Painting Fire Apparatus

The finish on a "fire engine" has to have parade quality and tractor durability. Pierce Manufacturing has new facilities that produce finishes exceeding fire-department expectations while meeting production needs of the next decade...

By Joe Schrantz
Midwest Editor

One of the highlights of a typical Fourth-of-July parade is when the shiny fire trucks pass by with sirens screaming. The smiles on the faces of bystanders, especially children, beam happy approval at the spotlessly clean behemoths and their firefighter crews, who return the smiles.

The parade-goer takes it for granted that those fire trucks will always look brand new, as if they had just been driven off the "showroom" floor. Have you ever seen a dirty, rusty fire truck in a parade? No way!

Nobody realizes the importance of a good finish on a fire truck more than the paint- line employees at Pierce Manufacturing, Inc., Appleton, Wisconsin. Pierce, one of the world's largest manufacturers and customizers of firefighting apparatus, takes great pride in building a fire truck that will perform as expected at a fire and look good at many parades.

Pride in the finish. As evidence of its "pride in the finish," Pierce recently built a 75,000-sq-ft addition to its Assembly Plant in Appleton. It's now referred to as the South Paint Shop. The plant's original painting facility (the "North Paint Shop") has been refurbished to function mainly as a parts-painting shop.

The expansion became fully operational in August of 1993. "We completed the project ahead of schedule and under budget," says Gerald Leath, manufacturing engineering manager, Projects and Process Group. "It was a team project, with George Koch Sons, Inc., Evansville, Indiana acting as general contractor for the finishing system, helped by cooperation of all Pierce employees and numerous suppliers."

The driving force for the new addition was production capacity. "Limited space in the original painting facility was causing production bottlenecks and requiring a great deal of overtime," notes Mr. Leath.

"However, in planning for the addition, a number of secondary objectives surfaced. These included improving employee safety, paint quality, process efficiency and environ-

mental compliance," adds Dan Ketter and Tony Hofkens, manufacturing engineers.

The expansion was Pierce's first major investment in truck painting since the early 1970s, when the original paint shop was built.

From the Ground Up. Pierce manufactures its fire apparatus, including fire and rescue trucks, "from the ground up" at three plants employing 1200 in Appleton. Of course, engines, transmissions, pumps, hoses, sirens, etc. are purchased.

The Chassis Plant does custom chassis assembly and also builds new fire-service cabs. It has its own painting facility. The plant builds about 85 pct of the chassis used by Pierce. "We build a high-quality chassis, but will buy a commercial chassis from Navistar, GMC, Freightliner, Ford, or whomever, if that is what the customer wants," explains Mr. Leath.

The Fabrication Plant produces most of the piece parts and manufactures major subassemblies, such as cabs, body panels and water tanks. It processes 6.5 million pounds of steel and 3.5 million pounds of aluminum a year. It also has its own painting facility.

The Assembly Plant has 10 body lines for new production and four lines for its Service Center. The new addition gives the Assembly Plant the company's most sophisticated painting facility.

A major part of Pierce's business is refurbishing fire apparatus. A used fire truck, for example, may be given a new engine and new pumps and be modified to comply with the latest National Fire Protection Association (NFPA) standards. It also may be painted, which could include stripping to bare metal, sanding, pretreating, priming and topcoating.

Bottlenecks eliminated. "The new facility is paying for itself over and over again," notes Mr. Leath. "No longer do we have production bottlenecks. Required man-hours have been cut by 13 pct."

"One of the reasons for this," interjects Mr. Ketter, "is that two of our booths have pits for operator access to the undersides of the vehicles. In the old facility a truck had to be jacked up, the wheels removed, and an operator had to lie down on a creeper to get underneath. Features such as dust control and improved booth lighting have reduced rework to an all-time low. The new painting facility is helping us to apply the best finish in the industry today."

"The addition also improves employee safety. Dust and fume control provide cleaner breathing air and help employees stay clean on the job," adds Mr. Hofkens.

"We have also brought about environmental savings," adds Mr. Leath. "The non-chrome pretreatment now used enables us to reclassify 4.9 million gallons of wastewater from hazardous to non-hazardous."

"Also, the addition is designed to be energy-efficient, bringing additional savings," adds Mr. Ketter. "The filtering system in our metal-finishing booth enables us to recirculate up to 85 percent of the booth air during winter."

