A Mn/DOT task force was formed to design an ergonomically correct snowplow truck cab which is cost effective and efficient. After brainstorming problems relating to snowplow cabs, four main issues were identified: visibility, controls, warning systems, and comfort.

A survey was sent to Mn/DOT operators asking them to rate various factors on the four main issues. The survey also asked for additional comments on each of the factors. The overall ratings were lower than anticipated. A review of the comments led to the conclusion that lowered ratings were a result of the use of older trucks. Not all operators have exposure to or are aware of the improvements that have been implemented in newer trucks.

This report includes the questionnaire, all responses, and recommendations for solving the problems which were identified.
SNOWPLOW TRUCKCAB
ERGONOMICS TASK FORCE REPORT

FINAL REPORT

Prepared by

Dan Peterson

Minnesota Department of Transportation
Office of Maintenance
395 John Ireland Boulevard, St. Paul, MN 55155

August 1993

This report represents the results of research performed by the authors and does not necessarily reflect the official views or policy of the Minnesota Department of Transportation. This report does not contain a standard or specified technique.

The authors and the Minnesota Department of Transportation do not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the objective of this report.
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.  INTRODUCTION - HISTORY</td>
<td>3</td>
</tr>
<tr>
<td>II. APPROVED LEVELS OF SERVICE</td>
<td>4</td>
</tr>
<tr>
<td>III. ACKNOWLEDGEMENT</td>
<td>5</td>
</tr>
<tr>
<td>IV. PURPOSE STATEMENT</td>
<td>5</td>
</tr>
<tr>
<td>V.  LITERATURE SEARCH</td>
<td>5</td>
</tr>
<tr>
<td>A. Private Industry</td>
<td>5</td>
</tr>
<tr>
<td>B. Other Government Agencies Outside Mn/DOT in the North American Continent</td>
<td>5</td>
</tr>
<tr>
<td>C. Mn/DOT</td>
<td>5</td>
</tr>
<tr>
<td>VI. BRAINSTORMING OF PROBLEMS AND ISSUES</td>
<td>6</td>
</tr>
<tr>
<td>A. Visibility</td>
<td>6</td>
</tr>
<tr>
<td>B. Controls</td>
<td>6</td>
</tr>
<tr>
<td>C. Comfort</td>
<td>6</td>
</tr>
<tr>
<td>D. Warning Systems</td>
<td>6</td>
</tr>
<tr>
<td>Fishbone Chart (Figure 1)</td>
<td>7</td>
</tr>
<tr>
<td>VII. GAP ANALYSIS</td>
<td>6</td>
</tr>
<tr>
<td>A. State-Wide Survey of all Truck Station Snowplow Operators</td>
<td>6</td>
</tr>
<tr>
<td>The Survey Sent Out (Attachment 1)</td>
<td>17-19</td>
</tr>
<tr>
<td>B. Survey Results (Figure 2)</td>
<td>8</td>
</tr>
<tr>
<td>Survey Comments (Attachment 2)</td>
<td>20-30</td>
</tr>
<tr>
<td>VIII. PROBLEM SOLVING</td>
<td>9</td>
</tr>
<tr>
<td>A. Visibility:</td>
<td></td>
</tr>
<tr>
<td>Mirrors</td>
<td></td>
</tr>
<tr>
<td>Windshields</td>
<td>9</td>
</tr>
<tr>
<td>Glare</td>
<td>9</td>
</tr>
<tr>
<td>Wiper Arms</td>
<td>9</td>
</tr>
<tr>
<td>Windshield Washers</td>
<td>9</td>
</tr>
<tr>
<td>Side Windows</td>
<td>10</td>
</tr>
<tr>
<td>Lighting</td>
<td>10</td>
</tr>
<tr>
<td>B. Controls:</td>
<td></td>
</tr>
<tr>
<td>Two-Way Radio</td>
<td>10</td>
</tr>
<tr>
<td>Control Levers</td>
<td>10</td>
</tr>
<tr>
<td>Steering Wheels</td>
<td>11</td>
</tr>
<tr>
<td>Switches</td>
<td>11</td>
</tr>
<tr>
<td>PTO Levers</td>
<td>11</td>
</tr>
<tr>
<td>Automatic Shift Systems</td>
<td>11</td>
</tr>
<tr>
<td>Levers on Left-Hand Wing Trucks</td>
<td>12</td>
</tr>
<tr>
<td>C. Warning Systems</td>
<td></td>
</tr>
<tr>
<td>Box Height Limiters</td>
<td>12</td>
</tr>
<tr>
<td>Warning Wing Lights</td>
<td>12</td>
</tr>
<tr>
<td>Operator Awareness</td>
<td>12</td>
</tr>
<tr>
<td>Turn Signal Controls</td>
<td>12</td>
</tr>
<tr>
<td>Accessory Warning Lights</td>
<td>12</td>
</tr>
<tr>
<td>Four-Way Flashers</td>
<td>12</td>
</tr>
</tbody>
</table>
Table of Contents
Page 2

D. Comfort: Seats .................................................. 13
Noise ................................................................. 13
Squeaks and Rattles ............................................... 13
Cold Cabs ........................................................... 13

IX. RECOMMENDATION  Part 1 Equipment ......................... 13-15
    Part 2 Training ............................................... 15

X. CONCLUSION ....................................................... 16

ATTACHMENT 3 - Specification 35.0-013 ................................ 31-32
ATTACHMENT 4 - Specification 33.08-008 ................................ 33-34
ATTACHMENT 5 - Heated Windshields Letters ............................ 35-37
ATTACHMENT 6 - L-8000, LT-9000 Options .............................. 38
INTRODUCTION

In the fall of 1992, the NTREC Committee asked that a Snowplow Truck Cab Ergonomics Task Force be organized to look at Mn/DOT's fleet. The charge was to improve snowplow truck ergonomics (cab environment).

Responsibilities of this task force were as follows:

- Complete a literature search.
- Search for products and ideas that have been developed by private industry, other agencies, etc.
- Assimilate data into a proposal for improvements in Mn/DOT trucks.
- Bring the proposal to the NTREC Committee.

This task force was to include two (2) safety administrators, Roger Erickson from outstate and Dennis Deming from Metro; Gene Valley from Mn/DOT Central Shop; and Dan Peterson, highway maintenance supervisor. Four (4) snowplow operators were first asked to participate with two (2) from the Metro area, one (1) from the outstate north region, and one (1) from the outstate south region. A second maintenance supervisor was included in the group. After our first meeting, it was decided that the task force should be expanded to be more diverse in size and gender. Our task force then totaled 10 persons.

One-person snowplow operation during snow and ice operations are required to clear roadways, shoulders, turn lanes, intersections, and interchanges for a minimum shift of (eight) 8 hours or extended shifts as emergencies require.

Varying weather conditions require a variety of snow removal techniques including multiple operations of sander, box, wing (right- or left-hand), plow (stationary or reversible), and an underbody plow.

