ENVIRONMENTAL CONTROL SYSTEM DESIGN
FOR THE ANIMAL SCIENCE BUILDING
OKLAHOMA STATE UNIVERSITY

By

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Bachelor of Science

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the requirements for
the Degree of
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ACKNOWLEDGMENT

I wish to express my sincere gratitude to all the people who assisted me in this work and during my stay at Oklahoma State University. In particular, I am especially indebted to my major adviser, Dr. Lester L. Boyer, for his intelligent guidance, concern and help.

I am also thankful to the other committee members, Prof. Walter T. Grondzik and Allen Brunken, for their advisement in the course of this work. Special thanks are due to Prof. Walter T. Grondzik for his guidance, encouragement and remarks at various phases of the project.

My parents, my wife, Healan, my brothers and sister deserve my deepest appreciation for their constant support, encouragement, and understanding.

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CHAPTER I. INTRODUCTION

1. BACKGROUND

Historically, each aspect of the environmental control systems in a building have been designed by the isolated specialist of each discipline such as mechanical engineering, civil engineering, electrical engineering, each knowing only a very small area of technology involved in the building system; the process lacks system coordination with an architectural background. As the size and the function of the modern buildings have become greater and more complicated, buildings have become more reliant on the supporting environmental control systems; the cost of the systems reached great portion of the total building cost. Moreover, the increasing cost of energy in recent years requires more intra-and interdisiplinary coordination in the building design.

The Architectural Engineering/Environmental Control program in the School of Architecture, O.S.U. has been developed to educate and produce the architectural engineer who can meet the increasing need for coordinator between architects and engineers as well as between engineers of several diciplines in the architectural industry.

Besides the general architecture courses including architectural design and structure courses, and general engineering courses, the core courses of the A.E./Environmental control program consists of Basic Environmental Control Systems I and II, Comfort Analysis, Environmental Power and Alternative Energy Systems, Advanced Illumination and Power Systems, Advanced Acoustics and Noise Control, Environmental Hazards and Special Environment, Advanced E.C.-I(Lowrise HVAC), Advanced E.C.-II(Highrise System Integration), E.C. Control Seminar and Professional Project.

2. PURPOSE AND OBJECTIVES

The purpose of this professional project is to fulfill the partial requirements for the degree of the Master of Architectural Engineering.

The Animal Science Building of the Oklahoma State University is selected as the project building because of its multiple function, and its greater reliance on the environmental control system than other ordinary buildings.

The objectives of this project are to develop an academic approach and a professional experience in the analysis, design, and documentation of the efficent environmental control systems for the complicated, multi-functional building; and to recognize the importance of intra-and intersystem coordination and integration.

3. SCOPE AND LIMITATION

This project will deal with the development of HVAC, lighting, electrical, plumbing, acoustical, and safety/fire protection systems for classroom/ lacture halls, research laboratories, administrative offices, and other supporting facilities in the Animal Science Building, under the assumption that the major architectural and structural design has completed.

The development of each system will consist of three phases:

Task analysis: to identify and analize the needs and problems.

Preliminary design: to conceptualize and develop the needs and solutions.

Detail design: to select and distribute the components based on the design concept.

Each system will deal with the entire building, however, detailed analysis and design will be limited to the major space categories identified in the task analysis phase.

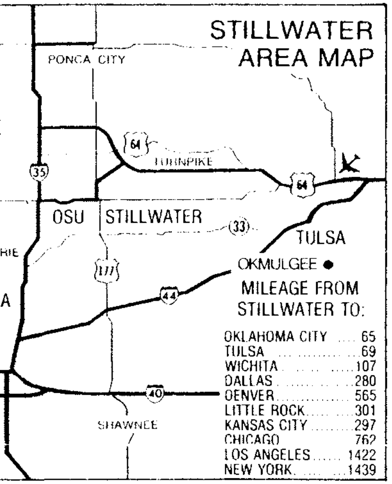
CHAPTER II. DATA ANALYSIS

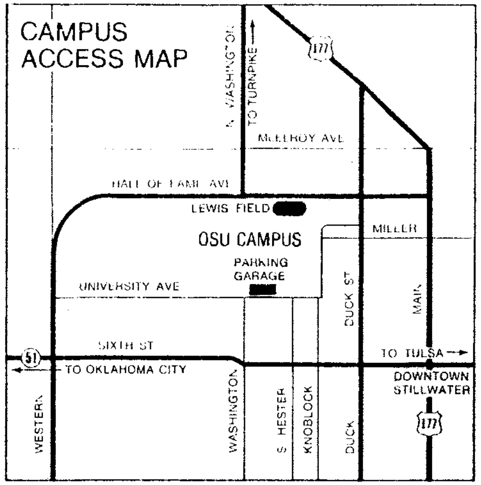
1. SITE ANALYSIS

A. SITE DESCRIPTION

The Animal Science Building is located in the central section of the O.S.U. campus. The principal facade faces east on to Monroe Street. The building is bounded on the east across Monroe Street by the University printing service building, on the south across Farm Road by the Agriculture Hall, on the west by the Meat Laboratory, and on the north by the poultry building. The University physical plant and the O.G.& E. substation are both located close to the site on the east and west respectively.

Vehicular circulation around the site is heaviest on Monroe Street, which is one of the most frequently used access roads to the main campus from Hall of Fame Avenue. Parking is located at the corner of Monroe Street and Farm Road. Truck delivery and service access to the building is provided on the west side between the Meat Laboratory and the Poultry Building, from Lincoln Street.



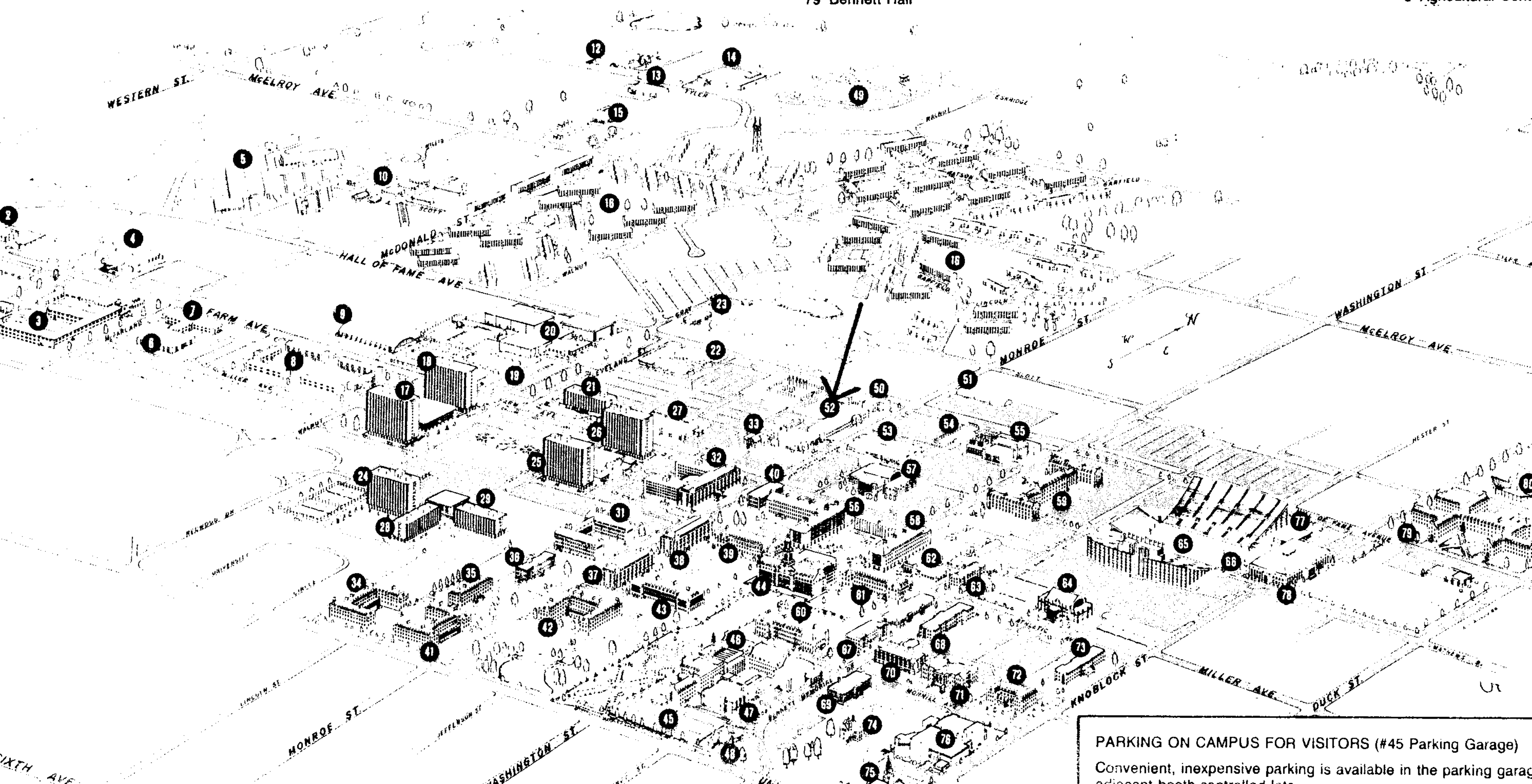


OSU Campus

FIG - II - 1

Alphabetical Index

Numerical Inde



PARKING ON CAMPUS FOR VISITORS (#45 Parking Garage)

Convenient, inexpensive parking is available in the parking garag

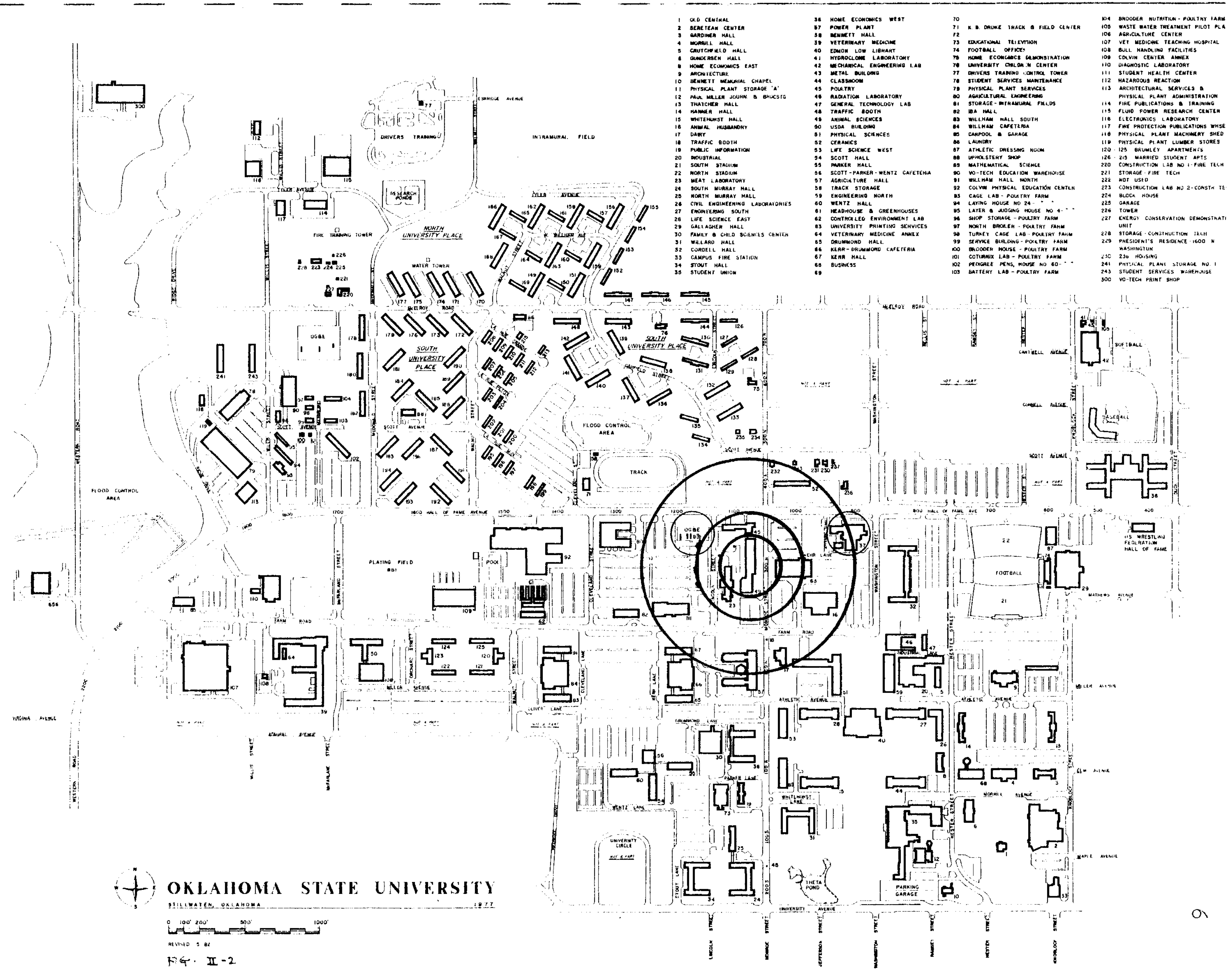

1 OLD CENTRAL
2 SERETEAN CENTER
3 GARDINER HALL
4 MORRILL HALL
5 CRUTCHFIELD HALL
6 GUNDERSEN HALL
8 HOME ECONOMICS EAST
9 ARCHITECTURE
10 BENNETT MEMORIAL CHAPEL
11 PHYSICAL PLANT STORAGE 'A'
12 PAUL MILLER JOURN. & BRDCSTG
13 THATCHER HALL
14 HANNER HALL
15 WHITEHURST HALL
16 ANIMAL HUSBANDRY
17 DAIRY
18 TRAFFIC BOOTH
19 PUBLIC INFORMATION
20 INDUSTRIAL
21 SOUTH STADIUM
22 NORTH STADIUM
23 MEAT LABORATORY
24 SOUTH MURRAY HALL
25 NORTH MURRAY HALL
26 CIVIL ENGINEERING LABORATORIES
27 ENGINEERING SOUTH
28 LIFE SCIENCE EAST
29 GALLAGHER HALL
30 FAMILY & CHILD SCIENCES CENTER
31 WILLARD HALL
32 CORDELL HALL
33 CAMPUS FIRE STATION
34 STOUT HALL
35 STUDENT UNION
36 HOME ECONOMICS WEST
37 POWER PLANT
38 BENNETT HALL
39 VETERINARY MEDICINE
40 EDMON LOW LIBRARY
41 HYDROCLONE LABORATORY
42 MECHANICAL ENGINEERING LAB
43 METAL BUILDING
44 CLASSROOM
45 POULTRY
46 RADIATION LABORATORY
47 GENERAL TECHNOLOGY LAB
48 TRAFFIC BOOTH
49 ANIMAL SCIENCES
50 USDA BUILDING
51 PHYSICAL SCIENCES
52 CERAMICS
53 LIFE SCIENCE WEST
54 SCOTT HALL
55 PARKER HALL
56 SCOTT-PARKER-WENTZ CAFETERIA
57 AGRICULTURE HALL
58 TRACK STORAGE
59 ENGINEERING NORTH
60 WENTZ HALL
61 HEADHOUSE & GREENHOUSES
62 CONTROLLED ENVIRONMENT LAB
63 UNIVERSITY PRINTING SERVICES
64 VETERINARY MEDICINE ANNEX
65 DRUMMOND HALL
66 KERR-DRUMMOND CAFETERIA
67 KERR HALL
68 BUSINESS
69
70
71 K. B. DRUKE TRACK & FIELD CENTER
72
73 EDUCATIONAL TELEVISION
74 FOOTBALL OFFICES
75 HOME ECONOMICS DEMONSTRATION
76 UNIVERSITY CHILDREN CENTER
77 DRIVERS TRAINING CONTROL TOWER
78 STUDENT SERVICES MAINTENANCE
79 PHYSICAL PLANT SERVICES
80 AGRICULTURAL ENGINEERING
81 STORAGE-INTRAMURAL FIELDS
82 IBA HALL
83 WILLHAM HALL SOUTH
84 WILLHAM CAFETERIA
85 CARPOOL & GARAGE
86 LAUNDRY
87 ATHLETIC DRESSING ROOM
88 UPHOLSTERY SHOP
89 MATHEMATICAL SCIENCE
90 VO-TECH EDUCATION WAREHOUSE
91 WILLHAM HALL NORTH
92 COLVIN PHYSICAL EDUCATION CENTER
93 CAGE LAB - POULTRY FARM
94 LAYING HOUSE NO 24 - " "
95 LAYER & JUDGING HOUSE NO 4 - " "
96 SHOP STORAGE - POULTRY FARM
97 NORTH BROILER - POULTRY FARM
98 TURKEY CAGE LAB - POULTRY FARM
99 SERVICE BUILDING - POULTRY FARM
100 BROODER HOUSE - POULTRY FARM
101 COTURNIX LAB - POULTRY FARM
102 PEDIGREE PENS, HOUSE NO 60 - " "
103 BATTERY LAB - POULTRY FARM
104 BROODER NUTRITION - POULTRY FARM
105 WASTE WATER TREATMENT PILOT PLA
106 AGRICULTURE CENTER
107 VET MEDICINE TEACHING HOSPITAL
108 BULL HANDLING FACILITIES
109 COLVIN CENTER ANNEX
110 DIAGNOSTIC LABORATORY
111 STUDENT HEALTH CENTER
112 HAZARDOUS REACTION
113 ARCHITECTURAL SERVICES & PHYSICAL PLANT ADMINISTRATION
114 FIRE PUBLICATIONS & TRAINING
115 FLUID POWER RESEARCH CENTER
116 ELECTRONICS LABORATORY
117 FIRE PROTECTION PUBLICATIONS WHSE
118 PHYSICAL PLANT MACHINERY SHED
119 PHYSICAL PLANT LUMBER STORES
120 - 125 BRUMLEY APARTMENTS
126 - 219 MARRIED STUDENT APTS
220 CONSTRUCTION LAB NO 1 - FIRE TECH
221 STORAGE - FIRE TECH
222 NOT USED
223 CONSTRUCTION LAB NO 2 - CONSTR TE
224 BLOCK HOUSE
225 GARAGE
226 TOWER
227 ENERGY CONSERVATION DEMONSTRATI UNIT
228 STORAGE - CONSTRUCTION TECH
229 PRESIDENT'S RESIDENCE - 1600 N WASHINGTON
230 236 HOUSING
241 PHYSICAL PLANT STORAGE NO. 1
243 STUDENT SERVICES WAREHOUSE
300 VO-TECH PRINT SHOP
INTRAMURAL FIELD
DRIVERS TRAINING
RESEARCH PONDS
FIRE TRAINING TOWER
WATER TOWER
NORTH UNIVERSITY PLACE
SOUTH UNIVERSITY PLACE
FLOOD CONTROL AREA
TRACK
PLAYING FIELD
FOOTBALL
US WRESTLING FEDERATION HALL OF FAME
SOFTBALL
BASEBALL
THETA POND
PARKING GARAGE
UNIVERSITY CIRCLE
McELROY ROAD
HALL OF FAME AVENUE
FARM ROAD
ATHLETIC AVENUE
UNIVERSITY AVENUE
WASHINGTON STREET
HESTER STREET
KNOBLOCK STREET
WESTERN ROAD
VIRGINIA AVENUE
OKLAHOMA STATE UNIVERSITY
STILLWATER, OKLAHOMA
1977
0 100' 200' 500' 1000'
REVISED 5 82

FIG. II-2

B. GEOGRAPHICAL DATA

This region is characterized by rolling plains with scattered trees and various vegetation. Stillwater is located in the north central part of the state, north of Oklahoma City and west of Tulsa.

Longitute: 36° 10'
Latitude : 97° 10'
Elevation: 834'
Critical Sun Angle: 30° on December 21(winter solstice)
80° on June 21(summer solstice)

C. CLIMITICAL DATA

The climate of this region is characterized by a variety of moderate to extremes mixed with the prevailing conditions of a pleasant continental climate; however, it can at times be unpredictable and harsh. Summer temperature extremes occasionally reach and exceed $100^{\circ}F$, while Arctic air-masses cause winter temperatures to drop to $-10^{\circ}F$. The hottest months are July and August and the coldest months are January and February.

The annual precipitation in this region averages 33" per year. Highest rainfall is usually in May with an average of 5.7", while the lowest is in December with an average 0.6" in. Average mid-day and early-evening humidities in July range from 60 to 70 percent.

Wind velocities in north central Oklahoma are among the highest in the continental United States The average wind velocity is about 14 mph. The prevailing direction of the wind is from the southwest in summer, and from the northwest in winter. In spring, fronts of warm moist Gulf air often trigger sudden brief thunderstorms, high winds, and tornadoes.

Sunshine is predominant in all seasons, with September having the highest index of clear skies.

D. UTILITY DATA

Steam and chilled water are supplied from the University Power Plant. Normal Electrical Power is supplied from the O.G.& E. substation and backed-up by the emergency power from the University Power Plant. Public water, sanitary sewer, storm sewer, natural gas supply and telephone lines are also available as indicated in the drawing(Fig. II-3).

Water: 65 lbs/sq.in. public water from 8" city main
Steam supply: 50 lbs/sq.in. 350°F
Steam return: 12 lbs/sq.in. 195°F
Chilled water supply: 96 lbs/sq.in. 40°F
Chilled water return: 82 lbs/sq.in. 56°F
Electricity: 12.47 kv from O.G.& E substation
Natural gas: 35 lbs/sq. in. natural gas from O.N.G. Co.
Storm drain
Sanitary sewer
Fire hydrant
Telephone vault

2. BUILDING ANALYSIS

A. BUILDING DESCRIPTION

The basic layout of the Animal Science Building is that of a two story, linear-shaped main structure, with a one story annex connected to the south end of the structure. The main entrance lobby is located where the annex joins the main building.

The main structure is divided into two zones along side the main corridor: on the east side is the office zone and on the west side are the research laboratories and supporting service facilities, including mechanical and electrical rooms, janitors' closets, and toilets.

The annex structure is also divided into two sections along side the corridor: on the east are two classrooms and on the west are two large lecture halls.

The operation hour of the building facilities is basically from 7:30 am. to 5:00 pm. on weekdays, however, some night time and weekend operation of the laboratories are expected.

B. SPACE CATEGORIZATION

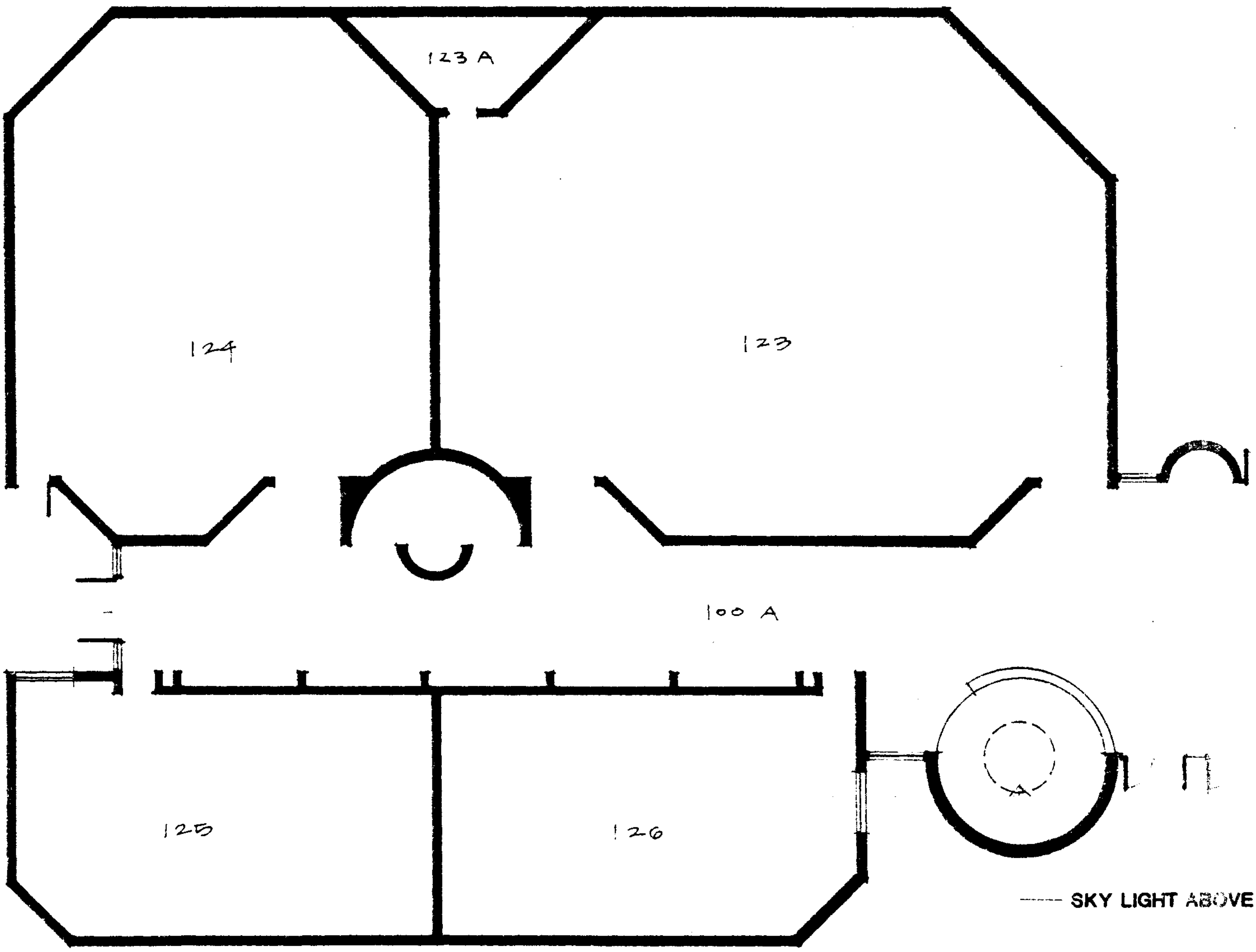
	floor area(sq. ft.)		
		main building	
space category	annex	1st. fl.	2nd. fl.
class/lecture	6338	-	-
office	-	3181	3343
circulation	2123	2263	2290
reception/hall	-	1323	1496
conference	-	979	160
computer	-	-	300
work/service	-	408	643
laboratory	-	5349	5304
toilet	-	434	280
non-conditioned	123	4500	3947
total	8584	18505	17763

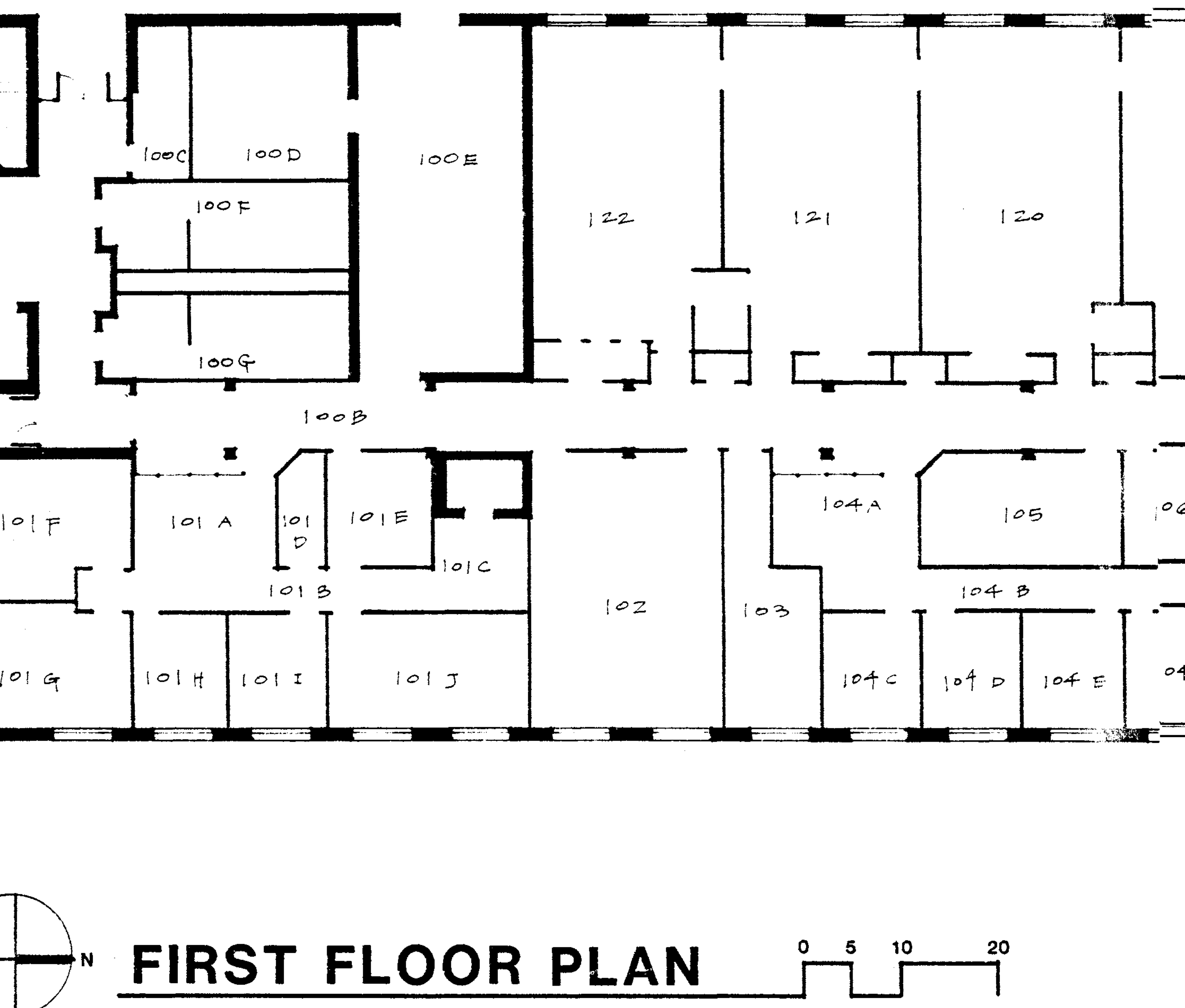
C. STRUCTURAL SYSTEMS

Several structural systems were combined to allows environmental control systems to be installed and serviced ecomically.

In the main structure, 8' widi and 2' deep double trees were placed over the exterior load bearing wall, and interior steel beams and column along the main corridor. Over the double tee were placed the metal deck and concrete slab. As a result, ceiling plenum over the corridor can be utilized as a mechanical distribution space. The roof of the corridor was raised and expanded to provide more ceiling plenum space for mechanical distribution system.

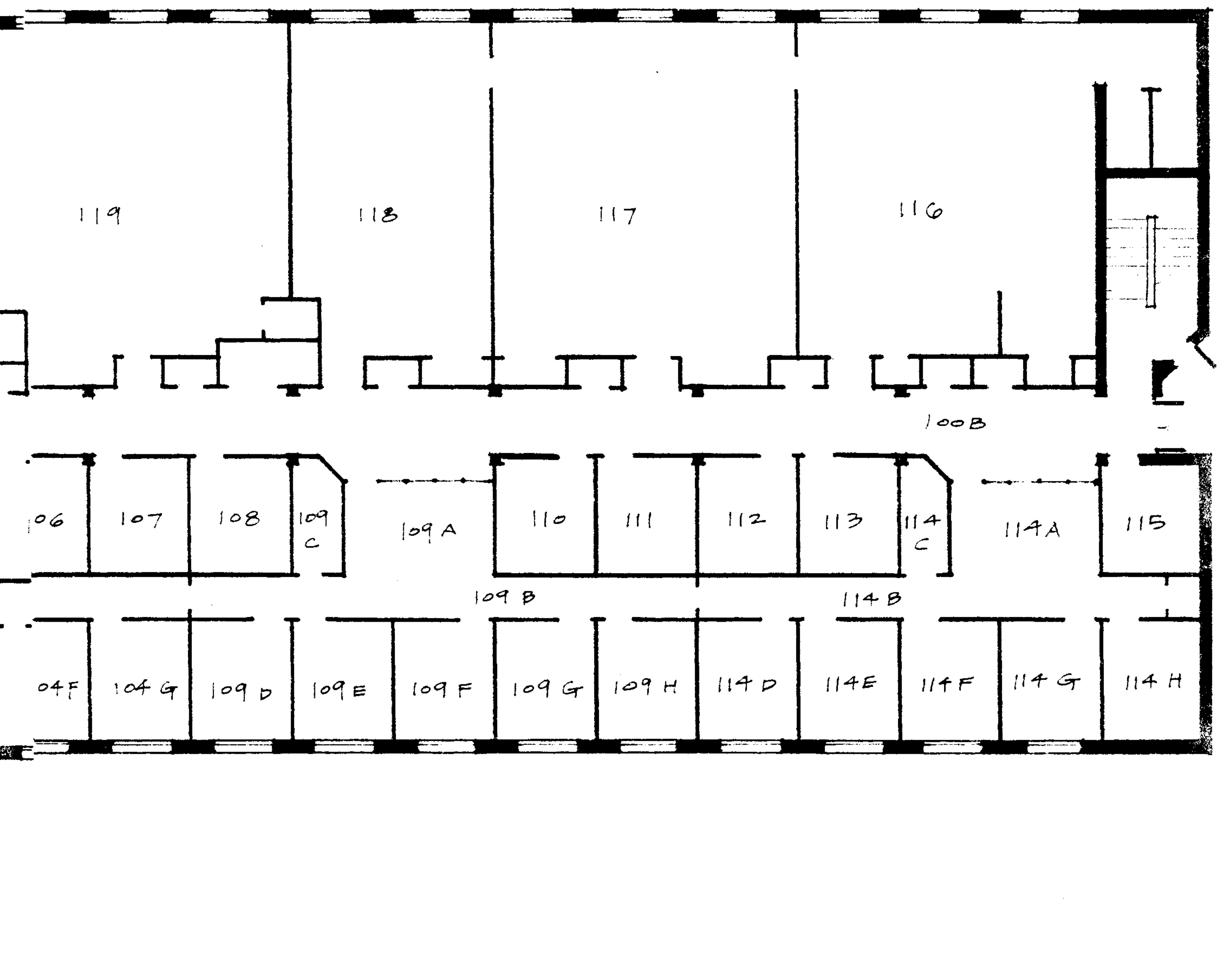
Open web steel joist were utilized for roof structures over the mechanical room and the annex building.

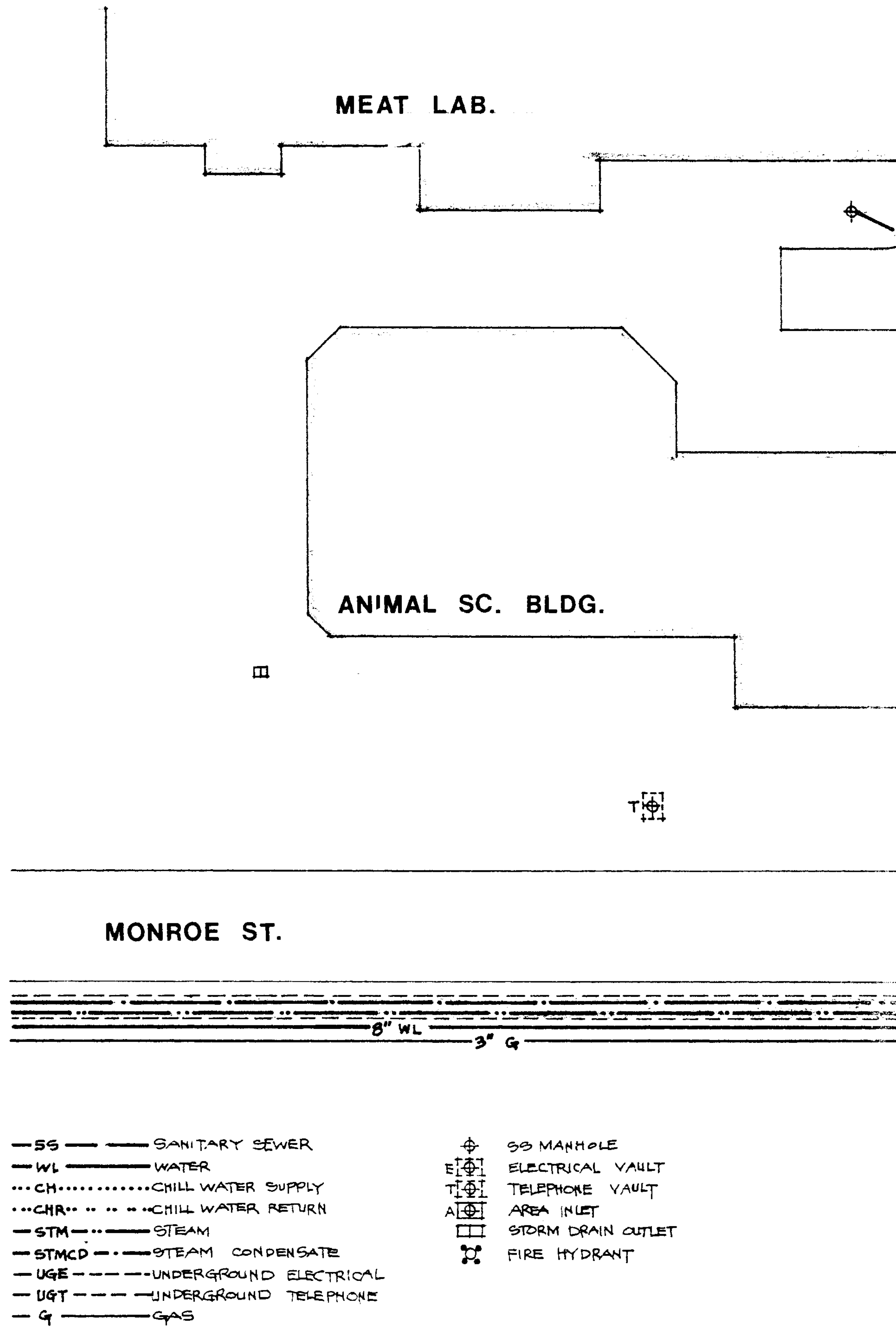

123 A
124
123
100 A
125
126
SKY LIGHT ABOVE

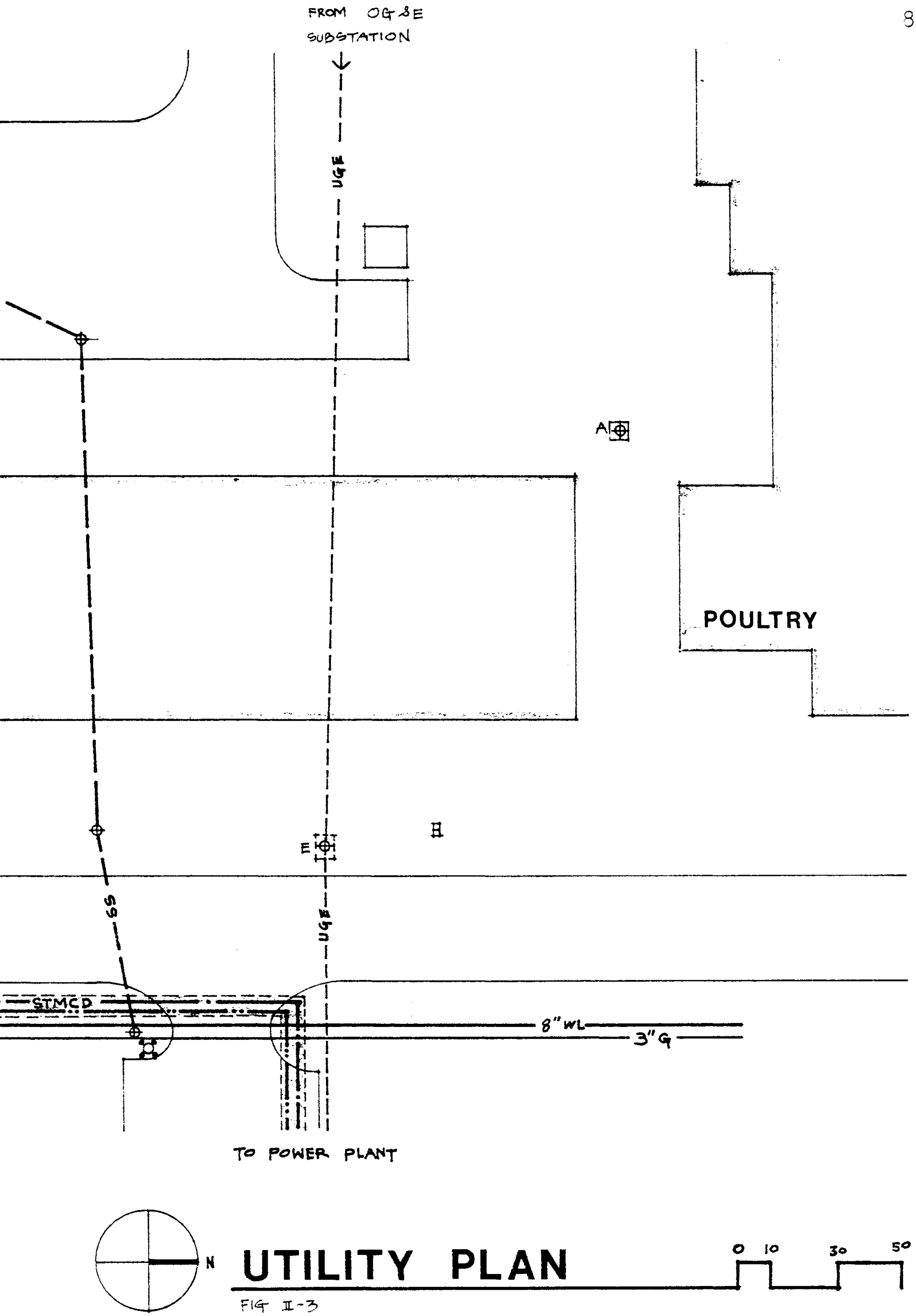


FIRST FLOOR PLAN

FIG II-4

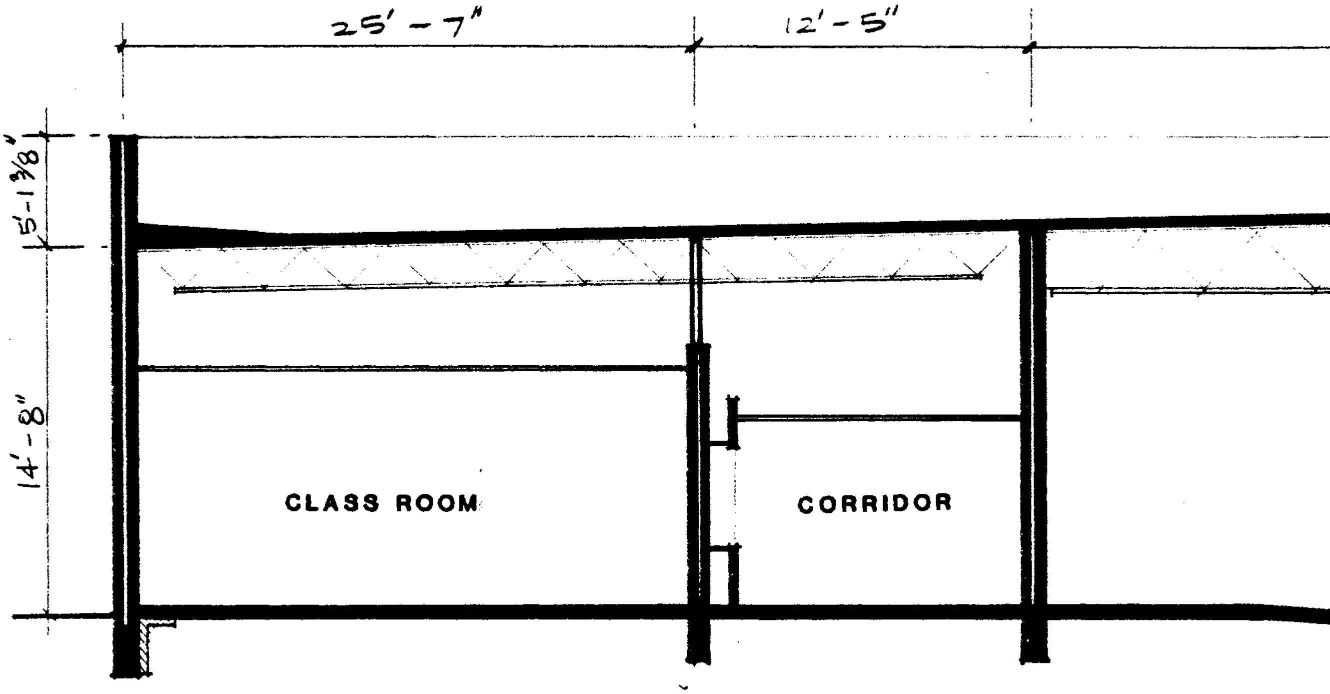

119
118
117
116
100B
06
107
108
109 C
109 A
110
111
112
113
114 C
114A
115
109 B
114 B
04F
104 G
109 D
109 E
109 F
109 G
109 H
114 D
114E
114F
114 G
114 H


MEAT LAB.
ANIMAL SC. BLDG.
T
MONROE ST.
8" WL
3" G
SS SANITARY SEWER
WL WATER
CH CHILL WATER SUPPLY
CHR CHILL WATER RETURN
STM STEAM
STMCD STEAM CONDENSATE
UGE UNDERGROUND ELECTRICAL
UGT UNDERGROUND TELEPHONE
G GAS
SS MANHOLE
E ELECTRICAL VAULT
T TELEPHONE VAULT
A AREA INLET
STORM DRAIN OUTLET
FIRE HYDRANT



UTILITY PLAN

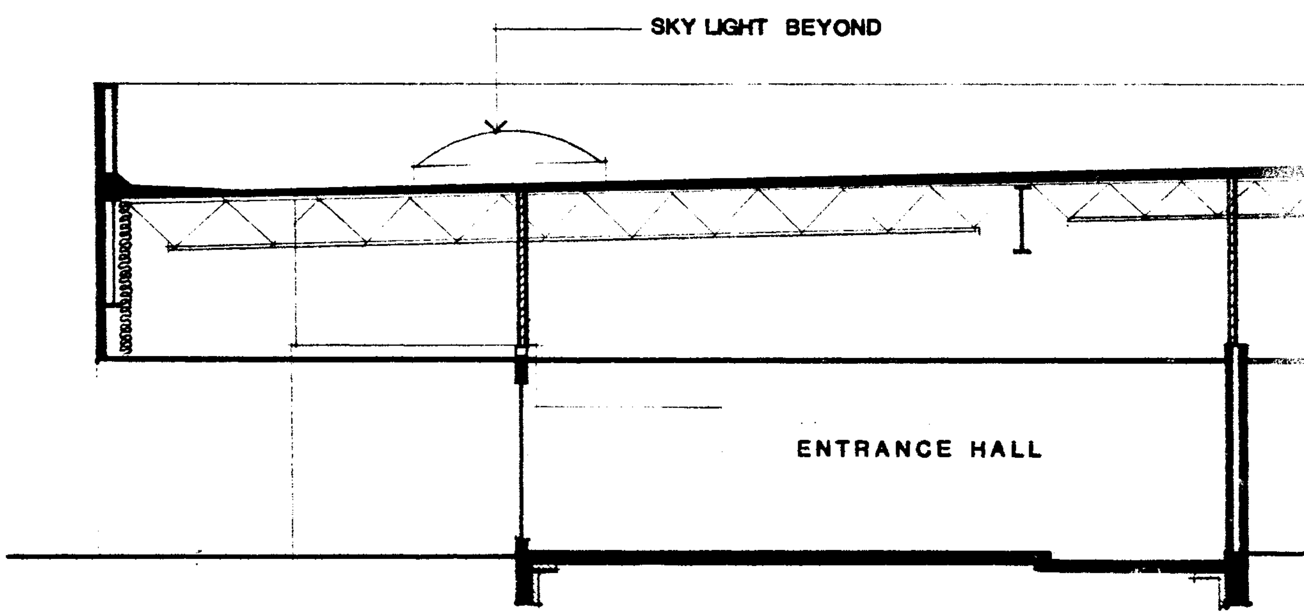
FIG II-3



SECTION A-A

0 1 3 5 10

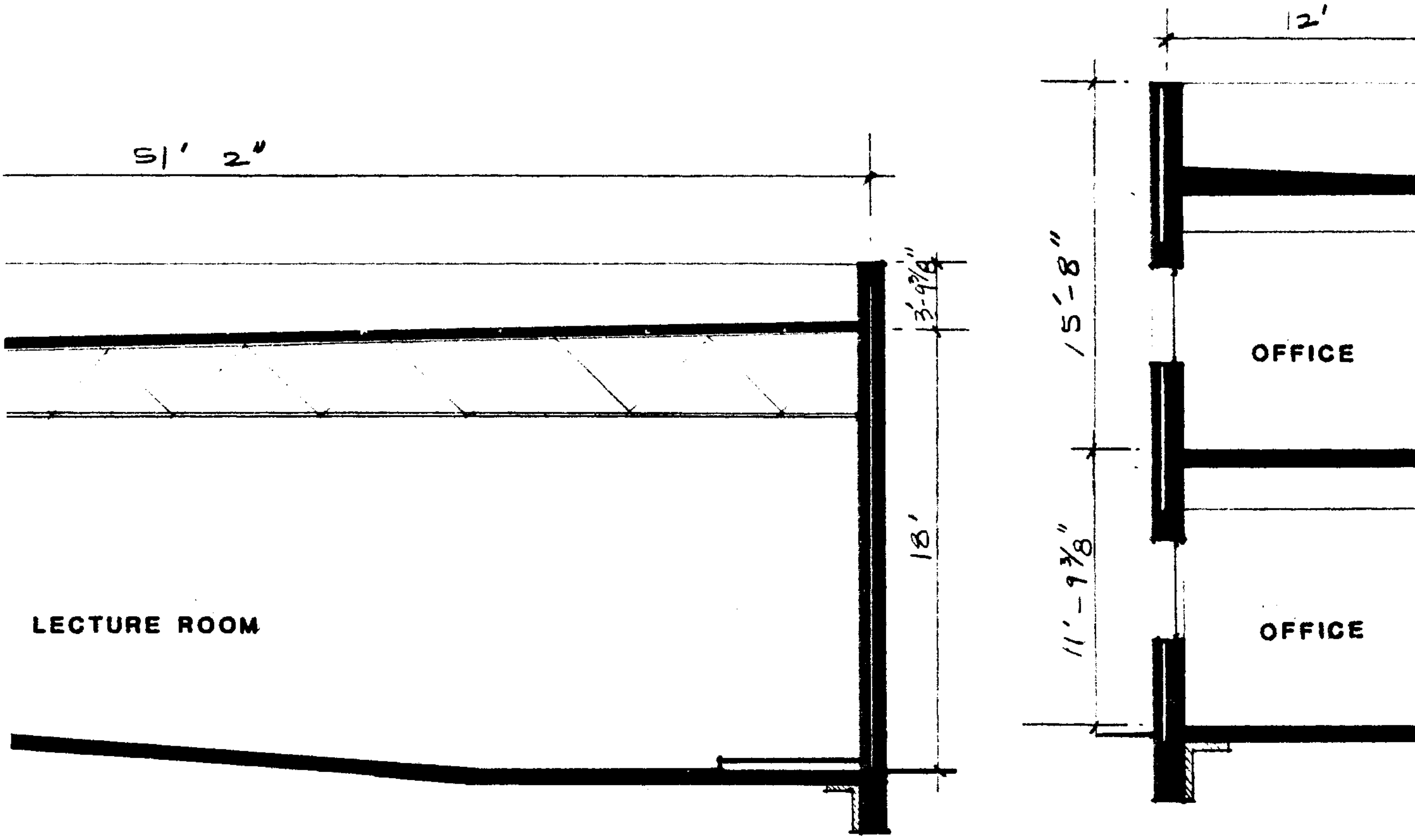
FIG II-10



SECTION B-B

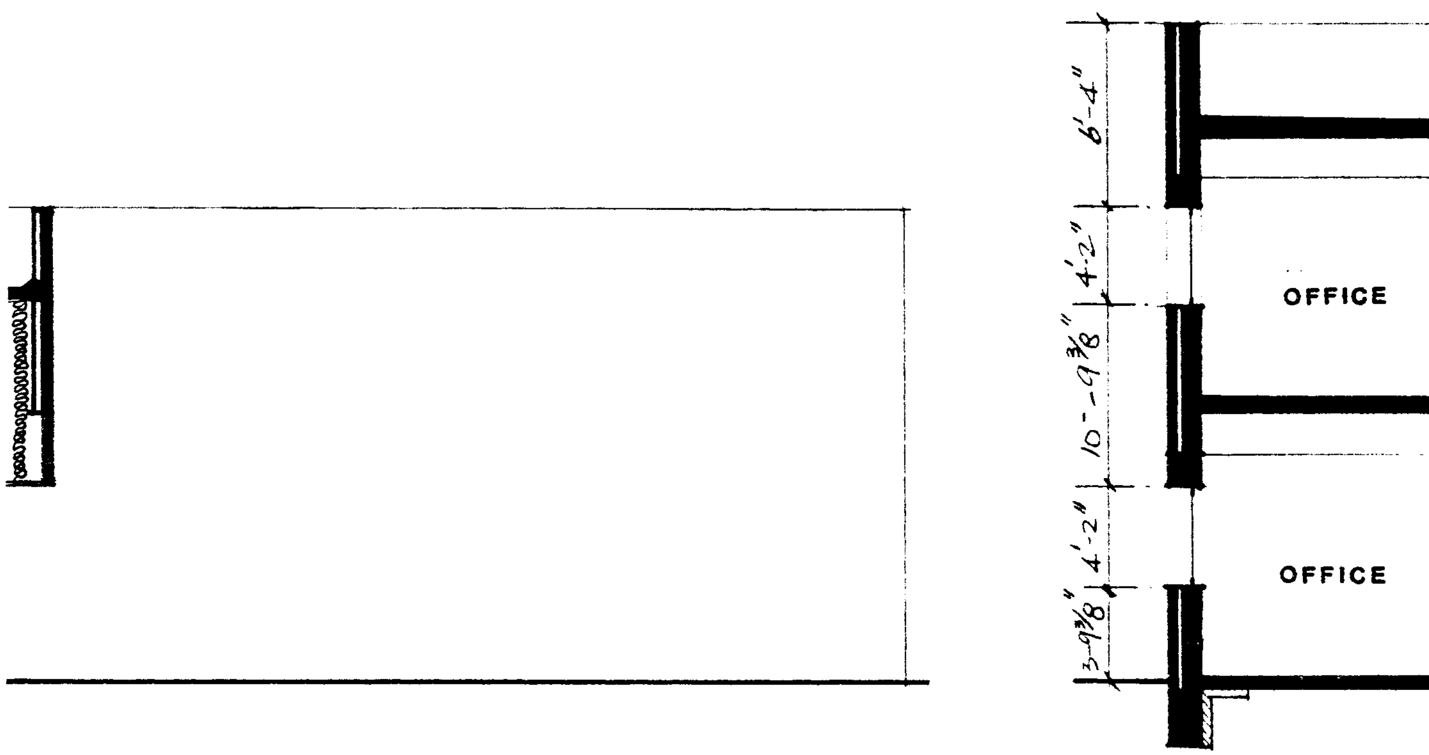
0 1 3 5 10

FIG II-11



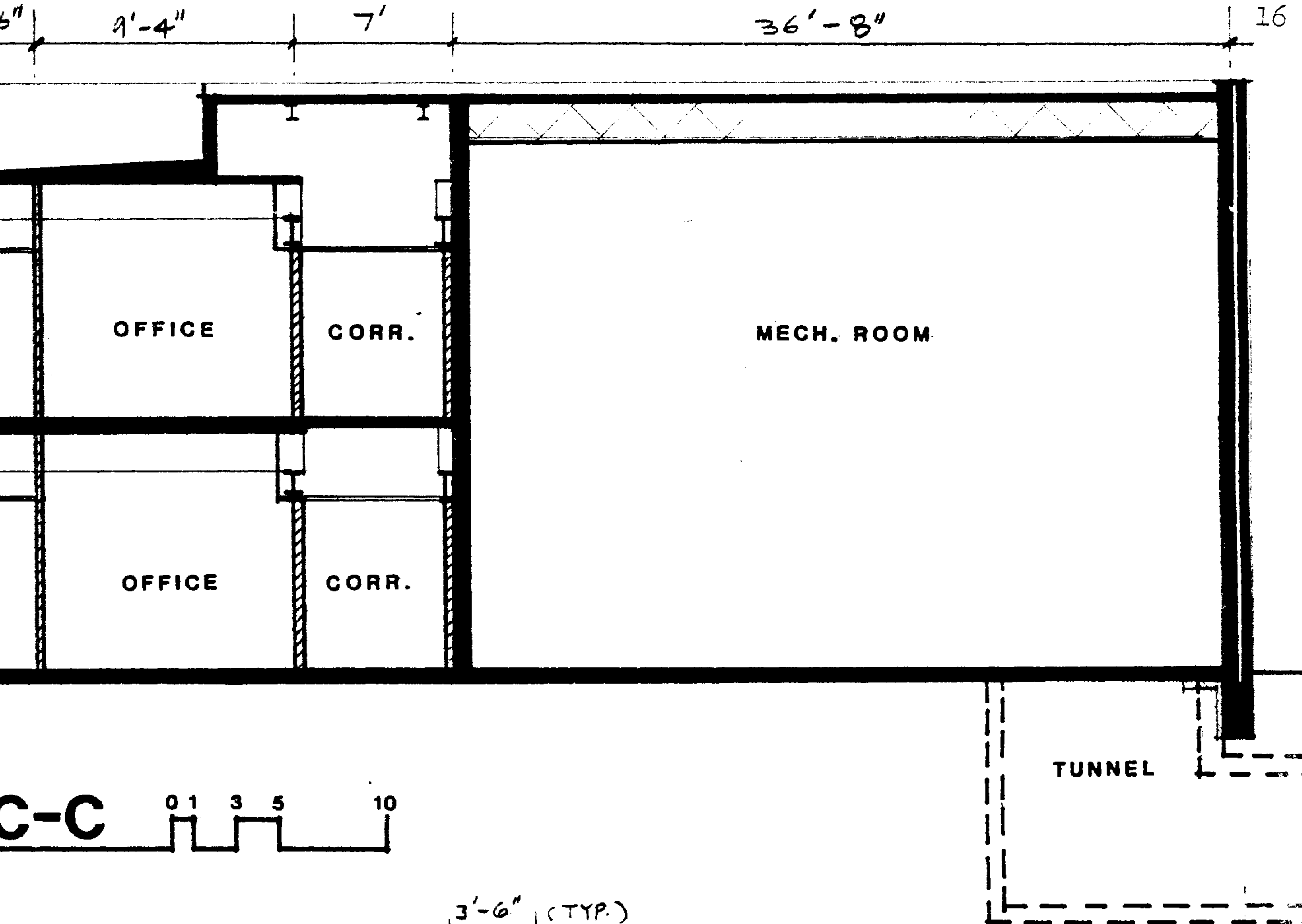
SECTIO

FIG II-12

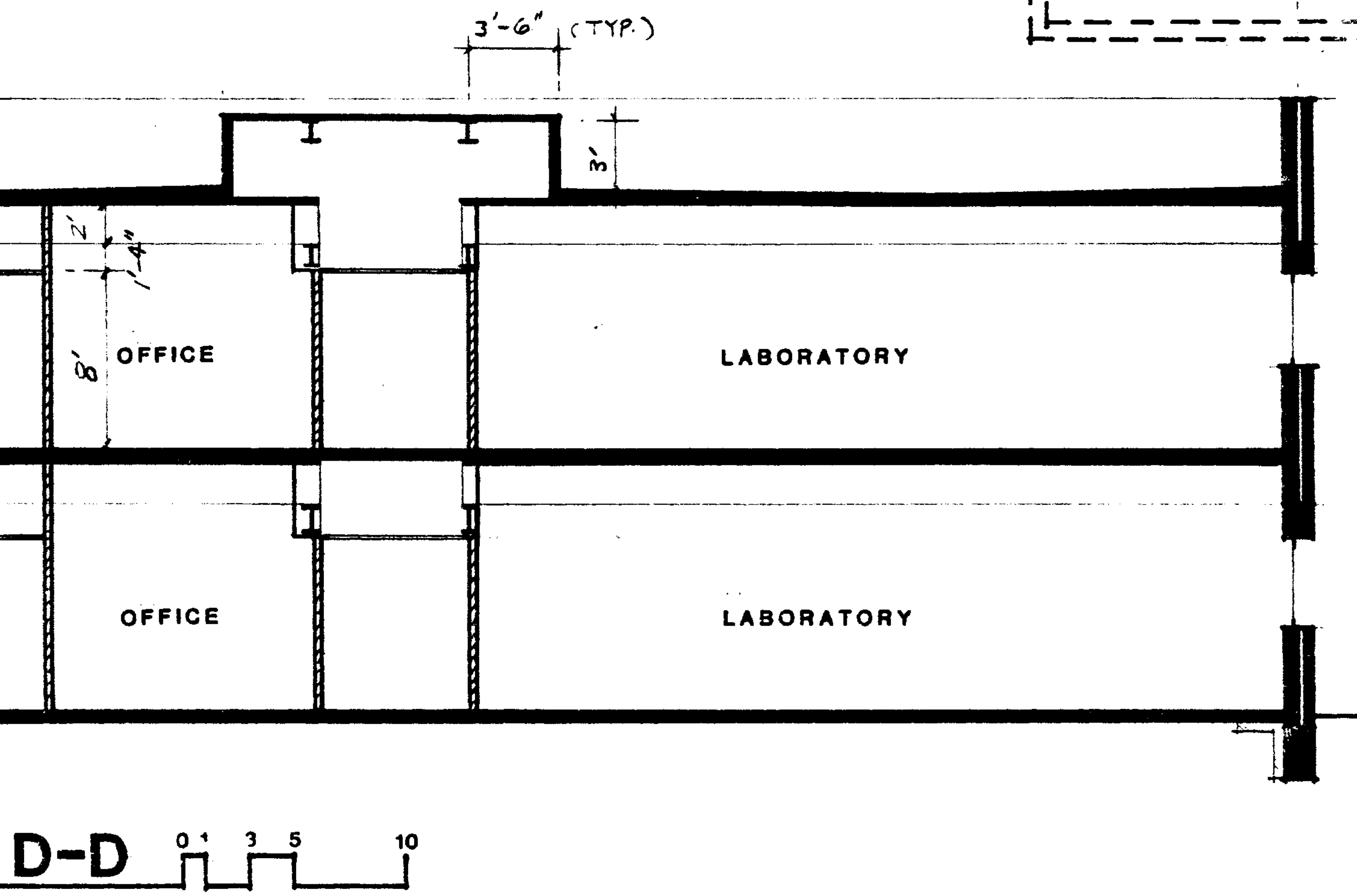


SECTI

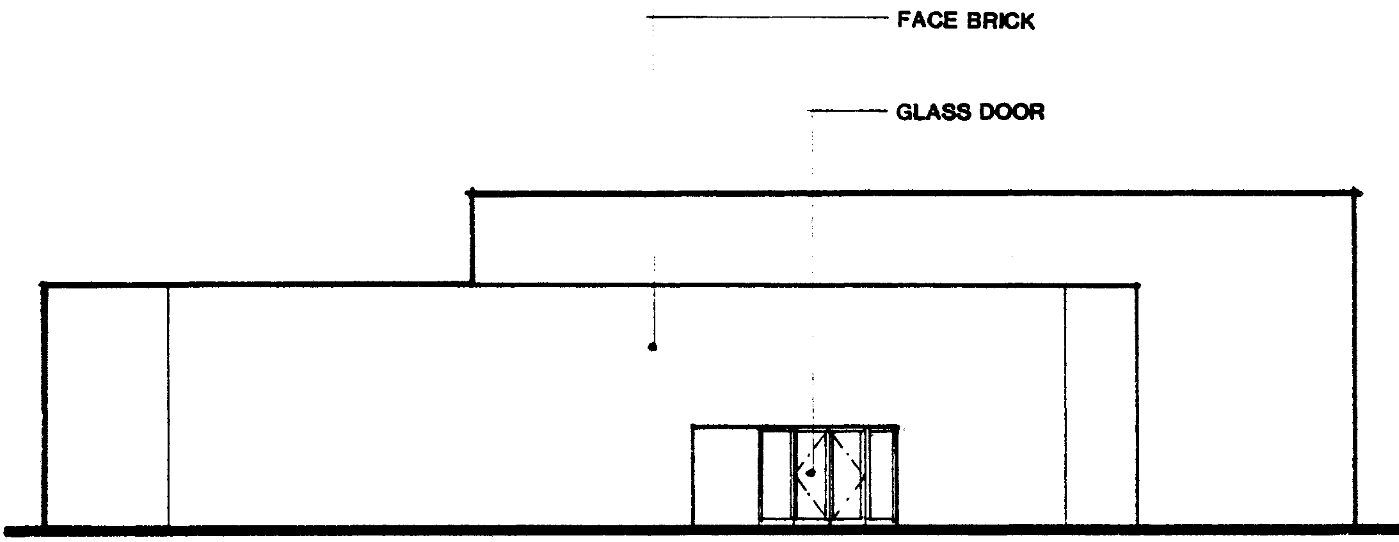
FIG II-13


9'-4"
7'
36'-8"
OFFICE
CORR.
MECH. ROOM
OFFICE
CORR.
TUNNEL
0 1 3 5 10

C-C


3'-6" (TYP.)
3'
2'
1'-4"
8'
OFFICE
LABORATORY
OFFICE
LABORATORY
0 1 3 5 10

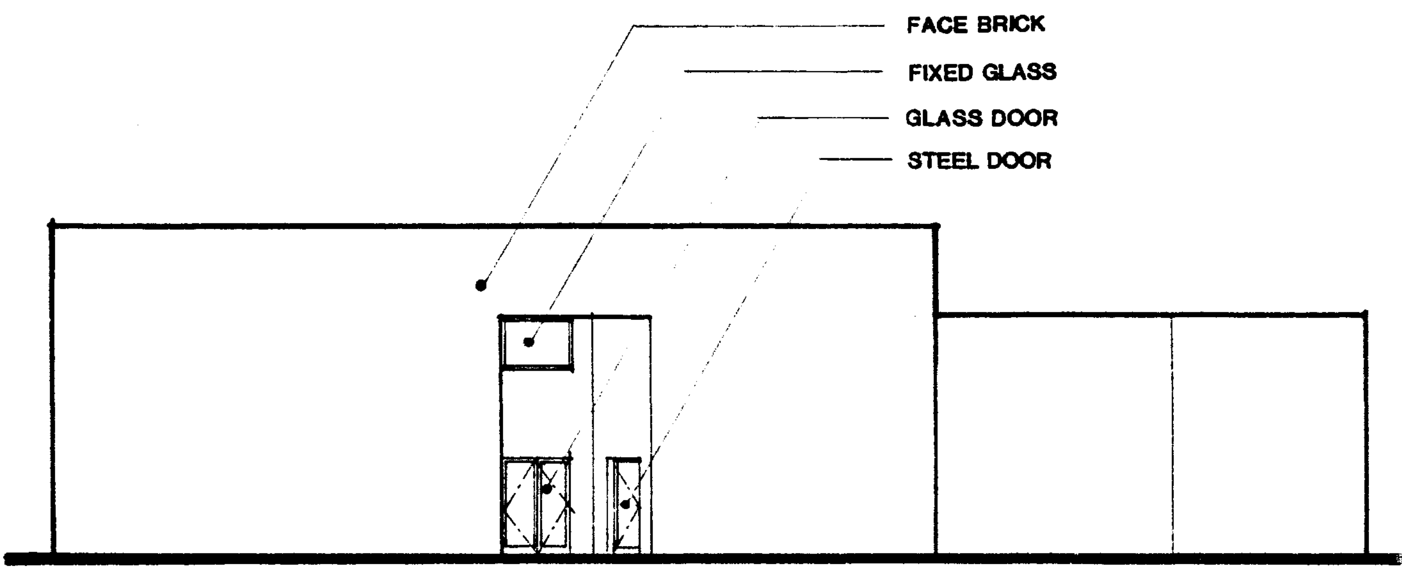
D-D



SOUTH ELEVATION

0 5 10 20

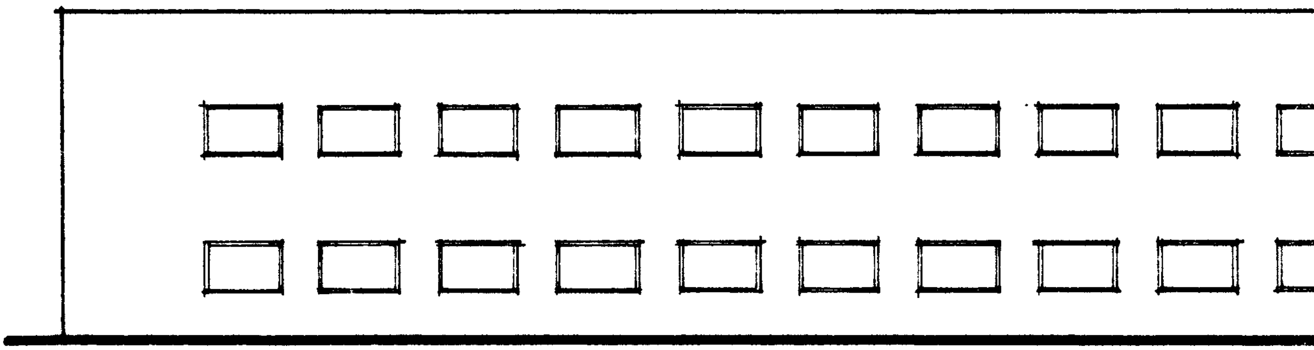
FIG II-8



NORTH ELEVTION

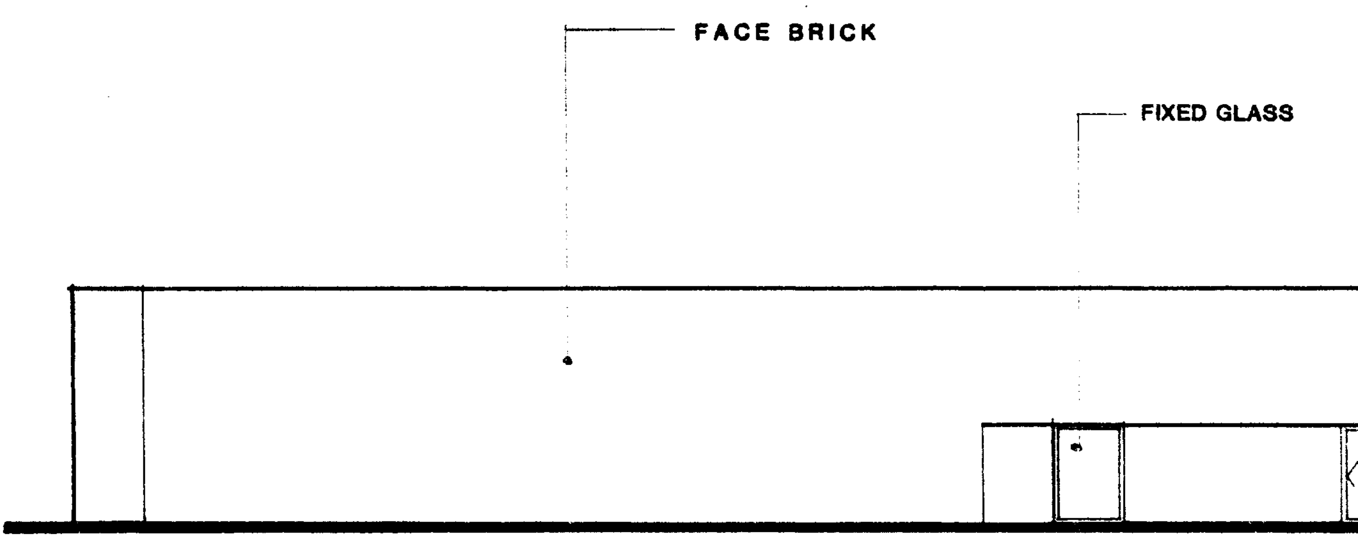
0 5 10 20

FIG - II - 9



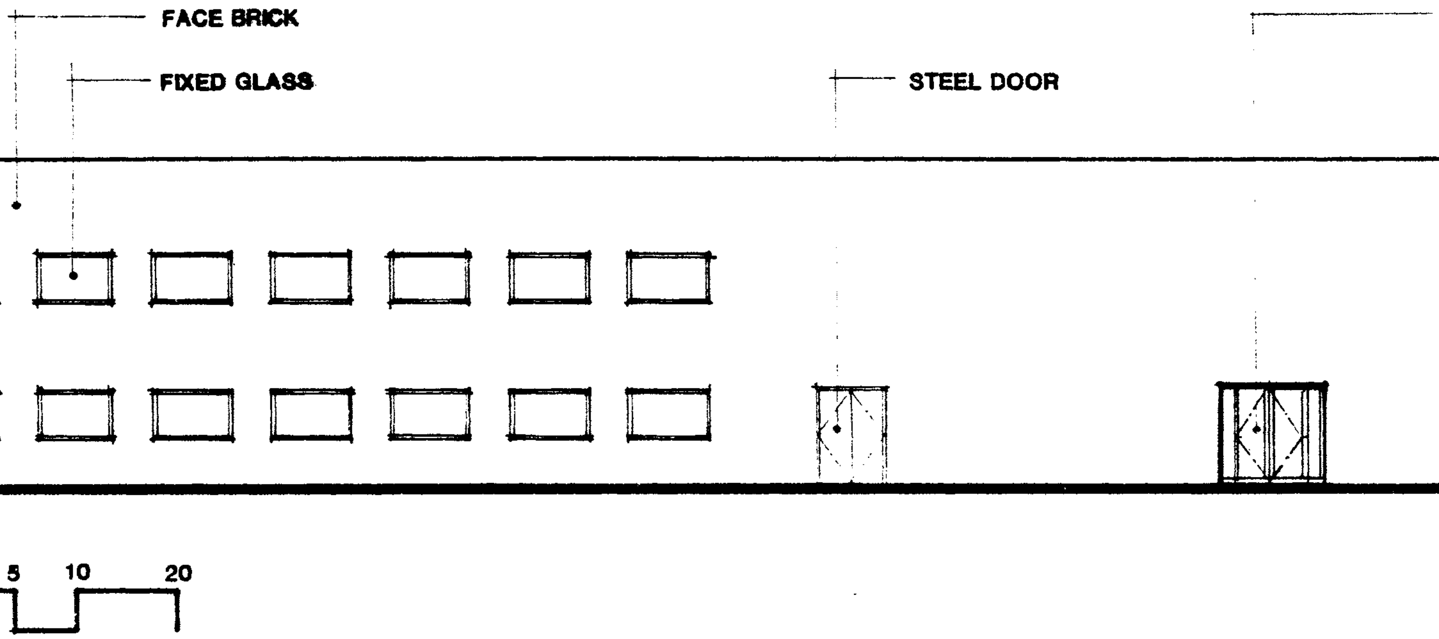
WEST ELEVATION

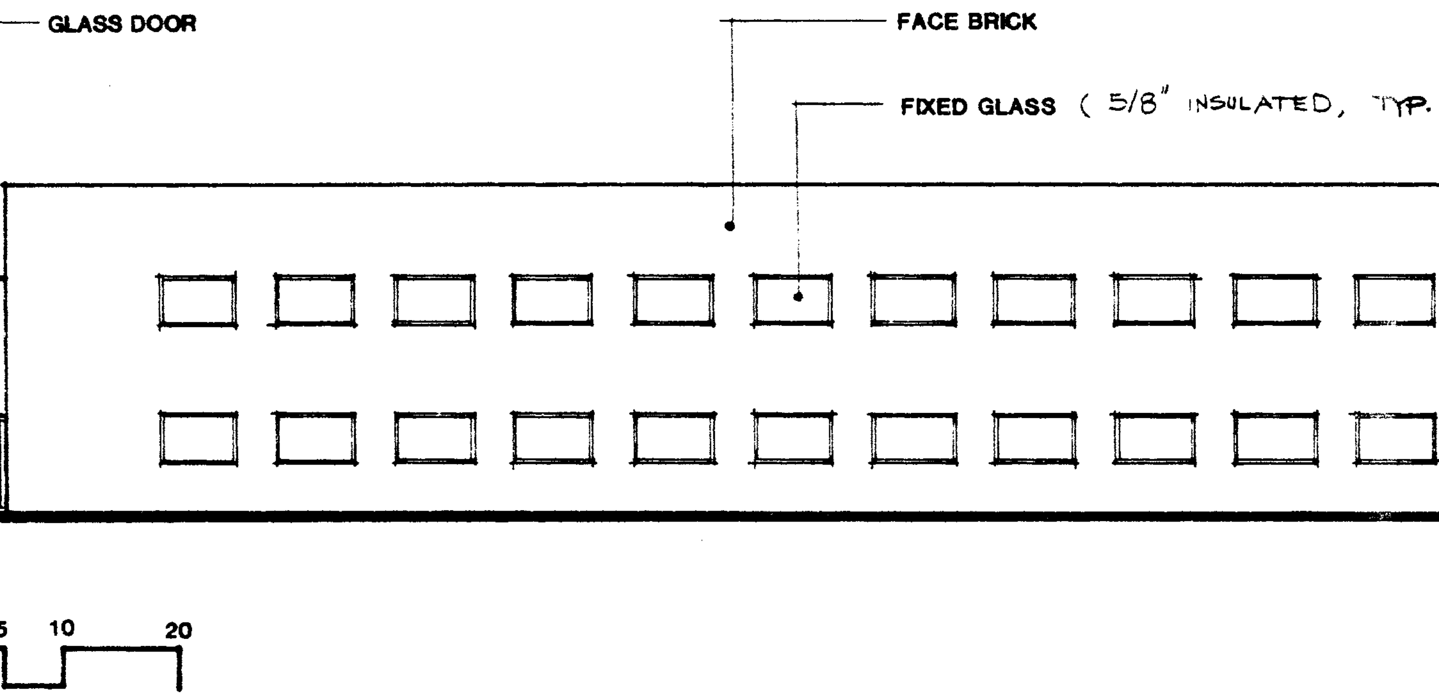
FIG II-6

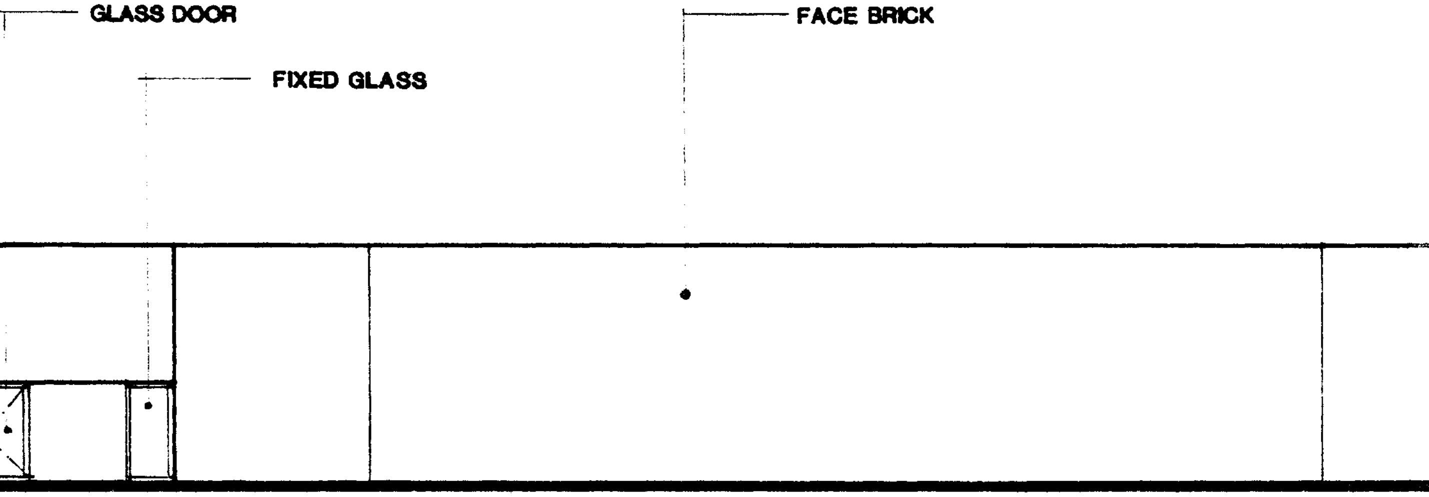


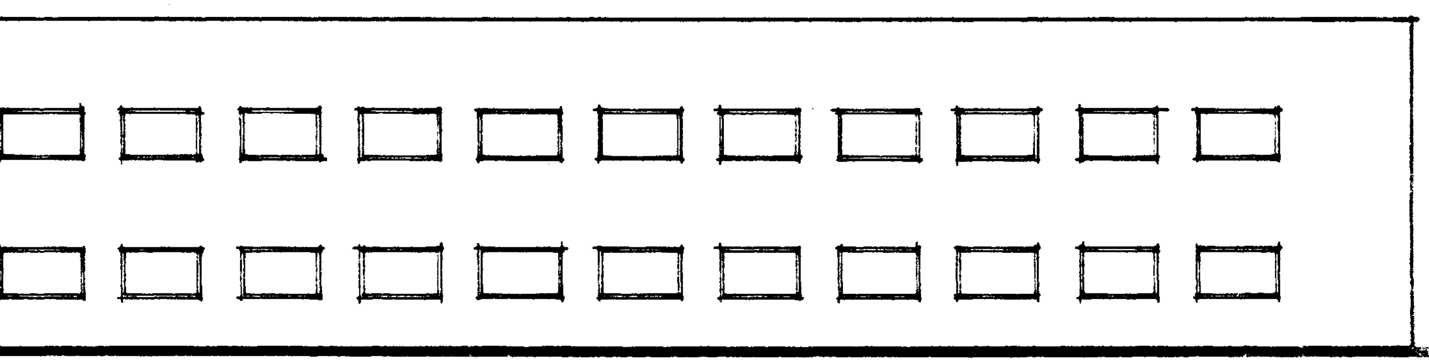
EAST ELEVATION

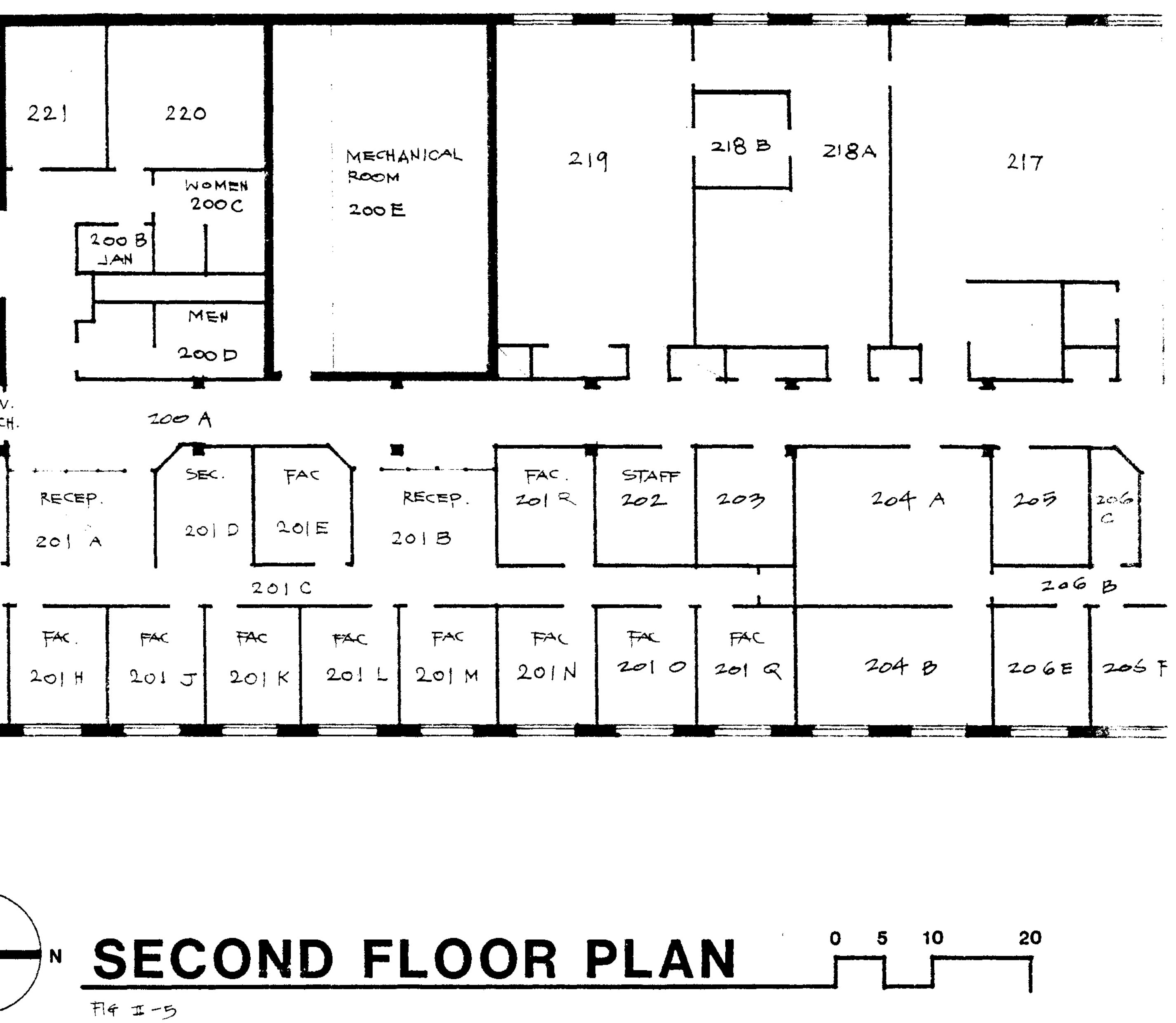
FIG II-7


FACE BRICK
FIXED GLASS
STEEL DOOR
5 10 20


GLASS DOOR
FACE BRICK
FIXED GLASS (5/8" INSULATED, TYP.
5 10 20

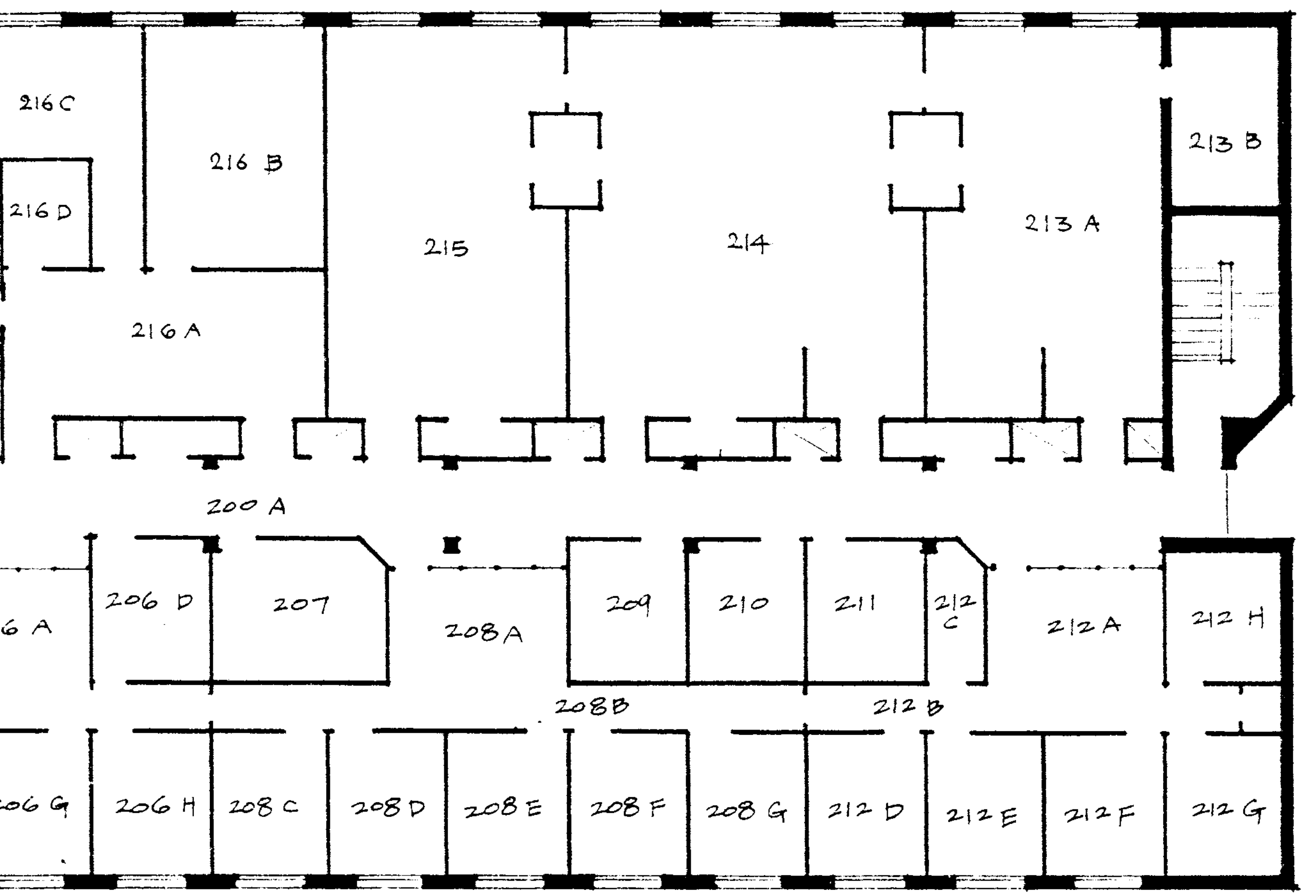

GLASS DOOR
FIXED GLASS
FACE BRICK





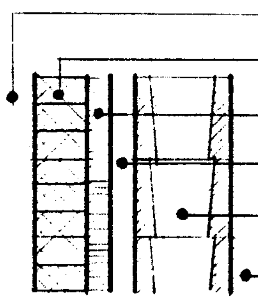
SECOND FLOOR PLAN

FIG II-5


216 C
216 B
216 D
215
214
213 A
213 B
216 A
200 A
6 A
206 D
207
208 A
209
210
211
212 C
212 A
212 H
208 B
212 B
06 G
206 H
208 C
208 D
208 E
208 F
208 G
212 D
212 E
212 F
212 G

D. ENVELOPES ANALYSIS

LOCATION: EAST, WEST WALL - MAIN BUILDING

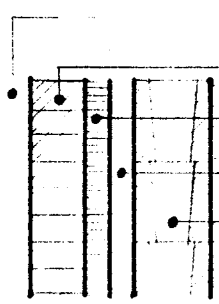


	WINTER	SUMMER	MASS/SQFT
OUTDOOR AIR FILM	0.17	0.25	
4" FACE BRICK	0.44	0.44	43
2" POLYSTYRENE INSULATION	10.	10.	
2" AIR SPACE	1.02	0.87	
8" CONC. BLOCK	1.72	1.72	43
INDOOR AIR FILM	0.68	0.68	
ΣR	14.03	13.96	86 lb/SQFT.
U_o (BTUh/°F. sqft.)	0.0713	0.0716	

WALL TYPE 1

TOTAL AREA: 8200 SQ.FT.

LOCATION: SOUTH, NORTH WALL - MAIN BUILDING

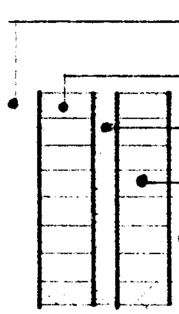


	WINTER	SUMMER	MASS/SQFT.
OUTDOOR AIR FILM	0.17	0.25	
4" FACE BRICK	0.44	0.44	43
2" POLYSTYRENE INSULATION	10.	10.	
2" AIR SPACE	1.02	.8	
6" CONC. BLOCK	1.29	1.29	32
INDOOR AIR FILM	0.68	0.68	
ΣR	13.60	13.53	75 lb/sqft
U_o (BTUh/°F. sqft.)	0.0735	0.0739	

WALL TYPE 2

TOTAL AREA: 2750 SQFT

LOCATION: ANNEX BUILDING EXTERIOR WALL

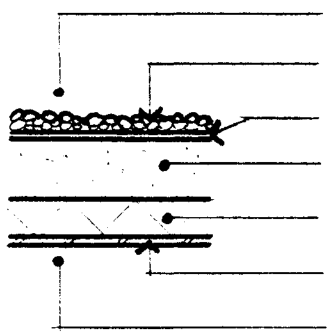


	WINTER	SUMMER	MASS/SQFT.
OUTDOOR AIR FILM	0.17	0.25	
4" FACE BRICK	0.44	0.44	43
2" POLYSTYRENE INSULATION	10.	10.	
4" FACE BRICK	0.44	0.44	43
INSIDE AIR FILM	0.68	0.68	4
ΣR	11.73	11.81	86 lb/SQFT.
U_o (BTUh/°F.SQFT)	0.0853	0.0847	

WALL TYPE 3

TOTAL AREA: 6100 SQ.FT.

LOCATION : ANNEX

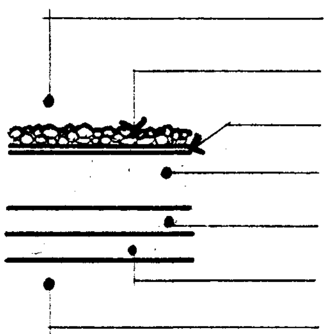


	WINTER	SUMMER	MASS/sq.ft.
OUTDOOR AIR FILM	0.17	0.25	
BUILT UP ROOF	0.33	0.33	
WATERPROOF MEMBRANE	0.06	0.06	
5" INSULATING CONC. (Perlite)	5.40	5.40	17
3½" RIGID INSULATION	17.50	17.50	
METAL DECK	0	0	
INDOOR AIR FILM	0.61	0.92	
ΣR	24.07	24.46	17 lb/sq.ft
U_o (Btuh/°F.sq.ft)	0.0415	0.0409	

ROOF TYPE 1

TOTAL AREA = 9362 SQ FT

LOCATION : MAIN BUILDING - LAB, OFFICE

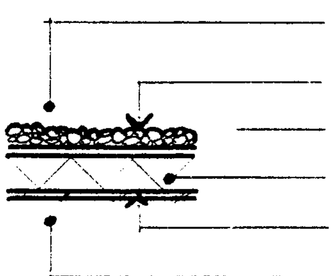


	WINTER	SUMMER	Mass/sq.ft
OUTDOOR AIR FILM	0.17	0.25	
BUILT UP ROOF	0.33	0.33	
WATERPROOF MEMBRANE	0.06	0.06	
5" INSULATING CONC (Perlite)	5.40	5.40	17
2" RIGID INSULATION	10.00	10.00	
2" PRECAST CONC., double-T	0.22	0.22	23
INDOOR AIR FILM	0.61	0.92	
ΣR	16.79	17.18	40 lb/sq.ft
U_o (Btuh/°F.Sq.ft)	0.0596	0.05821	4

ROOF TYPE 2

TOTAL AREA : 13490 SQ.FT.

LOCATION : MAIN BUILDING - CORRIDOR



	WINTER	SUMMER	MASS/sq.ft
OUTDOOR AIR FILM	0.17	0.25	
BUILT UP ROOF	0.33	0.33	
WATERPROOF MEMBRANE	0.06	0.06	
3½" RIGID INSULATION	17.50	17.50	
METAL DECK	0	0	
INSIDE AIR FILM	0.61	0.92	
	18.61	19.05	
	0.0536	0.525	

ROOF TYPE 3

TOTAL AREA : 3638 SQ FT.

Window: 5/8" double insulated glass

overall U-value: 0.49 Btuh/^{o}F ft^2 in winter
0.56 Btuh/^{o}F ft^2 in summer

total area : 2710 sq. ft.

Door: steel door-solid urethane foam core with thermal break

over all U-value: 0.40 Btuh/^{o}F ft^2
total area : 63 sq.ft.

ENVELOPE THERMAL PROPERTY ANALYSIS

component	ashrae 90-80 maximum value		animal sc.bldg. value
wall(Btuh/^{o}F ft^2)	0.32	>	0.134
roof(Btuh/^{o}F ft^2)	0.093	>	0.0524
ottv(Btuh/ft^2)	32.3	>	14.0

Stillwater: 3800 D.D.
TD eg = 23^{o}F (71 lbs/ft^2 and above)
SF = 125 Btuh/ft. (36^{o}10", Stillwater)
ΔT = 18^{o}F(96^{o} - 78^{o})
SC = 0.55

CHAPTER III. PLUMBING SYSTEMS

1. TASK ANALYSIS

A SYSTEM REQUIREMENTS

1) DOMESTIC WATER SUPPLY: Domestic hot water and cold water shall be provided in each of the toilets, janitor's closet, conference room coffee sink, darkroom and laboratory modules. Also, domestic cold water shall be provide for drinking fountains and hose bibbes at the building perimeter wall.

2) LABORATORY UTILITY SERVICE: Besides domestic hot and cold water supply, each laboratory module shall be provided with following utility services including deionized water, natural gas, air, vacuum.

3) SOIL AND WASTE DRAINAGE SYSTEMS: Every toilets, janitor's closets, isolate sinks, drinking fountain, and laboratory modules shall be provided with soil or waste drainge and vent systems.

4) STORM DRAINGE SYSTEM: Each enclosed portion of the building roof shall be provide with roof storm drain systems.

B SYSTEM DESIGN CONSIDERATIONS

1) SYSTEM FLEXIBILITY: System shall be designed to cope with future changes, rearrangements, and/or additions in the laboratories.

2) SITE UTILITY: System shall be designed to utilize and/or cope with the available service at the building site.

3) PUBLIC SAFETY: System shall be designed to conformed the major applicable codes for public safety.

a) BOCA BASIC BUILDING CODE/1981

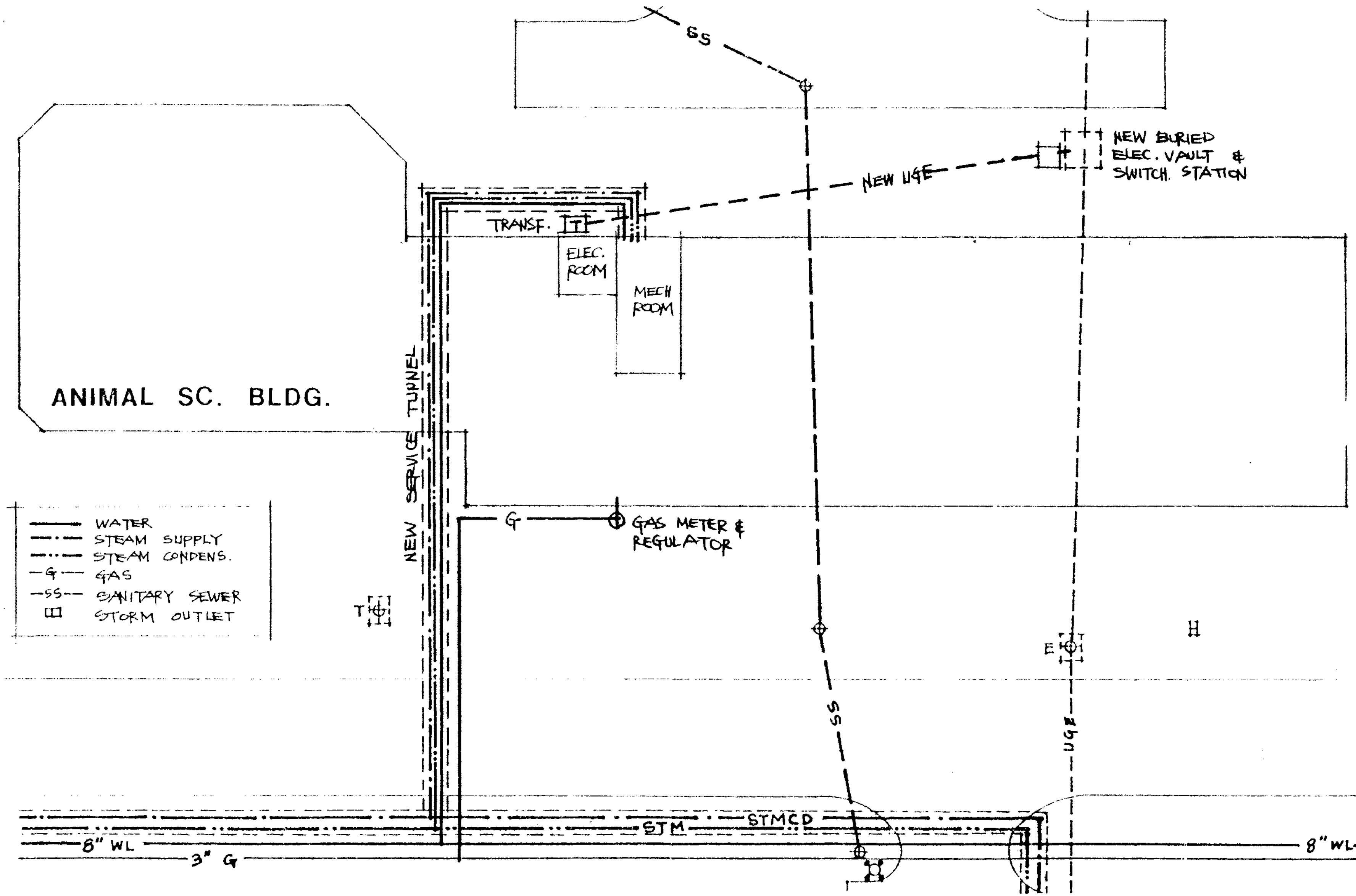
2204.2.1: Potable water shall be supplied from the city water main.
2204.4.2: No cross connection between potable water and waste or soil system.

b) BOCA BASIC PLUMBING CODE/1981

P.303.1: The water distribution and drainge system shall be connected to a public water supply and sewer system if available.
P.1202.0: Minimum number of plumbing fixtures Table P.1202.1

4) ENERGY CONSERVATION: System shall be designed to conserve energy.

5) SYSTEM COORDINATION: System shall be designed to coordinate with and fit to the architectural and/or structural system.



UTILITY MAP (REVISED)

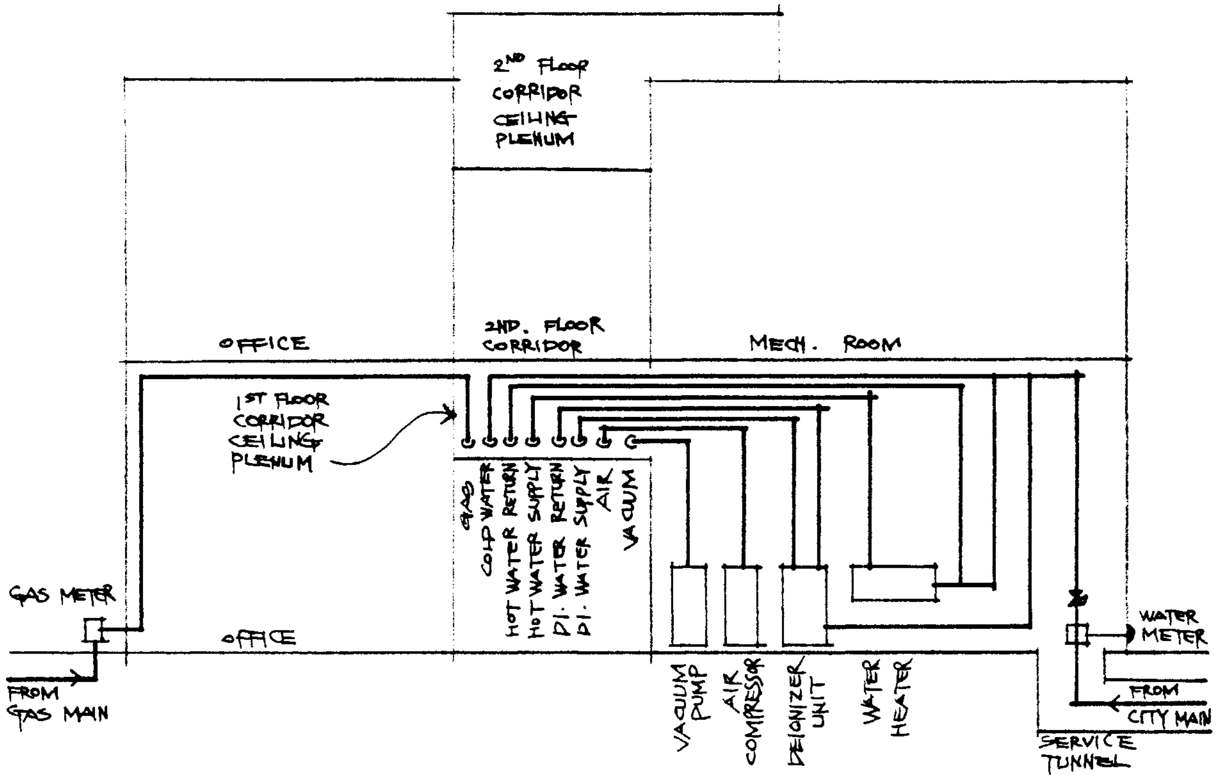
FIG III - 1

2. PRELIMINARY DESIGN

A. GENERAL: A service tunnel shall be provided to house service entry pipes from the university main tunnel to the building mech. room.(fig. III-1)

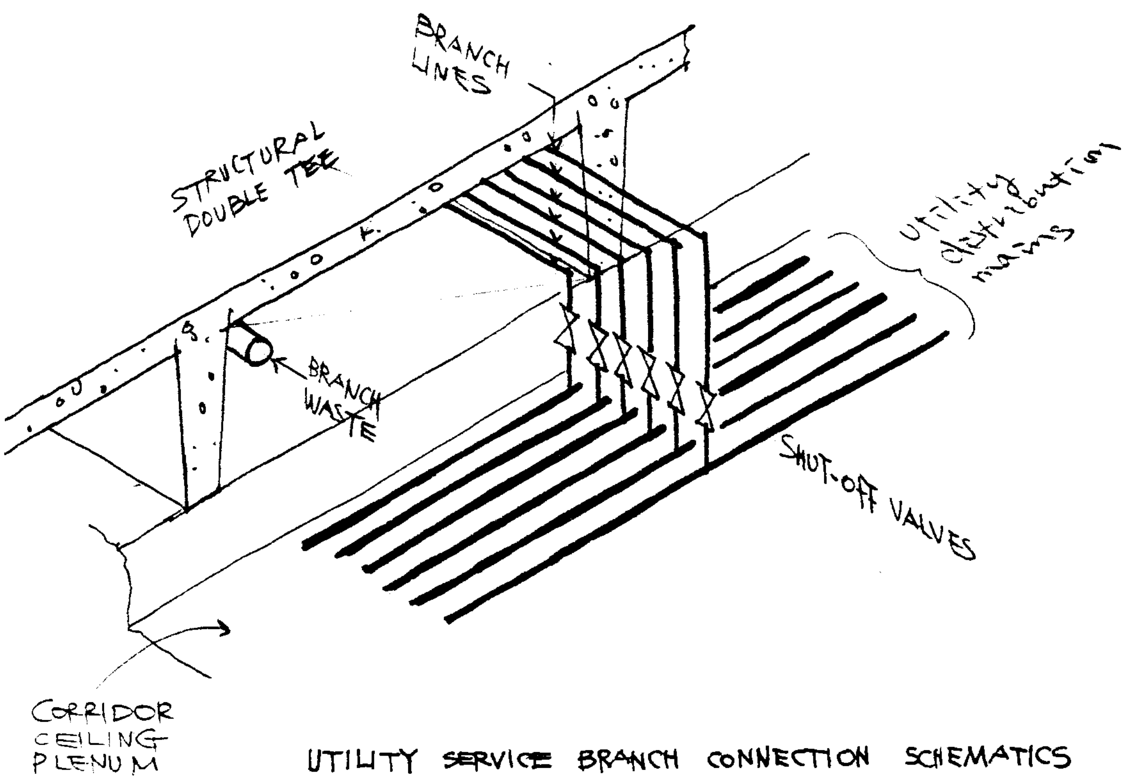
B. SYSTEM OUTLINES

1) DOMESTIC WATER SUPPLY: The service entry pipe, tapped from the city main, shall enter the mechanical room through the service tunnel to connect to the building riser with a building shut-off valve and a water meter. The domestic cold water main shall be installed in the ceiling plenum of the 1st. floor corridor to be tapped into the branch water lines to each laboratory module. The domestic cold water main shall also be tapped inside the mech. room to feed the domestic hot water heater, deionizer unit and the branch water line to the toilets. The domestic hot water heater shall be an instantaneous steam heat exchanger operated with steam supplied from the OSU physical plant The domestic hot water supply main and return main shall be installed in the 1st. floor corridor ceiling plenum to be tapped into the branch water lines to each laboratory module. The hot water circulation pump shall be provided in the mech. room.



WATER AND UTILITY SERVICE ENTRANCE SCHEMATIC DIAGRAM

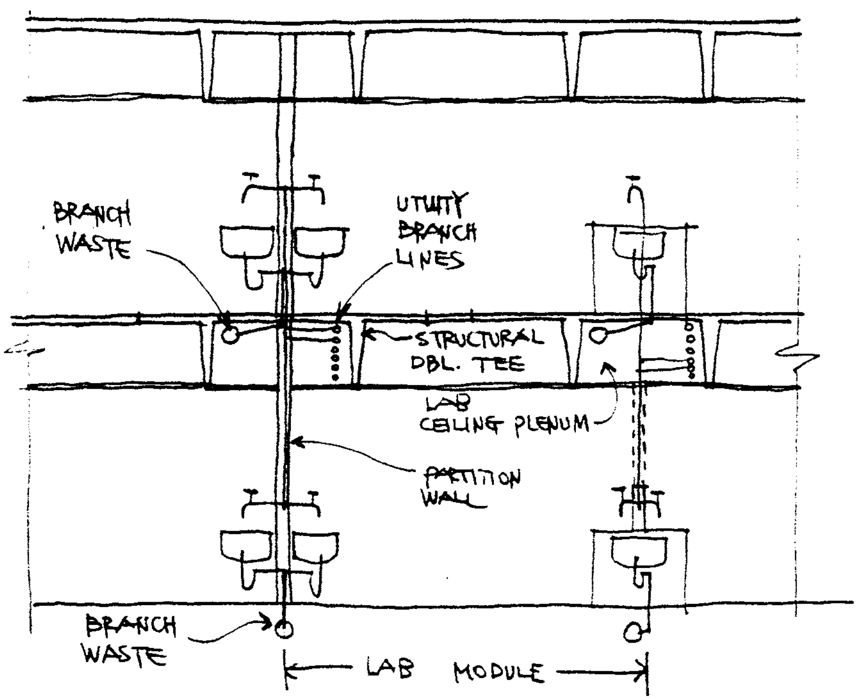
FIG. III - 2



UTILITY SERVICE BRANCH CONNECTION SCHEMATICS

FIG III - 3

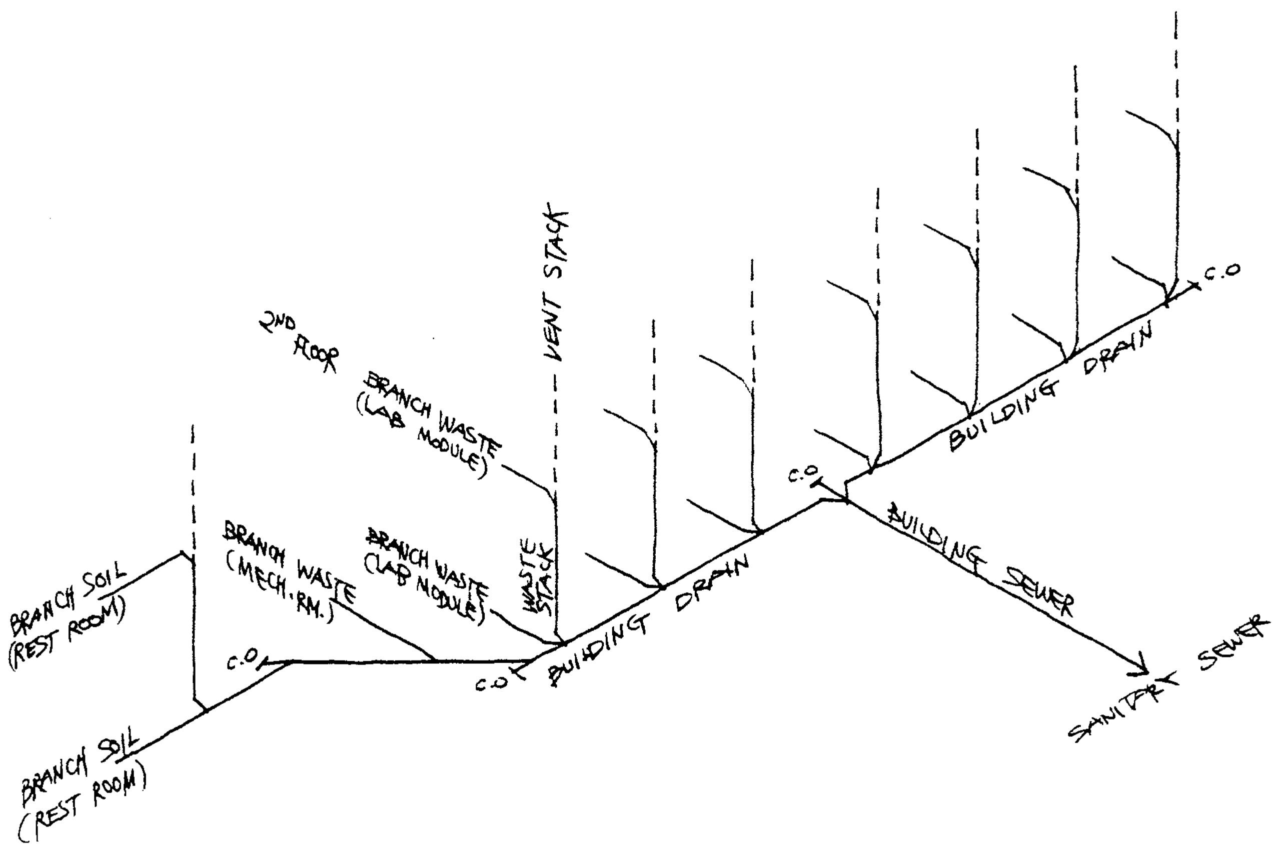
2) LABORATORY UTILITY SERVICE: Distribution mains for the lab. utility services including natural gas, air, vacuum, and deionized water, togather with domestic hot water and cold water, shall be housed in the first floor corridor ceiling plenum, and tapped into the branch lines with shut-off valves to each lab. module. The utility branch line shall be housed in the laboratory ceiling plenum togather with a branch waste to serve the laboratory module above and below. Air compressor, vacuum unit and deionizer unit including recirculation pump shall be located in the mech. room. Gas meter and regulator as a service entry from the OG & F natural gas main shall be provided.



LAB MODULE UTILITY DISTRIBUTION SCHEMATIC SECTION

FIG III-4

3) SOIL AND WASTE DRAINAGE: Soil stack from the second floor rest room shall be installed in the toilet cavity wall and connected to the branch soil from the first floor restroom, which will then be connected to the building waste drain. A building sewer shall be provided to be connected to the sanitary sewer. Waste stacks for each lab. module of the 2nd. floor shall be provided and installed in the service shaft or service closet, to connect branch wastes of each lab. module to the building drain. Branch wastes from each lab. module of the 1st. floor shall also be connected to the building drain.



SOIL AND WASTE DRAINAGE SCHEMATIC LAYOUT

FIG III - 5

4) STORM DRAINAGE: Any encloused part of the roof shall be provided with at least two roof drains to cope with a situatuon when one roof drain fails. Scuppers or overflow drain shall also be provided for every encloused part of the roof.

3. DETAIL DESIGN

A. DOMESTIC WATER SUPPLY

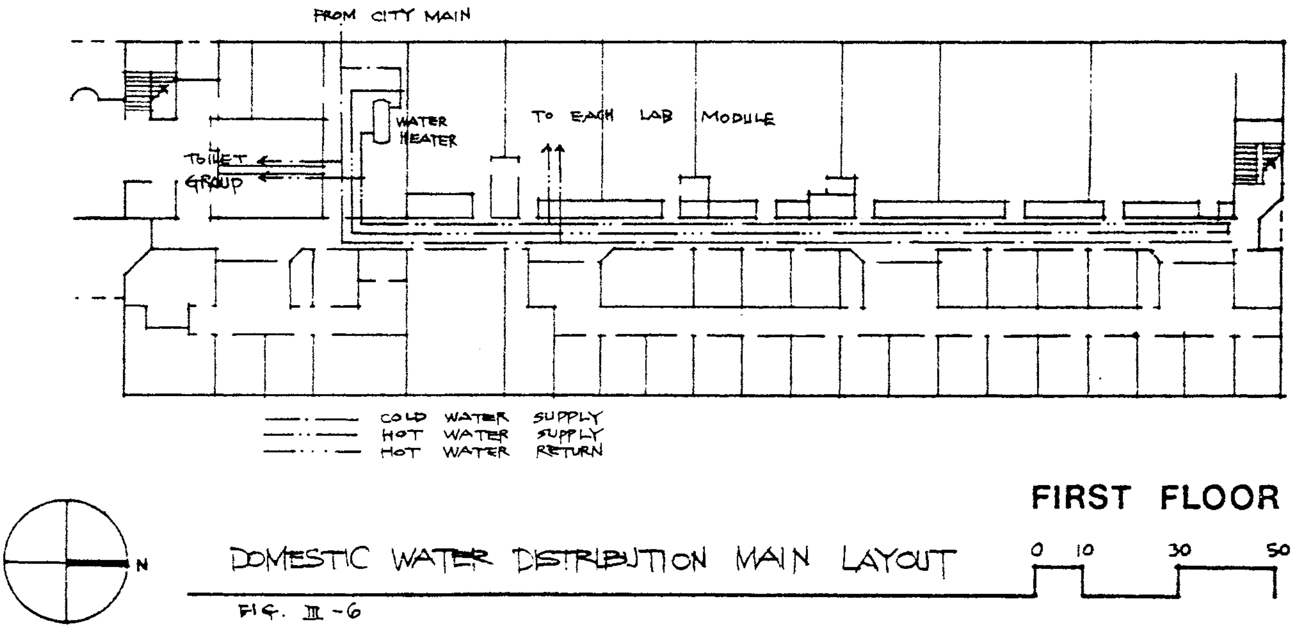


FIG. III-6

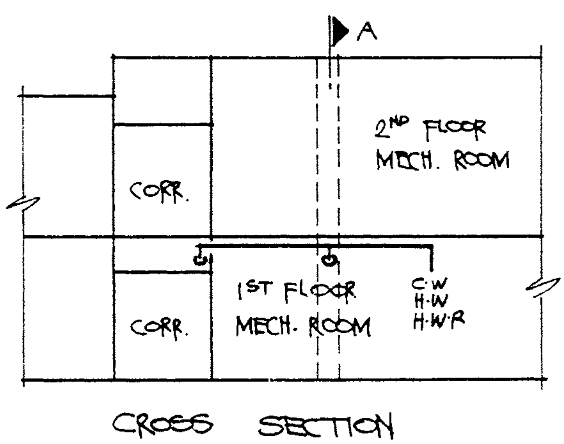


FIG. III-7

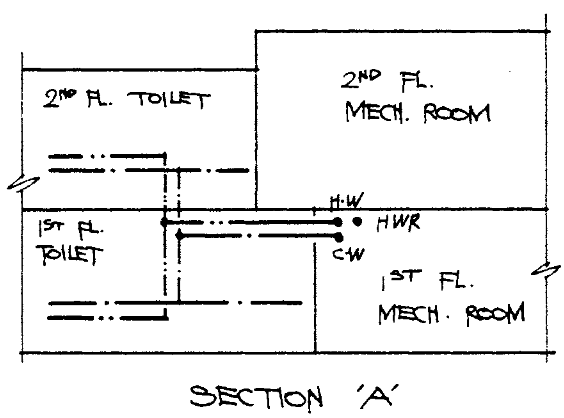
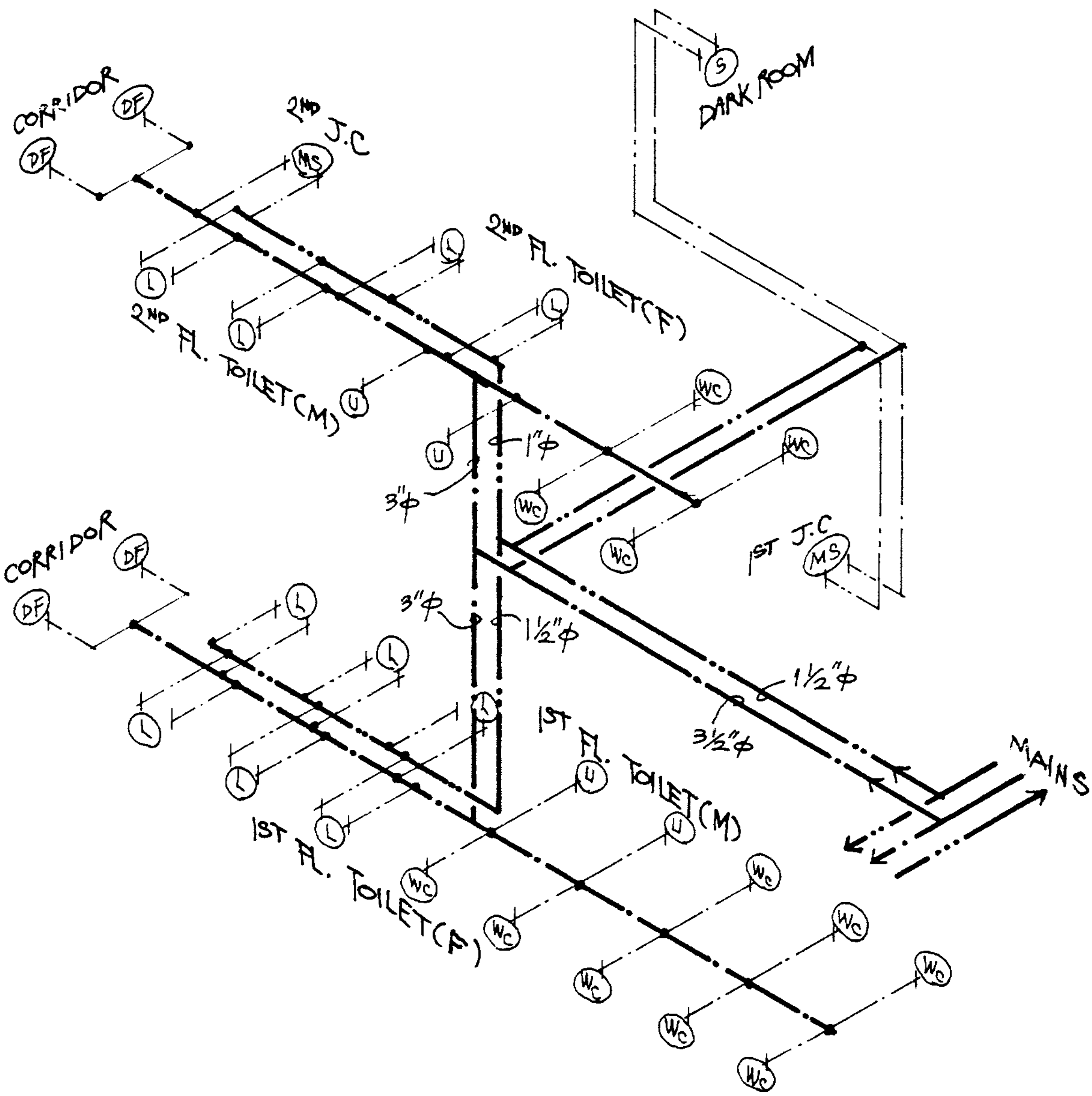


FIG. III-8



S : SINK
MS : MOP SINK
L : LAVATORY
U : URINAL
WC : WATER CLOSET
DF : DRINK. FOUNT.

———— · ———— COLD WATER SUPPLY
———— ·· ———— HOT WATER SUPPLY
———— ··· ———— HOT WATER RETURN

DOMESTIC WATER SUPPLY ISOMETRIC (TOILET GROUP)

FIG III - 9

2) DEMAND LOAD AND PIPING

a) CRITERIA

i) Demand weights of fixture (F.U. per fixture) shall be based on the table C.3.1., C.4.1.a BOCA plumbing code '81.

ii) Water supply demand in GPM shall be based on the table C.3.2. BOCA plumbing code '81

iii) Schedule 40 steel pipe shall be selected for cold water piping and type L copper tube shall be selected for hot water circulation piping.

iv) Pipe sizing shall be based on a pipe friction loss criteria of 2.5' H_2O/100' with permissible range of 1' – 4' H_2O/100'

b) SIZING

Location	Fixture	No. Fix.	Unit F.U.	C.W. F.U.	H.W. F.U.	Total F.U.
LAB. MODULE BRANCH						
Upper lab.	Sink	3	4	9	9	12
Lower lab.	Sink	3	4	9	9	12
	BRANCH TOTAL			18	18	24
	DEMAND LOAD (GPM)			15	15	
	PIPE SIZE ("ø)			1½	1½	
LAB. SUPPLY MAIN						
	Branches	18		324	324	432
	Hose bibbes	5	5	25	-	25
	MAIN TOTAL			349	324	457
	DEMAND LOAD (GPM)			95.5	90.0	
	PIPE SIZE ("ø)			3½	3	
2nd. FLOOR TOILET RISER						
Corridor	Drink. fount.	2	1	2	-	2
J.C.	Mop sink	1	3	2.25	2.25	3
Toilet (M)	W.C. (f. valve)	2	10	20		20
	Urin. (f valve)	2	10	20		20
	Lavatory	2	2	3	3	4

continued

Location	Fixture	No. Fix.	Unit F.U.	C.W. F.U.	H.W. F.U.	Total F.U.
Toilet(F)	W.C.(f.valve)	2	10	20		20
	Lavatory	2	2	3	3	4
	RISER TOTAL			70.25	8.25	73
	DEMAND LOAD(GPM)			58	6.5	
	PIPE SIZE("ø)			3	1	
1st. FLOOR TOILET RISER						
Annex	Hose bibb	3	5	15		15
M. bldg.	Hose bibb	1	5	5		5
Conf. Rm.	Kitchem sink	1	2	1.5	1.5	2
Corridor	Drink fount	2	1	2		2
Toilet(M)	W.C.(f.valve)	3	10	30		30
	Urin (f.valve)	2	10	20		20
	Lavatory	3	2	4.5	4.5	6
Toilet(F)	W.C.(f.valve)	5	10	50		50
	Lavatory	3	2	4.5	4.5	6
	RISER TOTAL			132.5	10.5	136
	DEMAND LOAD(GPM)			76	8	
	PIPE SIZE("ø)			3	$1\frac{1}{4}$	
DARK ROOM BRANCH						
Dark Rm	Sink	1	3	2.25	2.25	3
J.C.	Sink	1	3	2.25	2.25	3
	BRANCH TOTAL			4.5	4.5	6
	DEMAND LOAD(GPM)			4	4	
	PIPE SIZE("ø)			1	1	
TOILET GROUP MAIN						
2nd. floor	Toilet riser			70.25	8.25	73
1st. floor	Toilet riser			132.5	10.5	136
Dark Rm.	Branch			4.5	4.5	6
	MAIN TOTAL			207.25	23.25	215
	DEMAND LOAD(GPM)			93	16	
	PIPE SIZE("ø)			$3\frac{1}{2}$	$1\frac{1}{2}$	
BUILDING SUPPLY MAIN						
	Lab. supply main			349	324	432
	Toilet group main			207.25	23.25	215
	MAIN TOTAL			556.25	347.25	647
	DEMAND LOAD(GPM)			151	95	161
	PIPE SIZE("ø)			4	3	4

Note: Each lab. module was assumed to have equivalent capacity of three sinks on accounting for dish washer, emergency shower and/or other installations.

3) HOT WATER CIRCULATION SYSTEM

a) HEAT EXCHANGER

i) CRITERIA: An instantaneous indirect water heater utilizing steam from the physical plant shall be selected.

* Primary hot water temperature: $140^{\circ}F$.
* Hot water peak demand: 95 gpm.
* Stream pressure: under 50 psi.

ii) SELECTION: 8212 SW instantaneous water heater by TACO or equivalent(cat.III-1).

* Steam pressure: 25 psi.
* No. of pass: 2
* Capacity: 105 gpm.
* Pressure drop: 2.1 ft.H_2O(0.9 psi)

b) RETURN PIPE

i) CRITERIA: Domestic hot water return water flow shall be determined based on the heat loss in the pipe according to the chapter 37, ASHRAE systems '80.

* Total est. circulation pipe length: 400 ft.
* Heat loss in pipe = 400' × 30 Btuh/ft.
  = 12,000 Btuh.
* Return flow rate = 12,000 ÷ 10,000
  = 1.2 gpm.
* Pipe friction loss: 1' - 4'/100'

ii) SELECTION

* Type : Type L copper tube
* Size : 1/2" ø
* Friction: 3.5'/100'

c) PUMP

i) CRITERIA: Centrifugal pump shall be selected to circulate the amount of hot water to maintain the water temperature. Available pressure of 65 psi. from the city main can provide enough flow pressure for all of the fixtures.

* Flow pressure at the highest and most remote fixture.

Est. developed length	: 300'
Est. fittings equiv. length	: 150'
Total est. equiv. length	: 450'
Pipe press. loss	= 450' × 2.5'/100' = 11.25' H_2O
Water heater pressure loss	: 2.1' H_2O
Elevation head	: 20' H_2O
Fixture flow pressure: 10psi	: 23' H_2O
Total required pressure head	: 56.35' H_2O (24.4 psi)

* Return water pressure loss

Return est. developed length	: 200'
Return est. fittings equiv. length	: 100'
Total est. equiv. length	: 300'
Return pipe pressure drop	= 300' × 3.5'/100' = 10.5' H_2O
Water heater pressure drop	= 2.1' H_2O
Supply pipe pressure drop	= 11.25' H_2O
Total pressure drop	= 23.85' H_2O

* Flow rate: 1.2 gpm.

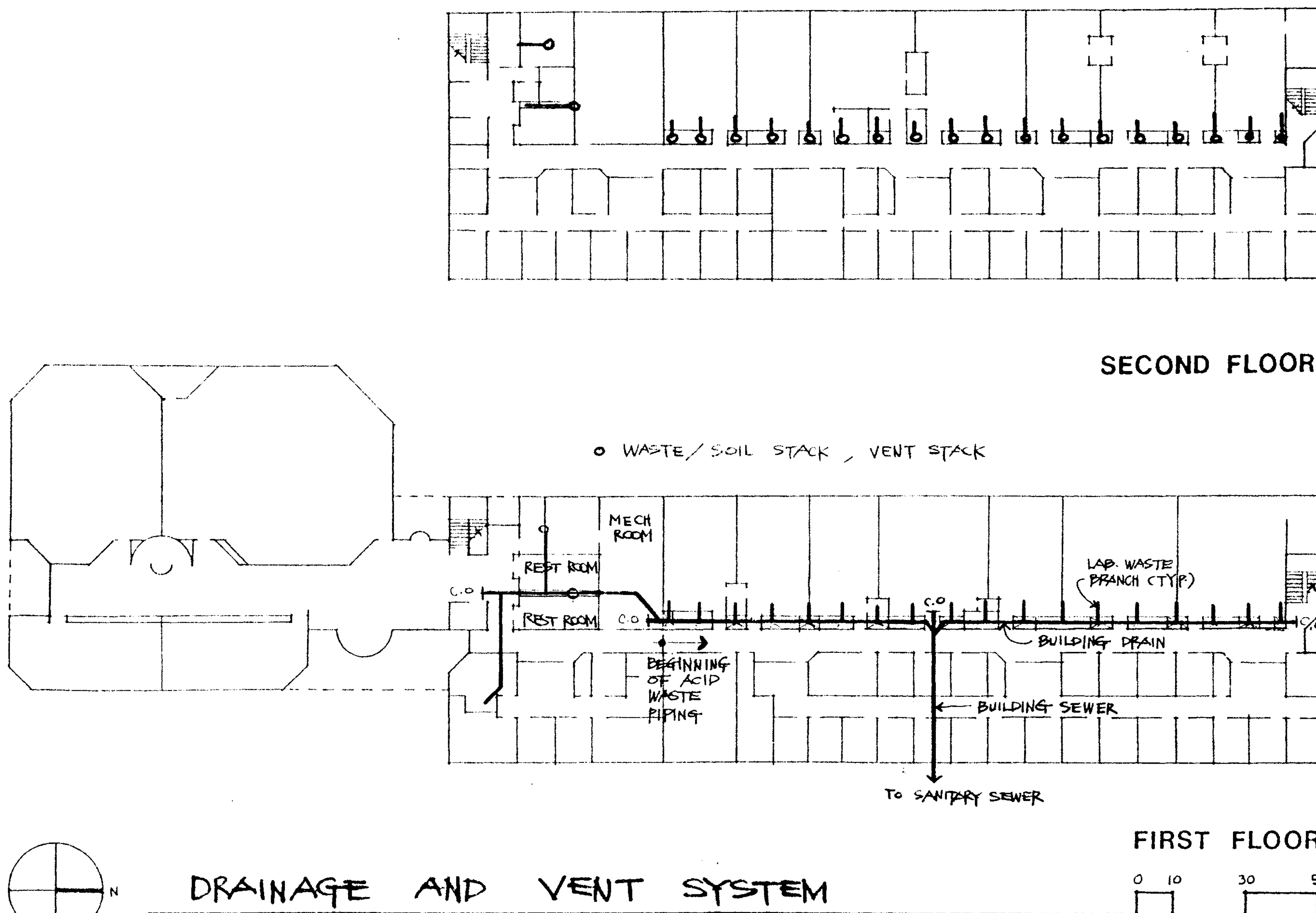
ii) SELECTION: 1737-R 1" centrifugal pump by WEIL or equivalent(cat.III-2).

* IMP dia: 4½"
* RPM : 1750 rpm.
* BHM : 0.2 bhp.
* Motor : 1/4 HP

B SOIL AND WASTE DRAINAGE

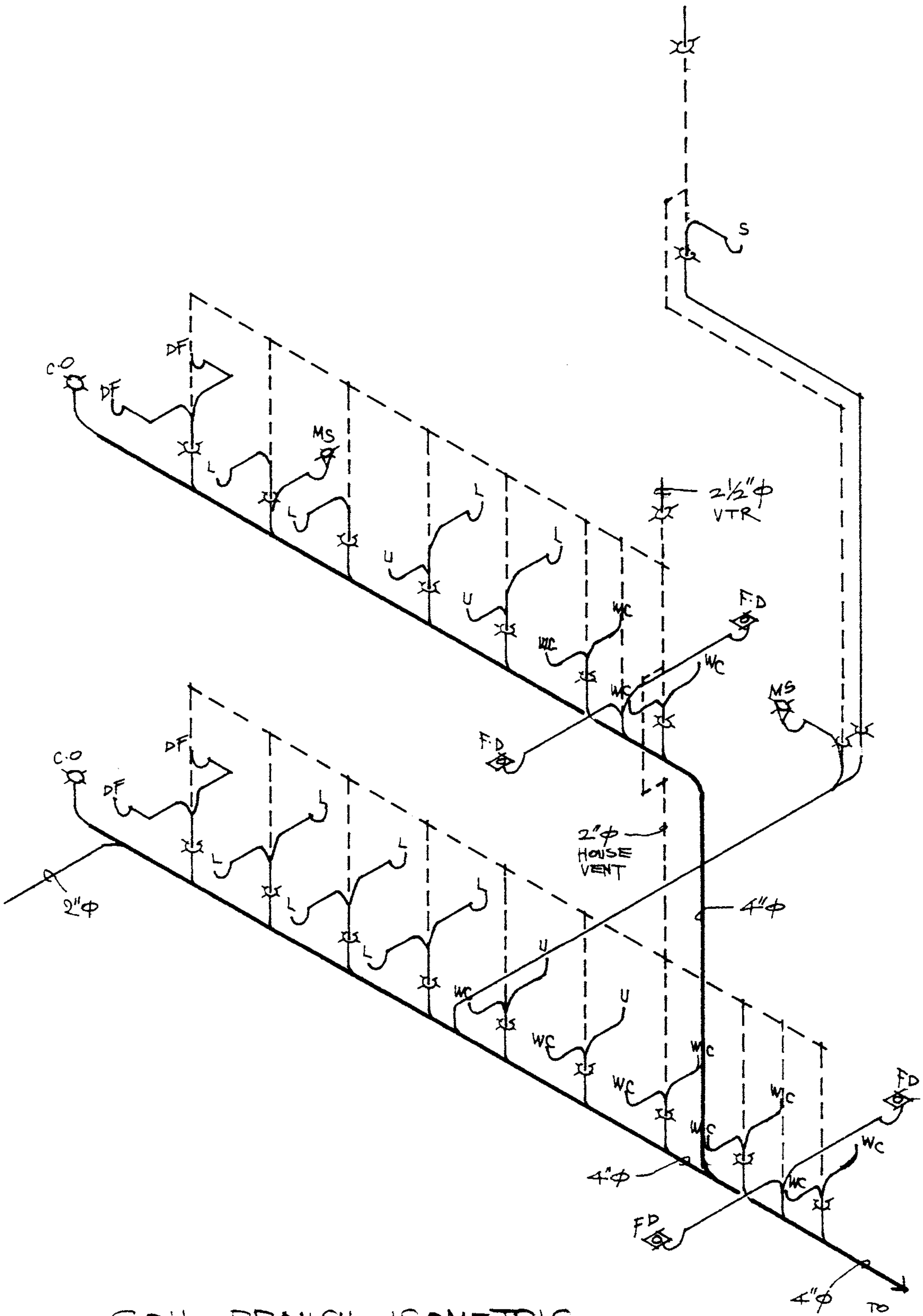
1) SYSTEM LAYOUT

See drawing next page.



DRAINAGE AND VENT SYSTEM

FIG. III.-10



SOIL BRANCH ISOMETRIC

TOILET ROOMS

FIG III-11

2) SOIL AND WASTE PIPING

a) CRITERIA

i) Cast iron pipes shall be selected for DWV installations, for its durability and resistance to corrosion.

ii) Design and sizing of DWV shall be based on the BOCA Basic plumbing code '81.

P-601.1: Drainage F.U and trap size
P-601.2: Drainage piping sizing
P-902.0: Vent sizing.

iii) Horizontal piping shall have a slope of 1/8" per foot.

b) SYSTEM SIZING

Location	Fixture	No. Fix.	Unit D.F.U.	Total D.F.U.	Trap Size
2nd. FLOOR TOILET					
Corridor	Drinking fountain	2	1/2	1	$1\frac{1}{4}$"
J.C.	Mop sink	1	3	3	3"
Toilet(M)	W.C.	2	6	12	-
	Urinal	2	6	12	-
	Lavatory	2	1	2	$1\frac{1}{4}$"
	Floor drain	1	2	2	2"
Toilet(F)	W.C.	2	6	12	-
	Lavatory	2	1	2	-
	Floor drain	1	2	2	2"
	Total DFU			48	
	Soil branch			4" ø	
	Vent branch			2" ø	
	Soil stack			4" ø	
	Vent stack			$2\frac{1}{2}$" ø	
1st. FLOOR TOILET					
Conf.room	Kitchen sink	1	2	2	$1\frac{1}{2}$"
Corridor	Drinking fountain	2	1/2	1	$1\frac{1}{4}$"
Dark room	Sink	1	3	3	3"
J.C.	Mop sink	1	3	3	3"
Toilet(M)	W.C.	3	6	18	-
	Urinal	2	6	12	-
	Lavatory	3	2	6	$1\frac{1}{4}$"
	Floor drain	1	2	2	2"
Toilet(F)	W.C.	5	6	30	-
	Lavatory	3	2	6	$1\frac{1}{4}$"
	Floor drain	1	2	2	2"

continued

Location	Fixture	No. Fix.	Unit D.F.U.	Total D.F.U.	Trap Size
Mech.room	Floor drain	2	2	4	2"
	1st. floor				
	Sub. total D.F.U.			89	
	2nd. floor				
	Sub. total D.F.U.			48	
	Total D.F.U.			137	
	Soil branch drain			4" ø	
LAB. MODULE WASTE BRANCH					
Upper lab.	Sink	3	2	6	2"
Lower lab.	Sink	3	2	6	2"
	Branch total			12	
	Waste branch			3" ø	
	Vent stack			2" ø	
BUILDING DRAIN					
	Soil branch drain			137	
	Lab waste branch	18	12	216	
	Building drain total			353	
	Building drain size			5" ø	
	Building sewer size			5" ø	

C. STORM DRAINAGE

1) STSTEM LAYOUT

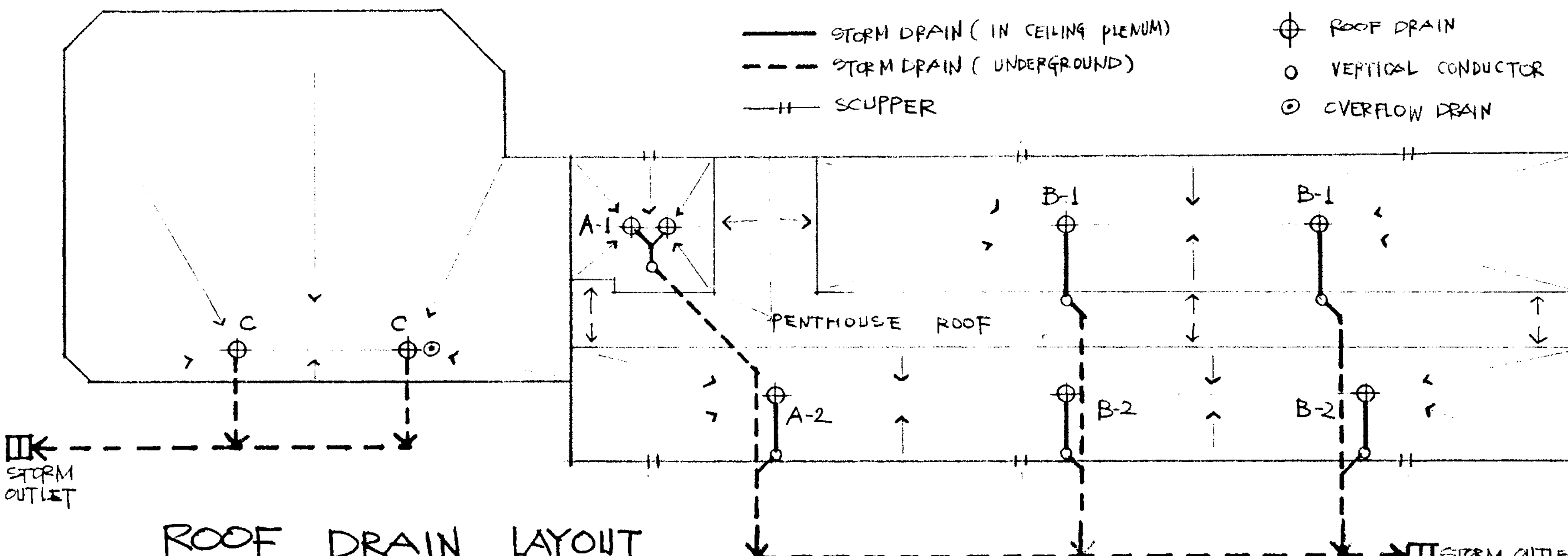
See drawing next page.

2) SYSTEM SIZING

a) CRITERIA: Storm drainage system shall be sized based on a maximum rate of rainfall of 3.75 inches per hour according to the BOCA plumbing code '81(P-803.1, P-803.2, Appendix-F). Horizontal drain shall have 1/8" per foot slope.

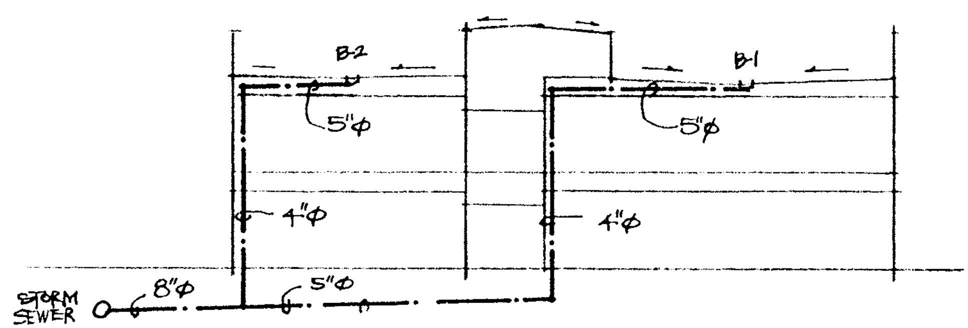
b) SIZING

Route	Main Building				Annex
Roof drain	A-1	A-2	B-1	B-2	C
No. of drain	1	1	2	2	2
Projected roof area(sq.ft.)	1850	2880	3515	2880	5100
Equiv. roof area(sq.ft.)	6938	9706	13180	9706	19125
Hor. drain(1/8" slope)	4"ø	5"ø	5"ø	5"ø	
Vert. corductor	4"ø	4"ø	4"ø	4"ø	5"ø
Building storm drain	6"ø		8"ø		6"ø



ROOF DRAIN LAYOUT

FIG - III -12



SECTION 'B'

FIG III - 13

CHAPTER IV FIRE PROTECTION/SAFETY SYSTEMS

1. TASK ANALYSIS

A CLASSIFICATION OF FIRE HAZARD

Classification of fire hazard shall be determined according to the section 1402 BOCA Basic Building Code/ 1981.

1) MAIN BUILDING

* Function: Laboratory, office
* User group: B
* Classification: 2 hour

2) ANNEX

* Function: College
* User group: A-4
* Classification: 1½ hour

B TYPE OF PROTECTION REQUIRED

Type of protection required mandatorily shall be determined according to the BOCA Basic Building Code/1981

1) MANUAL FIRE ALARM SYSTEM: Required in the Annex building(B-1717.3.2)

2) FIRE EXTINGUISER: Not required

3) AUTOMATIC FIRE ALARM: Not required

4) FIRE SUPPRESSION SYSTEM: Required in the storage over 50 sq.ft. in floor area(1702.12).

5) STANDPIPE AND HOSE SYSTEM: Not required.

2 PRELIMINARY DESIGN

A. GENERAL OVERVIEW

Even though code requires only manual fire alarm and fire suppression system partially in the building, more protection shall be provided to protect occupants as well as the property of the building.

B. SYSTEM OUTLINES

1) FIRE ALARM SYSTEM: A general building-wide alarm system alerting an immediate evacuation of the premises shall be provided for personal safety. The system shall consist of the manual fire alarm and the automatic fire alarm including sprinkler detectors and smoke detectors.

2) FIRE SUPRESSION SYSTEM: Automatic sprinkler system shall be provided in the main corridor and entrance lobby for secure route of escape, as well as in the large storages.

3) PORTABLE FIRE EXTINGUISHER: Portable fire extinguishers shall be provided for the first-line protection of the occupants and the property of the building.

4) SMOKE CONTROL SYSTEM: HVAC system shall be designed to faciliate the control of smoke when smoke is detected.

5) STANDPIPE AND HOSE SYSTEM: Not provided.

3. DETAIL DESIGN

A. AUTOMATIC SPRINKLER SYSTEM

1) SPRINKLER HEAD

a) CRITERIA: Quartzoid bulb type sprinkler head shall be selected and installed conforming to the NFPA-13-4.2.

* Max. distance between sprinkler heads: 15'
* Max. distance from wall to end sprinkler :
  Small room($<$800 ft): 9'
  Large room($\geq$800 ft): $7\frac{1}{2}$'
* Max. area per sprinkler head: 200 sq.ft.

b) SELECTION: Quartzoid pendent standard sprinker head by GRINNELL or equivalent(cat.IV-1).

* Distribution: refer to figure IV-2.

2) PIPING

a) CRITERIA: A wet pipe system shall be selected and designed conforming to the NFPA-13-2.2.1(pipe schedule method) and NFPA-13-3.4. Steel pipe shall be selected and the system shall be divided into 3 zones: the 1st. floor zone, the 2nd. floor zone, the annex zone with zone water flow detectors. An alarm check valve and O.S. & Y valve shall be provided at the base of the main riser,and the siamese connection with a fire dept check valve shall be connected to the main riser.

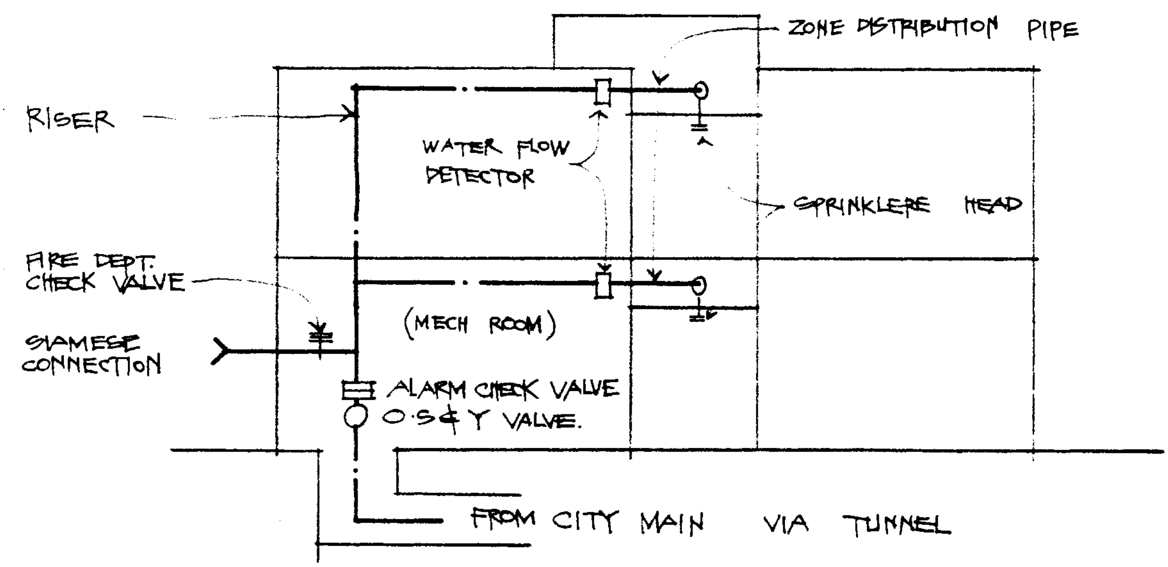
* Classification of occupancy: Light hazard
* Flow rate at base of riser: 750 gpm.
* Min. duration: 30 min.
* Water source: City main(65 psi.)
* Residual pressure: 15 psi.
* Max. distance between branch: 15'

* Max. No. of sprinkler heads on either side of a cross main: 8
* Pipe schedule(steel pipe)

No. sprinkler head	2	3	5	10	30	60	100
Pipe dia(inch)	1	$1\frac{1}{4}$	$1\frac{1}{2}$	2	$2\frac{1}{2}$	3	$3\frac{1}{2}$

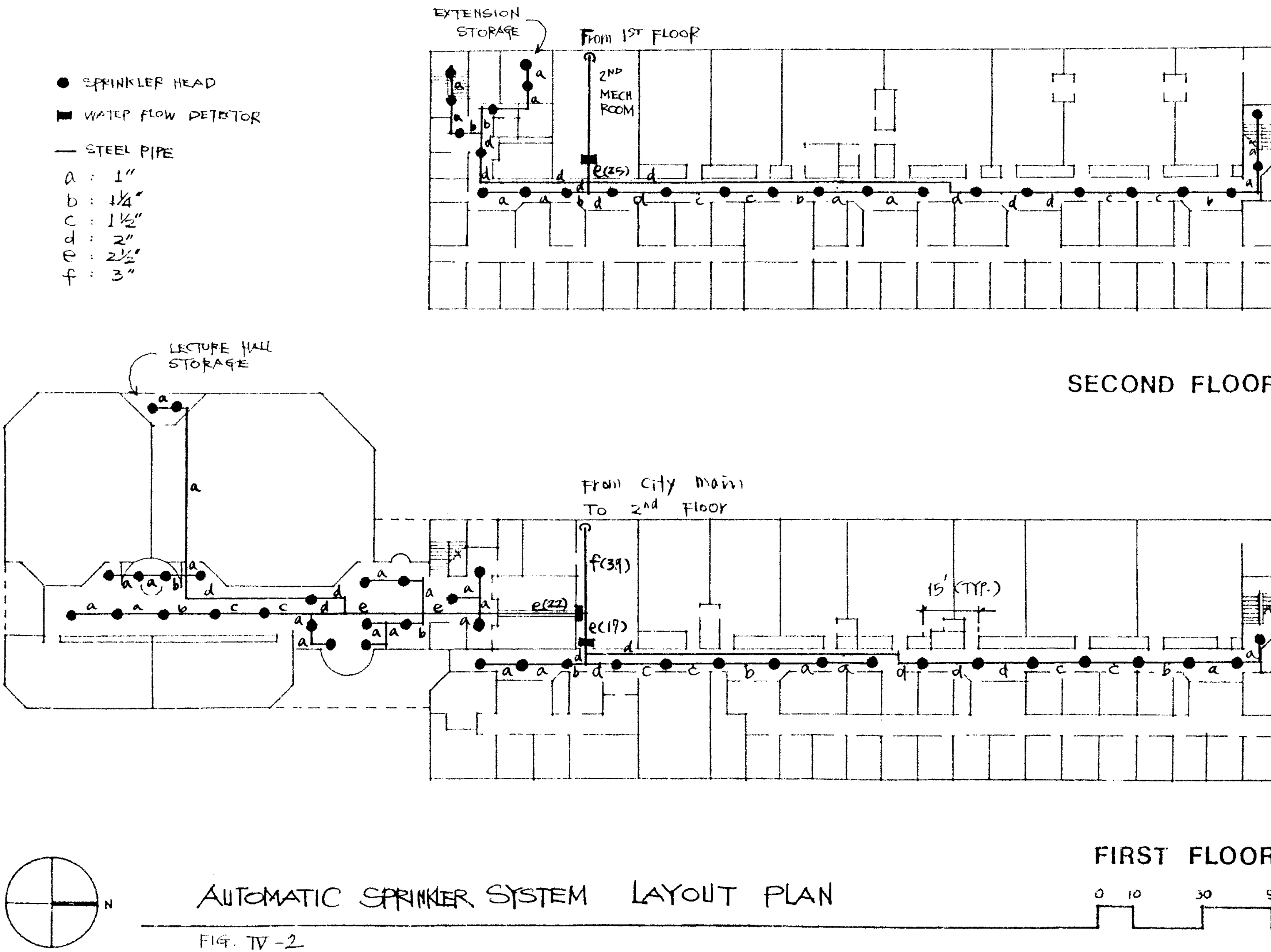
b) SELECTION

* Major pipe size	Sprinkler heads	Pipe size (" ø)
Main riser	64	$3\frac{1}{2}$
1st. floor zone main	17	$2\frac{1}{2}$
2nd. floor zone main	25	$2\frac{1}{2}$
Annex zone main	22	$2\frac{1}{2}$



AUTOMATIC SPRINKLER SYSTEM SCHEMATICS

FIG IV - 1.



AUTOMATIC SPRINKLER SYSTEM LAYOUT PLAN

FIG. IV-2

B. PORTABLE FIRE EXTINGUISHERS

1) ANNEX

a) CRITERIA

* Major function: Classroom/Lecture hall
* Type of fire: Class A
* Class of hazard: Light
* Type of extinguisher: Water(class A)
* Min. rated single extinguisher: 2A
* Max. travel distance: 75'
* Max. area per unit of A: 3,000 sq.ft.

b) SELECTION: Model LS-900 A by GENERAL or equivalent(cat.IV-2).

* Quantity: 4 units
* UL rating: 2-A

2) MAIN BUILDING/OFFICE

a) CRITERIA

* Major function: Office
* Type of fire: Class A
* Class of hazard: Light
* Type of extinguisher: Water(class A)
* Min. rated single extinguisher: 2A
* Max. travel distance: 75'
* Max. area per unit of A: 3,000 sq.ft.

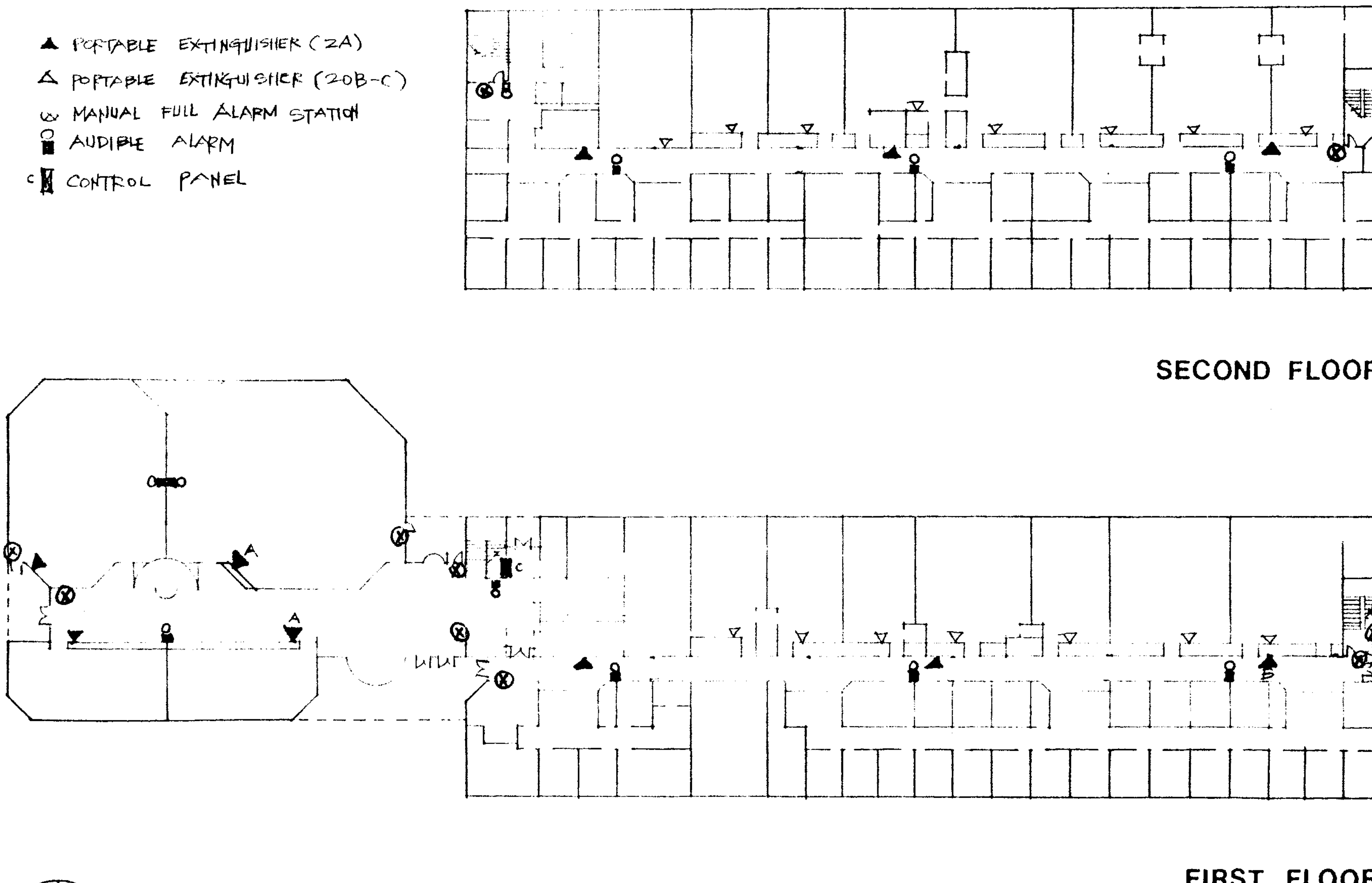
b) SELECTION: Model LS-900 A by GENERAL or equivalent(cat. IV-2).

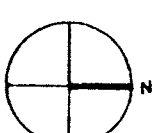
* Quantity: 3 units per floor
* UL rating: 2-A

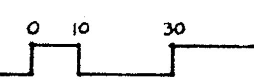
3) MAIN BUILDING/LAB, MECH. ROOM

a) CRITERIA

* Major function: Laboratory, Mech./Elect. room
* Type of fire: Class B, C
* Class of hazard: Light to ordinary
* Type of extinguisher: Multi-purpose dry chemical.
* Min. rated single extinguisher: 20 B
* Max. travel distance: 50 ft.







FIRE EXTINGUISHER AND ALARM SYSTEM LAYOUT

FIG. IV-3

b) SELECTION: model CP-5J by GENERAL or equivalent(cat. IV-3).

* Quantity: One unit per room
* UL rating: 20 BC

C. FIRE ALARM SYSTEM

1) GENERAL: A general building-wide closed-circuit, supervised fire alarm system alerting an immediate evacuation of the premises shall be provided primarily for personal safety. 120 volt AC normal utility power shall be supplied to each systems through the emergency circuit Control and emergency DC power shall be supplied from the control panel through the class B wiring in accordance with the NEC and NFPA-72. The system shall be compatible to connect to the existing campus fire alarm system.

2) CONTROL PANEL

a) CRITERIA

The control panel shall be capable of future expansion and shall provide 11 active signal initiating zones and provisions for future addition of 3 zones.

Zone	Items
1.	1st. floor, Main building
2.	2nd. floor, Main building
3.	Annex(Classroom building)
4.	Main sprinkler water flow
5.	Valve supervisory switch
6.	1st. floor, Water flow, Main building

7. 2nd. floor, Water flow, Main buinding
8. Annex, Water flow
9. 1st. floor, Smoke detector, Main building
10. 2nd. floor, Smoke detector, Main building
11. Annex, Smoke detector
12. Future
13. Future
14. Future

The built-in annunciation panel shall use light emitting diodes(LED) through out. Each signal initiating circuit shall be represented by a yellow LED and a red LED to indicate trouble and alarm. Each circuit shall include individual supervisory and alarm relay and or circuitry.

Input power shall be 120 volt AC utility power converted to 24 V. DC through a built-in converter. Emergency power during utility failure shall be supplied from built-in rechargeable gell cells or Nicard battery with automatic battery charger. Capacity of the battery shall power the system under trouble and stand-by condition for 24 hours and to ring all alarm devices for a mininum of 5 mins at the end of this period.

b) SELECTION: Model 4,800 control panel by NOTIFIER or equivalent(cat. IV-4).

3) MANUAL ALARM STATION

a) CRITERIA: Manual alarm stations shall be non-code, non-break glass type equipment with a key operated test-retest lock: provided at locations as indicated on the drawing.

b) SELECTION: Model BNG by NOTIFIER or equivalent (cat. IV-5).

4) SPRINKLER DETECTOR

a) CRITERIA: Vane-type water flow detectors in the sprinkler system distribution pipe and a sprinkler supervisory switches on the main sprinkler riser shall be installed as indicated on the drawing.

b) SELECTION: Model NGV(OS & Y gate valve) and Model WFD(water flow detector) by NOTIFIER or equivalent(cat. IV-6).

5) SMOKE DETECTOR

a) CRITERIA: Duct mounted ionization detectors shall be located in the supply and exhaust ducts as specified in the HVAC chaper and in accordance with NFPA 90 A.

b) SELECTION: Model DH-20 Duct housing by NOTIFIER or equivalent(cat, IV-7).

6) ALARM DEVICES

a) CRITERIA: Audible alarm signals shall be bells of the underdome vibrating type with gongs no smaller than 6" in diameter with red finish Bells shall be polarized and operate 24 volt DC. Bells shall be located as shown on the drawing.

b) SELECTION: Model N-CO-Bell by NOTIFIER or equivalent(cat. IV-8).

7) SYSTEM OPERATION

The actuation of any manual alarm station or automatic initiating device shall cause the following actions or effects to take place.

* Indicate by LED the zone from which the device was actuated.
* Transmit an alarm signal to the fire dept. by reverse polarity leased telephone lines.
* Sound all audible devices until manually silenced.
* Call the elevator to return to the ground floor.
* Actuate smoke control mode in HVAC system only upon activation of the duct smoke detectors.

CHAPTER V HVAC SYSTEMS

1. TASK ANALYSIS

A. SYSTEM REQUIREMENTS

1) HUMAN COMFORT

ASHRAE Standard 55-1981, Thermal Environmental Conditions for Human Occupancy shall be applied to determine the condition of the thermal comfort.

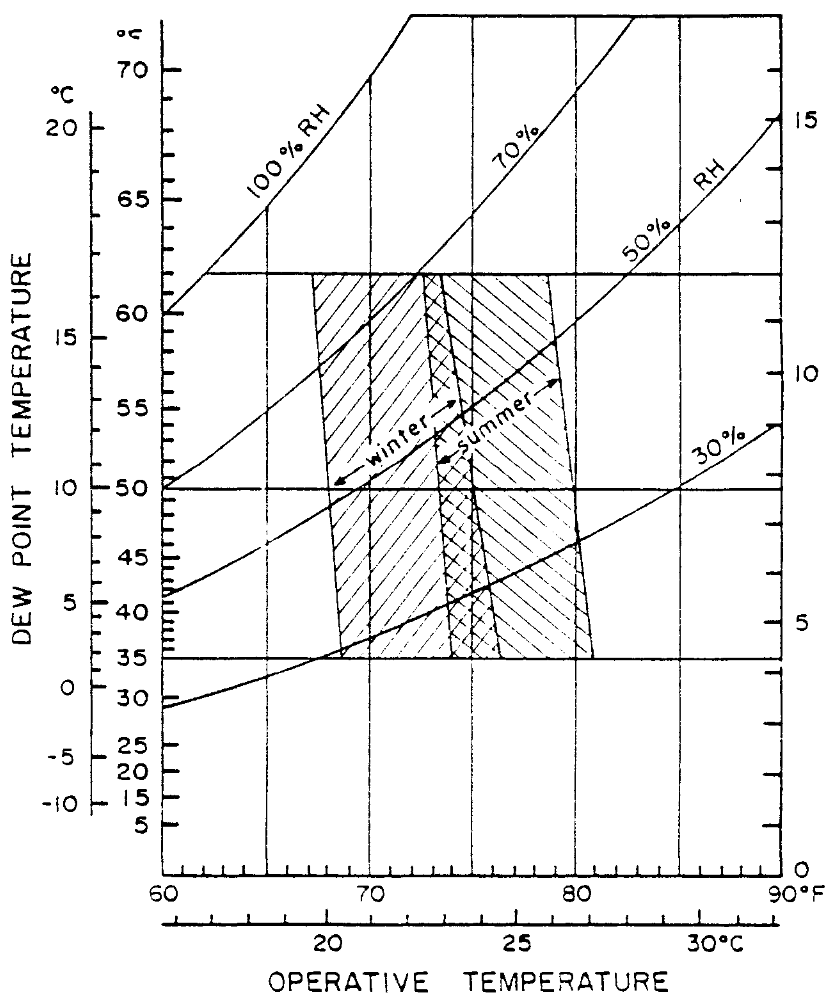


FIG. V-1.
COMFORT ZONE

ACTIVITY: The activity involved in this building can be classified as sedentary or light activity. However, since the most works are sedentary even in the laboratory, the activity shall be considered as sedentary.