Updating the Old Facility. After the new painting facility became op-

erational, renovating of the old 35,000-sq-ft paint line included: 1) a 3,000-sq-ft addition for a stripping bay and new parts/doors metal finishing booth; 2) a new paint booth and radiant-wall oven for compartment doors; 3) parts and doors pretreatment upgrade; 4) a new compartment-door primer-sanding booth; 5) a "response" line for painting trucks that do not fit well into the process flow of the new addition, such as three-color paint jobs.

The renovated facility now has three waterwash booths and two dry-filter booths. JBI Spray Booths & Systems, Osseo, Wisconsin, undertook the booth improvements, while George Koch Sons, Evansville, Indiana, added the radiant-wall oven.

The old paint facility included a section for abrasive finishing to prepare trucks for painting. The lack of dust-collection capability required segregation of metal finishing from painting operations. Operators formerly had to wear respirators and coveralls, as they literally worked in a cloud of dust. Moving vehicles back and forth across the street helped contribute to a production bottleneck.

New System Layout. The new paint shop has its longest dimension (350 ft) in the north-south direction, with about one fourth of the width on the west side devoted to supporting services, such as paint storage, paint kitchen and lab. The remainder of the addition houses four parallel finishing lines, each laid out in a north-south direction.

Line 1, along the east side of the building, is for metal finishing. Line 2 is for applying the first color coat. Line 3 is for pretreatment. Paralleling the support facilities is Line 4, for applying the second color coat. Layout of the new lines accommodates the normal radius turns required by fire trucks. It is also ideal for the location of paint spray booth water collection in the center of the building.

Pierce is gradually changing the method of moving trucks and truck assemblies through the system. Right now truck movers push a truck through the four lines, with the truck mounted on its own wheels. In the future the trucks will be painted in three sections: 1) chassis 2) pump houses and 3) bodies. The painted sections will then be moved to assembly. The sections will be mounted onto carts that are designed to facilitate painting, including painting the underside.

Line 1. At the beginning is a staging area approximately 75 ft long. This allows bringing a truck in from the cold during winter to permit warm-up before metal finishing. The next 180 ft of Line 1 is a metal-finishing booth, which has a width and height of 20 ft. It has a downdraft of 75 fpm and a makeup air capacity of 20 pct. Total burner capacity is 6.6 million BTUs. All sanding dust is captured at 99.99 pct efficiency at 10 microns. Dust is pulled down under the floor, filtered from the air and deposited in 55-gallon drums. The booth was provided by JBI Spray Booths & Systems, Osseo, Wisconsin.

The booth is partitioned into four 45-ft zones, permitting work on from one to four trucks simultaneously. Every square inch of metal surface is

smoothed with air-powered sanders, first using a coarse paper, followed by a fine-grit paper. Welds are ground with a coarse-grit disk. Some surfaces are filled and sanded.

"The air inside the booth is so clean," says Leath, "that operators can wear street clothes and only a dust mask."

Line 3. A pretreatment booth 60 ft long by 20 ft wide and 20 ft high is at the entry. Operators spray pretreatment chemicals, using a wand and water pressure of 1000 psi. An overhead trolley system simplifies moving hoses.

The booth has an access pit in the floor running almost the entire length of the booth. "This greatly simplifies spraying the truck undersides. We can pretreat a truck in 90 minutes now, while it used to take much longer, says Mr. Leath.

In fabricating fire body and cabs, Pierce uses galvanneal steel, stainless steel and aluminum, all of which are much more corrosion resistant than cold-rolled steel.

Steel substrates receive a three-stage pretreatment: 1) combination cleaner/iron phosphate, 150F; 2) non-chrome sealer rinse; 3) reverse-osmosis rinse. Aluminum undergoes a five-stage pretreatment: 1) acid etch; 2) tap-water rinse; 3) iron-phosphate; 4) non-chrome sealer rinse; and 5) reverse-osmosis rinse. The pretreatment chemicals are supplied by Parker Amchem, Madison Heights, Michigan.

A system made by Aaladin Industries, Elk Point, South Dakota, heats and sprays solutions. Updraft air ventilation exhausts mists.

Pretreated trucks are pulled out of the booth into a section of line about 100 ft long, for drying and masking. Several fans directed at the truck speed drying.

Workers mask numerous parts of trucks prior to painting. These include wheels, windshields, valves, threads and electrical components.

