

# **WHITE PAPER**

## **REPORT TO THE AMERICAN FIRE SERVICE**



***SUBMITTED BY:***

**FIRE APPARATUS MANUFACTURERS' ASSOCIATION  
MEMBERSHIP**

**March 1, 2000**

# FOREWORD

**The Fire Apparatus Manufacturers' Association (FAMA) takes great pride in presenting this “White Paper” to the American fire service. FAMA believes this report can be used as a resource tool for funding justification, and can assist the forward-thinking fire service administrator in analyzing the department’s future equipment needs. The data contained in this report was gathered by FAMA members for informational purposes only and is not intended to promote or endorse a particular product or manufacturer. FAMA welcomes your comments on this report, its format, and its utility to the fire service community.**

3 D Manufacturing Inc.  
4-Guys Inc.  
911 Seats, Inc.  
Action Coupling & Equipment  
Aerialscope, Inc.  
AFAC, Inc.  
Akron Brass Co.  
Alexis Fire Equipment Co.  
Allison Transmission Div GM  
Aluminum Ladder Company  
American LaFrance div Freightliner  
Becker Fire Equipment Co.  
Boise Mobile Equipment, Inc.  
C.E. Niehoff & Company  
CSI Emergency Apparatus  
Cast Products Inc.  
Caterpillar Inc.  
Central States Fire Apparatus, Inc.  
Churchville Safe-T-Lite  
Class 1, Inc.  
Code 3  
Crash Rescue Equipment Service, Inc.  
Cummins Engine Co Inc.  
Custom Fire Apparatus Inc.  
Danko Emergency Equipment Co.  
Dependable Emergency Vehicles  
Detroit Diesel Corporation  
Duo-Safety Ladder Corp.  
E.J. Murphy Company  
EWH Spectrum, Inc.  
Edwards Manufacturing, Inc  
Elkhart Brass Mfg. Co., Inc.  
Emergency One Inc.  
Federal Signal Corporation

Ferrara Fire Apparatus, Inc.  
Fire Equipment Serv, div G&G Metal  
Fire Products Company, The  
Fire Research Corporation  
Fire Resources, Inc.  
Fort Garry Industries Ltd.  
FWD Corp., Seagrave Fire Apparatus, Inc.  
General Safety Equipment  
H & W Emergency Vehicles  
Hackney Emergency Vehicles, div of TTI Inc  
Hale Products Inc.  
Hannay & Son, Inc  
HME, Inc.  
Hypro Corp Foam Pro Division  
Innovative Controls, Inc.  
Key Fire Hose  
KME Fire Apparatus  
Kochek Company Inc.  
Koehler-Bright Star, Inc.  
Ladder Towers, Inc.  
Luverne Fire Apparatus Company, Ltd.  
Marion Body Works, Inc.  
Maxima Technologies  
MC Products, div of ESH Inc.  
Meritor/Rockwell Int'l.  
Michelin North America  
Muncie Power Products  
National Foam System Inc.  
Navistar Intl. Trans. Corp  
Pierce Manufacturing Inc.  
Precision Fire Apparatus, Inc.  
Pro Poly of America Inc.  
Quala-Tel/Sigtronics  
Quality Manufacturing Inc.

Realwheels Cover Co.  
ROM Corporation  
S & S Fire Apparatus Co  
Saulsbury Fire & Rescue Ap  
Schwing America Inc. Fire App. Div.  
Semo Tank & Supply Company  
Smeal Fire Apparatus Co.  
Spartan Motors Inc.  
Spencer Manufacturing Inc.  
Spicer/Dana Corporation  
Stainless Flow Technologies, Inc.  
Super Vacuum Manufacturing Co., Inc.  
Sutphen Corporation  
Telma Retarder, Inc.  
Towers Fire Apparatus Co Inc  
Toyne Fire Apparatus  
Transportation Safety Devices, Inc.  
Truck Cab Manufacturers Inc  
U.S. Tanker - Fire Apparatus  
United Plastic Fabricating Inc  
VisionMark  
W.S.Darley & Company  
Waterous Company  
Weldon Technologies, Inc.  
Whelen Engineering Co.Inc.  
Will-Burt Co.  
Ziamatic Corp.