Metabolic Rates of Typical Tasks

Activity	Metabolic rate in met units
Reclining	0.8
Seated, quietly	1.0
Sedentary activity (office, dwelling, lab, school)	1.2
Standing, relaxed	1.2
Light activity, standing (shopping, lab, light industry)	1.6
Medium activity, standing (shop assistant, domestic work, machine work)	2.0
High activity (heavy machine work, garage work)	3.0

CLOTHING: Occupants shall be assumed to wear typical clothing as described in the ASHRAE Standard 55.

Season	Description of typical clothing	clo
Winter	heavy slacks, long sleeve shirt and sweater	0.9
Summer	light slacks and short sleeve shirt	0.5
	minimal	0.05

TEMPERATURE/HUMIDITY: Operative temperature and humidity shall be maintained within the comfort zone specified in the figure (V-1). Operative temperature shall be assumed to be approximately the average of air temperature and MRT.

AIR MOVEMENT: Average air movement shall be limited to 30 fpm. in winter and 50 fpm. in summer.

2) OPERATIONAL CONDITION

LABORATORY: No special ambient condition for the process of laboratory experiment is required except for the normal indoor condition. Providing of proper ventilation and exhaust of toxic gas is important to the safety of human occupants.

COMPUTER ROOM: The room condition shall be maintained for the optimum operation and shall not exceed the allowable maximum range.

	optimum	allowable
ambient temperature	$72^{\circ}\pm 2^{\circ}F$	$60^{\circ}-80^{\circ}F$
relative humidity	$55\pm 5\%$	40-70%

3) VENTILATION REQUIREMENT

	minimum CFM per person	
space category	vent. air[a]	outdoor air[d]
class/lecture	10[b]	5
office	15	5
circulation	15[b]	5
reception/hall	15	5
conference	25	8.3
computer	5	5
work/service	10	5
laboratory	15	5
toilet	40 CFM per W.C.-exhaust	

a. BOCA BASIC MECH. CODE '81(M-1002.1)
b. BOCA BASIC MECH. CODE '81(M-1001.1)
c. BOCA BASIC MECH. CODE '81(M-1009.1)
d. BOCA BASIC MECH. CODE '81(M-1010.0)

B. SYSTEM DESIGN CONSIDERATIONS

1) SYSTEM FLEXIBILITY

System shall be flexible enough to permit furture control zone changes, especially in the laboratories, as well as to accommodate chainging operational modes.

a) Simultaneous heating/cooling due to the space orientation and solar position.

b) Heating/cooling change-over in same day.

c) Night/weekend and partial operation due to changing occupancy mode.

d) Great change in air cir circulation rate due to laboratory exhaust.

2) SITE UTILITY

System shall be designed to utilize the available source of energy and service at the building site.

3) ENERGY CONSERVATIONS

System shall be designed to meet the energy conservation requirement of the BOCA Basic Mechanical Code/ 1981.

* M 1301.2: 100% economizer cycle for all-air system.
* M 1301.4.8: Simultaneous heating/cooling independent systems serving common spaces shall either provide sequential temperature control of both heating and cooling capacity in each zone or limit the heating energy input through automatic reset control of the heating medirm temperature, to only that necessary to offset heat loss due to transmission and infiltration.
* M 1304.5: Setback and shut-off requirements.

4) SYSTEM COORDINATION

HVAV System shall be designed to coordinate with other systems.

a) System shall fit to the architectural and/or structural system.

b) System shall meet the noise criteria.

c) System shall be designed to faciliate the smoke control in case of fire.

C. THERMAL LOAD

1) LOAD CALCULATION CRITERIA

a) THERMAL DESIGN CONDITIONS

HVAC system thermal load shall be calculated based on the thermal design criteria, specified in the BOCA Basic Mechanical Code/1981.(M.1301,0)

OUTDOOR DESIGN CONDITION

	winter[a]	summer[b]
Design Dry-Bulb	13° F	96° F
Design Co-incident Wet-bulb	-	74° F
Mean Daily Range	-	24° F

a. 97.5% value from ASHRAE Fund. '81, 24.12
b. 2.5% value from ASHRAE Fund. '81, 24.12

INDOOR DESIGN CONDITION

	winter	summer
Design Dry-Bulb	70° F	78° F
Relative Humidity	-	60%

b) INTERNAL HEAT GAIN CRITERIA

OCCUPANTS

Space Category	Activity	Heat gain(BTUH)* Sens.	Lat.	Total
Class/lecture	seated, very light	230	190	420
Office	seated, very light	230	190	420
Conference	seated, very light	230	190	420
Reception	seated, light	255	255	510
Computer	seated, light	255	255	510
Lab.	standing, light	315	325	640
Toilet	standing, light	315	325	640
Corridor	standing, light	315	325	640

* ASHRAE '81 Fund. 26.25.

LIGHTING AND APPLIANCES

	Lighting Heatgain		Appliance Heatgain	
Space Category	Avg fc	Sensible (BTUH/ф)[a]	Sensible (BTUH/ф)	latent (BTUH/ф)
Class/lacture	50	9.5	1.5[b]	-
Office	50	9.5	3.0[c]	-

Conference	30	5.8	3.0[c]	-
Reception	30	5.8	3.0[c]	-
Computer	20	3.4	75.0[d]	-
Lab	75	13.6	20.0[e]	10.0[e]
Toilet	15	2.6	-	-
Corridor	15	2.6	-	-

a MEEB p.867(including ballast)
b. eatimated
c. ASJRAE Fund. 26. 27 mean value for office
d. ASHRAE Fund. 26. 27 low value for digital computer
e. ASHRAE J. (Sept. 1972, p.60)

2) LOAD CALCULATION

a) METHOD

Calculation of space cooling load shall be based on the CLTD method of the ASHRAE '81 Fundamentals, which considers the thermal storage effect to determine an economical cooling equipment capacity.

Calculation of space heating load shall be based on the maximum probable heat loss of each space to be heated while maintaining the design air temperature during periods of design outdoor weather conditions.

The coil load shall be the peak instantaneous sum of the space cooling load for all the spaces served by the system, plus additional loads imposed on the system external to the conditioned spaces.

b) PROCEDURE

A Fortran Computer program based on the CLTD method was developed and utilized to faciliate the load calculation procedure.

The program statements, input form and the output of the calculations are included in the Appendix.

Several sets of computer run have been executed after initial load calculation, as the system design has been changed and developed.

Final calculations were executed according to the final scheme of the system.

c) LOAD SUMMARY

	Annex	Office	Lab.
Cooling peak time	16:00	16:00	16:00
Space sen.	203402	204571	371257(Btuh)
Space lat.	122420	69060	127500(Btuh)
Space total	325822	273631	498757(Btuh)
Vent. CFM.	5840	4875	4080(cfm)
Exhaust CFM.	400	240	39100(cfm)
Heating space total	76280	86270	55267(Btuh)

* Heating/cooling load for outdoor air and return air not included(refer to appendix).

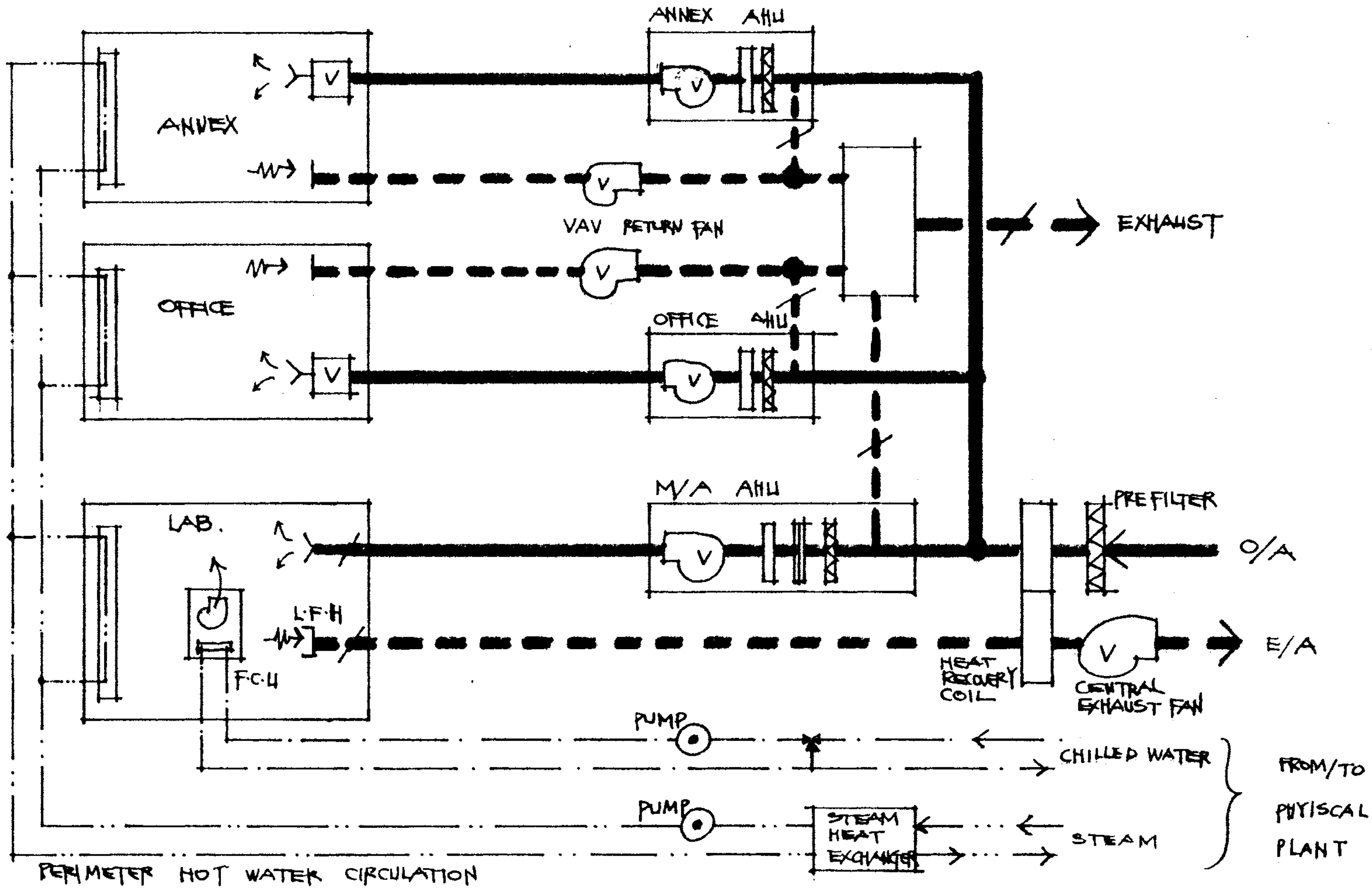
2. PRELIMINARY DESIGN

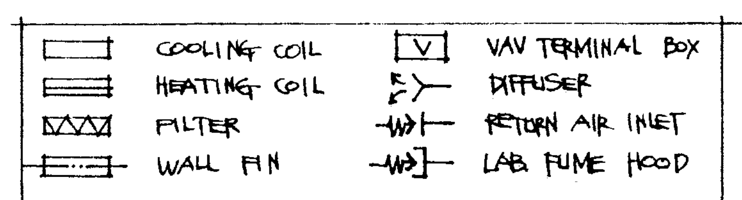
A. GENERAL OVERVIEW

AIR CIRCULATION: To handle the extremely large and flexible amount of air circulation requirement for the laboratories, a centralized VAV exhaust and make-up air system shall be selected. A heat recovery coil shall be provided to transfer energy from the outgoing exhaust air into the incoming fresh outdoor air.

SPACE COOLING: An all-water system shall be selected for the laboratories, since the cooling load and air requirements are not usually closely related in the laboratories. Meanwhile, a centralized all-air system shall be selected for the rest of the main building(mainly offices) as well as the Annex since the cooling load and air requirements are related.

HEATING: An all-water system shall be selected and designed to off-set the heat loss through the building envelope.





SYSTEM SCHEMATIC DIAGRAM

FIG V-2.

B. SYSTEM OUTLINES

1) LAB. EXHAUST AND MAKE-UP AIR SYSTEM

The lab. exhaust system shall be a centralized VAV exhaust fan system connected with each laboratory's exhaust terminal equipment.

A heat recovery coil shall be provided to transfer energy from the outgoing exhaust air into the incoming outdoor make-up air.

The make-up air supply system shall also be a centralized VAV system providing make-up air for each laboratory room.

The make-up AHU shall be equipped with a mixing box, a filter, a coil and a VAV fan.

After being filtered and pre-tempered through the heat recovery coil, the outdoor air shall be mixed with the transfer air from the two central air conditioning systems(Annex, Main Building). The mixed air shall be filtered, tempered(78°F in summer, 70°F in winter) and distributed through the supply duct.

In the laboratory, each exhaust terminal unit shall be provided with its own make-up air supply damper which is opened simutaneously with the exhaust terminal damper.

Each exhaust terminal unit shall be provided with its own branch duct into the main exhaust duct located in the penthouse.

The perchrolic acid fume hood system and the toilet exhaust system shall be an independent system provided with its own duct and fan.

2) LAB. FAN COIL UNIT SYSTEM

The laboratory space cooling system shall be a chilled water fan coil unit system.

Fach laboratory module(10' bay) shall be provided with its own fan coil unit, thus become an independent control zone.

Each unit shall be equipped with a cooling coil, filter and circulating fan.

Chilled water circulation system shall be a two-pipe reverse return system.

3) CENTRAL AIR CONDITIONING SYSTEMS

The centralized all-air cooling systems for the Annex and the main building excluding the laboratories shall be central VAV air conditioning systems providing space cooling and ventilation. An independent air handling unit(AHU) shall be provided for each of the annex and the main building.

The AHU shall be equipped with a mixing box, a filter, a coil and a VAV fan.

Each occupied space(room) shall be an independent zone with a VAV terminal box.

Supply air shall be distributed to the occupied spaces through the supply air duct and relief air shall be returned via the ceiling plenum.

In the normal operational mode, 40% of the return air shall be transferred into the Laboratory Make-up Air system while 60% of the return air shall be returned into the AHU for recirculation.

The return air shall be mixed with the fresh outdoor air which is pre-filtered and tempered through the heat recovery coil.

In the economizer cycle mode, 100% of the outdoor air, by-passed the heat recovery coil, shall be supplied and 100% of the relief air shall be directly exhausted to outside the building.

The supply air temperature shall be maintained at 55^{o}F at all time except for the economizer cycle mode.

4) PERIMETER HEATING SYSTEM

The all-water heating system shall be a perimeter hot water wall fin radiator/convector system. The system shall have three zones: the annex zone, the east zone and the west zone.

Hot water circulation system shall be a zone series loop system with a two-way flow contrlo valve to adjust the water flow into the zone loop according to the zone sol-air sensor.

Wall fin shall be installed at every window sill of the main building and at the base of the perimeter wall of the annex.

3. DETAIL DESIGN

A. LAB EXHAUST AND MAKE-UP AIR SUPPLY SYSTEM

1) ROOM TERMINAL COMPONENT

a) GENERAL: Presentation of the room terminal components selection procedures shall be limited to one typical laboratory module(10' bay) with one laboratory fume hood.

b) LABORATORY FUME HOOD

i) CRITERIA: A laboratory fume hood with following features shall be selected and installed at the location where there is not frequent traffic movement.

* Face velocity: 100 fpm
* By-pass feature
* Motorized damper switch

ii) SELECTION: Type SS-05 single compartment fume hood by DURALAB or equivalent(cat.V-1).

* Face area: 10.8 sq.ft.
* Exhaust rate: 1080 cfm
* Collar size: 10.5" ∅
* Hood static pressure loss: 0.375" w.g.

c) MAKE-UP AIR DIFFUSER

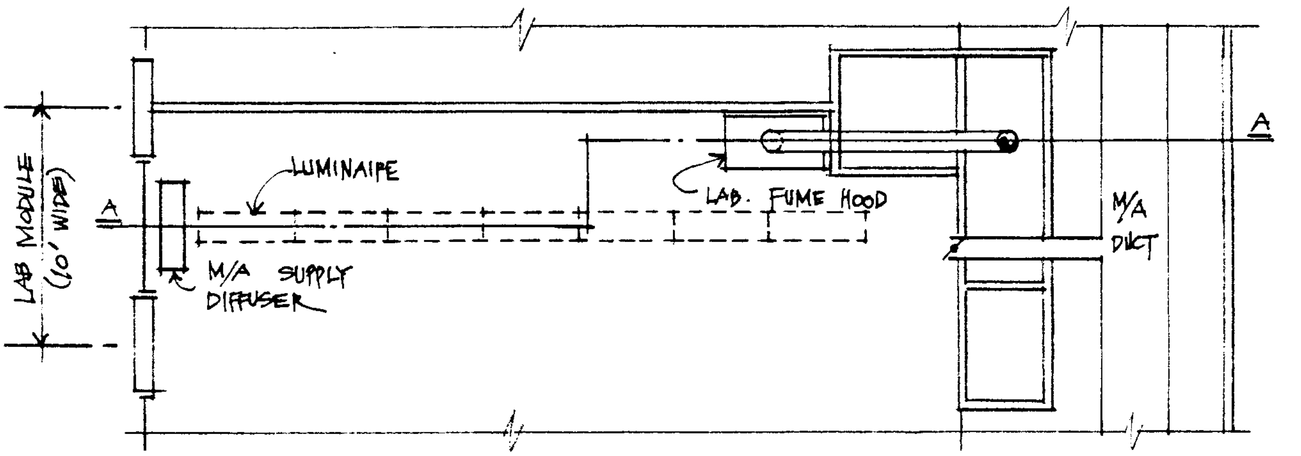
i) CRITERIA: Perforated panel with following features shall be selected and installed at the ceiling adjacent to the perimeter window to distribute fresh air evenly over the space without affecting the laboratory fume hood operation.

* Discharge rate: 1080 cfm
* Noise criteria: under NC 45

ii) SELECTION: Series A-CT by TUTTLE & BAILEY or equivalent(cat. V-2).

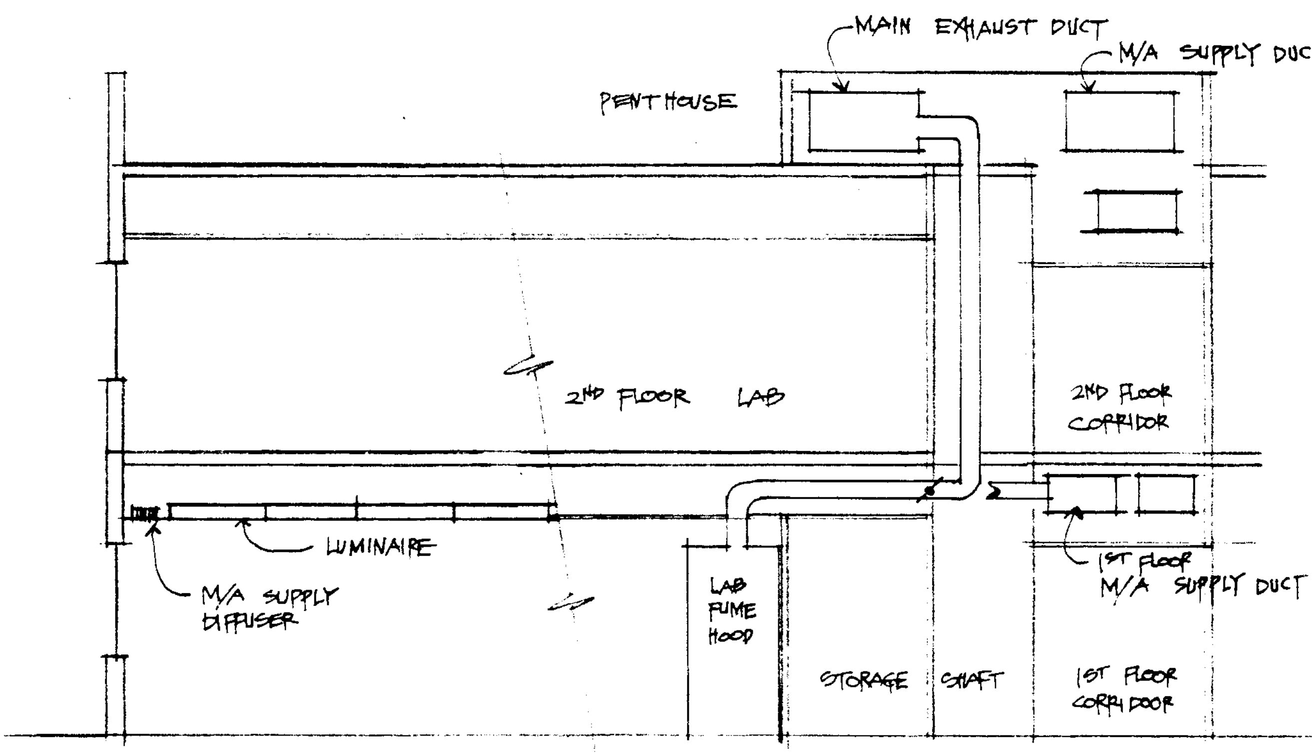
* Face area: 24" × 18"
* Noise: Under NC 20
* Static pressure loss: 0.02" w.g.

d) COMPONENTS LAYOUT



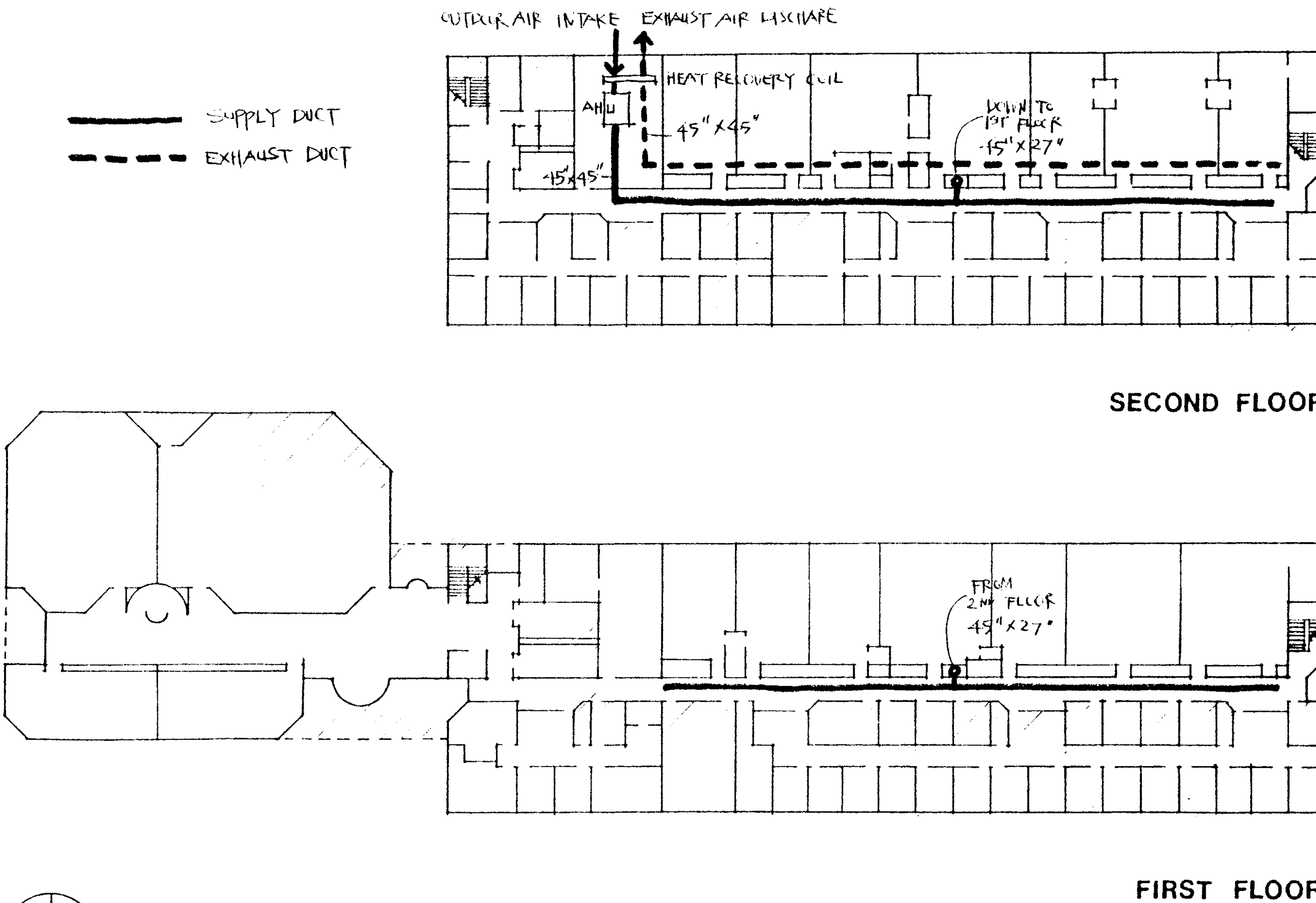
LAB COMPONENTS LAYOUT PLAN

FIG V-2



LAB. SECTION A-A

FIG V-3



LAB. EXHAUST AND MAKE-UP AIR SYSTEM MAIN DUCT LAYOUT

N

0 10 30 50

FIG V-4

2) BUILDING DISTRIBUTION COMPONENTS

a) DUCT DESIGN CRITERIA: Exhaust and make-up air duct shall be sized based on the equal friction method.

* System max. air flow: 40,000 cfm
* Main duct friction: 0.2" w.g./100'
* Branch duct friction: 0.1" w.g./100'

b) SUPPLY DUCT: The main supply duct shall be located in the main corridor ceiling plenum as shown in the drawing(Fig. V-3,4).

* Max. duct size/air velocity: 28" × 70"/3100 fpm
* Est. main duct total equiv. length: 350'
* Est. branch duct total equiv. length: 50'
* Est. total duct friction loss
  $= 350 \times (0.2/100) + 50 \times (0.1/100) = 0.75$" w.g.

c) EXHAUST DUCT: The main exhaust duct shall be located in the penthouse as shown in the drawing(Fig. V-3,4).Each branch exhaust duct shall be installed in the lab. ceiling plenum and the vertical chase to tap to the main exhaust duct individually.

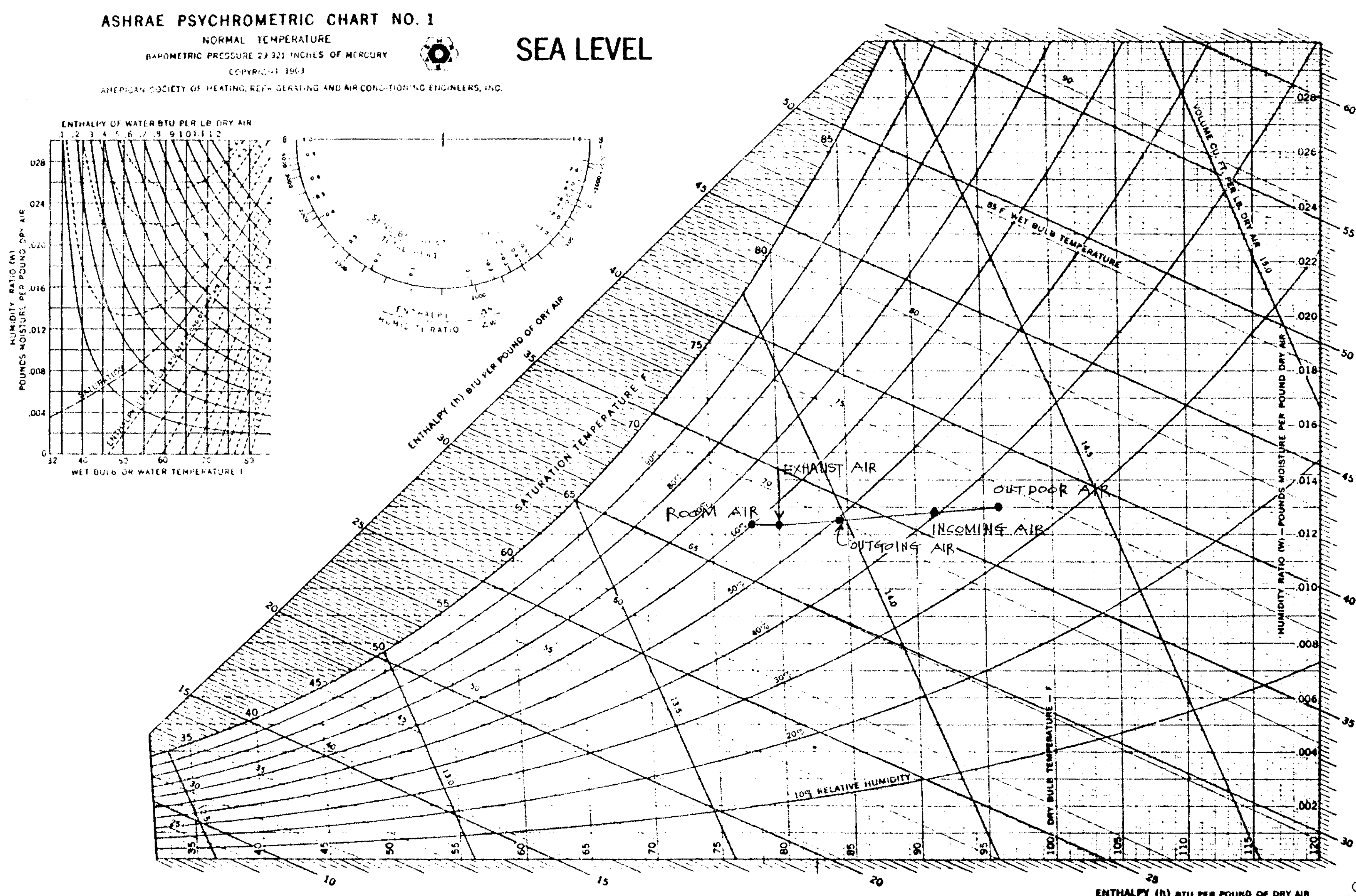
* Max. duct size/air velocity: 28" × 70"/3100 fpm
* Est. main duct total equiv. length: 300'
* Est. branch duct total equiv. length: 80'
* Est. total duct friction loss
  $= 300 \times (0.2/100) + 80 \times (0.1/100) = 0.68$" w.g.

3) EXHAUST FAN AND HEAT RECOVERY COIL

a) HEAT RECOVERY COIL

i) CRITERIA: A thermosiphon-passive, air-to-air heat recovery coil shall be select with following features:

* Max. air folw rate: 40,000 cfm
* Face velocity: not more than 600 cfm
* Efficiency: more than 50%



ASHRAE Psychrometric Chart (Reprinted by permission from ASHRAE Guide and Data Book, 1963)

FIG. V-5 HEAT RECOVERY COIL PERFORMANCE

ii) SELECTION: Thermosiphon Heat Recovery Coil by Gamewell or equivalent(cat. V-5).

* Type: copper tube -6 row
* Face area: 9' X 7.5' = 66.5 sq.ft.(each way)
* Face velocity: 590 fpm
* Static pressure drop = 0.175X6 =1.05" w.g.
* Efficiency: 57%
* Performance

Performance	Summer(°F db)	Winter
Exhaust air	80	70
Outdoor air	96	13
Incoming air	91.4	29.1

refer to chart(Fig. V-5).

b) EXHAUST FAN

i) CRITERIA: Double width, double inlet, multi-blade centrifugal, air foil fan with variable speed motor drive in a factory assembled unit casing shall be selected.

* Max air flow: 40,000 cfm
* Total static pressure

Fume hood	0.375
Exhaust duct	0.68
Heat recovery coil	1.05
Discharge duct	0.19 @ 1225 fpm
Louver/Damper	0.15 @ 1225 fpm
Total static pressure	2.445" w.g.

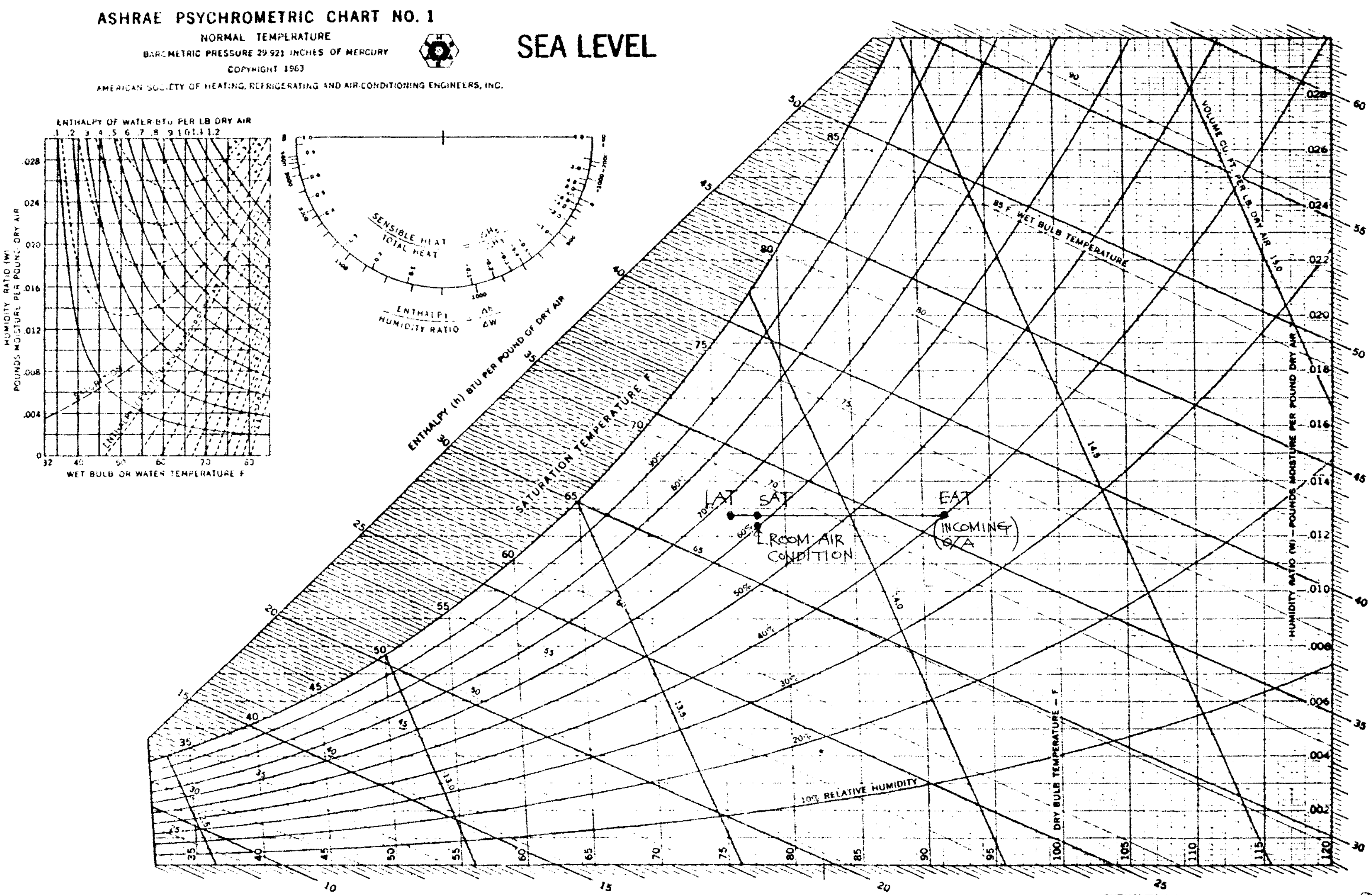
ii) SELECTION: No. 63F - HDT- 36.5" AF fan with variable speed motor drive by TRANE or equivalent(cat. V-7).

* Inlet size: 7'$\frac{1}{4}$" x 9'6"
* Outlet size: 54$\frac{3}{8}$" x 53$\frac{7}{8}$"
* RPM: 947 rpm
* BHP: 27.35 bhp
* Motor: 30 HP

4) MAKE-UP AIR HANDLING UNIT

a) COIL

i) CRITERIA: Coil shall be initially selected



ASHRAE Psychrometric Chart (Reprinted by permission from ASHRAE Guide and Data Book, 1963)

FIG V-6. M/A COOLING COIL PERFORMANCE

and sized for sensible cooling capacity and checked for heating capacity.

* SCFM: 40,000 cfm
* Face velocity: 635 cfm
* Air condition

Air condition	Summer	Winter
Entering air(EAT)	91.5°Fdb/72.5°Fwb	29.1°F
Leaving air(LAT)	76°Fdb/68°Fwb	68°F
Supply air(SAT)	78°Fdb/68.5°Fwb	70°F

refer to chart V-6.

* Coil load(sensible) 682000Btuh(56.8ton) 1711.6MBH
* Water temperature

Water temperature	Summer	Winter
Entering water(EWT)	42°F	180°F
Water temp. rise(WTR)	12°F	- 30°F
Avg water temp(AWT)	48°F	165°F

* Tatal GPM = Q/(500 × WTR) = 113.7 GPM

ii) SELECTION: Type W water coil by TRANE or equivalent(cat. V-6).

* Face area = 42"(W) × 108"(H) × 2 coils = 63 sq.ft.
* GPM per coil = 113.7/2 = 56.85 gpm
* FPS = (GPM × 1.66)/fin width = 2.25 fps
* Series and row

$$\frac{TDA}{ITD} = \frac{EAT - LAT}{EAT - EWT} = \frac{91.5 - 76}{91.5 - 42} = 0.313$$

$$\frac{WTR}{TDA} = \frac{12}{91.5 - 76} = 0.774$$

From chart 11-1
Basic row factor(No) = 3.1
From chart 10-1

series	turb	correction factor	corrected row factor
58	no	0.46	1.43
55	no	0.72	2.23
58	yes	0.4	1.24
55	yes	0.66	2.05

Select 2 row series 58 without tubulator

* Heating capacity

$$\frac{TDA}{ITD} = \frac{LAT - EAT}{EWT - EAT} = \frac{68 - 29.1}{180 - 29.1} = 0.258$$

$$\frac{TDW}{TDA} = \frac{EWT - LWT}{LAT - EAT} = \frac{180 - 150}{68 - 29.1} = 0.77$$

From chart 11-1
Basic row factor(No) = 2.35
From chart 91-1
Correction factor(f) = 0.38

Row require for heating
$N = No \times f$
$= 2.35 \times 0.38 = 0.89 < 2$
Thus 2 row of series 58 has sufficient heating capacity

* Air side pressure drop = 0.18" w.g. @ 635 fpm
* Water side pressure drop

Total header P.D. = 0.92' @ 2.25 fps
Tube water P.D. = 0.51'/pass @ 2.25 fps

Total water P.D. = 0.92 + (0.51' × 2)
= 1.94' H_2O

b) SUPPLY FAN AND UNIT CASING

i) CRITERIA: Air handling unit shall be a factory assembled, vertically sectionalized casing consisting of separate fan, coil, mixing/filter box sections. Fan shall be double width, double inlet, multiblade, centrifugal type, air foil fan with variable speed motor drive.

* SCFM: 40,000 cfm
* Total static pressure

Terminal(including diffuser)	: 0.02
Supply duct:	: 0.78
Coil	: 0.18
Filter(T.A. dirty)	: 0.48
Heat recovery coil	: 1.05
Prefilter/damper	: 0.15
Intake louver	: 0.15
Total static pressure	: 2.81" w.g.

ii) SELECTION: No. 50 Vertical Draw-Thru Climate changer with No. 50 H-VDT-33" AF fan with variable speed motor drive by TRANE or equivalent, (cat. V-8).

* Inlet size : 5'8½" × 9'6¼"
* Outlet size: 49⅛" × 48⅜"
* RPM : 1240 rpm
* BHP : 36 bhp
* Motor : 40 HP

5) CONTROL AND OPERATIONAL SEQUENCE

a) ROOM TERMINAL

i) LAB. FUME HOOD/CEILING HOOD AND M/A SUPPLY: The hood switch shall be utilized to control the motorized exhaust damper and supply damper to open or close simultaneously.

ii) PERCHROLIC ACID FUME HOOD AND M/A SUPPLY: The hood switch shall actuate the separate perchrolic acid fume hood exhaust fan and open the exhaust damper and supply damper simultaneously.

iii) VENTILATION: The room general lighting switch shall be utilized to control the motorized supply damper and relief damper simultaneously.

b) CENTRAL VAV FAN CONTROL

i) GENERAL: Diaphrgm-type differential pressure controllers shall be utilized to control fan to maintain desired static pressure as air volume requirements change. Proportional actuators positioned by the static pressure controllers shall adjust fan speed as necessary to maintain required duct static pressure.

ii) SUPPLY FAN: The static pressure sensing tap for the supply system shall be located in the branch duct near the end of the system to establish the lowest permissible static pressure control setting. The setting shall be just high enough to provide the required inlet static pressure at the VAV box associated with the highest system pressure loss.

iii) EXHAUST FAN: The static pressure for the exhaust fan shall be controlled by locating the sensing tap as closed to the exhaust fan as possible.

c) MAKE-UP AIR TEMPERATURE CONTROL

i) HEAT RECOVERY COIL: Exhaust air and incoming outdoor air shall be passed through the heat recovery coil to exchange heat when the outdoor air temperature is higher than 80°F. in cooling mode or lower than 68°F. in heating mode. In between, the two streams of exhaust air shall be by-passed the heat recovery coil.

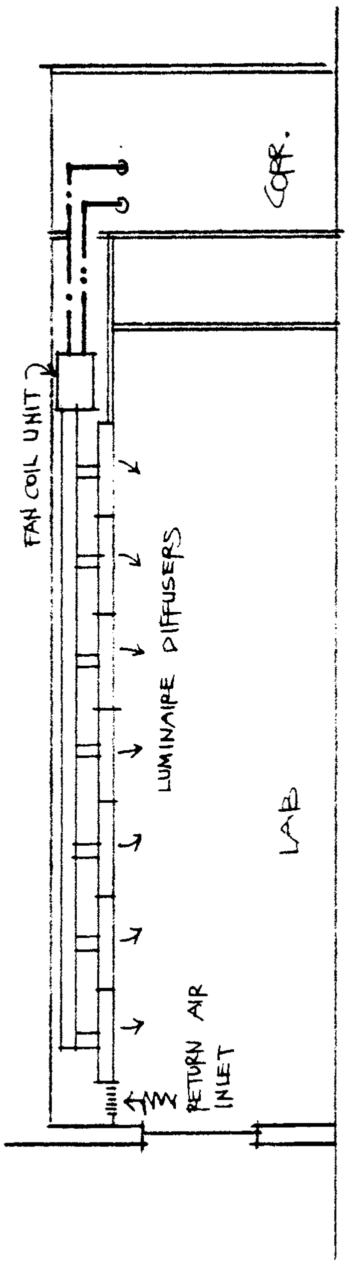
ii) HEATING/COOLING COIL: Make-up air shall be tempered to maintain 78°F.db in cooling season and 70°F.db in heating season through the heating/cooling coil according to the following control sequence.

Coil EAT	Control	Coil LAT	M/A T
above 76° F.	Act. Cooling	76° F.	78° F.
76-68° F.	Econo. Cycle	76-68° F.	78-70° F.
below 68° F.	Act. Heating	68° F.	70° F.

B. LAB. FAN COIL UNIT SYSTEM

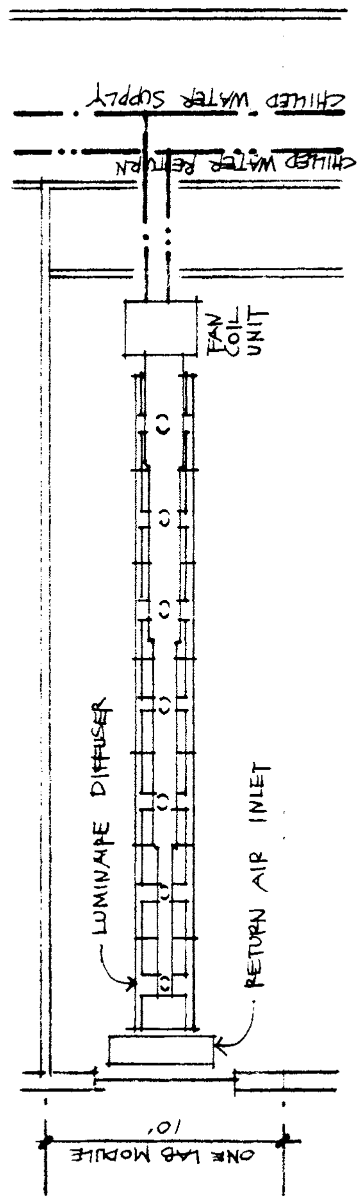
1) ROOM TERMINAL COMPONENT

a) GENERAL: Presentation of the room terminal components selection procedures shall be limited to one typical laboratory module in the lab. #119.



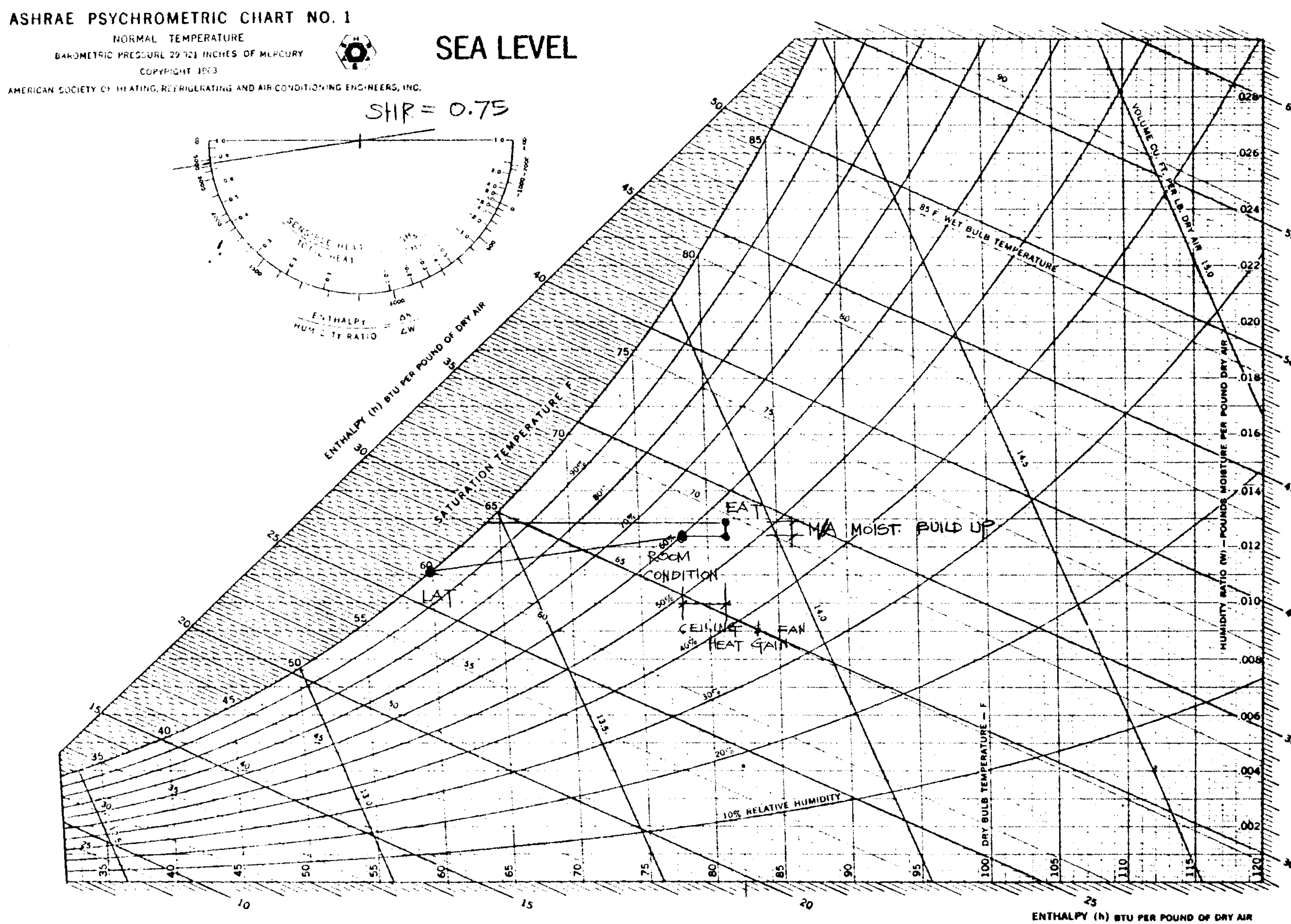
LAB MODULE SECTION

FIG V-7



FAN COIL UNIT COMPONENTS LAYOUT

FIG V-8



ASHRAE Psychrometric Chart (Reprinted by permission from ASHRAE Guide and Data Book, 1963)

FIG V-9. FAN COIL UNIT COIL PERFORMANCE

b) FAN COIL UNIT

i) CRITERIA: Fan Coil Unit(FCU) shall be horizontal type for ceiling plenum installation and include a cooling coil, drain pan, fan and filter. Supply air duct shall be utilized

* Space cooling load: 10670 Btuh(sensible)
* Sensible heat ratio: 0.75
* Air conditions

Air conditions	°F db	°F wb	Btuh/lb
Entering Air(EAT)	81.5	69.5	34.6
Leaving Air(LAT)	60		26.5

refer to chart(Fig. V-9).

* SCFM = 10670/(1.1 × (78 -60)0 = 540 cfm
* Total cooling coil load = 4.5 × SCFM × ΔH = 19683 Btuh
* Sensible cooling coil load = 540 × 1.1 × (81.5 - 60) = 11610 Btuh
* Chilled water

Chilled water	°F
Entering Water(EWT)	42° F
Water Temp. Rise(WTTR)	12° F

* Total external static pressure

Supply duct	0.04
Diffuser	0.04
Return inlet	0.02
Filter(T.A. dirty)	0.25

Total external static pressure: 0.35" w.g.

* Noise criteria: NC 40-45

ii) SELECTION: UNITRANE-C32 AL with A coil and G-4, High External Static Pressure Motor by TRANE or equivalent(cat. V-11).

* Coil rating: A 006H, 560 cfm
* Performance at design condition (interpolated from cat.V-11).
  Total heat: 22.1 MBH
  Sens. heat: 12.4 MBH
  GPM : 3.8 gpm
  Press drop: 17.0' water
* Fan performance @ 0.35" s.p.(refer to cat V-11): 101.5%(570 cfm)
* Control package: a volume control valve at the coil outlet.

c) DIFFUSER

i) CRITERIA: Linear luminaire diffusers shall be selected

* Max total air flow: 560 cfm
* Throw: 5' @ 50 fpm
* Noise: NC 45 or below
* Static pressure loss: under 0.05" w.g.

ii) SELECTION: Type TD 4'-diffuser with top-inlet, dual plenum by TUTTLE & BAILEY or equivalent(cat. V-3).

* No of diffuser: 7
* CFM per diffuser: 80 cfm
* Inlet size: 6" ø
* Static pressure: 0.04" w.g.
* Noise: under NC 20
* Throw/spread: 3' @ 100fpm/5-6'

d) RETURN AIR INLET

i) CRITERIA: The perforated panel selected for make-up air supply shall be utilized as the fan coil unit return air inlet into the ceiling plenum

ii) SELECTION: Series A-CT by TUTTLE & BAILEY or equivalent(cat. V-2).

* Face area : 24" x 18"
* Noise : under NC 20
* Static pressure loss : 0.02" w.g.

e) SUPPLY DUCT

i) CRITERIA: The supply duct shall be sized based on the equal friction method

* Max total air flow: 560 cfm
* Duct friction: 0.05" w.g./100'
* Noise: under NC 45

ii) DESIGN: The supply duct shall be installed in the ceiling plenum as shown in the drawing (Fig. V-7,8).

* Max. duct size/air velocity: 6" X 27"/625 fpm.
* Est. Total duct equiv length: 60'
* Est. Total duct friction loss: 0.03" w.g.

2) BUILDING DISTRIBUTION COMPONENTS

a) GENERAL: The fan coil unit system main chilled water circulation loop shall be tapped from the building primary chilled water loop. The circulation system shall be a reverse return system with a variable speed drive pump The main circulation pipe shall be installed in the main corridor ceiling plenum and tapped into each fan coil unit.

b) CIRCULATION PIPE

i) CRITERIA: Pipe sizing shall be based on the standard friction loss of 2.5' H_2O/100 ft.

* Design range: 1.0' - 4.0' H_2O/100 ft.
* GPM per unit: 3.8 gpm.
* System total GPM: 129 gpm.

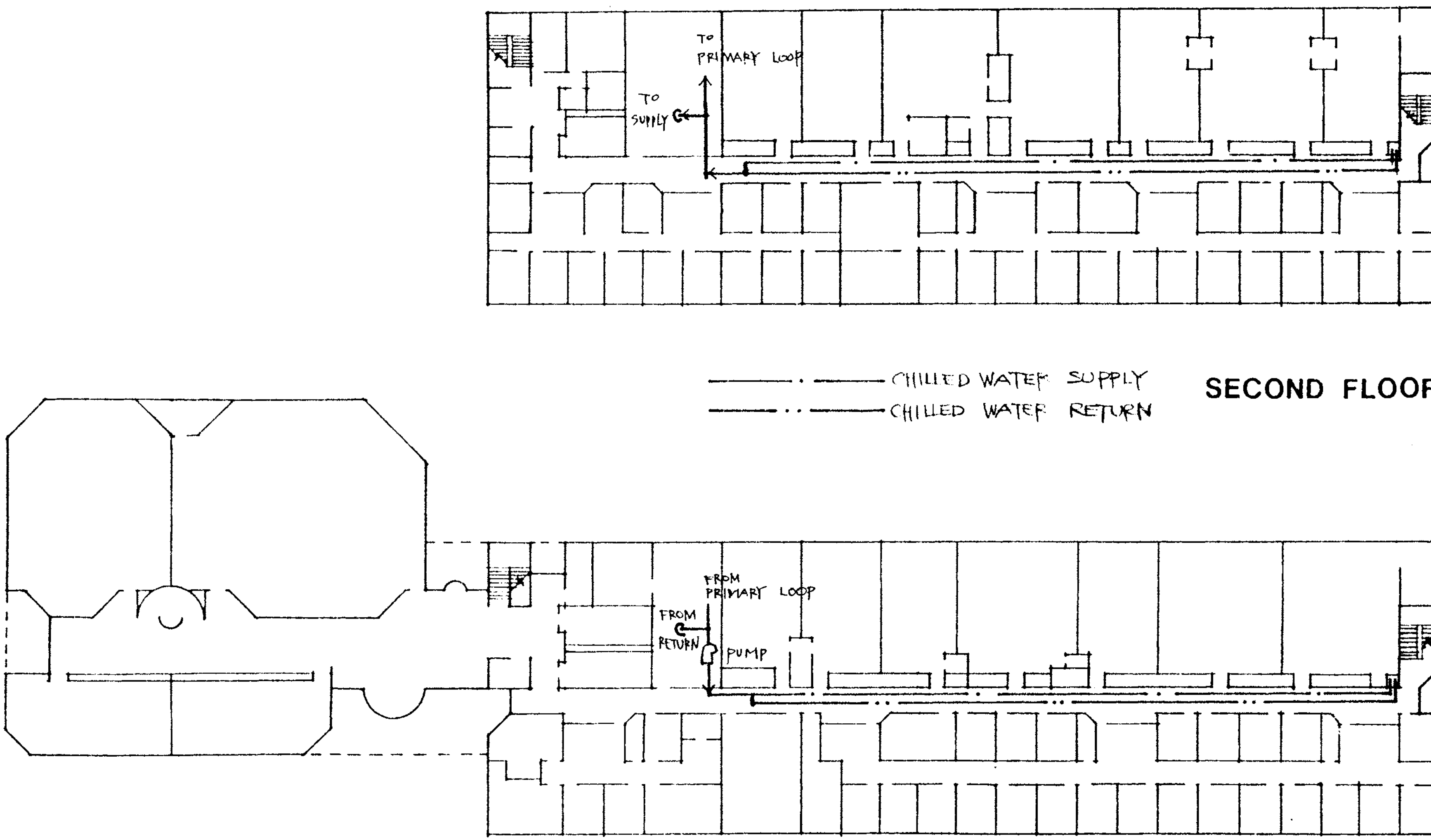
ii) PIPE SIZING: Type L copper tube shall be selected.

* Branch pipe size: 1" ø
* Main pipe size: 3½" ø(max.)
* Pipe length

Items	Equiv. Elbow	No	Pipe " ø	Equiv. Length
Ebow	1	30	2½	150
Tee	4	2	2½	40
Flow control valve	20	1	1	40
3-way mix valve	4	2	3½	56
Others				14
Est. Total fitting equiv length				300'
Est. Total pipe length				400'
Est. Total pipe equiv length				700'
* Est. Total pipe friction head				17.5' H_2O

c) CIRCULATION PUMP

i) CRITERIA: Centrifugal pump with variable



FIRST FLOOR

FAN COIL UNIT CHILLED WATER CIRCULATION

FIG. V-10

speed motor drive shall be selected

* GPM: 129 gpm
* Pump Head

Piping friction head	:	17.5'
Coil pressure drop	:	17
Total pump head	:	34.5' H_2O

ii) SELECTION: 4087 SF-VKYM 2" centrifugal pump by WEIL or equivalent(cat. V-14).

* IMP. DIA : $7\frac{1}{2}$"
* RPM : 1750
* Efficiency: 75%
* BHP : 1.7 bhp
* Motor : 2 HP with variable speed controler

3) CONTROL AND OPERATIONAL SEQUENCE

a) ROOM TERMINAL

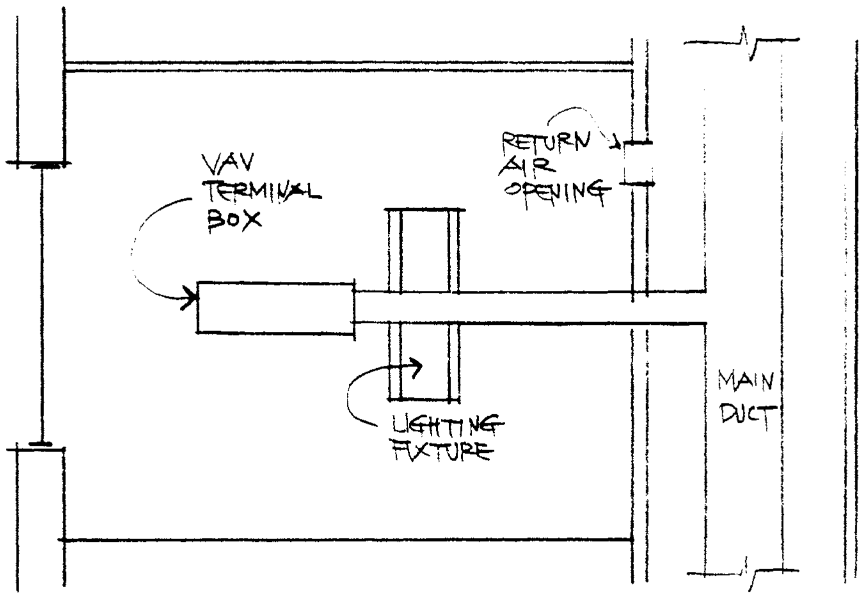
i) FAN CONTROL: Each zone unit shall be provide with a wall-mounted 4-position fan speed switch; low, medium, high and off. The room general lighting switch shall be utilized as the room main fan switch.

ii) TEMPERATURE CONTROL: The zone thermostat shall control. An electric two way control valve shall be provided and controlled by the electric zone thermostat. The value shall be closed when the zone fan switch is off position or the room main switch(general lighting switch) is off.

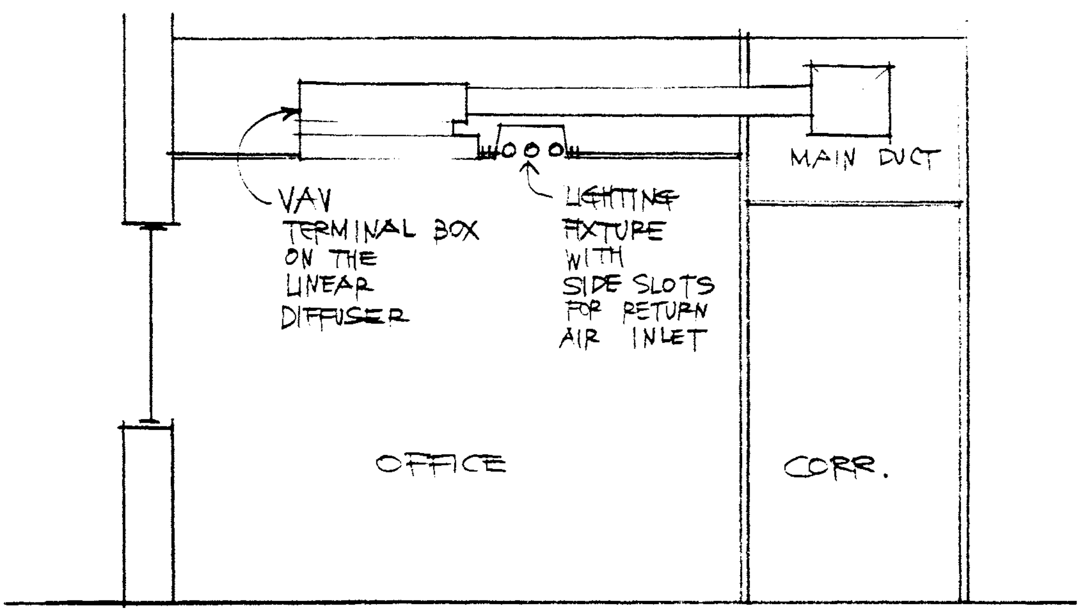
C OFFICE AIR CONDITIONING SYSTEM

1) ROOM TERMINAL COMPONENTS

a) GENERAL: Presentation of the individual room terminal components selection process shall be limited to one typical office Room #114D.



TERMINAL COMPONENTS LAYOUT CEILING PLAN
FIG V-11



TERMINAL COMPONENTS LAYOUT SECTION
FIG V-12

b) TERMINAL BOX/DIFFUSER

i) CRITERIA: Terminal box shall be a VAV, pressure independent, system powered assembly mounted directly on a linear diffuser. The assembly shall include a diffuser mounted thermostat, control line filter, volume regulator and flow controller.

* Max Air flow rate: 100 cfm
* Noise criteria: under NC 35
* Throw: 5' @ 50 fpm

ii) SELECTION: Model TCT-ML by TITUS or equivalent(cat. V-4).

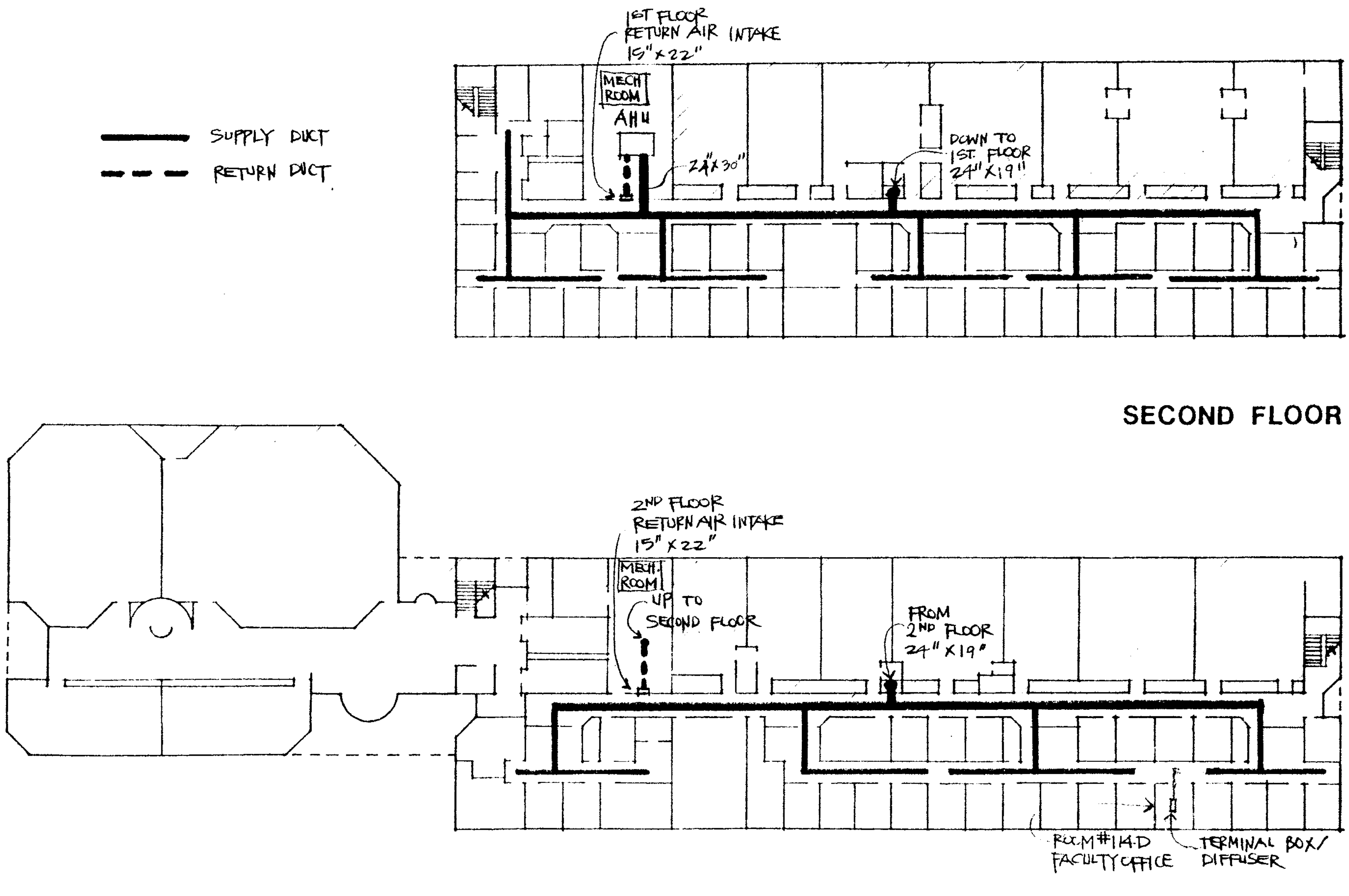
* Diffuser: 2-slot, 48"
* Inlet size: 6" ø
* Min Static pressure: 1.0" w.g.
* Noise: NC 35
* Throw: 4' to 50 fpm

c) RETURN AIR INLET: Side slots of the luminare fixture shall be utilized as a return air inlet to the room ceiling plenum. A hole shall be provide on the partition between the corridor and the room ceiling plenum for a return air path.

2) BUILDING DISTRIBUTION COMPONENTS

a) DUCT DESIGN CRITERIA: Duct shall be sized based on the equal friction method and installed in the main corridor ceiling plenum.

* Duct friction loss: 0.1" w.g./100'
* System max air flow: 9000 cfm



MAIN BUILDING AIR CONDITIONING SYSTEM DUCTWORK LAYOUT

FIG - V - 13

b) SUPPLY DUCT: Main supply duct shall be located in the main corridor ceiling plenum as shown in the drawing(Fig. V-11,12,13)

* Max. Duct size/Air velocity: 24" × 30"/1720fpm
* Est. Total duct equivalent length: 350'
  Est. Total duct length: 250'
  Est. Total fittings equiv length: 100'
* Est. Total duct friction loss: 0.35" w.g.

c) RETURN DUCT: Return duct shall be provided between the AHU and the return air intake in each floor.

* Est. Total duct equivalent length: 100'
  Est. Total return duct length: 50'
  Est. Total fitting equiv length: 50'
* Est. Total duct friction loss: 0.1" w.g.

3) CENTRAL AIR HANDLING UNIT

a) COIL

i) CRITERIA

* SCFM: 9000 cfm
* Sensible heat ratio: 0.84
* Face velocity: 600 FPM
* Air condition

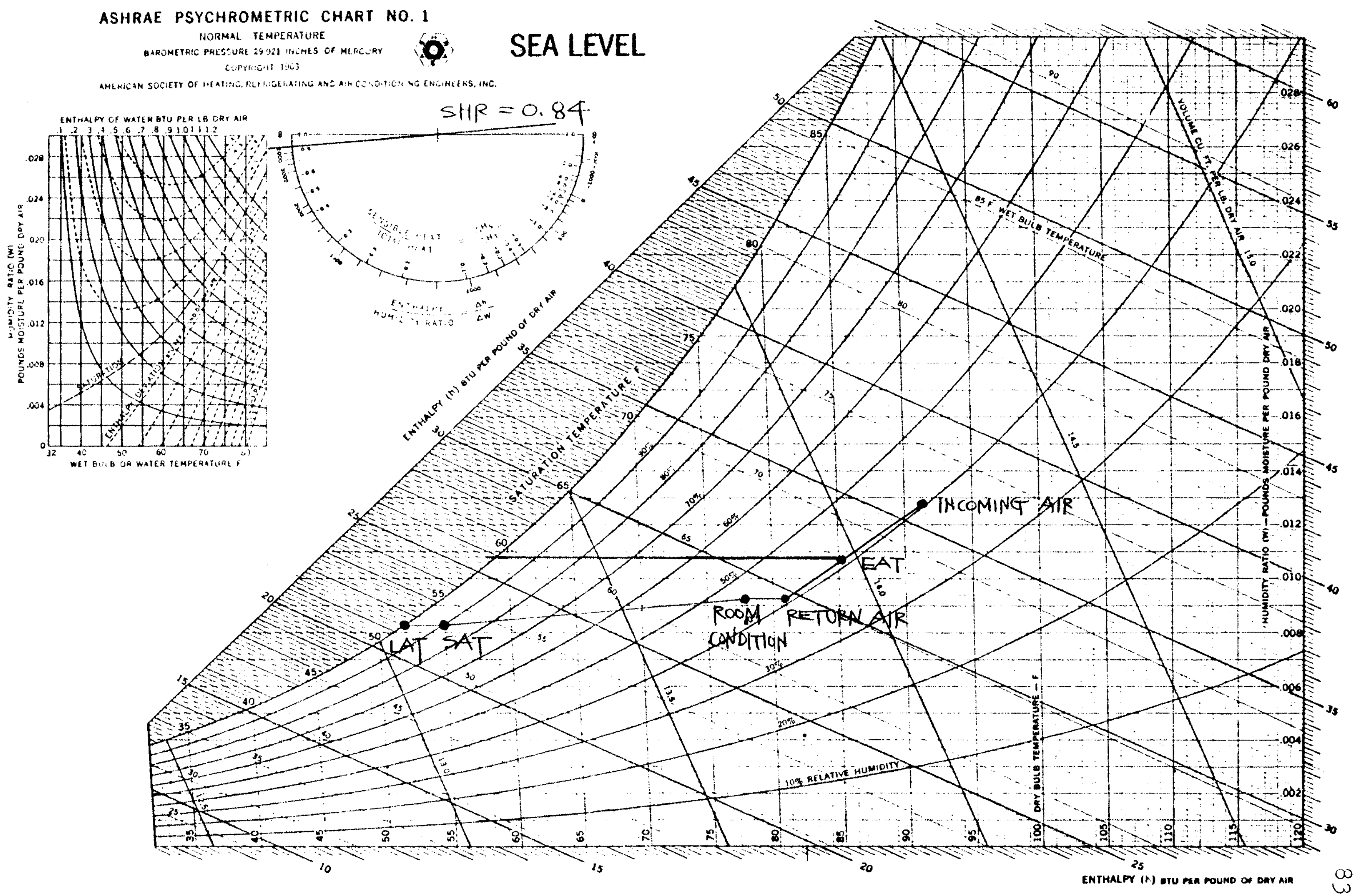
Air condition	°Fdb	°Fwb	Btu/lb
Fntering Air(EAT)	85	68	32.2
Leaving Air(LAT)	51		21.5

  refer to chart(Fig. V-14).

* Total coil load = 4.5 × SCFM × ΔH
  = 433,350 Btuh
  = 36.1 Ton cooling
* Chilled water

Chilled water	°F
Entering Water(EWT)	42
Water Temp Rise(WTR)	12

* GPM = Q/(500 × WTR) = 72.2 gpm



ASHRAE Psychrometric Chart (Reprinted by permission from ASHRAE Guide and Data Book, 1963)

FIG V-14 . OFFICE A/C COIL PERFORMANCE

ii) SELECTION: Type W water coil by TRANE or equivalent(cat. V-6).

* Face area: 30"(W) × 72"(L) = 15 sq.ft.
* Capacity: Q/Face area = 28.9 MBH/sq.ft.
* Water flow: GPM × 1.66/W = 4.0 fps.
* Select 6 row series 58 from manufacturer's catalog
* Performance, @ design condition by interpolating manufacturer's catalog
  Cooling capacity: 29.6 MBH
  Leaving air: 52.2 $^{o}F_{db}$ /51.8 $^{o}F_{wb}$
* Air pressure drop: 0.82" w.g. @ 600 fpm. (Chart 76-1).
* Water pressure drop(Tab. 75).
  Total header P.D.: 1.71'
  Tube water P.D.: 0.98'/pass
  Total water P.D : 7.59' H_2O

b) SUPPLY FAN AND UNIT CASING

i) CRITERIA: AHU shall be a factory assembled vertically sectionalized casing consisting of separate fan, coil section as well as a mixing/filter box section Fan shall be double width, double inlet, multiblade centrifugal type forward curved fans with variable speed motor drive.

* SCFM: 9,000 cfm.
* Total static pressure

Terminal(including diffuser)	1.0
Supply duct total	0.35
Coil	0.82
Filter(T.A. dirty)	0.48
Heat recovery coil	1.05
Prefilter/damper	0.15
Intake louver	0.15
Total static pressure	3.85"w.g.

ii) SELECTION: No. 17 Vertical Draw Thru Climate changer with No. 17F-VDT-13.5" F.C. Fan with variable speed motor drive by TRANF or equivalent(cat. V-9).

* Inlet size: $2'5\frac{1}{2}" \times 7'3"$
* Outlet size: $24\frac{3}{8}" \times 24\frac{1}{2}"$
* RPM: 1150 rpm.
* BHP: 11.0 bhp.
* Motor: 15 HP.

c) RETURN FAN

i) CRITERIA: Return fan shall be centrifugal type air foil fan with variable speed motor drive.

* SCFM: 9,000 cfm
* Total static pressure

Room return air inlet	0.02
Return entry into duct	0.20
Return duct total	0 10
Discharge duct	0 08
Exit louver	0.12
Total static pressure	0.52"w.g.

ii) SELECTION: 27 AF-SW-Class I(model 81), Lightface type fan by TRANE or equivalent(cat. V-10).

* Wheel dia: 27"
* RPM: 900 rpm.
* BHP: 2.13 bhp.
* Motor: 3 HP

4) CONTROL AND OPERATIONAL SEQUENCE

a) ROOM TERMINAL CONTROL: The zone thermostat shall control the actuator of the pressure independent VAV terminal box to determine the amount of supply air required.

b) CENTRAL VAV FAN CONTROL

i) GENERAL: Diaphrgm-type differential pressure controllers shall be utilized to control fan to maintain desired static pressure as air volume requirements change. Proportional actuators positioned by the static pressure controllers shall adjust fan speed as necessary to maintain required duct static pressure.

ii) SUPPLY FAN: The static pressure sensing tap for the supply system shall be located in the branch duct near the end of the system to establish the lowest permissible static pressure control setting. The setting shall be just high enough to provide the required inlet static pressure at the VAV box associated with the highest system pressure loss.

iii) RETURN FAN: The static pressure for the return fan shall be controlled by locating the sensing tap as closed to the return fan as possible.

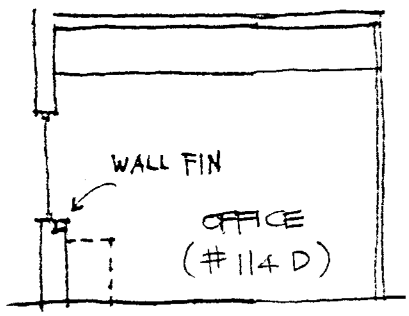
c) SUPPLY AIR TEMPERATURE CONTROL: Supply air shall be maintained 55^{o}F. at all seasons

d) ECONOMIZER CYCLE: When the enthalphy controller senses that outdoor air has less total heat than the return air, 100% outdoor air shall be introduced into the AHU. As the outdoor temperature drops below 55^{o}F. , the winter economizer mixed air stat shall control the volume of the return air to maintain supply air at 55^{o}F.

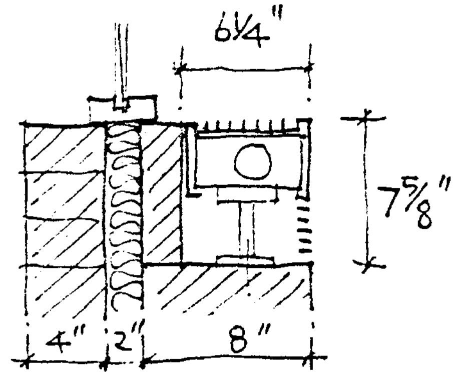
D. PERIMETER HEATING SYSTEM

1) ROOM TERMINAL COMPONENTS

a) GENERAL: Presentation of the room terminal components selection process shall be limited to one typical office(Room #114D)



SECTION
FIG. V-15



DETAIL
FIG. V-16

b) SELECTION CRITERIA: Hot water wall fin shall be selected to be installed at the window sill

* Peak heating load: 1492 Btuh (refer to Appendix)
* Entering water temperature: 180°F.
* Water temperature drop: 20°F.
* Entering air temperature: 70°F.

c) SELECTION: Type 3EA, copper-aluminum-1", series 68, 3¼" Hydronic Wall Fin by TRANE or equivalent (cat.V-12).

* Capacity: 484 Btuh/ft @ 70°F. air temp.
* Length: peak load/capacity: 3.1 ft.

2) BUILDING DISTRIBUTION COMPONENTS

a) GENERAL: The zone hot water circulation system shall be a zone series loop system with a zone water flow control valve tapped from the main perimeter hot water circulation loop. The main perimeter hot water circulation loop shall be tapped from the building primary hot water circulation loop with a variable speed motor drive circulation pump.

b) PIPING

i) CRITERIA: Connecting pipe shall be the same size with the wall fin

	East	West	Annex
* Total heating load(Btuh)	79600	79250	76950
* Water flow rate(GPM)	8	8	8
* Wall fin type	1" copper-aluminum		
* Water velocity(FPS)	3	3	3

ii) SELECTION

* Type: type L, copper tube
* Pipe size: 1" ø

* Loop pipe length(f.t.)	East	West	Annex
Est. total pipe length	700	660	570
Est. total fit. equiv. L.	175	165	200
Est. total loop equiv. L.	875	825	770
* Est. total loop WPD(ft. H_2O)	37.2	35.2	32.7

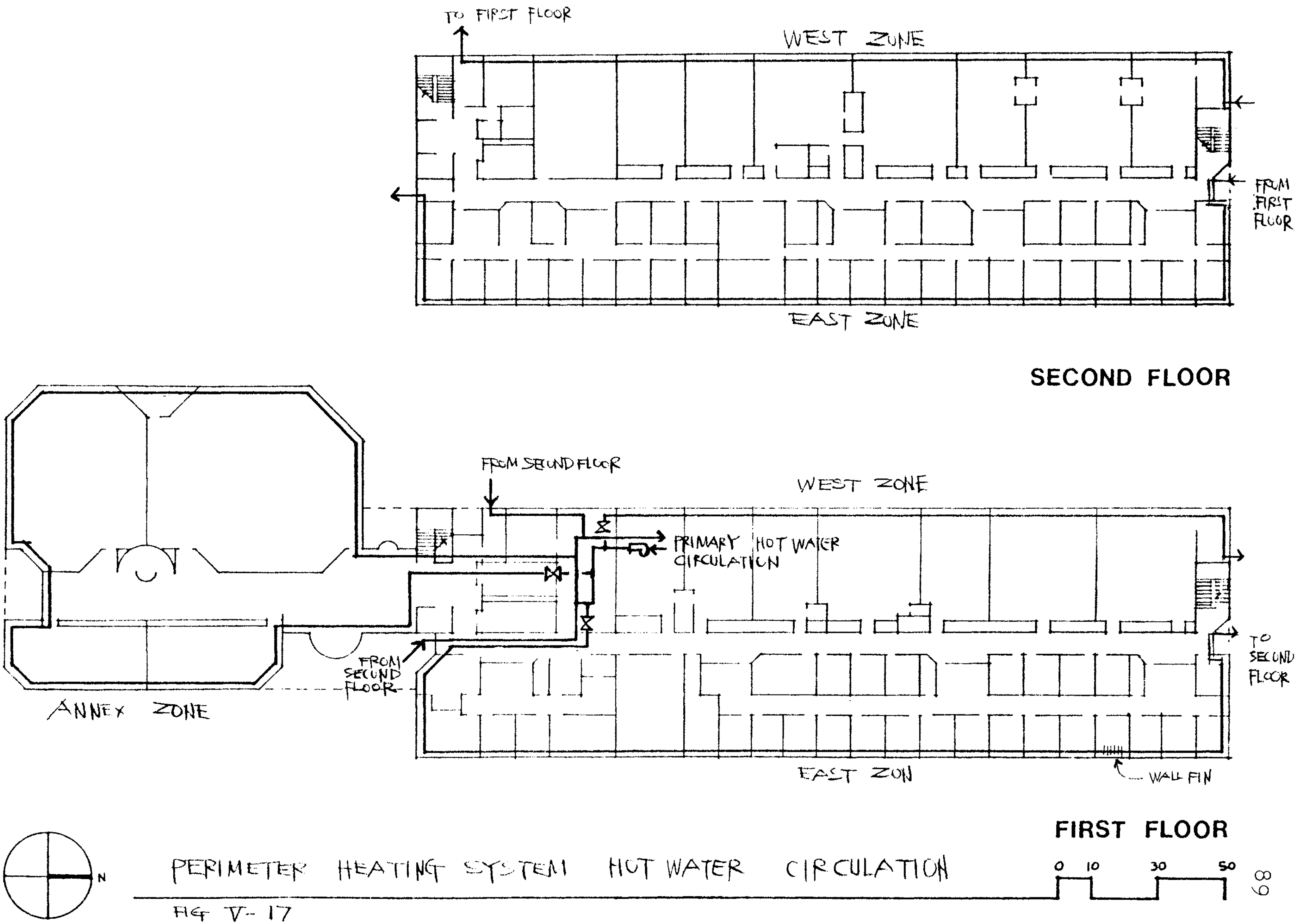
c) CIRCULATION PUMP

i) CRITERIA: Centrifugal pump with variable speed motor drive shall be selected

* GPM: 24 gpm
* Pump head: 37.2' H_2O

ii) SELECTION: 5175-RYAJ $1\frac{1}{4}$" centrifugal pump by WEIL or equivalent(cat. V-15).

* IMP. DIA: $6\frac{1}{2}$"
* RPM: 1750 rpm
* BHP: 0.7 bhp
* Motor: $\frac{3}{4}$HP with variable speed controler.



PERIMETER HEATING SYSTEM HOT WATER CIRCULATION

FIG V-17

3) CONTROL AND OPERATIONAL SEQUENCE

a) ROOM TERMINAL CONTROL: At every enclosure of the room wall fin shall be provided with a inlet air damper to manually regulate heat flow.

b) ZONE WATER FLOW CONTROL: Water flow rate of the zone shall be modulated by the two-way flow control valve according to the zone sol-air sensor control

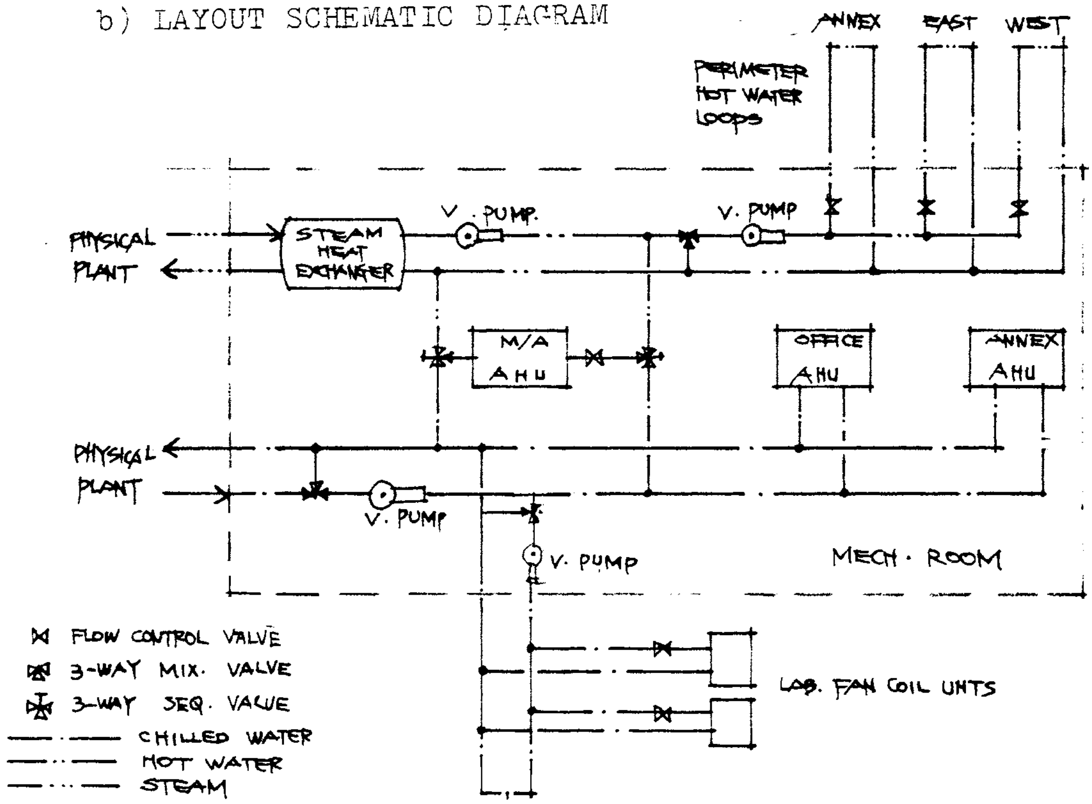
c) WATER TEMPERATURE: Water temperature shall be maintained at 180°F. during operation.

F. BUILDING PRIMARY HOT/CHILLED WATER CIRCULATION SYSTEM

1) GENERAL

a) SYSTEM OUTLINE: The building primary hot and chilled water circulation loops shall circulate the hot and chilled water within the mech. room to feed each of the AHUS or the secondary water circulation loop with the hot and/or chilled water. Hot water shall be heated by the steam heat exchanger and supplied at 180°F. Chilled water shall be directly tapped from the campus chilled water line and supplied at 42°F.

b) LAYOUT SCHEMATIC DIAGRAM



BUILDING PRIMARY CHILLED/HOT WATER CIRCULATION

FIG V-18

2) CHILLED WATER LOOP

a) PIPING

i) CRITERIA

* Water flow rate

Lab M/A AHU	114
Annex A/C AHU	61
Office A/C AHY	72
Lab Fan coil units	129
Primary loop total	376 GPM

* Pipe friction range: 1.0 - 4.0' H_2O/100'

ii) SELECTION

* Type: Type L copper tube

	Branch				
	Ann.	Off.	M/A	FCU	Main
* Pipe size(" ø)	$2\frac{1}{2}$	$2\frac{1}{2}$	3	3	5
* Friction('H_2O/100')	2.5	3.3	3.1	3.8	2.5

b) CIRCULATION PUMP

i) CRITERIA: Centrifugal pump with variable speed motor drive shall be selected

* Max GPM: 376 gpm
* Pump head

	ANNEX		OFFICE		M/A		F/C		PRIMARY	
FITTING (E.E)	n	E.E	n	E.E	n	E.E	n	E.E	n	E.E
Elbow (1)	6	6	6	6	6	6	6	6	10	10
Tee (4)	2	8	2	8	2	8	1	4	1	4
C. valve (20)	1	20	1	20	1	20	1	20	1	20
others		4		4		4		4		4
Total Equiv. El.		38		38		38		34		38
Fitting E. L.		190		190		228		204		380
Est. Pipe L.		20		20		20		20		80
Total E. L.		210		210		248		224		460
Pipe Fric. Head		5.25		6.93		7.69		8.51		11.5
Coil Fric. Head		7.75		7.59		1.94		.		.
Sub total Head		13.0		14.52		9.63		8.51		11.5

SYSTEM PUMP HEAD = 14.52 + 11.5 = 26' H_2O

ii) SELECTION: 1731 -R 4" centrifugal pump by WEIL or equivalent(cat. V-16).

* IMP. Dia : 6"
* RPM : 1750 rpm
* Efficiency : 73%
* BHM : 3.5 bhm
* Motor : 5 HP with variable speed controller

3) HOT WATER LOOP

a) PIPING

i) CRITERIA

* Water flow rate

Lab. M/A AHU	114
Perimeter heating loop	24
Primary loop total	138 GPM

* Pipe friction range: 1.0 - 4.0' H_2O/100'

ii) SELECTION

* Type: Type L copper tube

	M/A	P/H	Main
* Pipe size(" ø)	3	2	3
* Friction('H_2O/100')	3.3	1.4	3.8

b) HEAT EXCHANGER

i) CRITERIA: Steam heat exchanger shall be selected

* Max. GPM: 138
* Max. heating load: 1,947,000 Btuh.
* Leaving water temp : 180°F.
* Entering water temp : 152°F.
* Steam pressure: under 50 psi.

ii) SELECTION: 8204 SR converter by TACO or equivalent(cat. V-13).

* Steam pressure: 25 psi.
* No. of pass: 2
* Capacity: 142 × 10,000 × 28/20 = 1,988,000 Btuh.
* Pressure drop: 2.4' H_2O

c) CIRCULATION PUMP

i) CRITERIA: Centrifugal pump with variable speed motor drive shall be selected.

* Max GPM: 138 gpm.
* Pump head

	M/A		P/H		Main	
Fitting(E.E.)	n	E.E.	n	E.E.	n	E.E.
Elbow (1)	8	8	6	8	15	15
Tee (4)	2	8	2	8		
C. valve (20)	1	20	1	20		
Others		4		4		10
Total equiv. elbow		40		40		25

Fitting E.L.	240	160	150
Est. pipe L.	20	20	80
Total E. length	260	180	230
Pipe F. head	8.58	2.52	8.74
Coil F. head	1.94	-	2.40
Sub total head	10.52	2.52	11.14
System Pump Head			21,66'H_2O

ii) SELECTION: 2154 - RS 3" centrifugal pump by WEIL or equivalent(cat. V-17).

* IMP Dia: 5"
* RPM: 1750
* Efficiency: 67%
* BHP: 1.1 bhp.
* Motor: $1\frac{1}{2}$ HP. with variable speed controller.

F. SPECIAL SYSTEM CONSIDERATIONS

1) ENERGY CONSERVATION

a) VAV SYSTEM: VAV fans shall be utilized for the M/A and E/A system as well as the centralized A/C supply and return systems, to save fan energy when there is reduced space cooling load or exhaust requirements Also, variable speed motor drive shall be utilized for the hot or chilled water circulation pumps to save pump energy when there is reduced cooling or heating load

b) HEAT RECOVERY SYSTEM: Air-to-air heat exchange system shall be selected to recover energy from the exhaust air into the incoming outdoor air, since the energy to temper, the exhaust make-up air is incomparably greater than the energy to cool or heat the space.

		Space peak	Make-up peak
Summer	Total load(Btuh)	1,048,040	1,311,300
	Air(CFM)	28,820	40,000
Winter	Total load(Btuh)	-217,820	-2,508,000
	Air(CFM)	6,600	40,000

2) SMOKE CONTROL

Smoke detectors shall be distributed at the several locations in the corridor ceiling plenum and main exhaust duct.

When smoke is detected, all the return air damper to the AHU's shall be closed and return air fan shall be activated to exhaust smoke directly to the outside of the building.

With all the circulation of hot or chilled water shut-off, the AHU's shall be operated to provide exhaust make-up air into the space.

3) NIGHT AND WEEKEND OPERATION

In any season, the central AHU, the M/A AHU, all the fan coil units and the water circulation system shall be shut off during unoccupied periods of the night and the weekend.

When partially occupied, only the system(s) involved with the occupied zone shall be activated by the manual override switch.

In heating season, the perimeter heating system shall be operated to maintain the building at a set-back temperature during unoccupied periods. Return to the occupied mode shall be actuated by time clock or manual control.

4) MECHANICAL ROOM LAYOUT

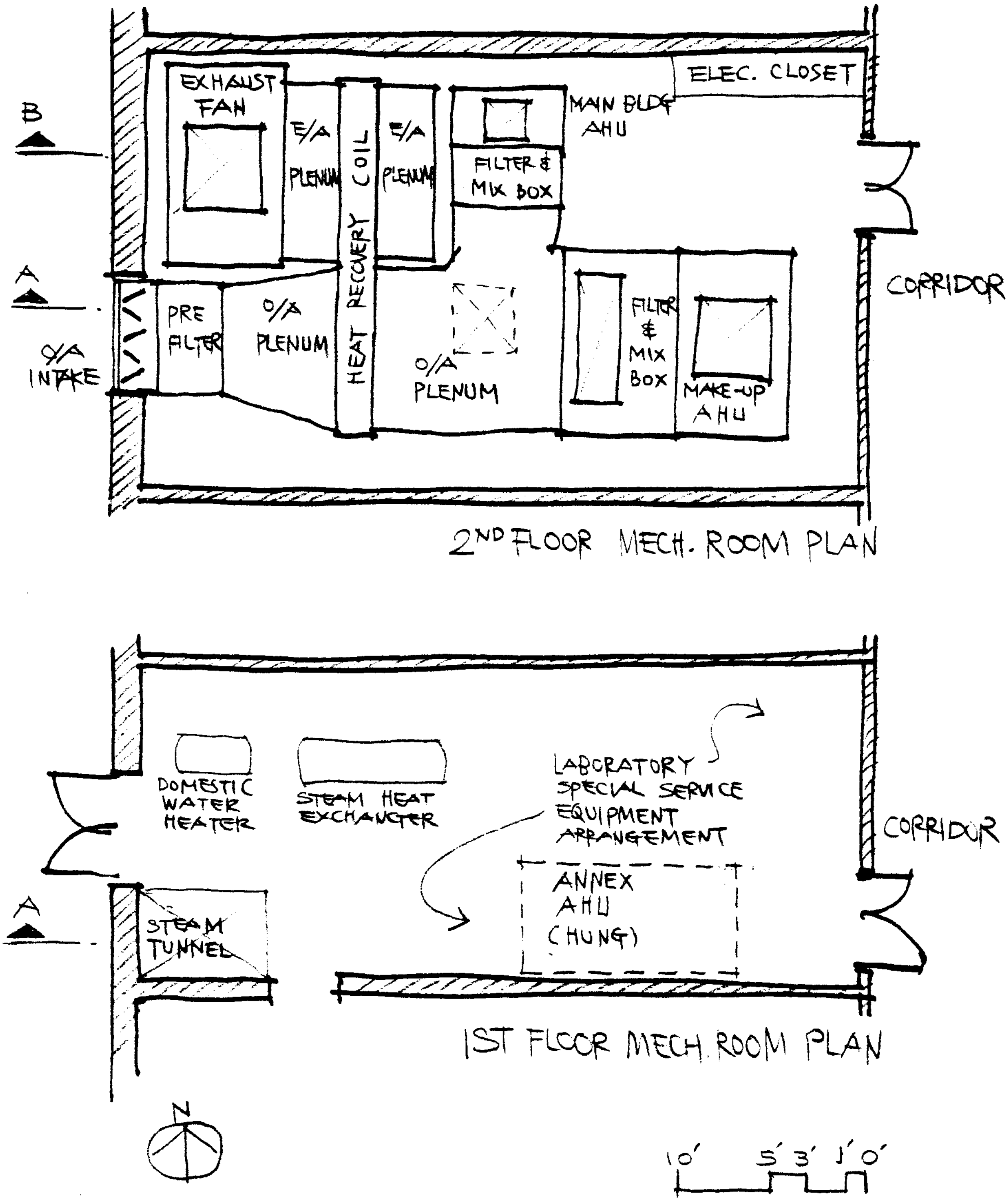
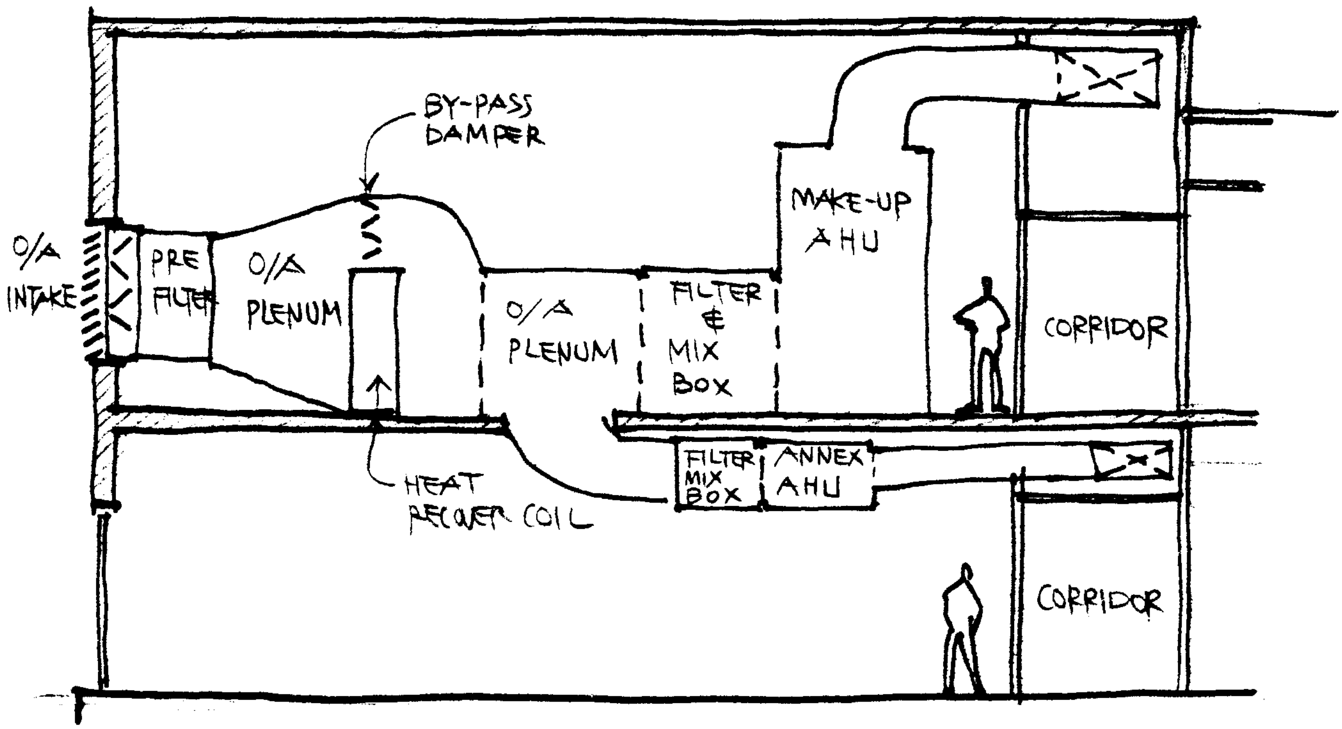
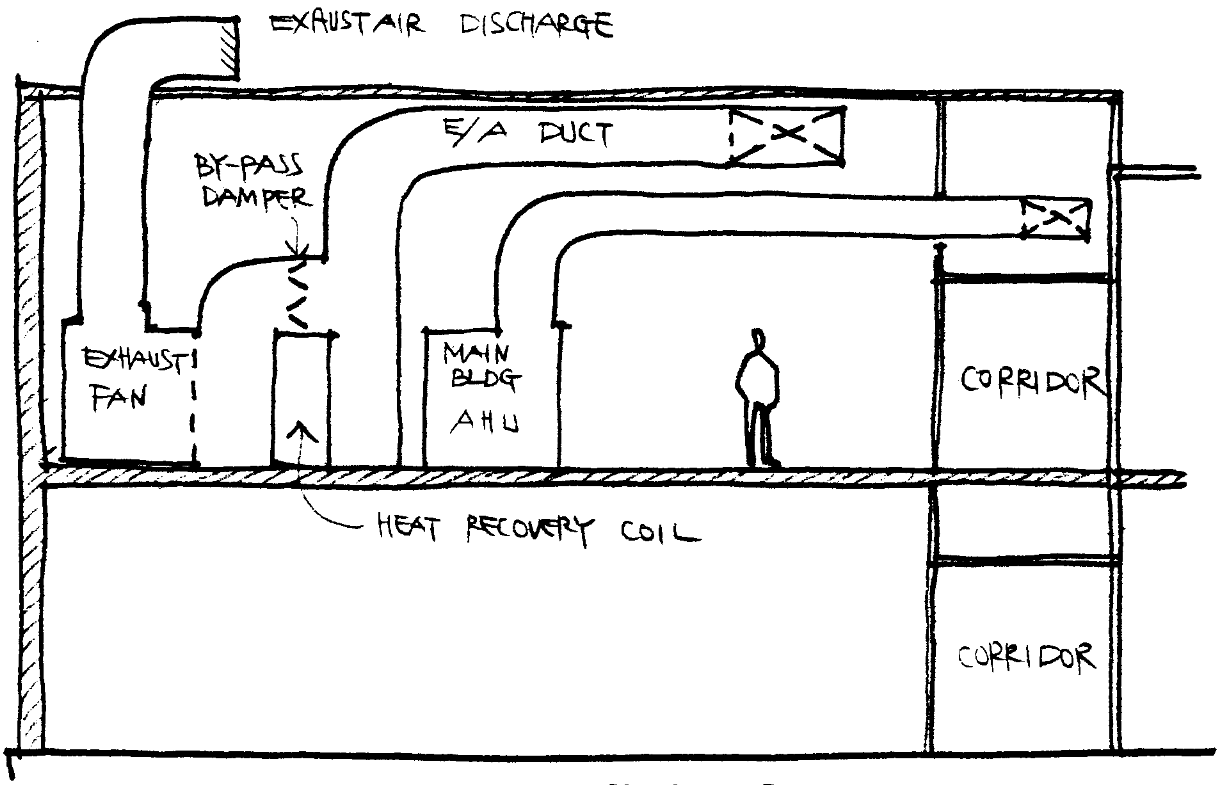


FIG V-19



SECTION A



SECTION B

CHAPTER VI. LIGHTING SYSTEM

1. TASK ANALYSIS

A. SYSTEM REQUIREMENTS

1) GENERAL: System requirements for each specific visual task in the space shall be analized in terms of illumination level and quality of the lighting. Required illumination level shall be determined according to the IES Handbook '81 Application (refer to Appendix for detail calculation).

2) LECTURE HALL/CLASS ROOM

a) SEEING CHALKBOARD

i) ILLUMINATION LEVEL: 50 fc. at chalkboard.

ii) QUALITY OF LIGHTING

* Control of direct glare in the sight line
* Control of reflected glare at task surface

b) READING PENCIL WRITING ON THE DESK

i) ILLUMINATION LEVEL: 50 fc. at the desk top

ii) QUALITY OF LIGHTING

* Control of reflected glare at task surface

c) WATCHING DEMONSTRATION TABLE

i) ILLUMINATION LEVEL: 150 fc. at demonstration table.

ii) QUALITY OF LIGHTING

* Control of direct glare
* Control of reflected glare
* Color rendition important

d) WATCHING T.V. OR PROJECTOR SCREEN

i) ILLUMINATION LEVEL: 10 fc. general lighting

ii) QUALITY OF LIGHTING

* Adequate brightness ratio
* Control of direct glare
* Control of reflected glare on T.V. screen

3) OFFICE

a) READING PENCIL WRITING ON THE DESK

i) ILLUMINATION LEVEL: 75 fc. at the desk top

ii) QUALITY OF LIGHTING

* Control of reflected glare

4) CONFERENCE

a) SEEING CHALKBOARD

i) ILLUMINATION LEVEL: 50 fc. at chalkboard

ii) QUALITY OF LIGHTING

* Control of direct glare in the sight line
* Control of reflected glare at task surface

b) CONFERRING

i) ILLUMINATION LEVEL: 30 fc. at desk top

ii) QUALITY OF LIGHTING

* Control of reflected glare

5) RECEPTION/SECRETARY

a) RECEPTION

i) ILLUMINATION LEVEL: 15 fc. general

ii) QUALITY OF LIGHTING

* Adequate brightness ratio

b) TYPING

i) ILLUMINATION LEVEL: 100 fc. at the dest top

ii) QUALITY OF LIGHTING

* Adequate brightness ratio
* Control of reflected glare

6) COMPUTER/DATA PROCESS

a) CRT SCRFENS

i) ILLUMINATION LEVEL: 7.5 fc. general

ii) QUALITY OF LIGHTING

* Adequate brightness ratio
* Control of reflected glare on CRT screen

b) THERMAL PRINT READING

i) ILLUMINATION LEVEL: 75 fc. at printer

ii) QUALITY OF LIGHTING

* Adequate brightness ratio
* Control of reflected glare on printer

7) LABORATORY

a) SCIENCE LABORATORIES

i) ILLUMINATION LEVEL: 75 fc. at bench table

ii) QUALITY OF LIGHTING

* Control of reflected glare on bench table
* Color rendition not critical
* Adequate illumination on vertical surface

8) OTHERS

Space	Category	Illumination-level
Circulation	C	15 fc. average
Lobby	C	15 fc. average
Stair way	C	15 fc. average
Toilet	C	15 fc. average
Mech. room	C	15 fc. average

B. SYSTEM CONSIDERATIONS

1) ENERGY CONSERVATION: System shall be designed to save energy by proper zoning, control switch, and daylight utilization.

2) COORDINATION: Lighting system shall be designed to coordinate with other systems including architectural, structural, HVAC, acoustical, and electrical systems.

2 PRELIMINARY DESIGN

A GENERAL: Preliminary design of lighting systems shall be done based on the categorized individual spaces. The objective of this phase is to conceptualize the needs in terms of system, type, source and pattern of lighting.

B. LECTURE HALL

1) SYSTEM

* General lighting with supplementary task lighting at chalkboart and demo. table.

2) TYPE

* Direct or simi direct lighting with high VCP and CRF.

3) SOURCE

* Fluorescent for general lighting
* Incandescent and/or fluorescent for supplementary lighting.

4) PATTERN

* Run rows of fixtures front to back to reduce direct glare
* Distribute fixtures as evenly as possible to reduce reflected glare.

C. OFFICE

1) SYSTEM

* General lighting for ambient back-ground lighting of minimum 25 fc. with supplementary task lighting to provide 75 fc at working surfcae (desk)

2) TYPE

* Direct or simi-direct lighting

3) SOURCE

* Fluorescent in general
* Day-lighting for ambient lighting when available

4) PATTERN

* High diffuse with high VCP unit for general lighting
* Movable fluorescent lamp for task lighting

D. CONFERENCE

1) SYSTEM

* Task lighting

2) TYPE

* Semi-indirect for conference table
* Direct lighting for chalkboard and wall wash lighting system.

3) SOURCE

* Fluorescent in general with incandescent for wall wash lighting.

4) PATTERN

* Fluorescent lighting over the table
* Incandescent lighting along the wall

E. SECRETARY/RECEPTION

1) SYSTEM

* General lighting with supplementary task lighting on secretary desk

2) TYPE

* Direct or semi-direct lighting

3) SOURCE

* Fluorescent for general and task lighting
* Incandescent for psychological effect

4) PATTERN

* Fluorescent lightings over the secretarys' working area
* Incandescent lighting to illuminate wall or vistor's sitting area.

F. LABORATORY

1) SYSTEM

* General lighting

2) TYPE

* Direct or simi-direct lighting

3) SOURCE

* Fluorescent in general
* Day-lighting when available

4) PATTERN

* Run rows of fixture over the asile to reduce veiling reflection on the bench table
* Select batwing distribution type diffuser with high VCP
* Zoning to utilize day-lithting

G. COMPUTER ROOM

1) SYSTEM

* General lighting of minimum illumination level around CRT units with supplementary task lighting on the printer

2) TYPE

* Direct lighting

3) SOURCE

* Fluorescent

4) PATTERN

* Concentrate the illumination around printer

H. CIRCULATION

1) SYSTEM

* General lighting

2) TYPE

* Direct lighting

3) SOURCE

* Fluorescent in general and some incandescent for aesthetic effects

4) PATTERN

* Slightly higher illumination level(20-25 fc.) around the exit area.
* Locate fixtures over the bulletins or the displayed in lobby area.
* Locate fixtures along over the closet side of the corridor.

3. DETAIL DESIGN

A. GENERAL: Detailed design of the lighting systems shall focus on major individual spaces in the building including the lecture hall(# 124), a typical lab.(3-bay) and a typical office(# 104 D). Emergency lighting system and exit lights shall also be included.

B. LECTURE HALL

1) SYSTEM OVERVIEW: Fluorescent lighting fixtures shall be distributed to provide 50 fc. of general illumination level. Additional fluorescent lighting fixtures shall be selected and arranged to provide 50 fc. of vertical illumination level on the chalkboard and incandescent track lights shall be arranged to supplement the required illumination level of 150 fc. on the demonstration table.

2) GENERAL LIGHTING

a) CRITERIA: Fluorescent lighting fixtures shall be selected and distributed to provide a 50 fc. general illumination level.

* Recessed mounting with return air slots

* Parabolic louvers
* CW lamps
* 60 HZ 277 Volts, rapid start, A-sound rated ballast.

b) SELECTION

i) LUMINAIRE: 3 lamp-PARALOUVER II by DAY-BRITE or equivalent(cat.VI-1).

* Size: 48" x 20" with 24 cell parabolic louvers.
* Lamp: F 40T 12 CW
* Max S/MH: 1.0

ii) CALCULATIONS: Required number of fixtures shall be determined by the lumen method based on the manufacturer's data(refer to appendix).

* C U : 0.55
* L L F : 0.59
* No. of luminaires: 28
* Actual Maint Illuminance: 50.5 fc.

3) TASK LIGHTING - CHALKBOARD

a) CRITERIA: Fluorescent lighting fixtures shall be selected to provide a 50 fc. vertical illumination level on the chalkboards as well as to increase ambient lighting level on the demonstration table and the platform area.

* Capable of mounting at 45° inclined angle
* Spread type, direct lighting fixture
* C W lamps
* 60 HZ, 277 volts, rapid start, A-sound rated ballast

b) SELECTION

i) LUMINAIRE: 4 lamp-DAYLUME by DAY-BRITE or eqivalent(cat.VI-2).

* Size: 48" x 24"

* Lamp: F 40T 12 CW
* No. of fixtures: 6 units

ii) CALCULATIONS: Illumination level shall be determined by the point method base on the manufacturer's data Reference point shall be at the center of the task surface (refer to appendix).

* LLF: 0.59
* Vertical illuminance from the task lighting fixtures: 44 fc.
* Vertical illuminance from the gereral lighting fixtures: 15.4 fc.
* Total maint vertical illuminance: 59.4 fc.

4) TASK LIGHTING - DEMO. TABLE

a) CRITERIA: Incandescent track lights shall be selected to provide a 150 fc of illumination level on the demo. table together with the general lighting and chalkboard task lighting fixtures

* 60 HZ, 120 volts
* PAR lamps

b) SELECTION

i) LUMINAIRE: LITE-TRAC 93440, by PRESCOLITE or equivalent(cat.VI-3).

* Lamp: 150 W , PAR-38/3 spot, side prong

ii) CALCULATIONS: Required No. of fixtures shall be determined by the point method based on the manufacturer's data. (refer to appendix).

* No. of track lights: 3

* LLF: 0.61
* Maint. illuminance from track lights: 46.1 fc.
* Illuminance from the general lighting fixtures: 50 fc.
* Illuminance from the chalkboard task lighting fixtures: 51.3 fc
* Total illuminance at the task: 147.4 fc.

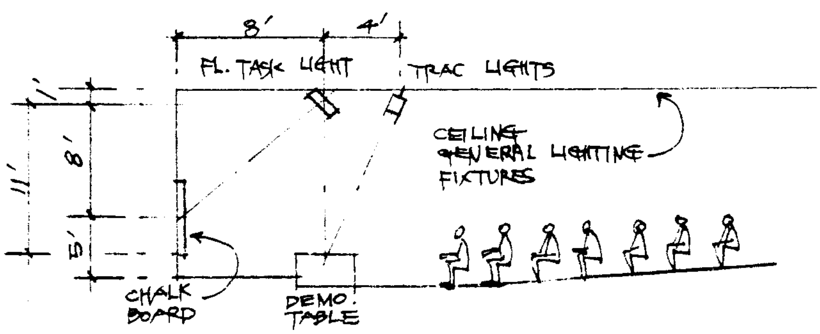
5) CONTROL AND FIXTURE LAYOUT

a) CRITERIA: General lighting system shall be divided into 5 control zone with separate zone switches and dimmers Task lighting systems shall also be provided with switches. All control switches and dimmers shall be located at the front wall as indicated on the drawing. Additional switches for 4 general lighting zone shall also be provided beside the main door. Two lighting fixtures as indicated on the drawing shall be provided with emergency light retrofit inverters as specified in emergency lighting section.

b) SELECTION

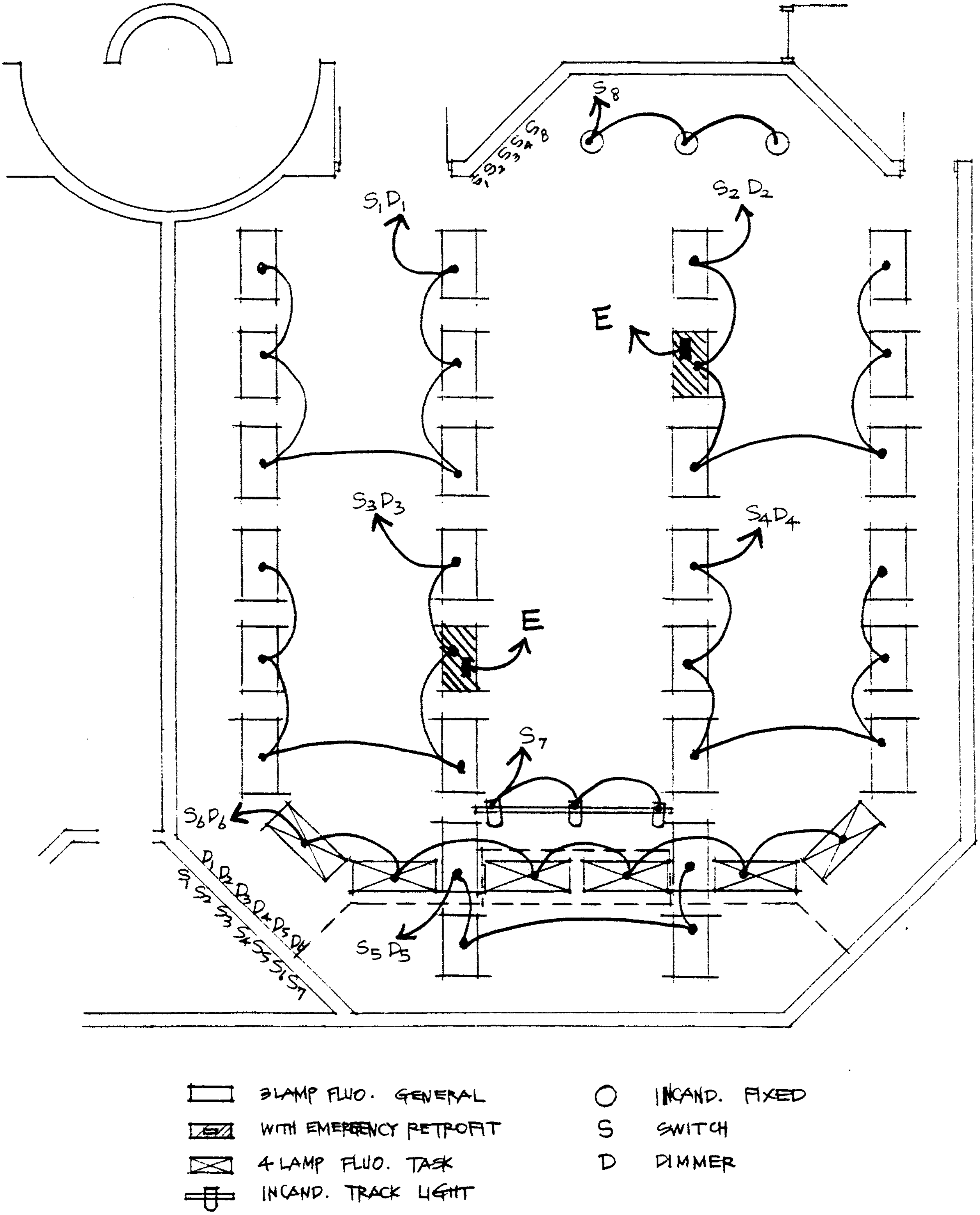
i) DIMMER: AF-1527 solid state dimmer by HUNT ELECTRONICS or equivalent(cat. VI-8).

ii) LAYOUT



SECTION 'A'

FIG. VI-1



124 LECTURE HALL LIGHTING FIXTURE LAYOUT

FIG. VI-2

C LABORATORY

1) SYSTEM DESCRIPTION: Fluorescent lighting fixtures shall be distributed to provide 75 fc. of general illumination level. Day-lighting shall be examined for utilization during day-time.

2) GENERAL LIGHTING

a) CRITERIA: Fluorescent lighting fixtures shall be selected and destributed to provide a 75 fc. general illumination level.

* Recessed mounting with side slots
* Parabolic louvers
* 60 HZ 277 volts, rapid start, A-sound rated ballast
* CW lamps

b) SELECTION

i) LUMINAIRE: 3 lamp-PARALOUVER II by DAY-BRITE or equivalent(cat. VI-1).

* Size: 48" x 20" with 24 cell parabolic louvers
* Lamp: F 40T 12 CW
* Max S/MH: 1.0

ii) CALCULATIONS: Required number of fixtures shall be determined by the lumen method based on the manufacturer's data(refer to appendix).

* C U : 0.67
* LLF: 0.59
* No. of luminaires: 21
* Maint. Horizontal illuminance: 79.2 fc.
* Maint. Vertical illuminance: 25.5 fc.

3) DAY LIGHTING

a) CRITERIA: Day-light factors shall be calculated to examine the possibility of utilization of day lighting and proper zoning for the electrical lighting system.

b) CALCULATION: The BRS protractors shall be utilized to determine daylight factors under the CIE sky condition to be conservative in results.

i) DAYLIGHT FACTORS: Calculation procedures shall be refered to appendix.

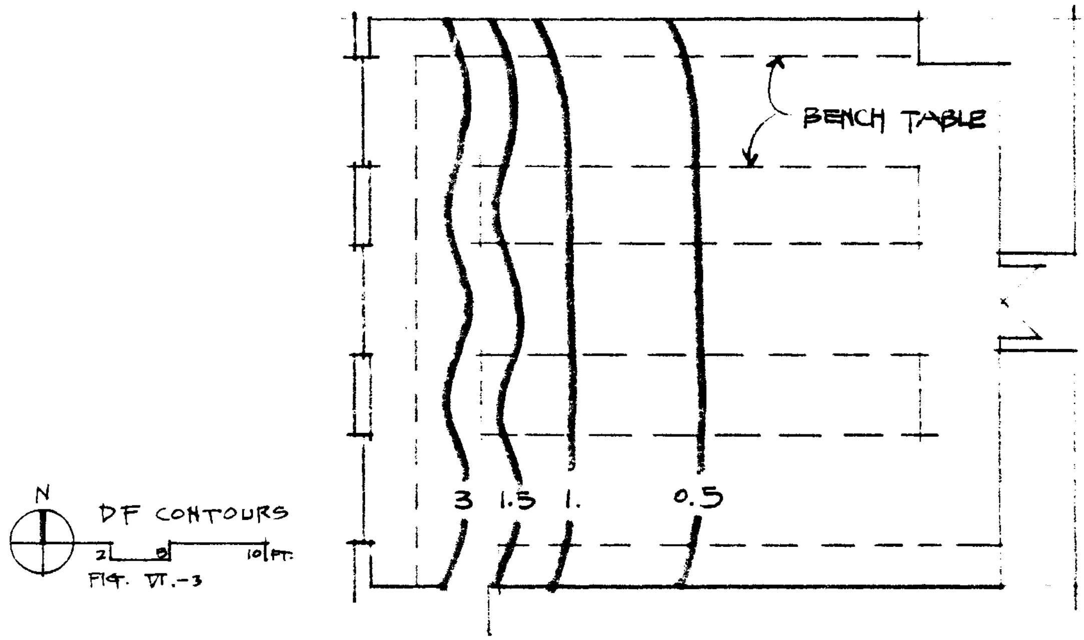


FIG. VI.-3

ii) DAYLIGHT UTILIZATION: As shown on the DF contour drawing, 3% DF reaches only 4 feet from the window and 1.5% DF reaches the edge of the working benches. However, this 1.5% DF can reaches far behind 75 fc and provide over 30 fc. for only about 50% of the time. Thus, daylighting shall not be relied on for laboratory alternative lighting sources except for the circulation and working table adjacent to the window.

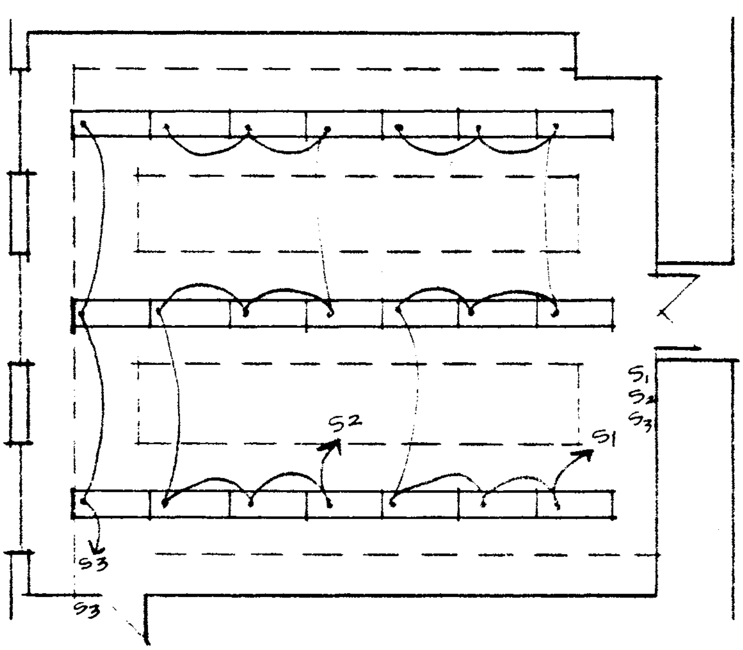
Time between 9:00-7:00 exeeding E-out	E-out (fc.)	E-in(fc.) 3% DF	1.5% DF	1% DF
90%	750	22.5	11.3	7.5
85%	1030	30.9	15.5	10.3
80%	1250	37.5	18.8	12.5
70%	1500	45	22.5	15
60%	1800	54	27	18
-	2500	75	37.5	25
-	5000	150	75	50
-	7500	225	112.5	75

* Note: Lat. 36°, from fig. 19.8, MEEB

4) CONTROL AND FIXTURE LAYOUT

i) CRITERIA: Fixtures shall be located along the asile. Zoning and control switch shall be arranged for partial operationg and daylighting.

ii) LAYOUT: General lighting system shall be divided into 3 control zones with separate zone switches. All zone switches shall be located beside the main door, and additional switches for the perimeter zone shall be provided beside the secondary door.



N

LIGHTING LAYOUT

2 5 10 FT.

FIG. VI-4

D. OFFICE

1) AMBIENT LIGHTING

a) CRITERIA: Fluorescent lighting fixtures shall be selected to provide a 25 fc. average ambient illumination level.

* Recessed mounting with side slots
* Parabolic louvers
* 60 HZ 277 volts, rapid start, A-sound rated ballast
* CW lamps

b) SELECTION

i) LUMINAIRE: 3 lamp-PARALOUVER II by DAY-BRITE or equivalent(cat. VI-1).

* Size: 48" x 20" with 24 cell parabolic louvers
* Lamp: F 40T 12 CW
* Max. S/MH: 1.0

ii) CALCULATIONS: Required no. of fixture shall be determined by the lumen method base on the manufacturers' data(refer to appendix).

* C U : 0.60
* LLF: 0.59
* No. luminaire: 1
* Maint. illuminance: 25.6 fc.

2) SUPPLEMENTARY LIGHTING

a) CRITERIA: Fluorescent lighting fixtures shall be selected to provide a 50 fc. of supplementary lighting at the desk.

* Relocatable pendant type
* 60 HZ, 120 volts, rapid start, A-sound rated ballast
* Built-in switch
* CW lamps

b) SELECTION

i) LUMINAIRE: 2 lamp TASCON-K 12 LENS by ARMSTRONG or equivalent(cat. VI-4).

* Mounting height: 7'
* Lamp: F 40T 12 CW lamp

ii) CALCULATIONS

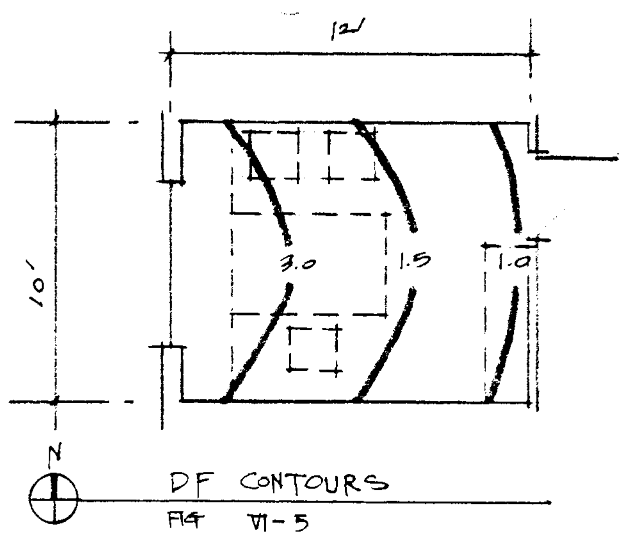
* LLF: 0.59
* Initial illuminance at task from the supplementary lighting: 80 fc. average
* Maint. illuminance at task from the supplementary lighting: 80 × 0.59 = 47.2 fc.
* Maint. illuminance from the ambient lighting: 25.6 fc.

3) DAY-LIGHTING

a) CRITERIA: Daylight factors shall be calculated to examine the possibility of utilization of day-lighting.

b) CALCULATION: The BRS protractors shall be utilized under the CIE sky condition to be conservative in results.

i) DAY-LIGHT FACTORS: Calculation procedures shall be refered to appendix.



DF CONTOURS

FIG VI-5

ii) DAY-LIGHT UTILIZATION

% time during 9:00-17:00	Day-lighting at Ref. point	Task lighting fixture control
65%	over 50 fc.	0 lamp on
24%	over 25 fc.	1 lamp on
12%	under 25 fc.	2 lamp on

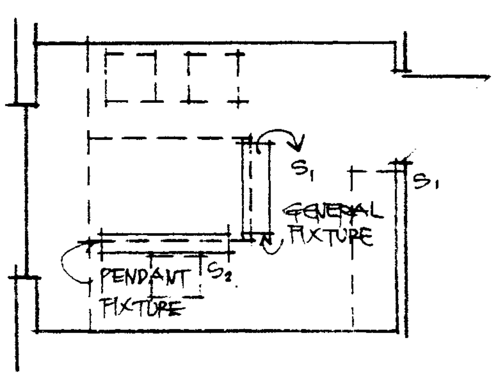
As shown on the DF contour drawing, 3% DF reaches the task referance point on the desk. Based on the CIE sky condition without contribution of reflected component, illuminance at task from the day-lighting exceeds 25 fc. for 88% of time during 9:00 - 17:00. Thus day-lighting can be utilized as task lighting during the daytime office hours as above.

4) CONTROL AND FIXTURE LAYOUT

a) CRITERIA: Supplementary lighting fixture shall be located to prevent veiling reflectance.

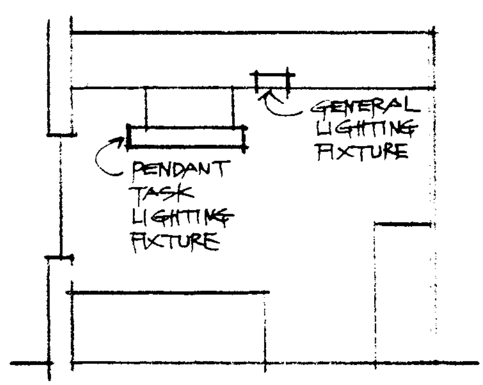
A built-in control switch for supplemantary lighting fixture shall be provided.

b) LAYOUT



LAYOUT PLAN

FIG. VI-6



LAYOUT SECTION

FIG VI-7

E EMERGENCY LIGHTING/EXIT LIGHTS

1) RETROFIT INVERTER

a) CRITERIA: The inverter shall permit normal AC operation of the lamp to which it is connected. Upon utility power failure, the inverter shall operate one standard T-12 fluorescent lamp of up to 40 watts with DC power input from the emergency power unit.

b) SELECTION: Model 77 Emergency Light Retrofit Inverter by KOR-LITE or equivalent(cat. VI-5).

* DC voltage: 12 volts
* Max. Amps: 1.4 amps

2) EXIT LIGHT

a) CRITERIA: Exit light shall be operated on utility AC power of 277 volts in the normal mode. Upon utility power failure, the exit light shall be operated on DC power input from the emergency power unit.

b) SELECTION: Model 75-Exit Light by KOR-LITE or equivalent(cat.VI-6).

* Lamp: 6-watts fluorescent tube
* DC voltage: 12 volts
* Max. Amps: 0.4 amps

3) POWER UNIT

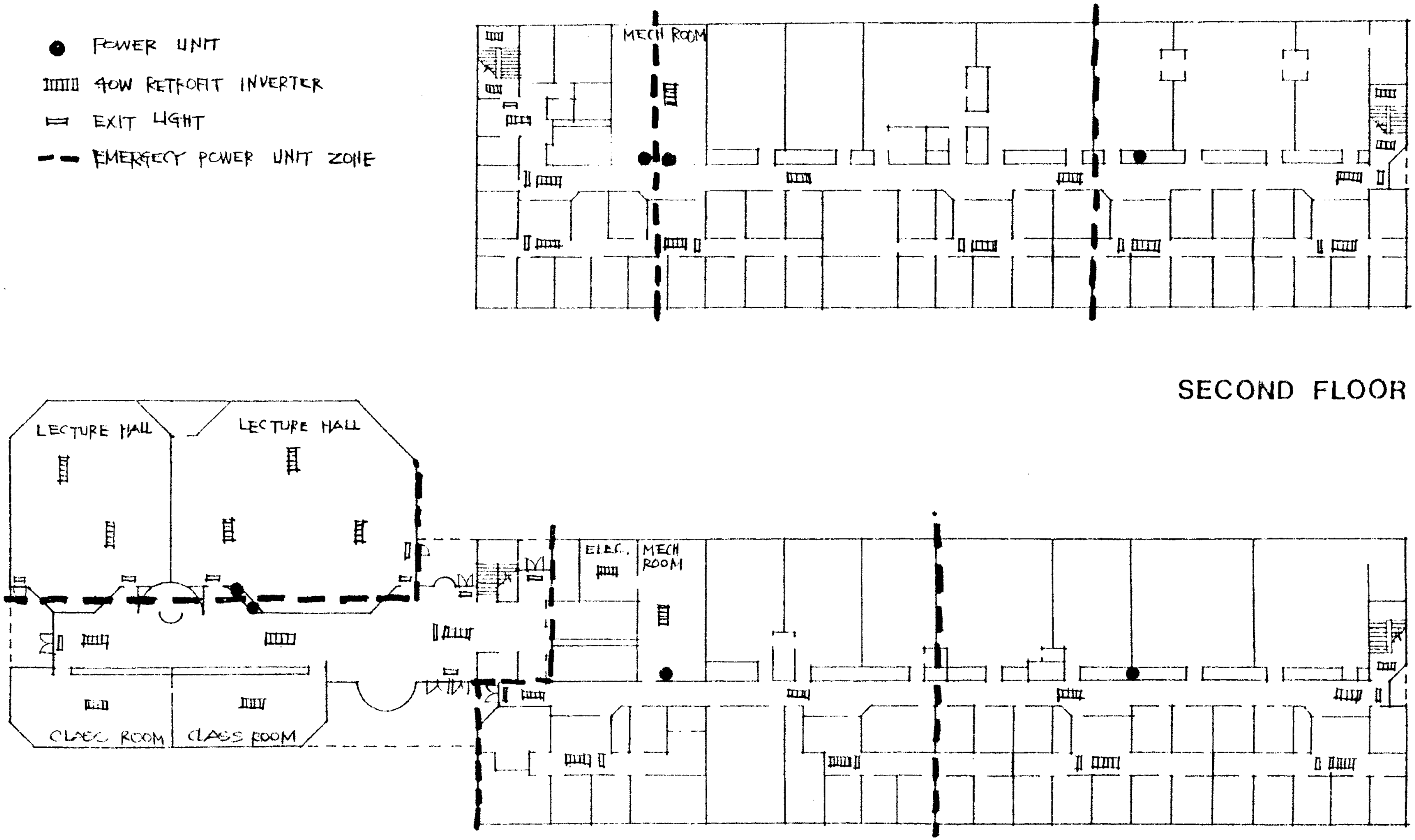
a) CRITERIA: Power unit shall contain 12 volt rechargeable battery and circuitry for monitoring, switching and control. The control circuit shall automatically energize the 40-watt retrofit inverters and exit lights in the event of utility failure or voltage drop of 55% of nominal voltage.

b) SELECTION: Model 88-Power Unit by KOR-LITE or equivalent(cat, VI-7).

* Input: 60 HZ, 277 volts AC
* Output: 12 volt DC/ 9.6 Amp. max.
* Battery: Sealed lead acid battery
* Capacity: 90 minute

4) SYSTEM LAYOUT

See drawing next page.



EMERGENCY LIGHTING / EXIT LIGHT LAYOUT

FIG. VI – 8

CHAPTER VII. ELECTRICAL POWER DISTRIBUTION SYSTEM

1. TASK ANALYSIS

A. SYSTEM REQUIREMENTS

1) BUILDING SYSTEM VOLTAGE

a) INCOMING PRIMARY SERVICE VOLTATE: 12.47 KV

b) BUILDING SERVICE VOLTAGE

* General receptacles: 120 V - 1 ø
* Lab. equipment : 120 V/208 V - 3 ø
* General lighting : 277 V - 1 ø
* Large equipment : 480 V - 3 ø

2) CATEGORIZED ELECTRICAL LOAD

Space	General lighting (277 V.)	Receptacles, appliances (120 V. otherwise specified)
Lecture hall	3.0W/sq.ft.	projector T.V. tape system duplex outlet
Classroom	3.0W/sq ft	projector duplex outlet
Office	3.5W/sq.ft.	duplex outlet per.40sq.ft.
Reception	3.5W/sq.ft.	duplex outlet
Conference	3.5W/sq.ft.	projector duplex outlet per.40sq.ft.
Computer	3.5W/sq,ft	mini-computer micro-computer CRT duplex outlet
Lab.	3.5W/sq.ft.	equipments(120/208V)10W/sq.ft. cold room(480V.-3 ø)
Corridor	0.5W/sq.ft.	receptacle per. 50 ft.
Mech.room	0.5W/sq.ft.	receptacles(120/208 V.) building equipments(480V. - 3 ø)

B. SYSTEM DESIGN CONSIDERATIONS

1) FLEXIBILITY: The system capacity and the wiring shall be designed to accommodate all probable patterns, arrangements, and locations of electric load, especially in the laboratory units.

2) RELIABILITY: The electrical power supply and the distribution system shall be design to ensure maximum reliability for the emergency system including fire alarm/signal, emergency lighting system.

3) ENERGY CONSERVATION: The distribution system shall be designed to conserve electrical energy and conform the ASHRAE standard 90-80.

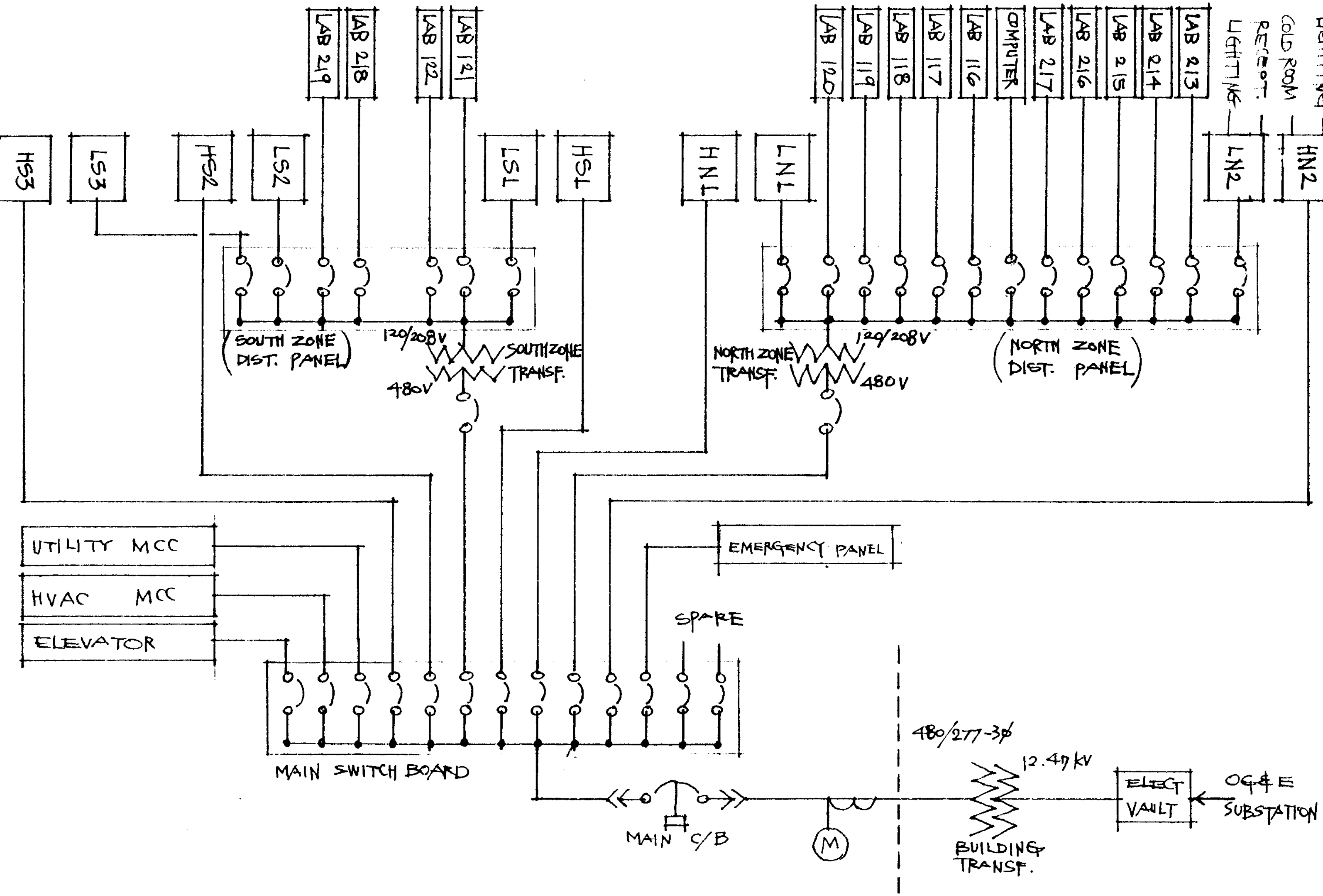
2. PRELIMINARY DESIGN

A BUILDING SERVICE ENTRANCE

1) ELECTRICAL VAULT: A new buried electrical vault with a switching station shall be provided to connect the underground service lateral to the building as indicated on the utility map(Fig III-1, p 22).

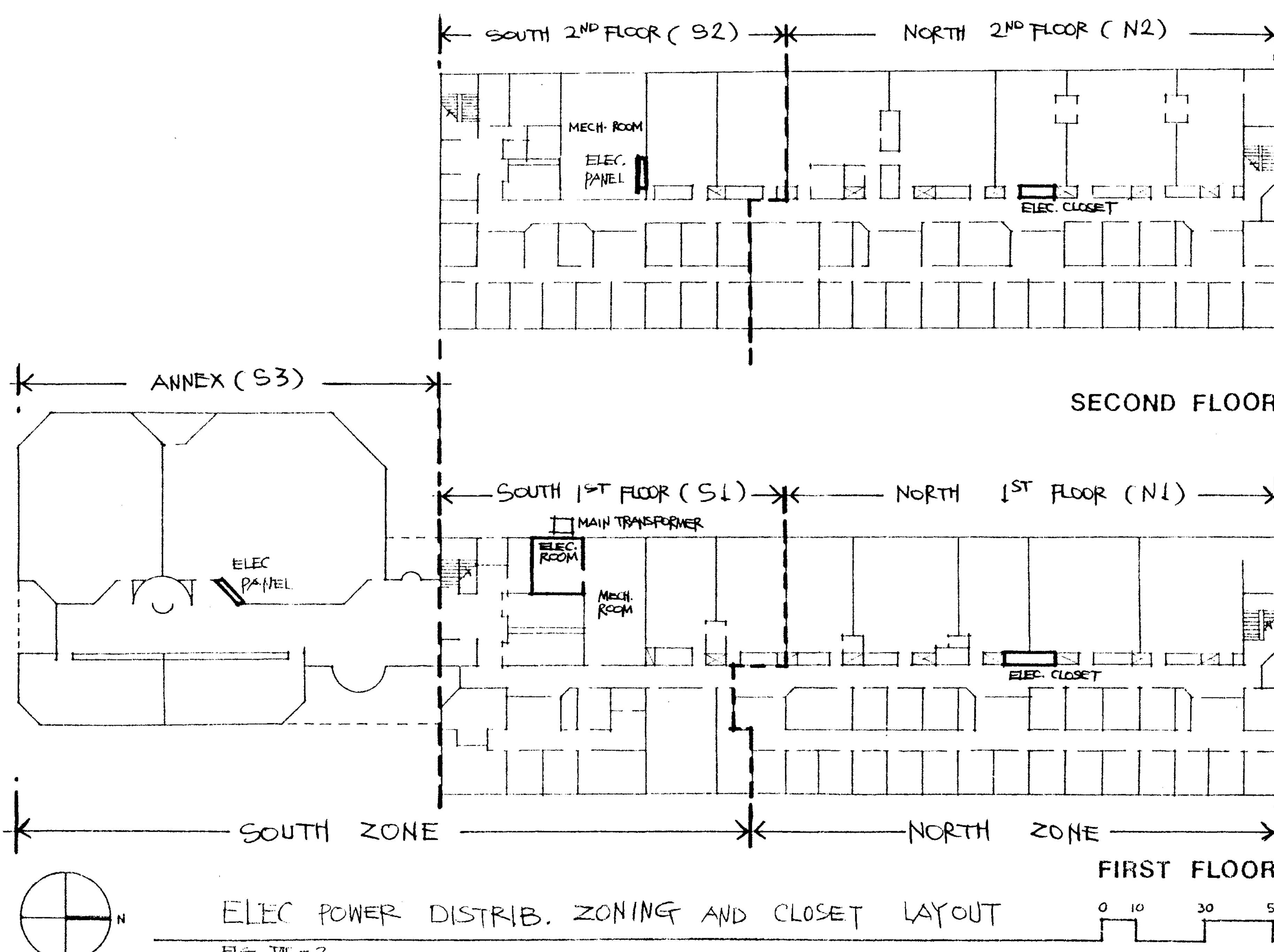
2) BUILDING TRANSFORMER: A building transformer with meter shall be located outside of the electrical room and set down 12.47 KV of incoming service voltage to 277/480V-3ø.

3) BUILDING MAIN SWITCHBOARD: A main switch board (MSB) shall be provided in the electrical room to



BUILDING POWER RISER DIAGRAM

FIG VII-1



ELEC POWER DISTRIB. ZONING AND CLOSET LAYOUT

FIG VII-2

distribute high-volt(277/480V-3ø) main feeders to the zone High-Volt Distribution panels, Zone secondary transformers, Emergency panel, Elevator, HVAC MCC, and Utility MCC.

B. BUILDING POWER DISTRIBUTION

1) ZONING: The building distribution system shall be divided into 2 main zones and each zone shall be further divided into subzones as indicated in the drawing(Fig. VII-1,2).

South zone	* South 1st. floor	(S1)
	* South 2nd. floor	(S2)
	* Annex	(S3)
North zone	* North 1st. floor	(N1)
	* North 2nd. floor	(N2)

2) HIGH VOLT. DISTRIBUTION: The subzone High-volt Distribution panels shall distribute 277/480V-3ø to the subzone general lighting system and lab. equipments, which requires high voltage.

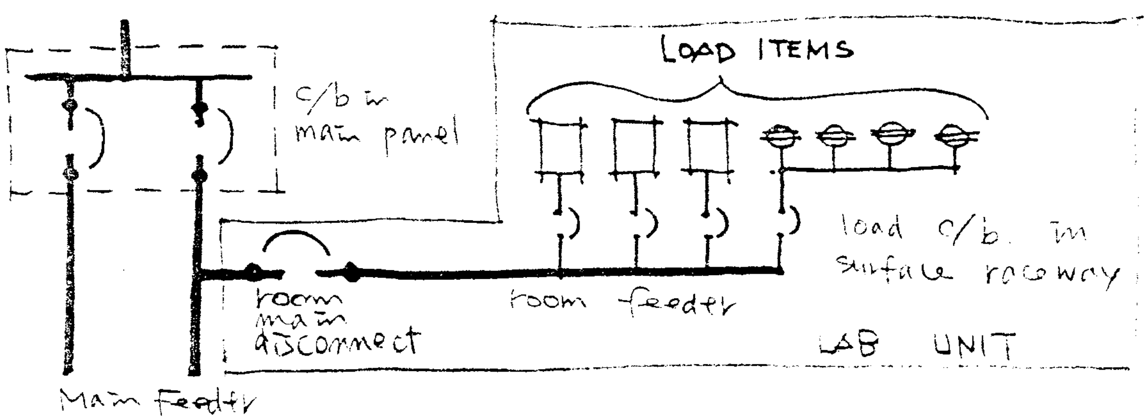
3) LOW VOLT. DISTRIBUTION

a) ZONE SECONDARY TRANSFORMER: The zone secondary transformers shall be provided for each zone to step down the high voltage to low voltage(120/208V-3ø) for general receptacles and lab. equipments appliance outlets.

b) ZONE MAIN DISTRIBUTION PANEL: The zone Low-volt. Main Distribution panel(LS 1, LN 1) shall distribute 120/208V-3ø feeder to the subzone low-volt. panel board(LS 2,LS 3, LN 2), and each laboratory and computer room main disconnect.

c) PANEL BOARD: The subzone Low-volt. panel board shall then distribute 120V-1ø branch circuit for subzone general receptacles.

d) ROOM MAIN DISCONNECT: Each lab and the computer room shall be provided with a 120/208V-3ø feeder to distribute lab. equipments outlets, instead of the conventional radial or 'tree' type branch circuit wiring. The main feeder is tapped by the room main disconnect that protects room feeder and the room feeder is run in surface raceway and tapped at each load with a load circuit breaker. The advantage of this arrangement is that by eliminating branch circuit wiring, installation costs are reduced, voltage drop and energy loss in circuit conductors are negligible and loads are individually protected with a great flexibility.



ROOM FEEDER CONNECTION SCHEMATICS

Fig. VII-3

3. DETAIL DESIGN

A ZONE DISTRIBUTION SYSTEM

1) GENERAL: Presentation of the zone distribution system design shall be limited to the N 1 zone.

2) BRANCH CIRCUITS

a) CRITERIA

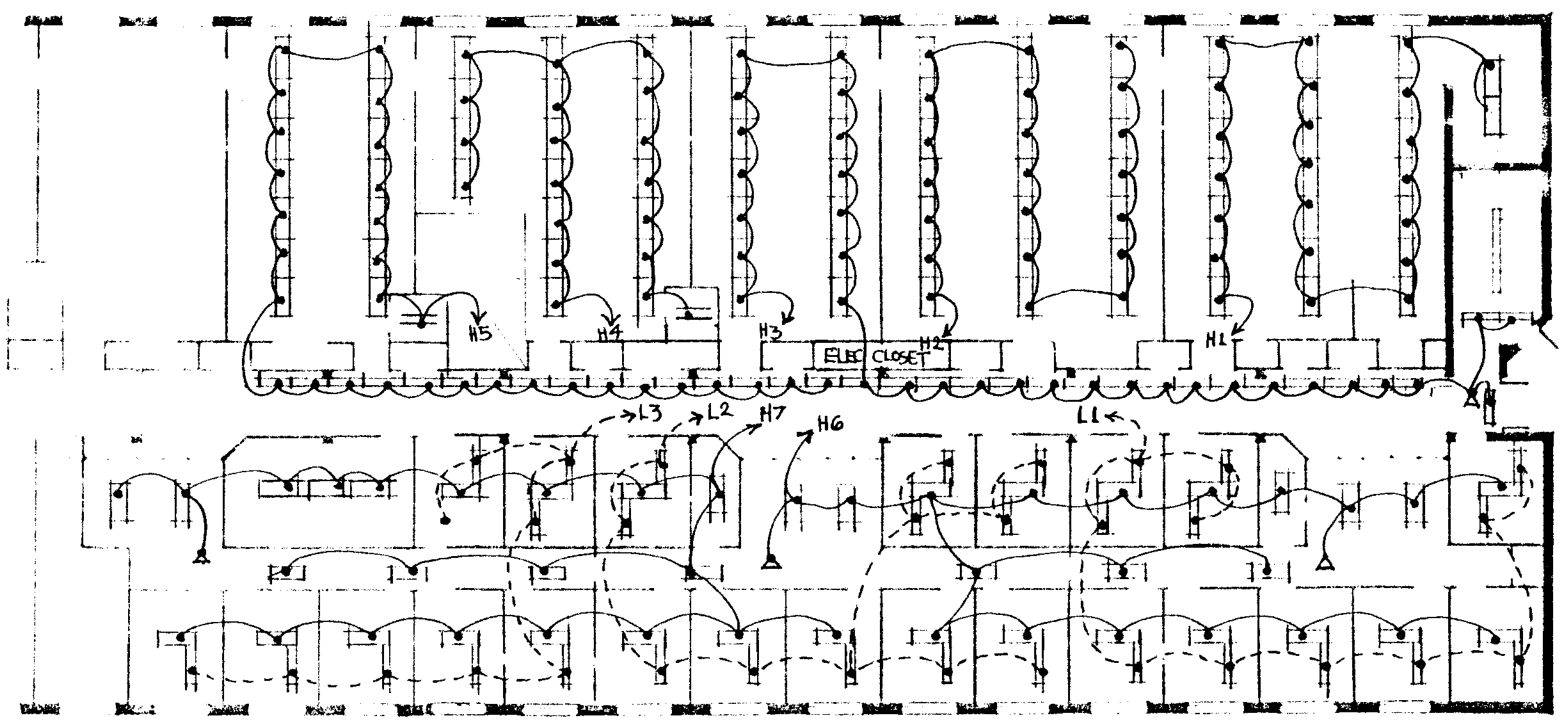
* Separate groups of circuits shall be provided for lighting, convenience receptacles and appliance.
* Loads shall be considered as contineous.
* Each specific appliance, device, lighting fixture shall be taken at its nameplate rating and each convenience outlet shall be counted as 1.5 amp.(NEC '80, art 220)
* Each circuit shall have spare capacity for future growth of 50% for lighting and 75% for convenience receptacles and appliance circuit
* Max. voltage drop in branch circuit shall be less than 3%(ASHRAE 90-80,Sec. 17.5).

b) SELECTION: 20 Amp. circuit

* Initial load per circuit
  General lighting: $20A \times 0.8 \div 1.5 = 11A$
  Others: $20A \times 0.8 \div 1.75 = 9A$
* Circuit breaker
  Frame 50A/Trip 20A
* Conductor: # 12 AWG
* Max. circuit distance: 100'

c) LAYOUT

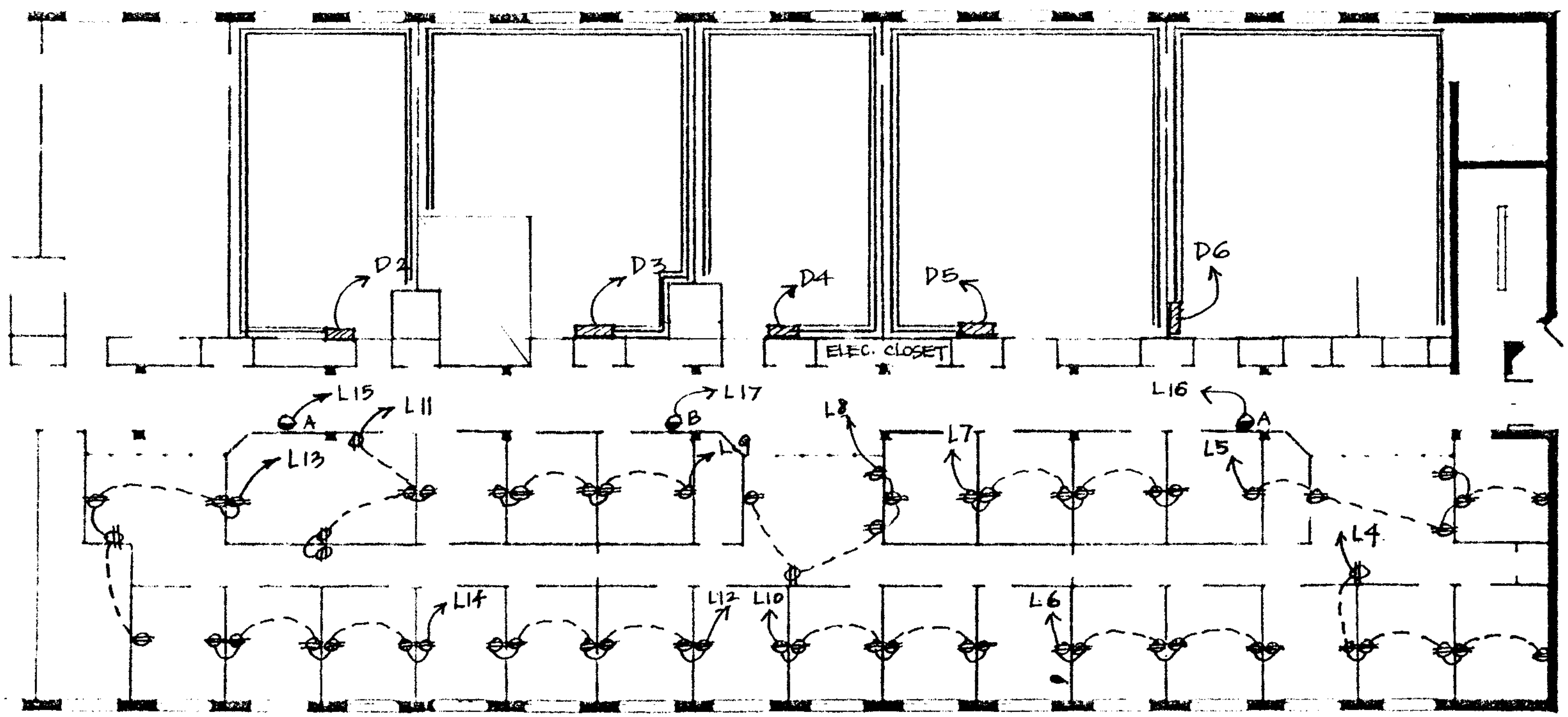
See drawings next page.



- - - - - - 120 V CIRCUIT
——— 277 V CIRCUIT

N 1 ZONE LIGHTING CIRCUITED ELEC. PLAN

FIG VII-4



▨ LAB. POWER MAIN S/B
═ SURFACE METAL RACEWAY
⏀ DUPLEX CONVENIENCE RECEPTACLE
◒A 20 Amp. DUPLEX OUTLET (1 POLE)
◒B 20 Amp. OUTLET (2 POLE)

0 5 10 20

N 1 ZONE POWER CIRCUITED ELEC. PLAN

FIG VII-5

3) PANEL BOARDS

a) CRITERIA

* Load shall not less than $3\frac{1}{2}$ watt/sq ft for general lighting, 1 watt/sq.ft. for general receptacles in office area and 1/2 watt/ sq.ft. for general lighting in corridor.
* Spare circuits of 20% of the number of active circuits shall be included.
* Space of approzimately same number of spare circuits shall be provided.
* Feeder shall be sized for initial plus spare load with conduit oversized by one size for future rewiring.
* Main breake shall be selected for the entire eventual load of the panel
* Voltage drop in the feeder shall not be more than 2%.

b) HIGH VOLTAGE PANELBOARD(HN 1)

i) PANEL SCHEDULE

Panel board-HN 1		277/480V 3ø 4W					
		Load in watts			Branch circuit		
No.	Serves	ø A	ø B	ø C	Poles	Frame	Trip
1	Lighting	3024			1	50	20
2	Lighting	3024					
3	Lighting		3024				
4	Lighting		3024				
5	Lighting			3024			
6	Lighting			3024			
7	Lighting	3024					
8	Spare		3024				
9	Spare			3024	1		
10	Cold room	2220					
	Compressor		2220		3		
	(3 pole)			2220			
11	Cold room	2220					
	Compressor		2220		3		
	(3 pole)			2220			
12	Cold room	2220					
	Compressor		2220		3		
	(3 pole)			2220			
13	Cold room	2220					
	Compressor		2220		3		
	(3 pole)			2220			
14	Spare	2220					
			2220		3		
	3 pole			2220			
15-20	Space only				1		
	Phase total	20172	20172	20172			
	Panel total		60516				

ii) PANEL LOAD

* Initial ø current: 73 amp.
* Future ø current = 73 × 1.25 = 91 amp.
* Eventual ø current = 18 ccts × 16 amp/$\sqrt{3}$
  = 166 amp.

iii) FEEDER

* Selection: 4 - #2 RHW in 2" conduit.
* Initial capacity: 92 amp ...ok
* Rewired capacity: 235 amp...ok
* Max. distance for 2% voltage drop:
  140 ft....ok

iv) MAIN CIRCUIT BREAKER

* Frame: 225A 3 pole
* Trip: 100A setting

c) LOW VOLTAGE PANELBOARD

i) PANEL SCHEDULE

Panel board LN 1		120/208V. 3ø 4W					
		Load in watts			Branch circuit		
No.	Serves	øA	øB	øC	Poles	Frame	Trip
1	Lighting	1060			1	50	20
2	Lighting		1060				
3	Lighting			870			
4	Receptacles	1080					
5	Receptacles	1080					
6	Receptacles		1080				
7	Receptacles		1080				
8	Receptacles			1080			
9	Receptacles			1080			
10	Receptacles	1080					
11	Receptacles	900					
12	Receptacles		1080				
13	Receptacles		900				
14	Receptacles			1080			
15	Receptacle-corr			900			
16	Receptacle-corr	900					
17	Receptacle-corr		1000		2		
	(2 pole portion)			1000			
18	Spare	1080			1		
19	Spare		1080		1		
20	Spare			1080	1		
21-24	Space only				1		
	Phase total	7180	7280	7090			
	Panel total	21,550					
	Max. ø current	60 Amp					
	25% spare capacity	15 Amp(future loads)					
	Total current	75 Amp					

ii) PANEL LOAD

* Initial ϕ current = 60 amp.
* Future ϕ current = 60 × 1.25 = 75 amp.
* Eventual ϕ current = 24 ccts × 16 amp/$\sqrt{3}$
  = 222 amp.

iii) FEEDER

* Selection: 4 - #3 RHW in 2" conduit.
* Initial capacity: 80 amp....ok
* Rewired capacity: 235 amp....ok
* Max. distance for 2% voltage drop:
  140 ft....ok

iv) MAIN CIRCUIT BREAKER

* Frame: 225A 3 pole
* Trip: 90A setting

d) LOW VOLTAGE LAB. ROOM MAIN DISCONNECT

i) ROOM LOAD

* Initial load = 10 watt/sq.ft. × 1140 sq.ft. + 443 W
  ≐ 12750 watts
* Initial ϕ current = 12750/(208 × $\sqrt{3}$)
  = 35.4 amp.
* Future ϕ current = 35.4 × 1.25 = 44.3 amp.
* Eventual ϕ current = 44.3 × 300% = 133 amp.

ii) FEEDER

* Selection: 4 - #6 RHW in $1\frac{1}{2}$" C.
* Initial capacity: 52 amp.....ok
* Rewired capacity: 155 amp....ok
* Max. distance for 2% voltage drop:
  160 ft....ok

iii) MAIN DISCONNECT

* Frame: 225A 3 pole
* Trip: 50A setting

4) ZONE SWITCHBOARD

a) CRITERIA: The zone low voltage switchboard and secondary transformer shall be selected for the sum of the various feeder load.

b) SWITCHBOARD SCHEDULE

Distribution panel north zone 120/208V 3ø 4W						
		Load		Feeder circuit		
No.	Serves	KVa	Amp	Poles	Frame	Trip
1	Panel LN 1	27.0	75.0	3	225	90
2	Lab. 120	10.6	29.5	3	100	40
3	Lab. 119	15.9	44.3	3	225	50
4	Lab. 118	10.6	29.5	3	100	40
5	Lab. 117	15.9	44.3	3	225	50
6	Lab. 116	15.9	44.3	3	225	50
7	Lab. 217	10.6	29.5	3	100	40
8	Lab. 216	15.9	44.3	3	225	50
9	Lab. 215	10.6	29.5	3	100	40
10	Lab. 214	15.9	44.3	3	225	50
11	Lab. 213	10.6	29.5	3	100	40
12	Panel LN 2	27.0	75.0	3	225	90
	Panel total	186.5 Kva (518 amp.)				

5) ZONE SECONDARY TRANSFORMER

a) TRANSFORMER

i) CRITERIA

* Type: Floormount, general purpose, dry type
* Voltage: 480V - 208Y/120V, 3 ø
* Capacity: 187 KVA

ii) SELECTION: Type DT-3 by GENERAL ELECTRIC or equivalent(cat.VII-1).

* Rating: 225 KVA

b) FEEDER

i) CRITERIA

* Initial ø current: 224 amp.
* Eventual ø current: 270 amp.

ii) SELECTION: 4-No, 500 MCM in 3½" C.

* Capacity: 304 amp....ok
* Max. distance for 2% voltage drop: 200 ft....ok

c) MAIN BREAKER

* Frame: 400A 3 pole
* Trip: 225A setting

B. BUILDING DISTRIBUTION SYSTEM

1) MOTOR CONTROL CENTERS

a) HVAC MOTOR CONTROL CENTER

HVAC MCC		480V. 3ø 4W	
No.	Services	Design H.P.	FLA
1	Exhaust fan	30	40.0
2	M/A fan	40	52.0
3	Annex AHU	10	14.0
4	Annex Return fan	3	4.8
5	Main bldg. AHU	15	21.0
6	Main bldg. Return fan	3	4.8
7	Perimeter hot water pump	3/4	1.4
8	F.C. unit chilled water pump	2	3.4
9	Primary hot water pump	1½	2.6
10	Primary chilled water pump	5	7.6
	Subtotal		151.6
	25% of the highest rating		13
	Total		164.6

b) SERVIVE MOTOR CONTROL CENTER

Service MCC		480V. 3ø 4W	
No.	Serves	Design H.P.	FLA
1	Air compressor	15	21.0
2	Vacuum pump	15	21.0
3	Deionized water circul. pump	1	1.8
4	Domestic hot water circul. pump	1	1.8
	Subtotal		45.6
	25% of the highest rating		5.25
	Total		50.85

2) BUILDING SWITCHBOARD

a) CRITERIA: The main building switchboard shall constitues a combination of service equipment and feeder switchboard.

b) SWITCHBOARD SCHEDULE

Building switch board		480V 3ø 4W				
		Load		Feeder circuit		
No.	Serves	Kva	Amp	Poles	Frame	Trip
1	Elevator		26			
2	HVAC MCC		165			
3	Service MCC		51			
4	Transformer(N-zone)	187	225	3	400	250
5	Transformer(S-zone)	116	140	3	225	150
6	Panel HN 1	75	90	3	225	100
7	Panel HN 2	75	90	3	225	100
8	Panel HS 1	32	38	3	100	50
9	Panel HS 2	32	38	3	100	50
10	Panel HS 3(Annex)	24	29	3	100	50
	Switch board total	892 Amp(741.6 Kva)				
	Main circuit breaker	1200A 3 pole frame 1000A Trip setting				

c) MAIN BREAKER

* Frame: 1200A 3 pole
* Trip : 900A setting

3) BUILDING TRANSFORMER

a) CRITERIA

* Type: Outdoor padmount, distribution type
* Voltage: 12.47 KV - 480 Y/277 V, 3 ø
* Capacity: 742 KVA
* Cooling medium: Oil

b) SELECTION: Type POW-R-PAD transformer by GENERAL ELECTRIC or equivalent(cat.VII-2).

* Rating: 750 KVA

CHAPTER VIII. ACOUSTICS

1. TASK ANALYSIS

A. GENERAL: Each space shall be categorized and analized to identify the acoustical activities, needs, and problems.

B. PROBLEM IDENTIFICATION

1) LECTURE HALL/CLASSROOM

a) ACTIVITIES

* Lecture
* Conference

b) NEEDS

* Provide proper acoustical environment for intelligibility of speech especially from the lecturer at the platform.

c) PROBLEMS

* Sound transmission from adjacent room, streeet, corridor.
* Noise from HVAC system and lighting fixture.
* Room acoustics: echo, reverbration.

d) ANALYSIS

* N.R. analysis
* R.T. analysis
* A.I. analysis

2) OFFICE

a) ACTIVITIES

* Office work

* Conversation

b) NEEDS

* Speech privacy
* Quiet environment for office work

c) PROBLEMS

* Sound transmission from adjacent room, street, corridor.
* Noise from HVAC system and lighting fixture
* Room acoustics: reverbration

d) ANALYSIS

* N.R. analysis
* R.T. analysis
* Speech privacy analysis

3) CONFERENCE ROOM

a) ACTIVITIES

* Meeting, Conference
* Slide presentation

b) NEEDS

* Excellent intelligibility of speech from any location.
* Speech privacy

c) PROBLEMS

* Sound transmission from adjacent space, street.
* Noise from HVAC system and lighting fixture
* Room acoustics: reverbration

d) ANALYSIS

* N.R. analysis
* R.T. analysis
* A.I. analysis
* Speech privacy analysis

4) RECEPTION/SECRETARIAL AREA

a) ACTIVITIES

* Typing
* Telephone

* Conversation

b) NEED

* Moderately good listening condition

c) PROBLEMS

* Noise from adjacent space(corridor)
* Noise from HVAC system and lighting fixture

d) ANALYSIS

* N.R. analysis

5) LABORATORY

a) ACTIVITIES

* Research experiment
* Conversation

d) NEED

* Fair listening condition

c) PROBLEMS

* Sound transmission from adjacent space(lab.), street
* Noise from laboratory equipment
* Noise from HVAC, plumbing, and lighting fixture.

d) ANALYSIS

* N.R. analysis

6) MECHANICAL ROOM

a) ACTIVITIES

* Operation of service equipment

b) NEED

* Minimize transmission of air borne and structure borne noise into occupied space.

c) PROBLEMS

* Fan noise and vibration
* Pump noise and vibration

d) ANALYSIS

* N.R. analysis
* Vibration analysis

2. DETAIL ANALYSIS

A. GENERAL: Detailed analysis and design shall be limited to the following representative spaces

* Lecture hall #124: R.T. and Articulation Index Analysis
* Typical office: Speech privacy analysis
* Mech. room: Noise/Vibration control

B LECTURE HALL

1) REVERBERATION TIME ANALYSIS

a) CRITERIA: The reverberation time of the initial condition shall be analyzed and then proper correction shall be provided.