Masked trucks are pulled into a 50-ft-long paint booth earmarked primarily for applying primer. However, a colorcoat is also applied in this booth to underside areas, and a multiple-color coating is applied to compartment interiors. This booth also includes a floor pit for access to truck undersides.

The booth has four stations. Operators use HVLP spray guns supplied with compressed air by plant compressors rather than from turbines. "The transfer efficiency with the HVLP guns is extremely high," Mr. Hofkens comments.

Operators reach the tops of trucks with the aid of stepladders. "In planning for the new painting facilities, we gave operators the choice of using a man-lift or stepladders, and they overwhelmingly preferred the ladders," explains Mr. Leath.

The downdraft waterwash primer booths recirculate 2,000 gpm below the floor to capture overspray. Incoming air is filtered to 10 microns.

After they are painted, the trucks move into an adjoining radiant-wall oven. The walls of the oven are contoured to increase infrared radiant efficiency and have a porcelain lining, allowing easier cleaning.

The oven has two automatically

sequencing cycles: 1) a very low air movement to permit the paint to skin over, and 2) a turbulent movement of 35,000 cfm of filtered recirculated air to speed drying. Infrared heat is applied with porcelain emitters. The gas-fired oven has a heating capacity of 3.5 million Btu's, providing up to 275F. The oven exhaust is filtered to 10 microns at 99.9 pct efficiency.

Line 2. Trucks entering this line have been pretreated, primed and baked. The first booth is for sanding primed surfaces with 280-grit paper to smooth out any film irregularities. The booth is 50 ft high by 20 ft wide and 20 ft high. A downdraft booth, its four exhaust fans generate 75,000 cfm, with a capture efficiency of 99.9 percent at 10 microns. Makeup air mixes in at a 20 pct rate. Heating capacity is 3.33 million Btu's. The booth is lined with a sound-deadening matting to lower noise. Before the sanded trucks are moved from the booth, they are wiped to remove all traces of sanding dust.

The next two stages of Line 2 are a topcoat paint booth/radiant oven combination identical to those at the end of Line 3. The only difference is that instead of using HVLP guns, operators use conventional air-atomize guns. "We are looking into the possibility of replacing these guns either with HVLP or electrostatic units in order to increase transfer efficiency," says Mr. Leath. The topcoat includes the application of a white top, which is common on many Pierce trucks.

A 50-ft space at the exit of the oven is used for inspection. Defects are removed in another sanding booth at the end of Line 2. All sanded areas are tack-wiped.

Line 4. This line has another paint booth/oven combination identical to those on previous lines, except that the booth does not have an access pit. "At this point we no longer have any need to get below the truck," explains Mr. Ketter. Operators apply a second color of topcoat here.

There is another inspection station at the exit of the oven. The final stage is a dry-filter paint booth, used for detail painting, touchup and minor buffing. Trucks go from here to the assembly area.

The primer and topcoat are two-component polyurethanes from Sikkens Division of Akzo/Nobel, Troy, Michigan. The components are mixed automatically in a Graco Precision Mix system. The mixing is done just ahead of the guns. "While these coatings have short potlife, the proximity almost entirely eliminates any waste coating," notes Mr. Leath.

The Environment. The company takes great pride in being environmentally minded. It has switched to paints totally free of chromium and lead pigments. Overspray collected in the three waterwash booths goes to a 40,000-gal holding pit in the centralized waste-treatment facility. After being detackified, the waste paint is centrifuged to separate the solids. Because the solids contain no hazardous materials, they can be disposed of as non-hazardous waste. Pierce is looking for a possible use for these materials. The centrifuged water is reused in the waterwash booths.

All wash solvents are sent to a recycler, who distills them and returns clean solvent to Pierce. The floors in the paint-storage room slope toward the middle for waste containment in the event of accidental spills.

Pierce is in the early stages of switching to a high-solids polyurethane topcoat. The new topcoat will contain 3.5 lb VOC/gal. "We have been testing low-VOC topcoats for several years. We want to be absolutely certain that we do not sacrifice quality before making the change," says Mr. Leath.

The company received two environmental awards in 1994: 1) the Governor's Award for excellence in hazardous-waste reduction, and 2) the Wisconsin Environmental Working Group and Wisconsin Manufacturers & Commerce Wisconsin Business Friend of the Environment Award.

Quality. Pierce displays its official quality policy on signs throughout the plant, in company literature and on the back of employee business cards: "The quality of our products and services is our number one priority. It is our policy to maintain unprecedented levels of customer satisfaction, to deliver defect-free products, with service second to none."

