

## CHAPTER 3

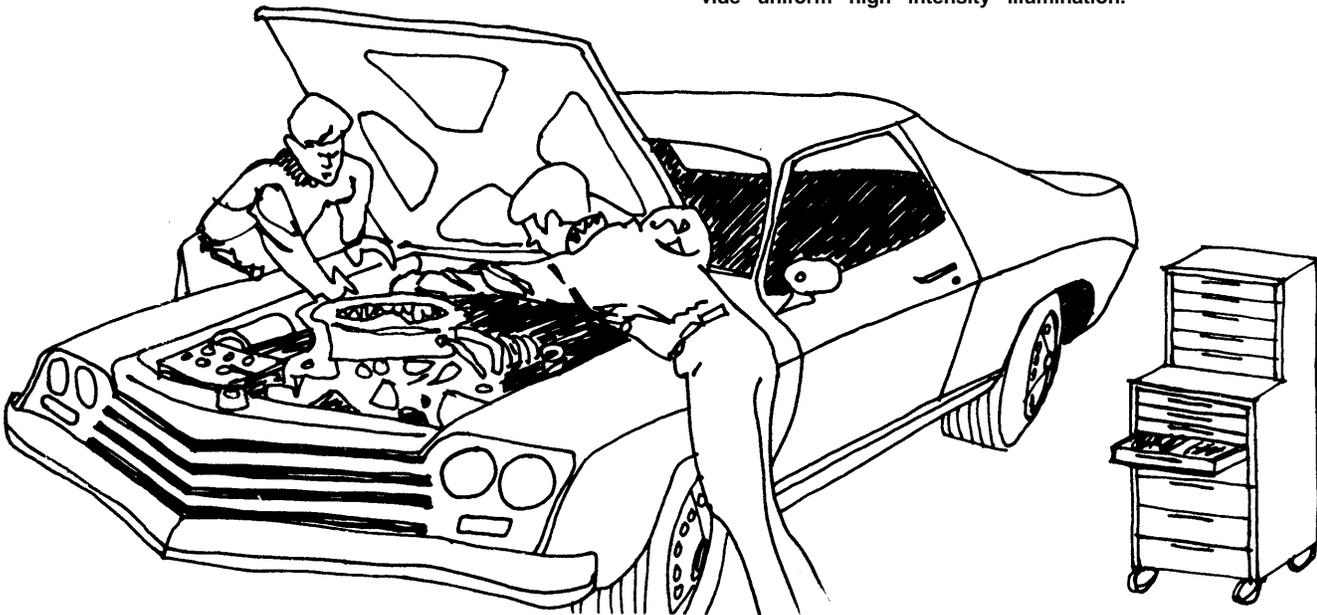
# Functional Space Requirements

## 3-1 General

a. The Department of Defense *Construction Criteria Manual* 4270.1-M establishes the maximum space allowances for Auto Crafts Centers based upon the military population of the installation and the overall maximum allowance for the entire facility of 500 square feet per automobile repair stall. The example illustrations in this guide are for installations with military populations of 15,000 to 20,000. A facility of this size provides 34 stalls and an authorized gross area of 17,000 square feet exclusive of mechanical equipment rooms.

b. The general repair and tune-up stalls, the muffler and tire shop, and the lubrication stalls should be designed to facilitate frequent movement of vehicles. These functions are compatible to the extent that they can all be performed within a common maintenance area.

c. Auto body work stalls should be separated from other work areas because of the dust and noise produced. A separate ventilation system adequate to remove injurious dust and vapors is required. Paint spray booths also require physical separation and independent exhaust systems. Prefabricated spray booths are becoming more popular on military installations and are usually better than those built on site. These may be installed within the garage itself or free standing in an outdoor work area. They are often modular and available in a wide range of sizes. Units must meet stringent design requirements of fire underwriters to confine any accidental blaze. Most booth manufacturers have attempted to position their diffusers and light sources to remove overspray and provide uniform high intensity illumination.