* Optimum R.T. for speech: 0.3 log(V/353.2)
* Max. R.T. for speech: 1.2 × R.T. opt. (ref: MEFB p.1178).

b) INITIAL CONDITION

* Room size: 40'(W) × 45'(L) × 18.5'(avg.H)
* Volume: 33,300 cu.ft.
* Optimum R.T. = 0.3 log(V/353.2) = 0.59(Sec.)
* Max. R.T. = 1.2 × R.T. opt = 0.71(Sec.)

MATERIAL	AREA sq.ft	α			Sα		
		125Hz	500Hz	2000Hz	125Hz	500Hz	2000Hz
Brick, unglazed	2856	0.03	0.03	0.05	85.68	85.68	142.8
Chalk board	160	0.28	0.17	0.10	44.8	27.2	16.
Metal deck ceiling	1800	-	-	-	-	-	-
Audience @ tablet	700	0.30	0.50	0.85	210.	350.	595
Carpet, heavy on Conc	1100	0.02	0.14	0.60	22.	154.	660
TOTAL					362.5	616.9	1413.8
$R.T = 0.049 V / \Sigma S\alpha$ (sec)					4.5	2.64	1.15

* R.T. of the existing condition are too high over the entire frequency range, but especially at the lower frequency range

c) CORRECTED CONDITION

* Corrections
  - 5/8" random fissured fiberglass board shall be installed for the suspended ceiling
  - Foam rubber shall be added under the carpet
  - 1 9/16 in thick, square pattern Acoustimetal shall be added over the rear wall surface
* Corrected room size: 40'(W) × 45'(L) × 15' (avg. H)
* Corrected volume: 27,000 cu.ft.
* Optimum R.T. = 0.3 log(V/353.2) = 0.57 (Sec.)
* Max. R.T. = 1.2 × R.T. opt = 0.68 (Sec.)

MATERIAL	AREA	α			$S\alpha$		
	sq.ft	125 Hz	500 Hz	2000 Hz	125 Hz	500 Hz	2000 Hz
Brick, unglazed	2326	0.03	0.03	0.05	70	70	116
Chalk board	160	0.28	0.17	0.10	45	27.	16.
Acoustimetal	530	0.59	0.88	0.97	313	446	514
Fiberglass board	1800	0.64	0.68	0.83	1152	1224	1494
Audience @ tablet	700	0.30	0.50	0.85	210	350	595
Carpet w/ rubber	1100	0.08	0.39	0.48	88	429	528
TOTAL					1898	2546	3263
R.T = $0.049V / \Sigma S\alpha$ (sec.)					0.70	0.52	0.41

* Corrected condition gives optimum to good R.T. for speech.

2) ARTICULATION INDEX ANALYSIS

a) CRITERIA: Articulation index shall be analyzed to provide 'good' level of communication from the speaker to the most remote listener.

* Space volume: 27,000 cu.ft.
* Total surface area: 6,045 sq.ft.
* Maximum distance from speaker: 40'
* Background noise: NC 35

* Acceptable AI criteria for the speaker-listener relationship

Range of the articulation index				Category of acceptability
		AI	< 0.3	Unsatisfactory
0.3	<	AI	< 0.5	Acceptable
0.5	<	AI	< 0.7	Good
		AI	> 0.7	Very good to excellent

b) CALCULATION

* Room effect

Room effect	125 HZ	500 HZ	2000 HZ
RT(sec.)	0.70	0.52	0.41
$\Sigma S\alpha$ (sabins)	1878	2546	3263
$\bar{\alpha} = \Sigma S\alpha / \Sigma S$	0.28	0.39	0.49
$R = S\bar{\alpha}/(1-\bar{\alpha})$	2622	4140	6436
dB reduction	28	29	31

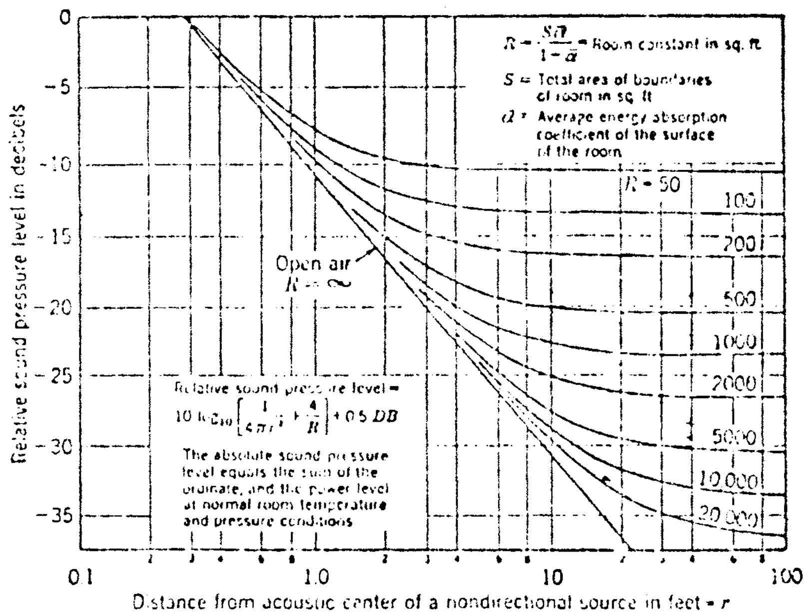


Fig.VIII-1 Relative SPL Due to Room Constant and Distance (Ref. 34).

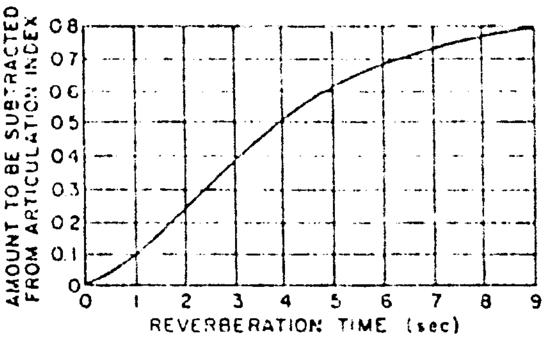


Fig. VIII-2 Effect of Reverberation Time on AI (Ref. 26).

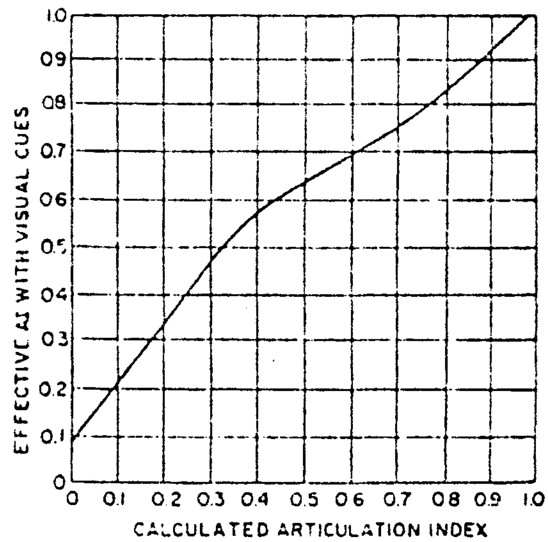


Fig. VIII-3 Effect of Visual Cues on AI (Ref. 26).

* Articulation index

Octave Band (HZ)	Voice PWL (dB)	+12dB for peak	Room Effect (dB)	Background Noise (dB)	Weight fraction	Resultant for the Octave band
150 - 300	74	+12	-28	-47	0.0017	0.0187
300 - 600	78	+12	-29	-41	0.0040	0.0800
600 - 1200	79	+12	-29	-37	0.0065	0.1625
1200 - 2400	74	+12	-31	-35	0.0107	0.2140
2400 - 4800	65	+12	-31	-33	0.0084	0.1092
4800 - 9600	52	+12	-31	-32	0.0020	0.0020

Subtotal = 0.5364
Effect of R.T. = -0.1

Net AI = 0.4864
Effective AI (with visual cues) = 0.62

* Acceptability: good

C. OFFICE

1) SPEECH PRIVACY ANALYSIS

a) CRITERIA: Speech privacy for the typical faculty office against the adjacent secretary/ reception area shall be analyzed and corrected, if needed, to ensure apparent satisfaction

* Source room: Faculty office
* 10'x12'x9.5'
* Speech effort: Conversational
* Degree of privacy required: Normal

b) INITIAL CONDITION

* Receiving room: Secretary/reception area
  15' x 14' x 8' (H)
  Average live room
* Receiving room background noise: NC 35 (45 dBA)
* Barrier sound transmission class
  Wall: dry partition(STC_W = 41)
  10' x 8'(H)
  Door: 1½" hollow core without gasket
  (STC_D = 22)
  3' x 7'(H)
  Composite barrier STC_C
  $STC_W - STC_D = 19$
  $S_D / S_C = 26.25\%$
  $STC_W - STC_C = 13$
  $\therefore STC_C = STC_W - 13 = 28$

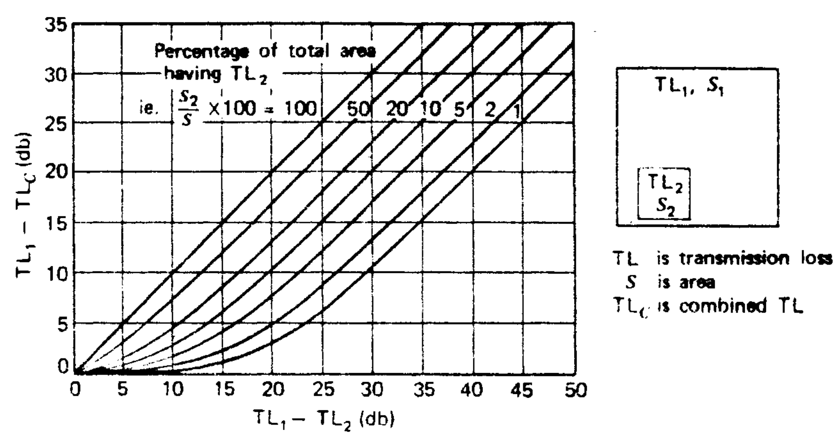
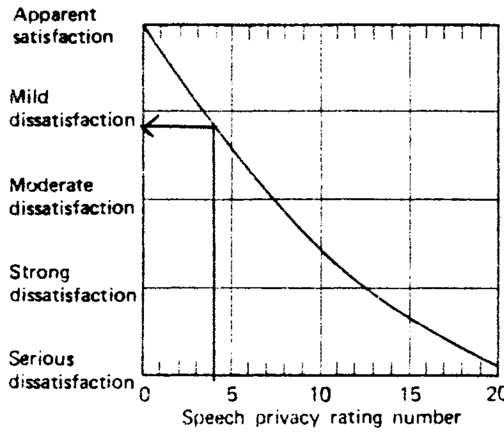


Fig. VIII-4. *Transmission loss of a two-element composite barrier as a function of the relative transmission loss of the components. From E. B. Magrab,* Environmental Noise Control, *Wiley, New York, 1975, pp. 266, Fig. 7-45 and 268, Fig. 7-47.*

Anticipated response to privacy situation



NOTE: Curve shows average response to speech noise intrusion, as calculated below.

Speech rating

1. Speech effort — from source room	Loud / Raised / Conversational: 72 / 66 / 60	60
2. Source room floor area (A_1)— effect of source room absorption	125 / 250 / 500 / 1000 (sq ft): 10 / 6 / 3 / 0	10
3. Privacy allowance — degree of privacy required	Confidential / Normal: 15 / 9	9
	■ Speech rating total	79

Isolation rating

4. Sound transmission class (STC)— common barrier		28
5. Noise reduction factor (A_2/S)— effect of receiving room absorption and barrier size	1 / 5 / 10 (Unitless): −2 0 2 3 4 5 6 7 8	2
6. Adjacent room background noise level (dBA)— masking sound available		45
	■ Isolation rating total	75
Speech privacy rating number		

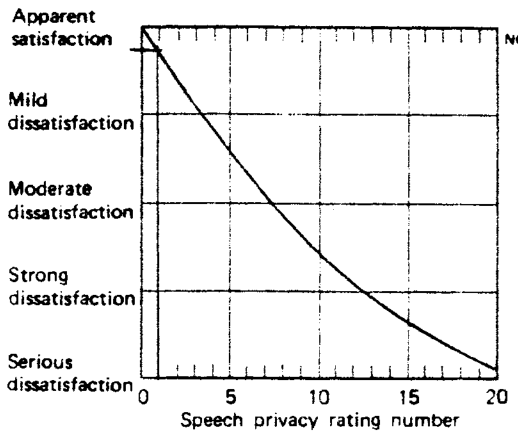
Find speech privacy rating number by subtracting isolation rating total from speech rating total. Then use graph at top of sheet to predict degree of satisfaction. 4

Speech privacy analysis sheet. Based on "Speech Privacy in Buildings," by W. J. Cavanaugh, W. R. Farrell, P. W. Hirtle, and B. G. Wattern, J. Acoust. Soc. Amer., Vol. 38, No. 4, October 1965.

c) CORRECTED CONDITION

* Barrier STCc: The common barrier STC shall be increased by upgrading the door STC
Door: 1½" hollow core with gaskets and drop closure STC_D = 25
Composite barrier STCc
$STCw - STC_D = 41 - 25 = 16$
$S_D/Sc = 26.25\%$
$STCw - STCc = 10$ (see fig. VIII-4)
$\therefore STCc = STCw - 10 = 31$

Anticipated response to privacy situation



NOTE: Curve shows average response to speech noise intrusion, as calculated below.

Speech rating

1. Speech effort – from source room — Loud 72, Raised 66, Conversational 60 — 60

2. Source room floor area (A_1)– effect of source room absorption — 125, 250, 500, 1000 (sq ft); 10, 6, 3, 0 — 10

3. Privacy allowance – degree of privacy required — Confidential 15, Normal 9 — 9

Isolation rating

■ Speech rating total — 79

4. Sound transmission class (STC)– common barrier — 31

5. Noise reduction factor (A_2/S)– effect of receiving room absorption and barrier size — 1, 5, 10 (Unitless); –2 0 2 3 4 5 6 7 8 — 2

6. Adjacent room background noise level (dBA)– masking sound available — 45

■ Isolation rating total — 78

Speech privacy rating number — 1

Find speech privacy rating number by subtracting isolation rating total from speech rating total. Then use graph at top of sheet to predict degree of satisfaction.

Speech privacy analysis sheet. Based on "Speech Privacy in Buildings," by W. J. Cavanaugh, W. R. Farrell, P. W. Hirtle, and B. G. Wattern, J. Acoust. Soc. Amer., Vol. 38, No. 4, October 1965.

D MECH. ROOM

1) AIR BORNE NOISE CONTROL

a) CRITERIA: Transmitted noise to the adjacent lab # 122 shall be controled to be under the laboratory background noise level of NC 45

* Analysis shall be limited at 500 HZ due to the limited data.

* Major noise sources
  Air compressor: 100 dBA
  Vacuum pump: 108 dBA
  (from MEEB. p.1186).
* Anticipated peak noise level
  $IL_N = 10 \log(10^{10} + 10^{10.8})$
  $= 109$ dBA
* Common barrier area(S) = 450 sq. ft.
* Lab. total surface area(A) = 2840 sq. ft.

b) INITIAL CONDITION

* Barrier sound transmission class
  8" conc. block: STC 48
* Lab. total sound absorption: Medium live
  $Ar = A \times \bar{\alpha}$
  $= 2840 \times 0.1 = 284$ (sabins)
* Noise reduction @ 500 HZ
  $NR = STC - 10 \log(S/Ar)$
  $= 48 - 10 \log(450/284)$
  $= 46$
* Noise intensity level @ Lab
  $IL_R = IL_N - NR$
  $= 109 - 46$
  $= 63$ dBA $>$ 55 dBA
* Anticipated response: Dissatisfaction

c) CORRECTED CONDITION

* Barrier STC shall be increased by adding sand to cores of hollow blocks and adding a ½" gypsum wall board with 3 5/8" metal stud

8" conc block	STC 48
Sand filling	+ 3
GWB with metal stud	+66
Compound wall	STC 57

* Noise reduction @ 500 HZ
  $NR = STC - 10 \log(S/Ar)$
  $= 57 - 2 = 55$
* Noise intensity level @ Lab
  $IL_R = IL_N - NR$
  $= 109 - 55$
  $= 54$ dBA $>$ 55 dBA
* Anticipated response: Satisfaction

2) HVAC NOISE CONTROL

a) CRITERIA: The fan noise from the AHU to the nearest office(# 201R) shall be analyzed and proper correction shall be provided.

* Noise criteria: NC 35
* Floor area : 120 sq.ft.
* Ceiling height: 9 ft.
* Surface rating: average

b) INITIAL CONDITIONS: Natural attanuation shall be calculated according to the chap. 35 ASHRAE '80 systems.

Items	Ref. table	SPL(dB) @ HZ 125	500	2000
FC fan noise	7	86	78	68
Duct(24" x 30" x 20')	9	-2	-2	-2
Elbow(no lining, vanes)	11	-1	-7	-3
Elbow(no lining, vanes)	11	-1	-7	-3
Division(80%)	12	-1	-1	-1
Branch division(5%)	12	-13	-13	-13
Elbow(no lining, vanes)	10	0	0	-2
Duct(6"ø x 5')	9	-1.5	-0.5	-0.5
End reflection effect	13	-12	-4	0
Room effect	20,21	-4	-4	-4
Room criteria NC-35		-53	-40	-34
Required attenuation		-2.5	0.5	5.5

c) CORRECTION: Two duct width(5') of lining shall be added ahead of the first elbow.

* Noise attanuation: 5 dB.

3) VIBRATION CONTROL

a) CRITERIA: Equipment shall be provided with proper base and vibration isolators according to the Tab. 27. chap. 35, ASHRAE '80 systems.

b) SELECTION

	Fl. type	Base type	Iso. type	Def. (inch)
AHU/FAN with Flex duct	2	1	2	0.75
Water pump(<7.5hp)flex coupled	1	2	1	0.25
Air compressor(15 hp)	1	3	2	-
Vacuum pump(15 hp)	1	3	2	-

Floor type 1) on grade
2) 40 ft. floor span

Base type	1) no base, isolator attached directly
	2) structural steel rail
	3) concrete inertia base
Isolator type	1) rubber floor isolator or hanger
	2) spring floor isolator or hanger

APPENDIX A - SPACE NAME AND FLOOR AREA

I.D.#	SPACE	FLOOR AREA
ANNEX BUILDING		
100A	Lobby	2123
123	Lecture hall	2831
124	Lecture hall	1727
125	Class room	893
126	Class room	884
MAIN BUILDING 1st. FLOOR		
100B	Corridor	2263
100C	Janitor's closet	97
100D	Electrical room	225
100E	Mechanical room	577
100F	Toilet(Men)	217
100G	Toilet(Women)	217
101A	Reception	150
101B	Hall	108
101C	Work room	100
101D	Storage	45
101E	Mail room	105
101F	Conference room	223
101G	Dept. head room	227
101H	Office	110
101I	Office	110
101J	Book keeper	218
102	Conference	536
103	Work room	203
104A	Reception	150
104B	Hall	179
104C	Office	110
104D	Office	110
104E	Office	110
104F	Office	110
104G	Office	110
105	Seminar	215
106	Office(S)	104
107	Office(S)	104
108	Office(S)	104
109A	Reception	150
109B	Hall	179
109C	Storage	46
109D	Office	110
109E	Office	110
109F	Office	110
109G	Office	110
109H	Office	110
110	Office(S)	104
111	Office(S)	104
112	Office(S)	104
113	Office(S)	104
114A	Reception	150
114B	Hall	165
114C	Storage	46

I.D.#	SPACE	FLOOR AREA
114D	Office	110
114E	Office	110
114F	Office	110
114G	Office	110
114H	Office	110
115	Office(S)	104
116	Physiology lab.	1088
117	Physiology lab.	991
118	Physiology lab.	605
119	Muscle biology lab.	958
120	Food microbiology lab.	605
121	Food microbiology lab.	598
122	Food microbiology lab	586
MAIN BUILDING 2nd FLOOR		
200A	Corridor	2290
200B	Janitor's closet	30
200C	Toilet(Women)	108
200D	Toilet(Men)	172
200E	Mech room	770
201A	Recept	150
201B	Recept	150
201C	Hall	303
201D	Secretary	103
201E	Office	103
201F	Office	110
201G	Office	110
201H	Office	110
201J	Office	110
201K	Office	110
201L	Office	110
201M	Office	110
201N	Office	110
201O	Office	110
201Q	Office	110
201R	Office	103
202	Office(S)	103
203	Office(S)	103
204A	Computer	300
204B	Data process	224
205	Office(S)	104
206A	Recept	150
206B	Hall	139
206C	Storage	45
206D	Office	104
206E	Office	110
206F	Office	110
206G	Office	110
207	Conference	160
208A	Recept.	150
208B	Hall	179
208C	Office	110

I.D.#	SPACE	FLOOR AREA
208D	Office	110
208E	Office	110
208F	Office	110
208G	Office	110
209	Office(S)	104
210	Office(S)	104
211	Office(S)	104
212A	Recept.	150
212B	Hall	165
212C	Storage	46
212D	Office	110
212E	Office	110
212F	Office	110
212G	Office	110
212H	Office	95
213A	Nutrition lab	627
213B	Lab office	135
214	Non-ruminant lab	900
215	Ruminant lab	620
216A	Feed analysis lab	318
216B	Kjendahl	276
216C	Solvent extraction	227
216D	Grind	49
217	Ruminant lab	887
218A	Ruminant lab	554
218B	Balance room	80
219	Ruminant lab	631
220	Extension storage	240
221	Dark room	132

APPENDIX B - COOLING/ HEATING LOAD CALCULATION

```
$JOB            ,TIME=(0,40)
      DIMENSION CLTDR(4,4),CLTDW(32,4),CLTDG(4),LM(9),ALT(4),AZI(4)
      DIMENSION SHGF(5,12),CLFL(4),CLFP(4),CLFG(20,4),FLOOR(10,2)
      DIMENSION GLAS(10,5),WALL(10,3),ROOF(10,3),SKY(10,4),SHAD(10,5)
      DIMENSION A(8),RM(18,5),BLDG(22,5)
      DIMENSION NAME(72),DESCR(70)
      DIMENSION TDCL(4),TRAT(4)
      INTEGER DESCR
      REAL LM,INFILT
      DATA CLTDR /27.,17.,13.,23.,52.,17.,30.,21.,70.,21.,48.,22.,74.,
     1 28.,60.,25./
      DATA CLTDW /11.,15.,18.,18.,15.,19.,21.,16.,9.,13.,15.,14.,11.,
     1 15.,17.,13.,6.,20.,26.,19.,5.,6. ,6.,5.,12.,35.,55.,49.,22.,12.,
     1 11.,11.,                                10.,15.,19.,18.,14.,18.,
     2 19.,15.,8.,15.,19.,16.,11.,14.,15.,12.,9.,25.,36.,31.,13.,9.,9.,
     * 8.,18.,26.,40.,48.,39.,26.,19.,18.,
     *    10.,16.,21.,19.,14.,17.,18.,14.,9.,17.,22.,20.,12.,13.,14.,
     4 11.,13.,26.,37.,37.,24.,18.,14. ,13.,23.,27.,31.,36.,46.,50.,41.,
     4 27.,                                  10.,18.,23.,21.,15.,17.,18.,
     5 14.,10.,19.,25.,23.,15.,15.,15.,12.,17.,26.,34.,36.,32.,32.,27.,
     * 20.,24.,26.,29.,30.,37.,63.,67.,47./
      DATA CLTDG /4.,9.,13.,14./
      DATA LM /.5,.5,0.,-.5,-1.,-.5,0., .5,1./
      DATA ALT /59.4,74.6,59.4,35.8/
      DATA AZI /112.,180.,248.,270.7/
      DATA SHGF /22.,166.,252.,166.,155.,26.,195.,232.,195.,199.,30.,
     1 223.,192.,223.,238.,35.,225.,135.,225.,262.,33.,220.,93.,220.,
     2 272.,47.,215.,77.,215.,273.,39.,216.,90.,216.,268.,36.,218.,131.,
     3 218.,257.,31.,210.,187.,210.,230.,27.,187.,225.,187.,195.,22.,
     4 163.,248.,163.,154.,20.,151.,254.,151.,136./
      DATA CLFL /.72,.77,.82,.85/
      DATA CLFP /.61,.72,.80,.84/
      DATA CLFG /.80,.62,.58,.15,.72,.63,.57,.34,.11,.48,.59,.51,.31,.12
     1,.43,.60,.49,.33,.14,.45,.89,.27,.83,.17,.85,.76,.42,.59,.14,.66,
     2 .70,.39,.52,.14,.59,.69,.36,.51,.16,.59,.86,.22,.68,.53,.81,.82
     3 ,.32,.65,.32,.74,.75,.31,.58,.29,.67,.72,.29,.55,.30,.64,.75,.17,
     4 .35,.82,.58,.79,.25,.50,.57,.67,.74,.26,.47,.50,.62,.70,.24,.43,
     5 .49,.58/
      DATA TRAT /.56,.23,.03,.03/
      DATA IN,LP /5,6/
      DO 1001 J=1,4
 1001 PRINT,'CLTDR',J,(CLTDR(J,K),K=1,4)
      DO 1002 J=1,32
 1002 PRINT,'CLTDW',J,(CLTDW(J,K),K=1,4)
      PRINT,'CLTDG',(CLTDG(K),K=1,4)
      PRINT,'LM',(LM(K),K=1,9)
      PRINT,'ALT',(ALT(K),K=1,4)
      PRINT,'AZI',(AZI(K),K=1,4)
      DO 1003 J=1,5
 1003 PRINT,'SHGF',J,(SHGF(J,K),K=1,12)
      PRINT,'CLFL',(CLFL(K),K=1,4)
      PRINT,'CLFP',(CLFP(K),K=1,4)
      DO 1004 J=1,20
 1004 PRINT,'CLFG',J,(CLFG(J,K),K=1,4)
      READ(IN,5001) NAME
      READ(IN,    *) LINE,MOC,MOH,SLAT,SLONG,ELEV
      READ(IN,    *) LINE,TIN,TOUT,TRAN,HUMO,HUMI,CAIR,CWT,CWRT
      READ(IN,    *) LINE,THIN,THOUT,THRAN,WHUMO,WHUMI,HAIR,HWT,HWRT
      TOA=TOUT - TRAN/2
      DO 1005 K=1,4
```

```
 1005 TDCL(K)=(TOUT-TIN) - TRAN*TRAT(K)
      TDHT=THOUT - THIN
      HD=HUMO - HUMI
      WTDS=CWT-CWRT
      WTDW=HWT-HWRT
    7 DO 8 J=1,5
    8 A(J)=0.
      READ(IN,    *) LINE,(A(J),J=1,5)
      LEAD=LINE/10
      GO TO (10,20,30,40,50,60,70),LEAD
   10 NO=LINE - 10
      DO 11 K=1,3
   11 ROOF(NO,K)=A(K)
      PRINT,'ROOF', NO, (ROOF(NO,K),K=1,3)
      GO TO 7
   20 NO=LINE-20
      DO 21 K=1,4
   21 SKY(NO,K)=A(K)
      PRINT,'SKY ', NO, (  SKY(NO,K),K=1,4)
      GO TO 7
   30 NO=LINE - 30
      DO 31 K=1,3
   31 WALL(NO,K)=A(K)
      PRINT,'WALL', NO, (WALL(NO,K),K=1,3)
      GO TO 7
   40 NO=LINE - 40
      DO 41 K=1,5
   41 GLAS(NO,K)=A(K)
      PRINT,'GLAS', NO, (GLAS(NO,K),K=1,5)
      GO TO 7
   50 NO=LINE - 50
      DO 51 K=1,5
   51 SHAD(NO,K)=A(K)
      PRINT,'SHAD', NO, (SHAD(NO,K),K=1,5)
      GO TO 7
   60 NO=LINE - 60
      DO 61 K=1,2
   61 FLOOR(NO,K)=A(K)
      PRINT,'FLOOR',NO,(FLOOR(NO,K),K=1,2)
   70 CONTINUE
      WRITE(LP,6001)
      WRITE(LP,6026) NAME,NAME,NAME
      WRITE(LP,6027) SLAT,SLONG,ELEV
      WRITE(LP,6028)MOH,MOC,THIN,TIN,THOUT,TOUT,THRAN,TRAN,WHUMO,HUMO,
     +WHUMI,HUMI,HAIR,CAIR,HWT,CWT,HWRT,CWRT
      TAREA=0.
      TVOL=0.
      BVENT=0.
      BINFIL=0.
      BEXHAU=0.
      BCFMS=0.
      BCFMW=0.
      DO 86 K=1,5
        DO 85 J=1,22
   85   BLDG(J,K)=0.
   86 CONTINUE
   90 READ(IN,5002) NPAGE,DESCR
      IF(NPAGE .EQ. 999900) GO TO 700
      READ(IN,    *) I,RLEN,RWID,AREA,RHEI,NSYS,NSPACE
      DO 94 K=1,5
```

```
      DO 93 J=1,18
   93 RM(J,K)=0.
   94 CONTINUE
   95 DO 96 J=1,8
   96 A(J)=0.
      READ(IN,    *) I,(A(J),J=1,8)
      LEAD=(I-NPAGE)/10
      GO TO (100,200,300,400,500),LEAD
  100 CONTINUE
C     ROOF/CEILING
      NRF=IFIX(A(1))
      DCE=A(3)
      UCE=A(4)
      ACE=A(5)
      CVENT=A(6)
      NSK=IFIX(A(7))
      NUMSK=IFIX(A(8))
      ASK=0.
      IF(NSK .EQ. 0) GO TO 140
      ASK=SKY(NSK,1)*NUMSK
      USK=SKY(NSK,2)
      L=IFIX(SKY(NSK,4))*5+5
      DO130 K=1,4
      RM(2,K)=RM(2,K) + SKY(NSK,3)*CLFG(L,K)*SHGF(5,MOC)*ASK
      RM(3,K)=RM(3,K) + CLTDG(K)*USK*ASK
  130 CONTINUE
      RM(3,5)=RM(3,5) + USK*ASK*TDHT
  140 CONTINUE
      IC=1
      IF(UCE .NE. 0.) IC=2
      ARF=A(2)-ASK
      IF(NRF.EQ.0) GO TO 193
      MRF=IFIX(ROOF(NRF,1))*IC
      COLOR=ROOF(NRF,2)
      URF=ROOF(NRF,3)
      NORNT=9
      XLM=LM(NORNT)
      DO 190 K=1,5
      IF(K.EQ. 5) GO TO 145
      XTD=CLTDR(MRF,K)
      YTD=(XTD + XLM)*COLOR + TOA - TIN- 7.
  145 IF(K .EQ. 5) YTD=TDHT
      RFCL=URF*ARF*YTD
      IF(UCE   .EQ. 0.) GO TO 150
      RM(17,K)=RM(17,K) + RFCL
      RM(18,K)=RM(18,K) + ARF*URF + ACE*UCE + ACE*CVENT*1.1
      GO TO 190
  150 RM(1,K)=RM(1,K) + RFCL
  190 CONTINUE
      GO TO 199
  193 IF(UCE.EQ.0.) GO TO 199
      DO 195 K=1,5
  195 RM(18,K)=RM(18,K) + ACE*UCE + ACE*CVENT*1.1
  199 GO TO 95
  200 CONTINUE
C     WALL/WINDOW
      NWL=IFIX(A(1))
      XWL=A(2)
      HWL=A(3) - DCE
      NORNT=1+IFIX(A(4)/45.)
```

```
      NGL=IFIX(A(5))
      NUMG=IFIX(A(6))
      NSH=IFIX(A(7))
      LS=NORNT/2 + 1
      SHADRT=0.
      AGL=0.
      IF(NGL .EQ. 0) GO TO 280
      LG=5*IFIX(GLAS(NGL,5))+LS
      AGL=GLAS(NGL,1)*GLAS(NGL,2)*NUMG
      UGL=GLAS(NGL,3)
      GSC=GLAS(NGL,4)
      IF(NSH .EQ. 0) GO TO 240
      HSPACE=SHAD(NSH,2)
      VSPACE=SHAD(NSH,4)
      IF(HSPACE.EQ. 0.) HSPACE=GLAS(NGL,1)
      IF(VSPACE.EQ. 0.) VSPACE=GLAS(NGL,2)
  240 DO 270 K=1,4
      ALTI=ALT(K)
      ALPH=A(4) - AZI(K)
      IF(ALPH .GE. 90.) GO TO 250
      IF(ALPH .LE.-90.) GO TO 250
      IF(NSH .EQ. 0) GO TO 260
      ALPH=SQRT(ALPH*ALPH)
      ALTI=ALTI*3.141593/180.
      ALPH=ALPH*3.141593/180.
      HSHDH=(SHAD(NSH,1)+ SHAD(NSH,3))*SIN(ALTI)/COS(ALTI)
      IF(HSHDH .GT. HSPACE) HSHDH=HSPACE
      HSHRT=HSHDH/HSPACE
      VSHDW=(SHAD(NSH,1) + SHAD(NSH,5))*SIN(ALPH)/COS(ALPH)
      IF(VSHDW .GT. VSPACE) VSHDW=VSPACE
      VSHRT=VSHDW/VSPACE
      SHADRT=HSHRT + VSHRT - HSHRT*VSHRT
      GO TO 260
  250 CONTINUE
      SHADRT=1.
  260 CONTINUE
      SOLSHD=AGL*SHADRT*SHGF(1,MOC)
      SOLSUN=AGL*(1.-SHADRT)*SHGF(LS,MOC)
      GSCL=GSC*CLFG(LG,K)*(SOLSHD+SOLSUN)
      RM(5,K)=RM(5,K) + GSCL
      GTD=CLTDG(K) + TOA - TIN- 7.
      GTCL=UGL*AGL*GTD
      RM(6,K)=RM(6,K)+GTCL
  270 CONTINUE
      RM(6,5)=RM(6,5) + UGL*AGL*TDHT
  280 IF(NWL .EQ. 0) GO TO 299
      AWL=HWL*XWL  - AGL
      COLOR=WALL(NWL,2)
      UWL=WALL(NWL,3)
      LW=8*(IFIX(WALL(NWL,1))-1)+NORNT
      XLM=LM(NORNT)
      DO 290 K=1,5
      IF(K.EQ. 5) GO TO 285
      XTD=CLTDW(LW,K)
      YTD=(XTD + XLM)*COLOR + TOA - TIN- 7.
  285 IF(K .EQ. 5) YTD=TDHT
      WLCL=AWL*UWL*YTD
      PWAU=DCE*XWL*UWL
      PWCL=PWAU*YTD
      RM(4,K)= RM(4,K)+WLCL
```

```
      RM(17,K)=RM(17,K)+PWCL
      RM(18,K)=RM(18,K)+PWAU
  290 CONTINUE
  299 GO TO 95
  300 CONTINUE
C     PARTITION/DOOR/FLOOR
      TDPT=A(6)-TIN
      DO 350 K=1,5
      IF(K.LT.5)  TDDR=TDCL(K)
      IF(K.EQ.5)  TDDR=TDHT
      IF(K.EQ.5)  TDPT=A(5)-THIN
      RM(7,K)=RM(7,K)+A(1)*A(2)*TDDR
      RM(8,K)=RM(8,K)+A(3)*A(4)*TDPT
  350 CONTINUE
      NFL=IFIX(A(7))
      IF(NFL .EQ. 0) GO TO 395
      FLD=A(8)*FLOOR(NFL,1)
      IF(FLOOR(NFL,2) .EQ. 0) GO TO 380
      DO 370 K=1,4
  370 RM(9,K)=RM(9,K)+FLD*TDCL(K)
      RM(9,5)=RM(9,5)+FLD*TDHT
      GO TO 395
  380 RM(9,5)=RM(9,5)-FLD
  395 GO TO 95
  400 CONTINUE
C     EQUIPMENTS
      DO 490 K=1,4
      RM(12,K)=RM(12,K) + A(1)*A(3)*A(4)*A(5)
      RM(15,K)=RM(15,K) + A(2)
      RM(17,K)=RM(17,K) + A(1)*A(3)*A(4)*(1.-A(5))
  490 CONTINUE
      GO TO 95
  500 CONTINUE
C     PEOPLE/LIGHT/INFILT./VENT
      INFILT=A(7)
      VENT=A(6)*A(1)
      EXHAU=A(8)
      DO 590 K=1,5
      IF(K.EQ. 5) GO TO 540
      TDINFL=TDCL(K)
      RM(11,K)=RM(11,K) + A(1)*A(2)*CLFP(K)
      RM(15,K)=RM(15,K) + A(1)*A(3)
      RM(10,K)=RM(10,K) + 3.41*A(4)*AREA*CLFL(K)*A(5)
      RM(17,K)=RM(17,K) +3.41*A(4)*AREA*CLFL(K)*(1.-A(5))
  540 IF(K.EQ. 5) TDINFL=TDHT
      RM(13,K)=RM(13,K) + 1.1*A(7)*TDINFL
      RM(15,K)=RM(15,K) + 4840*A(7)*HD
      TDCE=0.
      IF(RM(18,K) .EQ. 0.) GO TO 550
      TDCE=RM(17,K)/RM(18,K)
  550 RM(1,K)=RM(1,K) + UCE*ACE*TDCE
      RM(17,K)=RM(17,K)-UCE*ACE*TDCE
  590 CONTINUE
C     ROOM SUMMARY
      SMAX=0.
      DO 650 K=1,5
        DO 640 J=1,13
          RM(14,K)=RM(14,K) + RM(J,K)
  640   CONTINUE
        RM(16,K)=RM(14,K) + RM(15,K)
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        IF(K .EQ. 5) GO TO 650
        IF(RM(14,K) .LT. SMAX) GO TO 650
      SMAX=RM(14,K)
        ITIME=8 + 2*K
      PEAK=RM(16,K)
  650 CONTINUE
      BSFS=PEAK/AREA
      BSFW=RM(16,5)/AREA
      SHRS=SMAX/PEAK
      SHRW=1.
      SCFMS=SMAX/(1.1*(TIN-CAIR))
      SCFMW=RM(16,5)/(1.1*(THIN-HAIR))
      SGPMS=0.
      SGPMW=0.
      DO 690 K=1,5
        DO 680 J=1,17
          BLDG(J,K)=BLDG(J,K)+RM(J,K)*NSPACE
  680   CONTINUE
  690 CONTINUE
      ISPACE=NPAGE/100
      VOL=AREA*RHEI
      TAREA=TAREA + AREA*NSPACE
      TVOL=TVOL + VOL*NSPACE
      BVENT=BVENT+VENT*NSPACE
      BINFIL=BINFIL + INFILT*NSPACE
      BEXHAU=BEXHAU + EXHAU*NSPACE
      WRITE(LP,6021) NAME
      PRINT, ' '
      PRINT, ' '
      PRINT, ' '
      WRITE(LP,6024) ISPACE,NSPACE,AREA,VOL,NSYS
      WRITE(LP,6025) DESCR
      WRITE(LP,6023)
      WRITE(LP,6011)(RM(J,5),(RM(J,K),K=1,4),J=1,16)
      WRITE(LP,6013) ITIME
      WRITE(LP,6015) BSFW,BSFS,SHRW,SHRS,SCFMW,SCFMS,VENT,VENT,INFILT
     1,INFILT,EXHAU,EXHAU,SGPMW,SGPMS
      GO TO 90
C     BUILDING SUMMARY
  700 CONTINUE
      BPEAK=0.
      DO 790 K=1,5
      OAIR=BEXHAU-BINFIL
      IF(BEXHAU.LT. .33*BVENT) OAIR=.33*BVENT-BINFIL
      IF(K .EQ. 5) GO TO 785
      BLDG(18,K)=1.1*OAIR*TDCL(K)
      BLDG(19,K)=4840*OAIR*HD
      GO TO 788
  785 BLDG(18,5)=1.1* OAIR*TDHT
      BLDG(19,5)=0.
  788 CONTINUE
      BLDG(20,K)=BLDG(14,K) + BLDG(17,K) + BLDG(18,K)
      BLDG(21,K)=BLDG(15,K) + BLDG(19,K)
      BLDG(22,K)=BLDG(20,K) + BLDG(21,K)
      IF(K .EQ. 5) GO TO 790
      IF(BLDG(22,K) .LT. BPEAK) GO TO 790
      BPEAK=BLDG(22,K)
      BMAX=BLDG(14,K)
      ITIME=8 + 2*K
  790 CONTINUE
```

```
      TONS=BPEAK/12000
      TONW=0.
      SFTS=TAREA/TONS
      SFTW=0.
      BSFS=BPEAK/TAREA
      BSFW=BLDG(22,5)/TAREA
      BCFMS=BMAX/(1.1*(TIN-CAIR))
      BCFMW=BLDG(14,5)/(1.1*(THIN-HAIR))
      CGPMS=0.
      CGPMW=0.
      RGPMS=0.
      RGPMW=0.
      TGPMS=0.
      TGPMW=0.
      WRITE(LP,6021) NAME
      WRITE(LP,6022) TAREA,TVOL
      WRITE(LP,6023)
      WRITE(LP,6011)(BLDG(J,5),(BLDG(J,K),<=1,4),J=1,16)
      WRITE(LP,6012)(BLDG(J,5),(BLDG(J,K),K=1,4),J=17,22)
      WRITE(LP,6013) ITIME
      WRITE(LP,6014) TONW,TONS,SFTW,SFTS,BSFW,BSFS,BCFMW,BCFMS,BINFIL
     1,BINFIL,BVENT,BVENT,BEXHAU,BEXHAU,SGPMW,SGPMS,CGPMW,CGPMS,RGPMW
     2,RGPMS,TGPMW,TGPMS
      WRITE(LP,6021) NAME
C     FORMAT
 5001 FORMAT(72A1)
 5002 FORMAT(I6,1X,70A1)
 6001 FORMAT(1H1)
 6011 FORMAT(10X,F11.0,4X,'ROOF / CEILING ',F12.0,3F13.0/
     +          10X,F11.0,4X,'SKYLIGHT-SOLAR ',F12.0,3F13.0/
     +          10X,F11.0,4X,'SKYLIGHT-TRANS ',F12.0,3F13.0/
     +          10X,F11.0,4X,'EXTERIOR WALLS ',F12.0,3F13.0/
     +          10X,F11.0,4X,'WINDOW - SOLAR ',F12.0,3F13.0/
     +          10X,F11.0,4X,'WINDOW - TRANS ',F12.0,3F13.0/
     +          10X,F11.0,4X,'EXTERIOR DOORS ',F12.0,3F13.0/
     +          10X,F11.0,4X,'PARTITION WALL ',F12.0,3F13.0/
     +          10X,F11.0,4X,'FLOOR/SLABEDGE ',F12.0,3F13.0/
     +          10X,F11.0,4X,'ELEC. LIGHTING ',F12.0,3F13.0/
     +          10X,F11.0,4X,'PEOPLE    - SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'EQUIPMENT- SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'INFILT.   - SEN ',F12.0,3F13.0/10X,84('-')/
     +          10X,F11.0,4X,'SPACE     - SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'SPACE     - LAT ',F12.0,3F13.0//
     +          10X,F11.0,4X,'SPACE   - TOTAL ',F12.0,3F13.0/10X,84('-'))
 6012 FORMAT(10X,F11.0,4X,'RETURN AIR-SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'OUT. AIR - SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'OUT. AIR - LAT ',F12.0,3F13.0/10X,84('-')/
     +          10X,F11.0,4X,'BUILDING - SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'BUILDING - LAT ',F12.0,3F13.0//
     +          10X,F11.0,4X,'BUILDING TOTAL ',F12.0,3F13.0/10X,84('-'))
 6013 FORMAT(//17X,'ANY',8X,'PEAK TIME',10X,I2,':00'/10X,45('-'))
 6014 FORMAT(10X,F11.2,4X,' TOTAL - TONS   ',F12.2/
     +          10X,F11.2,4X,' SQ.FT. / TON   ',F12.2/
     +          10X,F11.2,4X,' BTUH / SQ.FT. ',F12.2//
     +          10X,F11.2,4X,' BUILDING CFM   ',F12.2/
     +          10X,F11.2,4X,' INFILT.  CFM   ',F12.2/
     +          10X,F11.2,4X,' VENT     CFM   ',F12.2/
     +          10X,F11.2,4X,' EXHAUST  CFM   ',F12.2//
     +          10X,F11.2,4X,' SPACE    GPM   ',F12.2/
     +          10X,F11.2,4X,' CENTRAL  GPM   ',F12.2/
```

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     +           10X,F11.2,4X,' RM. UNIT GPM   ',F12.2/
     +           10X,F11.2,4X,' TOTAL      GPM   ',F12.2/)
      6015 FORMAT(10X,F11.2,4X,' BTUH / SQ.FT. ',F12.2//
     +           10X,F11.2,4X,' S / H  RATIC   ',F12.2//
     +           10X,F11.2,4X,' SPACE     CFM  ',F12.2//
     +           10X,F11.2,4X,' VENT      CFM  ',F12.2//
     +           10X,F11.2,4X,' INFILT.   CFM  ',F12.2//
     +           10X,F11.2,4X,' EXHAUST   CFM  ',F12.2//
     +           10X,F11.2,4X,' SPACE     GPM  ',F12.2//)
      6021 FORMAT( 1H1//10X,72A1//)
      6022 FORMAT(10X,'BUILDING TOTAL          AREA=',F10.0, 7X, 'VOL.=',F12.0/)
      6023 FORMAT(//10X,84('-')/15X,'WINTER',44X,'SUMMER'/17X,'MAX',5X,
     +     'LOAD COMPONENT',8X,'10:00',8X,'12:00',8X,'14:00',8X,'16:00'
     +     /10X,84('-'))
      6024 FORMAT(10X,'SPACE=',I5,4X,'NUMBER OF SPACE=',I5,4X,'AREA=',F7.1,
     +4X,'VOL.=',F10.2,4X,'SYSTEM=',I2/)
      6025 FORMAT(10X, 'DESCRIPTION :   ', 66A1/20X,66A1/20X, 66A1//)
      6026 FORMAT(1H1//10X,72A1//10X,72A1//10X,72A1//////)
      6027 FORMAT(10X,'LATITUDE  =',F6.1//10X,'LONGITUDE =',F6.1//
     +           10X,'ELEVATION =',F6.1///)
      6028 FORMAT(10X,35('-')/
     +           10X,'DESIGN CONDITION   WINTER   SUMMER',/10X,35('-')//
     +           10X,'DESIGN MONTH',5X,I6,I8//
     +           10X,'INDOOR  AIR TEMP ',2F8.1//
     +           10X,'OUTDOOR AIR TEMP ',2F8.1//
     +           10X,'      TEMP RANGE ',2F8.1//
     +           10X,'OUTDOOR HUMIDITY ',2F8.4//
     +           10X,'INDOOR  HUMIDITY ',2F8.4//
     +           10X,'SUPPLY  AIR  TEMP',2F8.1//
     +           10X,'SUPPLY WATER TEMP',2F8.1//
     +           10X,'RETURN WATER TEMP',2F8.1/)
           STOP
           END

      $ENTRY
DR     1    27.0000000    52.0000000    70.0000000    74.000000
DR     2    17.0000000    17.0000000    21.0000000    28.000000
DR     3    13.0000000    30.0000000    48.0000000    60.000000
DR     4    23.0000000    21.0000000    22.0000000    25.000000
DW     1    11.0000000    10.0000000    10.0000000    10.000000
DW     2    15.0000000    15.0000000    16.0000000    18.000000
DW     3    18.0000000    19.0000000    21.0000000    23.000000
DW     4    18.0000000    18.0000000    19.0000000    21.000000
DW     5    15.0000000    14.0000000    14.0000000    15.000000
DW     6    19.0000000    18.0000000    17.0000000    17.000000
DW     7    21.0000000    19.0000000    18.0000000    18.000000
DW     8    16.0000000    15.0000000    14.0000000    14.000000
DW     9     9.0000000     8.0000000     9.0000000    10.000000
DW    10    13.0000000    15.0000000    17.0000000    19.000000
DW    11    15.0000000    19.0000000    22.0000000    25.000000
DW    12    14.0000000    16.0000000    20.0000000    23.000000
DW    13    11.0000000    11.0000000    12.0000000    15.000000
DW    14    15.0000000    14.0000000    13.0000000    15.000000
DW    15    17.0000000    15.0000000    14.0000000    15.000000
DW    16    13.0000000    12.0000000    11.0000000    12.000000
DW    17     6.0000000     9.0000000    13.0000000    17.000000
DW    18    20.0000000    25.0000000    26.0000000    26.000000
DW    19    26.0000000    36.0000000    37.0000000    34.000000
DW    20    19.0000000    31.0000000    37.0000000    36.000000
DW    21     5.0000000    13.0000000    24.0000000    32.000000
```

