INSTALLING TOWERS & ANTENNAS SAFELY

2012 Dayton Hamvention

Antenna Forum

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OBSERVATIONS FROM NEARLY 100 YEARS OF TOWER WORK

Things you SHOULD DO

Things you SHOULD AVOID

or

Planning Prevents Poor Performance

Today's talk ?
(or why it's important to listen to us)

- We'll talk about things that can save you time & money (you probably already know many of them, but might have forgotten some)
- Techniques which might just save a life…
- And we'll share things we often see:

SAFETY

- Safety is too often taken for granted by hams (or simply NEVER CONSIDERED at all)
- NO JOB is so important that it has to be done in an UN-SAFE manner!
- NEVER RUSH when doing a tower or antenna installation

The First Steps…

- BEFORE thinking about permits…
  - Develop a STATION/SYSTEM Plan: a concept, a design, & a realistic budget

Some Design/Planning Considerations?

Single Op, Multi-single, Multi-Op, M-M, SO2R/SO3R, DXing, contesting, rag chewing, VHF, et cetera…

Permits

- Always ASSUME one or more permits will be required & proceed from there
- Do your homework — buy (and read) K1VR's book
- Be friendly & positive in every human interaction with public officials & your neighbors
- And remember: it's not a tower — it is an

Errors…
ASSUMING too much

- Hardware ALWAYS has physical limits
- Towers, (especially crank ups), masts, & rotators — are too often over-loaded
- Larger antenna array designs should have PE analysis & approval
- Never under-estimate Mother Nature
  - Can one really build for ICE & WIND?
  - Yes, but…outcome is always un-certain

The tower itself

- Planning — how many towers & antennas will you want, need, or afford over time? Think future!

  (Interests & circumstances will change)

- Size matters — wind load drives tower design & the materials required
- Budget cannot govern physical limits
- Always comply with manufacturer

Used vs. New

- KNOW what is or is not a bargain
  - Check current prices on QTH.com, eham.net & seek advice from an expert or professional
- We're not all millionaires — new is nice, but being practical is all right, too
- If it seems the deal is too good to be true… it probably is!

Hardware considerations

- You get what you pay for.
  Purchase properly rated materials & components…DON'T BUY JUNK!
- Let's look at basic tower hardware:
  guys, turnbuckles, thimbles, shackles, nuts & bolts

Guying materials

- 3 Choices & ONLY 3 Choices
  - **EHS steel** (NOT Aircraft Cable)
  - **Phillystran**
  - **Polygon Rod**
- DON'T USE plastic covered clothesline cable, baling wire, TV hardline, black Dacron rope (or any type of rope) for tower guying
- Preforms — the preferred choice for each
  - Cable clamps — if used, install them correctly!
- Antenna truss material — consider changing

Do not use "hardware store" items for tower guying!

NEVER use hardware which is not load-rated. It's DANGEROUS!

Turnbuckles

- Use ONLY HD galvanized turnbuckles
- Size matters again — longer is better
  - 12-inch long, ½-inch diameter length preferred
  - Chinese hardware works well & is significantly less expensive than Rohn equivalents
  - No failures in 20+ years of use
- Use quality galvanized turnbuckles on

Thimbles & shackles, items misunderstood or over-looked

- Use ONLY H-D thimbles . DO NOT use rope thimbles you find at hardware store
- DO NOT hammer thimbles onto turnbuckles or EQ plates — use a shackle to make the connection
- Anchor Shackles — screw pin style is preferred, as it's the easiest to work with. Use at EQ plate & turnbuckle guy

