

**ENGINEERING
SERVICES**

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WITCH PIPE SUSPENSION EQUIPMENT

1.0 APPLICATIONS ENGINEERING SERVICES

A well designed support system is highly critical for safe and efficient operation of the plant.

Carpenter & Paterson maintains offices in the UK to permit direct interface with consultants, engineering companies and utilities utilising our design service.

To be cost effective and to minimise costly site modifications, early participation of trained Pipe Support engineers and designers has proved to be an invaluable aid to assure timely recognition of potential problems. Carpenter & Paterson, through their strategically located design offices, offer **complete analysis, design and detailing services for application and selection of pipe support, restraint devices and structural members.**

1.1 APPLICATION ENGINEERING

This activity offers a wide range of design capabilities in the field of pipe support drawings. Our staff consist of experienced engineers and draughtsmen who have handled various National and International projects. The main task of the group is the selection of location, function of the supports and the preparation of the final installation drawings.

1.1.1 Design and Detail Package

We are able to undertake a comprehensive design and detail service for a wide range of Pipe Support systems associated with the Power Generation, Petrochemical, Oil, Gas and related industries.

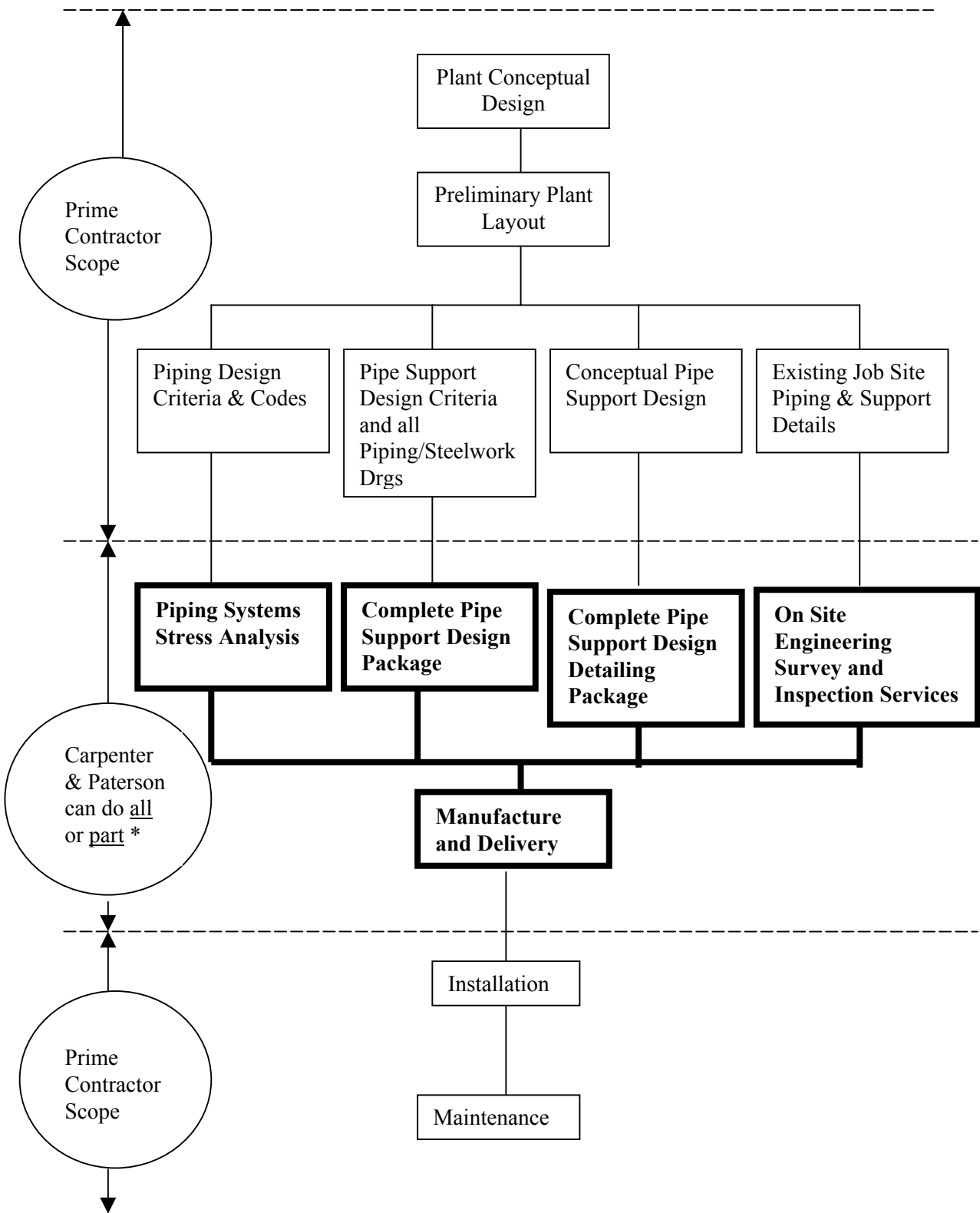
Typical of information required from the client would be:-

