MIL-D-9898C
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SUPERSEDING
MIL-D-9898B(USAF)
6 Nov 1970

MILITARY SPECIFICATION

DRAWINGS, TUBE BEND

This specification is approved for use by the Department of the Air Force, and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

* 1.1 Scope. This specification covers tube bend drawings prepared by the Air Force and by contractors for tubing formed by draw bending machines.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

* 2.1.1 Specifications and standards. Unless otherwise specified (see 6.2), the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

MILITARY

DOD-D-1000	Drawing, Engineering and Associated List.
MIL-D-5480	Data, Engineering and Technical; Reproduction Requirements for.
MIL-C-5501	Cap and Plug, Protective, Dust and Moisture Seal.
MIL-M-9868	Microfilming of Engineering Documents, 35 mm, Requirements for.

STANDARDS

MILITARY

DOD-STD-100	Engineering Drawing Practices.
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property.
MIL-STD-1247	Marking, Functions and Hazard Designations of Hose, Pipe, and Tube Lines for Aircraft, Missile, and Space Systems.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: the Engineering Division, San Antonio ALC/MMEDO, Kelly AFB, TX 78241 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A AREA DRPR

MS33583	Tube End, Double Flare, Standard Dimensions for.
MS33584	Tubing End, Standard Dimensions for Flared.
MS33611	Tube End Radii.
MS33660	Tubing End, Hose Connection, Standard Dimensions for.

* (Copies of specifications and standards required by manufacturers in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 3951-82 Standard Practice for Commercial Packaging.

(Application for copies of ASTM publications should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

2.1.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Engineering drawings of tube bend data shall be design activity documents and shall comply with the following.

* 3.1.1 Drawing requirements. Symbols, references, designations, code, and abbreviations shall be in accordance with DOD-STD-100.

3.1.2 Tube bend drawings shall indicate color code requirements as specified by MIL-STD-1247.

3.2 Drawing sizes. Tube bend data shall be furnished on a vertical "A" size drawing in accordance with figure 1.

3.3 Drawing format. Drawing format and required informational entries shall be in accordance with figure 1. For some special tubes having wye branches, brackets, or other details which cannot be shown in the space limitations of figure 1, a detail drawing of any suitable standard size may be provided and the bend data shall be shown on the detail drawing in the format of figure 1.

3.4 Drawing numbers. Drawings shall be assigned Government design activity drawing numbers, or assigned contractor design activity drawing numbers.

* 3.5 Drawing materials. Materials used for the preparation of tube bend drawings shall be in accordance with DOD-STD-100.

3.6 Duplicates which become drawing media. Materials in this category shall conform to the requirements for "duplicate originals" specified in MIL-D-5480.

3.7 Delineation on tube bend drawings. Unless otherwise specified in procurement documents or orders, tube bend drawings, including those for vendor items, shall contain the following minimum engineering data as applicable.

3.7.1 The data furnished under this specification shall be suitable for use on bending machines utilizing the principle of "draw bending," e.g., the tube to be bent is clamped against a bending form which rotates and draws the tube through a pressure die and over a mandrel.

3.7.2 The information necessary to perform the tube bending shall be depicted on the format of figure 1 in five (5) columns as follows:

3.7.2.1 The "Bend Number" column shall specify the number of the bend that is to be performed. Bends shall be numbered consecutively from the "B End" of the tube as shown in figure 2.

3.7.2.2 The "C (distance)" column shall specify the dimension, before bending from the "A End" of the tube to the beginning point of the bend to be performed; that is, the distance from the "A End" to the center line of the radius block before bending is started. The "C" dimension layout is illustrated in the top view of figure 2.

3.7.2.3 The bend radius "F (inches to center line)" column shall specify the radius of bend to be performed, measured from the center line of the tube, as shown in figure 2.