Heavy snow, blowing snow, and freezing rain compounded by drifting snow, compaction, and variable traffic volume combine to reduce visibility to near zero at times.

In addition, an operator is responsible for avoiding guardrails, signs, bridges, curbing, culverts, mailboxes, stalled vehicles, and unwary motorists.

Mn/DOT's maintenance work force has an average of 15.78 years of employment. Our truck replacement program of single axle 3 ton dumps (Class 33) and tandem axle dumps (Class 35) is 10 years and 240,000 miles minimum or 12 years maximum on a Class 33 and 10 years and 350,000 miles minimum or 14 years maximum on a Class 35. Maintenance workers can expect to see one new truck during their employment.

Mn/DOT has a work force that is continually changing with great diversity. At times employees have physical limitations or personal injuries requiring work units to modify equipment to meet their needs. Any modifications recommended are evaluated by shop personnel and completed within reason to accommodate the driver's limitations.
# APPROVED LEVELS OF SERVICE

<table>
<thead>
<tr>
<th>CYCLE COVERAGE</th>
<th>TIME</th>
<th>TIME</th>
<th>RECOMMENDED LEVELS OF SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HRS.</td>
<td>HRS.</td>
<td>Classifications</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CLASSIFICATION</th>
<th>AADT</th>
<th>TIME</th>
<th>TIME</th>
<th>RECOMMENDED LEVELS OF SERVICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Super Commuter</td>
<td>Over</td>
<td>1.2</td>
<td>24</td>
<td>All lanes will have substantially bare pavement before coverage time is reduced.</td>
</tr>
<tr>
<td></td>
<td>30,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban Commuter</td>
<td>10,000</td>
<td>1.5</td>
<td>24</td>
<td>All lanes will have substantially bare pavement before coverage time is reduced.</td>
</tr>
<tr>
<td></td>
<td>30,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural Commuter</td>
<td>2,000</td>
<td>2.1</td>
<td>20</td>
<td>The right lane on divided roadways and both lanes on two-lane roads will have bare wheel paths with intermittent bare pavement before coverage time is reduced. The left lane on divided roadways will have intermittent bare wheel paths with sanded hills and curves.</td>
</tr>
<tr>
<td></td>
<td>10,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Primary</td>
<td>800</td>
<td>4.0</td>
<td>18</td>
<td>Both lanes will have intermittent bare wheel paths with sanded hills and curves before coverage time is reduced.</td>
</tr>
<tr>
<td></td>
<td>2,000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary</td>
<td>Under</td>
<td>5.0</td>
<td>12</td>
<td>One wheel path in each lane will have intermittent bare pavement with sanded hills and curves before coverage time is reduced.</td>
</tr>
<tr>
<td></td>
<td>800</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Some additional explanation to clarify the new Levels of Service are given below:

a) 'Intermittent' may be defined as generally being over 50% bare and snow packed or icy areas generally less than 100' in length.

b) In all classifications, 'before coverage time is reduced', means before returning from a Winter Maintenance Schedule providing 12-20 hours per day coverage time to a normal (8 hours per day) work schedule.

c) **Coverage time** is the suggested number of hours per day snowplow trucks work during and after winter storms to maintain the desired condition of driving surface. **Cycle time** is the theoretical period of time it takes to make a pass on a snowplow route.

d) Review section 5-391-300 of the maintenance manual for additional information on snow and ice control activities.
ACKNOWLEDGEMENT

We would like to thank the many individuals who participated in the Snowplow Truck Cab Ergonomics Task Force.

Dan Peterson - Chair
Dan Antrim
Beryl Board
Dennis Deming
Roger Erickson
Kermit Fletcher
Rob Koisti
Chuck Larson
Ken Pedersen
Gene Valley

H. M. Supervisor - District 4B
H. M. Wr. Sr. - Metro
H. M. Wr. Sr. - Metro
Dist. Safety Admin. - Metro
Dist. Safety Admin. - District 2A
H. M. Supervisor - District 4B
H. M. Wr. Sr. - District 2A
H. M. Wr. Sr. - District 6B
H. M. Wr. Sr. - Metro
Central Shop Supervisor

We would like to give special thanks to the NTREC Committee Chair George Welk and the AMEs for allowing us to spend time on this project. Also, thanks to all the survey participants.

PURPOSE STATEMENT

The responsibility of this task force will be to design an ergonomically correct snowplow truck cab that will be cost-effective and efficient.

LITERATURE SEARCH OF SNOWPLOW TRUCK CAB ERGONOMICS

The private sector turned up no actual response. We contacted Bob Deirlein, research editor of Fleet Equipment magazine and Sam Wasson of Evergreen Holding Corporation and received no information.

A request was made from the Mn/DOT library which turned up nothing on record by other agencies.

We then contacted the Ministry of Transportation in Ontario. Mr. Brian Gaston, the maintenance operations engineer, sent us a copy of their "Ergonomic Study of One-Person Operation of a Snowplow With a Wing Plow". This report was reviewed by our group and was used as a reference for justification of our recommendation.

Gene Valley provided us specifications of the latest Class 33 single axle and Class 35 tandem axle truck orders. This gave the group a better understanding as to what is currently being ordered. Gene’s position provided us with a warehouse of data for our Mn/DOT systems. His knowledge of procurement, specifications, availability as well as mechanics of truck systems were valuable in our assessments.

\(^{1}\)See Attachment 3 and 4.
BRAINSTORMING PROBLEMS

We brainstormed problems with snowplow truck cabs we now have currently in our fleet. These problems were recognized on units from 1975 through 1993.

Some problems apply to all trucks and some problems exist in specific years or models of trucks.

Four (4) main issues were identified:
- Visibility
- Controls
- Warning Systems
- Comfort

They are illustrated in the fishbone chart Figure 1, page 7.

GAP ANALYSIS

A survey we sent out was done to check if we were missing any issues and to see if we were on track. We also wanted to know how the operators felt about the fleet in general. We asked simple questions of our four (4) main issues and setup a rating system. We asked for personal comments on important issues. See Attachment 1: Survey.

SURVEY RESULTS

We thought the overall rating was lower than anticipated, Figure 2, page 8. After analyzing the comments (Attachment 2), the factors which brought the scores down were originated on older trucks. Not all operators have exposure to or are aware of the improvements that have been implemented in newer trucks. 

We saw a correlation in our survey with the snowplow truck ergonomics report from Canada. Visibility was listed in both reports as an area where improvements are needed.

The comments were reviewed and problems which were not covered by our group were then added to our list.

Personal issues that could be corrected at the district level were referred to those areas.

