NASA ORAL HISTORY PROJECT
EDITED ORAL HISTORY TRANSCRIPT

JEAN WRIGHT
INTERVIEWED BY JENNIFER ROSS-NAZZAL
HOUSTON, TEXAS – MAY 14, 2024

ROSS-NAZZAL: Today is May 14th, 2024. This interview with Jean Wright is being conducted for the NASA Oral History Project in Houston, Texas, on Microsoft Teams. Jean is joining us from her home in Titusville, Florida. Thank you again for joining me this morning, I really appreciate it.

WRIGHT: Thank you.

ROSS-NAZZAL: I wondered if you could give me a brief overview of your life and experiences before you came to work at NASA.

WRIGHT: I was a mom of three children, and I'd been sewing since I was seven years old. When I was a stay-at-home mom, I would do either alterations or I would make clothes for my next-door neighbors to earn a little side cash. Eventually I worked at a ladies' dress store, and I would do alterations for them. I managed a candy store for five years, which is why my email address is candylady. I make candy and bake cookies too. That's what I did. I did mom stuff before I started working.

I was late when I started working for NASA. It was something I always wanted to do, literally since we walked on the Moon. I was almost 14 then, in '69. That night, I went outside and looked at the Moon and was amazed that there were men walking on there. Somehow in my

heart I said, "You know what, that's such a neat thing, and I don't know how, I don't know why, I don't know how it's ever going to happen." But I just knew that I had to work for NASA. I don't know why.

I had an alright childhood I'd say. My parents didn't get along. It was kind of like escapism, something that literally was out of this world. It just took you away from stuff they had going on at the house. It was a little rough growing up.

ROSS-NAZZAL: I'm sorry to hear that.

WRIGHT: It's fine. It just gave me something to look forward to, something to get out of the tension at the house. It was just nice to have something that was out of this world to take you away from things that were going on at home.

As I tell everybody, I was 49 when I started out there. I know you asked in the list of questions about how I found out about that job. I knew NASA had seamstresses. The obvious connection was the space suits. Whenever you would see cutaway pictures of NASA you would see oh, that's fabric. Like on Hubble. You could see the films. You could see fabric. Obviously I knew there was some sewing. I didn't know to what extent the Shuttle featured fabric at the time until we had a Return to Flight series in our local newspaper, *Florida Today*. Chris Kridler was the writer of those articles. She was our space reporter at the time. She has since retired.

She was highlighting various I guess you could say departments of the Space Shuttle, and she happened to be focusing on thermal protection that day, which is the system I worked. There was a photograph of a woman named Pilar Ryan in the article. She was sewing a blanket, and I

remember being giddy looking at the picture and saying, "I knew it! I knew there was sewing on the Shuttle. I knew." But I didn't know what extent.

She was working on I want to say a thermal barrier. She was using a regular needle and thread, which excited me, because I'm a quilter like Karen [L.] Nyberg is. Karen Nyberg is a quilter too. She's the astronaut that hand sewed a quilt block in space. I follow Karen too.

I saw the picture, and I immediately waned to send an email. I looked her up and sent an email to Pilar. I said, "I know you don't know me from Adam, and please don't think I'm crazy. I just want to know what the qualifications are for the job." She was nice enough to send the requirements back and tell me what was needed.

Sewing of course was obvious. She said at first you maybe needed an associate's degree, but that was not exactly necessary. Basic blueprint reading was a mandatory skill. If you knew how, which I did, because my next-door neighbor Mr. Hansford worked for General Motors at the time. I'm from Flint, Michigan. He would let me look at the blueprints, so I'd kind of get a feel of what they looked like.

When I first applied, I didn't hear anything for six months. I thought well, maybe it's not to be. They keep your resume for six months, then it's discarded. After the six months I hadn't heard anything. I thought maybe I should just tweak it, and I did. In the interim, I got on the computer and studied everything I could about the thermal systems. I thought that was the most fascinating system as the Shuttle was covered with quilted blankets!

I looked at the article again, and I thought well, I see this phrase here, I see this phrase. I rewrote my resume, and then it was about oh, a week or two after that that I got a call. Kennedy Space Center [KSC, Florida] came up on the caller ID. I thought somebody was playing a mean

joke on me because all my friends knew how badly I wanted to work out there. I thought somehow somebody was playing a joke.

I answered the phone, and it was a request for me to come interview for the position. I did, and it was so cold that day. It was January 24th that I got my interview. That was in 2005.

ROSS-NAZZAL: Oh, wait, Jean. I think we might have to go back. I'm at the Center. I'm not at home. The Internet went out for a few minutes. The last thing that I wrote down was that you learned about reading blueprints from your neighbor.

WRIGHT: From my next-door neighbor Mr. Ross Hansford. He worked for General Motors and had them laying on his worktable at home. I was constantly asking him how to read them.

ROSS-NAZZAL: My apologies for that. I don't know why that happened.

WRIGHT: Mrs. Hansford, Diane, and Mr. Hansford couldn't have any children. We lived next door to them, and she used to invite us all the time to come over to her house.

Mrs. Hansford was the one who taught me to sew. I'd never seen a steam iron before, which I know sounds so ancient. To actually hear an iron hiss, and it made such perfect seams. I have a twin sister Joan. Joan and I would go over there, and she would teach us how to match plaids. Most people know if you buy a really nice garment and the plaids match, you know they've taken time and it shows quality. It takes extra fabric. Most people who don't sew don't think about these things. I learned some skills from my grandmother, but for the most part it was Mrs. Hansford who took the time to teach us how to sew.

After the book [*Sew Sister: The Untold Story of Jean Wright and NASA's Seamstresses*] came out, I wondered if she was alive because it had been so many years since I saw her, I assumed she had died. But I looked on the Internet, and I found her. She's 89 now. I just got another letter from her yesterday. My twin sister Joan—she's in the book too—visited her couple months ago and showed her the book. Mrs. Hansford actually had tears in her eyes and said, "I never thought I would be in a book." There is a drawing of her at the ironing board with her and my sister and me. Mrs. Hansford is still alive. I'm glad she got the chance to see the book.

ROSS-NAZZAL: That's wonderful.

WRIGHT: Getting back to the job interview—it was so cold and windy that day! In my excitement, I got there an hour early And being unfamiliar with the space center, I parked way too far away from the Thermal Protection System Facility [TPSF]. It's right across the street from bays OPF [Orbiter Process Facility]-1 and 2. It's near the parking lot of the VAB [Vehicle Assembly Building]. We're right in the thick of everything there. My interview lasted about two hours, and I had three people that were asking me all sorts of questions. I was nervous.

I'd seen a few interviews of Kevin [T.] Harrington, who was my eventual boss, doing interviews on NASA TV. I'd tell friends, "You're looking at my new boss." Even though I interviewed at the TPSF the ladies were actually working at the Shuttle Landing Facility, now called the Launch and Landing Facility. There's a white hangar out there. That's where parts of *Columbia* were sadly brought after we lost her.

During my interview, they were impressed with how much I knew because I studied fabrics and threads and everything else to do on the Shuttle with the thermal protection system. They

were fascinated with what I knew. I got up when my interview was finished. Kevin said, "You know what, I think it'd be a good idea to have Jean go out to the hangar. I want her to meet the other ladies."

