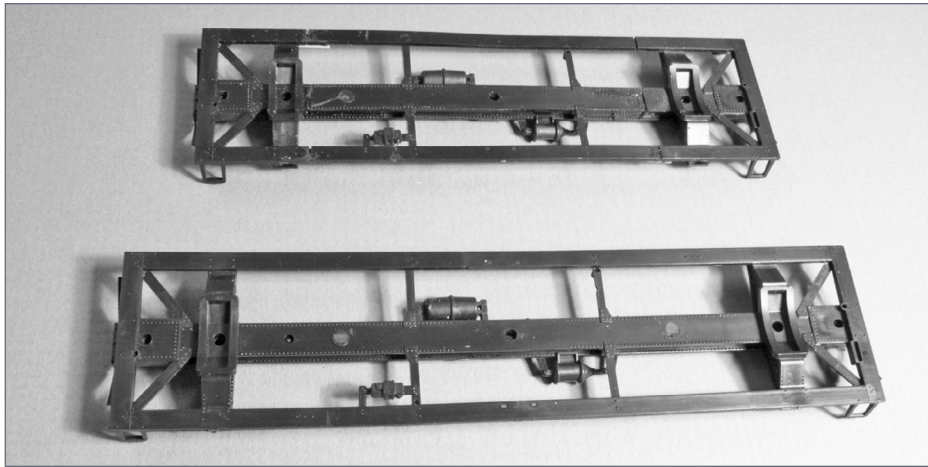
11. At the top of the Athearn metal ladder, a short walkway was located, using plastic grid walk cut from the same Atlas tank car part used for the platform of the Hooker car [10]. This short walkway matches the prototype part.

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The two models just described, involving only replacement of valve bonnets and addition of vertical-staff handbrakes, brake rigging, and appropriate top walkways or platforms, are relatively simple to carry out. Next I turn to more extensive projects to modify tank car models, both in body modification and in scratchbuilding.

### More extensive tank car modification

One example of more extensive modification is the swapping of tanks and underframes. This may require one of the two swapped parts to be significantly modified. Here is one example. The InterMountain 8000-gallon tank car is an accurate AC&F Type 27. But if one wishes to model a General American car, a different style of underframe construction is needed. Either the AC&F



12. Shown here are a stock Athearn tank car underframe, at bottom, and a shortened one at top. The stock part was cut at the bolsters and the center section shortened to match an InterMountain 8000-gallon tank. When reglued and spliced, as in the underframe at top here, the frame is sturdy and effective.

## GETTING REAL | 13



13. The kit swap described in the text, placing an InterMountain 8000-gallon tank on a cut-down Athearn underframe, resulted in this GATX model. The lettering is from custom decals. The car is shown delivering vegetable oil to a fish cannery.

underframe of the InterMountain car must be reconstructed, or a General American underframe substituted.

In one project, I chose to do the latter. The Athearn underframe is indeed a General American design, if crude in some of its details, but has the drawback that it is sized for a larger tank car, 12,500 gallons. It can readily be shortened, however, to fit the InterMountain tank. That was what I did; see [12]. The InterMountain tank is screwed to the underframe through the bolsters, so the spacing of those screws sets the distance between bolsters of the shortened frame.



## GETTING REAL | 14

When complete, the model was lettered with custom decals to represent a General American car leased to El Dorado Oil Works of Berkeley, California, a producer of edible oils, not petroleum products. It is shown in [13], and was described in my *Railroad Model Craftsman* magazine article of 2011 (see Bibliography).

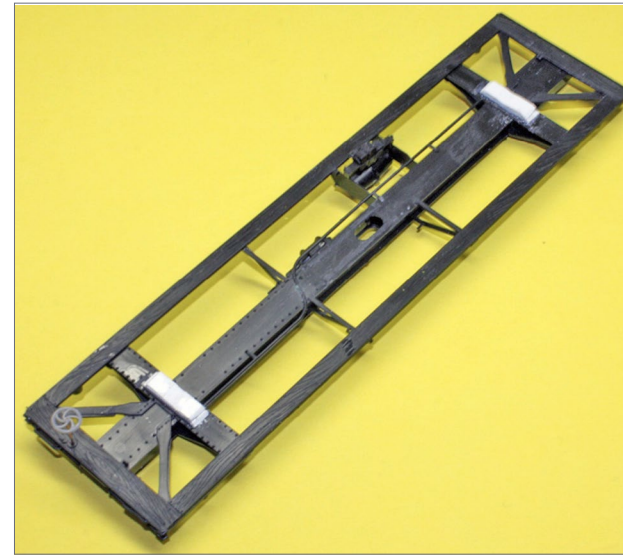
In that same article, I described the “reverse” of the swap just described, using the leftover InterMountain AC&F underframe to accept the tank that had been in the Athearn kit from which I took the underframe for [12]. In this case, the tank was too large, and had to be cut down to the length of its new underframe. And once again, the distance between bolster screw centers was an essential measurement, this time for the new dimensions of the cut-down tank.