```
TDW     22        6.0000000         9.0000000        18.0000000        32.000000
TDW     23        6.0000000         9.0000000        14.0000000        27.000000
TDW     24        5.0000000         8.0000000        13.0000000        20.000000
TDW     25       12.0000000        18.0000000        23.0000000        24.000000
TDW     26       35.0000000        26.0000000        27.0000000        26.000000
TDW     27       55.0000000        40.0000000        31.0000000        29.000000
TDW     28       49.0000000        48.0000000        36.0000000        30.000000
TDW     29       22.0000000        39.0000000        46.0000000        37.000000
TDW     30       12.0000000        26.0000000        50.0000000        63.000000
TDW     31       11.0000000        19.0000000        41.0000000        67.000000
TDW     32       11.0000000        18.0000000        27.0000000        47.000000
TDG        4.0000000           9.0000000          13.0000000          14.0000000
      0.5000000          0.5000000          0.0000000         -0.5000000          -1.0
    0.0000000          0.5000000          1.0000000
      59.3999900         74.6000000         59.3999900         35.8000000
     112.0000000        180.0000000        248.0000000        270.6999000
GF       1       22.0000000        26.0000000        30.0000000        35.0000000
    47.0000000        39.0000000        36.0000000        31.0000000        27.0000
    20.0000000
GF       2      166.0000000       195.0000000       223.0000000       225.0000000
   215.0000000       216.0000000       218.0000000       210.0000000       187.0000
   151.0000000
GF       3      252.0000000       232.0000000       192.0000000       135.0000000
    77.0000000        90.0000000       131.0000000       187.0000000       225.0000
   254.0000000
GF       4      166.0000000       195.0000000       223.0000000       225.0000000
   215.0000000       216.0000000       218.0000000       210.0000000       187.0000
   151.0000000
GF       5      155.0000000       199.0000000       238.0000000       262.0000000
   273.0000000       268.0000000       257.0000000       230.0000000       195.0000
   136.0000000
FL         0.7200000          0.7700000          0.8200000          0.8500000
FP         0.6100000          0.7200000          0.8000000          0.8400000
FG       1        0.8000000         0.8900000         0.8600000         0.7500000
FG       2        0.6200000         0.2700000         0.2200000         0.1700000
FG       3        0.5800000         0.8300000         0.6800000         0.3500000
FG       4        0.1500000         0.1700000         0.5300000         0.8200000
FG       5        0.7200000         0.8500000         0.8100000         0.5800000
FG       6        0.6300000         0.7600000         0.8200000         0.7900000
FG       7        0.5700000         0.4200000         0.3200000         0.2500000
FG       8        0.3400000         0.5900000         0.6500000         0.5000000
FG       9        0.1100000         0.1400000         0.3200000         0.5700000
FG      10        0.4800000         0.6600000         0.7400000         0.6700000
FG      11        0.5900000         0.7000000         0.7500000         0.7400000
FG      12        0.5100000         0.3900000         0.3100000         0.2600000
FG      13        0.3100000         0.5200000         0.5800000         0.4700000
FG      14        0.1200000         0.1400000         0.2900000         0.5000000
FG      15        0.4300000         0.5900000         0.6700000         0.6200000
FG      16        0.6000000         0.6900000         0.7200000         0.7000000
FG      17        0.4900000         0.3600000         0.2900000         0.2400000
FG      18        0.3300000         0.5100000         0.5500000         0.4300000
FG      19        0.1400000         0.1600000         0.3000000         0.4900000
FG      20        0.4500000         0.5900000         0.6400000         0.5800000
DF       1        1.0000000         0.5000000         0.0415000
DF       2        1.0000000         0.5000000         0.0596000
DF       3        2.0000000         0.5000000         0.0536000
Y        1       45.0000000         0.7000000         0.4600000         0.0000000
LL       1        2.0000000         1.0000000         0.0713000
LL       2        2.0000000         1.0000000         0.0735000
LL       3        2.0000000         1.0000000         0.0853000
```

.L	4	1.0000000	1.0000000	0.2242000	
.L	5	1.0000000	1.0000000	0.2481000	
.L	6	3.0000000	1.0000000	0.4673000	
.S	1	8.0000000	1.0000000	0.4900000	0.5100000
.S	2	4.1700000	6.0000000	0.4900000	0.5100000
.S	3	7.0000000	3.0000000	0.4000000	0.0000000
.D	1	10.0000000	0.0000000	0.0000000	0.0000000
.D	2	0.5000000	0.0000000	0.0000000	0.0000000
OOR	1	30.0000000	0.0000000		

1,ANIMAL SCIENCE BUILDING, OSU, STILLWATER, CKLAHOMA
1,ANIMAL SCIENCE BUILDING, OSU, STILLWATER, CKLAHOMA
1,ANIMAL SCIENCE BUILDING, OSU, STILLWATER, CKLAHOMA

LATITUDE = 36.2
LONGITUDE = 97.2
ELEVATION = 884.0

DESIGN CONDITION	WINTER	SUMMER
DESIGN MONTH	1	7
INDOOR AIR TEMP	70.0	78.0
OUTDOOR AIR TEMP	13.0	96.0
TEMP RANGE	0.0	24.0
OUTDOOR HUMIDITY	0.0000	0.0130
INDOOR HUMIDITY	0.0000	0.0103
SUPPLY AIR TEMP	100.0	55.0
SUPPLY WATER TEMP	220.0	40.0
RETURN WATER TEMP	200.0	56.0

1,ANIMAL SCIENCE BUILDING, OSU, STILLWATER, CKLAHOMA

SPACE= 4 NUMBER OF SPACE= 1 AREA= 1730.0 VOL.= 28545.00 SYSTEM= 1
DESCRIPTICN : LECTURE HALL-124

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
-4092.	ROOF / CEILING	933.	1831.	2477.	2621.
0.	SKYLIGHT-SOLAR	0.	0.	0.	0.
0.	SKYLIGHT-TRANS	0.	0.	0.	0.
-7789.	EXTERIOR WALLS	1692.	1611.	1660.	1932.
0.	WINDOW - SOLAR	0.	0.	0.	0.
0.	WINDOW - TRANS	0.	0.	0.	0.
-551.	EXTERIOR DOORS	44.	121.	167.	157.
0.	PARTITION WALL	0.	0.	0.	0.
-2790.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	10194.	10902.	11610.	12035.
0.	PEOPLE - SEN	12627.	14904.	16560.	17388.
0.	EQUIPMENT- SEN	2600.	2600.	2600.	2600.
0.	INFILT. - SEN	0.	0.	0.	0.
-15222.	SPACE - SEN	28090.	31968.	35073.	36742.
0.	SPACE - LAT	17100.	17100.	17100.	17100.
-15222.	SPACE - TOTAL	45190.	49068.	52173.	53842.

ANY	PEAK TIME	16:00
-8.80	BTUH / SQ.FT.	31.12
1.00	S / H RATIO	0.68
461.27	SPACE CFM	1452.23
900.00	VENT CFM	900.00
0.00	INFILT. CFM	0.00
0.00	EXHAUST CFM	0.00
0.00	SPACE GPM	0.00

1.ANIMAL SCIENCE BUILDING, OSU, STILLWATER, OKLAHOMA

BUILDING TOTAL AREA= 9854. VOL.= 124522.
(ANNEX ZONE)

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
-12823.	ROOF / CEILING	3584.	6178.	8092.	8597.
0.	SKYLIGHT-SOLAR	3994.	4715.	4494.	3218.
-1795.	SKYLIGHT-TRANS	126.	283.	409.	441.
-32853.	EXTERIOR WALLS	7783.	7561.	7770.	8621.
0.	WINDOW - SOLAR	3794.	4160.	4643.	5315.
-14357.	WINDOW - TRANS	756.	2015.	3023.	3274.
-1101.	EXTERIOR DOORS	88.	241.	334.	334.
0.	PARTITION WALL	0.	0.	0.	0.
-13350.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	41596.	44484.	47373.	49106.
0.	PEOPLE - SEN	83509.	98568.	109520.	114996.
0.	EQUIPMENT- SEN	9500.	9500.	9500.	9500.
0.	INFILT. - SEN	0.	0.	0.	0.
-76280.	SPACE - SEN	154729.	177707.	195157.	203402.
0.	SPACE - LAT	122420.	122420.	122420.	122420.
-76280.	SPACE - TOTAL	277149.	300127.	317577.	325822.
-15347.	RETURN AIR-SEN	29750.	31852.	34256.	36215.
-120835.	OUT. AIR - SEN	9667.	26457.	36632.	36632.
0.	OUT. AIR - LAT	25185.	25185.	25185.	25185.
-212463.	BUILDING - SEN	194146.	236015.	266045.	276248.
0.	BUILDING - LAT	147605.	147605.	147605.	147605.
-212463.	BUILDING TOTAL	341751.	383620.	413649.	423853.

ANY	PEAK TIME	16:00
0.00	TOTAL - TONS	35.32
0.00	SQ.FT. / TON	278.98
-21.56	BTUH / SQ.FT.	43.01
2311.52	BUILDING CFM	8039.59
0.00	INFILT. CFM	0.00
5840.00	VENT CFM	5840.00
400.00	EXHAUST CFM	400.00
0.00	SPACE GPM	0.00
0.00	CENTRAL GPM	0.00
0.00	RM. UNIT GPM	0.00
0.00	TOTAL GPM	0.00

1,ANIMAL SCIENCE BUILDING, OSU, STILLWATER, CKLAHOMA

SPACE= 15 NUMBER OF SPACE= 16 AREA= 120.0 VOL.= 1320.00 SYSTEM= 1

DESCRIPTICN : FACULTY OFFICE-101H,I,1C4C,D,E,F,G,109D,E,F,G,H,114D,E,F,G

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
0.	ROOF / CEILING	0.	0.	0.	0.
0.	SKYLIGHT-SOLAR	0.	0.	0.	0.
0.	SKYLIGHT-TRANS	0.	0.	0.	0.
-386.	EXTERIOR WALLS	95.	122.	142.	153.
0.	WINDOW - SOLAR	1387.	134.	109.	85.
-699.	WINDOW - TRANS	37.	98.	147.	159.
0.	EXTERIOR DOORS	0.	0.	0.	0.
0.	PARTITION WALL	0.	0.	0.	0.
-300.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	486.	520.	554.	574.
0.	PEOPLE - SEN	140.	166.	184.	193.
0.	EQUIPMENT- SEN	360.	360.	360.	360.
0.	INFILT. - SEN	0.	0.	0.	0.
-1385.	SPACE - SEN	2505.	1400.	1496.	1534.
0.	SPACE - LAT	190.	190.	190.	190.
-1385.	SPACE - TOTAL	2695.	1590.	1686.	1724.

ANY	PEAK TIME	10:00
-11.54	BTUH / SQ.FT.	22.46
1.00	S / H RATIO	0.93
41.96	SPACE CFM	99.03
15.00	VENT CFM	15.00
0.00	INFILT. CFM	0.00
0.00	EXHAUST CFM	0.00
0.00	SPACE GPM	0.00

1, ANIMAL SCIENCE BUILDING, OSU, STILLWATER, OKLAHOMA

BUILDING TOTAL AREA= 17449. VOL.= 169412.

(OFFICE ZONE)

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
-18856.	ROOF / CEILING	4888.	8497.	11041.	11845.
0.	SKYLIGHT-SOLAR	0.	0.	0.	0.
0.	SKYLIGHT-TRANS	0.	0.	0.	0.
-27697.	EXTERIOR WALLS	6228.	7351.	8411.	9638.
0.	WINDOW - SOLAR	56196.	6221.	5293.	4264.
-29516.	WINDOW - TRANS	1553.	4143.	6214.	6732.
0.	EXTERIOR DOORS	0.	0.	0.	0.
0.	PARTITION WALL	0.	0.	0.	0.
-10200.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	40105.	42890.	45675.	47346.
0.	PEOPLE - SEN	45512.	53719.	59688.	62672.
0.	EQUIPMENT- SEN	62075.	62075.	62075.	62075.
0.	INFILT. - SEN	0.	0.	0.	0.
-86270.	SPACE - SEN	216556.	184906.	198396.	204571.
0.	SPACE - LAT	69060.	69060.	69060.	69060.
-86270.	SPACE - TOTAL	285616.	253956.	267456.	273631.
-61550.	RETURN AIR-SEN	41508.	48428.	52772.	57883.
-100869.	OUT. AIR - SEN	8069.	22085.	30579.	30579.
0.	OUT. AIR - LAT	21023.	21023.	21023.	21023.
-248688.	BUILDING - SEN	266133.	255419.	281747.	293033.
0.	BUILDING - LAT	90083.	90083.	90083.	90083.
-248688.	BUILDING TOTAL	356216.	345502.	371830.	383116.

ANY	PEAK TIME	16:00
0.00	TOTAL - TONS	31.93
0.00	SQ.FT. / TON	546.54
-14.25	BTUH / SQ.FT.	21.96
2614.23	BUILDING CFM	8085.81
0.00	INFILT. CFM	0.00
4875.00	VENT CFM	4875.00
240.00	EXHAUST CFM	240.00
0.00	SPACE GPM	0.00
0.00	CENTRAL GPM	0.00
0.00	RM. UNIT GPM	0.00
0.00	TOTAL GPM	0.00

1,ANIMAL SCIENCE BUILDING, OSU, STILLWATER, OKLAHOMA

SPACE= 42 NUMBER OF SPACE= 17 AREA= 230.0 VOL.= 2530.00 SYSTEM= 1

DESCRIPTION : LAB.MODULE-1ST FLOOR

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
0.	ROOF / CEILING	0.	0.	0.	0.
0.	SKYLIGHT-SOLAR	0.	0.	0.	0.
0.	SKYLIGHT-TRANS	0.	0.	0.	0.
-386.	EXTERIOR WALLS	108.	95.	88.	95.
0.	WINDOW - SOLAR	75.	85.	1186.	2098.
-699.	WINDOW - TRANS	37.	98.	147.	159.
0.	EXTERIOR DOORS	0.	0.	0.	0.
0.	PARTITION WALL	0.	0.	0.	0.
-300.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	1355.	1449.	1544.	1600.
0.	PEOPLE - SEN	1537.	1814.	2016.	2117.
0.	EQUIPMENT- SEN	4600.	4600.	4600.	4600.
0.	INFILT. - SEN	0.	0.	0.	0.
-1385.	SPACE - SEN	7712.	8141.	9581.	10669.
0.	SPACE - LAT	3750.	3750.	3750.	3750.
-1385.	SPACE - TOTAL	11462.	11891.	13331.	14419.

ANY	PEAK TIME	16:00
-6.02	BTUH / SQ.FT.	62.69
1.00	S / H RATIO	0.74
41.96	SPACE CFM	421.71
120.00	VENT CFM	120.00
0.00	INFILT. CFM	0.00
1150.00	EXHAUST CFM	1150.00
0.00	SPACE GPM	0.00

1.ANIMAL SCIENCE BUILDING, OSU, STILLWATER, OKLAHOMA

BUILDING TOTAL AREA= 7820. VOL.= 86020.
(LAB. ZONE)

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
-13283.	ROOF / CEILING	3029.	5942.	8040.	8506.
0.	SKYLIGHT-SOLAR	0.	0.	0.	0.
0.	SKYLIGHT-TRANS	0.	0.	0.	0.
-13124.	EXTERIOR WALLS	3684.	3224.	2993.	3224.
0.	WINDOW - SOLAR	2538.	2876.	40323.	71339.
-23759.	WINDOW - TRANS	1250.	3335.	5002.	5419.
0.	EXTERIOR DOORS	0.	0.	0.	0.
0.	PARTITION WALL	0.	0.	0.	0.
-5100.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	46079.	49279.	52479.	54399.
0.	PEOPLE - SEN	52255.	61590.	68544.	71971.
0.	EQUIPMENT- SEN	156400.	156400.	156400.	156400.
0.	INFILT. - SEN	0.	0.	0.	0.
-55267.	SPACE - SEN	265246.	282746.	333781.	371257.
0.	SPACE - LAT	127500.	127500.	127500.	127500.
-55267.	SPACE - TOTAL	392746.	410246.	461281.	498757.
0.	RETURN AIR-SEN	30719.	32853.	34986.	36266.
-2451570.	OUT. AIR - SEN	196126.	536765.	743213.	743213.
0.	OUT. AIR - LAT	510959.	510959.	510959.	510959.
-2506836.	BUILDING - SEN	492091.	852363.	1111979.	1150736.
0.	BUILDING - LAT	638459.	638459.	638459.	638459.
-2506836.	BUILDING TOTAL	1130549.	1490822.	1750437.	1789194.

ANY	PEAK TIME	16:00
0.00	TOTAL - TONS	149.10
0.00	SQ.FT. / TON	52.45
-320.57	BTUH / SQ.FT.	228.80
1674.75	BUILDING CFM	14674.20
0.00	INFIL T. CFM	0.00
4080.00	VENT CFM	4080.00
39100.00	EXHAUST CFM	39100.00
0.00	SPACE GPM	0.00
0.00	CENTRAL GPM	0.00
0.00	RM. UNIT GPM	0.00
0.00	TOTAL GPM	0.00

APPENDIX C - SPACE ILLUMINATION LEVEL REQUIREMENTS

1) CLASSROMM/LECTURE HALL

Task Category : E (50-75-100)

* seeing blackboard

Weighting Factors :

* Age .... (-1) under 40
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (-1) 20%

Total .... (-1)

Illumination Level :

* 50 fc at blackboard

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare in the sight line
* Control of reflected glare at task surface
* Color rendition not critical

Task Category : E (50-75-100)

* reading pencil writing on the desk

Weighting Factors :

* Age .... (-1) under 40
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (-1) 77%

Total .... (-1)

Illumination Level :

* 50 fc at the desk top

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare
* Control of reflected glare at task surface
* Color rendition not critical

Task Category : F (100-150-200)

* watching demonstration table

Weighting Factors :

* Age .... (-1) under 40
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (0) 40%

Total .... (0)

Illumination Level :

* 150 fc at demonstration table

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare
* Control of reflected glare
* Color rendition important

Task Category : B (5-7.5-10)

* watching T.V. or projector screen

Weighting Factors :

* Age .... (-1) under 40
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (+1) room surface(25%)

Total .... (+1)

Illumination Level :

* 10 fc general lighting

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare
* Control of reflected glare on T.V. screen

2) OFFICE

Task Category : E (50-75-100)

* reading pencil writing on the desk

Weighting Factors :

* Age	(+1)	over 55
* Speed	(0)	important
* Accuracy	(0)	important
* Background reflectance	(-1)	77%
Total	(0)	

Illumination Level :

* 75 fc at the desk top

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare
* Color rendition not critical

3) CONFERENCE

Task Category : E (50-75-100)

* seeing blackboard

Weighting Factors :

* Age	(+1)	over 55
* Speed	(-1)	not important
* Accuracy	(0)	important
* Background reflectance	(-1)	20%
Total	(-1)	

Illumination Level :

* 50 fc at blackboard

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare toward the blackboard
* Control of reflected glare
* Color rendition not critical

Task Category : D (20-30-50)

* conferring

Weighting Factors :

* Age .... (+1) over 55
* Speed .... (-1) not important
* Accuracy .... (0) important
* Background reflectance .... (0)

Total .... (0)

Illumination Level :

* 30 fc at desk top

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare
* Color rendition not critical

4) RECEPTION/SECRETARY

Task Category : C (10-15-20)

* reception

Weighting Factors :

* Age .... (0) 40-55
* Speed .... (0)
* Accuracy .... (0)
* Background reflectance .... (0)

Total .... (0)

Illumination Level :

* 15 fc general

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare not critical
* Color rendition not critical

Task Category : E (50-75-100)

* typing

Weighting Factors :

* Age .... (0) 40-55
* Speed .... (+1) critical
* Accuracy .... (+1) critical
* Background reflectance .... (-1) 77%

Total .... (+1)

Illumination Level :

* 100 fc at the desk top

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare
* Color rendition not critical

5) COMPUTER/DATA PROCESS

Task Category : B (5-7.5-10)

* CRT screens

Weighting Factors :

* Age .... (0) 40-55
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (-1)

Total .... (0)

Illumination Level :

* 7.5 fc general

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare on CRT screen
* Color rendition not critical

Task Category : E (50-75-100)
* thermal print

Weighting Factors :

* Age .... (0) 40-55
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (-1) 77%

Total .... (0)

Illumination Level :

* 75 fc at printer

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare on printer
* Color rendition not critical

6) LABORATORY

Task Category : E (50-75-100)
* science laboratories

Weighting Factors :

* Age .... (+1) over 55
* Speed .... (0) important
* Accuracy .... (0) important
* Background reflectance .... (-1) bench table (under 30%

Total .... (0)

Illumination Level :

* 75 fc at bench table

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare on bench table
* Color rendition not critical
* Adequate illumination on vertical surface

APPENDIX D - DETAILED ILLUMINATION LEVEL CALCULATION

GENERAL INFORMATION

Project identification: # 124 LECTURE HALL, ANIMAL SC. BLDG.
(Give name of area and/or building and room number)

Average maintained illumination for design: 50 footcandles

Luminaire data:

Manufacturer: DAY BRITE

Catalog number: VT – 1

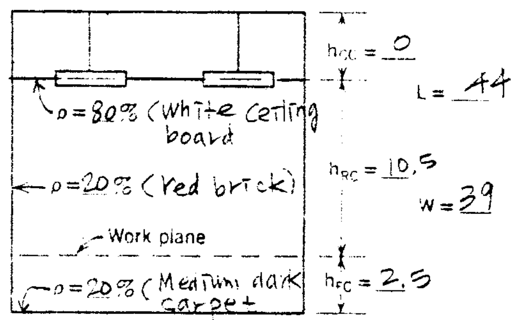
Lamp Data:

Type and color: F40T 12CW

Number per luminaire: 3

Total lumens per luminaire 9450

SELECTION OF COEFFICIENT OF UTILIZATION



Step 1: Fill in sketch at right.

Step 2: Determine Cavity Ratios from Fig. 20.34, or by formulas.

Room Cavity Ratio, RCR = 2.44

Ceiling Cavity Ratio, CCR = 0

Floor Cavity Ratio, FCR = 0.58

Step 3: Obtain effective ceiling cavity reflectance (ρ_{CC}) from Table 20.9 ρ_{CC} = 80

Step 4: Obtain effective floor cavity reflectance (ρ_{FC}) from Table 20.9 ρ_{FC} = 26

Step 5: Obtain coefficient of utilization (CU) from manufacturer's data. CU = 0.55

SELECTION OF LIGHT LOSS FACTORS

Unrecoverable		Recoverable	
Luminaire ambient temperature	0.9	Room surface dirt depreciation	0.95
Voltage to luminaire		Lamp lumen depreciation	0.85
Ballast factor		Lamp burnouts factor	0.95
Luminaire surface depreciation		Luminaire dirt depreciation LDD	0.85

Total light loss factor, LLF (product of individual factors above): 0.59

CALCULATIONS

(Average Maintained Illumination Level)

$$\text{Number of Luminaires} = \frac{(\text{Footcandles}) \times (\text{Area in square feet})}{(\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}$$

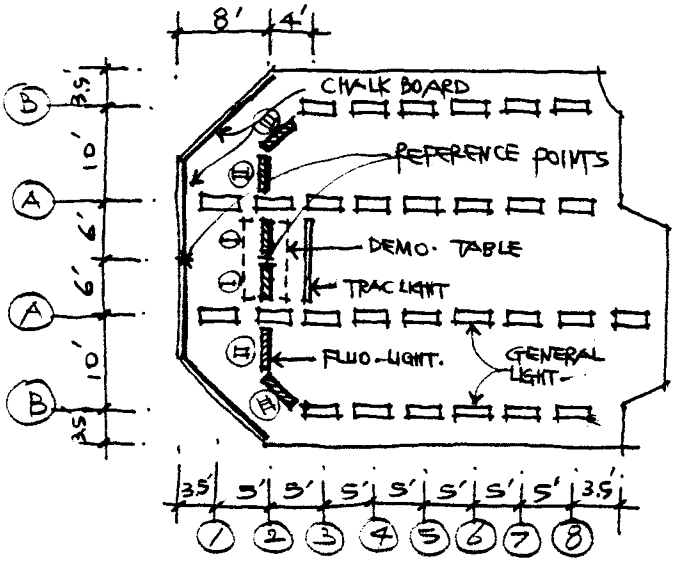
$$= \frac{50 \times 1700}{3150 \times 3 \times 0.55 \times 0.59} = 27.7 \rightarrow 28$$

$$\text{Footcandles} = \frac{(\text{Number of luminaires}) \times (\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}{(\text{Area in square feet})}$$

$$= \frac{28 \times 3150 \times 3 \times 0.55 \times 0.59}{1700} = 50.5$$

Calculated by: LEE Date:

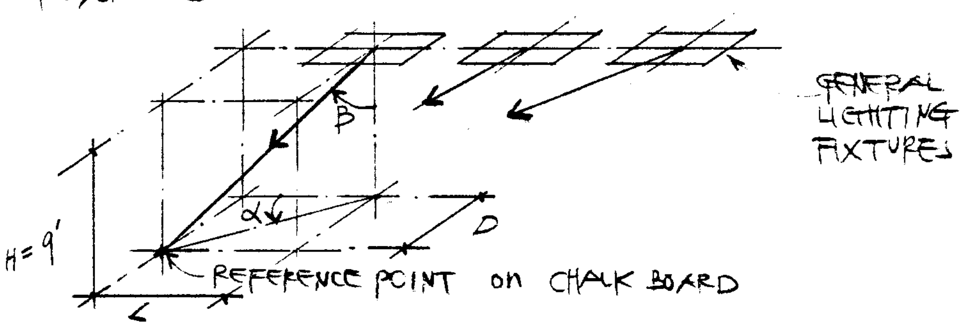
Zonal Cavity Method calculation Form (this and opposite page). Courtesy of the IES.



REFLECT. CEILING PLAN

a) CHALK BOARD

- Required Vertical Illumination level : 50 fc
- Vertical Illumination from general lighting fixtures :



$$\alpha = \tan^{-1}(D/L)^{\circ}$$
$$\beta = \tan^{-1}(\sqrt{L^2+D^2}/H)^{\circ}$$
$$IFC = CP_{\alpha\beta} / L^2+D^2+H^2 \quad (fc)$$
$$VFC = I \times \cos\alpha \times \sin\beta \quad (fc)$$

	D	L	α	β	$CP_{\alpha\beta}$ *	IFC	VFC
A1	6'	3.5'	60°	38°	2230	17.3	5.3
A2	6'	8.5'	35°	49°	1410	7.5	4.6
A3	6'	13.5'	24°	59°	650	2.2	1.7
A4	6'	18.5'	18°	65°	280	0.61	0.53
A5	6'	23.5'	14°	70°	166	0.25	0.23
B3	12'	13.5'	50°	67°	450	0.87	0.51
B4	12'	18.5'	40°	71°	134	0.20	0.14

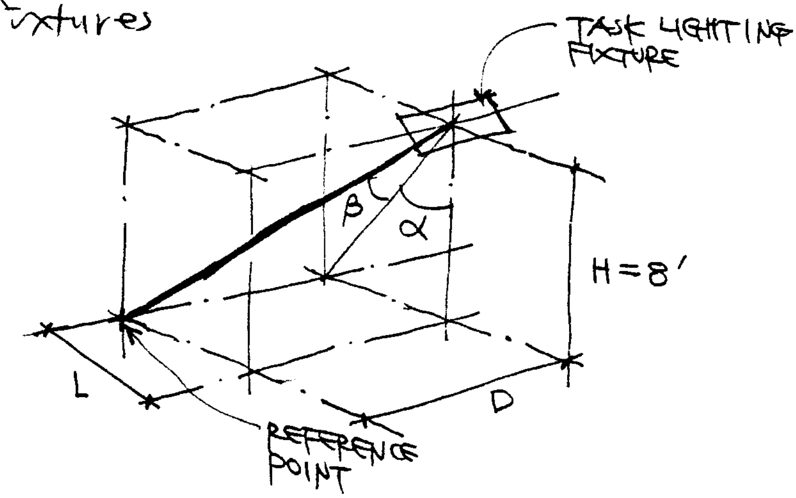
* From manuf. data.

Minimum total vertical fc at the reference point excluding reflected component is 26.02 fc initial.

Maint. fc = Initial fc × LLF

= 26.02 × 0.59 = 15.35 fc

□ Vertical Illumination from Fluorescent task lighting fixtures



	D	L	α	β	CD_β *	ICF	VCF
I	2′	8′	45°	10°	3517	26.6	18.6
II	6′	8′	45°	28°	3064	18.7	11.7
III	9′	9′	48°	37°	2607	11.5	6.8

NOTE

$\alpha = \tan^{-1}(L/H)$

$\beta = \tan^{-1}(D/\sqrt{L^2+H^2})$

$ICF = CP_\beta / L^2+H^2+D^2$

$VCF = ICF \times \sin\alpha \times \cos\beta$

* From Manuf. data

Total vertical fc at the reference point from Six 4-Lamp fluorescent task lighting fixture is 74.5 initial fc.

Maint. fc = Initial fc × LLF

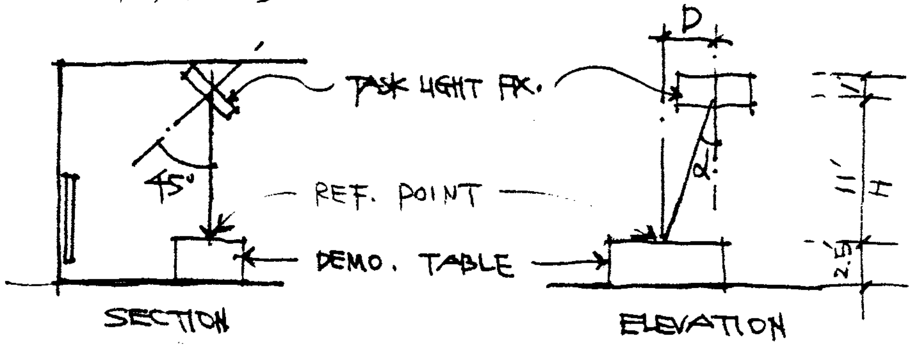
= 74.5 × 0.59 = 43.96

□ Total maintained vertical illumination at reference point = 15.35 + 43.96

= 59.3 fc > 50 fc, ok.

b) DEMONSTRATION TABLE

- Required Illumination level : 150 fc.
- Illumination from general lighting system : 50 fc, maint.
- Illumination from fluorescent task lighting fixtures :



	D	α	$CD^{*}_{\alpha,45}$	ICF	HCF
I	2'	10°	2550	20.4	20.1
II	6'	29°	2500	15.9	13.9
III	9'	39°	2470	12.2	9.5

NOTE $\alpha = \tan^{-1}(D/H)$

$ICF = CP_{\alpha,45} / (D^2 + H^2)$

$HCF = ICF \times \cos\alpha$

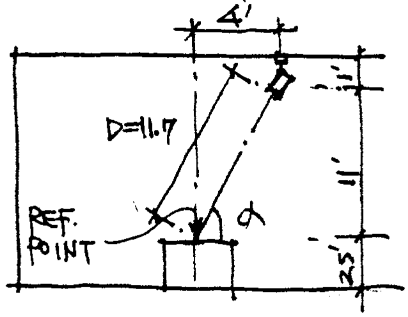
* From Manuf. Data.

Total illuminance at the reference point from six, 4-lamp fluorescent task lighting fixture is 87 initial fc

Maint. fc = Initial fc × LLF

= 87 × 0.59 = 51.3 fc

- Illumination from Incandescent track light



Initial fc for uniform lighting.

at 10' distance : 110 fc (from manuf. data)

at 11.7' distance : 80.4 fc

Initial $fc_{@table}$ = Initial $fc_{@11.7'}$ $\times \sin\alpha$

$= 80.4 \times 11/11.7$

$= 75.6$ fc

Maint fc = Initial $fc_{@table}$ $\times$ LLF

$= 75.6 \times 0.61$

$= 46.1$ fc

Spacing $= H \times S/H$

$= 11 \times 0.35$

$= 3.85'$

No. of fixture = 3.

□ Total Illuminance at the demonstration table

$= CF_{general} + CF_{F.TASK} + CF_{I.TRACK}$

$= 50 + 51.3 + 46.1$

$= 147.4 \approx 150.$ ok.

GENERAL INFORMATION

Project identification: TYPICAL 3-BAY LAB
(give name of area and/or building and room number)

Average maintained illumination for design: 75 footcandles

Luminaire data:

Manufacturer: DAY BRITE

Catalog number: VT-1

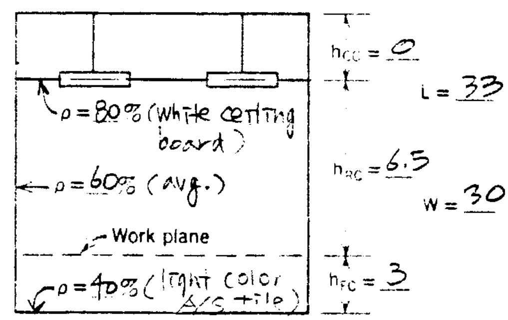
Lamp Data:

Type and color: F40T 12 CW

Number per luminaire: 3

Total lumens per luminaire: 9450

SELECTION OF COEFFICIENT OF UTILIZATION



Step 1: Fill in sketch at right.

Step 2: Determine Cavity Ratios from Fig. 20.34, or by formulas.

Room Cavity Ratio, RCR = 2.07

Ceiling Cavity Ratio, CCR = 0

Floor Cavity Ratio, FCR = 0.95

Step 3: Obtain effective ceiling cavity reflectance (ρ_{CC}) from Table 20.9 ρ_{CC} = 80

Step 4: Obtain effective floor cavity reflectance (ρ_{FC}) from Table 20.9 ρ_{FC} = ____

Step 5: Obtain coefficient of utilization (CU) from manufacturer's data. CU = 36

SELECTION OF LIGHT LOSS FACTORS

Unrecoverable		Recoverable	
Luminaire ambient temperature	0.9	Room surface dirt depreciation	0.95
Voltage to luminaire		Lamp lumen depreciation	0.85
Ballast factor		Lamp burnouts factor	0.95
Luminaire surface depreciation		Luminaire dirt depreciation LDD	0.85

Total light loss factor, LLF (product of individual factors above): 0.59

CALCULATIONS

(Average Maintained Illumination Level)

$$\text{Number of Luminaires} = \frac{(\text{Footcandles}) \times (\text{Area in square feet})}{(\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}$$

$$= \frac{75 \times 990}{(3150 \times 3) \times 0.67 \times 0.59} = 19.9 \rightarrow 21$$

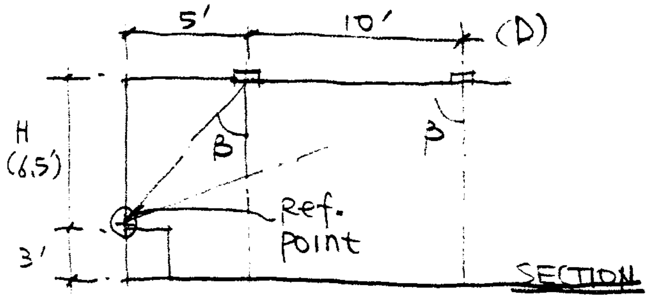
$$\text{Footcandles} = \frac{(\text{Number of luminaires}) \times (\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}{(\text{Area in square feet})}$$

$$= \frac{21 \times (3150 \times 3) \times 0.67 \times 0.59}{990} = 79.2$$

Calculated by: LEE Date: ____

Zonal Cavity Method calculation Form (this and opposite page)./*Courtesy of the IES.*

□ Actual Maint Illumination Level (Vertical)



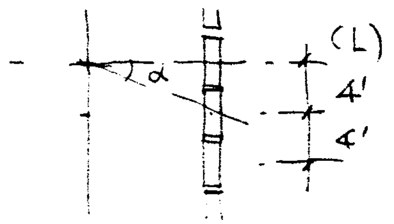
SECTION

$\alpha = \tan^{-1}(L/D)$

$\beta = \tan^{-1}(\sqrt{L^2+D^2}/H)$

$IFC = CP_{\alpha\beta} / L^2+D^2+H^2$

$VFC = IFC \times \cos\alpha \sin\beta$



REF. CEILING PLAN

D	L	α	β	$CP_{\alpha\beta}$	IFC	VFC
5'	0'	0°	38°	1894	28.2	17.3
5'	4'	39°	45°	1060	12.7	7.0
5'	8'	58°	55°	460	3.5	2.9
5'	12'	67°	63°	130	0.62	0.21
10'	0'	0°	57°	330	2.3	1.95
10'	4'	22°	59°	260	1.64	1.3
10'	8'	39°	63°	124	0.60	0.54
10'	12'	50°	67°	39	0.14	0.06

Minimum illumination level on a vertical surface from two rows of lighting fixtures, excluding reflected component : 37.5 initial fc

Maint. Fc = Initial FC × LLF

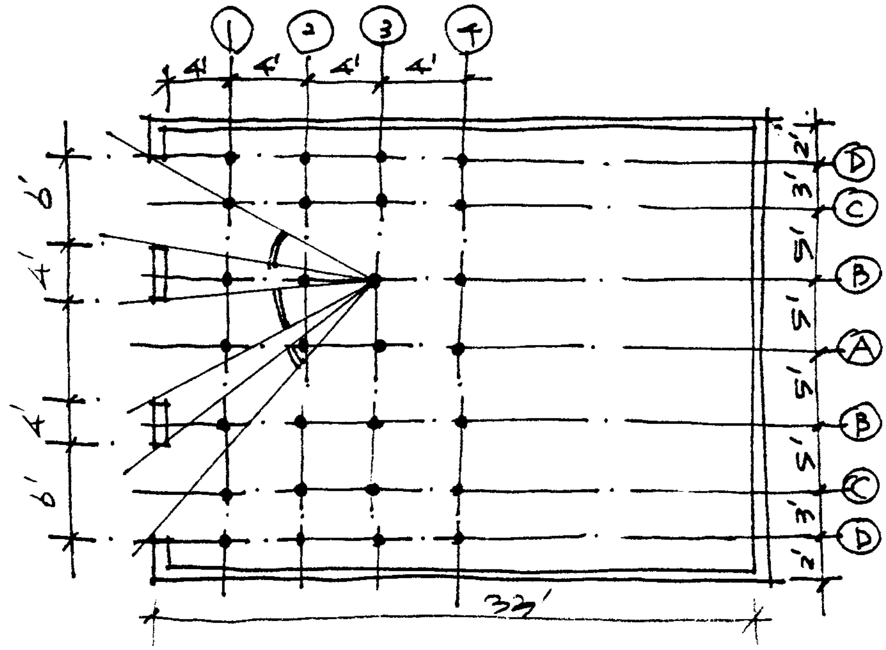
= 43.3 × 0.59

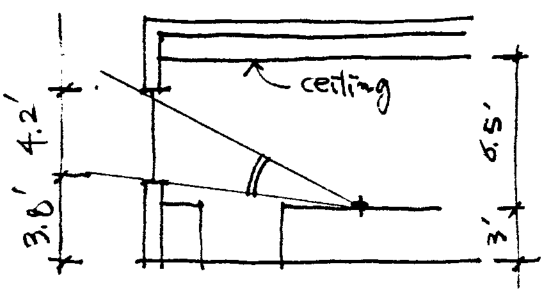
= 25.5 fc , OK.

DAY LIGHTING

Protractor Method shall be utilized to determine DF's.

Sky condition shall be assumed as a CIE sky to be more conservertive in results.





NOTE

- IRC, ERC

  Ratio of Window area to total room surface = 0.022

  Wall ratio = 0.43, Wall RF = 60%

  Avg. Reflectance Factor = 0.48

  From Nomogram 1 $IRC_{initial} = 0.63$

  D-Factor = 0.9

  $IRC_{corr} = IRC_{initial} \times$ D-Factor $= 0.57$

  ERC = 0

- GMB Factors
  - G (Glass) Factor = 0.85 (Clear, double glazing)
  - M (Maintenance) Factor = 0.9 (Vertical, non-Industrial)
  - B (Bar/Frame) Factor = 0.85 (All metal window)
  - $G \times M \times B = 0.65$

		PROTRACTOR SCALE 1 SC initial	PROTRACTOR SCALE 2 Correct Factor	SC correct	NOMOGRAM (IRC=0.57, ERC=0) IRC+ERC+SC	GxMxB=0.65 (GxMxB)x(IRC+ERC+SC) = DF
1	A	7	.616	4.312	4.882	3.17
	B		.372	2.604	3.174	2.06
	C		.608	4.256	4.826	3.14
	D		.427	2.989	3.559	2.31
2	A	2.7	.560	1.512	2.082	1.35
	B		.472	1.274	1.844	1.20
	C		.464	1.253	1.823	1.18
	D		.365	.986	1.556	1.01
3	A	1.4	.480	.672	1.242	.81
	B		.444	.622	1.192	.77
	C		.395	.553	1.123	.73
	D		.350	.490	1.060	.67
4	A	0.8	.440	.352	.922	.60
	B		.415	.332	.902	.59
	C		.323	.258	.828	.54
	D		.300	.240	.810	.53

GENERAL INFORMATION

Project identification: TYPICAL FACULTY OFFICE
(Give name of area and/or building and room number)

Average maintained illumination for design: 25 footcandles

Luminaire data:

Manufacturer: DAYBRITE

Catalog number: VT-1

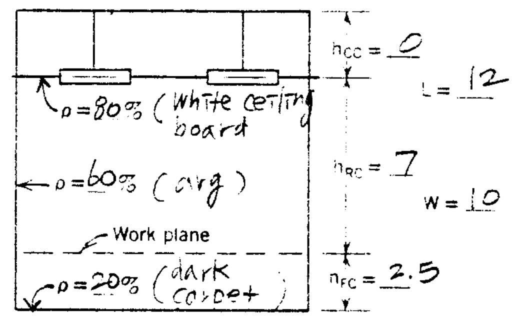
Lamp Data:

Type and color: F40T 12CW

Number per luminaire: 3

Total lumens per luminaire: 9450

SELECTION OF COEFFICIENT OF UTILIZATION



Step 1: Fill in sketch at right.

Step 2: Determine Cavity Ratios from Fig. 20.34, or by formulas.

Room Cavity Ratio, RCR = 2.57

Ceiling Cavity Ratio, CCR = 0

Floor Cavity Ratio, FCR = 0.92

Step 3: Obtain effective ceiling cavity reflectance (ρ_{CC}) from Table 20.9 ρ_{CC} = 80%

Step 4: Obtain effective floor cavity reflectance (ρ_{FC}) from Table 20.9 ρ_{FC} = 20%

Step 5: Obtain coefficient of utilization (CU) from manufacturer's data. CU = 0.6

SELECTION OF LIGHT LOSS FACTORS

Unrecoverable		Recoverable	
Luminaire ambient temperature	0.9	Room surface dirt depreciation	0.95
Voltage to luminaire		Lamp lumen depreciation	0.85
Ballast factor		Lamp burnouts factor	0.95
Luminaire surface depreciation		Luminaire dirt depreciation LDD	0.85

Total light loss factor, LLF (product of individual factors above): 0.59

CALCULATIONS

(Average Maintained Illumination Level)

$$\text{Number of Luminaires} = \frac{(\text{Footcandles}) \times (\text{Area in square feet})}{(\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}$$

$$= \frac{25 \times 120}{(3150 \times 3) \times 0.55 \times 0.59} = 0.98 \rightarrow 1$$

$$\text{Footcandles} = \frac{(\text{Number of luminaires}) \times (\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}{(\text{Area in square feet})}$$

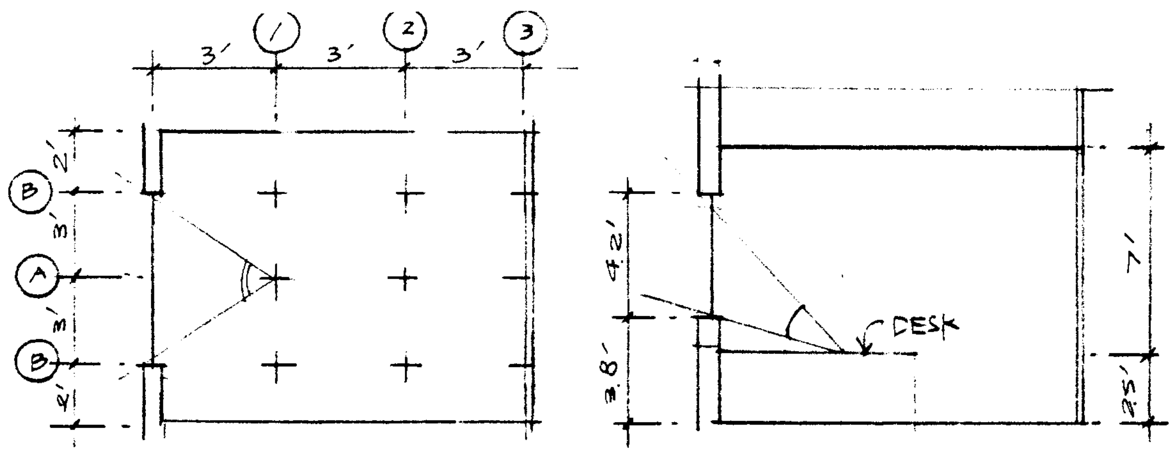
$$= \frac{1 \times (3150 \times 3) \times 0.55 \times 0.59}{120} = 25.6$$

Calculated by: LEE Date: ______

Zonal Cavity Method calculation Form (this and opposite page).(Courtesy of the IES.

DAYLIGHTING

Protractor Method shall be utilized to determine DFs'.
Sky condition shall be assumed as a CIE sky to be conservertive in results



		PROTRACTOR		SC correct	NOMOGRAM	GMB = 0.65
		SCALE 1	SCALE 2		IRC=0.57 ERC=0	(GMB) x (IRC+ERC+SC)
		SC initial	Correct factor		IRC+ERC+SC	= DF
1	A	7.85	.54	4.24	5.28	3.43
	B		.41	3.22	4.26	2.77
2	A	3.31	.40	1.32	2.36	1.53
	B		.34	1.13	2.17	1.41
3	A	1.61	.30	0.48	1.52	0.99
	B		.27	0.43	1.50	0.98

NOTE) Refer to Lab.

APPENDIX E - MANUFACTURER'S CATALOG

"SW" INSTANTANEOUS WATER HEATERS

CAPACITIES 40 F TO 140 F
(For Heating Water with Steam Instantaneously)

Capacities listed are based on the Thermal Standards of the Fuel Oil and Water Heater Manufacturers Association for commercially clean tubing. If fouling is anticipated, select a unit one or two feet longer. If excessive fouling is anticipated ask for our recommendation.

For temperature and pressure conditions other thar those listed, request a copy of our "L & S" Nomograph Chart.

To determine pressure drop and velocity thru tubes see chart on Page 20.

• CAPACITIES IN GPM — 40 F TO 140 F •

2 PASS

No. of Unit	0 PSI	2 PSI	5 PSI	10 PSI	15 PSI	$\boxed{25 \text{ PSI}}$	50 PSI
4204SW	1.1	1.2	1.4	1.7	1.9	2.4	3.4
4206SW	2.4	2.7	3.1	3.8	4.3	5.3	7.6
4208SW	4.3	4.7	5.5	6.8	7.7	9.4	13.5
4210SW	6.7	7.4	8.6	11.3	12.1	14.8	20.8
4212SW	9.6	10.4	12.4	15.2	17.1	21.0	30.0
4214SW	13.1	14.4	16.8	20.4	23.4	29.0	32.8
6204SW	2	3	3	4	4	5	8
6206SW	5	6	7	9	10	12	17
6208SW	10	11	12	15	17	21	30
6210SW	15	17	19	25	27	33	47
6212SW	21	23	28	34	39	47	68
6214SW	29	32	38	46	53	65	74
6216SW	38	42	49	60	74	74	
8204SW	5	6	7	8	10	12	17
8206SW	12	13	15	19	22	27	38
8208SW	21	23	28	34	39	47	67
8210SW	34	37	43	56	60	74	104
$\boxed{8212SW}$	48	52	62	76	86	$\boxed{105}$	150
8214SW	65	72	84	102	117	144	164
8216SW	85	94	109	134	164	164	
8218SW	108	118	138	164			
10206SW	19	21	25	30	35	43	61
10208SW	34	37	44	54	62	75	108
10210SW	54	59	69	90	96	119	167
10212SW	77	83	99	122	137	168	240
10214SW	104	115	134	163	187	230	262
10216SW	136	150	174	215	262	262	
10218SW	173	189	221	262			
10220SW	213	234	262				
12206SW	29	32	37	46	52	64	91
12208SW	51	56	66	82	93	113	162
12210SW	81	89	103	135	145	178	250
12212SW	115	125	149	183	206	252	360
12214SW	157	173	202	245	281	346	394
12216SW	205	226	261	322	394	394	
12218SW	259	283	331	394			
12220SW	319	350	394				
14206SW	36	40	46	57	65	80	114
14208SW	64	70	83	102	116	141	202
14210SW	101	111	129	169	181	222	312
14212SW	144	156	186	228	257	315	450
14214SW	196	216	252	306	351	432	492
14216SW	256	282	326	402	492	492	
14218SW	324	354	414	492			
14220SW	399	438	492				
16206SW	50	55	65	80	91	112	160
16208SW	90	98	116	143	162	198	283
16210SW	141	155	181	237	253	311	437
16212SW	202	218	260	319	360	441	630
16214SW	274	302	353	429	492	605	689
16216SW	358	395	457	563	689	689	
16218SW	454	496	580	689			
16220SW	559	613	689				
20206SW	72	79	92	114	130	160	228
20208SW	128	140	166	204	232	282	405
20210SW	202	222	258	339	361	444	624
20212SW	288	312	372	456	514	630	900
20214SW	391	432	504	612	702	864	984
20216SW	511	564	653	804	984	984	
20218SW	648	708	828	984			
20220SW	798	876	984				

4 PASS

No. of Unit	0 PSI	2 PSI	5 PSI	10 PSI	15 PSI	25 PSI	50 PSI
3404SW	2.2	2.4	2.6	3.3	3.8	4.6	6.5
3406SW	4.8	5.2	6.0	7.2	8.5	10.6	11.0
3408SW	8.6	9.3	10.6	11.0	11.0	11.0	
3410SW	11.0	11.0	11.0				
4404SW	2.2	2.4	2.8	3.4	3.9	4.7	6.8
4406SW	4.8	5.2	6.2	7.6	8.6	10.6	15.0
4408SW	8.5	9.4	10.9	13.4	16.4	16.4	16.4
4410SW	13.3	14.6	16.4	16.4			
4412SW	16.4	16.4					
6404SW	5	6	7	9	10	12	17
6406SW	12	13	16	19	21	26	38
6408SW	21	24	27	34	40	40	40
6410SW	33	37	40	40			
6412SW	40	40					
8404SW	11	12	14	17	19	24	34
8406SW	24	26	31	38	43	53	75
8408SW	43	47	54	67	82	82	82
8410SW	67	73	82	82			
8412SW	82	82					
10406SW	38	42	50	61	69	84	120
10408SW	68	75	87	107	131	131	131
10410SW	106	117	131	131			
10412SW	131	131					
12406SW	58	62	74	91	103	126	180
12408SW	102	113	130	161	197	197	197
12410SW	160	175	197	197			
12412SW	197	197					
14406SW	72	78	93	114	129	158	225
14408SW	128	141	163	201	246	246	246
14410SW	200	219	246	246			
14412SW	246	246					
16406SW	101	109	130	160	180	221	315
16408SW	180	198	229	282	344	344	344
16410SW	279	307	344	344			
16412SW	344	344					
20406SW	144	156	186	228	257	315	450
20408SW	256	282	326	402	492	492	492
20410SW	399	438	492	492			
20412SW	492	492					

6 PASS

No. of Unit	0 PSI	2 PSI	5 PSI	10 PSI	15 PSI	2
6604SW	7	8	9	11	13	
6606SW	16	18	21	25	25	
6608SW	25	25	25			
8604SW	17	18	22	27	30	
8606SW	38	41	48	57	57	
8608SW	57	57	57•			
10606SW	54	59	69	82	82	
10608SW	82	82	82			
12606SW	86	94	110	131	131	1
12608SW	131	131	131			
14606SW	108	118	138	164	164	1
14608SW	164	164	164			

METHOD OF SELECTION

The maximum pressure drop (pd) lowest temperature and longest unit in all diameters, is as follows:—

2 Pass Units—11 feet or 4.8 P.S
4 Pass Units—20 feet or 8.7 P.S
6 Pass Units—23 feet or 10.0 P

The pd's for higher temperatures anc er length units will be correspor lower and may be determined fro charts on Page 20.

In the majority of cases a 6 Pass Unit be the most economical. The most e ical selection however may not alv suitable because of the pressure drop space limitations.

It is accordingly suggested that you your selection along the lines of the ing example.

EXAMPLE

Assume you want to heat 50 GPM GPH) from 40°F to 140°F with 10 steam pressure (10 PSI).

Referring to the 10 PSI columns yo find the nearest above 50 GPM in the est diameters to be:—

2 Pass Unit—No. 6216SW—60 G
(6" Dia., 2 Pass, 8' long)
4 Pass Unit—No. 8408SW—67 G
(8" Dia., 4 Pass, 4' long)
6 Pass Unit—No. 8606SW—57 G
(8" Dia., 6 Pass, 3' long)

In this case the No. 6216SW ar 8606SW would be more economica the No. 8408SW but note that the is 5 feet longer than the No. 8606S 4 feet longer than the No. 8408SW.

Referring to the Pressure Drop Ch Page 20 you will find the pd's f example to be:—

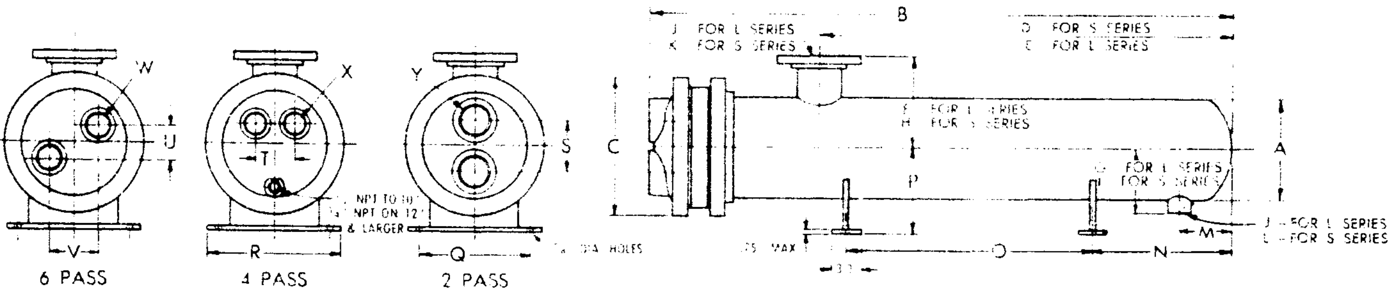
2 Pass Unit—No. 6216SW— 1.9 PSI
4 Pass Unit—No. 8408SW— 2.4 PSI
6 Pass Unit—No. 8606SW— 4.3 PSI

Now you have the lengths and p drops of all 3 units which permits make the most suitable selection.

The lengths indicated above repres length of the tube bundle. See Pag overall lengths of units.)

ALL SERIES HEAT EXCHANGERS

III-1b



HEATER NUMBER 2 PASS	4 PASS	6 PASS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	APPROX. WEIGHT IN LBS.
	3404		3.5	26.5	7.5	19	19	2.2	2.2	2.8	2.6	1.25T	2T	1T	2.5	9	10	4	4.5	6.5	2.2					1T		42
	3406		3.5	38.5	7.5	31	31	2.2	2.2	2.8	2.6	1.25T	2T	1T	2.5	9	22	4	4.5	6.5	2.2					1T		49
	3408		3.5	50.5	7.5	43	43	2.2	2.2	2.8	2.6	1.25T	2T	1T	2.5	9	34	4	4.5	6.5	2.2					1T		56
	3410		3.5	62.5	7.5	55	55	2.2	2.2	2.8	2.6	1.25T	2T	1T	2.5	9	46	4	4.5	6.5	2.2					1T		63
	3412		3.5	74.5	7.5	67	67	2.2	2.2	2.8	2.6	1.25T	2T	1T	2.5	9	58	4	4.5	6.5	2.2					1T		69
4204	4404		4.5	27	9	19	19	2.8	2.8	3.2	2.8	1.5T	2T	1T	2.5	9	10	4.5	5.5	7.5	2.5	2.4				1T	1.5T	65
4206	4406		4.5	39	9	31	31	2.8	2.8	3.4	2.8	1.5T	2.5T	1T	2.5	9	22	4.5	5.5	7.5	2.5	2.4				1T	1.5T	75
4208	4408		4.5	51	9	43	43	2.8	2.8	3.4	2.8	1.5T	2.5T	1T	2.5	9	34	4.5	5.5	7.5	2.5	2.4				1T	1.5T	84
4210	4410		4.5	63	9	55	55	2.8	2.8	3.4	2.8	1.5T	2.5T	1T	2.5	9	46	4.5	5.5	7.5	2.5	2.4				1T	1.5T	94
4212	4412		4.5	75	9	67	67	2.8	2.8	3.4	2.8	1.5T	2.5T	1T	2.5	9	58	4.5	5.5	7.5	2.5	2.4				1T	1.5T	104
4214	4414		4.5	87	9	79	79	2.8	2.8	3.4	2.8	1.5T	2.5T	1T	2.5	9	70	4.5	5.5	7.5	2.5	2.4				1T	1.5T	123
6204	6404	6604	6.6	27.2	11	16	19	3.6	3.6	4	3.8	2T	2.5T	1T	3.5	9	10	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	120
6206	6406	6606	6.6	39.2	11	28	31	3.6	3.6	4	3.8	2T	3T	1.25T	3.5	9	22	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	148
6208	6408	6608	6.6	51.2	11	40	43	3.6	3.6	6.5	3.8	2T	4F	1.5T	3.5	9	34	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	182
6210	6410	6610	6.6	63.2	11	52	55	3.6	3.6	6.5	3.8	2T	4F	1.5T	3.5	9	46	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	207
6212	6412	6612	6.6	75.2	11	64	67	3.6	3.6	6.5	3.8	2T	4F	1.5T	3.5	9	58	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	235
6214	6414	6614	6.6	87.2	11	76	79	3.6	3.6	6.5	3.8	2T	4F	1.5T	3.5	9	70	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	262
6216	6416		6.6	99.2	11	88	91	3.6	3.6	6.5	3.8	2T	4F	1.5T	3.5	9	82	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	290
8204	8404	8604	8.6	28	13.5	16	18	5.2	5.2	8.8	4.8	3T	4F	1.5T	4.5	9	10	6.8	9	11	5	4	2.8	6	2T	2T	3T	192
8206	8406	8606	8.6	40	13.5	28	30	5.2	5.2	8.8	4.8	3T	4F	1.5T	4.5	9	22	6.8	9	11	5	4	2.8	6	2T	2T	3T	234
8208	8408	8608	8.6	52	13.5	40	42	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	34	6.8	9	11	5	4	2.8	6	2T	2T	3T	283
8210	8410	8610	8.6	64	13.5	52	54	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	46	6.8	9	11	5	4	2.8	6	2T	2T	3T	326
8212	8412	8612	8.6	76	13.5	64	66	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	58	6.8	9	11	5	4	2.8	6	2T	2T	3T	369
8214	8414	8614	8.6	88	13.5	76	78	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	70	6.8	9	11	5	4	2.8	6	2T	2T	3T	[illegible]
8216	8416		8.6	100	13.5	88	90	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	82	6.8	9	11	5	4	2.8	6	2T	2T	3T	453
8218	8418		8.6	112	13.5	100	102	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	94	6.8	9	11	5	4	2.8	6	2T	2T	3T	496
10204	10404	10604	10.8	28.5	16	16	18	6.3	6.3	10	6	3T	4F	1.5T	4.5	9	10	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	285
10206	10406	10606	10.8	40.5	16	28	30	6.3	6.3	10	6	3T	6F	2T	4.5	9	22	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	353
10208	10408	10608	10.8	52.5	16	40	42	6.3	6.3	10	6	3T	6F	2T	4.5	9	34	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	415
10210	10410	10610	10.8	64.5	16	52	54	6.3	6.3	10	6	3T	6F	2T	4.5	9	46	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	476
10212	10412	10612	10.8	76.5	16	64	66	6.3	6.3	10	6	3T	6F	2T	4.5	9	58	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	537
10214	10414	10614	10.8	88.5	16	76	78	6.3	6.3	10	6	3T	6F	2T	4.5	9	70	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	598
10216	10416		10.8	100.5	16	88	90	6.3	6.3	10	6	3T	6F	2T	4.5	9	82	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	660
10218	10418		10.8	112.5	16	100	102	6.3	6.3	10	6	3T	6F	2T	4.5	9	94	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	721
10220	10420		10.8	124.5	16	112	114	6.3	6.3	10	6	3T	6F	2T	4.5	9	106	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	782
12206	12406	12606	12.8	41.2	19	26	28	7.3	7.3	11	6.8	3T	6F	2T	4.5	9	22	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	510
12208	12408	12608	12.8	53.2	19	38	40	7.3	7.3	11	6.8	3T	6F	2T	4.5	9	34	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	596
12210	12410	12610	12.8	65.2	19	50	52	7.3	7.3	11	6.8	3T	6F	2T	4.5	9	46	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	681
12212	12412	12612	12.8	77.2	19	62	64	7.3	7.3	11	7.2	3T	8F	2.5T	4.5	9	58	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	772
12214	12414	12614	12.8	89.2	19	74	76	7.3	7.3	11	7.2	3T	8F	2.5T	4.5	9	70	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	857
12216	12416		12.8	101.2	19	86	88	7.3	7.3	11	7.2	3T	8F	2.5T	4.5	9	82	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	941
12218	12418		12.8	113.2	19	98	100	7.3	7.3	11	7.2	3T	8F	2.5T	4.5	9	94	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	1027
12220	12420		12.8	125.2	19	110	112	7.3	7.3	11	7.2	3T	8F	2.5T	4.5	9	106	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	1111
14206	14406	14606	14	41.5	21	26	28	12	10	12	7.6	4F	6F	2T	6	14	14	12	12	14	8	6.5	5	8	3T	4T	6T	568
14208	14408	14608	14	53.5	21	38	40	12	10	12	8	4F	8F	2.5T	6	14	26	12	12	14	8	6.5	5	8	3T	4T	6T	664
14210	14410	14610	14	65.5	21	50	52	12	10	12	8	4F	8F	2.5T	6	14	38	12	12	14	8	6.5	5	8	3T	4T	6T	756
14212	14412	14612	14	77.5	21	62	64	12	10	12	8	4F	8F	2.5T	6	14	50	12	12	14	8	6.5	5	8	3T	4T	6T	847
14214	14414	14614	14	89.5	21	74	76	12	10	12	8	4F	8F	2.5T	6	14	62	12	12	14	8	6.5	5	8	3T	4T	6T	937
14216	14416		14	101.5	21	86	88	12	10	12	8	4F	8F	2.5T	6	14	74	12	12	14	8	6.5	5	8	3T	4T	6T	1029
14218	14418		14	113.5	21	98	100	12	10	12	8	4F	8F	2.5T	6	14	86	12	12	14	8	6.5	5	8	3T	4T	6T	1120
14220	14420		14	125.5	21	110	112	12	10	12	8	4F	8F	2.5T	6	14	98	12	12	14	8	6.5	5	8	3T	4T	6T	1212
16206	16406		16	41.8	23.5	25	27	13	11	13	9	6F	8F	2.5T	7	16	14	13	13	15	9.2	7.8				4T	6T	745
16208	16408		16	53.8	23.5	37	39	13	11	13	9	6F	8F	2.5T	7	16	26	13	13	15	9.2	7.8				4T	6T	863
16210	16410		16	65.8	23.5	49	51	13	11	13	9	6F	8F	2.5T	7	16	38	13	13	15	9.2	7.8				4T	6T	981
16212	16412		16	77.8	23.5	61	63	13	11	13	9	6F	10F	3T	7	16	50	13	13	15	9.2	7.8				4T	6T	1105
16214	16414		16	89.8	23.5	73	75	13	11	13	9	6F	10F	3T	7	16	62	13	13	15	9.2	7.8				4T	6T	1187
16216	16416		16	101.8	23.5	85	87	13	11	13	9	6F	10F	3T	7	16	74	13	13	15	9.2	7.8				4T	6T	1305
16218	16418		16	113.8	23.5	97	99	13	11	13	9	6F	10F	3T	7	16	86	13	13	15	9.2	7.8				4T	6T	1424
16220	16420		16	125.8	23.5	109	111	13	11	13	9	6F	10F	3T	7	16	98	13	13	15	9.2	7.8				4T	6T	1541
20206	20406		20	42.5	27.5	23	27	15	13	15	11.2	6F	8F	2.5T	7.5	16	14	15	14	16	11.2	8.8				6T	8T	1060
20208	20408		20	54.5	27.5	35	39	15	13	15	11.2	6F	10F	3T	7.5	16	26	15	14	16	11.2	8.8				6T	8T	1226
20210	20410		20	66.5	27.5	47	51	15	13	15	11.2	6F	10F	3T	7.5	16	38	15	14	16	11.2	8.8				6T	8T	1386
20212	20412		20	78.5	27.5	59	63	15	13	15	11.2	6F	10F	3T	7.5	16	50	15	14	16	11.2	8.8				6T	8T	1547
20214	20414		20	90.5	27.5	71	75	15	13	15	11.2	6F	10F	3T	7.5	16	62	15	14	16	11.2	8.8				6T	8T	1706
20216	20416		20	102.5	27.5	83	87	15	13	15	11.2	6F	10F	3T	7.5	16	74	15	14	16	11.2	8.8				6T	8T	1867
20218	20418		20	114.5	27.5	95	99	15	13	15	13	6F	12F	4F	7.5	16	86	15	14	16	11.2	8.8				6T	8T	2041
20220	20420		20	126.5	27.5	107	111	15	13	15	13	6F	12F	4F	7.5	16	98	15	14	16	11.2	8.8				6T	8T	2202

NOTE: Shell Connections 3" and smaller are threaded, 4" and larger regularly furnished flanged.

PRESSURE DROP CHART – THRU TUBES – "L" AND "S" SERIES

HOW TO USE THIS CHART

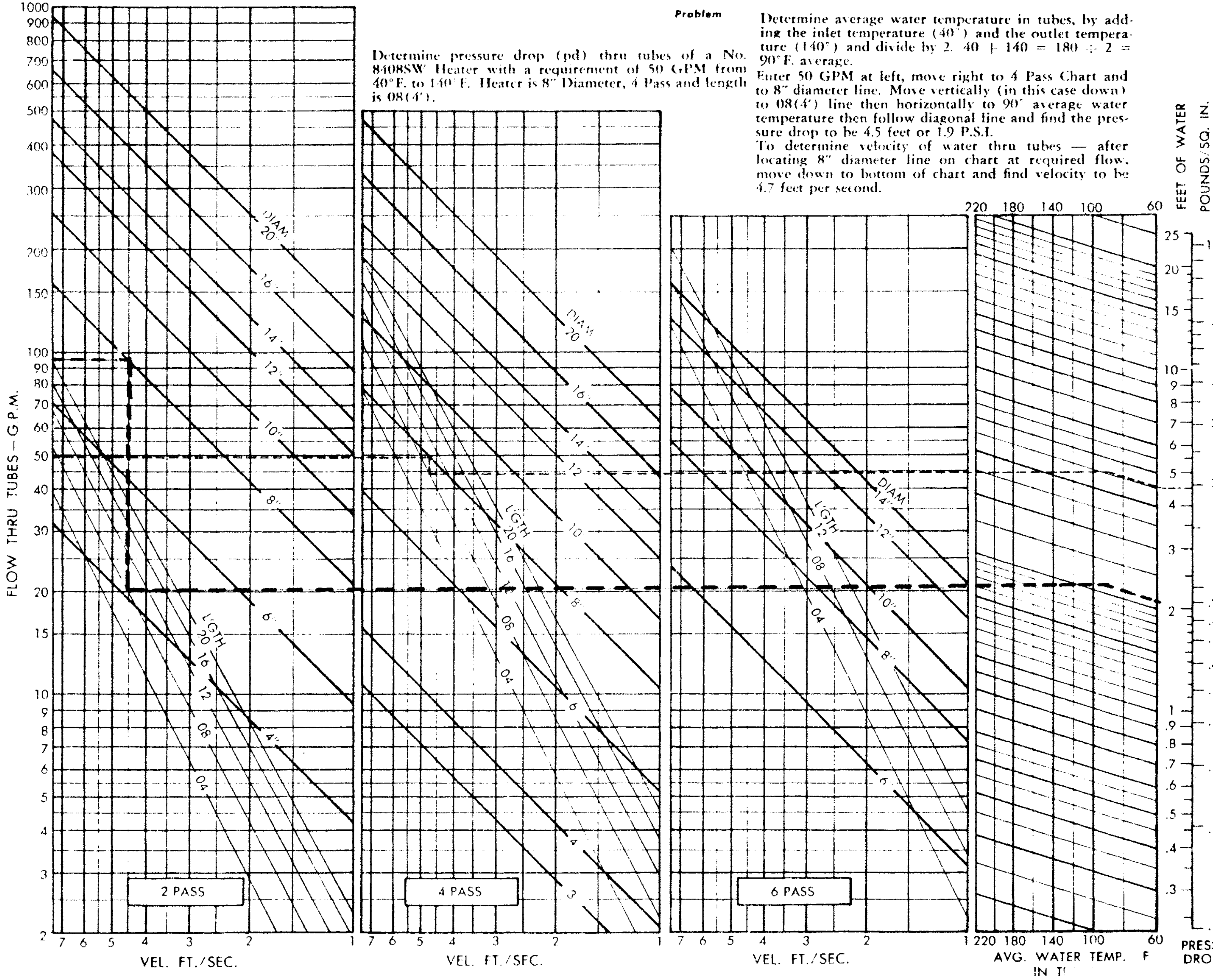
Problem

Determine pressure drop (pd) thru tubes of a No. 8408SW Heater with a requirement of 50 GPM from 40°F. to 140°F. Heater is 8" Diameter, 4 Pass and length is 08(4').

Determine average water temperature in tubes, by adding the inlet temperature (40°) and the outlet temperature (140°) and divide by 2. 40 + 140 = 180 ÷ 2 = 90°F. average.

Enter 50 GPM at left, move right to 4 Pass Chart and to 8" diameter line. Move vertically (in this case down) to 08(4') line then horizontally to 90° average water temperature then follow diagonal line and find the pressure drop to be 4.5 feet or 1.9 P.S.I.

To determine velocity of water thru tubes — after locating 8" diameter line on chart at required flow, move down to bottom of chart and find velocity to be 4.7 feet per second.



weil PUMP COMPANY

CHICAGO - ILLINOIS U.S.A.

— CENTRIFUGAL PUMP PERFORMANCE CHART —

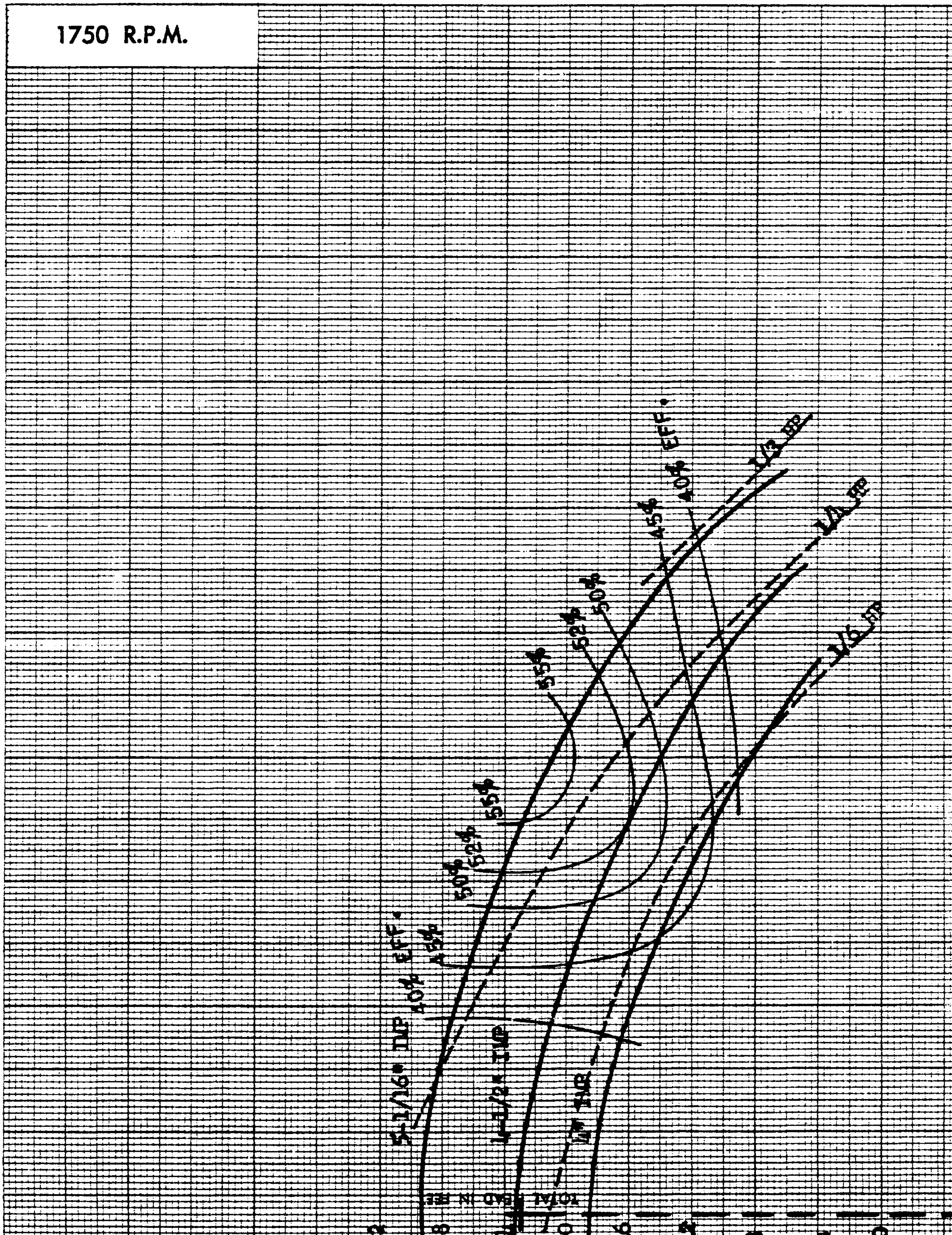
SERIAL NO. ....

SIZE — TYPE....................

IMP. NO. ....

DATE ....

FOR PUMP TYPES KU, KY, RU,



FOR A MAXIMUM PERMISSIBLE SUCTION LIFT OF 15 FEET

IV-1

GRINNELL

GRINNELL FIRE PROTECTION SYSTEMS COMPANY, INC.

STANDARD SPRINKLERS

Grinnell offers a broad range of standard sprinkler styles for different types of installations. A general cross-section of standard sprinklers are pictured at right and ceiling types are featured on the opposite page.

Pendent

For use on piping close to ceiling or concealed above the ceiling. Typical installations include schools, office and apartment buildings, hotels, nursing homes, retail stores, and shopping centers. Available in Duraspeed, Quartzoid, and Duraspeed with Quick Response, and Aquamatic.

Upright

For use on exposed piping. Typical installations include factories, warehouses, schools, chemical plants, oil refineries. Available in Duraspeed, Quartzoid, and Aquamatic.

Ceiling (or Recessed)

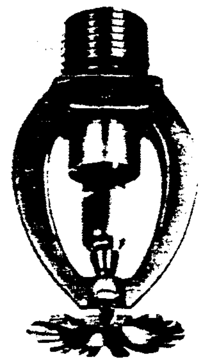
For effective yet unobtrusive protection: designed to preserve interior decor. Typical installations include apartments, universities, hospitals, hotels, public buildings, museums, schools, banks, lobbies, auditoriums. Available in Duraspeed (recessed), Quartzoid (recessed and ceiling), Cleanline (recessed) and Aquamatic (recessed). (Illustrated opposite page.)

Sidewall

For wall-mounting in areas where standard installations are impractical. Typical installations include apartments, universities, hospitals, hotels, public buildings, museums, schools, office buildings, nursing homes. Available in Duraspeed, Duraspeed with Quick Response, and Quartzoid.

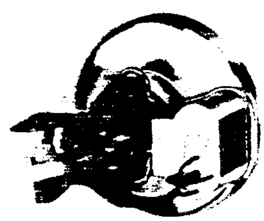
Horizontal sidewall

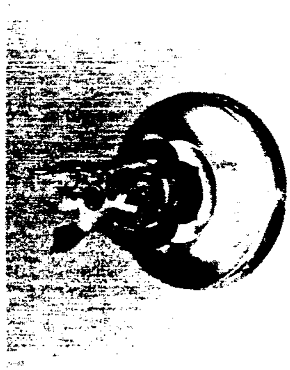
For areas where sprinklers must be mounted horizontally from walls. Available in Duraspeed with Extended Coverage and/or Quick Response.

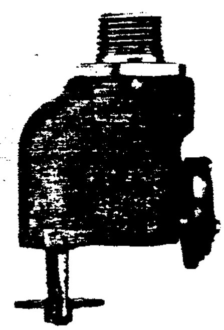

Quartzoid pendent

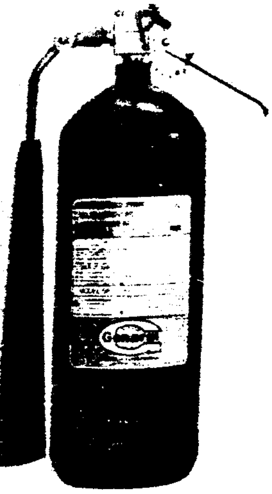

Duraspeed pendent


Sidewall


Quick Response


Extended Coverage


Aquamatic



CARBON DIOXIDE

IV-2

General makes more portable CO_2 steel extinguishers than any other manufacturer in the world. The General line of hand portable carbon dioxide extinguishers includes three models with 5, 10, and 15 pound capacities. They provide excellent protection for certain flammable liquid, gas, and electrical hazards, and immediate cooling capability to prevent flashbacks.

They are especially suited for use on indoor hazards of these types where winds and drafts will not affect the discharge of the CO_2, and where an extinguishing agent leaving no residue is required. General's CO_2 units have standardized operation-pull pin, squeeze lever. Sturdy wall hanger hooks are provided. Marine and heavy-duty vehicle mounting brackets are available as optional equipment.

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S. C GU
5-R	02328	5 lbs.	11 sec.	20 lbs.	16 5/8"	8 1/4"	5 B:C	Appr
10-RH	02280	10 lbs.	9 sec.	38 lbs.	24"	12"	10 B:C	Appr
15-RH	01688	15 lbs.	11 sec.	51 1/2 lbs.	30"	12"	10 B:C	Appr

WHEELED UNITS

All General wheeled extinguishers are designed to be pulled and maneuvered by one person. They are compact enough to be used indoors and moved through standard doorways as well as outside over soft ground or rough surfaces.

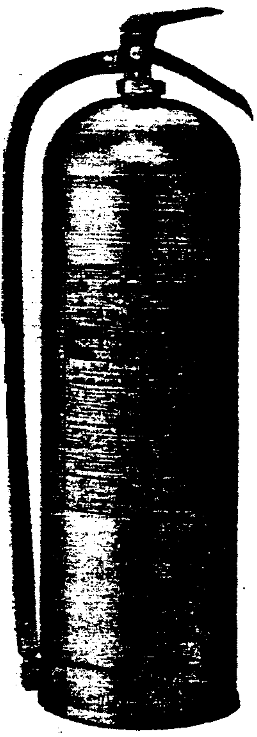
They are activated quickly through hand opening valves at the nozzles.

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S. C GU
WHEELED UNITS								
50-RH	26738	50 lbs.	26 sec.	221 lbs.	51"	25"	20 B:C	...
100-T (two 50 lb. cylinders) (c/w manifolded valve)	02052	100 lbs.	65 sec.	433 lbs.	66"	27"	20 B:C	...

FEATURES:

- Heavy Duty Nickel-Plated Forged Brass Discharge Valve Body
- Heavy Duty Integral Hanger Loop on Valve Body (Hand Portable Only)
- Tubular Steel Cartridge (Wheeled Units Only)
- Frangible Safety Burst Disc for Pressure Relief
- High Pressure Non-Kink Hose
- Heavy Duty Patented Stay-Put Discharge Horn and Swivel Assembly (5 Lb. Units Only)
- Thermal-and Impact-Resistant Discharge Horn
- Rubber Insulated Horn Handle
- Integral Diffusion Tip for Safety in Recharging

PRESSURIZED WATER or LOADED STREAM



General's pressurized water extinguishers have a 2 1/2 gallon capacity. They offer good protection against small Class A fires (word, paper, rags). The cylinders are made of stainless steel. Operation is simple. No inversion is required. Just pull ring pin and squeeze the lever. A steady stream is supplied from start to finish. Recharging requires only a water supply and a source of compressed air with a pressure capacity of at least 100 psi.

General's pressurized loaded stream extinguishers are identical in construction, capacity, operation and maintenance to the pressurized water units. The "Freeze-Guard" loaded stream charge prevents freezing to -40°F., increases the effectiveness of the agent on Class A fires and adds extinguishing capability on Class B fires (flammable liquids, greases, etc.). Sturdy wall hanger hooks are provided.

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S. C GU
WS/LS-900A	35380	2 1/2 gal.	45-65 sec.	8 lbs. 8 oz.	24 1/2"	8 5/8"	2A	...

FEATURES:

- Nickel-Plated, Brass Valve Body
- Stainless Steel Cylinder
- Stainless Steel Collar
- Oil-Filled Stainless Steel Pressure Gauge
- Pressurization Air Valve
- Stainless Steel Handle and Ring Pin
- Heavy Duty Stainless Steel Hanger Bracket

IV-3

STORED PRESSURE DRY CHEMICAL

General's line of hand portable stored pressure dry chemical extinguishers offers a choice of capacity and type of agent to satisfy a variety of fire protection requirements. They range in capacity from 2 1/2 to 20 pounds; all models are Underwriter's Laboratories listed.

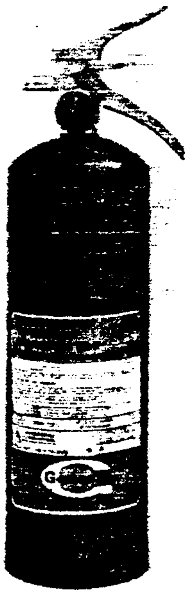
All models are available with either standard Quick Aid, ABC type Triplex, or Purple K dry chemicals, offering an opportunity to select the extinguisher that will most efficiently and economically provide protection against a particular hazard.

Standardized, easy operation (pull pin, squeeze lever) and durable construction make them the choice of safety directors and fire chiefs.

Large, easy-to-read pressure g and simplified recharging (no s tools required) earn praises from tenance and servicing perso Marine-vehicle mounting bracke wall hooks are supplied with 2 1/2 pound models. Wall hooks are su for 10 and 20 pound models with vehicle mounting brackets availa optional equipment.

QUICK AID

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S.
CP-2 1/2J	34981	2 1/2 lbs.	9.0 sec.	5 lbs.	15 5/8"	5 1/4"	10 B:C	Ap
CP-5J	35022	5 lbs.	8.5 sec.	10 1/4 lbs.	16 1/2"	5 5/8"	20 B:C	Ap
GP-10E	34021	10 lbs.	8.5 sec.	21 1/2 lbs.	22"	8 3/4"	60 B:C	Ap
GP-20D	34022	20 lbs.	27 sec.	38 lbs.	26 1/2"	9 1/2"	120 B:C	Ap



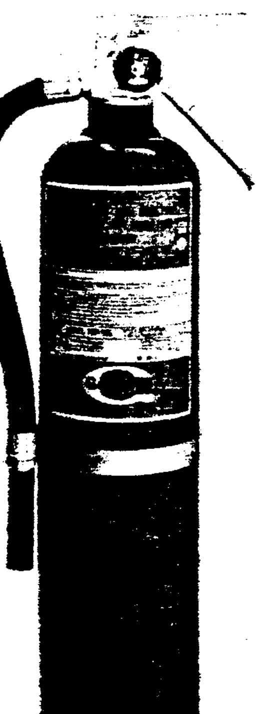
TRIPLEX

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S.
TCP-2 1/2J	34983	2 1/2 lbs.	10 sec.	5 1/2 lbs.	15 5/8"	5 1/4"	1A-10 B:C	Ap
TCP-5J	35024	5 lbs.	10 sec.	9 3/4 lbs.	16 1/2"	5 5/8"	2A-10 B:C	Ap
TCP-5JH	35027	5 lbs.	9.5 sec.	10 lbs.	16 1/2"	7 1/4"	2A-10 B:C	Ap
TGP-10E	34027	9 1/2 lbs.	15 sec.	21 lbs.	22"	8 3/4"	4A-40 B:C	Ap
* TGP-10ES	35307	9 1/2 lbs.	15 sec.	22 lbs.	22"	8 3/4"	4A-40 B:C	Ap
** TCP-10LH	35179	9 lbs.	18.5 sec.	14 lbs.	23 1/2"	8 5/8"	4A-60 B:C	Ap
TGP-20D	34028	18 lbs.	22 sec.	36 lbs.	26 1/2"	9 1/2"	20A-80 B:C	Ap

* Underground, Ignition-proof Construction

**Aluminum Cylinder

PURPLE "K"



MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S.
KCP-2 1/2J	34982	2 1/2 lbs.	9.0 sec.	5 1/2 lbs.	15 5/8"	5 1/4"	10 B:C	Ap

FEATURES:

- Simple and Economical Maintenance
- Heavy Duty Steel Cylinder
- Interchangeable Internal Valve Parts between all 2 1/2 and 5 Pound Units
- Heavy Duty Bar Stock Anodized Aluminum Valve Body on 2 1/2 and 5 Pound Units
- Heavy Duty Forged Anodized Aluminum Valve Body on 10 and 20 Pound Units
- Heavy Duty Time-Proven Seal Design
- Heavy Duty Integral Hanger Loop on Valve Body of 10 and 20 Pound Units
- Stainless Steel Pressure Gauge
- Corrosion-Resistant Anodized Aluminum Handles
- High Corrosion-Resistant Red Enamel Paint Finish

NOTICE Some manufacturers sell only D.O.T. specification cyli requiring Hydrostatic Testing every 5 years. General manufac

NERAL

e 4800 is a multi-zone alarm detection and non-ded alarm signaling panel designed in com-ance with NFPA-72A Local Protective Signaling stem specifications, NFPA-72B Auxiliary Pro-tive Signaling System Specifications, NFPA-C Remote Station Signaling Specifications and PA-72D Proprietary Protected Premises Speci-ations to provide flexibility for multi-zone fire otection applications.

e 4800 can accommodate up to 6 circuit cards t provide various detection alarm functions. ee catalog sheets beginning with 20A-14-2). e basic unit has two general alarm circuits plus xiliary control and annunciation functions all of ich are housed in a single enclosure.

ATURES

Up to 24 supervised Locking Class B Zone Monitoring Circuits in increments of four per plug-in module.

Two, 24 Vdc supervised alarm circuits.

Alarm signal resound feature.

Supervised power supply.

Integral charging circuit for gelled electrolyte emergency batteries.

Individual zone alarm and trouble annunciation (circuit card feature) as well as Common Alarm and Common Trouble annunciation.

Optional normally open alarm contacts for each zone (circuit card feature).

Remote station reverse polarity transmitter or local energy master box connections with master box disconnect switch.

Internal trouble buzzer or external audible device.

Fire Drill Switch.

Flashing Common Alarm LED.

Circuit card supervision to cause trouble condition when circuit card is removed.

Compatible for use with Notifier SAS-100 Firefighters Communications System.

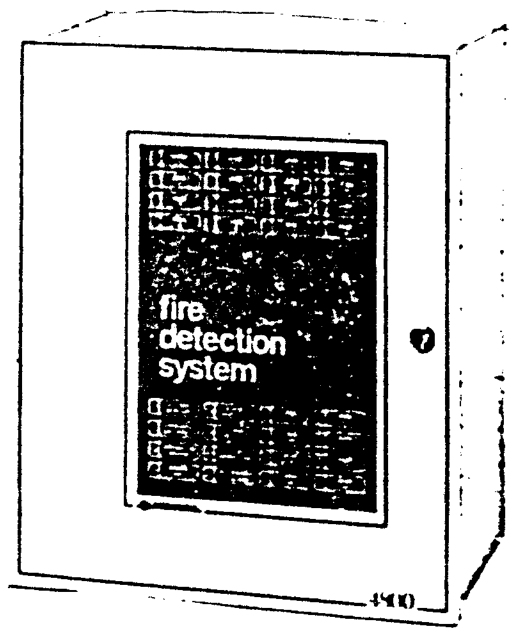
Motherboard Backplane concept.

External Power Supervision.

Individual Trouble LEDs for Battery, Charger, and External Power Troubles.

Cable Connectors to allow additional Motherboards for added circuit capacity.

Optional Supervisory Current Meter.



4800 CONTROL PANEL

BASIC PANEL CONFIGURATION

The 4800 consists of a four position motherboard with power supply and common control boards provided as standard. The other two circuit positions can accomodate any of the circuit cards described on the catalog sheets (20A-14 series). Two rows of eight terminals each are provided for field wiring, one above and one below the circuit card edge connector.

Battery brackets are available to mount two 4.5 AH batteries.

A semi flush mounting flange is also available where such mounting configuration is required.

SPECIFICATIONS

ELECTRICAL

Input power ....120 V, 60 Hz, 1 amp
*Reverse polarity transmitter ......24 Vdc, 24 mA
*Local energy master box ....Loop, 30 ohms max.
Emergency Battery
options ....24 Vdc, 4.5 AH or 9 AH
(larger sizes require separate cabinet)
Charging current ....4.5 AH, 0.65 amp
9 AH, 1.3 amp

Maximum current available for
alarm loops, products of combustion
detectors, and auxiliary functions ....3 amps
with 4.5 AH battery
2.5 amps with
9 AH battery

Products of combustion detector
power ....27 ± 1 V Clipped FWR, 0.5 A max.

Alarm circuits
(each) ....1.5 amp with 4.5 AH battery
1.25 amp with 9 AH battery
4.7K End-of-line resistor

Common Alarm and Common
Trouble contacts
(SPDT) ....120 Vac, 1 amp
24 Vdc, 2 amps

*Either reverse polarity transmitter or local energy master box signaling may be used, not both.

PHYSICAL

Back Box....................15 inches wide (38.1 cm)
18 inches high (45.7 cm)
7 inches deep (17.8 cm)

Finish .... Beige Baked Enamel

FUNCTION SWITCHES AND ANNUNCIATORS

RESET — Returns panel to normal operation after an alarm condition has been detected and cleared and also resets ionization detectors.

LAMP TEST — Applies power to all LED's in the panel to verify operation.

SILENCE — Silences alarm and trouble audible devices upon actuation. A subsequent alarm signal will resound devices.

MASTER BOX DISCONNECT — Disconnects panel from master box when performing system tests.

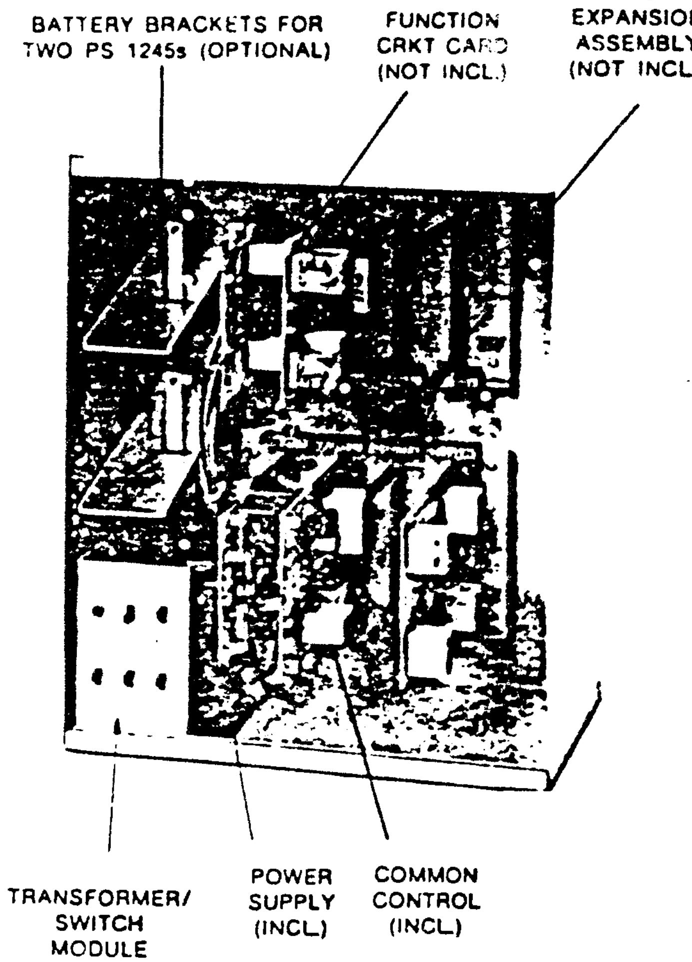
CIRCUIT BREAKER — Push-to-Reset circuit breaker is provided on the ac input line.

DRILL — Momentary switch causes alarm devices to operate.

ANNUNCIATORS — Common panel annunciators consist of a green power pilot LED, a yellow common trouble LED, and a red common alarm LED. Yellow trouble LED's for alarm circuit 1, alarm circuit 2, city box inoperative, voltage monitor, charger (over voltage), battery, and ground on system. The four-zone circuit modules have individual alarm and trouble LED's for each zone.

ORDERING INFORMATION

4800 Basic Panel w/o Meter 512-9706
4800 Basic Panel w/Meter 512-9707
Semi-Flush mounting Flange 512-9662
Battery Brackets w/Btry. leads 141-9983
Four Card Expansion Ass'y. 512-9708



MANUAL FIRE ALARM STATION

SERIES [redacted] or BRG IV-5a

CALIFORNIA LISTED 7150-028:3

APPLICATION

Designed for use as a means of allowing anyone on the premises to turn in non-coded alarm quickly without chance of error. There is no need for delay—no danger of giving incorrect or incomplete instruction.

Installed in any type of building where there is a requirement for manually initiating a fire alarm.

1. Schools
2. Hospitals
3. Retail stores
4. Industrial plants
5. Warehouses

Compatible with any appropriate control panel to:

1. Initiate local alarm signals
2. Trip a municipal fire alarm box
3. Start fire pumps
4. OR ANY OTHER FUNCTION THAT CAN BE INITIATED OR CONTROLLED BY THE OPENING OR CLOSING OF A SWITCH CONTACT.

OPERATION

STATIONS ARE BREAK GLASS OR NON-BREAK-GLASS OPERATION.

The stations are operated by a pull on the pull cover. This causes a key latch to act against a retaining mechanism until adequate force is applied to open the station. As the station opens, a switch is released to initiate an alarm. The retainer in Model BNG is a permanent high tensile coil spring, which eliminates the need for a glass retainer. The retainer in Model BRG is a replaceable glass, which is not broken when key tested. When so operated, the cover hangs down (and cannot be made to stay in a closed position) indicating that the station was used to turn in the alarm. (OPERATED STATIONS CAN BE SEEN UP TO 100 FEET AWAY.)

Resetting is easily accomplished by use of a test-reset key.

Testing is accomplished by Notifier's simple and patented test-reset lock mechanism.

CONSTRUCTION

The attractive design of the stations highligh its engineered simplicity and unusual depend ability; bumping, shaking, or jarring will no activate the switch or circuit. Instructions fo operation of the station are provided on the front of the pull cover.

The BNG-1 and BRG-1 Stations are die-formed from ⅛" satin finish aluminum; with the operating instructions depressed and filled with rec enamel.

Stations come in surface or semi-flush mounting models.

Ratings of: 3 amp., 120 VAC, 120 VDC.

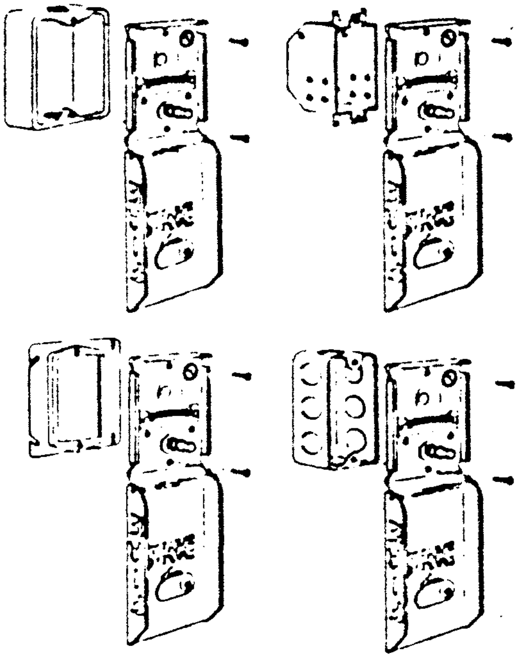
Master key fits all stations used in an installation of the same series.

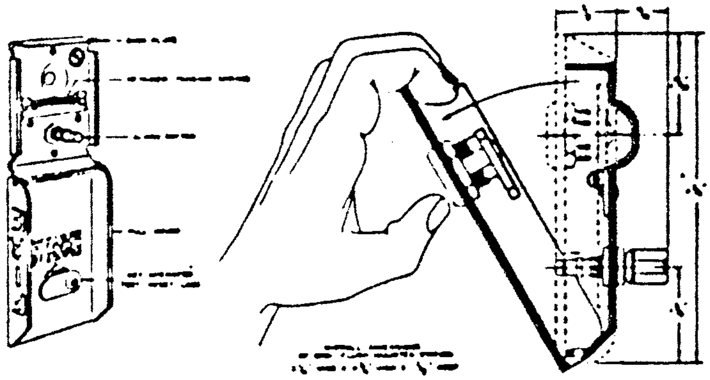
UNDERWRITERS' LABORATORIES LISTED.

FACTORY MUTUAL APPROVED.

ENGINEERS SPECIFICATIONS

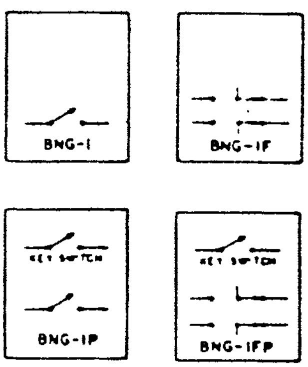
Manual Fire Alarm Stations shall be non-code, break-glass (or non-break-glass) type, equipment with a key operated test-reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of one hundred feet, front or side. Manual Stations shall be constructed of die-formed satin-finished aluminum, with operating directions provided on the cover in depressed red letters. The word FIRE shall appear on each side of the stations in depressed letters, one-half inch in size or larger. Stations shall be suitable for surface mounting on matching back-box, or semi-flush mounting on a standard single-gang box or switch plate, and shall be installed not less than four and one-half feet, nor more than six feet above the finished flood. Manual Stations shall be Underwriters' Laboratories Listed.



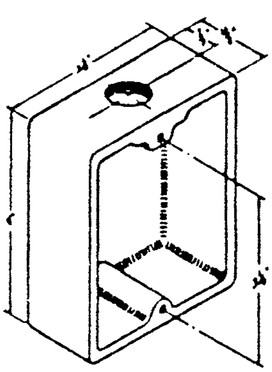


ORDERING INFORMATION

Model No.	Description
	MANUAL FIRE ALARM STATION
BNG or BRG — 1	Single-Pole, Single-Throw, Normally open Switch
BNG or BRG — 1F	Double-Pole, Double-Throw Switch
BNG or BRG — 1P	Single-Pole, Single-Throw, Normally open, Station Switch; Single-Pole, Single-Throw, Lock-type general alarm switch mounted under pull cover
BNG or BRG — 1FP	Double-Pole, Double-Throw Station Switch; Single-Pole, Single-Throw, Lock-type general alarm switch mounted under pull cover
BRG-1TS	BRG-1 with terminal strip for field wiring
BNG-1TS	BNG-1 with terminal strip for field wiring
BNG-1FTS	BNG-1F with terminal strip for field wiring



BACK-BOXES FOR ABOVE STATIONS
(Cast Aluminum — Baked Enamel)



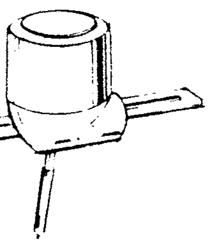
Model No.	Description
BG — 2	Surface mounting Back-Box for BNG Series stations, one end tapped for ½" conduit
BG — 2a	Same as BG — 2, except both ends tapped for ½" conduit
BG — 2b	Same as BG — 2, except one end tapped for ¾" conduit
BG — 2c	Same as BG — 2, except both ends tapped for ¾" conduit

Part No.	
1460000	Replacement Glass Retainer for BRG

orns shall incorporate a visual fire light model AV-32. The
ght shall:

flash during alarm ☐ remain steady during alarm

he lamp circuits shall be supervised and the lamp shall emain on after the horns have been silenced.

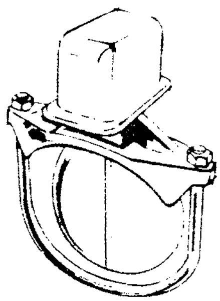


SPRINKLER SUPERVISORY SWITCHES

(Refer to catalog section E, page 20E-16-1).

Model NGV (OS & Y Gate Valve)
Model NIP (Indicator Post Valve)

ator Post Valve Supervisory Switches or Gate Valve Su- sory Switches shall be installed on each valve as desig- d on the drawings and/or as specified herein. Switches be mounted so not to interfere with the normal operation e valve and shall be adjusted to operate within two revo- ns of the valve control or when the stem has moved no e than one-fifth of the distance from its normal position. mechanism shall be contained in a weatherproof die cast inum housing which shall provide a ¾-inch tapped con- entrance and incorporate the necessary facilities for at- ment to the valve. Switch housings shall be finished in baked enamel. The switch mechanism shall have a mini- rated capacity of one amp. 125 volt A.C., or 0.25 amp. olt D.C. The entire installed assembly shall be tamper- f and arranged to cause a switch operation if the housing r is removed or if the unit is removed from its mounting. ator Post Valve Supervisory Switches or Gate Valve ches shall be Underwriters' Laboratories Listed and Fac- Mutual Approved.

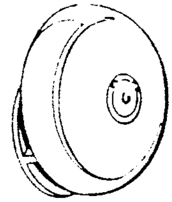


NE-TYPE TERFLOW DETECTOR

Refer to catalog section E, age 20E-12-2).

odel WFD

e-Type Waterflow Detectors shall be installed on the nkler system piping as designated on the drawings or as specified herein. Detectors shall be designed for nting on either vertical or horizontal piping, but shall not mounted in a fitting or within 12 inches of any fitting that ges the direction of waterflow, and shall have a sensi- setting to signal any flow of water that equals or exceeds discharge from one sprinkler head. Detector switch hanisms shall incorporate an instantly recycling pneu- c retard element with an adjustable range of 0 to 70 sec- . Switches shall have a minimum rated capacity of 7 s at 6-125 volts A.C./.25 amps at 6-24 volts D.C. and be actuated by a polyethylene vane extending into the rway of the piping. Detectors shall be of weatherproof, -tight construction and shall provide a ½ inch conduit en- ce and shall be finished in red baked enamel. Vane-type Detectors shall be Underwriters' Laboratories actory Mutual Approved. Operating pressure at 250 P.S.I.

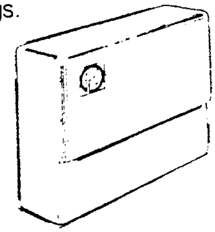


AUDIBLE ALARM BELLS

(Refer to catalog section F, page 20F-1-1 N-CO-Bell Brochure).

Series N-CO-Bell

Audible Alarm Signals shall be bells of the underdome vibrat- ing type with gongs no smaller than 6", 8" or 10" in diamete with red finish. Bells shall be polarized and operate at 24 vo D.C. Bells shall be suitable for surface or semi-flush moun ing. Surface mount shall be weatherproof. Semi-flush sha mount to any standard 4 inch square, 4 inch octagon or sir gle-gang box with a maximum projection of 2-½". Bells sha be located as shown on the drawings.

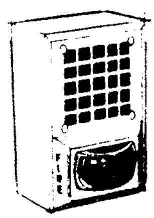


ALARM CHIMES

(Refer to catalog section F, page 20F-3-1)

Model Series CH

Signal chimes shall be installed in a vertical position only each location designated on the drawings and/or as spec fied herein. Chimes shall be of the single stroke solenoid ty designed for operation on 24 volt D.C. Chimes shall be su face mounted on standard outlet box or plaster ring or flu mounted in special back box with stainless steel flush cov plate. The chime mechanism shall be completely enclosed a removable cover to prevent dust accumulation and m chanical damage. Chime solenoids shall be of low current d sign with a maximum power requirement of 6 watts. Chim shall be polarized.



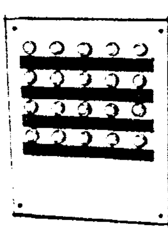
VISUAL & AUDIO/VISUAL ALARM DEVICES

(Refer to Catalog Section F, page 20F-5-2)

Model AV & V Series

Visual Fire Alarms shall be installed at each location des ated on the drawings and/or as specified herein. Vi alarms shall be of the continuous or flashing type desig for operation on 24 VDC. Visual Alarms shall be sur mounted on a special surface back box or flush mounted a special flush back box. Visual alarms shall be comple enclosed and for interior use only. Lamps shall have a m mum current requirement of 0.10 amps for 24 VDC. AV ries shall incorporate an alarm horn operating at 24 VDC a maximum current requirement of 0.20 amperes.

☐ The lamp circuits shall be supervised and the lamp remain on after the horns have been silenced.

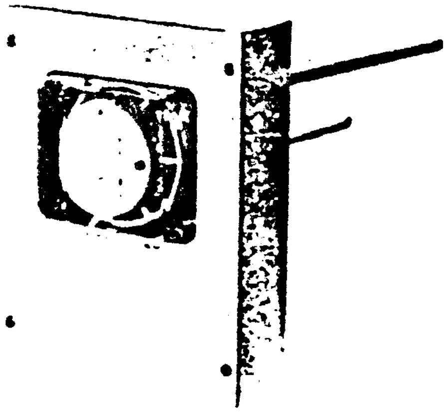


REMOTE ANNUNCIATOR

(Refer to catalog section F, page 20F-6-1).

Model Series AU (lamp type)

A remote annunciator shall be furnished and installe shown on the drawings. The annunciator shall be of the



FEATURES

- System or Single Station Operation
- Two or Four-wire Supervised Connection
- Accommodates 700 Series Smoke Detectors
- Remote Indication, Relay Test and Reset Options
- Transparent Inspection Port
- Attractive, Rugged and Compact Steel Housing
- UL and ULC Listed

UL

DESCRIPTION

The Model DH-20 air duct detector housing is intended for use on air handling ducts to sample air and detect visible and invisible smoke and combustion products. The housing accepts the 700 Series smoke detectors. Air sampling is accomplished through sampling and return tubes which extend into the ducts.

The detector may be utilized either as an AC powered single station device, or as a 2-wire or 4-wire DC powered device intended for system application. It is equipped with relay contacts which may be utilized directly for releasing device service in single station or 4 wire applications.

A transparent inspection port permits viewing of the detector alarm indicator over a wide viewing angle and inspection of the conditions of cleanliness inside of the detector mounting area without the need for disassembly.

AIR HANDLING SYSTEM CHARACTERISTICS

The DH-20 duct housing is intended for air velocities ranging from 500 ft. per minute to 3100 ft. per minute. The uniformity of sensitivity over the velocity ranges specified insures that compensating adjustments for operation at specific air velocities is unnecessary.

SAMPLING TUBES

The DH-20 utilizes one inlet and one outlet sampling tube. In order to insure uniform sampling of the air in the duct and to avoid the effects of laminar flow and stratification, it is recommended that the sampling tubes extend over the entire width of the duct. Sampling tubes are available in a variety of standard lengths to suit most applications. Tube length should be selected to match the width of the duct.

ELECTRICAL SPECIFICATIONS

	DC OPERATION
INPUT VOLTAGE:	18.0 - 40.0 DC
STANDBY CURRENT:	100 ua max. @ 24 VDC
ALARM CURRENT WITH REMOTE LED:	30 to 100 ma
ALARM CURRENT WITHOUT REMOTE LED:	15 to 100 ma
INPUT RATING (AC Operations):	120 VAC, 2 Watts

RELAY CONTACTS
Two Form C contacts rated 2 amps @ 26 VDC, or 120 VAC.

ACCESSORIES

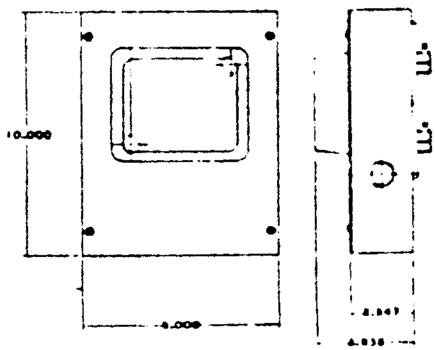
REMOTE ALARM INDICATOR — Model #RAI-2
Red bipolar LED glows under alarm conditions.

REMOTE ALARM INDICATOR/KEYSWITCH — Model #RMC-500
Red bipolar LED glows under alarm conditions. Momentary keyswitch acuates alarm relay and simultaneously resets detector.

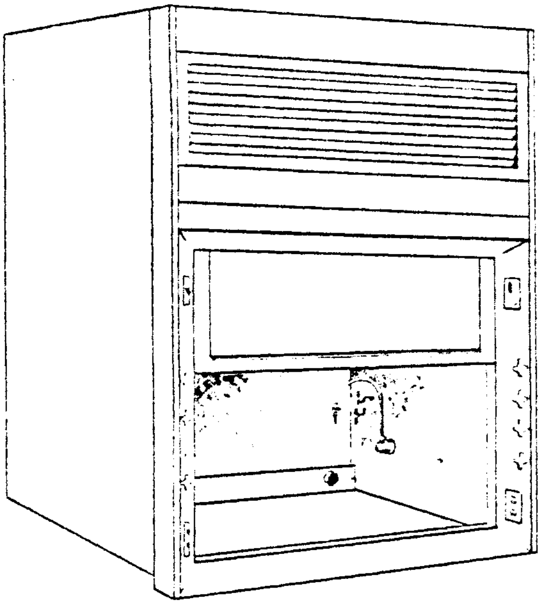
REMOTE POWER/ALARM INDICATOR/KEYSWITCH — Model #RCM-600
Green LED glows under power conditions; red bipolar LED glows under alarm conditions. Momentary keyswitch actuates alarm relay and simultaneously resets the detector.

AC WIRING KIT — Model #ACA-200
Provides single station, 120 VAC operation of the individual duct detector. Installs inside the DH-20 housing.

DIMENSIONS



TYPE SS SINGLE COMPARTMENT FUME HOOD SUPERSTRUCTURES



The Duralab Slimline Series Fume Hoods, combining the air-entrainment and air by-pass features, have a 3 11/16" wide full double wall construction to conceal the service fixture piping, providing flush and unobstructed interiors.

EXTERIOR: corrosion resistant lead coated steel with a specially formulated acid, alkali and solvent resistant baked-on resin paint finish. Superstructure end panels are easily removable for access to service fixtures and to piping.

INTERIOR: chemically treated, corrosion resistant Transite. No exposed metal fasteners. Access panels provided only where fixtures are specified.

EQUIPMENT: fluorescent light fixture and switch, B-2 adjustable baffle, enamelled lead-coated steel sash glazed with 1/4" thick laminated safety glass.

ACCESSORIES SHOWN (OPTIONAL)

4 - Electric, 2 - Air, 2 - Gas, 2 - Vacuum, 2 - Cold Water, 1 - Blower switch and pilot light, 8 - Remote control valves.

ALL ACCESSORIES ARE MOUNTED ON SIDE WALLS

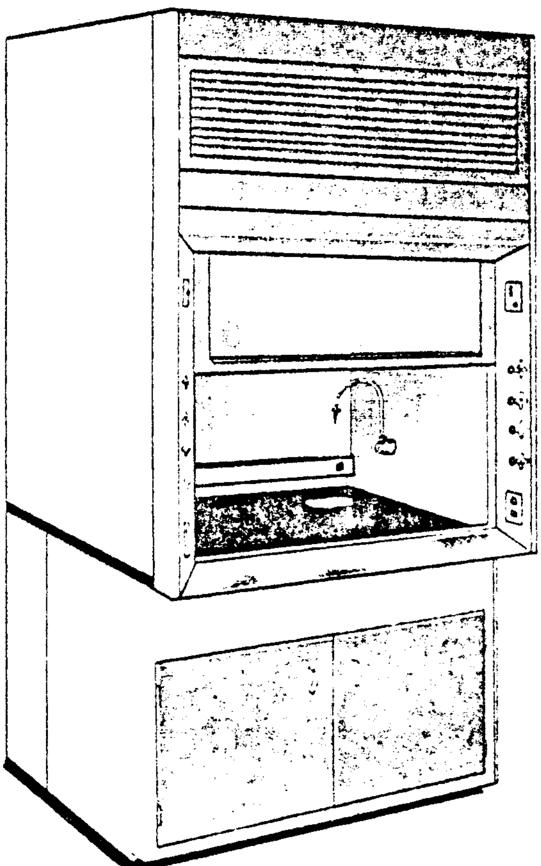
Cat. No.	Length	Width	Height	Face Area+
SS-3	35"	33"	60"	5.8
SS-4	47"			8.3
SS-5	59"			10.8
SS-6	70"			13.0
SS-7*	82"			15.5
SS-8*	94"			18.0

+Square feet (sash fully open)
*Sash has center mullion

REFER TO THE FOLLOWING PAGES FOR ADDITIONAL EQUIPMENT:

[1] Other interior linings and working surfaces - Pg. 250
[2] Exhaust and supply blowers - Pg 238.
[3] Other sash arrangements, filters, enclosures, racks - Pg. 249
[4] Additional accessories and service fixtures (special coated fixtures) Pg. 241.
[5] Water and vapor baths - Pg. 248.
[6] Roughing-in details - Pg. 214.

TYPE SS SINGLE COMPARTMENT FUME HOODS



The Duralab Slimline Series Fume Hoods, combining the Air-entrainment and Air-By-Pass features, have a 3 11/16" wide full double wall construction to conceal the service fixture piping, providing flush and unobstructed interiors.

EXTERIOR: corrosion resistant lead coated steel with a specially formulated acid, alkali and solvent resistant baked-on resin paint finish. Superstructure and panels are easily removable for access to service fixtures and to piping.

INTERIOR: chemically treated, corrosion resistant Transite. No exposed metal fasteners. Access panels provided only where fixtures are specified.

WORK SURFACE: Charcoal gray Colorlith. 1 1/4" thick, with raised front edge to contain spillage.

EQUIPMENT: fluorescent light fixture and switch, B-2 adjustable baffle, enamelled lead-coated steel sash glazed with 1/4" thick laminated safety glass, supporting base structure as shown.

ACCESSORIES SHOWN (OPTIONAL)

4 - Electric, 2 - Air, 2 - Gas, 2 - Vacuum, 2 - Cold Water, 1-3" x 6" oval cup sink, 1 - Blower switch and pilot light, 8 - Remote control valves.

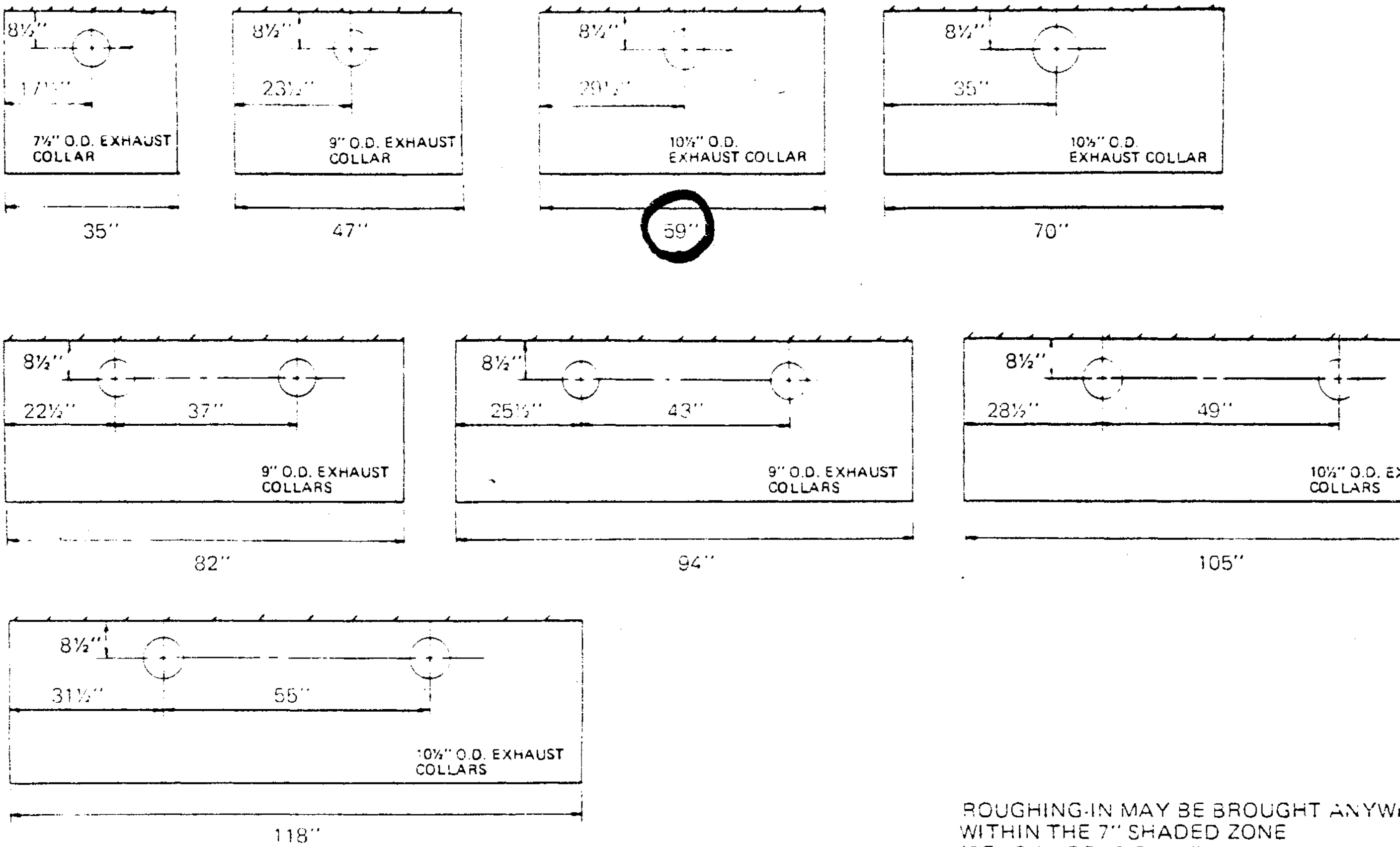
ALL ACCESSORIES ARE MOUNTED ON SIDE WALLS

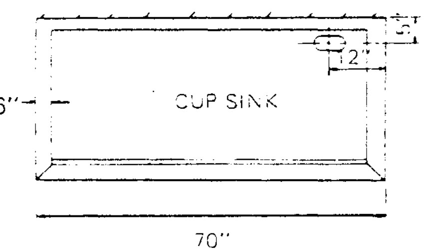
Cat. No.	Length	Width	Height	Face Area+
SS-03	2'-11"	2'-9"	8'-0"	5.8
SS-04	3'-11"			8.3
SS-05	4'-11"			10.8

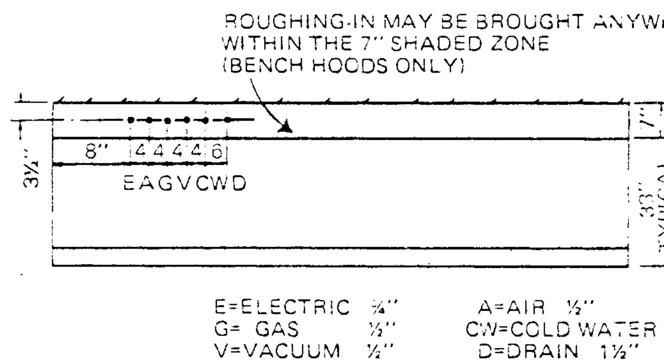
+Square feet (sash fully open)

SLIMLINE SERIES BENCH FUME HOODS

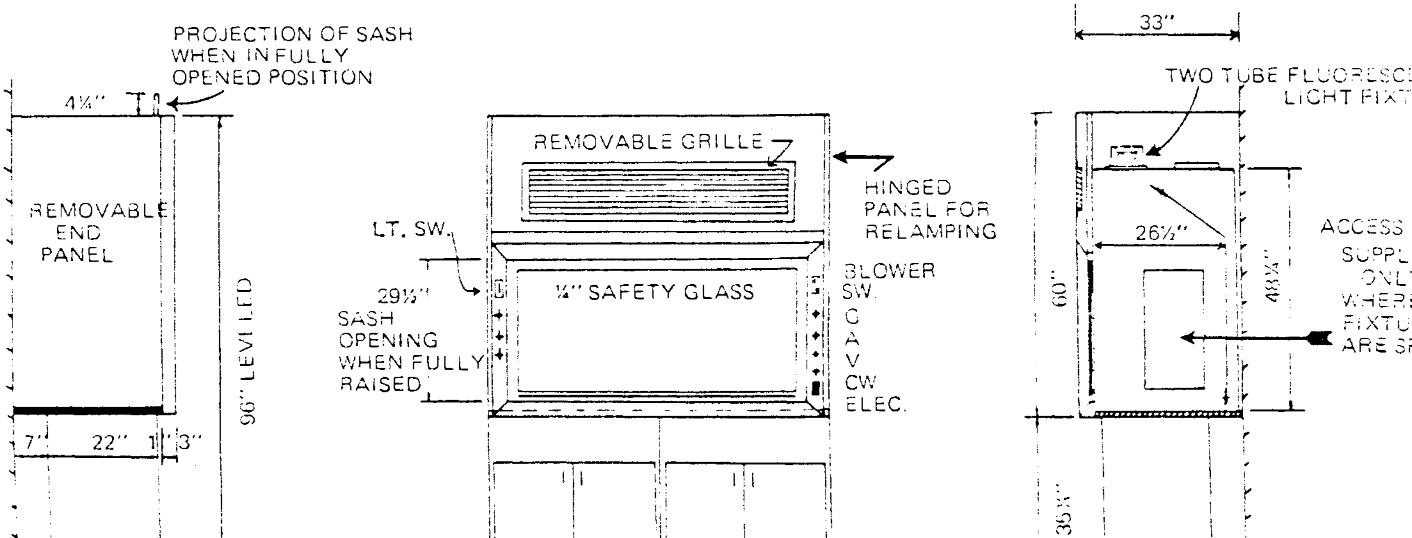
ROUGHING-IN DETAILS & DUCT COLLAR LOCATIONS & SIZES V-1







ALL PIPING FROM VALVES, CONDUIT, WIRING INTERNAL OR SUPPLY, TRAPS AND DRAINLINES BY OTHERS.



BLOWER CALCULATIONS

V-1 c

The total volume of air exhausted by a fume hood, expressed in cubic feet per minute (CFM), is the amount of air necessary to operate a fume hood under a selected set of conditions. This volume is the product of (1) the fume hood face velocity and (2) the square footage opening of the sash(s). (See chart below)

Face velocities for fume hoods are expressed in feet per minute (FPM) through the front hood opening, or hood face, and may vary considerably under different operating conditions such as cross drafts, large heat loads, hood location or apparatus within the fume hood chamber. Under normal operating conditions, blower requirements should be established utilizing a face velocity for the Duraline Series of 100 FPM, for the Slimline Series of 90 FPM and for the Airline Series of 80 FPM, all at a full sash opening. However, other velocities can be used for specific conditions.

The static pressure loss (S.P.), expressed in inches of water, is the sum of all friction losses throughout the hood and duct system and must be considered when selecting the blower. Since blower sizes are affected by the static pressure loss in the duct system, a lower static pressure loss is realized by minimizing the number of elbows and by avoiding sharp bends.

For calculation purposes, 3/8" should be used as the static pressure loss through the fume hood.

FUME HOOD FACE OPENINGS*

Overall Hood Length	DURALINE SERIES at Full Sash Opening	SLIMLINE SERIES at Full Sash Opening	AIRLINE SERIES at Full Sash Opening
35"	6.2	5.8	5.0
47"	8.6	8.3	7.3
59"	10.9	10.8	9.8
70"	13.0	13.0	12.1
82"	15.4	15.5	14.6
94"	17.8	18.0	17.1
105"	20.1	20.5	19.4
118"	21.9	23.0	22.1
47" Dist.	10.3	——	10.0
59" Dist.	13.5	——	13.5
70" Dist.	16.5	——	16.6
47" Walk-In	16.7	——	15.8
59" Walk-In	22.0	——	21.2
70" Walk-In	26.8	——	26.2

* Given in Square Feet.

SAMPLE CALCULATIONS

1. DURALINE SERIES FUME HOOD

Cat. #DS-06, 70" long overall.

1. Determined face velocity - 100FPM
2. Calculated friction loss (S. P.) in duct system (less Fume Hood) - 7/8"
3. Total S. P. in duct system with hood - 7/8" + 3/8" (for hood) = 1¼" total S. P.

From chart on Pg. 239, Duraline Series Fume Hood, operating @ 100 FPM, requires blower #S-33 under column heading 1¼ system static pressure.

When calculating air requirements, it is important that the blower is sized to account for the static pressure loss throughout the entire system and should take into account such friction developing items in the ductwork as sharp bends, 90° turns, constructions, dampers, animal screens, shutters and long runs.

V-2a

RANSFER GRILLES ND REGISTERS

erforated Face eries A-CT AN-CT ¼ inch margin inch margin

ALUMINUM

es A-CT and AN-CT transfer grilles and registers have perfor- faces with 51% free area and perform efficiently on transfer, rn and exhaust systems where ease of face maintenance is ortant. Faces are welded to the side margin, and are available dampers and mounting frames.

ATURES

verlap margins — two sizes are available. 1¼ inch wide, with sket, pierced screw holes and mounting screws (Series A-CT).

inch wide, with gasket, pierced screw holes and mounting rews (Series AN-CT). Fit lay-on tee bar ceiling opening with , 23, 35, 47 inch listed sizes which have full margin rein- rced edges to lay flat. (Corresponding overall sizes 11¾, 23¾, ¾, 47¾ inch.)

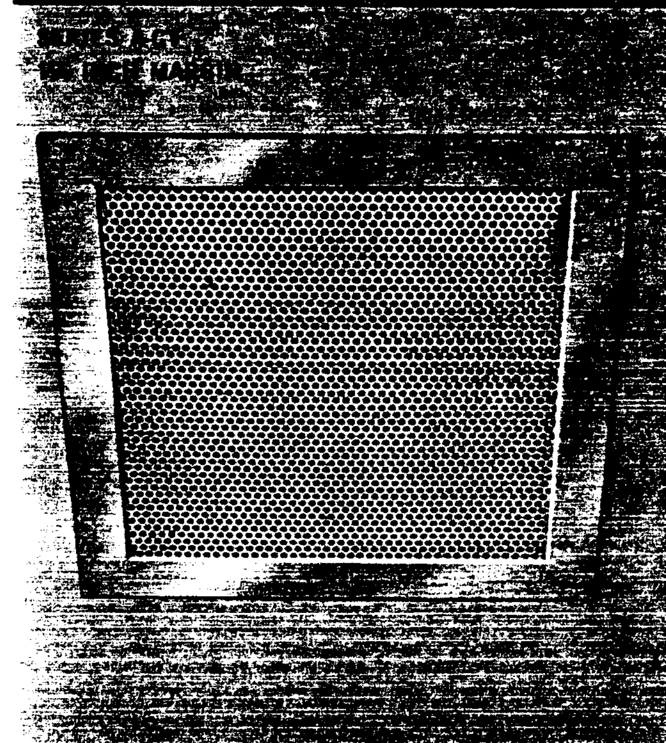
uminum construction — heavy gauge extruded aluminum mar- ns with hairline corners, perforated faces with 3/16 inch round les.

ounting frames — available for use as plaster stop or separable ame to facilitate grille removal. Matching screw holes in grille d frame factory pierced for easy installation.

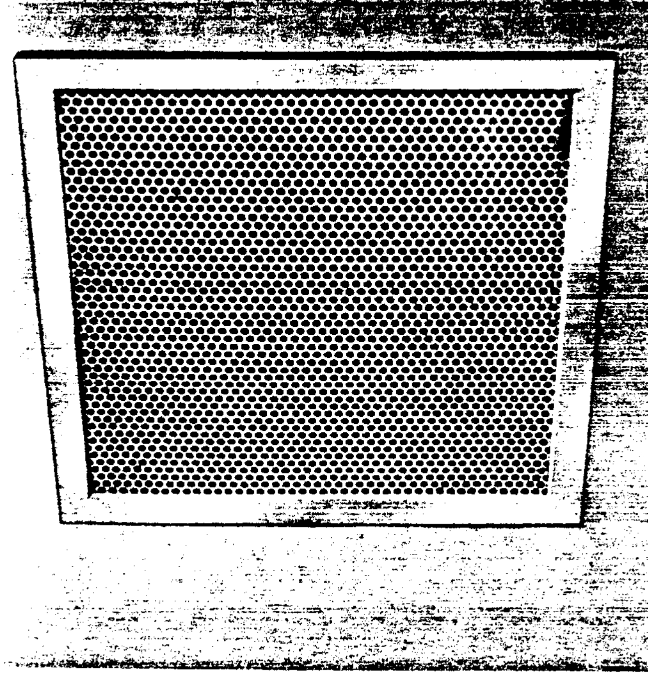
tegral dampers — heavy gauge extruded aluminum blades in a id aluminum frame. Opposed blade design with a removable y operator.

ked enamel finish — White No. 8-377 or etched and acrylic at (RL). Special paint finishes available.

STYLE



SERIES AN-CT



LISTED SIZES AVAILABLE in one piece

Min. W x H	Max. W x H
4 x 4	48 x 24
One inch increments of width and height.	
A-CT multiple sections furnished for sizes greater than maxi mum. AN-CT multiple sections furnished for sizes greater than maximum width; maximum height remains 24.	

All Dimensions in Inches.
Engineering Performance Data on page 55
Multiple section details and screw hole locations in Installation Manu

ENGINEERING PERFORMANCE DATA

V-2b

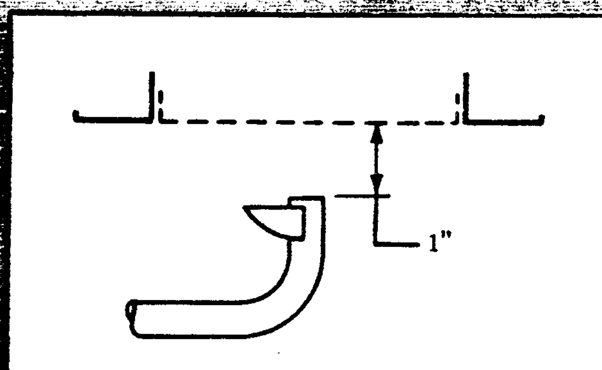
RETURN AIR GRILLES AND REGISTERS

		NC 20—25 Application Non-Ducted		NC 25—30 Application Ducted		NC 30—40 Application Ducted	
		P_s		P_s		P_s	
Listed Size W x H	A_K	—.02"	—.03"	—.08"	—.10"	—.15"	—.20"
		CFM	CFM	CFM	CFM	CFM	CFM
8 x 4	.26	35	45	70	80	95	110
8 x 6	.34	55	70	110	125	150	175
10 x 6	.42	70	85	140	155	190	220
12 x 6	.50	85	105	170	190	235	270
10 x 8	.53	95	115	190	210	260	300
12 x 8	.63	115	140	230	260	315	365
10 x 10	.64	155	190	310	345	425	490
18 x 6	.75	170	210	340	380	465	535
12 x 12	.89	230	280	460	515	630	730
18 x 12	1.3	350	430	700	780	955	1110
22 x 10	1.4	355	435	710	795	970	1120
24 x 12	1.7	470	575	940	1045	1280	1485
18 x 18	1.9	530	650	1065	1190	1460	1680
34 x 10	2.1	550	675	1100	1230	1510	1740
30 x 12	2.2	590	725	1180	1320	1620	1865
24 x 18	2.5	715	875	1430	1590	1950	2260
22 x 22	2.8	800	975	1590	1785	2190	2530
30 x 18	3.2	900	1100	1790	2010	2460	2840
24 x 24	3.3	950	1160	1890	2120	2600	3000
36 x 18	3.8	1070	1310	2140	2390	2920	3380
30 x 24	4.1	1195	1460	2380	2680	3260	3770
34 x 22	4.3	1240	1515	2480	2770	3390	3920
36 x 24	4.9	1440	1710	2870	3210	3940	4550
46 x 22	5.9	1690	2070	3380	3780	4625	5350
36 x 30	6.1	1800	2210	3600	4025	4930	5700
48 x 24	6.6	1940	2380	3890	4350	5325	6150

Symbols: P_s Static Pressure in. H_2O
A_K Outlet Area, 1" Out from Face
NC re 10db room attenuation

For grille details see page no. [illegible]

AIR MEASUREMENT



2220A Velometer Jet for V_K velocity measurement.
CFM = A_K x V_K

TD

UAL PLENUM
OP INLET

esigned and constructed as component assem-
ies to fit luminaires in installations requiring
ual plenums for higher capacity applications
th a single top inlet.

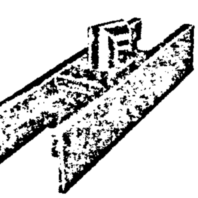
EATURES

- Air pattern adjustable with positive positioning "Uniflex" controller.
- Two styles and two heights.
- Separate inlet damper.
- Two way opposite air path.
- Horizontal or vertical pattern.
- Round inlets in four sizes.
- Air balancing damper adjustable through outlet slots.
- UL listed.
- Coordinated with over 30 luminaire manufacturers.
- Supply or return application.
- Low profile — minimum space requirements.

CCESSORIES

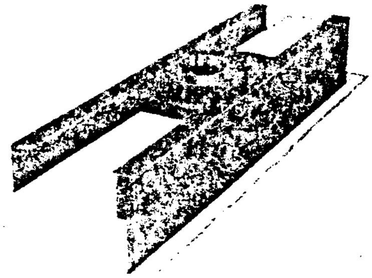
TYPE FTC FLEX TUBING CONNECTOR saves time and expense of field fasteners in joining flex tubing to the branch duct, as they screw easily into the flex and snap-in-fit a round hole in the metal duct. Available in 4" and 5" inlet sizes.

TYPE IJ INSULATION JACKETS of ½" glass fiber with aluminum vapor barrier to minimize heat transfer between the TD and the ceiling plenum. 1" insulation optional.

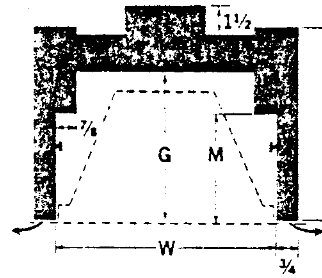


TYPE TU TURRET CONNECTORS facilitate alignment of unit inlet with flexible or metal ducting for ease of installation.

ual plenum units are fabricated as three separate pieces
esigned for snap-fastening together at installation. Gasketed,
lf-locating with positive holding springs — the crossover con-
ction securely holds the assembly and forms an air tight
onstruction. Savings in transportation, job handling, and job stor-

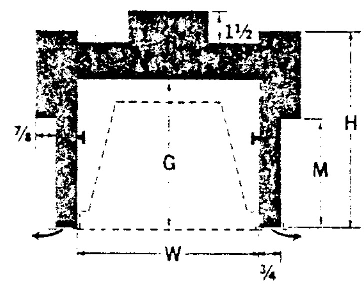


V-3a



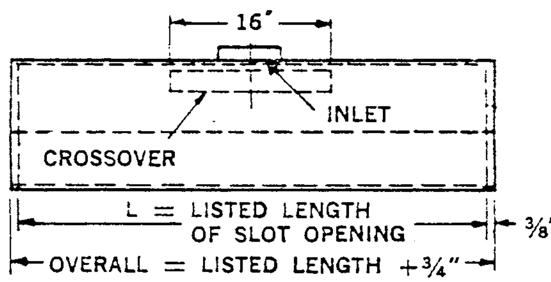
STYLE FF

Style KK available to fit Regressed Slot Luminaire.



STYLE EE

Style JJ available to fit Regressed Slot Luminaire.
Style EE, FF, JJ, KK available to fit 1" Throat Flange.



STANDARD "W" DIMENSION
9½" FOR 1 FOOT LUMINAIRE
21½" FOR 2 FOOT LUMINAIRE

OTHER WIDTHS AVAILABLE WHEN SPECIFIED.

STANDARD "L" LISTED LENGTHS
39½" FOR 4 FOOT LUMINAIRE
29" FOR 3 FOOT LUMINAIRE
20" FOR 2 FOOT LUMINAIRE

17"-60" LENGTHS AVAILABLE IN ½" INCREMENTS WHEN SPECIFIED.

DIMENSIONS

	G		H		M	
Height	6"	8"	6"	8"	6"	8"
Style FF	4 3/16	6 3/16	6 3/16	8	2½	4⅜
Style EE	4 3/16	6 3/16	6 3/16	8	2½	4⅜

All Dimensions in Inches.

HOW TO SPECIFY

8 x 39½ x 21½ 4TD6-T2 STYLE FF

Listed Height x | Nominal Luminaire | Inlet | Dual Plenum Cross-over | Dual Plenum | Dual Plenum | Plenum Style

TD

DUAL PLENUM SIDE INLET

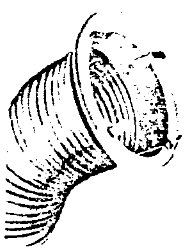
V-3

Designed and constructed as component assemblies to fit luminaires in installations requiring dual plenums for higher capacity applications with a single side inlet.

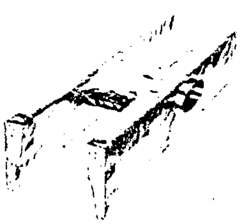
FEATURES

- Air pattern adjustable with positive positioning "Uniflex" controller.
- Two styles and two heights.
- Separate inlet damper.
- Two way opposite air path.
- Horizontal or vertical pattern.
- Oval inlets in three sizes.
- Air balancing damper adjustable through outlet slots.
- UL listed.
- Coordinated with over 30 luminaire manufacturers.
- Supply or return application.
- Low profile — minimum space requirements.

ACCESSORIES



TYPE FTC FLEX TUBING CONNECTOR saves time and expense of field fasteners in joining flex tubing to the branch duct, as they screw easily into the flex and snap-in-fit a round hole in the metal duct. Available in 4" and 5" inlet sizes.

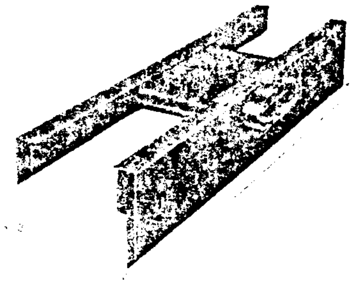


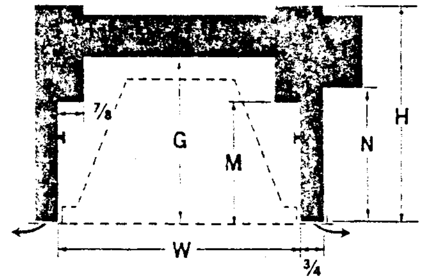
TYPE IJ INSULATION JACKETS of ½" glass fiber with aluminum vapor barrier to minimize heat transfer between the TD and the ceiling plenum. 1" insulation optional.

HOW TO SPECIFY

8 x 39½ x 9½ 4TD6-S1 STYLE FH

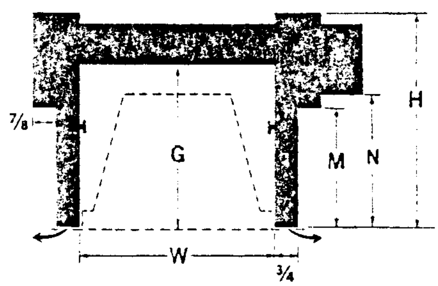
- Listed Height x Length x Width
- Nominal Luminaire Length 4'-3'-2'
- Inlet Size 4"-5"-6"
- Dual Plenum Cross-over
- Dual Plenum Side Inlet
- Dual Plenum Width 1'-2'
- Plenum Style





STYLE FH

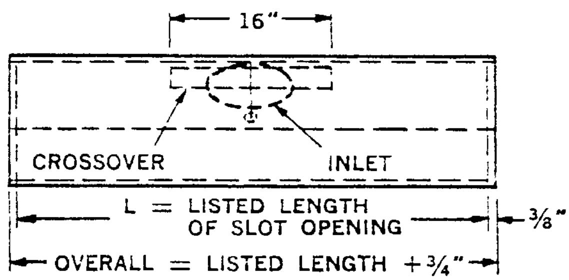
Style KM available to fit Regressed Slot Luminaire.



STYLE EG

Style JL available to fit Regressed Slot Luminaire.

Style EG, FH, KM, JL available to fit 1" Throat Flange.



STANDARD "W" DIMENSION
9½" FOR 1 FOOT LUMINAIRE
21½" FOR 2 FOOT LUMINAIRE

OTHER WIDTHS AVAILABLE WHEN SPECIFIED.

STANDARD "L" LISTED LENGTHS
39½" FOR 4 FOOT LUMINAIRE
29" FOR 3 FOOT LUMINAIRE
20" FOR 2 FOOT LUMINAIRE

17"-60" LENGTHS AVAILABLE IN ½" INCREMENTS WHEN SPECIFIED.

DIMENSIONS

	G		H		M		N	
Height	6"	8"	6"	8"	6"	8"	6"	8"
Style FH	4 3/16	6 1/16	6 1/16	8	2½	4 3/3	2¾	4⅝
Style EG	4 3/16	6 1/16	6 1/16	8	2½	4⅜	2¾	4⅝

All Dimensions in Inches.

Dual plenum units are fabricated as three separate pieces designed for snap-fastening together at installation. Gasketed, self-locating with positive holding springs — the crossover connection securely holds the assembly and forms an air tight construction. Savings in transporta-

ENGINEERING PERFORMANCE DATA

V-3C

NOTES:

Use Chart 2 to evaluate room air motion for modular unit installation, all unit lengths.
Use Table 2 to evaluate performance for individual units, nominal 4 ft. length.
Use Table 2A to evaluate performance for individual units, nominal 2 ft. length.

A Air change based on 8'-6" ceiling height. For other ceiling heights, enter Chart 2 with design cfm reduced by following amounts

9'-0" less 5%
9'-6" less 10%
10'-0" less 15%
10'-6" less 20%

B Room velocity V_R, measured in the occupied zone, and terminal velocity V_T at the zone boundary, are based on a cooling differential of 20 F.

C Luminaire or TD module area served in sq. ft.
Module area 25–150 sq. ft.

D cfm/unit for 20"–48" length.

CHART 2 — ROOM VELOCITY

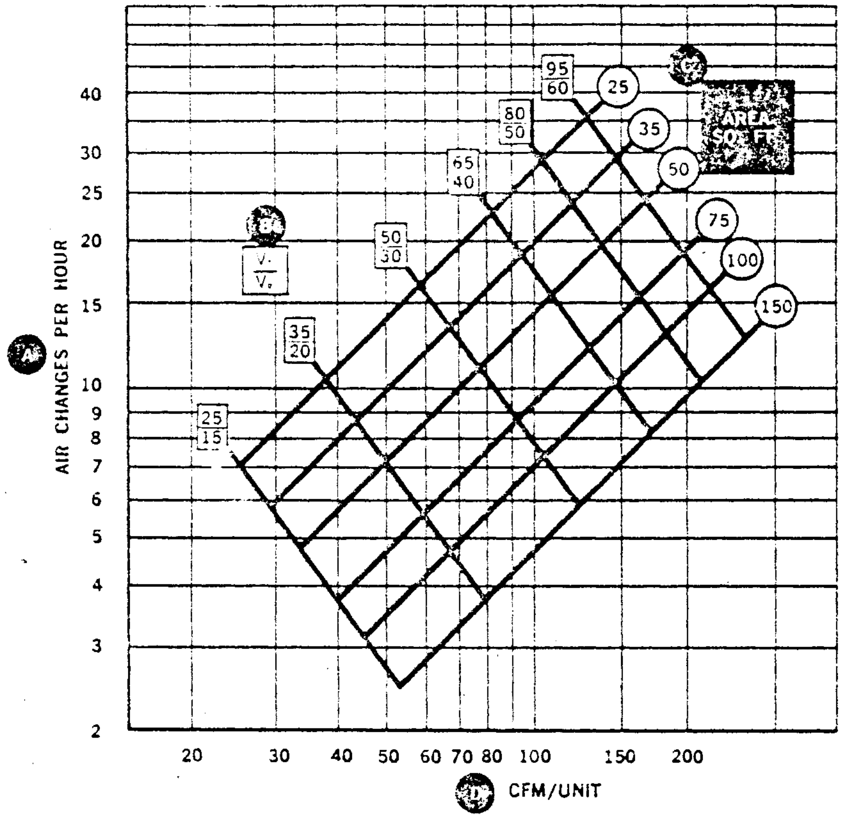


TABLE 2 SUPPLY PERFORMANCE, Nominal 4 Ft. Length, Horizontal Pattern

CFM	Minimum P_s* in. H_2O				NC @ Minimum P_s							Throw in Feet		Spread in Feet
	Inlet Size				T1 Inlet Size			T2 Inlet Size				@ 125 fpm V_T	@ 100 fpm V_T	
	8"	6"	5"	4"	6"	5"	4"	8"	6"	5"	4"			
60	.02	.03	.04	.04	<20	<20	<20	<20	<20	<20	<20	1	2	4-6
80	.03	.04	.06	.06	<20	<20	25	<20	<20	20	20	2	3	5-6
100	.04	.07	.09	.09	<20	<20	30	<20	<20	25	25	3	4	6-7
120	.06	.10	.13	.13	25	25	35	20	20	25	30	4	5	6-7
140	.08	.14	.17	.18	25	30	35	25	25	30	35	5	6	7-8
160	.11	.19	.22	.24	30	30	40	25	30	30	40	5	7	8-9
180	.13	.25	.28	.31	35	35	45	30	35	35	40	6	8	9-12
200	.16	.31	.34	.39	40	40	45	30	35	40	45	7	9	10-13
220	.20	.36	.41		40	40		35	40	40		8	9	10-14
240	.23	.45			45			35	40			8	10	10-14

*Reduce P_s 10% for vertical pattern

TABLE 2A SUPPLY PERFORMANCE, Nominal 2 Ft. Length, Horizontal Pattern

CFM	Minimum P_s* in. H_2O				NC @ Minimum P_s							Throw in Feet		Spread in Feet
	Inlet Size				T1 Inlet Size			T2 Inlet Size				@125 fpm V_T	@100 fpm V_T	
	8"	6"	5"	4"	6"	5"	4"	8"	6"	5"	4"			
60	.04	.06	.07	.08	20	20	25	<20	<20	20	20	2	3	4-6
80	.06	.10	.11	.12	25	25	30	20	20	25	25	3	4	5-6
100	.08	.14	.17	.18	30	30	35	25	25	30	30	4	5	6-7
120	.12	.20	.26	.27	35	35	40	30	30	35	35	5	7	6-7
140	.16	.28	.35	.36	35	40	45	30	30	35	40	6	8	7-8

*Reduce P_s 10% for vertical pattern.
Nominal 2 ft. data based on ADC approved nominal 4 ft. data.

Inlet Size	P_V Velocity Pressure in. H_2O — CFM									
	60	80	100	120	140	160	180	200	220	240
8"	.01	.01	.01	.01	.01	.01	.02	.02	.03	.03
6"	.01	.01	.02	.02	.03	.04	.05	.07	.08	.09
5"	.01	.02	.03	.05	.07	.09	.11	.14	.16	.19
4"	.03	.05	.08	.12	.16	.21	.27	.33	.40	.48

$P_T = P_V + P_S$

Multiple Outlet Addition to NC Rating Tables 2, 2A					
Module Area — Sq. Ft.					
25	35	50	75	100	150
−10	−10	−5	−5	−5	0

SYMBOLS

TITUS® PRODUCTS

System Powered Assemblies

V-4a

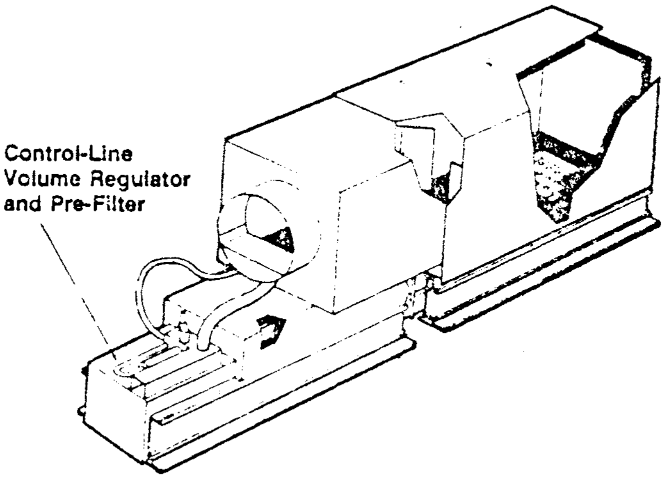
Models TCT-ML & TC-ML

Variable Volume Full Shut-Off With Modulinear Diffuser

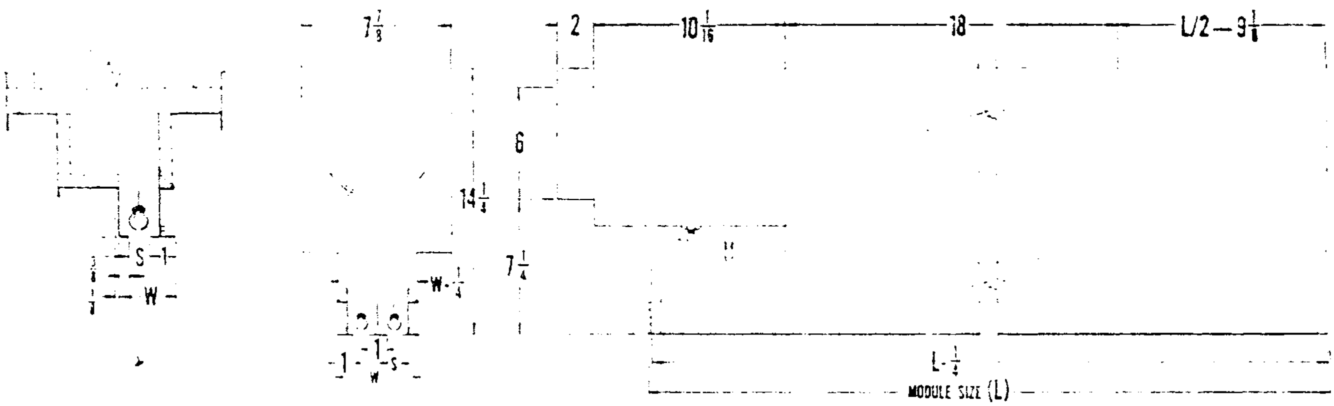
Model TCT-ML is a complete system powered assembly mounted directly on a 2-slot Modulinear diffuser. The assembly includes a diffuser mounted thermostat, control line filter, volume regulator and flow controller. It varies the air flow rate from 0 to 100%. Available with a 2-slot diffuser only.

Model TC-ML is the same as Model TCT-ML except that it does not include the thermostat, control line filter and volume regulator. It is designed to be controlled from the auxiliary control line connection on another assembly, o from a remote thermostat and volume regulator. Available with either a 1- o 2-slot diffuser.

A flow rate dial on the assembly adjust the flow controller orifice plate to pre select the maximum flow rate. This fiel adjustment is normally performed onl once, when the system is initially bal anced. The flow controller self-adjust for varying inlet pressures.



Module Size L = 24", 30", 36", 48", or 60"
Slot Width S = 1"
Overall Width W = 2⅜" for one slot
= 5" for two slots



Finish:

Diffuser face is #25 Off-White ENVIRO-THERM enamel. Pattern controller is flat black. For other finishes see inside back cover or your TITUS Products representative for Color Selection Guide AA-O.

Features:

- Pressure independent control
- Built-in control system. No field piping.
- Attached MODULINEAR diffuser. Adjustable for horizontal, vertical, one-way or two-way throw.
- One-inch, 1½ pound insulation, coated to prevent air erosion. Meets requirements of NBFU90A and 90B.

Thermostats: page G53

Thermostat/volume regulator dia grams: page G54

Applications: pages G37 and G38

Controller operating principle: pag G36

System Powered Assemblies

Model TCT-ML & TC-ML Performance

TITUS PRODUCTS

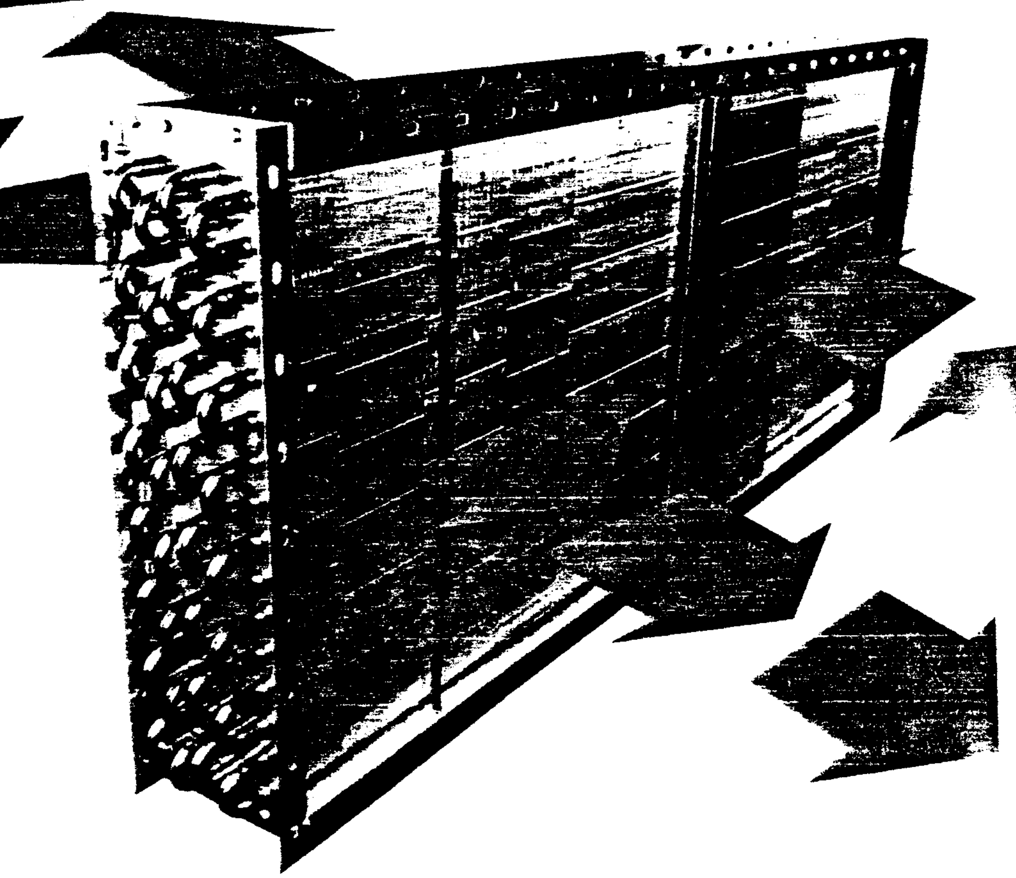
V-4 b

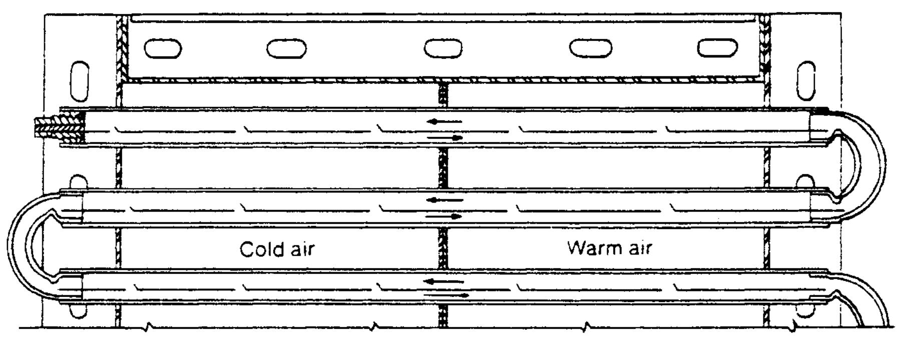
- Minimum SP. Static pressure difference from assembly inlet to discharge, in inches of water. Minimum required to maintain rated flow.
- CFM. Assembly flow rates are affected by downstream resistance. To obtain ratings shown in performance table, downstream resistance must be less than 0.30 inches of water.
- L_w. Sound power level in third octave band, re 10^{-12} watts.
- Room Outlet NC. Room noise criterion curve which will not be exceeded by assembly-generated noise transmitted through duct to room. Based on 10dB room absorption, re 10^{-12} watts.
- Diffuser. Performance table is based on diffuser 48 inches long with two 1-inch slots. Pattern controllers set for two-way horizontal air flow.
- Throw. Minimum throw is to terminal velocity of 150 fpm, middle to 100 fpm, maximum to 50 fpm.
- Contact your TITUS Products representative for other sizes and models.

Cfm	Throw, Ft.	1 In. S.P.		1.5 In. S.P.		2 In. S.P.		3 In. S.P.	
		Lw 3RD O.B.	Room NC OUTLET	Lw 3RD O.B.	Room NC OUTLET	Lw 3RD O.B.	Room NC OUTLET	Lw 3RD O.B.	Room NC OUTLET
75	1-2-4	53	33	54	34	55	35	57	37
100	1-2-4	55	35	56	36	57	37	58	38
125	2-3-5	56	36	57	37	58	38	60	40
150	3-4-6	57	37	59	39	60	40	61	41
175	3-5-7	58	38	60	40	61	41	62	42
200	4-6-8	59	39	61	41	62	42	63	44
225	4-7-9	60	40	61	41	62	42	64	45
250	5-7-10	—	—	62	42	63	44	64	45

V-5a

iAMEWELL HERMOSIPHON EAT ECOVERY OIL ...





mewell Thermosiphon heat
overy coils are designed for
in a wide range of air condi-
ing and industrial/commercial
t recovery applications.
erever hot, contaminated air
as must be exhausted, and
ther stream of cooler air
st be heated, there is poten-
for heat recovery and energy
ings. Coils can serve air-
ams ranging in temperatures
n −50°F to 500°F or install
or more remote coils with
rconnecting piping using the
rmosiphon principal.
antages: It's a passive device
no moving parts. Because
e are no mechanical parts,
only maintenance required
ccasional cleaning. Since
e is nothing to wear out,
ected service life is long.
so provides the versatility
ir-to-air or air-to-water heat
overy systems.
events cross-contamination
ause the coil is separated
two casings with double
al wall separating air streams.
e fin coils are easy to clean.
designed to withstand differ-
al pressures between air-
ams to 10" W.G.
as all-metal air-side com-
ents. Coils meet most local
safety codes.
simple to install. Compact.
piping. No flexible ducts

tion is achieved with no moving parts.

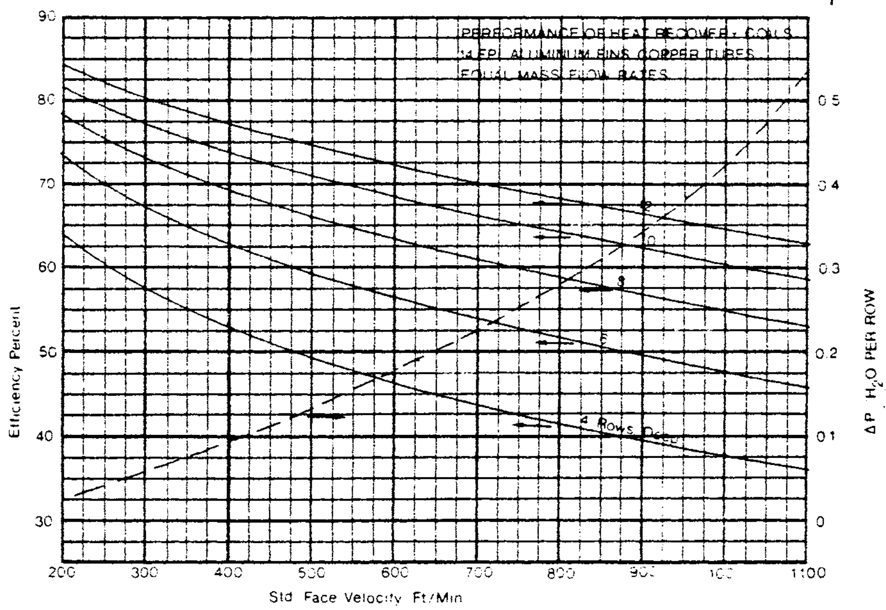
The Gamewell heat recovery coil consists of horizontal tubes expanded into vertical fins. A coil casing surrounds the coil, and central partitions divide the coil into two faces, one for the cold air stream, the other for the hot air stream. The casing and central partitions are provided with flanges and bolting holes for easy duct attachment.

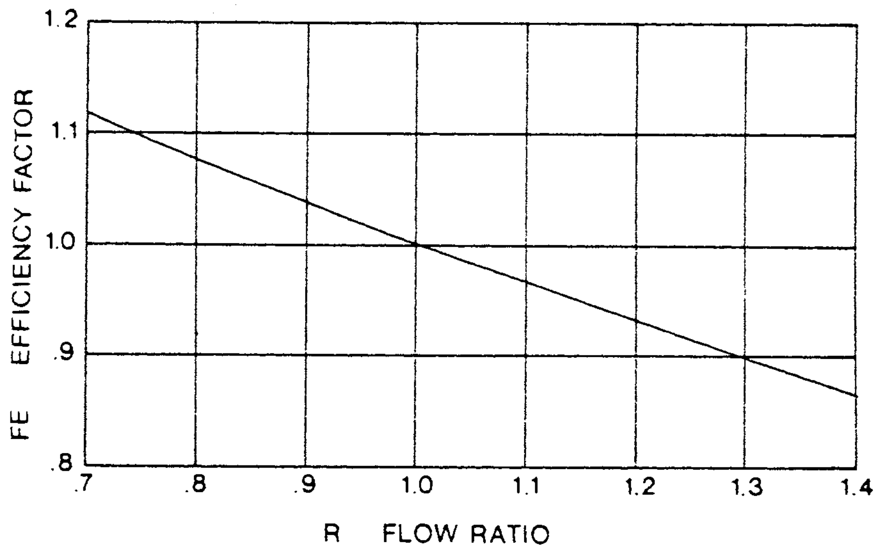
The rate of heat recovery is proportional to the temperature

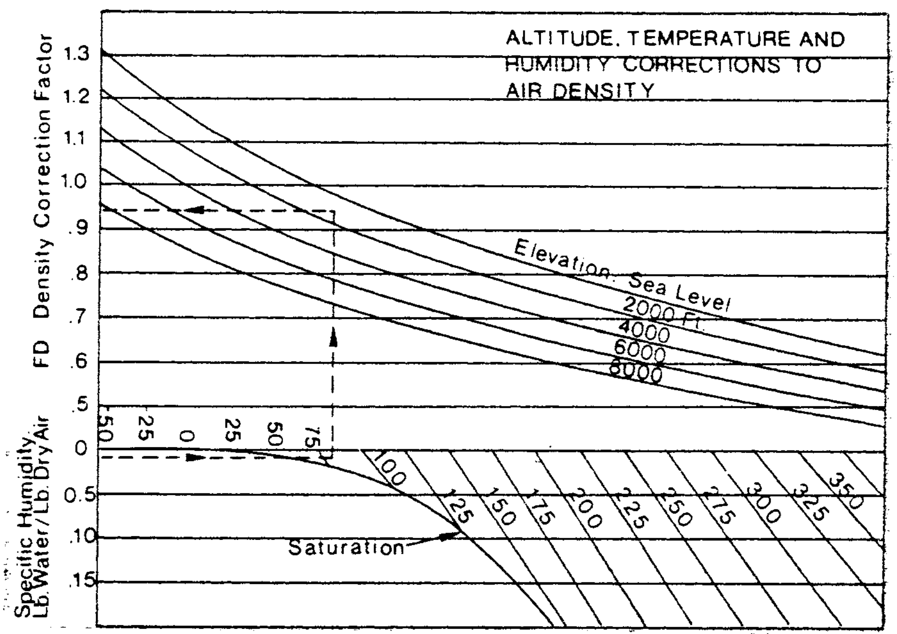
greater the rate of heat recovery efficiency.

The basic heat recovery coil is a completely passive device ... as long as air is flowing across both faces, the unit will recover a fixed percentage of heat available. In some applications it is necessary to control the rate of heat recovery to maintain certain conditions in space or process. For applications where frost formation is likely, an optional defrost kit is available which periodically deactivates the cold-

copper tubes, aluminum fins (14 fins/inch), and 16 gauge galvanized steel coil casing.
Options include . . . • 8 to 14 fpi aluminum or copper fins • Aluminum casing • Stainless steel casing • Carbon steel tubes, fins and casing (4, 8 or 12 fpi) • Chemical resistant polyurethane dip coating of all airside surfaces.
All coils comply with ANSI Standard B9. The working fluid used within the coil is non-toxic and non-flammable. It's guaranteed to produce no less than rated efficiency with no more than rated air side pressure drops when operated at rated air flows and temperatures and when properly installed. And to be free from defects in material or workmanship for a period of 15 months from date of shipment or 12 months from date of initial operations, whichever occurs first.
Gamewell also manufactures Tailor-Pak™ heat recovery units complete and ready for field installation with a minimum of field labor. They feature modular design that allows a wide variety of options to meet customer needs. Tailor-Pak™ heat recovery packages may include Thermosiphon coils, fans, filters and supplemental heating and refrigeration equipment. These packages are of industrial quality construction designed for many years of reliable operation. They are available for air flow rates ranging from 3,600 to 60,000 cfm.

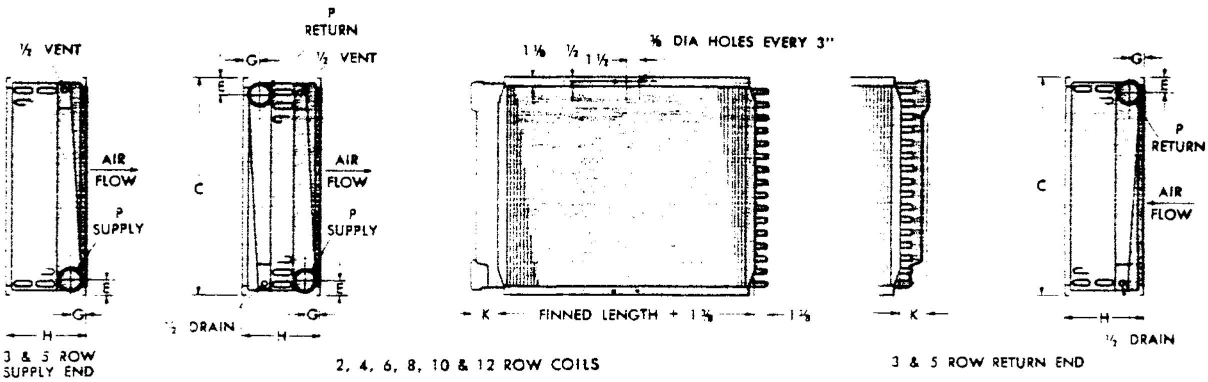






COOLING COIL DIMENSIONAL DATA

E W

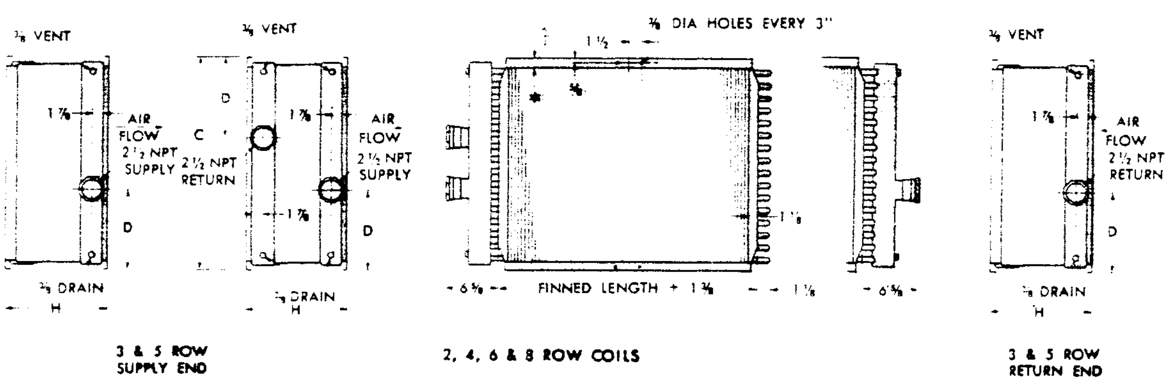


NOTE: All dimensions approximate.
Certified prints on request.

E 66-1— Type W Coil Dimensions (Headers 33" and less)

FINNED WIDTH	C	E	G	H 2 ROW	3 ROW	4 ROW	5 ROW	6 ROW	8 ROW	10 ROW	12 ROW	K	P (NPT)
12	13½	1½	2⅛				*					2	1¼
18	19½						*						
24	25½	2¼	1⅞	6½	8	9½	11	12½	15½	18½	21½	3⅜	2½
30	31½												
33	34½												

row type W coil not available in 12" and 18" finned width.



E 66-2 – Type W Coil Dimensions (36", 42" and 48" Headers)

INED DTH	C	D	H 2 ROW	3 ROW	4 ROW	5 ROW	6 ROW	8 ROW
36	38¼	16⅛						
42	44¼	19⅛	6½	8	9½	11	12½	15½
48	50¼	22⅛						

CHILLED WATER COOLING COIL CAPACITIES

V-6b

80 / 90 EDB — 68 EWB

80/68 EDB/EWB

WTR	FPS	ROW	FIN	400FPM MBH	400FPM LDB	400FPM LWB	500FPM MBH	500FPM LDB	500FPM LWB	600FPM MBH	600FPM LDB	600FPM LWB	700FPM MBH	700FPM LDB	700FPM LWB
10	1	2	55	6.1	68.9	63.6	6.5	69.9	64.2	6.9	70.6	64.7	7.2	71.2	65.0
			56	7.0	66.8	62.9	7.5	67.9	63.6	7.9	68.8	64.2	8.3	69.3	64.6
			58	7.9	64.7	62.2	8.4	65.9	63.0	8.9	66.6	63.7	9.3	68.0	54.1
		4	55	10.9	[illegible]	[illegible]	11.8	[illegible]	[illegible]	12.9	64.7	61.7	13.8	[illegible]	62.4
			56	12.2	59.8	58.6	13.4	61.4	59.9	14.3	62.6	[illegible]	15.1	63.5	61.8
			58	13.6	58.1	57.5	14.7	59.7	59.6	15.7	60.6	60.0	16.6	61.5	60.6
		6	55	14.4	57.8	56.6	16.2	59.2	58.0	17.4	60.5	59.1	18.5	61.6	60.0
			56	16.2	55.6	55.1	18.0	57.3	56.7	19.6	58.8	58.0	20.8	59.7	58.9
			58	17.6	54.0	53.9	19.6	55.9	55.6	21.2	57.2	57.0	22.5	58.3	58.1
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	19.8	51.8	51.7	22.8	53.7	53.4	24.6	55.2	54.8	26.8	56.4	56.0
			56	21.6	50.3	50.1	24.0	52.0	51.9	27.2	53.6	53.3	28.6	54.7	54.6
			58	22.7	48.9	48.8	26.2	50.8	50.7	28.6	52.3	52.2	31.4	53.6	53.5
	2	2	55	7.4	67.7	62.5	8.0	68.9	63.3	8.5	69.7	63.9	8.9	70.4	64.3
			56	8.7	65.4	61.5	9.5	66.6	62.4	10.1	67.6	63.1	10.6	68.4	63.6
			58	10.0	62.9	60.5	10.8	64.4	61.5	11.5	65.5	62.3	12.1	66.3	62.9
		4	55	12.8	[illegible]	[illegible]	14.2	61.8	[illegible]	15.3	[illegible]	[illegible]	16.3	64.1	[illegible]
			56	14.6	57.9	[illegible]	[illegible]	[illegible]	[illegible]	17.8	[illegible]	[illegible]	18.8	61.7	[illegible]
			58	16.6	56.4	[illegible]	[illegible]	[illegible]	[illegible]	19.6	[illegible]	[illegible]	21.2	[illegible]	[illegible]
		6	55	16.9	55.5	54.5	19.0	57.2	56.0	20.8	58.6	57.2	22.3	59.7	58.2
			56	18.8	53.6	52.8	21.5	54.7	54.2	23.7	56.1	55.8	25.5	57.3	56.8
			58	20.7	51.1	51.0	23.6	52.8	52.7	26.0	54.3	54.1	28.0	55.6	55.3
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	22.1	48.7	48.5	25.6	51.4	51.1	28.6	52.8	52.6	31.2	54.0	53.7
			56	23.9	47.8	47.7	28.0	49.5	49.2	31.6	50.7	50.6	34.7	51.8	51.7
			58	29.2	46.4	46.3	28.7	47.9	47.8	33.7	49.2	49.1	37.3	50.4	50.3
	4	2	55	8.5	66.8	61.7	9.3	68.0	62.5	10.0	68.9	63.1	10.5	69.7	63.6
			56	10.2	64.0	60.3	11.3	65.4	61.3	12.2	66.4	62.0	12.9	67.3	62.6
			58	11.9	61.3	58.9	13.1	62.8	60.1	14.1	64.0	61.0	14.9	65.0	61.6
		4	55	14.4	58.9	58.7	16.1	60.3	58.1	17.6	61.6	59.1	18.8	62.8	59.8
			56	16.7	55.8	54.7	18.6	57.5	56.1	20.8	58.8	57.2	22.4	59.8	58.1
			58	18.8	53.2	52.7	21.4	54.8	54.2	23.6	56.4	55.6	25.4	57.6	56.7
		6	55	18.5	53.9	53.0	21.2	55.6	54.5	23.4	57.0	55.7	25.3	58.2	56.7
			56	20.9	51.1	50.7	24.1	52.7	52.3	27.0	54.1	53.5	29.4	55.3	54.6
			58	22.8	48.9	48.8	26.6	50.5	50.4	29.8	51.9	51.7	32.7	53.1	52.9
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	23.5	49.2	49.1	27.8	49.7	49.5	31.2	51.1	50.8	34.4	52.3	51.9
			56	25.3	46.2	46.1	30.2	47.5	47.4	34.6	48.6	48.5	38.5	49.7	49.6
			58	26.8	44.8	44.7	32.8	46.0	45.8	36.8	47.0	46.9	41.4	48.0	47.9
	8	2	55	9.3	66.1	61.1	10.2	67.3	61.9	11.0	68.3	62.6	11.7	69.1	63.1
			56	11.4	63.0	59.4	12.7	64.4	60.4	13.8	65.5	61.1	14.7	66.4	61.8
			58	13.5	59.8	57.6	15.0	61.5	58.8	16.3	62.8	59.8	17.4	63.8	60.5
		4	55	[illegible]	57.8	[illegible]	17.8	[illegible]	57.1	[illegible]	[illegible]	[illegible]	[illegible]	61.6	[illegible]
			56	18.9	54.6	53.6	20.8	[illegible]	54.6	22.8	57.5	55.9	25.6	58.6	56.8
			58	20.8	51.6	51.1	23.8	53.2	52.7	26.3	54.7	53.8	28.6	55.9	55.0
		6	55	19.6	52.8	52.0	22.6	54.5	53.4	25.2	55.9	54.6	27.4	57.0	55.8
			56	22.2	49.7	49.4	26.0	51.3	50.8	29.3	52.8	52.0	32.2	53.7	53.1
			58	24.2	47.4	47.3	28.6	48.8	48.7	32.5	50.1	50.0	35.9	51.3	51.1
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	24.4	47.3	47.2	28.8	48.7	48.5	32.9	49.8	49.6	36.8	51.0	50.7
			56	26.2	45.3	45.2	31.6	46.3	46.2	36.5	47.3	47.2	41.0	48.3	48.2
			58	27.4	43.9	43.8	33.3	44.8	44.7	38.8	45.7	45.6	43.9	46.5	46.4
12	1	2	55	5.8	69.1	63.8	6.2	70.0	64.4	6.6	70.8	64.8	6.9	71.3	65.1
			56	6.7	67.0	63.1	7.2	68.1	63.8	7.7	68.9	64.3	7.8	69.9	64.8
			58	7.6	64.9	62.4	8.1	66.1	63.2	8.6	67.0	53.8	8.9	68.5	54.3
		4	55	10.4	62.5	60.1	11.4	63.6	61.2	12.1	64.9	62.0	12.8	65.8	62.8
			56	11.8	60.2	59.0	12.9	61.7	60.2	13.8	62.9	61.1	14.6	63.7	61.8
			58	13.0	58.5	57.9	14.2	60.0	59.3	15.2	61.2	60.3	16.1	62.1	61.1
		6	55	14.1	58.0	57.0	15.8	59.7	58.4	16.8	60.9	59.5	17.8	61.9	60.3
			56	15.6	56.1	55.6	17.4	57.7	57.2	18.8	59.0	58.3	20.0	60.0	59.3
			58	17.0	54.5	54.4	18.9	56.2	56.1	20.5	57.6	57.4	21.8	58.7	58.4
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	19.3	52.5	52.3	21.8	54.2	54.0	24.0	55.7	55.3	25.9	56.8	56.4
			56	20.9	50.8	50.7	23.9	52.6	52.5	26.4	54.0	53.9	28.5	55.2	55.1
			58	22.2	49.5	49.4	25.4	51.3	51.2	28.2	52.8	52.7	30.5	54.1	54.0
	2	2	55	7.1	58.0	62.8	7.6	69.1	53.5	8.1	69.9	64.1	8.6	70.6	64.5
			56	8.3	65.7	61.8	9.0	66.9	62.7	9.7	67.8	63.3	10.2	68.5	63.7
			58	9.6	63.3	60.8	10.4	64.6	61.6	11.1	65.7	62.5	11.6	56.5	63.1
		4	55	12.3	60.8	58.5	13.8	62.3	59.7	14.7	63.5	60.6	15.6	64.4	61.3
			56	14.2	58.2	56.9	15.8	59.8	58.3	17.1	61.0	59.3	18.2	62.6	60.1
			58	15.9	55.9	55.4	17.7	57.6	57.0	19.2	59.0	58.2	20.4	60.0	59.1
		6	55	16.3	56.0	55.1	18.3	57.7	56.6	20.0	59.1	57.7	21.4	60.2	58.6
			56	18.3	53.6	53.2	20.7	55.3	54.8	22.8	56.7	56.0	24.6	57.6	57.1
			58	20.0	51.6	51.5	22.8	53.4	53.3	25.1	54.9	54.6	27.1	56.1	55.8
		8	55	19.2	52.7	[illegible]	21.8	[illegible]	[illegible]	24.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			56	21.2	[illegible]	[illegible]	24.4	53.2	[illegible]	27.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	21.4	50.3	50.2	24.8	52.0	51.8	27.6	53.4	53.1	30.1	54.6	54.2
			56	23.3	48.4	48.3	27.2	49.9	49.8	30.7	51.3	51.2	33.7	52.4	52.3
			58	24.7	46.9	46.8	29.0	48.4	48.3	32.9	49.8	49.7	36.2	51.0	50.9
	4	2	55	8.1	67.2	62.0	8.8	68.3	62.8	9.5	69.2	63.4	10.0	69.9	63.8
			56	9.8	54.5	60.7	10.7	65.8	61.6	11.6	66.8	52.3	12.3	67.6	62.8
			58	11.4	61.7	59.3	12.6	63.2	60.4	13.5	64.4	61.3	14.3	65.3	61.9
		4	55	13.8	59.5	57.3	15.4	61.0	58.5	16.8	62.3	59.5	18.0	63.3	60.3
			56	16.1	56.4	55.3	18.2	58.0	56.6	20.0	59.3	57.7	21.5	60.4	58.6
			58	18.2	53.8	53.3	20.6	55.5	54.9	22.6	56.9	56.1	24.4	58.1	57.1
		6	55	17.9	54.5	53.6	20.3	56.2	55.1	22.4	57.6	56.3	24.3	58.7	57.2
			56	20.2	51.7	51.4	23.3	53.3	52.9	26.0	54.7	54.1	28.3	55.9	55.2
			58	22.2	49.5	49.4	25.8	51.1	51.0	28.9	52.5	52.3	31.6	53.7	53.5
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	22.9	48.9	48.7	26.8	50.4	50.2	30.2	51.7	51.5	33.3	52.9	52.5
			56	24.8	46.8	46.7	29.5	48.1	48.0	33.7	49.3	49.2	37.4	50.3	50.2
			58	26.2	45.3	45.2	31.4	46.5	46.4	36.1	47.6	47.5	40.4	48.6	48.5
	8	2	55	3.8	66.5	61.4	9.7	67.7	62.2	10.5	68.6	62.9	11.1	69.3	63.3
			56	10.8	63.5	59.8	12.1	64.8	60.8	13.1	65.9	61.5	14.0	66.7	62.1
			58	12.9	50.4	58.1	14.4	61.9	59.3	15.6	63.2	60.2	16.6	64.2	60.9
		4	55	14.8	58.5	58.4	16.7	60.1	57.7	18.3	61.4	58.8	19.7	62.4	59.4
			58	17.4	55.1	54.0	19.8	56.8	55.4	22.0	58.1	56.5	24.0	59.1	57.4
			58	19.8	52.2	51.8	22.8	53.9	53.3	25.3	55.3	54.5	27.8	56.4	55.6
		6	55	18.9	53.5	52.6	21.7	55.1	54.1	24.2	56.5	55.2	26.3	57.7	56.2
			56	21.5	50.4	50.1	25.1	52.0	51.5	28.2	53.3	52.7	31.1	54.4	53.7
			58	23.6	48.0	47.9	27.8	49.5	49.4	31.5	50.8	50.6	34.8	51.9	51.7
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	23.8	47.9	47.8	28.1	49.4	49.2	31.9	50.6	50.3	35.4	51.7	51.4
			56	25.7	46.3	45.7	30.8	47.0	46.9	35.6	48.0	47.9	39.9	48.9	48.8
			58	27.0	44.4	44.3	32.8	45.3	45.2	38.1	46.2	46.1	43.0	47.1	47.0

90/68 EDB/EWB

WTR	FPS	ROW	FIN	400FPM MBH	400FPM LDB	400FPM LWB	500FPM MBH	500FPM LDB	500FPM LWB	600FPM MBH	600FPM LDB	600FPM LWB	700FPM MBH	700FPM LDB	700FPM LWB
10	1	2	55	6.9	74.3	62.9	7.7	76.0	63.5	8.4	77.3	63.9	9.0	78.3	64.3
			56	8.1	71.6	61.9	9.1	73.6	62.6	9.8	75.2	63.2	10.5	76.4	63.6
			58	9.4	66.8	60.9	10.4	71.1	61.8	11.2	73.1	62.5	11.9	74.8	63.0
		4	55	11.8	63.1	58.9	13.3	65.9	59.9	14.6	[illegible]	60.7	15.6	[illegible]	61.5
			56	13.6	59.4	57.5	15.1	62.8	58.7	16.6	65.1	59.8	17.8	66.5	60.3
			58	14.9	56.2	56.1	16.8	59.6	57.5	18.4	62.2	58.9	19.7	64.0	59.3
		6	55	15.5	57.6	55.8	17.8	59.2	56.9	19.4	60.7	57.9	21.0	62.8	58.7
			56	17.3	54.8	54.0	19.6	58.5	55.5	21.7	57.2	56.6	23.5	59.6	57.5
			58	18.8	52.8	52.6	21.4	54.5	54.2	23.6	55.9	55.4	25.6	56.8	56.4
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	20.6	51.2	50.8	23.8	52.9	52.4	26.5	54.3	53.7	28.8	55.5	54.7
			56	22.3	49.3	49.2	[illegible]	50.9	50.8	29.0	52.3	52.1	31.8	53.4	53.2
			58	23.5	48.0	47.9	27.5	48.8	48.5	30.5	51.8	50.8	33.9	52.1	52.0
	2	2	55	7.9	72.0	62.1	8.8	74.1	62.8	9.7	75.4	63.3	10.4	76.5	63.6
			56	9.5	68.5	60.8	10.5	70.9	61.7	11.6	72.5	62.3	12.5	73.8	62.7
			58	11.1	64.8	59.5	12.3	67.6	60.5	13.5	69.7	61.3	14.6	71.1	61.8
		4	55	13.9	61.7	57.8	15.2	[illegible]	[illegible]	16.2	[illegible]	[illegible]	18.0	[illegible]	[illegible]
			56	15.5	[illegible]	56.7	17.6	59.2	[illegible]	19.4	[illegible]	57.8	21.6	[illegible]	[illegible]
			58	17.4	54.6	53.4	19.6	[illegible]	[illegible]	21.8	[illegible]	[illegible]	22.7	[illegible]	57.4
		6	55	17.4	55.8	53.9	19.9	57.5	55.3	22.1	59.0	56.4	24.1	60.1	57.2
			56	19.8	52.6	51.9	22.9	54.3	53.3	25.1	55.7	54.5	27.4	56.9	55.5
			58	21.4	50.2	50.0	24.8	51.9	51.8	27.7	53.3	52.9	30.3	54.5	54.0
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	22.5	48.3	49.6	26.3	50.9	50.4	29.7	52.3	51.7	32.7	53.5	52.7
			56	24.3	47.2	47.1	28.7	48.6	48.5	32.7	49.9	49.7	36.2	51.0	50.8
			58	25.6	46.6	46.7	30.5	47.1	47.0	34.9	48.3	48.2	38.8	49.4	49.3
	4	2	55	8.8	71.0	61.4	9.8	72.2	62.1	10.7	73.8	62.7	11.5	75.1	63.2
			56	10.7	67.0	59.8	12.0	68.2	60.7	13.1	70.1	61.4	14.0	71.8	62.0
			58	12.7	62.7	58.1	14.2	64.1	59.2	15.8	66.5	60.1	16.8	68.3	60.7
		4	55	14.7	60.6	56.4	16.7	62.3	57.5	18.5	63.7	58.8	20.1	64.6	59.2
			56	17.2	58.5	54.2	19.6	58.2	55.5	21.8	58.8	56.5	23.8	60.8	57.3
			58	19.4	52.8	52.6	22.3	54.7	53.5	24.8	56.2	54.7	27.1	57.4	56.7
		6	55	18.8	54.4	52.6	21.7	58.2	54.0	24.2	57.7	55.1	26.5	58.9	56.0
			56	21.3	51.0	50.2	24.8	52.8	51.8	27.9	54.0	52.8	30.7	56.2	53.8
			58	23.3	48.3	48.2	27.3	49.9	49.8	30.9	51.2	50.8	34.1	52.4	51.9
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	23.7	46.1	47.7	28.0	49.5	49.0	31.9	50.8	50.2	35.4	51.9	51.2
			56	25.5	46.0	46.8	30.6	47.0	46.8	36.2	48.1	47.9	38.6	49.1	48.8
			58	26.8	44.5	44.4	32.4	45.4	45.3	37.6	46.4	46.3	42.3	47.3	47.2
	8	2	55	9.4	70.5	60.9	10.6	71.9	61.7	11.5	72.5	62.3	12.5	73.8	62.7
			56	11.6	66.1	59.1	13.1	57.7	60.0	14.4	68.2	60.7	15.6	69.8	61.3
			58	13.9	61.5	57.1	15.7	63.3	58.2	17.3	64.8	59.1	18.7	65.7	59.8
		4	55	12.8	[illegible]	56.6	17.7	[illegible]	58.6	19.8	62.9	57.7	21.5	[illegible]	[illegible]
			56	18.3	55.3	53.7	21.2	57.0	54.4	23.7	58.5	56.4	25.6	58.7	56.3
			58	20.8	51.8	50.6	24.2	53.2	52.1	27.6	54.7	53.5	28.9	56.6	54.2
		6	55	19.7	53.5	51.7	22.9	55.2	53.1	25.7	56.7	54.2	28.3	57.9	56.1
			56	22.4	49.8	49.1	26.3	51.4	50.4	29.9	52.7	51.5	33.1	53.8	52.5
			58	24.5	47.1	46.9	29.1	48.5	48.2	33.2	49.7	49.3	36.9	50.8	50.4
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	24.5	47.3	46.9	29.1	48.6	48.2	33.3	49.8	49.2	37.2	50.9	50.2
			56	26.3	45.1	46.0	31.7	46.0	45.9	36.8	47.0	46.8	41.8	47.9	47.7
			58	27.5	43.7	43.6	33.5	44.5	44.4	39.1	45.3	45.2	44.5	46.0	45.9
12	1	2	55	5.8	74.6	63.0	7.6	76.3	63.6	8.2	77.6	64.0	8.8	78.6	64.4
			56	8.0	71.9	52.0	8.9	73.9	62.7	9.7	75.4	63.3	10.2	76.7	63.7
			58	9.2	59.1	61.1	10.2	71.5	61.9	11.0	73.4	62.6	11.7	74.9	63.1
		4	55	11.6	63.7	59.1	13.0	66.4	60.1	14.2	68.5	60.8	15.4	70.0	61.4
			56	13.2	60.1	57.7	14.8	63.1	58.6	16.1	66.4	59.8	17.6	67.2	60.4
			58	14.7	58.7	56.4	16.5	60.0	57.7	18.0	62.8	58.7	19.4	64.6	59.5
		6	55	15.2	57.9	55.9	17.2	58.7	57.2	19.0	61.3	58.2	20.6	63.3	58.9
			56	16.9	55.1	54.3	19.2	56.8	55.7	21.3	57.6	56.8	23.1	60.1	57.7
			58	18.5	53.1	52.9	21.0	54.8	54.4	23.2	55.8	55.7	25.2	57.3	56.6
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	20.2	51.6	51.3	23.3	53.3	52.8	26.0	54.6	54.0	28.4	55.8	56.0
			56	21.8	49.7	49.6	25.4	51.3	51.2	28.4	52.8	52.4	31.2	53.6	53.5
			58	23.2	48.4	48.3	27.0	50.0	48.9	30.4	51.3	51.2	33.3	52.5	52.4
	2	2	55	7.6	72.7	62.3	8.6	74.4	62.9	9.4	75.7	63.4	10.2	76.8	63.7
			56	9.3	69.0	61.0	10.3	71.3	61.8	11.4	72.8	62.4	12.3	74.1	62.8
			58	10.9	65.3	59.7	12.1	68.0	60.7	13.3	70.0	51.4	14.3	71.5	61.9
		4	55	13.1	62.1	57.8	14.8	63.0	58.8	16.2	66.3	59.7	17.7	67.1	60.3
			56	15.2	58.3	56.0	17.2	60.0	57.2	19.0	61.2	58.1	20.8	63.3	58.9
			58	17.1	55.2	54.2	18.4	56.9	55.6	21.4	57.5	56.7	23.2	58.9	57.8
		6	55	17.0	56.2	54.3	19.5	57.9	55.8	21.6	59.3	56.6	23.6	59.4	57.4
			56	19.2	53.0	52.3	22.1	54.7	53.7	24.6	56.0	54.8	26.9	57.2	55.8
			58	21.0	50.7	50.5	24.3	52.3	52.0	27.1	53.7	53.3	29.7	54.8	54.3
		8	55	18.8	[illegible]	51.8	22.8	[illegible]	52.0	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			56	21.9	48.8	48.5	25.6	51.3	51.0	[illegible]	[illegible]	[illegible]	31.7	[illegible]	[illegible]
			58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	22.0	49.8	49.4	25.7	51.4	50.9	29.0	52.7	52.1	32.0	53.8	53.1
			56	23.9	47.8	47.5	28.2	49.0	48.9	32.0	50.3	50.1	35.5	51.4	51.2
			58	25.2	46.2	46.1	30.0	47.5	47.4	34.3	48.7	48.6	38.2	49.8	49.7
	4	2	55	8.5	70.6	61.6	9.6	72.6	62.3	10.4	74.3	62.9	11.3	75.4	63.3
			56	10.4	66.4	60.1	11.7	68.8	60.9	12.6	70.9	61.7	13.8	72.2	62.1
			58	12.4	62.9	58.4	13.9	64.7	59.4	15.2	67.0	60.3	16.3	68.9	61.0
		4	55	14.3	60.9	56.7	16.3	62.7	57.8	18.0	64.8	58.7	19.6	64.8	59.4
			56	16.7	56.8	54.6	19.2	58.8	55.8	21.3	59.9	56.8	23.3	61.1	57.8
			58	19.0	53.3	52.4	21.9	55.0	53.8	24.3	56.6	56.0	26.6	57.7	56.8
		6	55	18.4	54.9	53.0	21.2	56.6	54.4	23.6	58.0	55.4	25.9	59.2	56.3
			56	20.8	51.4	50.7	24.2	53.0	52.1	27.3	54.4	53.2	30.0	55.5	54.2
			58	22.8	48.8	48.6	26.8	50.3	50.0	30.3	51.7	51.3	33.4	52.8	52.3
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	23.2	48.8	48.2	27.4	50.0	49.5	31.2	51.3	50.7	34.7	52.4	51.8
			56	25.1	46.3	46.2	30.1	47.5	47.4	34.8	48.6	48.4	38.7	49.8	49.4
			58	26.5	44.8	44.7	31.9	45.8	45.7	37.0	46.8	46.7	41.8	47.7	47.6
	8	2	55	9.1	70.7	61.1	10.3	72.1	61.9	11.2	73.0	62.4	12.0	74.5	62.9
			56	11.2	66.4	59.4	12.7	68.0	60.2	14.0	68.8	60.9	15.2	70.3	61.5
			58	13.6	61.9	57.4	15.3	63.6	58.5	16.9	64.4	59.3	18.3	58.3	60.0
		4	55	15.1	60.2	56.0	17.3	61.9	57.1	19.2	63.3	58.0	21.0	64.4	58.7
			56	17.8	55.8	53.5	20.8	57.5	54.8	23.1	58.9	55.8	25.3	60.0	56.8
			58	20.4	52.0	51.1	23.7	53.7	52.5	26.6	55.1	53.6	29.2	56.3	54.8
		6	55	19.2	54.0	52.2	22.3	55.7	53.5	25.0	57.1	54.6	27.5	58.3	55.5
			56	21.9	50.3	49.6	25.7	51.9	50.9	29.2	53.1	52.0	32.3	54.3	52.9
			58	24.0	47.6	47.4	28.5	48.9	48.7	32.5	50.2	49.8	36.2	51.3	50.8
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	24.0	47.8	47.4	28.5	49.1	48.7	32.6	50.3	49.7	36.4	51.4	50.7
			56	25.9	45.5	45.4	31.2	46.5	46.4	36.2	47.4	47.3	40.8	48.4	48.1
			58	27.2	44.1	44.0	33.1	44.8	44.7	38.8	45.7	45.6	43.8	46.4	46.3

NOTE: 1. MBh = MBh ft.² Coil Face Area; WTR = Water Temperature Rise, degrees F; fps = Water Velocity, Ft./Second; LDB = Leaving Dry Bulb, degrees F; LWB = Leaving Wet Bulb, degrees F; EWT = Entering Water Temperature, degrees F.

2. When using turbulators, make selection based on double the actual water velocity.

EWT

CHILLED WATER COOLING COIL CAPACITIES

V-6C

80 / 90 EDB / 70 EWB

80/70 EDB/EWB

WTR	FPS	ROW	FIN	400FPM MBH	400FPM LDB	400FPM LWB	500FPM MBH	500FPM LDB	500FPM LWB	500FPM MBH	500FPM LDB	500FPM LWB	700FPM MBH	700FPM LDB	700FPM LWB
10	1	2	55	6.7	69.7	65.3	7.1	70.7	66.0	7.5	71.5	66.6	7.8	72.1	66.9
			56	7.7	67.9	64.6	8.1	69.0	65.5	8.5	69.9	66.1	8.8	70.5	66.5
			58	8.5	66.1	64.0	9.0	67.3	64.9	9.4	68.3	65.6	9.7	69.0	66.1
		4	55	10.6	66.1	64.2	12.0	64.7	62.6	13.6	65.8	63.0	14.5	66.7	64.3
			56	13.6	63.1	63.1	14.6	62.7	61.5	15.6	64.0	62.6	16.3	64.9	63.3
			58	14.6	59.4	59.0	16.0	61.2	60.6	17.6	62.5	61.6	17.6	63.5	62.7
		6	55	16.2	58.6	57.6	17.8	60.4	59.4	19.1	61.6	60.7	20.3	62.9	61.6
			56	17.9	56.6	56.3	19.8	58.5	58.1	21.4	60.0	59.4	22.6	61.1	60.5
			58	19.3	55.2	55.1	21.4	57.1	57.0	23.1	58.7	58.5	24.4	59.9	59.7
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	22.0	52.7	52.5	25.6	54.7	54.5	27.2	56.3	56.0	28.4	57.6	57.3
			56	23.7	51.0	50.9	27.1	52.8	52.8	30.0	54.6	54.5	32.3	55.9	55.6
			58	25.0	48.7	48.6	28.8	51.7	51.6	31.8	53.4	53.3	34.4	54.6	54.2
	2	2	55	8.3	68.4	64.2	8.9	69.6	65.0	9.5	70.4	65.6	9.9	71.1	66.1
			56	9.7	66.2	63.1	10.5	67.5	64.1	11.1	68.5	64.8	11.6	69.3	65.4
			58	11.0	64.0	62.0	11.8	65.5	63.2	12.5	66.7	64.1	13.1	67.6	64.7
		4	55	14.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.0	64.6	[illegible]	18.0	65.1	63.6
			56	16.0	59.0	57.8	18.2	60.3	59.2	18.7	61.7	60.4	20.6	62.8	61.3
			58	18.3	56.4	56.0	20.1	58.2	57.5	22.0	59.6	58.8	23.3	61.0	60.3
		6	55	18.8	58.2	55.5	21.2	58.1	57.2	23.1	59.5	58.5	24.7	60.8	59.6
			56	21.0	53.7	53.5	23.8	55.6	55.3	26.2	57.2	56.7	28.1	58.5	57.9
			58	22.8	51.9	51.8	25.9	53.8	53.7	28.6	55.4	55.3	30.8	56.8	56.6
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	24.6	50.2	50.1	28.4	52.8	51.8	31.7	53.6	53.4	34.6	54.9	54.6
			56	26.5	48.2	48.1	31.0	49.9	49.8	34.9	51.4	51.3	38.3	52.8	52.7
			58	27.8	46.8	46.7	32.6	46.6	46.4	37.2	48.9	48.8	41.1	51.2	51.1
	4	2	55	9.5	67.3	63.2	10.4	68.6	64.1	11.1	69.5	64.8	11.8	70.3	65.3
			56	11.4	64.7	61.7	12.6	66.1	62.8	13.5	67.2	63.6	14.3	68.1	64.2
			58	13.3	62.1	60.2	14.6	63.7	61.5	15.6	65.0	62.5	16.5	66.0	63.3
		4	55	16.1	59.8	57.9	18.6	61.2	59.3	19.8	62.8	60.4	21.6	63.7	61.3
			56	18.7	56.6	56.6	21.1	58.3	57.2	23.2	59.7	58.4	24.9	60.9	59.6
			58	21.0	53.9	53.5	23.2	56.0	56.3	26.1	57.4	59.0	28.3	58.7	57.8
		6	55	20.7	54.4	53.8	23.6	56.3	55.4	26.1	57.8	56.8	28.2	59.0	57.9
			56	23.3	51.6	51.3	26.9	53.3	53.0	30.0	54.8	54.4	32.7	56.1	55.8
			58	25.4	49.3	49.2	29.5	51.1	51.0	33.1	52.7	52.5	36.1	54.0	53.8
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	26.2	48.5	48.4	30.8	50.2	50.0	34.8	51.6	51.4	38.4	52.9	52.8
			56	28.2	46.4	46.3	33.5	47.8	47.7	38.4	49.1	49.0	42.8	50.3	50.2
			58	29.5	44.6	44.9	35.4	46.3	46.2	40.9	47.4	47.3	45.8	48.6	48.5
	8	2	55	10.4	66.6	62.6	11.5	67.8	63.5	12.4	68.8	64.2	13.2	69.6	64.7
			56	12.7	63.6	50.7	14.2	65.0	61.8	15.4	66.1	62.6	16.5	67.0	63.3
			58	15.1	60.5	56.8	16.8	62.2	60.1	18.2	63.6	61.2	19.4	64.6	62.0
		4	55	17.2	[illegible]	[illegible]	19.2	[illegible]	59.3	21.9	61.9	59.4	23.1	62.8	60.3
			56	20.2	56.7	54.2	23.2	58.7	58.6	25.7	58.1	57.8	28.0	59.3	58.0
			58	22.9	56.0	51.7	28.3	[illegible]	[illegible]	28.3	56.4	54.8	31.6	58.7	56.0
		6	55	21.8	53.2	52.7	25.2	56.0	54.3	28.1	58.5	55.6	30.7	57.7	56.7
			56	24.7	56.1	49.9	28.9	51.8	51.5	32.7	53.2	52.6	36.0	54.4	53.9
			58	27.0	47.7	47.6	31.8	49.3	49.2	38.2	50.6	50.5	40.0	51.9	51.7
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	27.1	47.5	47.4	32.2	49.0	48.9	36.7	50.3	50.2	40.8	51.5	51.3
			56	29.1	46.4	45.3	35.1	46.5	46.4	40.8	47.6	47.5	45.6	48.6	48.5
			58	30.4	44.0	43.9	37.9	44.9	44.8	43.1	45.8	45.7	48.7	46.8	46.7
12	1	2	55	6.4	69.9	65.5	6.8	70.9	66.2	7.2	71.6	66.7	7.4	72.2	67.1
			56	7.3	68.1	64.9	7.8	69.2	65.6	8.2	70.0	66.2	8.5	70.7	66.6
			58	8.2	66.3	64.2	8.7	67.5	65.1	9.1	68.4	65.8	9.4	69.2	66.3
		4	55	11.5	63.5	61.8	12.8	65.0	62.8	13.3	66.1	63.7	13.9	67.0	64.4
			56	13.0	61.5	60.8	14.1	63.1	61.8	15.0	64.3	62.8	15.7	65.2	63.6
			58	14.2	58.8	58.4	15.4	61.5	61.8	16.4	62.8	62.1	17.2	63.8	63.0
		6	55	15.6	59.1	58.3	17.2	60.8	59.6	18.4	62.2	61.0	19.5	63.3	61.9
			56	17.3	57.2	56.9	19.1	59.0	58.6	20.6	60.4	59.9	21.8	61.5	60.9
			58	18.7	55.7	55.6	20.7	57.6	57.5	22.3	59.1	58.9	23.6	60.3	60.0
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	21.4	53.3	53.2	24.2	55.2	55.0	26.5	56.8	56.5	28.4	58.1	57.7
			56	23.1	51.6	51.5	26.3	53.5	53.4	29.0	55.1	55.0	31.3	56.4	56.3
			58	24.5	50.3	50.2	28.9	52.3	52.2	30.9	54.0	53.9	33.4	55.4	55.3
	2	2	55	7.9	68.7	64.4	8.5	69.8	65.2	9.0	70.7	65.8	9.4	71.3	66.3
			56	9.3	66.5	63.4	10.0	67.8	64.3	10.7	68.7	65.0	11.1	69.5	65.6
			58	10.6	54.4	62.4	11.4	65.8	63.5	12.0	66.9	64.3	12.6	67.8	65.0
		4	55	13.8	60.6	58.8	18.2	63.2	61.1	16.3	64.5	62.1	17.3	65.6	62.9
			56	15.8	59.1	58.1	17.5	60.6	58.7	18.9	62.1	60.8	20.1	63.2	61.7
			58	17.6	57.0	56.8	19.5	58.8	58.3	21.0	60.3	59.6	22.3	61.4	60.6
		6	55	18.2	56.8	56.1	20.4	58.6	57.7	22.2	60.1	59.0	23.7	61.3	60.0
			56	20.4	54.4	54.1	23.0	56.3	55.9	25.3	57.7	57.2	27.2	58.9	58.4
			58	22.2	52.5	52.4	25.2	54.4	54.3	27.7	56.0	55.8	29.8	57.3	57.1
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	23.9	50.8	50.7	27.6	52.7	52.5	30.7	54.2	54.0	33.4	55.5	55.2
			56	25.8	48.8	48.8	30.2	50.6	50.5	34.0	52.0	51.9	37.3	53.3	53.2
			58	27.3	47.3	47.2	32.1	49.0	48.9	36.3	50.5	50.4	40.0	51.8	51.7
	4	2	55	9.1	67.7	63.5	9.9	68.9	64.4	10.6	69.8	65.0	11.2	70.5	65.5
			56	11.0	65.1	62.1	12.0	66.5	63.1	13.0	67.5	63.9	13.7	68.4	64.5
			58	12.8	62.6	60.6	14.0	64.1	61.9	15.0	65.4	62.9	15.8	66.3	63.6
		4	55	15.5	60.1	58.4	17.2	61.7	59.8	18.8	63.0	60.8	20.1	64.1	61.7
			56	18.0	57.1	56.2	20.3	58.8	57.7	22.3	60.2	58.9	23.9	61.4	59.8
			58	20.2	54.6	54.2	22.8	56.4	55.9	25.1	57.8	57.3	27.0	59.2	58.4
		6	55	20.0	56.1	54.4	22.8	56.9	56.0	25.1	58.3	57.3	27.2	59.5	58.4
			56	22.6	52.2	52.0	26.0	54.0	53.7	29.0	55.5	55.0	31.6	56.7	56.2
			58	24.7	50.0	49.9	28.7	51.8	51.7	32.0	53.3	53.2	35.0	54.6	54.5
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	25.5	48.2	48.1	29.9	50.8	50.7	33.8	52.3	52.1	37.2	53.5	53.3
			56	27.6	47.0	46.9	32.8	48.5	48.4	37.4	49.8	49.7	41.6	50.9	50.8
			58	29.1	45.4	45.3	34.8	46.8	46.7	40.0	48.0	47.9	44.7	49.2	49.1
	8	2	55	9.9	67.0	62.9	11.0	68.2	63.8	11.6	69.1	64.5	12.6	69.9	65.0
			56	12.2	64.0	61.1	13.6	65.4	62.2	14.7	66.5	63.0	15.7	67.4	63.6
			58	14.5	61.1	59.3	16.1	62.7	60.6	17.4	64.0	61.6	18.6	65.0	62.4
		4	55	16.6	59.6	57.4	18.8	60.7	58.8	20.6	62.0	58.9	22.2	63.1	60.7
			56	19.6	56.7	54.6	22.4	57.4	56.3	24.8	58.7	57.5	26.9	58.9	58.5
			58	22.3	52.7	52.4	28.5	54.5	54.1	28.3	56.0	56.5	30.8	57.3	56.6
		6	55	21.2	53.8	53.3	24.4	55.7	54.9	27.1	57.1	56.2	29.5	58.3	57.2
			56	24.1	50.8	50.6	28.1	52.4	52.1	31.6	53.6	53.4	34.8	55.0	54.5
			58	26.4	48.3	48.2	31.0	49.9	49.8	35.1	51.3	51.2	38.8	52.6	52.4
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	26.6	48.1	48.0	31.4	49.7	49.5	35.7	51.0	50.8	39.6	52.2	52.0
			56	28.7	45.9	45.8	34.4	47.2	47.1	39.7	48.2	48.1	44.5	49.3	49.2
			58	30.0	44.4	44.3	36.4	45.4	45.3	42.3	46.4	46.3	47.7	47.4	47.3

90/70 EDB/EWB

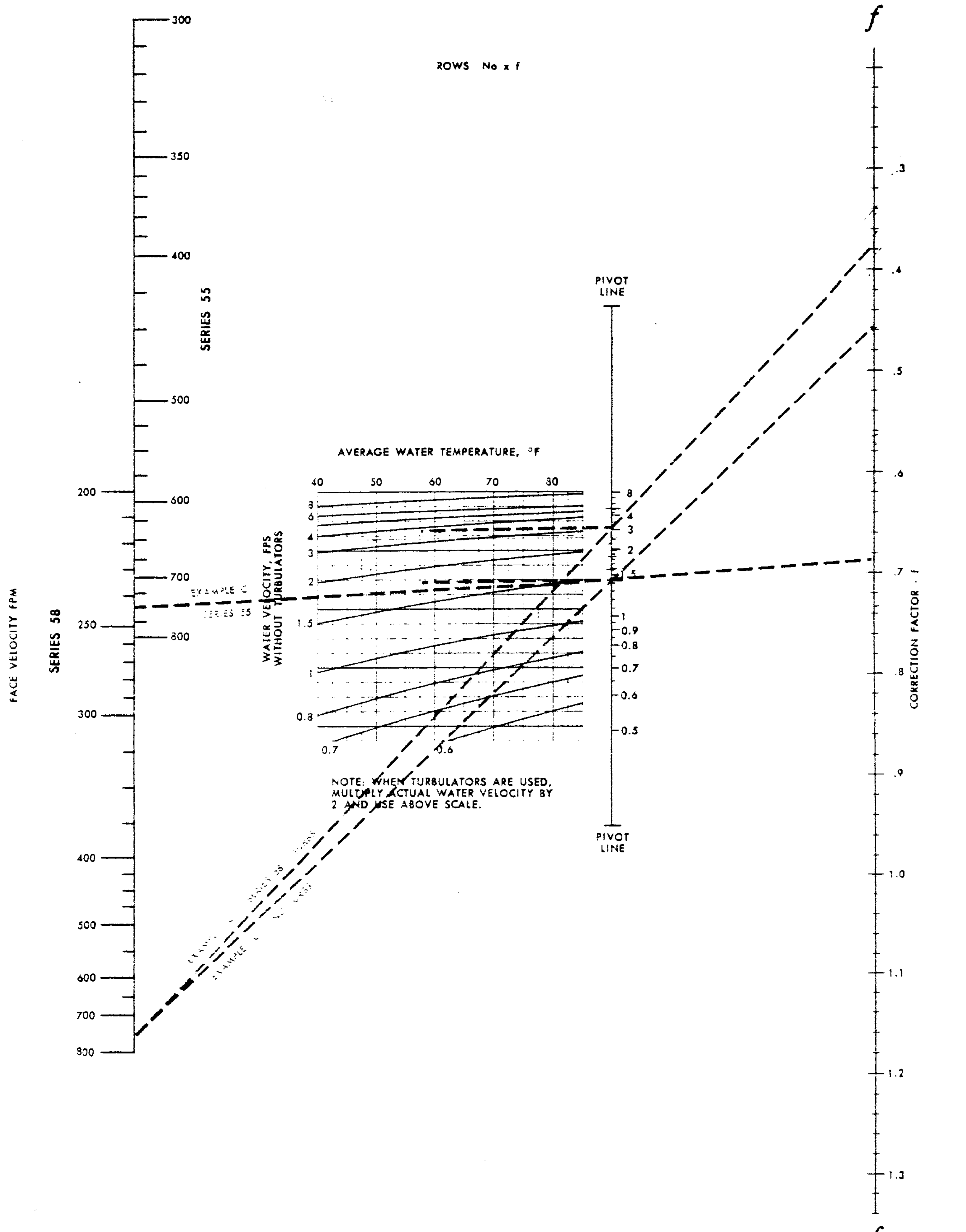
WTR	FPS	ROW	FIN	400FPM MBH	400FPM LDB	400FPM LWB	500FPM MBH	500FPM LDB	500FPM LWB	600FPM MBH	600FPM LDB	600FPM LWB	700FPM MBH	700FPM LDB	700FPM LWB
10	1	2	55	7.1	73.9	65.0	7.7	76.0	65.7	8.4	77.3	66.1	9.0	78.4	66.4
			56	8.3	71.2	64.1	9.1	73.6	64.9	9.8	75.2	65.4	10.5	76.5	65.8
			58	9.5	68.5	63.1	10.4	71.1	64.0	11.2	73.1	64.7	11.9	74.7	65.2
		4	55	12.3	64.7	60.8	13.6	66.4	61.9	14.8	67.4	62.6	16.6	68.4	63.4
			56	14.2	61.6	59.4	15.7	63.3	60.7	17.8	64.5	61.7	18.2	66.6	62.4
			58	15.7	59.0	58.1	17.4	60.7	59.6	18.9	63.5	60.7	20.1	64.0	61.6
		6	55	18.7	59.0	57.3	18.6	60.9	58.8	20.3	62.3	59.9	21.8	63.5	60.8
			56	18.5	56.4	55.6	20.8	58.2	57.3	22.8	58.7	58.5	24.4	60.8	58.6
			58	20.1	54.4	54.2	22.7	56.3	56.0	24.8	57.8	57.4	26.6	59.0	58.5
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	22.4	52.3	52.0	25.7	54.3	53.8	28.4	55.8	55.3	30.8	57.1	56.4
			56	24.2	50.4	50.3	27.9	52.2	52.1	31.7	53.9	53.6	33.9	55.1	54.8
			58	25.6	48.6	48.9	28.7	50.8	50.7	30.8	52.6	52.3	35.2	53.8	53.7
	2	2	55	8.4	72.8	64.0	9.2	74.1	64.8	10.0	75.0	65.3	10.4	76.5	65.8
			56	10.0	69.3	62.8	11.0	70.8	63.7	11.9	72.1	64.4	12.5	73.9	65.0
			58	11.6	65.6	61.5	12.8	66.8	62.6	13.8	69.2	63.4	14.6	71.2	64.1
		4	55	14.5	[illegible]	[illegible]	16.2	[illegible]	[illegible]	17.6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			56	16.7	59.8	57.2	18.8	61.2	59.2	20.5	62.2	59.8	22.8	63.6	60.2
			58	18.7	56.2	56.4	21.5	58.2	57.1	23.6	60.6	58.6	25.6	61.6	59.6
		6	55	19.0	56.9	55.2	21.5	58.8	56.8	23.7	60.4	58.0	25.8	61.7	59.0
			56	21.3	53.7	53.1	24.3	55.6	54.8	27.0	57.2	56.1	29.2	58.5	57.2
			58	23.3	51.3	51.2	26.7	53.2	53.0	29.7	54.8	54.5	32.2	56.2	55.7
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	24.7	50.1	49.8	28.7	51.9	51.5	32.2	53.5	52.9	35.4	54.8	54.1
			56	26.6	47.9	47.8	31.4	49.8	49.4	36.6	50.9	50.8	39.3	52.2	52.0
			58	28.1	46.3	46.2	33.3	47.9	47.8	38.8	49.2	49.1	42.1	50.9	50.4
	4	2	55	9.5	71.8	63.2	10.5	73.3	64.0	11.3	74.4	64.6	12.1	75.3	65.1
			56	11.5	68.0	61.6	12.8	69.6	62.6	13.9	70.9	63.3	14.8	71.9	63.9
			58	13.6	64.0	59.9	15.1	65.8	61.1	16.3	67.3	62.1	17.4	68.5	62.8
		4	55	16.1	61.5	57.8	18.1	63.4	59.1	18.8	64.9	60.2	21.4	66.1	61.0
			56	18.7	57.5	55.4	21.3	59.4	57.0	23.5	60.9	58.1	25.6	62.2	58.1
			58	21.2	54.0	53.2	24.2	56.0	54.6	26.7	57.6	56.2	28.6	59.0	57.4
		6	55	20.7	55.3	53.7	23.7	57.2	55.3	26.3	58.6	56.5	28.8	60.1	57.6
			56	23.3	51.8	51.1	27.1	53.6	52.7	30.4	55.1	54.1	33.2	56.4	55.2
			58	25.5	49.1	48.9	29.8	50.8	50.6	33.8	52.4	52.0	37.0	53.7	53.3
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	26.1	48.6	48.3	30.8	50.2	49.8	34.9	51.7	51.2	38.7	53.0	52.3
			56	28.2	46.3	46.2	33.7	47.8	47.5	38.6	48.8	48.7	49.2	50.6	49.8
			58	29.6	44.6	44.7	38.6	45.9	45.8	41.2	47.8	46.9	46.3	48.1	48.6
	8	2	55	10.3	71.1	62.5	11.5	72.6	63.4	12.4	73.8	64.1	13.3	74.7	64.6
			56	12.7	66.9	60.8	14.2	68.6	61.7	15.5	69.9	62.5	16.8	71.0	63.2
			58	15.1	62.6	58.6	16.9	64.5	59.9	18.5	66.0	60.9	19.9	67.3	61.7
		4	55	17.2	60.6	58.0	18.6	62.4	58.2	21.8	63.6	60.2	23.7	65.2	60.1
			56	20.2	56.1	54.1	23.2	58.6	55.6	25.6	58.5	58.6	28.7	60.6	57.8
			58	22.9	52.3	51.6	26.5	54.2	53.2	29.0	56.8	54.6	32.3	57.2	56.7
		6	55	21.8	54.2	52.6	25.2	56.1	54.2	28.1	57.7	55.4	30.8	59.0	56.5
			56	24.7	50.4	49.8	28.9	52.1	51.3	32.7	53.6	52.6	36.1	54.9	53.7
			58	26.9	47.6	47.5	31.9	49.2	48.9	36.3	50.6	50.2	40.4	51.8	51.4
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	27.0	47.7	47.4	32.1	49.2	48.8	36.7	50.5	50.0	40.8	51.7	51.1
			56	29.0	45.3	45.2	35.0	46.4	46.3	40.8	47.5	47.4	45.7	48.5	48.3
			58	30.3	43.9	43.8	36.8	44.8	44.7	43.1	45.6	46.5	48.9	48.5	48.4
12	1	2	55	6.8	74.6	65.2	7.6	76.3	65.8	8.2	77.6	66.2	8.8	78.7	66.5
			56	9.0	71.9	64.3	8.9	73.9	65.0	9.7	75.4	65.5	10.2	76.8	66.9
			58	9.2	69.1	63.4	10.2	71.5	64.2	11.0	73.4	64.8	11.7	74.9	65.3
		4	55	12.2	66.0	61.0	13.5	66.6	62.1	14.8	67.9	63.6	16.0	68.8	63.6
			56	13.8	61.8	59.7	15.4	63.5	60.9	16.7	64.8	61.8	17.8	67.0	62.6
			58	15.4	59.3	58.4	17.1	60.9	59.8	18.5	62.1	59.8	19.7	64.5	61.7
		6	55	16.2	59.4	57.6	18.2	61.2	59.1	19.8	62.6	60.2	21.3	63.7	61.0
			56	18.1	56.7	56.0	20.3	58.5	57.6	22.3	59.8	58.8	23.9	61.1	59.8
			58	19.7	54.7	54.6	22.2	56.6	56.3	24.3	58.1	57.7	26.1	59.2	58.7
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	21.9	52.8	52.5	25.1	54.7	54.2	27.8	56.2	55.6	30.1	57.5	56.8
			56	23.7	50.8	50.7	27.3	52.7	52.5	30.5	54.2	54.0	33.2	55.5	55.2
			58	25.2	49.4	49.3	29.1	51.3	51.2	32.5	52.8	52.7	35.5	54.1	54.0
	2	2	55	8.2	73.0	64.2	9.0	74.3	64.9	9.4	75.8	65.6	10.2	76.8	65.9
			56	9.7	69.5	63.0	10.7	70.6	63.8	11.4	72.9	64.6	12.3	74.1	65.1
			58	11.3	65.9	61.7	12.5	67.4	62.7	13.5	69.7	63.5	14.3	71.6	64.2
		4	55	14.1	63.3	59.8	15.7	65.1	60.7	17.2	66.5	61.8	18.4	67.8	62.5
			56	16.3	58.7	57.6	18.3	61.5	58.0	20.0	63.0	60.1	21.5	64.1	60.9
			58	18.3	56.7	55.8	20.6	58.6	57.5	22.5	60.1	58.7	24.2	61.3	59.7
		6	55	18.5	57.4	55.7	20.9	59.2	57.2	23.0	60.8	58.4	24.9	62.0	59.3
			56	20.8	54.2	53.6	23.8	58.1	55.2	26.3	57.6	56.5	28.5	58.8	57.6
			58	22.8	51.8	51.6	26.2	53.7	53.4	29.0	55.2	54.9	31.5	56.5	56.1
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	24.1	50.6	50.3	28.1	52.4	52.0	31.5	53.9	53.4	34.5	55.2	54.5
			56	26.2	48.4	48.3	30.8	50.0	49.9	34.8	51.4	51.2	38.4	52.7	52.5
			58	27.7	46.8	46.7	32.8	48.3	48.2	37.3	49.7	49.6	41.3	51.0	50.9
	4	2	55	9.2	72.1	63.4	10.1	73.5	64.2	11.0	74.6	64.8	11.8	75.4	65.3
			56	11.1	68.3	61.9	12.4	69.9	62.8	13.5	71.1	63.5	14.4	72.1	64.1
			58	13.2	64.3	60.2	14.7	66.1	61.4	15.9	67.5	62.3	17.0	68.0	63.0
		4	55	15.6	62.0	58.2	17.6	63.8	59.6	19.5	65.3	60.6	20.8	66.4	61.3
			56	18.3	58.0	56.9	20.7	58.8	57.4	22.8	61.3	58.8	24.8	62.5	59.4
			58	20.7	54.6	53.7	23.6	56.4	55.3	26.1	58.6	56.7	28.3	59.3	57.7
		6	55	20.1	55.8	54.2	23.0	57.7	55.7	25.5	59.3	57.0	27.8	60.5	57.9
			56	22.8	52.3	51.7	26.4	54.1	53.3	29.6	55.6	54.6	32.4	56.9	55.7
			58	25.0	49.6	49.4	29.2	51.3	51.1	32.9	52.8	52.5	36.1	54.1	53.7
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	25.8	49.2	48.9	30.1	50.8	50.4	34.1	52.2	51.7	37.7	53.5	52.8
			56	27.7	46.8	46.7	33.0	48.1	48.0	37.9	49.4	49.2	42.3	50.5	50.3
			58	29.2	45.2	45.1	35.1	46.4	46.3	40.5	47.5	47.4	45.5	48.6	48.5
	8	2	55	9.9	71.5	62.8	11.0	72.9	63.7	12.0	74.0	64.3	12.8	74.9	64.8
			56	12.2	67.4	61.0	13.7	69.0	62.0	15.0	70.2	62.8	16.1	71.3	63.4
			58	14.7	63.0	59.0	16.4	64.8	60.2	18.0	66.3	61.2	19.3	67.6	62.0
		4	55	16.6	61.0	57.3	18.8	62.9	58.6	20.8	64.4	58.7	22.6	65.6	60.6
			56	19.6	56.7	54.7	22.5	58.5	56.1	25.8	60.8	57.3	27.3	61.3	58.2
			58	22.3	52.9	52.1	25.6	54.7	53.7	28.8	56.3	55.8	31.8	57.7	58.1
		6	55	21.2	54.8	53.2	24.5	56.8	54.7	27.3	58.2	55.9	29.9	59.5	56.9
			56	24.1	51.0	50.4	28.2	52.7	51.9	31.9	54.1	53.1	35.2	55.4	54.2
			58	26.5	48.1	48.0	31.3	49.7	49.5	35.6	51.1	50.8	39.4	52.3	51.9
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	26.5	48.2	47.9	31.4	49.8	49.4	35.8	51.1	50.6	39.9	52.3	51.7
			56	28.6	45.8	45.7	34.4	48.9	46.8	39.8	48.0	47.9	44.8	49.1	48.9
			58	30.0	44.2	44.1	36.5	45.2	45.1	42.5	46.1	46.0	48.1	47.0	46.9

NOTE: 1. MBh = MBh ft.^{2} Coil Face Area; WTR = Water Temperature Rise, degrees F; fps = Water Velocity, Ft./Second; LDB = Leaving Dry Bulb, degrees F; LWB = Leaving Wet Bulb, degrees F; EWT = Entering Water Temperature, degrees F.

2. When using turbulators, make selection based on double the actual water velocity.

V-6 d

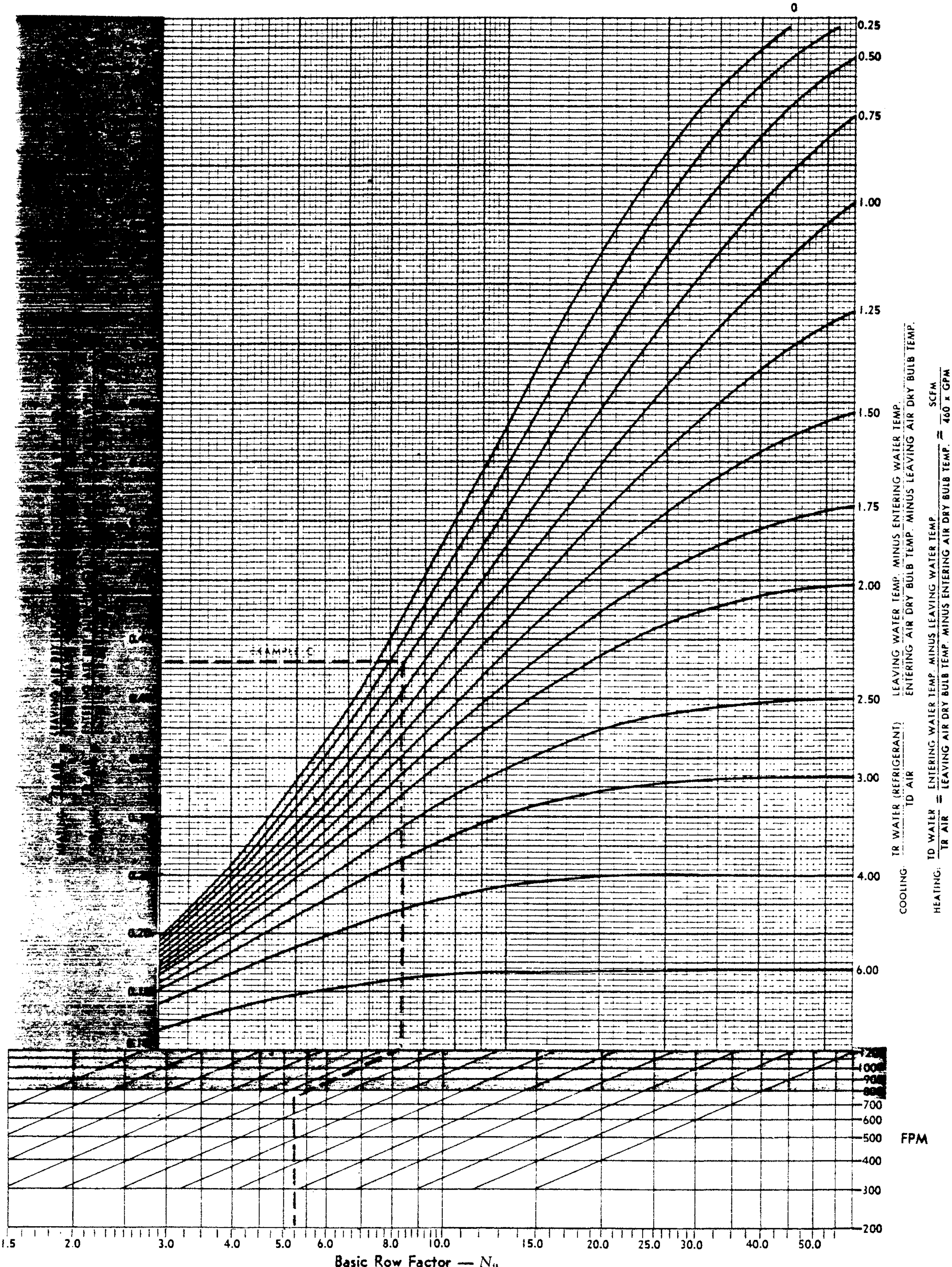
CHART 10-1 — Water Sensible Cooling Coil Capacity Correction Factor



NOTE: Shaded Areas beyond ARI Certification.

CHART 11-1 — Water Sensible Cooling and Heating Coil Basic Row Factors (N)

V-6e



V-6?

TABLE 75-1 — Total Header Water Pressure Drop (Ft. H_2O)

COIL TYPE	FINNED WIDTH	VELOCITY (FPS)							
		1	2	3	4	5	6	7	8
P2	ALL	.06	24	.51	.87	1.39	2.04	2.76	3.60
P4	ALL	094	.29	63	1.15	1.71	2.64	3.57	4.70
P8	ALL	.10	.36	.79	1.44	2.23	3.19	4.37	5.87
W.D.K	12"	.09	.32	1.29	1.30	2.04	2.96	4.04	5.25
W.D.K	18"	.05	18	.40	70	1.11	1.61	2.18	2.79
W.D.K	24"	.07	.29	.65	1.16	1.82	2.64	3.57	4.69
W.D.K	30"	.10	.43	.95	1.71	2.64	3.79	5.20	6.78
W.D.K	33"	.13	.49	1.09	1.96	3.06	4.40	6.00	7.83
W	36"	.15	.60	1.33	2.41	3.77	5.42	7.38	9.64
W	42"	.18	.70	1.57	2.79	4.36	6.27	8.54	11.16
W	48"	.20	.81	1.82	3.22	5.04	7.25	9.86	12.89
DD	18"	.10	.43	.97	1.69	2.62	3.80	5.25	6.75
DD	24"	.18	.75	1.68	2.96	4.71	6.77	9.21	11.99
DD	30"	.30	1.17	2.62	4.72	7.49	10.53	14.05	18.75
DD	33"	.35	1.43	3.17	5.70	8.79	12.66	17.38	22.81

TABLE 75-2 — Tube Water Pressure Drop Per Pass (Ft. H_2O)*

FINNED LENGTH (IN.)	VELOCITY WITH TURBULATORS (FPS)								VELOCITY WITHOUT TURBULATORS (FPS)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
12	.07	.27	.57	.95	1.38	1.96	2.63	3.52	.02	.09	.18	.30	.45	.62	.82	1.04
24	.11	.39	.82	1.37	2.00	2.85	3.81	4.86	.04	.13	.26	.44	.65	.89	1.19	1.51
36	.15	.51	1.08	1.80	2.62	3.73	5.00	6.37	.05	.17	.34	.57	.85	1.17	1.56	1.98
48	.18	.64	1.34	2.22	3.25	4.62	6.18	7.88	.06	.20	.42	.71	1.06	1.45	1.93	2.45
60	.22	.76	1.59	2.65	3.87	5.50	7.37	9.39	.07	.24	.50	.84	1.26	1.72	2.30	2.92
72	.25	.88	1.85	3.08	4.49	6.39	8.55	10.90	.08	.28	.58	.98	1.46	2.00	2.67	3.39
84	.29	1.00	2.10	3.50	5.11	7.27	9.74	12.41	.09	.32	.66	1.11	1.66	2.28	3.04	3.86
96	.32	1.12	2.36	3.93	5.73	8.16	10.92	13.92	.10	.36	.74	1.25	1.86	2.55	3.41	4.33
108	.36	1.25	2.62	4.35	6.36	9.04	12.11	15.43	.11	.40	.82	1.38	2.06	2.83	3.78	4.80
120	.39	1.37	2.87	4.78	6.98	9.93	13.30	16.94	.12	.44	.90	1.52	2.27	3.11	4.15	5.27
132	.43	1.49	3.13	5.21	7.60	10.81	14.48	18.45	.13	.48	.98	1.65	2.47	3.39	4.52	5.74
144	.46	1.61	3.38	5.63	8.22	11.70	15.67	19.96	.14	.52	1.06	1.79	2.67	3.66	4.89	6.21

*Based on W coils. For P, D, DD, K coils, Use Table 75-3
NOTE: Apply temperature correction factor, Table 75-4 for average water temperature other than 60 F.

TABLE 75-3 — Additional Water Pressure Drop Per Pass For P, D, DD, K Coils

COIL TYPE	VELOCITY WITH TURBULATORS (FPS)								VELOCITY WITHOUT TURBULATORS (FPS)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
P2, P4, P8	.00	.03	.05	.09	.13	.19	.25	.32	.00	.01	.02	.03	.04	.06	.08	.10
D	.03	.12	.23	.37	.55	.78	1.04	1.33	.01	.03	.07	.12	.18	.24	.32	.41
DD	.03	.10	.21	.35	.51	.73	.97	1.24	.01	.03	.07	.11	.16	.23	.30	.38
K	.07	.25	.52	.86	1.26	1.79	2.39	3.05	.02	.08	.16	.27	.40	.56	.74	.94

WATER PRESSURE DROP EXAMPLE

EXAMPLE:

Determine WPD for a 4-row P2 Coil, 18" x 60", with 9.05 gpm, and 60 F average water temperature.

1. Velocity (fps) = gpm/1.81
   = 9.05/1.81
   = 5 fps
2. Header WPD = 1.39 ft. H_2O (Table 75-1)
3. Tube WPD = (Tube WPD Per Pass, Table 75-2 + Additional WPD Per Pass, Table 75-3 × (Number Passes, Table 75-5) × (Average Water Temperature Correction Factor, Table 75-4)
   = (1.26 + .04) × 24 × 1.00
   = 1.30 × 24
   = 31.20 ft. H_2O
4. Total WPD = Header WPD + Tube WPD
   = 1.39 + 31.20
   = 32.59

TABLE 75-4 — Average Water Temperature Correction Factors For Water Pressure Drop (F)

	TEMPERATURE (F)					
	40	50	60	100	150	200
W/TURB.	1.07	1.30	1.00	.91	.83	.78
WO/TURB.	1.12	1.05	1.00	.87	.78	.72

TABLE 75-5 — Number of Water Passes By Coil Type

COIL TYPE	FINNED WIDTH				
	ROWS	12"	18"	24"	30"
P2	4	16	24	32	40
P2	6	24	36	48	60
P4	2	4	6	8	10
P4	4	8	12	16	20
P4	6	12	18	24	30
P4	8	16	24	32	40
P8	4	—	6	8	10
P8	8	—	12	16	20
W, D, K	NUMBER PASSES = NUMBER ROWS				
DD	NUMBER PASSES = NUMBER ROWS × 0.5				

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TABLE 76-1 — Coil Face Area (Square Feet) Not Including Casing

FINNED WIDTH (INCHES)	FINNED LENGTH (INCHES)													
	12	18	24	30	36	42	45	48	51	54	60	66	72	78
12 18	1.0	1.5 2.25	2.0 3.0	2.5 3.75	3.0 4.5	3.5 5.25	3.75 5.62	4.0 6.0	4.25 6.37	4.5 6.75	5.0 7.5	5.5 8.25	6.0 9.0	6.5 9.75
24 30			4.0	5.0 6.25	6.0 7.5	7.0 8.75	7.5 9.37	8.0 10.0	8.5 10.62	9.0 11.25	10.0 12.5	11.0 13.75	12.0 15.0	13.0 16.25
33 36					8.25 9.0	9.63 10.5	10.32 11.25	11.0 12.0	11.69 12.75	12.38 13.5	13.75 15.0	15.13 16.5	16.5 18.0	17.88 19.5
42 48						12.25	13.0	14.0 16.0	15.0 17.0	15.75 18.0	17.5 20.0	19.25 22.0	21.0 24.0	22.75 26.0
	FINNED LENGTH (INCHES)													
	81	84	90	96	99	102	105	108	114	120	126	132	138	144
12 18	6.75 10.12	7.0 10.5	7.5 11.25	8.0 12.0	8.25 12.37	8.5 12.75	8.75 13.12	9.0 13.5	9.5 14.25	10.0 15.0	10.5 15.75	11.0 16.5	11.5 17.2	12.0 18.0
24 30	13.5 16.87	14.0 17.5	15.0 18.75	16.0 20.0	16.5 20.62	17.0 21.25	17.5 21.87	18.0 22.5	19.0 23.75	20.0 25.0	21.0 26.25	22.0 27.5	23.0 28.75	24.0 30.0
33 36	18.57 20.25	19.25 21.0	20.63 22.5	22.0 24.0	22.69 24.75	23.38 25.5	24.07 26.25	24.75 27.0	26.13 28.5	27.5 30.0	28.88 31.5	30.25 33.0	31.63 34.5	33.0 36.0
42 48	23.63 27.0	24.5 28.0	26.25 30.0	28.0 32.0	28.88 33.0	29.75 34.0	30.63 35.0	31.5 36.0	33.25 38.0	35.0 40.0	36.75 42.0	38.5 44.0	40.25 46.0	42.0 48.0

TABLE 76-2 — FPS, GPM Conversion Factors

P2 COIL P4 COIL P8 COIL	FPS = GPM/1.81 FPS = GPM/3.62 FPS = GPM/7.24
W, D, K COILS	$FPS = \frac{GPM \times 1.66}{FINNED\ WIDTH}$
DD COIL	$FPS = \frac{GPM \times .83}{FINNED\ WIDTH}$

CHART 76-1 — Dry Air Friction (In. H_2O) Water and Refrigeration Coils

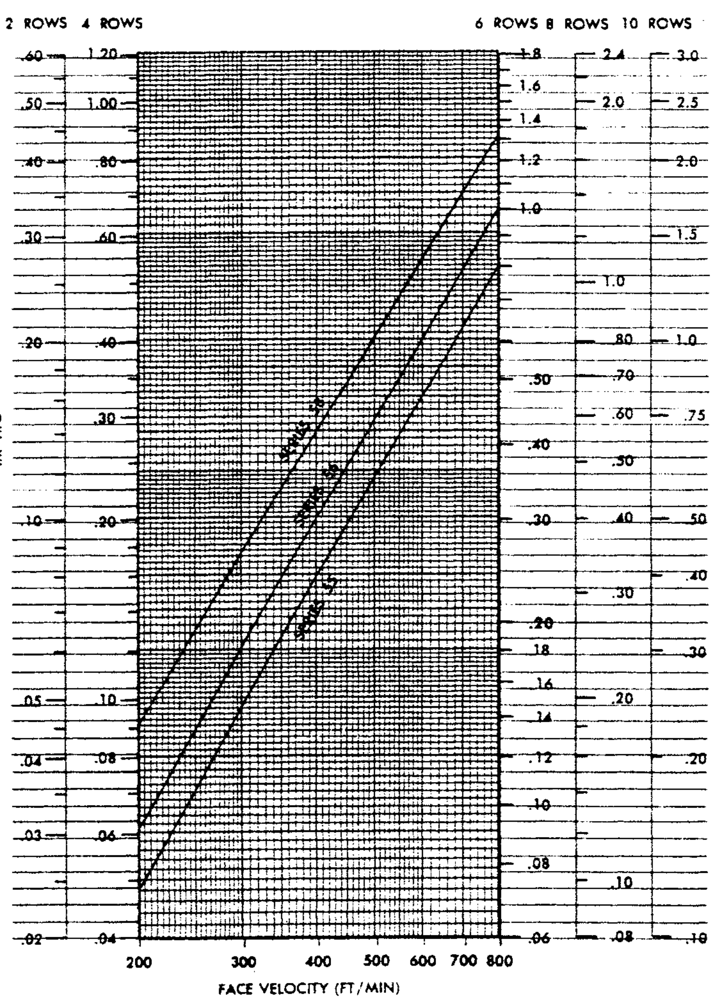

CHART 76-2 — Wet Air Friction (In. H_2O) Water and Refrigeration Coils

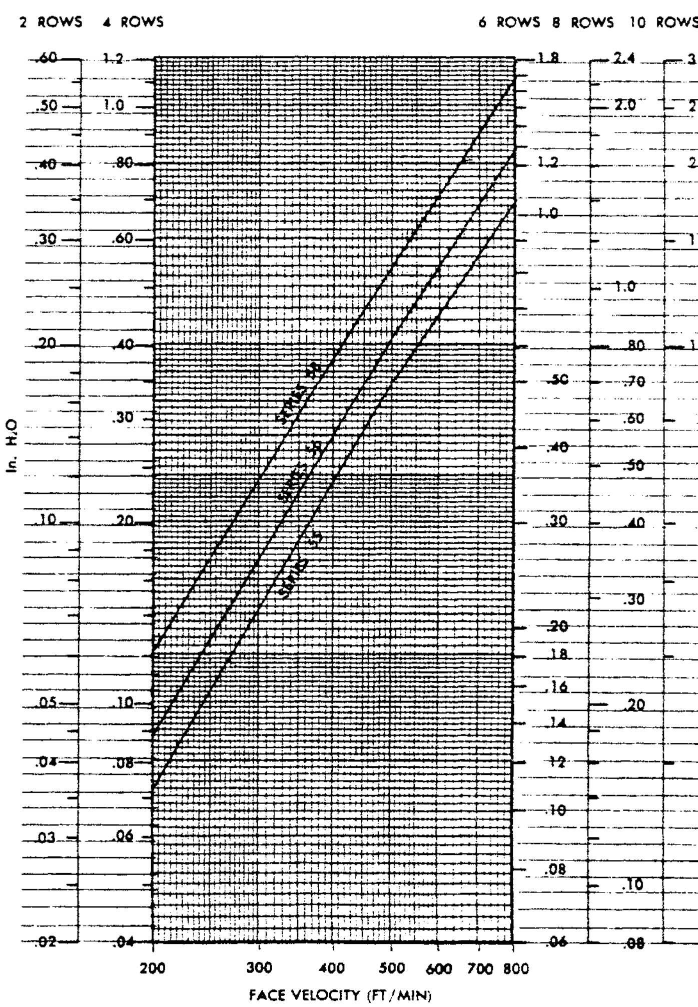

CHART 83-1 — Two-Row Type W Coil Selections (Without Turbulators)

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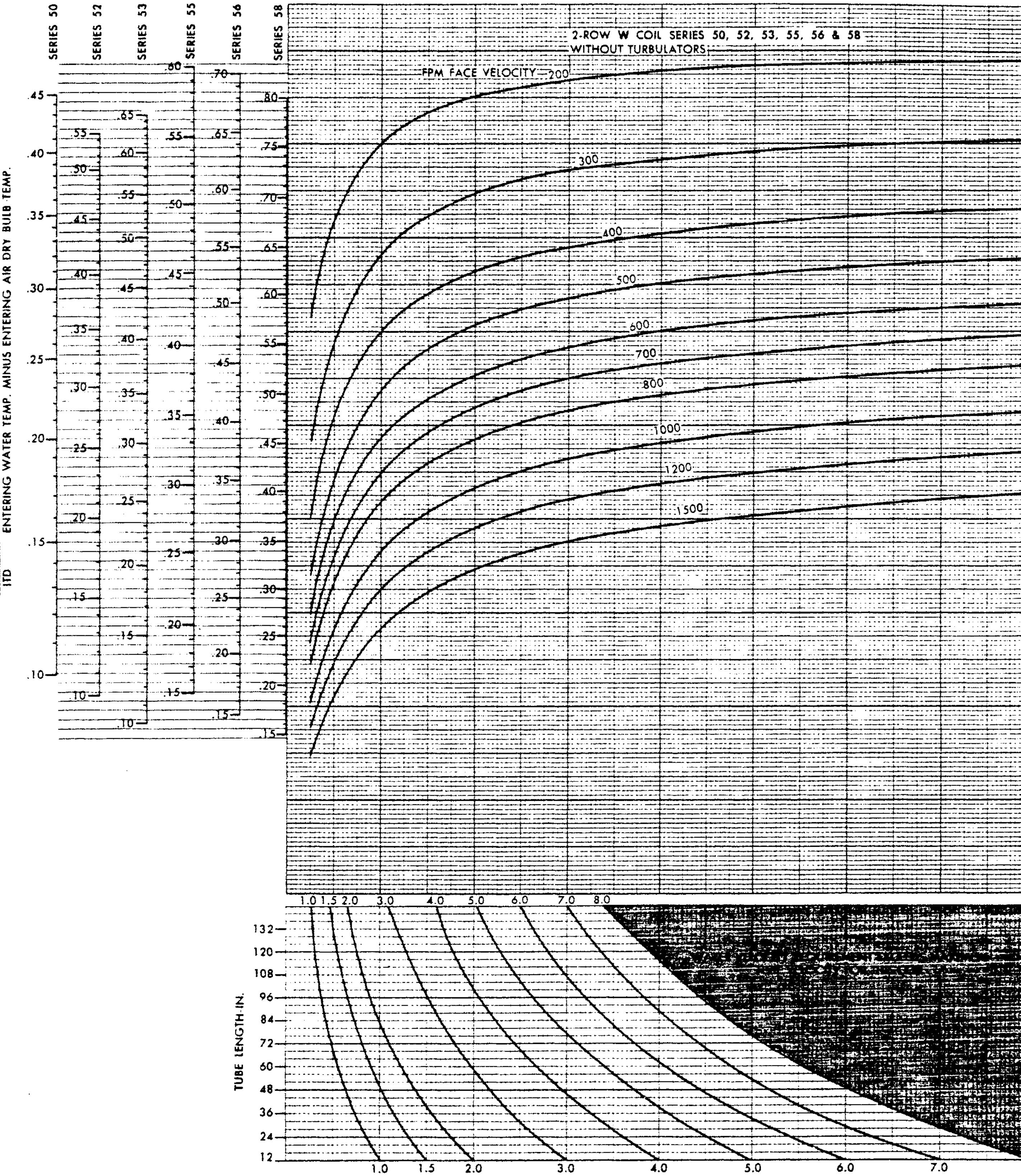

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RT 91-1 — Water Heating Coil Capacity Correction Factor

V-6i

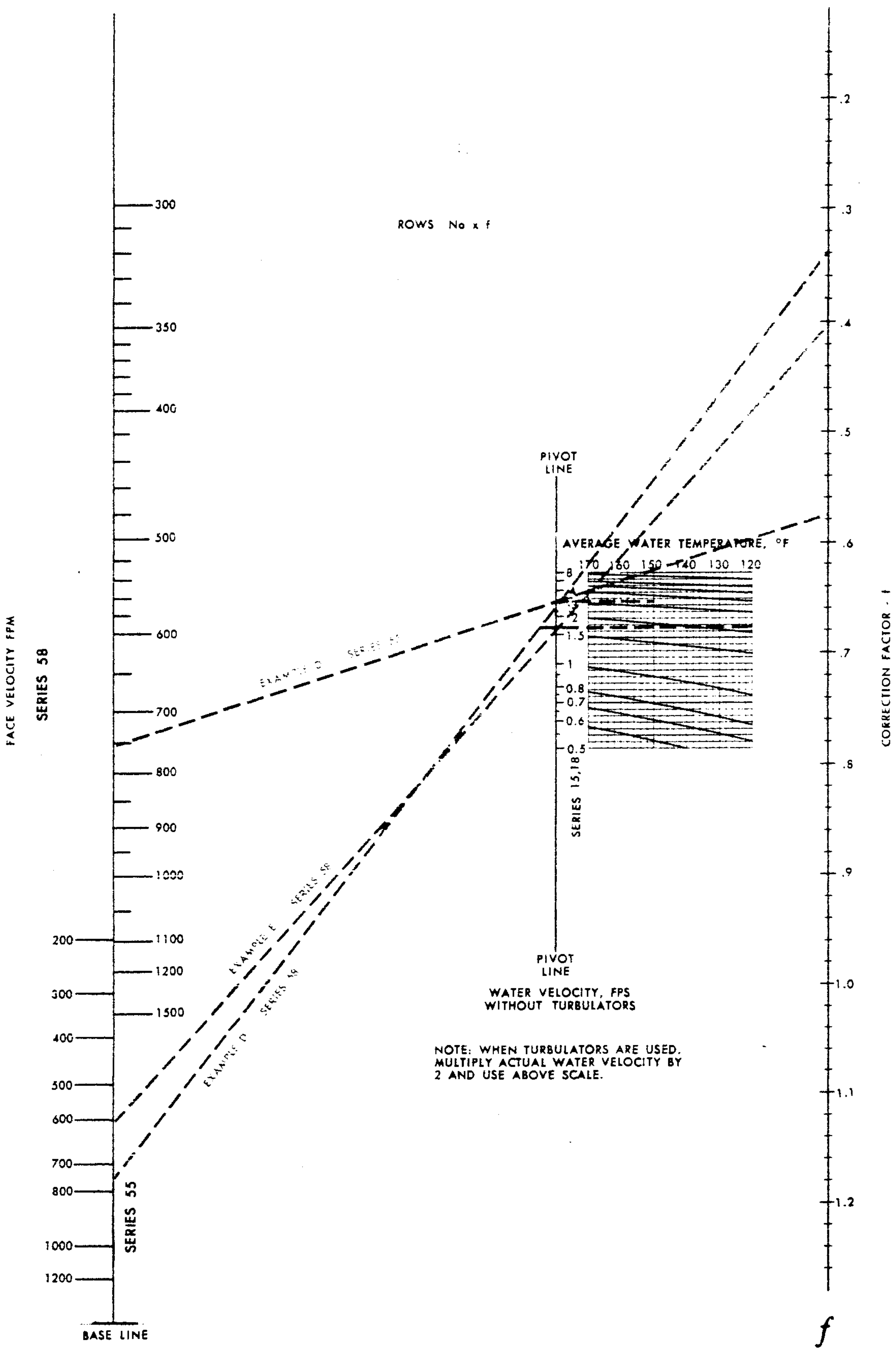

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FIGURE 32-1 — No. 63E, F, G HDT - 36.5" AF Fan

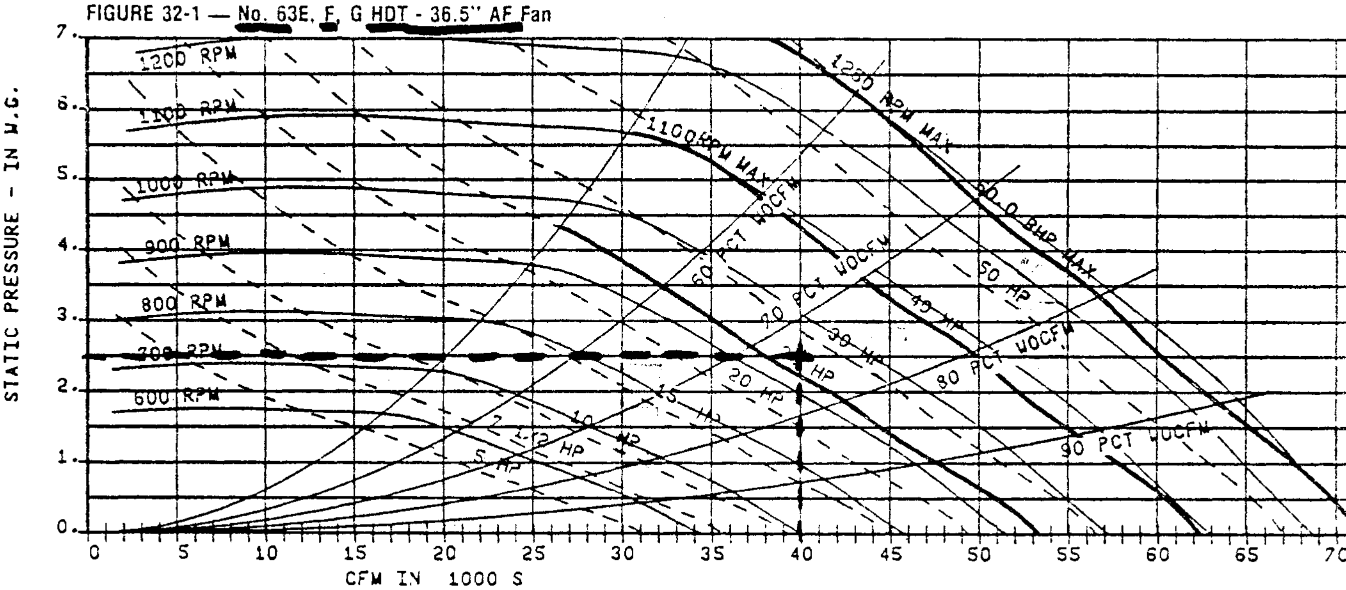


FIGURE 32-2 — No. 63H, J, HDT - 33" AF Fan With Inlet Vanes

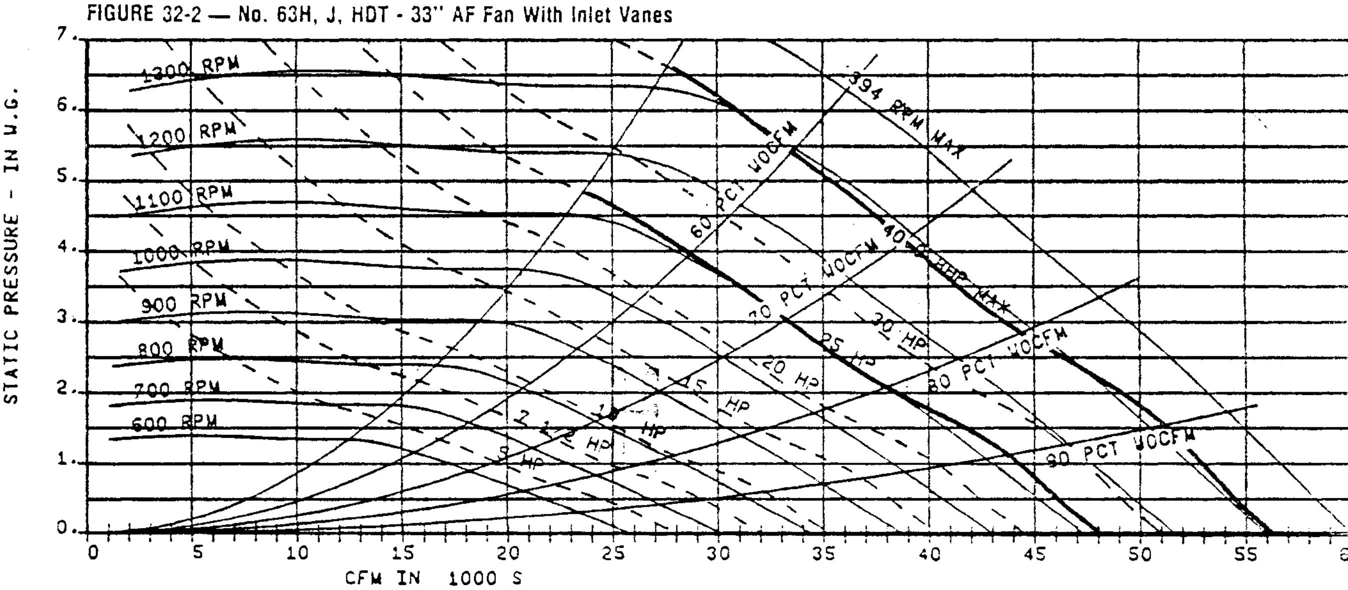
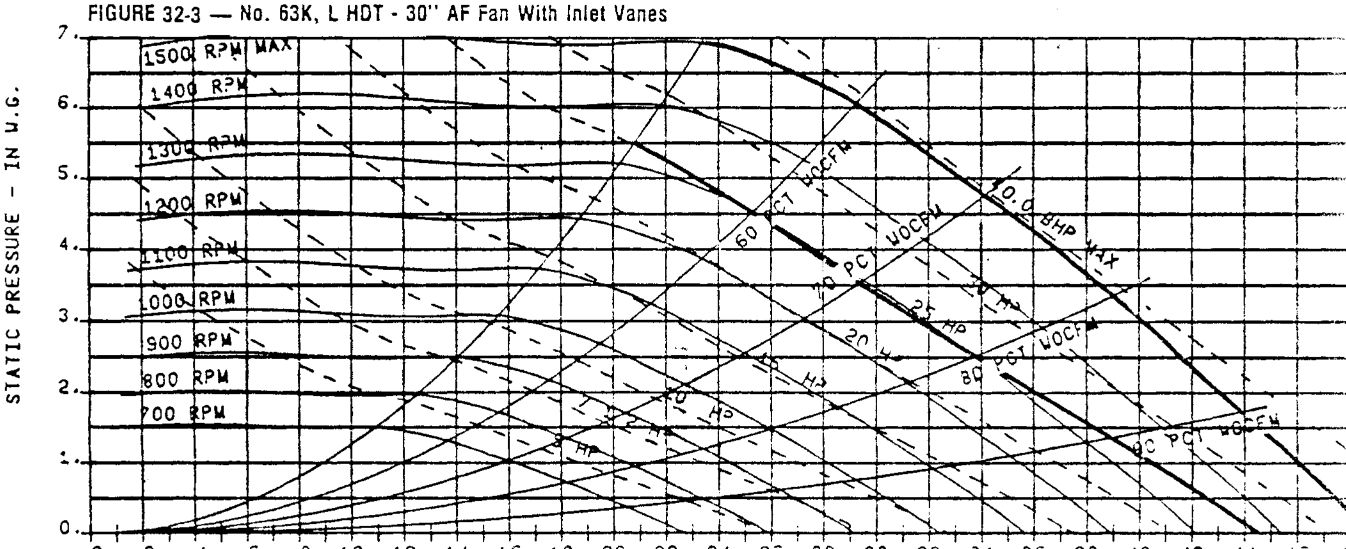


FIGURE 32-3 — No. 63K, L HDT - 30" AF Fan With Inlet Vanes



DIMENSIONAL DATA

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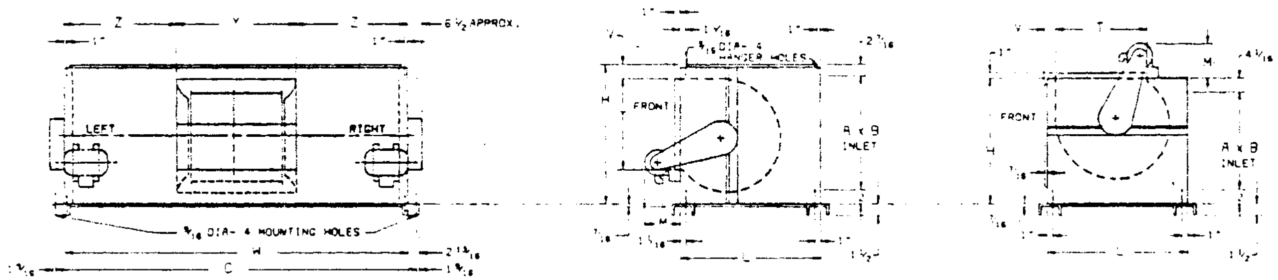
RE 53-1 — Cabinet Fans (Sizes 25-31 and 25V-31V)



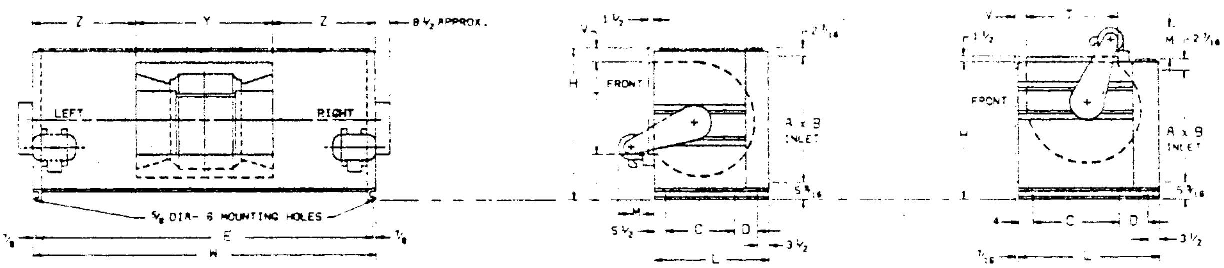
E 53-1 — Casing Dimensions

E	W	L	H	A	B	C	M
	9'7"	3'5 1/8"	3'11 1/2"	2'9"	9'3"	9'9 1/2"	Refer to Table 77-1
	9'7"	3'5 1/8"	3'11 1/2"	3'7"	9'3"	9'9 1/2"	
V	9'7"	3'11"	3'11 1/8"	2'9"	9'3"	9'9 1/2"	
V	9'7"	3'11"	3'11 1/8"	3'7"	9'3"	9'9 1/2"	

TABLE 53-2 — Duct Connection Size/Location

FAN DIA	T	Y	Z	V
22	27 1/4"	27 1/4"	43 1/8"	1"
25	31 1/4	31 1/8	42"	1"

RE 53-2 — Cabinet Fans (Sizes 35-86, and 35V-86V)



ABLE 53-3 — Casing Dimensions

SIZE	W	L STD	L "V" UNIT	H STD	H "V" UNIT	A	B	C STD.	C "V" UNIT	D STD	D "V" UNIT	E	M
35	9'7"	4'4"	5'0"	5'0"	4'11 1/8"	4'4"	9'3"	2'9"	3'7 1/2"	10"	9"	9'5 1/4	Refer to Table 77-1
41	9'10"	4'9"	5'5 1/2"	5'5"	5'4 5/8	4'9"	9'6"	3'3"	4'2"	9"	8"	9'8 1/4"	
50	9'10"	5'3"	6'0 1/2"	6'4"	6'3 5/8"	5'6"	9'6"	3'9"	4'9"	9"	8"	9'8 1/4"	
63	10'6"	5'9"	6'7 1/2"	8'0 1/2"	8'0 1/8"	7'4 1/2"	9'6"	3'9"	4'10"	1'3"	1'2"	9'8 1/4"	
73	10'6"	5'6"	6'4 1/2"	8'0 1/2"	8'0 1/8"	7'4 1/2"	9'6"	3'9"	4'10 1/2"	1'0"	10 1/2"	10'4 1/4"	
86	10'6"	5'6"	6'4 1/2"	8'0 1/2"	8'0 1/8"	7'4 1/2"	9'6"	3'9"	4'10 1/2"	1'0"	10 1/2"	10'4 1/4"	

TABLE 53-4 — Duct Connection Size/Location

SIZE	T	Y	Z	V STD	V "V" UNIT
35	40 1/8	40 1/4	37 3/8"	2 1/2"	2 1/2"
41	44 1/2	44 1/4	36 7/8"	2 1/2"	2 1/2
50	49 1/2	46 7/8	34 5/8"	2 1/2"	2 1/2
63	54 1/8	53 7/8"	36 1/8"	2 1/2	3 1/2
73	54 3/8	53 7/8	36 7/8	2 1/2	3 1/2"
86	54 3/8	53 1/8"	36 1/8	2 1/2	3 1/2"

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FIGURE 60-1 — No. 50F, G, H VDT - 33" AF Fan

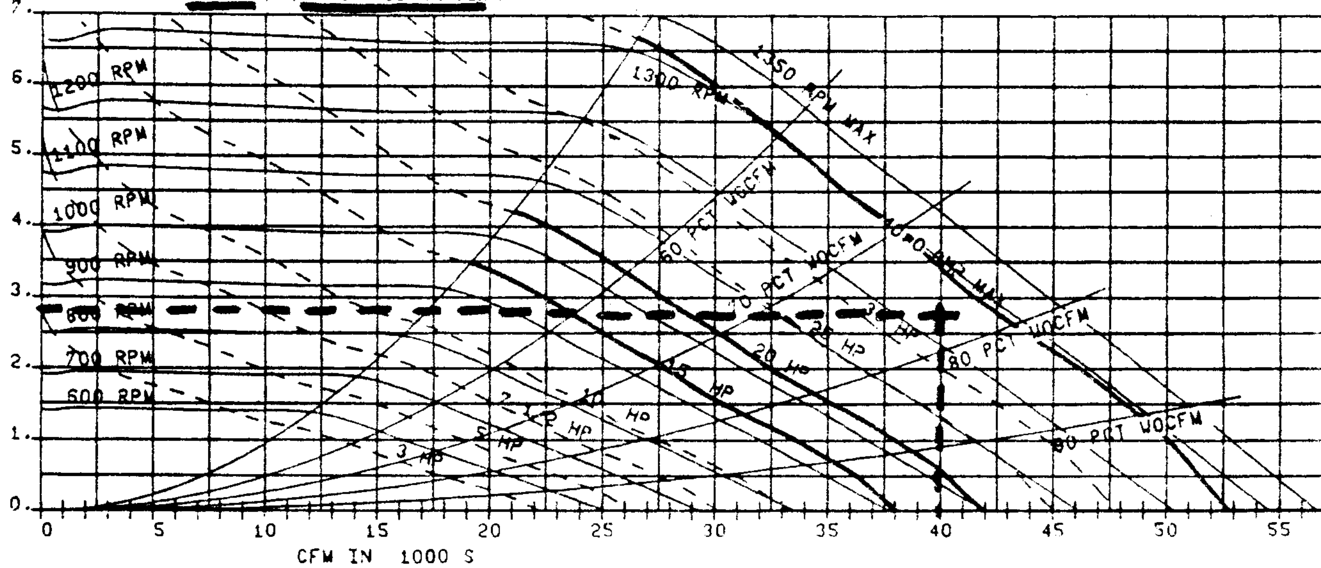


FIGURE 60-2 — No. 50J, K, L VDT - 30" AF Fan With Inlet Vanes

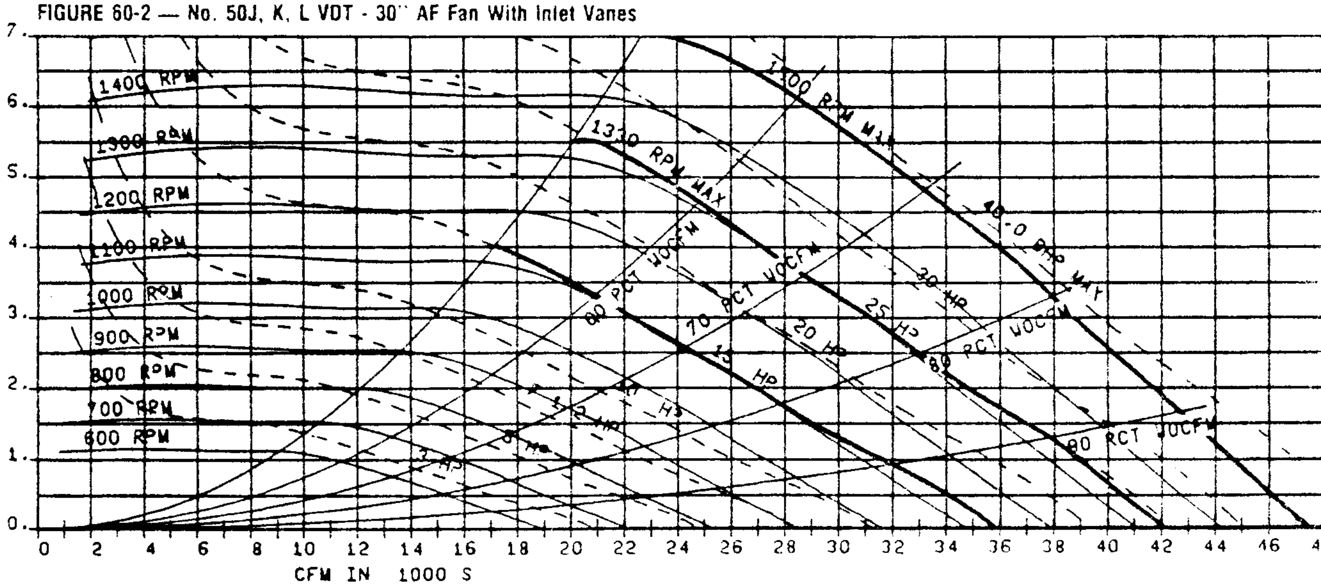
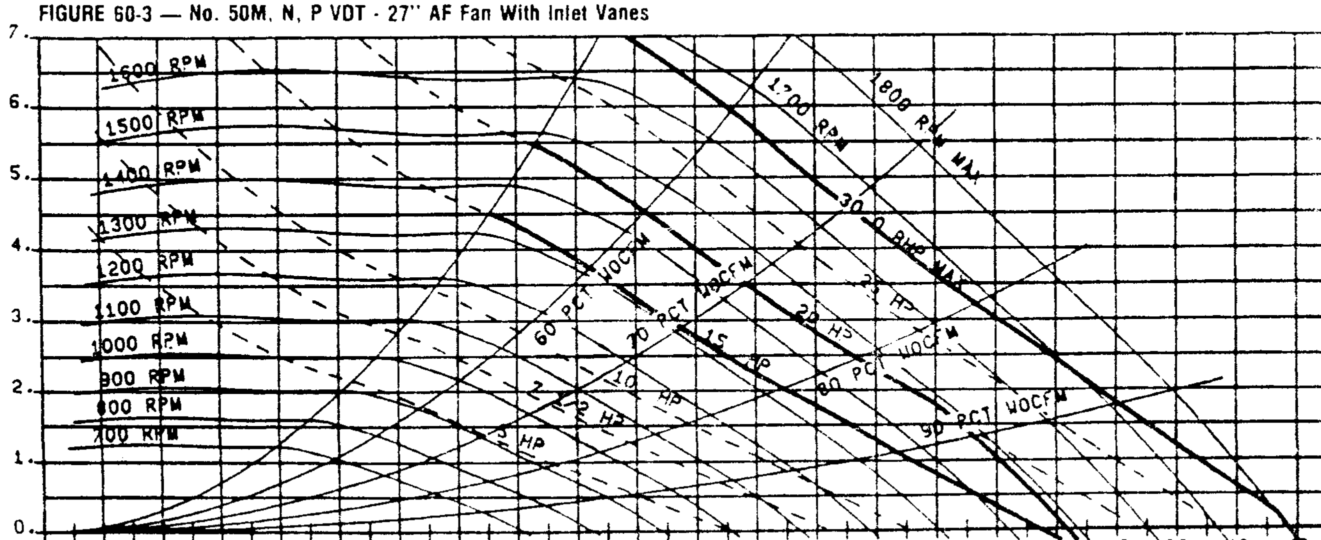


FIGURE 60-3 — No. 50M, N, P VDT - 27" AF Fan With Inlet Vanes



DIMENSIONAL DATA

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FIGURE 47-1 — Vertical Draw-Thru (Sizes 35-50)

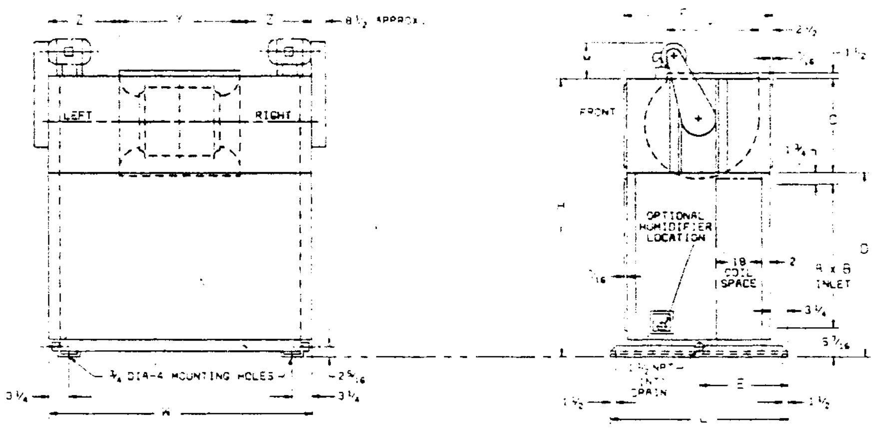

TABLE 47-1 — Casing Dimensions

SIZE	W	L	H ARRG 5, 6	H ARRG 7, 8	A	B	C ARRG 5, 6	C ARRG 7, 8	D	E	F	M
35	9' 7"	5' 2½	8' 7⅝	9' 8¼	4' 4½	9' 3¼	3' 8	4' 9	4' 11⅝"	2' 7¼"	4' 8⅞"	Refer to Table 77-1
[illegible]	9' 10"	5' 7½"	9' 6⅝	10' 6¼	4' 9½	9' 6¼	4' 2	5' 2	5' 4⅝	2' 9¾	5' 1⅞"	
50	9' 10"	5' 6½	10' 11⅝	12' 4¼	5' 8½	9' 6¼	4' 8	6' 1"	6' 3⅝	3' 3¼	6' 0⅞	

TABLE 47-2 — Duct Connection Size/Location

SIZE	T	Y	Z
35	40⅛	40¼	37⅜
[illegible]	[illegible]	44¼	36⅞
50	49⅛	46⅛	34½

FIGURE 47-2 — Vertical Draw-Thru Discharge Arrangements (Sizes 35-50)

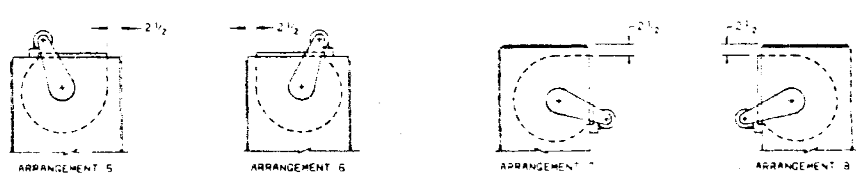

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FIGURE 48-1 — No. 17A, B, C VDT - 20" FC Fan With Inlet Vanes

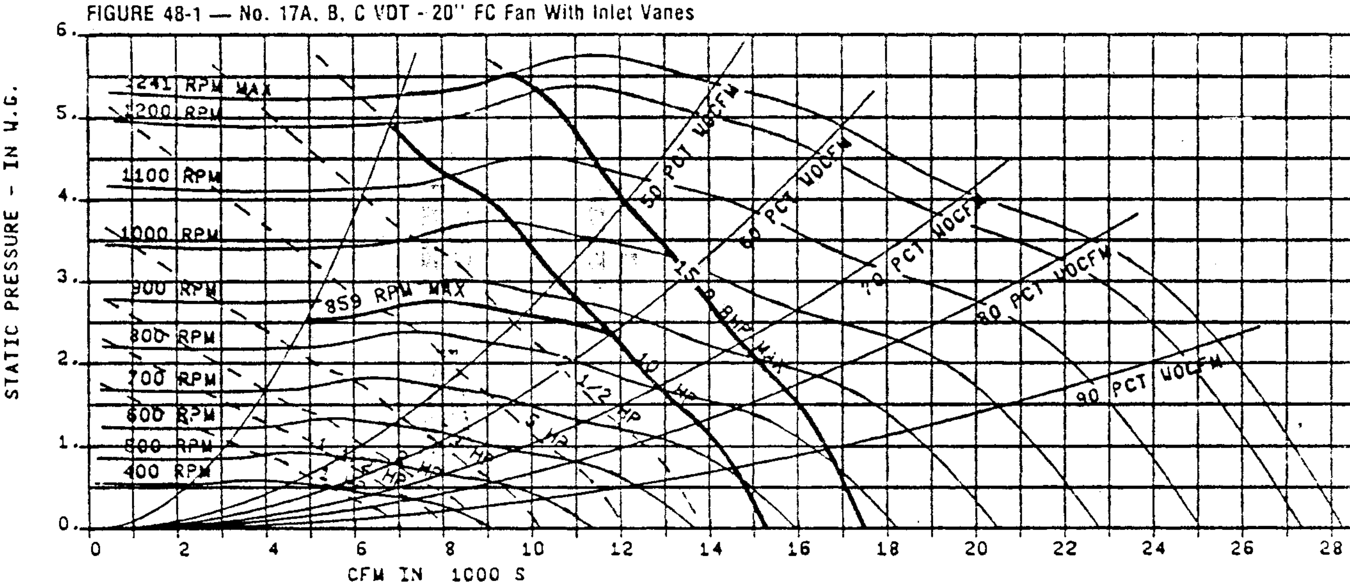


FIGURE 48-2 — No. 17D, E, F VDT - 18.25" FC Fan

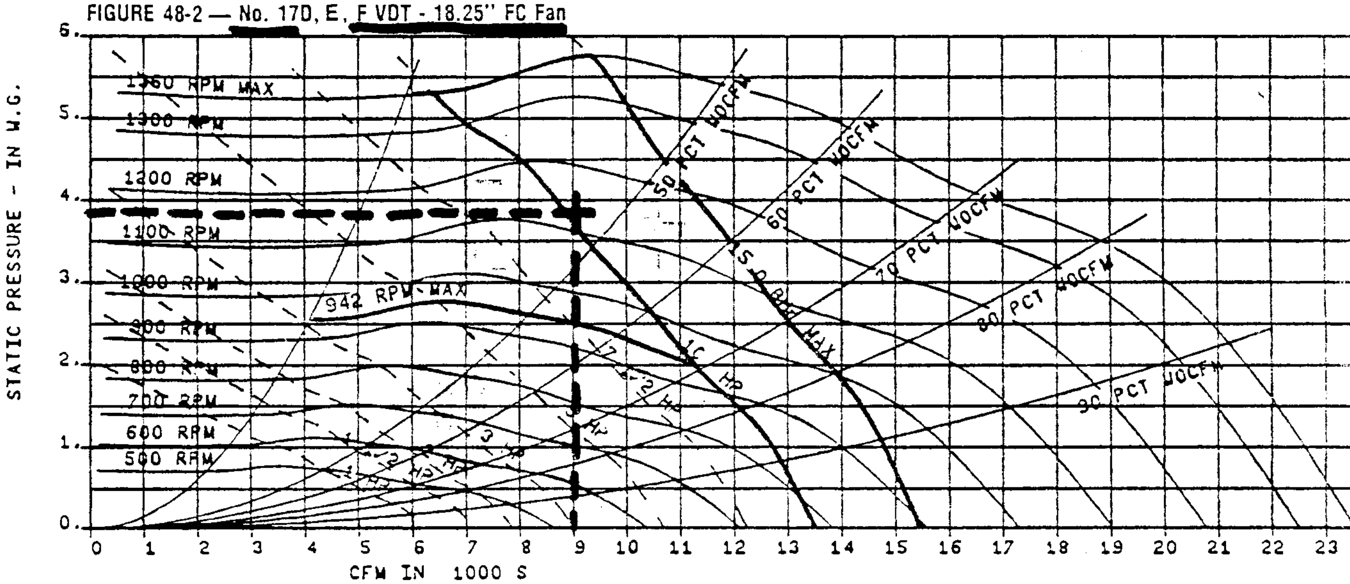
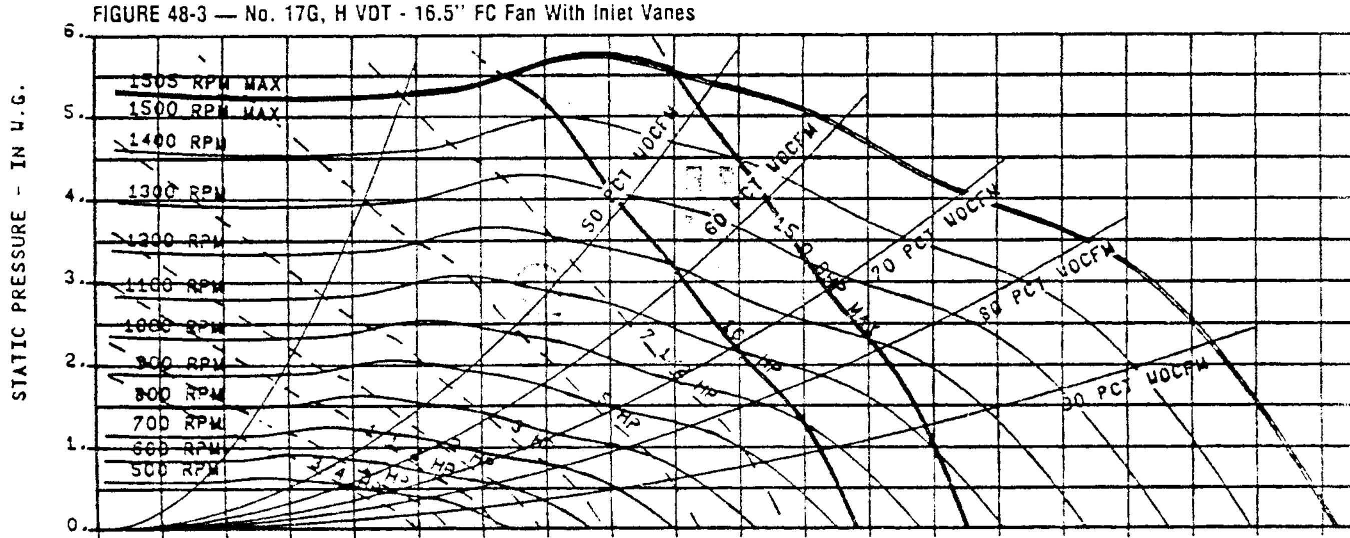


FIGURE 48-3 — No. 17G, H VDT - 16.5" FC Fan With Inlet Vanes



V-10a

Class I (Model 81) Ratings, Lightface Type
Class II (Model 82) Ratings, **Mediumface Type**
Class III (Model 83) Ratings, **Boldface Type**

Heavy Line Indicates Maximum Static Efficiency.

Wheel Diameter 27 In. Outlet Area, 4.19 Sq. Ft.

Tip Speed FPM = 7.07 x RPM Max. BHP $= 3.12 \left(\frac{RPM}{1000}\right)^3$

TABLE 9

VOL. CFM	OUT. VEL. FPM	1/4" S.P.		3/8" S.P.		1/2" S.P.		5/8" S.P.		3/4" S.P.		1" S.P.		1 1/4" S.P.		1 1/2" S.P.		1 3/4" S.P.		2" S.P.	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3352	800	399	0.20	442	0.27	479	0.34	511	0.41	547	0.49										
3771	900	428	0.24	468	0.32	505	0.40	537	0.48	565	0.55	629	0.73								
4190	1000	461	0.30	494	0.38	530	0.46	563	0.56	592	0.64	645	0.81	702	1.02						
4609	1100	494	0.36	523	0.45	556	0.54	588	0.63	618	0.74	670	0.92	718	1.12	770	1.34				
5028	1200	527	0.44	557	0.53	583	0.62	614	0.72	643	0.83	697	1.05	741	1.25	785	1.46	833	1.70		
5447	1300	561	0.52	589	0.62	613	0.72	640	0.82	669	0.94	721	1.17	767	1.39	806	1.60	849	1.85	893	2.11
5866	1400	597	0.62	622	0.73	648	0.84	669	0.94	695	1.05	746	1.29	793	1.55	834	1.79	870	2.01	909	2.28
6285	1500	631	0.73	656	0.84	680	0.96	701	1.07	723	1.18	772	1.44	817	1.70	861	1.98	898	2.23	931	2.47
6704	1600	667	0.85	690	0.97	713	1.09	735	1.22	754	1.33	798	1.59	842	1.87	885	2.16	925	2.46	959	2.72
7123	1700	702	0.98	726	1.12	747	1.24	768	1.38	788	1.51	826	1.76	869	2.05	910	2.35	949	2.66	986	2.97
7542	1800	738	1.13	760	1.27	780	1.41	801	1.55	821	1.69	856	1.95	896	2.25	935	2.56	973	2.88	1011	3.21
7961	1900	774	1.29	795	1.44	816	1.60	834	1.73	854	1.89	887	2.16	923	2.46	962	2.79	999	3.11	1035	3.45
8380	2000	810	1.48	831	1.63	851	1.79	868	1.94	887	2.10	922	2.41	953	2.70	988	3.03	1025	3.37	1060	3.72
8799	2100	846	1.67	866	1.84	886	2.01	902	2.16	920	2.32	955	2.66	984	2.96	1016	3.29	1052	3.64	1086	4.01
9218	2200	882	1.89	902	2.06	921	2.24	939	2.41	954	2.57	988	2.92	1019	3.27	1046	3.57	1078	3.93	1112	4.31
9637	2300	919	2.13	938	2.31	956	2.49	973	2.67	988	2.84	1021	3.20	1052	3.57	1078	3.88	1107	4.25	1138	4.63
10056	2400	956	2.38	974	2.57	991	2.76	1008	2.95	1025	3.14	1054	3.50	1085	3.88	1113	4.26	1138	4.59	1166	4.97
10475	2500	993	2.66	1010	2.86	1027	3.05	1043	3.25	1059	3.45	1088	3.82	1118	4.22	1146	4.61	1169	4.95	1196	5.34
10894	2600	1030	2.96	1046	3.16	1063	3.37	1079	3.57	1094	3.78	1122	4.16	1151	4.58	1179	4.99	1205	5.40	1227	5.74
11313	2700	1067	3.29	1083	3.49	1099	3.70	1114	3.92	1129	4.13	1159	4.56	1184	4.96	1212	5.39	1238	5.81	1258	6.17
11732	2800	1104	3.53	1119	3.85	1135	4.07	1150	4.29	1165	4.51	1193	4.96	1218	5.36	1245	5.80	1270	6.25	1295	6.69
12570	3000	1178	4.40	1193	4.63	1207	4.86	1222	5.10	1236	5.33	1263	5.81	1289	6.29	1312	6.72	1336	7.19	**1368**	**7.67**
13408	3200	1253	5.27	1267	5.52	1280	5.76	1294	6.01	1307	6.26	1333	6.77	**1358**	**7.28**	**1380**	**7.73**	**1403**	**8.24**	**1426**	**8.75**
14246	3400	1328	6.26	1341	6.52	**1354**	**6.78**	**1367**	**7.04**	**1379**	**7.31**	**1404**	**7.84**	**1428**	**8.39**	**1451**	**8.93**	**1471**	**9.40**	**1493**	**9.93**

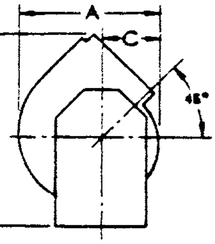
VOL. CFM	OUT. VEL. FPM	2 1/4" S.P.		2 1/2" S.P.		3" S.P.		3 1/2" S.P.		4" S.P.		4 1/2" S.P.		5" S.P.		5 1/2" S.P.		6" S.P.		6 1/2" S.P.	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
5866	1400	950	2.55																		
6285	1500	967	2.75	1005	3.04																
6704	1600	990	2.97	1023	3.25	1094	3.89														
7123	1700	1017	3.25	1049	3.53	1111	4.15	1178	4.83												
7542	1800	1045	3.54	1075	3.83	1131	4.41	1194	5.12	1258	5.84										
7961	1900	1070	3.81	1102	4.15	1158	4.78	1212	5.41	1272	6.16	1333	6.94								
8380	2000	1094	4.08	1127	4.45	1185	5.14	1238	5.81	1290	6.52	1348	7.30	1405	8.12						
8799	2100	1118	4.37	1151	4.75	1212	5.53	1264	6.22	1311	6.89	1364	7.69	1418	8.51	1474	9.38				
9218	2200	1145	4.69	1175	5.07	1237	5.89	1292	6.68	1339	7.38	**1384**	**8.09**	**1436**	**8.96**	**1487**	**9.81**	**1540**	**10.72**		
9637	2300	1171	5.03	1202	5.43	1260	6.24	1317	7.10	**1366**	**7.86**	**1412**	**8.63**	**1454**	**9.38**	**1504**	**10.29**	**1553**	**11.18**	**1604**	**12.13**
10056	2400	1197	5.38	1228	5.79	1285	6.63	1341	7.52	**1393**	**8.39**	**1438**	**9.17**	**1482**	**9.97**	**1523**	**10.75**	**1570**	**11.72**	**1617**	**12.64**
10475	2500	1224	5.75	1254	6.18	1311	7.05	**1365**	**7.94**	**1418**	**8.87**	**1466**	**9.76**	**1506**	**10.56**	**1547**	**11.34**	**1589**	**12.21**	**1635**	**13.22**
10894	2600	1253	6.16	1280	6.59	1337	7.49	**1390**	**8.39**	**1442**	**9.36**	**1491**	**10.31**	**1534**	**11.16**	**1576**	**12.04**	**1613**	**12.84**	**1653**	**13.70**
11313	2700	1283	6.59	1309	7.02	**1364**	**7.94**	**1416**	**8.88**	**1466**	**9.83**	**1516**	**10.85**	**1562**	**11.83**	**1602**	**12.69**	**1642**	**13.60**	**1677**	**14.43**
11732	2800	1314	7.05	1339	7.49	**1389**	**8.42**	**1442**	**9.39**	**1491**	**10.36**	**1540**	**11.38**	**1587**	**12.43**	**1630**	**13.43**	**1668**	**14.32**	**1706**	**15.26**
12151	2900	**1351**	**7.62**	**1368**	**7.98**	**1417**	**8.93**	**1468**	**9.92**	**1517**	**10.93**	**1564**	**11.94**	**1611**	**13.03**	**1655**	**14.10**	**1696**	**15.13**	**1732**	**16.03**
12570	3000	**1383**	**8.14**	**1401**	**8.52**	**1446**	**9.47**	**1495**	**10.47**	**1543**	**11.51**	**1589**	**12.54**	**1635**	**13.63**	**1679**	**14.78**	**1722**	**15.86**	**1781**	**16.91**
13408	3200	**1449**	**9.26**	**1470**	**9.76**	**1507**	**10.65**	**1550**	**11.67**	**1597**	**12.75**	**1642**	**13.86**	**1685**	**14.95**	**1728**	**16.10**	**1770**	**17.27**	**1811**	**18.48**
14246	3400	**1515**	**10.48**	**1536**	**11.02**	**1577**	**12.09**	**1611**	**13.02**	**1651**	**14.11**	**1695**	**15.28**	**1738**	**16.43**	**1779**	**17.62**	**1819**	**18.79**	**1859**	**20.03**
15084	3600	**1582**	**11.81**	**1602**	**12.38**	**1642**	**13.53**	**1679**	**14.65**	**1711**	**15.62**	**1750**	**16.78**	**1791**	**18.00**	**1831**	**19.24**	**1871**	**20.50**	**1909**	**21.73**
15922	3800	**1649**	**13.27**	**1669**	**13.87**	**1707**	**15.08**	**1744**	**16.29**	**1774**	**17.30**	**1809**	**18.48**	**1846**	**19.70**	**1884**	**20.97**	**1923**	**22.29**	**1961**	**23.61**
16760	4000	**1721**	**14.98**	**1737**	**15.50**	**1774**	**16.77**	**1810**	**18.04**	**1845**	**19.30**	**1872**	**20.34**	**1905**	**21.59**	**1940**	**22.88**	**1976**	**24.21**	**2014**	**25.59**
17598	4200	**1790**	**16.73**	**1805**	**17.26**	**1841**	**18.59**	**1876**	**19.92**	**1910**	**21.26**	**1943**	**22.58**	**1968**	**23.64**	**2000**	**24.96**	**2033**	**26.31**	**2067**	**27.70**

VOL. CFM	OUT. VEL. FPM	7" S.P.		7 1/2" S.P.		8" S.P.		8 1/2" S.P.		9" S.P.		9 1/2" S.P.		10" S.P.		10 1/2" S.P.		11" S.P.		11 1/2" S.P.	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
10056	2400	**1666**	**13.63**																		
10475	2500	**1680**	**14.19**	**1726**	**15.20**																
10894	2600	**1698**	**14.81**	**1741**	**15.81**	**1785**	**16.86**														
11313	2700	**1716**	**15.39**	**1759**	**16.48**	**1800**	**17.52**	**1843**	**18.60**	**1887**	**19.73**										
11732	2800	**1740**	**16.11**	**1778**	**17.10**	**1819**	**18.23**	**1859**	**19.32**	**1900**	**20.42**	**1941**	**21.57**								
12151	2900	**1769**	**17.01**	**1801**	**17.88**	**1838**	**18.91**	**1877**	**20.07**	**1916**	**21.21**	**1955**	**22.33**	**1995**	**23.51**	**2038**	**24.73**				
12570	3000	**1795**	**17.84**	**1831**	**18.85**	**1862**	**19.75**	**1897**	**20.80**	**1935**	**21.99**	**1972**	**23.18**	**2010**	**24.32**	**2048**	**25.53**	**2087**	**26.77**		
12989	3100	**1821**	**18.69**	**1857**	**19.73**	**1891**	**20.78**	**1921**	**21.70**	**1955**	**22.77**	**1990**	**23.94**	**2028**	**25.22**	**2064**	**26.41**	**2101**	**27.63**	**2138**	**28.90**
13408	3200	**1849**	**19.64**	**1883**	**20.65**	**1917**	**21.72**	**1951**	**22.80**	**1979**	**23.75**	**2012**	**24.64**	**2046**	**26.03**	**2082**	**27.35**	**2117**	**28.60**	**2153**	**29.83**
13827	3300	**1874**	**20.48**	**1911**	**21.67**	**1943**	**22.70**	**1977**	**23.81**	**2009**	**24.92**	**2040**	**26.02**	**2068**	**27.01**	**2101**	**28.21**	**2136**	**29.58**	**2170**	**30.86**
14246	3400	**1898**	**21.32**	**1938**	**22.57**	**1972**	**23.79**	**2003**	**24.84**	**2035**	**25.99**	**2066**	**27.13**	**2097**	**28.27**	**2124**	**29.26**	**2155**	**30.48**	**2188**	**31.76**
14665	3500	**1922**	**22.14**	**1960**	**23.47**	**1997**	**24.76**	**2031**	**26.01**	**2061**	**27.08**	**2093**	**28.26**	**2123**	**29.44**	**2153**	**30.61**	**2179**	**31.62**	**2209**	**32.64**
15084	3600	**1947**	**23.02**	**1984**	**24.34**	**2021**	**25.71**	**2058**	**27.03**	**2090**	**28.32**	**2119**	**29.42**	**2149**	**30.63**	**2178**	**31.84**	**2208**	**33.05**	**2233**	**34.07**
15922	3800	**1997**	**24.90**	**2033**	**26.25**	**2080**	**27.63**	**2104**	**29.03**	**2139**	**30.48**	**2172**	**31.88**	**2204**	**33.24**	**2231**	**34.38**	**2261**	**35.66**		
16760	4000	**2050**	**26.98**	**2085**	**28.38**	**2119**	**29.73**	**2153**	**31.16**	**2187**	**32.62**	**2221**	**34.15**	**2254**	**35.84**						
17598	4200	**2103**	**29.14**	**2138**	**30.59**	**2172**	**32.08**	**2205**	**33.53**	**2237**	**34.98**										
18436	4400	**2156**	**31.45**	**2191**	**32.98**	**2224**	**34.47**	**2257**	**36.00**												
19274	4600	**2214**	**33.87**	**2245**	**35.48**																

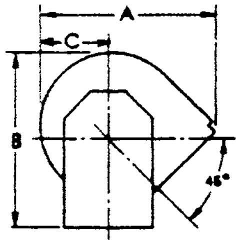
V-10b

Sizes 12"-36" Convertible (with round inlet)
Sizes 40"-60" Nonconvertible (with square inlet)

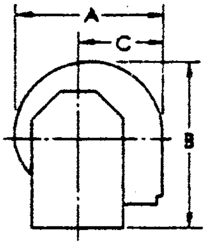
Class I
SW Arrangement 10



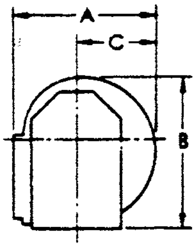
TAU
Top Angular Up



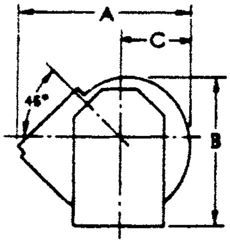
TAD
Top Angular Down



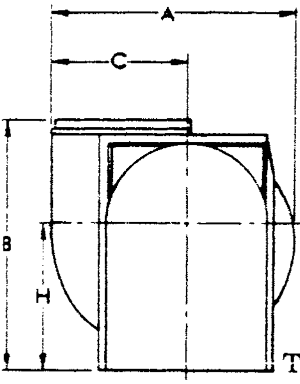
DB
Down Blast



BH
Bottom
Horizontal

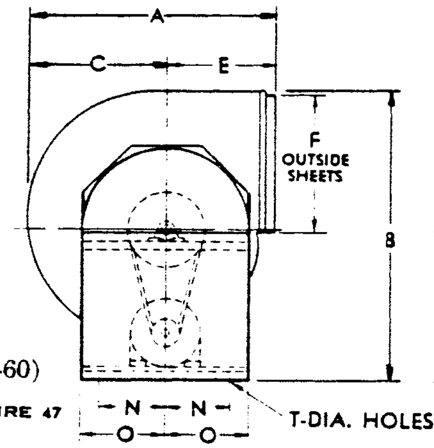


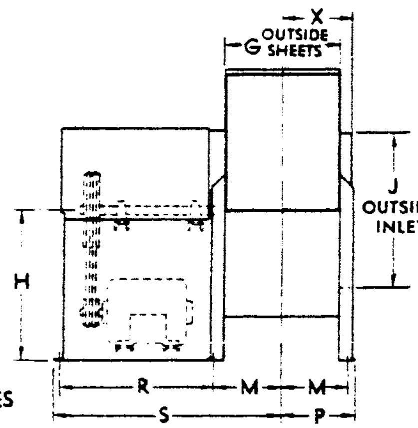
BAU
Bottom Angular Up



UB
Up Blast
(Construction
Typical for Sizes 40-60)

FIGURE 47





TH Top Horizontal
(Construction Typical for Sizes 12-36)

TABLE 51

FOR SPECIFIC DISCHARGE

FAN SIZE	A TH BH	A UB DB	A TAU	A TAD	A BAU	B TH	B UB	B BH	B DB	B TAU	B TAD	B BAU
12	23½	22¾	21⅞	27⅞	27⅞	27¼	27½	25½	26¼	32⅛	26¾	25¼
13	25½	24⅞	24	30⅜	30⅜	28½	28⅛	26½	27⅜	33½	27⅞	26¼
15	27⅞	27⅝	26⅝	33½	33½	31⅛	30½	29	29⅞	36⅝	30½	28⅝
16	30½	30¼	29⅛	36⅝	36⅝	34⅛	33¼	31⅝	32¾	40	33⅜	31⅜
18	33⅜	33⅜	32¼	40¼	40¼	37¾	36⅝	35⅛	36¼	44¼	37	34¾
20	37⅛	36½	35⅛	44⅝	44⅝	41¼	40⅝	38¼	39½	48¾	40⅜	37⅞
22	41	40½	39	49¼	49¼	45⅜	44½	42⅛	43½	53½	44⅜	41⅝
24	44⅛	46½	44⅞	54⅛	54⅛	54⅛	47½	48⅜	52⅝	60	54¼	46¾
27	48¼	51⅛	49⅜	59½	59½	59¼	51¾	52⅞	57½	65⅝	59⅜	51⅛
30	53¾	56¾	54⅞	66¼	66¼	66¼	58	59⅛	64¼	73⅜	66⅜	57⅛
33	58¾	62⅜	60¼	72½	72½	72⅝	63¼	64¾	70½	80¼	72¾	62⅝
36	64⅜	68⅞	66½	79¾	79¾	79¾	69	71⅛	77⅜	87⅞	79⅞	68¾
40	69¾	77	72½	94½	91½	79¾	72¼	78⅞	76¾	93⅞	75⅜	76⅛
44	76⅝	84⅞	80⅛	103½	100½	87½	79¼	86¾	84	103	82⅞	83¾
49	84⅝	93⅞	88¼	113¾	110⅞	97	87¾	95⅛	93⅜	114⅛	91⅝	91⅞
54	93¼	103⅝	97¾	124⅞	121⅞	106¾	96¼	105	102⅜	125	101⅛	101⅜
60	102⅝	114¼	108	137¼	134¼	117½	105¾	115⅝	112½	137½	111⅛	111⅝

FAN SIZE	C TH BH	C UB DB	C TAU	C TAD BAU	H TH	H UB	H BH BAU	H DB	H TAU	H TAD
12	11¼	12¼	10¼	10⅞	15	15	15	15	15	15
13	12⅜	13½	11¼	11⅞	15	15	15	15	15	15
15	13⅝	14⅞	12⅜	13⅛	16¼	16¼	16¼	16¼	16¼	16¼
16	15	16⅜	13⅝	14⅜	17¾	17¾	17¾	17¾	17¾	17¾
18	16½	18	14⅞	15⅞	19¾	19¾	19¾	19¾	19¾	19¾
20	18	19¾	16⅜	17⅜	21½	21½	21½	21½	21½	21½
22	20	21⅞	18⅛	19¼	23½	23½	23½	23½	23½	23½
24	24⅝	26⅛	18¾	22¼	28	28	28	28	28	28
27	27	28¾	20⅝	24⅜	30½	30½	30½	30½	30½	30½
30	30	32	22⅞	27⅛	34¼	34¼	34¼	34¼	34¼	34¼
33	33	35⅛	25⅛	29¾	37½	37½	37½	37½	37½	37½
36	36⅜	38¾	27¾	32⅞	41	41	41	41	41	41
40	39¾	44¼	30⅛	35¾	35½	42¼	46	37	38¼	33
44	43⅞	48¾	33¼	39½	38¾	46½	50½	40	42	36
49	48⅜	54	36⅝	43½	43	51½	55¼	45	46¾	40
54	53½	59½	40⅝	48¼	47¼	56½	60¾	48¾	51¼	44
60	59⅛	65½	44⅞	53¼	52	62¼	66¾	53¼	56½	48

FOR ALL DISCHARGES

FAN SIZE	WHEEL DIA.	E	E†	E††	F	G	J	M	N	O	P
12	12¼	12¼			13⅛	9¾	13⅞	5⅞	5¾	7	6¾
13	13½	13⅛			14⅜	10¾	15⅜	6⅜	6½	7¾	7¼
15	15	14¼			15⅞	11⅞	16⅞	7	7	8½	7⅞
16	16½	15½			17⅜	13⅛	18⅝	7⅝	7½	9⅜	8½
18	18¼	16⅞			19⅛	14½	20⅛	8⅜	8	10⅛	9⅜
20	20	19⅛			21⅜	15⅞	22⅞	9⅛	9	11½	10⅛
22	22¼	21			23⅜	17¾	25⅛	10⅛	10	12⅝	11⅛
24	24½	19½			25¾	19½	29	11⅞	11¾	15¼	12⅞
27	27	21¼			28⅜	21½	31½	12⅞	13	16½	13⅞
30	30	23¾			31⅝	23¾	34½	14	14½	18	15½
33	33	25¾			34¾	26¼	37½	15¼	16	19½	16¾
36	36½	28			38⅜	29⅛	41	16¾	17¾	21¼	18¼
40	40¼	30	34½	38¾	42¼	32	42¾	18	18½	23⅜	19½
44	44½	32¾	37½	41¾	46¾	35¼	47	19⅝	20½	25½	21⅛
49	49	36¼	41¼	45¼	51½	38¾	51½	21⅜	22½	28¼	23⅜
54	54¼	39¾	44¾	49	57	43	56¾	23½	25	30⅞	25½
60	60	43½	49	53¼	63	47½	62½	25¾	28	33⅜	27¾

FAN SIZE	R	S	T	X	MAX. MOTOR FRAME	* FAN SHAFT DIA.	** FAN SHAFT DIA.	* SQ. KEY	** SQ. KEY
12	22	28¾	⅝	7⅜	213T	15/16	15/16	¼	¼
13	22	29¼	⅝	7⅞	213T	15/16	15/16	¼	¼
15	25	32⅞	⅝	8½	215T	15/16	15/16	¼	¼
16	25	33½	⅝	9⅛	215T	15/16	15/16	¼	¼
18	25	34⅜	⅝	10⅛	254T	1 3/16	1 3/16	¼	¼
20	25	35⅛	⅝	10⅞	254T	1 3/16	1 3/16	¼	¼
22	28	39⅛	⅝	11¾	256T	1 3/16	1 3/16	¼	¼
24	27	40⅛	¾	12	284T	1 7/16	1 7/16	⅜	⅜
27	28½	42⅝	¾	13	284T	1 7/16	1 7/16	⅜	⅜
30	30¼	45½	¾	14⅜	286T	1 11/16	1 11/16	⅜	⅜
33	32	48¾	¾	16½	286T	1 11/16	1 11/16	⅜	⅜
36	34	52¼	¾	17⅞	324T	1 15/16	1 15/16	½	½
40	38	57½	⅞	19¾	324T	2 3/16	1 15/16	½	½
44	40	61⅛	⅞	21⅜	326T	2 7/16	2 3/16	⅝	½
49	42	65⅜	⅞	23⅞	364T	2 11/16	2 7/16	⅝	⅝
54	46	71½	⅞	26	365T	2 11/16	2 7/16	⅝	⅝
60	49	76¾	1	28¼	404T	2 15/16	2 11/16	¾	⅝

V-11a

Approved Standard Ratings are in accordance with Industry Standard 441-66 for Room Fan-Coil Air-Conditioners.

COOLING SELECTION

At 25% outside air and 75% recirculated air, a 400 cfm unit is required to meet the 100 cfm ventilation requirement.

The mixed air temperature entering the coil can be determined from a psychrometric chart as 80DB/67WB, 50% RH.

Since catalog capacity is for sea level conditions, adjust the room loads for 6,000 feet elevation before entering capacity tables. From Chart 3 of page 21, the sensible heat factor for 6,000 ft. elevation is .8; the total heat factor is about .93.

At 80DB/67WB, 50% RH, enter cooling capacity on page 39 for horizontal units at high speed with adjusted loads of $\frac{6.9\text{ MBH}}{.8}$ or 8.6 MBH. Sensible Heat, $\frac{10.7\text{ MBH}}{.93}$ or 11.5 MBH Total Heat. The Type "D" high temperature rise coil should be used since it is designed specifically for water temperature rises of 12F and higher. The 400 cf unit with the Type "D" coil will provide the adjuste capacity at 16F water temperature rise. Coil gpm is 1. coil pressure drop is 2.8 feet. Coil Sensible Heat Ratio 75%. Therefore, the Total Heat factor for 6,000 ft. eleva tion is valid.

Table 1, page 18 indicates a 400 cfm horizontal Un Trane unit at high speed will produce a sound level belo the required sound power level.

HEATING SELECTION

The mixed air temperature to the coil can be calculate from the psychrometric chart as 60DB. Chart 10, page 49 indicates an ITD of 100F and gpm of 1.5 can be used at hig speed to satisfy the adjusted room load of $\frac{(13.8\text{ MBH}}{.8}$ or 17.2 MBH adjusted for 6,000 feet elevation. The enter ing water temperature would be 100F plus 60F or 160F

TABLE 8—ARI Approved Standard Ratings

VERTICAL UNITRANE													
			COOLING[1] CAPACITIES						COOLING[1] CAPACITIES			MOTOR POWER[2] INPU	
COIL & SIZE	RATED CFM[4]	GPM	PD[5]	SENS. HEAT MBH	TOTAL HEAT MBH	COIL & SIZE	RATED CFM	GPM	PD	SENS. HEAT MBH	TOTAL HEAT MBH	SHADED POLE WATTS	PSC WATTS
A002	230	1.2	1.7	4.3	5.3	D002	210	1.6	6.3	5.4	7.8	120	85
A003	320	1.9	5.8	6.6	9.0	D003	300	2.5	18.5	8.0	12.0	160	85
A004	410	2.3	4.9	8.5	11.4	D004	390	3.1	16.4	10.1	15.1	135	75
A006	570	3.4	13.3	11.9	16.4	D006	540	4.6	46.0	14.9	22.4	180	90
A008	840	4.9	12.5	17.3	24.2	D008	840	5.9	9.7	20.4	29.2	—	130
A010	1000	5.8	8.3	20.3	28.4	D010	990	6.9	9.9	23.5	33.9	—	170
A012	1200	7.2	10.3	25.4	35.4	D012	1200	8.5	12.5	28.9	41.7	—	190
HORIZONTAL UNITRANE													
A002H[6]	220	1.3	1.1	4.8	6.2	D002H[6]	200	1.5	3.6	5.2	7.4	120	85
A003H	300	1.9	4.1	6.3	8.8	D003H	270	2.0	7.6	6.8	10.0	160	85
A004H	420	2.5	4.8	9.0	12.4	D004H	380	2.7	8.6	9.2	13.4	135	75
A006H	560	3.4	13.8	11.5	16.5	D006H	500	3.7	19.7	12.4	18.2	180	90
A008H	880	4.7	14.6	16.9	23.1	D008H	850	5.8	5.2	20.3	28.4	—	130
A010H	1040	5.7	8.2	20.2	27.8	D010H	990	6.8	5.9	23.7	33.3	—	170
A012H	1200	6.6	6.5	23.5	32.2	D012H	1130	7.9	9.2	27.6	38.8	—	190
LOW VERTICAL UNITRANE													
A002 L[7]	200	1.1	2.5	3.6	5.3							120	85
A003 L	290	1.9	9.0	6.0	8.7							160	85
A004 L	360	2.2	6.6	7.5	11.0							135	75
A006 L	550	3.2	10.5	11.1	15.7							180	90

NOTES: 1. BASED ON 80 DB AND 67 WB EAT. 45F EWT. 10F TEMPERATURE RISE. HIGH FAN SPEED. GRILLE FREE AREAS SHOWN IN TABLE 1
2. MOTOR VOLTAGE 115/60/1 POWER SOURCE. SEE TABLE 13 FOR OTHER MOTOR DATA.
3. FILTER TYPE: ½" PERMANENT CLEANABLE. SEE TABLE 9 FOR OTHER FILTER DIMENSIONS.
4. AIR FLOW UNDER DRY COIL CONDITIONS.
5. WATER PRESSURE DROPS SHOWN IN FEET OF WATER.
6. H SUFFIX INDICATES HORIZONTAL COIL CONFIGURATION.
7. L SUFFIX INDICATES LOW VERTICAL COIL CONFIGURATION.

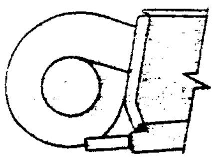
TABLE 9—UniTrane Filter Sizes, Inches

NOMINAL CFM	VERTICAL & HORIZONTAL	LOW VERTICAL
200	19⅞ X 8¼	19½ X 8
300	27⅞ X 8¼	27½ X 8
400	31⅞ X 8¼	35½ X 8
600	43⅞ X 8¼	47½ X 8
800	45¾ X 11	—
1000	57¾ X 11	—
1200	69¾ X 11	—

TABLE 10—UniTrane Grille Free Areas, Sq. In.

NOMINAL CFM	MODELS					
	VERTICAL		HORIZONTAL		LOW VERTICAL	
	INLET	OUTLET	INLET	OUTLET	INLET	OUTLET
200	65	62	102	82	56	50
300	82	87	144	115	78	73
400	94	99	164	132	100	95
600	129	138	226	182	133	129
800	187	226	306	285	—	—
1000	235	283	396	356	—	—
1200	283	339	488	428	—	—

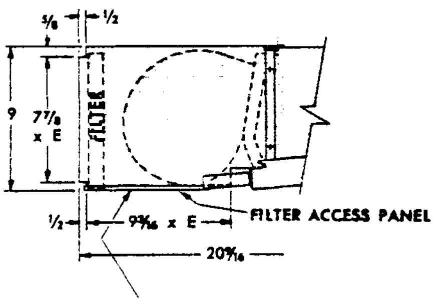
NOTE: ARI CAPACITIES ARE OBTAINED WITH GRILLE FREE AREAS SHOWN ABOVE.



EXPOSED FAN
INLET 2

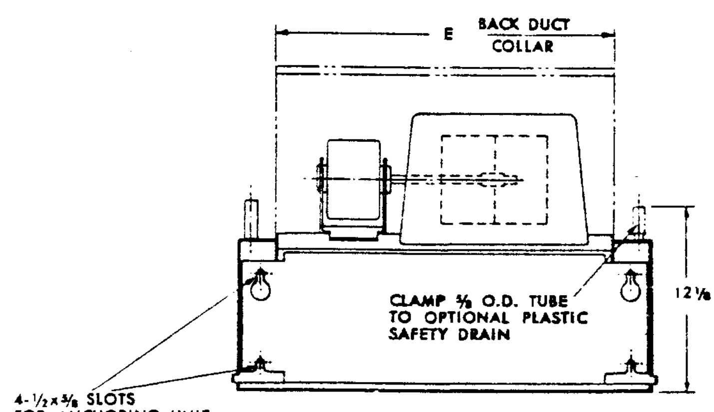
TABLE 19—Model C, 02-06, Unit Dimensions

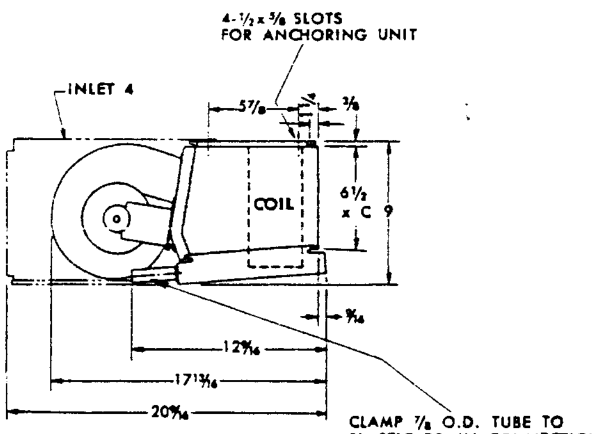
UNIT SIZE	CFM	NO. OF FANS	A	B	C	D	E
02	200	1	23⅞	23⅛	18½	20¾	20
03	300	1	31⅞	31⅛	26½	28¾	28
04	400	2	35⅞	35⅛	30½	32¾	32
06	600	2	47⅞	47⅛	42½	44¾	44

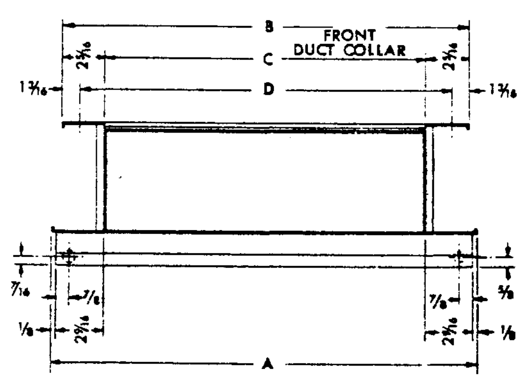


NOTE: FOR OPTIONAL BOTTOM OPENING (9⁹⁄₁₆xE) CONTRACTOR MUST REMOVE BOTTOM FILTER ACCESS PANEL AND INSTALL ON BACK DUCT COLLAR.

BACK DUCT COLLAR-INLET 4







CERTIFIED COMPLIANCE ROOM FAN-COIL AIR CONDITIONER INDUSTRY STANDARD 441

Approved Standard Ratings are in accordance with Industry Standard 441-66 for Room Fan-Coil Air-Conditioners.

HORIZONTAL MODELS

V - 11 c

ENT. AIR 80.0 db/63.5 wb, 40% R.H.

WTR	CFM	40° EWT								44° EWT							
		A-COIL				D-COIL				A-COIL				D-COIL			
		TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD
6	200	7.9	6.4	2.7	4.5	8.8	6.8	3.0	12.8	6.7	5.9	2.3	3.3	7.4	5.2	2.6	9.5
	300	10.5	8.2	3.7	14.4	11.5	8.7	3.8	24.9	8.8	7.5	3.1	10.6	9.8	8.0	3.3	18.4
	400	14.9	11.8	5.1	17.4	15.3	11.7	5.2	27.9	12.5	10.7	4.3	12.6	13.0	10.7	4.4	20.9
	600	19.1	14.8	6.5	46.5					16.1	13.5	5.5	34.2	17.5	14.4	6.0	41.2
	800					33.5	26.3	11.3	18.2					28.6	24.2	9.7	13.6
	1000	33.0	26.3	11.2	24.0	39.0	30.7	13.2	20.3	27.6	24.0	9.4	18.2	33.4	28.2	11.3	15.3
	1200	38.7	30.8	13.1	18.2	45.4	35.6	15.4	31.5	32.2	28.0	10.8	13.9	38.8	32.7	13.1	23.7
8	200	7.3	6.2	1.9	2.3	8.3	6.6	2.1	6.8	6.2	5.7	1.6	1.7	7.0	6.0	1.8	5.0
	300	9.9	8.0	2.6	7.7	11.0	8.5	2.8	13.6	8.3	7.3	2.2	5.6	9.3	7.8	2.3	9.9
	400	14.1	11.4	3.6	9.2	14.7	11.5	3.8	15.3	11.8	10.4	3.0	6.7	12.4	10.5	3.2	11.3
	600	18.2	14.4	4.7	25.0	19.8	15.4	5.1	30.3	15.3	13.2	4.0	18.3	16.8	14.1	4.3	22.4
	800	26.1	21.4	6.6	26.7	32.0	25.7	8.1	9.8	21.7	19.5	5.5	19.4	27.2	23.6	6.9	7.2
	1000	31.1	25.5	7.9	13.8	37.3	29.9	9.5	11.0	26.1	23.4	6.7	10.5	31.8	27.6	8.1	8.2
	1200	36.2	29.7	9.2	16.7	43.5	34.7	11.0	17.1	30.4	27.3	7.7	8.3	37.0	31.9	9.4	12.7
10	200	6.8	5.9	1.4	1.3	7.8	6.4	1.6	4.1	5.8	5.5	1.2	1.0	6.6	5.9	1.4	3.0
	300	9.4	7.8	2.0	4.6	10.5	8.3	2.1	8.3	7.9	7.2	1.7	3.4	8.8	7.6	1.8	6.0
	400	13.3	11.1	2.7	5.5	14.1	11.2	2.9	9.4	11.1	10.2	2.3	4.0	11.9	10.3	2.4	6.9
	600	17.4	14.1	3.6	15.2	19.0	15.1	3.9	18.6	14.6	13.0	3.0	11.1	16.0	13.8	3.3	13.7
	800	24.5	20.7	5.0	16.1	30.5	25.1	6.2	5.9	20.4	18.9	4.2	11.7	25.7	23.1	5.2	4.3
	1000	29.4	24.8	6.0	8.9	35.7	29.3	7.2	6.7	24.7	22.9	5.0	6.8	30.2	27.0	6.1	4.9
	1200	34.2	28.8	7.0	7.1	41.6	33.9	8.4	10.4	28.5	26.5	5.8	5.4	35.1	31.2	7.1	7.7
12	200	6.4	5.8	1.1	0.8	7.4	6.2	1.3	2.6	5.4	5.4	0.9	0.6	6.2	5.8	1.1	1.9
	300	8.8	7.5	1.5	2.9	10.0	8.1	1.7	5.4	7.4	7.0	1.3	2.2	8.4	7.5	1.4	3.9
	400	12.5	10.7	2.1	3.6	13.5	11.0	2.3	6.2	10.6	10.0	1.8	2.6	11.4	10.2	1.9	4.6
	600	16.5	13.8	2.8	9.9	18.2	14.7	3.1	12.3	13.9	12.7	2.4	7.2	15.3	13.6	2.6	9.0
	800	23.0	20.0	3.9	10.4	29.0	24.4	4.9	3.8	19.2	18.5	3.3	7.7	24.2	22.5	4.1	2.7
	1000	27.8	24.1	4.7	6.1	34.1	28.6	5.8	4.4	23.3	22.3	4.0	4.6	28.5	26.3	4.8	3.2
	1200	32.0	28.0	5.4	4.9	39.7	33.1	6.7	6.8	26.8	25.9	4.6	3.8	33.1	30.4	5.6	4.9
16	200	5.5	5.5	0.7	0.4	6.5	5.9	0.8	1.2	4.6	4.6	0.6	0.3	5.5	5.5	0.7	0.9
	300	7.9	7.2	1.0	1.4	9.0	7.7	1.1	2.6	6.6	6.6	0.9	1.0	7.5	7.2	0.9	1.9
	400	11.2	10.2	1.4	1.2	12.3	10.5	1.6	3.1	9.0	9.4	1.2	1.2	10.3	9.8	1.3	2.3
	600	15.0	13.2	1.9	4.9	16.6	14.1	2.1	6.1	12.6	12.3	1.6	3.6	14.0	13.1	1.8	4.5
	800	20.2	18.9	2.6	5.1	25.9	23.2	3.3	1.8	16.9	16.9	2.2	3.7	20.9	20.9	2.7	1.2
	1000	24.8	22.9	3.2	2.2	30.7	27.2	3.9	2.1	20.8	20.8	2.7	2.5	24.9	24.9	3.2	1.5
	1200	28.3	26.4	3.5	2.7	36.6	31.4	4.5	3.3	23.7	23.7	3.0	2.1	28.8	28.8	3.7	2.2
20	200					5.7	5.6	0.6	0.7					4.8	4.8	0.5	0.5
	300	6.9	6.8	0.7	0.7	8.0	7.4	0.8	1.4	5.8	5.8	0.6	0.5	6.8	6.8	0.7	1.0
	400	9.9	9.7	1.0	0.9	11.1	10.1	1.1	1.7	8.3	8.3	0.9	0.6	9.4	9.4	1.0	1.3
	600	13.5	12.6	1.4	2.7	15.1	13.5	1.6	3.4	11.3	11.3	1.2	1.9	12.6	12.6	1.3	2.5
	800	17.8	17.8	1.8	2.7	22.4	21.8	2.3	0.9	14.7	14.7	1.5	2.0	17.3	17.3	1.8	0.6
	1000	22.0	22.0	2.3	1.9	26.9	25.7	2.7	1.1	18.4	18.4	1.9	1.4	20.9	20.9	2.1	0.7
	1200	24.9	24.9	2.5	1.6	31.2	29.7	3.2	1.7	20.7	20.7	2.1	1.2	24.1	24.1	2.5	1.1

WTR	CFM	45° EWT								50° EWT						
		A-COIL				D-COIL				A-COIL				D-COIL		
		TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM
6	200	6.4	5.8	2.2	3.0	7.1	6.1	2.5	8.8	5.2	5.2	1.8	2.1	5.7	5.0	2.0
	300	8.5	7.4	3.0	9.8	9.3	7.8	3.1	17.0	6.8	6.8	2.4	6.7	7.4	7.1	2.5
	400	11.9	10.5	4.1	11.6	12.4	10.5	4.3	19.2	9.6	9.6	3.3	7.8	10.0	9.7	3.4
	600	15.4	13.2	5.3	31.4	16.7	14.0	5.7	38.0	12.3	12.2	4.3	21.0	13.3	12.9	4.6
	800					27.4	23.7	9.3	12.6	17.5	17.5	6.0	22.1	21.1	21.1	7.2
	1000	26.4	23.5	9.0	16.9	31.9	27.6	10.8	14.1	21.1	21.1	7.2	12.0	24.7	24.7	8.4
	1200	30.7	27.4	10.4	12.9	37.2	32.0	12.6	21.9	24.5	24.5	8.4	9.3	28.6	28.6	9.7
8	200	5.9	5.6	1.6	1.6	6.7	5.9	1.7	4.6	4.8	4.8	1.3	1.1	5.4	5.4	1.4
	300	8.0	7.2	2.1	5.2	8.9	7.6	2.2	9.1	6.4	6.4	1.7	3.6	7.1	7.1	1.8
	400	11.3	10.2	2.9	6.1	11.9	10.3	3.1	10.4	9.1	9.1	2.4	4.2	9.6	9.6	2.5
	600	14.6	13.0	3.8	16.9	16.0	13.8	4.1	20.6	11.8	11.8	3.1	11.5	12.8	12.8	3.3
	800	20.7	19.1	5.3	17.9	25.9	23.1	6.6	6.6	16.6	16.6	4.3	12.2	19.6	19.6	5.0
	1000	25.0	23.0	6.4	9.8	30.4	27.0	7.7	7.5	20.0	20.0	5.1	7.0	23.0	23.0	5.9
	1200	28.9	26.7	7.4	7.7	35.3	31.2	9.0	11.7	23.2	23.2	5.9	5.6	26.6	26.6	6.8
10	200	5.5	5.5	1.2	0.9	6.3	5.8	1.3	2.8	4.5	4.5	1.0	0.6	5.1	5.1	1.1
	300	7.5	7.0	1.6	3.1	8.4	7.5	1.7	5.5	6.1	6.1	1.3	2.2	6.8	6.8	1.4
	400	10.6	10.0	2.2	3.7	11.4	10.2	2.3	6.4	8.6	8.6	1.8	2.5	9.2	9.2	1.9
	600	14.0	12.7	2.9	10.2	15.3	13.6	3.2	12.6	11.3	11.3	2.4	7.0	12.3	12.3	2.6
	800	19.5	18.6	4.0	10.8	24.5	22.6	5.0	3.9	15.7	15.7	3.2	7.5	18.2	18.2	3.7
	1000	23.6	22.4	4.8	6.3	28.7	26.4	5.8	4.5	19.0	19.0	3.9	4.5	21.3	21.3	4.4
	1200	27.3	26.0	5.6	5.1	33.4	30.5	6.8	7.0	21.9	21.9	4.5	3.7	24.5	24.5	5.0
12	200	5.2	5.2	0.9	0.6	5.9	5.7	1.0	1.8	4.2	4.2	0.7	0.4	4.8	4.8	0.9
	300	7.1	6.9	1.3	2.0	8.0	7.3	1.3	3.6	5.7	5.7	1.0	1.4	6.5	6.5	1.1
	400	10.1	9.8	1.7	2.4	10.9	10.0	1.9	4.2	8.1	8.1	1.4	1.6	8.8	8.8	1.5
	600	13.3	12.5	2.3	6.7	14.6	13.3	2.5	8.3	10.8	10.8	1.9	4.6	11.8	11.8	2.1
	800	18.3	18.1	3.1	7.1	22.9	22.0	3.9	2.5	14.7	14.7	2.5	4.9	17.0	17.0	2.9
	1000	22.3	21.9	3.8	4.3	27.0	25.7	4.6	2.9	18.0	18.0	3.1	3.1	19.9	19.9	3.4
	1200	25.7	25.4	4.4	3.5	31.4	29.7	5.3	4.5	20.6	20.6	3.5	2.6	22.9	22.9	3.9
16	200	4.4	4.4	0.6	0.3	5.3	5.3	0.7	0.8					4.2	4.2	0.6
	300	6.3	6.3	0.8	1.0	7.2	7.1	0.9	1.7	5.0	5.0	0.7	0.6	5.8	5.8	0.7
	400	9.0	9.0	1.2	1.1	9.9	9.7	1.3	2.1	7.1	7.1	0.9	0.7	7.9	7.9	1.0
	600	12.1	12.1	1.6	3.3	13.4	12.9	1.7	4.1	9.6	9.6	1.3	2.2	10.7	10.7	1.4
	800	16.2	16.2	2.1	3.5	19.6	19.6	2.5	1.1	12.7	12.7	1.6	2.3	14.5	14.5	1.9
	1000	19.9	19.9	2.6	2.3	23.3	23.3	3.0	1.3	15.7	15.7	2.0	1.6	17.2	17.2	2.2
	1200	22.7	22.7	2.9	1.9	27.0	27.0	3.5	2.0	17.8	17.8	2.3	1.4	19.7	19.7	2.5
20	200															
	300	5.5	5.5	0.6	0.5	6.5	6.5	0.7	0.9							
	400	7.9	7.9	0.8	0.6	9.0	9.0	0.9	1.2	6.0	6.0	0.6	0.4	6.9	6.9	0.7
	600	10.8	10.8	1.1	1.8	12.1	12.1	1.3	2.3	8.3	8.3	0.9	1.1	9.4	9.4	1.0
	800	14.0	14.0	1.4	1.8	16.0	16.0	1.6	0.5	10.5	10.5	1.1	1.1			
	1000	17.5	17.5	1.8	1.3	19.4	19.4	2.0	0.6	13.2	13.2	1.4	0.9			
	1200	19.7	19.7	2.0	1.1	22.4	22.4	2.3	0.9	14.7	14.7	1.5	0.7	16.4	16.4	1.7

ENT. AIR 80.0 db/67.0 wb, 50% R.H.

WTR	CFM	40° EWT								44° EWT							
		A-COIL				D-COIL				A-COIL				D-COIL			
		TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD
6	200	9.5	6.1	3.3	6.2	10.4	6.5	3.6	17.4	8.0	5.4	2.8	4.5	8.9	5.8	3.1	13.2
	300	12.7	7.9	4.4	20.2	13.8	8.5	4.6	34.6	10.8	7.1	3.7	15.0	11.8	7.6	3.9	26.1
	400	16.0	11.3	6.1	24.6	16.3	11.3	6.2	38.7	15.2	10.1	5.2	18.1	15.7	10.1	5.3	29.2
	600									19.7	12.8	6.7	49.1				
	800					40.3	25.4	13.6	25.6					34.2	22.6	11.5	18.9
	1000	40.4	25.6	13.6	32.9	46.9	29.5	15.8	28.4	34.1	22.8	11.6	25.2	39.7	26.3	13.4	21.0
	1200					54.8	34.4	18.5	44.4	39.9	25.6	13.5	19.0	46.5	30.7	15.7	32.9
8	200	8.7	5.7	2.3	3.1	9.8	6.2	2.5	9.2	7.3	5.1	1.9	2.2	8.3	5.6	2.2	6.9
	300	12.0	7.6	3.1	10.7	13.1	8.2	3.3	18.7	10.0	6.8	2.6	7.8	11.2	7.3	2.8	13.9
	400	16.9	10.8	4.3	12.9	17.5	11.0	4.5	21.0	14.2	9.7	3.6	9.3	14.9	[illegible]	3.8	15.6
	600	22.0	13.9	5.6	35.3	23.7	14.8	6.1	42.0	18.5	12.3	4.7	25.7	20.1	13.1	5.1	31.1
	800					37.8	24.2	9.6	13.3	26.6	18.3	6.8	27.6	31.6	21.6	8.0	9.5
	1000	38.0	24.5	9.6	18.9	44.1	28.3	11.1	14.9	31.8	21.8	8.1	14.3	36.8	25.1	9.3	10.7
	1200	44.4	28.5	11.2	14.5	51.6	32.1	13.0	23.3	37.0	25.4	9.4	13.1	43.0	29.2	10.9	16.8
10	200	8.0	5.4	1.7	1.8	9.2	6.0	1.9	5.5	6.6	4.9	1.4	1.2	7.7	5.3	1.6	4.0
	300	11.2	7.3	2.3	6.3	12.5	7.9	2.5	11.3	9.3	6.5	1.9	4.5	10.5	7.0	2.1	8.3
	400	15.9	10.4	3.2	7.9	16.7	10.8	3.4	12.7	13.1	9.3	2.7	5.4	14.1	9.8	2.8	9.4
	600	20.9	13.3	4.3	21.1	22.7	14.3	4.6	25.5	17.3	11.9	3.6	15.1	19.1	12.7	3.9	18.8
	800	29.9	19.7	6.1	22.8	35.3	23.1	7.1	7.7	24.4	17.4	5.0	16.0	29.7	20.8	6.0	5.6
	1000	35.7	23.4	7.2	12.0	41.2	27.0	8.3	8.7	29.3	20.8	6.0	8.9	34.8	24.3	7.2	6.4
	1200	41.5	27.3	8.4	9.4	48.2	31.5	9.8	13.7	34.0	24.2	6.9	7.0	40.6	28.2	8.2	10.0
12	200	7.3	5.2	1.3	1.1	8.6	5.7	1.5	3.4	6.0	4.7	1.0	0.7	7.1	5.1	1.2	2.4
	300	10.4	7.0	1.8	4.0	11.9	7.6	2.0	7.4	8.6	6.2	1.5	2.8	9.9	6.8	1.7	5.3
	400	14.8	9.9	2.5	4.7	15.9	10.2	2.7	8.3	12.2	8.9	2.1	3.3	13.3	9.2	2.3	5.8
	600	19.6	12.8	3.4	13.5	21.8	13.8	3.7	16.7	16.2	11.4	2.8	9.6	18.0	12.3	3.1	12.1
	800	27.7	18.7	4.7	14.4	33.1	22.2	5.6	4.9	22.4	16.6	3.8	10.0	28.0	20.1	4.7	3.6
	1000	33.2	22.4	5.8	8.1	38.7	25.9	6.5	5.6	27.1	19.8	4.6	5.9	32.8	23.6	5.6	4.1
	1200	38.4	26.0	6.5	6.4	45.2	30.2	7.6	8.7	31.2	23.1	5.3	4.7	38.3	27.4	6.3	6.4
16	200	6.0	4.7	0.8	0.4	7.4	5.2	1.0	1.5	4.8	4.3	0.6	0.3	6.0	4.7	0.8	1.1
	300	9.0	6.4	1.2	1.8	10.5	7.0	1.3	3.5	7.3	5.7	1.0	1.2	8.5	6.3	1.1	2.4
	400	12.8	9.1	1.6	2.1	14.2	9.5	1.8	4.0	10.4	8.2	1.3	1.5	11.6	8.6	1.5	2.8
	600	17.5	11.9	2.2	6.4	19.4	12.9	2.5	8.1	14.2	10.7	1.8	4.4	15.9	11.5	2.0	5.6
	800	23.4	17.0	3.0	6.5	29.5	20.8	3.7	2.3	18.7	15.2	2.4	4.4	24.4	18.8	3.1	1.6
	1000	28.5	20.5	3.6	4.0	34.8	24.4	4.4	2.7	23.0	18.4	2.9	2.9	29.0	22.1	3.7	1.9
	1200	32.5	23.7	4.2	3.3	40.6	28.2	5.1	4.2	26.2	21.3	3.3	2.4	33.7	25.6	4.3	3.0
20	200	4.9	4.3	0.5	0.2	6.3	4.8	0.7	0.8					5.0	4.4	0.5	0.5
	300	7.6	5.9	0.8	0.9	9.1	6.5	0.9	1.8	6.1	5.3	0.7	0.6	7.3	5.9	0.7	1.2
	400	11.0	[illegible]	1.1	1.1	12.5	8.9	1.3	2.1	8.8	7.5	0.9	0.7	10.1	9.0	[illegible]	[illegible]
	600	15.2	11.3	1.6	3.5	17.1	12.0	1.8	4.3	12.2	10.0	1.3	2.2	13.6	10.8	1.4	2.9
	800	19.7	15.6	2.0	3.3	25.9	19.4	2.6	1.2	15.5	14.1	1.6	2.2	20.5	17.4	2.1	0.8
	1000	24.4	19.0	2.5	2.2	30.9	22.9	3.1	1.6	19.5	17.2	2.0	1.6	24.8	20.6	2.5	1.0
	1200	27.5	21.8	2.8	1.8	35.9	26.5	3.7	2.2	21.8	19.7	2.2	1.3	28.7	23.8	2.8	1.6

WTR	CFM	45° EWT								50° EWT						
		A-COIL				D-COIL				A-COIL				D-COIL		
		TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM
6	200	7.6	5.3	2.6	4.1	8.5	5.6	2.9	12.2	5.7	4.6	2.0	2.5	6.6	4.9	2.3
	300	10.3	6.9	3.6	13.8	11.3	7.3	3.8	24.1	7.8	5.9	2.8	8.5	8.8	6.3	2.9
	400	14.5	9.8	4.9	16.6	15.0	9.8	5.1	26.9	11.0	8.4	3.8	10.0	11.6	8.5	4.0
	600	18.8	12.4	6.4	45.1					14.3	10.7	4.9	27.7	15.7	11.4	5.4
	800					32.5	22.0	11.0	17.3	20.4	15.8	7.0	20.0	25.2	19.1	8.6
	1000	32.5	22.1	11.0	23.4	37.9	25.6	12.8	19.2	24.5	18.9	8.3	15.0	29.4	22.2	10.0
	1200	38.0	25.8	12.9	17.7	44.3	29.8	15.0	30.1	28.5	22.1	9.7	12.6	34.3	25.8	11.4
8	200	6.9	5.0	1.8	2.0	7.9	5.4	2.1	6.3	5.2	4.4	1.4	1.2	6.0	4.7	1.6
	300	9.5	6.6	2.5	7.1	10.7	7.1	2.7	12.8	7.2	5.7	1.9	4.3	8.2	6.1	2.1
	400	13.5	9.4	3.4	8.5	14.2	9.5	3.6	14.4	10.2	8.1	2.6	5.0	10.9	8.2	2.8
	600	17.6	11.9	4.5	23.5	19.2	12.8	4.9	28.7	13.3	10.3	3.5	14.2	14.7	11.0	3.8
	800	25.2	17.7	6.4	25.1	30.2	21.0	7.7	8.8	18.6	15.1	4.8	14.8	23.5	18.4	6.0
	1000	30.1	21.1	7.7	13.2	36.3	24.5	8.9	9.9	22.4	18.2	5.7	8.3	27.5	21.5	7.0
	1200	35.0	24.6	8.9	10.2	41.2	28.5	10.4	15.5	25.9	21.1	6.6	8.6	32.1	24.9	8.2
10	200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.7	4.2	1.0	0.7	5.5	4.5	1.2
	300	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.6	5.5	1.4	2.5	7.6	5.9	1.5
	400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9.3	7.8	1.8	2.8	10.2	8.0	2.1
	600	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12.4	10.0	2.6	6.3	13.8	10.7	2.9
	800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.0	14.6	3.5	8.6	21.8	17.8	4.4
	1000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20.6	17.8	4.2	5.1	25.6	20.9	5.2
	1200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	23.7	20.4	4.9	4.1	29.2	24.1	6.1
12	200	5.6	4.5	1.0	0.7	6.8	5.0	1.2	2.2	4.2	4.1	0.8	0.4	5.0	4.4	0.9
	300	8.2	6.1	1.4	2.6	9.4	6.6	1.6	4.8	6.0	5.3	1.1	1.5	7.0	5.7	1.2
	400	11.5	8.5	2.0	3.0	12.6	8.9	2.2	5.5	9.5	7.6	1.5	1.9	10.5	7.8	1.6
	600	15.5	11.1	2.7	8.8	17.2	12.0	2.9	11.0	11.5	9.7	2.0	5.2	12.9	10.4	2.2
	800	21.1	16.1	3.6	9.0	26.7	19.6	4.5	3.3	15.5	14.0	2.7	5.8	20.1	17.3	3.4
	1000	25.6	19.4	4.4	5.4	31.3	23.0	5.3	3.8	18.9	17.0	3.2	3.4	23.7	20.2	4.0
	1200	29.6	22.5	5.0	4.3	36.5	26.7	6.2	5.5	21.7	19.2	3.7	2.8	27.6	23.4	4.7
16	200	4.6	4.2	0.6	0.3	5.7	4.6	0.7	1.0					4.2	4.1	0.6
	300	6.9	5.6	0.9	1.1	8.1	6.1	1.0	2.1	5.1	5.1	0.7	0.7	6.0	5.4	0.8
	400	9.6	8.0	1.3	1.3	11.0	8.3	1.4	2.5	7.3	7.1	0.9	0.8	8.2	7.4	1.1
	600	13.4	10.4	1.7	4.0	15.0	11.2	1.9	5.1	9.9	9.2	1.3	2.3	11.2	9.9	1.5
	800	17.7	14.8	2.3	4.0	23.1	18.3	2.9	1.9	12.9	12.9	1.7	2.4	16.3	16.0	2.1
	1000	21.7	18.0	2.8	2.6	27.5	21.6	3.5	1.7	16.0	16.0	2.1	1.7	18.6	18.3	2.5
	1200	24.7	20.7	3.2	2.2	32.8	25.6	4.3	2.7	18.1	18.1	2.3	1.4	22.7	21.7	2.9
20	200					4.7	4.3	0.5	0.5							
	300	5.7	5.2	0.6	0.5	6.9	5.7	0.7	1.1					5.0	5.0	0.5
	400	8.5	7.5	0.9	0.9	9.6	7.9	1.0	1.3	6.6	6.0	0.6	0.4	7.5	7.0	0.7
	600	11.5	9.8	1.2	2.0	13.0	10.5	1.4	2.6	8.4	8.4	0.9	1.1	9.5	9.5	1.0
	800	14.7	13.8	1.5	2.0	19.2	17.0	2.0	0.7	10.5	10.5	1.1	1.1			
	1000	18.3	16.3	1.9	1.4	23.2	20.1	2.4	0.9	13.2	13.2	1.4	0.9	15.2	15.2	1.6
	1200	20.6	19.3	2.1	1.2	26.9	23.1	2.7	1.3	14.7	14.7	1.5	0.7	17.3	17.3	1.8

NOTE—TOTAL HEAT (TH) AND SENSIBLE HEAT (SH) EXPRESSED IN MBH. WATER TEMPERATURE RISE (WTR)—DEGREES F. PRESSURE DROP (

ENT. AIR 78.0 db/65.0 wb, 50% R.H.

WTR	CFM	40° EWT A-COIL TH	SH	GPM	PD	40° EWT D-COIL TH	SH	GPM	PD	44° EWT A-COIL TH	SH	GPM	PD	44° EWT D-COIL TH	SH	GPM	PD
6	200	8.5	5.8	2.9	5.0	9.4	6.2	3.2	14.4	7.0	5.2	2.4	3.6	7.9	5.5	2.7	10.6
	300	11.4	7.6	3.9	16.6	12.4	8.1	4.1	28.5	9.5	6.7	3.3	12.0	10.5	7.2	3.5	20.9
	400	[illegible]	10.8	5.5	20.1	[illegible]	10.8	5.6	31.9	12.6	9.2	4.6	14.3	13.5	[illegible]	4.2	25.4
	600									17.3	12.3	5.9	30.8	18.7	12.9	6.4	46.2
	800					36.0	24.2	12.2	20.4					[illegible]	21.8	10.3	[illegible]
	1000	30.5	24.2	12.2	27.6	41.5	28.7	14.1	23.1	29.8	21.6	10.3	20.5	34.9	25.0	11.8	16.5
	1200					48.0	30.0	16.9	38.2	34.8	25.2	11.8	18.8	[illegible]	[illegible]	[illegible]	[illegible]
8	200	7.8	5.5	2.0	2.5	8.8	5.9	2.3	7.6	6.4	4.9	1.7	1.8	7.3	5.3	1.9	5.5
	300	10.6	7.2	2.8	8.6	11.8	7.8	2.9	15.3	8.8	6.5	2.3	6.2	9.9	7.0	2.5	11.1
	400	[illegible]	[illegible]	[illegible]	[illegible]	15.7	[illegible]	4.0	17.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	600	15.6	13.2	5.0	28.6	21.2	14.1	5.4	34.3	16.3	11.7	4.2	20.4	17.8	12.8	4.6	29.8
	800					35.8	23.1	8.5	10.7	23.8	17.6	5.9	21.8	28.2	20.8	[illegible]	[illegible]
	1000	33.8	23.8	[illegible]	15.7	39.1	26.9	9.6	12.0	27.7	20.7	7.1	11.6	32.5	24.2	8.4	[illegible]
	1200	39.8	27.2	10.8	[illegible]	45.5	32.3	11.8	18.8	32.2	24.1	8.2	9.0	38.4	28.2	9.8	13.8
10	200	7.1	5.2	1.5	1.4	8.2	5.7	1.7	4.5	5.8	4.7	1.2	1.0	6.8	5.1	1.4	3.2
	300	9.9	6.9	2.1	5.1	11.2	7.5	2.2	9.2	8.1	6.2	1.7	3.6	9.3	6.7	1.9	6.6
	400	14.2	9.8	2.9	6.1	15.0	10.3	3.1	10.8	11.8	8.9	2.4	4.2	12.4	9.2	2.6	7.5
	600	18.5	12.7	3.8	17.0	20.2	13.6	4.1	20.8	15.2	11.3	3.1	12.0	16.9	12.2	3.3	15.0
	800	26.3	18.7	5.4	18.2	31.5	22.2	6.4	6.3	21.2	16.5	4.3	12.6	26.5	20.1	5.4	4.3
	1000	31.6	22.3	6.4	9.9	36.8	25.9	7.5	7.1	25.6	19.5	5.2	7.2	31.0	23.5	6.3	5.2
	1200	36.6	25.9	7.4	7.8	43.0	30.1	8.7	11.1	29.6	23.1	6.0	5.7	36.2	27.2	7.4	8.2
12	200	6.5	5.0	1.1	0.9	7.7	5.5	1.3	2.8	5.2	4.5	0.9	0.6	6.2	4.9	1.1	1.9
	300	9.2	6.6	1.6	3.2	10.6	7.3	1.8	6.0	7.5	6.0	1.3	2.2	8.7	6.5	1.4	4.1
	400	13.2	9.5	2.2	3.8	14.2	9.8	2.6	6.8	10.7	8.8	1.8	2.8	11.7	8.8	2.0	4.8
	600	17.5	12.3	3.0	10.9	19.3	13.2	3.3	13.6	14.3	11.0	2.5	7.6	15.9	11.8	2.7	9.8
	800	24.3	17.8	4.1	11.5	29.8	21.5	5.0	4.0	19.5	15.8	3.3	7.9	24.8	19.4	4.2	2.9
	1000	29.3	21.4	5.0	6.6	35.0	25.1	5.9	4.6	23.7	19.1	4.6	4.7	29.2	22.8	5.0	3.3
	1200	33.8	24.8	5.7	5.3	40.8	29.2	6.9	7.2	27.2	22.1	4.6	3.9	34.0	26.4	5.8	5.2
16	200	5.3	4.5	0.7	0.4	6.5	5.0	0.9	1.2	4.3	4.2	0.6	0.2	5.3	4.6	0.7	0.8
	300	7.9	6.1	1.0	1.4	9.3	6.7	1.2	2.8	6.4	5.6	0.9	1.0	7.5	6.1	0.9	1.9
	400	11.3	8.8	1.5	1.7	12.8	9.2	1.8	3.2	9.5	7.9	1.2	1.2	10.2	8.8	1.3	2.2
	600	15.4	11.4	2.0	5.1	17.2	12.4	2.2	6.5	12.4	10.3	1.6	3.5	13.9	11.1	1.6	4.5
	800	20.6	16.2	2.6	5.2	26.4	26.5	3.4	1.3	16.4	14.2	2.1	3.5	21.4	18.1	2.2	1.3
	1000	25.1	19.7	3.2	3.3	31.3	23.6	4.0	2.2	20.2	17.8	2.8	2.3	25.5	21.4	3.3	1.5
	1200	28.7	22.7	3.7	2.7	36.4	27.4	4.6	3.4	22.9	20.5	2.9	2.0	29.6	24.2	3.8	2.4
20	200					5.5	4.7	0.6	0.6								
	300	6.7	5.7	0.7	0.7	8.0	6.3	0.8	1.4	5.3	5.2	0.6	0.5	6.4	5.7	0.6	0.9
	400	9.7	8.2	1.0	0.8	11.1	8.5	1.1	1.7	7.7	7.4	0.8	0.6	8.9	7.9	0.9	1.2
	600	13.4	10.7	1.4	2.6	15.1	11.6	1.6	3.4	10.7	9.7	1.1	1.8	12.1	10.5	1.3	2.3
	800	17.3	15.0	1.8	2.6	22.8	18.7	2.3	0.9	13.6	13.6	1.4	1.7	17.4	16.2	1.8	0.6
	1000	21.5	18.3	2.2	1.8	27.4	22.1	2.8	1.2	17.1	16.7	1.8	1.3	21.2	19.8	2.2	0.7
	1200	24.2	21.0	2.5	1.5	31.8	25.5	3.2	1.8	19.1	19.1	2.0	1.1	24.5	22.8	2.5	1.3

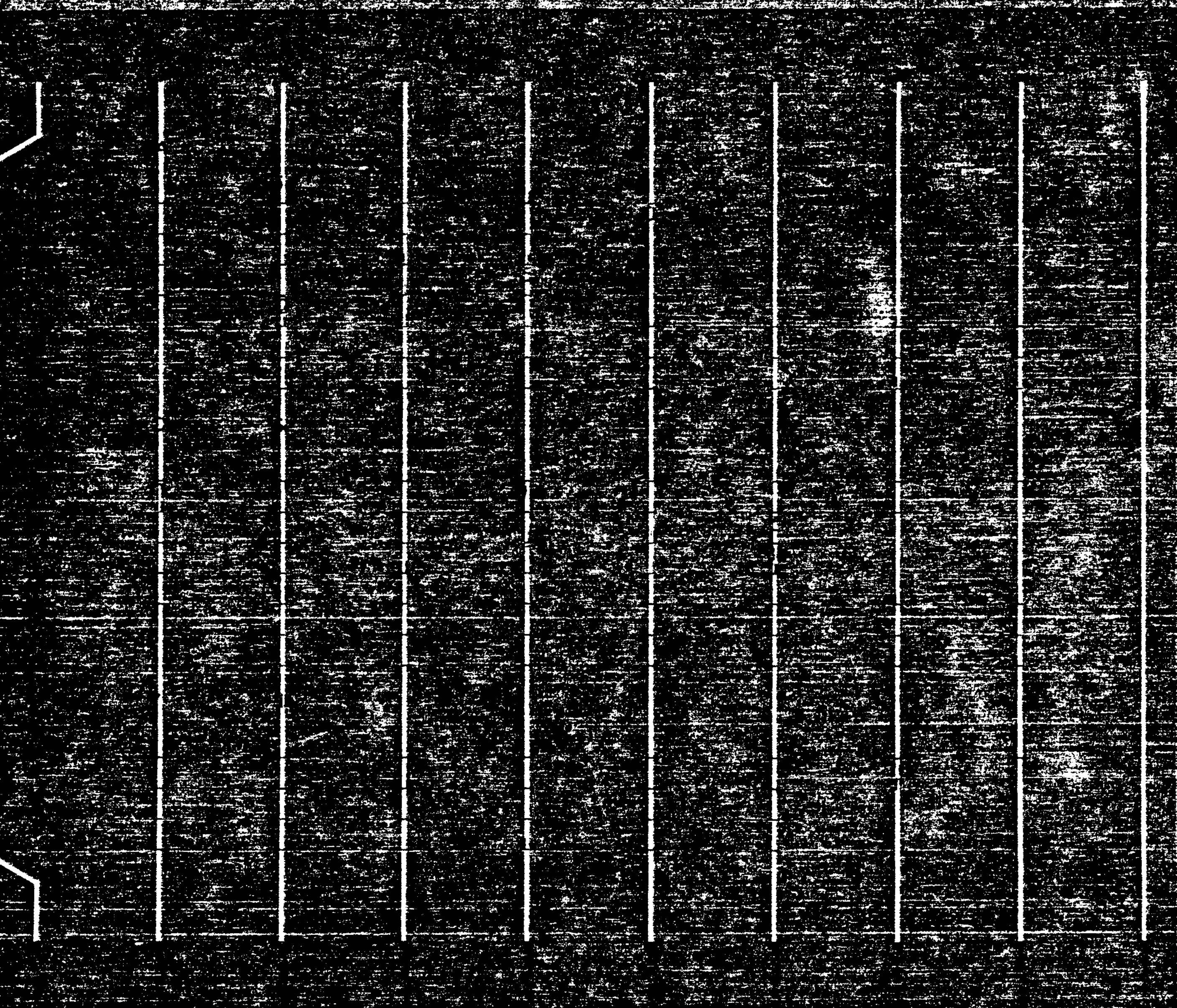
WTR	CFM	45° EWT A-COIL TH	SH	GPM	PD	45° EWT D-COIL TH	SH	GPM	PD	50° EWT A-COIL TH	SH	GPM	PD	50° EWT D-COIL TH	SH	GPM	PD
6	200	6.7	5.0	2.3	3.3	7.5	5.4	2.6	9.8	5.0	4.4	1.8	2.0	5.7	4.7	2.0	5.9
	300	9.0	6.5	3.2	11.0	10.0	7.0	3.3	19.2	6.7	5.7	2.4	6.6	7.6	6.0	2.5	11.6
	400	12.7	9.5	4.5	13.2	13.8	9.6	4.8	21.6	9.6	8.5	3.3	7.7	10.6	8.1	3.5	13.8
	600	16.4	11.8	5.6	35.5	17.9	12.6	6.1	42.9	12.3	10.2	4.3	21.2	13.8	10.9	4.7	28.3
	800					28.8	20.8	9.7	13.6	17.8	15.1	6.6	22.2	22.6	18.3	7.9	[illegible]
	1000	28.3	20.5	9.6	18.9	33.5	24.4	12.2	18.2	27.6	18.1	7.2	11.9	26.7	21.3	8.7	9.2
	1200	38.1	26.8	11.2	14.4	38.9	[illegible]	[illegible]	[illegible]	24.5	21.8	8.4	9.5	29.9	[illegible]	[illegible]	[illegible]
8	200	6.0	4.8	1.6	1.6	7.0	5.2	1.8	5.0	4.5	4.3	1.2	1.0	5.2	4.5	1.4	3.0
	300	8.3	6.3	2.2	5.6	9.4	6.8	2.4	10.2	6.2	5.5	1.7	3.3	7.0	5.9	1.8	6.0
	400	11.6	[illegible]	3.0	[illegible]	12.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	600	15.4	11.4	4.0	18.6	17.0	12.2	4.4	22.9	11.5	9.8	3.0	11.0	12.7	10.6	3.3	13.2
	800	21.9	16.8	5.8	19.6	26.9	20.2	6.8	7.3	16.0	14.8	4.6	11.8	20.4	17.7	5.2	4.6
	1000	28.2	20.1	6.7	10.6	31.4	23.6	8.0	8.0	19.4	17.5	5.0	6.6	23.9	20.7	6.1	4.9
	1200	30.4	23.4	7.8	8.3	36.7	27.4	9.2	12.9	22.4	20.3	5.8	5.3	27.8	24.0	7.2	7.8
10	200	5.5	4.6	1.2	0.9	6.4	5.0	1.3	2.9	4.1	4.1	0.9	0.5	4.8	4.4	1.0	1.7
	300	7.7	6.0	1.6	3.2	8.8	6.5	1.8	6.0	5.7	5.3	1.2	1.9	6.5	5.7	1.3	3.5
	400	10.8	8.6	2.2	3.8	11.6	8.8	2.3	6.8	8.1	7.8	1.7	2.5	8.8	7.8	1.8	4.9
	600	14.4	11.0	3.0	10.3	16.0	11.8	3.3	13.6	10.8	9.2	2.3	6.5	11.9	10.4	2.5	8.3
	800	20.0	16.1	4.1	11.4	26.2	19.8	5.1	4.2	14.8	14.1	3.0	6.8	18.8	17.2	3.8	2.4
	1000	24.2	19.3	4.9	6.6	29.6	22.9	6.0	4.8	17.9	17.0	3.7	4.1	22.1	20.1	4.5	2.2
	1200	27.9	22.4	5.7	5.3	34.5	26.8	7.0	7.4	20.6	19.7	4.2	3.4	25.7	23.2	5.3	4.4
12	200	4.9	4.4	0.9	0.5	5.9	4.8	1.0	1.8	3.7	3.7	0.7	0.3	4.4	4.3	0.8	1.1
	300	7.1	5.8	1.3	2.0	8.2	6.3	1.4	3.7	5.3	5.2	1.0	1.2	6.1	5.6	1.0	2.2
	400	10.2	8.3	1.7	2.4	11.1	8.6	1.9	4.4	7.8	7.4	1.3	1.2	8.3	7.6	1.4	2.1
	600	13.5	10.7	2.3	6.9	15.0	11.5	2.6	8.7	10.1	9.8	1.8	4.1	11.2	10.1	2.0	3.2
	800	18.3	15.4	3.1	7.1	23.5	18.9	4.0	2.6	13.6	13.6	2.3	4.2	17.1	16.6	2.9	1.0
	1000	22.3	18.6	3.8	4.3	27.8	22.2	4.7	3.0	16.6	16.6	2.9	2.7	20.2	19.4	3.5	1.2
	1200	25.7	21.6	4.4	3.5	32.3	25.2	5.8	4.7	19.0	19.0	3.3	2.3	23.5	22.4	4.0	2.0
16	200	4.0	4.0	0.5	0.2	5.0	4.5	0.7	0.8					3.7	3.7	0.5	0.5
	300	6.0	5.4	0.8	0.9	7.0	5.9	0.9	1.7	4.4	4.4	0.6	0.5	5.2	5.2	0.7	1.0
	400	8.8	7.8	1.1	1.0	9.7	8.7	1.3	2.0	6.4	6.4	0.8	0.8	7.2	7.2	0.9	1.2
	600	11.8	10.0	1.5	3.1	13.2	10.8	1.7	4.0	8.7	8.7	1.2	1.9	9.8	9.8	1.3	2.4
	800	19.4	14.3	2.0	3.2	20.1	17.9	2.0	1.1	11.3	11.3	1.5	1.9	13.4	13.4	1.7	0.8
	1000	19.0	17.4	2.4	2.1	23.9	20.8	3.1	1.4	14.1	14.1	1.8	1.4	16.2	16.2	2.1	0.7
	1200	21.6	20.1	2.8	1.8	27.8	24.0	3.6	2.1	15.9	15.9	2.1	1.2	18.7	18.7	2.4	1.8
20	200																
	300	5.0	5.0	0.5	0.4	6.0	5.6	0.6	0.8								
	400	7.3	7.3	0.8	0.5	8.4	7.6	0.9	1.0	5.2	5.2	0.8	0.3	6.1	6.1	0.6	0.4
	600	10.1	9.5	1.1	1.6	11.4	10.2	1.2	2.1	7.3	7.3	0.8	0.9	8.3	8.3	0.9	1.2
	800	12.8	12.8	1.3	1.6	16.1	16.1	1.7	0.5								
	1000	16.1	16.1	1.7	1.2	19.6	19.2	2.0	0.6	11.4	11.4	1.2	0.7				
	1200	18.0	18.0	1.9	1.0	22.6	22.1	2.3	1.0	12.6	12.6	1.3	0.6				

ENT. AIR 78.0 db/68.0 wb, 60% R.H.

WTR	CFM	40° EWT A-COIL TH	SH	GPM	PD	40° EWT D-COIL TH	SH	GPM	PD	44° EWT A-COIL TH	SH	GPM	PD	44° EWT D-COIL TH	SH	GPM	PD
6	200	10.1	5.6	3.5	6.9	11.0	6.1	3.8	19.3	8.5	5.0	2.9	5.1	9.5	5.4	3.2	14.7
	300	13.5	7.4	4.6	22.4	14.6	8.0	4.9	38.4	11.5	6.6	4.0	16.9	12.6	7.1	4.2	29.4
	400	19.1	10.6	6.5	27.3	19.4	10.6	6.8	42.7	16.3	9.3	5.5	20.4	16.7	9.4	5.7	32.7
	600																
	800					42.7	23.7	14.4	28.5					36.5	20.9	12.3	21.4
	1000					49.7	27.5	16.7	31.5	36.5	21.0	12.3	28.0	42.5	24.4	14.3	23.7
	1200					58.1	32.2	19.8	49.4					49.7	28.4	16.8	37.1
8	200	9.3	5.3	2.4	3.5	10.4	5.8	2.7	10.2	7.7	4.6	2.0	2.5	8.8	5.1	2.3	7.5
	300	12.7	7.1	3.3	11.9	13.9	7.7	3.5	20.8	10.7	6.2	2.8	8.7	11.9	6.8	3.0	15.6
	400	18.0	10.1	4.6	14.4	18.6	10.2	4.7	23.3	15.1	8.8	3.9	10.5	15.8	9.0	4.0	17.5
	600	23.3	12.9	6.0	39.2	25.1	13.8	6.4	46.6	19.8	11.4	5.1	29.1	21.5	12.2	5.5	35.1
	800					40.2	22.6	10.2	14.9					33.9	19.8	8.6	10.9
	1000	40.4	22.7	10.2	20.8	46.9	26.3	11.8	16.6	34.1	20.0	8.7	16.0	39.5	23.1	10.0	12.2
	1200	47.2	26.5	11.9	15.8	54.8	30.7	13.8	26.1	39.6	23.3	10.0	12.2	46.2	27.0	11.7	19.1
10	200	8.4	4.9	1.7	1.9	9.7	5.5	2.0	6.0	6.9	4.3	1.4	1.4	8.1	4.8	1.7	4.3
	300	11.9	6.7	2.5	7.0	13.3	7.4	2.7	12.6	9.8	5.9	2.1	5.0	11.1	6.4	2.2	9.2
	400	16.9	9.6	3.4	8.5	17.7	9.9	3.6	14.2	13.9	8.4	2.8	6.0	14.9	8.6	3.0	10.4
	600	22.2	12.4	4.5	23.6	24.1	13.3	4.9	28.5	18.5	10.8	3.8	17.1	20.3	11.7	4.2	20.9
	800	31.9	18.2	6.5	25.4	37.6	21.4	7.6	8.7	26.3	15.8	5.4	18.2	31.1	18.7	6.3	6.3
	1000	38.1	21.7	7.7	13.3	44.0	25.0	8.9	9.8	31.5	18.9	6.4	9.9	36.4	21.8	7.4	7.4
	1200	44.3	25.3	9.0	10.4	51.4	29.2	10.4	15.4	36.5	22.0	7.4	7.8	42.6	25.5	8.6	10.5
12	200	7.7	4.6	1.3	1.2	9.0	5.2	1.6	3.7	6.1	4.0	1.1	0.8	7.4	4.5	1.3	2.6
	300	11.1	6.4	1.9	4.4	12.5	7.0	2.1	8.1	9.0	5.5	1.6	3.0	10.4	6.1	1.7	5.8
	400	15.7	9.1	2.7	5.3	16.8	9.5	2.9	9.2	12.8	7.9	2.2	3.6	13.9	8.2	2.4	6.4
	600	21.0	11.9	3.6	15.2	22.9	12.8	3.9	18.6	17.2	10.3	2.9	10.6	19.0	11.1	3.2	13.3
	800	29.7	17.2	5.0	16.3	35.0	20.3	5.9	5.4	23.9	14.9	4.1	11.2	28.5	17.7	4.8	3.7
	1000	35.5	20.6	6.0	8.9	41.0	23.7	6.9	6.2	28.7	17.8	4.9	6.4	33.4	20.6	5.6	4.2
	1200	41.1	23.9	7.0	7.1	47.9	27.7	8.1	9.7	33.1	20.7	5.6	5.1	39.0	24.0	6.6	6.4
16	200	6.1	4.0	0.8	0.5	7.6	4.6	1.0	1.6	4.7	3.6	0.6	0.3	6.1	4.0	0.8	1.1
	300	9.4	5.7	1.2	1.9	10.9	6.4	1.4	3.7	7.4	4.9	1.0	1.3	8.8	5.5	1.1	2.5
	400	13.4	8.1	1.7	2.3	14.8	8.6	1.9	4.3	10.5	7.1	1.4	1.5	12.0	7.5	1.5	3.6
	600	18.3	10.8	2.4	7.0	20.3	11.7	2.6	8.8	14.6	9.3	1.9	4.6	16.4	10.1	2.1	6.0
	800	24.7	15.2	3.2	7.2	29.9	18.2	3.8	2.4	19.1	13.1	2.6	4.6	24.5	16.2	3.1	1.4
	1000	30.1	18.4	3.8	4.4	35.2	21.4	4.5	2.7	23.5	15.9	3.0	3.0	29.1	19.0	3.7	1.5
	1200	34.3	21.2	4.4	3.5	41.1	24.5	5.2	4.3	26.6	18.3	3.4	2.4	33.9	22.1	4.3	2.6
20	200	4.8	3.6	0.5	0.2	6.3	4.1	0.7	0.8					4.8	3.6	0.5	0.5
	300	7.7	5.1	0.8	0.9	9.3	5.7	0.9	1.8	5.9	4.4	0.6	0.6	7.2	4.9	0.7	1.1
	400	11.1	7.3	1.1	1.1	12.8	7.8	1.3	2.2	8.5	6.4	0.9	0.7	10.0	6.8	1.0	1.4
	600	15.6	9.7	1.6	3.5	17.6	10.6	1.8	4.5	12.1	8.4	1.3	2.2	13.8	9.2	1.4	2.9
	800	20.0	13.5	2.1	3.4	25.9	16.7	2.6	1.2	15.1	11.7	1.6	2.1	20.3	14.7	2.1	0.8
	1000	24.8	16.4	2.5	2.3	30.8	19.7	3.1	1.4	19.0	14.3	2.0	1.5	24.5	17.4	2.5	0.8
	1200	27.9	18.7	2.8	1.9	35.9	22.9	3.7	2.2	21.1	16.4	2.2	1.2	28.5	20.2	2.9	1.5

WTR	CFM	45° EWT A-COIL TH	SH	GPM	PD	45° EWT D-COIL TH	SH	GPM	PD	50° EWT A-COIL TH	SH	GPM	PD	50° EWT D-COIL TH	SH	GPM	PD
6	200	8.1	4.8	2.8	4.6	9.0	5.2	3.1	13.5	6.0	4.0	2.1	2.7	6.9	4.3	2.4	8.4
	300	11.0	6.3	3.8	15.6	12.1	6.8	4.0	27.2	8.3	5.2	2.9	9.5	9.3	5.7	3.1	17.0
	400	15.5	9.0	5.3	18.8	16.0	9.1	5.4	30.3	11.7	7.5	4.0	11.3	12.4	7.6	4.2	19.0
	600									15.4	9.6	5.3	31.4	16.8	10.2	5.8	38.2
	800					34.9	20.3	11.8	19.7					26.4	16.9	9.0	11.3
	1000	34.8	20.3	11.8	26.1	40.6	23.6	13.7	21.8	26.4	16.9	9.0	16.9	30.8	19.6	10.4	13.2
	1200	40.8	23.8	13.8	19.6	47.5	27.5	16.0	34.2	30.8	19.8	10.5	13.0	36.0	22.9	12.2	20.7
8	200	7.3	4.5	1.9	2.2	8.4	4.9	2.2	6.9	5.3	3.7	1.4	1.3	6.3	4.1	1.6	4.1
	300	10.2	6.0	2.7	8.0	11.4	6.5	2.9	14.4	7.5	5.0	2.0	4.7	8.6	5.4	2.2	8.6
	400	14.4	8.5	3.7	9.6	15.1	8.7	3.9	16.1	10.6	7.1	2.7	5.5	11.5	7.3	2.9	9.8
	600	18.9	11.0	4.8	26.7	20.5	11.8	5.3	32.3	14.1	9.1	3.6	15.7	15.6	9.8	4.0	19.7
	800	27.2	16.2	6.9	28.6	32.2	19.2	8.2	9.9	19.7	13.3	5.1	16.5	24.1	16.0	6.1	5.8
	1000	32.4	19.3	8.2	14.8	37.6	22.3	9.5	11.1	23.7	15.9	6.1	9.1	28.1	18.6	7.2	6.6
	1200	37.8	22.5	9.6	11.4	44.0	26.0	11.1	17.5	27.5	18.5	7.0	7.2	32.9	21.7	8.4	10.9
10	200	6.5	4.2	1.4	1.2	7.7	4.6	1.6	3.9	4.6	3.5	1.0	0.7	5.6	3.9	1.2	2.3
	300	9.3	5.6	2.0	4.5	10.6	6.2	2.1	8.4	6.7	4.7	1.4	2.6	7.9	5.2	1.6	4.8
	400	13.2	8.1	2.7	5.4	14.2	8.3	2.9	9.5	9.6	6.7	2.0	3.0	10.5	6.9	2.2	5.8
	600	17.6	10.4	3.6	15.5	19.3	11.3	4.0	19.1	12.9	8.7	2.7	8.9	14.4	9.4	3.0	11.3
	800	24.8	15.2	5.1	16.5	29.4	18.0	6.0	5.5	17.5	12.5	3.6	9.0	22.1	15.3	4.5	3.5
	1000	29.8	18.2	6.1	9.1	34.4	21.1	7.0	6.3	21.2	15.0	4.3	5.3	25.9	17.9	5.3	3.4
	1200	34.5	21.2	7.0	7.2	40.2	24.6	8.2	9.9	24.4	17.4	5.0	4.3	30.3	20.8	6.2	5.8
12	200	5.7	3.9	1.0	0.7	7.0	4.4	1.2	2.4	4.0	3.3	0.7	0.4	5.0	3.7	0.9	1.3
	300	8.5	5.3	1.5	2.7	9.8	5.9	1.6	5.2	6.0	4.5	1.1	1.5	7.1	4.9	1.2	2.9
	400	12.1	7.6	2.1	3.3	13.2	8.0	2.3	6.0	8.8	6.4	1.5	1.8	9.6	6.6	1.7	3.4
	600	16.3	9.9	2.8	9.6	18.0	10.7	3.1	12.1	11.7	8.3	2.0	5.3	13.1	8.9	2.3	6.8
	800	22.3	14.3	3.8	10.0	27.1	17.1	4.6	3.4	15.5	11.8	2.7	5.3	20.2	14.6	3.4	2.8
	1000	27.0	17.2	4.6	5.8	31.8	20.0	5.4	3.9	18.9	14.3	3.3	3.4	23.8	17.1	4.1	2.3
	1200	31.1	19.9	5.3	4.7	37.2	23.3	6.3	6.1	21.6	16.5	3.7	2.8	27.8	19.9	4.7	3.4
16	200	4.4	3.4	0.6	0.3	5.7	3.9	0.7	1.0					3.9	3.3	0.5	0.5
	300	6.9	4.8	0.9	1.1	8.2	5.3	1.0	2.2	4.7	4.0	0.6	0.6	5.7	4.4	0.7	1.1
	400	9.9	6.8	1.3	1.3	11.3	7.2	1.5	2.7	6.8	5.8	0.9	0.7	7.9	6.1	1.0	1.4
	600	13.7	9.0	1.8	4.1	15.4	9.8	2.0	5.3	9.5	7.6	1.3	2.2	10.8	8.2	1.4	2.9
	800	17.8	12.6	2.3	4.1	23.1	15.7	2.9	1.5	12.1	10.7	1.6	2.1	16.1	13.3	2.1	0.8
	1000	22.0	15.4	2.8	2.7	27.5	18.5	3.5	1.7	15.1	13.0	2.0	1.5	19.3	15.7	2.5	0.9
	1200	24.8	17.6	3.2	2.2	32.1	21.4	4.1	2.7	16.9	14.9	2.2	1.3	22.9	18.1	2.9	1.4
20	200																
	300	5.5	4.3	0.6	0.5	6.7	4.8	0.7	1.0								
	400	7.9	6.2	0.8	0.6	9.3	6.6	1.0	1.3	5.3	5.3	0.6	0.3	6.3	5.6	0.7	0.6
	600	11.3	8.1	1.2	1.9	12.8	8.9	1.3	2.6	7.6	6.9	0.8	1.0	8.7	7.5	0.9	1.3
	800	14.0	11.3	1.4	1.8	18.9	14.2	1.9	0.7								
	1000	17.6	13.9	1.8	1.3	22.8	16.8	2.3	0.8	11.7	11.7	1.2	0.7				
	1200	19.6	15.8	2.0	1.1	26.5	19.5	2.7	1.3	12.9	12.9	1.3	0.6	16.5	16.1	1.7	0.8

WATER PRESSURE DROP



TE: PRESSURE DROPS BASED ON 170 F WATER. PRESSURE DROPS LOWER THAN SHOWN ABOVE NOT RECOMMENDED.

V-11

centage of Rated Free Flow CFM for Various External Static Pressures

UNIT SIZE	EXTERNAL STATIC PRESSURES (INCHES OF WATER)						
	FREE FLOW	.05	.10	.15	.20	.30	.40
SPEED (G-1) AND 3-SPEED (G-2 AND G-3) MOTORS							
02	100%	92%	79%	67%	—	—	—
03	100%	91%	82%	71%	—	—	—
04	100%	91%	81%	67%	—	—	—
06	100%	92%	82%	71%	—	—	—
08	100%	91%	82%	71%	—	—	—
10	100%	92%	83%	74%	—	—	—
12	100%	89%	78%	66%	—	—	—
IGH EXTERNAL STATIC PRESSURE (G-4) MOTOR							
04	—	149%	142%	133%	124%	105%	82%
06	—	141%	136%	131%	126%	111%	92%
08	—	122%	117%	111%	105%	92%	77%
10	—	129%	123%	117%	111%	95%	75%
12	—	132%	125%	119%	112%	97%	79%

TE: DATA BASED ON HIGH FAN SPEED.

TRANE RECONNECTED WINDING MOTORS

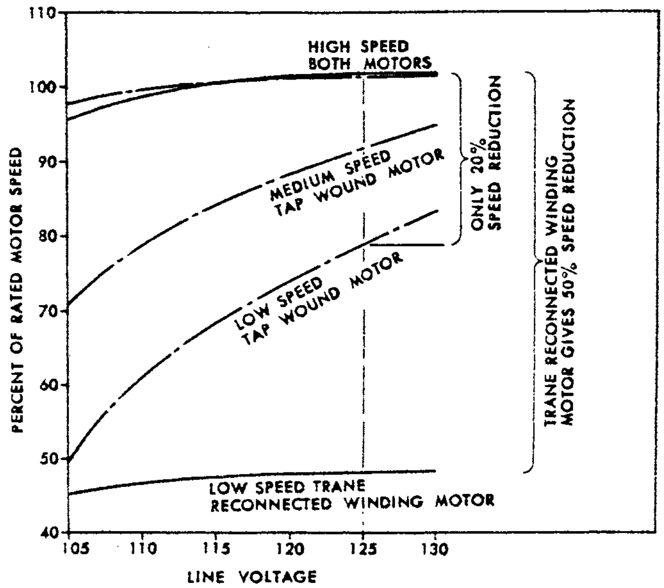
A major problem with fan-coil room units, in the 200 to) cfm range, has been the lack of positive significant tor speed reduction for good capacity control. When e voltage is above nominal, but within power company cifications, a common occurrence, tap wound motors ve negligible capacity control. Even at nominal line tages, tap wound motors offer at most only 30 percent acity reduction from high to low speed.

To solve this problem, Trane developed the 2-speed, onnected winding, shaded pole motor, optional on all)-600 cfm units. This exclusive design assures positive percent speed, 55 percent capacity reduction from 105 130 line volts. See Chart 13.

With the Trane design, positive 50 percent speed re- ction is accomplished by incorporating the equivalent a 6-pole and 12-pole motor within the same housing. e winding is reconnected by indexing the motor switch high speed (6-pole) or low speed (12-pole) operation.

Tap wound motors are also available. This includes optional permanent split capacitor design for use when eptionally high motor efficiency, power factor, and are desired. All UniTrane fan motors have been care- y designed to provide long, trouble-free operation.

CHART 13—Positive 50% Speed Reduction With Trane Reconnected Winding Motor

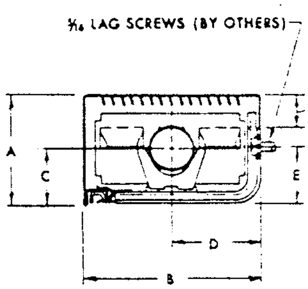


.E 13—UniTrane Motor Characteristics

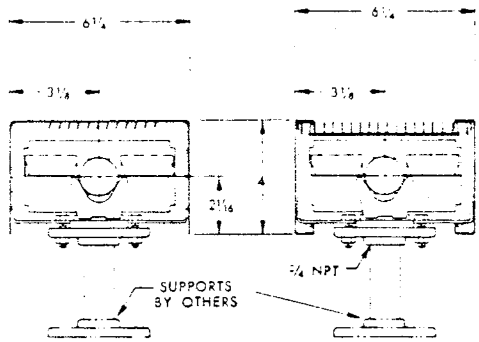
MOTOR	CHARACTER-ISTICS	UNIT SIZE 02	03	04	06	08	10	12
SP	VOLTS PF RPM CFM AMPS WATTS HP	115/60/1 .75 1100/500 230/105 1.40/.70 120/60 1/60	115/60/1 .73 1100/500 320/150 1.90/.95 160/75 1/30	115/60/1 .78 1075/500 410/190 1.50/.75 135/60 1/30	115/60/1 .71 1075/500 570/265 2.20/1.20 180/80 1/20	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE
SP	VOLTS PF RPM CFM AMPS WATTS HP	115/60/1 .59 1100/900/700 230/200/145 1.40/.65/.40 95/50/30 1/60	115/60/1 .74 1100/900/700 320/260/200 1.60/1.15/.85 135/100/75 1/30	115/60/1 .64 1075/900/700 410/340/265 1.50/.85/.75 110/65/55 1/30	115/60/1 .56 1075/900/700 570/475/370 2.10/1.45/1.30 135/105/90 1/20	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE
PSC	VOLTS PF RPM CFM AMPS WATTS HP	115/60/1 .87 1100/900/700 230/200/145 .85/.40/.30 85/40/30 1/60	115/60/1 .82 1100/900/700 320/260/200 .90/.40/.30 85/50/40 1/30	115/60/1 .76 1075/900/700 410/340/265 .90/.50/.35 75/50/35 1/30	115/60/1 .78 1075/900/700 570/475/370 1.00/.75/.65 90/70/60 1/20	115/60/1 .70 775/650/525 840/710/570 1.60/1.15/.90 130/95/75 1/12	115/60/1 .85 775/650/525 1000/840/680 1.80/1.25/.90 170/115/80 1/8	115/60/1 .85 775/650/525 1200/1000/810 1.90/1.15/75 190/110/70 1/6
NOTE) SP (02-06) PSC (08-13)	VOLTS PF RPM CFM AMPS WATTS HP	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	115/60/1 .59 1600/1400/1050 690/530/390 3.39/2.23/1.62 248/171/128 1/8	115/60/1 .63 1500/1050/700 880/375/410 3.85/2.58/1.89 285/205/147 1/8	115/60/1 .68 1100 1180 3.50 275 1/4	115/60/1 .71 1100 1530 4.30 350 1/3	115/60/1 .85 1100 1560 4.0 360 1/2
PSC	VOLTS PF RPM CFM AMPS WATTS HP	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	230/50/1 .93 680/540/425 700/590/480 .80/.35/.23 170/70/45 1/12	230/50/1 .85 680/540/425 830/700/570 .90/.39/.25 175/70/45 1/8	230/50/1 .89 680/540/425 1100/830/680 1.30/.47/.28 265/85/45 1/6
PSC	VOLTS PF RPM CFM AMPS WATTS HP	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	230/60/1 .93 775/650/525 840/710/570 .77/.38/.23 165/80/45 1/12	230/60/1 .94 775/650/525 1000/840/680 .81/.40/.25 175/85/45 1/8	230/60/1 .89 775/650/525 1200/1000/810 1.60/.57/.31 325/110/55 1/6
SP	VOLTS PF RPM CFM AMPS WATTS HP	230/50/1 .60 1100/900/700 230/200/145 .40/.30/.25 55/40/30 1/60	230/50/1 .65 1100/900/700 320/260/200 .60/.50/.35 90/80/55 1/33	220/50/1 .67 1075/900/700 410/340/265 .65/.50/.40 100/75/60 1/30	230/50/1 .68 1075/900/700 570/475/370 .90/.70/.55 140/115/90 1/20	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE

E: THIS DATA BASED ON .05" EXTERNAL STATIC PRESSURE TO A C32AL UNIT. THE MINIMUM TO BE USED WITH G4 MOTORS.

TYPES E, E3, E3A, AND E3-2W DIMENSIONS AND RATINGS



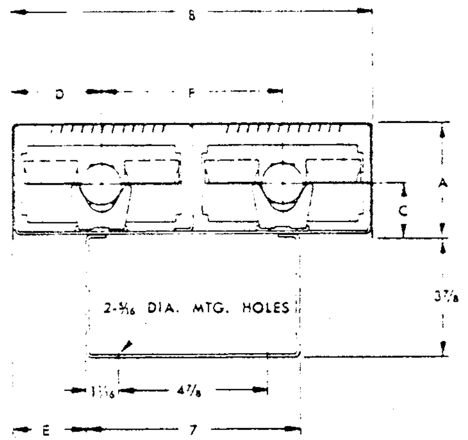
TYPE 3E & 4E



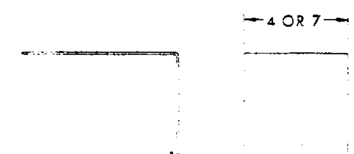
TYPE E3

TYPE E3A Extruded Grille

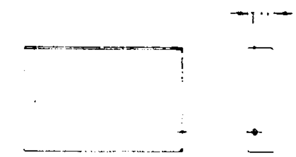
FRONT AND BACK PANEL



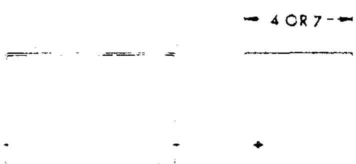
TYPE E3-2W



TRIM STRIP (E)



END PANEL (E)



TRIM STRIP (E3)

END PANEL (E3)

TABLE 18—Enclosure Dimensions, Types E and E3-2W

Dimension	3¼" Fin		5¼" Fin	
	3E	E3-2W	4E	E3-2W
A	3⅜	3	3⅞	3¾
B	4	7 13/16	6	11 13/16
C	1¼	1 9/16	2	1 13/16
D	2	2	3	2 15/16
E	1½	¾	2	2⅜
F	—	3¾	—	5 15/16

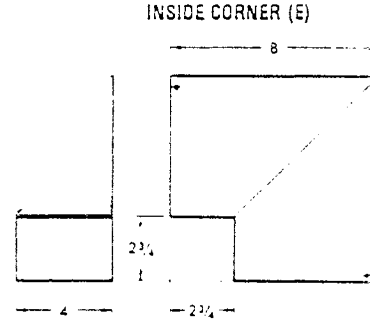
NOTE: Type E3A available in 18 gauge front and back panels only. Types E3 and E3-2W available in 16 gauge only. Types 3E and 4E available in 16 or 14 gauge. All enclosures are cleaned and phosphatized to prevent corrosion and rust creep from scratches, finished in baked grey enamel primer. Baked enamel final finish in choice of seven colors.

All dimensions approximate.
Certified drawings available on request.

TABLE 19—Inside and Outside Corners

Dimension	3E	4E	E3 & E3A	E3-2W	
				3¼" Fin	5¼" Fin
8	6¼	8¼	9½	10 11/16	14 11/16

INSIDE CORNER (E)



OUTSIDE CORNER (E)

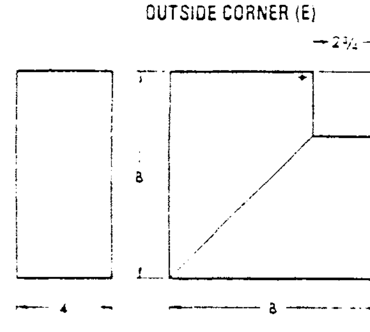


TABLE 20—Ratings of Wall Fin Elements With Type E, E3, E3A, and E3-2W Enclosures

Element	Rows	Enclosure	Installed Height	Steam Capacity/Ft. 1 PSI at 65 F Air		Hot Water Capacity—Btu/Hr./Ft. at 65 F Air, Average Water Temp. (IBR Factor—Steam to Hot Water)					
				EDR Sq. Ft.	Btu/Hr.	220F (1.05)	210F (0.95)	200F (0.86)	190F (0.78)	180F (0.69)	170F (0.61)
Steel—1¼" Series—40 Fins—2½" x 5¼" x .0299" Finish—Black		4E	9½	4.35	1040	1090	990	890	810	720	630
	1 2	E3* E3A* E3-2W*	7⅝	4.75 8.55	1140 2050	1200 2160	1080 1940	980 1760	890 1600	790 1420	700 1260
Steel—1¼" Series—52 Fins—2½" x 5¼" x .0299" Finish—Black		4E	9½	4.90	1170	1230	1110	1010	910	810	710
	1 2	E3* E3A* E3-2W*	7⅝	5.40 9.70	1290 2320	1350 2430	1230 2210	1110 2000	1010 1820	890 1600	790 1420
Copper-Aluminum—1¼" Series—60 Fins—2½" x 5¼" x .015" Finish—Black		4E	9½	5.85	1400	1470	1330	1200	1090	970	850
	1 2	E3* E3A* E3-2W*	7⅝	6.40 11.50	1540 2770	1620 2910	1460 2630	1320 2370	1200 2150	1060 1910	940 1690
Copper-Aluminum—1" Series—68 Fins—2" x 3¼" x .011" Finish—Black		3E	9½	3.15	750	790	710	650	590	520	460
	1 [illegible]	E3* E3A* [illegible]	7⅝	3.45 6.20	830 1490	870 1560	790 1420	710 1280	650 1170	570 1020	510 920

*IBR does not have procedure for rating pedestal mounted enclosures.

NOTE: Rating is Btu/hr./ft. of finned length (for element dimensions see Page 15). Hot water ratings determined by applying correction factor to steam ratings are for water velocities of 3 ft./sec. or greater. See Chart 1, Page 12 for correction factors for water velocities other than 3 ft./sec. For definition of installed height and heating effect factor, see Page 13. For heating ratings at other steam pressures and/or entering air temperatures, see Table 1, Page 12.

"SR" SERIES CONVERTERS – 2 PASS

(For Heating Radiation with Steam)

(See next page for 4 Pass)

V-13

Capacities listed are in Gallons Per Minute (GPM) and based on the Thermal Standards of the Fuel Oil and Water Heater Manufacturers Association for commercially clean tubing. If fouling is anticipated select a unit one or two feet longer. If excessive fouling is anticipated, ask for our recommendation.

To obtain rating in Btu, multiply capacities listed by 10,000 for a 20 F drop or 5,000 for a 10 F drop (See Page 9.)

For temperatures and pressures other than those listed, request a copy of our "L & S" Nomograph Chart.

To determine pressure drop (pd) and velocity thru tubes, see chart on Page 20.

CAPACITIES IN G.P.M. — 2 PASS UNITS

(for 4 Pass Units — See Next Page)

110 F to 130 F (Floor Panel Heating)

Unit No.	0 PSI	2 PSI	5 PSI	10 PSI	25 PSI
4204SR	20	23	28	33	33
4206SR	33	33	33		
6204SR	46	51	62	74	74
6206SR	74	74	74		
8204SR	102	114	138	164	164
8206SR	164	164	164		
10204SR	163	182	221	262	262
10206SR	262	262	262		
12206SR	394	394	394	394	394
14206SR	492	492	492	492	492
16206SR	689	689	689	689	689
20206SR	984	984	984	984	984

130 F to 150 F (Ceiling Panel Heating)

Unit No.	0 PSI	2 PSI	5 PSI	10 PSI	25 PSI
4204SR	13	15	20	26	33
4206SR	30	33	33	33	
6204SR	30	34	44	59	74
6206SR	67	74	74	74	
8204SR	66	76	98	130	164
8206SR	149	164	164	164	
10204SR	106	122	157	208	262
10206SR	238	262	262	262	
12206SR	358	394	394	394	394
14206SR	447	492	492	492	492
16206SR	626	689	689	689	689
20206SR	894	984	984	984	984

130 F to 150 F (50% Glycol Solution for Snow Melting)

Unit No.	0 PSI	2 PSI	5 PSI	10 PSI	25 PSI
4204SR	9	10	13	17	22
4206SR	20	22	22	22	
6204SR	20	23	29	40	50
6206SR	45	50	50	50	
8204SR	44	51	66	87	110
8206SR	100	110	110	110	
10204SR	71	82	105	139	176
10206SR	159	176	176	176	
12206SR	240	264	264	264	264
14206SR	300	330	330	330	330
16206SR	419	462	462	462	462
20206SR	599	659	659	659	659

160 F to 180°

Unit No.	0 PSI	2 PSI	5 PSI	10 PSI	25 PSI
4204SR	5	6	9	14	28
4206SR	11	14	21	32	33
4208SR	20	26	33	33	
4210SR	32	33			
6204SR	11	14	20	32	64
6206SR	26	32	48	72	74
6208SR	46	58	74	74	
6210SR	71	74			
8204SR	25	32	44	72	142
8206SR	57	71	106	160	164
8208SR	102	128	164	164	
8210SR	158	164			
10204SR	41	51	71	115	227
10206SR	91	114	170	256	262
10208SR	163	205	262	262	
10210SR	253	262			
12206SR	137	171	254	384	394
12208SR	245	307	394	394	
12210SR	379	394			
14206SR	171	214	318	480	492
14208SR	306	384	492	492	
14210SR	474	492			
16206SR	239	300	445	672	689
16208SR	428	538	689	689	
16210SR	664	689			
20206SR	342	428	636	960	984
20208SR	612	768	984	984	
20210SR	948	984			

180 F to 200 F

Unit No.	0 PSI	2 PSI	5 PSI	10 PSI	25 PSI
4204SR		2	4	8	19
4206SR	3	5	9	17	33
4208SR	5	9	16	31	
4210SR	8	14	26	33	
4212SR	12	20	33		
4214SR	16	27			
6204SR		5	9	18	42
6206SR	7	11	21	39	74
6208SR	12	20	36	69	
6210SR	18	31	59	74	
6212SR	26	44	74		
6214SR	36	60			
6216SR	47	74			
8204SR		11	21	39	93
8206SR	15	25	47	87	164
8208SR	26	43	80	154	
8210SR	41	68	130	164	
8212SR	59	98	164		
8214SR	79	134			
8216SR	104	164			
8218SR	131				
10204SR		18	34	62	149
10206SR	23	39	75	139	263
10208SR	42	69	129	247	
10210SR	65	109	208	263	
10212SR	94	157	262		
10214SR	126	214			
10216SR	166	262			
10218SR	210				
10220SR	262				
12206SR	35	59	113	208	394
12208SR	62	104	193	370	
12210SR	97	164	312	394	
12212SR	141	235	394		
12214SR	190	322			
12216SR	250	394			
12218SR	314				
12220SR	394				
14206SR	44	74	141	260	492
14208SR	78	130	241	462	
14210SR	122	205	390	492	
14212SR	176	294	492		
14214SR	237	402			
14216SR	312	492			
14218SR	393				
14220SR	492				
16206SR	61	103	197	364	689
16208SR	109	182	338	647	
16210SR	171	287	546	689	
16212SR	246	412	689		
16214SR	332	563			
16216SR	437	689			
16218SR	550				
16220SR	689				
20206SR	88	148	282	520	984
20208SR	156	260	482	924	
20210SR	244	410	780	984	
20212SR	352	588	984		
20214SR	474	804			
20216SR	624	984			
20218SR	786				
20220SR	984				

190 F to 210 F

Unit No.	2 PSI	5 PSI	10 PSI	25 PSI
4204SR		2	5	15
4206SR		5	11	33
4208SR	3	8	20	
4210SR	5	13	32	
4212SR	7	19	33	
4214SR	9	25		
6204SR		5	11	33
6206SR		11	26	74
6208SR	7	19	45	
6210SR	11	29	71	
6212SR	15	42	74	
6214SR	21	58		
6216SR	27	74		
8204SR		10	25	74
8206SR		23	57	164
8208SR	15	41	100	
8210SR	23	64	158	
8212SR	34	93	164	
8214SR	46	128		
8216SR	60	164		
8218SR	76			
10204SR		17	40	119
10206SR		37	91	263
10208SR	24	66	160	
10210SR	37	102	253	
10212SR	54	149	263	
10214SR	74	205		
10216SR	96	262		
10218SR	122			
10220SR	150			
12206SR		56	137	394
12208SR	36	99	240	
12210SR	56	154	379	
12212SR	82	223	394	
12214SR	110	307		
12216SR	144	394		
12218SR	182			
12220SR	226			
14206SR		70	171	492
14208SR	45	124	300	
14210SR	70	192	474	
14212SR	102	279	492	
14214SR	138	384		
14216SR	180	492		
14218SR	228			
14220SR	282			
16206SR		98	240	689
16208SR	63	174	420	
16210SR	98	269	664	
16212SR	143	391	689	
16214SR	193	538		
16216SR	252	689		
16218SR	319			
16220SR	395			
20206SR		140	342	984
20208SR	90	248	600	
20210SR	140	384	948	
20212SR	204	558	984	
20214SR	276	768		
20216SR	360	984		
20218SR	456			
20220SR	564			

200 F to 220 F

Unit No.	5 PSI	10 PSI	25 PSI
4204SR		3	11
4206SR	2	7	25
4208SR	3	12	33
4210SR	5	13	
4212SR	7	26	
4214SR	9	33	
6204SR		7	25
6206SR	4	15	56
6208SR	7	26	74
6210SR	11	41	
6212SR	16	59	
6214SR	21	74	
6216SR	28		
8204SR		14	56
8206SR	9	32	125
8208SR	15	58	164
8210SR	24	90	
8212SR	35	130	
8214SR	47	164	
8216SR	62		
8218SR	78		
10204SR		23	39
10206SR	14	52	199
10208SR	25	93	263
10210SR	38	144	
10212SR	55	208	
10214SR	75	263	
10216SR	99		
10218SR	125		
10220SR	154		
12206SR	21	73	299
12208SR	37	139	394
12210SR	58	216	
12212SR	83	312	
12214SR	113	394	
12216SR	149		
12218SR	187		
12220SR	230		
14206SR	26	97	373
14208SR	46	174	492
14210SR	72	270	
14212SR	104	390	
14214SR	141	492	
14216SR	186		
14218SR	234		
14220SR	288		
16206SR	36	136	523
16208SR	65	244	689
16210SR	101	378	
16212SR	145	546	
16214SR	197	689	
16216SR	260		
16218SR	328		
16220SR	403		
20206SR	52	195	747
20208SR	92	348	984
20210SR	144	540	
20212SR	208	780	
20214SR	282	984	
20216SR	372		
20218SR	468		
20220SR	576		

METHOD OF SELECTION (2 PASS UNITS)

The maximum pressure drop (pd) for the lowest temperature and longest units listed on this page, for all diameters is 11 feet or 4.8 PSI. The pd's for higher temperature and shorter length units will be correspondingly lower and may be determined from the chart on page 20.

In the majority of cases a 4 pass unit (page 11) would be the most economical selection. The most economical selection, however, may not always be suitable because of the pressure drop and/or space limitations. It is accordingly suggested that you make your selection along the lines of the following example.

EXAMPLE

Requirements — 300,000 Btu.
Water Temperature — 190°F (180-200 F)
Temp Drop — 20°F
Steam Pressure — 5 PSI

This represents a flow thru the system of 30 GPM (300,000 ÷ 10,000 — see above and page 9.)

Referring to the 5 PSI column and 180-200 F table above, you will find the nearest above 30 GPM in the smallest diameter to be

No. 6210SR — 59 GPM (6" Dia., 2 Pass, 10' long)

The pressure drop thru this unit will be less than 4.8 PSI as indicated above. However, if the exact pressure drop is required, refer to chart on page 20 and you will find it to be .7 PSI.

Before deciding that this is the unit you require, refer to the next page for 4 pass units. Perhaps a 4 pass unit will meet the requirements and be more economical.

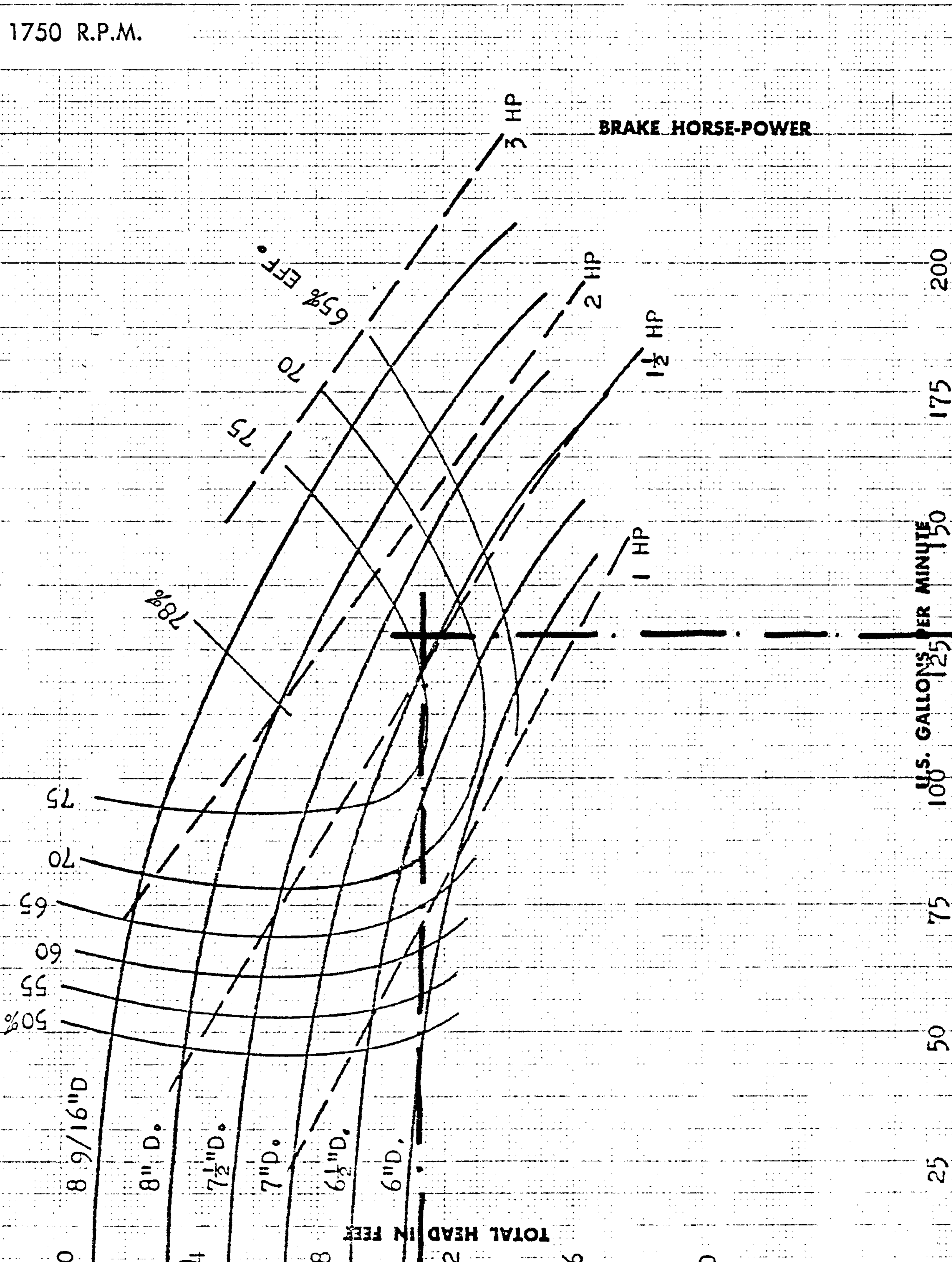
veil PUMP COMPANY

CHICAGO - ILLINOIS U.S.A.

SERIAL NO. ....4087 SF
SIZE — TYPE ....VKYM 2"
IMP. DIA. ....VARIED
IMP. NO. 1486
SP. GRAV. 1.0
DATE 12/29/58
Also for Pump Type VR

V-14

RIFUGAL PUMP PERFORMANCE CHART —



FOR A MAXIMUM PERMISSIBLE SUCTION LIFT OF 15 FEET

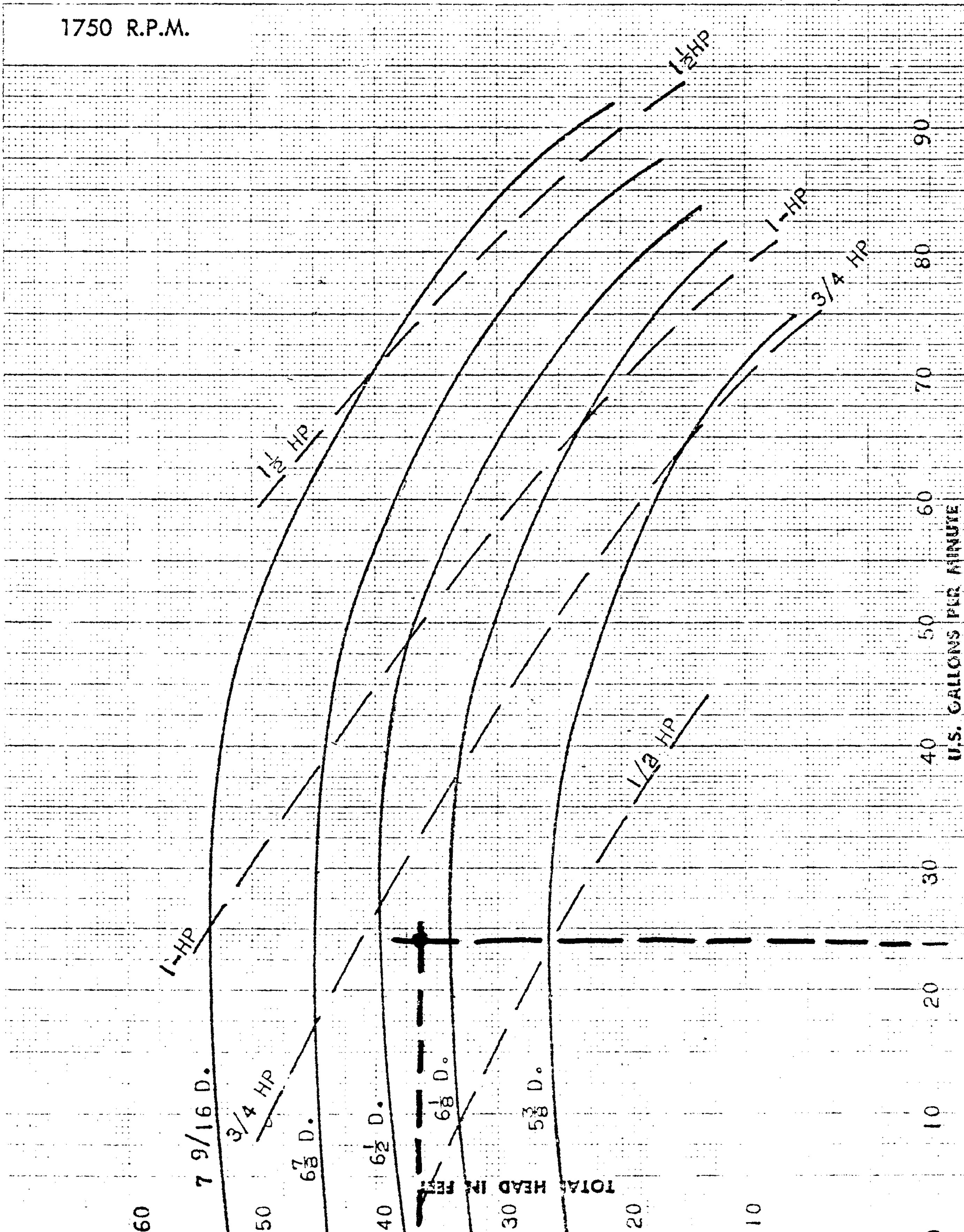
weil PUMP COMPANY

CHICAGO - ILLINOIS U.S.A.

— CENTRIFUGAL PUMP PERFORMANCE CHART —

SERIAL NO. 51
SIZE — TYPE.....................1¼" RY
IMP. DIA. ....VARI
IMP. NO. 37
SP. GRAV. ....
DATE 10-22-

ALSO FOR PUMP TYPES
KYGJ, KUGJ, RUGJ



weil PUMP COMPANY

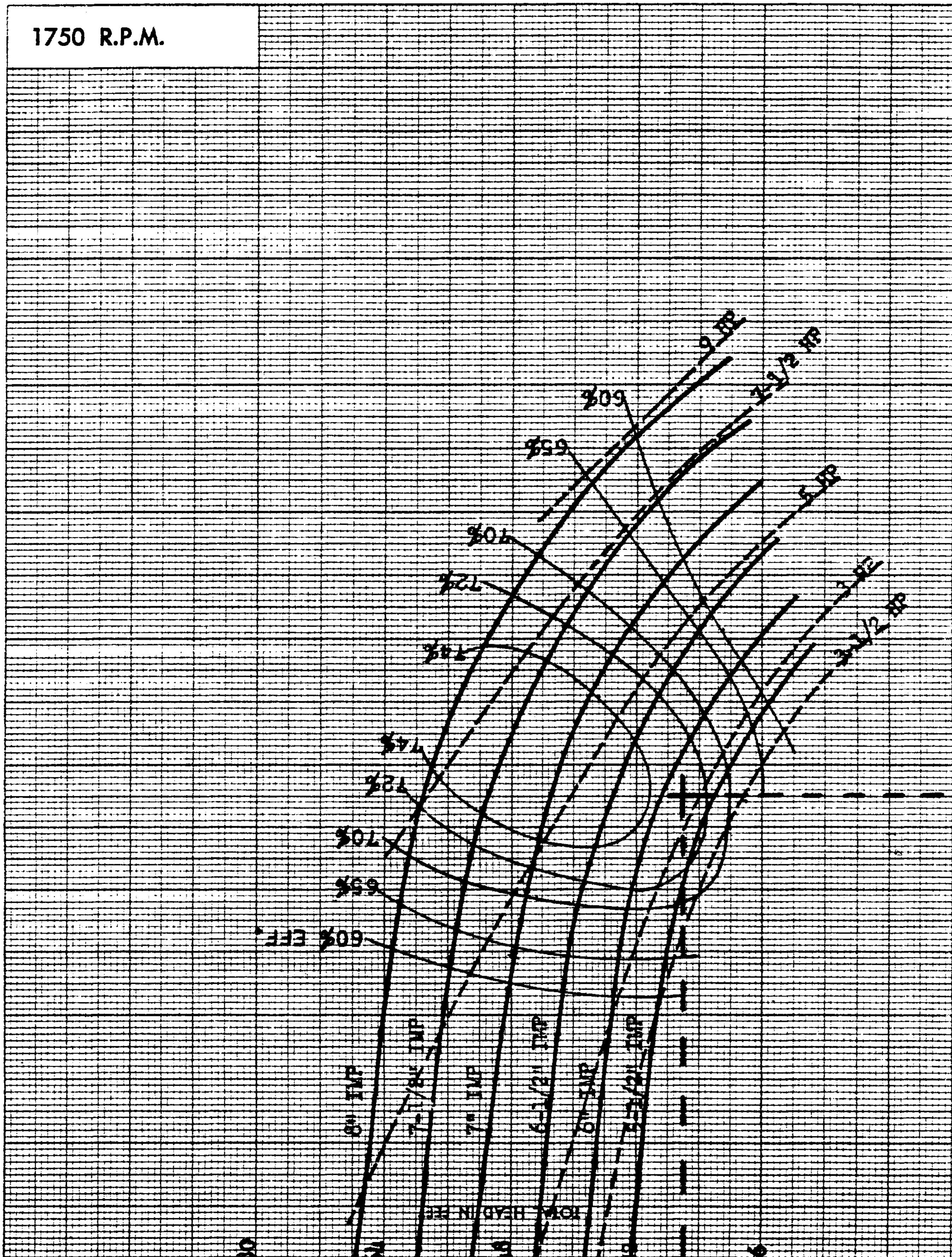
CHICAGO - ILLINOIS U.S.A.

SERIAL NO. ....
SIZE — TYPE....................
IMP. NO. ....
DATE 2

— CENTRIFUGAL PUMP PERFORMANCE CHART —

FOR PUMP TYPES KU, RU

V-16



FOR A MAXIMUM PERMISSIBLE SUCTION LIFT OF 15 FEET

weil PUMP COMPANY

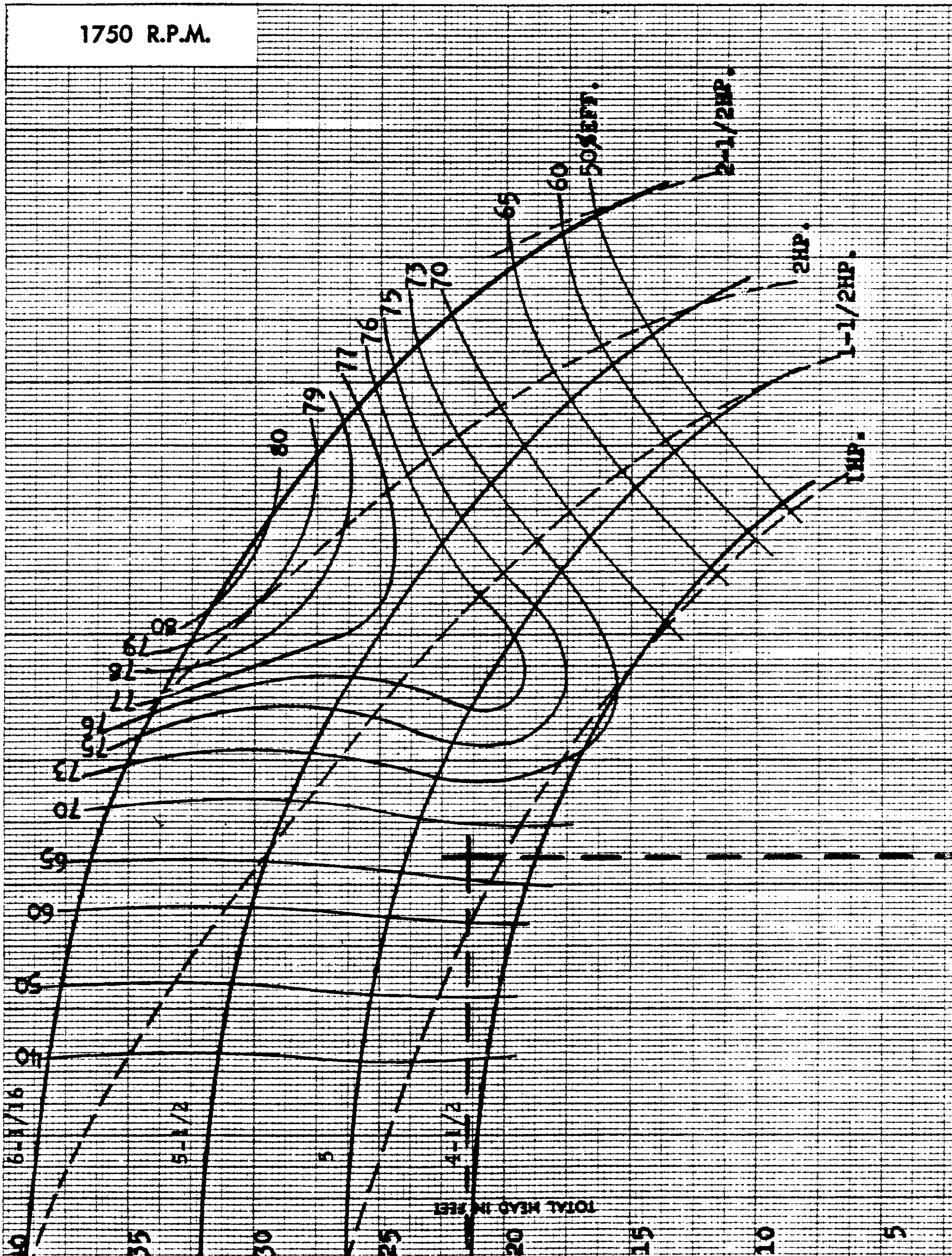
CHICAGO - ILLINOIS U.S.A.

SERIAL NO. ....
SIZE — TYPE....................
IMP. NO. ....
DATE ....
FOR PUMP TYPES KUS, KYS, RUS,

V - 17

— CENTRIFUGAL PUMP PERFORMANCE CHART —

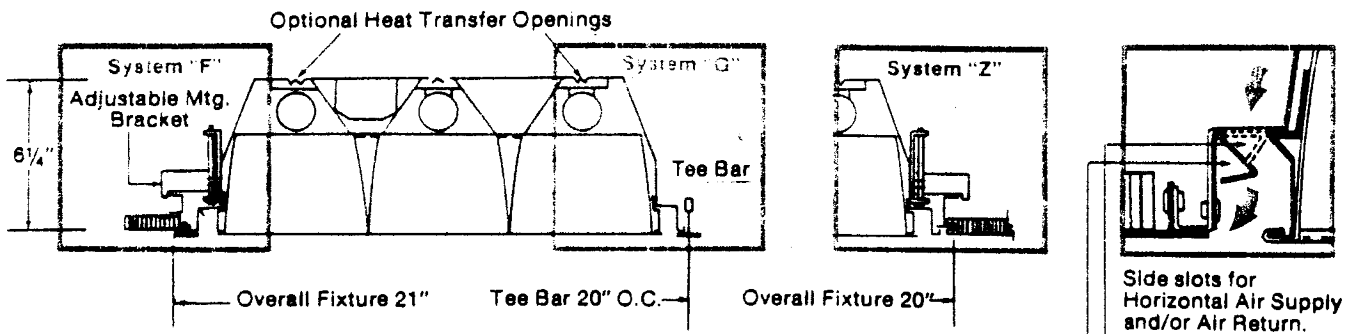
FOR A MAXIMUM PERMISSIBLE SUCTION LIFT OF 15 FEET



PARALOUVER II — 20" x 48" WITH 24 CELLS

DIMENSIONS

VT-1



Side slots for Horizontal Air Supply and/or Air Return.

Dotted line shows closed position.

Open for air function desired.

(NEMA Type F)
Flange for acoustical ceilings using concealed mechanical suspension. Swing-jack mounting brackets: adjustment 3¾" max. and 1 7/16" min.

(NEMA Type G)
Lay-in for acoustical ceilings using exposed grid suspension, with tees for fixtures on 20" x 48" spacing.

For most concealed spline ceilings ATS, and some snap-in metal-pan systems. Swing-jack mounting brackets: adjustment 3¾" max. and 1 7/16" min.

PHOTOMETRIC DATA

2-Outside Lamps									3-Lamp								
pfc	20								pfc	20							
pcc	80			70			50		pcc	80			70			50	
pw	70	50	30	70	50	30	50	30	pw	70	50	30	70	50	30	50	30
RCR									RCR								
0	71	71	71	69	69	69	66	66	0	69	69	69	68	68	68	65	65
1	67	65	63	65	64	62	61	60	1	66	64	62	64	62	61	60	59
2	63	60	57	62	59	56	57	54	2	62	58	56	60	57	55	55	53
3	59	54	51	58	54	50	52	49	3	58	53	50	56	52	49	51	48
4	55	50	46	54	49	45	47	44	4	54	48	45	53	48	44	46	43
5	51	45	41	50	44	40	43	40	5	50	44	40	49	43	40	42	39
6	48	41	37	47	41	36	40	36	6	47	40	36	46	40	36	39	35
7	44	37	33	43	37	33	36	32	7	43	36	32	42	36	32	35	31
8	41	34	29	40	33	29	32	29	8	40	33	29	39	32	28	32	28
9	37	30	26	37	30	26	29	25	9	37	30	25	36	29	25	29	25
10	35	27	23	34	27	23	27	23	10	34	27	23	33	27	22	26	22

Test #6794-1 S/MH=1.4   Test #6793-1 S/MH=1.3

2-Outside Lamps				3-Lamp		
End	45°	Cross	Angle	End	45°	Cross
1894	1894	1894	0	2762	2762	2762
1850	1896	1921	5	2711	2777	2817
1721	1891	2025	15	2524	2783	2982
1552	1822	2055	25	2282	2673	2995
1330	1623	1608	35	1960	2371	2330
1017	1068	934	45	1513	1561	1353
510	430	402	55	770	629	571
44	48	46	65	68	71	68
0	5	3	75	12	15	13
0	0	0	85	0	0	0

2-Outside Lamps			3-Lamp	
End	Cross	Angle	End	Cross
1275	1170	45	1264	1131
788	622	55	793	588
92	96	65	95	95
0	10	75	28	30
0	0	85	0	0

- 80-50-20 reflectances (ceiling-wall-floor)
- LLF = 0.78 3150 lumens/lamp very clean
- Room width divided by room height = 5 or more, 2 or 1

Fixture Size & # of Lamps	Room Width / Room Height =	Approx. Area (sq. ft.) per Fixture				
		30 ft-c	50 ft-c	70 ft-c	100 ft-c	150 ft-c
20' x 48' 3-Lamp	5	—	94	67	47	31
	2	118	71	51	35	24
	1	88	53	38	27	—
20' x 48' 2 Outside Lamps	5	106	64	46	32	—
	2	82	49	35	25	—
	1	61	36	26	—	—

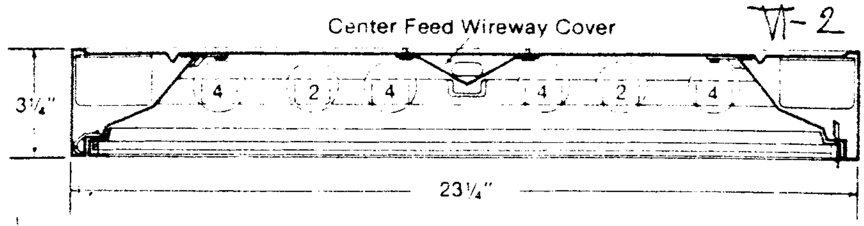
LLF = 0.78
LLF = Light Loss Factor
LDD = Luminaire Dirt Depreciation IES Category IV Clean Annually
LLD = Lamp Lumen Depreciation
BF = Ballast Factor (commercial ballast performance relative to reference ballast)

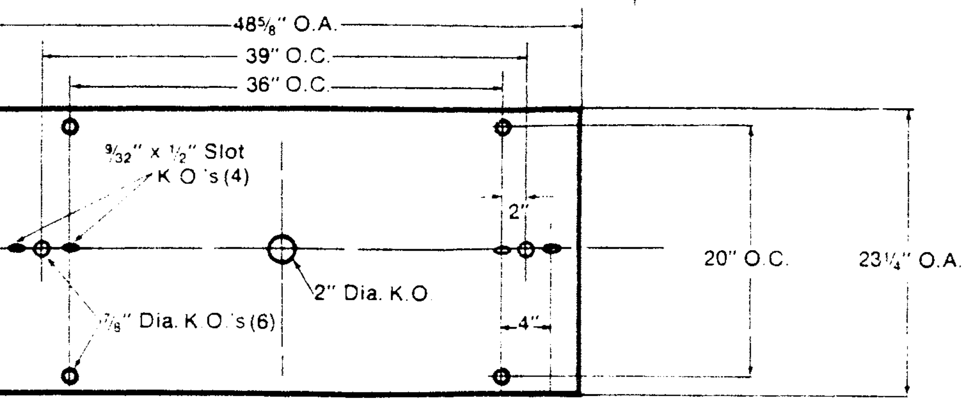
Light Loss Factor (LLF) = LDD×LLD×BF
LDD = Very Clean 0.94 Clean 0.90 Medium 0.
LLD = 0.88 • 40% Rated Lamp Life
BF = 0.94 (Std. Ballasts & Lamps) Relamp • 70% Lamp Life

DAY-BRITE

Day-Brite Lighting Division
Emerson Electric Co.
Tupelo, Mississippi 38801
Phone: (601) 842-7212

DIMENSIONS





PHOTOMETRIC DATA

	4-Lamp w/DB-12								4-Lamp w/Gridless Octex								
pfc	20								pfc	20							
pcc	80			70			50		pcc	80			70			50	
pw	70	50	30	70	50	30	50	30	pw	70	50	30	70	50	30	50	30
RCR									RCR								
0	79	79	79	77	77	77	74	74	0	81	81	81	79	79	79	76	76
1	74	72	69	72	70	68	67	66	1	76	73	71	74	71	69	69	67
2	69	64	61	67	63	60	61	58	2	70	65	62	68	64	61	62	59
3	64	58	54	62	57	53	55	52	3	65	59	54	63	58	53	56	52
4	59	52	48	58	52	47	50	46	4	60	53	48	59	52	47	50	46
5	55	47	42	53	46	42	45	41	5	55	47	42	54	47	41	45	41
6	51	43	37	49	42	37	41	37	6	51	43	37	50	42	37	41	36
7	47	38	33	46	38	33	37	32	7	47	38	33	46	38	32	37	32
8	43	35	29	42	34	29	33	29	8	43	34	29	42	34	29	33	28
9	39	31	26	39	31	26	30	25	9	40	31	25	39	30	25	29	25
10	37	28	23	36	28	23	27	22	10	37	28	22	36	27	22	27	22

Test #6075-2 S/MH=1.4 Test #6456-1 S/MH=1.4

For 2-Lamp coefficients, multiply above by 1.12

4-Lamp w/DB-12				4-Lamp w/Gridless Octex		
End	45°	Cross	Angle	End	45°	Cross
3616	3616	3616	0	3442	3442	3442
3580	3612	3622	5	3383	3442	3481
3454	3525	3574	15	3278	3366	3437
3194	3349	3488	25	3050	3213	3363
2760	3103	3320	35	2686	2984	3224
1996	2446	2600	45	2088	2501	2851
1270	1024	1409	55	1252	1322	1376
556	346	589	65	524	586	552
185	216	208	75	188	289	207
55	102	54	85	82	71	114

4-Lamp w/DB-12			4-Lamp w/Gridless Octex	
End	Cross	Angle	End	Cross
1288	1677	45	1347	1839
1010	1120	55	995	1094
600	636	65	566	595
326	367	75	331	365
286	281	85	429	594

- 80-50-20 reflectances (ceiling-wall-floor)
- LLF = 0.77 3150 lumens/lamp Very Clean
- Room width divided by room height = 5 or more, 2 or 1

Fixture Size & # of Lamps	Room Width / Room Height =	Approx. Area (sq. ft.) per Fixture				
		30 ft-c	50 ft-c	70 ft-c	100 ft-c	150 ft-c
2' x 4' 4-Lamp w/DB-12	5	—	140	100	70	47
	2	—	101	72	50	34
	1	123	74	53	37	25
2' x 4' 4-Lamp w/Gdls. Octex	5	—	142	101	71	47
	2	—	103	73	51	34
	1	123	74	53	37	25

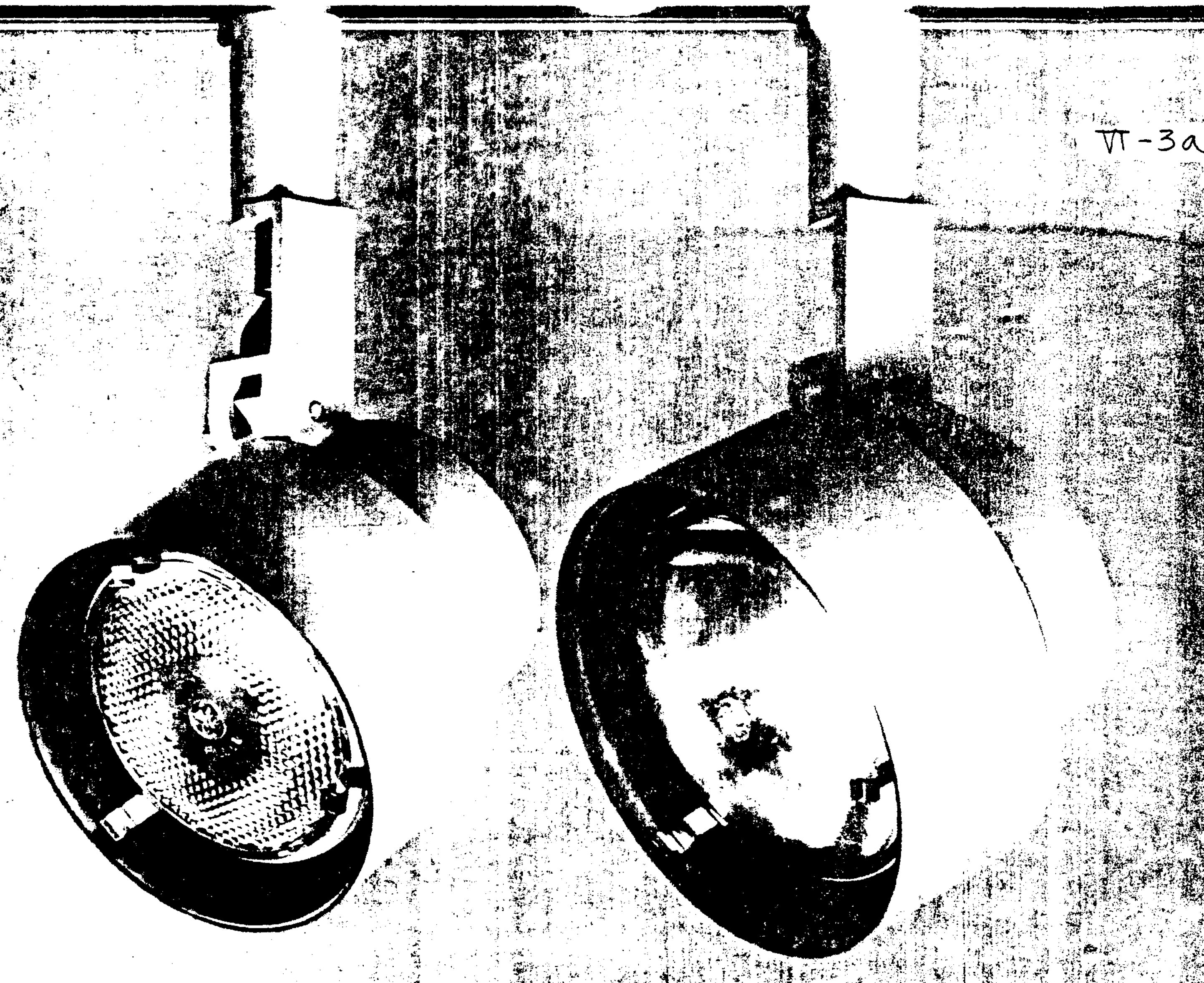
LLF = 0.77
LLF = Light Loss Factor
LDD = Luminaire Dirt Depreciation
IES Category V Clean Annually
LLD = Lamp Lumen Depreciation
BF = Ballast Factor (commercial ballast performance relative to reference ballast)

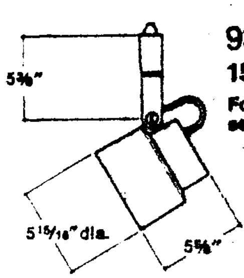
Light Loss Factor (LLF) = LDD×LLD×BF
LDD = Very Clean 0.93 Clean 0.88 Medium 0.82
LLD = 0.88 • 40% Rated Lamp Life
BF = 0.94 (Std. Ballasts & Lamps) Relamp • 70% Lamp Life

DAY-BRITE

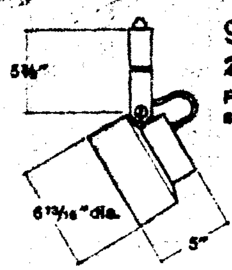
Day-Brite Lighting Division
Emerson Electric Co.
Tupelo, Mississippi 38801
Phone: (601) 842-7212

VI-3a





93440
150W, PAR-38/3 side prong
For lighting data
see page 35



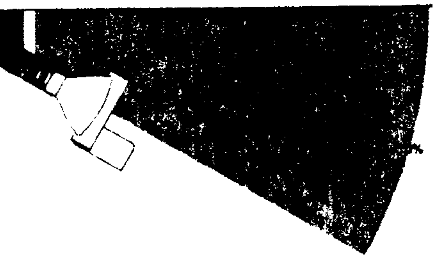
93441
200W, PAR-46/3 side prong
For lighting data
see page 35

VI -3 b

150W, PAR-38 FLOOD

FOR USE WITH NO. 93451 w/93449.

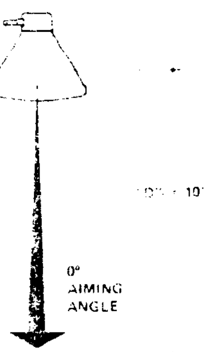
INITIAL LUMENS 1740

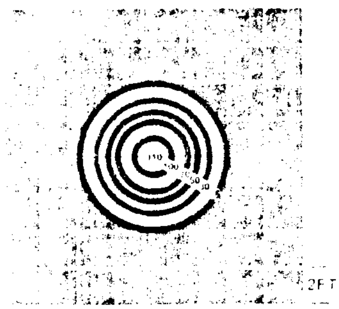


SINGLE — FIXTURE MOUNTED 3 FEET FROM WALL						MULTIPLE — UNITS ON 2 FOOT CENTERS			UNITS ON 3 FOOT CENTERS		
DISTANCE FROM CEILING IN FEET	DISTANCE ALONG WALL IN FEET (SINGLE UNIT) 0	1	2	3	4	Directly Ahead Of One Unit	Midpoint Between Units	Directly Ahead Of One Unit	Directly Ahead Of One Unit	Midpoint Between Units	Directly Ahead Of One Unit
1	28.8	24.7	11.3	4.4	1.8	55.0	60.0	55.0	37.6	38.7	37.6
2	48.3	41.3	22.7	7.4	2.9	99.5	100.2	99.5	63.1	68.3	63.1
3	42.0	37.5	24.0	11.2	4.4	98.8	101.00	98.8	64.4	67.7	64.4
4	31.7	27.0	19.5	11.5	5.3	81.3	81.8	81.3	54.7	54.2	54.7
5	21.9	19.7	15.0	9.6	5.6	63.1	64.0	63.1	41.1	43.0	41.1
6	14.9	13.3	10.4	7.4	4.8	45.3	46.8	45.3	29.7	31.2	29.7
7	9.9	9.4	7.7	5.7	4.2	33.7	35.6	33.7	21.3	24.0	21.3
8	6.6	6.1	5.3	4.3	3.4	24.0	25.2	24.0	15.2	17.0	15.2
9	4.5	4.6	3.9	3.4	2.5	17.3	20.0	17.3	11.3	13.0	11.3
10	3.1	3.2	3.0	2.5	2.1	13.3	14.6	13.3	8.1	9.9	8.1
11	2.4	2.4	2.2	2.0	1.7	10.2	11.4	10.2	6.4	7.6	6.4
12	1.8	1.8	1.7	1.6	1.2	7.6	9.0	7.6	5.0	5.8	5.0

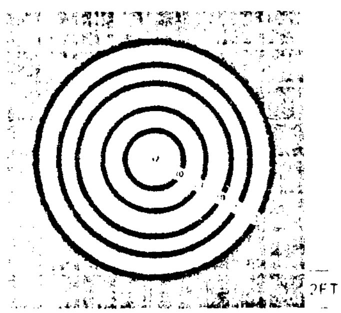
150W, PAR-38/3

	SPOT	FLOOD
INITIAL LUMENS	1740	1740
APPROX. BEAM SPREAD TO 10% MAX. C.P.	28°	60°
SPACING TO DISTANCE RATIO (FOR UNIFORM LIGHTING)	.35	.65





SPOT



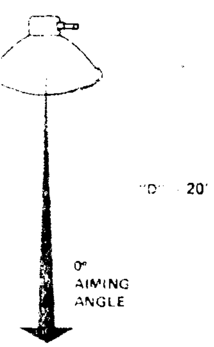
FLOOD

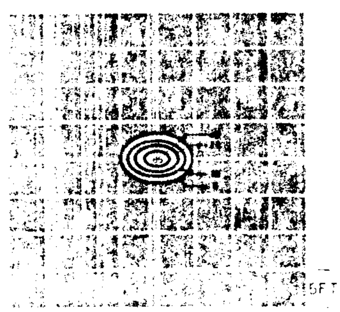
	DISTANCE AND FT-C. CORRECTION FACTORS		
	DISTANCE "D" (FEET)	MULTIPLY GRID SCALE BY	GRID FT-C BY
SPOT	2.5	0.3	16.0
	5.0	0.5	4.0
	7.5	0.8	1.8
	10.0	1.0	1.0
	12.5	1.3	0.6
	15.0	1.5	0.4
	17.5	1.8	0.3
	20.0	2.0	0.3
	25.0	2.5	0.2
	30.0	3.0	0.1
FLOOD	2	.2	25.0
	4	.4	6.3
	6	.6	2.8
	8	.8	1.6
	10	1.0	1.0
	12	1.2	0.7
	14	1.4	0.5
	16	1.6	0.4
	18	1.8	0.3
	20	2.0	0.3

200W, PAR-46/3

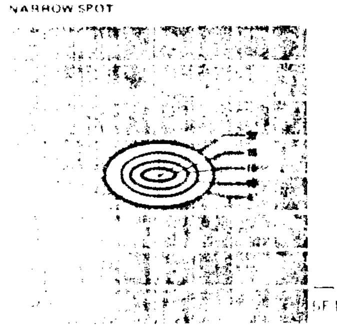
	SPOT	FLOOD
INITIAL LUMENS	2300	2300
APPROX. BEAM SPREAD TO 10% MAX. C.P.	19° x 23°	23° x 38°
SPACING TO DISTANCE RATIO* (FOR UNIFORM LIGHTING)	.14/.17	.20/.50

*TWO SPACING RATIOS ARE GIVEN FOR OVAL BEAMS





NARROW SPOT



MEDIUM FLOOD

	DISTANCE AND FT-C. CORRECTION FACTORS		
	DISTANCE "D" (FEET)	MULTIPLY GRID SCALE BY	GRID FT-C BY
NARROW SPOT	5.0	0.3	16.0
	7.5	0.4	7.1
	10.0	0.5	4.0
	12.5	0.6	2.6
	15.0	0.8	1.8
	20.0	1.0	1.0
	25.0	1.3	0.6
	30.0	1.5	0.4
	35.0	1.8	0.3
	40.0	2.0	0.3
MEDIUM FLOOD	5.0	0.3	16.0
	7.5	0.4	7.1
	10.0	0.5	4.0
	12.5	0.6	2.6
	15.0	0.8	1.8
	17.5	0.9	1.3
	20.0	1.0	1.0
	25.0	1.3	0.6
	30.0	1.5	0.4
	35.0	1.8	0.3

VI-4a

Armstrong

Tascon™

Task lighting system

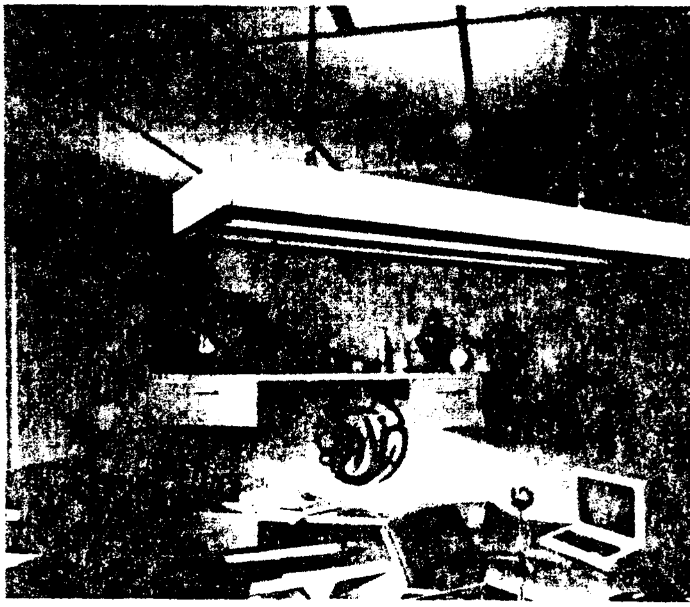
High-quality, low-energy lighting

[illegible] is a unique task lighting fixture that's designed to offer optimum performance at a minimum of cost. It positions light at the proper distance over the work surface, above the worker, concentrating it where it's needed. Each Tascon fixture, installed according to specifications, delivers up to [illegible] footcandles and Equivalent Sphere Illumination (ESI) values of 40 to 60 on the work surface. Tascon's high-quality light eliminates glare, shadows, and veiling reflections from both horizontal and vertical work surfaces, making Tascon an excellent light source for CRT stations. In addition [illegible] the work surface [illegible] upward. [illegible]

Using one fixture per 100 square feet of office floor space, Tascon consumes only .92 watt per square foot, ballast included. It's a two-lamp fixture that is available with three different lens options: clear prismatic injection molded, H-8224, and H-8224 with diffuser overlay.

The [illegible] and [illegible] suspension bars make Tascon suitable for use in open plan and private offices. A contemporary high-tech task fixture.

Size and Detail	length 53⅛" (nominal) width 13½" height 4½" In typical office installations the fixtures should be positioned seven feet above the floor
Lens Options	clear prismatic K-12 injection molded H-8224 H-8224 with diffuser
Installation	[illegible]
Grid Systems	Standard [illegible] are available for use with standard round- and square-[illegible] [illegible] and [illegible] Luminaire Systems
Switch Options	120[illegible] optional



[illegible]

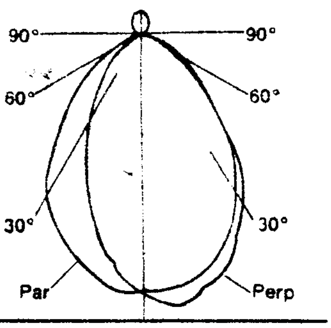
scon Pendant Fixture
o-lamp Specular Aluminum Reflector,
K-12 Lens—TOPA

VT-4b

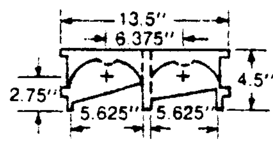
Photometric Data

Tascon is available with three lens options. The photometrics shown here are representative of the two-lamp K-12 option. Individual photometric data will be provided upon request.

ght Output



Zone	% Bare Lamp
0-30	21.82
0-40	32.55
0-60	45.15
0-90	48.61
90-180	7.94
0-180	56.55



ootlamberts

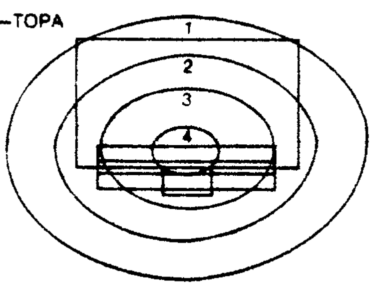
ngle	Maximum Par.	Perp	Average Par.	Perp
5	1581	2290	910	937
5	924	1124	596	518
5	644	614	472	320
5	657	294	411	190
5	549	124	267	14

amps: Two F40T12/CW each rated 3200 lumens

oefficients of Utilization
oor Cavity Reflectance—0.20
eiling Cavity Reflectance—0.80

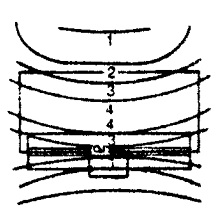
all Reflectance / oom Cavity Ratio	50	30	10
	.59	.58	.56
	.54	.51	.49
	.49	.45	.43
	.44	.41	.38
	.40	.36	.33
	.37	.33	.30
	.34	.30	.27
	.31	.27	.24
	.28	.24	.21
0	.26	.22	.19

inimum Classical Footcandles*
scon Fixture
. K-12 Lens—TOPA



1 = 30
2 = 50
3 = 70
4 = 90

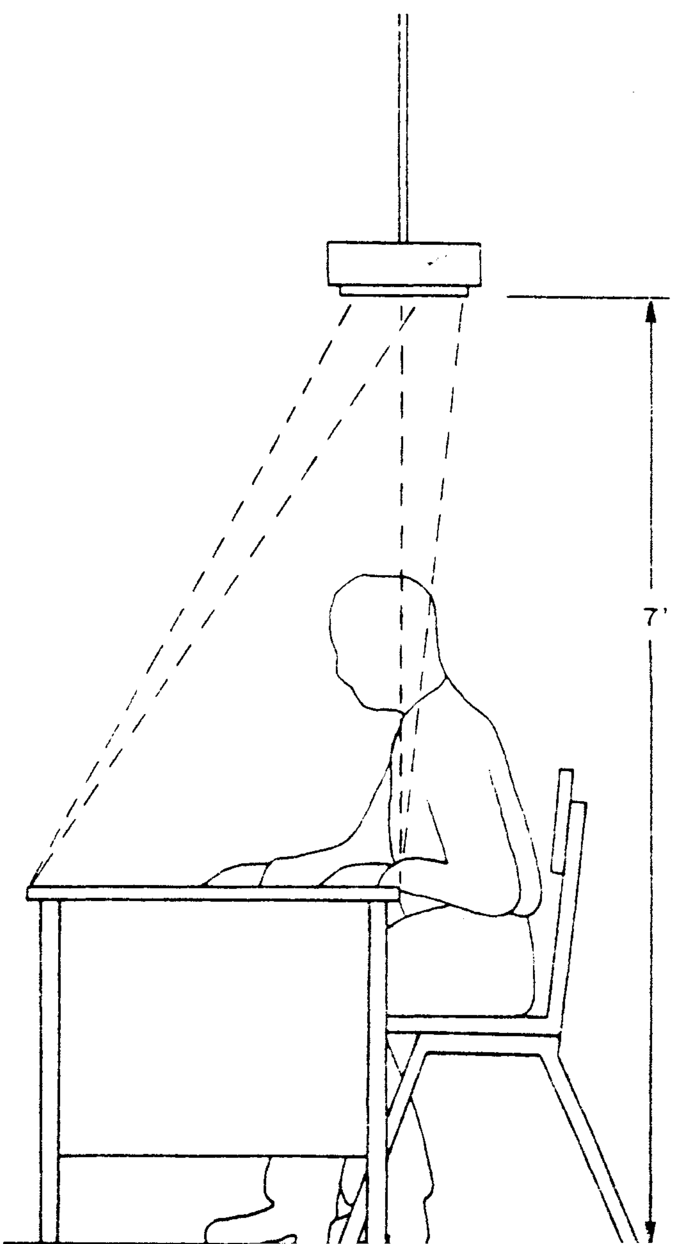
inimum Equivalent Sphere Illumination (ESI) otcandles*
scon Fixture
. K-12 Lens—TOPA



1 = 10
2 = 20
3 = 30
4 = 40

ontributions of single fixture measured at 9' ceiling height—7' fixture eight—reflectance 80/0/0. Footcandle level will increase with multiple fix-ires depending on numbers, spacing, and surface reflectances.

Tascon is designed to be positioned approximately 7' from the floor. The fixture should be placed so that light falls on the back and over the worker and work surface as shown in the sketch.



‹ORLITE has earned a reputation for reliable performance n a wide variety of applications throughout the world.

›P—OVERALL PRODUCT. IN PLACE

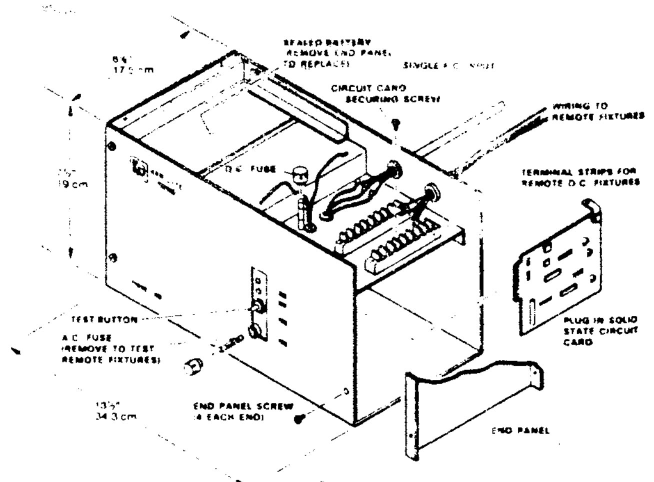
‹OR-LITE's exclusive supervisor-charger design charges one entral battery only when needed and eliminates trickle harging, outgassing, and heat dissipation which shorten attery life.

The KOR-LITE System is completely automatic, providing nstant power to the fluorescent fixtures in the event of a ower failure or brown-out. When power is restored, fixtures re turned off, and electronic control places the battery on harge. When the battery is fully charged, the proprietary lectronic sensor terminates the charge to prevent damage. f for any reason battery charge drops as much as 10%, the lectronic supervisor-charger automatically initiates and controls the proper amount of charge.

All KOR-LITE fixtures are fed with low voltage DC power in mergency mode.

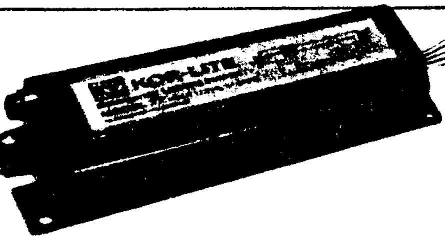
Model 77 Retrofit Inverter operates one T-12 fluorescent amp of up to 40 Watts, selected virtually in any standard fixure. The inverter does not affect lamp operation during normal ‹C power.

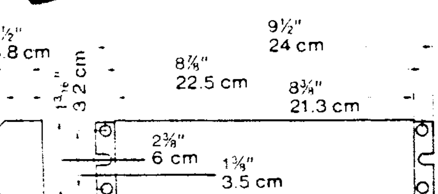
The Model 75 Exit Light with separate AC input provides always on" safety to identify exits. Meets downlight equirements.



MODEL 88-POWER UNIT

Includes: 12 Volt. 30 Ampere-Hour, sealed lead acid battery, supervisor-charger and controls.
Input: 115 VAC, 60 Hz, 30 Watt Max. (230 VAC or 277 VAC, 50/60 Hz available at no extra charge)
Output: 12 VDC, 9.6 Amp max. Finish: Gray enamel
Weight: 38 lbs (16.34 kg) Full charge in less than 24 hours.
Ninety (90) min. minimum emergency power under full load conditions.

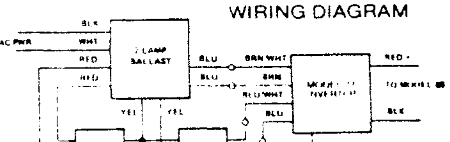


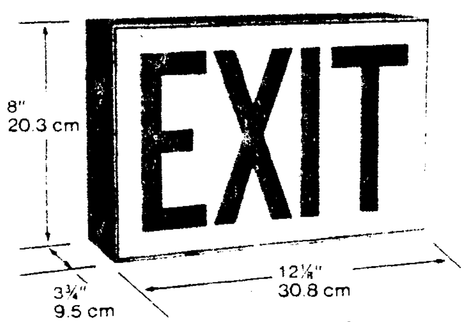


‹ODEL 77 EMERGENCY LIGHT RETROFIT INVERTER

nput power: 12 VDC. 1.4 Amp from KOR-LITE Model 88 Power Unit/Battery. No AC Input.
Operates any T-12 Fluorescent lamp up to 40 Watt.
Up to six (6) Inverters can be operated from one Model 88 Power Unit/Battery.
Mounts in fixture in line with standard ballast as retrofit installation.
naudible high frequency operation.
Weight: 18 oz. (0.51 kg)
Wiring diagram for other ballast arrangements available (see Technical Support section).
Does not require source of unswitched AC.
Also supplied for fixture factory mounting.

WIRING DIAGRAM



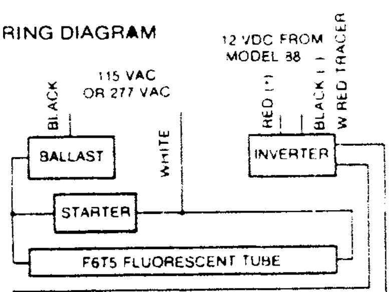


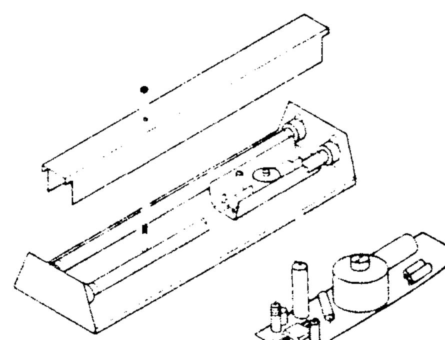
MODEL 75-EXIT LIGHT

Matte Oyster Finish, Single or Double Face, Red or Green Illuminated Letters.

Includes two 6 Watt (F6T5) fluorescent tubes plus inverter circuit and ballast with separate AC input.
Mounting canopy and other hardware for universal mounting and provision for arrows are also included.
Input for normally-on lamp: 115 VAC. 60 Hz 0.16 Amp (230 VAC, 50 Hz or 277 VAC, 60 Hz available at no extra charge)
Input for emergency-on lamp: 12 VDC, 0.4 Amp
Weight: 7.1 lbs (3.22 kg)

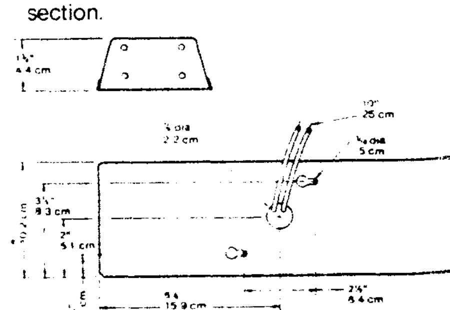
WIRING DIAGRAM





MODEL 70-TWIN LAMP FLUORESCENT FIXTURE

Includes two 8 Watt (F8T5) fluorescent lamps and inverter circuit.
Each lamp operates independently and complies with the two lamp requirement of 1978 National Electric Code-700-14.
Input power: 12 VDC, 0.6 Amp
Weight: 20 Ounces (0.57 kg)
Finish: Brushed Aluminum
Diffusion Screen: Clear Acrylic
Operates down to −100F (−73.3C) ambient temperature. See Technical Supp... section.



VI - 8a

HUNT ELECTRONICS
1101 Summit Avenue
Plano, Texas 75074
(214) 422-1112
Telex 730995

AF-1527 (U.L. Listed)

veloped by Hunt Electronics, der patent number 3,484,623, -1527 dimmers represent an vanced design in solid state ntrol for fluorescent lighting. corporating a Silicon Gated itch, these dimmers provide ooth control of the complete nming range, and stable low ensity operation. The circuit lizes line voltage regulation ough a Symmetrical AC Regulator, h a field-adjustable nming range. Thoroughly tested its, the AF-1527 are recommended use with Universal dimming lasts. Universal 679-L-TC-P and iversal 676-A-TC-P—227 Volt.

CEPLATES

decorative black snap-in nel is shipped with the dimmer; wever, any standard decorative ll plate may be attached in place of e panel supplied. Use ⅞" long 6-32 screws to attach a ndard-type wall plate.

PE OF LAMPS

approved ballasts specified are designed exclusively for use with rapid-start, 40-watt fluorescent lamps. It is suggested that only one brand and one color of lamp be utilized throughout each dimming application, since fluorescent lamps of different colors may have slightly varying dimming characteristics. Using the same color of lamp in any given installation also assures smooth dimming performance, as well as equal light distribution throughout the dimming range.

LAMP HOLDERS AND FIXTURES

Most fluorescent lamp fixtures available today will perform satisfactorily in dimming applications. However, it is important that the contact resistance at the lamp holder pins be as low as possible. Firm contact between the lamp holder and the lamp pins will assure proper starting and will preclude early lamp failure or lamp aging which will result in poor performance at the low end of the dimming range. For this reason, high quality lamp fixtures and holders should be used. As an added assurance to proper starting, especially at low light levels, it is mandatory that the fixture be constructed to provide the necessary starting capacity or starting aid, which is a sheet of metal at least one inch wide placed within ½ inch of the lamp along its entire length. This metal must be grounded to assure proper starting and operation at low light levels. As stated earlier, most quality lamp fixtures meet this requirement. When installed in the fixture, the dimming ballast must be installed in such a way that there is good electrical contact between the case of the ballast and the frame of

connected to the neutral side of line source. All connections mad the ballast and to the dimmer mu be firm, tight connections. It is suggested that the leads be sold or secured with crimp-type connectors wherever possible. A poor connection to the dimmer o the ballast will most certainly res early lamp failure or improper dimming and starting.

INSTALLATION

Be careful to install and wire the dimmer according to directions the back page. Use only recommended dimming ballasts rapid-start 40-watt lamps *(See page 1.)*

GANGING: *(Illustrated on page*

The AF-1527 may be ganged in combination. The aluminum hea sinks are designed with breakof points to accommodate such ganging.

To Gang Two Dimmers

Break off the left side set of fins one dimmer, and the right side s fins of the other. Gang as indica in Fig. 3, using snap-in panels shipped with dimmers or standa two-gang switch wall plate.

To Gang Three Dimmers

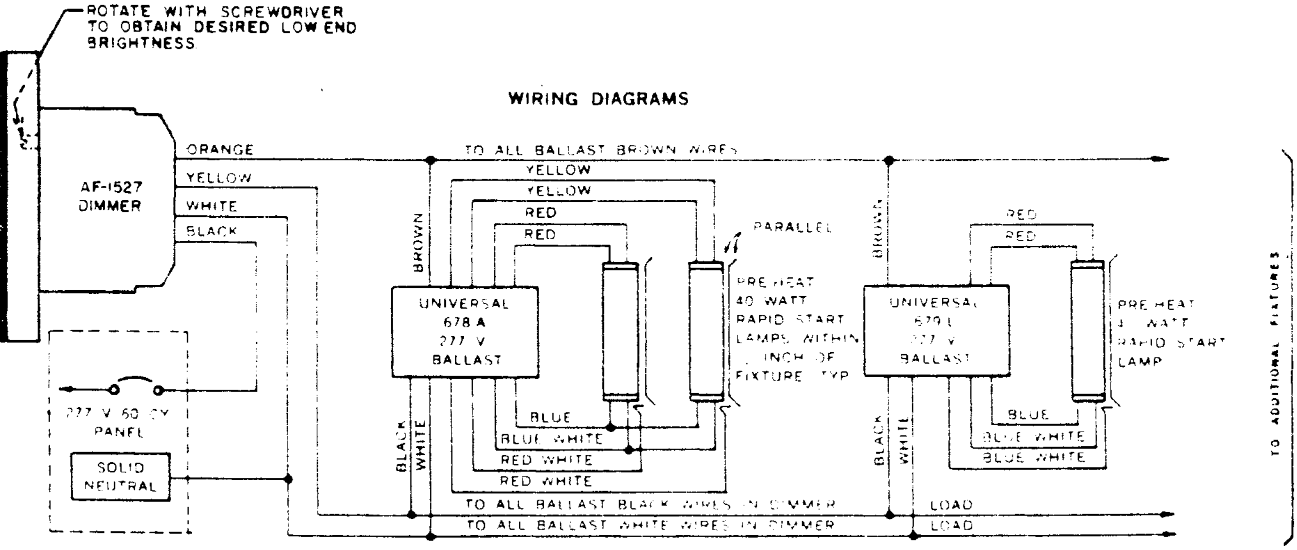
Break off the fins on both sides the center dimmer, the right side of fins of the second dimmer, an left side set of fins of the third dimmer. Gang as shown in Fig. using snap-in panels provided o three gang switch plates. If desi blank plates may be purchased

VT-8b

LOAD TABLE
AF-1527

Ballast Mtg Type	Max No of lamps Mounted singly	Max No of lamps One fin removed	Max No of lamps Both fins removed
iversal 679-L	30	26	22
iversal 678-A	30	26	22

TE: A MAXIMUM OF THIRTY (30) LAMPS MAY BE CONTROLLED WITH AN AF-1527



RATING

AF-1527 must be derated when ged. *For specific ganging rmation see Table above.* The ximum number of lamps that can controlled under both single and ging conditions is shown in Load ble.

PE OF BALLAST

y ballasts approved for use with Hunt fluorescent dimmer should nstalled (see load table). Ballast es should not be intermixed on dimming system, since rmixing may cause improper ration.

SPECIFIC DATA

The effects of the electromagnetic radiation from all solid state dimmers on radios and intercom units can be minimized by observance of certain precautions in wiring. The dimmer should be installed as far as possible from radio receivers, intercom amplifiers, or public address systems. A minimum distance of six feet is recommended. The wires to the lamp lead and to the line should be routed as far as practicable from intercom speaker leads and antennas.

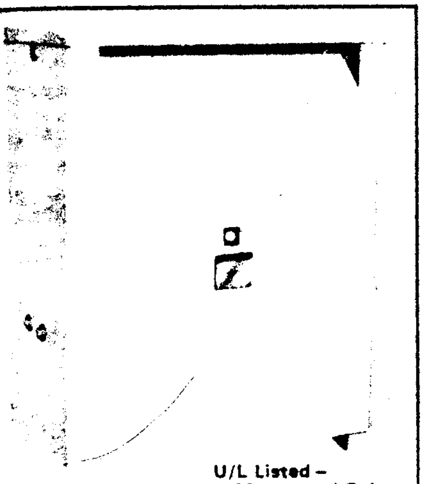
Improper dimming will result unless all connections to the dimmer and the fixtures are tightly in place. Check all fixtures, connections to ballasts and dimmer, and secure preferably with crimp-type wire nu All fixtures must be grounded. Separate neutral is needed for ea phase run.

IMPORTANT: The aluminum chas of these dimmers is designed as a heat sink to remove heat from the dimmer components. The fins will normally run quite warm to the to when operated at full bright. **This normal operation heat and does indicate malfunction in the dim**

Dry Type Distribution Transformers

5 Kv and Below, Single Phase
5 Kv and Below, Three Phase
30 through 1500 Kva (Ventilated)
30 Kva and Below (Encapsulated)

ypes DS-3 and DT-3



U/L Listed – 1000 Kva and Below 600 Volt Class

dvantages and Application

ry type distribution transformers are eally suited for indoor application and fer many advantages over liquid-filled ansformers. They may be installed in actically any indoor location not subject submersion or to a high concentration of estructive fumes.

ir insulated and cooled by natural con- ection of air, they are safe and cannot xplode, no toxic gases can be released, nd fire hazards are negligible. Elimination these principal liquid filled transformer otential hazards makes them especially esirable for installation in hospitals, oteis, theaters, schools, factories, and ther working areas where large groups of eople are present.

here space limitations and insurance egulations prohibit the use of liquid-filled ansformers, the dry type transformer is e answer.

omplete application details may be ound in TD 46-72

izes and Ratings

eneral Purpose, ventilated, dry-type ansformers are supplied in the following atings:

Single Phase: Type DS-3 37½—500 Kva ,000 Volts and Below
Three Phase: Type DT-3 30—1500 Kva ,000 Volts and Below

Additional Reference Information for Pages 125-127
Description: DB 46-751
Technical Data: TD 46-770
Wiring Diagrams: TCS 46-770
Application Data: AD 46-760

Dimensions and Weights

Single Phase
Type DS-3 (5 Kv and Below)

Kva	Approximate Dimensions: (Inches) Height	Width	Depth	Net Weight (Lbs.)
HV: 240 x 480-600 LV: 120/240				
37½①	28	16	19	[illegible]
50①	37	17	22	[illegible]
75①	42	21	24	500
100①	42	21	24	610
167①	63	30	34	1100
250	63	30	34	1350
333	75	37	43	2350
500	75	37	43	2950
HV: 2400/4160Y – 4160-4800 LV: 120/240 – 240/480				
37½	28	16	19	300
50	37	17	22	400
75	42	21	24	560
100	42	21	24	700
167	63	30	34	1200
250	63	30	34	1500
333	75	37	43	2350
500	75	37	43	2950

① U/L Listed.

Three Phase
Type DT-3 (5 Kv and Below)

Kva	Approximate Dimensions: (Inches) Height	Width	Depth	Net Weight (Lbs.)
HV: 240Δ – 480Δ – 600Δ LV: 208Y/120 – 240Δ – 480Y/277				
30①	30	24	16	450
37①	30	24	16	500
45①	30	24	16	500
50①	39	28	20	650
75①	39	28	20	650
112①	39	28	20	850
150①	45	32	23	950
225①	50	35	27	1250
300①	50	35	27	1500
500①	75	44	36	2085
750①	75	44	36	3100
1000①	90	53	36	4800
1500	90	57	43	6000
HV: 2400Δ – 4160Δ – 4800Δ LV: 208Y/120 – 240Δ – 480Δ – 480Y/277				
45	39	28	20	600
75	39	28	20	800
112½	45	32	23	950
150	50	35	27	1250
225	50	35	27	1500
300	50	35	27	1750
500	75	44	36	2640
750	75	44	36	3475
1000	90	53	36	4800
1500	90	57	43	6000

Typical Specification (DS-3, DT-3)

Ventilated dry type transformers shall be designed in full accordance with the latest revisions of (a) ANSI C89.2 (NEMA ST-20) for all KVA ratings 600-volts and below, and up through 500 KVA above 600 volts; (b) NEMA TR-27 for ratings above 500 KVA and 600 volts.

Transformers shall be designed for continuous operation at rated KVA, 24 hours a day, 365 days a year, with normal life expectancy as defined in IEEE #65. This performance shall be obtainable without exceeding 150 degree C. average temperature rise by resistance or 180 degree C. hot spot temperature rise in a 40 degree C. maximum ambient and 30 degree C. average ambient. The maximum coil hot spot temperature shall not exceed 220 degree C.

Transformers shall have proven 220 degree C. insulation systems. The coils shall be wound with aluminum or copper which shall be insulated with proven, high temperature resistant, 220 degree C. materials.

All materials used in the transformer shall be flame retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

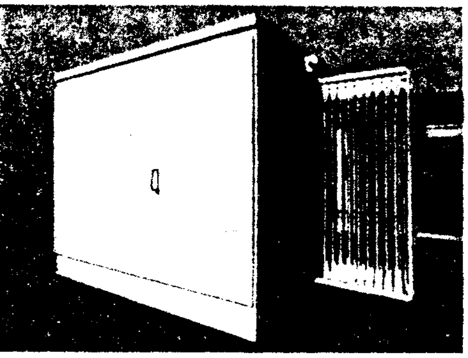
Final insulation treatment shall be total immersion in a insulating varnish which will maintain superior bond strength, high dielectric strength, and outstanding power factors at temperatures associated with the 220 degree C. system. After immersion the varnish shall be cured at normal operating temperatures for such a period of time as to assure complete curing of the varnish and scourging of all volatiles in the varnish solvent.

Transformers shall be constructed with core materials of a high quality, low loss nature so as to minimize exciting current, no-load losses, and interlaminar vibrations. Design shall incorporate built in vibration dampening systems to minimize and isolate sound transmission. Sound levels shall be in accordance with the applicable NEMA-ANSI standards according to KVA rating. Sound level tests shall be conducted in a laboratory with anechoic characteristics where ambient sound level does not exceed 24 db, to provide a true basis for measurement.

The core-coil assembly shall be designed and mechanically braced to withstand short circuit tests as defined in NEMA TR 27 by the use of full scale testing. The coil

Section VI

A-Line Three Phase POW-R-PAD



Introduction

The Three Phase POW-R-PAD transformer is offered as two distinct product lines especially designed for construction and general industrial uses:

The A-Line consists of those units which are pre-engineered designs such that manufacturing information is readily available. This is achieved by limiting the number of voltages, features, options and accessories to combinations which fall into a "ready-to-manufacture" design matrix. The specific advantages of this program of specific designs for industry and construction include:

- Quick Shipment – 90 day normal lead time.
- Emergency Shipment usually available. (Check each situation with Westinghouse.)
- Instant Approval – Construction drawings from standard technical sheets available in Westinghouse field sales offices.
- Firm price quotations allow contractors to figure jobs quickly and accurately.
- Higher impedances limit secondary fault currents such that coordination with EHB breakers is usually possible. (Low impedances are also available if required for paralleling, etc.)
- Standard color is ASA 70 light grey rather than "telephone green". This better matches switchgear, busway, motor control centers, etc. (Green is available as an option to match other units, if required.)
- Field reliability is enhanced by complete production test sequence including a full BIL impulse test. This can be critical due to the severe implications to a shopping center, hospital or industry should the primary transformer fail.

The C-Line Three Phase POW-R-PAD differs from the A-Line only in that it expands on the A-Line by including those units requiring special engineering, multi-divisional coordination, bought outside items, or other special application considerations. The C-Line POW-R-PAD is covered elsewhere in this catalog although the general information given in this section also applies.

Application

The Westinghouse POW-R-PAD is an oil-filled, three phase, commercial padmounted distribution transformer specifically designed for servicing such underground distribution loads as shopping centers, schools, institutions and industrial plants. It is available in both live front and dead front construction, for radial or loop feed applications, with or without taps.

Ratings

- kVA: 75, 112½, 150, 225, 300, 500, 750, 1000, 1500
- High Voltages (Primary)

4160 GrdY/2400	2400Δ
8320 GrdY/4800	4160Δ
12470 GrdY/7200	4800Δ
13200 GrdY/7620	7200Δ
13800 GrdY/7970	8320Δ
	12000Δ
	12470Δ
	13200Δ
	13800Δ
	14400Δ

- HV Taps: 2-2½% above and below normal or 4-2½% below normal
- HV BIL: 2400 volts; 60 kV BIL; 4160, 4800 volts; 75 kV BIL; 7200 through 14400 volts; 95 kv BIL.
- Low Voltages (Secondary)
  All low voltages are rated 30 kV BIL (Not available on 1500 kVA).
  480 Y/277
  480Δ (Not available on 1500 kVA).
  208 Y/120(Not available on 1500 kVA).
  240Δ (Not available on 1500 kVA).
  240Δ/120 lighting tap (Not available on 750 and 1000 kVA).

Typical Design Impedances in %

	4160 Delta		12,000 Delta		12,470 Delta		13,200 Delta		13,800 Delta	
kVA	208Y	480Y	208Y	480Y	208Y	480Y	208Y	480Y	208Y	480Y
75	3.5	3.5	4.0	3.6	4.4	4.1	4.4	3.6	4.0	4.2
112	3.2	3.5	3.4	3.7	3.9	4.0	3.4	4.2	3.5	4.2
150	2.7	2.9	3.0	3.1	2.9	3.6	3.0	3.5	3.3	3.5
225	2.8	3.0	3.2	3.3	3.6	3.8	3.4	3.7	3.5	3.8
300	3.1	3.1	3.2	3.3	3.7	3.7	3.8	3.7	3.6	3.6
500	3.7	4.3	3.9	4.4	4.4	4.1	4.3	4.7	4.3	4.6
	4160Y/2400		8320Y/4800		12,470Y/7200		13,800Y/7970		13,200Y/7620	
kVA	208Y	480Y	208Y	480Y	208Y	480Y	208Y	480Y	208Y	480Y
75	3.3	3.2	3.6	3.3	3.6	3.3	3.4	3.5	3.4	3.4
112	3.0	3.3	3.0	3.3	3.1	3.4	3.0	3.5	3.1	3.4
150	2.6	2.6	2.6	2.8	2.7	2.8	2.7	2.8	2.8	2.8
225	2.7	2.9	2.7	3.0	2.8	3.0	2.9	2.9	2.9	3.0
300	2.7	2.9	3.0	3.1	2.9	3.0	3.0	3.5	3.0	3.0
500	3.5	3.7	3.6	3.7	3.8	4.0	3.7	3.9	3.6	4.4

750 kVA—5.75%
1000 kVA—5.75%
1500 kVA—5.75%

Optional low impedance units range from 1.5 to 2.0% for the 75 through 500 kVA ratings. Only ANSI standard 5.75% is available on the 750 through 1500 kVA.

APPENDIX A - SPACE NAME AND FLOOR AREA

I.D.#	SPACE	FLOOR AREA
ANNEX BUILDING		
100A	Lobby	2123
123	Lecture hall	2831
124	Lecture hall	1727
125	Class room	893
126	Class room	884
MAIN BUILDING 1st. FLOOR		
100B	Corridor	2263
100C	Janitor's closet	97
100D	Electrical room	225
100E	Mechanical room	577
100F	Toilet(Men)	217
100G	Toilet(Women)	217
101A	Reception	150
101B	Hall	108
101C	Work room	100
101D	Storage	45
101E	Mail room	105
101F	Conference room	223
101G	Dept. head room	227
101H	Office	110
101I	Office	110
101J	Book keeper	218
102	Conference	536
103	Work room	203
104A	Reception	150
104B	Hall	179
104C	Office	110
104D	Office	110
104E	Office	110
104F	Office	110
104G	Office	110
105	Seminar	215
106	Office(S)	104
107	Office(S)	104
108	Office(S)	104
109A	Reception	150
109B	Hall	179
109C	Storage	46
109D	Office	110
109E	Office	110
109F	Office	110
109G	Office	110
109H	Office	110
110	Office(S)	104
111	Office(S)	104
112	Office(S)	104
113	Office(S)	104
114A	Reception	150
114B	Hall	165
114C	Storage	46

I.D.#	SPACE	FLOOR AREA
114D	Office	110
114E	Office	110
114F	Office	110
114G	Office	110
114H	Office	110
115	Office(S)	104
116	Physiology lab.	1088
117	Physiology lab.	991
118	Physiology lab.	605
119	Muscle biology lab.	958
120	Food microbiology lab.	605
121	Food microbiology lab.	598
122	Food microbiology lab	586
MAIN BUILDING 2nd FLOOR		
200A	Corridor	2290
200B	Janitor's closet	30
200C	Toilet(Women)	108
200D	Toilet(Men)	172
200E	Mech room	770
201A	Recept	150
201B	Recept	150
201C	Hall	303
201D	Secretary	103
201E	Office	103
201F	Office	110
201G	Office	110
201H	Office	110
201J	Office	110
201K	Office	110
201L	Office	110
201M	Office	110
201N	Office	110
201O	Office	110
201Q	Office	110
201R	Office	103
202	Office(S)	103
203	Office(S)	103
204A	Computer	300
204B	Data process	224
205	Office(S)	104
206A	Recept	150
206B	Hall	139
206C	Storage	45
206D	Office	104
206E	Office	110
206F	Office	110
206G	Office	110
207	Conference	160
208A	Recept.	150
208B	Hall	179
208C	Office	110

I.D.#	SPACE	FLOOR AREA
208D	Office	110
208E	Office	110
208F	Office	110
208G	Office	110
209	Office(S)	104
210	Office(S)	104
211	Office(S)	104
212A	Recept.	150
212B	Hall	165
212C	Storage	46
212D	Office	110
212E	Office	110
212F	Office	110
212G	Office	110
212H	Office	95
213A	Nutrition lab	627
213B	Lab office	135
214	Non-ruminant lab	900
215	Ruminant lab	620
216A	Feed analysis lab	318
216B	Kjendahl	276
216C	Solvent extraction	227
216D	Grind	49
217	Ruminant lab	887
218A	Ruminant lab	554
218B	Balance room	80
219	Ruminant lab	631
220	Extension storage	240
221	Dark room	132

APPENDIX B - COOLING/ HEATING LOAD CALCULATION

