



A Publication
of Reliable Methods
for the Preparation
of Organic Compounds

Working with Hazardous Chemicals

The procedures in *Organic Syntheses* are intended for use only by persons with proper training in experimental organic chemistry. All hazardous materials should be handled using the standard procedures for work with chemicals described in references such as "Prudent Practices in the Laboratory" (The National Academies Press, Washington, D.C., 2011; the full text can be accessed free of charge at http://www.nap.edu/catalog.php?record_id=12654). All chemical waste should be disposed of in accordance with local regulations. For general guidelines for the management of chemical waste, see Chapter 8 of Prudent Practices.

In some articles in *Organic Syntheses*, chemical-specific hazards are highlighted in red "Caution Notes" within a procedure. It is important to recognize that the absence of a caution note does not imply that no significant hazards are associated with the chemicals involved in that procedure. Prior to performing a reaction, a thorough risk assessment should be carried out that includes a review of the potential hazards associated with each chemical and experimental operation on the scale that is planned for the procedure. Guidelines for carrying out a risk assessment and for analyzing the hazards associated with chemicals can be found in Chapter 4 of Prudent Practices.

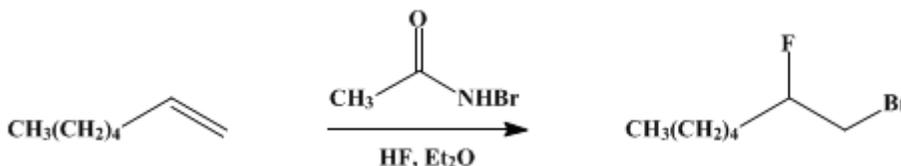
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These paragraphs were added in September 2014. The statements above do not supersede any specific hazard caution notes and safety instructions included in the procedure.

Organic Syntheses, Coll. Vol. 5, p.136 (1973); Vol. 46, p.10 (1966).

1-BROMO-2-FLUOROHEPTANE

[Heptane, 1-bromo-2-fluoro-]



Submitted by F. H. Dean, J. H. Amin, and F. L. M. Pattison¹.

Checked by P. B. Sargeant and B. C. McKusick.

1. Procedure

Caution! Hydrogen fluoride is very hazardous. All operations must be carried out in a hood, and the precautions outlined in (Note 1) should be followed.

A 1-l. polyethylene bottle is fitted with a three-holed rubber stopper. Three lengths of 0.25-in. (6-mm.) stiff polyethylene tubing extend through the stopper into the bottle. One length of tubing serves as an inlet tube for dry **nitrogen**, which is monitored by first bubbling through mineral oil. The second tube, the gas-outlet tube, carries a polyethylene drying tube packed with indicating Drierite[®]. These tubes extend only about 2 cm. into the bottle. The third tube serves as an inlet for anhydrous **hydrogen fluoride** and extends halfway into the bottle; it is connected to a hydrogen fluoride cylinder by a short length of Tygon[®] tubing secured to the cylinder outlet by **copper** wire. The bottle contains a Teflon[®]-covered magnetic stirring bar.

The bottle is flushed with dry **nitrogen**, and a slow stream of **nitrogen** passes through the bottle during all subsequent operations to ensure the exclusion of atmospheric moisture (Note 2). **N-Bromoacetamide** (80 g., 0.58 mole) is added (Note 3). The bottle is cooled in a mixture of dry ice and **acetone**, and 250 ml. of anhydrous **ether** is added with efficient magnetic stirring. About 100 g. (100 ml., 5 moles) of anhydrous **hydrogen fluoride** is allowed to condense into the bottle with magnetic stirring (Note 4). This requires about 2 hours.

1-Heptene (49 g., 0.50 mole) (Note 3) is mixed with 50 ml. of anhydrous **ether**. The solution is added during 20 minutes through what was originally the nitrogen inlet; the hydrogen fluoride inlet now serves as the nitrogen inlet. The reaction mixture is stirred in the dry ice bath for an additional 4 hours. The dry ice bath is replaced by an ice bath, and the mixture is stirred for 40 minutes. It is then allowed to stand overnight in a mixture of dry ice and **acetone** in a Dewar flask.

