Green Bank Observatory
Electronics Division Technical Note

EDTN 230

GBT Receiver Room Turret Gasket

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INTRODUCTION:

The GBT receiver room houses a motor driven turret. The turret is approximately 14 feet in diameter and has 8 holes which holds up to 8 receivers. The turret is rotated, as needed, to put a receiver into observing position.

A gasket is installed between the rotating turret and the stationary room structure. The gasket provides the necessary weather, RFI, and HVAC seal for the receiver room. It is subjected to the temperature extremes of summer and winter. It maintains continuous electrical contact between the room and the structure, thus reducing radiated energy from inside the room from entering the feeds.

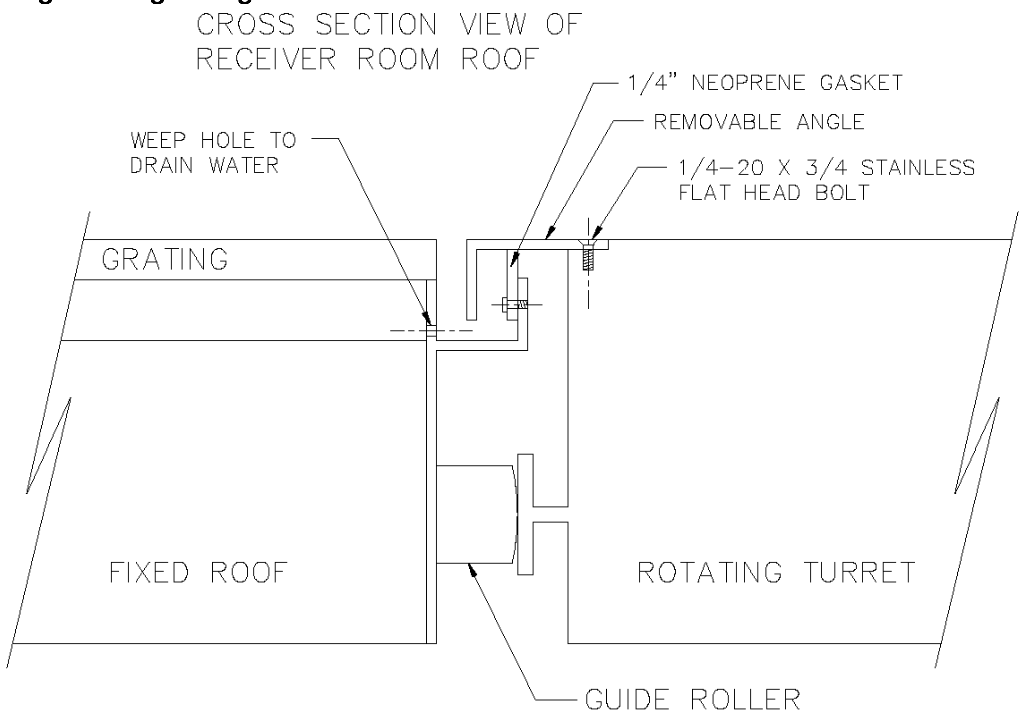
Rotation of the turret produces drag on the drive motor. The design of the gasket rub surface minimizes drag, so that the current specifications of the motor are not exceeded. The design also provides a long service life, with minimal ongoing maintenance.

There are four rolled steel angles bolted to the top surface of the turret. Each angle covers one 90-degree quadrant, and are bolted in place to allow access and maintenance of the gasket. Copper tape is used to cover the gap between each section, and caulking is used to keep water out.

HISTORY:

The original contract with Loral called for them to install a non-conductive weather seal, with the thought that we (NRAO) would remove their gasket and install a conductive one in its place.

Original flange and gasket:

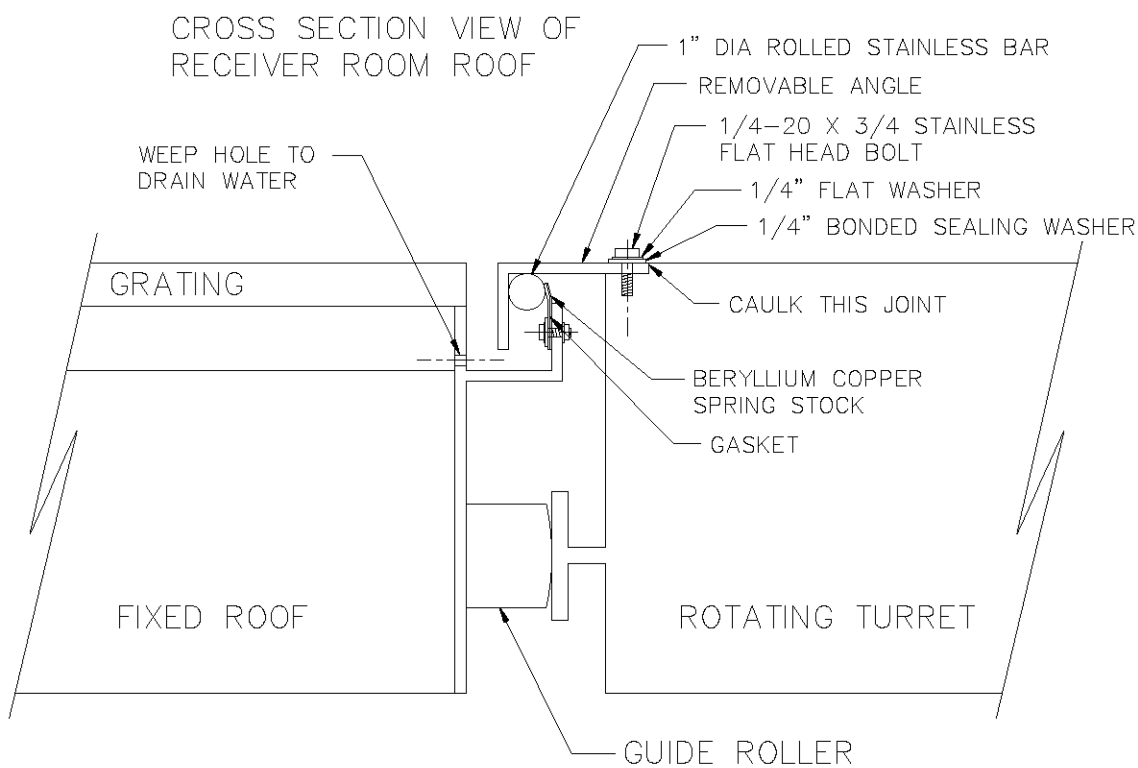


In July 1996, Loral purchased a 1/4 inch thick, non-conductive black neoprene seal to prove the concept. We noted lots of problems, mostly related to the flange of the rx room (not the turret) not being even in height around the perimeter. We measured deviations of up to 0.9". To fix this, a track torch was mounted on the turret. It was then rotated, which evened out the flange, fixing the misalignment. A hand grinder was used to smooth out the rough torch cut. This helped, however, the contact between the gasket and the top rail remained uneven.

