Shively Labs®

Circularly Polarized FM Broadcast Antenna

Versa2une (SLV)
1 to 6-bay, half- and full-wave-spaced versions

Instruction Manual

Installation, Operation, & Maintenance

Congratulations!

Thank you for purchasing one of the finest FM broadcast antennas on the market today. The Shively Labs Versa2une is the top-of-the-line in its class for its simplicity, superior performance and durability.

Your purchase is backed by the best technical support in the industry. Shively is a leading manufacturer in the broadcast industry, providing an extensive range of antennas, transmission line and components. Our technical staff has a wealth of experience in the broadcast industry and is standing by to serve you in any way.

This manual is intended to give you a good basic understanding of your antenna: its proper and safe installation, startup, and operation, and trouble-shooting and maintenance information to keep it working satisfactorily for years to come. *Please have everyone involved with the antenna read this manual carefully, and keep it handy for future reference.*

Meanwhile, please feel free to contact your sales representative at Shively Labs at any time if you need information or help. Call or write:

Shively Labs®
A Division of Howell Laboratories, Inc. Bridgton, Maine 04009 USA
188 Harrison Rd., P. O. Box 389, Bridgton, Maine 04009 USA
(207) 647-3327 1-888-SHIVELY 24-hour (207) 329-5118 FAX (207) 647-8273
sales@shively.com www.shively.com
An Employee-Owned Company ISO 9001 Certified

Publication No. im-SLV 1-6 (171227)

IMPORTANT

Please read this manual in its entirety before beginning installation of your antenna!

Failure to follow the installation and operation instructions in this manual could lead to failure of your equipment and might even void your warranty!

This manual applies only to one- to six-bay SLV antennas (SLV-1 to SLV-6). For eight- to twelve-bay antennas (SLV-8 to SLV-12), refer to the appropriate manual on our Web site.

Table of Contents

Table of Contents

Table of Contents

1 Preparation

Check the shipment.

As soon as you receive your antenna, *BEFORE* signing for the shipment:

a. Check to be sure all the material has arrived.

b. Check for evident damage to any of the boxes.

c. If any boxes are missing, or if any are obviously damaged, describe the problem in a WRITTEN note on the shipping papers BEFORE signing them. Then call Shively right away, and we'll do everything we can to correct the situation.

Important!

Never store the antenna system outdoors, boxed or otherwise. Take pains to keep the antenna components dry. You will need to purge moisture from the interior of the antenna components before applying transmitter power, and purging will be much more time-consuming if the components get wet.

Torque specifications.

NOTE

Use an anti-seize compound to minimize galling on stainless steel threads.

Table 1. Torque specifications

Hardware size	Torque (dry)	Torque (lubricated)
M5 stainless steel	3.75 lb-ft (0.52 kg-m)	3.4 lb-ft (0.47 kg-m)
M8 stainless	16 lb-in (2.2 kg-m)	14 lb-ft (1.9 kg-m)
M12 stainless	54 lb-ft (7.5 kg-m)	48 lb-ft (6.6 kg-m)
7/16 DIN (antenna input fitting)	18 - 22 lb-in (21 - 25 cm-kg)	n/a

Check the parts.

Check to be sure all the parts listed in Table 4, Table 5, and Table 6 have arrived in good condition.

NOTE

Item callouts are consistent across all the illustrations in this technical sheet.

Prepare the mounting location.

Figure 1. Tower layout, single antenna bay

Remember!

It is YOUR responsibility to ensure that your installation meets all applicable codes and the centerline-of-radiation requirements of your FCC construction permit.

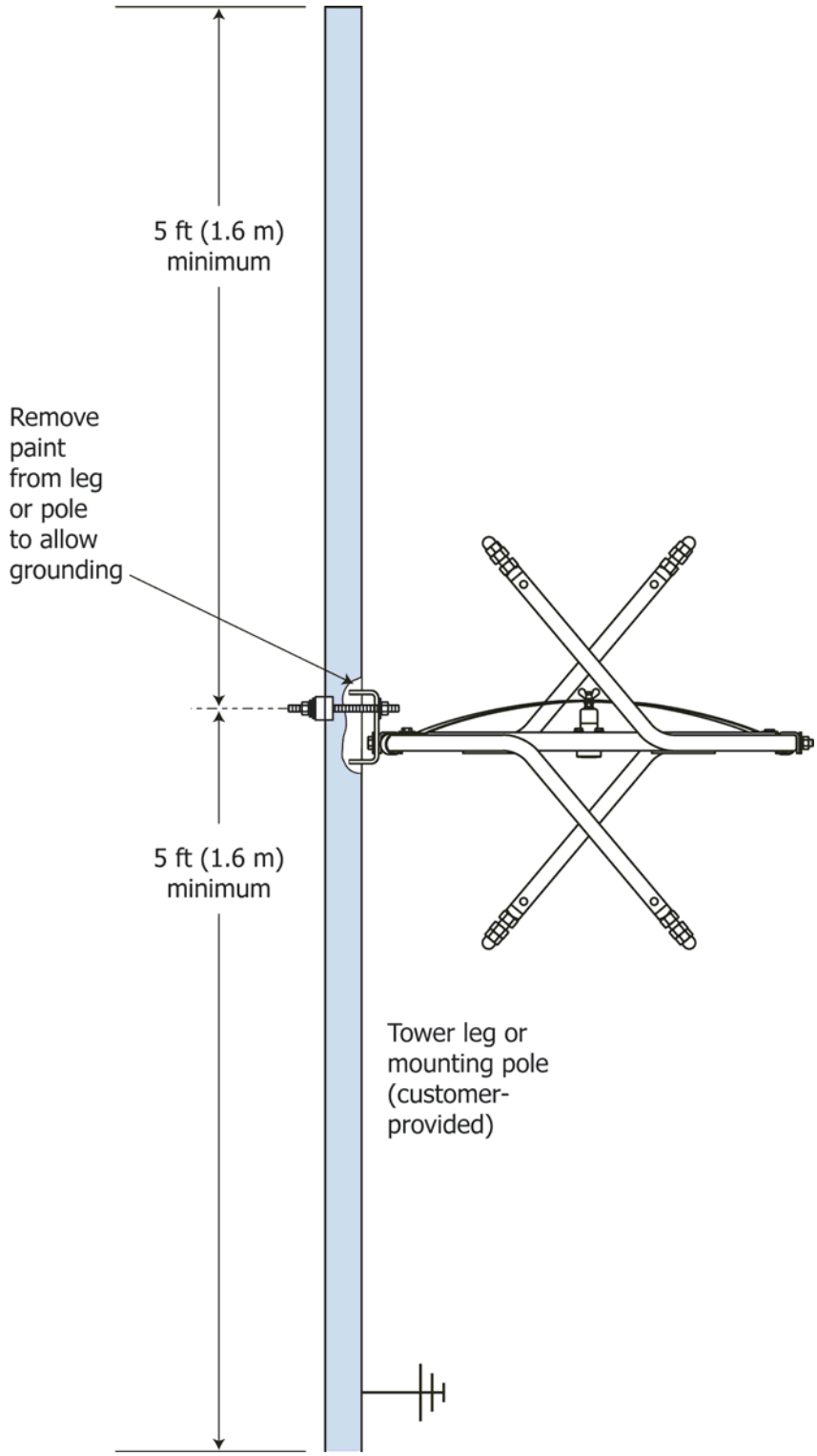


Figure 2. Tower layout, two-bay antenna

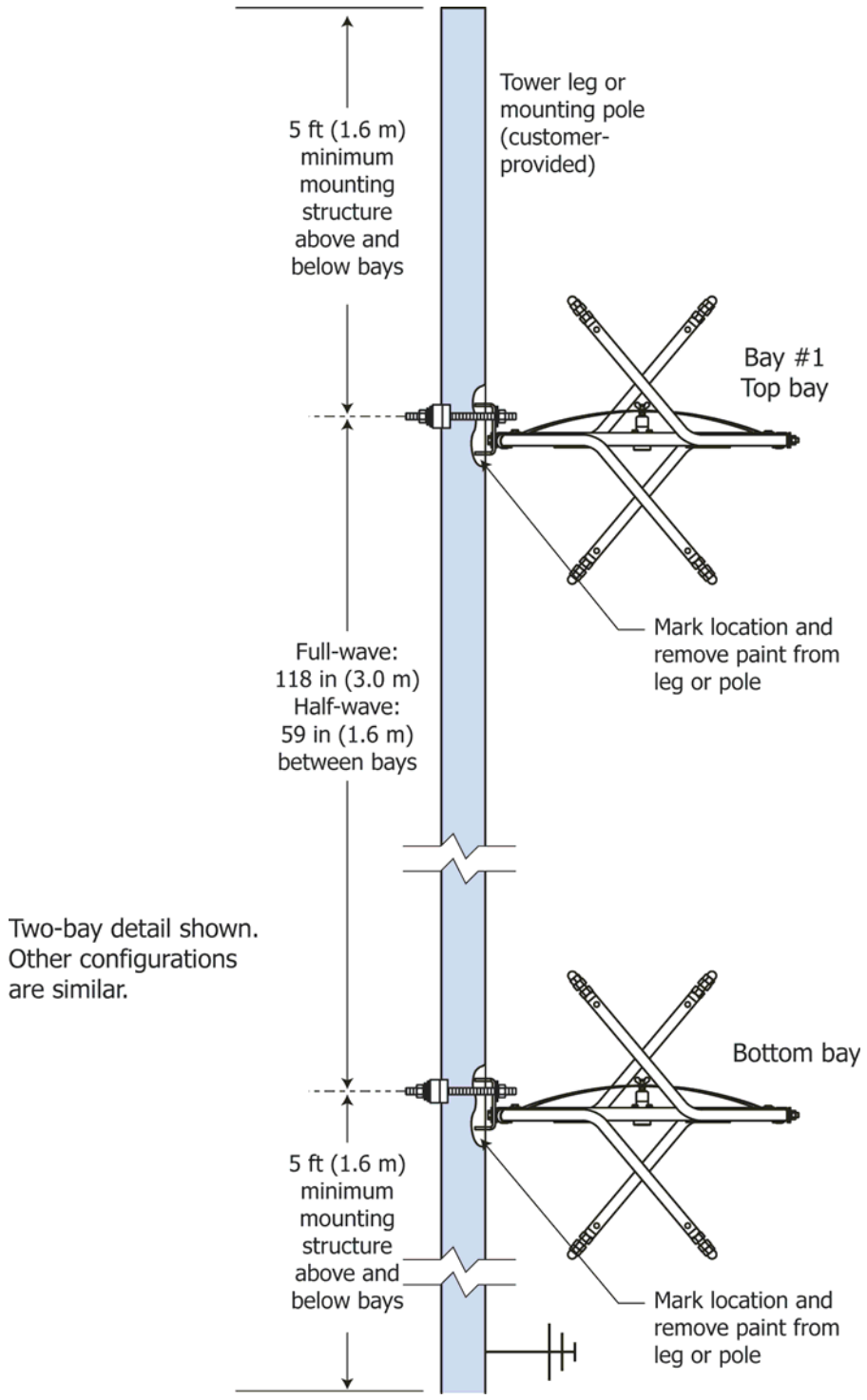


Figure 3. Tower layout, four-bay antenna

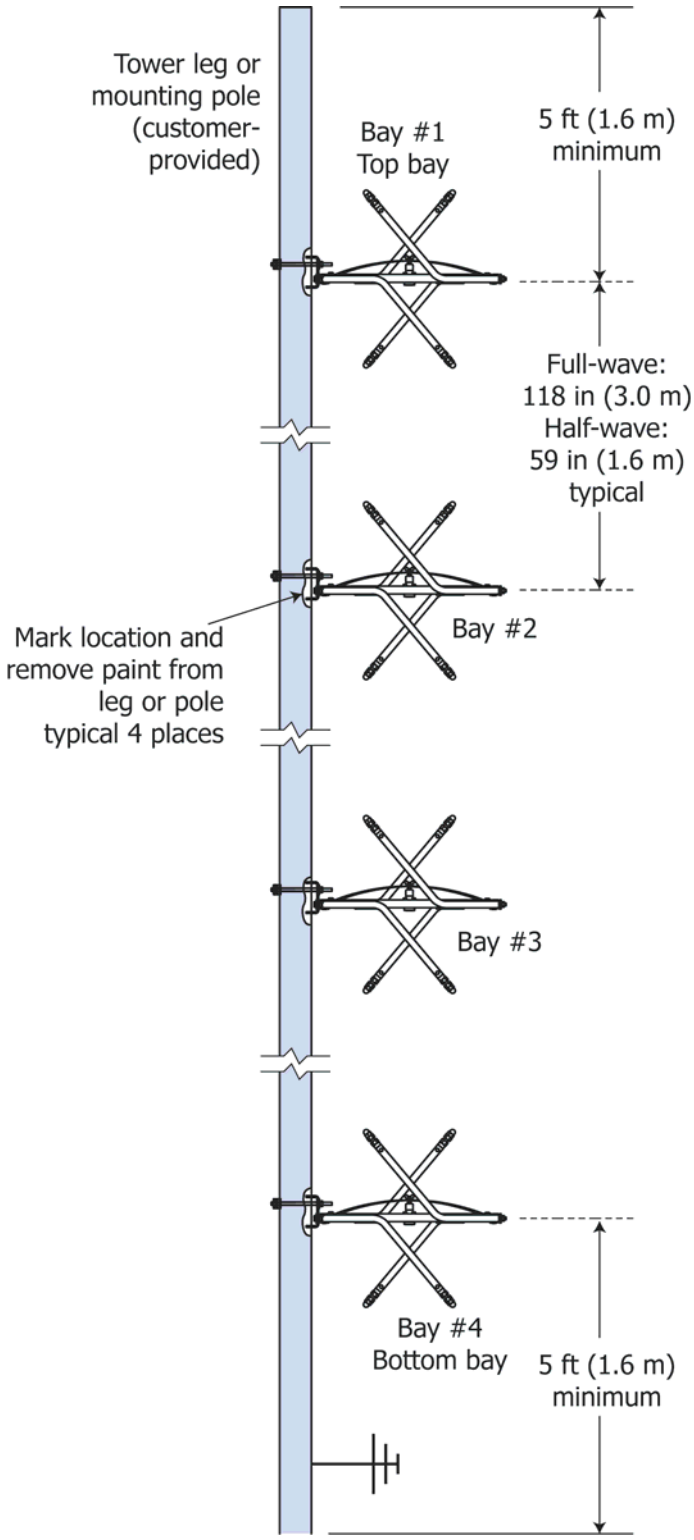
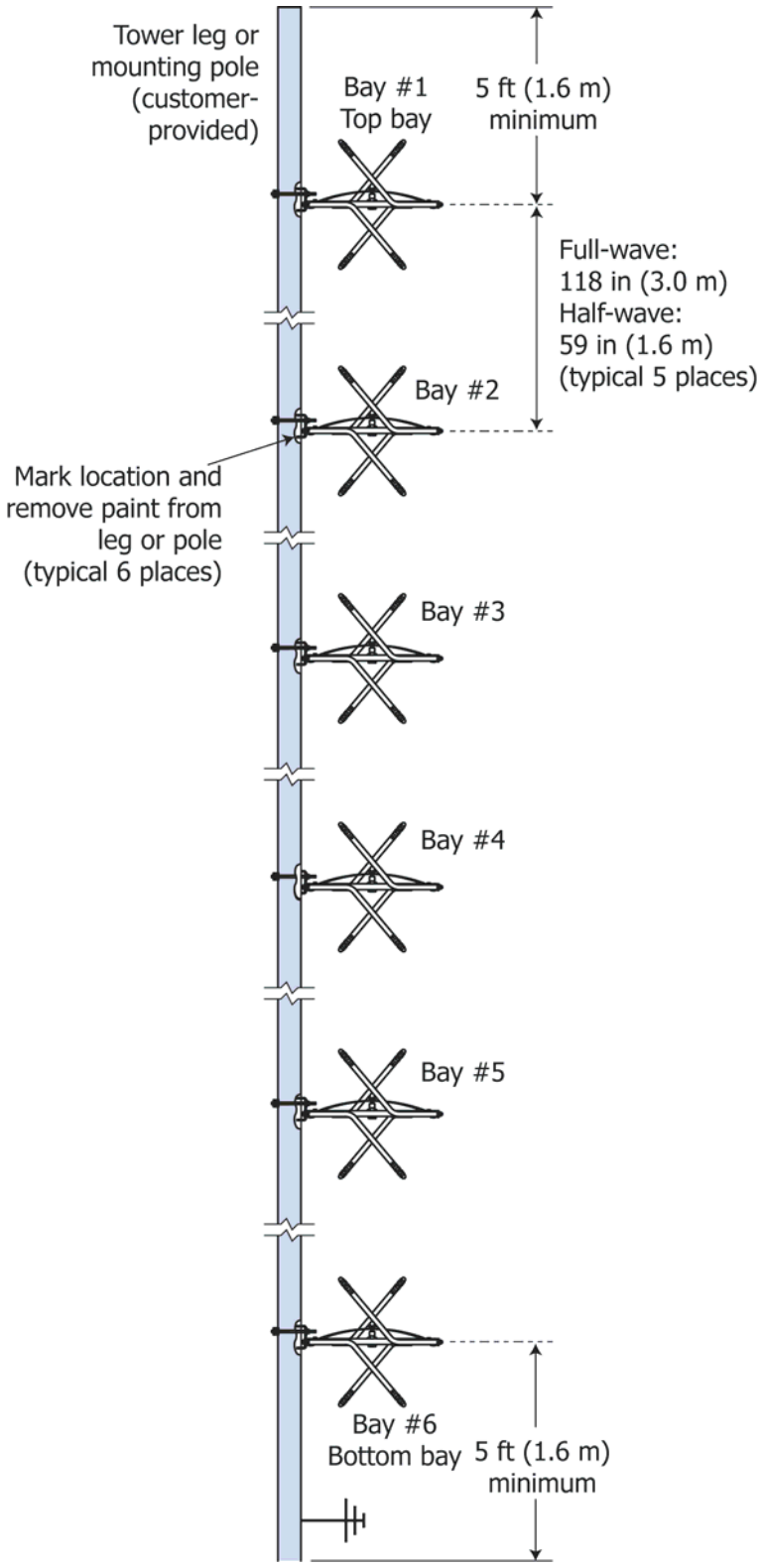


