

**NORFIELD INDUSTRIES**

DOOR HARDWARE INSTALLATION MACHINES, TOOLS, SUPPLIES, SERVICE & KNOWLEDGE



# White Paper

Time Fold Series  
for the  
Assembly of Residential Exterior Doors

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### Norfield Contacts

Call toll-free nationwide (800) 824-6242, 6:30am to 4:30pm PST.

## Introduction

This White Paper is intended to provide an understanding of how to select and use the Norfield Time Fold Series Modules for the assembly of residential exterior doors. We will review the basic features and benefits of the system, the Norfield concept of door assembly, the product description (including system selection process), workload balancing, typical system configurations and a competitive product analysis.

This document can also be used as a source book for information on shop layout and material handling procedures.

## Contents

Norfield Contacts .....	1
Basic Principles and Features .....	3
Assembly Requirements .....	3
Safety .....	4
Material Handling Procedures .....	4
The Concept .....	4
Prehanging Single Units .....	5
Lite Installation .....	6
Product Description .....	6
Assembly of Typical Two Station System .....	7
Assembly of Typical Three Station System .....	7
System Selection Process .....	8
Sample Worksheets .....	8
Typical System Configurations .....	9
General Shop Layout .....	9
Double and Special Units .....	9
Competitive Product Comparisons .....	10
Balance Work Sheet .....	11
System Configuration Work Sheet .....	12
Time Fold Series Unit Dimensions .....	12

# Basic Principles and Features

An effective exterior door assembly operation is defined by:

- Low Labor Cost
- Consistent Quality Product
- Minimum Inventory Investment
- Minimum Space Requirements
- Quick Response Time
- Ergonomically Efficient
- Nominal Capital Investment

The basic design principles of the Time Fold Series are:

- **Reduced labor per unit without high investment** - The system is low cost, the production of door units per person per day is an improvement over current methods through reduced material handling and an ergonomically arranged work flow.
- **Modules for easy customization** - The system is modular, allowing for easy customization to fit differing requirements in any shop at any production level without creating custom or expensive modifications.
- **Flow-through design** - The system is an assembly line process with the workload evenly distributed over each worker on the line. The workload is consistently performed with a minimum of variation for each worker. In other words, the right tools and materials are in the right place at the right time in the process.
- **Flexible production capabilities** - The system must be flexible to allow for varying production levels, both on a day to day basis in any shop, or as the business grows.
- **A defined process to insure efficiency and quality** - The system has a well thought out process, with each door assembled the same way every time. This allows for less training, a consistent labor cost, and repeatable quality on each and every door.

The features and benefits of the Time Fold Series are:

- **Low cost** - Get started improving the process without a large investment. Start with a basic system and expand as the need arises.
- **Flexible production capability** - Increase efficiency at any production level, by shifting workloads and adding labor. Increase production without a machine set limit, or decrease production without increase in labor cost per door.
- **Modular design** - Add modules or expand the line without obsoleting any machinery. Modules will accept all accessories to configure the system to meet individual requirements.
- **Easily expanded** - Start with an assembly table and tilt unit, then later add more tables to split the functions on the line for more capacity.
- **Air distribution and manifolds built in** - The square tubing used to make the top of the frame is an air manifold with connection points located along each side of the table. This allows for easy connection of air lines to staple guns and screwdrivers. The connector module between each table includes a shield that covers the air supply line, eliminating hoses on the floor and trip points. Tools at the right place and easily accessible can increase efficiency.
- **Clamp for sill** - An air operated clamp for the sill insures a tight fit, even with caulking, and helps increase the quality of the assembled product.
- **Supports for easy butt applications** - Applying the hinges at the door line eliminates excessive material handling by only handling the jambs once.
- **Tilt-off table for easy door lifting** - When the door is completed, it is tilted to an upright position so that one person can place it on a cart, reducing labor and strain.
- **Parts and material bins supplied** - Parts bins located on a shelf beneath the work surface keeps all material and tools close to where they are needed, improving efficiency. Hardware trays are available for hinges and screws.

## Assembly Requirements

In the interest of reducing the cost of equipment and freight, the Time Fold Series units are shipped partially assembled. Estimated assembly time is 1 to 1-1/2 hours for 2 persons for the Assembly Master and 2 to 2-1/2 hours for 2 persons for the Tilt Master. Assembly time for a typical five-table system with modules is estimated at 8 to 10 hours for 2 persons.

