Aerial Spraying for Forest Management

SILVICULTURE SECTION

JUNE 1991

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Silviculture Section
Ministry of Natural Resources
P.O. Box 1000
Sault Ste. Marie, Ontario
P6A 5N5

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FOREWORD

This manual, made up of parts specifically for Project Supervisors, Application Bosses, Safety Officers, Navigators and Weather Officers, has been compiled as a reference source and a key planning document which is to be used In Ministry aerial spraying programs. It does not include all the information required to plan and conduct all aerial spraying projects.

Project Supervisors are to be fully conversant with the material in Part 1, The Project Supervisor's Guide. Project Supervisors also must be familiar with all of this manual, as they are responsible for the spray project.

Application Bosses must fully understand the material in Part 2, The Application Boss's Guide; and other sections of the manual dealing with the handling of pesticides and fuels (including propane), hazards of working around aircraft, transportation of dangerous goods, spray weather parameters, and weather equipment. Application Bosses must also have a general understanding of the responsibilities of other project personnel.

Safety Officers must be fully conversant with the material in Part 3, Occupational Health and Safety. Safety Officers must be very familiar with the duties and responsibilities of the other officers listed in this manual for it is the Safety Officers' responsibility to ensure that the on site portion of the spraying project be conducted safely.

Navigators are to fully understand Part 4, The Navigator's Guide; Part 5, The Weather Officer's Guide; and the sections of the Project Supervisor's Guide and appendices that discuss spray block design. Navigators should also be familiar with the duties and responsibilities of the other spray project officers.

Weather Officers must fully understand Part 5, The Weather Officer's Guide. They should also have a passing knowledge of the duties and responsibilities of the other officers listed in this manual.

This manual will be updated by the Silviculture Section as new material, revised policies and directives become available. Between updates you are expected to keep abreast of developments pertinent to your area of responsibility as directed by the Silviculture Section; Aviation, Flood and Fire Management; Regional Safety Officers; the Ministry of the Environment; etc.

ACKNOWLEDGEMENTS

This manual was produced from material contained in:

Aerial Spraying for Forest Management - an Operational Manual 1981;

Aerial Spraying - Project Supervisor's Guide 1987;

Application Boss Manual 1987;

"Pointing" (Aerial Navigation) to Control Forest Spraying Operations - A Guide 1986;

Provincial Spray Project Safety Manual 1987;

Ontario Ministry of Natural Resources, Aerial Spraying for Forest Management - Weather Interpretation Guide 1987.

The following people contributed to these publications: Brian Anderson, Vic Bursey, Bob Campbell, Bob, Dennis, Ambrose Etrnanskie, John Gillham, Chris Hope, Cohn Ingram, Ed lskra, Mark Johnson, Ross Johnston, Brian Moulder, Steve Nicholson, Peter Schaeffer, Sandy Schyff, Kerry Sinibaldi, Steve Wilkins and numerous others.

This manual went through many stages in production. First, repetitious material was removed and a uniform format was set by W.P.L. Osborn, Forest Health and Protection Section. The manual then went through two reviews by a technical committee consisting of C.A. Howard, Forest Health and Protection Section; E. lskra, Dryden District; R. Johnston, Thunder Bay District; W. Knight, Carleton Place District; D. Kott, Kapuskasing District; L. Pilkey, Fort Frances District; and P. Schaeffer, Kenora District. This committee updated information, removed unnecessary material and re-organized the information. Next, sections of the manual went to specialists for review. The manual then went out to the Regions for field review. An index was created by W.P.L Osborn and S.A. Walsh, Forest Health and Protection Section. The manual was then sent to Communications Section as preparation for printing.

Please note that due to the 1991 reorganization of the Ministry of Natural Resources, Forest Health and Protection Section ceases to exist in September 1991. Administration of aerial spraying programs will be transferred to the Silviculture Section.

Silviculture Section would like to thank the Regional and District personnel who field reviewed this manual. Silviculture Section also would like to thank M. Treitz and V. Bursey of Aviation, Flood and Fire Management, J. Weeks and D. Doran of Occupational Health and Safety Section, and A.A. Etmanskie of Eastern Region for supplying information and reviewing sections of this manual.

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AERIAL SPRAYING FOR FOREST MANAGEMENT
PART 1: PROJECT SUPERVISOR'S GUIDE

A. INTRODUCTION

Aerial spraying is an essential technique for the control of insects and unwanted vegetation in Ontario's forests. In most cases, it is the only practical technique for applying pesticides. Yet there is growing concern about aerial spraying in forestry. If this technique is to be retained and developed for forest management, It is essential that all projects be conducted with a high degree of operational control. The objective should be to maximize effectiveness and minimize adverse effects.

Once the decision to spray has been made, this manual must be used to plan and ensure good operational control of the project. It is not intended that this manual will be used in total for every aerial spraying program; supervisors should utilize the contents to the degree justified by the size and nature of the project.

The references for some of the material in this manual are from Policies **FR.04.O1.O1 – Licensing Requirements for Pesticide Use, FR.04.1O.O1 - Aerial Application of Insecticides for Forest Management, and FR.04.20.01 - Aerial Application of Herbicides for Forest Management, and Procedures FR.04.01.10 - Licensing Requirements for Pesticide Use, FR.04.1O.1O – Aerial Application of Insecticides for Forest Management, and FR.04.20.1O - Aerial Application of Herbicides for Forest Management.**

Any questions concerning this manual or proper aerial application procedures should be directed to the Manager, Silviculture Section, Box 1000, Sault Ste. Marie, Ontario, P6A 5N5.

B. PRE-OPERATION PLANNING

B.1 Vegetation Control

Currently, aerial spraying is used primarily for chemical site preparation and conifer release in Ontario. Decisions involving the use of herbicides for vegetation control are made by District Staff in consultation with the Silviculture Section.

B.2 Insect Control

At present MNR establishes a Work Committee for each major insect problem. This Committee, with representation from each District and Region with the problem, Silviculture Section and Great Lakes Forestry Centre, operates on an annual basis and decides on action to be taken. This action should be defined by mid-January, so that services, material and supplies can be purchased.

B.2.1 The Insect Work Committee

- Considers the extent of insect infestation, identifies high priority areas and decides on areas to be sprayed.
- Decides on insecticides, rate and volume.
- Prepares operational plan, including all information for technical data sheet (see Appendix 1, p 151).
- Decides areas to be treated with each insecticide so material may be purchased and invitation to tender may be issued to aerial applicators.
- Determines staff and equipment needed for project (pp 11-14 and 15-16, and Appendix 2, p 167).

B. 3 Project Supervisor

B. 3.1 Project Supervisor's Reporting Relationships

DEPUTY MINISTER
ASSISTANT DEPUTY MINISTER
REGIONAL DIRECTOR
REGIONAL COORDINATOR
DISTRICT MANAGER
PROJECT SUPERVISOR

The above shows the flow of decision making power from the Deputy Minister to the Project Supervisor, who implements the spray program. The chain of command is probably familiar but it is significant in the people (offices) that are missing. Consider the following who have roles In aerial spraying projects.

Information Officers
Regional Foresters
Regional Safety Specialists
Forest Management Supervisors
Regional Engineers
Regional Pilots

These people are advisors; they are outside of the chain of command. For them to influence your program they must: discuss the matter with a higher authority in the chain of command, and if accepted, you will receive orders or; influence the Project Supervisor directly, thus requiring a decision on your part to accept or reject the Idea. A Project Supervisor has total authority over the spray project, and should be clear on what is “an order” and what is advice. Advisors such as Regional Pilots, or any employee (under the right to refuse to work), may take unilateral action if health and safety are endangered. Also your District Manager may TM circuit” the line of authority and ask you to take orders from someone other than himself/herself.

Remember, Project Supervisors:

1. Have total authority over the project.
2. Receive orders from the District Manager.
3. Are to safely and efficiently complete the program following the Project Description using experience, skill and good judgment.

B. 3.2 Project Supervisor's Role

A Project Supervisor is appointed by the District Manager for each aerial spraying project. The Supervisor has total authority over the program in his/her district. The Supervisor's duties and responsibilities are to:

1. Prepare a Project Description (see Appendix 1, p 151 for an example) following the calendar of events listed in Appendix 3, p 171. The following ten topics should be addressed:

   a) Objective of spraying.
   b) Forest description - tree species, age class, etc.
   c) Values to be protected.
   d) Pesticide to be used - name and formulation.
   e) Rate and method of application.
   f) Type of aircraft and spraying capability required.
   g) Name of Project Supervisor.
   h) Timing of application.
   i) Location of Project; prepare:
      a) **Small scale map** (ca 1:500,000)
      Shows locations of spray blocks and airstrips within the district.

b) **Medium scale map** (ca 1:50,000 or 1:100,000)
Shows spray block boundaries in relation to local physiographic features. Mark location of airstrip and points of public access into spray area. In larger spraying programs pilots may use this map directly.

c) **Large scale map** (Ca 1:15,000)
Shows boundaries of spray blocks and various spray treatments, if more than one is planned. This map will be used to record progress of the program. Calculate the area of each block and record on map.

To prepare these maps consult with District Biologists, Parks staff and local government to identify all values which need to be protected from spray application and/or drift (see Bulletin PS.04.03.32 below). Consideration should be given to agricultural fields, beekeepers, areas of unique ecological value, inhabited areas, large water bodies, organic gardeners, recreation areas, water supplies, etc. Use the Ontario Ministry of the Environment Buffer Zones Guidelines for Aerial Application of Pesticides in Crown Forests of Ontario to determine buffer zones and mark the buffer zones on the project maps (1:15,000, 1:50,000).

NON-TARGET AREAS. Areas that do not need treatment (e.g. wrong stand type, clearings, bogs, etc.) should be delineated and marked NON-Target or “N/T’.

For large scale projects, divide the area into blocks so the progress of the spray program can be accurately recorded, e.g. treatment and date. The blocks should be about 200 ha or the area covered by one lift of aircraft spray. Use physiographic features to define blocks where possible. Number blocks sequentially, or use a grid system (letter and numbers) to facilitate identification. Lay out blocks so that longest flight lines are used and ensure that flight lines are not oriented east-west, so that pilots will not have the sun in their eyes. See Section B.5.3 (p 12), Spray Block Design in The Navigator’s Guide (pp 140-141) and Appendix 5 (p 175).

See Appendix 1 (p 151) for an example of map and photo preparation.

j) The methods for notifying the public.

a) The project description for herbicide projects is submitted as part of the Annual Work Schedule (AWS) and is subject to the internal MNR review and approval process of the AWS. The schedule for these projects for MNR and FMA proposals on Crown land requires that the submission deadline for project description to the MNR District Manager by November 30th.

The approval of the project description is made by March 15th. The approved project description is included in the AWS. A public notice of the AWS approval and its availability for public inspection is issued by March 31St.

b) For insecticide projects the Planning and Environmental Assessment Branch, Environmental Assessment Section’s Bulletin PS.04.03.32, Direct Public Notices to Government Ministries/Agencies - Timber Management Planning must be followed. This Bulletin states:

> “Any public notices which are issued during...or the annual planning of protection operations, must be specifically provided to each of the following agencies:

i) Local School Boards (Ministry of Education),
ii) Local Medical Officers of Health (Ministry of Health),
iii) Each municipality and planning board,
iv) Regional Manager of Engineering and Right-of-Way, Regional Office, Ministry of Transportation,
v) Director, Design and Development Division - Transmission, Main Office, Ontario Hydro, and

This specific direction should be considered as additional to the more general direction outlined in the Class EA, which requires that direct public notices should be provided to local and regional offices of relevant government ministries or agencies.” That general direction still applies to ensure that other ministries/agencies such as the Ministry of Tourism and Recreation, the Ministry of Culture and Communications, and the Ministry of Northern Development and Mines are also provided direct public notice.”

2. Obtain 1:15,000 original aerial photos of the area to be used by pilots to fly the area**. Photocopies are not acceptable.** Have extra sets on hand in case some photos are lost, If recent F.R.I. photos are not available, supplementary air photography (SAP) must be arranged. For herbicide spraying projects photos must have been taken within the last two years, or more recent if cutting has taken place. For insect spraying projects, older photos may be adequate if no cutting has taken place. See Procedures FR.04.10.10 and FR.04.20.10.

3. Prepare Operations, Safety, Communications and Security Plans.

4. Submit an TM to Perform an Extermination from an Airborne Machine” to the Ministry of the Environment at least **60 days prior** to the anticipated start of the project (form available from the nearest MOE office; see Appendix 7, p 183 for an example). MOE requires that a copy of the project description, and a set of aerial photos (1:15,840) and a map (1:15,000 or 1:50,000) complete with detailed information such as spray blocks and buffer zones around areas of concern, accompany this permit. Apply for permission to treat the maximum area under consideration. You can always reduce the area to be treated later but you cannot necessarily get MOE approval to **expand or substitute** the area later. Send a copy of this form to the MOE EA Branch.

5. Plan the Accommodations, Air Operation, Mixing/loading, and Staffing.

    a) Arrange for navigation/observer aircraft where warranted.
    b) Determine location of nearest airstrips. Secure permission to use the airstrip. Where possible, use an airstrip close to spray block to minimize ferry time (e.g. forest access road). In management units where aerial spraying is anticipated on a regular basis, an airstrip may be constructed. This can be done most economically at time of road construction. Specifications are provided in Appendix 6 (p 177). Contact Aviation, Flood and Fire Management (AFFM) to schedule an airstrip inspection.
    c) Ensure that airstrip is graded and packed. The contractor and pilots must approve the airstrip at least 2 weeks before the project starts. The airstrip **must be acceptable to the pilot** - he has the final say on the airstrip he uses.
    d) Determine **mixing/loading** site. It should be accessible to aircraft, MNR vehicles, adequate for heavily laden vehicles (e.g. water tankers), and should be inaccessible to the general public (see Section B.4.3, p 8). Locate the site so that pesticide spills will not drain into a water body.
    e) Contact regional MOE office to give MOE an opportunity to inspect the mixing site. Also request location of disposal site for drums, rinsings, etc. before the operation starts. See pages 54-56 in the Part 3: Occupational Health and Safety, of this manual, for MOE guidelines on pesticide storage, transport and disposal. See page 18 for disposal of rinsings.
    f) Ensure that staff member who is supervising pesticide mixing holds a valid **MOE applicator's licence** of the appropriate class. An alternate licensee should be available in case of illness.

6. Be on site during operations.

7. Run the Hazard Identification Model (see pp 117-124) for various jobs, under the following conditions:

    a) A new job has been created;
    b) The Project Supervisor is new;
    c) If, in the Project Supervisor's judgement, the Job Is highly complex or has a high degree of risk associated with it.

NOTE: On projects in which the organization is sufficiently large or complex to have a Safety Officer, duty numbers 8-14 below will be delegated to the Project Safety Officer.

8. Obtain a copy of Pesticides Safety Handbook" from the regional MOE office, and read it.

9. Send an advisement to MOL identifying work location.

10. Inspect camp, mixing site, chemical storage site (see pp 105-1 09) to identify safety and fire hazards and make recommendations to the Project Supervisor.

11. Set the location of no smoking areas.

12. Maintain a list of all emergency numbers.

13. Watch for, and report to the Project Supervisor, fatigue among the project staff.

14. Organize the set-up of a mobile first aid station and procedures. Ensure that required forms are completed promptly and accurately (see pp 62-64, 76-80).

15. Decide when to start and stop daily spraying, in consultation with pilots, Navigators, and Weather Officer.

16. Decide when to begin and terminate the spraying operation, In consultation with the Silviculture Section and the Forest Insect and Disease Survey (FIDS) staff.

17. Communicate with:

    a) Internal MNR (Communication Services Branch, Regional and District Staff);
    b) Project staff;
    c) Families of employees;
    d) Pilots;
    e) MOE;
    f) District Managers of other districts (especially when spraying across district boundaries):
    g) Scientists (MNR and federal).

NOTE: The District Manager appoints one staff member as the sole spokesperson (usually the Project Supervisor) to respond to media or public inquires about the spray program. See Procedures FR.04.1O.1O and FR.04.20.1O.

18. Conduct daily operations briefings and debriefings.

19. Manage staff, which requires:

    a) Familiarity with staff capabilities;
    b) Familiarity with union matters;
    c) Setting priorities for staff;
    d) Tact and skill in dealing with people;
    e) Training of staff, including health and safety training such as WHMIS (see pp 114-116).

20. Explain project to all staff with attention to:

    a) Objectives;
    b) Schedule;
    c) Daily routine;
    d) Hazards in the workplace;
    e) Contingency plans in case of accident (see pp 56-80);
    f) Individual staff duties, with additional training where necessary. Review organization chart with staff (see p 15 for an example of an organization chart);
    g) Communication. Generally, staff should be discouraged from discussing any aspect of the project outside of the workplace. Such discussions frequently lead to misinformation being passed on to the public.

21. Maintain records on:

    a) Hours for staff, aircraft, contractors;
    b) Area sprayed, rate sprayed;
    c) Pesticide - delivery, usage, maintenance;
    d) Radio, logs, manifest;
    e) Detailed daily diary;
    f) Daily progress reports;
    g) Equipment movement;
    h) Personnel exposure records.

22. Be familiar with responsibilities under:

    a) Pesticides Act (pp 82-83);
    b) Transportation of Dangerous Goods Act (pp 85, 97-98);
    c) Occupational Health and Safety Act (pp 82, 87-93);
    d) WHMIS (pp 114-116);
    e) Construction Lien Act (p 86);
    f) Collective Agreement with OPSEU (p 86).

23. Upon completion of the project:

    a) Clean-up site and equipment;
    b) Authorize payments;
    c) Complete project reports including those in the Silvicultural Information System (SIS);
    d) Complete all administrative requisites;
    e) Deal with all other requests for specific information.

B.4 Project Planning

The District Manager and Project Supervisor are responsible for the preparation of the following project plans by **April 1st** for insecticide spray projects and April 15th for herbicide spray projects. These plans must be included with the final Project Plan for regional review. See Appendix 3 (p 171) for the planning schedules for aerial application of insecticides and herbicides. Refer to Procedures FR.04.10.10 and FR.04.20.10 for details.

B.4.1 Operations Plan

The objective of this Plan is to describe the project organizational roles and responsibilities to ensure good operational control of the project. This will be done by following the information contained in this manual. It is imperative that all staff involved in the project be conversant with the plan and fully aware of their specific roles and responsibilities.

B.4.2 Communications Plan

The objective of the Project Communications Plan Is to detail the manner in which information concerning the project will be provided to Ministry/resource industry employees, interest groups, the public and/or the media (see Calendar of Events and Information Services checklists, Appendices 3 and 4, pp 171 -174), and to ensure the security of the total project. It is designed to prevent the accidental spraying or injury of members of the public, personal risk to project staff, delays and disruptions of the operation, and damage to or loss of equipment and materials.

A letter advising of planned operations may be sent to individuals within one kilometre of proposed spray blocks, including tourist operators, forest operators, hunt camps, recreation camps, cottagers, trappers, etc. All MNR staff, resource industry employees, silvicultural contractors, etc. expected to be working in or adjacent to any of the treatment areas must be identified and informed of the planned program. Emergency communication procedures are to be outlined and in place as well.

Immediately prior to the start of the spray program, the Project Supervisor or his designate will review the Project Communications Plan to ensure that all agencies working in or adjacent to the treatment areas have been notified.

B.4.2.1 Regional Information Officer

The Regional Information Officer:

1 Prepares the Communications Plan for the Region's program.
2 Liaises with the Project Supervisor and Project Information Officer, Regional Coordinator, and Communications Services Branch.
3 Provides functional guidance to Project Information Officer.

B.4.2.2 Public Information

The District Manager appoints an official spokesperson (usually the Project Supervisor unless it is felt that the spokesperson role would prevent him/her from carrying out his/her Supervisor role) to handle media and public, inquiries and ensures that the public is informed of the spray program by:

1. A Notice of Aerial Spraying. This paid public notice should appear, in weekly local newspapers serving the area concerned, once at least 30 days prior to aerial spraying and a second time at least 7 days prior to spraying. The wording of this notice is:

> "As part of the Ministry of Natural Resources' ongoing program to regenerate and protect our forests, selected forest stands in this area will be sprayed with (insecticide(s) or herbicide(s) and P.C.P. number(s) of pesticide(s) used) to control (name of insect or competing vegetation), starting on or about (date).
>
> Further details about the program, including specific 'locations and maps, are available from your Area/District Office of the Ministry of Natural Resources.
>
> Address
> Phone Number"

In addition to the formal advertisement, paid (to ensure delivery) media notices should be prepared. These notices should be carefully worded so there is no duplication or conflicting messages. The notices should include the following:

a) Location of areas to be sprayed and the planned time they are to be sprayed;
b) Location of affected access routes, the extent to which they should be affected by closures, with reference to when, how and alternative routes;
c) Canoe and hiking routes are to included;
d) Methods of pre- and post-spray posting, i.e., barricades, staff assigned;
e) Daily progress reports and notices of where aircraft are working, what access routes are closed and any other restrictions to be imposed.

2. Direct contact by mail of spray area users and to all persons residing within 1 km of a proposed spray block.
3. Local commercial airstrips should be notified of daily flight plans where air traffic safety could be affected.
4. Spray Blocks posted not more than 7 days prior to spraying.
5. Ensure that spray signs are dated after the spray.
6. Spray signs remain in place for at least 30 days but they must be removed by November 1St.
7. Specific arrangements should be made for “guided” tours in the event of requests by the media.

Pass on regional scale enquiries to the Regional Information Officer.

<u>B.4.2.3 Internal Information</u>

On-site information person is identified for each project who:

1. Reports daily to District Manager or designate;
2. Handles public inquiries at site;
3. Is aware of communications strategies in crisis situations;
4. Liaises with other airstrips, District and Regional Information Officers to assist in identifying and dealing with issues;
5. Maintains an internal information network at the airstrip;
6. Implements Regional Communications Plan;
7. Develops specific Project Communications Plan (where appropriate) to deal with specific internal and external needs.

The District Manager is to keep Regional Director and Regional Information Officer informed of daily events (when appropriate).

<u>B.4.2.4 Incident Procedures</u>

In a crisis such as plane crash, spill, person sprayed, etc. see pages 56-80. In the event of an accident involving aircraft, follow Procedure AF.01 .31.02.

B.4.3 Security Plan

The objective of this plan Is to ensure the security of the total project. It Is designed to prevent the accidental spraying or injury of members of the public, personal risk to project staff, and delays and disruptions of the operation.

Security on a spray project is carried out by:

1. Securing of the spray blocks to prevent accidental spraying of people, or other accidental injuries to the public.

    a) The public will be apprised of the project as outlined in Section B.4.2, pp 7-8.
    b) The public will be apprised of the project through the posting of signs on the spray blocks, located at all “usual access points” as per Procedures FR.04.10.10 and FR.04.20.10. Standard signs are supplied by Silviculture Section and are to be used when posting areas before and after spraying. The signs must indicate what the area will be, or was, sprayed with and the date it is to be, or was, sprayed on.

Where access is available from adjoining districts, arrangements must be made to apprise the public of spraying operations, post signs in those areas, and to control that access during spraying. Inaccessible areas will be posted at the closest access.

c) During spraying operation, spray blocks will be closed to public access by the use of manned barricades. If Provincial highways require closure for short periods for safety reasons, Ministry personnel may do so under the Highway Traffic Act. The O.P.P. must be notified of such closures. If the highways must be closed for long periods O.P.P. assistance Is required. The respective detachment commander(s) should be contacted well in advance to ensure cooperation.

   It is suggested that Conservation Officers or D.C.O.'s in uniform using enforcement vehicles be used to control access on major routes other than Provincial highways. A cheaper alternative is have the personnel manning the road blocks wear official coveralls with crests and the government logo embossed on it.

d) Heavily used canoe routes should be posted and closed at access areas to prevent users from being in the area during spraying.

e) Efforts will be made to detect and avoid spraying persons who are in the area by undertaking aerial reconnaissance before spraying.

f) In the event of persons being sprayed:

   i) They will be provided with a toxicological fact sheet for the pesticide sprayed;
   ii) U) They will be provided with the opportunity to shower and to have tents or clothes laundered;
   iii) They will be advised that, if they have any concern, OMNR will transport them to medical authorities for examination/consultation;
   iv) They will be advised that any food, drink and/or smoking material that may have been contaminated by the pesticide should not be used;
   v) Follow the communication procedures detailed on page 74.

2. The Operations Base and Airstrip(s) will be secured by prohibiting public access.

   a) Signage will notify the closure.
   b) Manned barricades will enforce the closure.

      i) Airstrips are closed under the Public Lands Act and the Highway Traffic Act;
      ii) Consideration should be given to a check-in/check-out system where temporary closure of public access is provided (using the roadway for landing);
      iii) In the event of difficulties (civil disobedience), O.P.P. should be consulted/utilized.

   c) 24-hour security must be provided at MNR operated operations bases (chemicals, materials, equipment).
   d) Pesticide storage and security are governed by Guidelines for the Storage, Disposal and Transportation of Pesticides specifically the section titled "Airfield Storage", see pages 54-56.

3. Immediately following the operation, all barricades, equipment and signs notifying of closures will be removed. Persons referred to in Section 8.4.2 (pp 7-8) will be notified so that they may resume normal operations in the spray blocks.

B.4.4 Safety Plan

The objective of this plan is to ensure that:

1. The operations base is safe in respect to:

    a) Living conditions;
    b) Fire hazard(s);
    c) General working conditions. See pages 49-124.

2. The mixing, loading and fuelling activities are safe.

3. The aircraft operations are safe (see pp 103-105) in respect to:

    a) Airspace control (including NOTAMs where appropriate);
    b) Communications.

4. Contaminated materials are disposed of as per MOE regulations (see pp 32, 54-56). Contaminated waste gasoline, pesticides, etc. may fall under Regulation 309 of the Environmental Protection Act (see p 86 for a short discussion of this regulation).

The above can be most easily monitored by carrying out daily inspections (see pp 105-109 for examples).

The Project Supervisor has the overall responsibility for safety. **NOTE: On projects in which the organization is sufficiently large or complex to have a Safety Officer, duty numbers 1-7 below will be delegated to the Project Safety Officer.** The Project Supervisor (or Safety Officer) will ensure that:

1. Designated project staff are informed and trained, as appropriate, in respect to:

    a) First aid;
    b) Emergency response (spills, injuries, fires motor vehicle accidents, and aircraft accidents and incidents see pp 56-80);
    c) Air Operations Manual, AFFM, MNR;
    d) Health and Welfare Pesticide Handling - a safety handbook;
    e) WHMIS training of project staff (see pp 114-116).

2. Designated safety equipment (see p 110), wash-up facilities, absorbent material (see pp 54-56 and 64-65), fire extinguishers (see pp 110-113), and first aid kits (see pp 62-63) will be provided on site, along with appropriate manuals, for example:

    - Personal Protective Equipment for Pesticide Users (MOE)
    - Toxicological Fact Sheets (for an explanation of terminology see pp 49-54)
    - Material Safety Data Sheets (for a guide to MSDS see pp 114-116)

3. A component of the plan will be prepared for coping with medical emergencies, including:

    a) Advance notification of medical/health officials of the pesticide(s) to be used;
    b) Immediate medical response as per toxicological fact sheet procedures;
    c) transport to medical aid;
    d) Advisement (who and when) of an incident (See pp 62-64, 70, 74, 75).

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[1] Notices to Airman are to be arranged in consultation with and through AFFM.

4. A component of the plan will be prepared for coping with non-medical emergencies (spill or dump; see pp 58-62, 64-69, 71-75) including:

    a) Containment procedures;
    b) Clean-up procedures;
    c) A supply of clean water (minimum 200 L) and soap must be located at the mixing site in the event of accidental chemical spill;
    d) Advisement of MOE, MOL and others as required.

5. Personal Protective Equipment shall be used as per the Occupational Health and Safety Act. See page 110 for a guide to Personal Protective Equipment.

6. Emergency survival kits for the navigation aircraft (see Appendix 4, p 174).

7. Signs: Chemical Storage (see pp 54-55), No Smoking, No Parking, Flammable Liquids, Caution (e.g. hearing protection required), First Aid Station, First Aid Supplies, Fire Extinguishers Here and, if required, placards under Transportation Dangerous Goods Act (see pp 97-98) and traffic control signs.

8. Procedures will be identified for gathering and/or providing access to flying weather information (see pp 147-1 50 and Appendix 8, p 195).

Hazards can be identified and their controls determined in a systematic manner using the Hazard Identification Model developed by the Occupational Health and Safety Section of the OMNR. The Project Supervisor must run through the Hazard Identification Model when:

1. A new job has been created;
2. The Project Supervisor is new;
3. In the Project Supervisor's judgement, the job is highly complex or has a high degree of risk associated with it.

See pages 117-124 for an explanation of the Hazard Identification Model and for an example of the running of the Model.

B.5 Staff Requirements and Duties

For smaller projects, the Project Supervisor may readily take charge of spray control, spray records and communication. However, ft is inadvisable for the mixing/loading foreman to have any additional duties; ensuring that pesticides are properly handled, mixed and loaded is sufficient responsibility. Likewise a weather monitor should always be as near the spray block as possible to report on weather, observe the application, verify the location of spraying, and take action in case of emergency.

B.5.1 Application Boss

1. In charge of mixing/loading and general operation of air base. See Part 2, The Application Boss's Guide, page 19.

2. Responsible for:

    a) Mixing of pesticides;
    b) Instructing assistants in safe handling of pesticides;
    c) Equipment operation and maintenance;
    d) Equipment and supplies at mixing site;
    e) Safe storage and handling of supplies;
    f) Security at airstrip and mixing site;
    g) Calibration of spray aircraft;
    h) Weather sampling at airstrip;

- i) Daily mapping of areas and hectares sprayed;
- j) Maintain diary for staff involved;
- k) Daily record keeping;
- l) Training staff in the use of equipment and safety;
- m) Clean up of the mixing/loading site after the program;
- n) Ensure that project equipment is cleaned, maintained and stored in p for the next project.

3. Must have attended the Grower Pesticide Safety Course or must have Land Classes 1 and 3 Exterminator's Licence.

B.5.2 Safety Officer

1. Whether a Safety Officer will be required on an aerial spray project will be determined by the District Manager, in consultation with the Project Supervisor and the Regional Safety Officer. A Safety Officer is required on a project that is too large or complex for the Project Supervisor to be confident that she/he can competently oversee health and safety concerns over and above supervising the project.

2. This is a staff position reporting to the Project Supervisor. The Safety Officer is located on site.

3. Responsible for:

   - a) Locating no smoking areas;
   - b) Aircraft safety procedures;
   - c) Safety instruction to staff (WHMIS);
   - d) Operating mobile first aid station and for first aid procedures;
   - e) Advisement being sent to MOL identifying work location;
   - f) Inspection of camp, mixing site, chemical storage site, etc. to identify safety and fire hazards;
   - g) Prompt completion of forms;
   - h) Ensuring air operations are safe;
   - i) Having pesticide safety handbook, Ontario Health and Safety Act and Regulations handbook, and personal protective equipment for pesticide users;
   - j) Having a list of all emergency numbers;
   - k) Maintaining a daily diary;
   - l) Warehouse duties - maintaining inventory;
   - m) Watching for fatigue among the program staff;

B.5.3 Chief Navigator

1. In charge of assigning aircraft to ensure that various treatments are directed to the appropriate locations.
2. Must hold a valid Restricted Radio Operator's Licence and have attended a Navigator's Training Course.
3. Responsible for:

   - a) Assigning spray aircraft to correct blocks;
   - b) Recording all data on Aerial Spraying Records (see Appendix 7, p 183);
   - c) Ensuring that pilots and navigators are supplied with aerial photos and maps showing spray block boundaries;
   - d) Maintaining maps showing area treated during each spray period; calculating area of each block so that pilots know the volume to be applied; cross-checking volumes delivered against hectares treated;
   - e) Ensuring adequate fuel supply for contract aircraft;
   - f) Familiarize navigation aircraft pilots and navigators with spray blocks and plans.

On small projects the Project Supervisor takes on the duties and responsibilities of the Chief Navigator.

B.5.4 Navigator

1. Directs pesticide application by spray aircraft to ensure that they are treating the correct area, leaving non-target areas untreated, etc. See Part 4, The Navigator's Guide, pages 125-146. Under the Pesticides Act the pilot normally is responsible for properly applying the pesticide. In cases when the MNR is informing the pilot, via a navigator, where to "boom on" and "boom off", the MNR may be held responsible if an incident occurs involving improper application of pesticides.

2 Must hold a valid Restricted Radio Operator's Licence and have attended a Navigator's Training Course.

3. Responsible for:

a) Familiarity with areas to be sprayed; have available required plans, maps and photos for navigation and instruction;
b) Reviewing with pilots the flight paths to be used between airstrip and spray blocks;
c) Having spray pilots make reconnaissance flight over spray blocks before spraying starts (done with the guidance aircraft and navigator);
d) Communicating by radio with spray pilots to advise them of flight path, when to turn on and shut off booms, etc.;
e) Advising ground staff on wind conditions at spray block;
f) Height, speed, formation of aircraft while spraying; general performance of spray aircraft;
g) Recording hours of aircraft use for invoicing purposes;
h) Monitoring of spray aircraft to detect leakage, improper functioning spray equipment.

B.5.5 Weather Officer

1. Located at or close to spray block before start of spraying and during spraying.
2. Responsible for:

a) Training observing staff for the weather network;
b) Determining the number of weather stations necessary for the project and their installation (see Section B.7.2, p 16);
c) Providing one formal weather briefing each day followed by continual monitoring of weather behaviour within the project area (see Part 5, The Weather Officer's Guide, pages 147-150, for weather parameters);
d) Maintaining weather record during spraying (see Appendix 7, p 183);

B.5.6 Air Traffic Advisor

1. Located at airstrip.
2. Responsible for:

a) Set up and inspection of radios;
b) Checking radios prior to lift off;
c) Maintain daily log of all transmissions;
d) Maintain list of emergency numbers;
e) Having a thorough knowledge of emergency procedures regarding aircraft (pp 58-61, 67-69, 71);
f) Assist Project Supervisor in record keeping duties (Appendix 7, p 183).

3. Must have a valid Restricted Radio Operator's Licence.

B.5.7 District Office

Although the District Office is not part of an aerial spraying project, it does provide back up support for the operation of the spray program.

1. Maintains a summary of up to date activities on the spray program.
2. Acts as the first line of communication for outside agencies interested in the spray program.
3. General record keeping:

    a) All individuals in program and equipment/vehicle status;
    b) Accomplishments to date including whether spray is in progress.

4. Recording all contracts and transmitting appropriate messages to and from spray camp (Project Supervisor).

B.6 Spray Operation Organization Design

The objective of this section is to provide you with some guidelines in designing an organization to meet your requirements for effective, efficient, project operations. This is only a guide. Project Supervisors must develop the art of adjusting the level to meet increasing or decreasing workloads, to best suit the staff operating within that organizational structure.

Organizations vary in size, and complexity, but follow two basic principles in design.

1. Chain of command - Who reports to whom?
2. Span of control - The number of subordinates that can be effectively supervised.

The size of an organization reflects the number of tasks to be addressed, and the workload of each task. For example, all organizations require some degree of support or service, however the amount will vary with each situation, depending on factors such as type of camps, camp location, amount of transport required, and equipment.

B.6.1 Organization Design

Project Supervisors will design their organization to address all of the functions, while maintaining an effective span of control, and chain of command. This is accomplished by levels of supervision placed in the organization.

B.6.1.1 Level One

The Project Supervisor directly supervises all aspects of the organization. This is effective in operations where less than 20 staff are operating. When workload makes additional staff necessary, the span of control can become difficult for the Project Supervisor. To alleviate this situation, an additional level of supervision is added.

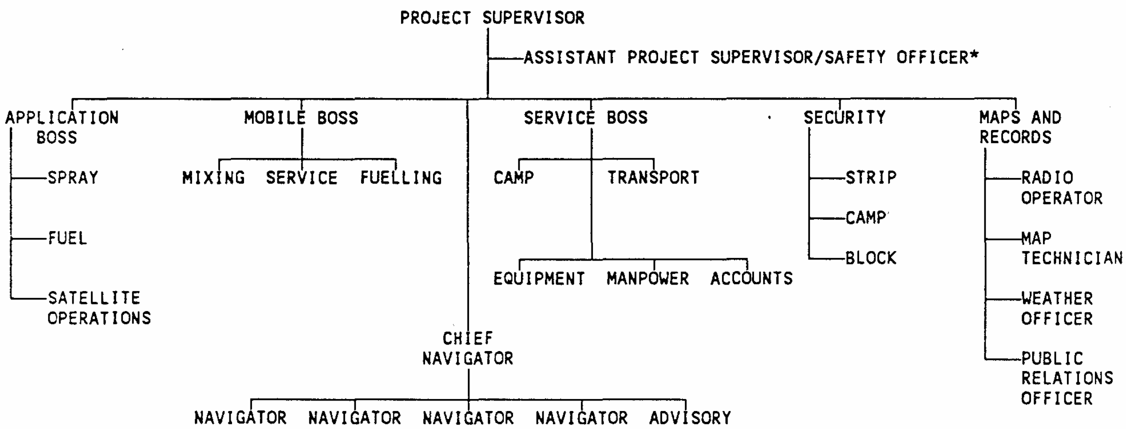
B.6.1.2 Level Two

The Project Supervisor delegates some authority to line supervisors, effectively maintaining a workable span of control. This must also be true for the subordinates. Additional levels of organization can be added where workloads for line supervisors become difficult to provide direct supervision (see Figure 1 for an example).

B.6.1.3 Level Three

This level provides for the further division of functions with additional line supervisors.

Project Supervisors may elect to combine levels of organization, where some functions are carried on In a two or three level organization, and other functions are conducted under a two or even one level system. This can provide the Project Supervisor with more direct input in areas he/she feels might present problems.



* On projects in which there is no Safety Officer, the Project Supervisor takes over the responsibilities of the Safety Officer.

FIGURE 1. Level two organization chart.

B.7 Equipment, Supplies and Procedures

B.7.1 Communication Equipment (Procedures FR.04.1O.1O and FR.04.20.1O)

1. It is essential to have radio communication between the mixing site and the aircraft, and the spray block and aircraft. Also there must be a good communication link between the District Office and the project. Only MNR vehicles equipped with FM radios should be used. Some operators have aircraft equipped with FM radios.

2. Surface to air AM radios (aeronautical radios) are available from the Regional Communication Labs. These may be fire radios or they may be radios that have been specifically assigned to aerial spray operations. Aeronautical frequencies are assigned by the Department of Communications through AFFM. These radios are compatible with the aircraft radios. There should be at least one radio located at the spray block and one at the mixing/loading site. Ensure that all are in working order upon removal from the Communication Lab. FM radios are preferable, if available.

3. A standby phone system should be established using nearby pay phones or private phones, if available. Phones located near the spray block and near the mixing site can be used to relay information (e.g. weather conditions, cease operation, etc.). Distribute phone numbers for key personnel, first aid and contact points to operational staff.

4. Visual signals, especially a mandatory “Cease Operation” signal must be agreed upon; vehicles, lights or flags can be used.

B.7.2 Weather Officer Equipment - Spray Block

1. Meteorological equipment (see The Weather Officer's Guide, pp 147-150).

2. Weather Record forms (see Appendix 7, p 183).

3. Radio-equipped truck. If access is difficult, a four-wheel drive vehicle may be necessary.

4. Maps and/or aerial photos, with spray blocks and boundary markings shown to aid in locating blocks and monitoring spray application.

B.7.3 Aircraft Guidance Equipment

See Appendix 5 (p 175).

B.7.4 Fuel

After the Project Supervisor has accepted an aviation fuel shipment, responsibility for the fuel is turned over to the Application Boss. The Application Boss ensures that his/her aviation fuel products are maintained and delivered to the spray project aircraft in a clean and free of water condition. Good fuel handling and quality control relates directly to the safety of personnel in the air, on the spray site, as well as to the aircraft and fuelling equipment.

The following are the areas of responsibility that concern the Project Supervisor:

1. Amount of each type of fuel required, calculated from usage.
2. Method of acquisition (MNR or private sector can make fuel deliveries).
3. Deliveries: when; where; test for contaminants carried out by the Application Boss, if not acceptable by MNR standards the Project Supervisor will refuse to accept delivery.
4. If delivery is accepted the Project Supervisor will document the shipment for future reference.

C. SPRAY PREPARATION

C.1 Checklist

The Project Supervisor should review the checklist to determine the status of material supplies, services, etc. (see Appendix 4, p 173).

C.2 Boundary Marking of Spray Area

For each spray block, boundaries should be easily recognizable by the pilot. This is the responsibility of the Navigator, but in smaller projects the Project Supervisor is responsible. On herbicide projects, Project Supervisors should consult with the aerial applicator about block layout. The points to be considered in boundary establishment are listed in the Navigator's Guide (pp 125-146) and Appendix 5 (p 175).

C.3 Aircraft and Pilots

1. Familiarize guidance aircraft pilots and navigator with spray blocks and plans.
2. Have spray pilots make a reconnaissance flight over the spray block before spraying starts. This should be done with the guidance aircraft and navigator.
3. Review with pilots the flight paths to be used between airstrip and spray blocks. Flight paths should avoid inhabited areas and large water bodies. Discuss with pilots where load can be dumped in the event of aircraft mechanical failure. Pilots are to sign MOE Form 5.

C.4 Support Vehicles

1. Are vehicles operating properly, recently serviced, fuelled, and equipped with necessary safety equipment? See Sections B.7.1 and 6.7.2, pages 15-16.
2. Is a back-up vehicle available In case of breakdown?
3. Do radios work between aircraft, spray block and mixing/loading site? See Section B.7.1, p 15.

C.5 Spray Block

1. Is the spray block crew, e.g. weather monitor, properly equipped? See Section 6.7.2 (p 16) and Appendix 5 (p 175).
2. Do the radios work between aircraft, spray block and air base? See Section B.7.1, page 15.

D. DAILY SPRAY OPERATIONS

D.1 The Night Before or the End of Each Spray Session

1. Key personnel should meet to plan for the next spray period and discuss the following:

   a) General comments on progress to date;
   b) Plan of action for the next spray;
   c) Weather forecast for the area;
   d) Coordination with environmental impact monitoring and spray deposit crew if appropriate;
   e) Arrange weather monitoring for early morning information on conditions at spray block.

2. The weather monitor must be at the spray block early (sleeping nearby the night before may be necessary) and must relay weather conditions to the Project Supervisor. This information is essential to decide whether to proceed with mixing and spraying.
3. Check the tank mixes required and determine amount of pesticides and adjuvants required.
4. Review the area to be sprayed with the pilots and navigator.

   a) Provide marked photos, and maps
   b) Review the spray block boundaries and all ground reference points
   c) Point out the areas within and adjacent to the spray block to be protected with a buffer zone, including special requests (e.g. private property, beekeepers, poultry farmers, etc.)
   d) Make certain that the pilot and navigator fully understand these points before take-off

5. Clean up mixing/loading site; handle spills according to procedures listed on pages 64-65.
6. Secure aircraft and tanks, and lock all accessible valves.
7. Supervisor and pilots should review and certify daily aerial spraying records (Appendix 7, p 183).
8. Weather and Aerial Spraying Load Records should be completed and forwarded to Supervisor (Appendix 7, p 183).
9. Update large scale maps to show daily spraying progress or changes.
10. All key personnel should meet to plan next spray period. See Section D.1 #1, p 17.
11. Post all sprayed areas. See Bulletin FR.04.06.20.

D.2 Pre-Flight

1. Post personnel as previously discussed.
2. Obtain weather conditions from block based weather monitors.
3. Dispatch mixing crew and pilots to air base. Be prepared to take-off at first light; mixing crew and pilots should be at air base 30-60 minutes before sunrise. Project Supervisor should ensure that personnel are on the job site this early to make best use of spray time.
4. Check communication with spray block and with aircraft on ground.

5. Ensure that warning signs and flagmen are placed on roads to keep public out of spray area and mixing site.
6. Commence mixing/loading operations.

D.3 During Spraying

1. Navigator or weather monitor should keep the Project Supervisor informed of progress in the spray block and advise whether to mix more pesticide.
2. Spray block crew should maintain weather record; weather readings should be recorded every 15 minutes immediately prior to and during the spray period (see Appendix 7 p 183)2.
3. The Project Supervisor should ensure that Aerial Spraying Load Record[2] is maintained (Appendix 7, p 183).
4. Where possible, aerial and ground observers should monitor aerial application for:
   a) Swath width and overlap;
   b) Positive shut off at end of spray run and when crossing 'NON-TARGET areas;
   c) Malfunction of application equipment (e.g. plugged or dripping nozzles);
   d) Drifting of spray cloud outside of boundaries and/or spray cloud not settling;
   e) Correct flying height.
5. Report and record all malfunctioning or overdue aircraft immediately as in the flow chart Provincial Spray Program - Aircraft Occurrence Reporting Sequence (pp 67-69). **Note: All aircraft must report to base every 30 minutes or they will be considered overdue.**
6. Prohibit public access to or through spray blocks during spraying.
7. Rinse pesticide drums three times with water and add rinsings to mixing tank or aircraft hopper. Do not store as they will present a disposal problem later. See point #2 below for disposal of rinsings.

E. PROGRAM COMPLETION

1. Mixing/loading site should be cleaned up; any spills should be handled according to approved procedures listed on pages 54-56.
2. All pumps and hoses should be flushed prior to storage.
3. Empty containers must be rinsed and removed from the airstrip and recycled or disposed of in approved manner (see pages 54-56). **NOTE: "rinsings" may be added to the water used to dilute the product only if the product is being applied at a rate less than the maximum specified on the label, otherwise rinsate can be applied, through the spray delivery system on a spray block.**
4. The boundary markers and swath markers should be removed.
5. Maps should be completed to show progress and any changes.
6. Pilots and Project Supervisor should sign Aerial Spraying Records to indicate they agree on total area treated.
7. The MOE Final Report must be completed (see Appendix 7, p 183).
8. Ensure that all sprayed areas are posted.

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[2] In this era of increasing public sensitivity to aerial spraying and chemical trespass, accusations about drift and off-target spraying are not uncommon. In the event of such charges, it is essential to be able to document what pesticide mix was used, the location and time of application of each plane load, and the weather conditions at the time. The Weather Record, Aerial Spraying Record and records of tank mixes are intended to provide this documentation.

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PART 2: APPLICATION BOSS'S GUIDE

A. INTRODUCTION

The Application Boss is in charge of all aspects of the operation that involve storage, transfer and handling of pesticides, general use and maintenance of pesticide related equipment, aircraft calibration, and equipment set-up. In some projects, the Application Boss may be responsible for fuel procurement and handling, airstrip maintenance, record keeping, weather monitoring and site(s) security.

Application Bosses must have mechanical aptitude along with demonstrated ability to supervise staff, make precise calculations, perform manual labour, and work long hours for extended periods in isolated conditions. They also must have or have been trained in:

- MOE Exterminator's Licence/Growers Course (Ministry of Agriculture and Food), Land Class 1 and 3
- Application Boss Course
- Aircraft safety training
- Workplace Hazardous Material Information System (WHMIS)
- Transportation of Dangerous Goods

Additional licences and training that may be required include:

- Standard First Aid Certificate
- Restricted Radio Operator's Licence
- valid MTO Driver's Licence

A.1 Responsibilities

1. Familiarity with the planning and the objectives of the program, all district project plans, the pesticide(s) in use.

2. Provide Project Supervisor with information regarding the pesticide(s), project equipment (see Appendix 2, p 167; Appendix 11, p 213 and Appendix 12, p 221), aircraft and calibration, as well as airstrip(s) and fuelling status.

3. Ensure staff under his/her supervision are familiar with their duties, and have received adequate training, including safety, pertaining to pesticides, aircraft and the work site.

4. For the pesticide(s) on site, including storage, handling and transfer, mixing and loading, rinsing and disposal.

5. Pesticide handling and storage equipment, including identification of equipment needs to the Project Supervisor; establishment and maintenance of equipment, maintaining equipment inventories and ensuring all equipment is serviced during and after the project (see Appendices 9-12, pp 209-238).

6. Working knowledge of spray aircraft and pointer aircraft, including the calibration of all spray aircraft, daily checks of spray systems, and aircraft fuel requirements.

7. Ensure the availability of required fuel and appropriate fuelling equipment. Ensure fuel quality is checked and that fuel handling procedures are followed.

8. Maintain records on pesticides, fuels, his/her staff, daily and final project reports, etc. See Appendix 7 (p 183).

9. Participation in daily on site briefings, and district/project debriefing sessions.

B. OPERATIONS

B.1 Training

As an Application Boss, it is your responsibility to ensure staff are adequately trained and instructed to perform their duties safely and legally. This training may include first aid (pp 62-64), aircraft awareness (pp 98-105), fuel handling (pp 34-39), pesticide handling (pp 19-34), etc.

B.2 Personnel

The size of the program dictates the number of personnel working in the "pits". Mixing/loading is concentrated during spray hours. The Application Boss must ensure that he/she has enough personnel working so that the delay in loading or fuelling aircraft during spray sessions is at an absolute minimum. Once your project is under way, and your crew is functioning efficiently, you may feel you can "get by" with fewer personnel. Resist the urge to streamline at this point. One lost spray session due to the ground crew's inadequacy, or worse, one accident caused by the "sneaky fatigue" working spray hours brings on, will cost much more than the salary dollars you might think you are saving.

During an aerial spray project, personnel may work irregular hours over extended periods. This may result in:

1. Fatigue - this can be minimized by ensuring suitable accommodations are on site and that ample time is allotted to rest during non-spray periods.

2. Tasks becoming routine - as tasks become repetitive project personnel may become less conscious of hazards and may ignore safety procedures. This can be averted by observing staff behaviour; rotation of staff and assignment of duties on the project will reduce this problem.

B.3 Mixing/Loading Site Selection

B.3.1 Location Along Airstrip

- locate the mixing/loading set-up towards either end of the airstrip; this reduces taxiing by the spray aircraft
- not necessary to base set-up location on prevailing wind direction since the wind speeds will be minimal during operations (see the Weather Officer's Guide, pp 147-150)
- ensure that aircraft approaches for each end of the runway remain unobstructed by tanks, vehicles, other aircraft, etc.
- fixed wing aircraft must have room for a turnaround at each end of the runway
- the mixing/loading sites should have convenient access to facilitate the delivery of pesticide and equipment
- the distance to an ample source of clean water will be of greater concern to projects where water is the carrier for the pesticide. Additional uses of water are:

    1. Rinsate for decontamination;
    2. Dust control;
    3. Washing facilities.

B.3.2 Security

Consider the cost of providing adequate security relative to the location of mixing/loading area on the airstrip, i.e. fenced facility, as compared to an open area. Twenty-four hour security is required on programs run by the MNR.

B.4 Mixing/Loading Area

Each site must be designed to minimize the time aircraft must spend fuelling and loading between productive flying time. Any or all spray aircraft should be fully serviced within 5-6 minutes. To achieve this level of efficiency both fuelling and loading must be accomplished simultaneously. Hot fuelling will be permitted only if the conditions listed in section C.4.2.1 (p 38) are met.

B.4.1 Fuel Tanks

- leave 25-30 m for aircraft between tank farm and fuel tanks
- consider the safety hazards of locating the pesticide(s) and fuel close together as well as the hose lines and wires concentrated on one side of the aircraft
- ensure provision of adequate hose lines and grounding wires to reach the aircraft (Figure 2, p 21)

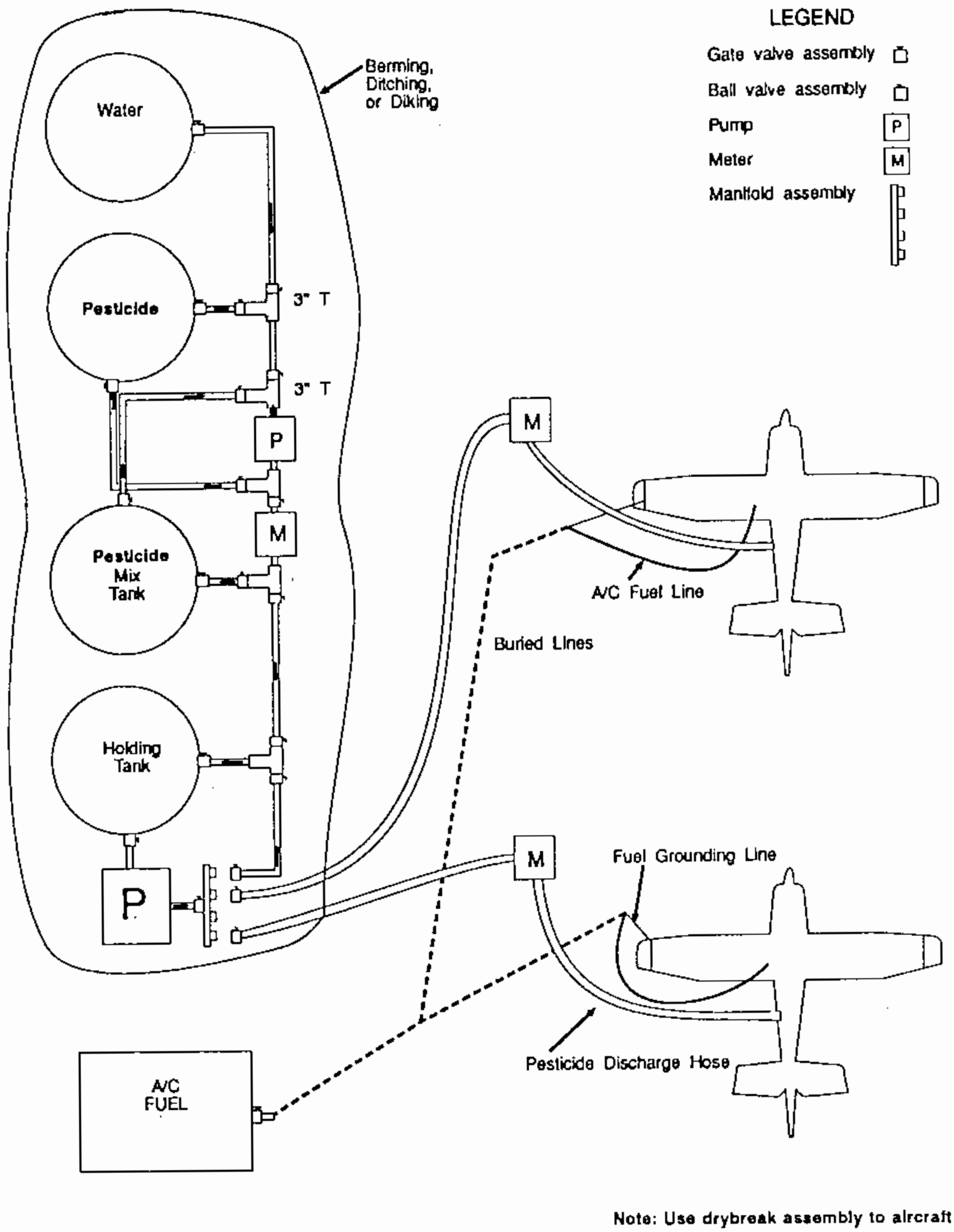


FIGURE 2. Tank farm set-up for a pesticide "mix" operation with the fuel tank adjacent to pesticide storage.

B.4.2 Tank Farm or Pesticide Storage Area

- ensure tanks are placed on flat surface such as sheets of chipboard to protect against puncture from stones. Thoroughly clean the sheets of chipboard before use.
- use various configurations of tanks to fit available area. See Figure 2 on page 21, Figure 8 on page 28, Figure 10 on page 29 and Figure 13 on page 33.
- determine method of containment in case of major spill. It is common on large bulk tank operations to "berm and dike" the tank farm as a method of spill containment. Small projects may have less elaborate containment strategies.
- provide working space between the tanks, i.e. 0.5-2 m

NOTE: **All fixed wing aircraft load on the left side.**

B.4.3 Lighting

- set up lighting system to provide adequate illumination around the mixing and storage areas, since much of the work will be carried out in darkness before the morning, and after the evening, session.
- lighting should be concentrated around the fuelling area, meters, pumps and tanks. Bury all exposed hose lines, etc. to ensure work site remains uncluttered. Do not bury extension cords. Position extension cords in such a way as to minimize their hazard.

B.4.4 Water Supply

Bulk tanks may be used to store clean water if the water delivery system cannot meet the demands of the mixing unit.

B.4.5 Aircraft Parking

Ensure sufficient area is set aside for aircraft parking (properly graded and packed) and that tie downs are available.

B.4.6 Emergency Pump-Out System

Prepare an emergency off-loading system. A pump with sufficient hose and a foot valve should be available. Most aircraft are equipped with a check valve inside the hopper blocking attempts to off-load the pesticide through the drybreak (aircraft inlet valve). These aircraft may be quickly pumped out directly from the top of the hopper.

B.5 Decontamination of Equipment

In order to prevent crop damage and equipment failure, all spray aircraft and equipment must be thoroughly cleaned after each project. Upon the arrival of the spray aircraft a thorough inspection of the hopper and the spraying system will reveal whether decontamination measures are necessary. The following procedures apply to all spray aircraft, portable mixing units, storage tanks and hose lines. Rinse with sufficient volume of solution to clean the equipment.

B.5.1 Oil Based Pesticide (e.g. 2,4-D L.V. Ester)

1. Rinse with Diluent 585
2. Rinse with 2% solution of detergent and water (1:50 ratio)
3. Final rinse with clean water
4. Drain system
5. Dispose all rinsates as per instructions in the section **Program Completion** on page 18.

B.5.2 Water Based Pesticide (e.g. Glyphosate, Futura XLV)

1. Rinse with 2% solution of detergent and water
2. Rinse with clean water
3. Drain system
4. Some pesticides may require special cleaning procedures. If unsure contact the supplier or Silviculture Section.

B.6 Barrel Operations

Pesticides are shipped in various containers but the most commonly used is the drum. As drums are extremely heavy, planning should consider machinery to minimize physical handling.

B.6.1 Handling

For loading and unloading purposes, the services of a truck with a Hiab type loader and barrel sling or a power tailgate, or a fork lift or a tractor with a large bucket provides safe and rapid transfer of large quantities of barrels. To complement the movement of barrels with Hiab type booms, a nylon ratchet-style barrel sling is required. This type allows the handling of both metal and plastic barrels.

Barrel carts can be used for movement of barrels on the ground within the mix site. Pneumatic tires allow greater versatility especially on loose soils.

Avoid damaging barrels. When barrels are damaged there is the possibility of leakage. Also, ruptured barrel liners can cause clogging of filters in pesticide loading systems and aircraft. Damaged barrels are considered unacceptable by recycling firms.

B.6.2 Agitation

The following applies to B.t. Before transferring the contents of barrels into mixing systems the contents should be agitated. Methods used are:

1. Rolling barrels manually
2. Recirculate with a transfer pump
3. Agitate contents with a portable compressor, pumping air, via a long probe, into the bottom of the barrel

B.6.3 Small Containers

Small containers (i.e. 10 L plastic jugs) create their own problems as spraying projects require large numbers of containers. Cardboard shipping containers are susceptible to deterioration when wet and the jugs will fall out during handling. Protect shipments with tarps or plastic sheets.

B.7 Pesticide Transfer

Transferring pesticides from containers must be done safely and efficiently and with a minimum of worker exposure. Various methods are outlined below.

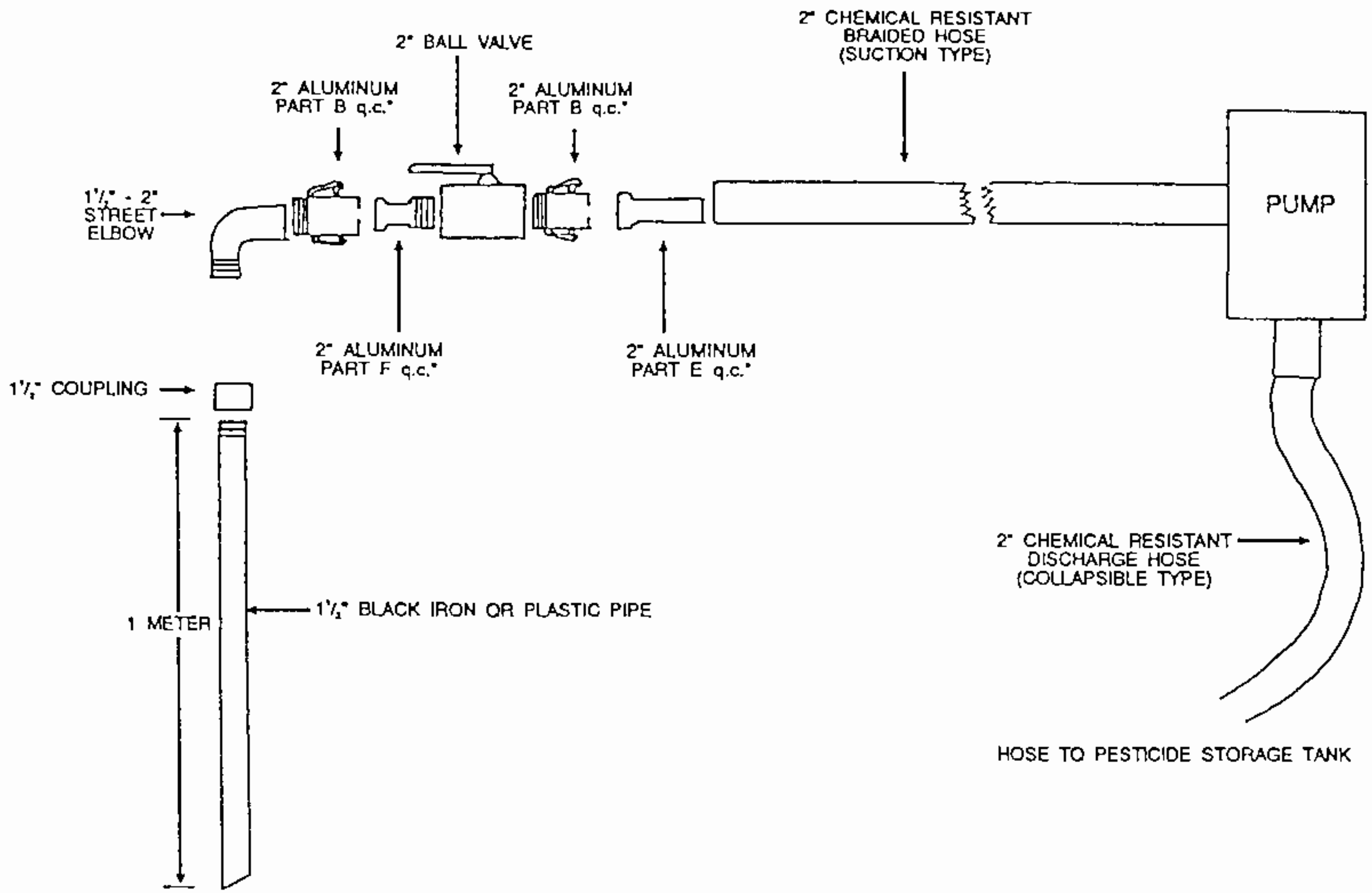
B.7.1 Barrel Standpipe

A ball valve or drybreak must be installed at the end of the suction line nearest the barrel (Figure 3). This retains the pump prime and prevents spillage when the line is detached from the barrel.

When transferring the standpipe to another barrel, care must be taken to prevent the accidental splashing of the pesticide.

B.7.2 Barrel Suction Method

This method is the quickest way of handling large numbers of barrels. In Figure 4, a male drybreak is attached to the drum. This allows the intake hose (female drybreak) to be attached while the barrel is on its side and provides additional protection from accidental splashing of the pesticide. The drybreak must be screwed into the 2 inch barrel bung and then the suction line attached. The drum must then be laid on its side with the small bung on the top side. Before pumping begins, the small bung must be unscrewed slightly to allow air to enter and prevent the barrel from collapsing during pumping. As the level of the barrel contents fall below the small bung, the bung must be removed. When light enough the barrel may be lifted to help drain the contents. A rapid increase in the pump rpm indicates that the barrel is empty. Close the ball valve and shut down the pump to prevent loss of pump prime.



* q.c. - QUICK COUPLE

FIGURE 3. Barrel standpipe.

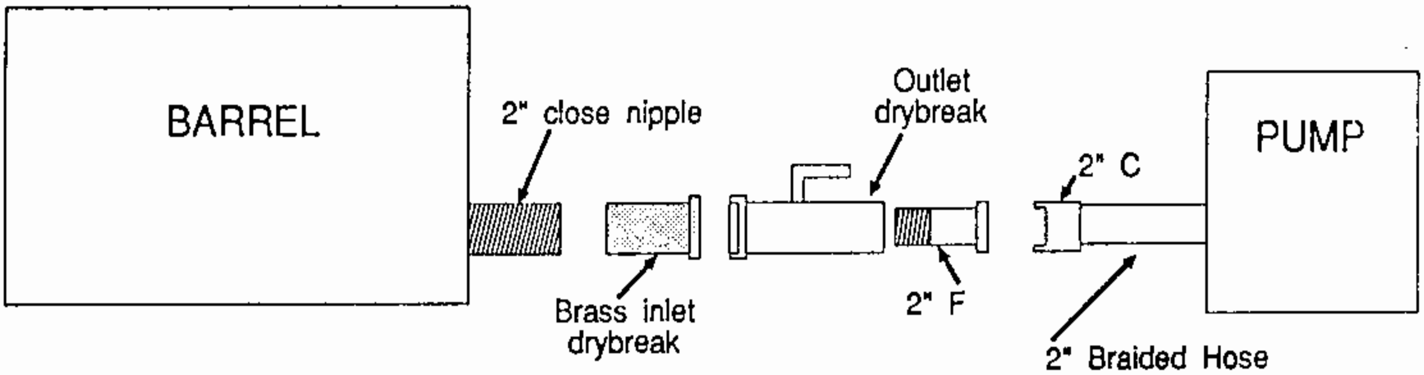


FIGURE 4. Barrel suction method with a drybreak.

B.7.3 Small Transfer Pumps

An electric transfer pump is another method of transferring pesticides from barrels on small operations. Such pumps are suited for pumping non-viscous liquids.

An alternative is a manual transfer pump but again it is only suitable for small operations.

B.7.4 Residual Collection

There will always be some residual pesticide in the barrels. When time allows, this can be poured into pails and transferred to the pesticide holding tank.

B.8 Barrel Rinsing Procedures

Barrels must be rinsed three (3) times as per MOE regulations. Rinsate should be placed in a separate holding tank and disposed of as outlined in **Program Completion** on page 18.

Small quantities of barrels of water based pesticides may be allowed to accumulate for rinsing immediately prior to project completion. If barrels are allowed to accumulate on large projects, unnecessary delays are created as aircraft will be required to remain on site for disposal of the rinsings. This could prove expensive and cause a delay in equipment dismantling and post project storage.

Barrel washers can be fabricated in your own shop (see Figures 5 and 6), or a fog nozzle may be attached to a pipe, or the nozzle purchased commercially (see Figure 7).

As a guideline, use a minimum of 5% of the container capacity for each rinsing. Examples:

205 L drum - use 10 L of water per rinse
10 L jug - use 0.5 litre per rinse

To remove rinsing use one of the pesticide transfer methods as described in Section B.7 (pp 23-25) or tip contents out of the barrel into a pail. Wash the outside of barrels.

B.8.1 Empty Containers

Empty containers (10-205 L) should be taken to a separate designated storage area, away from the aircraft operations. This minimizes confusion with full containers and ensures that empty containers are not blown about by wind or propwash. If space is limited, empty barrels may be stacked on their sides.

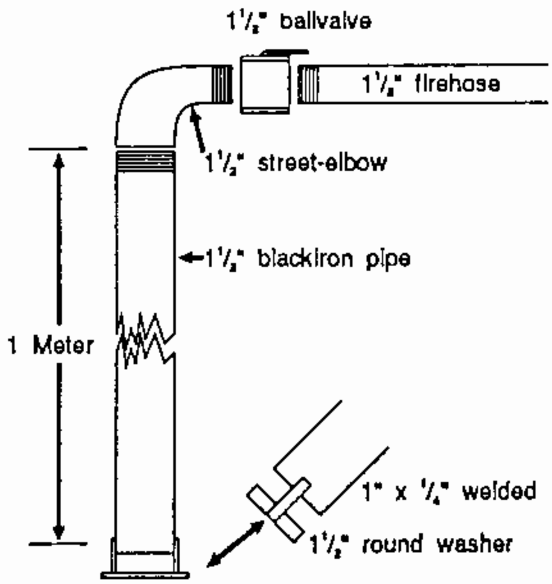


FIGURE 5. Plans for one type of barrel washer.

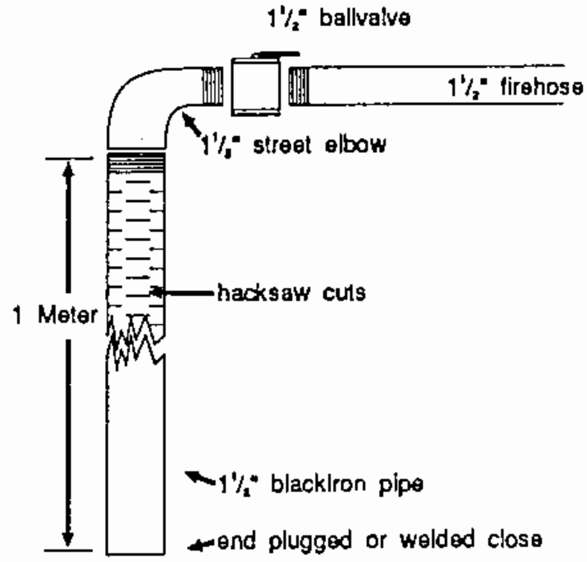
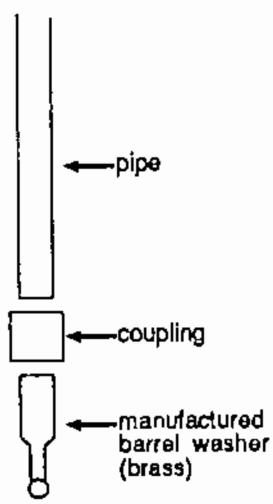


FIGURE 6. Plans for another type of barrel washer.



Connector assembly same as in Figures 5 and 6 except sizes are 3/4"

FIGURE 7. John Brooks barrel washer.

B.9 Tank Farm Set-Up

1. Calculate the total volume of pesticide required and the number of tanks, hoses, etc. required, including a water tank, a rinsing tank and a spare tank.
2. Tank farm configuration - consider size of area required for all tanks and equipment.

For an example of a simple "neat" operation see Figure 8, and for an example of a simple "mix" operation see Figure 2 (p 21).

B.9.1 Operations of Pesticide/Water Mix System

In some operations the pesticide must be mixed with water before loading into spray aircraft. This requires a mixing tank and possibly a separate tank to store quantities of the prepared mixture.

A separate water delivery system is required to fill the water storage tank. Water should be strained using an inline separator (Laakos). The carbon steel model is recommended as the plastic model breaks easily. The Laakos separator is available from:

Continental Industrial Supply
282 Belfield Road
Rexdale, Ontario
M9W 1H5
(416) 675-7629

A 5 hp pump is used to transfer water from the storage tank to the mixing tank; it may also be used for mixing the final formulation.

As the water in the mix tank is being recirculated from bottom outlet to top inlet, the correct volume of pesticide is added using an L.C. Meter into the centre inlet. The circulation process is maintained until thoroughly mixed. The contents of the mix tank are then pumped into a mix storage tank using the circulation hose. From the mix storage tank the mix is metered to the aircraft.

B.9.2 Mixing Problems

Proper mixing procedures, adequate recirculation and minimizing the storage time of prepared spray mixture will help ensure a trouble-free operation. A clearly legible chart, posted at the mixing site, showing amounts of various spray ingredients to be used in standard, double and half batches of tank mix, will ease the mixing procedure. The lettering on the chart should be waterproof. Some pesticides in bulk format or in a final spray mixture may settle out and require recirculation prior to the loading of the spray aircraft.

Some insecticides (i.e. oil based B.t. formulations) may form an invert emulsion if improperly mixed with water. Check the label for any special handling procedures and consult with the supplier or the Silviculture Section for further details.

B.10 Bulk Operations

Bulk operations are those projects that receive the pesticide via truck tanker loads of approximately 20,000-25,000 L each.

B.10.1 Planning

Planning for bulk deliveries requires:

- good road conditions to the loading site; some transports are not equipped to travel on secondary or bush roads - check with shipper
- bridges of sufficient tonnage rating to allow the tanker to cross
- check half load seasons on delivery routes that affect load size and thus the delivery schedule
- compatibility of unloading systems with tankers - confirm with the shipper

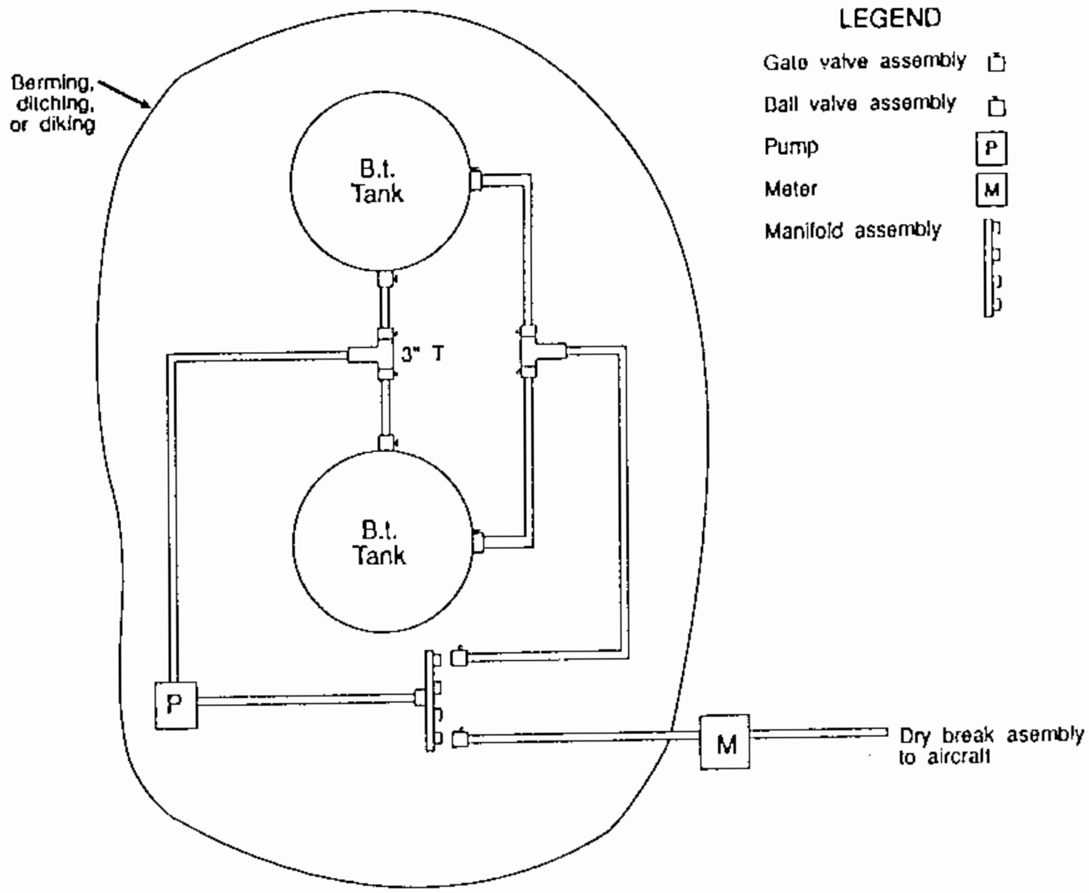


FIGURE 8. Pesticide neat tank farm set-up.

B.10.2 Unloading

As with barrel operations the pesticides may require agitation prior to unloading. This may be achieved by pumping air from the air brake compressor system into the tank. If the truck does not have this capability, the use of a "blow back" unit will accomplish the task. This device is designed to transfer compressed air from the tractor's compressor through the bottom tank outlet (3" A or F) and agitate the liquid through a bubbling action. About 20 to 30 minutes is required for adequate agitation. Figure 9 shows the types of equipment that may be used in this operation.

NOTE: **Ensure that the tank's manhole lid remains open during this operation to prevent pressurization of the tank.**

Alternatively an 18 hp. pump from the tank farm (Figure 8) may be turned around to pump from the truck into the bulk tanks as shown in Figure 10. Ball valves at the bulk tanks may be adjusted to allow for equal rate of filling.

WARNING: Do not overfill storage tank beyond the "dome" line.

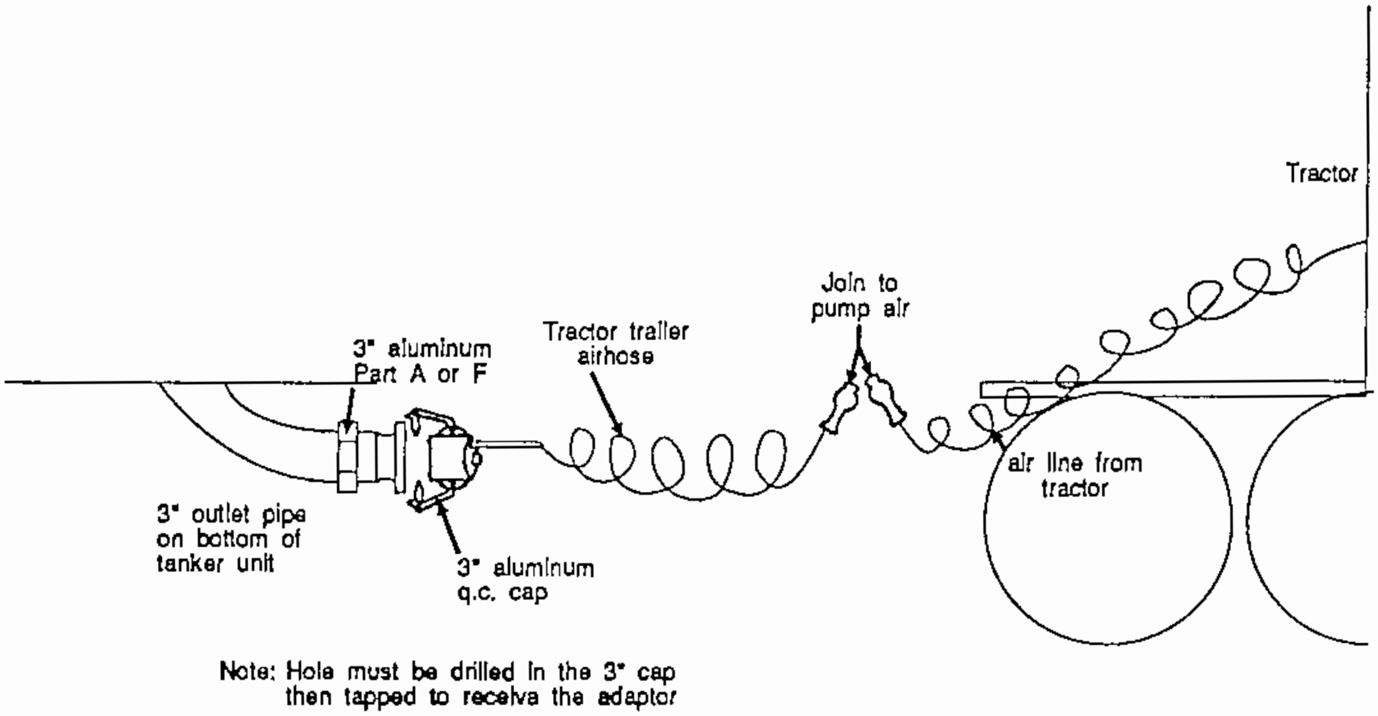


FIGURE 9. Blow back unit attached to tractor.

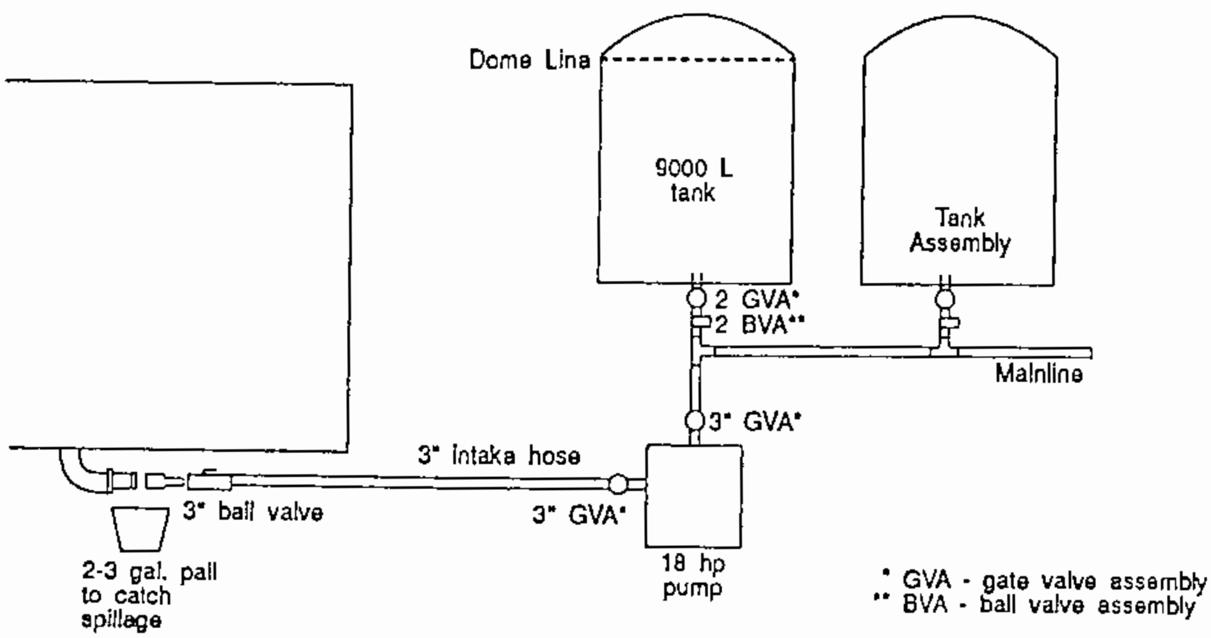


FIGURE 10. Tanker unloading system.

B.10.3 Bulk Handling and Loading

B.10.3.1 Agitation

To agitate the contents of a 9,000 L tank, set up a system where the pesticide is pumped from the bottom of the tank into the middle or top of the same tank. This process may take up to an hour to achieve a thorough mix. The meter should be bypassed during this process.

Where it is desirable to circulate more than one tank at a time, entire batches may be agitated at once without cross contamination of batches. This process involves recirculating the contents of all tanks of the same batch/lot simultaneously through the pump into the same tanks.

WARNING: **The tank levels will fluctuate and must be closely monitored throughout the agitation process to avoid overflow. Ensure this process is closely observed at all times.**

B.10.3.2 Loading Aircraft

Most spray aircraft are equipped with male drybreak loading valves on the left side of the fuselage. Some helicopters do not have loading ports so a device such as shown in Figure 11 should be constructed.

The Application Boss must ensure all staff is properly trained in the operation and handling of all equipment. Special precautions must be taken to avoid hose kinks, protect the drybreak from dirt (immerse the end of the hose in a large bucket of clean water) and damage, and especially to avoid damage to the aircraft and/or its components.

Cooler temperatures may affect the viscosity of the pesticide. The viscosity of the pesticide within the hoses will fluctuate with the ambient temperatures especially in comparison to the pesticide in the bulk tanks. It is advisable to recirculate the contents of all hoses including the discharge/loading hose, prior to start up in the morning. This will not only speed up the loading process but it will also minimize the effects on both the L.C. and the aircraft flowmeters.

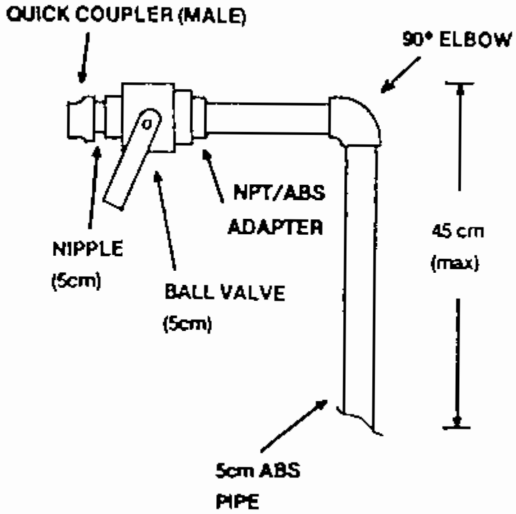


FIGURE 11. Equipment for safe loading of helicopters.

B.10.3.3 Bulk Tank Clean up

Once the tank has been drained some pesticide remains in the bottom of the bulk tanks even with a siphon tube in the drain. However most of this can be removed by tipping the tank using a pry and blocking. Prior to tipping, dig a hole under the bottom valve on the opposite side to prevent breakage. Use a long handled pool cleaner/squeegee to scrape residual pesticide to suction port. See Figure 12.

