

# A REPORT ON THE SACH FOOT

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In an attempt to solve many of the problems associated with the use of articulated ankle joints with the Syme stump, the Prosthetic Services Centre of the Canadian Department of Veterans' Affairs in 1952 developed a plastic socket with an extension, or keel, around which neoprene crepe shoe sole material was glued and shaped to form a foot (Fig. 1). Plantar flexion was afforded by compression of the crepe wedge under the keel and the keel extended to a point which permitted the crepe material in the toe to flex to yield the equivalent of a toe joint. Inspired by the success of the Canadians, workers at the University of California, who had felt that a foot without an ankle joint was desirable for conservation of energy during locomotion, adapted the principles of the Canadian device to a separate unit that could be used for all lower-extremity amputations at a higher level. Wood was used for the keel and the wedge-shaped heel cushion was fashioned from laminations of crepe rubber in order to decrease the amount of bulge occurring as a result of compression upon heel contact. A bolt through the keel was used to fasten the unit to the shin.

After extensive testing the UC design, which came to be known as the SACH foot (solid-ankle, cushion-heel) (Fig. 2), was released for general use in 1957, and three manufacturers began to make the SACH foot available to specifications developed by the Veterans Administration Prosthetics Center.

In an attempt to determine to what extent the SACH foot is being used and what problems, if any, were arising as a result of the SACH foot, the Committee on Advances in Prosthetics developed a questionnaire (Appendix "A") which was mailed to all members of the Association.

Questionnaires were received from ninety-nine prosthetics facilities. Of these only two firms reported that they had no experience with the SACH foot.

## Use of Sach Foot by Amputation Type

A table showing the number of firms reporting the percentage of use of the SACH foot by amputation level is given below:

Percentage use reported	1-9%	10-29%	30-69%	70-89%	90-100%
Symes -----	19	3	8	5	42
BK -----	8	19	16	11	39
AK -----	10	11	13	15	37
HD -----	14	8	11	4	32

For each amputation level more firms reported fitting 90 - 100% of their cases than for any other category. Nearly half the firms reporting are using SACH feet for most of their lower-extremity fittings.

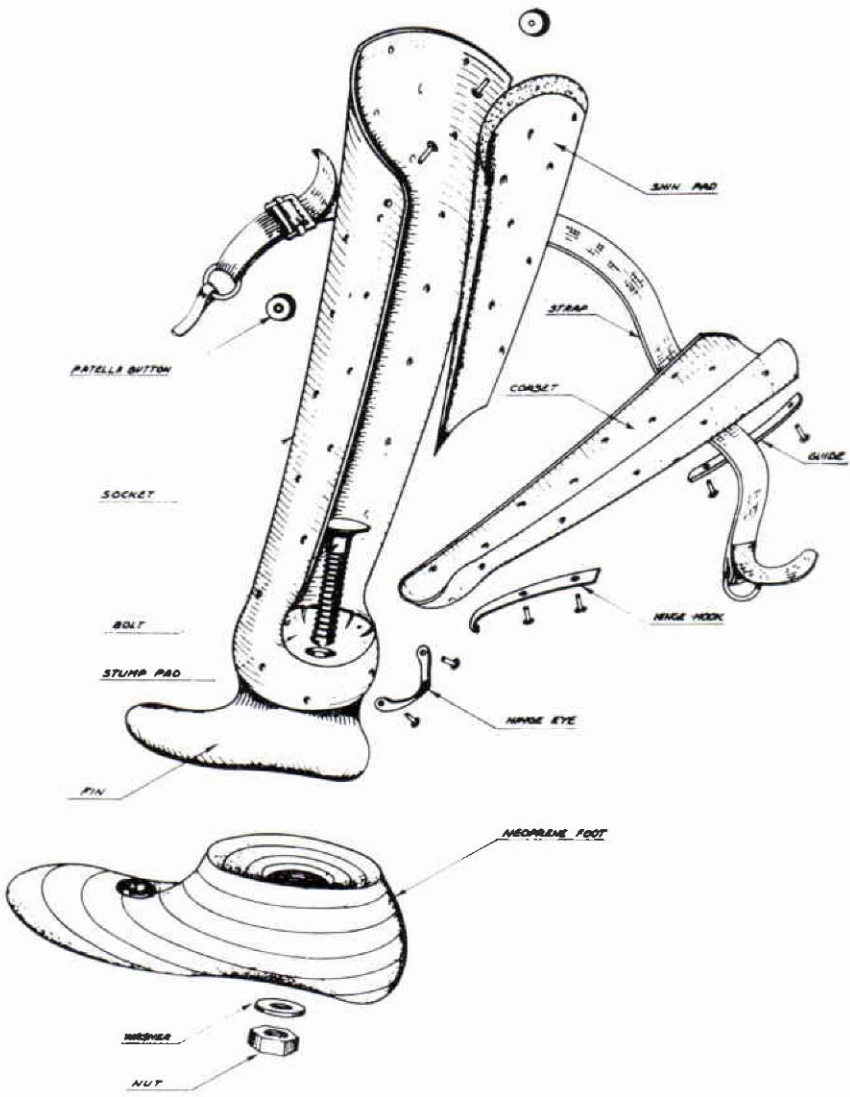


Fig. 1. Early version of a plastic prosthesis developed by the Prosthetic Services Center, Department of Veterans' Affairs, Canada. Note the fin, neoprene foot, and lack of an ankle joint. Courtesy of the Department of Veterans' Affairs, Canada.

