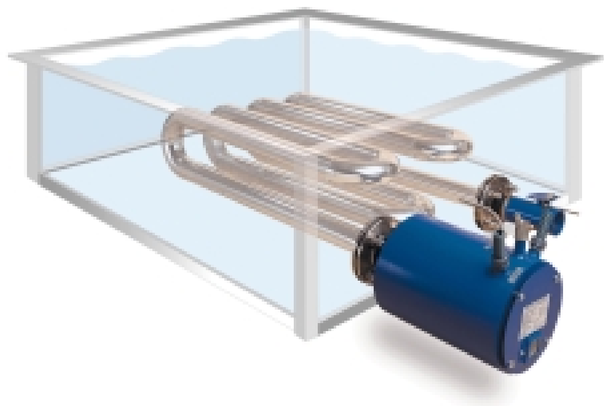
LANEMARK INTERNATIONAL

TX TANK HEATING SYSTEM
SYSTEM APPLICATIONS MANUAL



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MAY 2000

BACK

C O N T E N T S

SECTION 1 - INTRODUCTION

1.1 OVERVIEW

1.1.1. LANEMARK Advantages
1.1.2. Applications
1.1.3. Market Opportunities

1.2 WHAT AN END USER NEEDS TO KNOW ABOUT THE TX SYSTEM

1.3 TX SYSTEM TERMINOLOGY

1.1 OVERVIEW

The LANEMARK TX series burners feature an innovative technology which applies to the heating of liquids used throughout commerce and industry.The system requires no combustion chamber and a minimal intrusion into tank or vessel working areas. TX burners operate directly into a small bore immersion tube heat exchanger which is submerged in the liquid to be heated. The immersion tube varies in size from 1.5" to 6" nominal bore.

1.1.1 LANEMARK ADVANTAGES

* High efficiency (in excess of 80%) heat transfer. Other systems typically operate at efficiencies 20% to 30% lower.

* Multiple burner installations can be designed to operate with a common fan.

* Smaller diameters and shorter lengths of heat exchangers permits compact vessel designs, reducing installation, heat exchanger construction and chemical costs.

* The burners can operate into circular helical coils – ideal for vertical cylindrical tanks.

* Lower maintenance costs. No moving parts on burner housing so systems should only require annual maintenance after initial adjustment.

* Rugged construction with no exposed operating parts or electrical connections allows TX burners to operate in a wide variety of process environments.

* TxCalc ™ heat loss and heat exchanger computer design program.

1.1.2 APPLICATIONS

Typical applications include a wide range of aqueous solutions and other liquids such as :-

Acids	**Chromates**	**Lubricating Oils**
Alkali Cleaners	**Cooking Oils**	**Phosphates**
Beers	**Demineralised Water**	**Water**
Brighteners	**Detergents**	**Waxes**

These applications exist in market areas which include :-

Specialist Metal Finishers	**Hospitals**	**Food**
Appliance Manufacturers	**Colleges**	**Drink**
Original Equipment Manufacturers (OEM)		

1.1.3 MARKET OPPORTUNITIES

The high efficiency of the LANEMARK TX system opens up completely new marketing possibilities including the replacement of inefficient steam system, old fashioned gas heating arrangements and expensive to run electrical systems.

The compactness of the LANEMARK TX system introduces gas to new market areas such as hot water production in calorifiers or hot water storage cylinders, mini breweries, etc.

The typical equipment payback period will be 3-24 months.

Replacing other heating systems with the TX system will pose few problems as the fixing arrangements to the tank are simple. To the experienced gas engineer setting up the burners is also straightforward and little different from any other TX process burner equipment.

1.2 WHAT AN END USER NEEDS TO KNOW ABOUT THE TX SYSTEM

Heating liquids in industry and commerce is an expensive operation. The combined use of a high efficiency heating system utilising a competitively priced fuel offers the end user the most cost effective method of process liquid heating.

The TX burner system offers this particular combination. Operating efficiencies are designed to be in excess of 80% for all aqueous heating applications and the burners operate on either natural or L.P. gases.

Comparisons with other heating methods

1.2.1 Steam/Hot Water
1.2.2 Electricity
1.2.3 Gas

1.2.1 STEAM/HOT WATER

Process tanks are often heated by steam or hot water supplied by central boiler plant.

Four principal methods of secondary heat exchange within or adjacent to a tank are commonly used:

1. Steam coils or plates within the process tank.
2. Heat exchangers external to the process tank.
3. Water jackets around the process tank.
4. Direct steam injection into the process tank or water jacket.

The two main disadvantages of this type of arrangement are:

1. Low overall efficiency
2. Lack of controllability and flexibility.

Many central boiler plants are located a considerable distance from the point of application of their steam or hot water outputs.

If a boiler itself is operating at an efficiency of 75%, it will probably lose in excess of 10% of its output over the transmission network between the boiler house and the process tank. If a coil or plate heat exchanger is in use within the tank the secondary heat transfer efficiency is likely to be in the region of 80%.

If these three heat exchange ratios are taken together it can be seen that the overall system efficiency is approximately 54%.

Therefore for every 1 unit of heat required by the process tank, 1.85 unitsof fuel input are required at the boiler.

Where boilers have seen better days or where transmission pipework is poorly lagged, even a 54% overall efficiency level may not be achievable. The cost per useful unit of heat input will then be accordingly higher.

As far as the production manager is concerned, close control of liquid temperatures can be difficult with these indirect heating methods. Many plants have to cope with components of various sizes passing along an individual production line. It is particularly necessary in these instances that the process heating equipment should respond quickly to the sudden changes in heat demand that will occur as a result.

A central boiler usually supplies energy for more than one application. Often factory space heating for example, is achieved by using steam or hot water unit heaters or radiant panels. During summer months when space heating is not required, it can be an extremely inefficient and costly practice to maintain a boiler supply or part load only for process requirements which, in some instances, will purely be that associated with the heating of solution tanks.

There are also other costs associated with the operation of boilers which should not be overlooked. Chemical treatment of feed water supplies are expensive as are boiler house manning costs and annual boiler insurance premiums and inspections.

1.2.2 ELECTRICAL SYSTEMS

Process tanks can be efficiently heated by using electrical immersion elements. The particular attraction of using electrical immersion units is their relatively low capital cost. They offer good control over liquid temperatures, require minimal maintenance and provide an extremely flexible approach to tank heating. Electrical immersion heaters can be assumed to operate at an efficiency level close to 100%.

However, they do suffer one very major drawback in that their running cost is often prohibitive.

Generally, unless the tank to be heated is either extremely small, used very infrequently or for some reason only at night, when preferential tariffs can be made available, then electrical heating is not an attractive proposition.

1.2.3 GAS SYSTEMS

Natural gas has been used to heat tanks for a number of years. A number of methods have been employed, each with their own inherent advantages and disadvantages.

The three principal methods of gas fired tank heating are:

A. Underfiring.

B. Large diameter immersion tubes.

C. Small bore immersion tubes.

A. **Underfired Systems**

Underfired tank heating is perhaps the simplest and oldest method of heating industrial process tanks utilising gas. Rows of natural draught bar burners are arranged beneath the base of each tank.

There are two principal disadvantages to this approach. Firstly, the overall efficiency of such a system is usually extremely low. Efficiencies as low as 20% have been identified! Secondly, the products of combustion are often released around the sides of a tank, into the factory environment, which naturally is not a recommended practice.

B. **Large Diameter Immersion Tubes**

Packaged forced draught or natural draught gas burners can also be used in conjunction with large diameter immersion tubular heat exchangers. These tubes are fitted within each process tank and can be up to 10-12 inches in diameter.

The burner is located on the "firing leg" of the heat exchanger, the products of combustion being exhausted, usually to atmosphere, from the "exit leg".

These systems again have a number of drawbacks:

a. The overall efficiency of the arrangement tends to be rather low and the surface temperatures can be high.

b. A large diameter tubular heat exchanger can represent a significant intrusion into the internal tank space available for production requirements within a dip tank, especially as the heat exchanger shape usually needs to be kept simple to keep the pressure drop through the arrangement to a minimum.

c. The cost of the heat exchanger can be very expensive should the process liquid dictate that the tube needs to be constructed from any material other than mild steel.

C. **Small Bore Immersion Tubes**

Small bore immersion tube gas fired tank heaters usually represent the best solution to the problem of selecting process tank heating equipment.

A forced draught burner can be utilised but once again the shape of the heat exchanger must be kept simple, for example, a two pass configuration, so that the pressure resistance of the tube can be overcome by the burner fan. Again high surface temperatures are not unusual.

An alternative induced draught option is the LANEMARK TX burner system.

The system utilises a specially designed matrix gas burner, known as the **THERMIMAX** burner. The burner fires directly into the first leg of a small bore heat exchanger which is usually shaped into a multi-pass configuration. A centrifugal suction fan is connected to the opposite exit leg of the heat exchanger and the products of combustion are exhausted to atmosphere through a flue. (See LANEMARK TX literature)

The suction fan is capable of overcoming substantial heat exchanger pressure drops.
Heat exchangers can therefore be designed to fit unobtrusively into a tank causing little or no interference to the process concerned. They can be simply arranged to lie horizontally across the base of a tank or equally they can be designed to operate in a vertical attitude along the side walls. Heat exchangers can also be manufactured in a coiled form, for location within cylindrical tanks.

The tubes are generally constructed from mild steel for water based or alkali heating applications, or from the various grades of stainless steel where more corrosive solutions such as acids or phosphates are to be heated.

The heat exchanger diameters range from 1.5" n.b., which is capable of handling a maximum input of 45 kW (150,000 Btu/h, to 6" n.b.at a maximum rating of 730 kW (2,500,000 Btu/h). These ratings necessarily imply a relatively high intensity of heat transfer. It is therefore extremely important that the heat transfer rates along the complete length of any particular design of heat exchanger can be calculated and examined to ensure that they do not exceed any pre-determined maximum, for example, in cooking oil applications.

LANEMARK engineers use the dedicated TxCalc^{TM} computer program to carry out all the heating calculations associated with each tank heating project. This software is available for use by any Lanemark equipment user following a simple registration process.

Information from the Liquid Heating Enquiry Form (Section 2.1) is used to calculate the gas input required to achieve the tank's operating temperature within the specified warm-up time and the gas input load during the working day, whilst the tank is being used for production.

A specimen heat exchanger design is subsequently entered and the computer models the performance of the design at the required gas input level.

The overall pressure drop of the heat exchanger is calculated and compared to the exhaust fan specifications which are available.

The temperature of the combustion products at the outlet of the heat exchanger, is estimated and the overall system efficiency calculated.

Each tank heating system is fully automatic. Early morning startup is usually under timeswitch control. An immersion thermostat switches the burner between a "high input" setting, i.e. the full burner rating and a "low input"
setting when the process temperature has been reached. Using conventional thermostats a 2-3ºC (4-6 ºF) temperature switching differential is typical. Closer control can easily be obtained if electronic temperature controllers are utilised.

Because each system is self contained and independent, (even when a common fan is utilised) individual tanks can be used as and when required offering maximum flexibility to production management.

Each system is usually designed to operate at an efficiency level of 80%. The LANEMARK TX small bore natural gas system can offer fuel cost savings of approximately 30% and 50% compared to the central boiler and electrical alternatives.