I had to remove five scale feet from the Athearn insulated tank. On the upper part of the tank, I could cut out five feet anywhere near the center. But for the bottom sheet, to keep the center anchorage details in the center of the tank, I had to remove two equal parts from each side of the center. As always in such cutting



**14. An Athearn insulated tank body, shortened to fit the InterMountain frame, and reassembled. Cuts in the top and bottom pieces are differently located (see text). Longitudinal rivets seen here are incorrect and were removed.**

## GETTING REAL | 15



**15. The InterMountain frame could be used almost in stock condition, though styrene pads were added at the bolster to support the tank correctly. A vertical-staff handbrake has been installed, and additional brake rigging was added later.**

and reassembly, I cut out a little less than would be needed, so that cleanup of the cut parts can bring the size to just the right length. Shown in [14] are all the tank parts, re-glued and with a little modeling putty used to fix any small errors.

The InterMountain frame to be used is an AC&F design, which fit the prototype I was aiming at, a Warren Petroleum ICC 104 car, like the one shown in Part 1. (Using a prototype photo is, of course, a good guide to all the changes in detail needed to complete a model.) The tank was cut down mainly to fit the frame, but also to reduce its size to about the 10,000 gallons of the Warren car.

The InterMountain frame needed only spacer pads under the Athearn tank to line up all the parts correctly. This minor change in the underframe is shown in [15].

The dome of the Warren car in question was insulated and was visibly larger in diameter than the required two-percent

## GETTING REAL | 16

expansion dome would be. It was easy to make a new dome from tubing, in the way shown in [16]. It was also necessary to make new dome-top fittings, like the air vent and siphon covers shown in Part 1. I simply turned some styrene rod to make these conical-looking parts, and also added the bolted manway from the Tichy tank car detail set (see Parts List).

The final model [17] has the advantage that it represents a car not available any other way, as well as consuming the leftover frame and tank from the El Dorado Oil project!

One other example of cutting down a kit model to make something else comes from the work of the late Richard Hendrickson. His article in *RailModel Journal* in 1996 described construction of this model (see Bibliography), so I will only briefly summarize here. He wanted to make a 10,000-gallon General American tank car from the 12,500-gallon Athearn tank. To do that, he cut down



the Athearn frame length, much as I showed in [12], then did similar cutting and reassembly of the Athearn tank to that shown in [14].

**16. Dome creation is easy if abrasive paper is wrapped around tubing of the tank diameter, and then the dome tubing is sanded to shape. Shown here is aluminum tubing, but this method works equally well for Plastruct and other types of tubing.**

## GETTING REAL | 17



**17. The completed 10,000-gallon tank car using the Inter-Mountain underframe and the cut-down Athearn insulated tank body, with a new dome. A mixture of Champ and Jerry Glow decals was used.**

His tank cuts were alongside the hold-down bands at each end, to make them easier to clean up upon reassembly [18]. The completed car is shown also [19].