3.7.2.4 The turn angle "E (degrees)" measured from the plane of the first bend, CCW viewed from B end, shall specify the angle through which the tube is rotated from the zero reference plane established by bend number one to the plane of the bend to be performed. The "tube turn" shall be expressed as counter-clockwise rotation when looking from the "B end" toward the "A end," using a 360° dial. An equivalent dial setting for specified tube rotation will depend on the type of dial used (figure 3) and must be determined by the tube bending machine operator when converting from one dial system to another.

3.7.2.5 The bend angle "G (degrees)" column shall specify the angle through which the tube is to be bent as shown in figure 4. The bend angle is the finished angle and does not include spring-back. Each entry shall be CW (clockwise) unless noted as CCW (counter-clockwise).

3.7.3 The tube size (inches) shall specify the nominal outside diameter, wall thickness, and length necessary to make the finished tube assembly.

3.7.4 The "D" length is the length of the tube before bending which includes the necessary allowance for beading or flaring the ends. This length does not, however, include any allowances past the "A end" for clamping the tube, which will be required when the last bend is very close to the "A end." Also, allowance may be required past "B end" to complete a close starting bend. These additional lengths will be shown in the notes.

3.7.5 The "type of end" column shall be used to designate the end fittings. Any variation from the standard shall be noted and if necessary, illustrated in the "note" block.

3.7.6 Special treatment, marking, protection and testing of tubes shall be noted in the "note" block.

3.7.7 Reference to specifications and standards for requirements, materials, processes, treatments, test methods, and procedures; the applicable type, grade, class, or condition shall be shown.

3.7.8 Delineate directly or by reference sufficient engineering requirements and characteristics for the item such as material, dimensions, tolerances, form, and finish necessary to enable the Government or contractor to procure or reproduce the item or obtain an adequate interchangeable substitute.

3.7.9 Each tube bend drawing shall show engineering data for only one tube or tube assembly. If the number of tube bends exceeds the available spaces, additional drawings shall be used as indicated as a set (sheet 1 of 2; sheet 2 of 2; etc.). The note "continued on next sheet" shall appear as the last entry on all sheets except the last.

* 3.8 Item identification and part number. Each tube or tube subassembly shall be identified by one part number in accordance with DOD-STD-100. If a substitute material for a tube is authorized, a special note on the drawings shall describe how the tube would be marked to identify the material from which the tube has been made.

3.8.1 Identification on drawings. In accordance with 3.8 items shall be identified by showing the identifying part number.

3.8.2 The design activity shall indicate on the drawing the part number to be marked and the method of marking of the finished tube. Identification marking requirements shall be in accordance with MIL-STD-130.

3.8.3 Identification of materials, processes, and protective treatment. Materials, processes, and protective treatment necessary to meet the design requirements for the tube shall be identified on the drawing by reference to applicable specifications, or standards. The applicable type, grade, class, condition, etc., shall be indicated. The applicable amendment symbol of the specification or standard shall not be shown. Additional reference to other equivalent specifications is permitted.

3.8.4 Other identification. When materials, processes, and protective treatment are used which cannot be identified adequately in accordance with 3.8.3, the drawing shall provide additional information for complete identification including the following:

a. Trade names or commercial designation.

b. Name, address and Federal Supply Code for Manufacturers (FSCM) of the producer of the material, process, or protective treatment.

c. Physical and mechanical properties in sufficient detail to disclose strength and safety characteristics where required by the design.

3.9 Care and maintenance of original drawings and referenced documents. The design activity shall care for and maintain original engineering drawings and referenced documents in such manner to assure satisfactory reproducibles in accordance with MIL-D-5480.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the contractor may use his own of any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Examination. The contractor shall review and check the drawings and referenced documents for completeness, technical and engineering accuracy, sufficiency of information for accomplishment of the functions specified in the contract requirements, legibility, reproducibility, and for conformance to all applicable requirements of the governing documents. These inspections shall be accomplished prior to submission of the data for Government acceptance. Evidence or records of performance of the required inspection shall be made available to the Government inspector, upon request, at the time the data are presented for acceptance.

