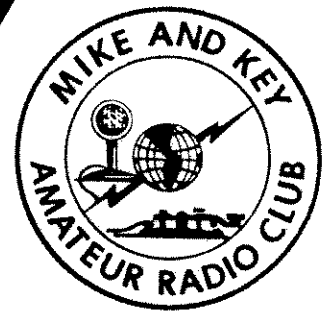


# K7LED RELAY



The K7LED RELAY is the Official publication of the MIKE and KEY AMATEUR RADIO CLUB, P.O. Box 2121, Kirkland, Wa. 98083-2121. The Club meets the third Saturday of each month at 9:30am in "The Good Neighbor Center", 305 S 43rd St. Renton, Wa. All "Hams" invited. The MIKE and KEY net meets each Monday evening at 1930 hrs on 224.12MHz. Your check-in is welcome.

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AN ARRL AFFILIATED CLUB LOCATED NEAR SEATTLE, WASHINGTON.

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19415 SE 21st  
Issaquah, Wa. 98027  
Phone 392-5303

REPEATER FREQUENCY  
52.05 - 53.05  
146.22 - 146.82  
224.12



First Class

## BOARD MEETING

FIRST TUESDAY  
OF EACH MONTH

## CLUB MEETS:

18 JULY 1987

UGN CENTER  
RENTON 10:00

## BREAKFAST

BOB'S BIG BOY  
RENTON--8:00AM  
3RD SATURDAY

PETE HEDBERG K7WTG  
20904 NE 77TH ST  
REDMOND  
WA 98053

COFFEE AND DONUTS WILL BE READY AT 9:30

## FROM THE EDITOR

A big thank-you to all of you who are submitting articles for the RELAY. It sure is great!!! There is more than can go into this month's issue, but that is okay, some of the info can go in next month.

Just a reminder that the deadline for articles is Tuesday August 4 for the September issue, but I would appreciate having as much as possible earlier than that. I will need to get the final draft to Vern on Thursday, June 6 for printing.

Keep up the good work, you are certainly making my job easy.

Joyce KB7BGW

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**ACHIEVEMENT:** The man who rows the boat generally doesn't have time to rock it.

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## HANDI-HAM SYSTEM

The ARRL is looking for people interested in helping physically disabled people obtain their amateur license. An organization called 'Courage Handi-Ham System', Minneapolis, MN, is looking for volunteer instructors.

The Handi-Ham System, at present, has no structured program for teaching physically disabled prospective hams. Most of the teaching is accomplished on a one-to-one basis. They are interested in getting a pool of volunteer instructors willing to learn how to help the physically disabled prospective ham. The Courage Handi-Ham System will provide the volunteer instructor with adaptive devices. The volunteer instructor can contact the Handi-Ham System by phone or letter for personal advice on problems that might come up.

If you are interested in joining in on this worthwhile activity, I have more information and a registration form to be sent in to the ARRL for forwarding to the Courage Handi-Ham System.

K7ND

## FROM THE PRES

I want to take this opportunity to thank all of the club members that participated in the 1987 FIELD DAY activity. Not only was there a supurd effort, but the scores reflect just how well we did. I hope that next year will be even better for us.

I want to thank all who came down to the beach and helped to put up the 40 meter CW antenna. Your help made for a great effort on that band--once, again, thanks to all.

If you should know of someone in our club that could use some help getting things done with antennas or equipment, let any of the board members know so that we can organize some help for them...if we don't know, we can't help!!!!

There has been a lot of interest shown in our club nets and we need your help to get the word to our membership on Monday nights. If you can take a Monday out of your schedule once a month to run the net, it sure would be welcome. Those of us tjat run the net would be more than glad to help you get started--and not leave you hanging!! So please try and give it a chance.

We at the MIKE and KEY are trying to attain ideas from all of it's club membership and new prospective members as to how we do things to make ourselves as a club better for you and our community. You and only you can do this. If you have an idea or thought about what we might do to make improvements in our present direction, please write them down on a piece of paper and submit them to the board. Word of mouth doesn't always do the job of getting your ideas to the board.

73---Rick NU7Z

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## ADVERTISING

He who has a thing to sell  
And goes and whispers in the well,  
Is not so apt to get the dollars  
As he who climbs a tree and  
hollers.

## FIELD DAY '87

Well, it's over. Field Day at Fort Flagler with the Mike & Key. It'll be hard to beat this years good weather and company.

Early Friday was setup time on the beach. If you have ever wondered at the workings inside your presidents head, you should have been there to put up the 40 meter antenna he designed. Fortunately, it worked great and I might make one for this years SS at my station. (20 meters Rick !). Also on the beach was 20/80 CW by Hal and Steve, and they were pretty well set up by evening also.

The Friday night clam feast was a roaring success. There was plenty of food and munchies and the clams runneth over. Ray WA7EKH played chef and kept the clams coming at a rapid pace. My thanks to all that brought food and refreshments.