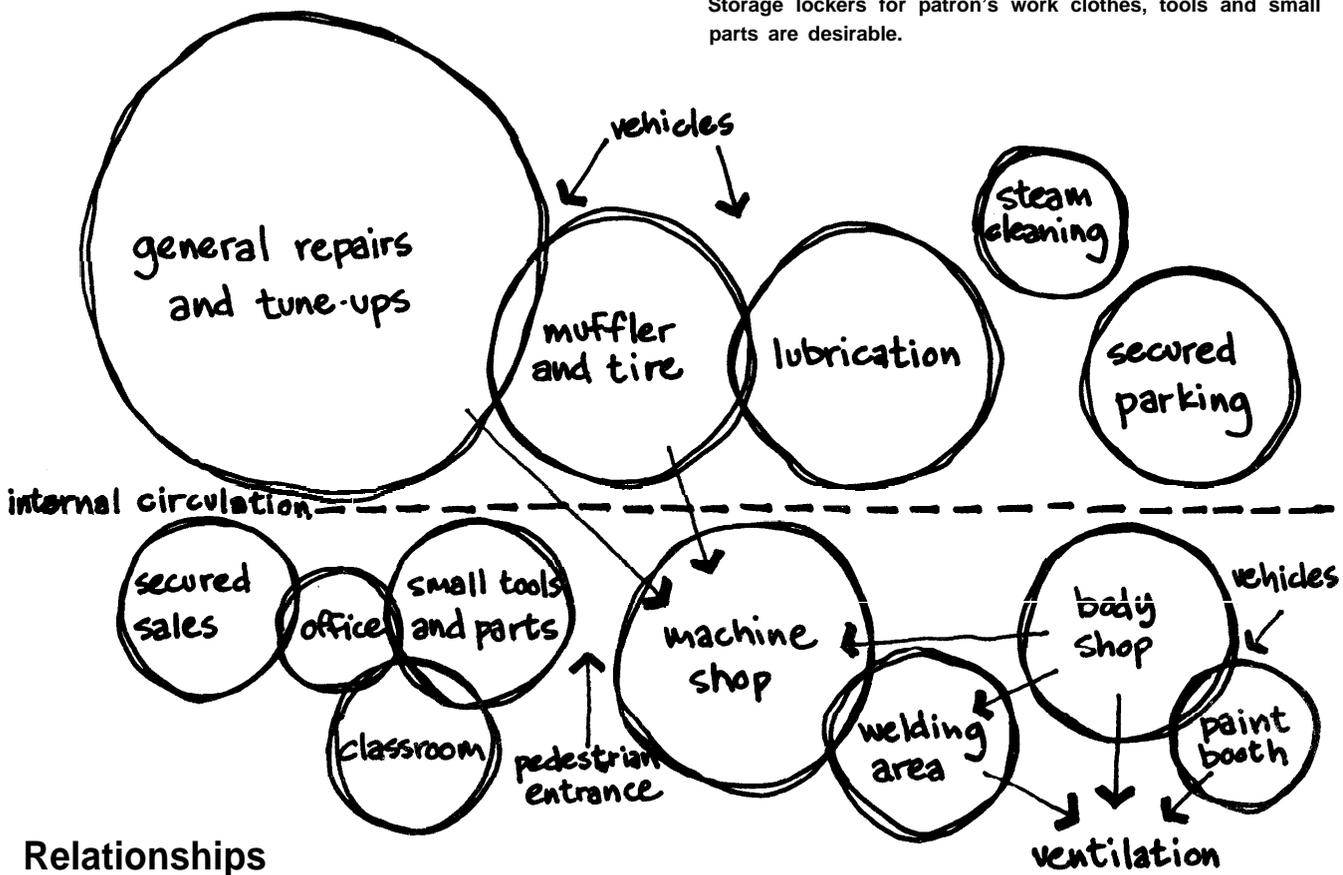


d. Steam cleaning stalls should be separated from dry activity areas. Steam cleaning can also be done outdoors, and ideally the equipment may be located for both indoor and outdoor use. Concrete pads should be provided to eliminate deterioration of asphalt paving.