1.3 TX SYSTEM TERMINOLOGY

Controls	:	Burner supervision equipment.
TX Burner	:	A cylindrical housing enclosing the Thermimax burner head assembly plus ignition and flame rectification electrodes.
Exhaust Damper	:	A combustion air damper fitted in the exhaust pipework after the heat exchanger but before inter-connection to either exhaust pipes or the exhaust fan.
Exhaust Fan	:	High pressure blower unit to provide suction through one or more heat exchangers.
Gas Train	:	Gas supply system incorporating mains and start valves.
Heat Exchanger	:	Small diameter steel or alloy pipe (1.5" - 6" n.b.) that is immersed in the liquid to be heated.
Temperature Controller	:	Temperature control device (Typically plus or minus 1ºC (2 ºF) perhaps incorporating temperature display.
Thermostat	:	Temperature control device typically plus or minus 3º C (5 ºF)

SECTION 2 - TX SYSTEM APPLICATION

2.1 TX SYSTEM LOAD CALCULATIONS & SURVEY GUIDELINES

2.1.1. Enquiry Form and Guidelines
2.1.2. Additional Background Information
A - Internal Considerations
B - External Considerations

2.1.3. LANEMARK TxCalc™ Design Program
A - Heat Loss Computer Program
B - Heat Exchanger Design Computer Program

2.1.4. The Job Estimate & Customer Proposal

2.2 ENGINEERING DATA

Burners
Gas Train Piping (typical)
Control system wiring (typical)
Heat Exchanger Pipes *
Heat Exchanger Pipe Lengths *
Heat Exchanger Flanges *
Exhaust Dampers

***Note -** Heat exchanger pipe designs will be included in the LANEMARK scope of supply. These designs must be followed exactly, utilising indicated pipe and bend types and radii shown if performance/efficiency levels are to be maintained.

The actual supply of heat exchanger pipes will <u>not</u> normally be part of the LANEMARK scope of supply unless requested.

2.1 TX SYSTEM LOAD CALCULATIONS & SURVEY GUIDELINES

The success of each TX system application is totally dependant upon the attention that is paid to detail when the initial site survey is made. The LANEMARK TxCalc™ Design Program makes the subsequent load calculation, performance estimate and equipment quotation stages as simple and efficient as is possible by providing -

a) Computer based heat loss calculations.

b) TX system performance estimates using the latest computer modelling techniques.

c) Burner, immersion tube heat exchanger and exhaust fan selections.

2.1.1 ENQUIRY FORM AND GUIDELINES

One enquiry form should be completed for each tank unless either a series of tanks are exactly the same or there are only minor variations which can be noted on a common enquiry form. (Please see Appendix 1 for example).

Company, Address, Name, Position, etc.

This data relates to the organisation to whom the quotation is to be addressed.

Process Line : End user client identification

Tank Identification : Name, number or reference for each tank to be considered.

Dimensions : Data can be accepted in most common units.

(NOTE: If tank is cylindrical or of an irregular shape please sketch and notate in "Plant Sketch" section on the reverse side of the form)

Insulation : Thickness in mm or inches.It will be assumed that the tank base is not insulated.

Top Surface : Tick boxes as appropriate.If lip (air) extract volume is available please include as a note.

Contents : Information relating to liquid to be heated is required particularly if specific heat is other than 1.0 so that the program (& Lanemark) can make.

1. Correct heat load calculations.
2. Recommendations for heat exchanger pipe material.
3 Advise if the TX system is suitable for the application which is under consideration.

Note : The TX system is not suitable for the heating of highly viscous liquids such as asphalt. Convection in viscous liquids is much reduced compared with water based solutions and excessive pipe temperatures could result if the TX system is applied in these cases.

Operation : 'Heat up time' is the maximum time permissible to raise the tank temperature from 'cold' (please state 'cold' temperature : 10ºC (50 ºF) will be assumed unless otherwise advised).

Note: Most tanks will only fall to 'cold' temperature after extended shutdown periods or following cleaning and re-filling. It will be assumed that any air extraction systems will <u>not</u> be in operation during the warm up phase. Similarly it will be assumed that no production will take place until the desired tank temperature has been attained.

Data relating to operating periods will permit running cost estimates to be computed.

Product Throughput: This section specifically relates to 'Dip Tanks' where a weight of material (and perhaps a supporting carrier such as a C-hook) are immersed in the tank.

If the tank is used to supply a hot liquid to a process then data inserted within this section will be used for information only' as the required heat load calculations will be made from data inserted into subsequent sections.

Solution Make Up : Information is requested concerning the volume and temperature of any 'cold' liquid make-up which is used to maintain the liquid level within the tank (This section is not intended to provide information on supply and return, flow temperatures in 'pumped' systems - see next section)

Any Other Losses : This is the section where any other sources of heat loss be identified.These losses are usually associated with the temperature differentials that result from liquid flows to and from processes e.g. spray pre-treatment systems, hot water distribution networks, etc. While it is appreciated that this data is sometimes difficult to obtain it is <u>vital</u> that measurements be taken because severe under or over estimates of hot loads can result. In each case the volume of liquid flowing, the discharge temperature and the return temperature are required..

Existing System (where applicable)

Data inserted in this section is used to –

a) cross check heat load calculations (particularly useful for comparative purposes for spray/pumped heating systems).

b) provide base data for efficiency comparisons between the TX and the existing heating arrangement (where applicable); necessary if a project pay back analysis is required.

Supplies: Please give as much information as possible on fuel types and pressures together with available electrical supply data so that correct sizing (and costing) of gas train components can be made and suitable motors for exhaust fans can be selected.

Plant Sketch Individual tank details, possible heat exchanger pipe orientation/limitations, tank groupings, basket/load dimensions, etc. can be shown. Where multiple tank heating systems are to operate utilising a common exhaust fan please show preferred layout here.

Reasons for Consideration of Change of Heating and Additional Comments.

Please provide any other useful background information which could have a bearing on -

a) heating system selection/sizing
b) suitable project presentation approach to the client

2.1.2 ADDITIONAL BACKGROUND INFORMATION

Below are listed a series of points that should be used as a `check list' when surveying a new project. Many points particularly relate to the ultimate installation of a new TX system or series of systems.

A. INTERNAL CONSIDERATIONS

1. **Tank Material -** Useful to note : usually heat exchanger pipe material is similar.

2. **Existing Heating System Material -** Again a good indicator of what heat exchanger pipe material will be suitable.

3. **Tank Linings -** Is inside of tank lined with rubber, glass fibre etc. Why? Usually an indicator of an aggressive liquid and therefore care will be needed when heat exchanger pipe material is selected.

4. **Heat Exchanger Sealing -** Two alternative forms of heat exchanger sealing are recommended

   a) Flange mounting
   b) Plate mounting

Both require that a gasket is fitted to make a liquid tight seal. Butyl rubber is the usual selection, unless the system is for use in the food industry where “food” grade gasket materials should be utilised.

- Check to determine suitability and reselect if necessary.

The welding of heat exchanger pipes to tank walls is not recommended. Whilst this method of installation will not affect the system performance the pipes will not be removable should a either failure occur or if severe scaling requires 'out of tank' cleaning.

5. **Heat Exchanger Positioning -** Heat exchanger pipes can be installed in any orientation, i.e. usually a selection between horizontal (parallel to tank floor) or vertical (adjacent to one or more tank walls). They may be supplied as one complete assembly or flanged internally when required.
   The selection of a suitable orientation should include consideration of the following –

   a) the liquid in the tank must cover the heat exchanger at all times.
      If necessary investigate the supply of a liquid level switch to protect the burner system against low liquid and/or to operate an automatic liquid filling arrangement.

   b) obstruction to any work loads (always determine maximum outside dimensions of any work loads for dip immersion tanks and method of suspension/support of work loads when immersed to provide necessary clearance data for heat exchanger pipes).

   c) possible build up of chemical 'sludge' on tank floor.

   The heat exchanger must remain clear of any sludge at all times as a loss of heating efficiency and severe overheating of the heat exchanger material will result from any submersion within sludge deposits.

   d) will internal or external tank bracings (if any) obstruct mounting flanges or mounting plates?

   e) can the heat exchanger be physically fitted into the tank, bearing in mind headroom, and external clearances from walls, stanchions, etc.

      NOTE : Do not overlook the access requirements at the site necessary to ring the heat exchanger from the vehicle off-loading position to the tank location.

   f) ease of providing any necessary protection to the heat exchanger.

   g) heat exchanger support options.

6. **Temperature Sensor**s **-** Note suitable position for temperature control sensor pocket and select appropriate type.

B. EXTERNAL CONSIDERATIONS

1. **Tank Position -** Note if there is adequate clearance to fit and maintain TX burner equipment. Take particular care if tank is located in a 'pit'.
   Note if the atmosphere surrounding burner area is aggressive'. Particular care should be taken where either hot or cold acid tanks are situated in the vicinity.
   (End user must utilise adequate air extraction systems to ensure that corrosive vapours do not 'lie' at low levels. Note if burner will require ducted combustion air and if necessary determine suitable routing. Note if the burner equipment will require protection from splashing, personnel or possible mechanical damage.

2. **Tank Support -** Note if tank is located directly on to floor or supported by steelwork. Measure clearance from floor. Important : TX series burner diameters are larger than mounting flange diameters. Therefore in cases where heat exchanger mounting flanges are required to be close to tank bottom ensure there is adequate height available to accept the burner diameter at the outside of tank.

3. **Gas Supplies -** Note exact type of gas to be used

   e.g. Natural : Calorific value.
   LPG : Propane or Butane : Calorific values and specific gravities.

   - Note position of gas supply and anticipated pressure available at gas train entry point.

   - Note intended location for gas train and specify any gas train handing requirements.

4. **Electrical Controls -** Note best position for burner controls.

5. **Exhaust Pipework -** Can a common exhaust fan be used for a number of TX burners?

   - Determine optimum route for exhaust pipework from exhaust damper to exhaust header (if applicable) and on to a selected position for the exhaust fan.

   - Determine exit route for exhaust flue after the exhaust fan bearing in mind flue support requirements.

   - Determine whether exhaust pipework needs to be insulated (usual exhaust temperatures will be in the 190º C (375-525 ºF) range.

2.1.3. LANEMARK TxCalc™ DESIGN PROGRAM

Following the completion of 'Liquid Heating Enquiry Forms' and any associated support documentation, engineers can quickly calculate hot loads and prepare suggested TX system equipment design options using Lanemark's TxCalc™ design program.

A) Heat Loss Computer Program

The TxCalc 'Heat Loss section of the program provides a comprehensive statement of the heat loads which will result from -

Production Heat Losses

Wall Losses
Surface Losses
Make Up Losses
Production/Carrier Losses
Other Losses

Warm-Up Loads

For each tank a print out of this information such as that shown in Appendix 2 will be made available.

NOTE: Often 'Warm Up Loads' are considerably in excess of the anticipated 'Production Heat Losses' due to 'short' warm up periods being requested. 'Short' warm up times should only be requested where the process itself requires a particular warm up period or where a 'manual' start is desired which itself dictates the appropriate time available.

B) Heat Exchanger Design Computer Program

Having established both the 'Production Heat Losses' and 'Warm Up Loads' the TxCalc program can then select a possible TX burner system together with a proposed heat exchanger configuration, the performance of which can then be `modelled' using the 'Heat Exchanger Design ' section of the program.

Data is inserted relating to the following -

1. Quotation or Project Reference (automatically transferred if heat losses have been previously calculated by the program).

2. Heat input (Gross gas input - whichever is the greater, the Production Heat Losses or the Warm Up Load).

3. Liquid Temperature
   Pipe size and wall thickness

The program will then suggest an initial pipe configuration incorporating long radius bends.