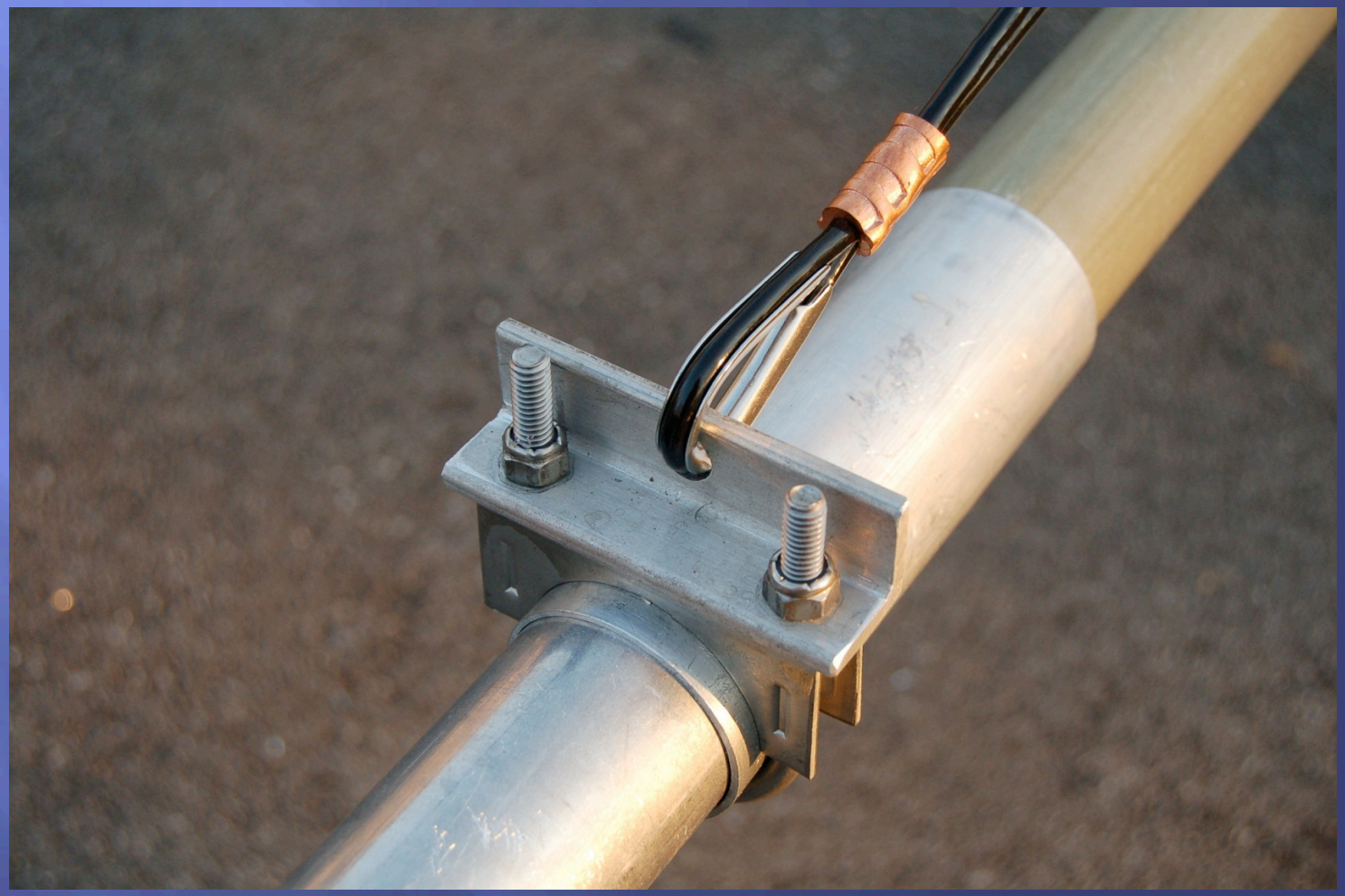
Thimble & Shackle examples

Incorrect/Correct Thimble examples

¼-inch hardware store Rope thimble on ¼-inch EHS

Properly-sized HD thimble (7/16-inch) on ¼-inch EHS

Truss support & Nicopress example

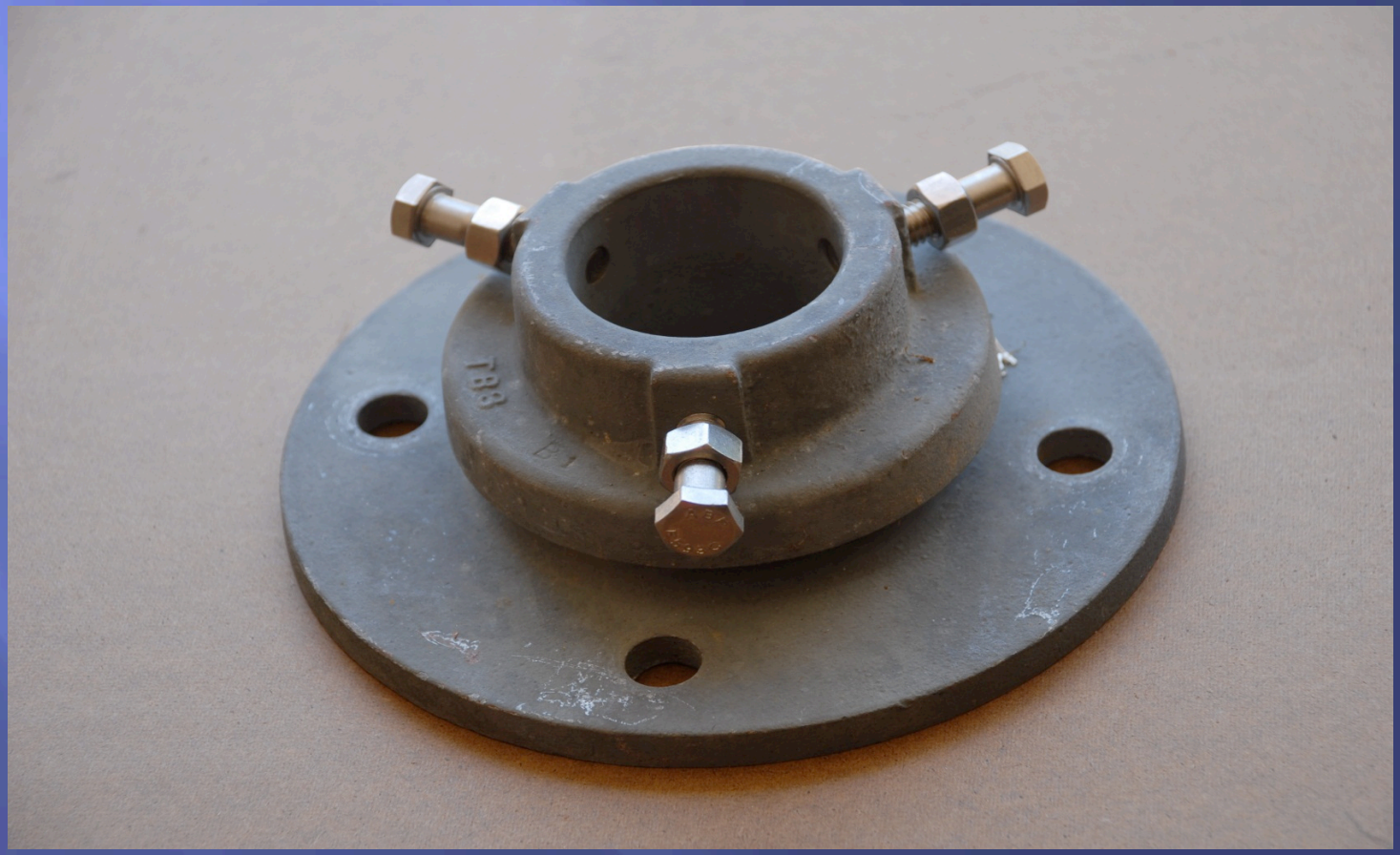


Masts…

- Steel tubing is specified for most installations:
  - 4130 chrome-moly tubing
  - Drawn over mandrel tubing (DOM)
- Aluminum — 6061-T6 alloys, $\frac{1}{4}$-inch wall minimum, $\frac{1}{2}$-inch wall preferred
- Water pipe? It's not 1970, so unless the load will literally be an inch above your thrust bearing, don't even consider using it

