

# Foreword

This illustrated manual has been prepared for the light aircraft enthusiast who may or may not be his own designer-builder. The primary purpose in creating this illustrated manual is to allow the individual to have a ready reference at hand, graphically illustrating the basic requirements for the proper design details, and to allow them to be put into practical use.

One cannot over-emphasize the importance of accuracy in aircraft design detail. It should be understood and impressed upon the reader that a finished aircraft is composed of many thousands of detailed designed parts, and it is self-evident that even if one minute part is poorly made or installed the results can, and often are, disastrous. In many cases of structural or mechanical failures discovered during ground or inflight operations, the final report of the Federal Aviation Agency investigation will identify the failure due to a single or a combination of poorly designed or installed parts. However, it should be mentioned that all heavier-than-air craft are designed with predetermined safety factors, and these are certainly subject to maximum and minimum operating limitations. Obviously, if the aircraft is operated above or below these established design limits, there is the strong probability of failure, and this cannot be blamed on the design.

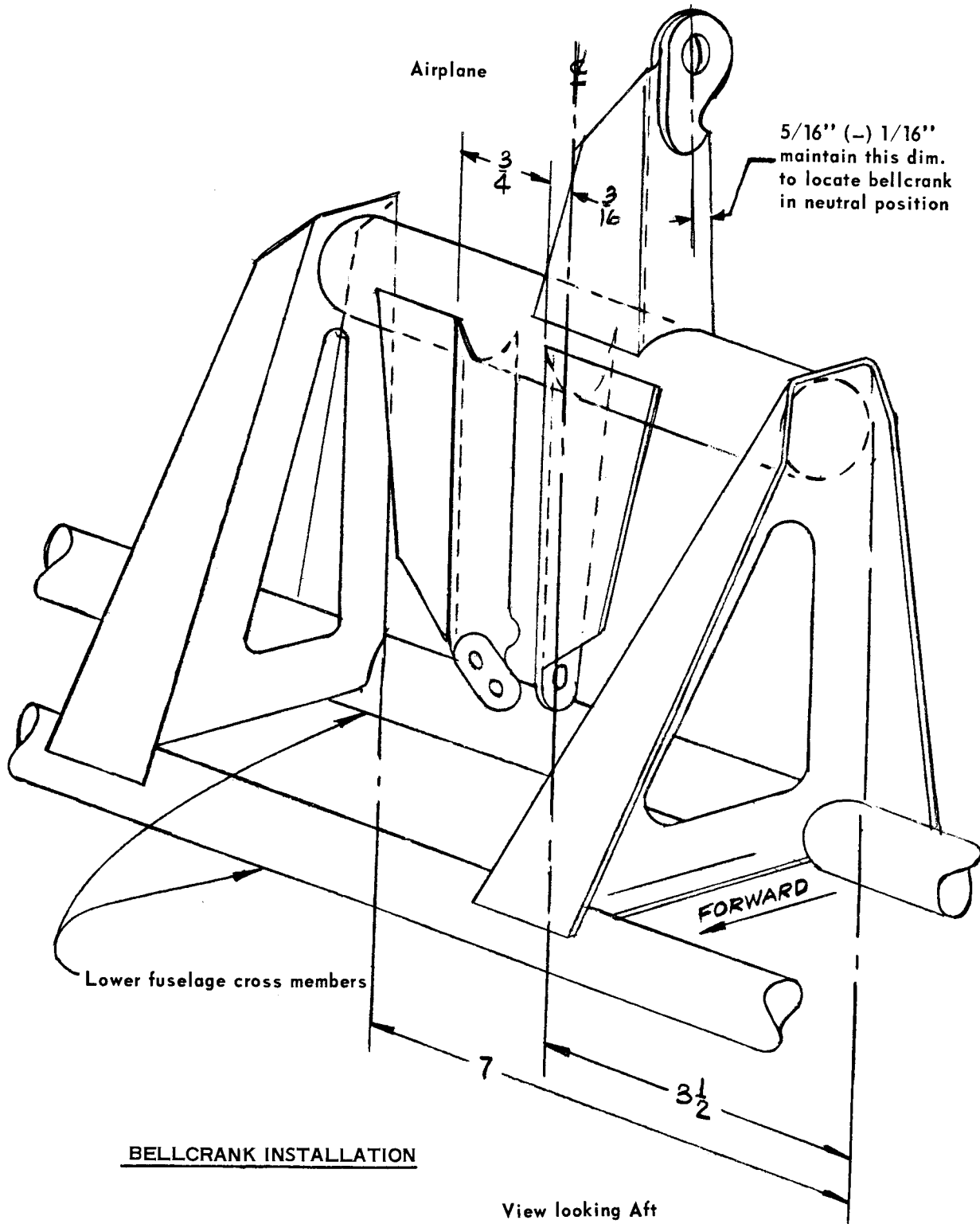
A qualified designer who has designed racing or acrobatic aircraft has successfully met all of the design requirements to withstand the high speed and the abrupt flight maneuvers to which that craft will be subjected to. Unfortunately, this should not influence the designer of the light or ultralight fun-sport-pleasure aircraft into saying, "I will design and build my plane only for good VFR flying weather because my aircraft will not encounter the high stress loads of an acrobatic or racing plane." This reason is false and you could be dead wrong. Sooner or later all aircraft will be subjected to some unanticipated abuses, such as rough terrain, abrupt flight maneuvers to avoid ground or airborne obstacles, violent weather conditions, hard landings, etc. This does not imply that proper light plane design means a "beefed up" design is the solution. The most common fault of the poor design is one that the builder-designer has over-designed his aircraft, usually the result of insufficient knowledge or experience.