4.3 Inspection conditions. Sample items or packs and the inspection of the preservation, packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5, or the documents specified therein.

* 5. PACKAGING

* 5.1 Original and duplicate original drawings shall be prepared for delivery in accordance with DOD-D-1000.

5.2 Microfilm shall be prepared for delivery in accordance with MIL-M-9868.

5.3 Reproducibles and nonreproducibles shall be prepared for delivery in accordance with MIL-D-5480.

5.4 Preservation. The levels of preservation shall be A and Commercial.

5.4.1 Level A. (Use data in MIL-D-5480).

5.4.2 Commercial. Commercial preservation shall be in accordance with ASTM D-3951.

5.5 The levels of packing are A, B and Commercial.

5.5.1 Level A. (Use data in MIL-D-5480).

5.5.2 Level B. (Use data in MIL-D-5480).

5.5.3 Commercial. Commercial packing shall be in accordance with ASTM D3951.

5.6 Marking of shipments. Interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129. Each interior package shall be marked in such manner that the markings will not become damaged when the packages are opened. The nomenclature for interior packaged and exterior shipping containers shall be as follows:

Drawing for (name or item), Specification (as applicable)	
Name of manufacture	x
Name of contractor (If different from design activity)	x
Contract or Order No.	x

x Information to be entered by the design activity

6. NOTES

6.1 Intended use. Tube bend drawings covered by this specification may be used by the Military activities for design, procurement, manufacture, testing, evaluation, production, production and reviewing inspection, overhaul, shipping, storage, identification of stock, ordering and storage of replacement parts, inspection of items at overhaul, general maintenance of equipment, and wherever engineering drawings are needed.

* 6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Level of drawings to be provided (see 1.2). When drawings are required, include the applicable code identification and drawing numbers.

c. Kinds of materials for originals if they are to be provided (see 3.5).

d. Levels of preservation and packing (see 5.4 and 5.5).

e. Quantity and type of reproducible, nonreproducible or microfilm copies of drawings to be provided.

f. Any applicable instructions and procedures pertaining to control and approval of drawings and revisions thereto.

g. Delivery dates and destination for drawings and other documents.

* 6.3 Submittal of tube bend drawings, standards, and related documents. In addition to the requirements of the contract or order for levels of drawings to be submitted, it shall be the responsibility of the prime contractor to include the requirements of this specification in contracts or orders with subcontractors and to insure compliance therewith.

* 6.3.1 Contractor design activity documents referenced in tube bend data drawings. All contractor design activity documents referenced on drawings shall be furnished as part of the set of drawings and shall show the appropriate FSCM in accordance with DOD-STD-100. Duplication of a prior submission of these documents to the military procuring activity is not required.

6.4 The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

Custodian:
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Preparing activity:
Air Force - 82

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Air Force - 16

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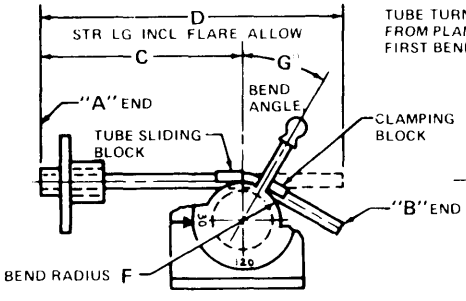
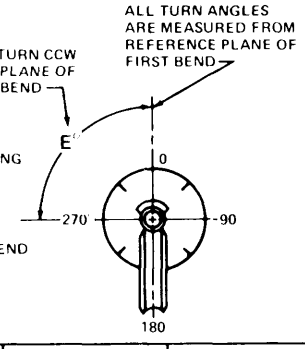
(Project DRPR-F262)

APPLICATION		REVISIONS			
NEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED

INTERPRET PER MIL-D-9898





TUBE SIZE		
OD	WALL	D LENGTH

HEAT TREAT

FINISH

COLOR CODE

PART IDENT.