- Pipe work General Arrangement Drawings
- Steelwork General Arrangement Drawings
- Pipe Temperatures
- Pipe Materials
- Pipe Support Specification
- Other relevant information

From the details, Carpenter & Paterson would calculate and provide:-

- Support Positions
- Support Loads and Movements
- Support Designs
- Fully detailed design drawings
- Material take off lists

DESIGN ENGINEERING SERVICES OVERVIEW



* Based on requirements of Prime Contractor

1.1.2 Detailed Design Package

Providing the hardware package forms part of the scope of supply, then Carpenter & Paterson are able to provide the detailed design of the Pipe Support assemblies at no extra charge.

In this instance, we would expect the client to provide the following information:-

- Pipe Support Conceptual Design
- Support Loads and Movements
- Support Positions
- Pipe Temperatures
- Pipe Materials

For this information, we would provide fully detailed engineering drawings of each supports, complete with material lists.

Internally, this department provides technical support to applications engineering and is responsible for developing engineering standards for the production group.

1.2 OTHER IN-HOUSE ENGINEERING ACTIVITIES

1.2.1 Piping Engineering

- a) ANSI B31.1, B31.3, B31.5, CAESAR II, **PIPING STRESS ANALYSIS** as well as various European standards which include:-
 - Thermal Analysis - analysis for free and restrained thermal growth conditions
 - Dead weight Analysis - analysis at ambient temperature with a system of hangers at specific locations to support the weight of the system, for allowable stress and reactions at equipment connections
 - Seismic Analysis - either equivalent static or dynamic analysis
 - Wind Load Analysis - equivalent static stress analysis
 - Transient Analysis - for various transient loading conditions such as turbine trip, pipe whip, safety relief valve trip, etc.
- b) Piping Support System Optimisation
The company's long experience in pipe support analysis engineering enables optimisation of piping restraint systems as well as hanger optimisation.

- c) **Special Field Services**
Experienced engineers observe and evaluate piping vibration problems. Such problems, usually caused by flow induced vibrations or transient loadings, would also result from inadequate supporting of the piping system.
- d) **Job Specification Consultation**
The company's experience and expertise is available for the development of design specifications and standard catalogues for any aspect of piping engineering.

1.2.2 Structural/Mechanical Engineering

- a) Pipe hangers, restraints, anchors - design and analysis in compliance with various code and safety provisions such as ANSI B31.1 code, etc.
- b) Vibration control and suppression - design/selection of devices to control vibrations or to absorb shock loadings.
- c) Design review - either of one aspect or an entire design, leading to correction/modification of un-acceptable conditions.
- d) Material and structural testing - testing of mechanical properties of materials and experimental stress analysis on prototype and scaled structural models.

1.3 "Witch-Hanger" Pipe Support Design Program

Introduction to "Witch-Hanger"

Since 1991, Carpenter & Paterson have provided customers with Variable and Constant Effort Spring Selection Software upon request. This software (entitled Vecesel) provided a user friendly and time-saving program for the selection of spring units.

