



# PPE PLASTICS INDUSTRY FORUM

June, 2009

## Editor's Note:

The Auto Industry has taken more than its share of abuse both from within and outside their corporate bubble. Remember, the national story many, many years ago about the rattle one customer had inside their drivers door. After the dealer pulled the door panel, they discovered a worker at the car factory hid a Coke bottle in the door. Remember the oil and gas shortage in 1973 and 1974? The long gas lines and the rising gas prices. Several U.S. car makers rushed to try to quickly convert gas engines to diesel as a quick fix answer for better milage on cheaper fuel.

Another failure. Remember those that bought a Toyota in the seventies and into the eighties soon had a bucket of rust plus other poor quality problems within one or two years. This gave the U.S. auto makers the advantage as our U.S. made cars lasted a few years longer. That advantage was short lived when Edward Demming went to Japan and straightened out their quality problems well beyond automobiles. Another negative blow to the auto makers was with the Tax Reform Act of 1986. The Feds managed to screw both the auto makers, the dealers and the taxpayers in one

sweep. Joe taxpayer could no longer deduct the interest paid on the finance loan for a car, truck or other motor vehicle on his Federal Tax Return. Next the quiet rebellion in the 70's and 80's not to buy foreign imported cars not made in America. The foreign car makers quickly opened plants her in the U.S.A. so they could say "Made in America by American workers". You figure it out, but in the interim, buy an American made car or truck if you can and if you need one. That definitely helps all of the downstream companies that supply parts and goods to the auto industry.

## How Detroit's Automakers Went from Kings of the Road to Roadkill

by Joseph B. White, *The Wall Street Journal*



JOSEPH B. WHITE is a senior editor in the Washington, D.C., bureau of *The Wall Street Journal*. A graduate of Harvard University, he has worked for the Journal since 1987, and for most of that time he covered the auto industry, serving as Detroit bureau chief from 1998-2007. He writes a weekly column on the car business and the regulatory and social issues that surround it for the *Journal's* online and print editions, and contributes new-car reviews to SmartMoney magazine. Mr. White is co-author (with Paul Ingrassia) of *Comeback: The Fall and Rise of the American Automobile Industry*, and won the Pulitzer Prize for reporting in 1993.

The following is adapted from a speech delivered at Hillsdale College on January 26, 2009, at a seminar on the topic, "Cars and Trucks, Markets and Governments," co-sponsored by the Center for Constructive Alternatives and the Ludwig von Mises Lecture Series.

I'D LIKE to start by congratulating all of you. You are all now in the auto business, the Sport of Kings-or in our case, presidents and members of Congress. Without your support—and I assume that most of you are fortunate enough to pay taxes—General Motors and Chrysler would very likely be getting measured by the undertakers of the bankruptcy courts. But make no mistake. What has happened to GM is essentially bankruptcy by other means, and that is an extraordinary event in the political and economic history of our country.

GM is an institution that survived in its early years the kind of management turbulence we've come to associate with particularly chaotic Internet startups. But with Alfred P. Sloan in charge, GM settled down to become the very model of the modern corporation. It navigated through the Great Depression, and negotiated the transition from producing tanks and other military materiel during World War II to peacetime production of cars and trucks. It was global before global was cool, as its current chairman used to say. By the mid-1950s the company was the symbol of American industrial power—the largest industrial corporation in the world. It owned more than half the U.S. market. It set the trends in styling and technology, and even when it did not it was such a fast and effective follower that it could fairly easily hold its competitors in their places. And it held the distinction as the world's largest automaker until just a year or so ago.

How does a juggernaut like this become the basket case that we see before us today? I will

oversimplify matters and touch on five factors that contributed to the current crisis—a crisis that has been more than 30 years in the making.

First, Detroit underestimated the competition—in more ways than one.

Second, GM mismanaged its relationship with the United Auto Workers, and the UAW in its turn did nothing to encourage GM (or Ford or Chrysler) to defuse the demographic time bomb that has now blown up their collective future.

Third, GM, Ford, and Chrysler handled failure better than success. When they made money, they tended to squander it on ill-conceived diversification schemes. It was when they were in trouble that they often did their most innovative work—the first minivans at Chrysler, the first Ford Taurus, and more recently the Chevy Volt were ideas born out of crisis.