After the tank has been drained, rinsing and clean up starts. Tanks should be cleaned as soon as possible, as some pesticides (i.e. B.t.) tend to harden making the clean up difficult. Remove all valves from the tank, install caps where required. Lay tank on its side with all outlets facing up to prevent dirt from entering. Using a separate uncontaminated water pumping system and 1.5" fire hose with adjustable spray nozzle, rinse three times through the top manhole. An alternate method is to remove all valves, roll the tank onto ramp and rinse capturing the rinsate in a barrel or bucket. Either way, one can tip the tanks and pump or drain the rinsate out and place in a designated rinsate holding tank.

Prevent empty tanks from blowing about in high winds, i.e. partially fill them with water.

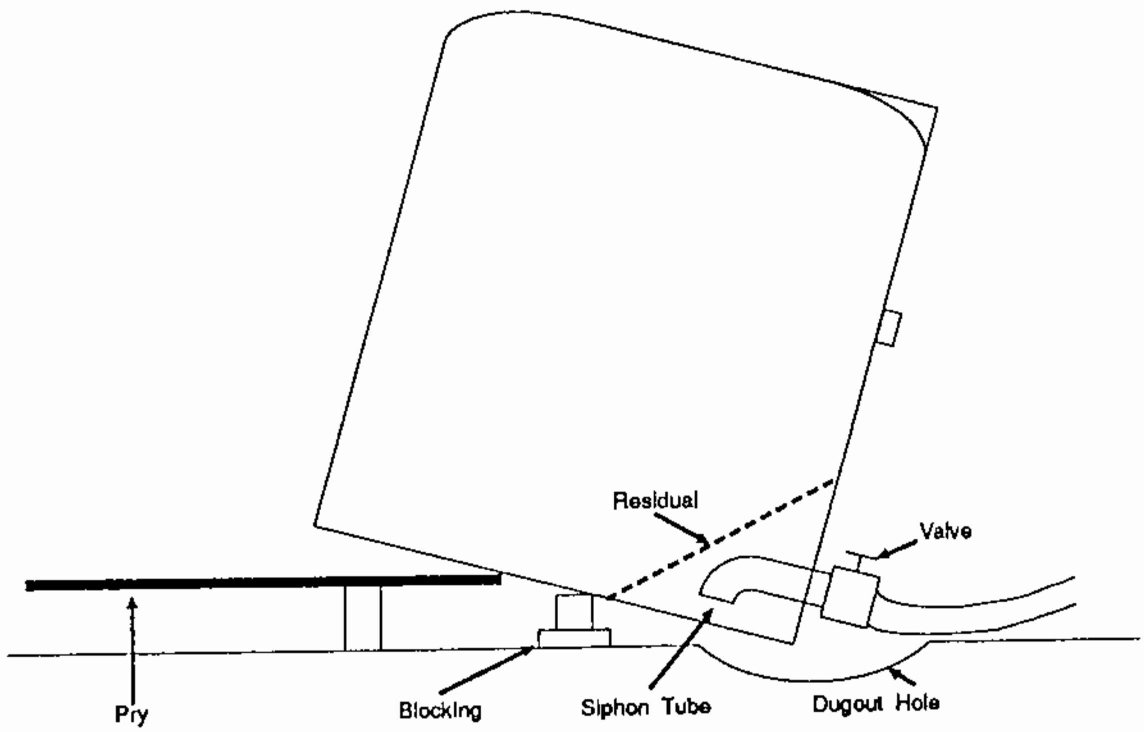


FIGURE 12. Tank draining set-up.

B.11 Portable Mixing Units

Portable mixing units (P.M.U.'s) are built using basic components to provide premixing of chemicals, before loading into the aircraft. They can be very simple or very complex. See Figure 13 for an example. The most important thing to remember when assembling a mixing unit is whether it will have the capacity to fill the size and number of aircraft involved. When assembling a mixing unit keep in mind:

1. Keep all hoses that will have pesticide or mix going through them as short as possible, to reduce the amount of water required in rinsing and also, more importantly, to reduce the amount of pesticide left in the system.

2. If possible, put shut-off valves before and after T's or Y's. This will enable the system to be shut off in a number of places, for a number of reasons. For example: should the system develop a leak, the extra shut-offs will enable the hoses to be shut off and connections repaired, with a minimum amount of mix to be drained off.

3. If the pumps and meters are to be bolted down permanently, ensure that there are rubber pads fitted under the bases. This ensures that while these components remain secured, no damage is done to the motors from vibrations.

B.11.1 Rinsing

- Return all unused pesticide to its original container
- Take into consideration that the entire system will contain residual pesticides and/or pesticide mixtures
- Triple rinse all hoses and tanks (one rinse with detergent, if required) into one of the mixing tanks. Load the aircraft with this rinsate and disperse on the spray area
- Drain thoroughly, including the distribution manifold
- After the system has been decontaminated, disconnect all lines from the meter and the pump and tie them down to the unit; prepare for storage

B.12 Disposal of Containers

At present there are two methods of container disposal: recycling and burying. All containers must be triple rinsed prior to disposal.

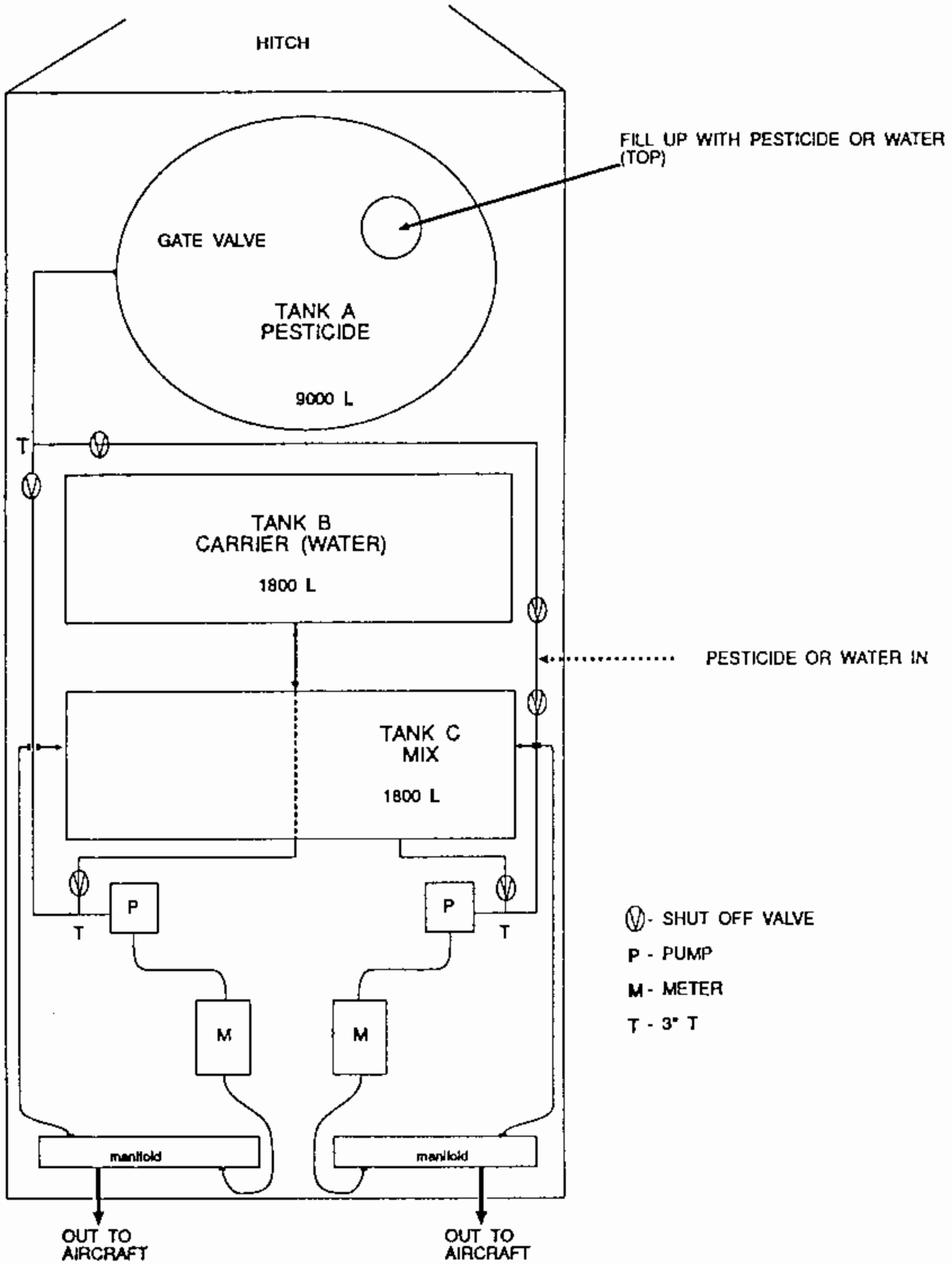
B.12.1 Drum Recycling

Container recycling may be advantageous as a disposal site is not required. The cost of transport to the recycling plant is reduced through funds received.

B.12.2 Burial

Burial is the least preferred method of container disposal. However, there are some containers that can not be recycled (i.e. small plastic jugs). They must be rinsed three times and buried as per MOE guidelines (see pp 54-56).

- Identify disposal sites prior to project start up
- If tractors are being used within the district on site preparation projects, they can be utilized to construct disposal pits for non-recyclable containers
- All disposal sites must be recorded on a map, with reference to location, number and type of containers, i.e. metal or plastic - 205 L drum or 10 L, and name of original pesticide contents, i.e. 2,4-D, Vision. Keep all information in a separate file.



Depending on the mix ratio of carrier to pesticide, storage tanks A and B may change roles from pesticide to carrier storage. For a herbicide mix, the larger tank would logically be used for water, the smaller for herbicide.

FIGURE 13. Schematic sketch of a Portable Mixing Unit (P.M.U.).

B.13 Disposal of Rinsings

The disposal of rinsings is the responsibility of the Application Boss, and must be done in a safe and approved manner. See **Program Completion** on page 18 and **Disposal** on page 56.

B.13.1 Planning

- Rinsate disposal must be considered prior to project start up. The proposed method must be approved by MOE and must be included in the Project Description and the District Operations Plan.
- An approved method of rinsate disposal is to apply the rinsate to the MOE licensed project area. This can be done only if so doing does not exceed the application rate outline on your Form 5 Approval. The rinsings can be identified as a second or third application on your Form 5 Application on insecticide programs.

WARNING: **When using herbicides, dispersal of the rinsate over the target area can cause crop damage if the rinsate has not been sufficiently diluted. Be sure to dilute the rinsate to a harmless level. If the pesticide being used is an insecticide, this generally presents no problems as the insecticides do not damage the crop.**

C. AVIATION FUEL MANAGEMENT

The objective of this section is to provide guidelines for the management of aircraft fuelling systems to ensure that aviation fuel is maintained and delivered to aircraft in a clean and dry condition. Proper fuel handling techniques at all levels of operations are essential to insure that high quality fuels are available at all times and handled in a safe and proper manner.

C.1 Quality Control

C.1.1 Fuel Types and Identification

Fuel Type and Grade	Colour of Fuel	Refueller Decal
100 LL	Blue	100 LL
Jet A, A1	Colourless or Straw	Jet A or Jet A1 or Turbo A1
Jet B, JP-4	Colourless	Jet B or JP-4 or Turbo B

C.1.2 Fuel Contamination

Contamination of fuels occurs in three ways: the introduction of solids, free and dissolved water, and the mixing of fuel grades.

C.1.2.1 Introduction of Solids

The most common types of solid contamination are iron rust, seals, sand and dirt. Solids contamination can be minimized by proper filtering, use of dust plugs and caps, and the avoidance of rusty or dirty hose lines, drums, and containers.

C.1.2.2 Free and Dissolved Water

Water occurs in aviation fuels in two forms, dissolved and free. All aviation fuels dissolve water in various amounts depending on the type of fuel and the temperature. Any water which is not dissolved is called free water. Cooling temperatures cause dissolved water to come out of solution as free water. Free water may appear as water slugs or entrained water. Entrained water is suspended as droplets in the fuel and may or may not be visible to the naked eye, but gives fuel a hazy or cloudy appearance. Free water can be removed with proper filtration. Free water accumulated by condensation in fuel storage tanks can be minimized by keeping tanks as full as possible.

C.1.2.3 Mixing of Fuel Grades

Mixing of fuel grades will affect both the octane rating and the lead content of the final mix. Carbonization and knocking problems may result if Avgas is contaminated by the addition of turbo fuel. Turbo fuel has a lower octane rating than Avgas. Before fuelling, the operator **must** check that the fuel in the dispenser is the correct one for the aircraft. **Mixing of jet fuel into a piston engine could result in total engine failure.**

Switching products in a tank should be avoided. If necessary, the tank should be well flushed and drained before filling with new product.

C.1.3 Fuel Testing

Aviation turbine fuels must be several times cleaner than aviation gasoline. While a visual check (clean and bright) is usually adequate for the latter, turbine (jet) fuels require further testing. MNR is responsible for providing a safe fuel dispensing unit and the quality control for MNR supplied fuel. The following tests should be done daily (i.e. each morning) and whenever a quality check is requested. Check with Regional fire personnel for guidance and detailed instructions. It may be advisable that when the daily fuel testing is done, the contractor's chief pilot inspects the sample and initials the fuel sheet.

C.1.3.1 Clean and Bright Test

Draw off a sample of fuel into a clean, dry glass jar. If the fuel is acceptably free of water, it will be bright with a fluorescent appearance and will not be cloudy or hazy.

C.1.3.2 Swirl Test

A product sample is obtained from delivery vehicles (from the nozzle) into a clean, white, open receptacle. It is checked for odour and to see if it is clean and bright. The product is swirled, then allowed to settle. Solid contaminants, if present, will collect at the centre of the vessel.

C.1.3.3 Paste Test

The paste test detects free water in aviation fuel storage tanks and drums. The paste is rubbed onto a dry stick which is then lowered into the fuel at the lowest end of the tank. If free water is present the paste will change from green to red. This test will not indicate contamination by entrained water.

The paste product is McCabe water level indicator and can be obtained from R.N.G. Equipment Co., 32 Stoffel Drive, Rexdale, Ontario, M9W 1A8

C.1.4 Equipment Inspections

As well as regular fuel inspections, all equipment used for aviation fuel dispensing should be checked to ensure it is in good working order and free from defects.

C.1.4.1 Pre-delivery Check on Delivery Vehicle

- Check hoses for cleanliness
- See that compartments are sealed
- Check product identification
- Carry out swirl test and paste test
- Check flushing report (tank truck condition before loading)
- Check compartments for proper fuel level

C.1.4.2 Daily Checks

- Check nozzle for product identification tags and cleanliness
- Check all connections for leaks
- Nozzles - check screen, bonding wire and dust caps
- Condition of total length of hose under pressure
- Signs and fire extinguishers

C.1.4.3 Weekly Checks

- Tank dip and paste test
- Clear and bright at the filter housing

C.1.4.4 Filters

- Replace yearly or as required
- When pressure differential (in/out) approaches 10 lbs., replace elements
- Every morning open valve on 3 L filter to drain out any water
- The third stage of the 3 L filter is a monitor fuse, which will shut off the fuel flow if water is present. If this happens the fuse monitor must be removed and replaced with a new fuse.

C.2 Bonding/Grounding

C.2.1 Static Electricity

Static electricity is generated by friction. The free falling of fuels into the tanks or even the movement of fuel through hose and pipe will generate static electricity. Safety precautions must be taken to prevent the build up of static electricity and sparking potential.

C.2.2 Bonding

Bonding is an electrical connection between two or more objects. When objects are bonded, static electricity equalizes and sparking between the objects is prevented.

C.2.3 Grounding

Grounding is an electrical connection between an object and the ground. Static electricity within an object is conducted into the ground away from the object.

Before fuelling of an aircraft begins, it is essential that certain grounding and bonding procedures are followed. The pump is the greatest generator of static electricity and it **must** be grounded to a ground rod. Finally, the nozzle **must** be bonded to the aircraft prior to insertion of the nozzle. The bonding cable which is permanently attached to the nozzle must be attached to the aircraft in the appropriate location with the jack or clip.

NOTE: If the Project Supervisor is uncertain that bonding and ground is carried out properly in a full service contract contact AFFM. Be prepared to describe the equipment and procedures in detail.

C.3 Equipment

C.3.1 Bulk Fuel Tanks

Several options for fuel storage are available for the project.

C.3.1.1 Roll-A-Gon Systems

This system is a collapsible rubber drum. They are available in 900 and 1,800 L capacities. If using this system, the "Portable Aviation Refuelling Kit - Field Users' Guide" should be consulted for proper set-up.

C.3.1.2 Fuel Storage Tanks

Steel storage tanks in various sizes are available for bulk storage of fuel. Sizes include 2,250, 4,500 and 9,000 L. Steel storage tanks must conform to Underwriters' Standard Specifications ULC-S601 and The Gasoline Handling Act, Section 6 "Above Ground Storage Tanks". Some Regions have 9,000 litre "slip-on-tanks" with skid-mounted pump and filter. These may be available for the project.

C.3.1.3 Fuel Bowsers

Bowsers (fuel delivery trucks) may be rented from the commercial sector. They are ideal units to consider because of their size and the convenience of a self-contained pump. However, ensure the system is compatible for the type of fuel used. Insurance costs and availability may make them too expensive.

C.3.1.4 MNR Fuel Trailers

MNR fuel trailers are available in some areas. They come in several sizes - from 1100 to 2250 L. At present, they can only be used as fuel storage and dispensing as they do not conform to requirements of the Gasoline Handling Act for highway transport. Consult with AFFM for further information on these units.

C.3.1.5 Drum Fuel

205 L drums of fuel can be purchased.

Fuel will not be dispensed from an unsealed drum unless the person dispensing the fuel has prior knowledge of the condition of the fuel and the pilot is fully aware that the drum was not sealed.

C.3.2 Pump Systems

Use only pumps approved for pumping fuel. The standard portable aviation refuelling pump is a Gorman Rupp, self priming centrifugal, gasoline engine driven Model 82 D1-8X, 2" X 2" N.P.T. female, with Briggs Model 8, 3 h.p. gasoline engine.

Barrel pumps come in various sizes and types. Manual pumps or electric pumps are available. A good electric barrel pump to consider is G.P.I. Model M120 fuel transfer pump, #24389 element assembly, and #044233 M2 filter assembly. This unit is available in 12 or 24 volt system and can be purchased through Standard Aero in Winnipeg (for more details, contact AFFM purchasing section).

C.3.3 Filters

At this time, the only recommended filter for use is a 3 L three Stage Filter Unit Model No. V-818-15 available from "3 L" Filters Ltd., Cambridge, Ontario. A detailed description of this unit is found in the AFFM Fuel Manual.

C.3.4 Delivery Hose and Nozzles

Hose should be: Buckeye, part No. F0782-067, 1" aluminum complete with rigid tube, locked in 100 mesh screen, dust cap, and bonding wire assembly; purchased in 15 m lengths; 1" I.D.; fitted with Scoville male fittings on each end. Identification tags, 100 LL or A-1 Turbo fuel should be affixed to the nozzle.

C.4 Fuelling Procedure

C.4.1 Bulk Transfer

Aviation fuel will generally be delivered to spray sites by fuel bowser with a trained driver. You should be aware of the following safety concerns:

1. Inspect delivery vehicle as detailed in the **Quality Control** pages 34-36.
2. Dip check receiving storage tanks to ensure enough room to accommodate expected delivery.
3. Ground and bond bowser to storage tank.
4. Use a long fill pipe or the lower nozzle into the tank to reduce or eliminate free fall of fuel. This will minimize build-up of static electricity.

C.4.2 Aircraft Fuelling Rules

The following safety precautions are **recommended** to ensure a safe operation. It is by no means an exhaustive list, and specific site conditions may require other precautions.

1. Perform the quality control checks appropriate to the type of fuel (see **Quality Control** pp 34-36).
2. Post the NO SMOKING signs in visible locations.
3. Maintain the fire extinguisher in an accessible location.
4. No smoking within 30 m of a vehicle used for hauling or storing fuel, or an aircraft refuelling station.
5. Check colour of the fuel and the identification tag on nozzle before filling aircraft.
6. NEVER use leaking equipment. Attend to minor leaks by tightening fittings.
7. Ensure that the bonding/grounding connections have been completed in the proper order, before fuelling. NEVER use a **non-metallic** funnel between the nozzle and aircraft since they cannot be bonded/grounded.
8. DO NOT fuel when there is an electrical disturbance (storm) in the area. Hot fuelling is permitted only under the conditions listed below in **C.4.2.1 Hot Fuelling**.
9. No aircraft maintenance to be performed while fuelling.
10. Fuelling will not be done while any personnel are on-board the aircraft.
11. Fuelling personnel are advised NOT to wear nylon clothing since it builds up static electricity easily.
12. Wear safety goggles when fuelling aircraft. If aviation fuel is accidentally splashed into the eyes, IMMEDIATELY FLUSH WITH CLEAN RUNNING WATER FOR **AT LEAST 10 MINUTES**.
13. It is recommended that waste fuel (that which is flushed through the nozzle before fill-ups) be put into a clearly marked container for later disposal in an approved location.

C.4.2.1 Hot Fuelling

Hot fuelling, fuelling of an aircraft while its engine is running, is permitted on spray projects only if the following conditions are met:

1. Single point fuelling with a closed system and Transport Canada approval for the modification.
2. Proper grounding prior to connecting the hose.
3. Quick disconnects with dust caps installed on both the aircraft and the fuel dispenser.
4. The carrier supply the necessary fittings to modify the fuel dispenser to the fittings on his aircraft.
5. If operating out of a Municipal Airport, permission to hot fuel must be obtained from the Airport Manager.

If there are any questions on hot fuelling contact AFFM

C.4.3 Aircraft Fuelling Sequence

The potential for a serious accident exists whenever an aircraft is refuelled. Proper fuelling procedure by trained staff will minimize this risk. Air carrier personnel are responsible for refuelling at all times. MNR personnel only assist.

The following steps should be followed in the sequence indicated:

1. Ensure pump is grounded to a properly installed ground rod.
2. Ground aircraft to appropriate ground rod.

3. Flush small quantity of fuel through hose to clear line. Flush fuel into well marked "waste" drum. Waste fuel must be disposed of at a site designated by the local MOE Office.
4. Connect bond plug/clip from nozzle to aircraft receptacle.
5. Remove cap from aircraft fuel tank.
6. Insert nozzle in fuel filter pipe and commence refuelling. Ensure air in fuel filter has been bled off.
7. Attend nozzle at all times during refuelling and frequently check fuel level to avoid over filling.
8. Remove nozzle after refuelling and replace aircraft tank fuel cap.
9. Disconnect bonding plug/clip from aircraft receptacle.
10. Disconnect grounding wire from aircraft.
11. Store nozzle with dust cap in place and off ground to avoid dirt contamination.
12. Avoid dragging nozzle on ground when moving hose.

C.4.4 Use of Drums

All drum fuel is "JET B" or Avgas 100 LL.

The following precautions must be taken when using drum fuel:

1. Segregate drums into lots according to type.
2. Store all drums horizontally off the ground (i.e. on pallets or poles) and with bungs parallel to ground.
3. Ensure bungs are replaced tightly when drum is empty and store bottom side up, off the ground on poles or pallets.
4. Store empty drums in a separate location, well away from aircraft operating area.

The following fuelling procedures must be completed before refuelling of an aircraft:

1. After moving a fuel drum, the fuel must settle for 1 hour for Avgas and 2 hours for turbo fuel. A one day supply of fuel should be pre-positioned to the aircraft fuelling location the night before, and stored with drums slightly tilted to allow moisture to drain off the top and bungs.
2. Check fuel quality as previously detailed.
3. If contaminants are found, the product should not be used and barrel contents disposed of.
4. When transferring **turbo** fuel to an aircraft, micronic filtration is required. Do not use a felt or chamois liner in a funnel as the tiny hairs that the fuel picks up could clog fuel nozzles in the engine.
5. When transferring **Avgas**, a felt or chamois can be used if a proper filter is not available.
6. Bond drum to aircraft.
7. Ensure the fuelling nozzle is bonded to the aircraft.
8. Other safety precautions to be taken as in preceding sections (Aircraft Handling) as applicable.

C.5 Reference Material

The following manuals, guides, etc. are available for reference:

1. Fuel Management - Instructor guide
2. Aviation, Flood and Fire Management Fuel Manual
3. Portable Aviation Refuelling Kit - Field Users' Guide
4. Tanker Truck Fuelling Unit (Bowser) - Northern Region
5. Policy and Procedure Directives
6. Fuel Inventory and Control Record
7. Policy and Procedure for "Transportation of Dangerous Goods."

D. AIRCRAFT CALIBRATION

The purpose of aircraft calibration is to ensure that the aircraft spray system is adjusted to deliver the prescribed volume of pesticide. Appendix 13 (p 239) lists the specifications (e.g. wing span, payload) of aircraft commonly used on spray projects.

Spray aircraft are to be calibrated upon arrival at the airstrip, at the discretion of the Project Supervisor.

D.1 Calibration Variables

The volume distributed on a given area is determined by: 1) the speed of the aircraft, 2) the tracking space used, and 3) the flow rate of pesticide through the booms.

D.1.1 Aircraft Speed

The working speed of an aircraft during actual spray activities may be less than the ferry speed to the block. Speed can be expressed in **knots, miles per hour or kilometres per hour**. Check with the pilot to confirm the unit of measure he uses when stating his speed. The working speed can be confirmed by measuring the actual time it takes to fly over a known distance.

D.1.2 Track Spacing

Track spacing is the distance between flight lines on a spray block. It is determined by averaging several effective swath measures for a particular aircraft/spray gear combination. It is MNR's practice to specify the track spacing that a particular aircraft type must fly on crown programs when tendering for aircraft services occurs, i.e. the track spacing of the spray aircraft is specified in the spray contract. Further adjustments of track spacing would not normally occur once aircraft bids have been submitted.

D.1.3 Total Swath

The total swath of a spray application is a measure of the distance that measurable spray deposit is recorded. The total swath would include deposits at the swath extremities that will be insufficient to be effective. The total swath varies as the volume applied, aircraft altitude and wind speed change.

D.1.4 Effective Swath

The effective swath is that portion of the total swath that deposits sufficient pesticide to meet pest control targets (Figure 14). The effective swath of a pesticide application will vary as atomizers (nozzles), flying height, wind speed and wind direction change.

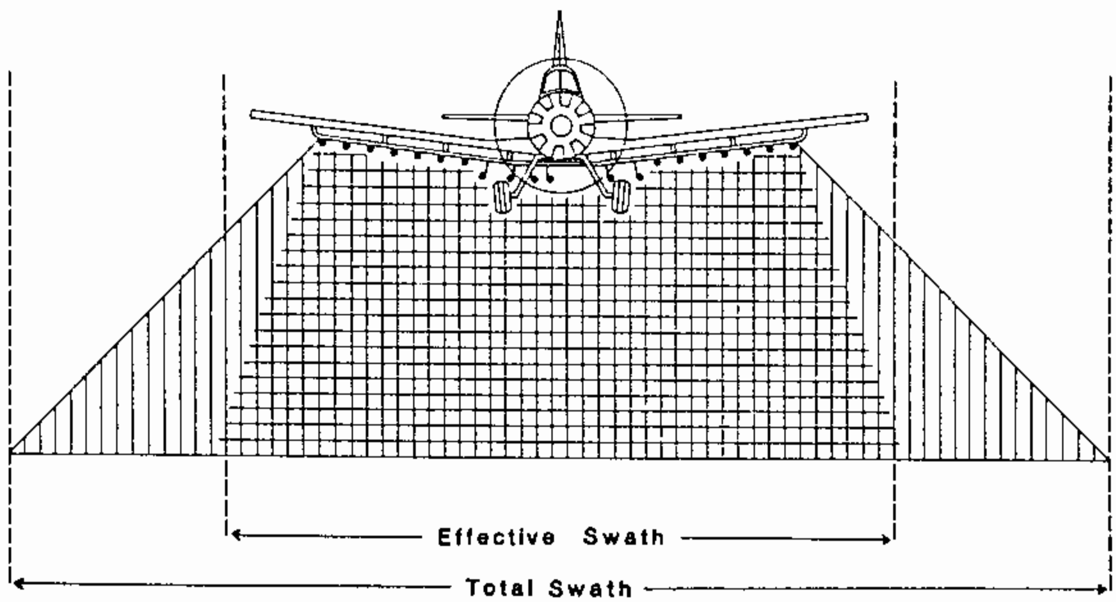


FIGURE 14. Aircraft swath widths.

D.1.5 Application Rate/Application Volume

The application rate is how much undiluted pesticide is applied on a hectare. It may be measured in terms of volume (i.e. 6 L of Vision per ha) or weight (2.1 kg of Vision per ha). Application volume is the mixed volume of pesticide, adjuvant plus carrier that is applied on a hectare. A typical application volume for forest herbicide applications in Ontario is 33 L/ha (e.g. 6 L of herbicide plus 27 L of water).

D.1.6 Active Ingredient

The active ingredient in a pesticide is the material in the formulated product that is responsible for the pest control activity of the product. The active ingredient of the biological insecticide Bacillus thuringiensis (B.t.) is measured as B.I.U. (Billion International Units of bacteria). In the case of the herbicide Vision the active ingredient is measured in grams of glyphosate.

Example: 1989 Spruce Budworm Project - Pesticide Applied

Name:	Futura XLV (B.t.)
Active Ingredient:	15.6 B.I.U./L applied at 30 B.I.U./ha
Application Rate:	1.9 L/ha
Application Volume:	1.9 L/ha*

***Note: applied without dilution.**

D.1.7 Flow Rate

This is the volume per minute that must be delivered by the spray aircraft in order to apply the prescribed spray volume.

D.2 Calibration Calculations

Calculations for calibrating aircraft are simple if they are approached in a step by step fashion.

Step 1: How much area will you cover in one minute?

You know: Aircraft speed = 178 kph (110 mph)
Track spacing = 50 m (162.5 ft)

You know your aircraft travels 178 km in one hour, so in one minute your aircraft travels:

$$\frac{178 \text{ km/hour}}{60 \text{ min/hour}} = 2.97 \text{ km/minute}$$

In one minute, your aircraft will spray an area that is 2.97 km long and 50 m (the track spacing given above) wide. Convert the 2.97 km to meters by multiplying by 1,000. Thus 2.97 km = 2,970 m

The area calculation is: A = length x width
= 2970 m/min x 50 m
= 148,500 m^2/min

Divide this number by 10,000 to convert square meters to hectares

$$\frac{148{,}500 \text{ m}^2\text{/min}}{10{,}000 \text{ m}^2\text{/ha}} = 14.85 \text{ ha/min}$$

Therefore Step 1 is solved. Your aircraft is spraying 14.85 ha in one minute.

Step 2: Determine Flow Rate/minute

Given: Application Volume = 4 L/ha
Area treated/minute = 14.85 ha/min

This is a straight forward calculation: you are treating an area of 14.85 ha with 4 L of material for each hectare. Therefore the volume required to treat that area (and the flow rate that the aircraft will need to obtain to apply the correct volume) is the product of the two givens:

Flow rate = 4 L/ha x 14.85 ha/min = 59.4 L/min

The four cornerstones of correct pesticide application are now known:

1. Forward speed
2. Track spacing
3. Application volume
4. Flow rate

With any three of these cornerstones, the fourth can be determined. The ability to perform and understand this calculation is important for an Application Boss.

D.3 Field Calibration

The calibration calculations will provide you with the numbers you need to calibrate your aircraft. Field calibrations are simply a matter of fine tuning the aircraft spray system so that your calculated spray parameters are obtained by a "real" aircraft.

D.3.1 Spray System Check

The purpose of this exercise is to check that the aircraft spray system is in working order.

1. Load a small amount of water in the aircraft using your loading system. Use your operational set-up, thereby checking that aircraft fittings and loading hose fittings are compatible.
2. Inspect the nozzles/atomizers and certify that they are correct in size (D8-46 is the recommended nozzle for herbicide work, but you are not limited to it; rotary atomizer set to the fastest possible rotational speed is recommended for insecticide work); clean; not corroded; that the suck back valves have clean diaphragms installed; and that their placement on the boom is correct.
3. Have the pilot run up the aircraft and spray the water on the ground while you check for:

   - Leaks in the system
   - Plugged or dripping nozzles/atomizers
   - Irregular spray pattern
   - Equal flow among atomizers/nozzles
   - Have the pilot demonstrate for you that his flowmeter is in working order

4. Have the pilot shut off the booms. Watch for:

   - Dripping nozzles (indicates suck back valves are not functional)
   - Have the pilot demonstrate that his dump door is working.

D.3.2 Flight Test

There are several variations that can be utilized in the next step in calibrating an aircraft. The following is a basic method.

1. Prime the system.
2. Load 100-130 L of water into the aircraft.
3. Have the aircraft fly at operational speeds and spray at approximate operational pressures. The pilot can find this by watching his flowmeter until he reaches the prescribed flow rate.
4. Once the pilot's boom pressure drops, have him shut down and return to base.
5. Load 3 minutes worth of spray simulant (water) (3 minutes = 3 times the flow rate) into the aircraft.
6. Have the pilot spray in a pattern circling the airstrip so that you can see his booms come on and shut off.
7. Measure the time it takes for the pilot to spray out.
8. Compare the actual time it took (what you saw the plane do) to your calculated time. If they are exactly equal, your aircraft is calibrated. Record the pressure the pilot was spraying at for future purposes. Verify that the aircraft flowmeter is functional. If the actual time is less than the calculated time, the aircraft is spraying too quickly. Instruct the pilot to lower his boom pressure and repeat the test flight. If the actual time is greater than the calculated time the aircraft is spraying too slowly. Tell the pilot to increase his boom pressure and repeat the test flight.

Once the actual and calculated boom times are within five percent, your aircraft is functionally calibrated.

D.4 Calibration Checks During the Spray Missions

Once the spray aircraft is working, calibration would normally just need to be monitored rather than flight tested. There are at least two methods of monitoring aircraft flow rate during each spray mission.

D.4.1 Flowmeter Check

All aircraft working on MNR projects are contractually obligated to have functioning flowmeters on board. Have the pilot read out the flowmeter readings over the radio during his spray session. Check the total showing on the flowmeter at the end of the load. The total should equal the volume you loaded in. This will verify that the flowmeter is still working properly. As a second check, compare the volume reading on the flowmeter with the volume required to treat the area the pilot thinks has just been treated. See the section on Area Check below for more details.

D.4.2 Area Check

Have the pilot show you, on a copy of the map or photo he is flying by, where he sprayed on the last load. While the next load is being flown, measure the area that has been treated. Divide the volume loaded on the last load by the area sprayed. The answer should be within 5% of your application volume.

<u>Example</u>: Area sprayed = 15 ha
Volume loaded = 520 L
Application Volume = 33 L/ha

520 L/15 ha = 34.6 L/ha

[(34.6 - 33)/33] x 100 = 4.8 %

As this is within the 5% margin of acceptable error, recalibration is not necessary. However, tell the pilot the spray is 5% heavy. Continue to monitor.

D.4.3 Time Check

Using a vantage point where you can observe the spray craft for an entire load, use a stopwatch to measure his actual boom time for the load. Then, divide the volume loaded by the calibrated flow rate. This will give you what the total boom time should have been.

<u>Example</u>: Boom time - actual = 1 min 45 seconds (1.75 min)
Volume loaded - actual = 520 L
Calibrated flow rate = 195 L/min

$$\frac{\text{Volume loaded}}{\text{Calibrated flow rate}} = \frac{520\ \text{L}}{195\ \text{L/min}} = 2.67\ \text{min}$$

In this case there is nearly a 50% margin of error. Check your calculations, the spray speed and the spray system on the aircraft. Too heavy an application rate is being applied.

D.5 Viscosity Errors

For most materials that are sprayed in Ontario, their viscosity will be similar enough to water's, so that water can be used as a calibration fluid. However it is possible that the spray material you are using flows more or less quickly than water, and thus may affect your flow rate calculations. Do a field check of viscosity by timing equal volumes of water and spray mix through your meter and the aircraft flowmeter (hook into the aircraft system in front of the flowmeter turbine and just after it and you will be able to recover all of your spray material). The ratio between the times (e.g. 120 seconds water/140 seconds spray mix) will be your correction factor as used in the exercise.

NOTE: **Temperature affects the viscosity of oil based pesticides.**

Contact Silviculture Section if you have any questions concerning the viscosity factor of the pesticide you are working with.

D.6 Droplet Calibration

Average droplet size, droplet spectrum and number of droplets per unit area all influence efficacy of insecticide and herbicide sprays. These parameters are determined by: nozzle number, type, size, and orientation; boom pressure; aircraft speed, and type; spray mix viscosity; and flying height. The number of drops per volume of liquid increases exponentially with decreasing droplet radius. Therefore the probability of making contact with a target surface is increased when small droplets are sprayed.

Droplet calibration is a complex and time consuming process and thus is not practical to attempt in the field. Consult Silviculture Section if necessary.

D.7 Nozzles

D.7.1 Nozzle Orientation (Figure 15)

The position that the nozzle is mounted on the boom in relation to the air flow (shear angle) affects the size of droplets produced.

D.7.2 Herbicide Nozzles

The D8-46 Core Nozzle mounted parallel to the air flow will provide the best droplet size for low volume herbicide work (20 - 50 L/ha).

D.7.3 Insecticide Nozzles

Rotary atomizers such as **Micronairs** (see Appendix 14, p 241) are usually used for ultra low volume work (1-10 L/ha). They will generate large numbers of smaller droplets.

D.7.4 Nozzle Placement

D.7.4.1 Fixed Wing

The position of the outboard nozzle cannot be more than midway on the aileron (i.e. 70% of a wing length) (Figure 16). In Ag-Cats the position of the outboard nozzle must be within the inside strut. Droplets sprayed from nozzles placed further outboard will be lost in the vortex generated by the wing tip.

D.7.4.2 Helicopter

The placement of the outboard nozzle cannot be more than 70% the length of the main rotor (Figure 17). Droplets sprayed from nozzles placed further outboard will be lost in the vortex generated by the main rotor.

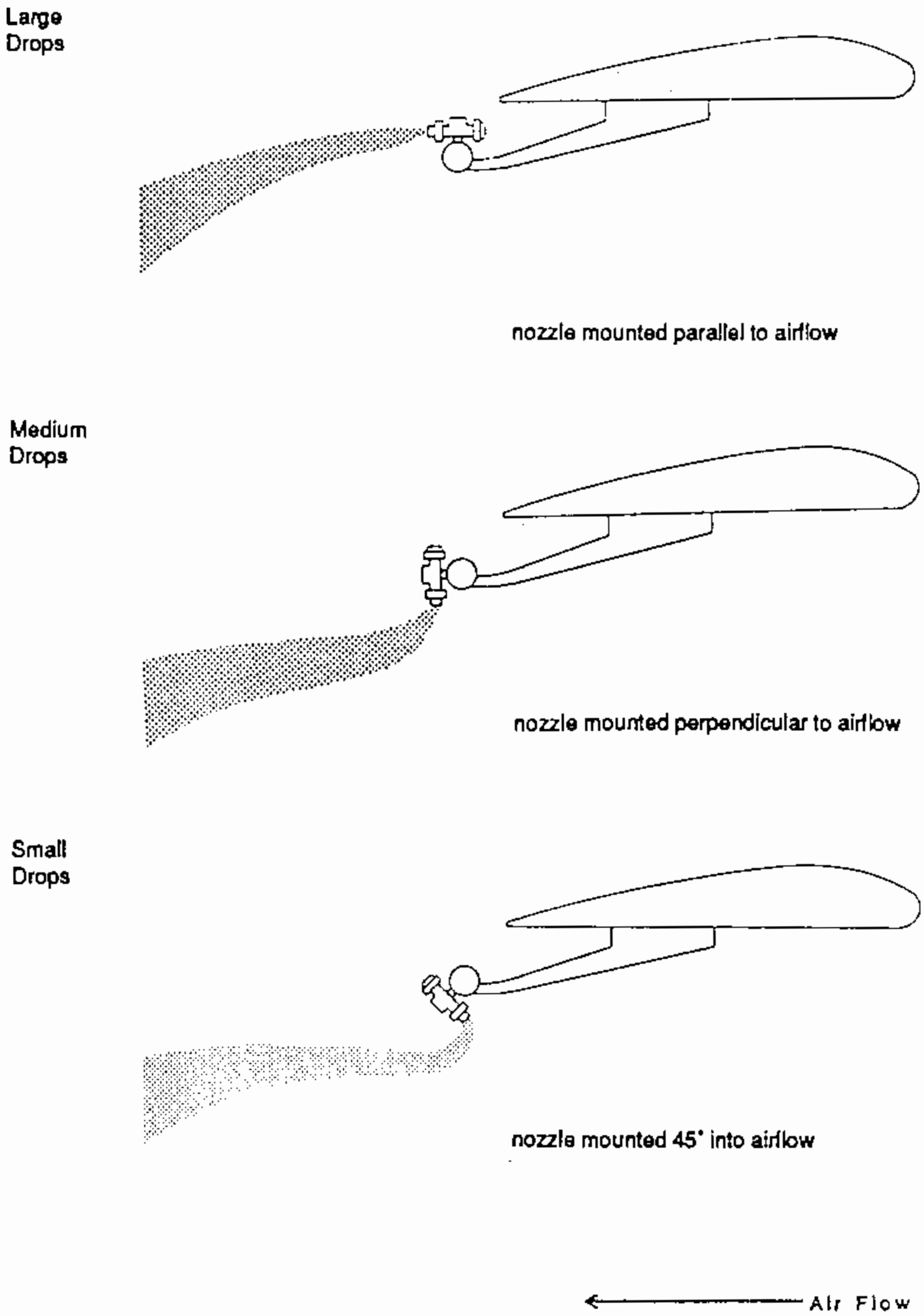


FIGURE 15. Nozzle orientation's affect on droplet size.

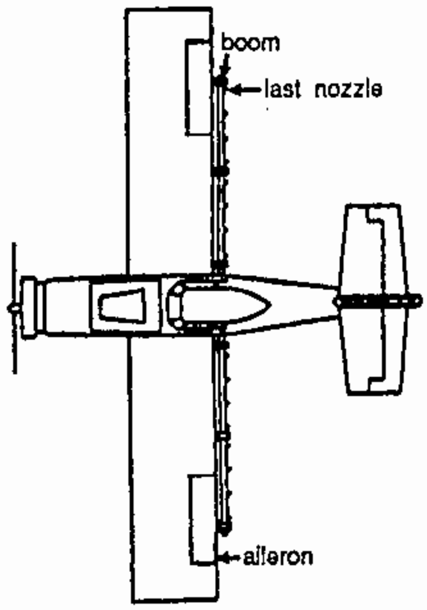


FIGURE 16. Nozzle placement on a fixed wing aircraft.

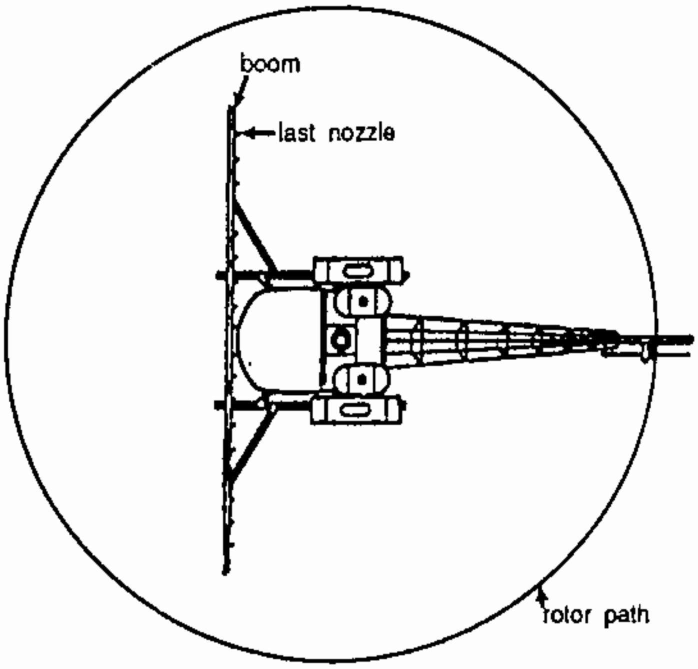


FIGURE 17. Nozzle placement on a rotary wing aircraft.

E. RADIO COMMUNICATIONS

Radio communications play a key role in aerial spray projects. The size of the project dictates the number and type of radios required. Two radio systems may be used: Aeronautical Radios and MNR FM[3] radio system. Aeronautical Radios are line-of-sight and thus have limited use on a project. **Anyone communicating via Aeronautical Radios must hold a valid Restricted Radio Operator's Licence.**

The federal Department of Communications assign Aeronautical Radio frequencies. Applications for frequencies used in specific localities must be made by your Regional Communications office.

E.1 Communications Links

The following are communications links which must be set up on a large aerial spray project. Smaller projects will require some variation from this organization.

E.1.1 Specific Linkages - see Figure 18

1. Application Boss to Air Traffic Advisor (ATA): The Ministry FM[3] system should be used to keep the Application Boss **informed of incoming aircraft**, and **advised when Pointers request the dispatch of spray aircraft to the spray block**. The Application Boss will notify the Air Traffic Advisor when the spray aircraft are ready for dispatch.

2. Application Boss to Loading Crew and Fuelling Crew: On MNR FM[3] system. Radios equipped with head sets are an asset here because of noise levels in loading areas. This link is necessary to advise loading crew of how much pesticide and fuel is required. A discreet frequency may be required to avoid excess traffic on base set.

3. Application Boss to Pilots While On Ground: If personal communication is difficult, the Aeronautical band radios may be used. This link is necessary for the pilots to advise the Application Boss of pesticide and fuel requirements and for the Application Boss to give further instructions to pilots.

E.1.2 General Linkages - see Figure 19

1. Base to District Office: If a telephone is unavailable the MNR FM[3] system may be used. This is the only link to the outside world and is very necessary in case of emergencies. Up-to-date weather forecasts, daily progress reports, messages, etc. are essential information for the project.

2. Base to Aircraft: Done on Aeronautical radios by Air Traffic Advisor. Messages and flight instructions, i.e. dispatch spray aircraft, spray aircraft returning to base, change in plans, divert to alternate block, take-off or landing advisory, are transmitted over this communication link. **Note: Aircraft must report to base every 30 minutes or emergency procedures must begin.**

3. Base to Airstrip Security: Done on MNR FM[3] system - Notice of incoming aircraft, airstrip secure from vehicular traffic, etc.

4. Pointer Aircraft to Spray Aircraft: Done on Aeronautical radios. Navigators pass instructions to the spray aircraft pilots. If 2 or 3 teams are working from the same airstrip it may be necessary to assign a discreet frequency, other than the ATA frequency, to each spray team to avoid confusion.

5. Aircraft to Spray Block: Done on Aeronautical Radios. Establishes contact between spray block and aircraft for spray block security, performance of spray aircraft, relocation of ground staff, weather information, etc.

[3] Alternative communication systems are radio telephones and walkie talkies.

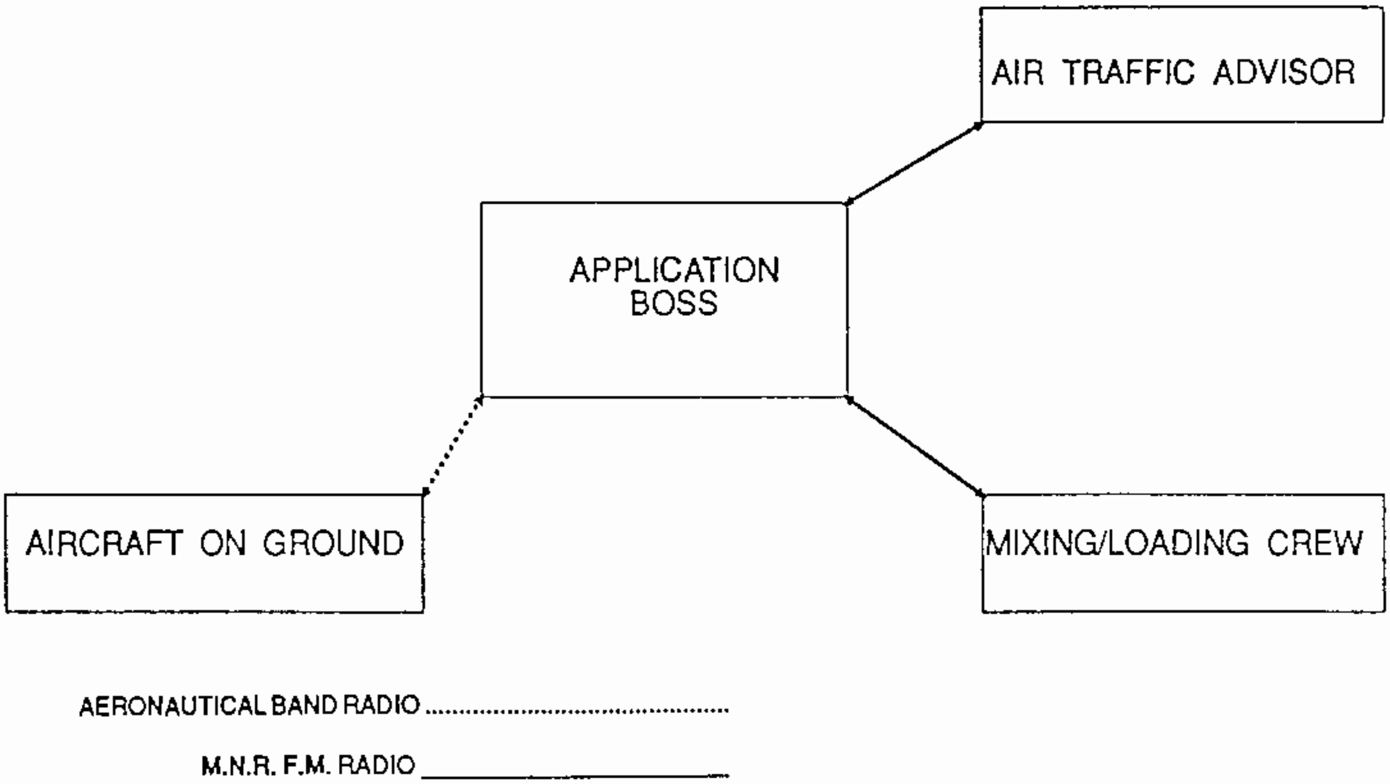


FIGURE 18. Communication links specific to Application Boss.

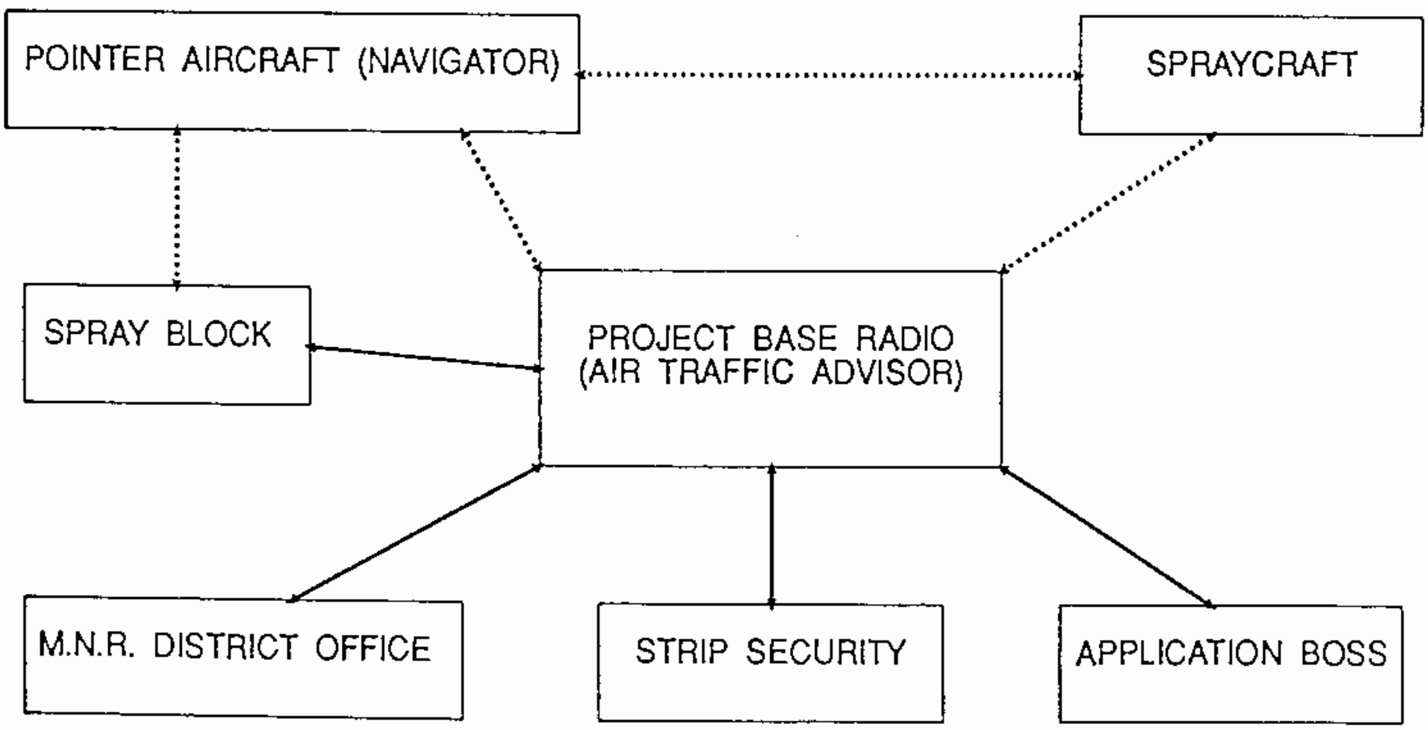


FIGURE 19. General communication links beyond Application Boss's area of responsibility.

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PART 3: OCCUPATIONAL HEALTH AND SAFETY

A. SAFETY OFFICER

The Safety Officer's function is to make sure that the spray project is carried out safely. The Safety Officer is outside the chain of command. Depending on the project size, safety responsibility could be linked with another function. Normally the Safety Officer operates in a staff position, not as a line supervisor. This provides him/her with an equal interactive role with all functions on the project. In addition it identifies the major part that safety plays in accomplishing project objectives.

Whether or not a Safety Officer will be required on an aerial spray project, will be determined by the District Manager, in consultation with the Project Supervisor and the Regional Safety Officer. A Safety Officer is required on a project that is too large or complex for the Project Supervisor to be confident that she/he can competently oversee health and safety concerns, over and above supervising the project.

A.1 Responsibilities of a Safety Officer

1. Responsible to the Project Supervisor and only for the on site Safety Program.
2. Develops a safety guide specific to the site, using the Regional plan and the Hazard Identification Model (pp 117-124) as guides.
3. Completes daily safety check sheet (see pp 105-109) and presents his/her findings to the Project Supervisor for consideration.
4. Advises staff on Health and Safety matters, such as interpretation of the Ontario Health and Safety Act (pp 87-93), Workplace Hazardous Materials Information System (pp 114-116), aircraft safety (pp 98-105).
5. Develops on site emergency procedures for crashes, spills, fires, etc. (pp 56-80).
6. Establishes contact points with Search and Rescue, the Ministry of the Environment, and the Ontario Provincial Police (pp 67-72, 74).
7. If accommodations and eating facilities are on site, arrange for regular drinking water tests and one inspection by the County Health Inspector prior to camp opening.
8. Familiarizes himself/herself with all aspects of the spray program.
9. Posts Health and Safety documents, and warning signs (pp 54-56, 98-105) as required.
10. Arranges for on site dry runs for the Emergency Response Team (p 58).
11. Checks and restocks first aid kits and items as required (pp 62-64). Checks fire extinguishers regularly (p 112).
12. Administers first aid and completes necessary Worker's Compensation Board forms (pp 63-64, 76-80).
13. Visits sites of mobile units and makes recommendations to Project Supervisor.
14. Investigates all personal injuries, motor vehicle accidents and other occurrences (shares this information with other Safety Officers).
15. On site training as required and identifies hazards of the workplace and ensures all staff are aware of them (pp 117-124).
16. Liaison with District Joint Health and Safety Committee.

B. PESTICIDES

B.1 Toxicity and Labels

The information contained in the next few pages is a brief outline of pesticide toxicity and labels. It is by no means complete and readers should review the information contained in the "Pesticide Handling, A Safety Handbook" published by Health and Welfare Canada.

"Pesticide" is an all inclusive word meaning "killer of pests." Only chemical pesticides are considered here. The most common chemical pesticides used in forestry are insecticides, herbicides, fungicides and rodenticides. Some other chemical pesticides would be miticides, algicides, piscicides, nematocides.

Pesticides are in formulations such as solutions, suspensions, emulsions, dusts, and granules. A formulation is made up of a carrier such as water, oil or claylike powder to which an appropriate amount of chemical active ingredient is added and mixed.

The toxicity of the material being used is one of the most important considerations for safe use. Toxicity is generally rated on an LD_{50} (Lethal Dose 50%) basis as outlined in the following from the "Pesticide Handling, A Safety Handbook."

> Lethal Dose 50% (LD_{50})
>
> The standard term for rating acute oral or dermal toxicity is the LD_{50}. The LD_{50} value is a statistical estimate of a chemical dose which, when administered, will kill 50 percent of the test animals within a stated period of observation (24 hours - 7 days). The test animal is usually a rat, mouse or rabbit. LD_{50} values are only estimates for humans.

The figures which designate the LD_{50} values are expressed in milligrams of dose per kilogram of body weight of the test animal. Thus the chemical dose to kill a large animal (1,000 kg) is greater than the dose to kill a small one (100 kg). In simple terms "the smaller the LD_{50} value the greater the toxicity".

Toxicity varies with the type of absorption into the body. Oral, dermal, and respiratory exposure routes are the most common; LD_{50} values may be available for all the various exposure routes. Oral and dermal LD_{50} are the most widely used values.

Each individual group of chemical compounds has its own characteristic effect. Knowing which chemical group a particular pesticide is in will help in determining the precautions to be taken. A brief description of the different chemical groups can be found in the Pesticide Handling, a Safety Handbook. Oral and dermal LD_{50} values for most pesticides are in the handbook.

Although all pesticides have some degree of toxicity it is important to remember that all chemicals are toxic. Table salt has an oral LD_{50} of 3,300 while glyphosate (herbicide) has an oral LD_{50} of 4,320. Caffeine has an LD_{50} of 200 (equivalent to 140 cups of coffee). Thus glyphosate is less toxic than either caffeine or salt. Although a chemical may be toxic it becomes a hazard only when abuse or negligence is introduced. A chemical with low toxicity combined with high exposure can be as hazardous as a very toxic chemical with low exposure. With pesticides, not using the recommended safety protection would create a hazard.

In Ontario pesticides are classified into six schedules based on their toxicity, environmental or health hazard, persistence, concentration and usage. See "Ontario Classification of Pesticide Products" for an outline of the criteria used for scheduling pesticides in Ontario (pp 52-54).

The registration number (P.C.P. number) found on the pesticide label is specific only to that pesticide. A complete listing of all the pesticides registered for use is contained in the Index of Agent Codes (Government of Ontario). This publication contains the product name, its registration number, the registrant, and the Canadian Agent along with their addresses. If for some reason, you only have the pesticide registration number or only the pesticide name, you could use this information and the Index of Agent Codes to further identify the product and its manufacturer and agent.

The label on the pesticide container is important and should be read before the product is used. The label contains the following important information; P.C.P. number, guarantee (active ingredient and concentration), trade name, precautionary and protective measures, directions for use, first aid, and poison symbol. The poison symbols are shown in Figure 20.

Knowing the pesticide you are working with, its toxicity, possible effects on humans, and using the recommended protection to reduce exposure as outlined on the label, are common sense items which contribute to safe handling of the pesticide.

		LD_{50} VALUE
DANGER	POISON	0-500
WARNING	POISON	500-1000
CAUTION	POISON	1000-2500

FIGURE 20. Poison symbols as relate to oral LD_{50}.

B.2 Pesticide Handling

There is a great deal of data that confirms that if pesticides are handled as intended, they should not create human health or environmental problems. Problems occur through negligence or accident, where exposure to the pesticide is longer than intended.

Twelve rules of pesticide safety are:

1. ALWAYS be familiar with the pesticide being used:

    a) Read the label;
    b) Obtain, read and post current fact sheets on the pesticides which are available from the pesticide suppliers;
    c) Know the LD_{50} and recommended emergency first aid procedures (if seeking medical aid take the label and/or container with you).

2. ALWAYS inspect pesticide containers for leaks before handling.
3. ALWAYS inspect pesticide vehicles for spills after unloading, taking precautionary measures as required.
4. Should a leak or spill occur, contain the spill, restrict traffic through the area, decontaminate thoroughly and advise Project Supervisor.
5. NEVER handle containers roughly or carelessly.
6. ALWAYS wear required protective clothing.
7. ALWAYS dispose of or decontaminate protective equipment.
8. ALWAYS wash hands thoroughly after handling any pesticide.
9. NEVER store pesticides or empty pesticide containers near food, drink (including that for animals) or clothing.
10. DO NOT bring contaminated items into the living areas.
11. NEVER eat, drink, or smoke in a pesticide work area.
12. NEVER rub the eyes or touch the mouth while working with pesticides.

It is recommended that copies of these twelve rules be prominently displayed in every work area.

B.3 Ontario Classification of Pesticide Products[4]

Under the authority of the Pesticides Act, and regulations administered by the Ministry of the Environment, all federally registered pesticide products sold in the Province of Ontario must be classified and assigned a schedule.

The classified pesticides are listed by their P.C.P. number (Registration number) in their assigned Schedule in a publication entitled "Index of Canadian Agent Codes".

Pesticides are classified into six schedules on the basis of their toxicity, environmental or health hazard, persistence of the active ingredient, or its metabolites, concentration and usage. The classification system is aimed at controlling the distribution, availability and use of pesticides in Ontario.

A procedure has been put in place to streamline the classification process for pesticide products. This procedure provides for "interim status" products. These products are proposed by the Minister for inclusion in a schedule to Regulation 751, and the proposal is published in the Ontario Gazette. A person who sells or uses such a product as if it were in the specified schedule, is exempt from the prohibition against sale or use of an unscheduled product.

In practice, the procedure to classify new pesticide products is as follows:

1. Notice of proposed scheduling of products recommended by the Ontario Pesticides Advisory Committee and approved by the Minister of the Environment will be regularly published in the Ontario Gazette as "interim status" products.
2. Once such a notice has been published, a pesticide product can be legally sold, used, stored, displayed or transported provided it is treated as being in the schedule specified in the notice.
3. The "interim status" of products remains in effect until:

   a) A revocation of the listing is published in the Ontario Gazette;
   b) Eighteen months have expired since the listing was published in the Ontario Gazette; or
   c) The product is placed in a schedule to Regulation 751 by a regulatory amendment.

4. The "interim status" of a product will be reviewed within eighteen months of publication in the Ontario Gazette and will be considered for placement in one of the six schedules to Regulation 751.
5. A product which has been placed in a schedule to Regulation 751 retains this classification until changed or revoked.

Under the new system pesticide products will continue to be carefully reviewed for toxicity, environmental or health hazards and persistence by the Ontario Advisory Committee and the Ministry.

The following is a brief outline of the criteria used for scheduling pesticides in Ontario and is meant as a guide for candidates preparing for their Operator's and Exterminator's licences.

B.3.1 Schedules 1 and 5

Schedule 1 pesticides are restricted and can only be used by the holder of specific use permit. Schedule 5 pesticides are limited to application on agricultural land.

Criteria used for defining Schedule 1 include:

1. Pesticides that pose a serious hazard to public health and/or natural environment.
2. Pesticides exhibiting:

   Acute oral LD_{50} (single dose - mg/kg) of 0-50
   Acute dermal LD_{50} (single dose - mg/kg) of 0-100
   Inhalation Limits LC_{50} (continuous for 8 hours - mg/L air) of 0-2, e.g. methyl bromide

[4]From MOE Factsheet 30-01-01, January, 1987.

3. Pesticides which are persistent and/or give rise to persistent metabolites that produce undesirable side effects on non-target organisms either by acute or chronic toxicity, e.g. DDT.
4. Pesticides which through their mode of action may inflict unnecessary suffering to vertebrate pests.

Criteria used for defining Schedule 5 include:

1. Pesticides that pose a serious hazard to public health and/or the natural environment.
2. Pesticides exhibiting:

   Acute oral LD_{50} (single dose - mg/kg) of 0-50
   Acute dermal LD_{50} (single dose - mg/kg) of 0-100
   Inhalation Limits LC_{50} (continuous for 8 hours - mg/L air) of 0-2

3. The lack of less hazardous control products which could provide adequate protection to agricultural crops.

B.3.2 Schedule 2

Pesticides in this schedule are restricted to agriculturists, licenced exterminators and registered custom sprayers.

Criteria used for defining Schedule 2 include:

1. Organic pesticides that do not present problems of long term persistence or accumulation in biological tissues and those inorganic pesticides that may present a degree of hazard to the environment.

2. Pesticides exhibiting:

   Acute oral LD_{50} (single dose - mg/kg) of 50-500
   Acute dermal LD_{50} (single dose - mg/kg) of 100-1,000
   Inhalation Limits LC_{50} (continuous for 8 hours - mg/L air) of 2-20

B.3.3 Schedule 3

Schedule 3 pesticides are available to the home owner. Hazards are considered minimal for the use to these pesticides.

Criteria used for defining Schedule 3 include:

1. Pesticides exhibiting:

   Acute oral LD_{50} (single dose - mg/kg) of 500-5,000
   Acute dermal LD_{50} (single dose - mg/kg) of 1,000-10,000
   Inhalation Limits LC_{50} (continuous for 8 hours - mg/L air) of 20-200

2. Pesticides should pose minimal hazards to the environment and to public health.
3. Organic pesticides that are short-lived and do not produce either persistent or toxic metabolites.
4. Those organic pesticides that present a minimal environmental hazard.
5. Product residues should not pose a problem when 'empty' containers are disposed of in municipal garbage.

B.3.4 Schedules 4 and 6

Schedule 4 products are those that can safely be handled by any type of outlet and would be available for sale in food handling establishments. They must carry a federally approved domestic label.

Schedule 6 products are identical to those in Schedule 4 but there is no limit to package size and the product may be designed for commercial use.

Criteria used for defining Schedules 4 and 6 include:

1. Pesticides exhibiting:

   Acute oral LD_{50} (single dose - mg/kg) of greater than 5,000
   Acute dermal LD_{50} (single dose - mg/kg) of greater than 10,000
   Inhalation Limits LC_{50} (continuous for 8 hours - mg/L air) of greater than 200

2. Pesticides that are of no known hazard to the environment or domestic pets.

B.4 Toxicological Testing

Test animals for toxicological data in order of preference are:

1. Primates
2. Dogs and cats
3. Rodents
4. fish and birds

Classification is based on lowest valid LD_{50} values. Other effects considered - carcinogenesis, etc.

C. GUIDELINES FOR THE STORAGE, DISPOSAL AND TRANSPORTATION OF PESTICIDES[5]

To meet the requirements under The Pesticides Act, the following guidelines must be observed:

C.1 Pesticide Storage

1. Pesticides must be stored in an area that is used exclusively for the storage of pesticides. There must be sufficient separation between pesticides storage and the storage of other commodities to avoid contamination of those other products.

2. Only pesticides and pesticide adjuvants (e.g. emulsifiers, diluents, spreaders and dyes) must be stored in this building, room or part thereof.

3. If the area used for pesticides storage is later used for other purposes, it must be decontaminated.

4. Insecticides, herbicides and fungicides should be stored separately.

5. The storage area should be screened and ventilated to the outside atmosphere.

6. Placards should be posted on the doors bearing the words "Chemical Storage, WARNING, Authorized Persons Only" (suitable signs are available from the Ministry of the Environment).

7. The building or room should be lockable to control access and the responsibility for security should be assigned to one staff member. No one should be able to enter the storage area without authorization.

8. There should be no floor drains unless they flow into a separate holding tank which can be pumped out and the spill disposed of in accordance with Regulation 309 under the Environmental Protection Act.

[5]From MOE Factsheet 30-01-03 February 1990, MOE Factsheet 30-01-04, March 1986 and the 1988 publication of the Ontario Pesticides Act. For further information please contact your nearest Regional or District office of the MOE.

9. Protective clothing must be readily available, e.g. neoprene or rubber gloves, hat, coveralls, boots, eye and respiratory equipment adequate to protect the person from adverse effects of the pesticides that will be stored and handled in the area. This equipment should be stored so that it does not become contaminated (for example, in an adjacent room or in polyethylene bags).

10. Place emergency telephone numbers in a prominent place. Such emergency numbers must include the Doctor, Poison Control Centres, Fire, Police, Spills Action Centre, Ministry of the Environment Pesticides Control Officer and Natural Resources Officer responsible for the area.

11. Absorbent material (such as sawdust, soil or rags) should be available in sufficient amount to clean up any spills or leaks from containers. See the Pesticides Safety Handbook, Ministry of the Environment, pages 45-46 for decontamination of equipment.

12. To prevent breakdown or inactivation of pesticides, they should be stored in a cool, dry area. Some pesticides can tolerate sub-zero temperatures, others cannot. You should check the label for any special storage requirements in winter.

13. Pesticides should be stored in their original labelled containers. If you must change containers, a manufacturer's label must be attached to the new container.

14. Any new building or new storage structure should be placed so as to avoid contamination of watercourses in the event of a spill, explosion or fire. For existing buildings, modifications should be made to the building and surrounding terrain so that run off will be contained.

15. Wash-up facilities with adequate supplies of soap and water should always be available.

16. Regulations require that MOE be notified of any fire, or spill where there is environmental impact. Any fire, spill or theft of pesticides must be reported to the Spills Action Centre.

17. Only trained personnel wearing adequate protective equipment should clean up spills.

C.2 Airfield Storage

1. Temporary storage locations should be near the airstrip, away from a watercourse such as a lake, stream or river. The distance from a watercourse will depend on the soil type, slope and topography of the area. Advice on a suitable location may be obtained from the local Pesticides Control Officer. It may be desirable to dig a ditch around the storage area to contain any spills and prevent contamination of the surroundings.

2. A pesticide transport vehicle or trailer may be used as a temporary storage area. If no trailer is available the containers must be fenced off using snow fence or tarpaulin and sufficient security measures taken so that only authorized persons have access to the pesticides.

3. A placard should be posted at each entrance bearing the words: "Chemical Storage, WARNING, Authorized Persons Only".

4. Pesticide container deterioration should be guarded against by the use of pallets, appropriate ground sheets, or a tarpaulin, if the type of container warrants it.

5. Protective clothing such as neoprene or rubber gloves, hat, coveralls, boots, eye and respiratory equipment must be readily available at the storage area. This equipment should be stored so that it does not become contaminated (for example, in an adjacent room or in polyethylene bags). Such clothing should be adequate to protect the person from possible adverse effects of handling pesticides.

6. A communications system, such as a radio, is recommended for contacting personnel in an emergency.

7. Sufficient absorbent material, decontaminants and equipment should be available to clean up any spills or leaks from containers (see pp 64-65).

8. Wash up facilities, including a large supply of soap and water, should always be available.

C.3 Disposal

1. Before puncturing, wash (triple rinse) all empty containers and add washing to the spray tank.

2. Puncture the bottoms of containers and crush them. Dispose of the containers in a landfill site **approved** by the District Pesticides Control Officer, Ministry of the Environment or bury under a minimum of 50 cm of soil in a site away from a watercourse. Alternatively, recycle the containers through a company which has suitable facilities or return to the pesticide manufacturer. Contact the Silviculture Section for advice on recycling pesticide containers and for names of companies capable of recycling containers, or contact your local MOE office.

C.4 Transportation

1. Never leave pesticides unattended in parked vehicles unless the vehicle is locked or parked in an area to which the public is denied access.
2. A sign indicating "Chemical Storage, WARNING, Authorized Persons Only" must be placed on unattended vehicles containing pesticides.
3. Pesticides should not be transported with food, drink, fertilizer, live plants, seed, toiletries, clothing, bedding or similar commodities, unless they are separated in such a manner to prevent their contamination by the pesticide(s).
4. Pesticides should be transported by a road vehicle only if the pesticide is secured in such a manner as to prevent its escape or discharge. See pages 97-98.
5. Vehicles transporting large quantities (over 500 litres) of pesticides must be placarded with a chemical warning sign at all times.

C.5 General

Pesticide labels must be consulted for any special precautions relating to the storage, disposal, handling, use and transportation of the pesticide.

Equipment used for filling spray tanks from water bodies must have a device to prevent back-flow.

Damaged or leaky containers must be emptied into containers similar to the original ones and labelled with the original labels. Empty containers should be decontaminated and disposed of as above.

Applicators should remove contaminated clothing and have them cleaned separately from the general laundry.

If you have any problems regarding the handling of pesticides you should contact your local MOE office.

D. EMERGENCY PLAN

MNR must have a contingency plan for any foreseeable emergency, including the points listed below. These points shall be addressed as part of the Safety Plan (see pp 10-11 and 163-164).

- Downed aircraft on or off site
- Fuel or chemical spills
- Motor vehicle accidents
- Structural, fuel or chemical fires
- Personal injuries
- Medical emergencies
- Equipment failures

Emergency response may be provided by MNR personnel, contracted emergency agencies, or by contractor's personnel. The following are the recommendations for an MNR Emergency Response Team.

D.1 Emergency Response Team

The Project Supervisor will recommend the need of an emergency response team to the District Manager and the Regional Health and Safety Specialist, and they will determine whether an emergency response team will be established. The scope and limitations of this team will be determined before the projects begins.

D.1.1 Qualifications for Emergency Response Team Members

The recommended requirements for team members:

- Valid Standard First Aid and C.P.R. Certificates
- Some Safety Training or background

D.1.2 Training for Emergency Response Teams

An aggressive training program for all team members must be conducted prior to the start of the spray program. This ensures the best possible response to emergencies. The training should include:

- Transportation of Casualties
- Fire Suppression
- Aircraft Extrication
- Search and Rescue Procedures
- Helipad Construction
- Helitac Procedures
- Evidence Preservation
- And others as may be required due to special circumstances

D.1.3 Team Members Designation

Each team member should be assigned specific jobs and duties to be carried out during an emergency. It is important that members understand each others jobs as they may be called upon to assist at any time. A standard team of four should be designated: a First Aid Leader, a Fire Leader (one of these two should be the team leader), a First Aid Assistant and a Fire Assistant. As an option one team member (i.e. the Radio Operator or Project Supervisor) may standby to make the necessary calls to outside emergency agencies, while the emergency team is responding.

D.2 Emergency Alerting System

An Emergency Alerting system is important because during spray program operation (when most emergencies occur) team members will be scattered. Suggested systems are:

- horns, bells or sirens
- 2 way radio communications with all team members
- flashing lights placed about the site

If radios are used a word code system is required, e.g., **Code Yellow** - standby; **Code Red** - response; **Code Green** - stand down. If alarms or lights are used then team members must report to a predesignated location for information prior to responding.

D.3 Emergency Response Equipment

The following is recommended; additional equipment may be added.

- 5	20 lb. ABC fire extinguishers.	- 1	axe and shovel.
- 7	emergency blankets.	- 1*	chain saw and kit (with 50' rope).
- 1	collapsible stretcher.	- 1	basket stretcher.
- 1	long board with straps.	- 1	short board with straps.
- 1	collapsible long board with straps.	- 7	cervical collars.
- 1	air splint set.	- 1	15 Man First Aid Kit.
- 1	Burn Trauma Kit.	- 3	water bottles.
- 6	cold packs.	- 1	beal tool.
- 1	bolt cutters.	- 1	paramedic scissors.
- 1	seat belt cutter.	- 1	Come-a-long.
- 2	50" Lanyards.	- 2	ropes (1 @ 150' - 1 @ 250').
- 1	compass.	- 5	insect repellent.
- 1	package cheese cloth.	- 2	flashlights (radar).
- 1	pack sack.	- 5	pairs work gloves.
- 1	roll duct tape.	- 5	rolls flagging tape.
- 1	MH-10 with spare batteries.	- 1	emergency response vehicle (1/2 ton, van ,truck, or car).

*MUST HAVE CHAIN SAW CERTIFICATION

In addition, each team member should have: cotton coveralls or turnout gear; hard hats with eye, hearing, and face protection attached; personal First Aid Kit.

D.3.1 Equipment Placement

Although most of the Emergency Response Equipment will be kept on board the Emergency Response Vehicle, duplications can be placed at the office or First Aid room. The equipment of team members should be placed to allow fast pick up.

D.4 List of Emergency Telephone Numbers

A list of emergency telephone numbers should be posted at the airstrip telephone (if available) or with the radio operator at the District Office to ensure a quick response from outside agencies.

D.5 Dry Runs

Dry runs of various emergency situations should be carried out to ensure that spray operation personnel know emergency procedures.

D.6 Emergency Situations

The person who witnesses an emergency situation must report the emergency to the person in charge of the emergency alerting system, who then activates the system. Only Emergency Response Team members are to approach the accident site; other personnel would hamper rescue attempts. Attempts to rescue casualties are to be made only if it is safe to do so - additional casualties will make rescue more difficult.

D.6.1 Aircraft Emergencies

A checklist for suggest items for a survival kit for aircraft is listed in Appendix 4 (p 173).

D.6.1.1 Definitions and Reporting Procedures

"Aviation Occurrence" means: any accident or incident associated with the operation of aircraft; and any situation or condition, if left unattended, could induce an accident or incident described above.

"Accident" means any aviation occurrence where, at any time from the first person boarding an aircraft for the purpose of flight to the last person leaving the aircraft after the flight:

1. A person, other than a stowaway, sustains a serious or fatal injury, that is not self-inflicted or inflicted by another person or caused by natural causes, as a result of that person:
   a) being in the aircraft,
   b) coming into direct contact with any part of the aircraft, including any part that may have become detached from the aircraft, or
   c) being directly exposed to the jet blast or prop wash of aircraft.
2. The aircraft sustains damage or structural failure affecting the structural strength, performance or flight characteristics of the aircraft and normally requiring major repair or replacement of any affected part, other than damage or failure that is limited to:
   a) the engine, its cowlings, or its accessories,
   b) the propellers, wing tips, antennae, tires, brakes or fairings, or
   c) small dents or puncture holes in the aircraft skin.

"Incident" means an occurrence, other than an accident, that affects or may affect the safe operation of an aircraft.

D.6.1.1.1 Mandatory Reporting

See page 68.

D.6.1.1.2 After Accident Return to Service

The Director of Flight Operations or another person described in the air carrier's Operation Manual must approve, after consulting the pilot, an aircraft for flight following an accident involving damage to an aircraft.

Before granting approval for the commencement of a flight, the Director of Flight Operations shall satisfy himself that:

1. The procedures established for inspection and certification of the airplane after damage have been followed; and
2. The occurrence of the accident or incident was not attributable to the state of competence, fatigue or health of the pilot-in-command of that flight.

D.6.1.1.3 Aerial Spray Program Reporting Procedures - Accident

The Project Supervisor is to immediately advise the Regional Fire Centre Duty Officer of the following:

1. Type, nationality and registration mark of the aircraft.
2. Name of owner and company of the aircraft.
3. Name of the pilot-in-command of the aircraft.
4. Last known position of the aircraft.
5. Names and addresses of flight crew members and passengers aboard the aircraft.
6. Action being taken to locate the aircraft.
7. Position of the aircraft with reference to some easily defined geographical point.
8. Number of crew killed and number of crew seriously injured.
9. Number of passengers killed and number of passengers seriously injured.
10. Nature of the accident and the extent of damage to the aircraft, so far as is known.

The Regional Fire Duty Officer immediately advises the Assistant Director-Aviation, AFFM or his delegate of facts as known and any Regional action being taken to locate or assist.

The site of an accident involving an aircraft shall not be disturbed until the Department of Transport Accident Investigation team or Ministry are completely satisfied that removal of various aircraft components or other debris will not hamper investigation efforts and unanimously give permission for the clean up process to proceed.

D.6.1.1.4 Aerial Spray Program Reporting Procedures - Incident

The Project Supervisor files a full written report to the Assistant Director - Aviation, AFFM consisting of the following:

- Type, nationality and registration mark of the aircraft.
- Name of owner and company of the aircraft.
- Name of the pilot-in-command of the aircraft.
- Nature of the incident and the extent of damage to the aircraft, so far as is known.

D.6.1.2 Downed Aircraft on the Airstrip

1. The Emergency Response Team will perform fire fighting to the best of their ability and training, without endangering themselves, in order to reach the casualties.
2. Treat the casualties at the site if safe to do so, if not remove the casualties to a safe place, then administer first aid.
3. Attend to the people first then the aircraft.
4. The Project Supervisor must report aircraft incidents and accidents, and serious and/or fatal injuries as per the flow charts on pages 67-70.

D.6.1.3 Downed Aircraft Away from the Airstrip

1. The pilot of the downed plane, or a pilot witnessing/discovering a downed plane, radios the airstrip.
2. The Radio Operator notifies the Project Supervisor who calls Search and Rescue, and the Rescue Coordination Centre (Trenton or Edmonton) and render any assistance requested.
3. A description (colour, type, registration number, etc.) of all aircraft on the project should be recorded and posted near the radio. This may prove valuable should an aircraft go missing and Search and Rescue request an immediate description of the aircraft.
4. The Project Supervisor must report aircraft incident and accidents, and serious and/or fatal injuries as per the flow charts on pages 67-70.

D.6.1.4 Missing Aircraft

1. **All aircraft must call into the airstrip every 30 minutes or they will be considered overdue.**
2. If the Radio Operator has not had contact from an aircraft in this period the Radio Operator must inform the Project Supervisor.
3. The Project Supervisor will report a missing aircraft as per the flow chart on page 67, render assistance to search and rescue as requested, and fill out the Missing Aircraft Form (an example is on page 71).
4. A description (colour, type, registration number, etc.) of all aircraft on the project should be recorded and posted near the radio. This may prove valuable should an aircraft go missing and Search and Rescue request an immediate description of the aircraft.

D.6.1.5 Aircraft Flight Impairment

1. Affected pilot will notify other members of the team (spray aircraft and/or Pointer) of the problem. If flying alone notify the airstrip.
2. Team Leader (spray aircraft and/or Pointer) will notify airstrip of situation and advise of any pertinent information, i.e. action being taken, etc.
3. If possible, any aircraft with impaired flight will be accompanied by another plane on the return flight to the airstrip.
4. Wherever possible, the accompanying aircraft should be a Pointer. In the event of a mishap, the Pointer may be best equipped to map the exact location of a downed aircraft. Also, a Pointer aircraft will likely have more fuel.

5 a). If the affected aircraft is a spray aircraft the pilot will make the decision to attempt to return the payload and land it at the airstrip.

5 b). If the impairment of a tanker occurs en route to a spray block all members of the spray team will accompany the malfunctioning aircraft back to the airstrip and re-group.

6 a). If the impairment occurs during spraying to a tanker and there are two Pointers, the Lead Pointer will accompany the impaired spray aircraft back to the airstrip and the Number 2 Pointer will guide the balance of the spray team and finish the load. If Single Pointing, the Pointer will accompany the affected sprayer to the airstrip and the other spray aircraft may finish the load or return to re-group, as the situation warrants.

6 b). If a Pointer is impaired during double Pointing, the other Pointer aircraft will accompany the impaired one to the airstrip. The spray aircraft may finish the load themselves or return with the Pointers to re-group, as the situation warrants. If the Pointer is affected during Single Pointing, the spray team accompanies the Pointer aircraft to the airstrip as more than one aircraft will likely be needed to assist if the Pointer aircraft should go down en route.

7. In all situations the radio operator will advise the Project Supervisor of an inbound disabled aircraft.

NOTE: **At all times, avoid a cluster of orbiting aircraft over a crash site. It can very easily lead to other accidents. If it is necessary to orbit with more than one aircraft, then each should do so at a different altitude and maintain that assigned height. The best approach is to get as much information as possible about the crash situation as quickly as possible and forward it to the Project Supervisor so that an efficient rescue can be implemented. Assist as directed.**

D.6.2 Fires

Fire prevention is easier than fire fighting. Observe and enforce the no smoking zones around fuel and aircraft. If a fire does start,

1. The person who discovers the fire is not to rush in and jeopardize their safety; suppress the fire only if they are sure they are able to do so.
2. If she/he is unable to suppress the fire he/she must notify the person in charge of the emergency alerting system.
3. The Emergency Response Team will attempt to fight the fire only if they are sure it can be done with the equipment at hand.
4. Otherwise the Emergency Response Team will evacuate the area and call in fire fighting professionals, if available in your area.
5. In the case of an aircraft or vehicle fire the Project Supervisor follows the reporting sequence in the flow charts on pages 68 and 72, and fills out the Driver's Motor Vehicle Accident Report (an example is on page 73).

D.6.2.1 Pesticide Fires

1. Pesticide Material Safety Data Sheets should be reviewed, in advance, to determine hazards associated with pesticide fires.
2. The person who discovers a fire in the pesticide storage area is to immediately inform the person in charge of the emergency alerting system, she/he is not to attempt suppression.
3. Only the Emergency Response Team, wearing personal protective equipment, will attempt to fight the fire.
4. The Emergency Response Team will call in professional help even if able to suppress the fire, to be on the safe side if something were to go wrong.
5. The Project Supervisor is to report a fire in the pesticide storage area as per the flow chart on page 74 and fill out the Pesticide Incident Report Form if necessary (see p 75).