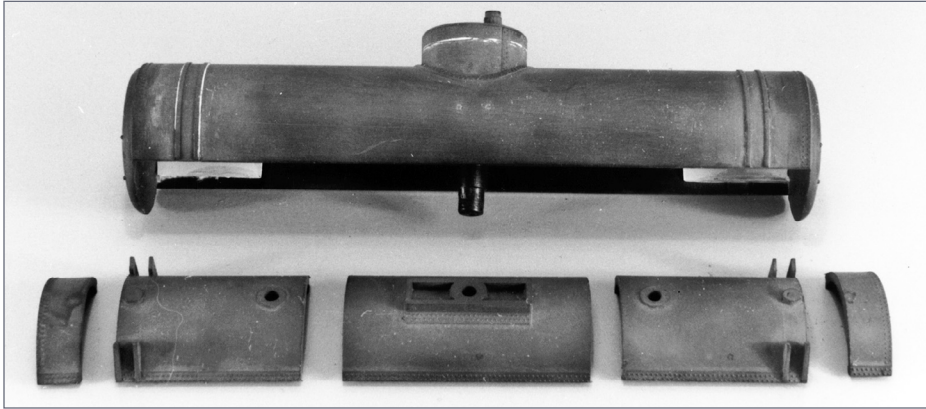
### Scratchbuilding tank cars

This idea sounds intimidating to many, but as with a lot of projects, the key is recognizing that the model is made up of sub-assemblies, and each one is quite manageable. A major component is the underframe. These are actually not hard to scratch-build. The ones I have done were based on an Eric Stevens “Dollar Car” project article in *Model Railroader* (see Bibliography).

This article showed an easy way to scratchbuild an underframe for a tank car using interlocking wood parts. The general idea is sketched in [20], with the end notches intended to hold coupler boxes. I used basswood, 3/16-inch square, to make the center



## GETTING REAL | 18

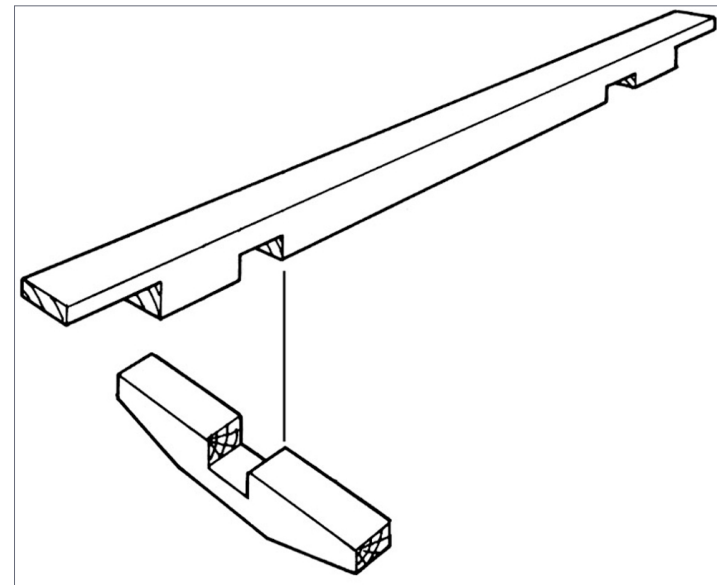


18. The cut-down tank parts for Richard Hendrickson's model. The top has already been reassembled and dome height increased as in [3]; the modeling putty at joints alongside the tank hold-down bands is visible. The bottom sheet had to be cut into five pieces also. "Fins" on bottom sheet were removed. (Richard Hendrickson)



19. The completed 10,000-gallon tank car built by Richard Hendrickson from an Athearn tank car kit. Note that the tank bands at bolsters have been redone as separate bands. I inherited this model from Richard.