Due to the program's popularity, and customer feedback, it was evident that a more sophisticated and broader based software package was required. As a result, the Carpenter & Paterson Witch-Hanger Graphical Pipe Support Design Program was developed in-house to eliminate the conventional method of producing complete pipe support assembly drawings and detail sketches by hand.

"Witch-Hanger" was designed for use on single or multi-user systems, and can also be linked to most CAD systems. The program uses a comprehensive database of Carpenter & Paterson and BS 3974 components, and the user friendly menu control and help facilities ensure that design engineering costs can be substantially reduced. The program is available **FREE OF CHARGE** - please contact our head office for full details.

1.4 Computer Aided Design (CAD)

A computer graphic system is available to provide the following:-

- 1.4.1 Automated design of standard component type supports using tables and calculations in computer memory.
- 1.4.2 Computer assisted design of special structures with automatic structural member selection
- 1.4.3 Automated production of drawings; including detailed list of material, job instructions and specification
- 1.4.4 Automated minor design and drawing revisions, quick response for major design revisions, via instant recall of former level data and criteria.

2.0 SITE INSPECTIONS AND SURVEYS

2.1 During the late 1970's and the early 1980's, requests for technical assistance associated with engineered products increased significantly. These requests were a result of the dramatic increase in the size and overall magnitude of piping system projects, boilers, ducts and related components.

The nuclear industry brought even greater demands on pipe supports and associated technology and plant designs approached 1300 megawatts and the inclusion of pipe supports as “**safety related**” items also impacted technical requirements.

Piping systems and various other station equipment subsequently became far more dependent on pipe support products to accommodate thermal expansion, equipment loadings, abnormal operating occurrence and even natural disaster such as earthquakes and high winds.

To meet the increased demand for service requests and technology, Carpenter & Paterson expanded their in-house capabilities in the following areas involving pipe supports and piping, along with a variety of inspection techniques.

- Inspection and testing of pipe supports including regular and periodic inspection along with troubleshooting of unique problems associated with operating occurrences.
- Integrity analysis and inspection of piping systems.
- Snubber technology including installation, maintenance, testing and repair of hydraulic snubbers as well as mechanical snubbers.
- Provide photographs of critical and/or typical situations.
- Project management of pipe support system projects including supervision, installation and material receipt coordination.
- Training and service are also provided for all able mentioned items,
- **Notes on Pipe Supports and general information is shown within this document.**

If you require additional information or know someone who would like to receive information about our service then please contact us.

2.2 **Pipe Support Inspection Guidelines and Consideration**

In general the overall integrity and performance of pipe supports have been ignored once installed and exposed to service conditions.

Unfortunately, many problems associated with incorrect support performance can go unnoticed unless regular and periodic inspections are performed. Furthermore, many of the problems which do eventually develop are long term in nature and are also generally not traceable to the supports, unless proper care and inspections are part of an active ongoing program.

Example of problems that can develop as a result of poor support performance include the following:

- Undesirable elevation changes in steam lines which can alter the piping pitch and the ability to remove condensate from various locations. Water hammer and flashing are common problems which can result.
- Failures in various branch lines as a result of binding in strategic locations from unanticipated elevation changes (sagging).
- Cracking in girth welds and end connections as a result of bending moments which develop as a result of unanticipated restrictions of stresses within the piping system.

In recent times the various industries have become more aware of the above factors and the overall importance of pipe supports, particularly those installed on high energy piping systems. However, much confusion remains over the proper inspection procedures and methods that should be followed.

Whether or not an inspection program is being performed for the first time or involves an ongoing process, some type of control, planning and rules must be followed to ensure a minimum and acceptable level reliability – basically this can be achieved in four steps.

2.2.1 Anticipate results: this phase would include a review of design information in order to understand the concepts used to support the equipment, pay particular attention to the types of supports installed, and also note cases or locations involving the special application of standard products.

2.2.2 The actual inspection:

The inspection should actually be performed in to phases:

- first phase involves a review of the supports in their operating position
- second phase would be performed cold, after the piping or equipment has had sufficient time to cool
- record on an appropriate form for all readings from flexible type supports as compared to design
- rigid supports, restraint control, devices, and snubbers should also be inspected along with incorporating appropriate settings

- the overall position of the equipment should be noted in addition to evidence of damage to connected equipment, insulation and structural members

2.2.3 Compare inspection results with this anticipated

Not only is this phase essential for immediate comparisons, but historically the information will prove to be quite valuable. Furthermore, the reliability of one time or in depth inspections associated with the supported equipment can be enhanced.