D.6.3 Personal Injuries

1. The person who witnesses an injury occurring or discovers a casualty is to notify the person in charge of the emergency alerting system.
2. The Emergency Response Team will treat the injuries following Standard First Aid procedures and transport the casualties to hospital if necessary.
3. The Project Supervisor must report injuries as per the flow chart on page 70.

All work related injuries must be reported on Worker's Compensation Forms (see pp 63-64, 76-80).

D.6.3.1 First Aid Requirements

According to the Workers' Compensation Board, First Aid Regulations (950) every employer shall provide and maintain a first aid station with a box containing the materials listed under the following conditions:

1. No more than 5 workers in any one shift
   - a current edition of a standard St. John Ambulance First Aid Manual
   - 1 card of safety pins
   - dressings consisting of
     - 12 adhesive dressings, individually wrapped
     - 4 sterile gauze pads, 3 inches square
     - 2 rolls of gauze bandage, 2 inches wide
     - 2 field dressings, 4 inches square or two 4-inch sterile bandage compresses
     - 1 triangular bandage

2. More than 5 but no more than 15 workers in any one shift
   - a current edition of a standard St. John Ambulance First Aid Manual
   - 1 card of safety pins
   - dressings consisting of
     - 24 adhesive dressings, individually wrapped
     - 12 sterile gauze pads, 3 inches square
     - 4 rolls of 2-inch gauze bandage
     - 4 rolls of 4-inch gauze bandage
     - 4 sterile surgical pads suitable for pressure dressing, individually wrapped
     - 6 triangular bandages
     - 2 rolls of splint padding
     - 1 roll-up splint

3. More than 15 but less than 200 workers in any one shift
   - a current edition of a standard St. John Ambulance First Aid Manual
   - 24 safety pins
   - 1 basin, preferably stainless steel
   - dressings consisting of
     - 48 adhesive dressings, individually wrapped
     - 2 rolls of adhesive tape, 1 inch wide
     - 12 rolls of 1-inch gauze bandage
     - 48 sterile gauze pads, 3 inches square
     - 8 rolls of 2-inch gauze bandage
     - 8 rolls of 4-inch gauze bandage
     - 6 sterile surgical pads suitable for pressure dressing, individually wrapped
     - 12 triangular bandages
     - splints of assorted sizes
     - 2 rolls of splint padding

In each of the above three conditions the employer shall ensure that the first aid station is, at all times, in the charge of a worker who:

1. holders a valid St. John Ambulance First Aid Certificate or equivalent,
2. works in the immediate vicinity of the first aid box.

D.6.3.2 Worker's Compensation Board Forms

1. Employee must report all work related injuries to his/her supervisor.

2. The supervisor must:

   a) Provide required First Aid and/or Medical Attention.
   b) Complete the record of all First Aid administered.
   c) Complete form 0156 (pink) if Medical attention required.
   d) Complete form 0007 (buff).
   e) Complete form 0009 (yellow) when required.

3. MNR First Aid Report Form 652 (white) completed for all First Aid or First Aid logged in a book. These records to be kept by District, available for inspection (p 76).

4. Employers Report of Injury, Form 0007 WCB (pp 77-78) completed for all medical aid or lost time injuries. Employers must report within three (3) calendar days all injuries either by Form 0007 or letter, otherwise a penalty may be assessed. Forms 0007 or letters must be sent as follows. Original and second copy to:

   Ministry of Natural Resources
   Human Resources Branch
   Occupational Health and Safety Section
   Room 4520 Whitney Block
   99 Wellesley Street West
   Toronto, ON
   M7A 1W3
   FAX: (416) 324-7309

   Third copy to MNR Regional Office
   Fourth copy to MNR District Office concerned.

D.6.3.2.1 Completion of Employer's Report of Accidental Injury or Industrial Disease Form (see pp 77-78)

Fill in this form as per instructions listed on reverse side of the form. The following points may aid you in filling out the form:

- The Firm Name is MNR Toronto M7A 1W3
- The Firm No. is 820111
- Rate No. - leave blank
- Phone No. is the number to be called concerning claim
- Plant, dept., etc., is your District and pertinent location within the District
- Worker Reference No. - leave blank
- Miner's Certificate No. - leave blank
- Date and hour of injury (obtained from the injured worker and/or witness)
- Date and hour injury was reported (may differ from time of injury)
- Doctors Name and Location (the doctor may be a Dentist, Optometrist, etc.)
- The signature at the bottom of the form must made by a responsible person NOT THE CLAIMANT

D.6.3.2.2 Completion of Employer's Subsequent Statement (see p 79)

This form shows the date the employee returned to work plus other information on that date. It must be completed for all lost time injuries other than those which have completed section (III) of lost time information on Employer's Report of Accidental Injury or Industrial Disease Form.

NOTE: **A follow up of the injured worker is important to ensure an early return to work.**

D.6.3.2.3 Completion of Treatment Memorandum (see p 80)

This form is to be completed and given to the injured worker's Doctor. This advises the Doctor that the worker is a MNR employee.

NOTE: **The above three forms (i.e. form 0007, 0009C and 0156F) will be replaced by form 905.**

D.6.3.2.4 Injury and First Aid Record (see p 76)

This is not a WCB form, it is an MNR form and must be filled out and kept on file for future reference at the District level. This form does not replace Employer's Report of Accidental Injury or Industrial Disease Form.

D.6.4 Fuel and Pesticide Spills

1. The person who discovers a spill is to notify the Application Boss.
2. The Application Boss will: notify the person in charge of the emergency response alerting system (if necessary for rescue or first aid); initiate containment; and clean up procedures (as outlined below), and will notify the Project Supervisor of a spill.
3. The Project Supervisor must report fuel and pesticide spills as per the flow chart on page 74. If personnel have been exposed to pesticides the Pesticide Incident Form (see p 75) must be filled out.

D.6.4.1 Guidelines for Handling Spills[6]

The following guidelines may be used for handling spills. **They are to be used to supplement information from the product label and other key agencies, not to replace it.** They are:

- Remove all persons and animals from the spill area. Extreme caution should be exercised in entering a contaminated area and adequate personal protective equipment should be worn.

[6] From MOE Factsheet 80-04-03, February 6, 1984 and the MOE's "Spills Response Program", Queen's Printer for Ontario, 1988 ISBN 0-7729-3210-7, and Health and Welfare Canada's "Pesticide Handling, A Safety Handbook", Canadian Government Publishing Centre, Ottawa, Canada, 1986.

- Apply general first aid, remove contaminated clothing, and thoroughly wash affected skin area with soap and water.

- Isolate the area so that no unauthorized person, animal or vehicle is exposed or contaminated by moving through the spill, or is exposed to fumes from the pesticide. Establish a decontamination line around the perimeter such that anyone entering the area must be wearing adequate protective equipment; and persons and/or vehicles leaving the spill area can be decontaminated.

- Contain the pesticide to prevent further environmental contamination, in particular water courses. If possible stop the leaking of a container. A barrier may be made of soil, sawdust, newspaper; or an absorbent material such as soil, sawdust, activated charcoal, vermiculite, or pet litter may be used.

- Call the following organizations to obtain appropriate information on the clean up and decontamination of the spill area in the order indicated: 1) the Spills Action Centre (telephone, 1-800-268-6060), 2) the local MOE Pesticides Control Officer, 3) the distributor or registrant of the pesticide product.

  First aid information and advice can be obtained from the local police, fire and/or works departments.

- Clean up of the spill area. Surplus liquid product should be pumped into drums. Small amounts of liquids should be soaked up using an absorbent. Dry powder or granular products should be lightly wetted or sprinkled with damp soil or sawdust. These materials should then be shovelled into a drum. If the spill occurred on the ground, it may be necessary to dig up the contaminated area and place the soil in drums. Leaky or damaged containers should be placed in a drum or heavy plastic bag. If the spill occurred inside a building, ventilate the area to prevent the build-up of toxic fumes.

- Decontaminate the spill area. Protective equipment must be worn and respirators may be needed because of the possible corrosive nature of solutions produced during the decontamination process. For roadways or hard packed areas such as concrete floors do the following. After removing the spilt pesticide, soak the contaminated area with a 1:1 mixture of bleach and water. Caustic soda or lye in water may be used instead of bleach. A dike placed around the spill area will prevent the spread of the decontamination solution. Then, without removing the chemicals, spread hydrated lime over the entire area and leave for 1-2 hours. After this period shovel the material into drums. Repeat the application of bleach in water (1:1 ratio) over the entire area and allow to stand for an additional 30 minutes. Then hose down the area with water and a detergent as final clean up. **Consult the label for specific instructions on decontamination since not all pesticides are detoxified by the above procedures.** For pesticide spills into soil do the following. Remove soil down to a depth of at least 5 cm below the limit of penetration. The removed soil should be placed in drums or bags for disposal.

- All equipment used in the clean up, as well as vehicles contaminated by the spill, should be decontaminated using the same procedures.

- Drums containing the clean up material should be covered and labelled "Spilled Pesticide - Poison" and with the trade name or common names shown. Drums should be transported to the disposal site designated by the local MOE office.

- All workers must take a shower, and change into clean clothing. Wash all clothing, boots, gloves, etc. with soap and water before re-use.

READ THE LABEL

D.6.5 Motor Vehicle Accidents

Motor vehicle accidents must be reported to the Project Supervisor who follows the reporting sequence on page 72. The employee involved in the accident must fill out the Driver's Motor Vehicle Accident Report (see p 73). This form is completed for damage to MNR owned or leased vehicles, other than wind-shields damaged by debris thrown from other vehicles on roadways. Most of the form is self-explanatory thus only that which may be confusing is covered. All spaces must be filled out or N/A (Not Applicable) substituted.

1. A police investigation is required:
   - If an injury occurs.
   - When a third party is involved.
   - When damage exceeds $700.00
   - When supervisors deem it necessary.

2. When a MNR vehicle is involved in a collision with a third party the MNR driver should approach the other driver regardless of the situation, with courtesy, no arguments, designate no blame. Exchange information necessary for insurance claims and form completion, i.e. Insurance Co., Ownership of Vehicle, Name, Address and Driver License Numbers. Attempt to get the Colour, Make, Model and License Number of the other vehicle. If third party is not receptive, wait for the police.

3. The damage estimate is an estimate. The cost for similar damages has gone from $100.00 to $700.00 in a few years. **If in doubt request an investigation.**

4. It is important that all injuries from all vehicles involved be recorded regardless of how minor they may seem. Use back of sheet if more room is required.

5. State the damage and specify the location and extent of damage, i.e. Front Bumper bent, Left Front Fender caved in, Left Headlight broken.

6. Record names of witnesses other than vehicle occupants. These may be necessary should there be charges arising from the incident, so it is important to obtain their names and addresses. Even the license number of cars can be helpful.

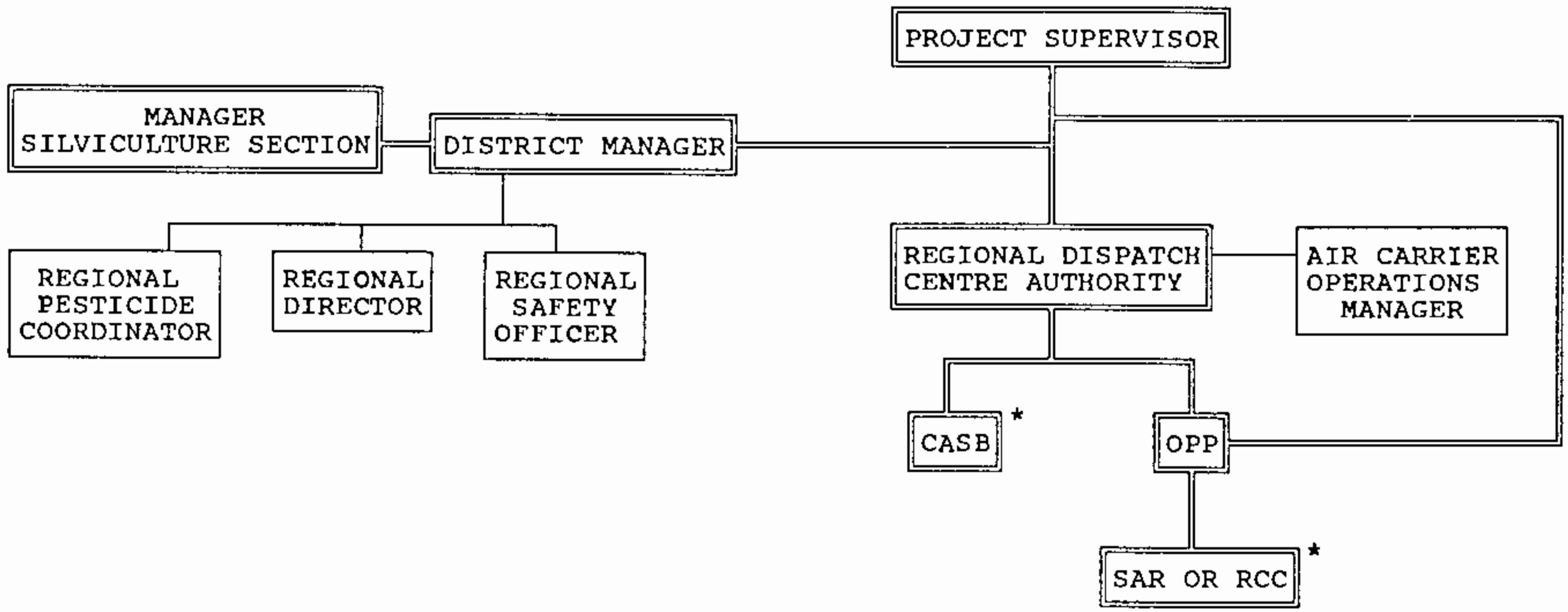
7. Describing Incident - Here it is necessary to draw a word picture of the incident as you remember it. Brief, factual, to the point. DO NOT ASSUME.

8. Sketch - It is important to leave the scene with the necessary measurements to draw a sketch. The measurements should be made while the marks etc. are fresh and before the vehicles are moved. This is after the scene is protected and injuries are cared for. Remember each MNR Mileage Book has copies of Form Law 1 in the back. These are to assist the driver at the scene. All data necessary to complete Form 777 including the sketch can be entered here.

9. The driver enters the date and signs at the bottom, completing his portion of the form.

PROVINCIAL SPRAY PROGRAM - AIRCRAFT OCCURRENCE REPORTING SEQUENCE

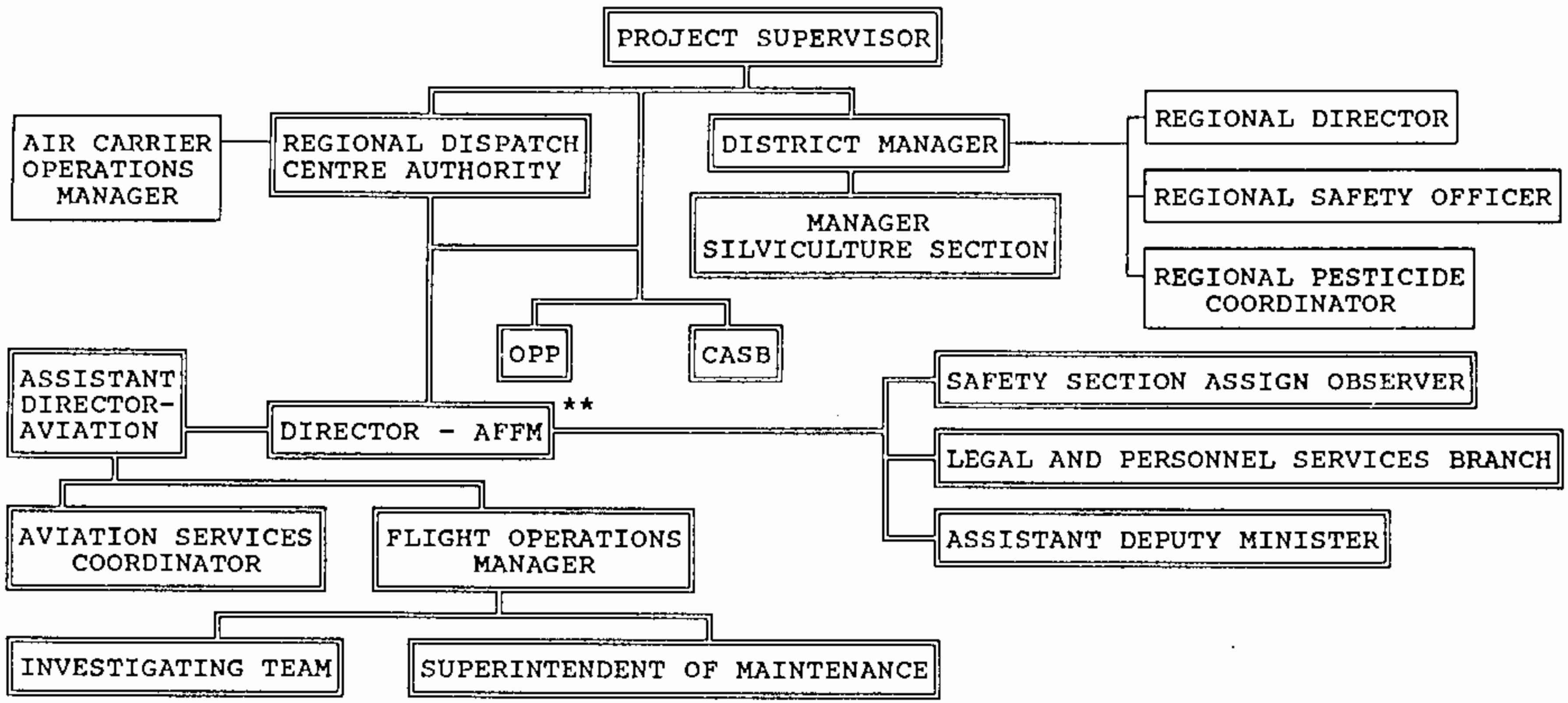
1. MISSING AIRCRAFT (SEARCH AND RESCUE OPERATIONS)



*CASB - Canadian Aviation Safety Board (Toronto or Winnipeg)
RCC - Rescue Coordination Centre (Trenton or Edmonton)
SAR - Search and Rescue
DOUBLE LINE (══) indicates mandatory reporting sequence
SINGLE LINE (──) indicates optional reporting sequence for provincial programs

PROVINCIAL SPRAY PROGRAM - AIRCRAFT OCCURRENCE REPORTING SEQUENCE (CONTINUED)

2. AIRCRAFT ACCIDENT AND REPORTABLE INCIDENT*

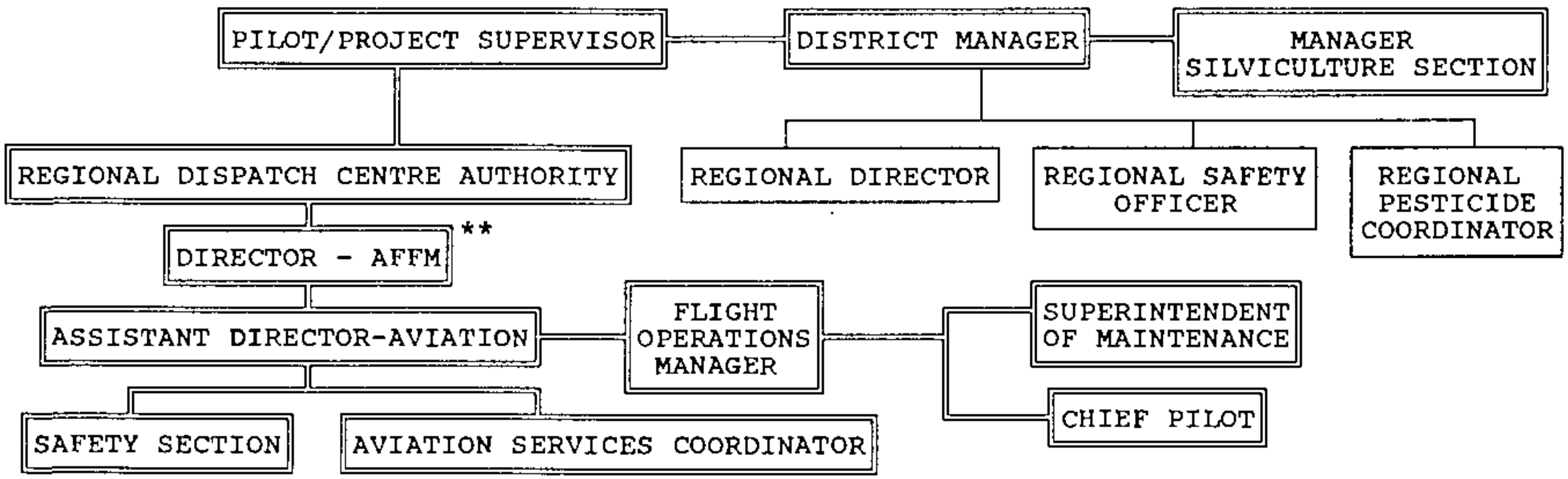


*If a pesticide is involved (i.e. a spill has occurred), the Spills Action Centre (1-800-268-6060) must be notified as soon as possible. Follow the reporting sequence for pesticide incidents on page 74.

**AFFM - Aviation, Flood and Fire Management
CASB - Canadian Aviation Safety Board (Toronto or Winnipeg)
DOUBLE LINE (═══) indicates mandatory reporting sequence
SINGLE LINE (───) indicates optional reporting sequence for provincial programs

PROVINCIAL SPRAY PROGRAM - AIRCRAFT OCCURRENCE REPORTING SEQUENCE (CONTINUED)

3. AIRCRAFT INCIDENT*



*If a pesticide is involved (i.e. a spill has occurred), the Spills Action Centre (1-800-268-6060) must be notified as soon as possible. Follow the reporting sequence for pesticide incidents on page 74.

**AFFM - Aviation, Flood and Fire Management
DOUBLE LINE (═══) indicates mandatory reporting sequence
SINGLE LINE (───) indicates optional reporting sequence for provincial programs

SERIOUS AND/OR FATAL INJURIES

INJURY TO MINISTRY PERSONNEL

PROJECT SUPERVISOR
- Assist Police and MOL
- Submit report

SAFETY OFFICER*
- Confirm details
- Secure area
- Submit WCB forms
- First aid

DISTRICT MANAGER
- Arrange investigation committee
- Health and Safety Committee
- Advise OPSEU Representative

POLICE
- Advise next of kin

MINISTRY OF LABOUR

DIRECTOR HUMAN RESOURCES BRANCH

ASSISTANT DEPUTY MINISTER

REGIONAL DIRECTOR

REGIONAL COORDINATOR

REGIONAL INFORMATION OFFICER
- Coordinates media briefings, releases

REGIONAL SAFETY OFFICER

OCCUPATIONAL HEALTH AND SAFETY SECTION

ASSISTANT DEPUTY MINISTER (NORTH/SOUTH)

DEPUTY MINISTER

MINISTER

INJURY TO NON MINISTRY PERSONNEL

PROJECT SUPERVISOR
- Assist Police and MOL
- Submit report

SAFETY OFFICER*
- Confirm details
- Secure area
- First aid

DISTRICT MANAGER
- Arrange invest. committee

EMPLOYER

POLICE
- Advise next of kin

MINISTRY OF LABOUR

DIRECTOR HUMAN RESOURCES BRANCH

ASSISTANT MINISTER (ADMIN.)

REGIONAL DIRECTOR

REGIONAL COORDINATOR

REGIONAL INFORMATION OFFICER
- Coordinates media briefings, releases

REGIONAL SAFETY OFFICER

OCCUPATIONAL HEALTH AND SAFETY SECTION

ASSISTANT DEPUTY MINISTER (NORTH/SOUTH)

DEPUTY MINISTER

MINISTER

*On projects in which there is no Safety Officer, the Project Supervisor takes over the responsibilities of the Safety Officer

ONTARIO MINISTRY OF NATURAL RESOURCES
SILVICULTURE SECTION
JUNE 1991

NOTE: ADVISE MTO IN CASE OF THIRD PARTY VEHICLE ACCIDENT OR FATALITY

MISSING AIRCRAFT REPORTING FORM

Type of Aircraft:____________________

Nationality:____________________

Registration:____________________

Colour of Aircraft:____________________

Name of Owner: ____________________

Name of Operator: ____________________

Name of Hirer: ____________________

Name of Pilot:____________________

Date and Time (Standard) of Last Known Takeoff:____________________

Last Known Position of Aircraft:____________________

Last Point of Departure:____________________

Point of Intended Landing:____________________

Names and Addresses of Crew Members:____________________

Names and Addresses of Passengers:____________________

Action Being Taken to Locate Aircraft:____________________

E.L.T. on Board________

Detailed list of survival kit contents aboard aircraft by aircraft type. NOTE: Flight Operations Manager to provide list to Flight Coordinator____________________

Name of Person Reporting:____________________

Telephone Number:____________________

VEHICLE ACCIDENT/INCIDENT

MOTOR VEHICLE ACCIDENT
MNR OR RENTAL

PROJECT SUPERVISOR
- Operator completes form 777
- Accident report
- Complete all other required documentation

SAFETY OFFICER*

- First aid/treat injured
- Medivac
- Investigate as required
- Control traffic

POLICE

DISTRICT MANAGER
- Investigation Committee
- Health and Safety Committee

REGIONAL DIRECTOR

REGIONAL COORDINATOR

REGIONAL SAFETY OFFICER

*On projects in which there is no Safety Officer, the Project Supervisor will take over the responsibilities of the Safety Officer

NOTE: INJURIES AND/OR FATALITIES ASSOCIATED WITH ACCIDENT OR INCIDENT TO BE HANDLED AS PREVIOUSLY OUTLINED

ONTARIO MINISTRY OF NATURAL RESOURCES
SILVICULTURE SECTION
JUNE 1991

Ministry of Natural Resources
Ontario

Driver's Motor Vehicle Accident Report

Vehicle Accident No.

☐ Government Owned Vehicle ☐ Leased or Rented Vehicle ☐ Private Vehicle on mileage

Ministry of Natural Resources	Branch / Region / District	Section

Date of Accident	Time	Name of Investigating Police Force	Name of Investigating Police Officer

Location of Accident

Road Conditions	Weather Conditions	Road Surface Width ft.	Road Grade Width ft.	Type of Road Surface

Vehicle Operated by Ministry Employee

Driver's Name | Age

Address

Job Classification

Driver Licence No. | Vehicle Type

Vehicle Licence No. | Leased or Rented from

Address of Lessor or Rentor

Insured by ☐ Lessor ☐ Crown | Name of Insurance Company

Insurance Policy No. | M.N.R. Vehicle No.

Damage to Vehicle

Estimated Cost to Repair

Name(s) and Address(es) of other Occupant(s) (Indicate if Injured)

Were Front lights on? ☐ Yes ☐ No | Were Rear lights on? ☐ Yes ☐ No | Approx. Speed Km | Were You Injured? ☐ Yes ☐ No

Other Vehicle or Property

Owner's Name

Address

Driver's Name

Address

Driver Licence No. | Vehicle Type

Vehicle Licence No | Name of Insurance Company

Address of Insurance Company

Insurance Policy No. | Damage to Vehicle and/or Property

Estimated Cost to Repair

Name(s) and Address(es) of other Occupant(s) (Indicate if Injured)

Were Front lights on? ☐ Yes ☐ No | Were Rear lights on? ☐ Yes ☐ No | Estimated Speed Km | Was Driver Injured? ☐ Yes ☐ No

Names and Addresses of Witnesses (Other than occupants of accident vehicles.)

Description of Accident - How it happened, Cause, Your actions before, during and after accident.

☐ Continued on reverse

Sketch of Accident Site - Show positions of vehicles, etc.

Date | Signature of Driver

777 (83/4)

SPILLS/PESTICIDE INCIDENTS

Defined as any occurrence outside of normal operating/handling procedures which may be in contravention of existing guidelines. As well, Pesticide Incidents include all occurrences involving the public or bystander exposure.

All incidents shall be recorded and reported to the Project Supervisor immediately. A reportable incident is considered as having adverse environmental, health, safety or communications implications, and is to be reported to the appropriate authorities, i.e. MOE, MOL, Medical Officer of Health.

RECORDABLE

PROJECT SUPERVISOR
- Clean up and document

SAFETY OFFICER*
- Confirm details
- Secure area

DISTRICT MANAGER
- Arrange investigation if required

MANAGER - SILVICULTURE SECTION

REPORTABLE

PROJECT SUPERVISOR
- Take corrective action
- Submit report

SAFETY OFFICER*
- Confirm details
- Secure area

MANAGER - SILVICULTURE SECTION

MINISTRY OF THE ENVIRONMENT**

DISTRICT MANAGER

MEDICAL OFFICER OF HEALTH

MINISTRY OF LABOUR***

DIRECTOR HUMAN RESOURCES BRANCH****

ASSISTANT DEPUTY MINISTER (ADMIN)

REGIONAL DIRECTOR

REGIONAL COORDINATOR

REGIONAL INFORMATION OFFICER
- Coordinates media briefings, releases

REGIONAL SAFETY OFFICER

OCCUPATIONAL HEALTH AND SAFETY SECTION

ASSISTANT DEPUTY MINISTER (NORTH/SOUTH)

DEPUTY MINISTER

MINISTER

* On projects in which there is no Safety Officer, the Project Supervisor takes over the responsibilities of the Safety Officer

** Nearest MOE District Office and Spills Action Centre (Tel. 1-800-268-6060)

*** Nearest MOL Regional Office, Attn. Industrial Health and Safety Branch

**** If incident affects personnel e.g. poisoning, over-exposure

ONTARIO MINISTRY OF NATURAL RESOURCES
SILVICULTURE SECTION
JUNE 1991

PESTICIDE INCIDENT REPORT FORM

In the event of occupational/bystander exposure to pesticides (insecticides, herbicides, fungicides, etc.) complete this form and take it and a pesticide label to the Doctor with the patient. For first aid READ THE LABEL or see the Emergency Number section of the telephone directory for your nearest Poison Information Centre.

DATE: ______________________________

TIME: ______________________________

NAME, ADDRESS & PHONE OF PERSON(S) EXPOSED: ______________________________

____

______________________________(attach additional pages)

LOCATION: ______________________________

PESTICIDE PRODUCT NAME: ______________________________

P.C.P. NUMBER: ______________________________

ACTIVE INGREDIENT: ______________________________

MANUFACTURERS: ______________________________

COMPONENTS OF SPRAY MIX: ______________________________

APPLICATION RATE: ______________________________

APPLICATION EQUIPMENT USED: ______________________________

SAFETY EQUIPMENT/PROTECTIVE CLOTHING USED: (full description, i.e. half face respirator with MSA organic vapour cartridge #23C-79)

____

____

____

DESCRIBE THE INCIDENT: (type of exposure [inhalation, ingestion, dermal], duration of exposure, events leading to exposure, number of people exposed, etc.)

____

____

DESCRIBE THE SYMPTOMS OBSERVED, CONDITION OF PATIENT AND FIRST AID TREATMENT:

____

____

____

NAMES OF CONTACTS MADE: (see attached reporting of pesticides incidents)

DISTRICT MANAGER: ______________________________

SPILLS ACTION CENTRE: ______________________________

PESTICIDES CONTROL OFFICER (MOE): ______________________________

INDUSTRIAL HEALTH AND SAFETY BRANCH (MOL): ______________________________

MEDICAL OFFICER OF HEALTH: ______________________________

POISON CONTROL CENTRE: ______________________________

SILVICULTURE SECTION: ______________________________

Ontario

Ministry of Natural Resources

Injury and First Aid Record

Branch, Region or District:	Date:

Identification

Surname:	Given Name(s):
Occupation:	Foreman:

Date of injury:	Time: ☐ a.m. ☐ p.m.	Date of First Treatment:	Time: ☐ a.m. ☐ p.m.

Nature of Injury and Treatment:

Injured's Description of Accident:

Signature of First Aider: ______________________________

If insufficient space use reverse side.

Note: This form does not replace W.C.B. Form 7 when required; it must be kept on file for future reference at District, Region or Branch level.

652 (04/78)

Workers' Compensation Board | Commission des accidents du travail | 30 Cedar Street Sudbury, Ontario P3E 1A4 | *Ce formulaire est disponible en français sur demande.* | 77

Employer's Report of Accidental Injury or Industrial Disease

Please see reverse for further details.

Claim No.

Employer Identification

Firm Name | Firm No. | Rate No. | Phone No.

Address | City/Town | Province | Postal Code

Plant, dept., or worksite where employed | Worker Reference No. (A) | Miner's Certificate No.

Worker Identification

Last Name | First Name | Sex | Area Code | Phone No. | Date of Birth

Address (no., street, apt.) | City/Town | Province | Postal Code

Date of Employment | Occupation at time of the injury and years of experience in that occupation | Yrs. Exp. | Language [] English [] French | Other (if interpreter required) | Social Insurance No.

Date and hour of accidental injury m | (C) Date and hour reported to employer m | Name and address of attending physician(s)

(D) History of Accidental Injury or Industrial Disease

1. What happened to cause the injury?
2. Explain what the worker was doing and the effort involved.
3. Identify the size, weight and type of equipment or materials involved.
4. Describe injury, part of body involved and specify left or right side.
5. Where did the accident occur?
6. What conditions contributed to the accident and what steps have been taken to prevent recurrence?
7. Give the names and addresses of witnesses or persons having knowledge of the injury.

Claim Information

Please answer ALL questions – Explain "Yes" answers at the bottom of this section or attach a letter if necessary.

		No	Yes
(E)	1. Is the injured person an owner, spouse of the employer, (sub) contractor or executive of the business?	[]	[]
	2. Did the accident happen outside Ontario? If yes, state Canadian province or country. ______	[]	[]
	3. Was anyone not in your employ totally or partially responsible for the accident?	[]	[]
(F)	4. Do you have any reason to doubt the history of injury?	[]	[]
	5. At the time of injury, was the worker doing work other than for the purpose of the employer's business?	[]	[]
(G)	6. Was there any serious and wilful misconduct involved?	[]	[]
(H)	7. To your knowledge, has the worker had a previous similar disability?	[]	[]
	8. Do you have any information that the worker could have returned to work earlier?	[]	[]

Earnings and Lost Time Information

(I) Complete this section if the worker will be totally or partially disabled beyond the day of injury.

Date and hour last worked m | Date and hour returned to work m

(J) Provide the average gross earnings on the day of injury and specify: [] hourly [] daily $

Normal working hours on last day worked From m To m | Estimate length of time off work

Earnings for last day worked | Normal earnings for last day worked

(M) Enter worker's normal working days by: F = full day H = half day and total weekly pay hours.

S	M	T	W	T	F	S	Total

(K) Specify type of any additional benefits and weekly value $

If the worker worked after the first layoff, please enter dates. From m To m

(L) From Revenue Canada TD1 form provide:

Net Claim For Exemption $ | Net Claim Code

(N) If you have advanced or will be advancing anything to cover period of disability, give particulars including dates covered.

Identify type of employment

[] Full time [] Part time [] Casual (Occasional)
[] Independent Operator [] Apprentice

Status	Injury	Injury	Forms	Sig.	App.

(O) Authorized Signature | Official Title | Date

0007 (07/87) | 0007

Guide to Completing Employer's Report of Accidental Injury or Industrial Disease

When to Fill Out This Form

The Workers' Compensation Act requires that you file a report within three days of learning of an occupational injury or disease that disables a worker or requires health care. Failure to do so may result in a late filing penalty being levied.

Health care includes treatment by a hospital emergency, medical doctor, dentist, chiropractor or other practitioner. Claims may be submitted for eye glasses, dentures and artificial appliances damaged while being worn in an accident.

This form must be completed and sent to the Workers' Compensation Board, Box 10000, Sudbury, Ontario, P3A 5G6. Please make a copy for your own records.

Please type or print clearly in ink. If all of the information is not immediately available to you, please send what you have and submit the rest later. For additional space, please attach a separate letter.

You do not have to report injuries requiring **first aid only**. However, the Workers' Compensation Act requires that you keep a record of details.

If there is entitlement to benefits beyond the day of injury, the employer is required by the Act to pay full wages on the day of injury.

Employer Identification

Ⓐ If you intend to have your own identification number for this claim, such as the worker's payroll number to be shown on future correspondence or enquiries, please enter in the space provided. For mining companies and contractors doing mine work, please **also** report the worker's miner's certificate number.

Worker Identification

Ⓑ The Board provides services in English and French. Unless indicated, all communication with the worker will be in English. If the worker requires an interpreter for any other language, please state language spoken.

History of Accidental Injury or Industrial Disease

Ⓒ Please state the date and hour that the injury was first reported to an employer representative, such as first aid, immediate supervisor, or time office.

Ⓓ The history of accidental injury or industrial disease should clearly describe an accident, circumstances surrounding the onset of pain in the apparent absence of an accident, or the events leading up to the industrial disease. Please answer the following questions explicitly to avoid additional enquiries.

1. Describe anything unusual that may have caused the injury. Examples: worker slipped, tripped, fell, struck wrist.
2. What was the worker doing when the symptoms were noticed? Was an awkward position, repetitive motion or physical exertion involved?
3. State the size and weight of any objects handled. Specify the tools, equipment, machinery, chemicals, and materials involved.
4. Describe the type of injury, all parts of the body affected and when applicable specify right or left side. Examples: cut right hand, low back pain, rash to both feet.
5. Where specifically did the accident occur? Examples: company parking lot, machine shop, Kingston construction site, Highway 400 near Barrie.
6. What conditions contributed to the accident? Examples: faulty equipment, icy parking lot, oily machine shop floor, littered worksite, slippery roads, ladder not tied down.
7. Were there any eye witnesses to the accident or others having knowledge of the history of injury as reported by the worker? If so, please state their names and addresses.

Claim Information

Ⓔ Employers, owners, partners, independent operators, and their spouses, or an executive officer of a business, must have personal coverage to be considered a worker for the purposes of compensation. An executive officer is anyone holding the position of Chairman, Vice-Chairman of the Board of Directors, President, Vice-President, Secretary, Treasurer, or Director in a limited liability company, or General Manager or Manager designated an officer by by-law or resolution of the Directors.

For additional information about the above including contractors and sub-contractors, please refer to the current booklet titled "General Information and Guide For Completing the Employer's Statement of Payroll" or consult the Sudbury Regional Office.

Ⓕ Your explanation of any doubts about the history of injury should take into account statements given by all of the witnesses.

Ⓖ Serious and wilful misconduct is the deliberate disobedience of an expressed order, or the breach of a law or rule which is enforced, well known to and designed for the safety of the workers. A thoughtless act does not constitute serious and wilful misconduct.

Ⓗ List any claim numbers for a similar disability if such are immediately available. Do not delay submission of this form to obtain them.

Earnings and Lost Time Information

Ⓘ This section must be completed if the worker was (will be) totally or partially disabled beyond the day of injury whether or not full wages are paid.

Ⓙ Enter the worker's average gross earnings as the hourly or daily rate which best reflects the rate per week at which the worker was remunerated at the time of the injury. If this is not a fair representation, we will make additional enquiry upon application.

Average gross earnings must include all earnings such as production bonuses, shift premium, tips and gratuities. Do not include vacation pay, overtime or temporary expenses for out-of-town jobs.

Ⓚ If the worker received additional benefits such as room and board, meals, or accommodation, please specify the benefit type and the weekly value. If the benefits will continue during the period of disability, please indicate so in the advances area. Please refer to guide item N.

Ⓛ To calculate the worker's benefit rate, we require the "net claim for exemptions" and the applicable "net claim code" from the Revenue Canada TD1 taxation form in effect at the time of the injury. Where no exemption status is stated, a single status will be used.

Ⓜ Enter the normal working days with F for a full day or H for a half day worked plus the total number of hours per week for which the worker is normally paid. Example: F, F, F, F, H (Total — 36 hours.)

For rotating shift workers, print **shift** across the boxes and state a weekly total representing an average number of hours per week for which the worker is paid. When the worker returns to work, complete the **Employer's Subsequent Statement** (Form 9) stating the total number of shifts lost plus the number of pay hours per shift.

Ⓝ If the worker will receive any benefits from your company or any other insurance plan for the period of disablement, state the weekly gross value of these benefits and dates covered. Please also note guide item K.

Authorized Signature

Ⓞ This report must be signed by an authorized representative of your company. A partner or an executive officer of the company (except a sole owner) may *not* sign the report of his/her own injury.

If you require further assistance, or more compensation information, please telephone the Sudbury Regional Office or the office nearest you.

Hamilton	(416) 523-1800	North Bay	(705) 472-5200	Sault Ste. Marie	(705) 942-3002	Timmins	(705) 267-6427
Kingston	(613) 544-9682	Ottawa	(613) 238-7851	Sudbury	(705) 675-9301	Toronto	(416) 927-7222
Kitchener/Waterloo	(519) 576-4130	St. Catharines	(416) 937-2020	Thunder Bay	(807) 343-1710	Windsor	(519) 966-0660
London	(519) 663-2331						

If you are not in the local calling area, check your telephone directory for the toll-free telephone number.

Workers' Compensation Board
Commission des accidents du travail
2 Bloor Street East
Toronto, Ontario
M4W 3C3

Employer's Subsequent Statement

Return to the Workers' Compensation Board when the injured worker returns or is able to return to work and at any other time requested.

Claim Number

Worker's Surname (Please Print)	Given or Christian Name(s)		Date of Injury
Address	City/Town	Province	Postal Code

1	Has the worker returned to work since the injury? If so, give date commenced.	Date Commenced / time ☐ a.m. ☐ p.m.
2	If the worker worked after the first layoff, please enter dates.	From: day / month / year / time ☐ a.m. ☐ p.m. To: day / month / year / time ☐ a.m. ☐ p.m.
3	For Rotating Shift Workers Only Please complete the following:	Total number of shifts lost. Number of pay hours per shift.
4	Did worker return as soon as able? (Give your opinion) If not, give date and time you consider worker was able. On what do you base your opinion?	
5	If unable to do former work, what kind of work is worker doing or able to do? If only able to do other than former work what do you consider services worth? When, if ever, will worker in your opinion be able to do former work?	Please express in terms of percentage. %
6	Provide the worker's average gross weekly earnings since returning to work.	Average weekly gross earnings $
	Are these earnings reduced in any way?	☐ No ☐ Yes
7	If the worker received any benefits or payments from your company or any other insurance plan for the period of disablement, please provide the following.	Gross total payment $ / Dates Covered From day month year To day month year Name of insurance company, if applicable
8	Any further information or remarks	

Employer's Name (Please Print)

Authorized Signature	Official Title	Date

Workers' Compensation Board / **Commission des accidents du travail**
30 Cedar Street
Sudbury, Ontario
P3E 1A4

Treatment Memorandum
Avis de traitement

Practitioner / Hospital The worker claims to have been injured in our employ and requests treatment. We, the employer, are sending a report to the Workers' Compensation Board.

Praticien / hôpital *Le travailleur affirme avoir subi une lésion alors qu'il était à notre emploi et demande des traitements. En tant qu'employeur, nous ferons parvenir un rapport à la Commission des accidents du travail.*

Worker Identification / *Identification du travailleur*				
Last Name / *Nom de famille*	First Name / *Prénom*	Initial / *Initiale*	Social Insurance No. / *N° d'assurance sociale*	
Address (no., street, apt.) / *Adresse (n°, rue, app.)*	City/Town / *Ville*		Province	Postal Code / *Code postal*

Employer Identification / *Identification de l'employeur*			
Firm Name / *Nom de l'entreprise*		W.C.B. Firm No. / *N° d'entreprise à la CAT*	
Address / *Adresse*	City/Town / *Ville*	Province	Postal Code / *Code postal*

Accident Information / *Renseignements sur l'accident*		
Date and hour of accidental injury / *Date et heure de l'accident*	Date and hour accident reported / *Date et heure où fut signalé l'accident*	Nature of Injury / *Nature de la lésion*
m	m	

Important: Please retain and file this document for future reference and submission to the Board if requested.

Veuillez conserver ce document aux fins de références futures et de soumission à la Commission, sur demande.

Please submit your account to the Board.

Veuillez envoyer votre facture à la Commission.

Name of Company Officer / *Nom du dirigeant de l'entreprise*	Date

Please see other side / *Voir au verso*

0156F (02/85)

Injured Worker

Regardless of whether you have received attention at a hospital emergency department for your injury, you are entitled to choose your practitioner (i.e. family doctor, dentist, chiropractor, specialist, etc.) if you require further treatment. After choosing, however, you may not change practitioners without the permission of the Worker's Compensation Board.

Practitioner

If you have determined the injured worker will be disabled from earning full wages on any day beyond the day of injury, please submit the appropriate form to the WBC: **Doctors** - Form 8, Doctor's First Report; **Chiropractors**, Form 8C, Chiropractor's First Report.

The Workers' Compensation Board supports early vocational rehabilitation. If your patient is disabled immediate action is recommended to ensure that appropriate rehabilitation measures are instituted. Many employers accommodate their injured worker advantageously by minor modifications to their normal jobs or by transfer to other occupations more suited to their current temporary disabilities. To assist the employer and the Board in planning such measures, the Board urges that you discuss this matter with your patient and cooperate with the employer's medical staff or responsible representatives in implementing a program which is reasonable and appropriate for the injured worker.

E. ACTS, REGULATIONS, PROCEDURES AND POLICIES

Aerial application activities span the jurisdiction of many government bodies and agencies. This is a list of pertinent acts, regulations, policies, procedures and guidelines set out by these various government bodies and agencies that have a bearing on Project Supervisors and Safety Officers. It is recommended that Project Supervisors and Safety Officers use this reference to obtain and review copies of these acts, policies, etc. to ensure that aerial application activities are conducted in accordance with all legislation and directives.

E.1 Safety

E.1.1 Occupational Health and Safety Act

Regs (4) - notification of Director, (MOL) of projects over $50,000.00 labour and material.

PART (1) APPLICATION: 2(1) - binds the Crown

Section 14 and 15 - responsibility of employer

Section 16 - responsibility of supervisor

Section 17 - responsibility of worker

Section 18 - responsibility of owner

Section 19 - responsibility of supplier

Section 23 - refusal to work

E.1.2 Occupational Health and Safety Act - Industrial Projects

- Refers to office buildings, factories, shops, arenas and any land, buildings and structures appertaining thereto:

7(1)	Safety Committees	49	Material Handling
14 & 15	Duties of Employers	52	Storage of Barrels/Drums
16	Duties of Supervisors	53	Compressed Gas Storage
17	Duties of Worker	65	Fuelling of Engines
20	Toxic Substances	71 & 74	Entry in Confined Spaces
23	Refusal to Work	83 & 88	Personal Protective Equipment
25	Notice of Death or Injury	128 & 145	Industrial Hygiene

E.1.3 Worker's Compensation Act

- Provides for compensation to an employee who suffers lost time injury resulting from an accident arising out of course of employment.
- Outlines processes, eligibility exemptions, conditions etc.
- Regulations 1 - 16 outline first aid requirements.

E.1.3.1 Worker's Compensation Board

- Body established under the Worker's Compensation Act to:
  - Establish assessment policies;
  - Review Acts and Regs. and recommend amendments;
  - Consider and approve operating budgets;
  - rule on compensation claims.

- Accident reporting Forms: WCB Form 0007, Form 642 Supervisor's Investigation, Form 652 First Aid Report.

E.1.4 Human Resources Branch - Occupational Health and Safety Section

Policy 13-5-1 Safety Policy

- Objective is to reduce hazards, prevent occupational illness and injury, property damage and fire.
- Outlines roles and responsibilities of levels of supervision.

Policy 8-3-1 Supervisor's Responsibilities under Occupational Health and Safety Act:

- Ensures workers are advised of hazards, comply with Acts, Policies and Procedures and take precautions to protect health and safety of fellow workers.

Policy 13-2-1 Reporting Fatalities and Critical Injuries involving MNR staff.

- Outlines notification and reporting procedures, reporting on forms: 652 First Aid Report, 642 Supervisor's Investigation Report, and WCB Forms 0007, 0009, 0156.

E.2 Pesticides

E.2.1 Pest Control Products Act - Agriculture Canada

- Act to regulate products used for the control of pests.

Sec. 3(1) - No person to manufacture, **store**, display, distribute or **use** any control product under unsafe conditions.

Reg. 43 - Storage away from food mandatory - separation by physical barrier.

Reg. 45 - Use of a control product in a manner inconsistent with the directions or limitations respecting its use shown on the label.

E.2.2 Ontario Pesticides Act

Sec. 4 - A pesticide may be discharged or applied if done in a proper manner so that it does not:

a) Impair quality of environment;
b) Damage plant or animal life;
c) Cause material discomfort to persons;
d) Affect health or likely to affect health;
e) Impair safety;
f) Render property, plants or animals unfit.

Sec. 5(1) - Exterminators licenses are required.

Sec. 5(2) - Operators license (this is a business license)

Sec. 7(1) - A permit is required **(NOTE: the regulations provide details of where permits required.)**

Sec. 9 - The operator carries the insurance.

Sec. 11(3) - The Director may impose conditions on a Permit.

Sec. 22 - Notification to Director of damage or impairment.

NOTE: MNR must supply the pilot with a copy of the permit and conditions placed on the permit.

E.2.2.1 Pesticides Act/Regulation 751

Sec. 19 - Insurance requirements are set.

Sec. 21(1) - Pesticides must be registered under Pest Control Products Act, Canada.

Sec. 21(3) - Research permits needed.

Sec. 22 - Backflow device is required when filling sprayer from surface sources of water.

Sec. 23 - Not to wash equipment in surface water.

Sec. 24 - Where pesticide is transferred to a secondary container, label required giving common name, concentration of active ingredient.

Sec. 25 - Disposal of empty containers for Schedule 1, 2 and 5:
a) Puncture or break and cover with 50 cm of soil;
b) Recycle containers in an approved manner.

Sec. 26 - Broken container - Replace with similar container. Approval for disposal of contents.

Sec. 27 - Fires, accidents and theft. The person responsible for the pesticide must notify the Director.

Sec. 59 - Class 7 or 8 licenses required for aerial application. Class 7 is for insecticides.

Sec. 67 - Airborne machine application requires permit for Schedule 1 and 5 pesticides or Schedule 2 pesticide containing a "hormonal type herbicide" only. (B.t. is Schedule 2 therefore no permit on private land.)

Sec. 67(2) - Permit is required for spraying of Crown timber with any pesticide.

Sec. 69 - The pilot shall not assist in the loading or otherwise expose himself to a pesticide.

Sec. 70(1)(a) - The exterminator or pilot records on Form 6.

Sec. 70(2) - Pilot or operator to provide the required record to Provincial Officer.

Sec. 98 and 99 - Storage area: away from food, ventilated, warning sign, locked, no flood drain; adequate respiratory protection available.

E.3 Forest Resources - Policy and Procedure Directives

FR.04.01.01 & FR.04.01.10 Licensing Requirements for Pesticide Use

- Land Class 1 or 3 Exterminator required under Ontario's Pesticides Act and indirectly under Pest Control Products Act.
- All pesticide applications must be supervised by a person holding a Land Class 1 or 3 Exterminators License.

FR.04.04.20 Diluent 585, Specifications and Suppliers

FR.04.05.01 & FR.04.05.10 Experimental Use of Pesticides

FR.04.06.20 Posting of Pesticide-Treated Areas

FR.04.10.01 & FR.04.10.10 Aerial Application of Insecticides for Forest Management in Ontario

- Outlines strategy and rationale
- Outlines procedures to initiate projects including roles and responsibilities

FR.04.20.01 & FR.04.20.10 Aerial Application of Herbicides for Forest Management in Ontario.

E.4 Parks and Recreational Areas Branch - Policy and Procedure

PM.02.16 Use of Pesticides in Provincial Parks.

E.5 Aircraft

E.5.1 Aeronautics Act - Air Carrier Regulations

- Outlines commercial air carrier classifications, license requirements, insurance requirements, and restrictions related to their services offered.

Sec. 2 - interpretations

Sec. 3 - classifications:

- Class 4 - offering charter service of persons and goods at specified rate per hour or per mile of aircraft and entire crew.
- Class 7 - specialty air service.

Sec. 4 - Grouping (Group A - H) by take-off weight, i.e. Group A: 4,300 lbs Group B: 7,000 lbs Group C: 18,000 lbs Group D: 35,000 lbs, etc.

Sec. 7 - Restricts operation of air service to conditions and restrictions on license.

Sec. 11 - Exemptions to Section 7, i.e. dry lease or wet lease where lessee holds license under specified conditions.

Sec. 20 - Minimum insurance requirements of $300,000 per passenger seat, plus $1,000,000 public liability for Group A and B, $2,000,000 public liability for Group C.

E.5.2 National Transport Act - Canada Aviation Regulations Section

- See sections appropriate for your project

E.5.3 Aviation, Flood and Fire Management - Aviation Section

AF.01.13.01 & AF.01.13.02 Use of Private Aircraft on Ministry Business

AF.01.21.01 Aviation Accident Insurance

AF.01.31.01 & AF.01.31.02 Reporting Occurrences Involving Aircraft

AF.01.32.01.02 Search and Rescue

AF.01.45.01 & AF.01.45.02 Airstrip and Heliport Standards, Aerial Spray Operations

AF.01.72.01 & AF.01.72.02 Charter Hire of Commercial Aircraft Services

AF.NEW Fire Control on Airstrip

E.6 Fuelling

E.6.1 Gasoline Handling Act

Sec. 1 - Interpretation
- Bulk storage includes 500 gals plus

Sec. 3 - approved containers

Sec. 6 - License requirements

Reg. 4 - License required to transport units of 1,000 lbs. or more

Reg. 5 - Transportation requirements, container specs., spec. of carrying vehicles, markings

Reg. 6 - Above ground storage tanks, design, construction, siting

Reg. 9 - Fire and safety requirements

E.6.2 AFFM Policies and Procedures - Aviation Fuel

AF.01.61.01 & AF.01.61.02 Dispensing Installations

AF.02.61.03 Purchase of Aviation Fuel

E.7 Environment

E.7.1 Environmental Assessment Act

- Requires proponents of major activities by or on behalf of Crown to present to MOE an assessment including description of purpose, rationale, alternatives, methods, and alternatives to the undertaking also, a description of environment, effects, and an evaluation of advantages and disadvantages.

Section 29 - Exemptions

- Grants for exemptions where in the opinion of the Minister it is in the public interest.

E.7.2 Class E.A. - Exemption for Forest Management

Exemption Order MNR 11/9 Forest Management Activities on Crown Land

Exemption Order MNR-41 Forest Management in Southern Ontario
- Conditions are: aerial application in accordance with Procedure FR.04.10.10 i.e. 30 days prior notification of public, MOE, and EA Branch; project descriptions available on request

E.7.3 MNR Land Use Planning - Policy and Planning Section

Policy PS.04.03.01 - Exemption conditions under Class E.A.

E.7.4 Transportation of Dangerous Goods Act

- To ensure public safety, provides a procedure for dealing with accidents, determines who is responsible.
- Provides for classification of dangerous goods, packaging, labelling, documentation reporting of incidents.

E.7.5 Classification of Pesticides and Fuels

- Refer to the manufacturer's shipping document.

E.7.6 Environmental Protection Act

- Provides for control order and regulates discharges to air and water.

E.7.6.1 Part 9 - (Spills Bill)

- A spill is defined as a discharge, that is, out of the ordinary and causes environmental damage.
- Discharger to give immediate notification to MOE (Spills Action Centre, 1-800-268-6060) and to notify the municipality where the spill occurred.
- A duty to clean up is imposed on the owner and the person in charge.
- Discharger has right of entry to property for clean up requirements.
- A person suffering loss or damage is entitled to compensation first from owner and secondly from Environmental Compensation Corporation (he must apply within 30 days).
- Approval for disposal of spill material is required.

E.7.6.2 Reg. 309

- All generators of hazardous or liquid industrial waste must be registered with the Ministry. Waste may not be moved unless the generator has a registration number.
- Carriers and receivers of hazardous or liquid industrial waste must be licensed by the Ministry.
- All transfers of hazardous or liquid industrial waste must be accompanied by a manifest which is completed by the generator, carrier and receiver.

E.7.7 Ontario Water Resources Act

- See sections appropriate for your project.

E.8 Administration

E.8.1 Public Service Act

- Outlines rules governing working relationship between Crown and its employees, i.e. appointments, resignations, grievances, wage negotiations, classifications, benefits.

E.8.2 Crown Employees Collective Bargaining Act

- Outlines rules related to negotiation of and adherence to the Collective Agreement between the Union and the Crown.

E.8.3 Collective Agreement

- Agreement between Management Board of Cabinet and Ontario Public Service Employees Union with respect to Working Conditions and Employee Benefits.

Article	3.3 Overtime	10 Shift Schedule	14 Call Back
	3.4 Reporting Pay	11 Shift Premiums	15 Stand By
	6 Temporary Assignments	12 Rest periods	16 On Call
	7 Hours of Work	13 Overtime	23 Travelling Time
	8 Days off		

E.8.4 Construction Lien Act

- Requirement to hold back 10% of invoice(s) price(s) for minimum of 45 days on regulated Crown projects; Administration handles money not Project Supervisors.
- Requirement of posting signs

E.8.5 Arbitration Act

- Outlines procedures for settling disputes between Crown and contractor.

E.8.6 Administrative Manuals

Management Board of Cabinet - Directives (Binder)
Management Board of Cabinet - Guidelines (Binder)
Finance Planning and Evaluation - Manuals

E.9 Training and Awareness[7]

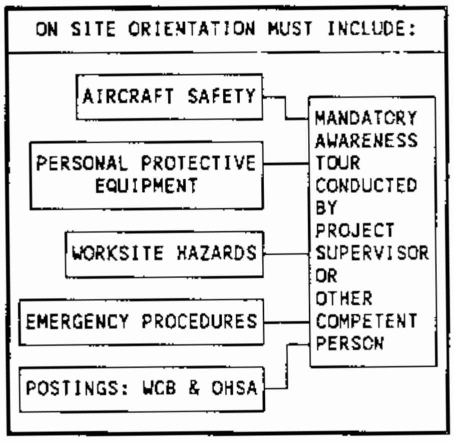
This section deals with the training and awareness that personnel must have who are taking part in aerial spray programs delivered or funded by the Ministry of Natural Resources.

Training

	1	2	3	4	5	6	7
PROJECT SUPERVISOR	X	X	X	X	X	D	X
APPLICATION BOSS		X	D	X	X		
NAVIGATOR			D	X		X	X
RADIO OPERATOR			D	X		X	X
PIT CREW			D	X			X D-2

X=Mandatory by Legislation D=Discretionary

Awareness



Training required and where to find it:

1. Occupational Health and Safety Training
   - Ministry of Labour

2. Exterminators Licence/Growers Course, Land Class 1 & 3
   - Ministry of the Environment
   - Ministry of Agriculture and Food

3. First Aid - St. John Ambulance

4. Workplace Hazardous Material Information System (WHMIS)
   - Industrial Accident Prevention Association
   - Consulting Firms

5. Transportation of Dangerous Goods
   - Transportation Safety Association

6. Restricted Radio Operators Licence
   - Transport Canada
   - Certified Instructors also in Ministry of Natural Resources

7. MTO Drivers Licence
   - Ministry of Transportation (may include "D" Licence, "Z" endorsement and Fuel Bowser Training)

Where Project Supervisor, Safety Officer, Application Boss or Navigator training is necessary, Ministry of Natural Resources courses are available.

F. SUMMARIES OF HEALTH ACTS, REGULATIONS AND PROCEDURES

F.1 Introduction to Health and Safety Act and Regulations

The Occupational Health and Safety Act (OHSA) was developed to enhance safety in the workplace. The regulations under OHSA (printed separately) cover a very large field such as mines and designated substances, i.e.: lead, asbestos, etc.

[7] Prepared by Ambrose Etmanskie, Kemptville Regional Office, and Steve Wilkins, Tweed District.

Pages 1-5 of the Act covers the interpretation (definitions). As in any Act you should familiarize yourself with these so the sections will have meaning. The Act from the bottom part of page 5 deals mainly with the application, the administration and the purpose. It is a good idea as well to read through the Act.

Sec. 13: Duties of a Constructor, Employer, Supervisor, Worker, Owner and Supplier (p 14). This section lays out what the Act intends and that the Constructor has to give the Director a notice in writing of projects.

Sec. 14: The duties of Employers (p 14). 14(1): The employer shall ensure that the equipment, materials, protective devices as prescribed are provided. That they be in good condition, that the procedures as required are carried out, that equipment, material, protective devices as provided are used. 14 (2)(a): As well the employer shall provide information, **instruction** and supervision to protect the health or safety of the worker. 14(2)(b): When appointing a **supervisor** appoint a **competent person**. 14(2)(c-h): Goes on to say, that you must acquaint workers with any hazards in the work, afford assistance and cooperation to the Committee and or its Health & Safety Representative. Only employ persons of an age prescribed, take every reasonable precaution in the circumstances for the protection of the worker, and post on the work site a copy of the Act.

Sec. 15: In addition to the requirements of section 14, section 15(1)(a-i) says the employer must establish an Occupational Health Service for workers as prescribed, and maintain it, keep accurate records of handling, storage, use and disposal of biological, chemical or physical agents. Monitor exposures to these agents and limit such exposures as prescribed. Where required provide a worker with written instructions as to the measures and procedures to be taken for the protection of a worker.

Sec. 16: Duties of a Supervisor: Section 16(1): A supervisor shall ensure that a worker: works in a manner and with the protective devices, measures, procedures required by this Act; and uses or wears the equipment, protective devices or clothing that his employer requires to be worn. Section 16(2): A supervisor shall advise a worker of any potential or actual danger to his health or safety, if necessary provide the worker with written instructions and take every precaution reasonable in the circumstances for the protection of the worker.

Sec. 17: Duties of a worker: 17(1) A worker shall work in compliance with the provisions of this act and regulations. Use or wear protective equipment devices or clothing that his employer requires to be used. Report to his Supervisor, the absence or defect of any equipment or device which may endanger him. Report any contravention of this act and regulations, or the existence of any hazard. Where prescribed, have at the expense of the employer, such medical examinations or X-rays as prescribed. Section 17(2): No worker shall remove or make ineffective any protective device, without providing a temporary device, and when the need has ceased replace the protective device immediately. Use or operate any machine or device in a manner that may endanger himself or other workers, or shall not engage in any prank, contest or feat of strength, unnecessary running or rough and boisterous conduct (horseplay).

Sec. 19: Every person who supplies any machine, device, tool, or equipment under any rental, leasing or similar arrangement for use in or about a workplace shall ensure that it:

a) is in good condition;
b) complies with this Act & Regulations;
c) be properly maintained.

Sec. 23: Refusal to work - see flow chart on next page.

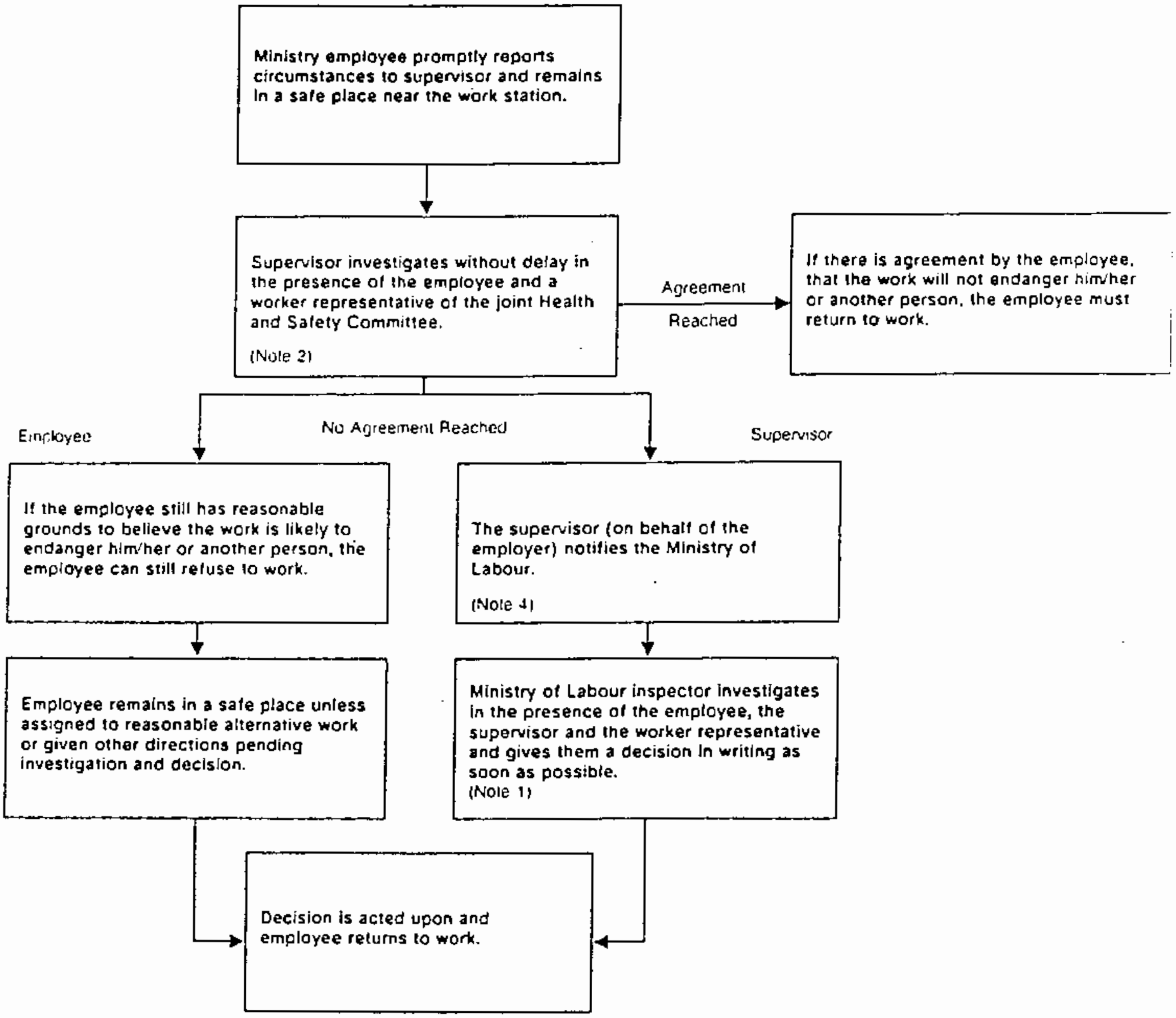
Ministry of Natural Resources
Ontario

Employee's Right to Refuse Work

Occupational Health & Safety Act

What to Do

When a ministry employee has reason to believe work is likely to endanger him/her or another worker . . . .



Notes:

1. Disputed machine or workplace is not to be used pending an investigation and a written decision by a Ministry of Labour inspector unless another employee agrees to work after having been told of the original refusal to work and the reasons.

2. Where a supervisor needs assistance in responding to a situation he/she should contact the MNR Regional Safety Office or the MNR Occupational Health and Safety Section, Human Resources Branch, Toronto.

3. All incidents involving refusal to work are to be recorded with an appropriate description of the nature of the refusal and the outcome, then sent to the MNR Occupational Health and Safety Section, Human Resources Branch, Toronto.

4. Contact the nearest Ministry of Labour District Office. Refer to Government of Ontario Telephone Directory for MOL office locations.

F.1.1 Ontario Regulation 714/82 Under the Occupational Health and Safety Act

The Regulations are lengthy and lay out the workings of the Act. We will not attempt to go through it step by step but show an example of its use.

> You have a query with regards to the use of deluge showers. Go to the index under Shower - It refers you to Sections 129 and 145. Section 129 states "When a worker is exposed to a potential hazard of injury to the skin due to contact with a substance, a quick-acting deluge shower shall be provided." (O. Reg 658/79 s. 129). Section 145 lists measures to be taken to prevent exposure to any toxic substance, including the use of personal protective equipment and clothing, the provision of a quick-acting deluge shower and an eye wash fountain (O. Reg 658/70 s. 145).

Another example is:

> You are interested in the use of Respirators, you will find this under Protective Clothing or Equipment. It will refer you to Section 74 and 143.

F.2 Regulation 193/84 Under the Health Protection and Promotion Act

F.2.1 Public Health

Public Health in the camps used on spray programs has two categories. Food Preparation and Camps in General. We will be referring to two references.

1. Guidelines for Food Service Personnel.
2. Ontario Regulation 193/84 under the Health Protection and Promotion Act 1983. (Camps in Unorganized Territory)

The guideline for food service personnel is not law but is based on the requirements of law. Regulation 193/84 under the Ontario Health Protection and Promotion Act is law for unorganized areas. This is the bare minimum standard that can be accepted for housing and feeding workers. Permanent camps or units in organized territories must exceed these requirements.

The Food Service Supervisors Code inside the cover flap of the guideline, should become your kitchen rules, and your safety guideline. Pin it up in the kitchen where it can be seen.

In order to meet your deadlines in the time allowed, you cannot accept sick workers due to unsanitary practices in the kitchen or sleeping facilities. Diarrhoea, Salmonella, Lice, Scabies all are serious within a work place and relate to unsanitary practices in the camp.

F.2.2 Personal Hygiene

In food preparation there are rules which govern personal hygiene. Section 27 of Regulation 193/84 states - Every operator shall ensure that each person, who handles or comes in contact with food or with any utensil used in preparation, processing, service or storage of food in a camp operated by him:

a) Does not use tobacco while so engaged;
b) Is clean;
c) Wears clean outer garments;
d) Wears headgear that confines the hair;
e) Washes his hands after use of the toilet;
f) Is free from any infectious agent or of disease, that may be spread through food;
g) Submits to Medical examination and tests as required by the Medical Officer of Health.

Section 28, Talks about infectious diseases.

Section 29, (1) You must supply hot and cold potable water in kitchens. 29(2) You must supply separate wash basins for cooking staff along with paper towels, roller towels or hot air dryers.

The above mentioned items are generally covered in the guideline.

F.2.3 Food Preparation

Food preparation per se is not specified by law but the guidelines have good rules.

a) Touch food with hands only when necessary.
b) Never serve undercooked meats: pork, fish, or poultry.
c) Keep food preparation tables clean.
d) Do not prepare sandwiches, salads, etc. on meat blocks.
e) Prepare salads, custards, cream pies, etc. immediately before use and keep refrigerated.
f) Keep temperatures of hot foods above 60°C (140°F). Cold foods below 5°C (41°F).
g) Keep contaminants separated. (Do not thaw turkey in the same sink as you make coleslaw).

Sections 19-29 of Reg. 193/84 Covers Food Preparation and Storage.

Sec. 19(1): Covers storage of food not requiring refrigeration in closed containers.

Sec. 19(2): Each camp has the necessary refrigeration.

Sec. 20(1): Covers keeping hot food hot and cold food cold.

Sec. 20(2): Covers storage of frozen food

Sec. 21: Covers cold room storage

Sec. 22-23: Food to be stored on racks not less than 15 cm off floor.

Sec. 24: Types of tools used in cooking.

Sec. 25: Every operator shall ensure that cloths and towels used to wash and polish utensils are in good repair, clean and used for no other purpose. (NOTE: **The recommended, sanitary practice is to air dry dishes after hot rinses.**)

Sec. 26: Covers handling of toxic and poisonous substances.

Sec. 48-49: Where equipment for washing by hand is used, utensils shall be:

a) Cleaned in a sink in a solution capable of removing soil.
b) Rinsed in a second sink in clean water at no lower than 43°C.
c) Sanitized in a third sink. Sec. 49 lays out the sanitizing methods.

Sec. 51: Lays out the rules for cleaning and using mechanical dishwashers.

Sec. 18: Every operator shall ensure that refuse and garbage in each camp operated by him is:

a) Deposited in leak-proof durable containers with tight lids.
b) Removed after each meal from any room in which food is prepared, served, or stored.
c) Collected daily and stored in a sanitary manner.

The guideline goes on to say that the containers should be washed and sanitized after each use. If garbage bags are used and kept intact this may not be necessary, but cans should be kept clean and dumped daily.

F.2.4 Water Supply

Covered in sections 9 to 12 of Regulation 193/84.

Sec. 9: Every camp operator shall ensure that water is:

a) Obtained from a source approved by the health authority;
b) Readily available for camp use;
c) Of sufficient quantity to meet the camp requirements.

Sec. 10(1): Every operator shall supply potable water.

Sec. 10(2): If not from a pressure system, supplied in sanitary containers.

Sec. 11(1): Where water intended for human consumption is obtained from surface sources water shall be treated in an approved manner.

Sec. 11(2): Where treated, operator will keep a daily record.

Sec. 11(3): Where treated, operator must keep equipment in camp for the testing of water.

Sec. 12: Talks about fountains for drinking and common cups not be allowed. The MNR goes farther in water supplies and for all camps not on a town or city water supply, the water be tested prior to camp opening and each week thereafter.

F.2.4.1 Water Test Procedures

Water test containers are available from the Ministry of Health. The following is the procedures to be followed.

a) The carrying container (plastic) should be sealed with a removable seal. Remove this seal and stick it on lower half of container.
b) Remove enclosed bottle and instructions and complete form.
c) Run taps for 2 to 3 minutes before test with aerator parts removed.
d) Remove cap from bottle and fill bottle to 1 inch from the top and replace cap. **(NOTE: be very careful not to touch neck of bottle or inside of cap during this operation.)**
e) For lake or stream testing sample is to be taken at least 12 inches below surface.
f) Wrap report around bottle and place back in shipping container and reseal.
g) Containers should be shipped in a cooler immediately (Within 12 hours) to the nearest test lab.

F.2.5 Sleep Camps

Types of camps may be - Tent Camps, Portable Buildings, or Permanent Structures. Camps used under 28 days are not controlled by Ontario Regulation 193/84. We recommend however that this regulation be followed to provide minimum protection. Normally straight tent camps will fall into this temporary standard. If the use is longer tent bottoms are normally supplied and all of the Ontario Regulation 193/84 applies. For all other camps this regulation or the Health Protection and Promotion Act would apply.

Spacing of sleeping facilities will depend on the type of facilities but each bed is required under Section 34(a) of Regulation 193/84 to have 3.72 square meters of floor space.

Sec. 34(b): Beds are separate, at least 30 cm above the floor - single tiered at least one (1) meter apart when not separated by a partition extending at least one half the length of the bed and one half the height of the wall - provide with one locker or one shelf for each bed.

Sec. 31: Designates that male and females must have separate sleeping, washing and bathing facilities.

Sec. 35(a): Covers heating requirements of not less than 20°C.

Sec. 35(b): Mattresses, blankets, sheets, pillows & pillow cases are sanitary and in sufficient supply to serve camps. - Sleeping bags are probably being used, remember sheets pillow cases etc. are being supplied weekly, sleeping bags should also be on a cleaning schedule.

Sec. 35(c): Permanent buildings are equipped with smoke alarms. **(NOTE: all buildings other than tent camps should have this protection.)**

Sec. 15: Covers screen protection for sanitary facilities. Though not covered by law screen doors and windows should be kept in good repair, not only in sanitary facilities but on kitchens and sleeping quarters as well.

F.2.6 Fire Protection

All cookeries should have a fire extinguisher readily available of at least 5BC. **NOTE: Grease around stoves and on exhaust vents is hazardous; stoves, filters and vents should be kept clean and free of grease.** (Trisodium Phosphate is a good degreaser but should be used while wearing rubber gloves)

Sleep camps should be equipped with at least one fire extinguisher 5BC or larger at each furnace room and or electrical panel. A class (A) fire extinguisher or water pump or pressure extinguisher are adequate for sleeping areas. (**NOTE: a fire plan should be developed and tested in each camp.**)

F.2.7 Washrooms and Sanitary Facilities

Section 13 to 16 Ontario Regulation 193/84. Section 13 lays out the requirements for toilets, privies versus water flush. Requirements for male and female.

Sec. 14(1): Covers requirements for doors and windows being tight fitting and screened, and properly ventilated. Sanitary facilities are to be kept clean and in good repair at all times.

Sec. 14(2): Where a camp is in operation all toilet seats shall be thoroughly scrubbed daily with a sanitizing agent.

Sec. 15: Lays out the requirements for supplies - toilet paper; a cleanable receptacle of sound construction for used towel and other refuse; soap; paper towels or hot air drying.

F.3 Excerpt From MNR Occupational Health and Safety Policy - Policy No. 13-5-1

Supervisors and managers are responsible for ensuring that Ministry occupational health and safety goals are met by:

1. Ensuring that employees under their supervision are adequately trained to perform their work safely and are familiar with all relevant provisions of the Occupational Health and Safety Act, other relevant legislation, and Ministry policy;

2. Being aware of all occupational health and safety hazards in the workplace and taking appropriate action to eliminate or reduce them to an acceptable level;

3. Recommending or initiating appropriate disciplinary action in accordance with Ministry policy, where an employee has wilfully contravened Ministry policy and in so doing has placed him/herself or others at risk;

4. Providing assistance and cooperation to Joint Health and Safety Committees in the performance of their functions.

Employees are responsible for ensuring that Ministry occupational health and safety goals are met by:

1. Working in compliance with the Occupational Health and Safety Act, other relevant legislation,and Ministry policy;
2. Using personal protective equipment where required;
3. Reporting to their supervisors or managers any occupational health and safety hazards in the workplace of which they may be aware.

G. GUIDE TO GASOLINE HANDLING ACT AND GASOLINE HANDLING CODE

Enforcement of this Act and Code is by the Ministry of Consumer and Commercial Relations. The Act (pp 1 to 12) covers definitions, what the act is for and who administers it. You should read the Act and know the definitions. The general index is in the front and the index is at the back of the book.

The Codes beginning on p 11 are broken into 10 sections, beginning with Section 1, the interpretation of the act (definitions). Familiarize yourself with the definitions.

The MNR normally falls under Consumer Outlets and Codes Pertaining, which usually spells out functions covered, i.e.: Marinas, Service Stations and Consumer Outlets.

Sec. 3: Deals with the products identification and lists products that must conform to special standards (p 19). Section 3 (3) lists the classes you should know:

1. Class I products having a flash point below 100°F include such products as Automotive Gasoline, Aviation Gasoline, Naphtha, and alcohol based antifreeze.
2. Class II products having flash points from 100°F to 150°F inclusive and include Fuel Oil, Diesel Fuel, Kerosene, Brake Fluid and Cleaning Fluid.
3. Class III products having flash points above 150°F include Heavy Fuel Oil (Bunker C), Engine Gear Oil, Shock Absorber Fluid, and Glycol Based Antifreeze.

Sec. 5(2): Specifications on containers under fifty (50) and over ten (10) gallons.

SEC. 8: (p 83) Operating Procedures

Sec. 8(7): No sale or purchase of any Class I,II,III products shall be made:

1. If packaged in other than containers that are clearly marked with the product name, and sealed in a leak-proof manner.
2. In transportable containers unless:

   a) The containers are clearly marked with the name of the product;
   b) The transportable container complies with subsection 2 of section 5;
   c) The containers are securely closed to prevent leaks or spills.

Sec. 8(9-12): Barrels, containers, etc. must be moved from a building before Class I fuel is dispensed or transferred.

Sec. 8(34): Requires that underground tanks be dipped daily except Sunday to check for leaks.

Sec. 8(31): No filling of containers at any outlet unless it is in safe condition and is approved.

Sec. 8(35): Shows procedure when a leak is suspected. This is arranging for a pressure test.

SEC. 9: (p 97) Fire and other safety precautions.

Sec. 9(1)(2): Prevention - These sections lay out precautions to be taken to prevent fires. These are:

1. Take precautions to prevent overflows or spills;
2. Don't overfill fuel systems;
3. Use absorbent to clean up spills;
4. No person shall be in possession within ten (10) feet of dispensing location with a lighted match, lighter, pipe, cigar or cigarette.

Sec. 9(5): No person shall discard any Class I,II, or III products except in properly vented traps or similar safe disposal facilities.

Sec. 9(27): A readily available 10BC fire extinguisher must be at every outlet.

Sec. 9(35): Covers inspecting and recharging extinguishers. They are to be inspected and serviced at least annually and if there is sign of them being emptied, tampered with or evidence of leaking. Extinguishers are then tagged with the month and year, the material used, and initials or special mark of the examiner, with the company and location of the inspector.

SEC. 10: (p 111) General Administration.

Section 10(8): Lays out the reporting procedure in case of fire or explosion.

This leads into the appendices which provide general information (p 117 properties of gasoline).

H. GUIDE TO PROPANE HANDLING AND TRANSPORT[8]

H.1 Propane Code

From this code you should know:

1. Propane containers must be transported without cover in an upright position.
2. No propane container of more than 4.5 lbs. capacity can be stored inside a building.
3. Propane storage must be at least 25 feet from other flammable liquids.

H.2 What to Know When Handling Propane Cylinders

H.2.1 The Regulator

Propane in a cylinder reacts rapidly to changes in temperature. When the temperature increases, the pressure increases. The regulator's function is to reduce the high and variable pressure in the cylinder to a lower and constant pressure for delivery to an appliance. A regulator should always be installed with its vent opening pointing downwards so that moisture can not build up inside it, impairing its operation. If this is not possible, cover the regulator with plastic or other waterproof material to keep rain or other liquids from entering the regulator and from forming ice build-up within the regulator.

H.3 How to Handle Propane Cylinders

The following rules apply to the handling of propane cylinders:

- Damaged, leaking or corroded cylinders should not be filled unless **re-qualified** for service.
- Never put a cylinder in place for use without making sure that it is secure.
- Never transport a cylinder lying on its side. A propane cylinder should always be upright.
- If transporting a cylinder in a vehicle, secure the cylinder in an upright position to prevent tipping. If transporting in the trunk, block the trunk lid open. If transporting in the passenger compartment, leave the windows open. In either case, it is recommended that the POL plug be threaded into the outlet of the service valve. This plug should remain in place whenever the cylinder is not in use.
- **Never store a cylinder inside a vehicle or any building, including a garage or basement.**

When purchasing a new cylinder, be sure that it is the size that fits the bracket. Check that all valves on appliances are closed before connecting a new cylinder.

H.4 Connecting a Propane Cylinder

When connecting a propane cylinder, use a proper fitting wrench (not pliers) to tighten the connection between the regulator and cylinder valve (see Figure 21). The fitting that connects to the cylinder valve has to be turned to the left (counterclockwise) to tighten. Connectors with a hand wheel only require hand tightening; ensure that the rubber "O" ring is in good condition and in place before connecting to the cylinder valve. Ensure all connections are tight before operating your propane appliance.

H.5 Check for Leaks

Before using a propane appliance, particularly if you have just connected a cylinder to it, it is advisable to check for leaks using the following method:

a) Make up a soap and water solution;
b) Turn the cylinder valve on;
c) Spread the soap and water solution over the connections with a paint brush;
d) Any leaks will result in bubbles forming in the solution;
e) If a leak is indicated, shut off cylinder;
f) Repair any leak, repeat a), b) and c) until no leaks are indicated before operating the appliance;
g) DO NOT go over connections looking for leaks with a match or cigarette lighter or any other flame.

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[8] Contains excerpts from the Ministry of Consumer and Commercial Relations publication Living Safely with Propane, Rev 02/84-100M, ISBN 0-7743-8873-0.

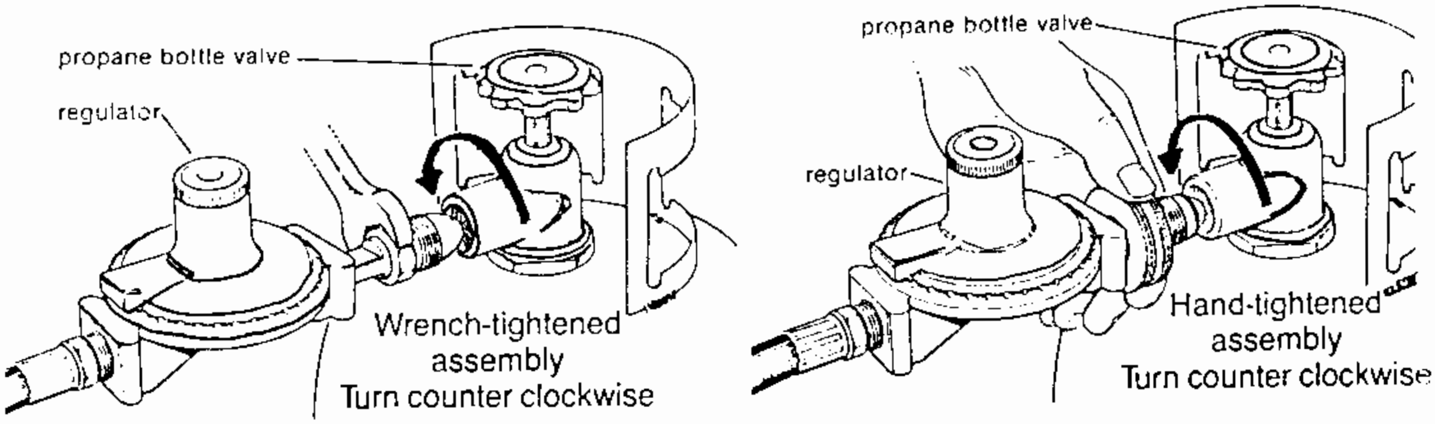


FIGURE 21. Connecting a propane cylinder.

H.5.1 Leak Detection

Propane is odourless and colourless when produced. However, in order for you to detect the presence of propane, an odour-producing substance is added to it by the propane producer. This odourant has a distinctive "rotten cabbage" smell, which is consumed and not noticeable when a burner is operating. If you do detect such an odour, do not light a match or turn an electrical switch on or off. Turn off each cylinder valve, ventilate the area well and search out the source of the leak.