```
$JUB                ,TIME=(0,40)
      DIMENSION CLTDR(4,4),CLTDW(32,4),CLTDG(4),LM(9),ALT(4),AZI(4)
      DIMENSION SHGF(5,12),CLFL(4),CLFP(4),CLFG(20,4),FLOOR(10,2)
      DIMENSION GLAS(10,5),WALL(10,3),RCOF(10,3),SKY(10,4),SHAD(10,5)
      DIMENSION A(8),RM(18,5),BLDG(22,5)
      DIMENSION NAME(72),DESCR(70)
      DIMENSION TDCL(4),TRAT(4)
      INTEGER DESCR
      REAL LM,INFILT
      DATA CLTDR /27.,17.,13.,23.,52.,17.,30.,21.,70.,21.,48.,22.,74.,
     1 28.,60.,25./
      DATA CLTDW /11.,15.,18.,18.,15.,19.,21.,16.,9.,13.,15.,14.,11.,
     1 15.,17.,13.,6.,20.,26.,19.,5.,6. ,6.,5.,12.,35.,55.,49.,22.,12.,
     1 11.,11.,                              10.,15.,19.,18.,14.,18.,
     2 19.,15.,8.,15.,19.,16.,11.,14.,15.,12.,9.,25.,36.,31.,13.,9.,9.,
     * 8.,18.,26.,40.,48.,39.,26.,19.,18..
     *    10.,16.,21.,19.,14.,17.,18.,14.,9.,17.,22.,20.,12.,13.,14.,
     4 11.,13.,26.,37.,37.,24.,18.,14.,13.,23.,27.,31.,36.,46.,50.,41.,
     4 27.,                            10.,18.,23.,21.,15.,17.,18.,
     5 14.,10.,19.,25.,23.,15.,15.,15.,12.,17.,26.,34.,36.,32.,32.,27.,
     * 20.,24.,26.,29.,30.,37.,63.,67.,47./
      DATA CLTDG /4.,9.,13.,14./
      DATA LM /.5,.5,0.,-.5,-1.,-.5,0., .5,1./
      DATA ALT /59.4,74.6,59.4,35.8/
      DATA AZI /112.,180.,248.,270.7/
      DATA SHGF /22.,166.,252.,166.,155.,26.,195.,232.,195.,199.,30.,
     1 223.,192.,223.,238.,35.,225.,135.,225.,262.,33.,220.,93.,220.,
     2 272.,47.,215.,77.,215.,273.,39.,216.,90.,216.,268.,36.,218.,131.,
     3 218.,257.,31.,210.,187.,210.,230.,27.,187.,225.,187.,195.,22.,
     4 163.,248.,163.,154.,20.,151.,254.,151.,136./
      DATA CLFL /.72,.77,.82,.85/
      DATA CLFP /.61,.72,.80,.84/
      DATA CLFG /.80,.62,.58,.15,.72,.63,.57,.34,.11,.48,.59,.51,.31,.12
     1,.43,.60,.49,.33,.14,.45,.89,.27,.83,.17,.85,.76,.42,.59,.14,.66,
     2 .70,.39,.52,.14,.55,.69,.36,.51,.16,.59,.86,.22,.68,.53,.81,.82
     3 ,.32,.65,.32,.74,.75,.31,.58,.29,.67,.72,.29,.55,.30,.64,.75,.17,
     4 .35,.82,.58,.79,.25,.50,.57,.67,.74,.26,.47,.50,.62,.70,.24,.43,
     5 .49,.58/
      DATA TRAT /.56,.23,.03,.03/
      DATA IN,LP /5,6/
      DO 1001 J=1,4
 1001 PRINT,'CLTDR',J,(CLTDR(J,K),K=1,4)
      DO 1002 J=1,32
 1002 PRINT,'CLTDW',J,(CLTDW(J,K),K=1,4)
      PRINT,'CLTDG',(CLTDG(K),K=1,4)
      PRINT,'LM',(LM(K),K=1,9)
      PRINT,'ALT',(ALT(K),K=1,4)
      PRINT,'AZI',(AZI(K),K=1,4)
      DO 1003 J=1,5
 1003 PRINT,'SHGF',J,(SHGF(J,K),K=1,12)
      PRINT,'CLFL',(CLFL(K),K=1,4)
      PRINT,'CLFP',(CLFP(K),K=1,4)
      DO 1004 J=1,20
 1004 PRINT,'CLFG',J,(CLFG(J,K),K=1,4)
      READ(IN,5001) NAME
      READ(IN,    *) LINE,MOC,MOH,SLAT,SLONG,ELEV
      READ(IN,    *) LINE,TIN,TOUT,TRAN,HUMO,HUMI,CAIR,CWT,CWRT
      READ(IN,    *) LINE,THIN,THOUT,THRAN,WHUMO,WHUMI,HAIR,HWT,HWRT
      TOA=TOUT - TRAN/2
      DO 1005 K=1,4
```