## Safety

The Time Fold Series has been designed to assist in the safe assembly of metal door units:

- **Tilt Unit** - Positions door units for easier lifting.
- **Air Manifold System** - Eliminates air hoses on floor that could be potential trip points.
- **Sill Clamp** - Clamps unit together so hands can be kept free when stapling sill.

## Material Handling Procedures

The production of exterior pre-hung doors is a process of material handling and assembly. Whether you're producing 50 or 500 doors per day, the same considerations can be made for material handling. From receiving to shipping, the entire process should be viewed as a system with all processes and materials in the system working together for optimum productivity and efficiency.

In fact, the labor involved in handling the door and its components is usually more than the labor involved in actually assembling the door unit itself. For this reason, it is most important that all aspects of material handling be analyzed before setting up a shop for production. **Time and money invested in establishing good material handling procedures will be well invested.**

Below is a list of basic material handling rules that should be followed in any assembly line-based manufacturing operation:

1. Handling the material as few times as possible.
2. When material is received, put it immediately into its storage location.
3. Store material in the same configuration as it is received.
4. Handle material only to perform an operation on it or to position it in preparation for an operation.
5. Any time a piece of material is handled, do as many operations on it as possible.
6. Move material in the largest quantities possible. "One at a time" is very expensive.
7. All materials should always be flowing toward shipping throughout the entire process.
8. Machine operators should be working on material, not trying to find it!

The first and most important step in getting material to the assembly line process is to coordinate the material at receiving to insure that the correct material is sent to the assembly area before it is needed. This step would also insure that the material pulled is of a usable quality.

The most efficient method to move materials from receiving to the places where they are needed is to use carts, mobile racks and fork lifts. These carts and racks would also take the place of permanent racks at each processing area. Restocking permanent racks is double material handling. It not only increases labor costs, but reduces flexibility when changing to a different type of material. The sample shop layout, shown later in this document, shows all materials being moved with carts and mobile racks.

The goal for an efficient operation is to have all materials in place along the assembly line before they are actually needed so as not to disrupt production. Again, carts and mobile racks are ideal as they can be quickly rolled into place to replace empty ones. To maintain continued production of the assembly line, a system needs to be established to insure proper flow of materials. Carts and racks must be loaded in advance and ready to go. Having the correct material at each station prior to its need is the goal.

## The Concept

Because the volume of residential metal and fiberglass doors has grown steadily, increased attention is being given to how to make the pre-hanging of these doors more efficient. This process is not complex, but achieving a successful outcome is more complicated than it first appears. This is primarily an assembly process, and the challenge comes from organizing the process to have flexibility while maintaining quality at the lowest labor cost. To begin, divide the process into two basic groups; single units and "everything else" which includes doubles, units with sidelites, etc. If your total volume is twenty units a day, both groups can be done effectively in a universal work cell using some type of table. As the volume grows, it is usually effective to separate the singles from the others. This allows focus on the higher volume singles by reducing the variables and establishing a repetitive routine. However, see "Double and Special Units" on page 9 for an option to this approach.

The **Time Fold Series** consists of a combination of wheel conveyor work stations, established procedures and trained personnel to make up an assemblyline process. Instead of bringing all the materials to a single assembly point, the door is moved along a series of work stations where materials and personnel are stationed.

The two most important factors in efficient assembly of metal and fiberglass doors are:

1. To have all materials and tools readily available
2. To have a defined assembly process.

The **Time Fold Series**, therefore, represents a philosophy more than just the equipment. To be most effective, we must consider the total process as well as the detailed steps in the process. We will begin with some basic rules or principles:

- If doors are transported on carts, they should be in a standing position for easier manual handling. This provides for easier lifting and less product damage.
- The installation of door lites, lock prep or other special modifications should be done prior to the door assembly line.
- Installation of full butts to the door and jamb should be accomplished on the assembly line. This system will also accommodate hinges pre-applied to either the door or jamb.
- This system is based upon starting with a door and quickly building the frame around the door.
- Component materials are handled in carts so replenishment can be quick and easy on the assembly line.

### Prehanging Single Units

It has been shown in numerous installations that building the frame around the door is the most efficient process. Most wood door pre-hanging systems have used this system for years. Less floor space is required and the materials are handled fewer times, resulting in less total labor cost.