The computer program then 'models' the anticipated performance of this suggested design by breaking down the total proposed heat exchanger into a number of zones (each equivalent to 'one pipe diameter') and by carrying out heat exchange calculations at every zone. The expected efficiency, flue gas temperature and pressure drop are calculated. When all the designs within a project are finalised the program can make a selection of a suitable exhaust fan based upon the total heat input and the calculated pressure drop(s) which will determine the number of TX systems which could be linked to a common fan unit.

Alternative heat exchanger configurations can easily be edited and 'modelled' using the program so that different heat exchanger design options can be made available.

2.1.4. <u>THE JOB ESTIMATE & CUSTOMER PROPOSAL</u>

LANEMARK are able to provide a quotation for the supply of -

TX Burners
Gas Trains
Burner Controls
Exhaust Dampers
Exhaust Fans
Temperature Controls
Heat Exchangers*

*Optional

A TX burner quotation should include a restatement of the essential design criteria extracted from the relevant enquiry form

e.g.Tank Dimensions
Insulation and Top Surface Data
Operating Temperature
Product Flow Data
Solution Make Up
Other Losses (e.g. Spray Rates and Temperature Differentials)
Warm Up Times (and Starting Temperature)

Any assumptions made should be highlighted. We strongly advise that this restatement of essential design criteria is passed back to the client in the final proposal for his confirmation/adjustment.

When required and provided sufficient data has been included on the original enquiry form, efficiency comparisons can be made between the TX system proposal and that of the equipment currently in use. Fuel consumption and running cost comparisons can then be made, which when limited to the overall end user project cost (i.e. including heat exchanger supply + installation + start up costs), will provide the client with a basis upon which to make a project pay back analysis.

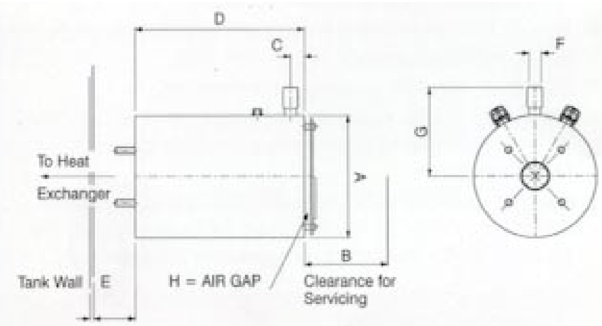
2.2 ENGINEERING DATA

Typical drawing/table information follows for the following items:

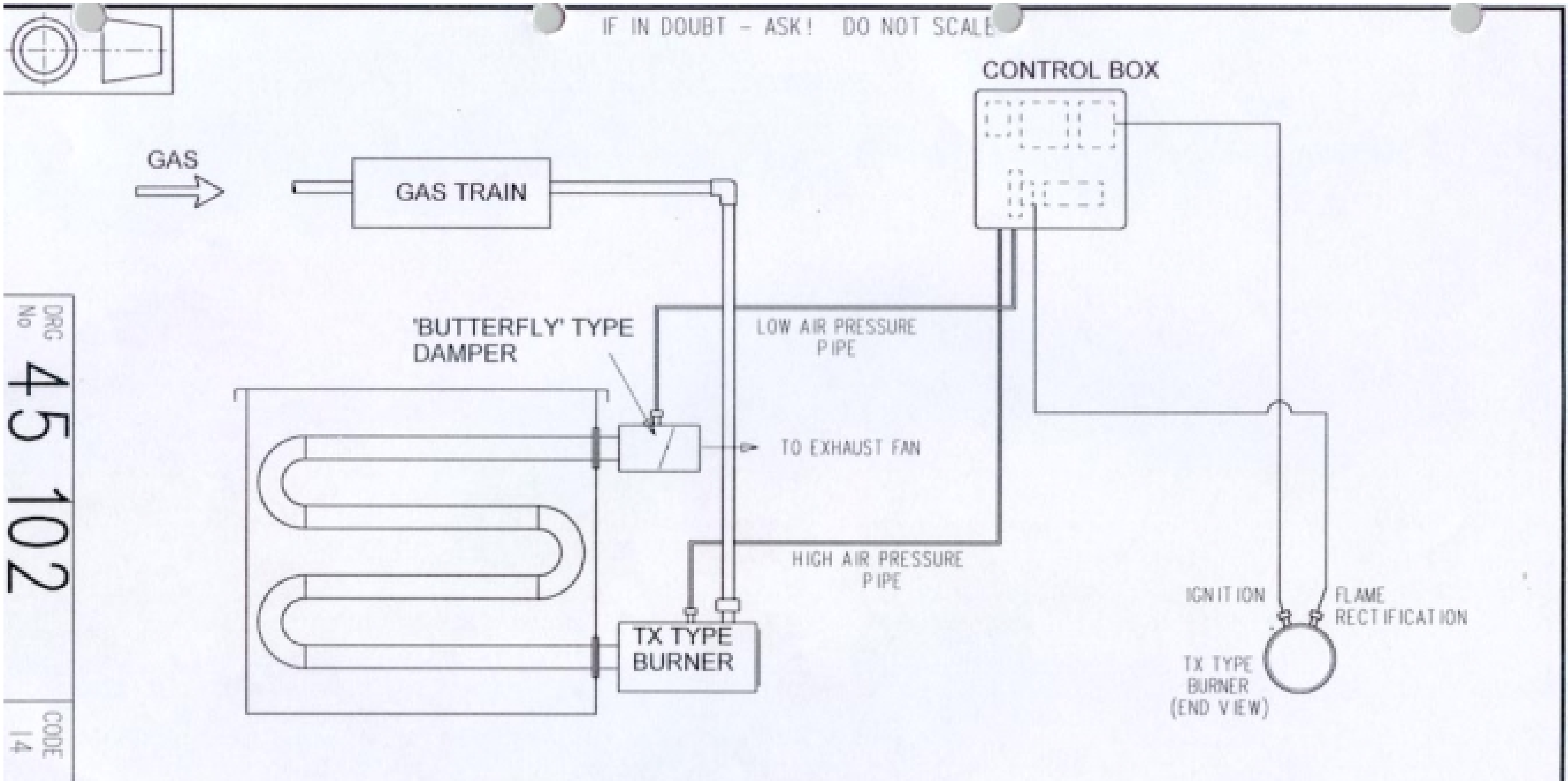
a) Burners
b) TX Burner System Connections
c) Gas Train Piping (typical)
d) Control system wiring (typical)
e) Heat Exchanger Pipes *
f) Heat Exchanger Pipe Lengths *
g) Heat Exchanger Flanges *
h) Exhaust Dampers

TX BURNER DIMENSIONS

MODEL NO.	DIMENSIONS							
	A	B	C	D	E	F	G	H
TX15/20	220	150	40	305	75	½" BSP	160	12
TX25E/30	295	225	50	450	75	1" BSP	210	25
TX40	295	300	50	500	75	1½" BSP	230	25
TX60	405	320	120	625	75	2" BSP	305	35



All dimensions are in mm, except where stated.



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SCALE at A4: 1 : 1	ASSEMBLY	DIMENSIONS ARE IN MM (Inches)	
CUSTOMER: TX	MATERIAL: -	DR'N BY: AJS	DATE: 20/10/98
		CHECKED: KC	DATE: 20/10/98

ISSUE	1		
CHANGE No			
DATE	20/10/98		
Signature	AJS		

TOLERANCES UNLESS OTHERWISE STATED ± -

TITLE
TX BURNER SYSTEM CONNECTIONS

Job No	REF No	SHEET	OF
		1	1

DRG No 45 102

CODE 14

LANEMARK INTERNATIONAL Ltd

GAS TRAIN DESIGN

DRG No. 55 637

DATE	DESTINATION COUNTRY	APPLICATION	HANDING	FUEL	ISS BY	SUPPLY VOLTAGE
05/01/00	ALL	Remote	L & R	Nat / Prop	AJS	230 V.A.C. 50 Hz

SCHEMATIC DRAWING

Approximate Size:

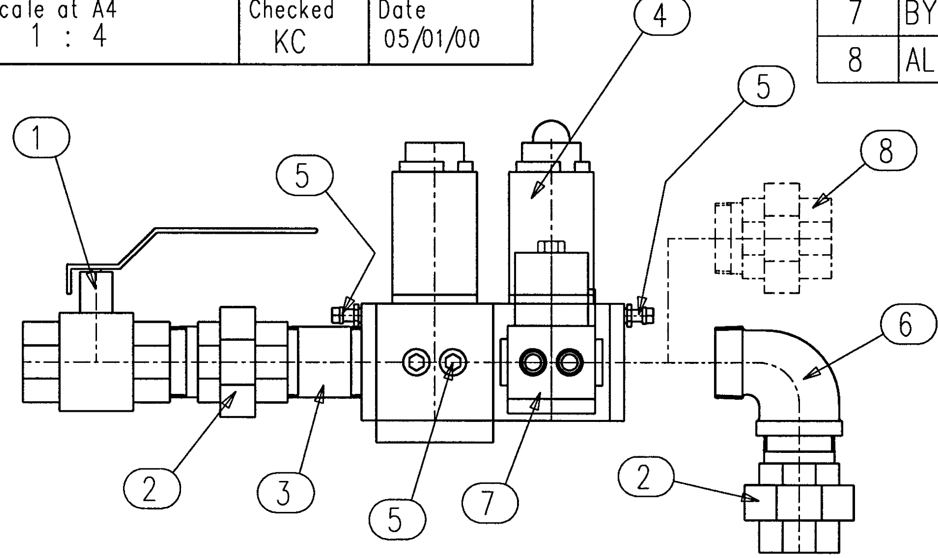
O/ALL LENGTH	O/ALL WIDTH	O/ALL HEIGHT
555	100	225

TYPE: GM4 230V 1xBYPASS

ISSUE	1		
CHANGE No	1775		
DATE	05/01/00		
SIGNATURE	AJS		

Scale at A4	Checked	Date
1 : 4	KC	05/01/00

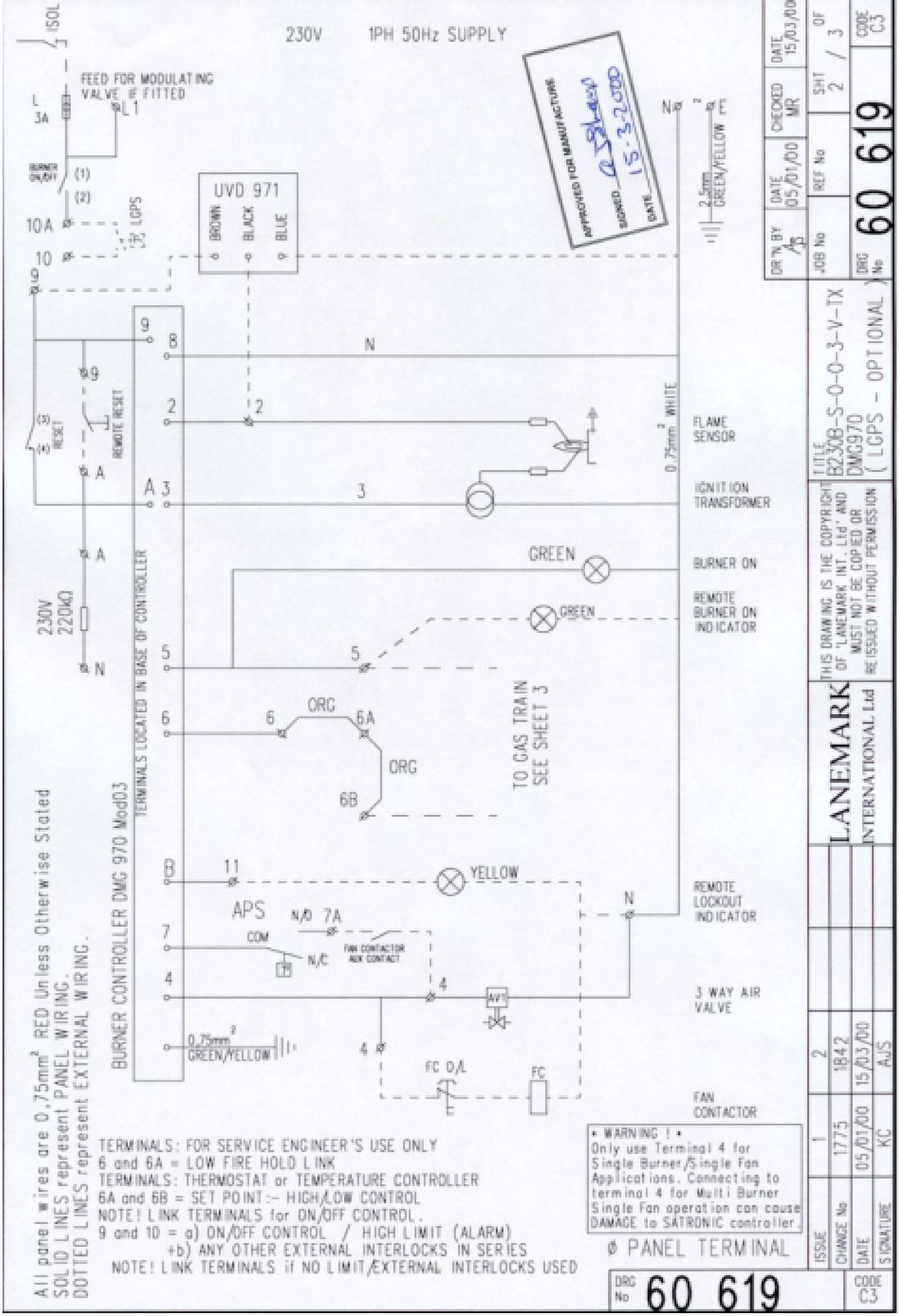
Item	Description	Part No
1	1 1/2" GAS BALL VALVE	15055
2	1 1/2" M/F UNION	18100
3	1 1/2" BARREL NIPPLE	18099
4	JOHNSON GM4 GAS BLOCK	10518
5	PRESSURE TEST POINT	22030
6	1 1/2" ELBOW	18243
7	BYPASS VALVE	10421
8	ALTERNATIVE - 1 1/2" M/F UNION	18100



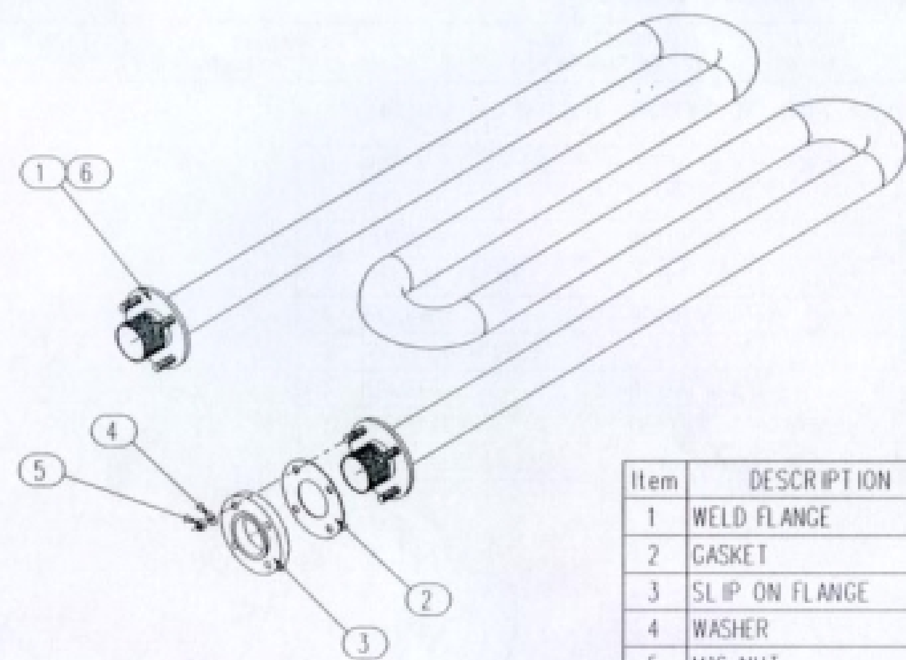
APPROVED FOR MANUFACTURE

SIGNED________

DATE________


230V 1PH 50Hz SUPPLY
ISOL
FEED FOR MODULATING VALVE IF FITTED
L1
L 3A
BURNER ON/OFF
10A
10
9
LGPS
UVD 971
BROWN
BLACK
BLUE
APPROVED FOR MANUFACTURE
SIGNED
DATE 15-3-2000
N
E
2.5mm² GREEN/YELLOW
0.75mm² WHITE
8
2
3
A
RESET
REMOTE RESET
FLAME SENSOR
IGNITION TRANSFORMER
GREEN
BURNER ON
REMOTE BURNER ON INDICATOR
5
6
6A
6B
ORG
TO GAS TRAIN SEE SHEET 3
230V 220kΩ
TERMINALS LOCATED IN BASE OF CONTROLLER
BURNER CONTROLLER DMC 970 Mod03
B
11
YELLOW
REMOTE LOCKOUT INDICATOR
APS
N/O 7A
COM
N/C
FAN CONTACTOR AUX CONTACT
7
4
AV1
3 WAY AIR VALVE
0.75mm² GREEN/YELLOW
FC O/L
FC
FAN CONTACTOR
All panel wires are 0.75mm² RED Unless Otherwise Stated
SOLID LINES represent PANEL WIRING.
DOTTED LINES represent EXTERNAL WIRING.
TERMINALS: FOR SERVICE ENGINEER'S USE ONLY
6 and 6A = LOW FIRE HOLD LINK
TERMINALS: THERMOSTAT or TEMPERATURE CONTROLLER
6A and 6B = SET POINT:- HIGH/LOW CONTROL
NOTE! LINK TERMINALS for ON/OFF CONTROL.
9 and 10 = a) ON/OFF CONTROL / HIGH LIMIT (ALARM)
+b) ANY OTHER EXTERNAL INTERLOCKS IN SERIES
NOTE! LINK TERMINALS if NO LIMIT/EXTERNAL INTERLOCKS USED
• WARNING ! •
Only use Terminal 4 for Single Burner/Single Fan Applications. Connecting to terminal 4 for Multi Burner Single Fan operation can cause DAMAGE to SATRONIC controller.
ø PANEL TERMINAL
DRG No 60 619
CODE C3
DR'N BY
DATE 05/01/00
CHECKED MR
DATE 15/03/00
JOB No
REF No
SHT 2 / 3 OF
TITLE B230B-S-0-0-3-V-TX DMC970 (LGPS - OPTIONAL)
THIS DRAWING IS THE COPYRIGHT OF 'LANEMARK INT. Ltd' AND MUST NOT BE COPIED OR REISSUED WITHOUT PERMISSION
LANEMARK INTERNATIONAL Ltd
ISSUE 1 2
CHANGE No 1775 1842
DATE 05/01/00 15/03/00
SIGNATURE KC AJS

IF IN DOUBT - ASK!   DO NOT SCALE



Item	DESCRIPTION	MATERIAL	QTY
1	WELD FLANGE	AS HEAT EXCHANGER	2
2	GASKET	BUTYL RUBBER	2
3	SLIP ON FLANGE	Mild Steel •	2
4	WASHER	Mild Steel •	8
5	M16 NUT	Mild Steel •	8
6	M16 x 50 BOLTS	AS HEAT EXCHANGER	8

• If requested the Material may be the same as the Heat Exchanger.

SCALE at A3	MATERIAL	TOLERANCES UNLESS OTHERWISE STATED = ± 3	DIMENSIONS ARE IN MM (Inches)	CUSTOMER	ASSEMBLY	DR'N BY	DATE	CHECKED	DATE
1 : 10	As Req'd					AJS	18/07/96	AJS	24/07/96

ISSUE	1			
CHANGE No				
DATE	18/07/96			
SIGNATURE	AJS			

LANEMARK INTERNATIONAL Ltd

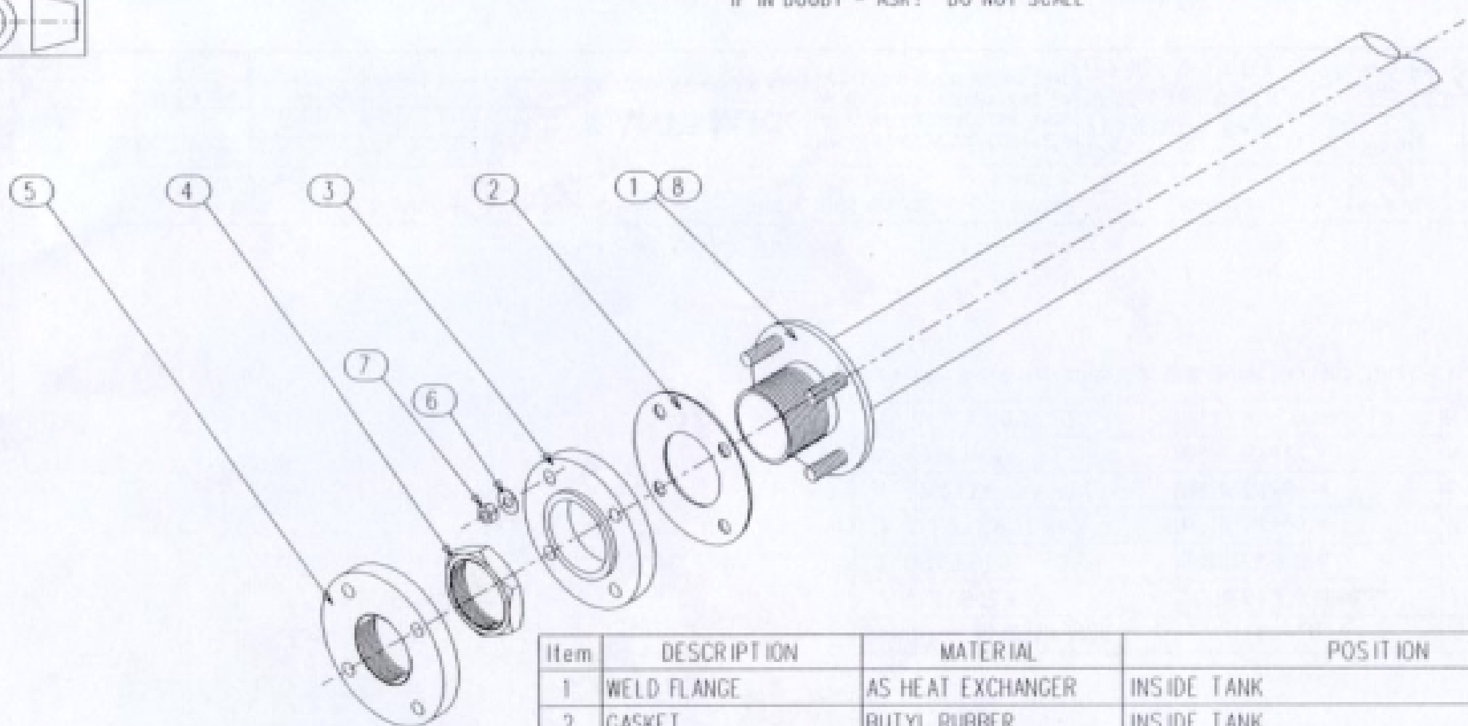
TITLE
TYPICAL 4 PASS
HEAT EXCHANGER
FLANGE MOUNTED

JOB No | REF No | SHT 1 / OF 1

DRG No 93 006 | CODE 13

DRG No 93 006
CODE 13

IF IN DOUBT - ASK! DO NOT SCALE



Item	DESCRIPTION	MATERIAL	POSITION
1	WELD FLANGE	AS HEAT EXCHANGER	INSIDE TANK
2	GASKET	BUTYL RUBBER	INSIDE TANK
3	SLIP ON FLANGE	Mild Steel *	OUTSIDE TANK WALL
4	LOCKNUT	Mild Steel *	TO LOCK SCREWED FLANGE IN POSITION
5	SCREWED FLANGE	Mild Steel *	TO ATTACH TX BURNER IN POSITION
6	WASHER	Mild Steel *	ON M16 BOLT
7	M16 NUT	Mild Steel *	ON M16 BOLT
8	M16 x 50 BOLTS	AS HEAT EXCHANGER	WELD TO FLANGE