---


3Ergonomic Study of One-Person Operation of Snowplow with Wing from Ontario, Canada "Under Report Summary", page 2, Section 1.3.1, "Equipment Survey" paragraph 3, line 4.
<table>
<thead>
<tr>
<th>VISIBILITY</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>WITH YOUR MIRRORS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH YOUR WINDSHIELD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH YOUR LIGHTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH YOUR ACCESSORIES</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH YOUR LEVERS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH YOUR STEERING WHEEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH YOUR SHIFT STICK OR SHIFT PATTERNS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH YOUR WARNING SYSTEMS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COMFORT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH THE CLIMATE CONTROL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH THE NOISE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WITH YOUR SEATS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2
PROBLEM SOLVING

VISIBILITY

Mirrors:  
- Freezing over has been resolved on the new trucks with heated west coast mirrors.
- Heated fender mirrors are not available at this time.
- New trucks are mounted with fender mirrors and some districts have retrofit old trucks.

Windshields:

Problems are that they cover over with ice, snow on the outside and moisture on the inside. The wipers get buried and become useless requiring the operator to physically climb onto the hood and clean off ice and snow. This creates a safety concern of slippery hoods, operators hanging by mirror brackets, or climbing over plow/wing carriages.

In 1991, five (5) heated windshields were installed and this eliminated the problems externally and internally. Feedback from the operators was excellent. See Attachment 5.

Glare on the windshield has been addressed by painting the hood a flat black; however, after time it loses its effect and periodically has to be repainted. There has been times when the operators were unaware of the reason for this painting and have polished or even painted the hood with a gloss black paint for decorative purposes.

- Tinted windshields reduce glare as does operators wearing sunglasses.
- An exterior visor would help and it is speculated that they create air disturbances which would help keep the windshields clean.

Wiper arms build-up with ice.

- Grooves were cut into the bottom of some windshields with marginal effectiveness. It was not done to all trucks and when a windshield was replaced, the process was not repeated.
- A heated windshield does resolve this problem.

Windshield washers would get buried in snow and slush causing the operator to remove the obstruction before they could work.

- Nozzles have been moved from the hood cowl to the wiper arms on the newer trucks. This will put the solvent on the windshield.
Problem Solving Continued

Side windows frost over.

- The use of frost shields are a temporary fix and have to be maintained. Installation of frost shields do not always match various operators line of visibility with their mirrors.

- In Canada they have installed electric window openers so when necessary the operator can lower the right window to remove the obstructions.\(^3\)

- If electrically heated side windows where available, we feel this would take care of any problems as does the heated windshields.

- Air conditioning would eliminate inside the cab moisture.

Lighting on some trucks is inadequate. Some plow designs will not allow lights to project.

- Headlights if not effective should be checked for proper adjustments.

- Older trucks can be retrofit with halogen headlights. New trucks have been ordered with them for several years.

- In cases where lights can not project over the plows when in transport position, proper aiming of or longer mounting brackets would be beneficial.

CONTROLS

Two-way radios and microphones have been inconveniently placed.

- The radio shop should get together with the Central Shop to identify their needs for radio placement. The radio shop should be aware of the operator's needs of radio placement.

With the number of controls (hydraulics, radios, lights, sanders) going into the trucks, it is hard to accommodate everyone.

- We need to consolidate some controls into a smaller package.

- Utilize multifunctional systems such as the joy stick concept. (Example: Wings can be operated with one (1) lever rather than two (2).) We could reduce the lever control panel from as many as eight (8) or less levers to four (4) or less. This could be accomplished by hybrid hydraulic systems.

\(^3\)"Canadian Ergonomic Study", page 29, paragraph 3, line 2.
Problem Solving continues

- Use various lever designs for operation identification.
- Valve bodies should be placed outside the cab to reduce the noise and eliminate pressurized oil lines from the cab removing the operator from exposure to danger.
- Design these control systems so they can be adjusted to satisfy the size of the operator\(^5\) (Figure 3)

![Figure 3](image_url)

Steering wheel heights and angles can be a problem for diverse operators. Smooth wheels can be slippery.

- Tilts/telescopic steering wheels would place the wheels in a more accessible location.
- Textured, soft steering wheels would improve operator's grips.

Unmarked, unlighted accessory switches that are on older trucks have been replaced with illuminated and marked switches on newer trucks.

Some power take-off levers hit operators in the knees when they are engaged.

- This can be resolved by relocating the lever by local shops.

T-handled automatic shift systems on 92 models are hard to reach. The operators have to take their eyes off the road to shift.

- This could be addressed by moving the levers to the dash, raise them, or move it closer to the driver's seat.

\(^5\) "Canadian Ergonomics Report", page 81, Figure 5.2, Adjustable Pedestal Mount.
Problem Solving Continued

Levers were mentioned as being a problem in trucks with left-hand wings, for some they were hard to reach.

- A multifunction control system setup on an adjustable pedestal will place the controls at a better location for easier use.

**WARNING SYSTEMS**

Box height limiters have been less than successful with the cable restricter or electrical switches. Both deteriorate from corrosion and then malfunction.

- A mercury switch or proximity switch are an available option which has worked well in the Golden Valley area.

Warning wing lights have been a long questioned idea. An electric warning switch is not available to implement a warning light.

- **Operator awareness** is the main protection in any operation. A training tape could be developed on the proper use, mounting, and transporting of a wing.

Turn signal controls on newer trucks do not cancel as did our older trucks. It was a perk we have become accustomed to and generally is available in most vehicles. Operators are annoyed with the new systems and have many times unconsciously not cancelled the turn and drove many miles down the road misinforming other vehicles on the road.

- They would like the cancelling turn signals back.

- Signal switches have been wired through the seat belt buzzer to make the operator aware when the signal is engaged.

The warning lights on the older trucks are unreliable for oil, transmission, and engine temperatures.

- The new trucks have lights, gauges, and buzzers and are an improvement.

- Each operator should have access to the operator's manual so they can familiarize themselves with the functions of these gauges and how to read them properly.

- Trucks which do not have gauges should have lights in full view.

Four-way flashers are hard to engage and this should be a one-hand operation.
COMFORT PROBLEM SOLVING

Seats - Seats in newer trucks with adjustable lumbar support, cushion-air ride, built-in chugger, air control seat height adjustment, 12 degree recline front tilt and length adjustment, contoured cushions and adjustable headrest may alleviate minor back problems and stress for the operator. Some operators with more serious back problems may consult with their physician for more appropriate customized supports that can be placed in any truck.

- For ride comfort refer to the manufactures instructions for proper adjustments.

Noise with hydraulic systems was addressed earlier by moving pressurized systems outside the cab. Some older trucks strobe units inside the cabs were loud, but it has been resolved with the installation of a different system.

- If some of these units still exist they should be checked out by the local shops.

Squeaks and rattles are a nuisance and the operator will have to maintain or secure the seat to resolve this movement problem.

- Notify the shop for air ride seats that need adjustments or just simply letting the air out when not in use may make a difference.

Some cabs are cold.

- Insulating them would help keep them warmer as well as quieting them from outside noises.

RECOMMENDATION

PART 1 - EQUIPMENT

Recommendations are set by priority according to the ratings taken by the operators' survey (Figure 2) page 8.

Lighting

- Retrofit older trucks by updating headlight systems to halogen lighting.

- All trucks should be properly adjusted for maximum performance.