### Typical Wood Door Assembly



Station 1: Machine door and jamb for hinges and install hinges  
Station 2: Add head and strike jamb

Station 3: Add casing  
Station 4: Add packaging material

The **Time Fold Series** uses this same proven process. This system is made up of a series of wheel conveyor work stations. The number of stations is dependent upon the maximum daily volume desired. Generally two people would work on a station and the process capacity should be nominally about forty doors per day per person. The process needs to be flexible as to volume because volume can vary from day to day. A system can be configured based upon the volume desired and the details of the assembly process for that market. If the volume grows, additional stations can be added to increase the number of people in the system. Each facility will have some variations in the process based upon local preferences. These include shipping methods, packing materials, labels, etc.

### Typical Metal Door Assembly



Station 1: Install hinge to door and jamb; install sweep  
Station 2: Add sill, head and strike jamb

Station 3: Add brickmould  
Station 4: Add packaging material

There are three key factors that make the assembly process efficient:

1. The work content between all the personnel on the line must be kept in balance.
2. All required materials need to be readily available at each location.
3. All necessary tools need to be in good condition and immediately available.

This system seeks to reduce all variables so workload balance can be achieved. The time duration for each task needs to be very consistent because the rate of the line is determined by the slowest operation. Therefore, operations that can cause variations in work content need to be done off-line or in another process (i.e., special departments). The single biggest

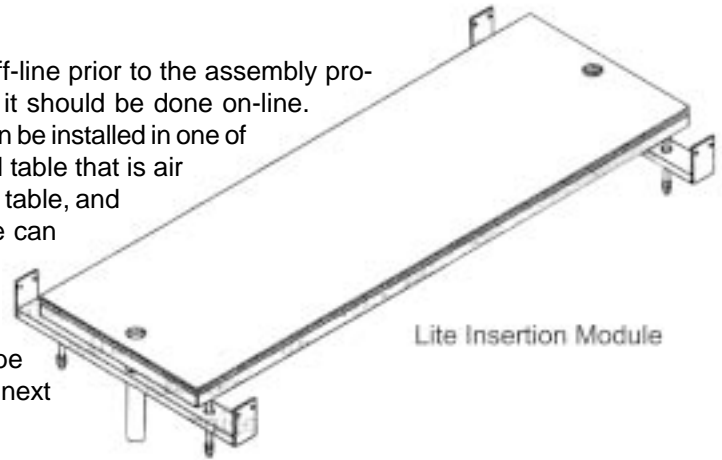
variable is door prep and lite installation. This needs to be done outside the primary assembly line. A door lite machine and lite installation table can be kept close to the assembly line, but not actually in the line.

A standard process can be established, but the operators should be trained to balance the workload to meet any variations or volume demand. For example, a four-station system could be used by only two people to produce seventy-five doors per day. Then more people could be added the next day, up to eight people for 300 doors per day. If only two people are working the system, they would start at the first station and then move with the door to each station until the door is completed and then go back and start over with the next door.

Each tool needs a consistent location, and the same is true for materials (i.e., jambs, screws, labels, staplers, caulking, guns, etc.).

#### Lite Installation

We normally recommend that lite installation be done off-line prior to the assembly process, but we recognize that there are situations where it should be done on-line. Therefore we have included a Lite Insertion Module that can be installed in one of the Assembly Master Modules. This is a carpet-covered table that is air operated. The bottom half of the lite can be placed on the table, and then the door can be positioned over the lite. The table can then be raised which will position the lite in the opening for installation. The door can be rotated ninety degrees, turned over by hand, and rotated back ninety degrees, thus placing the side up for pre-hanging. The table would then be lowered, placing the door on the wheels for transfer to the next station.



## Product Description

The Wheel Conveyor Stations consist of two basic types; the basic unit (Assembly Master) and the tilt unit (Tilt Master). Both units use soft rubber wheels (4" diameter) that have a flat, non-marking surface (2" wide). The frame of the unit is an air manifold with multiple air line connection points. The connector modules provide complete air interconnection of all units, so there is only one air supply for the entire system. Each unit also includes an adjustable shelf and easy-to-reach plastic bin boxes for storage of parts, tags, etc.

**Accessories** - Various accessories can be purchased for use on different parts of the system. Mounting holes are provided on all units to accept the accessories so they can be moved to a different unit if that is desired.

**Jamb Support Module** - The Jamb Support Module supports jambs for the installation of hinges to the door and jamb. It is available on either Assembly Master or Tilt Master.

**Hardware Tray Module** - The Hardware Tray Module holds hinges, screws, etc. for convenient access. It is available only on the Assembly Master.