* If required the Material may be the same as the Heat Exchanger

SCALE at A3	MATERIAL	TOLERANCES UNLESS OTHERWISE STATED = ±	DIMENSIONS ARE IN MM (Inches)	CUSTOMER	ASSEMBLY	DR'N BY	DATE	CHECKED	DATE
1 : 5	As Req'd					AJS	18/07/96	AJS	24/07/96

ISSUE	1	
CHANGE No		
DATE	18/07/96	
SIGNATURE	AJS	

LANEMARK INTERNATIONAL Ltd

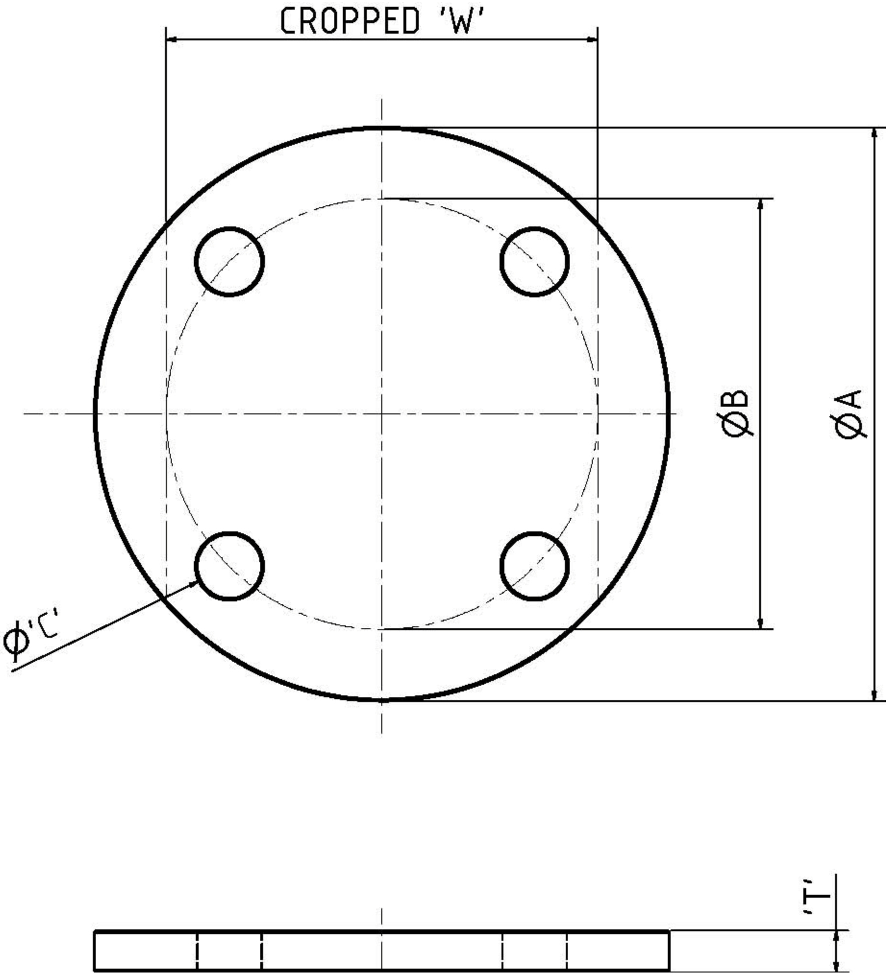
TITLE HEAT EXCHANGER END CONNECTION COMPONENTS

JOB No	REF No	SHT 1 / OF 1
DRG No 93 008		CODE 13

DRG No 93 008

CODE 13

PN16 FLANGES

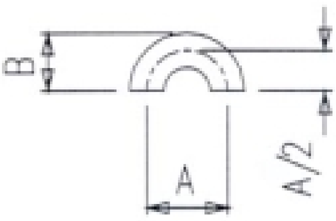


SIZE	A mm	B mm	C mm	T mm	W mm	Hole Qty
25	115	85	14	16	85	4
40	150	110	18	16	110	4
50	165	125	18	18	125	4
65	185	145	18	18	145	4
80	200	160	18	18	180	8
100	220	180	18	20	200	8
150	285	240	22	22	270	8
200	340	295	22	24	320	12

All to DIN STANDARD PN16

DIMENSIONS OF BENDS AND MITRES
HEAT EXCHANGER INSTALLATION DIMENSIONS

90° & 180° BENDS



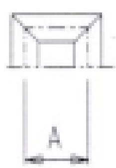
Long Rad Bends

SIZE	A	B	LENGTH 180°	LENGTH 90°	WEIGHT lbs
1"	3"	2 1/4"	4 3/4"	2 3/8"	0.70
1 1/2"	4 1/2"	3 1/4"	7"	3 1/2"	1.45
2"	6"	4 1/4"	9 1/2"	4 3/4"	2.75
2 1/2"	7 1/2"	5 1/4"	12"	6"	4.38
3"	9"	6 1/4"	14"	7"	6.65
4"	12"	8 1/4"	19"	9 1/2"	12.90
6"	18"	12 1/4"	28"	14"	30.10

Short Rad Bends

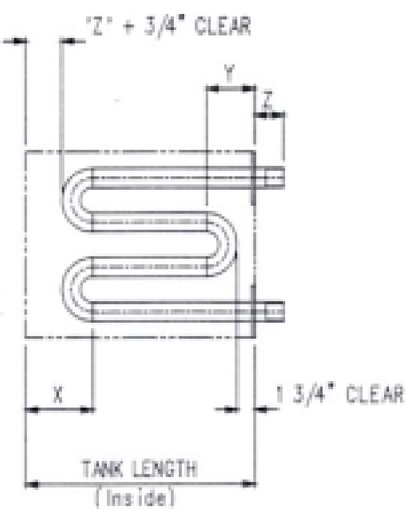
SIZE	A	B	LENGTH 180°	LENGTH 90°	WEIGHT lbs
1"	2"	1 3/4"	3 1/4"	1 5/8"	0.44
1 1/2"	3"	2 1/2"	4 3/4"	2 3/8"	1.00
2"	4"	3 1/4"	6 1/2"	3 1/4"	1.76
2 1/2"	5"	4"	8"	4"	2.90
3"	6"	4 3/4"	9 1/2"	4 3/4"	4.50
4"	8"	6 1/4"	12 3/4"	6 3/8"	8.60
6"	12"	9 1/2"	19	9 1/2"	20.40

MITRES



SIZE	1"	1 1/2"	2"	2 1/2"
A min	3.8"	4.4"	4.9"	5.5
SIZE	3"	4"	6"	
A min	6.0"	7.0"	9.0"	

INSTALLATION DIMENSIONS

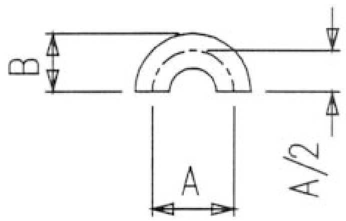


	LRB			SRB		
SIZE	X	Y	Z	X2	Y2	Lbs wt / ft
1"	6"	4"	3"	5 1/2"	3 1/2"	1.64
1 1/2"	7"	5"	3"	6 1/4"	4 1/4"	2.43
2"	8"	6"	3"	7"	5"	3.42
2 1/2"	9"	7"	3"	7 3/4"	5 3/4"	4.38
3"	10"	8"	3"	8 1/2"	6 1/2"	5.70
4"	13"	10"	4"	11"	8"	8.14
6"	17"	14"	4"	14"	11"	12.90

Weights based on Mild Steel to BS1387/1967

DIMENSIONS OF BENDS AND MITRES
HEAT EXCHANGER INSTALLATION DIMENSIONS

90° & 180° BENDS



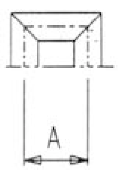
Long Rad Bends

SIZE	A	B	LENGTH 180°	LENGTH 90°	WEIGHT kg
1"	76.20	55	120	60	0.30
1 1/2"	114.30	82	180	90	0.65
2"	152.40	107	240	120	1.25
2 1/2"	190.50	134	300	150	1.95
3"	228.60	159	360	180	3.05
4"	304.80	210	480	240	5.80
6"	457.20	312	720	360	13.80

Short Rad Bends

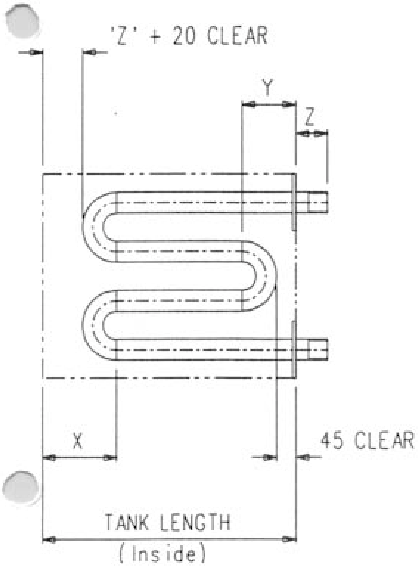
SIZE	A	B	LENGTH 180°	LENGTH 90°	WEIGHT kg
1"	50.80	43	80	40	0.20
1 1/2"	76.20	63	120	60	0.45
2"	101.60	81	160	80	0.80
2 1/2"	127	102	200	100	1.30
3"	152.40	121	240	120	2.05
4"	203.20	159	320	160	3.90
6"	304.80	237	480	240	9.25

MITRES



SIZE	1"	1 1/2"	2"	2 1/2"
A min	100	115	125	140
SIZE	3"	4"	6"	
A min	155	180	230	

INSTALLATION DIMENSIONS



SIZE	X (LRB)	Y (LRB)	Z (LRB)	X2 (SRB)	Y2 (SRB)	Kg wt / mtr
1"	150	100	75	140	90	2.44
1 1/2"	180	130	75	160	110	3.62
2"	205	155	75	175	125	5.09
2 1/2"	230	180	75	200	150	6.52
3"	255	205	75	215	165	8.47
4"	330	255	100	280	205	12.10
6"	435	360	100	360	285	19.20

Weights based on Mild Steel to BS1387/1967

Standard Pipe Sizes

Pipe dimensions in inches and millimetres			1"	1 1/2"	2"	2 1/2"	3"	4"	6"
* Mild	O.D.	in	1.330	1.905	2.374	2.996	3.496	4.492	6.625
Steel		mm	33,8	48,4	60,3	76,1	88,8	114,1	168,3
BS1387	Wall	in	0.128	0.128	0.144	0.144	0.160	0.176	0.280
Medium		mm	3,25	3,25	3,65	3,65	4,05	4,50	7,10
Gauge	I.D.	in	1.075	1.649	2.086	2.708	3.177	4.137	6.065
Tube		mm	27,3	41,90	53,00	68,80	80,70	105,1	154,1