Saturday, not too early now, brought Field Day and final station preparations. Down on the CW site, quick change of radios were needed on 40/15 and a keyer repaired. Even after the contest started it was determined we needed more goo towards 6 land and up went K7ND's Bobtail Curtain, in record time. Up on the phone site, everybody had to scramble for power as the big generator died as soon as the contest began. Murphy was on site.

24 hours later it was over. Talk to anybody and you'll get plenty of stories, many more than can be told here. Just want to thank Jim K7PHZ for his efforts. He put a lot into making this a successful FD and deserves a round of thanks from everyone. He did an excellent job. By the way, mark you calenders, next year's FD is June 27. WA7UVJ

### WANTED: FIELD DAY PICTURES

Did you take any Field Day pictures? How about sharing them with the club? Bring them to the July meeting for all to see. Let's show the members and guests who did not attend what it was like and how much fun we all had. THE BOARD

QST QST QST QST QST QST  
AMATEUR INFO SERVICE 224.16 MHZ REF  
PRESENTATIONS FOR JULY INCLUDE:  
JULY 7-REPEATERS  
JULY 14-PHONE PATCH & AUTOPATCH  
JULY 21-SIMPLE H.F. ANTENNAS FOR  
THE BEGINNER  
JULY 28-BASIC H.F. PROPAGATION

All presentations run approximately 10 minutes in length and are intended to promote discussions relating to the nights topic. The Amateur Information Service will also include local club news, news of general interest to the amateur community, technical "tid-bits", etc. If you have a particular topic in mind that you would like discussed or have any news of interest to the amateur community, please contact: Jerry Aceto-K6LIE 10712-126th Ave. N.E., Kirkland, WA. 98033.

The Amateur Information Service will begin at 9:00 PM every Tuesday evening. All amateurs are welcome to participate.

73 and see you on 224.16!  
Jerry-K6LIE

Don't Forget  
the



## PICNIC!

### FROM THE SECRETARY

I have new 610 forms for anyone requiring one.

FOUND: A hat belonging to KA7ZUR after last months VE testing session.

Info for ordering a 'General Radiotelephone Operator License Study Guide'.

Registration forms for the 'Tacoma Hamfair'.

\*\*\* COMMITTEES \*\*\*

The following are the active club committees and the contact for that committee.

FIELD DAY -- K7PHZ -- June 27 and 28 -- Field Day is over and was a tremendous success. Mike, WB7AYU, is working on the logs and a summary of how we did should be available at the next meeting. Approximately 105 members and family were in attendance.

REPEATERS -- Contact K7YR -- The IPA and repaired antenna were installed at the repeater site. However the antenna seems to have developed a problem and will have to come down again. The increased power has improved the coverage and the antenna has helped the receive coverage also. -- The 6 and 220 repeaters are continuing to operate normally.

HAM CLASSES -- Contact WA7UVJ -- The Tech/General class is over. The next class will be a Novice class to start the later part of September and run for 9 weeks. We would like to see more club members involved this coming fall.

NETS -- Contact K7YR is you can help out as net control. The net meets at 7:30 pm on Monday nites on the 224.12 repeater. The linking of the 2 meter repeater for net nites is in work and should be available soon.

FRIENDSHIP AWARD -- Contact K7KOT -- Contact 10 or more club members (no more than 5 on a repeater) and submit list to K7KOT for the certificate. Steve will have the details of the new program in the next Relay. Plans are to provide endorsements or new certificates for different bands. Rick, NU7Z, is attempting to contact 10 members on 432, and is pretty close to qualifying. -- How many members have you work??

PACKET RADIO -- Contact KD7NM -- This digital mode of communication is becoming very popular. Digital repeaters, called digipeaters, are available on the 2 and 1 1/4 meter and 70 cm bands. An organization for promoting Packet Radio meets monthly. Contact Bob, KD7NM, for

SCOUTING -- Contact WB7TBR -- Vic has provided an input to the TOTEM, a scouting newsletter that goes out to 8000 scout leaders. The input requests them to contact Vic if they are interested in involving the scouts with Ham Radio. Vic will need volunteers to provide Ham presentations if he gets any response.

K7LED OPERATING ACTIVITY -- The club call is available to members who wish to use it to publicize the club.-- Contact the Radio Officer, K7YR.

CLUB JACKETS -- Contact N7NW -- Orders will be placed about every three months if. The jackets may be silver or white with the logo on the back. You may provide your own jacket if you prefer. The jackets cost \$25.00 and the T-shirts \$7.00. The last order will be available at the July meeting.

PUBLIC SERVICE -- Contact K6DOW/WA7EBH -- The summer months host alot of events that require help from the hams to provide coordination and emergency communications. These are oportunities to put Ham Radios best foot forward. Many events in July will need our help. If you dont know what is envolved please contact Wayne, K6DOW, or Chuck, WA7EBH for a briefing. The events are always fun if not rewarding.

ARES -- Contact N7HKL -- Next month we will have an article about ARES.-- Ted, N7HKL, holds the ARES net on thursday at 7:30 pm on the 146.82 club repeater.-- Please checkin to see whats happening.