**Sill Clamp Module** - The Sill Clamp Module holds the sill tightly for side jamb stapling. It is available on either the Assembly Master or the Tilt Master.

**Lite Insertion Module** - The Lite Insertion Module is a carpet-covered table that lifts the lite into the door cutout and facilitates inverting the door for assembly. It is available on the Assembly Master only.

**Air Hose Assemblies** - These are high quality urethane spiral-wound air hoses with quick-disconnect fittings for quick exchange of air tools. They are available on either the Assembly Master or the Tilt Master.

**Connector Modules** - The Connector Modules connect units together to maintain the physical relationship and provide an air connection between units. They connect to either the Assembly Master or the Tilt Master. The quantity required is one less than the number of stations.

**Filter Regulator Shut-Off** - The Filter Regulator Shut-Off provides filtered, regulated air to the system. It also includes an OSHA-approved system shut off valve. One unit is required per system.

Accessories can be added or moved from station to station to help balance the workload, and can be made flexible, like an erector set, so they can be set up to suit the needs of a specific business.

## Assembly Processes for Typical Two-Station System

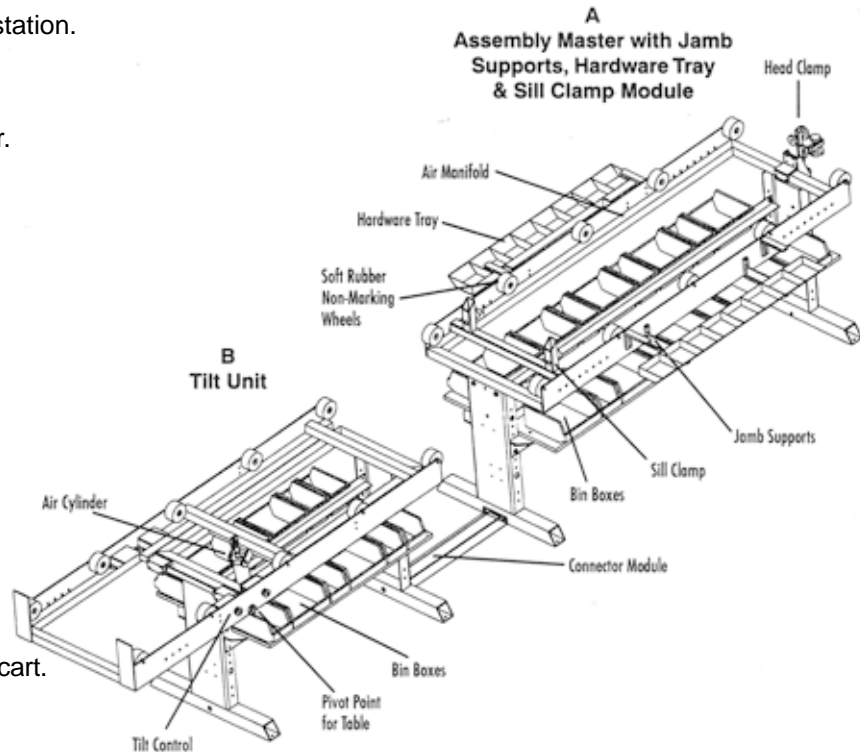
### TYPICAL TWO-STATION SYSTEM

#### Station A

1. Pull door from stack/cart and place on station.
2. Pull jambs, head, sill and sweep.
3. Install hinges to door and jamb.
4. Install shipping clips to lock side of door.
5. Position head jamb and staple.
6. Caulk jambs for sill.
7. Install sweep.
8. Position sill and clamp.
9. Staple side jambs to sill.

#### Station B

1. Screw shipping clip to jamb.
2. Pull brickmould.
3. Install brickmould.
4. Install shipping brace to bottom of sill.
5. Install instructions and product labels.
6. Mark with customer identification data.
7. Place completed unit in shipping area or cart.



## Assembly Processes for Typical Three-Station System

#### Station A

1. Pull door from stack/cart and place on station.
2. Pull hinge, jamb and sweep.
3. Install hinges to door and jamb.
4. Install shipping clips to lock side of door.
5. Install sweep.

