

MARTIN MARIETTA

# news

DENVER AEROSPACE

NUMBER 7/1984



MMU does it again!

# Michoud SRTs cut attrition, accidents and . . .

System refinement teams (SRT) have accomplished significantly more in the past four years than keeping the assembly process flowing smoothly for the Space Shuttle's external fuel tank.

SRTs—Michoud's versions of quality circles—offer individuals a say in their work, resulting in a new sense of teamwork among employees and the knowledge that their ideas and opinions count for something. That, in turn, has resulted in innovation, reduction in various types of accidents, a drastic cut in the attrition rate, and opportunities to grow.

"People started listening to us," said David Rawson, a supervisor who admitted he was skeptical about joining an SRT at first. "But things got done we didn't even think could be done."

One of the improvements management implemented following a suggestion from Rawson's team was a new scaffold for entering the liquid hydrogen tank. Besides being safer than the airlift workers had been using, the scaffold also reduces assembly time by three days.

Rawson is part of the mechanical assembly SRT, which won a 1982 NASA competition among all the quality circles of firms supplying Shuttle parts. The prize was a trip to Florida to view a Space Shuttle launch from Kennedy Space Center.

But the rewards of employee involvement—or participatory management, as it is called—go beyond those competitions. Both the company and the employees reap benefits.

"The people who are on the teams know the work best. Therefore, they know best how to improve that work," said Kenneth P. Timmons, Michoud division vice president and general manager. "Their suggestions are excellent. We listen and put them into effect."

Last year alone, Martin Marietta teams at Michoud completed more than 50 major projects to improve work quality, productivity, and safety while reducing costs. Improvements ranged from a new streamlined drawing system for engineers to better methods to keep track of the thousands of parts that go into each external fuel tank.

The superlight ablator team—which applies ablative insulation material to the tank—found that by spraying parts and test panels "wetter," it could reduce density test failures by 75 percent.

The mechanical assembly team identified and eliminated quality inspection checkpoints that were redundant, reducing work time on the tank by 7.5 days.

"We find the SRTs very good for employee motivation," Timmons said, explaining the program was, in fact, started during 1979 in part to address an attrition problem at Michoud. Employees were leaving the company at the rate of more than 20 percent a year. By the end of 1983, attrition was down to 9.1 percent, and the downward trend continues this year.

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Team members are trained in problem-solving techniques and analysis by nine facilitators and Dr. Philip Thompson, coordinator of the SRTs. Team leaders—often crew supervisors, but not always—receive special training in group dynamics, setting team goals, and improving team performance.

A comparison of hourly employees who participate in the SRT program and those not yet involved showed team members had 37 percent less unpaid lost time during 1982, submitted 32.6 fewer grievances, were involved in 10.3 percent fewer bodily injury accidents and 44.4 fewer hardware damage incidents, had 45.1 percent lower attitude-related attrition, and produced 49.2 fewer defects in the hardware.

Results have been so outstanding, in fact, that the company has formed joint teams of Martin Marietta employees, suppliers, and NASA, and is encouraging its suppliers and subcontractors to initiate system refinement teams.

Thompson said the company has been "assisting NASA nationwide to install their quality circles . . . (and) have trained NASA facilitators around the country."

He added the SRT program continues to expand because "it offers an opportunity for people to grow, to advance . . . to show their best and be seen."

## McCandless reiterates praise of MMU

The first man to ever fly untethered in space was considerably more than enthusiastic about the equipment that made the feat possible during that February 7 Space Shuttle mission (see Martin Marietta News No. 6, 1984).

Astronaut Bruce McCandless's enthusiasm for the Martin Marietta-designed manned maneuvering unit (MMU) still seems unabated, based on comments in his March 4 letter to Norman R. Augustine, president of Denver Aerospace.

"Let me express my appreciation to Martin Marietta," wrote the U.S. Navy captain, "for the superb job of design, fabrication, and qualification of the MMUs. It's not often that a complex piece of space hardware functions perfectly on its first trial, and practically unheard of for two units to behave identically. A lot of the credit for this success is due to Bill Bollendonk (MMU program manager at Denver Aerospace) for his intense personal involvement and commitment to 'making the MMU fly right.'"