Stainless	O.D.	In	1.315	1.900	2.375	2.875	3.500	4.500	6.625
Steel		mm	33,4	48,26	60,33	73,02	88,90	114,3	168,3
Sch. 5	Wall	In	0.065	0.065	0.065	0.083	0.083	0.083	0.109
ASTMA		mm	1,65	1,65	1,65	2,11	2,11	2,11	2,77
seam-	I.D.	In	1.185	1.770	2.245	2.709	3.334	4.334	6.407
welded		mm	30,1	44,96	57,03	68,80	84,68	110,08	162,76

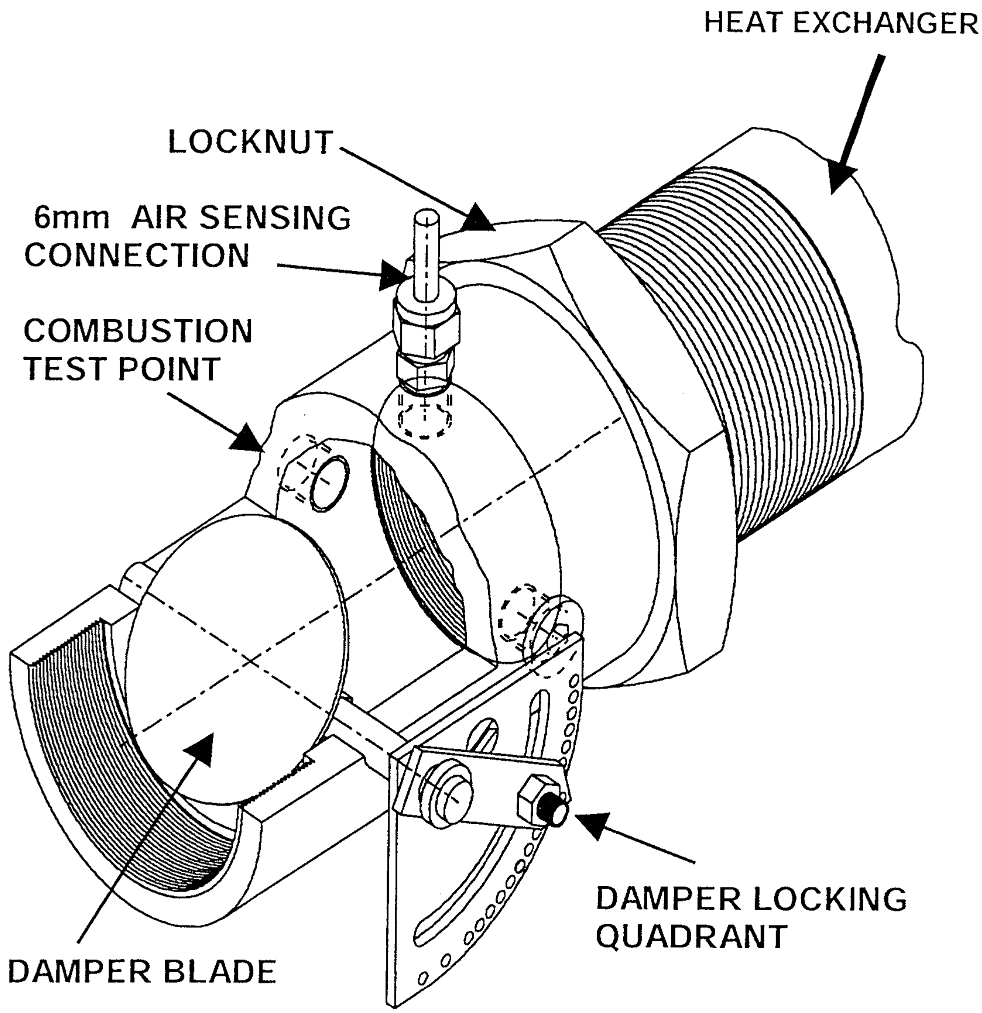
Stainless	O.D.	In	1.315	1.900	2.375	2.875	3.500	4.500	6.625
Steel		mm	33,4	48,26	60,33	73,02	88,90	114,30	168,30
Sch. 10	Wall	In	0.109	0.109	0.109	0.120	0.120	0.120	0.134
ASTMA		mm	2,77	2,77	2,77	3,05	3,05	3,05	3,40
seam-	I.D.	In	1.097	1.682	2.156	2.635	3.260	4.260	6.357
welded		mm	27,86	42,72	54,79	66,93	82,80	108,20	161,50

Stainless	O.D.	In	1.315	1.900	2.375	2.875	3.500	4.500	6.625
Steel		mm	33,4	48,26	60,33	73,02	88,90	114,30	168,30
Sch. 40	Wall	In	0.133	0.145	0.154	0.203	0.216	0.237	0.280
ASTMA		mm	3,38	3,68	3,91	5,16	5,49	6,02	7,11
seam-	I.D.	In	1.049	1.610	2.067	2.469	3.068	4.026	6.065
welded		mm	26,64	40,90	52,51	62,71	77,92	102,26	154,08

Tank Drilling Size	1 3/8"	2 1/8"	2 1/2"	3 1/8"	3 3/4"	4 5/8"	6 3/4"
	35	54	64	80	95	118	172

* Except 6" tube = AP15L Grade 'B' or Similar

Fig 4 FLUE EXHAUST DAMPER



IMPORTANT: The damper assembly should be installed as shown with the 6 mm air sensing connection pointing upwards (to prevent condensation blocking it) and with sufficient clearance all around to allow Service Engineers access to set the damper quadrant and to use the combustion test point.

SECTION 3.

SELLING THE TX SYSTEM

3.1 INTRODUCTION

3.2 MARKET AREAS

- **3.2.1** Product Finishing
- **3.2.2** Food and Drink
- **3.2.3** Others

3.3 CUSTOMER TYPES

- **3.3.1** The End User
- **3.3.2** The Installation Contracto
- **3.3.3** The Consulting Engineer
- **3.3.4** The Original Equipment Manufacturer (OEM)
- **3.3.5** The Gas Supply Utility

3.4 TX COMPETITIVE ANALYSIS

- **3.4.1** Introduction
- **3.4.2** Large Diameter Pipes (Atmospheric Burners)
- **3.4.3** Large Diameter Pipes (Forced Draught Burners)
- **3.4.4** Small Diameter Pipes (Forced Draught Burners)
- **3.4.5** Small Diameter Pipes (Induced Draught Burners)

3.1 BACKGROUND

This section on selling the TX system indicates the principle market areas which are suited to the use of the TX system and the types of customer to whom the system should be presented.

The TX system has been available in Europe for over 20 years. Originally developed by Dunlop in the l970's, in conjunction with British Petroleum, the system has proved itself to be a market leader with process gas engineers expressing a clear preference for the system compared to alternative large bore or forced draught systems, which are also available.

The particular advantages of the TX system will be highlighted and ideas as to how they might be fully exploited put forward.

3.2 MARKET AREAS

PRODUCT FINISHING
FOOD AND DRINK
OTHERS

3.2.1 PRODUCT FINISHING

The prime market place for TX tank heating systems is in the product finishing industry.

This industry is split into two.

(1) Those manufacturing companies that utilise 'in house' product finishing processes.

(2) Specialist product finishing companies who act as sub-contractors to manufacturers.

The most common materials which require finishing are -

A. Metals
B. Wood
C. Plastics

Of these, metal finishing is by far the largest sector with potential applications for the TX burner system.

A. METAL FINISHING

The main areas which have the greatest number of liquid heating applications are -

1. PRE-TREATMENTS

For example :

Chemical degreasing and cleaning (including ultrasonic)
Pickling

Phosphating
Chromating

2. FINAL TREATMENTS

For example :

Anodising (Sulphuric, chromic, hard, bright and colour)
Electroplating

1. PRE-TREATMENTS

Chemical Degreasing & Cleaning

Grease, oil or other contaminants must be removed from a surface prior to final treatment whether this be electroplating, painting, anodising, etc.

The pre-treatment processes immediately prior to final finishing generally take the form of hot alkali degreasing/cleaning, possibly followed by acid dipping or pickling to remove any oxide films and then by a further rinse and/or alkaline clean.

Degreasing can also be accomplished using either cold or hot solvents such as TRICHLORETHYLENE.
THE TX SYSTEM IS NOT SUITABLE FOR HEATING SOLVENT DEGREASING SYSTEMS.

The choice of a hot alkaline metal cleaner is influenced by the material to be cleaned and also the type of soil or grease to be removed. As a rule the higher the alkalinity the more rapid the cleaning.

The common metals cleaned fall into the following groups –

1. Steel
2. Copper, brass, nickel, silver and other copper based alloys, magnesium and its alloys.
3. Zinc based alloy, tin and tin alloys.
4. Aluminium.

For alkaline cleaners a welded tank is normally used. Plastic lined, rubber lined, or also plastic or fibre glass tanks can also be used, subject to temperature limitations.
Small components may be immersed in a basket or barrel.Larger components are suspended from overhead C-hooks or similar.

The process can take the form of either a 'dip' or a 'spray' process. In ultrasonic cleaning the penetrating power of the cleaner is accelerated by using high frequency sound waves. TX system burners are ideally suited to the heating of alkali cleaning tanks. Usually mild steel heat exchangers will suffice.

Pickling

The term 'pickling' refers to the process of cleaning in acid, usually for the purpose of removing oxide or scale.

Articles which have been drawn, pressed or spun from bright cold rolled sheet without anodising retain their bright finish and require little or no pickling, but parts that have been heat treated may have scale or oxide which must be removed from the surface before the next operation.

Descaling may either be affected by pickling or shot blasting.

Sulphuric acid is commonly used for the pickling or descaling of iron, steel, copper, brass, nickel, silver and other copper alloys.

The acid may be contained in a lead lined or rubber lined welded steel tank.

TX heating systems can be used for heating pickling tanks provided the heat exchanger material is carefully selected in consultation with the end user and chemical supplier. Tanks containing hydrochloric acid are not usually suitable for heating using the TX system.

Care must be taken externally to the tank to ensure that acid vapours are adequately removed so that corrosion of burners, gas trains and electrical controls is avoided.

Phosphating

Phosphate coatings have a wide field of applications in manufacturing industry as an aid to mechanical production operations and in surface finishing.

Three main types of phosphate are utilised -

Zinc Phosphate
Iron Phosphate
Manganese Phosphate

The major applications for phosphate treatments are :-

a) the pre-treatment of surfaces to be painted or powder coated in order to provide improved coating adherence.

b) for protection against atmospheric corrosion.

c) to provide resistance to wear, scuffing and to aid running-in on rotating or sliding surfaces.

d) to act as a lubricant as a production aid in cold metal working operations such as cold forming and wire drawing where the treatment

- eliminates metal to metal contact.
- cushions the metal surface thus reducing the possibility of scoring or scratching.

- provides a surface which retains the oil or lubricant in place so that it flows with the metal during the forming process.
- enables a 'drawing' operation to run at a faster speed.

Phosphating can take place in either 'dip' or 'spray' plants. Conveyor spray and dip phosphating plants also incorporating the associated cleaning and rinsing stages, are in wide use throughout manufacturing industry for the processing of components prior to the painting of consumer durables such as washing machines, etc.

