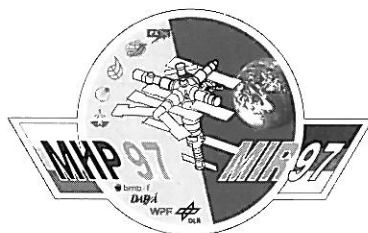


## TEST REPORT

# FORTIS OFFICIAL COSMONAUTS CHRONOGRAPH



Official Watch of the German  
Cosmonauts / Astronauts at Space Missions

## REPORT ON THE FORTIS CHRONOGRAPH TESTS HELD UNDER SPACE CONDITIONS

Various tests were carried out to check the space suitability of FORTIS Chronographs before using the watches in routine cosmonaut operations.

The tests were performed at the Yuri A. Gagarin Cosmonauts Training Centre in Star City near Moscow where 35 years ago Yuri Gagarin, the first man to venture into space, underwent the most rigorous endurance tests.

The technical specialists at this officially recognized training centre, whose long-standing experience in the reliable and successful preparation of manned space flights is also proving of benefit to the European Space Agency ESA for their latest EUROMIR mission, are responsible for proper completion of the tests.

Over a test period of around 6 months, the FORTIS Chronographs were exposed to various endurance tests. They were required to withstand both the simulated space conditions in the Cosmonauts Training Centre and routine use by the cosmonauts in space during various missions to the Russian space station orbiting the earth.

The FORTIS test watches reliably passed the endurance tests which simulated space conditions in the centrifuge, the pressure chamber, the hydrolaboratory and in weightlessness.

The FORTIS Chronographs proved their reliability inside and outside the space station on the wrists of the cosmonauts Talgat Mussabajew and Yuri Malentschenko. Both cosmonauts wore the FORTIS Chronographs over their spacesuits while carrying out essential maintenance work on the outer skin of the orbital station and in preparation of the docking manoeuvre with the American space shuttle Atlantis.

During this endurance test involving a total of more than 11 hours in the open space under vacuum conditions and extreme temperature fluctuations of between  $-200^{\circ}$  and  $+100^{\circ}$  centigrade, caused by work both in the earth's shadow and under direct solar irradiation, the FORTIS Chronograph was required to prove its space suitability.

As a result, the FORTIS Chronographs received a Russian diploma confirming their operability and high quality in extreme situations. Convinced of its reliable quality, the FORTIS Chronograph was declared the Cosmonauts Training Centre's „OFFICIAL COSMONAUTS CHRONOGRAPH“ and is one of the strictly specified equipment items.

Since its space premiere in the course of the European-Russian EUROMIR space mission in October 1994, the FORTIS OFFICIAL COSMONAUTS CHRONOGRAPH is handed over to the mission participants.

## RESULTS REPORT ON THE FORTIS OFFICIAL COSMONAUTS CHRONOGRAPH

Dr. Ulf Merbold, a German physicist and astronaut with extensive space experience was a member of the first space crew to receive the FORTIS OFFICIAL COSMONAUTS CHRONOGRAPH as part of the official equipment for the European-Russian EUROMIR space mission.

Besides a press conference given by ESA, the European Space Agency, Dr. Ulf Merbold reported on his experiences with the FORTIS Chronograph. He wore the chronograph for the duration of the EUROMIR mission and came to value it as a very reliable, useful and effective companion. For example, in daily fitness training it was used for stopping various training stages and other medical experiments in the space station.

Due to the orbiting velocity of 20,000 km per hour, the space station team experience sunrise and sunset 16 times in 24 hours. The wristwatch in this situation is the most important time orientation in relation to „earth time“. By virtue of the often diffuse lighting conditions on board the orbital station the chronograph indicator hands in neon orange, the large minute hand, the 24 hour indication and the strong luminosity of tritium-enhanced hands, numerals and indices proved to be particularly advantageous.

The seasoned space traveller also answered the burning question as to the operability of the automatic chronograph mechanism in the open space, for which up to now it was thought that only mechanical hand-winding watches were suitable. The FORTIS OFFICIAL COSMONAUTS CHRONOGRAPH ran smoothly throughout the entire 30 day mission from the launch in Baikonur to the landing in the Kazakh steppe. An additional manual winding was unnecessary.