Your propane system should be checked periodically for leaks even if the characteristic "rotten cabbage" odour is not detected.

H.6 Dangers of Propane

Used with care, propane is a safe and convenient fuel. Propane gas is not toxic. Nor is it injurious to you, should you be exposed to it in limited quantities. However, should a leak occur, the accumulation of propane gas can become dangerous. Propane is heavier than air and it tends to settle in the lowest available place. Very small amounts of propane are required to create a flammable mixture of gas and air. **In the limited space of a recreation vehicle, for instance, very little propane is needed to create a hazardous situation.**

H.6.1 The Importance of Ventilation

Propane requires a large volume of air to burn properly - 23.5 cubic feet of air is needed to burn one cubic foot of propane. With adequate ventilation, an operating burner gives off a number of harmless products such as carbon dioxide and water vapour. **A propane appliance starved of oxygen quickly produces dangerous amounts of carbon monoxide, the lethal gas produced from a car's exhaust. For safety's sake, use your propane appliance only for the purpose for which it was designed.**

H.6.2 Detection of Carbon Monoxide

Carbon monoxide is colourless and odourless. However, the following symptoms may appear:

- Headaches, and tightness across the forehead and temples;
- Weariness, weakness, dizziness and vomiting;
- Loss of muscular control;
- Watering and smarting of the eyes.

If any of these symptoms should develop, get into fresh air immediately.

H.7 Propane-fuelled Servel Refrigerators

Unserviced or poorly maintained propane-fuelled refrigerators can kill you. Lethal quantities of carbon monoxide can be produced if the refrigerator flame is improperly adjusted or partially blocked by dirt. For your safety, a propane-fuelled refrigerator must receive proper attention. Your unit must be cleaned and adjusted every year. **Never** start a propane-fuelled refrigerator at the beginning of a season without first making sure that is has been serviced.

The sale and installation of unvented propane refrigerators is prohibited.

A propane refrigerator with a blocked flue passage or an improperly adjusted or partially plugged burner can produce carbon monoxide in **deadly** quantities. For safe operation, service the refrigerator at the beginning of each season thoroughly cleaning the flue passage and burner. The burner must also be cleaned immediately after the refrigerator has been moved to another location regardless of the distance. This ensures the burner is free of any scale deposits that are often dislodged from the flue passage.

Cleaning and servicing should be done by a certified propane fitter familiar with this appliance.

I. TRANSPORTATION OF DANGEROUS GOODS BULLETINS - SUMMARY

The Transportation of Dangerous Goods (TDG) Bulletins introduce MNR personnel to the Transportation of Dangerous Goods Act and Regulations, and provide operating procedures that will insure compliance.

I.1 TDG 1 - Introduction to Dangerous Goods (1987 03 16)

Part 1 of Bulletin 1 gives background on the **Transportation of Dangerous Goods Act**, the impact of this Act on MNR operations, and a summary of the other TDG Bulletins are listed. Part 2 of TDG Bulletin 1 lists dangerous goods commonly transported by the MNR. A portion of this list, those dangerous goods that affect aerial spraying operations is included in Table 1.

I.2 TDG 2 - Gasoline Labels (1987 08 11)

This Bulletin states the requirements for gasoline labels on various sizes of gasoline containers, who is responsible for applying the labels and how the labels are to be applied.

I.3 TDG 3 - Container Labelling Standards (1987 03 16)

This Bulletin identifies and standardizes the labels and other marking required by the Transportation of Dangerous Goods Regulation on packages and containers commonly transported by the MNR.

I.4 TDG 4 - Placarding Vehicles (1987 03 16)

TDG 4 identifies the situations where placards are required to be displayed on vehicles transporting dangerous goods. Placards are not required when:

1. Gasoline containers transported in on open vehicle where:

   - Labels are visible from outside the vehicle;
   - Each container is secured to the vehicle;
   - The total capacity of the containers does not exceed 2,000 L (up to and including 9 barrels).

2. Propane, acetylene, oxygen or mixtures of methyl acetylene and propadiene, in cylinders or containers transported in an open vehicle where:

   - Labels are visible from outside of the vehicle;
   - Each container is secured in or on the vehicle;
   - There are not more than 5 cylinders;
   - The total quantity is not more than 500 kg.

3. Pesticides, or solutions thereof, where:

    - The tank has a capacity of less than 500 L; if more than 500 L but less than 5,000 L the vehicle must be placarded with MOE chemical warning signs; if more than 5,000 L the vehicle must be placarded under the Transportation of Dangerous Goods Act;
    - The tank is used for mixing or holding the product or solution prior to or during application;
    - If the tank is of a placardable quantity, placards are to be displayed on the tank.

<u>I.5 TDG 5 - Documentation</u> (1987 08 25)

This Bulletin lists the administration behind the documentation of Transportation of Dangerous Goods and how to fill out the **Dangerous Goods Shipping Document**. It also lists situations where the use of the **Dangerous Goods Shipping Document** is optional. These are the same as the listed above, except the last point under pesticides is not applicable.

<u>I.6 TDG 6 - Emergency Actions and Reporting</u> (1987 03 16)

TDG 6 lists actions to be taken, and who carries out these actions, should a dangerous good spill occur.

<u>I.7 TDG 7 - Training</u> (1987 03 16)

TDG Bulletin 7 covers the training required for MNR personnel who handle, offer for transport, or transport dangerous goods.

<u>I.8 Dangerous Goods Shipping Requirements for Goods Used in Aerial Spraying Projects</u>

Table 1, a list of the dangerous goods commonly used in MNR aerial spraying programs, is a guide. It is not intended to be a substitute for the information that is contained on the shipping documents provided by the manufacturer/supplier. Refer to the shipping documents provided by our suppliers for the information to be used on the MNR **Dangerous Goods Shipping Document**.

J. AIRCRAFT SAFETY

<u>J.1 Fixed Wing</u>

1. **NO SMOKING WITHIN 30 METERS OF AIRCRAFT.**

2. Hot fuelling is permitted only if under specific conditions (see p 38).

3. The engine or engines of any aircraft shall not be:

    a) Started unless the pilot's seat is occupied by a person competent to control the aircraft;
    b) Left running unless the pilot's seat is occupied by a person competent to control the aircraft.

4. The propeller is a potential killer; while turning, it is almost invisible. On turbo aircraft the propeller continues to spin silently for a while after the engine has shut down. Check to make sure the blades are stationary.

5. To approach an aircraft (Figure 22), either running or stopped: first, walk parallel to the direction that the aircraft is parked; second, walk parallel to the trailing edge of the wing. The reverse order is used when leaving the aircraft. Do not approach aircraft from directly in front or behind. You will not be in the view of the pilot. If it becomes necessary to move to the opposite side of the aircraft, go around the rear; the danger zone is in the front of fixed wing aircraft (Figure 23).

6. The tail of an aircraft can change position on the ground quickly when an aircraft is turned under power. If the pilot does not see you, you may be hit by the tail.

TABLE 1. Dangerous goods shipping requirements for goods used in aerial spraying projects.

MATERIAL	CLASS	PRODUCT IDENTIFICATION NUMBER	PACKING GROUP	REGULATED/NON-REGULATED
FUELS				
TURBO A[9]	3.3	UN1863	III	REG - BULK
DIESEL[9]	3.3	UN1201	III	REG - BULK
FUEL OIL[9,10]	3.3	UN1202	III	REG - BULK
PROPANE	2.1	UN1978	X	REG
GASOLINE	3.1	UN1203	II	REG
GASOLINE/OIL MIXTURES	3.1	UN1203	II	REG
TURBO B	3.1	UN1863	II	REG
KEROSENE[9]	3.3	UN1202	III	REG - BULK
NAPHTHA[11]				
PESTICIDES[12]				
DIPEL	-	-	-	NON
GLYPHOSATE	-	-	-	NON
THURICIDE	-	-	-	NON
FUTURA	-	-	-	NON
FORAY	-	-	-	NON
DIPEL	-	-	-	NON
2,4-D ESTER	9.2	UN2765	II	REG
HELIUM[13]	2.2	UN1046	X	REG
MALATHION 500 E	9.2	UN3018	II	REG
SEVIN 80S, 85W	9.2	UN2757	II	REG
TORDON 202C, 101	9.2	UN2765	II	REG
VELPAR LIQUID	3.3	UN1993	III	REG
FENITHROTHION	-	-	-	NON
EMPTY PURGED PESTICIDE CONTAINERS	-	-	-	NON

[9]Registered only if transported in bulk.

[10]Typically not regulated, but some lighter oils may be. Refer to supplier's shipping document.

[11]Naphtha is a generic name encompassing a variety of substances. Canadian Coleman classifies that product as NAPHTHA PETROLEUM, classification number - 3.1, product number - UN1255, and packing group - II.

[12]A vehicle must be placarded with MOE chemical warning signs if carrying more than 500 L of pesticide under an amendment of Regulation 751 of the Pesticides Act.

[13]Not a pesticide but helium is often used to inflate balloons used as markers during aerial spraying.

7. The trailing edges of aircraft wings can cause cuts (Figures 23 and 24). Particular attention must be paid to high wing aircraft such as Cessna 172 (used as Pointers). There is a constant danger of rapping your head on flaps or ailerons which may be in the down position, or colliding with the struts that support the wing. Never walk under the wings of high wing aircraft.

8. DO NOT LEAN on a stationary propeller. Movement of the propeller might cause a live ignition on a piston engine to fire, whipping the blades into action.

9. Avoid touching exhaust stacks. They are extremely hot for a while after motor shutdown. In fact there is no need to be around the front of the aircraft.

10. Wing and tail assemblies are fragile, do not use them to move the aircraft. These assemblies have moveable surfaces called ailerons, elevators, and flaps. Fingers could become trapped between them. The pilot will instruct you how to move his aircraft if he needs help. Pushing is usually done on the wing struts only. Never walk forward of a wing strut during a pushing operation.

11. Eye protection is mandatory. Prop wash from propellers carries dirt and stones.

12. Ear protection must be worn when working around running aircraft.

13. Never run. Stay alert, move carefully and think before you act. If in doubt, ask.

<u>J.2 Helicopter</u>

1. **NO SMOKING WITHIN 30 METERS OF HELICOPTERS.**

2 Danger areas around helicopters are shown in Figure 25.

3. The tail rotor (at the rear of the helicopter at head to chest level) is almost invisible while turning.

4. Some helicopters have exposed engines or exhaust systems. Exhaust from a turbo jet motor is extremely hot. DO NOT walk to the rear of a helicopter or take a short cut under its tail. If you must move from one side of a helicopter to another, walk around the front so the pilot sees you.

5. Always approach and leave the helicopter in a crouch. Main rotor height varies for each machine. On some, the blades can dip within a few feet of the ground. Sloping terrain further reduces rotor-ground clearance, as a precaution never approach a helicopter from up-slope.

6. NEVER approach or leave a helicopter in the area encompassed by the hatched line (Figure 25). Stay in the pilot's field of vision. The air turbulence from the main rotors will suck up unsecured light objects. This could easily damage the blades. NEVER approach a helicopter with a vehicle while the rotor is turning. Wait until the blades stop turning and the pilot gives the OK to move.

7. Downwash from a helicopter can be very strong. Dust and flying debris are a problem. Eye protection must be worn. It is prudent to face away during landings and takeoffs.

8. Ear protection must be worn when working around running helicopters.

9. Helicopter spray booms are exposed and supported by cables. They are 50-75 cm above ground level. Walking into the spray booms may cause personal injury or equipment damage.

10. Walk, never run. Stay alert, move carefully and think before you act. If in doubt, ask.

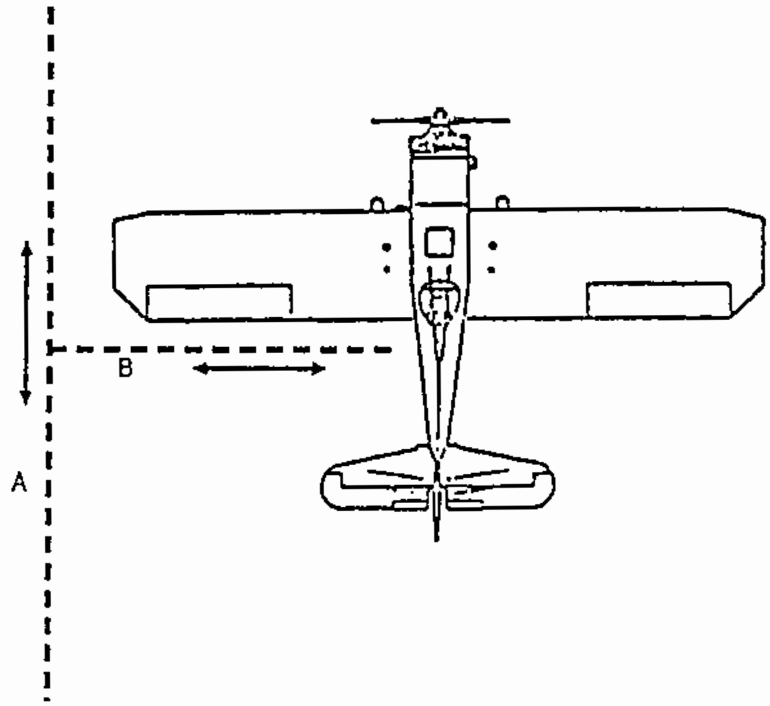


FIGURE 22. Proper approach to fixed-wing aircraft.

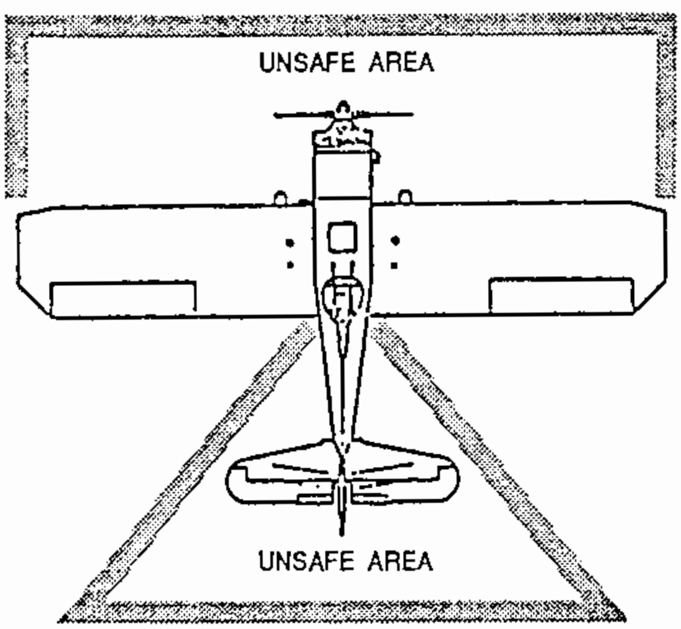
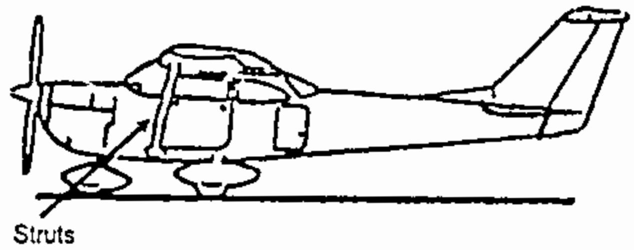
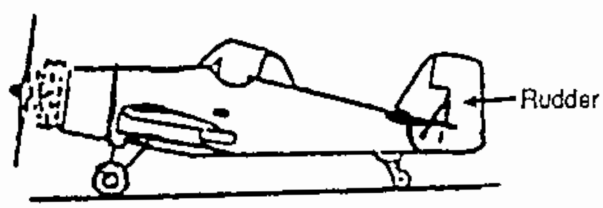


FIGURE 23. Unsafe areas around fixed-wing aircraft.

CESSNA 172



AG - AIRCRAFT



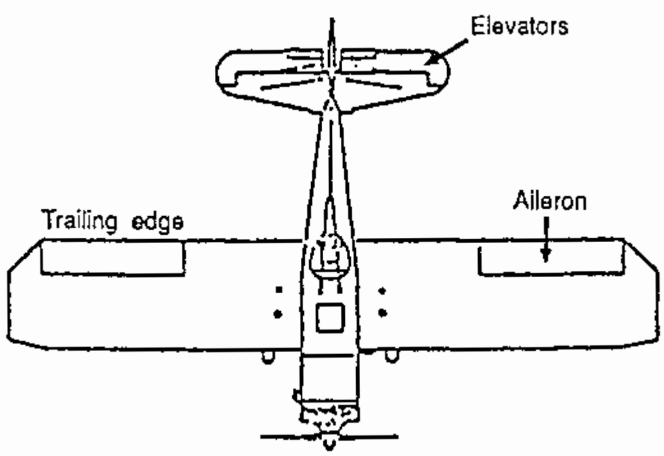


FIGURE 24. Dangerous areas of fixed-wing aircraft.

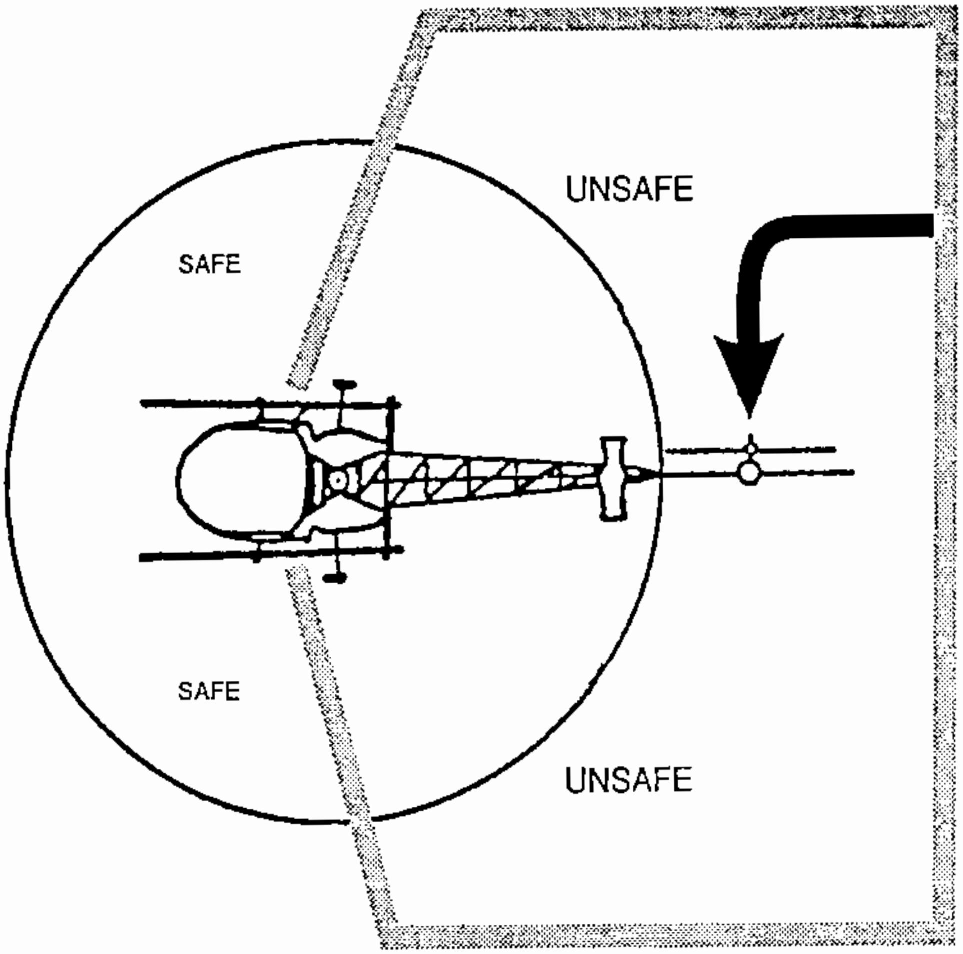


FIGURE 25. Unsafe areas around helicopters.

K. AIRCRAFT OPERATIONS - UNCONTROLLED AERODROMES[14]

K.1 General

An uncontrolled aerodrome is an aerodrome without a control tower or one where the tower is not in operation. There is no substitute for alertness while in the vicinity of an uncontrolled aerodrome and it is essential that pilots be aware of and look for other traffic and exchange traffic information when approaching or departing from an uncontrolled aerodrome, particularly since some aircraft may not have communication capability. To achieve the greatest degree of safety it is essential that all radio-equipped aircraft monitor a common designated frequency and follow common reporting procedures while operating on the manoeuvring area or flying within a "specified area" surrounding an uncontrolled aerodrome. "Specified area" means an area in the vicinity of an uncontrolled aerodrome for which a mandatory frequency has been designated and within which it is specified in the Canada Flight Supplement that mandatory frequency procedures apply (usually a circle with a 5-mile radius capped at 3,000 AAE).

Traffic information in Ontario may be exchanged in two ways: by communicating with a Flight Service Specialist (FSS) or a UNICOM (radio) operator or by a broadcast transmission. A Vehicle Advisory Service (VAS) in conjunction with Airport Advisory Service (AAS) is normally provided at aerodromes served by an FSS. Some uncontrolled aerodromes are indirectly served by an FSS through a Remote Communications Outlet (RCO). Some RCO's are located at aerodromes and AAS and VAS can be coordinated through the parent FSS. As FSS's are often located some distance from an aerodrome it is essential that they be kept fully informed of both aircraft and vehicle activity.

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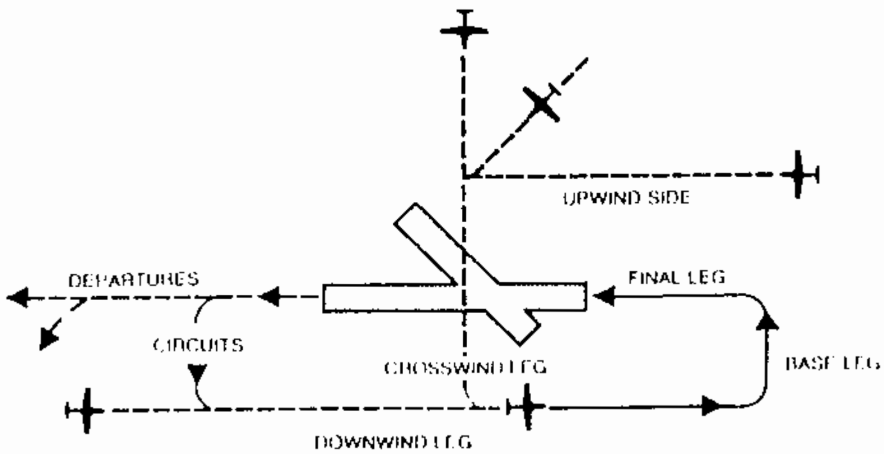
[14]From Aeronautics Information Publication, Transport Canada, RAC 4-15, February 9, 1989. Used with permission.

K.2 Traffic Circuit Procedures - Uncontrolled Aerodromes

The following procedures apply to all aircraft operating at aerodromes where airport control service is not provided, except those aircraft following a standard instrument approach procedure. Prior to joining a traffic circuit all pilots should announce their intentions, particularly when a partial circuit or straight-in approach is intended. All turns shall be to the left while operating in the vicinity of the aerodrome (Figure 26), unless a right-hand circuit has been designated.



NOTE: 1. **Circuit normally flown at 1,000' AAE.**
2. **If a right-hand circuit is designated the opposite of this diagram is applicable.**

FIGURE 26. Standard Left-Hand Circuit Pattern.

K.2.1 Joining the Circuit

Aircraft should approach the traffic circuit as follows:

1. From the upwind side, enter crosswind at circuit altitude and, taking due account of other traffic, join the circuit on the downwind leg. **OR**
2. Straight-in to the downwind leg and, taking due account of other traffic, join the circuit at circuit altitude, in level flight, where the downwind leg and crosswind intersect. If it is necessary for an aircraft to cross the airport prior to joining the circuit, it should be done well above circuit altitude and descent to circuit altitude should be made on the up-wing side.

Unless otherwise specified or required by the applicable distance from cloud criteria, aircraft should join the downwind leg, or enter the crosswind at an altitude of 1,000 ft. AAE and maintain that altitude until further descent is required for landing.

Landing and take-off shall be accomplished on or parallel to the runway most nearly aligned into wind. However, the pilot has final authority and responsibility for the safe operation of the aircraft and another runway may be used if it is determined to be necessary in the interest of flight safety.

K.2.2 Continuous Circuits

Aircraft performing a series of circuits and landings should, after each take-off, reach circuit altitude before joining the downwind leg.

K.2.3 Departing the Circuit

Aircraft departing the circuit should climb straight ahead on the runway heading until clear of the traffic circuit before commencing a left turn. All turns shall be to the left while operating in the vicinity of the aerodrome, unless a right-hand circuit has been designated.

K.3 Helicopter Operations

Pilots of helicopters at uncontrolled aerodromes are urged to avoid air taxiing or low flying across runways and taxiway areas where risk of collision with unseen aircraft or vehicles exists. In addition to maintaining a sharp look-out and practising good airmanship generally, pilots should avoid ground or air taxiing and hovering where blown dust, sand, or gravel can prove hazardous to other aircraft particularly when debris may be blown on to paved surfaces.

K.4 Mandatory Frequency

Transport Canada has designated a Mandatory Frequency (MF) for use at selected uncontrolled aerodromes or aerodromes that are uncontrolled between certain hours. Aircraft operating within the area in which MF is applicable, on the ground or in the air, shall be equipped with a functioning radio capable of maintaining two-way communication and specified procedures shall be followed.

L. DAILY INSPECTIONS

There are many reasons for inspecting the work site and camps on a daily basis. For example to:

- Ensure that various Acts and Regulations are being followed;
- Ensure that equipment and materials are in good working order;
- Ensure that workers are using equipment and materials properly;
- Eliminate hazards.

The checklists developed for use on Aerial Spray Programs are basic, yet they cover the items that must be inspected in order to comply with various Acts and Regulations. You may want to develop further checklists for specific areas, e.g. Emergency Response Equipment, Fire Protection, etc. so you can check many related items and then transfer the results to the main checklist.

When you are about to begin an inspection ensure that you have the tools required to complete the job:

- Clip board or pad;
- Pens, pencils, or markers;
- Act and Regulations (pertinent);
- Flashlight;
- Personal protective equipment.

As you inspect each area take the time to look over all equipment and facilities, for it is the small, often overlooked items that later cause the greatest problems. Inspect each area systematically. This way you will not miss or forget something.

The frequency of inspections varies; some items should be inspected daily or hourly, others on a weekly basis. A complete inspection should be carried out prior to a spray program and upon its completion. Some areas should be continuously monitored: Fire Hazards, Mixing/Loading, fuelling activities and Aircraft Operations.

You should fully understand the checklist and what is intended by each section before you begin. The marking of checklists must also be understood and followed uniformly.

1. "V" indicates the item or area is satisfactory - meets the standards as laid out.
2. "X" indicates the item or area is unsatisfactory - does not meet the standards or requires attention in order to bring it up to the minimum standards.
3. "N/A" indicates that this item or area does not apply to your program, however a written note should be attached explaining why.

Once you have completed the inspection, report your findings to the person or people responsible for the operation of each section of the project and to the Project Supervisor. Written reports are the best form. In all cases follow-up.

AERIAL SPRAYING SAFETY INSPECTION

Location: ______________
Date: ______________

V - satisfactory   X - unsatisfactory   N/A - not applicable

1. Operations Base Checklist

a) Living Conditions (MNR Staff)

i) Potable Water Supply............................______
ii) Food Storage Facilities........................______
iii) Washroom Facilities...........................______
iv) Shower/Bathing Facilities......................______
v) Heating/Cooking Facilities/Equipment............______
vi) Sleeping Quarters..............................______
vii) Fire Protection Devices.......................______
viii) Smoke Detection Devices......................______
ix) Trailer Location...............................______
x) Other...______

b) Fire Hazards

i) Gasoline Storage Facilities.....................______
ii) Refuelling Facilities - Vehicles...............______
- Aircraft.......................______
iii) Other...______

c) General Working Conditions

i) Overhead Hazards................................______
ii) Underfoot Hazards..............................______
iii) Equipment Design/Availability.................______
iv) Chemical Handling Equipment....................______
v) Environmental Concerns..........................______
vi) Other..______

Comments re Section 1.

2. <u>Mixing/Loading - Fuelling Activities Checklist</u>

a) <u>Mixing</u>

i) Procedures - Known/Explained...................._____
ii) Proper Mixing Equipment (as per plan)..........._____
iii) Proper Chemical Storage Tanks/Containers........_____
iv) Dispensing Equipment............................._____
v) Proper Protective Equipment/Devices............._____
vi) Appropriate Mixing Site........................._____
vii) Other..._____

b) <u>Loading</u>

i) Procedures - Known/Explained...................._____
ii) Proper Loading Equipment - hoses, valves........_____
iii) Loading Equipment - properly maintained and stored after use..............................._____
iv) Other..._____

c) <u>Fuelling Activities</u>

i) Appropriate Extinguishing Devices..............._____
ii) Proper Location of Extinguishing Devices........_____
iii) Adequate Grounding Cords (if required).........._____
iv) Proper Fuel Storage Facilities.................._____
v) Appropriate Location for Fuel Area.............._____
vi) Other..._____

<u>Comments re Section 2.</u>

3. Aircraft Operations Checklist

a) Pointer
- i) Air Worthiness of Pointer........................ _____
- ii) Pilot Qualification............................ _____
- iii) Air Worthiness of Pilot........................ _____
- iv) Miscellaneous.................................. _____

b) Airspace - Control
- i) Proper Notification of AFFM..................... _____
- ii) Miscellaneous.................................. _____

c) Communications
- i) Properly Radio Equipped......................... _____
- ii) Operators Trained in Use of Radios............. _____
- iii) Additional Back-up Units (if required)......... _____
- iv) Communication Plan Established Between Pointer and Ground Crews.................................. _____
- v) Miscellaneous.................................. _____

d) Airstrip
- i) Tower Operational with Lights................... _____
- ii) Windsock....................................... _____
- iii) Runway Dust Control............................ _____

Comments re Section 3.

4. Storage/Disposal of Material/Containers

i)	Proper Storage Facilities re: Chemicals - diking etc..............	_____
ii)	Proper Disposal of Contaminated Materials (MOE approved)...........................	_____
iii)	Proper Transportation of Surplus Chemicals......	_____
iv)	Recycling Procedures of Material Containers (MOE approved)...........................	_____
v)	Proper Storage Facilities Available for Unused Chemicals (MOE approved).......................	_____
vi)	Proper Personal Protective Equipment Available..	_____
vii)	Other..	_____

Comments re Section 4.

_________________________ _________________________

NAME (please print) SIGNATURE

M. PERSONAL PROTECTIVE EQUIPMENT

This is only a guide and does not supersede the Occupational Health and Safety Act and its Amendments.

Hard hats:	while head protection may not be necessary at all times, areas will be designated as locations where the wearing of head protection is mandatory.
Ear Protection:	will be available to all staff and must be worn during aircraft take-off and landing. Navigators will wear radio headsets to reduce ambient noise levels at all times while in pointer aircraft.
Eye Protection:	will be available to all staff; where staff are exposed to eye injury, eye protection must be worn.
Respirators:	while B.t. does not require the use of a respirator, where other pesticides are used it is suggested that the internal Health and Safety Specialist be consulted on the types of respirators to be used.
Coveralls:	fuel loaders must use fire resistant coveralls (i.e. 100% cotton). Personnel working with pesticides must wear one piece disposable coveralls or full rain suits.
Footwear:	where staff are exposed to injuries or chemicals, appropriate footwear, i.e. steel toe safety boots or rubber steel toe safety boots, must be worn.
Gloves:	personnel working with pesticides must wear non-flocked rubber gloves.
Chain saw Equipment:	safety hats, ear protection, eye protection, ballistic gloves/mitts, safety pants or chaps, safety footwear.

Visitors should be advised of restricted areas.

N. FIRE EXTINGUISHERS

Thoroughly assess your work area, identify potential hazards, identify and post no smoking zones and ensure staff are aware of the hazards and no smoking areas.

N.1 Portable Extinguishers

The number preceding the letter designates the potential size of fire that the extinguisher can be expected to extinguish.

N.2 Training

Fire fighters should become familiar with the detailed instructions found on the label of each extinguisher. In an emergency every second is of great importance, therefore every Fire Protection Team member should be acquainted with the general instructions applicable to most portable fire extinguishers:

P - Pull the pin at the top of the extinguisher (or by the nitrogen cartridge) that keeps the handle from being pressed. Break the plastic or thin wire inspection band. On those extinguishers with cartridges it will be necessary to push the lever to activate the cartridge and charge the extinguisher.

P - Point the nozzle or outlet toward the fire. Some hose assemblies are clipped to the extinguisher body; release it and point.

P - Press the handle above the carrying handle (or on the discharge hose) to discharge the agent inside. The handle can be released to stop the discharge at any time.

S - Sweep the nozzle back and forth at the base of the flames to disperse the extinguishing agent. After the fire is out, probe for remaining smouldering hot spots or possible reflash of flammable liquids. Make sure the fire is out.

Contact local Fire Marshall for training in the use of fire extinguishers.

N.3 Extinguisher Rating System

The rating system is based on tests conducted by the Underwriter's Laboratories of Canada that are designed to determine the extinguishing potential for each size and type of extinguisher. Full details of the test criteria are found in ULC-S508-1975 the standard for "Rating and Fire Testing of Fire Extinguishers." These ratings consist of both a numeral and letter for extinguishers intended for use on Class A and Class B fires (see Figure 27).

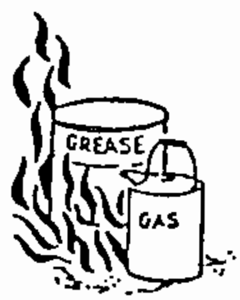
Extinguishers for use on Class C fires only receive the letter rating because there is no readily measurable quantity for Class C fires, which are essentially Class A or B fires involving energized electrical equipment. Class D extinguishers, likewise, do not contain a numerical rating. The effectiveness of a Class D extinguisher is detailed on the faceplate.

For those extinguishers that are effective on more than one class of fire there will be multiple letter or numeral-letter ratings.

This symbol indicates the extinguisher is applicable for use on combustibles such as wood, cloth, paper, rubber, etc. The background of the symbol will be either metallic or green.

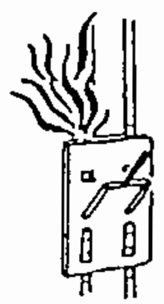
It is found on Water, Multi-purpose Water, Multi-purpose Dry Chemical and Foam type extinguishers and sometimes on Halon extinguishers.

This symbol indicates the extinguisher is for use on flammable gases, greases or similar materials. The background of the symbol will be either metallic or red.



It is found on Dry Chemical, Multi-purpose Dry Chemical, Carbon Dioxide, Halon and Foam type extinguishers.

This symbol indicates the extinguisher is applicable for use on fires involving energized electrical equipment. The background of the symbol will be either metallic or blue.



It is found on Dry Chemical, Multi-purpose Dry Chemical, Dry Chemical, Carbon Dioxide and Halon extinguishers.

This symbol indicates the extinguisher is applicable for usa on certain combustible materials such as sodium, magnesium, potassium, etc. The background of the symbol will be either metallic or yellow.

It is found on special Dry Powder extinguishers, but it would be a rare case indeed if your are faced with a Class D fire.

FIGURE 27. Fire extinguisher types.

N.3.1 Multiple Markings

Extinguishers are identified by both the letter classification/numerical rating method and by a "picture symbol" labelling system. The "picture symbol" labelling system now in use is designed to make the selection of fire extinguishers more effective and safe to use. This system also emphasizes when not to use an extinguisher on certain types of fires.

N.4 Inspection of Fire Extinguishers

Fire fighters are frequently required to inspect fire extinguishers. Two main factors that determine a fire extinguisher's worth and which will justify its purchase and installation are its serviceability and its accessibility.

When inspecting portable fire extinguishers look for the following:

1. Check accessibility and proper location;
2. Check tag for date of last recharge or inspection;
3. Check nozzle for obstructions and operation;
4. Examine for corrosion (leaks at seams) or mechanical damage;
5. Check lockpin and seal;
6. Determine if full (water level/pressure gauge/weight);
7. Examine condition of hose and hose coupling;
8. Check horns for cracks, dirt or grease accumulations;
9. Date of this inspection and initials of inspector should be placed on tag.

N.5 Fire Extinguisher Requirements

The number and types of extinguishers required will depend on the size of operation. As general guidelines, operations will be broken into two classes. Minimum requirements recommended by AFFM are:

1. Class I Airstrip - operations having more than 5 aircraft including pointer aircraft must have a minimum of 4 groups of two 20 lb BC class extinguishers (total of 8) placed around the fuel cache and refuelling stations, and 2 groups of two 20 lb. BC type extinguishers spotted along the airstrip. See Appendix 6 (p 177) for the definition of a Class I Airstrip.

2. Class II Airstrip - smaller operations having 5 aircraft or less must have at least half the above quantities, depending upon the number of aircraft, fuel quantities on hand, etc. See Appendix 6 (p 177) for the definition of a Class II Airstrip.

N.6 Extinguisher Placement

Figure 28 is a schematic of a large loading/fuelling area illustrating suggested fire extinguisher placement. In addition each structure on site should have a minimum of one 5 lb BC extinguisher.

N.7 Additional Fire Precautions

When there is a sufficient water source near the airstrip, a wet hose should be run along the full length of the strip.

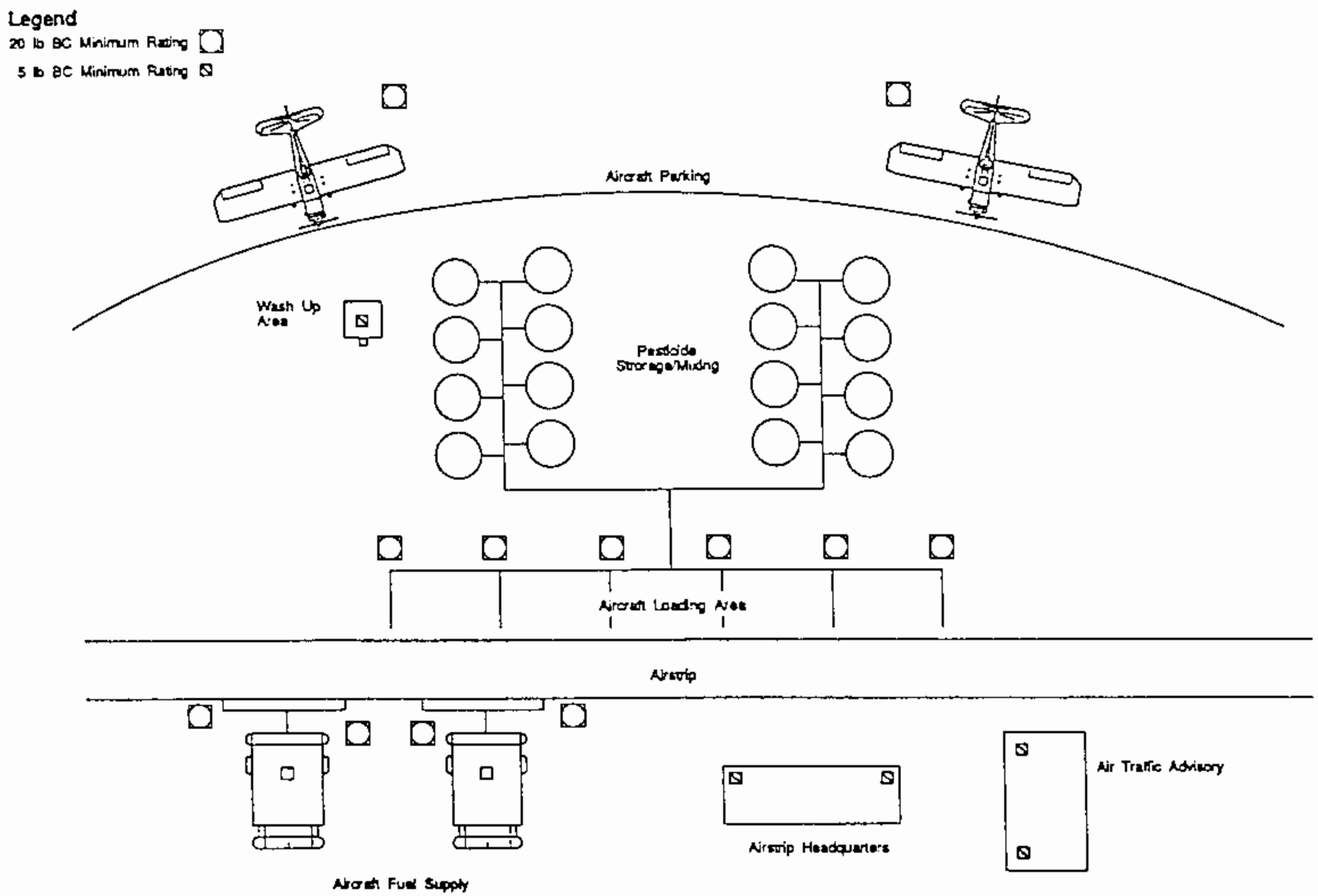


FIGURE 28. Recommended extinguisher placement.

P. WHMIS

WHMIS (Workplace Hazardous Materials Information System) is designed to help prevent injuries and illness from exposure to hazardous materials in the workplace.

Information on hazardous materials in the workplace is supplied to project personnel in three main ways: container labels, Material Safety Data Sheets (MSDS), and employee training. You will also inform project personnel about the hazards of controlled products (a legal term to describe classes of hazardous materials covered by WHMIS) in each work area, and the hazards of non-routine work tasks.

P.1 Container Labels

Supplier provided containers of controlled products in the workplace must:

1. Be labelled with the identity of the product. The supplier label also lists the name and address of the product's manufacturer (or other responsible party). It has a distinctive slashed border and is written in both official languages.

2. Warn of the particular hazards of the product, in words and symbols.

Controlled substances must be identified by appropriate means (e.g. signs, colour coding) and by employee training, when they are contained in: pipes, piping system including valves, tank cars or tank trucks, and other similar devices.

Other requirements for warning are in place for portable containers, bulk and multiple-container shipments, and controlled products poured from supplier containers.

P.1.1 Reading Supplier Labels

Supplier labels may include the following information:

1. **Product identifier** - a code number, chemical or trade name, etc.

2. **Hazard symbol(s)** - a special illustration appearing within a circle that classifies the product according to its hazards and provides an immediate warning of the product's dangers in general.

3. **Risk phrase** - briefly explains any hazard.

4. **Precautionary measures** - the essential measure to be taken when using, handling or working in the presence the product.

5. **First aid measures** - information on what to do if someone is exposed to the hazardous material.

6. **Reference to MSDS** - a reminder that more detailed information is given on the MSDS.

7. **Supplier identification** - the name of the supplier, the address and telephone number may also be added.

Supplier labels generally provide the above information. Labels, tags, etc. are also required for controlled products used anywhere in the workplace. Such labels are only required to list the identity of the product, its safe use and handling, and the availability of an MSDS.

P.2 Material Safety Data Sheets (MSDS)

An MSDS gives detailed information on a product and its hazards. MSDS's are divided into 9 sections and are available in both official languages.

P.2.1 Section I: Product Information

The name and address of the supplier of the product is listed, as well as a phone number to call in case of emergencies, or if more information is needed than listed on the MSDS.

P.2.2 Section II: Hazardous Ingredients

This section lists all the hazardous ingredient found in the product (except if an ingredient is a trade secret) and tells how hazardous each ingredient is by listing its LD_{50} or LC_{50} (see Appendix 16, p 267 for definitions). This gives an idea of how hazardous the mixture is as a whole.

P.2.3 Section III: Physical Data

This section describes the known properties of the substance and how it will act under certain circumstances. A list with short definitions of these properties is given below.

Boiling Point: This data is given if the material is liquid at 20°C (68°F).

Vapour Pressure: This data is given for materials that are liquid at 20°C (68°F) or for those which sublime.

Vapour Density: For volatile portion of product.

Specific Gravity: If specific gravity of product is not known, indicated as <1, =1, >1.

Odour Threshold: The level in parts per million at which most people will be able to smell the product

Evaporation Rate: Indicated as faster or slower than ethyl ether, unless otherwise stated.

pH: Indicates if the product is acidic (pH<7) or basic (pH>7). Dangerous pH levels are between 0 and 3 and near 14.

P.2.4 Section IV: Fire and Explosion Hazard

This section, along with the information on the physical properties, give an indication of potential fire hazards of the product. This section will explain under which conditions the material will catch fire and the type of fire extinguisher that should be used.

Flash Point: The lowest temperature at which the vapours above a liquid will ignite in air when exposed to a flame. The lower the flash point the greater the fire hazard.

Upper and Lower Fire Limits (UFL, LFL) and **Upper and Lower Explosion Limits (UEL, LEL)**: States that a vapour concentration between these limits will catch fire or explode when exposed to a source of ignition.

Auto-ignition Temperature: the lowest temperature at which a material will catch fire without a source of ignition.

Hazardous Combustion Products: hazardous products released when a substance burns.

Explosion Data: States if the product will explode when hit forcefully, or dropped or is sensitive to static electricity.

P.2.5 Section V: Reactivity Data

This section states when the product is unstable and the names of the materials with which the product reacts.

Hazardous Decomposition Products: Substances released when the material breaks down.

P.2.6 Section VI: Toxicological Data

This section tells about the effects of exposure to products that are poisonous or infectious. It states if the effects are immediate (acute) or develop over a long period of exposure (chronic). It tells how the chemical enters a person - swallowed (orally/ingestion), through the skin (dermally), or inhaled. It also lists the **exposure limits**, the concentrations set out by regulatory agencies above which a person cannot be exposed.

This section also states if the product is an **irritant** - causes a curable inflammation of the skin or eyes; a **sensitizer** - after repeated exposures, causes a serious skin or respiratory response; a proven or suspected **carcinogen** - shown to cause cancer in humans or test animals; **teratogen** or **embryotoxin** - causes birth defects or defects in fetuses; or a **mutagen** - causes cell defects that can be inherited. Also noted are effects that reduce fertility.

The MSDS may list the **synergistic effects** of the product. The names will be given of any material that, when used with the product, increase the product's hazards.

P.2.7 Section VII: Preventive Measures

This section indicates protective equipment and engineering controls to be used when handling the product. It also states how to safely handle, store, ship and dispose of the product and what to do if there is a leak or spill.

P.2.8 Section VIII: First Aid Measures

This section tells of actions to be taken if someone is injured because of contact with the substance by inhalation, ingestion or splashing it on the skin or eyes.

P.2.9 Section IX: Preparation Information

This section lists the person, department or group responsible for filling out the MSDS and the date the MSDS was completed or revised. By law, the MSDS should never be more than three years old. If it is, a new, possibly more accurate, MSDS should be obtained.

P.3 Information and Training

Under WHMIS you will discuss with project personnel:

1. What is required under any federal or provincial law related to WHMIS;
2. The company program for informing users about hazardous materials;
3. Work operations and areas where hazardous materials are used;
4. All worker, and health and safety committees will have printed reference material distributed to them.

As a result of WHMIS training program project personnel should be able to:

1. Read and interpret the information on MSDS's and container labels, and how to find and use hazard information;
2. Protect themselves from hazardous material while at work;
3. Learn specific information about the material they work with;
4. Use personal protective equipment to protect themselves from exposure to hazardous materials.

P.4 Keys to Safety in the Workplace

1. Be aware of hazardous material in the workplace;
2. Know how to use and understand the information on hazardous materials;
3. Ask your supervisor if you have any questions;
4. Use proper protective equipment, safety practices and procedures;
5. Know emergency procedures.

Q. HAZARD IDENTIFICATION MODEL

The MNR Occupational Health and Safety Section's Hazard Identification Model is a tool to be used by supervisors to assist them in identifying health and safety concerns of the work they are organizing. These concerns are then analyzed by supervisors who must determine the controls necessary to achieve an acceptable level of risk in the work plans they are developing. The Model is not intended to be applied to all tasks, rather, it is to be used by the supervisor in high risk or critical situations.

The quality of the work plan is dependant upon the ability of the supervisor, through his/her knowledge, training and experience, to organize the work and its performance.

The Model has five components and four factors. The interaction of the components and factors identify the health and safety concerns that are associated with the task. Once the concern has been identified controls can be introduced to achieve an acceptable level of risk.

Q.1 Instructions

1. The first step in the process is to identify the various components of the task. These five components are: the **People** involved in the activity, the **Equipment** used to carry out the activity, the **Material** used to carry out the activity, the **Environment** in which the activity is carried out, and the **Process** involved in carrying out the activity.

2. After the components have been identified, each component is evaluated by the four health and safety factors. These factors are: **Biological, Chemical, Physical,** and **Ergonomic**. Arising out of this evaluation will be a list of health and safety concerns.

3. Each concern must be analyzed to determine if it is at an acceptable level of risk. Those that are not will require controls to manage the risk thereby achieving an acceptable level.

4. Introduce and make the controls part of the work plan (as health and safety management activities are always part of the work being undertaken and do not stand alone). The controls will become the workplace standards and procedures.

5. The result of this exercise will be a plan, the work plan, and its existence will assist the supervisor in demonstrating reasonable duty of care.

Q.2 Controls

Before determining the control for each identified hazard or concern, the acceptable level of risk must be determined. Acceptable levels of risk are those risks found acceptable to our society. These acceptable risk levels have become our society's standards and are expressed in legislation, Ministry policy, standards (CSA etc.), peer industry standards and practices, and the work practices of supervisors.

A control may be administrative, changing the rules and procedures that govern a worker; or it may be an engineering control, which is a change in the process to eliminate or reduce the hazard. A combination of both types of controls may be used, however engineering controls are considered to be more effective as they directly address the hazard.

To clarify the Hazard Identification Model, the mixing/loading of the pesticide Vision by the Application Boss will be run through the Model.

Q.3 Components

Q.3.1 People

Mixer/Loader/Runner (since Mixers, Loaders and Runners are generally exposed to the same hazards, only the Mixer will be examined in this model)

Pilot

Q.3.2 Equipment

generators
pumps - fuel/pesticide
tanks
hoses
barrels
lighting
aircraft - fixed wing/rotary wing
plumbing
hand tools
meters
vehicles
accommodations
eating facilities
fire extinguishers

Q.3.3 Materials

Vision
Fuel - propane
- gas
- avgas
- diesel

diluent
bleach
insect repellant
dye
adjuvants
water

Q.3.4 Environment

runway
outdoors

Q.3.5 Process

pesticide delivery
fuel delivery - bonding and grounding

storage - pesticide
- fuel

loading - aircraft with pesticide/fuel
- generator
- tanks with pesticide/water
- plumbing system

mixing - pesticide and water
- pesticide and dye (sometimes adjuvant)
- circulating

cleanup - equipment
- site
- personnel

disposal - rinsate
- pesticide containers
- contaminated coveralls

site design

Q.4 An Example Run of the Hazard Identification Model

Hazards in the People Component as a Result of Biological Factors

	Hazards	Controls
Mixer	- contaminated water	- test water supply - use bottled water or ship in water if necessary
	- biting insects	- use insect repellant or mosquito netting
Pilot	- contaminated water - biting Insects	- see Mixer

Hazards in the People Component as a Result of Chemical Factors

	Hazards	Controls
Mixer - exposure	- Vision - fuels - diluent - dye - adjuvants	- to control exposure to all chemicals use a closed system, where possible, so that exposure to chemicals is minimized - where a closed system cannot be used personnel who may be exposed to chemicals must wear personal protective equipment
	- exhaust fumes	- install exhaust pipes on generators so that exhaust is emitted far enough above the work area as not to be a problem - design the site such that the generator is not near the work area - if there is no health hazard from the fumes tolerate the fumes
	- bleach	- store such that the bleach will not spill on a person when they reach for the bleach container
Pilot - exposure	- fuels - exhaust fumes	- see under Mixer

Hazards in the People Component as a Result of Physical Factors

	Hazards	Controls
Mixer	- lifting	- use lightest equipment or containers possible - training on how to lift objects - place equipment and containers so that there is little need to move them
	- aircraft - propwash - hot exhaust from aircraft	- possible to mark where planes will always stop, thus the safe areas can also be marked - design the site so that there will be limited number of people near the aircraft - educate personnel about aircraft hazards
	- aircraft noise	- use noise level indicator to identify control needs - set a distance from the noise source in which ear protection must be worn - type of ear protection to be worn - people who wear glasses will not be adequately protected by headsets since there is a gap in the headsets caused by the ear pieces of the glasses; thus glasses wearers are to use ear plugs
	- hot exhaust from pumps	- inform personnel of hazard
	- shock hazard	- use bonding and grounding - electrical wiring, including extension cords, are not to be buried unless the proper wiring is used and it runs from an outdoor box to an outdoor box - locate the electrical cords and generators out of the work area if possible - if the electrical cord must be in the work area run it over head

Hazards in the People Component as a Result of Physical Factors			Control
Mixer	- heat stress		- wear hats - supply plenty of fluids - wear ventilated protective suits - train personnel to recognize the signs of heat stress - emergency control measures: get out of the heat and administer first aid
	- climbing	- aircraft	- trained by the pilot - have the pilot do the climbing
		- tanks	- use tanks that do not require climbing where possible - use properly secured ladders or scaffolding
	- static electricity		- bonding and grounding - training in types of clothing to wear to reduce the build-up of static electricity
	- hand tools		- training in the use of hand tools - use the proper tool for the job
	- tripping over hoses, etc.		- design the work area such that hoses, etc. are assigned to a specific area and inform personnel of these locations
	- rupture of hoses due to internal pressure		- do not pressurize hoses to beyond their specifications - use pump only when there is some place for the material to be pumped to
Pilot	- aircraft noise		- see under Mixer
	- static electricity		- see under Mixer

Hazards in the People Component as a Result of Ergonomic Factors	
Mixer - overwork	- schedule sufficient time off - rotate personnel to different jobs to reduce boredom
Pilot - overwork	- contract for sufficient pilots to get the job done safely

Hazards in the Equipment Component as a Result of Biological Factors	
tanks - possibility of contamination with mould or bacteria	- clean to the set standards of cleanliness
hoses - as above	- set up a routine of inspection to determine if the tanks, etc. have been cleaned to these standards
food - hazard of contamination with Vision or with fuels	- segregate food from the work area - require personnel to wash before leaving the work area - follow Acts and Regulations (minimum standards) - the same controls go for smoking as for food
accommodations - hazard of contamination with Vision or with fuels	- segregate work from accommodation - require personnel to wash before leaving the work area - set cleaning schedule for the accommodations - follow Acts and Regulations (minimum standards)

Hazards in the Equipment Component as a Result of Chemical Factors	Controls
tanks - break down by chemicals inside hoses - as above plumbing - as above meters - as above	- use the proper equipment with each chemical - inspect equipment daily - follow the maintenance schedule - keep pipes as short as possible, with many valves in the system so if there is a leak only small portions of the system need to be drained

Hazards in the Equipment Component as a Result of Physical Factors	
vehicles - position with respect to other equipment (varies with time)	- post areas where vehicles are not permitted - mark on the runway where planes are to stop and where ground vehicles are allowed - rules about when and where ground vehicles are allowed and have a communication system in place as a backup
hoses - rupture due to internal pressure pumps - internal pressure	- inform workers of potential problem - post warning signs in work area "Equipment under pressure" - design the pump system to minimize the risk - emergency response: eye wash station and emergency shower
rotary aircraft - environmental temperature concerns	- use the helicopters only under specified operating conditions

Hazards in the Equipment Component as a Result of Ergonomic Factors	
hazards due to design of equipment	- proper choice of pieces of equipment in relation to other pieces of equipment - design the work area so that different pieces of equipment that one person is expected to operate at one time are close together

Hazards in the Material Component as a Result of Biological Factors	
none identified	

Hazards in the Material Component as a Result of Chemical Factors	
Vision - hazard of explosion if stored in galvanized or unlined steel (except stainless steel) containers or spray tanks	- make personnel aware of problem - specify in the contract that tanks, etc. are to be plastic or stainless steel - check the contractor's equipment before start of project
fuels - fires, explosions	- proper storage including using approved containers - proper labelling of containers following AFFM and the Gasoline Handling Act standards - no smoking within 30 meters of the fuel storage or loading sites - design the site to reduce risk
- gas and avgas - water contamination	- proper storage including tilting the barrels so that water does not collect over bungs
insect repellant - hazard of dissolving certain plastics - reacts with suntan lotion	- the supervisor informs workers of the hazard under WHMIS - tell workers to read the insect repellant's label and MSDS
diluent - low flammability hazard	- see under fuels
bleach - hazard of dissolving storage container	- if bleach needs to be transferred to a new container use a container made of the same material as the original container and label the new container
adjuvant - may be flammable	- awareness of the hazard - follow proper storage practices

Hazards in the Material Component as a Result of Physical Factors	Controls
fuels - spills, leaks	- regular inspection of containers - dike the storage area if large enough to warrant it - have the appropriate absorbent on hand - make sure personnel know the location of emergency shut-offs
adjuvant - spills, leaks	- see under fuels
Vision - spills, leaks - inactivation by suspended clay particles in the water it is mixed with	- see under fuels - test water source, if unacceptable find another source - filter water that seems clean
dye - drift of powdered dye	- use liquid dye instead - pre-measure and liquify the dye in a fumehood before hand - use personal protective equipment i.e. eye protection, gloves and a protective suit - emergency response: eye wash station - use proper equipment to load into aircraft e.g. a funnel in the case of a helicopter

Hazards in the Material Component as a Result of Ergonomic Factors	
propane - difficulties with container design and size	- have sufficient manpower to handle the container - if the site is permanent have the propane delivered
fuels - as above	- as under propane
Vision - as above	- as under propane
	- in planning the project balance the savings in using large containers against the ease of handling and lower risk of small containers

Hazards in the Environment Component as a Result of Biological Factors	
none identified	

Hazards in the Environment Component as a Result of Chemical Factors	
outdoors - hazard of application of spray to the wrong area	- mark blocks e.g. balloons - use navigation controls - have pilots fly pre-spray familiarization flights - use observer aircraft - supply pilots with up-to-date photos/maps
- hazard of wrong application rate	- proper training and practice in mixing - calibrate meters and check calibration against aircraft output during each session
- emergency dump	- if the pilot has time to decide where to dump, prioritize dump sites, i.e. dump over land rather than over water; the Project Supervisor and pilot discuss this before the project starts - if the aircraft is able to fly but its spray system malfunctions use a dump wagon for dumping the hopper while the aircraft is on the ground - after emergency dump notify MOE of a spill

Hazards in the Environment Component as a Result of Physical Factors	Controls
outdoors - the temperature, relative humidity and wind speed affects on the drift of Vision particles	- train personnel in the interpretation of weather conditions and the use of the spray weather parameters
runway - degradation with use and exposure to elements	- Project Supervisor, contractor, pilot and AFFM representative meet at the airstrip two weeks before the project to inspect the airstrip and to discuss any problems - follow inspection and maintenance schedules
Hazards in the Environment Component as a Result of Ergonomic Factors	
outdoors - weather conditions concern re: safety of flying and drift	- through training apply weather parameter guidelines to determine go/no go
Hazards in the Process Component as a Result of Biological Factors	
none identified	
Hazards in the Process Component as a Result of Chemical Factors	
pesticide delivery - spills and leaks	- regular inspection of off loading equipment, holding tanks, hoses - inspect delivery truck before accepting delivery - inspect drums before accepting delivery, if drums damaged or if seals broken do not accept delivery - take precautions to avoid spills - emergency response: absorbent material
fuel delivery - spills and leaks	- see under pesticide delivery
pesticide storage - spills and leaks	- inspect storage containers regularly
- incompatibility of materials stored together	- store incompatible materials in different areas (e.g. propane and gasoline) - label containers
fuel storage - spills and leaks	- see under pesticide storage
loading - spills	- take precautions to avoid spills - emergency response: absorbent material
- fuels - contaminated fuels	- carry out transfer in a manner as to avoid contamination with dirt - have enough equipment so that each fuel has its own pumping system - label the fuel containers and the pumping systems - inspect fuel storage site and fuel systems daily - pilot inspects the fuel before it is loaded into his aircraft as a final safe guard
- pesticide - contamination of pesticide with last load or dirt	- make sure last load is cleaned out of the system if it was a different product or rate - carry out transfer in a manner as to avoid contamination with dirt
clean up - equipment - spills and contamination of personnel	- proper training in how to do the job and in the standards to clean to; this is enforced by the Application Boss - have the proper equipment available - use personal protective equipment
disposal - environmental damage and human exposure risk from rinsate	- plan before the project starts as to the most efficient and safe way to dispose rinsate - it is suggested that the rinsate be disposed of as the project progresses rather than storing rinsate for disposal at the end of the project; this reduces the amount of rinsate workers are exposed to at a time and the amount of storage required - if the rate used in the project is below the maximum label rate then rinsings from barrels, etc. may be added to the water tank used for diluting the product (see p 18)

Hazards in the Process Component as a Result of Physical Factors	Controls
pesticide delivery - hazards during transport	- follow proper loading practices, i.e. tie downs - use proper placards and documentation as required under law - train personnel what to do in the event of a spill, make sure MSDS and a source of decontaminant material are available
pesticide delivery - site condition not suitable for delivery vehicle	- planning
- equipment not appropriate for the job	- planning
fuel delivery - as above	- as under pesticide delivery

Hazards in the Process Component as a Result of Ergonomic Factors	
pesticide delivery - concern about damaging drums, etc. during off loading	- use of proper equipment, e.g. hiab, forklift, etc.
fuel delivery - as above	- as above
storage - concern about security of storage area	- use locked storage - use fences - 24 hour patrols by MNR personnel, personnel supplied by contractor, or by a security guard firm
loading - generator - noise hazard	- locate generator as far from the work area as possible - test sound level to define the hazard - move away from the source of the sound if possible
- communication problems	- headset for the operator as hand signals are unreliable
- pumping system - as above	- see under generator
disposal - frequency of disposals of solid wastes	- follow guidelines set by MOE - store containers, contaminated suits, etc. in sealed garbage bags until there is enough to warrant transport to the disposal site

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PART 4: NAVIGATOR'S GUIDE

A. INTRODUCTION

This section will assist MNR staff involved in providing efficient, systematic aerial application of insecticides. **Pointing** is the method of aerial guidance used by the MNR. Pointing reflects the action of a navigator as he/she indicates terrain features to the pilot. Successful Pointing depends on competent, low level, visual navigation.

In situations where the methods presented here are not applicable, the principles listed will help experienced Navigators to modify the basic system. Keep all variations simple.

B. HISTORY OF POINTING

Since its inception the aerial flagging system has been successfully used with aircraft ranging in size from Piper Pawnees and Stearman biplanes to Grumman Avengers and DeHavilland DC-3's. Although electronic navigation has been successfully used, it is likely that "Pointing" (using a map- or photo-interpreting navigator in a guidance aircraft) will continue to be the dominant method of guidance control in Ontario's aerial insecticide spraying operations.

B.1 Why the need for a Navigator?

Spray pilots do more than just fly planes. They must: maintain a designated speed, flying height above the forest canopy, in formation with other spray aircraft; monitor the boom pressure of the aircraft spray system; watch for towering trees; monitor the aircraft instrumentation; perform precision team turns quickly in confined airspace; and always be alert to the slip stream (vortex) of aircraft. The spray aircraft's speed (40-65 m per second) and its proximity to the landscape (20-30 m above the trees), make recognition of small topographical features almost impossible. Thus it is extremely difficult for spray aircraft pilots to make course corrections necessary for accurate pesticide delivery.

The use of airborne navigators removes the burden of intricate navigation from the spray pilot team leader. It allows pilots to concentrate on safe flying and proper spray application. The Pointer aircraft flies several hundred feet above the terrain as it guides spray aircraft over the forest. With this bird's eye view the Navigator can see check points in advance and guide the spray aircraft accordingly.

The ground crew records: the spray mix used; which pilot and aircraft put the spray out; the date, time and atmospheric conditions when the spray aircraft left the airstrip; and where the spray was to go. Navigators are in the best position to record the time, accuracy and quality of application, they also record the atmospheric conditions at the spray location. The information gathered by the ground crew, and especially that gathered by the Navigators, is important should any legal dispute arise.

C. DUTIES OF A NAVIGATOR

C.1 Safety

Navigators and Pointer pilots are not to carry out duties, or work in situations they feel are unsafe. Navigators will bring all unsafe practices, situations, people and equipment to the attention of the Chief Navigator or Project Supervisor immediately.

C.1.1 In Flight

Through licensing, Pointer pilots have proven their ability to fly safely and safeguard their passengers and equipment. It is their responsibility to do this at all times.

The majority of Pointing requires normal flight, however low flying may be required during searches in emergency situations. Also tight, quick turns are advantageous in some Pointing situations. Any of these manoeuvres must be well within the operational limits of both the Pointer aircraft and the Pointer pilot. It is recommended that Navigators learn the basics of flight safety. This is best accomplished through the Pointer pilots as it: promotes a good working relationship between the Navigator and the Pointer pilot; emphasizes the Ministry's commitment to safety; and keeps safety uppermost on the Pointer pilot's mind.

C.1.2 On the Ground

The air worthiness of the Pointer aircraft is the responsibility of the Pointer pilot. However, as in the section on flight safety, Navigators are encouraged to learn from their Pointer pilots the rudiments of:

- Regular aircraft maintenance schedules
- Aircraft security
- Proper "tie down" procedures
- Ground "walk arounds"
- Proper fuelling
- Systems operations and checkouts
- Emergency procedures
- Emergency locator transmitter - location and usage
- Survival gear (Appendix 4, p 173)

C.1.3 Flight Plans

Formalized, individual flight plans are uncommon, but Ministry Aircraft Passenger Manifests are required if MNR personnel are passengers, thus generalized flight information about Pointers is available. The posting of manifests is a joint responsibility of the Navigators and Pointer pilots. The pilots, because they are normally responsible for filing flight plans, and the Navigators, because they usually decide when and where to go. For more information see Appendix 7, p 183.

Since much of a Navigator's safety depends on his/her initiative, Navigators and Pointer pilots are advised to take additional precautions:

- Show someone your destination(s), the intended flight path(s) and estimated time of arrival (E.T.A.)
- Radio contact must be made to the airstrip every 30 minutes
- Use the buddy system
- Be predictable

C.1.4 Weather

Pilots are trained to recognize dangerous, or the potential development of dangerous, atmospheric conditions. Since the Pointer pilot is responsible for the safety of his/her aircraft and passengers, he/she is also responsible for monitoring weather conditions which may endanger people and equipment. He/she is also responsible for advising other air crews of potential weather hazards.

Navigators are advised to learn about weather as it applies to flight (see the Weather Officer's Guide (pp 147-150) and Appendix 8, p 195). In particular, the Navigator should pay attention to: severe atmospheric instability, storm cells, "dust devils", fog formation (p 148), dew points (p 148), and low ceilings. Appendix 15 (p 257) gives definitions of weather report terminology. Navigators can learn about flight weather from their Pointer pilots.

C.1.5 The Human Element

Spray periods are usually in the early morning and the late evening, thus rest tends to be during the day. Occasionally, good atmospheric conditions result in long spray sessions with only brief periods of rest. For Navigators, post-spray documentation and pre-spray preparation will significantly shorten the available hours of rest.

Pointing is satisfying work, yet it can be exhausting. Navigators should be alert to the dangerous mix of fatigue and long periods of activity. To lessen the effects of mental and physical fatigue be sure to: eat properly, get regular rest, recreate at the proper time, and be sympathetic to the situations of others.

C.2 Pointing

C.2.1 Radio Communication Control

Using the Two Pointer System, as many as seven aircraft can be involved (two Pointers and a team of five spray aircraft). This can be accomplished only with clear concise instructions given by the Navigator to the spray pilots and good radio communication between the Navigators and the spray pilots.

Each Pointer/spray team should have its own radio frequency. The Airstrip Control Zone has its own frequency.

The Pointer and spray aircraft team are in two way radio contact to coordinate their positions and activities. Figures 29-36 illustrate the methodology of Two Pointer guidance.

C.2.2 Single Pointing versus Double Pointing

The Single Pointer operates similarly to the Lead Pointer in the Double Pointer system. The main reason for Double Pointing is accuracy, and secondarily more efficient use of spray weather. With two Pointers:

- A better track is defined for the lead Sprayer to follow. A Single Pointer, crabbing to offset a light wind, can confuse a spray pilot trying to track on it.
- The lead Pointer navigates primarily, leaving the trailing Pointer to give more accurate shut-offs for non-target areas and more effectively assess the tracking of the spray team.
- There is more likelihood of having one Pointer close to the spray team to give accurate instructions.
- Pointers can fly slower as they do not have to be ahead of the spray aircraft, and each Pointer "leads" on only about half of the spray block, thus navigation is easier and more accurate.
- Projects can be completed sooner because more powerful and faster spray aircraft, with larger payloads, can be used.
- Longer flight lines can be used thus more time is spent spraying and fewer turns are required. This is particularly suited to larger, faster spray aircraft that can more rapidly complete a job.

Single Pointing may be used where:

- Spray blocks have flight lines less than 5 km long (too small to efficiently coordinate two Pointers).
- Spray aircraft which operate at speed less than 150 kph are used. Most Pointer aircraft operate close to this speed and it would take too long for trailing spray aircraft to overtake one.
- Projects are small and cannot justify the cost of two Pointers.

C.2.3 When not to Point

C.2.3.1 Short Flight Lines

When spray blocks are small and flight lines are short (3 km or less), coordinating the efforts of a Pointer and spray aircraft team becomes increasingly difficult. More time is spent in "turning" than spraying. The Pointer's track will take on the appearance of a series of "S" turns, with no parallel "centres". On very small blocks, the Pointer and spray aircraft will find themselves commencing turns at opposite ends of the block.

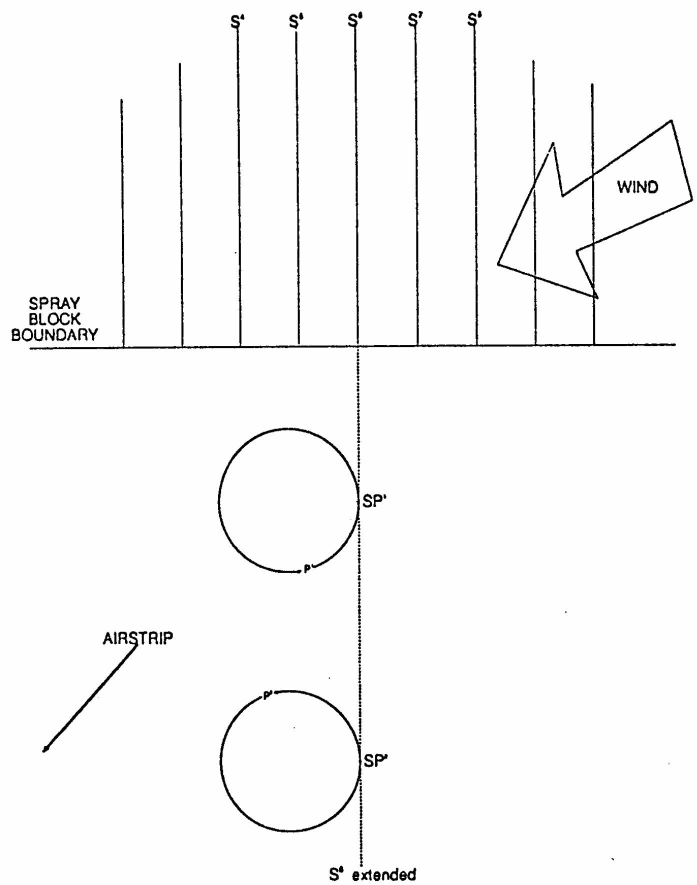

FIGURE 29. "The wait".

SP1, SP2: Pointer starts pointing, located on the projection of S6 and on the side of the block closest to the airstrip. Depending on conditions, SP1 and SP2 will be 2.5-3 km apart. Similarly, P1 will usually be about 1-1.5 km from the beginning of the spray block.

P1, P2: The Pointers await the spray team, which has departed the airstrip after taking on fuel and payload, i.e. the spray aircraft are ferrying. P1 will have confirmed with T1 the required echelon as determined by the wind. The Pointers are orbiting in large circles beside their identified starting points and at normal point altitude. Orbits should always be made adjacent to the intended flight line and closest to the airstrip. When the spray aircraft have visual contact with the Pointers, the latter should not orbit over the intended flight line, but beside it. This facilitates the spray aircraft in lining up.

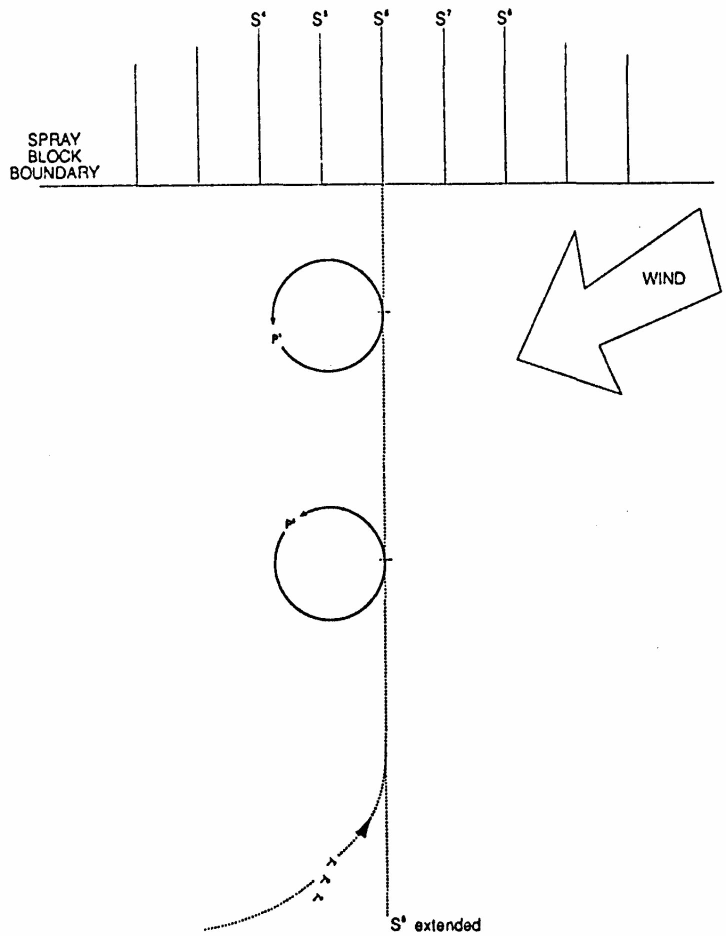

FIGURE 30. Lining up.

P1, P2:	The Pointers maintain the wait format until the spray aircraft and P2 have both established visual contact and the spray aircraft are about 3 km away from P2. At this time P1 and P2 tighten their orbits on SP1 and SP2 to more accurately indicate the extension of S6 for the spray aircraft.
T1, T2, T3, etc.:	As the spray aircraft approach the extension of S6 (as indicated by the outboard side of the tight orbits of P1 and P2), T1 turns in on P2 and announces that the spray aircraft are lining up on P2 and P1 (i.e. starting the chase).
P2:	First waits and then also turns in along the projection of S6 so that T1 is about 0.5 km behind.
P1:	When P2 announces that he/she is lining up P1 will do likewise.
T1:	T1 lines up the two Pointer aircraft and begin flying the indicated track.
T2, T3, etc.:	The wingmen position themselves appropriately.

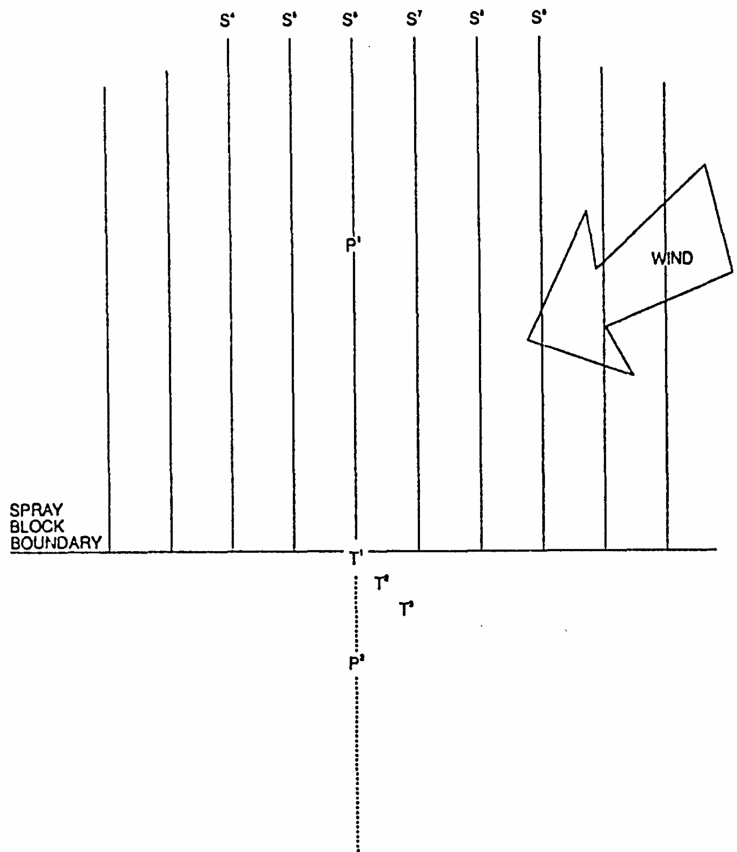

FIGURE 31. "Booms on".

P1:	Leads and points out the required track.
T1, T2, T3, etc.:	As the spray aircraft approach the starting boundary of the spray block, they will pass under P2 which flies slower than the spray aircraft. The spray aircraft then chase P1, which points out the required track.
P2:	As T1 crosses the spray block boundary P2 is about 0.5 km behind. P2 signals the spray pilot to commence spraying by radioing "Booms on".
T2, T3, etc.:	Maintaining formation T2, T3, etc each commence spraying opposite T1's start point. They do not require a message from P2 to do this.

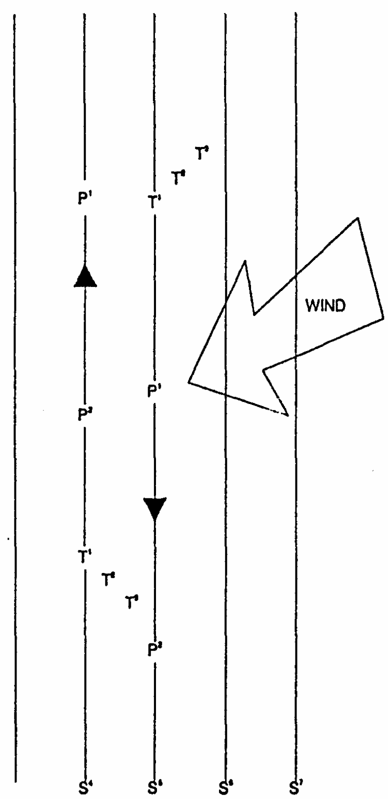

FIGURE 32. The basics of "the chase".

S1, S2, S3...Sn: Flight lines predetermined by the Pointer which are numbered sequentially, showing progress of spray application from the spray block boundary. Progression should be into the wind so that spray aircraft never have to fly through spray as application progresses.

Wind direction: determined by Navigators in the weather check.

P1, P2: position of the Pointers.

Pointers are code named by colour, e.g. P1 is Red Leader, P2 is Red Two. Pointers fly along the same flight line, 2.5-3 km apart and 150-180 m above the ground. The two Pointers alternate as leader (see subsequent Figures). In the two Pointer system the Pointer aircraft fly slower than the spray aircraft.

T1, T2, T3...Tn: Position of spray aircraft. Spray aircraft are descriptively code named. T1 is the spray team leader; T2, T3, etc. are spray team wingmen. T2 forms on T1, the leader; T3 forms on T2, etc. The spray team formation (i.e. spacing) is governed by their spray system apparatus. Navigators assess the accuracy of a spray team formation by mentally measuring the distance between adjacent spray aircraft in terms of wings spans from "tip to tip". T1 **lines up** P1 and P2 as though sighting a riffle and flies the track that P1 and P2 "point out". T1, T2, T3, etc. fly faster than P1 and P2 and at a spraying height of 30 m or less above the forest canopy.

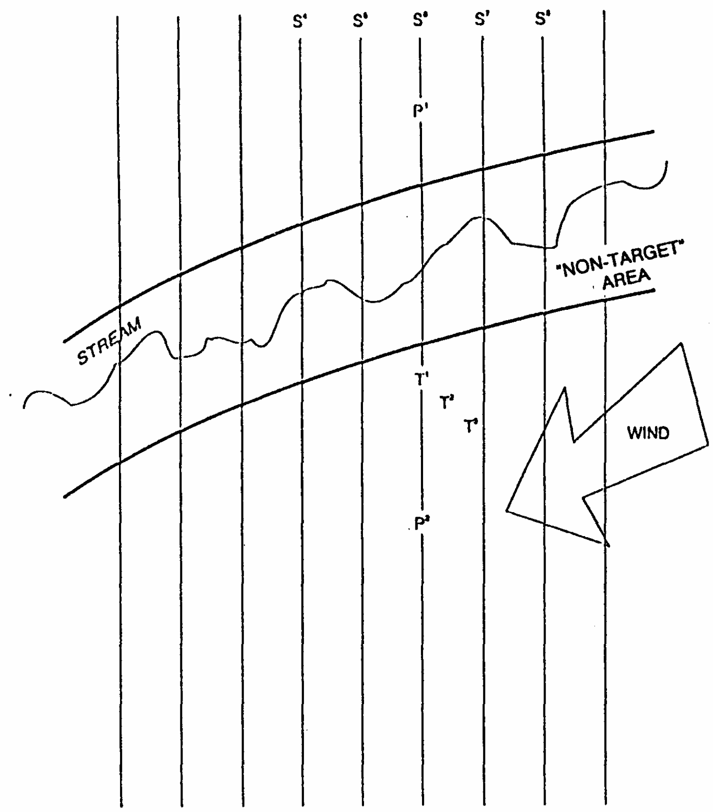

FIGURE 33. Non-target area.

P1: Continues to point out the required track. .

P2: Monitors formation of T1, T2, T3, etc. and gives instructions to each of the spray pilots. It may be necessary to adjust the position of individual spray aircraft within the formation, or adjust the position of the entire team as T1 tracks on a crabbing P1. As T1 approaches a non-target area P2 will radio to cease spraying - Booms off. The communication is timed so that T1's pilot ceases spraying at the boundary of the non-target area.

T2, T3, etc.: Maintain formation. Cease spraying opposite T1's shut-off point without contact from P2.

P2: As T1 prepares to exit the non-target area P2 relays a message to the spray team so that T1 recommences spraying at the boundary of the target area. T2, T3, etc. recommence spraying opposite T1's starting point without contact from P2.

NOTE: 1. Depending on the position of the spray team (i.e. nearer to P2 early on, or nearer to P1 towards the end of S6), the closest Navigator will give instructions to the spray aircraft pilots re: shut-offs, course corrections, formation adjustments, etc. However, it is easier for a Navigator to observe forward. Even with the 360° windscreens of the Cessna 172, the aircraft's tail section hinders viewing.

2. Depending on the shape of a non-target area, spray aircraft team members may require individual contact to stop and restart spraying.

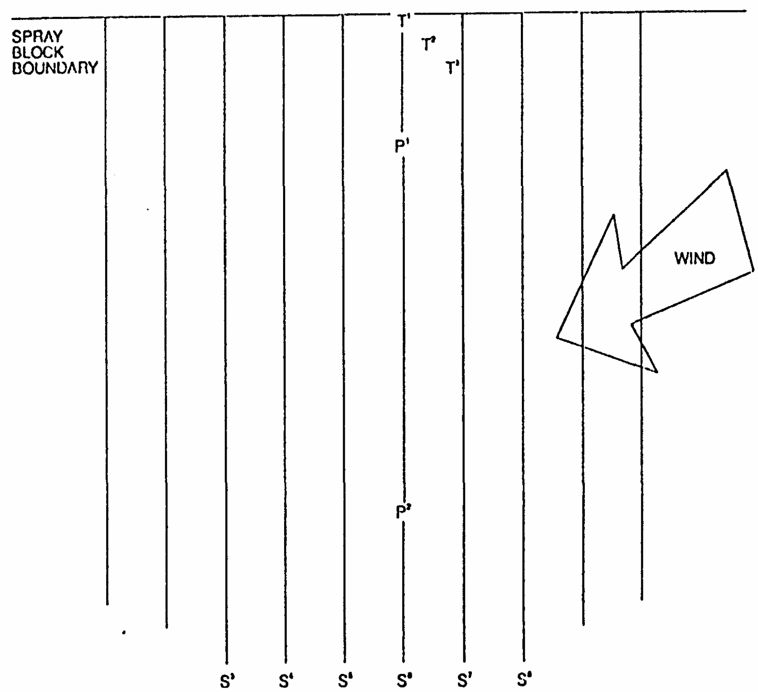

FIGURE 34. "Booms off and turn".

P1:	Has done the Pointing.
P2:	Has done most of the checking.
T1, T2, T3, etc.:	Have tracked on P1 and completed adjustments as directed by P2. Since their forward speed is greater than that of P1, the spray team passes under P1 and approach the end of the spray block. T1 should reach the end boundary when P1 is about 0.5 km behind.
P1:	Radios T1 - "Booms off and turn" as the team leader exits the spray block. "And turn" is very important - if the spray team does not hear these extra words they will continue on their heading as they pass under P1.
T2, T3, etc.:	Maintain formation. Cease spraying opposite T1's shut-off point without contact from P1.

