Type N Digital
Connector Gage Kit
Metrology Grade
Model A020K

020-110 (Rev A) 01/13

User Guide

Type N Digital Connector Gage Kit

Model A020K

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020-110 (Rev A) 01/13

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Gage Kit Description

The Maury model A020K connector gage kit is designed to measure Type N connectors with either female or male interfaces. The digital indicators used in the A020K connector gage kit provide a measurement resolution of .0001" when used in the inch mode or .001mm (0.000040 inches) when used in the metric mode. For simplicity, the rest of this manual will refer to measuring in inches. However, the principles presented apply equally when used in metric mode. The Maury A020K connector gage kit achieves excellent repeatability by maintaining tightly controlled tolerances on all machined parts. To achieve maximum accuracy, Maury recommends that an average of 3 measurements taken at different gage orientations be used to minimize random errors. See **Figure 1**.

The Maury model A020K1 measures female connectors and A020K2 measures male connectors These gage assemblies use a "thread-on" design that simulates actual mating conditions, allowing high accuracy measurements and hands-free operation. The connector gage assemblies are initially set to zero using master setting gages, A020D3 (female) or A020D4 (male), permitting measurements to be read directly on the digital indicator. Centering sleeves are provided for measuring beadless air lines and mismatch air lines. Flush setting sliding loads is easily accomplished using the A020K. the thread-on design of the A020K also allows more convenient and accurate measurements of network analyzer test ports.

Maury models A020K1 and A020K2 connector gages are compatible with Mitutoyo SPC Digimatic readouts for external display of data. Use Maury model A048B1 or A048B2 data cables. See **Figure 2**. All machined parts are made from heat treated stainless steel to assure long life and excellent stability. Gaging surfaces are lapped to ensure a high degree of accuracy. A parts list is shown in **Table 1**.

Item	Description	Maury Part Number	Quantity Per Assy.	Notes
1	Indicator Assembly, Female	A020K1	1	—
2	Indicator Assembly, Male	A020K2	1	—
3	Master Gage, Female	A020D3	1	—
4	Master Gage, Male	A020D4	1	—
5	Sleeve Set (2), 7mm	A028S1	1	*
6	Torque Wrench, 3/4	2698C2	1	12 in/lbs
7	Open End Wrench, 9/16	A040S5	1	—
8	Battery	SR44**	(1)	Commercial
9	Data Cable (40 inch)	A048B1	(1)	(Optional)
10	Data Cable (80 inch)	A048B2	(1)	(Optional)

* The centering sleeves are shipped in small plastic containers

** 20,000 hour life.

Table 1. Parts List

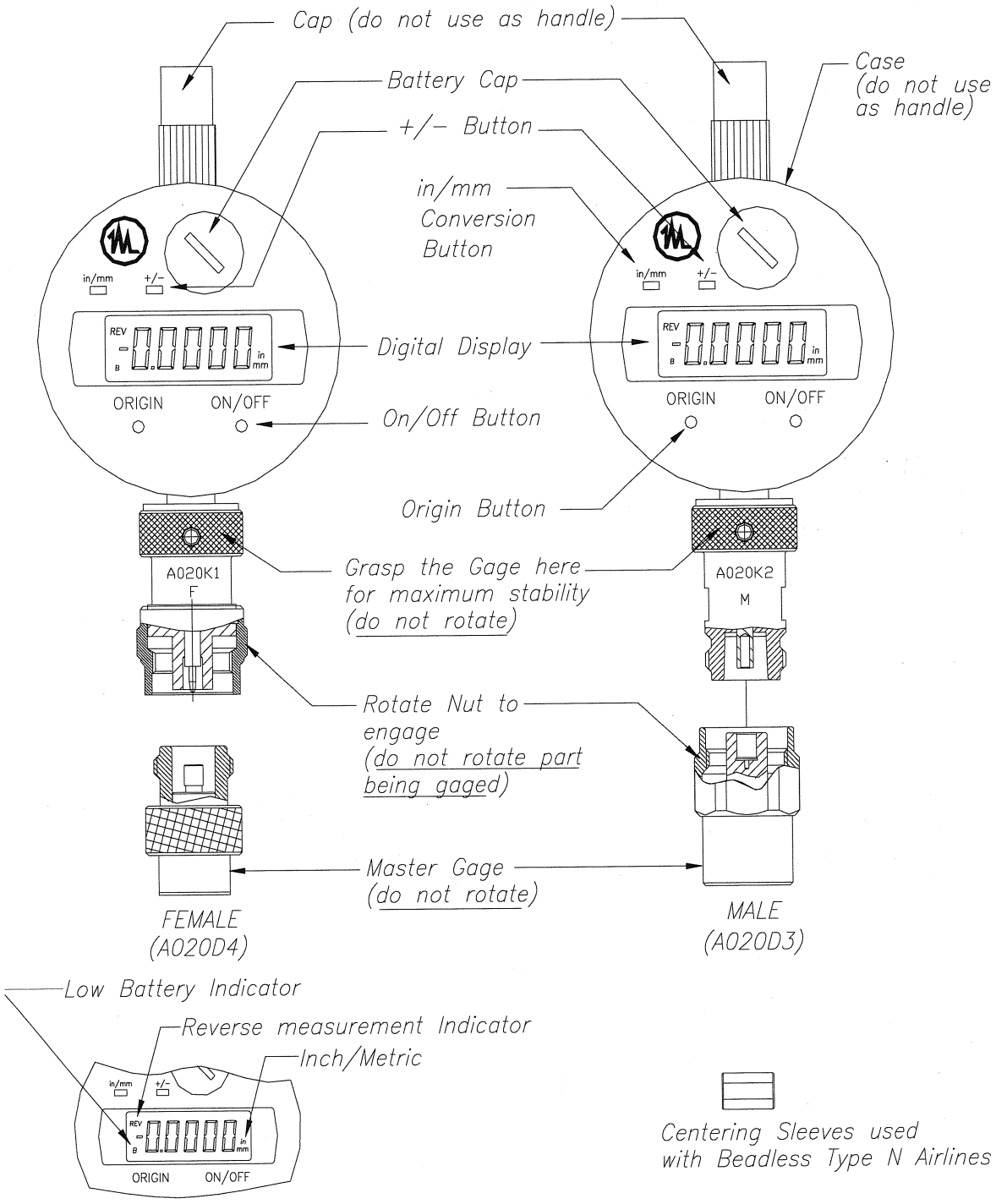
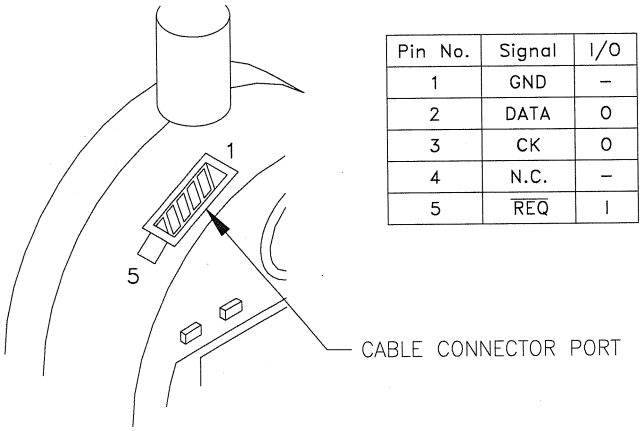
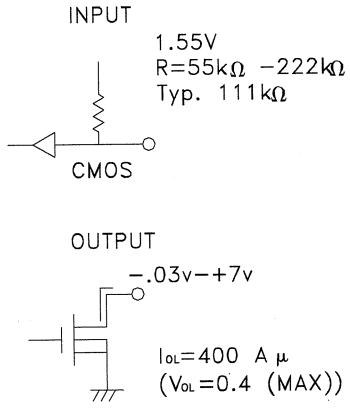