Figure 4. Tower layout, six-bay antenna



High-band or low-band?

87.5 - 98 MHz = Low-band

98.1 - 108 MHz = High-band.

Determine "A" dimension.

Note the "A" dimension for your antenna, full-wave (Figure 5) or half-wave (Figure 6) spaced and high- or low-band. You'll need it when assembling the bays.

Figure 5. Low-band and high-band "A" dimension values, full-wave-spaced

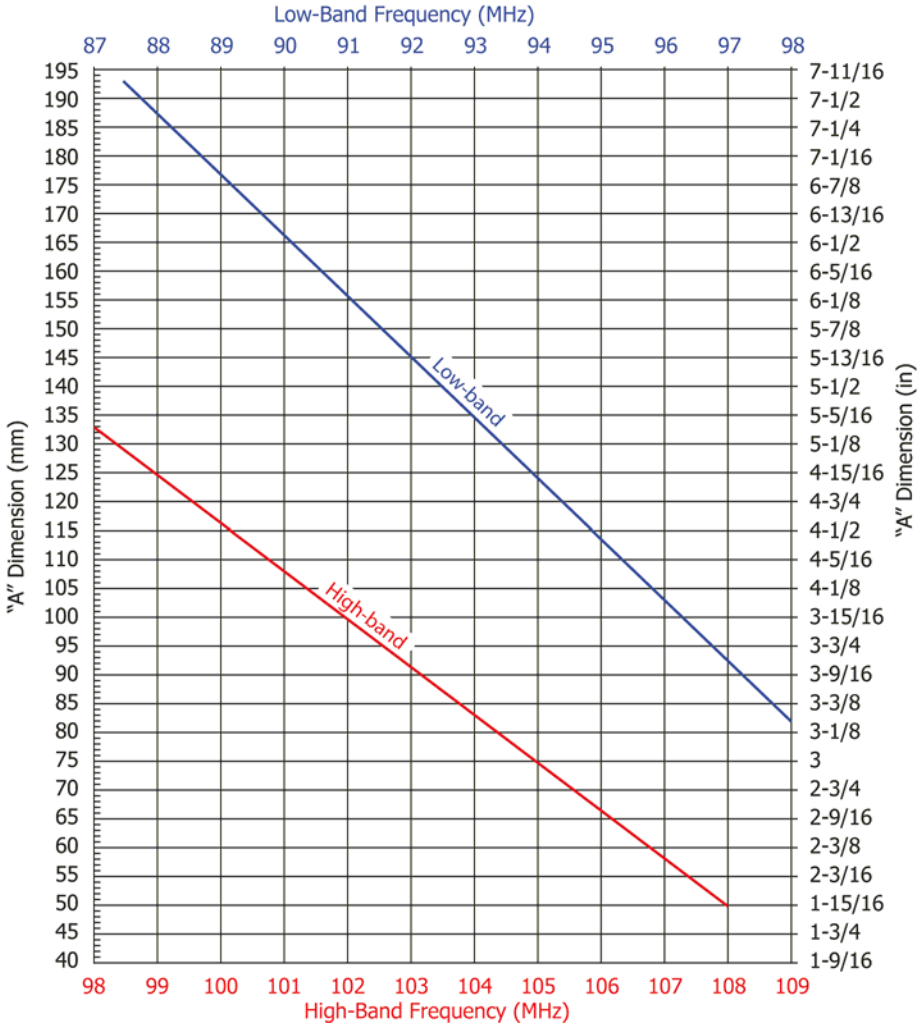
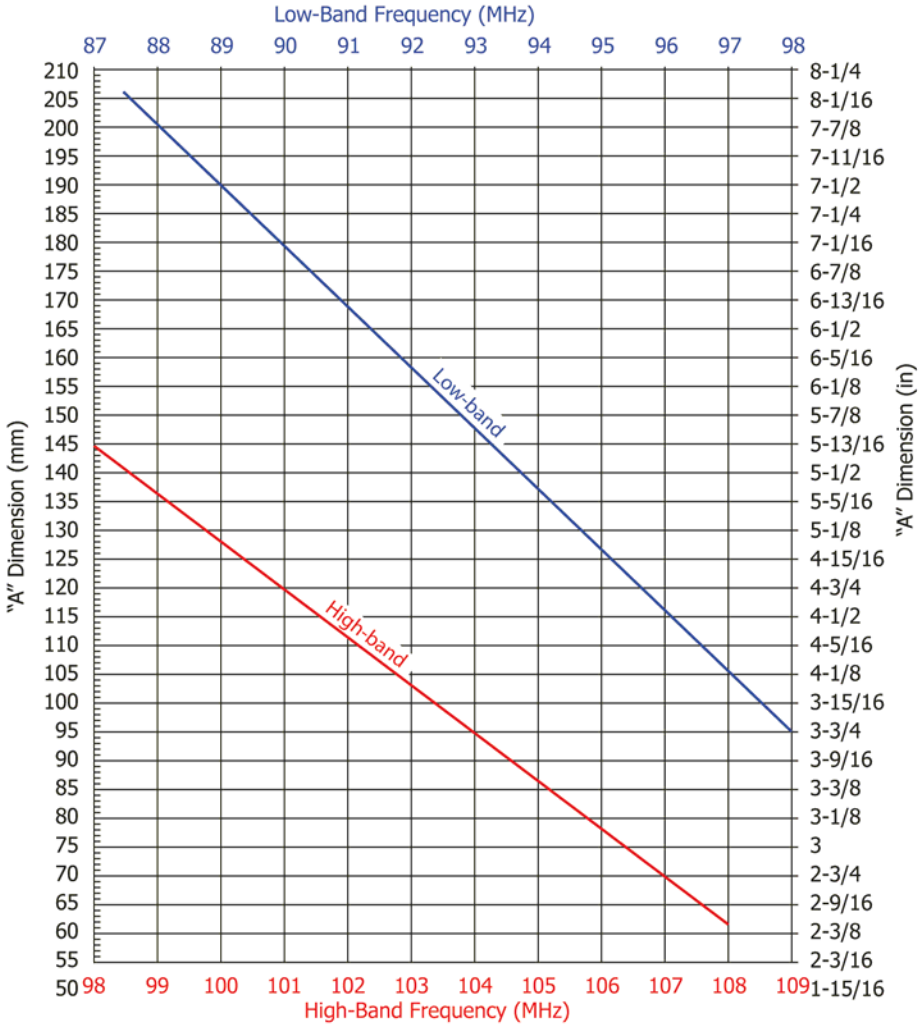


Figure 6. Low-band and high-band "A" dimension values, half-wave-spaced

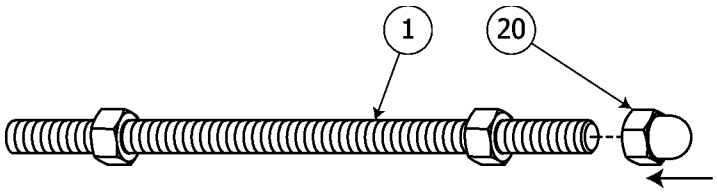


2 Arm Assembly

Assemble arms.

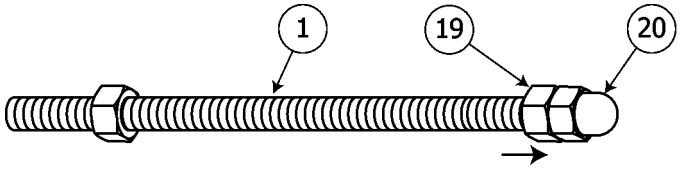
a. Screw the acorn nut (Figure 7, 20) onto the 230 mm threaded rod (1) as far as it will go.

Figure 7. Arm assembly a



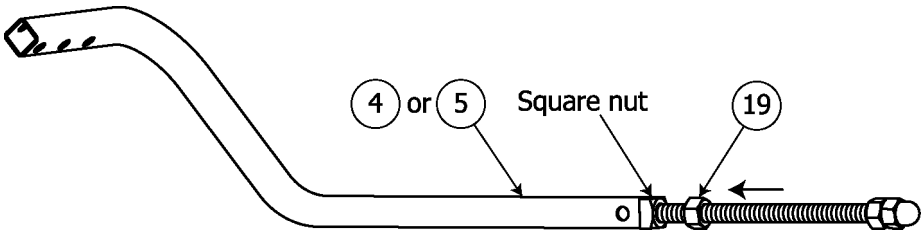
b. Screw an M12 hex nut (Figure 8, 19) tightly against the acorn nut.

Figure 8. Arm assembly b



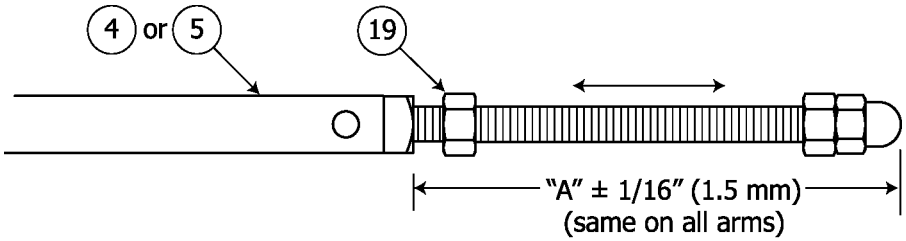
c. Insert the threaded rod into the arm (Figure 9, 4 or 5).

Figure 9. Arm assembly c



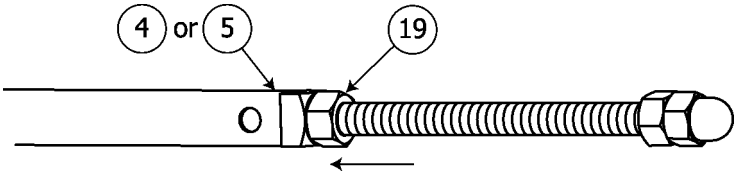
d. (Figure 10) Set the "A" dimension (from Figure 5) to a tolerance of ± 1/8" (3 mm).

Figure 10. Arm assembly d



e. (Figure 11)Screw the hex nut against the square nut at the end of the arm to secure the threaded rod and the "A" dimension.

Figure 11. Arm assembly e



f. (Figure 12) Repeat for the other 3 arms.

Figure 12. Arm assembly - complete

g. Repeat for the other bays, if applicable.

3 Bay Assembly (without radomes)

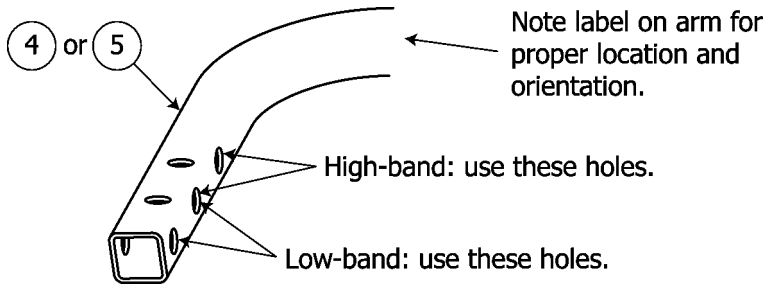
Attach the arms to the boom.

NOTE

This step may be made easier by clamping the boom to a surface or mounting it temporarily on a vertical pole.

a. (Figure 13) Identify the mounting holes to be used.