e. The machine and welding shop should be convenient to the repair areas and storage areas. A separate ventilation system is required for welding booths.

f. The classroom is used for formal instruction and club meetings. A small library may be included. Provisions should be made for the use and storage of visual aids, models and other training materials,

g. The office, sales, tool issue and storage areas should be designed as a unit so they may be controlled from a centrally located supervisor's station. The method of storing and issuing tools varies, but the options include individual tool kits, open tool panels which are sometimes portable, and controlled tool issue rooms. In addition to storage requirements for tools, storage of flammable material such as paint and welding tanks must be provided in enclosures away from the building and from vehicles. Storage lockers for patron's work clothes, tools and small parts are desirable.



Relationships

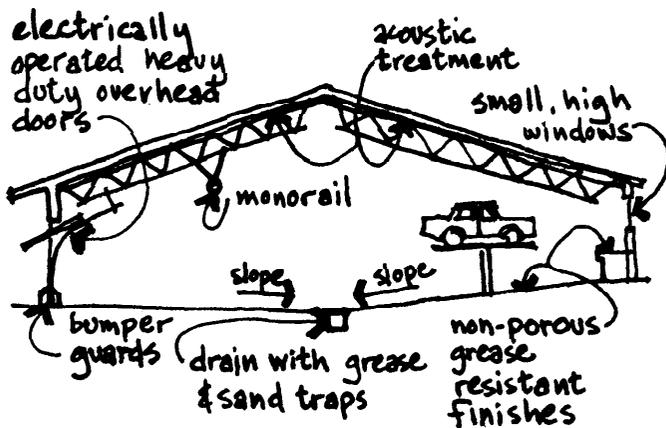
## 3-2 Physical Requirements

a. Most shop areas can be treated as typical industrial space. Floors should be impervious concrete sloped to adequate floor drains or gutters with special grease and sand traps. Wall surfaces should be durable, impervious to water and grease, and easily washable. The overhead roof structure can be exposed. A minimum ceiling height of 15 feet is necessary for areas with hydraulic lifts and it is frequently more economical to provide this headroom universally throughout the structure. Acoustical materials on the underside of roofs help to reduce noise to a comfortable level. A monorail, with a capacity of not less than one ton, is very desirable along at least one side of the shop. This requires reinforcement of the overhead structural system.

b. Modern automotive shop practice discourages the use of large numbers of windows. Wall space is at a premium for functional purposes. Natural light is not a necessity and the reduction of glazing makes the garage easier to heat and cool. Utility lines ideally are located exposed along walls above work counters and equipment where they can be easily changed or expanded, and where portable equipment can be easily connected,

c. The number of overhead vehicle doors depends on the size and layout of the garage. A high quality heavy duty door is important; it is recommended that each door be no less than 12 feet wide by 12 feet high. Residential type doors which have been installed in many facilities do not stand up well under the intensive use common to these garages. Electrically opened doors are preferable if they can be budgeted. They are essential where the design limits the number of openings so that the traffic through them is very heavy. The lower panels of the doors should be solid with vision panels above for safety. Heavy duty bumper guards should be used around all vehicle openings and on exposed wall corners.

d. The classroom is basically an open area and can be treated as typical instructional space. Floors should be provided with grease resistant tiles.