Figure 1. The A020K Connector Gage Kit

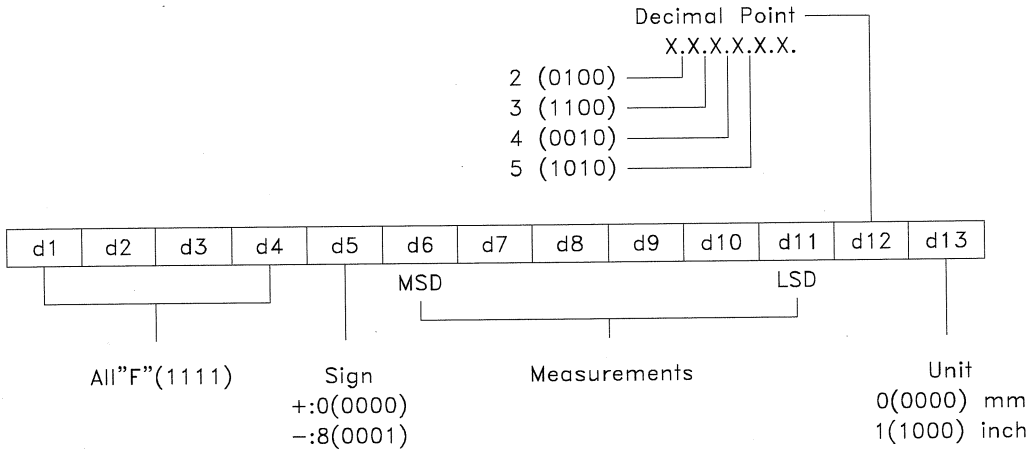
Output Connector Specification:



Pin No.	Signal	I/O
1	GND	–
2	DATA	O
3	CK	O
4	N.C.	–
5	$\overline{REQ}$	I



Output Data Format:



Timing Chart:

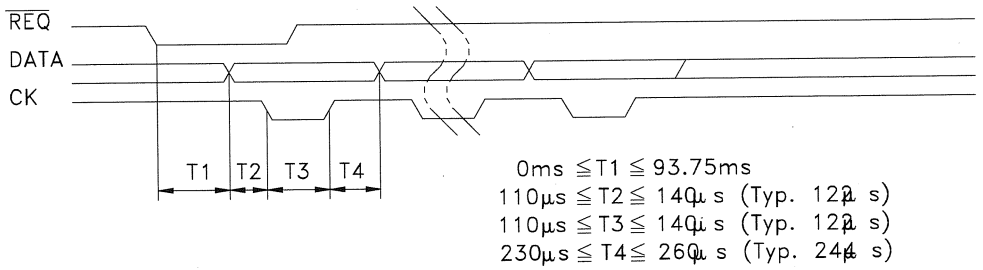


Figure 2. Data Output

Operation

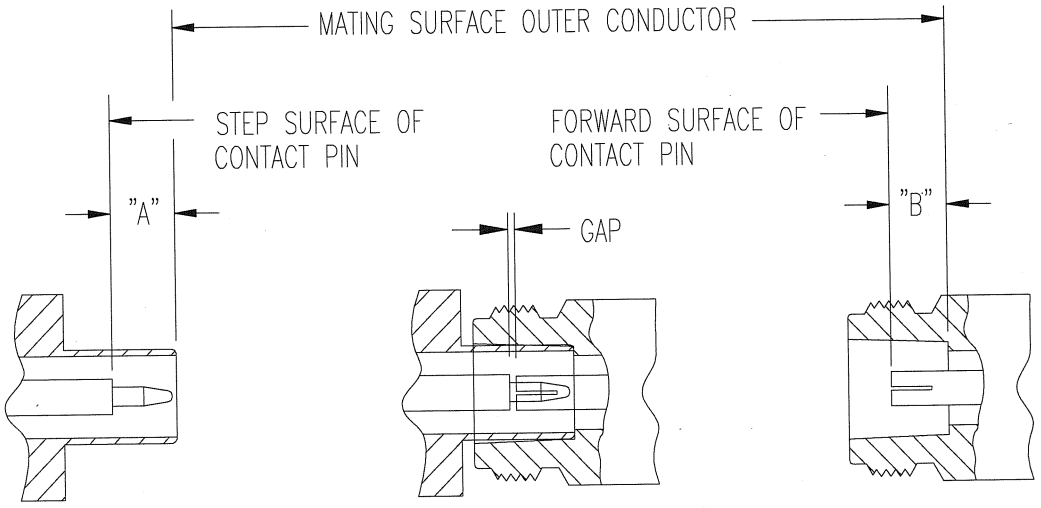


Figure 3. Contact Pin Locations

NOTE: Interface dimensions & tolerances of MIL-PRF-39012D are controlled by MIL-STD-348A.