# **FIRE APPARATUS MANUFACTURERS' ASSOCIATION**

## **WHITE PAPER Report on Application of New Technology To Modern Fire Apparatus**

### **Preface**

By 1975, the date which marked the birth of the United States Fire Administration (USFA), and shortly after release of the *America Burning* report, the North American fire service responded to public demand by broadening its response obligations to include a variety of emergency situations which required advanced technologies and improved functionality of fire apparatus and related equipment. Since that time, North America's fleet of fire apparatus has aged dramatically and, in many cases, existing equipment cannot continue to efficiently, functionally and safely support the expanded role and increased demands placed upon fire service organizations.

The Fire Apparatus Manufacturers' Association (FAMA) is comprised of almost 100 member companies who design, manufacture and market automotive fire apparatus and related equipment in the United States and Canada. Established in 1946, FAMA members have been committed to the development of technologically advanced fire apparatus and fire suppression equipment, and have worked tirelessly to improve the safety, performance and functionality of such equipment. This "White Paper" report was prepared by FAMA, through the input of its member companies, for the benefit of all North American fire service agencies that provide public fire protection to the citizens in their communities. The report is organized into five sections which summarize specific improvements and added features developed during the past 20 years related to (1) chassis, (2) cab & body, (3) pump and accessories, (4) foam systems, and (5) aerial devices.

This report is intended to serve as a resource for fire service administrators who are considering replacement of outdated or obsolete fire protection equipment, or who are in the process of purchasing new equipment. It has been formatted as a Microsoft Excel spreadsheet to facilitate flexibility in support of these administrators who need to present expenditures and budget justification to their sources of funding. In each section, specific new features have been itemized and paired with a description of particular benefits derived from each feature or technological improvement. The features are further distinguished as to whether the new technology was developed after 1990, and whether the new feature is now required under updated NFPA standards. In addition, each feature is categorized as related to improved a) safety, b) serviceability, c) durability, or d) performance of the apparatus. Using the "cut and paste" feature in Adobe Acrobat, the user is invited to easily incorporate the data contained in this report for constructing an effective presentation that is suited to a variety of applications.

<p><b>Chassis Advancements</b></p>
--

Item	New Feature	Benefits	Chapter/Section	1990+	<u>NFPA Required per 1999 edition</u>			
					Safety	Service	Durability	Performance
1	Introduction of electronically controlled diesel engine	Electronically controlled pressure governor, improved maintenance intervals, higher torque, higher horse power. Eliminates mechanical linkages and provides diagnostics capabilities, improved EPA startability and improved emission levels. Improved fuel	N/S	No	X	X	X	X
2	Introduction of rear engine	Reduced cab noise and increased cab room	N/S	No	X			
3	Improved engine placement in chassis	Improved useable cab space	N/S	No	X	X		
4	Introduction of the electronic transmission	Improved performance - diagnostic capabilities; provides communication link to the engine	N/S	No	X	X	X	X
5	Introduction of disc brakes over drum brakes	Improved stopping capability and brake design	N/S	Yes	X	X	X	X
6	Introduction of ABS braking as a standard	Improved operator control during emergency brake applications	10 - 3.1.1	Yes	X		X	X
7	Introduced auxiliary braking as a standard on vehicles over #36,000 GVWR	Increased stopping capability; improved operator control; extended brake life	10 - 3.1.7	Yes	X	X	X	X
8	More widespread use of engine brake device and drive line retarder systems	Increased stopping capability; improved operator control; extended brake life	N/S	Yes	X	X	X	X
9	Improved suspension and steering geometry	Improved ride quality; improved vehicle turning radius and maneuverability	N/S	No	X	X	X	X
10	Introduction of rear steer concept	Improved vehicle turning radius and maneuverability	N/S	No			X	X
11	Introduced function coding of all chassis wiring	Improved diagnostics and serviceability	11 - 2	No		X		

