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**PIPELINE ABANDONMENT STUDY**

**DRAFT REPORT**

By

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## **MANAGEMENT SUMMARY**

In some existing offshore fields around the world, reservoirs are becoming depleted. As production in the older areas becomes marginal and less revenue generating, operators will continue to face new challenges and strategy decisions related to pipeline abandonment, but at an ever increasing frequency.

Some pipelines, particularly in the Gulf of Mexico, have been in service, underwater at various depths, from 20 to 40 years. The continual public pressure over concerns about pipeline safety and the possible environmental damage hazards coupled with governmental legislative responses in the past few years have brought a new meaning to "economically feasible."

The operator's strategy, when it is time to abandon a subsea pipeline, will be formulated by decisions involving:

- Personnel
- Safety
- Governmental regulations - local and international
- An engineered plan for abandonment submitted to the controlling government/agency
- Location and depth of the line
- Size and service of the line
- Required equipment to perform the planned method of abandonment
- Overall cost justification

The method of abandonment may vary from leaving the pipeline in place to complete removal of the line and returning the seabed to its original natural state.

The consensus of most all of the governmental agencies and operators in the offshore (depths greater than 15 feet) world will allow and prefer to leave pipelines in situ upon abandonment. This position is allowed only if the abandoned pipeline:

- Is flushed to remove any hydrocarbon content, filled with seawater or other inert material, and has the ends capped and the ends buried.

- Will not present any future hazard to navigation, the ecology of the sea or seabed, or to any other user of the sea.
- Or if, in the opinion of the controlling government, there is less damage to the ecology of the seabed to leave the line in place than to completely remove it.

In consideration of costs to abandon a pipeline, the factor may be ten times or more to remove the line from the seabed than to leave it properly prepared in-place.

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## **1.0 INTRODUCTION**

### **1.1 General Introductory Comments**

The operating life of offshore and subsea pipelines is finite, and the economic justification for these is determined by the production platform(s) that were initially installed and by the subsequent number of pipeline and flowline tie-ins. The condition of the pipeline and its integrity for remaining in service is affected by the nature of the fluids transported in the pipeline and by the maintenance that has been provided since its installation.

As offshore fields mature and the production (from the platform wells) declines, more and more operators will be facing the decision to continue operating the platform and pipeline, abandon the platform and continue operating the pipeline, or abandon both. The pipeline operator will eventually have to decide to deactivate or abandon the line in a manner which prevents damage to the environment and avoids other liabilities, such as creating hazards to the fishing and shipping industries or restricting the access or right of way to other pipeline operators.

The management and technical staff of the operating company will be concerned with different issues when evaluating the disposition of offshore pipelines. Management is typically concerned with regulatory requirements, safe practices, trends and costs. Engineers and operating personnel are also concerned with regulatory requirements, but are interested in available methods and equipment, as well as the experience level of contractors and suppliers.

The alternatives for disposing of offshore pipelines may include the following methods and equipment:

- Employ a derrick barge, or some other vessel with heavy lift capability, to lift and cut the pipeline into sections for disposition onshore or in ultra-deep waters.

- Abandon the pipeline in place by capping the ends and jetting these ends and sections of pipeline deep into the seafloor.
- Temporarily abandon the pipeline by flushing and injecting treated seawater with inhibitors to preserve the line. This may also involve installing pressure-containing end caps where platform risers or other pipelines have been removed.

According to MMS records, over 2,800 pipelines or pipeline segments in the Gulf of Mexico have been reported by operators as abandoned in various categories of status. The Louisiana office of Conservation estimates that there are approximately 4,000 miles of abandoned pipelines in the offshore waters of Louisiana alone. While there has not yet been a significant number of lines that have been decommissioned or abandoned in the UK, Norwegian, Danish, and German sectors of the North Sea, the past two years have brought about a great movement toward simplification and unification of regulations and policies that will govern international waters concerning pipeline abandonment.

## **1.2 Objective**

The objective of this project has been to summarize and evaluate industry regulations, practices and precedents, and experiences in abandoning pipelines in key offshore regions, and to provide some guidelines for selecting the most cost effective alternative for typical cases.

## **1.3 Scope**

The project scope in this report includes:

- Geographical Offshore Regions
  - Gulf of Mexico
  - U.S. West Coast

- North Sea
- Contacts and Sources of Information and Data have come from:
  - Trade Journals and Conference Proceedings and Papers
  - Governmental Agencies
    - U.S. Federal (MMS/DOI, OPS/RSPA/DOT, FERC/DOE, USCG, and COE)
    - GOM States (Texas - RRC, GLO, and TNRC; Louisiana - DNR and CMD; California - SLC)
    - North Sea Countries (UK - DOE & IMO; Norway - NMIE & IMO; Denmark - SA & IMO; Netherlands - MOF & IMO)
- Pipeline Operators and Oil and Gas producers
- Equipment Suppliers
- Project Activities have included:
  - Review government records, regulations, and recommended practices since 1987;
  - Survey and interview operators, contractors, and equipment suppliers;
  - Gather and compile information and data, including cost information where available; and
  - Summarize and evaluate the feedback and data.

## **2.0 SUBSEA PIPELINE ABANDONMENT - BACKGROUND TO CURRENT DECISIONS AND POLICIES**

### **2.1 Discussing the Regulations**

#### **2.1.1 Gulf of Mexico/Texas and Louisiana**

This part of the report will begin with the regulations concerning offshore pipeline operations in the Gulf of Mexico (GOM), since this area of pipeline network represents possibly the greatest longevity and concentration of seafloor usage of any place in the world.

Since the federal government began leasing the Outer Continental Shelf (OCS) for exploration and production of hydrocarbons in 1954, the technological progression of development for platforms and pipelines (facilities), has moved from onshore to nearshore and now to deep water in excess of 3,000 foot depth. As would be expected, the majority of earlier gas and oil pipelines were laid in shallow waters, generally less than 15 feet deep. In the years from 1950 to 1965, less than 200 miles of subsea pipelines were installed per year; from 1965 to 1975 an average of 600 miles per year were installed, and from 1975 to 1985 an average of 800 miles per year were installed. A sharp decline in pipeline installation was seen in 1986 and 1987, but from 1988 to 1993 averages have climbed to over 1,000 miles per year. In these past five years the number of pipelines has decreased while the length of lines increased indicating facilities/installations have moved farther from shore, some out greater than 150 miles, into much deeper water.

#### **The Greatest Concern is With the Older Pipelines in Shallow Water.**

It is estimated that there are more than 3,800 production platforms

and more than 22,000 miles of pipelines associated with these facilities in the GOM OCS region. Given the fact that over 97 percent of all GOM OCS liquid hydrocarbon production and 100 percent of all GOM OCS natural gas production is transported to shore by pipeline, the public and state and federal government concerns over pipeline safety and environmental damage are receiving priority attention.

Some 9,000 miles of the above references pipelines have been installed in OCS waters for periods of 19 to 44 years, much beyond their intended design service life.

Several serious pipeline accidents in the Gulf of Mexico and in the North Sea in 1987 and 1989 spurred added emphasis on legislating new amendments, at the federal level, to the Natural Gas Pipeline Safety Act of 1968 and the Hazardous Liquid Pipeline Safety Act of 1979.

### **Texas Adopts Federal Regulations Into Its Pipeline Safety Rules.**

The basic rules and regulations governing offshore pipeline operations and safety include the guidelines for the inevitable pipeline abandonment decisions. These safety regulations are shared by the Office of Pipeline Safety (OPS) in the Research and Special Programs Administration (RSPA) within the Department of Transportation (DOT) and the Minerals Management Service (MMS) within the Department of the Interior (DOI).

The Railroad Commission of Texas (RRC), as part of its safety enforcement program, adopted the federal standards promulgated and administered by the RSPA/OPS/DOT contained in Title 49, Code of Federal Regulations, Part 192 (49 CFR 192) and Part 195 (49 CFR 195). In addition, the Railroad Commission issued more stringent standards which are set forth in Title 16, Texas Administrative Code, Sections 7.70-7.73 and 7.80-7.87 (16 TAC §§ 7.70-7.72 and 16 TAC §§ 7.80-7.87).

The Railroad Commission of Texas published its "Pipeline Safety

Rules" in a compilation of state and federal rules and regulations governing the transportation of natural gas (49CFR192) and hazardous liquids (49CFR195) by pipeline within the state of Texas, see appendix Ref. No. 8. For more detail regarding federal rules as adopted by Texas RRC, see paragraph 2.1.3 in this section and section 3.4 later in the report.

Offshore pipeline abandonment, therefore, in Texas/Gulf of Mexico waters is governed by the RSPA/OPS 49CFR192 and 195 which in essence states in section 192.727 for gas pipelines: (a) operators shall provide an operating and maintenance plan for abandonment or deactivation of pipelines, (b) each pipeline abandoned in place must be disconnected from the gas supply, purged of gas, filled with water or other inert materials and sealed at the ends (see Appendix Ref. No. 8b.)

For hazardous liquid pipelines in Texas/GOM offshore, Section 195.402, as of April, 1993, the RRC of Texas Pipeline Safety Rules (49 CFR 195) only addresses the requirement for an operations, maintenance, and emergencies procedural manual. Sub-section 195.402(c) requires a procedure for each of 13 items to provide safety during maintenance and normal operations. Item (10) in this sub-section requires a procedure for "abandoning pipeline facilities, including safe disconnection from an operating pipeline system, purging of combustibles and sealing abandoned facilities left in place to minimize safety and environmental hazards" (see Appendix No. 8e).

### **MMS Jurisdiction Now Includes Offshore Pipelines in State and Federal Waters**

It is important to realize at this point, that the RRC of Texas adopted the Federal Code Title 49, Parts 192 and 195 for rules on pipeline safety. As can be seen in the above paragraphs, the present code does not address pipeline abandonment with a great deal of detail.

Of further importance, the Memorandum of Understanding issued as a notice, by the Minerals Management Service (MMS) under the

Department of the Interior (DOI), February 17, 1994 redelegates and expands MMS' responsibilities of jurisdiction for offshore facilities, including pipelines (see Appendix Ref. No. 13a). In the understanding, "offshore facility" includes facilities of any kind located in, on, or under navigable waters or the United States.

In the redelegation process, MMS retained the jurisdiction of facilities, including pipelines, located seaward of the coast line, except for deepwater ports.

The RSPA/DOT (rules adopted by Texas RRC) was redelegated responsibility for transportation-related facilities, including pipelines, located landward of the coast line, and deepwater port.

The "coast line" in these jurisdictional responsibilities means "the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters.

With this understanding, the MMS now has jurisdiction over pipelines in state and federal waters in the GOM, the West Coast, East Coast and Alaska, etc. The divisional boundary being the coast line.

In addition to any state rules, regulations or statutes, the MMS will administer the Code of Federal Regulations 30, Parts 250-254 for oil and gas operations in the Outer Continental Shelf (OCS) and in state waters. See Paragraph 2.1.3 in this section and 3.4.1 in Section 3.0 for more detail on MMS regulations.

### **Louisiana Has Its Own Rules For Pipeline Abandonment in State Waters**

The Louisiana Department of Natural Resources, through its Coastal Management Division, issues Coastal Use Permits based on the rules (Standard Permit Conditions, Nov. 9, 1993) governing oil and gas operations in state waters.

The permittee/lessee is obligated to comply with the abandonment requirements as stated in the Standard Permit Conditions, wherein, "All structures, facilities, well and pipelines/flowlines occurring in open water areas or in oilfield canals or slips shall be removed within 120 days of abandonment of the facilities for the herein permitted use unless prior written approval to leave such structures in place is received from the Coastal Management Division and the Louisiana Department of Wildlife and Fisheries. This condition does not preclude the necessity for revising the current permit or obtaining a separate Coastal Use Permit, should one be required, for such removal activities.

"Site clearance of abandoned oil and gas facilities located in Louisiana State waters is also subject to authorization by the Office of Conservation pursuant to La. R.S. 30:4(J). The Site Clearance and Verification for Abandoned Oil and Gas Structures Regulations became effective December 20, 1992. The Pipeline Division, within the Office of Conservation is the designated regulatory agency for this regulation" (see Appendix Ref. No. 6).

The Site Clearance and Verification for Abandoned Oil and Gas Structures Regulations are administered by the Pipeline Division under the Office of Conservation in the Department of Natural Resources and states that "all abandoned well and platform locations shall be cleared of all obstructions present as a result of oil and gas activities unless otherwise approved by the commissioner of conservation.

Sites located in water depths greater than or equal to 5 ft. below mean tide level but less than 200 ft. shall have their location verified clear over 100 percent of their limits which can vary from 1,320 ft. radius to 400 ft. radius from the platform or well center. Trawling is the preferred method, however, there are no restrictions to be placed on the trawling procedure or trawling grid pattern for abandoned pipelines. It is the responsibility of the lessee (or operator) performing the site clearance verification activities to contact the former pipeline owner (or operator) and determine whether or not the line will cause an obstruction to unrestricted trawling operations. For more detail on Louisiana Rule, see

Appendix Ref. No. 7.

## **2.1.2 West Coast/California**

The State law and regulations of California specifically address the lease terms in State oil and gas leases on State tide and submerged lands as the controlling conditions of pipeline and/or facilities abandonment.

Section 6804.1 in Division 6 of the California Public Resources Code provides that a lessee may at any time make and file with the State Lands Commission, a written quitclaim or relinquishment of all rights under any lease, with the stipulation that the lessee is to place all wells on the lands to be quitclaimed or relinquished, in condition for suspension or abandonment "in accordance with the applicable lease terms and regulations" (see Appendix Ref. No. 1).

Section 2124 in Title 2 of the State Lands Commission (SLC) regulations expands the terms of the lease agreement requirements, stating: "Each lease shall provide that at the expiration of the lease or sooner termination thereof the lessee shall surrender the premises leased, with all permanent improvements thereon, in good order and condition, or, at the option of the commission and as specified by the commission, the lessee shall remove such structures, fixtures and other things as have been put on the lease by the lessee, all removal costs to be borne by the lessee (see Appendix Ref. No. 2).

Further to the SLC regulations in Section 2125, Article 3.2 pertains to oil and gas operations on State oil and gas leases located on state tide and submerged lands and applies to operations conducted from mobile and fixed offshore structures. In addition to complying with the California Code and regulation shown above, the lessee must also comply with all the applicable laws, rules and regulations of the United States, the State of California, and its Division of Oil and Gas, Department of Fish and Game, Division of Industrial Safety, the State Water

Resources Control Board, the Regional Water Quality Control Boards and the California Coastal Commission.

### **2.1.3 U.S.A., Federal Regulations**

This section of the report will cover just those regulations pertaining to pipeline abandonment and those agencies which promulgate and administrate the rules specific to abandonment.

The Minerals Management Service (MMS) in the Department of the Interior (DOI) is the primary federal agency responsible for implementing the national policy through regulation of oil and gas exploration, development, and production activities and facilities on the Outer Continental Shelf (OCS). The regulatory objective of the MMS is to promote operator safety during operations offshore and see that marine and coastal environments are protected. Other agencies that share some of the responsibilities for regulating offshore development include the Office of Pipeline safety (OPS), U.S. Coast Guard (USCG) and the U.S. Army Corps of Engineers.

The Office of Pipeline Safety is in the Research and Special Programs Administration (RSPA) under the Department of Transportation (DOT). Both MMS/DOI and OPS/RSPA/DOT promulgate and administer Codes of Federal Regulations, as noted earlier, Titles 30 CFR, Chapter II and 49 CFR, Chapter I, Subchapter D, respectively.

In using these codes and Federal Regulations, it is important to note that the Code of Federal Regulation is kept up to date by the individual issues of the Federal Register. These two publications must be used together to determine the latest version of any given rule.

In Section 2.1.1 of this report describing regulations relating to the states contiguous to the Gulf of Mexico, it was noted that all state and federal waters are now under the jurisdiction of the MMS concerning offshore facilities, including pipelines.

### **MMS Issues Notice of Redefined Jurisdictional Offshore Boundaries**

The MMS issued a notice, dated February 17, 1994, in the Federal Register/Vol. 59, No. 39/Monday, February 28, 1994, of a memorandum of understanding (MOU), establishing jurisdictional responsibilities for offshore facilities, including pipelines, which became effective February 3, 1994 (see App. Ref. No. 13a).

The MOU divides the responsibilities associated with oil-spill prevention and control, response planning, and response equipment inspection for offshore facilities. The MOU is among the DOI, DOT, and the Environmental Protection Agency (EPA), and will hopefully eliminate overlapping responsibilities of as many as four Federal agencies for some coastal facilities.

The coast line marks the boundary that determines which agency is responsible for an offshore facility. "Offshore Facility" continues to be defined to include facilities of any kind located in, on, or under navigable waters of the United States.

The MMS/DOI is responsible for offshore facilities, including pipelines but not deepwater ports, located seaward of the coast line.

The EPA is responsible for non-transportation-related offshore facilities located landward of the coast line.

The RSPA and USCG of the DOT will be responsible for transportation-related offshore facilities, including pipelines, located landward of the coast line.

### **MMS Rules for Pipeline Abandonment**

The MMS regulates operators of pipelines through the basic rules issued in 30 CFR, Chapter II (MMS/DOI), Subchapter B- Offshore, Part 250 - Oil and Gas and Sulphur Operations in the Outer Continental Shelf, Subpart J - Pipelines and Pipeline Rights-of-Way:

**§250.150 General Requirements**

- (a) Pipelines and associated valves, flanges, and fittings shall be designed, installed, operated, maintained, and **abandoned** to provide safe and pollution-free transportation of fluids in a manner which does not unduly interfere with other uses in the Outer Continental Shelf (OCS).
- (b) An application shall be submitted to the Regional Supervisor and approval obtained prior to the installation, modification, or abandonment of a pipeline which qualifies as a lease term pipeline and prior to the installation of a right-of-way pipeline or the modification or relinquishment of a pipeline right-of-way. For more details on the general requirements and applicable definitions see Appendix Ref. No. 13.

**§250.156 Abandonment and Out-of-Service Requirements for DOI Pipelines**

- (a)(1) A pipeline may be abandoned in place if, in the opinion of the Regional Supervisor, it does not constitute a hazard to navigation, commercial fishing operations, or unduly interfere with other uses in the OCS. Pipelines to be abandoned in place shall be flushed, filled with seawater, cut, and plugged with the ends buried at least 3 feet.
- (2) Pipelines abandoned by removal shall be pigged, unless the Regional Supervisor determines that such procedure is not practical, and flushed with water prior to removal.
- (b)(1) Pipelines taken out-of-service shall be blind flanged or isolated with a closed block valve at each end.
- (2) Pipelines taken out-of-service for a period of more than 1 year shall be flushed and filled with inhibited seawater.

- (3) Pipelines taken out-of-service shall be returned to service within 5 years or be abandoned in accordance with the requirements of paragraph (a)(1) or (2) in this section.

To review the rules of pipeline safety associated with abandonment and regulated by the RSPA/OPS/DOT found in 49CFR Parts 192 and 195 see Sections 2.1.1 and 3.4.2 in this report.

#### **2.1.4 United Kingdom and North Sea States**

From the beginning of oil and gas exploration and production on the United Kingdom Continental Shelf (USCS), the UK Government was concerned with the continued existence of offshore facilities once they had run their course of useful life. The original emplacement of offshore platforms and subsea pipelines was and will continue to be approved under the Coast Protection Act of 1949 with consent given by the Secretary of State. The consent was given with the condition that the site of activity would be cleared to the satisfaction of the Secretary of State when the platform or pipeline is abandoned. The Secretary of State could also impose any conditions of abandonment of wells through the model clauses incorporated in exploration and production licenses which were required for oil or gas well operation after the platforms and pipelines were in place. There has always been an argument regarding the extension of policy and enforcement from the abandonment wells to platforms and pipelines serving the wells.

The UK Government attempted to cover the missing aspects of abandonment legislation with the passing of two policy instruments: The Petroleum and Submarine Pipelines Act of 1975 and The Petroleum Act of 1987.

The earlier Petroleum and Submarine Pipelines Act of 1975 introduced the concept of "Works Authorizations", one of which related to pipeline abandonment and is given in the Submarine Pipeline Guidance Notes issued by the Department of Energy. These guidance notes set out that "Measures to prevent disused pipelines from becoming

a navigational or fishing hazard or a source of pollution may include:

- (a) Removal of the pipeline.
- (b) Cleaning the interior of the pipeline.
- (c) Sealing the ends of any part of the pipeline left in situ".

The works authorization implies that abandonment of a pipeline means to no longer use the line, with no plans to re-use, rather than to relinquish ownership for another's use. It also gives the Secretary of State the right to serve notice on the holder of the authorization specifying steps to be taken "to prevent the pipeline from being or becoming a hazard to navigation or fishing or a source of pollution."

### **The key to UKCS Abandonment Policy - The Petroleum Act 1987**

The Petroleum Act 1987 is the current key to policies concerning the abandonment of offshore pipelines and facilities on the UK Continental Shelf. The Act does not contain specific standards or a minimum list of activities for each abandonment case, but it enables standards to be prescribed in the form of regulations to be made by the Secretary of State for Energy.

The major provisions in the Act are listed here as most relevant to pipeline abandonment and will:

- Enable the Secretary of State to require the submission of costed abandonment program for all offshore pipelines and installations;
- When the abandonment program is approved, to ensure that it is carried out;
- In the event of failure to submit or carry out an abandonment program to enable the Secretary to carry it out and recover the costs from those persons given notice to submit a program;

- Enable the Secretary of State to make regulations relating to abandonment in order to prescribe standards and safety requirements, prevent pollution, provide for inspection, and the determination of fees.

For more information on the rules and regulations concerning Pipeline Abandonment see Section 3.5.1 later in this report and Appendix Reference Nos. 28, 29, 30, 53, 56, 57, 58 & 72.

### **UK and Other North Sea States Adopt International Maritime Organization (IMO) Guidelines**

The International Maritime Organization (IMO) guidelines have been developed mainly on the requirements of safe submarine navigation and are directed towards the removal of offshore platforms, not subsea pipelines. The guidelines have been adopted by the UK and the European user countries of the North Sea, but these States have yet to define specific policies on the steps of abandonment for submarine pipelines. The following other countries are listed with their basic policy of abandonment.

- **Norway**

The Royal Norwegian Ministry of Industry and Energy through their Petroleum Act requires a "closing-down plan" which shall contain the licensee's proposal for future disposal of facilities including pipelines and will, with a special permit issued, require pipelines to be kept in place. The Norwegian Government generally accepts proposals invoking the USA experience that petroleum will be drained from the pipeline and it will be filled with seawater and plugged (see Section 3.5.2 and App. Ref. No. 32).

- **Denmark**

The Subsoil Act forms the legal basis for petroleum operations in Denmark and provides through a "Model License for Exploration and

Production of Hydrocarbons" allowing the Danish Government to acquire free of charge, facilities at the time of disuse. However, if the government does not wish to acquire the facility, it may demand partial or complete removal (see Section 3.5.3 and App. Ref. No. 32).

- **The Netherlands**

The Netherlands Continental Shelf Act empowers the Ministry of Finance to issue regulations concerning offshore installations. The ministry may order that corroded or dangerous pipelines be repaired or removed, if they constitute a safety hazard for shipping or fishing. The current regulations contain rules for periodic inspection of pipelines for the above determination (see Section 3.5.4 and App. Ref. No. 32).

### **1990 Protocol to the Kuwait Convention and International Provisions for Pipeline Removal**

Article XIII of a Protocol to the Kuwait Convention has been adopted by the Contracting (Member) States around the North Sea and contains provisions for the removal of pipelines.

The Protocol concerning marine pollution from offshore operations on the continental shelf obliges each Contracting State to require that upon abandonment, pipelines be flushed to remove residual pollutants and that state governments have discretionary power to require operators to take whatever additional steps are considered appropriate.

Under the Article, in the case of a pipeline, each Contracting State shall ensure that the competent state authority has the power to require the operator of an offshore installation to:

- 1) Flush and remove any residual pollutant from the pipeline; and
- 2) Bury the pipeline, or remove part and bury remaining parts thereof, so as to eliminate for the foreseeable future any risk of

hinderance to navigation or fishing, taking all circumstances into account.

Also, see Section 3.5.5 of this report and App. Ref. No. 28.

## **2.2 Pipeline Industry Compliance/Methods**

### **2.2.1 Gulf of Mexico and the U.S.A.**

From the beginning of the pipeline industry in the 1860's, oil was first transported by pipeline; then natural gas pipelines started in the 1940's, with a tremendous expansion of systems throughout the U.S. in the 1950's and 1960's. At the time of this rapid growth in the mid-1950's, pipelines moved offshore into shallow waters along the Gulf of Mexico.

Unfortunately, it was not until the mid-1960's that the public and government became concerned over safety when several devastating natural gas pipeline ruptures got the attention of congress and the industry. As a result of this need for safety legislation, the Natural Gas Pipeline Safety Act was passed in 1968.

In the period of years since 1968, the public outcry for safety, environmental protection concerns in all areas, and demands for stronger legislative regulations by which industry must operate has set the stage for difficult business decisions in the future.

As of 1993 there were approximately 22,000 miles of pipelines in the Gulf of Mexico OCS with about 1,000 miles being added per year. The ongoing safety concerns with some 9,000 miles of these pipelines being installed for periods of 20 to 40 years has prompted recent legislation for pipeline surveys and periodic inspections to continually evaluate the condition and safety operation of these lines.

## **When Abandonment Decision Time Comes**

Pipeline operators in the GOM OCS and other areas of the Outer Continental Shelf controlled by U.S. Governmental agencies will for various reasons need to make abandonment decisions when:

- The reservoir area is depleted,
- Inspection of the pipeline indicates replacement is necessary,
- Pipeline systems need engineering changes to re-route transportation for better economics and/or tie-in to new field development, or
- The repair of pipeline segments is necessary in cases of material failure, outside impact, or seafloor shift/support.

The categories of abandonment are many; brought about by industry's choosing the most economical strategy to take, considering personnel, safety, regulatory and environmental rules, the competitive oil and gas business of the time in question, the field location (shallow water or deep water, coastal zone or miles of open space), and possible uses of the pipelines in future development in the same or adjacent fields.

The Minerals Management Service (MMS) data base, detailed in Section 4.0 of this report tracks as many as 12 different categories of "abandoned" pipelines or pipeline segments from information received from oil and gas companies operating in the GOM.

Using this MMS data base for non-producing pipelines in GOM as a historical basis, we see that industry thus far has made the following choices in some 2,900 cases listed.

- Abandoned: Left in situ, no desire to re-use 42%
- Combined: Pipeline or segment removed from current service and combined with other line(s) 10%

- Out-of-Service: Left in situ, properly prepared for re-use at a later date 22%
- Removed: Removed from the seabed and properly disposed of on shore 10%
- Other: Miscellaneous categories 16%

Throughout this study, the consensus of industry and regulatory agencies, state and federal, with possible exception of the fishing industry, concerning the abandonment of pipelines, is to leave the lines in place, if the proper steps are taken to prevent hazards to navigation and the environment involved with the seabed, coastal areas and the open sea habitat.

As required by state and federal statutes, the operator of any pipeline facility must as a minimum, apply to the regional director of the MMS with a plan of abandonment meeting all the criteria set forth by the basic rules contained in 30 CFR 250, Section 250.156 and listed below for reference.

Section 250.156 - Abandonment and out-of-service requirements for DOI pipelines.

- (a)(1) A pipeline may be abandoned in place if, in the opinion of the Regional Supervisor, it does not constitute a hazard to navigation, commercial fishing operations, or unduly interfere with other uses in the OCS. Pipelines to be abandoned in place shall be flushed, filled with seawater, cut, and plugged with the ends buried at least 3 feet.
- (2) Pipelines abandoned by removal shall be pigged, unless the Regional Supervisor determines that such procedure is not practical, and flushed with water prior to removal.
- (b)(1) Pipelines taken out-of-service shall be blind flanged or isolated

with a closed block valve at each end.

- (2) Pipelines taken out-of-service for a period of more than 1 year shall be flushed and filled with inhibited seawater.
- (3) Pipelines taken out-of-service shall be returned to service within 5 years or be abandoned in accordance with the requirements of paragraphs (a)(1) or (2) of this section.

Particular attention should also be considered in the abandonment strategy when complying with regulations for cover over pipelines required at various water depths from coastal regions (less than 12 feet) to the OCS (less than 200 feet).

Regulations from RSPA/DOT 49 CFR, Parts 192 and 195 require that all offshore pipelines in water 12 feet to 200 feet deep, measured from mean low tide, must be installed so that the top of the pipe is below the natural sea bottom.

All pipe installed under water less than 12 feet, as measured from mean low tide must have a minimum cover of 36 inches in soil or 18 inches in consolidated rock, between the top of the pipe and the natural sea bottom.

### **Costs for Pipeline Abandonment are Difficult to Define**

The varied strategies of subsea pipeline abandonment from in situ with a simple cut and plugging with an off-the-shelf plumber's plug to complete removal from the seabed requires a broad range of personnel and equipment. Couple this with a simple one-man diving operation in shallow water to the tasks involved with ROV operations in deep water for total removal of 80 foot segments of pipeline to barges and onshore disposal, the costs can grow tenfold or more.

If daily costs are \$5,000 to \$10,000 for shallow water abandonment

in place, then total removal operations for personnel and equipment may run \$50,000 to \$100,000 per day with 10 to 20 days involved in deep water locations depending on environmental conditions.

A very rough rule of thumb cost estimate from studies done in the North Sea indicates that the total 3,500 miles of pipeline (2,300 miles of 16" diameter and above, 1,200 miles of smaller diameter) would cost \$1 billion, 700 million for total removal, or \$486,000 per mile. To leave the pipelines in place after displacing the hydrocarbon content with water and protecting the subsea environment, the cost would be \$170 million or \$48,600 per mile.

## **2.2.2 UK Continental Shelf and International**

As mentioned in the previous section, the International Maritime Organization (IMO) guidelines for abandonment regulations are directed toward the removal of offshore platforms and do not yet define policies for subsea pipeline abandonment for the European user countries of the North Sea.

In the UK as with most of the other North Sea countries, each pipeline abandonment is considered on a case by case basis and requires the operating company to submit a plan or program for abandonment, to the Secretary of State or other head of state as each country may direct.

Recent meetings among various UK agencies and industries of concern regarding decommissioning of offshore pipelines have attempted to set out specific policies for abandonment so that North Sea operating companies can better plan the future financial obligations involved.

The UK Department of Energy commissioned John Brown Engineers and Constructors to study and examine the effects of pipeline abandonment on the environment, fishing, and other users of the sea. The ensuing report concluded that provided pipelines are properly

prepared for abandonment, adequately cleaned and filled with water, no ecological consequences are expected to be seen for a pipeline left on the seabed until such time when its physical disintegration takes place.

The Scottish Fisherman's Organization, however, maintains strong concerns with the John Brown study wanting complete removal of all unburied pipelines and associated debris following pipeline abandonment. The fishing industry does realize that this position is not always feasible due to technical and/or financial reasons.

The study report goes further in this regard in that even though the fishing industry utilizes large areas of the North seabed, dwindling fishing stocks and the effects of over fishing may eventually lead to significant reduction in bottom trawl fishing.

From the John Brown study and UK House of Commons Energy Committee meetings and report, operating companies have a basis upon which to draft their programs for abandonment when submitted to the Secretary of State.

The authors of the study have suggested among other future concerns, that:

- All pipelines should be decommissioned and thoroughly cleaned at the end of their operational phase. The activities should render the pipeline safe and in such a condition that if the contents are released at some time in the future, they will cause no threat to life or long term harm to the environment;
- If a pipeline is fully buried and the seabed is demonstrably stable then the pipeline may be left in situ full of water with the ends sealed;
- If a pipeline is fully trenched then providing that the pipeline, when it decays, will not be swept from the trench, the trench profile is such as to exclude trawl boards from it and the trench profile is

demonstrably stable, then the pipeline may be left full of water in situ with the ends sealed;

- If a pipeline is resting on the seabed then, if there is no fishing and there are no MOD concerns then the pipeline may be left full of water in situ with the ends sealed.
- In all other cases with a pipeline resting on the seabed, the pipeline should be either trenched or buried in the seabed;
- The process of long term pipeline burial should be the subject of periodic review.

In summary, regarding the UK pipeline industry position on self rule policies, the following is extracted from a memorandum submitted by the UK Offshore Operators Association Limited (UKOOA) to the energy committee, Wednesday 23 January 1991.

### ***Item 5 Pipeline Abandonment***

*In considering the abandonment programmes relating to the decommissioning of submarine pipelines, industry will be concerned to avoid pollution and the possible impact of the abandoned pipeline on navigation and other users of the sea. A minimum abandonment programme would include the displacement of hydrocarbons with water and leaving the pipeline in place. Filled with water instead of hydrocarbon, the submerged weight of the pipelines would be increased and its stability on the seabed improved. No longer under internal pressure and protected by its coat of reinforced concrete, it would remain inert on the seabed for a very long time. It would not pose a pollution problem.*

Other memorandums submitted by attending major oil company representatives during the same Energy Committee meetings contained the following policy statements regarding pipeline abandonment and are listed by company and statement brief.

**The British Petroleum Company plc****(b) Offshore Pipelines**

*There are three possible options for decommissioning of offshore pipelines:*

**(i) Clean and Flood**

*The pipeline is flushed through, filled with water, capped and left in situ.*

**(ii) Bury or Remove.**

*Those parts of the pipeline which cannot be buried are removed, the remainder is flooded, capped and buried in situ.*

**(iii) Total removal****Conoco (UK) Ltd.****2 Abandonment Method (Pipelines)****2.1 Pipelines**

*The oil and gas export pipelines would require to be fully decommissioned. This involves cleaning then dumping the residue to some collecting point followed by line flooding. The line can then be severed at the base of each platform and allowed to remain on the seabed. The riser can be removed in its entirety for later disposal as part of the jacket removal programme.*

**Mobil North Sea Limited****Pipelines**

*As part of the SAGE System, Mobil is currently installing a 180-mile long, 30-inch diameter gas export pipeline from Beryl Alpha to St. Fergus. This pipeline will also be connected to the Brae B and East Brae field platforms. In addition, Mobil operates a series of small-diameter interfield pipelines that are mainly located in the Beryl field. These are trenched to avoid any possibility of trawling gear fouling or interference. A number of these interfield lines are covered with dumped rocks to improve temperature installation as well as provide extra protection.*

*The UKOOA paper examines the effect of corrosion and dragging anchors on the long-term stability of pipelines. Mobil agrees with UKOOA's proposal that, after thorough cleaning and flushing, all lines should be left in place to avoid further disruption of the seabed.*

### **The Oil Industry International Exploration and Production Forum**

*With regard to abandonment of pipelines, the Forum believes that these can be left in place on the seabed after having been flushed, unless they are in an area of moving sands or bottom currents in which case they may have to be removed.*

### **2.2.3 Responses to Survey/Industry**

Even though the written responses from busy and often short-handed oil and gas company representatives contacted by letter with hopeful survey form returned were practically non-existent, follow-up telephone conversations reflected a definite pattern of industry policy regarding pipeline abandonment.

- Jan. 10, 1994, Telcon with Louisiana Department of Natural Resources, Coastal Management Division

*Their department keeps a record of pipelines in state waters and the status by permit applications. Once a permit for abandonment is issued, the operator has 120 days from notification to abandon and perform site clearance verification. Department does not generally inspect each abandonment, but uses the trawler verification report.*

*These policies have been in place 4 to 5 years and some lines prior to 1989 may have been abandoned in place. Their desire for complete removal comes from the fact that the majority of state coastal waters are 6 feet or less in depth.*

- Jan. 7, 1994, Telcon with California State Lands Commission

*The State Lands Commission has internal guidelines they follow when planning or approving a pipeline abandonment in state waters. Ideally, the ocean floor would be returned to its normal state upon abandonment, but actual experience has been different.*

*Not many pipeline abandonments have occurred, but all have been approached on a case by case basis, per the following SLC guidelines:*

- 1) *Pipelines on the beach and surf zone, from the high tide marker out to the 15 foot mean low water mark are almost always removed. Exceptions may be granted if the line is deeply buried.*
- 2) *Pipelines in deeper water than 15 feet are preferably removed. They consider each line, however, as to whether it will cause more damage to the seabed and surrounding environment to remove than to just leave in place, if there is significant marine growth in the area or if the seabed is mostly hard rock. The rocky bottom areas are not generally trawl fished.*

*Non-buried pipelines in sandy-bottom areas will generally be removed. The size of line may also dictate in these areas. Lines 4" diameter and larger are removed; smaller than 4" diameter may be left in place.*

*The percentage of pipelines abandoned in place has increased over the last 5 years, with the standard practice of pigging and flushing the line and being sure the line is stable in location and does not have a shoreline crossing. These are filled with seawater and have the ends capped.*

*Pipelines that cross the shoreline or are seen to be*

*unstable, but cannot be removed, are filled with grout.*

- Jan. 7, 1994 Telcon with Texas General Land Office

*Pipeline abandonments are generally reviewed when the easement for a particular pipeline comes up for renewal. Each line is handled on a case by case basis but generally the first preference by the GLO is to have the pipeline removed and the site cleared.*

*If the pipeline is buried, and unburying the line could cause damage to the environment, then they will allow the line to remain buried and abandoned. The main thing they look at when deciding whether a pipeline may remain in place is how much impact will removal have on the environment.*

*They do not currently have a formally published set of regulations and procedures but are in the process of writing these for publication.*

*In the event that a pipeline is allowed to be abandoned in place, then a "Perpetual Easement" is issued for that line at a reduced fee rate. The company who owns the pipeline maintains liability for the line as long as it exists.*

- Jan. 6, 1994, Telcon with Louisiana Department of Natural Resources, Office of Conservation

*Their office controls pipeline operations and has adopted the MMS & DOT regulations (30 CFR 250 and 49 CFR 192 & 195) as criteria for offshore pipelines. They have a Pipeline Safety Group which is similar to the DOT for state waters.*

*They do not have a comprehensive policy statement which spells out which regulations are applicable. They have*

*recently adopted a new regulation for site clearance. It basically says that any offshore structure that could be held as an obstruction must be removed upon abandonment. This does not include buried pipelines that can be shown to have a tendency to remain buried.*

- December 13, 1993, Telcon with Tenneco, New Orleans Office

*They average around 12 abandonments per year with a total of around 60-70 lines abandoned in the last 15-20 years.*

*Most of their lines are from platform to platform, so standard practice is to pig line between platforms to clear. They then cut ends and flood line, and plug off pipe ends with plumber's plugs. Ends of line are then buried if required.*

*Most of their abandonment has been done by hiring out divers and work barges themselves. Usually the work crews on site to remove platform and structures are too big and expensive, not cost-effective to use unless line is in deeper waters where saturation diving is required. Average cost is \$50K - \$60K.*

*Information on older lines from early 1970's through early 1980's is limited and difficult to trace. Sometimes the only information available is from handwritten notes.*

*Pipeline abandonment is normally a non-issue. Line is at the end of its life, procedure is a cost of doing business (i.e., non-revenue generating), and is pretty cut and dry.*

- December 3, 1993 Telcon with Chevron, New Orleans Office

*Contact has been involved with P/L abandonments for about*

*3 years. Not aware of a large amount of lines that Chevron has removed. They prefer to abandon in place whenever possible.*

*Lines are usually able to be abandoned in place, but if a line is not buried, where it could pose a problem to fishing, the line will probably have to be removed.*

*Typical process is to clean the line, fill it with seawater (treated water if line is out-of-service) and cap the ends with "plumber's plugs." Have not used HydroTech End Caps to date.*

*Factors that affect cost to abandon:*

- 1. Water depth*
- 2. Line Route*
  - a. Structure to structure (surface valves, risers)*
  - b. Structure to subsea tie-in (more diving work)*
- 3. Line service*
- 4. Line length*

*They have abandoned a line in a particular location and conducted a submerged tow of the line to a nearby location for commissioning and re-use.*

- *December 2, 1993 Telcon with Chevron, California Office*

*The California office has minimal experience with abandoned pipelines due to the fact that Chevron has so few lines (9) and platforms (4) on the West Coast. Stringent requirements on pipeline inspection include:*

- *External inspection every other year;*

- *Internal (smart pig) inspection every other year, alternating with external inspection;*
- *CP system inspection every year.*

*Guidelines from State Lands Commission prefer complete removal of abandoned lines, or alternatively, filling entire line with grout prior to abandoning in place.*

*SLC has allowed Chevron to clean pipe and cap the ends like in GOM for abandoned line, when it can be demonstrated that the line is not going to move or otherwise become unstable, or pose a hazard to fishing. Chevron is planning an abandonment, where they will grout fill the line at the shoreline crossing to the +15 foot water depth.*

### **3.0 REGULATIONS FOR PIPELINES/FACILITIES ABANDONMENT**

#### **3.1 State of California**

In the state of California, the State Lands Commission has the local jurisdiction responsibility over oil and gas lessee permits, operations and quitclaims or relinquishments of all rights under any lease pertaining to those operations on state oil and gas leases located on state tide and submerged lands. In accordance with State Law, Public Resources Code, Division 6, Para 6804.1 (see Appendix Reference No. 1), a lessee must file a written request to abandon the lease, but only "in accordance with the applicable lease terms and regulations." Those regulations, State Lands Commission Regulations, Title 2, Section 2124, regarding the "surrender of leased premises" (see App. Ref. No. 2), provide that at the end of the lease or lessee's request to abandon, the lessee shall surrender the premises leased, with all permanent improvements thereon, in good order and condition, or, at the option of the commission, all structures, fixtures and other things (pipelines) put on the lease by the lessee shall be removed with all costs to be borne by the lessee.

Article 3.2, Oil and Gas Drilling Regulations, Section 2125, pertains to operation on state leases located on State tide and submerged lands under the jurisdiction of the State Lands Commission and is applicable to operations conducted from mobile rigs, fixed offshore structures and upland locations. In addition to these regulations, the lessee must also comply with all applicable laws, rules and regulations of the United States and the State of California, Division of Oil and Gas, the Department of Fish and Game, the Division of Industrial Safety, the State Water Resources Control Board, the Regional Water Quality Control Boards, and the California Coastal Commission.

The above California regulations state that a lessee must file a written request to abandon the lease in accordance with the applicable lease terms (see App. Ref. No. 3). The California State Lands Commission provided a page to this report from their "Typical Lease Terms," which relates to the California position, when a lease terminates,

the lessee shall surrender the premises leased, with all permanent improvements thereon, or, at the option of the state and specified by the state, the lessee shall remove such structures, fixtures and other things as have been put on the leased lands by the lessee and otherwise restore the premises, all removal and restoration costs to be borne by the lessee.

In order to establish a base line of seafloor information, the California State Land Commission, in 1989, contracted Sachse Engineering Associates, Inc. to perform a seafloor hazards survey in California State Waters. The purpose of this survey was to locate, map and identify hazards to the local fishing interests (see App. Ref. No. 5). The State Lands Commission could use the identification and location of the hazardous objects as a decision basis to, wherever necessary and possible, oversee and specify their removal from the seafloor.

This particular survey was concentrated in the Santa Barbara Channel where the overall historical usage has been oilfield exploration and development, with special interest in possible seafloor oil and gas pipelines/valves being identified as hazardous to the local fishing community.

### **3.2 State of Louisiana**

In the State of Louisiana, pipeline and facilities abandonment is governed by the Site Clearance and Verification for Abandoned Oil and Gas Structures Regulations that became effective December 20, 1992 (see Appendix Reference No. 7). The Pipeline Division within the Office of Conservation is the designated regulatory authority for this regulation. The Office of Conservation is under the State of Louisiana, Department of Natural Resources. The Department of Natural Resources also has an Office of Coastal Restoration and Management whose Coastal Management Division is responsible for issuing permits regarding site clearance of abandoned oil and gas facilities located in Louisiana State waters (see App. Ref. No. 6).