Thrust Bearing FAQs

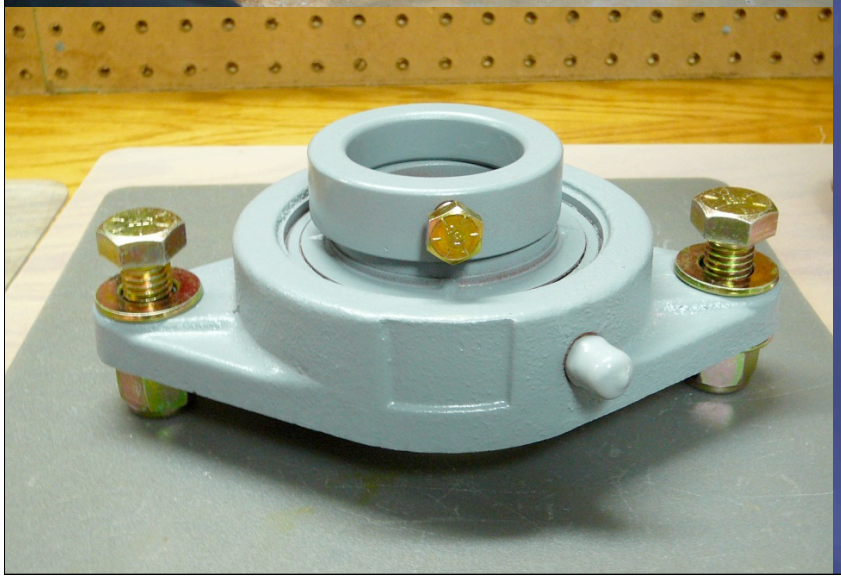
- Rohn TB-series vs. Machine Shop



TB-series is light-weight, inexpensive, & designed to carry ham antenna loads

- But there are some potential problems:
  - case cracking (rare but a sign of overloaded system design or improper installation)
  - replace Rohn collar bolts with Stainless to mitigate against dis-similar metal corrosion
  - metal migration (steel bearings on an aluminum race) - don't leave antennas parked in one position for long periods

"Machine Shop" bearings

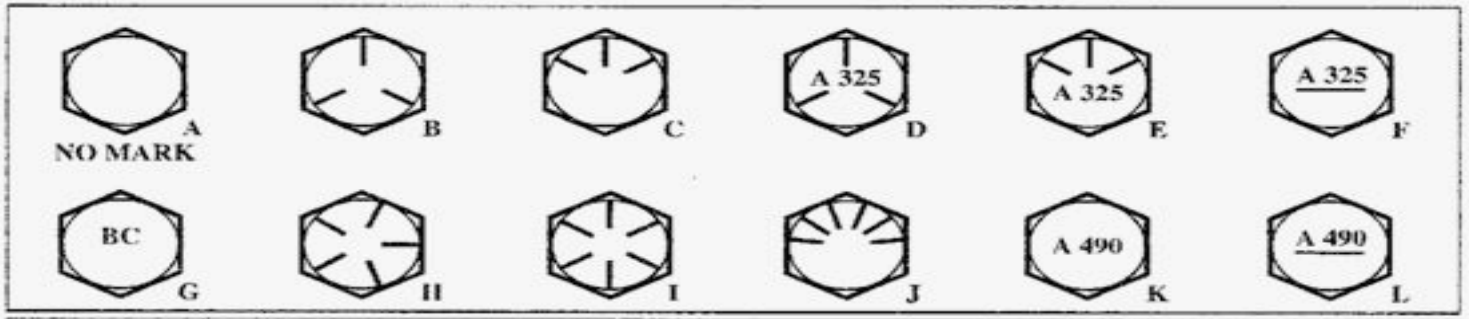


They are not weather-rated and rust quickly, allen set screw on the collar is often a problem, and the bearing requires lubrication

Rustoleum primer & a topcoat paint will mitigate rusting; use hex head bolt to prevent the collar

Nuts & Bolts

- Many choices to select from:
  - Hot dip galvanized
  - Stainless steel
  - Split washer & nut versus NYLOC
  - Proper tightening techniques
  - Too much anti-seize is never a good thing



