Trey: Good morning everyone, and thank you all for joining us. Today's webinar, High Performance Plastics for the Material Handling Industry, is brought to you by RTP Company. Your presenters today are Will Taber and Dr. Joel Bell. Will Taber is the Industrial Market Manager for RTP Company in Winona, Minnesota. He holds a Bachelor of Science in plastic engineering technology from Pittsburgh State University and an MBA with a focus on finance from the University of Kansas.

Joining Will is Dr. Joel Bell. Dr. Bell is the International Technology Manager for RTP Company, also based in Winona, Minnesota. He holds a Doctor of Philosophy in material science engineering from the University of Minnesota Twin Cities. My name is Trey McDonald with you all and I will be moderating today's event. Please send us your questions by typing them in the question box located on your screen. Our panelists will answer them at the end of the presentation. We are recording today's event and we'll send you a link by email when the slides and video have been posted to the UL Prospector Knowledge Center.

With that, I'd like to turn this presentation over to Will. Will?

Will: Thank you very much, Trey, for the introduction. I would like to welcome everybody, particularly those of you who are dialing in from Europe, I know it's getting late in the day there. We'll start with the agenda. We're gonna give you a little bit of an RTP Company profile, some background information for those of you who are not familiar with us.

Then we're gonna give some insight into the material handling industry, some of the opportunities and drivers that we see out there that's generating business for our customers. Then after that we're gonna talk about the products, our product families, the development process that we follow when we are recommending or developing a new material for an application.

And then we're gonna do a four-step process where I'm gonna talk about each of our key technologies within those families. I'm gonna talk about the benefits that these technologies provide to a material versus an unmodified base resin. And then very importantly we're gonna talk about the value that that brings to our customers, and we'll talk about some specific applications in a case study type format.

This is meant to be a comprehensive overview. I will be moving pretty quick. I won't be giving a lot of technical detail, but at the end what we'll do is we'll give you some links and some information related to data sheets, stress-strain curves, other engineering information that you might need and ways to find out more about our key product families. Then at the end Dr. Joel Bell will answer any technical questions that you might have.

With regard to profile, RTP Company, we are an independent privately owned compounder. This independence is very valuable to our customers, as we are open to any type of technology to solve your problems, both technical and economic. We have global manufacturing and engineering support. Our locations here in the US include, notably Winona, Minnesota, Fort Worth, Texas, South Boston in Virginia, Indianapolis. We also have plants in Germany, France, China, including Suzhou, Shenzhen, and also Singapore. We have worldwide sales to backup those global manufacturing sites.

We were established in 1982, so we've been at this for about 35 years. We have a lot of hard-earned institutional knowledge. We have over 1,500 employees, and last year we went over $500 million in sales.

For those of you who are familiar with us, what do we do? We utilize melt compounding techniques to incorporate reinforcing fibers, fillers, and additives into thermoplastic resins and thereby we create materials with value added mechanical, wear, thermal, electrical, and visual attributes.

These materials are used really in every major thermoplastic process, primarily injection molding and extrusion, but also blow-molding, rotational-molding, and structural foam as well. And you can see this picture on the left, this is a typical extrusion line that we have, we're pulling the strand, we're running it through that cooling tank and then we pelletize it and we ship that raw material to our customers. You can see up on the far left here, this is a typical tote that we would ship of material to send into an injection mold or an extruder.

We have a lot of institutional capabilities. We make over 6,000 products. We utilize over 60 different base resins and literally hundreds of different modifiers. And that really plays to my previous comment about our objectivity. We'll compound with anything from polypropylene to PEEK to address both your technical and

economic objectives.

We have a very strong R&D organization. We have over 35 scientists and engineers. These men and women are located in the field at our global locations to interact with your engineers and our customers on the local level. When a customer comes to us we can either recommend a product or we can develop a new product, and when we're done with that and many times during the course of that, our customers will work with our design services group.

These people can do mold filling analysis, warpage analysis, and stress analysis. That ensures that you're designing your part and your mold correctly. Many times this is done upfront. Unfortunately, sometimes it's done after the fact as well. We'll have customers come to us and say, "Hey, we're having a problem, can you do a mold filling analysis, help us with the weld line issue or a warpage issue," we do a lot of that. Many times it's a full-blown analysis, other times it's a 15-minute conversation on the phone with one of our experts. And it's a very valuable tool for us and our customers.

Once you come up with the material and you've got your design, your part and mold design, you're ready to launch a program, we've got technical service engineers, over 20 of them, at our global locations. They are at the press wherever you may be processing the material, they help you launch your new programs, they help you optimize your processes, also a very valuable tool that our customers enjoy. Really what this does is it helps you speed your product development cycle and minimize your risk as you introduce new programs.

Finally, once you're ready to go into production, our customer service, they are regionally located, it's a real time service. When you call in you get a real person, it's typically the same person, they know you, your order history. It's a very valuable resource and certainly something that's very helpful to our customers.