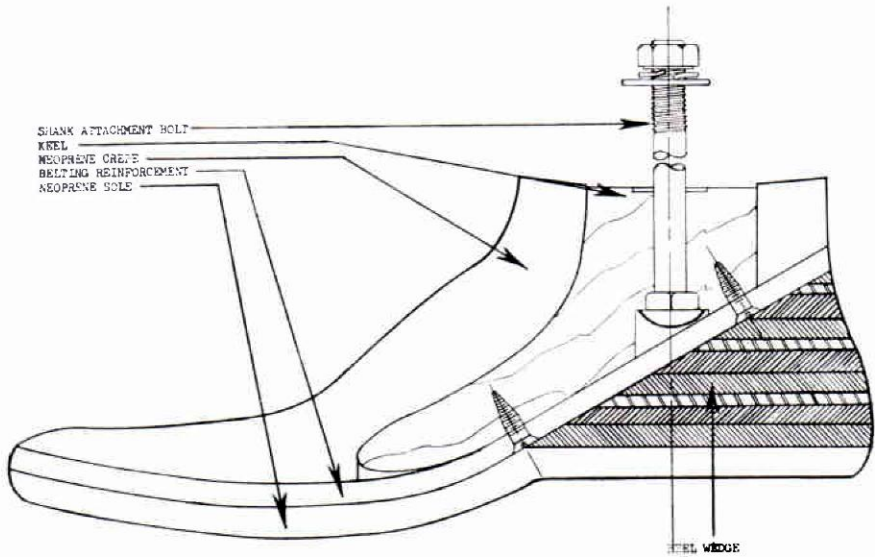


Fig. 2. Cross-section view of the SACH Foot. Courtesy of "Artificial Limbs."

### Use of Sach Foot with Respect to Men, Women, and Children

A breakdown of the number of firms reporting percentages of SACH foot fittings with respect to men, women, and children pretty well follows the pattern of the breakdown with respect to amputation level. The one significant point perhaps is the fact that a greater percentage of women are fitted with the SACH foot than are either men or children.

Percentage use reported	1-9%	10-29%	30-69%	70-89%	90-100%
Male -----	7	13	15	16	31
Female -----	9	4	13	12	45
Children -----	11	6	10	5	39

### Source of Units Used

In reference to the question concerning whether the units used were purchased or made in the shop, 86 reported that they used the commercially available unit, 3 make all their own, 5 reported making some and buying some, and 3 purchase all except those for the Syme prosthesis.

### Fitting, Aligning, and Adjusting

Fifty-eight respondents declared they encountered no problems in fitting, aligning, and adjusting the SACH foot while 35 reported that they did.

A tabulation of the problems reported and number of shops reporting

they had these problems is given below. No one problem seems to be much greater than the others.

PROBLEMS	Number of Shops Reporting	
	Frequently	Occasionally
Fitting the Shoe -----	6	17
Achieving adequate fore-and-after position.---	8	12
Selection of appropriate heel cushion -----	7	16
Fairing to shank -----	5	8
Other -----		9

### Maintenance

Fifty-nine of the respondents felt that maintenance problems were significant while 34 felt they were not.

A tabulation of the problems reported and the number of shops reporting each problem is given below:

PROBLEMS	Number of Shops Reporting	
	Frequently	Occasionally
Breakage of keel -----	7	35
Delamination of the rubber -----	22	28
Curling of the toe -----	22	24
Packing of heel cushion -----	11	14
Breakage of the attaching stud -----	2	19
Noise resulting from delamination of belting.---	23	27
Breakage of belting -----	3	10
Other -----		

In response to the question, "With respect to maintenance, how does the SACH foot compare with other types of feet in general use?", seventy-three reported less maintenance for the SACH foot, 10 felt that the maintenance required was about the same and 9 reported that more maintenance was required.

### Fitting Failures

- 30 facilities reported no fitting failures.
- 31 " " 1% or less fitting failures.
- 18 " " 2.5% fitting failures.
- 13 " " 10% or more fitting failures.
- 14 facilities reported failures were predominately in cases below 55 fitted initially with SACH foot.
  - 1 facility reported that failures were predominately in cases over 55 fitted initially with the SACH foot.
- 33 facilities reported failures were predominately in cases below 55 that changed to the SACH foot.
- 12 facilities reported failures were predominantly in cases above 55 that changed to the SACH foot.