```
 1005 TDCL(K)=(TOUT-TIN) - TRAN*TRAT(K)
      TDHT=THOUT - THIN
      HD=HUMO - HUMI
      WTDS=CWT-CWRT
      WTDW=HWT-HWRT
    7 DO 8 J=1,5
    8 A(J)=0.
      READ(IN,    *) LINE,(A(J),J=1,5)
      LEAD=LINE/10
      GO TO (10,20,30,40,50,60,70),LEAD
   10 NO=LINE - 10
      DO 11 K=1,3
   11 ROOF(NO,K)=A(K)
      PRINT,'ROOF', NO, (ROOF(NO,K),K=1,3)
      GO TO 7
   20 NO=LINE-20
      DO 21 K=1,4
   21 SKY(NO,K)=A(K)
      PRINT,'SKY ', NO, ( SKY(NO,K),K=1,4)
      GO TO 7
   30 NO=LINE - 30
      DO 31 K=1,3
   31 WALL(NO,K)=A(K)
      PRINT,'WALL', NO, (WALL(NO,K),K=1,3)
      GO TO 7
   40 NO=LINE - 40
      DO 41 K=1,5
   41 GLAS(NO,K)=A(K)
      PRINT,'GLAS', NO, (GLAS(NO,K),K=1,5)
      GO TO 7
   50 NO=LINE - 50
      DO 51 K=1,5
   51 SHAD(NO,K)=A(K)
      PRINT,'SHAD', NO, (SHAD(NO,K),K=1,5)
      GO TO 7
   60 NO=LINE - 60
      DO 61 K=1,2
   61 FLOOR(NO,K)=A(K)
      PRINT,'FLOOR',NO,(FLOOR(NO,K),K=1,2)
   70 CONTINUE
      WRITE(LP,6001)
      WRITE(LP,6026) NAME,NAME,NAME
      WRITE(LP,6027) SLAT,SLONG,ELEV
      WRITE(LP,6028)MOH,MOC,THIN,TIN,THOUT,TOUT,THRAN,TRAN,WHUMO,HUMO,
     +WHUMI,HUMI,HAIR,CAIR,HWT,CWT,HWRT,CWRT
      TAREA=0.
      TVOL=0.
      BVENT=0.
      BINFIL=0.
      BEXHAU=0.
      BCFMS=0.
      BCFMW=0.
      DO 86 K=1,5
         DO 85 J=1,22
   85    BLDG(J,K)=0.
   86 CONTINUE
   90 READ(IN,5002) NPAGE,DESCR
      IF(NPAGE .EQ. 999900) GO TO 700
      READ(IN,    *) I,RLEN,RWID,AREA,RHEI,NSYS,NSPACE
      DO 94 K=1,5
```

```
      DO 93 J=1,18
   93 RM(J,K)=0.
   94 CONTINUE
   95 DO 96 J=1,8
   96 A(J)=0.
      READ(IN,    *) I,(A(J),J=1,8)
      LEAD=(I-NPAGE)/10
      GO TO (100,200,300,400,500),LEAD
  100 CONTINUE
C     ROOF/CEILING
      NRF=IFIX(A(1))
      DCE=A(3)
      UCE=A(4)
      ACE=A(5)
      CVENT=A(6)
      NSK=IFIX(A(7))
      NUMSK=IFIX(A(8))
      ASK=0.
      IF(NSK .EQ. 0) GO TO 140
      ASK=SKY(NSK,1)*NUMSK
      USK=SKY(NSK,2)
      L=IFIX(SKY(NSK,4))*5+5
      DO130 K=1,4
      RM(2,K)=RM(2,K) + SKY(NSK,3)*CLFG(L,K)*SHGF(5,MOC)*ASK
      RM(3,K)=RM(3,K) + CLTDG(K)*USK*ASK
  130 CONTINUE
      RM(3,5)=RM(3,5) + USK*ASK*TDHT
  140 CONTINUE
      IC=1
      IF(UCE .NE. 0.) IC=2
      ARF=A(2)-ASK
      IF(NRF.EQ.0) GO TO 193
      MRF=IFIX(ROOF(NRF,1))*IC
      COLOR=ROOF(NRF,2)
      URF=ROOF(NRF,3)
      NORNT=9
      XLM=LM(NORNT)
      DO 190 K=1,5
      IF(K.EQ. 5) GO TO 145
      XTD=CLTDR(MRF,K)
      YTD=(XTD + XLM)*COLOR + TOA - TIN- 7.
  145 IF(K .EQ. 5) YTD=TDHT
      RFCL=URF*ARF*YTD
      IF(UCE    .EQ. 0.) GO TO 150
      RM(17,K)=RM(17,K) + RFCL
      RM(18,K)=RM(18,K) + ARF*URF  + ACE*UCE  + ACE*CVENT*1.1
      GO TO 190
  150 RM(1,K)=RM(1,K) + RFCL
  190 CONTINUE
      GO TO 199
  193 IF(UCE.EQ.0.) GO TO 199
      DO 195 K=1,5
  195 RM(18,K)=RM(18,K) + ACE*UCE  + ACE*CVENT*1.1
  199 GO TO 95
  200 CONTINUE
C     WALL/WINDOW
      NWL=IFIX(A(1))
      XWL=A(2)
      HWL=A(3) - DCE
      NORNT=1+IFIX(A(4)/45.)
```

```
      NGL=IFIX(A(5))
      NUMG=IFIX(A(6))
      NSH=IFIX(A(7))
      LS=NORNT/2 + 1
      SHADRT=0.
      AGL=0.
      IF(NGL .EQ. 0) GO TO 280
      LG=5*IFIX(GLAS(NGL,5))+LS
      AGL=GLAS(NGL,1)*GLAS(NGL,2)*NUMG
      UGL=GLAS(NGL,3)
      GSC=GLAS(NGL,4)
      IF(NSH .EQ. 0) GO TO 240
      HSPACE=SHAD(NSH,2)
      VSPACE=SHAD(NSH,4)
      IF(HSPACE.EQ. 0.) HSPACE=GLAS(NGL,1)
      IF(VSPACE.EQ. 0.) VSPACE=GLAS(NGL,2)
  240 DO 270 K=1,4
      ALTI=ALT(K)
      ALPH=A(4) - AZI(K)
      IF(ALPH .GE. 90.) GO TO 250
      IF(ALPH .LE.-90.) GO TO 250
      IF(NSH .EQ. 0) GO TO 260
      ALPH=SQRT(ALPH*ALPH)
      ALTI=ALTI*3.141593/180.
      ALPH=ALPH*3.141593/180.
      HSHDH=(SHAD(NSH,1)+ SHAD(NSH,3))*SIN(ALTI)/COS(ALTI)
      IF(HSHDH .GT. HSPACE) HSHDH=HSPACE
      HSHRT=HSHDH/HSPACE
      VSHDW=(SHAD(NSH,1) + SHAD(NSH,5))*SIN(ALPH)/COS(ALPH)
      IF(VSHDW .GT. VSPACE) VSHDW=VSPACE
      VSHRT=VSHDW/VSPACE
      SHADRT=HSHRT + VSHRT - HSHRT*VSHRT
      GO TO 260
  250 CONTINUE
      SHADRT=1.
  260 CONTINUE
      SOLSHD=AGL*SHADRT*SHGF(1,MOC)
      SOLSUN=AGL*(1.-SHADRT)*SHGF(LS,MOC)
      GSCL=GSC*CLFG(LG,K)*(SOLSHD+SOLSUN)
      RM(5,K)=RM(5,K) + GSCL
      GTD=CLTDG(K) + TOA - TIN- 7.
      GTCL=UGL*AGL*GTD
      RM(6,K)=RM(6,K)+GTCL
  270 CONTINUE
      RM(6,5)=RM(6,5) + UGL*AGL*TDHT
  280 IF(NWL .EQ. 0) GO TO 299
      AWL=HWL*XWL - AGL
      COLOR=WALL(NWL,2)
      UWL=WALL(NWL,3)
      LW=8*(IFIX(WALL(NWL,1))-1)+NORNT
      XLM=LM(NORNT)
      DO 290 K=1,5
      IF(K.EQ. 5) GO TO 285
      XTD=CLTDW(LW,K)
      YTD=(XTD + XLM)*COLOR + TOA - TIN- 7.
  285 IF(K .EQ. 5) YTD=TDHT
      WLCL=AWL*UWL*YTD
      PWAU=DCE*XWL*UWL
      PWCL=PWAU*YTD
      RM(4,K)= RM(4,K)+WLCL
```

```
      RM(17,K)=RM(17,K)+PWCL
      RM(18,K)=RM(18,K)+PWAU
  290 CONTINUE
  299 GO TO 95
  300 CONTINUE
C     PARTITION/DOOR/FLOOR
      TDPT=A(6)-TIN
      DO 350 K=1,5
      IF(K.LT.5) TDDR=TDCL(K)
      IF(K.EQ.5) TDDR=TDHT
      IF(K.EQ.5) TDPT=A(5)-THIN
      RM(7,K)=RM(7,K)+A(1)*A(2)*TDDR
      RM(8,K)=RM(8,K)+A(3)*A(4)*TDPT
  350 CONTINUE
      NFL=IFIX(A(7))
      IF(NFL .EQ. 0) GO TO 395
      FLD=A(8)*FLOOR(NFL,1)
      IF(FLOOR(NFL,2) .EQ. 0) GO TO 380
      DO 370 K=1,4
  370 RM(9,K)=RM(9,K)+FLD*TDCL(K)
      RM(9,5)=RM(9,5)+FLD*TDHT
      GO TO 395
  380 RM(9,5)=RM(9,5)-FLD
  395 GO TC 95
  400 CONTINUE
C     EQUIPMENTS
      DO 490 K=1,4
      RM(12,K)=RM(12,K) + A(1)*A(3)*A(4)*A(5)
      RM(15,K)=RM(15,K) + A(2)
      RM(17,K)=RM(17,K) + A(1)*A(3)*A(4)*(1.-A(5))
  490 CONTINUE
      GO TO 95
  500 CONTINUE
C     PEOPLE/LIGHT/INFILT./VENT
      INFILT=A(7)
      VENT=A(6)*A(1)
      EXHAU=A(8)
      DO 590 K=1,5
      IF(K.EQ. 5) GO TO 540
      TDINFL=TDCL(K)
      RM(11,K)=RM(11,K) + A(1)*A(2)*CLFP(K)
      RM(15,K)=RM(15,K) + A(1)*A(3)
      RM(10,K)=RM(10,K) + 3.41*A(4)*AREA*CLFL(K)*A(5)
      RM(17,K)=RM(17,K) +3.41*A(4)*AREA*CLFL(K)*(1.-A(5))
  540 IF(K.EQ. 5) TDINFL=TDHT
      RM(13,K)=RM(13,K) + 1.1*A(7)*TDINFL
      RM(15,K)=RM(15,K) + 4840*A(7)*HD
      TDCE=0.
      IF(RM(18,K) .EQ. 0.) GO TO 550
      TDCE=RM(17,K)/RM(18,K)
  550 RM(1,K)=RM(1,K) + UCE*ACE*TDCE
      RM(17,K)=RM(17,K)-UCE*ACE*TDCE
  590 CONTINUE
C     ROOM SUMMARY
      SMAX=0.
      DO 650 K=1,5
        DO 640 J=1,13
          RM(14,K)=RM(14,K) + RM(J,K)
  640   CONTINUE
        RM(16,K)=RM(14,K) + RM(15,K)
```

```
      IF(K .EQ. 5) GO TO 650
      IF(RM(14,K) .LT. SMAX) GO TO 650
      SMAX=RM(14,K)
       ITIME=8 + 2*K
      PEAK=RM(16,K)
  650 CONTINUE
      BSFS=PEAK/AREA
      BSFW=RM(16,5)/AREA
      SHRS=SMAX/PEAK
      SHRW=1.
      SCFMS=SMAX/(1.1*(TIN-CAIR))
      SCFMW=RM(16,5)/(1.1*(THIN-HAIR))
      SGPMS=0.
      SGPMW=0.
      DO 690 K=1,5
        DO 680 J=1,17
          BLDG(J,K)=BLDG(J,K)+RM(J,K)*NSPACE
  680   CONTINUE
  690 CONTINUE
      ISPACE=NPAGE/100
      VOL=AREA*RHEI
      TAREA=TAREA + AREA*NSPACE
      TVOL=TVOL + VOL*NSPACE
      BVENT=BVENT+VENT*NSPACE
      BINFIL=BINFIL + INFILT*NSPACE
      BEXHAU=BEXHAU + EXHAU*NSPACE
      WRITE(LP,6021) NAME
      PRINT, ' '
      PRINT, ' '
      PRINT, ' '
      WRITE(LP,6024) ISPACE,NSPACE,AREA,VOL,NSYS
      WRITE(LP,6025) DESCR
      WRITE(LP,6023)
      WRITE(LP,6011)(RM(J,5),(RM(J,K),K=1,4),J=1,16)
      WRITE(LP,6013) ITIME
      WRITE(LP,6015) BSFW,BSFS,SHRW,SHRS,SCFMW,SCFMS,VENT,VENT,INFILT
     1,INFILT,EXHAU,EXHAU,SGPMW,SGPMS
      GO TO 90
C     BUILDING SUMMARY
  700 CONTINUE
      BPEAK=0.
      DO 790 K=1,5
      OAIR=BEXHAU-BINFIL
      IF(BEXHAU.LT. .33*BVENT) OAIR=.33*BVENT-BINFIL
      IF(K .EQ. 5) GO TO 785
      BLDG(18,K)=1.1*OAIR*TDCL(K)
      BLDG(19,K)=4840*OAIR*HD
      GO TO 788
  785 BLDG(18,5)=1.1* OAIR*TDHT
      BLDG(19,5)=0.
  788 CONTINUE
      BLDG(20,K)=BLDG(14,K) + BLDG(17,K) + BLDG(18,K)
      BLDG(21,K)=BLDG(15,K) + BLDG(19,K)
      BLDG(22,K)=BLDG(20,K) + BLDG(21,K)
      IF(K .EQ. 5) GO TO 790
      IF(BLDG(22,K) .LT. BPEAK) GO TO 790
      BPEAK=BLDG(22,K)
      BMAX=BLDG(14,K)
      ITIME=8 + 2*K
  790 CONTINUE
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```
      TONS=BPEAK/12000
      TONW=0.
      SFTS=TAREA/TONS
      SFTW=0.
      BSFS=BPEAK/TAREA
      BSFW=BLDG(22,5)/TAREA
      BCFMS=CMAX/(1.1*(TIN-CAIR))
      BCFMW=BLDG(14,5)/(1.1*(THIN-HAIR))
      CGPMS=0.
      CGPMW=0.
      RGPMS=0.
      RGPMW=0.
      TGPMS=0.
      TGPMW=0.
      WRITE(LP,6021) NAME
      WRITE(LP,6022) TAREA,TVOL
      WRITE(LP,6023)
      WRITE(LP,6011)(BLDG(J,5),(BLDG(J,K),<=1,4),J=1,16)
      WRITE(LP,6012)(BLDG(J,5),(BLDG(J,K),K=1,4),J=17,22)
      WRITE(LP,6013) ITIME
      WRITE(LP,6014) TONW,TONS,SFTW,SFTS,BSFW,BSFS,BCFMW,BCFMS,BINFIL
     1,BINFIL,BVENT,BVENT,BEXHAU,BEXHAU,SGPMW,SGPMS,CGPMW,CGPMS,RGPMW
     2,RGPMS,TGPMW,TGPMS
      WRITE(LP,6021) NAME
C     FORMAT
 5001 FORMAT(72A1)
 5002 FORMAT(I6,1X,70A1)
 6001 FORMAT(1H1)
 6011 FORMAT(10X,F11.0,4X,'ROOF / CEILING ',F12.0,3F13.0/
     +          10X,F11.0,4X,'SKYLIGHT-SOLAR ',F12.0,3F13.0/
     +          10X,F11.0,4X,'SKYLIGHT-TRANS ',F12.0,3F13.0/
     +          10X,F11.0,4X,'EXTERIOR WALLS ',F12.0,3F13.0/
     +          10X,F11.0,4X,'WINDOW - SOLAR ',F12.0,3F13.0/
     +          10X,F11.0,4X,'WINDOW - TRANS ',F12.0,3F13.0/
     +          10X,F11.0,4X,'EXTERIOR DOORS ',F12.0,3F13.0/
     +          10X,F11.0,4X,'PARTITION WALL ',F12.0,3F13.0/
     +          10X,F11.0,4X,'FLOOR/SLABEDGE ',F12.0,3F13.0/
     +          10X,F11.0,4X,'ELEC. LIGHTING ',F12.0,3F13.0/
     +          10X,F11.0,4X,'PEOPLE    - SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'EQUIPMENT- SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'INFILT.   - SEN ',F12.0,3F13.0/10X,84('-')/
     +          10X,F11.0,4X,'SPACE     - SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'SPACE     - LAT ',F12.0,3F13.0//
     +          10X,F11.0,4X,'SPACE   - TOTAL ',F12.0,3F13.0/10X,84('-'))
 6012 FORMAT(10X,F11.0,4X,'RETURN AIR-SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'OUT. AIR - SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'OUT. AIR - LAT ',F12.0,3F13.0/10X,84('-')/
     +          10X,F11.0,4X,'BUILDING - SEN ',F12.0,3F13.0/
     +          10X,F11.0,4X,'BUILDING - LAT ',F12.0,3F13.0//
     +          10X,F11.0,4X,'BUILDING TOTAL ',F12.0,3F13.0/10X,84('-'))
 6013 FORMAT(//17X,'ANY',8X,'PEAK TIME',10X,I2,':00'/10X,45('-'))
 6014 FORMAT(10X,F11.2,4X,' TOTAL - TONS   ',F12.2/
     +          10X,F11.2,4X,' SQ.FT. / TON   ',F12.2/
     +          10X,F11.2,4X,' BTUH / SQ.FT.  ',F12.2//
     +          10X,F11.2,4X,' BUILDING CFM   ',F12.2/
     +          10X,F11.2,4X,' INFILT.  CFM   ',F12.2/
     +          10X,F11.2,4X,' VENT     CFM   ',F12.2/
     +          10X,F11.2,4X,' EXHAUST  CFM   ',F12.2//
     +          10X,F11.2,4X,' SPACE    GPM   ',F12.2/
     +          10X,F11.2,4X,' CENTRAL  GPM   ',F12.2/
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     +              10X,F11.2,4X,' RM. UNIT GPM   ',F12.2/
     +              10X,F11.2,4X,' TOTAL    GPM   ',F12.2/)
 6015 FORMAT(10X,F11.2,4X,' BTUH /  SQ.FT.  ',F12.2//
     +              10X,F11.2,4X,' S / H   RATIO  ',F12.2//
     +              10X,F11.2,4X,' SPACE     CFM  ',F12.2//
     +              10X,F11.2,4X,' VENT      CFM  ',F12.2//
     +              10X,F11.2,4X,' INFILT.   CFM  ',F12.2//
     +              10X,F11.2,4X,' EXHAUST   CFM  ',F12.2//
     +              10X,F11.2,4X,' SPACE     GPM  ',F12.2//)
 6021 FORMAT( 1H1//10X,72A1//)
 6022 FORMAT(10X,'BUILDING TOTAL          AREA=',F10.0, 7X, 'VOL.=',F12.0/)
 6023 FORMAT(//10X,84('-')/15X,'WINTER',44X,'SUMMER'/17X,'MAX',5X,
     +        'LOAD COMPONENT',8X,'10:00',8X,'12:00',8X,'14:00',8X,'16:00'
     +        /10X,84('-'))
 6024 FORMAT(10X,'SPACE=',I5,4X,'NUMBER OF SPACE=',I5,4X,'AREA=',F7.1,
     +4X,'VOL.=',F10.2,4X,'SYSTEM=',I2/)
 6025 FORMAT(10X, 'DESCRIPTION :   ', 66A1/20X,66A1/20X, 66A1//)
 6026 FORMAT(1H1//10X,72A1//10X,72A1//10X,72A1//////)
 6027 FORMAT(10X,'LATITUDE   =',F6.1//10X,'LONGITUDE =',F6.1//
     +              10X,'ELEVATION =',F6.1///)
 6028 FORMAT(10X,35('-')/
     +              10X,'DESIGN CONDITION    WINTER   SUMMER',/10X,35('-')//
     +              10X,'DESIGN MONTH',5X,I6,I8//
     +              10X,'INDOOR   AIR TEMP ',2F8.1//
     +              10X,'OUTDOOR AIR TEMP ',2F8.1//
     +              10X,'          TEMP RANGE ',2F8.1//
     +              10X,'OUTDOOR HUMIDITY ',2F8.4//
     +              10X,'INDOOR   HUMIDITY ',2F8.4//
     +              10X,'SUPPLY   AIR   TEMP',2F8.1//
     +              10X,'SUPPLY WATER TEMP',2F8.1//
     +              10X,'RETURN WATER TEMP',2F8.1/)
      STOP
      END
```

$ENTRY

R	1	27.0000000	52.0000000	70.0000000	74.0000000
R	2	17.0000000	17.0000000	21.0000000	28.0000000
R	3	13.0000000	30.0000000	48.0000000	60.0000000
R	4	23.0000000	21.0000000	22.0000000	25.0000000
W	1	11.0000000	10.0000000	10.0000000	10.0000000
W	2	15.0000000	15.0000000	16.0000000	18.0000000
W	3	18.0000000	19.0000000	21.0000000	23.0000000
W	4	18.0000000	18.0000000	19.0000000	21.0000000
W	5	15.0000000	14.0000000	14.0000000	15.0000000
W	6	19.0000000	18.0000000	17.0000000	17.0000000
W	7	21.0000000	19.0000000	18.0000000	18.0000000
W	8	16.0000000	15.0000000	14.0000000	14.0000000
W	9	9.0000000	8.0000000	9.0000000	10.0000000
W	10	13.0000000	15.0000000	17.0000000	19.0000000
W	11	15.0000000	19.0000000	22.0000000	25.0000000
W	12	14.0000000	16.0000000	20.0000000	23.0000000
W	13	11.0000000	11.0000000	12.0000000	15.0000000
W	14	15.0000000	14.0000000	13.0000000	15.0000000
W	15	17.0000000	15.0000000	14.0000000	15.0000000
W	16	13.0000000	12.0000000	11.0000000	12.0000000
W	17	6.0000000	9.0000000	13.0000000	17.0000000
W	18	20.0000000	25.0000000	26.0000000	26.0000000
W	19	26.0000000	36.0000000	37.0000000	34.0000000
W	20	19.0000000	31.0000000	37.0000000	36.0000000
W	21	5.0000000	13.0000000	24.0000000	32.0000000

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22    6.0000000    9.0000000    18.0000000    32.0000000
23    6.0000000    9.0000000    14.0000000    27.0000000
24    5.0000000    8.0000000    13.0000000    20.0000000
25    12.0000000   18.0000000   23.0000000    24.0000000
26    35.0000000   26.0000000   27.0000000    26.0000000
27    55.0000000   40.0000000   31.0000000    29.0000000
28    49.0000000   43.0000000   36.0000000    30.0000000
29    22.0000000   39.0000000   46.0000000    37.0000000
30    12.0000000   26.0000000   50.0000000    63.0000000
31    11.0000000   19.0000000   41.0000000    67.0000000
32    11.0000000   13.0000000   27.0000000    47.0000000
   4.0000000    9.0000000    13.0000000    14.0000000
  0.5000000    0.5000000    0.0000000    -0.5000000    -1.0000
 0.0000000    0.5000000    1.0000000
  59.3999900    74.6000000    59.3999900    35.8000000
  112.0000000   180.0000000   248.0000000   270.6999000
     1    22.0000000   26.0000000   30.0000000   35.0000000
 47.0000000    39.0000000    36.0000000    31.0000000    27.0000000
 20.0000000
     2    166.0000000  195.0000000  223.0000000  225.0000000
 215.0000000   216.0000000   218.0000000   210.0000000   187.0000000
 151.0000000
     3    252.0000000  232.0000000  192.0000000  135.0000000
 77.0000000    90.0000000    131.0000000   187.0000000   225.0000000
 254.0000000
     4    166.0000000  195.0000000  223.0000000  225.0000000
 215.0000000   216.0000000   218.0000000   210.0000000   187.0000000
 151.0000000
     5    155.0000000  199.0000000  238.0000000  262.0000000
 273.0000000   268.0000000   257.0000000   230.0000000   195.0000000
 136.0000000
     0.7200000    0.7700000    0.8200000    0.8500000
     0.6100000    0.7200000    0.8000000    0.8400000
 1    0.8000000    0.8900000    0.8600000    0.7500000
 2    0.6200000    0.2700000    0.2200000    0.1700000
 3    0.5800000    0.8300000    0.6800000    0.3500000
 4    0.1500000    0.1700000    0.5300000    0.8200000
 5    0.7200000    0.8500000    0.8100000    0.5800000
 6    0.6300000    0.7600000    0.8200000    0.7900000
 7    0.5700000    0.4200000    0.3200000    0.2500000
 8    0.3400000    0.5900000    0.6500000    0.5000000
 9    0.1100000    0.1400000    0.3200000    0.5700000
10    0.4800000    0.6600000    0.7400000    0.6700000
11    0.5900000    0.7000000    0.7500000    0.7400000
12    0.5100000    0.3900000    0.3100000    0.2600000
13    0.3100000    0.5200000    0.5800000    0.4700000
14    0.1200000    0.1400000    0.2900000    0.5000000
15    0.4300000    0.5900000    0.6700000    0.6200000
16    0.6000000    0.6900000    0.7200000    0.7000000
17    0.4900000    0.3600000    0.2900000    0.2400000
18    0.3300000    0.5100000    0.5500000    0.4300000
19    0.1400000    0.1600000    0.3000000    0.4900000
20    0.4500000    0.5900000    0.6400000    0.5800000
 1    1.0000000    0.5000000    0.0415000
 2    1.0000000    0.5000000    0.0596000
 3    2.0000000    0.5000000    0.0536000
 1    45.0000000   0.7000000    0.4600000    0.0000000
 1    2.0000000    1.0000000    0.0713000
 2    2.0000000    1.0000000    0.0735000
 3    2.0000000    1.0000000    0.0853000
```

[illegible]	4	1.0000000	1.0000000	0.2242000	
[illegible]	5	1.0000000	1.0000000	0.2481000	
[illegible]	6	3.0000000	1.0000000	0.4673000	
[illegible]	1	8.0000000	1.0000000	0.4900000	0.5100000
[illegible]	2	4.1700000	6.0000000	0.4900000	0.5100000
[illegible]	3	7.0000000	3.0000000	0.4000000	0.0000000
[illegible]	1	10.0000000	0.0000000	0.0000000	0.0000000
[illegible]	2	0.5000000	0.0000000	0.0000000	0.0000000
UR	1	30.0000000	0.0000000		

1,ANIMAL SCIENCE BUILDING, OSU, STILLWATER, CKLAHOMA
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LATITUDE = 36.2
LONGITUDE = 97.2
ELEVATION = 884.0

DESIGN CONDITION	WINTER	SUMMER
DESIGN MONTH	1	7
INDOOR AIR TEMP	70.0	78.0
OUTDOOR AIR TEMP	13.0	96.0
TEMP RANGE	0.0	24.0
OUTDOOR HUMIDITY	0.0000	0.0130
INDOOR HUMIDITY	0.0000	0.0103
SUPPLY AIR TEMP	100.0	55.0
SUPPLY WATER TEMP	220.0	40.0
RETURN WATER TEMP	200.0	56.0

1,ANIMAL SCIENCE BUILDING, OSU, STILLWATER, CKLAHOMA

SPACE= 4 NUMBER OF SPACE= 1 AREA= 1730.0 VOL.= 28545.00 SYSTEM= 1
DESCRIPTICN : LECTURE HALL-124

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
-4092.	ROOF / CEILING	933.	1831.	2477.	2621.
0.	SKYLIGHT-SOLAR	0.	0.	0.	0.
0.	SKYLIGHT-TRANS	0.	0.	0.	0.
-7789.	EXTERIOR WALLS	1692.	1611.	1660.	1932.
0.	WINDOW - SOLAR	0.	0.	0.	0.
0.	WINDOW - TRANS	0.	0.	0.	0.
-551.	EXTERIOR DOORS	44.	121.	167.	157.
0.	PARTITION WALL	0.	0.	0.	0.
-2790.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	10194.	10902.	11610.	12035.
0.	PEOPLE - SEN	12627.	14904.	16560.	17388.
0.	EQUIPMENT- SEN	2600.	2600.	2600.	2600.
0.	INFILT. - SEN	0.	0.	0.	0.
-15222.	SPACE - SEN	28090.	31968.	35073.	36742.
0.	SPACE - LAT	17100.	17100.	17100.	17100.
-15222.	SPACE - TOTAL	45190.	49068.	52173.	53842.

ANY	PEAK TIME	16:00
-8.80	BTUH / SQ.FT.	31.12
1.00	S / H RATIO	0.68
461.27	SPACE CFM	1452.23
900.00	VENT CFM	900.00
0.00	INFILT. CFM	0.00
0.00	EXHAUST CFM	0.00
0.00	SPACE GPM	0.00

1.ANIMAL SCIENCE BUILDING, OSU, STILLWATER, OKLAHOMA

BUILDING TOTAL AREA= 9854. VOL.= 124522.
(ANNEX ZONE)

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
-12823.	ROOF / CEILING	3584.	6178.	8092.	8597.
0.	SKYLIGHT-SOLAR	3994.	4715.	4494.	3218.
-1795.	SKYLIGHT-TRANS	126.	283.	409.	441.
-32853.	EXTERIOR WALLS	7783.	7561.	7770.	8621.
0.	WINDOW - SOLAR	3794.	4160.	4643.	5315.
-14357.	WINDOW - TRANS	756.	2015.	3023.	3274.
-1101.	EXTERIOR DOORS	88.	241.	334.	334.
0.	PARTITION WALL	0.	0.	0.	0.
-13350.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	41596.	44484.	47373.	49106.
0.	PEOPLE - SEN	83509.	98568.	109520.	114996.
0.	EQUIPMENT- SEN	9500.	9500.	9500.	9500.
0.	INFILT. - SEN	0.	0.	0.	0.
-76280.	SPACE - SEN	154729.	177707.	195157.	203402.
0.	SPACE - LAT	122420.	122420.	122420.	122420.
-76280.	SPACE - TOTAL	277149.	300127.	317577.	325822.
-15347.	RETURN AIR-SEN	29750.	31852.	34256.	36215.
-120835.	OUT. AIR - SEN	9667.	26457.	36632.	36632.
0.	OUT. AIR - LAT	25185.	25185.	25185.	25185.
-212463.	BUILDING - SEN	194146.	236015.	266045.	276248.
0.	BUILDING - LAT	147605.	147605.	147605.	147605.
-212463.	BUILDING TOTAL	341751.	383620.	413649.	423853.

ANY	PEAK TIME	16:00
0.00	TOTAL - TONS	35.32
0.00	SQ.FT. / TON	278.98
-21.56	BTUH / SQ.FT.	43.01
2311.52	BUILDING CFM	8039.59
0.00	INFILT. CFM	0.00
5840.00	VENT CFM	5840.00
400.00	EXHAUST CFM	400.00
0.00	SPACE GPM	0.00
0.00	CENTRAL GPM	0.00
0.00	RM. UNIT GPM	0.00
0.00	TOTAL GPM	0.00

1,ANIMAL SCIENCE BUILDING, OSU, STILLWATER, CKLAHOMA

SPACE= 15 NUMBER OF SPACE= 16 AREA= 120.0 VOL.= 1320.00 SYSTEM= 1

DESCRIPTICN : FACULTY OFFICE-101H,I,104C,D,E,F,G,109D,E,F,G,H,114D,E,F,G

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
0.	ROOF / CEILING	0.	0.	0.	0.
0.	SKYLIGHT-SOLAR	0.	0.	0.	0.
0.	SKYLIGHT-TRANS	0.	0.	0.	0.
-386.	EXTERIOR WALLS	95.	122.	142.	153.
0.	WINDOW - SOLAR	1387.	134.	109.	85.
-699.	WINDOW - TRANS	37.	98.	147.	159.
0.	EXTERIOR DOORS	0.	0.	0.	0.
0.	PARTITION WALL	0.	0.	0.	0.
-300.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	486.	520.	554.	574.
0.	PEOPLE - SEN	140.	166.	184.	193.
0.	EQUIPMENT- SEN	360.	360.	360.	360.
0.	INFILT. - SEN	0.	0.	0.	0.
-1385.	SPACE - SEN	2505.	1400.	1496.	1534.
0.	SPACE - LAT	190.	190.	190.	190.
-1385.	SPACE - TOTAL	2695.	1590.	1686.	1724.

ANY	PEAK TIME	10:00
-11.54	BTUH / SQ.FT.	22.46
1.00	S / H RATIO	0.93
41.96	SPACE CFM	99.03
15.00	VENT CFM	15.00
0.00	INFILT. CFM	0.00
0.00	EXHAUST CFM	0.00
0.00	SPACE GFM	0.00

1.ANIMAL SCIENCE BUILDING, OSU, STILLWATER, OKLAHOMA

BUILDING TOTAL AREA= 17449. VOL.= 169412.
(OFFICE ZONE)

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
-18856.	ROOF / CEILING	4888.	8497.	11041.	11845.
0.	SKYLIGHT-SOLAR	0.	0.	0.	0.
0.	SKYLIGHT-TRANS	0.	0.	0.	0.
-27697.	EXTERIOR WALLS	6228.	7351.	8411.	9638.
0.	WINDOW - SOLAR	56196.	6221.	5293.	4264.
-29516.	WINDOW - TRANS	1553.	4143.	6214.	6732.
0.	EXTERIOR DOORS	0.	0.	0.	0.
0.	PARTITION WALL	0.	0.	0.	0.
-10200.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	40105.	42890.	45675.	47346.
0.	PEOPLE - SEN	45512.	53719.	59688.	62672.
0.	EQUIPMENT- SEN	62075.	62075.	62075.	62075.
0.	INFILT. - SEN	0.	0.	0.	0.
-86270.	SPACE - SEN	216556.	184936.	198396.	204571.
0.	SPACE - LAT	69060.	69060.	69060.	69060.
-86270.	SPACE - TOTAL	285616.	253956.	267456.	273631.
-61550.	RETURN AIR-SEN	41508.	48428.	52772.	57883.
-100869.	OUT. AIR - SEN	8069.	22085.	30579.	30579.
0.	OUT. AIR - LAT	21023.	21023.	21023.	21023.
-248688.	BUILDING - SEN	266133.	255419.	281747.	293033.
0.	BUILDING - LAT	90083.	90083.	90083.	90083.
-248688.	BUILDING TOTAL	356216.	345502.	371830.	383115.

ANY	PEAK TIME	16:00
0.00	TOTAL - TONS	31.93
0.00	SQ.FT. / TON	546.54
-14.25	BTUH / SQ.FT.	21.96
2614.23	BUILDING CFM	8085.81
0.00	INFILT. CFM	0.00
4875.00	VENT CFM	4875.00
240.00	EXHAUST CFM	240.00
0.00	SPACE GPM	0.00
0.00	CENTRAL GPM	0.00
0.00	RM. UNIT GPM	0.00
0.00	TOTAL GPM	0.00

1,ANIMAL SCIENCE BUILDING, OSU, STILLWATER, OKLAHOMA

SPACE= 42 NUMBER OF SPACE= 17 AREA= 230.0 VOL.= 2530.00 SYSTEM= 1

DESCRIPTION : LAB.MODULE-1ST FLOOR

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
0.	ROOF / CEILING	0.	0.	0.	0.
0.	SKYLIGHT-SOLAR	0.	0.	0.	0.
0.	SKYLIGHT-TRANS	0.	0.	0.	0.
-386.	EXTERIOR WALLS	108.	95.	88.	95.
0.	WINDOW - SOLAR	75.	85.	1186.	2098.
-699.	WINDOW - TRANS	37.	98.	147.	159.
0.	EXTERIOR DOORS	0.	0.	0.	0.
0.	PARTITION WALL	0.	0.	0.	0.
-300.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	1355.	1449.	1544.	1600.
0.	PEOPLE - SEN	1537.	1814.	2016.	2117.
0.	EQUIPMENT- SEN	4600.	4600.	4600.	4600.
0.	INFILT. - SEN	0.	0.	0.	0.
-1385.	SPACE - SEN	7712.	8141.	9581.	10669.
0.	SPACE - LAT	3750.	3750.	3750.	3750.
-1385.	SPACE - TOTAL	11462.	11891.	13331.	14419.

ANY	PEAK TIME	16:00
-6.02	BTUH / SQ.FT.	62.69
1.00	S / H RATIO	0.74
41.96	SPACE CFM	421.71
120.00	VENT CFM	120.00
0.00	INFILT. CFM	0.00
1150.00	EXHAUST CFM	1150.00
0.00	SPACE GPM	0.00

1.ANIMAL SCIENCE BUILDING, OSU, STILLWATER, OKLAHOMA

BUILDING TOTAL AREA= 7820. VOL.= 86020.

(LAB. ZONE)

WINTER MAX	LOAD COMPONENT	SUMMER 10:00	12:00	14:00	16:00
-13283.	ROOF / CEILING	3029.	5942.	8040.	8506.
0.	SKYLIGHT-SOLAR	0.	0.	0.	0.
0.	SKYLIGHT-TRANS	0.	0.	0.	0.
-13124.	EXTERIOR WALLS	3684.	3224.	2593.	3224.
0.	WINDOW - SOLAR	2538.	2376.	40323.	71339.
-23759.	WINDOW - TRANS	1250.	3335.	5002.	5419.
0.	EXTERIOR DOORS	0.	0.	0.	0.
0.	PARTITION WALL	0.	0.	0.	0.
-5100.	FLOOR/SLABEDGE	0.	0.	0.	0.
0.	ELEC. LIGHTING	46079.	49279.	52479.	54399.
0.	PEOPLE - SEN	52255.	61690.	68544.	71971.
0.	EQUIPMENT- SEN	156400.	156400.	156400.	156400.
0.	INFILT. - SEN	0.	0.	0.	0.
-55267.	SPACE - SEN	265246.	282746.	333781.	371257.
0.	SPACE - LAT	127500.	127500.	127500.	127500.
-55267.	SPACE - TOTAL	392746.	410246.	461281.	498757.
0.	RETURN AIR-SEN	30719.	32853.	34986.	36266.
-2451570.	OUT. AIR - SEN	196126.	536765.	743213.	743213.
0.	OUT. AIR - LAT	510959.	510959.	510959.	510959.
-2506836.	BUILDING - SEN	492091.	852363.	1111979.	1150736.
0.	BUILDING - LAT	638459.	638459.	638459.	638459.
-2506836.	BUILDING TOTAL	1130549.	1490822.	1750437.	1789194.

ANY	PEAK TIME	16:00
0.00	TOTAL - TONS	149.10
0.00	SQ.FT. / TON	52.45
-320.57	BTUH / SQ.FT.	228.80
1674.75	BUILDING CFM	14674.20
0.00	INFILT. CFM	0.00
4080.00	VENT CFM	4080.00
39100.00	EXHAUST CFM	39100.00
0.00	SPACE GPM	0.00
0.00	CENTRAL GPM	0.00
0.00	RM. UNIT GPM	0.00
0.00	TOTAL GPM	0.00

APPENDIX C - SPACE ILLUMINATION LEVEL REQUIREMENTS

1) CLASSROMM/LECTURE HALL

Task Category : E (50-75-100)

* seeing blackboard

Weighting Factors :

* Age .... (-1) under 40
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (-1) 20%

Total .... (-1)

Illumination Level :

* 50 fc at blackboard

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare in the sight line
* Control of reflected glare at task surface
* Color rendition not critical

Task Category : E (50-75-100)

* reading pencil writing on the desk

Weighting Factors :

* Age .... (-1) under 40
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (-1) 77%

Total .... (-1)

Illumination Level :

* 50 fc at the desk top

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare
* Control of reflected glare at task surface
* Color rendition not critical

Task Category : F (100-150-200)

* watching demonstration table

Weighting Factors :

* Age .... (-1) under 40
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (0) 40%

Total .... (0)

Illumination Level :

* 150 fc at demonstration table

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare
* Control of reflected glare
* Color rendition important

Task Category : B (5-7.5-10)

* watching T.V. or projector screen

Weighting Factors :

* Age .... (-1) under 40
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (+1) room surface(25%)

Total .... (+1)

Illumination Level :

* 10 fc general lighting

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare
* Control of reflected glare on T.V. screen

2) OFFICE

Task Category : E (50-75-100)

* reading pencil writing on the desk

Weighting Factors :

* Age .... (+1) over 55
* Speed .... (0) important
* Accuracy .... (0) important
* Background reflectance .... (-1) 77%

Total .... (0)

Illumination Level :

* 75 fc at the desk top

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare
* Color rendition not critical

3) CONFERENCE

Task Category : E (50-75-100)

* seeing blackboard

Weighting Factors :

* Age .... (+1) over 55
* Speed .... (-1) not important
* Accuracy .... (0) important
* Background reflectance .... (-1) 20%

Total .... (-1)

Illumination Level :

* 50 fc at blackboard

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare toward the blackboard
* Control of reflected glare
* Color rendition not critical

Task Category : D (20-30-50)

* conferring

Weighting Factors :

* Age .... (+1) over 55
* Speed .... (-1) not important
* Accuracy .... (0) important
* Background reflectance .... (0)

Total .... (0)

Illumination Level :

* 30 fc at desk top

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare
* Color rendition not critical

4) RECEPTION/SECRETARY

Task Category : C (10-15-20)

* reception

Weighting Factors :

* Age .... (0) 40-55
* Speed .... (0)
* Accuracy .... (0)
* Background reflectance .... (0)

Total .... (0)

Illumination Level :

* 15 fc general

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare not critical
* Color rendition not critical

Task Category : E (50-75-100)

* typing

Weighting Factors :

* Age .... (0) 40-55
* Speed .... (+1) critical
* Accuracy .... (+1) critical
* Background reflectance .... (-1) 77%

Total .... (+1)

Illumination Level :

* 100 fc at the desk top

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare
* Color rendition not critical

5) COMPUTER/DATA PROCESS

Task Category : B (5-7.5-10)

* CRT screens

Weighting Factors :

* Age .... (0) 40-55
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (-1)

Total .... (0)

Illumination Level :

* 7.5 fc general

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare on CRT screen
* Color rendition not critical

Task Category : E (50-75-100)
* thermal print

Weighting Factors :

* Age .... (0) 40-55
* Speed .... (0) important
* Accuracy .... (+1) critical
* Background reflectance .... (-1) 77%

Total .... (0)

Illumination Level :

* 75 fc at printer

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare on printer
* Color rendition not critical

6) LABORATORY

Task Category : E (50-75-100)
* science laboratories

Weighting Factors :

* Age .... (+1) over 55
* Speed .... (0) important
* Accuracy .... (0) important
* Background reflectance .... (-1) bench table(under 30%)

Total .... (0)

Illumination Level :

* 75 fc at bench table

Quality of Lighting :

* Adequate brightness ratio
* Control of direct glare not critical
* Control of reflected glare on bench table
* Color rendition not critical
* Adequate illumination on vertical surface

APPENDIX D - DETAILED ILLUMINATION LEVEL CALCULATION

GENERAL INFORMATION

Project identification: # 124 LECTURE HALL , ANIMAL SC. BLDG.
(Give name of area and/or building and room number)

Average maintained illumination for design: 50 footcandles

Luminaire data:

Manufacturer: DAYBRITE

Catalog number: VT - 1

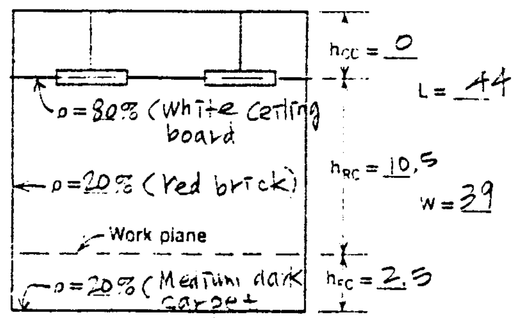
Lamp Data:

Type and color: F40T 12CW

Number per luminaire: 3

Total lumens per luminaire: 9450

SELECTION OF COEFFICIENT OF UTILIZATION



Step 1: Fill in sketch at right.

Step 2: Determine Cavity Ratios from Fig. 20.34, or by formulas.

Room Cavity Ratio, RCR = 2.44

Ceiling Cavity Ratio, CCR = 0

Floor Cavity Ratio, FCR = 0.58

Step 3: Obtain effective ceiling cavity reflectance (ρ_{CC}) from Table 20.9 ρ_{CC} = 80

Step 4: Obtain effective floor cavity reflectance (ρ_{FC}) from Table 20.9 ρ_{FC} = 26

Step 5: Obtain coefficient of utilization (CU) from manufacturer's data. CU = 0.55

SELECTION OF LIGHT LOSS FACTORS

Unrecoverable		Recoverable	
Luminaire ambient temperature		Room surface dirt depreciation	0.95
Voltage to luminaire		Lamp lumen depreciation	0.85
Ballast factor	0.9	Lamp burnouts factor	0.95
Luminaire surface depreciation		Luminaire dirt depreciation LDD	0.85

Total light loss factor, LLF (product of individual factors above): 0.59

CALCULATIONS

(Average Maintained Illumination Level)

$$\text{Number of Luminaires} = \frac{(\text{Footcandles}) \times (\text{Area in square feet})}{(\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}$$

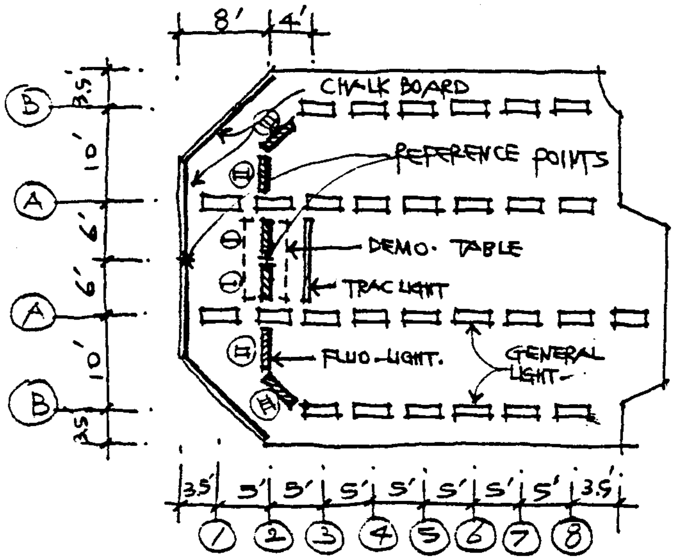
$$= \frac{50 \times 1700}{3150 \times 3 \times 0.55 \times 0.59} = 27.7 \rightarrow 28$$

$$\text{Footcandles} = \frac{(\text{Number of luminaires}) \times (\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}{(\text{Area in square feet})}$$

$$= \frac{28 \times 3150 \times 3 \times 0.55 \times 0.59}{1700} = 50.5$$

Calculated by: LEE Date:

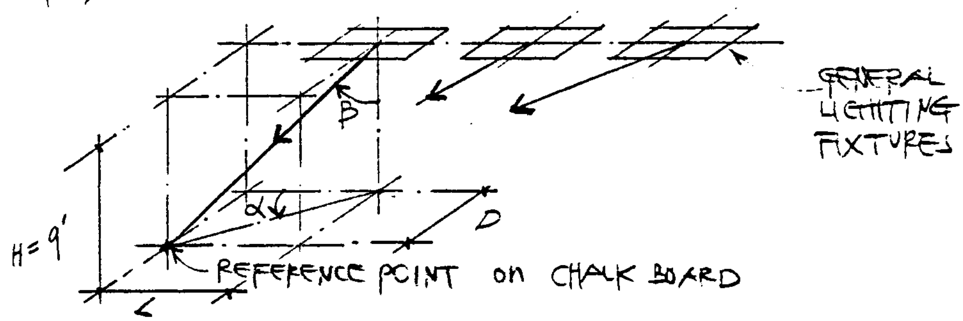
Zonal Cavity Method calculation Form (this and opposite page). Courtesy of the IES.



REFLECT. CEILING PLAN

a) CHALK BOARD

- Required Vertical Illumination level : 50 fc
- Vertical Illumination from general lighting fixtures :



$$\alpha = \tan^{-1}(D/L)^\circ$$
$$\beta = \tan^{-1}(\sqrt{L^2+D^2}/H)^\circ$$
$$IFC = CP_{\alpha\beta} / L^2+D^2+H^2 \quad (fc)$$
$$VFC = I \times \cos\alpha \times \sin\beta \ (fc)$$

	D	L	α	β	$CP_{\alpha\beta}$*	IFC	VFC
A1	6'	3.5'	60°	38°	2230	17.3	5.3
A2	6'	8.5'	35°	49°	1410	7.5	4.6
A3	6'	13.5'	24°	59°	650	2.2	1.7
A4	6'	18.5'	18°	65°	280	0.61	0.53
A5	6'	23.5'	14°	70°	166	0.25	0.23
B3	12'	13.5'	50°	67°	450	0.87	0.51
B4	12'	18.5'	40°	71°	134	0.20	0.14

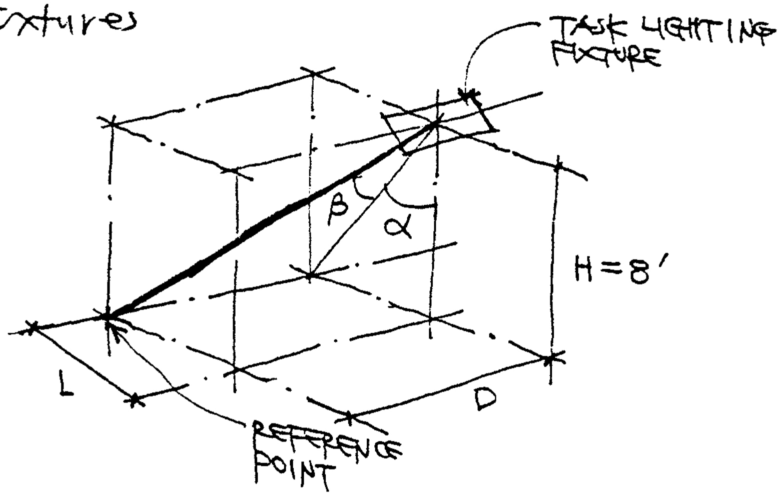
* From manuf. data.

Minimum total vertical fc at the reference point excluding reflected component is 26.02 fc initial.

Maint. fc = Initial fc × LLF

= 26.02 × 0.59 = 15.35 fc

□ Vertical Illumination from Fluorescent task lighting fixtures



	D	L	α	β	CD_{β}^{*}	ICF	VCF
I	2′	8′	45°	10°	3517	26.6	18.6
II	6′	8′	45°	28°	3064	18.7	11.7
III	9′	9′	48°	37°	2607	11.5	6.8

NOTE

$\alpha = \tan^{-1}(L/H)$

$\beta = \tan^{-1}(D/\sqrt{L^2+H^2})$

$ICF = CP_{\beta} / L^2+H^2+D^2$

$VCF = ICF \times \sin\alpha \times \cos\beta$

* From Manuf. data

Total vertical fc at the reference point from Six 4-Lamp fluorescent task lighting fixture is 74.5 initial fc.

Maint. fc = Initial fc × LLF

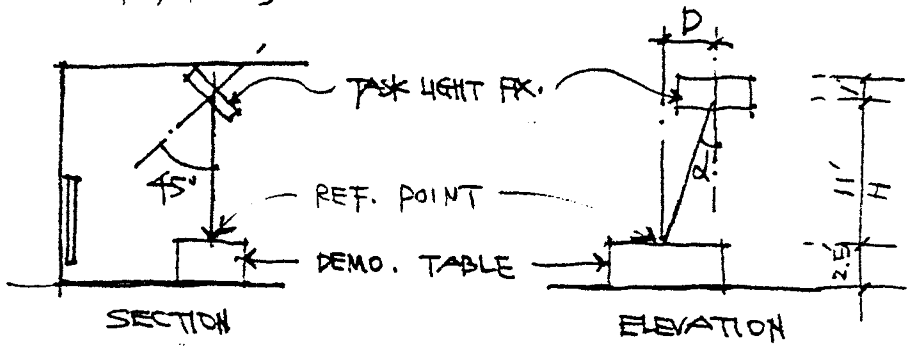
= 74.5 × 0.59 = 43.96

□ Total maintained vertical illumination at reference point = 15.35 + 43.96

= 59.3 fc > 50 fc, ok.

b) DEMONSTRATION TABLE

- Required Illumination level : 150 fc.
- Illumination from general lighting system : 50 fc. maint.
- Illumination from fluorescent task lighting fixtures :



	D	α	$CP^{*}_{\alpha,45}$	ICF	HCF
I	2'	10°	2550	20.4	20.1
II	6'	29°	2500	15.9	13.9
III	9'	39°	2470	12.2	9.5

NOTE $\alpha = \tan^{-1}(D/H)$

$ICF = CP_{\alpha,45} / (D^2 + H^2)$

$HCF = ICF \times \cos\alpha$

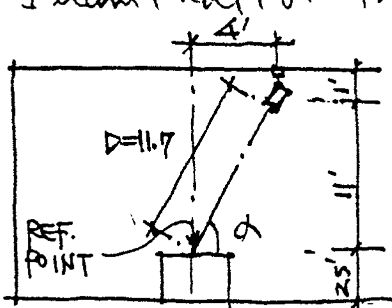
* From Manuf. Data

Total illuminance at the reference point from six, 4-lamp fluorescent task lighting fixture is 87 initial fc

Maint. fc = Initial fc × LLF

= 87 × 0.59 = 51.3 fc

- Illumination from Incandescent track light



Initial fc for uniform lighting.

at 10' distance : 110 fc (from manuf. data)

at 11.7' distance : 80.4 fc

Initial $fc_{@table}$ = Initial $fc_{@11.7'} \times \sin\alpha$

$= 80.4 \times 11/11.7$

$= 75.6$ fc

Maint fc = Initial $fc_{@table} \times$ LLF

$= 75.6 \times 0.61$

$= 46.1$ fc

Spacing $= H \times S/H$

$= 11 \times 0.35$

$= 3.85'$

No. of fixture = 3.

□ Total Illuminance at the demonstration table

$= CF_{general} + CF_{F.TASK} + CF_{I.TRACK}$

$= 50 + 51.3 + 46.1$

$= 147.4 \approx 150.$ OK.

GENERAL INFORMATION

Project identification TYPICAL 3-BAY LAB
(Give name of area and/or building and room number)

Average maintained illumination for design: 75 footcandles

Lamp Data:

Type and color: F40T 12 CW

Number per luminaire: 3

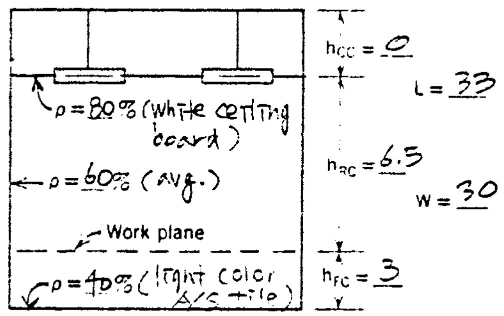
Total lumens per luminaire. 9450.

Luminaire data:

Manufacturer: DAY BRITE

Catalog number: VI-1

SELECTION OF COEFFICIENT OF UTILIZATION



Step 1: Fill in sketch at right.

Step 2: Determine Cavity Ratios from Fig. 20.34, or by formulas.

Room Cavity Ratio, RCR = 2.07

Ceiling Cavity Ratio, CCR = 0

Floor Cavity Ratio, FCR = 0.95

Step 3: Obtain effective ceiling cavity reflectance (ρ_{CC}) from Table 20.9 ρ_{CC} = 80

Step 4: Obtain effective floor cavity reflectance (ρ_{FC}) from Table 20.9 ρ_{FC} = ______

Step 5: Obtain coefficient of utilization (CU) from manufacturer's data. CU = 36

SELECTION OF LIGHT LOSS FACTORS

Unrecoverable

Luminaire ambient temperature
Voltage to luminaire
Ballast factor
Luminaire surface depreciation
} 0.9

Recoverable

Room surface dirt depreciation 0.95
Lamp lumen depreciation 0.85
Lamp burnouts factor 0.95
Luminaire dirt depreciation LDD 0.85

Total light loss factor, LLF (product of individual factors above): 0.59

CALCULATIONS

(Average Maintained Illumination Level)

$$\text{Number of Luminaires} = \frac{(\text{Footcandles}) \times (\text{Area in square feet})}{(\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}$$

$$= \frac{75 \times 990}{(3150 \times 3) \times 0.67 \times 0.59} = 19.9 \rightarrow 21$$

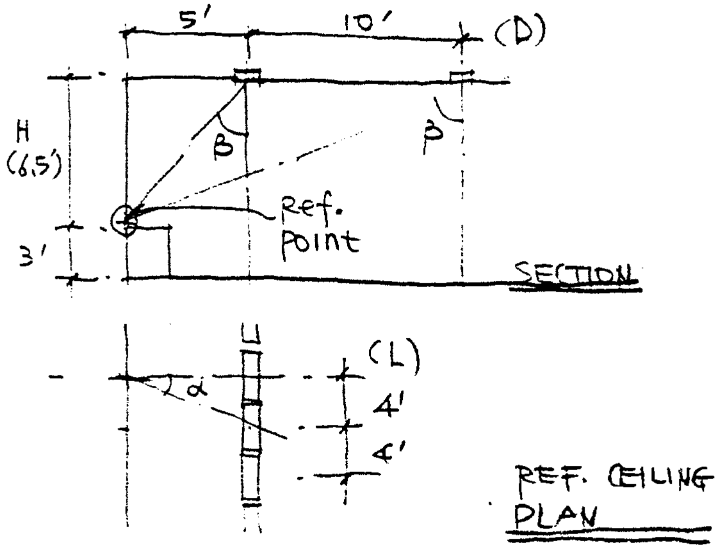
$$\text{Footcandles} = \frac{(\text{Number of luminaires}) \times (\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}{(\text{Area in square feet})}$$

$$= \frac{21 \times (3150 \times 3) \times 0.67 \times 0.59}{990} = 79.2$$

Calculated by: LEE Date: ______

Zonal Cavity Method calculation Form (this and opposite page).|*Courtesy of the IES.*

□ Actual Maint Illumination Level (Vertical)



$\alpha = \tan^{-1}(L/D)$

$\beta = \tan^{-1}(\sqrt{L^2+D^2}/H)$

$IFC = CP_{\alpha\beta} / L^2+D^2+H^2$

$VFC = IFC \times \cos\alpha \sin\beta$

D	L	α	β	$CP_{\alpha\beta}$	IFC	VFC
5'	0'	0°	38°	1894	28.2	17.3
5'	4'	39°	45°	1060	12.7	7.0
5'	8'	58°	55°	460	3.5	2.9
5'	12'	67°	63°	130	0.62	0.21
10'	0'	0°	57°	330	2.3	1.95
10'	4'	22°	59°	260	1.64	1.3
10'	8'	39°	63°	124	0.60	0.54
10'	12'	50°	67°	39	0.14	0.06

Minimum illumination level on a vertical surface from two rows of lighting fixtures, excluding reflected component : 37.5 initial fc

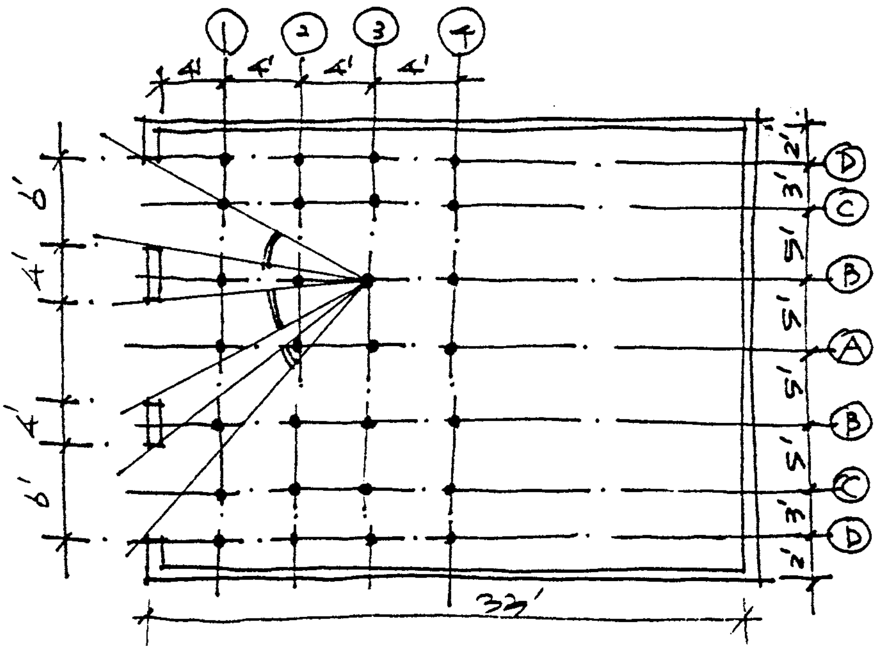
Maint. Fc = Initial FC × LLF

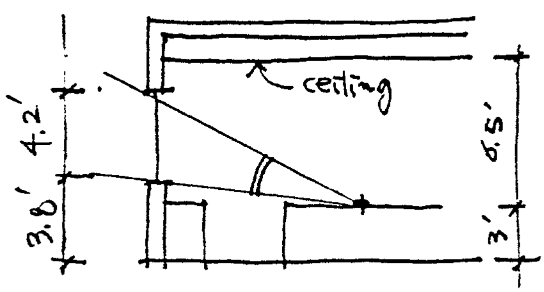
= 43.3 × 0.59

= 25.5 fc OK.

DAY LIGHTING

Protractor Method shall be utilized to determine DF's.
Sky condition shall be assumed as a CIE sky to be more conservertive in results.





NOTE

- IRC, ERC
  - Ratio of Window area to total room surface = 0.022

    Wall Ratio = 0.43, Wall RF = 60%

    Avg. Reflectance Factor = 0.48

    From Nomogram 1 $IRC_{initial} = 0.63$

    D-Factor = 0.9

    $IRC_{corr} = IRC_{initial} \times$ D-Factor $= 0.57$

    ERC = 0

- GMB Factors
  - G (Glass) Factor : 0.85 (Clear, double glazing)
  - M (Maintenance) Factor : 0.9 (Vertical, non-industrial)
  - B (Bar/Frame) Factor : 0.85 (All metal window)
  - G × M × B = 0.65

		PROTRACTOR		SC correct	NOMOGRAM	G×M×B=0.65
		SCALE 1	SCALE 2		(IRC=0.57 ERC= 0)	(G×M×B) × (IRC+ERC+SC)
		SC initial	Correct Factor		IRC+ERC+SC	= DF
1	A	7	.616	4.312	4.882	3.17
	B		.372	2.604	3.174	2.06
	C		.608	4.256	4.826	3.14
	D		.427	2.989	3.559	2.31
2	A	2.7	.560	1.512	2.082	1.35
	B		.472	1.274	1.844	1.20
	C		.464	1.253	1.823	1.18
	D		.365	.986	1.556	1.01
3	A	1.4	.480	.672	1.242	.81
	B		.444	.622	1.192	.77
	C		.395	.553	1.123	.73
	D		.350	.490	1.060	.67
4	A	0.8	.440	.352	.922	.60
	B		.415	.332	.902	.59
	C		.323	.258	.828	.54
	D		.300	.240	.810	.53

GENERAL INFORMATION

Project identification: TYPICAL FACULTY OFFICE
(Give name of area and/or building and room number)

Average maintained illumination for design: 25 footcandles

Luminaire data:

Manufacturer: DAYBRITE

Catalog number: VT-1

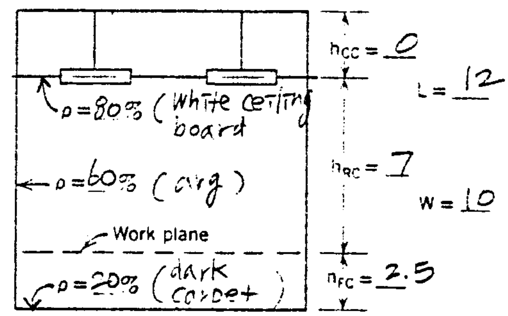
Lamp Data:

Type and color: F40T 12CW

Number per luminaire: 3

Total lumens per luminaire: 9450

SELECTION OF COEFFICIENT OF UTILIZATION



Step 1: Fill in sketch at right.

Step 2: Determine Cavity Ratios from Fig. 20.34, or by formulas.

Room Cavity Ratio, RCR = 2.57

Ceiling Cavity Ratio, CCR = 0

Floor Cavity Ratio, FCR = 0.92

Step 3: Obtain effective ceiling cavity reflectance (ρ_{CC}) from Table 20.9 ρ_{CC} = 80%

Step 4: Obtain effective floor cavity reflectance (ρ_{FC}) from Table 20.9 ρ_{FC} = 20%

Step 5: Obtain coefficient of utilization (CU) from manufacturer's data. CU = 0.6

SELECTION OF LIGHT LOSS FACTORS

Unrecoverable		Recoverable	
Luminaire ambient temperature	0.9	Room surface dirt depreciation	0.95
Voltage to luminaire		Lamp lumen depreciation	0.85
Ballast factor		Lamp burnouts factor	0.95
Luminaire surface depreciation		Luminaire dirt depreciation LDD	0.85

Total light loss factor, LLF (product of individual factors above): 0.59

CALCULATIONS

(Average Maintained Illumination Level)

$$\text{Number of Luminaires} = \frac{(\text{Footcandles}) \times (\text{Area in square feet})}{(\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}$$

$$= \frac{25 \times 120}{(3150 \times 3) \times 0.55 \times 0.59} = 0.98 \rightarrow 1$$

$$\text{Footcandles} = \frac{(\text{Number of luminaires}) \times (\text{Lumens per luminaire}) \times (\text{CU}) \times (\text{LLF})}{(\text{Area in square feet})}$$

$$= \frac{1 \times (3150 \times 3) \times 0.55 \times 0.59}{120} = 25.6$$

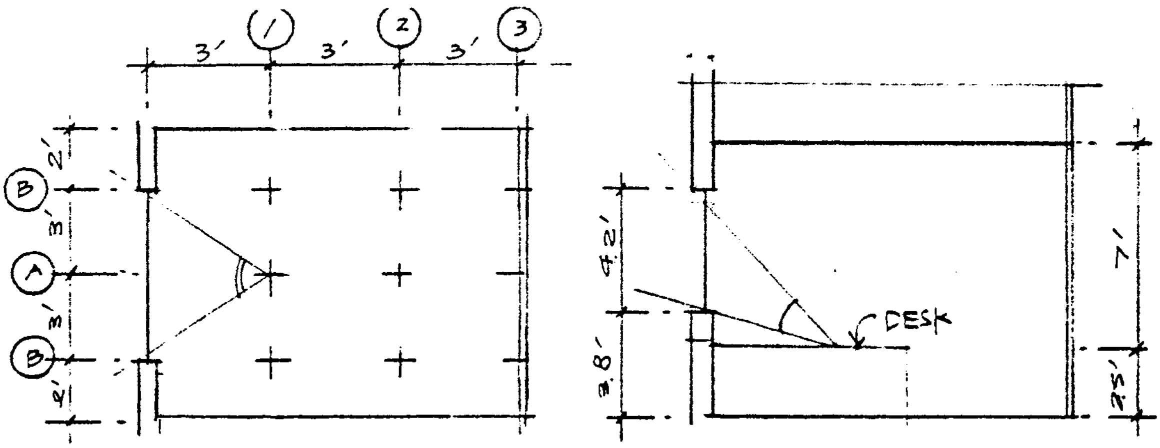
Calculated by: LEE Date:

Zonal Cavity Method calculation Form (this and opposite page). (Courtesy of the IES.

DAYLIGHTING

Protractor Method shall be utilized to determine DFs'.

Sky condition shall be assumed as a CIE sky to be conservertive in results



		PROTRACTOR		SC correct	NOMOGRAM	GMB = 0.65
		SCALE 1	SCALE 2		IRC=0.57 ERC=0	(GMB) x (IRC+ERC+SC)
		SC initial	Correct factor		IRC+ERC+SC	= DF
1	A	7.85	.54	4.24	5.28	3.43
	B		.41	3.22	4.26	2.77
2	A	3.31	.40	1.32	2.36	1.53
	B		.34	1.13	2.17	1.41
3	A	1.61	.30	0.48	1.52	0.99
	B		.27	0.43	1.50	0.98

NOTE) Refer to Lab.

APPENDIX E - MANUFACTURER'S CATALOG

III-1a

"SW" INSTANTANEOUS WATER HEATERS

CAPACITIES 40 F TO 140 F

(For Heating Water with Steam Instantaneously)

Capacities listed are based on the Thermal Standards of the Fuel Oil and Water Heater Manufacturers Association for commercially clean tubing. If fouling is anticipated, select a unit one or two feet longer. If excessive fouling is anticipated ask for our recommendation.

For temperature and pressure conditions other than those listed, request a copy of our "L & S" Nomograph Chart.

To determine pressure drop and velocity thru tubes, see chart on Page 20.

• CAPACITIES IN GPM — 40 F TO 140 F •

2 PASS

No. of Unit	0 PSI	2 PSI	5 PSI	10 PSI	15 PSI	25 PSI	50 PSI
4204SW	1.1	1.2	1.4	1.7	1.9	2.4	3.4
4206SW	2.4	2.7	3.1	3.8	4.3	5.3	7.6
4208SW	4.3	4.7	5.5	6.8	7.7	9.4	13.5
4210SW	6.7	7.4	8.6	11.3	12.1	14.8	20.8
4212SW	9.6	10.4	12.4	15.2	17.1	21.0	30.0
4214SW	13.1	14.4	16.8	20.4	23.4	29.0	32.8
6204SW	2	3	3	4	4	5	8
6206SW	5	6	7	9	10	12	17
6208SW	10	11	12	15	17	21	30
6210SW	15	17	19	25	27	33	47
6212SW	21	23	28	34	39	47	68
6214SW	29	32	38	46	53	65	74
6216SW	38	42	49	60	74	74	
8204SW	5	6	7	8	10	12	17
8206SW	12	13	15	19	22	27	38
8208SW	21	23	28	34	39	47	67
8210SW	34	37	43	56	60	74	104
8212SW	48	52	62	76	86	105	150
8214SW	65	72	84	102	117	144	164
8216SW	85	94	109	134	164	164	
8218SW	108	118	138	164			
10206SW	19	21	25	30	35	43	61
10208SW	34	37	44	54	62	75	108
10210SW	54	59	69	90	96	119	167
10212SW	77	83	99	122	137	168	240
10214SW	104	115	134	163	187	230	262
10216SW	136	150	174	215	262	262	
10218SW	173	189	221	262			
10220SW	213	234	262				
12206SW	29	32	37	46	52	64	91
12208SW	51	56	66	82	93	113	162
12210SW	81	89	103	135	145	178	250
12212SW	115	125	149	183	206	252	360
12214SW	157	173	202	245	281	346	394
12216SW	205	226	261	322	394	394	
12218SW	259	283	331	394			
12220SW	319	350	394				
14206SW	36	40	46	57	65	80	114
14208SW	64	70	83	102	116	141	202
14210SW	101	111	129	169	181	222	312
14212SW	144	156	186	228	257	315	450
14214SW	196	216	252	306	351	432	492
14216SW	256	282	326	402	492	492	
14218SW	324	354	414	492			
14220SW	399	438	492				
16206SW	50	55	65	80	91	112	160
16208SW	90	98	116	143	162	198	283
16210SW	141	155	181	237	253	311	437
16212SW	202	218	260	319	360	441	630
16214SW	274	302	353	429	492	605	689
16216SW	358	395	457	563	689	689	
16218SW	454	496	580	689			
16220SW	559	613	689				
20206SW	72	79	92	114	130	160	228
20208SW	128	140	166	204	232	282	405
20210SW	202	222	258	339	361	444	624
20212SW	288	312	372	456	514	630	900
20214SW	391	432	504	612	702	864	984
20216SW	511	564	653	804	984	984	
20218SW	648	708	828	984			
20220SW	798	876	984				

4 PASS

No. of Unit	0 PSI	2 PSI	5 PSI	10 PSI	15 PSI	25 PSI	50 PSI
3404SW	2.2	2.4	2.6	3.3	3.8	4.6	6.5
3406SW	4.8	5.2	6.0	7.2	8.5	10.6	11.0
3408SW	8.6	9.3	10.6	11.0	11.0	11.0	
3410SW	11.0	11.0	11.0				
4404SW	2.2	2.4	2.8	3.4	3.9	4.7	6.8
4406SW	4.8	5.2	6.2	7.6	8.6	10.6	15.0
4408SW	8.5	9.4	10.9	13.4	16.4	16.4	16.4
4410SW	13.3	14.6	16.4	16.4			
4412SW	16.4	16.4					
6404SW	5	6	7	9	10	12	17
6406SW	12	13	16	19	21	26	38
6408SW	21	24	27	34	40	40	40
6410SW	33	37	40	40			
6412SW	40	40					
8404SW	11	12	14	17	19	24	34
8406SW	24	26	31	38	43	53	75
8408SW	43	47	54	67	82	82	82
8410SW	67	73	82	82			
8412SW	82	82					
10406SW	38	42	50	61	69	84	120
10408SW	68	75	87	107	131	131	131
10410SW	106	117	131	131			
10412SW	131	131					
12406SW	58	62	74	91	103	126	180
12408SW	102	113	130	161	197	197	197
12410SW	160	175	197	197			
12412SW	197	197					
14406SW	72	78	93	114	129	158	225
14408SW	128	141	163	201	246	246	246
14410SW	200	219	246	246			
14412SW	246	246					
16406SW	101	109	130	160	180	221	315
16408SW	180	198	229	282	344	344	344
16410SW	279	307	344	344			
16412SW	344	344					
20406SW	144	156	186	228	257	315	450
20408SW	256	282	326	402	492	492	492
20410SW	399	438	492	492			
20412SW	492	492					

6 PASS

No. of Unit	0 PSI	2 PSI	5 PSI	10 PSI	15 PSI	25 PS
6604SW	7	8	9	11	13	1
6606SW	16	18	21	25	25	2
6608SW	25	25	25			
8604SW	17	18	22	27	30	3
8606SW	38	41	48	57	57	5
8608SW	57	57	57•			
10606SW	54	59	69	82	82	8
10608SW	82	82	82			
12606SW	86	94	110	131	131	13
12608SW	131	131	131			
14606SW	108	118	138	164	164	16
14608SW	164	164	164			

METHOD OF SELECTION

The maximum pressure drop (pd) fo lowest temperature and longest units in all diameters, is as follows:—

2 Pass Units—11 feet or 4.8 P.S.I
4 Pass Units—20 feet or 8.7 P.S.I
6 Pass Units—23 feet or 10.0 P.S

The pd's for higher temperatures and er length units will be correspond lower and may be determined fron charts on Page 20.

In the majority of cases a 6 Pass Unit v be the most economical. The most eco ical selection however may not alwa suitable because of the pressure drop a space limitations.

It is accordingly suggested that you your selection along the lines of the fo ing example.

EXAMPLE

Assume you want to heat 50 GPM GPH) from 40°F to 140°F with 10 p steam pressure (10 PSI).

Referring to the 10 PSI columns you find the nearest above 50 GPM in the s est diameters to be:—

2 Pass Unit—No. 6216SW—60 GP
(6" Dia., 2 Pass, 8' long)
4 Pass Unit—No. 8408SW—67 GP
(8" Dia., 4 Pass, 4' long)
6 Pass Unit—No. 8606SW—57 GP
(8" Dia., 6 Pass, 3' long)

In this case the No. 6216SW and 8606SW would be more economical the No. 8408SW but note that the 6" is 5 feet longer than the No. 8606SW 4 feet longer than the No. 8408SW.

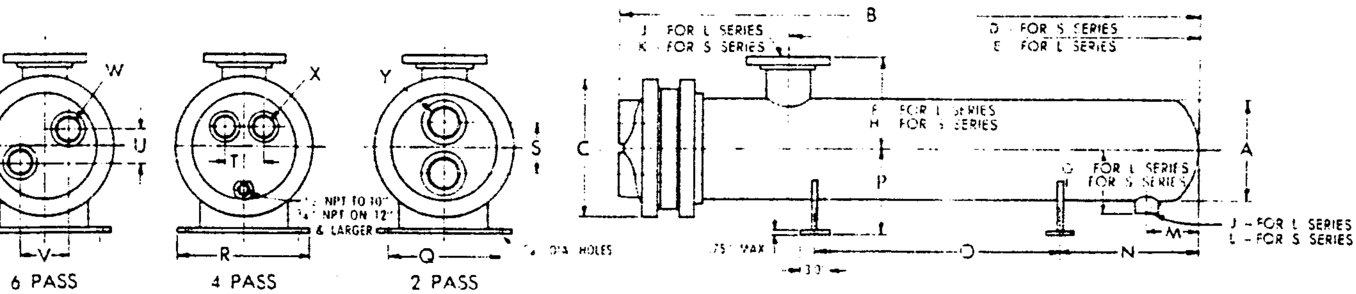
Referring to the Pressure Drop Cha Page 20 you will find the pd's for example to be:—

2 Pass Unit—No. 6216SW— 1.9 PSI
4 Pass Unit—No. 8408SW— 2.4 PSI
6 Pass Unit—No. 8606SW— 4.3 PSI

Now you have the lengths and pre drops of all 3 units which permits yo make the most suitable selection. (N The lengths indicated above represen length of the tube bundle. See Page overall lengths of units.)

ALL SERIES HEAT EXCHANGERS

III-1b



HEATER NUMBER 2 PASS	4 PASS	6 PASS	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	APPROX. WEIGHT IN LBS.
	3404		3.5	26.5	7.5	19	19	2.2	2.2	2.8	2.6	1.25T	2T	1T	2.5	9	10	4	4.5	6.5	2.2					1T		42
	3406		3.5	38.5	7.5	31	31	2.2	2.2	2.8	2.6	1.25T	2T	1T	2.5	9	22	4	4.5	6.5	2.2					1T		49
	3408		3.5	50.5	7.5	43	43	2.2	2.2	2.8	2.6	1.25T	2T	1T	2.5	9	34	4	4.5	6.5	2.2					1T		56
	3410		3.5	62.5	7.5	55	55	2.2	2.2	2.8	2.6	1.25T	2T	1T	2.5	9	46	4	4.5	6.5	2.2					1T		63
	3412		3.5	74.5	7.5	67	67	2.2	2.2	2.8	2.6	1.25T	2T	1T	2.5	9	58	4	4.5	6.5	2.2					1T		69
04	4404		4.5	27	9	19	19	2.8	2.8	3.2	2.8	1.5T	2T	1T	2.5	9	10	4.5	5.5	7.5	2.5	2.4				1T	1.5T	65
06	4406		4.5	39	9	31	31	2.8	2.8	3.4	2.8	1.5T	2.5T	1T	2.5	9	22	4.5	5.5	7.5	2.5	2.4				1T	1.5T	75
08	4408		4.5	51	9	43	43	2.8	2.8	3.4	2.8	1.5T	2.5T	1T	2.5	9	34	4.5	5.5	7.5	2.5	2.4				1T	1.5T	84
10	4410		4.5	63	9	55	55	2.8	2.8	3.4	2.8	1.5T	2.5T	1T	2.5	9	46	4.5	5.5	7.5	2.5	2.4				1T	1.5T	94
12	4412		4.5	75	9	67	67	2.8	2.8	3.4	2.8	1.5T	2.5T	1T	2.5	9	58	4.5	5.5	7.5	2.5	2.4				1T	1.5T	104
14	4414		4.5	87	9	79	79	2.8	2.8	3.4	2.8	1.5T	2.5T	1T	2.5	9	70	4.5	5.5	7.5	2.5	2.4				1T	1.5T	123
204	6404	6604	6.6	27.2	11	16	19	3.6	3.6	4	3.8	2T	2.5T	1T	3.5	9	10	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	120
206	6406	6606	6.6	39.2	11	28	31	3.6	3.6	4	3.8	2T	3T	1.25T	3.5	9	22	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	148
208	6408	6608	6.6	51.2	11	40	43	3.6	3.6	6.5	3.8	2T	4F	1.5T	3.5	9	34	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	182
210	6410	6610	6.6	63.2	11	52	55	3.6	3.6	6.5	3.8	2T	4F	1.5T	3.5	9	46	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	207
212	6412	6612	6.6	75.2	11	64	67	3.6	3.6	6.5	3.8	2T	4F	1.5T	3.5	9	58	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	235
214	6414	6614	6.6	87.2	11	76	79	3.6	3.6	6.5	3.8	2T	4F	1.5T	3.5	9	70	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	262
216	6416		6.6	99.2	11	88	91	3.6	3.6	6.5	3.8	2T	4F	1.5T	3.5	9	82	5.5	7.5	9.5	4	3.8	2	4.8	1.25T	1.5T	2T	290
204	8404	8604	8.6	28	13.5	16	18	5.2	5.2	8.8	4.8	3T	4F	1.5T	4.5	9	10	6.8	9	11	5	4	2.8	6	2T	2T	3T	192
206	8406	8606	8.6	40	13.5	28	30	5.2	5.2	8.8	4.8	3T	4F	1.5T	4.5	9	22	6.8	9	11	5	4	2.8	6	2T	2T	3T	234
208	8408	8608	8.6	52	13.5	40	42	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	34	6.8	9	11	5	4	2.8	6	2T	2T	3T	283
210	8410	8610	8.6	64	13.5	52	54	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	46	6.8	9	11	5	4	2.8	6	2T	2T	3T	326
212	8412	8612	8.6	76	13.5	64	66	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	58	6.8	9	11	5	4	2.8	6	2T	2T	3T	369
14	8414	8614	8.6	88	13.5	76	78	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	[illegible]	6.8	9	11	5	4	2.8	6	[illegible]	[illegible]	3T	[illegible]
16	8416		8.6	100	13.5	88	90	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	82	6.8	9	11	5	4	2.8	6	2T	2T	3T	453
18	8418		8.6	112	13.5	100	102	5.2	5.2	8.8	4.8	3T	6F	2T	4.5	9	94	6.8	9	11	5	4	2.8	6	2T	2T	3T	496
204	10404	10604	10.8	28.5	16	16	18	6.3	6.3	10	6	3T	4F	1.5T	4.5	9	10	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	285
206	10406	10606	10.8	40.5	16	28	30	6.3	6.3	10	6	3T	6F	2T	4.5	9	22	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	353
208	10408	10608	10.8	52.5	16	40	42	6.3	6.3	10	6	3T	6F	2T	4.5	9	34	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	415
210	10410	10610	10.8	64.5	16	52	54	6.3	6.3	10	6	3T	6F	2T	4.5	9	46	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	476
212	10412	10612	10.8	76.5	16	64	66	6.3	6.3	10	6	3T	6F	2T	4.5	9	58	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	537
214	10414	10614	10.8	88.5	16	76	78	6.3	6.3	10	6	3T	6F	2T	4.5	9	70	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	598
216	10416		10.8	100.5	16	88	90	6.3	6.3	10	6	3T	6F	2T	4.5	9	82	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	660
218	10418		10.8	112.5	16	100	102	6.3	6.3	10	6	3T	6F	2T	4.5	9	94	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	721
220	10420		10.8	124.5	16	112	114	6.3	6.3	10	6	3T	6F	2T	4.5	9	106	8	10	12	6.3	5.5	3.5	7.2	2.5T	3T	4T	782
205	12406	12606	12.8	41.2	19	26	28	7.3	7.3	11	6.8	3T	6F	2T	4.5	9	22	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	510
208	12408	12608	12.8	53.2	19	38	40	7.3	7.3	11	6.8	3T	6F	2T	4.5	9	34	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	596
210	12410	12610	12.8	65.2	19	50	52	7.3	7.3	11	6.8	3T	6F	2T	4.5	9	46	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	681
212	12412	12612	12.8	77.2	19	62	64	7.3	7.3	11	7.2	3T	8F	2.5T	4.5	9	58	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	772
214	12414	12614	12.8	89.2	19	74	76	7.3	7.3	11	7.2	3T	8F	2.5T	4.5	9	70	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	857
216	12416		12.8	101.2	19	86	88	7.3	7.3	11	7.2	3T	8F	2.5T	4.5	9	82	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	941
218	12418		12.8	113.2	19	98	100	7.3	7.3	11	7.2	3T	8F	2.5T	4.5	9	94	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	1027
220	12420		12.8	125.2	19	110	112	7.3	7.3	11	7.2	3T	8F	2.5T	4.5	9	106	10	11	13	8	5.8	4.2	8.4	3T	4T	4T	1111
206	14406	14606	14	41.5	21	26	28	12	10	12	7.6	4F	6F	2T	6	14	14	12	12	14	8	6.5	5	8	3T	4T	6T	568
208	14408	14608	14	53.5	21	38	40	12	10	12	8	4F	8F	2.5T	6	14	26	12	12	14	8	6.5	5	8	3T	4T	6T	664
210	14410	14610	14	65.5	21	50	52	12	10	12	8	4F	8F	2.5T	6	14	38	12	12	14	8	6.5	5	8	3T	4T	6T	756
212	14412	14612	14	77.5	21	62	64	12	10	12	8	4F	8F	2.5T	6	14	50	12	12	14	8	6.5	5	8	3T	4T	6T	847
214	14414	14614	14	89.5	21	74	76	12	10	12	8	4F	8F	2.5T	6	14	62	12	12	14	8	6.5	5	8	3T	4T	6T	937
216	14416		14	101.5	21	86	88	12	10	12	8	4F	8F	2.5T	6	14	74	12	12	14	8	6.5	5	8	3T	4T	6T	1029
218	14418		14	113.5	21	98	100	12	10	12	8	4F	8F	2.5T	6	14	86	12	12	14	8	6.5	5	8	3T	4T	6T	1120
220	14420		14	125.5	21	110	112	12	10	12	8	4F	8F	2.5T	6	14	98	12	12	14	8	6.5	5	8	3T	4T	6T	1212
206	16406		16	41.8	23.5	25	27	13	11	13	9	6F	8F	2.5T	7	16	14	13	13	15	9.2	7.8				4T	6T	745
208	16408		16	53.8	23.5	37	39	13	11	13	9	6F	8F	2.5T	7	16	26	13	13	15	9.2	7.8				4T	6T	863
210	16410		16	65.8	23.5	49	51	13	11	13	9	6F	8F	2.5T	7	16	38	13	13	15	9.2	7.8				4T	6T	981
212	16412		16	77.8	23.5	61	63	13	11	13	9	6F	10F	3T	7	16	50	13	13	15	9.2	7.8				4T	6T	1105
214	16414		16	89.8	23.5	73	75	13	11	13	9	6F	10F	3T	7	16	62	13	13	15	9.2	7.8				4T	6T	1187
216	16416		16	101.8	23.5	85	87	13	11	13	9	6F	10F	3T	7	16	74	13	13	15	9.2	7.8				4T	6T	1305
218	16418		16	113.8	23.5	97	99	13	11	13	9	6F	10F	3T	7	16	86	13	13	15	9.2	7.8				4T	6T	1424
220	16420		16	125.8	23.5	109	111	13	11	13	9	6F	10F	3T	7	16	98	13	13	15	9.2	7.8				4T	6T	1541
206	20406		20	42.5	27.5	23	27	15	13	15	11.2	6F	8F	2.5T	7.5	16	14	15	14	16	11.2	8.8				6T	8T	1060
208	20408		20	54.5	27.5	35	39	15	13	15	11.2	6F	10F	3T	7.5	16	26	15	14	16	11.2	8.8				6T	8T	1226
210	20410		20	66.5	27.5	47	51	15	13	15	11.2	6F	10F	3T	7.5	16	38	15	14	16	11.2	8.8				6T	8T	1386
212	20412		20	78.5	27.5	59	63	15	13	15	11.2	6F	10F	3T	7.5	16	50	15	14	16	11.2	8.8				6T	8T	1547
214	20414		20	90.5	27.5	71	75	15	13	15	11.2	6F	10F	3T	7.5	16	62	15	14	16	11.2	8.8				6T	8T	1706
216	20416		20	102.5	27.5	83	87	15	13	15	11.2	6F	10F	3T	7.5	16	74	15	14	16	11.2	8.8				6T	8T	1867
218	20418		20	114.5	27.5	95	99	15	13	15	13	6F	12F	4F	7.5	16	86	15	14	16	11.2	8.8				6T	8T	2041
220	20420		20	126.5	27.5	107	111	15	13	15	13	6F	12F	4F	7.5	16	98	15	14	16	11.2	8.8				6T	8T	2202

737 R 1" 892 1-48

RESSURE DROP CHART – THRU TUBES – "L" AND "S" SERIES

HOW TO USE THIS CHART

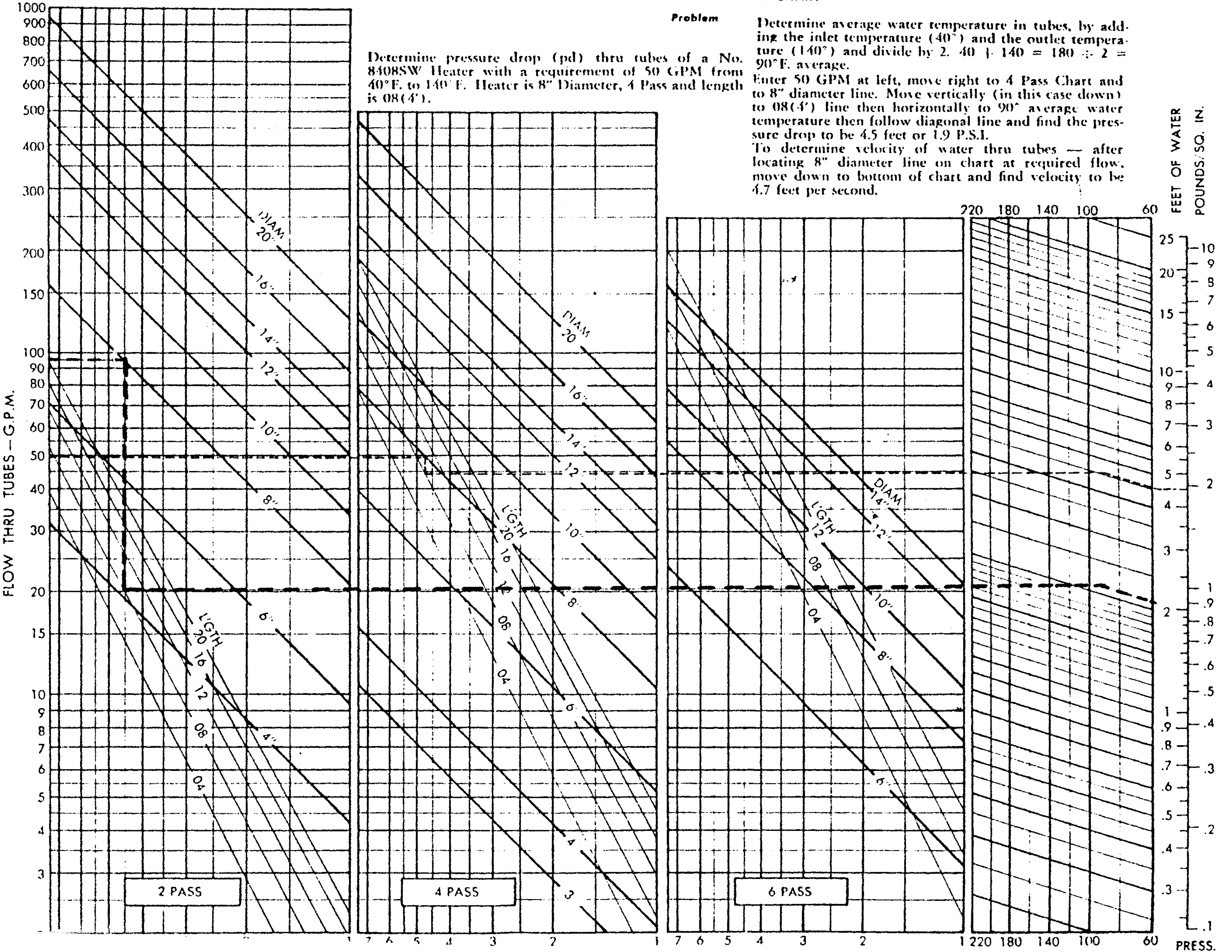
Problem

Determine pressure drop (pd) thru tubes of a No. 8408SW Heater with a requirement of 50 GPM from 40°F. to 140°F. Heater is 8" Diameter, 4 Pass and length is 08(4').

Determine average water temperature in tubes, by adding the inlet temperature (40°) and the outlet temperature (140°) and divide by 2. 40 + 140 = 180 ÷ 2 = 90°F. average.

Enter 50 GPM at left, move right to 4 Pass Chart and to 8" diameter line. Move vertically (in this case down) to 08(4') line then horizontally to 90° average water temperature then follow diagonal line and find the pressure drop to be 4.5 feet or 1.9 P.S.I.

To determine velocity of water thru tubes — after locating 8" diameter line on chart at required flow, move down to bottom of chart and find velocity to be 4.7 feet per second.



III-2

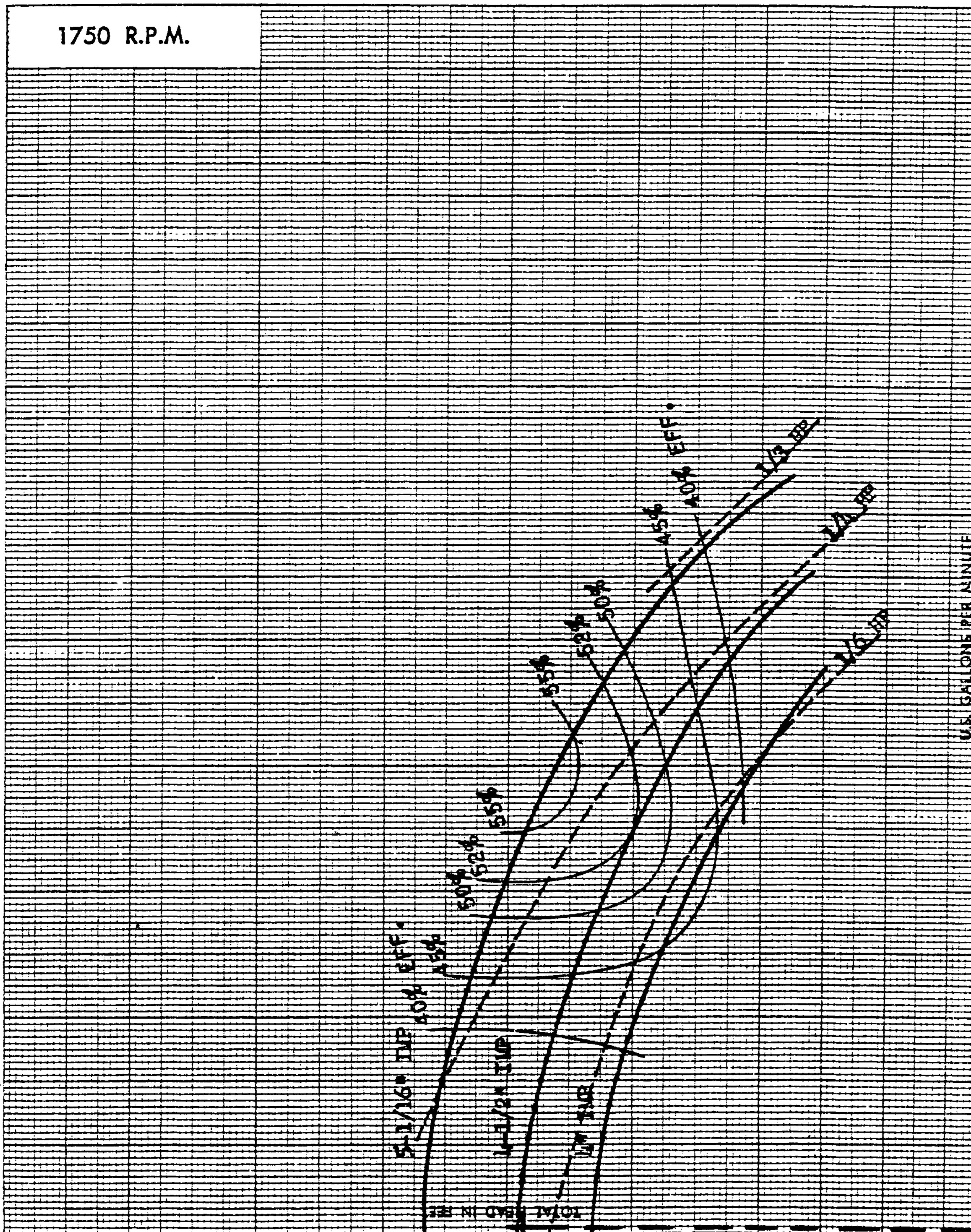
weil PUMP COMPANY

CHICAGO - ILLINOIS U.S.A.

— CENTRIFUGAL PUMP PERFORMANCE CHART —

SERIAL NO. ....
SIZE — TYPE........................
IMP. NO. ....
DATE 2
FOR PUMP TYPES KU, KY, RU,

FOR A MAXIMUM PERMISSIBLE SUCTION LIFT OF 15 FEET



IV-1

GRINNELL

GRINNELL FIRE PROTECTION SYSTEMS COMPANY, INC.

STANDARD SPRINKLERS

Grinnell offers a broad range of standard sprinkler styles for different types of installations. A general cross-section of standard sprinklers are pictured at right and ceiling types are featured on the opposite page.

Pendent

For use on piping close to ceiling or concealed above the ceiling. Typical installations include schools, office and apartment buildings, hotels, nursing homes, retail stores, and shopping centers. Available in Duraspeed, Quartzoid, and Duraspeed with Quick Response, and Aquamatic.

Upright

For use on exposed piping. Typical installations include factories, warehouses, schools, chemical plants, oil refineries. Available in Duraspeed, Quartzoid, and Aquamatic.

Ceiling (or Recessed)

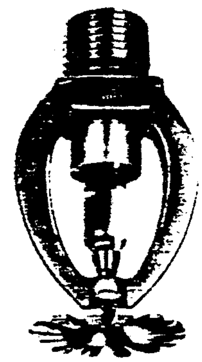
For effective yet unobtrusive protection: designed to preserve interior decor. Typical installations include apartments, universities, hospitals, hotels, public buildings, museums, schools, banks, lobbies, auditoriums. Available in Duraspeed (recessed), Quartzoid (recessed and ceiling), Cleanline (recessed) and Aquamatic (recessed). (Illustrated opposite page.)

Sidewall

For wall-mounting in areas where standard installations are impractical. Typical installations include apartments, universities, hospitals, hotels, public buildings, museums, schools, office buildings, nursing homes. Available in Duraspeed, Duraspeed with Quick Response, and Quartzoid.

Horizontal sidewall

For areas where sprinklers must be mounted horizontally from walls. Available in Duraspeed with Extended Coverage and/or Quick Response.



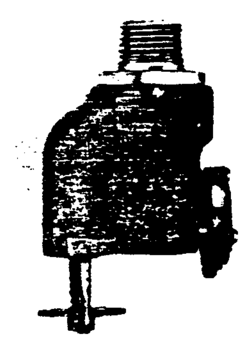
Quartzoid pendent

Duraspeed pendent

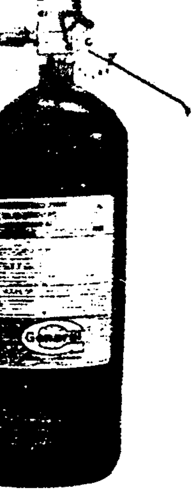
Sidewall

Quick Response

Extended Coverage



Aquamatic



CARBON DIOXIDE

General makes more portable CO_2 steel extinguishers than any other manufacturer in the world. The General line of hand portable carbon dioxide extinguishers includes three models with 5, 10, and 15 pound capacities. They provide excellent protection for certain flammable liquid, gas, and electrical hazards, and immediate cooling capability to prevent flashbacks.

They are especially suited for use on indoor hazards of these types where winds and drafts will not affect the discharge of the CO_2, and where an extinguishing agent leaving no residue is required. General's CO_2 units have standardized operation-pull pin, squeeze lever. Sturdy wall hanger hooks are provided. Marine and heavy-duty vehicle mounting brackets are available as optional equipment.

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S. COAST GUARD
5-R	02328	5 lbs.	11 sec.	20 lbs.	16 5/8"	8 1/4"	5 B:C	Approved
10-RH	02280	10 lbs.	9 sec.	38 lbs.	24"	12"	10 B:C	Approved
15-RH	01688	15 lbs.	11 sec.	51 1/2 lbs.	30"	12"	10 B:C	Approved

WHEELED UNITS

All General wheeled extinguishers are designed to be pulled and maneuvered by one person. They are compact enough to be used indoors and moved through standard doorways as well as outside over soft ground or rough surfaces.

They are activated quickly through hand opening valves at the nozzles.

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S. COAST GUARD
WHEELED UNITS								
50-RH	26738	50 lbs.	26 sec.	221 lbs.	51"	25"	20 B:C	.....
100-T (two 50 lb. cylinders) (c/w manifolded valve)	02052	100 lbs.	65 sec.	433 lbs.	66"	27"	20 B:C	.....

FEATURES:

- Heavy Duty Nickel-Plated Forged Brass Discharge Valve Body
- Heavy Duty Integral Hanger Loop on Valve Body (Hand Portable Only)
- Tubular Steel Cartridge (Wheeled Units Only)
- Frangible Safety Burst Disc for Pressure Relief
- High Pressure Non-Kink Hose
- Heavy Duty Patented Stay-Put Discharge Horn and Swivel Assembly (5 Lb. Units Only)
- Thermal-and Impact-Resistant Discharge Horn
- Rubber Insulated Horn Handle
- Integral Diffusion Tip for Safety in Recharging

PRESSURIZED WATER or LOADED STREAM

General's pressurized water extinguishers have a 2 1/2 gallon capacity. They offer good protection against small Class A fires (word, paper, rags). The cylinders are made of stainless steel. Operation is simple. No inversion is required. Just pull ring pin and squeeze the lever. A steady stream is supplied from start to finish. Recharging requires only a water supply and a source of compressed air with a pressure capacity of at least 100 psi.

General's pressurized loaded stream extinguishers are identical in construction, capacity, operation and maintenance to the pressurized water units. The "Freeze-Guard" loaded stream charge prevents freezing to -40°F., increases the effectiveness of the agent on Class A fires and adds extinguishing capability on Class B fires (flammable liquids, greases, etc.). Sturdy wall hanger hooks are provided.

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S. COAST GUARD
WS/LS-900A	35380	2 1/2 gal.	45-65 sec.	8 lbs. 8 oz.	24 1/2"	8 5/8"	2A	.....

FEATURES:

- Nickel-Plated, Brass Valve Body
- Stainless Steel Cylinder
- Stainless Steel Collar
- Oil-Filled Stainless Steel Pressure Gauge
- Pressurization Air Valve
- Stainless Steel Handle and Ring Pin
- Heavy Duty Stainless Steel Hanger Bracket

IV-3

STORED PRESSURE DRY CHEMICAL

General's line of hand portable stored pressure dry chemical extinguishers offers a choice of capacity and type of agent to satisfy a variety of fire protection requirements. They range in capacity from 2 1/2 to 20 pounds; all models are Underwriter's Laboratories listed.

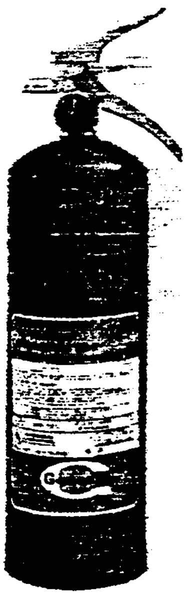
All models are available with either standard Quick Aid, ABC type Triplex, or Purple K dry chemicals, offering an opportunity to select the extinguisher that will most efficiently and economically provide protection against a particular hazard.

Standardized, easy operation (pull pin, squeeze lever) and durable construction make them the choice of safety directors and fire chiefs.

Large, easy-to-read pressure g and simplified recharging (no s tools required) earn praises from tenance and servicing perso Marine-vehicle mounting bracke wall hooks are supplied with 2 1/2 pound models. Wall hooks are su for 10 and 20 pound models with vehicle mounting brackets availa cptional equipment.

QUICK AID

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S
CP-2 1/2J	34981	2 1/2 lbs.	9.0 sec.	5 lbs.	15 5/8"	5 1/4"	10 B:C	Ap
CP-5J	35022	5 lbs.	8.5 sec.	10 1/4 lbs.	16 1/2"	5 5/8"	20 B:C	Ap
GP-10E	34021	10 lbs.	8.5 sec.	21 1/2 lbs.	22"	8 3/4"	60 B:C	Ap
GP-20D	34022	20 lbs.	27 sec.	38 lbs.	26 1/2"	9 1/2"	120 B:C	Ap



TRIPLEX

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S
TCP-2 1/2J	34983	2 1/2 lbs.	10 sec.	5 1/2 lbs.	15 5/8"	5 1/4"	1A-10 B:C	Ap
TCP-5J	35024	5 lbs.	10 sec.	9 3/4 lbs.	16 1/2"	5 5/8"	2A-10 B:C	Ap
TCP-5JH	35027	5 lbs.	9.5 sec.	10 lbs.	16 1/2"	7 1/4"	2A-10 B:C	Ap
TGP-10E	34027	9 1/2 lbs.	15 sec.	21 lbs.	22"	8 3/4"	4A-40 B:C	Ap
* TGP-10ES	35307	9 1/2 lbs.	15 sec.	22 lbs.	22"	8 3/4"	4A-40 B:C	Ap
** TCP-10LH	35179	9 lbs.	18.5 sec.	14 lbs.	23 1/2"	8 5/8"	4A-60 B:C	Ap
TGP-20D	34028	18 lbs.	22 sec.	36 lbs.	26 1/2"	9 1/2"	20A-80 B:C	Ap

* Underground, Ignition-proof Construction
**Aluminum Cylinder

PURPLE "K"

MODEL PRESSURIZED	PART NO.	CAPACITY	DISCHARGE TIME	SHIPPING WEIGHT	OVERALL HEIGHT	OVERALL WIDTH	U/L RATING	U.S
KCP-2 1/2J	34982	2 1/2 lbs.	9.0 sec.	5 1/2 lbs.	15 5/8"	5 1/4"	10 B:C	Ap

FEATURES:

- Simple and Economical Maintenance
- Heavy Duty Steel Cylinder
- Interchangeable Internal Valve Parts between all 2 1/2 and 5 Pound Units
- Heavy Duty Bar Stock Anodized Aluminum Valve Body on 2 1/2 and 5 Pound Units
- Heavy Duty Forged Anodized Aluminum Valve Body on 10 and 20 Pound Units
- Heavy Duty Time-Proven Seal Design
- Heavy Duty Integral Hanger Loop on Valve Body of 10 and 20 Pound Units
- Stainless Steel Pressure Gauge
- Corrosion-Resistant Anodized Aluminum Handles
- High Corrosion-Resistant Red Enamel Paint Finish

NOTICE Some manufacturers sell only D.O.T. specification cyli

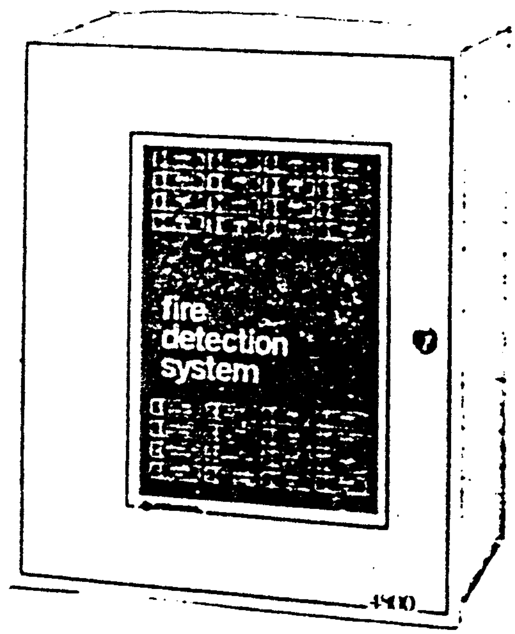
NERAL

4800 is a multi-zone alarm detection and non-ed alarm signaling panel designed in com-nce with NFPA-72A Local Protective Signaling tem specifications, NFPA-72B Auxiliary Pro-ive Signaling System Specifications, NFPA-Remote Station Signaling Specifications and PA-72D Proprietary Protected Premises Speci-tions to provide flexibility for multi-zone fire ection applications.

4800 can accommodate up to 6 circuit cards provide various detection alarm functions. e catalog sheets beginning with 20A-14-2). basic unit has two general alarm circuits plus iliary control and annunciation functions all of ch are housed in a single enclosure.

TURES

- Jp to 24 supervised Locking Class B Zone Monitoring Circuits in increments of four per lug-in module.
- wo, 24 Vdc supervised alarm circuits.
- larm signal resound feature.
- upervised power supply.
- ntegral charging circuit for gelled electrolyte mergency batteries.
- ndividual zone alarm and trouble annunciation circuit card feature) as well as Common Alarm nd Common Trouble annunciation.
- Optional normally open alarm contacts for each one (circuit card feature).
- emote station reverse polarity transmitter or ocal energy master box connections with mas-er box disconnect switch.
- nternal trouble buzzer or external audible de-ice.
- ire Drill Switch.
- lashing Common Alarm LED.
- Circuit card supervision to cause trouble con-ition when circuit card is removed.
- ompatible for use with Notifier SAS-100 Fire-ghters Communications System.
- lotherboard Backplane concept.
- xternal Power Supervision.
- ndividual Trouble LEDs for Battery, Charger, nd External Power Troubles.
- able Connectors to allow additional Mother-oards for added circuit capacity.



4800 CONTROL PANEL

BASIC PANEL CONFIGURATION

The 4800 consists of a four position motherboard with power supply and common control boards provided as standard. The other two circuit positions can accomodate any of the circuit cards described on the catalog sheets (20A-14 series). Two rows of eight terminals each are provided for field wiring, one above and one below the circuit card edge connector.

Battery brackets are available to mount two 4.5 AH batteries.

A semi flush mounting flange is also available where such mounting configuration is required.

SPECIFICATIONS

ELECTRICAL

Input power ....120 V, 60 Hz, 1 amp
*Reverse polarity transmitter ......24 Vdc, 24 mA
*Local energy master box ....Loop, 30 ohms max.
Emergency Battery
options ....24 Vdc, 4.5 AH or 9 AH
(larger sizes require separate cabinet)
Charging current ....4.5 AH, 0.65 amp
9 AH, 1.3 amp
Maximum current available for alarm loops, products of combustion detectors, and auxiliary functions ....3 amps
with 4.5 AH battery
2.5 amps with
9 AH battery

Products of combustion detector
power ....27 ± 1 V Clipped FWR, 0.5 A max.
Alarm circuits
(each) ....1.5 amp with 4.5 AH battery
1.25 amp with 9 AH battery
4.7K End-of-line resistor

Common Alarm and Common
Trouble contacts
(SPDT) ....120 Vac, 1 amp
24 Vdc, 2 amps

*Either reverse polarity transmitter or local energy master box signaling may be used, not both.

HYSICAL

Back Box ....15 inches wide (38.1 cm)
18 inches high (45.7 cm)
7 inches deep (17.8 cm)
Finish .... Beige Baked Enamel

UNCTION SWITCHES AND ANNUNCIATORS

ESET — Returns panel to normal operation after an alarm condition has been detected and cleared and also resets ionization detectors.

AMP TEST — Applies power to all LED's in the panel to verify operation.

ILENCE — Silences alarm and trouble audible devices upon actuation. A subsequent alarm signal will resound devices.

ASTER BOX DISCONNECT — Disconnects panel from master box when performing system tests.

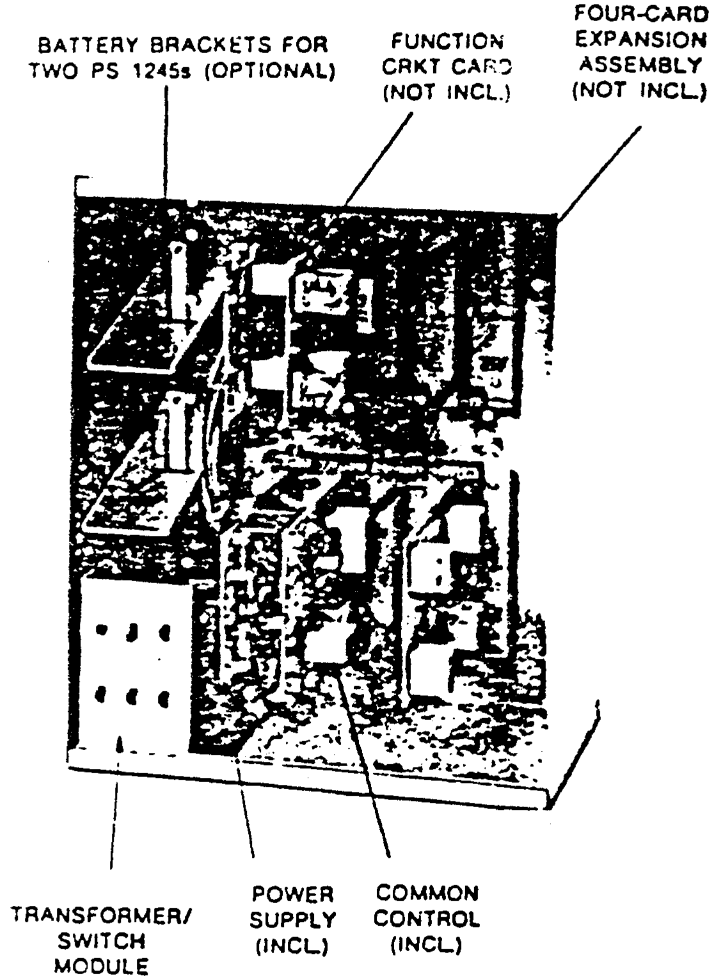
IRCUIT BREAKER — Push-to-Reset circuit breaker is provided on the ac input line.

RILL — Momentary switch causes alarm devices to operate.

NNUNCIATORS — Common panel annunciators consist of a green power pilot LED, a yellow common trouble LED, and a red common alarm LED. Yellow trouble LED's for alarm circuit 1, alarm circuit 2, city box inoperative, voltage monitor, charger (over voltage), battery, and ground on system. The four-zone circuit modules have individual alarm and trouble LED's for each zone.

ORDERING INFORMATION

4800 Basic Panel w/o Meter 512-9706
4800 Basic Panel w/Meter 512-9707
Semi-Flush mounting Flange 512-9662
Battery Brackets w/Btry. leads 141-9983
Four Card Expansion Ass'y. 512-9708



MANUAL FIRE ALARM STATION

SERIES BNG or BRG IV-5a

CALIFORNIA LISTED 7150-028:3

APPLICATION

Designed for use as a means of allowing anyone on the premises to turn in non-coded alarm quickly without chance of error. There is no need for delay—no danger of giving incorrect or incomplete instruction.

Installed in any type of building where there is a requirement for manually initiating a fire alarm.

1. Schools
2. Hospitals
3. Retail stores
4. Industrial plants
5. Warehouses

Compatible with any appropriate control panel to:

1. Initiate local alarm signals
2. Trip a municipal fire alarm box
3. Start fire pumps
4. OR ANY OTHER FUNCTION THAT CAN BE INITIATED OR CONTROLLED BY THE OPENING OR CLOSING OF A SWITCH CONTACT.

OPERATION

STATIONS ARE BREAK GLASS OR NON-BREAK-GLASS OPERATION.

The stations are operated by a pull on the pull cover. This causes a key latch to act against a retaining mechanism until adequate force is applied to open the station. As the station opens, a switch is released to initiate an alarm. The retainer in Model BNG is a permanent high tensile coil spring, which eliminates the need for a glass retainer. The retainer in Model BRG is a replaceable glass, which is not broken when key tested. When so operated, the cover hangs down (and cannot be made to stay in a closed position) indicating that the station was used to turn in the alarm. (OPERATED STATIONS CAN BE SEEN UP TO 100 FEET AWAY.)

Resetting is easily accomplished by use of a test-reset key.

Testing is accomplished by Notifier's simple and patented test-reset lock mechanism.

CONSTRUCTION

The attractive design of the stations highlight its engineered simplicity and unusual dependability; bumping, shaking, or jarring will not activate the switch or circuit. Instructions for operation of the station are provided on the front of the pull cover.

The BNG-1 and BRG-1 Stations are die-formed from 1/8" satin finish aluminum; with the operating instructions depressed and filled with red enamel.

Stations come in surface or semi-flush mounting models.

Ratings of: 3 amp., 120 VAC, 120 VDC.

Master key fits all stations used in an installation of the same series.

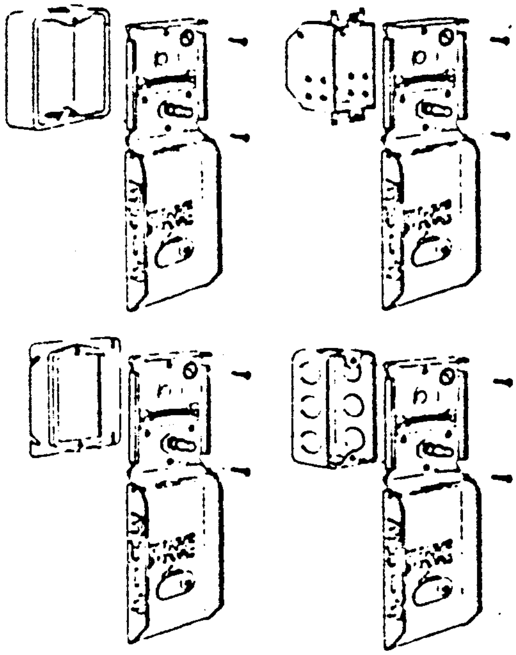
UNDERWRITERS' LABORATORIES LISTED. UL

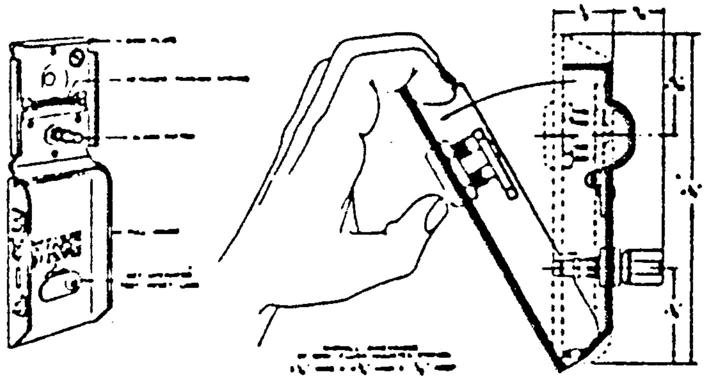
FACTORY MUTUAL APPROVED. FM

ENGINEERS SPECIFICATIONS

Manual Fire Alarm Stations shall be non-code, break-glass (or non-break-glass) type, equipment with a key operated test-reset lock in order that they may be tested, and so designed that after actual Emergency Operation, they cannot be restored to normal except by use of a key. An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of one hundred feet, front or side. Manual Stations shall be constructed of die-formed satin-finished aluminum, with operating directions provided on the cover in depressed red letters. The word FIRE shall appear on each side of the stations in depressed letters, one-half inch in size or larger. Stations shall be suitable for surface mounting on matching back-box, or semi-flush mounting on a standard single-gang box or switch plate, and shall be installed not less than four and one-half feet, nor more than six feet above the finished flood. Manual Stations shall be Underwriters' Laboratories Listed.

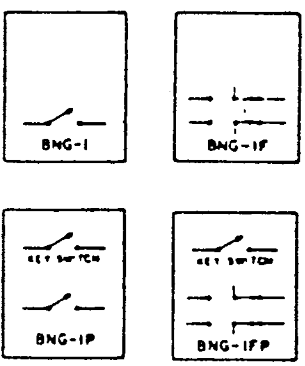
TV-5b



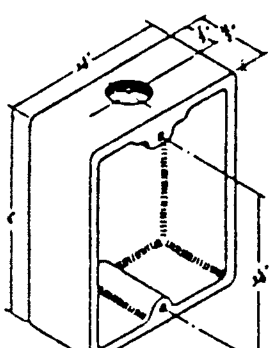


ORDERING INFORMATION

Model No.	Description
	MANUAL FIRE ALARM STATION
BNG or BRG — 1	Single-Pole, Single-Throw, Normally open Switch
BNG or BRG — 1F	Double-Pole, Double-Throw Switch
BNG or BRG — 1P	Single-Pole, Single-Throw, Normally open, Station Switch; Single-Pole, Single-Throw, Lock-type general alarm switch mounted under pull cover
BNG or BRG — 1FP	Double-Pole, Double-Throw Station Switch; Single-Pole, Single-Throw, Lock-type general alarm switch mounted under pull cover
BRG-1TS	BRG-1 with terminal strip for field wiring
BNG-1TS	BNG-1 with terminal strip for field wiring
BNG-1FTS	BNG-1F with terminal strip for field wiring



	BACK-BOXES FOR ABOVE STATIONS (Cast Aluminum — Baked Enamel)
BG — 2	Surface mounting Back-Box for BNG Series stations, one end tapped for ½" conduit
BG — 2a	Same as BG — 2, except both ends tapped for ½" conduit
BG — 2b	Same as BG — 2, except one end tapped for ¾" conduit
BG — 2c	Same as BG — 2, except both ends tapped for ¾" conduit



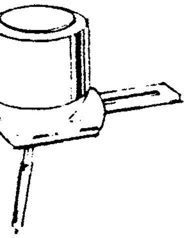
Part No.	
1460000	Replacement Glass Retainer for BRG

TV-6, 8

ns shall incorporate a visual fire light model AV-32. The
t shall:

ash during alarm ☐ remain steady during alarm

lamp circuits shall be supervised and the lamp shall
ain on after the horns have been silenced.

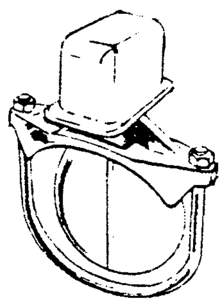


SPRINKLER SUPERVISORY SWITCHES

(Refer to catalog section E, page 20E-16-1).

Model NGV (OS & Y Gate Valve)
Model NIP (Indicator Post Valve)

or Post Valve Supervisory Switches or Gate Valve Su-
ory Switches shall be installed on each valve as desig-
on the drawings and/or as specified herein. Switches
e mounted so not to interfere with the normal operation
valve and shall be adjusted to operate within two revo-
of the valve control or when the stem has moved no
han one-fifth of the distance from its normal position.
echanism shall be contained in a weatherproof die cast
um housing which shall provide a ¾-inch tapped con-
trance and incorporate the necessary facilities for at-
ent to the valve. Switch housings shall be finished in
ked enamel. The switch mechanism shall have a mini-
ated capacity of one amp. 125 volt A.C., or 0.25 amp.
D.C. The entire installed assembly shall be tamper-
nd arranged to cause a switch operation if the housing
s removed or if the unit is removed from its mounting.
or Post Valve Supervisory Switches or Gate Valve
es shall be Underwriters' Laboratories Listed and Fac-
utual Approved.

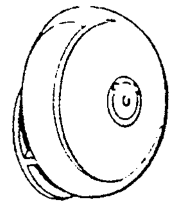


-TYPE ERFLOW DETECTOR

fer to catalog section E,
e 20E-12-2).

el WFD

Type Waterflow Detectors shall be installed on the
er system piping as designated on the drawings
as specified herein. Detectors shall be designed for
ng on either vertical or horizontal piping, but shall not
unted in a fitting or within 12 inches of any fitting that
es the direction of waterflow, and shall have a sensi-
etting to signal any flow of water that equals or exceeds
scharge from one sprinkler head. Detector switch
nisms shall incorporate an instantly recycling pneu-
etard element with an adjustable range of 0 to 70 sec-
Switches shall have a minimum rated capacity of 7
at 6-125 volts A.C./.25 amps at 6-24 volts D.C. and
e actuated by a polyethylene vane extending into the
ay of the piping. Detectors shall be of weatherproof,
ght construction and shall provide a ½ inch conduit en-
and shall be finished in red baked enamel. Vane-type
Detectors shall be Underwriters' Laboratories
actory Mutual Approved. Operating pressure
at 250 P.S.I.

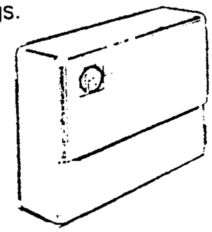


AUDIBLE ALARM BELLS

(Refer to catalog section F, page 20F-1-1 N-CO-Bell Brochure).

Series N-CO-Bell

Audible Alarm Signals shall be bells of the underdome vibrating type with gongs no smaller than 6", 8" or 10" in diameter with red finish. Bells shall be polarized and operate at 24 volt D.C. Bells shall be suitable for surface or semi-flush mounting. Surface mount shall be weatherproof. Semi-flush shall mount to any standard 4 inch square, 4 inch octagon or single-gang box with a maximum projection of 2-½". Bells shall be located as shown on the drawings.

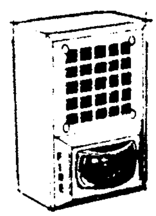


ALARM CHIMES

(Refer to catalog section F, page 20F-3-1)

Model Series CH

Signal chimes shall be installed in a vertical position only at each location designated on the drawings and/or as specified herein. Chimes shall be of the single stroke solenoid type designed for operation on 24 volt D.C. Chimes shall be surface mounted on standard outlet box or plaster ring or flush mounted in special back box with stainless steel flush cover plate. The chime mechanism shall be completely enclosed by a removable cover to prevent dust accumulation and mechanical damage. Chime solenoids shall be of low current design with a maximum power requirement of 6 watts. Chimes shall be polarized.



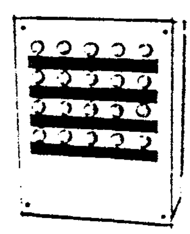
VISUAL & AUDIO/VISUAL ALARM DEVICES

(Refer to Catalog Section F, page 20F-5-2)

Model AV & V Series

Visual Fire Alarms shall be installed at each location designated on the drawings and/or as specified herein. Visual alarms shall be of the continuous or flashing type designed for operation on 24 VDC. Visual Alarms shall be surface mounted on a special surface back box or flush mounted on a special flush back box. Visual alarms shall be completely enclosed and for interior use only. Lamps shall have a maximum current requirement of 0.10 amps for 24 VDC. AV Series shall incorporate an alarm horn operating at 24 VDC with a maximum current requirement of 0.20 amperes.

☐ The lamp circuits shall be supervised and the lamp shall remain on after the horns have been silenced.



REMOTE ANNUNCIATOR

(Refer to catalog section F, page 20F-6-1).

Model Series AU (lamp type)

A remote annunciator shall be furnished and installed a
shown on the drawings. The annunciator shall be of the lam

…TURES

- …ystem or Single Station Operation
- …wo or Four-wire Supervised Connection
- …ccommodates 700 Series Smoke Detectors
- …emote Indication, Relay Test and Reset …ptions
- …ransparent Inspection Port
- …ttractive, Rugged and Compact Steel Housing
- …L and ULC Listed

…CRIPTION

…Model DH-20 air duct detector housing is in…ded for use on air handling ducts to sample air … detect visible and invisible smoke and com…tion products. The housing accepts the 700 …ies smoke detectors. Air sampling is accom…hed through sampling and return tubes which …end into the ducts.

… detector may be utilized either as an AC …vered single station device, or as a 2-wire or …ire DC powered device intended for system ap…ation. It is equipped with relay contacts which … be utilized directly for releasing device serv… in single station or 4 wire applications.

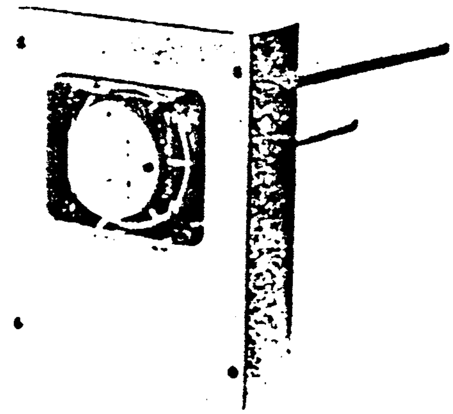
…ransparent inspection port permits viewing of … detector alarm indicator over a wide viewing …le and inspection of the conditions of cleanli…s inside of the detector mounting area without … need for disassembly.

… HANDLING SYSTEM CHARACTERISTICS

… DH-20 duct housing is intended for air veloci… ranging from 500 ft. per minute to 3100 ft. per …ute. The uniformity of sensitivity over the ve…ty ranges specified insures that compensating …ustments for operation at specific air velocities …nnecessary.

…MPLING TUBES

… DH-20 utilizes one inlet and one outlet sam…g tube. In order to insure uniform sampling of … air in the duct and to avoid the effects of …inar flow and stratification, it is recommended … the sampling tubes extend over the entire …lth of the duct. Sampling tubes are available in …ariety of standard lengths to suit most applica…ns. Tube length should be selected to match … width of the duct.



ELECTRICAL SPECIFICATIONS

	DC OPERATION
INPUT VOLTAGE:	18.0 - 40.0 DC
STANDBY CURRENT:	100 ua max. @ 24 VDC
ALARM CURRENT WITH REMOTE LED:	30 to 100 ma
ALARM CURRENT WITHOUT REMOTE LED:	15 to 100 ma
INPUT RATING (AC Operations):	120 VAC, 2 Watts

RELAY CONTACTS
Two Form C contacts rated 2 amps @ 26 VDC, or 120 VAC.

ACCESSORIES

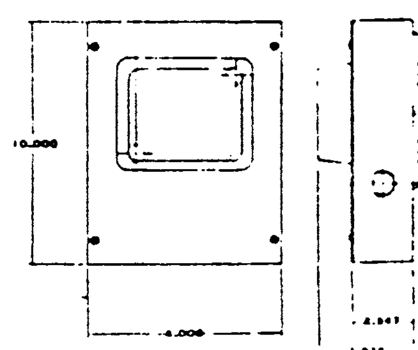
REMOTE ALARM INDICATOR — Model #RAI-2
Red bipolar LED glows under alarm conditions.

REMOTE ALARM INDICATOR/KEYSWITCH — Model #RMC-500
Red bipolar LED glows under alarm conditions. Momentary keyswitch acuates alarm relay and simultaneously resets detector.

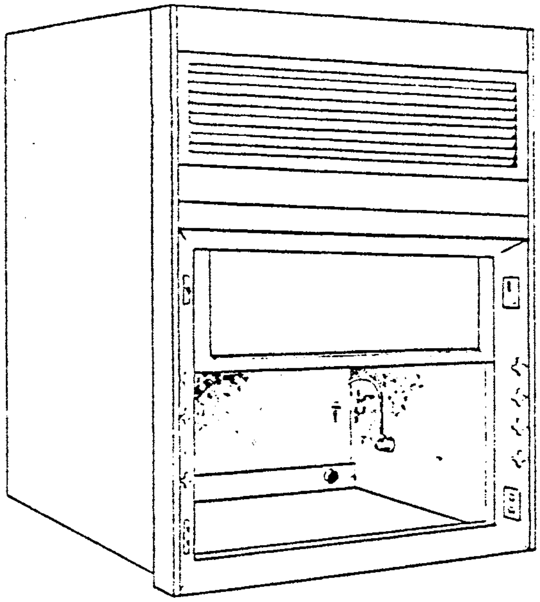
REMOTE POWER/ALARM INDICATOR/KEYSWITCH — Model #RCM-600
Green LED glows under power conditions; red bipolar LED glows under alarm conditions. Momentary keyswitch actuates alarm relay and simultaneously resets the detector.

AC WIRING KIT — Model #ACA-200
Provides single station, 120 VAC operation of the individual duct detector. Installs inside the DH-20 housing.

DIMENSIONS



TYPE SS SINGLE COMPARTMENT FUME HOOD SUPERSTRUCTURES



The Duralab Slimline Series Fume Hoods, combining the air-entrainment and air by-pass features, have a 3 11/16" wide full double wall construction to conceal the service fixture piping, providing flush and unobstructed interiors.

EXTERIOR: corrosion resistant lead coated steel with a specially formulated acid, alkali and solvent resistant baked-on resin paint finish. Superstructure end panels are easily removable for access to service fixtures and to piping.

INTERIOR: chemically treated, corrosion resistant Transite. No exposed metal fasteners. Access panels provided only where fixtures are specified.

EQUIPMENT: fluorescent light fixture and switch, B-2 adjustable baffle, enamelled lead-coated steel sash glazed with 1/4" thick laminated safety glass.

ACCESSORIES SHOWN (OPTIONAL)

4 - Electric, 2 - Air, 2 - Gas, 2 - Vacuum, 2 - Cold Water, 1 - Blower switch and pilot light, 8 - Remote control valves.

ALL ACCESSORIES ARE MOUNTED ON SIDE WALLS

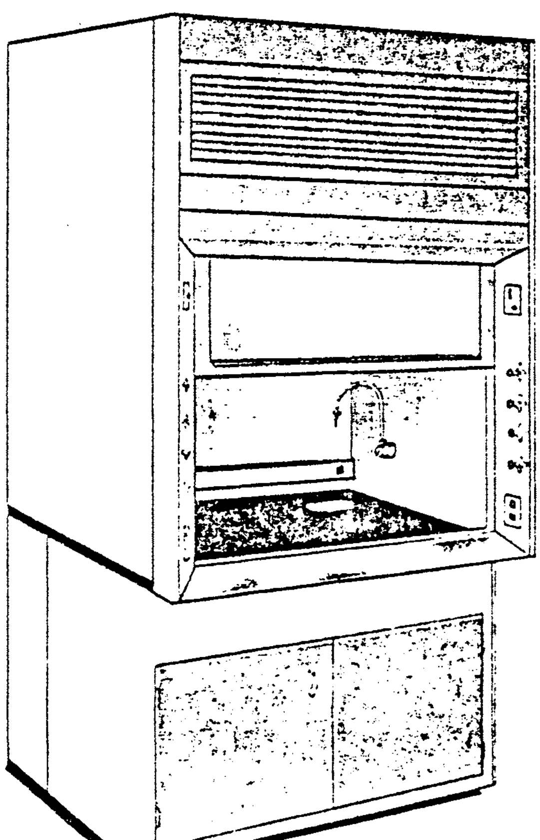
Cat. No.	Length	Width	Height	Face Area+
SS-3	35"	33"	60"	5.8
SS-4	47"			8.3
SS-5	59"			10.8
SS-6	70"			13.0
SS-7*	82"			15.5
SS-8*	94"			18.0

+Square feet (sash fully open)
*Sash has center mullion

REFER TO THE FOLLOWING PAGES FOR ADDITIONAL EQUIPMENT:

Other interior linings and working surfaces - Pg. 250
Exhaust and supply blowers - Pg 238.
Other sash arrangements, filters, enclosures, racks - Pg. 249
[4] Additional accessories and service fixtures (special coated fixtures) Pg. 241.
[5] Water and vapor baths - Pg. 248.
[6] Roughing-in details - Pg. 214.

TYPE SS SINGLE COMPARTMENT FUME HOODS



The Duralab Slimline Series Fume Hoods, combining the Air-entrainment and Air-By-Pass features, have a 3 11/16" wide full double wall construction to conceal the service fixture piping, providing flush and unobstructed interiors.

EXTERIOR: corrosion resistant lead coated steel with a specially formulated acid, alkali and solvent resistant baked-on resin paint finish. Superstructure and panels are easily removable for access to service fixtures and to piping.

INTERIOR: chemically treated, corrosion resistant Transite. No exposed metal fasteners. Access panels provided only where fixtures are specified.

WORK SURFACE: Charcoal gray Colorlith, 1 1/4" thick, with raised front edge to contain spillage.

EQUIPMENT: fluorescent light fixture and switch, B-2 adjustable baffle, enamelled lead-coated steel sash glazed with 1/4" thick laminated safety glass, supporting base structure as shown.

ACCESSORIES SHOWN (OPTIONAL)

4 - Electric, 2 - Air, 2 - Gas, 2 - Vacuum, 2 - Cold Water, 1-3" x 6" oval cup sink, 1 - Blower switch and pilot light, 8 - Remote control valves.

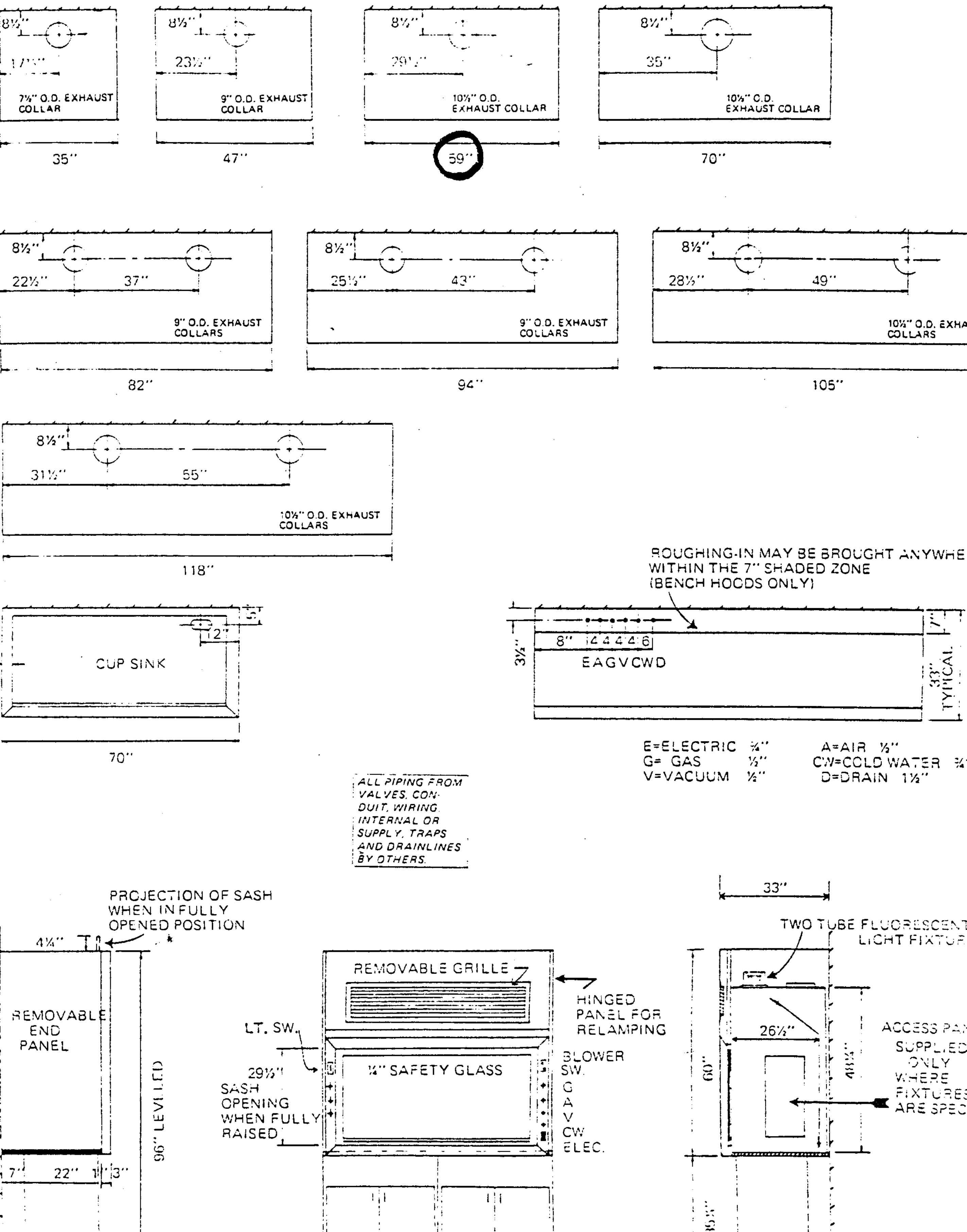
ALL ACCESSORIES ARE MOUNTED ON SIDE WALLS

Cat. No.	Length	Width	Height	Face Area+
SS-03	2' 11"	2'-9"	8'-0"	5.8
SS-04	3' 11"			[illegible]
SS-05	[illegible]			10.8

+Square feet [illegible]

SLIMLINE SERIES BENCH FUME HOODS

ROUGHING-IN DETAILS & DUCT COLLAR LOCATIONS & SIZES



BLOWER CALCULATIONS

V-1 c

The total volume of air exhausted by a fume hood, expressed in cubic feet per minute (CFM), is e amount of air necessary to operate a fume hood under a selected set of conditions. This volume is e product of (1) the fume hood face velocity and (2) the square footage opening of the sash(s). (See art below)

Face velocities for fume hoods are expressed in feet per minute (FPM) through the front hood ening, or hood face, and may vary considerably under different operating conditions such as cross afts, large heat loads, hood location or apparatus within the fume hood chamber. Under normal erating conditions, blower requirements should be established utilizing a face velocity for the raline Series of 100 FPM, for the Slimline Series of 90 FPM and for the Airline Series of 80 FPM, at a full sash opening. However, other velocities can be used for specific conditions.

The static pressure loss (S.P.), expressed in inches of water, is the sum of all friction losses roughout the hood and duct system and must be considered when selecting the blower. Since blower es are affected by the static pressure loss in the duct system, a lower static pressure loss is realized minimizing the number of elbows and by avoiding sharp bends.

For calculation purposes, 3/8" should be used as the static pressure loss through the fume hood.

FUME HOOD FACE OPENINGS*

Overall Hood Length	DURALINE SERIES at Full Sash Opening	SLIMLINE SERIES at Full Sash Opening	AIRLINE SERIES at Full Sash Opening
35"	6.2	5.8	5.0
47"	8.6	8.3	7.3
59"	10.9	10.8	9.8
70"	13.0	13.0	12.1
82"	15.4	15.5	14.6
94"	17.8	18.0	17.1
105"	20.1	20.5	19.4
118"	21.9	23.0	22.1
47" Dist.	10.3	———	10.0
59" Dist.	13.5	———	13.5
70" Dist.	16.5	———	16.6
47" Walk-In	16.7	———	15.8
59" Walk-In	22.0	———	21.2
70" Walk-In	26.8	———	26.2

* Given in Square Feet.

SAMPLE CALCULATIONS

1. DURALINE SERIES FUME HOOD

Cat. #DS-06, 70" long overall.

1. Determined face velocity - 100FPM
2. Calculated friction loss (S. P.) in duct system (less Fume Hood) - 7/8"
3. Total S. P. in duct system with hood - 7/8" + 3/8" (for hood) = 1¼" total S. P.

From chart on Pg. 239, Duraline Series Fume Hood, operating @ 100 FPM, requires blower #S-33 under column heading 1¼ system static pressure.

When calculating air requirements, it is important that the blower is sized to account for the static pressure loss throughout the entire system and should take into account such friction developing items in the ductwork as sharp bends, 90° turns, constructions, dampers, animal screens, shutters and long runs.

V-2a

ANSFER GRILLES
D REGISTERS

forated Face
ies A-CT AN-CT
inch margin
nch margin

ALUMINUM

A-CT and AN-CT transfer grilles and registers have perfor-
ces with 51% free area and perform efficiently on transfer,
and exhaust systems where ease of face maintenance is
ant. Faces are welded to the side margin, and are available
mpers and mounting frames.

JRES

ap margins — two sizes are available. 1¼ inch wide, with
et, pierced screw holes and mounting screws (Series A-CT).

ch wide, with gasket, pierced screw holes and mounting
vs (Series AN-CT). Fit lay-on tee bar ceiling opening with
3, 35, 47 inch listed sizes which have full margin rein-
d edges to lay flat. (Corresponding overall sizes 11¾, 23¾,
47¾ inch.)

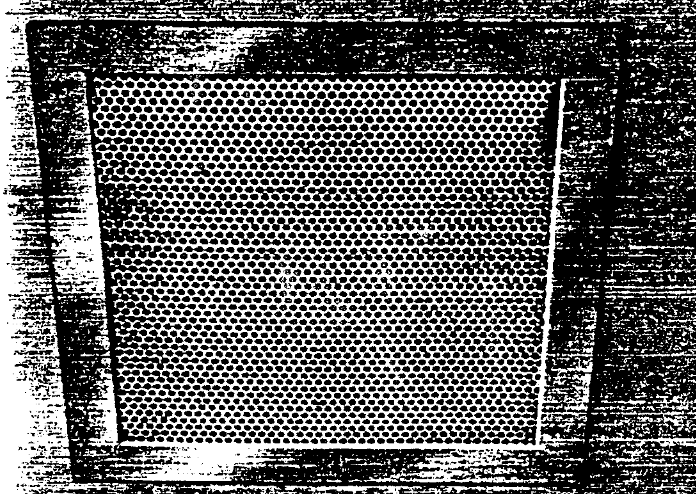
inum construction — heavy gauge extruded aluminum mar-
with hairline corners, perforated faces with 3/16 inch round
.

nting frames — available for use as plaster stop or separable
e to facilitate grille removal. Matching screw holes in grille
frame factory pierced for easy installation.