From page 3, Standard Permit Conditions, November 9, 1993, Department of Natural Resources, Coastal Management Division, Para. 16.a, "All structures, facilities, wells and pipelines/flowlines occurring in open water areas or in oilfield canals or slips shall be removed within 120 days of abandonment of the facilities for the herein permitted use unless prior written approval to leave such structures in place is received from the Coastal Management Division and the Louisiana Department of Wildlife and Fisheries."

Excerpts from the Rule, Title 43, Natural Resources, Part XI, Office of Conservation - Pipeline Division, Subpart 2., Underwater Obstructions, Chapter 3., Section 301., Definitions:

"For the purpose of site clearance, a pipeline shall be considered any size or type of pipeline (including flowlines)."

State Waterbottoms are "State-owned lands lying beneath the territorial sea, arms of the sea and all waterbottoms that are navigable in fact within the Louisiana coastal zone."

Territorial Seas is that "Belt of the seas measured from the line of ordinary low water along that portion of the coast that is in direct contact with the open sea and the line marking the seaward limit of coastal waters, and extending three miles seaward as set by decree of the United States Supreme Court in 1975 as being the three-mile limit and all state-owned waterbottoms."

### **All Abandoned Locations On State Waterbottoms Shall Be Cleared**

In accordance with the rule, Section 311.E.1., "All abandoned well and platform locations on state waterbottoms in the Gulf of Mexico and adjacent bays and inlets shall be cleared of all obstructions present as a result of oil and gas activities unless otherwise approved by the Commissioner of Conservation." Abandoned well and platform locations are defined as follows: In territorial seas, it is the area covered by a 1,320 ft. radius circle from the center of the platform. In coastal waters,

it is the area covered by a 400 ft. radius circle from the center of the platform. For single wells in open water, it is the area covered by a 400 ft. radius circle centered on the well.

The sites described above, when "located in water depths greater than or equal to 5 ft. below mean tide level but less than 200 ft. shall have their locations verified clear over 100 percent of their area limits in open waters or the length of the location in restricted waters. Trawling is the preferred method of site clearance verification."

When trawling in areas where pipelines are known to exist, the following guidelines shall be followed:

- a) There are no restrictions to be placed on the trawling procedure or pattern for abandoned pipelines.
- b) In general, trawling should not be closer than 300 ft. to any existing pipeline.
- c) Active pipelines which are buried and with no above seabottom obstruction must be trawled without any restrictions placed on the trawling procedure or pattern.
- d) For unburied active pipelines, eight inches diameter or larger and for unburied smaller diameter lines with obstructions above bottom, trawling shall be carried out no closer than 100 ft. to either side and parallel to the line. Do not trawl across the line.
- e) For unburied active pipelines smaller than eight inches in diameter, which have no obstructions, trawling must be carried out in the direction of the line and trawling on top of the line is acceptable. Do not trawl across the line.

Note that in (a) above, abandoned pipelines must pass the no-snag trawling test in any direction and along top of line and on any size line, i.e., no trawling restrictions.

"All man-made objects encountered on the seabed which are known (or suspected) to be present as a result of oil and gas activities shall be removed from the seabed or other remedial action taken and reported, unless otherwise approved by the Commissioner of Conservation."

### **3.3 State of Texas**

Operators of oil and gas pipelines in the State of Texas and its adjacent Gulf of Mexico waters are bound to a set of minimum federal safety standards, CFR 49, Parts 192 and 195, and Title 16, Texas Administrative Code. The Federal Standards contained in Title 49, Code of Federal Regulations, Part 192 (49 CFR 192) have been adopted by the Railroad Commission of Texas as part of its pipeline safety enforcement program for the transportation of natural and other gas by pipeline. As the regulatory agency for pipeline safety in Texas, the Railroad Commission has also issued more stringent standards set forth in Title 16, Texas Administrative Code, Sections 7.70-7.73 (16 Tac §§7.70 - 7.73). These state and federal rules and regulations specifically governing the transportation of natural gas by pipeline within the State of Texas and its territorial waters are published as a compilation, "Pipeline Safety Rules and Regulations" by Transportation/Gas Utilities Division, Pipeline Safety Section, Railroad Commission of Texas.

The "Transportation of Hazardous Liquids by Pipeline" rules and regulations are also compiled by the Commission as adopted by the State of Texas in Title 49 of the Code of Federal Regulations, Part 195 (49 CFR 195). State adoption of these standards and promulgation of additional standards compatible with 49 CFR is provided in Texas Natural Resources Code, Sections 117.001 - 117.101. Consequently, the Railroad Commission of Texas adopted 49 CFR 195 and additional standards on September 16, 1985, becoming effective on October 8, 1985. These additional standards, as amended, are found in Title 16, Texas Administrative Code, Sections 7.80 - 7.87.

As reference to this report, the cover page and table of contents (App. Ref. No. 8) from the Commission's Pipeline Safety Rules and those pages of specific sections involved with jurisdictional boundaries, pipeline cover and pipeline abandonment will be discussed below.

### **Texas Regulations Affecting Abandoned Gas Pipelines**

From the Commission's Pipeline Safety Rules, Part II, Part 192, "Transportation of Natural and Other Gas by Pipeline: Minimum Federal safety Standards," Section 192.1(2) (See App. Ref. No. 8), this part 192 prescribes minimum safety requirements for pipeline facilities and the transportation of gas, including pipelines within the limits of the outer continental shelf as that term is defined in the Outer Continental Shelf Lands Act (43 U.S.C. 1331).

Part 192.1(b), this Part 192 does not apply to "Offshore gathering of gas upstream from outlet flange of each facility on the outer continental shelf where hydrocarbons are produced or where produced hydrocarbons are first separated, dehydrated, or otherwise processed, whichever facility is farther downstream."

According to Section 192.3, Definitions (see App. Ref. No. 8), the "Gulf of Mexico and its Inlets" means the waters from the mean high water mark of the coast of the Gulf of Mexico and its inlets open to the sea (excluding rivers, tidal marshes, lakes, and canals) seaward to include the territorial sea and Outer Continental Shelf to a depth of 15 feet, as measured from mean low water.

Remembering that these regulations are minimum federal safety standards adopted by the State of Texas, these definitions are as stated in the Code of Federal Regulations, Title 49, Parts 178 to 199, revised as of October 1, 1992.

Three other definitions that become pertinent to pipeline abandonment rules and jurisdictional boundaries are as follows:

"Offshore" means beyond the line of ordinary low water along that portion of the coast of the United States that is in direct contact with the open seas and beyond the line marking the seaward limit of inland waters.

"Hazard to Navigation" means, for the purpose of this part, a pipeline where the top of the pipe is less than 12 inches below the seabed in water less than 15 feet deep, as measured from the mean low water.

"Exposed Pipeline" means a pipeline where the top of the pipe is protruding above the seabed in water less than 15 feet deep, as measured from the mean low water.

Section 192.319(c) requires that "All offshore pipe in water at least 12 feet deep, but not more than 200 feet deep, measured from mean low tide, must be installed so that the top of the pipe is below the natural bottom unless the pipe is supported by stanchions, held in place by anchors or heavy concrete coating, or protected by an equivalent means."

Minimum cover over a submerged gas pipeline is shown in Section 192.327(e), "All pipe installed in any offshore location under water less than 12 feet deep, as measured from mean low tide, must have a minimum cover of 36 inches in soil or 18 inches in consolidated rock, between the top of the pipe and the natural bottom (see App. Ref. No. 8).

Sections 192.612 and 192.613 (see App. Ref. No. 8a) involve the regulations for "Underwater Inspection and Reburial of Pipelines in the Gulf of Mexico and its Inlets" and "Continuing Surveillance" of buried gas pipelines. The sections instructed each operator to conduct an underwater inspection of its pipelines in the Gulf of Mexico and its Inlets. The initial inspection had to be completed before November 16, 1992. If as a result of this or any inspection or by notification of any person, an operator discovers that a pipeline it operates is exposed on the seabed

or constitutes a hazard to navigation he is obligated to the following steps.

- 1) Within 24 hours of discovery, must notify the National Response Center.
- 2) Within 7 days of discovery, mark the location of the pipeline in accordance with 33 CFR Part 64, "Marking of Structures, Sunken Vessels and Other Obstructions" under the jurisdiction of the Department of Transportation, U. S. Coast Guard.
- 3) Within 6 months after discovery, place the pipeline so that the top of the pipe is 36 inches below the seabed for normal excavation or 18 inches for rock excavation.

#### **Abandonment or Inactivation of Facilities**

Section 192.727 contains the basic policy of Texas offshore pipeline abandonment as 49 CFR Part 192 was adopted verbatim by the Railroad Commission of Texas. A summary of these requirements include: (a) each operator shall provide for pipeline abandonment or deactivation in its operating and maintenance plan; (b) each offshore pipeline abandoned in place must be disconnected from all sources and supplies of gas; purged of gas; filled with water or inert materials and sealed at the ends; (c) each inactive (out of service, MMS category) offshore pipeline that is not being maintained under this part must be disconnected from all sources and supplies of gas; purged of gas, filled with water or inert materials and sealed at the ends (see App. Ref. No. 8b).

#### **Texas Regulations Affecting Abandoned Hazardous Liquids Pipelines**

From the Commission's Pipeline Safety Rules, Part III, Part 195, "Transportation of Hazardous Liquids by Pipeline," Section 195.1 (a) (see App. Ref. No. 8d), this Part 195 applies to pipeline facilities and the transportation of hazardous liquids including pipeline facilities on the

Outer Continental Shelf.

This Part 195 does not apply to the transportation of hazardous liquids in offshore pipelines which are located upstream from the outlet flange of each facility on the Outer Continental Shelf where hydrocarbons are produced or where produced hydrocarbons are first separated, dehydrated, or otherwise processed whichever facility is farther downstream.

The pipeline abandonment related definitions in this part for hazardous liquids are the same as in Part 192 for gas pipelines, i.e., "Gulf of Mexico and its Inlets", "Offshore," "Hazard to Navigation" and "Exposed Pipeline."

Section 195.246(b) describes the same installation criteria for offshore pipelines in water at least 12 feet deep but not more than 200 feet deep as in Part 192 for gas pipelines.

Section 195.248(a) (see App. Ref. No. 8d), provides that hazardous liquid pipelines must be installed so that the cover between the top of the pipe and the sea bottom complies with the following table:

LOCATION	Cover (Inches)	
	Normal Excavation	Rock Excavation <sup>1</sup>
Industrial, commercial and residential areas	36	30
Crossings of inland bodies of water with a width of at least 100 ft. from high water mark to high water mark	48	18
Drainage ditches at public roads and railroads	36	36
Deepwater port safety zones	48	24

Other offshore areas under water less than 12 feet deep as measured from the mean low tide	36	18
Any other area	30	18

(1) Rock excavation is any excavation that requires blasting or removal by equivalent means.

Section 195.402(c)(10), first, requires that each operator shall prepare and follow for each pipeline system a manual of written procedures for conducting normal operations and maintenance activities which will include a procedure for "abandoning pipeline facilities, including safe disconnection from an operating pipeline system, purging of combustibles, and sealing abandoned facilities left in place to minimize safety and environmental hazards" (see App. Ref. No. 8e).

Section 195.413 (see App. Ref. No. 8e) provides for "Underwater inspection and reburial of pipelines in the Gulf of Mexico and its inlets" for hazardous liquid pipelines. Section 195.413(a) instructed each operator to conduct an underwater inspection of its pipelines, except for gathering lines 4-inch nominal diameter or smaller, in the Gulf of Mexico and its inlets. The initial inspection had to be completed before November 17, 1992.

Note, this Part 195 does not address continued surveillance after November 16, 1992 for exposed pipelines. But, good safety practice would conclude that as a result of any inspection or by notification of any person, an operator discovers that a pipeline it operates is exposed on the seabed or constitutes a hazard to navigation he is obligated as in the case of Part 192, for gas pipelines to notify, mark and rebury per Section 195.413(b)(1)-(3).

### **Texas' Pipeline Safety Rules From Government Regulations**

The historical background to the above underwater inspection and reburial of pipelines in 49 CFR Parts 192 and 195 for offshore gas and

hazardous liquid pipeline facilities in the Gulf of Mexico and its inlets is shown on (Appendix Reference No. 10), page 63764, Vol. 56, no. 234 of the Federal Register issued December 5, 1991. The Research and Special Programs Administration (RSPA) under D.O.T. issued a notice of Proposed Rulemaking on April 29, 1991, proposing regulations to implement the immediate provisions of Public Law 101-599 which was enacted November 16, 1990 to conduct underwater inspections of pipelines in shallow waters in the Gulf of Mexico and its inlets.

Amendments to 49 CFR Parts 192 and 195 from the enactment of public law 101-599 are summarized below and form the basis for "Abandoned Pipeline Facilities" addressed later in Public Law 102-508, October 24, 1992.

The RSPA pipeline safety regulations currently require that all newly constructed gas and hazardous liquid offshore pipelines located in water less than 12 feet deep must have a minimum cover of 36 inches in the soil or 18 inches in consolidated rock (49 CFR 192.327 and 195.248).

Newly constructed gas and hazardous liquid pipelines in offshore waters from 12 feet to 200 feet deep must be installed so that the top of the pipe is below the seabed unless the pipe is protected by other equivalent means (Sections 192.319 and 195.246).

### **U.S. Government Agencies With Jurisdiction In Texas Waters**

The MMS (Federal - Minerals Management Service) issues rights-of-way permits for pipelines on the Outer Continental Shelf (OCS) and requires that newly constructed pipelines be buried 36 inches (30 CFR 250.153).

The Corps of Engineers issues permits for burial of offshore pipelines and normally requires that newly constructed pipelines be buried to a depth of 36 inches in water less than 200 feet deep.

However, none of the three agencies (RSPA, MMS, COE) currently require that pipeline operators conduct an underwater inspection of those pipelines in waters 15 feet and deeper, as the Public law 101-599 states: "This (inspection) requirement shall apply to pipeline facilities between the high water mark and the point where the subsurface is under 15 feet of water, as measured from mean low water."

Upon the enactment of Public Law 102-508, October 24, 1992, Section 117, Underwater Abandoned Pipeline Facilities, further amended Section 3(h) of the Natural Gas Pipeline Safety Act of 1968 by adding at the end, the following new paragraph:

"(6) abandoned pipeline facilities -

"(A) Treatment. - For the purposes of this subsection, except with respect to the initial inspection required under paragraph (1), the term 'Pipeline Facilities' includes underwater abandoned pipeline facilities. For purposes of this subsection, in a case where such a pipeline facility has no current operator, the most recent operator of such pipeline facility shall be deemed to be the operator of such pipeline facility."

"(D) Abandoned Defined. - For purposes of this paragraph, the term 'abandoned' means permanently removed from service."  
(see App, Ref. No. 11).

As previously stated, the Federal rules and regulations have been included in the above summary for those sections applicable to pipeline abandonment in Texas coastal waters, wherein the Railroad Commission of Texas adopted 49 CFR parts 192 and 195 for their Pipeline Safety Rules.

### **3.4 United States, Outer Continental Shelf**

#### **3.4.1 Department of Interior/Minerals Management Service**

The Minerals Management Service (MMS) under the Department of the Interior (DOI) is the primary federal agency that has the responsibility for carrying out the national policy, through the rules and regulations, affecting oil and gas operations on the Outer Continental Shelf (OCS). Within the federal government, there are other departments and agencies involved in legislation and implementation of regulations relevant to mineral resource development on the OCS.

The OCS Lands Act, as amended, gives the MMS/DOI the authority to regulate offshore pipeline operations to ensure that they are conducted in a manner that protects life, property, and the marine, coastal, and human environment and minimizes conflicts with other uses of the OCS. In the implementation of this authority, the MMS has issued regulations (30 CFR 250, Subpart J) that contain specific requirements to ensure safe OCS pipeline operations (see App. Ref. No. 13, 14, and 18).

As a result of the Oil Pollution Act of 1990 amending the Clean Water Act (CWA) and the implementing of the Presidential Executive Order 12777, signed on October 18, 1991, the regulatory responsibility for safety and pollution prevention expanded the jurisdiction of the MMS to include all offshore pipelines in both State and Federal waters. A recent memorandum of understanding issued as a notice, dated February 17, 1994, by MMS/DOI redelegates responsibilities of jurisdiction associated with oil-spill prevention and control, contingency planning, and equipment inspection for offshore facilities, including pipelines. This re delegation affects the DOI (MMS), DOT (RSPA) and EPA as set forth below. (See App. Ref. No. 13a.)

For purposes of this MOU, the term "coast line" is defined as in the

Submerged Lands Act (43 U.S.C. 1301 (c)) to mean "the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters." The term "offshore facility" includes facilities of any kind located in, on, or under navigable waters of the United States.

- To the EPA, DOI redelegates responsibility for non-transportation-related offshore facilities located landward of the coast line.
- To the DOT/RSPA, DOI redelegates responsibility for transportation-related facilities, including pipelines, located landward of the coast line. The DOT retains jurisdiction for deepwater ports and their associated seaward pipelines.
- The DOI/MMS retains jurisdiction over facilities, including pipelines, located seaward of the coast line, except for deepwater ports and associated seaward pipelines.

Title 30, Chapter II, MMS, DOI, Subchapter B, "Offshore", Part 250, "Oil and Gas and Sulphur Operations in the Outer Continental Shelf", Subpart J, "Pipelines and Pipeline Rights-of-Way, Section 250.151, "Definitions", Section 250.156, "Abandonment and out-of-service Requirements for DOI Pipelines" (see App. Ref. No. 13, 14, and 18), sets the basic regulations for OCS Pipeline Abandonment.

Section 250.156 - Abandonment and out-of-service requirements for DOI pipelines.

- (a)(1) A pipeline may be abandoned in place if, in the opinion of the Regional Supervisor, it does not constitute a hazard to navigation, commercial fishing operations, or unduly interfere with other uses in the OCS. Pipelines to be abandoned in place shall be flushed, filled with seawater, cut, and plugged with the ends buried at least 3 feet.

- (2) Pipelines abandoned by removal shall be pigged, unless the Regional Supervisor determines that such procedure is not practical, and flushed with water prior to removal.
  
- (b)(1) Pipelines taken out-of-service shall be blind flanged or isolated with a closed block valve at each end.
  
- (2) Pipelines taken out-of-service for a period of more than 1 year shall be flushed and filled with inhibited seawater.
  
- (3) Pipelines taken out-of-service shall be returned to service within 5 years or be abandoned in accordance with the requirements of paragraphs (a)(1) or (2) of this section.

### **3.4.2 Office of Pipeline Safety/RSPA/DOT**

Safety regulations and responsibilities for offshore pipelines are also shared by the Office of Pipeline Safety (OPS) in the Research and Special Programs Administration (RSPA) operating under the Department of Transportation and the MMS/DOI. The MMS regulates the flowlines and production lines, including issuance of rights-of-way, installation and abandonment on the OCS, while RSPA/OPS/DOT regulates (49CFR 192 and 195) gathering and transmission pipelines on the OCS and on state waters. The U.S. Army Corps of Engineers (COE), under the DOD, also issues rights-of-way.

There are four Codes of Federal Regulations (CFRs) that are related to mineral resource activities on the OCS which specifically address pipeline abandonment for the purposes of this report, namely, 18 CFR 284, 30 CFR 250, 33 CFR 64 and 322, and 49 CFR 192 and 195 (see App. Ref. No. 18).

Rules and regulations administered by RSPA/DOT for pipeline abandonment are found in Title 49, Chapter I, RSPA, DOT, Subchapter D, "Pipeline Safety", Part 192, "Transportation of Natural and Other Gas

by Pipeline: Minimum Federal Safety Standards," Subpart M, "Maintenance," Section 192.727, "Abandonment or Inactivation of Facilities" (see App. Ref. No. 17 and 18).

Section 192.727 - Abandonment or Inactivation of Facilities

- (a) Each operator shall provide in its operating and maintenance plan for abandonment or deactivation of pipelines, including provisions for meeting each of the requirements of this section.
- (b) Each pipeline abandoned in place must be disconnected from all sources and supplies of gas; purged of gas; in the case of offshore pipelines, filled with water or inert materials; and sealed at the ends. However, the pipeline need not be purged when the volume of gas is so small that there is no potential hazard.
- (c) Except for service lines, each inactive pipeline that is not being maintained under this part must be disconnected from all sources and supplies of gas; purged of gas; in the case of offshore pipelines, filled with water or inert materials; and sealed at the ends. However, the pipeline need not be purged when the volume of gas is so small that there is no potential hazard.

A recent final rule from DOT/RSPA, RE, 49 CFR Parts 192 and 195 concerning "Operation and Maintenance Procedures for Pipelines" will become effective February 11, 1995 and affects the above section 192.727. The section heading and paragraph (a) are revised to read as follows:

§ 192.727 Abandonment or Deactivation of Facilities.

- (a) Each operation shall conduct abandonment or deactivation of pipelines in accordance with the requirements of this section. (See App. Ref. No. 17a.)

49CFR 195 "Transportation of Hazardous Liquids by Pipeline," Subpart F, "Operation and Maintenance," addresses the requirements of

an operator to prepare and follow for each pipeline system a manual of written procedures for conducting normal operations and maintenance activities and handling abnormal operations and emergencies.

Section 195.402(c)(10) - Require a procedure to cover "abandoning pipeline facilities, including safe disconnection from an operating pipeline system, purging of combustibles, and sealing abandoned facilities left in place to minimize safety and environmental hazards" (see App. Ref. No. 17 and 18).

### **3.4.3 Federal Energy Regulatory Commission/DOE**

Title 18, Chapter I, "Federal Energy Regulatory Commission (FERC), Department of Energy (DOE), Subchapter I, "Other Regulations...", Part 284, "Certain sales and transportation of natural gas under the natural gas policy act of 1978 and related authorities," Subpart G, "Blanket Certificates..." Section 284.221 (a),(d) covers a single blanket certificate authorizing the transportation of natural gas on behalf of others in accordance with this subpart and in (d), this extends a pre-grant of abandonment. Pursuant to section 7(b) of the Natural Gas Act abandonment of transportation services is authorized upon the expiration of the contractual term of each individual transportation arrangement. This pre-grant of service abandonment could then be used in an application to MMS for pipeline abandonment, permanently or out-of-service (see App. Ref. No. 18).

For additional background for all the regulations in the above section 3.4, see App. Ref. Nos. 15, 16, 19, 20, 21, 22, 23, 24, and 26.

### **3.5 United Kingdom Continental Shelf and International**

#### **3.5.1 UKCS**

The International Maritime Organization (IMO), the marine arm of the United Nations, adopted guidelines and standards, under Resolution A.672(16), on October 19, 1989 (see App. Ref. 30), entitled, "Guidelines and Standards for the Removal of Offshore Installations and Structures on the Continental Shelf and in the Exclusive Economic Zone."

These guidelines and standards were developed to establish criteria for the extent of removal of abandoned or disused installations to ensure the safety of navigation by expanding detail to Article 60(3) of the 1982 UN Convention on the Law of the Sea. The IMO guidelines are directed towards the removal of offshore platforms. It is generally accepted that the term "installations and structures" does not refer to offshore pipelines. The IMO and member North Sea states have not yet defined explicit policies on the abandonment of offshore pipelines (see App. Ref. No. 28).

On the United Kingdom Continental Shelf (UKCS), the abandonment of offshore pipelines, installations and structures is governed by the regulations of the Petroleum Act of 1987, which addresses the missing standards of the Coast Protection Act of 1949 relating to installation or pipeline abandonment (see App. Ref. No. 30).

Legislation found in the Petroleum Act of 1987 empowers the Secretary of State for Energy, Pipeline Inspectorate, Department of Energy, to adopt a case-by-case basis approach to pipeline abandonment proposals presented by a user.

The primary provisions for pipeline and installation abandonment in the Petroleum Act follows:

- 1) Enable the Secretary of State, by written notice, to require the

- submission of costed abandonment programs for all offshore installations and submarine pipelines. (Persons given notices are required to submit a joint program.);
- 2) Where an abandonment program is approved, make it the duty of each of the persons who submitted it to secure that it is carried out (each person is potentially liable for the entire abandonment cost);
  - 3) Provide means whereby the Secretary of State may satisfy himself that any person who has a duty to secure that an approved abandonment program is carried out will be capable of discharging that duty, and, where he is not so satisfied, require that person, by notice, to take such action as may be specified;
  - 4) In the event of failure by those given notice to submit a program or secure that it is carried out, enable the Secretary of State to do the work and recover the cost from those given notice;
  - 5) Provide penalties for failure to comply with notices;
  - 6) In certain cases, enable abandonment costs to be set off against royalty previously paid; and
  - 7) Enable the Secretary of State to make regulations relating to abandonment.
  - 8) These regulations may:
    - a) Prescribe standards and safety requirements in respect of dismantling, removal and disposal;
    - b) Prescribe standards and safety requirements in respect of anything left in the water where an installation or pipeline is not entirely removed;

- c) Make provision for prevention of pollution;
- d) Make provision for inspection;
- e) Make provision for the determination of the amount of any fees payable to the Secretary of State (see App. Ref. Nos. 30 and 58).

### **UK Also Adopts IMO Guidelines and Standards**

The UK Government has made it clear that it has also adopted and intends to comply with the IMO Guidelines and Standards as one of the North Sea Governments. Since there is no specific reference to offshore pipelines in the IMO guidelines, thus no specific international obligations on the UK regarding removal of pipelines, the UK government's abandonment policy is considered more stringent than IMO guidelines (see App. Ref. Nos. 28, 58, and 31)

More recently, in 1993 the British Standards Institute (BSI) has published the first British Standard exclusively for subsea pipelines, BS8010.

In BS8010, the Code of Practice for subsea pipelines, the new code, Part 3 provides recommendations of design, construction, installation, testing and commissioning of subsea pipelines constructed from steel and metal-reinforced polymers. In addition to the primary concerns of subsea pipelines intended for transmission of hydrocarbon gases and liquids, the new code clearly directs the designer and operator to the statutory requirements, required safety documentation and highlights the need for safety to be a design parameter. Part 4 as it's title implies, deals with "Pipelines on Land and Subsea: Operation and Maintenance" (see App. Ref. No. 64, 65, and 66).

### **3.5.2 Norwegian Ministry of Industry and Energy - Norwegian National Law - The Petroleum Act**

The Norwegian Petroleum Committee Report of June 22, 1993 to the Royal Norwegian Ministry of Industry and Energy proposed a new chapter IV with six new sections to replace section 30 in the Petroleum Act, relating to closing down petroleum operations on the continental shelf. The Petroleum Committee recognized the UN International Maritime Organization (IMO) directives for removal of offshore installations and structures on the continental shelf, though not formally binding international law, but generally accepted by most coastal states and took the substance of those directives into consideration when making its recommendations (see App. Ref. No. 32).

One principal committee objective in making additions to the Petroleum Act was an obligatory "closing-down plan" at the earliest possible stage in the life of a field so that the licensee and the authorities could decide on the manner of disposing of the facilities.

The closing-down plan shall contain the licensee's proposal for future disposal of the facilities and responses to the closing down rules that apply to petroleum production and transportation, including mobile and stationary drilling platforms and production platforms, shipping facilities and pipelines. Other examples of installations are riser platforms, wellhead platforms, loading buoys, storage tanks, booster platforms and living quarters platforms.

The Norwegian position on closing-down pipelines concludes in principle there is little difference between a pipeline and other fixed installations. Although the closing-down rules for installations are clearly intended to apply also to pipelines, the committee considered it necessary to deal with pipelines separately, the main rule, which requires a special permit, is that pipelines shall be kept in place. Further to this position, the Norwegian Government accepted committee proposal invokes the USA experience that petroleum will be drained from the pipeline and it will be filled with seawater and plugged.

### **3.5.3 Denmark - The Danish Continental Shelf**

The Subsoil Act (Act No. 293 of June 19, 1981 relating to the use of Danish subsoil) forms the legal basis for petroleum operations in Denmark. Section 33 of this Act provides the basis for regulating the removal issue: "In licenses granted pursuant to this Act further rules are stipulated for the manner of dealing with structures established by the licensee, when the license expires, is surrendered, lapses or recalled."

In addition, the "Model License for Exploration and production of Hydrocarbons," 1988, Section 37 contains rules which allows the Danish government to acquire free of charge; facilities, structures, and installations "when the license expires, is surrendered, lapses or is recalled." However, if the government does not wish to acquire the facility, it may demand that all or part of it be removed (see App. Ref. No. 32).

### **3.5.4 The Netherlands Continental Shelf**

Section 26 of the Netherlands Continental Shelf Act empowered the Ministry of Finance to issue regulations in 1967 concerning continental shelf installations.

Section 68 of those regulations reads: "A production facility that is no longer in use must be removed completely. The ministry may set a time limit for removal."

This rule does not apply to pipelines, as they are not regarded as being "production installations." However, removal of pipelines may be required if they form part of a production complex. The regulations also contain rules for periodical inspections of the pipelines. The ministry may order that corroded or dangerous pipelines be repaired, or removed, if they constitute a safety hazard for shipping or fishing (see App. Ref. No. 32).

### **3.5.5 International Provisions for Pipeline Removal - 1990 Protocol to the Kuwait Convention**

As previously discussed, the guidelines and standards adopted by the IMO do not refer to offshore pipelines, thus there are no specific international obligations on the Contracting (member) States around the North Sea regarding the removal of pipelines.

However, there are provisions on pipeline removal in Article XIII of a Protocol to the Kuwait Convention which was adopted and became effective February 17, 1990 (see App. Ref. No. 28).

The Protocol concerning marine pollution resulting from the exploration and exploitation of the continental shelf obliges each Contracting State to require that pipelines be flushed to remove residual pollutants and to have a discretionary power to require that certain other operations be performed as considered appropriate. See the summary synopsis of Article XIII below:

#### **Article XIII**

1. Each Contracting State shall ensure that the Competent State Authority has the power to require the operator of an offshore installation:
  - a) in the case of a pipeline -
    - i) to flush and remove any residual pollutants from the pipeline, and
    - ii) to bury the pipeline, or remove part and bury the remaining parts thereof, so as to eliminate for the foreseeable future any risk of hindrance to navigation or fishing, taking all circumstances into account.
  - b) in the case of platforms and other sea-bed apparatus and structures, to remove the installation in whole or in part to ensure the safety of navigation and in the interests of fishing.

Each Contracting State shall also take all practicable measures to ensure that the operator has sufficient resources to guarantee that any such requirements can be met.

2. Where Contracting States have a common interest in fishing grounds in the Protocol Area, they shall endeavor to adopt a common policy on the removal of installations.

In determining any case whether or not installations must be removed, Contracting States shall have regard to any Guidelines issued by the Organization. Whether pipelines are removed or not, they shall be flushed to remove residual pollutants.

3. Contracting States shall pass, and take all practicable steps to enforce, measures to ensure that no offshore installation which in use has floated at or near the sea-surface, and no equipment from an offshore installation, shall be deposited on the sea-bed of the continental shelf when it is no longer needed.

## **4.0 DATABASE INFORMATION ON ABANDONED PIPELINES IN THE GULF OF MEXICO**

Database information is often used to review or establish trends, common practices, and other statistical facts about a particular subject. This is difficult to accomplish for offshore abandoned pipelines in the Gulf of Mexico since several different State and Federal agencies are responsible for the gathering of information on these pipelines. Additional complications are introduced by the fact that record keeping and data management procedures differ between the various responsible agencies.

### **4.1 Available Database Information**

Although information on pipelines is required by Federal regulations to be submitted in order to obtain the necessary construction permits and operating licenses, once filed, this information may or may not be compiled into a computerized data base, or shared between agencies. In addition, once a pipeline or pipeline segment is abandoned, the file on that segment is often closed, with the reasoning being that since the line is abandoned there is no further need to track it.

Several State and Federal agencies and one private contractor were contacted in an effort to determine the extent of available information in database format on abandoned pipelines in the Gulf of Mexico. The contacted agencies are as follows:

#### **4.1.1 Corps of Engineers, Department of the Army**

District or division engineers with the Corps are responsible for the administration of permit applications for offshore pipelines. Records are generally kept by the district or division, but are not compiled into a database.

#### **4.1.2 Federal Energy Regulatory Commission (FERC)**

The FERC does not maintain a database of pipelines, or of the current status of individual pipelines.

#### **4.1.3 U.S. Coast Guard (USCG)**

The USCG maintains two database applications (see Appendix Reference No. 50) which track marine casualty incidents involving commercial seagoing vessels in all bodies of water worldwide. The **CASMAIN** database period ends with marine casualty investigations commenced or recorded prior to January 1, 1992. The **MINMOD** database application contains investigation cases occurring after this time.

These two applications do not have a separate category for tracking vessel collisions with pipelines. Incidents such as these would normally categorize the cause as **ESUBOBJ** (submerged object), but the category may vary. The October 3, 1989 fishing vessel **NORTHUMBERLAND** accident, for example, where the stern of the vessel ruptured a 16-inch natural gas pipeline resulting in the deaths of eleven crew members, is listed in **CASMAIN** with the cause **UNKNOWN**.

The July 24, 1987 fishing vessel **SEA CHIEF** collision with an 8-inch natural gas liquid pipeline, which resulted in the deaths of two crew members, is not listed in the casualty data report.

#### **4.1.4 DOI/Minerals Management Service (MMS)**

The MMS Gulf of Mexico Regional Office maintains a computerized pipeline database which contains an inventory of all pipeline segments in the GOM OCS. The database provides information such as line size, status, length, operating pressure, product, originating and ending points, as well as other information. This database is discussed in further detail in Section 4.2 and two

different printouts of the database are included as Appendix II.

#### **4.1.5 State Agencies**

None of the State agencies contacted for this report maintained a pipeline database. The agencies contacted were as follows:

- California State Lands Commission
- Louisiana Dept of Natural Resources/Coastal Management Division
- Louisiana Dept of Natural Resources/Office of Conservation
- Texas General Land Office
- Texas Railroad Commission

#### **4.1.6 John E. Chance and Associates (JECA)**

JECA maintains a computerized database that includes information on most of the pipeline segments in the Gulf of Mexico. The database is updated based upon information received from several sources, including the MMS, State agencies, pipeline operators and contractors, and from JECA clients. The primary use of this database is to advise or alert companies with pipelines in a specific area prior to JECA commencing work in that area.

The database information is more complete on pipelines located in the GOM OCS than in State waters, due to the wealth of information provided by the MMS database (see Section 4.2). JECA is more interested in maintaining the geographical location of the pipelines than in the status of the lines. Generally, the only lines listed as being abandoned or out of service in the JECA database are those lines that are listed as such in the MMS database.

## **4.2 MMS OISLMAST Database**

The MMS OISLMAST database is a working database inventory of all pipeline segments in the OCS. Information is derived by entering data from documents submitted to the Federal Government from oil companies, other government agencies, and/or the public. Printouts of specific information contained in the database are available from the MMS Public Information Office for a nominal fee. A copy of the database information is also available in ASCII format on diskette.

### **4.2.1 Description of Database Information**

The MMS OISLMAST database, as reviewed for this study, contained 7,493 pipeline segment records (as of October 7, 1993), with 41 different fields of information per record. Since the majority of information for the database is derived from existing documents, not all of the fields contain data entries for all pipeline segments records. This situation is generally more predominant among the older pipeline segment entries in the database. Several recent segment records, however, also contain vacant data fields.

Of the 41 information fields contained in the original database, 15 fields were used to generate the summary graphs found in this chapter, and also for the report printouts located in Appendix II. These fields are as follows:

- Pipeline segment number
- Pipeline segment operator
- Pipeline segment status
- Product in line segment
- Segment line size
- Maximum allowable operating pressure
- Originating block
- Originating block number
- Destination block
- Destination block number
- Segment length

- Minimum water depth
- Maximum water depth
- Line approval date
- Last revision date

#### **4.2.2 Description of Pipeline Segment Status**

The MMS OISLMAST database uses 15 different categories to designate the current status of a pipeline segment. Of these categories, 12 were considered relevant for the purpose of this study, and were used to generate the summary graphs for this chapter and the report printouts found in Appendix II.

- **ABANDONED** - The pipeline segment has been permanently abandoned in place, with the segment typically purged, pigged, and the ends capped and buried.
- **ABANDONED AND COMBINED** - Part of the pipeline segment has been permanently abandoned, and the other part of the segment has been re-connected to another pipeline segment, or portion of another segment, to create a new pipeline segment.
- \* ● **ACTIVE** - The pipeline segment is currently active and in use.
- \* ● **CANCELLED** - The plans for this new pipeline segment have been cancelled.
- **COMBINED** - The pipeline segment has been combined with another segment to create a new pipeline segment. (Example: A line segment arriving at a platform is combined with a line segment leaving the platform to create a continuous segment when the platform is abandoned.)
- **OUT 2nd COMBINED** - Part of the line segment has been taken out of service, and the other part has been combined with another segment, or portion of another segment, to create a new pipeline

segment. The Out-of-Service portion is usually a riser section to a platform which is to be abandoned at a future date. The riser generally terminates in a blind flange topside, and a capped and buried end subsea.

- **OUT OF SERVICE** - The line segment is currently out of service. The segment may be out of commission with the ends capped and waiting to be abandoned along with its host platform, or the operator may have future plans for the line. A line listed as Out-of-Service may already be abandoned but not approved as such by the FERC. An Out-of-Service segment must either be abandoned, or placed back in service within five years.
- **PROPOSED FOR ABANDONMENT** - The line segment is currently proposed for abandonment.
- **PROPOSED FOR REMOVAL** - The line segment is currently proposed for removal.
- **RELINQUISHED** - The line easement or right-of-way has been relinquished.
- \* ● **PROPOSED** - This is a proposed new line segment.
- **RELINQUISHED AND ABANDONED** - The line segment has been permanently abandoned, and the line easement has been relinquished.
- **RELINQUISHED AND COMBINED** - The line easement has been relinquished, and the line segment has been moved to another location and used to create a new line segment.
- **RELINQUISHED AND REMOVED** - The line segment has been abandoned by removal from the water, and the line easement has been relinquished.

- REMOVED - The line segment has been abandoned by removal from the water, and the site has been cleared.
  
- \* Indicates the status categories in the following descriptions that were not used.

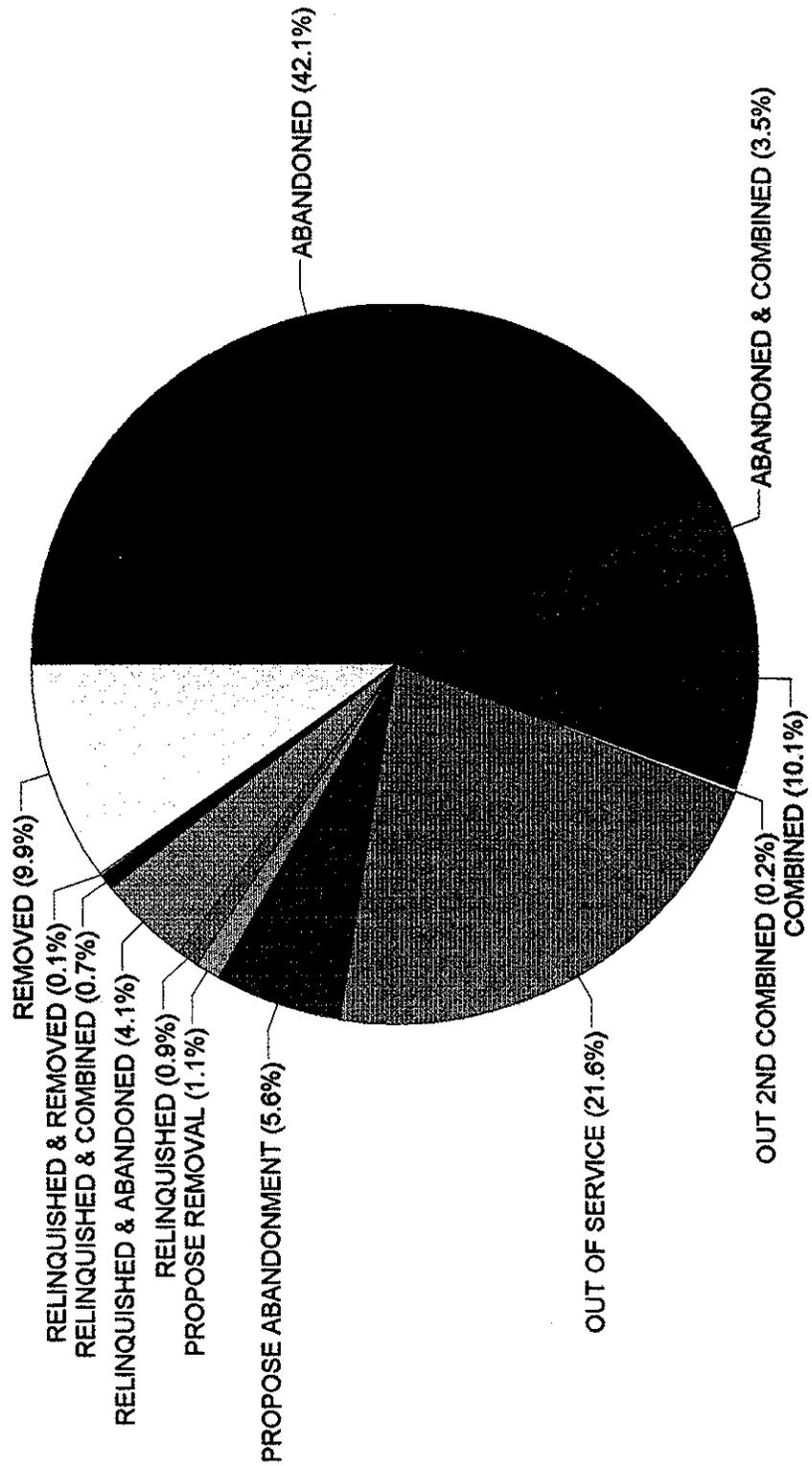
### **4.2.3 Description of Summary Charts and Graphs**

Of the original 7,493 records in OISLMAST, a total of 2,867 records met the desired status for this study. A number of pie charts summarizing the data for these records appear at the end of this chapter. These charts are divided into three major categories - STATUS, SERVICE, and SIZE. (Summary charts were not prepared by water depth due to the large number of records with blanks in the minimum and maximum water depth fields.)

A series of charts further subdividing the information are presented that compare line status percentages relative to line size groups. A series of bar graphs that compare individual line product groups vs. line size and status is also included. Finally, a series of status distribution charts that describe the percentages of lines that are abandoned, removed, out of service, etc. for several operating companies are included.