New Feature		Benefits	<u>NFPA Required</u> <u>per 1999 edition</u>		1990+	Safety	Service	Durability	Performance
Item	Section I		Chapter/Section						
12	Improved wiring methods and techniques w/weather tight connections	Lower failure rate; improved serviceability	11 - 2	No	X	X	X	X	
13	Improvements to noise suppression circuitry	Systems less susceptible to spikes and failure	11-7	No		X	X	X	
14	Introduction of multi-plex control systems	Less complex wiring (harnessing); diagnostic capability; flexible configuration of systems; fewer connections; ability to upgrade; improved serviceability and troubleshooting; less downtime	N/S	Yes		X	X	X	
15	Improved illumination of controls, Indicators, and work areas	Increased visibility; improved work area lighting; improved safety	11 - 3	Yes	X			X	
16	Improved diagnostic control and access	Improved serviceability; less down time	N/S	Yes		X			
17	Improved positive action multi safety interlock systems for pump chassis and aerial device functions	Improved safety with consistent performance of interlock functions	10 - 1 14 - 10 18 - 17	No	X			X	
18	Larger more efficient alternators	Increased electrical system capacity	11 - 3		X	X	X	X	
19	Introduced the closed loop hydraulic system	Service, durability and consistent operation	N/S	No		X	X		
20	Introduction of automatic engaging tire chains	Increased wheel traction in adverse weather conditions through automated activation without stopping the vehicle or leaving the operator's position	N/S	Yes	X		X	X	
21	Improved extended warranties up to and including lifetime	Lower operating costs which indicates a higher degree of confidence	N/S	No					
22	Improved packaging of chassis components	Better body configuration and space	N/S	Yes	X	X		X	
23	Introduction of air ride suspension	Reduces compound and structural wear; improved ride quality	N/S	No	X		X	X	
24	Implemented standard for line voltage equipment	Establishment of consistent installation methods, procedures and test criteria	Chapter 21	Yes	X	X	X	X	

New Feature		Benefits	<u>NFPA Required</u> <u>per 1999 edition</u>		1990+	Safety	Service	Durability	Performance
Item	Section I		Chapter/Section						
25	Generators - hydraulic, PTO direct drive and diesel/gas	Compact size, reduced noise levels, increased KW ratings, allow more compartment space	Chapter 21	Yes	X	X			
26	Improved lighting systems / towers	Increased scene lighting for improved firefighter safety	11 - 10	Yes	X			X	
27	Introduction of independent suspension	Improved ride quality and cornering stability; lower overall vehicle center of gravity (CG)	N/S	No	X		X	X	
28	Improved tire designs and rubber compounds	Low profile tires that lower vehicle CG (center of gravity) and improved rubber compounds for greater tread wear, casing life and load capacities	N/S	No	X		X	X	
29	Improved wheel design	Piloted wheel hub; improved centering of wheel; less vibration from advanced wheel balancing	N/S	Yes	X	X		X	
30	Incorporated the on-board battery conditioner	Improved battery life; reduced maintenance; maintain consistent battery condition	11 - 4.5	Yes	X		X	X	
31	Integration of electrical load management for low voltage electrical systems	Prevents electrical system overload at critical alternator output levels; assists in preserving battery condition; reduced maintenance; improved diagnostic capability and better serviceability; less electrical system failures and down	11-3.5	Yes	X	X	X	X	

## Cab and Body Advancements

New Feature		Benefits	NFA Required per 1999 edition	1990+	Safety	Service	Durability	Performance
Item	Section II							
1	Introduction of the four (4) door cab	Improved crew safety; allows firefighter rehab; improved working conditions and communication	12 - 1.1	Yes	X			X
2	Introduction of the tilt cab design	Improved access and serviceability	12 -2	No		X		
3	Improved construction of the aluminum cab and body	Lighter weight; more payload; longer durability	N/S	No	X		X	X
4	Reduction of interior noise levels	Improved communications; improved crew safety	12-1.3	Yes	X			X
5	Improved ergonomics in the cab	Safer operation of the vehicle improved crew safety	12 - 3	Yes	X	X		X
6	Improved cab access and egress	Safer and easier entry and exit of vehicle	12 - 1.8, 13 - 7.1	Yes	X			X
7	Total containment of all loose equipment located in passenger compartment areas	Improved organization and secure storage; improved crew safety	12-1.7	Yes	X		X	X
8	Increased use of roll-up doors	Improved access; less door damage; design flexibility and reduced maintenance	N/S	Yes	X	X		X
9	Improved paint process systems	Reduced maintenance, harder finish, better U.V. protection and adhesion qualities	13 -9	No			X	
10	Introduction of plastic polypropylene and composite body & cab components	Lighter weight; increased durability; reduced maintenance; corrosion resistant; design flexibility	N/S	Yes	X	X	X	X
11	Introduction of the top mounted pump panel	Improved safety and visibility for pump operator; improved service access to pump and plumbing	N/S	No	X	X		X
12	Moving of the pump operators panel inside the cab	Improved communication and working conditions	N/S	Yes	X			X