Figure 13. Arm hole selection

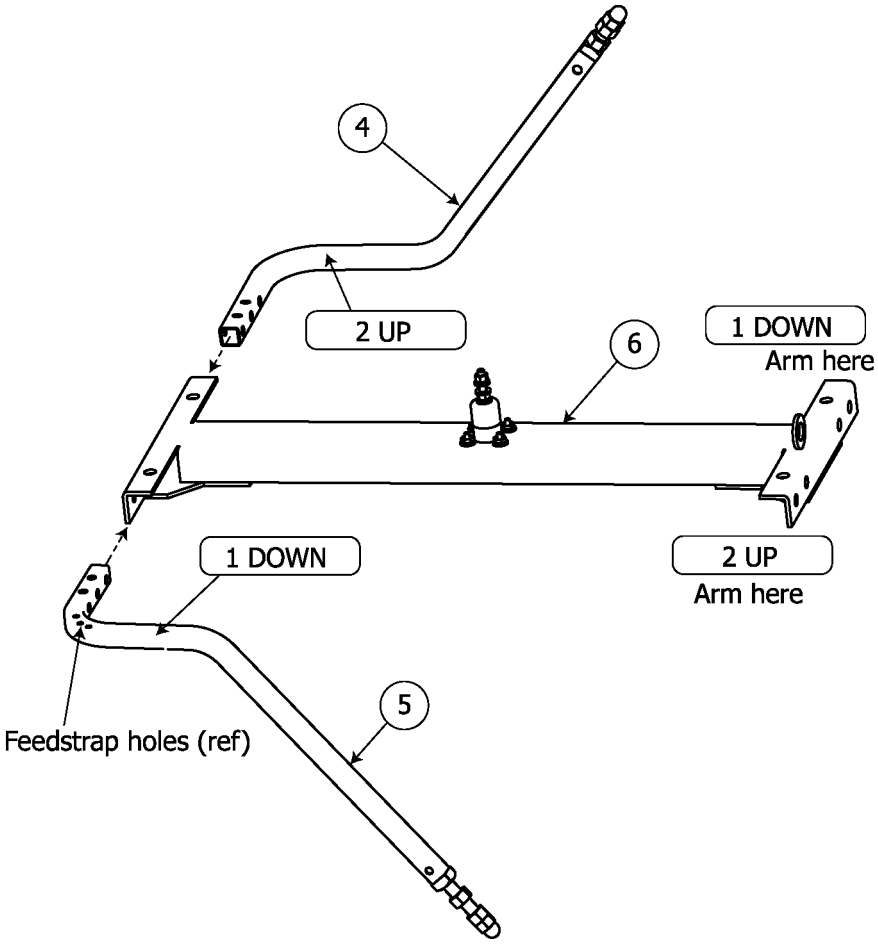


CAUTION

Parts 5, with the feedstrap mounting holes, must be mounted diagonally across from each other as shown.

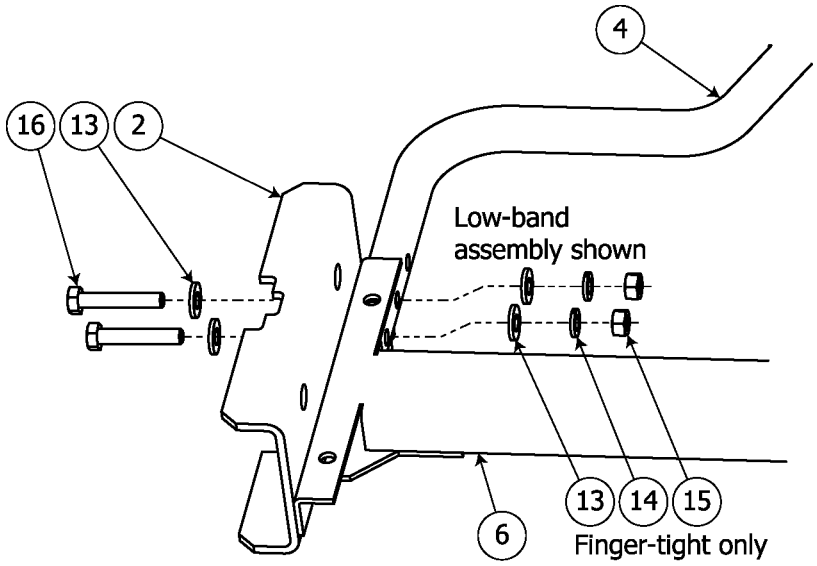
b. Position the first arms (Figure 14, 4 and 5) on the boom (6).

Figure 14. Position first arms



c. Attach the channel mount (Figure 15, 2) and arms, using M8 hardware (16, 15, 13, and 14), finger-tight only.

Figure 15. Channel attachment

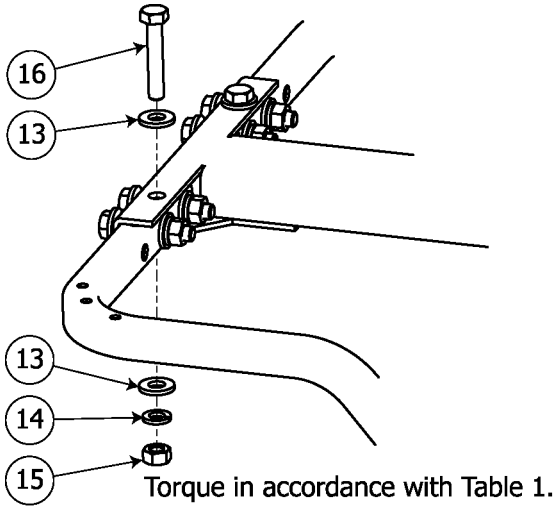


CAUTION

To ensure proper arm alignment, always tighten the nuts on the vertical bolts before tightening the horizontal ones.

d. Secure each arm with a vertical M8 bolt and hardware (Figure 16, 16, 15, 13, and 14). Torque in accordance with Table 1 on page 1.

Figure 16. Vertical bolts

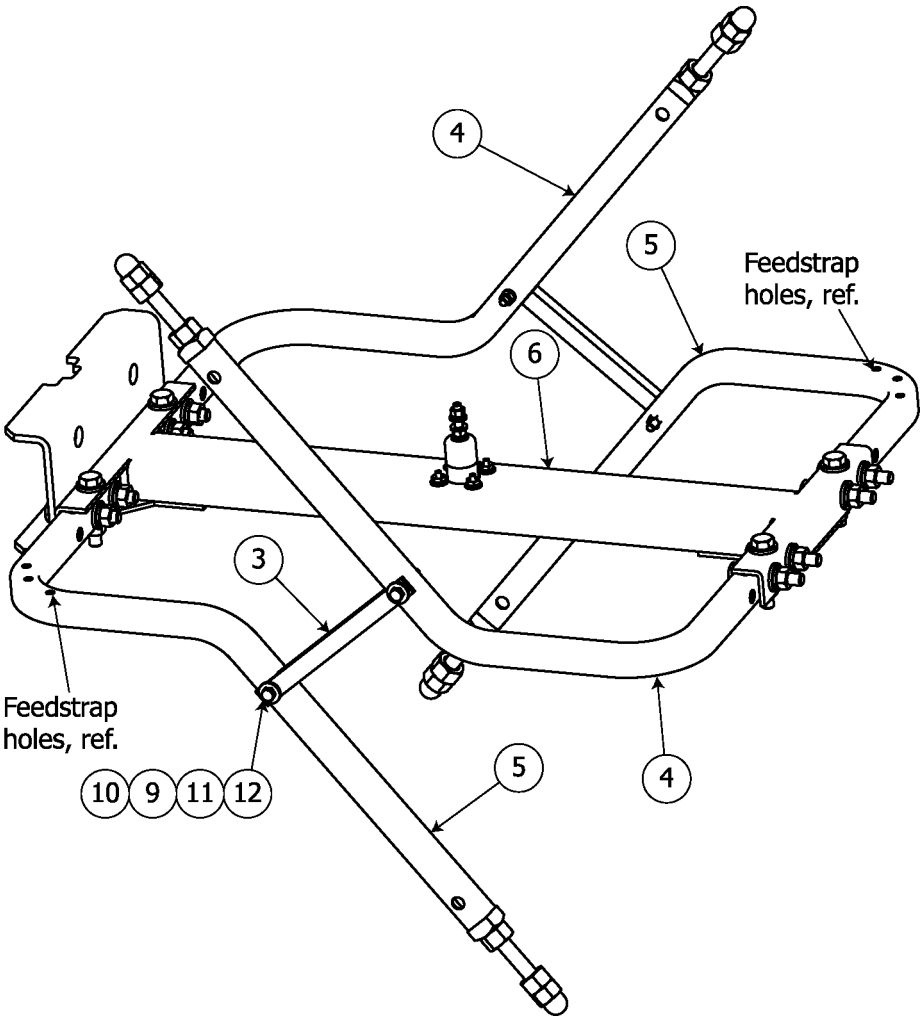


e. Tighten the nuts on the horizontal bolts. Torque in accordance with Table 1.

f. Repeat to attach the other two arms in their correct positions (Figure 17).

g. Using the M8 hardware (16, 15, 13, and 14), attach the spacers (3) across the gaps between the arms as shown.

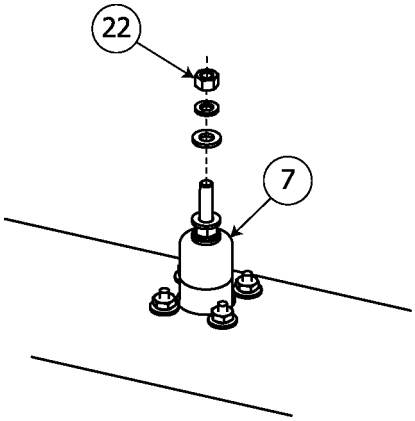
Figure 17. Arm attachment - complete



Install the feedstrap.

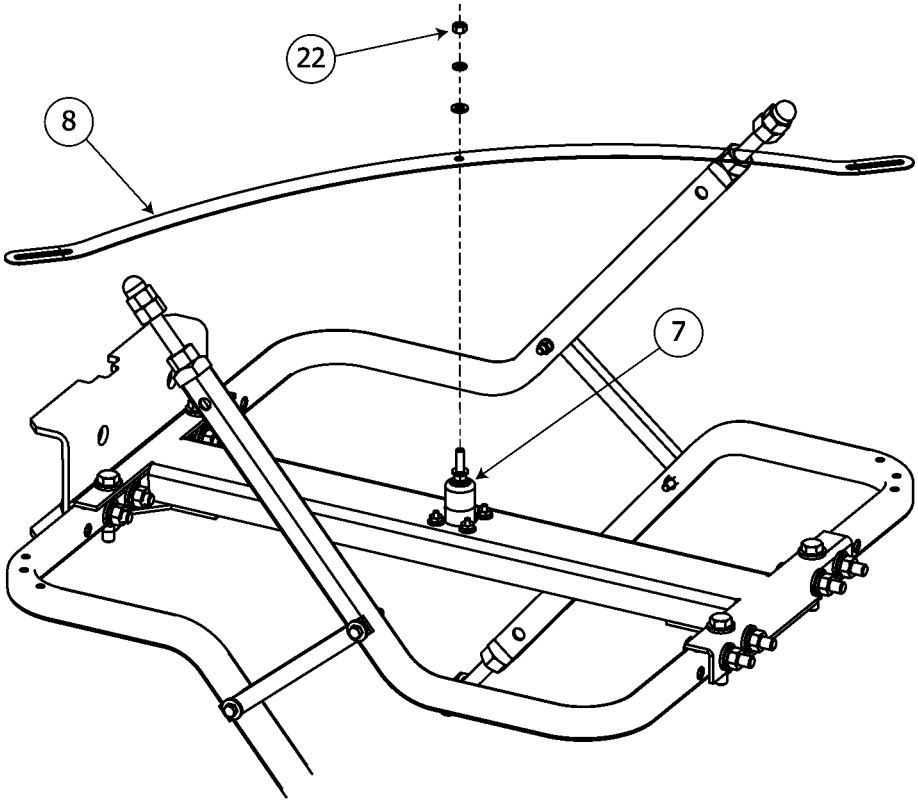
a. Remove the nut (Figure 18, 22), the top lockwasher, and the topmost flat washer from the endseal (7). Leave the second flat washer in place.

Figure 18. Remove nut from endseal



b. Secure the feedstrap (Figure 19, 8) to the endseal.

Figure 19. Feedstrap to endseal



c. Using the M5 hardware (Figure 20, 11, 12, 9, and 10), secure the feedstrap to the appropriate holes (see Table 2) in the arms.

Figure 20. Feedstrap to arms

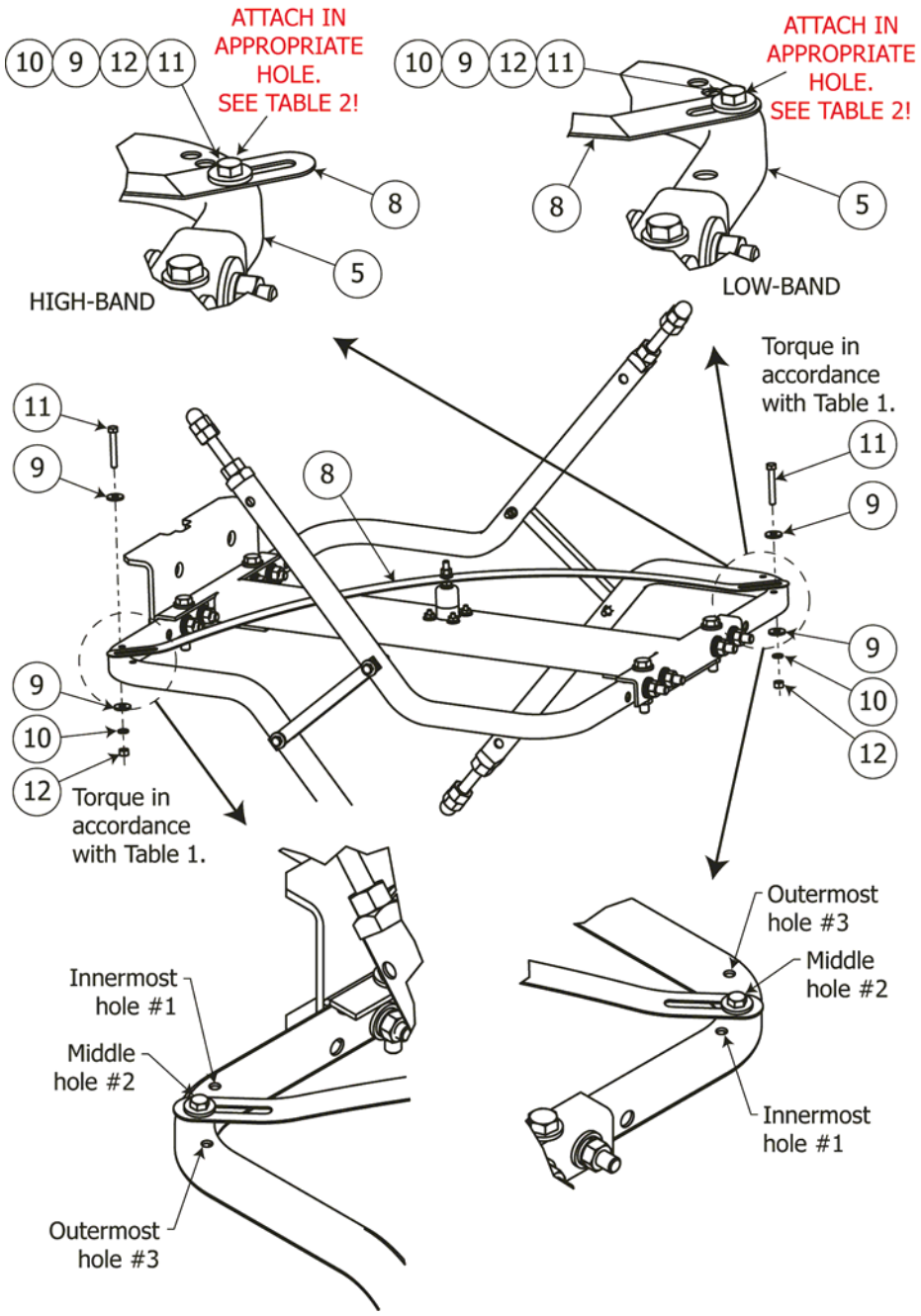


Table 2. Feedstrap Mounting Holes

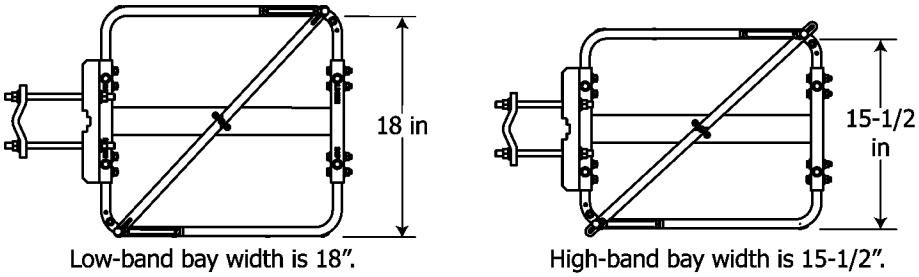
Full-wave-spaced: low-band single bay and arrays	Hole #1 (innermost hole)
Full-wave-spaced: high-band single bay and arrays	Hole #2 (middle hole)
Half-wave-spaced: high- and low-band arrays	Hole #3 (outermost hole)

Check antenna bay assembly.