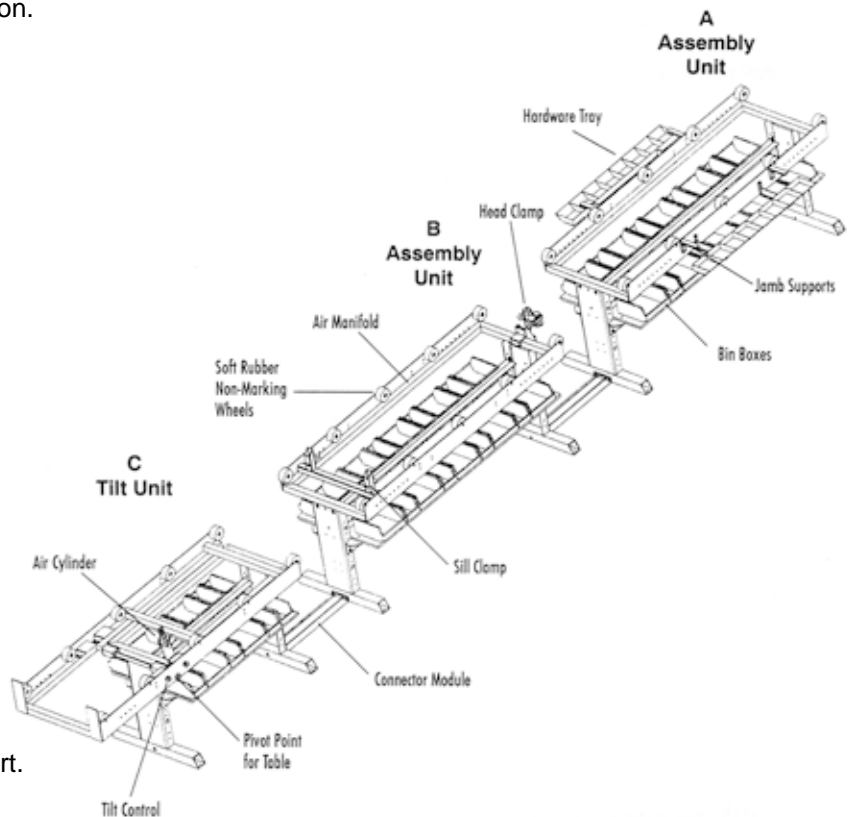
#### Station B

1. Pull head and strike jamb and sill.
2. Staple side jambs to head jamb.
3. Caulk side jambs for sill.
4. Position sill and clamp.
5. Staple side jambs to sill.
6. Screw shipping clip to jamb.

#### Station C

1. Pull brickmould.
2. Install brickmould.
3. Install shipping brace to bottom of sill.
4. Install instructions and product labels.
5. Mark customer identification data.
6. Place completed unit in shipping area or cart.

### TYPICAL THREE-STATION SYSTEM





# System Selection Process

This is a typical process and some variations will apply.

1. Begin by determining the capacity of the single door units per day to be assembled. Divide that number by 70 to determine the basic number of stations to be included. This assumes that door lites will be installed off-line.
2. If lites are to be installed on-line, add one station to the basic number.
3. If a tilt unit is desired to assist loading doors into the system, add one more station.

**EXAMPLE:**

1. Doors per day? 125 divided by 70 = 1.8 (use 2)
  2. Lites on line? No = 0
  3. Tilt unit for loading? Yes = 1
- Total Stations Needed = 3**

### Workload Balancing

Workload balancing can be a dynamic process with adjustments and re-evaluations made periodically. Sample worksheets appear on the following page, and blank forms are enclosed for your use (see pages 11-12).

The process begins by identifying all the steps in the process and the approximate person minutes to accomplish (see sample "Balance Work Sheet"). Then the steps are assigned to each station to try to achieve an equal amount of time at each station (see sample "System Configuration Work Sheet"). Remember to balance the stations and the work between the two people on each station. Once the workload is assigned to a work station, the Time Fold accessories can be determined for each work station.

It should be noted that there isn't one correct process for all systems. Each system can have variations; for example, assign only one person at a station if that best fits the flow balance. Supervision and the work team should be trained to adjust the process as needed.