## GETTING REAL | 19

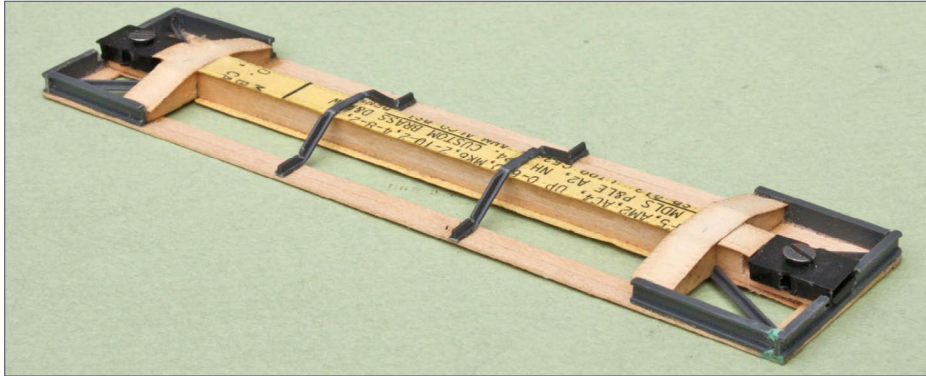


20. Tank car underframe construction from bass-wood. This is a very strong and rigid frame.

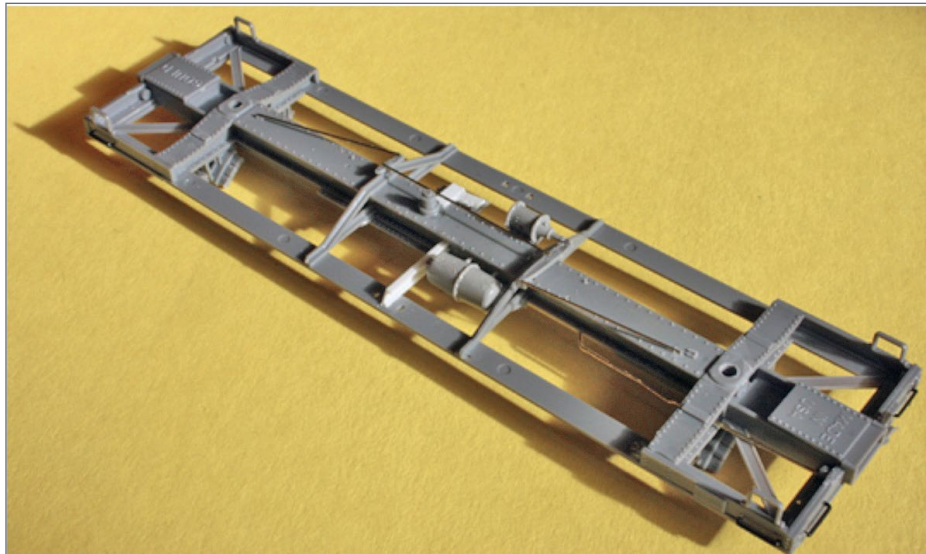
sill and bolsters. I then used light cardstock and made overlay strips, which were embossed with rivets made by a row of scribe indents, to make the wood parts look like flanged structural shapes [21]. This underframe is surprising easy to make, and when complete, is impressively strong and rigid.

But an excellent kit underframe is available also – the Tichy styrene frame (see Parts List). This is an AC&F underframe but is readily modified to represent the General American style of construction, and can also be easily modified for various tank diameters. Moreover, the location and arrangement of brake gear is also easy to adjust to match a prototype. The frame is intended for K brakes, but it is easy to install AB brakes, for example. This is shown in [22], with simple addition of styrene shapes to support the brake gear parts.

This underframe can also be shortened if needed, and re-detailed in a variety of ways. It is an excellent foundation for several kinds



21. A scratchbuilt tank car underframe in progress, based on the basswood construction shown in [20]. Wood running boards have been added, along with styrene side and end sills and running board supports. Rivet-impressed overlays for center sill and bolsters were made from a manila parts envelope.



22. A Tichy underframe, set 3011, modified to accept AB brake parts (also Tichy). Brake rigging applied, but piping not yet installed.

of tank car model projects. I show just one such project here, which is described in more detail in my article in *Railroad Model Craftsman* for January 2012 (see Bibliography).

I was aiming at a tank car of the kind modeled years ago in an article by Mark Feddersen, who I believe was way ahead of his time in his tank car modeling. Specifically, I wanted to model a hydrogen peroxide car (see Bibliography for Mark's article from January 1986). This is only a 6000-gallon car, rather smaller than any of the models described so far. I decided to create the tank from scratch.

