History and Development of Emergency Transportation

by

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Abstract

This report is an investigation of the engineering development and evolution of emergency medical vehicles as well as an analysis of standard orders of procedure in emergency services. Research began with an investigation of the major world war ambulance models. Investigation of these two wars showed that the Ford Model T was the prominent vehicle converted for ambulance use during World War One and that the Dodge Truck was the prominent vehicle converted for ambulance use during World War Two. The next phase of the research was to study civilian ambulance models from the early 1900s up to about 1980. This time period was classified as the 'conversion era' because of the popularity of converting normal vehicles (typically wagons or hearses) into ambulance transport vehicles. The third phase of research was the exploration of a series of major events between the 1950s and 1970s that completely changed the way ambulances were manufactured. The last phase of the research portion of this project was to study current ambulances. The time period between the 1980 to current was the 'modern era' for modern development.

By understanding past and present EMS services, our team set out to create an internet website where ambulance knowledge could be shared. Thus, the project culminated in the development of an online website that provided a history of the ambulance, an information about modern ambulance models and manufacturers, and lastly a forum for paramedics to freely discuss different aspects of the EMS world pertaining to ambulatory care and services.

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Acknowledgments

Our team would first like to give a special thanks to Professor Fofona for his constant guidance and strong vision for engineering innovation in the EMS world. Our group would also like to thank the personnel at the UMass Memorial Emergency Services for lettings us tour their ambulance facilities and giving us their opinion and insight into the lives of paramedics. Lastly, we would like to thank the Plaistow, NH Fire Department for letting us view their ambulance and also for giving us their thoughts and ideas about the paramedic world.

CHAPTER 1. EMS AND LIFE SAVING PRACTICES

1.Introduction

Emergency ambulatory services play a vital role in life saving practices. When an individual has sustained critical or possibly life-threatening injuries, time is of the essence and it is important that treatment is received as soon as possible. The time spent between the place of incident and the hospital is important. Both the patient and medical personnel are placed in danger while making an effort to reach a location of safety. Ambulatory patient requires medical treatment without a second to spare. That said, the safety and efficiency of emergency medical vehicles must be considered at great length to ensure the wellbeing of both patients and medical staff are during emergency rescue.

The members of this IQP investigative research team are undergraduate engineers at Worcester Polytechnic Institute. This project began underneath the lead of Professor M. S. Fofana, as a component of a much larger project encapsulating all areas of EMS services. This specific topic of history and development was selected as a critical area of research to propel the all-encompassing project a step further. There is always much to learn from past experiences. By looking back to the past we are able identify both the positive and negative aspects in medical services that may have been lost over the years or simply overlooked. These findings will help us to formulate our engineering computation and give us the ability to understand the progress of current EMS innovation.

This report is an overall history and evaluation from an engineering perspective. Chapter two compiles our research of the history of emergency services dating back to World Wars I and

II and spans through a time known as the Conversion Era. This historical evaluation led to the development of strict guidelines by the United States to regulate emergency medical services and set many guidelines that these vehicles were required to adhere to. Chapter two is the conclusion wherein modern day analysis of current ambulance companies are presented. Chapter three focuses on our final deliverable, an online database of EMS knowledge that will connect EMT's around the world. Chapter four concludes our report.

CHAPTER 2. EMS AND PATIENT-CENTRIC QUALITY CARE

2. Introduction

This chapter focuses on the developmental stages of ambulance history. The trends over the years of development are exposed and relationships are drawn amongst each stage. The driving forces of these changes are uncovered as well. With this information it is possible to uncover the thought that has been involved and the engineering practices that have landed the ambulance design where it is today. The final sections focus on modern day ambulance models. Dimensional analysis provides insight to the engineering design and functionality of each model based on the demand of the ambulances and the functions they will serve. An important factor looked at includes the selection of ambulances based on geographic profiles and the types of roads that will be travelled on. By uncovering this information it will be possible to suggest a model that is most efficient for specific categories of driving.

2.1 Wartime Ambulance

In the early stages of development, emergency transportation services were primarily horse drawn carts or simple hammock stretchers. These were responsible for carrying an immobile patient out of potentially dangerous environments and into the hands of a doctor. The Knights of St John developed this concept in Europe. During the eleventh century Crusades, the Knights were educated in first-aid by Arab and Greek doctors [51]. These trained individuals were then sent to battle to aid those wounded and took them to nearby medical tents. In Mona Nath's History of the Ambulance, other forms of transportation were mentioned. These included Roman Chariots, and litters that were effectively suspended between two horses with specially developed harnesses. It was mentioned; however, various wagon models lacked a means of braking and therefore had limited effectiveness over various terrains. These models were known for their simplicity and elementary design.

2.1.1 American Revolutionary War

On local land, American emergency ambulances were not quite on the same level as the Knights of St John. At the start of the American Revolutionary War there were approximately 3,500 physicians in the colony and only about 200 of those actually had medical degrees [3]. It was considered a harsh reality of war that wounded soldiers were not expected live. As wartime diseases such as pneumonia, small pox, and dysentery began spreading through troops, there became a need for more efficient medical personnel. George Washington and the Continental Congress put a medical corps in place in 1777. Despite these efforts and the 1,200 physicians enlisted, the mortality rate remained alarmingly high. Out of approximately 250,000 soldiers, 25,000 died. EMT-resources provided a statistical breakdown, “Of those 25,000 deaths, 6,500 died in battle; 10,000 died in hospital and the rest died en route. The wounded were transported in open carts with 25% of those dying from infection. [3].”

2.1.2 American Civil War

The necessity of life-saving practices in emergency ambulance services continued to emerge throughout the American Civil War and made drastic breakthroughs with the contributions of William Hammond, ‘The Father of Modern Ambulance Services’. During his time as the Surgeon General of the Army, Hammond implemented several modifications to the existing guidelines of life saving procedures [4]. Along with improving the sanitation, ventilation, and lighting in medical camps, Hammond further improved patient care by creating a purpose built ambulance wagon. This was part of a new division of the army, which became known as a Military Occupational Specialty (MOS). This relieved soldiers of their responsibility in transporting their wounded brothers by dispatching specialty wagon drivers and litter carriers to gather those fallen and transport them to medical camps. One Ambulance wagon was assigned to every 150 soldiers [4]. The efficiency of this service was highlighted at the battle of Antietam (1862) when Hammond's team of ambulance wagons successfully escorted all 9,420 of the Union's wounded soldiers in just one day [4].

2.1.3 War Ambulance

Stepping back in time from Dalton's ambulance service, World War I brought promising ideas to the world of emergency medical transportation. As with the American Civil War, a large issue came about with the need to transport wounded soldiers out of dangerous situations and into the hands of medical staff. For this conflict, America equipped troops with modified Ford Model T ambulance vehicles. Figure 1 blank shows a picture of the Ford Model T [4]. From the figure, one can see its boxy like structure and wooden frame.

Figure 1 - Picture of the Ford Model T

These vehicles were to be used in battle as a primary means of transporting those wounded on the battlefield. To accomplish this, a wooden box structure was built around an existing Model T chassis. Due to the fact that these vehicles were intended mainly for transporting soldiers, there was on a very limited cargo of medical supplies and the box was not designed to promote medical procedures en route. A complete converted Model T had an average weight of 1200-1500 pounds and were 134in x 66in [7]. This very lightweight model constructed of light metals, wood, and canvas allowed for a team of soldiers to easily lift the vehicle if it were to become stuck or disabled in adverse conditions. The four-cylinder, twenty horse power, gasoline powered engine with automatic transmission and manual crank starter was able to achieve a top speed of 45 miles per hour [7]. This was a significant advancement in medical transportation and clearly improved the turnaround time on those patients who needed immediate attention. Downfalls however did exist that were not addressed until later advancements were made in World War II. Largely, the problem focused itself around vibration control. These vehicles were required to travel over varying terrains for long periods of time.

Whether dirt roads littered with potholes or large fields with rolling hills and divots, the thirty-inch wooden-spoked bicycle styled wheels with no suspension system were not able to suppress the vibrations from the road. Depending on the situation and the condition of the patient, this was detrimental to the outcome of the ambulance. Also problematic to this model was the material of construction. Large portions of the additional body built on the Ford chassis was constructed with wood supported by light metal. Wood however, can be highly susceptible to degradation and damage from varying climates, road conditions, and overuse.

The 1940's brought about the changes necessary to start the great chain of advancements in early ambulance development. At the start of World War II, the American Army chose Dodge as its model ambulance chassis. Two models of significant advancements were the 1941 Dodge Field and Country and the 1942 Dodge WC-54 ¾ ton model. The field and country model was designed for front-line and cross-country use and was modeled around a delivery truck with the cargo box modified for patient transport. This four-wheeled drive, half-ton, steel paneled ambulance stood like a heavy artillery vehicle compared to the Ford Model T that ran the fields during World War I. The steel construction of this improved model provided increased climate resistance as well as added a margin of protection against stray projectiles common to the battlefield. To address the problems of road vibrations caused by the terrain, the Field and Country utilized sixteen inch steel wheels with low-pressure, all weather pneumatic tires with hydraulic brakes. These bulkier steel wheels were to handle the most unforgiving terrain while the low-pressure rubber tires absorbed a significant amount of vibrations cause by the rough driving surfaces [2]. Also improved from earlier years was the staff present in each of the Dodge war models. Two men, a driver and an orderly occupied each ambulance. While the driver was responsible for the driving, the orderly was responsible for loading and unloading patients, preparing the ambulance, and also administering any first aid necessary. This is a large step towards improving the outcome of patients transported by ambulance. Many observed that patients who received treatment both on site and en route to the hospital had a much better chance of survival than those who were transported with no aid given.

The modified box compartment of the Dodge models utilized improved patient organization in order to fit more wounded soldiers in one ambulance. The ability to transport more than one person at a time greatly reduced the amount of vehicles necessary on the field as well as greatly improved the time a victim lies on the field waiting for an ambulance. Metal brackets were installed in each ambulance, which made it possible to have suspended litters similar to bunk beds. This designed allowed a capacity of four litters, seven sitting, or two litters and four sitting.

Next in line for Dodge war ambulance was the redesigned 1942 WC-54 ¾ ton 4x4. This was a larger, improved design of the ½ ton Field and Country Model. The hood and cab were both widened and lowered to the ground on a rugged metal chassis that was strengthened to provide better stability and handling. Also enlarged were the tires that grew an inch and a half in width compared to the previous model. Now sitting 16 inches tall by 9 inches wide, these bulky pneumatic tires sitting around steel wheels took the most unforgiving abuse from all types of terrain. Also incorporated into the vibration suppressive unit was a leaf-spring suspension system to further assist in off-road transportation. In regards to patient comfort, the WC-54 covered all bases with its breakthrough engineering. Another feature highlighted in this model is the double rear door that closed the patient cab off from the surroundings. Most other ambulances in war were open backed compartments with as little as canvas draping separating the wounded and orderly from the environment. This proved to be dangerous not only in protection from the environment and battlefield dangers but also in keeping all occupants securely in the vehicle over whatever rough terrain might be encountered. It must be noted however that although the WC-54 boasted a speed of 54mph, the fuel consumption suffered greatly, only achieving 8 miles per gallon on average [2]. Seen in **Table 1** is a spec sheet of an actual Dodge WC-54 model. Unlike the Ford Model T, the Dodge World War II models enjoyed the luxury of a battery ignition system as opposed to the manual crank starters of the Model T.

TM 9-2800

STANDARD MILITARY MOTOR VEHICLES

AMBULANCE, ¾-TON, 4 x 4

Technical Manuals: TM 10-1531. Parts List: SNL G-502

Manufacturer: Dodge Brothers Corp. (Div. of Chrysler Corp.)

RA PD 66315

Classification: Standard

Purpose: To transport sick and wounded personnel.

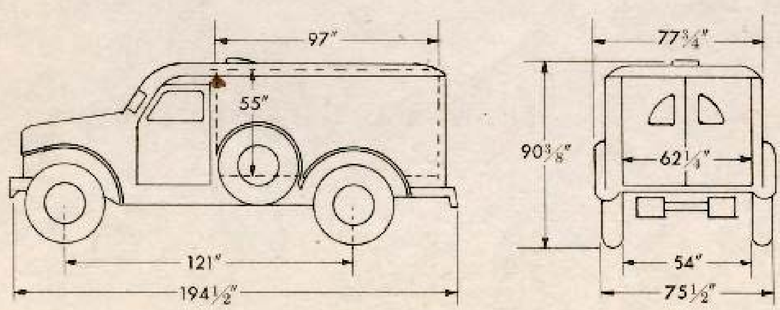


Figure 2. WC-54 Brochure, Page 1

Table 1- WC-54 Brochure, Page 2

TM 9-2800

SECTION XI—AMBULANCES

AMBULANCE, ¾-TON, 4 x 4

GENERAL DATA

Crew			2
Weight	Net	(lb)	5,920
	Payload	(lb)	1,800
	Gross	(lb)	7,720
Shipping dimensions	(cu ft) 790	(sq ft) 105	
Tires	Ply . . . 8	Size . . . 9.00 x 16	
Tread, center to center		(in.)	64¾
Ground clearance		(in.)	10⅝
Electrical system		(volts)	6
Capacities	Fuel, 72 octane gasoline	(gal)	30
	Cooling system	(qt)	8
	Crankcase (refill)	(qt)	5
Brakes		Hydraulic	

PERFORMANCE

Maximum gradability		(percent)	54
Turning radius (ft)	Right 24	Left 26	
Fording depth		(in.)	34
Angle of approach		(deg)	53
Angle of departure		(deg)	24
Fuel consumption, average conditions		(miles per gal)	8
Cruising range, average conditions		(miles)	240
Maximum allowable speed		(mph)	54
Number of speeds forward			4

ENGINE

Manufacturer	Dodge	Model T214	
Type	In-line, 4 cycle	Number of cylinders	6
Displacement		(cu in.)	230.2
Governed speed		(rpm)	3,200
Brake horsepower			76
Ignition type		Battery	

ADDITIONAL DATA

Figure 2 and **Table 1** show that these Dodge models were updated in terms of the time.

Engineering development was in progress as variable such as dimension, weight, and economy are being considered. This is in important progression towards the improvement of ambulance efficiency and safety.

Aside from war ambulance models, far from the battlefield, developments and transition phases were also stirring in the civilian scene. The same new thought processes were developing as engineers searched for efficiency in transporting patients in need of emergency care. Many options were explored during this movement and will be discussed in detail in the following section.

2.2 The Conversion Era

The first era of ambulance development to be discussed is the aptly named "conversion era." This time period of ambulance development is thus far the longest period of creation and development for a certain style ambulance to date. Starting in the early 1900's and ending in the 1980's this period typifies what is known to anyone over the age of 40 as the hearse ambulance era. The major turning points occur mostly due to legal documents, brought about by cataclysmic EMS events that highlight flaws in the ambulance design, which limited specifications in development. However, this discussion will focus on the time when civilian car chassis (not truck chassis) were converted into ambulances through use of hearse design. The basis of design during this time period revolved mostly around adapting car chassis into ambulances through hearse design. Therefore, many hearse companies developed both hearses and ambulances due to the extreme similarity between the two. The minor differences came in fitting patient support devices, mainly cots, as well as possible attendant seats and medical kits in the rear of the vehicle. Of course, as progress was made continuously, the car chassis evolved and with it hearse and ambulance design. The majority of ambulances seen during this time period were essentially hatchbacks of the time period with elongated rear sections for fitting a patient. An example of this can be seen in **Figure 3**:

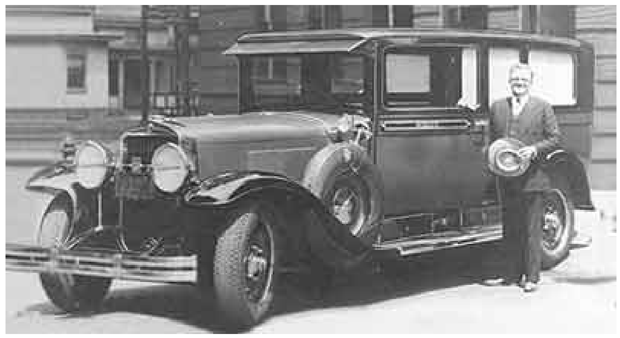


Figure 3 – Standard 1920's Coach

As seen in **Figure 3**, the ambulance of the time was largely similar to a standard car. This was largely due to motorized vehicles still being in the infantry of development during the early 1900's. Typical of pre-1920, developers built ambulances on chassis such as the Ford Model T or the Model 774 Automobile. This caused the majority of ambulance specifications to be identical to their standard car and hearse counterparts which in turn caused the ambulances to have the same flaws as them too. This included but was not limited to: tire failure caused by poor design (pneumatic), typical mechanical failure due to lack of knowledge in motorized mechanics, and an extremely bumpy ride due to lack of adequate suspension systems. Essentially, in order to compensate for the extra weight added to the hearse/ambulance models, companies would order the chassis with beefier steering and suspension. This reflected the overall demand for ambulances going forward and still exists today (smoother ride, more space for patients and ambulance personnel).

As far as a timeline goes, the birth of the motorized ambulance began in 1912 with the Model 774 Automobile Ambulance developed by Son & Company of Rochester, New York. The ambulance itself was the first mass produced ambulance. Its design featured 32 horsepower, 4 cylinder internal combustion engine, pneumatic tires, electric lights, a suspended cot for the patient, two attendant seats, and a side mounted gong.   From this stage forward, ambulance manufacturers developed ambulance specific features throughout the next six decades. Major improvements in ambulance design include: warning sirens and lights added mostly in the 1920's but improved upon in the 1930's, specific aesthetic design and styling improvements involving the module paneling as well as the front end of the cars in the 1930's, and typical car suspension and chassis improvements (lighter weight, shock absorbers, etc.). One of the first major companies to display many of these improvements and keep up with their customers' demands is the Automotive Conversion Corporation.

2.2.1 Automotive Conversion Corporation

The first company to be examined will be the Automotive Conversion Corporation. The company was a small coachbuilder that specialized in converting standard cars into ambulances and hearses. One of their major car models over the years was the Amblewagon. Originally the Amblewagon was converted on a Ford or Mercury chassis outfitted with a long list of accessories to accommodate patient care. These features included: Shades for the rear doors for privacy, removable frosted Plexiglas inserts, ambulance light flashers, siren, mounted ambulance lights on the grill and roof, a collapsible gurney, and custom-built interior cabinets.

In 1957 Ford introduced a new model with an improved tailgate design: the Ford Courier [45]. This forced Automotive Conversion Corp. to follow suit in order to keep their ambulances compatible with the Ford model. This compatibility depended on the modification of the rear door, a 9-passenger middle seat, and the removal of the tail and lift gates. Once ordered by the customer, ACC would then retrofit a new tailgate on that was larger (3 ½" to 5") to allow for more headroom [45].

In the late 1950's, the Amblewagon was a very affordable conversion ambulance. Converting most of Ford's models and keeping up with their new innovations, the company managed to keep conversion prices below $1000 [45]. Newer models during the decade included Ford's Edsel Station Wagon as well as the Edsel Villager, Roundup, or Bermuda. Also included were Mercury models of the time. Through the end of the decade, these models could be converted easily by the company from standard cars to either ambulance or hearse models. Essentially this allowed convenient retail to small towns in both rescue and graveside situations. This also allowed for towns to dispatch solely ambulatory cars to transport patients instead of relying on the funeral homes and their vehicles. The key component to the Amblewagon (and Arlington model discussed next) was that the models could be converted from ambulatory duties to stock car orientation within 5 minutes. The Amblewagon continued to be sold until ACC finally closed its doors in 1979 [45]. An example of a 1958 Edsel Amblewagon can be seen in

Figure 4 –

Figure 4 – 1958 Edsel Amblewagon

In the 1960's, ACC truly expanded to a company of affordability and flexibility when it came to car chassis model conversions. The company expanded its list of possible conversion chassis from mostly Ford and Mercury to Ford, Mercury, Chevrolet, Pontiac, Plymouth, Chrysler, and Dodge. Still remaining its biggest asset, the Amblewagon remained the conversion of choice for the company and along with the removal of the tailgate retrofitting (to save even more money for the customer), the company continued to sell Amblewagon models through the decade. In addition to the Amblewagon, a new conversion model, ACC introduced a new model to its line-up: the Arlington as seen in **Figure 5 –**

Figure 5 – ACC Arlington

The Arlington differed from the Amblewagon in that it included removable landau bar-equipped rear window inserts, a small cabinet, integral bier-pins and rollers for the curtains and patient gurney, and air-line style rear window drapes [45]. Like the Arlington, the conversion was capable of both funeral home as well as ambulance transport duties. However, the difference came in that it could perform first-call car duties on top of being a pallbearer's coach and a flower car. Therefore, the Arlington offered even greater function flexibility that the Amblewagon while still remaining affordable. The model, aside from typical car chassis adjustments over the years, didn't see much evolution n aside from vanity and aesthetic upgrades through 1979 when the company closed for good.

The next model ACC developed was the Rescu-All. This model was much different from the others in that it was designed around a GMC Suburban truck chassis (as seen in **Figure 6**).

Figure 6 – ACC Rescu-All

The truck was well equipped for rescue duty and due to the increase in space was equipped with all of the ambulatory warning lights, headlight flashers, medical cabinetry, an attendant's seat, full-size stretcher, frosted Plexiglas rear window inserts, and a siren [47]. This model was very helpful (although rather expensive compared to the other models) in that it allowed for more versatile rescue missions to be undertaken by rescue crews. This was mostly due to the flexibility a truck chassis ambulance offered. The Rescu-All was developed from 1959 to 1979 [47].

Automotive Conversion Corporation continued to develop ambulance models until 1979 when the EMS Systems Act was enforced. The EMS Systems Act was enacted in 1973 but did not require all automobile-based ambulances be taken off the roads until 1979 at which point ACC simply could not develop competitive models in the newer truck chassis modular design business.

2.2.2 Holcker Manufacturing Company

The next company to be discussed will be Holcker Manufacturing Company. The Holcker manufacturing Company had its home base in Kansas City, Missouri and developed from a buggy business based out of Crestline, Ohio. The business originated from three German brothers in the buggy business to make money for their family: Jacob, Charles, and Louis Holcker [47].

The business started in 1888 in an abandoned church in Kansas City, Missouri at the corner of Eighth St. and Grand Ave. While Louis and Charles ran the buggy business out of Crestline, Ohio, Jacob continued to expand the business in Kansas City. Eventually evolving into a carriage manufacturer, Louis' son Otto Holcker took over when he retired in 1909. After becoming a carriage body builder, the company filed for bankruptcy in 1916 after heavy expansion starting in 1910 that could not be financed. The company reorganized under the name Holcker Manufacturing Co [47].

By this time, the hearse was becoming a popular model amongst the population. The company therefore began manufacturing a small number of hearses for the surrounding area and Kansas City itself. An example of one of their more popular models (Holcker Studebaker) can be seen in **Figure 7**:

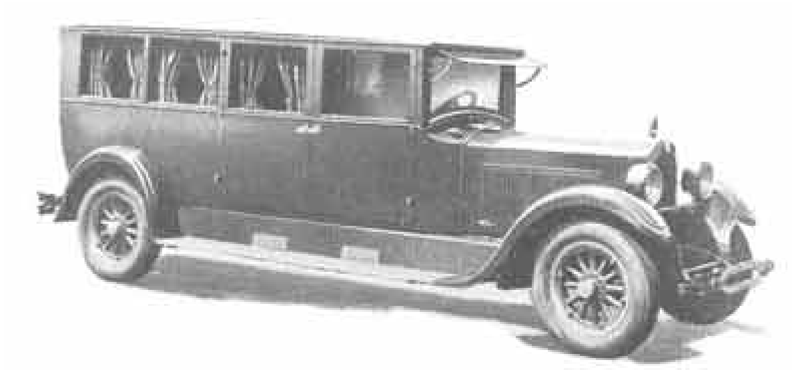


Figure 7 – Holcker Studebaker

These early Holcker models were built on long wheelbase Peerless chassis until the early twenties. The company then began using Dodge chassis for funeral car development. Throughout this time period there was a limited number of hearse models developed that the company converted to ambulance models. The company essentially mirrored its hearse and ambulance development with the hearses and ambulances of the time such that their models were comparable to other companies' model ambulances. In 1923, the company acquired another 15,000 square feet of manufacturing space essentially doubling its capacity to churn out funeral hearses and ambulance models [47]. By 1925 their ambulances had developed into a limousine-style hearse (as seen in the image above). Fully enclosed tops became the new standard for these models.

In addition to acquiring more manufacturing space, Holcker Co. became the new distributor for DuPont's DUCO furniture in their models. This allowed for a new level of finesse and beauty in the civilian coaches. However, this was only an aesthetic upgrade for the ambulance models considering the rear seats were removed to make room for casks and patients. The ambulance model eventually evolved into the popular landau=style Graham Brothers hearse.

At the time the company was building on Dodge, Graham Brothers, Buick, Hudson, and Studebaker chassis.

In 1926, Louis Holcker passed away and Otto and Clyde (his two sons) assumed control of the company. Clyde ran a separate part of the business dealing with the production and sales of high-pressure air and hydraulic tanks for airplanes. Otto continued the coach business. The tank business was eventually sold to Aircraft Products Corp. Eventually their coach body development was abandoned in the late 1920's for the more profitable DUCO furniture branch. The brothers' last legacy on the business was an automobile furniture dye by the name of Dyanize. Otto and Clyde Holcker passed away in 1940 and 1941 respectively [47]. The business was passed on to Otto's wife Doris.

2.2.3 National Hearse and Ambulance Company

The next company to be discussed is the National Hearse and Ambulance Company. Originating in 1853, the company was started in Waterville, Ohio as a buggy and carriage building company [43]. At the time the company went under the name the Shop of Siebert and produced reputable carriages and buggies. Once their reputation spread, the company began production of commercial quality carriages and hearses in Toledo, Ohio and Detroit, Michigan. After the first few decades of carriage, wagon, and hearse manufacturing, the company began production of motorized vehicle bodies in the early 1900's and even produced a model of their own called the Siebert between 1911 and 1916 [43].

The Siebert was offered in two configurations. The first was a 2-cylinder, 5/8 ton model while the second was a 4-cylinder 1-ton model. Soon after initial sales in 1911, a third model was added to production [43]. This model was a ¾-ton, 4-cylinder truck. All models of the time were built on three speed transmissions and a chain drive. Following the popular success of the Ford Model T, the models produced by the company fell out of favor by the general public and as such were discontinued.

After losing production wars to Ford, Siebert began what was typical of carriage/vehicle manufacturing businessmen and women of the time: converting old models as well as the most popular current vehicle models into hearse and ambulance capable cars/trucks. By the late 1920’s, after basing company sales out of Toledo, the company chassis of choice was the Ford A and the Ford AA although Chevrolet, Dodge, and Graham chassis were also fitted with Siebert bodies. In 1933, Siebert entered into an exclusive agreement to use Ford chassis for all his vehicles [43].

The process through which the bodies were converted is not all that complicated. Starting with the typical V8 sedan, the B pillar was cut and the frame was extended by either 24” or 36” depending on the customer’s order. After which, the rear door was fitted with front-opening “suicide” door hinges, added on to the C-pillar of the truck. The cost of the typical ambulance model sold at this time by Siebert was $1470 [43]. The theorized kit used when extending the Ford chassis is the W.G. Reeves conversion kit. This was possibly due to low profit margins of the company at the time, too low in fact to produce their own bodies for conversions. These kits were made specifically for Ford Model A, AA, B, and BB as well as the Model 40 and Model 46 passenger cars available in 24” and 36” extension configurations. Also offered by the company at the time was the Ford Sedan Bus. This bus was converted through standard means while four extra doors were added to the extended 190” chassis [43].

In the late 1930's before World War II, Siebert began production of the new Ford Aerodynamic models. These Deluxe V8 eight door sedans were very popular due to the new styling. The conversions were especially stunning and therefore increased in popularity as time passed. The models sold at the time were also very cost-effective, proving to be a viable option to the cost-conscious businessman.

Progressing into the 1940's, Siebert continued using the same stretching techniques for the ambulance models being produced while maintaining the company's exclusivity deal with Ford. Once the war started, popularity grew immensely for their long 15'passenger eight-door coaches due to the need to transport thousands of war workers to their destinations. After the war took its toll on the economy, the company continued production on whatever chassis they could find including the Ford ½ ton truck pick-up chassis. At this time, the company also changed all of the Ford model insignias for each model over to their "Siebert" nameplates with Siebert script writing [43].

By mid-1947, the company under Siebert's leadership opened its doors to Mercury vehicle chassis development and conversion. The typical stretching methods of converting the models were still in use during the time although it was expanded to include Ford and Mercury four-door coupes. Due to the supply and demand of the post-war United States economy era, the market was rich with people willing to buy. Therefore, Siebert saw an increase in demand of all models across the board (including ambulances). This included the long wheelbase multi-door transport limousines for resorts and airport use.

In 1950, Siebert introduced new models to accommodate for the newly styled Ford vehicles. The Leeds was a particularly noticeable ambulance of the time. The Leeds was a fastback 4-door ambulance with a sloping rear roof and quarter window built custom for the ambulance model. The extra stretching was achieved by using a stretched 4-door passenger car chassis. The suicide doors seen in the early 1930 models still remained on the converted ambulance models. In 1951, the company modified the rear roofline to look similar to the Ford Ranchwagon [43]. Siebert also included Jeep chassis in the list of chassis to build on, offering the Willys S.O.S. Ambulance. This Ambulance was built on a lengthened wheelbase and had a reduced cost compared to other ambulances of the time.

In the late 1950's, Siebert company retained a brisk business, also initiating the production of conversion models using the Edsel Villager chassis, not to be confused with the Edsel Amblewagon. This model was custom built and only one remains in existence today. The company continued into the 1960's providing standard limousine and transport vehicle conversions. Ambulance development ceased when the business proved to be too lucrative to gain any sort of reasonable profit [43].

2.2.4 Owen Brothers

The next analyzed company on the list is the Owen Brothers Co. Owen Brothers Co. started out as a restarted Palmer & Owen Co. of Lima, Ohio [46]. Founded by Merrill David Owen and John B. Palmer in 1899, the company was a successful carriage builder for the late 1800's and early 1900's (pre motorized vehicles). In 1902, when the company officially changed its name, David (Merrill) Owen's younger brother Robert D. Owen was brought in as the firm's first superintendent [46]. Together with their blacksmithing backgrounds they formed the backbone of the leadership of the company.

John B. Palmer was born in Columbus, Indiana in 1859. At 14 years old. John became the apprentice of the famous carriage builder James Cunningham of Son & Company. After completing his apprenticeship and travelling to the majority of the major carriage building companies across the northeastern United States, John Palmer met Merrill David Owen at the H. Kaiser Kenton Carriage Works in Kenton, Ohio [46]. After marrying his boss's daughter and losing out on inheriting the carriage company from his father-in-law, John Palmer decided to enter into the carriage business with Merrill Owen. The two together started the Palmer & Owen Carriage Co. in the middle of Lima's historic town square.

Merrill Owen was born in 1870 in Kenton, Ohio. Entering the business world as a young blacksmith at the Champion Fence Company of Kenton, he quickly rose through the ranks and eventually began work at the prestigious Pool Brothers carriage manufacturing company. After transferring to the H. Kaiser Kenton Carriage Works a few years later, Merrill found love and moved about Ohio finally settling down at Collins Buggy Co. in Akron, Ohio. Eventually Merrill Owen found himself in Lima, Ohio and entered into a partnership in 1899 with John Palmer to start the Palmer & Owen carriage building company [46].

The company grew quite quickly, maintaining the Palmer & Owen name until 1902 when, after finding an inventor and engineer (John W. Swan) to spearhead their vehicle development, the company hired Merrill's younger brother Robert Owen to be the company's first superintendent. After the re-organization of the company under the new name, the brothers opened up a major dealership to sell their cars, located in Lima, Ohio, known as the Lima Motor Car Company. Everything was going according to plan until November 1727th, 1905 when a gas leak explosion caused major damage to the company facilities [46]. The explosion was caused by an accumulation of gas in the underground storage compartments of the manufacturing building and went unnoticed for days. The gas eventually reached the blacksmithing forges and exploded on contact with the flames. Robert Owen was badly burned about the face and a painter, also severely injured, sent from the second floor to the pavement below. The majority of the other employees escaped unscathed. However, the damage was done.

Eventually recovering from his injuries, Robert Owen and brother Merrill re-organized the company (again) under the name of Owen Brothers Carriage Co in 1906. Excited and full of ambition, the brothers touted their company would bring the best carriages to one of the best cities on Earth. Under their direct supervision, the company building was built and maintained much more tightly than the previous. This new operation was done with efficiency and cost-effectiveness in mind. As both brothers were artisans and handyman of many years in the business, they knew what they needed and how things should be built in order to maintain low costs and quick turnover.

In 1916 the Company began taking on funeral home hearse work as well as work on ambulance conversions. To the customer's request, the company would build a hearse type model, converting to either a hearse or ambulance configuration by removing the rear seats. The company specialized in Cadillac, Buick, and Cole chassis. These hearse/ambulance conversions were based off a limousine-style coach. The models typically were 50 hp, 6-cylinder chassis with a 143" wheelbase [46]. By 1919, ready-made coaches were made available on Buick or Cadillac chassis. The company also converted horse-drawn buggies to motor vehicles using requested chassis. Some combinations didn't work although some did and turned out to be remarkably functional.

Also in 1916, the company relocated to a newer building built specifically for them in town. The move was necessary as the company started to outgrow its old building with the expansion it had undergone due to increasing profits and demand. The building gave employment to many townsfolk and businessmen alike, numbering around 50 (good for the time). The Owen Brothers Company also was estimated to convert one hundred and twenty-five hearse and ambulance models a year. This was a good average considering ambulance and hearse design was relatively new to the era.

In the early twenties, the Owen Brothers catalog contained within it a full spread of limousine coaches and sedan-type ambulances on Cadillac, Dodge, Nash, and Studebaker chassis. An example of two types of these models can be seen in **Figure 8** and **Figure 9**:

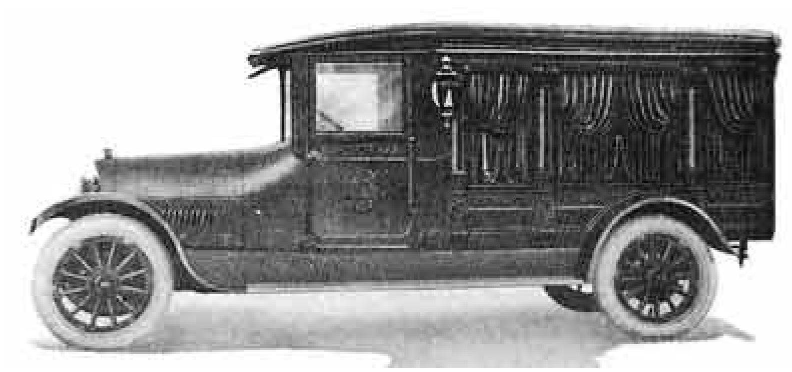


Figure 8 - 1920ReoOBhea

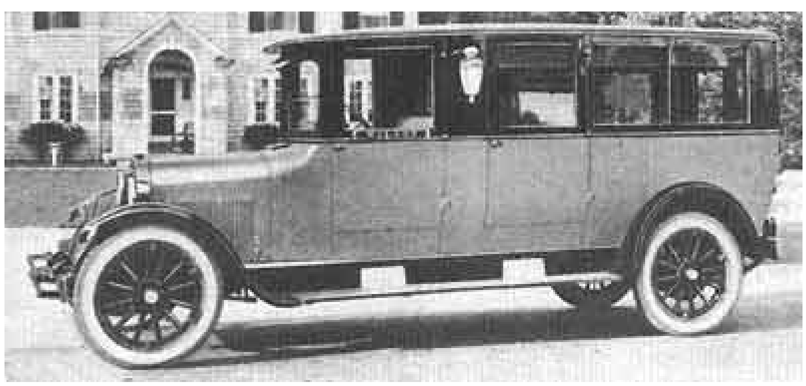


Figure 9 - 1927DodOBcomb

These were all offered as hearses and ambulance-hearse conversion models. By the late twenties the company's models looked outdated and were not keeping up with the styling of the time. Therefore the Owen brothers rethought their design and conversion technique in order to develop more modern looking conversion models. With the introduction of the re-designed hearses and ambulances came a low (not as low as the major production company's cars) and long coach. This coach had tiny coach lights, leather back styling and in their top of the line funeral/ambulance conversion car there were large arched windows from front to rear featuring well-designed carvings on the top edges. The coaches also had Gordon spare tire covers. Any of these models could be converted between rear and side loading coaches with an optional Eureka 3-way casket.

On October 29th, 1929, the younger Owen Brother, first superintendent of the company, Robert D. Owen, 59, passed away from a sudden heart attack [46]. Having been a partner for 22 years, the firm was in short straights for a while until Merrill Owen decided it was time to enter into a deal with Reo Motor Car Company. This deal essentially was a new start for the company after losing one of its major leaders. Expected to triple its payroll, the company underwent big expansion through the early 1930's. As demand increased, so did the company's production. This in turn was the cause of relocation. The company moved to what is now 111-121 S. Central Ave. The building was a three-story brick building offering a greatly expanded space for work to be conducted in. The building was also outfitted with the latest technology in ambulance and hearse building, ensuring the highest quality and efficiency with the product. The new machinery also assisted in the increase in volume of the conversion models.

Later that year, two funeral/ambulance conversion cars were delivered to the Reo Company in Lansing, Mich. where they were exhibited in front of 500 Reo dealers [46]. The cars were then shipped to New York City where they would be exhibited once again in front of major Reo dealers from both Canada and the United States. These new models were top of the line production conversions with state of the art equipment allowing for high sustainability and extremely rough durability under workload. These conversion bodies were capable of being placed on just about any chassis.

The Depression took a big toll on the company especially when it ended its contract with Reo due to the discontinuation of conversions on 152” chassis [46]. In order to stay afloat, the company performed general auto repairs, commercial work, and remounting older chassis with new bodies. The gem of Merrill’s work however came when he developed a design for two side mounting ambulance models constructed in 1936. In order to achieve the proper design, the cars were cut in half behind the B-pillar (like any typical conversion of the time) and a center section was inserted. The cars were then painted white and the doors within the center handcrafted section were modified to allow for side loading of patients or casks. After this time the Owen Brothers conversion company remained in business however ceasing the production of converted ambulances and hearse models, mostly performing regular auto repair and paint work.

2.2.5 Pinner Coach Company

The next company in line is the Pinner Coach Company. This company sees its roots in the Comet Coach Company of Memphis, Tennessee [41]. Essentially selling its name to the Ford Motor Company in 1961, the owners moved to Blytheville, Arkansas where they had recently overseen construction of a new manufacturing plant [41]. During this move, one of the owners of the company, Jack W. Pinner, decided to stay in Memphis and rename the company there to Pinner Coach Company.

Pinner Coach Company’s office location was at 4022 East Mallory Avenue in South Memphis whereas the manufacturing plant was located ten miles southeast in Olive Branch, Mississippi [41]. The company typically converted ambulances on Pontiac, Cadillac, Chevrolet, Chrysler, and Ford chassis. Long wheelbase Pinner vehicles (typically 22" extensions) featured high rooflines, commercial glass windows, airline-style drapes, and wrap-around rear corner windows. Short wheelbase Pinner vehicles were typically lower in nature and did not contain the rear corner wrap-around windows. At this time the typical cost of conversions was around $1000 for a high-top station wagon [41].

The company's vehicles were almost always limousine style ambulances with a few dedicated funeral coach and landau-style coaches built from time to time. In 1962, the main manufacturing factory for the company was moved 25 miles southeast of Memphis to Victoria, Mississippi. The company remained here supplying for fewer and fewer dedicated customers each year, eventually going off the radar of the competitive ambulance/hearse business around 1965 [41]. The last known vehicle produced was a 1968 Cadillac ambulance with high-headroom and roof warning lights.

2.2.6 Rock Falls Manufacturing Company

The next company to be discussed is the Rock Falls Manufacturing Company. Both this company along with the Eureka Manufacturing Company sees their origins in a man named Thomas Galt. Born in East Earl, Lancaster County, Pennsylvania on January 13th, 1828, Galt began his path to coach manufacturing with an education in a roadside school near his farm [48]. In 1855 after his schooling, Galt formed a hardware store with David Crawford, aptly named Galt & Crawford. In 1857, Galt bought out his partner's share in the hardware company and brought in his brother to re-establish the company under the name Thomas A. Galt & Brothers. In 1863, Galt became associated with a man by the name of George S. Tracey to partner with him and create a farm machinery company named Galt & Tracey, taking the company to a much larger scale than previously seen.

In 1867, after a few successful years manufacturing farm machinery, a tragic fire broke out in their factory effectively destroying it and causing a large amount of damage ($30,000 worth) in losses [48]. The firm relocated to a facility in Rock Falls, Pennsylvania. This relocation allowed for the assessment by the company's owners that their machinery was slowly growing out-of-date. As such, the company decided to research and develop/manufacture water-powered machinery. This technology was the up and coming technology of the time.

In 1870, the company was reorganized as the Keystone Manufacturing Company with the head officers of the company being Thomas Galt, George Tracey, and J.B. Patterson [48]. These three men also formed the Sterling Manufacturing Company in order to compete in a different sector of the business world at the time. Throughout the next twenty years, the company sold many farm machinery products with the most popular and most exhibited machinery being their Hay Loader, Combined Corn Husker & Fodder Shredder, and brand Disc Harrow. Due to their popularity and growth in the business as well as their desire to support the company's western customers, a satellite shop was set up in Council Bluffs, Iowa. The company also participated in the 1893 World's Columbia Exposition in Chicago.

Moving back in time to examine another influential person in the creation of the Rock Falls Manufacturing Company was Augustus Smith born in 1831 [48]. Born in Cobleskill, New York, he eventually became part of one of New York's largest leather glove businesses. After working in the leather glove business for some time, Augustus created a new settlement on an isolated region of land by Rock Falls with the help of Sterling Hydraulic Company. After pursuing the glove business for many years, Augustus Smith found himself amidst the rebirth of a company in transition, namely the Keystone Company's reorganization to the Rock Falls Manufacturing Company. Negotiations were then formed between the neighboring town of Sterling and Rock Falls such that the First Avenue Bridge was built to connect the two. Supplies were brought in by raceway and water power via the Rock River Dam.

After establishing the Rock Falls settlement, Smith made arrangements with the firm Galt & Tracy, which as previously mentioned had burned down the previous year, and incorporated them in the settlement as the first industrial residents of Rock Falls. Now the pieces were brought together and as one united front, Galt, Smith, and James A. Patterson created the Rock Falls Manufacturing Company.

The company originally started with five hearses and funeral cars in the range of $400 to $2000 most noticeable among the bunch being the World's Fair Car [48]. Another noticeable car was the "Sterling" with a rich elegant appearance. After exhibiting their initial production line, the market picked up and a second building was built next door to the initial building in 1895. After some misfortune surrounding the leadership of the company, Thomas A Galt along with Rock Falls' assistant treasurer W.A. Roe located a suitable leader for the company in a Chicago man by the name Chauncey R. Hardy [48].

Chauncey was an ambitious man with ambitious workers working under him. Two of the woodworkers would receive medals for their outstanding craftsmanship among the cars exhibited at the Louisiana Purchase Exhibition. The company's products would continue to be praised amongst the hearse and carriage market and eventually upon the emergence of ambulatory services the company decided to start developing their own ambulances. Starting in the early

1900's, the Rock Falls manufacturing company began development of their own electric ambulances. These ambulances contained a front sliding door, showing side door, typical carriage hearse body, and a short wheelbase with electric chassis [48]. These ambulances had the capability of escorting and treating three patients at a time and the attendant's seat could be converted into a cot if needed. An example of one of these models can be seen in **Figure 10**:

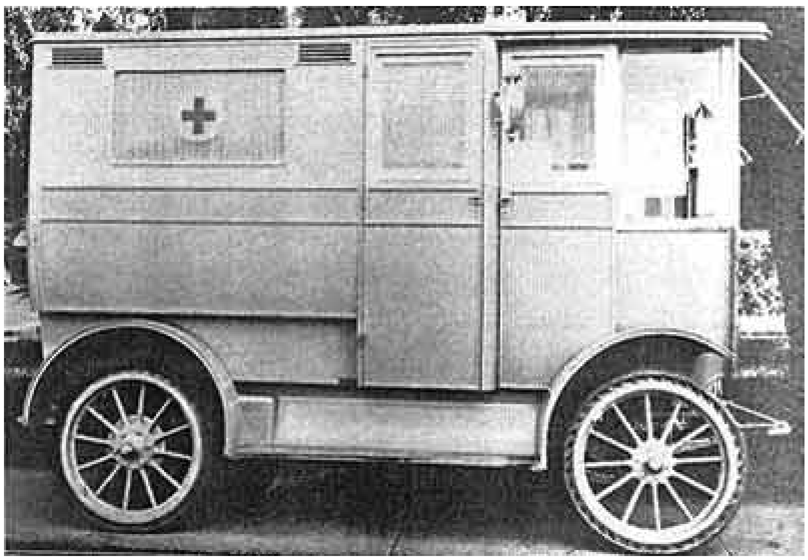


Figure 10 – Rock Falls Electric Ambulance

In 1915, Galt's son Edwin Galt Brookfield joined the business. Upon entering, he quickly rose to the top becoming the president of the business. After becoming president, he had the company's ambulance chassis developed by Velie for more suitable purpose-built ambulances. These chassis would continue to be built on into the 1920's. By 1920, the company was using limousine-style ambulances with side-entrances and a leaded-window treatment [48]. Also manufactured in this time was a one and a half ton truck still based off the Velie-provided chassis and maintaining similar specs to its carriage-limousine ambulance brothers. This truck was effectively priced at $1000 more than the assembled coach models.

An example of an owner's reaction to the ambulance model in 1923 can be seen here:

> "The ambulance is completely equipped. The interior contains a steel moveable cot on rollers. There are two comfortable side seats for those accompanying persons taken in the ambulance. Two cabinets are provided for carrying first aid materials. The car is automatically heated by the motor of the engine and an even temperature is maintained as the result of a thermometer installed for that purpose. An electric fan is provided for use in cases where necessary. A speaking tube is installed for use in giving instructions to the driver. The inside is finished in oak."

At this time, Rock Falls Manufacturing developed ambulances for mostly city uses. This can be deduced from the paint job of each ambulance including a "City Ambulance" title as well as a new-to-the-time red cross (symbolizing ambulatory services). This can be seen in **Figure 11**:

Figure 11 – Red Cross Symbol

Car values were approximately $5000 for standard coach-limousine models. In 1921, the company hired an engineer by the name of Harry Crossland Pfaff with experience at previous car-manufacturing companies including Ford, GM, and Maxwell. Pfaff began development of a new 2-cylinder steam-powered engine which would eventually see its debut in the Crossland automobile in January of 1923 [48]. The Crossland automobile was touted to have very high kerosene tank mileage in the range of 800 miles per tank of water and 500 miles on a tank of gasoline. In order to accommodate for the anticipated public orders on such an attractive car (for travelling folk), E. Galt Brookfield had a company created in its name: the Crossland Steam

Motive Corporation. However, the company failed to make it in the business with only a select few orders of the Crossland automobile. This failure would prove costly to the Rock Falls Manufacturing Co. Due to the financial drain that was the failure of Crossland Steam Motive Corporation; the Rock Falls Manufacturing Company eventually had to close its doors in 1925.

2.2.7 Acme Coach Company

The next company to be discussed is the Acme Coach Company. Existing for the short time period of only 5 years, the company saw its origins with a man named Donald Schultz [44]. Mr. Schultz owned a small body shop located in Sterling, Illinois on the north side of the previously talked about Rock River, across from the town of Rock Falls, Illinois. Due to increasing demand among the public for cheaper hearse and ambulance coaches, Schultz decided to build a few using Pontiac's sedan delivery car in the early 1950's. Increasing in popularity, the one-piece side-hinged rear door, blanked-in rear quarter paneled coach ambulance conversions were inexpensive and cheap and found a new home in Schultz's newly formed business, Acme Motor Company established in 1951.

The first official unit was a 156" wheelbase finished with a landau-style coach unit [48]. With the help of sales manager David H. Erby, the two put together a wide-array of limousines and landau-style ambulances for the company's catalog. The company's catalog also included hearse models, funeral coaches, combination cars, and sand and flower service cars all built on Pontiac's sedan delivery chassis. With such a wide array of cars, orders poured in from the consumer base causing the company to lease out a bigger building next door to its original location at 1818 North Locust St. In 1953 the company produced 90 coaches. However, this successful growth and expansion wouldn't last as it seemed the company's lifespan was doomed to be cut short when in late 1953, General Motors ceased the production of Pontiac sedans. This meant any small-time production companies of these models and its respective conversions would have to switch over to the more expensive station wagon model; an option Acme Coach Company didn't have the liberty of taking. The company lingered through 1954 and eventually closed its doors in 1955 despite the new Pontiac and Chevrolet models being available that year. It is suspected that the re-tooling cost of the plant to produce the new model conversions would have been too much for the already stagnant company.

2.2.8 Henney Motor Company

The next company to be discussed is the Henney Motor Company founded in 1879 by John W. Henney in Freeport, Missouri [39]. The first plant was built next to Freeport's main train track line on South Chicago Avenue. Most of the company's early business dealt with carriages and buggies but the company also developed funeral coach models typical of the time. This continued into the early 1900's when John Henney's son, John Henney Jr., took over the business becoming its superintendent. Theorizing an increase in popularity in carriages, John Henney Jr. expanded the business to a newer building filling up half a block for increased productivity. However, this was poor insight on Mr. Henney's part as the carriage business was fading quickly due to the increased popularity in motorized buggies. Attempting to convert the business to buggy building, John had the plant re-tooled for such a business. This proved lucrative as in 1915 the company liquidated and the building was taken over by Moline Plow Company.

This set-back didn't quell John Henney Jr's thirst of success however. In 1916, with plenty of money to his name, John Henney Jr. built a new business with the title of John W.

Henney Co. This building was also conveniently located adjacent to rail lines. The first models to come out of the company were originally truck and hearse models in 1916, built on a six-cylinder continental engine powered chassis. By the early 1920's, the company's name was the most well-known among hearse-builders.

The company continued to build truck chassis hearse models, most notable among the bunch in the year 1923 was the company's light-gray 12-column carved-panel funeral coach [39]. This coach contained giant nickel-plated disc wheels utilizing a Dodge chassis immediately following World War I. Unlike this model however, the Henney Co. offered a new funeral coach in 1924. This coach was a typical landau-limousine style, Meritas-bodied coach featuring nickel-plated landau bars with rounded rear quarters. Most importantly however, the company also offered a shorter wheelbase option model that was purpose specific to ambulatory services. In 1926, the company offered ambulance coaches including features such as choice of a single side-entrance for attendants, an extra wide double side door allowing easier access for cots, cycle fender styling, and shortened running boards with step plates beneath the doors [39].

In 1927, the business name was officially changed to Henney Motor Company from the John W. Henney Company. A year later, John Henney sold his interest in the company a year prior to the stock market crash of 1929. During the time when the stock market (and economy) was in a rut, the company sold extension taxicabs on Ford Model A chassis to remain afloat in the business world [39]. After this major time period in U.S. history, through the 1930's until about 1937, the company used mismatched engines and chassis to produce their models. An account of a local business man in the coach business can recall such a period in the company's history:

> "Chassis used in varying amounts during this period included Stephens (one assembled in our factory using a Continental motor), Velie/Buick/Auburn (using Lycoming motors), Pierce Arrow/Reo (a special car marketed by National Casket), Pontiac economy model, Oldsmobile - Progress Model."

Another account made from one of the company's spokespeople concerning the variety and mismatching of the building process can be seen below:

> "In addition we occasionally built a hearse or an ambulance on a chassis specified by the customer. This might be a Cadillac, LaSalle, Rolls Royce, Lincoln, Cord and others."

After this time, Henney Motor Company procured a breakthrough in the industry. After Mr. Henney himself witnessed the undignified approach to loading people into hearses and ambulances at the time (by backing the cars/trucks up into the curb), he decided he was going to develop a new model that would do away with such an antique of loading a body into the heart of the hearses and ambulances. Thus, the Henney 3-way was developed. An employee of the company at the time can be seen describing the 3-way development below:

> "Mr. Henney was repelled at the way hearses had to be backed up to the curb for loading, which he thought was much undignified. The 3-way idea was developed by a man named Heise out on the west coast, but Ed Richter perfected it. The 3-way feature added about $100.00 to the price of the car but Henney did very well with it. Henney was soon selling more than half the 3-ways in the industry, and we sold side-servicing equipment, including the mound, track and carrier to some of our competitors."

As seen above, the company was very successful in selling the 3-way style ambulance and hearse models. The company's other major model line, the Deluxe line, continued to sell unchanged as did their inexpensive Light-Six models [39]. These models were available in leather-back landau style roofs or a plain painted metal roof. Also available was the typical window styling: plain, frosted, leaded, or combination frosted/leaded.

In 1928, Henney was approached by the government to supply 23 ambulances to the United States Veterans Bureau for use in medical facilities. This proved to be good business and PR for the company. Following the governments contract, in 1929, the Henney line was re-designed to have swept front fenders, a longer lower body, and much wider front and rear doors to take full advantage of the 3-way style doors [39]. Then, later this year, Henney went on a smear campaign against Eureka, Meteor, and Sayers & Scovill companies in that they claimed to build original 3-way casket mounts in their hearses. Henney was eventually sued by the respective companies however Henney Co. won an injunction against them and in turn prospered [39]. This showed to be even more of a difficult trial for the losing companies in that Henney Co. was contracted to supply REO-chassis coaches to the National Casket Company who had just cancelled their contract with Kissel due to Kissel being supplied caskets by Eureka.

2.2.9 Memphis Coach Company

The next company to be discussed is the Memphis Coach Company. This company was more of a modern company in relation to the previous few that have been discussed. The main time period for economical growth for this company exists between the 1940’s and the 1960’s [49]. The Memphis Coach Company had its origins in Memphis Tennessee during its lifespan as a coach/hearse/ambulance building company. The owner of the company was a J. K. Barnett [49]. The company is best known for their Edsel, Pontiac, and Desoto long-wheelbase ambulance conversions.

The Memphis Coach Company started like any other upstart company during the 1940's. Mostly performing body work and repairs on coaches of the time, the business was small but lucrative. After experience in the repair business for a few years, the company eventually picked up steam in the mid 1950's [49]. One of the company's typical models can be seen in **Figure 12**:

Figure 12 – Memphis Coach Company Economy Coach

Sometime during 1955, J.K. Barnett officially organized the coach building firm as the Memphis Coach Company after a previous firm owner left him to lead the company. At this time, the company was using an inherited styling based off a 1955 Economy Coach [49]. This coach featured stamped stainless-steel upper door frames, flat commercial side glass, panoramic rear corner window options, and an almost unlimited number of chassis options. Among those options were chassis from Chevy, Chrysler, Ford, Mercury, Plymouth, and Pontiac.

In the late 1950's, Memphis was known to be one of the two coach building companies to have built Imperial professional cars; the other company being National of Knightstown, Indiana [49]. The company was especially known for its 1958 Imperial ambulance which ended up in an ad in the Yellow Pages. The ad proclaimed the company used Desoto and Imperial ambulance conversions exclusively. Some of the defining features at the time of their Imperial models were: signature roofline, stamped-steel door frames, commercial side glass, and quad tunnel lights. Also claimed by customers were the distinctive coaches Memphis Coach Company would build using Desoto chassis and selling through Desoto dealers. The most exclusive of this bunch was the 1957-1959 long wheelbase Memphis Coach Company profession car, typically stretched to a 150" wheelbase using Firedome, Fireflite, and Firesweep 4-door sedan models [49]. To achieve this sort of conversion, the leading edges of the rear doors were extended by about 12" as were the quarter panels on the car. The upper door frames were then welded to the lower doors with Memphis signature glass installation soon to follow. The glass sat between the new extensions and the also signature Memphis built metal roof. An image of a Pontiac Memorial Ambulance built using this process can be seen in **Figure 13**:

Figure 13 – Pontiac Memorial Ambulance

The ambulances produced by the company at the time had to be special ordered by the customer. Upon request, the Chrysler short-wheelbase Memphis factory built ambulance would have the aforementioned Firedome, Fireflite, or Firesweep 4-door sedan doors with special heavy-duty 7 to 9 passenger packages. This package was priced at $50-$100. The package would also include heavy-duty rear springs, shock absorbers, 70-amp battery, 40-amp generator, vinyl trim, and heavy duty torsion bars. All these additions in the package allowed for the use of more equipment in the rear as well as the ability to carry heavier passengers and payloads. The exceptions to these standard ambulance packages were a few 2-door sedans from Dodge and Plymouth as well as Chrysler.

In 1961, the company's typical model can be based off of its Memphian Pontiac ambulance. This ambulance was a 4-door sedan built for the US Air Force typically extended 24" but could be extended 36" as well [49]. The roof was of an unusual styling including a 48" high steel roof raised and placed on top of the standard chassis. The leading edges of the rear doors were extended a foot along with the leading edge of the quarter panels as previously mentioned. Pictures of a Pontiac version of this ambulance can be seen in **Figure 14** and **Figure 15**:

Figure 14 – 1960's Memphis Coach Company Pontiac Model

Figure 15 - 1960's Memphis Coach Company Pontiac Model (2)

The ambulance seen above is different than the ambulances from the time in that its unusually high roof allowed for much greater maneuverability in the rear of the ambulance or hearse. Again, this allowed for medics to tend to the patients with much greater comfort in comparison to the ambulances other companies of the time were offering. The firm remained in business until late 1961. At this time, sales seemed to fade away and the company lingered on stagnant in the ambulance/hearse selling business. Eventually Mr. Barnett sold the company's building to his other company by the name of Barnett Mechanical, specializing in water filtration, ice machines, and restaurant equipment.

2.2.10 Trinity Coach Company

The next ambulance company to be discussed is the Trinity Coach Company. This company can be considered a relatively modern car chassis ambulance company. Established in 1964 by a man named Joe W. Summers of the Summers Funeral Car Company, the company found itself in Duncanville, Texas at 606 Big Stone Gap Road [44]. The company was at this time, in essence, sponsored by General Motors.

Under the sponsorship of GM, the company built full Buick cars with new-car warranties using all new tooling machinery, although their cars were similar to National-Buick coaches. The difference between the two was the window frames. National used extruded bright metal frames whereas Trinity Coach Company used stamped, painted window frames. The angle of the door and pillars varied between the two companies as well. An example of a Buick Trinity model can be seen in **Figure 16**:

Figure 16 – Buick Trinity

This model is exemplary of both hearse models and ambulance models. The main difference between the two being simple markings on the car and the equipment inside of it [44]. The structure and body of the car as well as the chassis remained the same. Typically the chassis measured about 243" from end to end [44]. The names of the extended Electras from Trinity Coach were aptly named the Trinity Royals. In contrast, the standard wheelbase Wildcats and Electras were named the Trinity Triunes. Features in both included steel construction roof bow reinforcements and cost-reducing Plexiglas quarter windows.

The ambulance development hit a peak in the earliest stages of the company between 1967 and 1968. Unfortunately, while the business was rather lucrative in a local environment and customer base, the company lacked funding for a more national advertising campaign. As such, while other companies gained in national popularity, Trinity Coach Company fell out of favor and eventually went out of business. However, Mr. Summers retained part of the company, named the Summers Professional Vehicles Company, and it can still be seen today off I-35 South in Duncanville.

2.2.11 A.J. Miller Company

The next company to be discussed is a company by the name of A.J. Miller Company. The A.J. Miller Company was founded in 1853 by a man named A.J. Miller (accordingly) [45]. At the time he was both the president of this company as well as the Bellefontaine Automobile Company, both of which were located in Bellefontaine, Ohio. Throughout the late 1800's, much like many other start-up coach companies of the time, this company sold unique coaches to the public until the era of automobiles started.

Beginning in 1914, A.J. Miller Company began receiving automobile chassis from the Ohio Meteor Car Company, owned by Maurice Wolfe. During this time, the companies had an arrangement where Meteor would supply the chassis and the A.J Miller Company would apply the finishing touches, thereby leading the company straight down the path of ambulance and hearse conversions. This arrangement continued until 1917 when A.J Miller Company decided to go its own ways and develop/manufacture its own complete professional car.

In 1917, the typical Miller coach featured a six-cylinder engine mounted on a long wheelbase coach with approximately 52 horsepower available to it [45]. From this design, the company began production of converted chassis comprised mostly of hearse models with a few exceptions being both hearse and ambulance duty capable. An example of a chassis built in the late 1910's and early 1920's can be seen in **Figure 17**:

Figure 17 – 1920's A.J. Miller Company Model

The unique showmanship of the A.J. Miller Company can be seen in the shape of the rear windows. Typical of earlier models, less so during later development, these rear windows on both the passenger and driver side were typically made in an ovular shape, more profound than the competition of the time.

