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# Selection of Astronauts/ Medical Issues: The 1992 Canadian Astronaut Selection

## ABSTRACT

In 1993, the Canadian Space Agency selected four new astronaut candidates. The Canadian Forces Medical Services provided the medical screening. The medical standards applied were those published by NASA for Mission Specialist selection. Medical screening was carried out in three progressively intensive phases. Phase 1 consisted of a specially designed medical questionnaire. Phase 2 was a screening aircrew medical, carried out at a Canadian Forces medical unit. Phase 3 comprised an intensive one-week outpatient medical screening at the National Defence Medical Centre in Ottawa. This screening replicated the NASA procedures for Mission Specialist selection and ensured that Canadian candidates selected would not be screened out later during medical certification by NASA.

Of the 337 who entered Phase 1 medical screening, 159 (47%) were medically disqualified by the end of Phase 3 (109, or 68%, of these were for vision/ophthalmologic reasons). Other reasons for disqualification included a migraine history, hearing deficits, cardiac disorders discovered with echocardiography, reactive airways disease, chronic sinusitis, and an abnormal electroencephalogram.

## RÉSUMÉ

En 1993, l'Agence aérospatiale canadienne a choisi quatre nouveaux candidats astronautes. Le Service de santé des forces canadiennes effectue le filtrage qui s'impose selon les conditions publiées par la NASA pour la sélection des spécialistes de mission. Le filtrage médical a été effectué selon trois phases intensives. La phase 1 comprenait un questionnaire médical spécialement conçu à cet effet. La phase 2 consistait en une visite médicale de filtrage des équipages de bord à l'Unité médicale des forces canadiennes. Pour la phase 3, les candidats devaient subir un filtrage intensif en tant que patients extérieurs au centre médical de la Défense nationale à Ottawa. Ce filtrage reprenait les procédures de sélection des spécialistes de mission de la NASA et assurait que les candidats canadiens ne seraient pas éliminés plus tard au cours de la certification par la NASA.

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## INTRODUCTION

In 1991 a decision was made by the Canadian Space Agency (CSA) to recruit four new astronauts. In January 1992, the CSA ran advertisements in Canadian newspapers inviting applicants for astronaut selection. A commercial selection agency (Selectra) was contracted to co-ordinate and supervise the selection process in consultation with the CSA. As in the 1983 selection process, the Canadian Forces Medical Service (CFMS) was requested and agreed to carry out the medical screening and selection procedures.

The response to the advertisements was overwhelming. Over 5,000 applications were received before the January 26, 1992 deadline. Over the next four months, an intensive selection process narrowed the field, and on June 6 four new astronauts were introduced to the Canadian press and public.

This paper describes the medical aspects of the screening process, including the medical standards and procedures used in selection.

## THE MEDICAL SELECTION PROCESS

### Standards

In 1989-90, the Canadian Space Agency participated with NASA and other international partners in the Space Station to develop medical procedures and standards for astronaut and Space Station duties. The selection process involved initial medical selection in the home country, then later joint medical certification at NASA/Johnson Space Center. Three levels of medical standards were defined: Pilot (class I); Mission Specialist (class II); and Payload Specialist (class III).

From the onset, the decision was made by the CSA that the 1992 selection would be based on the Mission Specialist medical standards. This differed from the 1983 selection, where the less stringent standards for Payload Specialist were used. The decision was based on the possibility of future employment of Canadian astronauts on shuttle or space station missions in a Mission Specialist role.

NASA Medical Standards for Mission Specialist are specified in NASA Publication JSC-24834,<sup>1</sup> and include uncorrected visual acuity of 20/150 or better correctable to 20/20 in each eye, near vision correctable to 20/20, and hearing thresholds under 30DB 500-2000 Hz and under 50DB at 4000

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Des 337 candidats retenus pour le filtrage médical de la phase 1, 159 (47 p. cent) ont été disqualifiés pour des raisons médicales à la fin de la phase 3 (pour 109, 68 p. cent, les causes étaient d'ordre ophtalmologique ou concernaient la vision). Les autres raisons de disqualification étaient des antécédents de migraine, des faiblesses auditives, des désordres cardiaques découverts par l'échocardiographie, des affections respiratoires réactionnelles, de la sinusite chronique et un électroencéphalogramme anormal.