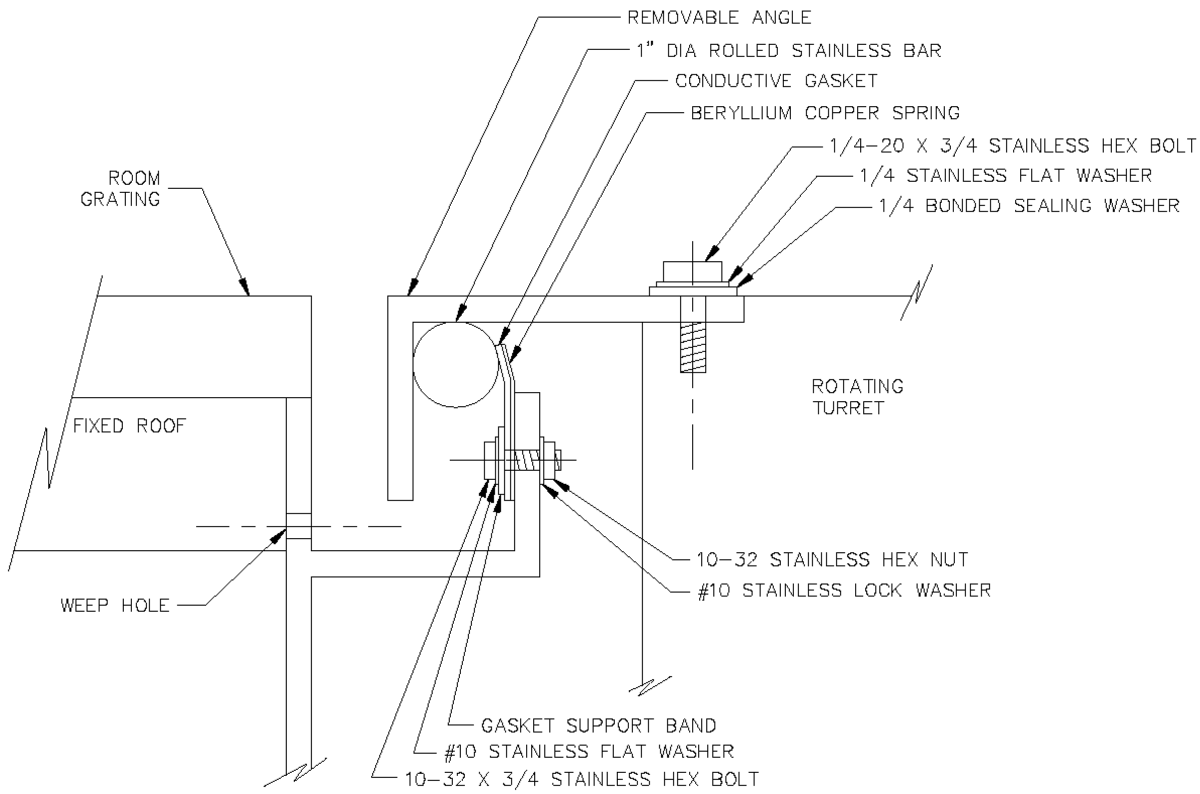
Further testing showed the thick neoprene material was causing unacceptable drag (high current draw) on the turret motor. The gasket was greased, which helped, but there was still too much drag. The 1/4 material was simply too rigid, so a new design was needed.

For the new design, a 1-inch diameter round stainless bar was welded into the angles. This concept allows for small height changes, less drag, and better service life.

Modified flange and gasket:



Detail:



A 2" wide x 1/16" non-conductive silicone gasket was installed. We hoped that the thinner material, along with positive air pressure inside the rx room, would keep the gasket in constant contact with the round bar; thus, causing less drag. However, there was not enough air pressure to maintain contact. To correct this, beryllium copper sheet metal was fabricated to act as a backing spring to the gasket. The sheet metal keeps the gasket in constant light pressure to the 1-inch bar. This gasket was kept in place for the next 2 years. Periodic Inspection showed very little wear.

In October 1998, we purchased and installed the current blue conductive gasket. The selection of gasket was based on performance, availability, and price. It is Chomerics 19-09-F067-1285, and uses silver/aluminum in a silicone binder. Reference GBO requisition 182856, 10/18/2021, Chomerics quote Q-547864 for most recent price and delivery information. Forty-five feet (2-inch wide x 1/16" thick) is needed, but we purchased 50 feet from Chomerics in order to have extra. Bare metal surfaces were painted with Chomerics conductive Pro-Shield 7103. The gasket was lubricated with Chomerics Cho-Lube 4220 conductive grease. Latex caulking was used to cover the joints for water sealing.

In August of 1999, after one year of service, one rail was removed to allow gasket inspection. Some light rust was noted but, otherwise, the gasket looked good.

In August of 2004, one rail was pulled, and the turret rotated for inspection. We noted a lot of rust as the conductive paint was flaking-off the metal. The grease seemed to attract lots of light debris. However, the gasket showed very little wear. Everything was cleaned, and debris was vacuumed.

During reassembly, the metal was left bare; no conductive paint was used. Conductive grease was re-applied. Rather than latex caulking, we used butyl caulking.