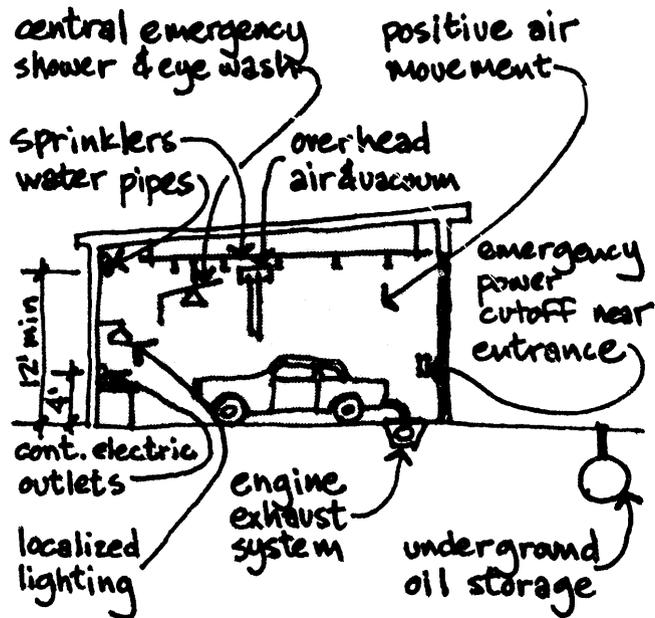


### Treatment

## 3-3 Technological Requirements

a. An engine exhaust system is essential. It is recommended that this be at least 8 inches in diameter and installed under floors, preferably in trenches with removable steel covers for maintenance. Flexible conduits from outlets at floor level can be connected to tailpipes or engine. If underground ducts are impractical or too expensive, an overhead exhaust system may be used. This means that flexible connections must be brought down from above at convenient locations. A forced convection fan with automatic control and visual indicator is necessary to reduce pressure in the system at all times.

b. Positive air movement through the work areas must be provided to minimize carbon monoxide dangers. Local climate conditions will influence heating, cooling, and ventilation requirements. However, heating, air conditioning and ventilation shall conform to the applicable portions of current editions of NFPA No. 88B, ASHRAE Handbooks and DOD *Construction Criteria Manual*



Services

4270.1 -M. Consideration should be given to such items as comfortable floor level temperatures, hot air compensation for heat loss at exterior doors, and zone heating controls.

c. In the body work area, machine shop and welding booths, separate ventilation systems which remove dust and filings should be provided. Paint booths also require their own ventilation systems, and a hood with independent exhaust should be placed over battery charging benches. Air conditioning may be provided for the classroom and office as permitted by the DOD *Construction Criteria Manual 4270.1-M*.

d. An underground storage tank for waste engine oil is the most satisfactory storage solution if a pump removal service is available at the installation.

e. Hot and cold water supplies are necessary to toilet rooms and service sinks in the shops. Electric chilled water drinking fountains are very desirable in each shop. At least one emergency eye wash and shower, centrally located, is essential.

f. Water pipes should run underground or along walls at least 12 feet overhead so they will not be readily damaged. Oil and sand interceptors are required on floor drainage. There are stringent regulations on some installations concerning water discharged into sewage systems and an early check of the requirements should be made when planning a facility. A long interceptor gutter about 15 inches wide covered by sectional metal grating is a good solution to the washdown problem in the shops.

g. Compressed air outlets should be provided at the work counters. In addition to portable fire extinguishers, shops should be sprinklered.

h. Electric outlets should be located at approximately 10 foot intervals along the walls. Power should be 115 V, 60 cycles, single phase, A.C. and also a 6 volt and 12 volt D.C. supply at work benches is important. Heavy duty fans, air compresses and other equipment require 208 volt, three phase A.C. current. Motors, switches, and lights in spray booths must be vaporproof. Circuits should be limited to about four outlets, and master emergency "stop" switches should be provided for each circuit.

## 3-4 Furnishings and Equipment

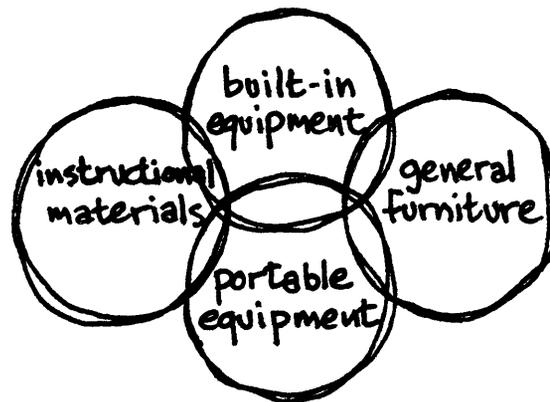
Automotive design is characterized by frequent model changes which affects service procedures and maintenance equipment. Auto Crafts Centers should therefore be equipped for future adaptations as new procedures occur. A case in point is the emission control testing equipment that is necessary in response to the latest federal and state requirements.