# Status Distribution

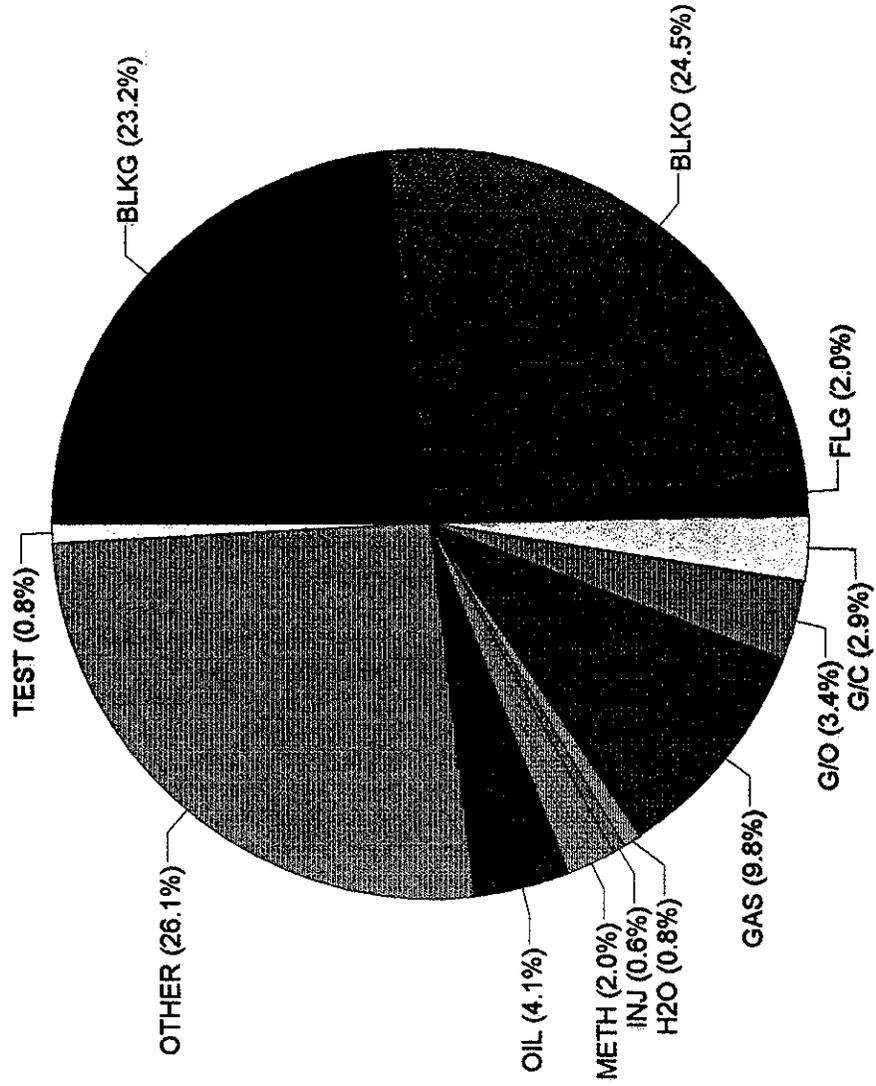
2,867 total lines



"OTHER" category includes: ABANDONED & COMBINED, OUT 2ND COMBINED, PROPOSE ABANDONMENT, PROPOSE REMOVAL, RELINQUISHED, RELINQUISHED & ABANDONED, RELINQUISHED & COMBINED, RELINQUISHED & REMOVED

# Service Distribution

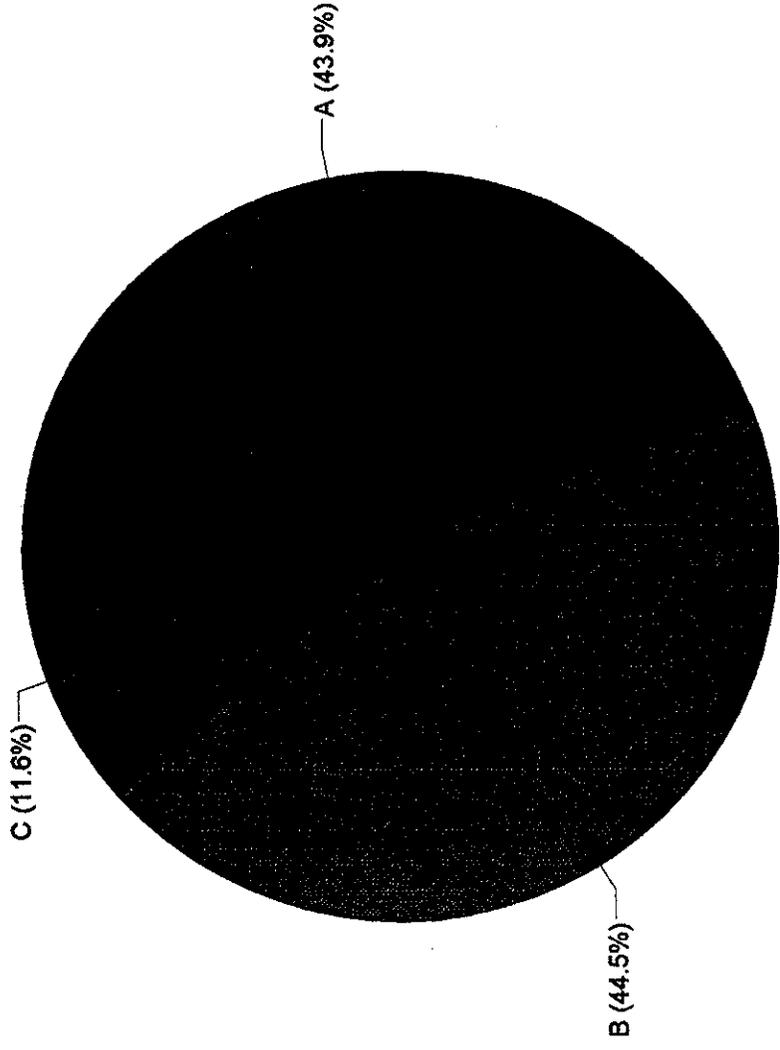
2,867 total lines



"OTHER" category includes: Acid, Pneumatic, Chemical Injection, Condensate, Liquid Gas Enhanced Recovery, Gas Lift, Out of Service, Service, Supply Gas, Spare  
"OTHER" category also includes records that were BLANK

# Size Distribution

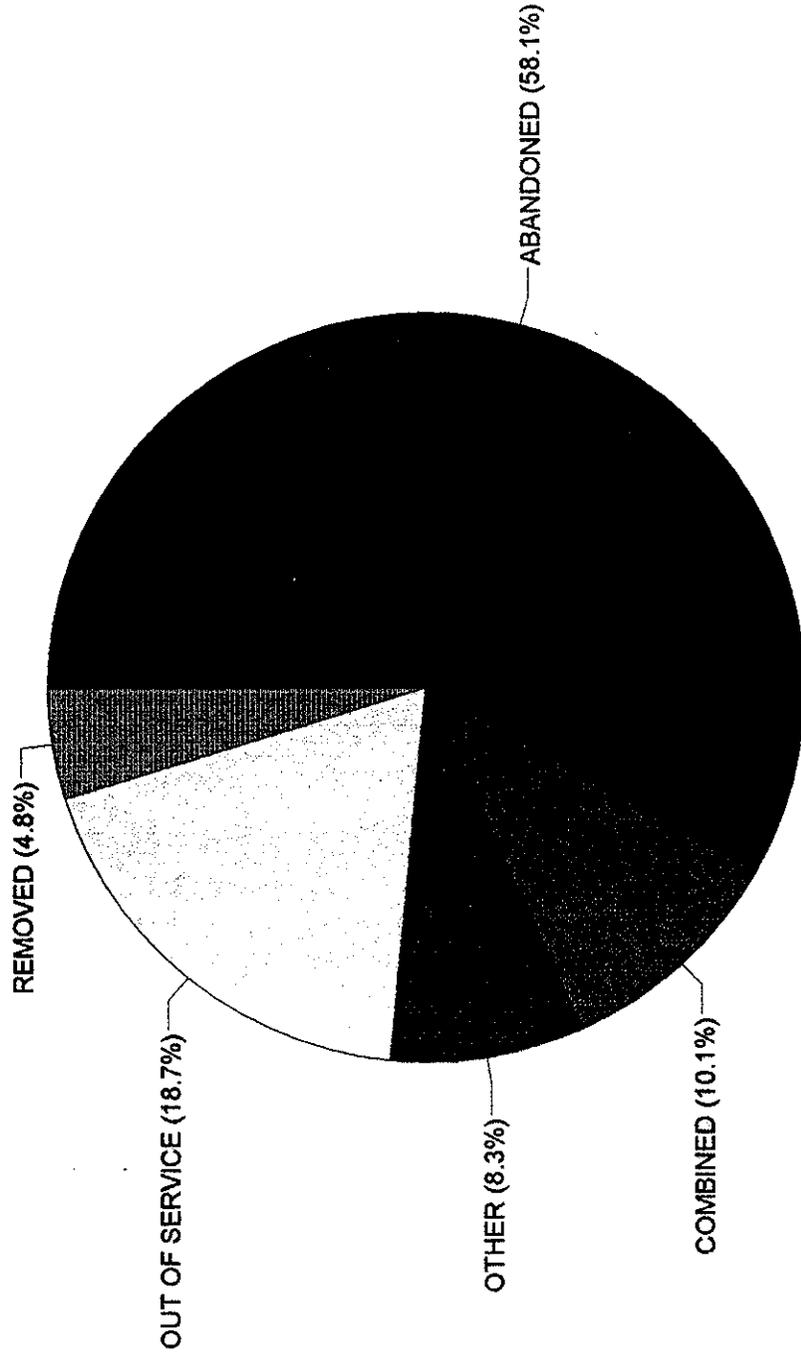
2,867 total lines



**LEGEND:**  
A - 3" and smaller  
B - 4" to 6"  
C - 8" and larger

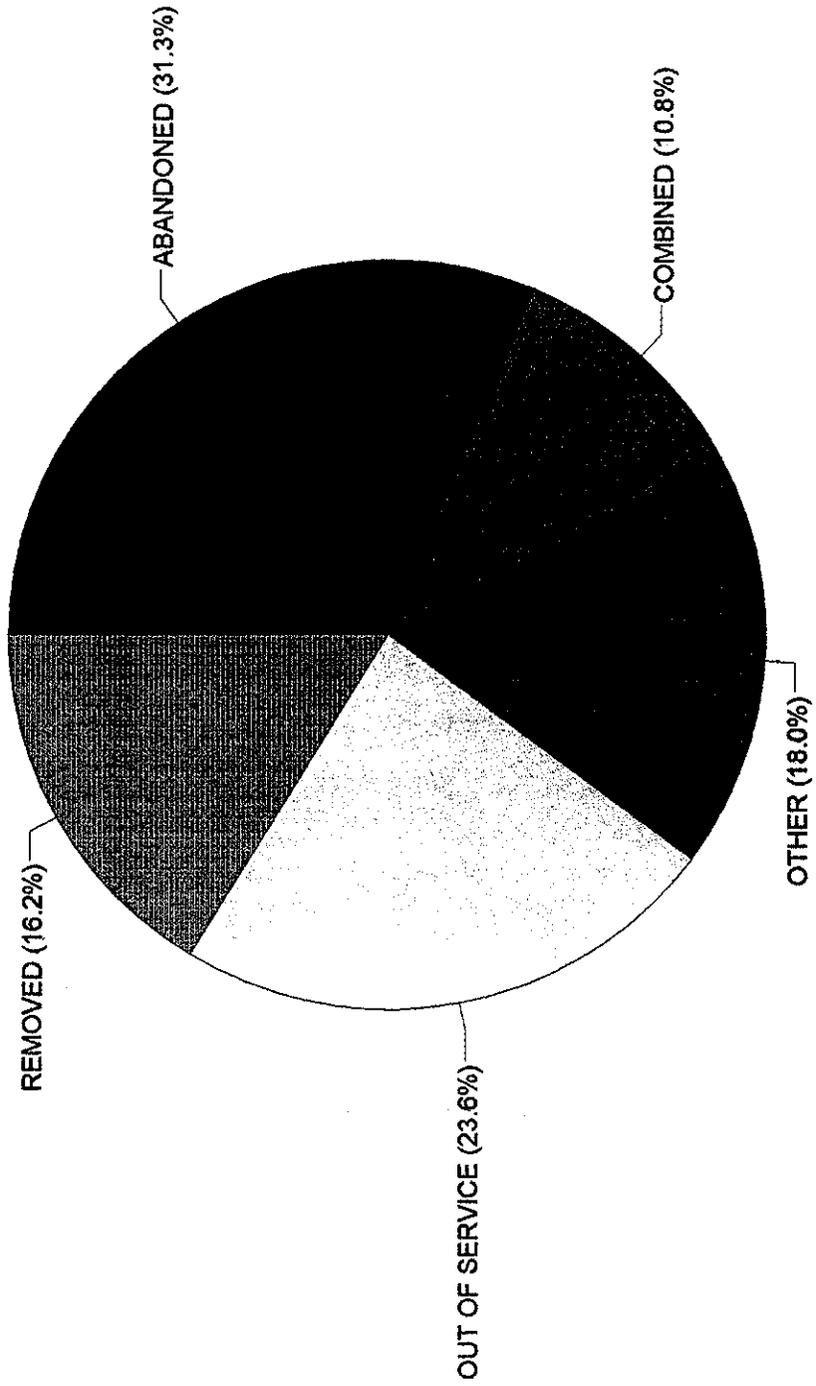
# Status for Lines 3" and Smaller

1290 of 2,867 total



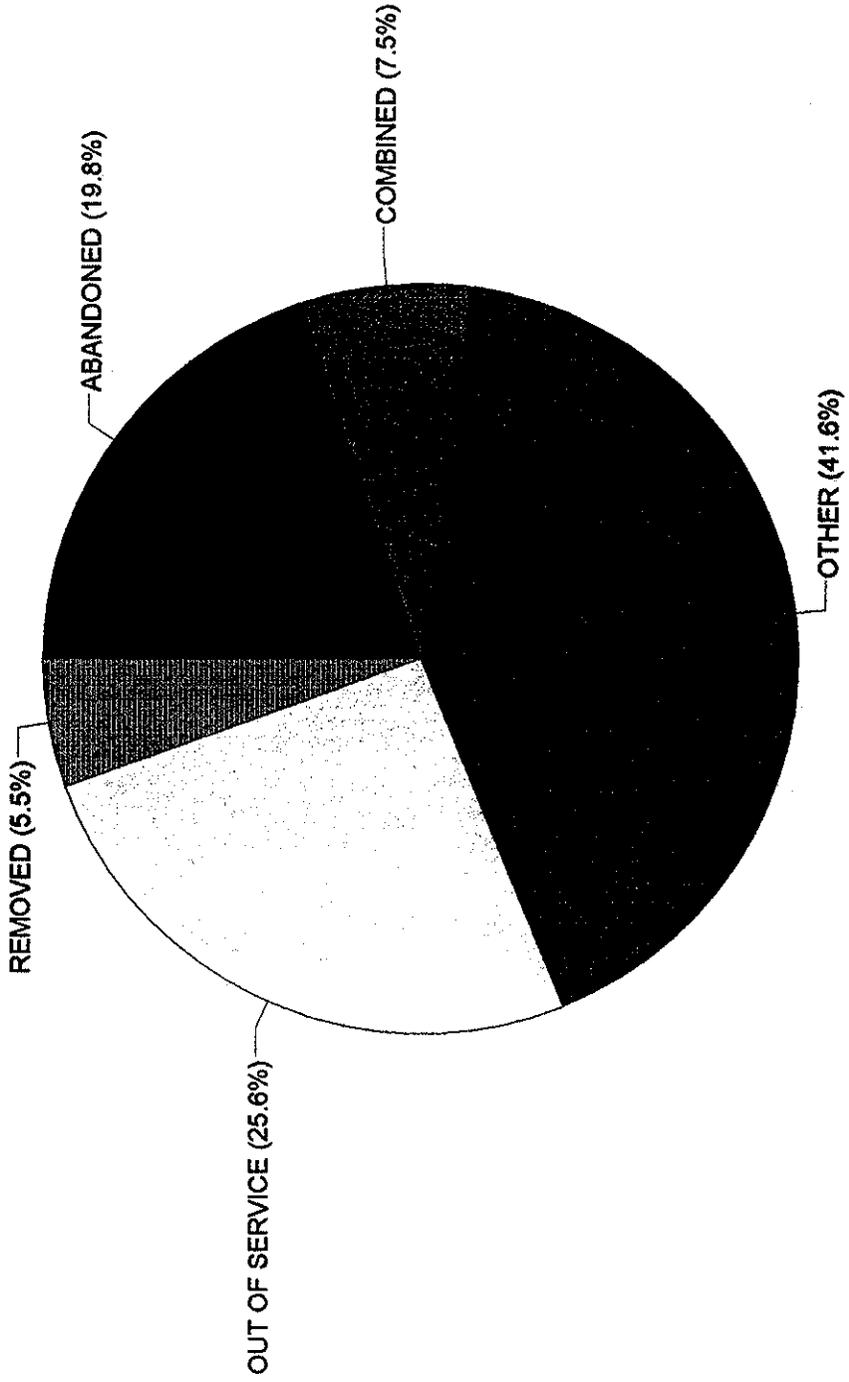
# Status for Lines From 4" to 6"

1269 of 2,867 total



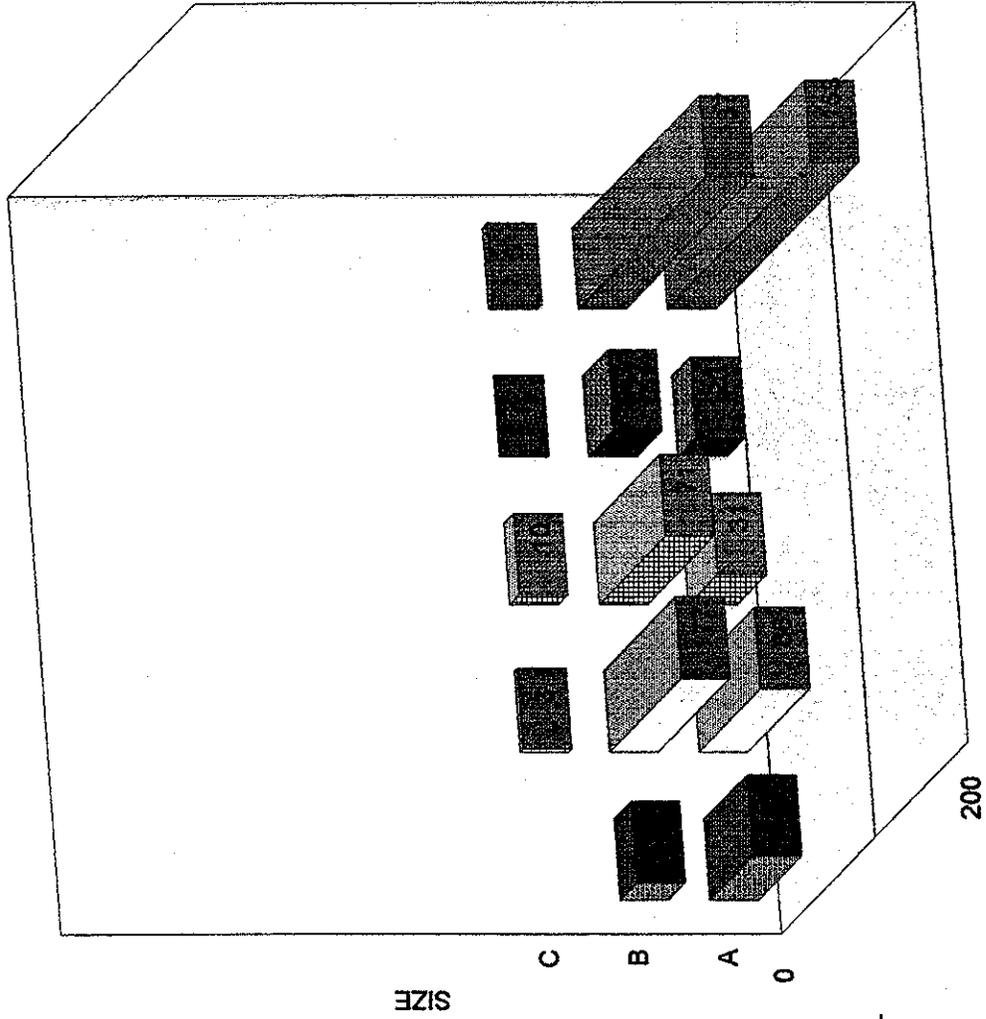
# Status for Lines 8" and Larger

308 of 2,867 total



# Summary for Bulk Gas Lines

665 of 2,867 total lines



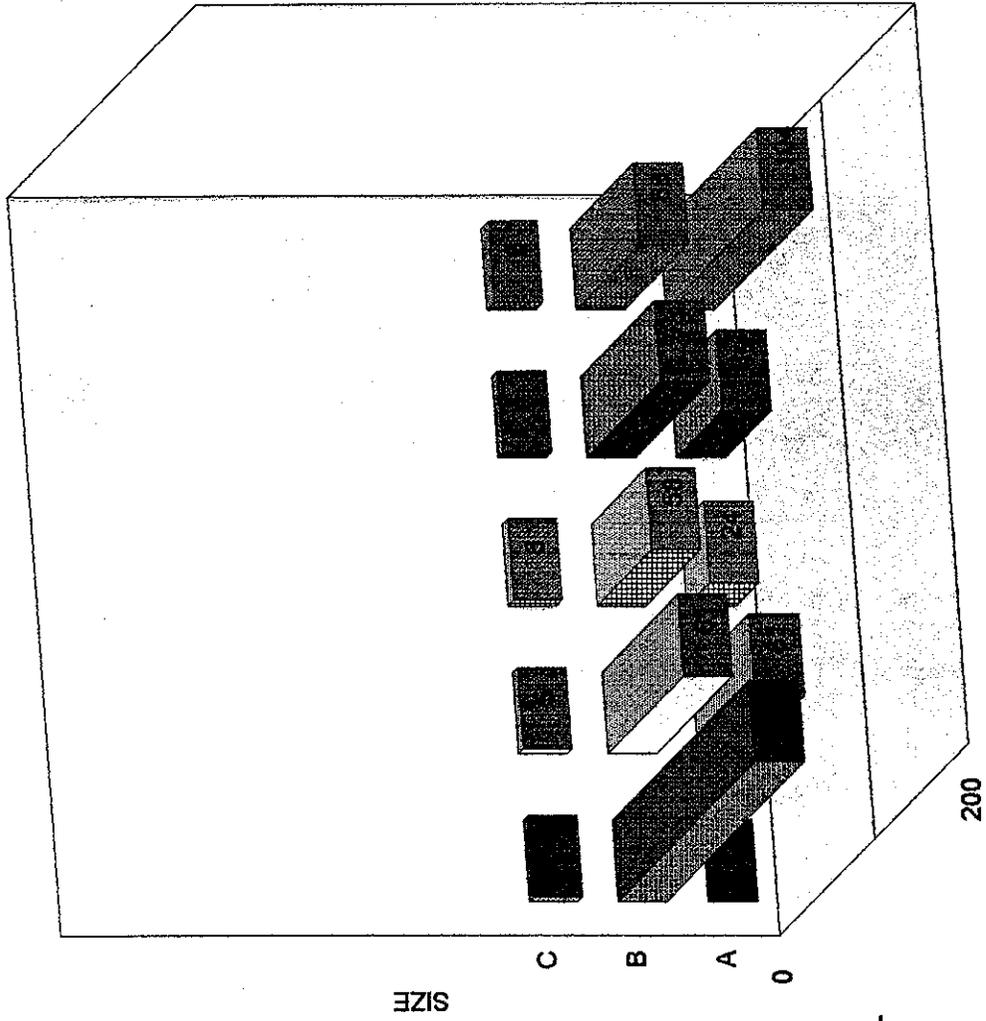
SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger

PRODUCT



# Summary for Bulk Oil Lines

701 of 2,867 total lines



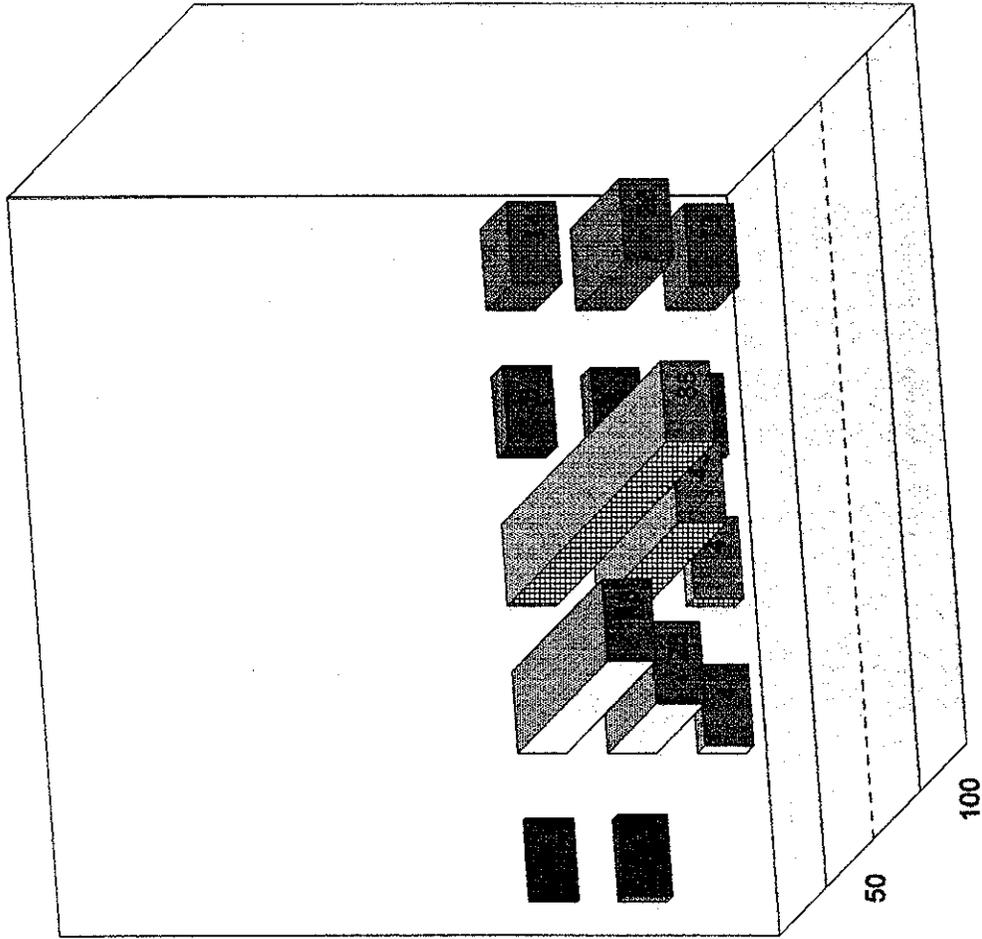
SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger

PRODUCT

- ABANDONED
- COMBINED
- OTHER
- OUT OF SERVICE
- REMOVED

# Summary for Gas Export Lines

280 of 2,867 total lines

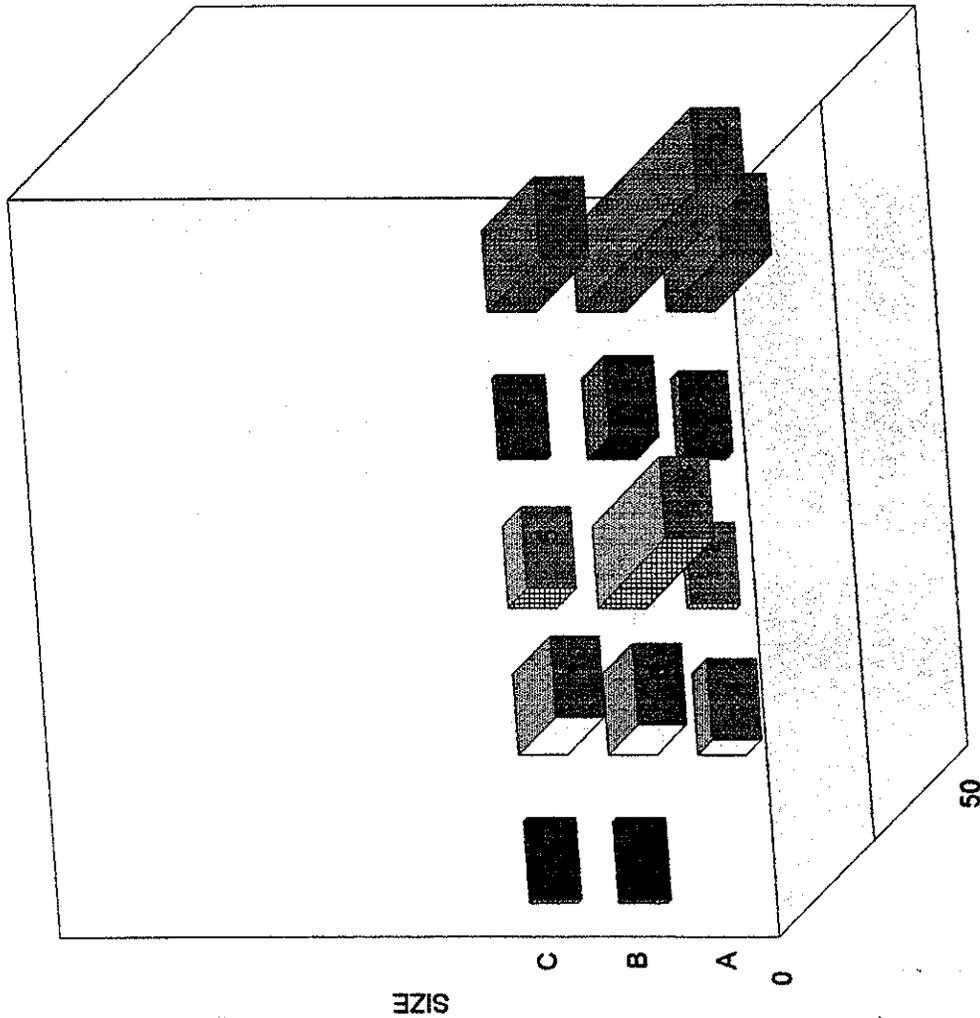


SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger

- ABANDONED
- COMBINED
- OTHER
- OUT OF SERVICE
- REMOVED

# Summary for Oil Export Lines

118 of 2,867 total lines

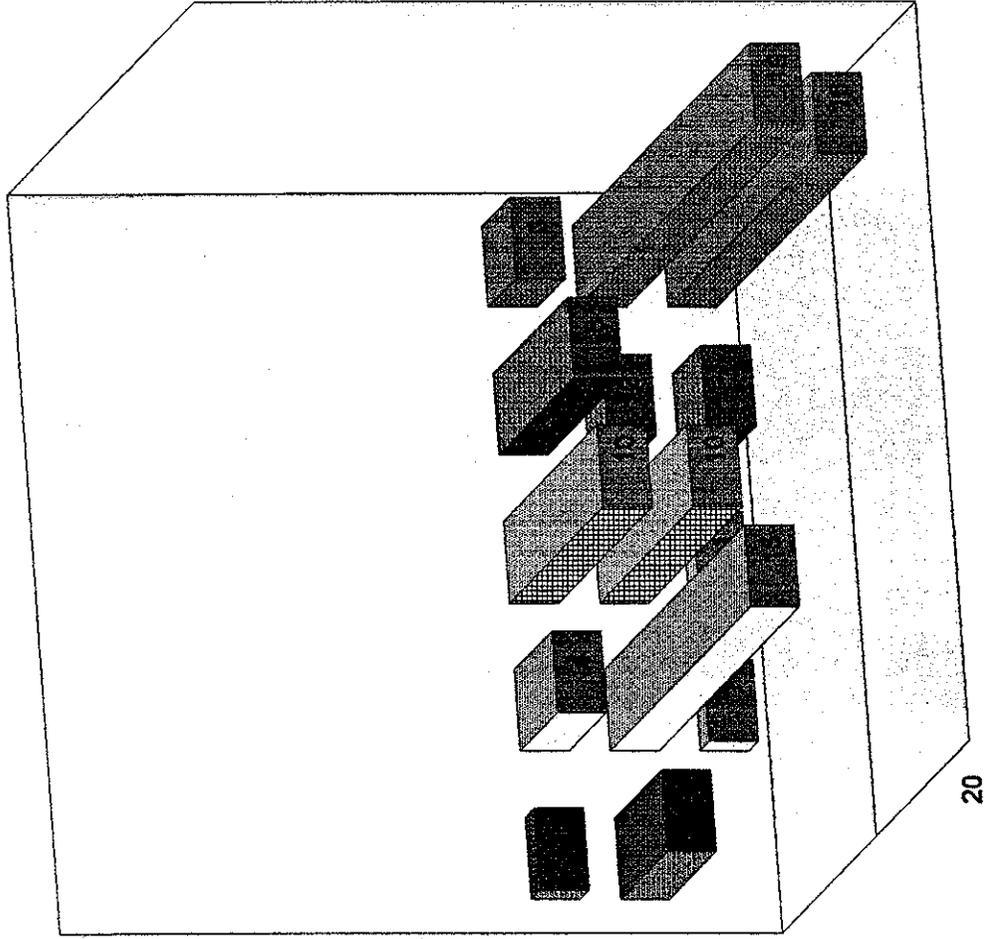


SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger

- ABANDONED
- COMBINED
- OTHER
- OUT OF SERVICE
- REMOVED

# Summary for Gas/Oil Lines

98 of 2,867 total lines



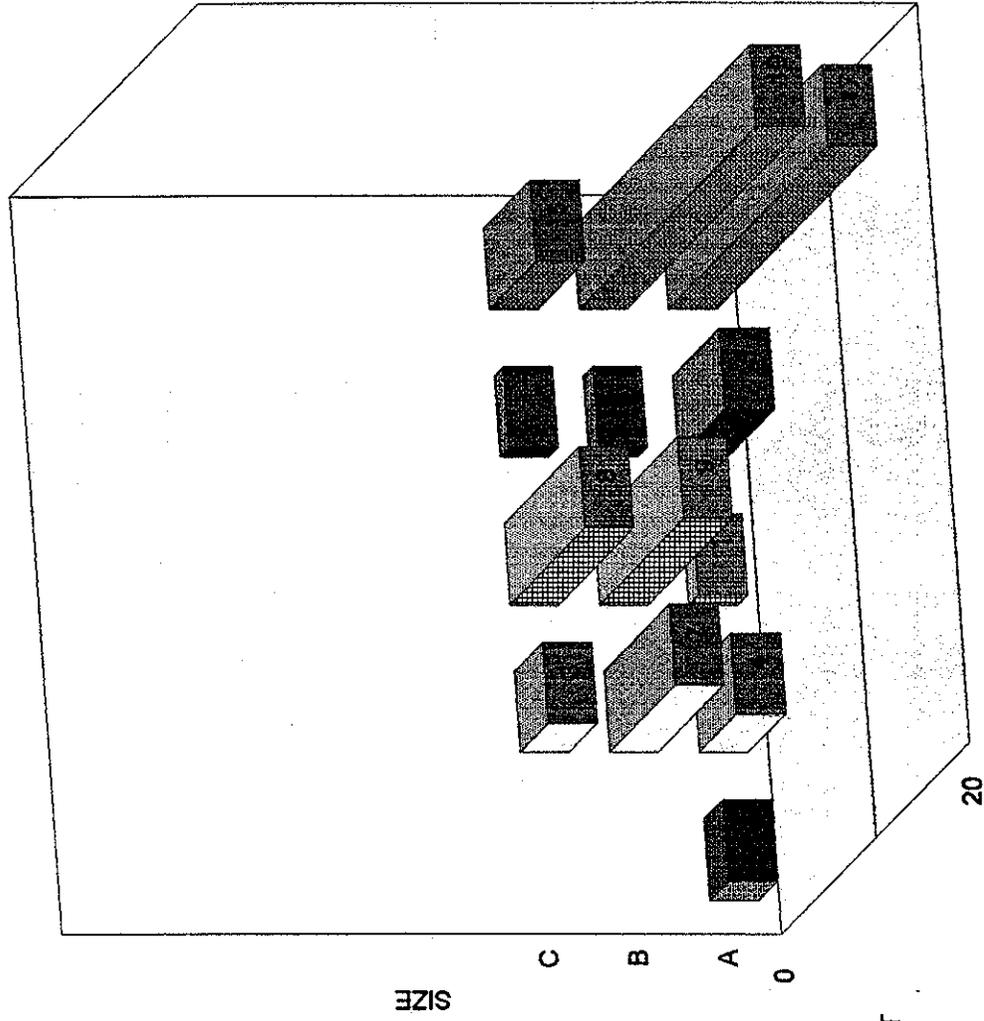
SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger

PRODUCT

- ABANDONED
- COMBINED
- OTHER
- OUT OF SERVICE
- REMOVED

# Summary for Gas/Condensate Lines

82 of 2,867 total lines



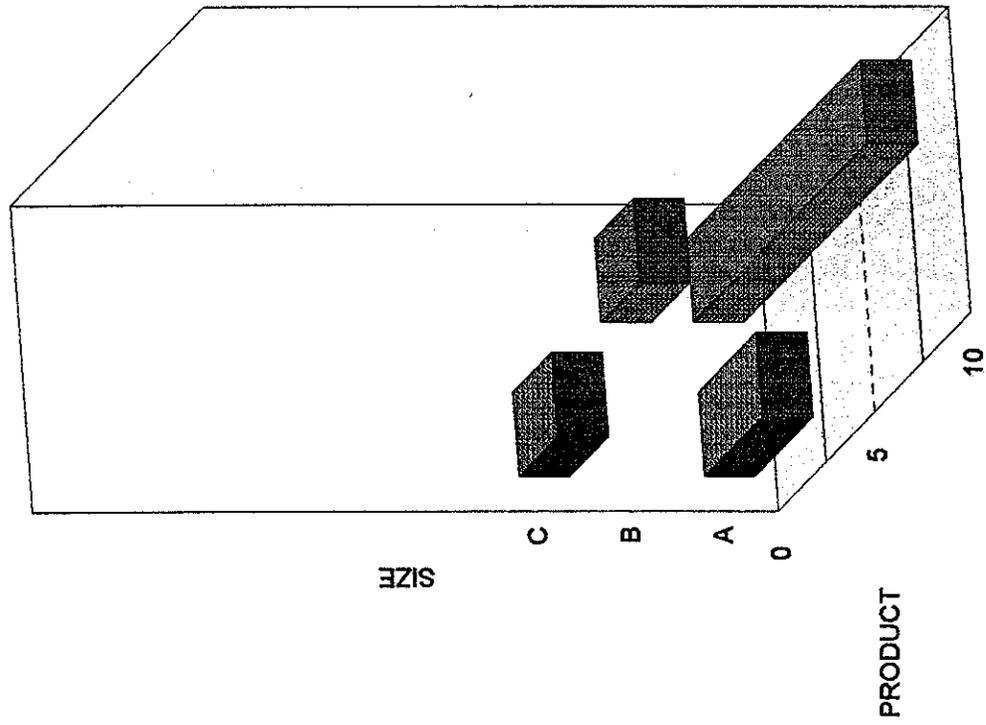
SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger

PRODUCT

- ABANDONED
- COMBINED
- OTHER
- OUT OF SERVICE
- REMOVED

# Summary for Gas Injection Lines

16 of 2,867 total lines

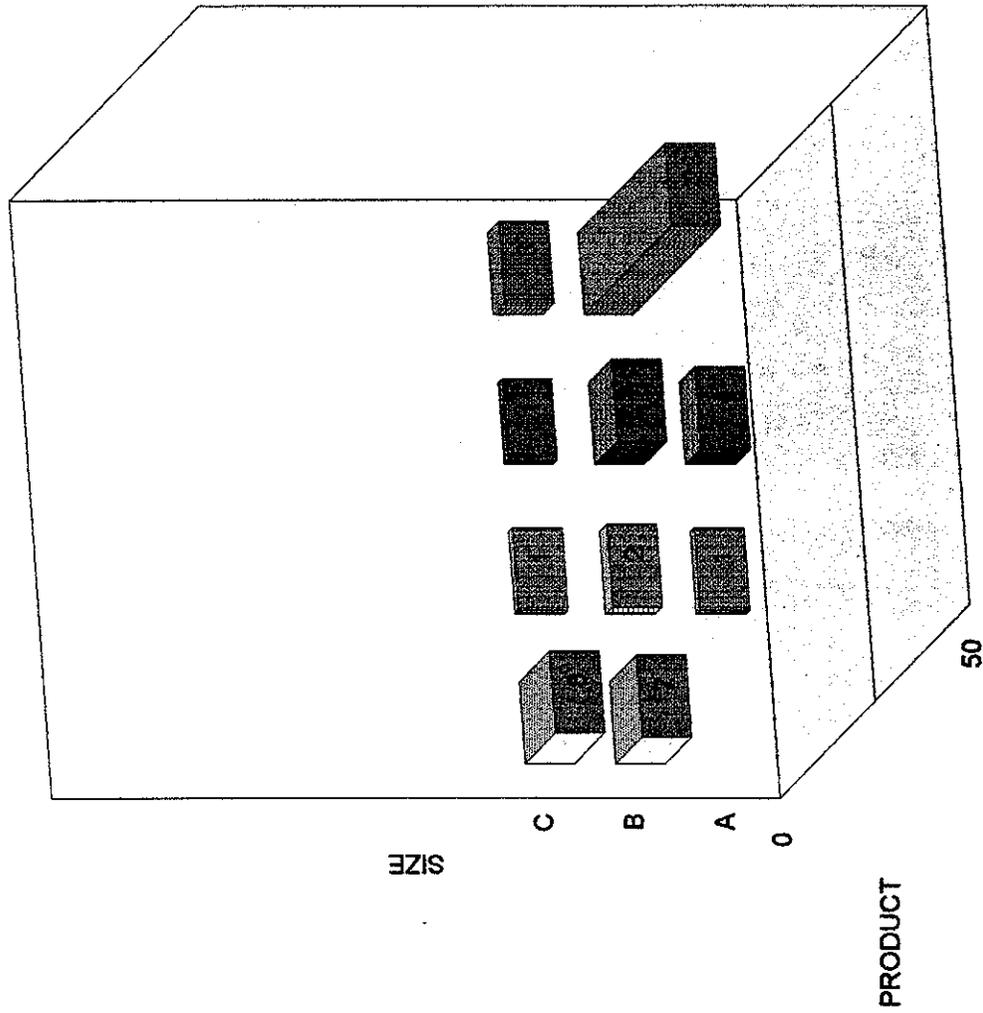


SIZE: A - 3" and smaller  
B - 4" to 6"  
C - 8" and larger

ABANDONED      OUT OF SERVICE

# Summary for Flare Gas Lines

56 of 2,867 total lines

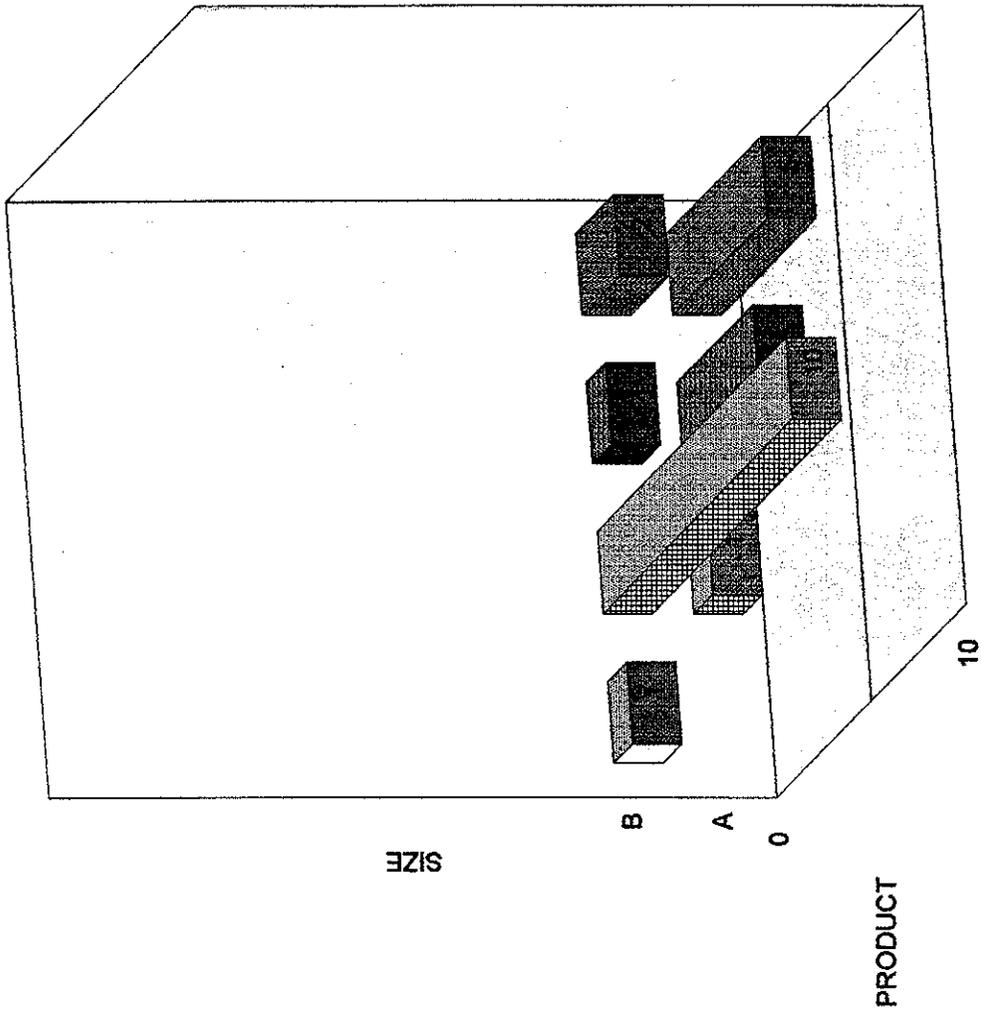


SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger

- ABANDONED
- OTHER
- OUT OF SERVICE
- REMOVED

# Summary for Test Lines

24 of 2,867 total lines

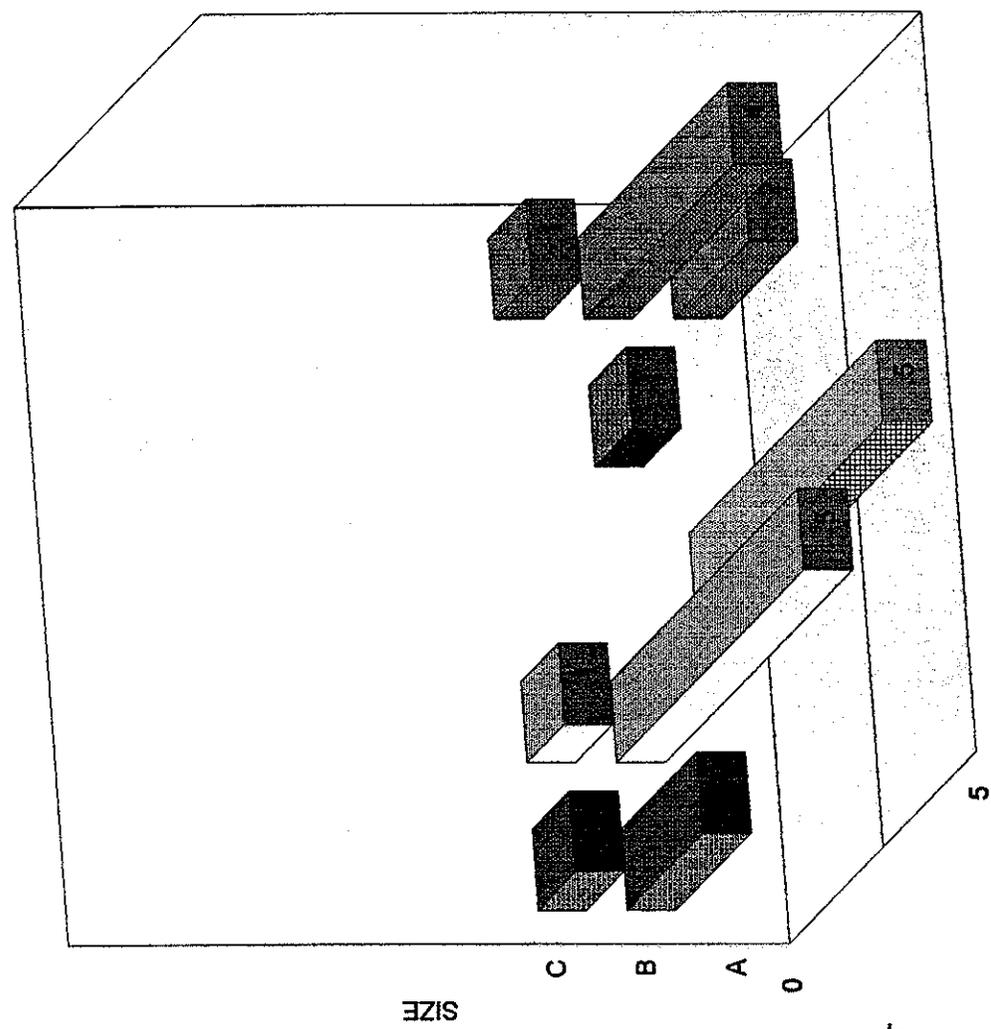


SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger



# Summary for Water Injection Lines

22 of 2,867 total lines

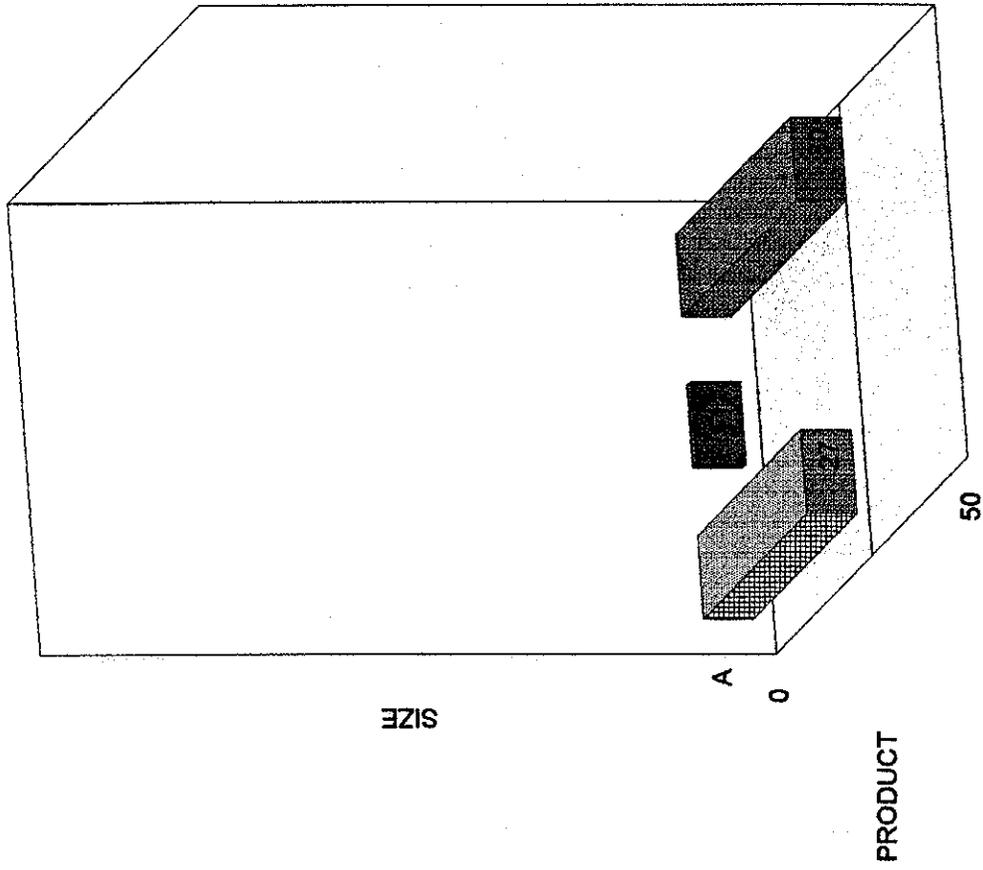


SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger

- ABANDONED
- COMBINED
- OTHER
- OUT OF SERVICE
- REMOVED

# Summary for Methanol Lines

58 of 2,867 total lines



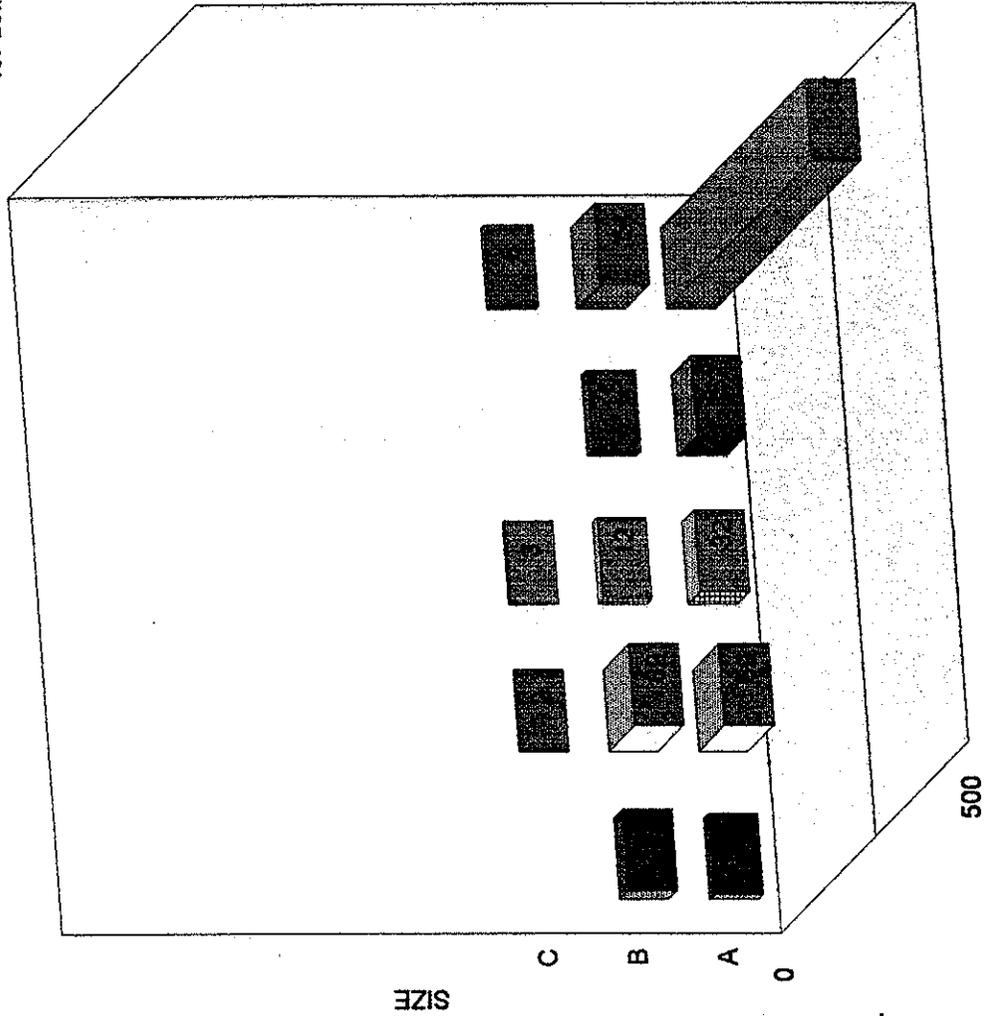
SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger

ABANDONED      OTHER      OUT OF SERVICE

# Summary for Other Lines

747 of 2,867 total lines

\* See service distribution pie chart for definition of "OTHER"

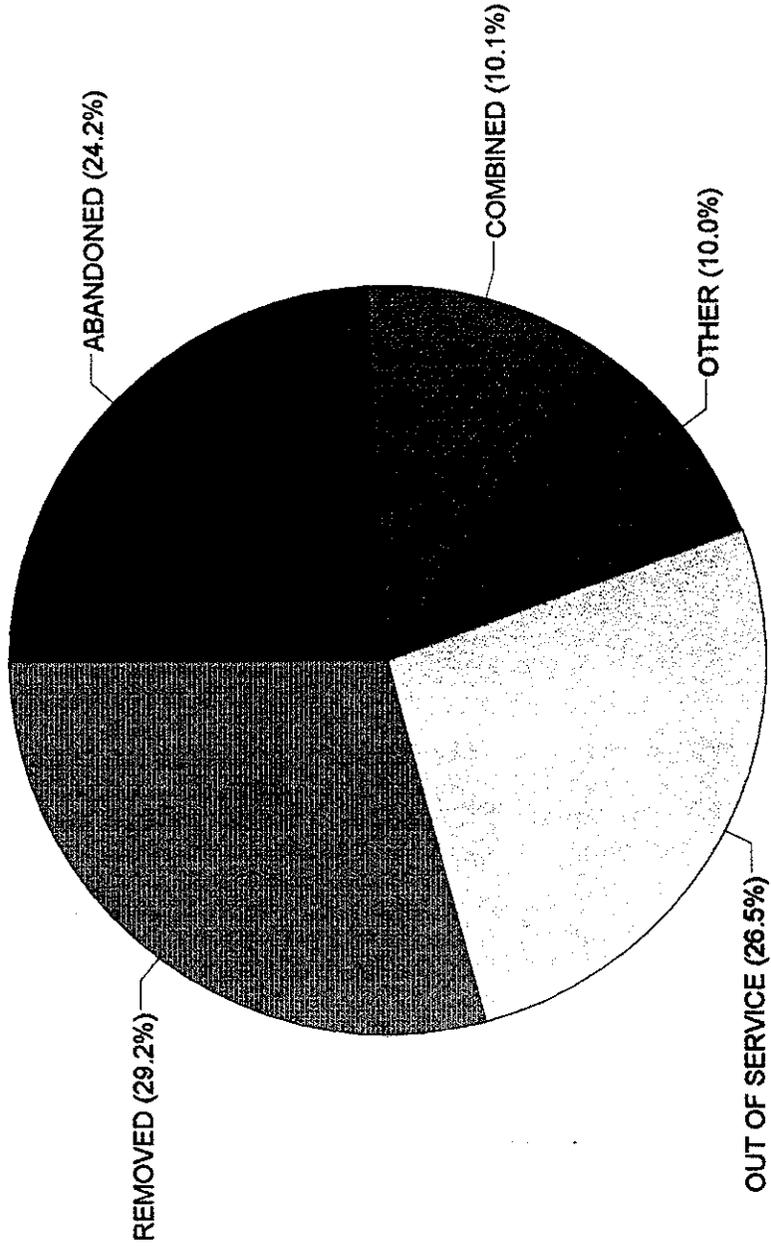


SIZE: A - 3" and smaller  
 B - 4" to 6"  
 C - 8" and larger

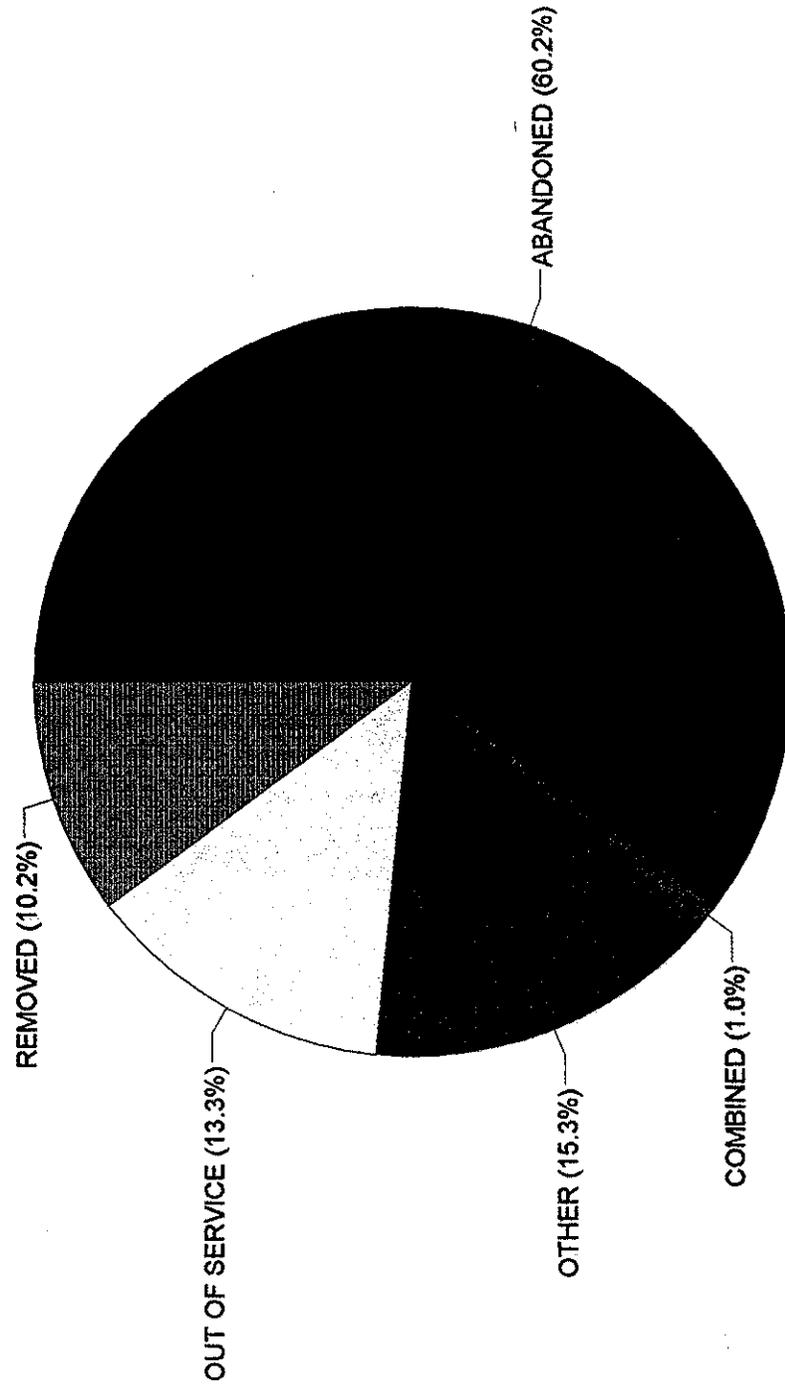
PRODUCT

- ABANDONED
- COMBINED
- OTHER
- OUT OF SERVICE
- REMOVED

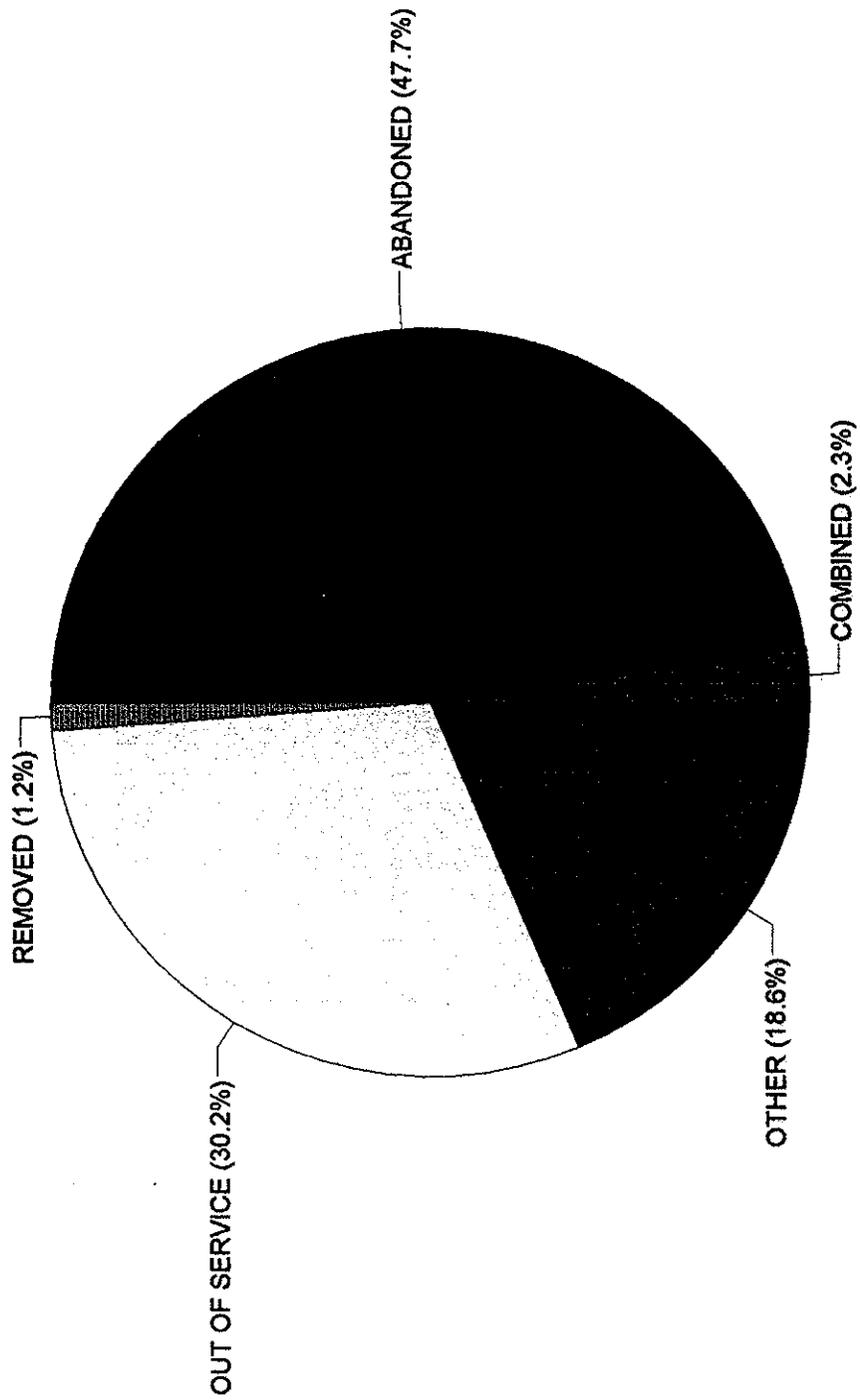
**Chevron Lines**  
623 of 2,867 total



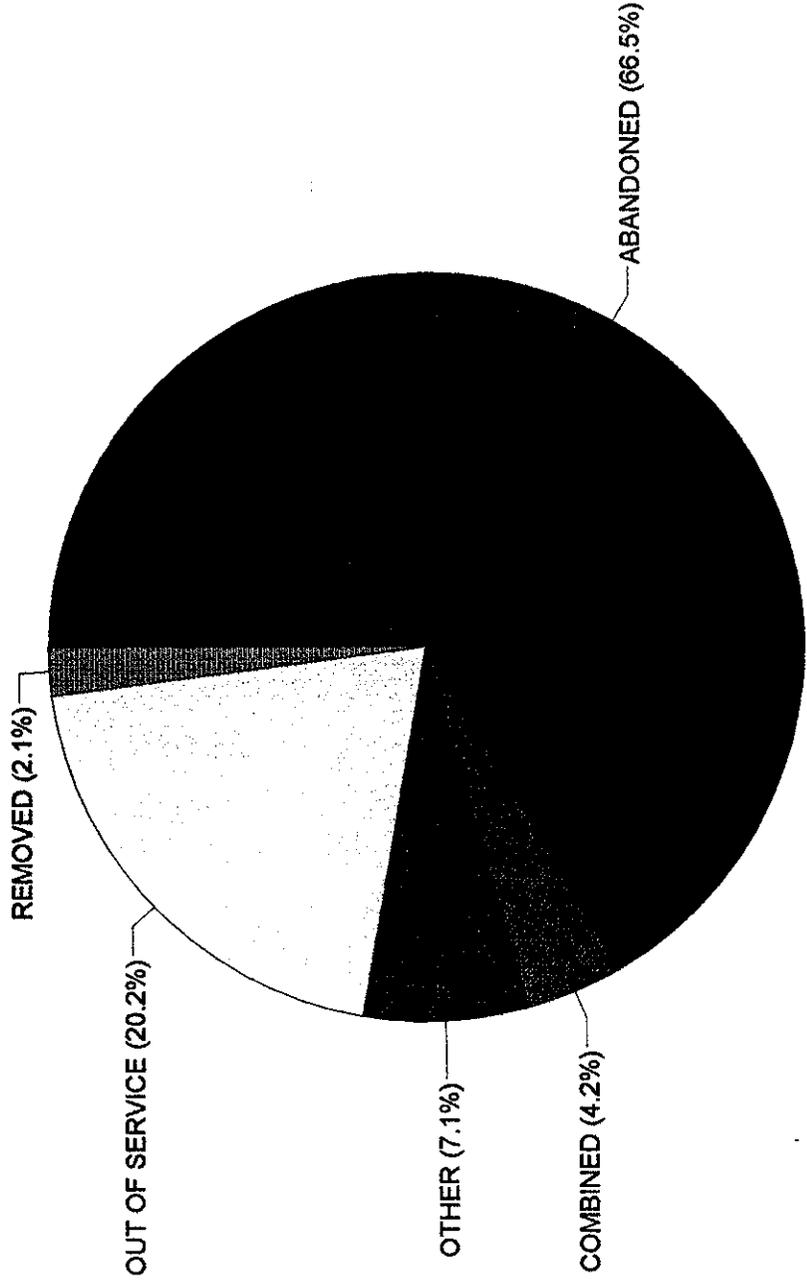
**Conoco Lines**  
98 of 2,867 total



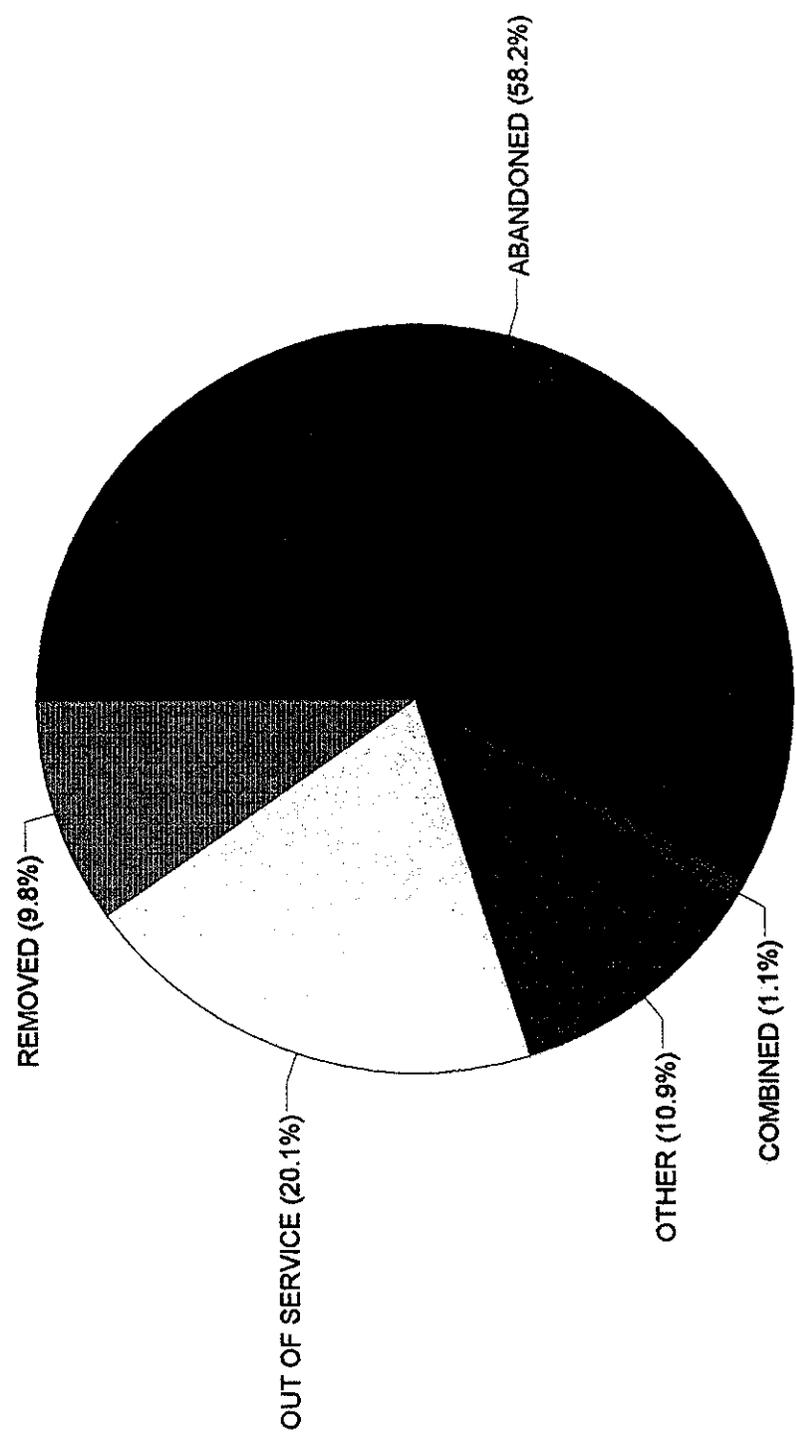
**Exxon Lines**  
86 of 2,867 total



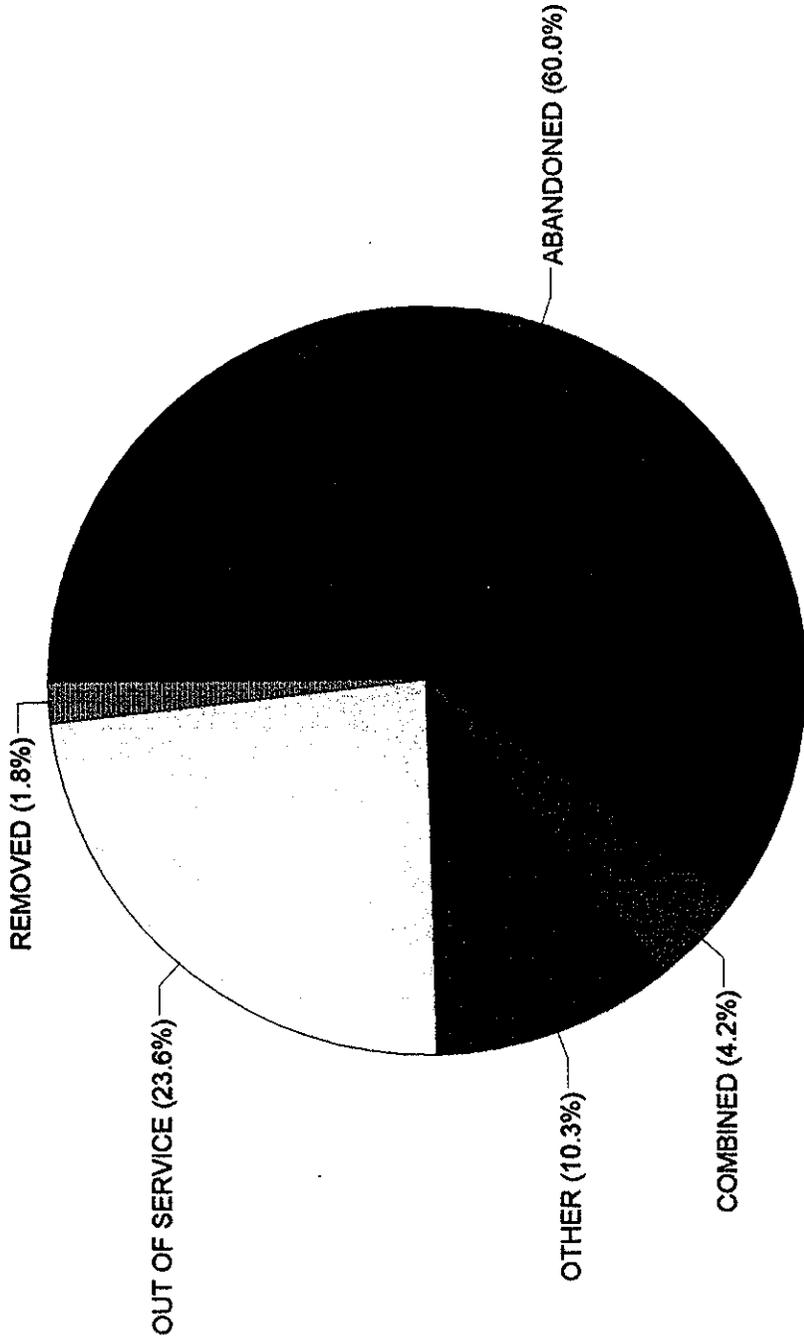
**Mobil Lines**  
382 of 2,867 total



**Shell Lines**  
184 of 2,867 total

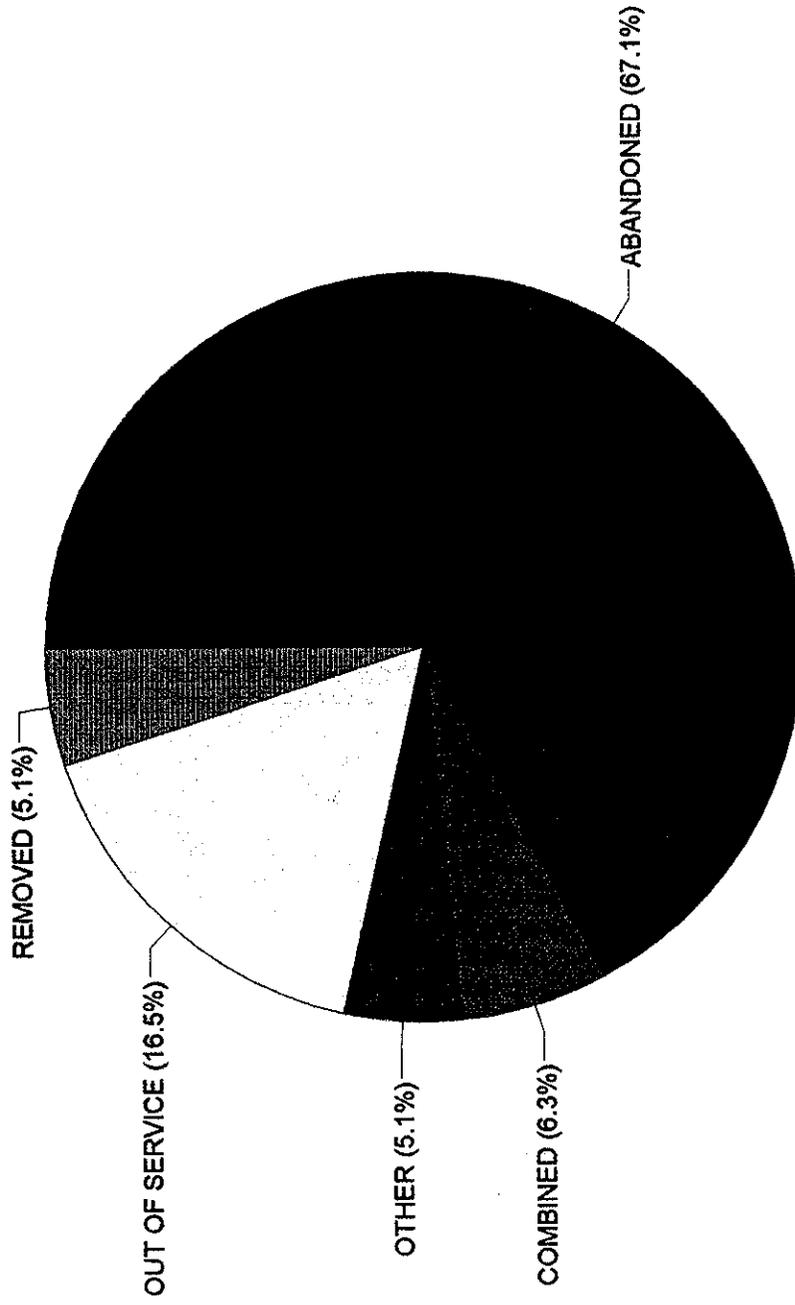


**Texaco Lines**  
165 of 2,867 total



# Union Oil Co. Lines

79 of 2,867 total



## **5.0 PIPELINE CONNECTION SYSTEMS FOR ABANDONMENT IN-SITU**

### **5.1 General Discussion of Available Equipment**

As can be seen in previous sections, an early trend has developed in government and the pipeline industry operator decision making concerning pipeline abandonment; to properly prepare the line and leave it in place. It has been noted in most regulations worldwide, the abandonment process usually requires the pipeline to be flushed of any residual contaminants to protect the environment and aquatic life, then fill the line with sea water or other inert medium and seal the ends.

Data from the Minerals Management Service (MMS) statistics shown in Section 4.0, indicate fewer than 10% of the some 2,900 listed non-producing pipelines in the MMS data base for the Gulf of Mexico, have been removed from the seabed. The other 90%, approximately 2,600 lines have been abandoned in various categories of consideration for future use.

The wide range of options available to operators when abandoning a line, such as, abandon and allow to deteriorate, take out of current service (temporary) with hopes of using the line in future new field development, or abandon and combine with another line, have prompted manufacturers to adopt many of their pipeline products to capping or plugging the ends of the abandoned pipelines.

#### **5.1.1 Mechanical Connectors, Slip and Packing Type Systems**

Abandonment options by operators to leave a pipeline in place for future use usually includes the selection of end connectors that can be removed, valved, blind flanged, flanged with a stringer (piece of pipe or spool) to facilitate pigging or maintenance of the line until re-connection.

This category of mechanical connectors use elastomer seals and wedge-shaped "slips" for anchoring the connection onto the end of the pipeline's outside surface. The HydroTech and Hydratight Morgrip use steel balls on a taper (wedge) to anchor onto the pipe. The slips and seals can be set independently or simultaneously, mechanically or hydraulically, depending on the supplier's design. The elastomer seals provide a proven sealing mechanism between the connector body and the rough outside surface of the pipe end. The slips provide the tensile strength capability.

The following vendors provide this hardware; see their information in the indicated sub-section:

- HydroTech Systems Inc. 5.3.1
- Big-Inch Marine Systems, Inc. 5.3.2
- Dasplit Mfg. Co. 5.3.3
- Hydra-Tight Ltd./Morgrip 5.3.4
- Team Inc. 5.3.5
- Gripper Inc. 5.3.6
- Oceaneering Pipeline Repair Systems Div. 5.3.7

### **5.1.2 Internal Plugs and End Packers - Stoppers**

When the abandonment option is driven by economics with no future use of the pipeline anticipated, the most cost effective approach can be to follow regulation guidelines, flush the line to remove pollutants, fill with seawater or other inert media, seal and bury the ends.

Several inexpensive devices, off-the-shelf items, have been used for years for stoppers in piping for repairs, regulating flows, pipe hydro-testing, and permanent plugging. Those most frequently selected for subsea pipeline abandonment are included in this section, namely, mechanical insert type end plugs and bladder type stoppers.

Like the mechanical connectors described in Section 5.1.1, the mechanical insert end plugs are designed to withstand pipeline pressures

up to 3,000 psi and are generally rated at -65°F to +250°F, using the same "slips" and elastomer seals. These are also set in place mechanically, the pressure increase forms an even tighter seal. They can be left with a center stem opening to the pipeline for subsequent inhibitor injection as may be required for periodic maintenance.

The bladder type stopper is strictly a low pressure (1-5 psi) differential plugging device, designed to be inflatable for pipeline stopper plugs and hydraulic flushing operations in pipe maintenance applications. This type unit can also be left in place to seal out aquatic life and keep the inert medium (sea water) in the pipeline by filling the stopper/bladder with grout.

A more permanent method of pipeline abandonment has evolved through an environmentally safe practice, approved by the Texas Water Commission, for abandoning underground storage tanks in place. This method has been developed by Elim-A-Tank, Inc. and uses a sand and water slurry pumped into the line. With the company's proprietary additive incorporated into the slurry, solidification occurs after several hours curing, forming a sand stone type material meeting TWC and API Requirements for being "an inert solid".

In practice, the slurry can be pumped up to 1,500-2,000 feet in a 4" pipeline. A recent job for a petrochemical plant on the Houston Ship Channel involved a 24" pipeline which was estimated to cost approximately \$160,000 to debury and remove. The slurry was pumped in place in about four (4) hours and cost \$12,000.

Vendors and information on plugs, stoppers and permanent means of pipeline abandonment follow:

- Thaxton Division, Hy-Tech Machine 5.3.12
- Peterson Products Company 5.3.13
- Perma-Type Rubber 5.3.11
- Elim-A-Tank, Inc. 5.3.8

### **5.1.3 Pipeline Recovery Equipment**

As the more recent fields in greater water depths become targets for decommissioning facilities and pipelines for production economics considerations, the real need for deep water pipeline retrieval has arrived. It may be that just segments of a line need to be retrieved for current "abandonment and combine" to tie into another production transportation line on the seabed, or with higher cost materials, the line will be used again elsewhere. To this impending need for technical and physical service, various companies around the world have begun to respond to what could be a banner business, where facilities abandonment could cost more than the original installation.

GenFlo Underwater Engineering, Ltd. has developed a large capacity twin-dredge with two 10 inch suction heads installed in a sled-type frame, which sits above the pipeline, a nozzle on both sides of the pipe. In June, 1992, this unit was commissioned by Stena Offshore for pipeline trenching and deburial in the Danish sector for the Maersk pipeline project (see the three (3) articles in Section 5.3.9, GenFlo Underwater Engineering, Ltd. for more information).

Stena Offshore has developed a new pipeline recovery system to support Stena's continuing move into deepwater pipelay which allows pipelines to be retrieved from the seabed without the need for diver intervention. According to Stena, their system is cheaper than conventional methods of pipeline recovery and is designed for water depths of over 3,300 feet. Stena's Remote Systems Group incorporated their new ROV, the MRV1 which features a diamond impregnated wire loop for remote pipe cutting and a new pipe handling tool (see two (2) articles in Section 5.3.10, regarding pipeline recovery/retrieving system).

## **5.2 Summary of Connector Usage to Date**

Cleaning and capping abandoned lines has been more prevalent with recent environmentally sensitive legislation and awareness of accumulated contaminants in pipelines and the danger to sea life upon entering an open pipeline.

In the past several years, operators in the Gulf of Mexico have been more inclined to "temporarily" abandon pipelines, the MMS category labeled "out of service". There is the desire to keep pipelines in good condition to be brought back into service if a new field is developed near the pipeline arrangement. Also, platform decommissioning and removal operations are requiring, as a minimum, that lines in the proximity of the platform (risers) be removed at the seafloor termination and the pipelines be temporarily abandoned.

The mechanical abandonment cap (pipe end connector) seems to best suit the purpose for temporary abandonment. Using the HydroTech Systems provided "User's List" of December, 1991 as an attached reference, approximately 50 of their "slip-on" mechanical couplings configured as pipe end connectors have been installed mostly in the Gulf of Mexico ranging in sizes from 3" to 30". About one-half of these connectors incorporated "stingers" (welded or flanged and welded pipe spools) which provide pig launching/receiving capability and access for pumping fluids such as inhibitors into the pipeline. As can be seen in the HydroTech User's List, most of the pipe end connector (PEC) applications, those marked with an asterisk, have been placed in service in the past 4 to 5 years.