Identifier	Grade	Size (in.)	Min. Strength (10^3 psi)			Material & Treatment
			Proof	Tensile	Yield	
A	SAE Grade 1	¼ to 1½	33	60	36	1
	ASTM A307	¼ to 1½	33	60	36	3
	SAE Grade 2	¼ to ¾	55	74	57	1
		⅞ to 1½	33	60	36	
	SAE Grade 4	¼ to 1½	65	115	100	2, a
B	SAE Grade 5	¼ to 1	85	120	92	2,b
	ASTM A449	1⅛ to 1½	74	105	81	
	ASTM A449	1¾ to 3	55	90	58	
C	SAE Grade 5.2	¼ to 1	85	120	92	4, b
D	ASTM A325, Type 1	½ to 1	85	120	92	2,b
		1⅛ to 1½	74	105	81	
E	ASTM A325, Type 2	½ to 1	85	120	92	4, b
		1⅛ to 1½	74	105	81	
F	ASTM A325, Type 3	½ to 1	85	120	92	5, b
		1⅛ to 1½	74	105	81	
G	ASTM A354, Grade BC	¼ to 2½	105	125	109	5,b
		2¾ to 4	95	115	99	
H	SAE Grade 7	¼ to 1½	105	133	115	7, b
I	SAE Grade 8	¼ to 1½	120	150	130	7, b
	ASTM A354, Grade BD	¼ to 1½	120	150	130	6, b
J	SAE Grade 8.2	¼ to 1	120	150	130	4, b
K	ASTM A490, Type 1	½ to 1½	120	150	130	6, b
L	ASTM A490, Type 3					5, b

What to do on Installation Day

- After completing your design, & procuring properly rated materials, the work begins!
- Who's in charge during tower work?
  It's ALWAYS the CLIMBERS!
- Have a work plan. Pre-visualize how tasks should be done (task order, materials, needed, etc.) and be ready to go
- Make sure ALL of the helpers know the plan before anyone climbs
- Discuss safety issues. Anticipate what can

What makes a good ground crew?

- Stage (& organize) all needed materials & tools near the base of the tower
- LISTEN & PROMPTLY follow directions given by the tower climbers (their lives are at risk!)
- EVERYONE must wear a hard hat & work gloves at all times
- Stay alert (& attentive). Anticipate the needs of the climbers – it's definitely NOT