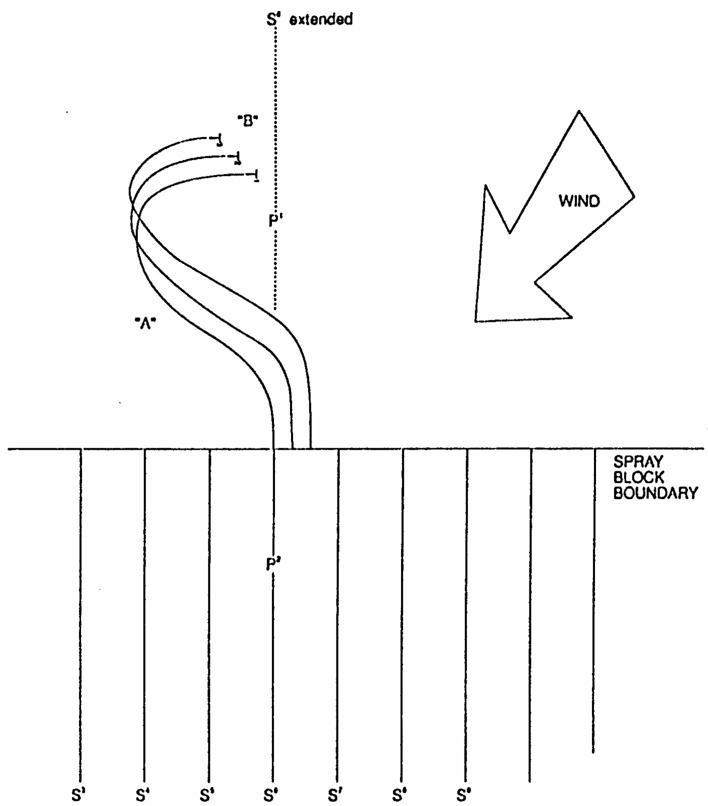

FIGURE 35. "The turn" - Part A: the spray aircraft.

T1:	Having received the radio signal "Booms off and turn" from P1, T1 commences the "P-turn". Having closed the spray system, T1 first turns away from the wind (away from his/her wingmen).
T2, T3, etc.:	Stop spraying opposite T1's "shut-off" point and follow T1's turn in formation, while elevating slightly.
T1:	When T1's pilot feels he/she is far enough away from the end of S6 to complete a safe turn, T1 turns into the wind (towards his/her wingmen). See position "A". T1 may descend slightly, to drop the vortex over which T2, T3, etc. must "climb".
T2:	As T1 turns toward T2's tract, T2 lifts up and over T1's vortex and descend on T1's opposite side while following T1's turn.
T3:	As T2 descends into position, T3 lifts up and over T2's vortex and descends on T2 opposite side while following T2's turn. So on for T4, etc.
T1, T2, T3, etc.:	At the "top of the turn", i.e. position "B", the spray team has reversed their echelon and is ready to turn onto the next swath (S7).
P1, P2:	While T1, T2, T3, etc have manoeuvred to position "B", P1 has proceeded along the extension of S6, and P2 has held a normal track along S6.

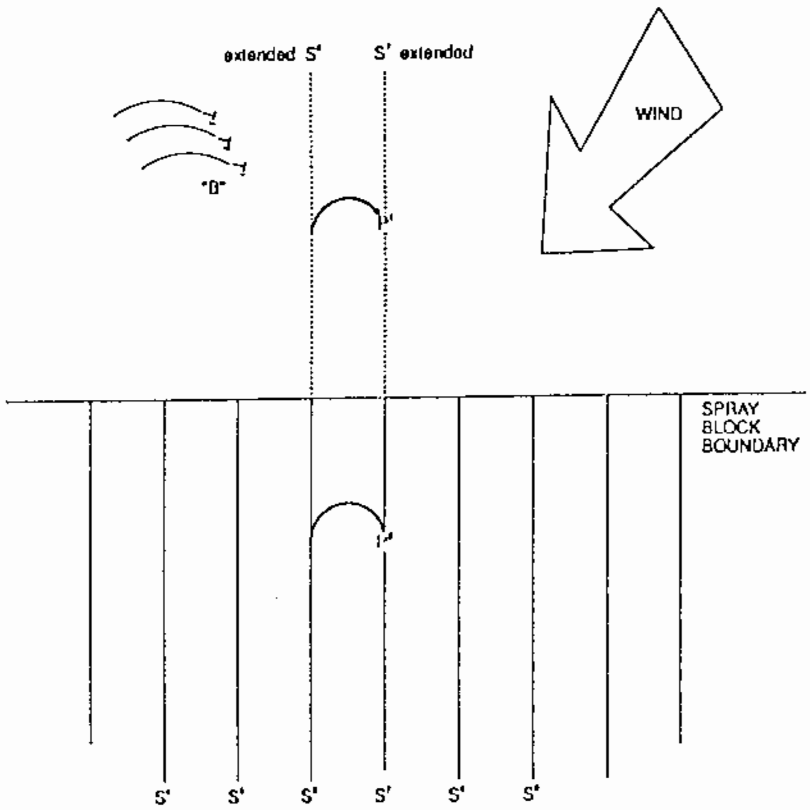

FIGURE 36. "The turn" - Part B: the Pointer.

T1, T2, T3, etc.:	At the "top of the turn".
P1:	Announces intention to turn. Reverses direction by turning quickly into the wind and flies back along the extension of flight line S7.
P2:	Hearing P1's intention to turn makes a similar turn onto S7.
T1:	"Turns in" on P1 and begins flying the track as pointed out by P1 and P2.
T2, T3, etc.:	Follow T1 in formation.
P1:	Gives T1 "Booms on" as T1 passes under P1 and enters the spray block.
T2, T3, etc.:	Commence spraying opposite T1's starting point.

At this point all aircraft are operating as though they are just staring a new mission, i.e. the stalk has been completed, the Pointers have lined up and the chase is on.

The process is repeated for swaths S7, S8, etc. until the spray aircraft have emitted their loads or the spray block has been completed.

NOTE: **It is important that the Pointers make coordinated turns when moving from one flight line to another, or when "exiting an orbit" to start the first flight line. Pointers should not over shoot the intended flight line and have to turn back to resume a correct position. This makes it difficult for spray aircraft turning in to line up properly and to be in the correct formation for entrance to the spray block. If necessary, Pointer aircraft should perform a P-turn to ensure proper positioning when changing direction and moving from one swath to another.**

C.2.3.1.1 Option 1

A Single Pointer can lead the spray team on the first flight line, and the spray team leader sets his/her Gyro-Compass to indicate the track "pointed out". At the end of the first swath, the Pointer elevates and does a slow orbit clockwise around the spray block to enable the navigator to have an unobstructed view of the spray operation to monitor formation, direction and shut-offs.

After turning, the lead spray pilot will use the Gyro-Compass to maintain a track parallel to the first swath. To ease turning (without a Pointer to track on) the spray team can "stretch" their formation lengthwise. As the spray team leader "exits" the turn at the end of the spray block, he/she can "turn in" alongside the visible spray swath of the last wingman who will have just stopped spraying and started turning.

C.2.3.1.2 Option 2

If the spray block has well defined boundaries, the spray team may be able to work it alone as many spray pilots are accustomed to spraying agricultural fields and they could use these methods in this situation. A Pointer could assist, monitor, etc. while in an elevated clockwise orbit. Where small blocks have no easily recognizable boundaries the methods presented in Appendix 5 (p 175) should be used.

C.2.3.1.3 Option 3

Small blocks with poorly defined boundaries may best be sprayed with helicopters. The spray pilot has the ability to cease spraying, hover, ascend, orient himself, descend and resume spraying. Current aerial photos are a necessity.

<u>C.2.3.2 Irregular Blocks</u>

Occasionally, spray blocks are too irregular to permit traditional Pointing. These usually occur along winding rivers and streams. Guidance, similar to that provided in Option 1 for Short Flight Lines, has been successfully used. The Pointer starts the spray team, elevates and orbits slowly in a clockwise fashion, while directing the lead spray pilot. The Navigator gives directional changes in "degrees left" or "degrees right". This system is called contouring.

C.2.4 Preparation

<u>C.2.4.1 Mapping</u>

A topographic map rarely shows sufficient features for Pointing. Navigators should fly their assigned treatment areas to update their Application Map for changes such as: fires, blow downs, flooded areas, roads, power lines, cut-overs, agricultural clearings, etc. At the same time, Navigators should identify those micro-features which will define the exact location of proposed flight lines and sketch their exact location on their application map (see Figure 37). Examples of micro-features (or check points) are: beaver ponds, swamps and bogs, rock outcrops, vegetation changes - anything that can be recognized at a distance making it easier for the Pointer pilot to set a track towards it. In addition to good checkpoints at each end of a flight line, Navigators should try to locate recognizable features at least every 2 km along a proposed flight line.

Preparing a Navigator's application map is time consuming and expensive - protect it, an entire operation may depend on one map.

A photo mosaic may be used instead of a topographic map. Photo mosaics show sufficient features for Pointing.

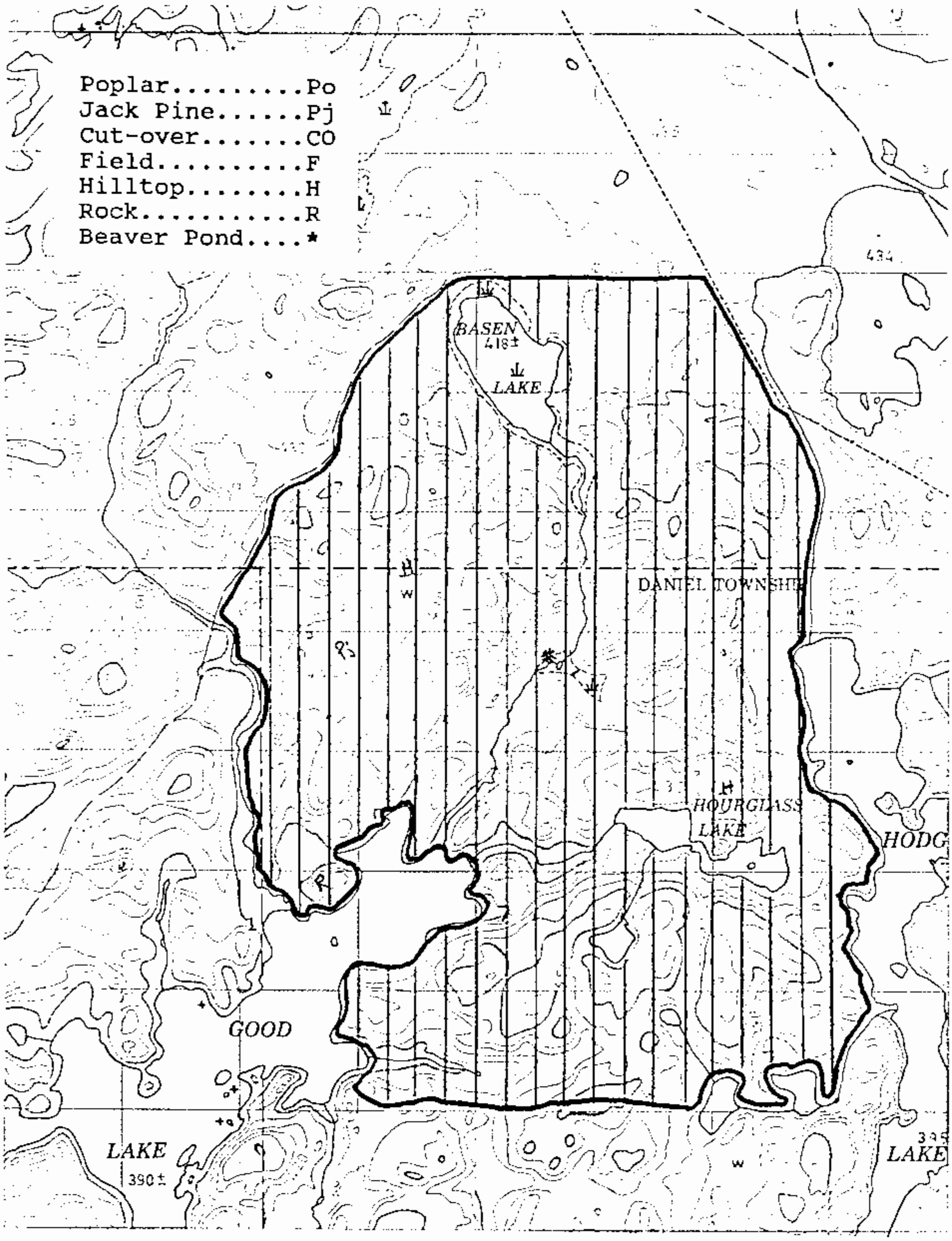

FIGURE 37. Application map.

C.2.4.2 Flight Lines

Once the boundaries of the spray blocks and non-target areas have been finalized, and the spray aircraft effective swath widths are known, Navigators can put the appropriate flight lines on their maps for the treatment areas. When Double Pointing, the Navigators must ensure that the flight lines on their respective maps match exactly.

Navigators use a variety of methods to mark flight lines on their application map - pencil (black; coloured; different colour by direction), hi-lighter, etc., and/or pre-made clear, plastic overlays with the appropriate swaths imprinted on them. Each method has its advantages and disadvantages, many of which are personal preferences. Regardless of the method used, Navigators should be flexible, i.e. be prepared to work with a reduced spray team size on short notice (thus a shorter distance between flight lines).

Navigators must ensure that proposed flight lines extend well beyond the top and bottom of the spray block on their map, to facilitate turning in and lining up manoeuvres, as well as sighting of distant reference points.

Spray blocks should be designed such that their overall widths divide evenly into swaths. This makes spraying from either side, depending on the wind encountered, easier.

C.2.4.3 Practice

Pre-season practice is critical to building confidence and sharpening a Navigator's ability. Navigators should practice their flight lines, alone, and with their Pointer team mate.

Navigators should be able to work from either side of a spray block, depending on the wind. If necessary, Navigators should be able to break off a spray mission, re-organize and start elsewhere on the spray block to allow for a change in wind direction.

Navigators should be aware of how the checkpoints along their flight lines change appearance depending on lighting conditions. Examples of this are: puffs of fog/mist locate a small pond, hidden in the trees at a distance; and a low angle sun casts a shadow of a hill, or tree line.

Navigators should always practice the upcoming mission while waiting for the spray aircraft to load and ferry out; but be in position when they arrive.

C.2.4.4 Pre-mission Briefing

Discuss the treatment area with the spray team leader. Show him/her what portion of the spray block to approach and from what direction. If you can predict the wind direction, do so, as well as the anticipated echelon for the first swath. Discuss any non-target areas and how they will be flown. If a long session evolves, ensure he/she knows where the next series of spray blocks are. Remind the spray team leader of any no fly zones or danger areas (e.g. power lines). If the load has to be divided between areas, discuss how you will do that. The leading Pointer can finish the first area while the trailing Pointer flies to the second area.

Discuss action to take if anything goes wrong. Examples: if the radio of the spray team leader malfunctions, which wingman will assume his/her role and have the spray team members develop a signal to alert one another of the need to exchange a wingman with the leader; if the spray team and Pointer do not meet as planned, then the spray aircraft should not spend a lot of time searching for the Pointers. Mutually agree on an easily recognizable terrain feature where the spray aircraft can orbit until the second Pointer retrieves them and leads them back to the orbiting Lead Pointer. It sounds elementary, but it can be difficult to organize an unplanned meet by radio only. Other teams may be working on the same frequency; the less interruption, the better.

C.2.5 Operational Techniques

C.2.5.1 Altitude

The lowest permissable Pointing altitude is 150 m. Pointers in the same block should work at the same altitude, but it may be advisable not to so if the abundance of terrain feature varies widely from one end of the block to the other.

C.2.5.2 Speed

It is easier to Point at slower speeds. In well featured terrain, Pointers should work at no more than 160 kph. Pointing at 130 kph has been very successful. As terrain becomes more featureless, the Pointer will find a slower speed necessary, or perhaps more altitude, or a combination. When the spray aircraft that are faster than the Pointer, Double Point.

With experience, Navigators will learn to slow down and wait for the spray aircraft to give them a good track. As the spray aircraft approach, the Pointer will speed up, so that both Pointer and spray aircraft reach the end of the block at roughly the same time.

A Single Pointer may lead up the flight line only to reduce speed and let the spray aircraft fly under him, where the spray aircraft spray systems can be monitored and an accurate shut-off made.

Pointer aircraft turns should be quick and precise. They are best made when the spray team is at the "top of the turn". As the spray team leader turns back towards the spray block, he/she can easily see the Pointer aircraft which flashes its entire underside in profile as it banks sharply onto a new flight line.

Pointers may also have to increase speed to regain position on the flight line after misjudging a turn.

C.2.5.3 Point Ahead

Give direction to the Pointer pilot by relating the intended flight line to checkpoints in the distance. The Pointer pilot should memorize the checkpoints along the first flight line of a mission. This allows the Navigator to organize the spray team line up during the stalk and to make an accurate start of the mission. As you approach a distant checkpoint, correct your position with features along the track.

As the Pointer aircraft approaches the end of the block the Navigator should show the Pointer pilot a terrain feature, over which the return flight line should pass. As the spray team turns, the Navigator can monitor spray systems, shut-offs, etc. while the Pointer pilot turns the Pointer aircraft and commences the next flight line himself.

Navigators should familiarize Pointer pilots with actual terrain features that resemble one flight line. The Navigator often has to give instructions in terms of one (or more) track left (or right) of a recognizable feature. Do not use too many - find another check point.

C.2.5.4 Flight Line Adjustments

Make changes in your flight path when the spray team is well behind you; it eases the spray aircraft course correction, and reduces the off target deposit. When Pointer aircraft make a mid course correction it should do so promptly. Do not instruct spray teams to make course or formation corrections at the end of the spray block, prior to their starting a turn. It is too late to accomplish anything and it can create confusion.

C.2.5.5 Visibility

Pointer aircraft should be of a high wing design to allow downward visibility. This is essential for accurate monitoring of the position of both the Pointer aircraft and the spray aircraft. Also the Pointer aircraft should have windows to allow 360° visibility. The wrap around windscreens of the Cessna 172, 182 and 206 offer excellent visibility, while the Cessna 180 permits no observation aft.

Use your landing lights (Pointer aircraft and spray aircraft) to facilitate a meet. Lights are particularly useful in haze.

C.2.5.6 Crabbing

Pointer pilots must assess the wind and determine the heading correction needed so that the Pointer aircraft flies the required flight line accurately. Otherwise the Pointer aircraft will be blown off course and require continual correction, making tracking difficult for the spray team leader. Navigators should advise the spray team leader of the amount and direction of the Pointer aircraft crab.

C.3 Spray Block Design

Proper subdivision of a proposed treatment area into sprayable units (blocks) is essential. Chief Navigator and/or experienced Navigators are best equipped to subdivide the treatment area.

In conjunction with the Chief Navigator/Project Supervisor, the Navigator refines the actual boundaries of the area(s) to be sprayed. This is based on: safety; the operational capability of the spray aircraft; the topography and size of the proposed treatment area; any treatment constraints, e.g. non-target areas; and the inherent limitation of Pointing.

C.3.1 Preparation

Given the prioritized values map and an indication of the types of spray aircraft available, Chief Navigators and/or experienced Navigators should be able to divide the proposed treatment area into operable units on an application map. The blocks are initially based on concentrations of values to be treated. Theoretically, the treatment area should be divided into spray blocks and then the appropriate spray aircraft acquired for the designated block conditions. Realistically, spray aircraft are usually at a premium. Hence, it becomes necessary to design application around the available equipment. This is especially true of small projects that have insufficient area for large payload spray aircraft.

C.3.2 Principles of Design

In designing spray blocks, different Navigators produce variations of the same theme. All Navigators observe the following principles: orientation, length, width, size, contours, start/end points, boundaries, haul distances and non-target areas.

C.3.2.1 Orientation

Orient spray blocks so that direction of flight is north/south. It avoids flying into the rising or setting sun. If offset from north/south is advantageous do so in even amounts, i.e. 10°, 20°, etc., to help the Pointer pilot.

C.3.2.2 Length

Make spray lines as long as possible to maximize use of spray weather and minimize unproductive time spent in turns. To accommodate extra long lines, Pointers can increase flying speed somewhat, increase the separation between the two Pointers and/or use starting points that are slightly inside the spray block, i.e. further along the flight lines. However in doing this, Navigators should be aware of the inaccuracies it could create, due to quicker navigating and overly long perspectives. Any efficiency gained in flight lines longer than 10 km may be offset by a possible loss of navigational control.

Double Pointing may be possible down to 2.5-3 km, but below that, Pointing becomes awkward.

C.3.2.3 Width

Operationally, spray blocks can be any width, i.e. any number of spray team loads. Administratively, it is best to divide potentially large treatment areas into smaller blocks for ease of identification, record keeping and assignment to spray aircraft.

C.3.2.4 Contours

Whenever possible, fly with rugged contours. Avoid working across severely broken terrain. Where this is unavoidable, divide area into smaller blocks and use slower, more manoeuvrable spray aircraft.

C.3.2.5 Start/End Points

Do not end spray blocks where spray aircraft will have to turn up steep slopes. Turning up steep slopes may be possible when spray aircraft have emitted most of their payload. Discuss start/end points with the spray pilots.

C.3.2.6 Boundaries

Try to delineate all spray block boundaries with readily identifiable features. The ends of the block can be any shape, but the sides are usually parallel with the flight lines.

C.3.2.7 Haul Distance

Use fastest spray aircraft and those with the largest payloads on areas with the longest ferry time. Use slower, low payload spray aircraft closer to the airstrip.

C.3.2.8 Non-target Areas

Non-target areas must be large enough to work with, i.e. while a spray pilot reacts to a message to cease spraying, his/her aircraft can spray 100-120 m. Many spray aircraft team swaths are only about 200 m. Non-target areas may be best coordinated with the boundaries of spray blocks. When non-target areas occur in the central portion of a flight line, Navigators have difficulty judging the exact position of the spray aircraft.

C.4 Spray Pilot Familiarization

Suitable weather for spraying is at a premium. One way to make the most efficient use of time is to ensure that spray aircraft team leaders are familiar with the treatment area so that direct, unescorted ferry flights to and from the airstrip/spray block occurs. Such familiarity will occur naturally as the operation progresses, but it can be hastened by having the Navigator, Pointer pilot and spray team leader do familiarization flights prior to project commencement. The following should be discussed or made available on such flights.

C.4.1 1:250,000 Scale Cross Country Maps

Each spray pilot should have a 1:250,000 cross country map complete with all spray block locations and identifications. All airstrips should be shown. Thus each spray team leader could go to any block and each spray pilot could fill in as team leader. Spray team leaders could fly to the treatment areas in formation and with the proper alignment on the Pointer(s). No time is wasted in lining up. No treatment area is missed by a poorly organized start. If necessary, each spray pilot could leave their team formation and return unassisted to the base airstrip. In an emergency, each pilot could find an alternate airstrip.

C.4.2 Major Topographical Features

Point out major topographical features on the map and on the ground. They assist spray team leaders in locating the Pointers during the projects's first spray missions. They also assist a disoriented pilot, or one flying in deteriorating weather.

C.4.3 Danger Areas

Mark power lines, towers, etc. on the cross country maps. Point them out - they can be hard to see, especially in poor light or deteriorating weather.

C.4.4 Non-target Areas and No Flight Areas

Non-target areas are areas not to be sprayed, such as sensitive fisheries and wildlife areas.

Where possible human habitation and reservoirs are to be avoided to eliminate prospective emergencies in such areas. It could mean the difference between a successful job and a law suit.

C.4.5 Pilot Experience

Do not make assumptions about the experience of spray pilots. Generally, spray team leaders will have had some experience, but in large forest operations it is common to find spray pilots that are new to this type of work, or new to inaccessible terrain. Many pilots have a lot of experience, but it was all acquired in developed agricultural areas where fields and country roads provided ample opportunity for successful emergency landings. This is often true of pilots from other provinces or other countries.

C.5 Spray Pilot Briefing

The Navigator or Chief Navigator is the person best suited to familiarize the spray pilots with the guidance system to be used. This can be done collectively by the Chief Navigator in a meeting format, or informally by the Navigators themselves with their assigned spray pilots. However accomplished, the message must be the same - successful forest spraying requires the best use of available resources. Juggling of Navigators and assigned spray aircraft may occur thus it is important that spray pilots have similar training.

The major topics reviewed should be: methodology of aerial guidance; and radio communications control of aerial forest spraying. These subjects have been presented in section C.2 Pointing (p 127). The following topics should also be discussed.

C.5.1 Spray Team Makeup

Who sprays with whom is usually determined by the spray pilots. Obviously, aircraft of similar performance and capability will work together. Contractors prefer their aircraft to work together to facilitate maintenance and supervision.

Spray team leaders are chosen by the team pilots. Sometimes the contractor chooses who will lead his/her aircraft. Pilots experienced in MNR methods should lead. Lead pilots must be coherent on the radio. New pilots should be wingmen.

C.5.2 Team Assignments

Experienced Navigators should be matched with inexperienced spray pilots, and vice versa. Experienced Navigators should work with spray teams that have narrow team swath widths. Inexperienced Navigators should be assigned well featured terrain. Navigators working alone should be experienced. If the ferrying distance is great Pointer teams may be assigned two spray teams.

A personnel chart should be made showing: team makeups, assignments and code names; assigned aircraft type and registration; assigned radio frequencies for aircrews and airstrips. Navigators should keep a current chart of all aircrew personnel with them.

C.5.3 Pointer Pilots

Navigators may be required to train their own Pointer pilots. Navigators should confine their input to the mechanics of the program and let pilots instruct pilots on the flying required to implement it. For example if a Pointer pilot is having difficulty making a 180° turn within one swath width, then the Navigator can suggest how other pilots do it, or better yet have another pilot demonstrate.

In addition to information in this manual, Navigators should make use of experienced Pointer pilots.

Note: All Pointer pilots should have attended a Pointer Pilot Certification Course.

C.6 Spraying Audit

The Pointer guides the spray aircraft as they emit a predetermined volume of pesticide per hectare of forest. Additionally, the Navigator will monitor the actual pesticide application.

C.6.1 Lining up

Did the spray aircraft approach the block in formation? Did they turn in and line up properly? If not, a wedge of unsprayed forest, or off target application could occur.

C.6.2 Turns

Did the spray aircraft execute proper turns? Were they in formation as they exited and re-entered the target area? If not, effects could be similar to those described for lining up.

C.6.3 Formation Flying

Did the spray aircraft maintain proper formation while spraying? Were the spacings between aircraft correct? If not, overlapping applications or missed treatment areas will result.

C.6.4 Accuracy

Was any target area missed? Were non-target areas observed? Were booms on and booms off well done? Did the spray aircraft fly at the correct speed?

Judging height is difficult, and as the project proceeds, some pilots gradually get closer to tree top level. A good way to describe the proper spraying altitude to a spray aircraft pilot is to relate it to the approximate height of the trees being sprayed.

C.6.5 Equipment Check

Did the pesticide emission equipment appear to function properly? Were all emission units operating? Did the emissions from some spray units appear leaner or richer than others? Did emission units shut off completely, or did they trail pesticide?

C.6.6 Calibration

How close together did the members of a spray team run out of pesticide? If calibrated correctly, they should be close. Use a stopwatch to measure the actual emission time per spray aircraft, exclusive of turns and non-target areas. This information helps the Application Boss in monitoring the calibration accuracy. This assumes that the spray aircraft are maintaining the required speed.

C.7 Weather Check

Atmospheric conditions at the airstrip may be different than at the treatment site. Thus Navigators usually are required to assess weather conditions at the spray blocks immediately prior to (and during) spray sessions. Based on these assessments (and his/her own) the Project Supervisor declares the session a go or no-go.

The operational limitations of temperature, wind and relative humidity vary with the spray droplet size required (equipment and calibration used) and the pesticide formulation (oil base, water base, etc.). Navigators should acquire the allowable limits for atmospheric conditions from the chief Navigator/Project Supervisor prior to job start-up.

C.7.1 Temperature

Warm air is unstable. It rises and is usually turbulent, which creates poor conditions for the settling of spray. Hence, forest spraying is usually confined to the cool, still hours of early morning and late evening, or to calm overcast days.

Temperature can be monitored via the Pointer aircraft thermometer. Temperature assessment is usually most critical towards the end of a morning session (when daytime heating occurs) and the start of an evening session (when daytime heating has yet to dissipate). As the spraying season progresses (mid June), the effects of daytime heating will occur earlier in the morning and last later into the evening.

Assessing the effects of increasing air temperature is a self educating process. Navigators should watch for the temperature at which spray rises. Rising spray has a bumpy appearance. As daytime heating increases (hence turbulence as well), the peaks of the ribbon of emitted spray will appear to burst upwards. If a Pointer aircraft flies 25-30 m above a freshly emitted swath of oil base spray formulation, the spray shows up on the aircraft windscreen if it is rising. Fine droplets of rising water base formulation are less likely to appear, as the water component usually evaporates quickly. Larger water droplets would only rise under severe turbulence.

Under correct conditions, spray dissipates gradually, but evenly, without breaking up.

C.7.2 Wind

Wind affects the accuracy of forest spraying as it may move the spray before it can settle on the intended target area(s). The effects of wind are most significant in relation to working near non-target areas. Otherwise, in large areas of uninterrupted treatment application, wind can be tolerated to a greater extent than high air temperature.

Warm, rising air with no noticeable wind is unacceptable for spraying, but cool air with light winds is desirable. Light winds move the spray through the forest canopy and lessens the possibility of gaps in the application.

The strength of wind is difficult to assess, but as with temperature, it should be estimated at the treatment area and at normal spray aircraft altitude. Wind assessment is also a self educating process. Navigators should compare known wind speeds (as determined by the airstrip anemometer or wind sock) with the observed effect on the following.

C.7.2.1 Trembling Aspen

Trembling aspen foliage quivers with the slightest air movement. Usually, acceptable wind only rattles a portion of the trembling aspen crowns. If the entire crown rattles, or begins to sway, unacceptable wind may be occurring.

C.7.2.2 Water Surfaces

Observe ripples on lakes. Portions of the water surface ripple, while others remain glassy. Eventually the disturbed areas merge and the entire lake surface becomes wavy. At what speed did wind streaks occur? These are caused by gusting, strengthening winds (as opposed to steady, light air movement). Steady lapping or breaking of small wave crests that create foam streaks indicate deteriorating conditions. White caps indicate unacceptable winds. Wind effects on water vary with surface area. The benchmarks you derive for a lake in your treatment area will likely vary on lakes elsewhere. On small lakes, air movement has difficulty in reaching the water surface. Avoid using tree ringed ponds for your observations. On large lakes, air movement has the full sweep along the length of the water body so wind effects can be exaggerated.

Remember that air is fluid; it takes the path of least resistance. Thus, its movement can be exaggerated as it is channelled along a long lake. It can also be interrupted/diverted as it flows cross-grain over narrow water bodies. Similarly, wind will intensify on hill tops.

Navigators should teach themselves about the benchmark effects of wind on trees, lakes, etc. as close to a wind anemometer as possible. Be aware that improperly positioned wind measuring devices (anemometers, socks) will affect your self instruction. The device should be exposed to the true air movement. It should not be sheltered by hills, tree lines along airstrips and/or structures.

C.7.3 Relative Humidity

The amount of water vapour in the atmosphere can affect the dissipation of spray. Warm, dry air will quickly evaporate the water component of a water based spray droplet. With the heavy carrier gone the small, dissolved particles of pesticide are free to float away. Conversely, moist atmosphere will repel the dissipation of oil based spray droplets. The spray swaths will hang and sink slowly. Control may not be affected (likely enhanced), but good mixing of the individual spray aircraft swaths may be hampered and dissipation through the forest canopy hindered.

The Navigator cannot measure relative humidity at the treatment site. The Application Boss will monitor relative humidity at the airstrip.

The Navigator can advise the Chief Navigator/Project Supervisor of any disparities in weather conditions observed between airstrip and treatment site. For example: the presence or absence of cloud cover (i.e. cool and overcast, or daytime heating); observed differences in wind speed (drying effect); presence of rain shower activity (increased relative humidity); and visibility (relates to relative humidity - haze).

C.7.4 Flight Safety

Weather checks must first assess atmospheric conditions for safe flight. Pointer aircraft may have the range to reach an airstrip with instrument landing facilities but the Pointer pilot may not be qualified for instrument flight and landing in poor visibility and/or darkness. Some spray aircraft have neither the range or instrumentation. You may get off the airstrip but is there enough time to ferry out, spray, ferry back and land safely?

In early summer, when warm days alternate with cool nights, fog formation is common in low lying areas and over water. With daytime heating, it eventually burns off. However, before this happens, the slightest air movement can move fog around.

Many airstrips are close to water, since flat terrain is found there. Since ground fog usually intensifies after daybreak, when aircraft have departed, air movement can push fog formed over a nearby lake over the airstrip and prevent landing. The prop wash of grounded aircraft have been used to blow enough fog away to permit landings. Also, low passes by aircraft over fog laying on an airstrip may help.

Under certain conditions, extensive fog, mist and poor visibility can develop quickly. Navigators should draw on the experience of pilots to learn about poor visibility. Navigators should learn the relationship between air temperature and relative humidity as they relate to dew point (see the Weather Officer's Guide, p 147, and Appendix 8, p 195). Similarly, Navigators should be aware of frost formation and its effect on flight.

C.8 Records

In addition to documenting their own work, Navigators record the major features of their spray check. Navigators must document who did what in the spray application, and where, when and how they did it. The information is presented on the Pointer Report, and the Project Status Map. As well the Navigator may be required to provide input for other forms such as the MNR Aircraft Passenger/Cargo Manifest and the Aerial Spraying Load Record. The former is usually completed in conjunction with the Radio Operator and the latter is a form utilized by the Application Boss. See Appendix 7 (p 183) for samples of the above reports.

C.9 Related Duties

In addition to the major duties previously outlined, Navigators may be required to do auxiliary duties.

C.9.1 Calibration

The Application Boss is responsible for calibrating spray aircraft to ensure they are each capable of applying the required amount of pesticide per hectare at a specified flying speed. The process involves some trial and error, and the results will require confirmation by the Navigator. A calibrated spray aircraft emits a known quantity of pesticide in a predetermined time. Pointer aircraft are used to monitor the spray aircraft being tested. Upon radioing the results to the Application Boss, any required adjustments can be made prior to other test runs.

Calibration tests are rarely conducted with actual spray mix; water is the usual test medium. Since the pesticide formulation viscosity may be different than water's, Navigators must conduct spray session calibration checks as early as possible.

Spray aircraft are used to spray a variety of materials and carriers. Given time, precipitates and corrosion will occur in the spraying system, especially after an off season lay over. As a project progresses systems flush out. Thus emission units may plug (hindering application) or wear (increasing the flow rate). Calibration checks by the Navigator, during spray missions, will alert the Application Boss to any refinements that may be required.

C.9.2 Ferrying

It may be necessary to lead a spray team to and from the spray block. This occurs when spray pilots are in unfamiliar terrain or when visibility is poor and the likelihood of a Pointer/Spray team miss is high. With two Pointers, one Pointer can orbit at the spray block and the other (usually Number 2) can lead the spray aircraft to the orbiting Number 1 Pointer.

C.9.3 Emergencies

Navigators should be prepared for emergency situations. See pages 58-62, 67-69, and 71.

D. POINTING: THE LIMITATIONS

Pointing is most successful with:

- Two Pointer Aircraft
- Pointer speeds of 130-145 kph
- Pointer altitudes no lower than 150 m
- Spray team swath widths of 300 m
- Spray blocks size of several thousand hectares
- Flight lines that are at least 7 km long
- Good lighting and visibility
- An abundance of recognizable terrain features.

Pointing is designed to be used in large scale operations. Deviations from the design features result in less control. The negative impact of some deviations can be tolerated, or minimized:

- Narrower team track spacing is possible with an increase in recognizable terrain features;
- Faster spray aircraft and hence faster Pointing are tolerable in well featured terrain;
- Single Pointing is tolerable when the treatment area has only simple shut-offs and preferably a lack of non-target areas.

NOTE: A pointer aircraft with 360° visibility is mandatory when Single Pointing.

Early morning and late evening darkness may hinder Pointing. The sky is bright, but the forest canopy and flight line checkpoints are obscure. Strong haze also can prevent accurate Pointing.

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PART 5: WEATHER OFFICER'S GUIDE

A. INTRODUCTION

This part of the manual provides direction to the Spray Program Weather Officer. The Weather Officer are to understand this part of the manual, and the Portable Fire Weather Station Slide/Tape Program. For more in depth discussion of weather forecasting see Appendices 8 and 15 (p 195 and p 257).

The Weather Officer reports to the Project Supervisor. The duties and responsibilities of the project Weather Officer are:

1. Training weather network staff in weather observation.
2. Determining the number of and installing all weather stations necessary for the project.
3. Providing one formal weather briefing each day followed by a continual monitoring of weather behaviour within the project area.
4. Maintaining weather record during spraying.

B. WEATHER PARAMETERS

The ability to select the correct weather conditions under which to spray determines the success or failure of any spray project. The art of forecasting is learned with time. There are no hard and fast rules that say if X occurs at a certain time, then Y will happen one hour later. Some of the variables that influence weather are temperature, relative humidity, wind direction, wind speed, time of year and time of day, topography, adjacent water bodies, vegetation cover and cloud cover. Based on past experience, Go/No-go parameters have been developed (Table 2).

TABLE 2. Go/No-go parameters for aerial spraying.

PRODUCT	TEMPERATURE (°C)	WIND SPEED (KPH)	MINIMUM RELATIVE HUMIDITY
B.t.	5 - 24	1 - 13	50%
Vision	5 - 24	1 - 8	50%
2, 4-D	5 - 21	1 - 8	60%

B.1 How the Weather Parameters were Developed

TEMPERATURE: A temperature of less than 5°C may affect how Micronair atomizers operate as B.t. becomes thicker at lower temperatures. Insects may not be active when it is cold; there is no value in spraying B.t. if feeding is not occurring. If B.t. is applied prior to a predicted lengthy cold spell, the product could be inactivated before the insects start feeding. Water based formulations have frozen in the booms and nozzles due to the wind chill during the ferry flight.

With temperatures greater than 24°C thermal turbulence and local winds usually develop. It becomes dangerous for the spray aircraft operating at low altitudes. The droplet may actually move up. This allows more time for evaporation.

RELATIVE HUMIDITY: Relative humidity (RH) has an effect on drift, the lower the RH the greater the risk of drift. For example, at 20°C a water based product applied in a 200 micron droplet, that falls 13 m will lose 60% of its volume due to evaporation when applied at 90% RH. This loss in volume varies with emission height, droplet size, formulation and humidity.

WINDS: Winds may cause droplets to drift. Periods of dead calm are detrimental when applying small droplets which do not have enough mass to rapidly descend into the canopy. A slight wind will push them in. Drifting insecticides do not cause foliage damage as herbicides would under the same conditions thus the lower top wind speed parameter for herbicides.

INTERPRETATION: The essential issue is not the absolute numbers but the interpretation of them. Project personnel should observe the rate of change of these parameters; is the RH dropping quickly? is the temperature rising more rapidly? Plotted over time, these changes indicate the cutoff point for spraying. Monitoring of trends is very important.

DECISIONS: Weather readings taken at an airstrip are not necessarily the same as weather conditions in distant spray blocks. If it is impossible or impractical to have a weather station in the block, then spray/no spray decisions must be made in consultation with the navigator and/or spray pilots, who are in the best position to observe settling and drifting trends. Pesticide spotting on aircraft wind-screens indicates that the spray is not settling.

B.2 Aerial Spraying Tips

For spraying tips that are of concern to Navigators see Section C.7 in the Navigator's Guide, p 143.

TEMPERATURE: Low temperatures permit spray droplets to sink rapidly. Higher temperatures cause the droplets to be suspended in the air for long periods. Evaporation of water based carriers and pesticides occurs with high temperatures. The active ingredient will crystallize. The evaporation problem is compounded if the humidity is low.

CLOUDS: Solid cloud cover is preferred to broken or scattered clouds. Breaks in cloud cover contribute to uneven surface heating and instability. These variations affect settling and drifting rates of the droplets, creating difficulties in obtaining even spray patterns. Morning temperatures rise more slowly on cloudy days than on clear days. Cooling is more rapid on evenings with clear skies than cloudy skies.

RAIN: After a period of rain, spray must not be applied to saturated leaves. Saturation is the point at which if liquid is added, an equal amount will drip off. An increase in temperature or light a breeze will solve this problem.

RESPRAY: Pesticide product data sheets indicate time frame when respraying is required due to rain. Respraying herbicide on a release project is not advised. It is impossible to calculate what acid equivalent was absorbed by the non-target species. No problem exists with respraying herbicide for site preparation since eradication of all species is desirable, or the respraying of B.t. The prospect of respraying must be covered in the MOE Form 5.

B.3 Other Considerations

FOG: **It is extremely important to remember that if the air temperature is near the dew point then the spray block and/or runway could be closed due to fog.** Dew point is the temperature at which the air becomes saturated (relative humidity of 100%). It is essential that pilots are aware of alternative landing sites if this occurs. Monitor your relative humidity closely to predict when fog will "roll in".

DEW: Heavy dew (usually associated with fog) is most prominent in the fall. It may cause the same problem of leaf drip as a pre-spray rain.

TOPOGRAPHY: The Venturi effect may occur in valleys with steep slopes. Wind speeds increase in the constricted part of the valley as the air mass passes through. This rare occurrence may cause pesticide to settle off target.

BLOCK SIZE: The smaller the target area, the earlier in the morning or later in the evening it should be sprayed. Small blocks located near sensitive areas should be sprayed in low winds and only when the wind is blowing away from the sensitive area.

LOCATION: Spraying on the top of a slope near a lake must never be done in the evening. The droplets will appear to settle parallel to the slope, but as the air cools and contracts, they flow down the slope to the shoreline and lake.

INVERSIONS: Temperature inversions (a state in which the air temperature increases with altitude rather than decreasing) can prevent the droplets from settling on target.

ROCK: Spray block with areas of exposed bedrock or rock outcroppings can cause problems during the evening spray session. Thermals persist over these areas as the heat that was accumulated during the day is slowly released. Rough flying conditions and poor spray pattern usually result.

B.4 Other Sources of Weather Information

The meteorological staff at your nearest Transport Canada Flight Service Stations will provide you with the most accurate trend forecasts. If a number of spraying operations are obtaining additional weather information from the same source, e.g. the Federal Ministry of Transport at a local flight services station, it is suggested that only one person contact them, then that person distributes the information to the other operations. This way you are less likely to wear out your welcome. It is also a good idea if you make personal contact with the organization involved, explain the program and go over the format in which you would like to receive the information. This way both parties will be communicating on the same wave length. Other sources of information are the radio, TV and MNR fire weather technicians.

C. WEATHER STATIONS

Weather stations can be simple or elaborate. It is essential that whatever system is chosen, it is able to measure wind speed, temperature, and relative humidity accurately.

C.1 Site Selection

The following give representative values of weather station site parameters. It may not be possible to meet all the criteria, but major departures could cause reduced accuracy. The weather station should be located:

1. In representative area with respect to elevation, topography, forest cover and weather patterns. Avoid valleys and exposed ridge tops. Level ground is preferred. If slopes must be used avoid north and east facing slopes, as well as concave surface depressions.
2. Such that the instrument area is at the centre of a forest clearing having a diameter of no less than 10 times the height of the surrounding timber.
3. No closer than 100 m from any major source of moisture (lakes, streams, swamps, etc.)
4. No closer than 10 m from large reflective or radiating surfaces, or if buildings no closer than a distance equal to twice the height of the building. These include metal or white painted surfaces, black topped or gravelled surfaces, rock outcrops, or recently burned areas.
5. No closer than 1.5 times the height of obstructing buildings, trees, or dense vegetation.
6. No closer than 5 m from any road.
7. At least 50 m away from excessively dusty areas, such as parking lots and helipads.

If the prevailing wind direction is known, locate the station upwind from any water, radiating or reflecting surface, or dust origin. The instrument area surface should be short grass or close cut natural vegetation. In brush locations the area should be free of logs and underbrush. If difficulty is encountered in selecting a weather station site, contact the Regional Weather Technician for assistance.

C.2 Anemometer, Wind Sensor Sites and Mounting Towers

The anemometer and wind sensors should be mounted on a substantial, well-guyed mast, with provision for climbing, or lowering the anemometer sensors for servicing. The towers should be adequately grounded for lightning protection.

Wind speed increases rapidly with height and is greatly affected by nearby obstructions. The standard height for wind sensors over open ground is 10 m. This height is acceptable in a clearing if the nearest edge is more than five times the average height of the timber from the mast. If clearings of this size are not available, the best alternative is a taller mast. The correct height for the mast would be 10 m above the mean tree top level. In many cases a compromise between the size of the clearing and the distance from the surrounding timber can be made. It is recommended that Table 3 and Figure 38 be used as references when selecting a site for wind sensor exposure. Where the clearing is rough or dotted with brush the heights from Table 3 are measured from the effective ground level as determined in Figure 38.

C.3 Weather Station Equipment

The recommended equipment in a weather station is a: rain gauge, thermo-hygrometer, Stevenson screen, thermometer and psychrometer. You may obtain weather equipment and training in their use from the Regional Weather Technician. Additions, substitutions and deletions may be made.

TABLE 3. The required height, in meters, of the anemometer for small clearing based on the average distance from the timber edge in meters, and the average stand height in meters.

Average distance from timber edge in meters (d)	Average Stand Height in meters (h)									
	5	10	15	20	25	30	35	40	45	50
5	14.2			MAST HEIGHT = TREE HEIGHT PLUS						
10	12.4	18.4	23.8		10 METERS					
15	11.0	16.7	22.6	28.1	33.2	38.7	43.8	48.9		
20	10.3	14.9	20.9	26.7	32.2	37.7	42.9	48.2	53.3	58.5
25		13.2	19.9	25.1	30.9	36.7	42.1	47.4	52.6	57.8
50			12.1	16.5	22.2	28.2	34.1	40.2	45.8	51.8
100	MAST HEIGHT =				11.4	14.1	18.4	23.0	28.6	34.4
150	10 METERS						11.3	13.2	16.2	19.8
200									11.4	12.8

Example: If the mast is located 30 m from the edge of a 20 m tall stand of trees, the required anemometer height above open level ground is 23.4 m [Find h = 20 and d = 30. Interpolate between 25.1 (d =25) and 165 (d = 50). 5/25 X (25.1-16.5) = 1.7. So 25.1 - 1.7 = 23.4]. If the mast could be located 50 m from the same stand edge, the mast height could be reduced to (intersection of h = 20 and d = 50) 16.5 meters.

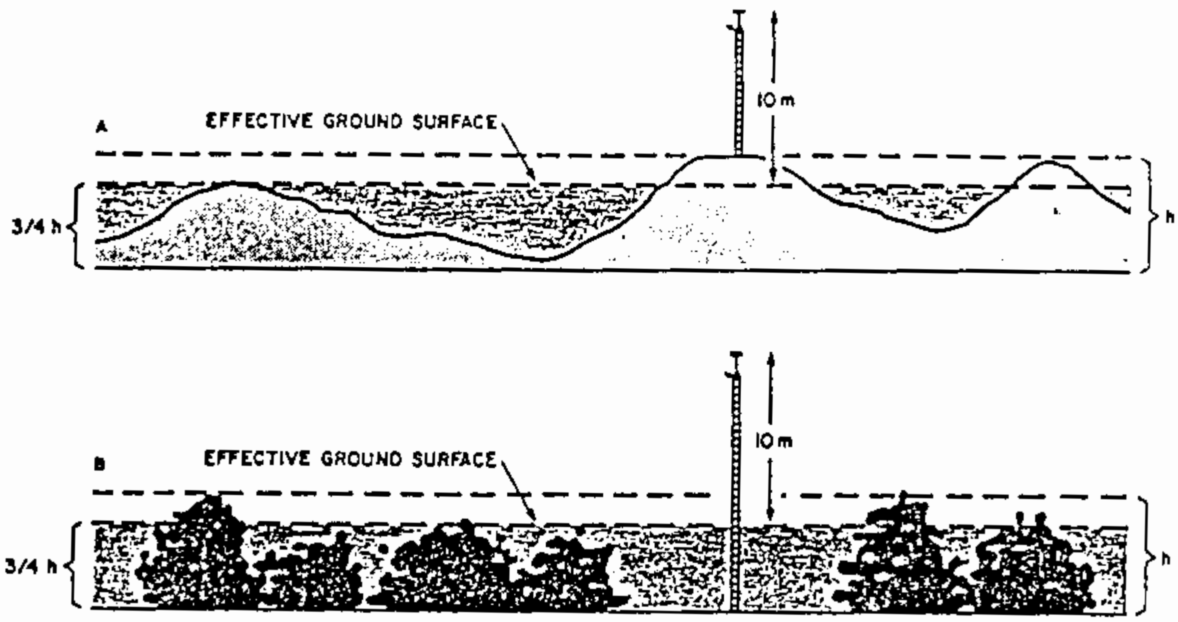


FIGURE 38. Example A. Anemometer mounted in a clearing in rough terrain. Sensor should be 10 m above a representative high spot determined by taking 3/4 of the difference in height between ridges and valleys.

Example B. Anemometer mounted in a clearing covered with clumps of brush 2 m high. Mast should be 10 m + (3/4 X 2 m) = 11.5 m.

APPENDIX 1: EXAMPLE OF A SPRAY PROJECT DESCRIPTION

This is an example of an aerial herbicide project description. A description of an aerial insecticide project will be similar, but with changes in important dates. See Procedure FR.04.10.10 for details.

APPROVAL FOR PROPOSED DISTRICT AERIAL SPRAY PROGRAM 1991

I have examined the proposed 1991 aerial herbicide spraying project for conifer release on the Crown Management Unit and have forwarded comments to the District Manger, concerning the project.

FOREST MANAGEMENT SUPERVISOR	DATE
FISH and WILDLIFE SUPERVISOR	DATE
PARKS SUPERVISOR	DATE
LANDS SUPERVISOR	DATE
FIRE BRANCH SUPERVISOR	DATE

I have examined the proposed 1991 aerial herbicide spraying project for conifer release on the Crown Management Unit. All values to be protected have been considered and modifications to the proposal have been made where necessary.

DISTRICT MANAGER	DATE

REVIEWED BY:

REGIONAL FORESTER	DATE

1991 Aerial Chemical Tending, Langley Township

Operations

The proposed operation will be between Aug. 15/91 and Sept. 15/91 using a helicopter to spray Vision on 283 ha of plantations. This area was recently regenerated to Jack Pine. Tendering this area will permit the Pine to grow to provide suitable sawlog material in the future. The target species in this area is mainly overstory Poplar and Poplar suckers. 30 spray loads are required. The spray time per load is about 10 min., thus 300 min. is required to complete the project. Spraying will normally occur, weather permitting, between 6-10 AM and 5-8 PM. The operations base for each site will be the nearest cleared area. This reduces ferry distance, facilitates security and provides a safe barrier distance for staff.

Security

The spray block will be closed to the public during spraying. MNR staff will man road barriers during spraying and permit traffic through only during non spraying hours. The operations base will be blockaded with a sign stating "No Entry". Public tours are to be approved by the District Manager.

The chemical storage area, enclosing drums of Vision, will be sandbagged, snowfenced and posted. The mixing site and helipad will be cordoned off and posted. Prior to each spray session the helicopter pilot will do a reconnaissance flight over the spray block to see if anyone is in the area. If someone is found to be in or near the spray block, spraying will not commence until the person is removed.

Personnel

The contractor will provide mixing/loading staff. The contractor must posses a valid Pesticide Operators license and provide all equipment to properly mix and load chemical. MNR personnel will supervise and monitor the project. There will be no personnel on the spray block during spraying.

Communications

The District will place ads in local papers 30 and 7 days before the start of the project, notifying the public that the spray plan is available for viewing at the District Office. The spray plan will also form part of the 1991/92 Annual Work Schedule, which will be available for public review on April 1, 1991. The Project Supervisor will apply for a MOE spraying permit at least 60 days before the start of the project. **Also see attached communications plan.**

Posting

The proposed spray blocks will be posted with bilingual signs notifying the public that the area will be sprayed. The posting will be done 7 days before the start of the project. The signs will remain in place for at least 30 days, but will be removed by Nov. 1/91.

Weather

The weather will be recorded every 15 min. prior to and during spraying. This will be done by erecting an on site weather station, consisting of an anemometer and a hygrometer (Stevenson screen and hygrometer must be borrowed from fire branch). The spray base will obtain long range weather forecasts from the District Fire Office.

Reports

The Project Supervisor will maintain up to date records including spray hours, amount of chemical used, area sprayed, staffing and inventory.

Areas of Concern

A 60 m buffer zone will be left on all creeks/streams that are within or beside the spray blocks. This is as per FR.04.20.10 (Buffer Zones).

Training

The Project Supervisor will attend the Project Supervisor's Workshop in January 1991.

1991 Aerial Chemical Tending

OBJECTIVE: To release conifer plantations from competing vegetation.

LOCATIONS: See Figure 39.

Levack Twp.	Block A	42 ha
	Block B	6 ha
	Block C	24 ha
	Total	72 ha
Haentschel Twp.	Block A	2 ha
	Block B	25 ha
	Block C	9 ha
	Block D	3 ha
	Block E	2 ha
	Block F	80 ha
	Block G	2 ha
	Block H	6 ha
	Block I	6 ha
	Block J	3 ha
	Total	138 ha
Langley Twp.	Block A	36 ha
	Block B	37 ha
	Total	73 ha

Totals for all Townships: 283 ha.

PROPOSED DATE OF APPLICATION: August 15 to September 10, 1991

TYPE OF PESTICIDE AND RATE OF APPLICATION:

Glyphosate (Vision)
- present as Isopropylamine salt, 356 grams of active ingredient (a.i.) per litre. Registration # 19899.
- to be applied at a rate of 1.6 kg of a.i per ha in a mixture of 33 L/ha.

CARRIER: water

AIRCRAFT CAPABILITIES AND CAPACITIES: Aircraft must be equipped with:

1. A minimum lift off capacity of 300 L.
2. A boom and nozzle delivery system calibrated to deliver the volumes described in the attached specifications.
3. A leak-proof spray distribution system and hopper equipped with a positive action leak-proof shut off valve capable of eliminating all drippings.
4. A quick release dumping mechanism.
5. Aeronautical band transceivers operating in the 118 to 136 MHz spectrum.

PROJECT SUPERVISOR: M. Dorie, Administrative Technician, Sudbury District, Telephone: 522-7823

Any requests for technical information regarding Vision and its effects are to be directed to: Silviculture Section, Box 1000, Sault Ste. Marie, ON P6A 5N5.

Ministry of Natural Resources
Ontario

1991 AERIAL HERBICIDE PROGRAM

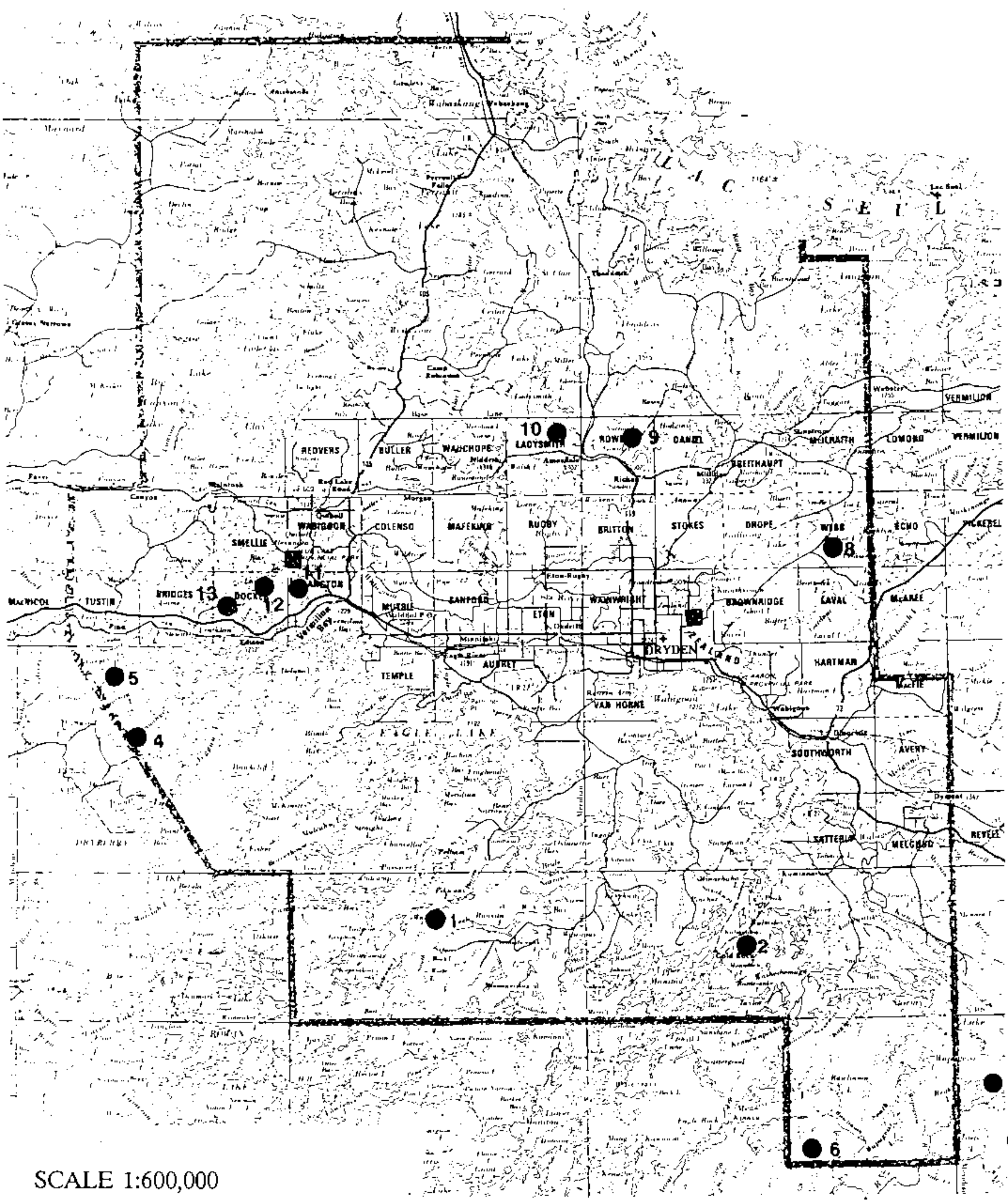


FIGURE 39. Aerial tending sites 1991.

Aerial Herbicide Application, Chemical Tending, 1991

LOCATION: Langley Township.

AREA: 73 ha

OBJECTIVE: To release Jack Pine seedlings from competing vegetation.

Stand Inventory:

```
Stand 19 - Po4, Bw3, Pj2, B1, Ms1, 60 years old   53 ha
Stand 62 - Pj7, Po1, Sw1, Bw1, 64 years old       20 ha
```

Cutover: Between 1981 and 1987
Jack Pine sawlogs and pulpwood, hardwood fuelwood

Soil: Deep fresh medium sands

Site Preparation: August 87/88 Power Trencher, 107 ha
August 88 Chemical Site prep. 49 ha

Regeneration: Planted with Jack Pine, 1989 73 ha

Crop Trees and Competition: - Jack Pine seedlings, ocular estimate - 60% stocking
- Competition from grasses, and Maple

Type of Pesticide: Glyphosate (Vision), 356 grams of a.i. per litre

Rate of Application: up to 1.6 kg of a.i. per ha applied in a mixture of 33 litres per hectare

Values: as per attached maps and photo (Figures 40-42)

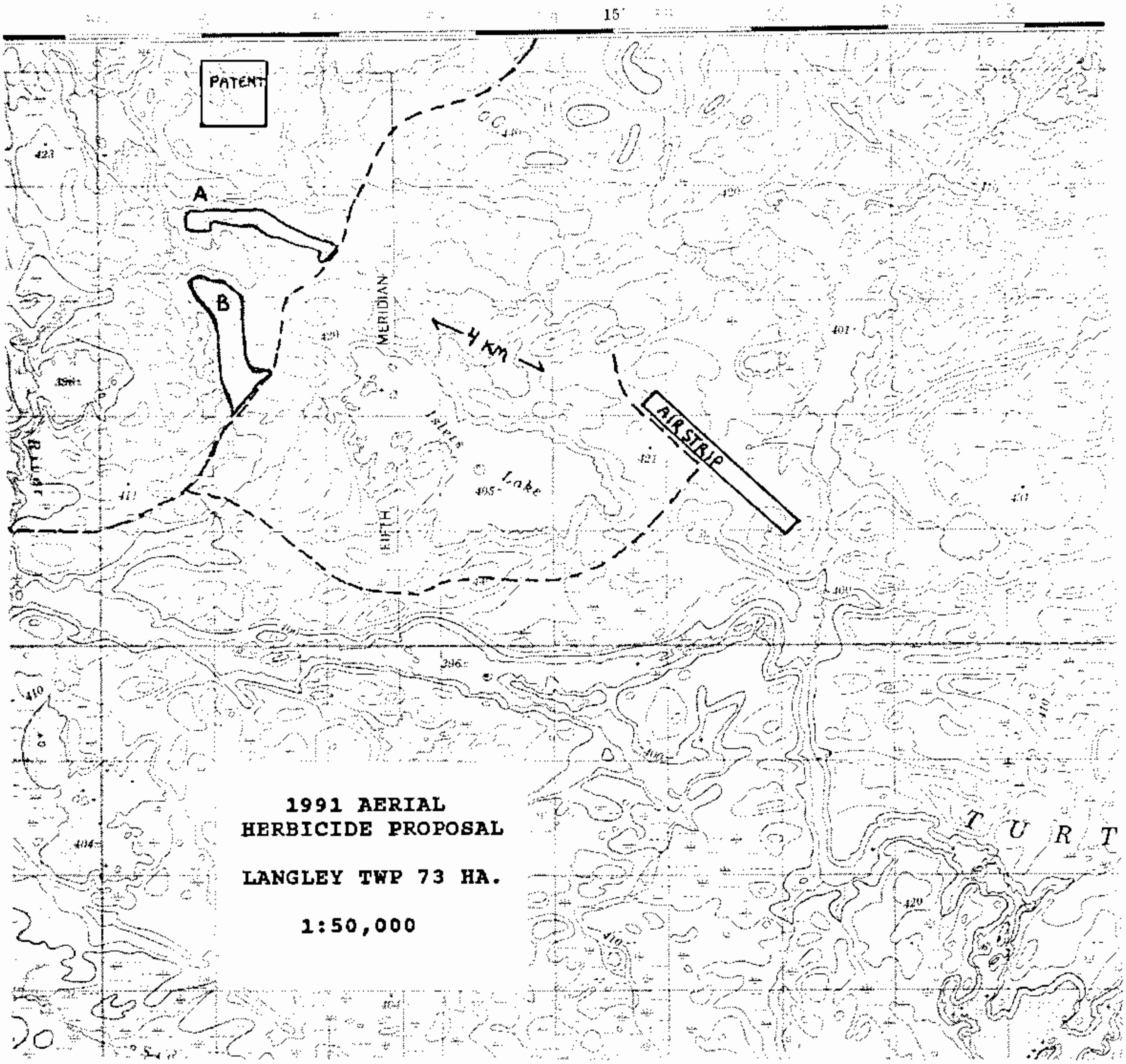


FIGURE 40. Spray blocks in Langley Township (1:50,000 map).

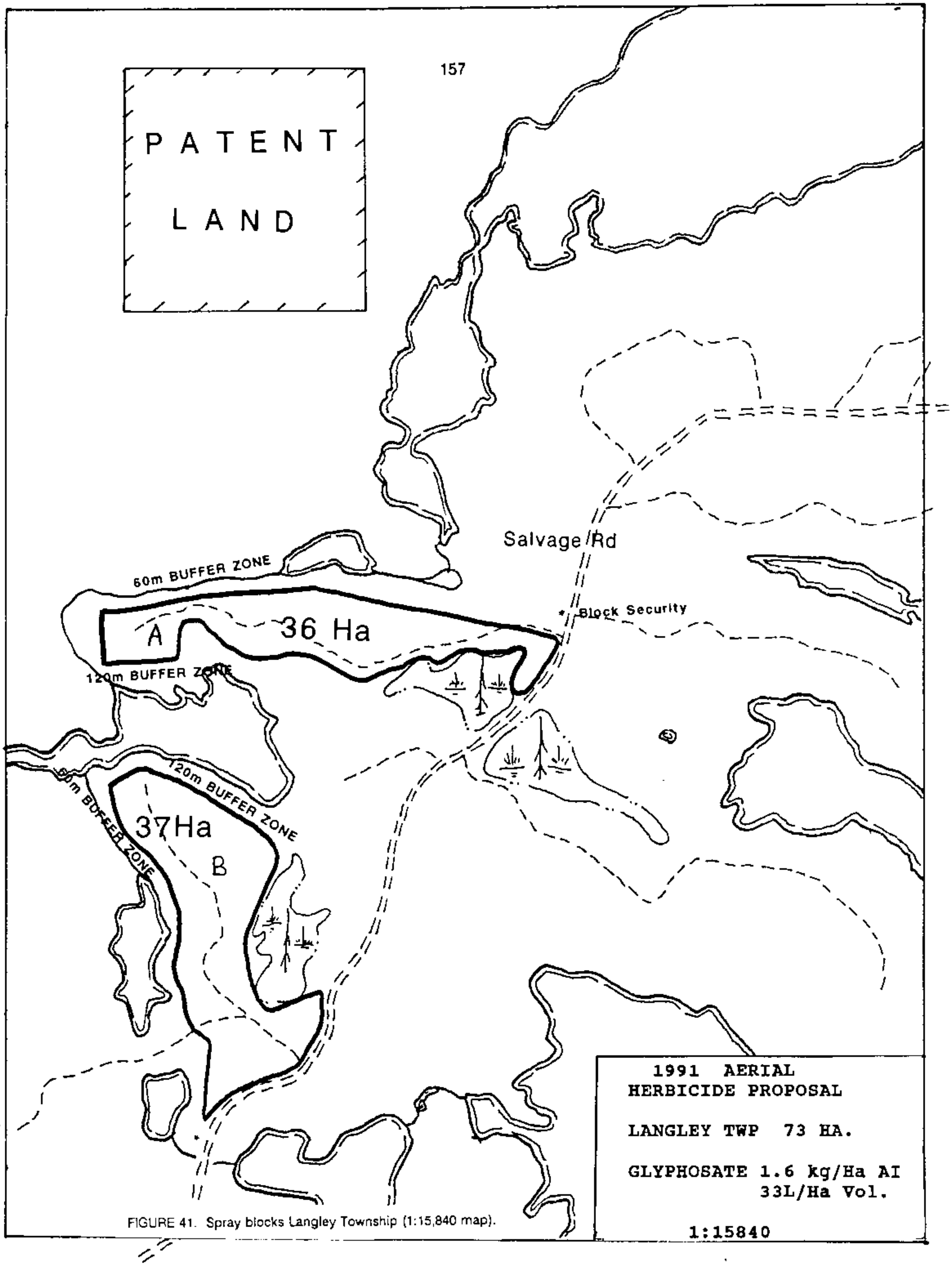


FIGURE 41. Spray blocks Langley Township (1:15,840 map).

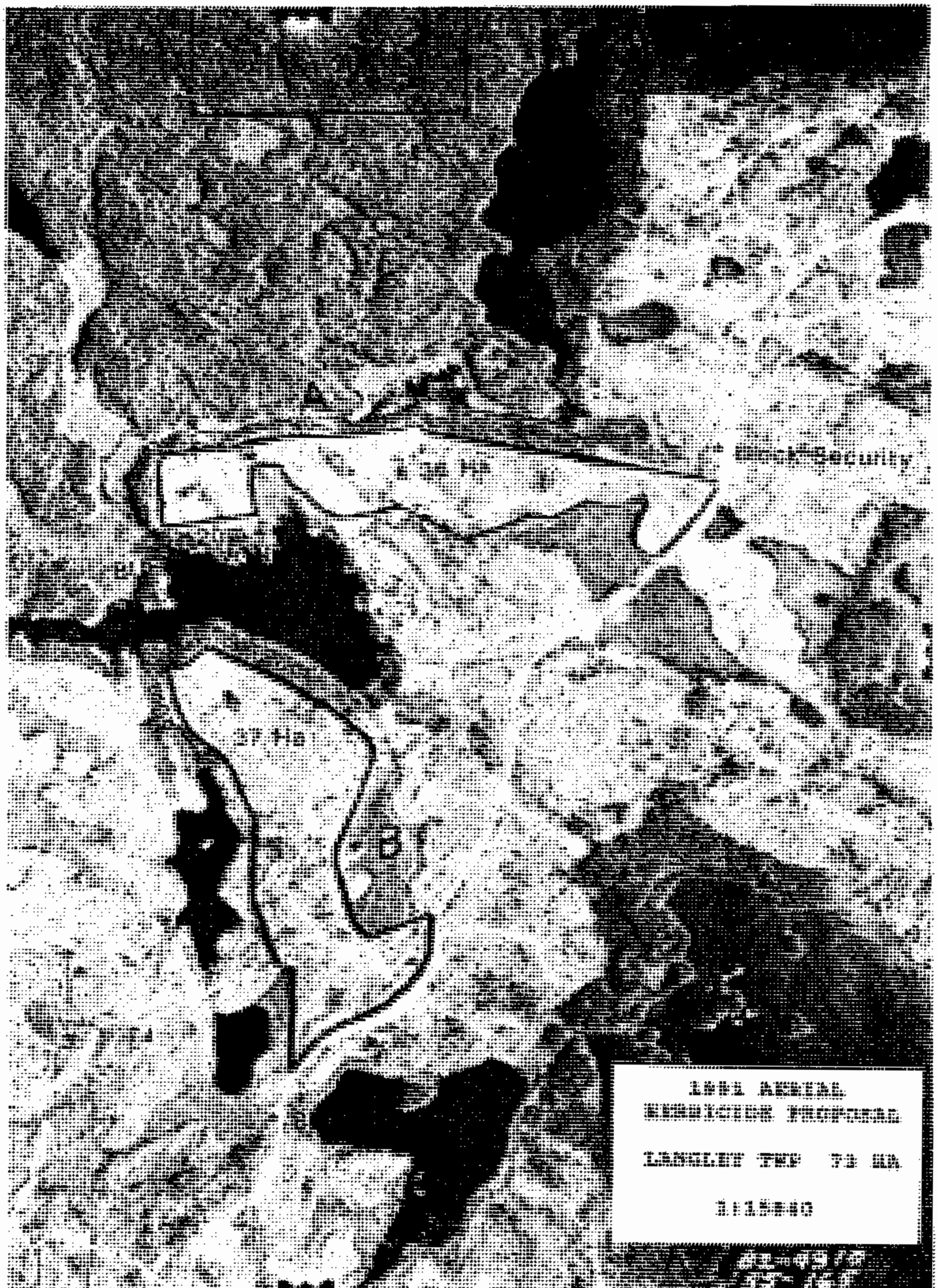


FIGURE 42. Spray blocks in Langley Township (1:15,840 photo).

Operations Plan (sample)

The objective of this plan is to ensure good operational control of the project to maximize efficacy of the project and to minimize adverse non-target effects.

Aircraft

The project will be carried out using helicopters with a minimum lift-off capacity of 300 litres of chemical mix.

Organization

Figure 43 indicates the duties and responsibilities of people involved in this project.

Transport, Storage and Loading

The herbicide will arrive in 115 litre drums, the contractor will do the mixing of chemical and loading of aircraft. The herbicide will be stored on site or at the District's chemical storage building.

Control

Control of herbicide placement will be done by ground check personnel, by visual observation of spraying from a distance.

Maps and Records

The Application Boss will be responsible for:

1. Recording all data on aerial spray record sheet.
2. Monitoring weather conditions at spray site and recommending go or no-go.
3. Check daily the amount of herbicide delivered compared to the area treated.

Airstrip/Helipad

Helipads will be located as near as possible to the spray blocks to reduce ferry distance.

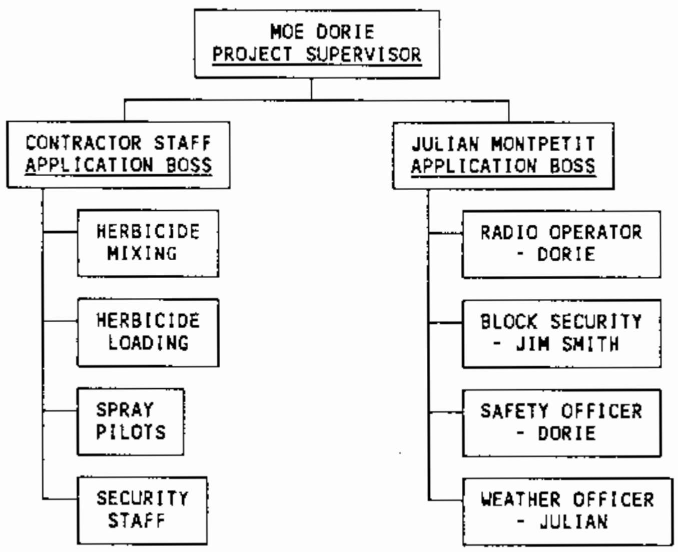


FIGURE 43. Aerial spray project personnel flow chart.

Duties of Spray Block Personnel

1. Posting of "Notices of Aerial Spraying" signs at all usual access points into spray blocks.
2. Manning of barricades to restrict access to blocks during spraying.
3. Removal of barricades and signs when needed.
4. Other duties as assigned.

Duties of Project Supervisor

1. Notifying MOE Environmental Assessment Branch of herbicide projects in writing.
2. Notifying any public within 1 km of a spray.
3. Having Operating, Communications, Security and Safety Plans in place.
4. Dealing with public and news media relating to operational program.
5. Forest Management Supervisor and District Manager will be the only district staff authorized to answer questions from the media or public.
6. Obtaining from the Mining Recorder's office the location of mining claims in the treatment area and contact any claim holders prior to spray, and inform them of our proposed operations.

Duties of the Application Boss

See pages 11-12 of the Project Supervisor's Guide.

Duties of Radio Operator

1. Maintaining daily log of all radio transmissions.
2. Maintaining a list of emergency phone numbers.
3. Communicating via radio between Application Boss and aircraft for fuelling and loading of chemicals.

Weather Parameters

Weather conditions on site will be monitored by the Project Supervisor. The application of the herbicide will occur when the following parameters are met:

1. Temperature between 5° and 21°C.
2. Relative humidity greater than 60%.
3. Winds less than 8 kph.
4. Do not spray less 6 hours before an anticipated rainfall, allow 2 to 3 hours for applied herbicide to dry.

Mix/Load and Fuel

Will be done by the contractor. Water will be hauled in from Islets Lake.

Communications

Base to Sudbury District will use MNR radio. Base to spray aircraft will use Unicom (122.9 MHz) or MNR radio.

The Safety Plan and Security Plan form part of this plan. Copies are attached. The project will be carried out following the guidelines laid down in the Aerial Spraying for Forest Management Manual and procedure FR.04.20.10.

Application Rate

Glyphosate at up to 1.6 kg a.i./ha applied at 33 L of Vision mixture per hectare.

Communications Plan (sample)

This plan are to provides district coordination of communications for spraying operations and to provide a guideline for communications during any emergency situations that may occur in connection with the spraying operations. See the Emergency Plan (pp 67-70, 72, and 74) for reporting flow charts.

Message

Where, when and how the project is to be undertaken. Public notices (for wording see the Project Supervisor's Guide, p 7) will be placed in newspapers which service this area. Letters will be sent to:

- Land Use Permit holders in the immediate spray area
- Tembec Forest Products Inc.
- Mainville Lumber Company Ltd.
- Ministry of Labour
- Ministry of the Environment (Environmental Assessment Branch)
- Health officials, i.e. Memorial Hospital, Sudbury; General Hospital, Sudbury
- OPP, Sudbury

Scope

METHOD	TIMING	RESPONSIBILITY
Newspaper Ads		
- 30 days public notice	July 16, 1991	
- 7 days public notice	August 8, 1991	District
News Release		
- notice of spraying		
- review of Operating Plan	Mid April	Region
Project Description		
- available at District office for public review 45 days prior to project commencement	July 1, 1991	District
Situation/Status Report	daily during operations	Project Supervisor to District Spokesperson
Signage		
- for spray areas as required by the EA Act	5 days before spray - removed by November 1, 1991	District
Media and other tours to spray operation areas	as required	District and Region
Letters to be Sent		
- Tembec Forest Products Inc.	May 10, 1991	
- Mainville Lumber Co. Ltd.	May 10, 1991	
- M.J. Poupore Lumber Co. Ltd.	May 10, 1991	
- LUP Holders	May 10, 1991	
- Ministry of Labour	May 10, 1991	
- Health Officials	May 10, 1991	
- MOE Environmental Assessment Branch (Toronto)	April 10, 1991	District

Other communications activities will be carried out by this district as required and suitable to local needs.

Project Staff	Office	Home
Project Supervisor - Moe Dorie	522-7823	693-2326
Project Staff - Dave Cerutti	522-7823	560-6090
- Bruce Basso	522-7823	522-4496
- Julian Montpetit	522-7823	

Any additional personnel will be determined prior to project start.

Contacts and Phone Numbers

EMERGENCY PHONE NUMBERS

Police - Sudbury OPP (705) 522-3388 or Zenith 50000
Hospital - Sudbury General (705) 674-3181
- Sudbury Memorial (705) 673-8421
Air Ambulance 1-800-461-4850
Poison Control - (705) 674-3181
Ministry of the Environment (24 hours) 1-800-268-6060
Ministry of the Environment (Regional) (705) 675-4501

	Name	Office	Home
Sudbury District			
District Manager	J.A. Simpson	522-7823	692-3710
Forest Mgt. Supervisor	D.R. Potvin	522-7823	566-1209
Fire Operations Manager	E. Ducharme	522-7823	566-4688
F & W Supervisor	A. Zimmerman	522-7823	522-4092
Engineering Services	J. Vandeligt	522-7823	969-3012
Unit Forester	R. Frankling	522-7823	560-7370
Project Supervisor	M. Dorie	522-7823	693-2326
Regional Office			
Regional Director	M. Klugman	675-4120	
Regional Forester	J. Miller	675-4120	
Regional Safety	M. Lucyk	675-4120	
Regional Fire Centre		675-4120	
Information Officer	M. Gordon	675-4120	
Communications Super.	Regional Cache	522-0896	
Companies			
Tembec Forest Products	J. Quirt	857-2772	
Mainville Lumber Co.	R. Mainville	855-2577	
M.J. Poupore Lbr.	D. Bird	693-2761 ext. 3355	

Safety Plan (sample)

The objective of this plan is to ensure the health, comfort and well being of all personnel, directly and indirectly involved; the protection of equipment and compliance with all known governing regulations.

The Project Supervisor who is on site will be designated the overall responsibility for safety and will ensure that the objectives are met.

Summary of Operations

1. a) Number of hectares to be sprayed - 242 ha
   b) Herbicides to be used - Glyphosate (Vision)

2. Operational base will be Haentschel and Levack Townships.

3. Spray Contractor not yet determined; invitation to tender to be issued January 1991. The contractor will supply all aircraft fuel and oil and do his own refuelling.

4. MNR project staff organization: Project Supervisor - Moe Dorie; Application Boss - Julian Montpetit; Block Security - Bruce Basso.

   To achieve the stated objective the following actions will be implemented:

   a) Project staff will be informed and trained as appropriate in respect to:

      i) **First Aid:** As many MNR employees as possible on site will possess a valid Standard First Aid Certificate.
      ii) **Emergency Response:** Air Ambulance - Sudbury (705) 673-1117; Northeastern Region Service Centre - Sudbury (705) 675-4120.
      iii) **Aircraft Awareness:** Persons working around or with aircraft (fixed wing and helicopter) will be informed of proper procedures and dangers by pilot and Project Supervisor.
      iv) **Aerial Spraying for Forest Management Manual:** Copies of this manual will be provided to persons involved on site with particular emphasis on the section of each individual's involvement.
      v) **Health and Welfare Canada's Pesticide Handling - A Safety Handbook:** Same as above.

   b) Project staff will be equipped and informed as appropriate in respect to:

      i) **Personal Safety Equipment:** All staff will be issued with the personal safety equipment necessary for them to perform their assigned duties as per the Aerial Spraying for Forest Management manual.
      ii) **Fire:** Suppression equipment will consist of self-contained portable pressurized fire extinguisher classes A, B, C, and D (each extinguisher will not have all ratings).
      iii) **Transportation of Dangerous Goods.**

   c) In the event of a medical or non-medical emergency all or part of the following actions will be implemented:

      i) Regular operations will be suspended, and all necessary efforts made to aid injured persons, stabilize condition and dispatch to medical facilities; the incident will be investigated and corrective measures taken to prevent a re-occurrence.
      ii) In the event of an injury or death, the directions set forth in the flow charts in the Emergency Plan section (pp 67-70, 72, and 74) will be followed.
      iii) In the event of an aircraft or vehicle accident the directions set forth in the flow charts found in the Emergency Plan section (pp 56-80) will be followed. Procedure number AF.01.31.02 also covers response to an aircraft accident.

iv) A helicopter based at Sudbury Airport may be available to reach injured persons at a remote location or dispatch victims directly to medical facilities.

v) Provincial Air Ambulance in Sudbury, as well as neighbouring medical facilities (Sudbury Memorial Hospital, 673-8421), will be notified before the start of operations of the pertinent details necessary for them to prepare for a response, i.e. nature of project, approximate time period, probable type of injuries and any specialized corrective measures to be used.

vi) Notify MOL of work location.

d) Aircraft and their operation will be controlled as follows:

i) Communications between the air traffic advisor and spray planes will be by Unicom radio - **122.9**. The air traffic advisor will also have radio contact via the regular MNR radio system with Sudbury District Office and ground vehicles. Appropriate ground personnel in block security will be equipped with Mh10 or mobile portable radios.

ii) AFFM will provide, through the Regional Fire Centre, a special weather forecast daily or upon request. A number of small data gathering weather stations will be operating within the spray zone to provide accurate localized information. If this is not available, then Environment Canada will be contacted for a weather synopsis.

iii) All aircraft and pilots involved will spend time familiarizing themselves with navigational landmarks, neighbouring airstrips, emergency dump sites and landing areas before the start of the project.

e) To verify that instructions, training and procedures are fully understood, a full range of practice runs including loading, fuelling, taking off, aerial manoeuvring, communicating and landing will be carried out before operational spraying commences.

f) A spill or dump will be responded to as follows:

i) Sites will be located and approved by MOE before operations begin for disposal of contaminated material and emergency dumping.

ii) MOE will be notified immediately of any dump or spill, response will be as per MOE guidelines (see Emergency Plan pp 56-80).

iii) Any rinsings will be applied to previously completed blocks in the regular manner.

iv) Left over pesticide, tanks and equipment will be secured and removed as soon as possible after completion of the project.

g) Fuel Loading Safety: to be done by the contractor.

h) Vehicle Safety:

i) Access to operations base will be controlled.

ii) Vehicles are to be parked in designated areas.

Security Plan (sample)

The objectives of this plan are to ensure the security of the total project in terms of ensuring that members of the public are not accidentally sprayed or otherwise injured and that there is no damage to or loss of equipment and materials, no personal risk to project staff and no delay or disruption of the operation.

Security of Spray Blocks

1. Public notification through advertisements placed in local newspapers on July 1, 1991 for a 30 day public notice; as well as on August 8, 1991 for a 7 day public notice, in the following newspapers: Sudbury Star, Northern Life and Le Voyageur.

   Project Descriptions will be available for public viewing at the Sudbury District Office from March 31, 1991.

2. Notice of aerial spraying signs will be posted at all usual access points into designated spray blocks 7 days prior to application. Map indicating location of sign placement will be at the District Office.

3. While spraying is in progress, access will be prohibited and controlled using manned barricades.

4. Mainville Lumber and Tembec Forest Products will be notified in writing prior to spray operations in case their tree cutters may be working near the spray blocks.

5. Reconnaissance flights, immediately prior to application, will be flown to ensure that persons who are in the area by virtue of deliberate action or inadvertent access (fly-in or canoe-in) are not sprayed.

   In the event of persons being sprayed, they immediately will be:

   a) Provided with toxicological fact sheets for Vision;
   b) Provided with the opportunity to shower and to have tents or clothes laundered;
   c) Advised that if they have any concern, OMNR will transport them to medical authorities for examination/consultation;
   d) Advised that any food, drink and/or smoking material that may have been contaminated by the pesticide should not be used.

6. Immediately following the operation, all barricades, equipment and signs notifying of closures will be removed. Persons referred to in section 4 above will also be notified so that they may resume normal operations in the spray blocks.

Security at Mixing Site/Helipad

The operations base and helipad will be secured by prohibiting public access (to prevent loss or damage of equipment and materials, personal risk to project staff, or delay/disruption of the operation).