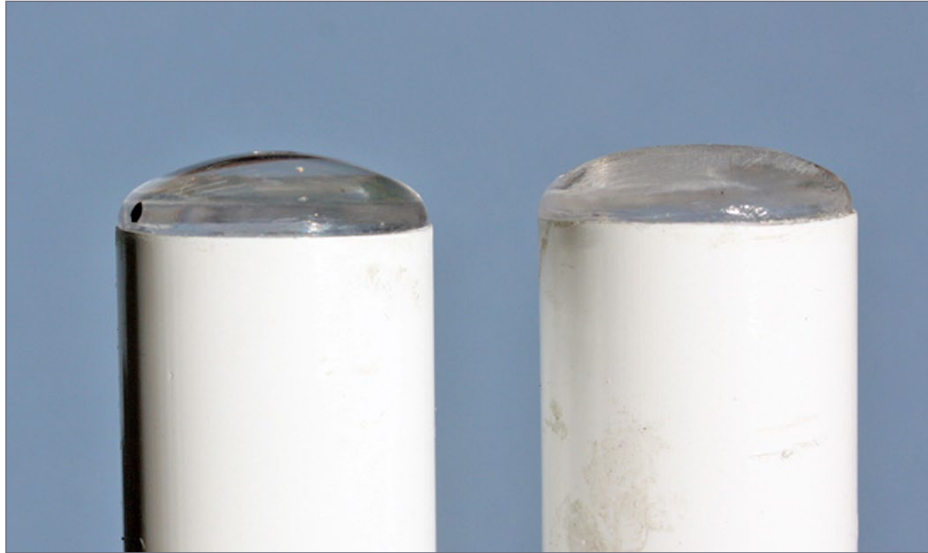
Tanks are easily made from the various diameters of Plastruct tubing, particularly since they also sell matching end caps. The elliptical ones are still too rounded, but as the material is fairly soft acrylic, they are very easy to file and sand to a flatter profile [23]. I used 3/4-inch tubing for this car.

I used the Tichy underframe for the model, with the significant modification of narrowing the tank cradle width to accommodate the 3/4-inch tubing.

I applied Precision Scale handrail stanchions as needed, with 0.019-inch brass wire handrails. This is almost exactly the prototype size (nominal 1-1/4-inch pipe) in HO scale. Unions in the handrail were made from 0.020-inch ID hypodermic tubing (see Parts List). I made tank hold-down bands from styrene strip.

Dome top appliances are typically different on tank cars like this one, with various kinds of unloading pipes and other details, along with the usual manway cover and safety valve. For this car, I used a Tichy manway cover, a single safety valve (as called for with this car of less than 6500 gallons, see Part 1), and a steam locomotive pop valve to represent the access pipe cover. These are shown in [24]. The completed car is in [25].





23. On the left is the elliptical end cap sold by Plastruct, while on the right is an end cap filed and sanded to match prototype tank car end shapes.



24. The dome top on the Becco peroxide car shown in [25]. As is typical, the manway cover is offset to one side, and a safety valve and access pipe cover are alongside it.

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25. The completed peroxide tank car, with Champ decals for Buffalo Electro Chemical Company (Becco) applied. This is a Plastruct tank with K&S aluminum tubing for the dome, and a variety of detail parts used for the dome top.



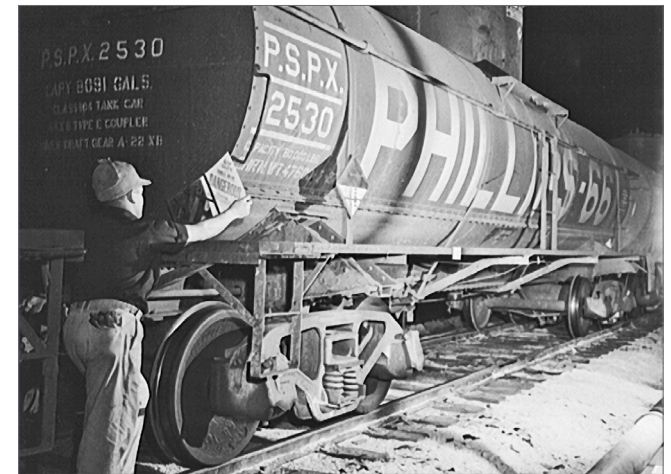
26. A riveted 7000-gallon acid tank car from a resin kit produced by Resin Car Works. As was typical before 1948, the dome platform is wood planks. (Eric Hansmann photo)

In my January 2012 *Craftsman* article that described building the Becco car in [25], I also showed a scratchbuilt acid tank car, for which there were then no commercial models. Now there are two excellent ones, a welded one from Tangent and a riveted one as a resin kit from Resin Car Works [26]. Time does march on, in a good way.