BEND NO.	C DISTANCE	F BEND RADIUS	E TURN ANGLE	G BEND ANGLE

LIMIT WRINKLES, FLATNESS PER MS33611

END	FITTING	TYPE
A		
B		

TYPE OF END

1	FLARE	MS33584
2	DBL FLARE	MS33583
3	BEAD	MS33660
4	SQUARE	
5	NOTED	

PROTECT ENDS PER MIL C 5501

NOTES
1. ADD_____INCHES TO D LENGTH AT "A" END FOR CLAMPING, ETC WHEN REQUIRED
2. ADD_____INCHES TO D LENGTH AT "B" END FOR FIRST BEND WHEN REQUIRED
3. **PRESSURE TEST TO_____PSI PER_____**

DASH NO.

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± DECIMALS .XX ± .XXX ± ANGLES ±

MATERIAL AND MATERIAL SPEC.

DR
CHK
ENG

A.F. AUTHENTICATION

A.F. RELEASE

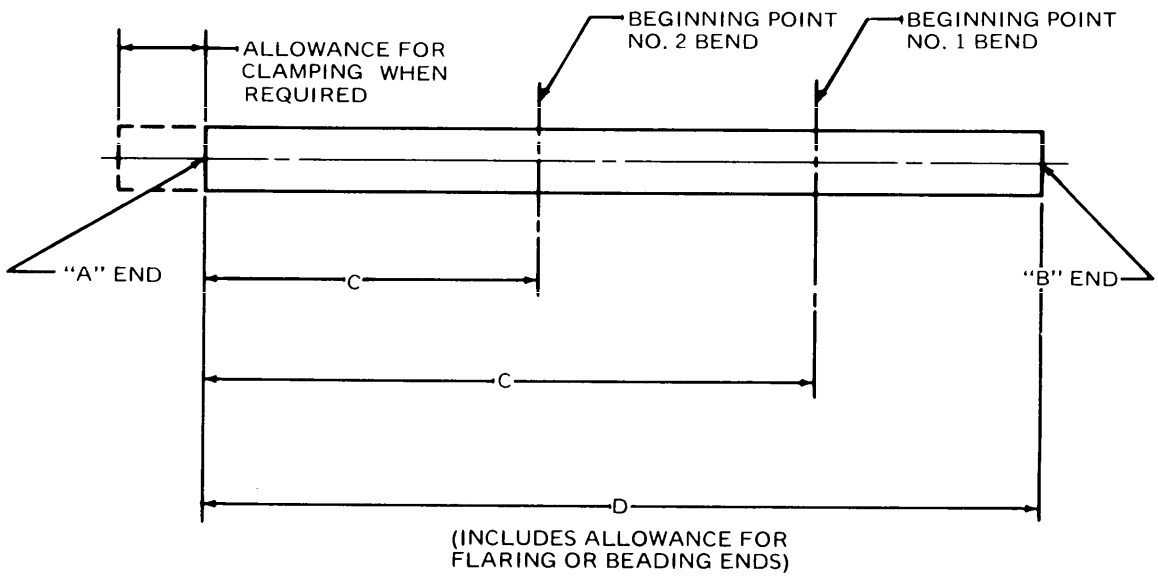
U.S. AIR FORCE

TITLE

SIZE A | FSCM | DRAWING NO.