Before proceeding, take a moment to check the assembly of your bays.

The dimensions should be approximately as shown in Figure 21. If they are, you have used the correct arm attachment holes and oriented the arms correctly.

Figure 21. Bay assembly check



Low-band bay width is 18".

High-band bay width is 15-1/2".

Connect the coax cable.

CAUTION

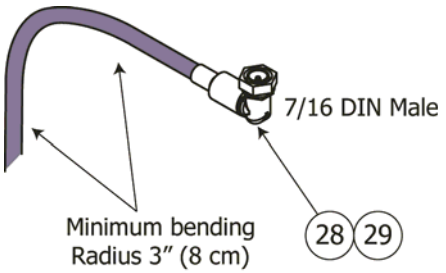
Stressing a coax connection after assembly can detune the system. Therefore, never make a connection and then bend or twist the cable, or use the connector to force the coax into shape. Form the cable first, then attach it to the connector.

CAUTION

The minimum bending radius for 1/2" coax is 3" (8 cm). Do not bend it too tightly; you may damage it.

a. Form the cable (Figure 22, 28) to the desired shape.

Figure 22. Form coax cable

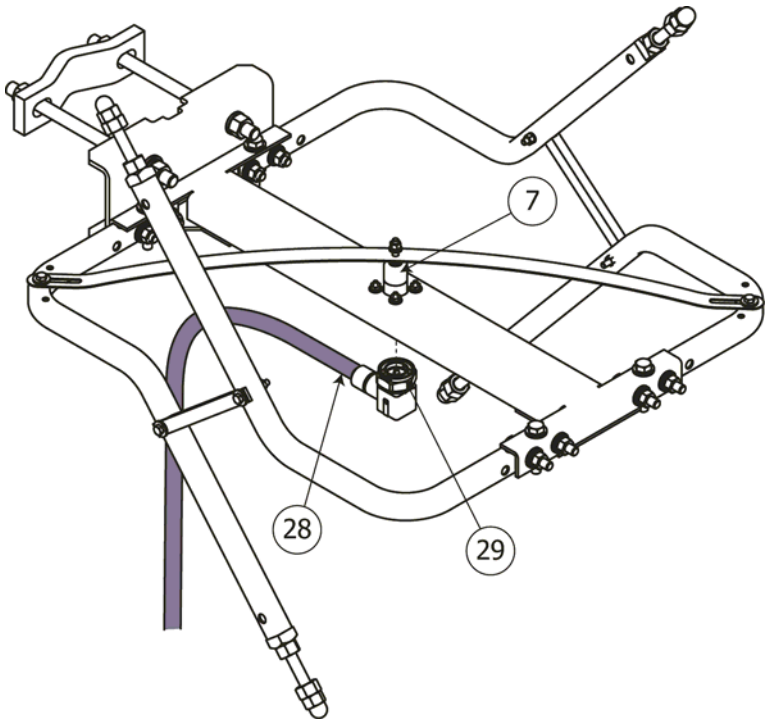


CAUTION

Do not overtighten the connectors. Overtightening may damage them.

b. (Figure 23) Attach the elbow on the cable (28) to the antenna input. Torque the connector to 18 - 22 lb-in (21 - 25 kg-cm).

Figure 23. Attach coax cable to antenna input



c. Seal the joint thoroughly with splice tape (29).

This completes assembly of your antenna bay without radomes (Figure 24 on page 18).

If your antenna has multiple bays, repeat this chapter for the remaining bays.

Then please proceed to Mounting the Antenna Bay(s) on page 29.

Figure 24. Finished antenna bay assembly

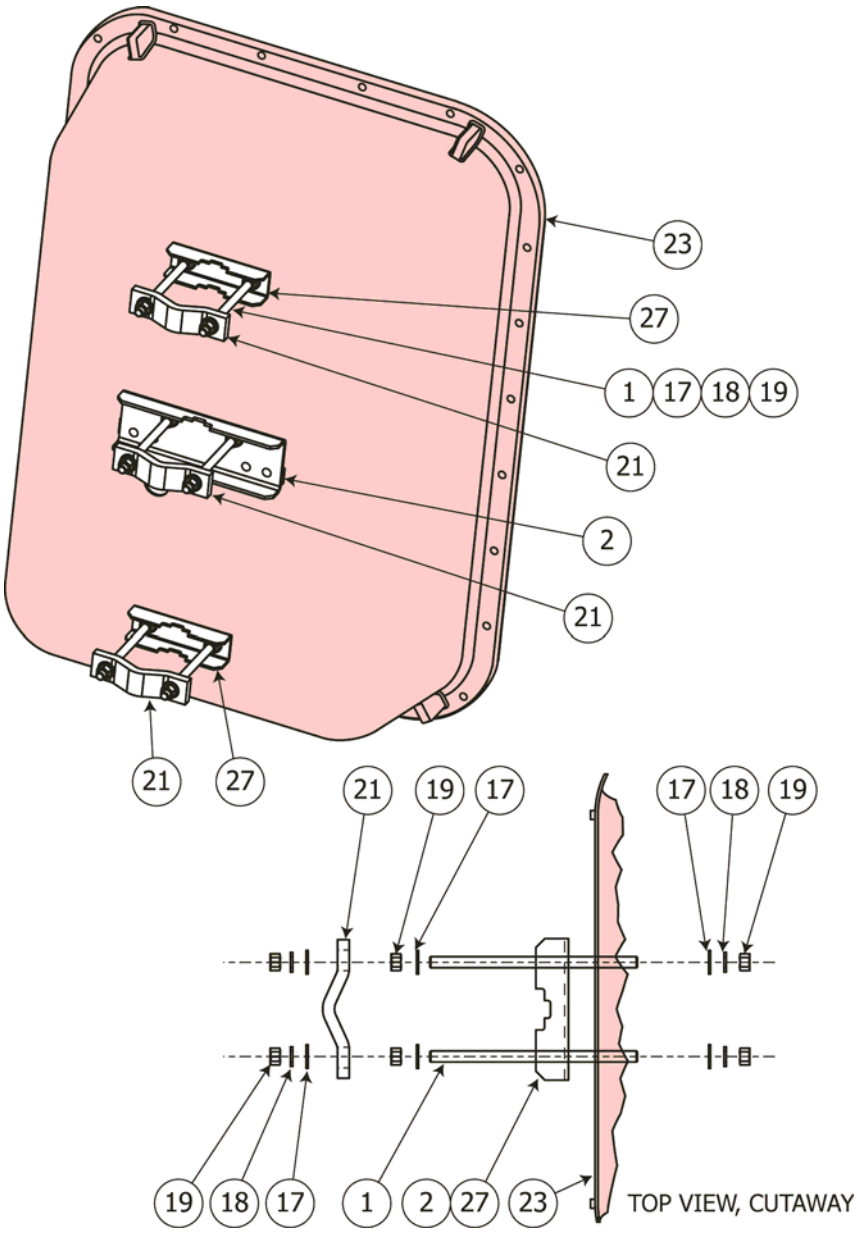
4 Bay Assembly (with radomes)

Attach the mount channels to the radome back half.

a. Attach a center mount channel (Figure 25, 2) and two end mount channels (27) to the radome back half (23), using the threaded rods (1) and M12 hardware (19, 17, 18) as shown.

b. Loosely attach the clamp halves (21) to the threaded rods.

Figure 25. Mount channels and clamp halves to radome (channels, clamp halves, radome)



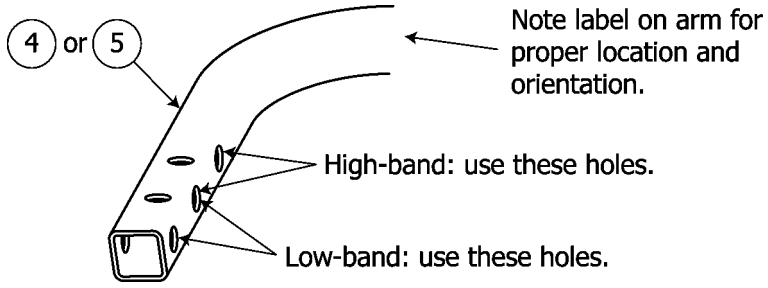
Attach the arms to the boom.

NOTE

This step may be made easier by clamping the boom to a surface or mounting it temporarily on a vertical pole.

a. (Figure 26) Identify the mounting holes to be used.

Figure 26. Arm hole selection

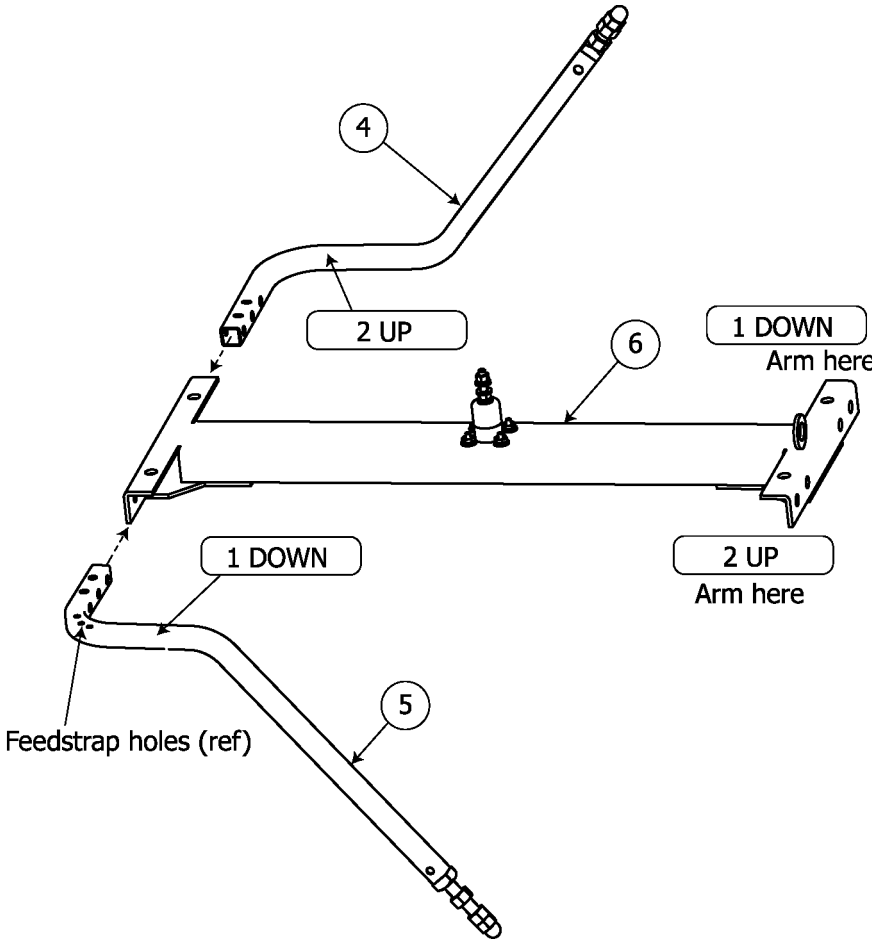


CAUTION

b. Parts 5, with the feedstrap mounting holes, must be mounted diagonally across from each other as shown.

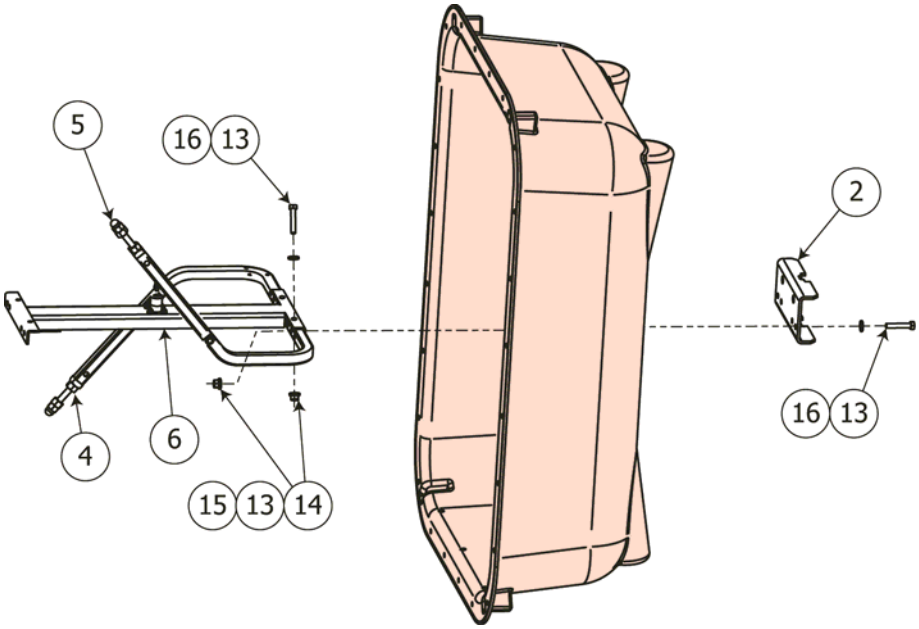
c. Position the inner arms (Figure 27, 4 and 5) on the boom (6).

Figure 27. Position inner arms



d. Attach the radome back half assembly (assembled above), the center mount channel (Figure 28, 2), and the inner arms (4) and (5) to the boom (6), using M8 hardware (16, 15, 13, and 14), finger-tight only.

Figure 28. Radome, inner arms to boom (bay, radome)



NOTE

The channel of the boom fits into the rectangular slot in the back of the radome half.

CAUTION

To ensure proper arm alignment, always tighten the nuts on the vertical bolts before tightening the horizontal ones.

e. Secure each arm with a vertical M8 bolt and hardware (16, 15, 13, and 14). Torque in accordance with Table 1 on page 1.