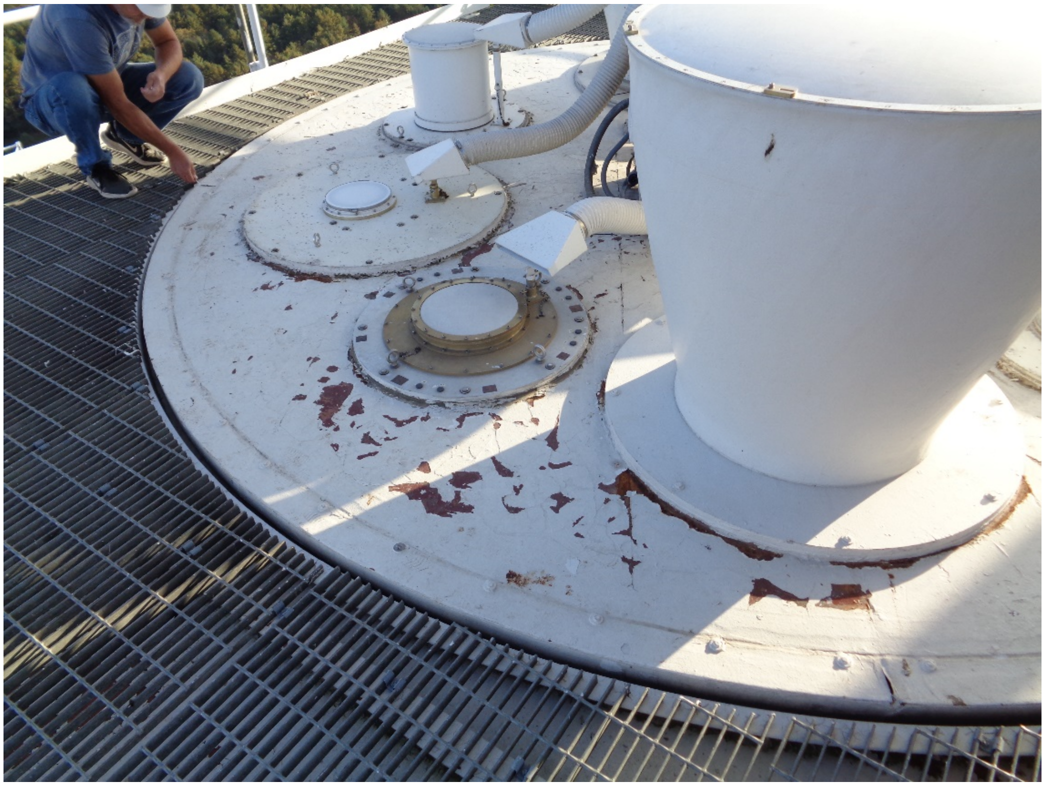
In August of 2007 one rail was pulled for inspection, and we noted that the surfaces were clean, with very little rust. For long-term use, the Butyl caulking is much better than latex. The gasket was cleaned with alcohol; however, we did not apply conductive grease. Used butyl caulking to seal.

Note that in June of 2010, the original turret drive motor was replaced with a larger, higher torque unit. This allows the turret to be rotated when the GBT is tipped in elevation. Because of this, any drag associated with the gasket should be further minimized.

PROCEDURE FOR INSPECTING GASKET:

1. Select one (of four) rails to remove. Use a rigid, sharp putty knife to remove old caulking. Remove the copper tape between rail sections.
2. Use a 7/16" wrench to remove the ¼-20 bolts.
3. Use a small pry-bar to lift the rail section. This will expose the RFI gasket.
4. Use an angle grinder with a wire brush attached to clean the rail section and turret. Be careful to not damage the gasket when using the wire brush.
5. Use alcohol and paper towels to clean the gasket. Use a vacuum cleaner on all surfaces.
6. Inspect and clean any debris from the rain-water weep holes in the roof of the receiver room.
7. Have an operator rotate the turret slowly from limit to limit using the PMU controller. During the move, inspect the entire gasket for damage.
8. Assuming no damage, carefully re-install the rail section. Use new ¼-20 x ¾ stainless bolts (McMaster 92240A540) with ¼x5/8 dia stainless washers (McMaster 92141A029) and ¾ dia bonded sealing washers (McMaster 94708A412).
9. Apply several layers of copper tape over the gap between rail sections.
10. Apply a quality Butyl caulk (DAP Butyl-Flex gutter seal or equivalent) in the joint between the rail section and the turret. Cover the copper tape with a thin layer of the caulk. Once dry, paint over the caulking and all screw heads.
11. Note, if the gasket is damaged or in need of replacement, all four rail sections must be removed, and cleaned as described above.
12. To remove the gasket, the 10-32 bolts holding the gasket/spring material must be first removed, followed by gasket removal.
13. Install the new gasket, then go to step 7 above.

Rail section to be removed:



Old caulking, bolts, and copper tape between rail sections removed:

1 inch diameter stainless rolled bar:

Wire brushing to remove old caulk, rust, and paint:

Finger spring backing strip, RFI gasket, and turret rim:

Finger spring backing strip and RFI gasket:

Cleaned rail section reinstalled with new hardware:

New copper tape over joint section. Ready to apply new caulk and paint:

Copper tape and gap covered with Butyl caulk prior to painting:

Chomerics 1285 conductive gasket data sheet. See Chomerics handbook for additional information.