The 1920's marked a new era for the A.J. Miller Company. At this point in time, the company was building its Miller coaches on sturdy Studebaker Big-Six chassis, the cheaper Dodge commercial chassis, or on their in-house manufactured 55/75hp Continental chassis [45]. The company also offered a unique 7 passenger, 126" wheelbase, Studebaker ambulance, the interior and exterior of which can be seen in **Figure 18** and **Figure 19**:

Figure 18 – A. J. Miller Company Studebaker Ambulance

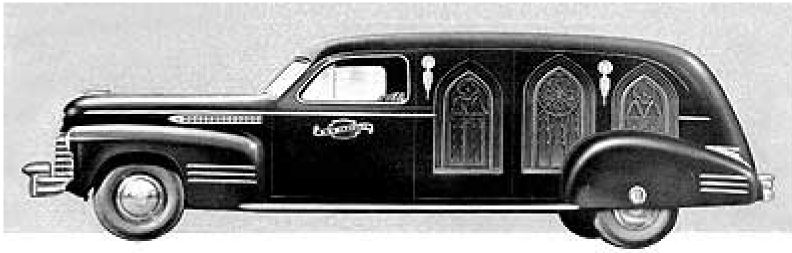


Figure 19 - A. J. Miller Company Studebaker Ambulance (2)

As you can see, this design allowed the A.J Miller Company cars to truly stand out as the unique wood paneling on the side exterior of the modular design was unique to this company. By 1924, the company introduced a limousine-style ambulance with landau-bar padded top on a Studebaker Big Six chassis which also feature the now standard disc wheels. In 1926 the company introduced a new chassis to its line-up: the extra-long 60hp Nash Advanced-Six chassis [45]. Particularly of note, is the features the typical Miller ambulance came with during this time: running water, rear compartment heater, medical storage cabinets, folding attendant seats, and collapsible gurney.

By the late 1920's, the A.J Miller Company adopted a new type of styling to their rear window panels. As seen above as well as below, the cars now began to generate buzz amongst the public as being highly attractable and unique due to the personal stampings customers could order for their Miller coach upon request. Another example of this type of stamping can be seen in **Figure 20**:

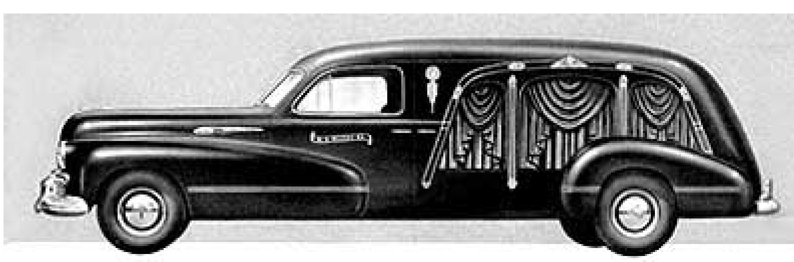


Figure 20 – Side Panel Detailing

As you can see between this picture and the previous one, the two cars have different stampings on the rear window panels. This proved to be a big marketing success for the company. Aside from that, nothing major changed in the cars, aside from minor chassis adjustments, through the rest of the decade.

After the Depression, beginning in the 1930's, the company slashed the prices on all of its models. This caused the A.J. Miller Company to display a long line of budget-priced, inexpensive, Nash chassis models. The price range for these cars was typically $2000 for a Miller-Nash funeral car to approximately $4600 for a top of the line Miller-Packard Chief funeral coach [45]. An image of one can be seen in **Figure 21**:

Figure 21 – Miller-Packard Chief Model

The major changes in styling occurred with the aerodynamics of the car. As you can see in the image, much of the front of the car is curved and more aerodynamic when compared to its earlier predecessors. These cars also feature a two-piece drive shaft and a 31'extension to the chassis. Most of these features came with the chassis provided by Packard and not much extra work was required by the A.J. Miller Company workers.

By the late 1930's, much of the design work was streamlined for the coaches of the A.J. Miller Company. The public seemed to be fascinated with the idea of stream-lining a car and became obsessed with coaches that followed this new notion of aerodynamics. As such, the designs were streamlined further and the company advertised as such. An example of the catalyst starts of this era can be seen in **Figure 22**,a 1934 Miller Art model Hearse/Ambulance model.

Figure 22 – 1934 A.J. Miller Company Art Model

As can be seen, the front end of the car as well as the general cabin area is much longer than the previous designs. Again this was due to the increasing desire of the public to get their hands on a "stream-lined" coach model.

In 1937, the company picked up a few chassis types from well-known businesses of the time. These included Buick, LaSalle, and Cadillac's, all of which came from the General Motors line of manufacturers. By 1938 the company had moved almost entirely to GM chassis although a few Chrysler chassis could be seen in the line-up [45]. Also during this year, the models finally came with side-serving doors cleverly disguised by the stamped steel paneling.

The 1940's proved to be big for the A.J. Miller Company. During the early 1940's the stylish shifted again to match public desire. This time, on a new torpedo-arched steel body frame, the company's models featured modern forward-sloping C-pillars as well as rear quarter panels. These, in combination with the stamped-steel body sill and floorboard, the steel bodies were guaranteed to be free from squeaks and full of insulation to keep the ride smooth for passengers. These models were mounted on Cadillac, LaSalle, and Oldsmobile chassis. Ambulances featured roof-top lights as well as rear interior heaters and air-conditioning. The air-conditioning however proved to be inconvenient to use and fairly expensive so few were ordered until after WWII when they became more advanced and cheaper. During the war, the company focused mostly on contract work typically building boat hulls, rather than the coach production it participated in the previous years.

After the war, Oldsmobile chassis became very unpleasant aesthetically speaking, ergo Chassis models were taken up as the new standard for the company. These models included rear fender skirts and optional automatic transmission. Pricing at the time was around $5000 and up to $7000 for fully equipped ambulance models [45]. This production continued until 1954 when the company was purchased by Wayne Works of Richmond, Indiana. The new firm was to be named the Miller-Meteor Coach Company. The manufacturing work was moved to Piqua, Ohio. The first coaches of the company, built on Cadillac chassis, were produced in 1957.

After the transition years for the company, the production continued through the 1960's following much the same trend as other coach manufacturing companies out there aside from the mostly Cadillac chassis line-up. Due to the 1973 EMS Systems Act, the company ceased production in 1979, producing 21 ambulances during the year of 1973 and a much reduced production of four ambulances in 1973.

2.2.12 Weller Brothers Incorporated

The final ambulance company to be discussed for this section is the Weller Brothers Incorporated coach manufacturing business. Like our previously discussed company, this company was located in Memphis, Tennessee and was in business mostly for the 1940's through the 1960's. The company was founded by two brothers named George and Harold Weller [42].

As with most pre-1980's ambulance companies, the Weller Brothers Incorporated coach building company started a rebuild and refinishing business. In 1922, Harold and George started their refurbishing business in the back yard of their Memphis home. Eventually gaining reputation and showing good craftsmanship, the two moved to an actual building dedicated to their business in Memphis a few years later.

The ambulance building for the company didn't really start until the 1930's and didn't pick up until the 1940's. In the 1930's, the brothers were converting mostly Chevrolet, Dodge, and Ford sedans and panel vans into ambulances and hearses. This combination of hearse/ambulance conversions was typical of all pre-1980 ambulance and hearse converting companies. The big order that started the manufacturing conversion period of the Weller Brothers Incorporated company was an order of many Chevrolet Civil Defense ambulances in 1939 [42].

Following this order, sedan deliveries were still built using Chevrolet Stylemaster 1508 chassis. The big thing with this conversion was that it could be used for 4 different delivery purposes: child's hearse, ambulance, flower car, or ambulance. This sedan conversion featured Hy-tex leatherette interior, linoleum floor, a folding attendant's seat, and Plexiglas windows [42].

In the late 1940's, the corporation completely re-styled their Dodge, Chevrolet, and Ford conversions. The new conversions had a much lengthened chassis, available in either limousine or landau-style car as was typical at the time. The big differences also came in which vehicles were converted. Originally starting on bigger vans and sedan models, the company now shifted its focus to a standard 2-door fastback that would be chopped in half behind the driver's door and converted using a 36' extension conversion kit unique to Weller Brothers Incorporated.

In 1949, an advertisement was posted about a statement made by one of its owners claiming the company furnished any unit for any make of car, further promoting the adaptivity and breadth of the Weller Brothers Corporation's line up. Also in this year, the corporation built a very attractive 1949 Lincoln Cosmopolitan Hearse and ambulance conversion. This model featured a standard 4-oor wheelbase, a 6' raised-roof, and a 12' body extension [42].

The company continued to manufacture hears and ambulance conversions into the mid-1950's and offered high-roof station wagon conversions specifically into the 1960's with most of them built on Chevrolet an Ford chassis. Military ambulance conversions were built mostly on Dodge chassis through the 1950's. The business remained until about the 1970's when the company converted itself back into a body shop like it was originally.

2.2.14 'Conversion Era' Conclusion

In conclusion, we see that the conversion era for ambulance development created the foundation for future ambulance evolution. Starting with the early 1910's we see the emerging of motorized vehicles and along with it specific function based vehicles such as basic hearse and ambulance models. In the 1920's, as seen with the National Hearse Company, we see the emergence of Ford, Dodge, and Chevrolet as major chassis builders, as well as limousine/landau-style ambulances. Starting with the late 1920's and continuing into the 1930's, we see the emergence of ambulatory warning systems such as lights and sirens, on top of a re-modeling of all car models to look more "stream-lined". In the 1940's, war struck the economy. As such, ambulance and hearse models became much more affordable to prospective buyers. In the 1950's, overall chassis improvements were made with cheaper materials to further lower the cost of these specialty vehicles. These improvements included better suspension systems and more efficient engines. In the 1960's ambulance development continued to produce low-cost ambulance vehicles to local EMT/Police services. Finally, in the 1970's, car ambulance chassis died out to give way for the rise of a new type of ambulance (as dictated by the EMS White Paper): the truck chassis based ambulance (Type I, Type II, Type III). A table of companies prominent throughout the 20th century is available in the appendices. This table organizes the companies based on prominence throughout each decade.

2.3 Events That Changed It All

2.3.1 Introduction

From the early 1950s to the mid 1970s, a series of events occurred that changed the way ambulances were built and the way people thought about ambulances and emergency medical care in general. During this time period, the ambulance changed from a converted normal vehicle to a specialized emergency vehicle. There are four main events that caused this drastic transformation. The first event was the Harrow and Wealdstone rail crash. This was a major train crash in Great Britain in 1952 that brought about some awareness for the need for additional medical care inside of ambulance instead of just transport. The next major event that occurred that changed outlook on ambulances was the publishing of a manuscript called "Accidental Death and Disability: The Neglected Diseases of Modern Society," also known as the EMS White Paper, in 1966. This paper brought much needed attention to a disease plaguing America: accidental death and disability. The published manuscript is plausibly the single-handedly most influential event that transcended emergency medical care on a grand scale. The next event was a legislation passed by the US Congress in 1966 called the National Highway safety act. This act provided financial support for communities for emergency medical services. The final event that revolutionized the way ambulances and emergency medical care is the EMS Systems Act, an addition to a bill passed by Congress in 1973. This piece made it law that if communities wanted government aid for emergency medical services, they needed to follow a strict set of guidelines for ambulance and care in general. This led to the Star-of-Life ambulance specifications, which are a detailed set of rules that mandate nearly all aspects of ambulance models and ambulance care. During the mid 1970s, one sees the end of the 'conversion era' and the beginning of the 'modern era.'

2.3.2 Harrow and Wealdstone Rail Crash

On the Morning of October 8th, 1952, a great tragedy occurred that started a revolution in the way people thought about emergency medical care. According to BBC News, just outside of London, England at around 8:00 AM an express train heading to London collided with a commuter train that was just about to leave the Harrow and Wealdstone Train station in England. It is believe that the train was traveling at speeds of around 60 mph. Almost right after the initial train wreck, a third express train, unable to avoid the wreckage, ploughed into the other two trains. Considered of the worst train crashes ever to happen, approximately 108 people were killed and 300 more were injured. Most of the damage considered to be at the rear of the commuter train and the front of the express trains. Accordingly, this is where most people were hurt or killed. It was estimated to be about 1000 people on all three trains combined. The total wreckage was public spectacle as it reached heights of 30 feet in the air. The sound from the crash was characterized as a "deafening" explosion, as glass and debris flew everywhere. One survivor said, "It all happened in a second. There was a terrible crash and glass and debris showered on me." He also said, "I blacked out for a moment and when I came round I found I was lying on the line with debris on top of me. I managed to free myself and drag myself on to the platform." While many of the victims were passengers in the trains, others were just people waiting at the train station for the next express train [27].

Figure 23 and **Figure 24** show the massive train wreckage that was amassed on that dismal day. In **Figure 23**, one can see the mass amount of confusion that took place as well as the trains that were all over the place to the multiple crashes. In **Figure 24**, you can see the height if the wreckage that reached more than 30 feet in the air.

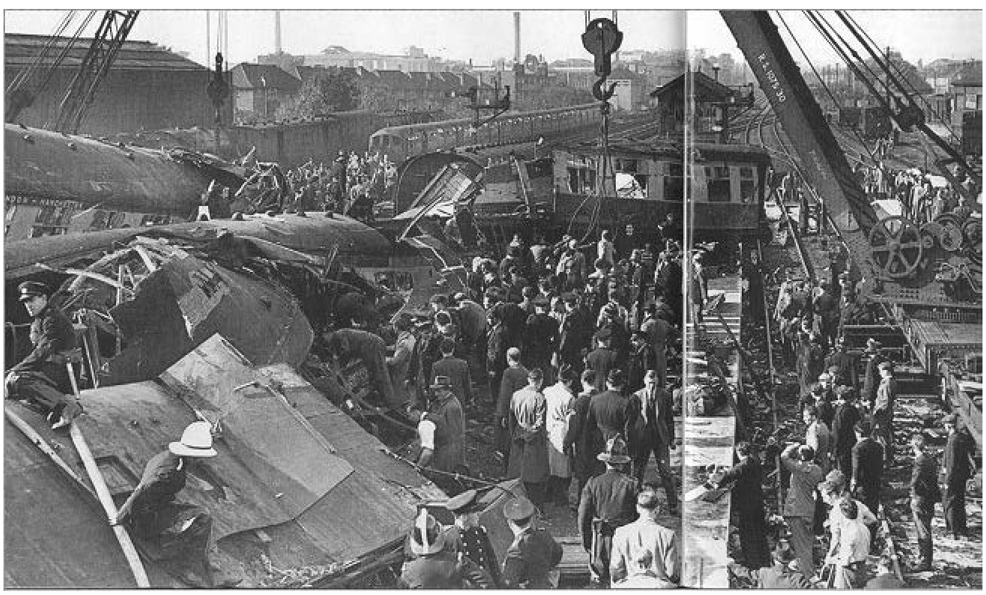


Figure 23- Harrow and Wealdstone Additional Photos

Figure 24- Harrow and Wealdstone Wreck Photo

While rescue workers fought to save as many lives as possible, not everybody could be saved. Also, it is believed that many died on the way to hospitals in the emergency transport available at the time or shortly after arriving at the hospital. After this crash, people started to realize that if the emergency ambulances were better equipped, then many lives could have been saved that day. Thus, it was discovered that the medical ambulance needed to transform from a simple transport system to a small-scale emergency care center on wheels. From here, ambulance companies start to build bigger ambulances that were better equipped with more life-saving equipment.

2.3.3 EMS White Papers

Accidental Death and Disability: The Neglected Disease of Modern Society [53] (actual document can be found in the Appendix A), produced by the National Academy of Sciences in

1966 and better known as *The White Paper* [31], was an extremely influential piece of literature that shaped structure of emergency medical services in the United States today. According to the paper, 52 million people were accidentally injured in 1965. Among those 52 million, 107,000 were killed, 10 million were disabled temporarily, and 400,000 were permanently handicapped. The cost due to all of these atrocities was in the ballpark of $18 billion. With today's inflation, that number is well over $100 billion. The paper described the accidental injuries as the "most important environmental health issue," as it was the most common cause of the death in the first half of an average person's life. This paper illustrated the current (in the 1960s) procedures and the shortcomings at different levels of emergency medical care [53].

According to EMT-Resources, the White Paper claims that the general public was imperceptive of how much of a problem accidental death and injury really were [31]. According the White Paper while millions did not have knowledge in basic first aid, there were comparatively fewer professionals that were sufficiently trained in CPR, childbirth, and other life-saving techniques. These included paramedics, policemen, and firemen. Likewise, local and federal authorities were not meeting their responsibility in optimizing emergency medical service and accident prevention. Similarly, there was simply a lack of data in accidental death and injury. Other areas the White Paper talked about were the fact that helicopter ambulances had not yet been applied to non-wartime needs, hospital emergency departments were overcrowded and poorly organized, emergency techniques for shock and trauma were poorly funded, and medical and health-related organization neglected to join forces to share knowledge and inform the Congress as well as the general public. The following is a list of steps recommended by the writers of the White Paper to improve different levels of emergency medical care in a national effort [53]:

- “Conduct of National Conferences on Emergency Services”
- “Establishment of a National Trauma Association”
- “Organization of Community Councils on Emergency Medical Services”
- “Formation of a National Council on Accident Prevention”
- “Creation of a National Institute of Trauma

The body of the paper first examined pertinent data about the major issue at hand: death. According to the paper, accidents were the number one cause of death for individuals between 1 and 37 years of age, and it was the fourth highest cause of death for persons of any age. In 1965 alone, there were approximately 107,000 accidental deaths, 49,000 of which were from motor vehicles, 28,500 from home, and 14,100 from work. The problem of accidental death was worsening with time, as there were 10,000 more accidental deaths in 1965 as there were in 1955. Likewise, there was a 3 percent increase from 1964 to 1965. The true tragedy here is that a very high percentage of these deaths that were caused by trauma happened to perfectly healthy people that one would expect to live long, health lives. While many terrible diseases such as cancer, heart disease, and stroke were catching everybody’s attention and support, the leading cause of death for many went unnoticed. And even worse, many of those accidental deaths could have prevented if proper emergency medical care was available [53].

Death was not the only problem; costs were a major issue as well. In 1965, total cost associated with accidental deaths was in the $18 billion range. Some of the cost is detailed below [53]:

- Wage losses - $5.3 billion
- Medical expenses - $1.8 billion
- Administrative and claim settlements - $3.6 billion
- Property loss in fires - $1.4 billion
- Property damage in motor vehicle accidents - $3.1 billion

- Indirect cost of work accidents - $2.8 billion

The overall total compares similarly to the overall costs associated annual costs of the Vietnam War [31].

The paper proposes that the ultimate solution to the problem of accidental death is "accident prevention." It explains that although medical professionals are concerned with decreasing death and disability as a result of accidents, the main sources of accident prevention can be attributed to those not in the medical profession. These professions include educators, engineers, public health officials, regulatory officials, and lay people. Medical professionals can help in other ways asides from helping the wounded in the hospital by informing the public of health hazards; safer design of vehicles, appliances, houses, and buildings; and the identification of relationships between different substances and human defects with accidents [53].

Other parts of prevention include the setting of higher standards. One such standard is periodic car safety inspection. In fact, in 1965 thirty states did not require automobile inspection. Other standards include standards for building new buildings, equipment, and appliances. Likewise, precise record keeping was very important [53].

Another important step in prevention is the spread of information. Educating people in work, home, and school can help reduce accidents. Likewise, pertinent information for reducing some sort of information if distributed to the news media can reach a cast amount of people in a short amount of time. Similarly, public courses of first aid should be offered to the general public [53].

The next section of the paper talked about emergency first aid and medical care. The first problem is that people that are not medical professionals are not properly trained in first aid. Thus, medical treatment for an accident victim does not usually begin until he or she gets to the emergency room. So there is a need to start medical service at the time of the accident to help prevent death. It is speculated by expert consultants that a seriously wounded person would have a better chance of survival in a combat zone than an average city street because of the initial first aid and excellent transportation. These reasons are factors for extreme reduction of battlefield deaths. 8% of battlefield injuries resulted in death in WW1, while only 4.5% resulted in death in WW2. These numbers reduced to 2.5% and less than two percent in the Korean and Vietnamese wars, respectively. The shrinkage of the amount of time before a victim gets medical attention is a key aspect of preventing accidental death and no American community could do it as well as the armed forces [53].

In order to help the prevention of accidental deaths, the paper suggests that every American citizen should be trained in basic first aid once he or she finishes the fifth grade. While 28,000,000 people have been certified by the American Red Cross in first aid training since 1909, this certification is not universally required (at the current time) to be a lifeguard, paramedic, policeman, or firefighter. In order to extend first aid knowledge, the paper suggests that a universal standard for first aid training should be mandatory for all service workers [53].

Similarly, there were little to no uniform ambulance system structure in the United States. There was little information and nearly no framework for the collection of ambulance data. The little information available showed that there was great diversity in ambulance standards (if any at all) and inadequate or unnecessary equipment. The paper says that ambulance service is just as important as police service and firefighting. There should be standards for ambulances amongst communities to serve local needs as well as natural disasters and national emergencies. 50% of ambulance services were provided by 12,000 morticians in 1965. This showed the lack of medical treatment inside ambulance at the time since these ambulances were merely converted hearses. Often times, ambulance care was a private service and the ambulances themselves were not suitable for medical care during transport, did not have adequate equipment, and did not have properly trained personal to perform first aid [53].

At the time, there were no accepted standards for ambulance attendants. Likewise, there were no accepted standards for ambulance manufacturers. The “ambulances” were only passenger-type vehicles that were converted to ambulance-type or rescue vehicles. Also, there was no set standard for the types of equipment that should be included inside an ambulance. Another standard that needed to be set was the rules regarding the actual ambulance transport including the use of sirens and speeding. In 1966, the National Highway Traffic and Safety Administration set standards for the construction of ambulances. Although this set of standards set a very nice guideline for ambulance manufacture, it was not a law that communities had to follow [53].

The White Paper had many other parts pertaining to the reduction of accidental death including data and suggestions about the development of trauma registries, hospital trauma committees, medicolegal problems, autopsy of victims, care of casualties under conditions of natural disaster, and research in trauma. The paper concludes with specific recommendations [53]. These include:

- Accident prevention
- Emergency First Aid and Medical Care
    - First Aid
    - Ambulance Services

- Communication
- Emergency Department
- Interrelationships between the Emergency Department and the Intensive Care Unit

- The Development of Trauma Registries
- Hospital Trauma Committees
- Convalescence Disability and Rehabilitation
- Medicolegal Problems
- Autopsy of the Victim
- Care of Casualties Under Conditions of Natural Disaster
- Research in Trauma

In conclusion, the *Accidental Death and Disability: The neglected Disease of Modern Society* was possibly the most influential manuscript that shaped the way ambulance standards are the way they are today. Not only were ambulance services affected, but also many committees and organizations were created that have tied together medical service with medical research. This collaborative effort conveyed the strong facts to a country that was ignoring an epidemic on its own soil. It is safe to say that this paper brought a great deal of much needed attention to the lack of medical services provided in the United States and provided a basis for a series of actions that took place in the following decades.

2.3.4 National Highway Traffic and Safety Administration

Following the release of the *Accidental Death and Disability: The Neglected Disease of Modern Society*, the United States Congress quickly responded by passing legislation called the National Highway Safety Act of 1966 [56]. Before this time, there was little to no federal involvement in emergency medical services. In fact, no specific programs which supported emergency medical services even existed. With advising from the National Highway Traffic and Safety Administration, the act's main goal was to improve medical services associated with highway accidents to reduce accidental death and disability. While there was little financial support for emergency medical services before the act, more than $48 million was given to the emergency medical services section of the National Highway Traffic Safety Program between 1966 and 1973. Additionally, over $73 million was given to various emergency medical service activities by at least 10 other federal programs in the same time period. Maryland and Illinois both in particular took advantage of the federal programs available at the time. In both areas, many research facilities were created including various hospitals and universities. Also, especially in Illinois, ambulance manufacturers began to prosper [37].

The program was another step in the evolution of the emergency medical ambulance in the United States. Following the White Paper, this act provided the financial support for emergency medical services that was previously never available. This act not only helped set the way for the construction of safer ambulances but also guided the creation of research centers and better emergency medical facilities. As substantial as this act was in shaping the way modern ambulances are today, it was just an intermediate step that led to further Congress input into the evolution of the emergency medical ambulance.

2.3.5 EMS Systems Act 1973

Between the 1966 and 1973, millions of dollars was given to various organizations in the effort to reduce accidental death and disability. While these efforts were successful and steps in the right direction, the United States Congress took the effort to another level. In November of 1973, the Congress added the Emergency Medical Services (EMS) Systems Act of 1973 to the already existent Public Health Service Act. The premise of this legislation was to increase the development of EMS program across the country. Required by the act, all regions of the country were called to have sufficient medical staff, emergency facilities, emergency vehicles and equipment, and all other necessary resources to react properly to emergency situations. Similarly, all emergency requests were to be directed through a common communication network that connected all of the networks resources. The more important part of the act however is that in order to receive monetary support from the government for emergency care purposes, communities needed to meet 15 standard requirements. Some of these include proper staffing, sufficient training, sufficient communication systems, and good record keeping. Another stipulation of this bill was that that ambulances needed to meet certain criteria regarding size of ambulance, structure of ambulance, and equipment inside the ambulance [37]. Ultimately, this led to what is now known as the "Federal Specification for the Star-of-Life Ambulance," this is shown in **Figure 25** [55].

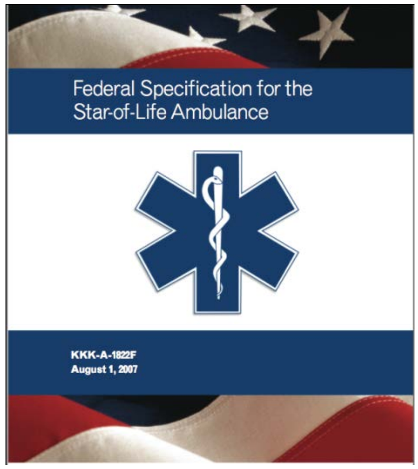


Figure 25 Star of Life Ambulance Logo

According to the U.S. General Services Administration, in order for an ambulance to nationally recognized, it must follow the Star-of-Life standards. The standards maintain that any recognized ambulance must fit the classification of a Type I, II, or III ambulance. Type I specifies that the vehicle should be a cab chassis furnished with a modular body with a GVWR between 10,001 and 14,000. Type II should be a long wheelbase van with integral cab-body, maintaining a GVWR between 9,201 and 10,000. Type III requires a cutaway can with integrated ambulance body while maintaining a GVWR between 10,001 and 1400. Both Type I and Type III can be classified as Type I – AD and Type I – AD, respectively, the GVWR for either is 14,001 or greater. Aside from these basic classifications, which limit what types of vehicle chassis can be used as ambulance bases, the Star-of-Life standards set a lengthy list of specification that absolutely must be met. One such specification is that the primary patient cot must be loaded into the ambulance in such a way that the head of the patient is toward the front of the ambulance and also the cot be mounted once loaded. The following is a basic outline taken directly from the Star-of-Life Specifications (circa 2007), which can be found in the appendices, that shows some of the types of things required [55]:

- General Vehicular Design, Types, and Configuration
  - Design
  - Type I Ambulance
  - Type II Ambulance
  - Type III Ambulance
  - Configuration of Patient Compartment
- Vehicle, Ambulance Components, Equipment, and Accessories
  - Medical Devices
- Recovered Materials
- Vehicle Operation, Performance, and Physical Characteristics
  - Operation and Performance
  - Temperature Conditions (exterior and interior)
  - Noise and Sound Level Limits, Exterior
  - Vehicle Performance
  - Speed
  - Acceleration
  - Gradeability (at speed and minimum low speed)
  - Fuel Range
  - Fording
  - Vehicle Physical Dimensional Requirements (length, width, height, ect.)
- Vehicle Weight Ratings and Payload
  - Curb Weight
  - Payload Capacity
  - Gross Vehicle Weight and Rating (GVWR)
  - Weight Distribution
  - Ratings
  - Cab to Axle (CA), Type I and III Vehicles
- Chassis, Power Unit, and Components
  - Chassis-Frame
  - Vehicle Lubrication
  - Power Unit, Engine
  - Power Unit Components (oil filter, air filter, etc.)
  - Drive Train (Components, Automatic Transmission, Brake System, Suspension, ect.)
  - Steering
  - Wheels
  - Tires
  - Tires Chains and Clearance
  - Wheel Tire Balancing
  - Hubcaps

- Electrical System and Components
    - Electrical System (indicators, wiring, ect.)
    - Grounding
    - Windshield Wipers and Washers
    - Horns
    - Low Voltage Electrical Systems
    - Battery System
    - 125-Volt AC Utility Power
    - Drive Compartment Controls
    - Patient Compartment Controls
    - Marking of Switches, Indicators, and Control Devices
    - Electromagnetic Radiation and Suppression
- Lighting, Exterior, and Interior
    - Ambulance Exterior Lighting
    - Ambulance Emergency Lighting (configuration, arrangement, ect.)
    - Flood and Loading Height
    - Ambulance Interior Lighting
- Cab-Body Driver Compartment and Equipment
    - Driver's Compartment, Cab-Body Structure
    - Cab-Body Provisions
    - Cab Component Driver and Passenger Seat
    - Controls and Operating Mechanism
    - Outside Rearview Mirrors
    - Bumpers and Steps
    - Body Protection
    - Engine Hood
    - Cab Connecting Bellows for Type I and I AD Vehicle
- Ambulance Body and Patient Area
    - Body Accommodations
    - Cab/Patient Compartment Access Window
    - Emergency Medical Services Provider (EMSP) Seating
    - Patient Compartment Interior Dimensional Parameters
    - Body, General Construction
    - Ambulance Body Structure
    - Body Mounting
    - Doors
    - Door Latches, Hinges, and Hardware
    - Floor
    - Floor Coverings and Color
    - Step Well (Side Door)

- Wheel Housings
- Bulkhead/Partition for Type II, III, and III – AD Vehicles
- Door/ Walkthrough for Type II, III, and III – AD Vehicles
- Insulation
- Interior Surfaces

- Storage Compartments
    - Interior Stowage Accommodations
    - Exterior Storage Accommodations
    - Storage Compartments and Cabinets
    - Patient Compartment Seating
    - Seat Safety Belts and Anchorages
    - Litter Fasteners and Anchorages
    - IV Holder for Intravenous Fluid Containers
- Oxygen, Main Supply and Installation
    - Oxygen Pressure Regulator
    - Suction Aspirator, Primary Patient
- Environmental: Climatic and Noise Parameters
    - Environmental Systems
    - Heating Criteria
    - Air Conditioning Criteria
    - Ventilation Criteria
    - Environmental Controls
    - Patient Compartment Sound Level Criteria
- Communications
    - Communication Equipment
    - Radio (Mobile) Provisions
    - Antenna Cable and Access
    - Siren – Public Address System
- Additional Systems, Equipment, Accessories, and Supplies
    - Additional and Optional Equipment
    - Standard Mandatory Miscellaneous Equipment
    - Configuration Worksheet
    - Defined Options (Option Codes)
- Painting, Color, and Markings
    - Preparation for Painting
    - Color, Paint, and Finish
    - Salt Spray Resistance
    - Reflective Emblems and Markings
- Markings, and Caution and Identification Plates
- Manuals, and Handbook of Instruction

- Predelivery Inspection and Servicing
- Workmanship

Aside from the abovementioned regulations, there are also various quality assurance provisions, delivery restrictions, and other miscellaneous notes. The complete Star-of-Life Specifications can be found in the Appendix B.

Although the list described above is probably much more detailed than it was when it was originally created, the fact remains that the emergency vehicle manufacturing industry was struck with standards in the 1970s that it had never before seen. It is obvious this legislation is the straw the broke the ambulance manufacturing industry's back. Consequently, the 1970s marked the collapse of the 'conversion era' and the beginning of the 'modern era.'

2.4 The modern Era

2.4.1 Introduction

Around the turn of 1980, America sees a shift from the 'conversion era' of the ambulance to the 'modern era.' The 'conversion era' is defined as all ambulance models that were simply ordinary vehicles that were converted to ambulances for medical service and/or transport. The 'modern era' is defined as all ambulance models that are Type I, II, or III as described in the Star-of-Life Specifications mentioned in previous sections and seen in the appendix. As the EMS Systems Act was passed in 1973, the 1970s marked the breakdown of the 'conversion era' and the emergence of the 'modern era.' By about 1980, nearly all 'conversion'-type ambulances ceased to exist. The standard ambulance was basically the same type of ambulance we see today with various simple improvements. It is either a cargo van modified into an ambulance or a large van or truck chassis with a box mounted to the back of the chassis featuring life-saving equipment and other required materials as described in the Star-of-Life Specifications.

Around 1980 as we the transition of ambulance models, we also see the transition of ambulance companies. Since the older style ambulances were no longer useful and had no market many went out of business or converted their companies to cater to other field that still used normal vehicles converted to specific needs, such as the hearse industry. Similar to the configuration and style of ambulances, ambulance companies have not changed much since the start of 1980. The 1980s as one can imagine marked the beginning of a new ambulance industry and the creation of many new companies. The only big changes in the ambulance industry since the 1980s are simply the addition of new companies. **Table 2** is a list of the different ambulance companies associated with the 'modern era.'

Table 2- List of current, prominent ambulance companies in North America

Company	Location	Region
AEV	Jefferson, NC	East Coast
Braun	Van Wert, OH	Lakes Region
Crestline Coach	Saskatoon, Saskatchewan	Canada
Demers	Beloeil, QC	Canada
Excellance, Inc	Madison, AL	South
Frazer, Inc	Houston, TX	South
Horton	Grave City, OH	Lakes Region
Leader	South El Monte, CA	West Coast
Life Line Emergency Vehicles	Summer, IA	Mid-West
Marque, Inc	Elkhart, IN	Lakes Region
McCoy-Miller, Inc	Elkhart, IN	Lakes Region
Medix	Elkhart, IN	Lakes Region
MedTec	Goshen, IN	Lakes Region
Miller Coach Company, Inc	Springfield, MO	Central
Osage Ambulance	Linn, MO	Central
PL Custom Emergency Vehicles	Manasquan, NJ	Northeast
Road Rescue	Marion, SC	East Coast
Taylor Made Ambulances	Newport, AR	South
Wheeled Coach	Winter Park, FL	South East

In the following sections, each of the above ambulance companies will be talked about briefly describing the company, its location, all of its ambulance models and key features of each model. Available pictures of each ambulance model will also be included. All information in the following sections about the ambulance companies listed above was found at each of the company's respective websites. These websites can be found in the reference section of this paper. It should be noted that the amount of information that is provided about each company is dependent upon the amount of pertinent information, as determined by the research team, available at the companies' respective websites at the time of examination.

2.4.2 AEV

Prominent in modern ambulance manufacturing is American Emergency Vehicles, located in Jefferson North Carolina, AEV takes pride in providing quality ambulance that are a product of high quality raw materials and components combined with modern engineering. . All of the following information regarding AEV ambulances was found at the AEV ambulance website cited in the reference list[8]. The AEV fleet is composed of various models including type I, type II and type III models. An example of a type III model is their 148" Chevy Model "TraumaHawk" which is built around a GM chassis. The interior of this model shows an interior unlike most modern ambulance. As seen in Figure 26, the stretcher position is slightly offset from the center. This eliminates the ability to have paramedics seated on both sides of the patient. Rather, there is one side bench for multiple paramedics and one single seat at the head of where the stretcher would be located.

Figure 26- AEV Type III Interior

Aside from the unique stretcher placement, this ambulance is fairly common to other type III models. Seen in Figure 27 and Figure 28 are the engineer drawings of this model.

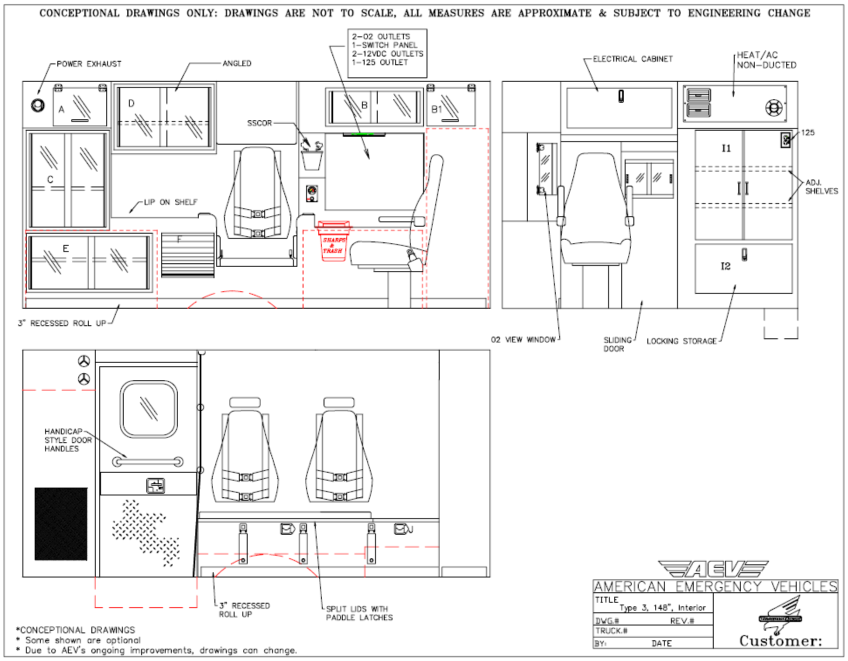


Figure 27- AEV Type III Interior

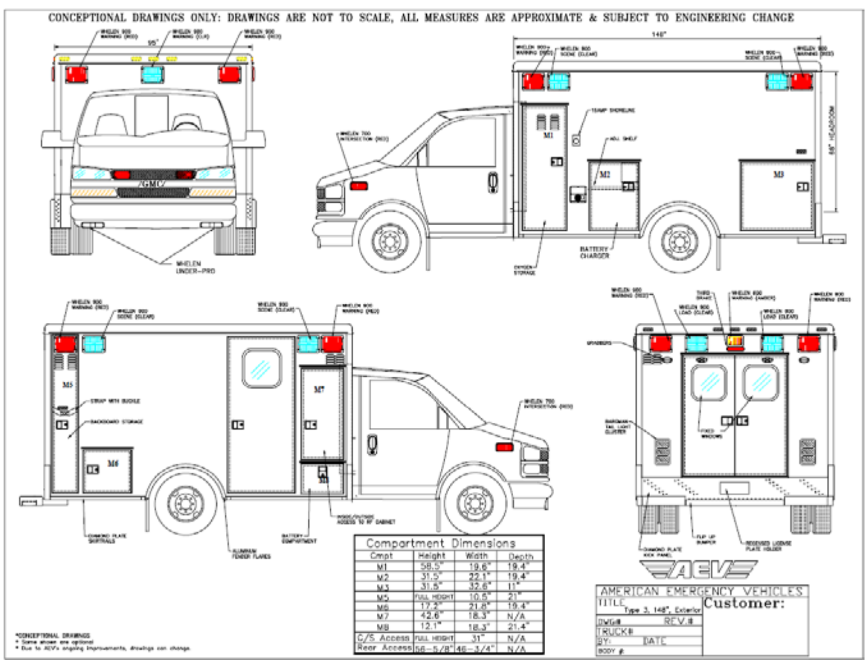


Figure 28- AEV Type III Exterior

A good example of an AEV type II model is the Sprinter 2500 Van. These compact vehicles are known for ease of driving however are extremely lacking in terms of interior space and headroom. This specific model is built around a Mercedes 3.0 diesel chassis. Although smaller, the interior layout of this model is similar to that of the Type III Chevy model. Shown in Figure 29, the left centered stretcher placement allows paramedic access from the right side bench as well as the single seat at the head of the stretcher. Figure 30 shows the unique size and shape of the smaller type II ambulance model.

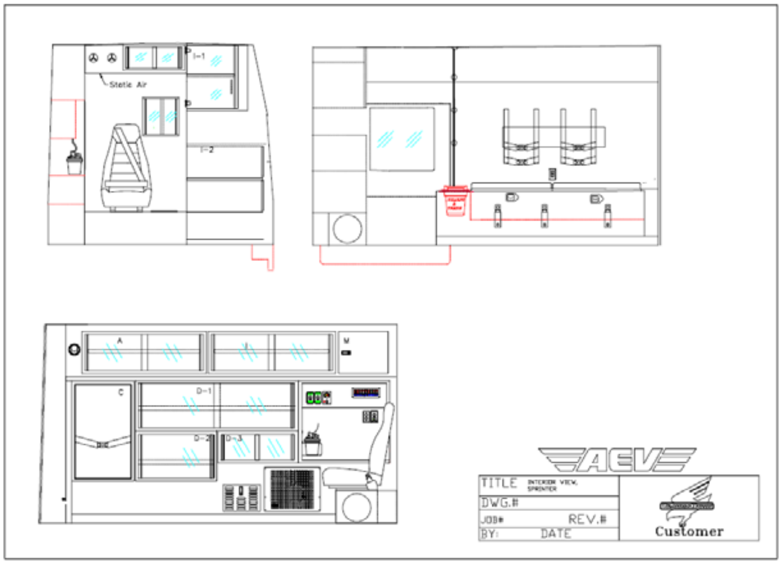


Figure 29- AEV Type II Interior

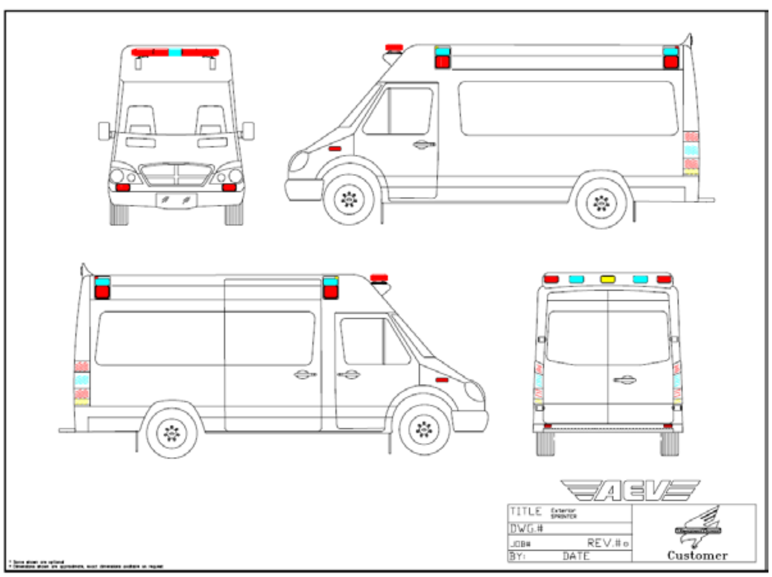


Figure 30- AEV Type II Exterior

A significant type I model that AEV offers is the Dodge 4500 148" model. Figure 32 displays how these type I models appear similar to type III models however lack specific features such as the passage way connecting the drivers cockpit to the patient compartment. The interior drawing of this vehicle shown in Figure 31 shows the arrangement of seating as one long bench as well as a captain's chair at the head of the stretcher and an additional bucket seat recessed into the cabinet and storage area allowing patient access from multiple directions.

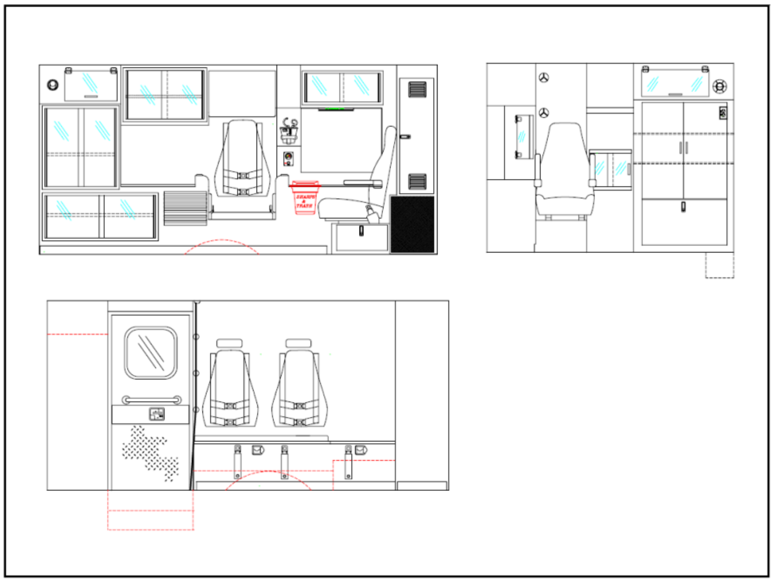


Figure 31- AEV Type I Interior

Figure 32- AEV Type I Exterior

As a whole, the AEV fleet is very much standard of modern ambulance design. The three ambulance types are available with several feature options among the fourteen different models.

2.4.3 Braun

Based out of Van Wert, OH, Braun Ambulances is another leading manufacturer specializing in custom ambulance vehicles [6]. Like many other companies still in the ambulance manufacturing business, Braun Ambulances develops type 1, type 2, and type 3 ambulances. In addition to this, Braun also uses state of the art cabin User Interface technology (Master Tech III), singularly integrated body construction (SolidBody Construction), new sliding side door technology (EZ Glide Door), and state-of-the-art door latches (Eberhard Latches) [6].

Braun prides their ambulances on versatility, comfort, and state-of-the-art quality. Most of the models contain the features listed above as well as unique features to each model. The company has a wide array of ambulatory vehicles that can perform a multitude of tasks. All of the following information is provided by Braun Ambulances at the company's respective website[9]. A list of the models the company produces is listed in **Table 3**:

Table 3 - Complete list of Braun Ambulance models

Braun	Chassis	Body Length	Width	Headroom	Storage (ft3)	Weight
Type 1						
Chief XL	Ford E450	169	98	72		10811
	Ford F450	166	98	72		12554
	Dodge D4500	166	98	72		****
	Chevy G4500	169	98	72		10778
Express	Ford E350	144	95	68		9341
	Ford F450	144	95	68		10760
	Chevy G3500	144	95	68		9150
Metro Express	Chevy G3500	144	95	68		****
Liberty	Ford E450	156	98	72		10341
	Ford F450	156	98	72		12071
	Dodge D4500	156	98	72		****
	Chevy G4500	156	98	72		****
Patriot	Spartan Furion	170	96	73		25470
Raider	Ford E350 Gas	147	98	69.8		****
	Chevy G3500	147	98	69.8		10005
Super Chief	International 4300	170	98	73		15933
	Spartan Furion	170	98	73		****
	Freightliner M2	170	98	73		****
Type 3						
Chief XL	Ford E450	169	98	72		10811
	Ford F450	166	98	72		12554
	Dodge D4500	166	98	72		****
	Chevy G-4500	169	98	72		10778
Express	Ford E350	144	95	68		9341
	Ford F450	144	95	68		10760
	Dodge G3500	144	95	68		9150
Metro Express	Dodge G3500	144	95	68		****
Liberty	Ford E450	156	98	72		10341
	Ford F450	156	98	72		12071
	Dodge D4500	156	98	72		****
	Chevy G-4500	156	98	72		****
Patriot	Spartan Furion	170	96	73		25470

As seen above in **Table 3**, Braun offers many ambulances on many different chassis that can function as mostly type 1 and type 3 ambulances. The table also displays sizing of each ambulance for both relevant interior and exterior dimensions. The data offered above is current as of the end of 2010. As a company, offering such high quality, up-to-date models with many choices in customizability presents a variety of choices for the customers of these ambulances. It also allows Braun to market the ambulances with both versatility and modern customizations in mind.

An example of a model that typifies the innovation presented in the standard Braun ambulance models for the type 1 ambulance category is the Braun Patriot Type 1 fire ambulance. This ambulance features: Guardian Serenity Seating, Whelen LED Freedom Front Light Bar, Nesting Eagle Siren, Whelen 900 Series LED Warning and Scene Lights, KKK Compliant Chevron Striping on the rear module, and an Equalizer CAFS System. Images of the vehicle can be seen in Figure 33, Figure 34, and Figure 35:

Figure 33 Braun Patriot Type 1 Ambulance

Figure 34 Braun Patriot Interior (1)

Figure 35 Braun Patriot Interior (2)

As you can see in Figure 33, the latches and LED lighting are very modern and stand out against other dated ambulances. The interior is also very clean cut with safety as priority number one (as seen in the safety harnesses for the side seats of the module). The user interface can be seen in Figure 34. Most noticeably, the interface itself is very streamlined and simple to use and navigate. Also, the model itself functions as both an ambulance as well as a fire rescue vehicle. Again this allows Braun Ambulances to market this particular ambulance with both variety and quality in mind. This ambulance mainly functions as a Medium Duty type 1 ambulance.

The next major type of model manufactured by Braun Ambulances is their type 3 ambulances. One of the major examples of this type of ambulance is the Braun Express Type III ambulance. Mainly built on a 2009 Ford E-350 chassis, this ambulance features: AudioVox Camera System, Whelen Halogen Warning Lights, Whelen 4500 Series Front & Rear Light Bars, EZ Glide Sliding Door, MasterTech III Electrical System, and an Impact Suction System. As you can see, this ambulance has a unique AudioVox Camera System to assist with driving in tightly confined areas such as small city streets. The ambulance also has the MasterTech III

Electrical System to improve generator efficiency. Images of the ambulance can be seen in Figure 36, Figure 37, Figure 38:

Figure 36 Braun Express Type III Exterior

Figure 37 Braun Express Type III Interior (1)

Figure 38 Braun Express Type III Interior (2)

As seen in the above images, the ambulance continues the theme of versatility as well as state-of-the art quality. The ambulance does not look much different than most ambulances developed by modern ambulance companies due to the strict regulations outlined in the regulations section of this paper. However, in Figure 37 and Figure 38 we see the interior featuring the streamlined user interface (located above the counter on the LCD screen by the attendant's seat). Also we see the lights on the top oblique's of the interior cabin that prevent shadows from projecting onto the patient. They can also be adjusted to any setting of brightness to further suit the needs of either the patient or the attending EMS unit. The approximate weight of this model is anywhere between 9300-10700 lb.

The Braun Ambulance Company is an ambulance developer that continues to stand out as a quality manufacturer that keeps up with emerging technologies to outfit their ambulances with in order to maintain their versatility and state-of-the-art status. Offering a wide variety of type 1 and type 3 ambulance models, we see Braun Ambulances as a reliable company that can accommodate to even the most precise of needs (such as highly adjustable lighting and drive-assisting cameras). In essence, Braun Ambulances will be a company that continues to stay on top of the ambulance business for the foreseeable future due to their ability to adapt to the situation at hand.

2.4.5 Crestline Coach

Based out of Sakatoon, Saskatchewan (Canada), Crestline Coach is one of North America's leading ambulance manufacturers. They pride themselves on creating industry innovations. Their excellent manufacturing quality and customer service has led to a large number of faithful customers across the globe. Crestline Coach has four ambulance models currently available, all of which are type 3 models. A list of these models can be seen in the table below. All of the following information regarding Crestline Coach ambulances was found at the Crestline Coach ambulance website cited in the reference list [10]. **Table 4** is current as of year ending 2010.

Table 4 - List of Current Crestline Coach ambulance models

Crestline Coach		Chassis	Wheelbase	Body Length	Body Width	Headroom	Total Length	Body Style
Type 3								
New Era		Chevy Cutaway	139"	151"	83"	67"	250"	Aerobody
Apex		Chevy Cutaway-gas or diesel Ford E350 Cutaway-Diesel	139" 138"	151"	90"	67"	250"	Aerobody
FleetMax		Chevy Cutaway-gas or diesel Ford E350 Cutaway-Diesel	159" 158"	164"	88"	67"	266"	Aerobody
Commander		Chevy Cutaway-gas or diesel Ford E350 Cutaway-Diesel Ford E450 Cutaway-Diesel	159" 158" 158"	164"	94"	67" or 72"	267"	Aerobody

The first model available is the New Era model. While this model runs on a Chevy Cutaway chassis, the model has a smaller sized 151 inch base. As seen in the table above, this model has an aerobody style. Some key features of this ambulance are Crestline Coach's Crestcoat technology, which is an exterior powder finish that provides an excellent resistance to corrosion, while maintaining industrial strength mechanical properties; a roll cage, which provides more protection for the ambulance in case of accident; squad bench safety nets, which provide more safety in the interior of the ambulance; and larger cab space, which provide greater interior space and flexibility to paramedics. Another key feature about this ambulance is that it is a left-mounted ambulance, which provides working space for the paramedics. Also, if the ambulance is left mounted, there is enough room for a bench on the right side, which can provide space for an additional stretch in case of major emergency. This configuration can be seen in **Figure 39**.

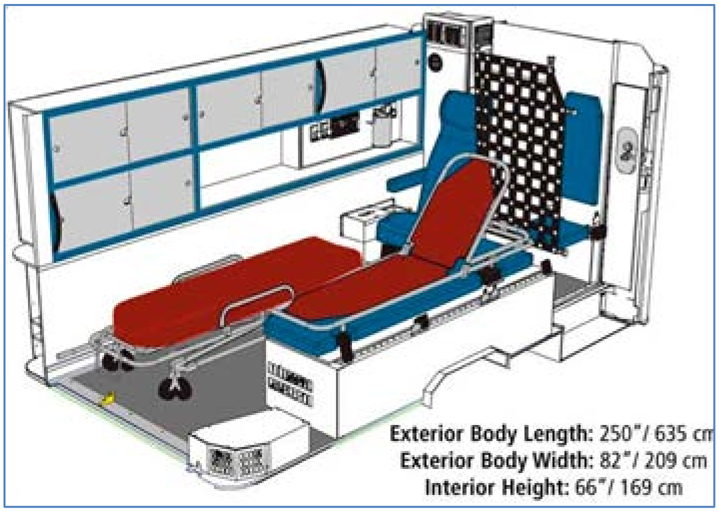


Figure 39 - Interior View of a typical Crestline Coach Ambulance model, showing the left mounted stretcher

Figure 40 shows an exterior view of the New Era Model. As you can see from this figure, the ambulance is not overly large but is of sufficient size depending on the consumers' needs. Also, the smaller size provides for better drivability.

Figure 40 - Exterior View of the New Era model

Figure 41 depicts a photo of an interior view of the New Era ambulance model. This picture shows one of the key features for Crestline Coach: the squad safety net. This is the black net on the right side of the ambulance, which provides "soft wall" that prevent a paramedic from falling off the side of the bench without being hurt from being thrown into a rigid wall.

Figure 41 - Interior View of the New Era Model

The remaining ambulances for Crestline Coach are all type 3 models. They all have Crestline Coach's signature features explained above. The only real changes are differences in size dimensions and chassis. Shown in **Figure 42** is an exterior view of the Apex model, which is quite similar to the New Era Model but is wider. It also has the option for a Ford E-350 cutaway chassis.

Figure 42 - Exterior View of the Apex ambulance model

Shown in **Figure 43** is an interior view of the Apex model. In the figure, you can see the squad safety net and left mounted stretcher mount. As mentioned above, this model is very similar to New Era Model.

Figure 43 - Interior View of the Apex model ambulance

Figure 44 shows Crestline Coach's third type of ambulance model: the FleetMax. This 164 inch model has all the same features mentions above on a larger body. This all-aluminum ambulance body is usually mounted on either a Chevy cutaway or Ford E-350 chassis.

Figure 44 - Exterior View of the FleetMax model

Shown in **Figure 45** is the interior view of the FleetMax model. As you can see, this model has ample storage capacity underneath the squad bench. There are also many pads along the ceiling edges and walls, which provide a soft impact surface.

Figure 45 - Interior View of the FleetMax model

The fourth and final model available from Crestline Coach is the Commander. This model is Crestline Coach's largest ambulance model. It provides the most width, length, and headroom. While this model has all the similar features from the other ambulance models described above, it is available on a larger Ford E-450 chassis. This model is depicted **Figure 46**

Figure 46 - Exterior View of the commander ambulance model

Overall, Crestline Coach offers a full range of type 3 ambulance models. There models typically run on either the Chevy Cutaway or Ford E-350 chassis and all have similar features. Additional information about current ambulance models offered by Crestline Coach can be found at their website, which is listed in the reference section of this manuscript.

2.4.6 Demers

Based out of Beloeil, Quebec City (Canada), Demers is the oldest continuous ambulance manufacturing company in North America. They have been providing various ambulance constructions since 1892. Demers was also one of the first companies to institute the ambulance with a van chassis. Today, Demers has five current ambulance models, either of type 2 or type 3 categorization. Three of the models are of type 2 designation and the remaining two models are of type 3 designation. A complete list of ambulance models from Demers can be found in the table below. This table provides the different ambulance models with their respective chassis, size dimensions, and GVWR. All of the following information regarding Demers ambulances was found at the Demers ambulance website cited in the reference list [11]. **Table 5** is current as of year ending 2010.

Table 5 - List of Demers Ambulance Models

Demers	Chassis	Wheelbase	Body Length	Headroom	Payload(lbs)	GVWR(lbs)
Type 2						
Mirage EX Sprinter	Mercedes-Benz Freightliner			75"		8550
Mirage CX	Ford E-350 gas or diesel	138"		64"	1900	9500
Mirage LT2	GM Chevy Express Cargo Van 3500 gas or diesel	155"		65"	1800	9600
Type 3						
Mistere MX 160/S	Ford E-350	158"	160"	72"	2400	14500
	Ford E-450					
	GM 3500	159"	160"	72"	2400	14200
Mistere MX 170S	GM 4500					
	Ford E-450 Super Duty Cutaway	158"	170"	72"	3400	14500
	GM Chevy Express 4500 Cutaway	159"				14200

The first type 2 model from Demers is the Mirage Ex Sprinter, which runs on the Mercedes-Benz Freightliner chassis. This model has features typical of all type 2 models for Demers. These features include aerodynamic roof design, multiple oxygen outlets, and rounded interior corners throughout the units. Also a nice feature found in the type 2 models are squad safety nets. Figure 1 shows an exterior view of the Mirage EX Sprinter. **Figure 47** displays the aerodynamic roof.

Figure 47 - Exterior View of the Mirage EX Sprinter

Figure 48 shows and interior view of the ambulance model. From this picture, you can see the safety net and the rounded corners.

Figure 48 - Interior View of the Mirage EX Sprinter

The remaining two models for type 2 ambulances from Demers are called the Mirage CX and LT2. Both of these models have similar features to the Mirage EX Sprinter. The main difference is the different chassis. These differences can be seen in the table above. There are also slight difference in headroom, payload, and GVWR. These can also be seen in the table above. **Figure 49** shows an example of the Mirage CX ambulance.

Figure 49 - Mirage CX ambulance model

Figure 50 shows and example of the Mirage LT2 model. This model has a lot of the same features as the other type 2 models. The major difference is the chassis change, which can be seen in the table above. Also seen are any changes in size dimensions, payload, and GVWR.

Figure 50 - Exterior View of the Mirage LT2 model

The type 3 models display similar characteristics as the type 2 models. The main differences are the size differences and the chassis differences. The type 3 ambulance models are much larger and have more interior space. Consequently, the available chassis options are much larger. The two type 3 models available from Demers are Mistere MX 160/s and the Mistere MX 170/s. The chassis and size dimensions for these models can be seen in the above table. The only real difference between these models is the length. As you can guess from the names, these models are 160 inches and 170 inches of length. **Figure 51** shows an example of the Mistere MX 170/s. The Mistere MX 160 S is nearly exactly as the 170 S option; it is just 10 inches shorter.

Figure 51 - Mistere MX 170 S ambulance model

As you can see from the photo, this model is much larger than the type 2 options. Figure 6 shows an interior view of the abovementioned ambulance. From this figure, one can see the safety net and the rounded corners as well as the left mounted stretcher mount.

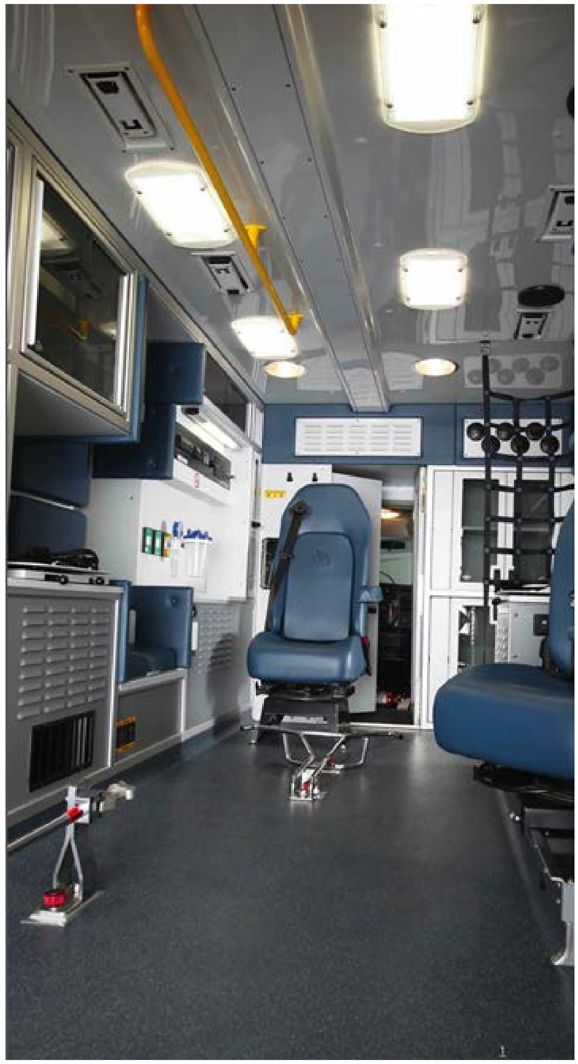


Figure 52 - Interior View of the Mistere MX 170 S

Overall, Demers offers a full range of type 3 and type 2 ambulance models. There models typically run on either the Chevy, GM, and Ford chassis and all have similar features. Additional information about current ambulance models offered by Demers can be found at their website, which is listed in the reference section of this manuscript.

2.4.8 Horton

Based out of Grove City, Ohio, Horton is one of the leading ambulance manufacturing companies in the United States. Created in the 1960s, Horton is one of the original companies that built van based ambulances at the end of the 'conversion era' and should be considered a forerunner for ambulances today. Horton prides themselves on innovative products and engineering excellence. Some key features that Horton has made standard in the ambulance market are all-aluminum welded body, modular cabinetry, electronically controlled oxygen systems, electronic throttle controls, solid-state electronics, vehicle diagnostics, and electrical load management.