Let's talk about the material handling industry. By definition, material handling is the movement, protection, storage and control of materials and products throughout manufacturing, warehousing, distribution, consumption, and disposal. That's a pretty broad definition. It is a very big industry. It's expected to grow to $123 billion this year. It's very important to us. We've invested a lot of time and resources here and have a lot of valuable products to help our customers grow their business and meeting their customer objectives.

We are involved in a lot of different products, conveyors at large, whether that's belting, rollers, tracks, guides, we are involved in a lot of applications there, as well as casters and wheels, both the treads that you might over-mold and then the hubs themselves that might be of different molded plastics. We are involved in a number of types of bins, pallets and totes, anything from structural products to flame retardant or anti-static or static dissipative products. We are involved in a lot of dock equipment. Forklifts and pallet jacks are also typical applications.

There's a lot other trends that we see that's driving a lot of activity with our customers within the industry. Advanced equipment is certainly a big area. You see a lot of work in automated conveying systems, in automated guided vehicles, different types of electric vehicles and the associated components, storage, and tracking systems.

And really the drivers for this that we see come up over and over is people looking for reduced labor costs, energy efficiency, growing e-commerce, growing international trade, and then developing nations. As countries develop their manufacturing base, they need ways to deal with that more successfully, more efficiently, and more cost effectively as well. Those are some of the trends that we see.

Now we'd like to talk about our particular product families. They include structural, wear resistant products, conductors, thermoplastic elastomers, flame retardant, color, and then film and sheet. And of course we have a lot of cross pollination of these product groups. For instance, you may have a structural product, say a material that is nylon 6/6 that's glass reinforced and also conductive, or you may have a tool housing that's a glass reinforced nylon and also pre-color. We'll talk in depth a lot of these different technologies, product groups, and how we use them together to aid our customers.

A lot of the common issues and needs that we're addressing for our customers out in the industry, people are always looking for weight reduction and parts consolidation, that's always kind of lumped together as ways to take cost out, let's say a machine to metal part. We also see a lot of people who are looking to improve chemical or corrosion resistance of their products. Of course plastics themselves lend themselves

to being chemically resistant and corrosion resistant, so there's a lot of advantages there. We use different resin systems depending on the type of chemical or corrosion, corrosive environment it might be exposed to.

Extended life is also big. When you're running a conveying system 24 hours a day seven days a week, downtime, you're always looking to minimize that. That equates to better wear and friction many times, and that might be for belting systems or different types of guides. Sometimes it's as simple as noise reduction, expanded operating conditions. And when I say that, you might need higher impact pipe applications or a belting system that is bearing heavier loads or exposed to different types of greases and oils.

And then finally static management, we see a lot of people out there who are trying to be ATEX compliant. ATEX of course is a European directive that regulates the use of tools and equipment in explosive environments. That's a big area that people are trying to become compliant with. Sometimes it's as simple as not wanting to generate a static charge that will collect dirt or dust in a food processing type application. These are the common issues and needs that we see on a repeated basis.

When a customer comes to us and they wanna address one of these issues, we follow a four-step process and typically we'll start with product requirement. How is that part functioning, what is the operating environment? Is it having a lot of heavy weight, like frozen meat dropped on a belting system? Are you looking to support a seat in a forklift? What is the operating environment in terms of temperature? What types of regulatory constraints are you trying to meet? Is it ATEX, is it a UL flammability spec? And then economic constraints. And that really plays to our independence.

There's a lot of materials and a lot of answers that you can come up with to solve a technical problem but we're always looking to come up with the best technical answer balanced with the best economics as well. That's an important first step, is to look at that. Once we pinpoint that a little bit we talk more and we hone in on the base resin. We do this...there's two main questions that really narrow things down, thermal requirements and chemical resistance.

And that will many times guide you to an amorphous or a semi-crystal material or more of a lower temperature commodity material, or a material that can handle elevated temperatures. Other things that we consider are warpage, maybe dimensional stability due to moisture absorption, and then other secondary operations, if you're going to be doing some adhesive bonding or other fastening techniques.

Once we've gone through those first two steps we start looking at the reinforcement, fillers or modifiers that we might need to add. For instance, you may have a base resin that we need to boost the impact strength with an impact modifier or raise the tensile strength or stiffness and bending via glass reinforcement. Other times we're looking at adding wear and abrasion additives to reduce friction, improve wear resistance, conductive additives, and of course flame retardance. Sometimes we're looking at ways to make a plastic metal detectable or x-ray detectable.

Once we've put together the formulation, and many times with an industry like this that we've invested a lot of time in, we have a lot of ready answers because we've seen it. Other times we're developing something entirely new. And when we're done with that we look at the compounding method. Depending on the additives and reinforcement that we use will determine whether we process that on a typical single or twin screw type machine. Other times when you're incorporating additives that you really have a lot of surface area you have to wet out, you might look at other special methods like a Banbury mixer.