ATV -- Contact W7SRZ -- They taped the 1987 Dayton Hamvention and have a short program to present at one of our next meetings. -- Chuck and Dick, W7TWU taped our Field Day activities and will be ready for viewing next meeting. --Contact Chuck if you are interested in ATV.

PICNIC -- WA7UVJ, Mike -- The picnic will be August 29th starting at noon at Van Doren park in Kent. There will be a softball game. See elsewhere in relay for details.

FLEAMARKET 1988 -- N7NW, Hal --  
There will be an advance planning  
committee meeting after the next  
club meeting.

\*\*\* WELCOME ABOARD \*\*\*

At the May meeting the following  
were voted into the club.

WA7BUY, Gerald Sanpont, known as  
Jerry, is a technician class  
amateur. Jerry is a member of ARRL.  
He works for the city of Seattle and  
lives in Kirkland. Welcome Jerry!!

WA7C, Don Wilbrecht is a Extra  
class amateur, having just recently  
upgraded and changed calls. He may  
be more recognizable as WA7IKM which  
he had held for many years. Don  
lives in Lacy and works for the  
State of Washington, drives one of  
those bubble gum machines. He has  
other interests in computers and  
photography. Don grew up in Auburn  
and was a previous member of the  
original Mike and Key Radio Club.  
Welcome!!

KB7AIO, Joyce VanTuyl, is a Novice  
class amateur now studying for her  
tech. Joyce was a graduate of our  
last fall novice class. Joyce's  
husband, Ted N7HKL, is also a club  
member. She enjoys camping and  
baking. Joyce keep the novice class  
supplied with fresh cookies. Joyce  
is the Assistant Area Coordinator  
for Area 19 Special Olympics.  
Welcome!!

At the June meeting the following  
were voted into the club:

Paul Roth, N7DOH, is a general  
class amateur who enjoys SCUBA,  
skiing, boats, fishing and other  
outdoor sports. Paul works for  
National Guardian Alarm Services and  
lives in Bellevue. Paul is a member  
of ARRL. Welcome Paul.

Mike Hanson, KA7CSE, has recently  
upgraded to General and has passed  
his extra class code requirements  
and is planning to upgrade to extra  
his fall. Mike enjoys radio  
controlled sailplanes and sailboats  
and photograph. Mike also bowls and  
plays golf. Mike works for Boeing  
as a plumber and lives in Renton.  
Welcome Mike.

Mark Northcutt, KB7BTN, is a newly  
licensed novice. Marks dad is  
Chuck, W7SRZ, is also a member.  
Mark works for Paladin Advertising  
Co. and lives in Seattle. Marks  
call was used for the novice station  
at field day and did a bang up job.  
Thanks Mark and welcome to the club.

Don Werts, KA6QMT, is a novice  
amateur. He is interested in  
computers. Don lives in Renton and  
is a Sales Representative. Welcome  
Don.

Herschel Whiting, WA7IMC, is an  
advanced class amateur. Herschel is  
retired and lives in Bellevue. He is  
a life member of ARRL. Welcome  
Herschel.

\*\*\* ARES NEWS \*\*\*

Do you know what ARES is? If you  
don't, then maybe I can give you an  
idea or two as to what I think it  
is. Do the words DISASTER  
PREPAREDNESS, or the words EMERGENCY  
COMMUNICATIONS, or the words PUBLIC  
SERVICE COMMUNICATIONS bring  
anything special to mind? We all  
provide some of these to some extent  
in our daily adventures of Amateur  
Radio.

The Amateur Radio Emergency  
Service is a volunteer radio  
communications service available to  
Federal, state, county, and local  
governments, as well as non-profit  
organizations. Please consider ARES  
as a worthy recipient of your  
donated time and effort. The King  
County ARES Team T (south county)  
net meets each week at 20:00 hrs  
pacific time on the club 2 meter  
repeater (146.820 mhz). Please feel  
free to join us and contribute your  
ideas.

73, de N7HKL, Ted

SEAFAIR is coming up the last week  
of July. See Chuch WA7EBH, or  
call, to sign up for the parades.  
He needs lots more of you to help.  
As of this writing only 5 club  
members have signed up to assist.  
For a list of parades, see you June  
RELAY. WA7EBH

Wasn't the weather great for the Field Day Weekend? We have been going to the same place for 12 or 13 years and this past was the biggest in attendance we have ever had.

All band chairmen and chairwomen did a great job. I was pleased at the way most of the stations were collectively assembled. When help was needed, no one stood by and watched the work being done.

Several people did an outstanding job in making sure we got most all the "bonus points" available.

For you that did not get to see the "Novice" station being set up, you missed out. It was a joy seeing all the newcomers working together and the station was ready to go in no time.

Things were sure jumping as 12 O'Clock drew near and the Big Generator burped and died - all hands went looking for small generators for each station but the Big wait came alive and did not, again, fail us - much to the watchful eyes of Mike WB7AYU and his dad.