I thought okay. This was exciting. The reason why they were at the hangar was during 2004, we had like four or five hurricanes that year. The TPSF roof got partially blown off our sewing area at our building. Mold was everywhere and the building smelled horrible according to my fellow Sew Sisters! The sewing machines had locked up from salt water. They transferred everything out to the white hangar, which is about oh, a mile and a half away from the TPSF.

I met the ladies, and I was looking at them sewing flight hardware. What made me really think about how important the job was is they still had the yellow grid work tape on the floor from where they reassembled *Columbia*. Every time you would see the bakers' racks—the ladies were sewing parts and putting them on the bakers' racks—you would see the floor with the grid work, and you knew what the grid work was for.

But what I think in a case of going full circle is that after we moved out of that building, those same bakers' racks that we put Shuttle parts from *Columbia*, we were building new Shuttle parts; that were going on the racks to be taken across the street to be installed on the Shuttles: *Discovery* and *Endeavour* and *Atlantis*. That was full circle.

Four days later Kennedy Space Center comes up on the caller ID. Now there were three other ladies that interviewed after me, but I found out when I got my phone call that I had gotten the job. I said to my daughter, "Wow! This'll be the most important phone call your mother will ever get in her whole life."

TPSF secretary, Betty Schott, called and said, "We want to offer you the position." It's called aerospace composite tech (soft goods), in essence sewing flight hardware with fabric and

other materials. It's a really long title and is NASA-speak. But aerospace composite technician is the name of the job. Soft goods meaning anything to do with fabrics and films.

My boss came on the line and said to me, "Well, congratulations, there was such sadness in our building after we lost the *Columbia*. I was so impressed with your knowledge about the Shuttle and the materials that we use. There was something about you. You had such passion for the program and such heart." I joked, and I said, "Well, I used to watch NASA TV all the time." He said, "It was much more than that. You have such passion and such kindness. There was just something about you that I knew we needed in the building. We were still reeling from losing *Columbia*. You were just the spark that we needed, and I could see that in you. I interviewed the other three ladies, but the second you left the room, I said, 'I'll interview them but I know right now she's the one I want.'"

As I mentioned to you earlier, I was the first one that had been hired there in about nine years. A couple reasons why they needed somebody. Ruby, who was the lady who had said the materials they used were very irritating, and she just wanted to move on. (I ended up receiving her workbag.) With the Shuttle Program being down for the few years after we lost *Columbia*, they knew the workload would pick up, requiring a replacement. "We have all these contracts from many countries to fulfill. The pace will be incredible to complete the Space Station." They told me, once I found out I'd gotten the job, "You're going to hit the ground running because we have to play catch-up. We have all these years we're behind to get the Space Station done."

That made me happy when he said that you're just the right person. I started on Valentine's Day because it took two weeks for my security clearance. I tell everybody, "Oh, the job I knew I would always love, how appropriate I would start on Valentine's Day." I make cookies all the time, and since it was Valentine's Day, I brought these three giant bowls of homemade chocolate

chip cookies. Everybody's just looking at me. Kevin says, "She was nice enough to make cookies for you guys, why don't you come over and meet her? Come on and meet her again."

My cookies have a reputation. They call me the Cookie Lady. We had a NASA family day picnic, and my cookies won best cookie at KSC that year. That's my favorite chocolate chip cookie recipe that I've made for years! Some of the ladies I worked with joke and say, "Oh, that's probably how you got the job is you brought your cookies to the interview." Of course, I told them I didn't.

When you start out there, you don't immediately start sewing flight hardware. They have you do what they call nonflight sewing, working on computer bags, things like that, so that you get the idea of working with industrial sewing machines. These machines that we use are massive. We have all sorts of machines, regular size ones, little teeny ones and large industrials, to get us used to working on the big sewing machines that we may not be familiar with.

That was probably a couple of months. Then after that I went onto second shift, and we had our trainer named Karen [Bishop]. Karen was the one who used to be a tech a long time ago, but she was our official trainer. She made sure number one that we knew how to sew, but she also taught us how to read blueprints and things like that, because we had three different companies. We had McDonnell Douglas and a couple other companies that we would have to look at the blueprints and then build the part from there.

On some occasions we had some of our patterns that we used in a file cabinet. But if we didn't have a pattern for it, we would have to go back to the blueprint and literally hand-draw our pattern on Mylar to create the blankets, thermal barriers, gap fillers, or any of the thousands of pieces of flight hardware. What fabric or film. Where the threads would be tufted. Where the I.D.

tag would go. What kind of seam it would have. All sorts of details. She taught me how to do all that.

What's kind of neat, and I should have mentioned here earlier, was Karen actually let me keep the first blanket I built that was not flight hardware, but it was a training blanket. It was made out of silver polyimide, and it's one of 5,500 blankets that we have inside the bulkheads and inner walls of the Space Shuttle. There are thousands of different shapes, but when we build them we make two of one shape. One of the blankets would have batting inside, three layers generally. That would be called a blanket TCS [thermal control system]. But then we also made a matching one that was called an MLI or multilayer insulated blanket which would have anywhere between I would say 12 and 20 layers. But those blankets, even though you think oh wow, 20 layers, they must be very thick, but they were only maybe a sixteenth of an inch high. We would have to make the same shape blanket MLI and a blanket TCS and stack them together. That's why there were so many in the payload bay liners. They're silver blankets that you would never ever see from the outside, but the blankets protected the astronauts from radiation. That was their main purpose. I tell everybody when you open up the payload bay doors you see all the white payload bay blankets. Those are made of Beta cloth. There's about 2,200 of those. "But underneath all that there's 5,500 silver polyimide blankets that you don't see and we built those too."

What I find kind of amazing is the first four years of the Shuttle Program they had a 24-karat gold blend that they used on the blankets instead of the silver Polyimide. The were very very pretty but gold went "sky high," and they were expensive to build. We know *Columbia* and *Challenger* had them. Those blankets were probably built in the late '70s. About four years into the program, we switched to polyimide for the internal blankets on Shuttle. But what I think is so neat is about every few years the Shuttles would get sent back to California and I think the acronym

is OMDP, Orbiter Maintenance Down Period, what we called a tune-up. We always would know what Shuttle had come back from that because we would get hundreds and hundreds of gold blankets on our racks, and they would say, "These blankets all need to be rebuilt in the polyimide." It's so beautiful because it looked like a pot of gold, because there were so many gold blankets.

As a seamstress what was so cool to me was these blankets, since they were built for the very first two Shuttles. Like I said we would have our patterns in a file, but these blankets were so old in some areas of the Shuttle they hadn't seen the light of day in years. So you'd look in a file for an old pattern to make the blanket, and they didn't have any. We could take the blanket apart and make that as a template for us to build a new part. We had to do that often when we got the gold ones, because like I said they were put in nooks and crannies that hadn't seen the light of day in years. Sometimes internal structures had changed, so they needed to be changed out. I always thought that was neat. We could always date the age of the blankets by what color they were. Very pretty blankets.

ROSS-NAZZAL: It's a shame you couldn't reuse them and just put them back.

WRIGHT: That's true, but one thing I also wanted to talk about is about when we would build the blanket, again, and we'd have to draw our own patterns. We had a sheet of Mylar—it's like an opaque plastic that we would pull off a roll and cut. Yes, we would draw the pattern on the Mylar. Our Quality would look at the blueprint, look at my Mylar, and stamp it, before I could even build it. I say build because we normally one would say sew, but ours is a manufacturing

position so the term they always told us is it's not you're sewing a part, you're building a part. It's building this, building that.