Mark V HydroCouple Products

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User Reference List

Page 1

PRODUCT GROUP: Mk V SPRU

SLSORD#	CUSTOMER	GEO	QTY	SIZE	RATING	CLASS	MON/YR	SERVICE	LOCATION
245	HH Gulf Oil	E	4	6"	ANSI	300	10/75	Oil	Gabon
268	HH Total/Crest	E	4	12"	ANSI	900	6/76	Oil	Java Sea
273	HH Conoco/CAGC	D	2	8"	ANSI	900	7/76	Oil	Gulf Of Mexico
277	HH Agip (Rana)	E	1	2"	API	5,000	8/76	Oil	Mediterranean
277	HH Agip (Rana)	E	1	6"	API	5,000	8/76	Oil	Mediterranean
278	HH Agip (Rana)	E	1	14"	ANSI	900	8/76	Oil	Mediterranean
278	HH Agip (Rana)	E	1	3"	ANSI	900	8/76	Gly	Mediterranean
279	HH Agip (Rana)	E	1	10"	ANSI	900	8/76	Oil	Mediterranean
279	HH Agip (Rana)	E	1	3"	ANSI	900	8/76	Gly	Mediterranean
315	HH Esso	E	1	6"	ANSI	300	7/77	Oil	Malaysia
319	HH Stingray P/L Co	D	2	16"	ANSI	600	8/77	Gas	Gulf Of Mexico
325	HH Agip	E	1	10"	ANSI	1,500	9/77	Oil	Mediterranean
325	HH Agip	E	1	3"	ANSI	1,500	9/77	Gly	Mediterranean
338	HH Mich-Wisc P/L Co	D	4	8"	ANSI	600	11/77	Gas	Gulf Of Mexico
349	HH Gulf Oil	D	2	8"	ANSI	600	1/78	Oil	Gulf Of Mexico
358	HH Agip (Rana)	E	1	14"	ANSI	900	4/78	Oil	Mediterranean
358	HH Agip (Rana)	E	1	3"	ANSI	900	4/78	Gly	Mediterranean
385	HH Lovaca	D	4	12"	ANSI	900	8/78	Gas	Gulf Of Mexico
400	HH Petrobras	E	4	12"	ANSI	300	2/79	Oil	Brazil
400	HH Petrobras	E	4	8"	ANSI	300	2/79	Oil	Brazil
427	HH Petrobel	E	2	12"	ANSI	600	7/79	Oil	Red Sea
428	HH Cities Service	D	2	8"	ANSI	600	7/79	Oil	Gulf Of Mexico
443	HH Amoco Intl	E	2	16"	ANSI	600	10/79	Oil	Trinidad
443	HH Amoco Intl	E	2	8"	ANSI	600	10/79	Oil	Trinidad
462	HH Agip	E	1	14"	ANSI	900	2/80	Oil	Mediterranean
462	HH Agip	E	2	3"	ANSI	900	2/80	Gly	Mediterranean
477	HH Agip	E	1	12"	ANSI	600	4/80	Gas	Mediterranean
477	HH Agip	E	1	3"	ANSI	600	4/80	Gly	Mediterranean
479	HH Agip (Rana)	E	2	8"	ANSI	900	5/80	Oil	Adriatic
514	HH Texas Eastern	D	1	10"	ANSI	600	1/81	Gas	Gulf Of Mexico
533	HH Occidental-UK	E	2	10"	ANSI	900	3/81	Gas	North Sea
533	HH Occidental-UK	E	2	6"	ANSI	1,500	3/81	Water	North Sea
533	HH Occidental-UK	E	2	8"	ANSI	1,500	3/81	Oil	North Sea
553	HH Amoco Prodction	D	2	10"	ANSI	600	6/81	Oil	Gulf Of Mexico
553	HH Amoco Prodction	D	2	20"	ANSI	600	6/81	Oil	Gulf Of Mexico
603	HH INOC (Finetex)	E	2	10"	ANSI	900	2/82	Oil	Arabian Gulf
603	HH INOC (Finetex)	E	2	12"	ANSI	900	2/82	Oil	Arabian Gulf
616	HH Mesa Petroleum	D	2	4"	ANSI	1,500	3/82	Oil	Gulf Of Mexico
616	HH Mesa Petroleum	D	2	8"	ANSI	1,500	3/82	Oil	Gulf Of Mexico
766	HH Agip	E	1	10"	ANSI	900	12/82	Oil	Adriatic Sea
766	HH Agip	E	1	3"	ANSI	900	12/82	Gly	Adriatic Sea
797	HH British Pet	E	2	12"	ANSI	900	1/83	Oil	North Sea
929	HH Agip	E	2	3"	ANSI	600	6/83	Gly	Adriatic Sea
930	HH Agip	E	1	10"	ANSI	900	6/83	Oil	Adriatic Sea
1250	HH Shell Oil	D	2	10"	ANSI	1,500	3/84	Water	California
1386	HH Agip	E	1	10"	ANSI	900	10/84	Oil	Congo
1409	HH Agip	E	3	6"	ANSI	900	10/84	Oil	Congo
1432	HH United Gas P/L	D	4	24"	ANSI	600	2/85	Gas	Gulf Of Mexico
1434	HH Corp de Fomento	E	1	10"	ANSI	900	2/85	Oil	Chile
1451	HH (TM) Occidental-UK	E	2	12"	ANSI	900	5/85	Water	North Sea
1486	HH Agip	E	1	12"	ANSI	600	10/85	Oil	Nigeria
* 1518	HH United Gas P/L	D	1	8"	ANSI	600	4/86	Gas	Gulf Of Mexico
1548	HH ANR Pipeline	D	2	6"	ANSI	900	9/86	Gas	Gulf Of Mexico
1554	HH ANR Pipeline	D	2	10"	ANSI	900	9/86	Gas	Gulf Of Mexico
1580	HH Shell Oil	D	2	8"	ANSI	900	1/87	Oil	Gulf Of Mexico
1606	HH NGPL (RUPE)	D	1	16"	ANSI	900	5/87	Gas	Gulf Of Mexico
1623	HH (TM) Occidental-UK	E	1	12"	ANSI	900	9/87	Water	North Sea
1624	HH Shell Oil	D	1	12"	ANSI	900	8/87	Oil	Gulf Of Mexico
* 1668	HH Forest Oil	D	1	6"	ANSI	900	12/87	Oil	Gulf Of Mexico
1753	HH Shell Pipeline	D	1	12"	ANSI	900	9/88	Oil	Gulf Of Mexico
1753	HH Shell Pipeline	D	2	14"	ANSI	900	9/88	Gas	Gulf Of Mexico
1753	HH Shell Pipeline	D	2	16"	ANSI	900	9/88	Oil	Gulf Of Mexico
1753	HH Shell Pipeline	D	2	8"	ANSI	900	9/88	Oil	Gulf Of Mexico

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PRODUCT GROUP: Mk V SPRU

SLSORD#	CUSTOMER	GEO	QTY	SIZE	RATING	CLASS	MON/YR	SERVICE	LOCATION
1759	HH Standard Oil	D	2	12"	ANSI	900	9/88	Oil	Gulf Of Mexico
* 1784	HH Columbia Gulf (Cal Div)	D	1	6"	ANSI	900	12/88	Gas	Gulf Of Mexico
1809	HH ANR Pipeline	D	1	6"	ANSI	900	3/89	Gas	Gulf Of Mexico
1856	HH Long Islnd Ltng	D	1	24"	ANSI	300	7/89	Oil	Long Islnd Snd
1887	HH ONGC	E	2	26"	ANSI	900	9/89	Oil	Bombay High
1887	HH ONGC	E	2	30"	ANSI	900	9/89	Gas	Bombay High
1887	HH ONGC	E	2	36"	ANSI	900	9/89	Gas	Bombay High
1943	HH RUPE (ANR P/L)	D	2	10"	ANSI	900	12/89	Gas	Gulf Of Mexico
1981	HH Shell Oil	D	2	12"	ANSI	900	3/90	Oil	Gulf Of Mexico
2043	HH S.I.R. / Total	E	1	42"	ANSI	150	7/90	Oil	Ivory Coast
2186	HH Walter O & G	D	2	6"	ANSI	900	2/91	Oil	Gulf Of Mexico
2223	HH Chevron USA	D	2	8"	ANSI	600	3/91	Oil	Gulf Of Mexico
2309	HH Oxy USA	D	2	12"	ANSI	900	7/91	Oil	Gulf Of Mexico
2341	HH S.I.R. / Total	E	1	24"	ANSI	150	7/91	Oil	Ivory Coast
2346	HH Texaco Intl	E	1	8"	ANSI	600	7/91	Oil	Angola
2349	HH Shell Offshore	D	2	8"	ANSI	900	8/91	Oil	Gulf Of Mexico
* 2362	HH Cal Dive	D	1	12"	ANSI	900	8/91	Oil	Gulf Of Mexico
2525	HH ONGC	E	2	20"	ANSI	900	3/92	Oil	Bombay High
2525	HH ONGC	E	2	24"	ANSI	900	3/92	Oil	Bombay High
2577	HH SIR Ivory Coast	E	1	24"	ANSI	150	6/92	Oil	Ivory Coast
2616	HH SIR Ivory Coast	E	1	30"	ANSI	150	8/92	Oil	Ivory Coast
2638	HH Petrobel	E	2	18"	ANSI	600	8/92	Oil	Red Sea
2638	HH Petrobel	E	2	6"	ANSI	600	8/92	Oil	Red Sea
2678	HH Energy Development Co.	D	2	6"	ANSI	900	9/92	Oil	Gulf Of Mexico
2705	HH Energy Development Co.	D	1	6"	ANSI	900	11/92	Oil	Gulf Of Mexico

TOTAL FOR Mk V SPRU 154  
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PRODUCT GROUP: Mk V RRU

SLSORD#	CUSTOMER	GEO	QTY	SIZE	RATING	CLASS	MON/YR	SERVICE	LOCATION
281	HH Arco/Lapco	E	1	10"	ANSI	900	9/76	Oil	Arabian Gulf
281	HH Arco/Lapco	E	1	8"	ANSI	900	9/76	Oil	Arabian Gulf
282	HH Texas Eastern	D	1	8"	ANSI	600	9/76	Gas	Gulf Of Mexico
336	HH COPE	E	2	12"	ANSI	600	11/77	Oil	Red Sea
470	HH Shell (Scallop)	E	2	3"	PSI	1,000	3/80	Oil	Arabian Gulf
483	HH Shell Oil	D	1	6"	ANSI	900	6/80	Oil	Gulf Of Mexico
540	HH CNG Producing	D	1	6"	ANSI	900	4/81	Gas	Gulf Of Mexico
544	HH Agip	E	1	6"	ANSI	900	5/81	Oil	Mediterranean
1376	HH Pemex	E	1	14"	ANSI	600	9/84	Oil	Mexico
1376	HH Pemex	E	2	20"	ANSI	600	9/84	Oil	Mexico
1376	HH Pemex	E	2	24"	ANSI	600	9/84	Oil	Mexico
1433	HH Pemex (LaMare)	E	6	12"	ANSI	600	2/85	Oil	Mexico
1450	HH Pemex (LaMare)	E	1	12"	ANSI	600	5/85	Oil	Mexico
1547	HH Agip (RANA)	E	1	3"	ANSI	1,500	8/86	Gly	Adriatic
1631	HH Pemex	E	1	36"	ANSI	600	9/87	Oil	Mexico
1640	HH Pemex	E	1	12"	ANSI	600	10/87	Oil	Mexico
1640	HH Pemex	E	1	8"	ANSI	600	10/87	Oil	Mexico
1698	HH Diamond Servcs	D	1	6"	ANSI	900	5/88	Oil	Gulf Of Mexico
* 1798	HH Chevron-USA	D	1	4"	ANSI	600	2/89	Oil	Gulf Of Mexico
1808	HH Chevron-USA	D	1	6"	ANSI	900	3/89	Oil	Gulf Of Mexico
* 1856	HH Long Islnd Ltng	D	1	4"	ANSI	300	7/89	Fuel	Long Islnd Snd
1915	HH Chevron-USA	D	2	6"	ANSI	900	11/89	Oil	Gulf Of Mexico
1925	HH Hall Houston	D	1	3"	ANSI	1,500	11/89	Oil	Gulf Of Mexico
1977	HH Chevron	D	1	4"	ANSI	900	3/90	Oil	Gulf Of Mexico
2006	HH Hall Houston	D	1	6"	ANSI	900	5/90	Oil	Gulf Of Mexico
2020	HH Texaco	D	1	8"	ANSI	900	6/90	Oil	Gulf Of Mexico
2074	HH Transco	D	1	8"	ANSI	600	9/90	Oil	Gulf Of Mexico
2098	HH Texaco	D	1	8"	ANSI	600	10/90	Oil	Gulf Of Mexico
2102	HH Shell Offshore	D	1	3"	ANSI	1,500	10/90	Oil	Gulf Of Mexico
2102	HH Shell Offshore	D	1	4"	ANSI	1,500	10/90	Oil	Gulf Of Mexico
2217	HH Chevron USA	D	1	4"	ANSI	900	3/91	Oil	Gulf Of Mexico
2226	HH Walter O & G	D	2	4"	ANSI	900	3/91	Oil	Gulf Of Mexico
2238	HH Chevron USA	D	1	4"	ANSI	900	3/91	Oil	Gulf Of Mexico
2264	HH Conoco, Inc.	D	2	8"	ANSI	900	5/91	Oil	Gulf Of Mexico
2450	HH Global P/L PLUS	D	1	4"	ANSI	900	10/91	Oil	Gulf Of Mexico

TOTAL FOR Mk V RRU 47  
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PRODUCT GROUP: Mk V PEC

SLSORD#	CUSTOMER	GEO	QTY	SIZE	RATING	CLASS	MON/YR	SERVICE	LOCATION
237	HH Arco	D	4	2"	API	5,000	7/75	Oil	Gulf Of Mexico
458	HH Texaco Intl	E	1	30"	ANSI	150	2/80	Water	Ecuador
*1518	HH United Gas P/L	D	1	8"	ANSI	600	4/86	Gas	Gulf Of Mexico
*1526	HH Texaco (CalDive)	D	2	6"	ANSI	900	5/86	Oil	Gulf Of Mexico
*1599	HH Placid (Cal Dive)	D	2	3"	ANSI	1,500	4/87	Oil	Gulf Of Mexico
*1613	HH Chevron (Cal Dive)	D	1	4"	ANSI	600	6/87	Oil	Gulf Of Mexico
*1642	HH ANR Pipeline	D	1	12"	ANSI	900	10/87	Gas	Gulf Of Mexico
*1668	HH Forest Oil	D	1	6"	ANSI	900	12/87	Oil	Gulf Of Mexico
*1674	HH ONGC	E	1	13"	API	5,000	1/88	Oil	Bombay High
*1674	HH ONGC	E	1	20"	API	2,000	1/88	Oil	Bombay High
*1674	HH ONGC	E	1	9"	API	5,000	1/88	Oil	Bombay High
*1702	HH Trunkline Gas	D	2	16"	ANSI	600	5/88	Gas	Gulf Of Mexico
*1784	HH Columbia Gulf (Cal Div)	D	1	6"	ANSI	900	12/88	Gas	Gulf Of Mexico
*1793	HH Agip (McDermott)	E	1	12"	ANSI	900	1/89	Oil	Nigeria
*1821	HH Shell Offshore	D	3	8"	ANSI	600	4/89	Oil	Gulf Of Mexico
*1824	HH Transco	D	2	8"	ANSI	900	4/89	Gas	Gulf Of Mexico
*1856	HH Long Islnd Ltng	D	1	24"	ANSI	300	7/89	Oil	Long Islnd Snd
*1856	HH Long Islnd Ltng	D	1	4"	ANSI	300	7/89	Fuel	Long Islnd Snd
*1951	HH ANR Pipeline	D	1	12"	ANSI	600	1/90	Gas	Gulf Of Mexico
*1953	HH Transco	D	2	30"	ANSI	900	1/90	Gas	Gulf Of Mexico
*1954	HH Transco	D	2	20"	ANSI	900	1/90	Gas	Gulf Of Mexico
*1955	HH Transco	D	1	16"	ANSI	900	1/90	Gas	Gulf Of Mexico
2019	HH Shell Offshore	D	1	4"	ANSI	900	5/90	Oil	Gulf Of Mexico
*2218	HH Walter O & G	D	1	4"	ANSI	900	3/91	Oil	Gulf Of Mexico
*2222	HH Walter O & G	D	1	4"	ANSI	900	3/91	Oil	Gulf Of Mexico
*2228	HH ANR Pipeline	D	1	16"	ANSI	900	3/91	Gas	Gulf Of Mexico
*2254	HH Cal Dive Intl	D	2	6"	ANSI	900	4/91	Oil	Gulf Of Mexico
*2273	HH Cal Dive	D	1	4"	ANSI	900	5/91	Oil	Gulf Of Mexico
*2273	HH Cal Dive	D	2	6"	ANSI	900	5/91	Oil	Gulf Of Mexico
*2340	HH Samedan Oil	D	1	6"	ANSI	900	7/91	Oil	Gulf Of Mexico
*2362	HH Cal Dive	D	1	12"	ANSI	900	8/91	Oil	Gulf Of Mexico
*2395	HH Hassie Hunt	D	1	6"	ANSI	900	8/91	Oil	Gulf Of Mexico
*2397	HH Enron	D	1	8"	ANSI	900	9/91	Gas	Gulf Of Mexico
*2446	HH Walter O & G	D	1	6"	ANSI	600	10/91	Oil	Gulf Of Mexico
*2510	HH Columbia Gas	D	1	30"	ANSI	900	2/92	Gas	Gulf Of Mexico
2545	HH Kuwait Oil Co.	E	2	48"	ANSI	300	5/92	Oil	Arabian Gulf
*2552	HH Enron	D	1	20"	ANSI	600	5/92	Gas	Gulf Of Mexico
*2618	HH Tennessee Gas P/L Co.	D	1	12"	ANSI	600	8/92	Gas	Gulf Of Mexico
*2626	HH Southern Nat. Gas Co.	D	1	10"	ANSI	900	8/92	Gas	Gulf Of Mexico
*2688	HH Rana Intl.	E	1	36"	ANSI	150	10/92	Oil	Mediterranean
*2698	HH Divcon Intl. / Total Indo	E	1	30"	ANSI	150	10/92	Gas/Oil	Java Sea
*2698	HH Divcon Intl. / Total Indo	E	1	6"	ANSI	150	10/92	Gas/Oil	Java Sea
*2702	HH DelMar Exploration	D	1	10"	ANSI	900	10/92	Gas	Gulf Of Mexico
*2751	HH TEXAS GULF PETROLEUM	E	1	6"	ANSI	600	2/93	Oil	Mexico
*2775	HH B.C. MEEHAN / WMC	E	2	8"	ANSI	600	3/93	Oil	Timor Sea
*2862	HH Western Mining Pete. Div.	E	2	4"	ANSI	600	6/93	Oil	Timor Sea
*2863	HH Kerr McGee	D	1	4"	ANSI	900	6/93	Oil	Gulf Of Mexico
*2863	HH Kerr McGee	D	1	6"	ANSI	900	6/93	Oil	Gulf Of Mexico
*2867	HH Kerr McGee	D	1	4"	ANSI	600	6/93	Oil	Gulf Of Mexico

TOTAL FOR Mk V PEC 65  
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TOTAL: 266

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**5.3 Vendor Information**

- 5.3.1 HydroTech - Mechanical Abandonment Cap**
- 5.3.2 Big Inch Marine Ball Flange Connector**
- 5.3.3 Daspit Mfg. Co. - Perma-Lok II**
- 5.3.4 Hydra-Tight - Morgrip Coupling**
- 5.3.5 Team Inc. - Mech. Repair Coupling**
- 5.3.6 Gripper, Inc. - Grip & Seal Hydraulic Coupling**
- 5.3.7 Oceaneering Pipeline Repair Systems**
- 5.3.8 Elim-A-Tank, Inc.**
- 5.3.9 GenFlo Underwater Engineering, Ltd.**
- 5.3.10 Stena Offshore - BSW Engineering**
- 5.3.11 Perma-Type Rubber**
- 5.3.12 Thaxton, Inc.**
- 5.3.13 Petersen Products Co.**

### **5.3.1 HydroTech - Mechanical Abandonment Cap**

**HydroTech Systems**  
**General Installation Procedure**  
**for Mechanical Abandonment Cap**



**HydroTech Systems**

ENGINEERED PIPELINE PRODUCTS

GENERAL INSTALLATION PROCEDURE

PIPELINE END CONNECTOR

20 Inch

ANSI CLASS 600

SERIAL NO.: TBD

ASSEMBLY NUMBER: 06-032072

S.O. NUMBER: 2552HH

Pipeline Operator/Owner: ENRON CORPORATION

Contractor: TBD

Location: SOUTH PADRE ISLAND, BLOCK 1064-L

Water Depth: 96 FSW

Date: July 21, 1992



I. LOCATION AND INSPECTION

- A. Locate the pipeline and carry out preliminary visual inspection. Report bottom conditions such as visibility, type of soil, current, pipeline burial depth, condition of weight coating, etc.
- B. Locate the section of pipeline to be cut out. If the field joint will be in the area where the Pipe End Connector will be stabbed on the pipeline, then the pipe should be cut past the field joint.
- C. Make a rough measurement to determine the approximate location of the pipe cut.

II. SEABED PREPARATION

- A. It is necessary to excavate a hole in the seabed at the location selected for installing the PEC Assembly. Excavate around the pipeline only by use of a water jet method.
- B. The method and equipment selected by the diving contractor for making the hole in the seabed shall only be by use of a water jet method.
- C. The water jet equipment selected by the diving contractor for making the hole in the seabed shall be capable of maintaining the minimum hole dimensions until the repair operation is complete.



- D. The minimum dimensions at the bottom of the excavated hole are shown in Figure 1.

III. PIPELINE PREPARATION

- A. Jet out beneath the pipe to a depth and length in excess of the maximum dimensions of the connector. (See Figure 1) The excavation should be sloped upward so it terminates past the clean pipe area.
- B. HydroTech recommends the use of a high pressure (20,000 psi minimum) water blaster in conjunction with hydraulic powered underwater cleaning equipment to remove the concrete coating and anti-corrosion coating from the pipe. The actual method used is the responsibility of the diving contractor.

NOTE:

- |  | <u>Concrete<br/>Thickness</u> | <u>Mastic</u> | <u>Pipe<br/>Wall</u> | <u>Grd</u> |
|--|-------------------------------|---------------|----------------------|------------|
|  | 2.75 in                       | 5/8" Thick    | .406                 | X-52 DSAW  |
- C. Remove a minimum of 45 inches of weight coating and mastic protection using approved removal equipment. Precaution must be taken to avoid hammering or scarring the pipe with the cleaning equipment.
- D. Place a 48" straight edge on the pipe at the 12 and 3 o'clock positions. Report any gap. If the gap exceeds 1/16th inch, then the pipe must be cut back to locate a straight section.



- E. Remove the longitudinal weld seam by grinding over a distance of 45 inches from the cut end of the pipeline; grind so the weld seam matches the contour of the pipeline.
- F. Pass the pipe ring gauge along the cleaned pipe. If the gauge will not pass, check the pipe for mastic particles or pipe ovality. If the ovality exceeds the gauge limits then the pipe must be cut back to locate an acceptable roundness and nominal diameter.
- G. Cut the pipe so that at least 45 inches of cleaned pipe is exposed. Measure and record the distance.
- NOTE: Cut out the field joint weld if it is in the stabbing zone.
- H. Remove the old section of pipe toward the platform and retrieve it to the support vessel.
- I. Grind a 30° bevel on the pipe end to remove the square shoulder on the outer edge of the pipe. Grind smooth any metal burrs on the ID of the pipe.
- J. Measure from the pipe end 36.50 inches and place a marking band or tape marker to indicate the connector swallow.

NOTE: The stab measurement is to be confirmed by the HydroTech Technician's on site measurement.



IV. PIPELINE END CONNECTOR PREPARATION

Refer to Assembly Drawing No. 06-032072, attached.

- A. Inspect the PEC for physical damage and/or loss of critical components.
- B. Using a straight edge, check that the seals are not hanging below the PEC seal bore diameter. Make all necessary adjustments.
- C. Inspect the packing flange seals and metal guard rings. Insure they are tight and in their proper position.
- D. Measure distance across the PEC bore at the metal guard seals, from the packing flange to the compression shoulder and from the packing flange to the PEC body. Record these measurements. Inform the Diver Supervisor of these measurements.
- E. Insure the packers are covered with a light film of moly grease, wipe off any excess.
- F. Insure the three (3) packing flange spacers can be removed freely. Remove any paint residue that may prevent the spacer from being removed.



V. RIGGING

- A. It is recommended the PEC Assembly be rigged for positive buoyancy during installation on the pipeline so that final positioning is not affected by the vessel heave. A bottom manipulating frame may also be used if size and weight parameters are not prohibitive.
- B. The total weight in air of the PEC Assembly, spreader beam and rigging is approximately 3,250 lbs. The rigging equipment and airlift bags are to be provided by the contractor.
- C. The PEC Assembly should be rigged as shown in Figure 2. The recommended spreader beam dimensions are shown in Figure 2.
- D. Attach the spreader beam to the PEC Assembly using two (2) equal length cable slings with screw pin shackles. These slings should be of at least 3/4 inch diameter wire rope and between 3 feet and 5 feet in length. Rig the PEC Assembly for making vertical adjustments at one end.
- E. Attach the crane hook to two (2) equal length wire rope slings. Each of these slings should be at least 3/4 inch diameter and 10 feet in length. Attach the slings to the spreader beam with screw pin shackles.



- F. Attach the airlift bags, if used, to the spreader beam. The dive supervisor shall inspect and approve the airlift bag rigging.
- G. Using the deck crane, lift the PEC Assembly until it is clear of the deck. Check the rigging balance of the assembly. Place a bubble level on the PEC to level the connector.
- H. Attach a 1/2 inch poly rope guideline to the 20 inch pipeline approximately 10 feet from the end of the cleaned area of the pipeline.
- I. When the PEC Assembly is ready to be lowered to the seafloor, attach the guideline to the shackle on one end of the spreader beam.

## VI. PIPELINE END CONNECTOR STABBING

- A. Lift the PEC Assembly and lower it over the side of the vessel. Attach the downline to the end of the spreader bar. Do not bump the packing flange area of the connector.
- B. Lower the Pipe End Connector Assembly using a spreader bar with air bags to support the weight of 3,250 lbs. Stab the connector on to the cleaned pipe up to the mark placed there in Step III. J. Note that when the Pipe End Connector is fully stabbed there will be approximately one half



(1/2) inch from the mark to the packing flange.

- C. The diver must feel inside the flange end of the PEC to confirm that the pipe is against the compression shoulder.

## VII. SETTING THE PIPELINE END CONNECTOR

- A. At the packer end of the Pipe End Connector, loosen all nuts one revolution around the packing flange to allow removal of the three (3) yellow flange spacers. Return all spacers to the diver's tool basket.

NOTE: Before starting the torquing sequence check the stab mark at the packing flange. Restab to the mark if necessary. Check the compression shoulder against the pipe end. Place a straight edge across the compression shoulder and the pipe end at 10-4-8-2 o'clock. Report any offset between the pipe bore and the PEC bore at the compression shoulder. This measurement can vary from 1/8"-1/4".

- B. Run all nuts down hand tight. Measure the flange gap between the PEC body and packing flange. Start the torque pattern on the widest side.



Tighten the packing flange nuts in the 10-4-8-2 o'clock position with a mechanical torque wrench to bring the flange in evenly. Have the diver stop and measure the distance between the packing flange and Pipe End Connector body to insure even spacing around the flange. Start again at the wide side to bring flange in square. Use all nuts in the wide area to bring in the flange square.

- C. Torque the packing flange nuts in the 10-4-8-2 o'clock position to 150 ft-lbs. Run the remaining nuts down hand tight.
- D. Torque all nuts to the 150 ft-lbs moving in a clockwise sequence.
- E. Diver will measure the distance between the packing flange and PEC body at 10:00, 4:00, 2:00 and 8:00 o'clock positions and from the stab mark to the packing flange. Diver will report measurement to the dive controller. Record that distance.
- F. Diver will return the torque wrench to the surface and receive another wrench set at a higher torque value. The torque wrench will be set at 280 ft lbs.
- G. Repeat Steps C, D and E above. Make a minimum of six (6) complete passes on all nuts or torque



until the nut movement is less than 1/8 of a turn on all nuts on the same clockwise pass.

NOTE: Measure the distance from the mark on the pipeline to the packing flange. Record that distance. Measure the distance from the packing flange to the PEC body. Record that distance.

Place a straight edge across the compression shoulder and pipe bore and report and record any offsets at 10-4-8-2 o'clock.

#### VIII. TESTING THE PIPELINE END CONNECTOR

- A. Remove the metal seal cap and attach the annulus test hose to the injector plug on the side of the Pipe End Connector. Tighten the fitting to 25 ft lbs. Open the bleed valve on the top of the Pipe End Connector. Pump test fluid from surface until communication is achieved and a steady stream of fluid with no bubbles is flowing. Close the bleed valve and tighten it to 25 ft-lbs. Pump the annulus pressure to 2225 psi and hold the test for 60 minutes after the pressure has stabilized.

NOTE: A small drop in pressure (15-25 psi) during 60 minute time interval is not



uncommon due to seal creep, hose relaxation and residual air in hose.

- B. Release the pressure in the test hose. Diver will disconnect the test hose and replace the metal protective cap on the injector plug. Tighten the cap to 25 ft-lbs. Recover the test hose.
- C. Instruct the diver to make three (3) clockwise passes around the packing flange at the 280 ft lbs setting to insure all nuts move 1/8 turn or less.

IX. REPAIR TO PIPELINE COATING

After installation of the PEC, any exposed bare pipe which has coating removed during this repair shall be repaired with "Splash Zone Barrier" wrapped with synthoglass tape or burlap to contain the patch material until it solidifies. Contractor shall furnish all required materials.

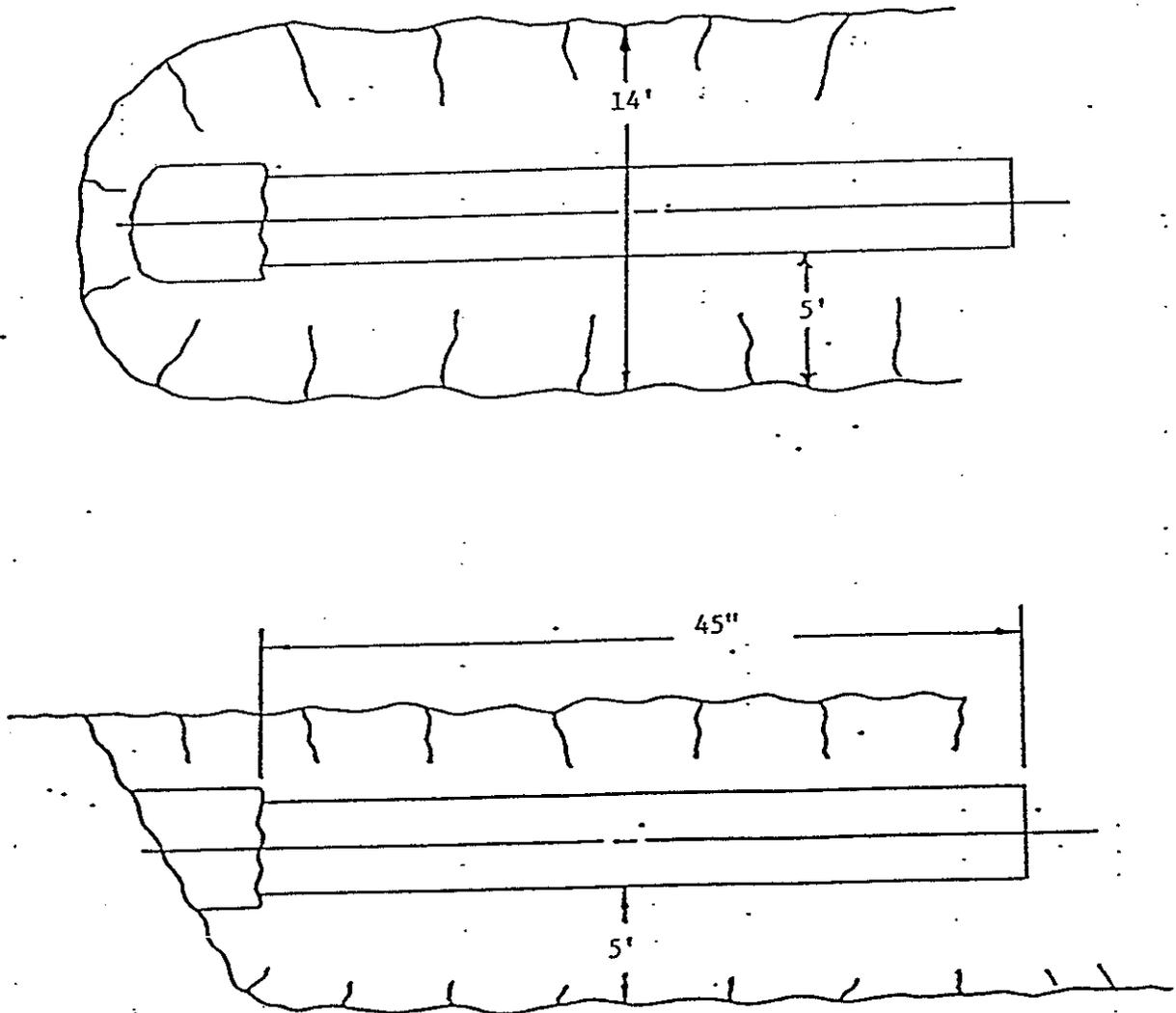
X. SANDBAGGING AND BACKFILL

- A. Sandbag under the pipeline and Pipe End Connector to support the additional weight on the pipeline end of 3,250 lbs. Use a sand/cement mixture. See Company drawing.
- B. Place sufficient sandbags under the PEC Assembly to keep it level once the pig launcher installation is started.



XI. SPHERE LAUNCHER ASSEMBLY

- A. Attach the rigging to the launcher assembly. Lift it off the deck to insure it is level. A come-along may be attached at the flange end to allow the diver up and down adjustments.
- B. Lift and lower the assembly over the side, down to the seafloor. The assembly can be set on sandbags to allow the diver time to adjust his rigging or inflate air bags, if used.
- C. Align the two flanges and insert studs in the lower half. Insert the ring gasket and all 24 - 1.625" diameter studs and tighten the nuts hand tight.
- D. Torque the 24 - 1.625" diameter studs and nuts to 1,265 ft lbs with a hydraulic torque wrench, using approved flanged make up procedures. After all nuts are at the specified torque, make a minimum of three (3) clockwise passes on all nuts.
- E. Sandbag under the launcher assembly distal end and on both sides of the flange connection. Use sand/cement bags.

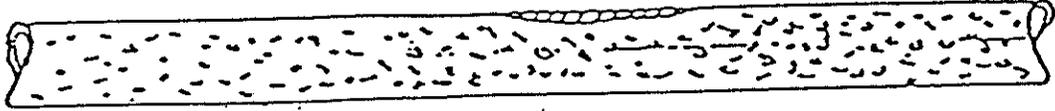


MINIMUM EXCAVATION AND PIPE CLEANING DIMENSIONS

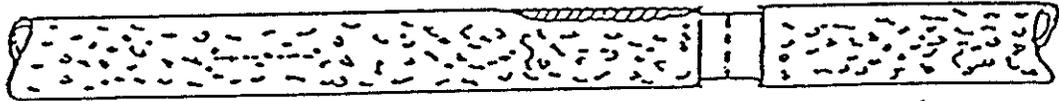
FIGURE 1



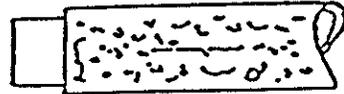
PIPELINE END CONNECTOR (PEC) INSTALLATION PROCEDURE



LOCATE DAMAGE ZONE OR SECTION TO BE ABANDONED



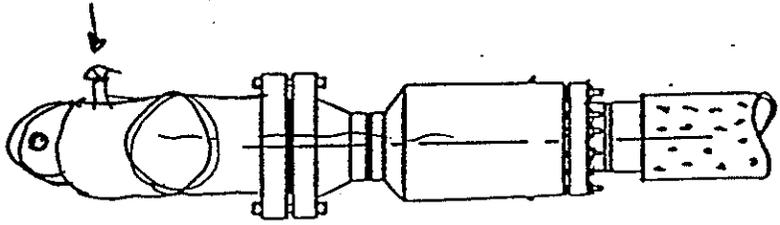
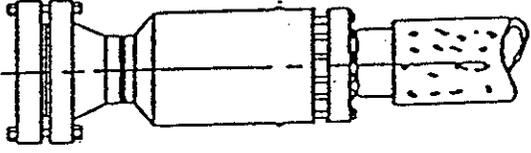
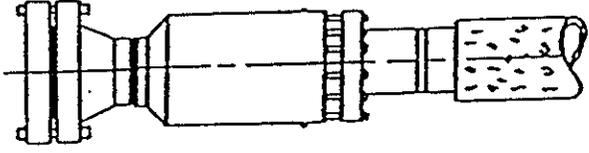
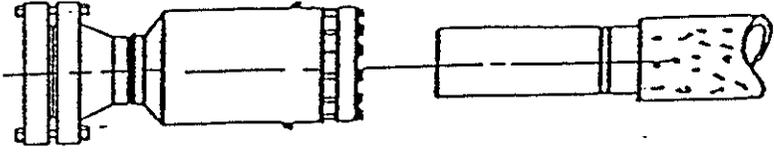
REMOVE CONCRETE AND CUT PIPELINE



REMOVE PIPELINE SECTION AND CLEAN CONCRETE



CONCRETE REMOVED, BEVEL GROUND ON END OF PIPELINE,  
STABBING MARK PLACED ON PIPELINE



**HydroTech Systems**  
**General Specification**  
**of a Mechanical Connector**



## GENERAL PRODUCT SPECIFICATION

### MARK V HYDROCOUPLE

#### I. GENERAL DESCRIPTION

The Mark V HydroCouple is a sleeve type pipeline connector designed to stab over an uncoated pipe. When mechanically actuated, the Mark V HydroCouple structurally attaches to and seals off the pipe. A typical Mark V HydroCouple is shown in Figure 1. The HydroCouple concept was first developed by HydroTech in 1966 to facilitate subsea pipeline connections made by divers working under adverse conditions. When properly installed, the HydroCouple can be used to permanently connect high pressure pipelines, flowlines and risers for both underwater repair and new construction applications. Nearly 300 Mark V HydroCouple connectors have been manufactured and installed in continuous service successfully for up to 17 years.

The HydroCouple connector structurally attaches to the pipeline, flowline or riser pipe using wedge-shaped "slip" segments positioned circumferentially inside the HydroCouple body. The slip segments are wedged between pipe outside surface and an outer wedge-shaped "bowl" causing the slips to be self-locking, i.e., the higher the tension or compression force, the tighter they grip the pipeline. For most applications, the Mark V HydroCouple utilizes a dual acting type slip to support both tension loads due to the thrust effects of internal pressure or any externally applied tension loads as well as compression loads resulting from pipeline thermal expansion or other loads of a compressive nature.

The HydroCouple sealing system consists of two stacks of elastomer packers. These packers are compressed in an axial direction when the Mark V HydroCouple is actuated by tightening the packing flange. This action sets both the slips and seals simultaneously. When axially compressed, the elastomer packers flow radially inward against the pipe OD and outwardly against the HydroCouple body. The sealing pressure of the HydroCouple is determined by the axial force applied to the packing stack and the resulting radial force exerted by the seals against the pipe and HydroCouple body. The seal system is backed-up at the extremities of each packing stack by metal guard rings which prevent seal extrusion into the gap between the HydroCouple and the pipe OD surface. A pressure test feature is provided for the verification of the sealing system after setting and installation of the HydroCouple. This is accomplished by pressuring the annulus space between the two packing stacks. The diver attaches a hydraulic hose from the surface support vessel to the annulus test port. Pressurization of the annulus is then carried out from a test unit on the surface where the pressure can be monitored directly by an installation supervisor.

When the pipeline operating temperature is unusually high compared to the temperature of the seawater, it may be necessary to provide the HydroCouple with a temperature compensated sealing system. This patented mechanism regulates the pressure fluctuations in the packers to a range that will neither damage the pipe due to excessive pressure or result in seal failure due to loss of sealing pressure. In most cases the HydroCouple and pipe are sufficiently elastic to self compensate for seal expansion and contraction due to temperature fluctuations.



## Mark V HydroCouple - General Product Specification

- 2 -

One of the significant advantages of the HydroCouple as a pipeline connector is the minimal amount of pipe end preparation required for successful installation. The Mark V HydroCouple is designed to stab over a subsea pipeline, flowline or riser which has been cut-off by a diver using no more than a standard underwater burning torch. Concrete weight coating, if present, must also be removed from the pipe as well as any other coating such as somastic and coal tar enamel. Thin film epoxy coatings, if no more than 0.010 - 0.015 inches thick, do not require complete removal. Total removal of the longitudinal weld seam to blend with the pipe contour is not required, however, some grinding to flatten the crown of the weld bead is generally advised.

HydroCouples are available in sizes and pressure ratings ranging from 3 inch - API 10000 psi to 48 inch - ANSI 600 Class. Almost any variation of pressure rating as well as hydraulic or mechanical actuation is available within this size range. In addition the HydroCouple is available in configurations in combination with other connectors and fittings. Several optional configurations are described in Section V of this specification.

## II. APPLICABLE DESIGN CODES

The HydroCouple pipeline connector is designed and manufactured to meet the requirements of any one or combination of the following codes or specifications:

1. ASME Pressure Vessel Code, Section VIII, Division 2, latest edition
2. API Specification 6D (18th Edition), Specification 6H (1st Edition)
3. DNV "Rules for Design, Construction and Inspection of Submarine Pipelines and Risers"
4. Dienst voor het Stoomwezen "Rules for Pressure Vessels"
5. NACE Standard MR 01-75 (1980 Revision)

Manufacturing quality standards meet the requirements of ASME, DNV, and British Standard 5750.

## III. MATERIALS

Materials utilized in the manufacture of the Mark V HydroCouple are from the following list, the exact choice depending on the application, design, code, or specification.

1. HydroCouple Body, Extension Nipple, Transition Piece and Packing Flange

**Standard:** ASTM A-105 or A-106 with modified chemistry and impact test requirements (HydroTech Specifications HMS-1)

**Optional:** ASTM A-350 LF2 with modified chemistry and impact test requirements per HydroTech Specification HMS-18, ASTM A-694 per HydroTech Specification HMS-16, or ASTM A-707 per HydroTech Specification HMS-21



## Mark V HydroCouple - General Product Specification

- 3 -

### 2. Slips and Bowls

**Standard:** AISI 4140 N,Q, and T to 32-36 Rc Hardness per HydroTech Specification HMS-4 Class 3

**Optional:** AISI 630 (17-4 PH stainless steel) heat treated to 28-32 Rc hardness

### 3. Studs and Nuts

**Standard:** ASTM A-193-B7 studs and A-194-2H nuts. All studs, nuts and washers are coated using the nickel-manganese phosphate conversion process followed by Xylan fluropolymer coating per HydroTech Specification HCS-8.

### 4. Seals

**Standard:** Molded nitrile elastomer (NBR) per HydroTech Specification HMS-15

**Optional:** Molded Viton or fluorel fluoroelastomer (FKN) per HydroTech Specification HMS-14. Other elastomer sealing compounds may also be specified.

Seal extrusion guard rings at the extremities of the elastomer packers are roll formed from annealed carbon steel or stainless steel sheet.

### 5. Corrosion Protection

**Standard:** (a) Cathodic protection for a minimum design life of 25 years using Galvalum III anodes.

(b) Exterior painted using white marine epoxy per HydroTech Specification HCS-4.

(c) Interior surfaces coated with petroleum wax compound per HydroTech Specification HCS-6.

**Optional:** Any acceptable customer specified coating

**Mark V HydroCouple - General Product Specification**

- 4 -

**IV. TESTING AND CERTIFICATION**

Each Mark V HydroCouple pipeline connector is hydrostatically tested at the design test pressure for a minimum of 4 hours. Hydrostatic test charts, quality assurance inspection reports, heat treatment furnace charts and any other critical materials processing and manufacturing documentation is available upon request.

**V. OPTIONAL CONFIGURATIONS****A. Spool Piece Repair Unit (SPRU)**

The Spool Piece Repair Unit consists of the basic Mark V HydroCouple connector with an extension nipple and a MisAligning Flange (MAF). The MAF is described in a separate General Product Specification. The Mark V HydroCouple is welded to the MAF ball with the retainer flange preinstalled. The mating MAF housing has a welding end compatible with the pipe diameter and wall thickness of the spool piece. An illustration of a Mark V SPRU is shown in Figure 2. The extension nipple and MAF ball inside diameter are the same as the HydroCouple I.D. The purpose of this configuration is to provide a capability to adjust the axial position of the HydroCouple on the pipeline end and therefore, reduce the criticality of the spool piece length measurement. The axial adjustment provided by the extension nipple is one (1) pipe diameter or 12 inches whichever is greater. A spool piece repair requires use of two (2) SPRU's.

**B. Riser Repair Unit (RRU)**

The RRU consists of the basic HydroCouple connector without compression slip capability. A Mark V RRU is shown in Figure 3. The riser pipe stabs into the body of the RRU until it rests against the shoulder in the RRU body. Any compression loads are then transmitted directly to the RRU body. Hence, a single acting slip is sufficient. The RRU has a welding end configuration that matches the nominal pipe diameter and wall thickness of the riser pipe. The body of the RRU can be specified to have a minimum yield strength at the welding end of up to 52,000 psi.