1. 24 hour security should be provided at the operations base from the time equipment is placed on the site to the time it is removed.
2. Pesticide storage and security are governed by MOE regulations (see "Guidelines for the Storage, Disposal and Transportation of Pesticides", pp 54-56); the pesticide storage site will be fenced-in to prevent unauthorized access.
3. Chemical storage signs will be visibly posted at the pesticide storage site.
4. Mixing tanks and equipment will be fenced-in and posted with chemical mixing loading signs and chemical storage signs. Access will be restricted to authorized persons.
5. Inventory of equipment and location will be maintained.
6. Tours of spray operations will be conducted by the Project Supervisor to selected groups only, which have provided advance notification. Tours will be kept to a minimum and carried out when aircraft have ceased operations. Specific arrangements should be made for "guided" tours in the event of requests by the media. These requests will go to the Regional Information Officer, Sudbury (M. Gordon 675-4120).
7. Immediately following the operation, all barricades, equipment and signs notifying of closures will be removed.

APPENDIX 2: DETERMINING EQUIPMENT REQUIREMENTS

This appendix deals with the choice, set up and operation of the equipment required to complete a spray project ranging from 100 to 100,000 ha. The scale of programs vary, but the job parameters remain the same; that is to get the job done **safely** and **efficiently** within a very **limited time**. There are a variety of problems that can hinder a spray project. Although the weather still remains out of our control, we can minimize other delays with good planning **prior** to the spray and a good organization during the spray.

Aircraft

Irrespective of the size of the mixing and loading operation, the efficiency of the spray operation primarily lies with the delivery system. The spray aircraft must be tailored to the project and the mixing system must then be able to adequately supply the spray aircraft.

The most important variables in choosing aircraft are:

- Payload - carrying capacity;
- Airstrip/helipad availability - helicopters versus fixed wing;
- Production (ha/min.) related to
  - track spacing
  - aircraft operating speed.

These variables are then rated:

1. **Total area to be sprayed**

   a) relates to number of aircraft required to meet the targets within the narrow time frame.
   b) aircraft payload.

   The following is an example of how a particular aircraft would be utilized on a spray project of 8,000 ha.

   Assume that B.t. and water for a total application volume of 5 L/ha (total product) is being used.

   Total mix required = Project Size (ha) x Application Volume (L/ha)
   = 8,000 ha x 5 L/ha
   = 40,000 L

   Assume we have one Piper Pawnee with a payload of 400 L, a cruising speed of 160 km/h and a swath width of 30 m.

   By using the cruising speed and swath width, the area sprayed per minute is 8 ha/min.

   Number of loads required = (Project Area x Application Volume)/Payload
   = (8,000 ha x 5 L/ha)/400 L
   = 100

   Area sprayed per load = Payload/Application Volume
   = 400 L/(5 L/ha)
   = 80 ha

2. Average distance between airstrip and spray block

For more than one block use weighted average based on number of loads required for each block.

Example: Block 1 - 25 km; 2 loads
Block 2 - 10 km; 1 load

average = 20 km

Ferrying time = [(Average distance x 60)/Speed] x 2
(60 changes to minutes; 2 takes into account the return time)
= [(20 km x 60)/160 km/h] x 2
= 15 min.

3. Turn time

The time required in "turning" at the block can be estimated by dividing the block width, in meters, by the track spacing and multiplying by 2 (for a turn at each end) x 45 seconds (the average time required for a spray aircraft to turn).

Example: Block width = 400 m
Track spacing = 30 m

Turn time = (Block width/track spacing) x 2 x 45 seconds
= (400 m/30 m) x 2 x 45 seconds
= 1,200 seconds = 20 min.

4. Total spraying hours required

Piper Pawnee - Speed = 160 km/h; 8 ha/min coverage
Track spacing = 30 m
Area sprayed/load = 80 ha
Ferrying time = 15 min.
Turn time = 20 min. **(calculated on a block by block basis)**
Loading time = 5 min.

Loading is an estimated value and includes fuelling and pilot briefing

To calculate:

Spraying time/load = (Area sprayed/load)/(coverage)
= (80 ha)/(8 ha/min.)
= 10 min.

Total spray time/load = Ferrying time + Spraying time/load + Turn time/Block
+ Loading time per load
= 15 min. + 10 min. + 20 min. + 5 min.
= 50 min.

To determine total spray time for a 8,000 ha project multiply the total spray time by the number of loads and covert the time to hours (in this example total spray time = 50 min. and the number of loads = 100).

Total spraying time required (hours) = [(Number of loads x Spray time/load)/number of aircraft]/60
= [(100 x 50)/1]/60
= 83 hours **(for one spray aircraft)**

5. **Spray window**

The spray window is the effective time frame for spraying. From this period determine the expected productive hours under acceptable weather conditions.

Example: Spray window is June 1 - 28 (28 days). Daily average for acceptable weather parameters is 1 hour. Therefore anticipated spray time is 28 hours. Compare this to the required spray time of 83 hours for one Pawnee. Thus the minium number of Pawnees required to complete this project is three.

Include a comfort margin in your calculation to ensure sufficient time for delays such as equipment and aircraft breakdowns or excessively bad weather.

6. **Types of airstrips available**

Compare the long term cost of improving strips versus the costs of using helicopters and helipads.

7. **Spray restrictions**

a) Spray block size and configuration.
b) Difficulty imposed by flying north/south to avoid morning and evening sun glare.

8. **Availability**

a) Number of aircraft available.
b) If flying in formation compatibility is important. Payload, fuel type, flying speed and track spacing should be similar.

9. Cost

a) When calculating final anticipated cost/ha do not only consider aircraft bid price per hectare but also production per flying hour.
b) Support costs increase the longer a project continues.
c) Include any airstrip modifications in cost comparisons.

The Mixing System

Spray Mixing systems should be capable of providing a continuous homogeneous mixture of adequately filtered, adequately calibrated pesticide to the spray aircraft with minimum delay. Any further details concerning mixing units in full service contracts should be stated in the contract.

The pump in the mixing system must be able to deliver a minimum of 150 L/min.

Let's use the 8,000 ha project with the three Pawnees to determine the size of tank required.

3 Piper Pawnees with a 400 L Payload each
Spray time per load = 50 minutes

Thus the mixing unit must supply 1,200 L every 50 minutes.

A holding tank should have the capacity to support an extended spray session for a limited time, or the mixing unit must be able to prepare the pesticide before the aircraft returns.

If we anticipate a three hour session, we then require a tank capacity of about 4,800 L (three Pawnees of 400 L capacity requiring loading every 50 minutes).

Restrictions on tank size are mobility and cost. A smaller tank may be used if you are able to mix new material between loads. A readily available water supply is required for this.

Direct Mixing in the Hopper

In an extended spraying session the application boss may have to delay the spray project while a new batch is mixed. When this occurs there is the option of bypassing the mixing tank and pumping both water and chemical directly into the aircraft hopper without prior mixing. The pumping action may be sufficient to provide adequate agitation. In order to keep the lines relatively clean of full strength pesticide, pump in the pesticide first, then water. The water being of greater quantity will take longer to pump and thereby provide a longer agitation period. **(Note: this should be done only as a last resort, or if you have been completely satisfied that there is a homogeneous final mix in the aircraft hopper; refer to the pesticide label for mixing directions.)**

<u>Advantages</u>

- extends spray capacity
- no premixing required during spray operations
- eliminates the possibility of having leftover mixture upon completion of the spray project

<u>Disadvantages</u>

- concern about sufficient agitation with certain pesticides
- increased possibility in major error of making an over-strength mix, especially when the ground crew is under pressure. For example if using a herbicide in a 10% mix, and double the required amount is accidentally pumped in, the extract strength mix cannot be diluted in the aircraft due to limited tank capacity and therefore must be pumped out. If the error goes unnoticed you will apply an illegal amount of material on your spray area.

Components of a Mixing System

1. Platform
   - should be level with pump area, slightly lower to accommodate pesticide drainage from the tank at the completion of the project
   - if the platform is on wheels, it should be blocked to take the weight off the springs and to provide stability
2. Mixing tank
   - capacity
   - construction material re: pesticide being used (for example see the "Vision"
   - label regarding steel tanks)
3. Pesticide holding tank
   - pesticide transfer
   - check construction re: pesticide being used
4. Water delivery system
   - must provide an adequate supply of clean water to support an extended period of spraying in one day
   - used to clean mixer, aircraft
   - used to rinse barrels, tanks
   - dust control in the loading area
5. Pump and motor
   - should be matched to move required volume of pesticide as quickly and quietly as possible
6. Metering system - filters
7. Intake lines - wire reinforced
8. Discharge lines
9. Valves
10. Agitator - mechanical or pump type
11. Lighting - for early morning and evening work
12. Water filtering system - removes fine dirt from water taken from ponds, etc.

APPENDIX 3: CALENDAR OF EVENTS

Herbicide Spray Projects

The dates noted below are deadlines. Earlier completion of duties is recommended.

PROCEDURE FR.04.20.10 MUST BE FOLLOWED IN APPLYING THIS GUIDELINE

Time Frame	Action
Aug. 15	- Next year's planning starts, Revised Project Details (Form 1's), site inspections completed
Nov. 15	- Communications Strategy prepared by Region
Nov. 30	- Project Descriptions prepared - Reviewed by district and region, modifications made where appropriate.
March 15	- Approval in writing of final Project Description by District Manager
Feb. 28	- Tendering of Planned Program
April 15	- District Plans (Operations, Security, etc.) completed
60 days before program starts	- Submission of MOE Form 5 (Spraying Permit to MOE Regional Pesticides Control Officer, with copy of Project Description - Submit MOE/EA Branch notification, i.e. copy of MOE Form 5 and covering letter
30 days before program starts	- Last date for **first media notification** - Project Description available for public review - **This must be a minimum of 30 days prior to the anticipated start of spraying** - Final site reinspection
7 days before program starts	- Last date for **second and final media notification** - Review of all district Project Plans by Project Supervisor, especially concerning security/notification to those in and around treatment areas - Posting of spray signs on spray blocks
0 days	- Project starts - Dating of spray signs on spray blocks
Nov. 1	- All spray signs removed from spray blocks

Insecticide Spray Projects

The dates noted below are deadlines. Earlier completion of duties is recommended.

PROCEDURE FR.04.10.10 MUST BE FOLLOWED IN APPLYING THIS GUIDELINE

Time Frame	Action
June 15	- District prepares egg mass sampling list - Regional Coordinator appointed
July	- Regional Director and Regional Coordinator view infestation, determine need for Work Committee
August	- Work Committee established and meets to review FORCAN FIDS defoliation mapping
Oct. 15	- Work Committee completes review of all possible options - FIDS presents egg mass results
Nov. 1	- Remove all signs form previous season's spray blocks
Nov. 15	- Project Proposal presented to Regional Director - Determine need for environmental monitoring of project - Develop Communications Strategy
Nov. 30	- Project and Budget Proposals presented to Executive Management Committee (EMC)
Dec. 15	- Invitations to Tender sent to eligible spraying companies
Jan. 15	- Public Information Centre established as District Office; public comment received for 30 days
Feb. 15	- Draft Project Description reviewed by District Supervisors and Regional Director, approved in writing by District Manager
Feb. 28	- Project Description presented to EMC for approval
April 1	- Prepare Project Plans
60 days before spraying starts	- Apply for spraying permit (MOE Form 5) - Submit MNR's District insect control program documentation and the supporting analysis of programs, a copy of the summary of public submissions on the proposed control program, and a copy of the final Project Description to MOE Pesticides Control Officer - Submit copy of covering letter outlining documentation to MOE EA Branch Director
30 days before spraying starts	- First media notice of project - Public inspection of final Project Description
7 days before spraying starts	- Second media notice of project - Post spray blocks
24 hours after	- Add details of spray program to signs

APPENDIX 4: PROJECT SUPERVISOR'S CHECKLISTS

Not all items listed here will be required for each operation.

Information Services

Establish reporting date for Project Information Officer
Review regional communications plan, schedule implementation of specific responsibilities.
Examples: media briefing
public viewing area
staff tours

Airstrip staff information packages and briefing
Arrange for flow of regular district mail and flow of daily spraying reports.
Examples: incident reports
daily spraying report
regional and provincial report
district news
weather, insect development

Arrange for large information board (e.g. 4' X 8' plastic covered plywood) posted in accessible location.
Post above noted items.
District information centre
Spokesperson role
review emergency communication procedures
Liaising with local media
Dealing with noise and other complaints from public
Liaising with concerned district manager

Field Preparation

Chemicals
- Check product labels
- Pesticide ordered
- Diluent or emulsifiers ordered, if necessary
- Materials delivered to site
- Field storage prepared (p 55)

Project Maps (p 2; Appendix 1, p 151)
- 1:15,000 to record treatments and progress (p 2)
- 1:50,000 topographic
- Recent aerial photos (1:15,000) for each pilot
- Spray block boundaries shown (p 2) and Appendix 1, p 151)
- Track spacing marked (pp 136-138)
- Key features highlighted (Appendix 1, p 151)
- Recent SAP

Washing Facilities
- Clean water
- Soap
- Dish pan or bucket
- Container, fitted with molasses (Rieke) valve

Radios (p 15)
- Appropriate FM radio and antenna to install in aircraft
- Mixing site radio to communicate to block
- Mixing site radio to communicate to aircraft
- Radios for traffic control personnel
- Adequate supply of batteries

Airstrip
- Meets specifications (Appendix 6, p 177)
- Sides brushed out
- Surface graded and packed
- Stones removed and holes filled
- Aircraft fuel ordered
- Aircraft fuel delivered to site

Water for Mixing
- Check pH and/or clarity of water supply
- Pump, with back-up unit
- Pump tool kit
- Intake hose
- Foot valve
- Float to keep foot valve off bottom
- Outlet hose to reach mixing tank or water truck
- Pail to prime pump
- Inlet strainer
- Gas for pump

Water for Wetting Runway
- Dribble bar if water truck is being used
- "Y" valve in water supply line
- Appropriate nozzle for spraying/wetting runway surface
- Adequate hose to cover 200 m of runway and turnabout area

Safety

For mixing crew (p 110)
- Neoprene safety boots
- Neoprene gloves, elbow length
- Full rain suits and disposable coveralls
- Hard hats with chin straps
- Respirators, full face or half face
- Safety goggles
- Pesticide cartridges with particulate filters
- Refills for respirators
- First aid kit and WCB forms (pp 62-64)
- Deluge shower
- Eye wash station

For camp:
- Fires extinguishers
- First aid kit
- Posted emergency procedures
- Traffic barricades on road/strip

For aircraft
- check Emergency Location Transmitter (ELT) is functional
- ensure Radio Watch and Flight Plan are are in place for aircraft flights other during sprays
- flashlights
- waterproof matches
- first aid kit
- axe
- insect repellent
- survival blankets
- 30 min. check in via radio to operations base for all aircraft

Weather Equipment (p 149)

Truck
Radio for weather monitor to contact mix site/guidance aircraft
Psychrometer
Water for psychrometer, rain or distilled if possible
Wind gauge
Aerial spray weather record to be filled out by the Application Boss (see pp 184 and 189)
Watch
Rain gauge
Signs to post sprayed areas

APPENDIX 5: AIRCRAFT GUIDANCE

Good aircraft guidance is essential to ensure that only the designated areas are sprayed and that coverage is complete without misses or double coverage. The establishment and marking of block boundaries, non-target areas and in some cases flight pattern lines in advance of spraying are necessary for good operational control of aerial spraying. Regardless which of the following methods is used, it is strongly recommended that for all large scale projects (see Procedures FR.04.10.10 and FR.04.20.10), **a guidance aircraft** with a **Ministry navigator** or **observer** be used to ensure that spray aircraft are operating according to program specifications.

Aerial Photos, Topographic Maps

Aerial photos and topographic maps, used in combination, provide a reliable and readily understood technique for boundary marking. If pilots are experienced in forestry spraying and if the spray blocks are large, rough and inaccessible, aerial photos and maps are the only practical method of guidance.

Aerial photos (1:15,840) taken within the last 2 years should be used. Spray boundaries, treatment boundaries, "Non-target" areas, and even flight lines in experimental programs, should be marked clearly on the photos. It is useful to make these markings on an acetate overlay. This allows the pilot to "lift" your notes for a better look at the map or photo. If recent photos are unavailable or if the vegetation cover has changed significantly, supplementary aerial photos (SAP) should be taken before the project, and marked clearly for the pilots. For large scale projects, many pilots prefer to use topographical maps (1:50,000 or 1:25,000). The spray block boundaries, treatment boundaries, "Non-target" areas, etc. should all be clearly marked on the maps. Maps provide an advantage in that they show the surrounding natural features clearly, i.e. surface contours, lakes, roads, etc.

Helium Balloons

Helium-inflated weather balloons can be effective boundary markers. Corners, boundaries and "Non-target" areas may be marked with balloons. Ensure that the pilots are aware of the location of each balloon and its significance before spraying. Try to minimize the number of balloons used in a block; too many balloons will distract and disorient the pilots.

If rough terrain or dense canopy precludes carrying an inflated balloon to a remote location, several deflated balloons, string, and D size (45 cm) helium canisters may be carried into such locations. A helium yoke is necessary to use the small canisters; these are a special order item from a medical gas supply company such as Medigas Ltd., 470 Lakeshore Blvd. West, Toronto ON, M5V 2V6, telephone: (416) 365-1050, (Model M93-4). The D size helium canisters are available from Canox; two weeks notice is required to ensure availability. These canisters contain helium for three 15 cm balloons so ensure enough canisters are available to service inaccessible points for the entire program.

Appropriate meteorological balloons (red, 15 cm) are available from Aero-Aqua Inc., 750 Woodbine Ave., Suite 100, Markham, ON, L3R 4G8 (allow four weeks for delivery), or from Sterling Rubber 1985 Inc., 675 Woodside St., Fergus, ON, N1M 2M4, (519) 843-4032.

Fluorescent Streamers

Marking dominant or co-dominant trees with fluorescent flagging material can be an effective way to mark block boundaries or corners. Two methods are suggested:

1. A line gun, a crossbow or longbow can be used to fire a light line over the crown of the tree. This line is then used to hoist a panel of fluorescent material into place on the top of the crown (Figure 44). Try to locate the panel on the side of the crown most visible to the pilots while spraying. For this method, a large panel is required, e.g. 1.5 m x 4.5 m.

2. A line gun, crossbow or longbow can be used to hoist a line into a horizontal position between two dominant trees. Fluorescent panel attached to this line make a very effective marker (Figure 45). With this system the panels are attached to the line before it is hoisted.

Complete details are given in Maksymiuk, B., 1978. Marking Methods for Improving Aerial Application of Forest Pesticides. PNW-262. Pacific Range and Forest Experiment Station, Portland, Oregon.

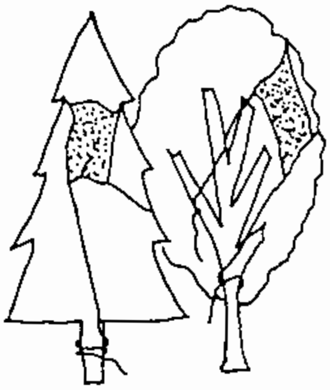


FIGURE 44. Marking panel tethered to trees.

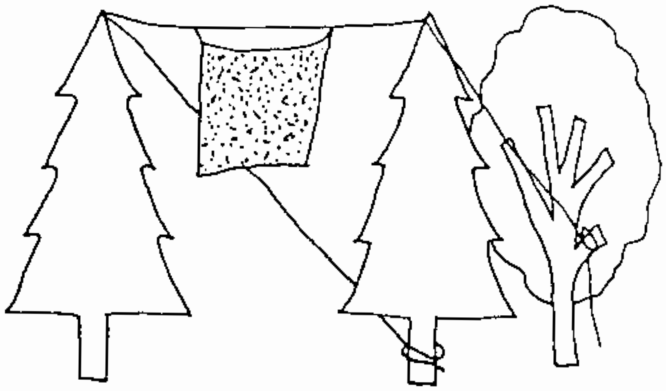


FIGURE 45. Marking panel suspended clothesline fashion.

One big advantage of tree-marking with fluorescent streamers is that marking can be done well in advance of spraying and they are fairly permanent.

<u>Beacon Lights</u>

In certain terrain and forest types, beacon lights provide an inexpensive, low-maintenance and permanent marker for pilots. These can be located prior to the start of the program and left operating until completion. They should be located in positions readily visible from the air, e.g. rock bluffs, tree tops, clearings on hill sides, etc. Inexpensive, battery-operated strobe lights, available from Radio Shack, Honeywell Ltd., or a retail electronics firm, are probably best suited for this technique.

<u>Miscellaneous</u>

Flag poles may also be used for aircraft guidance. Electronic navigational equipment can be used for aircraft guidance in large spraying operations.

APPENDIX 6: AIRSTRIP AND HELIPORT STANDARDS FOR AERIAL SPRAYING OPERATIONS

POLICY NO. AF.01.45.01

For the purpose of conducting aerial spray operations it is, from time to time, necessary to operate from facilities which are not recognized as airstrips and heliports for public use.

The objective of this policy is to ensure safe and cost effective operating standards with all types of fixed wing and rotary wing aircraft in conducting aerial spray operations in and for the Province of Ontario.

The Ministry of Natural Resources will operate aerial spray operations from airstrips and heliports designed and constructed to the standards established herein.

Airstrips will be classified into two levels of design and construction as follows:

Class I Airstrips[15]

Those strips requiring the use of all types of small to medium type aircraft incorporating aircraft Groups A, B & C including all uses of fixed wing guidance aircraft. Typical aircraft operated are Cessna 172, Cessna Ag-Truck, Dromadier M18.

Class II Airstrips[15]

Those strips requiring the use of the small high lift capability spray aircraft only, incorporating aircraft Groups A & B. Typical aircraft operated are Grumman Ag-Cat, Piper Pawnee.

Heliports

Heliport landing areas are those required to operate all types of light and medium rotary wing aircraft incorporating aircraft Groups A, B & C including all uses of rotary wing guidance aircraft of the same aircraft groups above. Typical aircraft operated are Bell 47-G-4, Bell 206-B, Sikorsky S-55, Bell 212.

Airstrips and heliport standards will be implemented by the Forest Resources Branch, Silviculture Section and the monitoring and inspection will be implemented by Aviation, Flood and Fire Management.

PROCEDURE NO. AF.01.45.02

The following points are to be considered in respect to the construction, maintenance and operation of aerial spray airstrips and heliports:

SITE SELECTION AND EVALUATION:

1. Locate the airstrip as close to the spray block as possible to reduce non-productive ferry time and to ensure communication between the spray block and the mixing/loading site. Maximum distance should not exceed 35 miles.
2. Location of the airstrip must include ground access; these roads must be adequate to handle heavily-laden trucks delivering material to the mixing/loading site.
3. Airstrip locations in areas remote from built-up areas are preferred. However, public airports should not be overlooked provided access to the mixing/loading site can be controlled and spray operations do not represent a conflict with normal airport operations.
4. Locate the airstrip within easy hauling distance of a water supply.

[15] Forest Health and Protection Section Note: Aircraft carrying MNR personnel may land on Class I Airstrips. Aircraft carrying MNR personnel cannot land at Class II Airstrips.

5. If spraying programs are anticipated as part of a management plan, then adequate airstrips are a prerequisite and can be incorporated into plans for road construction.

6. If included during the road planning stage, an airstrip paralleling an access road is acceptable. This way, traffic may be diverted over the airstrip for several seasons ensuring a well-drained, well-packed surface when aerial application begins. When the airstrip is brought into operation, traffic must be rerouted along the original roadway, eliminating the need for traffic control along the airstrip.

7. Airstrips should be oriented so that lift-offs and landings can be made into the prevailing winds. A compromise may have to be made in orientation to avoid sunrise/sunset visibility problems. The site characteristics of local topographic and geological features and forest stand densities should be considered to further assist in the positioning and orientation of the airstrip to minimize the effects of wind channelling and/or deflection.

GENERAL SPECIFICATION: All Airstrips

8\. a) The running surface should be smooth, well-drained and free of potholes and large stones.

b) A strip or shoulder should be brushed out along each side of the running surface to ensure wing clearance. The grade of the clearance strips should be lower than the running surface; small hills should be bulldozed and brush trimmed.

c) The running surface should not be crowned or sloped excessively across its width.

d) Grass, packed sand or fine gravel are all acceptable surface materials.

e) The running surface must be straight through its length; a "climb-out" and "approach" path brushed out at the ends of the strip. A five percent slope is acceptable (20:1).

f) Visibility along the entire length is essential.

g) The mixing/loading site can be at either end of a flat airstrips but only at the high end of a sloping airstrip. It should be at least 75 feet in radius with a further 30-foot wing clearance around the perimeter. If two or more planes are using the same facilities, the turnaround should be 125 feet in radius, also with a 30-foot wing clearance. The turnaround may be constructed as a widening of the road surface and will be additional to the clear runway length.

h) The mixing/loading equipment should be located alongside the turnaround preferably on the left side so that the plane will be in a taxi position before loading. All hook-ups are located along the left hand side of the fuselage.

i) The refuelling areas should be located immediately adjacent to the mixing/loading area separated sufficiently so as not to impede either function and positioned in such a manner as to facilitate fuelling of aircraft first.

j) A nearby clearing may be built up to the running surface level, to park and tie down aircraft. This space may also be used to store pesticides and materials.

k) Surface treatment should be considered for start-up/run-up/loading area, as the fine materials will quickly be blown away. "Black liquor"[16] or similar is suggested. Avoid calcium chloride.

l) Ditching, if required, should be placed to the outer edge of the wing clearance area rather than immediately adjacent to the runway. Deep "V" ditches should be avoided if possible to prevent accumulation of water in depth that could pose a threat to aircraft occupant before rescue or egress from an inverted aircraft.

[16]Forest Health and Protection Section Note: Contact local MOE office for approval to use "black liquor".

HELIPORT CRITERIA:

9. Heliport landing areas should be considered in conjunction with airport construction or as a separate entity, if helicopter spraying is being considered. The "Helicopter Administration, Management, Operations Manual" chapter V, Section 3 should be consulted for heliport construction.

10. a) A heliport with a single touchdown pad requires a safety area of 61 m x 61 m (200 ft x 200 ft) with a takeoff/landing area 100 ft in diameter.

b) A touchdown pad is not always required, firm level ground is preferred. The touchdown pad should be located in the centre of takeoff/landing area.

APPROACH AND DEPARTURE AREAS:

11. a) Should be as level as possible.

b) Should be void of any tall trees, snags, power lines, etc.

c) Dust free areas are preferred.

d) Take-off path should be into the prevailing winds.

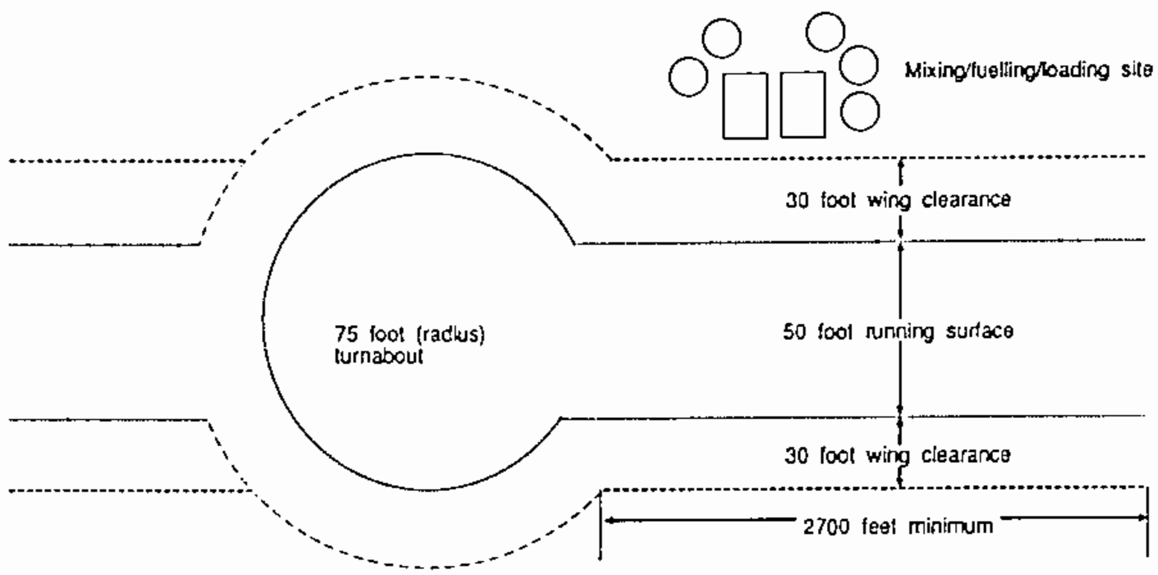
12. Exceptions:

Contractors who wish to operate off non-designated heliports must receive approval from the local Project Supervisor in each case to ensure that Ministry concerns related to safety, security, noise abatement, etc. are reviewed prior to operations commencing.

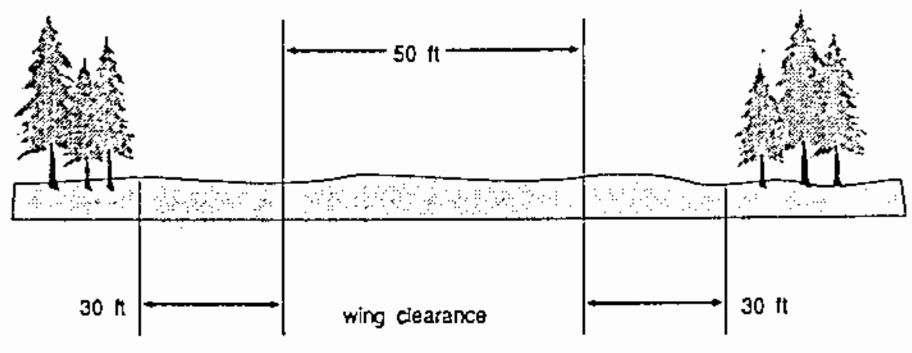
13. Enquiries regarding changes in criteria or design must be directed to and approved by the Aviation Section of Aviation, Flood and Fire Management prior to implementation.

CLASS I AIRSTRIP

Airstrip Design Standards



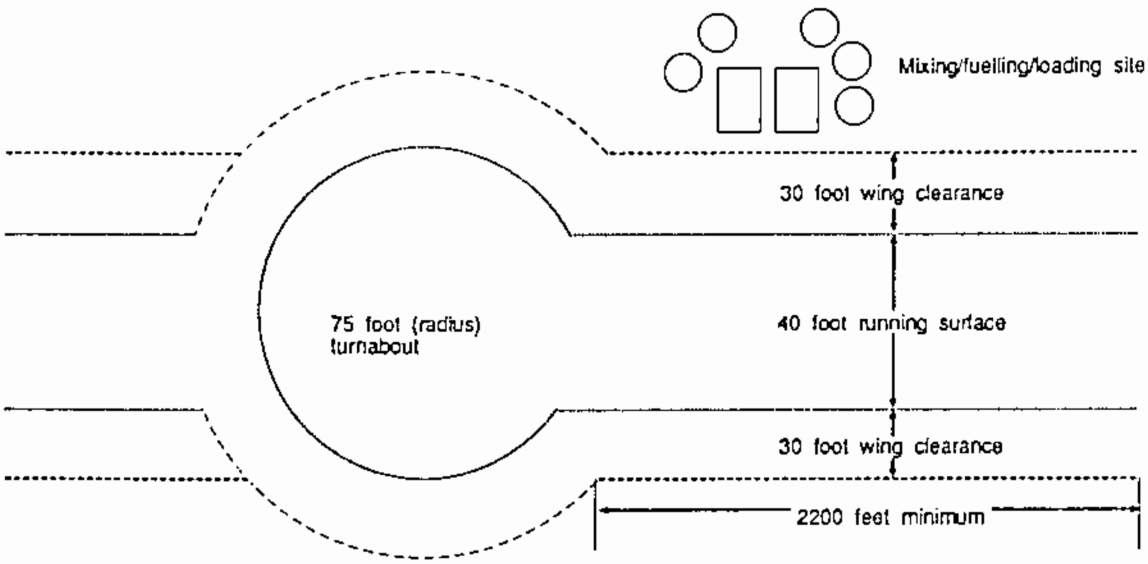
Aerial view of proposed airstrip



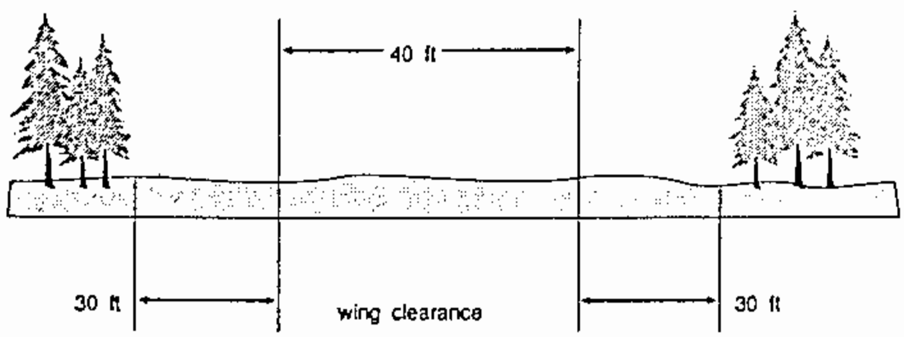
Airstrip x-section design

CLASS II AIRSTRIP

Airstrip Design Standards

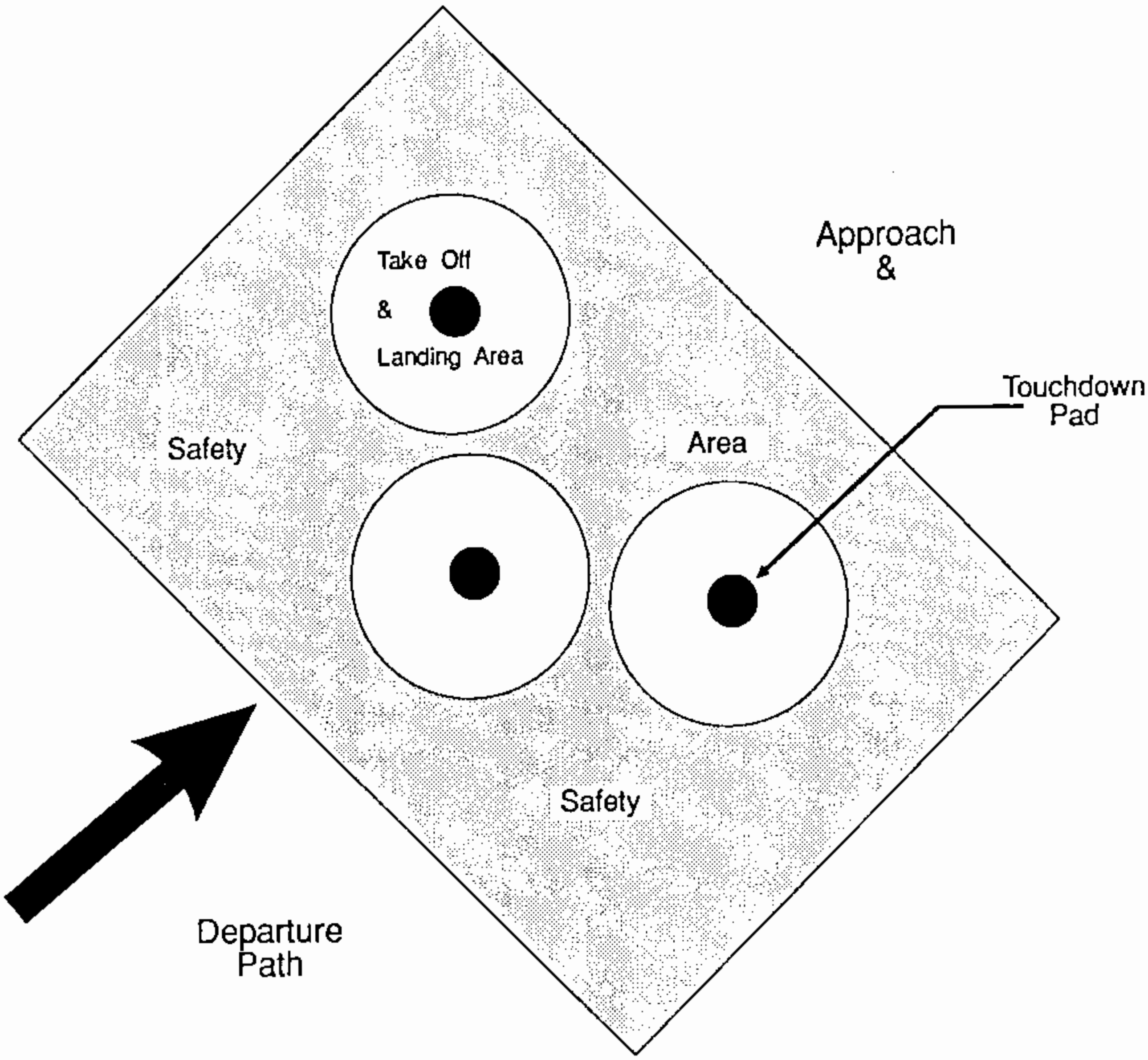


Aerial view of proposed airstrip



Airstrip x-section design

SAMPLE DIAGRAM OF MULTIPLE USE HELIPORT



APPENDIX 7: PROJECT REPORTS

Good documentation and record maintenance is a must on any aerial spray project. The following records are the direct responsibility of the Project Supervisor.

Daily Progress Report: To District Manager (and Regional Coordinator - at his/her discretion)

Daily Spray Summary: - Flexible format
- Important to summarize the day's activities
- Will simplify aerial spray report at end of project.

MOE FORM 5: (example on page 185)

- Provides authority to perform an extermination with an airborne machine.
- Details conditions under which project may be carried out.
- Pilots must sign.

NOTE: **The District Manager is the person applying for permission to perform an extermination with an airborne machine.**

Moe Final Report: (end of the project)

- Pesticide use pattern (e.g. forest protection, conifer release or site preparation)
- Hectares sprayed by block
- Total pesticide applied by block
- Volume of mix applied per hectare
- Number of applications by block
- Product sprayed (trade name) and P.C.P. number of product
- Concentration of active ingredient in pesticide
- Dates of spray (first and last flight)
- Name of contractor and all pilots
- Number of empty containers (pesticides) remaining after project
- Disposition of empty pesticide containers (exact location of disposal site if applicable)
- Amount of pesticide at end of project and where stored
- Any environmental problems encountered (spill, drift, accidents, etc.)
- Requires map of spray blocks (sprayed, unsprayed) at scale 1:250,000
- All exterminator licence numbers of each of the spray aircraft pilots involved in the project
- Aircraft registration and type
- Or any other conditions requested on the MOE Form 5.

NOTE: **Send a copy of this report to the Silviculture Section. This replaces the Project Report that was required by the Forest Health and Protection Section. Administration of aerial spraying becomes the responsibility of the Silviculture Section as of September 1991.**

Routine Records:

- Daily Time Record
- Time Sheets (bi-weekly)
- Radio Logs
- Master time Sheet
- Daily Cost Record (optional)
- Vehicle Diaries
- Personal Diaries
- Aircraft Incident Record

Aircraft Passenger Manifest: (example on page 186)

- Maintained separate from pilot records for project personnel
- On larger projects - air traffic advisor or radio operator; on small projects - Project Supervisor

Routine Reports: Accident Reports, First Aid Reports

Area Treated (mapping): (example on page 187)

- After each spray session - navigators record on master map actual area treated
- Map scale 1:50,000
- Date (including A.M. or P.M.) or 24 hour clock
- Team or aircraft doing work
- Batch number of pesticide
- Actual spray boundaries completed (including N/T areas)
- Actual area completed (in ha)

Equipment Inventory and Control:

- Establish inventory and control system early
- Maintain accurate records on inventory and movement (1284's, 190's, etc.)

Application Boss's Records

The following records are the direct responsibility of the Application Boss.

- Aerial spray load records (explanation below, example on p 188)
- Weather records (explanation below, example on p 189)
- Aircraft load tickets (example on p 190)
- Personnel exposure records (example on p 191)
- Fuel inventory and control records (example on p 192)
- Pesticide inventory and control records (example on p 193)
- Personal diaries (example on p 193)

The following records are the Project Supervisor's responsibility but may be delegated to the Application Boss.

- Daily mapping of the area treated (example on p 187). **NOTE: Although completion of spray maps is usually the Project Supervisor's responsibility, the Application Boss must be familiar with the information transferred to project maps.**
- Project reports
- Contractor evaluation, including aircraft and pilots
- MOE permit

Aerial Spray Load Record

This form is used to record spray aircraft deliveries. Also recorded on this form is type of pesticide used, batch number of pesticide, time out, and time in for each aircraft using the 24 hour clock. Useful information such as "calibration flight", or "aircraft returned with 100 litres on board" should be recorded in comment section. This form should be retained one year.

Aerial Spray Weather Record

One person must be assigned to take and record this information. Weather data must be taken every 15 minutes during spray operations. To complete Form 1137 "Aerial Spray Weather Record," record date, time (24 hour clock), cloud cover, temperature, relative humidity, wind direction and speed. Comments may include air stability, ceiling, fog, frost visibility range. This type of information would be required in the event of an aircraft incident or spraying incident. This record should be retained for one year.

Form 5 (MOE)

Ministry of the Environment — Hazardous Contaminants Coordination Branch
Ministère de l'Environnement — Direction de la coordination des normes sur les polluants dangereux

ORIGINAL
COPIE ORIGINALE

The Pesticides Act - Form 5
Application for a Permit to Perform an Extermination from an Airborne Machine
La loi sur les pesticides (the Pesticides Act) – formule 5
Demande de permis de destruction de nuisibles a partir d'un aéronef

Please print clearly
Écrire lisiblement en lettres moulées

Ministry Use Only / Réservé au ministère

Applicant's Name / Nom du demandeur: Ministry of Natural Resources
Company Name / Dénomination de la compagnie: Ministry of Natural Resources
Applicant's Address / Adresse du demandeur: 6-8-10 Government Road Kapuskasing Ontario P5N 2W4
Telephone / Téléphone: 705-335-6191
Exterminator's Name / Nom du destructeur de nuisibles: Tendered
Land Ext. Licence No. / N° de permis dest. de nuis. terrain: -
Telephone / Téléphone: -
Operator for Whom Extermination Will Be Done / Exp. o (uni pour qui la destruction de nuisibles est faite: Tendered
Operator's Licence No. / N° de permis d'exploitation: -
Telephone / Téléphone: -

4. Location to be Treated / Endroit à traiter	5. Crop / Récolte	6. Name of Pest / Nom du nuisible	7. Name of Pesticide / Nom du pesticide	8. No. of Hectares / Nombre d'hectares	9. Rate - kg/ha / Nombre de kg/ha	10. Treatment Period / Durée du traitement	11. Property Owner or Contact Person / Propriétaire de la propriété ou personne contact
Lot / Concession: See attached maps; Township / Canton: Barker Blks L to R; County/District/Municipality: Cochrane	Spruce regen.	Grass, poplar	Vision PCP 19899	300.0	2.0	July 15 to Sept 15/89	Name: Daniel Kott; Address: Ministry Kapuskasing; Postal Code: P5N 2W4; Telephone: ext 130
Lot / Concession: See attached maps; Township / Canton: Eilber Blks S, T; County/District/Municipality: Cochrane	Spruce regen.	Grass, poplar	Vision PCP 19899	50.0	2.0	July 15 to Sept 15/89	Name: Daniel Kott; Address: Ministry Kapuskasing; Postal Code: P5N 2W4; Telephone: ext 130
Lot / Concession: See attached maps; Township / Canton: McCowan Blk U to Y; County/District/Municipality: Cochrane	Spruce regen.	Grass, poplar	Vision PCP 19899	300.0	2.0	July 15 to Sept 15/89	Name: Daniel Kott; Address: MNR Kapuskasing; Postal Code: P5N 2W4; Telephone: ext 130
Lot / Concession: See attached maps; Township / Canton: Williamson Blk Z to HH; County/District/Municipality: Cochrane	Spruce regen.	Grass, poplar	Vision PCP 19899	800.0	2.0	July 15 to Sept 15/89	Name: Daniel Kott; Address: MNR Kapuskasing; Postal Code: P5N 2W4; Telephone: ext 130
Lot / Concession: See attached maps; Township / Canton: Fauquier Blks II to LL; County/District/Municipality: Cochrane	Spruce regen.	Grass, poplar	Vision PCP 19899	300.0	2.0	July 15 to Sept 15/89	Name: Daniel Kott; Address: MNR Kapuskasing; Postal Code: P5N 2W4; Telephone: ext 130

Amendment / Modification

Reg. Consent Approb. min.

Applicant's Signature / Signature du demandeur
Date: Nov 1/90

Permission is hereby granted under The Pesticides Act and Regulations to perform extermination(s) from an airborne machine in accordance with the conditions and amendments detailed above.
Le demandeur est par la présente autorisé à effectuer des opérations de destruction de nuisibles à partir d'un aéronef aux termes de la loi sur les pesticides (The Pesticides Act) et des règlements établis en vertu de celle-ci, conformément aux conditions et modifications indiquées ci-dessus.

Director's Signature / Signature du directeur
Date

MOE 1172 (2/87)

J.R. Grayston District Manager

Do not separate - send complete carbon set to Head Office.
Ne pas détacher - envoyer l'ensemble des copies et des carbones à l'administration centrale.

Ministry of Natural Resources
Ontario

Aircraft Passenger/Cargo Manifest

118336

Flight Starting From: Jellicoe

Flt. No.	Passenger Numbers	Charge Code	Route	Weights				Date of Flight
			Destination	Passenger	Baggage	Cargo	Total	
1	1		Blk. 39					June 7
2	1		Blk. 71					"
3								
4	1							June 8
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

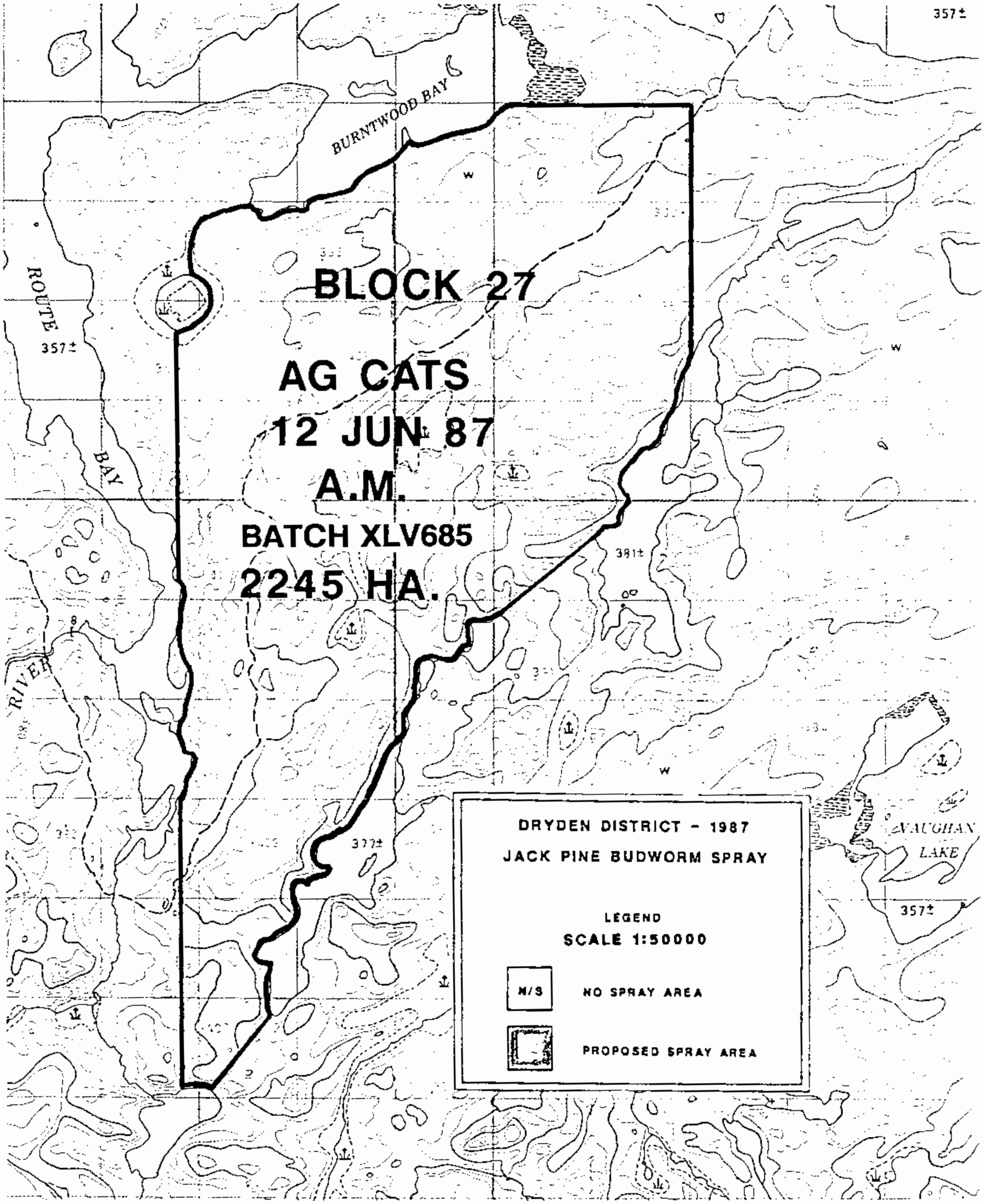
Special Flight Instructions

No.	Passenger Names	Ministry	No.	Passenger Names	Ministry	No.	Passenger Names	Ministry
1	Joe Miller	MNR	16			31		
2			17			32		
3			18			33		
4			19			34		
5			20			35		
6			21			36		
7			22			37		
8			23			38		
9			24			39		
10			25			40		
11			26			41		
12			27			42		
13			28			43		
14			29			44		
15			30			45		

Aircraft	Registration	Base	District	Flight Crew (Please Print)
Cessna 172	UQC	Jellicoe	Nipigon	John Kuipers
Region	**Prepared By (Please Print)**	**Prepared By (Signature)**	**Date Prepared**	
NCR	S.LINTON	S.Linton	June 7/76	

81 (04/78)

Area Treated (Maps)



Ministry of Natural Resources
Ontario

Aerial Spraying Load Record

District	Project

Instructions – Record each load completely and accurately.
– Take tank sample, if required.
– Obtain Project Supervisor's signature daily.

Batch No	Load No.	Delivered by		Pesticide	Time		Application		Comments
		Aircraft	Pilot		Out	In	No. of litres	Lot and Conc. or Block No	

1136 (81/5)

Completed by	Date	Approved by (Project Supervisor)

Ministry of Natural Resources
Ontario

Aerial Spraying Weather Record

District	Project
Location	

Instructions
- Take recordings every 15 minutes.
- Initial records after spray period.
- Forward to Project Supervisor when completed.

Time	% Cloud Cover	Temp.*		% Hum.	Wind		Comments	Time	% Cloud Cover	Temp.*		% Hum.	Wind		Comments
		Dry	Wet		Dir.	Vel.*				Dry	Wet		Dir.	Vel.*	

1137 (81/6)

*If non-metric, specify in "Comments" on 1st entry.

Monitored by	Date	Approved by (Project Supervisor)

Aircraft Load Ticket

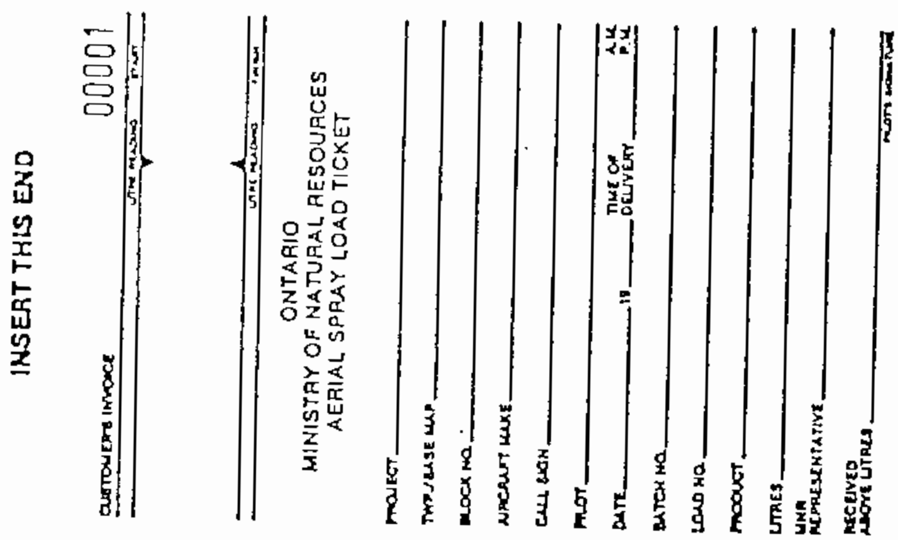
On most aerial spray projects a liquid flow meter with ticket printer is used. Complete information on this ticket includes:

- Type of pesticide
- Batch and load numbers
- Volume of pesticide loaded
- Aircraft and pilot identification
- Session (am or pm)
- Location

This record should be retained for one year.

A NOTE OF CAUTION:

The meters are mechanical devices, therefore not fool proof. Should there be a discrepancy between the meter reading and the hopper measurements, the hopper measurements take precedent. If a meter should malfunction or not have a ticket printer, the hopper reading is recorded and transferred to the aerial spraying load records.



Personnel Exposure Record

Each occasion on which an individual works with, handles or is in contact with pesticide must be recorded. This is a legal requirement under the Occupational Health and Safety Act. The following information must be recorded:

- Employee name
- Project title and number; providing sufficient information to identify a project at a later date and retrieve other records if necessary
- Pesticide trade name - PRINCEP NINETY, not simazine
- P.C.P. # - Pest Control Products registration number (from the label)
- Date
- Job performed - a brief description of duties (i.e. mixing crew, loading aircraft)
- Duration - number of hours exposed to each pesticide
- This is a permanent record to be kept in the person's personnel file

It is recommended that this record keeping be assigned to the individuals involved.

PERSONNEL EXPOSURE RECORD

NAME:______________________

Project	Dates	Pesticide P.C.P.#	Job Description	Exposure Hours

Fuel Inventory and Control Records

The period available for aerial spraying is very short and running out of aircraft fuel can be very costly to both the Ministry and contractor. An accurate daily record of fuel received and dispensed is a must. A variety of formats have been used dependent on size of project and number of aircraft.

It is recommended the pilot and fueller initial the form when the testing is done. This record should be retained for one year.

FUEL INVENTORY AND CONTROL RECORD

Project________________________

Tank Capacity____________ Tank Number____________ Type of Fuel____________

Date	Received	Dispensed	A/C Reg.	Fuel on hand	Remarks (Test Results) or Other Comments	Initials	
						Fueller	Pilot

Fuel Inventory and Control Records

The period available for aerial spraying is very short and running out of aircraft fuel can be very costly to both the Ministry and contractor. An accurate daily record of fuel received and dispensed is a must. A variety of formats have been used dependent on size of project and number of aircraft.

It is recommended the pilot and fueller initial the form when the testing is done. This record should be retained for one year.

FUEL INVENTORY AND CONTROL RECORD

Project________________________

Tank Capacity____________ Tank Number____________ Type of Fuel____________

Date	Received	Dispensed	A/C Reg.	Fuel on hand	Remarks (Test Results) or Other Comments	Initials	
						Fueller	Pilot

Pesticide Inventory and Control Record

This form is utilized to record the handling or history of the pesticide from time of delivery until loaded into the aircraft. Such information as Lot Numbers, mixing (giving accurate volumes) and agitation are recorded here. This record should be retained for a minimum of one year. Smaller herbicide projects may not require all the information indicated here.

PESTICIDE INVENTORY AND CONTROL RECORD

Amt. Rec'd	Lot No.	Date Rec'd	Date Sampled	Tank No.	Mixture Record			Agitation		Amount Dispensed	Comments
					Date	Ratio	Batch No.	Date	Duration		

Personal Diaries

This is probably one of the most important records to maintain yet one of the first to be forgotten. All project staff should maintain a detailed diary completed on a daily basis covering all aspects of the day's activities (i.e. what they did, hours of work, problems encountered, visitors to site, any recommendations for improvement, etc.). Diaries should be retained for a minimum of one year.

Pointer Report

The Pointer Report records individual spray team loads. It indicates: what was sprayed; where it was applied; when it was applied; how and who applied it; the conditions of application; any other pertinent information. The Pointer report is also the work sheet from which the Project Status Map is updated.

DATE: JUNE 9/86

IDENTIFICATION

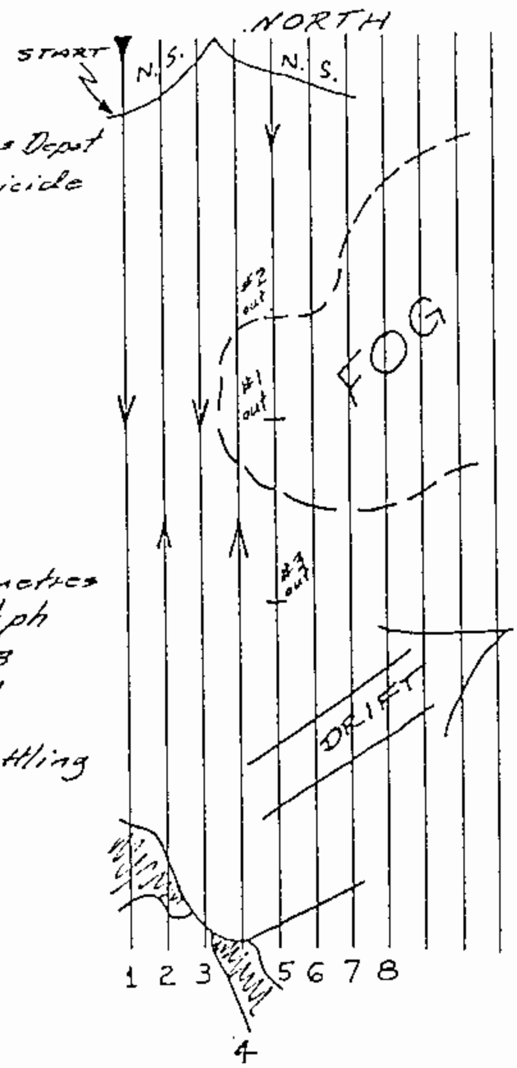
District: Temagami Airstrip: Gillies Depot
Pest: P. budworm Pesticide: Thuricide
Block: Gillies 3 Load No.: 1
Haul Distance: 4 km.

APPLICATION

No. 1 Pointer: B. Moulder
Pilot: D. Vipond
No. 2 Pointer: K. Sinibaldi
Pilot: R. Swanton
Team: Ag Cat 1,2,3 Swath: 200 metres
Altitude: 30 m. Speed: 175 kph
Start: 04:56 End: 05:18
Spraying Time: 18' 07" – #1
Spray Action: hanging, but gradually settling

WEATHER

Temp.: 15°C Wind: Nil
Cloud: Nil Rain: Nil



REMARKS

– Ground Fog along East side of sprayed area; dissipating quickly...
– #3 AgCat appears to have a "plugged" Micronair Unit (outboard – left side)... Unit trickled in turns & emission seemed "lean"... Strip & pilot advised to correct.... M

APPENDIX 8: WEATHER INTERPRETATION

Introduction

Meteorology is the study of the atmosphere and the changes that take place within it. The atmosphere occupies space and has weight. Compressed air is denser (thus heavier) than expanded air, since there are more molecules in the same space. As a result of this the atmosphere has half of its weight below 5.5 km. In general pressure decreases with height and thus when a parcel of air is forced to rise it reaches regions where the surrounding air is less dense and its molecules are free to expand. Similarly, when external pressure increases, the air is compressed and its density increases.

Moisture

A major concern of meteorology is the determination of when and where water vapour will change into a visible form, i.e. clouds. The formation of ice crystals or water droplets from water vapour is dependent on the presence of minute solid particles (commonly soil, smoke and salt from ocean spray). These particles are also significant to meteorology in that they may be present in sufficient amounts to reduce visibility.

When the atmosphere is cooled sufficiently, its water vapour changes into water droplets, a process called **condensation**. When the temperature is below freezing water vapour changing directly into ice crystals (**sublimation**). These processes can result in the formation of fog and clouds.

When sufficient heat is applied, water droplets change into water vapour. This is **evaporation**. The evaporation of fog or cloud requires heat. As evaporation takes place, energy becomes stored in the water vapour as potential energy, and is now **latent** or inactive and does not affect the temperature of the air. This heat is released when condensation occurs.

The moisture content of the air plays an important role in the determination of weather. The higher the moisture content, the more cloud that can form. The higher the temperature of the air, the greater its capacity for holding water vapour. When the air is holding the maximum amount of water vapour at a given temperature, it is said to be **saturated**. The degree to which the air is saturated is expressed by the **relative humidity (RH)**. The RH varies from 0% for completely dry air to 100% for saturated air. The RH of the air may change with no actual change in moisture content - just by heating (decreases RH) or cooling (increases RH) alone.

When the air is cooled, eventually it becomes saturated. Condensation will begin with further cooling. In order for condensation to take place in the atmosphere, minute solid particles on which water vapour can condense must be present. The temperature to which a sample of air must be cooled to cause saturation is called the **dew point**. The spread between the actual air temperature and the dew point is an indication of how close the air is to saturation. The higher the moisture content, the higher the dew point. Unlike relative humidity, the dew point of a sample of air remains unchanged during variations in the air temperature as long as the moisture content is constant.

Heat Transfer

<u>Radiation</u>

If the atmosphere were not heated there would be no interplay of temperatures and pressures to create changes in weather. The sun's energy is transferred to the Earth and the Earth's energy is transferred to the atmosphere and to space in the form of waves. This method of heat transfer is known as **radiation**. Radiation may be reflected or absorbed by matter. It must be absorbed before matter can be heated.

A balance exists between radiation received and lost by the Earth, otherwise the Earth would become progressively hotter or colder. The Earth does not absorb all of the incoming radiation. Some is absorbed by the upper atmosphere and some that reaches the lower atmosphere may be reflected into space by cloud tops. Of the incoming radiation that reaches the Earth's surface part is reflected. At night there is no incoming radiation but the outgoing radiation from the Earth continues. On a cloudy night clouds will absorb the outgoing radiation and re-radiate a considerable portion back, i.e. clouds act as a blanket by hindering the escape of heat.

The atmosphere is not heated directly by the sun. The lower levels of the atmosphere are heated primarily from below.

The Celsius scale is used to measure both surface and upper air temperature in Canada. The boiling point of water at sea level is marked at 100° on the Celsius scale. The freezing point under the same condition is 0°C.

Temperature Change in the Atmosphere

The heat energy of the sun is not received uniformly by all parts of the Earth, because the sun shines more directly on the lower latitudes. It is not necessarily true that if equal amounts of heat energy are received by equal areas of the Earth's surface, the surface temperatures of these areas would be the same. Surface temperatures depend not only upon the amount of heat received from the sun but also upon the relative compositions and masses of the substances on the surface in that area. For example, a deep lake will require more heat to warm it than a shallow lake of the same surface area. Also, because of its higher capacity for heat, water will heat or cool more slowly than land. Large bodies of water take up immense quantities of heat from the air when it is warm and release the heat when the air is cold. Thus large bodies of water have a moderating effect on temperature distribution in the land bordering them.

The process of transmitting heat from one body to another because they are touching is called **conduction**. Warmer bodies transfer their heat to the cooler bodies. As air is a poor conductor of heat, only the bottom meter of the atmosphere is heated by conduction. Conduction is more effective at transferring heat when it is combined with an eddying motion of the air (**convection**).

Either warm or cold air can be transported horizontally by wind. This process is known as **advection**. Over the same area, advection can occur at several levels simultaneously. At some levels, warm air may be affected; at other levels it may be the cold air. When affected air moves over a colder surface such as the land, ice, or water, heat transfer by conduction will take place. Warm air advection, that is, warm air moving over a colder surface, would result in **advection cooling** of the air.

At night, when radiation from the sun stops, the ground will continue to radiate its heat. The air near the surface will give up its heat to the colder earth by the process of conduction. Although this cooling of the air actually occurs due to conduction, as it is initiated by radiation losses from the ground it is called **radiation cooling**. Radiation cooling is effective only over land. Over water, heat is lost by radiation at night, but the surface temperature changes little. This is due to water's higher heat capacity and to the fact that cooler water becomes denser, sinks and is replaced by water that has not yet cooled.

Lifting Processes

Lift can result from unequal heating of the Earth's surface. Air which has been warmed becomes less dense than the surrounding colder air and rises. This lifting process is **convection**.

Lifting of the air might also occur if there is friction between the air and ground. This friction may disrupt the lower part of the airflow into a series of eddies termed **mechanical turbulence**. The effects of convection extend higher than the effects of mechanical turbulence.

A third cause of lift is some prominent topographical feature such as a range of mountains or a sloping plain. Lift that occurs under these conditions is referred to as **orographic lift**.

Another lifting process occurs in a situation similar to orographic lift. When air is forced upward by the slope of a cold air mass, the process is called **frontal lift**. Fronts will be discussed later.

When air near the surface accumulates in a region, the excess air is forced to rise. This phenomenon is usually associated with a low pressure area and is referred to as **convergence**.

Stability and Vertical Distribution of Temperature

Vertical motion cannot occur spontaneously. There must always be a lifting process in operation to initiate vertical motion, because the normal flow of air tends to be horizontal.

Rising air is cooled independently of the surrounding air. At any level then, three situations are possible: the temperature in the rising air could be colder, equal to, or warmer than that of the surrounding air. Differences in temperature are accompanied by differences in the air's density. Therefore, if a parcel of air is warmer than its surroundings, it rises; if colder, it sinks.

If rising air is cooled more quickly than the surrounding air, it will not continue to rise because it becomes denser than the surrounding air.

The air is stable when air that has been lifted is unable to continue to rise of its own accord. In other words, "stability" is the atmospheric resistance to vertical motion. Air in which vertical motion is prolonged is **unstable** air. Air in which vertical motion is resisted is **stable** air.

Some lifting processes (e.g. convection) merely act as trigger mechanisms. A parcel of air will continue to rise of its own accord only if the surrounding air is colder. Some lifting processes (e.g. orographic lift) persist to force air to rise. Thus, vertical motion can occur in stable air, although it is resisted.

Since stability of the air is dependent upon vertical distribution in temperature, the air may be very unstable, for example in the lower levels of the atmosphere, but stable above or vice versa. A large decrease of temperature with height indicates unstable air - there is colder air aloft which will tend to sink to the surface if the air is disturbed, while the warmer, lighter air of the lower levels will tend to rise.

Although temperature usually decreases with height, it may sometimes increase. This is an **inversion**. It may happen that for an ascent of several thousand feet, the temperature remains unchanged. Such a layer is called an **isothermal layer**. A small decrease of temperature with height, an isothermal layer, or an inversion is an indication of stable air. An inversion acts as a barrier to vertical motion. A lower level inversion can sometimes occur as a result of radiational cooling, warmer air moving over a colder surface (advection cooling) or warm air advecting over cold air.

Pressure and Wind

Pressure

Atmospheric pressure is defined as the force per unit area exerted by the air at a specific level. Generally, atmospheric pressure is expressed in **millibars (mbs)**. The average sea level pressure of 1.0 kg/sq cm is equal to 1,013 mbs or 101.3 kPa. Atmospheric pressure may also be expressed in inches of mercury (101.3 kPa = 29.92 inches of mercury).

The actual atmospheric pressure at the elevation of the observing station is call the **station pressure**. In order to compare the pressures recorded at stations having different elevations, the station pressures are adjusted to a common level. The level taken as a standard is **mean sea level (MSL)**. To adjust the station pressure to pressure at MSL, the station pressure is added to the weight of an imaginary column of air which is extended from the station level down to MSL The weight of this air column will depend on its temperature. This temperature is based on the average surface temperature for the past 12 hours. It is obvious that for any station located above sea level the adjusted pressure will always be greater than the station pressure. Station pressures are adjusted to MSL pressure for representing the pressure distribution on surface weather maps and for setting aircraft altimeters (pressure-sensitive instruments used to indicate the aircraft's height).

Horizontal Pressure Variations

To visually represent the variation in pressure across the continent, at any given time, lines called **isobars** are drawn. Isobars join points of equal MSL pressure. In Canadian weather offices, isobars are drawn only at 4 mbs intervals above and below the value of 1,000 mbs. It is often necessary to estimate the MSL pressure at a given point between recorded values.

Isobars on surface weather maps form pressure patterns which outline or enclose high and low pressure areas. A high pressure area, or a high, is a region of relatively high pressures with pressure values increasing towards the centre. A low pressure area, or a low, is a region of relatively low pressure with pressure values decreasing towards the centre. A low may also be called a cyclone. Hurricanes, typhoons, and tornadoes are all types of cyclones often associated with tropical areas. Lows are also commonly known as depressions. A high is sometimes called an anti-cyclone. While lows may vary in size, highs are almost always hundreds of kilometres in diameter.

Lows are characterized by rising air. When air rises it expands and cools. If moisture is present and the cooling of the air in a low pressure area continues long enough, the moisture will condense and cause cloud and sometimes precipitation. Thus, lows are often associated with cloudy weather.

Highs are characterized by descending air or **subsidence**. Subsidence compresses air which in turn heats it. When air is heated its RH decreases. As a result, high pressure areas are usually regions of clear weather.

The pressure patterns formed by isobars on a weather map are often asymmetrical, i.e. they may have bulges extending outward from their centres. A bulge in the side of a low pressure area indicates the presence of a **trough**, while one in the side of a high pressure pattern indicates a **ridge** of high pressure. Once a trough or ridge is known to be present, the actual trough or ridge can be located easily. A line is drawn extending from the centre of the pressure area outwards to the sharpest point in the bulge. This line is referred to as a trough or ridge line. Additional points which assist in locating troughs and ridges are:

1. Usually the most easily spotted ridges join highs, the most obvious troughs join lows;
2. Ridges and troughs must alternate;
3. Troughs and ridges vary considerably in shape and size - some are pronounced, others barely noticeable.

Since the amount of pressure change between isobars is always 4 mbs, and the space between isobars varies, it is obvious that the rate of change of pressure varies with horizontal distance. Rate of change of pressure with horizontal distance is called the **pressure gradient**. When isobars are closely spaced (a steep pressure gradient), a pressure change of 4 mbs occurs in a relatively short distance; and when the isobars are widely spaced the pressure gradient is called flat. Steep and flat pressure gradients may be described as deep or strong, and as shallow or weak, respectively. The pressure gradient is calculated, using a weather map, by measuring the perpendicular distance in kilometres between two adjoining isobars. The expression "4 mbs in 200 km" means that the pressure change of 4 mbs occurs over a 200 km distance. Pressure gradients are always expressed as 4 mbs in "X" km.

Note that almost the same terminology is used to describe pressure patterns as was used to describe pressure gradients. If the isobars are **closely** spaced: a low is termed **deep**; a high is termed **strong**. If the isobars are **widely** spaced: a low is termed **shallow**; a high is termed **weak**.

A low is said to be deepening when the central pressure is decreasing, i.e. the "valley" of low pressure is becoming deeper. As lows are associated with poor weather a deepening low would be associated with deteriorating weather conditions. A low is said to be filling when the central pressure is increasing. If the central pressure of a high is decreasing, it is said to be weakening. Conversely, when the central pressure of a high increase the high is said to be building. A building high is associated with improving weather conditions.

Weather reporting stations in most countries take hourly observations, including pressure readings. One of the reasons that pressure varies with time is that pressure systems vary in intensity. Other reasons are: pressure systems move; and there is a regular daily pressure variation. The rate of change of pressure with time is called the **pressure tendency**. Do not confuse this term with pressure gradient (rate of change of pressure with horizontal distance). Pressure patterns usually move. The upper level winds are generally westerly (from the west), thus pressure systems are likely to move west to east.

The observed pressure tendencies are valuable clues to movement of pressure patterns and thus general weather conditions. Before any conclusions can be drawn from them normal diurnal (daily) pressure variation or oscillation must be taken into account. Diurnal pressure fluctuations are due to a rhythmic expansion and contraction of the atmosphere caused by alternate heating and cooling. During a 24 hour period, there are normally two pressure minimums, recorded at approximately 4 AM and 4 PM, local time. Two pressure maximums are recorded at approximately 10 AM and 10 PM local time. Keep these diurnal pressure minimums and maximums in mind when studying observed pressure tendencies.

Wind

The horizontal movement of air is known as wind. Wind is caused by pressure differences in the horizontal. One of the factors which causes pressure variation in the horizontal is an unequal distribution of atmospheric temperature. Warm air rises, as it does cooler (thus denser) air flows in to take its place. The pressure gradient force starts the air moving directly from a region of high pressure to a region of low pressure. This moving surface air is immediately acted upon by two other forces. One force, the **Coriolis force**, is due to the Earth's rotation and causes the wind to change direction, so that the wind flows parallel to the isobars, with no loss of speed. In the northern hemisphere the wind is deflected to the right. This causes air to flow clockwise around a high and counterclockwise around a low. Since air, in most cases, flows parallel to the isobars, if you stand with your back to the wind in the northern hemisphere, the low would lie to your left. The second force is **friction**. Friction affects the speed and direction of the surface wind, and results from the air moving along the Earth's surface. The amount of friction is largely determined by the roughness of the surface. When air moves across the Earth's surface, friction acts on it to decrease its speed. Due to friction the lower level wind speed is frequently less than the speed indicated by the pressure gradient on a weather map. Friction also results in a change in wind direction. With surface winds, friction partially counteracts the Coriolis force and causes the air to then flow out of highs and into lows, crossing the isobars at angles ranging from 10°-45° and averaging 20°-30°. The greater the friction between the surface and the air, the greater the angle across the isobars will be. The angle will be smaller when the wind blows over water than land.

Wind direction is always named as the direction **from which** the wind is blowing. In meteorology, two methods for identifying wind direction are used: the points of the compass and 0° - 360° scale - you should be able to use both. Since wind direction identification must be as exact as possible, 16 point compasses are frequently used. Wind speed is measured in kilometres per hour (kph) or nautical miles per hour (knots).

Since pressure patterns are constantly moving and changing in intensity, winds frequently change direction. When wind makes a clockwise change, it is said to **veer**; a counterclockwise change is a **back**. For example, if a wind is blowing from the north (N) and then begins to blow northeast (NE), the wind direction has changed in a clockwise direction. Therefore, the wind is veering.

Diurnal changes in surface wind speed and direction may also occur as the result of daytime heating of the surface. The normal friction between the air and ground results in eddying motions or turbulence of the air. This turbulence is usually limited to the lower levels. If daytime heating is intense, the rising warm air will cause the turbulence to extend up to or above 3,000 ft. Over land on a hot summer day the winds tend to conform to the winds at the 3,000 ft. level. In making this change from its usual wind speed and direction, the surface wind will tend to veer and increase in speed. During the night, the surface cooling reduces the eddying motion of the air in the lower levels. The surface wind tends to assume its normal direction and speed, i.e. it backs and decreases in speed.

A **gust** is a relatively rapid increase in wind speed which lasts several seconds. Gustiness is associated with rapid changes in wind direction. Gusts are caused in two main ways: mechanical turbulence, and unequal heating of the Earth's surface.

A **squall** is another variation in lower level winds and is similar to gustiness. Squalls occur when wind speeds increase suddenly and maintain peak speeds for several minutes before diminishing. Therefore, the major difference between a gust and a squall is duration. Squalls, like gusts are frequently associated with rapid changes in wind direction as well as speed. The two principal causes of squalls are: thunderstorms and rapidly moving cold fronts.

Fronts and Frontal Weather

The transition zones between warm and cold air masses are called **fronts** or **frontal systems**. At every front, the warmer air rises up over the underlying wedge of the colder air mass. The transition zone separating the warm and cold air masses aloft is a **frontal surface**; at the surface it is simply a **front**. If the cold air mass is advancing, the front is called a **cold front**. If the warm air mass is advancing the front is called a **warm front**. If the cold air mass is neither advancing nor retreating the front is called a **stationary front**.

Referring to Figure 46, a comparison of the vertical distance ZX and the horizontal distance (to the surface position of the front) XY gives a measure of the steepness of the frontal surface ZY. This is called the **slope** and is equal to 3 km in 150 km or 1:50 in this example (which is the usual slope of a cold front). The diagram is not drawn to scale. This is the usual practice in representing frontal slopes and is done for clarity.

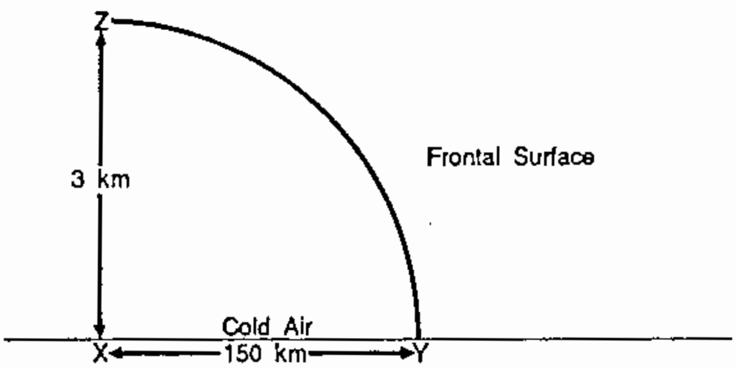


FIGURE 46. The slope of a cold front.

Due to the drag on the lower levels of the retreating cold air mass, a warm front tends to have a shallow slope. Warm fronts usually have such shallow slopes that they often make their effects felt far in advance of their surface position; and the changes in temperature and wind direction with the passage of a warm front are usually more gradual than those associated with the passage of a cold front. Although cold fronts tend to move more rapidly than warm fronts, they may be relatively slow or fast moving. In the case of cold fronts, the greater the speed of frontal movement, the steeper the slope.

The passage of a warm front over a given area will result in an increase in temperature. The passage of a cold front will generally result in a decrease in temperature. In the case of a cold front, the temperature change usually begins suddenly when the front reaches the area. The "front" is actually a "zone", often of considerable width and the first part of the cold air mass will have been warmed in the lower levels as a result of its passage over a warmer surface. Consequently, it may be many hours after the frontal passage before the temperature has dropped to the true value for the cold air mass. In the case of warm front, the temperature change may begin before the front reaches the area due to the proximity of the warm air to the surface as the depth of cold air over the area decreases.

Although a cold front usually brings decreased temperatures, for a short time, it may bring a slight increase before the drop. This may happen in the day when the cold air mass is much less cloudy than the warm air mass. Since cloud tops reflect incoming radiation, this results in more warming of the ground in the lower levels of the cold air mass than in the warm air mass. This slight increase of temperature accompanying the passing of a cold front occurs only at the surface not in the upper levels.

There is usually a change in wind direction when a front is crossed. On the ground, the wind shift usually occurs at the front. Air moves nearly parallel to the isobars. Thus as one passes through an approaching front (or it passes over), the wind shift occurs in a clockwise direction (a "veer"). If one passes from the air mass behind any front to the air mass ahead of it, the wind shift occurs in a counterclockwise direction (a "back"). Aloft, the wind shift occurs after passing through the frontal surface.

Pressure changes as follows when a front passes:

1. When a cold or warm front approaches the pressure falls, since fronts lie in troughs of low pressure;
2. When a cold front has passed there is a marked rise in pressure;
3. When a warm front has passed, the fall in pressure is more gradual or there may even be a slight rise in pressure.

Since warm air masses are able to hold more moisture than colder ones, the dew point will increase after the passage of a warm front, and decrease after the passage of a cold front. Table 4 summarizes the effects of the passage of fronts.

TABLE 4. The effect of the passage of fronts.

FRONT	TEMPERATURE	PRESSURE	DEW POINT
Warm	Increases	Drops as front approaches	Increases
	Change may begin before front passes	Drops more gradually or a slight rise as the front passes	
Cold	Decreases	Drops as front approaches	Decreases
	Hours before true value for air mass reached	Rises as front passes cold air mass	
	A slight rise possible before a drop over land during day if warm air mass is cloudy and cold air mass is clear	Rises as front passes cold air mass	

At a front, the colder air acts as an inclined plane that forces the warmer air to rise. This lift creates cooling which may produce cloud and precipitation. The severity of the weather created by the front depends on: slope, speed of the frontal movement, and the moisture content and stability of the lifted air (lifted warm air is behind the front in the case of a cold front, ahead in the case of a warm front).

A shallow slope tends to produce a wide area of cloud and precipitation. A steep slope tends to produce a narrow band of cloudiness and precipitation. Warm fronts tend to have shallow slopes and thus, a wide area of cloud and precipitation. In cold fronts, the greater the speed of the frontal movement, the steeper the slope. The slope of the frontal surface at a warm front is usually so shallow that most of the cloud and precipitation connected with the front will occur ahead of the surface front. In Figure 47, for example, Station A is getting precipitation long before the surface front arrives, while at Station B, just behind the front, the precipitation has already stopped.

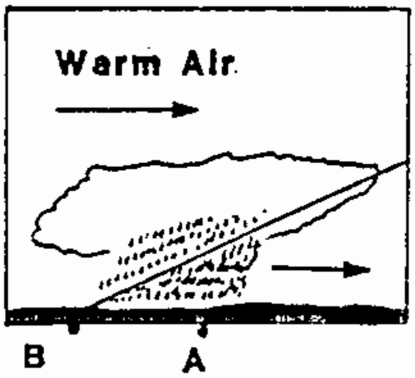


FIGURE 47. Cloud and precipitation associated with a warm front.

At a cold front if the warm air is: dry and stable there will be very little cloud but some irregular middle cloudlets or parallel rows of middle cloudlets are possible, and no precipitation; or moist and unstable there will be heap clouds and showery precipitation. The conditions listed will occur regardless of the moisture content or stability of the cold air.

When the warm air ahead of the front is moist and stable, the speed of the advancing cold front must be considered. Table 5 shows these conditions and the resulting clouds and precipitation. Table 6 shows the cloud and precipitation to expect ahead of a warm front under various conditions.

TABLE 5. The cloud and precipitation that result from warm and moist air with an advancing cold front.

CONDITION	CLOUD AND PRECIPITATION
Stable and the cold front is advancing slowly	Widespread layer clouds and intermittent or continuous precipitation
Stable and the cold front is advancing rapidly	A band of layer clouds and intermittent or continuous precipitation (not as wide-spread as with slowly advancing fronts).
Unstable and the cold front is advancing rapidly	A narrow band of low based cauliflower like clouds often preceded by a squall line.

TABLE 6. The cloud and precipitation to expect ahead of a warm front under various conditions.

CONDITION	CLOUD AND PRECIPITATION
If the warm air is dry and stable	No cloud or high or middle layer clouds, and no precipitation.
If the warm air is dry and unstable	No cloud or high or middle heap clouds.
If the warm air is moist and stable	Layer clouds. As the front approaches expect high isolated feathery clouds, then widespread high thin cloud, then a greyish-blue layer of middle cloud that may cover the entire sky, then a darker, i.e. thicker, layer of middle cloud which may produce rain.
	Continuous precipitation.
If the warm air is moist and unstable	As above plus low based cauliflower like clouds embedded in patches of grey/white rounded middle clouds and/or in low thin dull grey uniform sheet cloud which produce rain.
	Especially heavy precipitation beneath low based cauliflower appearing clouds due to additional showers.

Fronts can affect visibility as follows:

1. Cold fronts - usually bring improved visibility. The air behind the cold front will usually be unstable and vertical currents will carry pollution aloft.
2. Warm fronts - usually bring little change in visibility except that visibility is usually worse just ahead of the front due to fog and precipitation.
3. Warm and cold fronts which have recently passed over an industrial region - any part of an air mass which is both stable and has recently passed over an industrial region will be loaded with pollutants and thus have poor visibility.

Weather Phenomena

<u>Clouds</u>

Clouds are composed of water droplets or ice crystals. Clouds form as a result of air rising and being cooled by expansion until it reaches the condensation level. The condensation level is reached when the air temperature and the dew point are equal. The height of the cloud base will be determined by the condensation level. The actual moisture content of the air determines the dew point, and the degree to which the air is saturated determines the relative humidity. The smaller the spread between the air temperature and the dew point temperature, the higher the relative humidity. Note the terms used to denote the difference between air temperature and dew point: spread, dew point spread, and temperature-dew point spread.

Atmospheric stability helps determine the cloud form. You will recall that:

1. Stability refers to atmospheric resistance to vertical currents;
2. A large decrease of temperature with height, indicates unstable air;
3. A small decrease of temperature with height indicates stable air.

Strong vertical currents would indicate unstable air.

The top of the cloud will extend as far as the **vertical currents** in which the cloud forms. In stable air, vertical motion will cease when the lifting agency ceases to operate. In unstable air, vertical motion will cease only when the temperature of the rising air reaches equilibrium with the temperature of the surrounding air although the agency which started the lift may not operate that far. Occasionally, an inversion will exist, that is, the temperature will increase rather than decrease with height. Vertical currents tend to be blocked by an inversion.

Precipitation

Precipitation is the collective name for moisture in the liquid, supercooled and solid forms that falls from the atmosphere. The type of precipitation which will be encountered is partially determined by the form of the moisture in the cloud, that is:

1. Liquid - water droplets;
2. Supercooled - water droplets liquid at temperatures below freezing but freezing on impact;
3. Solid - water droplets that have frozen into ice or ice crystals forming directly from water vapour.