Hz. Maximum and minimum height are 148.6 cm to 193 cm, and weight limits are specified based on height, age, and gender.

### The Process

Approximately 5330 responses were received to the advertisements. These were screened by Selectra, and 630 were selected for further screening. Once these responses were returned, 339 were identified for further selection, including medical screening. Responses from these resulted in identification of 107 candidates, who underwent an interview process with Selectra, including psychological profiling. The medical selection process involved three phases:

- Phase 1. Questionnaire;
- Phase 2. Preliminary medical examination; and
- Phase 3. Final medical selection.

All three phases were carried out by the Canadian Forces Medical Services.

#### Phase 1: Questionnaire

The questionnaire included 59 items designed to screen for any serious medical problems that would clearly disqualify the individual and to confirm that the applicant's visual acuity met or was at least close to the Mission Specialist visual standards of 20/150. Questionnaires were sent out with applications and returned in a separate, sealed confidential envelope to the CSA. These sealed envelopes were forwarded to the Medical Assessment Section at the Defence and Civil Institute of Environmental Medicine for Flight Surgeon review. The CSA (Selectra) was then informed as to whether an applicant was medically fit or unfit for further selection.

#### Phase 2: Preliminary Medical Examination

Based on the Selectra interviews, 53 candidates underwent a preliminary medical examination at a Canadian Forces Medical Unit. Seven CFMS medical units participated in this screening to offer coast-to-coast accessibility. These units were CFH Esquimalt (Victoria, BC), CFB Calgary, DCIEM (Toronto), CFB Uplands (Ottawa), CFB Montreal (St. Hubert), CFH Valcartier (Quebec City), and CFB Shearwater (Halifax).

The Phase 2 medical screening was scheduled to coincide with the candidate interview process by representatives from the Canadian Space Agency and Selectra. The medical screening was essentially a basic aircrew medical and included a physical examination, visual acuity, audiogram, chest x-ray, and electrocardiogram. Results of these medicals were forwarded to DCIEM for review.

#### Phase 3: Final Medical Selection

Based on the Phase 2 medical screening and selection by Selectra and the CSA, 20 finalists were selected for an intensive week of screening in Ottawa. This included extensive medical investigations, which were carried out at the National Defence Medical Centre. The medical testing encompassed all the requirements for Mission Specialist screening, so that once the final four were selected, the CSA could be fairly certain that their chosen candidates would pass the NASA medical certification process. The procedures included in Phase 3 selection are shown in **Table 1**.

## RESULTS

The results at each level of screening are shown in **Figure 1** and **Tables 2, 3, and 4**.

In Phase I screening (questionnaire), 43% of the applicants were medically disqualified, primarily for vision. The NASA requirements for Mission Specialist selection are 20/150 in each eye, and many potential candidates did not meet this standard. The second most common reason for disqualification

**Table 1.**  
**Phase 3 Medical Screening Procedures.**

Clinical	NASA Aeromedical Questionnaire Physical examination by Flight Surgeon Flexible sigmoidoscopy TB skin test
Radiology	Chest, sinuses Abdominal ultrasound Mammogram
Cardiology Pulmonary	Pulmonary function tests Resting ECG Exercise treadmill test Echocardiogram Holter monitor
ENT	Audiogram Tympanogram Specialist clinical examination
OPHTHO	Acuity, colour vision, depth, phorias, tonometry, visual fields, slit lamp, retinal examination
Neurology	Electroencephalogram
Dental	Clinical examination, panorex x-rays
Psychiatry	Psychiatric interview
Laboratory	Extensive assessment following NASA guidelines: hematology, biochemistry, immunology (including HIV and hepatitis screen), endocrinology, urinalysis, 24-hour urine chemistry, microbiology (stool, urine, urethral, vaginal cultures) Drug screen