*This Martin B-57 jet—one of the few still in operation today—is being used by NASA in a weather-research program at Ames Research Center, Moffett Field, CA. Several hundred B-57s—the bomber that flew like a fighter—were built at Baltimore's Glenn L. Martin Company in the 1950s. That was before the firm merged with American Marietta Company of Marietta, OH, in 1961. Eight different versions of the aircraft were produced and many later were modified by the company for use in Southeast Asia as well as for other military and civilian applications. A number were transformed into special-purpose aircraft for research similar to the one shown here. Two B-57s, in fact, played major roles in laying out the high-altitude routes used by today's passenger jet airline fleets.*

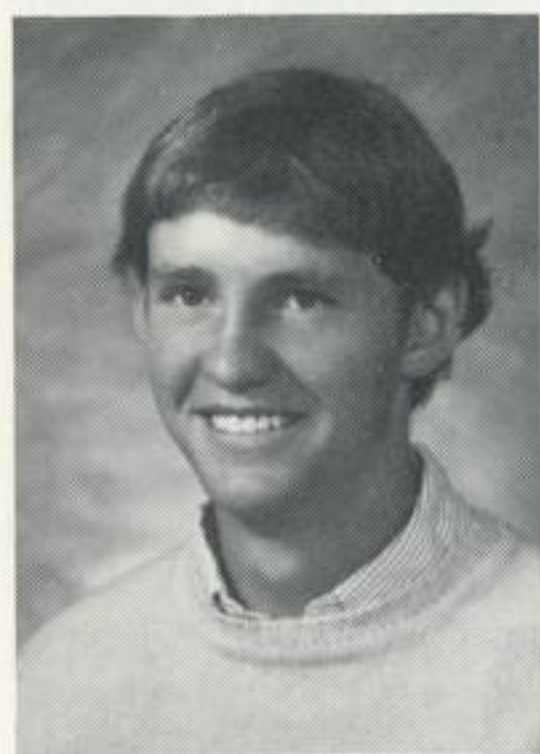
# Martin Marietta Foundation Selects 19 fo

Nineteen high school seniors whose parents are Denver Aerospace and Data Systems employees have been awarded 1984/85 college scholarships by the Martin Marietta Foundation.

Fifteen students are from the greater Denver area, one from Vandenberg operations, and three are from the Michoud division. Each will receive a \$3000 scholarship for the freshman year, which can be renewed for three additional successive years, depending on academic achievement while in undergraduate school.

More than 110 students applied for the scholarships, which were determined by a non-Martin Marietta selection committee.

Scholarship winners were:



**Michael P. Dickman**, son of Mr. and Mrs. Glen J. Dickman of Littleton, attends Heritage High School. The 17-year-old's father is a Denver Aerospace engineer. Young Dickman plans to major in electrical engineering and computer sciences

at the University of Colorado at Boulder.

A computer enthusiast since he was 13, he also builds radio-controlled model airplanes and plays the trumpet. His sports interests include soccer and track—in which he has lettered—and weightlifting.



**Kevin Scott Dorney**, son of Mr. and Mrs. Robert V. Dorney of Kittredge, attends Evergreen Senior High School. His father is an electrical engineer at Denver Aerospace. The 18-year-old expects to major in electrical engineering, with an emphasis on digital electronics, at the University of Colorado at Denver.

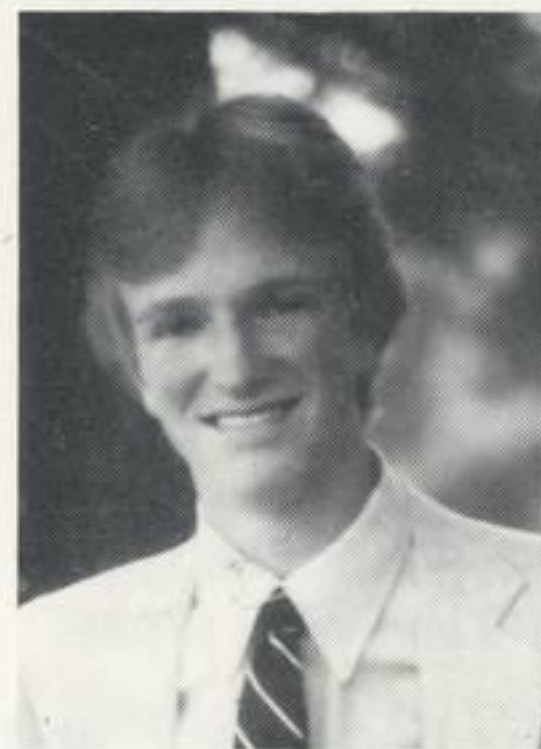
Another computer enthusiast, young Dorney also includes stamp collecting, travel, and bible study among his outside interests. He has helped put himself through school with part-time jobs during the school year and working full-time each summer.