Elastomer Binder Legend

Silicone	Fluorosilicone	EPDM	Fluorocarbon/ Fluorosilicone
(white)	(green)	(orange)	(blue)

Elastomer Filler Legend

Corrosion Resistant on Aluminum
(purple)

Table 5-3: Material Guidelines - Military and Commercial		Test Procedure (Type of Test)	CHO-SEAL 6502	CHO-SEAL 6503	CHO-SEAL 1298	CHO-SEAL 1285	CHO-SEAL 1287	CHO-SEAL 1215
Physical	Molded (M) or Extruded (E)	–	M/E	M/E	M/E	M/E	M/E	M/E
Physical	Conductive Filler	–	Ni/Al	Ni/Al	Passivated Ag/Al	Ag/Al	Ag/Al	Ag/Cu
Physical	Elastomer Binder	–	Silicone	Fluorosilicone	Fluorosilicone	Silicone	Fluorosilicone	Silicone
Physical	Type (Ref. MIL-DTL-83528)	–	Not Applicable	Not Applicable	Type D	Type B	Type D	Type A
Physical	Volume Resistivity, ohm-cm, max., as supplied without pressure sensitive adhesive	CEPS-0002[C] (Q/C)	0.150	0.250	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Physical		MIL-DTL-83528 (Q/C)	Not Applicable	Not Applicable	0.012	0.008	0.012	0.004
Physical	Hardness, Shore A	ASTM D2240 (Q/C)	68 ±10	72 ±10	70 ±7	65 ±7	70 ±7	65 ±7
Physical	Specific Gravity	ASTM D792 (Q/C)	1.85 ± 0.25	2.05 ± 0.25	2.00 ± 0.25	2.00 ± 0.25	2.00 ± 0.25	3.50 ±0.45
Physical	Tensile Strength, psi (MPa), min.	ASTM D412 (Q/C)	150 (1.03)	150 (1.03)	180 (1.24)	200 (1.38)	180 (1.24)	200 (1.38)
Physical	Elongation, % min. or % min./max.	ASTM D412 (Q/C)	100 min	50 min	60/260	100/300	60/260	100/300
Physical	Tear Strength, lb/in. (kN/m), min.	ASTM D624 (Q)	40 (7.00)	35 (6.13)	35 (6.13)	30 (5.25)	35 (6.13)	40 (7.00) / 25 (4.38)
Physical	Compression Set, 70 hrs at 100°C, % max. [A]	ASTM D395, Method B (Q)	30	30	30	32	30	32
Thermal	Low Temperature Flex TR10, °C, min.	ASTM D1329 (Q)	-55	-55	-55	-65	-55	-65
Thermal	Maximum Continuous Use Temperature, °C [B]	–	125	125	160/200	160/200	160/200	125
Thermal	Thermal Conductivity, W/m-K (Typical) 300 psi (2.07 MPa)	ASTM D5470	1.0	0.9	1.2	2.2	Not Tested	2.1
Electrical	Shielding Effectiveness, dB, min. [F]	Method 1: CHO-TP08[C] (Q) Method 2: MIL-DTL-83528 Para. 4.5.12 (Q) Method 3: CHO-TP09[C] (Q)	Method 2	Method 2	Method 2	Method 2	Method 2	Method 2
Electrical	200 kHz (H Field)		Not Tested	Not Tested	55	60	55	70
Electrical	100 MHz (E Field)		127	127	110	115	110	120
Electrical	500 MHz (E Field)		115	117	100	110	100	120
Electrical	2 GHz (Plane Wave)		116	116	95	105	95	120
Electrical	10 GHz (Plane Wave)		127	127	90	100	90	120
Electrical	40 GHz (Plane Wave)		Not Tested		75	Not Tested	75	90
Electrical	Electrical Stability, ohm-cm, max.: Heat Aging	CEPS-0002[C] (Q)	0.200 [H]	0.250 [H]	Not Applicable	Not Applicable	Not Applicable	Not Applicable
Electrical	Electrical Stability, ohm-cm, max.: Heat Aging	MIL-DTL-83528 Para. 4.5.15 (Q/C)	Not Applicable	Not Applicable	0.015	0.010	0.015	0.010
Electrical	Electrical Stability, ohm-cm, max.: Resistance During Vibration	MIL-DTL-83528 Para. 4.5.13 (Q)	Not Applicable	Not Applicable	0.015	0.012	0.015	0.004
Electrical	Electrical Stability, ohm-cm, max.: Resistance After Vibration	MIL-DTL-83528 Para. 4.5.13 (Q)	Not Applicable	Not Applicable	0.012	0.008	0.012	0.008
Electrical	Electrical Stability, ohm-cm, max.: Post Tensile Set Volume Resistivity	MIL-DTL-83528 Para. 4.5.9 (Q/C)	Not Applicable	Not Applicable	0.015	0.015	0.015	0.008
Regulatory	EMP Survivability, kA per in. perimeter	MIL-DTL-83528 Para. 4.5.16 (Q)	>0.9	>0.9	>0.9	>0.9	>0.9	>0.9
Regulatory	RoHS Compliant	–	Yes	Yes	Yes	Yes	Yes	Yes
Regulatory	UL 94 Flammability Rating	UL 94	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested	Not Tested