**C. Pipe End Connector (without axial adjustment)**

In some cases underwater pipeline and riser repairs can be made efficiently and economically by simply using the Riser Repair Unit described above in combination with an RTJ weld-neck or swivel-ring flange. In this configuration the assembly is called a Pipe End Connector as shown in Figures 4 and 5. For these applications the Mark V HydroCouple is used only for the purpose of attaching a flange to the end of a subsea pipeline or riser without lifting the pipeline above water and welding or making an expensive hyperbaric weld. In this configuration the HydroCouple connector provides no end gap compensation.



**Mark V HydroCouple - General Product Specification**

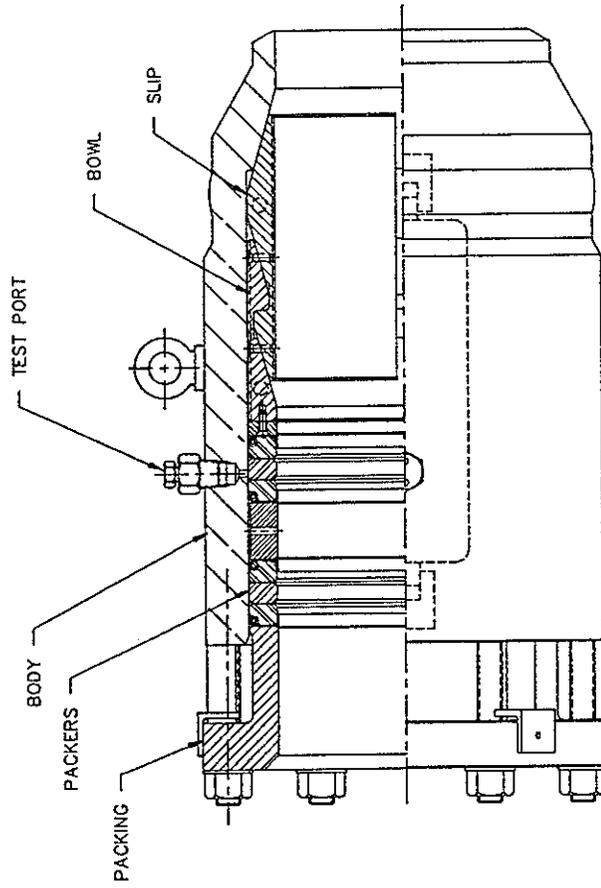
- 5 -

**D. Pipe End Connector (with axial adjustment)**

In applications where a spool piece is installed and Pipe End Connectors are used, it is frequently desirable to provide end gap (axial) adjustment in at least one (1) of the Pipe End Connectors. The configuration shown in Figure 6 illustrates a Pipe End Connector with end gap compensation capability.



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ENGINEERING PIPELINE PRODUCTS

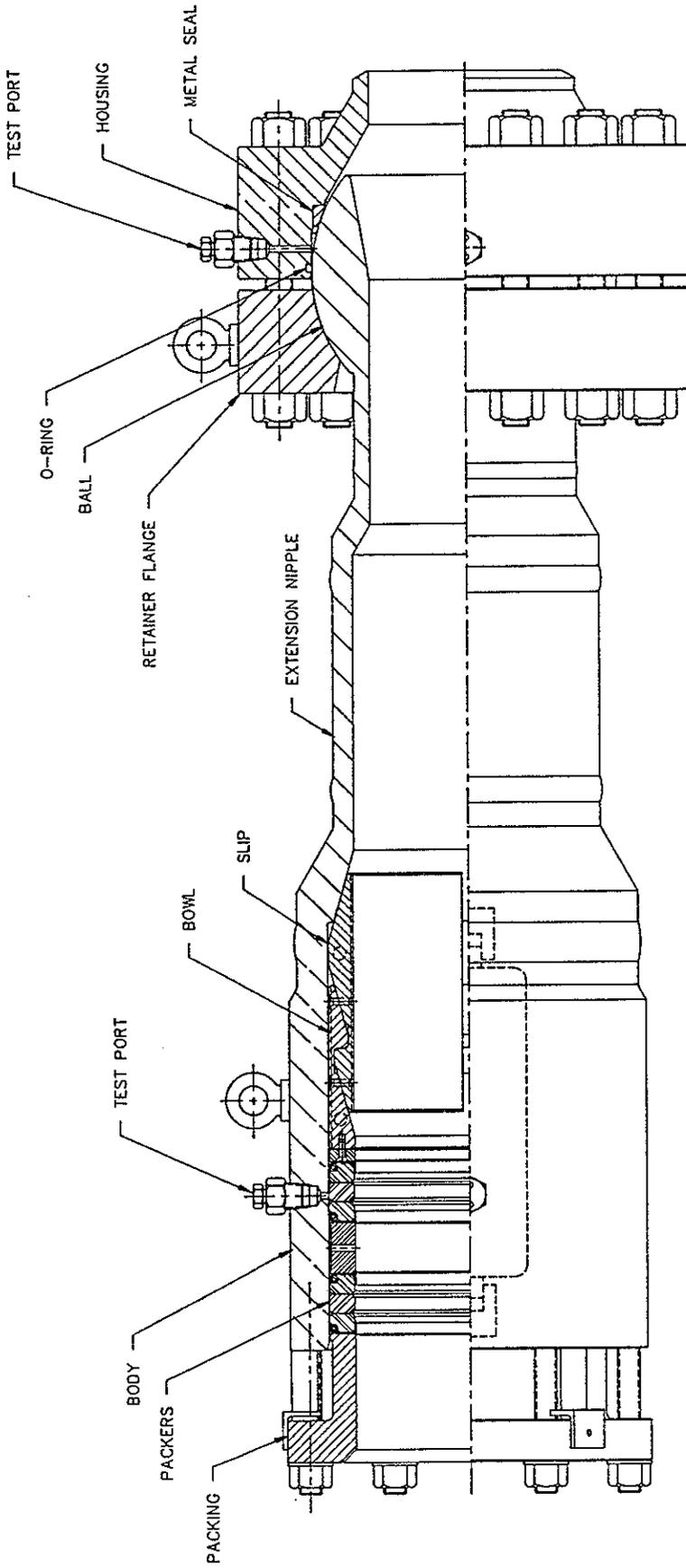


Mk V Hydrocouple Connector

Figure 1.



HydroTech Systems, Inc.  
ENGINEERING PIPELINE PRODUCTS

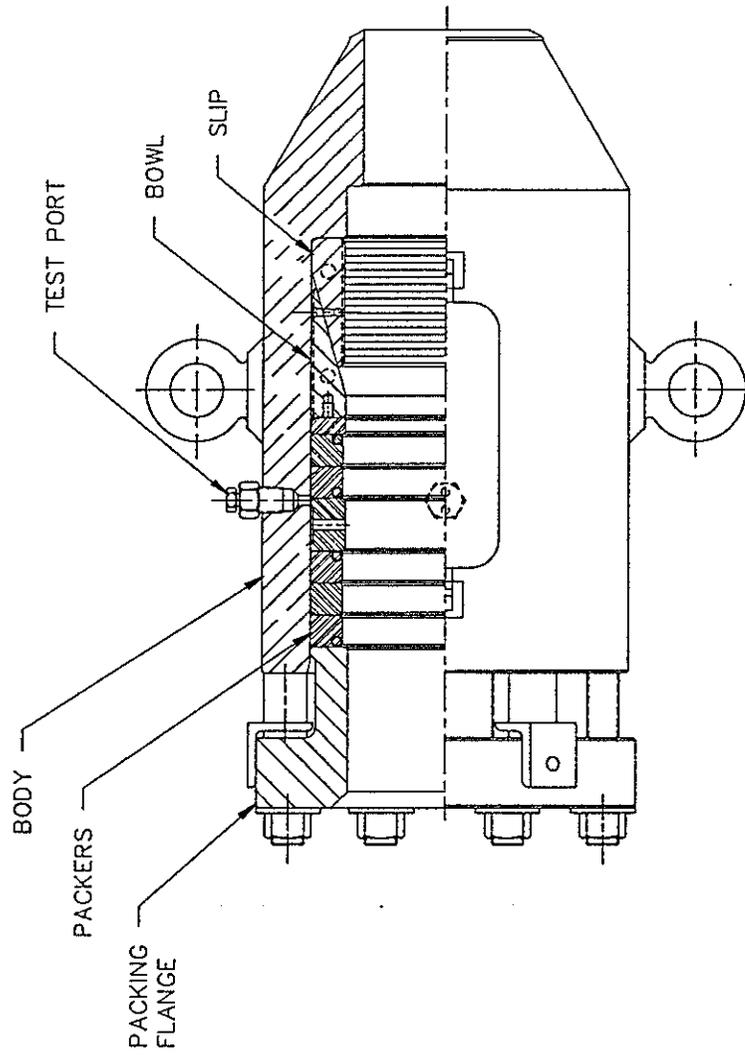


Spool Piece Repair Unit  
Mk V Hydrocouple/MAF

Figure 2.



HydroTech Systems, Inc.  
ENGINEERING PIPELINE PRODUCTS

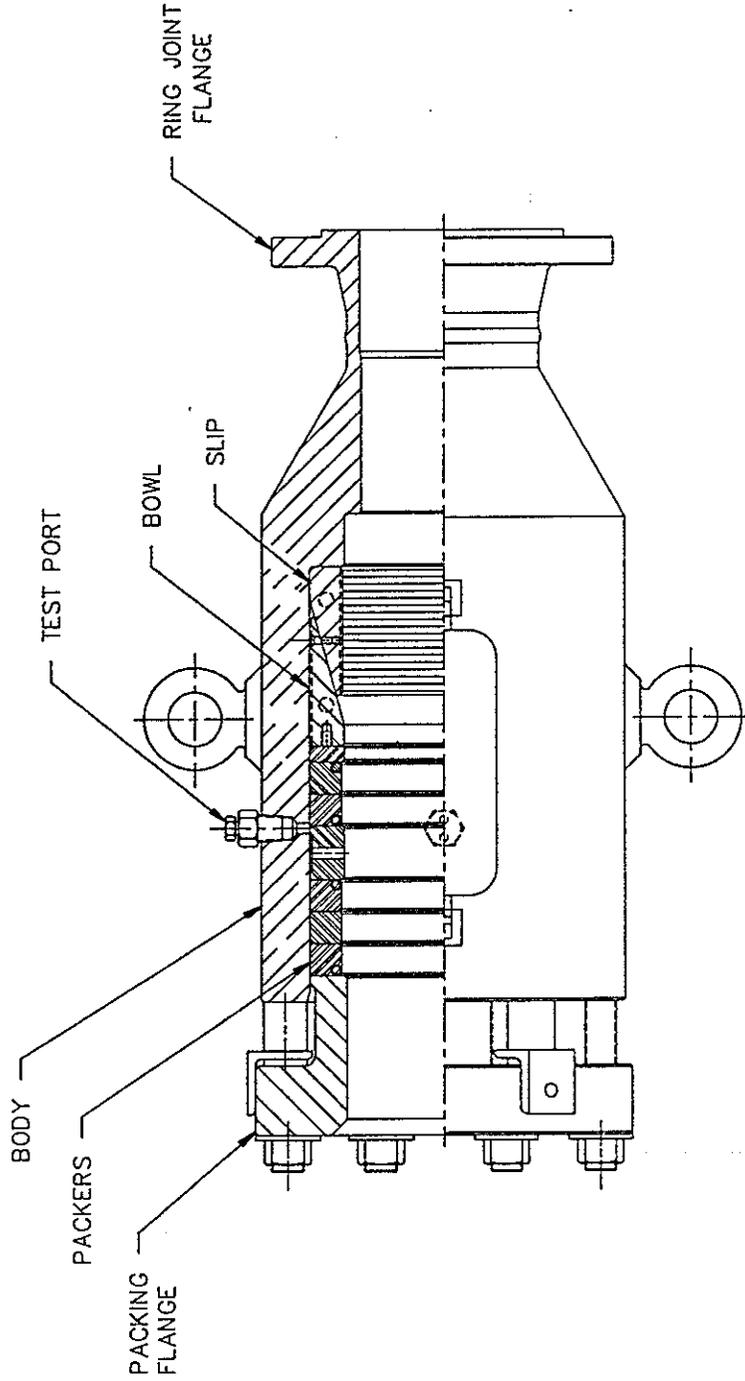


Riser Repair Unit

Figure 3.



HydroTech Systems, Inc.  
ENGINEERING PIPELINE PRODUCTS

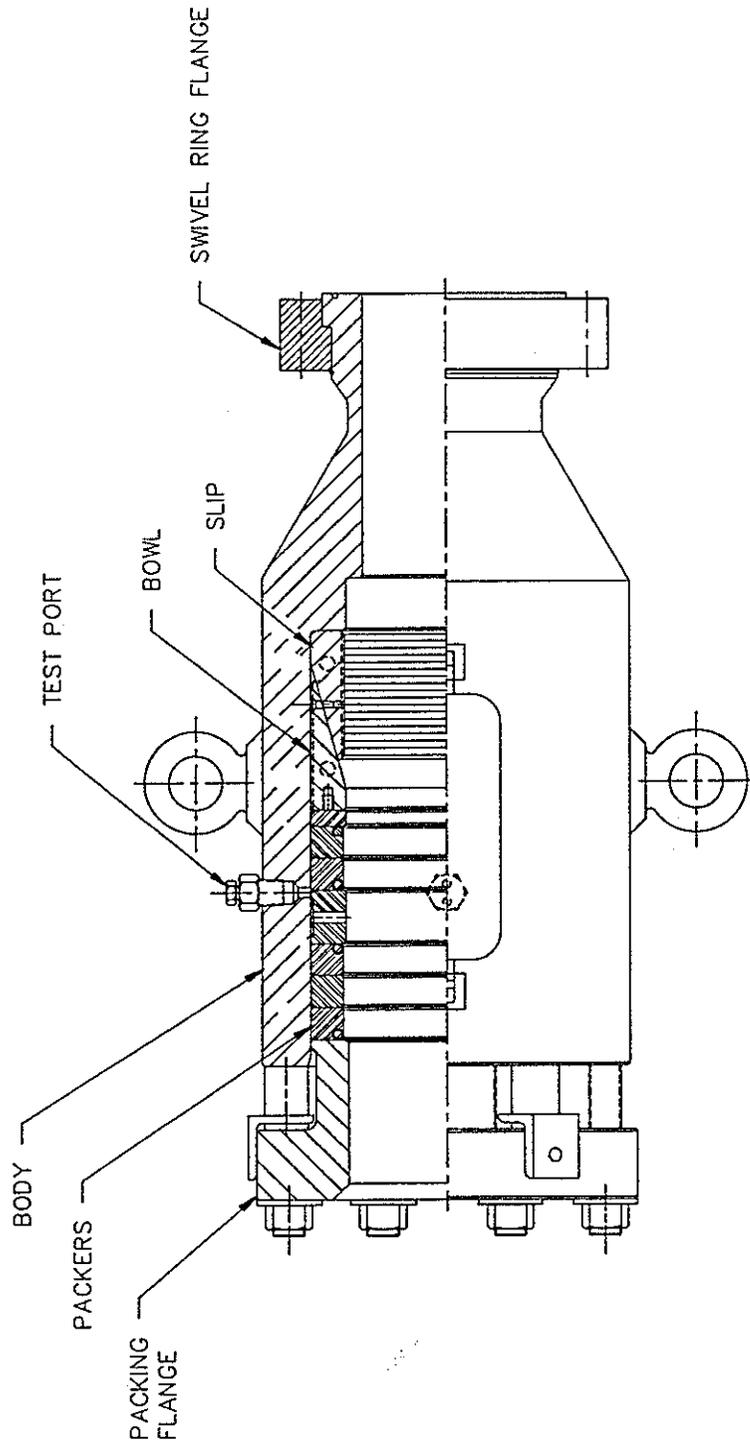


Pipe End Connector  
Mk V Hydrocouple/RTJ Flange

Figure 4.



HydroTech Systems, Inc.  
ENGINEERING PIPELINE PRODUCTS

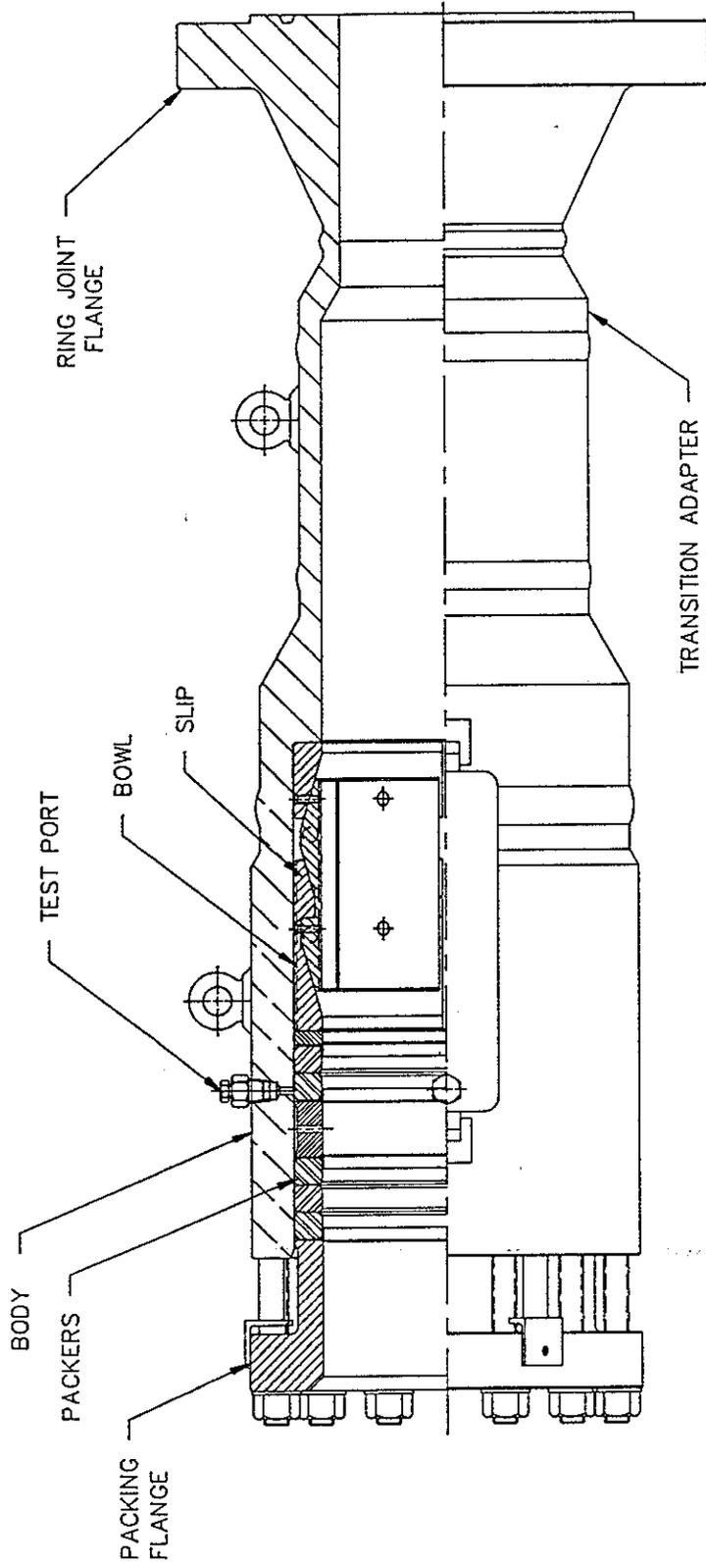


Pipe End Connector  
Mk V Hydrocouple/Swivel-Ring Flange

Figure 5.



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ENGINEERING PIPELINE PRODUCTS



Pipe End Connector (With Adjustment)  
Mk V Hydrocouple/RTJ Flange

Figure 6.

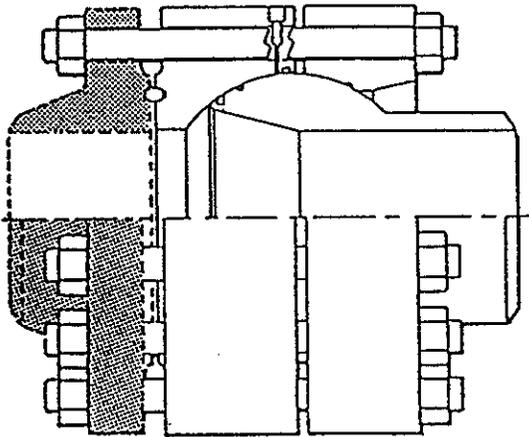
### **5.3.2 Big Inch Marine Ball Flange Connector**

# THE BIG INCH BALL FLANGE™ CONNECTOR

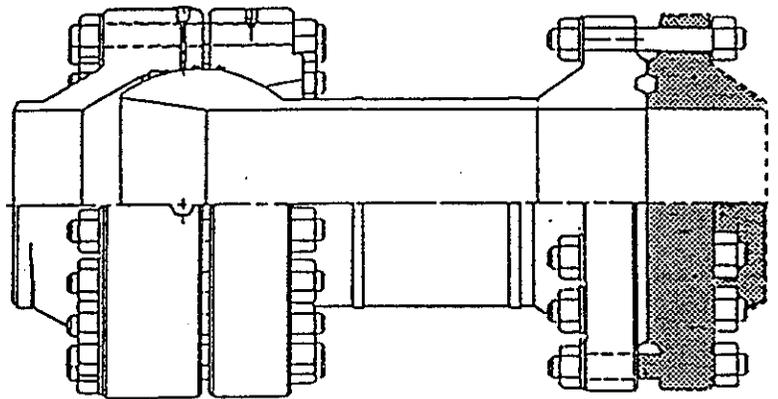
## THE UNIQUE MISALIGNMENT JOINT

Big-Inch's Marine Systems' Ball Flange™ Connector has a unique combination of features that *simplifies installation, minimizes diver requirements, and assures the long term reliability of a 100% metal-to-metal seal.*

### The Big-Inch Ball Flange™



### Or "Equal"???



#### The Big-Inch Ball Flange:™

1. Mates directly to a standard RTJ flange.
2. Uses just one set of studs and nuts to simultaneously lock the ball connector and complete the tie-in.
3. Incorporates the bolt hole alignment feature of a swivel ring flange.

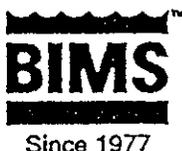
#### Alternate misalignment joint:

1. Requires a spoolpiece of pipe and a second flange to make the tie-in.
2. Requires two sets of studs and nuts and two separate tightening sequences by the diver.
3. Requires a separate swivel ring flange to facilitate bolt hole alignment.

There are other misalignment connectors but there is no "equal" to the Big-Inch Ball Flange.™ So simplify your next subsea tie-in by specifying the unique connector--the "Ball Flange".™

Need rapid delivery? Big-Inch stocks Ball Flange™ Connectors in the 4" to 24" size range.

Proven reliability! Over 325 installed worldwide.



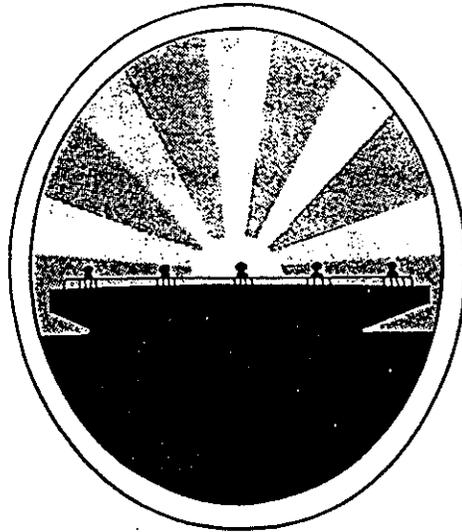
Big-Inch Marine Systems, Inc.  
5650 Guhn Road, Suite 100  
Houston, Texas 77040  
Phone: (713) 460-0003  
Fax: (713) 462-0603

Big-Inch Marine Systems, Ltd.  
Allens Industrial Estate  
Aberdeen, Scotland, U.K.  
Phone: (0224) 249040  
Fax: (0224) 249050

### 5.3.3 Daspit Mfg. Co. - Perma-Lok II

# PERMA-LOK II

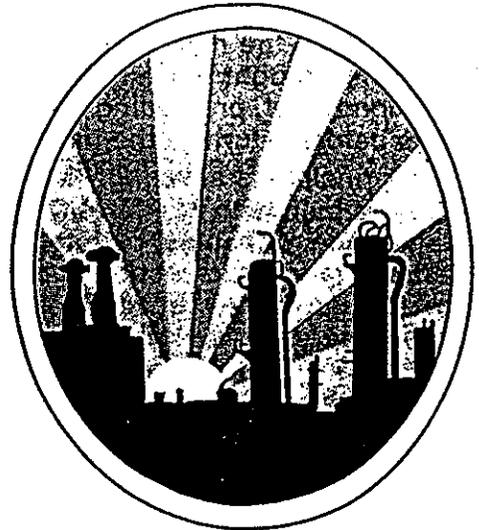
VERSATILITY PERSONIFIED  
in MECHANICAL CONNECTORS



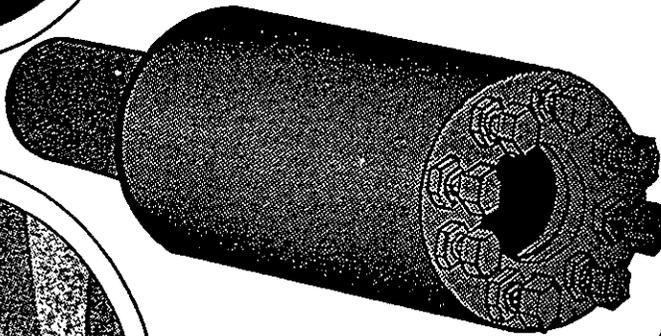
OIL BARGES



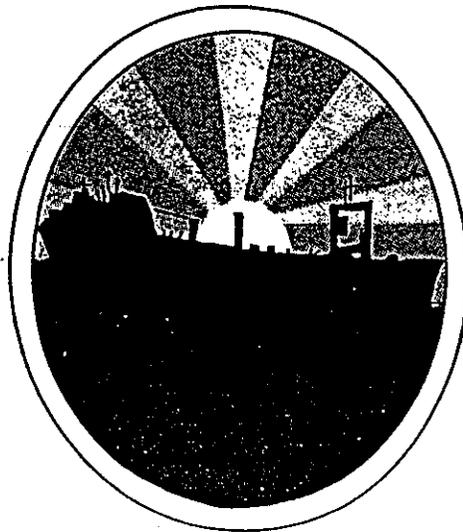
COMPRESSOR STATIONS



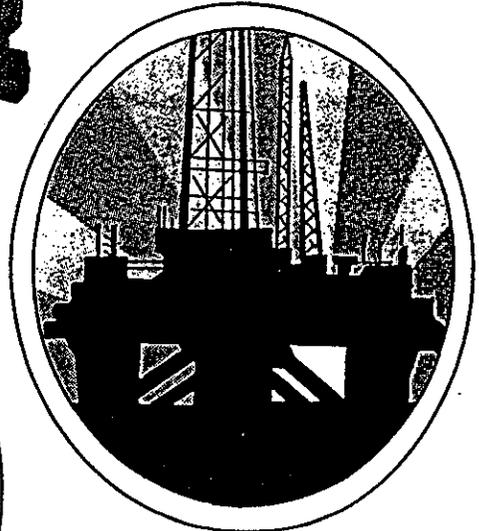
OIL REFINERIES



PETRO-CHEMICAL PLANTS



TANKERS



DRILLING OR PRODUCTION VESSELS

# **PERMA-LOK II\***

**VERSATILITY PERSONIFIED** in MECHANICAL CONNECTORS

PERMA-LOK I was initially designed for use in the marine oil industry for replacement or installation of high pressure pipeline risers. Since it had to dependably operate at high pressures and be exposed to the rigors of marine exposure while retaining the pipe under extreme tensile and transverse loading caused by hydrostatic pressure and storms, still remaining simple and easy to install by divers, it took the years of experience in design and manufacture of such connectors by a leader in this field to achieve such a goal.

Dasplit Mfg. Co., after designing, testing and field installing the PERMA-LOK I, brought models of the connector to various exhibits and conferences, and put them on display, to the pleasant surprise of their usual clients.

At the same time, engineers and men charged with maintenance of pipeline systems casually stopped, and on examination of the tool, saw possibilities of its application for diverse uses totally different from its original intent.

Because of the myriad of uses suggested for the PERMA-LOK, it was decided that PERMA-LOK II should be brought out and placed on the market, for applications in pipe repairs wherever hazardous conditions exist, precluding any burning or welding without extensive shut ins, gas freeing and lengthy delays before return to the use of the system.

The principle is amazingly simple. Whenever a line has to be replaced, a prefabricated replacement section is built with PERMA-LOKS on either or both ends, and the line to be replaced is isolated. A cold cut is made with pipe cutters, saws, or the like, and the section is removed. Once accomplished, the newly fabricated section is brought in and slipped into position with the PERMA-LOKS fitting over a short section of the preceding pipe. The connector bolts are then quickly secured and the line is ready for return to service.

**VERSATILITY IS ITS NAME:** As evidenced by the following recommendations made by men charged with responsibility in the following fields:

- (1) Replacement and repairs to corroded or eroded tube turns, lines, valves, flanges, etc. in oil refineries.
- (2) Repairs adjacent to oil or chemical tanks.
- (3) Repairs to loading lines on tankers, barges or dock facilities which handle flammables.
- (4) Repairs to offshore lines coming off wellheads or on platforms where an open flame is prohibited.
- (5) Maintenance in chemical or petrochemical plants in explosive areas.
- (6) Installation or repair in natural gas compressor stations, gas separator units or gasoline plants.
- (7) Repairs to fractured or leaking fuel lines on drill barges, derrick barges, dredge barges or any vessel which can't readily shut down, or be removed from location for repairs.
- (8) Repairs to steam lines in electric generator plants or refineries.
- (9) Public Utilities.

Cost savings can be readily realized from two views. The most important is, no downtime or limited downtime on the unit being repaired because no gas freeing is required, thus bringing to an absolute minimum the demurrage on the plant or vessel.

Secondly, the tool can be easily removed at a convenient time and put back on the shelf for later use, since it is readily removed by loosening a few bolts and sliding the tool from the intruded pipe, thus lowering the use cost with each application. It might be pointed out here, that the tool can be used for different service repeatedly, by simply changing the internal packing and installing packing recommended for the use desired, once again cutting the initial use cost.

## **FEATURES OF PERMA-LOK II**

High pressure: (over 1500psi) higher pressures or different design on an as ordered basis.

High tensile load: approaches yield strength of schedule 80 pipe.

Simple installation: no specialized personnel needed; only hand tools required.

Ease of removal: by loosening retaining bolts and lightly tapping exterior of outer shell.

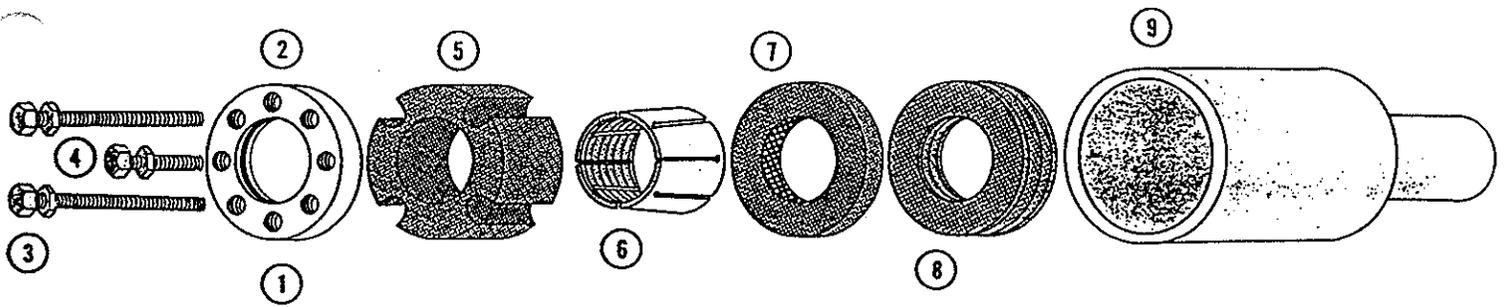
Repeated use for varied applications: quickly changing to appropriate packing.

No fire or explosion hazards involved.

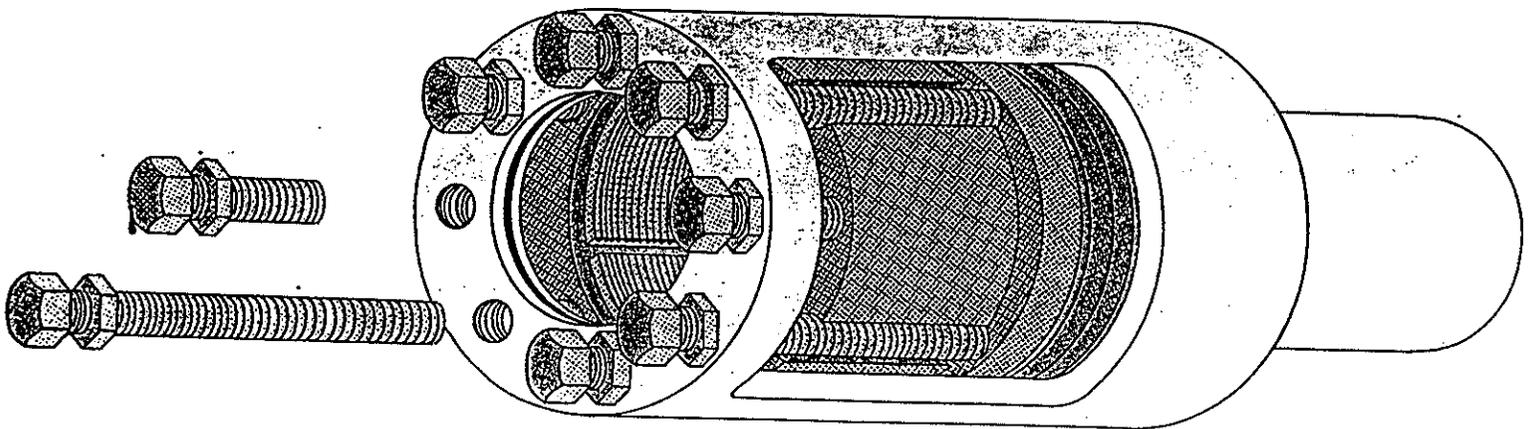
Permanent repair: No need for change. Can be welded on later, if desired.

Rapid installation: requires 15 - 30 minutes. (bolts require only 50 - 65 ft.lbs./in.<sup>2</sup> torque.)

\*Protected by U. S. & Foreign Patents



- 1.) End plate with threaded apertures and groove for "O" ring.
- 2.) "O" ring for exclusion of sea water and backup system to packing glands.
- 3.) Thrust bolt for compression of packing gland. Once torqued to a predetermined load, compression of the elastomeric packing is accomplished, preventing leakage of line products.
- 4.) Activator bolts for movement of bowl No. 6 inward onto male jaws (collet) No. 6, causing a closure of said collet onto the intruded pipe for secure retention in the event of a tensile load being exerted, attempting to separate the pipe from the connector.
- 5.) Movable female bowl.
- 6.) Male retaining jaws, machined with alternating longitudinal grooves.
- 7.) Metallic compression ring which travels inward by action of thrust bolt, placing packing under compression.
- 8.) Dual hardness elastomeric packing.
- 9.) Outer shell of connector machined to close tolerances for smooth functioning of inner components.



### **5.3.4      Hydra-Tight - Morgrip Coupling**

**...and flanged pipes now on contract**

**Biwater Pipes** has secured a five-year contract with **Severn Trent plc** to supply part of the company's non-stock requirement for flanged pipes of 300-mm diameter and above and deliver them directly to site. The pipes were previously supplied on an *ad hoc* basis. ●

*Reader enquiry service no: 906*

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## NEW PRODUCTS

*The information in this section is based upon that supplied by the companies described. PIPES & PIPELINES INTERNATIONAL cannot take any responsibility for the claims and performance details quoted.*

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### **Pipe coupling approved**

**Lloyds Register** has now formally approved **Hydra-Tight's** *Morgripp* pipeline coupling following extensive testing and evaluation. The company describes its coupling as being of particular interest to the oil, petrochemical and nuclear power areas or anywhere that steel pipes require joining and sealing. ●

*Reader enquiry service no: 907*

### **'Multiport' joint for pipe re-lining**

In demanding environments where pipe *in situ* re-lining is necessary, **Rotaflow** recommends its 'multiport' joint, which has two ports of 0.5-in diameter and one of 0.75-in diameter to transport a typical mix of adhesive/air/catalyst through a spray nozzle at pressures up to 4000psi. The joint has been designed to give the flexibility to pump from a drum reel through separate hoses, and individual ports inside the swivel joint, and the positioning of the air port between ports carrying adhesive and catalyst, ensure their complete separation prior to mixing in the spray nozzle. ●

*Reader enquiry service no: 908*

### **Failsafe facility for motorized valves**

Previous attempts to provide electrically-actuated valves with a failsafe back-up system in the event of power failure have often proved costly and have depended upon back-up battery supplies or complicated mechanical 'add-ons' involving springs and fly wheels.

**Valvestock Ltd** is now supplying a low-pressure electro-hydraulic power pack which, when used in conjunction with a conventional spring-return valve actuator, has been designed to provide an economical and reliable failsafe operation of the valve during power failure. An internal valve within the power pack falls open, allowing the springs within the actuator to return the valve to its pre-determined failsafe position.

In addition to being used as an on/off power supply, these units are also available in modulating form, and can be supplied as certified for use within hazardous areas. ●

*Reader enquiry service no: 909*

### **Solvent-free coating**

An external anti-corrosion coating for the protection of steel pipelines has been announced by **Resdev Ltd**. Reportedly easier and cheaper to apply than conventional coat-and-wrap materials, the solvent-free product has been designed to be used on subterranean, overland or subsea pipes.

It contains high-strength epoxy resins for resistance to flexing, abrasion, impact, extremes of temperature and chemical abuse and

**Pressure test keeps Esso Fife job to time**

Hydratight's unique MORGRIP pressure test ensured a tight production schedule remained on target for Babcock Thorn at Rosyth Dockyard.

In an effort to diversify following the reduction in naval repair work the yard now managed by Babcock Thorn has expanded its business into the oil and petrochemical fabrication business.

Having won a design and build contract to supply a pipeline system for a new tanker loading jetty at Esso's Mossmoran refinery in Fife, the pipecutting weld prepping and pressure testing was subcontracted to Hydratight Ltd. Pipe lengths and spool pieces that would eventually make up the pipeline required cutting to length, weld prepping and pressure testing in only 10 days.

A schedule that would have been virtually impossible if Hydratight had not developed the unique MORGRIP Pressure Test Cap.

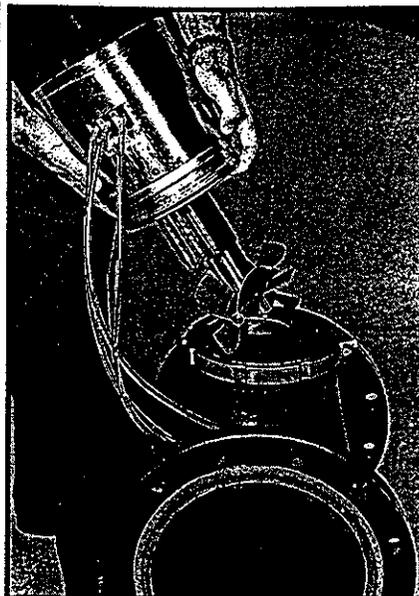
The yard had already used expanding pipe plugs to seal 8" and 12" spool pieces for pressure testing but were experiencing bell mouting when the plugs were activated to seal the 1150 psi test pressure. "A plug for the 18" was not readily available and would have been prohibitively expensive" quoted a Rosyth spokesman. To have to resort to welding special pressure



A weldless mechanical MORGRIP pressure test cap fitted to a pipe end ready for hydrotesting the line system. The integrity of the MORGRIP seal having been established by external testing before flooding the line.

domes on each pipe end and then to cut them off and reinstate the weld prep would have forced the contract schedule to overshoot and incur heavy penalties.

Hydratight engineers suggested the use of its unique MORGRIP Pressure Test Cap, a development of its mechanical pipeline connector which eliminates welding and for an 18" size cap takes only 10 to 15 minutes to assemble onto the pipe. Tensioning the bolts to activate the gripping mechanism establishes the seal through axial forces rather than radial forces imposed by pipe plugs. MORGRIP's modular design can operate at test pressures up to 10,000 psi (680 BAR), so the 1150 psi (78 BAR) was well within its capabilities.



**Sampler for terminal transfer lines**

Jiskoot/Transpec has enhanced and expanded their range of AQL (Acceptable Quality Level) samplers.

Their original AQL was available as a permanent mount to an 8" "T-piece". The range has now been expanded both ways to 8" and 10" sizes and a quick release "snap" coupling has been added to allow interchange of the sampler location.

The coupling is of the ball release type to allow easy operation but this has been enhanced for security - a locking pin must be unscrewed prior to rotation and release of the coupler. The AQL is a self powered sampler developed to take three independent and identical samples suitable for arbitration at manifold locations of barges or ships and can be used in terminal transfer lines.

**How to measure viscosity continuously**

Production and quality control engineers in the processing industries can now make a continuous measurement of the viscosity of a liquid flowing through a pipeline in order that the composition of the product can be speedily adjusted to stay within tolerance. This is made possible by the new Solartron Type 7827 Viscometer, which also provides simultaneous measurement of density and temperature, enabling the accurate determination of both dynamic and kinematic viscosity. Referral to base conditions can be automatically performed within the conditioning electronics of an associated Solartron

**Type 7945V Signal Converter.**

Viscosity is a direct measure of the quality of a fluid and any change in viscosity can indicate a fundamental change in the material composition. Measurement of viscosity can also be the most sensitive method of following a change in a reaction taking place.

Dual measurement of viscosity and density facilitates interface detection between batched liquids in a pipeline, also leak detection by measuring pressure drop over a given section of pipe - pressure drop being a function of the on-line viscosity and density. Viscosity of static liquids in tanks can also be measured.

**Victorian machine shop brought back to life**

Bath Industrial Heritage Centre has just had a complete Victorian engineering workshop automated thanks to the generosity of Rotork Controls Ltd.

The display of belt driven machinery, including a pipe threader, vertical drill, portable forge, shaper, miller and lathes, form part of the museum's Bowler collection. Jonathan Burdett Bowler started business in Bath in 1872 and the workshops remained unchanged until Mr. Bowler's grandson retired in 1969 and the business closed.

Russell Frears, a local designer and industrial historian, saved the collection which is now housed in the Bath Industrial Heritage Centre.

A Rotork engineer and an apprentice modified 5Q range actuators to provide linear drive and fitted an electric control panel which allows the museum guides to switch the antiquated machinery on and off for visitors without having to go near the dangerous belt drives. At a recent ceremony, attended by local dignitaries and friends of the heritage centre, Mr. Bill Whiteley, managing director of Rotork Controls Ltd. inaugurated the newly adapted machinery.

For details of this application or details of the complete range of Rotork actuators contact Rotork Controls Ltd., Brassmill Lane, Bath, Avon. Tel. 0225 428451.

**Codel launches new flue meter**

A low cost flue-gas flowmeter for continuous monitoring of the flow rate of hot, dirty gases within stacks has been introduced by CODEL. Designated the model 902, in combination with CODEL monitors, it enables an absolute measurement of total emissions to be made (e.g. kg/hr). By utilising a non-contract technique, the high maintenance costs and potential unreliability associated with methods requiring direct contact with the flue gases are avoided.

