

Nebraska Department of Roads  
Attachment A  
**SPECIFICATION**  
Motorola APX 4500 Mobile Radio Installation

**SPECIFICATION: Motorola Mobile APX 4500 Radio Installation**

All installations must meet the requirements of this document.

NDOR is organized geographically into eight (8) Districts. Installations will take place in all Districts except Districts 3 and 4. Each district will have between approximately one (1) and four (4) installation locations. Vendors may bid on a single district or multiple districts. The installations will take place at multiple locations across the state (*see Exhibits 1-8*). Radios will be installed in large plow trucks, pickups, graders, loaders, and other specialized equipment as designated in the following table. Radios installed in large trucks have remote mount control heads, most other radios are dash mount type. Installation in pickups that will have multiple radios will include installation of hump mount consoles and relocation of existing radio controls to hump mount consoles.

Installation may include the removal of the existing low band radios and antennas.

**NDOR will provide:**

1. Vehicles which are reasonably clean and clutter free.
2. New APX 4500 radios and cable.
3. Motorola HAD4008 antennas (150.8-162 MHz ¼ wave NMO).
4. Larsen NMOKDS dual shielded line kits (3/4" standard and 3/8"thick mount).
5. UHF crimp-on coax connectors.
6. Mini UHF to UHF adaptor cables.
7. Hump mount consoles.
8. Fuse plug tapping adaptors for connection to fuse blocks.
9. Heated shop bays where installations will be performed.
10. Checklist form to be completed after each installation (*see Attachment B*).
11. Inspection of all installations.

**Contractor will provide:**

1. Labor and miscellaneous materials required to install the radio in compliance with the standard procedure.
2. Tools, instruments, and equipment needed to perform the installation (to include screws, ties, sealer, etc.).
3. Travel to and from the installation locations (including lodging if needed).
4. Completed checklist and certification of installation according to standard procedures.
5. Prompt rework of any noncompliance with the standard procedure.
6. Removal of installation debris from vehicles.

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**NDOR SRS Vehicle Installation Guidelines**  
**Installation Requirements for Compliance with Radio Frequency (RF)**  
**Energy Exposure Safety Standards**

**This radio is intended for use in occupational/controlled conditions, where users have full knowledge of their exposure and can exercise control over their exposure to meet FCC limits. This radio device is NOT authorized for general population, consumer, or any other use.**

To ensure compliance to RF Energy Safety Standards:

- Install only approved antennas and accessories;
- Be sure that antenna installation is per “Antenna Installation,” of this manual; and
- Be sure that Product Safety and RF Safety Booklet enclosed with this radio is available to the end user upon completion of the installation of this radio. Before using this product, read the guide enclosed with your radio which contains important operating instructions for safe usage and RF energy awareness and control for compliance with applicable standards and regulations.

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## **Radio Mounting**

Radios must be mounted in locations which allow access to the radio for servicing. When practical, mount so State of Nebraska bar code is accessible for scanning.

Always use the shortest screws possible to secure the radio. DO NOT mount the radio on a plastic mounting surface unless screws also penetrate metal behind the plastic.

Truck radios will be mounted 12" or more above the floor on the rear cab wall, where they will not be contacted by the seat or any truck or plow controls.

Dash mount radios will be mounted using the same guidelines as control head mounting if no hump mount console is needed. When hump mount consoles are used, radios must be arranged in the console to allow optimum viewing of displays (referencing height of device above console surface).

## **Control Head Mounting**

In large trucks, control heads will be mounted on the dash (or other structurally suitable surface) as close to the driver as possible, at least 24" above the floor, pointing in the same direction as the other devices/surfaces in the area. Control head location must not interfere with other controls or displays in the cab.

Control heads will be mounted in the overhead compartment if a previous radio control head is being removed from that space, or if the space is available.

When hump mount consoles are used, control heads must be arranged in the console to allow optimum viewing of displays (referencing height of device above console surface).

## **Microphone Hang-Up Clip**

The hang-up clip must be within reach of the operator and close enough to the control head to prevent cable strain. Since the bracket has a positive-detent action, the bracket can be mounted in any position. To avoid interference when removing the microphone, a correctly sized flathead screw must be used in the top clip hole. Confirm location and fastener type with the NDOR to avoid re-work.

When hump mount consoles are used, side mount microphone mounting brackets (provided with the consoles) will be used to mount microphones.

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## **Cable Installation**

Plan wire and cable runs to provide maximum protection from pinching, crushing, and overheating.

Do not route any cabling under carpet or mat area used by driver's or passenger's feet, or under any carpet or mat area that will be loaded with tools or other heavy or sharp objects.

Splices are prohibited under carpet or under the sill plate. Continuous runs of wire should be used whenever possible. If a splice is necessary it must be located where it can be inspected and serviced. It is not permitted to route cabling or wiring inside the wheel wells of a vehicle.