**Scott David Hendrick**, son of Mr. and Mrs. Lee Hendrick of Littleton, attends Columbine Senior High School. The 18-year-old's father is a scientific programmer at Denver Aerospace. Young Hendrick plans to study astrophysics, then

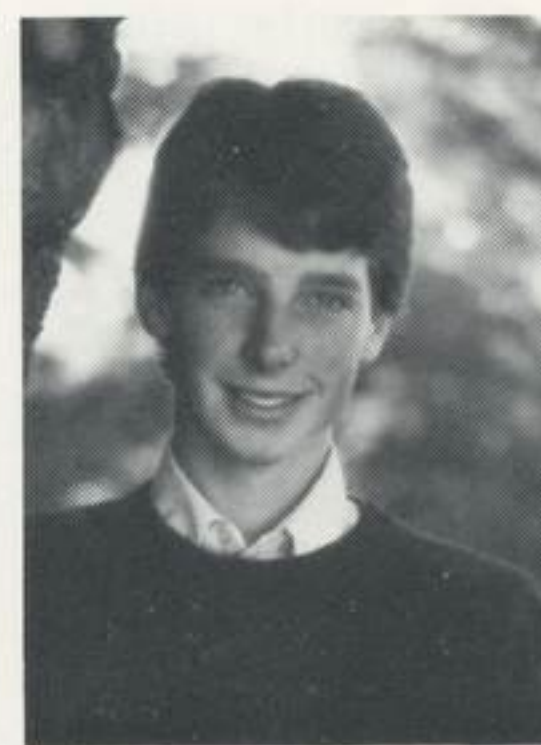
enter space programs when he completes his education. His first college choice is California's Stanford University.

He is an eagle scout and cocaptain of his school's swimming team. He also plays soccer for Columbine. An avid reader, he has an extensive science-fiction collection.



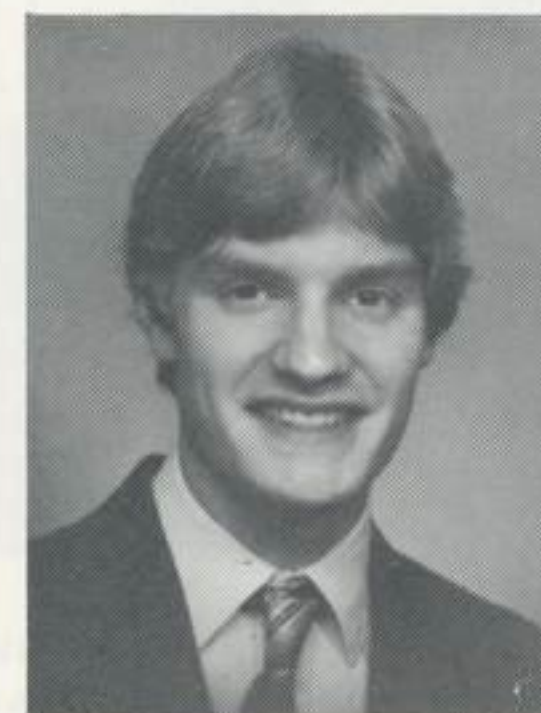
**Robert Rex Husted**, son of Mr. and Mrs. Richard R. Husted of Littleton, also attends Columbine. Both the 17-year-old's parents work for Denver Aerospace. His mother, Betty Jean, is a food service supervisor at Littleton Systems Center. His father is an engineer.

Young Husted plans to major in computer science and marketing at his first college choice, Colorado State University at Fort Collins. A member of the National Honor Society, he has spent the past year teaching basic Spanish to Colorow Elementary School students. He started as a teacher's aide, but by the third term progressed to teacher, instructing the students solo.



**David Eric Johnson**, son of Mr. and Mrs. Ronald W. Johnson of Sedalia, attends Douglas County High School at Castle Rock. His aim is to study veterinary medicine at Shepherd College in Shepherdstown, WV. His options include agriculture and business.

An active member of his local pony club and treasurer of his local 4-H club, the 17-year-old is also a member of the National Honor Society, the steering committee of his church, and the Arapaho Hunt Club.



**Jeffrey David Korgen**, son of Mr. and Mrs. Ben Korgen of Slidell, LA, attends Slidell High School. His mother, Judy, is a budget analyst at the Michoud division. He plans a double major in economics and psychology at his first college

choice, Harvard/Radcliffe colleges at Cambridge, MA.