New Feature		Benefits	<u>NFPA Required</u> <u>per 1999 edition</u>	1990+	Safety	Service	Durability	Performance
Item	Section II		Chapter/Section					
13	Introduction of hydraulic or electric ladder racks	Allows additional compartmentalization; safer storage of ladders and ease of ladder access	13 - 4	No	X			X
14	Introduction of inside the water tank ladder storage	Allows additional compartment utilization; improved safety for access and storage	N/S	No	X			
15	Electric windshield wipers	Consistent performance over air driven units	N/S	No	X	X	X	X
16	Incorporated tilt steering wheel	Improved ergonomics and safety	N/S	No	X	X		X
17	Introduction of plastic composite and polypropylene water and foam tanks	Lighter weight and longer lasting; lower maintenance; corrosion resistant; design flexibility	N/S	No	X	X	X	X
18	Improved body mounting isolation	Extended body life through less vibration; decreased stress and impact shock	N/S	No		X	X	X
19	Improved compartment door seals	Increased weather resistance	N/S	No		X	X	X
20	Improved fuel fill and air bottle doors	Improved latches; increased safety	13 - 5	No	X			
21	Improved pump enclosure access	Ease of maintenance and serviceability	13 - 6	No		X		
22	Improved compartment door hardware	Increased reliability, durability and safety	N/S	No	X		X	X
23	Enclosed cab seating	Improved safety; allows firefighter rehab; improved working conditions and communication	12 - 1.1	Yes	X			X
24	Established seat mounting standards	Increased safety to occupants	12 - 1.1	No	X			
25	Introduced three (3) point seat belts	Increased safety to occupants	12 - 1.1	No	X			
26	Established decibel number standards; relocated audible warning devices (air horns, sirens, speakers)	Reduced cab noise; improved communications; increased safety to occupants	12 - 1.3; 11 9	Yes	X			X

New Feature		Benefits	<u>NFPA Required</u> <u>per 1999 edition</u>	1990+	Safety	Service	Durability	Performance
Item	Section II		Chapter/Section					
27	Improved standards for electrical system performance	Better electrical systems; more opportunity for the vehicle to complete the mission; lower failure rate for batteries and alternator systems	Chapter 11	Yes	X		X	
28	Expanded optical warning light standard through the introduction of scientific data	Improved visibility of warning lights 360 degrees around vehicle; improved efficiency of warning devices	11 - 8	Yes	X			X
29	Improved siren performance and efficiency	Enhanced audible warning through better sound deflection	11 - 9.2	Yes	X			
30	Expanded warning label, decal and striping standard	Improved safety through increased identification of hazard areas	12 - 1.2, 13 - 9.2 18 - 23, 19 - 9 20 - 8, 21 - 11.6 21 - 13, 23 - 2.10	Yes	X			
31	Introduction of aerial stabilizer warning devices	Provides audible and visual warning of stabilizer movement and deployment	18-21.2.1 18-21.2.5	Yes	X			
32	Improved handrail grip material	Improved safety	13 - 8	Yes	X			X
33	Established minimum standards for folding steps	Improved safety, increased area and access	13 - 7.1	Yes	X			
34	Enclosed SCBA bottle fill station	Improved safety during cylinder refills	23 - 9.1	Yes	X			
35	Defined slip resistance for all walking and stepping surfaces	Improved safety	13 -7.3	Yes	X			
36	Tilt down equipment trays	Improved access to equipment	N/S	Yes			X	X
37	Expanded use of stainless steel	Less corrosion	N/S	Yes		X	X	X
38	Expanded tank baffling	Safer operation during transit, reduced water surge and better handling stability	17 - 2.4	Yes	X			X
39	Increased use of modular construction	Ease of repair	N/S	Yes		X		
40	SCBA storage incorporated into seats	Improves response time and safety	12 - 1.6	Yes	X			X
41	Side dump extension chutes	Improved safety and time during water shuttle operations	17 -5	Yes	X			X

