Report No. 9-RD-65

STANDARDIZATION TASK REPORT
TASK NO. 4

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ESTABLISHMENT OF STANDARDIZATION DATA FOR MONEL AND K-MONEL FASTENERS

Conducted for:
Department of the Navy
Bureau of Ships

Contract No. NObs-90493

28 April 1965

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Conducted by: E. Goodman
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I PURPOSE

The purpose of this task is to obtain data on which to base thread dimensions for 8UN interference-fit threads. The major diameter, minor diameter, and pitch diameter for external and internal threads for sizes 1 to 2 inches are to be determined. These dimensions are to be determined for monel studs engaged in tapped holes in HTS and HY80 plate and K-monel studs engaged in tapped holes in HTS and HY80 plate and monel and HY80 castings.

II MATERIALS TESTED

A. Requirements:-

1. K-Monel Studs - K-monel studs used in the performance of this task must conform to Military Standard MS18116 and the applicable requirements of specifications QQ-N-286 and MIL-B-857.

2. Monel Studs - Monel studs used in the performance of this task must conform to the applicable requirements of QQ-N-281 and MIL-B-857, except that the studs must have the following mechanical properties:

Tensile strength - 80,000 psi, minimum

Yield strength - 40,000 psi, minimum (0.2 percent offset)

Elongation in 2 inches - 20 percent, minimum

3. Plate Materials - Plate materials must conform to the following specifications.

Material	Specification
High Tensile Steel Plate (HTS)	MIL-S-16113 Grade HT
HY80 Steel Plate	MIL-S-16216
Cast HY80 Steel	MIL-S-23008
Cast Monel	QQ-N-288

4. Porosity - All cast materials must be subjected to radiographic examination to ascertain freedom from porosity.

B. Mechanical Properties:-

Table I is a compilation of the required and actual mechanical properties of the studs and materials used for tests performed in this task.

All cast materials were subjected to radiographic examination. The cast HY80 was found to be free from porosity. Several plates of cast monel had an area of porosity which was marked so that no holes were drilled and tapped in these areas.

Table I Mechanical Properties

Material	Item	Tensile Strength (psi)	Yield Strength (psi)	Elongation in 2"(%)
Monel Studs	Required Actual	80,000 min. 113,000	40,000 min. 99,000	20.0 min. 20
K-Monel Studs	Required Actual	130,000 min. 162,000	90,000 min. 121,000	20.0 min. 23
Monel Casting	Required Actual	65,000 min. 78,400	32,500 min. 39,900	25 min. 45.0
HY80 Steel Casting	Required Actual	For information only 113,000	80,000-95,000 92,000	20.0 min. 22.5

III THREAD GAGING AND DIMENSIONS

A. Thread Gaging:-

The thread major diameter, minor diameter and pitch diameter of all studs used in this task were measured. The major and minor diameters were measured on an optical comparator. The pitch diameter was measured over wires using the "three-wire method" (see Handbook H28, Part I, Appendix 4,

page 194). The thread dimensions of the tapped holes were measured in a like manner by making a cast of each of the holes.

B. Thread Dimensions:-

Since no dimensional data are available for interfence fit 8UN threads, the setting of thread dimensions for this task had to be essentially that of trial and error. The following were the guidelines used in setting the dimensions of the threads for the studs and tapped holes used in this task.

EXTERNAL THREADS

(a) The minimum pitch diameter was larger than the basic pitch diameter of the 8N series threads of the same size (see Handbook H28, Part I, Table III. 6, page 17).

(b) As in the class 5 interference fit threads, the maximum major diameter was set approximately equal to the minimum major diameter for 8N class 3A (see Handbook H28, Part I, Table III. 10, page 27).

INTERNAL THREADS

(a) As in the class 5 interference fit threads, the minor diameter limits were the same as those of 8N class 3B.

(b) The pitch diameter limits were set equal to those of 8N class 3B.

Table II and III contain the limits of size for the 8UN interference fit threads for the external and internal threads, respectively.

Table II Limits of Size, External Threads

Size and Threads per Inch	Major Diameter		Minor Diameter
	Max	Min	Max
1-1/8 - 8	1.108	1.095	0.980
1-1/2 - 8	1.483	1.469	1.357
2 - 8	1.980	1.966	1.836

Table III Limits of Size, Internal Threads

Size and Threads per Inch	Minor Diameter		Pitch Diameter		Major Diameter
	Min	Max	Min	Max	Min
1-1/8 - 8	0.990	1.005	1.0438	1.0505	1.1250
1-1/2 - 8	1.365	1.379	1.4188	1.4259	1.500
2 - 8	1.865	1.879	1.9188	1.9264	2.000

After the holes were tapped and measured, the studs were machined to give interferences on the pitch diameter ranging from 0.001 inch to 0.008 inch.