BALANCE WORK SHEET			
TASK NUMBER	TASK DESCRIPTION	PERSON MINUTES	
		OP1	OP2
1	PULL DOOR	.3	
2	PULL JAMBS, SILL & SWEEP		.5
3	INSTALL HINGES	1.2	
4	INSTALL SHIPPING CLIP		.4
5	CAULK JAMBS		.3
6	INSTALL SWEEP		.3
7	POSITION JAMBS, HEAD & STAPLE	.4	.4
8	POSITION SILL, CLAMP & STAPLE	.5	.5
9	MOVE UNIT TO NEXT STATION	.3	
10	PULL BRICKMOLD		.4
11	STAPLE ONE SIDE BRICKMOLD	.5	
12	STAPLE ONE SIDE & HEAD BRICKMOLD		1
13	SCREW SHIPPING CLIP TO JAMB	.3	
14	INSTALL SHIPPING BRACE		.5
15	INSTALL INSTRUCTIONS	.5	
16	MARK IDENTIFICATION	.3	
17	MOVE TO CART	.5	5

## SAMPLE WORKSHEETS

SYSTEM CONFIGURATION WORK SHEET											
		1		2		3		4		5	
		ASSEMBLY TASKS		ASSEMBLY TASKS		ASSEMBLY TASKS		ASSEMBLY TASKS		ASSEMBLY TASKS	
OP1	OP2	OP1	OP2	OP1	OP2	OP1	OP2	OP1	OP2	OP1	OP2
T	M	T	M	T	M	T	M	T	M	T	M
1	.3	2	.5	9	.3	10	.4				
3	1.2	4	.4	11	.5	12	1				
		5	.3	13	.3	14	.5				
		6	.3	15	.5						
		1.5	1.5	16	.3						
7	.4	7	.4			1.9	1.9				
8	.5	8	.5	17	.5	17	.5				
		2.4	2.4	2.4	2.4						
		TIME FOLD MODULES		TIME FOLD MODULES		TIME FOLD MODULES		TIME FOLD MODULES		TIME FOLD MODULES	
		JAMB SUPPORTS		3 STAPLE GUNS							
		HURSTABLE TOON									
		HEAD/SILL CLAMP									
		2 SCREW DRIVERS									
		2 STAPLE GUNS									
		FILTER, REC, S/O									
		CONNECTOR BKT									

## Typical System Configurations

The following systems are a guide to assist you in identifying the configuration that would work best for your application. The actual capacities can vary both up and down from the numbers shown due to the specifics at each location.

**System 1** - Single station tilt unit capable of up to 40-70 doors per day with one or two operators.

**System 2** - Two station system with one assembly unit and one tilt unit. Capacity is 80-140 doors per day with two to four operators.

**System 3** - Four station system with three assembly units and one tilt unit. Capacity is 80-280 doors per day with two to eight operators.

**System 4** - Five station system with three assembly units and two tilt units with lite installation on-line. Capacity is 80-210 doors per day with two to eight operators.

## COMPONENT LISTING

MODULE	SYSTEM			
	1	2	3	4
Tilt Master	1	1	1	2
Assembly Master		1	2	3
FR	1	1	1	1
Jamb Supports	1	1	1	1
Assembly Clamp	1	1	1	1
Air Hoses	4	6	6	8
Hardware Tray		1	1	1
Connector Brackets		1	3	4
Lite Jump Units				1

## GENERAL SHOP LAYOUT

Each shop layout will be determined by the specifics of the building and the shop configuration. There are basically six areas for consideration:

1. Material Storage - Warehouse
2. Door Prep and Lite Installation
3. Door Cart Staging
4. Single Unit Assembly
5. Double and Specials Assembly
6. Staging For Shipment

The sketch on page 12 shows one approach to elements two through five.