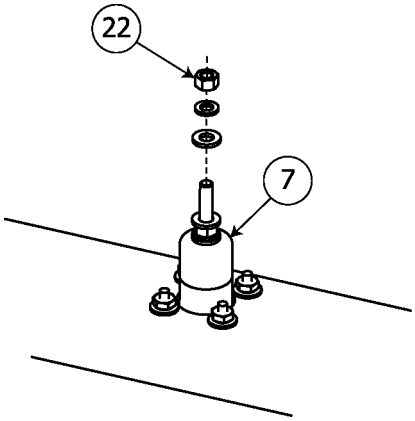
f. Tighten the nuts on the horizontal bolts (Figure 28). Torque in accordance with Table 1.

g. Repeat to attach the other two arms in their correct positions.

Install the feedstrap.

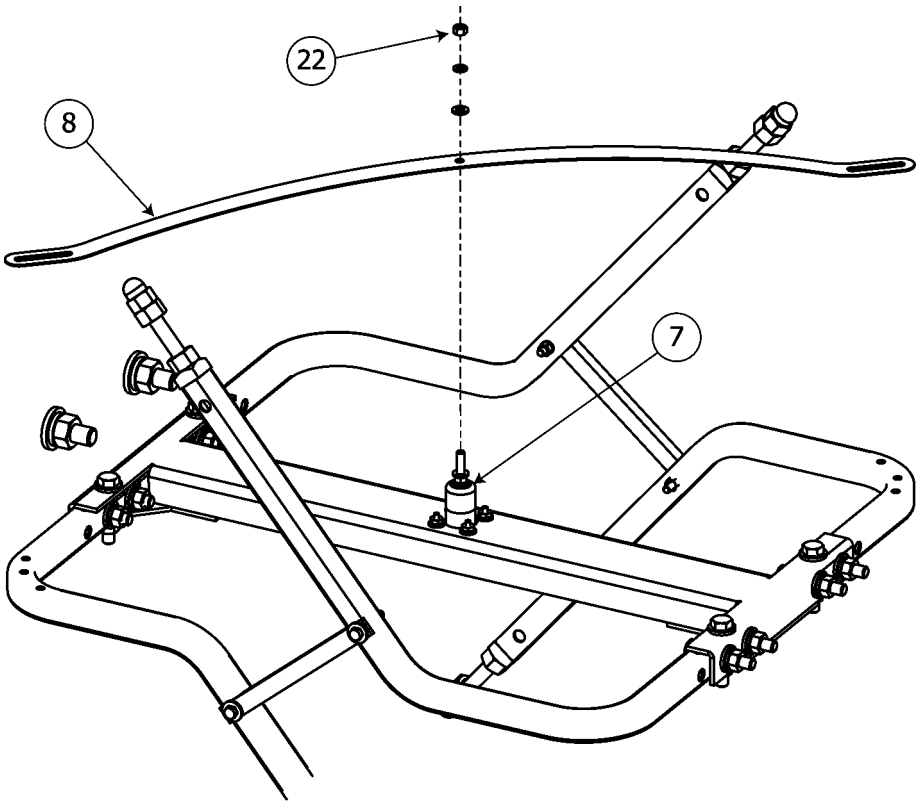
a. Remove the nut (Figure 29, 22), the top lockwasher, and the topmost flat washer from the endseal (7). Leave the second flat washer in place.

Figure 29. Remove wingnut



b. Using the endseal nut, secure the feedstrap (Figure 30, 8) to the endseal.

Figure 30. Feedstrap to endseal



c. Using the M5 hardware (Figure 31, 11, 12, 9, and 10), secure the feedstrap to the innermost holes in the arms.

Figure 31. Feedstrap to arms

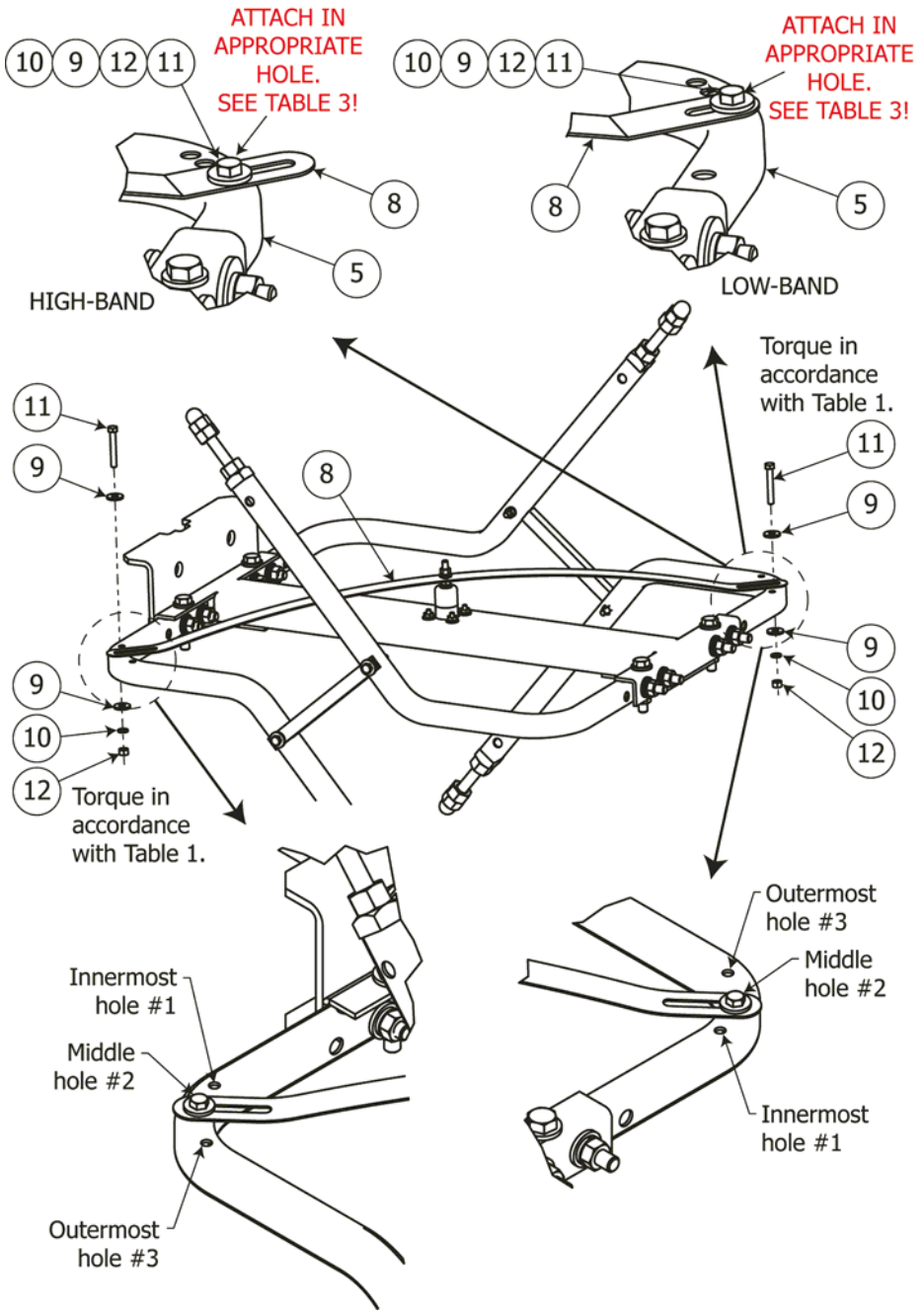
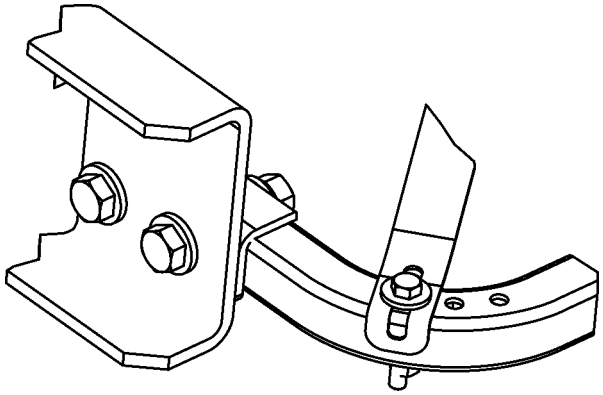


Table 3. Feedstrap Mounting Holes

Full-wave-spaced: low-band single bay and arrays	Hole #1 (innermost hole)
Full-wave-spaced: high-band single bay and arrays	Hole #2 (middle hole)
Half-wave-spaced: high- and low-band arrays	Hole #3 (outermost hole)

d. (High-band only) Bend the ends of the feedstrap down over the arms to allow clearance inside the radome (Figure 32).

Figure 32. Feedstrap ends bent down

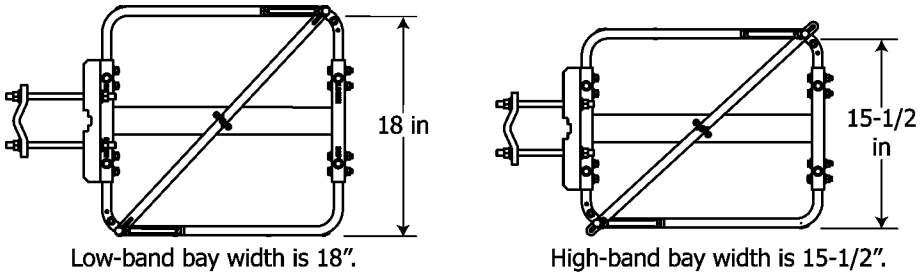


Check antenna bay assembly.

Before proceeding, take a moment to check the assembly of your bays.

The dimensions should be approximately as shown in Figure 33. If they are, you have used the correct arm attachment holes and oriented the arms correctly.

Figure 33. Bay assembly check



Low-band bay width is 18".

High-band bay width is 15-1/2".

Attach the coax cable.

CAUTION

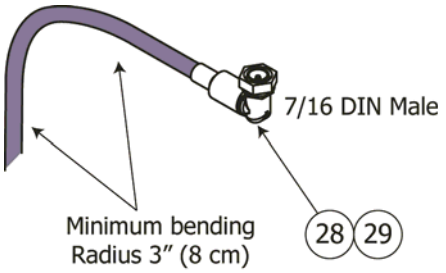
Stressing a coax connection after assembly can detune the system. Therefore, never make a connection and then bend or twist the cable, or use the connector to force the coax into shape. Form the cable first, then attach it to the connector.

CAUTION

The minimum bending radius for 1/2" coax is 3" (8 cm). Do not bend it too tightly; you may damage it.

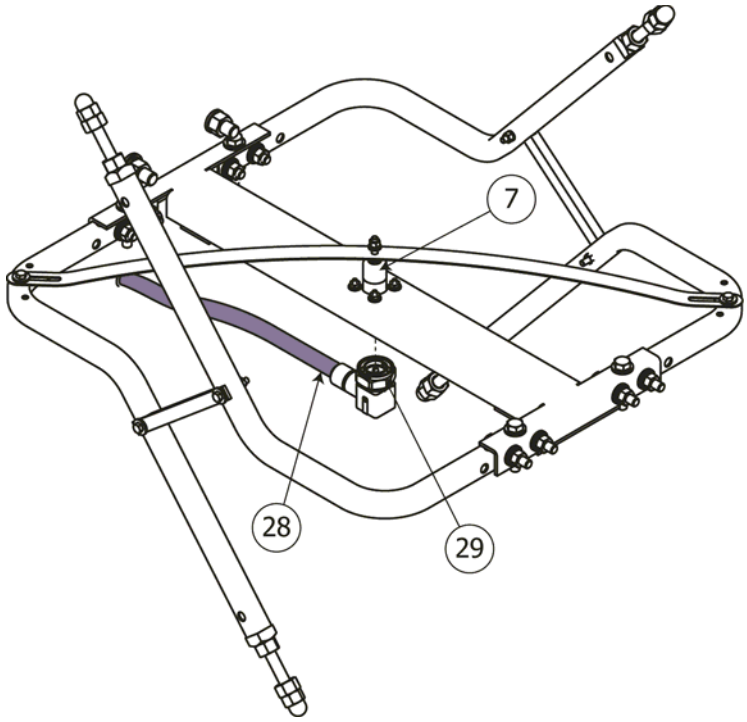
a. Form the cable (Figure 34, 28) to the desired shape.

Figure 34. Form coax cable



b. Insert the elbow end of the coax feedline cable (Figure 35, 28) in through the round hole in the back of the radome half (23), and connect it to the base of the endseal (7). Torque the cable fitting in accordance with Table 1 on page 1.

Figure 35. Attach coax cable to antenna input

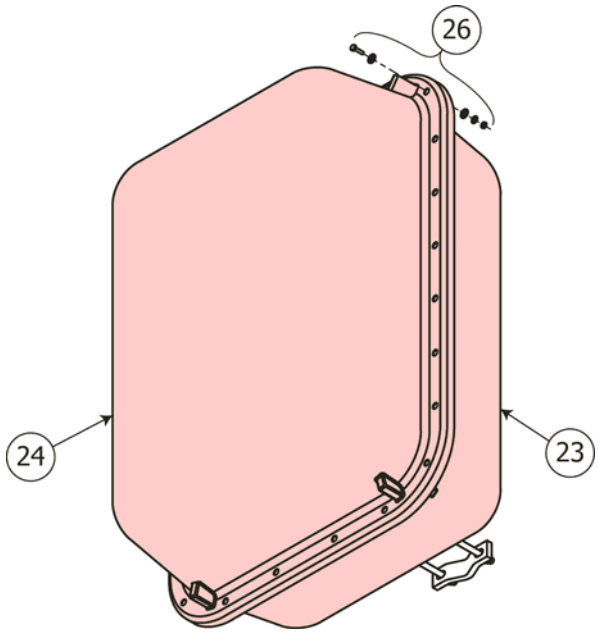


c. Seal the joint thoroughly with splice tape (29).

Install the radome front half.

a. Using the 1/4" hardware in the hardware kit (Figure 36, 26), attach the radome front half (24) to the radome back half (23).

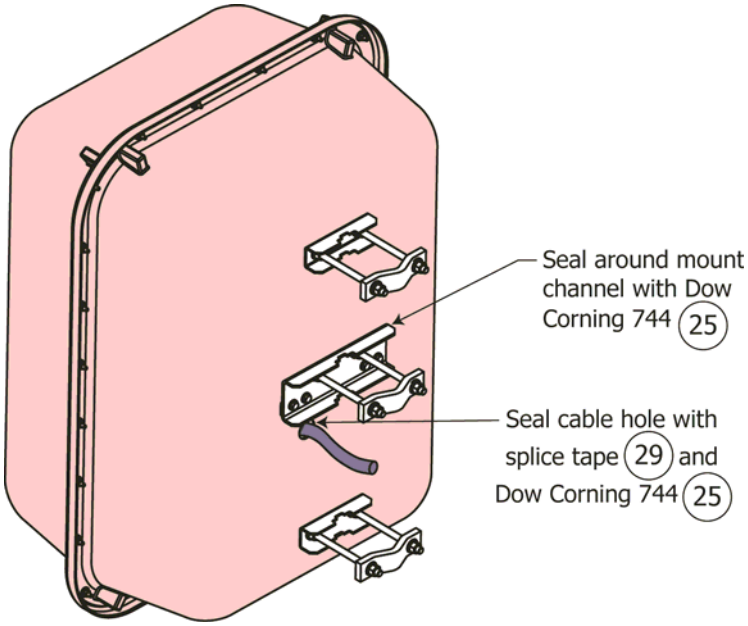
Figure 36. Radome front half installation



b. Using splice tape (Figure 37, 29, provided with the antenna) and Dow Corning 744 adhesive-sealant (25), seal:

- The perimeter of the center mount channel on the back of the radome, and
- The hole in the radome back half around the coax cable.