To show how old the program was, we would get a sheaf of paper in a folder called a traveler. Each Shuttle had a different color folder. For example, I believe *Endeavour* was a green folder. *Atlantis* was blue. We had orange for *Discovery*. Can't remember the folder color specifically, it's been too long. But each Shuttle had a different color. That told us what part was being built, provided a parts list, and where it was to be installed.

We'd get papers inside there, and one thing that always was kind of intimidating was the thing called the EO or the engineering orders. Sometimes the engineering order would only be a few pages. Sometimes it would be as many as 60 pages. Before we could build the part we literally had to read every single sheet of that paper before we could build it.

The reason why is sometimes there could be a situation where the fabric had changed. The film had changed. The thickness of the blanket had changed. The thread had changed. Little minute details that you wouldn't even think about. You had to go through every single page. Read every line. Sometimes there were more than that. Just to see if anything had changed, because some of those plannings were from the very beginning of the Shuttle Program, and of course this was latter part of it; things had changed. What they could change they did. Again it took reading all those sheets of paper before I could even start.

ROSS-NAZZAL: Like you're an astronaut yourself almost.

WRIGHT: Exactly.

ROSS-NAZZAL: You have your own checklist.

WRIGHT: Yes, a parts list. As you can imagine we had a lot of unique fabrics and threads. I love talking about the threads. Whenever I give a tour I always ask people, "Does anybody sew?" Most people don't anymore. But I always found it fascinating to talk about how it's a skill that's been around for thousands and thousands of years, and yet we still need it to build satellites and spacecraft and things.

As I mentioned earlier, we replaced thousands of tiles with thermal blankets called FIBs, flexible insulation blankets. The fabric that we used outside the Shuttle for the blankets, that was a quartz fabric or a ceramic. People ask me often when did we switch from tile to blankets. If you've ever had a chance to go to the Visitor Complex at KSC, don't know if you have.

ROSS-NAZZAL: I have.

WRIGHT: In the *Atlantis* exhibit there's a special room that has the window frames of *Columbia* and the midbody portion of *Challenger*. *Challenger* was the orbiter that we did the test blankets on for the Space Shuttle, to see how practical or feasible the idea was to convert from tile to the blankets. People ask me when I do the tour, "Well, what is that piece of blanket there?" I said, "Beginning with STS-6 they actually had sections of blankets that they installed all over the Shuttle to see how well fabric would fly."

What I find kind of amusing is eventually the blankets were coated with a ceramic nine paint called C-9. But for the first 10 Shuttle flights, from what I've been told—especially in the OMS [orbital maneuvering system] pod area—the wind coming over the top of it was battering

the blankets, and the threads were breaking, and batting was leaking out. The ladies would tell me it looked like blown out Pampers up in the OMS area.

Eventually they decided there was a need to coat it with ceramic paint, so they did. It stabilizes the blankets. After we lost *Challenger*, NASA found it was feasible to switch to blankets; we put *Columbia* in bay two, and she was retrofitted to be the way they are now, the blanket-tile ratio that they have. They had taken off probably about between 7,000 and 8,000 tile off *Columbia*. We're down to about 25,000 tile. People ask me, "Weren't the first two Shuttles covered with tile?" Yes, they were.

Columbia was the first one to be retrofitted with the blankets. The last three Shuttles were built that same way. Saved a bunch of time by doing that. Even though they're heavier than a tile, they're faster to manufacture. We have a giant 30-needle sewing machine that quilts the blankets and it makes a 30-by-30-inch piece of fabric called a production unit or P.U. In that 30-by-30-inch piece we could fit anywhere between probably 10 and 20 tile, depending on its shape and size. Tiles are time-consuming to make. They just are. They're very detailed in the cutting. They have beveled edges, little lips on them. It just takes a long time to make a tile. But the blankets were a gamechanger to us, especially fitting in the OMS pod area. You've got those really tight curves. Our tile guys used to have to do what they called a dice cut: cutting a tic-tac-toe design on the back of the tile to get the curvature that we needed in that area for the tile to fit properly.

I always refer to the Shuttle as a woman's curved body, because she has a lot of curves all over her. I've often been asked, "Why didn't they make tiles bigger like 12-inch-by-12-inch?" But NASA found that when vibration testing was done, they consistently cracked right in the middle. The majority of the tiles were six-by-six. A few eight-by-eight, but mainly six-by-six. I

just said, "She has a curved body, and she has to be tailored correctly." That's why everything is smaller. It's a tailored fit.

The fabric gave us such flexibility. It was just so easier to cover the Shuttle. They're all on upper surfaces. The blankets could do the exact temperature range of protection as the tile, which surprises everybody.

As for the blankets, we did 11 classes or thicknesses. It's kind of confusing how the system was, because class one, two, three, and four got progressively thicker in height. Five dropped down to a placemat thickness. Then 6 to 11 went thick again. I would ask my boss and my engineers, "Why is five so thin?" "We don't know. No one seemed to know the answer. We just know one through four got thicker, five dropped down to almost nothing." Class fives were seldom made at all. Oh, they were so difficult to make, because they literally were so thin! Made like a traditional quilt, you're talking about fiberglass backing, a spun-quartz batting middle, then you've got the quartz fabric on the outside. The blanket was so thin we used to have to slide a piece of cardboard underneath it just so we could put it through the machine as it was quilting. Pulling the cardboard down as the machine was quilting it.

The majority of our blankets that covered the Shuttle were what we called a class four. Those are about a half an inch thick. They would withstand about 650 degrees minimum. We wouldn't see that temperature in reality during reentry. But like everything else we always built something for more thermal protection than what we needed. For example that blanket may do 650, but we would probably only see maybe 400 or 500 in that area. What's surprising to most people, the majority of blankets we built for the Shuttle were class four. The area where the names of the Shuttles are painted on, all of those are class four blankets. The thicker blankets that we built were on the OMS pod. Those were our class 10 and 11s, anywhere from an

inch-and-three-quarter- to two-inch-thick blankets. They were built to withstand a minimum of 1,200 degrees. Again all white, because wherever you see the blankets, that's where we used to have the white tiles installed.

People say to me, "Oh, the reason why those blankets were so thick on the OMS pod is because it's so close to the engines." That is true that they're close to the engines, but that's not why they're so thick. The Shuttle skin beneath the blankets on the OMS is a composite material. NASA tells us that we can't get that skin of the Shuttle hotter than 350 degrees. That's why we have such thick blankets there. We do also have—and this may be surprising to you—people think it's the bottom of the Shuttle that gets the hottest on reentry, but it absolutely is not.

The two hottest areas, and I'll talk about the second one first, because it has to do with the OMS pod. Where the wing indents on the Shuttle is we call that the wing glove. We have 22 RCC (reinforced carbon carbon) panels on each wing. Panels six, seven, and eight are right in the curve of her wing. That's the second hottest area on reentry. We found that as she's coming home, that area was sending extra heat right in front of the OMS pod. Those tiles there used to be all white. Now they have black tiles which are tougher, because that excessive scorching heat from the wing glove panels was pouring over the front of the OMS pods and softening the tile. We call that the Shuttle eyeball, because it's white tile with black tiles in the middle. We always say that it took an act of God to change the tile, because everything goes through a lot of paperwork if there's any changes. To change those tiles to black involved a lot of time. That's why it looks like that.