Fourth, GM (and Ford and Chrysler) relied too heavily on a few, gas-hungry truck and SUV lines for all their profits-plus the money they needed to cover losses on many of their car lines. They did this for a good reason: When gas was cheap, big gas-guzzling trucks were exactly what their customers wanted—until they were not.

Fifth, GM refused to accept that to survive it could not remain what it was in the 1950s and 1960s—with multiple brands and a dominant market share. Instead, it used short-term strategies such as zero percent financing to avoid reckoning with the consequences of globalization and its own mistakes.

## Competition from Overseas

In hindsight, it's apparent that the gas shocks of the 1970s hit Detroit at a time when they were particularly vulnerable. They were a decadent empire—Rome in the reign of Nero. The pinnacles of the Detroit art were crudely engineered muscle cars. The mainstream products were large, V8-powered, rear-wheel-drive sedans and station wagons. The Detroit marketing and engineering machinery didn't comprehend the appeal of cars like the Volkswagen Beetle or the Datsun 240Z. But it took the spike in gas prices—and the economic disruptions it caused—to really open the door for the Japanese automakers.

Remember, Toyota and Honda were relative pipsqueaks in those days. They did not have much more going for them in the American market prior to the first Arab oil embargo than Chinese automakers have today, or Korean automakers did 15 years ago. The oil shocks, however, convinced a huge and influential cohort of American consumers to give fuel-efficient Japanese cars a try. Equally important, the oil shocks persuaded some of the most aggressive of America's car dealers to try them.

The Detroit automakers believed the Japanese could be stopped by import quotas. They initially dismissed reports about the high quality of Japanese cars. They later assumed the Japanese could never replicate their low-cost manufacturing systems in America. Plus they believed initially that the low production cost of Japanese cars was the result of automation and



**PLASTIC PROCESS EQUIPMENT, INC.**

8303 CORPORATE PARK DRIVE, MACEDONIA (Cleveland), OHIO 44056, U.S.A.  
216-367-7000 • Toll Free: 800-321-0562 • Fax: 216-367-7022 • Order Fax: 800-223-8305

**PPE WEST** 3615 Walnut Avenue, Chino, California 91710, U.S.A.  
909-627-8511 • 800-258-8877 • Fax: 909-627-8101

**PPE SOUTH** 11218 Challenger Avenue, Odessa, Florida 33556, U.S.A.  
727-834-8888 • 800-282-6783 • Fax: 727-834-8873

www.ppe.com • e-mail: ppe@nls.net

Toll Free: USA, Canada & Mexico  
**800-362-0706**



unfair trading practices. (Undoubtedly, the cheap yen was a big help.) In any case, they figured that the Japanese would be stuck in a niche of small, economy cars and that the damage could be contained as customers grew out of their small car phase of life.

They were wrong on all counts.

There were Cassandras—plenty of them. At GM, an executive named Alex Mair gave detailed presentations on why Japanese cars were superior to GM's—lighter, more fuel efficient, and less costly to build. He set up a war room at GM's technical center with displays showing how Honda devised low-cost, high-quality engine parts, and how Japanese automakers designed factories that were roughly half the size of a GM plant but produced the same number of vehicles.

Mair would hold up a connecting rod—the piece of metal in an engine that connects the piston to the crankshaft. The one made by GM was bulky and crudely shaped with big tabs on the ends. Workers assembling the engines would grind down those tabs so that the weight of the piston and rod assembly would be balanced. By contrast, the connecting rod made by Honda was smaller, thinner, and almost like a piece of sculpture. It didn't have ugly tabs on the end, because it was designed to be properly balanced right out of the forge. Mair's point was simple: If you pay careful attention to designing an elegant, lightweight connecting rod, then the engine will be lighter and quieter, the car around the engine can be more efficient, the brakes will have less mass to stop, and the engine will feel more responsive because it has less weight to move.

Another person who warned GM early on about the nature of the Japanese challenge was Jim Harbour. In the early 1980s, he took it into his head to try to tell GM's executives just how much more efficient Japanese factories really were, measured by hours of labor per car produced. The productivity gap was startling—the Japanese plants were about twice as efficient. GM's president at the time responded by barring Jim Harbour from company property.