Table 7 lists the common types of precipitation and gives their meteorological definitions.

TABLE 7. Types of precipitation and their definitions.

TYPE	DEFINITION
Drizzle	Precipitation in the form of very small droplets of water which appear to float.
Freezing drizzle	Drizzle which freezes on impact with objects.
Snow grains (Frozen drizzle)	Very small white opaque grains of ice.
Hail	Lumps of ice generally showing concentric layers of clear and opaque ice.
Snow	White or translucent ice crystals usually of branched hexagonal or star-like form, frequently interlocked to form large flakes.
Rain	Precipitation in the form of water droplets larger than drizzle.
Freezing rain	Rain that freezes on impact with objects.
Ice pellets	Transparent or translucent pellets of ice (frozen rain) that are spherical or irregular. They usually bounce when hitting hard ground and make a sound on impact.

Clouds form as a result of condensation (the process by which water vapour becomes liquid) or sublimation (the process by which water vapour changes directly into a solid). The same cloud may be formed by condensation in its lower levels, sublimation in its upper levels, and a combination between. Cloud particles which form as a result of condensation/sublimation are very small and usually remain suspended in the atmosphere. In cloud formed by condensation in very stable air, there is little vertical motion to sustain the small cloud droplets and they may escape and drift to earth. This type of precipitation is called drizzle. When the vertical motion associated with the cloud is stronger, the cloud droplets may be too small to escape and must grow to overcome the vertical currents before they can fall. Cloud particles can grow by two methods: the ice crystal process and the collision process.

The **ice crystal process** occurs in a cloud composed of both supercooled water droplets and ice crystals. Evaporation takes place from the droplets, and the resulting water vapour sublimates on the crystals. When this structure has become sufficiently heavy, it falls. The ice crystals may or may not melt during descent. The ice crystal process occurs in temperatures below freezing.

Water droplets may grow by colliding with other water droplets. This is particle growth by **collision.** Growth of cloud particles by collision is not restricted to water droplets. Ice crystals or mixtures of droplets and crystals may also join. Vertical air currents cause the particles to collide and assist in the growth of the clouds by carrying water vapour to higher altitudes. The stronger the vertical currents, the higher the cloud tops and the better the chance of forming precipitation size particles by collision.

For drizzle to occur there must be very stable air and small water droplets. For other types of precipitation there must be vertical currents (therefore, vertically thick clouds), and interaction of ice crystals and water droplets, or collision of cloud particles to form larger ones.

There are some clouds which do not precipitate. If the air is very cold (less than -40°C), there will be too little moisture to form precipitation. High clouds, because they form at extremely high altitudes (greater than 6 km) and, therefore, at temperatures well below freezing, do no precipitate. If clouds are small in volume, they will not be able to hold enough moisture for precipitation to occur.

The manner in which precipitation falls is described in one of three ways: continuous, intermittent, and showers. **Intermittent** or **continuous** precipitation falls from clouds formed in stable air. If there are significant variations in the water content of the cloud in the horizontal, or there is evaporation on descent, intermittent precipitation will fall. **Showers** fall from clouds formed in unstable air. During intermittent precipitation, the sky remains overcast between precipitation periods, and the area of precipitation is vaguely defined or indistinct. During showery precipitation, the sky brightens in between precipitation periods, and the area of precipitation is sharply defined. Except for hail and snow pellets, any precipitation type named without the term shower will be assumed to be non-showery, that is, intermittent or continuous.

The intensity of precipitation (light, moderate, or heavy) refers to the rate of accumulation over a given area. Only thick clouds produce precipitation at any intensity.

Precipitation can change its state as the temperature of its environment changes. Solid forms of precipitation will melt during descent if they fall into air with temperatures above freezing. Complete melting may or may not occur. Consider these situations:

1. When snow falls from a level having temperatures less than freezing into a level having a temperature less than freezing, it will arrive on the ground as snow.

2. When snow falls from a level having temperatures less than freezing into a level having above freezing temperatures, it will arrive on the ground as rain or mixed rain and snow.

3. Hail falling into levels above freezing will arrive as hail, since normally, only partial melting occurs.

4. Rain or drizzle falling into a level having below freezing temperatures will arrive as supercooled drops/droplets which freezes on impact. This type of precipitation is called freezing rain or freezing drizzle.

5. Rain or drizzle falling through a deep layer of atmosphere having below freezing temperatures (i.e. extended exposure) will freeze during decent and arrive as frozen particles, ice pellets in the case of rain and snow grains in the case of drizzle.

Modifications of precipitation during descent are not only due to vertical distribution of temperature, but also to variation in the moisture content in the vertical. Precipitation (liquid, solid or supercooled) when falling into clear dry air below the cloud may evaporate before reaching the ground.

Fog

Fog is a cloud which lies on the surface. Like a cloud, fog is composed of water droplets or ice crystals.

For fog to form, condensation must occur. Condensation will normally begin, provided there are sufficient condensation nuclei when the air is saturated. Condensation may be the result of cooling air to below its dew point or raising the dew point to above the air temperature through the addition of water vapour.

Turbulence

Turbulence may be divided into two categories: that initiated by friction and that initiated by thermal means.

Turbulence may result from friction between the air and ground. The following affect the strength and extent (the height to which turbulence reaches) of the turbulence:

1. The stability of the air - the more unstable the air, the higher the turbulence extends;
2. The roughness of the ground - the rougher the surface, the greater the friction and the greater the degree of turbulence;
3. The strength of the wind - the stronger the wind, the greater the friction and the greater the degree of turbulence.

A visual indication of turbulence resulting from friction between the air and the ground may be provided when loose material such as sand or snow is on the ground.

While turbulence may result from friction between the air and the ground, it may also result from friction between opposing air currents. This type of turbulence occurs when there is a strong wind shear, that is, a drastic change of wind speed and/or direction with distance. If a report of high level winds indicate a large increase of wind speed within a short distance then turbulence will probably be present.

Convection currents (vertical currents caused by unequal heating of the Earth's surface) are a form of thermal turbulence. The strength and extent of convection currents are affected by the stability of the air and by the degree of difference in heating. Considering that the degree of difference in heating affects the strength and extent of convection, and that the strength of the currents increases as the surface heating increases, the conditions under which thermal turbulence would be most pronounced, are in summer and during the afternoon. The strength and distribution of convection currents are affected by the nature of the Earth's surface as well as by diurnal and seasonal heating variations. Land heats faster than water, similarly, barren surfaces such as sandy or rocky wasteland and ploughed fields heat faster than ground covered by vegetation. Thus, variations in the composition of the surface result in uneven heating of the air near the ground causing convection currents to vary in strength within short distances.

Another form of thermal turbulence is the turbulence caused by cold air advection (i.e. cold air moving over warmer water or land). Heating from below creates an unstable condition which favours convection and therefore, turbulence.

The stability of the air largely determines the height to which vertical currents will extend. It can also be stated that the stability of the air will largely determine the height to which turbulence extends. Turbulence, therefore, will usually be most pronounced when the air is unstable.

When fog is present, the air is probably stable and therefore not turbulent. The amount the temperature decreases with height is a direct indication of the stability of the air. A large decrease in temperature with height would be associated with most pronounced turbulence. Under inversion conditions (increased temperature with height) vertical air movement is blocked, therefore the air is relatively stable and is probably not turbulent. Clouds may also indicate the stability of air. Clouds of vertical development would be associated with more pronounced turbulence. If cloud bases are about the same, more pronounced turbulence can usually be associated with a cloud of greatest vertical extent. Precipitation, and the manner in which it falls, may also be an indication of whether or not turbulence is present. The larger the particles, the stronger the vertical currents and, therefore, the greater the possibility of turbulence being present. Hail would indicate the possibility of turbulence. Rain falling with constantly changing intensity (heavy, then light) would suggest the greatest amount of turbulence.

Thunderstorms

The conditions which are necessary for cloud formation must be present for thunderstorms to develop:

1. High moisture content;
2. Some lifting agent to set the air in motion;
3. Condensation nuclei.

While only a few clouds of vertical development become thunderstorms, all thunderstorm clouds are clouds of vertical development. Consequently, thunderstorms only develop in conditions suited to cloud formation and vertical cloud development. Unstable air provides these conditions. Few cumulus clouds develop into thunderstorms. They do so only when the conditions necessary for vertical cloud development are sufficiently intense.

It is common for thunderstorms to develop in clusters, the individual thunderstorm "cells" being at various stages in their development and separated by a considerable amount of connecting cloud. The greater the number of cells in a thunderstorm, the greater the potential severity of the storm.

When the cloud particles (droplets, hail, ice crystals) within the cell become heavy enough, they overcome the effect of the up-drafts and fall. When precipitation finally starts to fall, the particles drag some of the air downward with them, thus initiating the downward flow of air which, once started, is accelerated by the instability of the air.

The down-drafts strengthen and spread, interfering with the upward movement of air and thus causing the up-drafts to weaken. This process continues until no more air is being fed up into the cloud. Precipitation at this stage will gradually stop. This is the dissipating stage of a cell and is characterized by an anvil-like cloud structure at the top of the cloud.

Even though the cool air in the down-draft is heated during descent, it is still relatively cool when it reaches the surface. Thus, the surface air temperature will start and continue to drop with the initiation of rainfall.

Wind direction changes also occur during a thunderstorm. As the first down-drafts develop, cold air spreads out along the surface, undercutting the warmer air which, at this stage, is still moving in and producing up-drafts. The friction between the opposing air currents causes shifts in wind direction which occasionally reach destructive force.

Thunderstorms are classified on the basis of the specific situation in which they form since this will determine the distribution and the time of occurrence and dissipation of a particular storm.

Types of Thunderstorms

Thunderstorms are usually classified as **frontal** or **air-mass thunderstorms**. The frontal type is caused by warm, moist air being forced over a wedge of cold air. This lifting may occur with warm fronts or cold fronts.

Warm-front thunderstorms are likely to be the least severe of frontal thunderstorms because of the shallow slope of the warm front surface. Surface wind conditions in the cold air wedge beneath the warm front may be unaffected by the thunderstorm.

Cold-front thunderstorms are generally more severe and occur in a more or less continuous line. Their bases are normally lower than those of other frontal thunderstorms.

Thunderstorms occurring along a squall line are similar to those along a cold front, but may be even more severe. Heavy hail, destructive winds and tornadoes are usually associated with **squall-line thunderstorms.**

Air-mass thunderstorms are usually scattered without an apparent pattern but occasionally occur in clusters or follow geographic features which contribute to their formation. Air-mass thunderstorms can be further classified as **convective** or **orographic** depending on the lifting process involved in their formation.

Convective thunderstorms occur as a result of increased air mass instability. They can be produced by any of the following processes acting singularly or in combination:

1. Uneven heating of the Earth's surface by the sun.
2. Advection of warm air at the surface and/or advection of cold air at high altitudes.
3. Advection of cool, moist air over a warmer surface. The surface can be land or water.

Remember that the surface temperature of large bodies of water have little if any diurnal variation. Therefore thunderstorms formed by cool air advection over warm water can occur at night and early morning until the land is heated at the source region to a temperature above that of the water. Also, due to the greater availability of moisture over water, thunderstorms can be more closely packed over water than over land.

Orographic thunderstorms develop when moist, unstable air is forced up mountain slopes. They tend to be more frequent during the afternoon and early evening because heating from below aids in the lifting process. Storm activity is usually scattered along the individual peaks of mountain ranges, but occasionally there will be a long unbroken line of thunderstorms.

If convergence is occurring in the air mass it will enhance any convective or orographic lifting.

High-level or Dry Thunderstorms

The lifting process may be orographic, convergence, cold-air advection aloft, or a combination of these, often aided by surface heating over mountain ranges. High-level thunderstorms occur most frequently in the mountainous West and prairies during the summer months. Their distinctive feature is that their cloud bases are so high, often above 15,000 ft., that precipitation from high-level thunderstorms is totally or mostly evaporated before it reaches the ground.

APPENDIX 9: APPLICATION BOSS'S CHECKLIST

Pre-Spray

approval of airstrip/helipad
correct amount of pesticide ordered
delivery of pesticide
- when, where, how
- storage
  - berm requirements
  - containment
- off-loading requirements
- secure location chosen

mixing/loading capabilities/set-up
equipment check
- tanks
- pumps
- lighting
- weather system
- water supply quality/quantity
- rinsing set-up
- agitation
- meters calibrated
- training
- radio
- safety equipment

disposal
- pesticide containers
- rinsates

fuel
- quantity/type
- set-up
- delivery
- training
- measuring
- contamination testing

calibration
- equipment required
- rates/block
- payload capacity verification
- swath width checks
- droplet deposition check

Spray Operations

forms completed
safety conscious
calibration check
inventory
- pesticide
- fuel

Post Spray Session

forms complete, accurate and legible
equipment clean up
equipment secure
inventory
- pesticide
- fuel

Post Spray Project

rinsate dispensed
equipment clean up
equipment inventory
forms complete, accurate and legible
disposal of pesticide containers

APPENDIX 10: AERIAL SPRAYING EQUIPMENT CHECKLISTS

Plumbing Equipment

quick couplers, 2",3"
part A adaptor, 2",3"
part B coupler, 2",3"
part C coupler, 2",3"
part D coupler, 2",3"
part E hose shank adaptor
part F adaptor, 2",3"
reducer bushings, 3" X 2"
reducer couplers, 3" X 2"
reducer T, 3" X 2" X 3"
nipples, 2",3"
strait elbows
drybreak - male
 - female

valves - ball c/w spare handles
 - gate, 2", 3"
 - foot, 2"

galvanized dust plug
galvanized dust cap
galvanized pipe, 10' X 3"
hose - wire braided intake, 2", 3"
 - discharge, 2",3"

manifolds, distribution
inline strainer
spare strainer baskets

Major Equipment

weather equipment
water truck
trailers
truck, c/w Hiab loader
fuelling equipment
flowmeter
generator
lighting units
Laakos separator
pumps
pesticide mixing unit
tanks - plastic, 9,000 L
 - plastic, 3,600 L
 - plastic, 1,800 L
 - fuel

Miscellaneous Equipment

hazard lights
blowback unit
jacks and blocks
booster cables
bung wrenches
wind sock c/w frame
portable air compressor
hurri tents
dye stuffs
wire brushes
fuel and oil supplies
teflon tape
hand cleaner
sample bottles (e.g. 100 mL Nalgen)

stand pipe
hose clamps
fog nozzles
barrel sling (for Hiab)
flashlights
extension cords
kem towels
batteries
silicone
steel wool
masking tape
electrical tape
duct tape

bottle brushes
wobble pumps
mico pumps
spark plugs
funnels
chain saw kit
rope - 3/8" nylon
sash cord #10, roll
wire-stovepipe, roll
22 L gas cans
barrel washer
L.C. meter spare parts
 - gaskets
 - strainer baskets

Tools

socket set (imperial, metric)
nut-driver set (imperial, metric)
screw driver set
combination wrench (imperial, metric)
chain wrench (imperial, metric)
pliers - standard, needlenose
hammers - ball pein, claw, sledge
band-it tools and clamps
vice, 6" jaws
crowbar
carpenter level
shovels
calibrated containers
- 20 L pail, 1-2 L measuring cups, etc for measuring smaller quantities

power bar
allan key set
pipe wrench
hacksaw and blades
wire cutters
tins snips
chisels and punches
vice grips
utility knife
step ladder
axes
garden rakes

Aircraft Calibration Equipment

calibrated drum (to check flow meter)
flowmeter
calibrated containers (pails)
- 20-25 L (2 L increments)
- 2 L
- 0.5 L

calculator
stopwatch
dye stuffs (optional)
kromekote cards (optional)
tape measure, 30 meters (optional)
adding machine tape (optional)

APPENDIX 11: BULK OPERATIONS EQUIPMENT

Tanks

Description (see Figure 48):

- 9,000 L capacity, weight 226.5 kg (available in 4,500 L) seamless (rotationally moulded) polyethylene available in assorted colours, normally white
- Fittings, 2" NPT removable PVC adaptor bulkhead fitting
- Lids, PVC 45 cm diameter, self venting

Comments:

- For minor repairs, use silicone or plastic welding
- Some white tanks currently in use may have the sign "2,000 Imp. Gals", the actual capacity is "2,000 U.S. Gals"
- Place on chipboard sheets to avoid puncture from stones, etc.
- NOTE: **Lids may not provide a water tight seal**

WARNING: Tanks are prone to movement by gusty winds. Store upright, do not store on their sides.

Table 8 (p 216) shows system components used for mixing/loading during spray operations.

Fittings

Fittings used for mixing/loading during spray operations are depicted in Table 9 (p 219).

- Cover fitting threads (male with teflon tape clockwise). Ensure there are no loose pieces of teflon tape, these may plug the meter filters
- When attaching fittings to bulk tanks, the bulkhead fittings will expand from extensive use. Therefore use a close nipple with its slightly tapered threads which can be made to maintain a good seal at the bulkhead.

NOTE: Certain combinations of fittings should not be attempted, the cam-locks on all couplers, (B, C & D) must have room for the levers to extend fully in order to open. Example: use close nipples as spacers for (1) bulk tanks; and (2) ball valves

2" or 3" Intake Hose

- Wire braided
- Handle carefully to avoid kinks in the hose
- Refer to section on Equipment Maintenance and Storage Standards 2" or 3" Discharge hose
- Thin walled
- Refer to section on Equipment Maintenance and Storage Standards

WARNING: handle carefully when charged to avoid pinching fingers

18 hp Pump, Gorman Rupp

- 3" F adapter on inlet and outlet

WARNING: exhaust hazard, secure a 15 cm diameter piece of galvanized duct pipe to act as an exhaust chimney

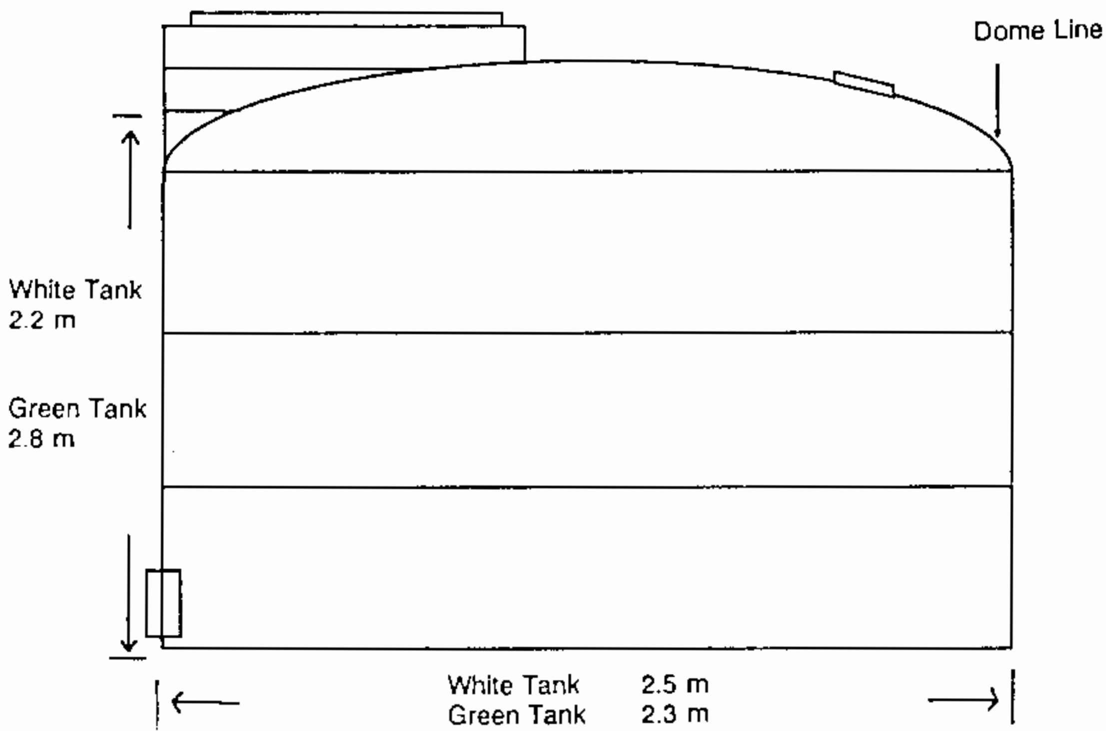


FIGURE 48. Storage tank.

Honda 5 hp Pump, GX 140 Motor

- Equipped with 3" port reduced to a 2" F adapter for both intake and outlet
- Avoid excessive use with insufficient prime (i.e. draining residual pesticide from the tank)
- Hearing protection required while operating pump

WARNING: Ensure that the two plastic clean-out plugs have been replaced with brass plugs

L.C. Meter

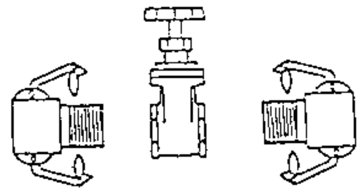
- Refer to sections of Operation and Equipment Maintenance and Storage
- Use storage container as a platform
- Protect meter head when not in use
- Equipped with 2" F adapter on both inlet and outlet
- Ensure slow initial flooding of meter to prevent hydraulic shock
- When reassembling meter tighten screws on cover plates a little at a time to prevent warping

Manifold

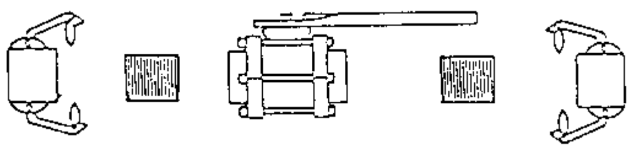
- 2" and 3" F adapter fittings
- 3" inlet port (1)
- 2" outlet (8)
- Cap unused port with dust caps

TABLE 8. System components.

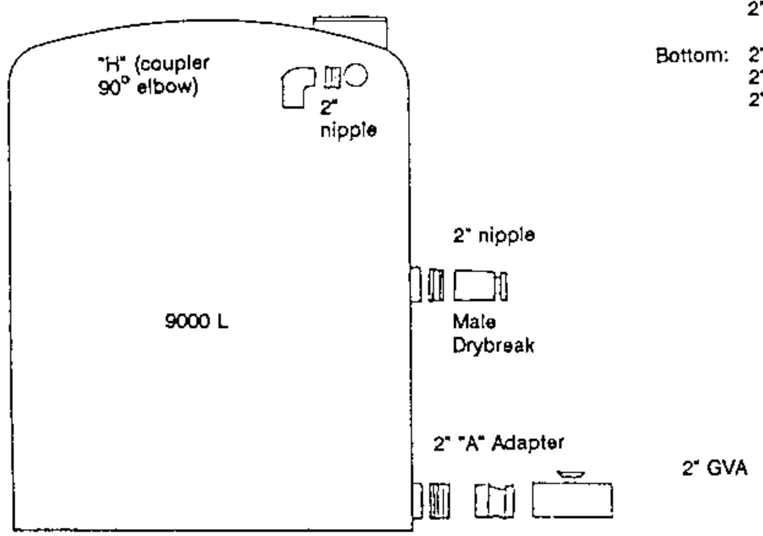
SYMBOL	SYSTEM	COMPONENTS
(A) GVA	Gate System Assembly	2 or 3" B Coupler + 2 or 3" Gate Valve + 2 or 3" B Coupler



SYMBOL	SYSTEM	COMPONENTS
(B) BVA	Ball Valve Assembly	2 or 3" D Coupler + 2 or 3" Close Nipple + 2 or 3" Ball Valve + 2 or 3" Close Nipple + 2 or 3" D Coupler



SYMBOL	SYSTEM	COMPONENTS
(C) TA	Tank Assembly	Top: 2" Close Nipple + 2" H Coupler X 90 Middle: 2" Close Nipple + 2" Male Drybreak Bottom: 2" Close Nipple + 2" A Adapter + 2" GVA



SYMBOL	SYSTEM	COMPONENTS
(D) 3 X 2 T	3" X 2" X 3"	All openings with 2/3" F Adapter

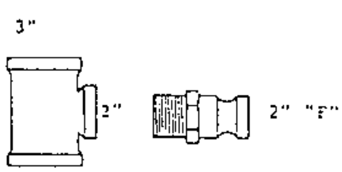
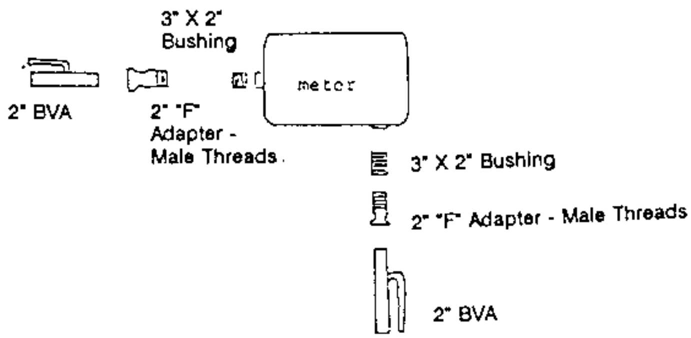
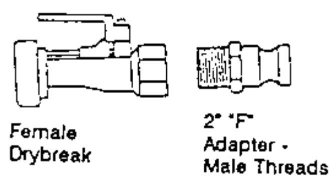


TABLE 8. System components (continued).

SYMBOL	SYSTEM	COMPONENTS
(E) Meter	L.C. Meter Assembly	Intake: 2" BVA+ 2" F Adapter + 3" X 2" Bushing + L.C. Meter Discharge: 3" X 2" Bushing + 2" F Adapter + 2" BVA



SYMBOL	SYSTEM	COMPONENTS
(F) DA	Drybreak Assembly	2" F Adapter + 2" Female Drybreak



SYMBOL	SYSTEM	COMPONENTS
(G) 18 Hp Pump	18 Hp Pump Assembly	Intake: 3" GVA + 3" F Adapter + 18 Hp Pump Discharge: 3" F Adapter + 3" GVA

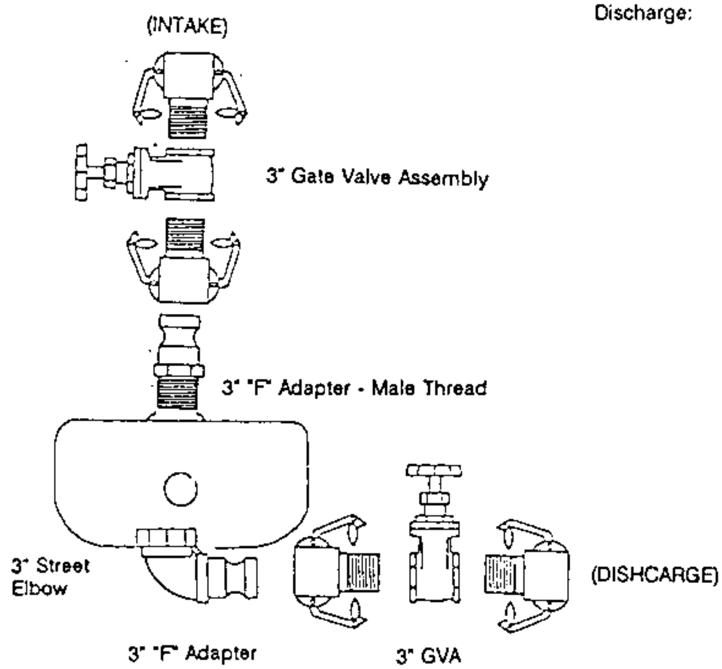
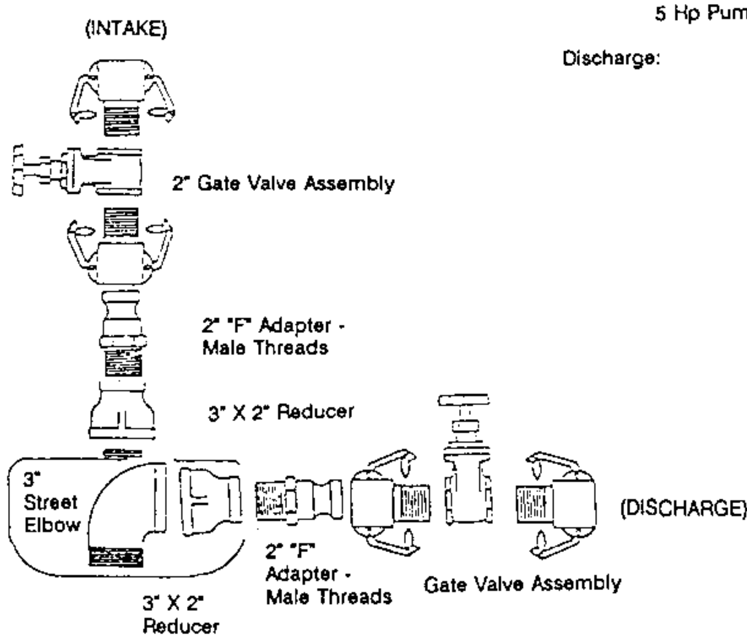


TABLE 8. System components (continued).

SYMBOL	SYSTEM	COMPONENTS
(H) 5 Hp Pump	5 Hp Pump Assembly	Intake: 2" GVA + 2" F Adapter + 3" X 2" Reducer + 5 Hp Pump Discharge: 3" X 2" Reducer + 2" F Adapter + 2" GVA



SYMBOL	SYSTEM	COMPONENTS
(I)	Manifold Assembly	Intake: 3" F Adapters + Manifold Discharge: 8, 2" F Adapters

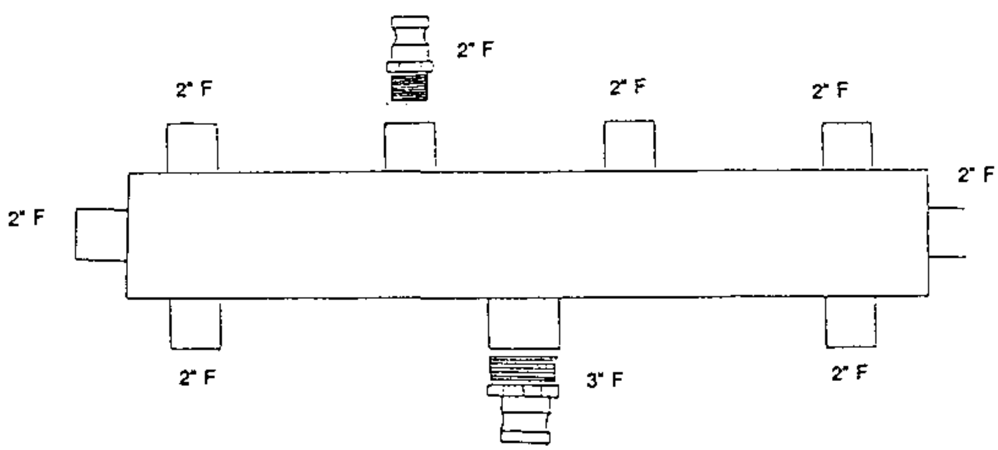


TABLE 9. Fittings used for mixing/loading during spray operations.

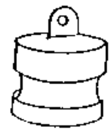
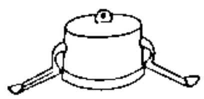
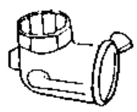
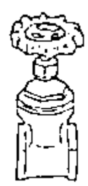
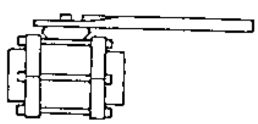
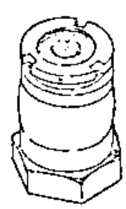
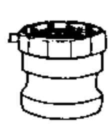
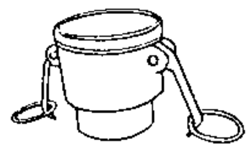
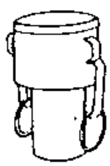
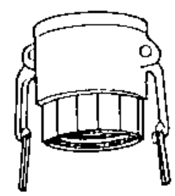
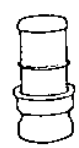
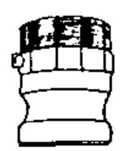
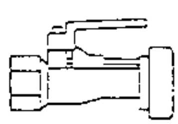
TYPE	DESCRIPTION	COMMENTS
2" or 3" Dust Plug		- plug for coupler fittings (male)
2" or 3" Dust Cap		- fits adapter fittings (female)
2" H Elbow		Coupler X Female NPT - 90° - H Elbows include checkvalve
2" or 3" Gate Valve		- check for metal fittings
2" or 3" Ball Valve		- ensure that ball valve handle has sufficient room to open to maximum
Male Drybreak		- inlet valve for aircraft, referred to as 'buckeye' fitting
2" or 3" A		Adapter X Female NPT

TABLE 9. Fittings used for mixing/loading during spray operations (continued).

TYPE	DESCRIPTION	COMMENTS
2" or 3" B		Coupler X Male NPT - fasten down Kam-Locks to prevent accidental release
2" or 3" C		Shank Coupler - lubricate with oil when attaching to hose - fasten down Kam-Locks
2" or 3" D		Coupler X Female NPT - fasten down Kam-Locks
2" or 3" E		Shank Adapter
2" or 3" F		Adapter X Male NPT
Female Drybreak		- compatable with male drybreak - protect against dust - attached to 2" F adapter to form 'drybreak assembly'

APPENDIX 12: EQUIPMENT MAINTENANCE AND STORAGE STANDARDS

Ministry equipment employed in pesticide operations is an expensive and vital resource. Proper use, maintenance and storage of equipment is essential for the success of spraying operations. Project Supervisors should ensure that field maintenance is carried out on equipment under their control in accordance with the procedures described in this appendix. These basic maintenance and storage procedures can be carried out by project staff in the field. Detailed instructions can be obtained from operator's manuals which should be available at each project. Major maintenance or repairs should be performed by qualified mechanical staff.

Compressor - Portable

<u>Daily</u>

- Clean thoroughly
- Check oil, engine and compressor crankcase
- Tighten loose nuts and bolts
- Check belts

<u>Weekly or 50 Hours</u>

- Clean thoroughly
- Purge tank by taking pressure up to maximum and releasing drain petcock
- Change engine oil
- Check compressor crankcase oil
- Tighten loose nuts and bolts
- Check belts
- Check, clean and regap spark plug
- Check and clean air and fuel filters

<u>Pre-storage</u>

- Clean thoroughly
- Change engine and compressor crankcase oil
- Drain all fuel from engine, fuel line, filter and tank
- Check and clean air filter and spark plug
- Pour 10 cc engine oil through spark plug hole and replace spark plug
- Pull recoil a few times to lubricate cylinder
- Tighten loose nuts and bolts
- Tag unit to indicate pre-storage maintenance is complete
- Store in dry place

NOTE: Refer to operator's manual for detailed instructions. Major maintenance or repairs of compressors should be performed by qualified mechanical staff.

Couplers - Quick Connect

<u>Pre-storage</u>

- Flush thoroughly with water
- Clean with bottle brush or wire brush
- Inspect for visible damage
- Dip in Diluent 585 or diesel fuel
- Dry thoroughly
- Check seal in female couplers

Drybreaks

<u>Pre-storage</u>

- Flush thoroughly with water or Diluent 585 or diesel fuel
- Scrub
- Inspect for visible damage
- Dry thoroughly

Eyewash Station

<u>Pre-storage</u>

- Drain water tank
- With air compressor types, drain air tank
- Clean thoroughly with bleach if there is an algae build-up
- Store in clean dry place, with lid removed

Fire Extinguishers

<u>Pre-operation</u>

- Fire extinguishers must be inspected and tested annually by a qualified technician

<u>Pre-storage</u>

- Clean thoroughly
- Inspect for visible damage
- Ensure inspection tag is attached to extinguisher
- Store in clean dry place

Fuel Equipment - Delivery Hose

<u>Pre-storage</u>

- Clean thoroughly
- Drain and dry completely
- Check for visible damage
- Protect exposed threads
- Roll, avoiding kinks
- Store in clean dry place

NOTE: All aviation fuel equipment is to be returned to Regional Aviation, Flood and Fire Management Centres for maintenance and storage.

NOTE: Detailed instructions are found in the AFFM Fuel Manual.

Fuel Equipment - Dispensing Pump

<u>Daily</u>

- Clean thoroughly
- Check engine oil
- Check for leaks
- Clean air filter
- Tighten nuts and bolts

<u>**Weekly or 50 Hours**</u>

- Clean thoroughly
- Check engine oil
- Check for leaks
- Check and clean air and fuel filters
- Check and regap spark plug

<u>**Pre-storage**</u>

- Clean thoroughly
- Drain all aircraft fuel from pump
- Change engine oil
- Drain all fuel from engine, fuel line, filter and tank
- Check and clean air filter
- Check, clean and regap spark plugs
- Pour 10 cc engine oil through spark plug hole and replace spark plug
- Pull recoil start a few times to lubricate cylinder
- Check recoil start
- Tighten loose nuts and bolts
- Protect exposed threads
- Tag unit to indicate pre-storage maintenance complete
- Store in clean dry place

NOTE: Refer to operator's manual for detailed instruction. Major maintenance and repairs should be performed by qualified mechanical staff.

Fuel Equipment - Filter Systems

<u>**Daily**</u>

- Clean thoroughly
- Drain water
- Inspect for visible damage
- Replace filters as required

NOTE: Operating and detailed instructions are found in the AFFM Fuel Manual (current edition).

<u>**Pre-storage**</u>

- Clean thoroughly
- Drain water
- Replace filters
- Inspect for visible damage

Fuel Equipment - Storage Tanks

<u>**Pre-storage**</u>

- Tanks should be purged and inspected by a certified fuel equipment contractor

Generators

<u>**Daily**</u>

- Clean thoroughly
- Check engine oil
- Tighten loose nuts and bolts

Weekly or 50 Hours

- Clean thoroughly
- Change engine oil
- Tighten loose nuts and bolts
- Check and clean air and fuel filters
- Check, clean and regap spark plug
- Check recoil starter rope
- Check bolts

Pre-storage

- Clean thoroughly
- Change engine oil
- Drain all fuel from engine fuel line, filter and tank
- Check and clean air filter
- Check and clean spark plug equipment
- Pour 10 cc engine oil through spark plug hole and replace spark plug
- Pull recoil a few times to lubricate cylinder
- Check and clean fuel filter
- Check recoil starter
- Tighten loose nuts and bolts
- Tag unit to indicate pre-storage maintenance is complete
- Store in clean dry place

NOTE: Refer to operator's manual for detailed instructions. Major maintenance or repairs should be performed by qualified mechanical staff.

Hose - Discharge

Pre-storage

- Flush thoroughly with water, Diluent 585 or diesel fuel
- Drain and dry thoroughly
- Inspect for visible damage to hose and couplers
- Install thread protectors on exposed threads
- Store flat, out of sunlight, in clean dry place

Hose - Intake

Pre-storage

- Flush thoroughly with water, Diluent 585 or diesel fuel
- Drain and dry thoroughly
- Inspect for visible damage to hose and couplers
- Install thread protectors on exposed threads or join male and female ends
- Store flat, out of sunlight, in clean dry place

Laakos Separators

Operation

- Mount securely on post in a vertical position
- Install common water tap on bottom end
- Connect two inch hoses from water supply and to mix unit
- Support all hoses to prevent damage to separator

Daily

- Periodically open tap on bottom to allow sediment to drain out

Pre-storage

- Rinse thoroughly with water
- Drain and dry thoroughly
- Store the plastic model in clean dry place
- Store the carbon steel model in Diluent 585 to prevent rusting; tag unit when it is loaded; open with caution to prevent spillage of the Diluent 585

L.C. Meters

To ensure easy operation/manoeuvrability the L.C. meter should be placed on a stand. The blue storage boxes, when turned upside down, are ideal for this purpose.

Calibrating

The L.C. meters should be calibrated before each project, using the material that is to be sprayed. The calibration should be checked throughout the spray project.

All L.C. meters come equipped with an adjuster. Discrepancies or deviations between volumes registered on the meter counter and actual volumes delivered can be corrected with the adjuster. To calibrate the meter:

1. Using a small flat-headed screwdriver remove the adjuster cover plate (Figure 49, #1). It is the plate on which the L.C. emblem is located.

2. Read and record the setting indicated on the adjuster (Figure 50), adjuster housing (Figure 49, #2).

3. Pump a large volume (about 2,000 litres) of liquid through the meter into a prover or container of known volume (tanks or barrels). **NOTE: To ensure precise calibration a large volume of liquid is imperative.** Metric or imperial measurements may be used, as the adjustment is expressed as a percent of the original volumes.

4. Record the deviation of volume indicated on the register (Figure 49, #8) and the volume in the container.

5. Determine percent deviation of registered volume from actual volume. You may use the following formula:

   $$\frac{\text{(volume on meter counter - volume in container)}}{\text{(volume on meter counter)}} \times 100$$

   = Percent to increase or decrease adjusted by

   Example: Assume the adjuster setting at the start of the test reads 2.05. Product is run through the meter until the counter registers 1,000 L. Assume the container shows a volume of 987 L. This error should be changed to percent. In this case the error is 1.3%. In this example, the volume in the container was short so you would add the 1.3 to the 2.05 original setting. The final setting will be 3.35. Conversely, if the volume in the container exceeded the volume registered on the counter, the percent error would be subtracted from the original adjuster setting, in this case 1.3 (i.e. from 2.05 to 0.75).

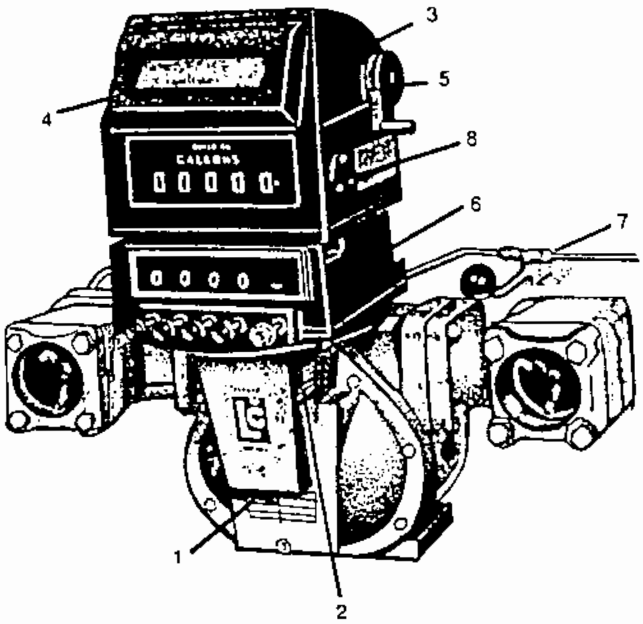


FIGURE 49. L.C. meter.

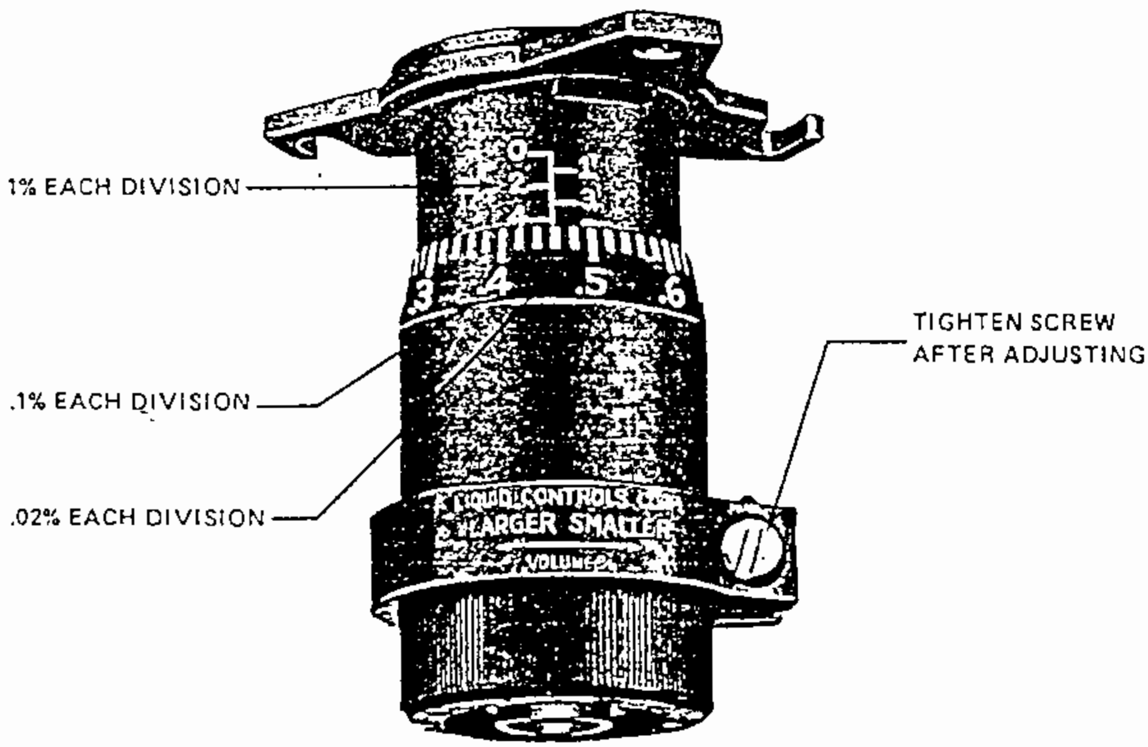


FIGURE 50. Calibration adjuster.

6. Loosen the adjuster clamp screw (Figure 50). Reset the adjuster to the proper setting. NOTE: **When setting the adjuster, always approach the number desired from a larger number.**

   Example: Desired adjuster setting is 2.6 - turn the adjuster thimble to the right to reach the number 3, then to the left to obtain the 2.6 setting.

7. Tighten screw on clamp (Figure 50) after adjustment has been made.

8. Check adjustment by following steps 2, 3 and 5.

9. Continue the process until the container volume and the counter volume are within ± 1 or 2%.

Operation (see Figure 49)

Strainers

L.C. strainers come in various mesh sizes. The size you use will depend upon the viscosity of the pesticide you are spraying. A 40 mesh strainer would be used for pesticides with a B.t. type viscosity, whereas an 80 mesh strainer would be used with herbicide type viscosities.

Meter Head

Before storage the L.C. meter head was turned 45° counter clockwise. This allowed for proper placement in the meter storage box. Before operation the head should be turned back to its operating position. Follow the procedures outlined in **Turning Meter Head** starting on page 235.

Load Ticket

Prior to filling a spray aircraft a load ticket is inserted in the L.C. ticket printer (3) to record pertinent load information.

1. To insert load ticket lift the ticket slot cover (4) and insert the ticket as far as it will go. If ticket does not enter because the sealing pin is blocking the slot, turn crank (5) one complete revolution clockwise until internal stop is reached and crank is straight down (two clicks will be heard). This procedure lifts the sealing pin to permit insertion of ticket.

2. When the ticket is in the ticket slot, turn the crank one complete turn clockwise until internal stop is reached (one click is heard). The printer is now ready for delivery.

Printer Register

The first four buttons from the left to right on the preset counter (6) are used to select the volume of liquid being moved. The counter is capable of measuring tenths of a litre. The maximum setting is 9999.9 litres.

Set the desired volume by depressing the preset keys. The digit above the key pressed decreases by one number with each depression.

Liquid Flow

1. To start liquid flow open the lever arm (7). To avoid having air compressed in the meter cavity, which will damage the internal systems, open the lever arm very slowly, particularly during initial operation.

2. Control the rate of flow by the rpm of the pump motor.

The digits on the preset counter (6) decrease as the liquid flows indicating the remaining amount to be transferred before the meter will shut off. The digits on the meter register (8) increase while the meter is in operation, indicating the total volume moved.

The L.C. meters have a two stage shutdown feature. When 30 litres remains to be transferred, the arming lever (7) will shut down one step slowing the delivery rate. The arming lever will shut down completely, stopping the liquid flow, when the delivery target is reached.

Shutdown

1. To stop the delivery mid-stream push the red stop button (the button farthest to the right) and keep it depressed until the arming level (7) is completely closed.

2. To retrieve the load ticket and to reset the counter (6) to zero turn the crank one complete revolution clockwise until internal stop is reached and the sealing pin is unlocked (two clicks will be heard). Do not try to force the ticket free.

When the sealing pin is unlocked the load ticket should be easily removed. Withdraw the ticket.

Removal

If the meter has to be removed for servicing a by-pass line can be installed. If this does occur the graduations on the aircraft hopper will have to be used to determine the amount delivered.

Preventive Maintenance

Inline Strainer

All liquids flow through the inline strainer prior to entering the meter head. The meter will not operate with a plugged strainer. New or repaired piping can be a source of welding slag or other foreign material that block or rupture the strainer. The strainer should be cleaned following each spray session.

The periodic cleaning of the strainer requires opening of a pressure containing component by the operator. **Before disassembly of the strainer basket ensure that all internal pressures are relieved.** Pressure must be at 00 PSI. To relieve the pressure build-up ensure the valves at the meter intake are closed and open the lever arm.

To clean the strainer (Figure 51, p 229)

1. Remove basket cover screws (2) and washers (3) with a 3/4 inch socket. Each screw should be loosened a little at a time to prevent warping the cover.
2. Remove basket cover (1), seal ring (4) and cover gasket (7). Be careful not to damage the seal ring or gasket.
3. Remove the strainer (5) and clean. Do not tap basket ends on hard surfaces to dislodge foreign matter. Water, Diluent 585, diesel fuel, or compressed air can be used to remove any foreign material. The filter cavity should be cleaned using a bottle brush.
4. Replace strainer, cover gasket, seal ring and basket cover.
5. Replace and tighten screws and washers.

Environmental Protection

If a meter is exposed to a difficult environment (i.e. dust, blowing sand, rain) ensure the ticket printer, preset counter and adjuster mount are covered.

Pre-storage Maintenance

Purpose

Through normal use with herbicides and insecticides chemical build-up, corrosion and salting-out may occur within the L.C. Meters. It is essential to thoroughly clean each meter following each spraying season. This will keep the meters in their best working condition. The following maintenance and storage procedures can be carried out by project staff in the field.

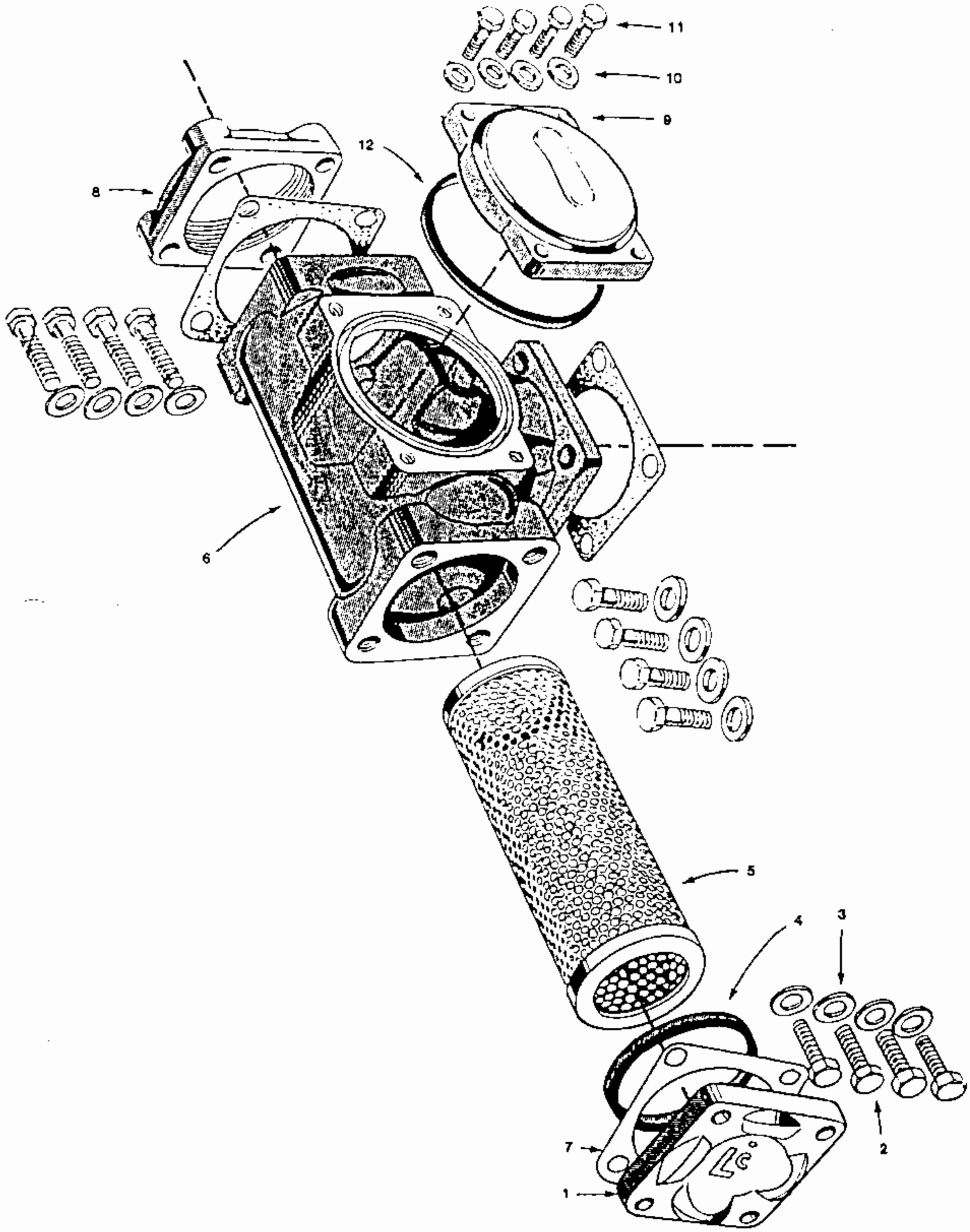


FIGURE 51. F-15 strainer assembly.

Required Equipment

Socket - 3/4 inch
- 9/16 inch

Ratchet
Open-end/box-end wrench - 7/16 inch
- 1/2 inch

Allan key
T-shaped allan key (optional)
Bottle brush
Steel wool pad
Wire brushes - both large and small

Recommended Spare Parts

Cover gaskets (parts #40862)
Basket cover gasket (parts #40871)
Valve cap gasket (parts #40738)
40 mesh strainer (parts #A3430)
80 mesh strainer (parts #A3431)

Spare parts should be on hand prior to the commencement of spray operations.

WARNING: **Before disassembly and/or inspection of any meter or accessory components that are connected to a pumping system all internal pressures must be at 00 (zero) PSI. To relieve the pressure build-up ensure the valves at the meter intake are closed and open the lever arm.**

Disassembly

Valve assembly (Figures 52 and 53, p 231)

1. Release the valve linkage from the meter head by freeing the ball joint (Figure 53; #1) from the trip ring.
2. Using a 3/4 inch socket remove the screws (2,3) and washers (1) from the valve cap (4).
3. Carefully pull lever rod (Figure 52; #2) This will cause the piston spring (6) to push the piston assembly partially clear of the housing (6).
4. Ease the piston assembly from the housing (8) by pulling the valve cap (4) away from the housing. It may be necessary to work one side at a time.

Rear Cover and Bearing Plate (Figure 54, p 232)

1. For access to the rear bearing plate (8) and housing (9) remove rear cover screws (3) and washers (4). They will require an allan key or a 1/2" open-end/ box-end wrench. A T-shaped allan key enables easy removal of allan screws.
2. Remove rear cover (6). It may be necessary to use a small flat head screwdriver to pry the rear cover free.
3. Remove rear bearing plate screws (5) and washers (5a) using a flat head screwdriver.
4. There are two notches on the bearing plate that accept screwdrivers. These will enable removal of the bearing plate without damage to the rotors. Gently pry the plate loose one side at a time.

Strainer (Figure 51, p 229)

1. To remove strainer remove basket cover screws (2) and washers (3) with a 3/4 inch socket. Each screw should be loosened a little at a time to prevent warping of the basket cover.
2. Remove basket cover (1) and seal ring (4), and gasket (7).
3. Remove strainer basket (5).

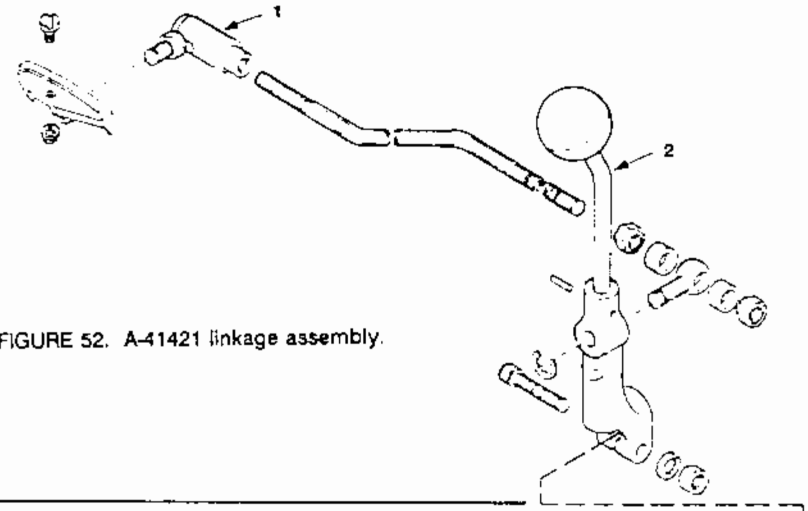


FIGURE 52. A-41421 linkage assembly.

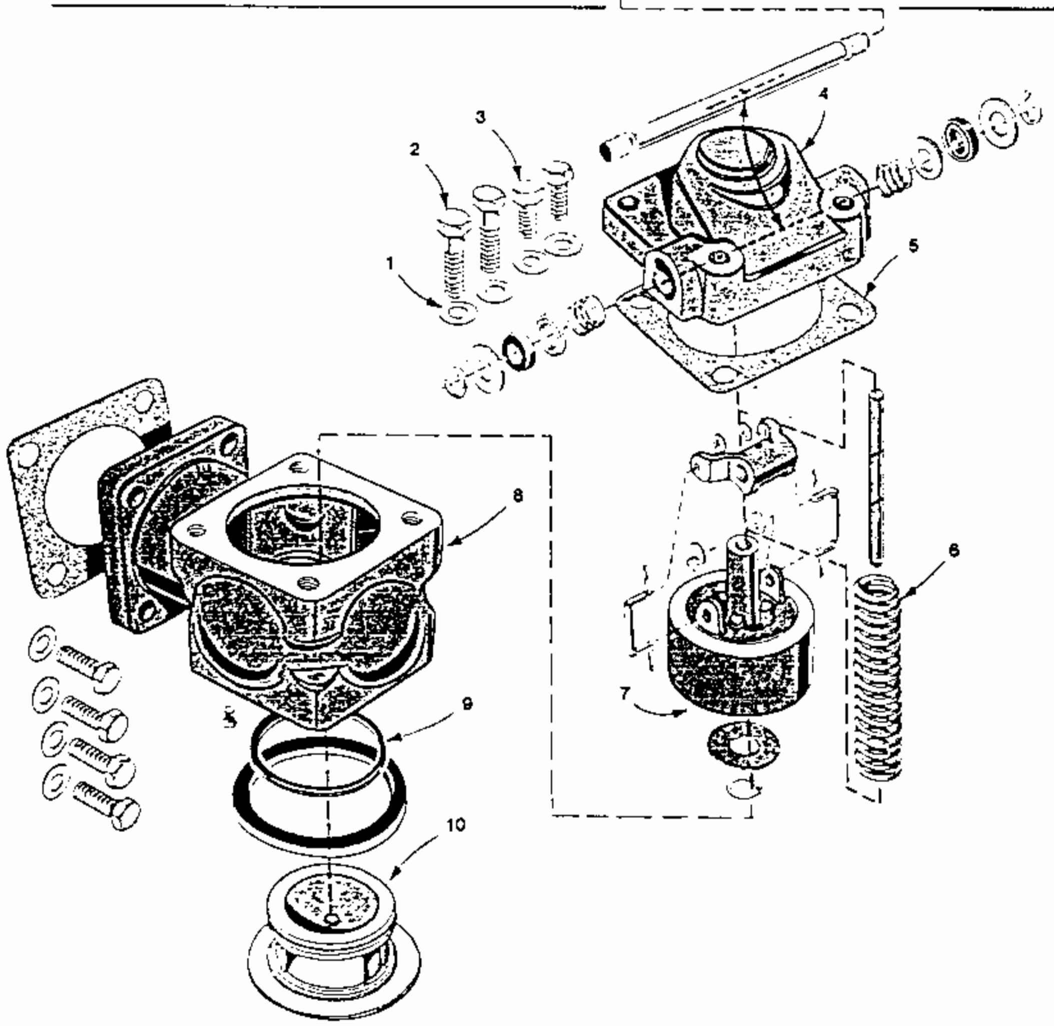


FIGURE 53. A-3620 valve assemblies.

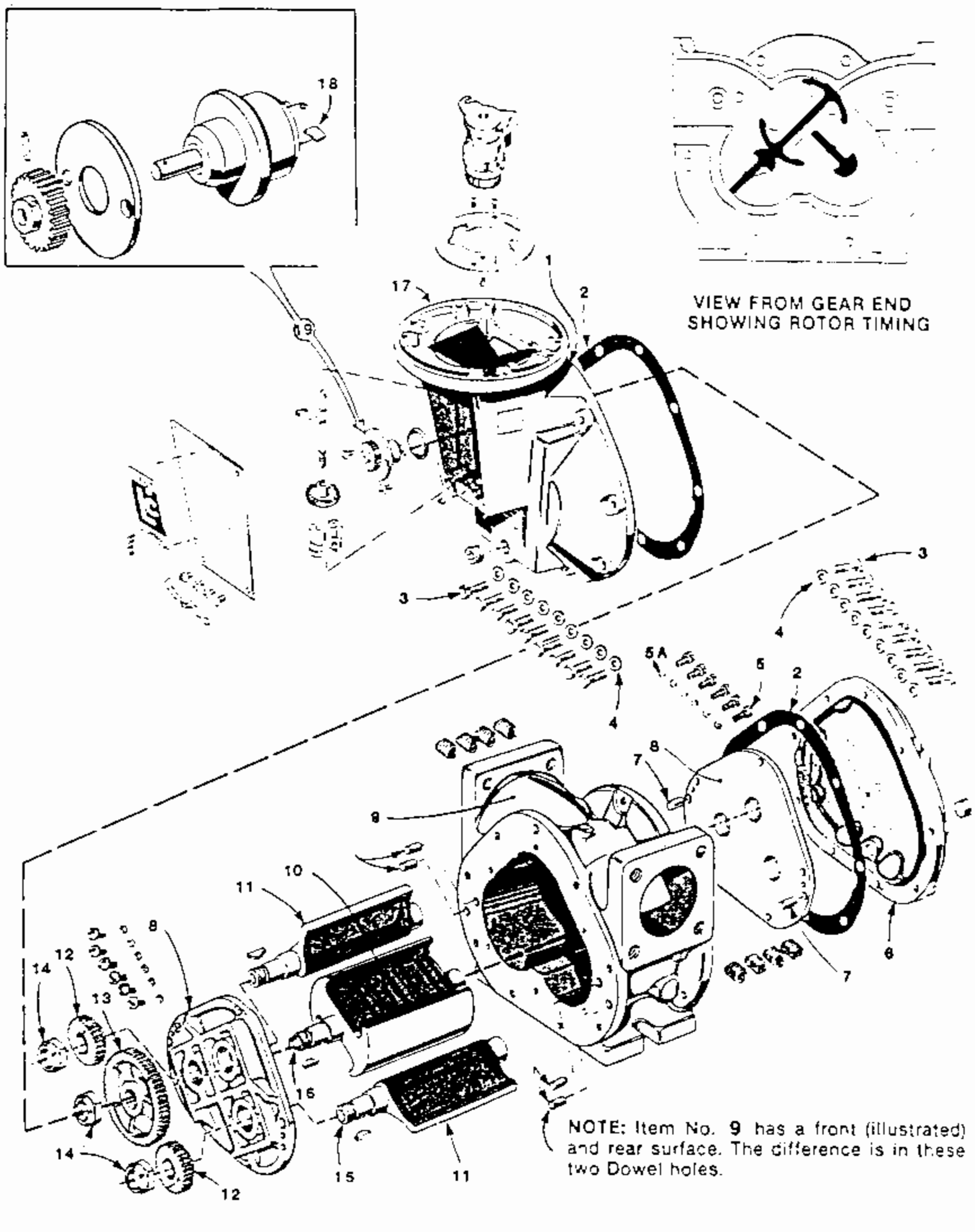


FIGURE 54. M-15 meters assembly No. M-3620.

Counter-End Cover and Meter Head (Figure 54, p 232)

1. To remove the counter-end cover (1) an allan key or box-head wrench will be needed.
2. The two bottom screws may be hard to reach. A combination of an open-end wrench and screwdriver or allan key and box-end wrench will be helpful for leverage.
3. Remove the cover screw located at the back of the counter-end cover last. Make sure the meter head is supported because the front cover may fall free as soon as the last screw is loosened.
4. If the front cover and meter head do not fall loose a small flat head screwdriver may be needed to pry them from the housing. Make sure the head is supported.
5. To prevent seepage of water into the preset and counter housings, cover the meter head with a plastic bag.
6. Lay the meter head and front cover down being careful of the present buttons.

Cleaning (see Figure 54, p 232)

1. To avoid water damage, ensure that the ticket printer, preset counter, and adjuster mount (17) are covered.
2. Hose down all internal parts and all removed parts until clean.
3. Flush the area between the rotor gears (12,13) and the front bearing plate (8).
4. The filter cavity of the strainer should be cleaned using a bottle brush. Do not tap basket ends on hard surfaces to dislodge particles. Water, Diluent 585, diesel fuel or compressed air can be used to remove any foreign material.
5. A steel wool pad and a wire brush may be necessary to free the rotor-end shafts (15,16) and lock nuts (14) of salt build-up and rust.
6. Clean the grooves on the rotor gears with a small wire brush. Foreign matter builds up in these grooves and may cause the gears to seize.
7. Dry all parts.

Inspection (see Figure 54, p 232)

1. Check for corrosion paying particular attention to the rotor-end shafts (Figure 54; #15,16). Keep records of any parts that are only slightly corroded. Change any parts that are badly corroded following instructions given in the "M15 Parts List and Installation Manual."
2. Check for worn or broken parts. Replace when necessary.
3. Replace any damaged or worn seal rings and gaskets.
4. Ensure that rotor gears (Figure 54; #10, 11) move freely. If they do not then foreign matter, somewhere in the assembly, is blocking rotation. Locate the source of trouble and remove it.

Reassembly

Valve Assembly (see Figures 52 and 53, p 231)

1. Ensure that the upper seal ring (9) is in good condition and is in place on the piston guide (10).
2. Ensure that the valve cap gasket (5) is in place.
3. Work the piston (7) onto the guide (10). To get the valve cap close enough to the housing (8) to replace the screws and washers, it may be necessary to compress the piston spring (6) using the lever arm (Figure 52; #2)
4. Tighten all screws.

Rear Cover and Bearing Plate (see Figure 54, p 232)

1. Reconnect the rear bearing plate (8) using the screws (5) and washers (5A).
2. Replace the rear cover (6) making sure the gasket (2) is in place.
3. Tighten all screws (3) and washers (4).

Counter-End Cover and Meter Head (see Figure 54, p 232)

1. To reconnect rear cover and meter head, first ensure that the wing (18) on the packing gland assembly (19) is positioned to fit the notch in the blocking rotor-end shaft (16). The two can be turned horizontal for smooth insertion.
2. Ensure the cover gasket (2) is in place.
3. Insert the housing dowels (7) into the front housing holes as a guide for proper line-up.

Strainer (see Figure 51, p 229)

1. Insert strainer basket (5) into housing (6).
2. Replace basket cover (1), gasket (7) and seal ring (4).
3. Replace and tighten screws (2) and washers (3). Tighten screws a little at a time to prevent warping the cover.

Meter Storage

Before a meter is stored it should be filled with Diluent 585 or a comparable oil to prevent corrosion as well as possible ice damage from moisture that was overlooked after cleaning. To do this:

1. Drill two holes in opposite corners of the blue meter storage box to provide drainage if the meter leaks.
2. Ensure that the meter is properly sealed. There should be an assembly consisting of a 3" x 2" NPT bushing, a 2" 'F', and a 2" dust cap on the meter inlet (Figure 51, p 229; #8) and on the meter outlet (Figure 53, p 231; #8).
3. Turn the meter head to ensure proper placement in the meter box. Follow the procedure outlined in "Turning Meter Head" page 235.
4. Place the meter in its box.
5. Remove the strainer cover plate (Figure 51, p 229; #9) using a 9/16" socket.
6. Carefully fill the strainer basket with Diluent 585. A transfer pump may be used. This process should be repeated three or four times. This is to allow the Diluent to settle in between fill ups and to ensure that the entire meter is filled.
7. Replace the strainer cover plate (Figure 51, p 229; #9) and tighten the screws (Figure 51; #11) and washers (Figure 51; #10). Make sure the seal ring (Figure 51; #12) is in place.
8. Tag the meter as serviced and fill with diluent.

If problems should arise that are not covered in this manual consult the "M-15 Meter Parts List and Installation Manual." When ordering parts from the meter parts list use the part numbers for the M-3260 Class 6 model. When ordering parts from the strainer parts list refer to A-3311. Most parts can be ordered from (allow up to six weeks for delivery):

RNG Equipment
32 Stoffel Drive
Toronto ON
M9W 1A8
Phone: (416) 249-7383
Fax: (416) 247-2973

Replacement lids for the blue cartpak storage boxes can be ordered from:

Buckhorn Material Handling Products Inc.
7612 Bath Road
Mississauga, Ontario
L4T 1L2
(416) 678-6545

<u>**Turning Meter Head**</u> (see Figure 55)

1. For storage, release the valve linkage from the meter head by freeing the ball joint (Figure 52, p 231; #1) from the trip ring.
2. Remove all four 7/16 bolts (1) with the wrench provided. The bolts hold the meter head to the mounting flange (2).
3. Without lifting meter head, turn both meter and trip ring 1/4 turn (45 degrees) (Figure 56) counter-clockwise for storage and clockwise for operation.
4. Replace all four bolts. Make sure the same holes in the flange are used.
5. For operation, attach the trip ring to the ball joint (Figure 52, p 231; #1).
6. Meter is now ready for storage or operation.

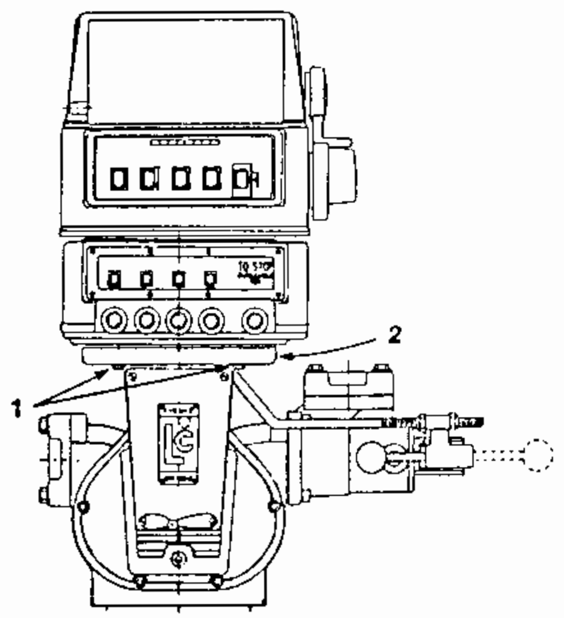


FIGURE 55. Meter head mounting screws.

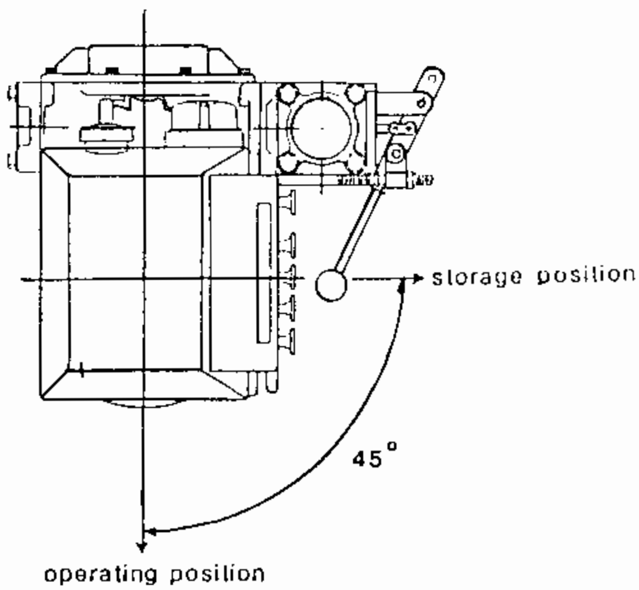


FIGURE 56. Meter head operating/storage position.

Lights - Hazard, Strobe, Quartz

<u>Pre-storage</u>

- Clean thoroughly
- Test to ensure proper operation
- Remove batteries
- Check cords for visible damage
- Store in clean dry place

Manifolds

<u>Pre-storage</u>

- Flush thoroughly with water
- Rinse with Diluent 585
- Coat inside with light film of oil
- Store in clean dry place

Pumps - Loading (3 h.p. - 18 h.p.)

Daily

- Clean thoroughly
- Check engine oil
- Check and clean air filter
- Tighten nuts and bolts

Weekly or 50 Hours

- Clean thoroughly
- Change engine oil
- Check and clean air and fuel filters
- Tighten nuts and bolts
- Check, clean and regap spark plug
- Clean battery terminals

Pre-storage

- Flush thoroughly with water
- Clean thoroughly
- Change engine oil
- Drain fuel from engine, filter and tank
- Check and clean air and fuel filters
- Check, clean and regap spark plug
- Place 10 cc oil in spark plug hole and replace spark plug
- Pull recoil start a few times to lubricate cylinder
- Remove drain plug and drain water from pump
- Store drain plugs in tool box
- Tighten nuts and bolts
- Remove battery, grease battery terminals, store off floor and in warm place
- Tag unit to indicate pre-storage maintenance is complete
- Store in clean dry place

NOTE: **Refer to operator's manual for detailed instruction. Major maintenance or repairs should be performed by qualified mechanical staff.**

Pumps - Transfer (Mico, Wobble)

Pre-storage

- Flush thoroughly with water
- Drain and dry thoroughly
- Inspect hoses for visible damage
- Tape exposed threads

Radio Equipment

Pre-storage

- Clean thoroughly
- Remove batteries
- Return to Regional Communications Lab for maintenance

Tanks - Storage

<u>Pre-storage</u>

- Flush thoroughly with water
- Drain and wipe inside
- Replace manhole covers and inlet caps
- Store away from direct sunlight if possible

Trailers

<u>Pre-operation</u>

- SHOULD BE PERFORMED BY QUALIFIED MECHANICAL STAFF
- Check licence and registration
- Check lights
- Check and lubricate wheel bearings and axles
- Check tires and pressure
- Check hitch and safety chains
- Check brakes and connector

<u>Pre-storage</u>

- Clean thoroughly
- Lubricate wheel bearings
- Jack up and block trailer
- Remove wheels and store in clean, dry place
- Wrap brake system in garbage bags to protect from condensation

NOTE: Maintenance of individual components such as pumps, generators, tanks and meters should be performed in accordance with procedures.

Weather Station

<u>Pre-storage</u>

- Clean all components thoroughly
- Remove batteries
- Place all components in shipping containers
- Store in clean dry place

Valves - Ball

<u>Pre-storage</u>

- Flush thoroughly with water
- Clean with bottle brush
- Inspect for visible damage and broken handle
- Rinse with Diluent 585 or diesel fuel
- Dry thoroughly
- Store in clean dry place

Valves - Gate

Pre-storage

- Place valve in open position
- Flush thoroughly with water, Diluent 585, or diesel fuel
- Scrub with wire brush or bottle brush
- Inspect for visible damage
- Dry thoroughly
- Store in clean dry place

APPENDIX 13: AIRCRAFT SPECIFICATION

The following data (Tables 10 and 11) are based on the best information currently available and from conversations with spraying contractors. Since aircraft and spray technology changes and improves, you should consult the contractor for specific current data on his aircraft and spray system prior to project start up.

TABLE 10. Fixed wing aircraft specifications.

MAKE OF AIRCRAFT	WING SPAN (m)	TOTAL LENGTH (m)	HEIGHT (m)	FUEL TYPE	FUEL CAPACITY (litres)	FUEL CON-SUMPTION (L/hr)	FERRY SPEED (km/hr)	WORKING SPEED (km/hr)	WORKING PAYLOAD (litres)
Cessna Ag Husky	12.70	8.08	2.49	100 LL	204	68	170-177	170-177	400-700
Cessna Ag Truck	12.70	7.90	2.49	100 LL	204	68	170-177	170-177	500-800
Cessna Wagon	12.80	7.90	2.49	100 LL	200	65-70	190-195	180	400-600
Snow Commander	13.50	8.63	2.69	100 LL	416	132	153-177	153-177	1,100
Piper Pawnee B	11.03	7.52	2.19	100 LL	159	50-55	160-177	160-177	350-400
Piper Pawnee C	11.00	7.53	2.13	100 LL	144	50-55	160-170	160-177	350-400
Piper Pawnee D	11.00	7.53	2.13	100 LL	146	50-57	160-170	160-177	350-400
Piper Super Brave	11.58	8.38	2.20	100 LL	324	75	150-185	193-200	650-800
Grumman Ag Cat A & B (450)	12.90	7.30	3.50	100 LL	242	83-91	100-185	153-169	700-800
Grumman Ag Cat C (600)	12.80	7.98	3.35	100 LL	303	127	100-190	160-185	700-900
Grumman Turbo Cat	12.95	10.08	3.68	Jet A	303	180	195-200	195-200	700-900
Grumman King Cat	12.80	9.14	3.48	100 LL	303-432	132	200	170-202	700-900
Air Tractor	13.70	9.00	3.00	100 LL	204-475	132	265	209-233	1,000-1,500
Thrush S-2R Piston	13.54	8.59	2.79	100 LL	378	132	177	153-177	1,000-1,300
Thrush S-2R Turbo	13.50	10.00	2.50	Jet A	719	207	209	209	900-1,440
PZL M18	17.70	9.50	3.70	100 LL	741	189	193	193	1,000-1,800

TABLE 11. Helicopter Specifications

MAKE OF AIRCRAFT	WING SPAN (m)	TOTAL LENGTH (m)	HEIGHT (m)	FUEL TYPE	FUEL CAPACITY (litres)	FUEL CON-SUMPTION (L/hr)	FERRY SPEED (km/hr)	WORKING SPEED (km/hr)	WORKING PAYLOAD (litres)
Bell 47 G2	10.71	12.62	2.83	100 LL	155	57	128	up to 128	170-200
Bell 47 G4	11.32	13.3	2.84	100 LL	216	75	128	up to 128	200-220
Bell 47 G5	11.32	13.3	2.84	100 LL	216	68	139	up to 130	200-240
Bell 206 B	10.15	11.83	2.90	Jet A	340	288	209	128-209	380-400
Bell 212	14.69	17.46	3.91	Jet A	814	378	168	96-130	1,300-1,500
Sikorsky S55	16.15	18.96	4.06	100 LL	700	108-208	130	up to 130	800-850
Hiller Uh-12E	10.8	12.41	3.08	100 LL	174	82	144	up to 144	170-200
Hughes 500	8.03	9.24	2.59	Jet A	242	91	224	up to 230	400-410

APPENDIX 14: MICRONAIR INFORMATION[17]

Droplet Size

To Select Correct Fan Blade Angle

1. Refer to the droplet size graph (pp 247, 251 and 253) and read off the appropriate atomizer speed required to produce the desired droplet size, (i.e. 80 micron corresponds to about 7,000 rpm).

2. Refer to the graphs of rpm versus airspeed (pp 245, 246, 249, 250, 254 and 255) Ensure that the graphs are appropriate for the fan blades being used. Identify the line on the graph corresponding to the nearest blade angle at the required flow per atomizer and read off the blade angle.

3. Set the fan blades on all atomizers to this angle (as described below) and carry out a check of the actual droplet size deposited on the crop. If necessary, the blade angle should be adjusted to achieve the optimum size.

The information in the graphs and tables is based on tests carried out using water in temperate conditions. It should be noted that the procedure outlined is only a very rough guide for obtaining a selected droplet size. Various factors such as temperature, humidity, type of chemical being applied, evaporation rate of material, flying height, etc. all have a considerable bearing on the droplet size finally deposited. It is recommended therefore, that droplet size checks be carried out in the particular area where the work is being undertaken, using, if possible, the mixture to be sprayed.

Assess the droplet pattern by spraying over slides, sensitive paper or a sheet of glass placed in the field and making a visual assessment of the deposit.

TO ADJUST BLADE ANGLE (Figure 57)

Slacken the five bolts (4) on the clamp ring (22), twist blades to the required angle by aligning the graduation mark on the blade boss with the appropriate graduation on the clamp ring. When the five blades are set, tighten bolts evenly until the blades are just nipped and check that blade angles have not altered. A gap of about 0.010 inches should remain between the faces of the clamp ring and hub. The bolts should not be over tightened to a point where the two faces meet. This would indicate that serious stresses are already present within the blade roots and added loads, imposed during operation, would likely cause blade failure.

A final check on the correct tightening of the clamping bolts is that it should be just possible to move the blades by hand after all five bolts have been evenly tensioned. To simplify the setting of blades and avoid the stamping of marks on the clamp ring, all Micronair atomizers will, in due course, be fitted with blades that have pips moulded into the root of the blade. The pips represent blade angles when set on the split line of the hub, as shown in Figure 57 (top drawing). These new blades (with pips) can be used with the old hubs (angles stamped on clamp ring) provided the split line is used as a reference and the angles are ignored. Stocks of the earlier blades can be used if small marks or nicks are placed in the boss of the blade at the same location as the pips. For convenience, the part numbers of the blades have not been changed as they are inter-changeable with one exception - the blades carrying a single pip cannot be used on hubs without angle settings unless the blade boss is marked, as described, to take the place of the pips.

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[17] From Micronair AU3000, AU4000, and AU5000 and AU5000-2 Atomizer Handbooks, published by Micronair (Aerial) Limited, Isle of Wight, England.

The minimum blade setting is 25° before loss of power is experienced. Should there be occasions when a setting below 35° is required, two marks can be made on the blade boss, adjacent to the last pip which is 35°.

Types of Fan Blades Available

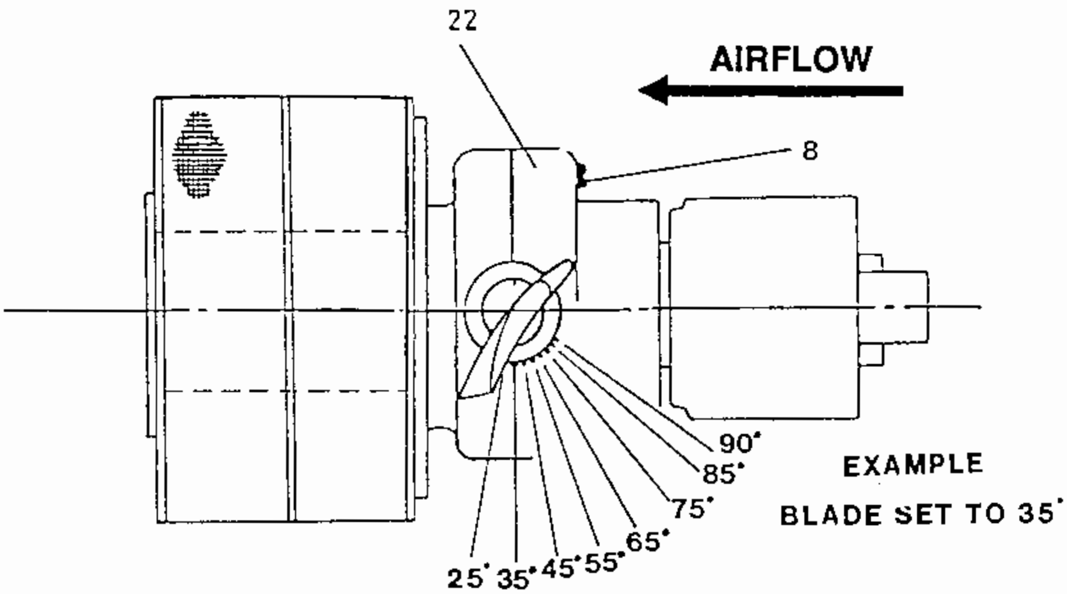
Two different lengths of twisted fan blades are available to suit various operating airspeeds. These are as follows:

Part No.	Length (X)	Fan Diameter	Airspeed
CBP289	3.625 inches	11	100-160 mph
CBP252	4.875 inches	13.5	80-100 mph

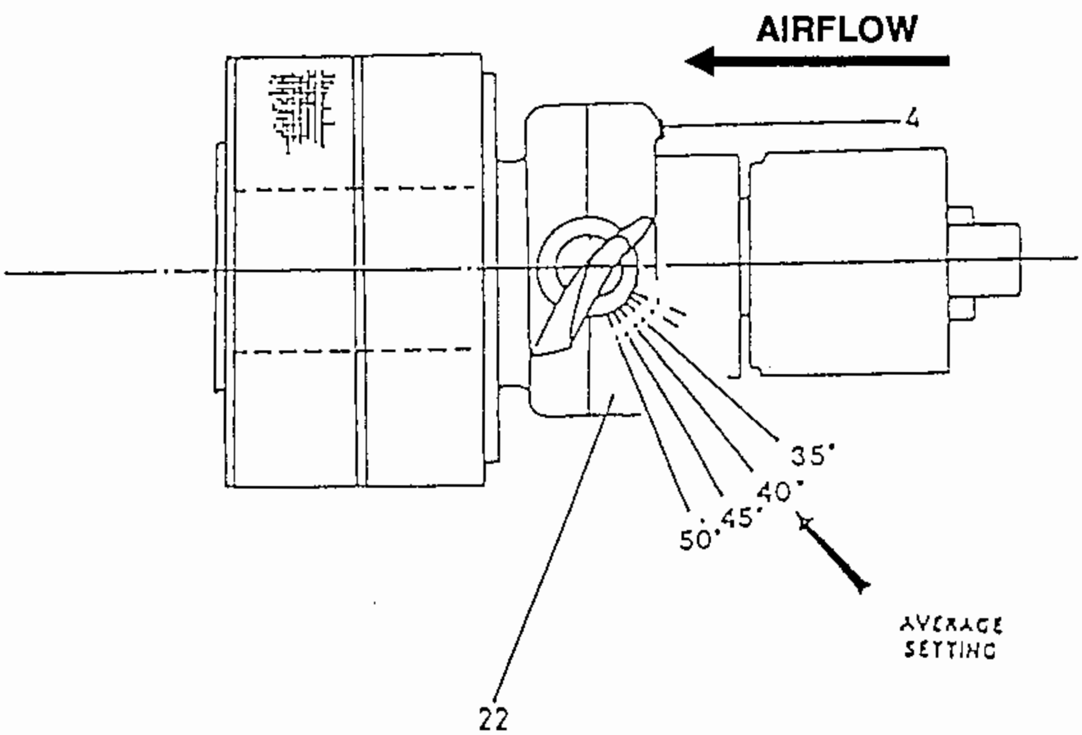
The CBP289 fan blade is supplied as standard with all spare atomizers and with most fixed-wing aircraft kits.