The hottest area is right underneath the nose, and you'll notice that both the leading edge and the nose are made out of RCC. It's technically a fabric, a graphite fabric. It's sintered or burned to an ash then it's layered with a phenolic resin much like how fiberglass is layered. A

company in Texas that made the fabric. They would shape the leading edge of the wing panels on a mold and even the nose was molded. There's a special curved panel underneath the nose called the chin panel. We called it the Shuttle smile, because it's curved like a soft little smile underneath her nose. In fact we used to say if you looked at the Shuttle dead on it looked like Snoopy with the big round nose and little smile underneath it.

Speaking of the blankets that we built in that area, especially the nose, the chin panel blanket was stitched all by hand, and it has a spring tube, which is a flexible tube stitched all the way around the edges. Again it's sewn by hand and that part is probably a good I'd say four- or five-day part to build. It's installed by compressing down those edges and putting it into that chin panel area. The spring tube pops open, then it's hand-stitched in. Probably the most critical blanket we built because it takes so much heat.

Inside the nose there's a giant bowl shaped blanket that's sewn in four different quadrants. That's probably about four inches thick. Inside the nose there's hundreds and hundreds of what we call puzzle blankets that are all stitched by hand; called puzzle blankets because they fit like puzzle pieces to fill the 19 inches of cavity from the inside of the nose to that first bulkhead.

But it's the thread that has fascinated me and the many people I have spoken to. In our really high-temperature areas we had a thread called AB 440, and it stands for aluminoborosilicate, which is very similar to the paint that we would put on the outside of the Shuttle tile. So you know it's a high-temperature thread. In our world, thread or fabric that's dyed a bright neon pink tells us that that's a high-temperature thread or fabric. Whenever we sew in our really high-temp areas: leading edge of the wings, inside the nose, the thermal barriers, they were all stitched with this high-temperature thread. The melting temperature, or high melt, is 3,200 degrees. All our

threads were made by 3M, which everybody thinks of the tape manufacturer. I had no idea they had a thread division, but they do. I think even now they make all the thread for every spacecraft that we do.

What was tough about that thread is the thickness. I would describe it like a sport yarn. Pretty thin, but way thicker than a sewing machine thread. The thing is you would think high-temperature, oh, it must be a really strong thread. It is for temperature. But as with anything made for high temperatures, they always had their little flaws. For example if I was making thermal barriers that lined the wheel well doors, we would stitch those with this high-temperature thread. They're about four feet long, two spring tubes running the length of those that ensure we have really tight-fitting wheel well doors. Those are all done with that thread, and they're also installed by hand. I have a picture of me with my arm up overhead with a curved needle stitching them into place, and it was a persnickety thread because it would take two of us about 18 hours to sew the 12 thermal barriers in to one wheel well door, because the thread, you could only stitch an inch, and it would fray so thin that you'd have to stop, knot it, and bury the knot into the part, and then continue on. In essence it's like you're stitching an inch, stop, stitching an inch, stop. All the way until you go about the four-foot length of the thermal barrier. The thermal barrier itself took us four days apiece just to build 1, and we had 12. There was three on each wall of the wheel well door of the Shuttle.

Usually the men and women across the street over at the OPF would do the installation on some of the parts. If they got behind schedule, they would ask us at the TPSF to come and help. They would come and say, "Hey, we need a couple seamstresses over here." I'd be so excited and always had my little sewing bag ready and packed to go. It got so my boss would just tap me on

the shoulder and I'd go, "Ooh, they need me across the street." It was just exciting to be over there, because you're actually climbing up inside of her and you're stitching stuff!

I used to look in amazement thinking gee, a little girl from Michigan and I'm actually working inside of a Space Shuttle. You're right up against everything, because I'm right up in the nose landing gear door. That was exciting.

ROSS-NAZZAL: What did you have in your bag that you would take with you besides thread and, I don't know, a thimble, your needle?

WRIGHT: Hemostat, it's kind of like a little plier that if you're sewing through something thick you clamp your needle onto and it helps it pull through. I had various needles: curved needles, straight needles. I had my reading glasses. That was before I had cataract surgery, so I'd have to take my glasses off. But if I was doing up close work I'd have my glasses on. I had certain pins that I carried. We had Mylar tape that I would sometimes just tape something in place until I could finish installing it. My "go bag" was my little sewing bag, and I kept it ready all the time on the off chance that I'd be called across the street.

Most of our parts took days to build. There's a rectangular support structure inside each of the twenty-two RCC panels inside of the win. We would hand-sew this thermal barrier called a horse collar. It's made out of a Nextel fabric and Inconel foil. We would wrap the horse collar around that support wood structure and hand stich it where the ends met.

Depending on what panel they were going behind, they would be made in different lengths. I don't know why they called them that. Nobody knew. I guess when you held them up, they kind of look like a horse collar pattern in an oval shape. We would have to tie hundreds and hundreds

of strings to the horse collar to pull them down into place. They weren't glued or anything, they were just pulled down into place. That was a unique part that we did.

Getting back to the varying temperature differences, the wing was especially a good example because you've got the RCC on the nose and leading edge. That RCC there is rated for a minimum of over 3,000 degrees. Then you go to the tile which is around 2,200 degrees. Then you go to the FIB, the flexible insulation blankets, the quilted blankets, that's anywhere up to 1,200, and then you go to FRSI, felt reusable surface insulation, it's about three-eighths-of-an-inch-thick piece of Nomex felt with a silicone coating. If you see really supersmooth areas on the Shuttle, chances are that's what that is. There's probably about 4,400 square inches of that. Like I said we're talking a huge temperature differences just in the wing alone.

You mentioned Lurch. Lurch is a machine I love talking about, because we had so many sewing machines upstairs, but Lurch was one of my favorites, because of his history being a Singer machine that was built in 1914. We had three Singers in that age category, roughly. We had some that were up to 1917, but they all started off really small. A section of the machines was taken out and almost four feet was added in the middle of them, to make it easier to quilt with a larger sewing area to create what we called our dome heat shield blankets. Those are the eight and a half foot each circular blankets that go around the engines.

But Lurch, its first job was sewing through two inches of leather to make saddles. All of them were saddle making machines. A lot of people question why do you need such heavy-duty machines. Nowadays most machines are made with plastic or some metal but they're not very sturdy. These machines we had are very heavy. They're really powerful! The force that they can go through sewing through two inches of leather is amazing! When we were building the dome heat shield blankets around the Shuttle engines, we're stitching through probably a half-inch piece

of Cerachrome that's stacked three layers high. When you're cutting it, it's as hard as a rock. It looks like shades of olive greens and grays, like particleboard, but it's actually this stiff material that when you cut it little glass balls roll from it.

Again, we're stitching through almost like stone when we're doing the dome heat shield blankets. When we put those three layers together, probably an inch and a half that you're stitching through, we need really strong machines. I bring up Lurch because people don't know this. The Apollo seamstresses were using Singer sewing machines to build the space suits, they started the tradition of naming their sewing machines. Big Moe and Sweet Sue were the name of their two sewing machines. We just kept the tradition going in our Thermal Protection Facility, and we named our sewing machines as well. When I visited ILC Dover, I noticed the ladies who continue to build the space suits still name their sewing machines!