Note A: Compression set is expressed as a percentage of deflection per ASTM D395 Method B, at 25% deflection. To determine percent recovery, subtract 0.25 of the stated compression set value from 100%. For example, in the case of 30% compression set, recovery is 92.5%.
Note B: Where two values are shown, the first represents max. operating temp. for conformance to MIL-DTL-83528 (which requires Group A life testing at 1.25 times max. operating temp.) and the second value represents the practical limit for ex posure up to 1000 hrs. (compressed between flanges 7-10%). Single values conform to both definitions.
Note C: Copies of CEPS-0002, CHO-TP08 and CHO-TP09 are available from Chomerics. Contact Applications Engineering.
Note D: Heat aging condition: 100°C for 48 hrs.
Note E: Heat aging condition: 150°C for 48 hrs.
Note F: It may not be inferred that the same level of shielding effectiveness provided by a gasket material tested in the fixture per MIL-DTL-83528 Para. 4.5.12 would be provided in an actual equipment flange, since many mechanical factors of the flange design (tolerances, stiffness, fastener location and size, etc.) could lower or enhance shielding effectiveness. This procedure provides data applicable only to the test fixture design of MIL-DTL-83528, but which is useful for making comparisons between different gasket materials. The 40 GHz test data for all materials uses TP08 test method.
Note G: Heat aging condition: 200 °C for 48 hours
Note H: Heat aging condition: 125 °C for 1000 hours