ITEM	SPECIFICATION	A		B		GAP		COMMENTS
						MIN	MAX	
A	High Precision [1]	0.207	+0.0005 -0.0000	0.207	+0.0000 -0.0005	0.0000	0.001	Maury High Precision Type N
B	Precision [2]	0.207	+0.003 -0.000	0.207	+0.000 -0.003	0.000	0.006	Maury Precision I.A.W. 5E-049
C	IEEE STD 287-2007	0.207	+0.004 -0.000	0.207	+0.000 -0.003	0.000	0.007	LPC & GPC
D	MIL-STD-348A Test Connector [3, 5]	0.208	+0.003 -0.000	0.207	+0.000 -0.003	0.001	0.007	402.1 & 402.2 & MIL-PRF-39012, Class 1
E	MIL-STD-348A [5]	0.210	+0.020 -0.000	0.207	+0.000 -0.020	0.003	0.040	304.1, 304.2 & MIL-PRF-39012 Class 2
F	MIL-C-39012 CLASS 1 [3, 4]	0.208	+0.003 -0.000	0.207	+0.000 -0.003	0.001	0.007	Standard Test Connector
G	MIL-C-39012 Class 2 [5]	0.210	+0.020 -0.000	0.207	+0.000 -0.020	0.003	0.040	Type N General Specification [3]
H	MIL-T-81490 [3]	0.208	+0.003 -0.000	0.207	+0.000 -0.003	0.001	0.007	Type EW Connectors

Table 2. Center Contact Locations for Type N Connectors

1 "High Precision" Maury type "N" Connector interfaces are used on primary standards, such as air lines, sliding loads, etc.
2 "Precision" Maury type "N" connector interfaces are used on all Maury standard type "N" components.
3 Type N male outer conductors may be slotted or solid. Items A, B, C, D & E are solid, F, G & H may be slotted or solid.
4 Use A020D14 Master Gage (male .208 dim.) Optional.
5 Use A020D15 Master Gage (male .210 dim.) Optional.

Specifications

In order to determine the specifications for the A020K gages, Maury performed an extensive gage study with the gages at the Maury factory. The study involved the use of multiple gages and personnel making multiple measurements of a known standard. A statistical analysis was performed on the data collected and the resultant +/- 2-sigma value was determined. Maury considers this value to be the achievable uncertainty under carefully controlled conditions in a controlled environment. The +/- 2-sigma uncertainty for the Maury A020K connector gage, male or female, is +0.0018mm (± 0.000070 inches).

In addition to uncertainty of the gage, the Type N set master uncertainty must also be considered. The tolerance for the Type N set master would add an additional ± 0.0002 inches (± 0.0051mm) (0.0004 inch (0.0102mm) range) of uncertainty to the total uncertainty.

The total worst case uncertainty for the A020K gage kit can be determined by adding these two values together for a total uncertainty of ± 0.000270 inches.

Visual Inspection

Inspect all connectors carefully before each use. If a connector shows deep scratches, dents, uneven wear, or particles clinging to the mating plane surfaces, clean it and inspect again. Damaged connectors should be set aside for repair. Also, try to determine the cause of the damage before making further connections.

75 Ohm Type N Connectors

75 Ohm Type N connectors differ from 50 Ohm Type N connectors in that the center conductor, male contact pin, and female contact hole are smaller. Therefore, mating a male 50 Ohm Type N connector with a female 75 Ohm Type N connector will destroy the female 75 Ohm connector by spreading the female contact fingers apart permanently or even breaking them. This kit is ***NOT*** designed to measure 75 Ohm connectors. We recommend you use the Maury A020G connector gage kit for this application.

Cleaning

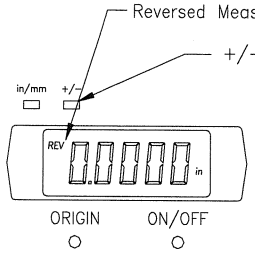
Use dry compressed air at a very low velocity first; then a solvent such as isopropyl alcohol. Clean the contacting surfaces, alignment parts and threads using a lint free swab. Then re-inspect the connector to make sure that no fibers have been left around the contact and interface surfaces.

NOTE: To maintain cleanliness, always wear cotton gloves when performing any of the procedures described in this manual.

CAUTION: For optimum measurements and to prevent damage, always hold the connector gage on the knurled part of the bushing when connecting (see **Figure 4**). Never rotate parts against each other since this could yield faulty readings or damage the mating surfaces.

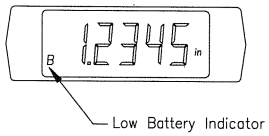
Error Messages

Paragraphs 3, 4 and 5 of **Figure 4** show the error messages which the indicator may display, as well as the appropriate response.

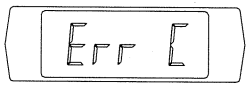


1. SETTING UP THE ORIGIN:
Displace the spindle to the position at which the origin is specified, then press and hold the ORIGIN button for more than one second. The origin will be set up, indicating "0.0000" on the display.

2. SETTING THE COUNT DIRECTION:
The +/− button switches the count direction of display values with respect to the spindle direction. The "REV" sign appears in the upper left of the LCD, if the indicator is set so that it counts down when the spindle is retracted.



3. MESSAGE "B":
The battery voltage is low. Replace the battery with a new one.



4. MESSAGE "Err C":
Water drops may have condensed on the detector unit due to sudden thermal change, or the detector may be contaminated due to other causes. If this message still appears after two hours of thermal stabilization with the power turned off, the indicator needs repair. Contact Maury Microwave Company.

5. LEAST SIGNIFICANT DIGIT DISPLAY "E" (ABS data composition error):
A temporary error due to an extremely quick displacement of the spindle. Keep on using the indicator, since there is no effect on measurement.

Figure 4. Operating Procedures and Error Messages

Gaging Male Type N Connectors

Zero Setting the Male Gage A020K2 (See Figures 5 and 6a)

1. Visually inspect the mating surfaces of your A020K2 connector gage and A020D4 master setting gage
2. Clean all mating surfaces of the master setting gage and connector gage using the recommended cleaning procedure above.
3. Push the ON/OFF button on the indicator to turn on the display.
4. Push the in/mm button until the display reads "in"
5. Set the +/- button so that the REV sign does ***NOT*** appear on the LCD.

   NOTE: Without anything connected to the gage and the REV sign ***NOT*** appearing in the display the gage should show a minus (-) number.
6. Align the connector gage and master setting gage carefully, then rotate the nut on the master setting gage clockwise, allowing it to engage with the thread of your A020K2. Apply light finger pressure avoiding rotation of the mating planes. If you use a torque wrench, it should be rated at 12 inch-pounds. Maury model 2698C2 is recommended and supplied with the A020K kit.
7. Push and hold the ORIGIN button until the display reads 0.0000 inches. This sets the indicator reading to the nominal dimension of .207" (or other nominal dimensions provided by other master setting gages).
8. Gently loosen and disengage the connector gage and the master gage. You are now ready to measure.

