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Aircraft Propeller Handbook

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Aircraft Propeller Handbook

CHAPTER I. INTRODUCTION

General Considerations

Objectives

(1) *Purpose.* This handbook has been prepared for use as a general guide in consideration of some of the most common problems associated with design, construction and use of both military and commercial aircraft propellers. Therefore, as an "ANC" document, it contains material which is acceptable to the Air Force, Navy, and Civil Aeronautics Administration (CAA) of the Department of Commerce. Specifically, it has been prepared for the following purposes:

(*a*) To acquaint aeronautical newcomers with problems of design, manufacture, and use of propellers to meet objectives of the Air Force, Navy, and CAA.

(*b*) To summarize and present propeller practices which have been found to be reasonably satisfactory.

(*c*) To present, where possible, the reasons for current propeller practices so that sound procedures will not be ignored through lack of understanding, or employed needlessly and possibly even detrimentally, where inapplicable.

(*d*) To stress the importance of airworthiness and safeness in propellers.

(2) *Use of the handbook.* It is not the purpose of this handbook to supplant propeller specifications. The handbook is an adjunct to specifications in that it is designed to furnish general background from which propeller specifications have emerged. In all cases, specifications applicable and made a part of particular contracts will take precedence. Those specifications cannot be subrogated by stipulations within this handbook. This handbook has not been designed to serve as a textbook.

Scope

It should be understood, of course, that methods, procedures, and techniques applicable to propeller design, development or testing, other than those outlined herein, may be acceptable provided those practices have been substantiated properly and adjudged, by the responsible governmental agency, to serve Government interests most adequately.

In a sense, this handbook is but a progress report of the state of propeller art. It is intended that basic findings will be presented for guidance, but that present practices, as presented herein, will not restrict in any manner development of new propeller designs and methods of fabrication or testing.

Airworthiness

(1) *Definition.* Airworthiness consists of two basic criteria; namely, structural safeness and functional achievement. Even though a propeller can deliver the required thrust with no more than the allowable drag or power consumption, it is of little value if it is not structurally sound and safe to use. This combination of safeness and capacity for functional accomplishment will determine airworthiness of a propeller.

(2) *Safeness.* The matter of safeness receives such an enormous amount of attention because propellers are a potential source of tremendous damage should they fail structurally. Like most aircraft items, propellers must be designed with minimum weight as a prime consideration; hence, propeller materials will be worked under highly stressed conditions.

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From Pages 276-277 Automatic Feathering Equipment Operating Characteristics

It should be noted that automatic feathering, as applied to reciprocating engines, is required and designed for use only during takeoff, when immediate feathering of a failed engine is of prime importance, and human delays or mistakes in diagnosing a power loss can be fatal. The propeller auto-feathering system automatically feathers the propeller of an engine in event of failure after takeoff power has been applied. The system operates by automatically causing an appropriate manual feathering button to be drawn in to feathering position if engine torque pressure falls to 40 p.s.i. or below after the throttles have been advanced beyond a position corresponding to 45 inches manifold pressure. The system is powered by direct current through an auto-feather switch, a torque pressure switch at each engine, and microswitches in the pedestal quadrant that close as the throttles are advanced. If torque pressure at one of the engines later falls, due to failure, or, if in some airplanes, power is reduced with the throttle, the torque pressure switch will close and connect direct current to a solenoid and holding coil at the corresponding manual feathering button. The feathering button will be drawn in and the propeller will automatically feather. A green indicator light shows when the auto-feather switch is turned to ON position and remains lighted until the propeller has been automatically or manually feathered, or until the auto feather switch has been moved to OFF, as is normally done after power has been reduced, following initial climb. The system will not feather a second propeller if one propeller has already been feathered either automatically or manually. A test system is provided for testing auto-feather operation prior to takeoff.

The autofeather system is provided for use during takeoff only. The system is armed by turning the autofeather switch to ON just before takeoff. If torque pressure drops to 40 p.s.i. or less after the power has once been advanced beyond 70 p.s.i. torque pressure on some airplanes, or 45 p.s.i. torque pressure on most airplanes, and beyond 45 inches Hg manifold pressure, the controlled propeller will be feathered automatically. One autofeathering operation disarms the system to prevent inadvertent autofeathering of another propeller in event of a power reduction below 40 p.s.i. torque pressure. Manual feathering of a propeller also disarms the autofeather system.

In addition, a time delay mechanism is placed between the torque sensing device and the auto-feather relay which prevents automatic feathering as a result of momentary power loss, such as that caused by engine back-fire.