Horton has a slew of ambulance models currently available, including Type I and Type II models, as well as a group of larger medium duty models. The following table is a list of all currently available Horton ambulance models with their respective chassis options, dimensions, and storage capacity. All of the following information regarding Horton ambulances was found at the Horton ambulance website cited in the reference list [13]. **Table 6** is current as of year ending 2010.

Table 6 - List of Horton Ambulance Models

Horton	-	Chassis	Body Length	Width	Headroom	Storage (ft3)
Type 1						
Model 403		Ford Chevy	137"	96"	64"	127.71
Model 453		Ford Chevy	145"	96"	72"	153.28
Model 457		Ford	157"	96"	72"	190.77
	12677	F450	157"			
	12763	F450	157"			
	13345	F450	157"			
Type 3						
Model 403		Ford Chevy	137"	96"	64"	127.71
	10651	E350	137"			
Model 453		Ford Chevy	145"	96"	72"	153.28

	12713	Chevy 3500	145"			
Model 533		Ford	163"	96"	72"	185.39
	533-De	E450	163"			
Model 553		Ford	169"	96"	72"	
	A					188.21
	B					195.5
	C					200.66
	12075	E350	169"			
	13389	E450	169"			
	13541	E450	169"			
	14036	Chevy G4500	169"			
	14489	E450 gas	169"			
Medium Duty						
Model 603		International	167"	96"	72"	
		Ford F-series				
		Sterling				
		Freightliner				
	A					191.6

	B					184.95
Model 623		International	173"	96"	72"	212.05
		Ford F-550				
		GMC				
		Sterling				
		Freightliner				
	12275	Int 4300	173"			
	12797	Int 4500	173"			
	13435	Freightliner Crew Cab	193"			
	13468	Int 4500	173"			
	14034	Int	173"			
	14494	Int	173"			

The first set of models is the Type 1 models. These models are all custom built and have key features that include 4-wheel drive, all-aluminum body, all-aluminum modular cabinetry, and fully multiplexed solid state electronics system (Intelliplex).

The first model is the Type 1 Model 403, which has chassis options of Ford or Chevy. This model is one of Horton's most compact ambulances and can easily serve public or private sectors. With a base length and width of 137 inches and 96 inches, respectively, this ambulance can easily be used in both city and rural communities. **Figure 52** shows and example Horton Type 1 Model 403.

Figure 53 - Horton Type 1 Model 403

The next type 1 model that Horton has to offer is the Type 1 Model 453, which also has Ford and Chevy chassis options. This model has base dimensions of 145 and 96 inches for the length and width, respectively. This classifies as a "mid"-size model for Horton Type 1's. This is slightly larger than the Model 403 option but small than the Model 457 option for Type 1s. It provides more headroom and storage than the smaller model, yet is still small enough to maneuver around city streets. **Figure 54** shows an example Horton Type 1 Model 453.

Figure 54 - Horton Type 1 Model 453

The last Type 1 model available from Horton is the largest, the Model 457. With base dimensions of 157 and 96 inches, respectively, this model has the most headroom and storage capacity. This model has the largest patient area. **Figure 55** shows the larger interior patient area. **Figure 55** and **Figure 56** show photos of the Horton Type 1 Model 457.

Figure 55 - Type 1 Model 457

Figure 56 - Type 1 Model 457 Interior View

The next set of ambulance offered by Horton is the Type 3s. This type has four different sizes and 10 different models. Although not necessary, these types can be made custom to order. Key features of these models include extra sound and thermal protection, Intelliplex, and detailed system monitoring.

The first Type 3 model is the Model 403, which has both Ford and Chevy chassis options. This model has all the same features as the Type 1 Model 403, but is a Type 3 configuration. This model too exemplifies compact size and good maneuverability. **Figure 57** and **Figure 58** show examples of the Horton Type 3 Model 403.

Figure 57 - Type 3 Model 403

Figure 58 - Type 3 Model 403 Interior Displaying All-Aluminum Modular Cabinetry

The next Type 3 ambulance available is the Model 453. This model also has similar dimensions to the Type 1 Model 453 but has a Type 3 configuration. This model is good for city use due to its sufficient size and good maneuverability. **Figure 59** and **Figure 60** show examples of the Horton Type 3 Model 453.

Figure 59 - Type 3 Model 453

Figure 60 - Type 3 Model 453 Interior

The next model by Horton is the Type 3 Model 533, which has the Ford chassis option. With a larger base (163 by 96 inches), this model proves to be very spacious and provides a less expensive alternative to some of Horton's larger, more expensive models. **Figure 61** and **Figure 62** show examples of the abovementioned model. **Figure 62** shows the interior that has a stretcher mount that is left-mounted.

Figure 61 - Type 3 Model 533

Figure 62 - Type 3 Model 533 Interior

The last model for the Type 3s is the Model 553, which has both Ford and Chevy chassis options. This 169-inch ambulance model has three different storage capacity options, seen in Table 1, and is custom-built once a storage capacity is chosen. This is Horton's most popular option. **Figure 63** **Figure 64** display the abovementioned ambulance. **Figure 64** shows that large interior space and storage capacity for this model.

Figure 63 - Type 3 Model 553

Figure 64 - Type 3 Model 553 Interior

The next set of ambulance that Horton has to offer is the Medium Duty Ambulances. These ambulances provide a very large payload, excellent durability, ample interior space, and large amounts of storage. Key features of these models include advanced biohazard controls, safety features, reliability systems, and acoustic and thermal standards. Also found in the Medium Duty models are the Intelliplex and electrical load management systems.

The first Medium Duty model is Model 603, which has many chassis options including International, Ford, Sterling, and Freightliner. This 167 inch body is made to cater to a departments space needs, as it has ample interior room and storage capacity. **Figure 65** and **Figure 66** show examples of the abovementioned model. **Figure 66** shows the large interior space and storage.

Figure 65 - Medium Duty Model 603

Figure 66 - Medium Duty Model 603 Interior

The last model Horton has to offer is the Medium Duty Model 623. This is 173 inch standard body can be adjusted to be as large as 193 inches. This is Horton's largest ambulance available. **Figure 67** and **Figure 68** show examples of this model. **Figure 68** shows the large interior and state-of-the-art equipment on a left-mounted body.

Figure 67 - Medium Duty Model 623

Figure 68 - Medium Duty Model 623 Interior

In conclusion, Horton designs very typical modern day ambulances with various size and storage dimensions. They offer a wide range of options for potential customer and have been an industry leader for quite some time. Additional information about current ambulance models offered by Horton can be found at their website, which is listed in the reference section of this manuscript.

2.4.9 Leader

Leader Emergency Vehicles, based in California, provide a small range of type II and type III ambulance models. The advertising focus is based around craftsmanship, design, and testing processes. As displayed on their website, Leader utilizes modern CNC technology to ensure the accuracy of their parts. This ensures flawless assembly while also leaving very little in terms of wasted material. Leader also ensures quality engineering development in their ambulance manufacturing processes.

> “Wherever possible through internal engineering and customer input Leader has made all efforts to increase the longevity and reduce down time for "nuisance" repairs. Some examples are the tempered Masonite® panels used to cover the rear doors on our type-II's. They resist rain and impact to last longer for you. The wiring gauge and insulation rating in all Leader circuits is well beyond any regulatory agencies requirements. Leader floor covering used in the patient compartment is not only highest grade for durability but installed in such a way to virtually eliminate any fluid entry into unreachable (un-cleanable) areas. Even the back board storage compartment in the type-II's is all welded aluminum. Not just a frame at the opening that is all too common. No matter how hard your crews slam the back boards back in you'll never see any damage to the cabinetry. At the head end of the squad bench on the standard type-II's you'll find a secure place to keep you portable D or E oxygen tanks. No cumbersome straps or buckles to fumble with just a quick release lever to remove the tanks.” [14]

It is clear that both the construction design and materials used are thoroughly investigated and selected with quality and reliability in mind. Ease of use is also highlighted. This is extremely important in an ambulance. In an emergency it is crucial to have everything as simple and quick as possible for the paramedics. Aside from their ambulance manufacturing, Leader also offers purchase support, warranty services, general ambulance services for all brands, remounting bodies to new chassis, and parts sales. All of the following information and specifications are provided on the Leader Ambulance website [14].

Leader offers four Type II models. These consist of the Ford Standard, Ford Silver, Chevrolet, and the Dodge Sprinter. While specifications are not available for all Type II models, each one appears standard of type II construction.

Figure 69- Leader Type II Ford Standard

Figure 69 shows the type II Ford standard model. It is clear that this is nothing more than a converted Ford van. Unique to this photo is the unbranded finish of the ambulance. This is a brand new model prior to sale so it is still entirely white. The required color schemes and logos will be applied based on the purchaser.

Figure 70- Leader Type II Ford Silver

Figure 70 is Leader's photo of the type II Ford Silver model. Based on the pictures provided, this model is no different than the previous Ford Standard model however, since no specifications are provided it must be assumed that the changes are internal features to provide the buyer with a wider range of options.

Of the four type II models, the dodge model is the only one with available specifications. As advertised by Leader, this model provides:

- On Board BIO Station includes paper towels hand sanitizer dispenser & rubber gloves
- 30% Better Fuel Mileage
- All Steel Raised Roof 74" Head Room
- Mercedes Benz Power Train
- 6 Point Harness System
- Smooth Silent Mercedes Benz V6 Diesel
- Capacity For Dual M Cylinders
- Standard Code 3 LED Warning Lights

- All LED Interior Compartment Lighting

In modern day ambulance models, the statistic of 30% better fuel mileage should be of great impact in choosing an ambulance. The nature of ambulance activity provides little time for an ambulance to not be running. A fuel efficient ambulance will save great amounts of money in the long term.

For type III models, Leader provides four models. Three separate Ford models and one Chevrolet complete the squad. For these models however, Leader does not provide any specifications or photos aside from one interior illustration that seems to be standard of all other type III models. This model features a right side paramedic bench as well as a left side bucket seat and a captain's seat at the head of the stretcher. Overhead cabinets and electronic control panels line the ceiling.

In all, Leader offers a standard variety of type II and type II ambulance models. Although the quality craftsmanship and engineering is displayed thoroughly, a major flaw lies in the lack of vehicle details. The website offers very little information specific to each model. This can be a major downfall in terms of sales and convenience of purchasing from Leader.

2.4.10 Life Line Emergency Company

Based out of Sumner, Iowa, Life Line Emergency Vehicles is one of the nation's top modern ambulance manufacturers. Producing type 1 and type3 ambulances, Life Line Emergency Vehicles manufactures ambulances that fit a wide variety of customer demands. As will be seen in the ambulance company report, Life Line offers many type 1 and type 3 ambulances produced on a variety of chassis. This allows the company to market their customizability and wide-spread functionality to customers worldwide. All of the following information is obtained from the Life Line Emergency Vehicles website cited in the reference list [15].

The main series produced by Life Line are the Highliner series, the Paraliner series, the Slant Side series, and the Superliner series. All four different series have separate benefits and drawbacks to offer. For instance, the slant side model while innovative in design does not have as much headroom as the Highliner model. However, the slant side model does offer a long wheelbase and module length for extra room in the rear for medical procedures. To see a full list of ambulance models offered by Life Line, see **Table 7**:

Table 7 Life Line Ambulance Models

		Life Line Ambulance				
Model	**Type**	**Chassis**	**Body Length**	**Width**	**Headroom**	**Storage (ft3)**
Highliner	164" Navister/IH	~24' International Navister	164 3/4"	96"	72 1/4"	83int + 95ext
	171" Navister/IH	24'7" International Navister	171 3/4"	96"	72 1/4"	83int + 95ext
	C4500 - 1	24' Chevy C4500	171 3/4"	96"	72"	83int + 95ext
	C4500 - 2	24' Chevy C4500	171 3/4"	96"	72"	83int + 95ext
	C4500 - 3	24' Chevy C4500	171 3/4"	96"	72"	83int + 95ext
	C4500 - 4	24' Chevy C4500	171 3/4"	96"	72"	83int + 95ext
	Freightline 171 - 1	24' 7" M2 Freightliner Chassis	171 3/4"	96"	72 1/2"	83int + 95ext
	Freightline 171 - 2	24' 6" M2 Freightliner Chassis	171 3/4"	96"	72 1/2"	83int + 95ext
Paraliner	Paraliner EMS Demo	20' 9" Life Line EMS Demo	147 3/4"	92 3/4"	68"	59int + 57ext
	Paraliner Provena Covenant Medical Center	21"6"	147 3/4"	96"	68"	59int + 57ext
Paraliner Type 1	Del Norte Community Ambulance	23' 5" F350	147 3/4"	96"	68"	59int + 57ext
	Bent County Ambulance Service	23' 10" F450	152"	96"	68"	59int + 57ext
	Winneshiiek Medical Center	25" 2" F450	167"	96"	68"	59int + 57ext
Slant Side	Cox Health EMS	23' 4" F700 Series	167"	96"	68"	
Superliner	ESD Superliner	23' Ford	167 3/4"	96"	68"	77int + 70-84ext
	ESD Superliner	22' 5" Ford	167 3/4"	96"	72 1/4"	77int + 70-84ext
	ESD Superliner	22' 5" Ford E450	167 3/4"	96"	72 1/4"	77int + 70-84ext

As you can see, the Highliner series offers the most variety with eight separate models being produced on separate chassis. The slant side series however offers the least bit of variety due to its unique design. An image of this can be seen below in **Figure 71**:

Figure 71 Life Line Slant Side Model

What is special and unique about the slant side model is its module design. If you look carefully you can see that the top of the module bows in and creates a slanted side effect (hence the series name). This allows for increased stability and strength in the module while still keeping the major dimensioning components. The slant side series is used for typical ambulatory functions and is a bit more efficient at longer transport functions than the Highliner series. If looking for more detailed dimensioning details, please see **Table 7**.

The next major series that Life Line develops is the Highliner series. This series is a larger series than the Slant Side or Paraliner series. This can be seen with its 171" body length and 72" width. This provides extra room in the rear to perform medical procedures. This series is typically the most adored by EMS personnel considering the extra space. However, the bigger models can be somewhat difficult to drive in urban settings and a smaller series might fit those particular situations better. To see an image of the Highliner series, see **Figure 72**:

Figure 72 Life Line Highiliner Model

As can be seen, the Highliner series is a beefier series that offers more space to operate and function in. It also provides more comfort to the driver and passenger in the front of the ambulance. However, this is at the cost of fuel efficiency due to the increased weight. Ergo, this series is not fully optimized for but still capable of long transport functionality. Another downside to this series is the increased cost due to the sizing. Again, we see each series has its particular pro's and con's but by offering a wide variety of demands, Life Line Emergency Vehicles covers all bases when it comes to functionality and quality.

The next series in the line-up is the Paraliner series. This series spans both type 1 and type 3 ambulance categories however for this discussion we will only look at the type 1 ambulance. This ambulance is not as big as the Highliner models but it still offers spacious module dimensioning and higher weight capacity. For an image of the model see **Figure 73**:

Figure 73 Life Line Paraliner Model

As you can see, this model is typically built on Ford or Chevy truck chassis which allows for higher payload than the Slant Line series. The slightly smaller size allows for more maneuverability in urban settings as well. This model is a bit more suited for long transport functionality than the Highliner series.

The final series to be discussed is the Superliner series. Life Line develops this series as its all-purpose model. This is also what most people would consider the stereotypical ambulance model. This model is roughly middle ground in every aspect. Average dimensioning that promotes functionality and quality over a specific niche. Although it still offers a spacious module in the rear for EMS personnel. To see an image of such a model, see **Figure 74**:

Figure 74 Life Line Superliner Model

These models are typically built on Ford and Chevy truck chassis much like the rest of the Life Line line-up. The emphasis here is again on functionality and customizability to fit a wide variety of customer needs versus filling specific ones. With such a wide variety of models and series to offer covering the two major types of ambulances here in the U.S. Life Line Emergency Vehicles truly ensures customer satisfaction with respect to what they would like to see in their ambulances. Also, with an emphasis on quality, Life Line Emergency Vehicles ensures its place in the modern ambulance manufacturing industry for some time to come.

2.4.11 Marque, Inc.

Located in Indiana, Marque, Inc. manufactures four main ambulance models as well as offers services to any brand of existing ambulances. All of the following information has been obtained from the Marque, Inc. website cited in the reference list [16]. They advertise the importance of recycling the module compartments of ambulances since these often outlive the chassis. This is far more economically efficient than retiring an entire unit when the module still has life in it. As well as their four main models offered, Marque also accepts completely customizable orders. Their four standard models include type I, II, and III options. The type II Squad Van is the lone type II model and has several desirable features including the steel superstructure which provides an extremely strong roll cage in the event of an accident. The interior of this model is shown in **Figure 75**. Very typical of Type II models, this interior shows one side bench coupled with a captain's chair at the head of the stretcher. Much protective padding can be seen which provides added safety if there were a collision or adverse driving conditions causing increased motion in the module.

Figure 75- Marque, Inc. Squad 2

The next model is the Recruit. This model offers greatly increased module interior than the type II Squad Van. With this extra space an additional seat in placed on the left side of the module recessed into the cabinet and counter area. **Figure 76** and **Figure 77** show both the exterior and the interior of the Recruit. Comparing the interior to the previously discussed Squad Van interior, the extra space is obvious.

Figure 76- Marque, Inc. Recruit

Figure 77- Marque, Inc. Recruit Interior

The last two models, the Commando and the Brigadier are very similar; however, no dimensions are provided to make strong comparisons. Based on the interior photographs shown in **Figure 78** and **Figure 79** the interior layouts seem similar aside from cosmetic color changes and some storage and window options.

Figure 78- Marque, Inc. Brigadier Interior

Figure 79- Marque, Inc. Commando Interior

Marque, Inc. provides a small fleet of reliable ambulances that resemble much of the qualities seen in all modern day ambulance companies. The module chassis relationship is standard and the options available may not be as vast as larger companies however their four models do provide an efficient choice for several situations.

2.4.12 McCoy Miller, Inc.

Based out of Elkhart, Indiana, McCoy Miller is ambulance manufacturing company that provides service to both the public and private sectors. Since their creation in 1974, McCoy Millers has prided themselves on building ambulances that can transport patients in a dependable, safe, and efficient manner. The following information has been obtained from the McCoy Miller, Inc. webpage found in the reference list [17].

McCoy Miller has a group of ambulances currently available of various sizes, types, and available features. They offer a line of ambulances that include Type 1, Type 2, and Type 3. The following table is a list of all currently available McCoy Miller ambulance models with their respective chassis options, dimensions, and GVWR. All of the following information regarding McCoy Miller ambulances was found at the McCoy Miller ambulance website cited in the reference list. **Table 8** is current as of year ending 2010.

Table 8 - McCoy Miller Current Ambulance Models

McCoy Miller	Chassis	Wheelbase	Body Length	Width	Headroom	GVWR (lb)
Type 1						
Medic 146 SE Commander series	Ford F-350 DRW	161"	146"		≥68	12,500
Type 2						
Guardian	Ford E-350 Supervan				≥65	9,400
Type 3						
Medic 163 SE Commander series	Ford E-450 XL DRW Cutaway	158"	163"	98"	≥72"	14,050
Medic 170 SE	Ford E-450 XL DRW Cutaway	158"	170"	98"	≥72"	14,500
Medic 146 SE	Ford E-350 DRW	138"	146"		≥68	10,700
Medic 142 SSB	Ford E-350 DRW	138"	142"	90"	≥66	11,500
Misc						
Resqmedic 170 RM	International 4300 Freightliner FL 50 Ford F-650	170" 167" 182"	170" 170" 170"		≥72" ≥72" ≥72"	20,000 20,000 22,000
GMC/Chevy		142"	90"			

For Type 1 models, McCoy Miller have one model available called the Medic 146 SE Commander series. This model has a 146 inch modular body with a GVWR of 12,500 pounds. Some key features of this ambulance include all aluminum cabinetry, painted aluminum door liners, durable Multispec Clear Coat Interior Finish, vacu-Formed Cushions, Squad Bench Overhead Storage, and acrylic polymer countertops. The chassis for this model is typically the Ford F-350 DRW. **Figure 80** and **Figure 81** show photos of the abovementioned ambulance. **Figure 80** depicts the entire ambulance model. **Figure 81** shows the all-aluminum interior cabinetry.

Figure 80 - McCoy Miller Type 1 Medic 146 SE Ambulance

Figure 81 - Type 1 Medic 146 SE Interior Ambulance View

As a Type 2 option, McCoy Miller offers the Guardian, which has a Ford E-350 Supervan option. This model offers a wide range of features including a full length Roll Cage, LED Diagnostic Control and Dorr Open Circuits, power inverter, Marine Grade High Current

Switches, and HD Machine Crimped Harness. This model has a GVWR of 9400 pounds. **Figure 82** and **Figure 83** show this model. **Figure 82** shows an exterior view of the type 2 Guardian. **Figure 83** shows the interior of the type 2 Guardian, which is a left mounted.

Figure 82 - Type 2 Guardian Ambulance

Figure 83 - Type 2 Guardian Interior View

Along with their Type 1 and 2 models, McCoy Miller also offers a range of Type 3 models. The first of these models is the Medic 163 SE. This 163 inch based ambulance has a GVWR of 14,050 pounds and typically runs on a Ford E-450 Cutaway chassis. Some of its key features include Etched-Trace Power Circuits, LED Diagnostic Control and Door Open Circuits, power inverted, and HD Machine Crimped Harness. **Figure 84** and **Figure 85** show the photos of this model. While **Figure 84** shows an exterior view of this ambulance model, **Figure 85** shows the all-aluminum cabinetry and large interior space.

Figure 84 - Type 3 Medic 163 SE

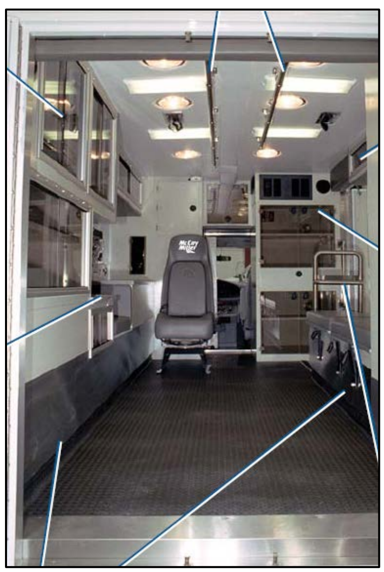


Figure 85 - type 3 Medic 163 SE Interior

With a slightly longer base, the Medic 170 SE is another Type 3 option. This also has a GVWR over 14000 and also runs on the Ford E-450 Cutaway chassis. This model has almost all of the same features as the Medic 163 SE. The only real difference for this ambulance is that it is longer. **Figure 86** pictures the exterior of this model. **Figure 87** shows an interior view showing a larger interior and aluminum cabinetry.

Figure 86 - Type 3 170 SE

Figure 87 - Type 3 170 SE Interior

McCoy Miller also offers two smaller Type 3 models, the 146 SE and the 142 SSB. These two models both a have a Ford E-350 chassis and have a GVWR of around 11000. Key features of these models are not different than any of the key features for any of the other models. **Figure 88** and **Figure 89** show examples of the 146 SE and 142 SSB, respectively. Both views are exterior views of the ambulances. As you can see, both are standard ambulance bodies.

Figure 88 - Type 3 146 SE

Figure 89 - Type 3 142 SSB

The last model McCoy Miller has to offer is a medium duty model called the International Resqmedic. While this model has similar features to all of the other models, it is by far the largest model available. This model has three different chassis options including the International 4300, Freightliner FL 50, and Ford F-650, all of which have a GVWR of at least 20,000. **Figure 90** shows an example of this model. As you can see, this model is by far the largest model.

Figure 90 - Resqmedic Model

Overall, McCoy Miller offers a full range of ambulance including type 1, 2 and 3. The have Models with chassis options as small as the Ford E-350 to as large as the Freightliner chassis. Additional information about current ambulance models offered by McCoy Miller can be found at their website, which is listed in the reference section of this manuscript.

2.4.13 Medix

Based out of Elkhart, Indiana, Medix Ambulance is an ambulance manufacturing company founded in January of 2001. The company prides itself on developing ambulances that exceed customer expectations both here in the U.S. as well as internationally. Certified under both Ford and GM, Medix Ambulance Company produces a wide array of vehicles that meet the demands of many different customers worldwide. The business philosophy of the company is that in order to be successful as a company, the customers have to be successful in their endeavors involving the company's products.

As stated before, the company offers a wide array of ambulances among many different styles of chassis (mostly Ford/GM based). This can be seen in **Table 9** . Any information from here on involving Medix Ambulance is provided by the company's website found in the reference list [26].

Table 9 - Complete List of Medix Ambulnce Models

Medix	Chassis	Body Length	Width	Headroom	Weight (GVWR)
Type 1					
Metro ExpressLTD	Ford F350	150 WB	94	70	13000
Type 2					
SilverHawk	Chevy G-30 Van Ford E350 Van Sprinter 2500 Van	155 WB 138 WB 144 WB			9600 9500 8550
Type 3					
Metro Express 150	Ford E-350	150	94	70	11500
Metro Express 166	Ford E-450 Chevy G-4500	166 166	94 94	72 72	14500 14200
Metro Express RP90	Chevy G-4500 Ford E-350	142 142	90 90	68 68	12300 11500
Sprinter Metro Express	Spartan Furion	142	86	68	11030

As you can see, the Medix Ambulance Company offers a wide variety of ambulances across multiple types (type 1, type 2, and type 3) much like most modern day ambulance manufacturers. However, a difference that may seem subtle but in actuality is quite important is the width parameter of each model. The models are only a few inches wider than those previously examined in the Life Line models at an average of about 90 inches wide. However, the models listed have more headroom than any of the ambulances examined so far. Any information provided from here on about Medix ambulances is provided by the Medix website.

One example of a model that typifies the company's type 1 ambulances is the Metro Express LTD 150. This model is typically built on a Ford F-350 chassis. The model's mini-spec sheet can be seen in Figure 91:

Metro Express LTD 150 Ford F-350 Chassis Cab

MEDIX SPECIALTY VEHICLES, INC.

CHASSIS
- Ford F-350 Chassis Cab, 165" WB, 13,000 GVWR
- Front Axle- 5250 GAWR, Rear Axle-9750 GAWR
- PowerStroke 6.4L DIT V-8 Diesel engine
- Automatic 5-Speed transmission
- Rear Axle- 4.10:1 gear ratio
- Alternators- Dual 115 amp
- 37-gallon fuel capacity
- LT275/75R16.0 "E" black sidewall tires
- Spare tire- matching, shipped loose
- Power door locks- Power windows
- OEM power side mirrors w/convex, turn signals
- Tilt steering wheel; Cruise Control
- AM/FM/CD/Clock radio with 4-speakers
- Dual Captain's chairs with tilt back
- Black rubber formed floor mats
- Back-Up Alarm- 97 decibel
- 47A Ambulance Builder's Prep Pkg

CHASSIS EXTERIOR - BODY
- Body- 150" x 94" x 70" Interior Headroom
- Body Structure- 2" 2" aluminum tubes laminated into solid panel walls and ceiling w/.090" skins
  Extruded aluminum radius vertical corners and roof edge
  Floor- 2" x 2" aluminum tube w/aluminum vapor barrier and .625" plywood sub floor
- Exterior Compartments-
  SS Front- ADP body, O2 M-cyl mount, single door
  SS Middle- ADP body, open storage, single door
  SS Rear- ADP body, BB storage, (2) belts
  CS Front, upper- ALS w/IS/OS access
- Doors & Windows-
  CS Entry door- w/fixed window
  Rear Entry doors- w/fixed windows
- MEDIX ADP rear bumper w/flip-up center step, rubber dock pads
- MEDIX ADP fixed front and rear rubber mud flaps
- Fender Flares- black rubber
- Running Boards- ADP (optional)
- Corner ADP stone guards, lower body ADP rub rail

ENVIRONMENTAL SYSTEMS
- Combination 36K BTU heat, 32K BTU A/C free blow system
- 720 CFM multi-speed fan
- Exhaust fan- 2-speed, 520 CFM
- Thermostatic control

POWER DISTRIBUTION & CONTROL
- OEM dual battery system- 1500 CCA total, under hood
- Digital volt/amp meter
- Basic, easy maintenance relay/circuit breaker system
- Electrical Cabinet- over walk-thru w/hinged, latching door
- Front and rear switch panels w/internal LED back-lighting; switch for each critical function and spare locations for options
- Wiring- GXL, point-to-point, color-coded, stamped labels; wiring sized to voltage requirements of each circuit
- Front Console, floor-mounted formed ABS body w/cup holders
- Rear control panel mounted in Action Area
- Shoreline- 125V-20 amp, 60 Hz covered receptacle
- Battery charger- prewire
- Inverter- prewire
- 125V outlets- (2)
- 12VDC outlets- (2)
- Radio Power/Ground- (2) with antenna coax

EMERGENCY LIGHTING & SIREN
- Light Bar, front- Whelen 4500, Halogen (2) red flashers, (1) clear flasher, (2) red rotators, (2) clear rotators
- Exterior Body- 9x7 Red Halogen on corners each sides and rear, 9x7 Amber Halogen (1) rear center
- Grille- (2) 5x2 Red LED w/chrome bezels
- Intersection- (2) 7x3 Red Halogen w/chrome flanges
- Scene Lights- (4) 9x7 Halogen 8°-32° Halogen
- Load Lights- (2) 9x7 Halogen 8°-32° Halogen
- Hand-held Spotlight- 400,000 CP, in cab
- Siren- 200 watt w/NC microphone in front console
- Siren Speakers- (2) 100 watt thru front bumper

PATIENT COMPARTMENT INTERIOR
- Patient Compartment- Interior Headroom- 70"
- Cabinet to Squad Bench Aisle-46"
- Cab to Patient Compartment walk-thru
- Laminated wood cabinetry-
  Full SS cabinet wall or w/CPR Seat w/Action Area and overhead, Walk-thru cabinets, bulkhead cabinet,
  ALS Cabinet- lower locking cabinet; middle, upper –open storage w/adjustable shelf
- Acrylic sliding doors w/extruded pull handles
- Squad Bench- (3) belted seating positions; hinged lid for interior storage access; Sharps/Waste drop-in w/red plex lid,
- Technician's Seat- rear facing steel storage base w/ cushion and backrest and Type I lap belt
- Interior Lighting- (8) Halogen dome lights recessed in ceiling w/5-minute check-out timer; 12" dual-switch incandescent bar light in Action Area
- Grab handles on each door interior
- Overhead grab rail in ceiling
- Heavy Duty seamless vinyl cushions w/3" foam
- Flooring- .125" vinyl, w/3" roll-up

PATIENT CARE SYSTEMS
- Suction Aspirator- disposable container and hose hard plumbed from gauge on AA wall to 12VDC vacuum pump in walk-thru cabinet
- Oxygen outlets- (2) in Action Area, (1) over Squad Bench

Figure 91 Metro Express LTD 150

The figure shows just how much the Metro Express LTD 150 can feature. Considering this specifications sheet is only a miniature version of the full specifications sheet, we can reason that Medix prides itself on customization while upholding high customer expectations. One particular specification previously listed to make note of is the width of the ambulance. At 94”, the Metro Express LTD 150 is a very wide ambulance. However this allows for a larger module patient area as well as more interior and exterior storage, as mentioned in the specifications sheet. The key idea behind this model, as dictated by Medix, is its affordability while offering larger than usual dimensioning. The module is also 70” high, another component that outshines other ambulance companies’ ambulance models.

The next ambulance type to be discussed about Medix is the type 2 ambulances. These ambulances are typically van-based and are not largely produced due to smaller customer demand and preferences to bigger ambulances by customers. The type 2 ambulance model offered by Medix is called the SilverHawk. This model’s mini-spec sheet can be seen in Figure 92:

SilverHawk Type II Sprinter 2500

MEDIX SPECIALTY VEHICLES, INC.

CHASSIS
- Dodge Sprinter 2500, 144" WB, 8,550 GVWR
- Front Axle- 3970 GAWR, Rear Axle- 5360 GAWR
- Mercedes Benz 3.0L CRD V-6 Diesel engine
- Automatic 5-Speed transmission
- Rear Axle- 3.91:1 gear ratio
- Alternator- Bosch 220 amp
- 25-gallon fuel capacity
- 225/75R16.0 black sidewall tires
- Spare tire- matching
- OEM High Roof
- Sliding curbside door- 51.75"W x 77.5"H opening
- Power door locks- Power windows
- Power operated side mirrors w/convex, turn signals
- Tilt/Telescoping steering wheel
- AM/FM/CD radio with 4-speakers
- Dual Captain's chairs with tilt back
- Gray rubber formed floor mats
- Auxiliary A/C compressor
- Back-Up Alarm- 97 decibel

CHASSIS EXTERIOR
- MEDIX painted rear bumper w/flip-up center step
- OEM fixed front and rear mud flaps

ENVIRONMENTAL SYSTEMS
- Combination 43.6K BTU heat, 32K BTU A/C updraft system ducted down through upper cabinetry
- 580 CFM multi-speed fan
- External auxiliary condenser mounted under body
- Exhaust fan- 2-speed, 520 CFM

POWER DISTRIBUTION & CONTROL
- OEM dual battery system
- Digital volt/amp meter
- Basic, easy maintenance relay/circuit breaker system
- Color-coded, stamped label wiring
- Front Console, floor-mounted aluminum body
- Rear control panel mounted in Action Area
- Shoreline- 125V-20 amp covered receptacle
- Battery charger- prewire
- Inverter- prewire w/universal mounting bracket
- 125V outlets- (2)
- 12VDC outlets- (2)
- Radio Power/Ground- (2) with antenna coax

EMERGENCY LIGHTING & SIREN
- Light Bar, front- Code 3 FM 9000 LED (4) red, (1) clear
- Exterior Body- 9x7 Red LEDs on corners each side, 9x7 Red LEDs each corner rear, 9x7 Amber LEDs (2) rear,
- Grille/Intersection- (2) 7x3 LEDs, (2) 5x2 LEDs in corner housing on bumper, (2) 7x3 LEDS on fenders.
- Interior, Rear Doors- When doors are open, 5x2 Red LEDs (2), (1) 5x2 Amber LED, (2) 26-degree load lights
- Scene Lights- (4) 7x3 LEDS
- Hand-held Spotlight- 400K candle power, in cab
- Siren- 200 watt w/NC microphone in front console
- Siren Speakers- (2) 100 watt in front bumper skirt

PATIENT COMPARTMENT INTERIOR
- Formed fiberglass ceiling panel
- Formed fiberglass curbside wall panel
- Laminated wood cabinetry
- Acrylic sliding doors with full height extruded pull handles
- Patient Compartment- Interior Headroom- 75"
- Cabinet to Squad Bench Aisle- 38"
- Cab to Patient Compartment walk-thru
- Patient Compartment Insulation- 2.5" fiberglass batting
- Sound deadening foam applied to wheel wells
- Squad Bench- (3) belted seating positions, rear access to slide-out Oxygen cylinder bracket.
- QuikNet soft storage above squad bench head pad
- Backboard Storage- 7" vertical slot accessible thru curbside door, holds 16" or 18" boards and scoop stretcher.
- ALS Cabinet- multi-level
- Technician's Seat- rear facing automotive style chair w/integral three-point shoulder harness/lap belt, on steel storage base.
- Interior Lighting- (8) Halogen dome lights recessed in ceiling w/5-minute check-out timer; 12" dual-switch incandescent bar light in Action Area.

PATIENT CARE SYSTEMS
- Suction Aspirator- disposable container and hose hard plumbed to 12V vacuum pump.
- Oxygen outlets- (2) in Action Area, (1) over Squad Bench
- Oxygen Cylinder Storage- Located under squad bench on slide-out, tilt-down bracket.
- IV Holders- (2) rubber, fold-down recessed in ceiling
- Cot Mount- FW # 175-5, single position, removable

PAINT, DECAL, LETTERING
- SOL Decals- optional
- Paint Stripe- optional
- Lettering- optional

WARRANTIES

CONVERSION:
- Electrical- 72 months/72,000 miles
- Limited- 12 months/12,000 miles
- Paint- if applicable- 48 months

MSVI 6/10/09

Figure 92 SilverHawk

As can be seen in the figure above, the SilverHawk is a different ambulance than type 1 and type 3 ambulances. It is van based with no cut in the chassis or inserted module at the rear. Therefore, the rear of the vehicle must be outfitted with the necessary medical equipment for ambulatory services. Some things to note is the short wheelbase (144") when compared to the type 1 and type 3 wheelbases (~154") as well as the similarity in the power distribution in the OEM dual battery system for both. This model, with its smaller size, is mostly used in rare occasions and places where a type 3 or type 1 ambulance is not an option due to either not being affordable or just size issues in the local streets.

The next type of model to be discussed is the type 3 ambulance. This ambulance is typically a truck chassis. As such, a prime example of this type of ambulance is the Metro Express RT90. This ambulance model is typically built on a Chevy G 4500 or Ford E-450 truck chassis with dimensions of 142”x90”x68”, weighing between 11500 and 12300 lb. The mini-spec sheet of this ambulance can be seen below in Figure 93 :

Metro Express RP90 *Chevy G-3500 Cutaway*

MEDIX SPECIALTY VEHICLES, INC.

CHASSIS
- Chevy G-3500 Cutaway, 139” WB, 12,300 GVWR
- Front Axle- 4600 GAWR, Rear Axle- 8600 GAWR
- DuraMax 6.6L DIT V-8 Diesel engine
- Automatic 5-Speed transmission
- Rear Axle- 3.73:1 gear ratio
- Alternators- Dual 145 amp
- 37-gallon fuel capacity
- LT225/75R16.0 “E” black sidewall tires
- Spare tire- matching, shipped loose
- Power door locks- Power windows
- Velvac manual side mirrors w/convex
- Tilt steering wheel; Cruise Control
- AM/FM/CD/Clock radio with 4-speakers
- Dual Captain’s chairs with tilt back
- Black rubber formed floor mats
- Back-Up Alarm- 97 decibel
- YF2 Ambulance Builder’s Prep Pkg

CHASSIS EXTERIOR - BODY
- Body- 142” x 90” x 68” Interior Headroom
- Body Structure- 2” 2” aluminum tubes laminated into solid panel walls and ceiling w/.090” skins
  Extruded aluminum radius vertical corners and roof edge
  Floor- 2” x 2” aluminum tube w/aluminum vapor barrier and .625” plywood sub floor
- Exterior Compartments-
  SS Front- ADP body, O2 M-cyl mount, single door
  SS Middle- ADP body, open storage, single door
  SS Rear- ADP body, BB storage, (2) belts
  CS Front, upper- ALS w/IS/OS access
  CS Front, lower- Battery tray, roll-out
- Doors & Windows-
  CS Entry door- w/fixed window
  Rear Entry doors- w/fixed windows
- MEDIX ADP rear bumper w/flip-up center step, rubber dock pads
- MEDIX ADP fixed front and rear rubber mud flaps
- Fender Flares- black rubber
- Running Boards- ADP
- Corner ADP stone guards, lower body ADP rub rail

ENVIRONMENTAL SYSTEMS
- Combination 36K BTU heat, 32K BTU A/C free blow system
- 720 CFM multi-speed fan
- Exhaust fan- 2-speed, 520 CFM
- Thermostatic control

POWER DISTRIBUTION & CONTROL
- OEM dual battery system- 1500 CCA total
- Digital volt/amp meter
- Basic, easy maintenance relay/circuit breaker system
- Electrical Cabinet- over walk-thru w/hinged, latching door
- Front and rear switch panels w/internal LED back-lighting; switch for each critical function and spare locations for options
- Wiring- GXL, point-to-point, color-coded, stamped labels; wiring sized to voltage requirements of each circuit
- Front Console, floor-mounted formed ABS body w/cup holders
- Rear control panel mounted in Action Area
- Shoreline- 125V-20 amp, 60 Hz covered receptacle
- Battery charger- prewire
- Inverter- prewire
- 125V outlets- (2)
- 12VDC outlets- (2)
- Radio Power/Ground- (2) with antenna coax

EMERGENCY LIGHTING & SIREN
- Light Bar, front- Whelen 4500, Halogen (2) red flashers, (1) clear flasher, (2) red rotators, (2) clear rotators
- Exterior Body- 9x7 Red Halogen on corners each sides and rear, 9x7 Amber Halogen (1) rear center
- Grille- (2) 5x2 Red LED w/chrome bezels
- Intersection- (2) 7x3 Red Halogen w/chrome flanges
- Scene Lights- (4) 9x7 Halogen 8°-32° Halogen
- Load Lights- (2) 9x7 Halogen 8°-32° Halogen
- Hand-held Spotlight- 400,000 CP, in cab
- Siren- 200 watt w/NC microphone in front console
- Siren Speakers- (2) 100 watt thru front bumper

PATIENT COMPARTMENT INTERIOR
- Patient Compartment- Interior Headroom- 68”
- Cabinet to Squad Bench Aisle-46”
- Cab to Patient Compartment walk-thru
- Laminated wood cabinetry-
  Full SS cabinet wall or w/CPR Seat w/Action Area and overhead, Walk-thru cabinets, bulkhead cabinet,
  ALS Cabinet- lower locking cabinet; middle, upper –open storage w/adjustable shelf
- Acrylic sliding doors w/extruded pull handles
- Squad Bench- (3) belted seating positions; hinged lid for interior storage access; Sharps/Waste drop-in w/red plex lid,
- Technician’s Seat- rear facing steel storage base w/ cushion and backrest and Type I lap belt
- Interior Lighting- (6) Halogen dome lights recessed in ceiling w/5-minute check-out timer; 12” dual-switch incandescent bar light in Action Area
- Grab handles on each door interior
- Overhead grab rail in ceiling
- Heavy Duty seamless vinyl cushions w/3” foam
- Flooring- .125” vinyl, w/3” roll-up

PATIENT CARE SYSTEMS
- Suction Aspirator- disposable container and hose hard plumbed from gauge on AA wall to 12VDC vacuum pump in walk-thru cabinet
- Oxygen outlets- (2) in Action Area, (1) over Squad Bench

Figure 93 Metro Express RP90

The figure above represents the majority of the details requested by customers of Medix. This specifications sheet is specifically for the Chevy G-3500 chassis version of this ambulance. This version is actually a bit shorter at 139” wheelbase, but still carries the same amount of medical material and supplies as the other chassis versions of this model. The power system is the same as the other ambulances with an OEM dual battery system. Not much is different from the type 1 ambulances aside from the dimensioning, weight capacity, and the way it is built (truck chassis cutaway).

Medix is a company that focuses on exceeding expectations of both domestic and international customers. As seen in the previous ambulance examples of all three types of ambulance the company can offer, the ambulances themselves are held to a high set of standards imposed by Medix. By developing high class ambulances, the company has solidified its existence in the ambulance manufacturing business for some time to come.

2.4.14 Medtec

Based out of Goshen, Indiana, Medtec is a leading ambulance manufacturer in North America, specializing in custom ambulance vehicles. Part of the Oshkosh Corporation Company, Medtec offers a wide range of ambulance including type 1, 2, and 3 ambulance models. They also provide a group of Additional Duty ambulances.

Medtec prides their type 1 ambulances on excellent performance, easy maintenance, and ample capacity. All of Medtec's type 1 models have an optional 4x4 configuration available. Currently available from Medtec are three different models, two normal and one additional duty. These models are seen in Table 1, along with all other current ambulance models from Medtec. For each ambulance model, chassis option(s), dimensions, and GVWR are displayed. All of the following information regarding Medtec ambulances was found at the Medtec ambulance website cited in the reference list [18]. **Table 10** is current as of year ending 2010.

Table 10 - List of Current Medtec Ambulance Models

Medtec	Chassis	Wheelbase	Body Length	Width	Headroom	Height	Total Length	GVWR
Type 1								
PD 146	Ford F-350 Ford F-450 Ford F-550 Dodge 4500	165" 165" 168.5"	146" 146" 146"	94" 96" 96"	66" 68"/72" 66"	83.5" 89.5" 87.5"	275.73" 275.73" 282.79"	13,000
PD 168F	Ford F-450	189"	168"	96"	72"	93.5"	297.75"	
AD-170	International 41-4400 Freightliner M2 Ford F-650 GM 4500 Sterling Acterra	169" 174" 182" 176"	170" 170" 170" 170"	96" 96" 96" 96"	72" 72" 72" 72"	93.5" 93.5" 93.5" 93.5"	292.01" 292.01" 295.50" 291.60"	
Type 2								
Ford Van	Ford E-350	138"	N/A	71"	66.5"	N/A	238.75	9,400
Sprinter	Dodge Sprinter 2500	144"	N/A	N/A	71"	N/A	N/A	8,550
Type 3								
RediMedic	Chevy G3500 Ford E-350	139" 138"	146" 146"	92" 92"	67" 67"	85.5 85.5	251.58" 247.73"	14,050
PD-168	Ford E-450 G4500	158" 159"	168" 168"	96" 96"	72" 72"	89.5" 89.5"	271.20" 275.03"	14,050
FD-160	Ford E-450 G4500	158" 159"	160" 160"	96" 96"	68" 68"	85.5" 85.5"	263.2" 267.03"	14,050
FD-146	CG 3500	139"	146"	90"	64"	81.5"	253.03	12,300

	Ford E-350	138"	146"	94"	66"	83.5"	" 249.2"	
PD-156	Ford E-450	158"	156"	96"	68"	85.5"	270.24 "	14,050
AD-170	Chevy 4500	165.5"	170"	96"	72"	93.5"	284.1"	16.500 +

The first type 1 model available is the PD 146, which has chassis options of Ford F-350, 450, or 550 and the Dodge 4500. This 146 inch long ambulance model has all normal features and is of conventional size. This model can be found many times in rural EMS settings. Some key features of this type 1 option include available multiplexed electrical systems, optional curbside action seat configurations with 5-point harness, and a vacuum and suction cup system. Figure 1 shows an exterior view of the PD 146.

Figure 94 - Exterior View of the PD 146

Figure 94 shows a cad drawing taken from the Medtec website showing an example drawing a Type 1 ambulance. This figure shows all basic dimensions of the ambulance. All other type 1 ambulance models are similar to this drawing, just with slightly different dimensions. This specific drawing is for the AD 170.

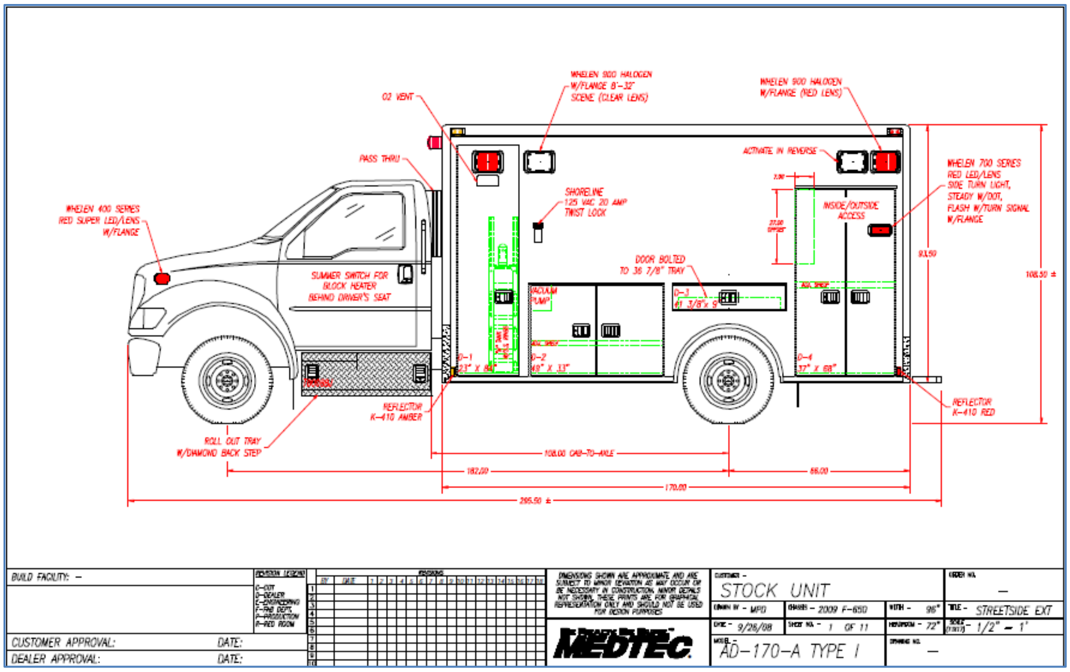


Figure 95 - CAD drawing for Type 1 AD 170

As seen in **Table 10**, there are two other including the PD 186 F and the AD-170. These two models are very similar to the PD 146 but are simply larger and have larger capacity. The AD-70 is especially large and is meant for ambulance service providers that are in need of a lot of space in their ambulances. **Figure 96** shows an exterior view of the PD 168F. This model as you can see is slightly larger than the smaller PD 146 yet it still has sufficient maneuverability. **Figure 97** shows an exterior view of the AD-170. As you can see this model is much larger than the other type 1 models. This ambulance is meant for additional duty needs.

Figure 96 - Exterior View of the PD 168

Figure 97 - Exterior View of the AD 170

Medtec offers two different type 2 model ambulances: the Ford van and the Dodge Sprinter van. As see in the table above, chassis options for these models, as described by their names, are the Ford E-350 and the Dodge Sprinter 2500.   Their base dimensions are much smaller than the types 1 and 3 but these models offer much better maneuverability. These ambulance models are more commonly used by private ambulance companies as opposed to public emergency service providers such as Fire Departments that provide ambulance services. Also, considering that they are considerably smaller than the other models, they can be purchased for at lower cost. A few key features of the type 2 models include non-slip linoleum floors and Mica-covered cabinetry. **Figure 98** shows a view of the Ford Van model. As you can see, this model is much smaller than the other models and is easier to drive. **Figure 99** shows the Dodge Sprinter model. As you can see from the model, this ambulance style is much slimmer and a little bit taller.

Figure 98 - Exterior view of the Ford Van model

Figure 99 - Exterior View of the Dodge Sprinter 2500 model

Figure 100 shows a cad drawing of the Ford van type 2 model, which can be found at the Medtec website. This figure shows all basic dimensions of the ambulance. The Dodge Sprinter model is similar to this drawing, just with slightly different dimensions. All basic features of both ambulances are basically the same.

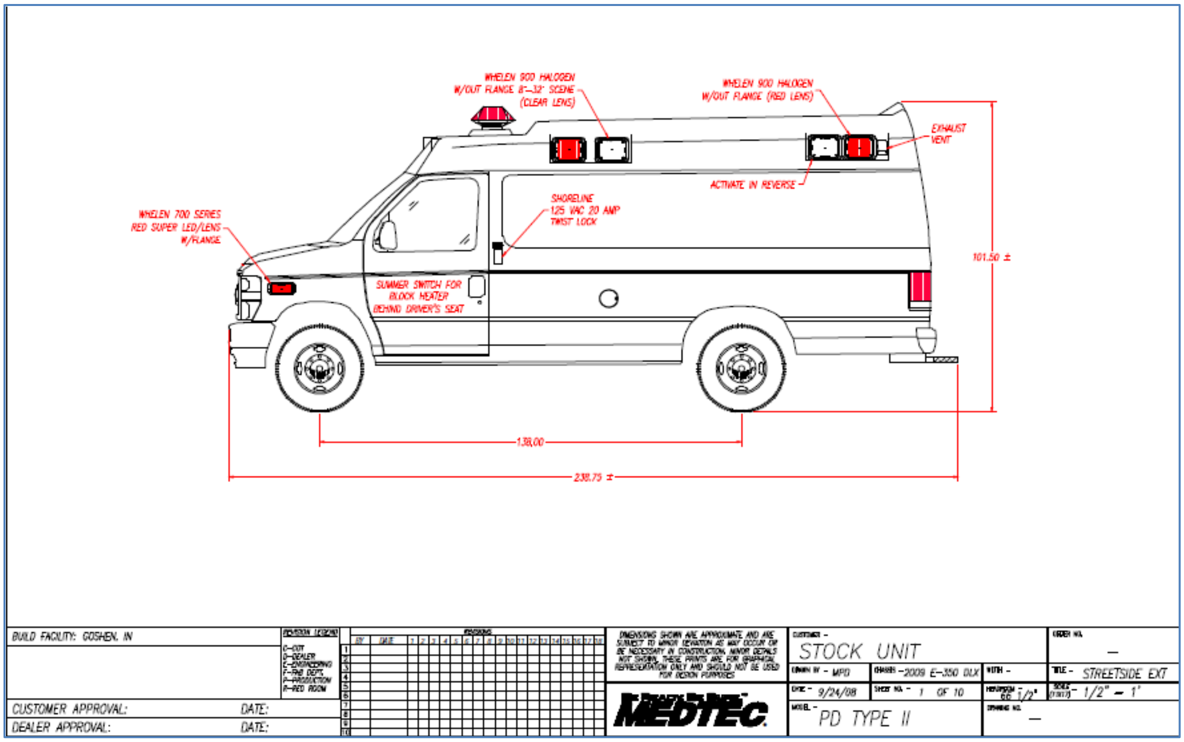


Figure 100- CAD drawing for Type 2 Ford Van

For type 3 models, Medtec has six different models, all of which can be seen in the table above. These models are all very similar with the main difference being in the size and type of chassis. Chassis options for this type are mostly Chevy and Ford options. They range from 146 inches to 170 inches in length. Headroom for these models ranges from 67 inches to 72 inches. Similar to the type 1 models, the type 3 models strike a good balance between ample volume and sufficient maneuverability. The different models display different combinations that cater different ambulance providers' needs. Key features for the type 3 models are the same as the key features for the other two models. The smallest type 3 model, the RediMedic is shown in **Figure 101**. This model typically has either Ford E-350 or Chevy G3500 chassis. Photos of the remaining type 3 ambulances can be found below.

Figure 101 - Type 3 RediMedic Ambulance Model

Figure 102 shows a photo of a PD 168. This model is a little bit larger than the RediMedic and typically runs on either a Ford E-450 or G4500 chassis. This professional duty ambulance has all the necessary room needed and still maintains good maneuverability.

Figure 102 - Photo of the type 3 PD 168 model

Figure 103 shows an exterior view of the FD 160. This model is very similar to PD 168 as it has the same chassis options and has similar size dimensions. The real difference is that the PD 168 is just a little bit nicer. As one would expect, this field duty model is a more affordable option.

Figure 103 - Exterior View of the FD 160

Figure 104 shows a picture of the FD 146. This field duty ambulance is a basically a smaller version of the FD 168. It has very similar features but the dimensions and chassis are smaller. This ambulance is more geared towards emergency service providers that do not need as much space in their ambulances. That the FD 168 would provide.

Figure 104 - Picture of the type 3 FD 146

Shown in **Figure 105** is the PD 156. This model is an intermediate sized ambulance between the FD 146 and the FD 168. It has very similar features as both of the other type 3 field duty models, but has slightly different dimensions.

Figure 105 - Figure of the type 3 PD 156

The last ambulance model available from Medtec is the AD 170. This additional duty ambulance is one the company's largest ambulance models. It compares to the type 1 AD 170s. This model however, typically runs on the Chevy 4500 chassis. Besides the change in chassis, its dimensions are very similar to the type 1 version. **Figure 106** shows the type 3 AD 170.

Figure 106 - Exterior View of the type 3 AD 170

Figure 107 shows a cad drawing of one of the type 3 models. As you can see, this specific model has an E-350 chassis. All other type 3 models have a similar cad drawing. The only real differences are the different size dimensions and the different chassis options.

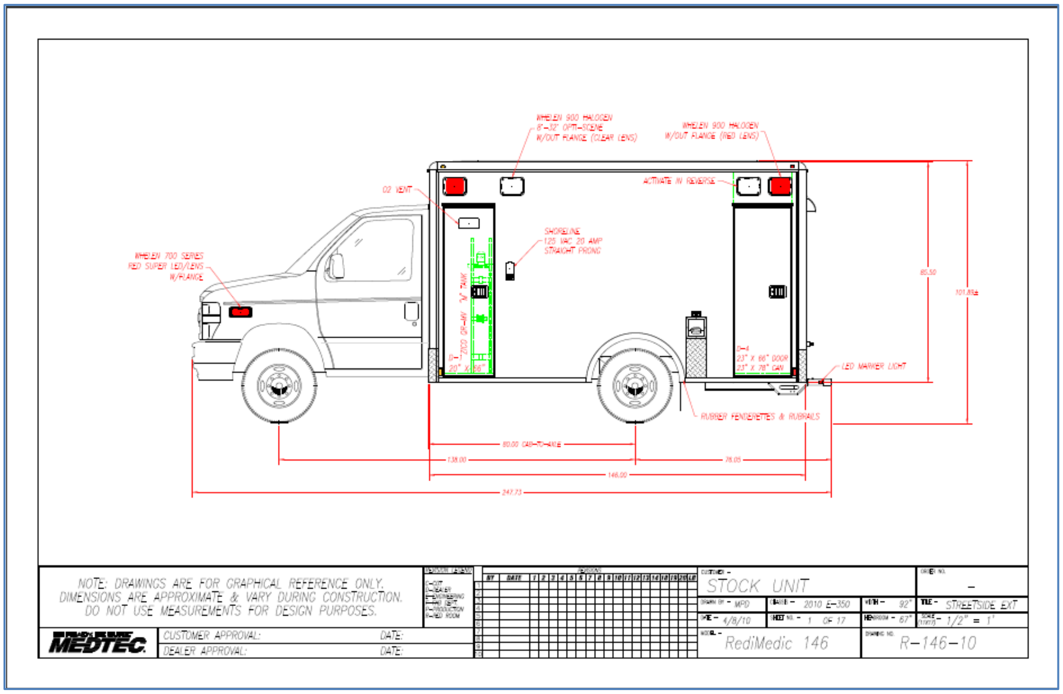


Figure 107 - cad drawing of a type 3 Medtec ambulance

Overall, Medtec offers a full range of ambulance including type 1, 2 and 3. The have Models with chassis options as small as the Ford E-350 to as large as the Freightliner chassis. Additional information about current ambulance models offered by Medtec can be found at their website, which is listed in the reference section of this manuscript.

2.4.15 Miller Coach Company, Inc.

Miller Coach Company is an ambulance manufacturing company with a lot of history. Originally reviewed in our pre-1970 history section, the company survived the change-over from car chassis to truck/van chassis based ambulances by selling ambulances based on van models a.k.a. type 2 ambulances. The company is based out of Springfield, MO and fulfills customer's needs both domestically and internationally. The ambulance models in particular resemble what is seen more in Europe and overseas countries than what we typically see here in the U.S. (type 1 and type 3 ambulances). However, the company, while small, still maintains an emphasis on customizability and quality. All of the following information regarding Miller, Coach Company, Inc. was obtained from the company website as cited in the reference list [19].

The company itself offers two main ambulance models: the 144 Sprinters and the 170 Sprinters. Both models are van based type 2 ambulances. Therefore the payload is not as high as other heavy duty truck based ambulances but the weight is also reduced and allows for a somewhat lighter ride. Essentially the number prefixes for the models dictate the length of wheelbase. As such there are a couple of different configurations available for the 144 and 170 Sprinter models. These configurations are listed below in **Table 11**:

Table 11 - Complete List of Miller Coach Company Ambulance Models

Miller Coach Company	Chassis	Body Length	Width
Sprinter Models			
0501 Sprinter	Sprinter 2500	144"	74"
144 LB/SB Sprinter	Sprinter 144LB/SB	144"/125"	44"
144 DS Sprinter	Sprinter 144DS	144"	74"
2482 Sprinter	Sprinter 2500	144"	58"
2483 Sprinter	Sprinter 2500	144"	58"
2484 Sprinter	Sprinter 2500	144"	58"

As seen in the **Table 11**, the Miller Coach Company doesn't offer many models. However, the key principle here is that each model is highly customizable. So customizable in fact that Miller Coach Company has created an entirely new seating arrangement for type 2 ambulances. This 3-seat arrangement is a step forward in terms of passenger and attendant safety in ambulances. It eliminates the hazardous side bench and introduces two forward facing seats next to the stretcher area. An image of such a set-up as well as the technical diagram of it can be seen below in Figure 108 and Figure 109 respectively:

Figure 108 Miller 3-Seat Configuration

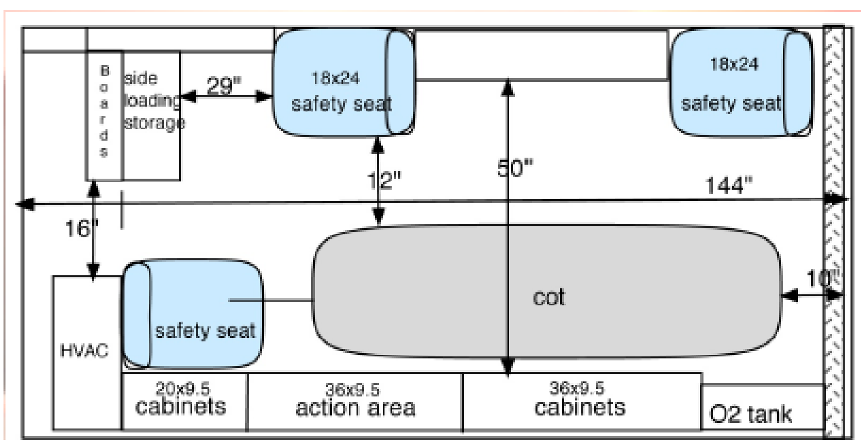


Figure 109 Miller 3-Seat Diagram

This new seating arrangement is quite unique and provides ample support to long distance transport. In addition to this seating arrangement, most ambulances developed by Miller come standard with the following equipment in each respective category:

Electrical

110VAC OUTLETS	1atActionWall,1onCurbside at back of sidedoor.Up to 2 additional can be added. Duplex GFI outlets with ON indicator.
12VDC OUTLETS	Cigar lighter type outlets. Currently 2 in ActionWall,Can be relocated anywhere in the car
USER OUTPUTS	Currently 2 fuseable sources up to 20amp behind ActionWall and 2 fuseable sources up to 20amp in FrontConsole. Additional pigtail can be added behind Drivers Seat
SIREN SPEAKERS	Cast SAD/P 6301-08SPR-6B100watt Speakers each on Pass/DriverSide. Through Bumper Mounting (Note Under Bumper Mounting no longer recommended by Mercedes Benz as it interferes with Crumple Zone and Air Bag deployment)
SIREN	SVP SA700 200 Watt Yelp/Wail/Hi-Lo with Public Address and Horn Ring interface. Can be interfaced to Radio.
INVERTER	Xantrex 1000Watt InverterCharger w/Shoreline Connection Drivers Side. All controls at ActionWall includes voltage indicators and Load indicator. 55Amp Charger with intelligent charging and battery conditioning.

