Ariane rocket moves into industrial phase

by Philippe Jamet and Laurent Rosenfeld

On June 15, at 13:19 hours European Time, the new Ariane-4 European Space Agency rocket took off from the Kourou, French Guiana launch complex, and put into a geostationary transfer orbit three satellites (Meteosat-P2, Amsat-3C,and Panamsat) representing a total weight of 3,200 kilograms (7,100 pounds). The successful launch of Ariane-4 is much more than just an improvement of the Ariane rocket family; it is a totally new phase in the development of the highly evolutionary European rocket, and beyond that, a new era for the European Space Agency: the age of industrial logistics.

For Europe, this launching symbolizes the maturity of the autonomous heavy launcher program started in 1973-74, whose obvious commercial success is based on the clever usage of several "windows" of commercial opportunity. At this time of extreme uncertainty about the future of the civilian space program in the United States, this independent European launch capability is of the utmost importance. The follow-on Ariane-5 rocket, will give Europe its first man-rated booster, which will carry the small shuttlecraft, Hermes, in the 1990s.

The Arianespace Corporation, which manufactures and markets the Ariane launcher, now enjoys a well-filled order backlog: About 25 future launches are already booked, representing 41 satellites and contracts for FF15 billion (U.S. $2.8 billion), plus about 20 reservations (not yet firm orders). The company, which has already started or planned the production of 21 rockets, is planning soon to produce 50 rockets simultaneously, in order to achieve economies of scale (reducing costs by 15-20%).

A big step forward

One of the efficient features of the Ariane program has been its ability to improve from the simple first generation Ariane-1 design, to the more complex and much more powerful Ariane-4, which was just tested successfully on June 15, through the intermediate Ariane-2 and Ariane-3 designs. At each phase of this development, improvements, such as the addition of strap-on auxiliary boosters, combined with increased thrust and boosting duration, and an increased size of the payload capacity have allowed the European rocket to launch larger and larger satellites. For example, in the recent past, going from Ariane-3 to Ariane-4 allowed a 400 kilogram (890 pound) increase in the payload, by adding two small strap-on solid propellant boosters to the first stage.

The development of Ariane-4, required by the coming on the market of larger and heavier satellites (Aussat, Insat, Intelsat-7, NATO-4), thus follows this general rule of the European space program. One should also not forget the role of international competition, which has forced the new European launch vehicle to obey a number of imperatives:

1) A significant increase of the launching capability, both in terms of the mass and the size of the payload. Technically, the basic engines remaining the same, this is obtained by lengthening the duration of the thrust (by increasing the quantity of fuel): The thrust of the first stage now lasts 210 seconds, compared to 135 in the case of Ariane-3. This, however, makes the rocket heavier, and, therefore, requires an increase of the thrust itself, obtained through the strap-on boosters.

2) The creation of a whole range of possible configurations, able to offer a wide array of mission types. The rocket has a modular design, which can use two types of boosters in various combinations, which gives the Ariane-4 rocket six different configurations, each with different payload capabilities. The boosters can be either solid propellant boosters, or more powerful liquid propellant ones, and the rocket can have the following configurations:

- Ariane-40: No strap-on booster; this configuration, roughly equivalent to Ariane-2, allows a payload of 1,900 kilograms into a geostationary transfer orbit (GTO);
- Ariane-42P: Two solid boosters; again, this configuration is roughly equivalent to Ariane-3, with a GTO performance of 2,600 kilograms;
- Ariane-44P: Four solid boosters (3,000 kg in GTO);
- Ariane-42L: Two liquid boosters (3,200 kg in GTO);
- Ariane-44LP: Two solid and two liquid boosters (3,700 kg in GTO); this is the model which has been successfully tested this time, on June 15;
- Ariane-44L: Four liquid boosters (4,200 kg to 4,300 in GTO).

The liquid propellant boosters use the same basic Viking engine as the main engines of the first stage, but adapted to the specific use conditions of a booster. The larger capability, more than four metric tons for the Ariane-44L configuration (as opposed to 2,600 kg for Ariane-3, the most powerful version so far) allows launching of the very large communications satellites now in use. Ariane-44L has a maximum take-off mass of 460 metric tons and a maximum height of 60.4 meters.

3) The generalization of double or triple launches (i.e., several satellites on the same rocket). Launching two or three satellites in the same launch obviously allows a sharp reduction of the launching cost per satellite.

Going from Ariane-3 to Ariane-4 is thus a very big step forward for the European Space Agency. It is in this context unfortunate and stupid that the Europeans are only concentrating on commercial success in this area, without planning any planetary probes.