- Trucks with plows which restrict lighting should be modified with new brackets at the district level.

Noise

- Insulate the doors and roof to help reduce exterior noise levels, floors can be covered with throw mats or carpet.
Recommendation Continued

- Hydraulic systems should be addressed by the local shops when complaints come in from the operators. We should be aware of the possibility of a problem with hydraulic systems inside the cab. If they can be maintained outside the cab, it would be ergonomically advantageous.

Windows

- If feasible when heated windshields become available, we should replace glass when existing glass breaks. We should also order new snowplow trucks with this feature.

- Electric window openers for the right side window should be ordered on new trucks.

- Older trucks can be retrofit with an add-on feature if so desired.

Mirrors

- Heated west coast mirrors are being ordered on new trucks.

- All new trucks have been ordered with convex fender mirrors, older models can be retrofit with parts at the local shops.

Control Levers

- There are three (3) hybrid hydraulic systems which are being tested once operators indicate which system they prefer, new trucks should be ordered with these controls. Uniformity of value banks should resemble patterns established as in the past. Levers should be identifiable by touch to assist operators in night-time operations.

Accessory Switches

- New trucks are being fit with illuminated and marked switches. Retrofitting older trucks would involve redesigning or adding new systems at a $1,000 per add on.

Seats

- Lumbar back support options are available and can be ordered on new trucks or retrofit on older models.

- Seats with built-in head protection should be mandatory on all drivers' seats and new trucks should be ordered with head protection, lumbar air ride seats with a contoured rap around seat that will minimize movement of operators on the seat.
Recommendation Continued

Steering wheels

- To conform to a diverse work force in size, telescopic/tilt wheel should be ordered on new trucks. Also wheels should be textured so as to reduce slippage.

Shift sticks and patterns

- Sticks can be and have been customized by heating and bending them to fit different drivers. Systems were automatics have been floor mounted have been ordered with a more user friendly handle and it has been moved closer to the driver’s seat.

Warning Systems

- New trucks are being ordered with lights, gauges, and buzzers.

- Retrofitting older trucks is possible, but this would be done on top of existing systems and could hinder maintenance and/or operation of the truck. We recommend that maintaining older systems as designed would help and order newer systems on new trucks.

- Costs and availability of items are listed on Attachment 6.

PART 2 - TRAINING

We would like to see training developed on snowplowing, winging, and sanding operations so all operators are given practical information. This could be included as part of the New Employee Orientation Training.

- Operators should be required to review pertinent operator equipment manuals.

- Operators should be encouraged to fill out evaluation reports to identify short falls in equipment designs. Shops should be responsive to operator’s requests to accommodate drivers so as to receive maximum performance from driver and machine.
CONCLUSION

We feel the Central Shop is staying in touch with the snowplow drivers and feel they are receptive to comments or problems in the field. We would like to recognize them for that. For too long the comments were, "Who orders this stuff? It has to be someone who does not understand how things work in the field." Mn/DOT has been restricted by availability, low bid, and lack of communication between the shop and the field. At times this makes for an unaccepted system. The feedback received from operators statewide indicate we have a functional, operationally sound truck, but certain ergonomics features could be improved.

If this task force is to recognize our customer, the snowplow operator, we would like to put their recommendations in a working unit. Their feedback is necessary to evaluate systems so they can do their job more safely and efficiently, then we responded to our/their needs. Ultimately they can better serve their customers, the highway user.

If you have any questions, please contact someone on the task force and we would be happy to answer them.

Thank you.
From: The Snow Plow Truck Ergonomics Taskforce

To: All Mn/DOT Truck Stations

Subject: We are asking that you participate in a survey. We are studying how the operator works with the truck during the snow and ice control operations. Please answer these questions as a team. If there are particular issues raised during your rating, please record these in the spaces provided, even if they are personal issues. Ask someone from the team to record the comments and ratings. When finished please send the survey to either Beryl Board at the Hastings Truck Station if you are from the Metro area, or to Roger Erickson in the Bemidji Headquarters if you are from outstate. We need them back by March 8th, so we can put together the information for our next meeting.

RATING SYSTEM
4 ---------------EXCELLENT
3 ---------------GOOD
2 ---------------WORKABLE
1 ---------------BAD WORKING ORDER
0 ---------------DOES NOT WORK

Example of team ratings. There are six persons at a truck station, the question is read. Then each participant would give it a rating. The groups scoring would look like this. (2+3+1+3+4+4) / 6 = 2.5

1. How is your visibility during the snow and ice control operation?
   a) With your mirrors? -------
      comments:
   b) With your windshield? ------
      comments:
   c) With your lights? --------
      comments:

2. How are the controls in which you would use in a snow and ice control operation?
a) With your accessories? ----------
   comments:

b) With your levers? ----------
   comments:

c) With your steering wheel? ----------
   comments:

d) With your shiftsticks, or shift patterns? ----------
   comments:

e) With the warning systems? ----------
   comments:

3. How comfortable is your truck during a snow and ice operation?
   a) With the climate control? ----------
      comments:

   b) With the noise? ----------
      comments:

   c) With the seats? ----------
      comments:

4. Are there any suggestions in our snow and ice operation which you feel
   would improve the efficiency or performance of our trucks or operators?
Thank you for your cooperation. Our taskforce will be making a presentation to the AME Executive Committee around May 1st. This information will be incorporated into the brainstorming portion of our report.

dlp

MN/DOT DISTRICT 3A
BEMIDJI HEADQUARTERS
ATTN: ROGER ERICKSON
BOX 490
BEMIDJI MN 56601

HASTINGS TRUCK STATION
ATTN: BERYL BOARD
951 E 21ST STREET
HASTINGS MN 55033
1. How is your visibility during the snow and ice control operation?

A. With your mirrors = 2.6

Comments: Check with trucking industry for new ideas
- With wing up, visibility blocked to the rear
- Mirrors with wipers
- Why not fender mirrors on all trucks? They are requested and we get turned down, fender mirrors are more effective.
- Rear blue lights block vision
- More mirrors the better
- Power adjustable mirrors
- Heated mirrors should be standard
- Vertical adjustment
- Wings coming up hitting mirrors
- Need power right side window or right wiper
- Have a heated mirror for the wing
- Need better mud flaps on new trucks; rear wheel throw snow/mud onto mirrors
- Left fender mirror can't be seen because of snow/ice on windshield not cleared by wipers
- Convex fender mirrors should be heated

B. With your windshield = 2.5

Comments: A lot of problems with ice build up
- Heated windshield
- Real problem during freezing rain
- Tinted windshield
- Need more defroster on windows
- Bug deflector to help push snow over the windshield
- Wiper blades ice up
- Use better grade of glass, pits too easily
- Wipers are too slow
- Wipers could be better and come down from the top
- Wipers don't fit contour of windshield
To: Snowplow Truck Ergonomics Task Force
Results of Survey
Date: March 19, 1993
Page: 2