DO NOT connect any wires to power sources until you have finished the entire radio installation. Incorrect wiring of the radio may result in incorrect ignition sense detection, incorrect power-on state, or incorrect power-off state of the radio system. The Control Head Power cable(RED) and Transceiver Power cables(RED) are always attached to the vehicle defined power point and NOT to an ignition switched source NOR directly to the battery.

The control head extension cable and the accessories cable should be installed and routed properly to avoid complications. Route the cables in the vehicle's wiring troughs (where available). If use of wiring trough is not possible, route the cables where they are protected from pinching, sharp edges, high heat, or crushing. Use grommets in any holes where the cable passes through metal panels.

A properly sized fuse must be located in each power or ACC lead as close as possible to the power source. Remove the fuse from the fuse holder and connect the red lead of the radio power cable to the positive source. The high current fuse kit provided with the radio will be installed near this point and secured with cable ties in a manner allowing fuse change without cutting the ties.

All NDOR radios are controlled by the ignition sense wire, in addition to the control head's on/off switch. The ignition sense wire will connect to the fuse block using an accessory connection device approved by the vehicle manufacturer and supplied by NDOR. This device will "share" the power feed of another circuit while providing separate fusing for the original and radio loads.

All radio grounds, with the exception of the coax ground at the antenna, will terminate at the vehicle manufacturer's cab ground point ("Single Point Ground"). Other grounding is by permission of NDOR only, on a per-vehicle basis. If the ground lead is not long enough to reach this point, one splice to additional stranded wire of equal or larger diameter (lower AWG number) is permitted and must be visible. No more than one splice may be used, and no splice may be concealed. DO NOT connect the black lead directly to the battery's negative terminal.

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## **Battery Switch**

Some vehicles are equipped with a “master battery switch” (motor grader, 2014 Volvo truck, etc). These switches almost always disconnect battery negative from the system. **DIRECT BATTERY CONNECTIONS ARE PROHIBITED IN ALL INSTALLATIONS.**

## **Antenna Installation**

**IMPORTANT:** To assure optimum performance and compliance with RF Energy Safety standards, these antenna installation guidelines and instructions are limited to metal-body vehicles with appropriate ground planes and take into account the potential exposure of back seat passengers and bystanders outside the vehicle.

For optimum performance and compliance with RF Energy Safety standards, mount the antenna in the center area of the roof (Pickups) or large truck cab protector (Trucks).

Unless there is a low-band antenna that will remain in the center of the pickup roof, mount directly to the roof, do not use a light bar. Thick mount connectors are supplied by NDOR for use where required.

Ensure that the antenna cable can be easily routed to the radio. Cut coax to serviceable length at radio. Do not coil extra coax.

Route the antenna cable as far away as possible from any vehicle electronic control units and associated wiring.

Ensure that any transmitting radio antennas on this vehicle are separated as much as possible.

The minimum distance between the antenna and the radio/accessories should be at least three (3) feet (91.44 cm).

The installation technician may be asked by the NDOR to test for interference using a mag mount antenna at the proposed location. This is not included in a standard installation, and is paid separately under Change Management. See *Interference Testing* in this document.

Final SWR should be less than 2:1 across the band.

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## **Antenna Connection**

Due to persistent problems with mini-UHF connectors which cannot be hand tightened properly on the radio connector, all connection to SRS radios must use Motorola adapter #HKN9557 (provided) and standard UHF male connector on the antenna coax.

Use pliers to **gently** tighten the mini-UHF connector to the radio. Over tightening can damage the connector and the radio.

## **Completing the Installation**

- ✓ Verify cables are hidden and secured.
- ✓ Verify all cables are connected to the radio and antenna.
- ✓ Connect all power and ignition cables to sources.
- ✓ Power the radio and verify power and ignition function as intended.
- ✓ Verify display.
- ✓ Key the radio on a local talk group (all radios should receive a channel grant tone) and verify:
  - Transmit power (Record the radio transmits, recording forward and reflected power readings)
  - Channel grant tone
  - Transmit audio.
- ✓ Verify receive audio.
- ✓ Verify volume control.
- ✓ Complete and sign P25 RADIO INSTALLER CHECKLIST (*see Attachment B*)

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## **Interference Testing**

Interference testing may be requested by the NDOR. If requested by NDOR and performed, testing is paid at the hourly rate as bid on the Cost Proposal Bid Sheet by the Contractor under Optional Electronic Work.

If a vehicle does not meet NDOR specifications for interference, NDOR staff and the Contractor's installation technician will work together to determine, if possible, the problem. Because this is unpredictable, this work is not part of the flat rate, but will be paid at the vendor's hourly rate as bid. It is understood that there may be interference problems that are a result of vehicle or radio defects that cannot be resolved in the field. The vendor is not responsible for correction of such problems. NDOR staff will determine how much time should be spent in the attempt to resolve interference problems. If a problem of poor radio installation workmanship or failure to follow manufacturer and NDOR installation instructions by the vendor's technician is found, there will be no additional payment for correction of this problem. The installer will be responsible for logging interference measurements when testing is required.