A solution of 690 g. (5.0 moles) of **potassium carbonate** in 2 l. of distilled water is prepared in a 4-l. polyethylene beaker or pail, and 500 g. of crushed ice and 300 ml. of **ether** are added. The cold reaction mixture is cautiously added to the carbonate solution with stirring. The pH of the aqueous layer becomes about 9. The **ether** layer is separated, and the aqueous layer is extracted with three 200-ml. portions of **ether**. The **ether** solutions are combined and washed with three 100-ml. portions of water. The **ether** solution is dried over anhydrous **sodium sulfate**, and the **ether** is removed by distillation. The oily residue is fractionated through a 15-cm. Vigreux column under reduced pressure. There is a fore-run of about 0.5 ml., and then 59–75 g. (60–77%) of **1-bromo-2-fluoroheptane** is collected at 70–78° (15 mm.); n_D^{25} 1.4408–1.4420. According to vapor phase chromatography, it is about 90% pure (Note 5).

2. Notes

1. Because of the hazardous nature of anhydrous **hydrogen fluoride**, *adequate precautions should be taken to protect the head, eyes, and skin*. Use of rubber gloves, an apron, and a plastic face mask is

strongly recommended. All operations should be carried out in a hood. After completion of the reaction, all equipment should be washed with liberal quantities of water. A bottle containing [magnesium oxide](#) paste in [glycerin](#) should be available in case of emergency. *Note! Burns caused by hydrogen fluoride may not be noticed for several hours, by which time serious tissue damage may have occurred.*

The checkers recommend that, if [hydrogen fluoride](#) comes in contact with the skin, the contacted area be thoroughly washed with water and then immersed in ice water while the patient is taken to a physician.

2. Moisture or inefficient stirring reduces the yield considerably.

3. Satisfactory sources of chemicals are: [N-bromoacetamide](#), Arapahoe Chemicals, Boulder, Colorado; [1-heptene](#), Aldrich Chemical Co.; [hydrogen fluoride](#), Matheson Co.

4. The amount of [hydrogen fluoride](#) is not critical. The amount of [hydrogen fluoride](#) may be estimated by condensing in enough to increase the volume of the reaction mixture by 100 ml.

5. According to vapor phase chromatography in a 6-ft. column at 150° over silicone grease, the product contains about 8% of one impurity and 2% of another. It is sufficiently pure for conversion to [2-fluoroheptanoic acid](#).²

3. Discussion

[1-Bromo-2-fluoroheptane](#)³ has been prepared only by the present procedure, which is similar to one described by Bowers and co-workers.⁴

4. Merits of the Preparation

The method is general for forming *vic*-bromofluorides, which in turn are useful intermediates; this is exemplified in their conversion to 2-fluoroalkanoic acids.² The procedure can be applied, with minor modification, to many types of alkenes.³

This preparation is referenced from:

- [Org. Syn. Coll. Vol. 5, 580](#)
- [Org. Syn. Coll. Vol. 5, 1135](#)

References and Notes

1. Department of Chemistry, The University of Western Ontario, London, Ontario, Canada.
 2. [F. H. Dean, J. H. Amin, and F. L. M. Pattison, this volume, p. 580.](#)
 3. [F. L. M. Pattison, D. A. V. Peters, and F. H. Dean, *Can. J. Chem.*, **43**, 1689 \(1965\).](#)
 4. [A. Bowers, L. C. Ibáñez, E. Denot, and R. Becerra, *J. Am. Chem. Soc.*, **82**, 4001 \(1960\).](#)
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Appendix

Chemical Abstracts Nomenclature (Collective Index Number); (Registry Number)

[potassium carbonate](#) (584-08-7)

[ether](#) (60-29-7)

[glycerin](#) (56-81-5)

[sodium sulfate](#) (7757-82-6)

nitrogen (7727-37-9)

hydrogen fluoride (7664-39-3)

copper (7440-50-8)

acetone (67-64-1)

magnesium oxide

N-Bromoacetamide (79-15-2)

1-Bromo-2-fluoroheptane,
Heptane, 1-bromo-2-fluoro- (1786-32-9)

1-Heptene (592-76-7)

2-Fluoroheptanoic acid (1578-58-1)