Anti-glare windshields
Air conditioning for moisture control in cab
Old pump washers don't work
Spray should come out of wipers
Needs sun shade
Poor wiper system
Poor visibility out side windows during snow
Problems with windshields leaking water into cabs
A separate air scoop for better defrosting to filter out fine snow
Heated wipers to eliminate freeze up
Certain plows allow too much snow and slush to come over onto the
windshield causing poor visibility
Automatic electric washers with filter in washer line
Place washer on the windshield wiper

C. With your lights = 2.2
Comments: Use quartz halogen plow lights
The lower the plow lights are mounted, the better it is
Better mounting brackets
Back-up lights are not good
Tail lights should be blow through
Need better yellow fog lights, don't buy Phillips brand
$80,000 truck and no cancel on signals
Don't go back to headlights on the cab
More light on front headlights for better snow penetration
Same lighting for 25 years; try something with good square halogens
Early morning, lights reflect back into the cab
Headlights not officially in adjustment
Need better quality lights
The 360° flash/reflect in your mirrors make you real tired before the
sun comes up
Should have 2 fog lights to increase visibility
Would like off road driving lights
Clearance lights should be on same switch as the headlights
Need something to prevent accumulation of snow around lights on the back
of trucks
Lights on back of 35's block view to the rear
Would like overhead lights on roof
Aircraft landing lights
A light bar to use when needed
Spot light for checking road by truck and checking stranded cars
During heavy snow at night glare back can reduce visibility to 15 feet,
caused mostly by needed height of head lights
Big swing plow blocks headlights
Lights don't work when plow is up; you see only orange
Lighting on wings

2. How are the controls in which you would use in a snow and ice control operation?
   A. With your accessories = 2.7
      Comments: Accessory light switches uniformly located
                Auxiliary defrost fans for windshield
                Heated wipers
                Intermittent wiper position
                Lighted switches
                Higher fan speed
                Like ground-oriented sanders
                Computerized spinner control is too sensitive
                Make all trucks uniform
                Minimum 100 gallon of fuel and fill from one side
                Headlights come on with the ignition
                Knobs for sander should be mounted better
                Better interior lights
                Factory radios AM-FM
                Should be labeled
                Make all units have same type radio if possible, talk-around channels vary
                Poor placement in truck; handles should be extended and spaced for ease
                and speed of operation
                Should have sander knobs on the dash somewhere
                Spinner control should be mounted where you can see it while driving
                Two way radio mounted poorly
                Need better heater/defroster control
                Improve dash lighting
                Should have all accessories located in front of driver and no lower than the
                dash
                Air horn poor

   B. With your levers = 2.6
      Comments: Long reach to wing levers
                On/off position not consistent from truck to truck
                Hydraulic levers need to be moved forward
                Improve location
                Some new truck levers are very hard to operate (cable system)
                Sander dial is in good location
                Standardize the levers
                Controls for sander are awkward to use
                Like valve body outside the truck, no leaking in cab and less noise. Cable
                may give us problems with freezing in sub-zero Weather.
                On new 90's sander lever hits arm rest
                Identify levers
                Upright mounted levers
To: Snowplow Truck Ergonomics Task Force
Results of Survey
Date: March 19, 1993
Page: 4

Put spinner control between seats; instead of on back
Left-hand wing levers to left of driver between seat and left door
Change the set of levers to different lengths; easier to find at night in dark
or fast when needed
PTO lever hits left knee on '92 singles
Control valve body freezing up in '91 tandems
Control valve should be put up front closer
Better lever controls - handier, easier to reach
Good with minor modifications per operator's desires
Plow and sander levers should be electric over hydraulic to reduce noise
and shoulder/back strain

Micro-switches

C. With your steering wheel = 2.9
Comments: Tilt steering to fit drivers better
Would like a steering knob
Foam steering wheel
Adjustment in and out (telescoping)
Good
Weak power steering
Wheel is too far ahead
Softer, more graspable wheel

D. With your shiftsticks, or shift pattern = 3.0
Comments: Panel light for automatics burn out easily
Should have 2 speed rear end
Ability to lock automatic transmission in 3rd gear to keep RPM's up
New class 33 poor location for shifter
Shorter person has a hard time reaching 6th & 7th gears
Gear shift cable at transmission should be set up for better lube
Another gear between 4th & 5th on the tandems
'92 trucks shift stick too short, could be located where old ones were
Don't put automatics in tandems
7-Speed in tandem is good
Shift lever should be centered more in the cab
Would like automatics in tandems
Older Class 33 does not have 2-3 positions
A 9-speed transmission would give a faster reverse
Should have 16 speed transmission
9-speed transmission with air splitter
Lock positions for different operations
6-speed transmission the difference between 5th and 6th too great in high
range
'92 floor shift is inconvenient and hard to reach
Need all shift patterns the same
Class 35 9 Speed Road Ranger would be my choice
To: Snowplow Truck Ergonomics Task Force  
Results of Survey  
Date: March 19, 1993  
Page: 5

E. **With the warning systems = 3.1**

Comments: Improve indicator for turn signals  
Have all gauges and located in one area  
Acceptable  
Really like 6 system strobes  
Turn signals should be self-canceling or have warning buzzer  
Back up alarms  
New lighting systems are excellent  
Install reliable box limiter warning sensor  
Amber strobe lights shine in mirrors irritating driver  
Should be standardized - use blue lights  
A better quality gauge that won't breakdown as often  
'91 & '92 fuel gauges don't read accurately  
Improve 4-way flashers on new trucks  
Need toggle switches instead of rocker switches  
Improve air horns

3. **How comfortable is your truck during a snow and ice operation?**

A. **With the climate control = 2.7**

Comments: Controls freeze up; have to plug openings to eliminate fogging  
Cab over heater because defroster must be kept on high fan and high heat  
to keep windshield clear  
Heaters in new trucks are good  
Does not keep windshield clear  
Side window defroster  
Thermostat temperature control  
Need air conditioning  
There is no in-between, either defrost 100% or floor heat 100%, have it so  
you can have a mixture  
Need better defrost system  
Eliminate humidity problems  
So far air conditioning heater is doing a good job of keeping windows clear  
Wind blows in  
Heated glass, then we could have heat on the floor  
Auxiliary dash fan for summer cooling  
Extra fan for windshield defrosting  
Heater controls after several years have problems with cables rusting and  
not functioning  
What climate control system?  
Heat side windows

B. **With the noise = 2.4**

Comments: Better insulated cabs  
Cut down on interior noise - poor acoustics  
Poor when idling
To: Snowplow Truck Ergonomics Task Force
Results of Survey
Date: March 19, 1993
Page: 6

85 is noisy
Engine, transmission, hydraulic pump, plow and wing noises come right into cab
Too much general cab noise
Are too noisy
Older trucks are terrible
New trucks are good
Loud hydraulic noise when spinners engaged
Keep valve body out of cab
Keep muffler under truck
Stacks should be mounted on the passenger side on all trucks
Have hydraulic noise when it gets below +20° and colder
Tandem has a lot of engine noise in cab; needs more insulation in fire wall