By the late 1980s, GM's chairman, Roger Smith, had figured out that his company had something to learn from the Japanese. He just didn't know what it was. He poured billions into new, heavily automated U.S. factories—including an effort to build an experimental “lights out” factory that had almost no hourly workers. He entered a joint venture with Toyota to reopen an old GM factory in California, called New United Motor Manufacturing, Inc., or NUMMI. The idea was that GM managers could go to NUMMI to see up close what the “secret” of Toyota's assembly system was. Smith also launched what he promoted as an entirely new car company, Saturn, which was meant to pioneer both a more cooperative relationship with UAW workers and a new way of selling cars.

None of these was a bad idea. But GM took too long to learn the lessons from these experiments—good or bad. The automation strategy fell on its face because the robots didn't work properly, and the cars they built struck many consumers as blandly styled and of poor quality. NUMMI did give GM managers valuable information about Toyota's manufacturing and management system, which a team of MIT researchers would later call “lean production.” But too many of the GM managers who gained knowledge from NUMMI were unable to make

an impact on GM's core North American business.

Why? I believe it was because the UAW and GM middle managers quite understandably focused on the fact that Toyota's production system required only about half the workers GM had at a typical factory at the time. That was an equation the union wouldn't accept. The UAW demanded that GM keep paying workers displaced by new technology or other shifts in production strategy, which led to the creation of what became known as the Jobs Bank. That program discouraged GM from closing factories and encouraged efforts to sustain high levels of production even when demand fell.

## GM and the UAW

This brings me to the relationship between Detroit management and the UAW.

It is likely that if no Japanese or European manufacturers had built plants in the U.S.—in other words, if imports were still really imports—the Detroit carmakers would not be in their current straits, although we as consumers would probably be paying more for cars and have fewer choices than we do. The fact is that the Detroit Three's post-World War II business strategies were doomed from the day in 1982 when the first Honda Accord rolled off a non-union assembly line in Ohio. After that it soon became clear that the Japanese automakers—and others—could build cars in the U.S. with relatively young, non-union labor forces that quickly learned how to thrive in the efficient production systems those companies operated.

Being new has enormous advantages in a capital-intensive, technology-intensive business like automaking. Honda, Toyota, Nissan, and later BMW, Mercedes, and Hyundai, had new factories, often subsidized by the host state, that were designed to use the latest manufacturing processes and technology. And they had new work forces. This was an advantage not because they paid them less per hour—generally non-union autoworkers receive about what UAW men and women earn in GM assembly plants—but because the new, non-union companies didn't have to bear additional costs for health care and pensions for hundreds of thousands of retirees.

Moreover, the new American manufacturers didn't have to compensate workers for the change from the old mass production methods to the new lean production approach. GM did—which is why GM created the Jobs Bank. The idea was that if UAW workers believed they wouldn't be fired if GM got more efficient, then they might embrace the new methods. Of course, we know how that turned out. The Jobs Bank became little more than a welfare system for people who had nothing more to contribute because GM's dropping market share had made their jobs superfluous.

Health care is a similar story. GM's leaders—and the UAW's—knew by the early 1990s that the combination of rising health care costs and the longevity of GM's retired workers threatened the company. But GM management backed away from a confrontation with the UAW over health care in 1993, and in every national contract cycle afterwards until 2005—when the company's nearness to collapse finally became clear to everyone.

In testimony before Congress this December, GM's CEO Rick Wagoner said that GM has spent

\$103 billion during the past 15 years funding its pension and retiree health-care obligations. That is nearly \$7 billion a year—more than GM's capital spending budget for new models this year. Why wasn't Rick Wagoner making this point in 1998, or 1999, or even 2003? Even now, GM doesn't seem willing to treat the situation like the emergency it is. Under the current contract, the UAW will pay for retiree health-care costs using a fund negotiated in last year's contract—but that won't start until 2010. GM is on the hook to contribute \$20 billion to that fund over the next several years—unless it can renegotiate that deal under federal supervision.

## Quality is Job One

Rick Wagoner told Congress: “Obviously, if we had the \$103 billion and could use it for other things, it would enable us to be even farther ahead on technology or newer equipment in our plants, or whatever.” Whatever, indeed.