Table 12 Miller Ambulance Electrical Components

Interior Features

OXYGEN	2 Ohio Type Outlets Mounted at Action Wall. Bottle storage is located at Rear Door Streetside in valve accessible cabinet. Door removes for easy bottle changeout.
SUCTION	SSCOR Regulator and built-in Suction Pump. Quick Change, easy to remove Aspiration Container mounted below controls at Action Wall.
HVAC	Proair 941 Series Heat/Air self-contained system with 2nd Compressor, Condensor and Evaporator. Air is vented throughout with 4 adjustable vents mounted at the top of the streetside cabinets. Makeup Air is taken from cab side of unit, not

	recirculated.
CABINET-MAIN	Cabinet Grade Plywood construction with washable Bio-Safe White laminate finish. Corners, crevices sealed. Large Sliding Doors for easy access and uppers with adjustable shelving.
CABINET-SIDE DOOR	Large storage locker at Side Door with upright LongBoard Storage and 2 large cabinets areas. Lower area can be used for Stair Chair Storage or large "Go Bag" area. Both upper and lower areas include safety straps.
ATTENDANT SEAT	Impact Stable Safety Seat with3-point Harness. Large 16 x 16 x 9 Lockable storage area under each seat.
WALK-THRU	16" X 60" WalkThru Doorway with SlidingDoor. Cab side lock included and12 x 15 Window
FLOORING	Tear/Gouge resistant Bio-Safe Flooring with rolled edges. Easy to clean neutral pattern.
VINYL	Vinyl Bio-Safe upholstery on finsh surfaces, Bulkhead, Oxygen Storage, and Head Protection. Cobalt Blue in color
IV HOOKS	Cast Fold away IV Hooks mounted in Ceiling. One mounted over forward Cot Area, one mounted on Curbside.
SAFETY RAIL	6 foot Stainless Steel Safety Rail mounted off center toward Street Side. 1 1/2 inch diameter mounted through finish ceiling into 1/4 inch afixed backing plate.
COT CATCH	Ferno Cot catches for 175-1 style cots. Floor mounted catch system with 16 inch bar

Table 13 Miller Ambulance Interior Features

Exterior Lighting

FRONT LIGHTBAR	Miller Coach POD with 8 Forward facing, 2 Side Facing TOMAR RECT-13 Super High Intensity LED Lights. Standard Lighting Package includes 8 RED LED's w/Clear Lens and 2 Center White LED's. KKK-Flash Pattern with

	Primary/Secondary. Local Jurisdiction Regulation Lighting Available all States.
CORNER PODS	Cast Housings with Weldon 7x9 Halogen Scene Lights, Weldon Diamondback 3x7 LED Emergency Light RED Lens and LED Marker Light (Amber Front/Red Rear). Lights Typical all 4 corners. KK Flash Pattern
REAR LIGHTBAR	Miller Coach POD with 8 Rear facing TOMAR RECT-13 Super High Intensity LED Lights. Standard Lighting Package includes 4 RED LED's w/Clear Lens and 4 AMBER LED's w/Clear Lens. KKK-Flash Pattern. This Light bar can be set to activate on door open.
EXT. REAR	2x15 LED Lights mounted on rear of unit. RED Lens. Low intensity used for Marker Lights High Intensity KKK-Flash. Mounted High for better visibility.
REAR LOAD	Small Footprint High Intensity LED Light for Rear Load. Activates by switch or Door open.
INTERSECTION	2x15 High Intensity LED Lights Mounted over Rear and Front Wheel wells. Lights mounted low for extra visibility.
FRONT BUMPER	Small 1" AMBER Light mounted on Front Bumper used as Master Switch Indicator. Designed as a reminder that the Master Switch has been left on when walking away from unit.
GRILL	Tomar High Intensity RECT-14 RED w/Clear Lens mounted at Grill
MIRRORS	Tomar High Intensity RECT-13 RED w/ Clear Lens mounted on each mirror for extra visibility
RUB RAIL	Small 1" Lights Mounted on each side on the Rub Rail for extra visibility. RED w/Clear Lens Rear, AMBER w/Clear Lens Front. In Non-Emergency mode, lights activate with Marker Lights. When Primary Emergency lights Activated, Lights follow KKK-Flash pattern.

Table 14 Miller Ambulance Exterior Lighting

Interior Lighting

DOME	5 center mounted LED dome lights with High and Low

LIGHTS	intensity. Dome lights turn on at low intensity with side and rear door opening.
ACTION WALL	LED Soft Glow light mounted under action wall provides indirect lighting for night time transport as an alternative to the higher intensity dome lights.
SIDE DOOR	The large cabinet at the side door includes LED lighting that activates on the door opening to light the contents of the cabinet during night time operation
REAR DOOR	The lower floor area of the Rear Door is lit with LED Lighting that activates with the door opening

Table 15 Miller Ambulance Interior Lighting

The tables listed above again are features that almost all the models from Miller contain. Aside from being a van chassis and requiring slightly less power with slightly less storage space, these models aren't much different from standard type 1 and type 3 ambulances. The dimensioning is smaller but the fuel economy is better, therefore these models are better suited for long distance transport versus intense medical treatment, although most offer the tools necessary to treat patients as any other ambulance could. Again the key component here for these type 2 models is the customizability provided with the seating arrangement as well as the interior features. It may seem a little unorthodox compared to the type 1 and type 3 ambulances but it still provides quality service.

With such great innovative products, the Miller Coach Company continues to produce type 2 ambulances of international quality. From their innovative 3-seat seating arrangement to their higher fuel economy long transport ambulances, this company continues to produce high quality, affordable, and adaptable ambulances that continue to meet customers' needs, both domestic and international. Although small, the company shall continue to fill its niche in the ambulance business with continuing success as long as it continues to provide the excellent ambulance manufacturing services it provides today.

2.4.16 PL Custom Emergency Vehicles

Based out of Manasquan, New Jersey, PL Custom is ambulance manufacturing company that has been providing emergency vehicles since 1946, while staying committed to producing high quality products that meet core values of reliability, durability, and safety. While PL Custom provides a group of set ambulance models, all models are custom made based off customer needs. All of the following information regarding PL Custom ambulances was found at the PL Custom ambulance website cited in the reference list [21].

PL Custom currently has a group of type 1 and type 2 ambulances, as well as couple medium duty models. While all models are custom made, features such as chassis option, size dimensions, and GVWR come standard. Some key features of all PL Custom Ambulances include centrally ducted climate control, lowered skirts, Power Logix electrical system, and increased safety. **Figure 110** shows a picture of the centrally ducted climate control. This can be seen on the top of the ambulance in the middle of the photo.

Figure 110 - View of centrally ducted climate control in PL Custom Ambulances

Figure 111 shows the lowered skirts. These allow for easier entry into the side doors of the ambulance. It also allows for easier transport of equipment in and out of the ambulance.

Figure 111 - View of lowered skirts in PL Custom Ambulances

Figure 112 shows a picture of the Power Logix electrical system. This electrical system powers most (if not all) of the electrical systems in the ambulance in an efficient manner. The other plus to this system is that everything can be controlled from one spot.

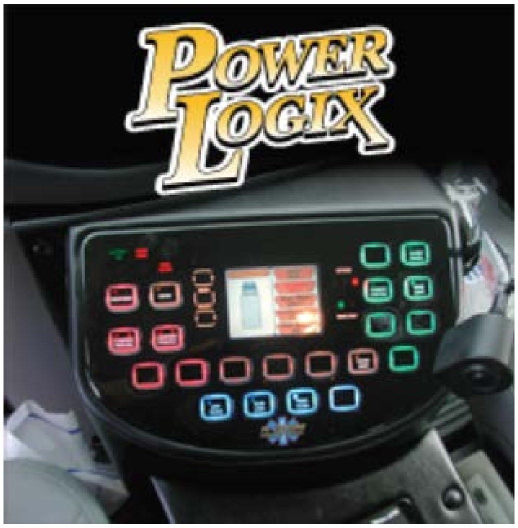


Figure 112 - View of the Power Logix electric system in PL Custom Ambulances

Figure 113 shows a view of the interior of a typical PL Custom ambulance. Increased safety can be found by the 3-point seat belts on each seat and the squad bench safety net at the end of the right side bench. Also, in an effort to increase safety, one can notice the rounded edges on the interior of the ambulance.

Figure 113 - View of increases safety features in PL Custom Ambulances

Table 16 lists all currently available ambulance models from PL Custom with their respective chassis options, size dimensions, and GVWR. This list is current as of year ending 2010.

Table 16 - List of currently available ambulance models by PL Custom

PL Custom	Chassis	Wheelbase	Body Length	Width	Headroom	Height	Total Length	GVWR
Type 1								
Classic F-350	Ford F-350 4x2	165"	147"	99"	68"	108"	280"	13,000
Classic F-Super-156"	Ford F-450 4x2/4x4	165"	156"	99"	68"	108"	289"	16,000
Classic F-Super-170"	Ford F-450 4x2/4x4	189"	170"	99"	68"	106"	302"	16,000
Titan Medium Duty								
Titan 4300 LP	International 4300LP	168"	170"	99"	68"/72"	106"/110"	290"	20,000
Titan M2	Freightliner M2	168"	170"	99"	68"/72"	106"/110"	289"	20,000
Type 3								
Medallion 100	Chevy Cutaway Ford E-350	159" 158"	164" 167"	99" 99"	68" 68"	103" 103"	274" 274"	12,300 12,300
Medallion 170	Chevy Cutaway Ford E-450	159" 158"	170" 170"	99" 99"	68" 68"	103" 103"	275" 275"	14,200 14,500
Medallion 80	Chevy Cutaway Ford Econoline	139" 138"	147.5" 147.5"	99" 99"	68" 68"	103" 103"	252" 252"	12,300 11,500

PL Custom offers three different styles of type 1 ambulances. All of these models, as seen in the table above, run on a Ford chassis, either a Ford F-350 or the Ford F-450. As features go, these ambulances are all very similar. The main difference is the size. For this reason, there are three different size options. The smallest option for type 1 ambulances from PL Custom is the 147 inch long body. The next size is the 156 inch body. The largest type 1 available is a 170 inch body, as well as increase width. This last model provides the most space and capacity for

PL Custom type 1s. While the smallest type 1 has a GVWR of 13,000, the other two models have a GVWR of 16,000. **Figure 114** displays a figure of a typical type 1 ambulance. As seen in the picture, type 1 ambulances typically have a truck chassis.

Figure 114 - Example of a PL Custom Type 1 ambulance

Figure 115 shows a typical drawing of a PL Custom type 1 ambulance. As you can see in the figure, the drawing contains many different views of the ambulance to go get a good perspective of the different dimensions that the ambulance has.

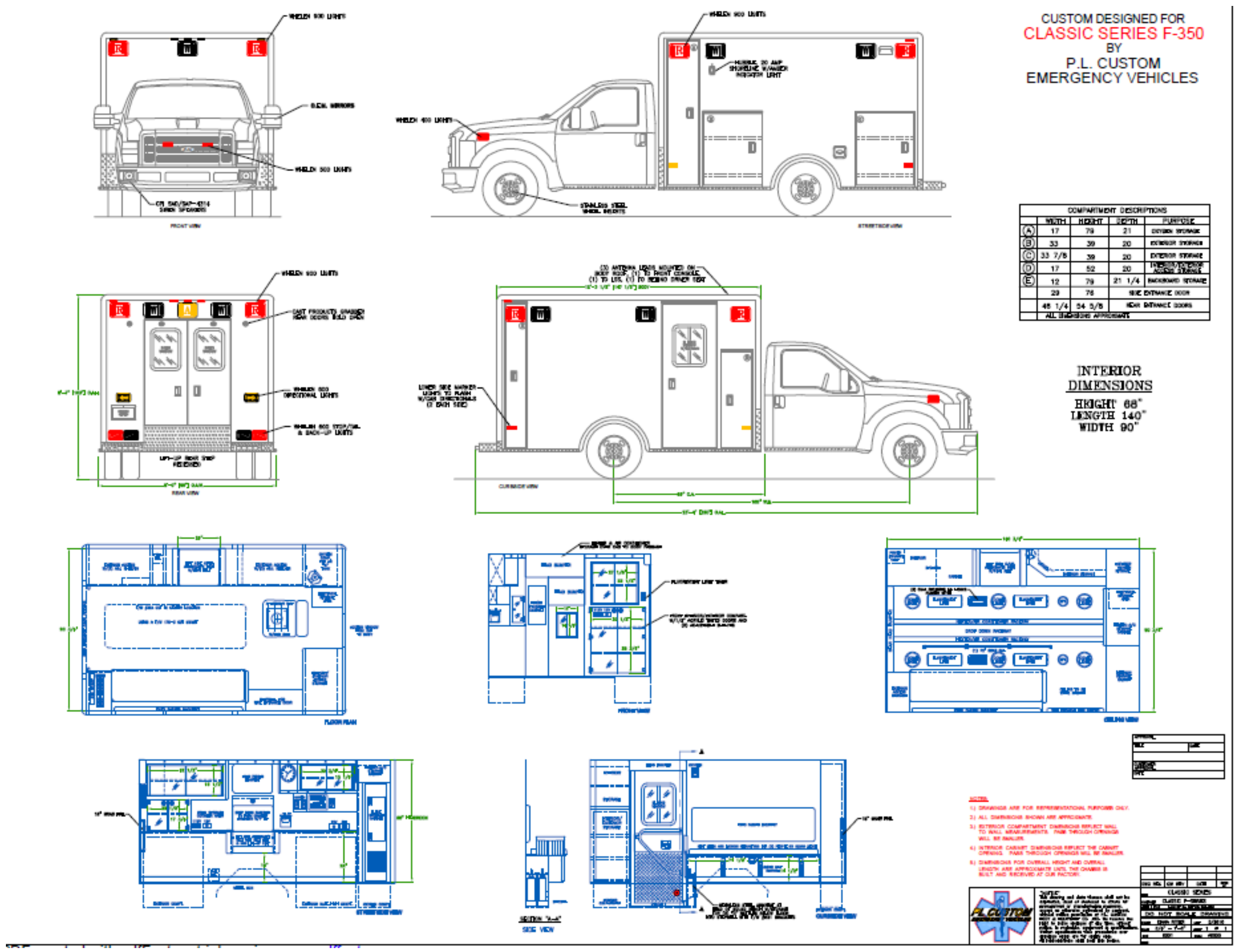


Figure 115 - Cad Drawing of a typical PL Custom type 1 ambulance

PL Custom also offers two different style medium duty ambulances. The main difference between these models is the type of chassis they run on. The two different chassis options , as seen in the table above, are a Freightliner chassis and an International chassis. Both of these ambulance models are typically 170 inches long and have GVWR upwards of 20,000. **Figure 116** shows a typical medium duty ambulance model. Its increased size is clear from the figure.

Figure 116 - Typical PL Custom medium duty ambulance

Figure 117 shows a typical cad drawing for a medium duty model. As you can see in the figure, the drawing contains many different views of the ambulance to go get a good perspective of the different dimensions that the ambulance has.

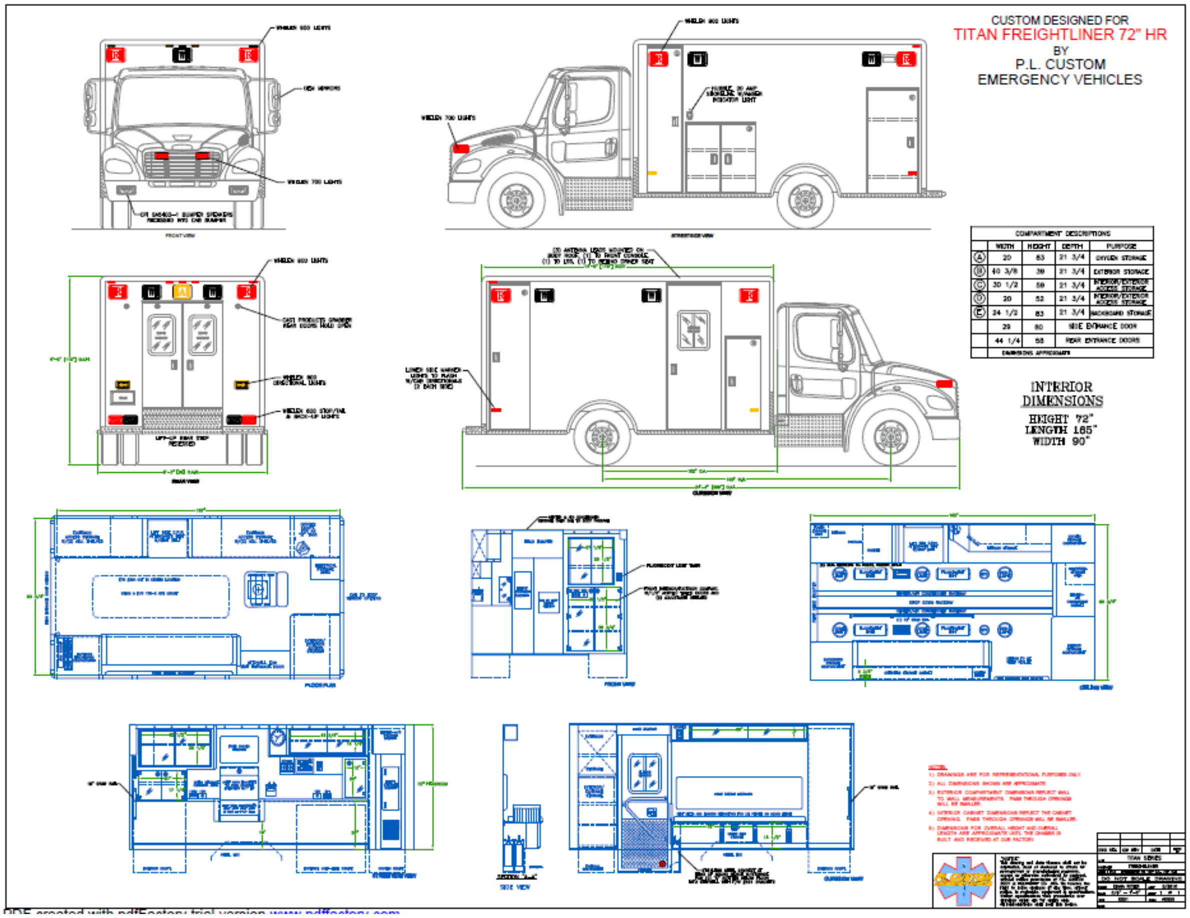


Figure 117 - cad drawing of typical PL Custom medium duty ambulance

PL Custom also offers three type 3 ambulance options. These models, as witnessed in the table above, are called the Medallion 80, 100, and 170. All of these models run on either a Ford or Chevy can chassis and have GVWRs between 11,000 and 15,000. Similar to the type 1s, there is not really much difference in the feature amongst these ambulances. The main difference is simply the size, which corresponds to how much space and capacity each model has. As one would guess, the medallion 80 is the smallest model, while the medallion 170 is the largest model. **Figure 118** shows a typical type 3 model. As seen in the figure, type 3 models typically run on a van chassis.

Figure 118 - typical PL Custom type 3 ambulance

Figure 119 shows a typical cad drawing for a type 3 model. As you can see in the figure, the drawing contains many different views of the ambulance to go get a good perspective of the different dimensions that the ambulance has.

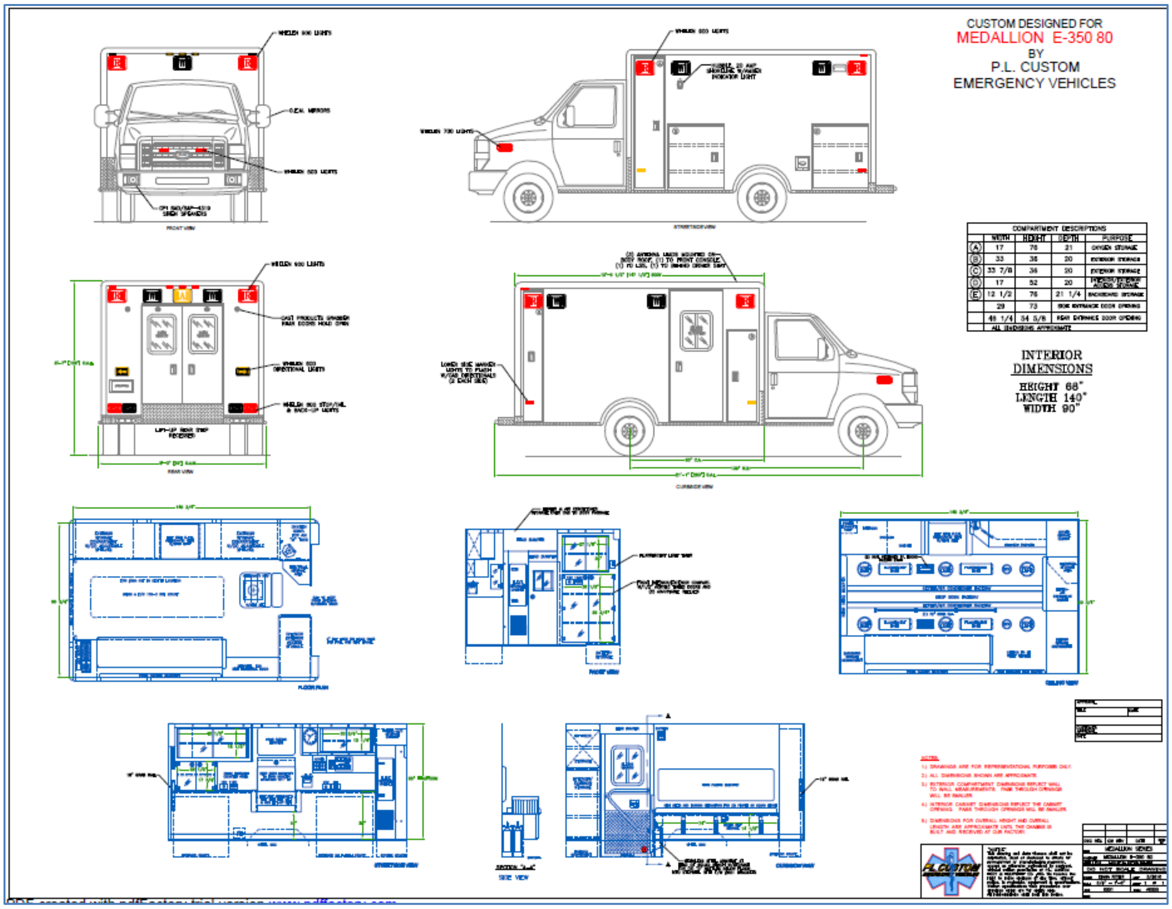


Figure 119 - cad drawing for typical PL Custom type 3 model

Overall, PL Custom offers a range of custom ambulances including type 1, 3, and medium duty. The have models with chassis options as small as the Ford F-350 to as large as the Freightliner chassis. Additional information about current ambulance models offered by PL Custom can be found at their website, which is listed in the reference section of this manuscript.

2.4.17 Road Rescue

The advertising slogan for Road Rescue reads, “In Service for Life”. Based in Florida, this company offers a very large range of ambulance models classified in four different categories: Ultramedic, Promedic, Duramedic, and specialty vehicles. All of these vehicles are said to boast top of the line safety, function, features, innovation, and maintenance. All of the following information regarding Road Rescue was found at the Road Rescue website cited in the reference list [22].

As for safety, Road Rescue puts paramedic crews and patients in the safest vehicles possible. From the placement of structural aluminum supports to their multi-leveled subflooring, the models offered have superior resistance to rollovers and side impacts. The subflooring has a layer of expanded foam that enhances the payload and cuts down on acoustics and other vibrations radiating through the floor of the ambulance. Grab bars are anti-microbial and no wood is used in the construction to ensure the cleanest environment. All materials in the interior of the ambulance are selected based on ease of cleaning and long term durability.

The Ultramedic category offers three models including a type I basic, type I medium duty, and a type III. For each model the buyer also has a variety of chassis to choose from based on their needs and driving styles. The type I medium duty model advertises a spacious environment combined with abundant storage capacity. The air ride suspension unit reduces much noise and vibrations created from the road surface. For chassis options, one could choose between Ford, Dodge, or International models.

Figure 120 depicts the standard setup in the medium duty model. Typical of other companies, this model is setup with a paramedic bench on the right side, with an additional bucket seat on the left and a captain's seat at the head of the stretcher. Figure 121 is a photograph of a unique cabinet feature that Road Rescue offers. While in use the cabinet is a standard sliding glass door for space efficient, quick access to important supplies. When servicing and cleaning however these cabinets also open outwards on gas shocks to allow for easier access.

Figure 120- Ultramedic Medium Duty Interior

Figure 121- Ultramedic Medium Duty Cabinet Assembly

The standard type I model is designed for long chassis and offers the best suspension system for long transports. There is maximum interior space for ease of working and the chassis can be chosen as two wheeled or four wheeled drive. Finally, the Ultramedic type III provides a blend of comfort, functionality and safety. Road Rescue declares this model as the best choice for city streets or long transports. There is an option between a Ford and Chevrolet Chassis. The interior of this model is shown in Figure 122. Very spaciously designed, this model features the typical seating as described of the previous models and has a variety of storage options.

Figure 122- Road Rescue Ultramedic Type III Interior

Next in the Road Rescue lineup is the Promedic series which offers three model varieties. One type I model and two type III models. The type I model is available on a Ford F450 chassis with an option of two wheeled or four wheeled drive. This model is advertised to provide plenty of legroom for the driver as well as easy access to the engine compartment. The type III models are offered as either a Ford F350 or a Chevrolet G3500. The Chevrolet model is the slightly longer model with overall dimensions of 150”x96” compared to the Ford measuring in at 146”x96”. Both models have the same amount of head room at 68”. Figure 123 and Figure 124 show these dimensions for the Ford E350 model. It is seen that the length measurement refers only to the patient compartment. This is important in determining the amount of space for both the patient and paramedics. The dimension of width must also be considered for this same reason however it is important to keep in mind the limitations set by the roads the ambulance will travel and the ability for the driver to maneuver the vehicle in tight situations.

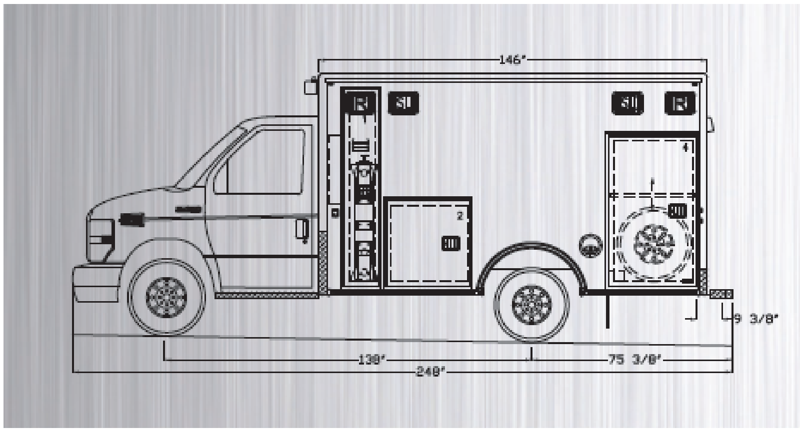


Figure 123- Promedic Type III Ford E350 Exterior Dimensions

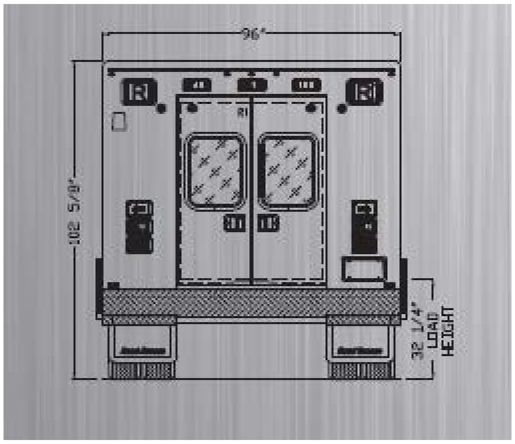


Figure 124- Promedic Type III Ford E350 Rear Dimensions

In Figure 125 and Figure 126 you can observe the dimensions of the alternate Type III Chevrolet model which shows a slightly longer patient compartment while maintaining the same vehicle width. This vehicle would be slightly more difficult to handle driving especially in terms of turning and maneuvering in tight spaces.

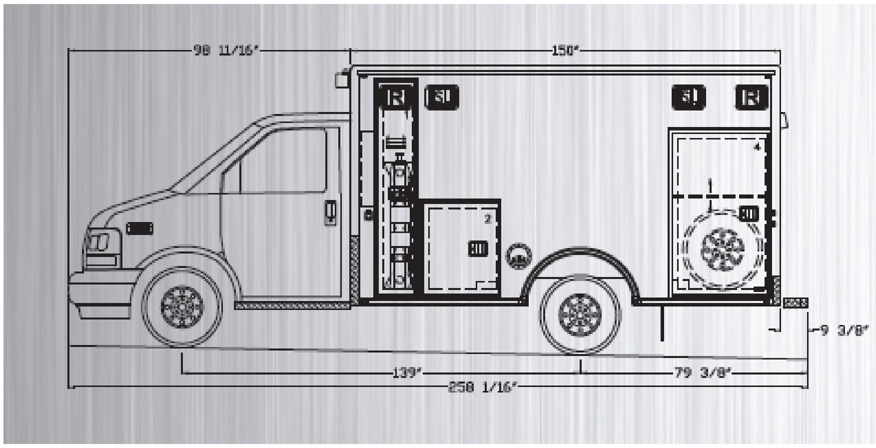


Figure 125- Promedic Type III Chevrolet G3500 Exterior Dimensions

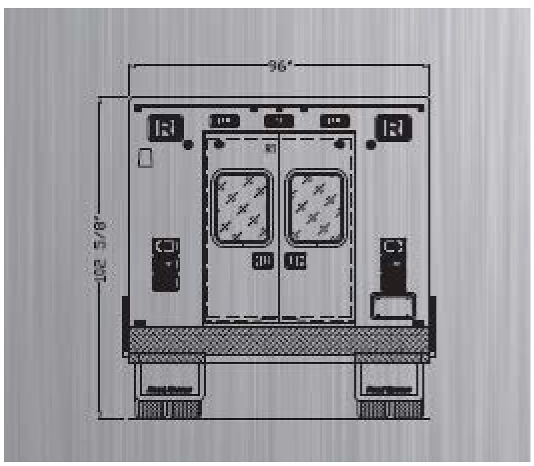


Figure 126- Promedic Type III Chevrolet G3500 Rear Dimensions

To conclude the Road Rescue lineup is the Duramedic line, offering two type II options and two type III models. Of the type I models there are options for the Ford F350, offered both four wheeled and two wheeled drive, as well as the Chevrolet K3500 UltraLight Model. These models are considerable smaller than other similar models and are therefore great for city driving where large vehicles often experience difficulty. Shown in Figure 127 Figure 128 are the exterior dimensions of the type I Ford Model. With a module length of 146" this is still considerably shorter than the previous type III models displayed, however, the Chevrolet UltraLight model is even smaller. Displayed in Figure 129 and Figure 130, the dimensions of the UltraLight model are respectively smaller and therefore more economical in terms of weight efficiency as well as improved maneuverability. As stated, these models are very practical in tight, dense traffic such as that often seen in a city culture.

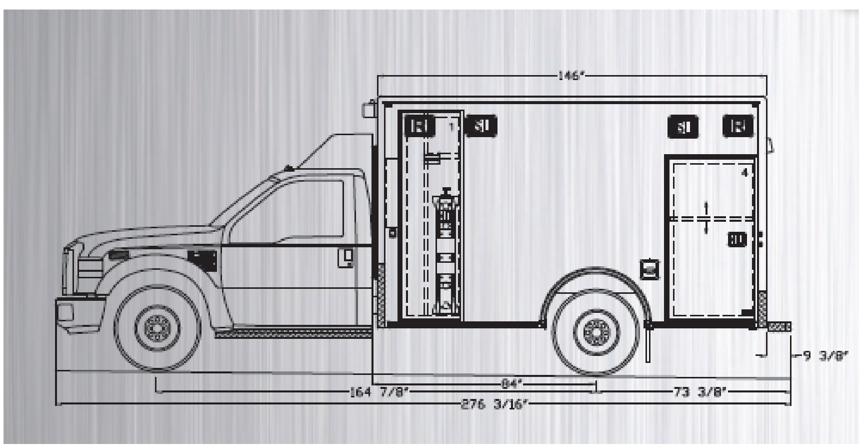


Figure 127 Duramedic Type I F350 Exterior Dimensions

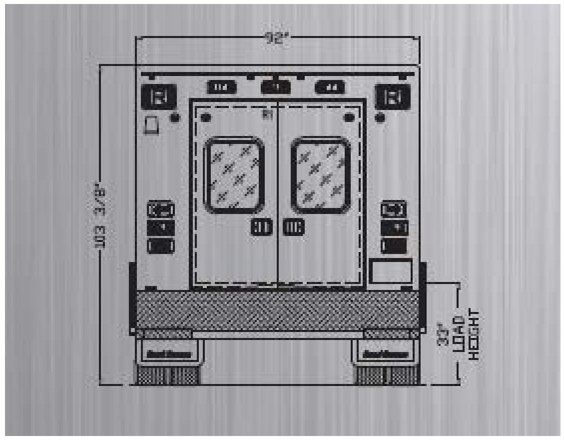


Figure 128- Duramedic Type I F350 Rear Dimensions

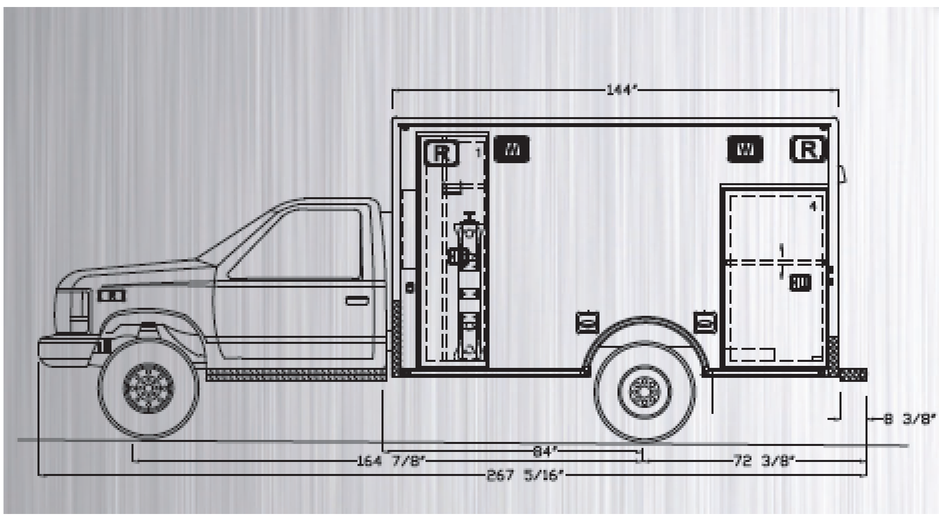


Figure 129- Duramedic Chevrolet UltraLight Exterior Dimensions

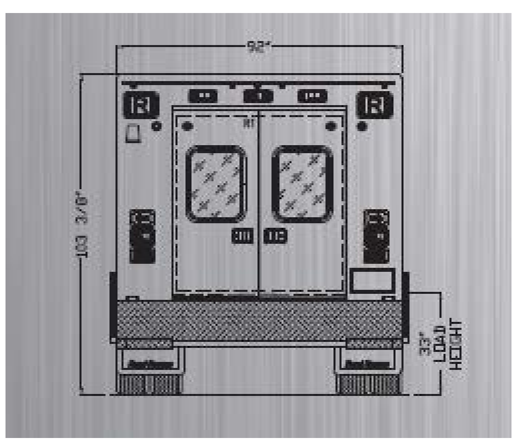


Figure 130- Duramedic Chevrolet UltraLight Rear Dimensions

Completing the Duramedic line is the type III models available as a Ford E350 or Chevrolet G3500. These models are explained on the Road Rescue webpage, "The Duramedic Type III is the meeting of price and features to create long-lasting value, and is constructed with exceptional attention to detail. While being cost efficient, the Duramedic offers all of the features and benefits that are provided on all of the Road Rescue models. The design of the Duramedic Type III allows it to be maneuvered in tight city streets and alleys." [Road Rescue] Like the type I models, these compact designs are built with effective driving and efficiency in mind. Often times the case may be that larger is not better. This is a balance of pros and cons that must be tuned precisely to optimize performance.

2.4.18 Taylor Made

Taylor Made offers a large number of ambulance models in all classes I, II, and III as well as specialty rescue vehicles. The following features along with the additional information detailed in this section are obtained on the Taylor Made webpage cited in the reference list [23]:

■Exclusive aluminum modular body provides a strong structure that is considered one of the strongest body in the industry.

■Multi-stage acrylic urethane hi-gloss paint system with mechanical/chemical barriers to reduce electrolysis.

■Seamless .125" thick aluminum exterior compartment walls.

■Heavy-duty rear bumper with fold-up extruded aluminum rear step for easy loading of any cot style.

■Quality plywood cabinets, covered inside and out with high-pressure laminate. Custom designed to meet your needs and specifications.

■Choice of multiple floor plans including streetside CPR seat configurations.

■Interior cabinet surfaces have rounded edges and padded surfaces for occupant safety.

■Aluminum walls and ceiling that are fully insulated for a quiet module.

■Cot mounts for Ferno-Washington or Stryker stretchers.

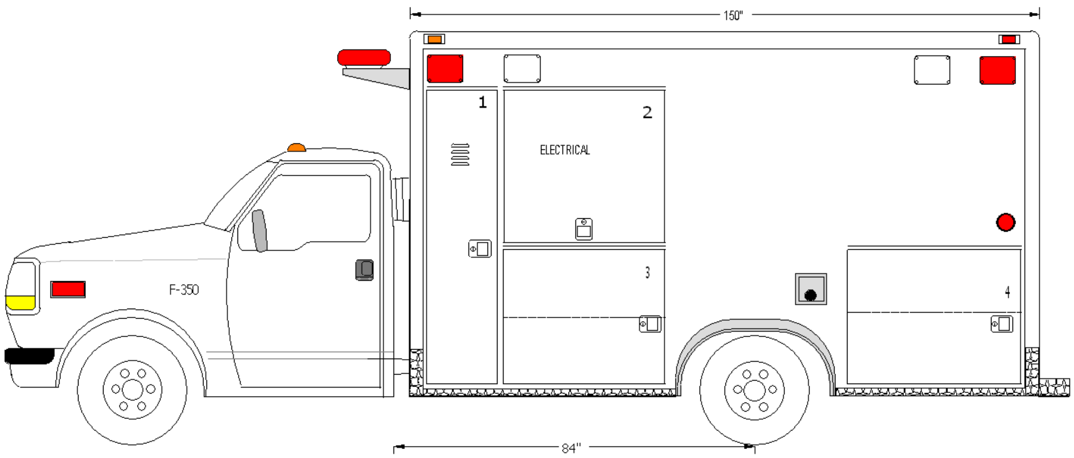
■Hi-back attendant seat with an FMVSS-approved seat base.

■Medical grade seamless polished stainless steel overhead handrail and grab rails on all entry doors.

■Vehicles are built and independently certified to the latest version of KKK-A-1822 standards.

The advertisement of the strongest body on the ambulance market is an important feature in both crash safety and the life expectancy of the individual models. Also adding to the level of crash safety is the rounded edges with extra padding on all cabinet surfaces. In the event of an accident it is important to ensure no sharp or hard corners are exposed to harm the paramedics or patient.

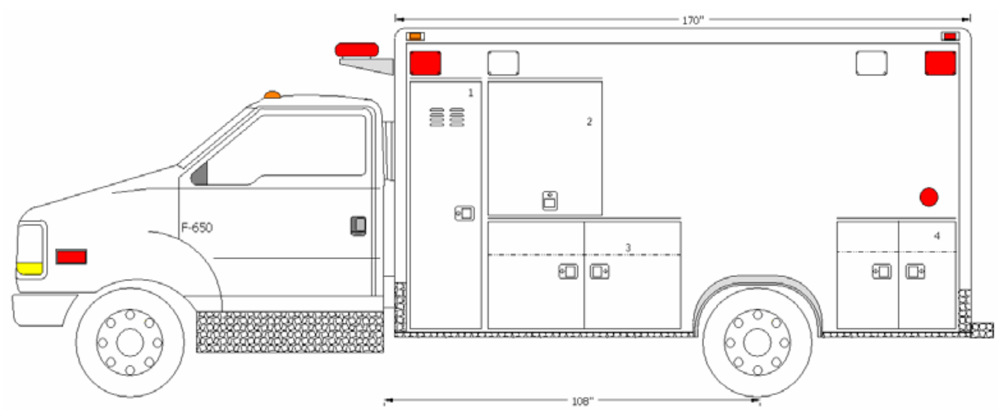
Of the seven type I models available, there are several Fords, International, Freightliner, and Chevrolet options. These models are further categorized as either type I small model or type I large model. **Figure 131** shows an example of a Ford type I small model. This module has a length of 150” and headroom of 68”. This can be compared to a type I large model such as the Ford F-650 seen in **Figure 132**. The drastic increase in size adds space to the module interior but also reduces fuel economy, efficiency, and become much more difficult driving in tight situations such as cities or small towns. This specific F-650 model is 170” by 72”. That is an extra twenty inches in module length and an additional four inches in headroom.



TAYLOR MADE AMBULANCE			
INSIDE FRAME DIMENSIONS			
#	HEIGHT	WIDTH	DEPTH
1	70"	15.5"	18"
2	36.5"	37.5"	5"
3	31.5"	37.5"	18"
4	31.5"	42.25"	18"

NOTES
FORD TYPE I F-350
150" MODULE 68" HEADROOM
STREETSIDE EXTERIOR
2009

Figure 131- Taylor Made Ford F-350 Type I Small Model



TAYLOR MADE AMBULANCE			
INSIDE FRAME DIMENSIONS			
#	HEIGHT	WIDTH	DEPTH
1	74"	21"	20"
2	40.5"	36"	7"
3	31.5"	55"	20"
4	31.5"	39 13/16"	20"

NOTES
FORD F-650 TYPE I
170" MODULE 72" HEADROOM
STREETSIDE EXTERIOR
2009

Figure 132- Taylor Made Ford F-650 Type I Large Model

For type II options, there is a Ford model and a GM model. While these models are similar in all aspects, the GM3500 van is slightly longer with a wheelbase of 155". The Ford E-

350 has a wheel base of 138”. These models are very compact and economical. Depending on the intended use and nature of the transports, efficiency and versatile driving capabilities may trump interior space. As seen in **Figure 133** and **Figure 134**, these two models are nearly identical aside from minor cosmetic changes and overall wheelbase.

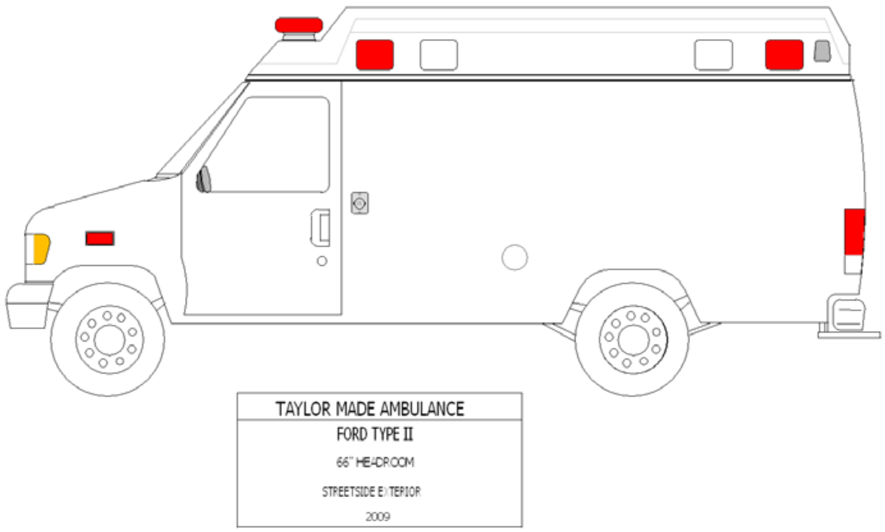


Figure 133- Taylor Made Ford E-350 Type II

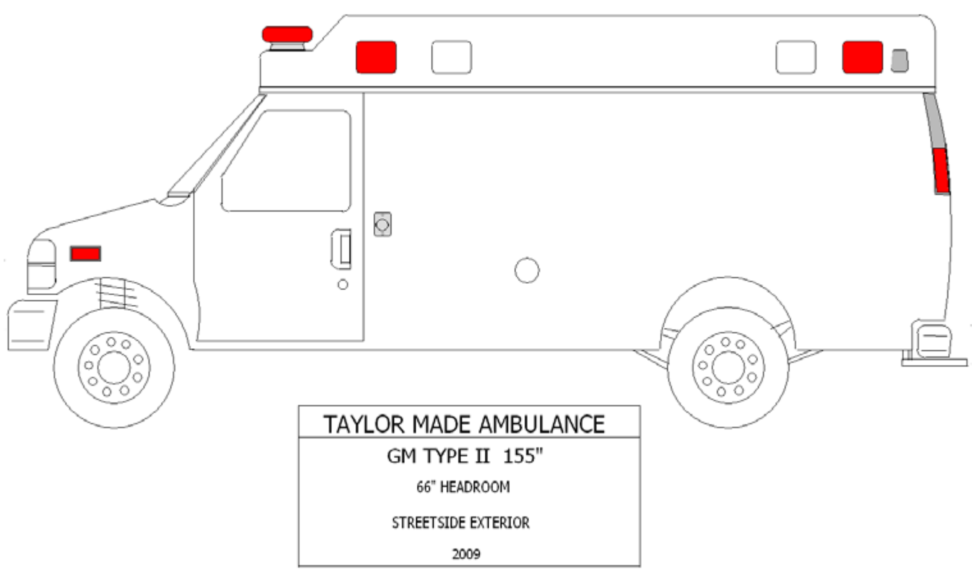
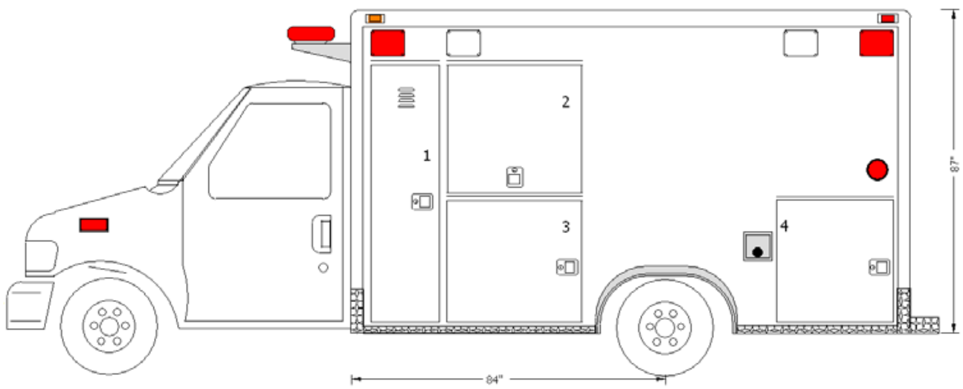


Figure 134- Taylor Made GM 3500 Type II

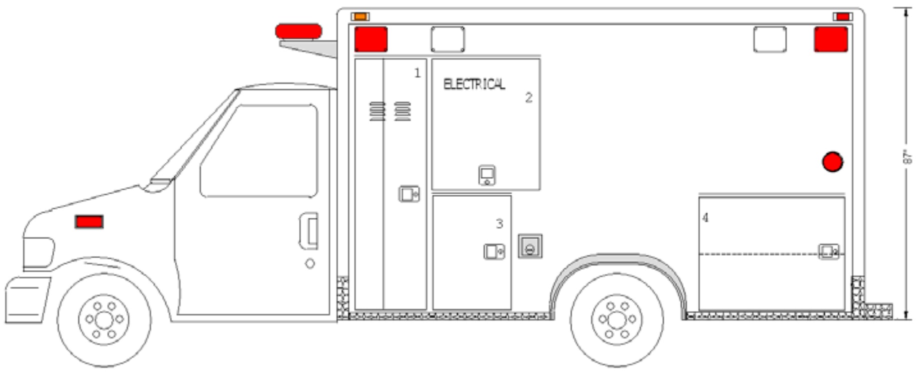
Similar to type I models, the type III models are categorized into type III small and type III large models. The type III small model is offered as a Ford E-350 or a GMC3500 while the type III large model is offered as a Ford E-450 or a GMC4500. The two small models are identical in dimensions, both advertising 150” module length and 68” headroom. These similarities are shown in **Figure 135** and **Figure 136**.



TAYLOR MADE AMBULANCE			
INSIDE FRAME DIMENSIONS			
#	HEIGHT	WIDTH	DEPTH
1	70"	15.5"	16"
2	36.5"	34.5"	5"
3	31.5"	34.5"	16"
4	31.5"	35"	16"

NOTES
FORD TYPE III E-350
150" MODULE 68" HEADROOM
STREETSIDE EXTERIOR
2009

Figure 135- Taylor Made Ford Type III E-350



TAYLOR MADE AMBULANCE				NOTES
INSIDE FRAME DIMENSIONS				GM TYPE III
#	HEIGHT	WIDTH	DEPTH	150" MODULE 68" HEADROOM
1	70"	19.5"	20"	
2	36.5"	31.75"	5"	STREETSIDE EXTERIOR
3	31.5"	22.25"	16"	
4	31.5"	37.75"	16"	
				2009

Figure 136- Taylor Made GM Type III C3500

On the opposing side of type III models, the two large ambulances are offered in much longer chassis options. The Ford E-450 measures in 164” long while the GMC4500 is available as either 164” or 170”. This varying size is an option the customer must base on the ambulance needs and requirements as well as expected budgets.

2.4.19 Wheeled Coach

Based out of Winter Park, Florida, Wheeled Coach is a company that, much like Miller Coach Company, has been in business for a very long time. This company originally started during the pre-1970 conversion era, converting car chassis into ambulances and hearses. However, after surviving the transition from car to truck/van chassis ambulances, the company continues to develop ambulances today with a strong focus on high quality technologies that are featured in their ambulances. The following information has all been obtained directly from the Wheeled Coach website which can be found in the reference list at the end of the report [24].

The company offers a large variety of ambulances that mostly exist as type 1 or type 3 ambulances. These ambulances are much like other companies that produce type 1 and type 3 ambulances in that they are very customizable to the customers' demands and are built under the standards set forth by government legal documents. A few pictures of the models can be seen below in Figure 137, **Figure 138**, and **Figure 139**:

Figure 137 Wheeled Coach FireMedic Type 1

Figure 138 Wheeled Coach Crusader Plus Type 2

Figure 139 Wheeled Coach Custom Type 3

As can be seen in the above figures, the ambulances developed by Wheeled Coach covered a large range of customer demands as well as functionality. Offering all three types of ambulances with high quality technology featured in each was a sure-fire way of maintaining a loyal customer base. To get into more details about these particular models, we first discuss the type 1 ambulance of the FireMedic series (which also offers a type 3 ambulance).

The FireMedic series is an ambulance category which fits the Fire Rescue functionality niche. In essence, this ambulance is the kind you would see originating from a fire station rather than a hospital. The ambulance itself (when looking at the Ford 350 chassi) features: 169” wheelbase, 149” body length, 95” width, 67/72”(optional) headroom, and a total weight with maximum payload of about 12,500 lbs . As you can see, the dimensioning of this model indicates an all-purpose ambulance that can serve as both an intense medical module as well as a transport vehicle. The optional headroom is especially preferred amongst EMS staff.

The next ambulance to be discussed is the type 2 Crusader Plus ambulance. This ambulance is suited more for transport duties but can still function as an ambulatory vehicle.

The emphasis here, as far as the Wheeled Coach model goes, is the increased driver and passenger room as well as increased capacity. The general dimensioning for this model is: 155" wheelbase, 144" body length, 98"width, 68" headroom, and a total weight with max payload of about 10,000lbs. This model therefore has the same sort of rear module dimensioning as the type 1 Firemedic (in headroom and width dimensions) but has a slightly smaller payload capacity, hence the emphasis on transport functionality.

The third ambulance to be discussed is the type 3 Custom Series ambulance developed by Wheeled Coach.   This series is more hospital based than the FireMedic series but also offers type 1 and type 3 variants of the different models. This series contains more tools for medical procedures than the other ambulances. The dimensioning details are as follows: 165" wheelbase, 149"/163"(optional) body length, 95" width, 66",72"(optional) headroom, with a total weight with maximum payload of 11,500 lbs . This model is unique in that a request can be made to extend the body length to allow for more room in the rear of the ambulance. For more information on the models offered by Wheeled Coach, please reference **Table 17**:

Table 17 - Wheeled Coach Ambulance Models

		Wheeled Coach Ambulance							
Model	**Type**	**Chassis**	**Body Length**	**Width**	**Headroom**	**Storage (ft3)**	**Weight(Payload)**	**Weight**	C
Citimedic	Stock	138" WB Ford E350	144"	90"	68"		2100 lb Payload	11500 GVWR	
	Stock Crusader Plus	155" WB Chevy CG33705	144"	90"	68"		2100 lb Payload	9600 GVW	
Custon	MAV	Freightliner M2	160" /170"(optional)	95"	66" /72"(Optional)		5000lb Payload		
		International 4300/4400	160" /170"(optional)	95"	66" /72"(Optional)		5000lb Payload		
		Ford F650	160" /170"(optional)	95"	66" /72"(Optional)		5000lb Payload		
		Chevy C4500	160" /170"(optional)	95"	66" /72"(Optional)		5000lb Payload		
		Sterling	160" /170"(optional)	95"	66" /72"(Optional)		5000lb Payload		
	SRV	165" WB Ford F350	145"	95"				13000 GVWR	
	Type1	165" WB Ford F350	149"	95"	66"			13000 GVWR	
	Type3	138" WBFord E350	149" /163"(optional)	95"	66" /72"(Optional)			11500GVWR	
Firemedic	MAV	Freightliner M2	163" /170"(optional)	95"	67" /72"(Optional)				
		International 4300	163" /170"(optional)	95"	67" /72"(Optional)				
		Ford F650	163" /170"(optional)	95"	67" /72"(Optional)				
		GMC 4500	163" /170"(optional)	95"	67" /72"(Optional)				
		Chevy C4500	163" /170"(optional)	95"	67" /72"(Optional)				
	Type 1 Dodge	167" WB Dodge Ram 3500	153"	95"	72"			12500 GVW	
		167" WB Dodge Ram 4500	153"	95"	72"			16500 GVW	
	Type 1 Ford	165" WB Ford F350	149"	95"	67" /72"(Optional)			12500 GVW	
		165" WB Ford F450	149"	95"	67" /72"(Optional)			15000 GVWR	
	Type 3	158" WB Ford E450	163" /170"(Optional)	95"	67"			14050 GVWR	

As seen in Table 17, we can conclude that Wheeled Coach maintains its status as a major modern developer of ambulances through the manufacturing of a wide variety of ambulance models and series that can fit to even the most extreme of customer demands. This table provides a large amount of information about the different ambulance models with regard to chassis option(s), size dimensions, and weight. From the FireMedic series to the Custom Series, Wheeled Coach ambulances feature some of the latest technologies to function at the highest level of quality.

2.4.20 Modern Era Conclusion

The modern era for the emergency ambulance can be summed up very quickly. The model either looks like a storage van or truck or van with a box attached to the back of it. Once the EMS Systems Act went into effect in 1973, the ambulance transformed from a converted civilian vehicle to a very large, specially manufactured vehicle. Through research of the modern era, one can easily say that the most common chassis options are for ambulance of today are the Ford and Chevy truck and van chassis. Generally the body length of the ambulances range from 144 to 190 inches. Similarly, typical headroom is around 66-68 inches. Likewise, GVWR is often between 10,000 and 20,000 pounds. While there were many major ambulance manufacturers before 1980, there are about 20 major ambulance companies in the Unites States and Canada in the modern era. This reduction can be directly related to the EMS Systems Act of 1973. Although there are few companies that take care of a large amount of customers, there has not been much change in the current ambulance manufacturing companies. Unfortunately, there are only minor differences amongst the different ambulance companies with respect to the style of the ambulances built due to the tight restrictions found in the Star-of-Life Ambulance Specifications (found in Appendix A), which all ambulance manufacturers need to follow. Any additional information regarding specific ambulances models or companies in general that have been talked about in this paper can be found in the respective companies website, which can be found in the reference sections.

After investigating the modern ambulance, the research team redirected its efforts towards creating an online database, which contained a multitude of ambulance information, which can be useful and interesting for EMS personnel, EMS service directors, and lay people alike. In the following sections, the creation and deliverance of the online database will be discussed.

CHAPTER 3. AMBUSPEC

3.1 Introduction

Based out of Worcester Polytechnic Institute in Worcester, Massachusetts, this website is a product of the collaborative work between three students completing an IQP project within the MIRAD Laboratory. The project originated from the desire to create a database that would bring together as much information as possible on past and current ambulances. Throughout this website, you can find a rich history of the emergency medical ambulance starting from the turn of the 20th century up to present, including civilian models and world war models. Similarly, one can see information about a series of events that completely changed the way ambulances were manufactured. Overall, our history of the ambulance will take you through the evolution of the emergency ambulance in America from the 'conversion era' all the way through the 'modern era'.

By understanding past and present EMS services, we have created this website as an internet commonplace to share knowledge about ambulances and EMS services. While the evolution of the ambulance is included in the site, a main portion of the website is a database for modern ambulance information. A list of major ambulance companies of today is including with each of their ambulance models lists along with links to their respective websites. Also, included is a forum for paramedics to freely discuss ambulances and EMS services in general. It is our hope that this website will become a key component in every ambulance purchaser's pursuit of finding the right ambulance for his or her department or company.

3.2 Website Creation

The website was constructed using Google.Sites.com. This was the chosen way of creating the website because the browser is free and very user-friendly. The general layout of the website was a standard template available through the google.sites direction. The colors for the website were chosen arbitrarily but with an objective to create a soothing inviting feeling to the website. To incorporate these conditions, we chose the website to be various shades of blue. The content of the website was decided upon after much deliberation with professor Fofana and the staff at UMass EMS. This content of the website will be described in the following sections of this chapter. Lastly, the name was chosen to be AmbuSpec. This was chosen after much time and thought of trying to find a name that encompassed the word ambulance and some form of the words specifications, information, or knowledge. Ultimately, the research team decided that AmbuSpec was the smoothest sounding name that encompassed those details. The following sections describe the layout of the website and the reasoning for each section as well as figures displaying the different sections of the website.

3.3 Website Description

Ambuspec was created using a tab based website design. That is, while the main pages are displayed in the center of the website, there is a list of tabs on the left side of the site to navigate to any portion of the website that is desired. The website is split into various sections, each with its own subsection(S). These sections will be described in further detail in the following sections of this chapter. An outline of the different sections of the AmbuSpec website can be seen in **Table 18**.

Table 18 - Outline of AmbuSpec website

Section of Website	Subsection(1)
General	• Home • About • Contact Information
Ambulance History	• War Models • ‘Conversion Era’ • Transformation to the Modern Ambulance
Current Ambulance Information	• Ambulance Companies • Ambulance Specs ▪ AEV ▪ Braun ▪ Crestline Coach ▪ Demers ▪ Excellance ▪ Fraser ▪ Horton ▪ Leader ▪ Life Line ▪ Marque ▪ McCoy Miller ▪ Medix ▪ Medtec ▪ Miller Coach ▪ Osage ▪ PL Custom ▪ Road Rescue ▪ Taylor Made ▪ Wheeled Coach
Ambulance Forum	• Ambulance Forum
Related Links	• Related Links

3.3.1 General

The first and most important section of the website is the home page. On this home page we have listed links to three separate sections: Evolution of the Ambulance, Ambulance Forum, and Ambulance Companies. These pages are most important as they provide links to the information designated as the most prominent to any browser of our website. Each individual section will be talked about more specifically in proceeding sections. An image of the home page can be seen below in **Figure 140**:

Figure 140 AmbuSpec Home Page

As you can see above, the home page contains the three links listed previously. This is to keep the website browsers focused on the three main components of the website. We also have on the left our tabs for each section of the website. These major tabs and consequent minor tabs reflect the three major tabs listed on the main page: General (Home, About, Contact

Information), Ambulance History(Evolution of the Ambulance, War Models, ‘Conversion Era’, Transformation to Modern Ambulance), Current Ambulance Information (Ambulance Companies, Ambulance Specs), Ambulance Forum, and Related Links.