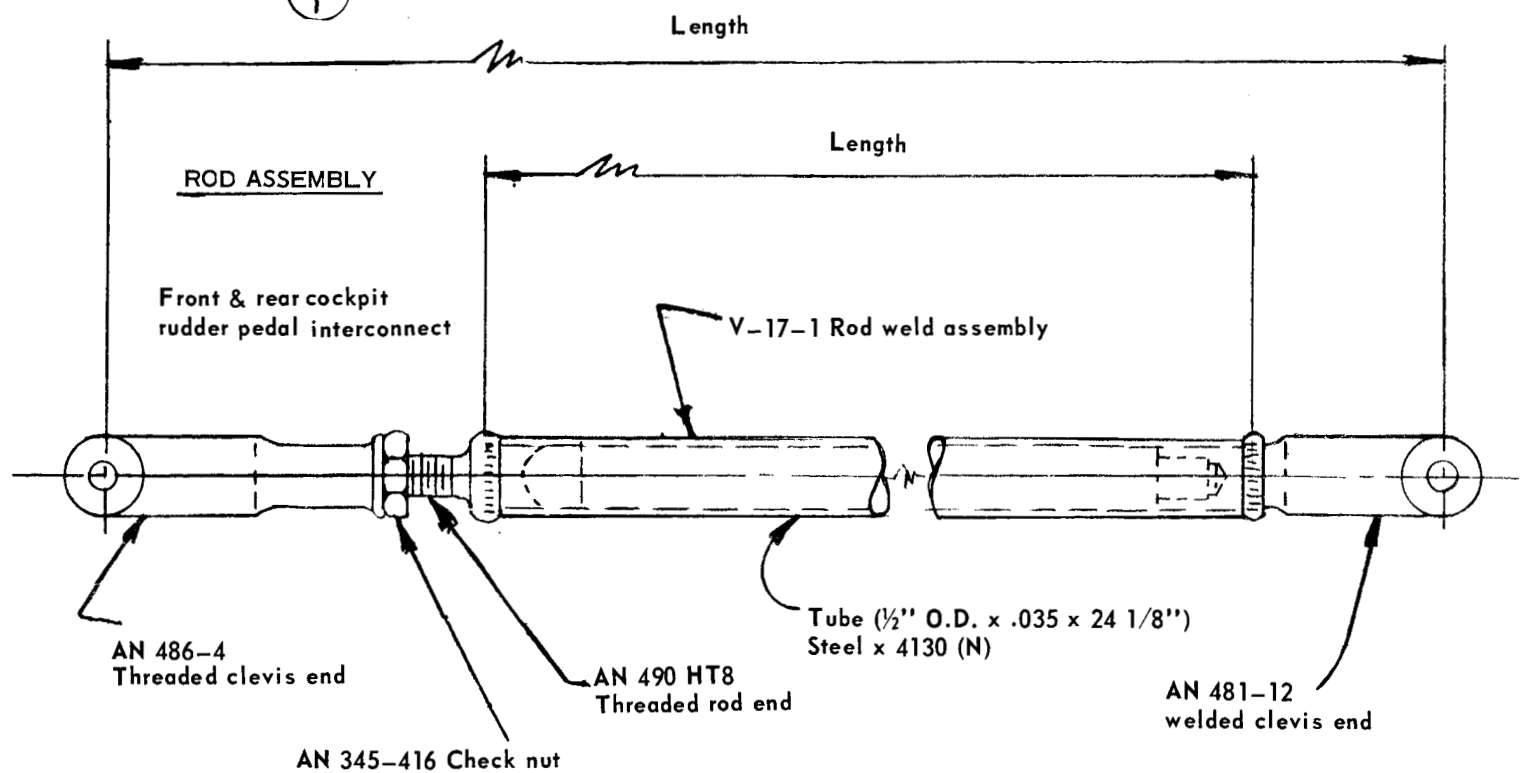
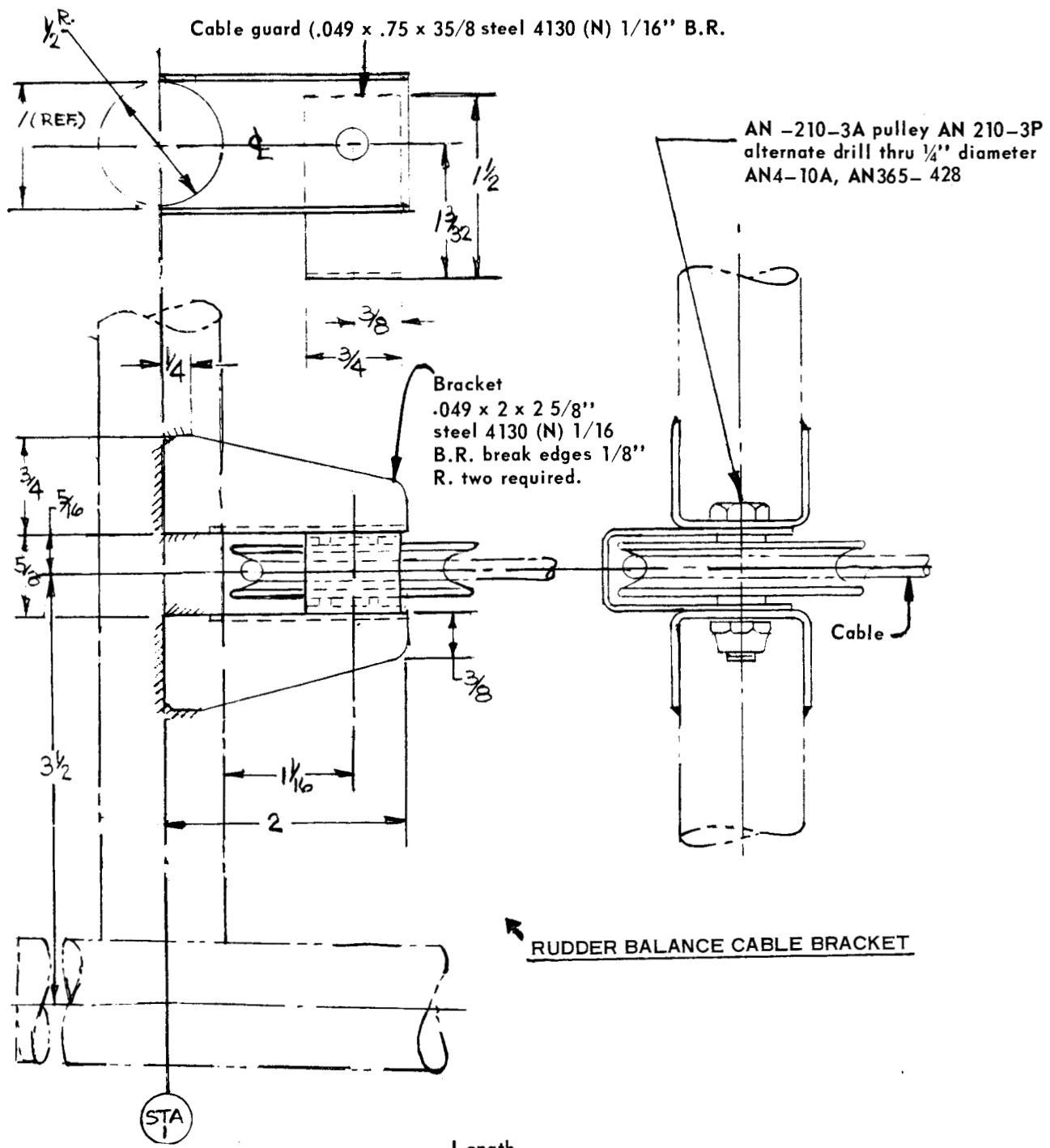
The secret of a correct design is the total elimination of unnecessary materials without sacrificing strength. The cardinal rule is