Figure 37. Seal around radome openings.

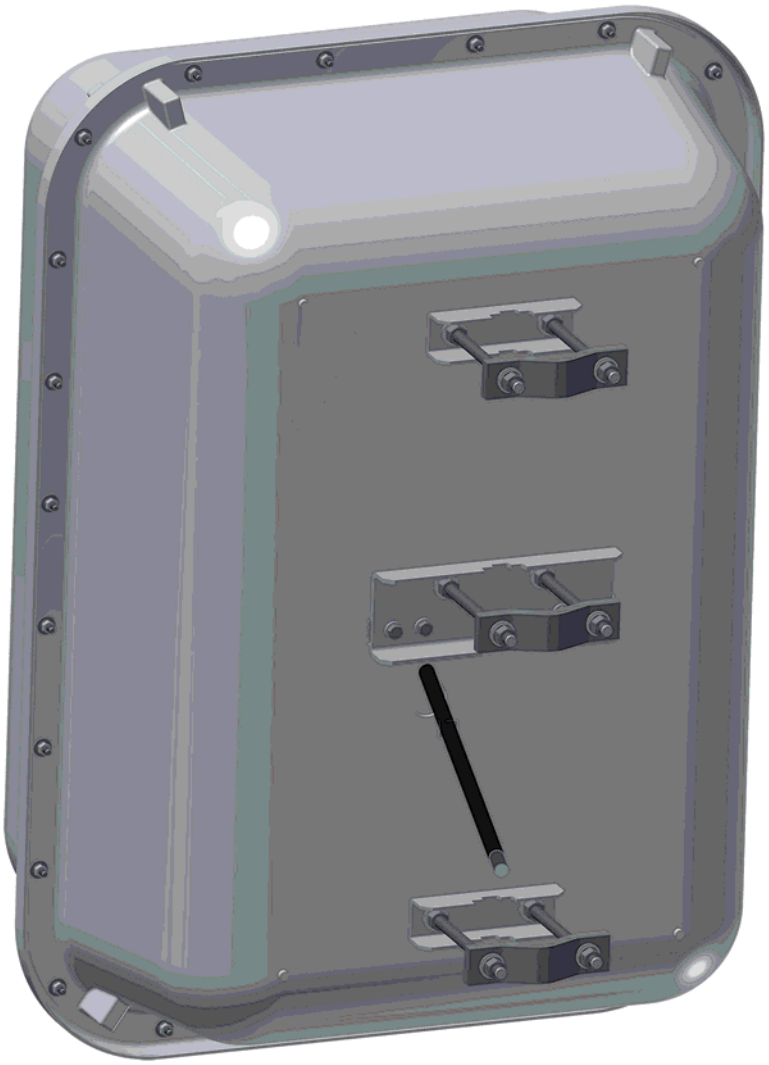


This completes assembly of your antenna bay with radomes (Figure 38).

If your antenna has multiple bays, repeat this chapter for the remaining bays.

Then please proceed to Mounting the Antenna Bay(s) on page 29.

Figure 38. Finished antenna bay assembly with radome, back view



5 Mounting the Antenna Bay(s)

Mount the antenna bay on the tower leg or pole.

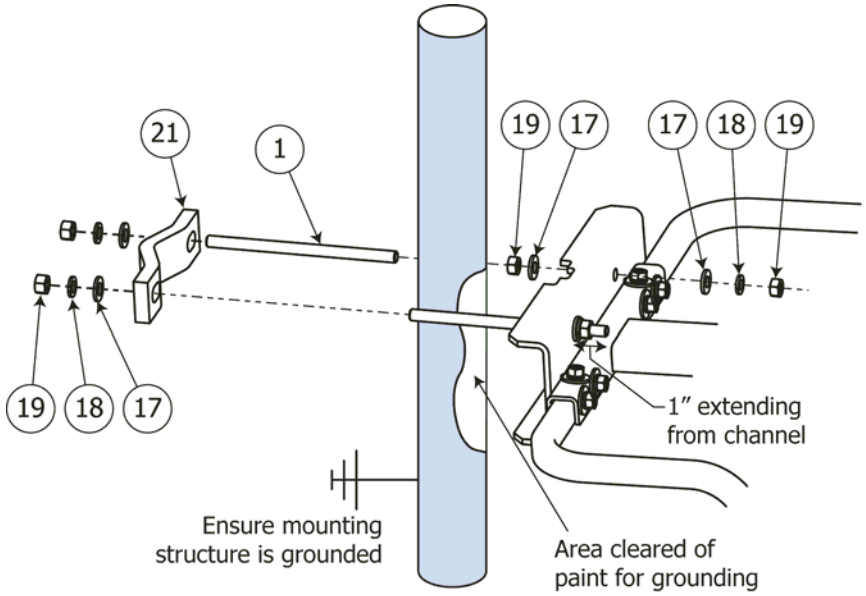
NOTE

If the supporting structure is non-metallic (for example, a chimney or a tree), run a ground cable (customer-supplied) from the antenna mount to a post driven into the ground.

a. Using the M12 hardware (Figure 39, 19, 17, 18), secure the threaded rods (1) to the mount channel, with the end of the threaded rod extending approximately one inch beyond the surface of the channel, as shown.

b. Then use the threaded rods with M12 hardware and clamp half (21) to clamp the antenna to the tower leg or pole at the location you marked and cleared of paint. Do not tighten fully at this time.

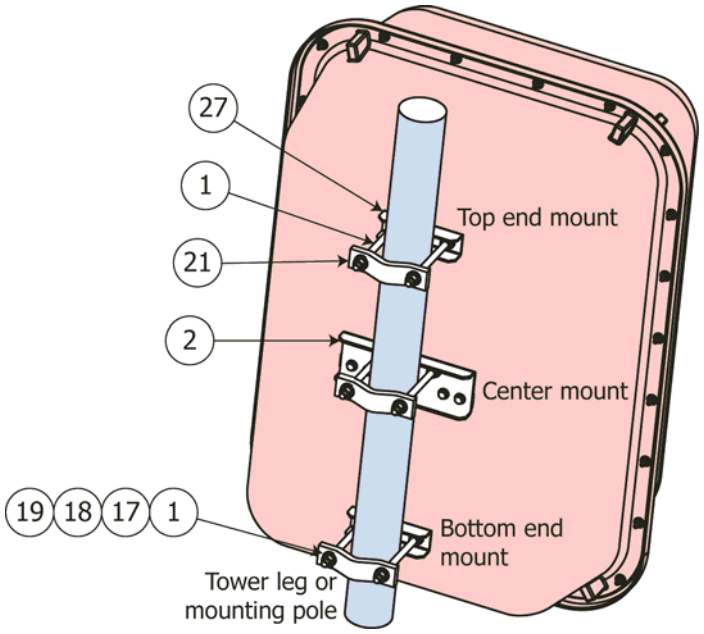
Figure 39. Mount the antenna bay(s) (without radomes)



Bay without radome shown. Radome bay is similar.

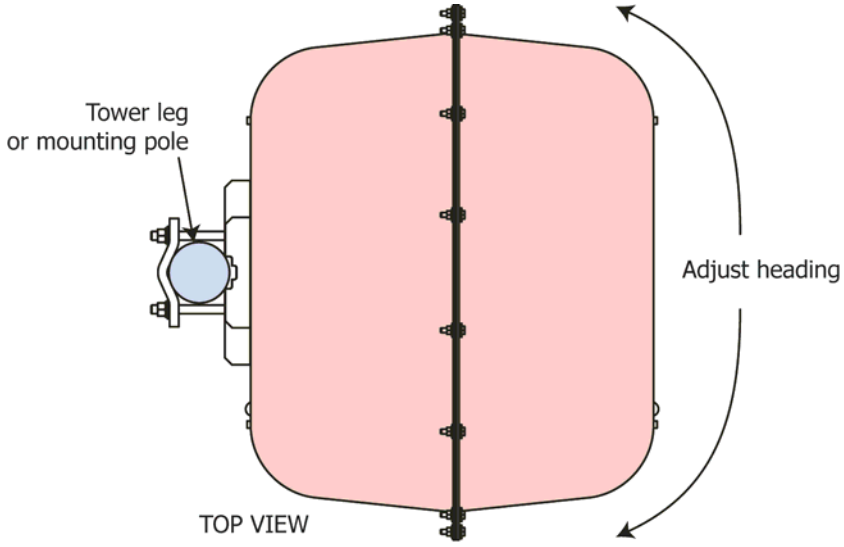
c. (With radomes only) Similarly, clamp the upper and lower end mount channels (27) to the tower leg or pole (Figure 40). Do not tighten fully.

Figure 40. Mount the antenna bay(s) (with radomes)



d. (Figure 41) Adjust the antenna heading.

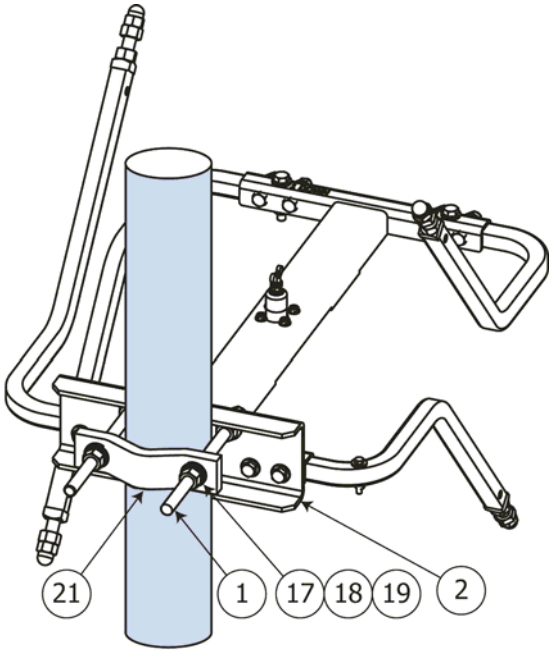
Figure 41. Adjust the heading.



Bay with radome shown. Bay without radome is similar.

e. (Figure 42) Tighten the mounting hardware (19, 17, 18) on the threaded rods (1). Torque in accordance with Table 1 on page 1.

Figure 42. Tighten mounting hardware.



Bay without radome shown. Radome bay is similar.

f. Retouch the tower paint as necessary.

g. (2-bay or 4-bay) Repeat this chapter for the remaining bays.

6 Connecting the Antenna (single-bay)

Connect the coax feedline cable.

CAUTION

Stressing a coax connection after assembly can detune the system. Therefore, never make a connection and then bend or twist the cable, or use the connector to force the coax into shape. Form the cable first, then attach it to the connector.

CAUTION

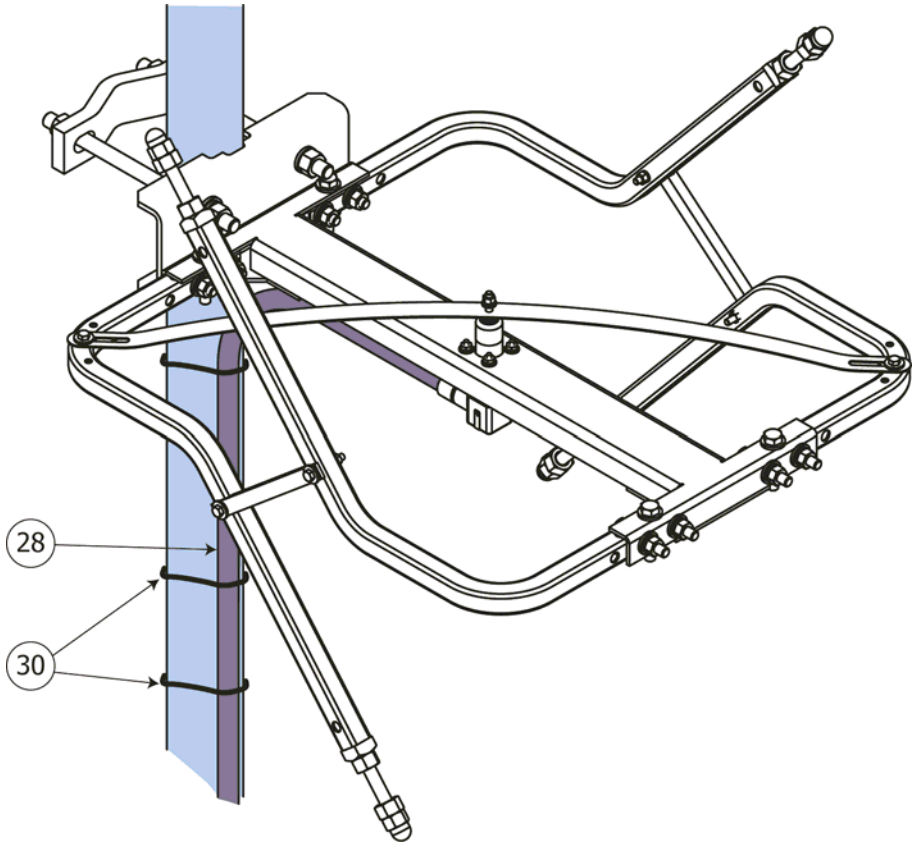
The minimum bending radius for 1/2" coax is 3" (8 cm). Do not bend it too tightly; you may damage it.

CAUTION

Do not overtighten the connectors. Overtightening may damage them.

a. Secure the cable (Figure 43, 28) to the mounting pole or tower leg, using tie-wraps (30) or customer-supplied cable clamps.

Figure 43. Secure feedline cable



Connect the transmission line cable.

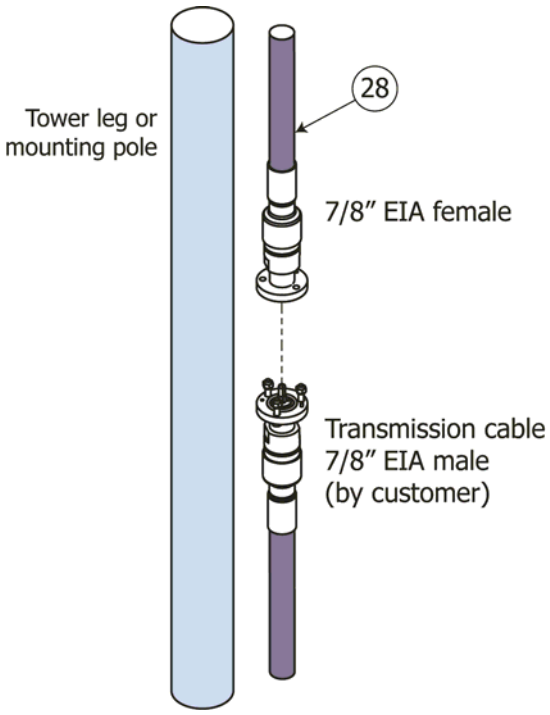
You need to provide a transmission line cable from your transmitter, terminated with a female 7/16 DIN connector.