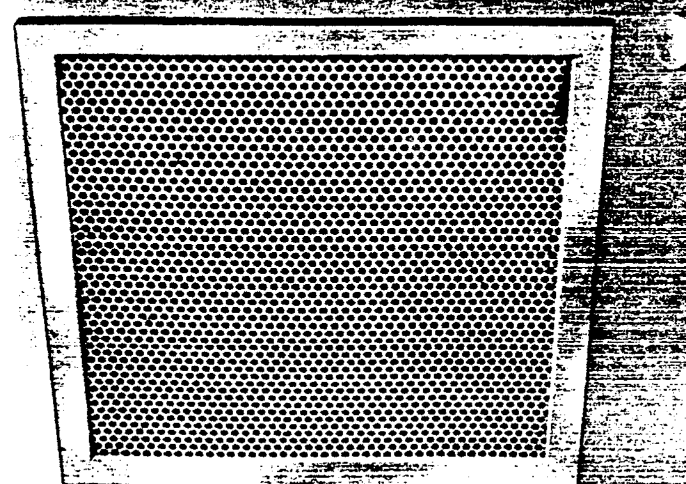
tral dampers — heavy gauge extruded aluminum blades in a
aluminum frame. Opposed blade design with a removable
perator.

d enamel finish — White No. 8-377 or etched and acrylic
(RL). Special paint finishes available.

STYLE



SERIES AN-CT



LISTED SIZES AVAILABLE in one piece

Min. W x H	Max. W x H
4 x 4	48 x 24
One inch increments of width and height.	
A-CT multiple sections furnished for sizes greater than maximum. AN-CT multiple sections furnished for sizes greater than maximum width; maximum height remains 24.	

All Dimensions in Inches.
Engineering Performance Data on page 55
Multiple section details and screw hole locations in Installation Manual.

ENGINEERING PERFORMANCE DATA

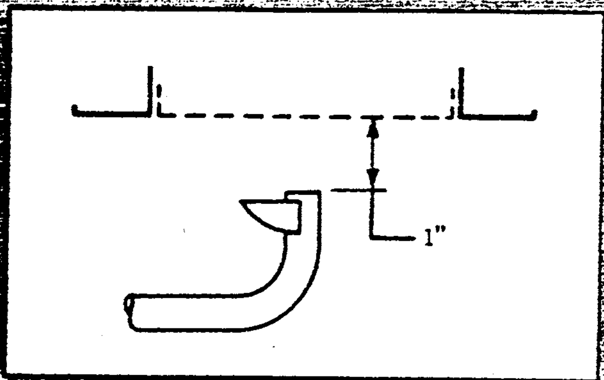
V-2b

RETURN AIR GRILLES AND REGISTERS

Listed Size W x H	A_K	NC 20—25 Application Non-Ducted P_s —.02" CFM	NC 20—25 Application Non-Ducted P_s —.03" CFM	NC 25—30 Application Ducted P_s —.08" CFM	NC 25—30 Application Ducted P_s —.10" CFM	NC 30—40 Application Ducted P_s —.15" CFM	NC 30—40 Application Ducted P_s —.20" CFM
8 x 4	.26	35	45	70	80	95	110
8 x 6	.34	55	70	110	125	150	175
10 x 6	.42	70	85	140	155	190	220
12 x 6	.50	85	105	170	190	235	270
10 x 8	.53	95	115	190	210	260	300
12 x 8	.63	115	140	230	260	315	365
10 x 10	.64	155	190	310	345	425	490
18 x 6	.75	170	210	340	380	465	535
12 x 12	.89	230	280	460	515	630	730
18 x 12	1.3	350	430	700	780	955	1110
22 x 10	1.4	355	435	710	795	970	1120
24 x 12	1.7	470	575	940	1045	1280	1485
18 x 18	1.9	530	650	1065	1190	1460	1680
34 x 10	2.1	550	675	1100	1230	1510	1740
30 x 12	2.2	590	725	1180	1320	1620	1865
24 x 18	2.5	715	875	1430	1590	1950	2260
22 x 22	2.8	800	975	1590	1785	2190	2530
30 x 18	3.2	900	1100	1790	2010	2460	2840
24 x 24	3.3	950	1160	1890	2120	2600	3000
36 x 18	3.8	1070	1310	2140	2390	2920	3380
30 x 24	4.1	1195	1460	2380	2680	3260	3770
34 x 22	4.3	1240	1515	2480	2770	3390	3920
36 x 24	4.9	1440	1710	2870	3210	3940	4550
46 x 22	5.9	1690	2070	3380	3780	4625	5350
36 x 30	6.1	1800	2210	3600	4025	4930	5700
48 x 24	6.6	1940	2380	3890	4350	5325	6150

Symbols: P_s Static Pressure in. H_2O
A_K Outlet Area, 1" Out from Face
NC re 10db room attenuation

AIR MEASUREMENT



2220A Velometer Jet for V_K velocity measurement.
CFM = A_K x V_K

TD

UAL PLENUM
OP INLET

V-3a

signed and constructed as component assem-
es to fit luminaires in installations requiring
al plenums for higher capacity applications
th a single top inlet.

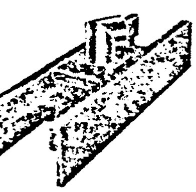
ATURES

- Air pattern adjustable with positive positioning "Uniflex" controller.
- Two styles and two heights.
- Separate inlet damper.
- Two way opposite air path.
- Horizontal or vertical pattern.
- Round inlets in four sizes.
- Air balancing damper adjustable through outlet slots.
- UL listed.
- Coordinated with over 30 luminaire manufacturers.
- Supply or return application.
- Low profile — minimum space requirements.

CCESSORIES

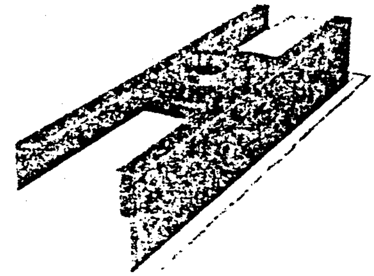
TYPE FTC FLEX TUBING CONNECTOR saves time and expense of field fasteners in joining flex tubing to the branch duct, as they screw easily into the flex and snap-in-fit a round hole in the metal duct. Available in 4" and 5" inlet sizes.

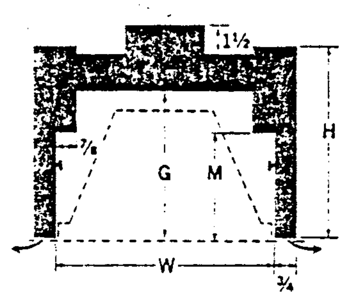
TYPE IJ INSULATION JACKETS of ½" glass fiber with aluminum vapor barrier to minimize heat transfer between the TD and the ceiling plenum. 1" insulation optional.



TYPE TU TURRET CONNECTORS facilitate alignment of unit inlet with flexible or metal ducting for ease of installation.

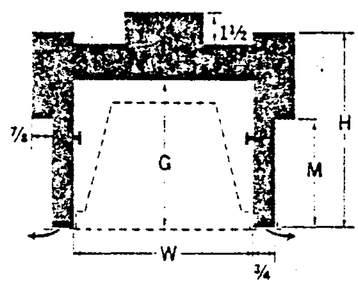
al plenum units are fabricated as three separate pieces
signed for snap-fastening together at installation. Gasketed.
lf-locating with positive holding springs — the crossover con-
ction securely holds the assembly and forms an air tight
nstruction. Savings in transportation, job handling, and job stor-
e result, with no compromise in unit quality or performance.





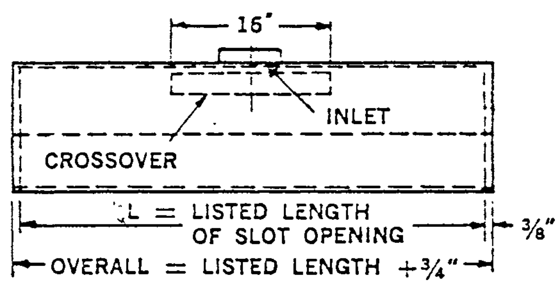
STYLE FF

Style KK available to fit Regressed Slot Luminaire.



STYLE EE

Style JJ available to fit Regressed Slot Luminaire.
Style EE, FF, JJ, KK available to fit 1" Throat Flange.



STANDARD "W" DIMENSION
9½" FOR 1 FOOT LUMINAIRE
21½" FOR 2 FOOT LUMINAIRE

OTHER WIDTHS AVAILABLE WHEN SPECIFIED.

STANDARD "L" LISTED LENGTHS
39½" FOR 4 FOOT LUMINAIRE
29" FOR 3 FOOT LUMINAIRE
20" FOR 2 FOOT LUMINAIRE

17"-60" LENGTHS AVAILABLE IN ½" INCREMENTS WHEN SPECIFIED.

DIMENSIONS

	G		H		M	
Height	6"	8"	6"	8"	6"	8"
Style FF	4 3/16	6 1/16	6 5/16	8	2½	4⅜
Style EE	4 3/16	6 1/16	6 5/16	8	2½	4⅜

All Dimensions in Inches.

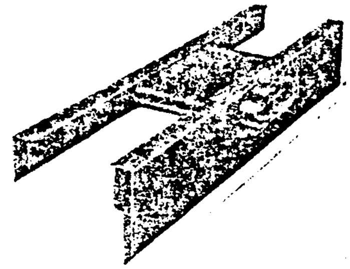
HOW TO SPECIFY

8 x 39½ x 21½ 4TD6-T2 STYLE FF

Listed Height x Length x
Nominal Luminaire
Inlet Size
Dual Plenum Cross-over
Dual Plenum
Dual Plenum
Plenum Style

TD

DUAL PLENUM SIDE INLET



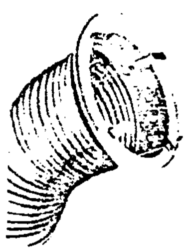
∇-3

Designed and constructed as component assemblies to fit luminaires in installations requiring dual plenums for higher capacity applications with a single side inlet.

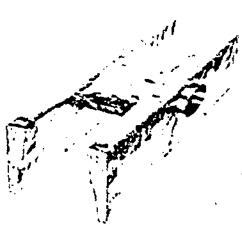
FEATURES

- Air pattern adjustable with positive positioning "Uniflex" controller.
- Two styles and two heights.
- Separate inlet damper.
- Two way opposite air path.
- Horizontal or vertical pattern.
- Oval inlets in three sizes.
- Air balancing damper adjustable through outlet slots.
- UL listed.
- Coordinated with over 30 luminaire manufacturers.
- Supply or return application.
- Low profile — minimum space requirements.

ACCESSORIES

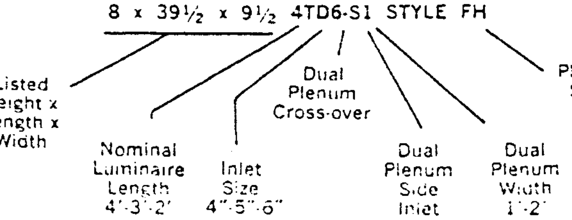


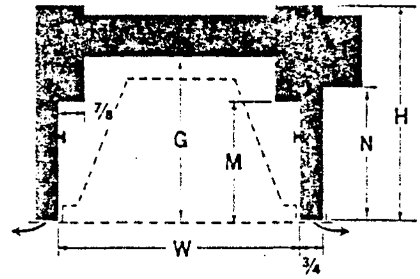
TYPE FTC FLEX TUBING CONNECTOR saves time and expense of field fasteners in joining flex tubing to the branch duct, as they screw easily into the flex and snap-in-fit a round hole in the metal duct. Available in 4" and 5" inlet sizes.



TYPE IJ INSULATION JACKETS of ½" glass fiber with aluminum vapor barrier to minimize heat transfer between the TD and the ceiling plenum. 1" insulation optional.

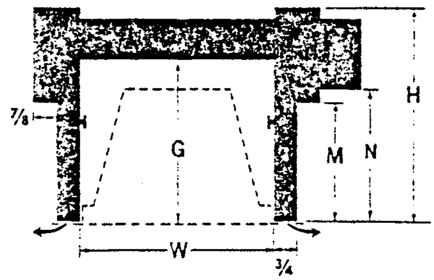
HOW TO SPECIFY





STYLE FH

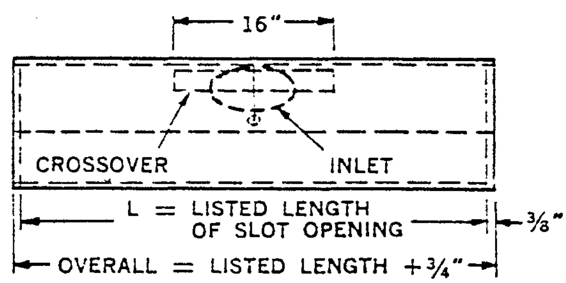
Style KM available to fit Regressed Slot Luminaire.



STYLE EG

Style JL available to fit Regressed Slot Luminaire.

Style EG, FH, KM, JL available to fit 1" Throat Flange.



STANDARD "W" DIMENSION
9½" FOR 1 FOOT LUMINAIRE
21½" FOR 2 FOOT LUMINAIRE

OTHER WIDTHS AVAILABLE WHEN SPECIFIED.

STANDARD "L" LISTED LENGTHS
39½" FOR 4 FOOT LUMINAIRE
29" FOR 3 FOOT LUMINAIRE
20" FOR 2 FOOT LUMINAIRE

17"-60" LENGTHS AVAILABLE IN ½" INCREMENTS WHEN SPECIFIED.

DIMENSIONS

	G		H		M		N	
Height	6"	8"	6"	8"	6"	8"	6"	8"
Style FH	4 3/16	6 1/16	6 1/16	8	2 1/2	4 3/8	2 3/4	4 5/8
Style EG	4 3/16	6 1/16	6 1/16	8	2 1/2	4 3/8	2 3/4	4 5/8

All Dimensions in Inches.

Dual plenum units are fabricated as three separate pieces designed for snap-fastening together at installation. Gasketed, self locating with positive holding springs — the crossover connection securely holds the assembly and forms an air tight construction. Savings in transportation, job handling, and job storage result, with no compromise in unit

ENGINEERING PERFORMANCE DATA

V-3C

NOTES:

Use Chart 2 to evaluate room air motion for modular unit installation, all unit lengths.
Use Table 2 to evaluate performance for individual units, nominal 4 ft. length.
Use Table 2A to evaluate performance for individual units, nominal 2 ft. length.

A Air change based on 8'-6" ceiling height. For other ceiling heights, enter Chart 2 with design cfm reduced by following amounts

9'-0" less 5%
9'-6" less 10%
10'-0" less 15%
10'-6" less 20%

B Room velocity V_R, measured in the occupied zone, and terminal velocity V_T at the zone boundary, are based on a cooling differential of 20 F.

C Luminaire or TD module area served in sq. ft.
Module area 25–150 sq. ft.

D cfm/unit for 20"–48" length.

CHART 2 — ROOM VELOCITY

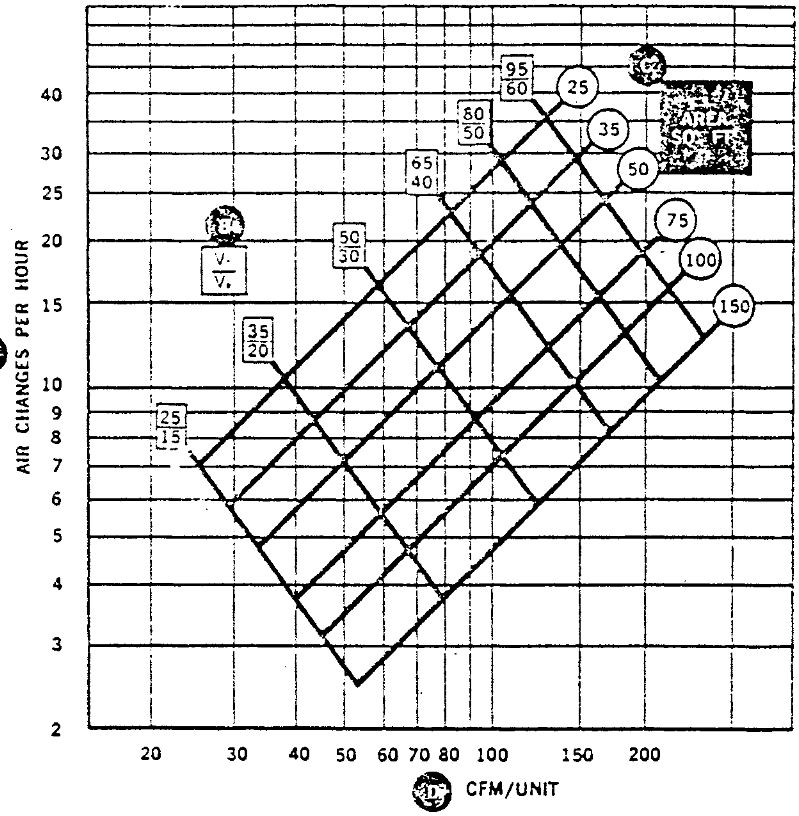


TABLE 2 SUPPLY PERFORMANCE, Nominal 4 Ft. Length, Horizontal Pattern

CFM	Minimum P_S* in. H_2O				NC @ Minimum P_S							Throw in Feet		Spread in Feet
	Inlet Size				T1 Inlet Size			T2 Inlet Size				@ 125 fpm V_T	@ 100 fpm V_T	
	8"	6"	5"	4"	6"	5"	4"	8"	6"	5"	4"			
60	.02	.03	.04	.04	<20	<20	<20	<20	<20	<20	<20	1	2	4-6
80	.03	.04	.06	.06	<20	<20	25	<20	<20	20	20	2	3	5-6
100	.04	.07	.09	.09	<20	<20	30	<20	<20	25	25	3	4	6-7
120	.06	.10	.13	.13	25	25	35	20	20	25	30	4	5	6-7
140	.08	.14	.17	.18	25	30	35	25	25	30	35	5	6	7-8
160	.11	.19	.22	.24	30	30	40	25	30	30	40	5	7	8-9
180	.13	.25	.28	.31	35	35	45	30	35	35	40	6	8	9-12
200	.16	.31	.34	.39	40	40	45	30	35	40	45	7	9	10-13
220	.20	.36	.41		40	40		35	40	40		8	9	10-14
240	.23	.45			45			35	40			8	10	10-14

*Reduce P_S 10% for vertical pattern

TABLE 2A SUPPLY PERFORMANCE, Nominal 2 Ft. Length, Horizontal Pattern

CFM	Minimum P_S* in. H_2O				NC @ Minimum P_S							Throw in Feet		Spread in Feet
	Inlet Size				T1 Inlet Size			T2 Inlet Size				@125 fpm V_T	@100 fpm V_T	
	8"	6"	5"	4"	6"	5"	4"	8"	6"	5"	4"			
60	.04	.06	.07	.08	20	20	25	<20	<20	20	20	2	3	4-6
80	.06	.10	.11	.12	25	25	30	20	20	25	25	3	4	5-6
100	.08	.14	.17	.18	30	30	35	25	25	30	30	4	5	6-7
120	.12	.20	.26	.27	35	35	40	30	30	35	35	5	7	6-7
140	.16	.28	.35	.36	35	40	45	30	30	35	40	6	8	7-8

*Reduce P_S 10% for vertical pattern.
Nominal 2 ft. data based on ADC approved nominal 4 ft. data.

P_V Velocity Pressure in. H_2O										
Inlet Size	CFM									
	60	80	100	120	140	160	180	200	220	240
8"	.01	.01	.01	.01	.01	.01	.02	.02	.03	.03
6"	.01	.01	.02	.02	.03	.04	.05	.07	.08	.09
5"	.01	.02	.03	.05	.07	.09	.11	.14	.16	.19
4"	.03	.05	.08	.12	.16	.21	.27	.33	.40	.48

$P_T = P_V + P_S$

Multiple Outlet Addition to NC Rating Tables 2, 2A					
Module Area — Sq. Ft.					
25	35	50	75	100	150
−10	−10	−5	−5	−5	0

SYMBOLS

V_T Terminal Velocity in FPM A Outlet area in sq. ft. P_V Velocity Pressure in. H_2O

TITUS® PRODUCTS

System Powered Assemblies

V-4a

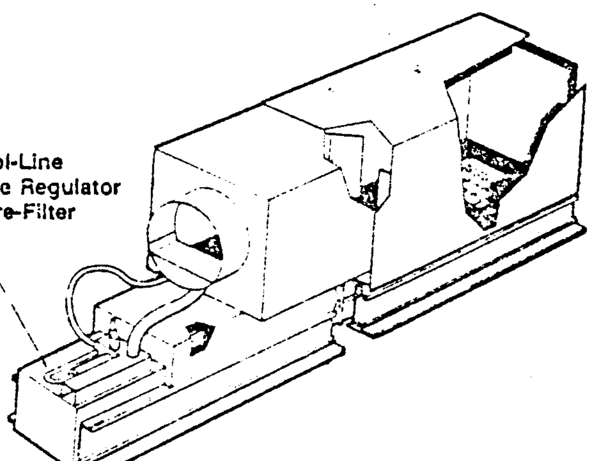
Models TCT-ML & TC-ML Variable Volume Full Shut-Off With Modulinear Diffuser

Model TCT-ML is a complete system powered assembly mounted directly on a 2-slot Modulinear diffuser. The assembly includes a diffuser mounted thermostat, control line filter, volume regulator and flow controller. It varies the air flow rate from 0 to 100%. Available with a 2-slot diffuser only.

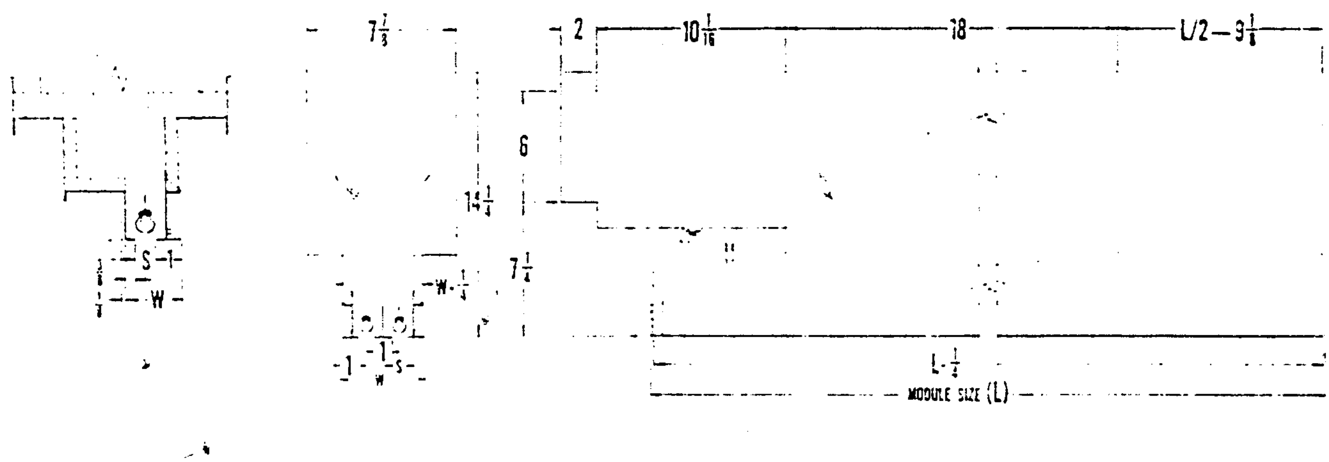
Model TC-ML is the same as Model TCT-ML except that it does not include the thermostat, control line filter and volume regulator. It is designed to be controlled from the auxiliary control line connection on another assembly, or from a remote thermostat and volume regulator. Available with either a 1- or 2-slot diffuser.

A flow rate dial on the assembly adjusts the flow controller orifice plate to preselect the maximum flow rate. This field adjustment is normally performed only once, when the system is initially balanced. The flow controller self-adjusts for varying inlet pressures.

Control-Line Volume Regulator and Pre-Filter



Module Size L = 24", 30", 36", 48", or 60"
Slot Width S = 1"
Overall Width W = 2⅜" for one slot
= 5" for two slots



Finish:

Diffuser face is #25 Off-White ENVIRO-THERM enamel. Pattern controller is flat black. For other finishes see inside back cover or your TITUS Products representative for Color Selection Guide AA-O.

Features:

- Pressure independent control
- Built-in control system. No field piping.
- Attached MODULINEAR diffuser. Adjustable for horizontal, vertical, one-way or two-way throw.
- One-inch, 1½ pound insulation, coated to prevent air erosion. Meets requirements of NBFU90A and 90B.

Thermostats: page G53

Thermostat/volume regulator diagrams: page G54

Applications: pages G37 and G38

Controller operating principle: page G36

Product improvement is a continuing endeavor at TITUS Products. Therefore, product descriptions are subject to change without notice. Contact your TITUS Products ...

System Powered Assemblies
Model TCT-ML & TC-ML Performance

TITUS PRODUCTS

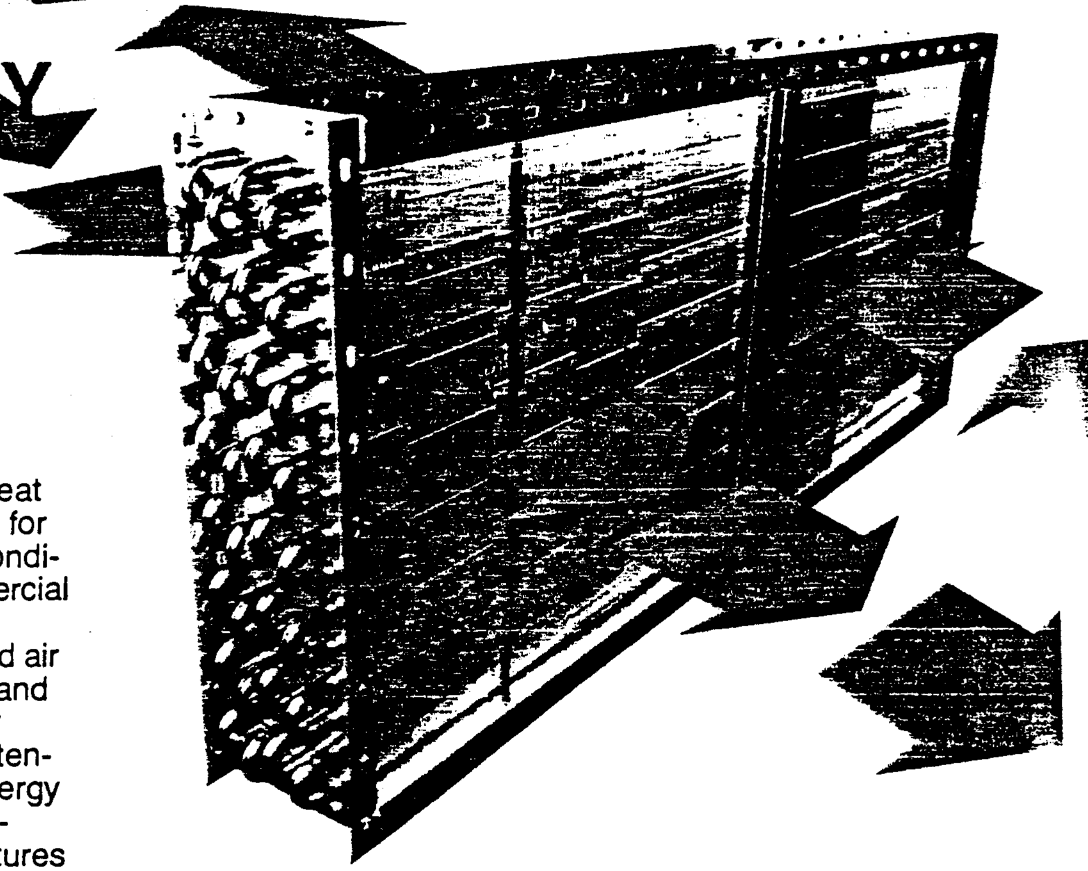
V-4b

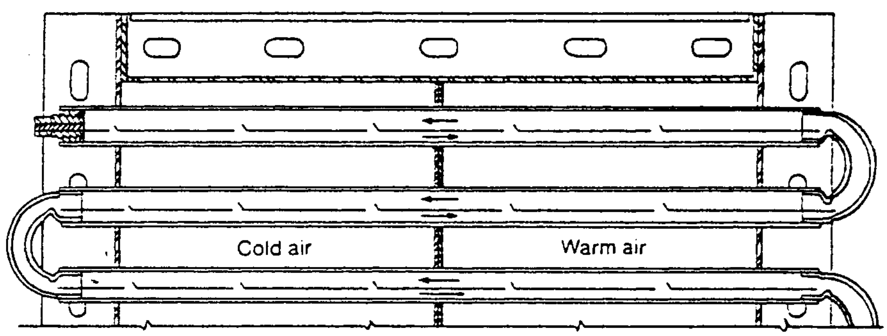
- Minimum SP. Static pressure difference from assembly inlet to discharge, in inches of water. Minimum required to maintain rated flow.
- CFM. Assembly flow rates are affected by downstream resistance. To obtain ratings shown in performance table, downstream resistance must be less than 0.30 inches of water.
- L_w. Sound power level in third octave band, re 10^{-12} watts.
- Room Outlet NC. Room noise criterion curve which will not be exceeded by assembly-generated noise transmitted through duct to room. Based on 10dB room absorption, re 10^{-12} watts.
- Diffuser. Performance table is based on diffuser 48 inches long with two 1-inch slots. Pattern controllers set for two-way horizontal air flow.
- Throw. Minimum throw is to terminal velocity of 150 fpm, middle to 100 fpm, maximum to 50 fpm.
- Contact your TITUS Products representative for other sizes and models.

Cfm	Throw, Ft.	1 In. S.P.		1.5 In. S.P.		2 In. S.P.		3 In. S.P.	
		Lw 3RD O.B.	Room NC OUTLET	Lw 3RD O.B.	Room NC OUTLET	Lw 3RD O.B.	Room NC OUTLET	Lw 3RD O.B.	Room NC OUTLET
75	1-2-4	53	33	54	34	55	35	57	37
100	1-2-4	55	35	56	36	57	37	58	38
125	2-3-5	56	36	57	37	58	38	60	40
150	3-4-6	57	37	59	39	60	40	61	41
175	3-5-7	58	38	60	40	61	41	62	42
200	4-6-8	59	39	61	41	62	42	63	44
225	4-7-9	60	40	61	41	62	42	64	45
250	5-7-10	—	—	62	42	63	44	64	45

V-5a

GAMEWELL
THERMOSIPHON
HEAT
RECOVERY
COIL . . .





mewell Thermosiphon heat covery coils are designed for e in a wide range of air condi- ning and industrial/commercial at recovery applications. herever hot, contaminated air gas must be exhausted, and other stream of cooler air st be heated, there is poten- for heat recovery and energy vings. Coils can serve air- eams ranging in temperatures m −50°F to 500°F or install o or more remote coils with erconnecting piping using the rmosiphon principal.
vantages: It's a passive device h no moving parts. Because re are no mechanical parts, only maintenance required occasional cleaning. Since re is nothing to wear out, pected service life is long.
lso provides the versatility air-to-air or air-to-water heat covery systems.
revents cross-contamination cause the coil is separated o two casings with double tal wall separating air streams.
ate fin coils are easy to clean.
designed to withstand differ- tial pressures between air- eams to 10″ W.G.
as all-metal air-side com- nents. Coils meet most local safety codes.
simple to install. Compact. piping. No flexible ducts

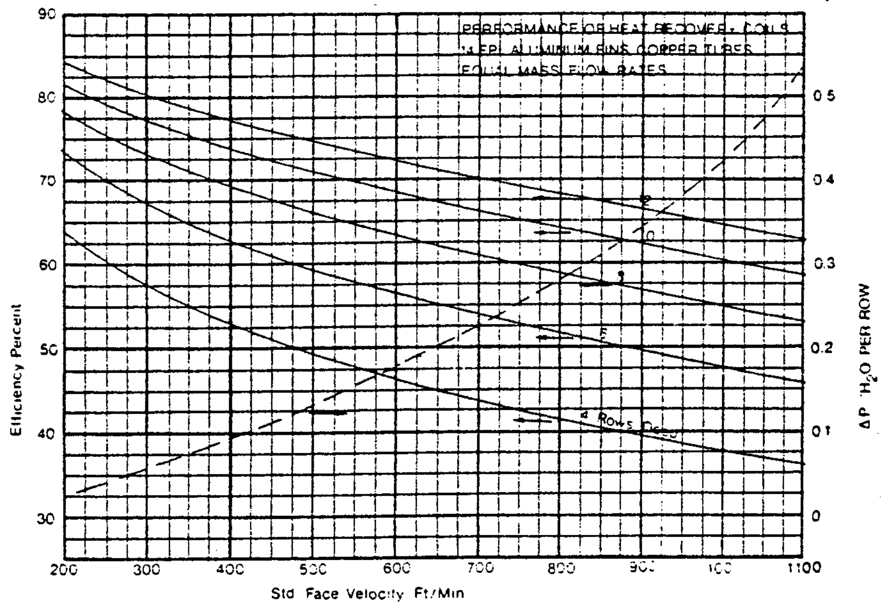
tion is achieved with no moving parts.
The Gamewell heat recovery coil consists of horizontal tubes expanded into vertical fins. A coil casing surrounds the coil, and central partitions divide the coil into two faces, one for the cold air stream, the other for the hot air stream. The casing and central partitions are provided with flanges and bolting holes for easy duct attachment.
The rate of heat recovery is proportional to the temperature

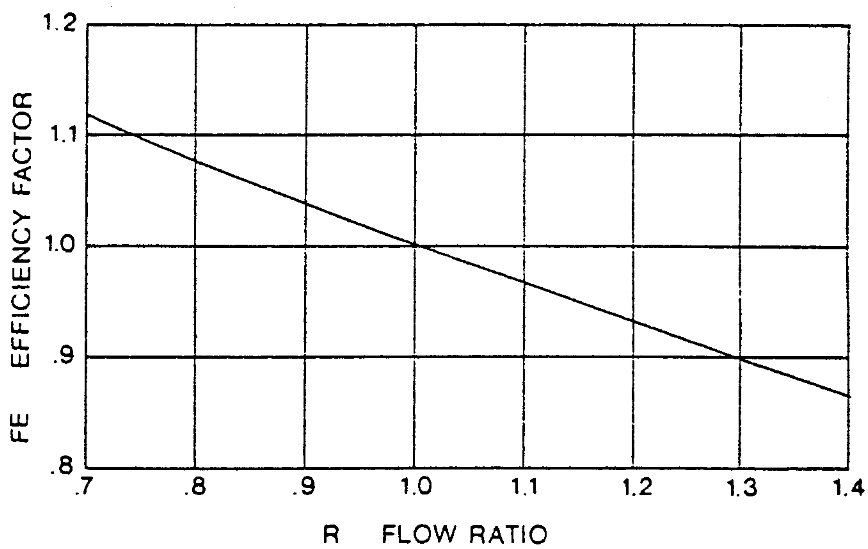
greater the rate of heat recovery efficiency.
The basic heat recovery coil is a completely passive device . . . as long as air is flowing across both faces, the unit will recover a fixed percentage of heat avail- able. In some applications it is necessary to control the rate of heat recovery to maintain certain conditions in space or process.
For applications where frost formation is likely, an optional defrost kit is available which periodically deactivates the cold-

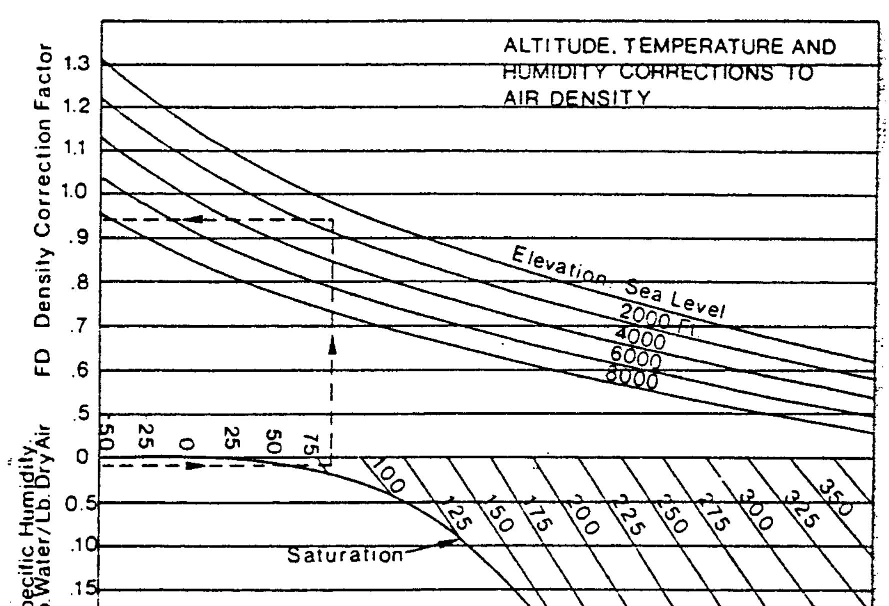
copper tubes, aluminum fins (14 fins/inch), and 16 gauge galvanized steel coil casing. Options include ... • 8 to 14 fpi aluminum or copper fins • Aluminum casing • Stainless steel casing • Carbon steel tubes, fins and casing (4, 8 or 12 fpi) • Chemical resistant polyurethane dip coating of all airside surfaces.

All coils comply with ANSI Standard B9. The working fluid used within the coil is non-toxic and non-flammable. It's guaranteed to produce no less than rated efficiency with no more than rated air side pressure drops when operated at rated air flows and temperatures and when properly installed. And to be free from defects in material or workmanship for a period of 15 months from date of shipment or 12 months from date of initial operations, whichever occurs first.

Gamewell also manufactures Tailor-Pak™ heat recovery units complete and ready for field installation with a minimum of field labor. They feature modular design that allows a wide variety of options to meet customer needs. Tailor-Pak™ heat recovery packages may include Thermosiphon coils, fans, filters and supplemental heating and refrigeration equipment. These packages are of industrial quality construction designed for many years of reliable operation. They are available for air flow rates ranging from 3,600 to 60,000 cfm.



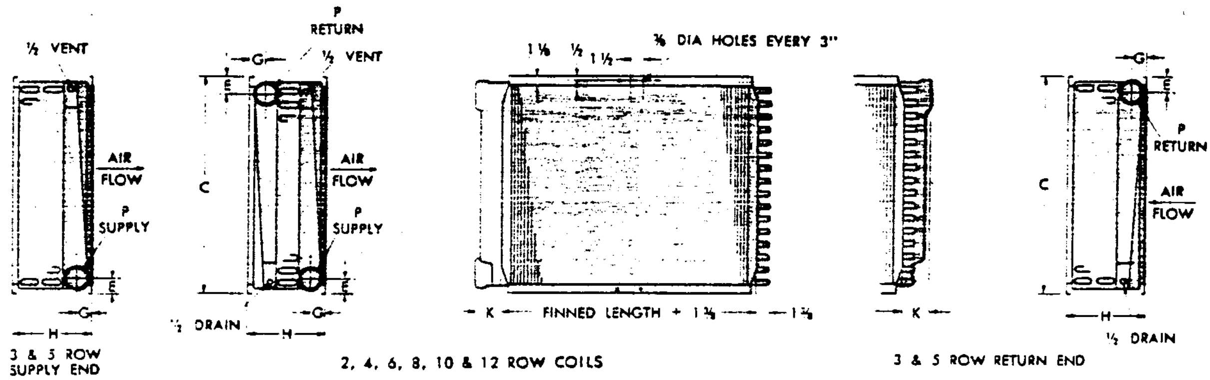




COOLING COIL DIMENSIONAL DATA

V-6a

E W.

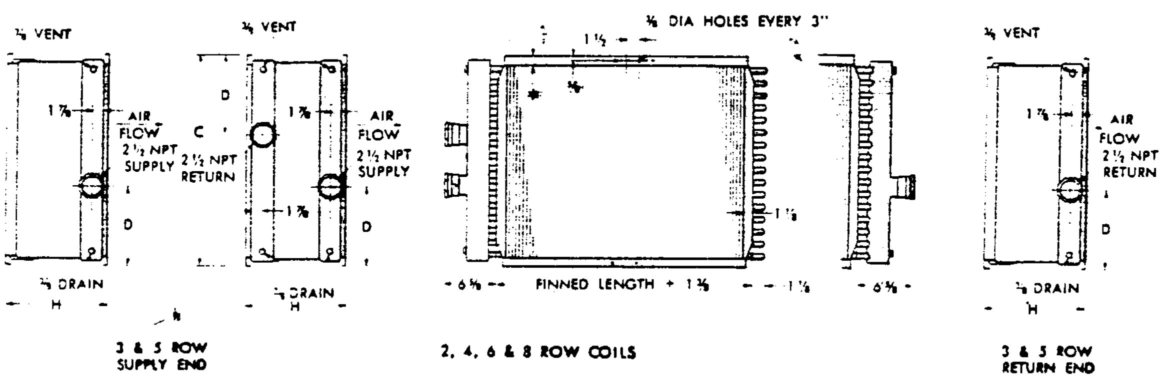


NOTE: All dimensions approximate.
Certified prints on request.

E 66-1— Type W Coil Dimensions (Headers 33" and less)

FINNED WIDTH	C	E	G	H 2 ROW	3 ROW	4 ROW	5 ROW	6 ROW	8 ROW	10 ROW	12 ROW	K	P (NPT)
12	13½	1½	2⅛	6½	8	9½	*	12½	15½	18½	21½	2	1¼
18	19½	2¼	1⅞				*					3¾	2½
24	25½						11						
30	31½												
33	34½												

row type W coil not available in 12" and 18" finned width.



E 66-2 – Type W Coil Dimensions (36", 42" and 48" Headers)

NED DTH	C	D	H 2 ROW	3 ROW	4 ROW	5 ROW	6 ROW	8 ROW
36	38¼	16⅛	6½	8	9½	11	12½	15½
42	44¼	19⅛						
48	50¼	22⅛						

CHILLED WATER COOLING COIL CAPACITIES

V-6b

80/68 EDB/EWB

WTR	FPS	ROW	FIN	400FPM MBH	400FPM LDB	400FPM LWB	500FPM MBH	500FPM LDB	500FPM LWB	600FPM MBH	600FPM LDB	600FPM LWB	700FPM MBH	700FPM LDB	700FPM LWB
10	1	2	55	6.1	66.9	63.6	6.5	68.9	64.2	6.9	70.6	64.7	7.2	71.2	65.0
			56	7.0	66.8	62.9	7.5	67.9	63.6	7.9	68.8	64.2	8.3	69.3	64.6
			58	7.9	64.7	62.2	8.4	65.9	63.0	8.9	66.6	63.7	9.3	68.0	54.1
		4	55	10.8	62.1	[illegible]	11.4	[illegible]	[illegible]	12.8	64.7	61.7	13.8	65.8	62.4
			56	12.2	59.8	59.6	13.4	61.4	59.9	14.3	62.6	60.6	15.1	63.5	61.6
			58	13.6	58.1	57.5	14.7	59.7	59.6	15.7	60.8	60.0	16.6	61.9	60.6
		6	55	14.6	57.6	56.6	16.2	59.2	58.0	17.4	60.5	59.1	18.5	61.6	60.0
			56	16.2	56.6	55.1	18.0	57.3	56.7	19.6	58.6	58.0	20.8	59.7	58.9
			58	17.8	54.0	53.9	19.6	55.8	55.8	21.2	57.2	57.0	22.5	58.3	58.1
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	19.8	51.8	51.7	22.8	53.7	53.4	24.8	55.2	54.8	26.8	56.4	56.0
			56	21.8	50.2	50.1	24.6	52.8	51.9	27.2	53.6	53.3	28.6	54.7	54.6
			58	22.7	48.8	48.8	26.2	50.8	50.7	28.8	52.3	52.3	31.5	53.8	53.8
	2	2	55	7.4	67.7	62.5	8.0	68.9	63.3	8.5	69.7	63.9	8.9	70.4	64.3
			56	8.7	65.4	61.5	9.5	66.6	62.4	10.1	67.6	63.1	10.6	68.4	63.6
			58	10.0	62.9	60.5	10.8	64.4	61.5	11.5	66.5	62.3	12.1	66.3	62.9
		4	55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			56	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		6	55	16.9	58.5	54.5	19.0	57.2	56.0	20.8	58.6	57.2	22.3	59.7	58.2
			56	18.8	53.8	52.8	21.5	54.7	54.2	23.7	56.1	55.5	25.5	57.3	56.6
			58	20.7	51.1	51.0	23.8	52.8	52.7	26.0	54.3	54.1	28.0	55.8	55.3
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	22.1	48.7	48.5	25.6	51.4	51.1	28.6	52.8	52.5	31.2	54.0	53.2
			56	23.8	47.8	47.7	26.8	49.7	49.2	31.6	50.7	50.6	34.7	51.8	51.7
			58	25.2	46.4	46.3	28.7	47.8	47.8	33.7	49.2	49.1	37.3	50.4	50.3
	4	2	55	8.5	66.6	61.7	9.3	68.0	62.5	10.0	68.9	63.1	10.5	69.7	63.6
			56	10.2	64.0	60.3	11.3	65.4	61.3	12.2	66.4	62.0	12.9	67.3	62.6
			58	11.9	61.3	58.9	13.1	62.8	60.1	14.1	64.0	61.0	14.9	65.0	61.6
		4	55	14.6	58.6	56.7	16.1	60.9	58.9	17.6	61.6	59.1	18.8	62.8	59.9
			56	16.7	55.8	54.7	18.6	57.5	56.1	20.8	58.8	57.2	22.4	59.8	58.1
			58	18.8	53.2	52.7	21.4	54.8	54.2	23.8	56.8	55.6	25.4	57.8	56.7
		6	55	18.5	53.9	53.0	21.2	55.8	54.5	23.4	57.0	55.7	25.3	58.2	56.7
			56	20.9	51.1	50.7	24.1	52.7	52.3	27.0	54.1	53.5	29.4	56.3	54.6
			58	22.8	48.9	48.8	26.6	50.5	50.4	29.8	51.9	51.7	32.7	53.1	52.9
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	23.5	48.2	48.1	27.6	48.7	48.5	31.2	51.1	50.8	34.4	52.3	51.9
			56	25.3	46.2	46.1	30.2	47.5	47.4	34.6	46.6	46.5	38.5	48.7	48.6
			58	26.8	44.8	44.7	32.0	46.0	46.9	36.9	47.0	46.9	41.4	48.8	47.9
	8	2	55	9.3	66.1	61.1	10.2	67.3	61.9	11.0	68.3	62.6	11.7	69.1	63.1
			56	11.4	63.0	59.4	12.7	64.4	60.4	13.8	65.5	61.1	14.7	66.4	61.8
			58	13.5	59.8	57.6	15.0	61.5	58.6	16.3	62.8	59.8	17.4	63.8	60.5
		4	55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			56	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			58	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		6	55	19.6	52.8	52.0	22.8	54.5	53.4	25.2	55.9	54.6	27.4	57.0	55.8
			56	22.2	49.7	49.4	26.8	51.3	50.8	28.3	52.8	52.0	32.2	53.7	53.1
			58	24.2	47.4	47.3	28.6	48.8	48.7	32.5	50.1	50.0	35.9	51.3	51.1
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	24.4	47.3	47.2	28.9	48.7	48.5	32.9	49.9	49.6	36.6	51.0	50.7
			56	26.2	46.3	46.2	31.6	46.2	46.2	36.5	47.3	47.2	41.0	48.3	48.2
			58	27.4	43.9	43.8	33.3	44.8	44.7	38.8	45.7	45.6	43.9	46.5	46.4
12	1	2	55	5.8	69.1	63.8	6.2	70.0	64.4	6.6	70.6	64.8	6.9	71.3	65.1
			56	6.7	67.0	63.1	7.2	68.1	63.8	7.7	68.9	64.3	7.8	69.9	64.8
			58	7.6	64.9	62.4	8.1	66.1	63.2	8.6	67.0	63.8	8.9	68.5	64.3
		4	55	10.4	62.5	60.1	11.4	63.8	61.2	12.1	64.8	62.0	12.8	65.8	62.8
			56	11.8	60.3	58.8	12.9	61.7	60.2	13.8	62.9	61.1	14.6	63.7	61.8
			58	13.0	58.5	57.9	14.2	60.0	59.3	15.2	61.2	60.3	16.1	62.1	61.1
		6	55	14.1	58.0	57.0	15.6	59.7	58.4	16.8	60.9	59.5	17.8	61.9	60.3
			56	15.8	56.1	55.6	17.4	57.7	57.2	18.8	59.0	58.3	20.0	60.0	59.3
			58	17.0	54.5	54.4	18.9	56.2	56.1	20.5	57.6	57.4	21.8	58.7	58.4
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	19.3	52.5	52.3	21.8	54.2	54.0	24.0	55.7	55.3	25.9	56.6	56.4
			56	20.9	50.8	50.7	23.8	52.8	52.5	26.4	54.0	53.9	28.5	56.2	56.1
			58	22.2	49.5	49.4	25.4	51.3	51.2	28.2	52.8	52.7	30.6	54.1	54.0
	2	2	55	7.1	68.0	62.8	7.6	69.1	63.5	8.1	69.9	64.1	8.6	70.6	64.5
			56	8.3	65.7	61.6	9.0	66.9	62.7	9.7	67.8	63.3	10.2	68.5	63.7
			58	9.6	63.3	60.6	10.4	64.6	61.8	11.1	65.7	62.5	11.6	66.5	63.1
		4	55	12.3	60.8	58.5	13.8	62.3	59.7	14.7	63.6	60.6	15.6	64.4	61.3
			56	14.2	58.2	56.9	15.8	59.8	58.3	17.1	61.0	59.3	18.2	62.0	60.1
			58	15.9	55.9	55.4	17.7	57.8	57.0	19.2	59.0	58.2	20.4	60.0	59.1
		6	55	16.3	56.0	55.1	18.3	57.7	56.6	20.0	59.1	57.7	21.4	60.2	58.6
			56	18.3	53.6	53.2	20.7	55.3	54.9	22.8	56.7	56.0	24.6	57.8	57.1
			58	20.0	51.6	51.5	22.8	53.4	53.3	25.1	54.9	54.6	27.1	56.1	55.8
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	21.4	50.3	50.2	24.8	52.0	51.8	27.6	53.4	53.1	30.1	54.6	54.2
			56	23.3	48.4	48.3	27.2	49.9	49.8	30.7	51.3	51.2	33.7	52.4	52.3
			58	24.7	46.9	46.8	29.0	48.4	48.3	32.8	49.8	49.7	36.2	51.0	50.9
	4	2	55	8.1	67.2	62.0	8.8	68.3	62.8	9.5	69.2	63.4	10.0	69.9	63.8
			56	9.8	64.5	60.7	10.7	65.8	61.6	11.6	66.8	62.3	12.3	67.6	62.8
			58	11.4	61.7	59.3	12.6	63.2	60.4	13.5	64.4	61.3	14.3	65.3	61.9
		4	55	13.8	58.8	57.3	15.4	61.0	58.5	16.8	62.3	59.6	18.0	63.3	60.3
			56	16.1	58.4	55.3	18.2	58.0	56.8	20.0	59.3	57.7	21.5	60.4	58.6
			58	18.2	53.8	53.3	20.8	58.5	54.9	22.8	56.9	56.1	24.4	58.1	57.1
		6	55	17.9	54.5	53.6	20.3	56.2	55.1	22.4	57.6	56.3	24.3	58.7	57.2
			56	20.2	51.7	51.4	23.3	53.3	52.9	26.0	54.7	54.1	28.3	55.9	56.2
			58	22.2	49.5	49.4	25.8	51.1	51.0	28.9	52.5	52.3	31.6	53.7	53.5
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	22.9	48.9	48.7	26.8	50.4	50.2	30.2	51.7	51.5	33.2	52.9	52.5
			56	24.8	46.8	46.7	29.5	48.1	48.0	33.7	49.3	49.2	37.4	50.3	50.2
			58	26.2	46.3	45.2	31.4	46.5	46.4	36.1	47.8	47.5	40.4	48.8	48.8
	8	2	55	8.8	66.5	61.4	9.7	67.7	62.2	10.5	68.6	62.9	11.1	69.3	63.3
			56	10.8	63.5	59.8	12.1	64.8	60.8	13.1	65.9	61.5	14.0	66.7	62.1
			58	12.9	60.4	58.1	14.4	61.9	59.3	15.6	63.2	60.2	16.6	64.2	60.9
		4	55	14.8	58.5	56.4	16.7	60.1	57.7	18.2	61.4	58.6	19.7	62.4	59.4
			56	17.4	55.1	54.0	19.8	56.8	55.4	22.0	58.1	56.5	24.0	59.1	57.4
			58	19.8	52.2	51.8	22.8	53.9	53.3	25.3	55.3	54.5	27.8	56.4	55.6
		6	55	18.9	53.5	52.6	21.7	55.1	54.1	24.2	56.5	55.2	26.3	57.7	56.2
			56	21.5	50.4	50.1	25.1	52.0	51.5	28.2	53.3	52.7	31.1	54.4	53.7
			58	23.6	48.0	47.9	27.9	49.5	49.4	31.5	50.8	50.6	34.8	51.9	51.7
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	23.8	47.9	47.8	28.1	49.4	49.2	31.9	50.6	50.3	35.4	51.7	51.4
			56	25.7	46.8	45.7	30.8	47.0	46.8	35.8	48.0	47.9	39.9	48.9	48.8
			58	27.0	44.4	44.3	32.8	45.3	45.2	38.1	46.2	46.1	43.0	47.1	47.0

90/68 EDB/EWB

400FPM MBH	400FPM LDB	400FPM LWB	500FPM MBH	500FPM LDB	500FPM LWB	600FPM MBH	600FPM LDB	600FPM LWB	700FPM MBH	700FPM LDB	700FPM LWB	FIN	ROW	FPS
6.9	74.3	62.9	7.7	76.0	63.5	8.4	77.3	63.9	9.0	78.3	64.3	55	2	1
8.1	71.6	61.9	9.1	73.8	62.6	9.8	75.2	63.2	10.5	76.4	63.8	56		
9.4	68.8	60.9	10.4	71.1	61.8	11.2	73.1	62.5	11.9	74.6	63.0	58		
11.8	63.1	58.9	13.3	65.8	59.8	14.8	66.7	60.7	15.8	66.7	61.5	55	4	
13.6	59.4	57.5	15.1	62.8	58.7	16.6	65.1	59.8	17.8	66.6	60.3	56		
14.9	56.2	56.1	16.8	58.8	57.5	18.4	62.2	58.9	19.7	64.0	59.3	58		
15.5	57.6	55.6	17.8	59.2	54.9	19.4	60.7	57.9	21.0	62.8	58.7	55	6	
17.3	54.8	54.0	19.6	58.5	55.5	21.7	57.2	56.6	23.5	59.8	57.5	56		
18.8	52.8	52.6	21.4	54.5	54.2	23.6	55.9	55.4	25.6	56.8	56.4	58		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
20.6	51.2	50.8	23.8	52.9	52.4	26.9	54.3	53.7	28.8	55.5	54.2	55	10	
22.3	49.3	49.2	25.8	50.9	50.8	28.8	52.3	52.1	31.8	53.4	53.2	56		
23.5	48.0	47.9	27.5	48.8	48.5	30.8	51.8	50.8	33.9	52.1	52.0	58		
7.9	72.0	62.1	8.8	74.1	62.8	9.7	75.4	63.3	10.4	76.5	63.6	55	2	2
9.5	68.5	60.8	10.5	70.9	61.7	11.6	72.5	62.3	12.5	73.8	62.7	56		
11.1	64.8	59.5	12.3	67.6	60.5	13.5	69.7	61.3	14.6	71.1	61.8	58		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	55	4	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	56		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	58		
17.4	58.8	53.8	19.8	57.5	55.3	22.1	59.0	56.4	24.1	60.1	57.2	55	6	
19.6	52.6	51.9	22.9	54.3	53.3	25.1	55.7	54.5	27.4	56.9	55.5	56		
21.4	50.2	50.0	24.8	51.9	51.8	27.7	53.3	52.9	30.3	54.5	54.0	58		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
22.3	48.3	48.0	26.3	50.9	50.4	29.7	52.3	51.7	32.7	53.3	52.7	55	10	
24.3	47.3	47.1	28.7	48.6	48.5	32.2	49.8	49.7	36.2	51.0	50.8	56		
25.6	46.6	46.7	30.5	47.1	47.0	34.9	48.3	48.2	38.8	49.4	49.3	58		
8.8	71.0	61.4	9.8	72.2	62.1	10.7	73.8	62.7	11.5	75.1	63.2	55	2	4
10.7	67.0	59.8	12.0	68.2	60.7	13.1	70.1	61.4	14.0	71.8	62.0	56		
12.7	62.7	58.1	14.2	64.1	59.2	15.6	66.5	60.1	16.8	68.3	60.7	58		
14.7	60.6	56.4	16.7	62.3	57.5	18.5	53.7	58.6	20.1	64.0	58.9	55	4	
17.2	56.5	54.2	19.6	58.2	55.5	21.8	58.6	56.5	22.8	60.8	57.3	56		
19.4	52.8	52.6	22.3	54.7	53.5	24.8	56.2	54.7	27.1	57.4	55.7	58		
18.8	54.4	52.6	21.7	56.2	54.0	24.2	57.7	55.1	26.5	58.0	56.0	55	6	
21.3	51.0	50.2	24.6	52.8	51.8	27.9	54.0	52.8	30.7	56.2	53.8	56		
23.3	48.3	48.2	27.3	49.9	49.8	30.9	51.2	50.8	34.1	52.4	51.9	58		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
23.7	48.1	47.7	28.0	49.5	49.0	31.9	50.8	50.2	35.4	51.9	51.2	55	10	
25.6	46.9	46.8	30.6	47.0	46.8	35.2	48.1	47.9	38.6	49.1	48.9	56		
26.8	44.5	44.4	32.4	45.4	45.3	37.6	46.4	46.3	42.3	47.3	47.2	58		
9.4	70.5	60.9	10.6	71.9	61.7	11.5	72.5	62.3	12.5	73.8	62.7	55	2	8
11.6	66.1	59.1	13.1	67.7	60.0	14.4	68.2	60.7	15.6	69.8	61.3	56		
13.9	61.5	57.1	15.7	63.3	58.2	17.3	64.8	59.1	18.7	65.7	59.8	58		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	55	4	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	56		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	58		
19.7	53.5	51.7	22.9	59.2	53.1	25.7	56.7	54.2	28.3	57.9	56.1	55	6	
22.4	49.8	49.1	26.3	51.4	50.4	29.9	52.7	51.5	33.1	53.8	52.5	56		
24.5	47.1	46.9	29.1	48.5	48.2	33.2	49.7	49.3	36.9	50.8	50.4	58		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
24.5	47.3	46.9	29.1	48.8	48.2	33.3	49.8	49.2	37.2	50.9	50.2	55	10	
26.3	45.1	46.0	31.7	46.0	45.9	36.8	47.0	46.8	41.8	47.9	47.7	56		
27.5	43.7	43.6	33.5	44.5	44.4	39.1	45.3	46.2	44.6	46.0	45.9	58		
6.8	74.6	63.0	7.6	76.3	63.6	8.2	77.6	64.0	8.8	78.6	64.4	55	2	1
8.0	71.9	62.0	8.9	73.9	62.7	9.7	75.4	63.3	10.2	76.7	63.7	56		
9.2	69.1	61.1	10.2	71.5	61.9	11.0	73.4	62.6	11.7	74.9	63.1	58		
11.6	63.7	59.1	13.0	66.4	60.1	14.3	68.5	60.9	15.4	70.8	61.4	55	4	
13.2	60.1	57.7	14.6	63.1	58.9	16.1	66.6	59.8	17.8	67.2	60.4	56		
14.7	56.7	56.4	16.5	60.9	57.7	18.2	62.8	58.7	18.4	64.8	59.5	58		
15.2	57.9	55.9	17.2	58.7	57.2	19.0	61.3	58.2	20.6	63.3	58.9	55	6	
16.9	55.1	54.3	19.2	56.8	55.7	21.3	57.6	56.8	23.1	60.1	57.7	56		
18.5	53.1	52.9	21.0	54.8	54.4	23.2	55.8	55.7	25.2	57.3	56.6	58		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
20.2	51.8	51.3	23.3	53.3	52.8	26.0	54.8	54.0	28.4	55.8	55.0	55	10	
21.8	49.7	49.5	25.4	51.3	51.2	28.4	52.8	52.4	31.2	53.8	53.5	56		
23.2	48.4	48.3	27.0	50.0	49.8	30.4	51.3	51.2	33.3	52.5	52.4	58		
7.6	72.7	62.3	8.6	74.4	62.9	9.4	75.7	63.4	10.2	76.8	63.7	55	2	2
9.3	69.0	61.0	10.3	71.3	61.8	11.4	72.8	62.4	12.3	74.1	62.8	56		
10.9	65.3	59.7	12.1	68.0	60.7	13.3	70.0	61.4	14.3	71.5	61.9	58		
13.1	62.1	57.8	14.8	63.8	58.8	16.3	66.3	59.7	17.7	67.7	60.3	55	4	
15.2	58.3	56.6	17.2	60.0	57.2	19.0	61.2	58.1	20.6	63.3	58.9	56		
17.1	56.2	54.2	19.4	56.9	55.6	21.4	57.5	56.7	23.2	58.8	57.8	58		
17.0	56.2	54.3	19.5	57.9	55.6	21.6	59.3	56.6	23.6	59.4	57.4	55	6	
19.2	53.0	52.3	22.1	54.7	53.7	24.8	56.0	54.8	26.9	57.2	55.8	56		
21.0	50.7	50.5	24.3	52.3	52.0	27.1	53.7	53.3	29.7	54.8	54.3	58		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
22.0	49.8	49.4	25.7	51.4	50.9	29.0	52.7	52.1	32.0	53.8	53.1	55	10	
23.9	47.8	47.5	28.2	49.0	48.9	32.0	50.3	50.1	35.5	51.4	51.2	56		
25.2	46.2	46.1	30.0	47.5	47.4	34.3	48.7	48.6	38.2	49.8	49.7	58		
8.5	70.6	61.6	9.6	72.5	62.3	10.4	74.3	62.9	11.3	75.4	63.3	55	2	4
10.4	66.4	60.1	11.7	68.8	60.9	12.8	70.9	61.7	13.8	72.2	62.1	56		
12.4	62.9	58.4	13.9	64.7	59.4	15.2	67.0	60.3	16.3	68.9	61.0	58		
14.3	60.9	56.7	16.3	62.7	57.8	18.6	64.8	58.7	19.6	66.6	59.4	55	4	
16.7	56.8	54.6	19.2	58.8	55.8	21.3	58.9	56.8	23.1	61.1	57.8	56		
19.0	53.3	52.4	21.9	55.0	53.6	24.3	58.6	56.0	26.6	57.7	56.8	58		
18.4	54.9	53.0	21.2	56.6	54.4	23.8	58.0	55.4	25.9	59.2	56.3	55	6	
20.8	51.4	50.7	24.2	53.0	52.1	27.3	54.4	53.2	30.0	55.5	54.2	56		
22.8	48.8	48.6	26.8	50.3	50.0	30.3	51.7	51.3	33.4	52.8	52.3	58		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
23.2	48.6	48.2	27.4	50.0	49.5	31.2	51.3	50.7	34.7	52.4	51.8	55	10	
25.1	48.3	46.2	30.1	47.5	47.4	34.8	48.6	48.4	38.7	48.8	49.4	56		
26.5	44.8	44.7	31.9	45.8	45.7	37.0	46.8	46.7	41.8	47.7	47.6	58		
9.1	70.7	61.1	10.3	72.1	61.9	11.2	73.0	62.4	12.0	74.5	62.9	55	2	8
11.2	66.4	59.4	12.7	68.0	60.2	14.0	68.8	60.9	15.2	70.3	61.5	56		
13.6	61.9	57.4	15.3	63.6	58.5	16.9	64.4	59.3	18.3	66.3	60.0	58		
15.1	60.2	56.0	17.3	61.8	57.1	19.2	63.3	58.0	21.0	64.4	58.7	55	4	
17.8	55.8	53.5	20.6	57.5	54.8	23.1	58.8	55.8	25.3	60.0	56.6	56		
20.4	52.0	51.1	23.7	53.7	52.5	26.8	55.1	53.6	29.2	56.3	54.6	58		
19.2	54.0	52.2	22.3	55.7	53.5	25.0	57.1	54.6	27.5	58.3	55.5	55	6	
21.9	50.3	49.6	25.7	51.9	50.9	29.2	53.1	52.0	32.3	54.3	52.9	56		
24.0	47.6	47.4	28.5	48.9	48.7	32.5	50.2	49.8	36.2	51.3	50.8	58		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
24.0	47.8	47.4	28.5	49.1	48.7	32.6	50.3	49.7	36.4	51.4	50.7	55	10	
25.9	45.5	45.4	31.2	46.5	46.4	36.2	47.4	47.3	40.8	48.4	48.1	56		
27.2	44.1	44.0	33.1	44.8	44.7	38.6	45.7	45.6	43.6	46.4	46.3	58		

1 MBh = MBh ft.² Coil Face Area. WTR = Water Temperature Rise, degrees F; fps = Water Velocity, Ft. Second; LDB = Leaving Dry Bulb, degrees F; LWB = Leaving Wet Bulb, degrees F. EWT = Entering Water Temperature, degrees F.

30
90
DB

70
WB

CHILLED WATER COOLING COIL CAPACITIES

V-6C

80/70 EDB/EWB

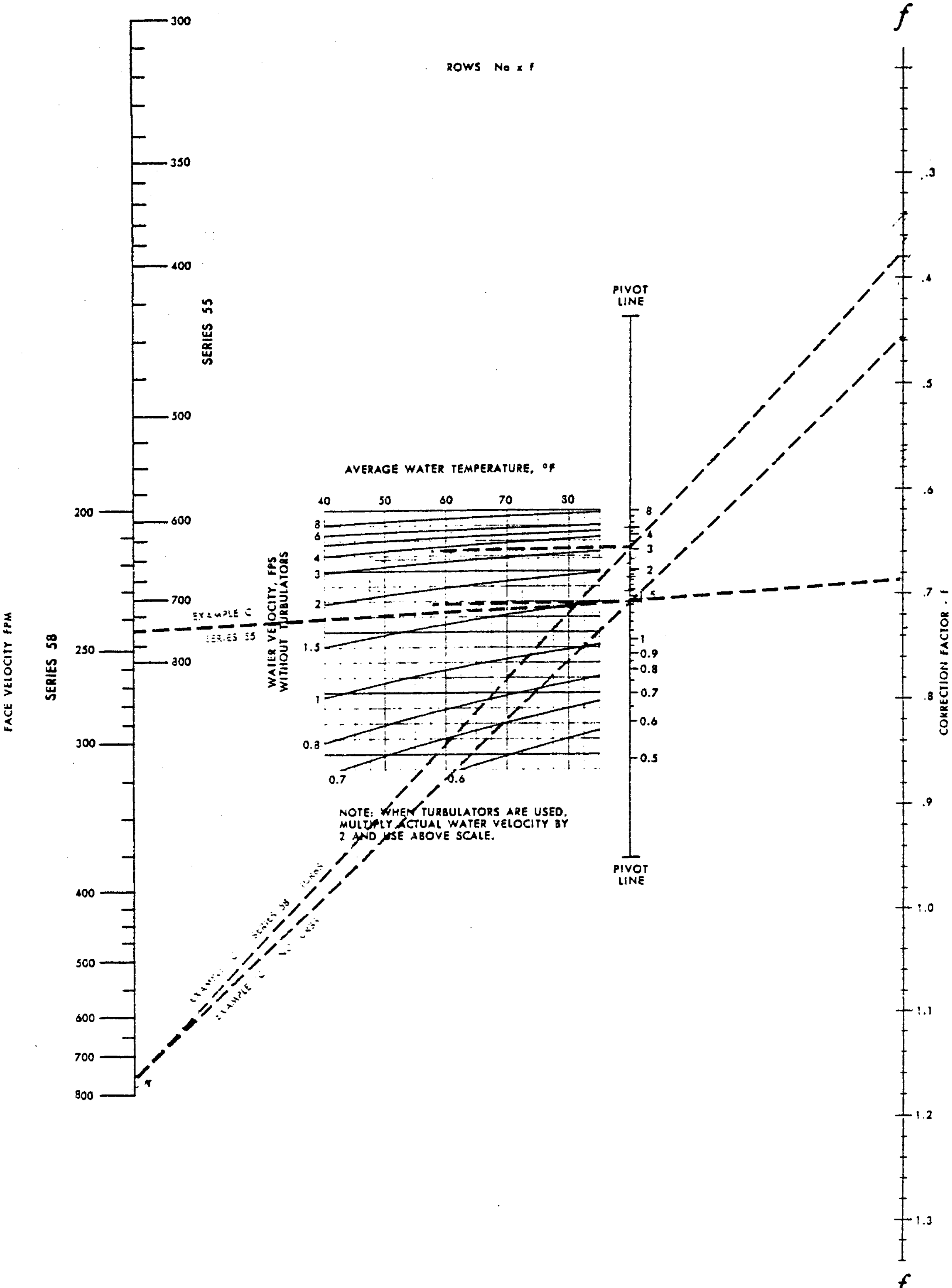
WTR	FPS	ROW	FIN	400FPM MBH	400FPM LDB	400FPM LWB	500FPM MBH	500FPM LDB	500FPM LWB	600FPM MBH	600FPM LDB	600FPM LWB	700FPM MBH	700FPM LDB	700FPM LWB
10	1	2	55	6.7	68.7	66.3	7.1	70.7	66.0	7.5	71.5	66.6	7.8	72.1	66.9
			56	7.7	67.9	64.6	8.1	69.0	65.5	8.5	69.9	66.1	8.8	70.5	66.5
			58	8.5	66.1	64.0	9.0	67.3	64.9	9.4	68.3	65.6	9.7	69.0	66.1
		4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		6	55	16.2	58.6	57.6	17.8	60.4	58.4	19.1	61.8	60.7	20.3	62.9	61.6
			56	17.9	56.8	56.3	19.8	58.5	58.1	21.4	60.0	59.4	22.6	61.1	60.5
			58	19.3	55.2	56.1	21.4	57.1	57.0	23.1	58.7	58.5	24.4	59.9	59.7
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	22.8	52.7	52.5	25.0	54.7	54.5	27.2	56.3	56.0	29.4	57.8	57.3
			56	23.7	51.0	50.8	27.1	52.9	52.8	30.0	54.6	54.5	32.3	55.8	55.6
			58	25.0	48.7	48.8	28.8	51.7	51.6	31.8	53.6	53.3	34.6	54.6	54.2
	2	2	55	8.3	68.4	64.2	8.8	69.6	65.0	9.5	70.4	65.6	9.9	71.1	66.1
			56	9.7	66.2	63.1	10.5	67.5	64.1	11.1	68.5	64.8	11.8	69.3	65.4
			58	11.0	64.0	62.0	11.8	65.5	63.2	12.5	66.7	64.1	13.1	67.6	64.7
		4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		6	55	18.8	58.2	55.5	21.2	58.1	57.2	23.1	59.5	58.5	24.7	60.8	59.6
			56	21.8	53.7	53.5	23.8	56.6	58.3	26.2	57.2	56.7	28.1	58.5	57.9
			58	22.8	51.9	51.8	25.9	53.8	53.7	28.6	55.4	55.3	30.8	56.8	56.6
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	24.6	50.2	50.1	28.4	52.8	51.8	31.7	53.6	53.4	34.6	54.9	54.6
			56	26.5	48.2	48.1	31.8	49.9	49.8	34.9	51.4	51.3	38.3	52.8	52.7
			58	27.8	46.8	46.7	32.8	46.6	46.6	37.2	48.9	48.8	41.1	51.2	51.1
	4	2	55	9.5	67.3	63.2	10.4	68.6	64.1	11.1	69.5	64.8	11.8	70.3	65.3
			56	11.4	64.7	61.7	12.6	66.1	62.8	13.5	67.2	63.6	14.3	68.1	64.2
			58	13.3	62.1	60.2	14.6	63.7	61.5	15.6	65.0	62.5	16.5	66.0	63.3
		4	55	16.1	59.8	57.9	18.6	61.2	59.3	19.6	62.8	60.4	21.6	63.7	61.3
			56	18.7	58.8	56.6	21.1	58.5	57.2	23.2	59.7	58.6	24.9	60.9	59.6
			58	21.0	53.9	53.5	23.2	55.8	56.3	26.1	57.0	56.6	28.1	58.7	57.8
		6	55	20.7	54.4	53.8	23.6	56.3	56.4	26.1	57.8	56.8	28.2	59.0	57.9
			56	23.3	51.6	51.3	26.9	53.3	53.0	30.0	54.8	54.4	32.7	56.1	55.8
			58	25.4	49.3	49.2	29.5	51.1	51.0	33.1	52.7	52.5	36.1	54.0	53.8
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	26.2	48.5	48.4	30.8	50.2	50.0	34.8	51.6	51.4	38.4	52.9	52.8
			56	28.2	46.4	46.3	33.5	47.8	47.7	38.4	49.1	49.0	42.5	50.3	50.2
			58	29.5	44.9	44.8	35.4	46.3	46.2	40.8	47.4	47.3	46.8	48.6	48.5
	8	2	55	10.4	66.4	62.6	11.5	67.8	63.5	12.4	68.8	64.2	13.2	69.6	64.7
			56	12.7	63.8	60.7	14.2	66.0	61.8	15.4	66.1	62.6	16.5	67.0	63.3
			58	15.1	60.5	58.8	16.8	62.2	60.1	18.2	63.6	61.2	19.4	64.8	62.0
		4	55	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
			56	20.2	56.8	54.2	23.2	58.7	58.6	25.7	59.2	57.8	28.0	59.3	58.6
			58	22.9	[illegible]	51.7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	31.9	[illegible]	[illegible]
		6	55	21.9	53.2	52.7	25.2	56.0	54.3	28.1	58.5	55.6	30.7	57.7	56.7
			56	24.7	50.1	49.9	28.8	51.8	51.5	32.7	53.2	52.8	36.0	54.4	53.9
			58	27.0	47.7	47.6	31.8	49.3	49.2	36.2	50.6	50.5	40.0	51.9	51.7
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	27.1	47.5	47.4	32.2	49.0	48.9	36.7	50.3	50.2	40.8	51.5	51.3
			56	29.1	46.4	46.3	35.1	46.5	46.4	40.6	47.8	47.5	45.8	48.6	48.5
			58	30.4	44.9	43.9	37.9	44.9	44.8	43.1	46.8	45.7	48.7	46.8	46.7
12	1	2	55	6.4	69.9	65.5	6.8	70.9	66.2	7.2	71.6	66.7	7.4	72.2	67.1
			56	7.3	68.1	64.9	7.8	69.2	65.6	8.2	70.0	66.2	8.5	70.7	66.6
			58	8.2	66.3	64.2	8.7	67.5	65.1	9.1	68.4	65.6	9.4	69.2	66.3
		4	55	11.5	65.5	63.6	12.8	66.0	62.8	13.3	66.1	63.7	13.9	67.8	64.4
			56	13.8	61.8	60.8	14.1	63.1	61.8	15.8	64.5	62.8	15.7	66.2	63.6
			58	14.2	58.9	59.4	16.4	61.5	61.8	18.4	62.8	62.1	17.2	62.8	63.0
		6	55	15.6	59.1	58.3	17.2	60.8	59.8	18.4	62.2	61.0	19.5	63.3	61.9
			56	17.3	57.2	56.9	19.1	59.0	58.6	20.6	60.4	59.9	21.8	61.5	60.9
			58	18.7	55.7	55.6	20.7	57.6	57.5	22.3	59.1	58.9	23.6	60.3	60.0
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	21.4	53.3	53.2	24.2	56.2	55.0	26.5	56.8	56.5	28.4	58.1	57.7
			56	23.1	51.8	51.5	26.3	53.5	53.4	29.0	58.1	55.8	31.3	58.4	56.3
			58	24.5	50.3	50.2	28.3	52.3	52.2	30.9	54.0	53.9	33.4	55.4	55.3
	2	2	55	7.9	68.7	64.4	8.5	69.8	65.2	9.0	70.7	65.8	9.4	71.3	66.3
			56	9.3	66.5	63.4	10.0	67.8	64.3	10.7	68.7	65.0	11.1	69.5	65.6
			58	10.6	64.4	62.4	11.4	65.8	63.5	12.0	66.9	64.3	12.6	67.8	65.0
		4	55	13.8	60.8	59.8	18.2	63.2	61.1	16.3	64.8	62.1	17.3	66.6	62.9
			56	15.8	59.1	58.1	17.5	60.6	59.7	18.9	62.1	60.8	20.1	63.2	61.7
			58	17.0	57.0	56.8	19.6	58.8	58.3	21.8	60.3	59.6	22.3	61.4	60.0
		6	55	18.2	56.8	56.1	20.4	58.6	57.7	22.2	60.1	59.0	23.7	61.3	60.0
			56	20.4	54.4	54.1	23.0	56.3	55.9	25.3	57.7	57.2	27.2	58.9	58.4
			58	22.2	52.5	52.4	25.2	54.4	54.3	27.7	56.0	55.8	29.8	57.3	57.1
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	23.9	50.8	50.7	27.6	52.7	52.5	30.7	54.2	54.0	33.4	55.5	55.2
			56	25.8	48.8	48.8	30.2	50.6	50.5	34.0	52.0	51.9	37.3	53.3	53.2
			58	27.3	47.3	47.2	32.1	49.0	48.9	36.3	50.5	50.4	40.0	51.8	51.7
	4	2	55	9.1	67.7	63.5	9.9	68.9	64.4	10.6	69.8	65.0	11.2	70.5	65.5
			56	11.0	66.1	62.1	12.0	66.5	63.1	13.0	67.5	63.9	13.7	68.4	64.5
			58	12.8	62.8	60.6	14.0	64.1	61.9	15.0	65.4	62.9	15.8	66.3	63.6
		4	55	15.5	60.2	58.6	17.2	61.7	59.8	18.8	63.0	60.8	20.1	64.1	61.7
			56	18.0	57.1	56.2	20.3	58.8	57.7	22.3	60.2	58.9	23.8	61.4	59.8
			58	20.2	54.6	54.2	22.8	56.6	56.0	25.1	57.8	57.3	27.8	59.2	58.4
		6	55	20.0	55.1	54.4	22.8	56.9	56.0	25.1	58.3	57.3	27.2	58.5	58.4
			56	22.6	52.2	52.0	26.0	54.0	53.7	29.0	55.5	55.0	31.6	56.7	56.2
			58	24.7	50.0	49.9	28.7	51.8	51.7	32.0	53.3	53.2	35.0	54.6	54.5
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	25.5	49.2	49.1	29.9	50.6	50.7	33.8	52.3	52.1	37.2	53.5	53.3
			56	27.6	47.8	46.8	32.8	48.5	48.4	37.4	49.8	49.7	41.6	50.9	50.8
			58	29.1	45.4	45.3	34.8	46.8	46.7	40.0	48.0	47.9	44.7	49.2	49.1
	8	2	55	9.9	67.0	62.9	11.0	68.2	63.8	11.8	69.1	64.5	12.6	69.9	65.0
			56	12.2	64.0	61.1	13.6	65.4	62.2	14.7	66.5	63.0	15.7	67.4	63.8
			58	14.5	61.1	59.3	16.1	62.7	60.6	17.4	64.0	61.6	18.6	65.0	62.4
		4	55	16.6	59.6	57.4	18.8	60.7	58.9	20.6	62.6	59.9	22.2	63.1	60.7
			56	19.6	56.7	54.8	22.4	57.4	56.3	24.8	58.7	57.5	26.9	58.8	58.6
			58	22.3	52.7	52.4	25.5	54.5	54.1	28.2	56.0	55.5	30.5	57.3	56.6
		6	55	21.2	53.8	53.3	24.4	55.7	54.9	27.1	57.1	56.2	29.5	58.3	57.2
			56	24.1	50.8	50.6	28.1	52.4	52.1	31.6	53.6	53.4	34.8	55.0	54.5
			58	26.4	48.3	48.2	31.0	49.9	49.8	35.1	51.3	51.2	38.8	52.6	52.4
		8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
		10	55	26.6	48.1	48.0	31.4	49.7	49.5	35.7	51.0	50.8	39.6	52.2	52.0
			56	28.7	45.9	45.8	34.4	47.2	47.1	39.7	48.2	48.1	44.5	49.3	49.2
			58	30.0	44.4	44.3	36.4	45.4	45.3	42.3	46.4	46.3	47.7	47.4	47.3

90/70 EDB/EWB

WTR	400FPM MBH	400FPM LDB	400FPM LWB	500FPM MBH	500FPM LDB	500FPM LWB	600FPM MBH	600FPM LDB	600FPM LWB	700FPM MBH	700FPM LDB	700FPM LWB	FIN	ROW	FPS
10	7.1	73.9	65.0	7.7	76.0	65.7	8.4	77.3	66.1	9.0	78.4	66.4	55	2	1
	8.3	71.2	64.1	9.1	73.6	64.9	9.8	75.2	65.4	10.5	76.5	65.8	56		
	9.5	68.5	63.1	10.4	71.1	64.0	11.2	73.1	64.7	11.9	74.7	66.2	58		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	
	16.7	58.0	57.3	18.6	60.9	58.8	20.3	62.3	58.9	21.8	63.5	60.6	55	6	
	18.5	56.4	56.6	20.8	58.2	57.3	22.8	58.7	58.6	24.4	60.6	58.6	56		
	20.1	54.4	54.2	22.7	56.3	56.0	24.8	57.8	57.4	26.6	59.0	58.5	58		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
	22.4	52.3	52.0	25.7	54.3	53.8	28.4	55.8	55.3	30.8	57.1	56.4	55	10	
	24.2	50.6	50.3	27.9	52.2	52.1	31.9	53.0	53.6	33.8	56.1	54.6	56		
	25.6	48.6	46.9	28.7	50.8	50.7	30.9	52.4	52.3	35.5	53.8	53.7	58		
	8.4	72.8	64.0	9.2	74.1	64.8	10.0	75.0	65.3	10.4	76.5	66.8	55	2	2
	10.0	68.3	62.8	11.0	70.6	63.7	11.9	72.1	64.4	12.5	73.9	65.0	56		
	11.6	66.6	61.5	12.8	68.8	62.8	13.8	69.2	63.4	14.6	71.2	64.1	58		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4	
	19.0	56.9	55.2	21.5	58.8	56.8	23.7	60.4	58.0	25.8	61.7	59.0	55	6	
	21.3	53.7	53.1	24.3	56.6	54.8	27.0	57.2	56.1	29.2	58.5	57.2	56		
	23.3	51.3	51.2	26.7	53.2	53.0	29.7	54.8	54.5	32.2	56.2	55.7	58		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
	24.7	50.1	48.8	28.7	51.9	51.5	32.2	53.5	52.9	35.4	54.8	54.1	55	10	
	26.6	47.9	47.8	31.4	48.6	48.4	35.8	50.9	50.8	38.3	52.7	52.8	56		
	28.1	46.3	46.2	33.3	47.9	47.8	38.6	49.2	49.1	42.3	50.9	50.6	58		
	9.5	71.8	63.2	10.5	73.3	64.0	11.3	74.4	64.6	12.1	75.3	65.1	55	2	4
	11.5	68.0	61.6	12.8	69.6	62.6	13.9	70.9	63.3	14.8	71.9	63.9	56		
	13.6	64.0	59.9	15.1	65.8	61.1	16.3	67.3	62.1	17.4	68.5	62.8	58		
	16.1	61.5	57.8	18.3	63.4	59.1	18.8	64.9	60.2	21.6	66.1	61.0	55	4	
	18.7	57.5	55.4	21.3	58.4	57.0	22.5	58.9	58.1	25.8	62.2	58.9	56		
	21.2	54.0	53.2	24.2	56.8	54.6	26.7	57.8	56.2	29.0	59.0	57.4	58		
	20.7	55.3	53.7	23.7	57.2	55.3	26.3	58.8	56.5	28.8	60.1	57.8	55	6	
	23.3	51.8	51.1	27.1	53.6	52.7	30.4	56.1	54.1	33.2	58.4	56.2	56		
	25.5	49.1	48.9	29.8	50.8	50.6	33.8	52.4	52.0	37.0	53.7	53.3	58		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
	26.1	48.8	48.3	30.8	50.2	49.8	34.8	51.7	51.2	38.7	53.0	52.3	55	10	
	28.2	46.3	46.2	33.7	47.8	47.5	38.6	48.8	48.7	43.2	50.6	49.8	56		
	29.6	44.6	44.7	36.6	45.8	45.8	41.2	47.8	46.8	46.5	48.1	48.6	58		
	10.3	71.1	62.5	11.5	72.6	63.4	12.4	73.8	64.1	13.3	74.7	64.6	55	2	8
	12.7	66.9	60.6	14.2	68.6	61.7	15.5	69.9	62.5	16.6	71.0	63.2	56		
	15.1	62.6	58.6	16.9	64.5	59.9	18.5	66.0	60.9	19.9	67.3	61.7	58		
	17.2	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	55	4	
	20.2	56.1	54.1	23.2	58.8	55.8	25.6	59.5	56.8	28.1	60.8	57.8	56		
	22.9	52.3	51.6	26.6	54.2	53.2	29.6	56.8	54.6	32.3	57.2	56.7	58		
	21.8	54.2	52.6	25.2	56.1	54.2	28.1	57.7	56.4	30.8	59.0	56.5	55	6	
	24.7	50.4	49.8	28.9	52.1	51.3	32.7	53.6	52.6	36.1	54.9	53.7	56		
	26.9	47.6	47.5	31.9	49.2	48.9	36.3	50.6	50.2	40.4	51.8	51.4	58		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
	27.0	47.7	47.4	32.1	49.2	48.8	36.7	50.5	50.0	40.8	51.7	51.1	55	10	
	29.0	45.3	45.2	35.0	46.4	46.3	40.8	47.5	47.4	46.7	48.5	48.2	56		
	30.3	43.9	43.6	36.9	44.8	44.7	43.1	45.6	46.5	48.8	46.5	46.4	58		
12	6.8	74.6	65.2	7.6	76.3	65.8	8.2	77.6	66.2	8.8	78.7	66.5	55	2	1
	8.0	71.9	64.3	8.9	73.9	65.0	9.7	75.4	65.5	10.2	76.8	65.9	56		
	9.2	69.1	63.4	10.2	71.5	64.2	11.0	73.4	64.8	11.7	74.9	65.3	58		
	12.2	66.0	61.8	13.5	66.6	62.1	14.6	67.9	63.0	16.6	68.8	63.8	55	4	
	13.8	61.8	59.7	15.4	63.5	60.9	16.7	64.9	61.8	17.8	67.0	62.6	56		
	15.4	59.3	58.4	17.1	60.9	59.8	18.5	62.1	59.8	19.7	64.5	61.7	58		
	16.2	59.4	57.6	18.2	61.2	59.1	19.8	62.8	60.2	21.3	63.7	61.0	55	6	
	18.1	56.7	56.0	20.3	58.5	57.6	22.3	58.8	58.8	23.9	61.1	59.8	56		
	19.7	54.7	54.6	22.2	56.6	56.3	24.3	58.1	57.7	26.1	59.2	58.7	58		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
	21.9	52.8	52.5	25.1	54.7	54.2	27.8	56.2	55.6	30.1	57.5	56.8	55	10	
	23.7	50.8	50.7	27.3	52.7	52.5	30.5	54.2	54.0	33.2	55.5	55.2	56		
	25.2	49.4	49.3	29.1	51.3	51.2	32.5	52.8	52.7	35.5	54.1	54.0	58		
	8.2	73.0	64.2	9.0	74.3	64.9	9.4	75.8	65.6	10.2	76.8	65.9	55	2	2
	9.7	69.5	63.0	10.7	70.8	63.8	11.4	72.9	64.6	12.3	74.1	65.1	56		
	11.3	65.9	61.7	12.5	67.4	62.7	13.5	69.7	63.5	14.3	71.6	64.2	58		
	14.1	63.3	58.6	15.7	66.1	60.7	17.2	66.5	61.8	18.6	67.0	62.5	55	4	
	16.3	58.7	57.8	18.3	61.5	58.0	20.6	63.0	60.1	21.5	64.1	60.8	56		
	18.3	58.7	55.8	20.6	58.8	57.5	22.5	60.1	58.7	24.2	61.3	59.7	58		
	18.5	57.4	55.7	20.9	59.2	57.2	23.0	60.8	58.4	24.9	62.0	59.3	55	6	
	20.8	54.2	53.8	23.8	56.1	55.2	26.3	57.6	56.5	28.5	58.8	57.6	56		
	22.8	51.8	51.6	26.2	53.7	53.4	29.0	55.2	54.9	31.5	56.5	56.1	58		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
	24.1	50.6	50.3	28.1	52.4	52.0	31.5	53.9	53.4	34.5	55.2	54.5	55	10	
	26.2	48.4	46.3	30.6	50.0	49.9	34.8	51.4	51.2	38.4	52.7	52.5	56		
	27.7	46.8	46.7	32.8	48.3	48.2	37.3	49.7	49.6	41.3	51.0	50.9	58		
	9.2	72.1	63.4	10.1	73.5	64.2	11.0	74.6	64.8	11.8	75.4	65.3	55	2	4
	11.1	68.3	61.9	12.4	69.9	62.8	13.5	71.1	63.5	14.4	72.1	64.1	56		
	13.2	64.3	60.2	14.7	66.1	61.4	15.9	67.5	62.3	17.0	68.0	63.0	58		
	15.8	62.0	58.2	17.6	63.8	59.6	19.2	65.3	60.6	20.8	66.4	61.3	55	4	
	18.3	58.0	55.9	20.7	58.8	57.4	22.8	61.3	58.8	24.8	62.3	59.4	56		
	20.7	54.6	53.7	23.8	56.4	56.3	26.1	58.6	56.7	28.3	59.3	57.7	58		
	20.1	55.6	54.2	23.0	57.7	55.7	25.5	59.3	57.0	27.8	60.5	57.9	55	6	
	22.8	52.3	51.7	26.4	54.1	53.3	29.6	56.6	54.8	32.4	56.8	55.7	56		
	25.0	49.6	49.4	29.2	51.3	51.1	32.9	52.8	52.5	36.1	54.1	53.7	58		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
	25.6	49.2	48.9	30.1	50.8	50.4	34.1	52.2	51.7	37.7	53.5	52.8	55	10	
	27.7	46.8	46.7	33.0	48.1	48.0	37.9	48.4	48.2	42.3	50.5	50.3	56		
	29.2	45.2	45.1	35.1	46.4	46.3	40.5	47.5	47.4	46.5	48.6	48.5	58		
	9.9	71.5	62.8	11.0	72.9	63.7	12.0	74.0	64.3	12.8	74.9	64.8	55	2	8
	12.2	67.4	61.0	13.7	69.0	62.0	15.0	70.2	62.8	16.1	71.3	63.4	56		
	14.7	63.0	59.0	16.4	64.8	60.2	18.0	66.3	61.2	19.3	67.6	62.0	58		
	16.6	61.0	57.3	18.9	62.9	58.6	20.8	64.4	59.7	22.5	66.6	60.5	55	4	
	19.6	56.7	54.7	22.5	58.5	56.1	25.6	60.6	57.2	27.3	61.3	58.2	56		
	22.3	52.9	52.1	25.8	54.7	53.7	28.5	56.5	55.0	31.8	57.7	56.1	58		
	21.2	54.8	53.2	24.5	56.6	54.7	27.3	58.2	55.9	29.9	59.5	56.9	55	6	
	24.1	51.0	50.4	28.2	52.7	51.9	31.9	54.1	53.1	35.2	55.4	54.2	56		
	26.5	48.1	48.0	31.3	49.7	49.5	35.5	51.1	50.8	39.4	52.3	51.9	58		
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	8	
	26.5	48.2	47.9	31.4	49.8	49.4	35.8	51.1	50.6	39.9	52.3	51.7	55	10	
	28.6	45.8	45.7	34.4	46.8	46.8	39.8	48.0	47.9	44.8	49.1	48.8	56		
	30.0	44.2	44.1	36.5	45.2	45.1	42.5	46.1	46.0	48.1	47.0	46.9	58		

TE: 1. MBh = MBh ft.^{2} Coil Face Area; WTR = Water Temperature Rise, degrees F; fps = Water Velocity, Ft./Second; LDB = Leaving Dry Bulb, degrees F; LWB = Leaving Wet Bulb, degrees F; EWT = Entering Water Temperature, degrees F.
2. When using turbulators, make selection based on double the actual water velocity.

CHART 10-1 — Water Sensible Cooling Coil Capacity Correction Factor



NOTE: Shaded Areas beyond ARI Certification.

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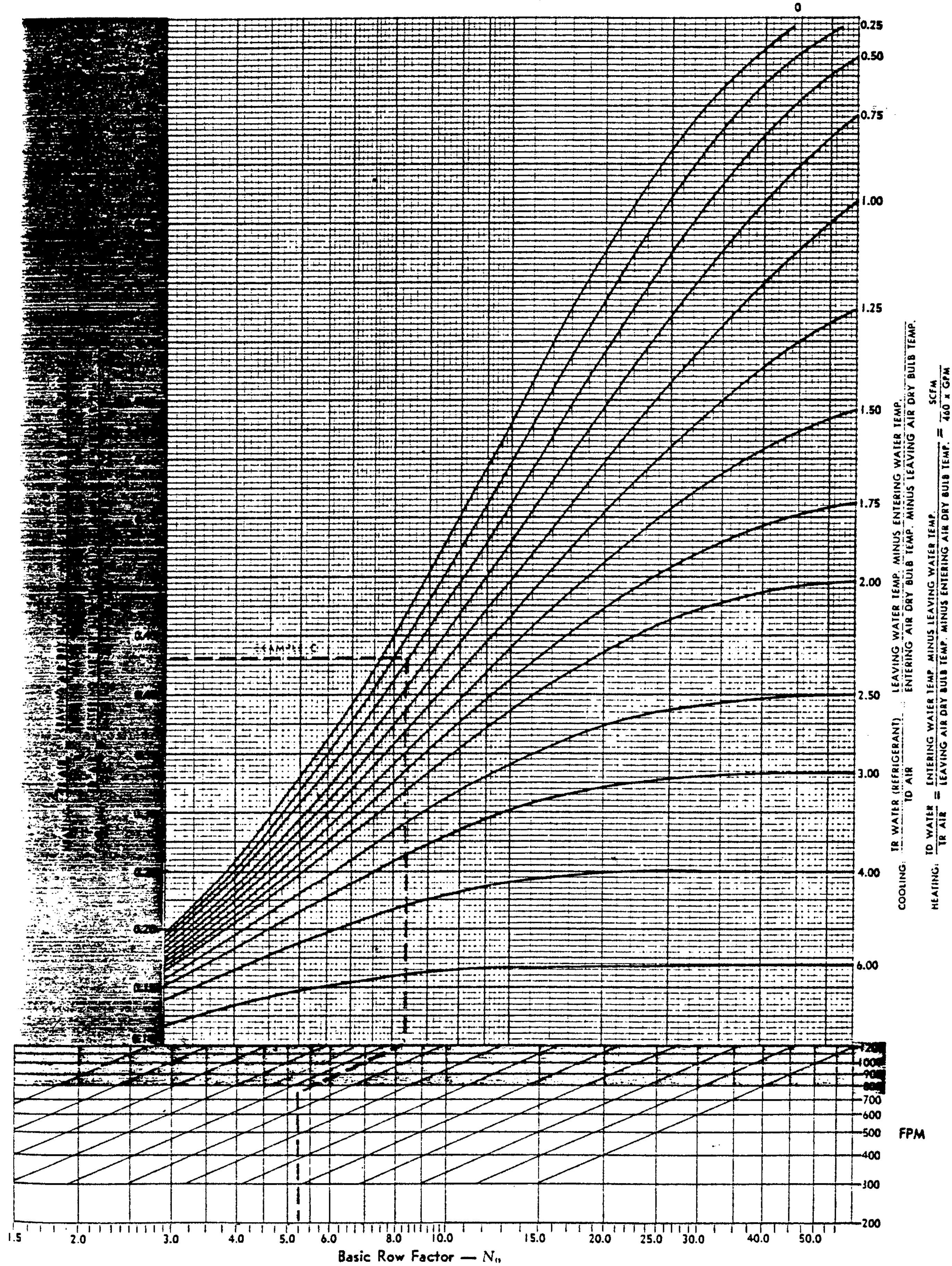
CHART 11-1 — Water Sensible Cooling and Heating Coil Basic Row Factors (N)



SHADED AREAS ARE BEYOND RANGE OF ARI CERTIFICATION

V-6P

TABLE 75-1 — Total Header Water Pressure Drop (Ft. H_2O)

COIL TYPE	FINNED WIDTH	VELOCITY (FPS)							
		1	2	3	4	5	6	7	8
P2	ALL	.06	.24	.51	.87	1.39	2.04	2.76	3.60
P4	ALL	.094	.29	.63	1.15	1.71	2.64	3.57	4.70
P8	ALL	.10	.36	.79	1.44	2.23	3.19	4.37	5.87
W,D,K	12"	.09	.32	1.29	1.30	2.04	2.96	4.04	5.25
W,D,K	18"	.05	.18	.40	.70	1.11	1.61	2.18	2.79
W,D,K	24"	.07	.29	.65	1.16	1.82	2.64	3.57	4.69
W,D,K	30"	.10	.43	.95	1.71	2.64	3.79	5.20	6.78
W,D,K	33"	.13	.49	1.09	1.96	3.06	4.40	6.00	7.83
W	36"	.15	.60	1.33	2.41	3.77	5.42	7.38	9.64
W	42"	.18	.70	1.57	2.79	4.36	6.27	8.54	11.16
W	48"	.20	.81	1.82	3.22	5.04	7.25	9.88	12.89
DD	18"	.10	.43	.97	1.69	2.62	3.80	5.25	6.75
DD	24"	.18	.75	1.68	2.96	4.71	6.77	9.21	11.99
DD	30"	.30	1.17	2.62	4.72	7.49	10.53	14.05	18.75
DD	33"	.35	1.43	3.17	5.70	8.79	12.66	17.38	22.81

TABLE 75-2 — Tube Water Pressure Drop Per Pass (Ft. H_2O)*

FINNED LENGTH (IN.)	VELOCITY WITH TURBULATORS (FPS)								VELOCITY WITHOUT TURBULATORS (FPS)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
12	.07	.27	.57	.95	1.38	1.96	2.63	3.52	.02	.09	.18	.30	.45	.62	.82	1.04
24	.11	.39	.82	1.37	2.00	2.85	3.81	4.86	.04	.13	.26	.44	.65	.89	1.19	1.51
36	.15	.51	1.08	1.80	2.62	3.73	5.00	6.37	.05	.17	.34	.57	.85	1.17	1.56	1.98
48	.18	.64	1.34	2.22	3.25	4.62	6.18	7.88	.06	.20	.42	.71	1.06	1.45	1.93	2.45
60	.22	.76	1.59	2.65	3.87	5.50	7.37	9.39	.07	.24	.50	.84	1.26	1.72	2.30	2.92
72	.25	.88	1.85	3.08	4.49	6.39	8.55	10.90	.08	.28	.58	.98	1.46	2.00	2.67	3.39
84	.29	1.00	2.10	3.50	5.11	7.27	9.74	12.41	.09	.32	.66	1.11	1.66	2.28	3.04	3.86
96	.32	1.12	2.36	3.93	5.73	8.16	10.92	13.92	.10	.36	.74	1.25	1.86	2.55	3.41	4.33
108	.36	1.25	2.62	4.35	6.36	9.04	12.11	15.43	.11	.40	.82	1.38	2.06	2.83	3.78	4.80
120	.39	1.37	2.87	4.78	6.98	9.93	13.30	16.94	.12	.44	.90	1.52	2.27	3.11	4.15	5.27
132	.43	1.49	3.13	5.21	7.60	10.81	14.48	18.45	.13	.48	.98	1.65	2.47	3.39	4.52	5.74
144	.46	1.61	3.38	5.63	8.22	11.70	15.67	19.96	.14	.52	1.06	1.79	2.67	3.66	4.89	6.21

*Based on W coils. For P, D, DD, K coils. Use Table 75-3
NOTE: Apply temperature correction factor. Table 75-4 for average water temperature other than 60 F.

TABLE 75-3 — Additional Water Pressure Drop Per Pass For P, D, DD, K Coils

COIL TYPE	VELOCITY WITH TURBULATORS (FPS)								VELOCITY WITHOUT TURBULATORS (FPS)							
	1	2	3	4	5	6	7	8	1	2	3	4	5	6	7	8
P2, P4, P8	.00	.03	.05	.09	.13	.19	.25	.32	.00	.01	.02	.03	.04	.06	.08	.10
D	.03	.12	.23	.37	.55	.76	1.04	1.33	.01	.03	.07	.12	.18	.24	.32	.41
DD	.03	.10	.21	.35	.51	.73	.97	1.24	.01	.03	.07	.11	.16	.23	.30	.38
K	.07	.25	.52	.86	1.26	1.79	2.39	3.05	.02	.08	.16	.27	.40	.56	.74	.94

WATER PRESSURE DROP EXAMPLE

EXAMPLE:

Determine WPD for a 4-row P2 Coil, 18" x 60", with 9.05 gpm, and 60 F average water temperature.

1. Velocity (fps) = gpm/1.81
   = 9.05/1.81
   = 5 fps
2. Header WPD = 1.39 ft. H_2O (Table 75-1)
3. Tube WPD = (Tube WPD Per Pass, Table 75-2 + Additional WPD Per Pass, Table 75-3 × (Number Passes, Table 75-5) × (Average Water Temperature Correction Factor, Table 75-4)
   = (1.26 + .04) × 24 × 1.00
   = 1.30 × 24
   = 31.20 ft. H_2O
4. Total WPD = Header WPD + Tube WPD
   = 1.39 + 31.20
   = 32.59

TABLE 75-4 — Average Water Temperature Correction Factors For Water Pressure Drop (F)

	TEMPERATURE (F)					
	40	50	60	100	150	200
W/TURB.	1.07	1.30	1.00	.91	.83	.78
WO/TURB.	1.12	1.05	1.00	.87	.78	.72

TABLE 75-5 — Number of Water Passes By Coil Type

COIL TYPE	FINNED WIDTH				
	ROWS	12"	18"	24"	30"
P2	4	16	24	32	40
P2	6	24	36	48	60
P4	2	4	6	8	10
P4	4	8	12	16	20
P4	6	12	18	24	30
P4	8	16	24	32	40
P8	4	—	6	8	10
P8	8	—	12	16	20
W, D, K	NUMBER PASSES = NUMBER ROWS				
DD	NUMBER PASSES = NUMBER ROWS × 0.5				

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TABLE 76-1 — Coil Face Area (Square Feet) Not Including Casing

FINNED WIDTH (INCHES)	FINNED LENGTH (INCHES)													
	12	18	24	30	36	42	45	48	51	54	60	66	72	78
12 18	1.0	1.5 2.25	2.0 3.0	2.5 3.75	3.0 4.5	3.5 5.25	3.75 5.62	4.0 6.0	4.25 6.37	4.5 6.75	5.0 7.5	5.5 8.25	6.0 9.0	6.5 9.75
24 30			4.0	5.0 6.25	6.0 7.5	7.0 8.75	7.5 9.37	8.0 10.0	8.5 10.62	9.0 11.25	10.0 12.5	11.0 13.75	12.0 15.0	13.0 16.25
33 36					8.25 9.0	9.63 10.5	10.32 11.25	11.0 12.0	11.69 12.75	12.38 13.5	13.75 15.0	15.13 16.5	16.5 18.0	17.88 19.5
42 48						12.25	13.0	14.0 16.0	15.0 17.0	15.75 18.0	17.5 20.0	19.25 22.0	21.0 24.0	22.75 26.0

FINNED WIDTH (INCHES)	FINNED LENGTH (INCHES)													
	81	84	90	96	99	102	105	108	114	120	126	132	138	144
12 18	6.75 10.12	7.0 10.5	7.5 11.25	8.0 12.0	8.25 12.37	8.5 12.75	8.75 13.12	9.0 13.5	9.5 14.25	10.0 15.0	10.5 15.75	11.0 16.5	11.5 17.2	12.0 18.0
24 30	13.5 16.87	14.0 17.5	15.0 18.75	16.0 20.0	16.5 20.62	17.0 21.25	17.5 21.87	18.0 22.5	19.0 23.75	20.0 25.0	21.0 26.25	22.0 27.5	23.0 28.75	24.0 30.0
33 36	18.57 20.25	19.25 21.0	20.63 22.5	22.0 24.0	22.69 24.75	23.38 25.5	24.07 26.25	24.75 27.0	26.13 28.5	27.5 30.0	28.88 31.5	30.25 33.0	31.63 34.5	33.0 36.0
42 48	23.63 27.0	24.5 28.0	26.25 30.0	28.0 32.0	28.88 33.0	29.75 34.0	30.63 35.0	31.5 36.0	33.25 38.0	35.0 40.0	36.75 42.0	38.5 44.0	40.25 46.0	42.0 48.0

TABLE 76-2 – FPS, GPM Conversion Factors

P2 COIL P4 COIL P8 COIL	FPS = GPM/1.81 FPS = GPM/3.62 FPS = GPM/7.24
W, D, K COILS	$FPS = \frac{GPM \times 1.66}{\text{FINNED WIDTH}}$
DD COIL	$FPS = \frac{GPM \times .83}{\text{FINNED WIDTH}}$

CHART 76-1 – Dry Air Friction (In. H_2O) Water and Refrigeration Coils

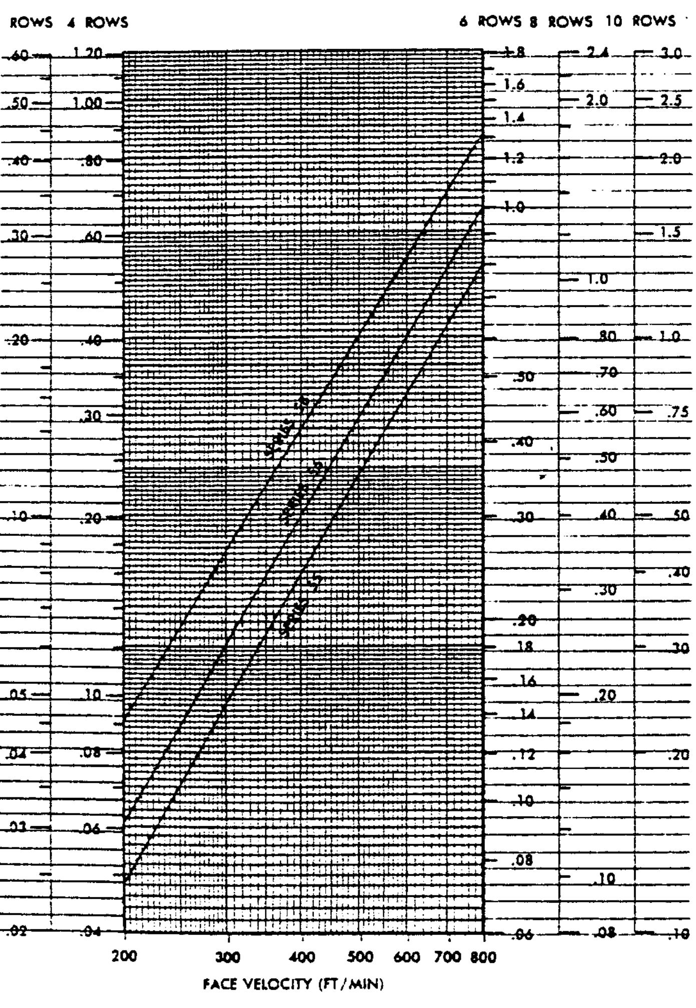


CHART 76-2 – Wet Air Friction (In. H_2O) Water and Refrigeration Coils

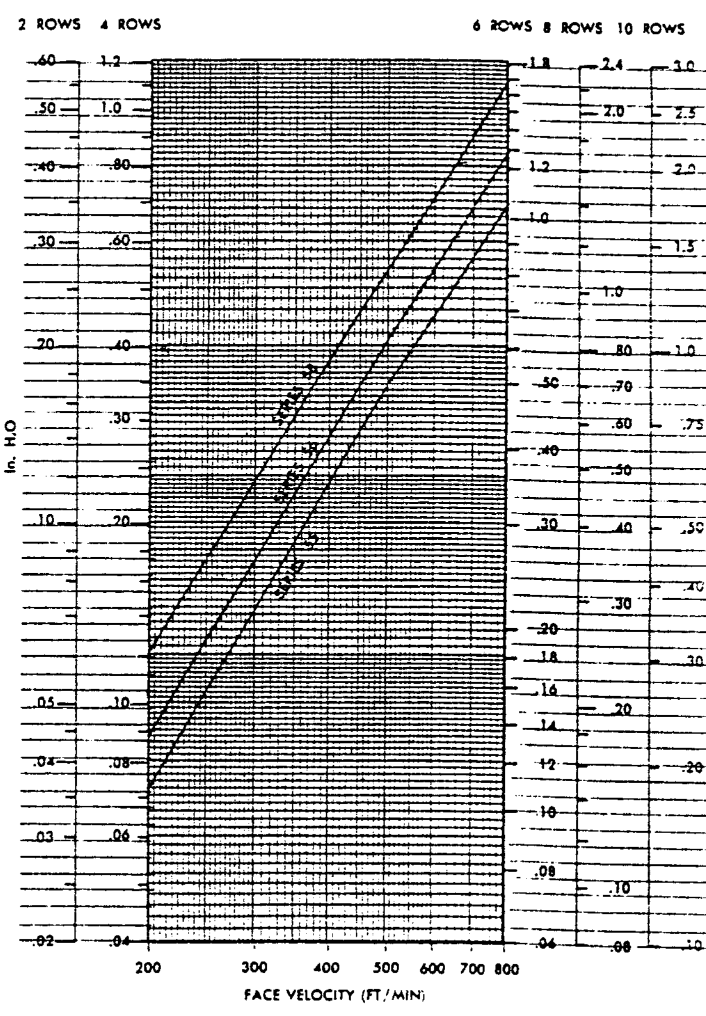
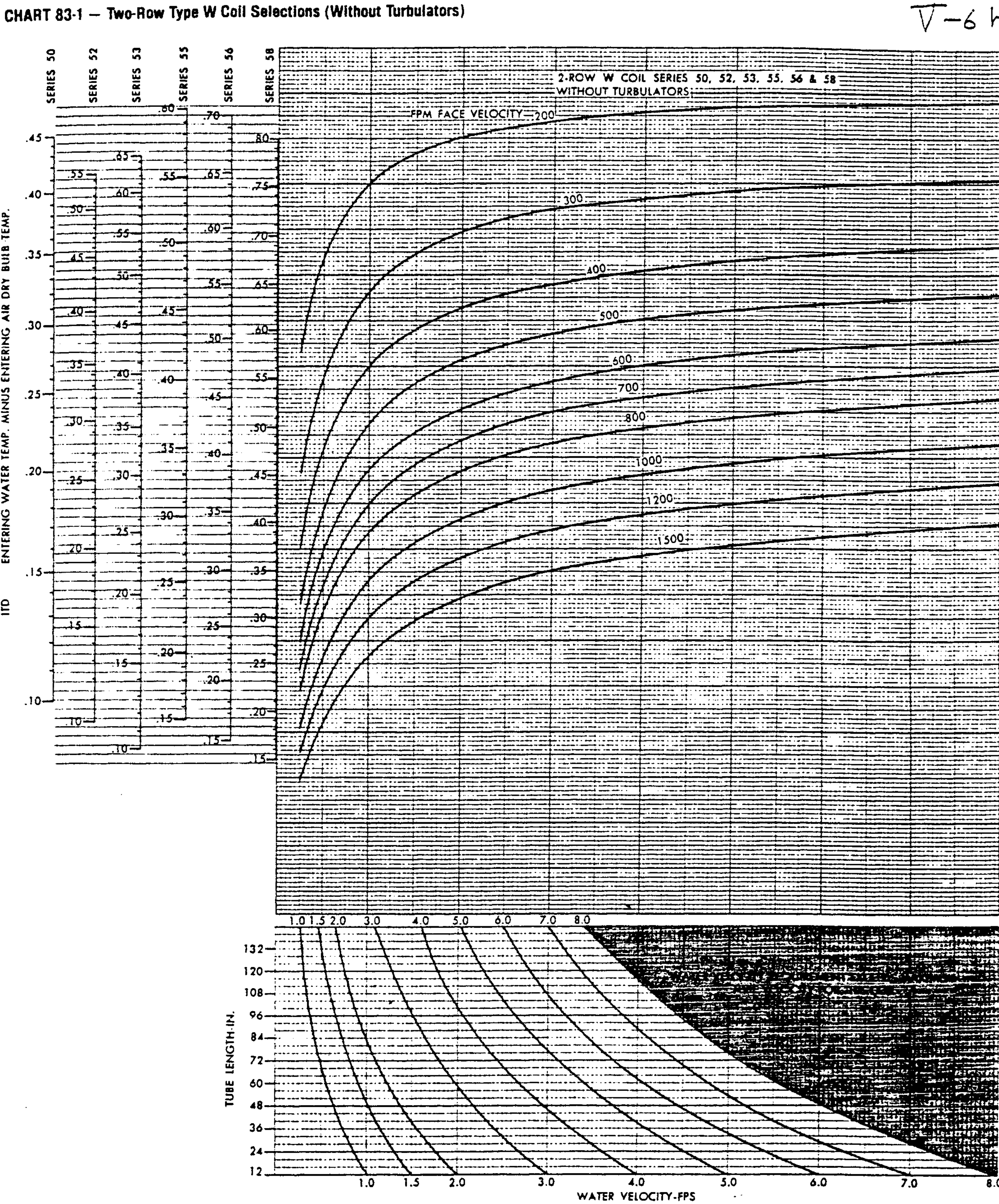


CHART 83-1 — Two-Row Type W Coil Selections (Without Turbulators)

V-6 h



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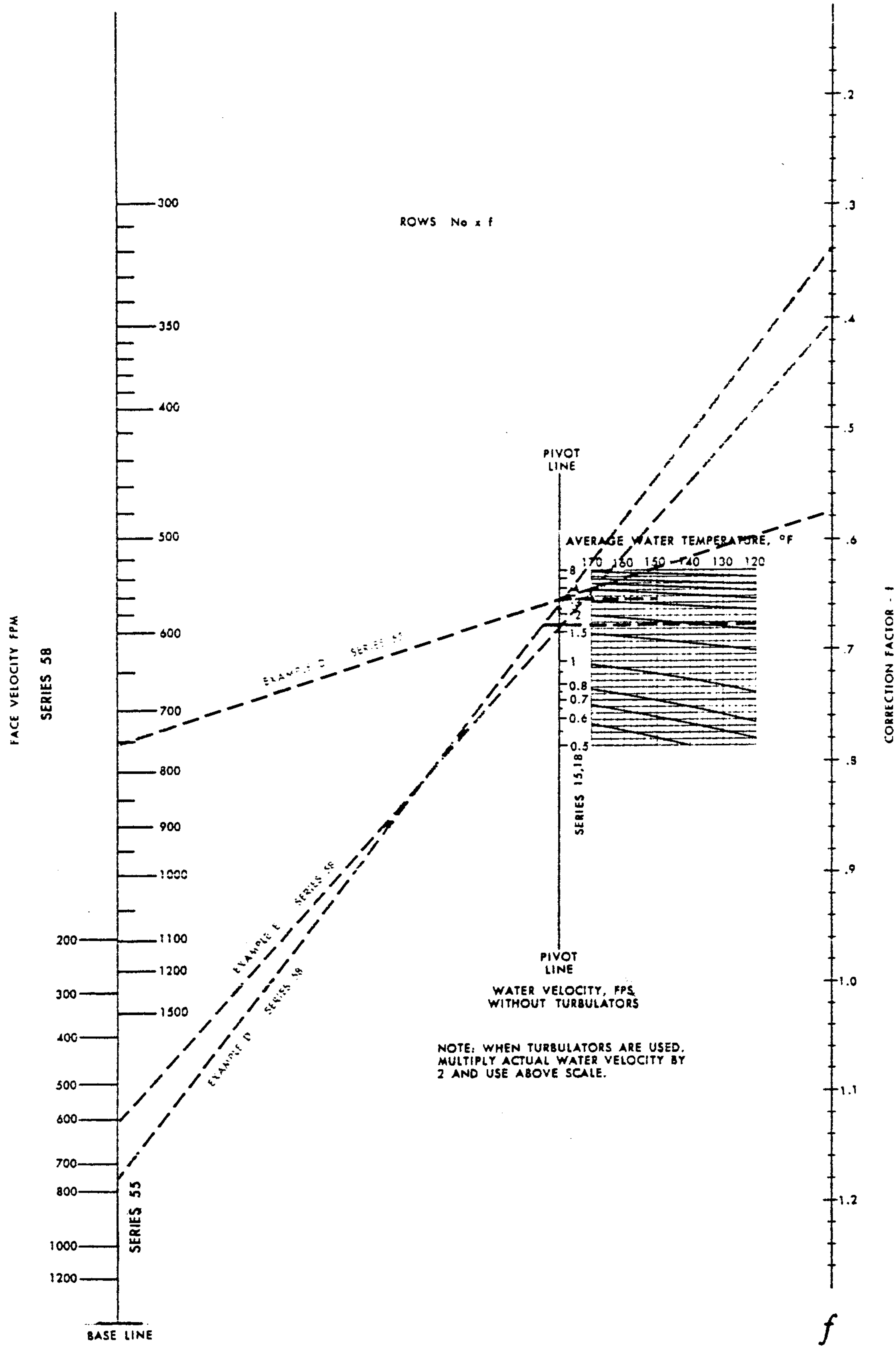
ART 91-1 — Water Heating Coil Capacity Correction Factor



TRANE

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FIGURE 32-1 — No. 63E, F, G HDT - 36.5" AF Fan

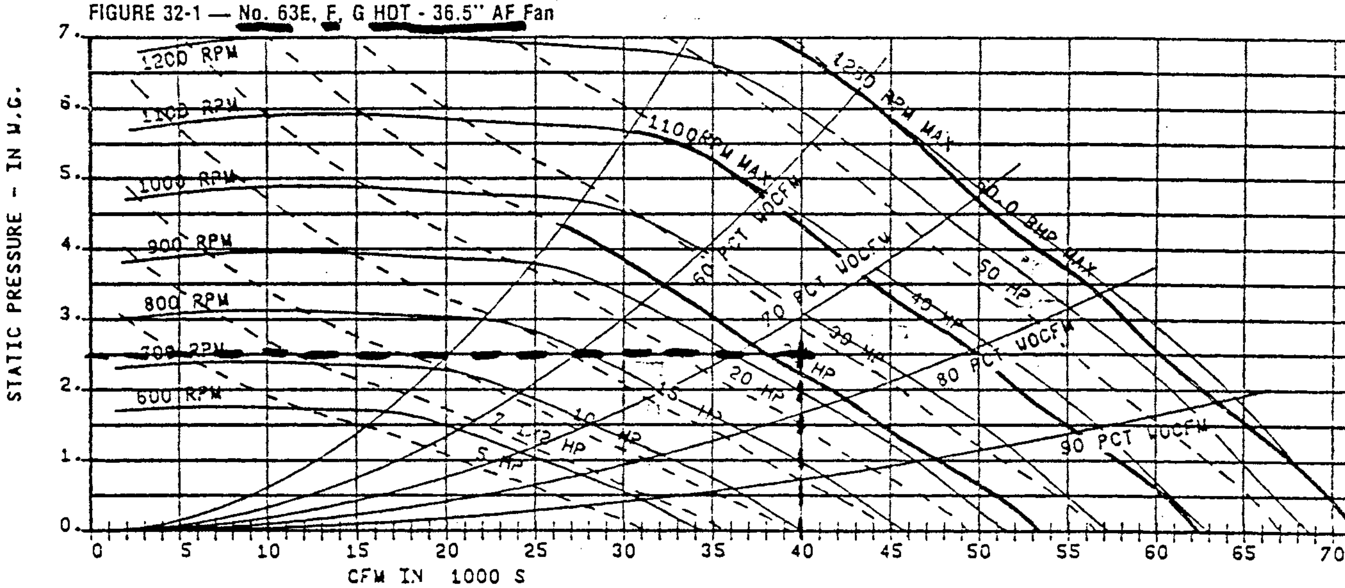


FIGURE 32-2 — No. 63H, J, HDT - 33" AF Fan With Inlet Vanes

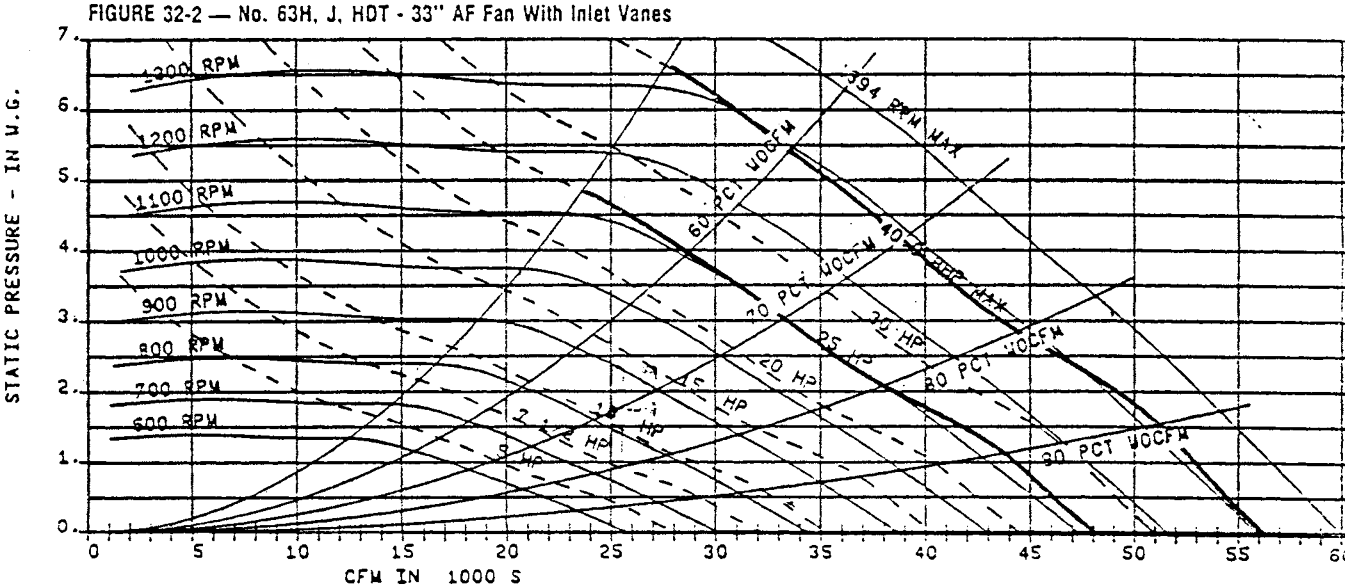
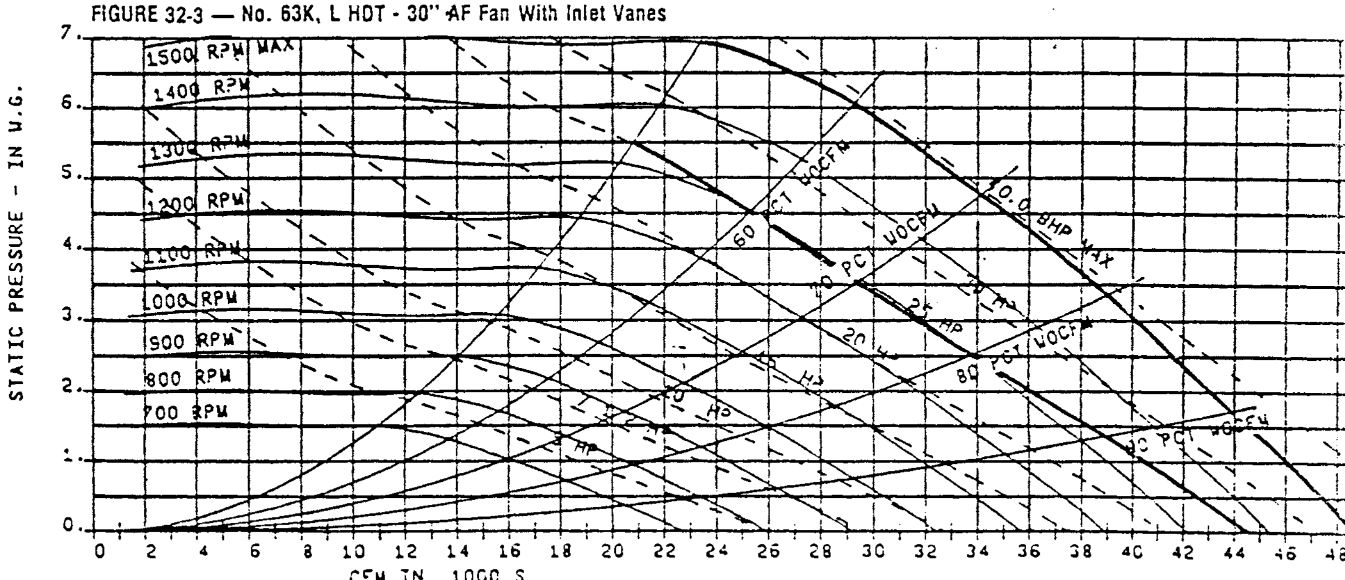


FIGURE 32-3 — No. 63K, L HDT - 30" AF Fan With Inlet Vanes



DIMENSIONAL DATA

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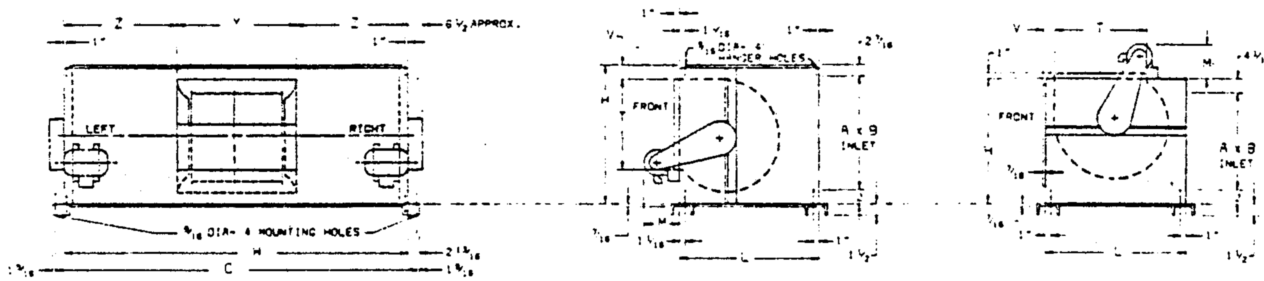
E 53-1 — Cabinet Fans (Sizes 25-31 and 25V-31V)



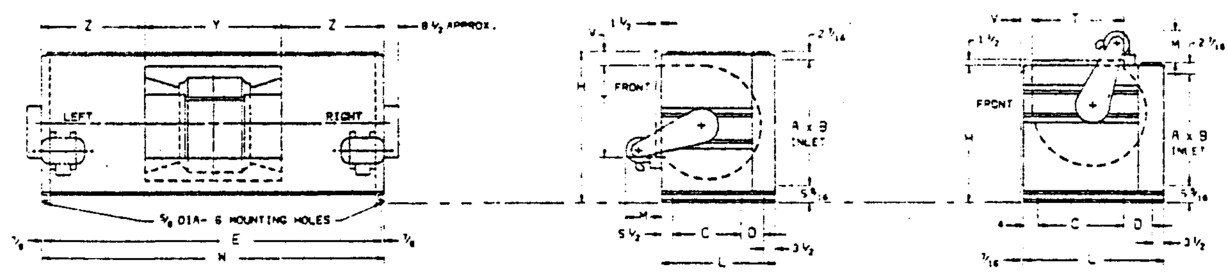
53-1 — Casing Dimensions

W	L	H	A	B	C	M
9' 7"	3' 5 1/8"	3' 11 1/2"	2' 9"	9' 3"	9' 9 1/2"	Refer to Table 77-1
9' 7"	3' 5 1/8"	3' 11 1/2"	3' 7"	9' 3"	9' 9 1/2"	
9' 7"	3' 11"	3' 11 1/8"	2' 9"	9' 3"	9' 9 1/2"	
9' 7"	3' 11"	3' 11 1/8"	3' 7"	9' 3"	9' 9 1/2"	

TABLE 53-2 — Duct Connection Size/Location

FAN DIA	T	Y	Z	V
22	27 1/4"	27 1/4"	43 1/8"	1"
25	31 1/4	31 1/8	42"	1"

E 53-2 — Cabinet Fans (Sizes 35-86, and 35V-86V)



BLE 53-3 — Casing Dimensions

SIZE	W	L STD	L "V" UNIT	H STD	H "V" UNIT	A	B	C STD.	C "V" UNIT	D STD	D "V" UNIT	E	M
35	9' 7"	4' 4"	5' 0"	5' 0"	4' 11 5/8"	4' 4"	9' 3"	2' 9"	3' 7 1/2"	10"	9"	9' 5 1/4	Refer to Table 77-1
41	9' 10"	4' 9"	5' 5 1/2"	5' 5"	5' 4 5/8"	4' 9"	9' 6"	3' 3"	4' 2"	9"	8"	9' 8 1/4"	
50	9' 10"	5' 3"	6' 0 1/2"	6' 4"	6' 3 5/8"	5' 8"	9' 6"	3' 9"	4' 9"	9"	8"	9' 8 1/4"	
[illegible]	10' 6"	5' 9"	6' 7 1/2"	8' 0 1/2"	8' 0 5/8"	7' 4 1/2	9' 6"	3' 9"	4' 10"	1' 3"	1' 2"	9' 8 1/4"	
73	10' 6"	5' 6"	6' 4 1/2"	8' 0 1/2"	8' 0 5/8"	7' 4 1/2"	9' 6"	3' 9"	4' 10 1/2"	1' 0"	10 1/2"	10' 4 1/4"	
86	10' 6"	5' 6"	6' 4 1/2"	8' 0 1/2"	8' 0 5/8"	7' 4 1/2	9' 6	3' 9"	4' 10 1/2"	1' 0"	10 1/2"	10' 4 1/4"	

TABLE 53-4 — Duct Connection Size/Location

SIZE	T	Y	Z	V STD	V "V" UNIT
35	40 1/8	40 1/4	37 3/8"	2 1/2"	2 1/2"
41	44 1/2"	44 1/4"	36 7/8"	2 1/2"	2 1/2"
50	49 1/2	46 7/8	34 5/8"	2 1/2"	2 1/2
[illegible]	54 3/8"	53 7/8"	36 1/8"	2 1/2	3 1/2
73	54 3/8	53 7/8	36 1/8	2 1/2	3 1/2"
86	54 3/8	53 1/8"	36 1/8	2 1/2	3 1/2

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FIGURE 60-1 — No. 50F, G, H VDT - 33" AF Fan

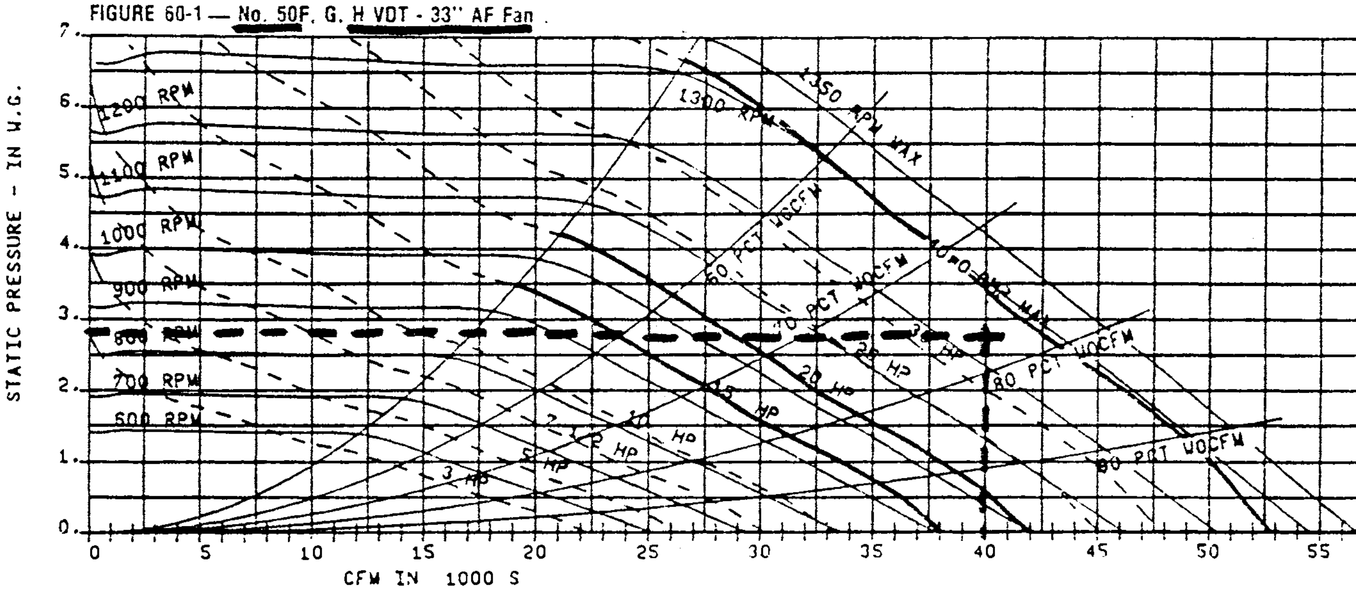


FIGURE 60-2 — No. 50J, K, L VDT - 30" AF Fan With Inlet Vanes

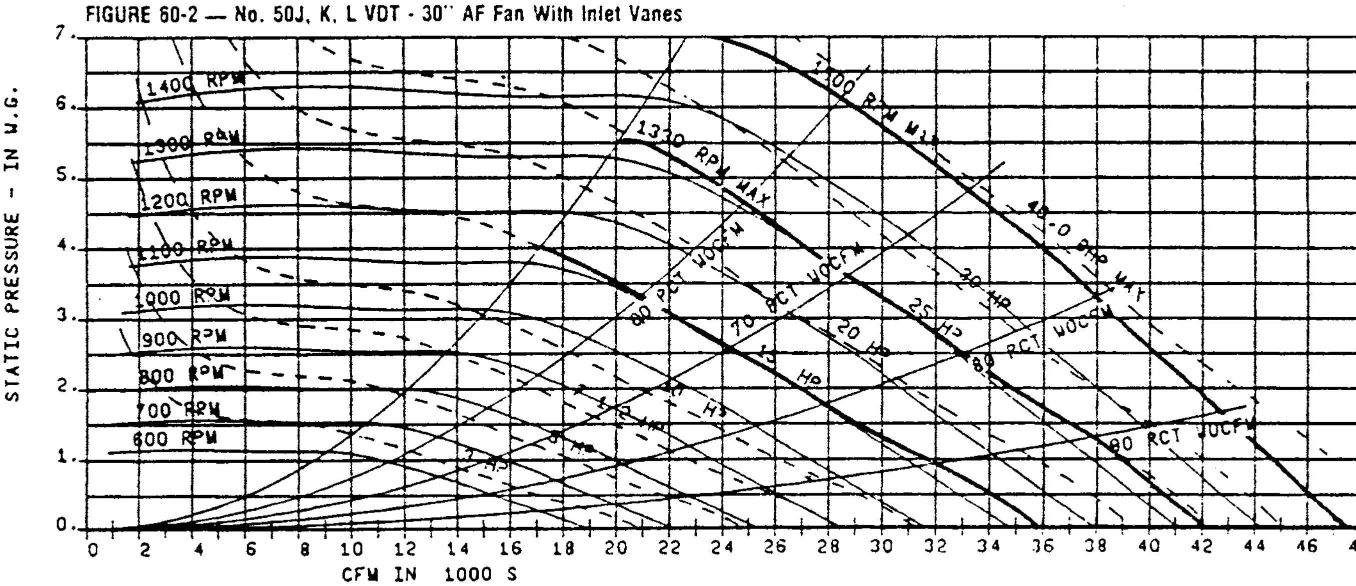
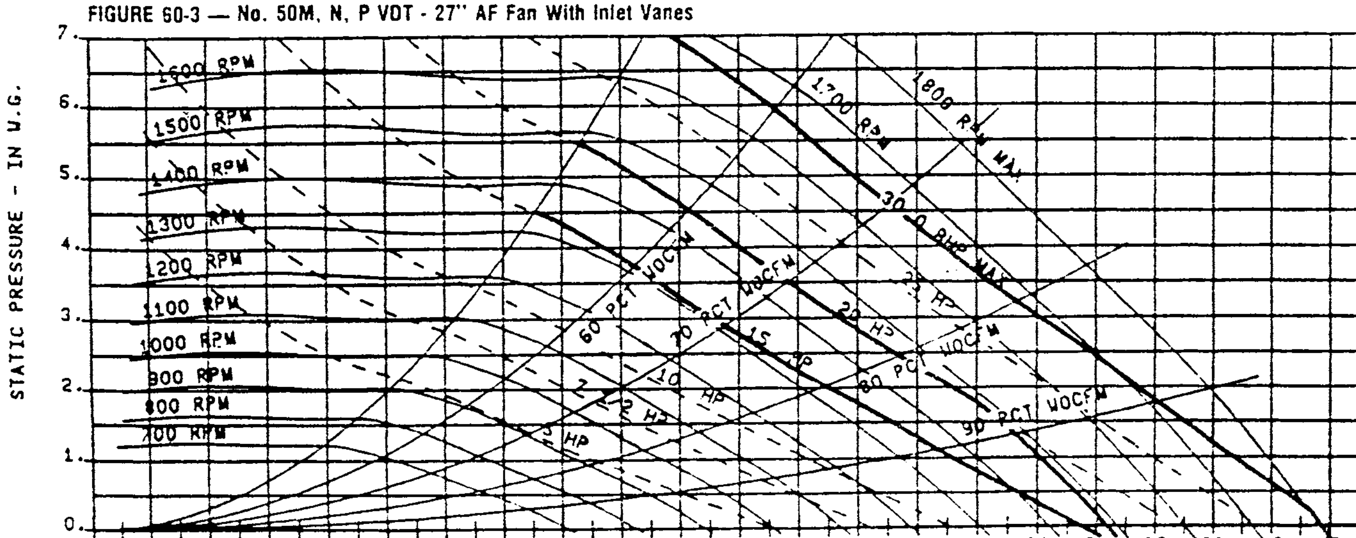


FIGURE 60-3 — No. 50M, N, P VDT - 27" AF Fan With Inlet Vanes



DIMENSIONAL DATA

V-8b
V-9b

FIGURE 47-1 — Vertical Draw-Thru (Sizes 35-50)

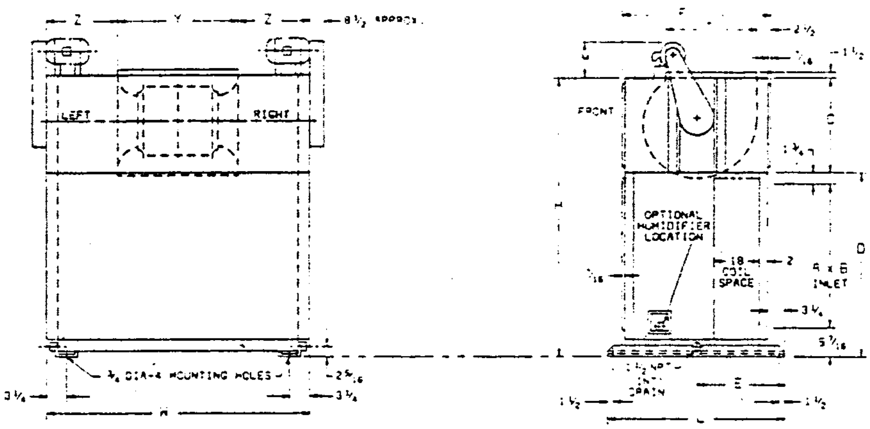


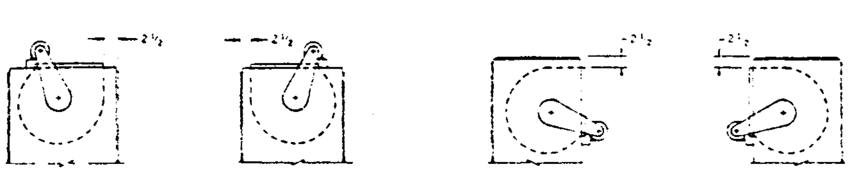
TABLE 47-1 — Casing Dimensions

SIZE	W	L	H ARRG 5, 6	H ARRG 7, 8	A	B	C ARRG 5, 6	C ARRG 7, 8	D	E	F	M
35	9' 7"	5' 2½"	8' 7⅝	9' 8¼	4' 4½	9' 3¼	3' 8	4' 9"	4' 11⅝"	2' 7¼"	4' 8⅞	Refer to Table 77
[illegible]	9' 10"	5' 7½"	9' 6⅝	10' 6¼	4' 9½	9' 6¼	4' 2	5' 2	5' 4⅝"	2' 9¾	5' 1⅞"	
50	9' 10"	6' 6½"	10' [illegible]	12' 4¼	5' 8½"	9' 6¼	4' 8	6' 1	6' 3⅝	3' 3¼	6' 0⅞	

TABLE 47-2 — Duct Connection Size/Location

SIZE	T	Y	Z
35	40⅛	40¼	37⅜
[illegible]	44½	44½	36⅞
50	49⅛	48¼	34½

FIGURE 47-2 — Vertical Draw-Thru Discharge Arrangements (Sizes 35-50)



V-9a

FIGURE 48-1 — No. 17A, B, C VDT - 20" FC Fan With Inlet Vanes

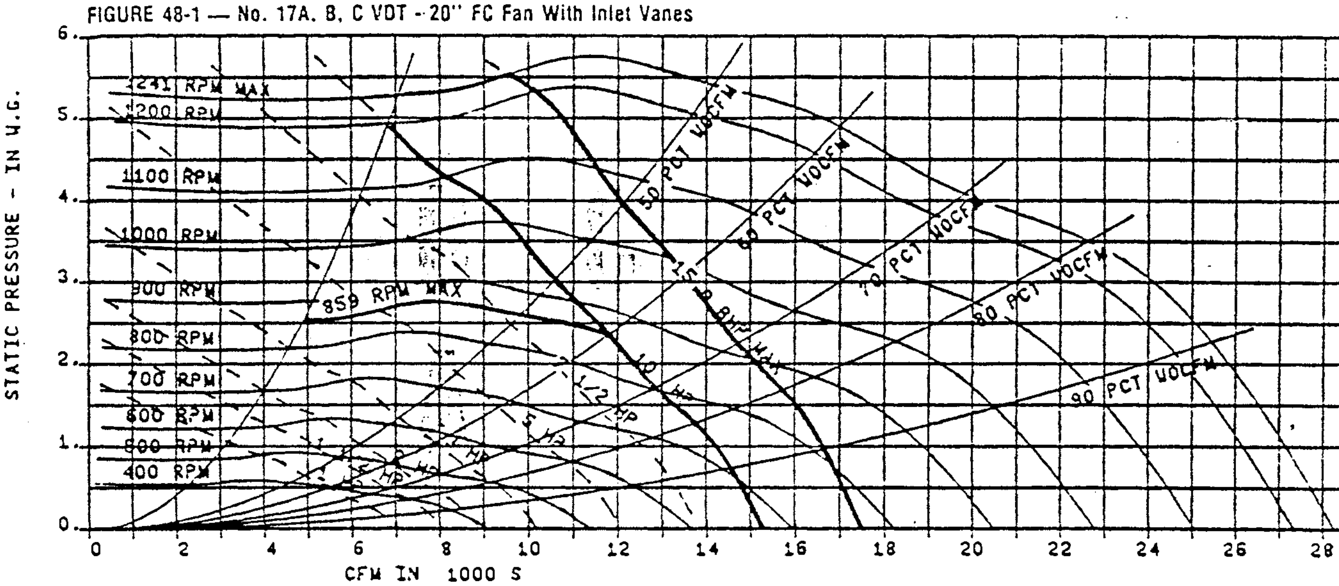


FIGURE 48-2 — No. 17D, E, F VDT - 18.25" FC Fan

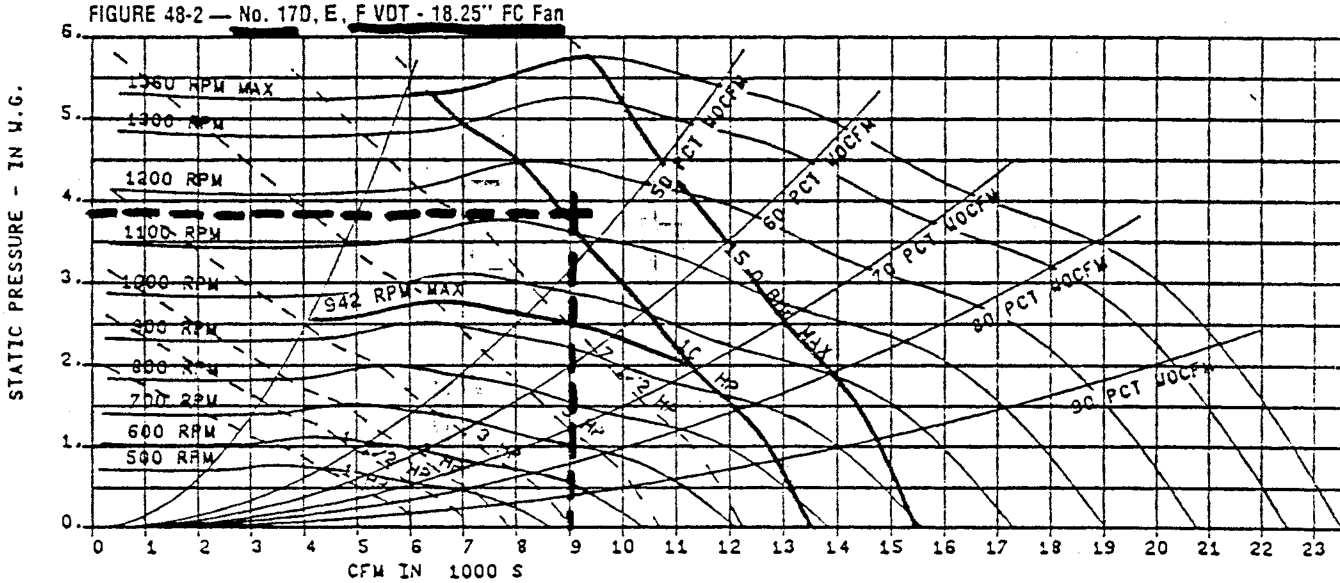
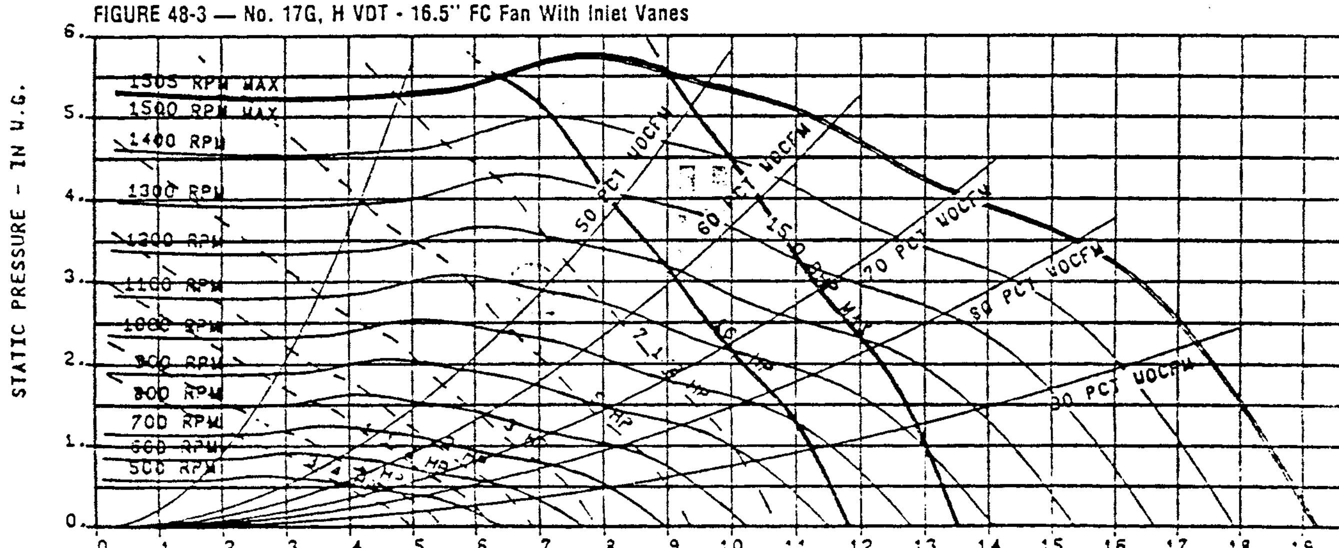


FIGURE 48-3 — No. 17G, H VDT - 16.5" FC Fan With Inlet Vanes



V-10a

Class I (Model 81) Ratings, Lightface Type
Class II (Model 82) Ratings, Mediumface Type
Class III (Model 83) Ratings, **Boldface Type**

Heavy Line Indicates Maximum Static Efficiency.

Wheel Diameter 27 In. Outlet Area, 4.19 Sq. Ft.

Tip Speed FPM = 7.07 x RPM Max. BHP $= 3.12 \left(\frac{RPM}{1000}\right)^3$

TABLE 9

VOL. CFM	OUT. VEL. FPM	¼" S.P.		⅜" S.P.		½" S.P.		⅝" S.P.		¾" S.P.		1" S.P.		1¼" S.P.		1½" S.P.		1¾" S.P.		2" S.P.	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
3352	800	399	0.20	442	0.27	479	0.34	511	0.41	547	0.49										
3771	900	428	0.24	468	0.32	505	0.40	537	0.48	565	0.55	629	0.73								
4190	1000	461	0.30	494	0.38	530	0.46	563	0.56	592	0.64	645	0.81	702	1.02						
4609	1100	494	0.36	523	0.45	556	0.54	588	0.63	618	0.74	670	0.92	718	1.12	770	1.34				
5028	1200	527	0.44	557	0.53	583	0.62	614	0.72	643	0.83	697	1.05	741	1.25	785	1.46	833	1.70		
5447	1300	561	0.52	589	0.62	613	0.72	640	0.82	669	0.94	721	1.17	767	1.39	806	1.60	849	1.85	893	2.11
5866	1400	597	0.62	622	0.73	648	0.84	669	0.94	695	1.05	746	1.29	793	1.55	834	1.79	870	2.01	909	2.28
6285	1500	631	0.73	656	0.84	680	0.96	701	1.07	723	1.18	772	1.44	817	1.70	861	1.98	898	2.23	931	2.47
6704	1600	667	0.85	690	0.97	713	1.09	735	1.22	754	1.33	798	1.59	842	1.87	885	2.16	925	2.46	959	2.72
7123	1700	702	0.98	726	1.12	747	1.24	768	1.38	788	1.51	826	1.76	869	2.05	910	2.35	949	2.66	986	2.97
7542	1800	738	1.13	760	1.27	780	1.41	801	1.55	821	1.69	856	1.95	896	2.25	935	2.56	973	2.88	1011	3.21
7961	1900	774	1.29	795	1.44	816	1.60	834	1.73	854	1.89	887	2.16	923	2.46	962	2.79	999	3.11	1035	3.45
8380	2000	810	1.48	831	1.63	851	1.79	868	1.94	887	2.10	922	2.41	953	2.70	988	3.03	1025	3.37	1060	3.72
8799	2100	846	1.67	866	1.84	886	2.01	902	2.16	920	2.32	955	2.66	984	2.96	1016	3.29	1052	3.64	1086	4.01
9218	2200	882	1.89	902	2.06	921	2.24	939	2.41	954	2.57	988	2.92	1019	3.27	1046	3.57	1078	3.93	1112	4.31
9637	2300	919	2.13	938	2.31	956	2.49	973	2.67	988	2.84	1021	3.20	1052	3.57	1078	3.88	1107	4.25	1138	4.63
10056	2400	956	2.38	974	2.57	991	2.78	1008	2.95	1025	3.14	1054	3.50	1085	3.88	1113	4.26	1138	4.59	1166	4.97
10475	2500	993	2.66	1010	2.86	1027	3.05	1043	3.25	1059	3.45	1088	3.82	1118	4.22	1146	4.61	1169	4.95	1196	5.34
10894	2600	1030	2.96	1046	3.16	1063	3.37	1079	3.57	1094	3.78	1122	4.16	1151	4.58	1179	4.99	1205	5.40	1227	5.74
11313	2700	1067	3.29	1083	3.49	1099	3.70	1114	3.92	1129	4.13	1159	4.56	1184	4.96	1212	5.39	1238	5.81	1258	6.17
11732	2800	1104	3.53	1119	3.85	1135	4.07	1150	4.29	1165	4.51	1193	4.96	1218	5.36	1245	5.80	1270	6.25	1295	6.69
12570	3000	1178	4.40	1193	4.63	1207	4.86	1222	5.10	1236	5.33	1263	5.81	1289	6.29	1312	6.72	1336	7.19	**1360**	**7.67**
13408	3200	1253	5.27	1267	5.52	1280	5.76	1294	6.01	1307	6.26	1333	6.77	**1358**	**7.28**	**1380**	**7.73**	**1403**	**8.24**	**1426**	**8.75**
14246	3400	1329	6.26	1341	6.52	**1354**	**6.78**	**1367**	**7.04**	**1379**	**7.31**	**1404**	**7.84**	**1428**	**8.39**	**1451**	**8.93**	**1471**	**9.40**	**1493**	**9.93**

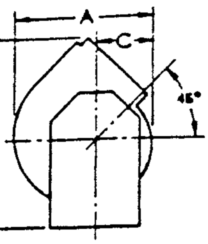
VOL. CFM	OUT. VEL. FPM	2¼" S.P.		2½" S.P.		3" S.P.		3½" S.P.		4" S.P.		4½" S.P.		5" S.P.		5½" S.P.		6" S.P.		6½" S.P.	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
5866	1400	950	2.55																		
6285	1500	967	2.75	1005	3.04																
6704	1600	990	2.97	1023	3.25	1094	3.39														
7123	1700	1017	3.25	1049	3.53	1111	4.15	1178	4.83												
7542	1800	1045	3.54	1075	3.83	1131	4.41	1194	5.12	1258	5.84										
7961	1900	1070	3.81	1102	4.15	1158	4.78	1212	5.41	1272	6.16	1333	6.94								
8380	2000	1094	4.08	1127	4.45	1185	5.14	1238	5.81	1290	6.52	1346	7.30	1405	**8.12**						
8799	2100	1118	4.37	1151	4.75	1212	5.53	1264	6.22	1311	6.89	1364	7.69	1418	**8.51**	**1474**	**9.38**				
9218	2200	1145	4.69	1175	5.07	1237	5.89	1292	6.68	1339	7.38	**1384**	**8.09**	**1436**	**8.96**	**1487**	**9.81**	**1540**	**10.72**		
9637	2300	1171	5.03	1202	5.43	1260	6.24	1317	7.10	**1366**	**7.86**	**1412**	**8.63**	**1464**	**9.38**	**1504**	**10.29**	**1553**	**11.18**	**1604**	**12.13**
10056	2400	1197	5.38	1228	5.79	1285	6.63	1341	7.52	**1393**	**8.39**	**1438**	**9.17**	**1482**	**9.97**	**1523**	**10.75**	**1570**	**11.72**	**1617**	**12.64**
10475	2500	1224	5.75	1254	6.13	1311	7.05	**1366**	**7.94**	**1418**	**8.87**	**1468**	**9.76**	**1506**	**10.56**	**1547**	**11.34**	**1599**	**12.27**	**1635**	**13.22**
10894	2600	1253	6.16	1280	6.59	1337	7.49	**1390**	**8.39**	**1442**	**9.35**	**1491**	**10.31**	**1534**	**11.16**	**1576**	**12.04**	**1613**	**12.84**	**1653**	**13.70**
11313	2700	1283	6.59	1309	7.02	**1364**	**7.94**	**1416**	**8.88**	**1468**	**9.83**	**1516**	**10.85**	**1562**	**11.83**	**1602**	**12.69**	**1642**	**13.60**	**1677**	**14.43**
11732	2800	1314	7.05	1339	7.49	**1389**	**8.42**	**1442**	**9.39**	**1491**	**10.36**	**1540**	**11.38**	**1587**	**12.43**	**1630**	**13.43**	**1668**	**14.32**	**1706**	**15.26**
12151	2900	**1351**	**7.62**	**1368**	**7.98**	**1417**	**8.93**	**1468**	**9.92**	**1517**	**10.93**	**1564**	**11.94**	**1611**	**13.03**	**1656**	**14.10**	**1696**	**15.13**	**1732**	**16.03**
12570	3000	**1383**	**8.14**	**1401**	**8.52**	**1446**	**9.47**	**1496**	**10.47**	**1543**	**11.51**	**1589**	**12.54**	**1635**	**13.63**	**1679**	**14.76**	**1722**	**15.86**	**1761**	**16.91**
13408	3200	**1449**	**9.26**	**1470**	**9.76**	**1507**	**10.65**	**1550**	**11.67**	**1597**	**12.75**	**1642**	**13.86**	**1685**	**14.95**	**1728**	**16.10**	**1770**	**17.27**	**1811**	**18.48**
14246	3400	**1515**	**10.48**	**1536**	**11.02**	**1577**	**12.09**	**1611**	**13.02**	**1651**	**14.11**	**1695**	**15.26**	**1738**	**16.43**	**1779**	**17.62**	**1819**	**18.79**	**1858**	**20.03**
15084	3600	**1582**	**11.81**	**1602**	**12.38**	**1642**	**13.53**	**1679**	**14.65**	**1711**	**15.62**	**1750**	**16.78**	**1791**	**18.00**	**1831**	**19.24**	**1871**	**20.50**	**1909**	**21.73**
15922	3800	**1649**	**13.27**	**1669**	**13.87**	**1707**	**15.08**	**1744**	**16.29**	**1774**	**17.30**	**1809**	**18.48**	**1846**	**19.70**	**1884**	**20.97**	**1923**	**22.29**	**1961**	**23.61**
16760	4000	**1721**	**14.98**	**1737**	**15.50**	**1774**	**16.77**	**1810**	**18.04**	**1845**	**19.30**	**1872**	**20.34**	**1905**	**21.59**	**1940**	**22.88**	**1978**	**24.21**	**2014**	**25.53**
17598	4200	**1790**	**16.73**	**1805**	**17.26**	**1841**	**18.58**	**1876**	**19.92**	**1910**	**21.26**	**1943**	**22.58**	**1968**	**23.84**	**2000**	**24.96**	**2033**	**26.31**	**2067**	**27.70**

VOL. CFM	OUT. VEL. FPM	7" S.P.		7½" S.P.		8" S.P.		8½" S.P.		9" S.P.		9½" S.P.		10" S.P.		10½" S.P.		11" S.P.		11½" S.P.	
		RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP	RPM	BHP
10056	2400	**1666**	**13.63**																		
10475	2500	**1680**	**14.19**	**1726**	**15.20**																
10894	2600	**1698**	**14.81**	**1741**	**15.81**	**1785**	**16.88**														
11313	2700	**1716**	**15.39**	**1759**	**16.48**	**1800**	**17.52**	**1843**	**18.60**	**1887**	**19.73**										
11732	2800	**1740**	**16.11**	**1778**	**17.10**	**1819**	**18.23**	**1859**	**19.32**	**1900**	**20.42**	**1941**	**21.57**								
12151	2900	**1769**	**17.01**	**1801**	**17.88**	**1838**	**18.91**	**1877**	**20.07**	**1916**	**21.21**	**1955**	**22.33**	**1995**	**23.51**	**2036**	**24.73**				
12570	3000	**1795**	**17.84**	**1831**	**18.85**	**1862**	**19.75**	**1897**	**20.80**	**1935**	**21.99**	**1972**	**23.18**	**2010**	**24.32**	**2048**	**25.53**	**2087**	**26.77**		
12989	3100	**1821**	**18.69**	**1857**	**19.73**	**1891**	**20.78**	**1921**	**21.70**	**1955**	**22.77**	**1990**	**23.94**	**2028**	**25.22**	**2064**	**26.41**	**2101**	**27.63**	**2138**	**28.90**
13408	3200	**1849**	**19.64**	**1883**	**20.65**	**1917**	**21.72**	**1951**	**22.80**	**1979**	**23.75**	**2012**	**24.84**	**2048**	**26.03**	**2082**	**27.35**	**2117**	**28.80**	**2153**	**29.63**
13827	3300	**1874**	**20.48**	**1911**	**21.67**	**1943**	**22.70**	**1977**	**23.81**	**2009**	**24.92**	**2040**	**26.02**	**2068**	**27.01**	**2101**	**28.21**	**2136**	**29.56**	**2170**	**30.86**
14246	3400	**1898**	**21.32**	**1936**	**22.57**	**1972**	**23.79**	**2003**	**24.84**	**2035**	**25.99**	**2066**	**27.13**	**2097**	**28.27**	**2124**	**29.26**	**2155**	**30.48**	**2188**	**31.78**
14665	3500	**1922**	**22.14**	**1960**	**23.47**	**1987**	**24.76**	**2031**	**26.01**	**2061**	**27.08**	**2093**	**28.28**	**2123**	**29.44**	**2153**	**30.61**	**2179**	**31.82**	**2209**	**32.84**
15084	3600	**1947**	**23.02**	**1984**	**24.34**	**2021**	**25.71**	**2056**	**27.03**	**2090**	**28.32**	**2119**	**29.42**	**2149**	**30.63**	**2179**	**31.84**	**2208**	**33.05**	**2233**	**34.07**
15922	3800	**1997**	**24.90**	**2033**	**26.25**	**2069**	**27.63**	**2104**	**29.03**	**2139**	**30.46**	**2172**	**31.88**	**2204**	**33.24**	**2231**	**34.38**	**2261**	**35.86**		
16760	4000	**2050**	**26.98**	**2085**	**28.38**	**2119**	**29.73**	**2153**	**31.16**	**2187**	**32.62**	**2221**	**34.15**	**2254**	**35.64**						
17598	4200	**2103**	**29.14**	**2138**	**30.59**	**2172**	**32.06**	**2205**	**33.53**	**2237**	**34.96**										
18436	4400	**2154**	**31.45**	**2191**	**32.96**	**2224**	**34.47**	**2257**	**36.00**												
19274	4600	**2214**	**33.97**	**2245**	**35.48**																

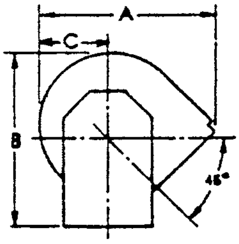
V-10b

Sizes 12"-36" Convertible (with round inlet)
Sizes 40"-60" Nonconvertible (with square inlet)

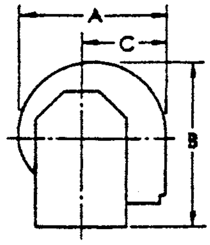
Class I
SW Arrangement 10



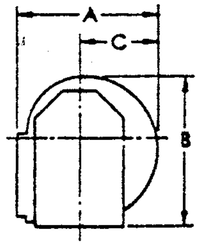
TAU
Top Angular Up



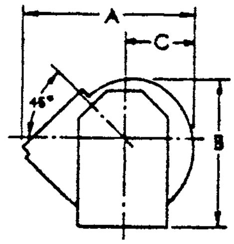
TAD
Top Angular Down



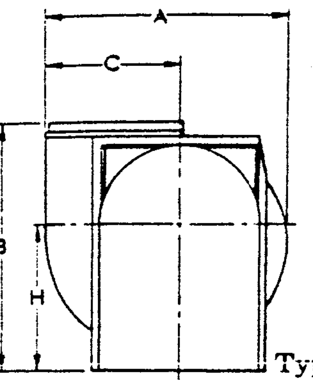
DB
Down Blast



BH
Bottom
Horizontal



BAU
Bottom Angular Up



UB
Up Blast
(Construction
Typical for Sizes 40-60)

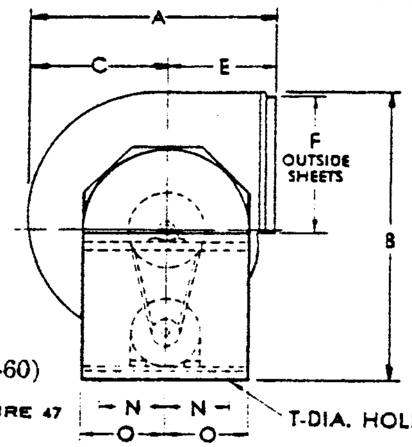
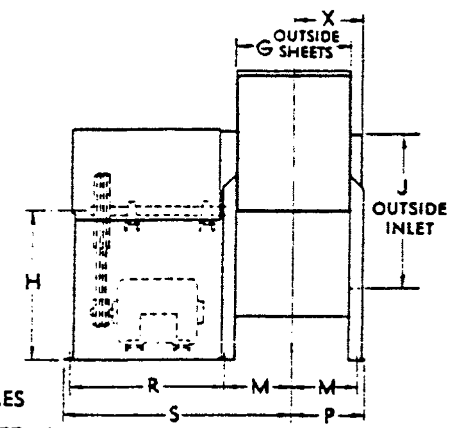


FIGURE 47

T-DIA. HOLES



TH Top Horizontal
(Construction Typical for Sizes 12-36)

TABLE 51

FOR SPECIFIC DISCHARGE

FAN SIZE	A: TH BH	A: UB DB	A: TAU	A: TAD	A: BAU	B: TH	B: UB	B: BH	B: DB	B: TAU	B: TAD	B: BAU
12	23½	22¾	21⅞	27⅞	27⅞	27¼	27½	25½	26¼	32⅛	26¾	25¼
13	25½	24⅞	24	30⅛	30⅛	28½	28⅛	26½	27⅛	33½	27⅞	26¼
15	27⅞	27⅝	26⅝	33½	33½	31⅛	30½	29	29⅞	36⅝	30½	28⅝
16	30½	30¼	29⅛	36⅝	36⅝	34⅛	33¼	31⅝	32¾	40	33⅛	31⅜
18	33⅜	33⅜	32¼	40¼	40¼	37¾	36⅝	35⅛	36¼	44¼	37	34¾
20	37⅛	36½	35⅛	44⅜	44⅜	41¼	40⅝	38¼	39½	48¾	40⅜	37⅞
22	41	40½	39	49¼	49¼	45⅜	44½	42⅛	43½	53½	44⅜	41⅝
24	44⅛	46½	44⅞	54⅛	54⅛	54⅛	47½	48⅜	52⅝	60	54¼	46¾
27	48¼	51⅛	49⅜	59½	59½	59¼	51¾	52⅞	57½	65⅝	59⅜	51⅛
30	53¾	56¾	54⅞	66¼	66¼	66¼	58	59⅛	64¼	73⅜	66⅜	57⅛
33	58¾	62⅜	60¼	72½	72½	72⅝	63¼	64¾	70½	80¼	72¾	62⅝
36	64⅜	68⅞	66½	79¾	79¾	79¾	69	71⅛	77⅜	87⅞	79⅞	68¾
40	69¾	77	72½	94½	91½	79¾	72¼	78⅞	76¾	93⅞	75⅜	76⅛
44	76⅝	84⅞	80⅛	103½	100½	87½	79¼	86¾	84	103	82⅞	83¾
49	84⅝	93⅞	88¼	113¾	110⅞	97	87¾	95⅛	93⅜	114⅛	91⅝	91⅞
54	93¼	103⅝	97¾	124⅞	121⅞	106¾	96¼	105	102⅜	125	101⅛	101⅜
60	102⅝	114¼	108	137¼	134¼	117½	105¾	115⅝	112½	137½	111⅛	111⅝

FAN SIZE	C: TH BH	C: UB DB	C: TAU	C: TAD BAU	H: TH	H: UB	H: BH BAU	H: DB	H: TAU	H: TAD
12	11¼	12¼	10¼	10⅞	15	15	15	15	15	15
13	12⅜	13½	11¼	11⅞	15	15	15	15	15	15
15	13⅝	14⅞	12⅜	13⅛	16¼	16¼	16¼	16¼	16¼	16¼
16	15	16⅛	13⅝	14⅛	17¾	17¾	17¾	17¾	17¾	17¾
18	16½	18	14⅞	15⅞	19¾	19¾	19¾	19¾	19¾	19¾
20	18	19¾	16⅛	17⅛	21½	21½	21½	21½	21½	21½
22	20	21⅞	18⅛	19¼	23½	23½	23½	23½	23½	23½
24	24⅝	26⅛	18¾	22¼	28	28	28	28	28	28
27	27	28¾	20⅝	24⅜	30½	30½	30½	30½	30½	30½
30	30	32	22⅞	27⅛	34¼	34¼	34¼	34¼	34¼	34¼
33	33	35⅛	25⅛	29¾	37½	37½	37½	37½	37½	37½
36	36⅜	38¼	27¾	32⅞	41	41	41	41	41	41
40	39¾	44¼	30⅛	35¾	35½	42¼	46	37	38¼	33
44	43⅞	48¾	33¼	39½	38¾	46½	50½	40	42	36
49	48⅜	54	36⅝	43½	43	51½	55¼	45	46¾	40
54	53½	59½	40⅝	48¼	47¼	56½	60¾	48¾	51¼	44
60	59⅛	65½	44⅞	53¼	52	52¼	66¾	53¼	56½	48

FOR ALL DISCHARGES

FAN SIZE	WHEEL DIA.	E	E†	E††	F	G	J	M	N	O	P
12	12¼	12¼			13⅛	9¾	13⅞	5⅞	5¾	7	6¾
13	13½	13⅛			14⅜	10¼	15⅜	6⅜	6½	7¾	7¼
15	15	14¼			15⅞	11⅞	16⅞	7	7	8½	7⅞
16	16½	15½			17⅜	13⅛	18⅝	7⅝	7½	9⅜	8½
18	18¼	16⅞			19⅛	14½	20⅛	8⅜	8	10⅛	9⅜
20	20	19⅛			21⅜	15⅞	22⅞	9⅛	9	11½	10⅛
22	22¼	21			23⅜	17¾	25⅛	10⅛	10	12⅝	11⅛
24	24½	19½			25¾	19½	29	11⅞	11¾	15¼	12⅞
27	27	21¼			28⅜	21½	31½	12⅞	13	16½	13⅞
30	30	23¾			31⅝	23⅜	34½	14	14½	18	15½
33	33	25¾			34¾	26¼	37½	15¼	16	19½	16¾
36	36½	28			38⅜	29⅛	41	16¾	17¾	21¼	18¼
40	40¼	30	34½	38¼	42¼	32	42¾	18	18½	23⅜	19½
44	44½	32¾	37½	41¾	46¾	35¼	47	19⅝	20½	25½	21⅛
49	49	36¼	41¼	45¼	51½	38¾	51½	21⅜	22½	28¼	23⅜
54	54¼	39¾	44¼	49	57	43	56¾	23½	25	30⅞	25½
60	60	43½	49	53¼	63	47½	62½	25¾	28	33⅜	27¾

FAN SIZE	R	S	T	X	MAX. MOTOR FRAME	* FAN SHAFT DIA.	** FAN SHAFT DIA.	* SQ. KEY	** SQ. KEY
12	22	28¾	⅝	7⅜	213T	15/16	15/16	¼	¼
13	22	29¼	⅝	7⅞	213T	15/16	15/16	¼	¼
15	25	32⅞	⅝	8½	215T	15/16	15/16	¼	¼
16	25	33½	⅝	9⅛	215T	15/16	15/16	¼	¼
18	25	34⅜	⅝	10⅛	254T	1 3/16	1 3/16	¼	¼
20	25	35⅛	⅝	10⅞	254T	1 3/16	1 3/16	¼	¼
22	28	39⅛	⅝	11¾	256T	1 3/16	1 3/16	¼	¼
24	27	40⅛	¾	12	284T	1 7/16	1 7/16	⅜	⅜
27	28½	42⅝	¾	13	284T	1 7/16	1 7/16	⅜	⅜
30	30¼	45½	¾	14⅝	286T	1 11/16	1 11/16	⅜	⅜
33	32	48¾	¾	16½	286T	1 11/16	1 11/16	⅜	⅜
36	34	52¼	¾	17⅞	324T	1 15/16	1 15/16	½	½
40	38	57½	⅞	19¾	324T	2 3/16	1 15/16	½	½
44	40	61⅛	⅞	21⅜	326T	2 7/16	2 3/16	⅝	½
49	42	65⅜	⅞	23⅞	364T	2 11/16	2 7/16	⅝	⅝
54	46	71½	⅞	26	365T	2 11/16	2 7/16	⅝	⅝
60	49	76¾	1	28¼	404T	2 15/16	2 11/16	¾	⅝

...te: Dimensions subject to change. For ... dimensions ... for certified prints. ... Not available in BAD Discharge.