All of our machines have names, except, unfortunately, our giant 30-needle sewing machine that actually quilts the blankets. It's just called multi-needle sewing machine, that's the one that quilts the FIBs for the exterior of the Shuttle. It takes about three and a half minutes for it to quilt a blanket one way. Then the frame is turned around and is quilted the other way. The machine looks like a giant quilting loom, and it's got a trough that holds about two gallons of WD-40 that we filled it with. Then it's kind of ironic because we would have a spray bottle of WD-40 that we would spray as the blanket was being quilted, and you're thinking oh my gosh, oil on fabric, it's criminal! But it helps the fabric go through the machine much more smoothly. When we made the blankets, the formula for it is the height of the blanket plus an inch and a half all the way around. You add an inch and a half, and you take the batting out of that inch-and-a-half area, you hand-knot all the way around the blanket where the threads intersect. That takes a long time, especially if you're doing a full P.U. that's 30 by 30 inches.

Then we flip the excess fabric to the back and hand stitch/baste it down. Precise 45-degree corners, like a picture frame, were created on all 2,200 blankets that on average each Shuttle had. After completion, the blanket goes across the street for its initial pre-fit check to see when it drops in its specific cavity if it's going to fit. If it does, it comes back to our building, and on our first floor where we have a pizza oven. It's blue, and it's got six racks in it. The techs that are working down in heat cleaning will take the blanket, put it in the oven to bake out the impurities. Sizing adds stability to the fabric to be able to go through the machine. But we don't want that. We need the blanket to be completely porous to absorb the C-9 ceramic paint that stabilizes the blankets for flight. I have my oils from my hands from the hand stitching. We don't want that either. The blanket is then "banked" at 650 degrees for four hours and then it's bumped up to 850 degrees for two more hours. The fabric looks opaque before it goes in there and then shiny white, it almost looks like silk.

This is where I have a funny story to tell. I don't know how I can be PC [politically correct] about it. I had a friend of mine, Bonnie, who, bless her, she died of brain cancer about five years ago. Bonnie was very welcoming. She was an older lady who'd been out at Kennedy for a long time. I'll tell it anyway.

She had a habit of putting her makeup on at her worktable, which really we weren't supposed to do. Since she was a woman of color, she had on this really dark foundation, almost a deep bronze. Quality went by her table one morning and said, "Bonnie, you shouldn't be putting makeup on at the table." "Oh, I'm almost done, it's okay, I'm almost done." She was working on a horse collar then. They said to her, "But Bonnie, if the makeup doesn't heat-clean out, you know that part will be scrapped." We're all laughing as she's saying, "Well, surely it'll come out at 850 degrees!" We all thought okay, no problem. It is 850 degrees. It'll come out. Well, it didn't. So

the next morning Quality comes to her worktable, lays it next to her with a scrap tag on it, and said, "Well, Bonnie, the heat cleaning didn't get your foundation out." We're all laughing, and I said to Bonnie, "Man oh man, if it won't even come out at that temperature what's it doing to your face?"

ROSS-NAZZAL: Oh my gosh.

WRIGHT: That's kind of funny. But I always remember that one.

ROSS-NAZZAL: Did that ever happen to you on your parts? Did you ever have something you had worked on was not up to par?

WRIGHT: Yes. I had one time. On polyimide, the silver film the seam has to be rolled twice. I remember an installation. One time apparently I didn't turn my second fold deep enough. When they installed it part of it ripped. I guess you could say I got wrote up for that, because I had to rebuild it again. But other than that I was fairly lucky. I never really had that happen much.

But you make a mistake, you learn from it. They were good about that. When that happened, they don't go at you and make you feel terrible. They just say, "Was there something about the training you forgot, or you didn't remember? Or would you like a refresher?" I said, "I don't really know what happened that day." But they don't rake you over the coals. The thing they told us is, "If you think you've made a mistake just tell us. We don't want you to lie. This is flight hardware." Of course we know the astronauts' lives are depending on it. "If you think you made a mistake tell us." I said, "At the time I didn't know that I had done that mistake."

That was fine. Also, there was one time when I had completed a part, and I don't know why, but that day I was second-guessing myself. I asked that they recall the part from across the street and bring it back to me. Quality looked at it and said, "Oh, this is fine, there's nothing wrong. But we're glad you asked. You were possibly over-thinking too much. But the fact that you came to us and said, 'I really think it needs to come back here so we can double-check it' was good. It was fine." But they said, "That's what we like about you. You're not trying to hide your mistakes." It makes you feel bad for a second, but they said, "we'd rather have you be honest." You learn that.

You asked me on my list of questions about the first flight hardware that I built. We use a special rubber-like vinyl, it looks like a Naugahyde, to create a liner underneath the engine's dome heat shield blankets called a flex seal. That was the first part that I actually had stamped, or what we called "bought" by Quality.

I remember thinking, when my stamp goes on this paperwork that means I bought it and I'm responsible. Yes, that was my first part, the liner that goes under the blankets of the engines. The dome heat shield blankets, that's the machine, the blankets that are made by Lurch. Again we're stitching through Cerachrome. They're eight and a half feet across, and they're the biggest blankets that we built for Shuttle. There's actually four blankets on each engine, two of the dome heat shield blankets. Those are about four, five days apiece because we have 125 rows of quilting stitches that radiate like the sunrays on those blankets, and we have to hand-knot and bury each knot. If we don't bury our knots you're going to have drag and heat that are going to collect in that area. It was always important we buried our knots. The blankets are finished off with a four-inch wide sleeving tape made out of ceramic that we hand-sewed on like bias tape all the way

around to finish all around the edges. Then Lurch would do the final quarter-inch top stitch to make sure that that binding on the edges was completely anchored on tight.

There's two other blankets called a splice pillows. They're shaped like a keystone. Each would take about five or six hours each to build. It had loops that we folded by hand and hand-sewed them on. It was called that because it spliced the blankets together. A dome heat shield blanket would be installed, then a splice pillow, then another dome heat shield. They laced on, much like tying on shoes.

The support structure would be on the floor. The finished blanket would be laid horizontal on it. Every quarter-inch there's a little hole in the structure so that the flex seal goes on first, then the blanket goes on, and then we take a wire thread called Inconel 625 with a curved needle and we hand-sew all the way around the whole blanket edge. When the whole component is installed, it's lifted into place around the Shuttle engines. That's the part I always love talking about when I gave tours, explaining all the hand-sewing, especially in the back aft. "Everybody is fascinated with the forward front end, but I like the back aft, because there's so much hand-sewing back there. The kind of sewing done in an area that would be totally unexpected. If we were lucky the blankets would fly about three times.

We were constantly building those blankets, as they were used for sound suppression. It was maybe a sixteenth of an inch thick liner. It was almost like a vinyl/Naugahyde. I think it was almost like a fabric Teflon. We had Teflon that we used in some of our parts, but I think it helped when the engines would gimbal. I think it kind of helps slide things around. It's almost like it made it kind of slick, kind of, as best I can describe it.

Obviously, those Shuttle engines were pretty loud! Giant wooden crates were built that resembled little coffins. They were made to put them in storage to be taken to Logistics until they were needed.