Dealing with Mother Nature

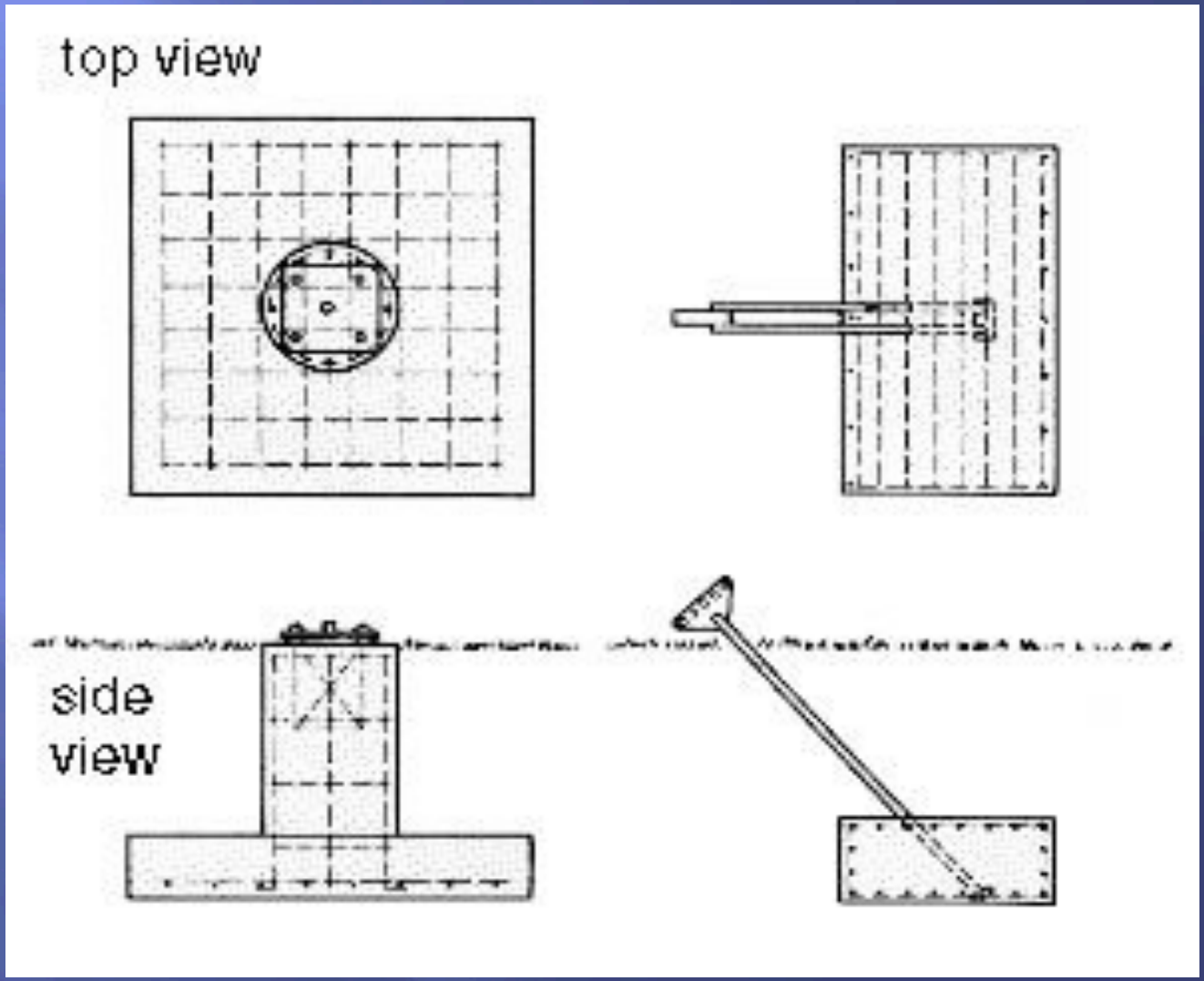
Working with Concrete

- Variety of tools needed to do concrete work (measuring, wood-working, metal-working, water, concrete finishing tools, etc.)
- Ready-Mix preferred over mixing yourself
- Proper curing is critical — it takes concrete 28 days to reach full strength (keeping new concrete damp is helpful)
- Add curing time to your project schedule

Tower Guy Anchors

- There are only three ACCEPTABLE choices:
  - Deadman anchors (Mfr. designs)
  - Screw-in earth anchors (Mfr. approved)
  - Elevated guy posts (PE-approved designs)
- UNACCEPTABLE: trees, fence posts, trailer tie-down anchors, building walls, abandoned

Deadman anchor



Expanding earth anchor

Critical spares for Installation Day

- Assorted spare nuts & bolts (tower leg and antenna hardware)
- Have enough rope on hand
- Other common items as construction spares:
  - Coax & Connectors (& series-adapters)
  - Shackles, Thimbles & Preforms
  - Ready access to your Station Notebook

Other things to consider…

- Mount the Stack-Matches at ground level
- Mount lightning protection devices close to shack in a utility box — and follow single point grounding guidelines
- Learn & practice good connection weather-proofing techniques
- Do an annual tower inspection — more

Successful cable Weather-proofing

- I begin with a Teflon wrap. Next is a layer (over-lapped one half tape width) of Scotch 130C (linerless rubber). Next are two layers (again over-lapped one half tape width) of Scotch 88 (preferred) or Scotch 33

- No known water ingress issues

Summary wrap-up

- You're not putting up an antenna or tower
  It's a total "SYSTEM"
- From concept through design & installation
  - Follow good engineering practices
  - Always use rated & quality materials
  - Always make personal safety your priority during construction

SHAMELESS SELF-PROMOTION

Check out the services we offer and reviews our clients have posted about us on eHam.net:

John Crovelli W2GD
http://www.eham.net/reviews/detail/6125

Don Daso K4ZA
http://www.eham.net/reviews/detail/5883

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We're assembling an element for a W3TX brand full-sized four element 40M OWA beam


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VP5JM


NR5M


KC9QQ

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Thanks for your attention!