b. The following list of service equipment is not intended to be all inclusive but rather to give designers a general idea of built-in and portable items that must be considered:

Paint spray booths, hydraulic lifts, drill presses, bench grinders, two-station arc welding tables, wheel alignment service center, one ton mechanical jacks, two ton hydraulic jacks, transmission and differential lifts, mono-rail system, one ton differential chair hoist, tire changers, air compresses, parts cleaner, steam cleaner, engine analysis system centers, portable parts cabinets and mechanics chests, steel topped work counters, metal lathes, brake lathes, armature lathes, battery chargers, motor repair stands, wheel balances, and hand tools, both metric and standard.

c. In addition to service equipment, the classroom requires the following instructional materials:

Demonstration table, classroom tablet arm chairs, table for upholstery work, sewing machine, glass demonstration motor with transmission, visual aid demonstration panels, instructor's desk and a supervisor's desk, portable work counters, chalkboard, projection screen, lockable file drawers, and small parts storage cabinets.



Types

## Suggested Quantity of Equipment

Equipment Items	Number of Automobile Stalls				
	4	8	12	16	30
Bench Grinder	1-3	1-3	2-4	3-6	6-10
Bench Buffer	1	1-2	2-4	2-4	2-6
Spark Plug Cleaner-Tester	1	1-3	3-6	3-8	4-8
Steel Work Benches	4-6	8-10	12-16	16-20	20-30
2-Station Welding Table	1	2-3	2-4	4-6	4-8
Hydraulic Lift	1	1-2	1-4	1-6	6-8
Alignment Service	0-1	1-2	1-4	1-6	1-6
Bumper Jacks	1-2	2-3	2-6	4-8	8-12
Tire Changer	1	1-3	1-4	1-6	3-8
Metal Lathe	0	0	1-2	1-3	2-4
Brake Lathe	0	0-1	1-2	1-3	2-4
Armature Lathe	1	1-2	1-3	1-6	2-8
Arbor Press	0	0-1	1	1	2
Vacuum Cleaner	1	1	2	2	4
Battery Charger	1-2	1-3	2-4	2-6	4-8
Safety Stands	2-4	4-6	6-8	12-18	30-40
Vacuum Fuel Pump	1	1-3	1-4	1-6	1-8
Tachometer	1-2	1-3	1-4	1-6	1-8
Micrometer	1-2	1-3	1-4	1-6	1-8
Headlight Adjuster	0-1	1-3	1-4	1-6	1-8
Portable Power Tools					
Polisher/Drill/Sander	1-3	1-4	1-6	2-12	20-25
Machinist Vise	1-3	2-4	3-10	4-12	10-20
Blacksmith Anvil	1-3	1-3	2-4	2-6	10-12
Air Compressor	1-2	1-3	1-4	1-6	2-12
Spray Booth	0-1	0-1	1-3	1-4	2-10
Lube Unit	1-2	1-3	2-6	2-8	6-10
Scope Analyzer	0-1	0-2	1-3	1-6	2-8
Soldering Unit	1-2	1-3	1-6	1-8	3-10
Welding Unit	0-1	0-1	1-3	1-6	2-8
Portable Crane	0-1	1-2	1-3	1-4	2-6
Valve Refacer	0-1	0-1	1-3	1-4	2-6
Steam Cleaner	0-1	0-1	1-2	1-3	2-4
Transmission/Differential Lift	1-2	1-3	1-4	2-6	4-6
Motor Repair Stand	1-3	2-4	2-6	2-8	4-10
Parts Cabinet	1-4	1-6	1-8	1-10	3-12
Washer Parts	0-1	0-1	1-3	1-4	2-6
Radiator Testing/Repair	0-1	1-3	1-4	1-6	2-8
Wheel Balancer	0-1	1-3	1-4	1-6	3-10
Impact Wrenches	1-2	1-3	2-4	2-6	6-8
Cylinder Sets	1-2	1-4	2-6	2-8	4-10
Puller Sets	2-3	4-6	9-11	13-18	26-32
Hand Tool Sets	Various	Various	Various	Various	Various