This is a good place to talk about the Detroit mistake that matters most to most people: quality. By quality, I mean both the absence of defects and the appeal of the materials, design, and workmanship built into a car. I believe most people who buy a car also think of how durable and reliable a car is over time when they think of quality.

The failure of the Detroit automakers to keep pace with the new standards of reliability and defect-free assembly set by Toyota and Honda during the 1980s is well known, and still haunts them today. The really bad Detroit cars of the late 1970s and early to mid-1980s launched a cycle that has proven disastrous for all three companies. Poor design and bad reliability records led to customer dissatisfaction, which led to weaker demand for new Detroit cars as well as used ones. Customers were willing to buy Detroit cars—but only if they received a discount in advance for the mechanical problems they assumed they would have.

During the 1990s and the 2000s, a number of the surveys that industry executives accept as reliable guides to new vehicle quality began to show that the best of GM's and Ford's new models were almost as good—and in some cases better—in terms of being free of defects than comparable Toyotas, Hondas, or Nissans. But the Detroit brands still had a problem: They started \$2,000 or more behind the best Japanese brands in terms of per-car costs, mainly because of labor and legacy costs, with a big helping of inefficient management thrown in. To overcome that deficit, GM and Ford (and Chrysler) resorted to aggressive cost-cutting and low-bid purchasing strategies with their materials suppliers.

Unfortunately, customers could see the low-bid approach in the design and materials used for Detroit cars. So even though objective measures of defects and things gone wrong showed new Detroit cars getting better and better, customers still demanded deep discounts for both new and used Detroit models. This drove down the resale value of used Detroit cars, which in turn made it harder for the Detroit brands to charge enough for the new vehicles to overcome their cost gap. GM, Ford, and Chrysler compounded this problem by trying to generate the cash to cover their health care and pension bills by building more cars than the market demanded, and then “selling” them to rental car fleets. When those fleet cars bounced back to used car lots, where they competed with new vehicles that were essentially indistinguishable



except for the higher price tag, they helped drive down resale values even more.

So the billions spent on legacy costs are matched by billions more in revenue that the Detroit automakers never saw because of the way they mismanaged supply and demand. This is why the Detroit brands appear to be lagging behind not just in hybrids—and it remains to be seen how durable that market is—but also in terms of the refinement and technology offered in their conventional cars.

## What to Build?

The recent spectacle of the Diminished Three CEOs and the UAW president groveling before Congress has us focused now on how Detroit has mishandled adversity. A more important question is why they did so badly when times were good.

Consider GM. In 2000 Rick Wagoner, his senior executive team, and a flock of auto journalists jetted off to a villa in Italy for a seminar on how the GM of the 21st century was going to look. Wagoner and his team talked a lot about how GM was going to gain sales and profit from a “network” of alliances with automakers such as Subaru, Suzuki, Isuzu, and Fiat—automakers into which GM had invested capital. They talked about how they were going to use the Internet to turbocharge the company’s performance. And so on. But five years later, all of this was in tatters. Much of the capital GM invested in its alliance partners was lost when the company was forced to sell out at distressed prices. Fiat was the worst of all. GM had to pay Fiat \$2 billion to get out of the deal—never mind getting back the \$2 billion it had invested up front to buy 20 percent of Fiat Auto. GM said it saved \$1 billion a year thanks to the Fiat partnership. Obviously, whatever those gains were, they didn’t help GM become profitable.

At least GM didn’t use the cash it rolled up during the 1990s boom to buy junkyards, as Ford did. But GM did see an opportunity in the money to be made from selling mortgages, and plunged its GMAC financing operation aggressively into that market. Of course, GM didn’t see the crash in subprime mortgages coming, either, and now GMAC is effectively bankrupt.

GM’s many critics argue that what they should have done with the money they spent on UAW legacy costs and bad diversification schemes was to develop electric cars and hybrids, instead of continuing to base their U.S. business on the same large, V8 powered, rear-wheel-drive formula they used in the 60s—except that now these vehicles were sold as SUVs instead of muscle cars. And indeed, Detroit did depend too heavily on pickup trucks and SUVs for profits. But they did so for understandable reasons. These were the vehicles that consumers wanted to buy from them. Also, these were the vehicles that government policy encouraged them to build.