that the strength-to-weight ratio must be kept high. In certain areas of the design the removal of metal from critical points may result in a more uniform stress distribution of many other critical parts. The designer must always realize the benefits from precise design since the potential reduction in weight and consequent increase in reliability is of vital importance. The failure of a poorly designed part normally occurs in the region of a localized stress point or at concentrations of stress points. It is therefore the rule of aircraft designers to give extremely close attention to those parts where local stress is the greatest. This is especially true where conditions of fluctuating loads exist.

For a better understanding of proper design practices, it should be clearly recognized exactly what are stress points. Many are the result of improper design such as notches, sharp corners, abrupt changes in sections, inadequate fillets, grooves, re-entrant angles, keyways, screw threads, and thin fins. Others are the insidious types resulting from poor execution of design, inferior machining, tool marks, scratches and undercutting adjacent to bolt heads or flanges on parts subject to high stresses. It is virtually impossible to construct any practical aircraft without some localized stress, on the other hand, no aircraft part can be designed if these stress points are ignored. Anyone contemplating an aircraft "design build" project should make himself very familiar with the basic fundamentals of aircraft, aerodynamics, structures, mechanics, and the selection of aircraft hardware, with special emphasis given to the quality of the hardware items. Before any project is started the designer-builder should be very well acquainted with texts on these subjects, and the study time spent on the basics may save hundreds of hours of building time. An ability to learn, study, analyze problems, and apply fundamental principles must be developed before construction is started. This volume is restricted by a manual of this nature to each of the various fundamentals. It is the sincere hope and recommendation of the author that the individual may be stimulated to pursue related technical literature available from other sources.

I would like to express my gratitude and appreciation to the following who have been a great assistance in the preparation of this manual: Mr. Gordon G. Gregg, design draftsman; Mr. Nick E. D'Apuzzo, noted aircraft design engineer; the National Aeronautics and Space Administration; and the Van Dusen Aircraft Supply Company.





Shaded areas may be removed if additional operational clearance is required.