Immersion phosphate treatments may be undertaken with the articles mounted on jigs or racks. Small components may be carried in baskets or barrels.
Spray phosphating is used for rapid and lighter coating processes. The articles to be processed are mounted on jigs or individually hung and carried by conveyor through a 'tunnel' which incorporates the various pre-treatment stages. In many cases the conveyor ultimately carries the product on to a drying stage where there may well be further application areas for LANEMARK burner equipment. Each process stage incorporates a number of jets arranged on risers. The solution after spraying returns through ducts in the tunnel floor back to the liquid holding tank.

THE HEAT LOSSES FROM THESE APPLICATIONS ARE OFTEN DECEPTIVELY HIGH. PLEASE REFER TO SECTION 2.1.1 FOR A DESCRIPTION OF THE SURVEY REQUIREMENTS FOR SPRAY SYSTEMS.

Tanks for zinc and manganese phosphates are usually constructed from stainless steel (grade 316 - EN58J). Iron phosphate can be contained within mild steel tanks.

PHOSPHATING PROCESSES CAN PRODUCE SLUDGE AND/OR SCALE WHICH

A) BUILDS UP ON THE TANK FLOOR
B) ADHERES TO HEAT EXCHANGER SURFACES.

HEAT EXCHANGERS MUST THEREFORE BE -

A) POSITIONED ABOVE THE ANTICIPATED SLUDGE LEVEL.
B) BE ACCESSIBLE FOR CLEANING WITHOUT REMOVAL.

IF STAINLESS STEEL HEAT EXCHANGERS ARE USED IT MAY BE APPROPRIATE TO POLISH THE OUTSIDE SURFACE (EITHER MECHANICALLY OR PREFERABLY BY ELECTROPOLISHING) SO THAT CLEANING IS MADE EASIER (USUALLY BY MEDIUM/HIGH PRESSURE WATER JET, RUBBER OR WOODEN HAMMER/SCRAPER).

(No hard implements should be used for cleaning polished pipes as once 'scratched' the polishing process is rendered ineffective and 'stronger' scale adhesion will result).

Chromating

Chromate treatments are applied to aluminium and zinc surfaces to provide an effective base for organic coatings and to improve the overall protective value of the coating system.

Chromate treatments are applied to steel, tin, copper and brass to render the surface passive and thus more resistant to corrosion or tarnishing.

Due to the wide variety of chromating chemicals and processes that can be used, it is not possible to comment on likely heat exchanger pipe material requirements and therefore particular attention to this detail must be made when a heating proposal is under consideration.

2. TREATMENTS

Anodising

Anodising provides a protective and decorative film on aluminium.

The anodising process is usually either based on sulphuric, chromic or oxalic acids which are used as electrolytes within an electrolytic oxidation process.

Following pre-treatment, the principle heat load in an anodising process comes at the final 'Sealing' stage. Heating of the electrolytic solution is not usually required. (Should there be a requirement - refer to Electroplating Section). Boiling water is the usual method used to seal anodised aluminium. Distilled or deionised water is often utilised. Sealing water is contained within stainless steel tanks which require careful temperature control at 100 deg.C. It is therefore usual to incorporate accurate electronic temperature controls as part of the process heating system.

Electroplating

Electroplating is a process whereby an electrolytic deposition of a metallic coating takes place on to a base material, for decorative, protective and functional purposes. Typical deposits include cadmium, chromium, copper, nickel, tin, zinc, gold and silver.

The design and construction of electroplating plant is very critical due to the corrosive nature of many of the solutions used and because 'stray' electric currents can readily accelerate corrosion in materials which are normally resistant.

Tanks for acid plating solutions are generally made of rubber-lined or plastic-lined steel, plastic or glass fibre.

Heating electroplating tanks using the TX system requires that the tanks be of sufficient size to justify the capital expenditure. Many electroplating installations utilise small tank arrangements.

The selection of heat exchanger pipe material is critical, as is the mounting position within the plating tank.

Generally the heat exchanger pipes should be located between the anodes and the tank wall. The pipes may be constructed from mild stainless steel, titanium, zirconium, or other specialist alloys. A specialist chemist (usually employed by the electroplater) should advise on the suitable material selection, its thickness and mounting position. He should also specify the gasket material which should be employed. Due to the aggressive nature of the chemicals concerned it is important to ensure that there will be no serious contamination to the external burner components (i.e. burner, gas train and electrical controls) from vapours. (Adequate room ventilation must be provided).

Wood and Plastic Finishing

Application for TX system heating in these market sectors are relatively few.

Each application should be reviewed on its own merit with particular attention being paid to chemical type and hence heat exchanger pipe material selection.

General comments included in the metal finishing pre-treatment and treatment sections apply.

3.2.2 FOOD & DRINK

The scope of the application of TX burner systems in the food and drink industries fall into three categories.

1. To heat liquids that are to be used for the washing of utensils, bottles, crates, floors, etc.

2. To heat liquids that are used in the pre-treatment processes prior to final production such as for pig or chicken scalding.

3. To heat liquids that are used in the actual food or drink production process, e.g. water for boiling, blanching, brewing; oil for frying etc.

   Traditionally these processes have generally been heated by steam or hot water.However, there is now a considerable movement towards decentralisation away from central boiler supply arrangements and in the interests of efficiency and operational flexibility.

Individual TX burner systems offer these advantages and provide a close temperature control capability which is often another major consideration.

Water based applications present few problems. However care must be exercised when heating other liquids, such as cooking oils, where the heat exchanger pipe surface temperature must remain within specified limits so as to avoid any breakdown of the heated liquid. Specific guidance should be sought from LANEMARK engineers when tackling these more specialised heating projects.

The market opportunities are extensive and justify a structured selling approach to the various types of customer which exist in this sector.

3.2.3 <u>OTHERS</u>

Whilst being the third and 'general market area category' very many viable application opportunities exist outside the product finishing and food/drink market areas.

Probably of prime interest will be the scope to offer TX heating systems for the production of hot water wherever it may be required. Conversion of calorifiers or hot water storage vessels from steam or electric heating is becoming an important area for application. The only special consideration that must be made is to the potential problem of heat exchanger pipe scaling in hard water areas. However such scaling will be equivalent or less than that to be expected when utilising a steam coil. Particular attention also needs to be paid to the access limitations which will exist for the installation, assembly or subsequent removal of heat exchanger pipes. (Please remember that internal flanged connections can be used with TX burner systems provided access is available for final assembly).

3.3 CUSTOMER TYPES

The following types of customer, specifying authority or influencing authority exist in all market areas.

1. The end user
2. The installation contractor
3. The consulting engineer
4. The original equipment manufacturer (OEM)
5. The gas supply utility.

3.3.1 THE END USER

A. Product Finishing

Manufacturing companies who have their own product finishing processes will provide a significant customer base for TX system sales.

Such companies usually employ capable works engineering staff who are able to suggest opportunities and are therefore able and willing to liaise on equipment layout design proposals.

Energy conservation and operational flexibility are seen to be important factors when considering either a change of heating system to an existing piece of plant (a retrofit) or when specifying the design criteria that should be included within a new product finishing facility. Works engineers will often require assistance with the preparation of a financial justification which has to be submitted to company accounting management.

Information supplied by the TxCalc^{TM} heat loss and heat exchanger design program will enable these running costs and capital cost assessments to be accomplished quickly and efficiently.

Specialist metal finishing companies tend to fall into two categories depending on size and area of specialisation.

1) The larger and more specialist finishing company will operate in a similar manner to the general manufacturing company described above, but with particular attention being paid to running costs which are understood to be of vital importance to their operations.

2) The smaller specialist finishing company is often rather more difficult to work with as they often seek the simplest and cheapest methods of heating (e.g. electric) from a capital cost viewpoint, even though the running cost arguments are quite apparent!

B. Food and Drink and Others

Food, drink and other process industry end users are generally well able to quantify their heating requirements but will require guidance concerning the various application areas which are potentially suited to TX burner systems due to the current domination of the industry by steam/hot water arrangements.

3.3.2 THE INSTALLATION CONTRACTORS

Some end users rely on the advice and guidance of contractors who regularly provide installation capabilities.

Installation contractors can therefore influence the equipment selection decision.

The type of installation contractor can vary from the small company (sometimes with a plumbing or limited heating and ventilating industry background) to the largest specialist process heating installation concerns. The range of experience with the use of TX type equipment will consequently vary accordingly.

3.3.3 THE CONSULTING ENGINEER

The larger type of new process engineering project may utilise the services of a consulting engineering company. It can be an advantage to be able to offer the TxCalc^{TM} design program to consultants in the hope that your assistance will be remembered (and rewarded!).

3.3.4. THE ORIGINAL EQUIPMENT MANUFACTURERS (OEM)

The OEM is a very important client base. OEM's range from small companies who work almost on a 'jobbing shop' basis for local manufacturing companies (including food and drink) to the large OEM's who specialise in certain produce areas of metal finishing pretreatment plants, food industry crate washing machines and so on.

The particular attraction of the OEM sector is that once 'specified' the TX burner system would enjoy repeat orders with little further design assistance requirements. However the competition will be fierce and OEM sales will require the smallest contribution margins.

3.3.5 THE GAS SUPPLY UTILITY

Natural gas, and LPG utilities often have strong links with their customer network. It is true that some utilities take more of an interest in the equipment used by their customers than others. However the local gas utility companies should see the TX system as an opportunity to 'tie' the end user to a gas load which is not possible with central boiler systems where fuel changes frequently occur.

Enlightened gas utility companies may therefore assist with the location of suitable end user companies and may even offer facilities to send direct mail shots to selected customers by SIC code using their 'billing databases'.

3.4 TX COMPETITIVE ANALYSIS

3.4.1. INTRODUCTION

For a general overview of the tank heating 'market' refer to Section 1.1 and 1.2 where the respective advantages and disadvantages of alternative tank heating methods are discussed.

Specific statements of advantages and disadvantages follow for :

(a) Large diameter immersion pipe systems using atmospheric burners.
(Specific example : Eclipse '1B' and 'ES' series)

(b) Large diameter immersion pipe systems using forced draught burners.
(Specific example : Eclipse 'IP' series)

(c) Small diameter immersion pipe systems using forced draught burners.
(Specific example : Eclipse 'IJ' series)

(d) LANEMARK TX small diameter immersion pipe system using induced draught burners.

3.4.2. LARGE DIAMETER IMMERSION PIPE SYSTEMS USING ATMOSPHERIC BURNERS

The LANEMARK TX tank heating system operates into heat exchangers (or immersion pipes) which can be at 1.5" to 6.0" nominal bore and achieve efficiencies in excess of 80%.

Alternative so called large bore tank heating systems require pipe diameters of 4" to 12" to accept similar gas input ratings which are in practice usually designed to operate at efficiencies less than 70% due to the practical limitations associated with the installation of 'long' large diameter piping within working process tanks.

Advantages

a) Relatively inexpensive burners but immersion pipes can be expensive if constructed from materials other than mild steel.

Disadvantages

a) Immersion pipes are expensive if constructed from materials other than mild steel.

b) Often utilise permanent pilot flames.

c) Should only be used for small tanks and low heat input duties i.e. upto 88 kW (300,000 Btu/h net).

d) Number of pipe bends very limited as pressure drop must be negligible.

e) Gas flame is directly visible and accessible. Not suited to modern factory safety standards.

f) Individual flues required for each burner system: large diameter and therefore expensive.

g) Immersion pipe and tank cleaning often difficult due to space occupied by heating system.

h) No computer aided design service such as LANEMARK TxCalc™ program

i) High surface temperatures at tank entry point and along initial length of immersion pipe. Can cause chemical breakdown or excessive sludge/scale formation. Also system mounting to rubber lined, plastic or glass fibre tanks is not possible.