The 18-year-old ran a button and T-Shirt business with a partner while in school, and was editor of the school's literary magazine, *In Medias Res*. Among his academic honors are biology first and second places in a district and a state rally, respectively, and an American history

second place at a district rally. The holder of a 3.8 grade point average, he placed as a National Merit Scholarship Program finalist, and his various accumulated scholastic tests scores have placed him in the top one percent of American high school seniors.



**Carolyn Ann Kiley**, daughter of Mr. and Mrs. Richard A. Kiley of Sedalia, attends Douglas County High School at Castle Rock. Her father is an engineering manager at Denver Aerospace. The 18-year-old plans to study theoretical physics at the University of Colorado at Boulder.

She is the National Honor Society chapter secretary at her school and a copy editor on the school paper. She is currently in the top one percent of her class with a grade point average of more than 4.0. She is listed in *Who's Who Among High School Students, 1982-83* and the *United States Achievement Academy National Awards Yearbook*. She also is a member of the math and Spanish clubs.



**Samuel Chun Chiang Lin**, son of Mr. and Mrs. Charles S. Lin of Englewood, attends Phillips Academy at Andover, MA. The 17-year-old's father is a staff engineer at Denver Aerospace. He plans to major in engineering at California's Stanford University.

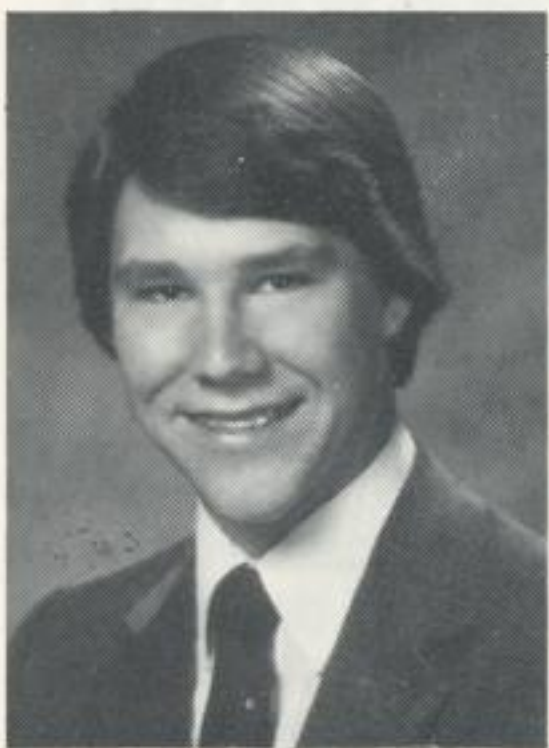
He plays three musical instruments—the French horn, piano, and trombone. Another computer enthusiast, he programs in Basic and FORTRAN and expects to learn Assembler and Pascal soon. Other interests include auto mechanics, photography, and foreign stamp collecting.



**Laura Ruth Loomis**, daughter of Mr. and Mrs. James Loomis of Arvada, attends Pomona High School. Her father is an aerospace engineer at Denver Aerospace. She plans to be an English major at Macalister College at St. Paul, MN.

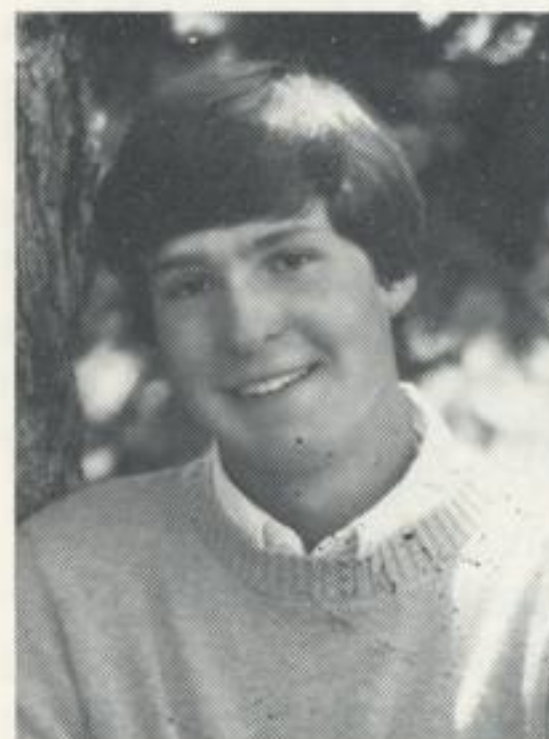
The 16-year-old's favorite hobby is creative writing, and she contributes to her school's annual literary magazine as a member of the creative writing club. She plays cello and will perform with the orchestra for the school musical. She maintains a B-plus average and is in the top 15 percent of her class.