Airplane

NOTE

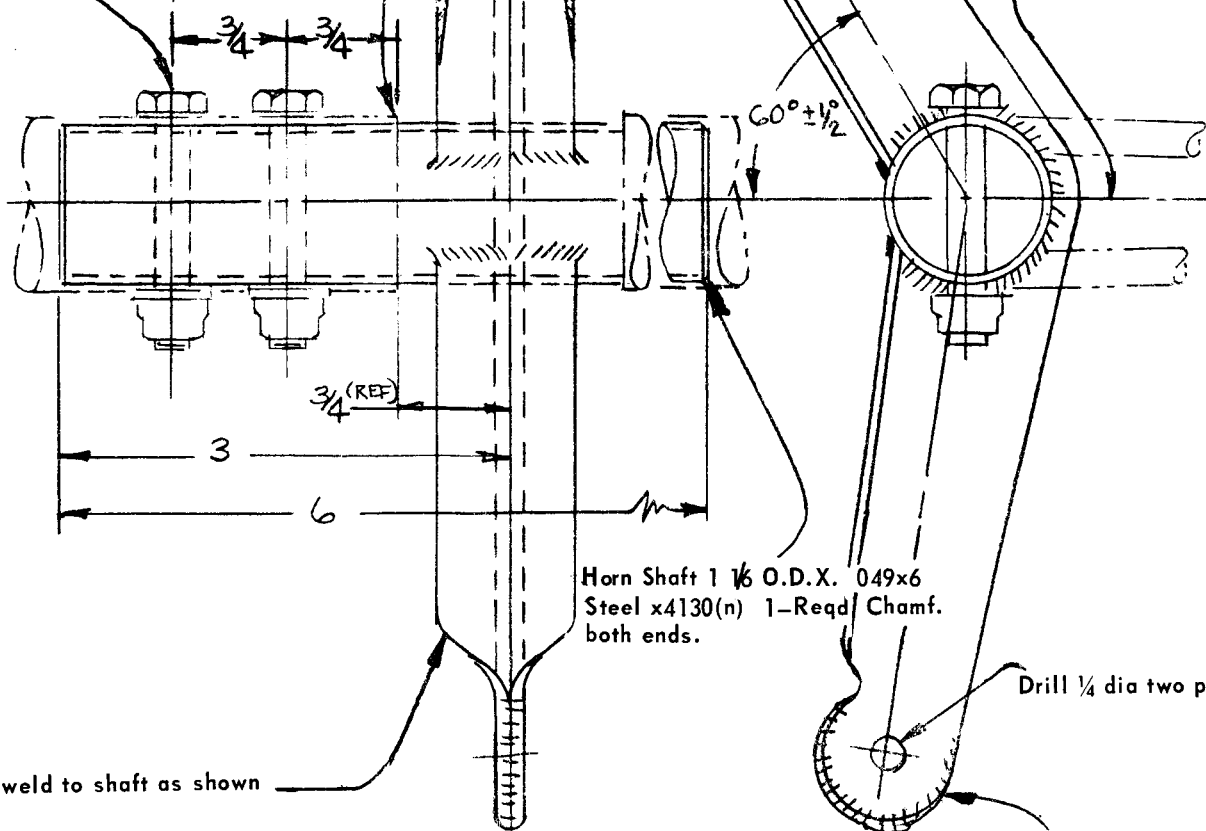
Ream I. D. of Elevator Spar to permit slip fit of shaft (both elevators) O. D. of H-10-1 Shaft may be ground or machined to fit elevator spar as alternative method.

Inboard end of Elevator Spar

Assemble Horn to shaft with long arm up.

Drill D (.246) Dia. 4 Places thru elevator spars and HGQO Assy. at angle shown AN4-15A(4) AN960-416(4) AN365-428 4- reqd.