We have a lot of experience in developing processes that maximize performance and also keep in mind minimizing cost. And then finally the last that we look at is what form does our customer wanna see this? We produce materials ranging from 50-pound bags to bolt trucks depending on the application. This is generally the process that we step through on a case by case basis.

At this point of the presentation I'd like to ask a poll question. Trey will open up where you can pick and answer from your screen. And the question is, what is the biggest need for your material handling products? We like to look at weight reduction. Will cost reduction really be a weight reduction or parts consolidation, extended life, or reliability? Again, that equates to better wear and friction properties, expanded operating conditions. That might be higher strength or higher temperature, strength, and then also static management.

If you could select one of those, Dr. Bell here is gonna tabulate this for us and this will give us a little bit of direction as we go forward in the areas that might be more pertinent to you. It looks like we're getting some

answers here. It looks like out of the gate the most important concern is cost reduction and strength and durability. Also it looks like there's a fair number of responses that are concerned with extended life and reliability as well as expanded operating conditions and static management.

Cost reduction is always a driver. Many times we're combining that with other attributes. That fits with where we're going with this presentation. And we're gonna start with our structural products. We're gonna start talking on the technologies that we use in this product area. They include glass fiber, both short and long glass fiber, carbon fiber reinforcement, impact modifiers, and many times ceramic or mineral fillers.

And you can see down below here a typical long glass fiber reinforcement on the left, you see a carbon fiber, you see the light powder that's typical of many impact modifiers that we use in a number of different base resins. And then on the right this might be representative of a mineral filler like talc that we might be simply using for some dimensional stability in a semi-crystalline material. The benefits that these additives and reinforcements deliver over an unmodified base resin are typically higher strength and stiffness, better impact or elongation, higher heat distortion, maybe it will pass through the X-rays, and again sometimes simply dimensional stability.

The customer value, where do our customers use this to satisfy needs in the marketplace? Again, they're looking to take cost out maybe by replacing a machine to metal part. We do that by taking out weight. You can consolidate parts.

Sometimes you're getting into applications that might not be suitable for an un-reinforced material, so higher strength. Other times you may have a nylon material that works really great most of the time until you're in a very cold, very dry environment and then you get some brittleness issues and we address that with impact modification.

Many of the applications we see, and some of them are shown on the bottom, include a number of different types of pallets and trays for material handling, anything from mail to sensitive electronics, conveyor sprockets, linkages, and then vehicle components. We've had some successes there where we've replaced say a stamped metal base stand for a seat.

One of the technologies that I'd like to get into a little deeper here is our very long glass fiber reinforcement. You see on the left a typical short glass fiber pellet. The pellet itself is about three millimeters long typically and the mean fiber length is about one millimeter. These materials are produced, we take fiber bundles, we introduce them into the compounding process and then extrude it into pellet. We have a lot of products, including both nylon, propylene, BPA, PPS, we sell tens of millions of pounds of this type of product.

In contrast to that, we have long glass fiber technology, and you see that type of pellet on the right. This type of pellet is produced in a little different fashion. It's more of a pultrusion process where we're taking a fiber glass robing, pulling it through a dye, we're wetting it out and then we're creating a strand that we pelletize, typically 12 millimeters long or half an inch long.

And you can see that in this technology the fiber, the glass fiber, runs the entire length of the pellet and it's much, it has a much longer mean fiber length. You get a lot more continuous matrix engagement, a better transfer of stress through the reinforcing fiber. And what this equates to is a very strong material. It's very stiff, it also has very high functional toughness and is very creep resistant over time.

We incorporate this technology in a number of different resin systems including polypropylene, nylon, really all the way up to high temperature materials like PEEK. It has a very long track record of metal replacement. And you can see a typical metal part here on the left, in the middle is a 50% long glass fiber reinforced PTA material, and then on the far right is that same part where we've taken that, we've driven off all the resin, or burn off all the resin, and we're just left with the long glass fiber.

A couple of things worth noting here is you see that the long fibers fill out all the intricate detail, including the teeth, and also they're forming an interpenetrating skeletal network which reinforces and gives these positive properties including resistance to crack propagation and therefore you get better functional toughness.

Another way to look at that, you've got this little graphic on the left, and we're showing you with short fiber reinforcement you can make something much stiffer and stronger, but you really don't do much to increase toughness, per se. With impact modification you can increase elongation and toughness but really you're

competing with your stiffness. Long fiber technology really bridges the gap in a different approach between these two lined up with something that's both stiff and strong and yet impact resistant.

To show a little bit of data here we've got some numbers that compare 40% glass fiber reinforced polypropylene with short glass fiber reinforcement and long glass fiber reinforcement. You can see with regard to tensile strength and then flexure modulus or stiffness in bending, you're getting about a 35% bump, but when you look at the notched Izod impact strength, you're increasing that by more than two and a half times. You also see slightly higher HDT and you have much better creep property. This is a very important technology for us that's very valuable in replacing metal.