# r Scholarships



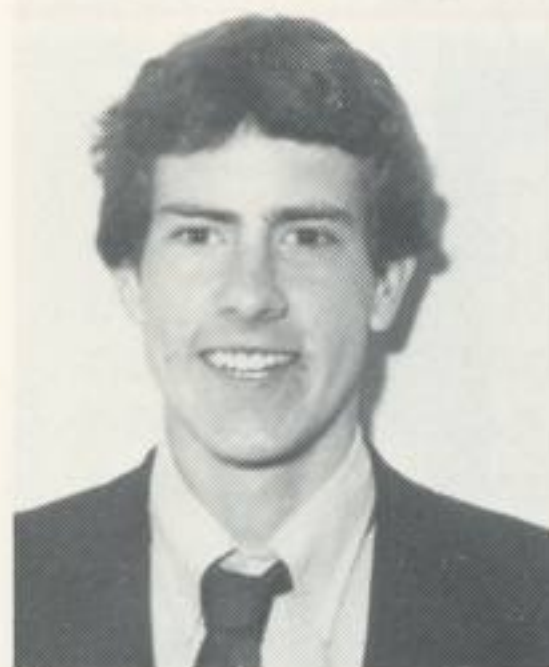
**Bruce David Reed**, son of Mr. and Mrs. Horace O. Reed of Lompoc, CA, attends Lompoc High School. His father is an electronic technician at Vandenberg. The 16-year-old plans to major in English or political science at Stanford University, Palo Alto, CA.

He has been his school's student body vice president and student representative to the school board while maintaining a 3.55 grade point average. He earned membership in the California Scholarship Federation during his 9th, 10th, and 12th grade years and subsequently earned life membership in the organization. Theater is another of his special-interest areas with lead appearances in "A Midsummer Night's Dream" and "Oklahoma." Last year young Reed became a Thespian life member.



**Stephen Eugene Parkhouse**, son of Mr. and Mrs. Ralph E. Parkhouse of Littleton, attends Arapahoe High School. His father is a staff engineer at Denver Aerospace. He plans to study engineering at the University of Colorado at Boulder.

The 17-year-old was on his school's soccer and golf teams and participates in many other extracurricular activities.



**James Gibson Van Alstyne**, son of Mr. and Mrs. Gibson Van Alstyne of New Orleans, attends Benjamin Franklin Senior High School there. His father is a manager in financial services at the Michoud division. The 17-year-old plans to

study aerospace engineering at Massachusetts Institute of Technology, Cambridge, MA.

Young Van Alstyne has played four years of varsity soccer and tennis at his school and played two years of varsity football.



**Charles James Voss II**, son of Mr. and Mrs. Charles J. Voss of Picayune, MS, attends Picayune Memorial High School. His father is a technical training specialist at Michoud. Young Voss plans to study electrical engineering at Tulane University, New Orleans.

The 18-year-old became an eagle scout in an Explorer post affiliated with the Junior Engineer's Technical Society. The holder of a part-time job, he has been active in his school's honor society, band, and year-book staff as well as playing basketball in a church league.



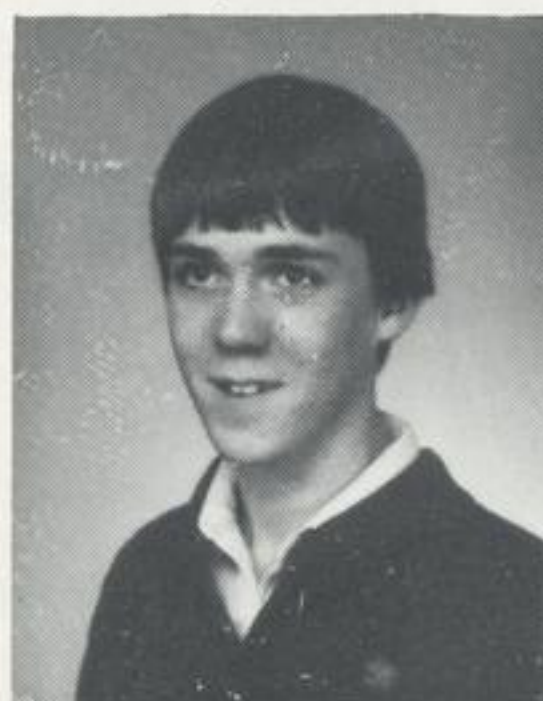
**Christopher Dwayne Romine**, son of Mr. and Mrs. Grady Lee Romine of Littleton, attends Littleton High School. His father is a senior staff engineer at Denver Aerospace. The 18-year-old plans to study the physical sciences at Princeton University in New Jersey.