I hope we have pictures available for all to see the big wire antenna farm down on the beach. Plenty work at home and then at Field Day site to have what we would all like to have at the home QTH.

As we all found out, we have some great new members that jumped in and filled spots that before usually meant many long hours of operating for just a few. Also good to see the ladies helping out as "Dupers".

We had a last minute change of bands regarding the challenge of Radio Club of Tacoma. W7DK and Hal N7NW and crew came through with flying colors. As of this writing

W7DK, Radio Club of Tacoma, will meet on July 22 at 7:30PM. Why not attend? Check with one of the board members for the place.

and conversation with W7DK people, looklike K7LED is the first winner of, I hope, many such challenges in the future.

Yes, we had some problems, most were handled on the spot, some will require more study and resolution.

Let's face it, we had a wonderful time. I want to thank you all for your "Ham Radio Enthusiasm" and making it all work so well.

73 Jim K7PHZ

#### MIKE AND KEY TRANSMITTER HUNT

Bet you haven't been on one of these in a while. It happens September 19, after the regular club meeting. The hunt area is South King County and Rick NU7Z is IT. (Better start looking for a good place to hide OM).

Why don't one of you oldtimers show a neophyte the DFing ropes. Ken K7YR will give a program at the July club meeting on the proper antennas and procedures to find the target. There will be a sign-up sheet at the club meeting

After the event, we'll hit some pizza parlor to discuss bragging rights. Now, should I make a Yagi or Quad? Or maybe.....? WA7UVJ

#### BULLETIN STATION

Bulletin Manager for the Washington Section, Pat N7CAK, is looking for someone in the M&K ARC to handle the ARRL bulletins for our club. The person handling this function doesn't have to be an Official Bulletin Station, but can become one. The easiest way to obtain the bulletin is via packet radio. All that is required is to bring or send the bulletins to the club meeting for all to read. It is possible that the bulletins may be also included in the Monday 220mhz net.

If you are interested, see me for more info. K7ND

## ARRL LETTER

**AMATEUR ANTENNA VICTORY IN MISSOURI**  
On May 15, the City Council of Kansas City unanimously passed a liberalized zoning ordinance allowing amateurs antenna tower heights of up to 60 feet and a safety setback of one-third the height from the adjoining property. The previous standard was five feet above the rooftop in residential areas.

After an amateur in Kansas City was cited for violating the previous ordinance, Kansas City amateurs banded together to attempt to obtain a more liberal ordinance. A meeting was held between amateurs and city officials which convinced the officials that antenna five feet above rooftop was not adequate for most amateur communications.

No opposition developed during the zoning commission hearings on the new ordinance and it became effective May 15.

### 1987 ARRL OPERATING MANUAL

The new edition is available in early July for \$15.00 from your local ARRL publication dealer, or add \$2.50 for postage and handling if ordered from HQ.

This contains more than three times the material offered in past issues. Among other things, this new edition provides nuts-and-bolts advice on contesting, DXing, net controlling, how to talk to OSCAR, packet radio, and much, much more.

### CW DEAD? NEVER!

Who says CW is dead? Not the FCC! The June 5 register presents a proposed amendment by the FCC to allow the use of CW (and voice) by Emergency Position Indication Radiobeacons (EPIRBs) and Emergency Locator Transmitters (ELTs). These are devices which automatically "turn on" if a plane makes an emergency landing or crashes. Presently these devices use a non-voice swept audio signal modulation.

**SUCCESS:** If you have tried to do something and failed, you are vastly better off than if you had tried to do nothing and succeeded.

### KC4 CALL SIGNS BEING ISSUED

Hearing lots of Antarctic stations on recently? Don't be surprised if KC4AJ0 turns out to be from Kentucky! For the past several weeks, group "D" 2x3 call signs beginning with the prefix KC4 are now being issued to new Novices in the fourth call area. US stations in the Antarctic are only assigned the following 32 call signs: KC4AAA-AAF and KC4USA-USZ.