IV TEST PROCEDURE

Studs were engaged to the minimum length of engagement as follows:

Stud Material	Size (inches)	Length of Engagement (inches) Internal Thread Material			
		Monel Casting	HTS Plate	HY80 Steel Plate	HY80 Steel Casting
Monel	1-1/8	-	0.71	0.64	-
K-Monel	1-1/8	1.07	1.00	0.79	0.86
Monel	1-1/2 1/	-	0.96	0.86	-
K-Monel	1-1/2 1/	1.40	1.25	1.00	1.10
Monel	2 1/	-	1.28	1.15	-
K-Monel	2 1/	1.90	1.70	1.35	1.50

1/ Extrapolated from data obtained in Task 2.

The break-away and back-out torques for removing the studs were, subsequently, determined. These torques were obtained without any preloading of the studs. The test set-up for determining these torques is shown in Figure 1. Internal holes were lubricated with "3-in-One" SAE 20 oil.

V RESULTS

Because of the relatively high break-away torques required for the 1-1/8 inch class 5 interference fit studs and tapped holes in the 0.001 - 0.008 inch interference range, it was felt that this interference range would be adequate for the 8UN interference fit threads. This proved to be an erroneous assumption, however. At the low end of the range break-away torques varied from 20 to 100 ft-lbs. At the high end of the interference range tested, namely 0.008 inches, maximum break-away torques were 250 ft-lbs. for 1-1/8 inches, 280 ft-lbs. for 1-1/2 inches and 480 ft-lbs. for the 2 inch studs. It appears, then, that the minimum interference for the 8UN interference fit series should be 0.007 - 0.008 inches.

VI DISCUSSION

The class 5 interference-fit thread series was based on ten years of research, testing and field study (Handbook H28, Part III, page 48). It was not intended, therefore, that testing performed in this task would be adequate to completely set dimensional requirements for the 8UN interference-fit series. However, several conclusions and beneficial suggestions can be made.

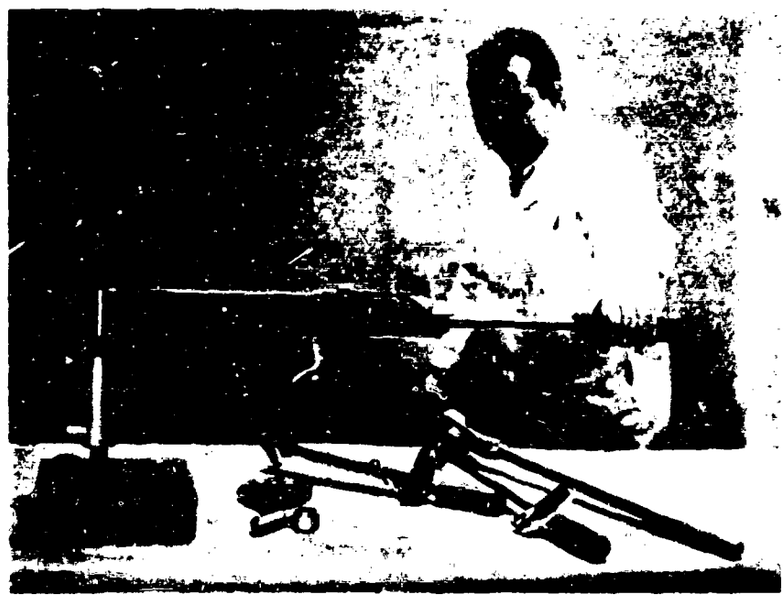

Figure 1 - Determination of Break-Away Torque

(a) The guidelines used in setting the limits of size for the external and internal threads appear to be valid. Relief of the external thread major diameter and internal thread minor diameter appear to be sufficient to allow for plastic flow which would greatly eliminate seizing and galling.

(b) The minimum pitch diameter interference should be 0.007 - 0.008 inches. The maximum interferences were not established in this task.

(c) Adequate break-away torques may possibly be achieved by increasing the length of engagement although the testing seems to indicate that increasing the pitch diameter interference would be more suitable.