The CODEL method resembles flow measurement using chemical, dye or radioactive tracers, where velocity is derived from the transport time of the tracer between two measuring points a known distance apart. However, instead of an artificial tracer being added, the naturally occurring fluctuations in infra-red energy in the gas stream are used as the tracer.

**Range of technical buildings**

'PORTASTOR Technical Buildings' is the title of an informative and copiously illustrated new brochure now available from Portastor High Security Products. It emphasises manufacturer Portastor Ltd's well proven resources to provide Clients with a complete turnkey custom-building service.

PORTASTOR Technical Buildings are designed, manufactured and factory finished to provide custom-built enclosures to house special equipment or to provide accommodation for personnel. Pre-engineered units and complexes are built to suit climates and conditions anywhere in the world.

This service includes: requirement analysis; design; manufacture; equipment installation; testing and system proving; site preparation; transportation; on-site commissioning, and future relocation and extension.



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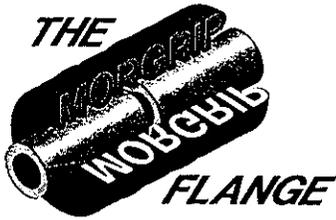
EAGLE HOUSE WEST TULLOS

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RECENTLY APPOINTED



AUTHORISED SERVICE CENTRE FOR SCOTLAND



# MORGRIP™ HP HIGH PRESSURE COUPLING

## MORGRIP™ HP SELECTAGUIDE

NOMINAL PIPE SIZE (in.)	ANSI RATING (LBS)	BOLT SIZE & No. OF	OVERALL LENGTH (mm)	OUTSIDE DIAMETER (mm)	WEIGHT (Kg)	MORGRIP PRODUCT (in.)
1	600, 900	4 x 1/2	195	98	10	H17/6 H17/9
	1500	4 x 1/2	265	98	13.6	H17/15
	2500	4 x 1/2	335	98	17.2	H17/25
1 1/2	600, 900	6 x 1/2	195	112	12.0	H17/6 H17/9
	1500	6 x 1/2	265	112	16.5	H17/15
	2500	6 x 1/2	335	112	20.7	H17/25
2	600, 900	8 x 1/2	220	137	20.0	H27/6 H27/9
	1500, 2500	8 x 1/2	340	137	30.9	H27/15 H27/25
	600, 900	8 x 3/4	230	207	48.6	H37/6 H37/9
3	1500	8 x 3/4	360	207	76.7	H37/15
	2500	8 x 3/4	490	207	103.6	H37/25
	600, 900	12 x 3/4	240	232	58.6	H47/6 H47/9
4	1500	12 x 3/4	380	232	93.2	H47/15
	2500	12 x 3/4	520	232	127.2	H47/25
	600	14 x 3/4	240	259	68.1	H57/6
5	900, 1500	14 x 3/4	380	259	108.1	H57/9 H57/15
	2500	14 x 3/4	520	259	147.7	H57/25
	600	14 x 7/8	262	292	90.0	H67/6
6	900, 1500	14 x 7/8	424	292	134	H67/9 H67/15
	2500	14 x 7/8	586	292	185.3	H67/25
	600	16 x 1 1/8	280	368	147.1	H77/6
8	900, 1500	16 x 1 1/8	460	368	241.1	H77/9 H77/15
	2500	16 x 1 1/8	820	368	430.2	H77/25
	600	16 x 1 1/8	284	422	176.3	H107/6
10	900	16 x 1 1/8	468	422	290.4	H107/9
	1500	16 x 1 1/8	652	422	404.5	H107/15
	2500	16 x 1 3/8	836	459	686.3	H107/25
12	600	16 x 1 1/4	340	510	320.9	H127/6
	900	16 x 1 1/4	510	510	483	H127/9
	1500	16 x 1 1/4	680	510	644	H127/15
	2500	18 x 1 1/2	850	536	998	H127/25

### PLEASE NOTE

- Larger Nominal Bores and ANSI ratings are available against specific requests.
- All MORGRIP FLANGES are manufactured to BS 5750.
- We recommend that the tensioning of MORGRIP FLANGES should be carried out by using HYDRATIGHT tensioning equipment. In addition, we can also supply a comprehensive range of in-situ machining equipment along with the services of experienced technicians.

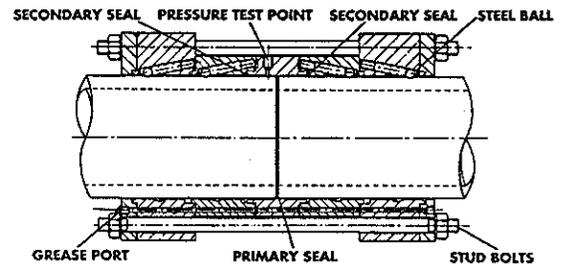
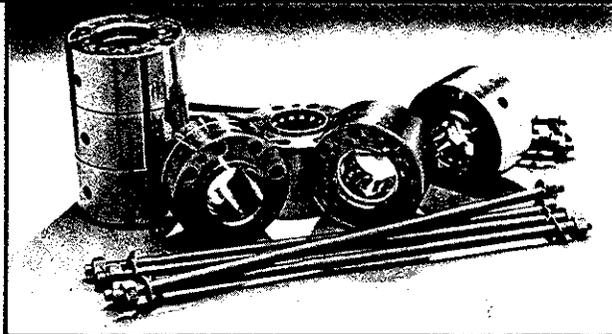
The MORGRIP Flange utilizes a unique gripping system and double seal arrangement which together enables the coupling to withstand extreme external loadings as it seals high internal pressures.

A series of spring loaded ball bearings is positioned around the circumference of the inside of the MORGRIP body.

Both primary and secondary seals are used. The primary seal is located between the pipe ends and the secondary arrangement seals against the pipe's circumference.

Tensioning of the bolts causes the ball bearings to swage into the pipe. As the pipe ends come together, the primary and secondary seals are compressed.

MORGRIP FLANGES are also available for Low Pressure, Sub-Sea and Blank End Pressure Testing applications.



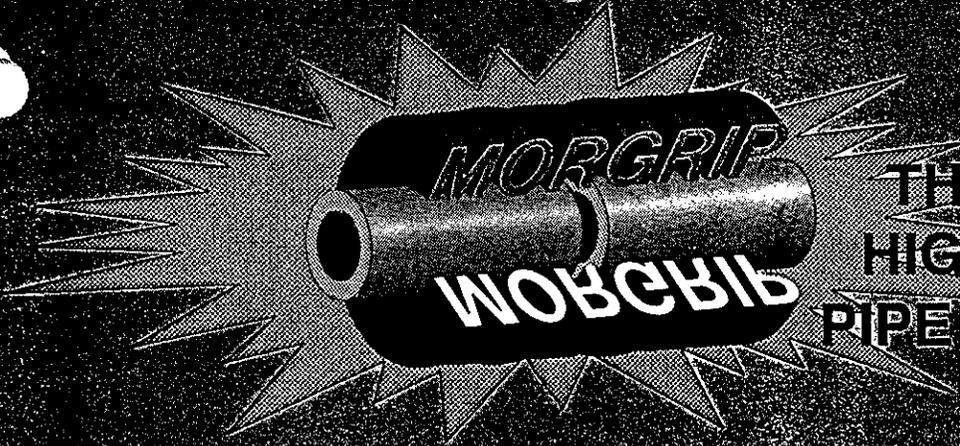
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## Introducing the MORGRIP™ HP...



## THE WELDLESS HIGH PRESSURE PIPE CONNECTOR

### SEALS AT PRESSURES UP TO 10,000 PSI

Joining high pressure pipe for repair or installation is no longer a time-consuming, labor intensive task thanks to HYDRA TIGHT and the MORGRIP flange. This unique coupling does not require any form of welding. It couples pipes together quickly and easily by utilizing a simple yet effective system of coupling segments and seals, all connected by tie rods. Once in place, the flange can be left unattended for years or taken apart and used over and over again.

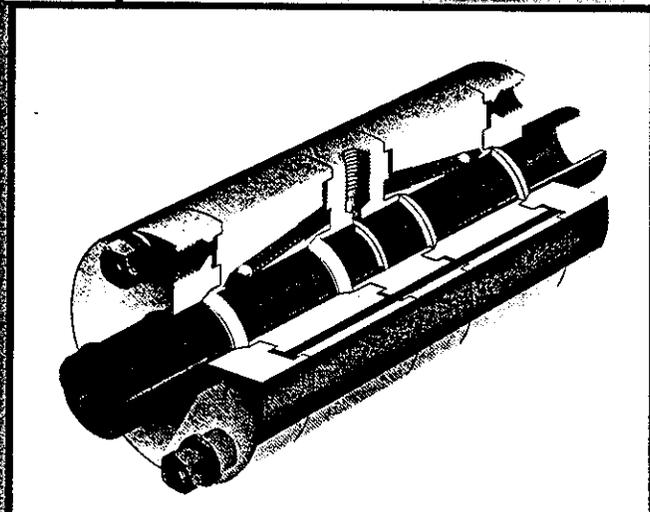
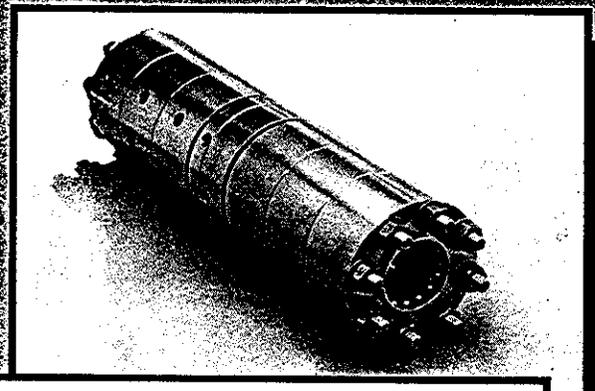
At the point where the pipes are to be connected, a coupling segment is slid onto both pipe sections. As the segments are drawn together during tensioning, ball bearings, located around the inner circumference of each segment, "bite" into the pipe, creating an axial force on the coupling. At the same time, primary and secondary seals are set. The only pipeline preparation is cutting the ends of the pipes square and removing any epoxy coating or weld seam.

### THE HIGH PRESSURE COUPLING--

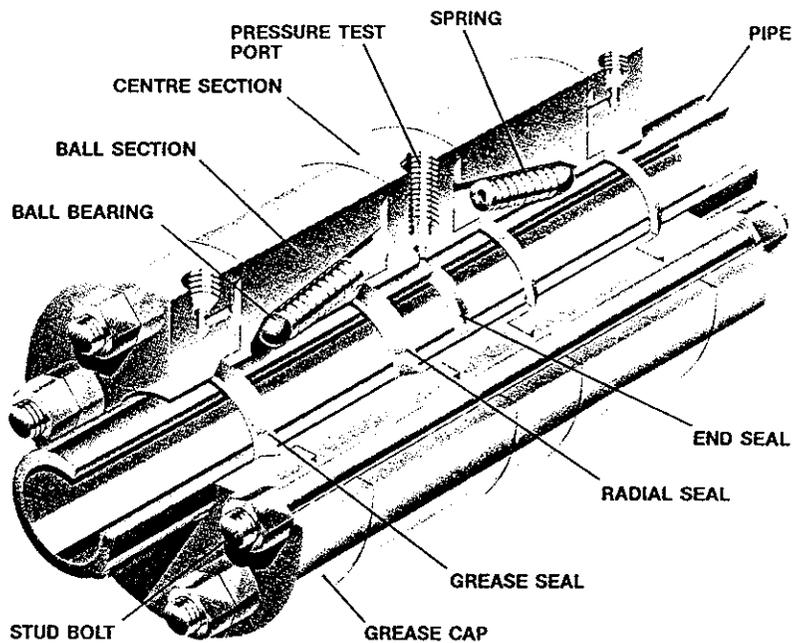
- is simple to install
- provides a permanent joint
- provides a stronger connection than the pipe in axial tension, bending and torsion if specified
- is compatible with the pipe line material
- is useable again and again
- takes up pipe ovality
- seals at pressures up to 10,000 psi, 2500 ANSI Rating lbs.

### APPLICATION BENEFITS--

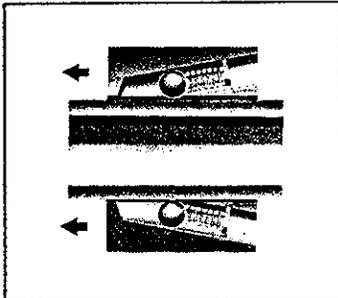
- Allows joint integrity testing without need to pressurize the line.
- Coupled area is stronger than the parent pipe components if requested.
- Light and easy to install.



# MORGRIP - Principles



*Before Bolt Loading*



The MORGRIP system has a unique and patented gripping system which together with the sealing system allows the couplings to withstand extreme external loadings and seal high internal pressures.

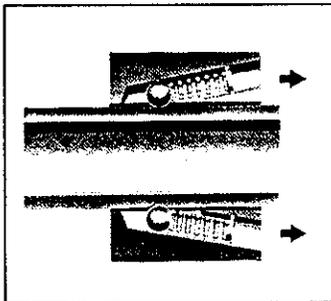
The coupling design is modular with ball segments each having a series of spring loaded ball bearings positioned circumferentially in angled housings around each MORGRIP segment.

The ball bearings provide the effective method of gripping the pipe to be connected.

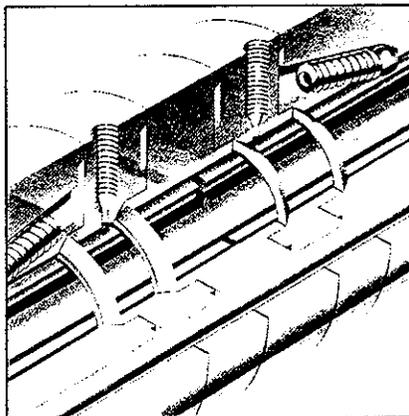
As tightening of the bolts takes place the MORGRIP ball segments are drawn together, causing the balls to roll and wedge into the external surface of the pipe, securely gripping it and effectively becoming one with it.

For normal applications the coupling comprises both an end and radial seal arrangement. The end seal is inserted between the pipe ends (which only require to be square

*After Bolt Loading*



*Twin Radial Seal Arrangement*



cut). The radial seals (two off) are located inside the coupling and are set into a specially designed seating arrangement, when the coupling is tensioned the seals are compressed to give a leak free joint. Alternatively, twin radial seals can be utilised if the condition of the pipe ends precludes the use of a pipe end seal.

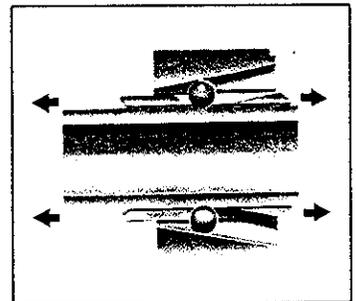
The use of a double seal arrangement allows the coupling to be externally pressure tested, thus eliminating the need to test the whole pipeline.

Although the MORGRIP system provides permanent pipe connections, the connectors are removable and reusable once the new seals are fitted.

With a special optional ball retraction system to withdraw the ball bearing the coupling segments are simply and easily removed from the pipe.

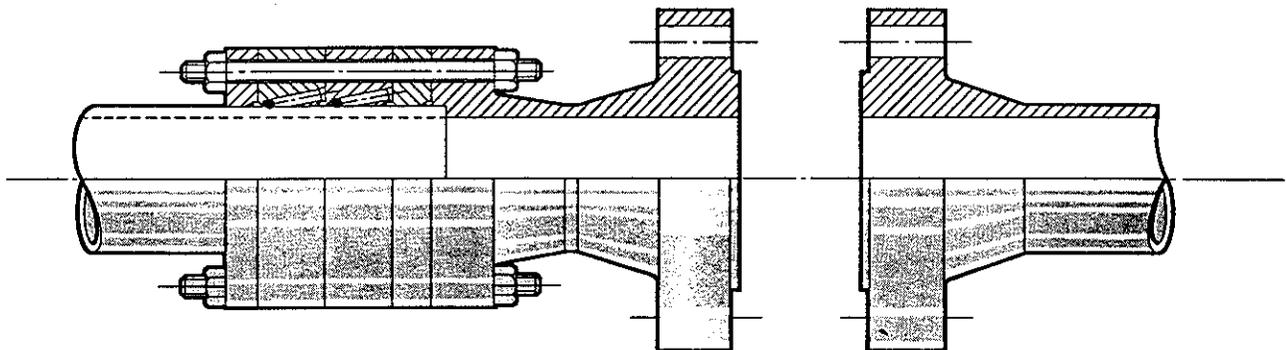
Replace the seals and the MORGRIP can be used again and again.

*Ball Retraction Mechanism*



# MORGRIP - The Problem

Perceived as a problem solver and a fully acceptable alternative to welding, yet smaller and lighter than conventional flanged connections, the MORGRIP coupling connection system offers a range of standard couplings with options to cope with misaligned pipe, flanges, blank end terminations, pressure testing, flanged components and clamp type connectors.



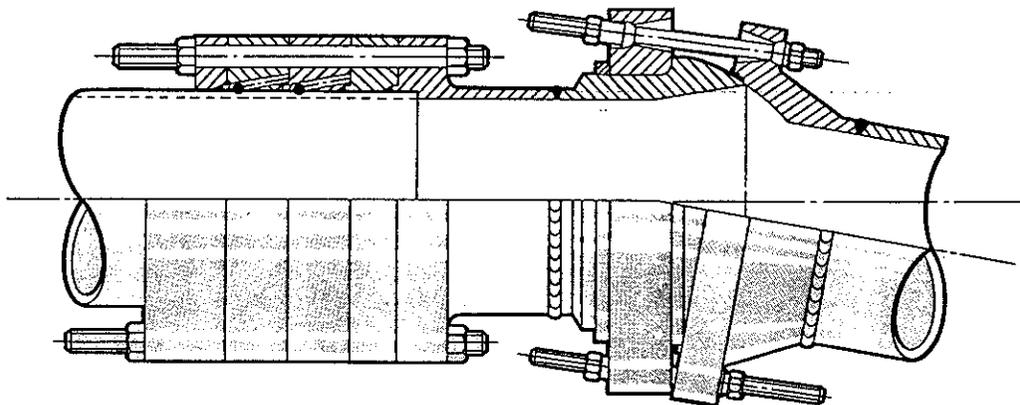
## ● Flange Adaptor

Designed to connect spool pieces to existing flanged pipe, this system eliminates the need for welding.

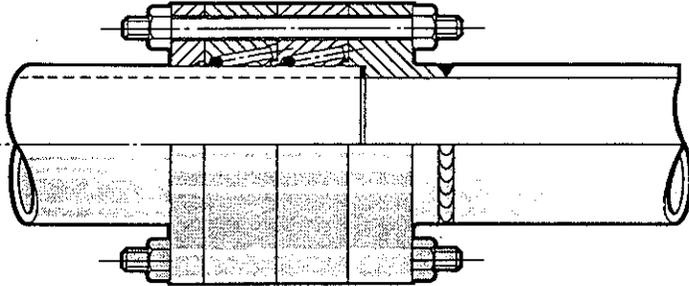
Using MORGRIP coupling segments to suit the pressure rating fitted to the pipe, the segments are bolted directly to the flange adaptor. This component incorporates a standard flange to suit that already on the existing pipe and a smaller special flange that mates with the MORGRIP coupling segments.

## ● Pipe Alignment Connector

This pipeline repair unit is specifically designed to compensate for pipe that has an angular misalignment of up to +/- 10 degrees. The system is the result of co-operation between Hydra-Tight Ltd. and Taper-Lok UK, thereby combining the twin benefits of the MORGRIP coupling and the well proven and approved Taper-Lok misalignment unit.

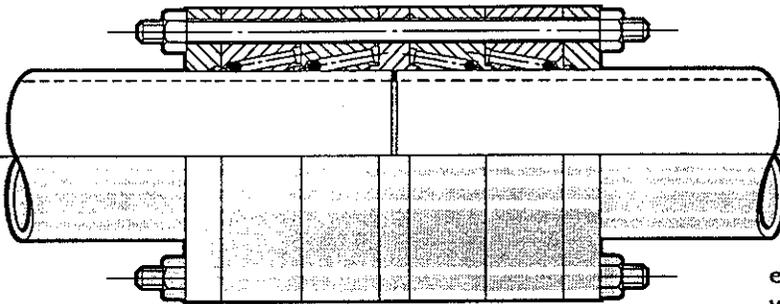


# Solver



## ● Pipe Adaptor

Similar in concept to the flange adaptor, this system provides special features where space is very tight. The MORGRIP flanged union is welded to a spool piece with coupling segments loosely assembled to the union. In restricted working, especially in riser bundles or caissons the spool piece can be easily stabbed on to the mating pipe. The bolts are then tensioned and a permanent connection created.



## ● Standard MORGRIP Coupling

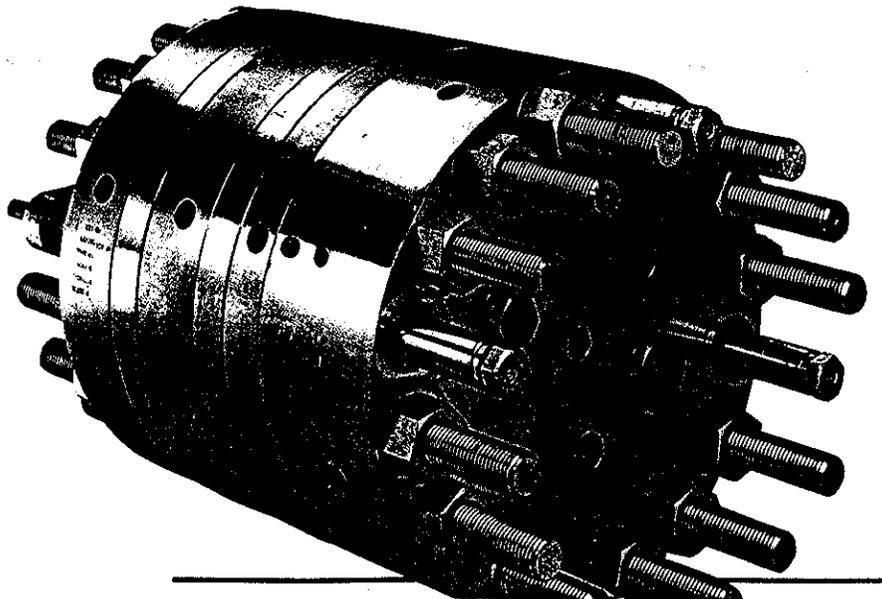
Where it all began. The original MORGRIP concept was developed to enable two plain pipe ends to be permanently connected without welding but without loss of strength or pressure rating.

MORGRIP ball segments are pre-assembled on each pipe end to be connected. Aligning the bolt holes is no problem as the couplings easily rotate. However, with the bolts fitted and tensioned the coupling effectively becomes a solid joint equal in strength to that of a welded joint. Increasing the number of ball segments in a coupling enhances its performance, to be capable of extreme loads and be stronger than the pipe itself, if necessary. Twin seals in each coupling enable all MORGRIP couplings to be externally pressure tested to ensure full seal integrity at above line pressure.

## ● Pressure End Cap

The MORGRIP system provides a simple on-off reusable test cap that eliminates welding to seal open pipe ends and is revolutionising hydrostatic testing. MORGRIP segments are assembled to a special end plate incorporating all the porting necessary to bleed and test. Again, the MORGRIP design enables the seals to be externally tested to ensure integrity before flooding of the pipe or vessel.

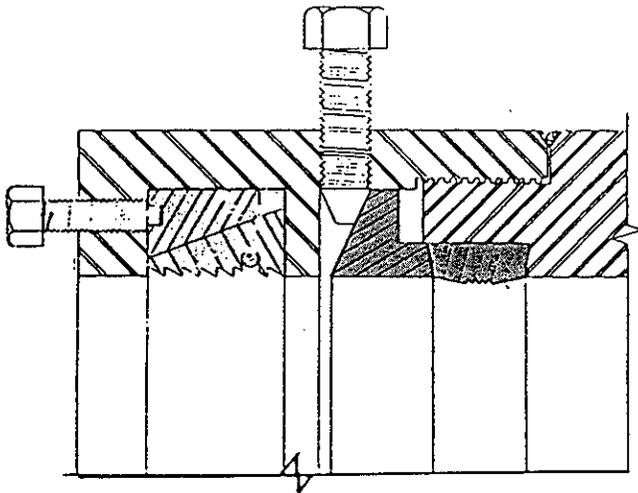
With a unique ball retraction mechanism which can be operated both manually or hydraulically, the MORGRIP pressure end caps are easily fitted and removed.



**5.3.5 Team Inc. - Mech. Repair Coupling**

## How to put a Posi Grip Style PRI Mechanical Pipe Coupling to work for you.

**PLEASE NOTE - THRUST SCREWS  
DO NOT TOUCH PIPELINE**



Apply a coat of lubricant on all moving collets and seals.

Mark a line on one end of the pipe to be joined. The line should be one-half ( $\frac{1}{2}$ ) the length of the M.P.C.

Before assembling, make sure the collets are recessed and will not grip during assembly.

Slide the M.P.C. on the pipe that has been marked, either to the line or the total length of the M.P.C.

Place the joining pipe and position the M.P.C. to its proper set mark.

Actuate the collets on both ends evenly by turning the collet thrust screws. The screws should be turned until resistance is encountered on all screws. (Max. torque to be applied is 100 lb./ft.).

The seals can now be energized by turning evenly the seal thrust screws. Turn the screws until moderate resistance is encountered (approximately 50 lb./ft.).

The pipeline is now ready to be pressurized. Slowly raise the pressure until maximum is reached. Check the pipe for any leaks. If a leak is located, turn the seal thrust screws evenly until leak stops.

If welding is specified, the screws can be cut flush with the housing of the M.P.C. and seal welded.

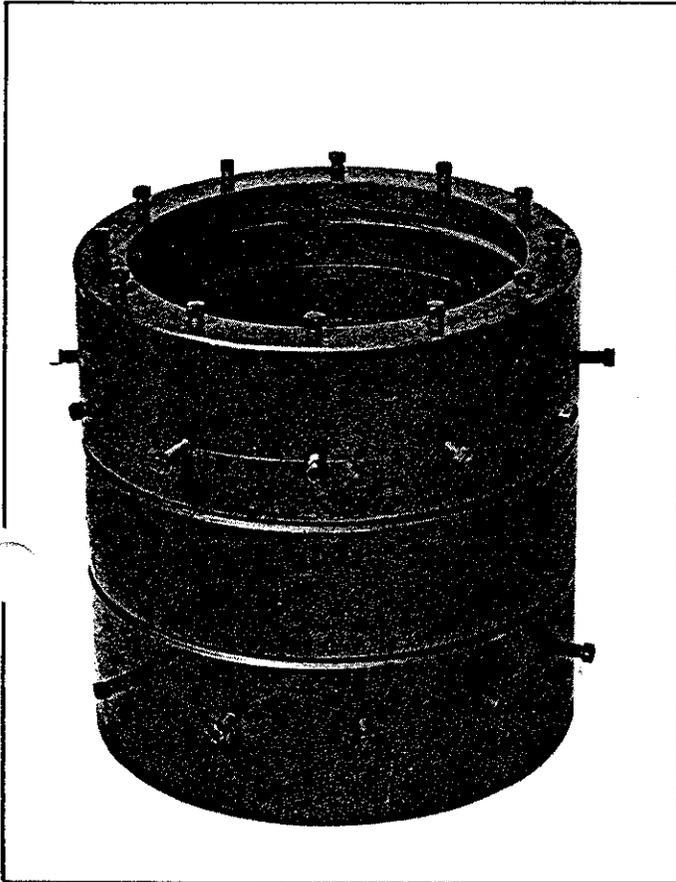
If welding is not performed, the collet thrust screws should be retorqued evenly to 120 lb./ft.



# Mechanical Pipe Couplings

## Underwater - Overland (Posi Grip Style)

### Pipe Repairs, Inc.



Mechanical Pipe Couplings

Mechanical Pipe Couplings equipped with new high tech "PosiGrip" collets, offer positive holdings where splicing or connecting pipelines are required.

PosiGrip is designed for the use on un-anchored pipelines where excessive end pulling loads are involved and welding is not feasible.

**FLOW CAN BE RESUMED IMMEDIATELY TO PIPELINE OPERATING PRESSURE AFTER INSTALLATION.**

#### Warranty

When you're considering repairs of pressured piping systems, call Pipe Repairs, Inc., (PRI). The standard and custom-designed clamps and self-sealing enclosures manufactured by PRI are used worldwide, and are warranted. For specific information about the PRI warranty, contact Pipe Repairs, Inc., in Alvin, Texas.

#### Specifications

	ASA	ASA	ASA	ASA
ANSI Standard	300	400	600	900
Pipeline Operating Pressure	720	960	1440	2160
Normal Pipe Diameters	4" thru 48"			
Sealing Materials	Buna "N" - Neoprene - AFLAS			



1019 South Hood Street  
P.O. Box 123  
Alvin, Texas 77512-0123  
713-331-6154  
U.S. 1-800-662-8326  
ITT 4938640  
Telefax (713) 331-4107

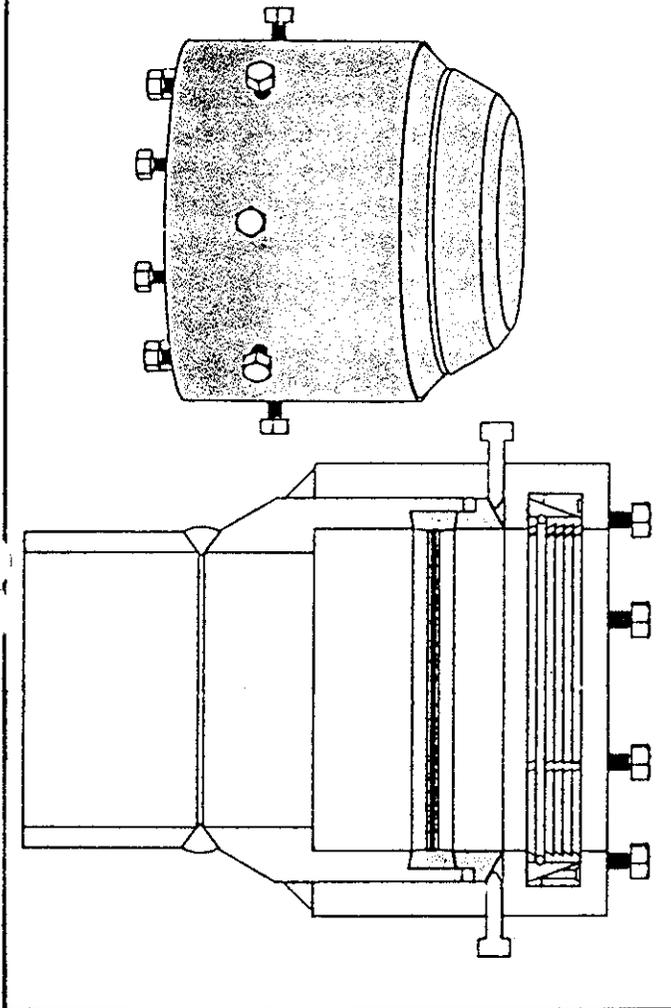
**Pipe Repairs, Inc. (PRI) manufactures both standard and custom designed clamps and self sealing enclosures.**



# Mechanical Riser Repair Couplings (Posi Grip Style)

## Pipe Repairs, Inc.

PLEASE NOTE - THRUST SCREWS  
DO NOT TOUCH PIPELINE



*Mechanical Riser Repair Couplings*

The Mechanical Riser Repair Couplings (MRRC), equipped with new high tech "PosiGrip" collets, is a mechanically actuated coupling type connector. The MRRC offers positive holding where splicing or connector pipelines are required. "PosiGrip" is designed to resist the tensile load due to hydrostatic pressure, where welding is not feasible.

FLOW CAN BE RESUMED IMMEDIATELY TO PIPELINE OPERATING PRESSURE AFTER INSTALLATION.

### Warranty

When you're considering repairs of pressured piping systems, call Pipe Repairs, Inc. (PRI). The standard and custom-designed clamps and self-sealing enclosures manufactured by PRI are used worldwide, and are warranted. For specific information about the PRI warranty, contact Pipe Repairs, Inc., in Alvin, Texas.

### Specifications

	ASA 300	ASA 400	ASA 600	ASA 900
ANSI Standard	300	400	600	900
Pipeline Operating Pressure	720	960	1440	2160
Normal Pipe Diameters	4" thru 48"			
Sealing Materials	Buna "N" - Neoprene - AFLAS			



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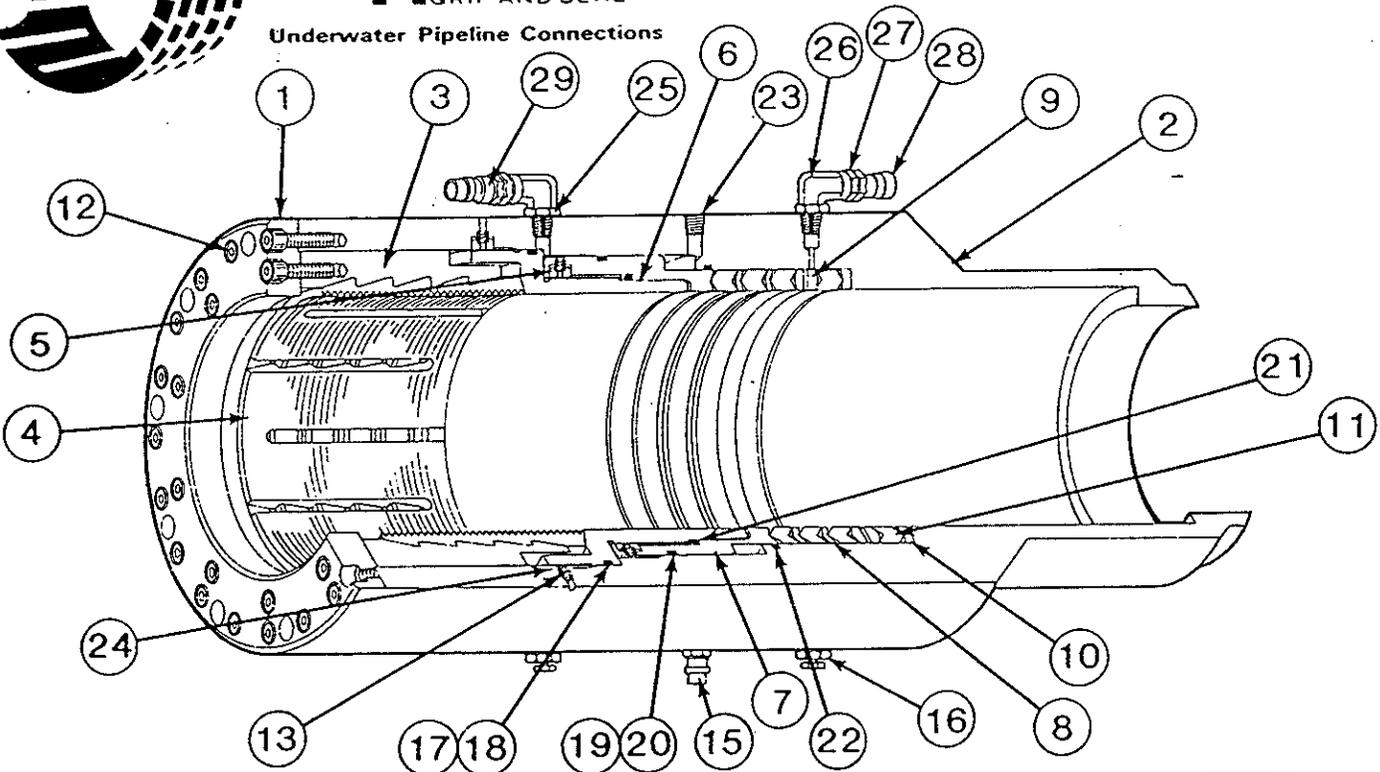
**Pipe Repairs, Inc. (PRI) manufactures both standard and custom designed clamps and self sealing enclosures.**

### 5.3.6      **Gripper, Inc. - Grip & Seal Hydraulic Coupling**



**Gripper Inc.**  
GRIP AND SEAL

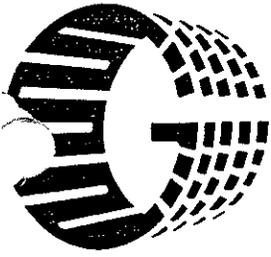
Underwater Pipeline Connections



ITEM	QTY.	DESCRIPTION
1	1	RETAINER FLANGE
2	1	CLAMP BODY
3	1	GRIP HOUSING
4	1	GRIP
5	1	RACHET SET
6	1	GRIP PUSHER
7	1	PACKING PUSHER
8	2	RETAINER
9	1	LANTERN RING
10	1	REAR STOP
11	6	PACKERS
12	*	SOCKET HEAD CAP SCREW
13	32	COMPRESSION SPRING
14	2	ANODE
15	1	RELIEF VALVE
16	2	BLEEDER PLUG
17	1	O RING
18	1	BACK-UP RING
19	1	O RING
20	1	BACK-UP RING
21	1	POLYPAK
22	1	O RING
23	1	PIPE PLUG
24	1	RACHET SET
25	2	PIPE THREAD REDUCER
26	2	STREET ELBOW
27	2	HEX PIPE NIPPLE
28	1	QUICK DISCONNECT COUPLER - FEMALE
29	1	QUICK DISCONNECT COUPLER - MALE

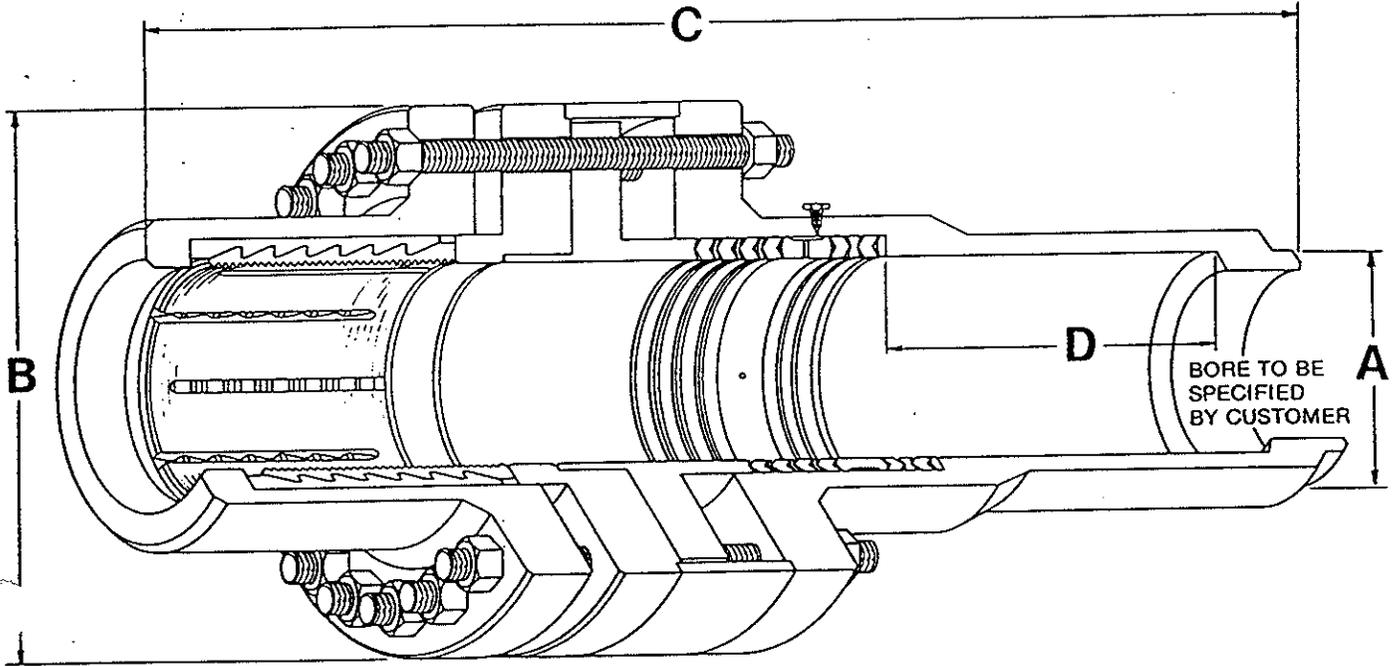
\*Dependent on size and pressure rating.

**GRIP AND SEAL HYDRAULIC COUPLING  
RISER REPAIR UNIT**



**Gripper Inc.**  
GRIP AND SEAL

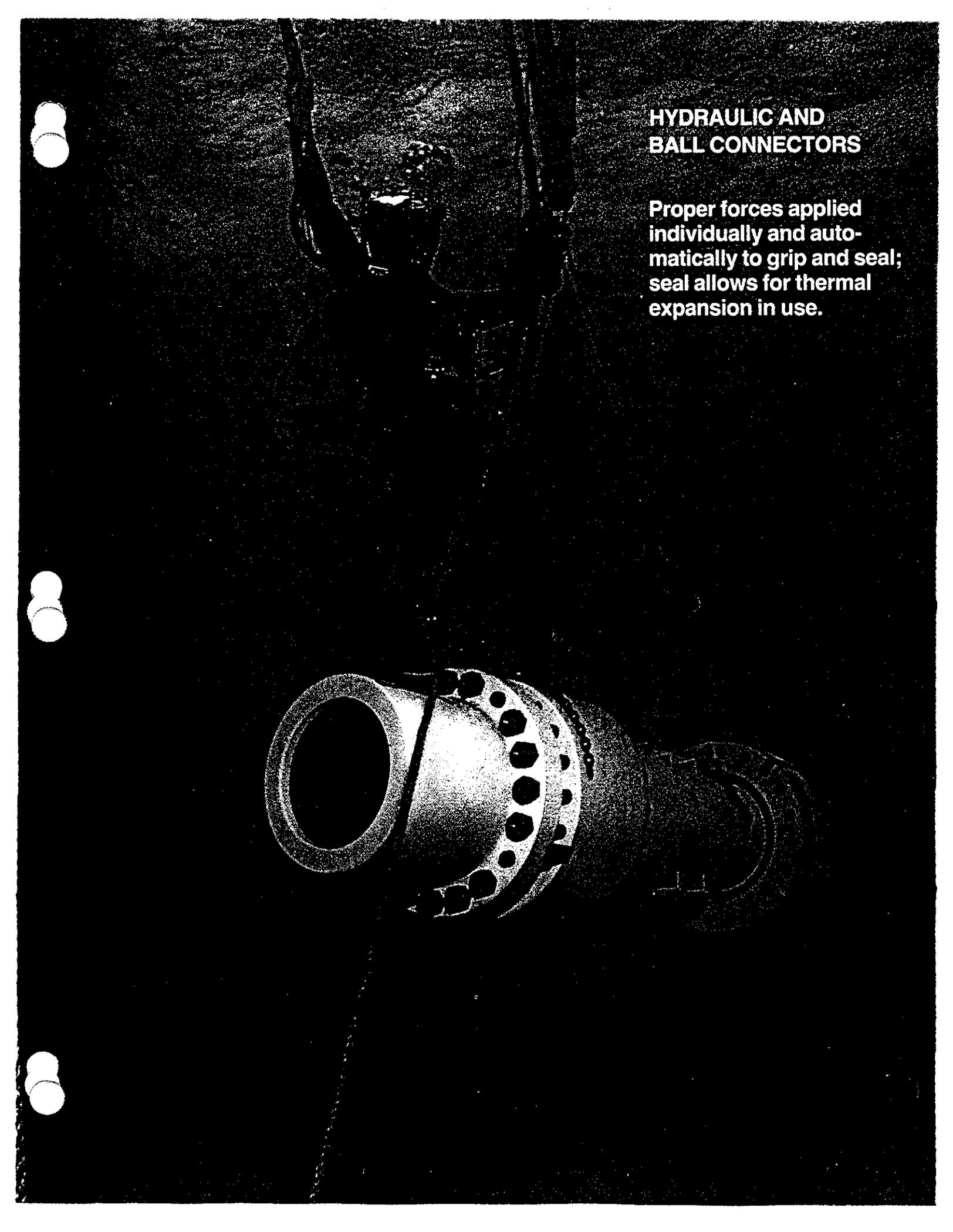
Underwater Pipeline Connections



NOM. PIPE SIZE	FLANGE O.D.	OVERALL LENGTH	TELESCOPE DISTANCE	WEIGHT
A	B	C	D*	
3	10.00	30.00	6	550
4	13.00	34.00	6	700
6	15.38	38.50	12	1000
8	20.50	42.00	12	1200
10	23.00	49.75	12	1600
12	25.38	52.00	12	2200
14	26.25	57.50	14	2800
16	29.25	60.50	16	3600
18	32.50	69.00	18	4600
20	35.25	71.00	20	6000
24	44.50	87.00	24	12000
30	54.75	108.50	30	15000
36	55.50	117.00	36	21500

\* Telescope distances to your specifications available on request.