3.4.3. LARGE DIAMETER IMMERSION PIPE SYSTEMS USING FORCED DRAUGHT BURNERS

Advantages

Relatively inexpensive burners but immersion pipes can be expensive if constructed from materials other than mild steel.

Disadvantages

Generally as listed for atmospheric burner systems except that gas flames are not directly visible or accessible and permanent pilot flames are not often utilised.

Also forced draught burner systems operating into large diameter pipe arrangements can have unacceptable noise levels.

3.4.4. SMALL DIAMETER IMMERSION PIPE SYSTEMS USING FORCED DRAUGHT BURNERS

Advantages (compared with large bore systems)

a) Immersion pipes occupy less tank space and therefore pipe and tank cleaning is easier.

b) Efficiency can be 80%+

c) Immersion pipes are relatively inexpensive.

Advantages (compared with LANEMARK TX induced draught small bore systems)

None.

Disadvantages (compared with large bore systems)

a) Burner system is relatively expensive but -

l. Compensated by increased operating efficiency.

2. Smaller tanks can be used for process, enabling the user to maximise the productivity of available floorspace.

3. Less chemicals required - can be significant.

<u>Disadvantages</u> (compared with LANEMARK TX induced draught small bore systems)

a) Burner system is expensive.

b) Can require large combustion chamber (typically 800 mm long by 250 mm diameter for a 4" n.b. system) which has the following implications.

1. Tank hole drillings need to be large and numerous – can be difficult especially in tanks constructed from harder grades of stainless steel.

2. Occupy valuable tank working area.

3. High surface temperature close to tank entry point - can cause chemical breakdown of excessive sludge/scale formation. (Note : Eclipse as a result exclude certain solutions from possible application list). Also a weld is required close to burner at end of combustion chamber to fix immersion pipe - can be under excessive thermal stress.

c) High gas and air pressures required to achieve equivalent ratings.

d) Heat exchanger piping must slope continuously downward towards exhaust outlet and provision made to drain condensate.

e) Can be prone to resonance.

f) Number of individual immersion pipe legs restricted by gas pressure/air pressure requirements.

g) Gas and air controls must be linked.

h) No computer aided design service such as LANEMARK RDS.

i) Exposed HT and flame rectification connection.

3.4.5 SMALL DIAMETER IMMERSION PIPE SYSTEM USING INDUCED DRAUGHT BURNERS (LANEMARK TX System)

<u>Advantages</u> (compared with large bore systems)
See Section 3.4.4. above.

<u>Advantages</u> (compared with forced draught small bore systems)

a) Burner system is less expensive.

b) No combustion chamber required - can fix to rubber lined plastic or glass fibre tanks and intrusion into tank working area is minimal.

c) Small tank hole drillings.

d) Relatively low gas pressures required. Increased combustion air fan duties do not increase gas pressure requirements.

e) No need to slope or orientate heat exchanger piping to permit draining of condensation.
Suction fan will exhaust any condensation.

f) Number of individual immersion pipe legs relatively unrestricted for most tank heating applications.

g) Gas and air control can be linked to maximise efficiency.

h) TxCalc™ computer program.

1. Calculates all heat losses.
2. Models anticipated performance of alternative burner/heat exchanger arrangements.

i) Multiple burner systems can operate with a common flue.
Some scope for horizontal flue runs sometimes necessary to gain access to outside wall. (Consult LANEMARK for specific guidance).

j) Low maintenance costs. No moving parts on burner housing.

k) Rugged construction with no exposed operating parts or electrical connections.

<u>Disadvantages</u> (compared with large bore systems)

See Section 3.4.4. above

<u>Disadvantages</u> (compared with small bore forced draught burner systems).
None.

APPENDIX 1

LIQUID HEATING ENQUIRY FORM

TANK HEATING ENQUIRY FORM **LANEMARK INTERNATIONAL LTD**

Company **Contact Name**

Address **Position**

Phone

Fax

Date **E-mail**

Process Line **Tank Identification**

Dimensions **Length** **m/mm/ft** **Width** **m/mm/ft** **Depth** **m/mm/ft**

Insulation

Yes		**No**	

Thickness **mm/in**

Top Surface

No lid		**Lid**		**Ball blanket: Single layer**		**Double layer**	

Lip extract (1 side)		**Lip extract (2 sides)**		**Rate**	**m^3/h cfm**
Other (specify)					

Contents

Description of liquid **Density (if known)**

Supplier (where applicable) **Specific Heat (if known)**

Operation

Heat up time required **hrs** **Operating temperature** **ºC/ºF**

Hours of operation: **From** **to** **Days of week in operation**

Product Throughput

Weight of material passing through tank per hour **kg/lb/ton**

Type of material

Weight of carriers, tracks etc. passing through tank per hour **kg/lb/ton**

Carrier material

Incoming temperature of product/carrier **ºC/ºF**

Solution Make-up

Amount of solution supplied to make-up losses **litres/h** **galls/h**

Incoming temperature **ºC/ºF**

Other Losses **(e.g Spray losses)**

Description **Pump rate** **litres/h** **galls/h**

Heat Input Required **kW Btu/h**

Existing System

Type

Steam, gas, oil or electrical consumption for this tank (if known):

Supplies

Fuel	**Natural Gas**		**Propane**		**Butane**		**Other**
	Pressure	**mbar/bar/in w.g/psi**					

Main Electrical Supply	**V ph Hz**	**Control Electrical Supply**	**V ph Hz**

Plant Sketch

Reason for considering change of heating system (where applicable) and any other comments

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APPENDIX 2

TYPICAL TxCalc ^{TM} PRINTOUTS

TxCalc™ **Loss calculations**

Licensed to New Company for use by New User (Demo use only)

Printed on 27/04/00, at 19:07

Project reference	: Example01	Project description	: Test Case
Customer reference	: SA01	Customer name	: Any Company Limited
Customer location	: Any Town		
Design reference	: 003	Design description	: Dip Tank (2)
Design date	: 27/04/00		

Rectangular tank

Tank length	3,000 mm	Tank width	1,500 mm	Tank depth	1,500 mm	Tank volume	6,750 litres
Liquid temperature	70 °C	Solution	1.00	Liquid depth	1,250 mm	Liquid volume	5,625 litres

Minimum ambient temperature 10.00 °C

						Losses	
Wall insulation	50 mm					Wall loss	2.7 kW
Top surface	Air			Air velocity	0.00 m/s	Top loss	18.3 kW
Make up	2.00 litre/min			Temp. in	10 °C	Make up loss	8.4 kW
Throughput....			**Material**				
Product weight	2,000.00 kg/h	Sp. Heat	0.12 Ms	Temp. in	10 °C	Product loss	16.7 kW
Carrier weight	500.00 kg/h	Sp. Heat	0.12 Ms	Temp. in	10 °C	Carrier loss	4.2 kW
Other loss....							
Type -		Flow	0.00 litre/min	Temp. diff.	0.0 °C	Other loss	0.0 kW

Equilibrium -
(Gross CV @ 80%)

Net	50.3 kW
Gross	62.8 kW

Warm up loads -
(Gross CV @ 80%)

Start temp.	10 °C	From cold	1,413,063 kJ
Warm up time	4.0 h	Net gas load	114.9 kW
		Gross gas load	143.6 kW

No. of burners	1	Burner rating	150.0 kW

TxCalc™ **Heat exchanger design**

Licensed to New Company for use by New User (Demo use only)

Printed on 27/04/00, at 19:07

Project reference	: Example01	Project description	: Test Case
Customer reference	: SA01	Customer name	: Any Company Limited
Customer location	: Any Town		
Design reference	: 003	Design description	: Dip Tank (2)
Design date	: 27/04/00		

Rectangular tank

Tank length	3,000 mm	Tank width	1,500 mm	Tank depth	1,500 mm	Tank volume	6,750 litres
Liquid temperature	70 °C	Solution	1.00	Liquid depth	1,250 mm	Liquid volume	5,625 litres

No. of burners	1	Model - TX30				Burner rating	150.0 kW
Nom. bore	3"	Pipe type	UK Ms				
Outside dia.	3.496 in	Inside dia.	3.177 in	Thickness	0.160 in		

Exchanger data

Pass No.	Length	Bend type
1	2,500 mm	180° Long
2	1,500 mm	180° Long
3	1,500 mm	180° Long
4	1,500 mm	180° Long
5	1,500 mm	180° Long
6	2,500 mm	None
Total	12,795 mm	inc. bends

Flue gas temperature	199 °C	
Anticipated efficiency	81.4%	
Average heat flux	34,202 W/m²	
Maximum heat flux	120,108 W/m²	@ 2,589.8 mm inc. bends
Max pipe temperature	117 °C	
Pressure drop	29.51 mbar	

Note: The first and last heat exchanger coil passes must be constructed to terminate in a BSP male threaded pipe connection 75 mm longer than shown above. This will extend outside the vessel walls and accomodate the burner head and exhaust damper threaded pipe connections.
All elbows are to be as shown above.

TxCalc™ **Heat exchanger design**

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Project reference	: Example01	Project description	: Test Case
Customer reference	: SA01	Customer name	: Any Company Limited
Customer location	: Any Town		
Design reference	: 006	Design description	: Vertical cylinder - set rate
Design date	: 27/04/00		

Vertical cylinder tank

		Tank dia.	2,000 mm	Tank height	2,500 mm	Tank volume	7,854 litres
Liquid temperature	100 °C	Solution	1.00	Liquid depth	2,000 mm	Liquid volume	6,283 litres

No. of burners	1	Model - TX40			Burner rating	300.0 kW
Nom. bore	4"	Pipe type	Sched. 40			
Outside dia.	114.30 mm	Inside dia.	102.26 mm	Thickness	6.02 mm	

Exchanger data

Coil - diameter 1,734 mm Pitch 185 mm Height 740 mm

Turn No.	Length	Coil type
1	5,949 mm	One Turn
2	5,451 mm	One Turn
3	5,451 mm	One Turn
4	5,949 mm	One Turn
Total	22,799 mm	

Flue gas temperature	197 °C	
Anticipated efficiency	81.5%	
Average heat flux	9,470 Btu/h/ft²	
Maximum heat flux	87,739 W/m²	@ 1,117.6 mm
Max pipe temperature	134 °C	
Pressure drop	39.64 mbar	

Note: The first and last heat exchanger coil passes must be constructed to terminate in a BSP male threaded pipe connection 100 mm longer than shown above. This will extend outside the vessel walls and accomodate the burner head and exhaust damper threaded pipe connections.
This length may need to be adjusted slightly to allow for the angle of entry/exit.

TxCalc™ **Fan selection calculations**

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Printed on 27/04/00, at 20:16

Project reference : Example01
Customer reference : SA01
Customer location : Any Town

Project description : Test Case
Customer name : Any Company Limited

Burner and Fan details

Design Ref	Burner No.	Burner Rating kW	Pressure drop mbar	Flue gas temp. °C	Fan group	Model	Power kW	Excess Press mbar
001	1	100.0	19.6	193	A	24/300DF	4.0	6.5
002	1	200.0	49.4	195	A			
003	1	150.0	25.9	190	A			
004	1	100.0	29.1	200	B	24/300DF	4.0	14.5
005	1	120.0	41.4	189	B			
006	1	300.0	39.6	197	C	24/150DF	2.2	14.8
007	1	230.0	21.2	198	B			