The About section of the website is where the description of the website and the reasons for creating the website is listed. Here, the emphasis is informing the web browser as to where the idea of the website came from and why the website exists. Mainly this is addressed in the introduction section. An image of the about section can be seen below in Figure 141 (any particular text that is not visible can be seen on the website itself https://sites.google.com/site/ambuspec/home):

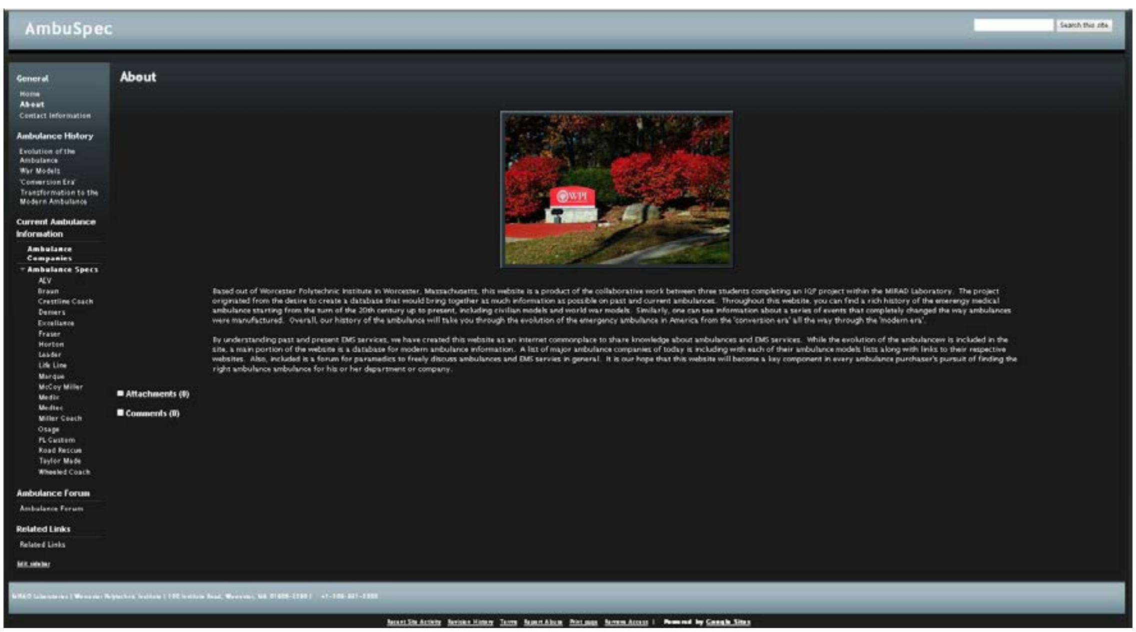


Figure 141 AmbuSpec About Page

As you can see in this picture, the description is very short and concise, describing why we did the project (more specifically the website) and where the idea for it originated. The about page is fairly simple as it only has to convey solely what the website was about to the web browser.

The final part of the Home tab involves the Contact Us page. This page is basically used for any feedback a web browser may have on the website itself or just the project in general. It allows us to better correct any mistakes we may have made as well as gain some constructive criticism as to how we can improve going forward. An image of this page can be seen below in Figure 131:

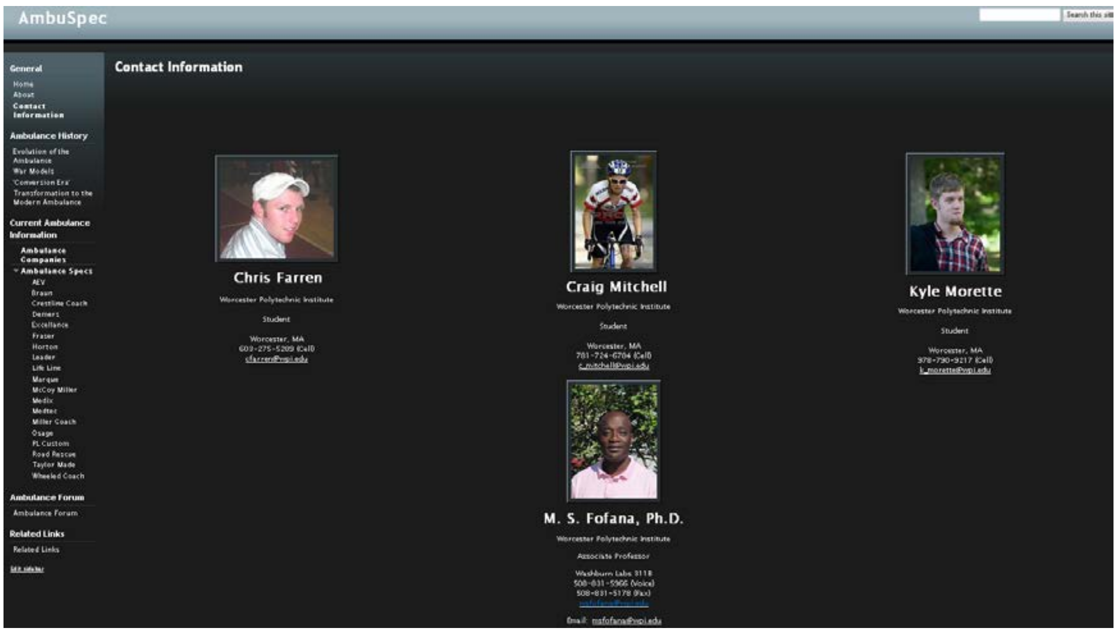


Figure 142 AmbuSpec Contact Us Page

As can be seen above, the image provides pictures of each of the contributing members to this project as well as their phone numbers and e-mail addresses. Again this is to allow easy access to provide feedback or constructive criticisms for the web browser. The next section will talk about the ambulance history provided in the website.

3.3.2 Ambulance History

The next section in this website is the Ambulance History section. This section has three tabbed subsections. Described in the background in this paper, these subsections are the same subsections described above in the background: “War Models,” “’Conversion Era’,” and

"Transformation to the Modern Ambulance," which is simply "the events that changed it all." These sections serve the purpose of the giving the reader a history of the emergency medical ambulance. The first part of this section, the War Models, can be seen in **Figure 143**. This figure shows a portion of the page dedicated to the war models. Included in this page is (although not shown in this figure due to size constraints of the picture snipping tool) a history of the war models, as well as figures of the different models.

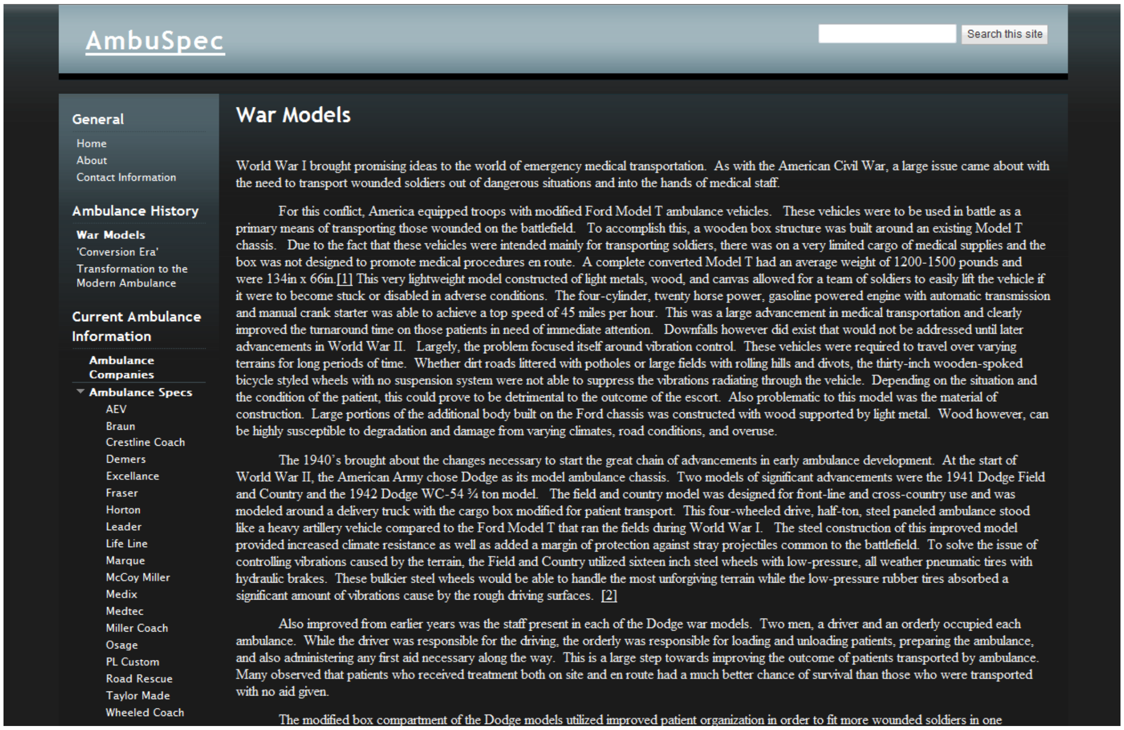


Figure 143 - AmbuSpec War Models tab

There are also tabs on the website for the 'conversion era' and 'transformation to the modern ambulance.' These two tabs are very similar to the 'War Models' tab shown above. They too offer information regarding the subject matter as well as pictures to help clarify the information. Like the 'War Models,' the information for these two tabs can be found in the background section of this paper. The following section will describe the 'modern era.'

3.3.3 Current Ambulance Information

Following the ambulance history, the website will have tabs for "Current Ambulance" information. For this section of the website, there are two different parts: 'Ambulance Companies' and 'Ambulance Specs.' The first of these two parts is simply a compilation of all the major modern ambulance companies with links to their respective websites, as well as each company's contact information. The list is shown on the website in table format. The table is shown below in **Table 19**.

Table 19 - Complete list of modern ambulance companies

Company	Contact Information	Link
American Emergency Vehicle (AEV)	165 American Way Jefferson, NC 28640 P: 800-374-9749 P: 336-982-9824 F: 336-982-9826 Email: info@aev.com	AEV
Braun Industries, Inc.	1170 Production Drive Van Wert, OH 45891 P: 800-22-BRAUN P: 419-232-7020 F: 419-232-7070	Braun
Crestline Coach Ltd.	802 57th Street East Saskatoon, Saskatchewan, S7K 5Z1, Canada P: 306-934-8844 (Canada) P: 888-887-6886 (Toll Free in North America) F: 306-242-5838 (Canada) F: 800-667-0002 (Toll Free in North America)	Crestline Coach
Demers Ambulances	28 Richelieu Beloeil, QC J3G 4N5, Canada P: 450-467-4683 (Canada) P: 1-800-363-759 (Toll Free in Canada and USA) F: 450-467-6526 (Canada) Email: info@demers-ambulances.com	Demers

Excellance, Inc.	453 Lanier Road Madison, AL 35758 P: 1-800-882-9799 P: 256-772-9321 F: 256-772-8792	Excellance
Fraser Ambulance	4780 NE 3rd Street Des Moines, IA 50313 P: 866-537-2737 P: 515-266-7766 Email: webmaster@fraserambulance.com	Fraser
Horton Emergency Vehicles	3800 McDowell Road Grove City, OH 43123 P: 614-539-8181 F: 614-539-8165 Email: info@hortonambulance.com	Horton
Leader Emergency Vehicles	10941 Weaver Avenue South El Monte, CA 91733 P: 626-575-0880 F: 626-575-0286	Leader
Life Line Emergency Vehicles	1 Life Line Drive Sumner, IA 50674 P: 563-578-3317 Email: dcole@lifelineambulance.com	Life Line
Marque Ambulance	1110 D.I. Drive Elkhart, IN 46514 P: 574-970-6799 P: 888-999-2175 (Toll Free) F: 574-970-6798	Marque
McCoy Miller	1110 D.I Drive Elkhart, IN 46514 P: 574-970-6700 P: 800-326-2062 F: 574-262-9236	McCoy Miller
Medix Ambulance Service	26021 Pala Mission Viejo, CA 92691 P: 949-470-8900 P: 949-470-8915 F: 949-470-8967	Medix
Medtec Ambulance Corporation	2429 Lincolnway East Goshen, IN 46526 P: 574-534-2631 P: 866-2MEDTEC (Toll Free)	Medtec

Miller Coach Company Inc.	1744 West College Street Springfield MO, 65086 P: 800-824-9643 Email: info@millercoach.com	Miller Coach
Osage Ambulances	194 Twin Ridge Road Linn, MO 65051 P: 800-822-3634 F: 573-897-3113 Email: info@osageind.com	Osage
PL Custom Emergency Vehicles	2201 Atlantic Avenue Manasquan, NJ 08736 P: 800-752-8786 F: 732-223-8456	PL Custom
Road Rescue	2737 North Forsyth Road Winter Park, FL 32792 P: 800-932-7077 F: 800-513-2688 Email: greg.gleason@roadrescue.com	Road Rescue
Taylor Made Ambulance	3704 Medallion Place Newport, AR 72112 P: 800-468-1310 F: 870-523-4835	Taylor Made
Wheeled Coach Industries	2737 Forsyth Road Winter Park, FL 32792 P: 407-677-7777 P: 800-422-8206 (Toll Free) F: 407-679-1337	Wheeled Coach

Figure 144 - AmbuSpec Ambulance Companies tab shows a small snippet of the 'Ambulance Companies' portion of the website. This gives you a better idea of what the above table looks like displayed on the website.

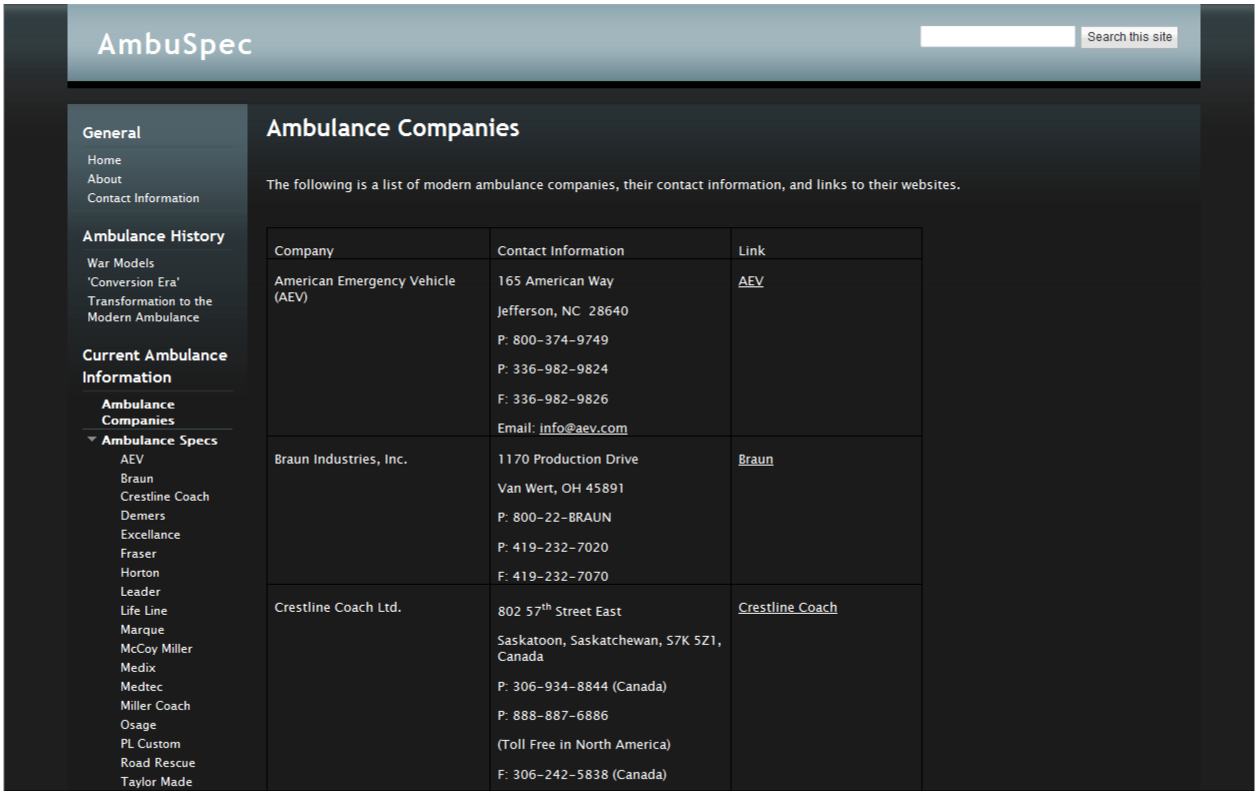


Figure 144 - AmbuSpec Ambulance Companies tab

After the Ambulance Companies tab, there is an Ambulance Specs tab. This tab has subtabs for all of the modern ambulance companies. For each tab, there is a small section on the top of the page showing a quotation from the respective company's website telling about the company. After the "about"section, there is a table displaying the company's different ambulance models with their respective chassis options as well as what type of ambulance they are. Also, each ambulance model displayed is a link to its respective page on the company's website. The figure below shows an example of one of the modern ambulance company's pages. **Figure 145**, one can see the about section and the beginning of the table.

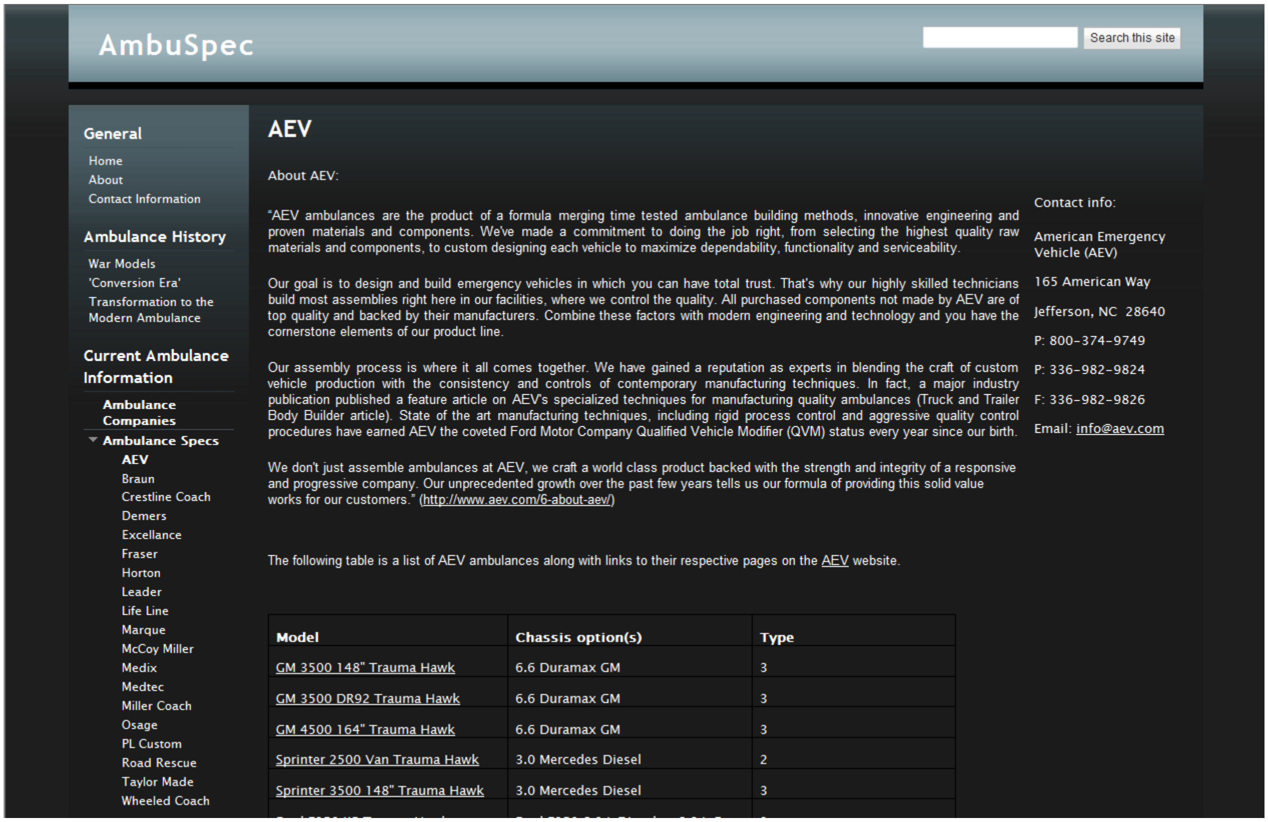


Figure 145 - Example of Modern Ambulance Company tab

This concludes the discussion of the modern ambulance portion of the website. The following section will discuss the forum.

3.3.4 Ambulance Forum

The next major part of our deliverable for this project, branching from the information website, is a forum. In this forum, medical personnel, mainly EMTs, can post about a slew of different topics. Some of these topics include but are not limited to: current events with respect to ambulance models as well as emergency events taking place, favorite ambulance model along with pros and cons as to why it is such, ambulance complaints, and a general discussion section. To see an image of the home page of the forum, please see Figure 146 below:

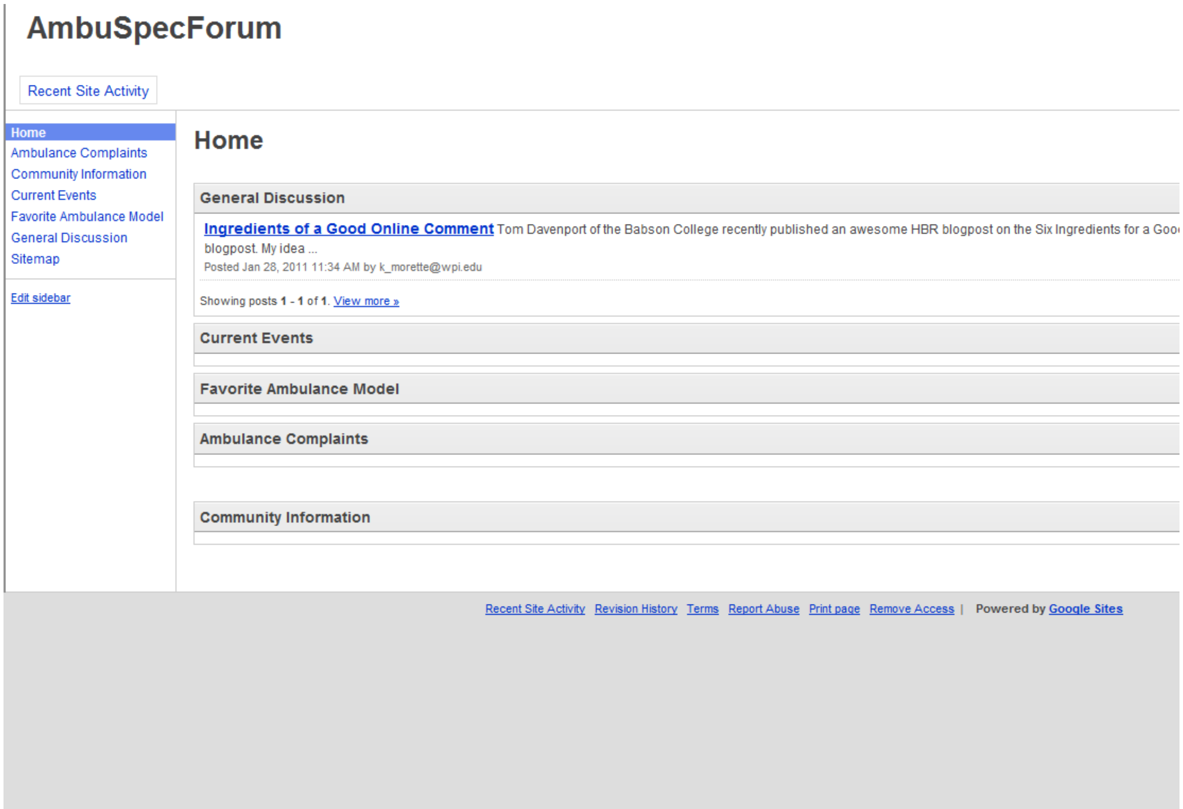


Figure 146 AmbuSpecForum Home Page

As you can see from the image above, the main priority in this forum is simplicity and efficiency. The goal was to provide any EMS personnel easy access to posting ambulance related information so that the information itself, be it personal opinions or actual important event-related information, could get out to the audience (other EMS personnel) fairly easily.

The website forum was developed using Google sites, much like the informational website. This was due to the ease of use of the Google site user interface when creating websites, especially forums. In addition, this allowed the moderators more control over what gets posted and the ability to delete posts that were inappropriate in nature and should not be posted on the website forum. Also, the moderators of the website can easily modify which tabs they want on the left and what category of forum post is displayed on the front page using the Google site editor options.

The tabs on the right are as follows: Home, Ambulance Complaints, Community Information, Current Events, Favorite Ambulance Model, and General Discussion. A higher resolution screen shot of this can be seen below in Figure 147:

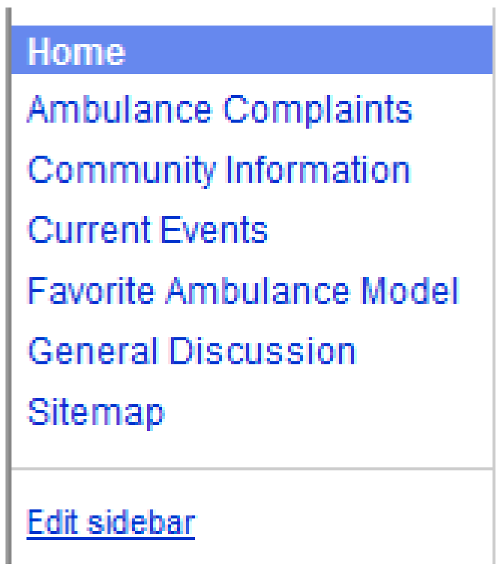


Figure 147 AmbuSpecForum Website Tabs

Again, the emphasis here was on simplicity and efficiency in getting information out there. With ease of access, any EMS personnel can use the forum in a speedy manner such that the information they desire to read about or post about can be accessed with minimal inconvenience.

To go into a little more detail about the tabs on the left side of the forum website, we will start with the home page. This page displays essentially the moderators' choice as to the most important forum posts under their respective categories. This allows any EMS personnel to see highly important topics right when they access the site. An image of the home page can be seen in Figure 146. The next tab on the sidebar for the forum website is the Ambulance Complaints tab. Here, the moderators encourage EMS personnel to explain in detail and with factual evidence some of the drawbacks to certain ambulance models or potentially specific options that these ambulances offer. An image of this tab can be seen below in Figure 148:

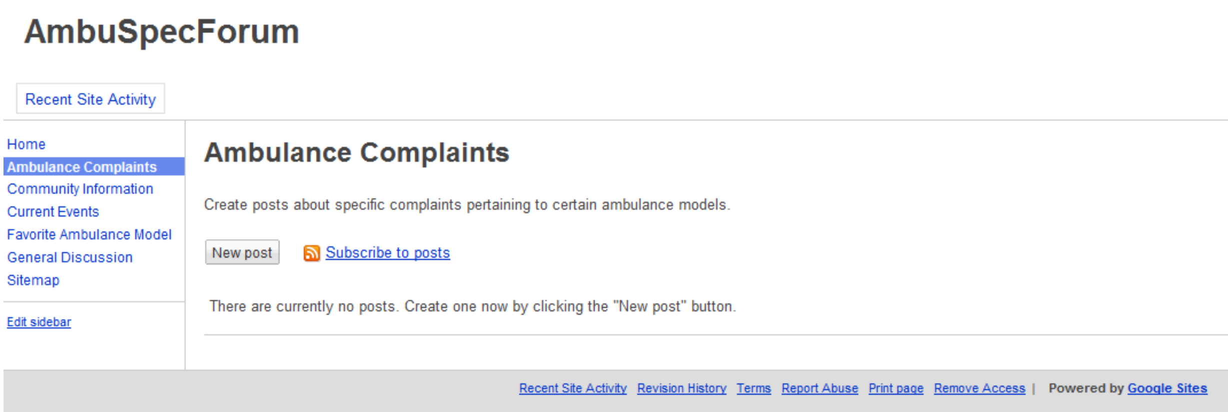


Figure 148 AmbuSpecForum Ambulance Complaint Page

The page is rather empty due to the website not being in the public domain as of yet. This is the case for the rest of the forum sections (aside from the General Discussion page). The next tab is the Community Information tab. This tab is used both for the moderators to convey information to the audience of the website as well as a way for EMS personnel to post general information they would like to address to other EMS personnel. This information is more general and would not be appropriate for the more specific ambulance tabs. An image of this can be seen below in Figure 149:

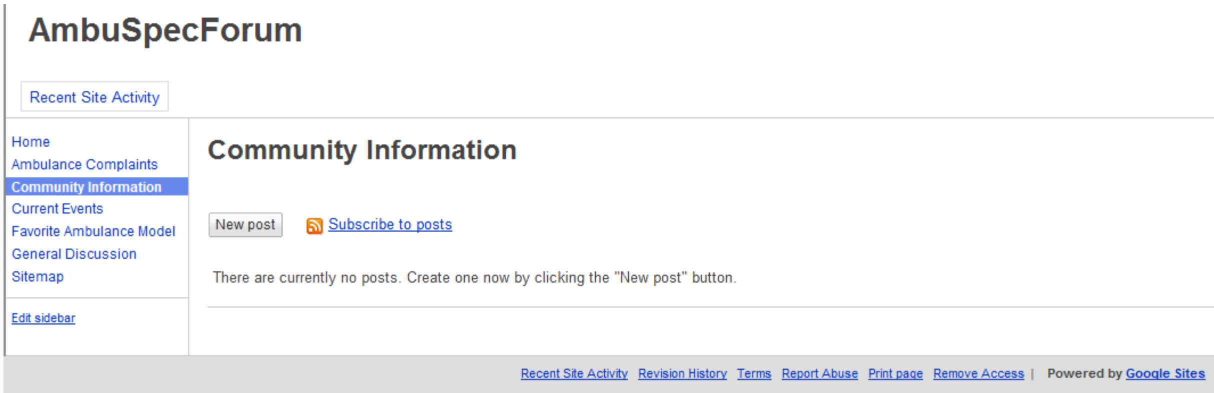


Figure 149 AmbuSpecForum Community Information Tab

As you can see, this tab does not have any posts on it due to the previously mentioned reasons. Once the website is up and running we fully expect to see more posts on each page. The next tab is the current events page. This page is where EMS personnel and fire chiefs for their respective stations can post about events that are happening, both in an emergency sense as well as just current informational events such as expos or seminars in local areas. An image of this tab can be seen below in Figure 150:

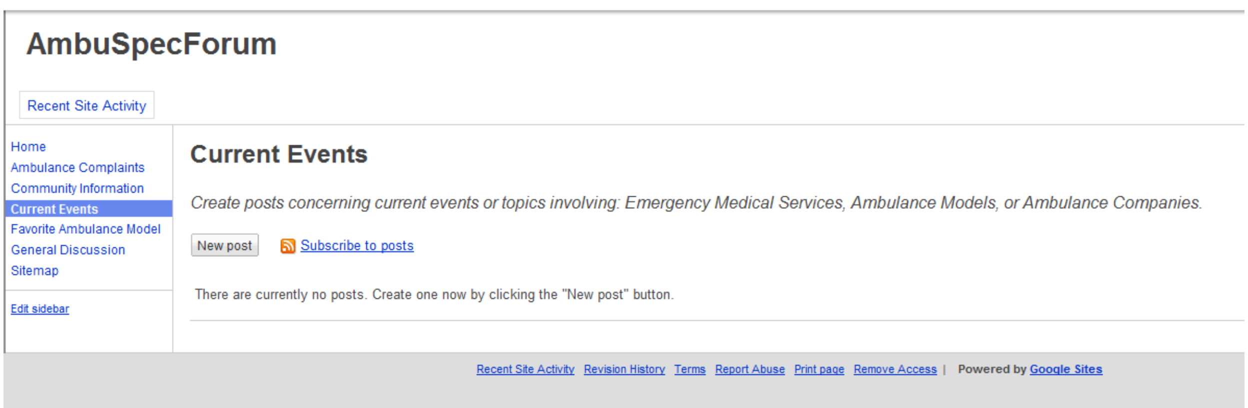


Figure 150 AmbuSpec Forum Current Events Tab

The page description can be seen underneath the header. Again, it is easy for posts to be created as all that is needed is to click the new post button. The next tab is the favorite ambulance model tab. Here, EMS personnel will describe specific ambulance models and their personal pros and cons for each. This will allow people possibly looking to buy ambulances to look into specific advantages and disadvantages of certain models. An image of this can be seen below in Figure 151:

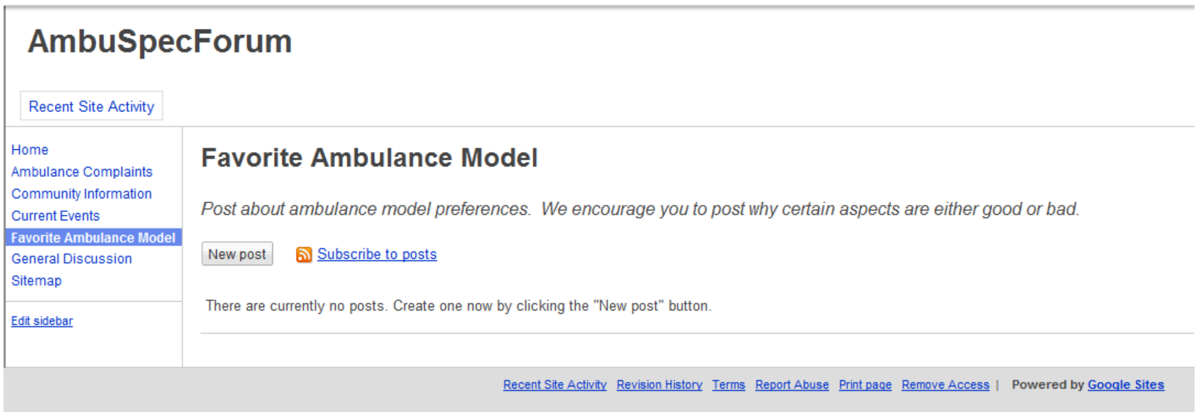


Figure 151 AmbuSpecForum Favorite Ambulance Model Tab

Again, the page is empty due to not being open to the public yet. The final tab to be discussed is the General Discussion tab. This tab is used for more general topics relating to ambulance models and EMS current events. This allows the EMS personnel posting on the page to come up with topics they feel are relevant that were not expected to be relevant by the moderators. An image of this tab can be seen below in Figure 152:

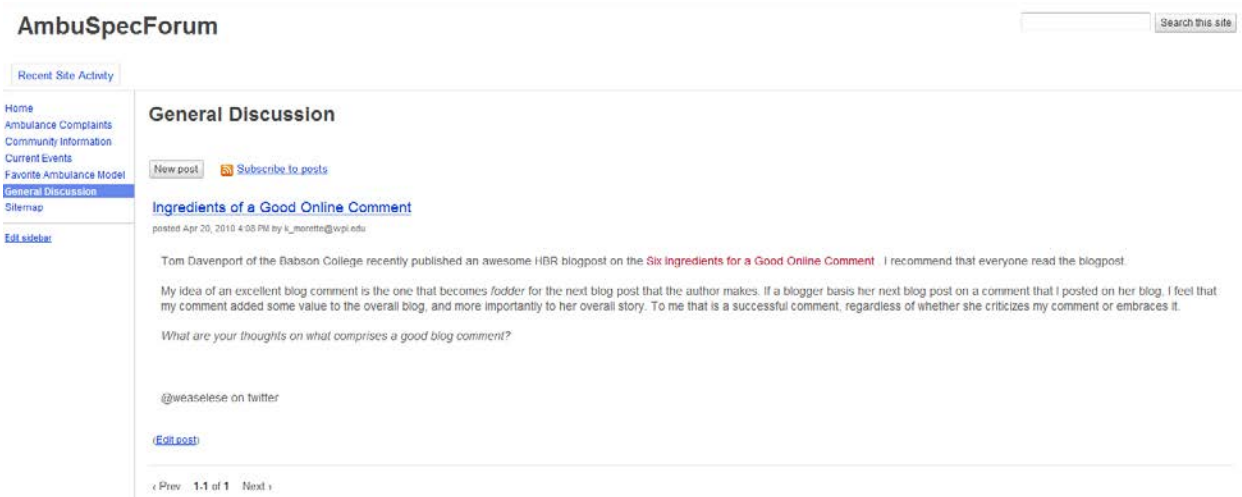


Figure 152 AmbuSpecForum General Discussion Tab

As can be seen, there is a post already in the general tab describing how to make a relevant and informative discussion post. This is necessary to keep the posts on the forum profession and descriptive in nature.

3.4.5 Related Links

This section provides a set of links that may be useful to anybody that finds the website at all interesting. As you can see from the figure below, it displays links to the different modern ambulance websites, to websites with general ambulance and EMS information, and to websites listed in the reference section of this paper. The page can be seen below in **Figure 153**.

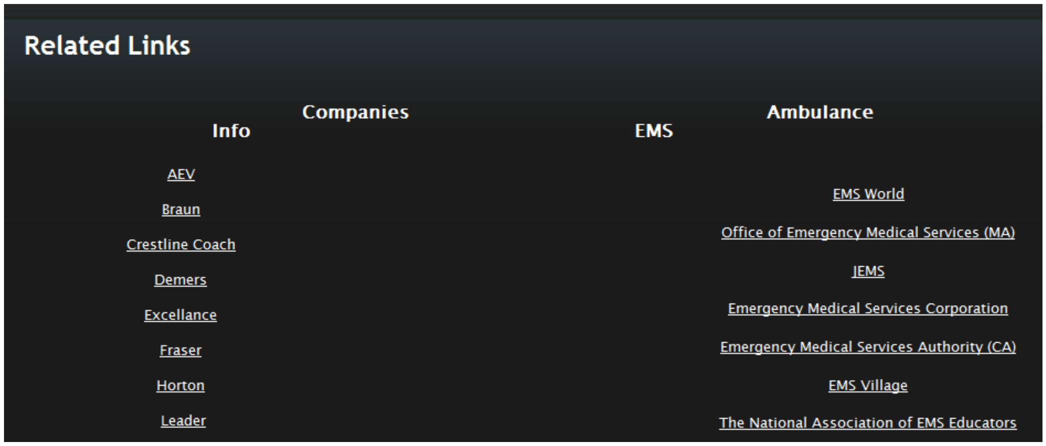


Figure 153 - Small View of the Related Links Page on AmbuSpec

CHAPTER 4. CONCLUSION

Overall, this report is a study of the history and development of the emergency medical ambulance throughout the 20^{th} century. As the research team worked through the decades starting at the beginning of the 1900s, special attention was taken on how the size and shape of the ambulance evolved as well the role of the ambulance in emergency medical care. Research began with an examination of the major war ambulance models. It was found that the major ambulance model for World War 1 was the Ford Model T. Likewise, the major ambulance model for WW2 was the Dodge truck.

Once research of the war ambulance models was finished, a study of the civilian ambulance models starting at the turn of the century was conducted. At the beginning of the century, ambulance models were typically truck based. One common model was the Ford Model T. As the 1920s and 1930s rolled around, ambulance models began to size down the common civilian vehicle began to get smaller. Trucks began to diminish into glorified wagons. As the 1940s and 1950s come around, the vehicles shrink even further into what we know today as wagons. As one would expect, the ambulance transformed with the change of the civilian vehicles. Throughout the 1960s and 1970s, this trend continued. Although the size and shape of the ambulance changed from around 1900 up to the 1970s, there were was common theme. This was that almost all ambulances were a civilian motor vehicle converted for emergency medical transport. During this time period, which was dubbed the ‘conversion era,’ ambulances provided very little if any medical care to patients; they were merely an emergency medical transport system. Between the early 1950s and the mid-1970s, a series of events occurred that completely changed the entire outlook of ambulances, from the manufacture of emergency medical ambulances to the entire emergency medical services field.

Starting with the Harrow and Wealdstone train wreck in 1952, which was a major train wreck in England that resulted over 100 casualties and 300 more injured, the emergency medical services community realized that ambulances needed to bigger and better equipped with life-saving equipment. It was evident from this tragedy that many of those lives could have been saved if emergency medical care and transport was up to date. From this time to the mid-1960s, there was much discussion of how emergency medical services could be improved. One side effect of this was the that ambulances began to become better equipped with life-saving equipment. The next major event that occurred was publication of a manuscript known as the *Accidental Death and Disability: The Neglected Disease of Modern Society*. This manuscript outlined an atrocity that was going on America, which they called accidental death and injury. Many facts were pointed out, such as the fact that accident death and injury was the leading cause of death for certain age groups in the United States. In addition to the facts, suggestions for improvement of the emergency medical services were given, which suggested standards for the emergency medical ambulance. Ultimately, this lead to a part of the EMS Systems Act in 1973, which led way to the Star-of-Life Ambulance Specifications, which mandate almost every detail of the manufacture and production of ambulance today. Consequently, this marks the collapse of the 'conversion era' and the commencement of the 'modern era.'

The 'modern era' can be defined from 1980 to current. With the Star-of-Life Ambulance Specifications in place, ambulance models do not change much from company to company. After an investigation of a list of major ambulance companies of the 'modern era,' the research team found that ambulance models really have not changed much in the last 30 years. The most important changes are increases in medical life-saving equipment and supplies. Likewise, the standard shape and size of the ambulance (either van or truck/van chassis with box body) has not changed significantly. The most important change regarding size has been the increased availability of larger ambulances. While size and the amount of stuff inside the ambulance has changed, it was found that the engineering for the most part did not. If there is one glaring flaw in the emergency medical ambulance today, it is the lack of expert engineering influence on the industry.

After the completion of the study of the ‘modern era,’ an internet website was to share ambulance knowledge and idea to the emergency medical community. While the evolution of the ambulance is included in the website, a main portion of the website is a database for modern ambulance information. A list of major ambulance companies of today is including with each of their ambulance models lists along with links to their respective websites. Also, included is a forum for paramedics to freely discuss ambulances and EMS services in general. It is our hope that this website will become a key component in every ambulance purchaser's pursuit of finding the right ambulance for his or her department or company.

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APPENDICES

Appendix A- Conversion ERA Prominence List

1910-1919	1920-1929
Crane & Breed Manufacturing Co.	Superior Motor Coach Body Co.
James Cunningham, Son & Co.	Flxible Co.
Riddle Coach & Hearse Co.	Sayers and Scovill Co.
Sayers and Scovill Co.	James Cunningham, Son & Co.
White Motor Car Co.	Meteor Motor Car Company
Rock Falls	A.J. Miller Company
Michigan Hearse & Carriage Co.	Crane & Breed Manufacturing Co.
	Studebaker Corp.
	Henney Motor Co.
	E.M. Miller & Co.
	Owen Brothers Co.
	Rock Falls
	Kissel Motor Car Co.

1930-1939	1940-1949
Knightstown Body Company	Henney Motor Co.
Eureka Mfg. Co. Inc.	Superior Coach Corp.
Studebaker Corp.	Eureka Mfg. Co. Inc.
Superior Body Co.	Flxible Co.
Sayers and Scovill Co.	Hess & Eisenhardt
A.J. Miller Company	Meteor Motor Car Company
Meteor Motor Car Company	A.J. Miller Company
Flxible Co.	Sayers and Scovill Co.
James Cunningham, Son & Co.	Economy Coach Co.
Henney Motor Co.	Weller Brothers
Weller Brothers	Shop of Siebert
Shop of Siebert	
Bender Body Company	
Auburn Automobile Company	

1950-1959	1960-1969
National Body Mfg. Co.	National Body Mfg. Co.
Henney Motor Co.	Miller-Meteor- Wayne Works
Flxible Co.	Flxible Co.
Superior Coach Corp.	Superior Coach Corp.
Miller-Meteor- Wayne Works	Amblewagon
Amblewagon	Sayers and Scovill Co.
Sayers and Scovill Co.	Pinner Coach Co.
Guy Barnette & Co.	Cotner-Bevington Corp.
Memphis Coach Co.	Trinity Coach Company
Economy Coach Co.	
Weller Brothers	
Comet Coach Co.	
Cotner-Bevington Corp.	
Shop of Siebert	
Richard Bros.	

1970-1979
National Body Mfg. Co.
Miller-Meteor- Wayne Works
Superior Coach Corp.
Amblewagon
Cotner-Bevington Corp.

Appendix B – EMS White Paper

ACCIDENTAL DEATH AND DISABILITY: THE NEGLECTED DISEASE OF MODERN SOCIETY

Prepared by the

COMMITTEE ON TRAUMA AND COMMITTEE ON SHOCK
DIVISION OF MEDICAL SCIENCES
NATIONAL ACADEMY OF SCIENCES
NATIONAL RESEARCH COUNCIL

NATIONAL ACADEMY OF SCIENCES NATIONAL RESEARCH COUNCIL
Washington, D. C., September, 1966

PREFACE

During the past three years, Committees on Trauma, Shock, and Anesthesia, and special task forces of the Division of Medical Sciences, National Academy of Sciences–National Research Council, have reviewed with representatives of a large number of organizations the present status of initial care and emergency medical services afforded to the victims of accidental injury. These studies include reviews of ambulance services, voice communication systems, emergency departments and intensive care units of hospitals; appraisal of current research in shock, trauma, and resuscitation; revision of the first aid textbook for the American National Red Cross; preparation of a formal statement on cardiopulmonary resuscitation; and participation in disaster survey studies. A summary of these deliberations and a number of recommendations designed to reduce accidental death and disability are assembled in this paper.

CONTENTS

INTRODUCTION

In 1965, 52 million accidental injuries killed 107,000, temporarily disabled over 10 million and permanently impaired 400,000 American citizens at a cost of approximately $18 billion. This neglected epidemic of modern society is the nation's most important environmental health problem. It is the leading cause of death in the first half of life's span.

Although 49,000 deaths in 1965 were due to motor-vehicle accidents, more than this number died from accidents at work, in the home, in other forms of transportation, in public buildings, in recreational activities, etc.

Public apathy to the mounting toll from accidents must be transformed into an action program under strong leadership. This can be accomplished by the methods employed to bring poliomyelitis and other epidemics under control, and to make frontal attacks to conquer cancer, heart disease, and mental disease. Federal and voluntary agencies have mobilized to prevent and treat birth defects, muscular dystrophy, sclerosis, and palsy. Such concerted attacks have been mounted by conduct of national conferences at the Executive level, appropriation of funds by the Congress, pooling of resources by lay and professional groups through voluntary health agencies, expansion of research, and implementation of programs at regional and community levels. Basic to this unified approach is identification of the individual citizen with a means by which he can satisfy the inherent desire to serve his fellow man. Accidental death and disability too, can be attacked by such concerted actions.

This report summarizes current practices and deficiencies at various levels of emergency care. Salient factors which require early solutions are:

The general public is insensitive to the magnitude of the problem of accidental death and injury.

Millions lack instruction in basic first aid.

Few are adequately trained in the advanced techniques of cardiopulmonary resuscitation, childbirth, or other lifesaving measures, yet every ambulance and rescue squad attendant, policeman, firefighter, paramedical worker and worker in high-risk industry should be trained.

Local political authorities have neglected their responsibility to provide optimal emergency medical services.

Research on trauma has not been supported or identified at the National Institutes of Health on a level consistent with its importance as the fourth leading cause of death and the primary cause of disability.

Potentials of the U. S. Public Health Service programs in accident prevention and emergency medical services have not been fully exploited.

Data are lacking on which to determine the number of individuals whose lives are lost or injuries are compounded by misguided attempts at rescue or first aid, absence of physicians at the scene of injury, unsuitable ambulances with inadequate equipment and untrained attendants, lack of traffic control, or the lack of voice communication facilities.

Helicopter ambulances have not been adapted to civilian peacetime needs.

Emergency departments of hospitals are overcrowded, some are archaic, and there are no systematic surveys on which to base requirements for space, equipment, or staffing for present, let alone future, needs.

Fundamental research in shock and trauma is inadequately supported.

Medical and health-related organizations have failed to join forces to apply knowledge already available to advance the treatment of trauma, or to educate the public and inform the Congress.

Specific recommendations follow discussions of the various levels of emergency care. Major steps toward a total national effort include:

Conduct of National Conferences on Emergency Medical Services

Under medical leadership, national forums should be conducted at the highest levels on all subjects important to total emergency care from the time of receipt of an injury through rehabilitation. The public must be aroused and fully informed of present practices, shortcomings in emergency services, and ways in which optimal care can be assured.

Establishment of a National Trauma Association

Responsible professional and lay organizations should pool their efforts through a voluntary National Trauma Association as a means of stimulating public demand for accident prevention and emergency medical services and satisfying these needs through research, public and professional education, and community services.

Organization of Community Councils on Emergency Medical Services

In each community, coordination of lay and professional responsibilities for emergency medical care should be centralized in a council on emergency services. A council would serve to coordinate teaching programs on basic and advanced first aid of the Red Cross, the Medical Self-Help Program of the Public Health Service, cardiopulmonary resuscitation of the American Heart Association, and others. It would bring together the resources of chapters of the Red Cross and the National Safety Council, committees on trauma of the American College of Surgeons, local and county medical societies of the American Medical Association, health departments, civic bodies, scouts, and others, to procure equipment, construct facilities and ensure optimal emergency care on a day-to-day basis as well as in disaster or national emergency. Councils could serve as active units to implement measures and to share in the contributions and benefits of nationwide programs of a National Trauma Association and other voluntary health and allied agencies devoted to emergency medical services.

Formation of a National Council on Accident Prevention

This report is concerned primarily with emergency care indicated after receipt of an injury and deals only briefly with problems of accident prevention. All pertinent research in this field should be reviewed. An analysis is in order of the several safety acts pertaining to government departments with administrative responsibility in accident prevention. The newly established Department of Transportation deals not only with motor vehicles but also with aviation, railroads, and other forms of transport. Other departments deal with mining, industry, flammable clothing, foods, and drugs. There are many common denominators of human behavior, environment, and mechanization applicable to each of these areas and their identification is essential to a systematic attack on this vital problem.

Creation of a National Institute of Trauma

Appropriated funds should be earmarked in support of the program of research in the therapy of trauma recently announced by the National Institute of General Medical Sciences. This would include processing of grant requests for research related to shock and trauma which are now considered by numerous Institutes. Training for academic careers and fellowships in traumatology should be supported. These combined activities call for establishment under the U. S. Public Health Service of a National Institute of Trauma.

THE MAGNITUDE OF THE PROBLEM

Deaths

Accidents are the leading cause of death among persons between the ages of 1 and 37; and they are the fourth leading cause of death at all ages. Among accidental deaths, those due to motor vehicles constitute the leading cause for all age groups under 75. Since 1903, when the "horseless carriage" toll assumed significance, there have been more than 6,500,000 deaths from accidents in this country, over 1,690,000 involving motor vehicles. In 1965, the accident death toll was approximately 107,000, including 49,000 from motor vehicles, 28,500 at home, and 14,100 at work. Deaths from traffic injuries have increased annually; 10,000 more were killed in 1965 than in 1955, and the increase from 1964 to 1965 was 3 percent. Seventy percent of the motor vehicle deaths occurred in rural areas and in communities with populations under 2500.[1]

Despite increasing mechanization, death rates from work accidents in manufacturing have decreased in the past 33 years, from approximately 37 accidental deaths per 100,000 workers in 1933 to a rate of 20 per 100,000 in 1965.[1] This reduction is due largely to education, training, and surveillance of industrial workers, and elimination of hazardous machinery in industrial plants. Similar efforts should be directed to the increasing millions of drivers and to vehicles.

The tragedy of the high accidental death rate is that trauma kills thousands who otherwise could expect to live long and productive lives, whereas those afflicted with malignancy, heart disease, stroke, and many chronic diseases usually die late in life. Thus many more millions of productive man-years are lost owing to deaths from accidents than from chronic diseases among older persons.

The human suffering and financial loss from preventable accidental death constitute a public health problem second only to the ravages of ancient plagues or world wars. In one year alone vehicle accidents kill more than we lost in the Korean War, and in the past 60 years more Americans have died from accidents than from combat wounds in all of our wars.[1] In the 20-year period from 1945 through 1964, there were over 97,000 accidental deaths among military personnel, predominantly caused by motor vehicles.[2]

Disability

The total number of nondisabling injuries treated at home, in doctors' offices, in outpatient clinics or in emergency departments is unknown. In 1965, *disabling* injuries numbered over 10,500,000, including 400,000 that resulted in some degree of permanent impairment.[1] It is estimated that the number of United States citizens now physically impaired by injuries is over 11 million, including nearly 200,000 persons who have lost a leg, a foot, an arm, or a hand and 500,000 with varying degrees of impaired vision.[3]

Costs

In 1965, accident costs totaled about $18 billion, including wage losses of $5.3 billion, medical expenses of $1.8 billion, administrative and claim settlements of $3.6 billion, property loss in fires of $1.4 billion, property damage in motor-vehicle accidents of $3.1 billion, and indirect cost of work accidents of $2.8 billion.[1] The total approaches the current national annual appropriation for conducting the war in Vietnam.

Medical Load

The care of accident cases imposes a staggering load on physicians, paramedical personnel, and hospitals. Approximately one of every four Americans suffers an accident of some degree each year. Of the more than 52,000,000 persons injured in 1965, although many were treated at home or at work, most received medical attention in physicians' offices or in outpatient or emergency departments of hospitals. It is estimated that in 1965 more than 2,000,000 victims of accidental injury were hospitalized; they occupied 65,000 hospital beds for 22,000,000 bed-days and received the services of 88,000 hospital personnel. This exceeds the number of bed-days required to care for the 4 million babies born each year or for all the heart patients and it is more than four times greater than that required for cancer patients. Approximately 1 of 8 beds in general hospitals in the United States is occupied by an accident victim.[4]

ACCIDENT PREVENTION

The long-term solution to the injury problem is prevention. The major responsibility for accident prevention rests not with the medical profession, but with educators, industrialists, engineers, public health officials, regulatory officials, and private citizens. Although the physician is concerned primarily with increasing survival and lessening disability of victims after accidents occur, there are many ways in which the medical profession can help to prevent accidents. These include the detection and reporting of health hazards introduced into the environment; calling attention to the relationship of design of vehicles, appliances, houses, and public buildings to types of accidents; and identifying the roles of human behavioral, physical, emotional, and mental defects, acute and chronic illness, alcohol, and drugs in accident liability.

One of the outstanding pieces of evidence of the value of accident prevention is in the improved safety record of employees in private industry as a result of the improved design of power machinery and the teaching of safety measures. Precise standards are followed in the construction of most buildings, equipment and appliances. Paradoxically, the hazards to the consumer in using these products of industry may go undetected or uncorrected. The introduction of a new drug receives close scrutiny and its untoward or "accidental" effects are reported until its use and limitations are well established, but there is little requirement that hazards or limitations of a new machine or an appliance be detected, reported, and corrected early in its use. There seems to be no explanation for the lack of national standards or codes with respect to motor vehicles or their equipment. Thirty states do not even require periodic automobile inspection;[5] they have become dumping-grounds for vehicles that fail to pass inspection in states that do require it. Federal imposition of proved safety standards and of periodic inspection, if applied as vigorously to vehicles engaged in interstate travel as are the regulations that preclude interstate commerce of drugs unapproved by the Food and Drug Administration, could greatly reduce the nation's annual traffic toll.

Prevention of accidents involves training in the home, in the schools, and at work, augmented by frequent pleas for safety in the news media; first aid courses and public meetings; and inspection and surveillance by regulatory agencies. Hazards involved in fabrication and utilization of vehicles, highways, appliances, farm implements, homes, and public buildings, or arising from participation in sports, or from fire, natural disaster, or national emergencies concern practically every segment of modern society. Of the nearly 52 million nonfatal accidental injuries in 1965, only 7 percent were caused by motor vehicles. Accident prevention must be directed to the 43 percent which occurred in the home, the 16 percent in industry and the 34 percent in public places, recreation, other forms of transportation, etc.[6]

There is need for an advisory agency in the form of a National Council on Accident Prevention, with representation from appropriate government agencies, industry, engineering, architecture, insurance, public health, education, the behavioral sciences, and medicine. Its major mission would be to ascertain the causes of accidental injury and to recommend or initiate measures necessary for their control or elimination. It would coordinate the findings and regulations now prescribed by industry and by the numerous federal safety laws dealing with many industries and administered by government departments whose primary missions are directly or indirectly related to health. It would identify needs and enlist federal and private support of research and of programs in federal departments, states and communities, and specialized research laboratories in the epidemiology and prevention of accidents. Some of these needs and many of the problems and their solutions have been identified by the Division of Accident Prevention of the U. S. Public Health Service and by the National Safety Council. The National Traffic Safety Advisory Committee, as provided for in the Highway Safety Act of 1966, affords for the first time a means by which preventive measures and standards can be delineated for all transport vehicles, including not only highway vehicles but also railroad, aviation, and coast guard conveyances. More than half of the accidental deaths, disabilities, and costs are unrelated to transportation, and factors peculiar to highways, vehicles and drivers constitute but a part of the total accident prevention problem.

RECOMMENDATION

Formation of a National Council on Accident Prevention at the Executive level for coordination of information and advice on implementation of measures and regulations now vested in scattered private, industrial, and federal agencies, and for research, public education, and development of improved standards in accident prevention.

EMERGENCY FIRST AID AND MEDICAL CARE

Successive steps in total emergency care involve local authorities and lay citizens for initial care and transportation, and medical and paramedical personnel under medical supervision for definitive treatment. With few exceptions, the role of the physician in the care of victims of accidental injury begins at the emergency department of the hospital. Only rarely is he available at the scene of injury.

One of the serious problems today in both the lay and the professional areas of responsibility for total care is the broad gap between knowledge and its application. Expert consultants returning from both Korea and Vietnam have publicly asserted that, if seriously wounded, their chances of survival would be better in the zone of combat than on the average city street. Excellence of initial first aid, efficiency of transportation, and energetic treatment of military casualties have proved to be major factors in the progressive decrease in death rates of battle casualties reaching medical facilities, from 8 percent in World War I, to 4.5 percent in World War II, to 2.5 percent in Korea, and to less than 2 percent in Vietman.[7]

Reduction of the time lag from receipt of injury to initiation of medical care is one of the important elements in prevention of death and permanent disability in the combat zone. Probably no American community can lay claim to maintenance of a model of first aid, sorting, communication, and transportation comparable to that of the Armed Services.

First Aid

Beyond the fifth grade of elementary school, every American citizen should be trained in basic first aid. Since initiation of the American National Red Cross first aid training program in 1909, over 28,000,000 students have been certified by qualified instructors (who currently number over 73,000).[8] This course should be, but is not, universally required as a prerequisite to the more advanced training of lifeguards, rescue squad personnel, ambulance attendants, policemen, firemen, personnel in public health and industrial clinics, and attendants at sports events. The Medical

Self-Help Program of the U. S. Public Health Service, designed to ensure care in a national emergency when the services of a psysician are not available, also provide basic first aid training. Only in the American National Red Cross training program and in the Medical Self-Help Program are nationally acceptable textbooks and standardized courses of instruction provided. There is need for equally acceptable textbooks and courses of instruction to meet the special requirements of rescue squad personnel and of ambulance attendants. A manual recently published by the Committee on Trauma of the American College of Surgeons provides guidance for uniformity in such training courses.[9]

RECOMMENDATIONS

1. Extension of basic and advanced first aid training to greater numbers of the lay population.
2. Preparation of nationally acceptable texts, training aids, and courses of instruction for rescue squad personnel, policemen, firemen, and ambulance attendants.

Ambulance Services

A review of ambulance services in the United States indicates a paucity of information and a limited framework for the collection of data on and the evaluation of current ambulance services. Research aimed at improvement of these services is equally limited. The available information shows a diversity of standards, which are often low, frequent use of unnecessarily expensive and usually ill-designed equipment and generally inadequate supplies.

Adequate ambulance services are as much a municipal responsibility as firefighting and police services. If the community does not provide ambulance services directly, the quality of these services should be controlled by licensing procedures and by adequate surveillance of volunteer and commercial ambulance companies. Ambulance services should not only be adequate for local needs, but should also be integrated within cities and among neighboring communities to ensure efficient utilization in natural disasters or national emergencies.

Very few communities provide sufficient financial support for adequate ambulance services. Where they are provided, they are usually maintained by the fire or police department. Many volunteer, nonprofit rescue squads and local ambulance groups provide commendable service and in many small communities this system would seem to meet basic, but usually only minimal needs. Approximately 50 percent of the country's ambulance services are provided by 12,000 morticians, mainly because their vehicles can accommodate transportation on litters. But in most instances, as in the case of many privately owned ambulances, the vehicles are unsuitable for active care during transportation, equipment and supplies are incomplete, and the attendants are not properly trained.

First class ambulance service exists in few cities. Some, such as Baltimore, employ highly trained full-time ambulance attendants with up-to-date vehicles and equipment as a separate mission of the fire department. Central screening and dispatching ensure open traffic lanes, communication en route, and distribution of casualties to assigned hospitals. In some cities, ambulance services are provided by the police department, some with ambulances and some with modified patrol station wagons.

In contrast to the days when an intern accompanied every ambulance on emergency call, the pendulum may have swung much too far toward total dependence on ambulance personnel. There is complete lack of information on the number who die at the site of injury or during transportation who might have been saved by professional attention. Calls for ambulance services should be screened by a responsible agent under medical supervision so that, when medical attendance is required, a physician can be dispatched and an ambulance properly equipped to his needs made available immediately. A number of foreign countries have demonstrated that these measures save many lives.