**Pump & Pump  
Accessories  
Advancements**

Item	New Feature	Benefits	Chapter/Section	1990+	<u>NFPA Required per 1999 edition</u>			
					Safety	Service	Durability	Performance
1	More wide spread use of single stage pumps	Simplicity; reduced cost; less moving parts and controls; more easily serviced; more efficient at rated capacity	N/S	Yes		X	X	X
2	Increased size and number of intake and discharge pump ports	To accommodate higher pump flow rates	N/S	Yes				X
3	Increased size and number of tank to pump ports and valves	To accommodate higher tank to pump flow rates; improved performance	N/S	Yes				X
4	Improved discharge manifolding	To accommodate higher discharge flow rates; improved performance, maintenance, service	N/S	Yes		X		X
5	Improvements in all midship pump transmissions	To accommodate torque from higher performance engines and provide switches for panel throttle interlocks for electronic engines; to handle torque reversals from transmission mounted retarders	N/S	Yes			X	X
6	Introduction of the rear mount pump	Allows flexible body designs	N/S	Yes				X
7	Expanded applications for high flow PTO driven pumps	Allows flexible body designs	N/S	Yes				X
8	Introduction of mechanical pump shaft seals	Reduced maintenance; quicker prime, extended pump shaft life	N/S	No			X	X
9	Increased access to the pump and controls	Improved serviceability; less downtime	13.6	No		X		
10	Introduction of electronic pump governors	Improved system performance and efficiency	N/S	Yes	X			X

Item	New Feature	Benefits	NFPA Required per 1999 edition		1990+	Safety	Service	Durability	Performance
			Chapter/Section						
11	Introduction of digital readout flow gauges	Improved system performance and efficiency, increased accuracy	N/S	No	X				X
12	Introduction of environmentally safe priming systems	Meets EPA requirements; environmentally safe	14-10.8	Yes					X
13	Introduction of electronically actuated valves	Design flexibility; smaller more efficient pump panels, controlled operation	N/S	No					X
14	Introduction of slow close valves	Improved operator safety and protected system integrity of pumping system	14 - 7.5	Yes	X				X
15	Increased use of stainless steel plumbing	Increased life of plumbing system; reduced maintenance and corrosion	N/S	Yes			X		
16	Introduction of pre-assembled flexible plumbing hose	Improved water flow efficiency by eliminating plumbing elbows; provided better plumbing flexibility in pump enclosure	N/S	Yes		X	X		X
17	Improved pressure control systems	Enhance operator and crew safety, better means to ensure systems in control of the pressure, controllable by one person	14 - 10.7	Yes	X				
18	Introduction of a more user friendly pump panel	Simplified operation; operator efficiency and crew safety	14 - 12.1	Yes	X				X
19	Introduction of thermal relief valves	Improved safety; protection of pump components; enhanced engine cooling	N/S	Yes	X				X
20	Improved plumbing and wide use of flanged pump connections	Improved safety; improved serviceability, design flexibility; reduction of pipe thread connection and extended system life	N/S	No	X	X	X		
21	Improved minimum hydrostatic testing standards of system piping, caps or closures	Verifies piping system integrity; improved system safety factors	14 - 7.4	Yes	X			X	
22	Introduction of plastic PVC suction hose	50% lighter than previous rubber hose; field repairable; replaceable coupling ends; easier to handle; visible water flow	N/S	Yes	X	X	X	X	X

23	Improved pump controls and inter-locks	Enhance operator and crew safety, multiple indicators to verify pump engagement	14 -10	Yes	X			X
----	--	---	--------	-----	---	--	--	---