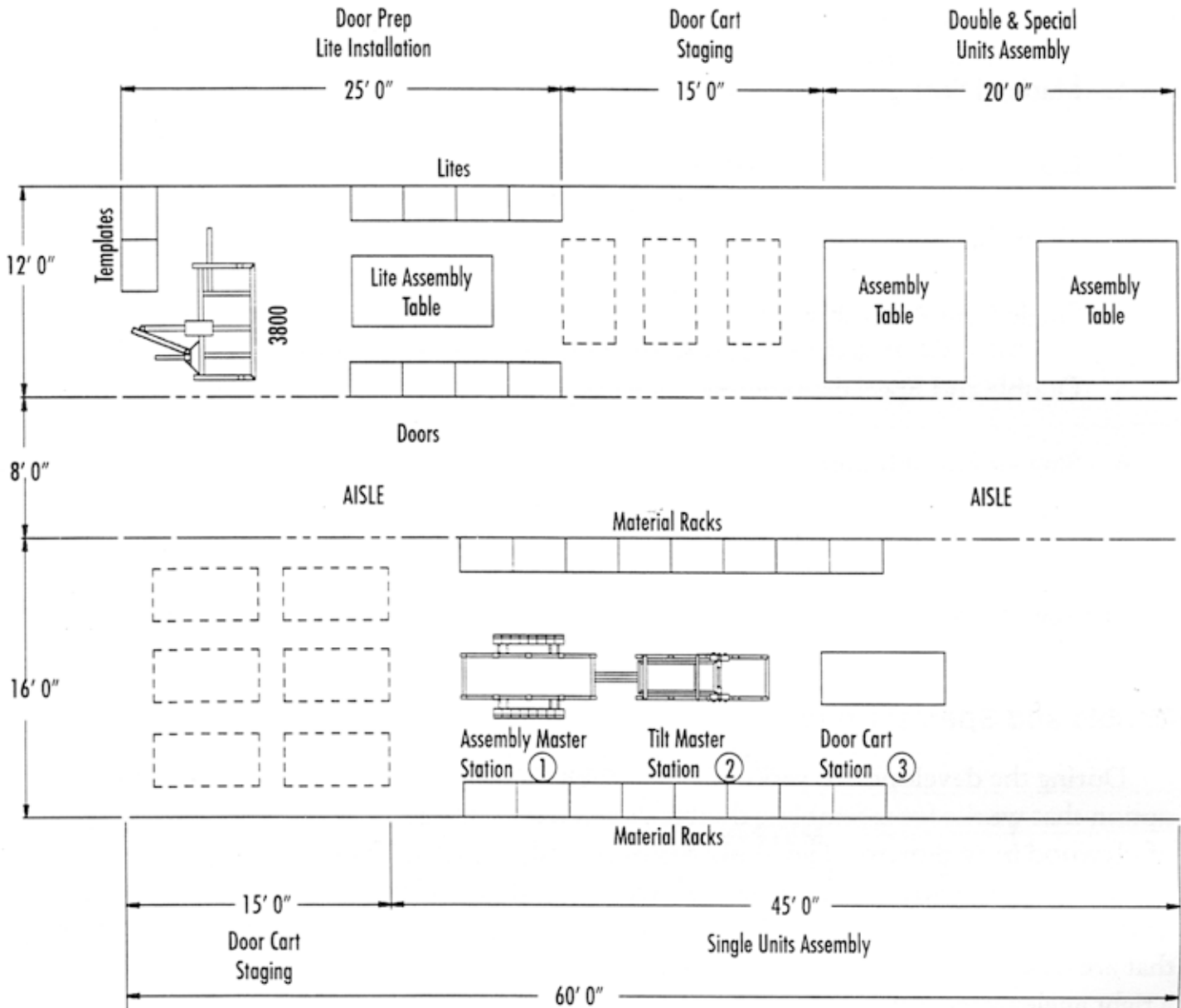
For specific unit dimensions of the Time Fold Series, refer to page 12 as well.

### Double and Special Units

During the development process of the Time Fold Series, one customer identified an option that works for assembling double doors and units with side lites. A cull door or piece of plywood is used on the Time Fold Series as a "slave pallet." This creates a moveable work table that is sent down the line allowing assembly of almost any size or shaped unit. This slave pallet can also be used to support the assembly of boxed side lites and other units that are narrower than a 2'6" door. (Double doors and units with side lites are assembled at a right angle to the normal flow direction.)

When the unit is complete, the Tilt Master can be used to bring the unit to a standing position for movement to a cart. The slave pallet can then be returned to the start of the line to begin the process again. A few slave pallets can be kept in the assembly area for use as needed.

# GENERAL SHOP LAYOUT



## COMPETITIVE PRODUCT COMPARISON

Norfield has researched the currently accepted practices of assembling metal doors and they are:

**Homemade tables** - Made of 2x4's, they are fabricated of plywood and carpet-covered, with the process of performing all assembly functions in one location.

**Single-station metal door assembly machines** - With the process of performing all assembly functions in one location.

Our observation, analysis, and our customers' input has led us to the following conclusions:

**The "PROS" of the homemade tables are:**

1. Low Cost.
2. Simplicity.

**The "CONS" of the homemade tables are:**

1. No opportunities for labor savings or an organized or structured process. Different operators would give you different results ( too much opportunity for errors due to lack of a system).

- 2. Too much lifting, placing doors on the table and taking the unit off is either a two man job or very risky for back injury.
- 3. Ergonomically inefficient, scattered tools, supplies and components, etc.

**The “PROS” of the single-station machines are:**

- 1. There is definitely a defined and repeatable process.
- 2. There is opportunity for improved ergonomics.