When gas was cheap, big gas-guzzling trucks were exactly what GM customers wanted. Consumers didn’t want Detroit’s imitation Toyota Camrys. Toyota was building more than enough real Camrys down in Kentucky. GM made profits of as much as \$8,000 per truck—and lost money on many of its cars. Federal fuel economy rules introduced in 1975 forced GM to shrink its cars so that they could average 27.5 miles per gallon. GM did this poorly. (Remember the Chevy Citation or the Cadillac Cimarron?) But federal laws allowed “light trucks” to meet a lower mileage standard. This kink in federal

law allowed GM, Ford, and Chrysler to design innovative products that Americans clamored to buy when gas was cheap: SUVs. When Ford launched the Explorer, and GM later launched the Tahoe and the upgraded Suburban, it was the Japanese companies that were envious. In fact, one reason why Toyota is on its way to a loss for 2008—its first annual loss in 70 years—is that it built too many factories in the U.S. in order to build more SUVs and pickups.

One irony of the current situation is that the only vehicles likely to generate the cash GM and the others need right now to rebuild are the same gas-guzzlers that Washington no longer wants them to build. Even *New York Times* columnist Thomas Friedman has now come to realize that you can’t ask Detroit to sell tiny, expensive hybrids when gasoline is under \$2 a gallon. We have two contradictory energy policies: The first demands cheap gas at all costs. The second demands that Detroit should substantially increase the average mileage of its cars to 35 or even 40 miles per gallon across the board. How the Obama administration will square this circle, I don’t know.

## Thinking Anew

So now, where are we? GM has become Government Motors. With the U.S. Treasury standing in for the DuPonts of old, GM is going to try to reinvent itself. One challenge among many for GM in this process will be coming to terms with the reality that the U.S. market is too fractured, and has too many volume manufacturers, for any one of them to expect to control the kind of market share and pricing power GM had in its heyday. Today, according to Wardsauto.com, there are ten foreign-owned automakers with U.S. factories that assembled 3.9 million cars, pickups, and SUVs in 2007, before auto demand began to collapse. That’s more than Ford’s and Chrysler’s U.S. production combined.

GM’s efforts to cling to its 1950s self—with the old Sloanian ladder brands of Chevy, Pontiac, Buick, and Cadillac, plus Saturn, Saab, Hummer, and GMC—have led its management into one dark wood of error after another. Since 2001, GM’s marketing strategy has come down to a single idea: zero percent financing. This was the automotive version of the addictive, easy credit that ultimately destroyed the housing market. Cut-rate loans, offered to decreasingly credit-worthy buyers, propped up sales and delayed the day of reckoning. But it didn’t delay it long enough. The house of cards began tumbling in 2005, and I would say it has now collapsed fully. Between 1995 and 2007, GM managed to earn a cumulative total of \$13.5 billion. That’s three-tenths of one percent of the total revenues during that period of more than \$4 trillion—and those are nominal dollars, not adjusted for inflation.

Between 1990 and 2007, GM lost a combined total of about \$33 billion. The six unprofitable years wiped out the gains from 12 profitable years, and then some. But old habits die hard. Within hours of clinching a \$6 billion government bailout last month, GMAC and GM were back to promoting zero-interest loans.

During the 1980s and 1990s, GM’s leaders refused—and I believe some still refuse—to accept the reality of the presence of so many new automakers in the U.S. market, more than at any time since the 1920s. This hard truth means the company’s U.S. market share going forward isn’t going to return to the 40 percent levels of the

mid-1980s, or the 30 percent levels of the 1990s, or even the mid-20 percent levels we have seen more recently. One thing to watch as GM tries to restructure now will be what assumptions the company makes about its share of the U.S. market going forward. If they call for anything higher than 15 percent, I would be suspicious.

Since all of you are now part owners of this enterprise, I would urge all of you to pay close attention, since what’s about to unfold has no clear precedent in our nation’s economic history. The closest parallels I can see are Renault in France, Volkswagen in Germany, and the various state-controlled Chinese automakers. But none of these companies is as large as GM, and none of these companies is exactly a model for what GM should want to become.