V-11a

Approved Standard Ratings are in accordance with Industry Standard 441-66 for Room Fan-Coil Air-Conditioners.

COOLING SELECTION

At 25% outside air and 75% recirculated air, a 400 cfm unit is required to meet the 100 cfm ventilation requirement.

The mixed air temperature entering the coil can be determined from a psychrometric chart as 80DB/67WB, 50% RH.

Since catalog capacity is for sea level conditions, adjust the room loads for 6,000 feet elevation before entering capacity tables. From Chart 3 of page 21, the sensible heat factor for 6,000 ft. elevation is .8; the total heat factor is about .93.

At 80DB/67WB, 50% RH, enter cooling capacity on page 39 for horizontal units at high speed with adjusted loads of $\frac{6.9 \text{ MBH}}{.8}$ or 8.6 MBH. Sensible Heat, $\frac{10.7 \text{ MBH}}{.93}$ or 11.5 MBH Total Heat. The Type "D" high temperature rise coil should be used since it is designed specifically for water temperature rises of 12F and higher. The 400 cf unit with the Type "D" coil will provide the adjust capacity at 16F water temperature rise. Coil gpm is 1. coil pressure drop is 2.8 feet. Coil Sensible Heat Ratio 75%. Therefore, the Total Heat factor for 6,000 ft. elevation is valid.

Table 1, page 18 indicates a 400 cfm horizontal Ur Trane unit at high speed will produce a sound level belo the required sound power level.

HEATING SELECTION

The mixed air temperature to the coil can be calculate from the psychrometric chart as 60DB. Chart 10, page 4 indicates an ITD of 100F and gpm of 1.5 can be used at hig speed to satisfy the adjusted room load of $\frac{(13.8 \text{ MBH}}{.8}$ or 17.2 MBH adjusted for 6,000 feet elevation. The ente ing water temperature would be 100F plus 60F or 160I

TABLE 8—ARI Approved Standard Ratings

VERTICAL UNITRANE													
			COOLING[1] CAPACITIES						COOLING[1] CAPACITIES			MOTOR POWER[2] INPU	
COIL & SIZE	RATED CFM[4]	GPM	PD[5]	SENS. HEAT MBH	TOTAL HEAT MBH	COIL & SIZE	RATED CFM	GPM	PD	SENS. HEAT MBH	TOTAL HEAT MBH	SHADED POLE WATTS	PSC WATTS
A002	230	1.2	1.7	4.3	5.3	D002	210	1.6	6.3	5.4	7.8	120	85
A003	320	1.9	5.8	6.6	9.0	D003	300	2.5	18.5	8.0	12.0	160	85
A004	410	2.3	4.9	8.5	11.4	D004	390	3.1	16.4	10.1	15.1	135	75
A006	570	3.4	13.3	11.9	16.4	D006	540	4.6	46.0	14.9	22.4	180	90
A008	840	4.9	12.5	17.3	24.2	D008	840	5.9	9.7	20.4	29.2	—	130
A010	1000	5.8	8.3	20.3	28.4	D010	990	6.9	9.9	23.6	33.9	—	170
A012	1200	7.2	10.3	25.4	35.4	D012	1200	8.5	12.5	28.9	41.7	—	190
HORIZONTAL UNITRANE													
A002H[6]	220	1.3	1.1	4.8	6.2	D002H[6]	200	1.5	3.6	5.2	7.4	120	85
A003H	300	1.9	4.1	6.3	8.8	D003H	270	2.0	7.6	6.8	10.0	160	85
A004H	420	2.5	4.8	9.0	12.4	D004H	380	2.7	8.6	9.2	13.4	135	75
A006H	560	3.4	13.8	11.5	16.5	D006H	500	3.7	19.7	12.4	18.2	180	90
A008H	880	4.7	14.6	16.9	23.1	D008H	850	5.8	5.2	20.3	28.4	—	130
A010H	1040	5.7	8.2	20.2	27.8	D010H	990	6.8	5.9	23.7	33.3	—	170
A012H	1200	6.6	6.5	23.5	32.2	D012H	1130	7.9	9.2	27.6	38.8	—	190
LOW VERTICAL UNITRANE													
A002 L[7]	200	1.1	2.5	3.6	5.3							120	85
A003 L	290	1.9	9.0	6.0	8.7							160	85
A004 L	360	2.2	6.6	7.5	11.0							135	75
A006 L	550	3.2	10.5	11.1	15.7							180	90

NOTES: 1. BASED ON 80 DB AND 67 WB EAT. 45F EWT. 10F TEMPERATURE RISE. HIGH FAN SPEED. GRILLE FREE AREAS SHOWN IN TABLE 1
2. MOTOR VOLTAGE 115/60/1 POWER SOURCE. SEE TABLE 13 FOR OTHER MOTOR DATA.
3. FILTER TYPE: ½" PERMANENT CLEANABLE. SEE TABLE 9 FOR OTHER FILTER DIMENSIONS.
4. AIR FLOW UNDER DRY COIL CONDITIONS.
5. WATER PRESSURE DROPS SHOWN IN FEET OF WATER.
6. H SUFFIX INDICATES HORIZONTAL COIL CONFIGURATION.
7. L SUFFIX INDICATES LOW VERTICAL COIL CONFIGURATION.

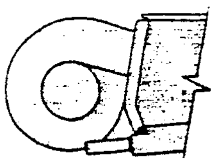
TABLE 9—UniTrane Filter Sizes, Inches

NOMINAL CFM	VERTICAL & HORIZONTAL	LOW VERTICAL
200	19⅞ X 8¼	19½ X 8
300	27⅞ X 8¼	27½ X 8
400	31⅞ X 8¼	35½ X 8
600	43⅞ X 8¼	47½ X 8
800	45¾ X 11	—
1000	57¾ X 11	—
1200	69¾ X 11	—

TABLE 10—UniTrane Grille Free Areas, Sq. In.

NOMINAL CFM	MODELS					
	VERTICAL		HORIZONTAL		LOW VERTICAL	
	INLET	OUTLET	INLET	OUTLET	INLET	OUTLET
200	65	62	102	82	56	50
300	82	87	144	115	78	73
400	94	99	164	132	100	95
600	129	138	226	182	133	129
800	187	226	306	285	—	—
1000	235	283	396	356	—	—
1200	283	339	488	428	—	—

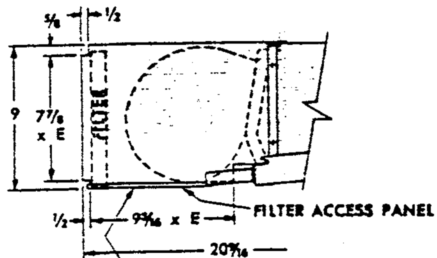
NOTE: ARI CAPACITIES ARE OBTAINED WITH GRILLE FREE AREAS SHOWN ABOVE.



EXPOSED FAN
INLET 2

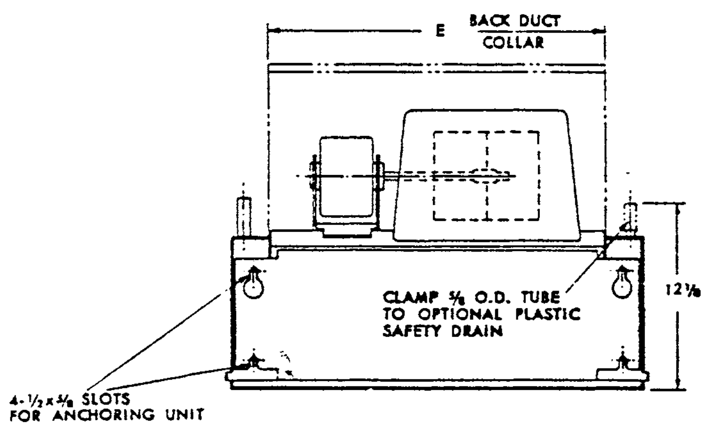
TABLE 19—Model C, 02-06, Unit Dimensions

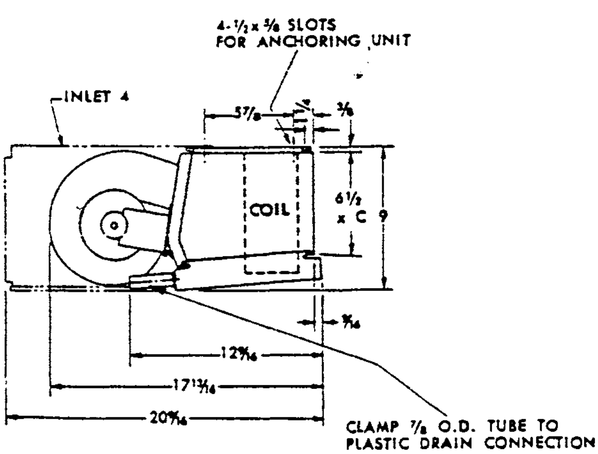
UNIT SIZE	CFM	NO. OF FANS	A	B	C	D	E
02	200	1	23⅞	23⅛	18½	20¾	20
03	300	1	31⅞	31⅛	26½	28¾	28
04	400	2	35⅞	35⅛	30½	32¾	32
06	600	2	47⅞	47⅛	42½	44¾	44

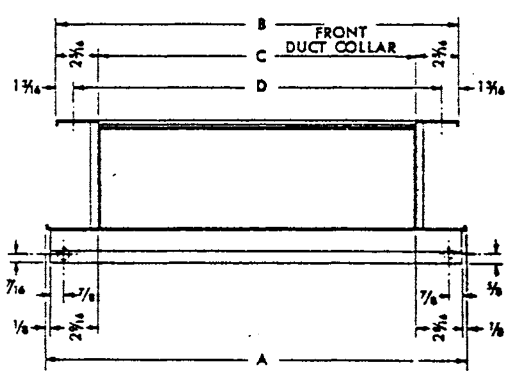


NOTE: FOR OPTIONAL BOTTOM OPENING (9⅜₁₆xE) CONTRACTOR MUST REMOVE BOTTOM FILTER ACCESS PANEL AND INSTALL ON BACK DUCT COLLAR.

BACK DUCT COLLAR-INLET 4







URE 8—Model C, 02-06 Units

Approved Standard Ratings are in accordance with Industry Standard 441-66 for Room Fan-Coil Air-Conditioners.

HORIZONTAL MODEL

∇ - 11 c

ENT. AIR 80.0 db/63.5 wb, 40% R.H.

WTR	CFM	40° EWT A-COIL TH	SH	GPM	PD	40° EWT D-COIL TH	SH	GPM	PD	44° EWT A-COIL TH	SH	GPM	PD	44° EWT D-COIL TH	SH	GPM	PD
6	200	7.9	6.4	2.7	4.5	8.8	6.8	3.0	12.8	6.7	5.9	2.3	3.3	7.4	6.2	2.6	9.5
	300	10.5	8.2	3.7	14.4	11.5	8.7	3.8	24.9	8.8	7.5	3.1	10.6	9.8	8.0	3.3	18.4
	400	14.9	11.8	5.1	17.4	15.3	11.7	5.2	27.9	12.5	10.7	4.3	12.6	13.0	10.7	4.4	20.9
	600	19.1	14.8	6.5	46.5					16.1	13.5	5.5	34.2	17.5	14.4	6.0	41.2
	800					33.5	26.3	11.3	18.2					28.6	24.2	9.7	13.6
	1000	33.0	26.3	11.2	24.0	39.0	30.7	13.2	20.3	27.6	24.0	9.4	18.2	33.4	28.2	11.3	15.3
	1200	38.7	30.8	13.1	18.2	45.4	35.6	15.4	31.5	32.2	28.0	10.8	13.9	38.8	32.7	13.1	23.7
8	200	7.3	6.2	1.9	2.3	8.3	6.6	2.1	6.8	6.2	5.7	1.6	1.7	7.0	6.0	1.8	5.0
	300	9.9	8.0	2.6	7.7	11.0	8.5	2.8	13.6	8.3	7.3	2.2	5.6	9.3	7.8	2.3	9.9
	400	14.1	11.4	3.6	9.2	14.7	11.5	3.8	15.3	11.8	10.4	3.0	6.7	12.4	10.5	3.2	11.3
	600	18.2	14.4	4.7	25.0	19.8	15.4	5.1	30.3	15.3	13.2	4.0	18.3	16.8	14.1	4.3	22.4
	800	26.1	21.4	6.6	26.7	32.0	25.7	8.1	9.8	21.7	19.5	5.5	19.4	27.2	23.6	6.9	7.2
	1000	31.1	25.5	7.9	13.8	37.3	29.9	9.8	11.0	26.1	23.4	6.7	10.5	31.8	27.6	8.1	8.2
	1200	36.2	29.7	9.2	10.7	42.5	34.7	11.0	17.1	30.4	27.3	7.7	8.3	37.0	31.9	9.4	12.7
10	200	6.8	5.9	1.4	1.3	7.8	6.4	1.6	4.1	5.8	5.5	1.2	1.0	6.6	5.9	1.4	3.0
	300	9.4	7.8	2.0	4.6	10.5	8.3	2.1	8.3	7.9	7.2	1.7	3.4	8.8	7.6	1.8	6.0
	400	13.3	11.1	2.7	5.5	14.1	11.2	2.9	9.4	11.1	10.2	2.3	4.0	11.9	10.3	2.4	6.9
	600	17.4	14.1	3.6	15.2	19.0	15.1	3.9	18.6	14.6	13.0	3.0	11.1	16.0	13.8	3.3	13.7
	800	24.5	20.7	5.0	16.1	30.5	25.1	6.2	5.9	20.4	18.9	4.2	11.7	25.7	23.1	5.2	4.3
	1000	29.4	24.8	6.0	8.9	35.7	29.3	7.2	6.7	24.7	22.9	5.0	6.8	30.2	27.0	6.1	4.9
	1200	34.2	28.8	7.0	7.1	41.6	33.9	8.4	10.4	28.5	26.5	5.8	5.4	35.1	31.2	7.1	7.7
12	200	6.4	5.8	1.1	0.8	7.4	6.2	1.3	2.6	5.4	5.4	0.9	0.6	6.2	5.8	1.1	1.9
	300	8.8	7.5	1.5	2.9	10.0	8.1	1.7	5.4	7.4	7.0	1.3	2.2	8.4	7.5	1.4	3.9
	400	12.5	10.7	2.1	3.6	13.5	11.0	2.3	6.2	10.6	10.0	1.8	2.6	11.4	10.2	1.9	4.6
	600	16.5	13.8	2.8	9.9	18.2	14.7	3.1	12.3	13.9	12.7	2.4	7.2	15.3	13.6	2.6	9.0
	800	23.0	20.0	3.9	10.4	29.0	24.4	4.9	3.8	19.2	18.5	3.3	7.7	24.2	22.5	4.1	2.7
	1000	27.8	24.1	4.7	6.1	34.1	28.6	5.8	4.4	23.3	22.3	4.0	4.6	28.5	26.3	4.8	3.2
	1200	32.0	28.0	5.4	4.9	39.7	33.1	6.7	6.8	26.8	25.9	4.6	3.8	33.1	30.4	5.6	4.9
16	200	5.5	5.5	0.7	0.4	6.5	5.9	0.8	1.2	4.6	4.6	0.6	0.3	5.5	5.5	0.7	0.9
	300	7.9	7.2	1.0	1.4	9.0	7.7	1.1	2.6	6.6	6.6	0.9	1.0	7.5	7.2	0.9	1.9
	400	11.2	10.2	1.4	1.2	12.3	10.5	1.6	3.1	9.0	9.4	1.2	1.2	10.3	9.8	1.3	2.3
	600	15.0	13.2	1.9	4.9	16.6	14.1	2.1	6.1	12.6	12.3	1.6	3.6	14.0	13.1	1.8	4.5
	800	20.2	18.9	2.6	5.1	25.9	23.2	3.3	1.8	16.9	16.9	2.2	3.7	20.9	20.9	2.7	1.2
	1000	24.8	22.9	3.2	2.2	30.7	27.2	3.9	2.1	20.8	20.8	2.7	2.5	24.9	24.9	3.2	1.5
	1200	28.2	26.4	3.5	2.7	36.6	31.4	4.8	3.3	23.7	23.7	3.0	2.1	28.8	28.8	3.7	2.2
20	200					5.7	5.6	0.6	0.7					4.8	4.8	0.5	0.5
	300	6.9	6.8	0.7	0.7	8.0	7.4	0.8	1.4	5.8	5.8	0.6	0.5	6.8	6.8	0.7	1.0
	400	9.9	9.7	1.0	0.9	11.1	10.1	1.1	1.7	8.3	8.3	0.9	0.6	9.4	9.4	1.0	1.3
	600	13.5	12.6	1.4	2.7	15.1	13.5	1.6	3.4	11.3	11.3	1.2	1.9	12.6	12.6	1.3	2.5
	800	17.8	17.8	1.8	2.7	22.4	21.8	2.3	0.9	14.7	14.7	1.5	2.0	17.3	17.3	1.8	0.6
	1000	22.0	22.0	2.3	1.9	26.9	25.7	2.7	1.1	18.4	18.4	1.9	1.4	20.9	20.9	2.1	0.7
	1200	24.9	24.9	2.5	2.6	31.2	29.7	3.2	3.7	20.7	20.7	2.1	3.2	24.1	24.1	2.6	1.1

WTR	CFM	45° EWT A-COIL TH	SH	GPM	PD	45° EWT D-COIL TH	SH	GPM	PD	50° EWT A-COIL TH	SH	GPM	PD	50° EWT D-COIL TH	SH	GPM
6	200	6.4	5.8	2.2	3.0	7.1	6.1	2.5	8.8	5.2	5.2	1.8	2.1	5.7	5.6	2.0
	300	8.5	7.4	3.0	9.8	9.3	7.8	3.1	17.0	6.8	6.8	2.4	6.7	7.4	7.1	2.5
	400	11.9	10.5	4.1	11.6	12.4	10.5	4.3	19.2	9.6	9.6	3.3	7.8	10.0	9.7	3.4
	600	15.4	13.2	5.3	31.4	16.7	14.0	5.7	38.0	12.3	12.2	4.3	21.0	13.3	12.9	4.6
	800					27.4	23.7	9.3	12.6	17.5	17.5	6.0	22.1	21.1	21.1	7.2
	1000	26.4	23.5	9.0	16.9	31.9	27.6	10.8	14.1	21.1	21.1	7.2	12.0	24.7	24.7	8.4
	1200	30.7	27.4	10.4	12.9	37.2	32.0	12.6	21.9	24.5	24.5	8.4	9.3	28.6	28.6	9.7
8	200	5.9	5.6	1.6	1.6	6.7	5.9	1.7	4.6	4.8	4.8	1.3	1.1	5.4	5.4	1.4
	300	8.0	7.2	2.1	5.2	8.9	7.6	2.2	9.1	6.4	6.4	1.7	3.6	7.1	7.1	1.8
	400	11.3	10.2	2.9	6.1	11.9	10.3	3.1	10.4	9.1	9.1	2.4	4.2	9.6	9.6	2.5
	600	14.6	13.0	3.8	16.9	16.0	13.8	4.1	20.6	11.8	11.8	3.1	11.5	12.8	12.8	3.3
	800	20.7	19.1	5.3	17.9	25.9	23.1	6.6	6.6	16.6	16.6	4.2	12.2	19.6	19.6	5.0
	1000	25.0	23.0	6.4	9.8	30.4	27.0	7.7	7.5	20.0	20.0	5.1	7.0	23.0	23.0	5.9
	1200	28.9	26.7	7.4	7.7	35.3	31.2	9.0	11.7	23.2	23.2	5.9	5.6	26.6	26.6	6.8
10	200	5.5	5.5	1.2	0.9	6.3	5.8	1.3	2.8	4.5	4.5	1.0	0.6	5.1	5.1	1.1
	300	7.5	7.0	1.6	3.1	8.4	7.5	1.7	5.5	6.1	6.1	1.3	2.2	6.8	6.8	1.4
	400	10.6	10.0	2.2	3.7	11.4	10.2	2.3	6.4	8.6	8.6	1.8	2.5	9.2	9.2	1.9
	600	14.0	12.7	2.9	10.2	15.3	13.6	3.2	12.6	11.3	11.3	2.4	7.0	12.3	12.3	2.6
	800	19.5	18.6	4.0	10.8	24.5	22.6	5.0	3.9	15.7	15.7	3.2	7.5	18.2	18.2	3.7
	1000	23.6	22.4	4.8	6.3	28.7	26.4	5.8	4.5	19.0	19.0	3.9	4.5	21.3	21.3	4.4
	1200	27.3	26.0	5.6	5.1	33.4	30.5	6.8	7.0	21.9	21.9	4.5	3.7	24.5	24.5	5.0
12	200	5.2	5.2	0.9	0.6	5.9	5.7	1.0	1.8	4.2	4.2	0.7	0.4	4.8	4.8	0.9
	300	7.1	6.9	1.3	2.0	8.0	7.3	1.3	3.6	5.7	5.7	1.0	1.4	6.5	6.5	1.1
	400	10.1	9.8	1.7	2.4	10.9	10.0	1.9	4.2	8.1	8.1	1.4	1.6	8.8	8.8	1.5
	600	13.3	12.5	2.3	6.7	14.6	13.3	2.5	8.9	10.8	10.8	1.9	4.6	11.8	11.8	2.1
	800	18.3	18.1	3.1	7.1	22.9	22.0	3.9	2.5	14.7	14.7	2.5	4.9	17.0	17.0	2.9
	1000	22.3	21.9	3.8	4.3	27.0	25.7	4.6	2.9	18.0	18.0	3.1	3.1	19.9	19.9	3.4
	1200	25.7	25.4	4.4	3.5	31.4	29.7	5.3	4.5	20.6	20.6	3.5	2.6	22.9	22.9	3.9
16	200	4.4	4.4	0.6	0.3	5.3	5.3	0.7	0.8					4.2	4.2	0.6
	300	6.3	6.3	0.8	1.0	7.2	7.1	0.9	1.7	5.0	5.0	0.7	0.6	5.8	5.8	0.7
	400	9.0	9.0	1.2	1.1	9.9	9.7	1.3	2.1	7.1	7.1	0.9	0.7	7.9	7.9	1.0
	600	12.1	12.1	1.6	3.3	13.4	12.9	1.7	4.1	9.6	9.6	1.3	2.2	10.7	10.7	1.4
	800	16.2	16.2	2.1	3.5	19.6	19.6	2.5	1.1	12.7	12.7	1.6	2.3	14.5	14.5	1.9
	1000	19.9	19.9	2.6	2.3	23.3	23.3	3.0	1.3	15.7	15.7	2.0	2.6	17.2	17.2	2.2
	1200	22.7	22.7	2.9	1.9	27.0	27.0	3.5	2.0	17.8	17.8	2.3	2.4	19.7	19.7	2.5
20	200															
	300	5.5	5.5	0.6	0.5	6.5	6.5	0.7	0.9							
	400	7.9	7.9	0.8	0.6	9.0	9.0	0.9	1.2	6.0	6.0	0.6	0.4	6.9	6.9	0.7
	600	10.8	10.8	1.1	1.8	12.1	12.1	1.3	2.3	8.3	8.3	0.9	1.1	9.4	9.4	1.0
	800	14.0	14.0	1.4	1.8	16.0	16.0	1.6	0.5	10.5	10.5	1.1	1.1			
	1000	17.5	17.5	1.8	1.3	19.4	19.4	2.0	0.6	13.2	13.2	1.4	0.9			
	1200	19.7	19.7	2.0	2.1	22.4	22.4	2.3	0.9	14.7	14.7	1.5	0.7	16.4	16.4	1.7

ENT. AIR 80.0 db/67.0 wb, 50% R.H.

WTR	CFM	40° EWT A-COIL TH	SH	GPM	PD	40° EWT D-COIL TH	SH	GPM	PD	44° EWT A-COIL TH	SH	GPM	PD	44° EWT D-COIL TH	SH	GPM	PD
6	200	9.5	6.1	3.3	6.2	10.4	6.5	3.6	17.4	8.0	5.4	2.8	4.5	8.9	5.8	3.1	13.2
	300	12.7	7.9	4.4	20.2	13.8	8.5	4.6	34.6	10.8	7.1	3.7	15.0	11.8	7.6	3.9	26.1
	400	18.0	11.5	6.1	24.6	18.5	11.5	6.2	38.7	15.2	10.1	5.2	18.1	15.7	10.1	5.3	29.2
	600									19.7	12.8	6.7	49.1				
	800					40.3	28.4	13.6	25.6					34.2	22.6	11.5	18.9
	1000	40.4	25.5	13.6	32.9	48.9	29.9	15.8	28.4	34.1	22.8	11.6	25.2	39.7	26.3	13.4	21.0
	1200					54.8	34.4	18.5	44.4	38.9	25.6	13.5	19.0	46.5	30.7	15.7	32.9
8	200	8.7	5.7	2.3	3.1	9.8	6.2	2.5	9.2	7.3	5.1	1.9	2.2	8.3	5.6	2.2	6.9
	300	12.0	7.6	3.1	10.7	13.1	8.2	3.3	18.7	10.0	6.8	2.6	7.8	11.2	7.3	2.8	13.9
	400	16.9	10.8	4.3	12.9	17.5	11.0	4.5	21.0	14.2	9.7	3.6	9.3	14.9	9.8	3.8	15.6
	600	22.0	13.9	5.6	35.3	23.7	14.8	6.1	42.0	18.5	12.3	4.7	25.7	20.1	13.1	5.1	31.1
	800					37.8	24.3	9.6	13.3	26.6	18.3	6.8	27.6	31.6	21.6	8.0	9.5
	1000	38.0	24.5	9.6	18.9	44.1	28.3	11.1	14.9	31.8	21.8	8.1	14.3	36.8	25.1	9.3	10.7
	1200	44.4	28.5	11.2	14.5	51.6	32.8	13.0	23.3	37.0	25.4	9.4	11.1	43.0	29.2	10.9	16.8
10	200	8.0	5.4	1.7	1.8	9.2	6.0	1.9	5.5	6.6	4.9	1.4	1.2	7.7	5.3	1.6	4.0
	300	11.2	7.3	2.3	6.3	12.5	7.9	2.5	11.3	9.3	6.5	1.9	4.5	10.5	7.0	2.1	8.3
	400	15.9	10.4	3.2	7.9	16.7	10.8	3.4	12.7	13.1	9.3	2.7	5.4	14.1	9.5	2.8	9.4
	600	20.9	13.3	4.3	21.1	22.7	14.3	4.6	25.5	17.3	11.9	3.6	15.1	19.1	12.7	3.9	18.8
	800	29.9	19.7	6.1	22.8	35.3	23.1	7.1	7.7	24.4	17.4	5.0	16.0	29.7	20.8	6.0	5.6
	1000	35.7	23.6	7.2	12.0	41.2	27.0	8.3	8.7	29.3	20.8	6.0	8.9	34.8	24.2	7.2	6.4
	1200	41.5	27.3	8.4	9.6	48.2	31.5	9.8	13.7	34.0	24.2	6.9	7.0	40.5	28.3	8.2	10.0
12	200	7.3	5.2	1.3	1.1	8.6	5.7	1.5	3.4	6.0	4.7	1.0	0.7	7.1	5.1	1.2	2.4
	300	10.4	7.0	1.8	4.0	11.9	7.6	2.0	7.4	8.6	6.2	1.5	2.8	9.9	6.8	1.7	5.3
	400	14.8	9.9	2.5	4.7	15.9	10.2	2.7	8.3	12.2	8.9	2.1	3.3	13.3	9.2	2.3	6.0
	600	19.6	12.8	3.4	13.5	21.8	13.8	3.7	16.7	16.2	11.4	2.8	9.6	18.0	12.3	3.1	12.1
	800	27.7	18.7	4.7	14.4	33.1	22.2	5.6	4.9	22.4	16.6	3.8	10.0	28.0	20.1	4.7	3.6
	1000	33.2	22.4	5.8	8.1	38.7	25.9	6.5	5.6	27.1	19.9	4.6	5.9	32.8	23.6	5.6	4.1
	1200	38.4	26.0	6.5	6.4	45.2	30.2	7.6	8.7	31.2	23.1	5.3	4.7	38.3	27.4	6.5	6.4
16	200	6.0	4.7	0.8	0.4	7.4	5.2	1.0	1.5	4.8	4.3	0.6	0.3	6.0	4.7	0.8	1.1
	300	9.0	6.4	1.2	1.8	10.5	7.0	1.3	3.5	7.3	5.7	1.0	1.2	8.5	6.3	1.1	2.4
	400	12.8	9.1	1.6	2.1	14.2	9.5	1.8	4.0	10.4	8.2	1.3	1.5	11.5	8.6	1.5	2.8
	600	17.5	11.9	2.2	6.2	19.4	12.9	2.5	8.1	14.2	10.7	1.8	4.4	15.9	11.5	2.0	5.6
	800	23.4	17.0	3.0	6.5	29.6	20.8	3.7	2.3	18.7	15.2	2.4	4.4	24.4	18.8	3.1	1.6
	1000	28.6	20.5	3.6	4.0	34.8	24.4	4.4	2.7	23.0	18.4	2.9	2.9	29.0	22.1	3.7	1.9
	1200	32.6	23.3	4.2	3.3	40.6	28.3	5.1	4.2	26.2	21.3	3.3	2.4	33.7	25.6	4.3	3.0
20	200	4.9	4.3	0.5	0.2	6.3	4.8	0.7	0.8					5.0	4.4	0.5	0.5
	300	7.6	5.9	0.8	0.9	9.1	6.5	0.9	1.8	6.1	5.3	0.7	0.6	7.3	5.9	0.7	1.2
	400	11.0	8.6	1.1	1.1	12.5	8.9	1.3	2.1	8.8	7.5	0.9	0.7	10.3	8.0	1.0	1.4
	600	15.2	11.3	1.6	3.3	17.1	12.0	1.8	4.3	12.2	10.0	1.3	2.2	13.8	10.8	1.4	2.9
	800	19.7	15.8	2.0	3.3	25.9	19.4	2.8	1.2	15.5	14.1	1.6	2.2	20.5	17.4	2.1	0.8
	1000	24.4	18.0	2.5	2.2	30.9	22.9	3.1	1.4	19.5	17.2	2.0	1.6	24.8	20.6	2.5	1.0
	1200	27.5	21.8	2.8	1.8	35.9	26.5	3.7	2.2	21.8	19.7	2.2	1.3	28.7	23.8	2.8	1.5

WTR	CFM	45° EWT A-COIL TH	SH	GPM	PD	45° EWT D-COIL TH	SH	GPM	PD	50° EWT A-COIL TH	SH	GPM	PD	50° EWT D-COIL TH	SH	GPM
6	200	7.6	5.3	2.6	4.1	8.5	5.6	2.9	12.2	5.7	4.6	2.0	2.5	6.6	4.9	2.3
	300	10.3	6.9	3.6	13.8	11.3	7.3	3.8	24.1	7.8	5.9	2.8	8.5	8.8	6.3	2.9
	400	14.5	9.8	4.9	16.6	15.0	9.8	5.1	26.9	11.0	8.4	3.8	10.0	11.8	8.5	4.0
	600	18.8	12.4	6.4	48.1					14.3	10.7	4.9	27.7	15.7	11.4	5.4
	800					32.5	22.0	11.0	17.3	20.4	15.8	7.0	20.0	25.2	19.1	8.6
	1000	32.5	22.1	11.0	23.4	37.9	25.6	12.8	19.2	24.5	18.9	8.3	15.8	29.4	22.2	10.0
	1200	38.0	25.8	12.9	17.7	44.3	29.8	15.0	30.1	28.5	22.1	9.7	15.6	34.1	25.8	11.6
8	200	6.9	5.0	1.8	2.0	7.9	5.4	2.1	6.3	5.2	4.4	1.4	1.2	6.0	4.7	1.6
	300	9.5	6.6	2.5	7.1	10.7	7.1	2.7	12.8	7.2	5.7	1.9	4.3	8.2	6.1	2.1
	400	13.5	9.4	3.4	8.5	14.2	9.5	3.6	14.4	10.2	8.1	2.6	5.0	10.9	8.2	2.8
	600	17.6	11.9	4.5	23.5	19.2	12.8	4.9	28.7	13.3	10.3	3.5	14.2	14.7	11.0	3.8
	800	25.2	17.7	6.4	25.1	30.2	21.0	7.7	8.8	18.6	15.1	4.8	14.8	23.5	18.4	6.0
	1000	30.1	21.1	7.7	13.2	36.3	24.5	8.9	9.9	22.4	18.2	5.7	8.3	27.8	21.5	7.0
	1200	35.0	24.6	8.9	10.2	41.2	28.5	10.4	13.5	25.9	21.1	6.6	8.6	32.1	25.0	8.2
10	200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	4.7	4.2	1.0	0.7	5.5	4.5	1.2
	300	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	6.6	5.5	1.4	2.5	7.6	5.9	1.5
	400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	9.3	7.8	2.0	2.8	10.2	8.0	2.1
	600	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	12.4	10.0	2.6	8.3	13.8	10.7	2.9
	800	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.0	14.6	3.5	8.6	21.8	17.8	4.4
	1000	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	20.6	17.6	4.2	5.1	25.6	20.9	5.3
	1200	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	23.7	20.4	4.8	4.1	29.2	24.1	6.1
12	200	5.6	4.5	1.0	0.7	6.8	5.0	1.2	2.2	4.2	4.1	0.8	0.4	5.0	4.4	0.9
	300	8.2	6.1	1.4	2.6	9.4	6.6	1.6	4.8	6.0	5.3	1.1	1.5	7.0	5.7	1.2
	400	11.5	8.5	2.0	3.0	12.5	8.9	2.2	5.5	8.6	7.6	1.5	1.8	9.5	7.8	1.6
	600	15.5	11.1	2.7	8.8	17.2	12.0	2.9	11.0	11.5	9.7	2.0	5.2	12.9	10.4	2.2
	800	21.1	16.1	3.6	9.0	26.7	19.6	4.5	3.3	15.5	14.0	2.7	5.8	20.1	17.3	3.4
	1000	25.6	19.4	4.4	5.4	31.3	23.0	5.3	3.8	18.9	17.0	3.2	3.4	23.7	20.2	4.0
	1200	29.8	22.5	5.0	4.3	36.5	26.7	6.2	5.5	21.7	19.2	3.7	2.8	27.5	23.6	4.7
16	200	4.6	4.2	0.6	0.3	5.7	4.6	0.7	1.0					4.2	4.1	0.6
	300	6.9	5.6	0.9	1.1	8.1	6.1	1.0	2.1	5.1	5.1	0.7	0.7	6.0	5.4	0.8
	400	9.8	8.0	1.3	1.3	11.0	8.3	1.4	2.5	7.3	7.1	0.9	0.8	8.2	7.4	1.1
	600	13.4	10.4	1.7	4.0	15.0	11.2	1.9	5.1	9.9	9.2	1.3	2.3	11.2	9.9	1.5
	800	17.7	14.8	2.3	4.0	23.1	18.3	2.9	1.5	12.9	12.9	1.7	2.4	16.3	16.0	2.1
	1000	21.7	18.0	2.8	2.6	27.3	21.6	3.5	1.7	16.0	16.0	2.1	3.7	18.8	18.8	2.5
	1200	24.7	20.7	3.2	2.2	32.8	25.0	4.1	2.7	18.1	18.1	2.8	3.4	22.7	21.7	2.9
20	200					4.7	4.3	0.5	0.5							
	300	5.7	5.2	0.6	0.5	6.9	5.7	0.7	1.1					5.0	5.0	0.5
	400	8.5	7.5	0.9	0.8	9.5	7.9	1.0	1.3	6.8	6.0	0.6	0.4	7.0	7.0	0.7
	600	11.5	9.8	1.2	2.0	13.0	10.5	1.4	2.8	8.4	8.4	0.9	1.1	9.5	9.5	1.0
	800	14.7	13.8	1.5	2.0	19.2	17.0	2.0	0.7	10.5	10.5	1.1	1.1			
	1000	18.3	16.3	1.9	1.4	23.2	20.1	2.4	0.9	13.2	13.2	1.4	0.9	15.2	15.2	1.6
	1200	20.6	19.3	2.1	1.2	26.9	24.1	2.7	1.3	14.7	14.7	1.5	0.7	17.3	17.3	1.8

HORIZONTAL MODELS

V-11 d

ENT. AIR 78.0 db/65.0 wb, 50% R.H.

WTR	CFM	40° EWT								44° EWT							
		A-COIL				D-COIL				A-COIL				D-COIL			
		TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD
6	200	8.5	5.5	2.9	5.0	9.4	6.2	3.2	14.4	7.0	5.2	2.4	3.6	7.9	5.5	2.7	10.6
	300	11.4	7.6	3.9	16.6	12.4	8.1	4.1	28.5	9.5	6.7	3.3	12.0	10.5	7.2	3.5	20.9
	400	[illegible]	10.8	5.8	[illegible]	[illegible]	[illegible]	5.6	31.9	[illegible]	9.2	4.6	14.3	[illegible]	9.5	4.2	[illegible]
	600	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	17.9	12.8	5.8	30.8	18.7	12.9	6.6	[illegible]
	800	[illegible]	[illegible]	[illegible]	[illegible]	36.0	24.2	13.2	20.8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	1000	36.6	24.2	12.2	27.6	41.9	28.0	14.7	23.1	29.8	21.6	10.1	20.9	34.8	25.0	11.8	18.5
	1200	[illegible]	[illegible]	[illegible]	[illegible]	46.8	30.8	16.3	38.2	[illegible]	25.2	12.8	18.8	[illegible]	[illegible]	13.8	[illegible]
8	200	7.8	5.5	2.0	2.5	8.8	5.9	2.3	7.6	6.4	4.9	1.7	1.8	7.3	5.3	1.9	5.5
	300	10.6	7.2	2.8	8.6	11.8	7.8	2.9	15.3	8.8	6.5	2.3	6.2	9.9	7.0	2.5	11.1
	400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	600	19.6	13.2	5.0	28.6	21.7	14.1	5.4	34.3	16.3	11.7	4.2	20.4	17.7	12.8	4.6	25.6
	800	[illegible]	[illegible]	[illegible]	[illegible]	35.8	23.1	8.5	10.7	25.0	17.6	5.8	21.6	28.2	20.8	[illegible]	[illegible]
	1000	33.9	23.2	8.6	15.7	38.1	26.9	9.6	12.8	27.7	20.0	7.1	11.6	32.8	24.2	8.4	[illegible]
	1200	38.0	27.2	10.6	[illegible]	45.6	32.3	11.8	18.8	32.2	24.3	8.2	9.0	36.8	28.2	9.8	13.8
10	200	7.1	5.2	1.5	1.4	8.2	5.7	1.7	4.5	5.8	4.7	1.2	1.0	6.8	5.1	1.4	3.2
	300	9.9	6.9	2.1	5.1	11.2	7.5	2.2	9.2	8.1	6.2	1.7	3.6	9.3	6.7	1.9	6.6
	400	14.2	9.8	2.9	6.1	15.8	10.3	3.1	10.8	11.8	8.9	2.4	4.2	12.8	9.2	2.6	7.3
	600	18.8	12.7	3.8	17.0	20.2	13.8	4.1	20.8	15.2	11.3	3.1	12.0	16.5	12.1	3.5	15.0
	800	26.3	18.7	5.4	18.2	31.5	22.2	6.4	6.3	21.2	16.5	4.5	12.6	26.5	20.1	5.4	4.3
	1000	31.6	22.5	6.4	9.9	36.8	25.9	7.5	7.1	25.6	19.5	5.2	7.2	31.0	23.3	6.3	5.2
	1200	36.6	25.9	7.4	7.8	43.0	30.1	8.7	11.1	29.6	23.1	6.0	5.7	36.2	27.2	7.4	8.2
12	200	6.5	5.0	1.1	0.9	7.7	5.5	1.3	2.8	5.2	4.5	0.9	0.6	6.2	4.9	1.1	1.9
	300	9.2	6.6	1.6	3.2	10.6	7.3	1.8	6.0	7.5	6.0	1.3	2.2	8.7	6.5	1.4	4.1
	400	13.2	9.5	2.2	3.8	14.2	9.6	2.6	6.8	10.7	8.6	1.8	2.8	11.7	8.8	2.0	4.2
	600	17.5	12.3	3.0	10.9	19.3	13.2	3.3	13.6	14.3	11.0	2.5	7.6	15.9	11.8	2.7	9.6
	800	24.3	17.8	4.1	11.5	29.8	21.5	5.0	4.0	19.5	15.8	3.3	7.9	24.8	19.4	4.2	2.9
	1000	25.3	21.4	5.0	6.6	35.0	25.1	5.9	4.6	23.2	19.1	4.0	4.7	29.2	22.8	5.0	3.3
	1200	33.2	24.8	5.7	5.3	40.8	29.2	6.9	7.2	27.2	22.1	4.6	3.9	34.0	26.6	5.8	5.2
16	200	5.3	4.5	0.7	0.4	6.5	5.0	0.9	1.2	4.3	4.2	0.6	0.2	5.3	4.6	0.7	0.8
	300	7.9	6.1	1.0	1.4	9.3	6.7	1.2	2.8	6.4	5.6	0.9	1.0	7.5	6.1	0.9	1.9
	400	11.5	8.8	1.5	1.7	12.8	9.2	1.8	3.2	9.2	7.9	1.2	1.2	10.2	8.8	1.3	2.2
	600	15.4	11.4	2.0	5.1	17.2	12.4	2.2	6.5	12.6	10.3	1.6	3.5	13.9	11.1	1.6	4.5
	800	20.6	16.2	2.6	5.2	26.4	20.1	3.4	1.3	16.4	14.2	2.1	3.5	21.4	18.1	2.2	1.3
	1000	23.1	19.7	3.2	3.3	31.3	23.6	4.0	2.2	20.2	17.8	2.6	2.3	25.5	21.4	3.5	1.5
	1200	28.7	22.7	3.7	2.7	38.4	27.4	4.6	3.4	22.9	20.5	2.9	2.0	25.6	24.7	3.6	2.4
20	200					5.5	4.7	0.6	0.6								
	300	6.7	5.7	0.7	0.7	8.0	6.3	0.8	1.4	5.3	5.2	0.6	0.5	6.4	5.7	0.6	0.9
	400	9.7	8.2	1.0	0.8	11.1	8.8	1.1	1.7	7.7	7.4	0.8	0.6	8.9	7.8	0.9	1.2
	600	13.4	10.7	1.4	2.6	15.1	11.6	1.6	3.4	10.7	9.7	1.1	1.8	12.1	10.5	1.3	2.3
	800	17.3	15.0	1.8	2.6	22.8	18.7	2.3	0.9	13.6	13.6	1.4	1.7	17.4	16.2	1.8	0.6
	1000	21.5	18.3	2.2	1.8	27.4	22.1	2.8	1.2	17.1	16.7	1.8	1.3	21.2	19.8	2.2	0.7
	1200	24.2	21.0	2.5	1.5	31.8	25.5	3.2	1.8	19.1	19.1	2.0	1.1	24.5	22.8	2.5	1.3

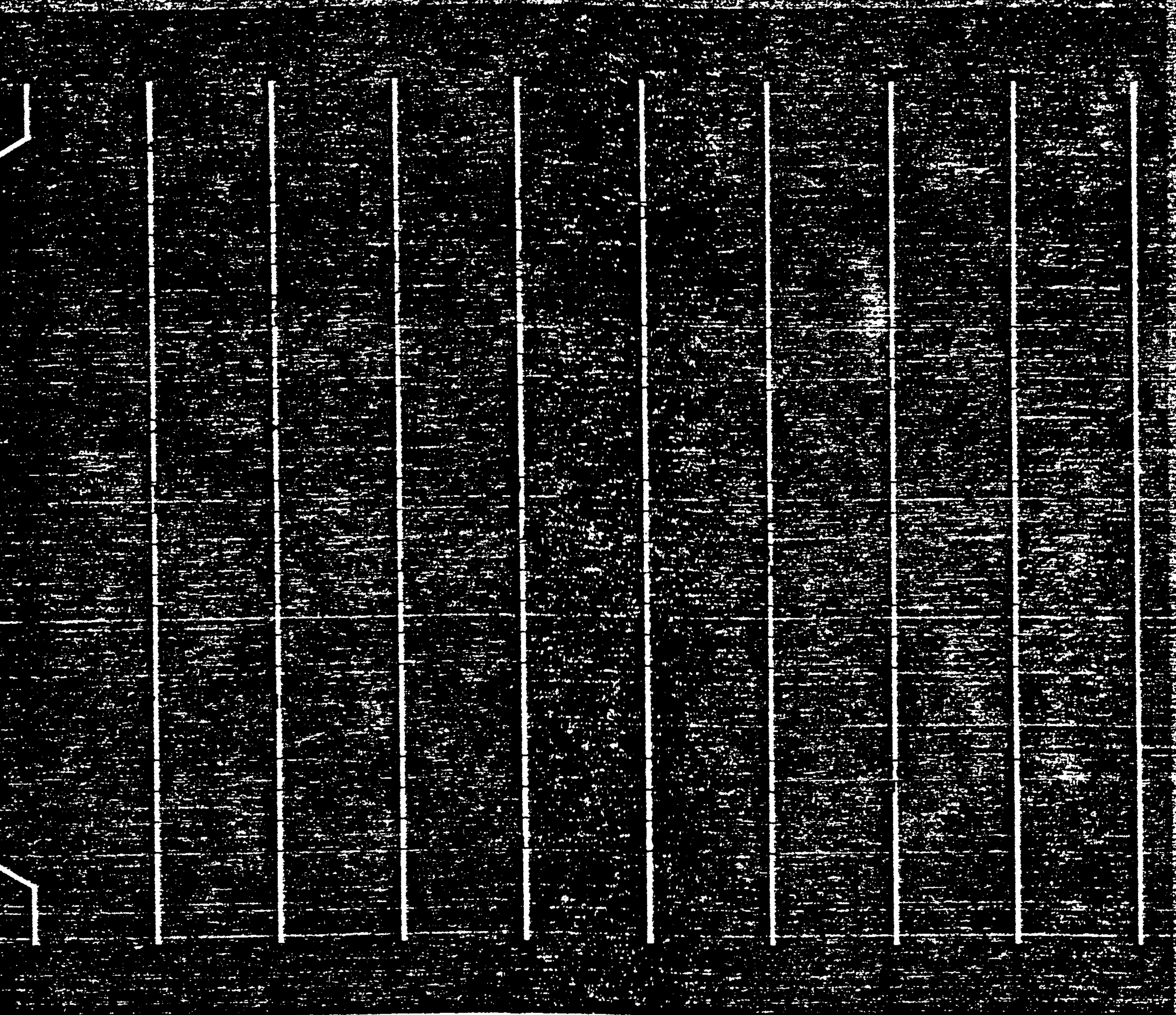
WTR	CFM	45° EWT								50° EWT							
		A-COIL				D-COIL				A-COIL				D-COIL			
		TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD
6	200	6.7	5.0	2.3	3.3	7.5	5.4	2.6	9.8	5.0	4.4	1.8	2.0	5.7	4.7	2.0	5.9
	300	9.0	6.5	3.2	11.0	10.0	7.0	3.3	19.2	6.7	5.7	2.4	6.6	7.6	6.0	2.5	11.6
	400	12.2	9.8	4.5	13.2	13.2	9.4	4.8	21.6	9.8	8.3	3.3	7.2	10.6	8.7	3.5	[illegible]
	600	16.4	11.8	5.6	35.5	17.9	12.6	6.3	42.9	12.3	10.2	4.3	21.2	13.8	10.9	4.7	28.8
	800	[illegible]	[illegible]	[illegible]	[illegible]	26.8	20.8	9.2	13.6	17.9	15.9	6.6	22.2	22.6	18.7	7.9	[illegible]
	1000	28.3	20.9	9.8	18.9	33.5	24.6	12.3	18.2	27.6	18.1	7.2	11.9	26.2	21.5	8.7	[illegible]
	1200	38.1	26.8	11.2	14.4	36.9	28.5	13.8	[illegible]	24.5	21.8	8.4	9.5	[illegible]	[illegible]	[illegible]	[illegible]
8	200	6.0	4.8	1.6	1.6	7.0	5.2	1.8	5.0	4.5	4.3	1.2	1.0	5.2	4.5	1.4	3.0
	300	8.3	6.3	2.2	5.6	9.4	6.8	2.4	10.2	6.2	5.5	1.7	3.3	7.0	5.9	1.8	6.0
	400	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	600	15.4	11.4	4.0	18.6	17.0	12.2	4.4	22.9	11.5	9.5	3.0	11.0	12.7	10.6	3.3	13.7
	800	21.5	18.8	5.8	13.6	26.9	20.8	6.8	7.3	16.0	14.0	4.6	13.3	20.4	17.7	5.2	4.6
	1000	26.2	20.1	6.3	18.6	31.4	23.8	8.0	8.0	19.9	17.5	5.0	6.6	23.5	20.7	6.1	4.7
	1200	30.4	23.4	7.8	8.3	36.2	27.4	9.2	12.5	22.4	20.3	5.8	5.8	27.2	24.0	7.2	7.2
10	200	5.5	4.6	1.2	0.9	6.4	5.0	1.3	2.9	4.1	4.1	0.9	0.5	4.8	4.4	1.0	1.7
	300	7.7	6.0	1.6	3.2	8.8	6.5	1.8	6.0	5.7	5.3	1.2	1.9	6.5	5.7	1.3	3.5
	400	10.5	8.6	2.2	3.8	11.8	8.8	2.4	6.8	8.1	7.8	1.7	2.5	8.8	7.8	1.8	4.4
	600	14.4	11.0	3.0	10.9	15.0	11.8	3.3	13.6	10.8	9.2	2.3	6.5	11.9	10.4	2.5	8.2
	800	20.0	16.1	4.1	11.4	25.2	19.8	5.1	4.2	14.3	14.1	3.0	6.8	18.0	17.2	3.8	2.4
	1000	24.2	19.3	4.9	6.6	29.6	22.9	6.0	4.8	17.5	17.0	3.7	4.1	22.1	20.2	4.5	2.2
	1200	27.9	22.4	5.7	5.3	34.5	26.8	7.0	7.4	20.6	19.7	4.2	3.4	25.7	23.2	5.3	4.4
12	200	4.9	4.4	0.9	0.5	5.9	4.8	1.0	1.8	3.7	3.7	0.7	0.3	4.4	4.3	0.8	1.1
	300	7.1	5.8	1.3	2.0	8.2	6.3	1.4	3.7	5.3	5.2	1.0	1.2	6.1	5.6	1.0	2.2
	400	10.1	8.3	1.7	2.4	11.1	8.6	1.9	4.4	7.3	7.4	1.3	1.2	8.3	7.6	1.4	2.1
	600	13.5	10.7	2.3	6.9	15.0	11.5	2.6	8.7	10.1	9.9	1.8	4.1	11.2	10.1	2.0	3.2
	800	18.3	15.4	3.1	7.1	23.5	18.9	4.0	2.6	13.6	13.6	2.3	4.2	17.1	16.6	2.9	1.2
	1000	22.3	18.6	3.8	4.3	27.8	22.2	4.7	3.0	16.6	16.6	2.9	2.7	20.2	19.4	3.5	1.2
	1200	25.7	21.6	4.4	3.5	32.3	28.2	5.8	4.7	18.8	18.0	3.3	2.3	23.5	22.4	4.0	2.8
16	200	4.0	4.0	0.5	0.2	5.0	4.5	0.7	0.8					3.7	3.7	0.5	0.5
	300	6.0	5.4	0.8	0.9	7.0	5.9	0.9	1.7	4.4	4.4	0.6	0.5	5.2	5.2	0.7	1.0
	400	8.6	7.8	1.1	1.0	9.7	8.7	1.3	2.0	6.4	6.4	0.8	0.8	7.2	7.2	0.9	2.2
	600	11.8	10.0	1.5	3.1	13.2	10.8	1.7	4.0	8.7	8.7	1.2	1.9	9.8	9.8	1.3	2.4
	800	15.4	14.3	2.0	3.2	20.1	17.9	2.6	1.1	11.3	11.3	1.5	1.9	13.4	13.4	1.7	0.8
	1000	19.0	17.4	2.4	2.1	23.9	20.8	3.1	1.4	14.1	14.1	1.8	1.4	16.2	16.2	2.1	0.2
	1200	21.6	20.1	2.8	1.8	27.8	24.0	3.6	2.1	15.8	15.8	2.1	1.2	18.7	18.7	2.4	1.8
20	200																
	300	5.0	5.0	0.5	0.4	6.0	5.6	0.6	0.8								
	400	7.3	7.3	0.8	0.5	8.4	7.6	0.9	1.0	5.2	5.2	0.8	0.3	6.1	6.1	0.6	0.6
	600	10.1	9.5	1.1	1.6	11.4	10.2	1.2	2.1	7.3	7.3	0.8	0.9	8.3	8.3	0.9	1.2
	800	12.8	12.8	1.3	1.6	16.1	16.1	1.7	0.5								
	1000	16.1	16.1	1.7	1.2	19.6	19.2	2.0	0.6	11.4	11.4	1.2	0.7				
	1200	18.0	18.0	1.9	1.0	22.6	22.1	2.3	1.0	12.6	12.6	1.3	0.6				

ENT. AIR 78.0 db/68.0 wb, 60% R.H.

WTR	CFM	40° EWT								44° EWT							
		A-COIL				D-COIL				A-COIL				D-COIL			
		TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD
6	200	10.1	5.6	3.5	6.9	11.0	6.1	3.8	19.3	8.5	5.0	2.9	5.1	9.5	5.4	3.2	14.7
	300	13.5	7.4	4.6	22.4	14.6	8.0	4.9	38.4	11.5	6.6	4.0	16.9	12.6	7.1	4.2	29.4
	400	19.1	10.6	6.5	27.3	19.4	10.6	6.8	42.7	16.3	9.3	5.5	20.4	16.7	9.4	5.7	32.7
	600																
	800					42.7	23.7	14.4	28.5					36.5	20.9	12.3	21.4
	1000					49.7	27.5	16.7	31.5	36.5	21.0	12.3	28.0	42.5	24.4	14.3	23.2
	1200					58.1	32.2	19.6	49.4					49.7	28.4	16.6	37.1
8	200	9.3	5.3	2.4	3.5	10.4	5.8	2.7	10.2	7.7	4.6	2.0	2.5	8.8	5.1	2.3	7.5
	300	12.7	7.1	3.3	11.9	13.9	7.7	3.5	20.8	10.7	6.2	2.8	8.7	11.9	6.8	3.0	15.6
	400	18.0	10.1	4.6	14.4	18.6	10.2	4.7	23.3	15.1	8.8	3.9	10.5	15.8	9.0	4.0	17.5
	600	23.3	12.9	6.0	39.2	25.1	13.8	6.4	46.6	19.8	11.4	5.1	29.1	21.5	12.2	5.5	35.1
	800					40.2	22.6	10.2	14.9					33.9	19.8	8.6	10.9
	1000	40.4	22.7	10.2	20.8	46.9	26.3	11.8	16.6	34.1	20.0	8.7	16.0	39.5	23.1	10.0	12.2
	1200	47.2	26.5	11.9	15.8	54.8	30.7	13.8	26.1	39.6	23.3	10.0	12.2	46.2	27.0	11.7	19.3
10	200	8.4	4.9	1.7	1.9	9.7	5.5	2.0	6.0	5.9	4.3	1.4	1.4	8.1	4.8	1.7	4.3
	300	11.9	6.7	2.5	7.0	13.3	7.4	2.7	12.6	9.8	5.9	2.1	5.0	11.1	6.4	2.2	9.2
	400	16.9	9.6	3.4	8.5	17.7	9.9	3.6	14.2	13.9	8.4	2.8	6.0	14.9	8.6	3.0	10.4
	600	22.2	12.4	4.5	23.6	24.1	13.3	4.9	28.5	18.5	10.8	3.8	17.1	20.3	11.7	4.2	20.9
	800	31.5	18.2	6.5	25.4	37.6	21.4	7.6	8.7	26.3	15.8	5.4	18.2	31.1	18.7	6.3	6.1
	1000	38.1	21.7	7.7	13.3	44.0	25.0	8.9	9.8	31.5	18.9	6.4	9.9	36.4	21.8	7.4	7.4
	1200	44.3	25.3	9.0	10.4	51.4	29.2	10.4	15.4	36.5	22.0	7.4	7.8	42.6	25.5	8.6	10.5
12	200	7.7	4.6	1.3	1.2	9.0	5.2	1.6	3.7	6.1	4.0	1.1	0.8	7.4	4.5	1.3	2.6
	300	11.1	6.4	1.9	4.4	12.5	7.0	2.1	8.1	9.0	5.5	1.6	3.0	10.4	6.1	1.7	5.8
	400	15.7	9.1	2.7	5.3	16.8	9.6	2.9	9.2	12.8	7.9	2.2	3.6	13.9	8.2	2.4	6.6
	600	21.0	11.9	3.6	15.2	22.9	12.8	3.9	18.6	17.2	10.3	2.9	10.6	19.0	11.1	3.2	13.3
	800	29.7	17.2	5.0	16.3	35.0	20.3	5.9	5.4	23.9	14.9	4.1	11.2	28.5	17.7	4.8	3.7
	1000	35.5	20.6	6.0	8.9	41.0	23.7	6.9	6.2	28.7	17.8	4.9	6.4	33.4	20.6	5.6	4.2
	1200	41.1	23.9	7.0	7.1	47.9	27.7	8.1	3.7	33.1	20.7	5.6	5.1	39.0	24.0	6.6	6.6
16	200	6.1	4.0	0.8	0.5	7.6	4.6	1.0	1.6	4.7	3.6	0.6	0.3	6.1	4.0	0.8	1.1
	300	9.4	5.7	1.2	1.9	10.9	6.4	1.4	3.7	7.4	4.9	1.0	1.3	8.8	5.5	1.1	2.5
	400	13.4	8.1	1.7	2.3	14.8	8.6	1.9	4.3	10.5	7.1	1.4	1.5	12.0	7.5	1.5	3.6
	600	18.3	10.8	2.4	7.0	20.3	11.7	2.6	8.8	14.6	9.3	1.9	4.6	16.4	10.1	2.1	6.0
	800	24.7	15.2	3.2	7.2	29.9	18.2	3.8	2.4	19.1	13.1	2.4	4.6	24.5	16.2	3.1	1.6
	1000	30.1	18.4	3.8	4.4	35.2	21.4	4.5	2.7	23.5	15.9	3.0	3.0	29.1	19.0	3.7	1.5
	1200	34.3	21.2	4.4	3.5	41.1	24.5	5.2	4.3	26.6	18.3	3.4	2.4	33.9	22.1	4.3	3.0
20	200	4.8	3.6	0.5	0.2	6.3	4.1	0.7	0.8					4.8	3.6	0.5	0.5
	300	7.7	5.1	0.8	0.9	9.3	5.7	0.9	1.8	5.9	4.4	0.6	0.6	7.2	4.9	0.7	1.1
	400	11.1	7.3	1.1	1.1	12.8	7.8	1.3	2.2	8.5	6.4	0.9	0.7	10.0	6.8	1.0	1.4
	600	15.6	9.7	1.6	3.5	17.6	10.6	1.8	4.5	12.1	8.4	1.3	2.2	13.8	9.2	1.4	2.9
	800	20.0	13.5	2.1	3.4	25.9	16.7	2.6	1.2	15.1	11.7	1.6	2.1	20.3	14.7	2.1	0.8
	1000	24.8	16.4	2.5	2.3	30.8	19.7	3.1	1.4	19.0	14.3	2.0	1.5	24.5	17.4	2.5	0.8
	1200	27.9	18.7	2.8	1.9	35.9	22.9	3.7	2.2	21.1	16.4	2.2	1.2	28.5	20.2	2.9	1.5

WTR	CFM	45° EWT								50° EWT							
		A-COIL				D-COIL				A-COIL				D-COIL			
		TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD	TH	SH	GPM	PD
6	200	8.1	4.8	2.8	4.6	9.0	5.2	3.1	13.5	6.0	4.0	2.1	2.7	6.9	4.3	2.4	8.4
	300	11.0	6.3	3.8	15.6	12.1	6.8	4.0	27.2	8.3	5.2	2.9	9.5	9.3	5.7	3.1	17.0
	400	15.5	9.0	5.3	18.8	16.0	9.1	5.4	30.3	11.7	7.5	4.0	11.3	12.4	7.6	4.2	19.0
	600									15.4	9.6	5.3	31.4	16.8	10.2	5.8	38.2
	800					34.9	20.3	11.8	19.7					26.4	16.9	9.0	11.8
	1000	34.8	20.3	11.8	26.1	40.6	23.6	13.7	21.8	26.4	16.9	9.0	16.9	30.8	19.6	10.4	13.2
	1200	40.8	23.8	13.8	19.6	47.5	27.5	16.0	34.2	30.9	19.8	10.5	13.0	36.0	22.9	12.2	20.7
8	200	7.3	4.5	1.9	2.2	8.4	4.9	2.2	6.9	5.3	3.7	1.4	1.3	6.3	4.1	1.6	4.1
	300	10.2	6.0	2.7	8.0	11.4	6.5	2.9	14.4	7.5	5.0	2.0	4.7	8.6	5.4	2.2	8.6
	400	14.4	8.5	3.7	9.6	15.1	8.7	3.9	16.1	10.6	7.1	2.7	5.5	11.5	7.3	2.9	9.8
	600	18.9	11.0	4.8	26.7	20.5	11.8	5.3	32.3	14.1	9.1	3.6	15.7	15.6	9.8	4.0	19.7
	800	27.2	16.2	6.9	28.6	32.2	19.2	8.2	9.9	19.7	13.3	5.1	16.5	24.1	16.0	6.1	5.8
	1000	32.4	19.3	8.2	14.8	37.6	22.3	9.5	11.1	23.7	15.9	6.1	9.1	28.1	18.6	7.2	6.6
	1200	37.8	22.5	9.6	11.4	44.0	26.0	11.1	17.5	27.5	18.5	7.0	7.2	32.9	21.7	8.4	10.5
10	200	6.5	4.2	1.4	1.2	7.7	4.6	1.6	3.9	4.6	3.5	1.0	0.7	5.6	3.9	1.2	2.3
	300	9.3	5.6	2.0	4.5	10.6	6.2	2.1	8.4	6.7	4.7	1.4	2.6	7.9	5.2	1.6	4.8
	400	13.2	8.1	2.7	5.4	14.2	8.3	2.9	9.5	9.6	6.7	2.0	3.0	10.5	6.9	2.2	5.8
	600	17.6	10.4	3.6	15.5	19.3	11.3	4.0	19.1	12.9	8.7	2.7	8.9	14.4	9.4	3.0	11.3
	800	24.8	15.2	5.1	16.5	29.4	18.0	6.0	5.5	17.5	12.5	3.8	9.0	22.1	15.3	4.5	3.5
	1000	29.8	18.2	6.1	9.1	34.4	21.1	7.0	6.3	21.2	15.0	4.3	5.3	25.9	17.9	5.3	3.8
	1200	34.8	21.2	7.0	7.2	40.2	24.6	8.2	9.9	24.4	17.4	5.0	4.3	30.3	20.8	6.2	5.8
12	200	5.7	3.9	1.0	0.7	7.0	4.4	1.2	2.4	4.0	3.3	0.7	0.4	5.0	3.7	0.9	1.3
	300	8.5	5.3	1.5	2.7	9.8	5.9	1.6	5.2	6.0	4.5	1.1	1.5	7.1	4.9	1.2	2.9
	400	12.1	7.6	2.1	3.3	13.2	8.0	2.3	6.0	8.8	6.4	1.5	1.8	9.6	6.6	1.7	3.4
	600	16.3	9.9	2.8	9.6	18.0	10.7	3.1	12.1	11.7	8.3	2.0	5.3	13.1	8.9	2.3	6.8
	800	22.3	14.3	3.8	10.0	27.1	17.1	4.6	3.4	15.5	11.8	2.7	5.3	20.2	14.6	3.4	2.6
	1000	27.0	17.2	4.6	5.8	31.8	20.0	5.4	3.9	18.9	14.3	3.3	3.4	23.8	17.1	4.1	2.5
	1200	31.1	19.9	5.3	4.7	37.2	23.3	6.3	6.1	21.6	16.5	3.7	2.8	27.8	19.9	4.7	3.6
16	200	4.4	3.4	0.6	0.3	5.7	3.9	0.7	1.0					3.9	3.3	0.5	0.5
	300	6.9	4.8	0.9	1.1	8.2	5.3	1.0	2.2	4.7	4.0	0.6	0.6	5.7	4.4	0.7	1.1
	400	9.9	6.8	1.3	1.3	11.3	7.2	1.5	2.7	6.8	5.8	0.9	0.7	7.9	6.1	1.0	1.4
	600	13.7	9.0	1.8	4.1	15.4	9.8	2.0	5.3	9.5	7.6	1.3	2.2	10.8	8.2	1.4	2.9
	800	17.8	12.6	2.3	4.1	23.1	15.7	2.9	1.5	12.1	10.7	1.6	2.1	16.1	13.3	2.1	0.8
	1000	22.0	15.4	2.8	2.7	27.5	18.5	3.5	1.7	15.1	13.0	2.0	1.5	19.3	15.7	2.5	0.9
	1200	24.8	17.8	3.2	2.2	32.1	21.4	4.1	2.7	16.9	14.9	2.2	1.3	22.9	18.1	2.9	1.4
20	200																
	300	5.5	4.3	0.6	0.5	6.7	4.8	0.7	1.0								
	400	7.9	6.2	0.8	0.6	9.3	6.6	1.0	1.3	5.3	5.3	0.6	0.3	6.3	5.6	0.7	0.6
	600	11.3	8.1	1.2	1.9	12.8	8.9	1.3	2.6	7.6	6.9	0.8	1.0	8.7	7.5	0.9	1.3
	800	14.0	11.3	1.4	1.8	18.9	14.2	1.9	0.7								
	1000	17.6	13.9	1.8	1.3	22.8	16.8	2.3	0.8	11.7	11.7	1.2	0.7				
	1200	19.6	15.8	2.0	1.1	26.5	19.5	2.7	1.3	12.9	12.9	1.3	0.6	18.5	16.1	1.7	0.8

WATER PRESSURE DROP



E: PRESSURE DROPS BASED ON 170 F WATER. PRESSURE DROPS LOWER THAN SHOWN ABOVE NOT RECOMMENDED.

V-11 e

centage of Rated Free Flow CFM for Various External Static Pressures

UNIT SIZE	EXTERNAL STATIC PRESSURES (INCHES OF WATER)						
	FREE FLOW	.05	.10	.15	.20	.30	.40
-SPEED (G-1) AND 3-SPEED (G-2 AND G-3) MOTORS							
02	100%	92%	79%	67%	—	—	—
03	100%	91%	82%	71%	—	—	—
04	100%	91%	81%	67%	—	—	—
06	100%	92%	82%	71%	—	—	—
08	100%	91%	82%	71%	—	—	—
10	100%	92%	83%	74%	—	—	—
12	100%	89%	78%	68%	—	—	—
HIGH EXTERNAL STATIC PRESSURE (G-4) MOTOR							
04	—	149%	142%	133%	124%	105%	82%
06	—	141%	136%	131%	126%	111%	92%
08	—	122%	117%	111%	105%	92%	77%
10	—	129%	123%	117%	111%	95%	75%
12	—	132%	125%	119%	112%	97%	79%

OTE DATA BASED ON HIGH FAN SPEED.

V-11 f

TRANE RECONNECTED WINDING MOTORS

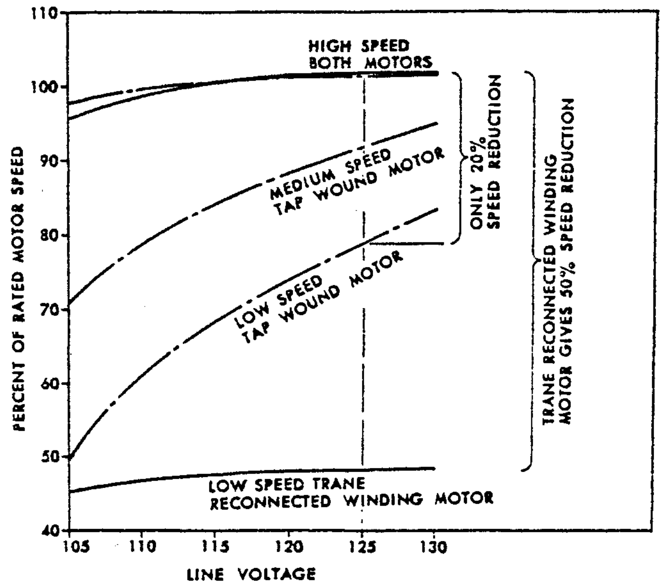
A major problem with fan-coil room units, in the 200 to 0 cfm range, has been the lack of positive significant tor speed reduction for good capacity control. When e voltage is above nominal, but within power company ecifications, a common occurrence, tap wound motors ve negligible capacity control. Even at nominal line tages, tap wound motors offer at most only 30 percent pacity reduction from high to low speed.

To solve this problem, Trane developed the 2-speed, onnected winding, shaded pole motor, optional on all 0-600 cfm units. This exclusive design assures positive percent speed, 55 percent capacity reduction from 105 130 line volts. See Chart 13.

With the Trane design, positive 50 percent speed re- ction is accomplished by incorporating the equivalent a 6-pole and 12-pole motor within the same housing. e winding is reconnected by indexing the motor switch high speed (6-pole) or low speed (12-pole) operation.

Tap wound motors are also available. This includes optional permanent split capacitor design for use when eptionally high motor efficiency, power factor, and e are desired. All UniTrane fan motors have been care- ly designed to provide long, trouble-free operation.

CHART 13—Positive 50% Speed Reduction With Trane Reconnected Winding Motor



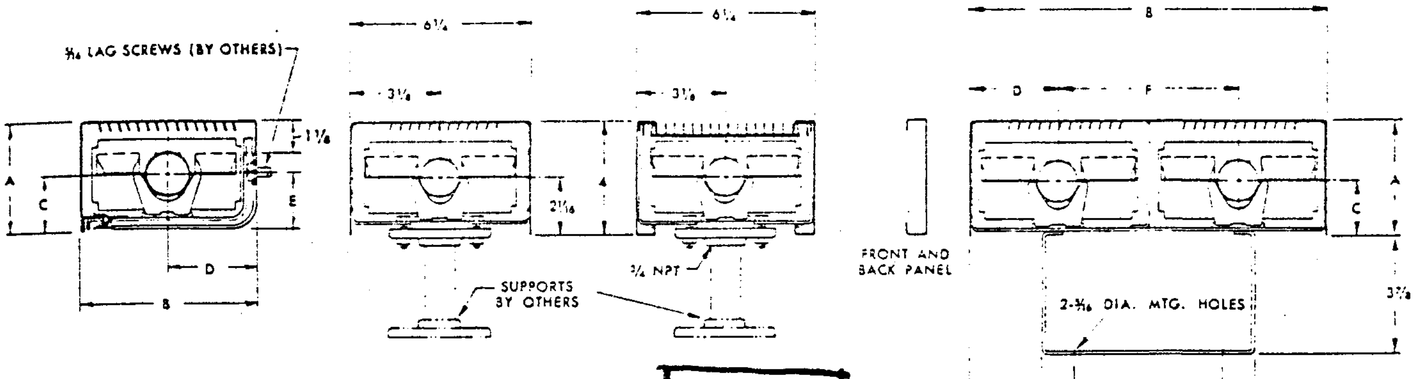
LE 13—UniTrane Motor Characteristics

MOTOR	CHARACTER-ISTICS	UNIT SIZE						
		02	03	04	06	08	10	12
SP	VOLTS PF RPM CFM AMPS WATTS HP	115/60/1 .75 1100/500 230/105 1.40/.70 120/60 1/60	115/60/1 .73 1100/500 320/150 1.90/.95 160/75 1/30	115/60/1 .78 1075/500 410/190 1.50/.75 135/60 1/30	115/60/1 .71 1075/500 570/265 2.20/1.20 180/80 1/20	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE
SP	VOLTS PF RPM CFM AMPS WATTS HP	115/60/1 .59 1100/900/700 230/200/145 1.40/.65/.40 95/50/30 1/60	115/60/1 .74 1100/900/700 320/260/200 1.60/1.15/.85 135/100/75 1/30	115/60/1 .64 1075/900/700 410/340/265 1.50/.85/.75 110/65/55 1/30	115/60/1 .56 1075/900/700 570/475/370 2.10/1.45/1.30 135/105/90 1/20	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE
PSC	VOLTS PF RPM CFM AMPS WATTS HP	115/60/1 .87 1100/900/700 230/200/145 .85/.40/.30 85/40/30 1/60	115/60/1 .82 1100/900/700 320/260/200 .90/.40/.30 85/50/40 1/30	115/60/1 .76 1075/900/700 410/340/265 .90/.50/.35 75/50/35 1/30	115/60/1 .78 1075/900/700 570/475/370 1.00/.75/.65 90/70/60 1/20	115/60/1 .70 775/650/525 840/710/570 1.60/1.15/.90 130/95/75 1/12	115/60/1 .85 775/650/525 1000/840/680 1.80/1.25/.90 170/115/80 1/8	115/60/1 .85 775/650/525 1200/1000/810 1.90/1.15/ 75 190/110/70 1/6
(NOTE) SP (02-06) PSC (08-13)	VOLTS PF RPM CFM AMPS WATTS HP	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	115/60/1 .59 1600/1400/1050 690/530/390 3.39/2.23/1.62 248/171/128 1/8	115/60/1 .63 1500/1050/700 880/575/410 3.85/2.58/1.89 285/205/147 1/8	115/60/1 .68 1100 1180 3.50 275 1/4	115/60/1 .71 1100 1530 4.30 350 1/3	115/60/1 .85 1100 1560 4.0 360 1/2
PSC	VOLTS PF RPM CFM AMPS WATTS HP	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	230/50/1 .93 680/540/425 700/590/480 .80/.35/.23 170/70/45 1/12	230/50/1 .85 680/540/425 830/700/570 .90/.39/.25 175/70/45 1/8	230/50/1 .89 680/540/425 1100/830/680 1.30/.47/.28 265/85/45 1/6
PSC	VOLTS PF RPM CFM AMPS WATTS HP	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	230/60/1 .93 775/650/525 840/710/570 .77/.38/.23 165/80/45 1/12	230/60/1 .94 775/650/525 1000/840/680 .81/.40/.25 175/85/45 1/8	230/60/1 .89 775/650/525 1200/1000/810 1.60/.57/.31 325/110/55 1/6
SP	VOLTS PF RPM CFM AMPS WATTS HP	230/50/1 .60 1100/900/700 230/200/145 .40/.30/.25 55/40/30 1/60	230/50/1 .65 1100/900/700 320/260/200 .60/.50/.35 90/80/55 1/33	220/50/1 .67 1075/900/700 410/340/265 .65/.50/.40 100/75/60 1/30	230/50/1 .68 1075/900/700 570/475/370 .90/.70/.55 140/115/90 1/20	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE	MOTOR NOT AVAILABLE

E: THIS DATA BASED ON [illegible] EXTERNAL STATIC PRESSURE TO A [illegible] UNIT. THE MAXIMUM TO BE USED WITH [illegible] MOTORS

V-12

TYPES E, E3, E3A, AND E3-2W DIMENSIONS AND RATINGS

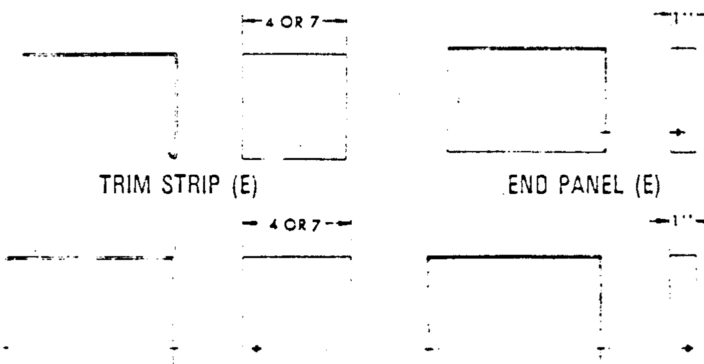


TYPE 3E & 4E

TYPE E3

TYPE E3A Extruded Grille

TYPE E3-2W



TRIM STRIP (E)

END PANEL (E)

TRIM STRIP (E3)

END PANEL (E3)

TABLE 18—Enclosure Dimensions, Types E and E3-2W

Dimension	3¼" Fin		5¼" Fin	
	3E	E3-2W	4E	E3-2W
A	3⅞	3	3⅞	3¼
B	4	7¹³⁄₁₆	6	11¹³⁄₁₆
C	1¾	1⁵⁄₁₆	2	1¹³⁄₁₆
D	2	2	3	2¹⁵⁄₁₆
E	1½	⅞	2	2⅞
F	—	3¾	—	5¹³⁄₁₆

NOTE: Type E3A available in 18 gauge front and back panels only. Types E3 and E3-2W available in 16 gauge only. Types 3E and 4E available in 16 or 14 gauge. All enclosures are cleaned and phosphatized to prevent corrosion and rust creep from scratches, finished in baked grey enamel primer. Baked enamel final finish in choice of seven colors.

TABLE 19—Inside and Outside Corners

Dimension	3E	4E	E3 & E3A	E3-2W	
				3¼" Fin	5¼" Fin
8	6¼	8¼	9¼	10¹¹⁄₁₆	14¹¹⁄₁₆

All dimensions approximate.
Certified drawings available on request.

INSIDE CORNER (E)

OUTSIDE CORNER (E)

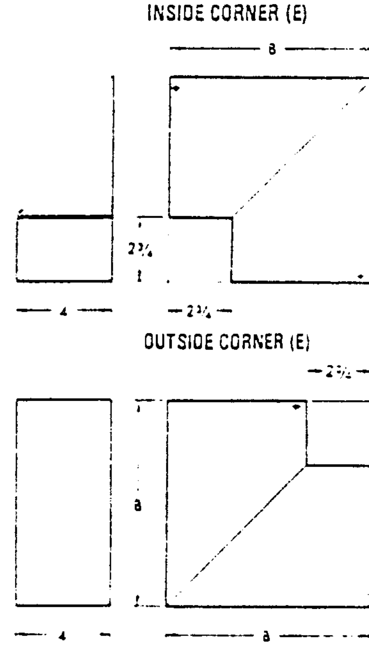


TABLE 20—Ratings of Wall Fin Elements With Type E, E3, E3A, and E3-2W Enclosures

Element	Rows	Enclosure	Installed Height	Steam Capacity/Ft. 1 PSI at 65 F Air		Hot Water Capacity—Btu/Hr./Ft. at 65 F Air, Average Water Temp. (IBR Factor—Steam to Hot Water)					
				EDR Sq. Ft.	Btu/Hr.	220F (1.05)	210F (0.95)	200F (0.86)	190F (0.78)	180F (0.69)	170F (0.61)
Steel—1¼" Series—40 Fins—2½" x 5¼" x .0299" Finish—Black		4E	9⅞	4.35	1040	1090	990	890	810	720	630
	1 2	E3* E3A* E3-2W*	7⅝	4.75 3.55	1140 2050	1200 2160	1080 1940	980 1760	890 1600	790 1420	700 1260
Steel—1¼" Series—52 Fins—2½" x 5¼" x .0299" Finish—Black		4E	9⅞	4.90	1170	1230	1110	1010	910	810	710
	1 2	E3* E3A* E3-2W*	7⅝	5.40 9.70	1290 2320	1350 2430	1230 2210	1110 2000	1010 1820	890 1600	790 1420
Copper-Aluminum—1¼" Series—60 Fins—2½" x 5¼" x .015" Finish—Black		4E	9⅞	5.85	1400	1470	1330	1200	1090	970	850
	1 2	E3* E3A* E3-2W*	7⅝	6.40 11.50	1540 2770	1620 2910	1460 2630	1320 2370	1200 2160	1060 1910	940 1690
Copper-Aluminum—1" Series—68 Fins—2" x 3¼" x .011" Finish—Black		3E	9⅞	3.15	750	790	710	650	590	520	450
	1 2	E3* E3A* E3-2W*	7⅝	3.45 6.20	830 1490	870 1560	790 1420	710 1290	650 1170	570 1020	510 920

*IBR does not have procedure for rating pedestal mounted enclosures.

NOTE: Rating is Btu/hr./ft. of finned length (for element dimensions see Page 15). Hot water ratings determined by applying correction factor to steam ratings are for water velocities of 3 ft./sec. or greater. See Chart 1, Page 12 for correction factors for water velocities other than 3 ft./sec. For definition of installed height and heating [illegible] factors, see [illegible] 13. For heating ratings at other steam pressures and/or entering air temperatures, see [illegible] Page 12.

"SR" SERIES CONVERTERS — 2 PASS

V-13

(For Heating Radiation with Steam)

(See next page for 4 Pass)

Capacities listed are in Gallons Per Minute (GPM) and based on the Thermal Standards of the Fuel Oil and Water Heater Manufacturers Association for commercially clean tubing. If fouling is anticipated select a unit one or two feet longer. If excessive fouling is anticipated, ask for our recommendation.

To obtain rating in Btu, multiply capacities listed by 10,000 for a 20 F drop or 5,000 for a 10 F drop. (See Page 9.)

For temperatures and pressures other than those listed, request a copy of our "L & S" Nomograph Chart.

To determine pressure drop (pd) and velocity thru tubes, see chart on Page 20.

CAPACITIES IN G.P.M. — 2 PASS UNITS

(for 4 Pass Units — See Next Page)

Unit No.	0 PSI	2 PSI	5 PSI	10 PSI	25 PSI
110 F to 130 F (Floor Panel Heating)					
4204SR	20	23	28	33	33
4206SR	33	33	33		
6204SR	46	51	62	74	74
6206SR	74	74	74		
8204SR	102	114	138	164	164
8206SR	164	164	164		
10204SR	163	182	221	262	262
10206SR	262	262	262		
12206SR	394	394	394	394	394
14206SR	492	492	492	492	492
16206SR	689	689	689	689	689
20206SR	984	984	984	984	984
130 F to 150 F (Ceiling Panel Heating)					
4204SR	13	15	20	26	33
4206SR	30	33	33	33	
6204SR	30	34	44	59	74
6206SR	67	74	74	74	
8204SR	66	76	98	130	164
8206SR	149	164	164	164	
10204SR	106	122	157	208	262
10206SR	238	262	262	262	
12206SR	358	394	394	394	394
14206SR	447	492	492	492	492
16206SR	626	689	689	689	689
20206SR	894	984	984	984	984
130 F to 150 F (50% Glycol Solution for Snow Melting)					
4204SR	9	10	13	17	22
4206SR	20	22	22	22	
6204SR	20	23	29	40	50
6206SR	45	50	50	50	
8204SR	44	51	66	87	110
8206SR	100	110	110	110	
10204SR	71	82	105	139	176
10206SR	159	176	176	176	
12206SR	240	264	264	264	264
14206SR	300	330	330	330	330
16206SR	419	462	462	462	462
20206SR	599	659	659	659	659
160 F to 180°					
4204SR	5	6	9	14	28
4206SR	11	14	21	32	33
4208SR	20	26	33	33	
4210SR	32	33			
6204SR	11	14	20	32	64
6206SR	26	32	48	72	74
6208SR	46	58	74	74	
6210SR	71	74			
8204SR	25	32	44	72	142
8206SR	57	71	106	160	164
8208SR	102	128	164	164	
8210SR	158	164			
10204SR	41	51	71	115	227
10206SR	91	114	170	256	262
10208SR	163	205	262	262	
10210SR	253	262			
12206SR	137	171	254	384	394
12208SR	245	307	394	394	
12210SR	379	394			
14206SR	171	214	318	480	492
14208SR	306	384	492	492	
14210SR	474	492			
16206SR	239	300	445	672	689
16208SR	428	538	689	689	
16210SR	664	689			
20206SR	342	478	636	960	984
20208SR	612	768	984	984	
20210SR	948	984			

Unit No.	0 PSI	2 PSI	5 PSI	10 PSI	25 PSI
180 F to 200 F					
4204SR		2	4	8	19
4206SR	3	5	9	17	33
4208SR	5	9	16	31	
4210SR	8	14	25	33	
4212SR	12	20	33		
4214SR	16	27			
6204SR		5	9	18	42
6206SR	7	11	21	39	74
6208SR	12	20	36	69	
6210SR	18	31	59	74	
6212SR	26	44	74		
6214SR	36	60			
6216SR	47	74			
8204SR		11	21	39	93
8206SR	15	25	47	87	164
8208SR	26	43	80	154	
8210SR	41	68	130	164	
8212SR	59	98	164		
8214SR	79	134			
8216SR	104	164			
8218SR	131				
10204SR		18	34	62	149
10206SR	23	39	75	139	263
10208SR	42	69	129	247	
10210SR	65	109	208	263	
10212SR	94	157	262		
10214SR	126	214			
10216SR	166	262			
10218SR	210				
10220SR	262				
12206SR	35	59	113	208	394
12208SR	62	104	193	370	
12210SR	97	164	312	394	
12212SR	141	235	394		
12214SR	190	322			
12216SR	250	394			
12218SR	314				
12220SR	394				
14206SR	44	74	141	260	492
14208SR	78	130	241	462	
14210SR	122	205	390	492	
14212SR	176	294	492		
14214SR	237	402			
14216SR	312	492			
14218SR	393				
14220SR	492				
16206SR	61	103	197	364	689
16208SR	109	182	338	647	
16210SR	171	287	546	689	
16212SR	246	412	689		
16214SR	332	563			
16216SR	437	689			
16218SR	550				
16220SR	689				
20206SR	88	148	282	520	984
20208SR	156	260	482	924	
20210SR	244	410	780	984	
20212SR	352	588	984		
20214SR	474	804			
20216SR	624	984			
20218SR	786				
20220SR	984				

Unit No.	2 PSI	5 PSI	10 PSI	25 PSI
190 F to 210 F				
4204SR		2	5	15
4206SR		5	11	33
4208SR	3	8	20	
4210SR	5	13	32	
4212SR	7	19	33	
4214SR	9	25		
6204SR		5	11	33
6206SR		11	26	74
6208SR	7	19	45	
6210SR	11	29	71	
6212SR	15	42	74	
6214SR	21	58		
6216SR	27	74		
8204SR		10	25	74
8206SR		23	57	164
8208SR	15	41	100	
8210SR	23	64	158	
8212SR	34	93	164	
8214SR	46	128		
8216SR	60	164		
8218SR	76			
10204SR		17	40	119
10206SR		37	91	263
10208SR	24	66	160	
10210SR	37	102	253	
10212SR	54	149	263	
10214SR	74	205		
10216SR	96	262		
10218SR	122			
10220SR	150			
12206SR		56	137	394
12208SR	36	99	240	
12210SR	56	154	379	
12212SR	82	223	394	
12214SR	110	307		
12216SR	144	394		
12218SR	182			
12220SR	226			
14206SR		70	171	492
14208SR	45	124	300	
14210SR	70	192	474	
14212SR	102	279	492	
14214SR	138	384		
14216SR	180	492		
14218SR	228			
14220SR	282			
16206SR		98	240	689
16208SR	63	174	420	
16210SR	98	269	664	
16212SR	143	391	689	
16214SR	193	538		
16216SR	252	689		
16218SR	319			
16220SR	395			
20206SR		140	342	984
20208SR	90	248	600	
20210SR	140	384	948	
20212SR	204	558	984	
20214SR	276	768		
20216SR	360	984		
20218SR	456			
20220SR	554			

Unit No.	5 PSI	10 PSI	25 PSI
200°F to 220 F			
4204SR		3	11
4206SR	2	7	25
4208SR	3	12	33
4210SR	5	[illegible]	
4212SR	7	26	
4214SR	9	33	
6204SR		7	25
6206SR	4	15	56
6208SR	[illegible]	26	74
6210SR	11	41	
6212SR	16	59	
6214SR	21	74	
6216SR	28		
8204SR		14	56
8206SR	9	32	125
8208SR	15	58	164
8210SR	24	90	
8212SR	35	130	
8214SR	47	164	
8216SR	62		
8218SR	78		
10204SR		23	89
10206SR	14	52	199
10208SR	25	93	263
10210SR	38	144	
10212SR	55	208	
10214SR	75	263	
10216SR	99		
10218SR	125		
10220SR	154		
12206SR	21	[illegible]	299
12208SR	37	139	394
12210SR	58	216	
12212SR	83	312	
12214SR	113	394	
12216SR	149		
12218SR	187		
12220SR	230		
14206SR	26	97	373
14208SR	46	174	492
14210SR	72	270	
14212SR	104	390	
14214SR	141	492	
14216SR	186		
14218SR	234		
14220SR	288		
16206SR	36	136	523
16208SR	65	244	689
16210SR	101	378	
16212SR	145	546	
16214SR	197	689	
16216SR	260		
16218SR	329		
16220SR	403		
20206SR	52	195	747
20208SR	92	348	984
20210SR	144	540	
20212SR	208	780	
20214SR	282	984	
20216SR	372		
20218SR	468		
20220SR	576		

METHOD OF SELECTION (2 PASS UNITS)

The maximum pressure drop (pd) for the lowest temperature and longest units listed on this page, for all diameters is 11 feet or 4.8 PSI. The pd's for higher temperature and shorter length units will be correspondingly lower and may be determined from the chart on page 20.

In the majority of cases a 4 pass unit (page 11) would be the most economical selection. The most economical selection, however, may not always be suitable because of the pressure drop and or space limitations. It is accordingly suggested that you make your selection along the lines of the following example.

EXAMPLE

Requirements — 400,000 Btu
Water Temperature — 190°F (180-200 F)
Temp Drop — 20°F
Steam Pressure — 5 PSI

This represents a flow thru the system of 40 GPM (400,000 ÷ 10,000 — see above and page 9.)

Referring to the 5 PSI column and 180-200 F table above, you will find the nearest above 40 GPM in the smallest diameter to be

No. 6210SR — 59 GPM (6" Dia., 2 Pass, 10' long)

The pressure drop thru this unit will be less than 4.8 PSI as indicated above. However, if the exact pressure drop is required, refer to chart on page 20 and you will find it to be 7 PSI.

Before deciding that this is the unit you require, refer to the next page for 4 pass units. Perhaps a 4 pass unit will meet the requirements and be more economical.

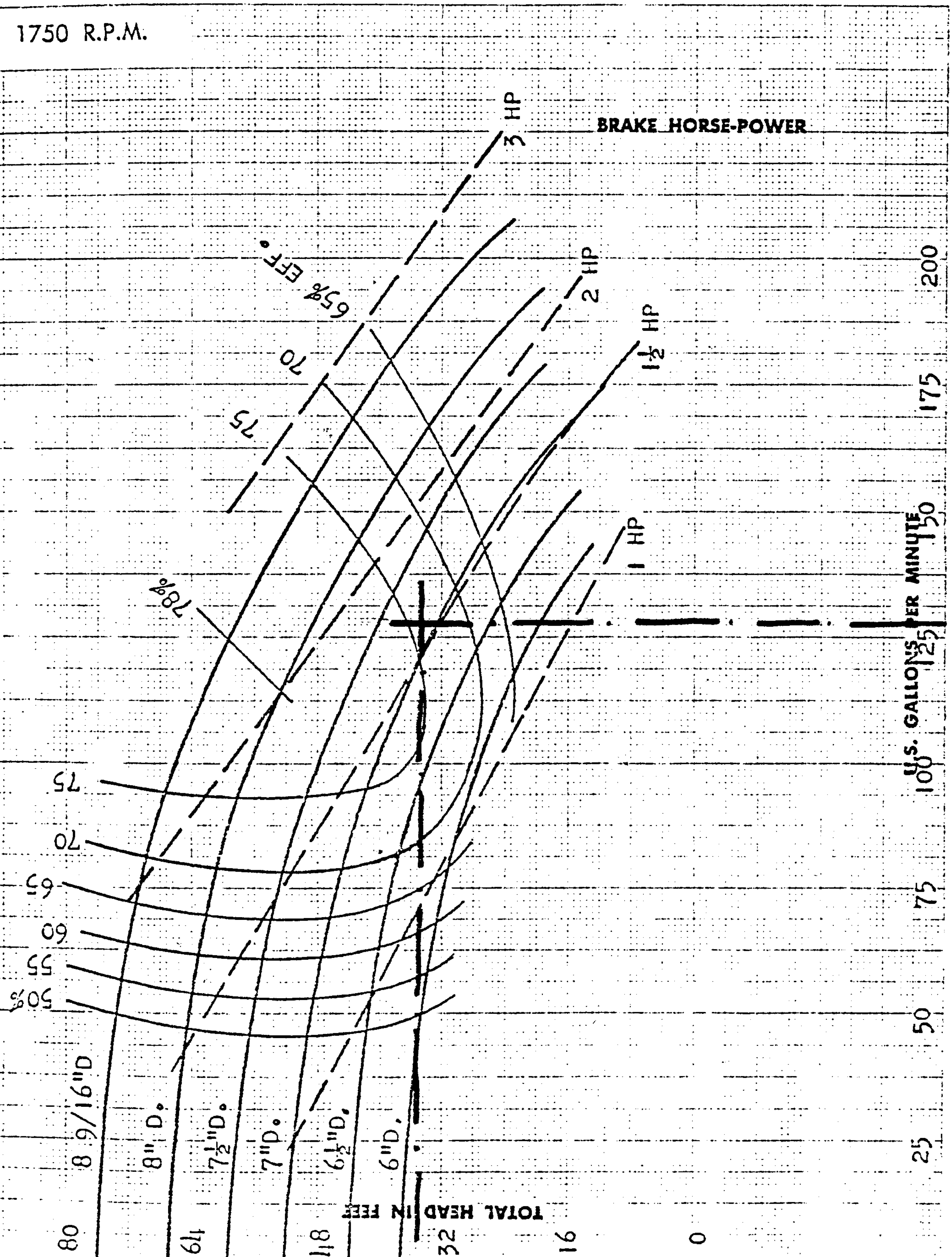
veil PUMP COMPANY

CHICAGO - ILLINOIS U.S.A.

SERIAL NO. ....4087 SF
SIZE — TYPE ....VKYM 2"
IMP. DIA. ....VARIED
IMP. NO. 1486
SP. GRAV. 1.0
DATE 12/29/58
Also for Pump Type VR

V-14

TRIFUGAL PUMP PERFORMANCE CHART-



FOR A MAXIMUM PERMISSIBLE SUCTION LIFT OF 15 FEET

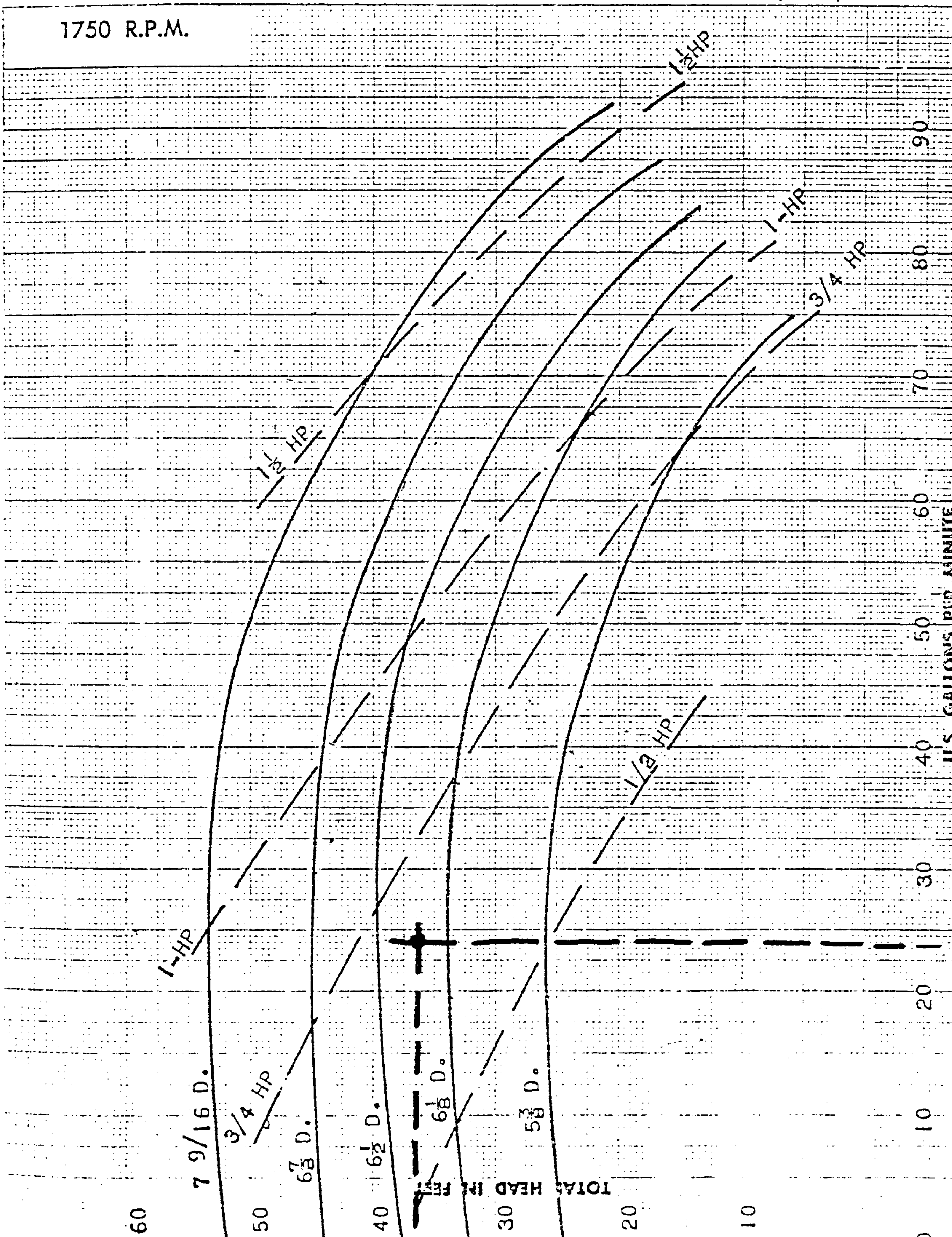
weil PUMP COMPANY

CHICAGO - ILLINOIS U.S.A.

— CENTRIFUGAL PUMP PERFORMANCE CHART —

SERIAL NO. 5
SIZE — TYPE.....................1¼" RY
IMP. DIA. ....VAR
IMP. NO. 3
SP. GRAV. ....
DATE 10-22

ALSO FOR PUMP TYPES
KYGJ, KUGJ, RUGJ



weil PUMP COMPANY

CHICAGO - ILLINOIS U.S.A.

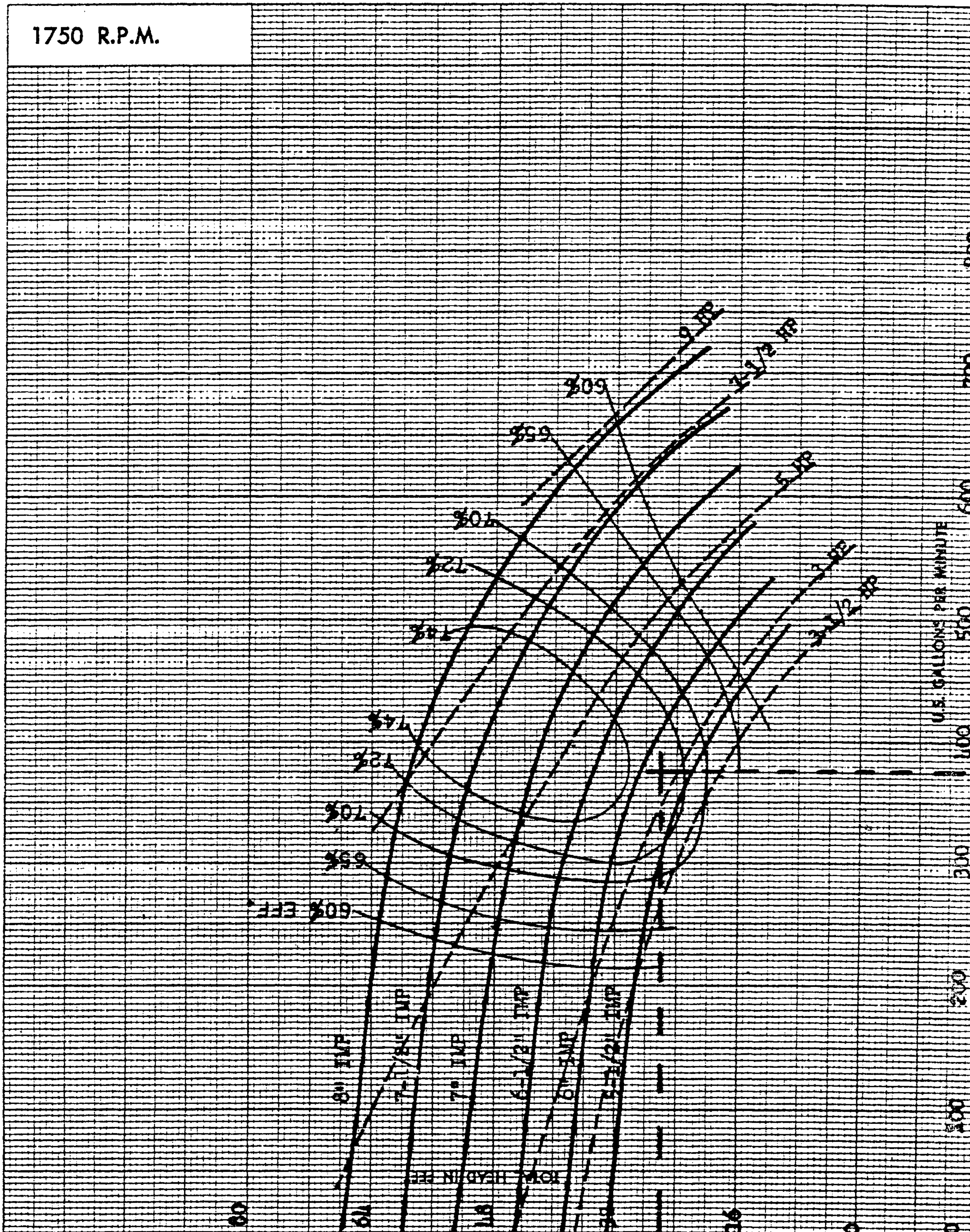
SERIAL NO. 173
SIZE — TYPE.....................R 4
IMP. NO. 144
DATE 2-17-4

— CENTRIFUGAL PUMP PERFORMANCE CHART —

FOR PUMP TYPES KU, RU

V - 16

FOR A MAXIMUM PERMISSIBLE SUCTION LIFT OF 15 FEET



Weil PUMP COMPANY

CHICAGO - ILLINOIS U.S.A.

— CENTRIFUGAL PUMP PERFORMANCE CHART —

SERIAL NO. ....

SIZE — TYPE....................

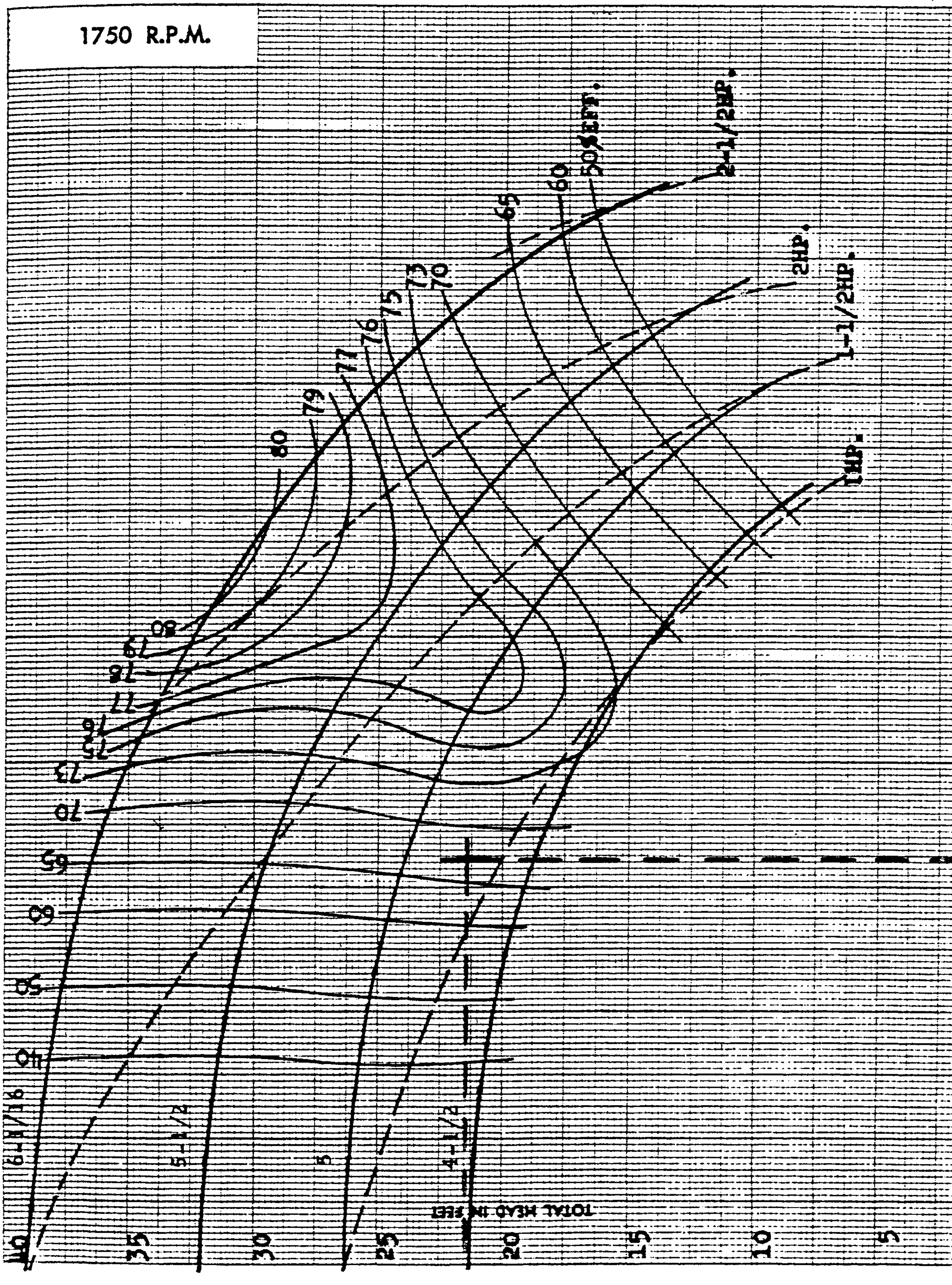
IMP. NO. ....

DATE ....

FOR PUMP TYPES KUS, KYS, RUS,

V - 17

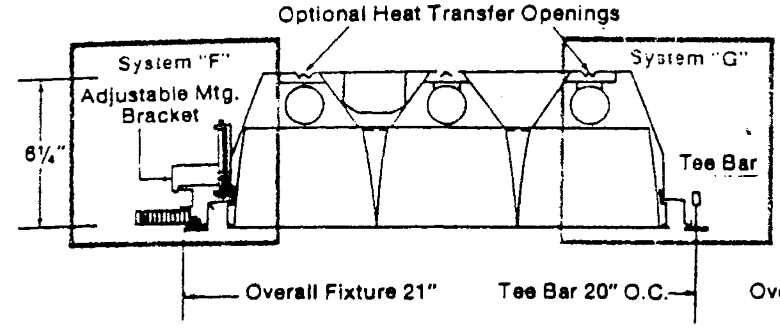
FOR A MAXIMUM PERMISSIBLE SUCTION LIFT OF 15 FEET

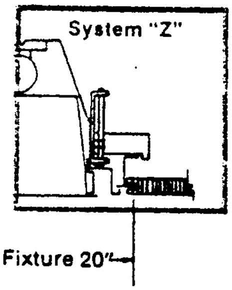


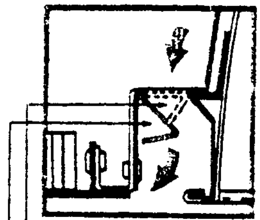
PARALOUVER II — 20" x 48" WITH 24 CELLS

VI-1

DIMENSIONS







(NEMA Type F)
Flange for acoustical ceilings using concealed mechanical suspension. Swing-jack mounting brackets: adjustment 3¾" max. and 1$\frac{7}{16}$" min.

(NEMA Type G)
Lay-in for acoustical ceilings using exposed grid suspension, with tees for fixtures on 20" x 48" spacing.

For most concealed spline ceilings ATS, and some snap-in metal-pan systems. Swing-jack mounting brackets: adjustment 3¾" max. and 1$\frac{7}{16}$" min.

Side slots for Horizontal Air Supply and/or Air Return.
Dotted line shows closed position.
Open for air function desired.

PHOTOMETRIC DATA

[illegible]

2-Outside Lamps									3-Lamp								
pfc 20									pfc 20								
pcc	80			70			50		pcc	80			70			50	
pw	70	50	30	70	50	30	50	30	pw	70	50	30	70	50	30	50	30
RCR									RCR								
0	71	71	71	69	69	69	66	66	0	69	69	69	68	68	68	65	65
1	67	65	63	65	64	62	61	60	1	66	64	62	64	62	61	60	59
2	63	60	57	62	59	56	57	54	2	62	58	56	60	57	55	55	53
3	59	54	51	58	54	50	52	49	3	58	53	50	56	52	49	51	48
4	55	50	46	54	49	45	47	44	4	54	48	45	53	48	44	46	43
5	51	45	41	50	44	40	43	40	5	50	44	40	49	43	40	42	39
6	48	41	37	47	41	36	40	36	6	47	40	36	46	40	36	39	35
7	44	37	33	43	37	33	36	32	7	43	36	32	42	36	32	35	31
8	41	34	29	40	33	29	32	29	8	40	33	29	39	32	28	32	28
9	37	30	26	37	30	26	29	25	9	37	30	25	36	29	25	29	25
10	35	27	23	34	27	23	27	23	10	34	27	23	33	27	22	26	22

Test #6794-1 S/MH=1.4   Test #6793-1 S/MH=1.3

[illegible]

2-Outside Lamps				3-Lamp		
End	45°	Cross	Angle	End	45°	Cross
1894	1894	1894	0	2762	2762	2762
1850	1896	1921	5	2711	2777	2817
1721	1891	2025	15	2524	2783	2982
1552	1822	2055	25	2282	2673	2995
1330	1623	1608	35	1960	2371	2330
1017	1068	934	45	1513	1561	1353
510	430	402	55	770	629	571
44	48	46	65	68	71	68
0	5	3	75	12	15	13
0	0	0	85	0	0	0

[illegible]

2-Outside Lamps			3-Lamp	
End	Cross	Angle	End	Cross
1275	1170	45	1264	1131
788	622	55	793	588
92	96	65	95	95
0	10	75	28	30
0	0	85	0	0

[illegible]

- 80-50-20 reflectances (ceiling-wall-floor)
- LLF = 0.78   3150 lumens/lamp   very clean
- Room width divided by room height = 5 or more, 2 or 1

Fixture Size & # of Lamps	Room Width / Room Height =	Approx. Area (sq. ft.) per Fixture				
		30 ft-c	50 ft-c	70 ft-c	100 ft-c	150 ft-c
20' x 48' 3-Lamp	5	—	94	67	47	31
	2	118	71	51	35	24
	1	88	53	38	27	—
20' x 48' 2 Outside Lamps	5	106	64	46	32	—
	2	82	49	35	25	—
	1	61	36	26	—	—

[illegible]

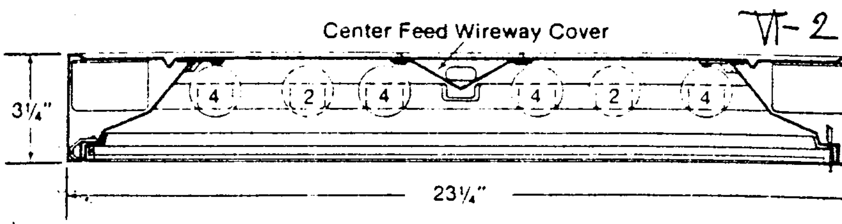
LLF = 0.78
LLF = Light Loss Factor
LDD = Luminaire Dirt Depreciation
IES Category IV Clean Annually
LLD = Lamp Lumen Depreciation
BF = Ballast Factor (commercial ballast performance relative to reference ballast)

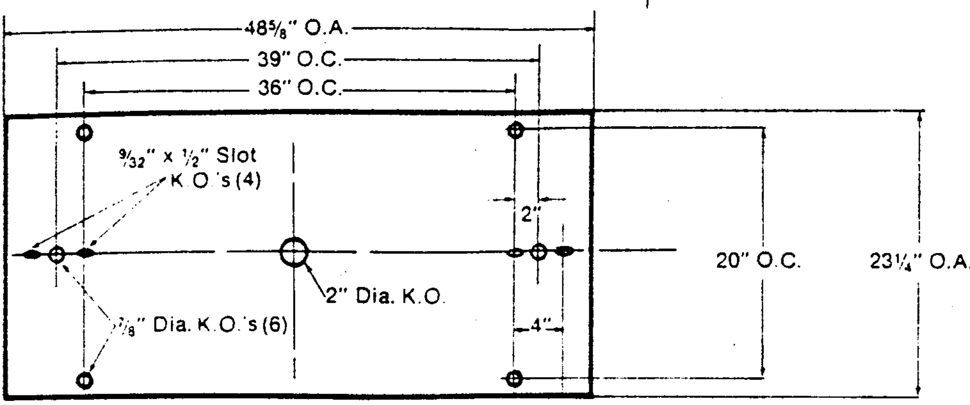
Light Loss Factor (LLF)
= LDD×LLD×BF
LDD = Very Clean 0.94 Clean 0.90
Medium 0.
LLD = 0.88 • 40% Rated Lamp Life
BF = 0.94 (Std. Ballasts & Lamps)
Relamp • 70% Lamp Life

DAY-BRITE

Day-Brite Lighting Division
Emerson Electric Co.
Tupelo, Mississippi 38801
Phone: (601) 842-7212

DIMENSIONS





PHOTOMETRIC DATA

[illegible]

4-Lamp w/DB-12									4-Lamp w/Gridless Octex								
pfc 20									pfc 20								
pcc	80			70			50		pcc	80			70			50	
pw	70	50	30	70	50	30	50	30	pw	70	50	30	70	50	30	50	30
RCR									RCR								
0	79	79	79	77	77	77	74	74	0	81	81	81	79	79	79	76	76
1	74	72	69	72	70	68	67	66	1	76	73	71	74	71	69	69	67
2	69	64	61	67	63	60	61	58	2	70	65	62	68	64	61	62	59
3	64	58	54	62	57	53	55	52	3	65	59	54	63	58	53	56	52
4	59	52	48	58	52	47	50	46	4	60	53	48	59	52	47	50	46
5	55	47	42	53	46	42	45	41	5	55	47	42	54	47	41	45	41
6	51	43	37	49	42	37	41	37	6	51	43	37	50	42	37	41	36
7	47	38	33	46	38	33	37	32	7	47	38	33	46	38	32	37	32
8	43	35	29	42	34	29	33	29	8	43	34	29	42	34	29	33	28
9	39	31	26	39	31	26	30	25	9	40	31	25	39	30	25	29	25
10	37	28	23	36	28	23	27	22	10	37	28	22	36	27	22	27	22

Test #6075-2 S/MH=1.4 Test #6456-1 S/MH=1.4
For 2-Lamp coefficients, multiply above by 1.12

[illegible]

4-Lamp w/DB-12				4-Lamp w/Gridless Octex		
End	45°	Cross	Angle	End	45°	Cross
3616	3616	3616	0	3442	3442	3442
3580	3612	3622	5	3383	3442	3481
3454	3525	3574	15	3278	3366	3437
3194	3349	3488	25	3050	3213	3363
2760	3103	3320	35	2686	2984	3224
1996	2446	2600	45	2088	2501	2851
1270	1024	1409	55	1252	1322	1376
556	346	589	65	524	586	552
185	216	208	75	188	289	207
55	102	54	85	82	71	114

[illegible]

4-Lamp w/DB-12			4-Lamp w/Gridless Octex	
End	Cross	Angle	End	Cross
1288	1677	45	1347	1839
1010	1120	55	995	1094
600	636	65	566	595
326	367	75	331	365
286	281	85	429	594

[illegible]

- 80-50-20 reflectances (ceiling-wall-floor)
- LLF = 0.77 3150 lumens/lamp Very Clean
- Room width divided by room height = 5 or more, 2 or 1

Fixture Size & # of Lamps	Room Width / Room Height =	Approx. Area (sq. ft.) per Fixture				
		30 ft-c	50 ft-c	70 ft-c	100 ft-c	150 ft-c
2' x 4' 4-Lamp w/DB-12	5	—	140	100	70	47
	2	—	101	72	50	34
	1	123	74	53	37	25
2' x 4' 4-Lamp w/Gdls. Octex	5	—	142	101	71	47
	2	—	103	73	51	34
	1	123	74	53	37	25

[illegible]

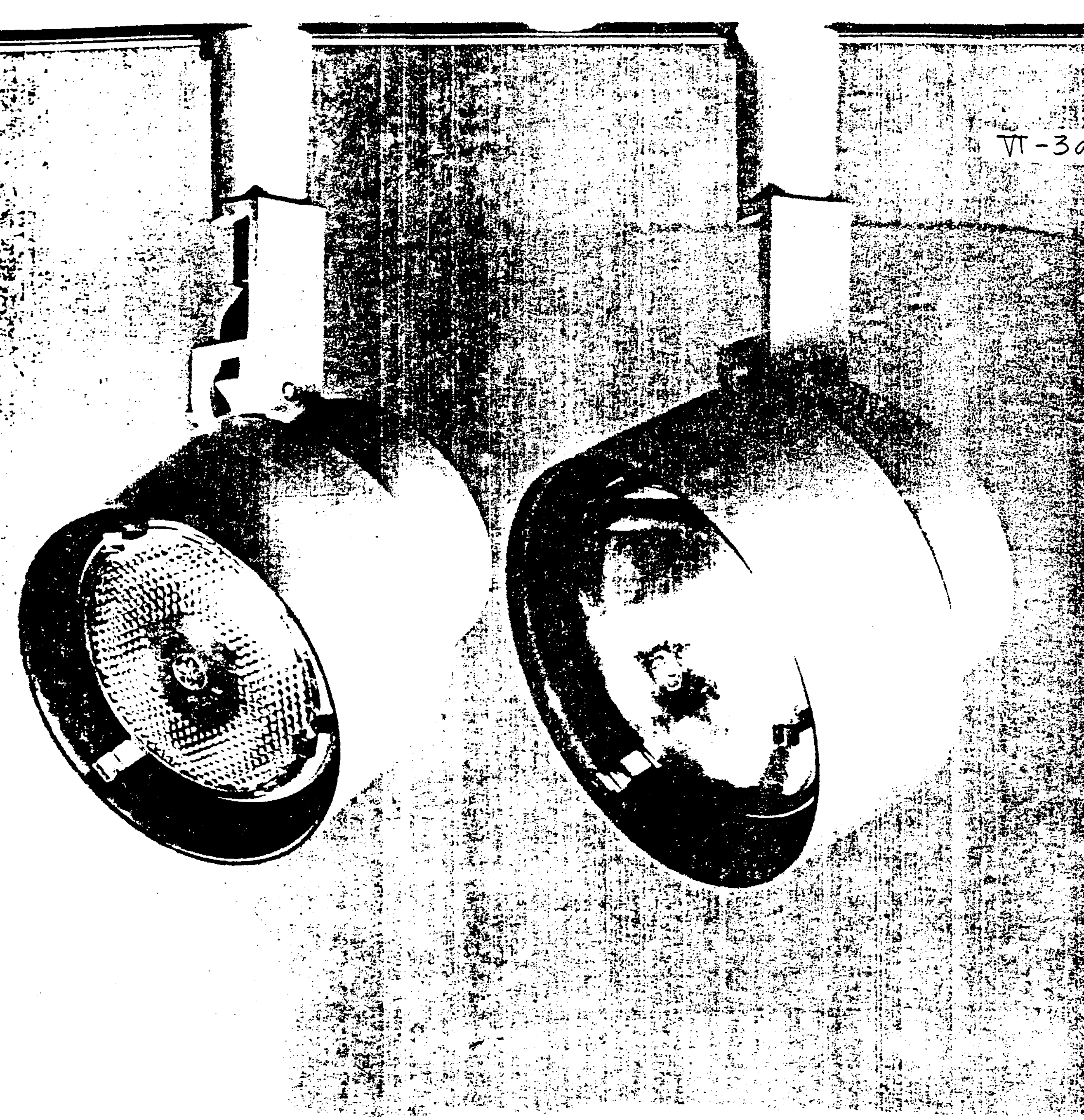
LLF = 0.77
LLF = Light Loss Factor
LDD = Luminaire Dirt Depreciation IES Category V Clean Annually
LLD = Lamp Lumen Depreciation
BF = Ballast Factor (commercial ballast performance relative to reference ballast)

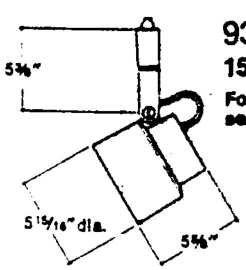
Light Loss Factor (LLF) = LDD×LLD×BF
LDD = Very Clean 0.93 Clean 0.88 Medium 0.82
LLD = 0.88 • 40% Rated Lamp Life
BF = 0.94 (Std. Ballasts & Lamps) Relamp • 70% Lamp Life

DAY-BRITE

Day-Brite Lighting Division
Emerson Electric Co.
Tupelo, Mississippi 38801
Phone: (601) 842-7212

VT-3

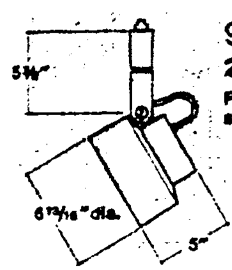




93440

150W, PAR-38/3 side prong

For lighting data
see page 35



93441

200W, PAR-46/3 side prong

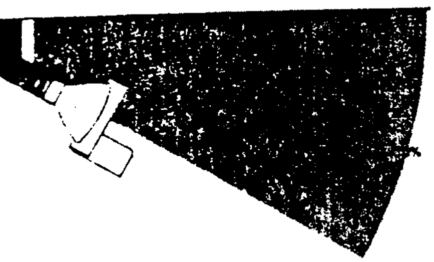
For lighting data
see page 35

VI - 3 b

50W, PAR-38 FLOOD

R USE WITH NO 93451 w/93449.

TIAL LUMENS 1740



SINGLE

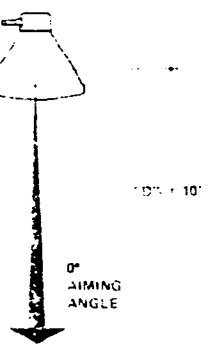
FIXTURE MOUNTED 3 FEET FROM WALL

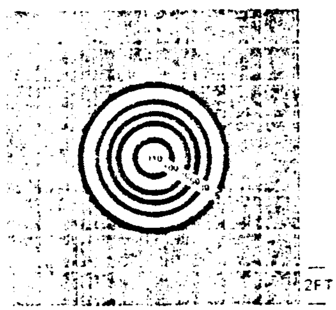
MULTIPLE

DISTANCE FROM CEILING IN FEET	Single: Distance along wall in feet (single unit) 0	1	2	3	4	Units on 2 foot centers: Directly Ahead Of One Unit	Midpoint Between Units	Directly Ahead Of One Unit	Units on 3 foot centers: Directly Ahead Of One Unit	Midpoint Between Units	Directly Ahead Of One Unit
1	28.8	24.7	11.3	4.4	1.8	55.0	60.0	55.0	37.6	38.7	37.6
2	48.3	41.3	22.7	7.4	2.9	99.5	100.2	99.5	63.1	68.3	63.1
3	42.0	37.5	24.0	11.2	4.4	98.8	101.00	98.8	64.4	67.7	64.4
4	31.7	27.0	19.5	11.5	5.3	81.3	81.8	81.3	54.7	54.2	54.7
5	21.9	19.7	15.0	9.6	5.6	63.1	64.0	63.1	41.1	43.0	41.1
6	14.9	13.3	10.4	7.4	4.8	45.3	46.8	45.3	29.7	31.2	29.7
7	9.9	9.4	7.7	5.7	4.2	33.7	35.6	33.7	21.3	24.0	21.3
8	6.6	6.1	5.3	4.3	3.4	24.0	25.2	24.0	15.2	17.0	15.2
9	4.5	4.6	3.9	3.4	2.5	17.3	20.0	17.3	11.3	13.0	11.3
10	3.1	3.2	3.0	2.5	2.1	13.3	14.6	13.3	8.1	9.9	8.1
11	2.4	2.4	2.2	2.0	1.7	10.2	11.4	10.2	6.4	7.6	6.4
12	1.8	1.8	1.7	1.6	1.2	7.6	9.0	7.6	5.0	5.8	5.0

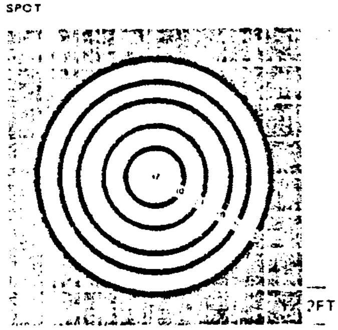
50W, PAR-38/3

	SPOT	FLOOD
TIAL LUMENS	1740	1740
PPROX. BEAM SPREAD C 10% MAX. CP	28°	60°
ACING TO STANCE RATIO OR UNIFORM LIGHTING)	.35	.65





SPOT



FLOOD

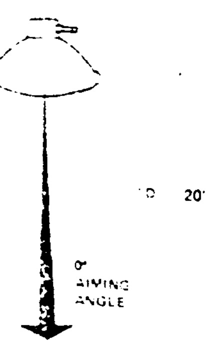
DISTANCE AND FT-C. CORRECTION FACTORS

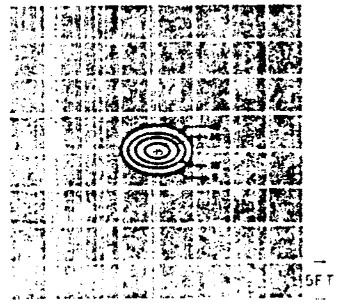
	DISTANCE "D" (FEET)	MULTIPLY: GRID SCALE BY	GRID FT-C BY
SPOT	2.5	0.3	16.0
	5.0	0.5	4.0
	7.5	0.8	1.8
	10.0	1.0	1.0
	12.5	1.3	0.6
	15.0	1.5	0.4
	17.5	1.8	0.3
	20.0	2.0	0.3
	25.0	2.5	0.2
	30.0	3.0	0.1
FLOOD	2	.2	25.0
	4	.4	6.3
	6	.6	2.8
	8	8	1.6
	10	1 0	1.0
	12	1.2	0.7
	14	1.4	0.5
	16	1.6	0.4
	18	1.8	0.3
	20	2.0	0.3

200W, PAR-46/3

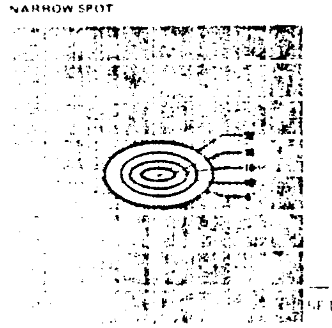
	SPOT	FLOOD
TIAL LUMENS	2300	2300
PPROX. BEAM SPREAD C 10% MAX. CP	19° × 23°	23° × 38°
ACING TO STANCE RATIO* OR UNIFORM LIGHTING)	.14/.17	.20/50

NO SPACING RATIOS ARE VEN FOR OVAL BEAMS





NARROW SPOT



DISTANCE AND FT-C. CORRECTION FACTORS

	DISTANCE "D" (FEET)	MULTIPLY: GRID SCALE BY	GRID FT-C BY
NARROW SPOT	5.0	0.3	16.0
	7.5	0.4	7.1
	10.0	0.5	4.0
	12.5	0.6	2.6
	15.0	0.8	1.8
	20.0	1.0	1.0
	25.0	1.3	0.6
	30.0	1.5	0.4
	35.0	1.8	0.3
	40.0	2.0	0.3
FLOOD	5.0	0.3	16.0
	7.5	0.4	7.1
	10.0	0.5	4.0
	12.5	0.6	2.6
	15.0	0.8	1.8
	17.5	0.9	1.3
	20.0	1.0	1.0
	25.0	1.3	0.6
	30.0	1.5	0.4
	35.0	1.8	0.3

Armstrong

Tascon™
Task lighting system

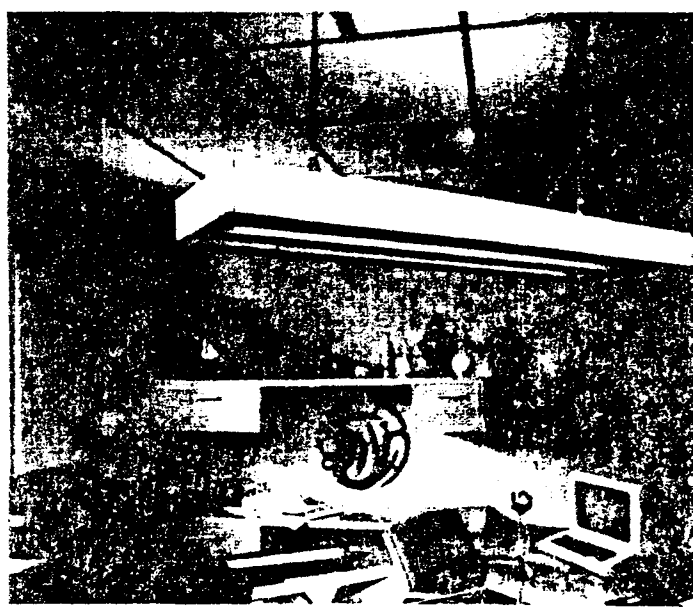
High-quality, low-energy lighting

[illegible] is a unique task lighting fixture that's designed to offer optimum performance at a minimum of cost. It positions light at the proper distance over the work surface, above the worker, concentrating it where it's needed. Each Tascon fixture installed according to specifications delivers up to 90 initial footcandles and Equivalent Sphere Illumination (ESI) values of 40 to 60 on the work surface. Tascon's high-quality light eliminates glare, shadows and veiling reflections from both horizontal and vertical work surfaces, making Tascon an excellent light source for CRT stations. In addition [illegible] high quality light on the work surface, [illegible] upward. This pro[illegible] [illegible].

Using one fixture per 100 square feet of office floor space, Tascon consumes only .92 watt per square foot, ballast included. It's a two-lamp fixture that is available with three different lens options: clear prismatic, injection molded, H-8224, and H-8224 with diffuser overlay.

The attractive injection-molded [illegible] frame and [illegible] suspension bars make Tascon suitable for use in open plan and private offices. A contemporary high-tech task fixture.

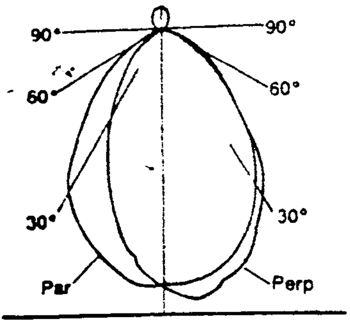
Size and Detail	length — 53⅛" (nominal) width — 13½" height — 4½" In typical office installations, the fixtures should be positioned seven feet above the floor.
Lens Options	clear prismatic K-12 injection molded H-8224 H-8224 with diffuser
Installation	[illegible] from two [illegible] [illegible] module in a standard grid system. [illegible] relocated [illegible]. For [illegible] installation [illegible] system [illegible] integrated into [illegible] grid systems.
Grid Systems	Standard fixtures are available for use with standard round- and square-tube [illegible] grid [illegible] Series and [illegible] Luminaire Systems.
Switch Options	120-[illegible] optional [illegible] capability



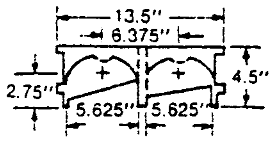
VT-4b

ascon Pendant Fixture
wo-lamp Specular Aluminum Reflector,
o. K-12 Lens—TOPA

Light Output



Zone	% Bare Lamp
0–30	21.82
0–40	32.55
0–60	45.15
0–90	48.61
90–180	7.94
0–180	56.55



Footlamberts

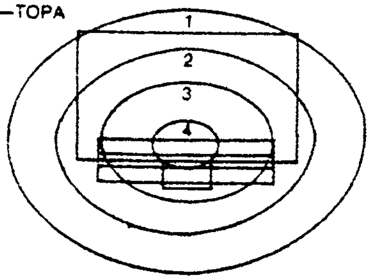
Angle	Maximum Par.	Perp	Average Par.	Perp
45	1581	2290	910	937
55	924	1124	596	518
65	644	614	472	320
75	657	294	411	190
85	549	124	267	14

Lamps: Two F40T12/CW each rated 3200 lumens

Coefficients of Utilization
Floor Cavity Reflectance—0.20
Ceiling Cavity Reflectance—0.80

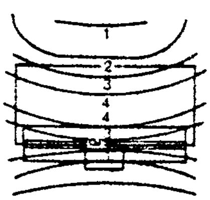
Wall Reflectance / Room Cavity Ratio	50	30	10
1	.59	.58	.56
2	.54	.51	.49
3	.49	.45	.43
4	.44	.41	.38
5	.40	.36	.33
6	.37	.33	.30
7	.34	.30	.27
8	.31	.27	.24
9	.28	.24	.21
10	.26	.22	.19

Minimum Classical Footcandles*
Tascon Fixture
No. K-12 Lens—TOPA



1 = 30
2 = 50
3 = 70
4 = 90

Minimum Equivalent Sphere Illumination (ESI) Footcandles*
Tascon Fixture
No. K-12 Lens—TOPA



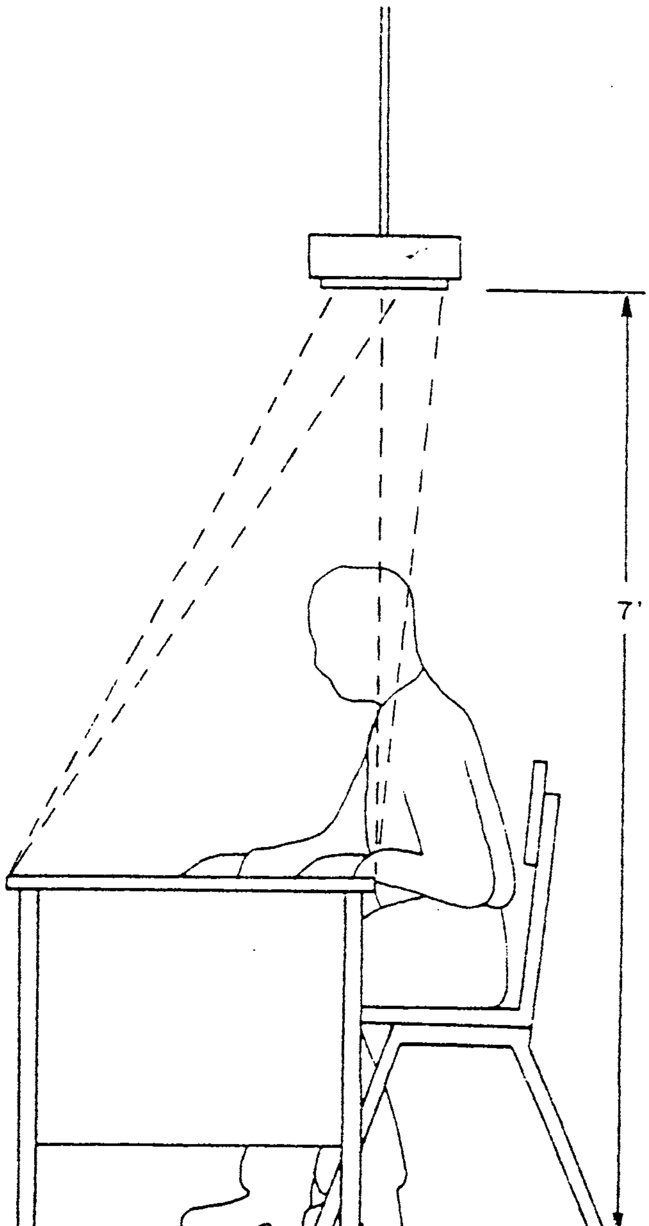
1 = 10
2 = 20
3 = 30
4 = 40

*Contributions of single fixture measured at 9' ceiling height—7' fixture height—reflectance 80/0/0. Footcandle level will increase with multiple fixtures depending on numbers, spacing, and surface reflectances.

Photometric Data

Tascon is available with three lens options. The photometrics shown here are representative of the two-lamp K-12 option. Individual photometric data will be provided upon request.

Tascon is designed to be positioned approximately 7' from the floor. The fixture should be placed so that light falls on the back and over the worker and work surface as shown in the sketch.



VT-5,6,7

KORLITE has earned a reputation for reliable performanc in a wide variety of applications throughout the world.

OP—OVERALL PRODUCT, IN PLACE

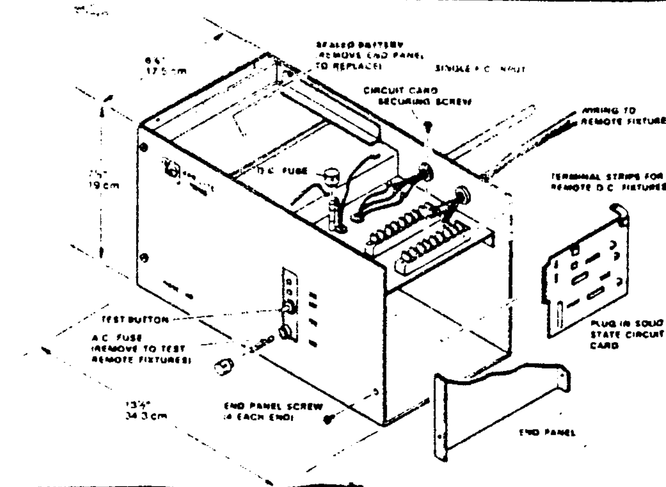
KOR-LITE's exclusive supervisor-charger design charges one central battery only when needed and eliminates trickle charging, outgassing, and heat dissipation which shorten battery life.

The KOR-LITE System is completely automatic, providing instant power to the fluorescent fixtures in the event of a power failure or brown-out. When power is restored, fixtures are turned off, and electronic control places the battery on charge. When the battery is fully charged, the proprietary electronic sensor terminates the charge to prevent damage. If for any reason battery charge drops as much as 10%, the electronic supervisor-charger automatically initiates and controls the proper amount of charge.

All KOR-LITE fixtures are fed with low voltage DC power in emergency mode.

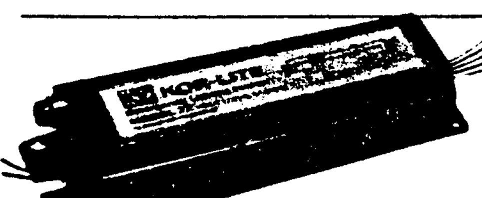
Model 77 Retrofit Inverter operates one T-12 fluorescent lamp of up to 40 Watts, selected virtually in any standard fixture. The inverter does not affect lamp operation during normal AC power.

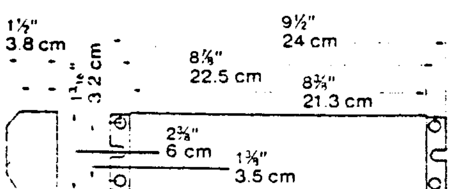
The Model 75 Exit Light with separate AC input provides "always on" safety to identify exits. Meets downlight requirements.



MODEL 88-POWER UNIT

Includes: 12 Volt, 30 Ampere-Hour, sealed lead acid battery, supervisor-charger and controls.
Input: 115 VAC, 60 Hz, 30 Watt Max. (230 VAC or 277 VAC, 50/60 H available at no extra charge)
Output: 12 VDC, 9.6 Amp max. Finish: Gray enamel
Weight: 38 lbs (16.34 kg) Full charge in less than 24 hour
Ninety (90) min. minimum emergency power under full load condition

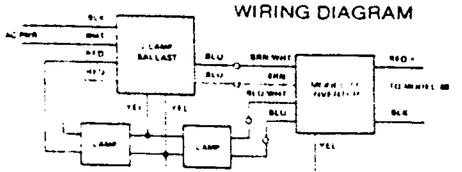


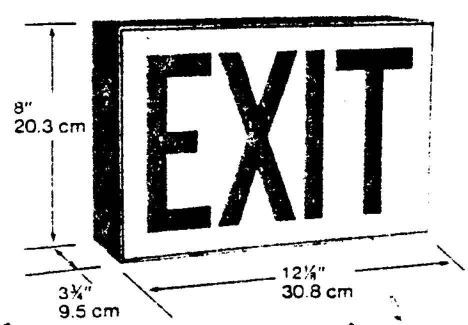


MODEL 77 EMERGENCY LIGHT RETROFIT INVERTER

Input power: 12 VDC, 1.4 Amp from KOR-LITE Model 88 Power Unit/Battery. No AC Input.
Operates any T-12 Fluorescent lamp up to 40 Watt.
Up to six (6) Inverters can be operated from one Model 88 Power Unit/Battery.
Mounts in fixture in line with standard ballast as retrofit installation.
Inaudible high frequency operation.
Weight: 18 oz. (0.51 kg)
Wiring diagram for other ballast arrangements available (see Technical Support section).
Does not require source of unswitched AC.
Also supplied for fixture factory mounting.

WIRING DIAGRAM

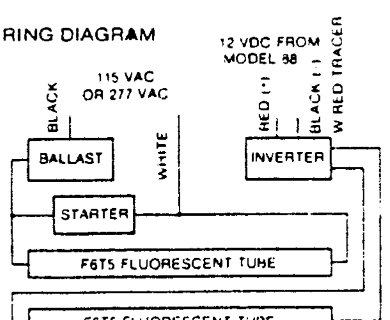


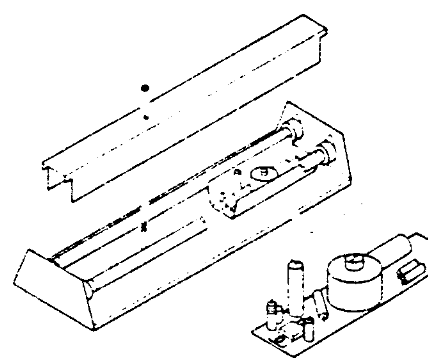


MODEL 75-EXIT LIGHT

Matte Oyster Finish, Single or Double Face, Red or Green Illuminated Letters.
Includes two 6 Watt (F6T5) fluorescent tubes plus inverter circuit and ballast with separate AC input.
Mounting canopy and other hardware for universal mounting and provision for arrows are also included.
Input for normally-on lamp: 115 VAC, 60 Hz 0.16 Amp (230 VAC, 50 Hz or 277 VAC, 60 Hz available at no extra charge)
Input for emergency-on lamp: 12 VDC, 0.4 Amp
Weight: 7.1 lbs (3.22 kg)

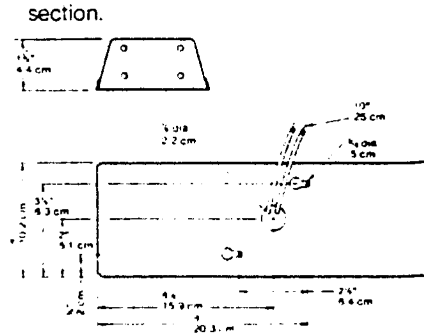
WIRING DIAGRAM





MODEL 70-TWIN LAMP FLUORESCENT FIXTURE

Includes two 8 Watt (F8T5) fluorescent lamp and inverter circuit.
Each lamp operates independently and complies with the two lamp requirement of 197 National Electric Code-700-14.
Input power: 12 VDC, 0.6 Amp
Weight: 20 Ounces (0.57 kg)
Finish: Brushed Aluminum
Diffusion Screen: Clear Acrylic
Operates down to −100F (−73.3C) ambie temperature. See Technical Suppo section.



VI - 8a

HUNT ELECTRONICS
1101 Summit Avenue
Plano, Texas 75074
(214) 422-1112
Telex 730995

AF-1527 (U.L. Listed)

eveloped by Hunt Electronics, nder patent number 3,484,623, F-1527 dimmers represent an dvanced design in solid state control for fluorescent lighting. ncorporating a Silicon Gated Switch, these dimmers provide mooth control of the complete limming range, and stable low ntensity operation. The circuit itilizes line voltage regulation hrough a Symmetrical AC Regulator, vith a field-adjustable limming range. Thoroughly tested nits, the AF-1527 are recommended or use with Universal dimming allasts. Universal 679-L-TC-P and Jniversal 676-A-TC-P—227 Volt.

ACEPLATES

decorative black snap-in panel is shipped with the dimmer; owever, any standard decorative vall plate may be attached in place of he panel supplied. Use ⅞" long = 6-32 screws to attach a standard-type wall plate.

YPE OF LAMPS

[illegible] fluorescent dimmers and the approved ballasts specified are designed exclusively for use with rapid-start, 40-watt fluorescent lamps. It is suggested that only one brand and one color of lamp be utilized throughout each dimming application, since fluorescent lamps of different colors may have slightly varying dimming characteristics. Using the same color of lamp in any given installation also assures smooth dimming performance, as well as equal light distribution throughout the dimming range.

LAMP HOLDERS AND FIXTURES

Most fluorescent lamp fixtures available today will perform satisfactorily in dimming applications. However, it is important that the contact resistance at the lamp holder pins be as low as possible. Firm contact between the lamp holder and the lamp pins will assure proper starting and will preclude early lamp failure or lamp aging which will result in poor performance at the low end of the dimming range. For this reason, high quality lamp fixtures and holders should be used. As an added assurance to proper starting, especially at low light levels, it is mandatory that the fixture be constructed to provide the necessary starting capacity or starting aid, which is a sheet of metal at least one inch wide placed within ½ inch of the lamp along its entire length. This metal must be grounded to assure proper starting and operation at low light levels. As stated earlier, most quality lamp fixtures meet this requirement. When installed in the fixture, the dimming ballast must be installed in such a way that there is good electrical contact between the case of the ba[illegible]ast and the frame of the fixture [illegible]ding the starting aid. The wa[illegible] the [illegible] must be

connected to the neutral side o line source. All connections ma the ballast and to the dimmer m be firm, tight connections. It is suggested that the leads be sol or secured with crimp-type connectors wherever possible. poor connection to the dimmer the ballast will most certainly re early lamp failure or improper dimming and starting.

INSTALLATION

Be careful to install and wire th dimmer according to directions the back page. Use only recommended dimming ballasts rapid-start 40-watt lamps *(See page 1.)*

GANGING: *(Illustrated on page*

The AF-1527 may be ganged in combination. The aluminum he sinks are designed with breako points to accommodate such ganging.

To Gang Two Dimmers

Break off the left side set of fins one dimmer, and the right side fins of the other. Gang as indic in Fig. 3, using snap-in panels shipped with dimmers or standa two-gang switch wall plate.

To Gang Three Dimmers

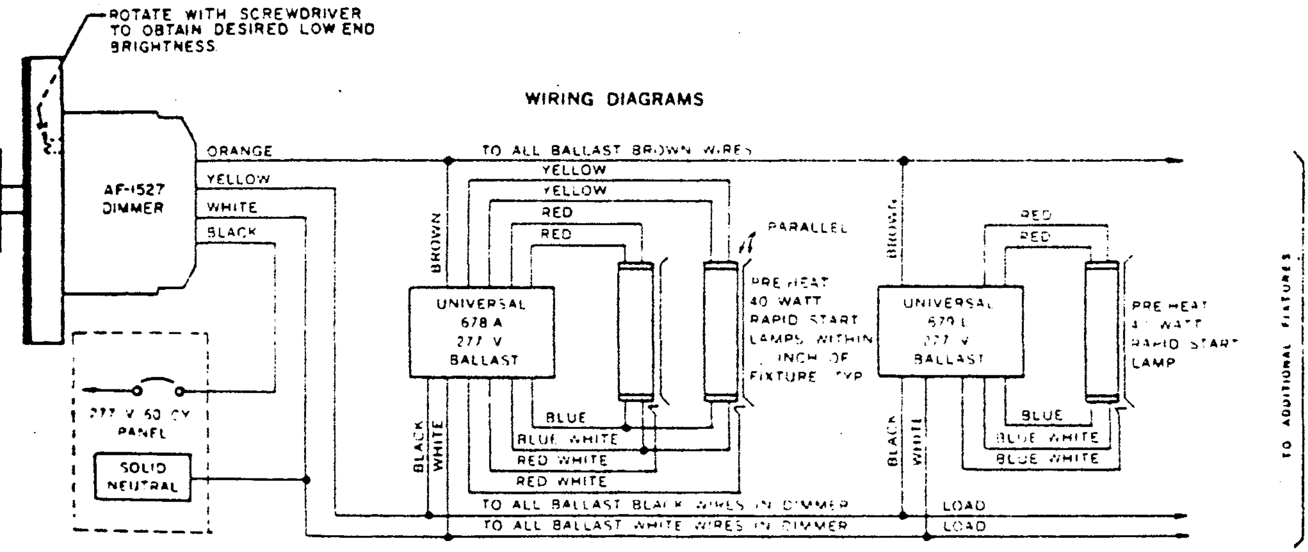
Break off the fins on both sides the center dimmer, the right sid of fins of the second dimmer, a left side set of fins of the third dimmer. Gang as shown in Fig. using snap-in panels provided o three gang switch plates. If des blank plates may be purchased drilled. Any number of dimmers

VT-8b

LOAD TABLE
AF-1527

Ballast Mfg Type	Max No of lamps Mounted singly	Max No of lamps One fin removed	Max No of lamps Both fins removed
Jniversal 679-L	30	26	22
Jniversal 678-A	30	26	22

IOTE: A MAXIMUM OF THIRTY (30) LAMPS MAY BE CONTROLLED WITH AN AF-1527



ERATING

he AF-1527 must be derated when anged. *For specific ganging formation see Table above.* The aximum number of lamps that can e controlled under both single and anging conditions is shown in Load able.

YPE OF BALLAST

nly ballasts approved for use with e Hunt fluorescent dimmer should e installed (see load table). Ballast pes should not be intermixed on ny dimming system, since termixing may cause improper peration.

SPECIFIC DATA

The effects of the electromagnetic radiation from all solid state dimmers on radios and intercom units can be minimized by observance of certain precautions in wiring. The dimmer should be installed as far as possible from radio receivers, intercom amplifiers, or public address systems. A minimum distance of six feet is recommended. The wires to the lamp lead and to the line should be routed as far as practicable from intercom speaker leads and antennas.

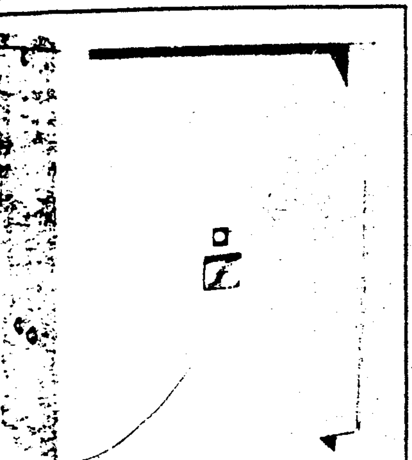
Improper dimming will result unless all connections to the dimmer and the fixtures are tightly in place. Check all fixtures, connections to ballasts and dimmer, and secure preferably with crimp-type wire nu All fixtures must be grounded. Separate neutral is needed for ea phase run.

IMPORTANT: The aluminum chas of these dimmers is designed as a heat sink to remove heat from the dimmer components. The fins will normally run quite warm to the to when operated at full bright. **This normal operation heat and does r indicate malfunction in the dimm**

Dry Type
Distribution Transformers

5 Kv and Below, Single Phase
5 Kv and Below, Three Phase
30 through 1500 Kva (Ventilated)
30 Kva and Below (Encapsulated)

pes DS-3 and DT-3



U/L Listed – 1000 Kva and Below 600 Volt Class

vantages and Application

y type distribution transformers are
ally suited for indoor application and
er many advantages over liquid-filled
nsformers. They may be installed in
ctically any indoor location not subject
submersion or to a high concentration of
structive fumes.

insulated and cooled by natural con-
ction of air, they are safe and cannot
plode, no toxic gases can be released,
d fire hazards are negligible. Elimination
these principal liquid filled transformer
tential hazards makes them especially
sirable for installation in hospitals,
tels, theaters, schools, factories, and
er working areas where large groups of
ople are present.

here space limitations and insurance
ulations prohibit the use of liquid-filled
nsformers, the dry type transformer is
answer.

mplete a[illegible] details may be
nd in TD [illegible]

es and Ratings

neral Purpose, ventilated, dry-type
nsformers are supplied in the following
ngs:

gle Phase: Type DS-3 37½—500 Kva
00 Volts and Below
ree Phase: Type DT-3 30—1500 Kva
00 Volts and Below

**ditional Reference Information for Pages
5-127**
scription: DB 46-751
chnical Data: TD 46-770
ring Diagrams: TCS 46-770
plication Data: AD 46-760

Dimensions and Weights

Single Phase
Type DS-3 (5 Kv and Below)

Kva	Approximate Dimensions: (Inches) Height	Width	Depth	Net Weight (Lbs.)
HV: 240 x 480-600 LV: 120/240				
37½①	28	16	19	275
50①	37	17	22	360
75①	42	21	24	500
100①	42	21	24	610
167①	63	30	34	1100
250	63	30	34	1350
333	75	37	43	2350
500	75	37	43	2950
HV: 2400/4160Y – 4160-4800 LV: 120/240 – 240/480				
37½	28	16	19	300
50	37	17	22	400
75	42	21	24	560
100	42	21	24	700
167	63	30	34	1200
250	63	30	34	1500
333	75	37	43	2350
500	75	37	43	2950

① U/L Listed.

Three Phase
Type DT-3 (5 Kv and Below)

Kva	Approximate Dimensions: (Inches) Height	Width	Depth	Net Weight (Lbs.)
HV: 240Δ – 480Δ – 600Δ LV: 208Y/120 – 240Δ – 480Y/277				
30①	30	24	16	450
37①	30	24	16	500
45①	30	24	16	500
50①	39	28	20	650
75①	33	28	20	650
112①	39	28	20	850
150①	45	32	23	950
225①	50	35	27	1250
[illegible]	[illegible]	[illegible]	27	1500
500①	75	44	36	2085
750①	75	44	36	3100
1000①	90	53	36	4800
1500	90	57	43	6000
HV: 2400Δ – 4160Δ – 4800Δ LV: 208Y/120 – 240Δ – 480Δ – 480Y/277				
45	39	28	20	600
75	39	28	20	800
112½	45	32	23	950
150	50	35	27	1250
225	50	35	27	1500
300	50	35	27	1750
500	75	44	36	2640
750	75	44	36	3475
1000	90	53	36	4800
1500	90	57	43	6000

Typical Specification (DS-3, DT-3)

Ventilated dry type transformers shall be designed in full accordance with the latest revisions of (a) ANSI C89.2 (NEMA ST-20) for all KVA ratings 600-volts and below, and up through 500 KVA above 600 volts; (b) NEMA TR-27 for ratings above 500 KVA and 600 volts.

Transformers shall be designed for continuous operation at rated KVA, 24 hours a day, 365 days a year, with normal life expectancy as defined in IEEE #65. This performance shall be obtainable without exceeding 150 degree C. average temperature rise by resistance or 180 degree C. hot spot temperature rise in a 40 degree C. maximum ambient and 30 degree C. average ambient. The maximum coil hot spot temperature shall not exceed 220 degree C.

Transformers shall have proven 220 degree C. insulation systems. The coils shall be wound with aluminum or copper which shall be insulated with proven, high temperature resistant, 220 degree C materials.

All materials used in the transformer shall be flame retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

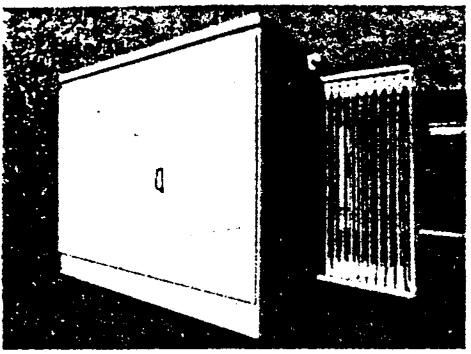
Final insulation treatment shall be total immersion in a insulating varnish which will maintain superior bond strength, high dielectric strength, and outstanding power factors at temperatures associated with the 220 degree C. system. After immersion the varnish shall be cured at normal operating temperatures for such a period of time as to assure complete curing of the varnish and scourging of all volatiles in the varnish solvent.

Transformers shall be constructed with core materials of a high quality, low loss nature so as to minimize exciting current, no-load losses, and interlaminar vibrations. Design shall incorporate built in vibration dampening systems to minimize and isolate sound transmission. Sound levels shall be in accordance with the applicable NEMA-ANSI standards according to KVA rating. Sound level tests shall be conducted in a laboratory with anechoic characteristics where ambient sound level does not exceed 24 db, to provide a true basis for measurement.

The core-coil assembly shall be designed and mechanically braced to withstand short circuit tests as defined in NEMA TR 27 by the use of full scale testing. The coil

Section VI

A-Line Three Phase POW-R-PAD



Introduction
The Three Phase POW-R-PAD transformer is offered as two distinct product lines especially designed for construction and general industrial uses:

The A-Line consists of those units which are pre-engineered designs such that manufacturing information is readily available. This is achieved by limiting the number of voltages, features, options and accessories to combinations which fall into a "ready-to-manufacture" design matrix. The specific advantages of this program of specific designs for industry and construction include:

- Quick Shipment – 90 day normal lead time.
- Emergency Shipment usually available. (Check each situation with Westinghouse.)
- Instant Approval – Construction drawings from standard technical sheets available in Westinghouse field sales offices.
- Firm price quotations allow contractors to figure jobs quickly and accurately.
- Higher impedances limit secondary fault currents such that coordination with EHB breakers is usually possible. (Low impedances are also available if required for paralleling, etc.)
- Standard color is ASA 70 light grey rather than "telephone green". This better matches switchgear, busway, motor control centers, etc. (Green is available as an option to match other units, if required.)
- Field reliability is enhanced by complete production test sequence including a full BIL impulse test. This can be critical due to the severe implications to a shopping center, hospital or industry should the primary transformer fail.

The C-Line Three Phase POW-R-PAD differs from the A-Line only in that it expands on the A-Line by including those units requiring special engineering, multi-divisional coordination, bought outside items, or other special application considerations. The C-Line POW-R-PAD is covered elsewhere in this catalog although the general information given in this section also applies.

Application
The Westinghouse POW-R-PAD is an oil-filled, three phase, commercial padmounted distribution transformer specifically designed for servicing such underground distribution loads as shopping centers, schools, institutions and industrial plants. It is available in both live front and dead front construction, for radial or loop feed applications, with or without taps.

Ratings
- kVA: 75, 112½, 150, 225, 300, 500, 750, 1000, 1500
- High Voltages (Primary)

4160 GrdY/2400	2400Δ
8320 GrdY/4800	4160Δ
12470 GrdY/7200	4800Δ
13200 GrdY/7620	7200Δ
13800 GrdY/7970	8320Δ
	12000Δ
	12470Δ
	13200Δ
	13800Δ
	14400Δ

- HV Taps: 2-2½% above and below normal, or 4-2½% below normal
- HV BIL: 2400 volts: 60 kV BIL; 4160, 4800 volts: 75 kV BIL; 7200 through 14400 volts: 95 kv BIL
- Low Voltages (Secondary)
  All low voltages are rated 30 kV BIL (Not available on 1500 kVA).
  480 Y/277
  480Δ (Not available on 1500 kVA).
  208 Y/120(Not available on 1500 kVA).
  240Δ (Not available on 1500 kVA).
  240Δ/120 lighting tap (Not available on 750 and 1000 kVA).

Typical Design Impedances in %

	4160 Delta		12,000 Delta		12,470 Delta		13,200 Delta		13,800 Delta	
kVA	208Y	480Y	208Y	480Y	208Y	480Y	208Y	480Y	208Y	480Y
75	3.5	3.5	4.0	3.6	4.4	4.1	4.4	3.6	4.0	4.2
112	3.2	3.5	3.4	3.7	3.9	4.0	3.4	4.2	3.5	4.2
150	2.7	2.9	3.0	3.1	2.9	3.6	3.0	3.5	3.3	3.5
225	2.8	3.0	3.2	3.3	3.6	3.8	3.4	3.7	3.5	3.8
300	3.1	3.1	3.2	3.3	3.7	3.7	3.8	3.7	3.6	3.6
500	3.7	4.3	3.9	4.4	4.4	4.1	4.3	4.7	4.3	4.6
	4160Y/2400		8320Y/4800		12,470Y/7200		13,800Y/7970		13,200Y/7620	
kVA	208Y	480Y	208Y	480Y	208Y	480Y	208Y	480Y	208Y	480Y
75	3.3	3.2	3.6	3.3	3.6	3.3	3.4	3.5	3.4	3.4
112	3.0	3.3	3.0	3.3	3.1	3.4	3.0	3.5	3.1	3.4
150	2.6	2.6	2.6	2.8	2.7	2.8	2.7	2.8	2.6	2.8
225	2.7	2.9	2.7	3.0	2.8	3.0	2.9	2.9	2.9	3.0
300	2.7	2.9	3.0	3.1	2.9	3.0	3.0	3.5	3.0	3.0
500	3.5	3.7	3.6	3.7	3.8	4.0	3.7	3.9	3.6	4.4

750 kVA—5.75%
1000 kVA—5.75%
1500 kVA—5.75%

Optional low impedance units range from 1.5 to 2.0% for the 75 through 500 kVA ratings. Only ANSI standard 5.75% is available on the 750 through 1500 kVA.