2.2.4 Corrective action or subsequent steps

Include adjustments, structural repairs, engineering studies, material replacement, operational changes or continuation of inspections. In addition to the basic items outlined above, consideration must be given to the wide range of factors which can impact performance, these include related both to the supports themselves and the support of equipment such as:

- Design
- Installation
- Fabrication
- Service exposure

2.3 **General information and facts**

The following involves general and specific information for pipe supports and inspection consideration.

- ANSI/ASME B31.1 has recognised the need for guidelines involving piping and pipe support inspection. Additional comments and information can be found in Appendix ‘V’. This is a non-mandatory section of the Code and first appeared in the 1986 issue as a result of the industry demands for information.
- Additional information on the inspection of the pipe supports can be found in the Manufacturers Standardisation Society (MSS-SP-89), “Pipe Hangers and Supports Fabrication Installation Practise”.
- Adjustment of hangers upon their condition alone should be discouraged. Wherever possible, establish the cause between discrepancies in scale readings and design setting.

2.4 Riser clamp inspection and design consideration

During the periodic inspection of pipe supports, attention is generally directed to the flexible type supports and associated indicator/load readings. Often overlooked are other strategic components such as pipe clamps. Of particular importance to the overall integrity of piping support systems are the riser type clamps installed on high energy pipes.

Depending upon service requirements and design conditions, riser clamps can generally be supplied in two separate configurations.

- Locations for low medium load (standard clamps)
- Locations for those supports having loads with critical applications. Characteristics for those clamps are the gusset plates welded at the press points.

Although riser clamp failures are rare, they have occurred. Additionally, various degrees of distortion can develop which impact hanger adjustment and the slope/elevation of the piping.

During periodic inspection of pipe supports, consideration must be given to critical pipe supports and riser clamp integrity.

The following items should be taken into account during these inspections or evaluations:

- Non-uniform loadings can develop when the hanger rods are not positioned in the middle of the clamp halves, in some instance this significantly increases stresses in one clamp half.
- Make note of “point” contact development between the shear lugs and clamps, consider shimming or repositioning the clamp at the locations where the conditions are severe.
- Perform routine and regular non-destructive examination of strategic supports including rigid rod hanger. Although complete inoperation is desirable, particular attention should be directed at clamp half press point and the section below the shear lugs.
- Make note of the alignment of shear lugs around the circumference of the pipe with respect to the centre line of the clamp, ideal positioning requires lugs place 90 degrees apart and 45 degrees off the axis of the clamp halves.
- Replace clamps which exhibit signs of distortion and which could cause elevation changes in the piping systems, at locations where distortion is severe, the drainage of the system can be affected.

2.5 **General facts and information**

The total weight of the clamp including stops, spacers and nuts must be considered when sizing flexible supports.

Fabrication tolerances acknowledge the permission variations allowed per the applicable ASTM specification for various pipe designs.

When determining load requirements for new clamps or verification calculations, acknowledge temporary loads such as hydrostatic and turbine trip out loads on appropriate systems.

If you require additional information or know some one who would like to receive information about our services, please do not hesitate to contact us.

On Site Labour

Any services provided during the effective period of the agreement

Weekdays (regular 8 hours)	}	Prices to be agreed between Carpenter & Paterson/Client dependant upon site services required.
Overtime	}	
Saturday	}	
Sunday or holiday	}	
Travel	}	
In-House engineering	}	

Expenses

All travel – and living expenses will be invoiced as cost price.

Reports

The report will include overall assessments, support readings, service records, recommendations, record sheets and details of critical areas and situations. In addition to detailing the existing conditions and corrective actions necessary, these reports are also useful as a planning and preventive maintenance tool.

Materials

Replacement material including hardware assemblies or single/double units will be quoted on an as needed basis.