There are no generally accepted standards for the competence or training of ambulance attendants. Attendants range from unschooled apprentices lacking training even in elementary first aid to poorly paid employees, public-spirited volunteers, and specially trained full-time personnel of fire, police, or commercial ambulance companies. Certification or licensure of attendants is a rarity. In a recent survey, it was found that over 48 different courses of instruction are provided with at least a score of different books and brochures being used as texts. There is no standard or uniformity in these courses, though the standard and advanced Red Cross courses are prerequisites for most. There is need for delineation of a standard course of instruction, a more generally acceptable text, and training aids to ensure training beyond that of the Red Cross program in first aid.

No manufacturer produces from the assembly line a vehicle that can be termed an ambulance. The bodies and fixed equipment of ambulances and rescue vehicles are produced by conversion of passenger-type vehicles or are fabricated completely to fit assembly line chassis, and are usually expensive in outward appearance, but impractical for resuscitative care. Although the Committee on Trauma of the American College of Surgeons has published recommendations on ambulance equipment, there are no acceptable standards for vehicle design, and most ambulances used in this country are unsuitable, have incomplete fixed equipment, carry inadequate supplies, and are manned by untrained attendants.

Authority now exists under the National Traffic and Motor Safety Act of 1966 (P.L. 89-563) to set national standards for ambulance design and construction. Authority also now exists under the Highway Safety Act of 1966 (P.L. 89-564) for the establishment of national standards for used motor vehicles, for motor vehicle inspection and for emergency services.

Through the efforts of the Joint Action Program of the American College of Surgeons, the American Association for the Surgery of Trauma, and the National Safety Council, a model ordinance has been developed for regulation of ambulance services. But in a recent survey of 16 state capitals, only seven were found to have ambulance ordinances. While most ambulance calls involve nonemergency cases, the justification for speeding, the use of sirens, and violation of local traffic regulations is debatable. It is the consensus of representatives of the Joint Action Program that more injuries and deaths are produced by improper control of ambulances than would be produced by delays occasioned by compliance with regulations. Helicopters have proved so successful as ambulances in combat theatres that they should be adopted for selected use in this country. They have proven to be necessary to move physicians and equipment to the accident site and to evacuate casualties from major highways, from remote areas, or from a community hospital to a more specialized center. Highway safety standards should include helicopter evacuation, which calls for landing pads at selected hospitals on a regional pattern.

RECOMMENDATIONS

1. Implementation of recent traffic safety legislation, to ensure completely adequate standards for ambulance design and construction, for ambulance equipment and supplies, and for the qualifications and supervision of ambulance personnel.
2. Adoption at the state level of general policies and regulations pertaining to ambulance services.
3. Adoption at district, county, and municipal levels of ways and means of providing ambulance services applicable to the conditions of the locality, control and surveillance of ambulance services, and coordination of ambulance services with health departments, hospitals, traffic authorities, and communication services.

4. Pilot programs to determine the efficacy of providing physician-staffed ambulances for care at the site of injury and during transportation.

5. Initiation of pilot programs to evaluate automotive and helicopter ambulance services in sparsely populated areas and in regions where many communities lack hospital facilities adequate to care for seriously injured persons.

Communication

Although it is possible to converse with the astronauts in outer space, communication is seldom possible between an ambulance and the emergency department that it is approaching.

It is important to recognize that major accidents, including disasters, provoke community response not only of first aid workers, ambulances, and hospital emergency departments but also authorities concerned with traffic, fire, security, utilities, civil defense, and others, and that communication facilities involve functions pertinent to each responding agency. Although these facilities must be designed for specific needs, they must be sufficiently flexible to ensure rapid and efficient cross communication, with medical components necessary to emergency care. It would be a mistake, therefore, for those concerned with the medical aspects of the problem to plan strictly medical response systems in parallel with or in isolation from the transportation and communication networks upon which they should be based. Since these two basic systems are in most parts of the country just beginning to be developed, it is essential that provision for the medical components be incorporated.

A need exists for prompt voice communication between emergency departments and those at the site of an accident or disaster, not only to plan for the reception of casualties at the hospital but also to dispatch physicians, when needed at the site of the accident. Communication facilities are essential to mobilize rescue equipment, clear traffic lanes, advise ambulance attendants on the management of complications en route, notify hospitals of the number and types of patients to be expected, and distribute patients among hospitals in accordance with the adequacy of space, facilities, and personnel.

With rare exceptions, current ambulance radio installations provide communication only between dispatcher and drivers, with no provision for direct or tie-in contact with hospital emergency departments, traffic control authorities, or civil defense agencies. Moreover, many existing communication systems are reserved for use only in case of disaster or national emergency. Voice communication should be used for day-to-day needs; should be under medical supervision; and should provide direct communication between the accident site, ambulances, and hospitals, and access to police, traffic control, fire, and civil defense agencies.

Although the Federal Communications Commission has allotted an adequate number of radiofrequency channels for the health field and industry has provided appropriate telephone and radio equipment, these facilities are rarely used to ensure voice communication between the site of an accident, ambulances, hospital emergency departments, fire departments, traffic control officials, and civil defense authorities. Usually a hospital is notified of a disaster through local radio or television or by telephone communication from police, or by the walking wounded. Certainly, the seriously ill and the injured deserve centralized screening and dispatching communication facilities as efficient as those used by taxicabs and in the coordination of personnel and equipment in fire fighting, forestry service, or highway maintenance.

At present, experience with radio communication in emergency medical situations is inadequate to serve as a basis for guidance of communities that would install and operate such facilities. Although available standardized equipment may be suitable for most communities, the organizational needs of the local community, geographic problems in radio transmission, and the size of the area to be served dictate variations of design and installation. Ready solutions to most of these problems are available through the radio industry. There is need at the national level for the preparation of a manual delineating the available radiofrequency channels, types and costs of equipment, and modifications of installation necessitated by local conditions. This is a function which should be the responsibility of the new National Highway Safety Agency in cooperation with the Federal Communications Commission, industry, and related groups. This Agency is charged with the responsibility for establishing standards for all aspects of state highway safety programs, of which communications is an essential element.

Under many circumstances, especially in remote areas or in the absence of telephones, delay and frustration are encountered in calling for an ambulance. It would seem feasible to designate a universal, easily remembered number for all dial telephones throughout the nation. Compared to European expressways, the scarcity of public telephones on our national highways represents a significant oversight in planning.

RECOMMENDATIONS

1. Delineation of radiofrequency channels and of equipment suitable to provide voice communication between ambulances, emergency departments, and other health-related agencies at community, regional, and national levels.
2. Pilot studies across the nation for evaluation of models of radio and telephone installations to ensure effectiveness of communication facilities.
3. Day-to-day use of voice communication facilities by the agencies serving emergency medical needs.
4. Active exploration of the feasibility of designating a single nationwide telephone number to summon an ambulance.

Emergency Departments

For decades the "emergency" facilities of most hospitals have consisted only of "accident rooms," poorly equipped, inadequately manned, and ordinarily used for limited numbers of seriously ill persons or for charity victims of disease or injury. Very few hospitals have met the needs imposed since World War II for the vast expansion of facilities, equipment, and personnel demanded by society, poor and rich, for routine off-hour treatment of non-emergency conditions and of the steadily increasing numbers of accidental injuries. Society now looks to the hospital emergency department as a community center for outpatient care. More than two-thirds of the 40,000,000 "emergency room" visits in 1966 cannot be classified as emergencies. Past and projected estimates of this increasing load are as follows:[10]

YEAR	ESTIMATED TOTAL NUMBER OF HOSPITAL OUTPATIENT VISITS (in Millions)	ESTIMATED EMERGENCY ROOM VISITS (in Millions)
1958	84.5	18.0
1960	91.9	23.0
1962	99.4	28.5
1968	121.6	44.1
1970	129.0	49.3

This social change has been paralleled by a decrease in the number of house calls and by more adherence to physicians' regular office hours.

Although over 90 percent of the more than 7000 accredited hospitals in the United States list emergency rooms, most such services operate at a financial loss. In contrast to staff coverage of the "accident room" by a hospital attendant and perhaps by an intern, minimal demands call for around-the-clock staffing by permanently assigned physicians and paramedical personnel trained in all aspects of the care of trauma. Wings need to be added to hospitals, highly specialized equipment is required, and additional personnel must be trained. Currently four national organizations are conducting "surveys" of emergency departments, with no evidence of pooling of their resources or knowledge, resulting in piecemeal approaches to problems that, if solved by concerted effort, would provide factual grounds for Hill-Burton funds for facilities and equipment.

New patterns of staff coverage of emergency departments are evolving. These include contractual relationships between the hospital and a group of physicians, usually general practitioners, who undertake all emergency care and staffing requirements for the emergency department. Some hospitals require that all medical personnel, regardless of specialty, share emergency department responsibility, including night coverage. No longer can responsibility be assigned to the least experienced member of the medical staff or solely to specialists who by the nature of their training and experience cannot render adequate care without the support of other staff members.

The number of physicians experienced in the treatment of multiple injuries is very limited. The need is now recognized for special training in immediate care and in the overall direction of emergency departments, of a calibre commensurate with that attained by only a few individuals in active military field units caring for combat casualties. Medical undergraduate and residency training programs are generally inadequate in traumatology and mass casualty care.

In recent years the Committee on Trauma of the American College of Surgeons has provided recommendations on architectural design and equipment of emergency departments and manuals on the treatment of fractures and soft-tissue injuries, the prevention of tetanus, and the initial management of burns. These commendable efforts of the medical profession are but a beginning. There remains a serious lag in application of the minimal standards, but of even greater importance is the dearth of basic research in resuscitation, shock, and other immediate and long-range problems in therapy.

Accreditation and Categorization of Emergency Departments

The current dictum that an ambulance should deliver a patient to the nearest emergency unit is no longer acceptable. It is essential that road maps and roads signs, at appropriate locations, designate routes to hospitals and emergency departments. The patient must be transported to the emergency department best prepared for his particular problem. In the absence of a descriptive categorization of the level of care that might reasonably be expected at a facility, neither the patient nor the ambulance driver can judge which facility is adequate to the immediate need. It is usually taken for granted by the general public that every emergency room can render full care for injuries of all magnitudes. There is the obligation to the severely injured patient as well as to the lone physician, to the small staffs of remote hospitals, and to institutions with minimal emergency department facilities, that the public be thoroughly informed of the extent of care that can be administered at emergency departments of varying levels of competence. A categorization of emergency departments would serve to indicate the level of care that a patient might reasonably expect. Current check lists used by the Joint Commission on Accreditation of Hospitals are not sufficiently comprehensive for this purpose.

In a given population, whether within a large city, a small community, or a sparsely settled area, the average number of patients requiring emergency care is generally stable, except under conditions of natural disaster or national emergency. Within a given region, it is uneconomical and impractical to expect that every emergency department deal with all degrees of severity of injury.

Hospital emergency departments should be surveyed in a number of differing geographical areas, to determine the numbers and types of emergency facilities necessary to provide optimal emergency treatment for the occupants of each region. Provision must be made for the expected doubling of population within a few decades. Once the required numbers and the types of treatment facilities have been determined, it may be necessary to lessen the requirements in some institutions, increase them in others, and even redistribute resources to support space, equipment, and personnel in the major emergency facilities. Until patient, ambulance driver, and hospital staff are in accord as to what the patient might reasonably expect and what the staff of an emergency facility can logically be expected to administer, and until effective transportation and adequate communication are provided to deliver casualties to proper facilities, our present levels of knowledge cannot be applied to optimal care and little reduction in mortality or lasting disability can be expected.

Emergency units might be categorized as follows:

Type 1. The Advanced First Aid Facility Information now available indicates that most emergency departments across the country are in this category. They do not have a full-time physician staff, and frequently not even a full-time nursing staff. Only modest first aid equipment is available and, although minor conditions and emergency resuscitation might be satisfactorily handled in this setting, it would be unfair to the patient as well as to the staff to expect or demand adequate care of the critically injured.

Type 2. The Limited Emergency Facility This type is found in many hospitals whose emergency departments function 24 hours daily, chiefly as outpatient clinics or first aid facilities, but are nevertheless often confronted with the need to render major emergency care beyond their capabilities. A nurse and perhaps a physician are available at all times. Because of limitations of equipment and facilities, problems of full-time physician coverage, and limited access to specialists, complete care cannot always be provided to the critically injured.

In sparsely populated areas and small communities and many urban hospitals, facilities of this type are essential, and, by proper sorting, large numbers of medical and surgical patients can be adequately handled and removed from the chain of evacuation. It is in the rural areas and the towns of fewer than 2500 people, however, that 70 percent of the traffic fatalities occur. The dedicated staffs of *limited* emergency departments recognize that the needs of the critically injured patients frequently exceed the capabilities of their facilities and personnel. To expect highly specialized care under these circumstances is unfair both to the patient and to the physician. Emphasis on resuscitation, expenditure of time and effort in thorough preparation before movement, and rapid and efficient transportation to *major* emergency facilities would lower morbidity and mortality rates. It is here that helicopter ambulances would be most effective. There have been no extensive surveys in either rural or urban areas to establish the number of either *limited* or *major* emergency facilities required or to define models of rapid transport.

Type 3. The Major Emergency Facility The need for major emergency facilities adequate to render complete care to the severely injured or the seriously ill is well recognized. Few such facilities exist. Most emergency departments of large hospitals have not yet met the space or personnel needs of outpatient and nonemergency cases, and few have the funds to construct, equip, and man adequate facilities. To carry out their mission, the number and location of major emergency facilities must be in keeping with the numbers of patients to be treated from day to day, with provision for expansion in disaster. They must be so located as to serve precisely designated rural areas or districts in densely populated areas. Major emergency facilities require 24-hour staffing by highly competent medical and paramedical personnel trained in resuscitation and other lifesaving measures before transfer of the casualty to the operating room, intensive care unit, or hospital ward. Bloodbanks, complete resuscitative equipment, X-ray facilities (including those for angiography), constantly available well-developed clinical laboratory services, and ready accessibility to operating rooms are essential. The director of a unit of this type should be experienced in the overall care, triage, and determination of priorities of treatment of victims of severe trauma. Nursing, paramedical, and administrative personnel should be assigned to the emergency department permanently or at least for protracted periods. Specialized consultants must be available at all times. The need for ready availability of highly qualified specialists in all branches of medicine and surgery and of laboratories devoted to clinical support and research strongly supports the view that the major emergency facility should be an integral element of large hospitals and university medical centers, rather than an isolated facility devoted solely to emergency care. Such a clinic is essential to proper training in trauma.

Type 4. The Emergency Facility Combined with a Trauma Research Unit This is designed to be the ultimate goal in combining the highest development of patient care with research facilities that permit investigation in support of therapy. These units are discussed in the section of this report on research in trauma.

RECOMMENDATIONS

1. Initiation of surveys and pilot programs to establish patterns of and the numbers and types of emergency departments necessary for optimal care of emergency surgical and medical casualties in a selected number of cities, groups of small communities, and sparsely populated areas.

2. Development of a mechanism for inspection, categorization, and accreditation of emergency rooms on a continuing basis.

3. Federal fund support to design, construct, and, in part, operate model emergency facilities of each type.

Interrelationships between the Emergency Department and the Intensive Care Unit

In planning emergency facilities for the future and in redesigning current facilities, it would seem advantageous to transfer certain protracted functions of resuscitation out of the emergency rooms and integrate them closely into the operation of the intensive care unit. Recent developments have made the intensive care unit the focal point of nursing and medical care in many large hospitals. Concentrated in this area are resuscitation equipment, monitors, respirators, defibrillators, pacemakers, suction devices, and, above all, the highly trained personnel needed for the care of the severely ill medical case or the injured patient.

RECOMMENDATION

Expansion of intensive care programs to ensure uninterrupted care beyond the immediate measures rendered in emergency departments.

THE DEVELOPMENT OF TRAUMA REGISTRIES

Emergency case records are often inadequate. Sufficient thought has not been given to extracting information concerning the nature of the accident, the clinical condition during transportation and at the time of entry to the emergency department, the resuscitative measures used, the response of the patient, the initial laboratory and X-ray records, and, finally, the ultimate outcome with or without temporary or permanent disability. This information is vital on several scores. It is essential in recreating the circumstances of the accident and in relating the mechanism of trauma to accident prevention. It is necessary for clinical analysis, for improvement of therapy, and for appraisal of emergency facilities. Finally, it could provide a basis for determining the duration, nature and degree of disability and the long-term, natural history of specific injuries. An example of the need for long-term records of this type is that of a patient in whom the ultimate manifestation of damage to the femoral artery accompanying a fracture of the femur was not apparent until 34 years later when generalized arteriosclerosis developed, and thrombosis of the involved femoral artery necessitated amputation. Information of this type on a broad scale could be obtained by the development of *trauma registries* within the hospital, similar to those established and maintained for many years in the cancer field. The vast pool of information available from such registries might provide guidelines for more objective definition of degrees of disability on which to base judgment in compensation cases.

RECOMMENDATIONS

1. Establishment of trauma registries in selected hospitals as a mechanism for the continuing description of the natural history of the various forms of injuries.

2. Subsequent consideration of establishment of a national computerized central registry.

3. Studies on the feasibility of designating selected injuries to be incorporated with reportable diseases under Public Health Service control.

HOSPITAL TRAUMA COMMITTEES

Trauma committees, as standing committees of hospital staffs, might serve several useful purposes. As multi-specialty groups, they would set the standards of care, supervise staffing and function of the emergency department, maintain the trauma registry, and conduct training programs for staff, paramedical and ambulance personnel in cardiopulmonary resuscitation and other advanced techniques. They should be prepared to coordinate research programs and to organize follow-up studies on the long-term effects of trauma as well as the treatment itself. An important function would be a continuing analysis of the physical status of patients on delivery to the emergency department, as a guide to correction of deficiencies in first aid and transportation, and of the extent to which physician care is indicated in advance of the hospital.

RECOMMENDATION

Formation of hospital trauma committees, on a pilot basis, in selected hospitals.

CONVALESCENCE, DISABILITY, AND REHABILITATION

At a meeting of a local Committee on Trauma of the American College of Surgeons, a theoretical problem was presented to approximately 50 distinguished surgeons as to when a young man should resume heavy labor following specific injury. The estimates of duration of disability ranged from 2 weeks to a year, with little concentration of the estimates in between. There is little scientific basis on which to predict or measure convalescence or disability. Rehabilitation should begin immediately after injury and its goals should be to prevent disability or shorten its duration and degree and to return the patient to a useful economic status. Rehabilitation should not be reserved for those with established permanent disabilities.

RECOMMENDATIONS

1. Development of additional studies on the quantitation of degrees of disability and the stages of convalescence at which return to productive work is indicated.
2. Development of studies on rehabilitation with emphasis on measures to be initiated in the earliest phases of treatment.

MEDICOLEGAL PROBLEMS

The courtroom sequelae of accidents are often, perhaps generally, dealt with in a manner below the general standards of the medical and legal professions. The courts for settlements of disability claims in some areas are provided with inadequate or inexpert evidence, and judgment may well reflect response to social, emotional, or political pressures, rather than to sound medical testimony. In this respect both lawyers and physicians for the claimants and for the defending insurance companies too often produce prejudiced medical testimony, diametrically and predictably contradictory. "Expert medical testimony" under these circumstances has commonly lacked clinical expertise. A system has been adopted by the judiciary in a number of localities to provide impartial evaluation of disability by a panel of physicians who are expert in their given fields and paid either by the court or jointly by the parties involved. This mechanism has proved to be of great value, and should be more universally employed. It is imperative that the physician's role be uninfluenced by socioeconomic pressures.

In the final analysis, compensation for disability is a drain on every citizen through federal taxation, withholdings from earnings, and the increasing upward spiral of premiums on disability insurance. All these costs could be reduced if the demonstrated fairness and objectivity in categorizing degrees of disability employed by the Armed Forces and the Veterans Administration were applied by the medical profession and the courts to persons disabled by accidental injury or disease. In the military services, processing begins at the time a member incurs an injury or disease that may be temporarily or permanently disabling. Findings are referred by a medical committee to a physical evaluation board and reviewed at the highest levels, with the benefit of counsel at all stages, providing an objective determination of degrees of disability to serve as a basis for compensation. Society concurs in the fairness of this system and the care with which the Veterans Administration and the Armed Forces protect the rights of the nearly 2,000,000 persons who receive service-connected disability compensation among the 21,800,000 veterans of military service.[11] The same objectivity and fairness can be applied to the rest of the population through optimal medical care to prevent disability, a hospital trauma committee to judge disability, and impartial medical panels to serve the courts. Systems for rapid and uniform processing and compensation of the injured with minimal recourse to the courts should be applied nationally.

Forensic medicine constitutes a medical specialty of high order and only when a sufficient number of specialized physicians are available to carry out this work will important information, now needed, become available. Unfortunately, most coroners in this country are political appointees, mostly laymen, frequently funeral directors; but this situation is being gradually corrected by establishment of medical examiner systems in several cities, some counties, and a few states. Progress in this area must be accompanied by the training of more pathologists in forensic medicine.

With the expansion of the role of the medical examiner, implementation of a uniform code for reporting accidents and accidental deaths, and mandatory autopsy of fatal cases, to include tests for alcohol and drugs, an opportunity exists to study effectively the specific causes and mechanisms of injury of all magnitudes and to establish base lines against which to measure the efficacy of control measures.

RECOMMENDATIONS

1. Judicial application of the principle of seeking impartial medical advice in the determination of disability.
2. Replacement, on a national scale, of lay coroners by medical examiners who are not only physicians but also qualified pathologists experienced in medicolegal problems.

AUTOPSY OF THE VICTIM

The exact cause of death in many of the injured can be learned only from complete autopsy examination. Especially in multiple injuries, priority of treatment may have been directed toward obvious, or overt, injuries, but covert injuries, such as laceration of major vessels, retroperitoneal hemorrhage, or fat embolism may have been the primary cause of death. Although it is the responsibility of the coroner to direct autopsy examination, this is not routinely performed. If this opportunity to ascertain the specific cause of death is to be grasped, complete autopsies must be performed routinely on those who have died as the result of injury. Furthermore, the findings in large numbers of autopsies must be critically analyzed in order to point the way to necessary changes in treatment. One such study, of 950 consecutive autopsies of accident cases, revealed an unexpected finding: in 38 percent of those who died in the hospital or after returning home following fracture of the hip, the primary cause was pulmonary embolism. Yet in a large number of similar patients who had not been autopsied, pulmonary embolism was the recorded cause of death in only 2 percent.[12] This is but one example of the value of careful autopsy examination. Such findings are important to alert emergency department staffs to the incidence of covert injuries that might well dictate first priority care, as well as the care and prophylactic measures that must be observed during definitive care and rehabilitation.

RECOMMENDATION

Routine performance and analysis of complete autopsies of accident victims.

CARE OF CASUALTIES UNDER CONDITIONS OF NATURAL DISASTER

It is apparent that the problems of care of disaster victims differ from those of the care of individually injured persons in that they are concerned with unexpected expansion of first aid, rescue, communication, sorting, distribution, and medical care. No plan for emergency care in disaster is likely to succeed unless it provides for an orderly utilization of currently functioning facilities. For this reason, emphasis should be placed on employment of all elements of disaster services on a day-to-day basis so that they will be functioning smoothly when the load of casualties suddenly increases.

Because disasters occur repeatedly in this country and because progress has been slow in solving problems of caring for mass civilian casualties, medical problems encountered in disaster should be under continued study and analysis by multi-disciplinary groups. The need for integration of public resources in coping with material damage in disaster is apparent, but the community role in handling human casualties is less well prescribed. The Disaster Research Group of the Division of Anthropology of the National Academy of Sciences-National Research Council, in its extensive studies from 1951 to 1963 for the Office of Civil Defense, and the Ohio State University Disaster Research Center, established in 1963, have both concentrated on responses of local, state, and federal agencies to the stresses imposed by unexpected disaster with emphasis on behavioral and sociological problems. Efforts of the American College of Surgeons to encourage members to report on casualty care in disasters have added little substantive information on which to improve results. The Committee on Disaster Medical Care of the American Medical Association has attempted to identify potentials for improved care, but no national action program has been implemented. An *ad hoc* Committee on Disaster Medical Care of the National Academy of Sciences-National Research Council finds no evidence of effort by these groups, or by independent workers or federal organizations, toward pooling of resources to assemble substantial data or to analyze medical management in a sufficient number of disasters of different types. In no single large disaster do we have precise information on the causes of death, the numbers and types of injuries of survivors, or the rewards of efficiency and the penalties of inefficiency in rescue, first aid, transportation, and medical care. A pattern exists in the organization and functions of the Office of Emergency Planning of the Executive Office of the President for gaining this type of information and for implementing improvements in management and care that would result from its analysis. Trained disaster specialists based at eight federal centers throughout the nation move out at first warning to areas imperiled by disaster. On the basis of their assessments, the President can declare a major disaster; under the direction of the Office of Emergency Planning 24 agencies would then be automatically authorized to provide assistance.[13] These are concerned mainly with supplies, equipment, and personnel to clear debris; provide food, medicine, and shelter; restore utilities; enforce law and order; and render financial assistance and welfare services. Many communities are unaware of the way to secure outside assistance in rescue, first aid, and medical help available through the American National Red Cross, the U. S. Public Health Service, civil defense agencies, and field units of the Armed Forces. Better utilization of these resources could be ensured if in each community or area a recognized committee or council on emergency medical services would assume the role of coordination of the efforts of these agencies. Physicians thoroughly familiar with the missions of the 24 federal agencies and versed in local medical problems in disaster should be included on the teams of trained disaster specialists of the eight federal centers.

RECOMMENDATION

Development of a center to document and analyze types and numbers of casualties in disasters, to identify by on-site medical observation problems encountered in caring for disaster victims, and to serve as a national educational and advisory body to the public and the medical profession in the orderly expansion of day-to-day emergency services to meet the needs imposed by disaster or national emergency.

RESEARCH IN TRAUMA

Current Status of Research Support

Research in trauma has suffered from the lack of recognition of trauma as a major public health problem. This is, in part, due to the present practice of evaluation of research support requests by study sections or other advisory committees of granting agencies identified with "disease" entities, rather than those related to "accidents," "injuries," or "trauma." An analysis of grants in 1965 identifies only $5 million in support of research related to trauma by six of the Institutes of the National Institutes of Health and other bureaus of the U.S. Public Health Service. National expenditures for all medical research in 1964 were estimated to be $1675 million of which $1134 million was from Government, $395 million from industry, and $146 million from private sources.[14] On the basis of these vast sums, it is estimated that current research expenditures by the National Institutes of Health and the Division of Chronic Diseases of the U.S. Public Health Service for fiscal year 1963 were 50 cents for each of the 10 million persons disabled by accidental injury, $220 for each of the estimated 540,000 cancer cases, and $76 for each of the estimated 1,420,000 cardiovascular cases. The 1966 federal budgets for research on cancer and cardiovascular diseases alone are estimated to be in excess of $280 million.[15]

There remains no doubt that society is reaping dividends from investments devoted to research in disease, and that this effort deserves continued support and expansion. Lack of a proportionate degree of support in accident prevention and care of the victims of trauma cannot be ascribed to unwilling legislators or directors of voluntary and philanthropic organizations. The most obvious reason for current lack of emphasis on the kinds of research required and the ways and means of utilizing knowledge we already have is that there is no unified mechanism, federal or nonfederal, to present the full picture of needs, to identify and encourage necessary research, to enlist financial support, to serve as a clearinghouse for information, or to offer advice and consultation.

During the years of expansion of the National Institutes of Health and other federal agencies and voluntary organizations concerned with national health problems, emphasis has been properly focused on fundamental research. A charge of the President to his Commission on Heart Disease, Cancer, and Stroke was to recommend practical steps to reduce the heavy losses exacted by these diseases, not only through the development of new scientific knowledge, but also through the use of lifesaving medical knowledge we already possess but fail to bring to so many stricken American families. The dispatch with which the program was defined and was supported by Congress was due in large part to the knowledge gained in recent years through generous support of basic research and to the wealth of information and assistance available through the American Cancer Society and the American Heart Association, both of which recognized years ago the necessity of joint participation of professional and lay organizations and of the general public, and which have pioneered for decades in the support of health research, public education, training of physicians and allied personnel, and direct service to patients. The need for such organized effort in the field of trauma is apparent.

Potentials in Fundamental and Clinical Research

To determine accurately the physiological changes produced by trauma alone, studies must be initiated promptly on persons who are otherwise healthy at the moment the stresses of trauma are imposed. Only by this approach can the hemodynamic, metabolic, ultrastructural, and other changes of diseases be compared with or differentiated from the hypoxia, collapse, and other effects of trauma as the sole etiological factor.

Relatively little has been done in fundamental studies on acutely injured subjects on wound healing; wound infection; hemodynamic, metabolic, cardiac, and respiratory changes following trauma; ultrastructural alterations in injury and shock; the effects of head, spinal cord, and nerve injuries; paralytic ileus; posttraumatic renal insufficiency; fracture healing; resuscitation, and many other areas of basic importance. To a limited extent these problems are now under investigation in laboratories devoted to studies on acute and chronic disease and malignancy, but rarely in relation to trauma specifically.

Many of the most important advances in surgery have evolved from discoveries at the war front. Wounds from high velocity missiles and the environmental factors that prevail in military combat areas produce changes that cannot be simulated in civilian life. Although contributions to the care of military casualties can be made through research in noncombat medical centers, there is as great a need for contributions that can be made only by sophisticated research in military front line medical installations. The opportunity should be fully grasped in Vietnam, as it was in Korea, to improve the care of the injured throughout the world by seeking, in an organized manner, improved ways of treating the critically injured person.

Specialized Centers for Clinical Research in Shock and Trauma

In the very recent past, owing in large part to stimulation and encouragement of the Committee on Shock of the National Academy of Sciences-National Research Council and with the support of federal and private granting agencies, basic and clinical scientists have been installed in highly sophisticated laboratories devoted to studies in shock and trauma in human patients in a limited number of medical centers. It is a tribute to the profession that these pioneer groups of investigators willingly devote long hours to research in trauma, a disease predominantly of nights and weekends. These units are designed to combine the highest development of patient care with research facilities that enable investigation to proceed without hampering therapy. For example, in one institution the space previously occupied by three surgical wards has been converted to laboratories to support intensive care and study of not more than four patients at a time. In this and other units the basic scientists in physiology, microbiology, biochemistry, electronics, isotopes, engineering, etc., collaborate with clinicians in carrying out highly complex studies in man that were previously limited to animal studies. Repetitive observations are rapidly computed and relayed to the clinician, providing moment-to-moment hemodynamic and biochemical measurements. The improved therapy that results from these studies is gradually modifying previous concepts of irreversibility in those suffering from hemorrhage, burns, and sepsis.

Units of this type must be adapted to measure and treat the overall effects of trauma, sepsis, or critical nonsurgical conditions, but additional studies might take one of several directions, depending on patient load and local research interests and talent. For example, a 10- or 12-bed burn unit might embrace the whole panorama of the burn problem, from the time of injury through rehabilitation. Another unit might be geared toward early hemodynamic or metabolic changes, shifts in the various body fluid compartments, oxygen utilization, or energy production. Others might center on severe head injuries, or abdominal injuries, or fractures. To date, no unit of this type has been developed for research in head and neck injuries, and such units are vitally needed.[16]

Such facilities might include ancillary equipment for hemodynamic measurements in the emergency department, so that the earliest possible changes as well as the response to resuscitative fluids and other therapeutic agents could be measured. These observations would then be continued in the operating room, the intensive care unit, or the special research unit for uninterrupted study throughout all phases of response to injury and recovery. Research on the acutely injured requires numerous personnel of many disciplines. The critical nature of the illness is such that research must continue around the clock. Nursing and laboratory personnel requirements are costly.

Numerous studies now point convincingly to the conclusion that moment-to-moment hemodynamic and biochemical measurements in the acutely ill or severely injured patient offer the best available guidelines for improved therapy. Information gained by these units proves valuable guidance for the treatment of injured patients in other less specialized hospitals where research is not feasible.

These clinical research units involve very specialized facilities with unusual demands for staffing and equipment, and for parallel facilities for animal experimental studies. The survival of critical medical and surgical cases has been increased, and many useful techniques have been adopted in other areas of the hospital.

The most significant obstacle at present is the lack of long-term funding. Unpredictability of financial support hinders recruitment of competent scientists and technicians, retention of key personnel, and procurement of necessary equipment.

The few clinical research units for the study of the acutely injured have been supported mainly by the National Institute of General Medical Sciences, the Medical Research and Development Command of the Army, and the John A. Hartford Foundation. Very recently the National Institute of General Medical Sciences, recognizing a need for coordination and identification of research needs in trauma, conducted a workshop conference on the management of trauma, including hospital arrangements and training; the physiology of shock, considered from the systems and organ level; and study of trauma at the cellular and subcellular levels. This Institute has now appointed a director for development of a program of research in the therapy of trauma, and is encouraging expansion of support in this direction. The needs for research in resuscitation, shock, trauma, and emergency conditions related to acute and chronic illness, for academic career training and fellowships in traumatology, for improved facilities and equipment, and for experimental and clinical laboratories in direct support of emergency departments and intensive care units warrant serious consideration of establishment of a National Institute devoted to trauma and emergency medical care.

RECOMMENDATIONS

1. Increased federal and voluntary financial support of basic and applied research in trauma.
2. Long-term financial support of specialized centers for clinical research in shock and trauma.
3. Expansion of clinical research in war wounds.
4. Expansion within the U. S. Public Health Service of research in shock, trauma, and emergency medical conditions, with the goal of establishing a National Institute of Trauma.

SPECIFIC RECOMMENDATIONS

ACCIDENT PREVENTION

Formation of a National Council on Accident Prevention at the Executive level for coordination of information and advice on implementation of measures and regulations now vested in scattered private, industrial, and federal agencies, and for research, public education, and development of improved standards in accident prevention.

EMERGENCY FIRST AID AND MEDICAL CARE

First Aid

Extension of basic and advanced first aid training to greater numbers of the lay population.

Preparation of nationally acceptable texts, training aids, and courses of instruction for rescue squad personnel, policemen, firemen, and ambulance attendants.

Ambulance Services

Implementation of recent traffic safety legislation to ensure completely adequate standards for ambulance design, and construction, for ambulance equipment and supplies, and for the qualifications and supervision of ambulance personnel.

Adoption at the state level of general policies and regulations pertaining to ambulance services.

Adoption at district, county, and municipal levels of ways and means of providing ambulance services applicable to the conditions of the locality, control and surveillance of ambulance services, and coordination of ambulance services with health departments, hospitals, traffic authorities, and communication services.

Pilot programs to determine the efficacy of providing physician-staffed ambulances for care at the site of injury and during transportation.

Initiation of pilot programs to evaluate automotive and helicopter ambulance services in sparsely populated areas and in regions where many communities lack hospital facilities adequate to care for seriously injured persons.

Communication

Delineation of radiofrequency channels and of equipment suitable to provide voice communication between ambulances, emergency departments, and other health-related agences at community, regional, and national levels.

Pilot studies across the nation for evaluation of models of radio and telephone installations to ensure effectiveness of communication facilities.

Day-to-day use of voice communication facilities by the agencies serving emergency medical needs.

Active exploration of the feasibility of designating a single nationwide telephone number to summon an ambulance.

Emergency Departments

Initiation of surveys and pilot programs to establish patterns of and the numbers and types of emergency departments necessary for optimal care of emergency surgical and medical casualties in a selected number of cities, groups of small communities, and sparsely populated areas.

Development of a mechanism for inspection, categorization, and accreditation of emergency rooms on a continuing basis.

Federal fund support to design, construct, and, in part, operate model emergency facilities of each type.

Interrelationships between the Emergency Department and the Intensive Care Unit

Expansion of intensive care programs to ensure uninterrupted care beyond the immediate measures rendered in emergency departments.

THE DEVELOPMENT OF TRAUMA REGISTRIES

Establishment of trauma registries in selected hospitals as a mechanism for the continuing description of the natural history of the various forms of injuries.

Subsequent consideration of establishment of a national computerized central registry.

Studies on the feasibility of designating selected injuries to be incorporated with reportable diseases under Public Health Service control.

HOSPITAL TRAUMA COMMITTEES

Formation of hospital trauma committees, on a pilot basis, in selected hospitals.

CONVALESCENCE, DISABILITY AND REHABILITATION

Development of additional studies on the quantitation of degrees of disability and the stages of convalescence at which return to productive work is indicated.

Development of studies on rehabilitation with emphasis on measures to be initiated in the earliest phases of treatment.

MEDICOLEGAL PROBLEMS

Judicial application of the principle of seeking impartial medical advice in the determination of disability.

Replacement, on a national scale, of lay coroners by medical examiners who are not only physicians but also qualified pathologists experienced in medicolegal problems.

AUTOPSY OF THE VICTIM

Routine performance and analysis of complete autopsies of accident victims.

CARE OF CASUALTIES UNDER CONDITIONS OF NATURAL DISASTER

Development of a center to document and analyze types and numbers of casualties in disasters, to identify by on-site medical observation problems encountered in caring for disaster victims, and to serve as a national educational and advisory body to the public and the medical profession in the orderly expansion of day-to-day emergency services to meet the needs imposed by disaster or national emergency.

RESEARCH IN TRAUMA

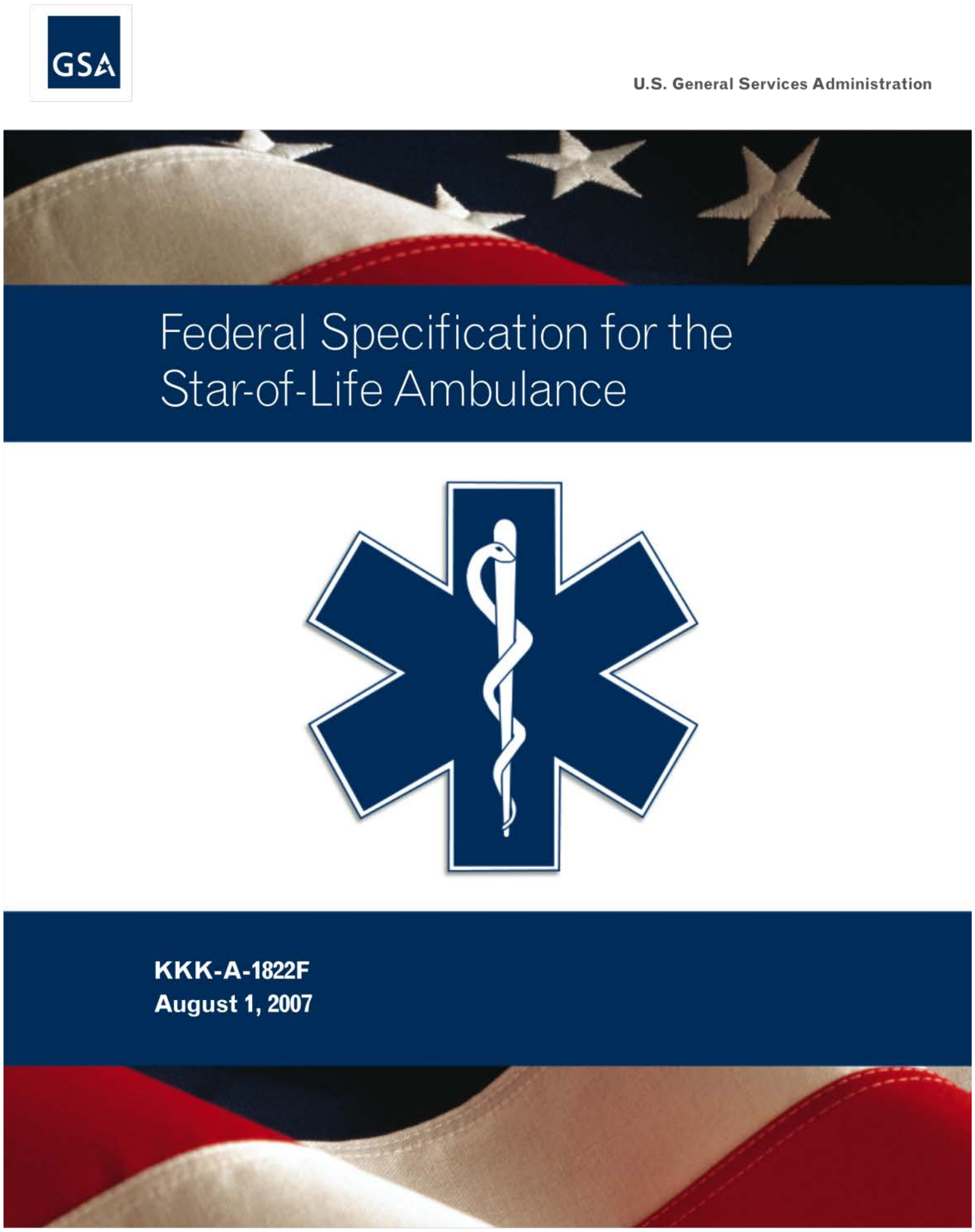
Increased federal and voluntary financial support of basic and applied research in trauma.

Long-term financial support of specialized centers for clinical research in shock and trauma.

Expansion of clinical research in war wounds.

Expansion within the U. S. Public Health Service of research in shock, trauma, and emergency medical conditions, with the goal of establishing a National Institute of Trauma.

Appendix C – Star-of-Life Ambulance Specifications


GSA

U.S. General Services Administration

Federal Specification for the
Star-of-Life Ambulance

KKK-A-1822F
August 1, 2007

Table of Contents

1. Scope, Purpose, and Classification

1.1 SCOPE.

This specification identifies the minimum requirements for new automotive Emergency Medical Services (EMS) ambulances (except military field ambulances) built on Original Equipment Manufacturer's Chassis (OEM) that are prepared by the OEM for use as an ambulance.

The ambulances are front or rear wheel driven (4x2) and minimally warranted as specified in Section 6.

Refurbishing and remounted vehicles are not covered by this standard. This standard applies to new vehicles only.

By definition an ambulance is a vehicle used for emergency medical care and patient transport. This specification is for the construction of ambulances, not for vehicles intended for use as fire apparatus. National and international standards exist for automotive fire apparatus. These standards can be obtained from organizations such as the National Fire Protection Association (NFPA).

Section 3 of this specification contains:
- Optional configurations.
- A worksheet to assist the purchaser in developing their procurement requirements.

1.1.1 DEFINITION OF AMBULANCE.

The ambulance is defined as a vehicle used for emergency medical care that provides:
- A driver's compartment.
- A patient compartment to accommodate an emergency medical services provider (EMSP) and one patient located on the primary cot so positioned that the primary patient can be given intensive life-support during transit.
- Equipment and supplies for emergency care at the scene as well as during transport.
- Safety, comfort, and avoidance of aggravation of the patient's injury or illness.
- Two-way radio communication.
- Audible and Visual Traffic warning devices.

1.1.2 PURPOSE.

The purpose of this document is to describe ambulances that are authorized to display the "Star of Life" symbol. It establishes minimum specifications, performance parameters and essential criteria for the design of ambulances and to provide a practical degree of standardization. The object is to provide ambulances that are nationally recognized, properly constructed, easily maintained, and, when professionally staffed and provisioned, will function reliably in pre-hospital or other mobile emergency medical service.

1.1.3 "STAR OF LIFE" CERTIFICATION.

The final stage ambulance manufacturer (FSAM) shall furnish to a purchaser an authenticated certification and label stating that the ambulance and equipment comply with this specification and applicable change notices in effect on the date the ambulance is contracted for. FSAMs making this certification are permitted to use the "Star of Life" symbol to identify an ambulance as compliant with the Federal specifications for ambulances. Use of the symbol must be in accordance with the purpose and use criteria set forth in published guidelines (Document Number DOT HS 808 721, Rev. June 1995) by the National Highway Traffic Safety Administration, an operating administration of the U.S. Department of Transportation.

2. Applicable Documents

2.1 THE FOLLOWING STANDARDS AND REGULATIONS FORM A PART OF THIS SPECIFICATION, TO THE EXTENT SPECIFIED OR REQUIRED BY LAW. UNLESS A SPECIFIC ISSUE OF A STANDARD OR REGULATION IS IDENTIFIED, THE ISSUE IN EFFECT, ON THE DATE THE AMBULANCE IS CONTRACTED FOR, SHALL APPLY.

FEDERAL SPECIFICATIONS:
RR-C-901C — CYLINDERS, COMPRESSED GAS: HIGH PRESSURE, STEEL DOT 3AA AND ALUMINUM APPLICATIONS

FEDERAL STANDARDS:
Federal Standard No. 297 — Rustproofing of Commercial (Nontactical) Vehicles

MILITARY STANDARDS:
MIL-STD-461 Requirements for the Control of Electromagnetic Interference Characteristics of Subsystems and Equipment.
MIL-STD-1223 Non-tactical Wheeled Vehicles, Painting, Identification Marking, and Data Plate Standards.

LAWS AND REGULATIONS:
29 CFR 1910.1030: Blood borne Pathogens
29 CFR 1910.7 Definition and Requirements for a Nationally Recognized Testing Laboratory
21 CFR 820: Quality System Regulation
40 CFR 86: Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines.
47 CFR, PART 90: Public Safety Radio Services (FCC)
49 CFR 393: Federal Motor Carrier Safety Regulations (FMCSR)
49 CFR 571: Federal Motor Vehicle Safety Standards (FMVSS)

2.2 OTHER PUBLICATIONS.

The following documents form a part of this specification to the extent specified. Unless a specific issue is identified, the issue in effect, on the date the ambulance is contracted for, shall apply.

THE TIRE AND RIM ASSOCIATION, INC.
Yearbook

NATIONAL FIRE PROTECTION ASSOCIATION
70 – National Electric Code
1901 – Standard for Automotive Fire Apparatus

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE), INC., STANDARDS, AND RECOMMENDED PRACTICES:

J163 Low Tension Wiring and Cable Terminals and Splice Clips
J537 Storage Batteries
J541 Voltage Drop for Starting Motor Circuits
J553 Circuit Breakers
J561 Electrical Terminals, Eyelet, and Spade Type
J575 Tests for Motor Vehicle Lighting Devices & Components
J576 Plastic Materials, For Use In Optical Parts Such As Lenses and Reflectors of Motor Vehicle Lighting Devices
J578 Color Specification for Electric Signal Lighting Devices
J595 Flashing Warning Lamps for Authorized Emergency, Maintenance, and Service Vehicles
J638 Test Procedure and Ratings for Hot Water Heaters for Motor Vehicles
J639 Safety Practices for Mechanical Vapor Compression Refrigeration Equipment or Systems Used To Cool Passenger Compartment of Motor Vehicles
J689 Approach, Departure, and Ramp Break over Angles
J682 Rear Wheel Splash and Stone Throw Protection
J683 Tire Chain Clearance
J858 Electrical Terminals, Blade Type
J928 Electrical Terminals, Pin, and Receptacle Type
J994 Backup Alarms, Performance Test and Application
J1054 Warning Lamp, Alternating Flashers
J1127 Battery Cable
J1128 Low Tension Primary Cable
J1292 Automobile, Truck, Truck-Tractor, Trailer, and Motor Coach Wiring
J1349 Engine Power Test Code, Spark Ignition and Diesel
J1318 Strobe Warning Lights
J2498 Minimum Performance of the Warning Light System Used on Emergency Vehicles

NATIONAL TRUCK EQUIPMENT ASSOCIATION / AMD:

AMD STANDARD 001 – AMBULANCE BODY STRUCTURE STATIC LOAD TEST
AMD STANDARD 002 – BODY DOOR RETENTION COMPONENTS TEST
AMD STANDARD 003 – OXYGEN TANK RETENTION SYSTEM STATIC TEST
AMD STANDARD 004 – LITTER RETENTION SYSTEM STATIC TEST
AMD STANDARD 005 – 12-VOLT DC ELECTRICAL SYSTEM TEST
AMD STANDARD 006 – PATIENT COMPARTMENT SOUND LEVEL TEST
AMD STANDARD 007 – PATIENT COMPARTMENT CARBON MONOXIDE LEVEL TEST
AMD STANDARD 008 – PATIENT COMPARTMENT GRAB RAIL STATIC LOAD TEST
AMD STANDARD 009 – 125V AC ELECTRICAL SYSTEMS TEST
AMD STANDARD 010 – WATER SPRAY TEST
AMD STANDARD 011 – EQUIPMENT TEMPERATURE TEST
AMD STANDARD 012 – INTERIOR CLIMATE CONTROL TEST
AMD STANDARD 013 – WEIGHT DISTRIBUTION GUIDELINES
AMD STANDARD 014 – ENGINE COOLING SYSTEM TEST
AMD STANDARD 015 – AMBULANCE MAIN OXYGEN SYSTEM TEST
AMD STANDARD 016 – PATIENT COMPARTMENT LIGHTING LEVEL TEST
AMD STANDARD 017 – ROAD TEST

AMD STANDARD 018 – REAR STEP AND BUMPER STATIC LOAD TEST
AMD STANDARD 019 – MEASURING GUIDELINES: CABINETS & COMPARTMENTS
AMD STANDARD 020 – FLOOR DISTRIBUTED LOAD TEST
AMD STANDARD 021 – ASPIRATOR SYSTEM TEST, PRIMARY PATIENT
AMD STANDARD 022 – COLD ENGINE START TEST
AMD STANDARD 023 – SIREN PERFORMANCE TEST
AMD STANDARD 024 – PERIMETER ILLUMINATION TEST
AMD STANDARD 025 – MEASURING GUIDELINES: OCCUPANT HEAD CLEARANCE ZONES

AMERICAN COLLEGE OF EMERGENCY PHYSICIANS (ACEP):
Guidelines for Ambulance Equipment

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) STANDARDS:

F 920	Standard Specification for Minimum Performance and Safety Requirements for Resuscitators Intended for Use with Humans
F 960	Standard Specification for Medical and Surgical Suction and Drainage Systems
D 4956	Standard Specification for Retroreflective Sheeting for Traffic Control
D6210	Standard Specification for Fully-Formulated Glycol Base Engine Coolant for Heavy-Duty Engines
B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
IPC-610D	Acceptability of Electronic Assemblies

NATIONAL EMSC (EMERGENCY MEDICAL SERVICES FOR CHILDREN) RESOURCE ALLIANCE:
COMMITTEE ON AMBULANCE EQUIPMENT AND SUPPLIES
Guidelines for pediatric equipment and supplies for Basic and Advanced life support ambulances

AUTOMOTIVE MANUFACTURERS EQUIPMENT COMPLIANCE AGENCY(AMECA):
Approval of Motor Vehicle Safety Equipment (emergency lights and sirens)

AMERICAN NATIONAL STANDARDS INSTITUTE:
Z535.1 American National Standard for Safety Colors

For assistance in obtaining the referenced documents, contact the Department of Commerce, National Technical Information Service (NTIS).

2.3 ORDER OF PRECEDENCE.

In the event of a conflict between the text of this specification and the references cited, the text of this specification shall take precedence.

3. Requirements

3.1 GENERAL VEHICULAR DESIGN, TYPES, AND CONFIGURATION.

3.1.1 DESIGN.

The ambulance and the allied equipment furnished under this specification shall be the OEM's current model year commercial vehicle of the Type and Configuration specified. The ambulance shall be complete with the operating accessories, as specified. The design of the vehicle and the specified equipment shall permit accessibility for servicing, replacement, and adjustment of component parts and accessories with minimum disturbance to other components and systems. The term "heavy-duty," as used to describe an item, shall mean in excess of the standard quantity, quality, or capacity and represents the best, most durable, strongest, etc., part, component, system, etc., that is commercially available on the OEM chassis.

3.1.2 TYPE I AMBULANCE (10,001 TO 14,000 GVWR).

Type I vehicle shall be a cab chassis furnished with a modular ambulance body.

3.1.2.1 TYPE I - AD (ADDITIONAL DUTY) AMBULANCE (14,001 GVWR OR MORE).

Type I-AD shall be a Cab-Chassis with modular ambulance body, increased GVWR, storage, and payload.

3.1.3 TYPE II AMBULANCE (9201 – 10,000 GVWR).

Type II ambulance shall be a long wheelbase Van, with Integral Cab-Body.

3.1.4 TYPE III AMBULANCE (10,001 TO 14,000 GVWR).

Type III shall be a Cutaway Van with integrated modular ambulance body.

3.1.4.1 TYPE III- AD (ADDITIONAL DUTY) AMBULANCE (14,001 GVWR OR MORE).

Type III-AD shall be a Cutaway Van with integrated modular body, and increased GVWR, storage, and payload.

3.1.5 CONFIGURATION OF PATIENT COMPARTMENT.

Primary cot shall be loaded to position the patient's head forward in the ambulance. The primary cot shall be mounted to provide maximum access from the EMSP seat.

3.2 VEHICLE, AMBULANCE COMPONENTS, EQUIPMENT, AND ACCESSORIES.

The emergency medical care vehicles; including chassis, ambulance body, equipment, devices, medical accessories, and electronic equipment shall be standard commercial products, tested and certified to meet or exceed the requirements of this specification. The ambulance shall comply with all Federal Motor Vehicle Safety Standards (FMVSS) and other Federal and state regulations applicable or specified for the year of manufacture. The chassis, components, and optional items shall be as represented in the OEM's current technical data. The ambulance body, equipment, and accessories shall be as represented in their respective FSAM's current technical data. The FSAM shall provide total standardization and interchangeability between similar vehicles, equipment, items, and accessories specified for all ambulance units under each contract.

3.2.1 MEDICAL DEVICES.

All medical devices furnished must be marketed in compliance with Food and Drug Administration (FDA) regulatory requirements.

3.3 RECOVERED MATERIALS.

All equipment, material, and articles required under this specification are to be new or fabricated from new materials produced from recovered materials. The term "recovered materials" means materials that have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed.

3.4 VEHICLE OPERATION, PERFORMANCE, AND PHYSICAL CHARACTERISTICS.

3.4.1 OPERATION AND PERFORMANCE.

All requirements in Section 3.4 shall be met with the ambulance loaded at curb weight plus total usable payload. The vehicle shall be capable of operating safely and efficiently under the environmental conditions outlined.

3.4.2 TEMPERATURE CONDITIONS.

3.4.2.1 EXTERIOR.

The ambulance and equipment shall be operable in ambient temperature ranging from 0°F to 95°F.

3.4.2.2 INTERIOR.

The interior of the ambulance patient compartment must be maintained at a minimum temperature of 50°F when the ambulance is prepared for immediate response. This requirement does not apply to ambulances that are fully operational but being held in reserve or ambulances that are not fully operational.

3.4.3 NOISE AND SOUND LEVEL LIMITS, EXTERIOR.

Unless more stringent sound levels are regulated by the states and municipalities where the ambulance will be based, the exterior noise level produced by the vehicle, except siren, shall not exceed federal regulations.

3.4.4 VEHICLE PERFORMANCE.

The ambulance shall provide a smooth, stable ride. When available from the OEM, automatic vehicle stability control (AVSC) shall be furnished.

3.4.5 SPEED.

The vehicles shall be capable of a sustained speed of not less than 65 mph over dry, hard surfaced, level roads, at sea level, and passing speeds of 70 mph when tested under normal ambient conditions.

3.4.6 ACCELERATION.

Vehicle shall have a minimum average acceleration, at sea level, of 0-55 mph within 25 seconds. Test shall be performed under normal ambient conditions.

3.4.7 GRADEABILITY.

The vehicle shall be capable of meeting the following performance requirements. The determination shall be made by actual test or OEM's certified computer prediction.

3.4.7.1 GRADEABILITY AT SPEED.

Minimum gradeability at speed shall be 55 mph on a 3% (1.72°) grade.

3.4.7.2 MINIMUM LOW SPEED GRADEABILITY.

The minimum low speed gradeability shall be 5 mph on a 35% (19.3°) grade.

3.4.8 FUEL RANGE.

The ambulance shall be capable of being driven for at least 250 miles without refueling.

3.4.9 FORDING.

The vehicle shall be capable of three fordings, without water entering patient and equipment compartments while being driven through a minimum of 8" of water, at speeds of 5 mph, for a distance of at least 100'.

3.4.10 VEHICLE PHYSICAL DIMENSIONAL REQUIREMENTS.

3.4.10.1 LENGTH.

Overall length of the ambulance (OAL) shall be specified by the purchaser, including bumpers, rear step and bumper guards.

3.4.10.2 WIDTH.

The overall width of ambulance bodies having dual rear wheels shall be a maximum of 96", excluding mirrors, lights, and other safety appurtenances.

The ambulance body sides, on a chassis with dual rear wheels, shall be symmetrical and within +/- 2.5" of the overall width of the tires (outside sidewalls). The 2.5" allowance is not cumulative; it applies individually to each side. Tires shall not extend beyond the fenders.

3.4.10.3 HEIGHT.

The purchaser shall specify the overall height of the ambulance when loaded to curb weight. This includes roof-mounted equipment, but excludes two-way radio antenna(s).

3.4.10.4 ANGLE OF APPROACH, RAMP BREAKOVER AND DEPARTURE.

With the exception of the OEM's furnished and installed components, the ambulance shall provide not less than the following clearance, measured in accordance with SAE J689.

Approach angle 20°
Ramp breakover 10°
Departure angle 10°

3.4.10.5 TURNING RADIUS.

Turning radius shall not be greater than the OEM standard.

3.4.10.6 FLOOR HEIGHT.

The finished floor (loading) height shall be a maximum of 34".

3.5 VEHICLE WEIGHT RATINGS AND PAYLOAD.

3.5.1 CURB WEIGHT.

Non-permanently mounted equipment is considered to be part of the payload, not the curb weight.

3.5.2 PAYLOAD CAPACITY.

Each ambulance's payload capacity shall be determined by completing the payload calculation form in Figure 2. The payload value of Figure 2, item 9 shall be displayed on the certification and payload signage as shown in Figure 1. The label shall be located in a conspicuous location in the ambulance.

The required minimum payload per vehicle without optional equipment shall be as follows:

1. Single rear wheeled, van ambulances (Type II)—1500 lbs.
2. Dual rear wheeled, modular ambulances (Type I or III)—1750 lbs.
3. Additional duty modular ambulances (Type I AD or III AD)—2,250 lbs.

The ambulance shall not be operated in an overloaded condition. EMSPs should determine that the actual load, to be placed on the vehicle, does not exceed the total usable payload as manufactured. Any additional items attached to, or carried on the vehicle by the EMSP will reduce the combined weight of occupants and cargo that comprise the total usable payload.

Additional weight added, resulting from specified options, will reduce the available minimum payload per vehicle.

Occupant weight shall be accommodated at 150 lbs. for each designated seating position and the primary patient.

FIGURE 1 – Certification & Payload Signage

The label shall be mounted on the body (module) interior in a conspicuous location.

- The label shown here is suggested format.
- Deviations in dimensions are acceptable.
- All text must be included.

CERTIFIED "STAR OF LIFE" AMBULANCE

Date of Manufacture ______________________

Mfg By ______________________

Address ______________________

City ______________________ State ________ Zip ____________

This ambulance conforms to Federal Specification KKK-A-1822 in effect on the date the ambulance was contracted for.

Final Stage Ambulance Manufacturers ID Number ______________________

VIN ______________________

OEM Chassis Model, Year of Manufacture ______________________

Vehicle Type ______________________

NOTICE: THIS VEHICLE, AS MANUFACTURED, CONFORMS TO THE PAYLOAD REQUIREMENTS OF THE FEDERAL AMBULANCE SPECIFICATION KKK-A-1822. USERS SHALL NOT LOAD VEHICLES ABOVE THE GVWR, GAWRs OR EXCEED THE TOTAL USABLE PAYLOAD LISTED BELOW.

TOTAL USABLE PAYLOAD ________________lbs.
(TOTAL REMAINING WEIGHT CAPACITY OF OCCUPANTS AND CARGO USER MAY ADD)

FIGURE 2 – Payload Calculation Form

The completed form shall be included in the handbook of instructions.

- The form shown here is suggested format.
- Deviations in dimensions are acceptable.
- All text must be included.

CUSTOMER USABLE PAYLOAD INFORMATION

Final Stage Ambulance Manufacturer's Name: ______________________

OEM Chassis Year, Make, Model: ______________________

1) Ambulance Model, Type, Prod. #: ______________________
2) OEM GAWR – Front: __________ lbs
3) OEM GAWR – Rear: __________lbs
4) OEM GVWR: __________lbs
5) Minimum Payload Per KKK-A-1822: __________lbs
6) Curb Weight – **AS BUILT** – Front Axle: __________lbs
7) Curb Weight – **AS BUILT** – Rear Axle: __________lbs
8) Total Curb Weight – **AS BUILT**: __________lbs
9) **CUSTOMER USABLE** Total Payload **AS BUILT** (item 4 minus item 8): __________lbs
10) **CUSTOMER USABLE** Front Axle Payload **AS BUILT** (item 2 minus item 6): __________lbs
11) Total Weight of Permanently mounted Options Specified (only required if item 9 does not meet or exceed item 5): __________lbs
12) Payload of Basic KKK Vehicle (item 9 plus item 11) (only required if item 9 does not meet or exceed item 5): __________lbs

3.5.3 GROSS VEHICLE WEIGHT RATING (GVWR).

The combination of the vehicle's curb weight and total usable payload weight shall not exceed the ambulance GVWR.

3.5.4 WEIGHT DISTRIBUTION.

Purchasers and FSAMs shall locate vehicle-mounted components, equipment, and supplies to provide a vehicle that is laterally balanced and within the GVWR and each gross axle weight rating (GAWR). The right and left wheel(s) of each axle of a completed ambulance shall be weighed to determine horizontal and lateral weight distribution. The weight distribution of a properly loaded ambulance on a level surface shall permit conformance to the FMVSS braking requirements in accordance with the statements provided by the OEM. All specifications and requirements for weight distribution and center of gravity of the OEM shall take precedence over the requirements contained in this section where the OEM's requirements are more restrictive or comprehensive.