General Yuri Glazkov, deputy Head of the Cosmonaut Training Centre, during the issuing of the FORTIS Cosmonaut Sets to Aleksandr Viktorenko, commander of the EUROMIR '94 mission and Dr. Ulf Merbold.

EXCERPTS FROM THE TEST CONDITIONS AND RECORDS

To simulate the pressure conditions arising in an elliptical orbit at an altitude of between 350 and 400 kilometers from the Earth, the FORTIS Chronographs were subjected to extreme negative pressure in a static state in the test chamber.

Within 160 seconds the normal air pressure of 760 Torr was lowered to only 40 Torr (40 mm Hg). The time interval corresponds to the length of the rocket climb into the earth's orbit. This test parameter was sustained for 10 minutes; the pressure was then equalized in 80 seconds.

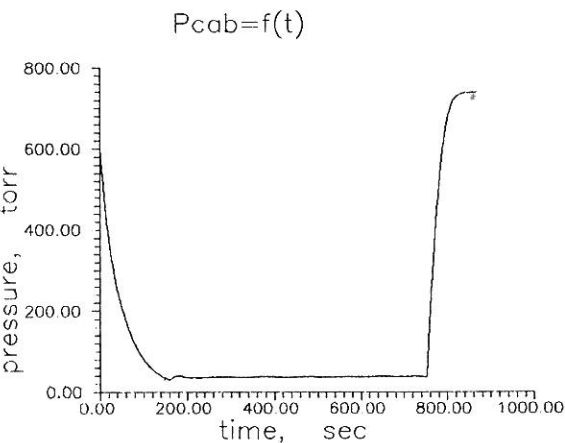


Рис. 1. График изменения давления в кабине.

Выводы: После воздействия вакуума в статическом режиме все часы сохранили прочность и работоспособность. Точность хода не проверялась.

ПРОТОКОЛ №1  
специальных испытаний наручных часов фирмы "FORTIS".

Программа испытаний: Проверка часов на прочность и работоспособность при создании вакуума в кабине в статическом режиме.

Результаты испытаний:  
Воздействию подвергались три вида часов, по два экземпляра каждого вида. График изменения давления в кабине представлен на рисунке 1. Результаты испытаний представлены в таблице 1.

Таблица 1. Результаты испытаний часов на прочность и работоспособность при создании вакуума в кабине в статическом режиме.

№ часов	Создаваемое давление	Время воздействия	Работоспособность после воздействия
11	40 мм.рт.ст	10 мин.	сохранилась
19	40 мм.рт.ст	10 мин.	сохранилась
31	40 мм.рт.ст	10 мин.	сохранилась
40	40 мм.рт.ст	10 мин.	сохранилась
53	40 мм.рт.ст	10 мин.	сохранилась
60	40 мм.рт.ст	10 мин.	сохранилась

In a further test stage, the operability and strength of the watches was tested with an overload of 6 g applied in the direction of all three axes and was proved successful. 6 g overload with 0.4 units/sec. Test time 1 minute.

After this successful test the overload was actually increased to 12 g, which corresponds to 12 times acceleration due to gravity: the result was perfect operability and no damage.

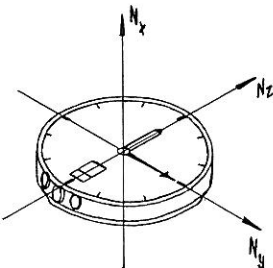
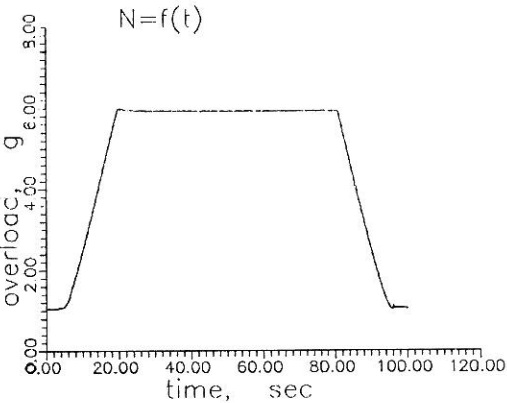


Рис. 2. Направление выбранных осей.

ПРОТОКОЛ №2  
специальных испытаний наручных часов фирмы "FORTIS".

Программа испытаний: Проверка часов на прочность и работоспособность при воздействии перегрузки в различных направлениях.