Checking my notes here. We talked earlier about the external thermal blankets. They're called flexible insulation blankets or FIB. That name was changed, oh gosh, I would say quite a number of years ago. They used to be called AFRSI, advanced flexible reusable surface insulation blankets. What I tell people doing research or history about Shuttle, they keep referring to the blankets on the outside as AFRSI, and that's what they used to be called. But when we started coating the top of the payload bay doors, the top of the wing, the half the sides of the Shuttle, and the top of the crew compartment with FRSI or flexible reusable surface insulation, the Nomex felt, the half-inch felt, people were confusing AFRSI with FRSI, and you can see why. Two entirely different things. Finally they just changed AFRSI or advanced flexible quilted blankets to FIB or flexible insulation blankets. AFRSI was what the blankets were known as and then they changed it to FIB, I don't know how many years ago. But that's the difference, because like I said I can look at old books and see AFRSI and I go, "Oh, that's early Shuttle. That's what they called early Shuttle."

The one thing that's amazing about the FIB and FRSTI is the weight savings. Between the blankets and FRSI that saved us almost eight thousand pounds in weight from our very first Shuttle, *Columbia*.

The one thing I'd love to mention now is even though we had all those Shuttles, with *Endeavour* being the last one built, *Atlantis* holds the record for being the lightest Shuttle, which is the one we have here at Kennedy; she is three pounds lighter than *Endeavour*. I don't know who weighed them, but she's the lightest Shuttle that we have weight wise. It's important and

fascinating that we can use fabrics to build spacecraft. I'm always telling kids who are talking about future careers with NASA materials sciences is where it's at, because we have fabrics I swear that are as strong as metal or we can use instead of metal. Fabrics have come a long way. Composite materials.

It's important that we had the weight savings. When we built *Columbia*, the first one, everything was overkill. We had metals on her that we didn't have before. She had probably had thermocouples or little thermometers in almost every single tile so we could get accurate temperature readings on reentry. But we found a lot of that stuff we didn't need anymore, especially when we switched to fabrics. When you save that kind of weight, we could carry heavier payloads, save fuel costs, things like that. At the time, I hear it's come down, but it was $10,000 a pound at the time during Shuttle that it cost to send something into space. That saves a lot of money: it really did!

Thinking about some of my other sewing experiences that I had on Shuttle. Well, we built the slidewire baskets. That was considered nonflight sewing. We'd lay a giant paper pattern on the floor, and it has these nylon straps that we would have to weave it on the floor, and then we would have to stitch the basket number on it. Those were built in our TPSF building.

Not only did we do flight and non-flight Shuttle stuff, but really unusual or not thought of things that we did. I was afraid of heights, but I mentioned earlier to you we have—it's called a GOX hose or gaseous oxygen venting hose. It's the hose that goes on top of the beanie cap. We have the orange external tank [ET] but the beanie cap is on top of that and it vents. It's a venting hood. We had these pleated hoses that looked like a dryer hose behind your dryer. That's the best way I can describe it. Some parts of the hose is hard. Where it was pleated fabric we would have to go up on the pad and patch those. I was afraid of heights, and I got asked to do that one day. I'm

like four hundred feet up in the air. My hips are as wide as the little ladder that goes up there, and I have my little tool bag. I remember being scared, and I'm thinking oh gosh, please don't let me look stupid when I'm out there because of course there's cameras everywhere up there. We'd have to hand-sew patches on them because they're exposed to the salt air and elements being with the ocean. There was always two people up there that you could talk to while you were working, because they had unique and surprising jobs.

The majority of people have no idea the launchpads are located in a wildlife area at Kennedy. We have buzzards, vultures, everything flying around Shuttle pad. We'd have all sorts of birds that try and lay nests in the external tank. There were two people up there. One had an air horn, and one had a water hose. Whenever we had birds flying around the Shuttle, it was their job to make sure the birds stayed away. That's all they did for eight hours. They couldn't listen to music. They couldn't read. That was their job being up there. It gets very hot and cold up there. That reminds me.

Don [Donald A.] Thomas is one of my favorite astronauts. I've made him some shirts with woodpeckers on them because his flight, STS-70, had thousands of divots that were pecked into his orange external tank for his flight on STS-70. They thought they could patch up the external tank out at the pad, but then they realized how many holes there were. They had to roll his Shuttle back to do repair work on it in the VAB.

They have an official patch, but they also added Woody Woodpecker on to their own collectible patch with Woody Woodpecker. We have so much wildlife out there. We have wild boards, snakes, and alligators among other creatures. It's like 140,000 acres here at KSC, with lots of animals. I've seen a lot of snakes and all sorts of little critters out there. We did have moments of pauses on occasion.

I believe it was STS-114 Return to Flight. We're watching, and I think it's on a NASA video from NASA TV. There's a buzzard flying around the Shuttle, then all of a sudden, when the Shuttle launches, you see the bird drop. There was obviously concern there. I'm almost positive NASA has it on TV. We were concerned because remember when we lost *Columbia* it was about a two-pound piece of foam that hit the wing from the ET. The first thing people are thinking then, wow, if foam did that to *Columbia*, what's a five-pound buzzard going to do to the Shuttle.

As it was that was when they first started doing the RPM, rendezvous pitch maneuver or "backflip" of the Space Shuttle in space to check the belly tiles and the leading edges of the wings, and they didn't see any damage. She (*Columbia*) did have a blanket pull back right outside Eileen [M.] Collins's window on the port side. I don't know if that had anything to do with the bird. But that's the funny thing. You see the bird flying around and then it drops. There was rightful concern over that.

When I worked on Orion test parachutes, they were behind schedule so they took three of us from our building over to the parachute facility. We were working on Orion test parachutes. They're primarily nylon ribbons. The first ones that we built were appropriately done in red, white, and blue ribbons when we built them. Those sewing machines, some of them had four bobbins because they sewed two rows at a time on both sides of the ribbon. It took probably, even for a small drogue chute, a month to mark the ribbons. If I was marking a twenty-pound ribbon we had tables that were one hundred fifty feet long. I would have to hang a twenty-pound weight off my twenty-pound ribbon to stretch it to give it tension as I marked it because it has to be under the same tension when it's dropped. The canopy at the top of the parachute was nine inches thick.

The sewing machine we used out there was called Thumper. His needle was probably about nine inches long. We had to wear sound protection when we sewed with that one because every stitch was like it was bam bam like hitting a wall. That was the only machine I would have to say that intimidated me because the needle is so long and you're stitching through such thickness.

Plus we also worked on aft skirt blankets—at the very bottom of the solid rocket boosters that's called a skirt. For Orion we knew that she was coming back at quite a bit of speed, I think 25,000 miles an hour compared to 17,000 initially for Shuttle. So we had to build these special blankets in the aft skirts for padding when it hit the water.

We used our multi-needle machine, the one we used on Shuttle blankets. For the first time we used Kevlar fabric in the machine instead of quartz. We used Kevlar thread instead of quartz. Instead of that two gallons of WD-40 that went inside the machine's trough, we joked we would take 100 bottles of Pepto-Bismol and pour it in there because it would give the machine an upset stomach for using fabric and thread that it had never used before.