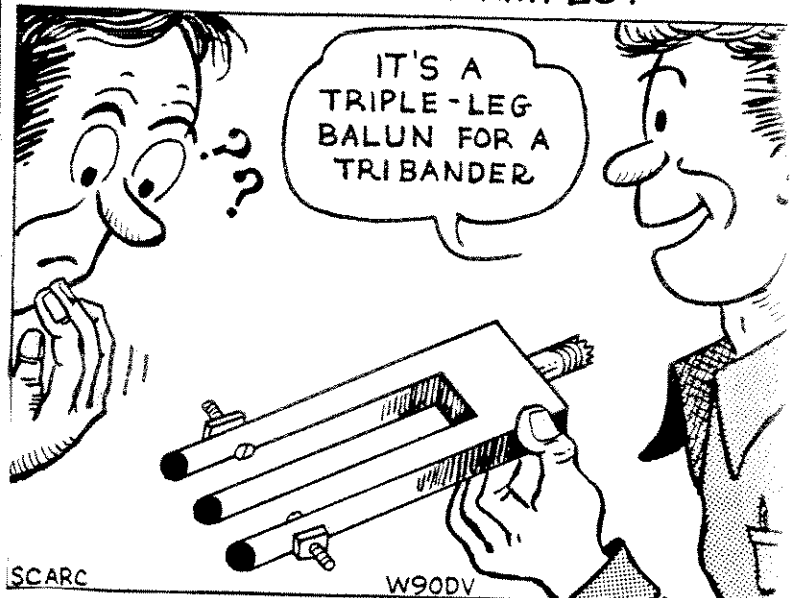
### POTPOURRI

With the advent of Novice Enhancement, Amateur Radio is growing--not only in terms of number of licenses but even more in terms of how many are active. The ARRL membership has increased by more than 1,000 in the last two months.

The 10-meter band has been virtually open round the clock to most of the US from New England during the past several weeks. Several HQ staffers have worked over 700 stations from W1AW in the Novice/Tech phone subband providing many new amateurs with their first W1AW or CT QSO.

**BUSINESS:** we are all manufacturers--some make good, others make trouble and still others make excuses.

### FOUND AT A HAMFEST

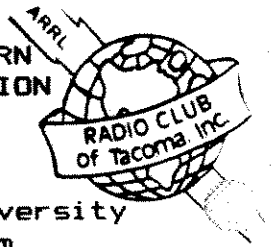


### FIELD DAY CAMPING '87

What fun we had in the camp ground! There were hams, XYLs, children, grandchildren, girlfriends, and guests. There were motorhomes, trailers, tents and vans, plenty of places to sleep if you had the chance. There were walks on the beach, chances to sit in the sun and get tanned (or burned?), whatever. The food was great and so were the cool refreshments found at each site. Oh!!! How about the spaghetti that Ken K7YR's boss made? Did he think the fort was still occupied, Ken? He made enough for an army, but oh so good. There were campfires with plenty of wood from Pete K7WTG's deck. Sorry you had to burn your deck to keep us warm, Pete. Then there were the guys who came down to the campsite on Sunday afternoon who hadn't seen water for three days. They almost plugged the shower. Infact, we expected to see flowers sprouting from the shower. Did you have any quarters left over from the collection for your shower, Ken? There were many bicycles for jaunts around the area. I, for one, am going to get mine fixed for next year. The fellowship was great and we all had a good time. Jack KB7ZS's campsite seemed to be the gathering place in the evenings when we weren't up at the operating site. Everyone is looking forward to next year. KB7BGW



ARRL NORTHWESTERN  
DIVISION CONVENTION  
and  
TACOMA HAMFAIR



Pacific Lutheran University  
Olson Auditorium  
Tacoma, Washington

AUGUST 22 & 23, 1987

Banquet Program "China Odyssey"  
Norm Ray W7LFA

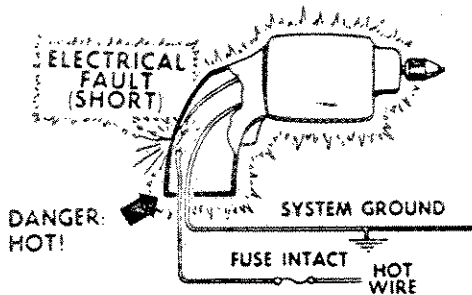
Door Prize - Kenwood TH21

Talk-in Frequencies: 147.98/38 &  
224.92/224.52

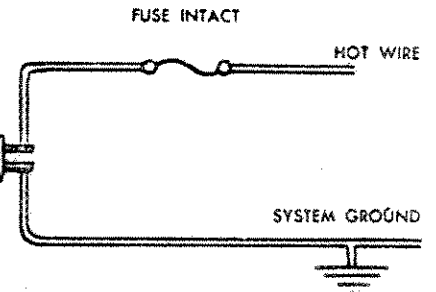
Pre-registration is \$5.00. At the  
door is \$6.00. W7DK

## WANTED

2000 WATT PEP  
ANTENNA TUNER  
40-ft TOWER  
(CRANK-UP PREFERRED)  
AND ROTOR  
Vern W7ZLW  
882-2907



EQUIPMENT GROUNDING



THIS SYSTEM IS DANGEROUS  
DON'T YOU ACT AS A GROUNDING  
CONDUCTOR  
- MAKE SURE EQUIPMENT IS  
GROUNDED THROUGH THE CORD!



GENERAL MEETING 6-20-87

Called to order @ 1001 by NU7Z w/pledge.

Introductions w/62 attendees

New members: Herchel WA7IMC, Mike KB7BTN, Don KA6QMT, Mark KB7BTN, Pau; N7DOH

2m repeater: Old repaired ant reinstalled, machine back up to full power, ARES net Thur @ 8PM

Activities: Field Day June 27-28, Picnic Aug 29, Bunny Hunt after the Sept meeting

Public Service: Sign up sheet for Sea-Fair, see Chuck WA7EBH, Tri-atholon July 19, see Wayne K6DOW, see calendar in RELAY for more.