SCALE | REF SPEC MIL-D-9898 | SHEET OF

FIGURE 1. TUBE BEND DATA DRAWING



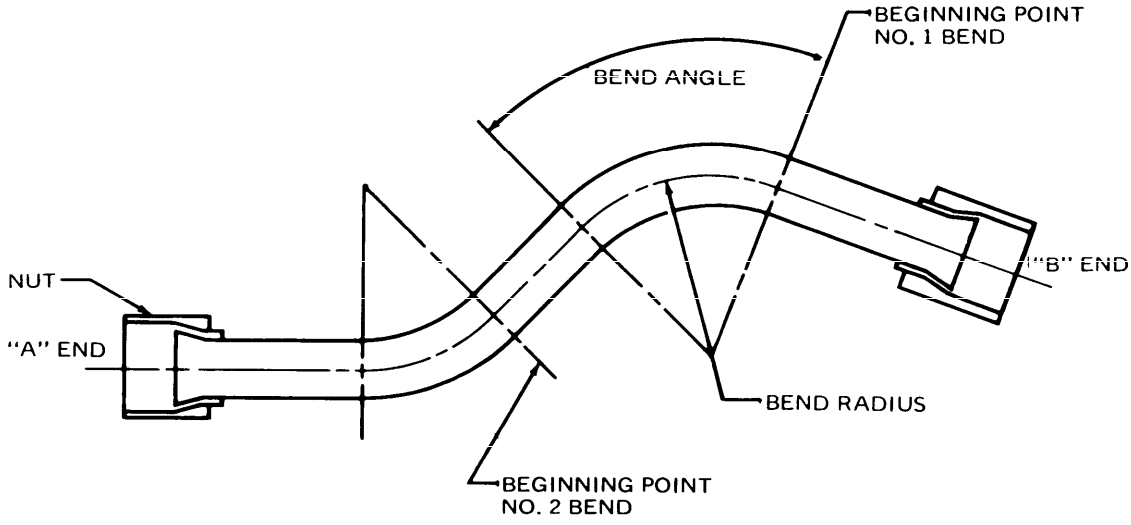
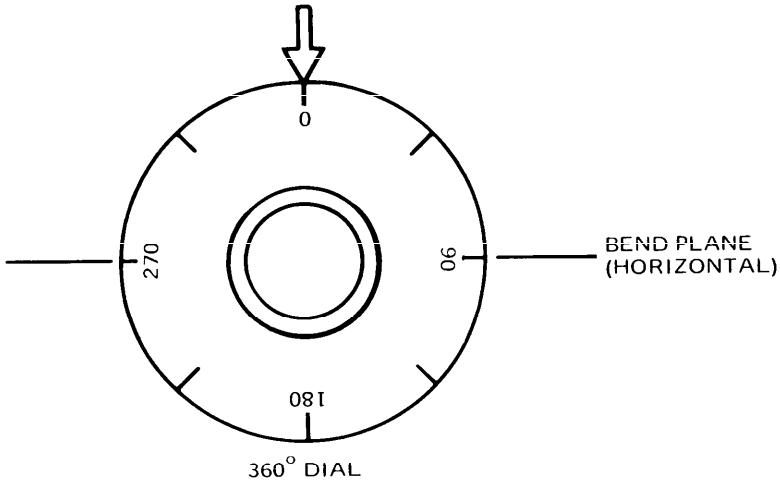


FIGURE 2. TUBE LAYOUT AND FINISHED ASSEMBLY.



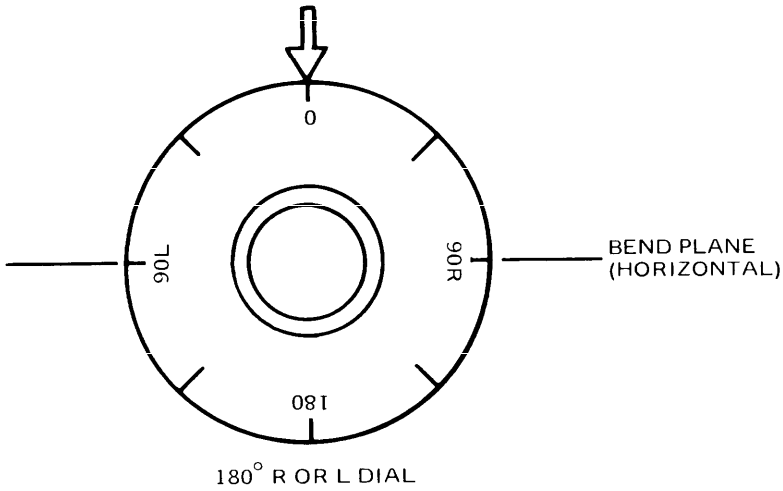


FIGURE 3. TYPES OF DIALS COMMONLY USED WITH TUBE BENDING MACHINES.