## Placards

Tank cars for many years have carried warning placards for various dangerous cargoes [27]. In the earliest days, these were made up by individual shippers or railroads, and the only standard one was for explosives, specified by the federal Bureau of Explosives. But in 1921 an amendment to the 1920 Transportation Act gave

27. A workman in this John Vachon photo is inserting a "DANGEROUS" placard in the holder on a loaded Phillips Petroleum tank car. The placard holder to his right still has the empty placard



from the previous trip; sometimes the black-white division in the diamond was placed horizontally, as here. Photo taken at the Phillips gasoline plant in Borger, Texas, November 1942. (Library of Congress, negative LCUSW3-011653)



the ICC (Interstate Commerce Commission) authority to regulate transportation of dangerous commodities, and they introduced four standard placards in that year [28]. By 1930, the need for other commodity descriptions was evident, and four additional placards were made standard [29].

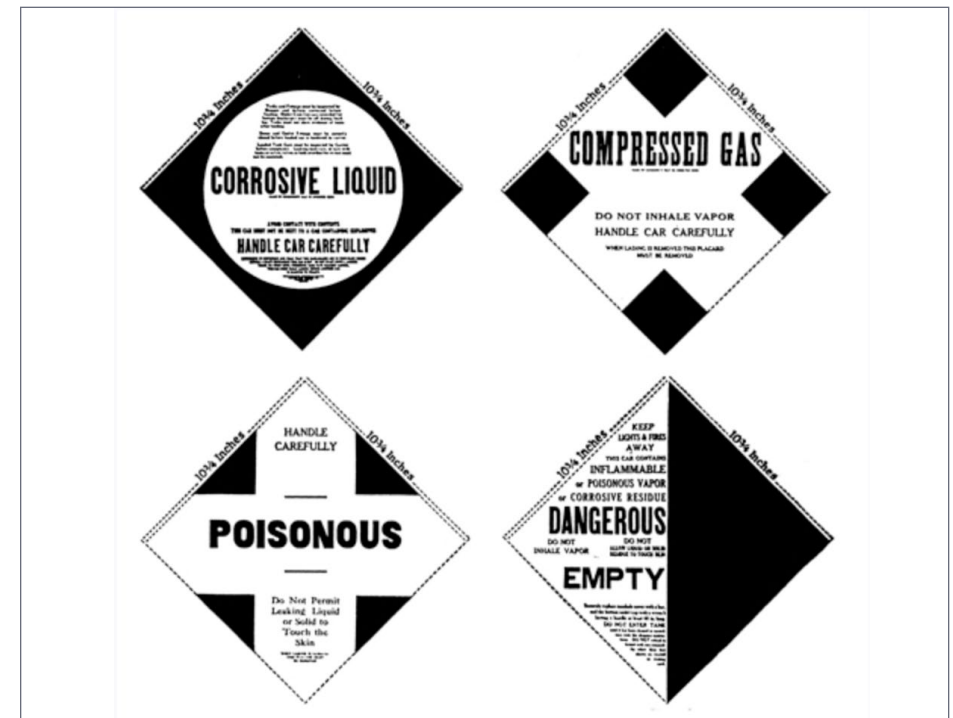
In the late 1930s, a more general “DANGEROUS” placard was introduced, with a blank space where the particular commodity could be written in. This is a flexible category, and this placard is



28. These are the first four standard placards, introduced in 1921. Before that time, various placards made by individual shippers or railroads were used, the only standard being a federal placard for explosives. “Inflammable” means the same as “flammable,” and today only the latter word is permitted. The use of red type helped make warnings visible.

used for many cargoes. An example printed by SL-SF in 1962, is shown in [30].

Since I model 1953, the placards in [28-30] are relevant. But modelers of later periods must recognize that after the 1950s, a series of changes to placard standards took place. In 1960, more color was added to some placards, and designs were given more of a family resemblance. In 1974, considerable changes were made,



29. In 1930, these four placards were added to the four shown in [28]. The placard for corrosives recognizes that liquids other than acids can be corrosive. The “EMPTY” placard was a printed version of the common practice of folding a loaded placard in half and placing it back in the holder, thus showing the black background of the holder.