"The very nature of a fire truck demands that it be built with superb quality. It must always function perfectly. Also, everyone expects that a fire engine must look good at all times," observes Mr. Leath.

The plant operates under a "total-quality-management" system. "Every employee, from top management on down, is responsible for quality. We keep our own quality-control charts, and we comply with all NFPA codes," adds Mr. Leath.

Every fire truck is tested before leaving the plant. "Part of our series of final tests includes running a fire truck's engine at 80 pct of full capacity and the pumps at full capacity for four hours. The customer must be totally satisfied before any fire truck leaves our plant," adds Mr. Ketter.

How long is the finish on a Pierce fire truck expected to last? "It all depends on how well the finish is maintained," explains Mr. Hofkens. "We see 20-year-old trucks that still have perfect finishes, because they have been maintained well. We see other poorly maintained vehicles that look bad when they come in for refurbishing after only seven or eight years. If one had to estimate the anticipated life of a fire truck, it probably would be about 20 years."

Fire trucks generally wear out "on the insides" and not "on the outsides." That is, usually the engine and pumps wear out, requiring the truck to be sent back to Pierce for refurbishing. "It's not the mileage on a truck's odometer that is meaningful, but the number of hours that the engine and pumps have been run," explains Mr. Leath.

Pierce fire apparatus operates in weather extremes around the world, including Antarctica, Brazil and Saudi Arabia. The polyurethane topcoat is formulated to be highly resistant to UV, chemicals and abrasion. The finish readily withstands 1,600 hours of

cyclical salt-spray," notes Mr. Leath. "It also has excellent color/gloss retention." The company keeps painted panels under test outdoors in Florida and other locations, as well as in various test labs.

"Extension" spray guns are being used to apply topcoat to hard-to-reach roof areas. "These 'stretch' guns greatly help our painters control film build in these areas," Mr. Ketter explains.

Pierce operates a quality-control lab equipped with a spectrophotometer and computer software from BYK Gardner, Inc., Silver Spring, Maryland, to match colors. "We have more than 150 colors, each with its own Pierce number. We can match the color on any vehicle we have produced," notes Mr. Leath. "The paint lab has a light booth that can duplicate incandescent, northern daylight, UV, and two types of fluorescent light. We refrigerate our color-standard panels in a dark place to prevent the color from fading." **PF**

More Information?

To obtain more information on products or processes mentioned in this article, circle corresponding numbers on the Reader Service Card.

Spray booths, sanding booths ..... Circle 287

Paint-finishing systems ..... Circle 288

Pretreatment chemicals ..... Circle 289

Pretreatment-spray wands...Circle 290

Color-match instrumentation ..... Circle 291

Two-component polyurethane coatings ..... Circle 292

Two-component-mix paint pumps ..... Circle 293

To request an additional copy of this article, write on company letterhead to "Reprints," c/o PRODUCTS FINISHING, 6600 Clough Pike, Cincinnati, OH 45244.

They Aren't Always "Fire-Engine Red"

Merriam Webster's Collegiate Dictionary, Tenth Edition, defines fire-engine red as "a bright red." One might thus conclude that all red fire engines are the same color — "fire-engine red."

Not so. Pierce Manufacturing has a "library" of 65 shades of red that it applies to fire trucks. How could this be?

"When we receive an order to build a new fire truck, the order will specify that the color must match other fire trucks in a department," according to Gerald Leath, manufacturing engineering manager, Projects and Process Group. "So, over the years, we have matched 65 different shades of 'fire-engine red.'"

But not all fire engines are fire-engine red. "The predominant colors of fire apparatus are first, red, and second, yellow/green or lime. We have a 'library' of about 30 shades of yellow/green. The next most popular color is probably white, and we match about 20 different shades of white," adds Dan Ketter, manufacturing engineer.

"We receive orders to paint fire apparatus in many other colors. For example, one fire department specifies that its fire apparatus should be painted robin egg blue. Some departments like to have a special color that the local community has adopted.

The Pierce "library" of custom colors for fire apparatus totals about 150. The gloss of all these colors is always well over 90 using a 60-degree meter geometry.

Don't Call It a "Fire Engine"

A typical little boy more likely than not wants to become a fireman and drive a "big fire engine." But did you know that it isn't called that anymore? The correct term today is "fire apparatus." However, "Daddy, I want to become a fireman and drive a fire apparatus" just doesn't sound right!