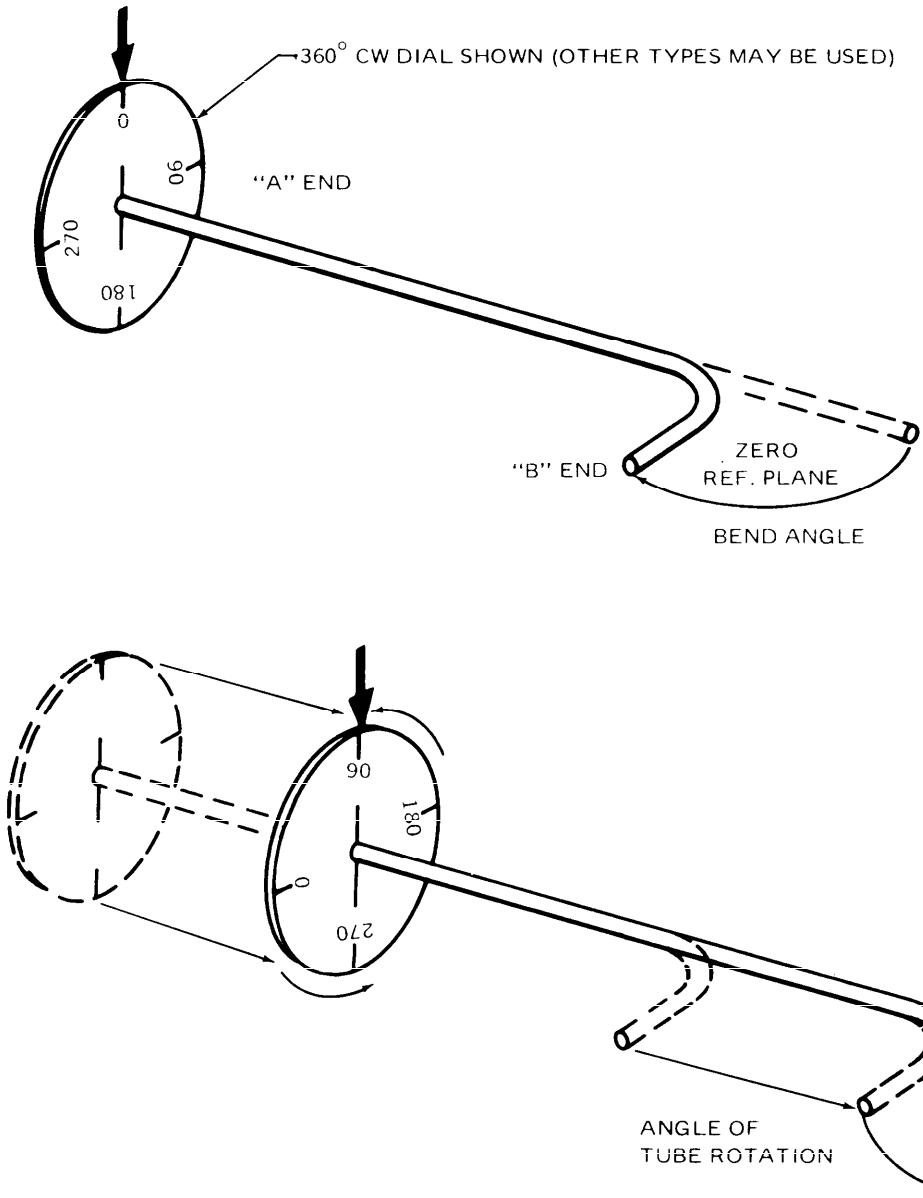


FIGURE 4. ANGLE OF TUBE ROTATION.

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Chief of the Defense Staff, a

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NOTE: This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document*(s)* or to amend contractual requirements.

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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-D-9898C	Drawings, Tube Bend

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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