Old Business: Minutes from May approved.

Activity: Field Day slide presentation by Harry W7JWJ

New Business: Field Day discussion

Closed 1145

FALL CLASSES

It isn't too early to start thinking about the Novice classes starting this fall at Highline Community College. The more teachers we have, the easier the burden. It's a unique experience and you can learn a lot, teaching.

Even if you can't teach, spread the word. The new enhancements make the Novice license very desirable for the beginner and classes are a good day for us to get these people in tune with the "spirit" of amateur radio.

This year we will follow the fall classes with an immediate Tech/Gen class, making it a matched set for those wishing to advance.

Still don't want to teach? Then just come down and visit. These people are excited about radio and it's infectious. WA7UVJ

MORE ARRL NEWS

May FCC Licensing figures indicate they processed 18,889 applications which includes 6,797 new amateurs. There are 14,679 new amateurs for the first 5 months of this year which is 70% ahead of last year.

Members will be notified of their license expirations as of August. This is a new service of ARRL.

During Field Day, June 27, the Goodyear Blimp Enterprise was operated under the call of Chuck Bachus WA4KVI. This took place at the blimp base in Pompano Beach, FL. A special QSO will be sent to stations worked.

EXPERIENCE is a wonderful thing. It enables you to recognize a mistake when you make it again.....

MIKE AND KEY ANNUAL PICNIC

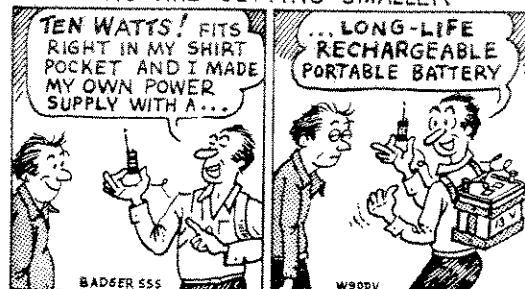
August 29th brings the Mike and Key Summer Picnic. This year it will be held at Van Dorens Landing in Kent. Van Dorens Landing is a park situated next to the Green River in north Kent just south of the Boeing Plant near there.

It is large enough to have a softball game in and the whole thing is reserved in our name. There are picnic tables, a childrens play area, and lot's of space. It doesn't have a covered area so hope for sunshine. (August is pretty reliable for that).

We even have permission to drink beer and wine, courtesy of the Kent Police and Park Departments. The good times start at noon. I'll have a sign-up sheet at the club meeting. For sure, bring the kids, your appetite and maybe a baseball mit.

WA7UVJ

HTS ARE GETTING SMALLER



# Equipment grounding

The more commonly accepted methods of grounding equipment operating at less than 600 volts are discussed in this article. It covers only "equipment grounding" as such, as opposed to "system grounding" of the electrical distribution system. Such equipment grounding includes the grounding of enclosures of fixed electrical wiring as well as the common forms of utilization equipment, including portable equipment.

## The need for grounding

Most electrical distribution systems that operate at 600 volts or less have one of their circuit conductors grounded. (This is the "ground circuit conductor" and is often the "neutral" conductor as well. Its insulation or termination markings is white or natural gray in color.) This circuit conductor is grounded at the distribution transformer and at the point of entry into a building or home.

Ordinarily, electric current will flow through the "hot" conductor to its connected load, such as a lamp or portable tool, and return to the transformer through the neutral conductor. However, deterioration of insulation, or the loosening of strands or wire at a termination point, may result in energizing the metallic enclosures. This "leakage current," as it is often called, will seek to complete its circuit back to the transformer by whatever conductive means is available to it. If no equipment ground is purposely provided, the current will flow through building steel, damp concrete, or human contact back to the point of neutral attachment to ground at the building. It then completes its circuit over the neutral conductor to the transformer windings.

It is for this reason that an equipment grounding conductor is required. Such a conductor provides an alternate, low-resistance pathway that minimizes the voltage difference between equipment and ground if a ground fault occurs. Its lower resistance also allows more current to flow, and increases the probability that the fuse or circuit breaker will open the circuit. Figure 1 explains the route that the fault current follows in a simple circuit.

Ungrounded metallic electrical enclosures present a serious hazard where they are installed in locations that are likely to have explosive gases or dusts present. Should a grounded object come in contact with a faulty, ungrounded enclosure in such a location, the resulting arcs or sparks could set off an explosion or cause a fire.

It should be well understood that ordinary 120-volt supplies can and do cause electrocutions. In addition to being the direct cause of death, electric shocks can produce startle reactions that may indirectly cause serious injury or death. Possible examples include a fall resulting from a shock received while working at the top of a ladder, dropping a heavy portable tool upon one's feet or upon someone working below, or a reaction that results in a person becoming caught in a piece of operating equipment.