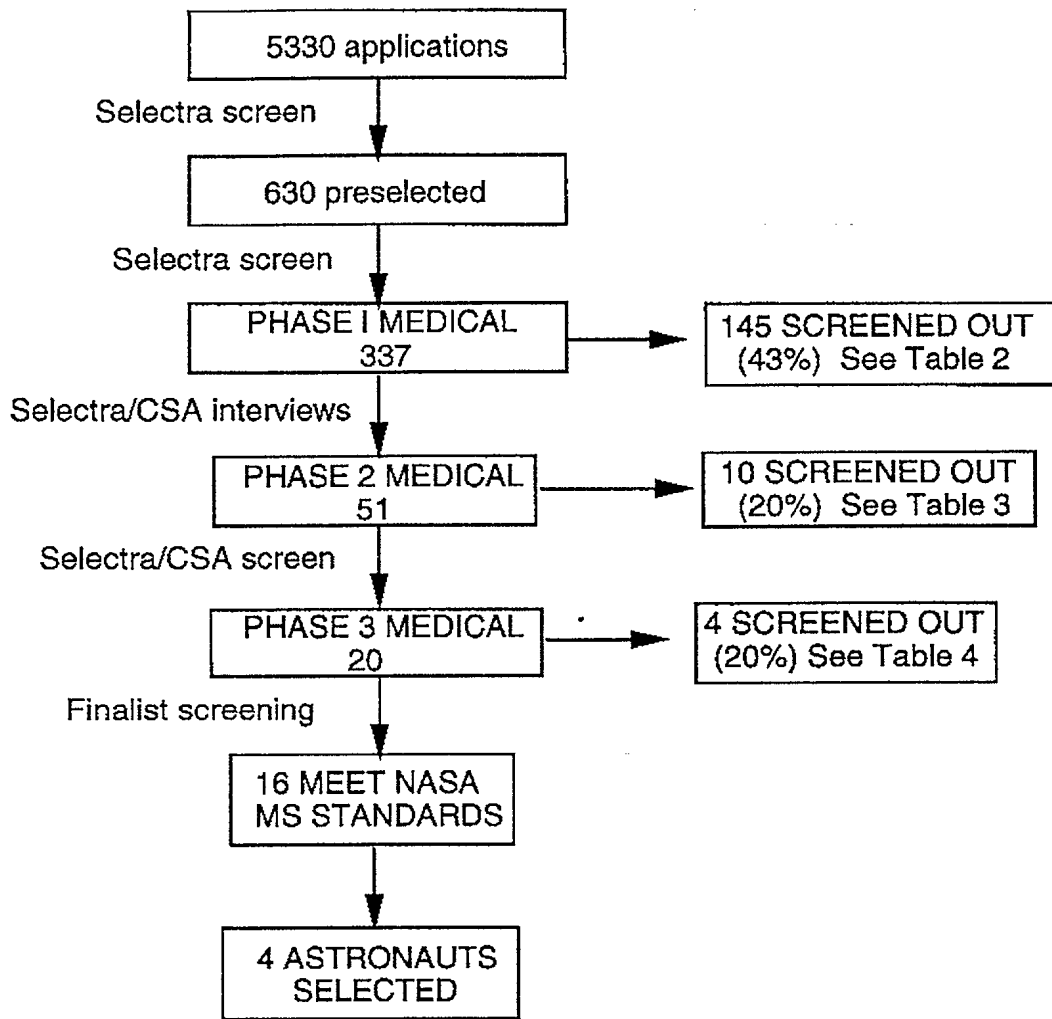


Figure 1.  
Flow diagram showing selection of four astronauts from 5,330 initial responses.

was a history of migraine headaches (this is disqualifying based on the NASA/International Partner medical standards).

Of the 51 candidates who underwent Phase 2 medical screening at a Canadian Forces medical unit, 10 (19.6%) were found to have disqualifying medical conditions (Table 3). Although echocardiography was not routinely part of Phase 2 screening, those candidates who came to DCIEM for Phase 2 did have an echocardiogram since this procedure was available and would be applied in Phase 3. Three candidates were found to have disqualifying cardiac conditions on echocardiography at DCIEM. Visual acuity disqualified another three, and two candidates were found to have asthma of sufficient severity to disqualify them.