- The weight between the right and left side of a given axle, when on a level surface, shall be within 5%.
- When loaded to the GVWR and within the GAWR for each axle, the front to rear weight distribution shall have not less than 20% of the total weight on the front axle, and not less than 50% nor more than 80% on the rear axle.
- The FSAM shall locate the center of gravity (CG) of the vehicle according to the requirements set by the OEM to determine and assure that the CG of the completed ambulance does not exceed any maximum horizontal and/or vertical limits.

To meet the above weight distribution requirements, consideration shall be given by the purchaser and FSAM to locate equipment and components to permit inherently proper lateral balance, front/rear axle loading, and center of gravity position.

3.5.5 RATINGS.

Vehicle and component ratings shall be the OEM's published ratings and shall not be raised above the OEM's rating.

3.5.6 CAB TO AXLE (CA), TYPE I AND III VEHICLES.

Cab to axle (CA) dimension of the vehicle chassis shall permit a minimum of 50% of the outside body length (including cab extensions) forward of the rear axle centerline, in addition to any cab to body clearance. Bodies designed with wheel openings shall have the rear wheels centered, within +/- 2" of those openings.

3.6 CHASSIS, POWER UNIT, AND COMPONENTS.

3.6.1 CHASSIS-FRAME.

The chassis shall include the OEM's ambulance preparation package when available. The chassis-frame and components shall be constructed to withstand the strains of on-off road service and any special service and equipment requirements specified. All chassis (including cab) components shall be as represented in the OEM's technical data.

3.6.2 VEHICLE LUBRICATION.

The chassis components, devices, accessories, and added equipment requiring lubrication shall be fully equipped with lubrication fittings, as provided by the OEM or equipment manufacturer.

3.6.3 POWER UNIT, ENGINE.

3.6.3.1 POWER UNIT.

The power unit shall meet or exceed the required vehicle performance specified at not more than the engine manufacturer's recommended operating engine speed. The OEM's diesel engine and power train shall be provided. The OEM's block heater shall also be furnished.

3.6.3.2 ENGINE LOW TEMPERATURE STARTING.

The engine shall start satisfactorily without the aid of engine block preheating devices (except glow plugs) or combustion air preheater at 0°F. The determination shall be made by actual test or OEM's certification.

3.6.4 POWER UNIT COMPONENTS.

3.6.4.1 OIL FILTER.

The oil filter shall be the OEM's standard for the engine offered.

3.6.4.2 AIR FILTER.

The air filter shall be the OEM's standard for the engine offered.

3.6.4.3 AIR POLLUTION CONTROL.

Vehicles destined for the 50 states, the District of Columbia, Puerto Rico, the Virgin Islands, Guam and American Samoa shall comply with the Environmental Protection Agency (EPA) regulations governing Control of Air Pollution from New Motor Vehicles and New Motor Vehicle Engines in effect on date of manufacture of the engine.

3.6.4.4 FUEL SYSTEM.

The fuel system shall conform to all applicable FMVSS, FMCSR, CARB, and EPA requirements.
The fuel system components shall be installed, connected, and routed in accordance with all OEM's guidelines. A permanent label at the fuel filler opening shall be furnished specifying the specific type of fuel required.

3.6.4.5 COOLING SYSTEM.

A coolant overflow recovery tank and compensating system shall be furnished. The cooling system shall be protected with an OEM solution of extended life antifreeze/coolant. Coolant to be the OEM's recommended type and mixture. The FSAM shall provide the OEM maximum size cooling system for the engine provided. The cooling system design shall maintain the engine at safe operating temperatures at all drivable altitudes and grades encountered during on and off road vehicle use.

3.6.4.6 EXHAUST SYSTEM.

The exhaust shall discharge at the vertical side(s) of the ambulance at a maximum distance of 1" beyond the side of the module and be angled /positioned to project the exhaust away from the door(s) to minimize fumes and contaminants entering the interior. On modular vehicles, the tailpipe outlet shall not terminate within 12" of the vertical axis of the fuel tank filler opening(s) when located on the same side. Modifications or extensions made to the OEM exhaust system shall meet or exceed OEM's requirements in terms of backpressure, components, design, and workmanship.

3.6.5 DRIVE TRAIN.

3.6.5.1 DRIVE TRAIN COMPONENTS.

The drive train and component's torque capacity shall meet or exceed the maximum torque developed in the lowest gear ratio by the engine.

3.6.5.2 AUTOMATIC TRANSMISSION.

The OEM's automatic transmission shall be provided. The transmission shall provide not less than four speeds forward and one reverse and shall be equipped with the OEM's heaviest duty transmission fluid cooler.

3.6.5.3 DRIVELINE.

The driveline (driveshaft, U-joints, etc.) shall be balanced and supported to perform throughout the design speed range without whipping or vibrating.

3.6.5.4 BRAKE SYSTEMS, SERVICE AND PARKING.

OEM's heaviest duty, power assisted brakes, linings, and parking brake shall be furnished on the OEM chassis offered. Antilock brake systems shall be furnished when available from the OEM.

3.6.5.5 SPECIAL TRACTION (REAR END) DIFFERENTIAL.

All ambulances shall have a positive traction, limited slip differential or automatic, locking type differential, unless not furnished with the OEM's AVSC system.

3.6.5.6 SUSPENSION.

Vehicle shall be equipped with laterally matched sets (front and rear) of spring, torsion, or air suspension system components. Components shall have a rated capacity in excess of the load imposed on each member. Only corrections permitted by the OEM to compensate for lean due to normal spring tolerance variations are permitted. Correction of lean due to imbalance is not permitted.

3.6.5.7 SPRING STOPS.

The OEM's standard spring bumpers and axle stops shall be furnished. The stops/bumpers shall prevent the wheel and axles from striking the engine, oil pan, fenders, and body under all conditions of operation.

3.6.5.8 SHOCK ABSORBERS.

Shock absorbers, double-acting type, heaviest duty available from OEM for model offered, shall be furnished on the front and rear axles.

3.6.6 STEERING.

The OEM's standard, power assisted steering shall be furnished.

3.6.7 WHEELS.

Types I, I AD, III & III AD ambulances shall be equipped with dual rear wheels and single front wheels. Type II ambulances shall be equipped with single, front and rear wheels. Wheels shall conform to the recommendations of the Tire and Rim Association, Inc., and shall be identical in type, size, and load rating for all wheels on the ambulance.

3.6.8 TIRES.

Tires shall be as furnished by the OEM and shall be OEM tubeless, steel belted radials.

3.6.9 TIRE CHAINS AND CLEARANCE.

Tire chain clearance on the furnished body shall be provided for all driving wheels per SAE J683. Sufficient chain clearance shall be provided to permit off road operation with the ambulance loaded to the maximum payload.

3.6.10 WHEEL TIRE BALANCING.

Wheel/tire, hubs, and brake drum assemblies of the vehicle shall be dynamically balanced to a minimum of 70 mph.

3.6.11 HUBCAPS.

When available from the OEM standard hubcaps or wheel covers shall be furnished on Type II ambulances.

3.7 ELECTRICAL SYSTEM AND COMPONENTS.

3.7.1 ELECTRICAL SYSTEM.

The ambulance electrical system shall be equipped with, but not limited to, the following:

1. Dual, OEM's batteries.
2. Generating, starting, lighting, visual and audible warning systems.
3. Specified electronics equipment and devices (including master consoles located in the cab and patient compartment).
4. Other specified accessory wiring.
5. All electrical system components and wiring shall be readily accessible through access panels.
6. All switches, indicators, and controls shall be located and installed in a manner that facilitates easy removal and servicing.
7. All exterior housings of lamps, switches, electronic devices, connectors, and fixtures shall be corrosion resistant and weatherproofed.
8. Electrical fixtures attached to the exterior sides of the ambulance below the 75" level shall be near flush mounted and not protrude more than 2", except for such items as spotlights and ventilators.
9. All electrical devices and equipment installed, including the electromagnetic coils of high current solenoids, and relays etc, which produce RFI, shall include filters, suppressers, or shielding to prevent electromagnetic radiation and the resultant interference to radios and other electronic equipment.
10. Vehicles shall be immune from interference caused by radio transmissions.

3.7.1.1 WARNING INDICATORS.

The electrical system shall incorporate a warning light panel located in the driver's compartment. It shall provide indicator lights for:

1. Open patient compartment entry doors.
2. Open cab entry doors (when available from the OEM).
3. Open equipment compartment door(s).
4. Extended devices (flood lights, etc).

The "Door/Equipment Open" indicator in the driver's compartment can be either a warning incandescent light with at least 0.2 sq. in. of lighted surface, an electronic text message visible in all ambient lighting conditions, or LED's with equal intensity as an incandescent light source.

Electronic displays that are visible in all ambient light, that projects narrative information may be used in lieu of discrete, colored, indicator/ warning lights provided the projected message is at least as visible as the basic required warning light.

3.7.2 WIRING INSTALLATION.

1. The ambulance body and accessory electrical equipment shall be served by circuit(s) separate and distinct from vehicle chassis circuits.
2. All wiring provided by the FSAM shall be copper.
3. All wiring shall have type SXL or GXL high temperature cross-linked polyethylene, or better, insulation.
4. The use of multi conductor or ribbon cables are permitted provided they are not exposed to under hood or under vehicle temperatures/conditions.
5. The wiring shall be permanently color coded or marked the entire length of the wire.

6. Wiring shall be routed in conduit or high temperature looms with a rating of 300°F.
7. When cables are supplied by a component manufacturer to interconnect system components, these cables need not be continuously color coded/identified. They shall be coded/identified at the termination or interconnection points.
8. All added wiring shall be located in accessible, enclosed, protected locations and kept at least 6" away from exhaust system components.
9. Electrical wiring and components shall not terminate in the oxygen storage compartment except for the oxygen controlled solenoid, compartment light, and switch plunger or trigger device.
10. Wiring necessarily passing through an oxygen compartment shall be protected from damage.
11. All conduits, looms, and wiring shall be secured to the body or frame with insulated metal cable straps.
12. All apertures on the vehicle shall be properly grommeted for passing wiring.
13. All items used for protecting or securing the wiring shall be appropriate for the specific application and be standard automotive, aircraft, marine, or electronic hardware.
14. Cable ties shall not be used to support harnesses, but may be used for bundling purposes.
15. Electrical panels that are accessible to accidental contact shall have a protective cover, shield, etc. to prevent shorts that can result in injury, fire, or damage to the electrical system.

3.7.2.1 WIRING CRITERIA.

1. All wiring (including grounds), devices, switches, outlets, etc., except circuit breakers, shall be rated to carry at least 125% of the maximum ampere load.
2. A service loop of wire or harness shall be provided at all electrical components, terminals, and connection points.
3. All splices and terminals provided shall comply with SAE J163, J561, or J928 as applicable.
4. All terminals shall be permanently numbered or coded.
5. Terminal strip(s) block(s), or multi-pin connector(s) shall be readily accessible for checking and service.
6. All exterior wiring to lights or any other component shall utilize sealed connectors or splices.
7. The ambulance electrical system shall incorporate a master circuit breaker panel with circuit breakers or other electronic, non-disposable, current protection devices, in each circuit, which comply with SAE J553 Type I, or Type III (if circuit breaker is readily accessible for resetting by the driver or EMSP).
8. When multiconductor cables/ribbon cables are used for low current (self limiting) circuits, additional fuses/circuit breakers are not required.
9. One extra 15-ampere circuit breaker shall be provided for future use.
10. For high current circuits, where SAE Type I breakers are not commercially produced, protection for these circuits may be provided with other types of circuit breakers.
11. All circuit breakers shall be securely mounted, easily removable, and readily accessible for inspection and service.
12. All electrical and electronic components, switches, connectors, circuit breakers, lamps, and indicators, including the vehicle batteries, shall be marked with an easily read identification code number and/or letter.

3.7.2.2 PRINTED CIRCUITS.

When printed circuits are utilized, they shall conform to IPC A-610D standards, "Acceptability of Electronic Assemblies." Printed circuit assemblies provided must qualify under Classification 1.4.1 as class 3 for "Life Support or other Critical Assemblies." Printed circuit board connections and components shall conform to all other specification requirements.

3.7.3 GROUNDING.

Dedicated grounds for all appliances, circuits, etc. shall be furnished. The use of appliance mounting screws/hardware shall not be used for grounding purposes unless specifically designed for such use by the appliance manufacturer.

3.7.3.1 RF GROUNDING.

To provide RF grounding and minimize potential interference with OEM's computers, the module and chassis cab shall be connected to the chassis frame with a separate dedicated minimum 3/4", braided ground strap with soldered ends that are secured to cleaned metal surfaces on the body and frame with lock washers. To prevent corrosion, both ends of the attached ground strap shall then be sealed with either rust proofing compounds or non-hardening battery terminal sealer. Regular stranded copper wire, while providing a DC ground, does not provide RF grounding and does not meet this requirement.

3.7.4 WINDSHIELD WIPERS AND WASHERS.

Vehicle shall be equipped with OEM intermittent windshield wipers.

3.7.5 HORNS.

The OEM's dual electric horns shall be furnished.

3.7.6 LOW VOLTAGE ELECTRICAL SYSTEM.

The ambulance shall, when available from the OEM, be equipped with standard or optional generating system designed for ambulance applications, and shall be nominally rated at 14 volts, with a minimum under hood temperature of 200°F. As a minimum, the generating system shall be capable of supplying at its regulated voltage, at 200°F, the continuous electrical load, which consists of the following electrical equipment and systems:

1. Engine/transmission control system.
2. Headlights (low beam).
3. All FMVSS 108 lights.
4. Windshield wipers (low speed).
5. Cab air conditioning (at coldest setting with highest blower speed).
6. Radio in receiving mode (or equal load, if not equipped).
7. Patient module dome lighting (in the high intensity setting).
8. Patient module air conditioning (at coldest setting with highest blower speed).
9. Emergency warning lighting system (in the daytime "primary" mode).
10. 20 amp medical load or equal.

The generating system shall supply the maximum electrical load, at the regulated voltage, at 200°F under hood temperature, and with an engine speed not exceeding of the furnished engine manufacturer's high idle setting in order to maintain battery charge at the regulated voltage. The throttle control device shall control the engine RPM necessary to maintain the heating and air conditioning systems, at full operating capacity, and to maintain the generating system's required output when the vehicle is stationary and the parking brake is set. The 12-volt electrical system shall incorporate a voltmeter and low voltage warning device which is functionally connected as shown in Figure 3. The FSAM shall test each ambulance prior to delivery and provide, to the purchaser, a written certification indicating the amount of generating capacity remaining, at the regulated voltage, at 200°F, after supplying the total electrical load as manufactured (including the purchaser options).

3.7.6.1 ENGINE HIGH-IDLE SPEED CONTROL.

The OEM Engine High-Idle speed control shall be furnished. The control shall be set to automatically increase the engine speed (RPM) to the engine manufacturer's recommended setting to sustain the ambulance's total continuous electrical load at the regulated voltage and provide maximum heating/air conditioning output.

The device shall operate only when switched to the "ON" position and the transmission is in "PARK" or "NEUTRAL." The parking brake shall be applied at all times when the Engine High-Idle speed control is in use.

The device shall disengage high idle operation according to OEM and/or engine manufacturer disablement strategy, or if not specified, when the operator depresses the service brake pedal or the transmission is placed in gear.

3.7.6.2 VOLTMETER AND VOLTAGE MONITOR.

A voltmeter illuminated for nighttime operation shall be furnished. The electrical system shall be monitored by a system that provides an audible and visual warning in case of the low voltage to persons in the ambulance of an impending electrical system failure caused by the excessive discharge of the batteries. The charge status of the battery shall be determined by direct measurement of the battery voltage. The alarm shall sound if the system voltage at the battery drops below 11.8 V for 12 V nominal systems for more than 120 seconds.

3.7.7 BATTERY SYSTEM.

Two batteries (or additional batteries as required by the OEM) for ambulance use shall be furnished. The batteries shall be equivalent to the OEM batteries. Batteries shall be located in a ventilated area, sealed off from occupant compartments, and shall be readily accessible for servicing and removal. When batteries are mounted in the engine compartment, they shall be provided with a heat shield as a safeguard against high under hood temperatures when relocating batteries; the OEM shall approve the method of relocation.

3.7.7.1 AUTOMATIC CHARGER/CONDITIONER.

An automatic charger/conditioner shall be provided.

1. The charger/conditioner shall be connected to the 12-volt DC battery system as shown in Figure 3.
2. The charger/conditioner shall be capable of supplying a minimum of 10 amperes charging current.
3. The charger/conditioner shall be permanently mounted, in the vehicle, in a properly ventilated, accessible location and wired to the 125-volt AC utility power as shown in Figure 4.
4. The battery conditioner shall monitor the battery state of charge and, as necessary, automatically charge or maintain the batteries without gassing, depleting fluid level, overheating, or overcharging.
5. A permanently mounted decal or engraved plate shall be furnished in a conspicuous location in the cab stating:

"This vehicle is equipped with a battery conditioner to maintain batteries in a full state of charge, and a dedicated 12-volt recharging circuit for portable battery powered equipment. For operation, vehicle shall be plugged into 125-volt AC shore power during periods of non-use."

3.7.7.2 PORTABLE EQUIPMENT CHARGING CIRCUIT.

A circuit shall be furnished (Figure 5) for charging all portable battery powered devices, i.e. suction units, hand lights, portable radios, etc. This circuit shall prevent discharge of chassis batteries by only permitting the charging of portable devices when the vehicle is either running or the optional battery conditioner is connected to shore power. Circuit breaker protection shall be provided and shall have a minimum 10 amp capacity. An additional tagged, identified lead shall be furnished in both the cab and module for connection of additional (future) portable equipment that requires recharging.

3.7.7.3 INTERNAL 12-VOLT DC POWER (REFERENCE FIGURE 3).

Two automotive "Power Point" type connectors shall be furnished, in the patient compartment. Each connector shall be rated for 12-volt DC, 20 ampere capacity, and be on a separately protected circuit. This circuit shall also include a (low voltage drop) "Schottky" diode to isolate medical equipment batteries from any electrical loads that the remainder of the ambulance electrical system may impose. The "Schottky" diode shall be heat-sink mounted, have an inverse voltage rating of at least 45 volts and also be rated to carry the maximum short circuit current, until the circuit breaker opens. The diode shall be physically located in an accessible location and be electrically connected between the circuit breaker and the "action wall" mounted connectors.

3.7.7.4 MASTER MODULE DISCONNECT SWITCH OR DEVICE.

An illuminated "Module Disconnect" switch shall control all electrical loads added by the FSAM, or an illuminated switch controlled solenoid as shown in Figure 3.This switch shall be located in the driver's compartment, be legibly marked, illuminated when "ON," and rated to carry at least 125% of the circuit's maximum current. The module disconnect switch or device shall be different in feel from other switches, or be physically isolated from them.

3.7.8 125-VOLT AC UTILITY POWER (REFERENCE FIGURE 4)

The ambulance shall be furnished with a 2-wire plus ground 125-volt AC wiring system that is separate and distinct from the vehicle's DC wiring system(s). Listing shall be by a nationally recognized testing laboratory, recognized by OSHA under Appendix A to 29 CFR 1910.7. The AC system is to be utilized while the vehicle is stationary for powering maintenance devices, medical equipment and battery chargers. The AC system shall not be utilized for operational ambulance interior lighting, such as dome and cot lights.

3.7.8.1 UTILITY POWER CONNECTOR.

A 125-volt AC flanged inlet conforming to NEMA 5-15, with spring loaded cover assembly suitable for wet locations, shall be installed on the driver's side of the ambulance body in close proximity to driver's door. The connection shall be permanently labeled with the following:

THIS CONNECTION IS FOR 125-VOLT AC, 60 Hz, 15-AMPERE SUPPLY.

This receptacle shall energize the vehicle's internal AC circuit from an external power source (utility power). The purchaser's stationary utility power circuit supplying the ambulance's 125-volt AC power should incorporate ground fault protection. A proper mating, weatherproof, 15 ampere connector body conforming to NEMA 5-15 shall also be furnished without cable and tagged specifying the size, type of wire necessary, and the polarity of the future hookup.

3.7.8.2 ELECTRICAL 125-VOLT AC RECEPTACLES.

The patient compartment shall be furnished with two (2) 125-volt AC duplex receptacles conforming to NEMA 5-15. Receptacles shall be near flush, vertically mounted. All interior outlets shall be installed in accordance with Section 210-7 (Receptacles and Cord Conductors) of the NEC. One outlet shall be located on the primary patient action wall and the other shall be located in the right front cabinet/storage area. Both outlets shall be at least 12 in from any oxygen outlet. An indicator shall be located within each 125-volt AC receptacle as a line monitor indicating a live (hot) circuit. The receptacles shall be labeled with the following: "125-VOLT AC."

3.7.8.3 125-VOLT AC SYSTEMS.

1. The electrical equipment and material indicated for connection to a wiring system rated 125 volts, nominal, 2-wire with ground shall incorporate a minimum 15 ampere circuit breaker which can be used as a master AC disconnect switch.
2. The AC wiring shall utilize stranded wire, Type SO or Type SEO cord with a WA suffix, rated at 600V and 194°F, covered with a minimum 300°F flame retardant wire loom, or approved wire in conduit.
3. All products shall be used only in the manner for which they were tested and found suitable.
4. Other sources of AC power shall be wired in full conformity with the requirements of this standard.
5. Grounding shall be in accordance with Section 250-6 [Portable and Vehicle Mounted Generators] of the National Electrical Code (NEC).
6. All 125-volt AC receptacle outlets of the ambulance shall have ground fault circuit interrupter protection.

7. Where rigid metal conduit or intermediate metal conduit is terminated at an enclosure with a lock nut and bushing connection; two lock nuts shall be provided, one inside and one outside of the enclosure. All cut ends of conduit shall be reamed or otherwise finished to remove rough edges.
8. Boxes are required for all inlets and/or outlets.
9. Non-metallic boxes shall be acceptable only with non-metallic conduit.
10. Boxes shall be mounted in accordance with Article 370 [OUTLET, DEVICE, PULL AND JUNCTION BOXES, CONDUIT BODIES AND FITTINGS] of the NEC.
11. No bend shall have a radius of less than five times the cable or conduit diameter, whichever is greater.
12. Tubing, conduit and loom shall be supported with clamps at the outlet boxes, distribution panel boards and splice boxes on appliances. Supports shall be provided every 24".
13. Where subject to physical damage, exposed type SO cable will be protected by guard strips, raceways or other means.
14. The branch circuit over current devices shall be rated:
    a) Not more than the circuit conductors and
    b) Not more than 150% of the rating of a single appliance rated 13.3 amperes or more and supplied by an individual branch circuit, or according to the appliance manufacturer, but
    c) Not more than the over current protection size marked on motor-operated appliances

3.7.8.4 DISTRIBUTION BOX.

1. The distribution box shall be of the dead-front type and shall be installed in a readily accessible location.
2. The distribution panel board shall have a grounding bus with sufficient terminals for all chassis grounding and separate neutral grounding conductors or other approved grounding means.
3. The grounded circuit conductor (neutral) shall be insulated from the equipment grounding conductors and from equipment enclosures and other grounded parts. The grounded (neutral) circuit terminals in the distribution panel board and in appliances shall be insulated from the equipment enclosure.

3.7.8.5 INTERIOR EQUIPMENT GROUNDING.

1) In the electrical system, all exposed metal parts, enclosures, frames, fixtures, canopies, etc., shall be effectively bonded to the grounding terminals or enclosure of the distribution panel board.
2) Only bare wires, green colored or green wires with yellow stripes shall be used for equipment grounding conductors.
3) Grounding of electrical equipment shall be provided as follows:
    a) Connection of metal raceway, i.e., conduit or electrical metallic tubing.
    b) A connection between the one or more equipment grounding conductor and a metal box by means of a grounding screw (which shall be used for no other purpose) or a listed grounding device.
    c) The equipment grounding conductor shall be permitted to be secured under a screw threaded into the fixture canopy other than a mounting screw or cover screw or attached to a listed grounding means (plate) in a non-metallic outlet box for fixture mounting (grounding means shall also be permitted for fixture attachment screws).
    d) A connection between the one or more equipment grounding conductors brought into a non-metallic outlet box shall be so arranged that a connection can be made to any fitting or device in that box which requires grounding.

e) Where more than one equipment grounding conductor or branch circuit enters a box, all such conductors shall be in good electrical contact with each other and the arrangement shall be such that the disconnection or removal of a receptacle, fixture, or other device fed from the box will not interfere with or interrupt the grounding continuity.
f) Cord-connected appliances shall be grounded by means of an approved cord with equipment grounding conductor and grounding attachment plug.

3.7.8.6 BONDING OF NON-CURRENT-CARRYING METAL PARTS.

1) All exposed non-current carrying metal parts that may become energized shall be effectively bonded to the grounding terminal or enclosure of the distribution panel board.
2) A bonding conductor shall be connected between the distribution panel board and an accessible terminal on the chassis. Aluminum or coppered aluminum conductors SHALL NOT be used. Any ambulance that employs a unitized metal chassis-frame construction to which the distribution panel is securely fastened with a bolt and nut shall be considered to be bonded.
3) Grounding terminals may be of the solderless type and listed as pressure terminal connectors recognized for the wire size used. The bonding conductor shall be copper strand and equal in amperage capacity to the main supply cables.
4) The ambulance body and exterior covering shall be considered bonded where:
   a) The metal panels overlap one another and are securely attached to the metal frame parts by metal fasteners or welding and
   b) The lower panel of the metal exterior covering is secured by metal fasteners at each cross member of the chassis, or the lower panel is bonded to the chassis by a metal strap.
   c) Metal circulating air ducts shall be bonded.
   d) The compressed gas pipes shall be considered bonded if they are bonded to the chassis.

3.7.8.7 APPLIANCE ACCESSIBILITY AND FASTENING.

All electrical appliances shall be accessible for inspection, service, repair, and replacement without removal of permanent construction. Appliances shall be fastened in accordance with the manufacturer's directions.

3.7.9 DRIVER COMPARTMENT CONTROLS.

In addition to the left-hand drive controls and switches, the FSAM shall provide and locate, within easy normal reach and view of the driver, the specified controls, and instruments.

3.7.10 PATIENT COMPARTMENT CONTROLS.

The patient compartment controls, switches, and instruments shall be panel mounted and located within normal reach of the seated EMSP.

3.7.11 MARKING OF SWITCHES, INDICATORS, AND CONTROL DEVICES.

All switches, indicators, and control devices supplied by the FSAM shall be clearly visible to the EMSP. They shall be perceptively and permanently identified with at least 12 point letters for the noun or function, and 8 point letters for the remainder of the legend. The identifications shall be contrasting colors etched or engraved in plastic or metal, or printed and laminated in see through plastic, and grouped according to function, and mounted in illuminated or backlit panel(s) or the console.

3.7.12 ELECTROMAGNETIC RADIATION AND SUPPRESSION.

In addition to OEM chassis, all added electrically operated or electrical generating devices, including alternators, air conditioning, warning light systems, electromagnetic coils of high current solenoids and relays, and medical equipment, shall be electromagnetic radiation suppressed, filtered, or shielded to prevent interference to radios and telemetry equipment aboard the vehicle and the surrounding area and shall not exceed MIL-STD 461 limits. Type certification for these devices is acceptable.

3.8 LIGHTING, EXTERIOR AND INTERIOR.

3.8.1 AMBULANCE EXTERIOR LIGHTING.

The basic exterior ambulance lighting shall include daytime running lights when available from the OEM. The lower front and rear side marker lights shall flash in conjunction with the directional signals. The FSAM shall furnish light assemblies that are manufactured with weather resistant materials that are installed in a manner that will not cause electrolysis of light housings or vehicle body.

3.8.2 AMBULANCE EMERGENCY LIGHTING.

An emergency lighting system shall provide the ambulance with 360° of conspicuity for safety during its missions. The system shall display highly perceptible and attention getting signals that function in a modal system, and convey the message in the "PRIMARY MODE" — "Clear the Right-of-Way" and in the "SECONDARY MODE" — "Hazard, Vehicle Stopped on Right-of-Way." The ambulance standard warning light system shall not impose a continuous average electrical load exceeding 40 amperes at 14.2 volts.

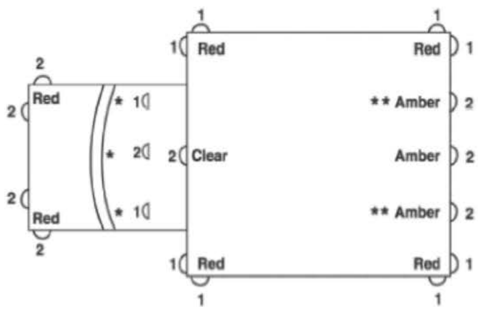
Warning light systems shall not impair the effectiveness of the ambulance's exterior lighting with conformity to the requirements of FMVSS No. 108.

3.8.2.1 EMERGENCY LIGHTING SYSTEM CONFIGURATION.

The ambulance standard emergency warning light system shall contain twelve fixed red lights, one fixed clear light and one fixed amber light. These lights shall function in a dual mode system as shown in Table 1 and meet the physical and photometric requirements. The upper body warning lights shall be mounted at the extreme upper corner areas of the ambulance body, below the horizontal roofline. The single clear light shall be centered between the two front facing, red, upper corner lights or in a dedicated housing mounted forward of the body on the cab roof. If due to limited body dimensions and physical size of the outboard forward facing lights, the lights may also be mounted in dedicated housings on the cab roof. Doors or other ancillary equipment shall not obstruct the standard warning lights. The amber light shall be symmetrically located between the two rear facing red lights. The red "grille" lights shall be located at least 30" above the ground and below the bottom edge of the windshield and be laterally separated by at least 18", measured from centerline to centerline of each lamp. The lateral facing intersection lights shall be mounted as close as possible to the front upper edge of each front fender and may be angled forward a maximum of 30°. All warning lights furnished shall be mounted to project their highest intensity beams on the horizontal plane.

Alternate approved lighting systems are NFPA 1901 compliant or SAE J2498 compliant.

TABLE 1 – Emergency Lighting



FLASH PATTERN

* Optional forward facing light locations on cab roof for two red and single center clear lights.

** Optional rear amber lights in lieu of single center light.

1 - Indicates lights flashing at the same time.
2 - Indicates lights flashing 180 degrees out of phase with 1.

MINIMUM FLASH ENERGY, Cd-S PER FLASH, PER FIXTURE				
COLOR	**RED**		**CLEAR**	**AMBER**
LOCATION	GRILL & FENDERS	UPPER BODY CORNERS	FRONT CENTER	REAR CENTER*
DAY	160 Cd-S @ HV	240 Cd-S @ HV	900 Cd-S @ HV	600 Cd-S @ HV
	80 Cd-S @ $\pm 5^0$ H Points	120 Cd-S @ $\pm 5^0$ H Points	450 Cd-S @ $\pm 5^0$ H Points	300 Cd-S @ $\pm 5^0$ H Points
	12 Cd-S @ All 5^0 V - 45^0 H Points	32 Cd-S @ All 5^0 V - 45^0 H Points	96 Cd-S @ All 5^0 V - 45^0 H Points	72 Cd-S @ All 5^0 V - 45^0 H Points
NIGHT	10 - 30% of the above			

* Single center rear or combined dual rear (Optional)

MODAL EMERGENCY LIGHTING SYSTEM				
COLOR & LOCATION / MODE OF OPERATION	**RED**	**CLEAR**	**AMBER**	**RED**
	Front and Rear Corners	Front Upper Center	Rear Center	Grille and Fender
PRIMARY "Clear the Right-of-Way"	ON	ON	ON	ON
SECONDARY "Hazard-Vehicle Stopped on Right-of-Way""	ON	OFF	ON	OFF

3.8.2.2 PHOTOMETRIC, CHROMATICITY, AND PHYSICAL REQUIREMENTS.

Each emergency light shall flash 75 to 125 times per minute. The chromaticity values of the lights shall conform to SAE J578, for their respective color, except for the red lights, which may conform to the following expanded boundary limits of: y =0.34; y = 0.32; x = 0.62. All warning lights shall project a beam spread of at least 5° up and 5° down and at least 45° left and right of H-V. Each light shall produce flash energy, (Cd-s) per flash, measured from the H-V to all the extreme test point coordinates and shall be tested at all 5° increments. At no point shall the Cd-s values drop to less than the minimum values as shown in Table 1 when tested at 14.2 volts. Flash energy shall be determined in accordance with the SAE J845 method for determining the flash energy of a light. Testing shall be conducted on the device(s) as manufactured including use of the actual light source and all other related system components.

3.8.2.3 SWITCHING ARRANGEMENTS.

The emergency light switches shall be wired and arranged to provide the warning light signal modes and combinations as specified. All emergency light switches shall be labeled and each Primary/Secondary mode switch shall have indicator light to show the driver which mode is activated.

3.8.2.4 HARDWARE CONSTRUCTION AND INSTALLATION.

The emergency lighting system shall be comprised of components and devices that comply with the general requirements and tests of SAE J575, J576, J578, and J551, as applicable for the unit. Warning lights shall be firmly fastened to reinforced body surfaces in accordance with the lighting manufacturer's requirements and recommendations and include aiming wedges to compensate for sloped body surfaces, grill, hood and fender angles or mold release angles on roof caps. The FSAM shall aim the lights to assure that all lighting performance requirements herein are met. The lights shall be aimed either mechanically or optically on the horizontal axis with a tolerance of +0° to -3°.
All switches, connectors, and wiring shall be rated to carry a minimum of 125% of their maximum ampere load. When halogen or other long duty cycle light source is used, the duty cycle of any device shall not exceed 50%. When strobe lights are furnished, all high voltage leads and connections shall be insulated and enclosed, or weatherproof connectors, with the proper voltage rating shall be used.

3.8.2.5 TESTS, WARNING LIGHT SYSTEM.

The lighting manufacturers shall furnish and certify or the FSAM shall measure and record the total average current load of the standard emergency warning light system on the vehicle as manufactured at the regulated voltage of 14.2 volts, when operated in the mode which draws maximum current. The warning light system and related components and devices shall be tested and approved by an Automotive Manufacturers Equipment Compliance Agency (AMECA) accredited laboratory independent from the lighting device manufacturer's own labs and listed with the AMECA for compliance with the requirements in this specification.

3.8.3 FLOOD AND LOADING LIGHT (EXTERIOR).

Flood and loading lights shall be not less than 75" above the ground and unobstructed by open doors. Floodlights shall be located on the sides, and a patient loading light on the rear of the ambulance. They shall be firmly fastened to reinforced body surfaces, below the roofline. These floodlights shall be mounted on fixed body surfaces. Floodlight switches shall be located on the cab console and control each side independently. Loading light(s) shall automatically be activated when rear doors are opened.

3.8.4 AMBULANCE INTERIOR LIGHTING.

The basic interior ambulance lighting configuration shall be designed to minimize electrical loads and include: A driver's compartment dome light; instrument panel lights; master switch panel; and console light(s). Lighting shall be designed and located so that no glare is reflected into the driver's eyes or his line of vision, from switch control panels or other areas that are illuminated while the vehicle is in motion. The EMSP's control panel shall be separately illuminated. All lights shall have lamp-shells and housings grounded.

3.8.4.1 PATIENT COMPARTMENT ILLUMINATION.

The patient compartment floor shall not be less than 15 foot candles intensity, measured along the centerline of the clear floor. The primary cot shall be provided with a minimum of 35 foot candles of illumination measured on at least 90% of the cot's surface area.

Blue light(s) or lenses shall not be used. Patient compartment lights shall not be powered by the vehicle's AC system if so equipped. The patient compartment dome lighting (in the dim setting) and exterior corresponding loading lamp(s) shall be automatically activated when the side entry or rear entry patient compartment doors are opened. All interior dome lighting, including "checkout" lights, shall be near flush mounted and not protrude more than 1.5".

Dome lighting shall not consume more than 25 amps in the bright setting and shall have two separately protected and controlled circuits. Switches, electronic controls, or fireproofed rheostats may be used to control lighting.

3.9 CAB-BODY DRIVER COMPARTMENT AND EQUIPMENT.

3.9.1 DRIVER'S COMPARTMENT, CAB-BODY STRUCTURE.

All cab compartments shall be of sufficient size to accommodate a driver and passenger, with space to perform driving and control activities. The cab shall be organized and designed with the specified and required equipment and accessories for ease of operation and safety. There shall be a console convenient to driver in the drivers cab. The console shall contain all added switches for operation of the ambulance.

3.9.2 CAB-BODY PROVISIONS.

An OEM two door cab shall be furnished that is suitable for the subsequent mounting of various ambulance equipment and bodies.

Driver's cab section shall provide:

a. Forward hinged doors.
b. Opening side windows.
c. Door stops.
d. External key operated door locks with two sets of keys.
e. Trim or closed panels and headliner (washable vinyl upholstery, or flooring type materials).
f. Floor covering (OEM's heat, noise and appearance trim packages).
g. Panel mounted instruments.
n. All exposed interior surfaces shall be painted.
h. Armrests, mounted on each side door.

i. Key operated ignition/starter switch.
j. Fuel gauge(s).
k. Oil pressure gauge.
l. Engine temperature gauge.
m. Speedometer with odometer.
n. Environmental controls (heater-defroster/air conditioner, etc.).
o. Type II Seatbelts and shoulder harness for driver and passenger.
p. Cab lighting and controls.
q. Tinted windshield.
r. Dual electric horn(s).

3.9.3 CAB COMPARTMENT DRIVER AND PASSENGER SEAT.

The driver's compartment shall be OEM two individual bucket-type seats (driver and passenger). The seats shall be frame constructed with cushioned springs or foam rubber, padded and upholstered to provide riding comfort. The seats shall be covered with fire-retardant, washable, nonabsorbent material. Driver's seat shall have the OEM's full, unobstructed seat track travel range of longitudinal adjustment, and a minimum of 30% of the range of inclination, but not less than the angle furnished on the OEM's standard non-reclining high back seat.

3.9.4 CONTROLS AND OPERATING MECHANISM.

All controls and operating mechanisms shall be located for left-hand drive. Lever controls, equipment, items, and devices shall be installed, located, and stowed for the convenience of the purpose intended and shall not interfere with the EMSP or patient's ingress or egress of respective compartments.

3.9.5 OUTSIDE REARVIEW MIRRORS.

Dual rearview OEM mirrors having a combination flat/convex mirror system, shall be furnished. The mirrors shall be the largest available from the OEM. When available from the OEM, all four mirror head faces shall be independently adjustable. Hardware and mirror heads shall have a corrosion resistant exterior finish.

3.9.6 BUMPERS AND STEPS.

OEM's standard chrome bumper shall be furnished in the front of the chassis. The rear of the ambulance shall be furnished with a sturdy, full-width, rear bumper, with step secured to the vehicle's chassis-frame. The bumper-step shall be designed to prevent the accumulation of mud, ice, or snow and made of anti-skid open grating metal. These steps shall not be located or exposed to the interior of the ambulance when the door(s) are closed. All necessary steps shall be at least the width of the door opening for which they are provided. The step's tread shall have a minimum depth of 5" and a maximum depth of 10". If the step protrudes more than 7" from the rear of the vehicle, a fold up step shall be furnished. The rear bumper and step shall be adequate to support a test weight of 500 lbs. without flexing. The height of the rear step shall not exceed 22".

3.9.7 BODY PROTECTION.

3.9.7.1 FENDERS.

Fenders and wheel housings shall be provided to cover all tires.

3.9.7.2 MUD FLAPS.

Mud flaps, at least as wide as the tire(s), shall be provided behind the front and rear wheels and shall be reinforced at the point of attachment to the vehicle. Mud flaps may be incorporated into the running boards.

3.9.7.3 FUEL FILL SPLASH PLATES.

The painted surface of the ambulance body shall be protected from discoloration due to spilled fuel during refueling. Protection shall be provided by a drain in the fuel fill housing(s) or by splash plate(s) under the fuel fill opening.

3.9.8 ENGINE HOOD.

Engine hood and cowl shall be fitted to prevent precipitation, heat, odors, and noise from entering the interior of the cab and body. Cab compartment engine covers shall be removable for easy access to engine and components.

3.9.9 CAB CONNECTING BELLOWS FOR TYPE I & I AD VEHICLE.

A flexible, weather-tight bellows, fabricated from EPDM, Hypalon, sheet or molded rubber, or other durable materials that meet the temperature requirements herein and resist ozone, sunlight, oil, fungus, and will not crack, rot or deteriorate, shall be provided between the cab and the modular body. Bellows shall be designed for proper fit and finish and be able to absorb lateral, vertical, and torsional displacement due to body/cab movement.

3.10 AMBULANCE BODY AND PATIENT AREA.

3.10.1 BODY ACCOMMODATIONS.

The ambulance body and patient compartment shall be sufficient in size to transport occupants and all specified stretchers, cots, and litters. There shall be space around the patient(s) to permit an EMSP to administer life support treatment to the primary patient during transit.

3.10.2 CAB/PATIENT COMPARTMENT ACCESS WINDOW.

The ambulance and body bulkheads shall have an aligned window opening of at least 150 sq. in., for visual checking and voice communications between the cab and the patient's compartment for non-walk through vehicles. The window in the cab or body shall be of the sliding type, shall be aligned, and connect with the modular body window opening and shall conform to requirements of the partition. The window shall be latchable from the cab side and shall be an adjustable, transparent, shatterproof panel.

3.10.3 EMERGENCY MEDICAL SERVICES PROVIDER (EMSP) SEATING.

The EMSP shall be provided with a seat conforming to all applicable FMVSS Standards, and be equipped with a safety belt and a padded back and a padded headrest. The seat shall be not less than 15" deep by 18" wide and a minimum distance of 43" from the top of the padded seat to any overhead obstruction. The EMSP seat shall be located to allow for the care of the primary patient.

3.10.4 PATIENT COMPARTMENT INTERIOR DIMENSIONAL PARAMETERS.

The patient compartment shall provide a minimum of 325 cubic feet of space (275 cubic feet of space for a Type II), less volume for cabinets, while complying with the following:

a. The length measured from the partition to the inside edge of the rear loading doors at the floor, shall be at least 122". The compartment configuration shall provide at least 25" of unobstructed space at the head of the primary patient, measured from the face of the backrest of the EMSP seat to the nearest edge of the cot. A minimum of 10" shall be provided, from the rear edge of the cot mattress to the rear loading doors, to permit clearance for traction or long board splints.
b. The compartment shall provide a minimum of 12" of clear aisle walkway between the edge of the primary patient cot and base of the nearest vertical feature measured along the floor.
c. The patient compartment shall provide at least 60" height, over the primary patient area, measured from floor to ceiling panels.

3.10.5 BODY, GENERAL CONSTRUCTION.

For modular construction, the body shall be all welded aluminum or, other lightweight, inherently corrosion resistant materials of equal, or greater, strength. The exterior of the body shall be finished smooth with symmetrically radius corners and edges, and shall include doors and windows specified herein. Ambulance body, as a unit, shall be designed and built to provide impact and patient compartment penetration resistance and shall be of sufficient strength to support the entire weight of the fully loaded vehicle on its top or side, if overturned, without separation of joints or permanently deforming roof bow or reinforcements, body posts, doors, stringers, floor, inner linings, outer panels, rub-rails, and other reinforcements. Wood, or wood products, shall not be used for structural framing. As evidence that the ambulance body meets the above criteria, the FSAM's body (fabricated, modified, or converted), excluding the conventional cab, shall furnish for each body model (Type) a certification that the ambulance body meets AMD Standards No. 001, 020 & 007. Additionally, the roof structure, liner, and outer skin or cap shall be designed and constructed to prevent separation.

Any absorbent material such as carpeting, fabric, or inside/outside plastic type carpeting, etc. That resists cleaning and decontamination shall not be used.

3.10.6 AMBULANCE BODY STRUCTURE.

All parts of the ambulance body and attachments shall be fastened in a manner that will preclude loosening. All fasteners shall be of the corrosion resistant type. Cabinets, benches, partitions, oxygen cylinder holders, guide rails, and cot holders shall be attached to metal tapping plates and/or framing welded to the body structure. These components shall be fastened by welding, bolting, or self-tapping (threading) machine screws, on a minimum of 18" centers. Sheet metal, self-tapping wood/metal screws, nails, staples, etc. shall not be used in assembling the ambulance structure, except for self-threading sheet metal screws used for light trim panels and for retention of wood or composite sub-flooring. Ambulance bodies with an extended roof shall have the roof structural members permanently fastened to structural members of the body. Drip rail(s) shall be provided around the entire modular body and have drain points at each corner. Drip rails shall also be furnished over each entry and compartment door. The body, roof, and panel joints shall be watertight. All openings between the chassis-body and occupant carrying compartments shall be sealed to prevent intrusion of water, dust, and exhaust gases.

3.10.7 BODY MOUNTING.

On modular ambulance bodies, to reduce stress on body and frame, minimize height above the frame, and isolate the patient compartment from noise and vibration, full floating, automotive style, rubber body mounts shall be furnished. A minimum four body mounts per frame rail not to exceed the mechanical properties of the body mounts and fasteners shall be furnished. Fasteners shall be a minimum of Grade 8.

3.10.8 DOORS.

Two patient compartment door openings shall be provided.

1) There shall be a door opening on the right forward side and at the rear of the body for loading a patient on a cot.
   a) The side opening shall have a single forward hinged door for modular bodies.
   b) Double hinged doors for Type II, shall be furnished.
   c) Door(s) shall provide a minimum right side clear opening of 30" wide and of 63" high for modular bodies.
   d) The OEM's standard opening for Type II vehicles.
2) There shall be a door opening at the rear of the body for loading a patient on a cot.
   a) Rear loading door(s) shall cover a clear opening of not less than 46" in height for modular bodies.
   b) Minimum width of 44" for modular bodies.
   c) The OEM's standard rear door width opening for Type II vehicles.
3) All ambulance body doors shall be equipped with not less than 250 sq. in. of safety glass area per door.
4) Each door shall have effective compression or overlapping seals to prevent leakage of exhaust fumes, dust, water, and air.
5) Patient compartment doors, on modular bodies, shall be flush or near flush style.
   a) Shall be full box type construction.
   b) Have removable inner panel.
   c) Inner panel shall be finished with a durable, washable type material.
   d) Shall include trim moldings around all unfinished, exposed edges.
6) A reflective device shall be furnished in any color meeting the reflector or conspicuity systems requirements of FMVSS 108.
   a) Have at least 60 sq. in. of total reflective area.
   b) Shall be installed on the interior of all patient compartment entry doors.
   c) The reflective device shall be so positioned as to provide maximum visibility when the doors are in the fully open position.

3.10.8.1 PROTECTION OF PATIENTS AND CREW.

Upholstered padding/cushions shall be provided at the upper interior areas of the doorframes.

3.10.9 DOOR LATCHES, HINGES, AND HARDWARE.

1) Door latches, hinges, and hardware furnished by OEM and FSAMs shall comply with FMVSS 206.
2) When doors are open, the hinges, latches, and door-checks shall not protrude into the access area.
3) All doors shall have hardware or devices to prevent inadvertent closing.
4) To facilitate entry and exit from the vehicle, a minimum 6", tubular or semi-oval, minimum 3/4" wide (diameter), grab handle shall be provided on the inside of each door or the adjacent body structure (in addition to a door operating handle).
5) Door shall be equipped with hold opens or stops.
6) One external operated lock, with key per door opening, shall be provided.
7) All patient compartment door locks shall be identically keyed.
8) Hardware shall be weather resistant.

3.10.10 FLOOR.

1) The floor shall be flat, except when the area near the rear entrance door is sloped for a lower entering height.
2) With the exception of cot related hardware, shall be unencumbered in the door(s) access and work area.
3) Shall support a "Distributed Loads" Medium footprint of 400 lbs.
4) Metal floors shall be reinforced to eliminate "oil canning."
5) Floors shall be insulated against outside heat and cold.
6) The sub floor of the modular body patient compartment shall be water resistant.
7) When plywood is utilized, it shall be water resistant.
    a) Not less than 1/2" thick, 5 ply minimum.
    b) Shall be supported by body framework.
8) Under the sub floor of the modular body shall be an aluminum heat shield/splash pan, minimum 0.050", sealed with silicone or other non-hardening sealant evenly distributed around its perimeter.
9) The sub floor of the Type II patient compartment shall be not less than 1/2" thick density, marine or exterior grade plywood.
10) Fiberglass, aluminum, or other non-hydroscopic composites, with at least the equivalent strength of plywood may be used as the sub floor.
11) Particleboard or equivalent type materials are not acceptable.
12) Voids or pockets, where water or moisture can become trapped to cause rotting and unsanitary conditions, are not acceptable.
13) Voids and pockets shall be filled with sealer or caulking compound.
14) Flooring shall extend the full length and width of the patient compartment or body (including space under the cabinets, unless otherwise insulated) or prevented by exterior compartment bodies or wheel wells that extend above floor level.

3.10.11 FLOOR COVERINGS AND COLOR.

Floor covering shall be easily cleaned, sanitized, and harmonize with the interior color and décor of the patient compartment. The floor covering shall be seamless, one piece, no wax type, solid linoleum, vinyl, or poured epoxy or acrylic not less than 1/16" thick and permanently applied to the sub floor. The floor material shall cover the entire length and width of the compartment's working area. The covering of joints (corners, etc.), where the sidewalls and covering meet, shall be sealed and bordered with corrosion resistant cove molding or the covering shall extend at least 3" up the sidewalls.

3.10.12 STEP WELL (SIDE DOOR).

Steps shall be provided in the door openings. Step well shall be the enclosed two-step type. Height of the bottom step shall not exceed 22". Step wells shall be lighted, and all step surfaces shall be constructed with anti-slip material.

3.10.13 WHEEL HOUSINGS.

Wheel housings of modular bodies shall include metal or plastic splash shields between the body wheel housing and the wheels extending over the top of the tires to the bottom of the body side skirting. Wheel house openings shall allow for tire chain usage and easy tire removal and service. OEM's standard wheel housings will be acceptable.

3.10.14 BULKHEAD/ PARTITION FOR TYPE II, III, AND III AD VEHICLES.

A full height and width partition or bulkhead (with or without compartments), with a walkthrough opening with a door shall be placed between the driver and patient's compartment. This partition shall be located directly behind the driver and companion seats when in the rearmost position. The partition shall be secured on the sides, ceiling, and floor by welding or bolting to tapping plates.

3.10.14.1 DOOR / WALKTHROUGH FOR TYPE II, III, AND III AD VEHICLES.

The door opening shall be at least 17" wide and 46" high and shall provide an aisle between the compartments. The door shall have at least a 150 sq. in., transparent, shatterproof viewing panel in the center section at the driver's eye level. The door shall be secured with a driver's side self-latching device in the open and closed positions.

3.10.15 INSULATION.

The entire body, sides, ends, and roof of the patient's compartment shall be completely insulated to enhance the performance of the environmental systems and prevent external noise from entering the vehicle interior. The insulation shall be a non-settling type, vermin-proof, mildew-proof, fire retardant, non-toxic, and non-hygroscopic. If fiberglass insulation is used, it shall not be exposed to water, e.g. door panels.

3.10.16 INTERIOR SURFACES.

The interior of the body shall be free of all sharp projections. All hangers or supports for equipment and devices shall be mounted as flush as possible with the surrounding surface. Interior body lining and cabinetry materials, excluding the cab compartment, shall be selected to minimize dead weight.

The finish of the entire patient compartment, including interiors of storage cabinets, shall be:

1. impervious to soap, water and disinfectants.
2. mildew resistant.
3. fire resistant.
4. easily cleaned/disinfected (carpeting, cloth, and fabrics are not acceptable).

3.11 STORAGE COMPARTMENTS.

Storage compartments shall be furnished for all items required by this specification and/or specified by the purchaser and include storage for, but not be limited to; backboards, portable cots/litters, stair chairs, and any other specified patient handling devices. Any absorbent material such as carpeting, fabric, or inside/outside plastic type carpeting, etc. that resists cleaning and decontamination shall not be used in any storage or patient compartment.

3.11.1 INTERIOR STOWAGE ACCOMMODATIONS.

The interior of the patient compartment shall provide a minimum volume of 35 cubic feet of enclosed stowage cabinetry, compartment space, and shelf space which shall be conveniently located for medical supplies, devices, and installed systems as applicable for the service intended. The 35 cubic feet of enclosed stowage cabinetry requirement does not apply to type II ambulances. Enclosed compartments and spaces shall be located at, in, or on the partition, sidewalls, overhead, seating areas, and doors. Compartment(s) under the floor, with opening panel(s) inside the patient compartment, shall not be acceptable. When furnished, top opening squad bench lids shall be fitted with an automatic hold open device and a quick release slam type latching device when closed.

3.11.1.1 LOCATION OF MEDICAL EQUIPMENT AND SUPPLIES.

Supplies, devices, tools, etc., shall be stored in enclosed compartments and drawers designed to accommodate the respective items. All medical devices and equipment shall be stowed or properly fastened in/on the action area according to the medical device manufacturer's directions.

3.11.1.2 WASTE AND SHARPS DISPOSAL.

The following shall be furnished: A trash receptacle compartment, with closure over opening, for general waste shall be furnished with a plastic/rubber trash can and disposable plastic liners, with 12 spare liners. The trash compartment shall be accessible to the EMSP seat. A sharps receptacle compartment/storage or a commercially available container mounted in a convenient area shall be furnished for retention of a sharps container that meets OSHA requirements.

3.11.2 EXTERIOR STORAGE ACCOMMODATIONS.

Ambulance exterior storage compartments shall be weather resistant Exterior compartment doors and hardware shall be flush or near flush style construction. All doors shall have spring or gas tube type, hold open devices that permit one hand closure. Hardware (hinges, locks, latches, etc.) shall be rust resistant. All exterior compartments shall have latches with locks and shall be keyed alike. All exterior compartments shall be automatically lighted when opened.

3.11.3 STORAGE COMPARTMENTS AND CABINETS DESIGN.

Storage cabinets, drawers, and kits shall be easily opened but shall not come open in transit. For rapid identification of contents, medical supply cabinets above the litter patient shall have shatter-proof, transparent or lightly tinted, sliding doors.

1) Doors shall be provided with near flush grip, or low profile handles.
2) Storage compartments shall be divided into sections.
   a) Drawers shall be marine style slide or tilt.
   b) All shelves shall be removable.
3) Sliding doors for cabinets designed to carry lightweight items such as dressings, bandages, etc. shall be furnished.
   a) Shall automatically latch or be fitted with friction holding devices when in a closed position.
4) Doors shall have positively locked latches that are bolted to the door and the door frame structure and are designed to remain closed during transports.
5) All cabinets shall be firmly anchored (bolted or welded) to tapping plates of the body structure.
   a) Use of sheet metal or wood screws is not acceptable.
6) Tops of the cabinets and shelves shall be surrounded by a lip of not less than 1/2" in height covered in a soft, pliable molding.
7) Storage for the main oxygen cylinder shall be accessible for replacement from an outside position.
8) The oxygen compartment shall be provided with at least a 9 sq. in. of open vent to dissipate/vent leaking oxygen to the outside of the ambulance.
9) Oxygen cylinder compartment shall not be utilized for storage of any other equipment.
10) Oxygen cylinder(s) shall be mounted with a restraining device(s).

3.11.4 PATIENT COMPARTMENT SEATING.

All seats in the patient compartment shall conform to applicable FMVSS Standards, will be padded and have the largest practical padded back and headrests. Padding material shall be rubber or polyester urethane foam of a medium to firm density, with a minimum finished thickness (padding and upholstery) of 2.5" for seat pads, and 2" for head and backrests. All padding and upholstery shall be fire retardant. The upholstery shall be non-absorbent, washable and impervious to disinfectants. Non-OEM seats shall have 40 oz. (minimum) reinforced vinyl upholstery. To facilitate cleaning and disinfecting, all seats furnished and installed by the FSAM shall be cleanable to OSHA standards, and all exposed surfaces shall be free of vent devices that would permit the entrapment of biological contaminates.

All seating positions in the patient compartment shall be provided with a vertical overhead clearance measurement of 43".

3.11.4.1 PATIENT SEATING.

The seats shall provide seating space for two persons and shall not be less than 15" deep by 18" wide (per seating position), and the seat backs shall be a minimum of 18" wide by 7" tall. The requirement to provide patient seating space for two persons shall not apply to Type II ambulances.

3.11.5 SEAT SAFETY BELTS AND ANCHORAGES.

All designated seating positions in the patient compartment shall be equipped with safety restraint systems appropriate for each type of seating configuration.

3.11.6 LITTER FASTENERS AND ANCHORAGES.

A cot fastener assembly with quick release latch shall be furnished. The installed cot fastener device(s) for wheeled cots shall be installed per the manufacturer's directions. At a minimum, the litter retention system, anchorages, and litter fastener(s) shall not fail or release when subjected to a force of 2,200 pounds applied in the longitudinal, lateral, and vertical direction. Should the manufacturer of the cot fastener assembly specify a greater force, the litter retention system, anchorages, and litter fastener(s) shall be tested to that greater force.

ALL COTS AND INFANT TRANSPORTERS SHOULD ONLY BE USED WITH THE REQUIRED FASTENER ASSEMBY AS PRESCRIBED BY THE COT|TRANSPORTER MANUFACTURER.

3.11.7 IV HOLDER FOR INTRAVENOUS FLUID CONTAINERS.

One ceiling mounted "hook" style device specifically designed for holding IV containers shall be provided, including Velcro type straps to adequately secure an IV bag/bottle. The device shall not protrude more than 1", and shall be located adjacent to, or on the cabinetry near the head of the primary patient. Swing down IV hangers with rigid support arms that can cause injury shall not be specified or furnished.

3.12 OXYGEN, MAIN SUPPLY AND INSTALLATION.

The ambulance shall have a piped medical oxygen system capable of storing and supplying a minimum of 3,000 liters of medical oxygen. The installed medical oxygen piping and outlet system shall be leak tested to 200 PSI. After the successful completion of tests, the system shall be capped then tagged with date and signature of person and firm performing the tests.

The main oxygen supply shall be from a single compressed gas cylinder that the consignee will provide and install at the time the vehicle is placed in service. A cylinder changing wrench shall be furnished. The wrench shall be chained and clipped within the oxygen cylinder compartment.

The cylinder controls shall be accessible from the inside the vehicle. A device shall be visible from the EMSP's seat that indicates cylinder pressure. The use of remote high pressure lines and gauges are not allowed. The oxygen cylinder shall be accessible for changing from the exterior of the body.

The purchaser shall specify the type of quick disconnect, to be used. The FSAM shall install all other components and accessories required for the piped oxygen system which shall include as a minimum:

- A pressure regulator.
- Low pressure, electrically conductive, hose approved for medical oxygen.
- Oxygen piping concealed and not exposed to the elements, securely supported to prevent damage, and be readily accessible for inspection and replacement.
- Oxygen piped to a self-sealing duplex oxygen outlet station for the primary patient with a minimum flow rate of 100 LPM at the outlet.
- Outlets shall be adequately marked and identified and not interfere with the suction outlet.

3.12.1 OXYGEN PRESSURE REGULATOR.

The medical, oxygen pressure reducing, and regulating valve with inlet filter at the cylinder shall have line relief valve set at 200 psi maximum, and a gauge or digital monitor with a minimum range of 0 to 2,500 psi with the gauge or display scale graduated in not more than 100 PSI increments. The regulator shall be easy to connect and preset, with a locking adjustment, at 50 +/- 5 psi line pressure, permitting a minimum 100 LPM flow rate at a bottle pressure of 150 psi.

3.12.2 SUCTION ASPIRATOR, PRIMARY PATIENT.

An electrically powered suction aspirator system shall be furnished with an illuminated switch and a panel mounted, labeled, quick disconnect inlet device on the EMSP panel. The electric type aspirator system shall be connected per Figure 3. The suction pump shall be located in an area that is accessible but sound and vibration insulated from the patient compartment.

1) The pump shall be vented to the vehicle's exterior.
2) A vacuum control and a shut-off valve, or combination thereof, shall be provided to adjust vacuum levels.
3) A vacuum indicator gauge of 3" +/-0.5" in diameter, with numerical markers at least every 100 mm Hg and a total range of 0 to 760 mm Hg, shall be provided.
4) The collection bottle or bag shall be non-breakable and transparent with a minimum 1,000 ml capacity.
5) The minimum inside diameter for the suction tubing connectors shall be at least 1/4". The end user shall provide any suctioning catheters desired.
(6) The suction aspirator system shall provide a minimum of 30 LPM flow at the catheter tip.

3.13 ENVIRONMENTAL: CLIMATIC AND NOISE PARAMETERS.

3.13.1 ENVIRONMENTAL SYSTEMS.

All ambulances will be equipped with a complete heating, ventilating, and air conditioning system(s) (HVAC) to supply and maintain clean air conditions and specified level of inside temperature in both driver and patient compartments. The system(s) may be separate or a combination system, which will permit independent control of the environment within the driver's cab and patient compartment. All ambulances will be equipped with HVAC that can be made to collectively operate using re-circulated air and outside ambient air and will be capable of maintaining a patient compartment temperature of 68°F to 78°F while patients are in the patient compartment. The air systems will be high volume capacity with low velocity delivery for minimum draft circulation. Environmental system components will be readily accessible for servicing at the installed location(s). Connecting hoses for heating and the air conditioning system will be supported by rubber-insulated metal clamping devices at least every 18".