For aircraft speeds above 160 mph (139 knots) the shortest fan blade (CBP289) may be further reduced in length by cutting down the tip in increments of 0.25 inch in order to ensure that the rotational speed of the atomizer remains below the "MAX RPM" speed of 10,000 rpm. If the fan blades are cut, it is vital that all blades must be the same weight. All cut blades must be weighed and trimmed as necessary to ensure that their weights remain within ± 0.5 grams.

On no account should blades of different lengths or types be mixed on the same atomizer or aircraft and all blades must be set at the same angle.



Align appropriate pip on blade with split line of hub to obtain desired blade angle.



Align pip on blade to appropriate degree line on hub to obtain desired blade angle.

FIGURE 57. Fan blade adjustment.

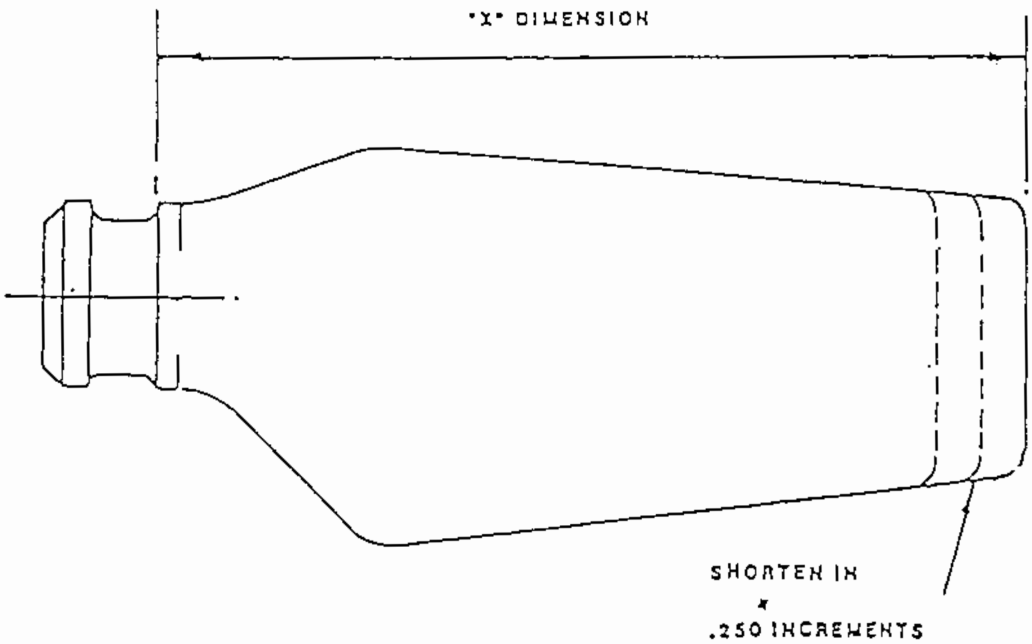


FIGURE 58. General fan blade.

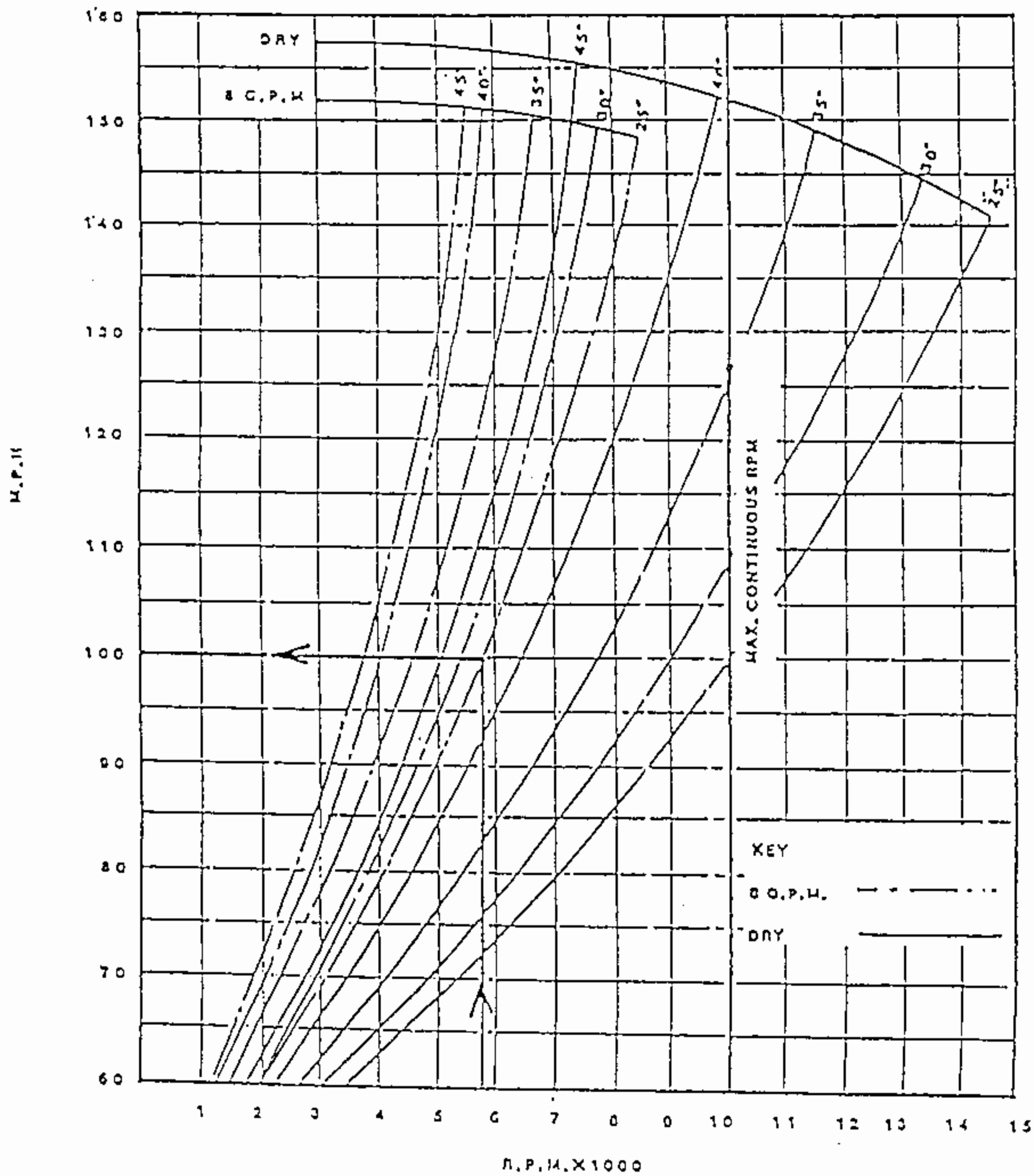


FIGURE 59. Graph of rotational speed vs airspeed-AU3000
11" twisted blade CBP289
5" diameter gauze assembly EX588

EXAMPLE: 5800 RPM 100 MPH 8 GPM = 25° BLADE ANGLE

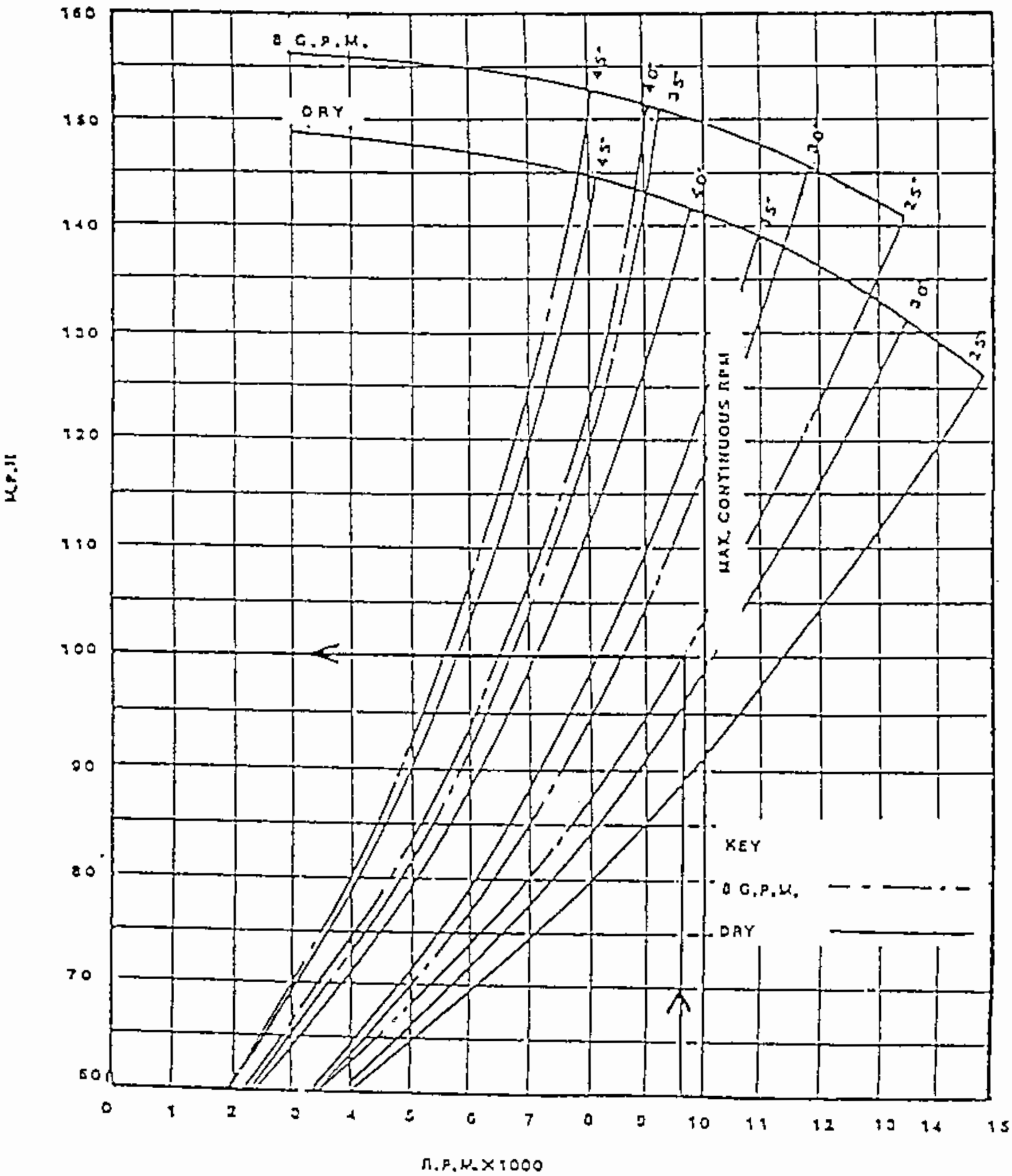


FIGURE 60. Graph of rotational speed vs airspeed-AU3000
13 1/2" twisted blade CBP252-AU3000

EXAMPLE: 9700 RPM 100 MPH 8 GPM = 25° BLADE ANGLE

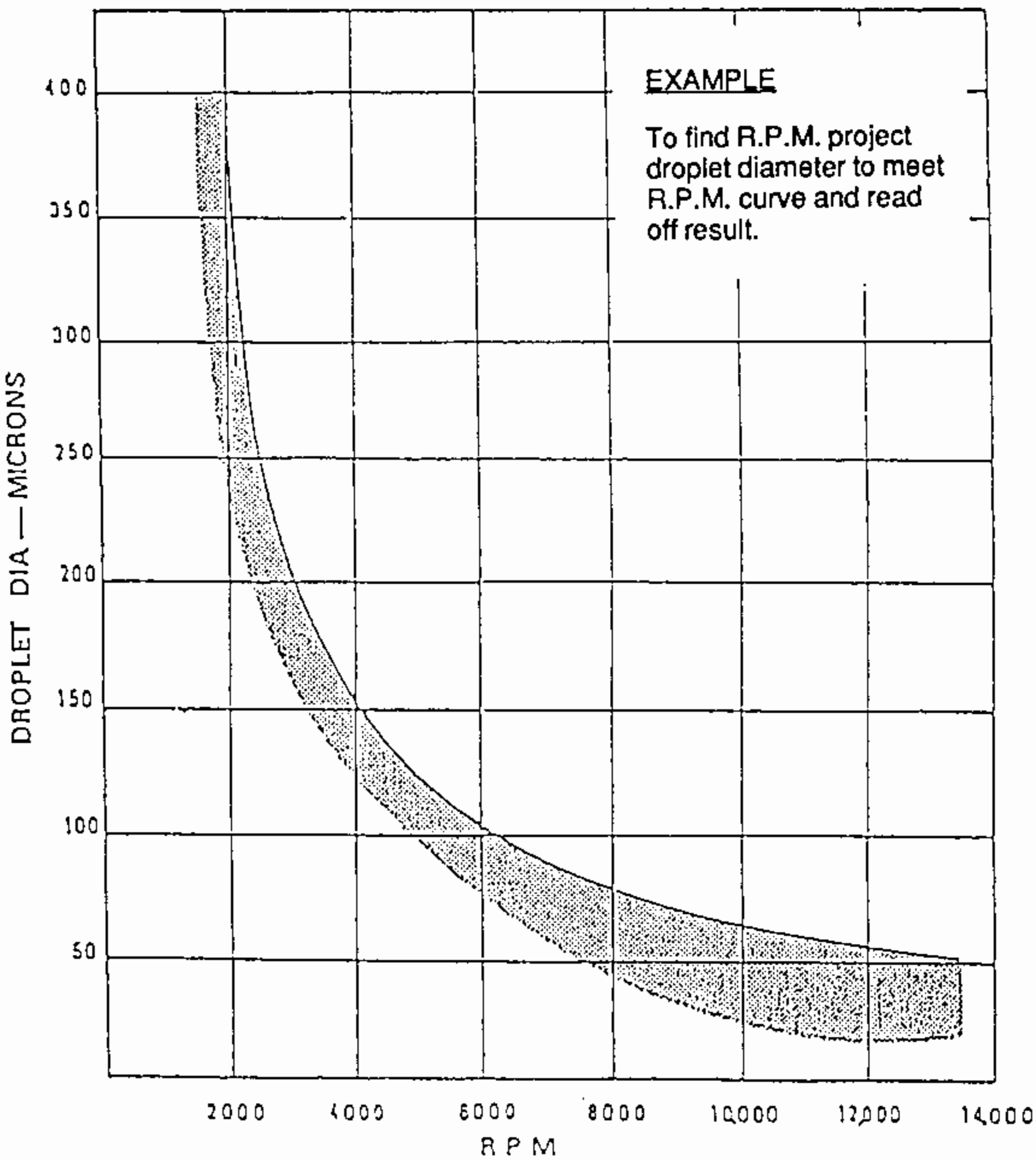


FIGURE 61. Graph of droplet size vs rotational speed for the AU300.

The above figures were obtained using water and are intended only as a guide. The droplet size may vary and will be reduced with oil-based formulations as shown by the shaded band.

A check should always be carried out under field conditions.

TABLE 12. Micronair rotary atomizer V.R.U. flow rates. Model: AU3000.

SETTING NUMBER	PRESSURE KPa/psi	FLOW PER MINUTE PER ATOMIZER IMP. PINTS	U.S. PINTS	LITRES
1	210/30	0.27	0.325	0.15
	280/40	0.48	0.576	0.27
	350/50	0.75	0.900	0.42
2	210/30	0.36	0.432	0.20
	280/40	0.54	0.648	0.30
	350/50	1.00	1.200	0.56
3	210/30	0.63	0.756	0.35
	280/40	1.12	1.340	0.63
	350/50	1.75	2.100	0.99
4	210/30	0.90	1.080	0.51
	280/40	1.60	1.920	0.90
	350/50	2.50	3.000	1.42
5	210/30	1.26	1.510	0.71
	280/40	2.24	2.690	1.27
	350/50	3.50	4.200	1.98
6	210/30	1.80	2.160	1.02
	280/40	3.20	3.840	1.81
	350/50	5.00	6.000	2.80
7	210/30	2.52	3.080	1.43
	280/40	4.48	5.300	2.54
	350/50	7.00	8.400	3.97
8	210/30	3.24	3.900	1.84
	280/40	5.76	6.850	3.27
	350/50	9.00	10.800	5.10
9	210/30	4.68	5.600	2.66
	280/40	8.32	9.980	4.72
	350/50	13.00	15.600	7.38
10	210/30	6.12	7.350	3.47
	280/40	10.88	13.060	6.18
	350/50	17.00	20.000	9.66
11	210/30	8.64	10.370	4.90
	280/40	15.36	18.500	8.70
	350/50	24.00	29.000	13.60
12	210/30	13.32	16.500	7.56
	280/40	23.68	28.500	13.45
	350/50	37.00	45.000	21.00
13	210/30	15.48	18.500	8.79
	280/40	27.52	33.000	15.63
	350/50	43.00	52.000	24.43
14	210/30	25.20	30.050	14.30
	280/40	44.80	53.500	25.45
	350/50	70.00	84.000	39.77

MICRONAIRS AU4000

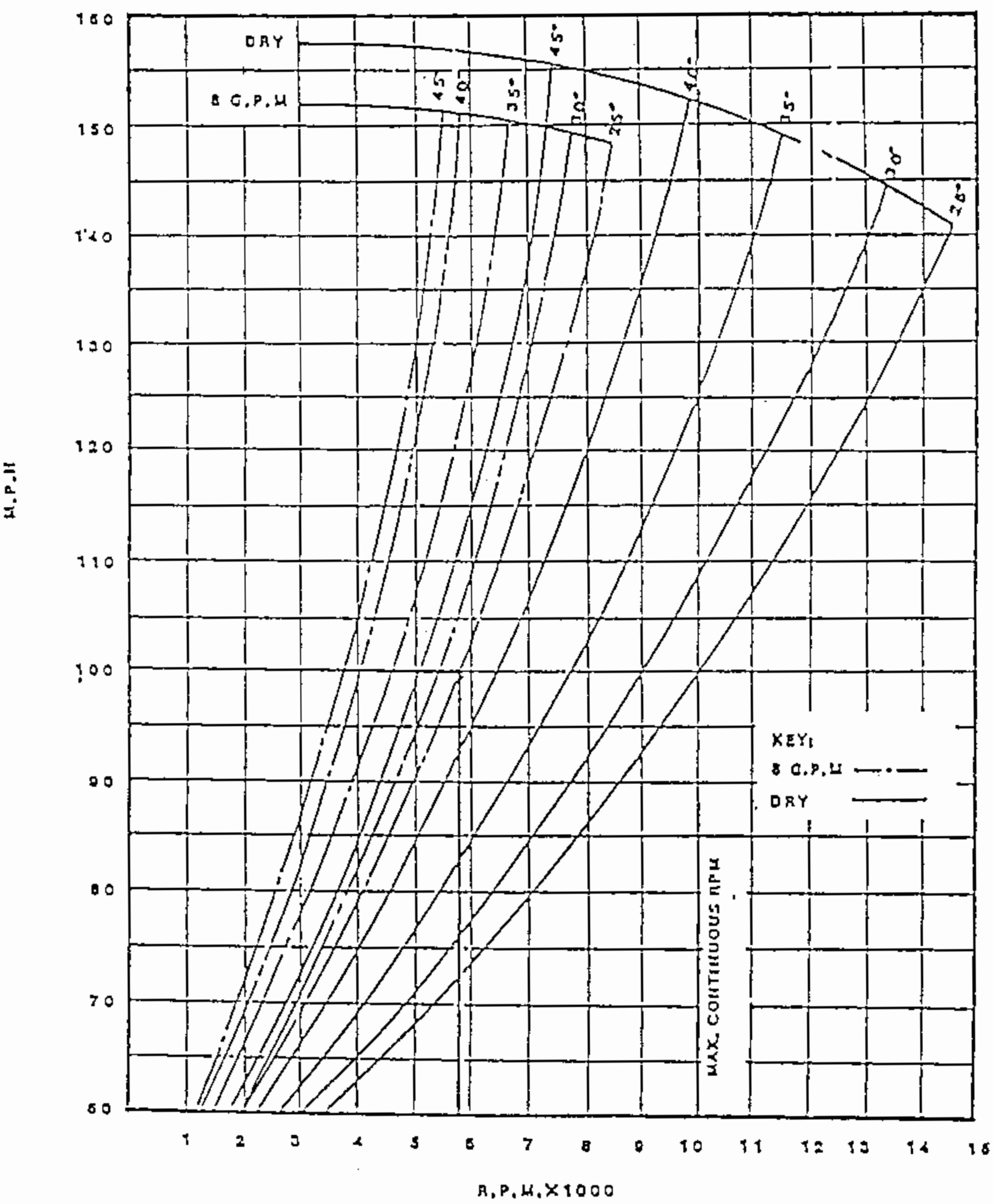


FIGURE 62. Graph of rotational speed vs airspeed-AU4000
11" twisted blade CBP289
5" diameter gauze assembly EX2326/20

EXAMPLE: 5800 RPM 100 MPH 8 GPM = 25° BLADE ANGLE

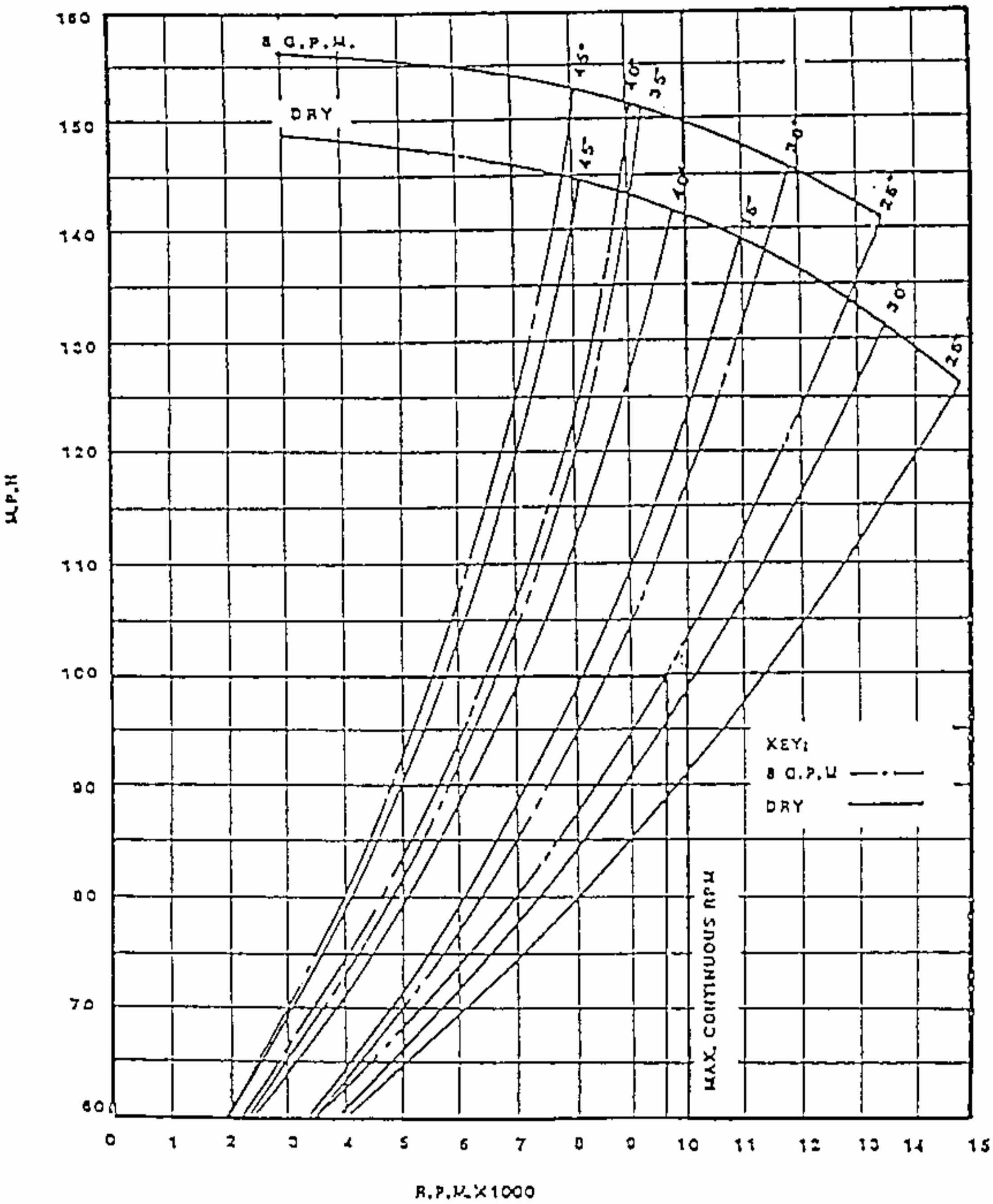


FIGURE 63. Graph of rotational speed vs airspeed-AU4000
13 1/2" twisted blade CBP252-AU4000
5" diameter gauze assembly EX2326/20

EXAMPLE: 9700 RPM 100 MPH 8 GPM = 25° BLADE ANGLE

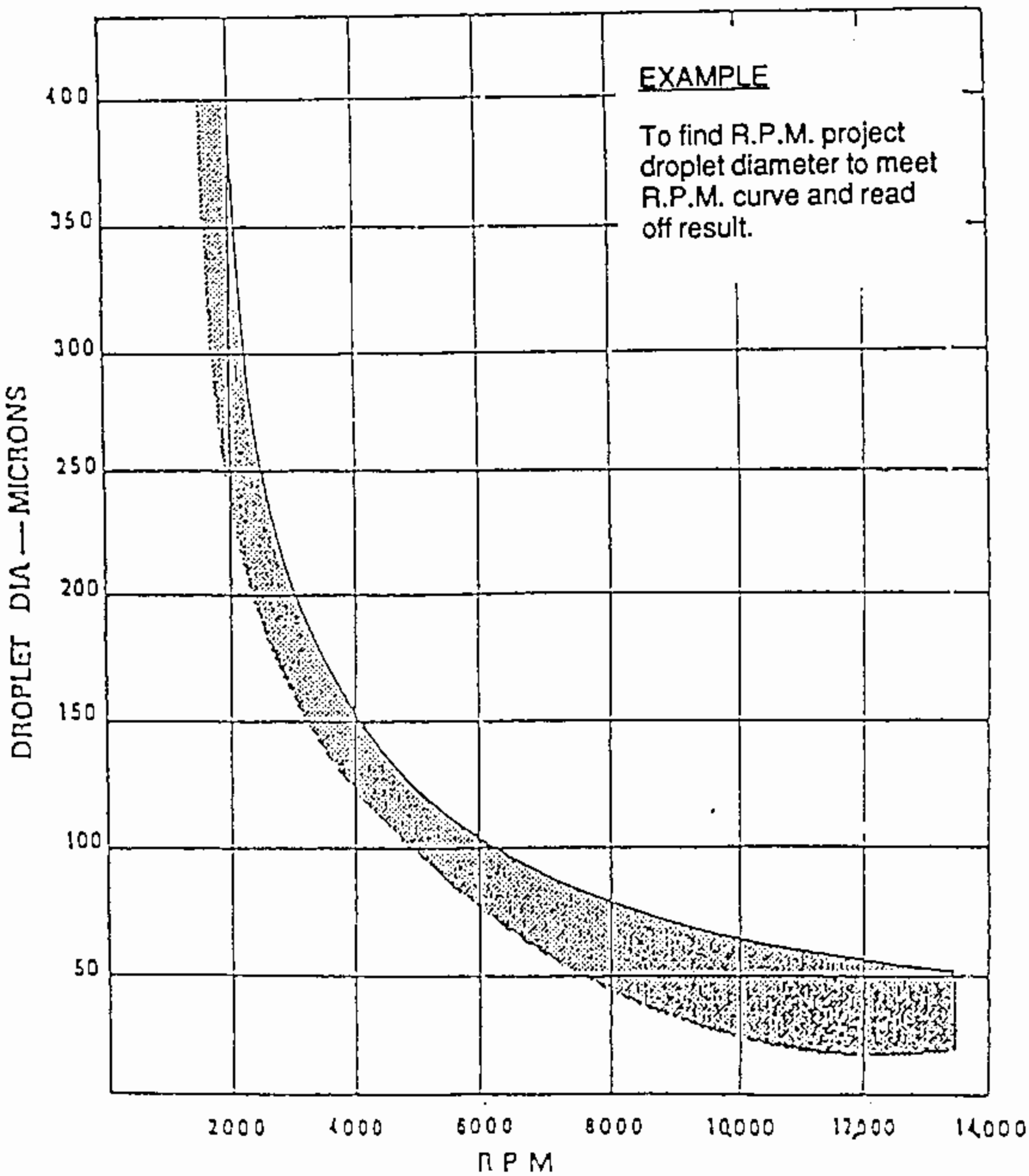


FIGURE 64. Graph of droplet size vs rotational speed for the AU4000.

The above graph is based on figures obtained with water at 68°F (20°C) and is intended only as a guide. The droplet size may vary or be reduced with many oil-based and ULV formulations as shown by the shaded band.

A check should always be carried out.

TABLE 13. Micronair compact atomizer V.R.U. flow rates. Model: AU4000.

V.R.U. NO.	PRESSURE (KPa/psi)	FLOW PER MINUTE PER ATOMIZER IMP. PINTS	US PINTS	LITRES
1	210/30	0.59	0.72	0.34
	280/40	1.05	1.27	0.60
	350/50	1.24	1.50	0.71
2	210/30	1.05	1.27	0.60
	280/40	1.23	1.48	0.70
	350/50	1.58	1.90	0.90
3	210/30	2.19	2.64	1.25
	280/40	2.71	3.28	1.55
	350/50	3.19	3.85	1.82
4	210/30	2.19	2.64	1.25
	280/40	3.50	4.23	2.00
	350/50	3.90	4.71	2.23
5	210/30	4.13	4.99	2.36
	280/40	4.90	5.92	2.80
	350/50	5.78	6.97	3.30
6	210/30	4.30	5.20	2.46
	280/40	5.67	6.85	3.24
	350/50	6.13	7.39	3.50
7	210/30	6.48	7.81	3.70
	280/40	7.35	8.87	4.20
	350/50	8.40	10.14	4.80
8	210/30	6.65	8.03	3.80
	280/40	8.40	10.14	4.80
	350/50	9.69	11.70	5.54
9	210/30	9.10	10.90	5.20
	280/40	10.05	13.10	6.20
	350/50	12.78	15.42	7.30
10	210/30	9.98	12.04	5.70
	280/40	12.25	14.79	7.00
	350/50	14.53	17.54	8.30
11	210/30	14.00	16.90	8.00
	280/40	16.80	20.28	9.60
	350/50	19.25	23.24	11.00
12	210/30	17.85	21.55	10.20
	280/40	21.35	25.78	12.20
	350/50	25.38	30.64	14.50
13	210/30	28.35	34.23	16.20
	280/40	33.95	40.99	19.40
	350/50	37.63	45.43	21.50
14	210/30	29.05	35.08	16.60
	280/40	36.40	43.95	20.80
	350/50	41.65	50.30	23.80

MICRONAIRS AU5000 AND AU5000-2

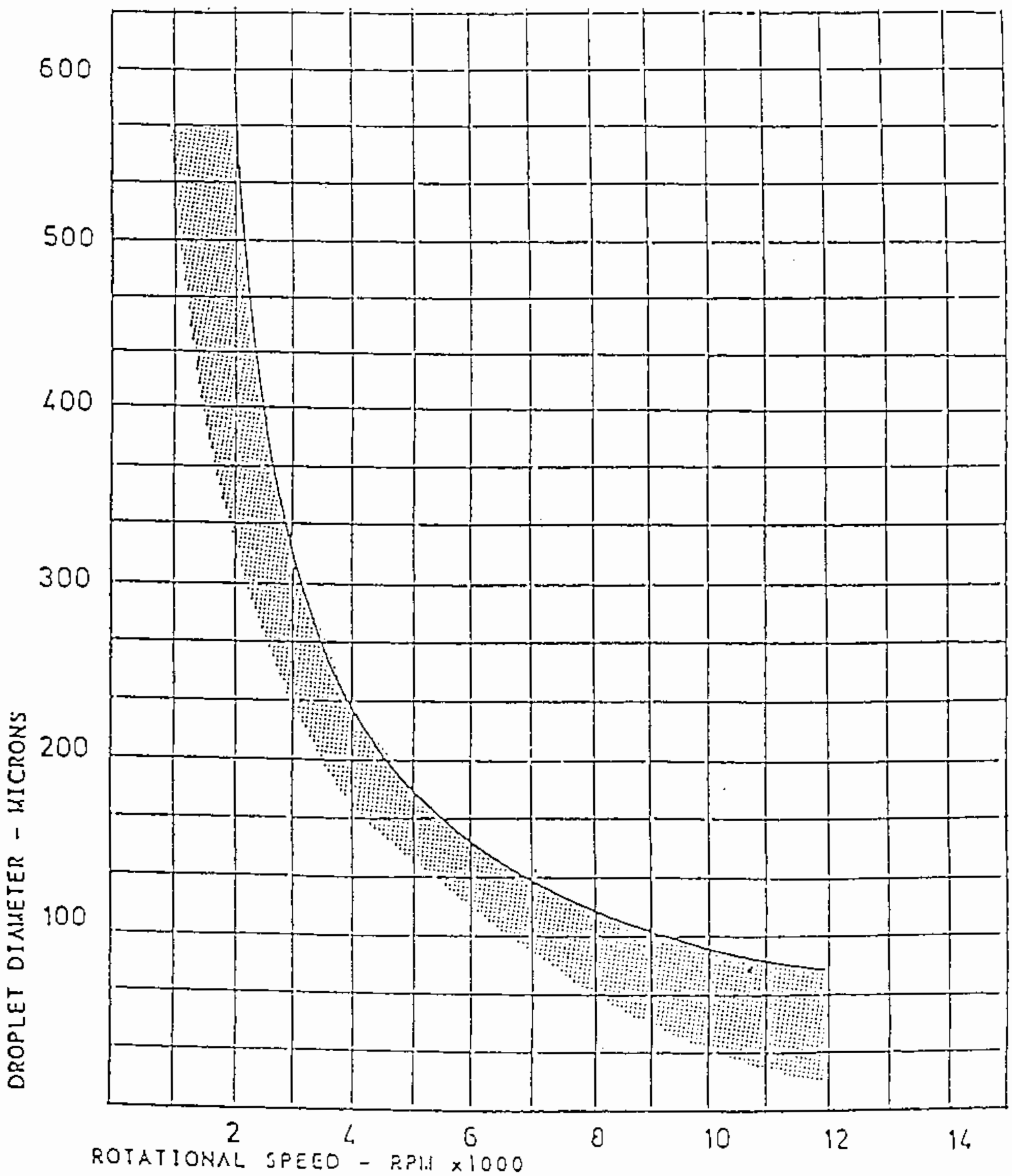


FIGURE 65. Graph of droplet size vs rotational speed for the AU5000 and AU5000-2.

This graph is based on tests with water. Actual droplet sizes will be influenced by the chemical used. Check actual droplet size under field conditions.

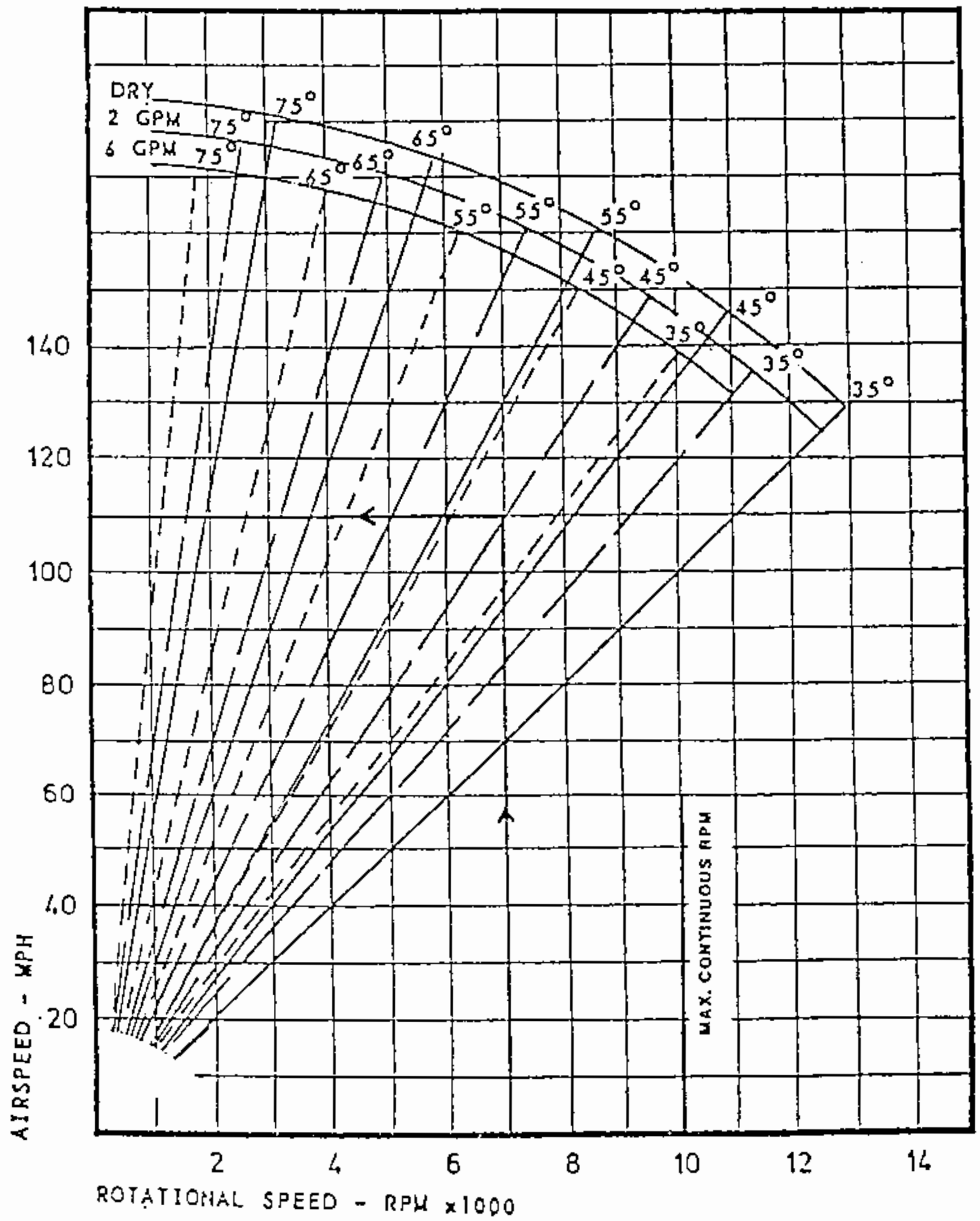


FIGURE 66. Graph of rotational speed vs airspeed (EX1772 Blades)
Atomizer fitted with EX1772 blades - supplied as standard

EXAMPLE: 7000 RPM 110 MPH 2 GPM = 45°

These figures are approximate only. Actual speeds will depend upon airflow over atomizers.

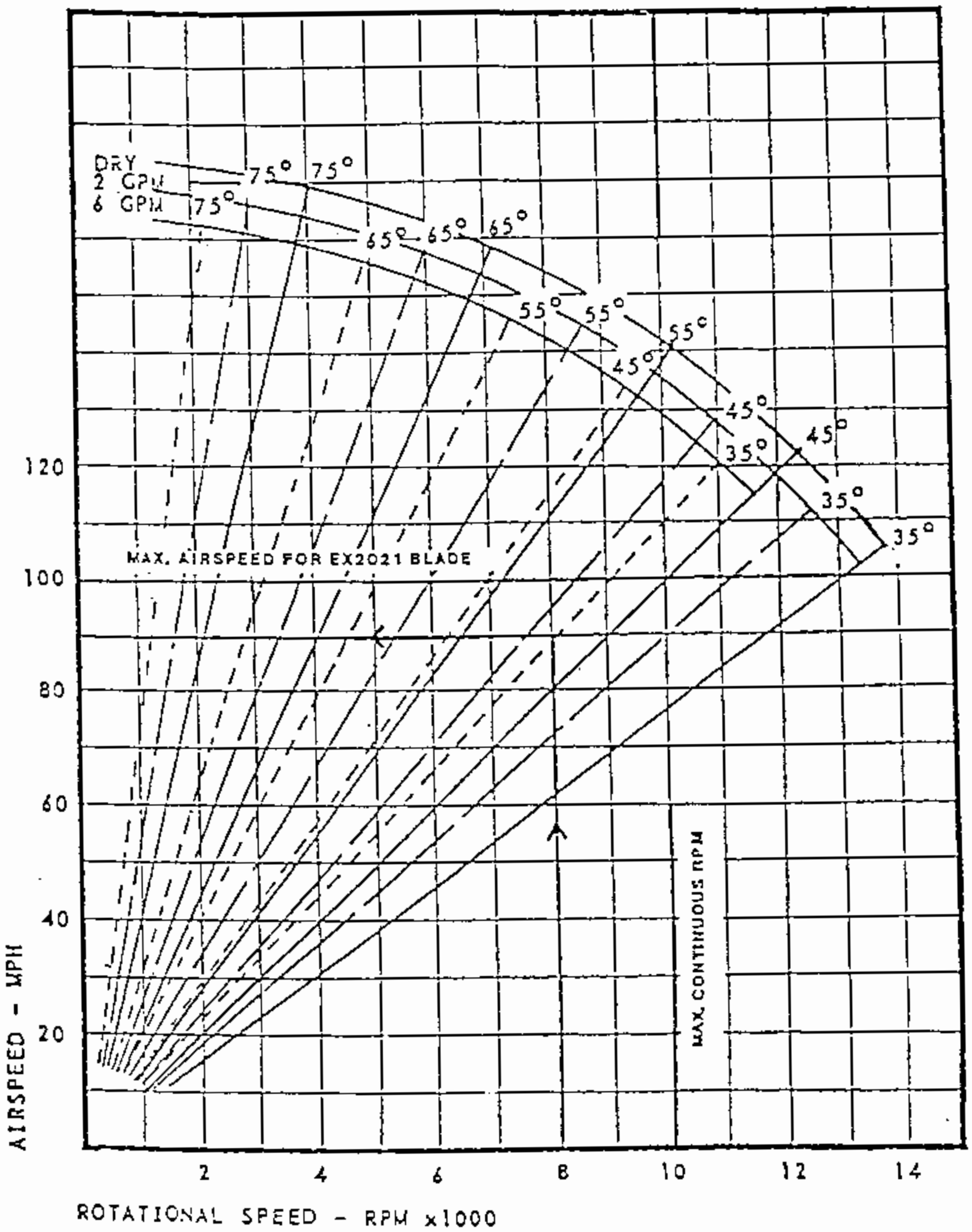


FIGURE 67. Graph of rotational speed vs airspeed (EX2021 Blades)
Atomizer fitted with EX2021 blades

EXAMPLE: 8000 RPM 90 MPH 6 GPM = 35°

These figures are approximate only. Actual speeds will depend upon airflow over atomizers.

TABLE 14. Micronair compact atomizer V.R.U. flow rates. Model: AU5000 and AU5000-2.

SETTING NUMBER	PRESSURE KPa/psi	FLOW PER MINUTE PER ATOMIZER		
		IMP. PINTS	U.S. PINTS	LITRES
1	140/20	0.51	0.61	0.29
	210/30	0.98	1.18	0.56
	280/40	1.19	1.45	0.68
2	140/20	0.79	0.95	0.45
	210/30	1.03	1.25	0.59
	280/40	1.40	1.69	0.80
3	140/20	1.35	1.63	0.77
	210/30	1.66	2.01	0.95
	280/40	2.06	2.49	1.18
4	140/20	2.19	2.64	1.25
	210/30	3.32	4.01	1.90
	280/40	4.04	4.88	2.31
5	140/20	3.29	3.97	1.88
	210/30	4.46	5.39	2.55
	280/40	5.42	6.55	3.10
6	140/20	3.90	4.71	2.23
	210/30	6.44	7.78	3.68
	280/40	7.98	9.63	4.56
7	140/20	4.48	5.41	2.56
	210/30	6.79	8.20	3.88
	280/40	8.35	10.08	4.77
8	140/20	5.44	6.57	3.11
	210/30	7.05	8.51	4.03
	280/40	8.71	10.51	4.97
9	140/20	6.82	8.24	3.90
	210/30	9.62	11.62	5.50
	280/40	12.00	14.49	6.86
10	140/20	7.30	8.81	4.17
	210/30	10.08	12.17	5.76
	280/40	12.12	14.63	6.92
11	140/20	11.30	13.65	6.46
	210/30	14.44	17.43	8.25
	280/40	18.29	22.08	10.40
12	140/20	13.18	15.91	7.53
	210/20	16.20	19.57	9.26
	280/40	20.75	25.06	11.86
13	140/20	15.22	18.38	8.70
	210/30	19.53	23.58	11.16
	280/40	25.90	31.27	14.80
14	140/20	16.45	19.86	9.40
	210/30	26.20	31.63	14.97
	280/40	33.46	40.40	19.12

APPENDIX 15: AVIATION WEATHER REPORTS TERMINOLOGY[18]

An Aviation Weather Report is a statement of weather conditions actually existing at a particular place at a given time. They are taken hourly by trained observers at hundreds of stations throughout Canada and the United States. The sequence in which weather data is transmitted in code by teletype is as follows: Station Identification; Type of Report; Sky Condition and Ceiling; Visibility; Weather and Obstructions to Vision; Sea Level Pressure; Temperature and Dew Point; Wind; Altimeter Setting; Clouds and Obscuring Phenomena; Remarks; Pressure Tendency.

The Aviation Weather Reports describe the existing weather conditions at specific times and at specific stations. They do not, therefore, give the complete weather picture. Between stations that are a hundred miles apart, the weather can be drastically different than that reported at either station. In addition, weather conditions can change very quickly and be quite different from the condition reported at a particular airport in the time it takes you to fly there.

For the full weather picture, consult the reports over several hours to determine the improving or deteriorating trend and also consult the forecasts.

SYMBOLS USED IN WEATHER REPORTS:

Weather reporting stations are assigned three letter identifications in both Canada and the United States. In the U.S., the letters are an abbreviation of the airport name, as, for example, "PIT" for Pittsburgh. In Canada, the second and third letters identify the airport. The first letter indicates the type of weather reporting station.

Y - reporting station co-located with an airport
W - reporting station not co-located with an airport
U - reporting station co-located with a radio beacon

e.g. YOW: Ottawa - weather reporting station is co-located with the airport; WMN: Mount Forest, Ontario - weather reporting station is not located at an airport.

Type and Time of Report

The type of report is designated by a code as follows:

SA	Regular observation (taken on the hour).
RS	Regular special (taken on the hour but reports a significant weather change).
SP	Special observation.
RS COR	Corrected regular special observation.
AUTO	Report from an automatic station.
SAWR	Report that may not contain all the elements of a regular observation such as MSL, dew point, clouds or obscurations.

A four figure group indicates the time of observation in UTC (coordinated universal time).

Sky Condition and Ceiling

Cloud layers are reported in ascending order of height.

CLS	Clear (no cloud).
SCT	Scattered (1/10 to 5/10 of the sky covered by a layer based aloft).
BKN	Broken (6/10 to 9/10 of the sky covered).
OVC	Overcast (10/10 of the sky is covered).
X	Obscured (10/10 of the sky is concealed by a layer of fog, snow or dust based on the ground).
-X	Partially obscured (less than 10/10 of the sky concealed).

A minus (-) preceding SCT, BKN or OVC means that the sky cover is thin. The sky conditions -BKN or -OVC do not constitute a ceiling.

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[18] From the 1987, 25th Revised Edition, From The Ground Up, Aviation Publishing Co. Ltd., Ottawa, Ontario.

A letter always precedes the numerical value of the ceiling and indicates the nature and method of determination of the ceiling.

M	- Measured	W	- Indefinite	A	- Aircraft
P	- Precipitation	B	- Balloon	E	- Estimated

Multiple layers of cloud, including the ceiling layer, are stated in hundreds of feet **above ground** with the final "00" of the figure omitted, e.g. "4" means 400 feet (400'). Higher layers follow lower layers in ascending order. The ceiling figure is always preceded by a letter indicating the nature and method of determining the ceiling. For example "E30" means Ceiling Estimated, 3,000'. The letter "V" following the ceiling figure means that the ceiling is variable and requires an entry in the Remark's section giving the range of variability. For example CIG 5-8 means varying from 500 to 800'.

Example (Sky Condition and Ceiling) - 10 SCT M30 BKN 100 OVC means: 1,000' scattered...ceiling measured 3,000' broken...10,000' overcast.

Visibility

The horizontal visibility is reported in figures representing statute miles and fractions of miles. For example "10" means 10 miles. "1/4" means one quarter of a mile. The letter "V" following the visibility figure in miles means "Visibility variable". (If the visibility is 6 miles or less, the reason is always given under the "State of Weather" or "Obstruction to Vision").

State of Weather

T+	Heavy thunderstorm	L	Drizzle	SG	Snow grains
T	Thunderstorm	ZL	Freezing drizzle	A	Hail
R	Rain	S	Snow	IC	Ice crystals
RW	Rain shower	SW	Snow showers	IP	Ice pellets
ZR	Freezing rain	SP	Snow pellets	IPW	Ice pellet showers

TORNADO and **WATERSPOUT** are always written in full.

The addition of a minus (-) sign to any of the above means "Light". Double minus (- -) means "Very Light". The addition of a plus (+) sign means "Heavy or Severe". The omission of any sign means "Moderate".

Examples: R+: Heavy rain. A-: Light Hail. S- -: Very light snow.

Obstructions to Vision

F	Fog	D	Dust	N	Sand
BS	Blowing snow	IF	Ice fog	BD	Blowing dust
H	Haze	BN	Blowing sand	K	Smoke

Sea Level Pressure

In Canada, Sea Level Pressure varies roughly between 960.0 and 1,050.0 millibars. Sea Level Pressure is indicated by a group of three figures representing tens, units and tenths of Millibars. The initial "9" or "10" is omitted.

Examples: "148" means 1,014.8 millibars. "899" means 989.9 millibars.

Temperature

Temperature is indicated by figures representing its value to the nearest degree Celsius, e.g. "9" means 9°C. Below zero temperature is indicated by a minus (-) sign preceding the figure, e.g. "-20" means -20°C. Zero degrees is shown as "0".

Dew Point

The dew point is indicated by figures representing its value to the nearest degree Celsius, e.g. "4" means 4°C. Below zero dew point temperature is indicated by a minus (-) sign preceding the figure.

Wind

The wind direction is reported in degrees of azimuth (to the nearest 10), e.g. 01=010°, 09=090°, 28=280°, etc. The direction is that from which the wind is blowing and it is reported from 36 directions in all. (Note: only the 30° intervals are numbered in Figure 68.) A wind blowing directly from the north is reported as 36. Absolute calm is reported as 00.

Wind direction is in degrees True (except when given by a tower for take-off or landing, when it is in degrees Magnetic). Wind speed is reported in knots; 5 knots is shown as 05, 16 kt as 16 and calm as 00.

Gustiness is indicated by a G after the speed, e.g., 3020G. The speed of the peak gust may be given after the G, e.g., 3020G32 wind from 300° 20 kts gusting to 32 kts.) Squalls are indicated by "Q" following the wind speed, e.g., 3025Q. Peak gusts with the squalls may be indicated by the number following Q, e.g., 3025Q35.

A wind shift may be reported in the remarks portion as follows:
WSHFT 1450Z, meaning "A wind shift occurred at 14:50Z".

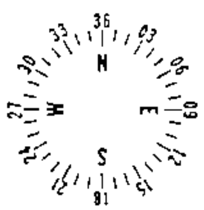

FIGURE 68. Compass points in relation to the degree scale.

Altimeter Setting

The Altimeter Setting is indicated by a group of three figures representing the pressure in inches and hundredths of inches of mercury. The first figure (whether 3 or 2) omitted, hence 30.00 inches of mercury is written 000. 29.72 inches of mercury is written as 972. (A number beginning with 5 or higher presupposes an initial 2; a number beginning with 4 or lower presupposes an initial 3.)

Clouds

The cloud form or an obscuring phenomenon, corresponding to each layer reported in the sky condition group, is given by an abbreviation followed by a number giving the tenths of sky concealed by the layer.

CI	cirrus	ST	stratus
CS	cirrostratus	SF	stratus fractus
CC	cirrocumulus	SC	stratocumulus
AS	altostratus	CU	cumulus
AC	altocumulus	CF	cumulus fractus
ACC	altocumulus castellanus	TCU	heavy cumulus
NS	nimbostratus	CB	cumulonimbus

Remarks

Any additional remarks are shown in teletype symbols and in abbreviations of plain English words, e.g. DRK OVCST NW means "Dark overcast in northwest".

Pressure Tendency

The group of figures that appears at the end of the report is a code to indicate the pressure tendency during the past three hours. The first number of the group indicates whether the pressure is rising, falling or is steady (0, 1 or 3 indicates rising pressure; 4 indicates steady; 5, 6 or 7 indicates falling pressure). The final grouping indicates in hundredths of millibars the change in pressure during the past three hours.

Missing Data

Any items which are normally sent, but for some reason are missing from the transmission, are indicated by the letter "M" entered in the place of the missing data.

Frequency

Normally, weather teletype reports are transmitted over a national network by airport weather stations once every hour. "Special" reports may be transmitted at more frequent intervals when the weather is changing rapidly.

AVIATION WEATHER REPORT

Example: YWG SA 0900 3 SCT M7 OVC 1 1/2R-FK 926/5/3/0404/925/SF3ST7 VSBY SW 1/2F 304

YWG:	Code letters of station reporting (YWG means Winnipeg).
SA:	Type of report (SA means regular observation).
0900:	Time of report (0900 means 0900Z).
3 SCT:	Sky condition (3 means 300'. SCT means scattered).
M7 OVC:	Ceiling (M means measured. 7 means 700'. OVC means overcast).
1 1/2:	Visibility (1 1/2 means 1 1/2 miles).
R-FK:	Obstructions to vision (R- means light rain. F means fog. K means smoke).
926:	Sea level pressure (926 means 992.6 millibars).
5:	Temperature (5 means 5°C).
3:	Dew point (3 means 3°C).
0404:	Wind (04 means from 040°, 04 means at 4 kts).
925:	Altimeter setting (925 means 29.25 inches of mercury).
SF3ST7:	Cloud form (SF3 means stratus fractus clouds covering 3/10th of the sky. ST7 means stratus clouds covering 7/10th of the sky).
VSBY SW1/2F:	Remarks (Visibility to the southwest is one half mile in fog).
304:	Pressure tendency. The pressure is rising and has changed .04 millibars in the last 3 hours.

RADAR WEATHER REPORTS/RAREPS (SDCN)

Specially designated weather surveillance radars are used at a number of airports in Canada. Observations of precipitation areas and convection type storms are made every hour and reports are transmitted on the teletype network. Basically, the radar presents a display of weather in a 100 mile radius. However, storms that have built up to considerable height and intensity can be seen on the radar display even if they are beyond the 100 mile range. The radar does not show turbulence. However, turbulence is usually associated with heavy rainfall and can be presumed to be present in any area showing heavy precipitation.

Radar weather reports are called RAREPS in the meteorology lexicon.

Example: YZ SD 051645Z LNBKNTRW STG 300/45 190/55 12W 2525

Decoded the above reads: Malton, Ontario (YZ), radar report (SD) for the 5th day of the month, issued at 1645Z. Line of broken echoes (LNBKN) with strong thunderstorms (TRW STG) is lying between 300° at 45 km (300/45) and 190° at 55 km (190/55) from the station. The line is 12 km wide (12W) and is moving from 250° at a speed of 25 kilometres per hour.

PILOT REPORTS (PIREPS - UA)

Observations of actual conditions taken by pilots during flight are also available on the teletype network.

Example: UA/OV YXU 04835 1537 FL090/TP BE80/SK OVC 070/TA -20/IC LGT RIME BLO-070/ RM WIND COMP HEAD 010 HG 048 TAS 210

Decoded the above reads: Pilot report. Location: London VORTAC, 048 degrees radial, 35 nautical miles. Time: 1537Z at 9,000'. Aircraft type: Beech Queen Air. Sky condition: overcast with tops at 7,000'. Air temperature: -20°C. Icing: light rime below 7,000'. Remarks: head wind component 10 kts, magnetic heading 048 degrees, true airspeed 210 kts.

JBI REPORTS

Until recently, a report on the runway braking action (James Brake Index) was also included in the Aviation Weather Reports. These reports are now transmitted on the teletype circuit as a special type of NOTAM and are available for the information of pilots as a voice advisory from the control tower at controlled airports and from Flight Service Stations at uncontrolled airports. Because the condition of the runway at his airport of destination is of as much concern to the pilot as is the condition of the weather, it is important to know where this information is available. These reports are issued whenever the JBI reading for a runway falls to .4 or below. Reports may also contain additional RSC (Runway Surface Conditions) information. As conditions change, new RSC/JBI reports are issued. When the JBI reading exceeds .4, a "Normal Winter Conditions" tent is transmitted, cancelling previous reports.

Such a report of runway conditions might appear as follows: JBI YOW RWY 07/25 -4 .28 1200Z

In this case, the report concerns Runway 07/25 at Ottawa International Airport. The temperature is -4°C at 1200Z. The readings are taken by a James Brake Indicator (JBI) on a scale from 0 (non-existent braking) to 1 (excellent braking). The braking action on the runway is rated at an average of .28 for the full length of the runway.

JBI readings are taken when there is dry, packed snow, ice or frost on the runways and when snow removal and sanding operations have been undertaken. When only a portion of the runway width has been cleared, the report will also include a description of the remaining portion of the runway (e.g. depth of snow windrows, etc.). JBI readouts are not accurate in conditions of slush or wet or loose snow.

An RSC report is distributed when there is any slush or when there is more than one inch of loose snow on the runway or when the cleared runway width falls below 100'. An RSC report might appear as follows: RSC YOW ALL RWYS COVERED 4 INCHES LIGHT SNOW 0600

An RSC report might also appear in conjunction with a JBI report as follows:

RSC YOW 07/25 SNOW DRIFTS 3-4 INCHES
JBI YOW 07/25 - 15 .3 1050

When the solid contaminant, such as ice or snow, changes to liquid form, such as water or slush, because of a temperature rise, the JBI report is replaced with an RSC report. Such a report might appear as follows: JBI YOW N/A RSC 07/25 wet with .25/.75 slush centre third.

Decoded this report reads: The JBI report for Ottawa, runway 07 is cancelled. Runway Surface Condition report is issued instead. Runway 07/25 is wet with slush on the centre section varying from a depth of 1/4 inch to 3/4 inch.

WEATHER FORECASTS

A weather forecast is a statement of anticipated conditions expected at a particular place, over an area, or along a route during a given period, based on available information. The forecaster will usually state the degree of confidence with which the forecast is made.

In planning a flight, the pilot must have reasonable knowledge of the following facts:

1. Whether the ceiling and visibility at his terminal - or at alternate landing places - will be sufficiently good to make a safe landing. If the flight is to be made by visual contact, the ceilings and visibilities must be "VFR" along the entire route.
2. He must know the wind conditions at various flight levels to estimate the time and fuel required, and to choose a route and altitude to fly that will give him the most favourable winds.
3. He must know at what levels to expect icing conditions and how to avoid severe icing zones.
4. He must know where thunderstorms, turbulence or hail may be encountered, so that he may delay the start of his flight or land en route to avoid dangerous weather in the air.

Since the weather is constantly changing, the conditions shown in a Weather Report may change during a flight and a forecast of the changes must be obtained before departure.

The following code identifies the various types of forecasts:

FTCN - Aerodrome Forecast
FACN - Area Forecast
FDCN - Winds and Temperatures Aloft Forecast
WSCN - SIGMET Message

Area Forecast (FACN)

An area forecast is a general statement of weather conditions to be expected over a particular region. They are prepared every 6 hours and are issued approximately one half hour before the beginning of their valid period (at 0000Z, 0600Z, 1200Z and 1800Z). They are valid for 12 hours and each new forecast replaces the last 6 hours of the preceding one. Forecasts also include a 12 hour outlook that applies to the period beyond the main forecast. The area forecast includes regional forecasts for each region in the area.

Example:

FACN1 CYEG 171730
18-06
OTLK 06-18
HGTS ASL UNLESS NOTED
PROG
FLAT RDG FORT SMITH-MCMURRAY-LETHBRIDGE AT 1800Z MOVG TO MEDICINE HAT-NORTH BATTLEFORD 250 MI E OF FORT SMITH BY 0600. SLOLY DPNG TROF PRINCE GEORGE-FORT NELSON. AIR UNSTBL AND FAIRLY MOIST. UPSLP CLDS OVR SRN ALTA.
YEG-1
LETHBRIDGE RGN
CLDS AND WX. 50 OVC 80 110 BKN 140 BCMG 50 BKN 80 110 BKN 140 AFT 04Z.
ICG.LGT RIME ICGIC. FRLVL 40.
OTLK VFR
YEG-2-3-4
CALGARY CORONATION EDSON REGIONS
CLDS AND WX. 60 BKN CU100 /-SCT BCMG /-SCT AFT 01Z.
ICG. LGT RIME ICG IN CU. FRLVL 40.
OTLK VFR
YEG-5
EDMONTON RGN
CLDS AND WX. 60 BKN CU100 OCNLY 60 BKN CU+150 6RW- BCMG 100 BKN 130 BY 0200Z.
ICG. MDT CLR ICG IN TCU 60-150 OTRW LGT ICGIC. FRLVL 40.
TURBC MDT VCNTY TCU TIL 2400Z.
OTLK VFR

Decoded the above reads:

Areas forecast (FACN) issued by the weather office at Edmonton International at 1730Z on the 17th of the month and valid from 1800Z to 0600Z on the 18th. Outlook valid from 0600Z to 1800Z on the 18th. All heights above Mean Sea Level unless noted.

Prognosis: Flat ridge overlying Fort Smith, McMurray and Lethbridge at 1800Z is moving towards Medicine Hat and North Battleford. Will be 250 miles east of Fort Smith by 0600Z. Slowly deepening trough Prince George to Fort Nelson. Air unstable and fairly moist. Upslope clouds over Southern Alberta.

YEG 1: Lethbridge Region
Clouds and Weather: 5,000' overcast, tops at 8,000' and 11,000' broken with tops at 14,000'. Becoming 5,000' broken, tops at 8,000' and 11,000' broken, tops at 14,000' after 0400Z.
Icing: Light rime icing. Freezing level 4,000'.
Outlook: VFR.

YEG 2-3-4: Calgary, Coronation, Edson Regions.
Clouds and weather: 6,000' broken. Cumulus clouds with tops at 10,000'. With thin scattered cirrus. Becoming high, thin scattered cirrus after 0100Z.
Icing: Light rime icing in cumulus clouds. Freezing level 4,000'.
Outlook: VFR

YEG 5: Edmonton Region
Clouds and Weather: 6,000' broken. Cumulus clouds with tops at 10,000'. Occasionally 6,000' broken. Heavy cumulus clouds with tops at 15,000'. Visibility 6 miles in light rain showers. Becoming 1,000' broken, tops at 13,000' by 0200Z.

Icing:	Moderate clear icing in towering cumulus from 6,000' to 15,000'. Otherwise light icing in cloud. Freezing level 4,000'.
Turbulence:	Moderate turbulence in vicinity of towering cumulus until 2400Z.
Outlook:	VFR.
IFR -	Ceilings more than 3,000' and/or visibility less than 3 miles.
MVFR -	Marginal VFR. Ceiling between 1,000 and 3,000' and/or visibility between 3 and 5 miles.
VFR -	Ceilings more than 3,000' and visibility more than 5 miles.

The cause of IFR and MVFR conditions is given in the outlook by indicating the ceiling or visibility restrictions. For example: IFR CIG F would indicate that the outlook is for IFR weather due to ceilings and fog. If winds are forecast to be greater than 25 kts, the word WIND is included. For example: VFR WIND would indicate that the outlook is for VFR weather with winds or gusts in excess of 25 kts.

In area forecasts, the forecast visibility is included if it is expected to be 6 statute miles or less. The forecast wind is included if it is expected to be 25 kts or more.

Aerodrome Forecast (FTCN)

An aerodrome forecast states in specific terms the expected weather conditions that will affect landing and take-off at the aerodrome. Cloud heights in hundreds of feet above the station, cloud layers in ascending order of height, ceiling, visibility, weather and wind are given for an area within 5 nautical miles of the aerodrome. Aerodrome forecasts are transmitted four times daily, approximately 30 minutes before their valid period. The normal valid period is 12 hours, beginning at 0500Z, 1100Z, 1700Z and 2300Z. Some forecasts have a 24 hour valid period.

Example: FTCN 241645
YYC 241705 30 SCT C90 OVE 1412. 1400Z C20 OVC 6RW-1415. 1900Z C30 BKN 1415.

Decoded the above reads:

A 12 hour aerodrome forecast issued at 1645Z on the 24th day of the month for Calgary. Valid from 1700Z to 0500Z.

30 SCT C90 OVC 1412: 3,000', scattered clouds, ceiling 9,000', overcast, surface wind from 140° at 12 kts.

1400Z C20 OVC 6RW-1415: By 1400Z becoming ceiling 2,000', overcast, visibility 6 miles, light rain showers, surface wind from 140° at 15 kts.

1900Z C30 BKN 1415: By 1900Z becoming ceiling 3,000', broken clouds, surface winds from 140° at 15 kts.

FTCN 091630
YTR 091717 30 SCT C100 BKN/OVC 6H 2315G20 OCNL RW-10Z 50 SCT C120 BKN 2315.

Decoded the above reads:

A 24 hour aerodrome forecast issued at 1630Z on the 9th day of the month for Trenton. Valid from 1700Z on the 9th to 1700Z on the 10th. 3,000' scattered, ceiling 10,000' broken. High cirrus overcast. Visibility 6 miles in haze. Surface winds from 230° at 15 kts gusting to 20 kts. Occasional light rain showers. At 1000Z 5,000' scattered, ceiling 12,000' broken. Surface winds from 230° at 15 kts.

Ceilings are indicated by the letter "C" immediately preceding the height figure. Towering cumulus (TCU) and cumulonimbus (CB) are indicated when expected.

The forecast wind is indicated in degrees true and in knots if it is expected to be 10 kts or stronger. The forecast visibility is included if it is expected to be 6 statute miles or less.

Upper Winds and Temperature Forecast (FDCN)

An upper winds and temperature forecast provides an estimate of upper wind conditions and temperatures at selected levels. Wind direction is given in degrees true and wind speed in knots. Temperatures are included for all but the 3,000 foot level. FDs are prepared twice daily. The validity period is indicated in the body of the forecast.

Example:

FDCN1 CWAO 171520
BASED ON 1200 DATA VALID 171800 FOR USE 1500-2100

	3,000	6,000	9,000	12,000	18,000
YVR	2021	2425-07	2430-10	2434-18	2542-26
YYF	2523	2432-04	2338-08	2342-13	2448-24
YXC		2431-02	2330-06	2344-11	2352-22
YYC		2426-03	2435-06	2430-12	2342-22
YOL		2527-01	2437-05	2442-10	2450-21

Decoded the above reads:

Winds and temperature forecast, issued by the Montreal Meteorological Centre at 1520Z on the 17th day of the month. Based on data fed into the computer at 1200Z. Forecast is valid for 1800Z on the 17th day of the month and for use for 3 hours either side of 1800Z, i.e. from 1500Z to 2100Z. Vancouver (YVR): At 3,000', wind from 200° at 21 kts. At 6,000', wind from 240° at 25 kts and temperature -7°C. At 9,000', wind from 240° at 30 kts and temperature -10°C. At 12,000', wind from 240° at 34 kts and temperature -18°C. At 18,000' wind from 250° at 42 kts and temperature -26°C. Some lower level groups are omitted. No winds are forecast within 1,500' of station elevation and no temperatures are forecast for 3,000 foot level or for a level within 1,500' of station elevation.

FDCN CWAO 081750
DATA BASED ON 081200Z VALID 090000Z FOR USE 1800-0300Z TEMPS NEG ABV 24000

	24,000	30,000	34,000	39,000
YVR	2973-24	293040	283450	273763
YYF	3031-24	314041	304551	304763
YQL	2955-28	306845	307455	791159

Decoded the above reads:

Winds and temperature forecast, issued by the Montreal Meteorological Centre at 1750Z on the 8th day of the month. Based on data fed into the computer at 1200Z on the 8th. The forecast is valid for use from 1800Z on the 8th to 0300Z on the 9th. Temperatures above 24,000' should be read as negative values. YQL: at 24,000 feet, the wind is from 290° at 55 kts and the temperature is -28°C. At 30,000' wind from 300° at 68 kts and temperature -45°C. At 34,000', wind from 300° at 74 kts and temperature -55°C. At 39,000' wind from 290° at 111 kts and temperature -59°C.

When the wind speed is greater than 100 kts (100 to 190 kts), 50 is added to the direction code and 100 is subtracted from the speed code. Therefore, in the YQL forecast for 39,000', subtract 50 from 79 to determine that the wind direction is from 290° and add 100 to 11 to determine that the wind speed is 111 kts.

If the wind speed is forecast to be greater than 200 kts, the wind group is coded as 199 kts. Thus, 6699 is decoded as the wind from 160° at 199 kts or greater. The code 9900 is used to indicate light and variable winds or wind speeds of less than 5 kts.

Winds aloft are given for a number of representative levels. Winds at heights not reported can be obtained by interpolation. For example what is the wind at Penticton (YYF) at 8,000 feet? The wind at 6,000' is from 240° at 32 kts. The wind at 9,000' is from 230° at 38 kts. Hence, the wind is backing approximately 3° per 1,000'. At 8,000', it would be from approximately 233°. The velocity of the wind is increasing 2 kts per 1,000'. At 8,000', it would be blowing at approximately 36 kts.

The same kind of interpolation can be made for the temperature.

APPENDIX 16: GLOSSARY

Active ingredient (a.i.): the component of a pesticide which makes it effective.

Absorbent material: a type of material which can take up liquid chemicals and hold them. May be used to clean up spills of dangerous goods.

Acid equivalent (a.e.): a measure of active ingredient for herbicide compounds.

Acute exposure: a single exposure to a substance or multiple exposures in a short period, usually during a working day.

Acute poisoning: severe poisoning occurring after one exposure to a toxin.

Acute toxicity: the toxic response resulting from a single dose or exposure to a toxin. Determined through oral, dermal or inhalation studies.

Adjuvant: a substance added to a pesticide mixture to improve effectiveness of the active ingredient. Examples: emulsifiers, stickers, wetting agents, synergists.

Ailerons: a movable part on an airplane wing which provides lateral control.

Airstrip circuit: a circular flight path of air traffic about an airstrip which aircraft enter and exit, while landing on or leaving the airstrip. Usually performed under the radio control of an airstrip tower operator.

Ambient temperature: the temperature of the surrounding environment.

Antidote: a remedy given by a doctor to counteract the effects of a poison.

Application map: The detailed, topographic, contour map, used by Pointers in guiding spray aircraft from the air. In addition to the basic information relating to spray block boundaries, block identification, flight lines, non-target areas, etc., the map is considerably enhanced when the location of a myriad of terrain micro-features are sketched in by the Pointer to facilitate Pointing.

Application rate: specified rate or dosage of pesticide to be applied for control purposes, usually expressed in weight of active ingredient per hectare (g/ha or kg/ha).

Application volume: the total volume specified or required to deliver the prescribed application rate, expressed in litres per hectare (L/ha).

Artificial respiration (A.R.): first aid method to establish and maintain breathing.

Booms off: a Pointer's message to spray aircraft to cease spraying. See booms on.

Booms on: a Pointer's message to spray aircraft to commence spraying. A boom supports a spray aircraft's spray apparatus. It is usually associated with a pipe that feeds payload from the spray aircraft's hopper to the spray units (nozzles, etc.).

Buffer zone: that portion of a treatment area immediately adjacent to a non-target area. It is established to prevent pesticide from being applied to a non-target area and is not planned to be sprayed. However, pesticide may occur therein because of operational limitations.

Calibration: process whereby pesticide application equipment is set up and/or adjusted to ensure that the required application volumes are maintained.

CANUTEC: Canadian Transport Emergency Centre, operated by Transport Canada. It was established to give information on chemicals.

Carrier: a substance in which a pesticide is dissolved in to aid in achieving the proper application rate.

Chasing: a term used to describe the portion of a spray mission when spray aircraft are actually tracking on Pointers. "The chase" has a corresponding meaning.

Chronic exposure: repeated exposure to a substance over a relatively long period.

Chronic toxicity: the toxic response resulting from repeated exposures to small doses of a toxin over long periods.

Classification (scheduling): the system used in Ontario to classify federally registered products by their toxicity and environmental and health hazards. It restricts the access of pesticides in Ontario. Also refers to the federal system used to group products by use and toxicity as **domestic, commercial, restricted** or **manufacturing.**

Common name (CSA chemical name): the simplified chemical name of the active ingredient in a pesticide which appears on the label as the guarantee (also known as the generic name).

Contaminate: to alter a material by the introduction of a foreign substance, making it unfit for a specific use.

Crabbing: altering the indicated compass heading of an aircraft to compensate for wind which pushes the aircraft off its intended course.

Decontaminate: to remove a contaminant by washing with water or by absorbing. Also to neutralize a contaminant with sand, soil, or charcoal.

Dermal: related to the skin.

Dermatitis: inflammation of the skin.

Diluent 585: a petroleum distillate, which meets rigorous production specifications, used as a pesticide solvent in spraying programs.

Dilute: to lessen the concentration of a pesticide by adding water, oil or inert solids.

Double Pointing: Pointing using two Pointer aircraft at similar altitudes and speeds, one 2.5-3 km directly behind the other on the same flight line. Spray aircraft line up the two Pointers much as one would use a rifle sight and spray the flight line/track indicated by their aligned positions.

Drift: airborne movement of pesticide droplets away from the target area.

Dump zone: a specified area (usually specified within the treatment area) where spray aircraft can eject pesticide. Used only when necessary, i.e. the payload cannot be landed.

Echelon: a term used to describe a formation of aircraft in flight whereby the team leader leads a group of wingmen, each of which is positioned the same fixed distance to the side and to the rear of the aircraft immediately ahead.

Efficacy: the production of the desired effect.

Effective swath width: that portion of the total swath width which receives the desired volume of pesticide; usually referred to as swath width.

Entomologist: a person who studies insects.

Exposure: contact or presence of a gas, liquid or solid on an applicator or bystander, which may be dermal, oral or respiratory.

Extension: the projection of a flight line beyond the boundaries of a spray block.

Ferry distance: the straight line distance that a spray aircraft transports payload from the centre of the airstrip to the point of commencement of spray.

Ferrying: spray aircraft flying a payload to the treatment area prior to actual application.

Flight line: the course to be flown by a Pointer aircraft over the target area, determined by the Pointer and flown by the Pointer pilot.

Formation: the organized distribution of the members of a spray team in flight.

Formulation: the form in which a pesticide is sold. Includes the active ingredient, carriers, diluents, etc.

Fuel bowser: self contained truck or trailer mounted fuel tanker.

Guarantee: the amount of active ingredient in a product as stated on the label, usually expressed as a percentage by weight or weight per unit volume.

Haul distance: see ferry distance.

Hot fuelling: fuelling aircraft while the aircraft engine is running.

Hydraulic shock: the force created by a sudden flow or stoppage of fluid under high pressure which may damage sensitive equipment components.

Inert ingredient: any ingredient in the formulation that has no pesticidal action; some may be to toxic to the applicator.

Ingestion: introduction of a substance into the body by swallowing.

Inhalation: introduction of a substance into the body by breathing.

Insecticide: a substance used to control or kill insects.

Invert emulsion: a liquid mixture characterized by increased viscosity which may cause undesirable handling characteristics.

Irritant: a substance which produces symptoms of inflammation on contact.

LC_{50}: lethal concentration to 50% of a population. A statistical estimate of the concentration of a toxin which will kill half of the test animals exposed under specific conditions.

LD_{50}: lethal dose to 50% of a population. A statistical estimation of the chemical dose which will kill 50% of test animals under specific conditions.

Lead Pointer: head Pointer of a Pointer team. He/she is responsible for the Pointing effort of the team.

Leading Pointer: the initial Pointer in the leading position on a flight line when Double Pointing. Alternates as the trailing Pointer on successive flight lines.

Lining up: positioning of tanker echelon behind the Pointers, coordinated by the spray team leader, such that it tracks on the flight line indicated by the Pointers. Pointers line up when they exit an orbit and commence flying along the adjacent flight line.

***Meet**: rendezvous of ferrying spray aircraft and orbiting Pointers.*

Negative fit check: a check to ensure that a respirator fits properly.

Neoprene: a synthetic rubber-like polymer.

No fly zone: any area over which aircraft are not to fly; may apply to all aircraft (by law) or to just spray aircraft (as per project design).

Non-target area: any area which is to be free of pesticide deposit.

NOTAM: Notices to Airman. These are to be arranged in consultation with and through AFFM.

Noxious: harmful.

Number 1 Pointer: see lead Pointer.

Number 2 Pointer: the subordinate Pointer in a Pointer team, responsible to the lead Pointer.

Octane: rating indicating the various properties of fuel.

Ocular: concerning the eyes.

Oral: concerning the mouth, or taken into the body through the mouth.

Orbit: a circular flying motion by a Pointer aircraft over the same area while waiting for a meet with ferrying spray aircraft.

Outboard: distant from the fuselage of an aircraft.

Payload: the pesticide mixture carried by spray aircraft.

P.C.P.#: Pest Control Product number, issued by Agriculture Canada, for all pest control products.

Pest: undesirable organism.

Pest Control Products Act: the Act administered by Agriculture Canada requiring pesticides to be adequately tested before registration. The pesticide product must have a registration number before legal sale.

Pesticide: a generic term for any substance used to control pests. This includes insecticides, herbicides, fungicides, etc.

Pointer: competent, low level navigator, experienced at determining and following parallel flight lines on which spray aircraft track thereby ensuring the correct delivery of the pesticide on a target area.

Pointing: aerial guidance system for large forest spraying operations where spray aircraft are guided, by Pointers, over the forest, along predetermined flight lines. Pointers fly in light aircraft, above and ahead of the spray aircraft. "Pointer aircraft" and "Pointer pilot" have corresponding meanings.

Poison: a chemical which when taken in small amounts causes illness or death.

Poison Information Centres: located in all provinces, Centres provide first aid information for poison victims, and antidotes and treatment procedures to doctors.

Prop wash: a flow of air produced by a rotating propeller.

Prover: a container of known volume used to cross check other volumes.

P-turn: a manoeuvre whereby aircraft reverse their course of flight in a very short horizontal distance without losing altitude. Aircraft first turn away (to acquire extra room to complete a safe turn) from the desired flight line and then turn back towards it as they complete the 180° turn.

Purge: to clean or drain a container.

Re-entry time: the time that must pass before a person not wearing suitable protective equipment is permitted to enter an area to which a pesticide has been applied.

Registered pesticide: a pesticide accepted under the Pest Control Products Act for the uses claimed.

Registrant: person or company that has registered a product.

Residue: quantity of pesticide left on a crop, animal or surface for a period after it has been treated.

Respirator: a device designed to protect the wearer from inhalation of hazardous air.

Rinsate: usually water, containing small quantities of pesticide and diluent obtained from rinsing pesticide equipment and containers.

Risk: the magnitude of harm resulting from a specific activity and the possibility of the harm occurring.

Shut-offs: a location on the terrain at which spray aircraft cease spraying; or a portion of the target area to which pesticide is not applied. See non-target area.

Single Pointing: Pointing using only one Pointer aircraft.

Solvent: a liquid used to dissolve substances.

Spills Action Centre: A centre established to receive calls reporting spills and to provide information concerning clean up. Operated by the Ontario Ministry of the Environment (1-800-268-0606).

Spray aircraft: an aircraft designed or adapted to apply pesticide at a predetermined application rate.

Spray block: a division of the treatment area. Designed to facilitate the efficient and systematic aerial application of pesticides as befits the Pointing system and spray craft being used. Also facilitates the administration of forest spraying operations.

Spray mission: time period in which the payload is ferried and applied to the treatment area and the spray aircraft returns to the airstrip for another payload.

Spray session: spray missions finished in one sequence of activity, i.e. a morning or evening session.

Spray team: two or more spray aircraft operating together in a coordinated fashion.

Spray team leader: the pilot of the spray aircraft that leads or directs the activities of a spray team.

Spray weather: a set of parameters defining meteorological limits during which spraying should occur.

Stand pipe: a device used to drain contents of a drum in an upright position.

Starting point: a recognizable terrain feature, selected by a Pointer and beside which the Pointer aircraft will orbit while awaiting the arrival of ferrying spray aircraft. It is located on the selected flight line, or extension thereof, beyond the boundaries of a spray block.

Status map: a map of the proposed treatment area on which Pointers record individual spray team loads as completed. As well as depicting the current completion status of the project, the map shows which spray aircraft sprayed what area when.

Sump: a well or recess in the bottom of a tank.

Supervisor: a person who has charge of a workplace or authority over a worker (Occupational Health and Safety Act, Revised Statutes, 1980, Chapter 321, Section 1 - Subsection 26).

Swath: the effective coverage of spray emitted by a spray aircraft in flight, measured perpendicular to the direction of travel.

Swath line: see flight line.

Target area: that portion of a treatment area selected for treatment.

Team swath: the combined, effective swath of a team of spray aircraft (see swath).

Tight orbit: a short radius orbit.

Top of the turn: that point in a P-turn when an aircraft is farthest from the spray block and has just started to turn in and line up the Pointer(s) for the next flight line.

Total swath width: the total width upon which spray deposit can be measured.

Toxicity: the ability of a substance to cause sickness or death. Toxicity is distinct from hazard.

Track: the course to be followed by spray aircraft over the forest canopy as indicated by the flight of a Pointer aircraft above the spray aircraft. Tracking has a corresponding meaning.

Trailing Pointer: the Pointer that follows the leading Pointer along a flight line when Double Pointing. Alternates as the leading Pointer on successive flight lines.

Transfer pump: pump used to transfer liquid from one container to another (a mico or wobble pump).

Transportation of Dangerous Goods Act: a federal Act, administered by Transport Canada, promoting safety in transporting dangerous goods. Many pesticides are classified as dangerous goods.

Treatment area: forest area to be protected with a pesticide.

Triple rinse: method of properly rinsing containers by filling container 10% full with water, then capping, shaking the container and adding the rinsate to the spray tank. Repeat two more times.

Turning in: when an aircraft changes its flight path to fly along a desired flight line; or when spray aircraft are lining up on Pointers, the latter exit their respective orbit and turn in on the flight line.

ULV (ultra low volume): a spray application of a pesticide that is almost pure active ingredient. Application rates are only 5 to 6 L/ha or less.

Viscosity: the ease with which a fluid will flow.

Volatility: refers to the ease with which a material evaporates.

Vortex: the spiralling movement of air produced at the tips of aircraft wings or helicopter rotor blades.

Waiting: a term used to describe that portion of a spray mission when Pointer aircraft orbit at their appropriate starting points and wait for ferrying sprayers.

Weather check: an assessment of the current atmospheric conditions. Best performed by Pointers over the proposed target area, immediately prior to a proposed spray mission. Air temperature and wind are the main subjects of assessment.

Wingman: member of a spray team (pilot or aircraft) other than the spray team leader; or the pilot or spray aircraft immediately behind another spray aircraft in a formation.

Wingspan: maximum width of an aircraft measured by the shortest distance from wing tip to wing tip.

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