Elevator



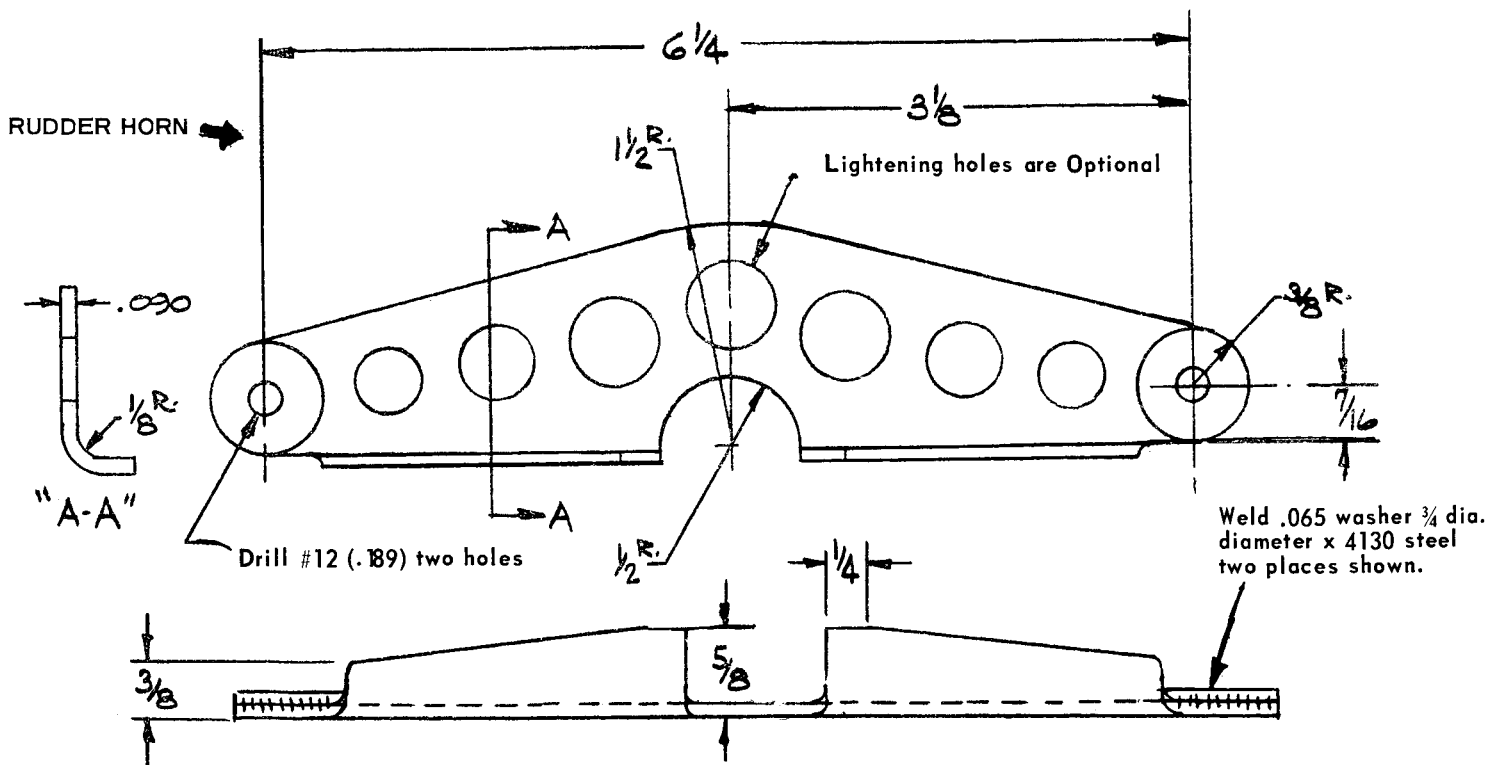
Horn Shaft 1/16 O.D. X .049 x 6 Steel x4130(n) 1-Reqd/ Chamf. both ends.

Drill 1/4 dia two places

Horn weld to shaft as shown

Weld as shown in two places.