**The “CONS” of the single-station machines are:**

- 1. Cost.
- 2. If you have lower volumes of production it is difficult to justify the expense.
- 3. If you have higher volumes of production, and reach the maximum capacity of the machine, the only way to increase output is to put in a second complete system.

## **BALANCE WORK SHEET**

TASK NUMBER	TASK DESCRIPTION	PERSON MINUTES

Please make use of the following forms and floorplan when setting up your Time Fold Series Stations.

# SYSTEM CONFIGURATION WORK SHEET

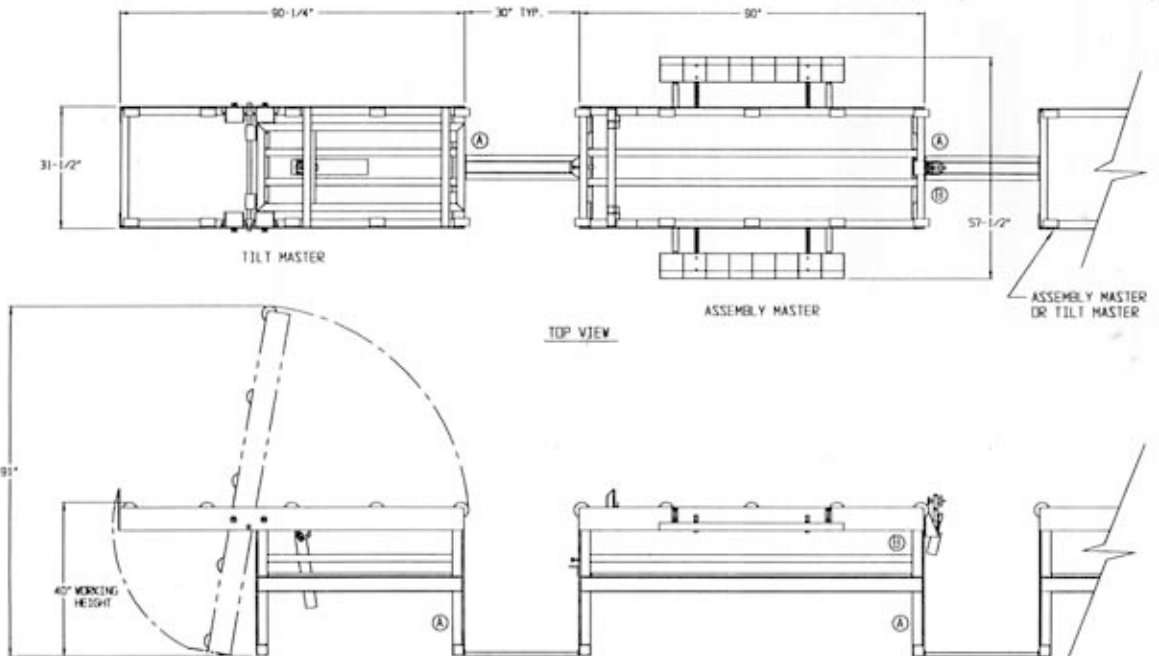
1	2	3	4	5
ASSEMBLY TASKS	ASSEMBLY TASKS	ASSEMBLY TASKS	ASSEMBLY TASKS	ASSEMBLY TASKS

TIME FOLD MODULES


NOTES:

REV:	ECO NUMBER	R/F



**AIR CONNECTION POINTS**

① 3/8" N.P.T. w/ FILTER/REGULATOR/SHUT-OFF VALVE (ONE LOCATION PER ASSEMBLY LINE)

② 1/4" NPT AT MANIFOLD ON STAND ALONE ASSEMBLY MASTER

**AIR REQUIREMENT**

- 8-10 C.F.M. DEPENDING ON SYSTEM CONFIGURATION AND NUMBER OF AIR TOOLS CONNECTED.
- 1/2" MINIMUM I.D. SUPPLY LINE

<b>NORFIELD MFG. CO.</b>		REVISION: 0 DATE: 1-28-97	FILE: 97ND402.PRT LEVELS: 250	DIMENSION TOLERANCES EXCEPT AS SPECIFIED  FINISH: UP TO AND INCLUDING .01" ... W-015 .01" TO AND INCLUDING .03" ... W-016 .03" TO ... W-017 Holes ... W-018 UNLESS OTHERWISE SPECIFIED ... W-019
TITLE: TIME FOLD SERIES PRE-INSTALLATION DRAWING NO.:	USED ON: FINISH:	DRAWN BY: LE CHECKED BY:		