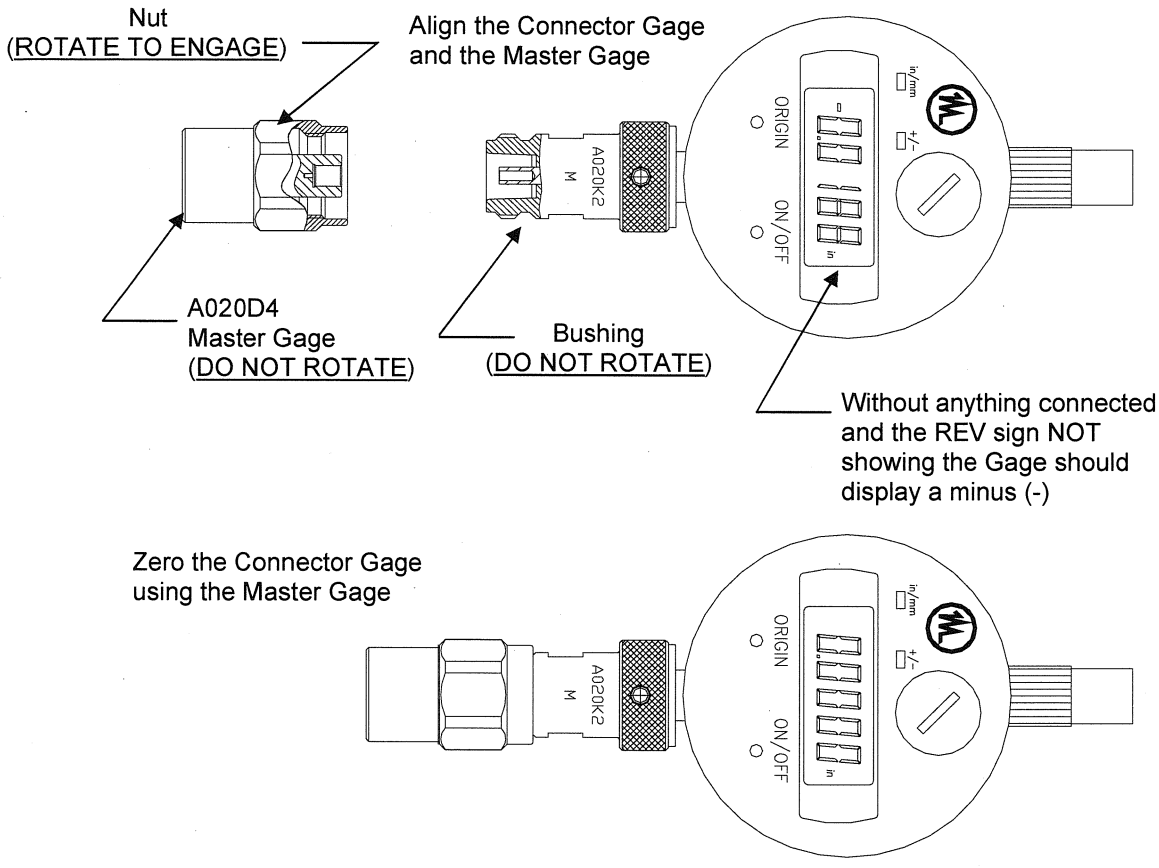


Figure 5. Zero Setting the Male Connector Gage
(Applies Equally to the Female Connector Gage)

Measuring Male Type N Connectors (.207 Dimension)

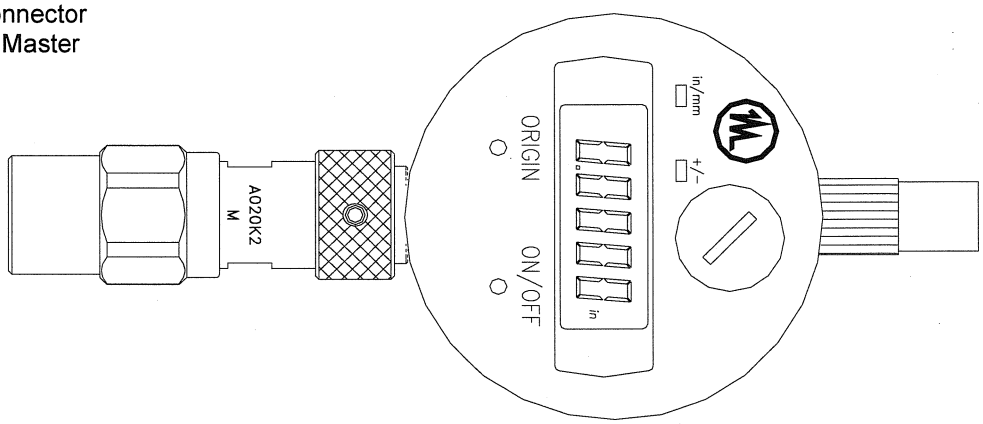
See Figure 6b and c.

1. Visually inspect the mating surfaces of the connector to be gaged.
2. Clean all mating surfaces: connector, master setting gage and connector gage.
3. Zero set your A020K2 by using the procedure described on page 7.
4. Align both the connector and your A020K2, then rotate the nut of the connector clockwise, allowing the threads to engage. Tighten with light pressure avoiding rotation of the mating planes at the same time. When using a torque wrench, make sure it is rated at 12 inch-pounds. Maury model 2698C2 is recommended.
5. Set the +/- button so that the REV sign does ***NOT*** appear on the LCD, in accordance with paragraph 2 of **Figure 4**.
6. When the number on the digital display ***IS*** prefaced by a minus (-) sign then the contact location is recessed from the nominal dimension set by the Master gage (0.207). To determine the actual contact location relative to the nominal .207 dimension set by the master gage ***ADD*** the absolute value of the number displayed to .207. For example a reading of -.002 is added to .207 for a total reading of .209 which is within the .207 +.003/-.000 tolerance as shown in **Table 2**.

