



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](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.

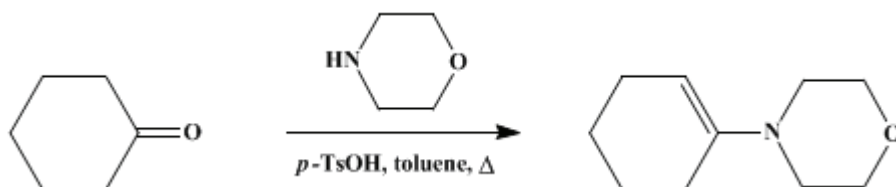
The procedures described in *Organic Syntheses* are provided as published and are conducted at one's own risk. *Organic Syntheses, Inc.*, its Editors, and its Board of Directors do not warrant or guarantee the safety of individuals using these procedures and hereby disclaim any liability for any injuries or damages claimed to have resulted from or related in any way to the procedures herein.

*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.808 (1973); Vol. 41, p.65 (1961).*

## 1-MORPHOLINO-1-CYCLOHEXENE

[Morpholine, 4-(1-cyclohexenyl)-]



Submitted by S. Hünig, E. Lücke, and W. Brenninger<sup>1</sup>.

Checked by B. C. McKusick and F. E. Mumford.

### 1. Procedure

A solution of 147 g. (1.50 moles) of [cyclohexanone](#), 157 g. (1.80 moles) of [morpholine](#) ([Note 1](#)), and 1.5 g. of [p-toluenesulfonic acid](#) in 300 ml. of [toluene](#) is heated to boiling in a 1-l. round-bottomed flask to which is attached a water separator<sup>2</sup> under a reflux condenser. The separation of water begins at once and ceases after 4 or 5 hours. An indented Claisen stillhead is attached to the flask, and the reaction mixture is distilled. Most of the [toluene](#) is removed at atmospheric pressure. [1-Morpholino-1-cyclohexene](#) is collected as a colorless liquid at 118–120°/10 mm.;  $n_D^{25}$  1.5122–1.5129 ([Note 2](#)). It weighs 180–200 g. (72–80%).

### 2. Notes

1. An excess of [morpholine](#) is required because the water that separates during the reaction always contains a considerable amount of it in solution.
2. [1-Morpholino-1-cyclohexene](#) is very easily hydrolyzed. Accordingly one must be careful to keep moisture out. On long standing in a refrigerator, the compound generally becomes somewhat yellowish, but this does not affect its usefulness in subsequent reactions.

### 3. Discussion

The procedure is that of Hünig, Benzing and Lücke.<sup>3</sup> It is based on earlier work on the preparation of enamines.<sup>4,5</sup>

### 4. Merits of Preparation

This is a general method of preparing enamines from a secondary aliphatic amine and [cyclohexanone](#) or [cyclopentanone](#). Acylation of such enamines is the first step in a general procedure for increasing the chain length of a carboxylic acid by 5 or 6 [carbon](#) atoms and of a dicarboxylic acid by 10 or 12 [carbon](#) atoms.<sup>6</sup> Alkylation of enamines of cyclohexanones by alkyl halides<sup>5,7</sup> or electrophilic olefins,<sup>8</sup> followed by hydrolysis, is a good route to  $\alpha$ -monoalkylcyclohexanones. The chemistry of enamines has been reviewed.<sup>9</sup>

This preparation is referenced from:

- [Org. Syn. Coll. Vol. 5, 533](#)
- [Org. Syn. Coll. Vol. 5, 869](#)

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### References and Notes

1. University of Marburg, Marburg, Germany.

2. S. Natelson and S. Gottfried, *Org. Syntheses*, Coll. Vol. **3**, 381 (1955).
  3. S. Hünig, E. Benzing, and E. Lücke, *Ber.*, **90**, 2833 (1957).
  4. M. E. Herr and F. W. Heyl, *J. Am. Chem. Soc.*, **74**, 3627 (1952); **75**, 1918 (1953).
  5. G. Stork, R. Terrell, and J. Szmuszkowicz, *J. Am. Chem. Soc.*, **76**, 2029 (1954).
  6. S. Hünig, E. Lücke, and E. Benzing, *this volume*, p. 533; *Ber.*, **91**, 129 (1958); S. Hünig and E. Lücke, *Ber.*, **92**, 652 (1959); S. Hünig and W. Lendle, *Ber.*, **93**, 909, 913 (1960).
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  8. G. Stork and H. K. Landesman, *J. Am. Chem. Soc.*, **78**, 5128 (1956).
  9. J. Szmuszkowicz., *Advan. Org. Chem.*, **4**, 1 (1963).
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**Appendix**  
**Chemical Abstracts Nomenclature (Collective Index Number);**  
**(Registry Number)**

Cyclohexanone (108-94-1)

carbon (7782-42-5)

toluene (108-88-3)

Cyclopentanone (120-92-3)

morpholine (110-91-8)

1-Morpholino-1-cyclohexene,  
Morpholine, 4-(1-cyclohexenyl)- (670-80-4)

p-toluenesulfonic acid (104-15-4)