### Fitting of Bilateral Cases

To the question, "In your opinion should SACH feet be fitted to bilateral cases?" shops replied as follows:

	Yes	No
BK - BK	60	26
BK - AK	46	31
AK - AK	35	43

### Comments Offered

Most of the respondents offered some comment and aside from the fact that most felt it could and should be used in most cases the only remark that seems to be of significance statistically is "Not suitable for heavy-duty use." This was offered eight times.

A tabulation of the comments of a critical nature and those offering indications and contraindications for prescription are given below:

- Not for BK with flexion contracture because of adjustment problem. 1
- Trouble fitting high heel shoes. 3
- Too heavy. 1
- New amputees are best suited to SACH. 5
- Not suitable for heavy duty use. 8
- Good for use where waterproofing is necessary. 5
- Not enough heel action—too much toe action. (Toe break too far posterior.) 1
- For active people. 1
- Not waterproof. 2
- Objectionable Color. 2
- Poor finish. 1
- Not for older people. 1
- Good for older people. 3

### Preliminary Conclusions

A punch card was made up for each shop reporting in an effort to correlate the data offered. Nothing of significance was uncovered. No types of fitting and alignment problems could be correlated with types of maintenance problems, etc.

The SACH foot is now in widespread use, and although 61% (59 shops) of the respondents felt that maintenance problems were "significant," 75% (73 shops) reported that less maintenance was required for the SACH foot than for other types in general use.

Slightly larger percentages of Syme and BK cases were fitted with the SACH foot, but all levels of leg amputation are being fitted successfully.

These findings do not, of course, mean that the SACH foot is the best foot than can be developed or that the manufacturers should not attempt to improve on the quality of the present product. It also might be in order to review the present fitting instructions to determine if additions or modifications could be introduced that might be helpful to prosthetists that are encountering some trouble in fitting.

The data given above was discussed during the 1959 National Assembly of the Orthopedic Appliance and Limb Manufacturers Association by a panel consisting of Kenneth C. Kingsley, Howard R. Thranhardt, C.P., Donald Colwell, C.P., and Charles Hennessy, C.O., C.P. The discussion brought out the following points:

1. The manufacturers all agreed that the total troubles were less than 1% of the feet produced.
2. The heel collapsing trouble has been rectified by using another type of rubber in the heel cushion.
3. The noisy feet due to unsaturated belting has been corrected by the substitution of a high grade rubber belting for balata belting.
4. The keel breakage has been helped by the use of the reverse bolt.
5. The bolt breakage was thought to be 100% the result of the prosthetists not realizing that the depression around the bolt was a shear relief. When this is ground off or filled with epoxy, the bolt can be sheared. Proper education should help eliminate this problem.

Appendix "A"

**1959 NATIONAL SURVEY — SACH FOOT**

*Conducted by the Committee on Advances in Prosthetics of OALMA*

Name of Firm ----- Date -----  
 Street Address -----  
 City -----

1. Have you had experience with the SACH Foot? Yes -----  
 No -----

2. If the answer is yes, please estimate the percentage of the following amputees you fit with SACH feet in your current practice:

Syme	-----	%
Below-Knee	-----	%
Above-Knee	-----	%
Hip-Disarticulation	-----	%
Male	-----	%
Female	-----	%
Children	-----	%

3. Do you use the SACH foot as commercially available, or do you make your own?

4. Have you encountered problems in fitting, aligning, and adjusting the SACH foot?

Yes -----

No -----

If the answer is yes, please check the appropriate boxes below:

Frequently Occasionally

Fitting the Shoe -----

Achieving adequate fore-and-aft position -----

Selection of appropriate heel cushion -----

Fairing to shank -----

Other (please state) -----

5. Have you encountered significant maintenance problems with the SACH foot?

Yes -----

No -----

If the answer is yes, please check the appropriate boxes below:

Frequently Occasionally

Breakage of keel -----

Delamination of the rubber -----

Curling of the toe -----

Packing of heel cushion -----

Breakage of the attaching stud -----

Noise resulting from delamination of belting -----

Breakage of belting -----

Other (please state) -----

6. With respect to maintenance, how does the SACH foot compare with other types of feet in general use?

More maintenance required than with the other types -----

About the same maintenance required as with the other types -----

Less maintenance required than with the other types -----

7. What percent of SACH foot wearers have had to change to another type of foot?

8. Did the "failures" occur predominately in one of the classes of amputees listed below?

If the answer is yes, please check.

Fitted initially with SACH foot, below 55 -----

Fitted initially with SACH foot, over 55 -----

Changed to SACH foot, below 55 -----

Changed to SACH foot, over 55 -----

9. In your opinion should SACH feet be fitted to the following classes of bilaterals?

Yes No

BK - BK -----

BK - AK -----

AK - AK -----

10. Please give us your general comments concerning the SACH foot, especially in reference to when it should be used.

Note: A signature or name below is optional.

If you prefer your answer to be confidential, leave space blank.

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 Name of person who filled out this form.