So a good application case study, you can see this sprocket. In this case the customer came to us and said, "We wanna replace a metal sprocket, we need something that is very stiff and strong but also exceptionally impact resistant and abrasion resistant." In this case, we chose rigid thermoplastic urethane as the base resin. We incorporated long glass fiber technology and ended up with something that is exceptionally stiff and strong with that good impact and abrasion resistance. A good example of where we apply this technology.

Other formulations that we look at with sprockets might be long fiber propylene. It is lower cost but it's not as tough or as abrasion resistant as the TPU. We also use, say nylon 6/12 which is exceptionally stiff and strong and has lower moisture absorption versus say a nylon 6/6. There are slightly different drivers for each of these choices in base resin.

Moving on to our wear products, we use a lot of different additives here including perfluoropolyether, polytetrafluoroethylene, graphite, silicone, and then ultrahigh molecular weight polyethylene that we actually use as an alloying component. We also use different carbon fiber and glass fiber many times. Those are used for higher load bearing capabilities, maybe for a trolley wheel. We also use aramid fiber which really doesn't reinforce but gives better abrasion resistance.

You can see down below here the different forms, silicone in the perfluoropolyether is typically a liquid. You've got your polytetrafluoroethylene which is the white powder, your graphite, and then your aramid fiber. We incorporate these differently and they require different process expertise. That's something that we've developed over the years.

The benefits that these provide over an unmodified material is primarily improved wear and abrasion resistance as well as decreased friction, whether that's static or dynamic coefficient of friction. It also increases the pressure-velocity limits the material can withstand. And then sometimes we're just looking to reduce noise.

The value to our customers, increased life and reliability, that's the big driver. Sometimes it's to eliminate secondary lubricants and/or increasing operating speeds that you can see in a conveying type application. Applications you can see below include different linkages, rollers, bushings, thrust washers, rings of all sorts and different guides where you're looking to improve or reduce downtime by improving your wear resistance.

A key technology that we employ here, or two key technologies, include polytetrafluoroethylene and silicone. And what I'm showing here in this graph is wear factor. We calculated wear factor per ASTM D3702. You can see the testing apparatus over here on the right. Really what this consists of is you've got your molded test specimen and you're running that against a mating thrust washer, so you apply a load, you're rotating that at a given speed and you're measuring the volume of the material that is removed per unit time and then we use this as a measuring stick to compare wear resistance between two different materials.

This data that we're showing here was generated rotating against steel. We could also replace that thrust washer with different types of metals and also different types of plastics. We've got some very good...some wear data that we've generated over 30 years of just hundreds of different wear pairs that are very valuable for comparison when you're designing a part.

In this case we're comparing nylon 6/6 on the left to acetyl on the right. These two materials by themselves are known to have good wear properties. But you can see when we add silicone we get a very vast reduction in that wear factor, so you're reducing the amount of material that's being removed or worn away. And then when you look at adding Teflon, specifically looking at acetyl there, you take something that's got very good wear properties and you're cutting that by more than half. This type of technology is a workhorse

technology. Sometimes we combine these two technologies as well and we employ them in a wide number of different base reference.

Another key technology I wanna talk about today is ourultrahigh molecular weight polyethylene alloys. And as many of you know out there, ultrahigh molecular weight polyethylene is ubiquitous in the industry, it's used a lot but the thing is it's not mill process-able. People will buy stock shapes, it might be plates, bar stock, rod stock and then they machine parts out of that.

Our customers have come to us over the years and said, "We love the properties, the abrasion and wear resistance of UHMW but our volumes have increased to the point where we really need to be able to injection mold a part." What we did is, our wear group, our wear engineers spent a lot of time developing alloys that utilize ultrahigh molecular weight polyethylene as one of the components and they combine that with other base resins that are injection moldable.

We've had a lot of success here and we've developed materials that have comparable wear and friction to UHMW polyethylene that is not moldable that is just available in stock shape. We've got moldable alternates to that, which equates to less scrap, tighter tolerances, and at the end of the day, reduced manufacturing time and lower overall cost. We've got extrusion grades available as well and we can utilize FDA compliant ingredients.

This is a product area that we're very excited about. There's really endless number of applications, including curves for conveyor systems, different tracks, wear strips, corners, guides, all types of different food processing tools as well.

Not to belabor this a lot but we do have some data here where we're showing ultrahigh molecular weight polyethylene just in the standard form, which is just process-able, as I mentioned, via ram extrusion. It's at the top. We're comparing that to three different UHMW alloys that we've come up with, and you can see that overall under most test conditions, again, we've altered the pressure velocity, the speed that we're rotating the material against the mating surface at and changing the load, but you can see that under most test conditions we have as good as or better wear factor with our UHMW alloys and we also had either equivalent or better or lower dynamic coefficient abrasion. We've got some exciting opportunity here for our customers. We're seeing more and more activity in replacing machined UHMW.