Electric arcs can also cause eye damage and flash burns. High energy arcs may cause clothing or other combustible materials to ignite; arcs may also cause any metal involved to explode or vaporize. Electrical burns produced by current passing through the body may be deep-seated and very slow to heal.

The amount of current that will flow through the body in a shock situation is basically dependent upon two things: (a) the available voltage, and (b) the total resistance the body presents. Because voltage is, in most cases, a constant (such as 125, 250, or 480 volts), the shock will depend largely upon the resistance of the body, including resistance at its point of contact. (See Figures 2 and 3 for an explanation of the variations in resistance.) This circumstance is described by the formula:

$$\text{Current through the body} = \frac{\text{Voltage applied to the body}}{\text{Resistance of body}}$$

## Equipment required to be grounded

*The National Electrical Code (NEC) NFPA 70*, requires that most metallic enclosures and framework of electrical equipment be a part of or be bonded to the equipment grounding conductor. Among those items falling under this requirement are:

- a. Equipment that is in wet or damp locations;
- b. Equipment in hazardous locations;
- c. Equipment having terminals operating at 150 volts or more to ground;
- d. Equipment in electrical contact with other metal items;
- e. Equipment supplied by a metal clad, metal sheathed, or metal raceway wiring method;

f. Equipment that is within eight feet (2.4 m) vertically or five feet (1.5 m) horizontally of ground or grounded metal objects and is subject to contact by persons.

## Types of equipment grounding conductors

The equipment grounding conductor should always be run with, or else constitute the enclosure of, the circuit conductors that it serves. In no case should it be run separate from the circuit conductors, because this makes it difficult to maintain, and the separation of conductors may produce enough impedance to prevent the operation of the fuse or the circuit breaker if a fault occurs.

The most commonly recognized form of equipment grounding conductor is green insulated copper wire. But equipment grounding may also be bare and made of another corrosion-resistant material. It may be solid or stranded wire, or it may be in the form of a busbar of any shape. It may be rigid or intermediate metal conduit, or electrical metallic tubing (e.m.t.) commonly known as "thin-wall." It can be the metal sheath or cladding of various types of cable assemblies, and it can also be ladder or channel-type cable trays. Flexible metal conduit can be used as an equipment grounding conductor only in lengths not exceeding a total of six feet (1.8 m) for a circuit of 20 amperes or less, and only when used with fittings that have been listed by Underwriters Laboratories as an equipment grounding means.

When purchasing electrical equipment, the ability of the equipment grounding conductor to carry fault current should be assured by looking for the Underwriters Laboratories label on the product or the carton.

The most vulnerable portions of the equipment grounding circuit are those points where terminations are made, where conduits are coupled together, or where conduits are attached to enclosures and boxes. Insulating lubricants should not be used on threaded fittings. Paint should be removed from mating surfaces or else a locknut or set-screw should be employed that penetrates the paint and makes a metal-to-metal contact. In some situations additional grounding techniques will be needed, such as using one locknut inside and one locknut outside of metal boxes or cabinets, using bonding-type locknuts and bushings, and by providing bond-

ing jumpers. The latter is an especially important consideration wherever concentric or eccentric knockouts are provided.

In all cases, every joint and connection should be made tight, using suitable tools. This practice should be rigidly enforced whether work is done by staff or through outside contractors.

In many forms of occupancies, high humidity, condensation, and splash and spray conditions rapidly degrade metal conduits and cabinets, and, consequently, the equipment ground is also compromised. Such occupancies may include meat and poultry processing plants, fertilizer plants, petrochemical plants, agricultural barns, boatyards and marinas, and other seacoast locations. This degradation is further accelerated by the action of acids, salts, and other chemicals. In such cases, the use of plastic conduit, boxes, and cabinets is essential, and equipment grounding must be furnished in the form of a separate conductor.

### Receptacles

Standard types of receptacles are provided with a green hex-head screw for the attachment of the equipment grounding conductor. Where the conduit system constitutes the equipment ground, a jumper must connect the receptacle and a grounding screw in the receptacle box. Attachment to the box can also be by means of a jumper and an Underwriters Laboratories listed box clip. Where grounding is by means of an equipment grounding conductor run with the circuit conductors, the receptacle is again grounded by means of a jumper, but connection must be made in such a manner that the equipment grounding conductor is not interrupted when the receptacle is removed.

Self-grounding receptacles are available that are equipped with a special attachment means, such as a spring-screw combination, that produces an automatic grounding connection when installed in a grounded box (Figure 4).

Another variation of the grounding receptacle is one whose mounting strap is insulated, and thereby isolated, from the green grounding screw. Such receptacles are called "Isolated Ground Receptacles." In this case, the mounting strap is only a mechanical means of support. Wherever electromagnetic interference (E.M.I.) is present in the normal grounding circuit, this receptacle permits the attachment of a separate equipment grounding conductor to the green hex-head screw; this conductor can then be run directly to the nearest transformer or service entrance, which-

ever comes first, with no intervening grounding connections. This will assist in eliminating E.M.I. from monitors, computers, and other sensitive equipment.