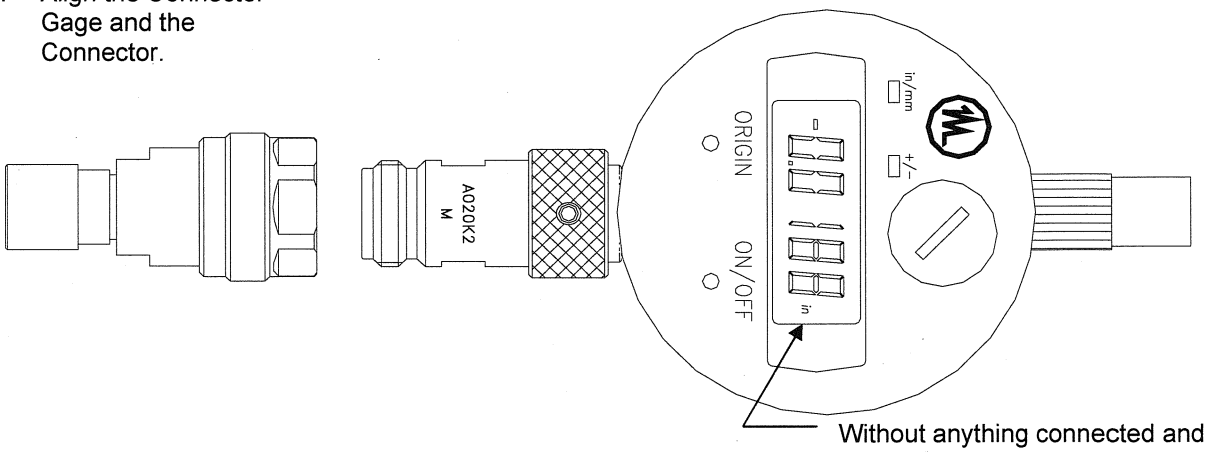
   When the number ***IS NOT*** prefaced by a minus sign and the REV sign does ***NOT*** appear on the LCD then the contact is protruding above the nominal dimension set by the Master gage (0.207) and is out of tolerance.

NOTE: A reading of zero on the connector gage corresponds to a pin depth of 0.207 inches as set by master gages A020D3 and A020D4; refer to **Table 2** for connector dimensions and tolerances.

a. Zero Set the Connector Gage using the Master Gage.

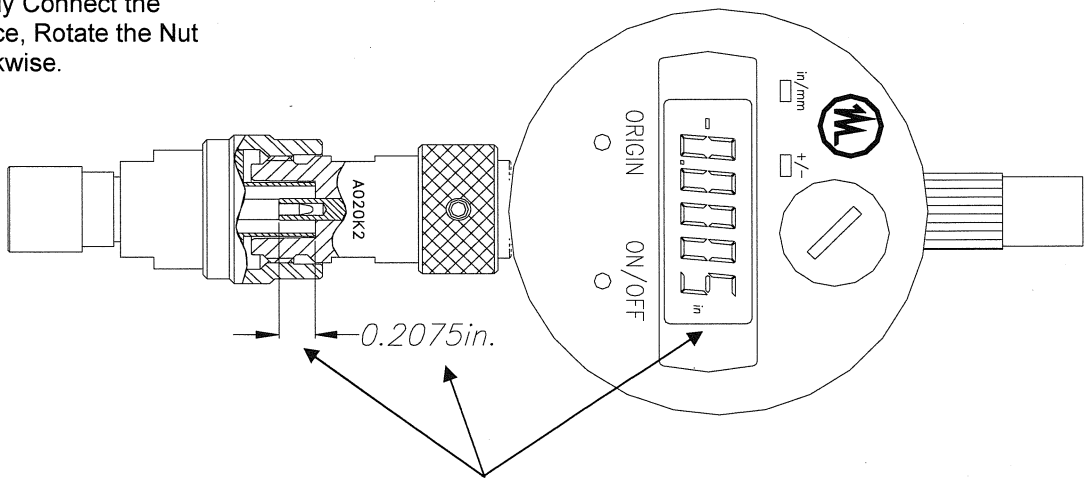


b. Align the Connector Gage and the Connector.



Without anything connected and the REV sign ***NOT*** showing the Gage should display a minus (-)

c. Gently Connect the Device, Rotate the Nut Clockwise.



To determine the actual contact location relative to the nominal dimension of a male connector, add the absolute value of a negative (-) reading on the gage to the nominal dimension set by the Master gage. In this example, 0.0005 is added to 0.207 to get 0.2075 in. (REV sign should ***NOT*** appear on the LCD)

Figure 6. Gaging Male Type N Connectors

Gaging Female Type N Connectors

Zero Setting the Female Gage A020K1 (See Figures 5 and 7a)

1. Visually inspect the mating surfaces of your connector gage and A020D3 master setting gage.
2. Clean mating surfaces using the procedure outlined under the section ***Cleaning*** on page 6.
3. Push the ON/OFF button on the indicator to turn on display.
4. Push the in/mm button until the display reads "in"
5. Set the +/- button so that the REV sign does not appear on the LCD.

   NOTE: Without anything connected to the gage and the REV sign ***NOT*** appearing in the display the gage should show a minus (-) number.
6. Align the connector gage and master setting gage carefully; then rotate the hex nut of the connector gage allowing it to engage with the thread of the A020D3. Let the master setting gage bottom freely against your A020K1. Apply light finger pressure avoiding rotation of the mating planes. If using a torque wrench, it should be rated at 12 inch-pounds. Maury model 2698C2 is recommended and supplied with the A020K kit.
7. Push and hold the ORIGIN button until the display reads 0.0000 inches. This sets the indicator reading to the nominal dimension of .207 (or other nominal dimensions provided by other master setting gages).
8. Gently loosen and disengage the connector gage and the master gage. You are now ready to measure.

Measuring Female Type N Connectors (.207 Dimension)

See Figure 7b and c.