3.13.2 HEATING CRITERIA.

The heating system(s) will have sufficient capacity to maintain the temperature in the patient compartment at a minimum dry bulb temperature of 68°F. Heater(s) will, to the maximum extent possible, be connected to the OEM's furnished interconnection points.

3.13.3 AIR CONDITIONING CRITERIA.

The air conditioning system(s) will have sufficient capacity to maintain the temperature in the patient compartment at a maximum dry bulb temperature of 78°F. When available, OEMs' interconnection points will be utilized.

3.13.4 VENTILATION CRITERIA.

Ventilation system(s) of the driver and patient compartments will provide a complete change of ambient air within both compartments at least every two minutes with the vehicle stationary. Ventilation will be separately controlled within the cab and patient compartments. Fresh air intakes will be located towards the front of the vehicle and exhaust vents will be located on the upper rear of the vehicle. Exhaust vents may be located on the rear lower half of the module/body, provided the vent/device incorporates a reverse flow damper to prevent back draft and intrusion of vehicle engine exhaust, dust, dirt, or road spray. The patient compartment will be ventilated by the air delivery system of the environmental equipment (heater-air conditioner) or by separate system(s), such as power intake, exhaust ventilator(s).

3.13.5 ENVIRONMENTAL CONTROLS.

Adjustable, manual or thermostatically operative controls will permit heating and/or air conditioning and ventilation in either compartment without affecting the other compartment. Switches and controls will be located in "action area" panel and/or remote panel and identified for function and operating position. Blower or fan system will have at least three speeds (excluding "OFF"). Separate non-corroding brass, bronze, stainless steel, plastic or other inherently corrosion proof shutoff valves, for the patient compartment hot water heating system, will be provided. The use of vacuum or electrically operated shutoff valves is acceptable provided it will meet the above criteria and the valve provides inherent sealing when vacuum is removed. This sealing will prevent engine cooling system pressure and water pump pressure from causing any leakage when vacuum is removed. Air systems will have adjustable louvers to direct the flow of air.

3.13.6 PATIENT COMPARTMENT SOUND LEVEL CRITERIA.

The patient compartment sound level shall not exceed 80 dBA at any time.

3.14 COMMUNICATIONS.

3.14.1 COMMUNICATION EQUIPMENT.

Any two way radio equipment shall be installed by a licensed installer approved by the radio manufacturer. Communications equipment will meet the applicable FCC rules and required state and local area EMS radio communication protocols.

3.14.2 RADIO (MOBILE) PROVISIONS.

All ambulances will be provided with sufficient ventilated space for a two-way radio (including convenience features), antenna openings, ground plane, terminal wiring for 12V power and ground.

3.14.3 ANTENNA CABLE, AND ACCESS.

The FSAM shall provide each ambulance with a ground plane, and coaxial lead-in wire from the ventilated radio storage area/compartment to the centerline of the patient compartment roof. An antenna wiring access/port shall be provided in the patient's compartment directly under the coaxial leads. The port shall provide a least a 16 sq. in. clear access. All nonmetallic roofs will be equipped with at least a 40" x 40" metal ground plane molded into the roof. The ground plane then shall be properly grounded to the chassis ground. The antenna cable (lead-in) shall be provided and clearly labeled with RG/58U or equal cable. Approximately 18" of extra cable shall be provided at the roof and approximately 36" at/in the radio area/compartment.

3.14.4 SIREN – PUBLIC ADDRESS SYSTEM.

A combination electronic siren with integral public address system including radio interface capability shall be provided. A "Horn/Siren" switch shall be provided on the driver's console. When on shall activate or change the siren tone when the horn button is pushed. The "Horn/Siren" switch shall be illuminated (in siren mode). Dual speakers shall be installed, outside the vehicle, in the bumper/hood area. Speakers shall not protrude beyond the face of the bumper or bumper guards. The siren shall be capable of producing a continuous warning sound at a minimum level of 123 dB, A-weighted, at 10'.

3.15 ADDITIONAL SYSTEMS, EQUIPMENT, ACCESSORIES, AND SUPPLIES.

3.15.1 ADDITIONAL AND OPTIONAL EQUIPMENT.

This specification provides the minimum technical requirements that new ambulances are required to meet. Some purchasers will require features in excess of these minimum requirements to complete their mission(s). Completing the worksheet in this section will assist purchasers in determining the optimum type, configuration and optional equipment required.

Purchasers may wish to consider some of the following criteria before completing the worksheet:

1. Operating environments such as inner city, rural areas, length of responses
2. Exposure to extreme ambient temperatures
3. Size of ambulance crew
4. State and/or local jurisdiction required medical equipment
5. State licensure requirements
6. Vehicle size and weight limitations in the response area
7. Expected service life of the ambulance
8. Additional non EMS equipment that must be carried on the ambulance
9. Future equipment requirements
10. Additional state or local requirements
11. Export requirements

In no event shall the specified or furnished optional item(s) reduce the quality and intent of the ambulance but shall enhance its design and purpose.

3.15.2 STANDARD MANDATORY MISCELLANEOUS EQUIPMENT.

Each ambulance shall be equipped with, but not limited to the following:

1. Fire extinguishers: Two, (ABC dry chemical or carbon dioxide) minimum 5 lb. unit, in a quick-release bracket, one mounted in the driver/cab compartment or in the body reachable from outside the vehicle and one in the patient compartment.
2. "No Smoking Oxygen Equipped" and "Fasten Seat Belts" signs: Conspicuously placed in the cab and patient compartment.
3. Overhead grab rail, minimum 60" long, maximum 4" depth, on the ceiling over the primary patient. Grab rail shall be stainless steel, aluminum, or other corrosion resistant material, and have padded or curved up ends, and rounded corners. Mounting brackets shall be chromed, stainless steel, polished cast aluminum or other corrosion resistant materials. The grab rail shall be tested to 300 lbs.
4. Backup alert alarm, (audible warning device) activated when the vehicle is shifted into reverse. Device shall be rated (SAE) for 97 dB-a at 4'.

3.15.3 CONFIGURATION WORKSHEET.

Reference Section 3.0 – REQUIREMENTS

This ambulance is to be a:
☐ BLS
☐ ALS
☐ Walkthrough
☐ Infrequent Transport

It is essential that the ambulance not be operated in an overloaded or unbalanced condition. The following information must be made available to properly design the interior and exterior compartmentalization of the ambulance per Section 3.5. Attach:

a. A list of medical and rescue equipment to be supplied by the FSAM with the ambulance stating the item, quantity, where it is to be mounted or carried, the weight of each item, and its dimensions (L x W x H).
b. A list of medical and rescue equipment to be supplied by the purchaser to be carried on the ambulance stating the item, quantity, where it is to be mounted or carried, FSAM's responsibility for mounting, the weight of each item, and its dimensions (L x W x H).
c. A list of medical and rescue equipment that might be carried on the ambulance in the future stating the item, quantity, the desired mounting location or compartment where it is likely to be carried, the weight of each item, and its dimensions (L x W x H).
d. A list of permanently mounted equipment required on the ambulance showing the item, quantity, weight of each, and dimensions (L x W x H), who is to furnish the equipment as well as the location where it is to be carried.

1. Specify the maximum number of seated positions on the ambulance if more than five for modular bodies, or more than three for Type II units (Standard seating is two in the cab, two on the side and one in the EMSP seat for modular bodies and two in the cab and one in the EMSP seat for Type II units):

2. Describe the usage duty cycle that the ambulance will be subjected to: ____________________
____

3. If design approval drawings and/or a copy of the FSAM's work order are required to validate the design criteria in 3.1, the type and quantity must be detailed here. ________________________
____

4. Careful consideration must be given to the ambient conditions the ambulance will operate in. Auxiliary heating and/or air conditioning may be required. If different than 3.4.2 and/or 3.13.1, state the minimum and/or maximum operating temperatures in °F. ________________

5. If different than 3.4.4, state the required ride performance requirements: ____________________
____

6. If different than 3.4.5, state the required min/max road speed required: ____________________
____

7. If different than 3.4.7, state the required gradeability:________________

8. If different than 3.4.8, state the required fuel range:________________

9. Per 3.4.10.1, state the maximum overall length in inches:________________

10. If different than 3.4.10.2, state the maximum overall width in inches:________________

11. Per 3.4.10.3, state the maximum overall height in inches:_______________

12. If different than 3.4.10.4, state the required angles:________________

13. Per 3.5.2, the average weight of an occupant is calculated at 150 lbs. per NHTSA. If your average occupant weight is greater, specify here:____
____

14. If a specific OEM's chassis is required in Section 3.6, list the OEM here:
____
____

15. If all-wheel drive (AWD) or all-wheel drive conversion (AWDC) is required specify here. (It should be noted that AWD and AWDC will reduce the available payload and will increase the floor loading height. In some cases the floor loading height may be increased beyond the 34" maximum).
____
____

16. A diesel engine is furnished as standard per 3.6.3. If other than a diesel engine is to be used, specify here. If a specific engine type is required, specify here: ____________________________
____

17. The OEM standard exhaust location and piping configuration is required per 3.6.4.6. If an alternate location of type of piping termination is required, specify here: _______________________
____

18. An automatic transmission is furnished as standard per 3.6.5.2. If a specific transmission type is required, specify here: ____
____

19. The OEM standard braking system is required per 3.6.5.4. If an optional type braking system is required (air brakes, retarder, exhaust brake, etc.), specify here: ___________________________
____

20. The OEM standard tires are furnished per Section 3.6.8. If an optional type tire is required, specify here. If a spare tire is required, specify mounting location here: ___________________________
____

21. If automatic or manual tire chains are to be furnished to operate in the space required by 3.6.9, specify here: ____
____

22. If different than 3.7.5, specify the type of horn (air horn, etc.) required: ______

23. Specify any electrical loads beyond those defined in 3.7.6 that are to be part of the minimum continuous electrical load. If a load management system is required, specify the sequence of control (shutdown). If functional enhancements (OEM or non OEM) are required to the high-idle system (interlock capabilities, automatic re-engagement, etc) specify here: ______

24. The OEM standard batteries are furnished per Section 3.7.7. If an optional type battery is required, specify here. If a specific mounting location is required, specify here: ______

25. Specify any portable equipment charging provisions required in excess of those required by 3.7.7.2: ______

26. If different than 3.7.7.3, specify the number and type of power points required: ______

27. Specify any AC utility power requirements that are in excess of those required in 3.7.8: ______

28. If an on board AC power system is required to operate with the system described in 3.7.8, the following must be specified:

    Wattage of power source: ______
    Voltage of power source: ______
    Purity of power source: ______
    (allowable total harmonic distortion, voltage variation, power factor, frequency variation, etc)

    Type of power source (shall be listed by a nationally recognized testing laboratory UL, CSA, etc):
    - ☐ Portable Generator
    - ☐ Hydraulically Driven Generator
    - ☐ Direct Drive Generator
    - ☐ Auxiliary Engine Driven Generator
    - ☐ Belt Driven Generator or Alternator
    - ☐ Derived From Ambulance Low Voltage Power Supply System (Inverter)
    - ☐ Other: ______

    Make, model, or other details of power source: ______

    Panelboard location: ______

AC Powered Receptacle Information

Quantity	NEMA Conf	Location

AC Powered Lighting Information

Style/Make	Location	Wattage/Bulb	Type Mounting

An automatic transfer switch shall be furnished which turns off this onboard AC supply (interlock) and disconnects its output, when the AC utility power is applied. Transfer equipment, if not integral with the listed power source, shall be installed to ensure that the current carrying conductors from the on board 125-volt AC power source and from the 125-volt AC utility power source are not connected to ambulance electrical circuit at the same time. Generators shall comply with Article 445, "Generators," of NFPA 70, National Electrical Code.

The following shall be wired so that they can be energized only from the utility power, and not the onboard AC supply:

1. DC battery conditioner
2. Engine block heater

29. If different than 3.7.8.1, specify the location for the utility power connector: ____________________
____

30. If known, specify the equipment that is to be powered by the receptacles specified in 3.7.8.2:
____

31. If different than 3.7.10, specify the location(s) for the patient compartment controls: ____________
____

32. If a specific manufacturer's DOT lighting system is required in Section 3.8.1, list the manufacturer here. State if a specific lighting system is required (such as all LED, etc.): ______________
____

33. If a specific manufacturer's emergency lighting system is required in Section 3.8.2, list the manufacturer and type (i.e.: strobe, LED, halogen) here. State if an alternate approved lighting system is required (such as NFPA 1901 compliant or SAE J2498 compliant). State if there are specific state or local jurisdiction requirements (such as California steady burning red, etc):____________
____

34. Specify any work lighting required beyond those defined in 3.8.3: ____________________________
____

35. Specify any interior lighting required beyond that defined in 3.8.4 (map light, high intensity cot light, etc.): ____
____

36. The FSAM's standard cab console will be provided per 3.9.1. If an optional type console is required (specific switch locations, specific size, etc.) specify here: _________________________
____

37. The OEM largest mirror system is required per 3.9.5. If an optional type mirror system is required (power, heated, etc) specify here: ____

38. If different than 3.10.4, state the required increase to the patient compartment interior length, width and height in inches:____

39. A cab/patient compartment access window is required per 3.10.2. On vehicles over 14,000 lbs. GVWR the opening may be expanded to permit a walk through opening in lieu of the window. If a walk through opening is required, specify the door type and size here:________________________
____

40. An aluminum modular body is required per 3.10.5. If an optional type body material is required specify here: ____
____

41. Hinged doors are required per 3.10.8. If an optional type door system is required (sliding, etc) specify here: ____
____

42. If a specific manufacturer's latch, locking system, grab handle system, etc. is required in Section 3.10.9, list the manufacturer and type here: ____
____

43. The floor is designed to carry a cot load of 400 pounds per 3.10.10. If a heavier load is to be applied to the floor (Bariatrics, etc) specify here: ____________________________________
____

44. If a specific manufacturer's flooring is required in Section 3.10.11, list the manufacturer and flooring type here: ____

45. Windows are required per 3.10.5. If an optional window and/or tint is required specify here: ____________________

46. All exterior compartments must be lighted per 3.11.2. If additional compartment lighting is required, specify here: ____________________

47. Removable shelving is required per 3.11.3. If optional type shelving is required (adjustable, quick loading, etc) specify here: ____________________

48. Patient compartment seating is required per 3.11.4. If an optional type seating is required (captain's chair, integral child safety seat, etc) specify here: ____________________

49. A cot fastener assembly is required per 3.11.6. Specify the type of cot to be fastened by manufacturer and model number. If a cot is to be furnished by the FSAM, specify the manufacturer and model number of the cot to be furnished: ____________________

50. A medical oxygen system is required per 3.12. Specify the type of outlets (DISS, NCG, Chemtron, Ohmeda, Puritan Bennett, etc) to be furnished. Specify the type and size of oxygen cylinder that will be furnished by the end user. If additional oxygen equipment is to be furnished by the FSAM, specify the manufacturer and model number to be furnished. If additional oxygen storage (more than 3000 liters) is required, specify here: ____________________

51. The patient compartment interior sound levels are not to exceed 80 dB per 3.13.6. If lower sound levels are required specify here: ____________________

52. If electronic communication between the patient compartment and the cab (silent intercom, voice intercom, headsets integrated with the radio system, etc) are required specify here: ____________________

53. Provisions for mobile radio equipment are defined in 3.14.2. Complete the following:
    Is the FSAM to provide the radio? ☐ Yes ☐ No
    Is the FSAM to install the radio? ☐ Yes ☐ No
    Make and model: ____________________
    Power requirements for radio: ____________________
    Mounting location for radio: ____________________
    Mounting location for control(s) and speaker(s): ____________________

54. Are there provisions required for computer equipment, drive camera, or other electronics? If so, list here:
    ____

55. If a specific manufacturer's siren and/or control system is required in Section 3.14.4, list the manufacturer here: ______________________________

56. Specify any additional backup assist systems required beyond those defined in 3.15.2-4: ______________________________

57. The ambulance will be painted and marked per 3.16. State if an alternate approved painting and/or marking system is required (such as NFPA compliant and/or specific state or local jurisdiction requirements). A graphic design meeting the reflectivity requirements of 3.16.4 shall be permitted to replace the required striping material if the design covers at least the same perimeter length and total area of coverage in sq. in. required by 3.16: ______________________________

58. Each ambulance comes with an instruction manual and handbook of construction per 3.18. These documents are designed to insure that the operator of the ambulance can properly operate and perform required operator level maintenance specific to the ambulance purchased. If additional operational instruction and/or maintenance instruction is required, those requirements should be detailed here. If actual service and parts manuals are required, those requirements should be detailed here. With a few exceptions, the manual and handbook of instruction will be in electronic form. If other media is required (all paper, etc.) specify here: ______________________________

Reference Section 4.0 – QUALITY ASSURANCE PROVISIONS

The type of inspection (source and/or destination) needs to be specified as well as where and when the acceptance inspection is to occur. ______________________________

Section 4.0 details the minimum testing requirements for acceptance. If additional or alternative testing is required, specify here: ______________________________

Section 4.3.3 requires 3rd party testing. If an alternate form of 3rd party validation of the testing is required, specify here: ______________________________

Reference Section 5.0 – PREPARATION FOR DELIVERY

If a different mode of delivery or preparation for delivery than is specified in Section 5.0 the requirements should be detailed here along with the delivery address for the ambulance. ______________________________

Reference Section 6.0 – NOTES

If an extended warranty (beyond what is required in 6.2.1) on the entire vehicle or specific components is required, indicate which component(s) and the length and scope of the warranty: ______________________________

3.15.4 DEFINED OPTIONS (OPTION CODES).

The following Option Code detailed requirements are offered for selected ambulance options.

3.15.4.1 CODE "SL" SPOTLIGHT.

A hand held spotlight shall be provided with a minimum 100,000 CP lamp, corrosion proof housing with momentary switch, and minimum 8 ft. heavy-duty coiled cord. It shall be hard wired to the vehicle 12-volt DC system (for anti-theft reasons) and stowed in a holder in a compartment/area, accessible to the driver and passenger.

3.15.4.2 CODE "HPL" PADDLE HANDLE DOOR LATCHES.

When code HPL is specified, a large automotive paddle style door handle shall be furnished for the patient entry and exterior compartment doors. The handle shall be chrome or bright metal finished and shall have a black outer trim gasket. Each handle shall be easily gripped with a gloved hand. The patient entry doors and exterior compartment doors shall be keyed alike.

3.15.4.3 CODE "K40" SERVICE BEFORE OVERSEAS.

When option K40 is specified, vehicles scheduled for overseas delivery shall be shipped to the FSAM's service center closest to the port of shipment. The service center shall ensure that the following services are performed:

1. A 3000 mile chassis service.
2. The OEM and Conversion equipment functions on the predelivery check list shall be successfully completed.
3. All open warranty items discovered as a part of this service shall be resolved.
4. The dealer shall deliver the vehicle to the port of shipment when the required services have been completed.

3.15.4.4 CODE "PLV" POWER LOCKS ON BODY.

When code PLV is specified, the side and rear patient entry doors as well as the front exterior ALS access door shall be equipped with electrically activated locks. These locks shall be interconnected to the OEM electric locks so that patient compartment and ALS access areas may be secured anytime the cab is locked. There shall further be a momentary activation switch located to the rear of the side wall adjacent to the rear patient entry doors. Switch shall be labeled Door Locks. Additionally there will be a rubber covered, weatherproof "stealth" switch that will unlock both the cab entry doors as well as the patient compartment entry doors. Switch shall be located in the front grille area.

3.15.4.5 CODE "PSM & PSME" PARTS AND SERVICE MANUALS.

When PSM or PSME is specified, the FSAM shall furnish all parts lists and service publications for the vehicle and all equipment furnished.

When PSM is specified, the publications furnished shall be printed documents.

When PSME is specified, the publications shall be electronic (CD or web-based).

NOTE: The publications may be shipped separately from the vehicle. The publications may be shipped to the consignee mailing address as shown on the Motor Vehicle Delivery Order (MVDO).

3.15.4.6 CODE "SROV" REVERSE OBSTACLE SENSOR.

When code SROV is specified, the vehicle shall be furnished with a sensor system that is installed on the rear of the body or rear bumper of the vehicle and detects the proximity of objects and transmits an audible signal to the driver. A switch shall be furnished that allows the driver to turn this device on/off.

3.15.4.7 CODES "AWD & K02" OEM ALL WHEEL DRIVE.

When Option AWD is specified, the OEM 4X4 chassis shall be furnished per specification. When Option K02A is additionally specified, the chassis shall have OEM automatic electric "shift on the fly" system.

3.15.4.8 CODE "K11" REAR AIR RIDE SUSPENSION.

When Option K11 is specified, OEM's furnished or approved rear air suspension, with electrically operated dump valve, shall be furnished. The air ride suspension system shall incorporate an inter-lock system that prevents the vehicle from moving while the system is in the "dumped" configuration.

3.15.4.9 CODE "K37" ADDITIONAL 12-VOLT POWER LEAD.

When K37 is specified, an additional lead shall be furnished to a specified location. All leads shall be tagged.

3.15.4.10 CODE "K32" ADDITIONAL ANTENNA & POWER LEAD.

When Option K32 is specified, an additional antenna and an additional power lead shall be furnished to a specified location. All leads shall be tagged.

3.15.4.11 CODE "K27" TEMPERATURE CONTROLLED DRUG COMPARTMENT.

When K27 is specified, a temperature controlled drug compartment shall be furnished to maintain temperatures 77°F +or– 10°F. with the vehicle exposed to the ambient temperatures in 3.4.2. The electrical power for the cooling/heating shall be from the power output in Figure 3 and Figure 4.

3.15.4.12 CODE "K49" AC/12-VOLT HEAT & AC COMB.

When code K49 is specified, the climate control system in the patient compartment shall be capable of operating from either AC power supplied by a shoreline input or the 12-volt D.C. power supplied by the OEM chassis. The AC portion of the system shall include an auto-eject shoreline input outlet located on the street side of the vehicle and adjacent to the standard shoreline outlet. The AC input shall activate an additional air conditioning compressor and condenser as well as an AC to 12-volt converter that will power the air conditioner blower motors inside the patient compartment. The AC portion of the heating and cooling system shall be connected to the interior heat/cool thermostat located in the action area.

3.15.4.13 CODE "K28" CAST ALUMINUM EMERGENCY LIGHT HOUSINGS.

When code K28 is specified, all exterior emergency and flood lights shall be flush mounted in cast, polished, aluminum housings and recessed to the maximum extent possible.

3.15.4.14 CODE "FTH" FRONT TOW HOOKS.

When code FTH is specified, the OEM's front recovery hooks shall be frame mounted on the front of the vehicle. The OEM's front recovery hooks shall be provided on all 4x4 vehicles.

3.15.4.15 CODE "PT" POWER TAKEOFF OPENING.
When code PT is specified, the designated transmission or transfer case shall be provided with a usable PTO opening. When a PTO unit is provided on a vehicle, a caution plate or decal reading, "Do not operate vehicle at highway speeds with PTO engaged," shall be installed in the cab, readily visible to the driver. Controls to operate the power takeoff shall be located in the truck cab accessible to the seated driver. The PTO unit shall have a rated capacity to operate the provided equipment.

3.15.4.16 CODE "PWL" POWER WINDOWS AND LOCKS.
When code PWL is specified, the OEM power windows and power locks option shall be provided.

3.15.4.17 CODES "RA, RAD & RACD".
When code RA is specified, the OEM AM/FM radio with integrated clock shall be provided.

When code RAD is specified, the OEM AM/FM/clock radio with integrated compact disc player shall be provided.

When code RACD is specified, the OEM AM/FM/clock radio with integrated compact disc and cassette player shall be provided.

3.15.4.18 CODE "RKE" REMOTE KEYLESS ENTRY.
When code RKE is specified, the OEM optional remote keyless entry system shall be furnished.

3.15.4.19 CODES "T5", AND "T6", FIVE, AND SIX SPEED MANUAL TRANSMISSION.
When code T5, or T6 is specified, a five, or six speed manual transmission, respectively, shall be furnished. The transmission shall be furnished with a PTO opening(s) in accordance with SAE J704, unless an exception is noted under the code.

3.15.4.20 CODE "AWDC" FOUR WHEEL DRIVE (4X4) CONVERSION.
(From OEM Pass-Through Approved Dealers Only)

When code AWDC is specified, an OEM pass-through four-wheel drive conversion shall be furnished. The conversion (4x4) shall be a professionally engineered conversion from a two-wheel drive (4x2) to a four-wheel drive (4x4) meeting or exceeding all applicable requirements of the OEM. Note that available payload will likely be reduced by the weight of the conversion and all payload requirements must be reviewed accordingly prior to contract.

The transfer case selector shall have a readily visible shift diagram, if applicable, and a position indicator. A yellow, dash mounted four-wheel drive warning light shall be provided in close proximity to permanent warning decal or metal plate advising conditions under which four-wheel drive shall not be used. A dash mounted metal plate or permanent decal indicating the proper procedure for engaging and disengaging the four-wheel drive shall be provided. The front drive axle hubs shall be manually engaged. Each vehicle's rear axle shall be furnished with chassis manufacturer's special traction differential (option code D3) when available.

The 4x4 converter shall provide to the purchaser a full parts and labor warranty covering all added 4x4 parts and materials, including workmanship and design. The warranty shall also cover all OEM components affected or modified by the conversion process. This warranty shall be at least equivalent, in mileage and time, to the chassis manufacturer's original warranty, including any extended warranties required or furnished.

3.15.4.21 CODE "RBV" RUNNING BOARD.

When code RBV is specified, OEM running boards (Code RB) or FSAM running boards shall be furnished. The FSAM running boards shall be securely mounted to the frame of the vehicle to prevent flexing when used by vehicle occupants during entry and exit.

3.15.4.22 CODE "LEDV" BODY EXTERIOR DOT LIGHTING, LED.

When code LEDV is specified, the exterior DOT lighting furnished, other than the backup lamp(s), shall be LED. The lighting system shall include sealed wiring harness with return ground wiring.

The LED lights shall have a five year warranty as a minimum.

3.15.4.23 CODE "SRP" RUSTPROOFING PER FED-STD 297E.

When code SRP is specified, the vehicle shall be rust proofed in accordance with FED-STD 297E

3.15.4.24 CODE "CPT" PAINT-CUSTOM COLOR.

This option must be specified when ordering paint colors other than the standard white. The required color(s) must be stated.

3.15.4.25 CODE "UCT" UNDERCOATING.

When code UCT is specified, the vehicle shall be undercoated be undercoated for sound deadening, corrosion, and stone damage protection. A commercial, sandless, undercoating or other materials providing equivalent protection, shall be applied to the underbody and under chassis sheet metal surfaces to a thickness of 1/16" to 1/8", except to the drive shafts, drain holes, lubrication points, engine/transmission oil pans, fuel tanks, heavy castings, suspension components, heat shields, heat diffusing devices, catalytic converters, and areas 12" or less from the exhaust system(s) as well as other areas specifically excluded by the chassis OEM. These areas shall be kept free of coating material. Chassis frame, underside of engine compartment hood, and underbody surfaces in excess of 1/8" thickness, or that is inaccessible without removing vehicle fuel tank(s) or other major components shall not require undercoating

3.15.4.26 CODE "K01" ALS CONFIGURATION.

When K01 is specified, the ALS configuration shall be furnished. It Includes:

a. Locked drug compartment.
b. High intensity cot light.
c. Two (2) Extra IV hangers
d. CPR Side Seat w/ occupant restraint device

3.15.4.27 CODE "K12" AUXILIARY AIR CONDITIONING CONDENSER.

When K12 is specified, an auxiliary condenser shall be provided which will allow for maximum system performance, based on the air conditioning and FSAM's recommendations. If the condenser is located above the cab, it shall not block the emergency lights. All added refrigeration lines and fittings shall be mechanical fittings compatible with OEM components furnished by the OEM.

3.15.4.28 CODE "SP" SKID PLATES.

When code SP is specified, OEM protective plates, or shields, shall be provided when available. The skid plate(s) shall provide protection for at least the transfer case. The skid plates shall be demountable for service of the components they protect. Sufficient openings shall be provided to enable draining of transmission and servicing the underside of the engine.

3.15.4.29 CODE "WR" INCREASED GVWR.

When code WR Is specified, the GVWR shall be increased by the OEM to the maximum level available.

3.15.4.30 CODE "K46" FURNISH "H" O2 CYLINDER IN LIEU OF "M" CYLINDER.

When code K46 is specified, an "H" O2 Cylinder shall be furnished in lieu of an "M" Cylinder.

3.15.4.31 CODE "DVE2" FURNISH EXTRA INTERIOR HEIGHT.

When code DVE2 is specified, the patient compartment interior height shall be increased to a minimum of 72".

3.15.4.32 CODE "K15C" REFLECTIVE CHEVRON.

When code K15C is specified, a minimum of 50% of the rear vertical surfaces of the exterior of the ambulance shall be covered with 4" alternating yellow and red chevron reflective striping sloping downward at an angle of 45° from the center of the vehicle

3.15.4.33 CODE "FFP" COOLANT HEATER – FUEL FIRED.

When code FFP is specified, a fuel fired coolant heater shall be furnished to assist in heating the patient compartment.

3.16 PAINTING, COLOR, AND MARKINGS.

3.16.1 PREPARATION FOR PAINTING.

Ambulance body and all attached equipment exterior surfaces, except polished metal parts, shall be thoroughly cleaned, treated, and coated with a firm primer and preservative with rust inhibiting properties, and painted in the finish color as specified. Ferrous metal interior surfaces shall be painted or, when not exposed for painting, shall be treated or coated to resist corrosion. Chassis and chassis frame components shall be preserved and finished in accordance to industry's standard practice.

3.16.2 COLOR, PAINT, AND FINISH.

The exterior color of the ambulance shall be gloss white in combination with a solid uninterrupted orange stripe and blue lettering and emblems. The stripe should be as close to parallel as possible with the road but a stripe transition angle is acceptable to connect the module beltline stripe with the chassis stripe. The exterior finish on painted metal modular bodies and metal roofs on Type II ambulances shall be an acrylic composition urethane or polyurethane paint. The FSAM's painted components shall have a paint film not less than 1.8 mils thick and a minimum total thickness of 2.6 mils including primers. The orange stripe shall not be less than 6" wide, nor more than 14" wide and shall encircle the entire ambulance body at the belt line below the bottom edge of cab windows but may exclude the front of the hood panel. The orange stripe shall be reflective tape. This single, solid band (except when interrupted by windows, locks, etc.), when viewed horizontally, shall appear as a stripe near parallel to the road. The interior finish shall be the FSAM's standard light color harmonizing with the color of upholstery. After application of the final film of paint, the surfaces shall be smooth and uniform.

3.16.2.1 COLOR STANDARDS AND TOLERANCES.

The exterior surface including the wheels shall be FSAM's standard gloss white.

3.16.3 SALT SPRAY RESISTANCE.

Treated exterior sheet metal of the ambulance body (except OEM Type II van) shall be capable of withstanding 250 hours of salt spray tested in accordance with ASTM B 117. The specimen used for the salt spray test shall be run through all steps of the cleaning and treating process, including priming. The primed specimen shall be scored from corner to corner using a sharp knife. After the test, the specimen panels shall exhibit no failure and not more than 1/8" rust or blister creepage from the scored lines.

3.16.4 REFLECTIVE EMBLEMS AND MARKINGS.

The material for the emblems and markings shall be applied using reflective material that has a coefficient of retroreflection measured in accordance with ASTM E 810 of 100 for White and 10 for Blue using 4° entrance angle and a 0.2° observation angle. The reflective color used shall be blue (color a) and white (color i) when applicable. The orange and blue markings shall be as specified Orange and Blue in American National Standard Z535.1, Safety Color Code. They shall comply with the tolerances expressed in terms of Munsell hue, value (lightness), and chroma (saturation). The emblems and markings shall be of the type, size, color, and location as follows:

A. Front markings
   1. The word “AMBULANCE,” mirror imaged, shall be in block, blue, die cut style letters, not less than 4" high, centered above the grille, on the orange or white background. The placement of the word ambulance on the curved surface of the hood or on a flat plastic type bugscreen is permitted.
   2. A “Star of Life” in 3", blue, die cut style, with a white border; shall be located both to the right and left of the word “AMBULANCE.”

B. Side and rear markings
   1. The word “AMBULANCE” shall be in block, blue, die cut style letters of not less than 6" in height, centered, with a white border, alongside or under the “Star of Life” on each side and rear of the vehicle body.
   2. A “Star of Life,” not less than 16", in blue, die cut style, with a white border, on the right and left side panels. A “Star of Life” emblem, shall be provided on each rear door.

C. Top markings

A “Star of Life,” of not less than 32" in blue, die cut style (may be without the white Staff of Aesculapius), shall be provided on the ambulance rooftop.

3.17 MARKINGS, AND CAUTION AND IDENTIFICATION PLATES.

FSAM's caution plates and identification plates shall be conspicuously installed for all equipment, etc., furnished requiring such notices. The FSAM's "Star of Life" certification shall be provided on a placard or label permanently affixed and easily visible.

Other than the manufacturer's trademark(s) names, no other identification than that specified shall be shown on exterior of the vehicle.

3.18 MANUALS, AND HANDBOOK OF INSTRUCTION.

The FSAM shall furnish with each ambulance one copy of a handbook of instruction in electronic media. This handbook shall contain all information and safety precautions to insure that the operator of the ambulance can properly operate and perform required operator level maintenance specific to the ambulance purchased. As a minimum, this handbook of instruction shall contain.

1. Table of contents
2. Copy of FSAM's invoice showing date of delivery and conditions of sale
3. FSAM's "Star of Life" certification of compliance statement
4. Copy of the FSAM's predelivery Inspection/test form signed by FSAM's inspector
5. Copy of FSAM's final (as built) work order.
6. Shipping papers.
7. List of the FSAM's service points
8. FSAM's components and equipment information (hardware, fixture, etc.) including part numbers specific to the ambulanced purchased
9. Complete wiring diagrams and schematics for wiring added to the OEM chassis by the FSAM
10. OEM's operator manual (may be in printed form if electronic form is not available from OEM)
11. Equipment manufacturer's operator manual(s) for any equipment furnished with, or as a part of the ambulance (may be in printed form if electronic form is not available from OEM)
12. All warranty information
13. Weight documents from a certified scale showing actual loading on the front axle, rear axle, and overall ambulance at curb weight
14. Payload Calculation Form
15. Certification of successful completion of the tests in AMD stds 5, 9, 10, 15, 21 & 25 by the FSAM for the ambulance listed in the FSAM's as built work order

If complete parts and service manuals are required for the ambulance, option PSM or PSME must be ordered.

3.19 PREDELIVERY INSPECTION AND SERVICING.

The FSAM prior to the acceptance and inspection of the ambulance(s) shall service and inspect each vehicle in accordance with the OEM's approved predelivery form, and the FSAM's predelivery (test, inspection, and road test) form. A signed copy of these forms (check sheets) shall be furnished with the vehicle. Servicing shall comply with ambient temperatures and conditions applicable with the route of transport to the consignee's ultimate destination. Servicing shall include all tank(s) full of fuel; checking to determine satisfactory and complete operation of all mechanical and electrical features, equipment and system; elimination of rattles, noises, and squeaks; cleaning the interior and exterior. Thus the vehicle shall be delivered ready to use.

3.20 WORKMANSHIP.

1. Vehicles shall be free from defects that may impair their serviceability or detract from appearance.
2. All bodies, systems, equipment, and interfaces with the chassis shall be done in accordance with the OEM Body Builders Book.
3. Defective components shall not be furnished. Parts, equipment, and assemblies that have been repaired or modified to overcome deficiencies shall not be furnished without the approval of the purchaser. Component parts and units shall be manufactured to definite standard dimensions with proper fits, clearances, and uniformity. General appearance of the vehicle shall not show any evidence of poor workmanship.
4. The following shall be reason for rejection:
   a) Rough, sharp, or unfinished edges, burrs, seams, corners, and joints.
   b) Grit, seeds, orange peel, fish eyes, streaks, running, sagging, wrinkles, pin holes, craters in paint, failure to meet minimum thickness requirements and non uniformity of specified color.
   c) Body panels or components that are uneven, unsealed, or contain cracks and dents.
   d) Misalignment of body fasteners, glass, viewing panels, light housings, other items with large or uneven gaps, spacing, etc., such as door, body panels, and hinged panels.
   e) Improperly fabricated and routed wiring or harness.
   f) Improperly supported or secured hoses, wires, wiring harnesses, mechanical controls, etc.
   g) Interference of chassis components, body parts, doors, etc.
   h) Leaks of any gas, vacuum, or fluid lines (air conditioning, coolant, oil, etc.).
   i) Noise, panel vibrations, etc.
   j) Inappropriate or incorrect use of hardware, fasteners, components, or methods of construction.
   k) Incomplete or improper welding, riveting, or bolting.
   l) Lack of uniformity and symmetry where applicable.

4. Quality Assurance Provisions

4.1 RESPONSIBILITY FOR INSPECTION AND TESTS.

The FSAM is responsible for the performance of all inspections and test requirements specified. The FSAM may use their own or any other facilities suitable for the predelivery and acceptance inspections unless disapproved by the purchaser. The purchaser reserves the right to perform any of the inspections and tests set forth in the specification where such inspections are deemed necessary to assure supplies and service conform to the specification and contract. The FSAM shall provide the purchaser's inspection representatives with the FSAM's readily available instruments and all such assistance as they may find necessary.

4.1.1 PURCHASER VERIFICATION.

Quality assurance operations performed by the FSAM will be subject to purchaser verification at unscheduled intervals. Verification will consist of observation of the operations to determine that practices, methods, and procedures of the FSAM's inspection are being properly applied. Failure of the FSAM to promptly correct observed deficiencies shall be cause for suspension of acceptance of the ambulance(s) until conformance to specification criteria has been demonstrated.

4.2 INSPECTION FOR ACCEPTANCE.

4.2.1 QUALITY CONFORMANCE INSPECTION.

Quality conformance inspection applies to all ambulance(s) offered for acceptance under the contract. Quality conformance inspection shall consist of:

1. Workmanship inspection
2. Operational checks
3. Examination of the ambulance handbook
4. Verification of successful completion of AMD tests 001-025

4.2.2 OPERATION CHECKS.

Operational checks of the ambulance shall cover all controls, electrical systems, and devices, doors, windows, cabinets, accessories, in and outside the ambulance. Ambulance shall be driven at highway speeds, turns made at minimum radii, brakes tested for dependability, checked for rattles and squeaks. All controls and mechanisms shall function and operate as intended at the time of delivery.

4.2.3 INSPECTION FAILURE OF AMBULANCE (S).

Failure of a production ambulance to have the certifications required or successfully complete the examinations and tests shall be cause for non-acceptance of any of the contract quantity, until deficiencies are corrected and evidence of the corrective action preclude recurrence of similar deficiencies. Failure of the ambulance to successfully complete inspection shall not constitute an excusable delay in meeting scheduled deliveries.

4.3 "STAR OF LIFE" CERTIFICATION REQUIREMENTS.

4.3.1 QUALIFYING PROVISIONS.

The FSAM is obligated to certify to the Government/ purchasers that the ambulance bearing the "Star of Life," its components, and equipment meet or exceed all the requirements and tests set forth in this specification. The certification and "Star of Life" label, verify that the ambulance conforms to the version of this specification in effect on the date the ambulance was contracted for. Compliance for a "Star of Life" label is defined as certification backed by confirmed verifications of inspections and tests. The verifications shall be in possession of the issuer and presented if and when challenged. For the benefit of purchaser's procuring activity evaluation and review, prior to or with each proposed bid (solicitation), the FSAM shall provide and forward representative material of their "Star of Life" ambulance(s). This material shall include: a letter certified by a company officer, stating that the delivered ambulance(s) shall comply with paragraphs 4.3.2 thru 4.3.5. Failure to provide certification, at the time the vehicle is presented for inspection, will deem the vehicle unacceptable and shall constitute grounds for termination in accordance with the terms of the contract. Also included shall be: general specification data, exterior and interior pictures, dimensional drawings/data, etc., and other information as requested.

4.3.2 DOCUMENTATION OF "STAR OF LIFE" CERTIFICATION.

The FSAM shall compile complete certified documentation of verifications for all the tests required under 4.4 conforming to 4.3.3 and 4.3.5 for each Type of ambulance intended to be marketed to the Emergency Medical Care industry as a "Star of Life" ambulance.

4.3.3 CRITERIA OF CERTIFICATIONS.

The initial testing and inspections required for certification shall be performed by a nationally recognized independent testing facility. The individual certifications will remain valid for five years as long as the type of ambulance tested remains in production. Design changes during the five year certification period must be tested at the time of production release.

Certifications that appear on the ambulance need not be re-submitted (i.e.; DOT, EPA, etc.). Certification(s) will be acceptable in lieu of actual verification test during inspections providing supporting verifying data complying with 4.3.3 is on file for examination.

Certification from OEM and individual equipment manufacturers are acceptable providing they are not part of a system(s) or altered and in accordance with 4.3.4.

Type certifications of individual components and equipment products are acceptable.

Each ambulance constructed shall be tested by the FSAM to demonstrate compliance with AMD Standards 5, 9, 10, 15, 21 & 25. This is in addition to the initial type testing certification required.

4.3.4 CERTIFICATION LETTER FORMAT.

Certification letters submitted for the ambulance model, components, and equipment being certified shall contain the following information on FSAM's letterhead stationery in electronic format (pdf files):

1. To whom certifying.
2. Date.
3. Units or items.
4. FSAM and address.
5. Date product tested.
6. Model number and specification data.
7. Applicable specification references and test requirement.
8. Summary of the test report.
9. A certifying statement w/ official signature.

4.3.5 CERTIFICATION VERIFICATION DATA REPORTS.

The testing facility for each certification shall supply supportive verification data and information on letterhead stationery in electronic format (pdf files):

1. For whom tested.
2. Report date.
3. Name of sample product or device.
4. FSAM's address.
5. Serial and model number(s).
6. Specification referral and amendment number(s), and test requirement(s).
7. Test facilities used and location.
8. Test equipment used.
9. Test procedure.
10. Test results.
11. Verifying test data.
12. Photographs.
13. Test conclusion(s).
14. Witness(es), and authorized signature.

4.4 TESTS.

4.4.1 TEST CRITERIA.

The ambulance shall be prepared for operation in accordance with OEM's recommendations, and AMD Standards 001-025. The ambulance shall successfully complete all parts of the quality conformance inspection.

5. Delivery

5.1 PREPARATION FOR DELIVERY.

The ambulance(s) shall be preserved and packaged for mobile delivery in accordance with the FSAM's standard commercial practice, insuring carrier acceptance and safe delivery to destination in compliance with regulations applicable to the mode of transportation.

5.2 GOVERNMENT/PURCHASER RESPONSIBILITY.

The FSAM shall deliver the vehicle to the consignee delivery address designated on the motor vehicle delivery/purchase order.

The Government/Purchaser is responsible for:

1. Notifying the FSAM of the delayed delivery date and the in-transit mileage accumulation as applicable.
2. In the presence of the delivering driver, immediately inspecting the vehicle for damage, abuse, loss or theft that may have occurred during transit. Any such findings should be accurately described on the delivery receipt the driver presents for signature. If the vehicle(s) are covered with snow, Ice or dirt so as to prevent a complete inspection at the time of delivery, this is to be noted on the delivery receipt. The driver is required to acknowledge any notification on the delivery receipt by signature.
3. Notifying the FSAM of any damages or shortages found within 24 hours.
4. Obtaining local safety and emission testing that may be required.
5. Obtaining the title and license plates that may be required.
6. Retuning the warranty registration card(s) to the FSAM. The FSAM's warranty does not go in effect until the ambulance is registered with the FSAM by the Government/Purchaser.

6. NOTES

6.1 INTENDED USE OF SPECIFICATION.

The intended use of this specification is to define and procure certified “Star of Life” ambulances for use by the federal government. The use of this specification by State and local Governments is permitted.

Since the use of this specification is voluntary for State Governments, each State Department of Health will generally determine if their state wishes to use this specification.

6.1.1 FEDERAL SPECIFICATION COVERAGE.

This federal specification covers only the ambulances approved to display the “Star of Life” symbols for use by the federal, state and local governments of the United States.

6.1.2 PRECAUTIONS AND OBSERVATIONS.

Purchasers should read the entire document before requisitioning an ambulance, in order to be knowledgeable of just what equipment is standard, and which options need to be exercised. Due to the variety of ambulance equipment or features, some options may be incompatible with the model desired (reference OEM and FSAM’s data books).

6.1.3 DEFINITION OF GOVERNMENT-PURCHASER.

Government or purchaser as used in the context of this document means the federal, state, or local government.

6.2 WARRANTY.

6.2.1 WARRANTY COVERAGE.

The FSAM shall warrant the ambulance and furnished equipment against parts failure or malfunction due to design, construction, or installation errors, defective workmanship, and missing or incorrect parts for a minimum period of 12 months or 12,000 miles (which ever occurs first) for domestic use, and 15 months or 12,000 miles (which ever occurs first) for foreign use from date of acceptance*, exclusive of any authorized accumulated driveway mileage.

However, if the FSAM received from any supplier or subcontractor additional warranty on the whole or any component of the ambulance, in the form of time and/or mileage, including any prorate arrangements, or the FSAM generally extends to their commercial customers a greater or extended warranty coverage, the Government/purchaser shall receive corresponding warranty benefits.

*The warranty begins when the Government/purchaser accepts the ambulance from the FSAM FOB point of destination.

6.2.1.1 DOMESTIC USE.

When vehicles are used within the 50 States of the United States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific islands, and the Virgin Islands, the warranty shall include furnishing, without cost to the Government (FOB FSAM's nearest dealer or branch to vehicle's location or station), new parts and assemblies to replace any that failed or malfunctioned within the warranty period. In addition, when the Government elects to have the work performed at the FSAM's plant, branch, or dealer, or with the FSAM's approval (i) to correct the vehicle itself or (ii) to have the vehicle corrected by a commercial garage facility, the cost of the labor involved in the replacement of the failed or malfunctioned parts or assemblies shall be borne by the FSAM.

6.2.1.2 FOREIGN USE.

When vehicles are used outside the 50 States of the United States, the District of Columbia, the Commonwealth of Puerto Rico, American Samoa, Guam, the Commonwealth of the Northern Mariana Islands, the Trust Territory of the Pacific islands and the Virgin Islands, the warranty shall include the furnishing of new parts or assemblies to replace any returned to the FSAM by the Government which failed or malfunctioned within the warranty period. The replacement parts or assemblies shall be delivered by the FSAM to the port of embarkation in the United States designated by the Government. The FSAM shall not be required to bear the cost of the labor involved in correcting defects in vehicles operated in foreign countries.

6.2.2 WARRANTY EXCLUSIONS: OEM PROVISIONS APPLY.

The following items are considered normal maintenance and repair for which the FSAM need not assume liability for reimbursing the Government/purchaser regardless of the ambulance age or mileage:

1. Abuse, negligence, or un-approved alteration of original parts.
2. Damage from accidents.
3. Standard brake and clutch adjustments.
4. General tightening, headlamp adjustments.
5. Wheel alignment or tire balancing.
6. Tires, batteries, medical supplies and equipment, and radio(s) (if warranted by their manufacturers.
7. Miscellaneous expense such as fuel, towing, telephone, travel, lodging, or loss of personal property.

6.3 REPAIR PARTS AND SERVICE.

As continuous operation of the ambulance described by this specification is of utmost importance for the successful FSAM to be in a position to render prompt service and to furnish replacement parts. Accordingly, FSAMs shall indicate the extent of their ability to render prompt service by furnishing a list of branch offices or agencies where complete stocks of repair parts are maintained and can be secured within a reasonable time after ordering by part number from the FSAM's part book and at such discount as may be quoted from year to year by the FSAM purchased under this specification.

6.4 STATEMENT OF ORIGIN OR BILL OF SALE.

A FSAM's Statement of Origin or Bill of Sale showing the applicable purchase order number is required for each ambulance procured under this specification. Such documents shall be forwarded to the consignee's mailing address.

6.5 CHANGES AND AMENDMENTS.

When a using agency or purchaser considers that this specification requires revision, a written request for change or additions to the document supported by adequate justification should be filed on the General Services Administration, Automotive Center, Engineering Branch (QMDAA)'s electronic comment collector. The agency will be informed of action taken. New and revised information regarding this specification may be issued from time to time under an amendment to the federal specification. These amendments are identified by the same number and title as the document. Amendments should be retained until such time as the entire document is revised.

Custodian & Preparing Activity:
GSA-FAS-QMDAA

FIGURE 1

Certification & Payload Signage

The label shall be mounted on the body (module) interior in a conspicuous location.
- The label shown here is suggested format.
- Deviations in dimensions are acceptable.
- All text must be included.

CERTIFIED "STAR OF LIFE" AMBULANCE

Date of Manufacture ______________________________

Mfg By ______________________________

Address ______________________________

City______________________State______Zip ___________

This ambulance conforms to Federal Specification KKK-A-1822 in effect on the date the ambulance was contracted for.

Final Stage Ambulance Manufacturers ID Number ______________________________

VIN ______________________________

OEM Chassis Model, Year of Manufacture ______________________________

Vehicle Type ______________________________

NOTICE: THIS VEHICLE, AS MANUFACTURED, CONFORMS TO THE PAYLOAD REQUIREMENTS OF THE FEDERAL AMBULANCE SPECIFICATION KKK-A-1822. USERS SHALL NOT LOAD VEHICLES ABOVE THE GVWR, GAWRs OR <u>EXCEED THE TOTAL USABLE PAYLOAD LISTED BELOW</u>.

TOTAL USABLE PAYLOAD ________________lbs.
(TOTAL REMAINING WEIGHT CAPACITY OF OCCUPANTS AND CARGO USER MAY ADD)

FIGURE 2

Payload Calculation Form

The completed form shall be included in the handbook of instructions.
- The form shown here is suggested format.
- Deviations in dimensions are acceptable.
- All text must be included.

CUSTOMER USABLE PAYLOAD INFORMATION

Final Stage Ambulance Manufacturer's Name:______________________________

OEM Chassis Year, Make, Model: ______________________________

1) Ambulance Model, Type, Prod. #: ______________________________

2) OEM GAWR – Front:	_________ lbs
3) OEM GAWR – Rear:	_________lbs
4) OEM GVWR:	_________lbs
5) Minimum Payload Per KKK-A-1822:	_________lbs
6) Curb Weight – **AS BUILT** – Front Axle:	_________lbs
7) Curb Weight – **AS BUILT** – Rear Axle:	_________lbs
8) Total Curb Weight – **AS BUILT**:	_________lbs
9) **CUSTOMER USABLE** Total Payload **AS BUILT** (item 4 minus item 8):	_________lbs
10) **CUSTOMER USABLE** Front Axle Payload **AS BUILT** (item 2 minus item 6):	_________lbs
11) Total Weight of Permanently mounted Options Specified (only required if item 9 does not meet or exceed item 5):	_________lbs
12) Payload of Basic KKK Vehicle (item 9 plus item 11) (only required if item 9 does not meet or exceed item 5):	_________lbs

FIGURE 3

12-Volt DC Electrical System

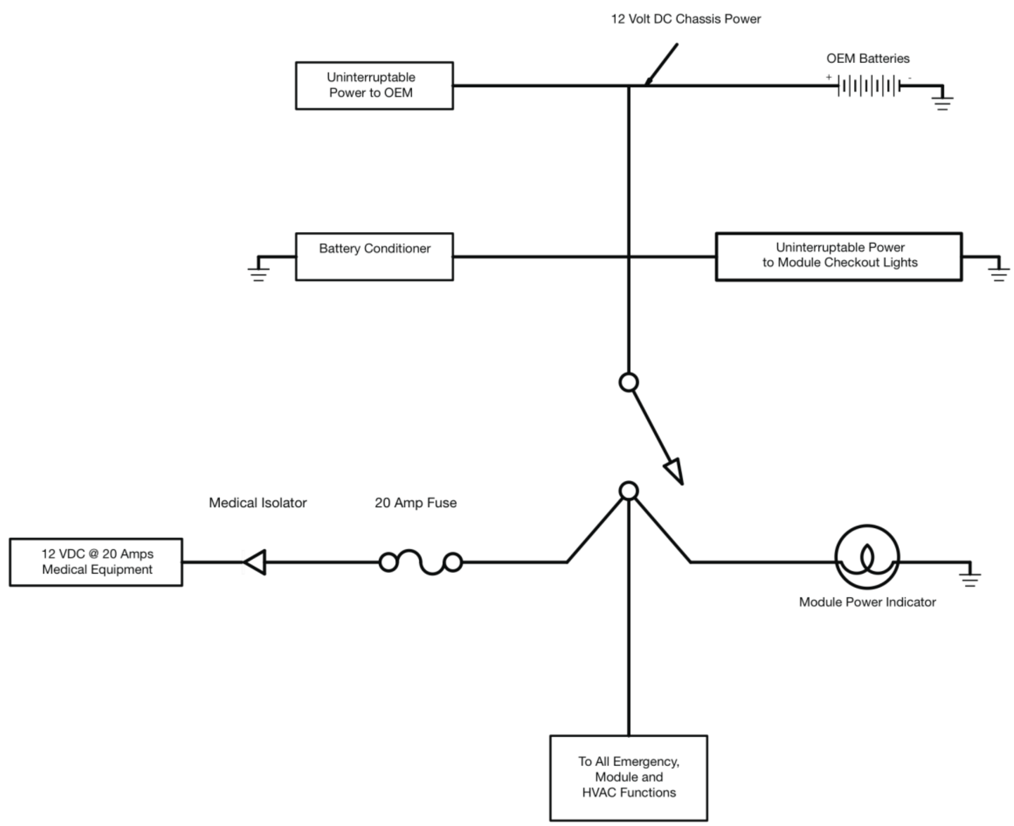


FIGURE 4

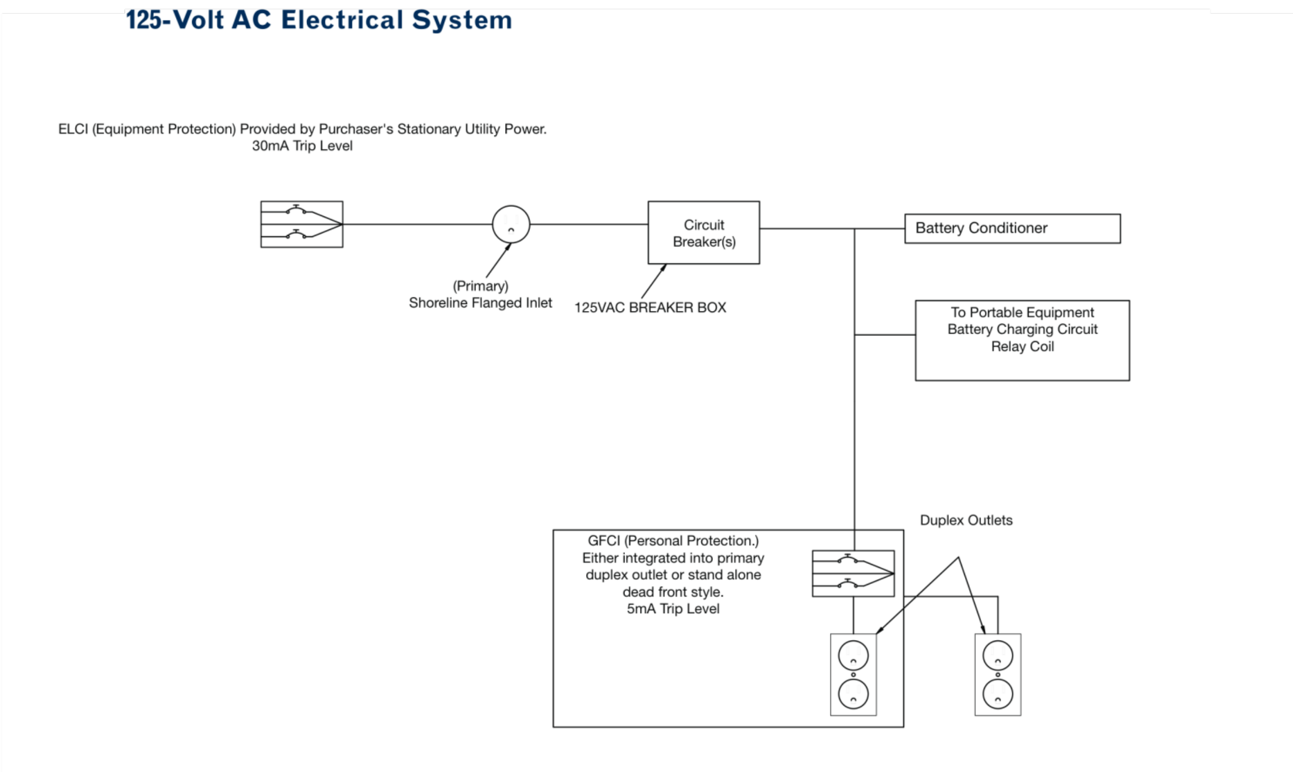

125-Volt AC Electrical System
ELCI (Equipment Protection) Provided by Purchaser's Stationary Utility Power.
30mA Trip Level
Circuit
Breaker(s)
Battery Conditioner
(Primary)
Shoreline Flanged Inlet
125VAC BREAKER BOX
To Portable Equipment
Battery Charging Circuit
Relay Coil
Duplex Outlets
GFCI (Personal Protection.)
Either integrated into primary
duplex outlet or stand alone
dead front style.
5mA Trip Level

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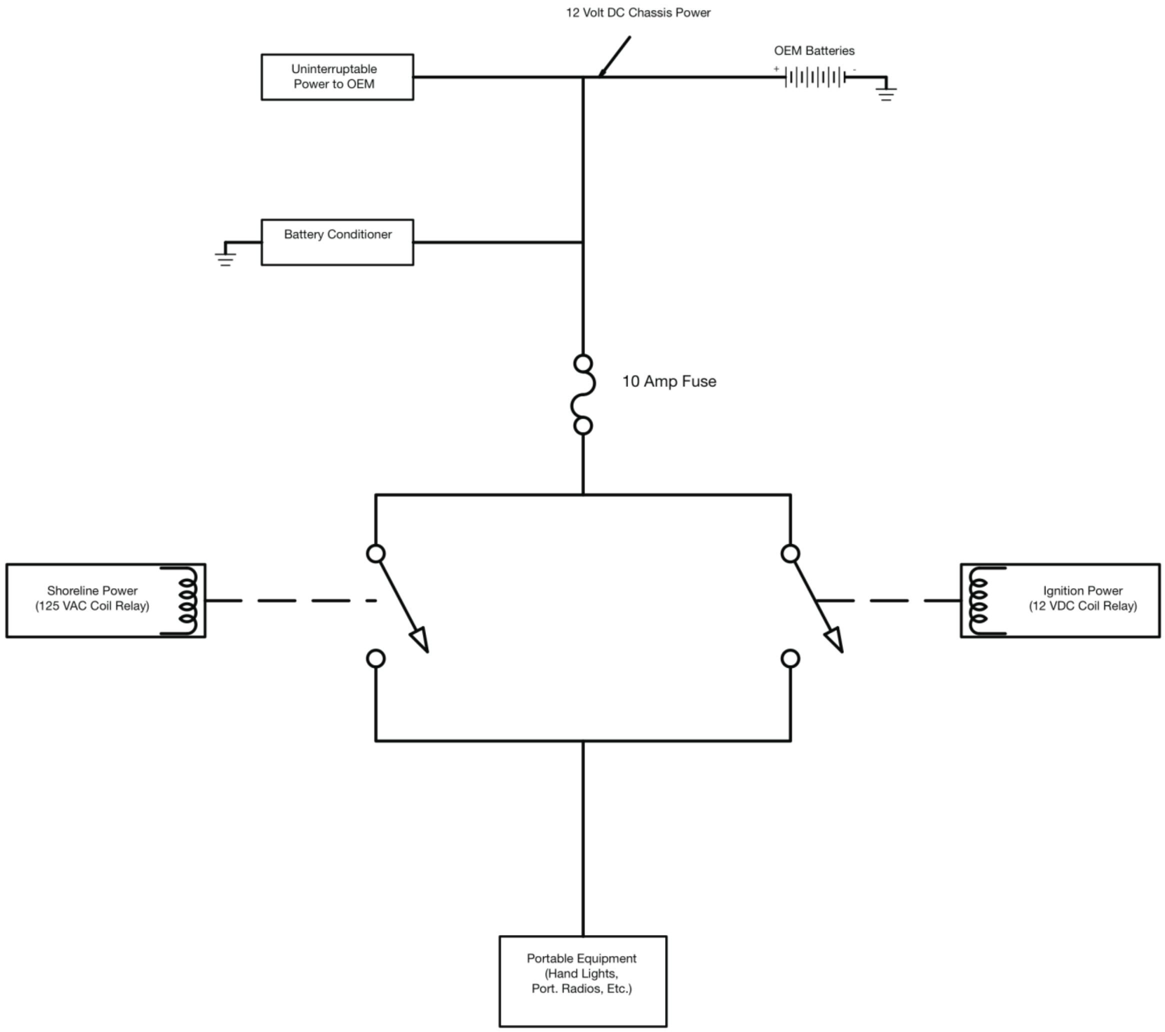
FIGURE 5

Portable Equipment Battery Charging Circuit



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Smarter Solutions

This document supersedes KKK-A-1822E, dated June 1, 2002

This document may be downloaded at no cost from the Internet at:
WWW.GSA.GOV/AUTOMOTIVE

Comments, information, and questions should be sent to:
Chief, Automotive Engineering & Commodity Management Branch (QMDAA)
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General Services Administration
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www.gsa.gov
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