**Foam Systems,  
Agents, Additives  
and Controls  
Advancements**

New Feature		Benefits	NFPA Required per 1999 edition	1990+	Safety	Service	Durability	Performance
Item	Section IV							
1	Introduction of Class A foam as an extinguishing agent for Class A fires	2-3 times faster knockdown than plain water; improved safety; reduced water consumption and fire damage; faster cleanup; less chance of rekindle; faster return to service of engine company; less environmental damage; faster recovery of visibility	N/S	No	X			X
2	Introduction of Compressed Air Foam as an extinguishing agent	3-5 times faster knockdown than plain water; improved safety; greater adherence for exposure protection; reduced water consumption and fire damage; faster cleanup; less chance of rekindle; faster return to service of engine company; reduced firefighter fatigue; less environmental damage; reduced wear and tear on apparatus; faster recovery of visibility	N/S	No	X			X
3	Introduction of superior foam agents and additives	Improved chemical properties; more efficient heat absorption; improved safety; faster knockdown; reduced water consumption; overall reduction in proportioning rates; longer shelf life; no environmental damage; reduced maintenance	N/S	Yes	X	X	X	X
4	Advanced foam proportioning systems	Improved accuracy and performance; broader operating range; easier to use; improved reliability	Chapter 19	No	X	X	X	X

5	Improved testing requirements for foam proportioning systems	Improved safety and accuracy	Chapter 19	Yes	X			X
6	Introduction of integrated foam cells in the water tank	Reduced firefighter fatigue. Maximize space requirements in hose bed and compartments. Improved accessibility for plumbing to pump and proportioning equipment	Chapter 19	Yes	X			X

**AERIAL DEVICE &  
COMPONENT  
ADVANCEMENTS**

Item	New Feature Section V	Benefits	Chapter/Section	1990+	<u>NFPA Required per 1999 edition</u>			
					Safety	Service	Durability	Performance
1	Establishment of a tip load standard	Uniform performance standard established a minimum recommendation; increased minimum performance	18 - 3	Yes	X			X
2	Improved the overload warning devices	Warns operator of potentially unsafe operating conditions	18 - 3.4	No	X			
3	Development of operational and structural safety standards	Better defined testing and inspection; improved compliance with nationally recognized welding and inspection standards	18 - 20	Yes	X			
4	Expanded the limiting safety interlocks	Reduces potential to put aerial in an unsafe operating condition; automatic operation.	18 - 17, 18 - 17.3, 18 - 17.3.1, 18 - 17.4	Yes	X			
5	Expanded aerial and ground ladder testing standards	Uniform test standards; third party test recommendations; improved documentation and verification of performance.	18 -22, 18 -23, 18 - 24	No	X		X	X
6	Aerial tip controls	Control ladder at tip for better firefighter control	18 - 5.4	No	X			X
7	Pinable waterway	Protects waterway in rescue operations	N/S	Yes	X		X	X
8	Aerial multi-plex systems	Added aerial features and better serviceable	N/S	Yes	X	X	X	X
9	Increased waterway flow capacities	Improved range of stream; faster fire knock down; less appliances required	18 -14	No	X			X
10	Increased system safety factors	Uniform standard; clarified performance; increased minimum standards	18 - 20	Yes	X		X	X
11	Introduction of short jack rotation limiter systems	Defines the range of operation; allows operation in narrow streets and alleys; reduces potential for tip overs.	18 - 17.4	Yes	X			X

Item	New Feature Section V	Benefits	NFPA Required per 1999 edition		1990+	Safety	Service	Durability	Performance
			Chapter/Section						
12	Skid-resistant rung surfaces or coverings.	Increased firefighter safety; provides consistent footing service; less chance of slippage during inclement weather.	18 - 2.5	No	X				
13	Improved component materials for use in ladder section slide mechanism	Smoother operation; improved service; improved durability and structural safety	18 - 5.3	No	X	X	X	X	
14	Remote tip mounted observation cameras	Acts as a remote aerial observation device; more precise placement of remote controlled fire streams; safer observation of fire ground scenarios	N/S	Yes	X				X
15	Improved aerial mounted breathing air systems and standards.	A uniform construction standard; low air warning system; increased duration; improved serviceability	18 - 2	Yes	X	X			X
16	Improved ladder mounted breathing air systems and standards.	More reliable systems	18 - 2	No	X				X
17	Remote nozzle and nozzle tip controls	Allows for the operation of a tip mounted water nozzle w/o need to have firefighter at the tip of the aerial; reduces potential for injuries	18 - 6.1						