**ELEVATOR HORN ASSEMBLY AND INSTALLATION**



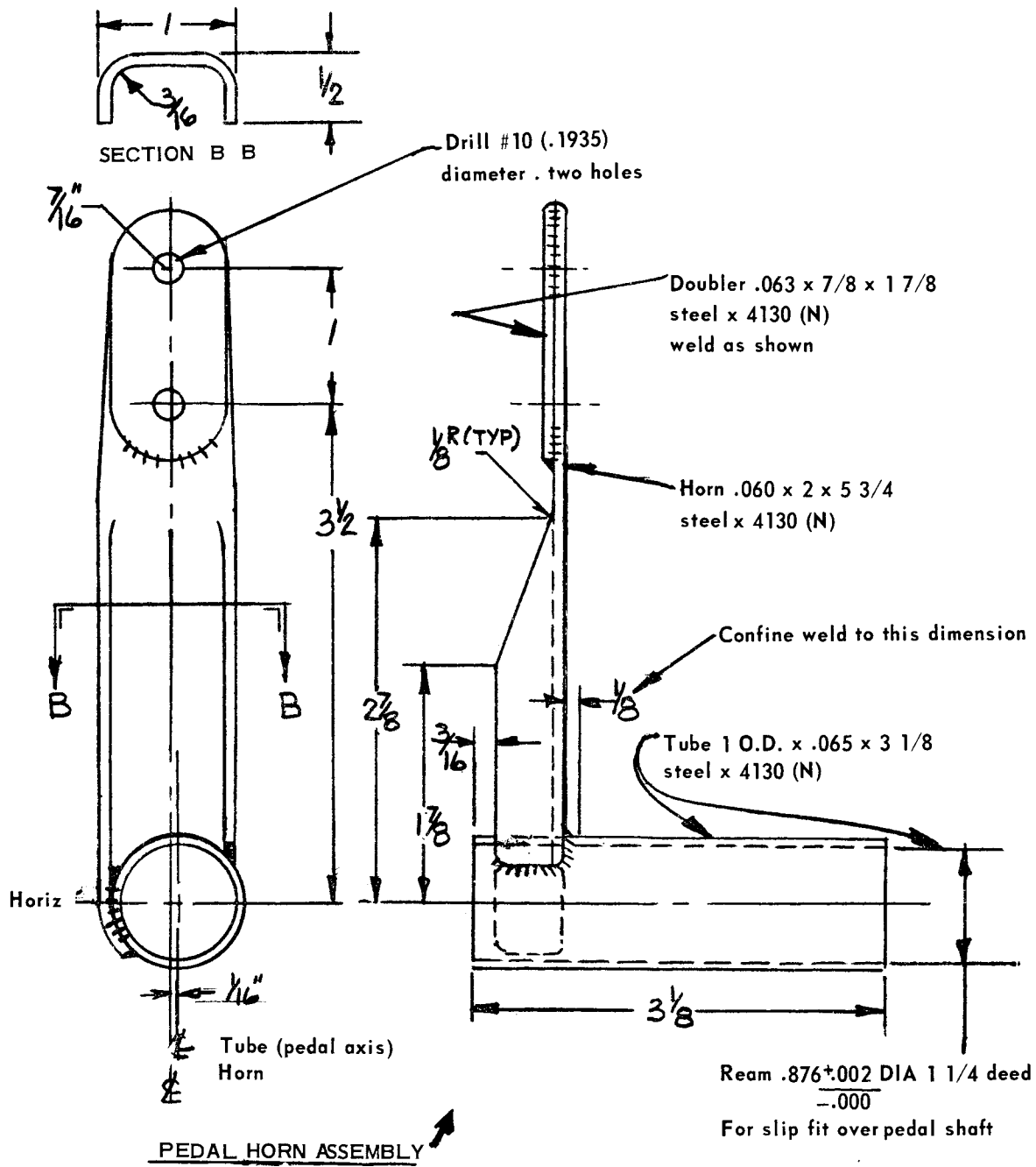
RUDDER HORN

Lightening holes are Optional

"A-A"