C. With the seats = 2.8
Comments: Makes your back sore
Some seats don't go back enough
For tall person, head rest is pressing between shoulders
Poor lumbar support
Lower cushions compress to nothing
More padding in arm rests
Be able to trip the seats back more
Want cloth seats
Older trucks have bad seats
Air ride seats in all trucks
Newer trucks are good
Hard as a rock, shoulder belt is around my neck
Good air seats, good seat-belt harness with shoulder belt
Seat belt catches sometimes when leaning forward to shift 6th & 7th gear
Not enough room behind seat to have air-ride seat oscillate
No air-ride seat for wing man/passenger
More leg room
The highback seats with the lumbar supports should have more adjustments
Some seats need to be upgraded
Air seats are great
Should have spring-loaded seats

4. Are there any suggestions in our snow and ice operation which you feel would improve the efficiency or performance of our trucks or operators?
Comments: Go back to manual sander and spinner controls
Newer trucks
New trucks coming with cab shields area problem for operators to see around. Either increase back window space or eliminate cab shield completely.
Bending problems on wing post on 9 ft wings
To: Snowplow Truck Ergonomics Task Force
Results of Survey
Date: March 19, 1993
Page: 7

Wing too heavy for existing cable
On 91's reversible plow is raised, headlight is blocked.
Too large of fins on reversible plow causing a real sight problem for operator
Cab sun visors
Poly box liners to help material slide better
Better vibrators on boxes, also install on Class 33's
A flap system that would cover the rear duals to prevent over spray and could easily be removed to wash under
Full fenders on all trucks
Make brake lights more visible and eliminate snow covering on backs of trucks
Windshield washers mounted on wipers
More manpower
Push bar on 1991-1992 trucks are too short and should be stronger
Underbody should have a different locking mechanism/more notches
Amber turn signals
Fuel tanks on one side
Better compliance with mailbox standards
Keep educating the public
Enforce snowmobile safety
Defrost intake from left side rather than wing side
Extensions on plow to keep snow off windshield
More underbodies
More power
1992 truck under carriage for plow is a poor fit for matching up to the truck
Better wheel rims needed
High discharge plows cause poor visibility and snow clouds
Area so lunch boxes can be safely stored
Bigger engines
More front plows
Use of back support belts would ease back problems
More tandems
Coordinate what the operators are doing
Communication is very important
Working in pairs of trucks is better
Removing the delineators
Sloping curbs are better
Remove light poles from Jersey barriers; the wing hits them
Cycle time for trucks should be 10 years
We are still using trucks that are 16 years old
New trucks would rate good to excellent
To: Snowplow Truck Ergonomics Task Force  
Results of Survey  
Date: March 19, 1993  
Page: 8

Should put good AM/FM radios and speakers in the trucks so driver can listen to more than the cutting edges
Better 2-way radios
Go back to the cable operated wings, less damage and better control
Put electric mirrors on all trucks 33 & 35’s
Better insulated cabs to keep noise levels down
Spend a little more time on truck maintenance in between storms, not when you are being called out
Vibrator on tailgates
Better plow or improved plow design
Better communication to media on how to drive during winter. Should be taught in school driving classes. Slow down, educate the people - a lot of them need it
Changing wing size was a mistake, wings should be longer not shorter, or stay with 10’ wing
Start staffing according to snow and ice operations; continued reductions in the field are hurting operations efficiency
More power in engine on Class 33 trucks
Air trip on single axle truck tailgates
We put a 3’ X 5’ arrowboard on cab guard of our left hand plow for Interstate 90; not many close calls anymore
Change system on calling people out, should be called out earlier to get a jump on traffic in morning
Small window in the lower portion of the passenger door would help visibility
Try cab-over with snowplow
Joy stick for plow control
Goodyear recap tires are not very good on our trucks
A light in the box to see how much sand you have in the box
Go back to the midmount wings on the plowing trucks
Wings on trucks that are strong and can be folded up close for carrying position
Air intake put on opposite side of plow
Spinner control in front of operator
Have a swivel put in all reversible plows so they carry level and at lower level
The drive wheel tread design of tires we buy on low bid are terrible, center of tread is too solid for traction on snow, we have grooved out center bars and improved
Traction 100%, suggest specs. be changed for a more aggressive tread for drive wheels
Should stay with 8’ wing and older wing mount on single axles
Could use a 12’ plow on single axles
To: Snowplow Truck Ergonomics Task Force  
Results of Survey  
Date: March 19, 1993  
Page: 9

Should not phase out single axles; some rural areas do just fine with these units.  
Should let drivers in some rural areas have more input on equipment installed on truck for their use.  
Work in own pay class; no matter what.  
Get rid of 12' plow; too wide for two way traffic.  
We don't like Detroits; Cummings are fine.  
Like the full locking feature, both between the two differentials and across the axles.  
Two-way radio install where the operator wants them.  
It would be nice if all wheels were interchangeable.  
All class 33's could just as well have the reversible plows.  
The '92 undercarriage and plow don't fit well together; doesn't pick up the plow correctly.  
Use stainless steel sanders that last longer with auger motor and auger are are one unit. This eliminated maintenance on sprockets and chains. Some counties are using these at the present time.  
Check with operator to see if they will use a Dickey-John ground oriented sander. If they don't like the automatic one; no use spending money on something they will override and not use.  
Mounting of fire extinguisher and first aid supplies mounted in a standardized location.  
More time for truck maintenance.  
Salt and sand usage should be more uniform where the districts intersect.  
Our highways intersect with the metro; it is very hard to compete with the straight salt applications.  
Update rear strobes to amber on older trucks.  
Have heated windshields.  
All controls should be the same on all 33 models (standard).  
Stop running 1/2 shifts - get enough trucks on the road to do the job.  
Better lighting.  
Better heating.  
Better visibility.  
Trucks need more power.  
Less confined cabs.  
Seats are too close.  
Trucks need better/brighter lights.  
Trade vehicles in before they are junk.  
Stay with updated equipment.  
Put more power in engines.  
Need headlights raised or in better position.  
Above 27°, use straight salt, save a trip or two.
To:  Snowplow Truck Ergonomics Task Force  
Results of Survey  
Date:  March 19, 1993  
Page:  10

Before we are sent out, give out clear instructions on which ramps/roads we are responsible for to avoid one person plowing someone else's sand off the road that was put on 10 minutes prior.