A good application case study here is these rollers. A customer came to us, they wanted to improve the wear and reduce the friction of a standard acetal while maintaining good abrasion and toughness. In this case we incorporated both Teflon or polytetrafluoroethylene and silicone into the material to get something that is very wear resistant and sleek. Other variations that we make of this is where we'll take and we'll add antimicrobials, we'll also use FDA compliant ingredients and then of course we combine these two wear additives and a whole host of other base resins as well.

Moving on to flame retardant products, we employ both halogenated and non-halogenated flame retardant technology. Many times our FR products incorporate some sort of supporting technology, a lot of times that's glass fiber reinforcement. We sell a lot of glass fiber reinforced polypropylene that also meets the ULB0 flammability spec. That's an industry standard and a workhorse that we make a lot of.

The benefits, really you're just looking to increase the resistance to ignition of a base resin. You're looking to a control burn rate, or limit the amount of heat and smoke that are generated during combustion. What's that equate to as far as value for your customers? It's really all about increased product safety. And that's the driver there.

Also to sell a product in certain markets you've got to be regulatory complaint as well, for instance UL flammability specs. You may also have to meet a RoHS requirement, REACH or other requirements like Factory Mutual. Some of the applications you see down below include a number of different electrical boxes, conveyor components, control housings of all sorts, and sometimes different sorts of totes or pallets.

One thing to point out here, there are a lot of inherently flame resistant materials. You can see on the left-hand side here in the blue box, these include polyphenylene sulphide or PPS, PEEK, olefin or polyetherimide, other fluoropolymers. These are great materials with high temperature properties, they're inherently flame retardant. The tradeoff is they're extremely expensive. You don't always need these high temperature capabilities, so then you can look at things that are less costly, say for the polyolefin families,

that might be polyethylene or polypropylene, nylons, polycarbonates. Then we've developed flame retardant technology to add to this to give the flame resistance that you need in a given application at a much lower cost. You're adding value versus going to a very expensive base resin.

If you're looking for a flame retardant material, we've probably got one existing on our website that will meet your needs. I know this shows 500 yellow cards I think that number really is exceeding 650 by now in all sorts of different base resins including propylene, nylons, polyesters, polycarbonates and a number of different alloys. We have a number of materials that are RoHS and REACH compliant that are drop in replacements for non-RoHS products.

And we see a lot of requests in the product, or in the market, where our customers are coming to us and saying, "We wanna go beyond RoHS, we wanna be completely be non-halogen or halogen free," we have a number of different products there. We are evaluating new commercial chemistries all the time and have certainly come a long way in terms of developing products that are completely non-halogenated with similar mechanical properties and costs.

We've also done some work with some green FR compounds using bio-based resins, recycled content, and then evolving green FR technologies.

A really good case study here is this controller housing. A customer came to us and said, "We need a controller housing that is gonna be UL flammability B0, it needs to be very durable, it needs to be grease resistant." And so in this case you might think about polycarbonate would be great for a housing but then when you start thinking about employees grabbing a hold of this thing with greasy or oily gloves it moves you away from an amorphous base resin. Really lends itself to something that's semi-crystalline like polypropylene which also happens to be lower cost.

In this case in order to maintain some good impact strength we used a co-polymer polypropylene, we compound in flame retardants, some other mineral for some dimensional stability for that housing. You get something that meets all those requirements at a very good cost point as well. That's a really good example where you're taking some inherent good properties of something that's more of a commodity like polypropylene and adding value to it.

Conductive products, the technologies, some of the main technologies that we utilize here include carbon black, carbon fiber, all polymeric or inherently dissipative polymers, carbon nanotube technology, and stainless steel fiber. And really what you're trying to do is you're trying to impart on a plastic, which plastics are typically inherently insulative, you're trying to impart different levels of conductivity.

That might be a lower level or anti-static properties where you're really just trying to prevent an accumulation of a static charge. Other times you might need a more rapid charge dissipation, say in milliseconds. And then other times you might need a direct, a ground, something that's completely conductive that's gonna dissipate a charge instantaneously. Other times you're looking for a compound that will be moldable but also provide protection against EMI or RFI radiation.

One other thing I might mention that we...we kind of looked into this group as metal detectability. More and more we have customers coming to us and say, "We molded a plastic bin or something like that but we need to somehow make this metal detectable." In this case we make master batches typically using stainless steel powders that they let down into those materials. That's a growing area.

The value for you is just that static management. Again, you might be looking to make it ATEX compliant because you've got an instrument that's operating in an explosive environment. Sometimes it's more simple than that, you're just trying to prevent collecting dirt and dust in a food processing application or you're looking to replace metal in a housing. Typical applications include conveyor rollers, links, bushings, a number of different types of hoses, and instrument housings.