Drill #12 (.189) two holes

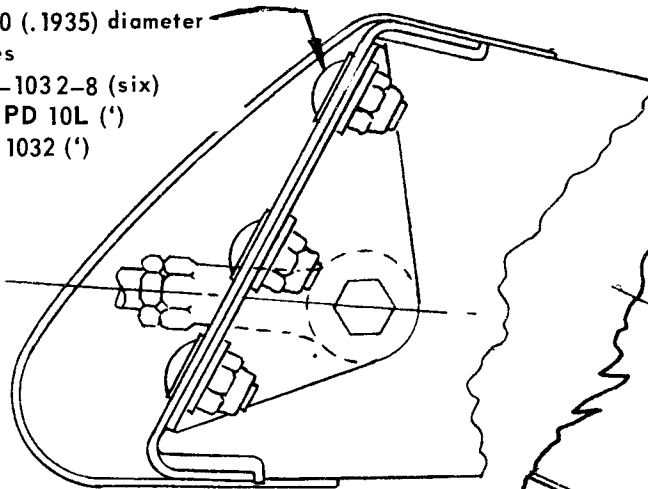
Weld .065 washer 3/4 dia. diameter x 4130 steel two places shown.



**PEDAL HORN ASSEMBLY**

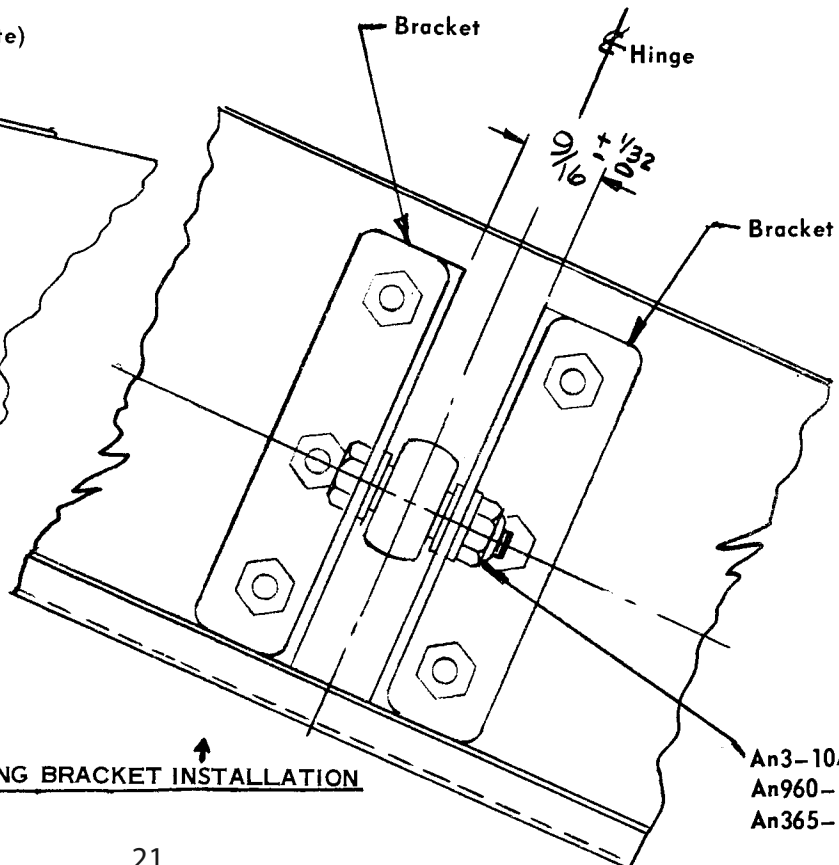
(right hand is opposite)

Drill #10 (.1935) diameter  
 six holes  
 AN 525-1032-8 (six)  
 AN 960 PD 10L (")  
 AN 365 1032 (")



Locate brackets vertically  
 to insure that Aileron Contour  
 matches adjacent rib contour in  
 the neutral position.

**DETAIL SHOWING BRACKET INSTALLATION**



An3-10A  
 An960-10  
 An365-1032