Radios work terrible  
Strobes aren't bright enough  
Driving lights not bright enough or high enough  
Not geared low enough  
Poor transmission  
Engine underpowered  
Do a better job on the wings  
Talk to operators about improvements  
Can't turn under body plow with wing in saddle or on ground, wing must be up  
Truck end of wing comes down very slow  
Loader operator on duty at all times  
More time - sufficient time to pre-trip & post-trip trucks  
New trucks are getting better all around  
Do not care for wide front tires - turning radius  
Trucks don't have enough power to plow, sand, etc all at one time  
New single axle trucks need an engine with lots more power  
All trucks should come with wings  
Front mounted wings on '89 tandems very very poor!  
Could use more reversible plows  
'89 tandem with reversible is slow to turn  
Reversible plows are too big and heavy  
Better shifts - uniform hours  
Foot feed angle bad in some  
Mechanic on duty  
Reversible plows put snow on windshield  
Go back to old type wing (with cables)  
Keep accessories within reach  
Need head rests  
Air seats are getting much better  
Get rid of old trucks - upgrade  
Heated mirrors  
Intermittent wipers  
Full fenders  
Mirror to see in box  
24 foot plow  
Need more instruction on How to Sand  
Get rid of post trip inspection  
Use 100% salt 90% of time  
'92 single axle shift lever sucks  
Disc players  

29
To: Snowplow Truck Ergonomics Task Force  
Results of Survey  
Date: March 19, 1993  
Page: 11

Snow plow flaps could be longer so snow doesn't come up and over on windshield so much
Better head lighting
Improve the way front plows are mounted you almost have to stand on your head to pug plow pins in. Also better way to hold pins in, besides cotter pins
They should ask the operators about the equipment before they buy it
Replace trucks sooner, 5 year buy back
Do not work operators longer than 14 hours, 20 hour days are B.S.
Trucks are being kept too long
Boxes are real weak after 15 years
Would help to plumb hydraulics to do more than one operation at a time
MINNESOTA DEPARTMENT OF TRANSPORTATION

EQUIPMENT SPECIFICATION

SPECIFICATION: 35.0-013

August 18, 1992

1. SCOPE

57,000 POUND G.V.W. DIESEL SNOWPLOWING DUMP TRUCK

This dump truck shall be a combination of the latest production models as currently advertised meeting the terms of this specification, new and complete in all details and ready for immediate operation. Furnish all standard equipment advertised, whether or not specifically called for here, except where over standard or conflicting equipment is specified.

3.3 CAB/TRIM/SEATS:

3.3.1 Cab, three man size conventional type constructed of (or a combination of) fiberglass, aluminum or galvanized (galvanized after all forming or welding) steel.

3.3.2 Cab, latest design, ventilated and with all windows of tinted safety glass.

3.3.6 Furnished with a left-hand door map pocket or glove compartment.

3.3.7 Furnished with a high back and dual arm rests, Bostrom air suspension seat, or National Cushion Air seat on both sides.

3.3.8 Must be sufficient space between seats for installation of eight (8) control levers mounted to floor in cab. Location to be approved by Mn/DOT (minimum of 16 inches).

3.3.10 Include dome light on a separate switch.

3.3.15 Seat trim, knitted vinyl, or heavy-duty cloth.

3.3.17 Dual low air pressure gauge and warning device (light and buzzer).

3.3.18 Low coolant lever/high temperature gauge and warning device (light and buzzer).

3.3.19 Gauge, low engine oil pressure and warning device (light and buzzer).

3.3.20 Fuel gauge setup to read both fuel tanks together or fuel gauge for each tank is acceptable.

3.3.24 Instrument panel, largest available from OEM.
Equipment Specification
August 18, 1992

3.3.25 Heater, highest output available from OEM.

3.3.28 Mirrors, outside, heated western, dual, retractable with auxiliary convex mirrors; all stainless steel including brackets with heated mirrors actuated by separate switch on dash.

3.3.29 Mirrors front fender mounted, dual (one on each side) convex, stainless steel mirrors and brackets, Retrac SS-983 Mirror Head with SS-3984 Fender Brackets or equal mounted per sample located at Mn/DOT Central Shop.

3.3.32 Windshield wipers, dual automatic full air wipers with Artic winter blades with operation designed to clean center of windshield.

3.3.33 Windshield washer, dual electric, frost resistant, nozzles mounted on wiper arms, largest available OEM reservoir mounted under the hood.

3.3.37 Factory installed air conditioning.

3.4 ELECTRICAL:

3.4.4 Manufacturer's standard turn signals and reflectors as required to meet SAE Class A standards, front turn signal lamps to be fender or hood mounted.

3.4.5 Simultaneous flashing warning lights.

3.12 HYDRAULIC SYSTEM:

3.12.7 Control levers to be mounted in the cab between the seats and connected to the valve bank via cables series 60 stainless core Mn/DOT approved. Cables to be minimum length required with no excessive slack in installation.

3.12.8 Eight valve bank, Greason Model V30 per drawing No. V30-344-A.

3.12.9 Sander lever to be assembled to the left.

3.12.10 Dumb box hoist lever second in line with other functions of plow lift, plow reversing, inner wing, and outer wing functions to follow and underbody levers positioned per Mn/DOT approval.

3.12.11 Sander lever shall be mounted so that a rear lever movement causes sander engagement.

3.12.12 All other levers shall be mounted so that forward movement causes downward movement of attachment.
MINNESOTA DEPARTMENT OF TRANSPORTATION

EQUIPMENT SPECIFICATION

SPECIFICATION: 33.08-008

August 24, 1992

1. SCOPE

36,500 POUND G.V.W. DIESEL SNOWPLOWING DUMP TRUCK

This dump truck shall be a combination of the latest production models as currently advertised, meeting the terms of this Specification, new and complete in all details. Furnish all standard equipment advertised, whether or not specifically called for here, except where optional over standard or conflicting equipment is specified. The unit must meet applicable safety standards.

3.3 CAB/TRIM/SEATS

3.3.1 Cab, three man size conventional type constructed of (or a combination of) fiberglass, aluminum or galvanized (galvanized after all forming or welding) steel.

3.3.3 Cab, latest design, ventilated and with all windows of tinted safety glass.

3.3.6 Furnished with a Left-hand door map pocket or glove compartment.

3.3.7 Furnished with a high back and dual arm rests Bostrom air suspension seat or National Cushion Air seat on both sides.

3.3.8 Must be sufficient space between seats for installation of a Gresen (drawing No. V-30-343-A) six section valve bank, mounted to rear of the cab per 1991 sample located at Mn/DOT Central Shop. (Minimum of 16 inches)

3.3.10 Include dome light on a separate switch.

3.3.12 Two single buckle shoulder harness safety seat belts, floor or frame anchored.

3.3.14 Left and right assist handles inside and outside.

3.3.15 Seat trim, knitted vinyl, or heavy-duty cloth.

3.3.17 Dual low air pressure gauge and warning device (light and buzzer).

3.3.18 Low coolant level/high temperature gauge and warning device (light and buzzer).
Equipment Specification
August 24, 1992

3.3.19 Gauge, low engine oil pressure and warning device (light and buzzer).

3.3.20 Transmission oil temperature gauge and warning device (light/buzzer)

3.3.26 Heater and factory air conditioning, highest output available from OEM. Oregon Equipment Manufacturing.

3.3.29 Mirrors, outside, heated western, dual, retractable with auxiliary convex mirrors; all stainless steel including brackets with heated mirrors actuated by separate switch on dash.