CAUTION

The antenna is non-pressurized. If you are using pressurized cable, you must install a gas stop at the coax cable input.

a. (Figure 44) Connect the transmission line cable to the coax cable input, with a gas stop if necessary. Torque to 18 - 22 lb-ft (2.4 - 3 Pa). Seal with splice tape.

Figure 44. Transmission line connection



b. Secure the transmission line cable to the mounting pole or tower leg, using customer-supplied cable clamps.

Installation of your Versa2une is complete. Please proceed to Startup.

NOTE

If you have any problems with installation, call Shively and talk with a designer or Sales.

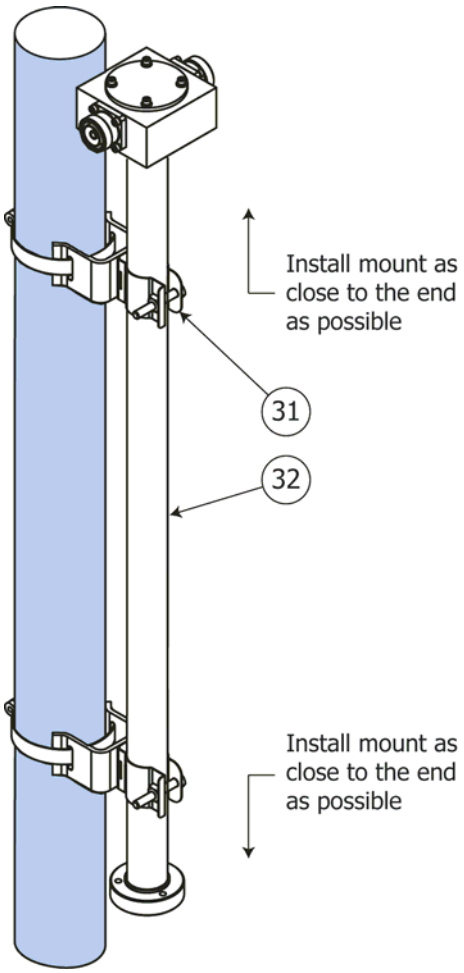
7 Connecting the Antenna (2 or more bays)

Mount the power divider(s).

Two-bay antenna:

Using two power divider mounting kits (Figure 45, 31), mount the power divider (32) to the mounting structure with its outlet ports roughly halfway between the antenna bays. Locate the mounts as close to the ends of the power divider as you can.

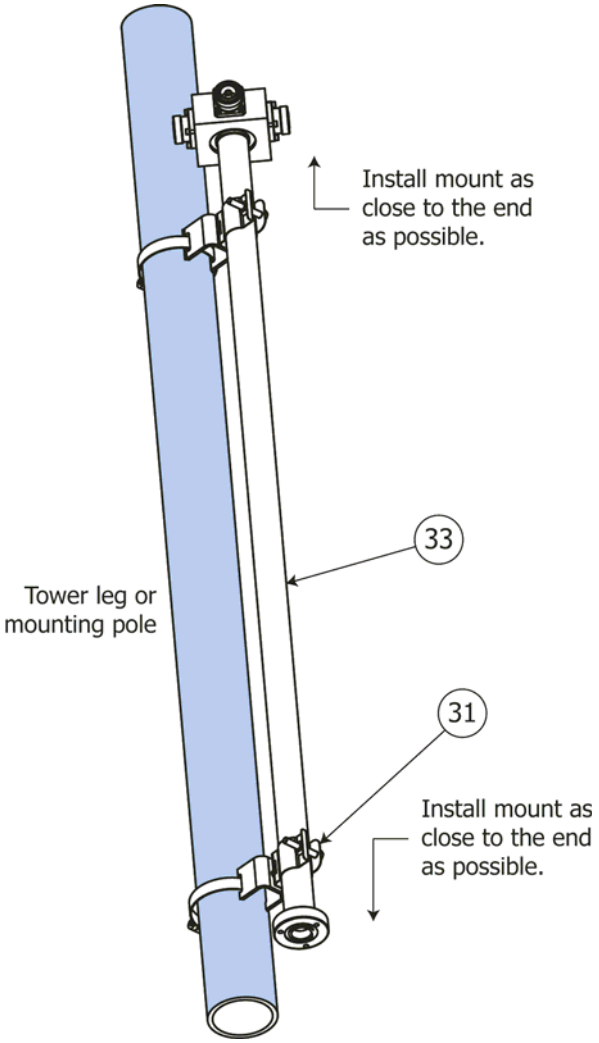
Figure 45. Power divider mounting (two-bay)



Four-bay antenna:

Using two power divider mounting kits (Figure 45, 31), mount the power divider (33) to the mounting structure with its outlet ports roughly halfway along the antenna bays. Locate the mounts as close to the ends of the power divider as you can.

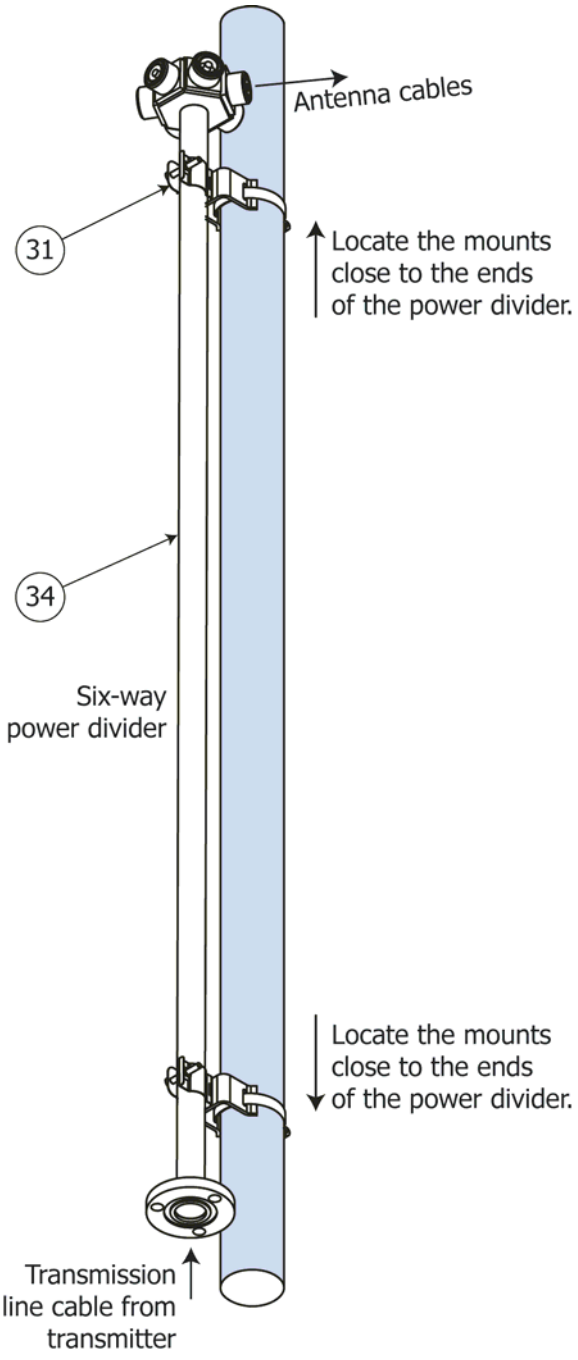
Figure 46. Power divider mounting (four-bay)



Six-bay antenna:

Using two power divider mounting kits (Figure 47, 31), mount the power divider (34) to the mounting structure with its outlet ports roughly halfway along the antenna bays. Locate the mounts as close to the ends of the power divider as you can.

Figure 47. Power divider mounting (six-bay)



Secure the coax feedline cables.

CAUTION

Stressing a coax connection after assembly can detune the system. Therefore, never make a connection and then bend or twist the cable, or use the connector to force the coax into shape. Form the cable first, then attach it to the connector.

CAUTION

The minimum bending radius for 1/2" coax is 3" (8 cm). Do not bend it too tightly; you may damage it.

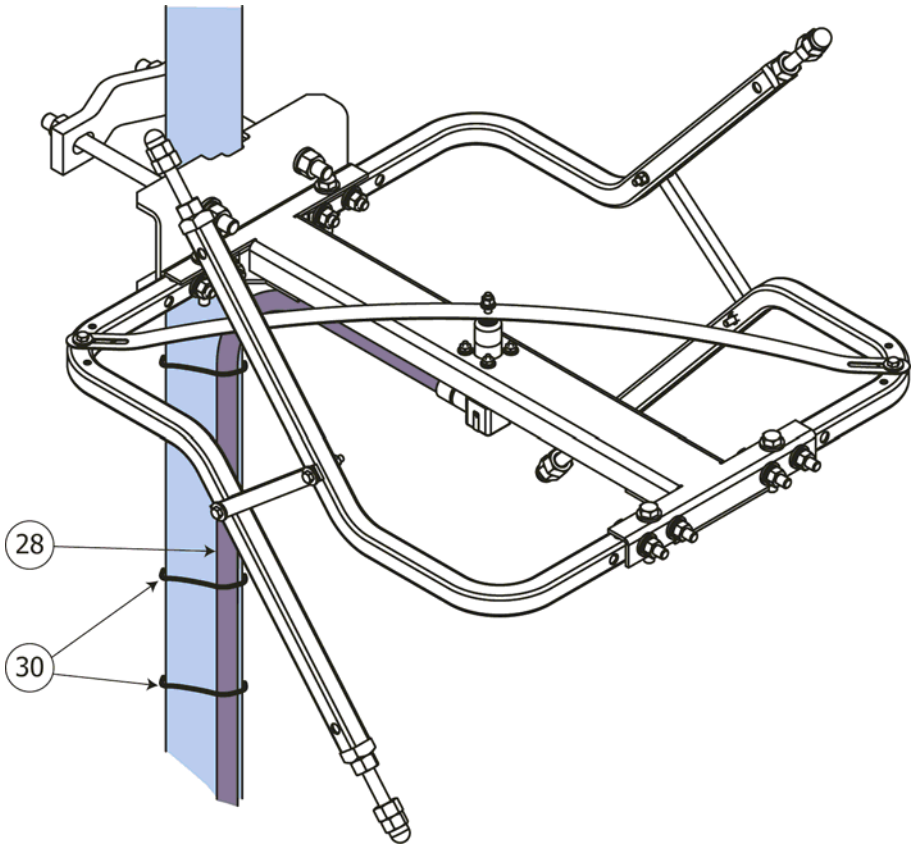
CAUTION

Do not overtighten the connectors. Overtightening may damage them.

a. Connect the input ends of the antenna bay cables (Figure 48, 28) to the power divider outputs.

b. Secure the cables to the mounting pole or tower leg, using tie-wraps (30) or customer-supplied cable clamps.

Figure 48. Secure the feedline cables



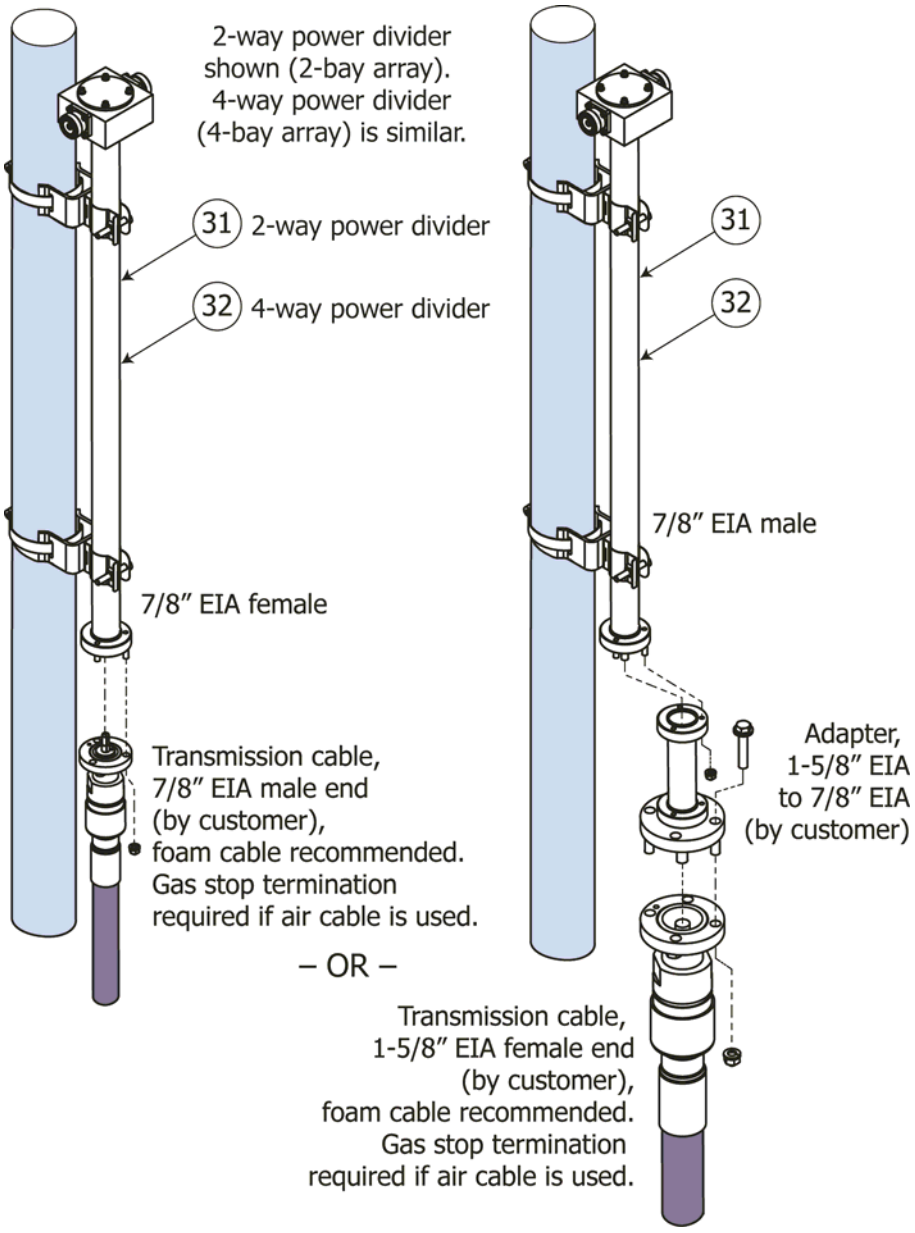
Connect the transmission line cable.

CAUTION

The antenna and power divider are non-pressurized. If you are using pressurized transmission line cable, it *MUST* include a gas stop termination.

a. Connect the transmission line cable from the transmitter to the input of the power divider (Figure 49, 32 or 33), with an adapter if necessary.

Figure 49. Transmission line cable connection



b. Secure the transmission line cable to the mounting pole or tower leg, using customer-supplied cable clamps.

Installation of your Versa2une is complete. Please proceed to Startup.

NOTE

If you have any problems with installation, call Shively and talk with a designer or Sales.

8 Startup

WARNING

Whenever a rigger is on the tower in the area of the antenna, shut off the signal and lock it off so that it cannot be turned on accidentally. RF emissions at close range are hazardous.