As I have tried to suggest, it’s hard enough for professional managers and technicians—who have a clear profit motive—to run an enterprise as complex as a global car company. What will be the fate of a quasi-nationalized enterprise whose “board of directors” will now include 535 members of Congress, plus various agencies of the Executive Branch? As a property owner in suburban Detroit, I can only hope for the best. ■

Copyright © 2009 Hillsdale College.

The opinions expressed in Imprimis are not necessarily the views of Hillsdale College. Permission to reprint in whole or in part is hereby granted, provided the following credit line is used: “Reprinted by permission from Imprimis, a publication of Hillsdale College.”



HILLSDALE COLLEGE

## GLOVES

Protect your employees. Protect yourself.

## VIBRATION DAMPENING GLOVES

USE WHEN: Sanding, Grinding, Polishing, etc.

### Full and Half-finger Gloves

These gloves are padded with a layer of vibration dampening polymer. Specially compounded, formed-chloroprene coated, seamless-lined gloves. Good for protection from repetitive impact and work with pneumatic vibrating tools. Ergonomic design offers both comfort and flexibility. Repetitive trauma associated with excessive vibration to the hands is a big problem in North America. Employees develop many symptoms associated with hand-arm vibration syndrome (HAVS). Hand-arm vibration is vibration transmitted into your hands and arms when you use hand-held powered work equipment. Too much exposure to hand-arm vibration can cause hand-arm vibration syndrome (HAVS) and carpal tunnel syndrome.

HAVS affects the nerves, blood vessels, muscles and joints of the hand, wrist and arm. It can become severely disabling if ignored.

### BENEFITS:

- Meets anti-vibration standards ISO10819.19196 and ANSI S3/525
- Black Nylon, 7 gauge shell for toughness.
- Machine washable
- Rot resistant
- Elastic wrist for snug fit.



7 Gauge Black Nylon Shell, Anti-Vibration Palm and Fingers

PART NUMBER	DESCRIPTION	PRICES
S10V1BL	LARGE - FULL FINGER	\$8.15
S10V1BXL	X-LARGE - FULL FINGER	8.15
S10V1BLHF	LARGE - HALF FINGER	9.95
S10V1BXLHF	X-LARGE - HALF FINGER	9.95

# The Case for Terrestrial Energy (follow up)

In follow up to the last PPE Forum regarding “The Case for Nuclear Energy” we are passing on the following additional information. We found more evidence of more safe uses of nuclear energy with its use by our nuclear Navy.

Nuclear navy, or nuclear powered navy consists of ships powered by relatively small onboard nuclear reactors known as naval reactors. The concept was revolutionary for naval warfare when first proposed, as it meant that these vessels did not need to stop for fuel like their conventional counterparts, being limited only by crew endurance and supplies.

The United States Navy has by far the most nuclear-powered aircraft carriers, with eleven in service. France's latest aircraft carrier, the FS Charles de Gaulle, is nuclear powered. The United Kingdom rejected nuclear power early in the development of its Queen Elizabeth-class aircraft carriers on cost grounds. As currently envisaged, France's new aircraft carrier would also be conventionally powered.

The United States Navy operates the largest fleet of nuclear submarines. Only the United States Navy, France's Marine Nationale, and the Royal Navy of the United Kingdom field an all-nuclear submarine force. By 1989, there were over 400 nuclear-powered submarines operational or being built. Some 250 of these submarines have now been scrapped and some on order cancelled, due to weapons reduction programs. Russia and the United States had over one hundred each, with the United Kingdom and France fewer than twenty each and China six. India is constructing a nuclear powered submarine called the Advanced Technology Vessel and is reported to be leasing two additional nuclear submarines from Russia. They can stay submerged for up to 400 days if the vessel is fully loaded.

The United States no longer has nuclear cruisers, but they are still in use by Russia, the largest of which are the Kirov-class battlecruisers. Russia also has eight nuclear icebreakers in service or under construction.

The U.S. Navy has accumulated over 5,400 "reactor years" of accident-free experience, and operates more than 80 nuclear-powered ships.