It was amazing to me because that machine took to both the fabric and thread change like a champ. Instantaneous! There was no need for adjustments. Everything was fine with the process! I don't know if you sew at all, but I remember the first time when I had gotten certified to use the multi-needle machine. Again we're talking 30 needles. They wanted me to reset the tension on it. It's always frustrating because you want really pretty even stitches and tension on your bobbin, like when you're doing home sewing. I'm adjusting the machine, and it took me an hour to do all the tension on all 30 needles. I proudly show Quality well, I'm done. I did a blanket sample. I said, "See, look at this, it's so pretty."

He goes, "Jean, that's not what we're looking for." I said, "But it's perfect" even stitches front and back. He says to me, "That's not what we're looking for." I said, "No?" They go, "See this?" He says, "Have you ever had tension so bad in your home sewing machine that you want to throw your machine out?" I go, "Yes, sometimes." He goes, "But that's exactly what we're looking for in this machine. We want it loopy. We want really loose stitches in the back of your bobbin thread. Some were bolted on if they were part of an access area, but I would say 95 percent of the FIBs were glued onto the Shuttle skin directly with room temperature vulcanization, RTV. It's a brick red glue. He said, "We need extra texture. It would allow the blankets to grip the aluminum skin of the Shuttle better. That's what we're looking for, a loose tension." I'm comparing my home sewing tension to this big old machine and that was something I was not supposed to do.

That was tricky, doing the tension for something like that. After a while we had a machine that we could drop the thread, and it would do the tension for us. But most of the time it's by feel. You get to know the machine so well you can just do it by feel. But I tell you whenever we were quilting class 11 blankets, which is our thick ones, almost two inches of those 30 needles the center third needles got really really hot because there seemed to be excessive tension in that area.

My friend Kathy and I built the majority of the blankets with that large machine as the program was ending. It was a bit intimidating using it. We had hearing protection on occasion, but what was more important was mainly eye protection. We would listen as the machine would slowly quilt and the needles were going down. We would listen for a ting, which means the needle was getting ready to break.

We had a Quality guy come in. I said, "John, you've got to hurry up and get your eye protection on." He goes, "I have glasses on." I go, "Well, John, I'd just feel better. We're quilting

an 11. Please just put your eyes on." I call them eyes. "Just put your eyes on." So he did and I swear almost immediately after he turned the corner of the machine the needle broke. It was under such tension it flew across the room. I said to John, "See, that's why everybody has to wear eye protection when they're here in the room." It's a very very heavy machine. It's huge! Like I said it's ten feet tall. It looks really really cool—like a weaving loom!

In fact two years before the program ended, Valerie Neal, who was the head curator at NASM [National Air and Space Museum, Washington, DC], (now retired) came and put this orange sticker on the machine. In fact I was inside the VAB while she was slapping stickers down the aisle of what the Smithsonian wanted. Sticker is still there. Sewing machine is still in my building. I still go in there from time to time.

I gave a talk at the Smithsonian on the fourth of this month. There's a woman named Christina or Christine who took her place. I have her business card. I told her, I said, "I know Valerie put the sticker on, and you guys want it here at NASM but really I don't want it to go there. There's only two of these machines in the United States. One in California, and we have one. I know just the perfect spot for it at the *Atlantis* exhibit."

She says, "You know what, we can reconsider things. It probably would be cheaper for us just to leave it there. We can consider it on loan." She said that it could stay there. I said, "Well, that would be all right with me. It's such a unique machine. It's funny because when people see the *Atlantis* for the first time I get asked so many questions. Why is Canada on the arm?" They say, "Oh." They think Canada built the Shuttle. I go, "No." Then they'll say to me, "Well, gosh, it's not the real Shuttle." I'll say, "Why?" They say, "Because it looks like papier-mâché." The C-9 paint on the blankets change color slightly with each flight—different tones of white and beige make it resemble papier-mâché. Then I smile because I know what they mean. FYI (for your

information), as the Shuttle flies the blankets get darker, the tiles get lighter, like charcoal briquets. We can tell the age of some of the blankets by what color they are, especially on the OMS pods. I'd often hear guests say it's fake because it looks "too clean" to have made it through the heat of reentry. Since I just saw *Discovery* again when I was at the [Steven F.] Udvar-Hazy [Center, National Air and Space Museum, Chantilly, Virginia], a couple weeks ago yes, *Discovery* is quite a bit dirtier. She flew 39 flights; *Atlantis* only flew 33. But huge difference in the charring on her and the reentry burns on her.

ROSS-NAZZAL: You had mentioned stamping your number for the first time. I wonder if you would talk about what that certification process was like for you to get an official stamp and what your number was. What did that all involve? How long did that process take?

WRIGHT: Well, my stamp number was 3281. I remember the first time. Even a basic piece of flight hardware has maybe 30 lines of steps required that have to be stamped. We work on paperwork that's in a colored folder called a traveler.

When I got my stamp the first time, I'm thinking wow, they'll see this, and they know it's me. You realize just what an awesome responsibility it is. It's not cliche to say that an astronaut's life is counting on you, because it is. You realize you've got this little thing in your hand that's telling everybody I'm okaying this for flight, this is the best I can do, that it's fine for flight. It's kind of overwhelming.

I was so nervous the first time I bought my part because I'm thinking it's the best of my ability. I know I did everything right. I know I did. But you start second-guessing yourself. "No, you've got to be sure of yourself." Yes, that flex seal liner was my first stamped part, it was

completely unseen. You do realize just what an awesome responsibility you've been given because you're building flight hardware. It's scary though.

ROSS-NAZZAL: Was it mainly through on-the-job training that you got certified to do flight hardware? Or was there an actual training program that you participated in?

WRIGHT: We have a building at KSC called OSB [Operations Support Building] II. That's where all the training is done. It's probably about, I don't know, half a mile from the TPSF. Our trainer Karen Bishop started out as a tech like me. She was the one that would show you how to read a blueprint initially, and you would build blankets for her so she could know you knew how to sew, and you knew what you were doing.

But on occasion we'd go back to OSB II for refresher classes because sometimes techniques or blueprints had changed. The companies would change different keys on what symbol was different. Once a year we had to recertify on everything that we did, every type of blanket we had to sew, etc. Then we would have to go to OSB II if there was any new training that had to be done and to be recertified in different things.

Even to be certified to work across the street at the OPFs, VAB, and/or at other buildings/areas, you'd have to have a special access certification for that. To work on the pad you'd have to have those badge numbers. Each building or each area would have a number, and I would have a card in my badge that would tell me what areas I was certified for or had access to work in. Yes that was wonderful to have the access numbers to be able to see all the wonderful things happening out there!

That's the one thing I have to say that I loved about the job. I always wanted to meet John [H.] Glenn, and I did as a docent when they had the fiftieth anniversary of his Mercury flight. I got to meet him then. So exciting!

When the Shuttle astronauts would complete their missions, they would go to all the NASA center auditoriums and do a half-an-hour-to-an-hour presentation of videos, a PowerPoint presentation of their flight. Without fail they would come. When they'd come to Kennedy they would do that same presentation at our NASA auditorium, and then from there would leave to go to our building. That was a tradition for them to come to our building and shake our hands and thank us for bringing them home safely. I got to meet quite a number of them. A great "perk" I might add.

Back on STS-114 we had crewmember Steve [Stephen K. Robinson], and I had the chance to meet him in person. For the first time in the Shuttle's program history, he had to go beneath the Shuttle and pull out two dislodged gap fillers. The concern was drag and extra heat accumulating in that area. They were called Ames gap fillers which is just ceramic fabric with ceramic paint. They're very very thin. Very different from the majority of the pillow gap fillers we made by hand for thicker spaces between the tile.