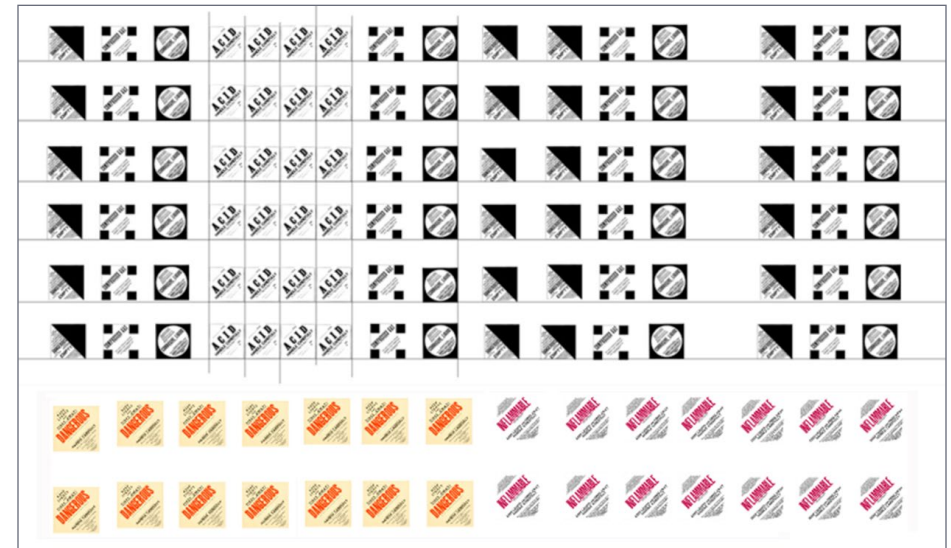
with many placards given an entirely new look, even different colors. And then in 1981, the United Nations international placard standards and commodity numbers were adopted, which are still in use today. This history, and much else on the topic, has been ably summarized by John Ryczkowski in a magazine article (see Bibliography).

With good images of these placards, modeling them is easy, as I show in [31]. I make up sets of these and have them printed at my local copy shop, which has a high-resolution color printer. They can then be cut out [32] and applied to tank car models as needed [33].

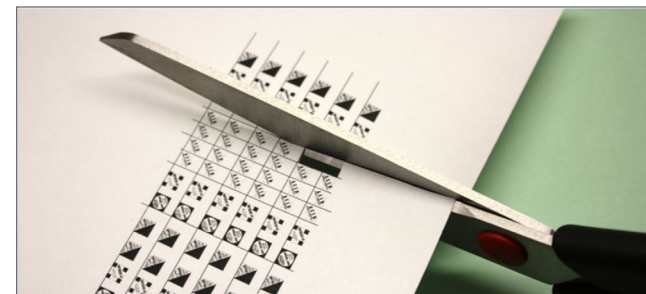
As mentioned in Part 1, there are commodity tables which tell you which cargoes are accompanied by which placards, and a link was provided to such a table. Even tank cars such as helium cars did carry placards [34].



30. This placard, printed in 1962 by the St. Louis-San Francisco Railway, is very similar to comparable placards first used in the 1930s. It has a space just below center to write in the particular cargo. (author's collection)



31. The prototype placards are specified to be 10.75 inches on a side. In HO scale, this comes out to exactly 0.125 or 1/8 inch. I reduce the prototype images to this size and print them in quantity, as you see here. This size, incidentally, also tells you the size that placard boards on model tank cars ought to be, though some models have distinctly oversize boards.



32. An accurate shear or good-quality scissors can be used to cut out the placards, or a hobby knife may be preferred. I usually print them on plain paper, but glossy paper may be better when color ones are being made.



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Once you are aware of the presence of placards, they show up in many prototype photos. The “EMPTY” placard was usually placed with the black-white division vertical [35], but especially in earlier



33. In this photo, an “EMPTY” placard is being placed over the placard supplied on this ready-to-run tank car from the Proto2000 line (now sold by Walthers). I usually use canopy glue for this application.



34. This AHM model helium car, with upgraded trucks and details, carries a “COMPRESSED GAS” placard. As explained in Part 1, it’s an ICC-107A tank car.

## GETTING REAL | 30



35. This UTLX tank car, photographed in 1948 and still showing (correctly) its “ARA Spec III” designation, has a standard “EMPTY” placard, the vertically divided diamond in black and white. Note the chalk marks on the car. The UTL car design has side and end sills of inward-facing channels, instead of the outward-facing channels of the AC&F underframe (Richard Hendrickson collection)



36. This Ethyl Corporation car, EBAX 6357, carries a “DANGEROUS” placard, with that word in red. Photographed at North Broadway Yard (Los Angeles) on the Southern Pacific in July 1961. (Morris Abowitz)



days, it was sometimes installed with the division horizontal [27]. Loaded placards are not always readable in prototype photos, though the example in [36] clearly is a “DANGEROUS” placard.