Admiral Hyman G. Rickover, (1900–1986), of the United States Navy, known as "father of the nuclear navy" was an electrical engineer by training, and was

the primary architect who implemented this daring concept, and believed that it was the natural next phase for the way military vessels could be propelled and powered. The challenge was to reduce the size of a nuclear reactor to fit onboard a ship or submarine, as well as to encase it sufficiently so that radiation hazards would not be a safety concern.

Soon after World War II, Rickover was assigned to the Bureau of Ships in September 1947 and received training in nuclear power at Oak Ridge, Tennessee. In February 1949 he received an assignment to the Division of Reactor Development, U.S. Atomic Energy Commission and then assumed control of the United States Navy's effort as Director of the Naval Reactors Branch in the Bureau of Ships. This dual role allowed him to lead the efforts to develop the world's first nuclear-powered submarine, USS Nautilus (SSN 571), which was launched in 1954. As Vice Admiral, from 1958, for three decades Rickover exercised tight control over the ships, technology, and personnel of the nuclear navy, even interviewing every prospective officer for new nuclear powered navy vessels.

Leading nuclear physicist Philip Abelson (1913–2004) turned his attention under the guidance of Ross Gunn to applying nuclear power to naval propulsion. Their early efforts at Naval Research Laboratory (NRL) provided an early glimpse at what was to become the nuclear Navy.

At the present time, many important vessels in the United States Navy are powered by United States naval reactors. All submarines and aircraft carriers are nuclear powered. Several cruisers were nuclear powered but these have all been retired.

United States naval reactors are given three-character designations consisting of a letter representing the ship type the reactor is designed for, a consecutive generation number, and a letter indicating the reactor's designer. The ship types are "A" for aircraft carrier, "C" for cruiser, "D" for destroyer, and "S" for submarine. The designers are "W" for Westinghouse, "G" for General Electric, "C" for Combustion Engineering, and "B" for Bechtel. Examples are S5W, D1G, A4W, and D2W.

Most information concerning United States naval reactors is not secret—see Naval Nuclear Propulsion Information.



**PLASTIC PROCESS EQUIPMENT, INC.**

8303 Corporate Park Drive, Macedonia, Ohio 44056, U.S.A.

PRESORT STD  
U.S. POSTAGE  
PAID  
CLEVELAND, OHIO  
PERMIT No. 1948



## CASTLE STYLE FREE FLOW CHECK RING VALVES



IDEAL FOR USE ON POLYETHYLENE - POLYPROPYLENE AND HIGH SPEED SCREWS PERFORMS BETTER THAN BALL CHECK SCREW TIPS



BOTH CASTLE AND STANDARD RINGS FIT THE SAME RETAINER AND SEAT ON OUR STOCKED FREE FLOW CHECK RING VALVES.

SEAT CASTLE STYLE RING

RETAINER (FREE FLOW)

- CASTLE STYLE IS IDEAL FOR USE WITH POLYETHYLENE AND POLYPROPYLENE MATERIALS PLUS OTHER GENERAL PURPOSE RESINS.
- OUR FREE FLOW DESIGN PROVIDES GENEROUS FLOW PATHS ELIMINATING SHEAR ON HEAT SENSITIVE AND GLASS FILLED RESINS.
- CASTLE STYLE IS AN IDEAL REPLACEMENT FOR BALL CHECKS TIPS PLUS YOU WILL REALIZE IMPROVED FLOW VOLUMES.
- FREE FLOW TIPS ARE AVAILABLE IN BOTH H-13 AND SUPER TOUGH CPM 9V STEELS.
- IDEAL FOR USE ON HIGH SPEED SCREWS, HIGHER BACK PRESSURES, PLUS YOU WILL REALIZE FASTER INJECTION CYCLES & RECOVERY RATES.
- CASTLE STYLE (LOCKING RING) ELIMINATES PREMATURE WEAR BETWEEN THE RING AND RETAINER FLUTES AS THE RING SPINS WITH THE RETAINER.
- A FREE FLOW DESIGN THAT INCORPORATES THE LOCKING RING (CASTLE STYLE) FOR FASTER SCREW RECOVERY.
- ALL THE ADVANTAGES OF A FREE FLOW DESIGN SCREW TIP WITH THE POSITIVE SHUT-OFF ACTION OF A BALL CHECK.