Of the 20 finalists who underwent extremely intensive medical screening at the National Defence Medical Centre, only four were found to have medically disqualifying problems. However, in addition to the definite medical disqualifications in Phase 3, a number of medical findings required further investigation or clarification including ophthalmologic findings (retinal), hemato-

logic findings (C-protein deficiency), and abnormal exercise stress test requiring an exercise thallium study.

## DISCUSSION

Astronaut selection is an extremely intensive (and expensive process), the aim of which is to select out individuals with medically disqualifying conditions or a significant risk of serious future disease. The cost of this intensive medical screening is estimated to be approximately \$75,000.

Since Canadian manned access to space is through NASA, Canadian astronaut selection is intricately interwoven with NASA medical standards. A second aim is to ensure that our astronauts will meet all NASA medical requirements and not be later disqualified medically during medical certification at NASA.

For the 1992 Canadian astronaut selection, over the course of four months, 337 potential candidates were funnelled into



three increasingly intensive levels of medical screening. Of the 337 who entered Phase 1 medical screening, 159 (47%) were medically disqualified by the end of Phase 3. Of these, 109 (68%) were for vision/ophthalmologic reasons. Other causes such as asymptomatic cardiac problems were surprisingly uncommon.

The medical screening process became increasingly resource-intensive through each stage. Phase 1 required the part-time employment of a single Flight Surgeon. Phase 2 involved Canadian Forces medical units from coast to coast. Resources included Canadian Forces Physician's Assistants and Medical Officers as well as laboratory and x-ray facilities to provide 51 screening medicals.

Phase 3 screening effectively required the dedication of a significant portion of the total resources of a large general hospital (National Defence Medical Centre) for a five-day period. It would be extremely difficult, if not impossible, to

dedicate resources and co-ordinate such intensive screening in such a short time period in a non-military hospital.

Was the overall selection process successful? One of the four astronauts chosen resigned from the program shortly after selection on learning he was not assigned for immediate Mission Specialist training. A replacement was chosen from the remaining candidates. From a medical perspective, one was later found to have a medically disqualifying condition that was not discovered or disclosed during the selection process. However, all three other astronauts successfully passed NASA Mission Specialist medical certification, and Canadian astronauts are accepted as respected professionals at NASA.

Should the screening process be repeated or changed for future Canadian astronaut selections? Publication of visual requirements as part of the initial application process might disincline application by candidates whose vision is clearly below standard. A more formally structured psychiatric interview technique might ensure more uniform screening. Otherwise, the medical selection process is well organized and sufficiently comprehensive to ensure Canadian astronauts are healthy and can meet NASA medical requirements. ✱

**Table 2.**  
**Reasons for Phase 1 Medical Disqualification.**  
(Total screened = 337)

Reason	Number	Percent of D/Qs
Vision	105	72.4
Migraine history	12	8.3
Thyroid disorders	5	3.4
Ears/hearing	4	2.7
Lungs/asthma	3	2.1
Misc.: Hodgkin's, MS, Crohn's, ulcers, nephrectomy, seizures, obesity, vertigo	16	11
Total	145	100

**Table 3.**  
**Reasons for Phase 2 Medical Disqualification.**  
(Total screened = 51)

Reason	Number	Percent
Cardiac	3	30
Vision	3	30
Asthma	2	20
Neurologic	1	10
Obesity	1	10
Total	10	100

**Table 4.**  
**Reasons for Phase 3 Medical Disqualification.**  
(Total screened = 20)

Reason	Number	Percent
Chronic sinusitis	2	50
Ophthalmologic	1	25
Abnormal EEG	1	25
Total	4	100

## REFERENCES

<sup>1</sup>NASA Astronaut Medical Standards: Selection and Annual Medical Certification, JSC-24834, June 1991.

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