At the same time, many common commodities, including petroleum products, like heating oil and kerosene, did not require placards in the 1950s, so not every model car would or should carry a placard. On my layout, there is no reversing loop, so the same side of each model car is always toward the viewer. I take advantage of this in applying my placards, with an “EMPTY” placard on one side, and an appropriate load placard on the other side. When a car changes status, from loaded to empty or vice versa, the car is



physically reversed to show the other side. Of course this would not work on every layout.

### Concluding remarks

I recognize that at least some, and maybe most, of the descriptions of model modifications and rebuilding may seem obsolete in light of new models of higher quality. The new models include the recent Tangent and Resin Car Works cars, but there is no better example than last year's introduction of the Kadee high-pressure tank car [37], which is what the Athearn tank car should have been. For my part, I very much hope that more cars of the

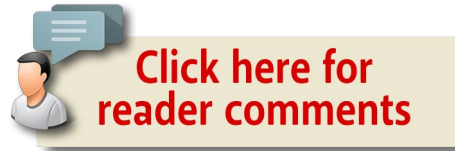
37. The recent Kadee 11,000 gallon ICC-105A tank car, lettered for Tidewater Associated Oil Company, and shown at the Associated dealer on my layout. Construction of this dealership model was described in *Model Railroad Hobbyist* in March 2014. The valve bonnet is white to assist in rapid return of these cars for reloading. Propane consumption jumped after World War II and cars were in short supply.



quality and accuracy of the Kadee tank car do come along. It will make the work of the modeler easier and better.

But in the meantime, there remain a great many prototype tank cars that will require kitbashing or scratchbuilding to create. The modeling challenge will continue. Some of the approaches outlined in this article may be of help if you confront such a situation.

The two parts of this article are intended in combination to demonstrate how and why different kinds of tank cars were built and regulated, the cargoes they were built to carry, and then an extended discussion of how to model them. ☒

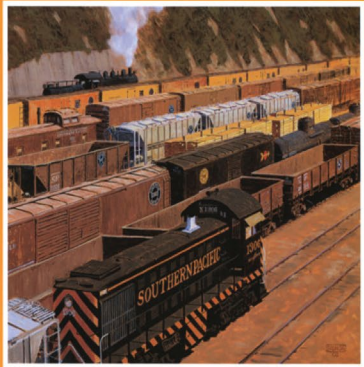


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## APPENDIX: LANDMARK DATES PART 1

- 1899 – American Car & Foundry formed from 13 firms
- 1902 – German-American Car Company incorporates
- 1903 – Master Car Builders (MCB) institutes recommended practice for tank cars
- 1910 – MCB 1903 practices adopted as standard; post-1903 cars become “Class II,” cars built before 1903 become “Class I”
- 1916 – German-American becomes General American
- 1917 – MCB becomes part of ARA; new ARA Class III for cars after May, 1917; Class IV specifications adopted (insulated, low-pressure for flammable cargo)
- 1918 – Class V specifications adopted (insulated, high pressure, dangerous cargo)
- 1924 – Class VI adopted for very high-pressure helium gas
- 1927 – On July 1, ARA specifications were superseded by ICC: Class III became ICC Class 103, Class IV became ICC Class 104, etc. Older cars retained ARA markings, such as “ARA Spec III.”
- 1957 – ICC begins introduction of new classes of domeless cars, ICC 109, 110, 111, 112

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### **Atlas**

kaolin tank car, "upper platform," part 9170013

### **Detail Associates**

NBW, part SY 2203

brass wire, 0.015 and 0.019 inch

### **K&S Engineering**

7/16-inch thin-wall aluminum tubing

### **Owl Mountain Models**

elbow safety valves, single or double, parts 1001, 1002

frangible disc safety vents, parts 1003, 1004

### **Plastruct**

3/4-inch tubing, part TB-24

elliptical end caps, part VHE-24

### **Precision Scale**

Handrail stanchions, brass, part 32110

Tank car pressure bonnet, part 31005

Pop valve, brass, part 3294

### **Small Parts**

0.020-inch hypodermic tubing, code B000FMYLZS

### **Tichy**

Tank Car Underframe, set no. 3011

Tank Car Detail Set, set no. 3007

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