The problem that Steve Robinson had was we'd never had an astronaut underneath the Shuttle before, and they were afraid he was going to hurt the somewhat fragile tile. As it was, it turned out to be a very easy fix. He just pulled them out. Apparently there was not enough RTV that glued them in place.

What was so neat about that is not only that I got to meet him but Terry [Terrence R.] White who was one of the bay managers, actually brought the two gap fillers that he pulled out from space over to our building so we could all see them. Now I think, in fact I know, they're on

display at the Smithsonian. It was just neat. I got to talk to him about that. There's experiences like that that we got to do.

Plus I also mentioned on STS-117 we had the blanket that pulled back. We call it the blanket-tile interface in front of the Shuttle OMS, the eyeball, where the blankets and the tile meet in front of the OMS. We had a blanket pull back, a class 11. John [D.] Olivas was the astronaut on the third spacewalk of that mission on 117, he was put out at the end of the arm so that he could fix it. We're laughing as we're watching NASA TV because initially when we saw the video he was using a little suture kit with a little teeny needle. We're saying, "That's a class 11 blanket. You're going to try and fix two inches of fabric in that little area?"

When they saw that blanket issue our whole building was abuzz. NASA was concerned about the situation. "It's a critical area, but not a very critical area like the bottom of the Shuttle. They didn't know if the blanket would peel back further or off on reentry. Or if they were going to have any excessive heat drawn to compromise the OMS composite skin that area."

They said, "You guys have 24 hours to replicate that section of the OMS pod." We had four we had to build. Each test sample had two blankets and four tile in front of it to replicate those four areas, and we had 24 hours to build all that and send it to Houston overnight where they did arc jet testing and heat testing and everything else to make sure that if John couldn't get the blanket back into place the Shuttle would still make it home safely. That was a busy and bit stressful time because we literally had just that short window to replicate that whole section and ship it overnight. The testing in Houston said everything would be fine if they couldn't get it fixed. He did have a needle and thread and then he also had these little things that he could screw down into it and he did use staples that he used, if I remember right. But he also did what anybody

else would do. He had his gloved fingers, and he just pushed the corner down as hard as he could get it to go. Everything was fine, and the Shuttle made it home all right.

Like I said that was kind of critical because generally with the blankets once we glued them on, unless they get torn, we just put patches on them. They're seldom ever taken off. We hadn't fired up the multi-needle machine in a while to build a class 11 blanket. We had to fire up the machine again and build as I recall probably two or four blankets that day of our thick blankets. That had to be done before we could even do the samples to send them to Houston. That was a little stressful trying to fire up the machine and get the tension right again, because it'd probably been about six months since we had fired that machine up. That all had to be done within 24 hours to send it all to Houston, so that was a stressful time.

We had one other incident. We had one fabric blanket on the Shuttle called an arrowhead blanket. It's where we had three attachment points to the external tank. It looks like a baseball diamond and it takes five days for us to do it completely by hand. The purpose of that blanket is for sound suppression. We didn't have that blanket there for all the Shuttle flights. But we found that when we used the explosive bolts to kick off the external tank, some of the tile were cracking around that area. By having that blanket there, it acts as sound suppression. I think it was back in 2009. Again we had a lot of hubbub going on in our building one morning.

The bolts that kick off the external tank are supposed to shoot off that way. One went straight up. If that blanket wasn't there to catch it, chances are we probably may have lost another Shuttle. There was all sorts of NASA people up that day wanting to know the process, watching the blanket being built. Everything else, to see what could have been done.

The blanket eventually was redesigned because the center hole bevels at a 45-degree angle. They did change the design somewhat. But other than that, and we have a protective plate

of reinforced carbon-carbon because people say, "How do you have a blanket that withstands reentry heat?" It's got a plate of RCC in the same shape of it that covers it. In fact if you look at a picture underneath the Shuttle right behind the nose landing gear doors you'll see what looks like a baseball diamond shape and that's the plate that's covering that blanket. But it's, I don't know, about this big. [Demonstrates] It's about thirteen inches high. Again it's a five-day part for us to do. It's a really cool blanket to look at.

Like I said that was kind of a hairy time too. Not much was said about that, but we knew something was wrong because everybody was up that day looking at everything and trying to figure out what could have happened. From what I understand that was the first and only time that situation had happened. That was a little hairy situation.

ROSS-NAZZAL: I bet. Do you remember what mission that was?

WRIGHT: No, I don't. No, I don't. I really don't. Like I said, there was kind of a hush-hushness about it. All I know is all these people were upstairs.

ROSS-NAZZAL: I never heard of it.

WRIGHT: They were saying, "How is this blanket being built?" The ladies that were at one table, one lady was sewing one. They were all over her looking at everything. Yes. Like I said things like that didn't happen very often. But like I said we had our little moments in history.

The funny thing is I was looking at up close pictures when we had 117 blanket peel back. We have an arrow stamp. All the blankets are oriented towards the nose. Even if the arrow

is not stamped on a blanket where the ID is, everyone knows who installs flight hardware. (Shuttle flight hardware is oriented to face the nose.) If the ID is here, the left side of the blanket, then it faces the nose. I didn't have an arrow stamp, so I used to have to make my own little design with a stick and print it that way. Once I looked up at close pictures of the blanket on 117 and noticed the blanket just to the left of it, and I'm thinking I made that blanket. The one right next to the one that peeled back.

As we're watching NASA TV the first thing everybody says is, "Who made the blanket?" We're going, "It's not who made the blanket. It's who installed the blanket." Apparently they didn't put enough RTV to bond it correctly.

I had kept a journal the whole time that I was working out there. If I was building a part, it was OV70. OV means orbiter vehicle so we know that's flight hardware. After the OV70, there's six numbers. Of those six numbers the first three tell us where the part is going to be installed on the Shuttle. It got so after a while you know. If you look at those three numbers you know exactly where it's going to go.

In that journal I'd write down the OV70 number, what Shuttle it was going to, what day I built it, where it was going to go. Everybody would tease me. "Oh, Jean has got her book out again." But I'd go, "I don't care." I said, "I just want to remember all of this. I just want to remember everything."

I would sometimes go around the tables and asked the ladies, "Oh, what part are you building? Where's it going to go?" I know they would roll their eyes. But I had the last laugh. During the final months of the program, the press would come and ask us what our favorite moments were or specific questions like what Shuttle got the last American flag sewn into the payload bay and who made it." No one could remember, so I pulled out my little journal and I said,

"That was Debbie and Jackie. The last flag blanket went on *Discovery*." Everybody goes, "Oh." I said, "See? You guys made fun of me, but I have a little historical record here. I still look at it from time to time.

ROSS-NAZZAL: What a great resource. I'm surprised the program didn't keep that.

WRIGHT: You're right. When was that issue with the arrowhead blanket? I'm thinking why didn't I ever write that down. I guess because like I said there was kind of an atmosphere of hush-hush about that. I don't remember ever writing anything down. I do remember I'm pretty sure it was in 2009 though. Sorry, I don't remember which one. I know it's time for you to go.

ROSS-NAZZAL: Can we get together after you come back from your cruise? I do have other questions for you if you're amenable to doing so.

WRIGHT: Yes. Just send me the link.

[End of interview]