3.3.30 Mirror, front fender mounted, dual (one on each side), convex, stainless steel mirrors and brackets, Retrac SS-983 Mirror Head with SS-3984 Fender Brackets.

3.3.32 Windshield, one piece. Split or two piece windshield not acceptable.

3.3.34 Windshield washers, dual electric, frost resistant with nozzles mounted on wiper arms, largest available OEM reservoir mounted under the hood.

3.3.39 Floor to top of windshield shall be minimum of 51 inches.

3.3.40 Floor to top of cab lining shall be a minimum of 56 inches.

3.12 HYDRAULIC SYSTEM:

3.12.6 Valves shall be mounted in the cab between the seats of the rear bulk head with supporting brackets per 1992 truck installation located at Central shop.

3.12.7 Valve shall be assembled in a sectional bank, including levers. The valve bank shall be a six bank valve Gresen Model V-30, reversible six bank setup, (per drawing No. V30-343-A).

3.12.8 Sander valve section to be assembled to the left.

3.12.9 Dump box hoist valve section second in line with other functions of plow lift, plow reverse, inner wing and outer wing functions to follow.

3.12.10 Sander lever anchor to be mounted so that an upward lever movement causes sander engagement.

3.12.11 All other lever anchors to be mounted so that a downward lever movement causes a downward movement of attachment.
November 12, 1992

Mr. Tom F. Langston
Senior Engineer
Glass Division
Ford Motor Company
Atrium Office Center
835 Mason Suite 300
Dearborn, Michigan 48123

RE: Heated Windshields

Dear Tom:

I have been informed by one of our snowplow drivers that the heated windshields on our 1991 LT-9000 is a must. Without it the ice builds up on the sides for about ten inches. This is due to the windshield wipers not contacting the glass at this point. The driver has to stop the truck, get out and manually chip the ice off.

With the heated windshield he has no problems and he doesn’t have to use the windshield wipers hardly at all. Drivers also like the tint as it cuts down the glare of snow and oncoming headlights. He already misses it just with the little snow we did have, and welcomes someone to ride with him to prove his point.

I would like to see the windshields reinstalled to get a better evaluation. This year’s truck specification has a heated windshield as an option to show the industry we are interested.

I will be looking forward to hearing from you. I hope we can get these windshields reinstalled.

Sincerely,

Gene Valley
Shop Supervisor
Office of Maintenance, Central Shop
Minnesota Department of Transportation
6000 Minnehaha Avenue South
St. Paul, MN 55111
January 6, 1993

Mr. Paul Tummonds
Manager Special Order Design Department
Ford Heavy Truck Plant
P.O. Box 32340
Louisville, Kentucky 40232

RE: Heated Windshields

Dear Mr. Tummonds:

The Minnesota Department of Transportation is extremely disappointed in the decision by Ford not to continue efforts to test and install the Insta Clear Windshields in L Series trucks. For years we have been trying to solve the windshield fogging and icing problem. The five experimental windshields that we tried last year were a true revelation. We not only solved the fogging and icing problem we also increase nighttime safety with the copper colored tint these windshields have.

For us in the snow removal business safety is a major concern. We see these windshields as the most significant safety item for us since air brakes and power steering were invented. I would ask that you at least let us participate with you on a continuation of the five truck experiment started last year.

It is true that we had two of these windshields break during the initial test. Both were from road thrown objects and were not related to the Insta Clear Windshield or its mounting. We do lose windshields frequently from scratching due to sand and ice on the windshields. However our field people are convinced that we will actually save money by installing Insta Clear Windshields since the wipers need not be used as much or under the severe icing conditions we now have to operate in. If we can get these windshields to last three years we will have saved 6 windshields since we average 2 per year per truck due to sand and ice scratches. With the Insta Clear system we have no ice at all and with the new wet arm system we have no sand accumulation. We think this is cost effective even if the safety issue was not present.
I realize we are not in the truck marketing business and have no access to market analysis and potential sales data. I can tell you, however, that there is national interest in this feature and that Mn/DOT will be purchasing or specing this feature as soon as it is available. We currently have a bid out for 63 trucks that has this feature as an option. We would like to be able to order these trucks with the heated windshields but have been told by our dealers that the program is dead at Ford. Please reconsider your decision to not allow this option. This is a major safety issue with us.

Sincerely,

Greg Felt  
Equipment Engineer  
Office of Maintenance, Equipment Section  
Minnesota Department of Transportation  
Ft. Snelling Complex  
6000 Minnehaha Avenue South  
St. Paul, MN 55111-4014

cc: Dave Strege  
Gene Valley  
Ed Swanson  
John Thors
# L-8000, LT-9000 Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
<th>NEW TRUCKS</th>
<th>RETROFIT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Lighting</td>
<td>Halogen Headlights</td>
<td>TRUCK</td>
<td>STANDARD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$7.76 EA.</td>
</tr>
<tr>
<td>2. Noise</td>
<td>Insulated Door Panels</td>
<td>CUSTOM</td>
<td>STANDARD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$7.76 EA.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CUSTOM high level</td>
<td>$145.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CUSTOM high level</td>
<td>$155.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SAME AS IN TRUCK</td>
<td>SAME AS IN TRUCK</td>
</tr>
<tr>
<td>3. Shield</td>
<td>Headliner</td>
<td>CUSTOM</td>
<td>PACKAGE</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>PACKAGE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CUSTOM high level</td>
<td>PACKAGE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CUSTOM high level</td>
<td>PACKAGE</td>
</tr>
<tr>
<td>4. Mirrors</td>
<td>Elect Power RH Window</td>
<td></td>
<td>$171.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>FORD $244.30</td>
</tr>
<tr>
<td>5. Hyd Controls</td>
<td>Electric Over Hydraulic</td>
<td>MID-AMERICA PENGWYN</td>
<td>$7000.00 &amp; $8000.00</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NOT RECOMMENDED</td>
</tr>
<tr>
<td>6. Whelen Acc Switches</td>
<td>Lighted</td>
<td>1987 &amp; NEWER</td>
<td>STANDARD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>INSTALL SMALL PANEL LIGHT</td>
</tr>
<tr>
<td>7. Seats</td>
<td>Driver</td>
<td></td>
<td>$500.00</td>
</tr>
<tr>
<td></td>
<td>Passenger</td>
<td></td>
<td>$500.00</td>
</tr>
<tr>
<td>8. Steering</td>
<td>Tilt &amp; Telescopic</td>
<td></td>
<td>$316.40</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NOT RECOMMENDED</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>$25.90</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NOT RECOMMENDED</td>
</tr>
<tr>
<td>9. Auto Trans</td>
<td>1991 #33</td>
<td>FACTORY MOUNTED</td>
<td>SHIFT FLOOR MOUNTED</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>MAY BE RE-POSITIONED</td>
</tr>
<tr>
<td>10. Lights, Gauges &amp; Buzzers</td>
<td></td>
<td></td>
<td>STANDARD</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>NOT RECOMMENDED</td>
</tr>
</tbody>
</table>