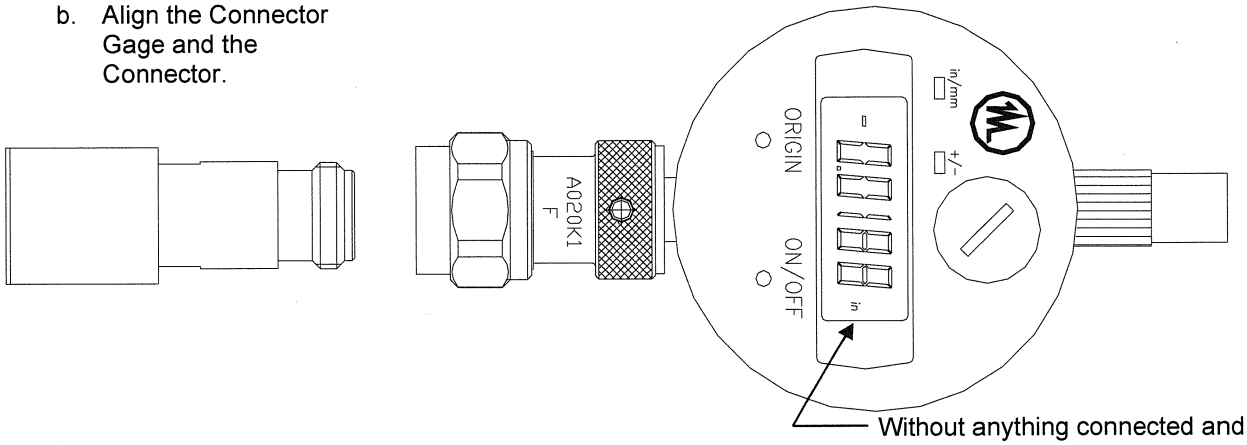
1. Visually inspect the mating surface of the connector to be gaged.
2. Clean all mating surfaces: connector, master setting gage and connector gage.
3. Zero set your A020K1 by using the master setting gage, following the procedure described above.
4. Align both the connector and your A020K1; then, rotate the knurled nut on the gage clockwise allowing the threads to engage. Let the connector bottom freely against your A020K1. Tighten with light finger pressure avoiding rotation of the mating planes. If using a torque wrench, it should be rated at 12 inch-pounds. Maury model 2698C2 is recommended.
5. Set the +/- button so that the REV sign does ***NOT*** appear on the LCD, in accordance with paragraph 2 of **Figure 4**.
6. When the number on the digital display ***IS*** prefaced by a minus (-) sign then the contact location is recessed from the nominal dimension set by the Master gage (0.207). To determine the actual contact location relative to the nominal .207 dimension set by the master gage ***SUBTRACT*** the absolute value of the number displayed from the nominal dimension set by the master gage. For example a reading of -.002 is subtracted from .207 for a total reading of .205 which is within the .207 +.000/-.003 tolerance as shown in **Table 2**.

   When the number ***IS NOT*** prefaced by a minus sign and the REV sign does NOT appear on the LCD then the contact is protruding above the nominal dimension set by the Master gage (0.207) and is out of tolerance.

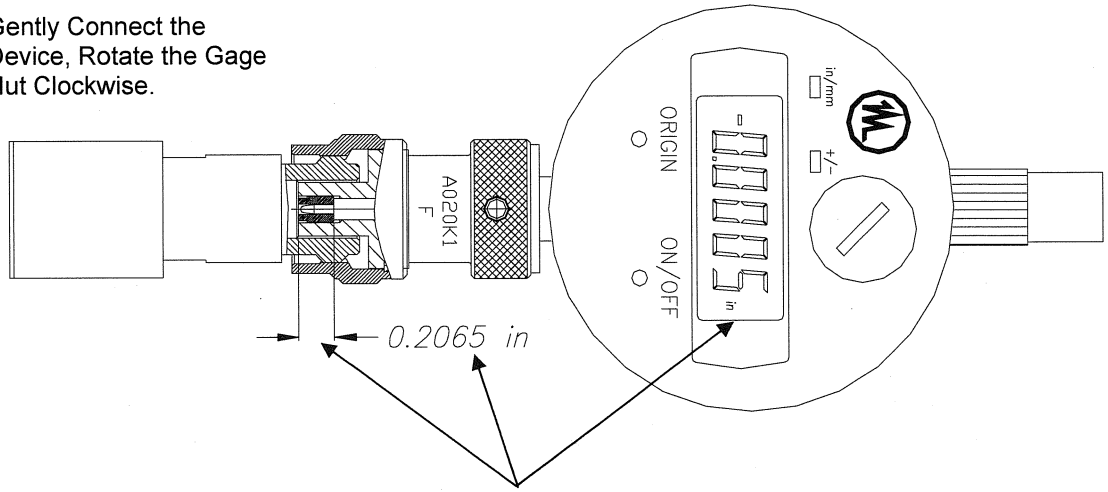
NOTE: A reading of zero on the connector gage corresponds to a pin depth of 0.207 inches as set by master gages A020D3 and A020D4; refer to **Table 2** for connector dimensions and tolerances.

a. Zero Set the Connector Gage using the Master Gage.

b. Align the Connector Gage and the Connector.



c. Gently Connect the Device, Rotate the Gage Nut Clockwise.



To determine the actual contact location relative to the nominal dimension of a female connector, subtract the absolute value of a negative (-) reading from the nominal dimension set by the Master gage. In this example, 0.0005 is subtracted from 0.207 to get 0.2065. (REV sign should ***NOT*** appear on the LCD)

Figure 7. Gaging Female Type N Connectors

Sliding Loads and Air Lines

About Sliding Loads

Most sliding loads come equipped with a simple center conductor lock consisting of some form of clamping mechanism. The sliding load connector interface is usually set for a "zero gap" or "flush set" as described below.

NOTE: *Gaging the sliding load is not required for zero gap operation.*

To set a zero gap, loosen the locking mechanism and extend the center conductor and mate it completely with the center conductor on the mating connector. Then mate the outer conductors using a torque wrench for the final connection. The sliding load center conductor remains free in the outer conductor housing as mating of the outer conductors takes place. The locking mechanism is tightened only when all connections have been made.

For flush set operation, the sliding load center conductor is first set to the correct position using a connector gage. Then the center conductor is aligned axially and connected to the mating connector.

NOTE: *The nominal interface dimension is set using the A020 type connector gage.*

For flush-set measurements, use Maury metrology grade sliding loads, models 8834A and 8834B, with flush-set and pull-back mechanisms. See **Figure 8.**

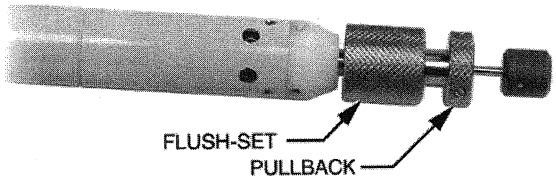


Figure 8. Sliding Load Flush Set/Pull Back Mechanism

The flush-set mechanism allows you to adjust the center conductor position very accurately, and the pull-back feature provides an easy way to expose the center conductor for connection without sacrificing the proper interface condition preset with the flush-set mechanism. For in-depth information, please refer to the operating instructions for your sliding load.