The key technology that we employ here is carbon black. There are many different types of carbon black. We are using roughly 10 different types of carbon black, very small particle size, a lot of surface area. The key to success in using these is proper dispersion. Carbon black is capable of covering a wide range of conductivity, relatively low cost. Like many conductive additives it's tough to dial it into that 1 times 10 to the 4th to 1 times 10 to the 6th ohm range because of a sharp percolation threshold or curve.

And you can see on the left here where we're showing a percolation curve for many of these additive technologies. And what we're doing is we are showing volume resistivity on the y-axis as a function of additive loading percentage on the x-axis. You can see you start off with very high volume resistivity, it's insulative. As you incorporate these conductive technologies into the matrix, then you derive different levels of conductivity.

What you're doing is you're setting up a conductive matrix or network so that you can transfer a charge from a conductive particle to particle or from a conductive fiber to a neighboring fiber. As you increase the loading and as you have good dispersion throughout the matrix, you reduce the resistivity and increase conductivity.

One thing I might point out here is carbon black, you can see that you get very much into the conductive range. Carbon fiber is you can get a higher level of conductivity at a lower loading percentage. It also has the advantage of being a reinforcement but it's much more expensive. A good example here where we combine technologies, we had a customer that was using a carbon fiber nylon 6/6 for a conductive impeller. It works really great, but as their volumes increased, their market share increased, they were looking for ways to take out costs.

We wanted to look at carbon black but it really didn't have the strength requirements they needed. In this case we combined that conductive carbon black technology with short glass fiber reinforcement. We came up with a compound that was not quite as strong as the carbon fiber but it met our needs at a much lower cost. It's a good example of combining those different product technologies to arrive at a solution.

A good example here and something you see a lot of out there is conductive totes. Many times they're using these to carry sensitive electronic components during the manufacturing process. We use a lot of polypropylene here. Many times it's co-polymer to give it good impact strength, high flow. It is also many times a key requirement. We are successfully getting less than 1 times 10 to the 6th ohms per square surface resistivity on these products. And it's certainly an important technology and product group for us.

Other formulations that are similar include what we call our PermaStat technology and this is the inherently dissipative polymer that we incorporate. You can't get to the same level of conductivity as you can with carbon black but it has the huge advantage of being colorable. If you just need a certain level of dissipation or an anti-static type product, these are a good fit there and can provide colorability.

Moving to the elastomer products, we really use any commercially available elastomer base resin available out there, including styrinic elastomers, thermoplastic vulcanizates, co-polyesters, urethanes, and we also do a lot of work in bondable technology for these systems. The benefits are really just being able to drive a broad price and property spectrum, different bonding options, and a wide range of hardness. Even amongst our bondable technology we have a number of different price performance balances that gives you a lot of the design flexibility.

The value, our customers are using these materials over-mold on a rigid substrate for ergonomic designs. Sometimes they're looking just to over-mold a housing to provide some protection in a rugged environment. Other times it's as simple as just providing a gripping surface or increased tackiness. Applications include different bumpers, linkage over-molds. An example is detectable belting. Different hose and mandrels all use different [inaudible 00:40:08] based elastomer systems.

One of the key technologies to touch on here a little bit out of that is our over-molding or bondable elastomer as I mentioned. And it's fairly simple to get an elastomer that will bond a polypropylene. A styrinic system will, a thermoplastic vulcanizate will, but then when you start looking at other higher performing or engineering grade substrates like nylon, polycarbonate, PBT, ABS, and then alloys of those, it becomes much more difficult to really get a good bond or good chain entanglement that provides a good adhesion to the base resin.

We've spent a lot of years developing good bondable technologies, again, in a wide array of hardnesses and price performance balances. These materials are designed to process via inserts, multi-shot or co-extrusion processes, and also we combine this many times with custom colors and other technologies.

A good example in the elastomer arena would be this electrostatic dissipative hose. In this case, for the base resin we used thermoplastic urethane, we incorporate carbon black. We can consistently get a very good volume...low volume resistivity of less than 1 times 10 to the 4th ohms per centimeter. At the same

time that urethane base resin gives you very good abrasion resistance and flexibility even at low temperatures.

Other base resins that we incorporate and use for hose type applications are PVC, which is much lower cost but also has much lower abrasion resistance. We also do a lot of work with EVA, and again, we're kind of balancing that abrasion resistance and economics. We're getting towards the end here.

I'd like to touch on our color products. The technologies that we supply to our customers here include Masterbatch, PreColor, sometimes we use Q blends for our customers. We blend a master batch into a base resin and ship to them.

We also incorporate functional additives. We color anything from polypropylene to polyetheretherketone. It's fairly simple to color polypropylene. When you get to the higher temperature base resins like PEEK and polysulfone it gets to be much more difficult. We have a lot of experience and the expertise in that area.

The reason for supplying both Masterbatch, PreColor and Q blend is really to help our customers balance ease of use, cost, and quality. And many times a customer will come to us and say, "We want to take cost out of this [inaudible 00:42:51] color now, can you develop the Masterbatch for us," so economics will drive that.