## 3-5 Summary of Space Allocations

a. Department of Defense *Construction Criteria Manual 4270.1 -M* establishes space allowances for the entire Auto Crafts Center at a maximum of 500 square feet per automobile stall. It should be recognized that discretion must be exercised in applying this space allocation to meet the needs of a particular installation. For instance, an outdoor covered work area is computed as one-half the square footage of a similar sized space fully enclosed. Regions of the country with climates which permit extensive use of outdoor covered work areas can take full advantage of this factor. Conversely, in very cold climates it makes little sense to adopt a design which is drafty, uncomfortable, and difficult to heat because of a large number of overhead vehicle doors. However, the type of design more common in larger commercial garages, which has a limited number of vehicular entrances also requires more space for maneuvering of cars inside. In such instances, an economic analysis should be made to balance the added cost of constructing extra space for internal vehicular circulation against the reduced cost of operation, the possible savings in perimeter walls, and the improvements in comfort of the participants.

b. The following tables show typical space allocations for two types of Auto Crafts Centers. Table A shows the allocation of space for a facility with vehicular circulation on the outside of the building and with an overhead access door for each auto stall. Table B shows the allocation of space in the same size facility, however, access to auto stalls is by vehicular lanes inside the building. The implications of providing vehicular circulation within the building can be readily seen by comparing the total number of auto stalls provided.

c. An example design for a new facility of 34 stalls and 17,000 square feet is provided in Chapter 5.

**TABLE A**  
**External Vehicular Circulation**

**TABLE B**  
**Internal Vehicular Circulation**

SPACE	UNIT AREA	ACTIVITY AREA	SPACE	UNIT AREA	ACTIVITY AREA
GENERAL REPAIRS & TUNE-UPS 17 stalls at 12' x 28'	336	5,712	GENERAL REPAIRS & TUNE-UPS 12 stalls at 12' x 24'	288	3,456
MUFFLER & TIRE SHOP 6 stalls at 12' x 24'	288	1,728	MUFFLER & TIRE SHOP 5 stalls at 12' x 24'	288	1,440
LUBRICATION STALLS 6 stalls at 12' x 24'	288	1,728	LUBRICATION STALLS 4 stalls at 12' x 24'	288	1,152
BODY SHOP 3 stalls at 12' x 24'	288	864	BODY SHOP 3 stalls at 12' x 24'	288	864
PAINT BOOTH 1 stall at 12' x 24'	288	288	PAINT BOOTH 1 stall at 12' x 24'	288	288
STEAM CLEANING STALL 1 stall at 12' x 24'	288	288	STEAM CLEANING STALL (Located outside)	---	---
MACHINE & WELDING SHOP Shop area Welding area	1,600 400	2,000	MACHINE & WELDING SHOP Shop area Welding area	1,600 400	2,000
OFFICE & STORAGE AREAS Office space Small tools and parts Issue area Secured sales	100 700 100 600	1,500	OFFICE & STORAGE AREAS Office space Small tools and parts Issue area Secured sales	100 700 100 600	1,500
CLASSROOM Classroom Storage room	600 50	650	CLASSROOM Classroom Storage room	600 50	650
SERVICE AREAS Mens' toilet & locker Womens' toilet & locker Wash areas Vending areas Custodial	240 150 200 50 70	710	SERVICE AREAS Mens' toilet & locker Womens' toilet & locker Wash areas Vending area Custodial	240 150 200 50 70	710
TOTAL NET AREA	15,468 square feet		TOTAL NET AREA	12,060 square feet	
CIRCULATION	600 square feet		CIRCULATION	4,340 square feet	
CONSTRUCTION	932 square feet		CONSTRUCTION	600 square feet	
GROSS BUILDING AREA	17,000 square feet		GROSS BUILDING AREA	17,000 square feet	
TOTAL NUMBER OF AUTO STALLS	34		TOTAL NUMBER OF AUTO STALLS	25	