Young Romine has played varsity soccer, basketball, baseball, and football at his high school.



**John Fowler Walker**, son of Mr. and Mrs. Ralph Walker of Littleton, attends Heritage High School. His father is a technical training specialist at Michoud. The 18-year-old plans to obtain a liberal arts degree from the University of California at Santa Cruz.

An avid reader and writer, young Walker worked from high school newspaper staff to editor and has written poetry, short stories, and articles.



**Gregory Cameron Phelps**, son of Mr. and Mrs. Robert L. Phelps of Sedalia, attends Douglas County High School at Castle Rock. His father is an electrical engineer at Denver Aerospace. The 17-year-old plans to study electrical

engineering at California's Stanford University.

Young Phelps has been active in such high school extracurricular activities as math club, National Honor Society, computer programming, and "Olympics of the Mind."



**Amy R. Schneider**, daughter of Mr. and Mrs. Wayne Schneider of Littleton, attends Columbine Senior High School. Her father is a systems analyst with Data Systems at Denver Aerospace. The 17-year-old plans to study

business and accounting at Colorado State University at Fort Collins.

She has a part-time job in promotions at Southwest Plaza Mall and is a senator in her school's student government body. She also has participated in many fundraising activities and headed the homecoming parade committee.



**Kathryn A. Wescott**, daughter of Mr. and Mrs. Peter C. Wescott of Aurora, attends Gateway High School. Her father is a computer operations manager for Data Systems at Denver Aerospace. The 18-year-old plans to study engineering at Stanford University, Palo Alto, CA.

She has been president of the Latin club and the Mu Alpha Theta society at her high school and works part-time at a pizza restaurant. Other extracurricular activities include volleyball, track, soccer, and speech.



**Steve Kenneth Piper**, son of Mr. and Mrs. Douglas G. Piper of Boulder, attends Boulder High School. His mother, Pamela, is a senior data base systems designer for Data Systems at Denver Aerospace. He plans to attend

Carleton College at Northfield, MN, but is yet uncertain about majoring in writing, computer science, or chemistry.

The 17-year-old is the current editor-in-chief of his high school newspaper, The Owl, the only weekly high school newspaper in Colorado. He has maintained a 3.5 grade point average while participating in track and cross-country and holding down a part-time volunteer job and involvement in Junior Achievement.

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DENVER AEROSPACE  
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April 13, 1984

## Teleoperation, telepresence keys to robots working in space

(Editor's note: the following is the second of a two-part article on robotics.)

In the very near future, astronauts may be joined by various types of robots. The movements of those highly complex mechanical systems could be directed by a person hundreds of miles away on Earth or from a space station.

Such teleoperation and telepresence systems for satellite servicing and repairs are being developed at Denver Aerospace through a department headed by Roger Schappell, manager of advanced automation technology.

Denver Aerospace, under a contract with NASA's Langley Research Center at Hampton, VA, recently designed a remote orbital servicing system (ROSS) for use on the front of an orbital maneuvering vehicle to service, maintain, and reconfigure spacecraft on orbit. ROSS, a flexible satellite servicing kit with two mechanical manipulator arms, tries to duplicate human presence at the site where the repair takes place.

Aside from various space-related applications, the technology also could be applied in such diverse ways as to replace a frogman underwater, handle munitions or hazardous materials, and work in a nuclear fuels reprocessing chamber.

Schappell explained that teleoperation and telepresence differ from robotics in that a robot is programmed to accomplish a specific task with very little human involvement from then on. But, "with telepresence, a human being with sensors attached to his body—the feedback simulating actual presence at the work site—can direct a mechanical device at a remote location to do specific tasks simply by moving his head, arms, and legs."

"The human operator, through the use of television cameras and other sophisticated sensors, actually sees, hears, and feels what the device sees, hears, and feels. In effect, the device mimics what the human operator does."