"Hospital grade" receptacles are subjected to special "torture tests" by Underwriters Laboratories, and, consequently, provide a more reliable grounding connection. They have proved useful in industrial and commercial applications where loss of grounding continuity would be critical.

### Grounding portable equipment

The *National Electrical Code*, in Section 250-45, specifies types of cord and plug connected equipment that must be grounded. Among those listed are freezers, refrigerators, air conditioners, washers, driers, drills, saws, lawn mowers, hedge clippers, and all devices used in wet locations or by persons standing on metal floors. Two important exceptions to the general grounding requirement permit the use of Underwriters Laboratories listed double-insulated tools and appliances, and tools and appliances that are supplied by not more than 50 volts from an isolating transformer.

Grounding terminals within tool or appliance housings are identified by a green hex-head screw. When repairs or inspections are made, care should be taken to assure that only the equipment grounding conductor is attached to this terminal.

Portable extension cords should also be available to accommodate work performed beyond the reach of the supply cord on the tool. Such extension cords should be made of Underwriters Laboratories listed components, and should be inspected and maintained for grounding continuity with the same care as the tool itself. Extension cords should never be used as a substitute for permanent wiring, nor should two-wire extension cords be used with equipment requiring grounding.

Grounding continuity should be checked on new tools and appliances before being put into service. Molded-on plugs may contain a hidden discontinuous ground; such a condition will occasionally occur within the cord itself and only an electrical check will indicate this hazard.

Plugs and connectors should be wired in such a manner that the grounding connection is provided with additional "slack." In the event of undue strain on the cord, the grounding connection will then be the last to be broken (see Figure 5).

Where two-wire receptacles are

encountered, they should be changed for the proper grounding configuration, making sure that there is adequate means for grounding the new receptacle.

The *National Electrical Code* permits the use of Underwriters Laboratories listed adapters. Such adapters are equipped with a rigid tab rather than a pigtail. (The pigtail, if not attached, may become inserted in the hot slot of the receptacle or contact a blade of the plug, energizing the equipment housing, and producing the very hazard that the adapter is intended to prevent.) The adapter must also have a wide neutral blade to assure proper polarity (Figure 6).

### Employee training

The following pointers will provide the basis for a grounding safety program:

a. Look for loose conduit and box connections. Are they adequately supported? Is excessive vibration present? Is the equipment corroded?

b. Make certain that all equipment requiring an equipment ground is provided with the appropriate grounding plug.

c. If the equipment is defective—if it gives the user a "tingle"—remove it from service immediately, tag it, and have it repaired.

d. Check all equipment and extension cords every time they are returned to a tool crib. Use good test equipment and keep records on each item.

e. Do not tin stranded wire with solder—this promotes corrosion and limits contact area. Use appropriate terminating hardware to confine strands.

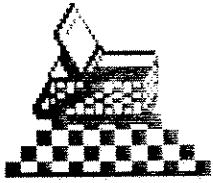
f. Check receptacle grounding and polarity periodically.

g. Check grounding of enclosures, cages, and other large metal structures that are likely to become energized.

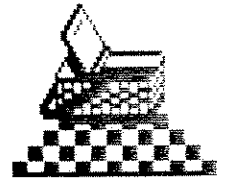
h. Check electrical housekeeping and workmanship. They are good indicators of potential hazards.












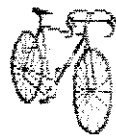


—National Safety Council

Thanks to Vic WB7TBR



# MIKE AND KEY AUGUST 1987



S	M	T	W	T	F	S
30	31  M&K UHF NET 1930 HRS /Z24.12					1  LAKE CITY SEAFAIR PARADE (5PM) CALL WATEBH 392-5303
2  HYDRO RACE AID STATION (7AM) CALL KA7G00 746-7702	3  M&K UHF NET 1930 HRS /Z24.12	4  BOARD MEETING 1930 AT QTH OF: WA7UVJ	5  TIM, W7QMI, HAS A "WESTLINK" PHONE CALL 634-3636 TO HEAR	6	7	8
9	10  M&K UHF NET 1930 HRS /Z24.12	11	12  LOOK FOR YOUR COPY OF THE RELAY IN THE MAIL TODAY OR TOMORROW	13	14	15  CLUB MEETING. COFFEE AT 0930. MEETING STARTS AT 1000 - BRING A FRIEND AND NEWSPAPERS!!
16	17  M&K UHF NET 1930 HRS /Z24.12	18	19	20	21	22  ARRL NW DIV. CONVENTION. TACOMA - PLU REGISTRATION AT 7AM, FAIR STARTS AT 0900
23  BELLEVUE TRI- ATHLON K6DDW WANTS A REPLACEMENT - HELP HIM	24  M&K UHF NET 1930 HRS /Z24.12	25	26	27	28	29  ANNUAL M & K PICNIC AT VAN DOREN LANDING IN KENT, 12 NOON. BE THERE!!!