"Today's fire-fighting equipment comes in so many different categories that 'fire engine' no longer is applicable," according to Gerald Leath. He explains that fire apparatus can include pumpers, tankers, rescue units of various types, and aerial and ladder devices. Fire trucks are from 22 ft to 65 ft. long, and cost from about $125,000 to $450,000.

Now, Firefighters Ride Inside

You've seen pictures of a "fire engine" rushing to a fire with one firefighter driving and half a dozen or so standing on a running board clinging to the sides of the truck.

No more! Fire-safety standards now require fire apparatus to house firefighters within a cab en route to and from a fire scene. This has radically changed the design of fire apparatus.

"Some new fire trucks are built with cabs big enough to house 10 firefighters," according to Dan Ketter. "The standards were changed after a study showed that many firefighter fatalities occurred en route to and from a fire."

The cabs also provide refuge from the elements at a fire scene. On a hot day the air-conditioned cabs cool firefighters; and on a cold day, they're a warm refuge.

Pierce regularly is called on to refurbish used fire apparatus, not only to replace worn engines and pumps and to refinish bodies, but also to bring units up to NFPA codes. It refurbishes fire apparatus of all types, including those built by competitors.

Another thing that has become scarce on modern fire apparatus is chromium plating. "Reflective metallic surfaces on modern fire apparatus are likely to be either stainless steel or polished aluminum. For example, a former chromium plated fender crown is now stainless steel," notes Mr. Ketter.

Picking Up a New Fire Truck is a BIG DEAL!

How does a fire truck get from the factory to the fire department? If the department is in North America, it is driven home by the fire chief or his designates. The commercial says, "Getting there is half the fun."

"Firemen often will take vacation time to go to Appleton, Wisconsin, and drive a new fire truck home from Pierce Manufacturing," according to Tony Hofkens.

"Often the fire chief or assigned firefighters will come to the factory and test the fire apparatus thoroughly before they drive it away."

Pierce's First Chassis Named After the Prestigious Pierce Arrow

A 1936 Pierce Arrow auto parked in the lobby of Pierce Manufacturing reveals the connection between the former Buffalo, New York, prestige automobile manufacturer and Pierce.

In the late 1970s Pierce Manufacturing received the rights to the name Pierce Arrow, the name given to the first custom cab built by Pierce, explains Gerald Leath.

"The Pierce Arrow was known for its beauty, power and quality. And today the same image is true for our fire apparatus," he adds.

Captions

1. A PIERCE "SABER" PUMPER. Note the large cab to house firefighters en route to and from a fire. Most reflective metallic surfaces are either stainless steel or polished aluminum.

2. A FIRE TRUCK awaits entry to the 180-ft-long metal-finishing booth in Line 1. At left are the sanding bay, first color booth and radiant oven of Line 2.

3. INTERIOR of the metal finishing-booth, where operators prepare surfaces for painting.

4. INTERIOR OF THE PRETREATMENT BOOTH in Line 3. Floor pit facilitates access to truck undersides.

5. OPERATORS in the sanding bay at the entry of Line 2 smooth primed surfaces with a fine-grit paper.

6. PAINTERS in the first color booth of Line 2 apply a colorcoat to a primed truck.

7. OPERATORS in the sanding booth at the exit of Line 2 use a fine-grit paper to touch up the first colorcoat. Note the padded walls to dampen noise.

8. A FIRE TRUCK awaits entry to the second colorcoat booth. From left to right are the exit of Line 1, exit of Line 2, entry to Line 3, and entry to Line 4.

9. A TRUCK EXITS the radiant oven on Line 4. The tear in the plastic covering is for a driver to see ahead. Note the push-button overhead roll-up door, which is comprised of narrow horizontal metal slats that roll and unroll around a cylinder.

10. Operators in the final touchup booth thoroughly inspect all surfaces and apply touchup paint as may be required.

11. WASTE TREATMENT PIT (right), where all waterwash materials are treated. The trailer (left) holds an assembly that is being blown dry after exiting pretreatment booth (left rear) on Line 3. Booth at right of the pretreatment booth is the sanding booth at the exit of Line 2.

12. DAN KETTER, manufacturing engineer, alongside painted samples of colors applied to fire trucks. Note the numerous shades of "fire-engine red."

13. DAN KETTER alongside samples of yellows and yellow-greens that are applied to fire trucks.