A person strapped into a remote-controlled device in New York, for example, could maneuver an empty automobile through Los Angeles. By turning the head left or right, the "driver" would cause a camera in the Los Angeles vehicle to turn left or right, thus allowing the operator to see what the camera sees—as if he is actually seated in the car. The operator could steer, accelerate, and brake the vehicle using legs and arms just as a driver would while driving.

## February PSP unit values announced

Unit values for the Performance Sharing Plan (PSP) as of February 29, 1984 were: Fund A (indexed equity): 2.2142133871; Fund B (fixed income): 1.8561639879; Fund C (Martin Marietta stock fund): 2.1512566594; Fund D (TRASOP): 0.8535590804.

## On the cover

# Another unqualified MMU success; repair mission still in balance

The manned maneuvering unit (MMU) and the Solar Maximum Observatory satellite had their long-awaited rendezvous in space Sunday, April 8.

In a picture-perfect flight, George Nelson flew one of the two onboard, Martin Marietta-designed MMUs out of the Space Shuttle Challenger's payload bay. Traversing about 150 feet, the astronaut guided the MMU into the same attitude as Solar Max, and began to match its spin rate. Then, as he had done so many times before in the space operations simulation (SOS) laboratory at Denver Aerospace's main plant, he closed in for final docking.

Nelson did slide the trunnion pin attachment device (TPAD) over a protruding trunnion pin on Solar Max, but the docking device failed to lock on to the pin. Nelson made two subsequent attempts for a hard dock, but each time the TPAD's mechanical jaws failed to activate and lock on.

A spokesman for ILC Space Systems of Houston, makers of the TPAD, later said there was "no way we can speculate right now what the problem might be."

Meanwhile, the three docking attempts disturbed Solar Max's attitude, causing it to move on all three axes instead of just one. Nelson tried to arrest the added pitch, yaw, and roll by maneuvering the MMU over to the solar panels on the satellite and grabbing them by hand. That attempt failed and Robert Crippen, spacecraft commander, ordered Nelson to return to the orbiter. Next, Terry J. Hart

tried unsuccessfully to grab the satellite with the Shuttle's manipulator arm.

During the next 24 hours, teams at Goddard Space Flight Center, Greenbelt, MD and Houston's Johnson Space Center ran through various complicated procedures trying to stabilize Solar Max before its batteries failed. Those successful efforts bordered on the miraculous.

The ailing satellite was stabilized and brought back into an attitude that made possible another attempt at capture with the remote manipulator arm.

Early Tuesday morning, April 10, Challenger made another rendezvous with Solar Max and Hart made a historic space catch. The arm locked on to the satellite, brought it back into the cargo bay, and berthed it to a servicing cradle.

The next day, Nelson and James van Hoften began repairs, following procedures developed by NASA and a Martin Marietta Aerospace systems engineering support team. Harold Maddera, head of that team, was confident those repairs would be successful. (Repairs still had not been completed by the time this issue went to press. *Martin Marietta News* will update the mission story in the April 27 issue.)

Despite the TPAD problem, NASA officials had many accolades for the MMU's performance, noting it had proved its value as a new space tool for astronauts.

"The MMU did everything it was supposed to do on this mission," added Bill Bollendonk, project manager.



It took four gallons of developer and fixer, six people to agitate the specially designed developer tank, a driveway substituting for the wash sink, a garage door and automobile top as a dryer, and, finally, an everyday clothing iron to make it wrinkle-free. The result—a four-by-eight-foot-black-and-white photographic mural of the Space Shuttle orbiter, Discovery, atop the NASA 747 when it visited Vandenberg Air Force Base, CA, last November. It now hangs in the GSS's modular complex, MOD 7300. The massive undertaking originated from an ordinary 35-mm snapshot by Bryan Carter, a 17-year-old senior at Cabrillo and grandson of Mack Stephenson, a ground support systems Martin Marietta employee at Vandenberg (both shown here). The youth, who literally sees the big picture, plans a career in photojournalism. Naturally.

## Recreation

**Softball**—The First Annual Martin Marietta Softball Tournament will be held May 18, 19, and 20. The competition is limited to the first 32 teams that register with the Recreation Department in Eng Bldg, module 128, ext 6750. Registration deadline is 9 to 11 a.m., Friday, April 27, and team rosters are due by 5 p.m. May 7. More information available from Recreation racks.

**Tennis**—"A" and "B" players only may try to qualify May 5 and 6 at the Arapahoe Community College tennis courts for the Denver Aerospace team in the 1984 Denver Corporate Games. Entry blanks and \$4 entry fees per competitor must be in to Recreation, mail stop 1321, by April 18. Details on flyers in Recreation racks.