Gaging Sliding Loads

CAUTION: This section may not have complete information for your particular sliding load. Please consult the manual for your sliding load first.

The following procedure applies to both female and male sliding loads. For female sliding loads, use the A020K1. For male sliding loads, use the A020K2. For in-depth information on how to properly set the interface dimension, refer to the manual provided with your sliding load.

Procedure

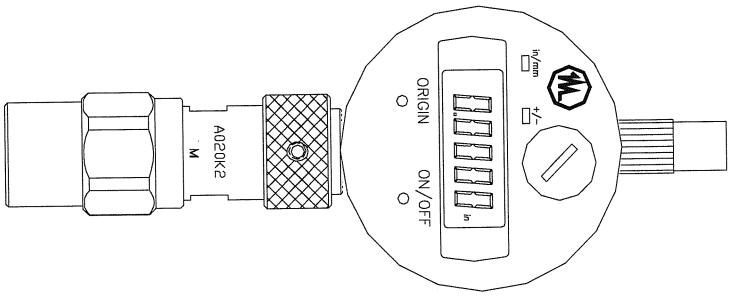
Refer to **Figures 9** and **10.**

1. Visually inspect the mating surface of the connector to be gaged before making a connection.
2. Clean all mating surfaces: connector, master setting gage and connector gage.
3. Zero set your connector gage with the appropriate master gage.
4. Expose the center conductor of the sliding load to allow easy engagement of the gaging pin.

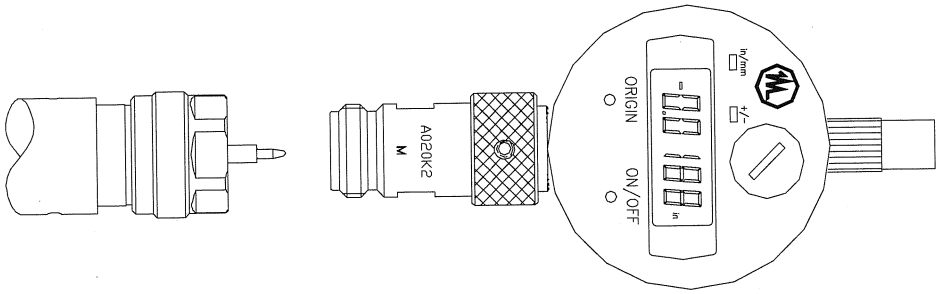
Figure 9. Gaging Precision Sliding Loads

5. Make a gentle connection. Avoid rotation of the mating planes to prevent excessive wear. When using a torque wrench, make sure it is rated at 12 inch pounds. Allow the center conductor to gently push back during the mating process. Set the interface dimensions following the procedure outlined in the operating instructions of your sliding load.

Zero Gage using the Master Gage.



Expose the Sliding Load Free Floating
Center Conductor for Ease of Engagement.



Set Proper Interface
Dimensions

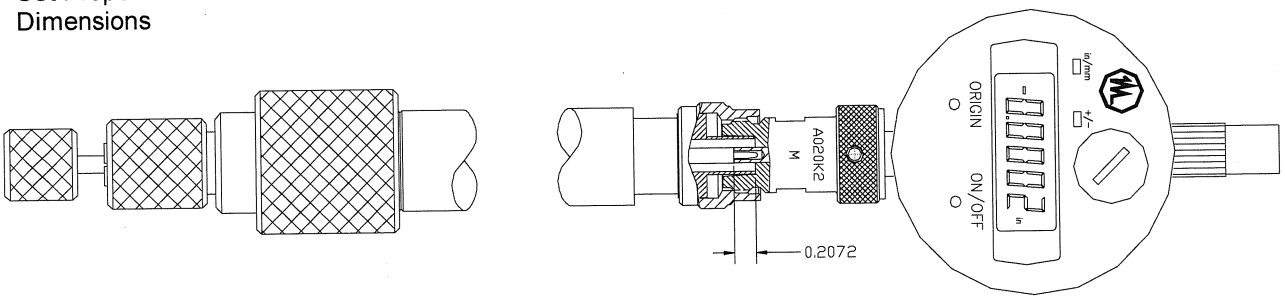


Figure 10. Gaging Precision Sliding Loads (cont.)

Gaging Type N Air Lines

NOTE: Use care when handling air line parts. Wear cotton gloves to prevent excessive thermal expansion.

Maury beadless precision air lines come basically in two connector configurations; female to male, and male to male. To gage these air lines, a master gage is first connected to one end and the corresponding A020K indicator gage is connected to the opposite end.

Procedure

See **Figures 11** and **12**.

NOTE: Sleeve set A028S1 is required for this measurement (see parts list **Table 1**).

1. Visually inspect the mating surfaces on the airline to be gaged before making a connection, and clean all mating surfaces.
2. Zero set the connector gage using the respective master setting gage.
3. Slip a centering sleeve on one end of the center conductor and insert into the air line. Avoid scratching the outer conductor while inserting the center conductor. Make sure that the sex of the outer and center conductors comply.
4. Connect the corresponding master setting gage onto the same end of the air line where the sleeve was inserted.
5. Insert the second sleeve into the open end of the air line.
6. Align the air line and your A020K; then carefully connect the connector gage. Tighten finger tight avoiding rotation of the mating surfaces against one another. When using a torque wrench, make sure it is rated at 12 inch pounds.