Other times a customer may come to us and say, "We are using Masterbatch but because of the critical nature of this match or maybe because our part is a very small volume relative to our shop size, we're not getting good mixing, we really just wanna go with a PreColor here to eliminate a lot of those manufacturing issues of incomplete mixing for instance." Whatever works for your application, we can put together. The tagline that we have for our color group really is, "Your color. Your way," and that goes not only for the form that we supply but really for the base resin that you're coloring as well.

The value of this, and really I like to say that color kind of transcends everything, so it helps in branding your products. It shows that you're different. It equates your value to the market. Sometimes it's simply product differentiation. We'll have engineers come to us and say, "You know, we've worked on this new design for years, it is different, it has all these different features, we want it to look different not only from our competition but from our other customers as well."

And then finally sometimes it's just parts identifications. Applications that you can see below, a lot of different totes, bins, linkages. And then also components used on different housings and equipment.

A good example here where we tie everything together with color is this linkage for a conveyor. In this case the customer said, "We've got an acetal linkage but we want it to be X-ray detectable," so we compound in a ceramic filler which of course makes it very brittle. Then we have to impact modify it to get that balance of impact strength and X-ray detectability. When we get that done, they come to us and they say, "Gosh, this is great. Now we want it our corporate color," so then to tie it all together we gave it a nice blue color for them and certainly a very interesting product.

To finish things up here, an exciting development for RTP Company is the introduction of our unmodified resins distribution arm which we call ResMart. ResMart is headquartered in Fort Worth, Texas. We have six warehouse locations across the U.S. and Mexico. It has the huge advantage of being able to leverage the existing RTP Company assets including our application developments, our tech service engineers, our design capabilities, all which is very valuable. It allows you to leverage those assets.

Many times we're combining the unmodified resins with our color technology such as Masterbatch or Q blends. You can see on the left here some of the resins that we supply, including ABS, polypropylene, polyethylene, but also higher end materials, engineering grade materials like polycarbonate, PBT, nylons. And then really exciting for us, we recently entered into a licensing agreement with Solvea to distribute their polysulfone, polyphenolsulfone and, PEEK. That's certainly an exciting development for us because it allows us to cover all your needs from very simple, very basic commodity base resins to more complicated higher temperature unmodified base resins and then of course value added custom compounds.

I know I've moved pretty quickly here. We've covered a lot of information. We will be posting on our website shortly here at www.rtpcompany.com this material handling brochure that gives a lot of different case studies and all the different product group areas that shows you existing formulations that we're selling into the

marketplace to address different issues related to conductivity, flammability and wear. It's a good compilation and an overview of how we work. This is very valuable. You can also request an email copy at the end of the webinar.

Also, because of time constraints we didn't go too deep into all the different product areas. You can certainly contact Joel and I to ask questions or we can guide you to your local sales engineer and R&D contacts. We also have in depth recorded webinars on our website that include the key technologies such as long fiber replacement, wear and friction, ESD control, and then our flame retardant products. That is also another great resource. We also have a lot of, literally thousands of different data sheets on our materials and other engineering information such as stress-strain curves.

With that said, I would like to thank everybody for the time. We've just gone a couple of minutes over. Dr. Joel Bell's information and mine, we've got up here on the screen. You can email us or call us at any time. We've got a little bit of time left, at this time I'm gonna turn things over to Dr. Bell. It looks like we've got a number of different questions that have come up during the presentation and he is going to address them at this time.

Dr. Bell: Thank you, Will. Good afternoon to some of you in Europe, good morning to many others here in North America. As I'm going through a few of the questions that have come in already, please feel free to type in additional questions into your question box and we'll try to field as many of them as we have time here today. And if we do not get to your question we will reply via email on those. Hopefully you guys come back with some good questions as they come in.

Starting with a few of them that we have had come in, does RTP use different wear additives for high temperature materials versus low temperature materials? That's a good question. For the most part all of our wear additives are applicable to all the resin systems. Some lend themselves better to others than other materials. There are some limitations, for instance with silicone there would be a temperature limitation on what resin systems we would put those into. But for the most part your workhorses, things like PTFE are applicable across the material spectrum.

Next question that came in as we were looking at the flame retardants, we had a question of can you have flame retardant materials that are V0 with food compliant additives. And the answer there is for materials where we have to add a flame retardant additive, be it halogen or non-halogenated, to give it flame retardant properties there are no FDA compliant ingredients that we have available to us that would allow you to have an FDA material.

What we would do in those types of applications is that's where the objectivity becomes really nice, we would look at something that is already inherently flame retardant sulfone material, perhaps PI or even depending on the applications it could be something like PEEK. We would have to move to those in order to meet the FDA requirement and still maintain flame retardancy.