**Alpine**—The Rocky Mountain Alpine Club (RMAC) will hold a beginner and intermediate cross-country skiing event at West St. Louis Creek Saturday, April 14. Contact Barb Converse, ext 4748 or 431-4424. RMAC also has scheduled an advanced cross-country "commando run," beginning at Vail Pass, Sunday, April 29. Contact Duane Cichy, ext 2398 or 697-6570. Details on both events are available from Recreation racks.

**Baseball**—Discounted tickets for all regular-season Denver Bears home games are available from individual Recreation representatives.

## Blood donors good for . . .

A reminder to employees—because the Belle Bonfils mobile blood unit will be collecting from donors April 16 and 17—that donors are good for:

— Barefoot kids who aren't careful. And those who exercise their inalienable right to climb trees—and fall out. For toddlers who manage to uncap a poison or cleaning solution. Or play with matches. For new mothers needing a transfusion and new babies who need a complete change of blood supply.

— For persons who go through red lights and windshields. Somebody with leukemia. Adults being operated on or into feudin' and fightin'. For persons who run into things.

— For hemophiliacs and daredevils alike. For persons undergoing dialysis or who fool around with guns. For open-heart surgery and cancer patients, and others with severe hepatitis.

In short, blood donors are good for many persons who are in a lot worse shape than most we know.

## Witnesses sought

Witnesses to the rear-end collision of a tan Honda Accord by a Douglas County dump truck on Titan Road at 7:20 a.m., Tuesday, March 27, 1984 are asked to contact Randy Schmidt, ext 3024.

# The best 10k by a dam site

The opening of one of the finest recreational areas in the Denver area begins at 9 a.m. Saturday, April 21 in Waterton Canyon with a 10-kilometer race to benefit the habitat of an unusual herd of Rocky Mountain bighorn sheep.

The race, broken down into eight separate age groups, will begin at the base of the new Strontia Springs Dam along the South Platte River and on into the historic town of Waterton (where the Kassler water treatment plant is located).

The race will be conducted by the Rocky Mountain Road Runners and is jointly sponsored by Martin Marietta, Coors, United Sportsmen's Council of Colorado, Jefferson County Schools, and the Rocky Mountain Bighorn Sheep Society.

The \$10 entry fee is tax deductible, and the money will go to continue the efforts

by Denver Aerospace, the U.S. Forest Service, the Denver Water Board, and the Colorado Wildlife Division to make long-term habitat improvements on the 5054-acre site at Martin Marietta. That project began in 1982 when some 30 acres were cleared for the remaining 18 to 20 bighorns that had survived a 1980 pneumonia epidemic that killed almost 80 percent of the then existing herd.

The result has been improved grazing and lambing areas, more accessible water, and greater protection from predators for the sheep because of increased visibility. There still is, however, considerable work to be done to make the habitat ideal for the majestic mountain creatures.

Details on the 10-kilometer event and entry forms are available from Recreation, and from the department's information racks throughout the company.

## Ten retirees notch 185-plus years

Ten employees have announced their retirement after an aggregate total of more than 185 years of service with Martin Marietta. Retirees, with the length of individual service, are:

Anthony Fria, 38 years/1 month; George

Von Vihl, 20/4; Hugh Hoover (Vandenberg), 14/3; Philip Vigil, 12/6; Virginia Bodemann, 26/10; Thomas Devlin (Vandenberg), 6/4; AnnaBelle Bruce, 15/11; Charles R. Thompson (Vandenberg), 6/5; Russ Hollister (Kennedy Space Center), 5/2; and Robert Ballard (Michoud), 40.



Norman R. Augustine, president of Denver Aerospace, has commended Canaveral operations in Florida for its 1983 United Way campaign effort. In a recent letter to Robert D. Rhodus, director, Augustine noted the "Cape Canaveral contingent racked up an impressive 96 percent employee participation level. That's terrific!" Interestingly enough, that figure is the same percentage Cape employees recorded during the 1982 campaign. Meanwhile, M. Lynn Johnson, employee relations administrator, and Richard A. Freeman, personnel manager, hold a plaque presented to Canaveral operations by the Treasury Department for "Patriotic service to the U.S. Savings Bonds program." The award recognizes the facility's 17 consecutive years of high employee participation in the bond program, averaging 98 percent overall. Treasury representatives John Bothelho, area manager, and Michael McKinney, area director, are on the respective flanks of the picture.