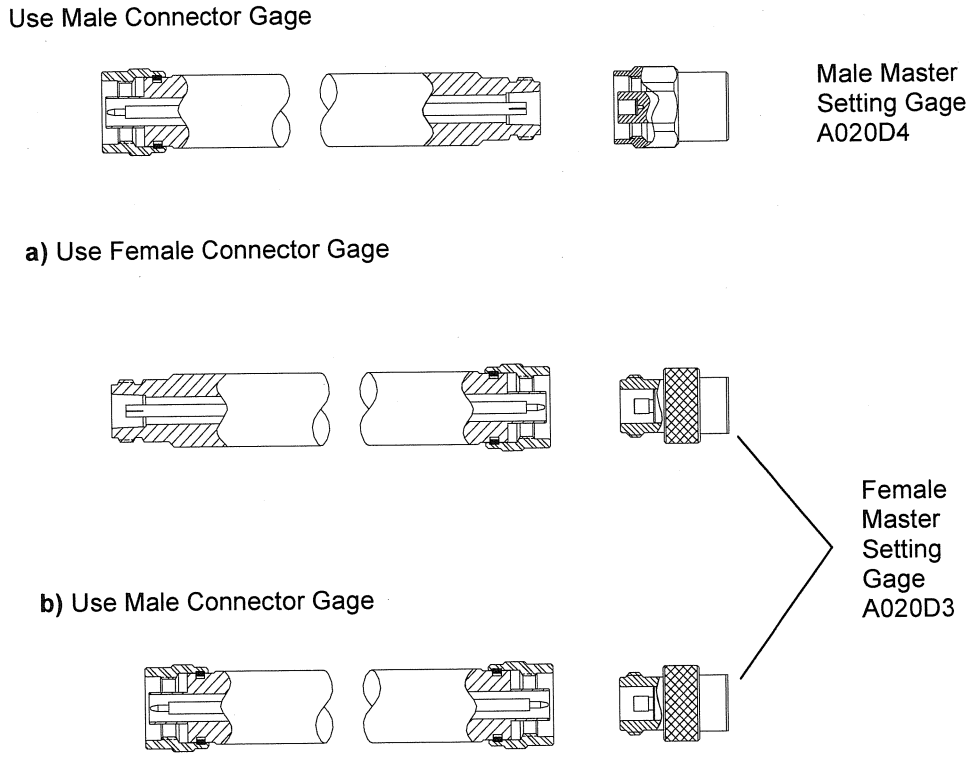
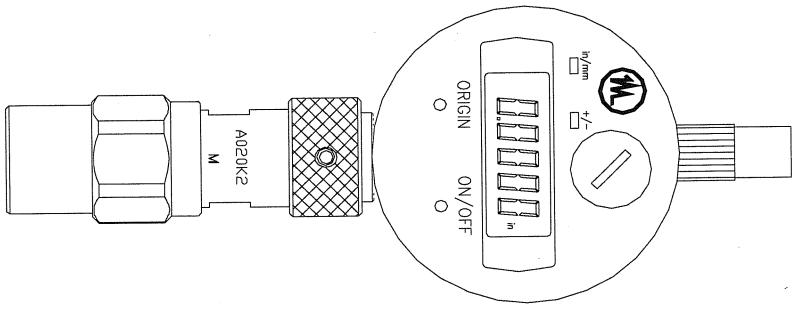


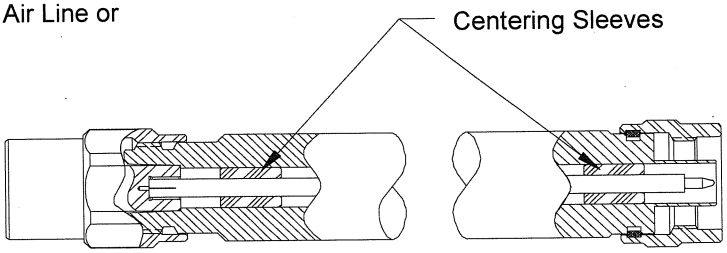
Figure 11. Precision Type N Two Port Standards

a) with different interfaces and b) with equal interfaces

Zero Set the Connector Gage
using the Master Setting Gage



Insert Centering Sleeves and
Connect Master Gage to Air Line or
Two Port Standard



Engage Air Line and
Connector Gage

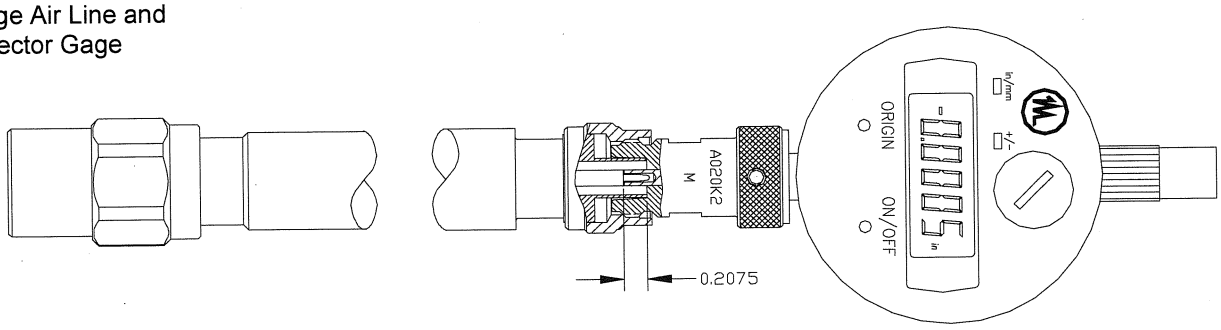


Figure 12. Gaging Beadless Precision Two Port Airlines & Mismatches

Maintenance and Calibration

Maintenance

This connector gage kit is relatively maintenance free if the components are handled with the same care that is appropriate to all precision equipment. As with any precision component, proper care should be taken to assure clean mating surfaces, correct alignment when mating, and proper torquing of connectors. To help maintain the integrity of the components in this kit, routine visual inspection and cleaning of mating surfaces is recommended. Failure to do so may result in degraded repeatability and accuracy, and may damage any mated devices. Refer to the *Operation* section of this User Guide for detailed instructions on visual inspection and cleaning.

Calibration

To maintain verification that a connector gage kit is performing to traceable specifications, we recommend that all kits be periodically returned to Maury Microwave for calibration. The typical calibration cycle is one year, although actual need may vary depending on usage.

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Appendix

Data Sheet Resources

2Y-001 – Connector Gages and Connector Gage Kits
http://maurymw.com/pdf/datasheets/2Y-001.pdf

2Y-032 – Type N Digital Connector Gage Kit
http://maurymw.com/pdf/datasheets/2Y-032A.pdf

2Y-050A – Torque Wrenches
http://maurymw.com/pdf/datasheets/2Y-050A.pdf

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Web Site http://maurymw.com

Web Resources

Visit our web site for additional product information and literature.

Maury Calibration Kits
http://maurymw.com/Precision/VNA_Cal_Kits.php

Maury Connector Gage Kits
http://maurymw.com/Precision/Connector_Gage_Kits.php

Maury Precision Coaxial and Waveguide-to-Coaxial Adapters
http://maurymw.com/Finder/Adapter_Finder.php

Maury Applications Notes Library & Technical Articles Archive
http://maurymw.com/Support/tech-support.php

Maury Sales Representative Finder
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