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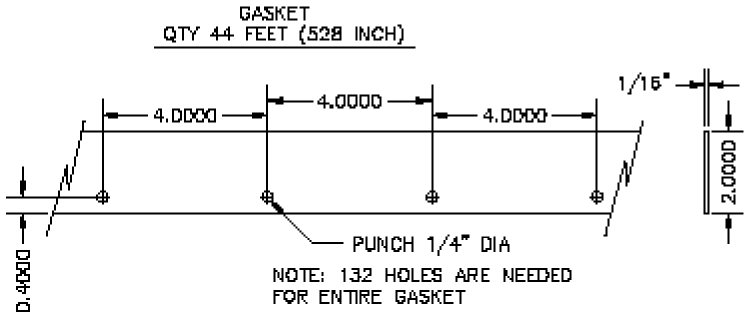
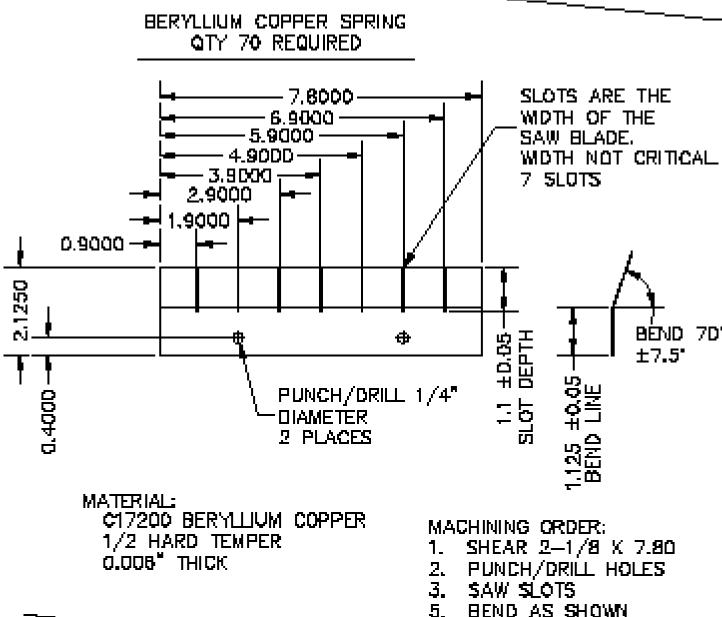
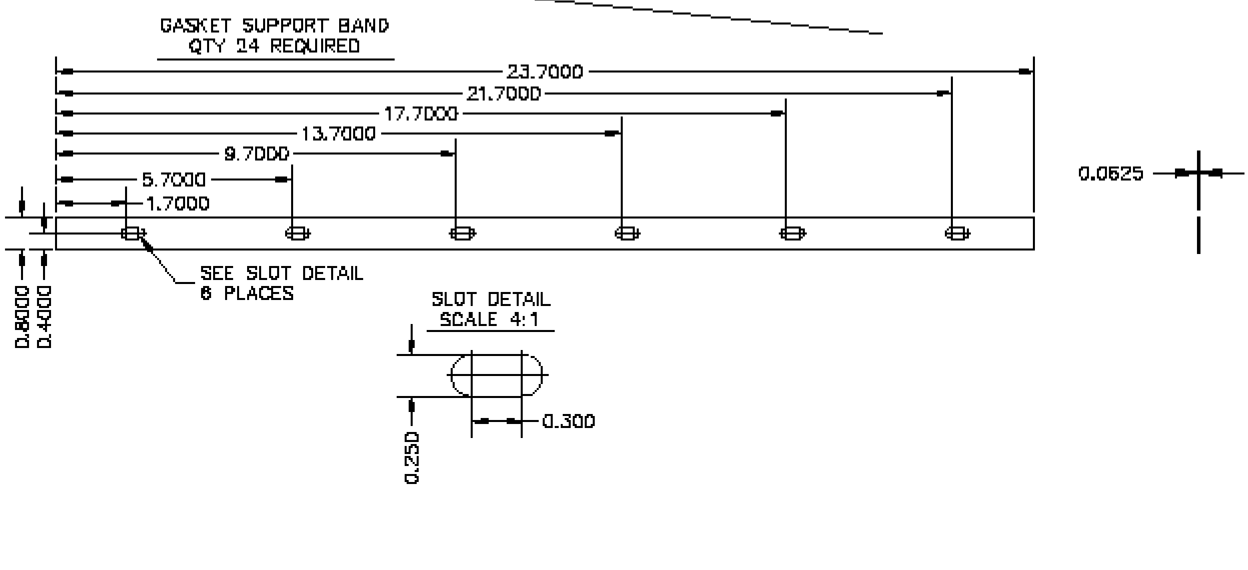

GASKET
QTY 44 FEET (528 INCH)
4.0000
4.0000
4.0000
1/16"
2.0000
0.4000
PUNCH 1/4" DIA
NOTE: 132 HOLES ARE NEEDED
FOR ENTIRE GASKET


BERYLLIUM COPPER SPRING
QTY 70 REQUIRED
7.8000
6.9000
5.9000
4.9000
3.9000
2.9000
1.9000
0.9000
2.1250
0.4000
SLOTS ARE THE
WIDTH OF THE
SAW BLADE.
WIDTH NOT CRITICAL
7 SLOTS
PUNCH/DRILL 1/4"
DIAMETER
2 PLACES
1.1 ±0.05
SLOT DEPTH
1.125 ±0.05
BEND LINE
BEND 70°
±7.5°
MATERIAL:
C17200 BERYLLIUM COPPER
1/2 HARD TEMPER
0.008" THICK
MACHINING ORDER:
1. SHEAR 2-1/8 X 7.80
2. PUNCH/DRILL HOLES
3. SAW SLOTS
5. BEND AS SHOWN


GASKET SUPPORT BAND
QTY 24 REQUIRED
23.7000
21.7000
17.7000
13.7000
9.7000
5.7000
1.7000
0.0625
0.8000
0.4000
SEE SLOT DETAIL
6 PLACES
SLOT DETAIL
SCALE 4:1
0.250
0.300