Результаты испытаний:  
Воздействию перегрузки величиной 6g в разных направлениях подвергались три вида часов, по пять экземпляров каждого вида. График изменения перегрузки представлен на рисунке 1. Направление осей показано на рисунке 2. Время воздействия 1 мин. Результаты испытаний представлены в таблице 1.

Таблица 1. Результаты испытаний часов на прочность и работоспособность при воздействии перегрузки в различных направлениях.

№ часов	Направление воздействия	Величина перегрузки	Градиент	Время воздействия
12	+Ny	6g	0.4	1 мин.
13	-Ny	6g	0.4	1 мин.
16	+Nx	6g	0.4	1 мин.
17	-Nx	6g	0.4	1 мин.
19	+Nx	6g	0.4	1 мин.
32	+Ny	6g	0.4	1 мин.
35	-Ny	6g	0.4	1 мин.
37	+Nx	6g	0.4	1 мин.
38	-Nx	6g	0.4	1 мин.

An extensive series of tests in a special TsF-18 centrifuge chamber was used to simulate both the 160 second climb into an orbit of 350 km as well as the ballistic return flight of the space capsule from orbit and its dehermeticization.

No faults or damage to the FORTIS test watches were observed, even with an acceleration effect of 12 g overload and simultaneous reduction of pressure to vacuum conditions of 40 mm Hg.

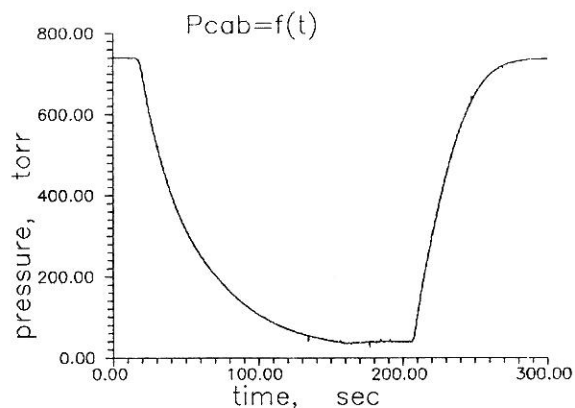
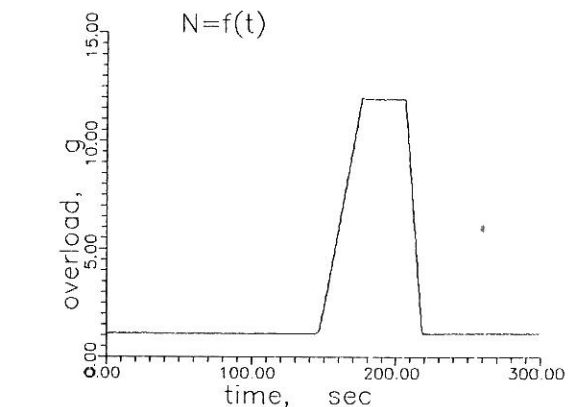


Рис.1 Графики изменения перегрузки и давления в кабине.

ПРОТОКОЛ №3  
специальных испытаний наручных часов фирмы "FORTIS"

Пункт программы испытаний: № 3.4 Проверка часов на прочность при моделировании нештатных ситуаций (баллистический спуск с орбиты и разгерметизация при спуске).

Результаты испытаний:

Воздействию перегрузки величиной 12g в разных направлениях с одновременным созданием вакуума в кабине подвергались три вида часов, по два экземпляра каждого вида. Графики изменения перегрузки и давления в кабине представлены на рисунке 1. Направление осей показано на рисунке 2. Результаты испытаний представлены в таблице 1.

Таблица 1. Результаты испытаний часов на прочность и работоспособность при моделировании нештатных ситуаций (баллистический спуск с орбиты и разгерметизация при спуске).

№ часов	Направление воздействия	Величина перегрузки	Градиент	Создаваемое давление	Время воздействия
18	+Nx	12g.	0.4g/c.	40 мм.рт.ст	30с.
19	+Nx	12g.	0.4g/c.	40 мм.рт.ст	30с.
39	+Ny	12g.	0.4g/c.	40 мм.рт.ст	30с.
40	+Nz	12g.	0.4g/c.	40 мм.рт.ст	30с.
59	+Nz	12g.	0.4g/c.	40 мм.рт.ст	30с.
60	-Nz	12g.	0.4g/c.	40 мм.рт.ст	30с.

Начальник отдела

Ведущий инженер по испытаниям

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