Next question we have here is if we are to do some mold filling and warpage analysis, what type of file does RTP need? Our CAE folks are pretty good at working with any 3D solid model that you might have. It could be from SOLIDWORKS, an Aegis file, so really any type of file that you can get in that's a 3D drawing, our folks can then import that into the mold flow software and be able to do some analysis for you, and we're happy to work on those.

Next question that came in, what is the most common flame retardant used to make a glass filled nylon material? It depends on whether you want halogenated or non-halogenated. Of course the workhorse, halogenated material would be a brominated type flame retardant. There are also non-halogen additives available. Either one of those can be used to make a glass fiber reinforced nylon type material.

I had a question come in on modifying nylon for low temperature impact and maintaining insulating properties. The low temperature impact, we could do that in one of two ways, one would be looking at just impact modifications, so using a rubber based additive to impart the low temperature impact performance. Another route would be looking at our long fiber technology which takes the impact properties you're able to impart at room temperature and because that glass fiber network dictates the impact performance, as we go down in temperature whether it be -40, -60 you really maintain the same impact performance. That's a nice technology for that type of application.

I had an interesting question come in here about the concern for carbon black as a carcinogen and whether or not we have alternatives to that. Really the thing that makes materials possible carcinogens are usually linked to the particle size of the materials. Carbon black is not one of the materials that is listed as a carcinogen or anything to be worried about. Any material that possibly would be of a particle size that would be of need to control really would be on our end in the processing and compounding of the material.

As you move to a fully compounded product, those products are now incorporated into the polymer matrix. They're not going to be free to come out of the material and enter the air which would then enter your streams. That's really not an issue for carbon black material. From a cleanliness standpoint some people prefer to go colored route and that's why we have our PermaStat type technology that can have colorability and still have anti-static performance.

Another question we have here is, is RTP currently investigating any new base resin technologies? We talked about the fact that we work with everything from polyethylene to PEEK, and as resin manufacturers come out with varying chemistries, new chemistry is available. We are often one of the first people that get that type of information and we do work on anything new that comes to the market. A lot of the technology and the types of...or at least the base chemistries of the materials that are on the market today have been around for 20 years. It's not that often that a brand new chemistry is introduced into the market.

One new technology that's actually an old technology and being re-introduced, that would be a polyketone. That's an offset material similar in properties to acetyl. It has very good wear and [inaudible 00:54:32] properties, good chemical resistance and is used heavily in wear modified applications. That is a newer base resin that has been re-introduced to the market after it went away from the previous supplier, and that is available from RTP.

Next question here, can RTP make colorable static dissipative materials for totes and bins? As Will showed, we have our inherently dissipative polymers which is our PermaStat technology. That's fully colorable as well as we have some transparent materials and ABS, amorphous nylon polypropylene that would allow you to have clear materials as well. That's one opportunity to do colored totes. Another technology is if the strength is of interest, carbon fiber has some minimal colorability associated with it and it brings apart the ESD properties as well as the stainless steel. Stainless steel is something that can be imparted into the material and still have some colorability associated with it.

Let's see, do we have some other questions? Let's try to pick one more. Do you have thermally conductive nylon products and if so, what conductivity value? Thermal conductivity is not something that Will touched on in the presentation, but this is a specialty technology that we do have available to us, and it lends itself very well to semi-crystalline materials like nylon or PPS. We actually have a range of materials that already have UL V0 listing.

For thermal conductivity, depending on whether it's an electrically conductive additive material, we can go up to in plane thermal conductivity values of 20 watts per meter kelvin. In materials where it's an insulative additive, so you would still have some colorability, there we can do in plane values approaching 10 watts per meter kelvin. Of course there's varying ranges of the thermal conductivity and that dictates the price and performance criteria for those materials.

It looks like we have time for one additional question, so I'm gonna try to scroll down here and choose one. And as I said, any other questions that we do not field, we'll be sure to follow up with folks. Do you have a polypropylene glass fiber reinforced material with flame retardant properties that has good UV stability?

We have a variety of materials that have been developed in polypropylene for things like the HVAC markets where they sit outside and we've imparted very good UV stability into those materials as well as taking care of the fiber reinforcement which brings the structural integrity and then imparting the flame retardant properties. And of course polypropylene is an amazing material because it's a good overall cost performance type material. That is definitely a technology and an application that we would love to talk to you about. With that, I'm gonna turn it back over to Trey. I thank you for all of the great questions and your attention for the presentation today.

Trey: Perfect, Joel. Thank you for that. And a big thank you to Will as well and everybody at RTP Company for a really great and informative presentation. We did want to encourage everybody we do also have some really great webinars on the Prospector Knowledge Center from RTP Company. You can actually sort and

view those by company, we've got a ton of them, really great information.

We will be sending...a couple of questions that have come in about slide availability, where can we see a copy of the presentation, we will be sending that out so do check your email for that in the coming days. We will be sending that to your emails so you guys can share that with others at your company or review that again at your leisure. Again, a big thank you to everybody for attending and have a good rest of the day.