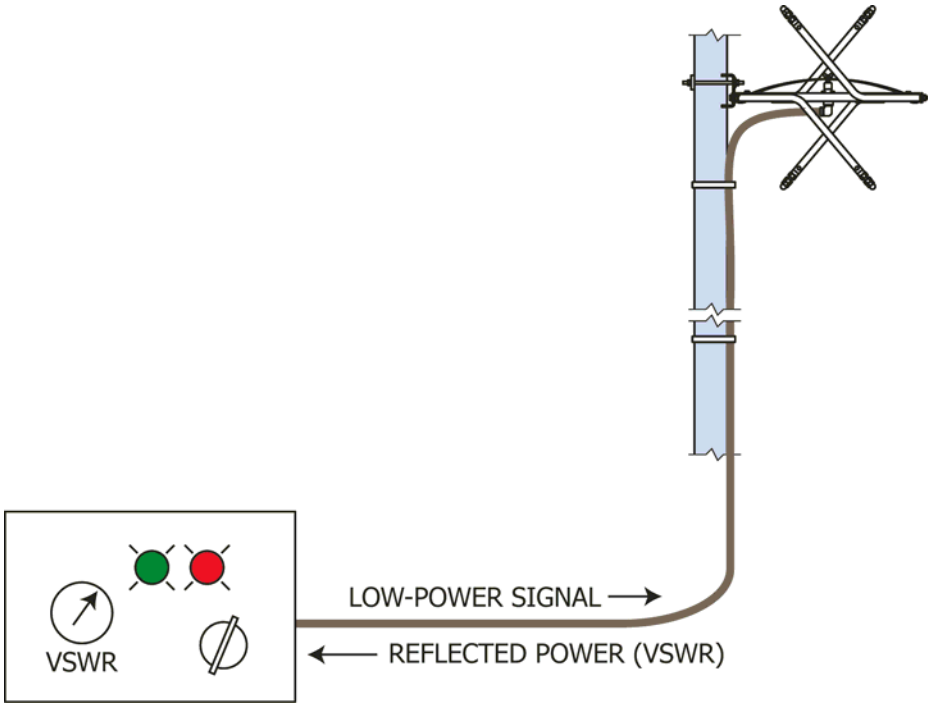
NOTE

The Versa2une does not require pressurization or purging.

Optimize VSWR.

(Figure 50) Apply a low-power signal to the antenna and read reflected power (VSWR). VSWR should be below 1.2:1.

Figure 50. Apply the signal



Adjust to minimize reflected power if necessary.

a. Loosen one jam nut on one arm of one antenna element and lengthen that arm by 10 mm (3/8"). With personnel clear, check VSWR again.

b. If the VSWR (reflected power) has increased, return that arm to its original setting. Then shorten ALL arms by 3 mm (1/8").

c. If the VSWR has decreased, return that arm to its original setting. Then lengthen ALL arms by 3 mm (1/8").

d. Repeat steps a - c until VSWR is below 1.2:1.

e. Secure all the arms by tightening their jam nuts.

Operate.

Once the antenna has been installed and VSWR has been confirmed, simply apply the transmitter signal. Don't exceed the rated power of the antenna.

9 Troubleshooting

Broad Spectrum RF Noise

This indicates that some component is not in good electrical contact with the tower. Make sure mounts are tight, that tower paint has been removed from under the mounts, and that components of other systems are likewise in good contact with the tower.

High VSWR

This is caused by any factor that changes the impedance match between the antenna and the transmitter. Look for:

- Defective RF connector. Make sure connectors are in good shape, and that center pins are not bent over.
- Damage to any antenna components.
- Paint on radiators.
- Ice buildup on radiators.
- Interference from other tower components, especially components broken by wind or ice.

Change in Coverage

This may be caused by the same factors that can cause high VSWR. Look for VSWR changes as well.

Do recognize, however, that apparent changes in coverage may be due to subjective factors or faults of the receiving equipment. Before doing more than checking the VSWR, be sure that an actual coverage change has occurred.

10 Maintenance

WARNING

Whenever a rigger is on the tower in the area of the antenna, shut off the signal and lock it off so that it cannot be turned on accidentally. RF emissions at close range are hazardous.

Log

We recommend that you keep a log of VSWR readings and any other performance notes and maintenance history for your antenna. Such a record can be invaluable for troubleshooting.

Inspection

Whenever a rigger is on the tower for any reason, it is a good idea to have him check your antenna for general condition, looseness of connectors and mounts, and electrical damage.

Paint

The radiator should never be painted; this will affect the VSWR.

Return Policy

When returning any material to the factory, be sure to call your salesperson and obtain an returned materials authorization (RMA) number first. Material may be refused and sent back to you at your expense if you don't do this.

11 Parts

Parts list.

NOTE

Item callouts are consistent across all the illustrations in this technical sheet.

Table 4. Bay components (per bay)

Description	without radomes				with radomes				Shively P/N
	1 bay	2 bays	4 bays	6 bays	1 bay	2 bays	4 bays	6 bays	
1. Threaded rod, M12 x 1.75 x 230 mm (9 in) long	6	12	24	36	10	20	40	60	M0012x1.75RC230 OO
2. Center mount channel	1	2	4	6	1	2	4	6	100394-01
3. Spacer, dipole arm	2	4	8	12	2	4	8	12	100394-04
4. Arm without feedstrap holes (marked with 2 UP sticker)	2	4	8	12	2	4	8	12	100394-G502
5. Arm with feedstrap holes (marked with 1 DOWN sticker)	2	4	8	12	2	4	8	12	100394-G503
6. Boom assembly (number stickers indicate arm locations)	1	2	4	12	1	2	4	12	100394-G504
7. Endseal assembly	1	2	4	6	1	2	4	6	96786-G503
8. Feedstrap	1	2	4	6	1	2	4	6	99350-04
9. Flat washer, M5 (part of hardware kit 99350-G507HP)	6	12	24	36	6	12	24	36	M0005SSF
10. Lock washer, M5 (part of hardware kit 99350-G507HP)	3	6	12	18	3	6	12	18	M0005SSS
11. Hex bolt, M5 x 0.8 x 35 (part of hardware kit 99350-G507HP)	3	6	12	18	3	6	12	18	M0005X0.8 SS035HM
12. Hex nut, M5 x 0.8 (part of hardware kit 99350-G507HP)	3	6	12	18	3	6	12	18	M0005X8SS
13. Flat washer, M8 (part of hardware kit 99350-G507HP)	27	54	108	162	27	54	108	162	M0008SSF
14. Lock washer, M8 (part of hardware kit 99350-G507HP)	15	30	60	90	15	30	60	90	M0008SSS
15. Hex nut, M8 x 1.25 (part of hardware kit 99350-G507HP)	15	30	60	90	15	30	60	90	M0008X1.25SS
16. Hex bolt, M8 x 1.25 x 45 (part of hardware kit 99350-G507HP)	13	26	52	78	13	26	52	78	M0008X1.25SS045 HM

Table 4. Bay components (per bay)

Description	without radomes				with radomes				Shively P/N
	1 bay	2 bays	4 bays	6 bays	1 bay	2 bays	4 bays	6 bays	
17. Flat washer, M12 (part of hardware kit 99350-G501HP)	6	12	24	36	18	36	72	108	M0012SSF
18. Lock washer, M12 (part of hardware kit 99350-G501HP)	4	8	16	24	12	24	48	72	M0012SSS
19. Hex nut, M12 x 1.75 (part of hardware kit 99350-G501HP)	15	52	108	162	26	52	108	162	M0012x1.75SS
20. "Acorn" nut, M12 x 1.75 (part of hardware kit 99350-G501HP)	4	8	16	24	4	8	16	24	M0012x1.75SSACN
21. Clamp half, bolt spacing 4-1/16"	1	2	4	6	1	2	4	6	SCP
22. Hex nut, M5 x 0.8 (shipped on endseal, item 13)	1	2	4	6	1	2	4	6	M0005-0.8SS

Figure 51. Bay assembly

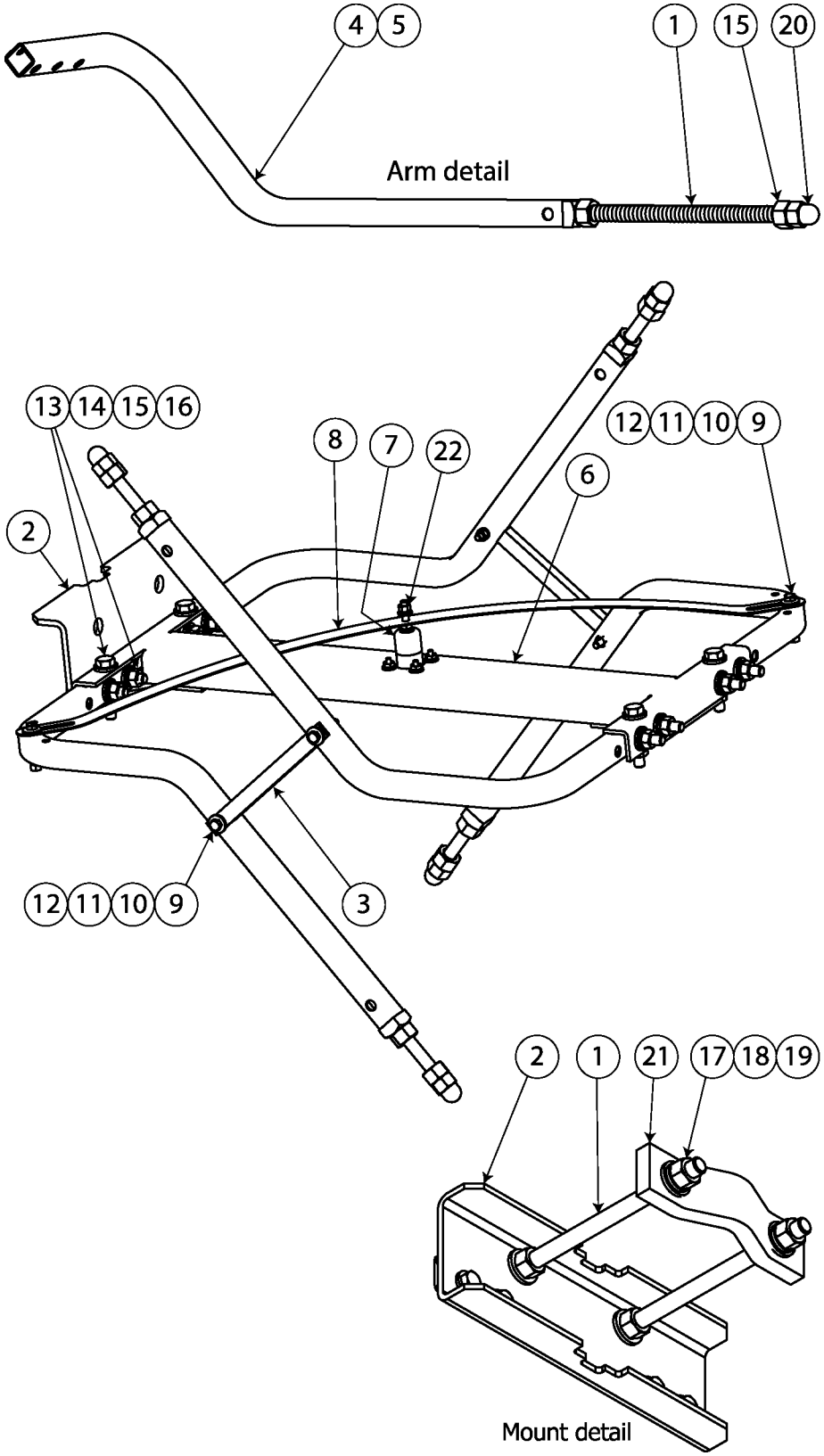


Table 5. Radome components (per bay)

Description	1 bay	2 bays	4 bays	6 bays	Shively P/N
23. Back radome half (cable hole & slot for boom channel)	1	2	4	6	99348-01
24. Front radome half (overlapping flange)	1	2	4	6	99348-02
25. Dow Corning 744 adhesive-sealant, cartridge	1	1	1	1	DO 88060
26. Radome flange bolt kit (contains 24 1/4-20 bolts, 24 nuts, 48 flat washers, 24 lock washers)	1	2	4	6	93585-G504
27. End mount channel	2	4	8	12	99351-02

Figure 52. Radome assembly

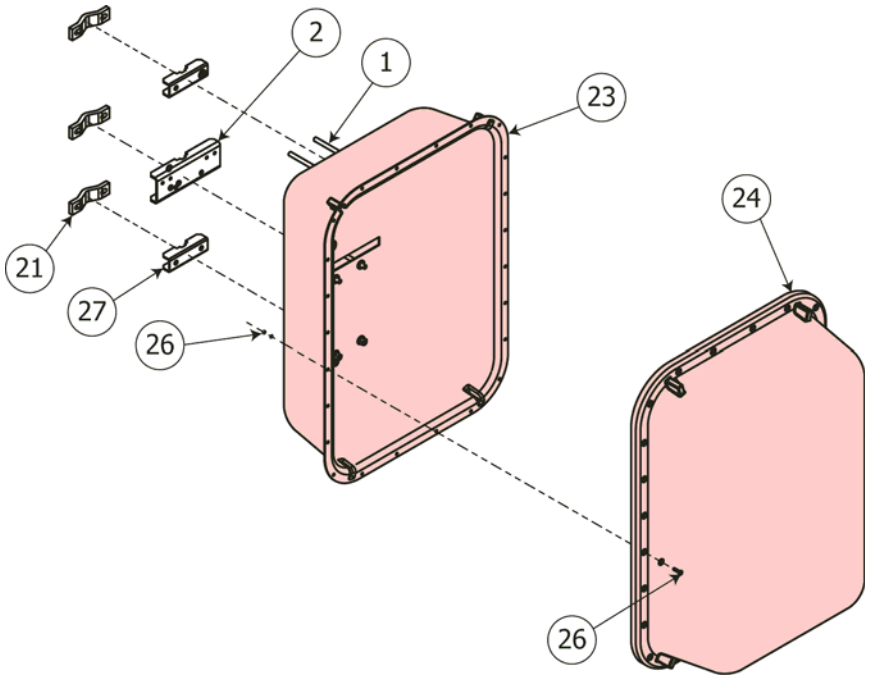


Table 6. Accessories (per array)

Description	1 bay	2 bays	4 bays	6 bays	Shively P/N
28. Coax cable section, 10 ft (3.0 m) long, 90° 7/16 DIN male on output end and 7/16 DIN male on input end	1	2	n/a	n/a	99349-G511
Coax cable section, 20 ft (6.1 m) long, 90° 7/16 DIN male on output end and 7/16 DIN male on input end	n/a	n/a	4	6	99349-G520
29. Splice tape	1	2	4	4	92042-01
30. Tie-wrap	36	72	144	144	TY529MX
31. Power divider mounting kit	0	1	1	1	98162-G501
32. Power divider, 2-way, 7/8" EIA flange to 716 DIN male	0	1	0	0	99332-G502
33. Power divider, 4-way, 7/8" EIA flange to 716 DIN male	0	0	1	0	99385-G501
34. Power divider, 6-way, 7/8" EIA flange to 716 DIN male	0	0	0	1	078F-716DX6