**GRIP AND SEAL MECHANICAL COUPLING  
CLASS 900**



## HYDRAULIC AND BALL CONNECTORS

Proper forces applied  
individually and auto-  
matically to grip and seal;  
seal allows for thermal  
expansion in use.

## PRINCIPAL BENEFITS OF HYDRAULIC CONNECTOR

Significantly reduced on-bottom installation time.

Uses same proven grips and seals in successful service since 1978.

No price increases as improvements have been added through the years.

Grip and seal set sequentially and automatically in one operation by continuous application of hydraulic pressure.

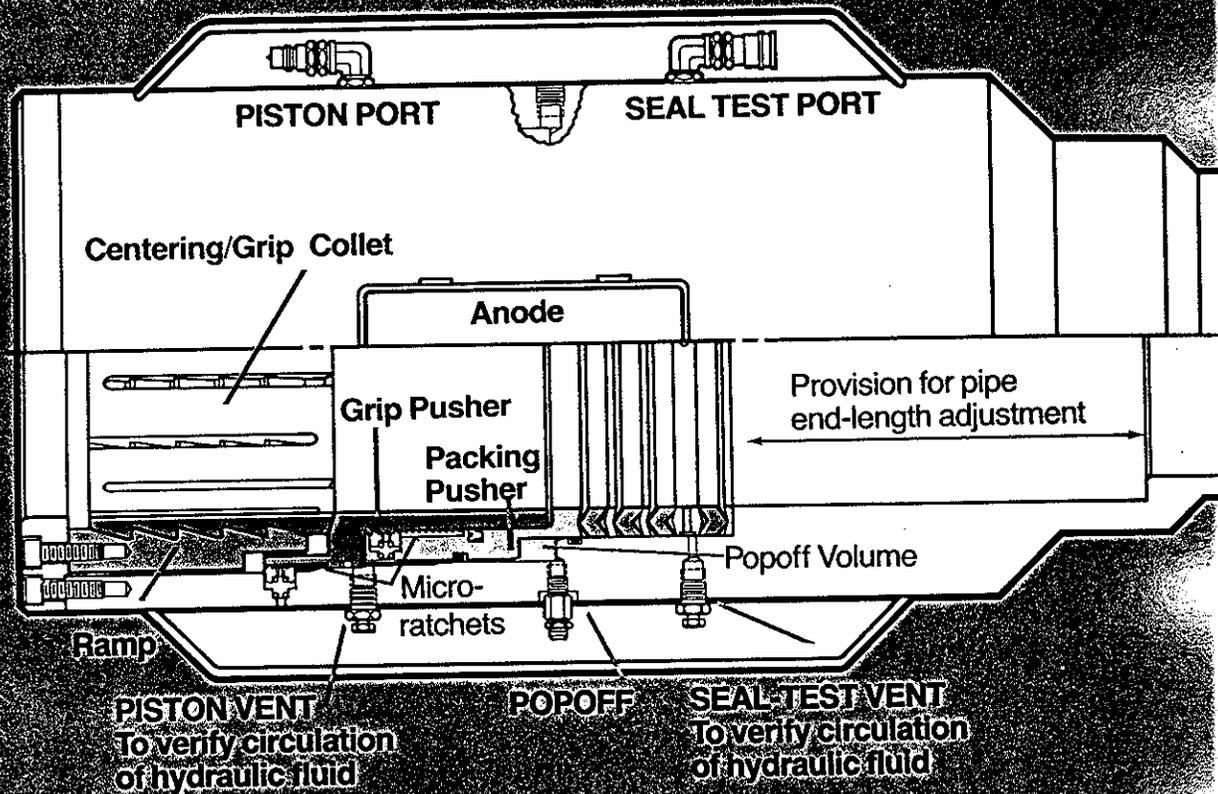
Field serviceable.

Grip collet centers pipe and counteracts out-of-round conditions.

Patented ratchet permanently locks grips and seal—no need to maintain hydraulic pressure or use epoxy to hold.

Chevron V-type ring seal elements provide built-in, permanent temperature compensation.

Full pressure test of seal after installation.



### OPERATION

Two vital facets of the Gripper hydraulic coupling design are not at all obvious. Both are essential to long service life.

1. For maximum seal effectiveness, the pipe should be centered before the seal is set.
2. There must be sufficient "give" somewhere in the seal system to allow for pipe expansion and contraction with temperature and pressure variations.

The Gripper design answers both these needs simply and automatically.

Centering takes place first as hydraulic pressure (red) is applied through the "Piston Port." This pressure forces the grip pusher (purple) and packing pusher (green) apart. The packing pusher is held in place by hydraulic oil in the "Popoff volume," so Piston Port pressure moves the grip pusher to force the grip collet (blue) along the ramp (brown). As the grip collet starts to close, it centers the pipe within the coupling.

Gripping action continues as the grip collet continues to slide along the ramp. This movement is mechanically locked by the grip "micro-ratchet" assembly.

Sealing starts when the grip collet is securely closed around the pipe and the hydraulic pressure exceeds the popoff valve setting. Hydraulic fluid bleeds through the popoff valve allowing the packing pusher (green) to squeeze packing elements in the seal assembly (orange). A "micro-ratchet" locks seal-setting movement.

When pressure at the surface hydraulic console reaches its required value and holds steady for a minute, grip and seal action is complete.

Gripper "micro-ratchet" assemblies have uni-directional teeth that engage similar teeth machined in the matching piece. Segments are spaced around the circumference of the moving parts so that a ratchet detent is passed for each predetermined increment of movement. Collet and seals can move for setting but are

## PRINCIPAL BENEFITS OF BALL CONNECTOR

Rapid and easy installation—flanges do not need to be perfectly parallel as required for ring joint flange.

Up to 10° articulation in any plane without affecting seal integrity.

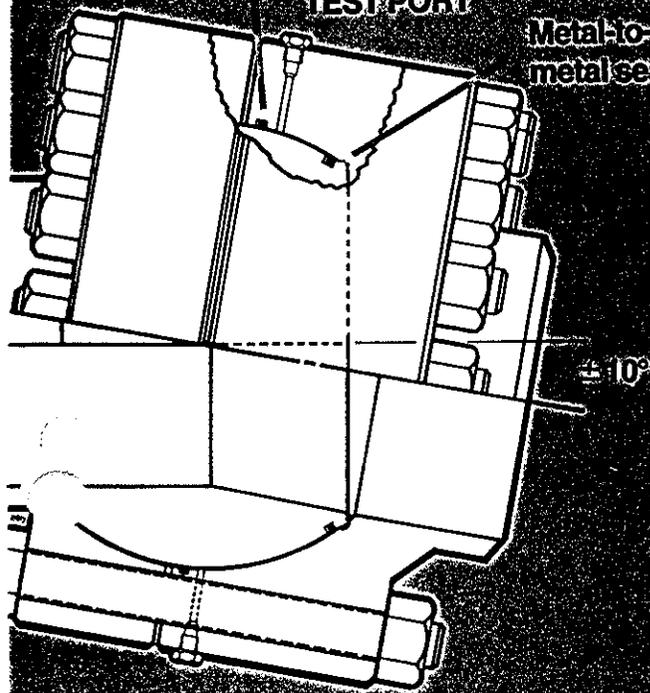
API approved

Test port allows seal pressure check after installation.

O-ring to allow pressure test of seal

TEST PORT

Metal-to-metal seal



held from reversing that movement. When hydraulic pressure is removed, the grips and seals are held firmly in place.

Seal pressure testing is done by releasing the grip/seal pressure from the Piston Port and attaching a male-to-male coupler (the two ports are different to avoid possible confusion underwater) and moving the hydraulic hose to the "Seal Test Port". Hydraulic pressure is again applied and fed to a lantern ring (grey) in the Chevron ring seal. When the applied test pressure holds steady it confirms seal integrity. Pressure is released, the hose disconnected, hydraulic fittings removed and ports plugged. Nothing protrudes from the installed coupling.

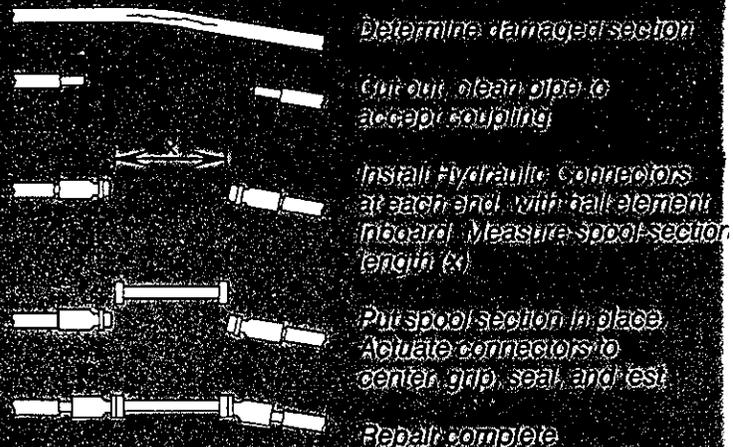
Temperature compensation is provided by the "void" space within the Chevron ring seal. No other mechanisms are required; the seal has been designed to inherently provide room for expansion while maintaining pressure integrity.

The Gripper hydraulic connector provides the most cost-effective subsea pipeline connection available. Its design automatically energizes the grip, centers the pipe and then sets the seals. This action — extremely important in achieving proper grip and seal — is superior to setting the grip by "hard-setting" seals in order to transmit force to the grip. The proper ratio of forces cannot be achieved, and there are no provisions for thermal expansion without modification or retrofit.

### Normally supplied with Ball Connector

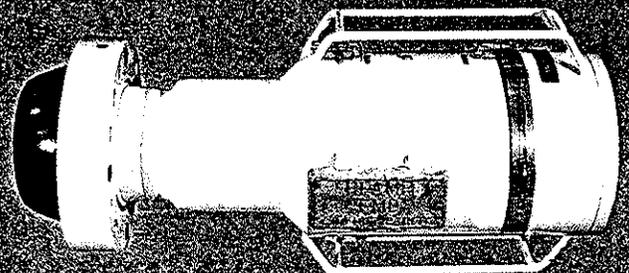
Although available with other fittings, the most typical configuration for subsea pipelines is a Gripper hydraulic connector with the ball portion of a ball connector attached. Allowing for  $\pm 10^\circ$  misalignment, the Gripper ball connector is installed simply by tightening flange nuts which creates a metal-to-metal seal between ball and grip. The seal can be tested before the pipeline is pressurized. As of early 1987, over 500 Gripper misalignment ball connectors were in use around the world.

### TYPICAL REPAIR SEQUENCE



### Similar sequence for new construction

The first Gripper connector was installed in March 1978. Since then over 250 have been delivered for pipe from 4" to 30" in diameter. Connectors are our major product, and the new hydraulic connectors incorporate all the design and operational features proven through the years.



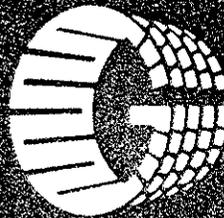
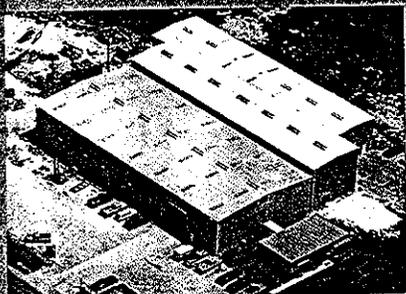
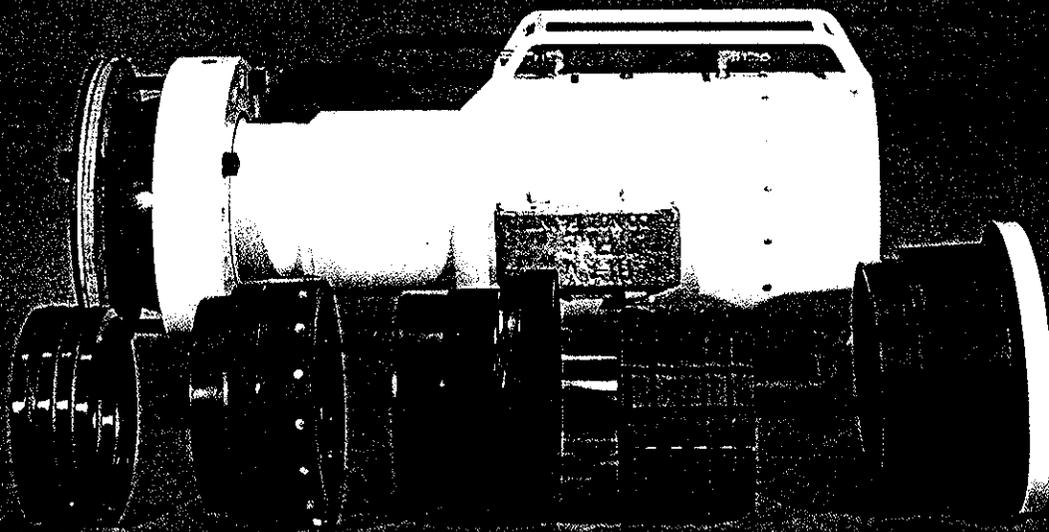
A Gripper hydraulic connector is not only easier and faster to install, but also stays in service much longer.

**NO FAMILY OF SUBSEA PIPELINE  
INSTALLATION, REPAIR, AND TAP PRODUCTS  
CAN BEAT THE GRIPPER RECORD**

Since 1975, over 1500 successful installations of Gripper products have provided unequalled service. *There has not been a single service failure!*

The customers include 47 oil companies, 20 pipeline companies, 22 service companies, and 23 supply companies. The equipment includes 17 different Gripper products. You may want to ask us for details of some of these products such as mechanically-sealed connectors, metal-sealed couplings, pipe-length compensators, grip-and-seal hot taps, structural and non-structural clamps, and the new dual-acting hydraulic bolt-tensioning system.

Why not enjoy the easy and rapid use of products that stay in service? Compare our product features and put our track record against any competitor—including hyperbaric welding or lay-barge methods. You can quickly see for yourself why Gripper will give you more for your money today and years into the future.



**Gripper Inc.**  
GRIP AND SEAL

1107 Aldine Mail Route  
Houston, TX 77039  
Phone: (713) 449-6205  
Telex: 77457  
Fax: (713) 449-8591

### **5.3.7      Oceanering Pipeline Repair Systems**

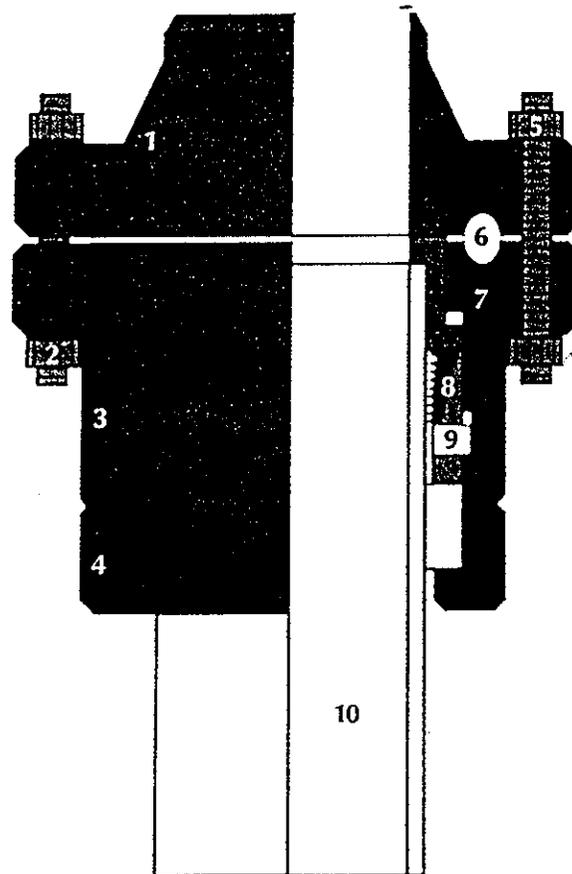
# Smart Flange Plus

## Oceaneering International

Oceaneering's Smart Flange Plus Mechanical Pipe Connector is functionally simple - and simply functional! Here are some good reasons to use Smart Flange Plus on your next pipe repair:

Inadvertent over-torquing of the nuts will not damage the Smart Flange Plus or the pipeline. The tool is fully set when the flanges mate. Additional torque is transmitted through the flanges.

- 1 The mating-flange, studs, nuts and seal ring are supplied as part of the assembly on all 2-inch through 6-inch, 600-series ANSI rated flanges.
- 2 Lower nuts, trapped by the flange housing, simplify installation.
- 3 A seamless forged SA-105 flange housing increases strength and reliability.
- 4 The screw-on cap allows 100% testing before delivery.
- 5 Torque on the upper nuts automatically sets Smart Flange Plus.
- 6 The Ring Type Joint is standard.
- 7 The flange may be swiveled for easy alignment during installation.
- 8 The slip anchor's 30-60 degree tooth design provides maximum strength.
- 9 Load from tension in the pipe is transferred through the slip and segmented ring to the forged housing, protecting the elastomer.
- 10 The design of the Smart Flange Plus compensates for certain errors in pipeline spool-piece measurements.



The standard Smart Flange Plus features Buna "N" elastomer, with Viton™ optional. Customer specified elastomers can be supplied for the Smart Flange Plus.

Every Smart Flange Plus manufactured is placed onto a test-stand, set with a blind flange, and tested to full ANSI flange test rating - this is our quality assurance.

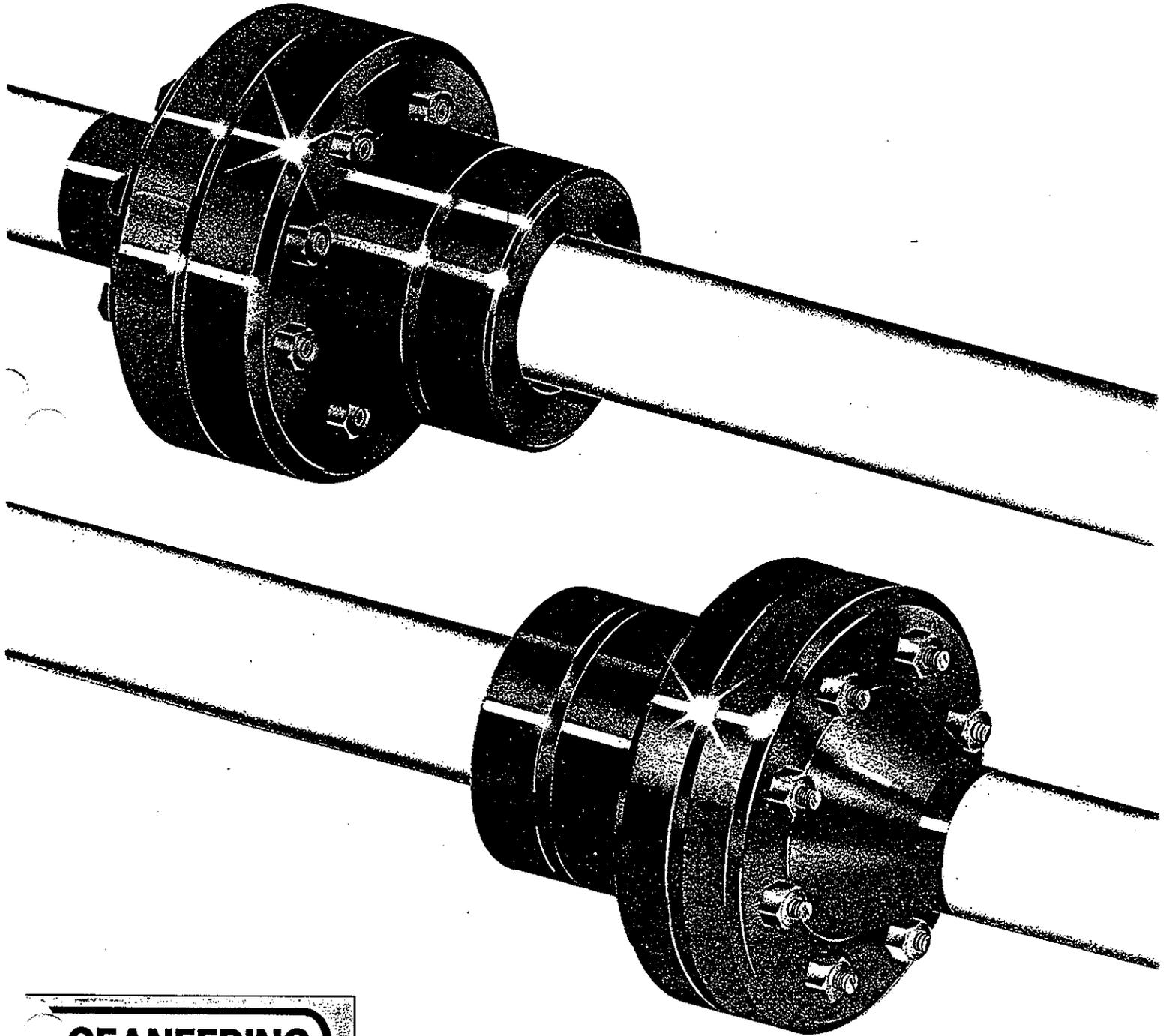
For simplicity, strength, and reliability, you can depend on Oceaneering's Smart Flange Plus.

For more information contact:

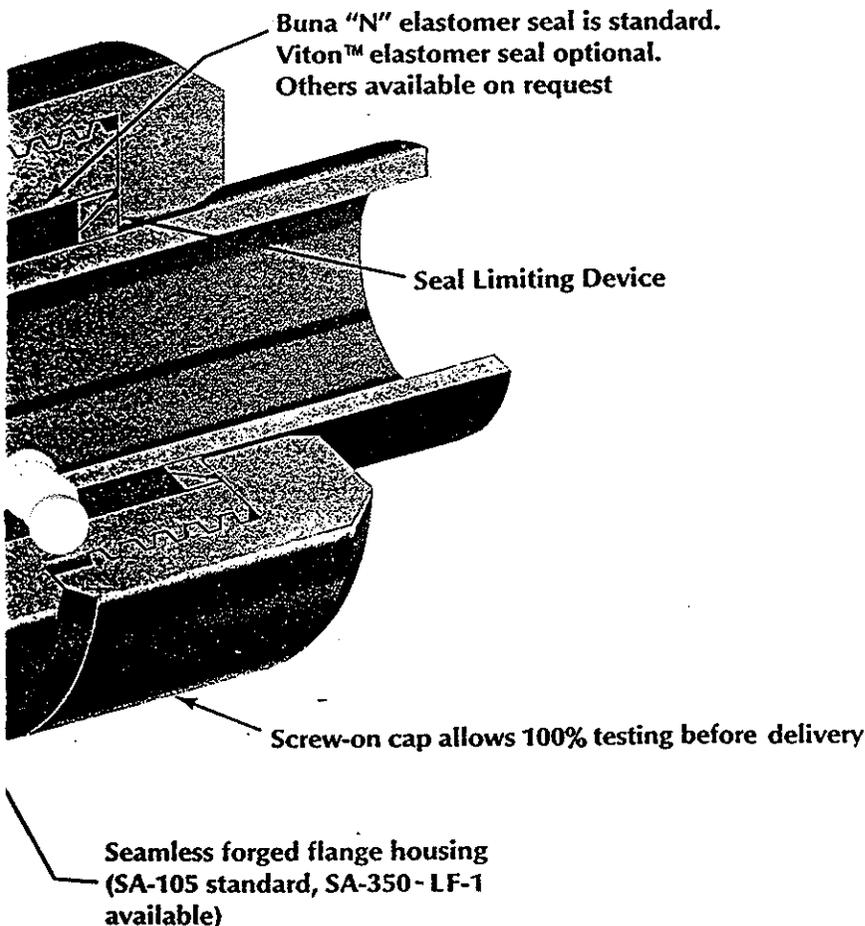
Oceaneering Pipeline Repair Systems Division  
P.O. Box 56546, New Orleans, Louisiana 70156  
Phone: (504) 392-6623 Fax: (504) 392-0046



# The Smart Pipeline Repair System



**CEANEERING**  
PIPELINE REPAIR SYSTEMS



**W**hen you need piping repairs, Oceaneering's Smart Flange Plus™ is available to remedy the problem. Smart Flange Plus is a mechanical connector with a flanged end that is designed to stab over a pipe, mechanically attach itself, and create a seal. With simplicity in mind, the Smart Flange Plus was designed for easy installation — without requiring any special training.

Smart Flange Plus provides a permanent solution for repairs on all topside facilities piping as well as risers and subsea pipelines. Repairs can be executed on pipes carrying gas, liquids, or solids, even at high temperatures and pressures with minimal shut-down time. Installation can be managed on any location without welding and does not require "Hot Work" in hazardous areas. With the convenience and quality of Smart Flange Plus, you will find pipeline repairs more efficient than ever before, whether you're in the petrochemical, oil and gas, refining, or hydrocarbon processing industry.

Before leaving our manufacturing facility, every Smart Flange Plus is placed onto a test stand, set with a mating flange, and hydrostatically tested to the full ANSI flange test rating - 1.5 times its working pressure. Hydrostatic test charts, quality assurance inspection reports, heat treatment furnace charts, and other material processing and manufacturing documentation is available. For maximum convenience, each Smart Flange Plus can be tested to your company's individual requirements, either at our facility or on site at your location. Smart Flange Plus is available in sizes ranging from 2 inches through 48 inches in 600 through 2,500 ANSI pressure classes. Larger custom-designed sizes and pressure classes are available to meet your specifications.

The Smart Flange Plus has successfully completed the following American Petroleum Institute (API) tests: 1) Bending Moment [API 6A Appendix F (235.3)] 2) API 6FB, Fire Test for flanged connectors. These tests were witnessed by Det Norske Veritas (DNV). In a separate test, 100,000 pounds of pull was paced on the Smart Flange while 1,600 foot-pounds of rotation was applied successfully.

**The SMART FLANGE PLUS has successfully completed the API Fire Test specification API 6fb witnessed by DNV.**

**5.3.8 Elim-A-Tank, Inc.**

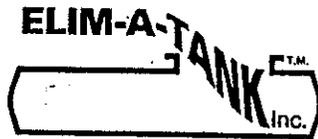


Underground storage  
tank abandonment

3939 Braxton  
Houston, Texas 77063-6380  
(713) 783-3150  
Fax: (713) 789-3065  
1-800-933-TANK

Richard C. Hannay  
President

TWC #CRP000884



Underground storage  
tank abandonment

3939 Braxton  
Houston, Texas 77063-6380  
(713) 783-3150  
Fax: (713) 789-3065  
1-800-933-TANK

Robert W. Pate  
VP — Finance

TWC #CRP000884

# HAZMAT WORLD

The Magazine for Environmental Management

June 1993

## UST closure alternative uses patented process

USTs located beneath surface improvements, such as buildings, process equipment and pipe runs generally must be abandoned in place. In some states, abandonment is an alternative for closure of any UST, as long as no subsurface contamination exists on-site.

Abandonment in-place has been a closure option for UST owners and operators in Texas since 1987, when the State enacted UST regulations. However, the option seldom is used, due to the demanding, time-consuming and labor-intensive methods for UST closures outlined in the American Petroleum Institute's (API; Washington, D.C.) Recommended Practice 1604. The API standard calls for excavating to the tank top, and cutting holes in the top, a potentially dangerous operation.

In July, 1992 the owner of a Houston restaurant, a converted gasoline service station, decided to close two 8000-gallon USTs that had been left in the ground onsite. Because most of the restaurant's parking area would have been affected by removing the tanks, the owner opted for abandonment in place. One of the bidders on the project was ELIM-A-TANK Inc., a Houston-based contractor specializing in tank abandonments.

ELIM-A-TANK opened for business in November, 1991 after developing a proprietary slurry material that can be pumped or poured into USTs through the fill line, eliminating the need for excavation and cold-cutting, as required by API 1604. The company's patented process was reviewed and deemed acceptable by the Texas Water Commission (TWC), the regulating agency in Texas for all UST activities.

As required by TWC regulations, an initial subsurface investigation was first performed at the site. Several soil borings



were installed around the tankpit, and samples of native soils were collected and analyzed for the presence of total petroleum hydrocarbons and BTEX, the aromatic constituents of gasoline. The results were below the TWC's action limits, so the site was declared "clean".

The next consideration was removing the two tanks' remaining contents. Several years earlier, when the service station was converted to a restaurant, the remaining gasoline was drained from the tanks and replaced with drilling mud, an acceptable fill material at the time. The mud was characterized for disposal, pumped from the USTs and transported to a disposal facility.

Once the tanks were empty, a liquid bio-cleaning solution was introduced into the tanks. This consisted of a proprietary mixture of hydrocarbon-degrading bacteria, nutrients, surfactants and water. The solution was applied to all interior surfaces through a spray nozzle. Three weeks later a sample of the solution was analyzed and deemed acceptable for transport back to ELIM-A-TANK's facility for recycling and

use in preparing new batches of solution. Thus, the tanks were cleaned and the bio-cleaning solution recycled, eliminating further waste disposal.

The contractor arranged for 80 cubic yards of a sand and water slurry to be delivered in concrete mixer trucks. The company's proprietary additive was incorporated into the slurry, and the mixture was poured through the fill lines into the USTs, filling them completely.

The operation took less than six hours in one afternoon. By the next morning, when the restaurant's breakfast customers arrived, the slurry had solidified, forming a sandstone-type material meeting TWC and API requirements for being "an inert solid".

The company says the process can be used on any UST, and the slurry material can be pumped up to 400 feet through a 4-inch hose, if necessary. The material also has been used to fill a 400-foot run of 48-inch pipeline as an alternative to excavation.

For more information on ELIM-A-TANK Inc. (Houston) and its services, circle Reader Information No. 500.

**5.3.9 GenFlo Underwater Engineering, Ltd.**

## Distinguishing between pipes

A hand-held pipechecking device which is described as intrinsically safe and simple to operate has been introduced by **Baugh & Weedon** to distinguish between gas- and liquid-filled pipes of 89-330mm external diameter. The probe of the *Ptpecheck* is simply placed on the cleaned and wetted crown of the pipe under test and the unit is switched on. Liquid registers green on an LED display, while gas registers red.

The company claims that any pipe material can be tested, including cast iron, steel and plastic, with thicknesses from 3-24mm, in operating temperatures from -10°C to +55°C. ●

*Reader enquiry service no: 970*

## Fluid flow surveys

The *IS32 Surveylogger* from **Detectronic** is designed to record flow at set intervals up to 30mins apart for on- or off-site hydraulic analysis of single sites or area surveys. It is housed in a double-walled, heavy-duty, tamper-proof enclosure suitable for field use, and the rechargeable battery can enable continuous recording for up to 10 weeks when recording at two-minute intervals. Solar cell boosters are available for extended field use.

Data may be interpreted using the company's own analysis program *FLOAT* or the flow-modelling program *WALLRUS* from **Hydraulic Research International**. ●

*Reader enquiry service no: 971*

## Subsea-pipeline deburial

**Genflo** has developed a large-capacity dredge with twin 10-in diameter suction-heads for dredging during pipeline deburial and trenching. Designed as a sled-type skid, 4m wide by 5.5m long, and fitted with buoyancy tanks, it is dragged along the seabed by tugger winches with the two heads astride the pipeline. The dredge is assembled on and operated from a surface vessel, and 60-100cum/hr of seabed materials including mud, small boulders or riprap, can be displaced for discharge up to 100m away. Its rigid tubular steel frame incorporates high-pressure manifolds, reverse-flush valves and side-bolted hatches for pump inspection. ●

*Reader enquiry service no: 972*

## Flowmeter detects pulses from vortices

A stainless-steel *wafer vortex* piezo-electric flowmeter in 1-6in sizes is available from **Skil Controls Ltd**. The instrument's transducers have been designed to detect the low-pressure pulses created by vortices generated by a small obstruction in the flow. The flowmeter can be supplied with scaled, pulsed, or 4-20mA output. Among the advantages described by the company in using this approach are: the pulses produced are linear with respect to flow velocity, eliminating the need for linearizing electronics with their inaccuracies; using a special dual-piezo sensor, the meter is immune to fluid noise; the density of the fluid does not effect accuracy, so the meter can be used in diverse applications (liquid, steam and gas) without recalibration; and as there are no moving parts, the design is rugged with a low power requirement. ●

*Reader enquiry service no: 973*

The researchers have used historical data, such as construction deadlines, estimated project duration, and labour- and materials-expenditure, from former projects to simulate the construction of the pipeline and predict a budget plan in which key risks are identified. By incorporating into the program historical data drawn from completed projects, the team can assess the accuracy of current estimates and gauge the likelihood of poor estimates.

Once the project has been designed, entry of data into the software spreadsheet is said to be relatively straightforward, and data may be readily updated and manipulated and analytical simulation undertaken. ●

*Reader enquiry service no: 991*

### **'Maersk' pipeline trenching and deburial**

Dredge-builder Genflo Underwater Engineering Ltd of Aberdeen has been commissioned by Stena Offshore to provide a twin-dredge for pipeline trenching and deburial in the Danish sector for the *Maersk* pipeline project, phase 3, tie-in and testing of the *Dagmar* and *Skjold* pipelines.

The high-capacity, water-driven dredge has two 10-in suction heads installed in a sled-type frame, which sits above the pipeline with one of its nozzles either side of the pipe. An example of its application was in operation from the diving-support vessel *Stena Orella*, when the dredge was used for three weeks in February/March, 1991, to trench/debury a 150-m length of pipeline at depths of 43m. Various sea-bed materials, mainly sands, silt and mud, were removed at the rate of 40-60cum/hr. ●

*Reader enquiry service no: 992*

### **Gas-storage caverns**

The pipeline and mechanical-services division of Morrison Biggs Wall has been awarded a contract in excess of £600,000 by British Gas for work on phase seven of the Humberside Hornsea gas-storage complex.

The project is designed to provide underground storage of high-pressure gas in caverns which are leached out of the underlying salt structure. The phase-seven contract is to install the heavy-duty leaching-pumps and pipework systems, and carry out associated civil, electrical and instrumentation work. ●

*Reader enquiry service no: 993*

### **Tension-control fasteners for Ferrybridge**

The use of *Rotabolt* tension-control fasteners at Ferrybridge 'C' power station has reportedly reduced leaks and maintenance costs and improved working conditions. The coal-fired station, established in 1966, is part of the PowerGen network, and produces 2000MW/d of electricity which is fed into the National Grid. Fluctuations in demand mean that the station does not operate continually at full capacity. As a result, a variation in operating temperatures, known as thermal cycling, occurs and can cause leaks in high-pressure steam lines, loss of generating capacity, and expensive repairs. At Ferrybridge, these problems have been significantly reduced since 1986 with the fitting of *Rotabolts* on various components including feed heater inlet/outlet valves, by-pass valves, self-regulating valves and feed-heater centre joints. ●

*Reader enquiry service no: 994*

1	INTERNATIONAL PIPELINE NEWS
3	ORDERS & CONTRACTS
7	NEW PRODUCTS
13	NEW PUBLICATIONS
14	APPOINTMENTS
16	EVENTS

# PIPELINE REPORT

JUNE 1993 No.50

## INTERNATIONAL PIPELINE NEWS

As we reported in our September-October, 1992, issue (*see COMMENT*), an 'industry group' set up in January, 1992, was receiving encouragement from the UK government in its investigations into the possibility of a UK-Europe gas pipeline. The group is continuing to make progress; its original membership of representatives from British Gas, BP, Conoco, Elf, Norsk Hydro, and Statoil was increased in April of this year by the addition of DISTRIGAZ of Belgium.

**UK-Europe  
gas link**

Speaking in Parliament in late May in response to a question, the UK's Energy Minister Tim Eggar said that: "I understand that the group will shortly be inviting potential users to participate in an interconnector linking the UK and Belgian gas grids. I welcome this initiative by the industry". He went on to say: "It will be for the Government to negotiate with the Belgian Government the necessary Treaty for a pipeline crossing our continental shelf boundary, and I am writing to the chairman of the group (Sir Geoffrey Chipperfield) to assure him of our readiness to do so".

It therefore seems increasingly likely that a gas pipeline link across the North Sea will at last be constructed. As many readers will probably be aware, the only previous attempt at such a crossing was the PLUTO fuel line constructed to support the D-day landings of the second World War. Treaties, at that time, were presumably considered unnecessary due to *force majeure*. ●

A management-consultancy division has recently been introduced by Genflo Underwater Engineering Ltd to assist offshore contractors and oil companies involved in the decommissioning of offshore platforms and pipelines. The consultancy will offer feasibility studies, turnkey packages and project management on specialist aspects of platform removal, well-head abandonment, subsea-pipeline cutting, and dredging around underwater installations and pipelines.

**Pipeline and  
platform  
decommissioning**

For several years the company has worked closely with contractors while developing specialist site-clearance equipment, including safety cutting tools and dredges, and providing full dredging and cutting services. ●

*Reader enquiry service no:1192*

A pipe mill acquired from Japan is being re-built and re-furnished by British Steel Tubes & Pipes at its Hartlepool works. The mill is designed to produce high-quality 42-in diameter steel pipes from flat plate; the plate is formed by three stages of

**Pipe mill replaced**



**5.3.10 Stena Offshore - BSW Engineering**

### British Gas to explore in Poland

British Gas Exploration and Production Limited has signed a contract with Poland's Minister of Environmental Protection, Natural Resources and Forestry for exploration and production rights over nine blocks covering an area of approximately 9,000 square kilometres.

British Gas will hold 100% of the equity interest in these blocks during the exploration phase; the Ministry has the right to become an equity participant at the time of any development.

The nine blocks, offered in Poland's first onshore licensing round, are located 100km west of Warsaw and comprise a gas-prone area that is geologically

similar to the Southern North Sea. Seismic techniques developed by British Gas in the North Sea will be used in the acreage.

The initial work commitment includes the acquisition of 300km of new seismic data and the drilling of one exploration well during the first three years, with an option to extend the exploration phase for a further three years. Seismic acquisition is expected to begin during the course of 1994.

Poland is currently a net importer of gas, with considerable potential for the development of an indigenous gas industry. British Gas has been building close links with the Polish gas industry for some time, and is interested in making downstream investments in Poland.

### Wellhead System is sold off

Houston, Texas U.S.A. - National Oilwell recently announced the signing of a letter of intent to sell its Wellhead Systems business to Kvaerner a.s. The transaction, which has an undisclosed purchase price, is subject to a number of conditions, including the negotiation of a definitive agreement, approval by the board of directors of National-Oilwell and Kvaerner, and necessary government approvals.

The Wellhead Systems business manufactures, distributes, and services subsea, platform, and land based wellheads, production trees, and other equipment globally. During fiscal 1992, the business had revenues of approximately \$60 million and currently employs about 400 employees in five countries. Joel V Staff, CEO of National-Oilwell, stated that "The sale of the Wellhead Systems is an important

component of the company's strategy to focus on core business.

"This acquisition is part of our long-term plan to become a total supplier to the offshore industry," says Executive Vice President Bjorn E Klepsvik at Kvaerner a.s.

### National Oilwell to focus on core business

National-Oilwell, a Houston, Texas based partnership between subsidiaries of Amco inc. and USX Corporation, provides products and

services to the energy industries and other industrial markets. The company has approximately 2,500 employees worldwide.

Kvaerner a.s, a publicly traded company based in Oslo, Norway, has revenues in excess of \$3 billion, more than 23,000 employees, and conducts business in five primary areas; mechanical engineering, offshore consulting and contracting, shipbuilding, paper and pulping equipment, and shipping operations.

### Prospects for '94 : the Editor writes...

What are the prospects for 1994? Higher oil prices look unlikely. And, as Colin Wright points out in this issue the full cost of new safety regulations will be felt throughout 1994.

There could be rich pickings in the former Russia, China and Far East and the Falklands factor could come into play. The head of BP Exploration in Europe takes the view that to extend the life of the North Sea, a new approach to

teamwork is a key. And Mike Fleming, head of energy at Scottish Enterprise adds that our industry must continue to internationalise its business. Our preview of 1994 is on the centre pages.

Offshore Oil International is expanding. A new office has been opened at East Kilbride. Hazel Speed has been appointed Marketing Executive. To reserve your advertising space phone Hazel now on 03552-61766. Can you afford in this competitive climate not to have your product, service or innovation in the shop window? As the man said "If you aren't part of the discussion, you won't be part of the outcome".

### OFFSHORE OIL INTERNATIONAL OFFICES AT:

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### Australian wins Petroleum Institute award



Postgraduate student Mark Jackson (centre right) from Australia was congratulated by Mr Ian Ward, Director General of The Institute of Petroleum (IP) on winning the IP award as the student with the best overall performance in the Master of Engineering degree course in Petroleum Engineering at Heriot-Watt University, Edinburgh, in 1993.

The award was presented at the annual IP Students Lecture at Heriot-Watt University, this year given by Dr Chris Gibson-Smith, Chief Executive, BP Exploration Europe, in the series of Lothian European Lectures, before an audience of 350 in the University's James Watt Centre on 23 November 1993. Picture (left to right) Professor Adrain Todd, Head of Department of Petroleum Engineering, Heriot-Watt; Mark Jackson; Dr Chris Gibson-Smith.

## Retrieving pipelines without a diver

### system tested at Scottish loch

Designed for depths over 4,000 metres

### Scottish offshore achievement awards : April 20

1993 sees the 10th Anniversary of these prestigious Oil and Gas Business Awards, which attract submission from all over Scotland.

For ten years the Scottish Offshore Achievement Awards have been recognising, rewarding and promoting the capabilities of Scottish based companies in the international marketplace for oilfield

services, goods and technology. The 1993 Awards will be presented on the evening of Wednesday 20th April 1994 at a dinner to be held in Aberdeen University's Elphinstone Hall. All companies who submit applications will be invited to this prestigious awards dinner, where the awards will be presented by a Government Minister.

### Offshore Newfoundland : June 20

The Newfoundland Ocean Industries Association (NOLA) will host its 10th Annual Offshore Petroleum Conference June 20-21, 1994 at Hotel Newfoundland in St John's, Newfoundland.

Theme for this year's conference is "Offshore Newfoundland: Risk and

Reward". Special sessions will include Hibernia Today, a panel discussion centred on Risk and Reward in the Offshore: Corporate Case Studies; and an overview of Future Developments Offshore Newfoundland.

1 INTERNATIONAL  
PIPELINE NEWS  
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11 NEW PRODUCTS

# PIPELINE REPORT

FEBRUARY 1994 No.54

## INTERNATIONAL PIPELINE NEWS

India's Minister for External Affairs is recently reported as saying that he is sure plans for a subsea gas pipeline between Oman and India will go ahead. A Memorandum of Understanding between the two countries' oil ministers was signed in March, 1993, covering the 1200-km long proposed pipeline, which would be laid at a depth of around 3000m in the Arabian Sea, and two refineries which would be constructed in India. It is anticipated that up to 50MMcum/d of gas could be transported through the pipeline, with crude oil being surface transported as a feedstock for the new refineries. ●

**Oman-India gas  
line...**

A feasibility study is being undertaken to investigate the possibility of transporting Iranian gas to India by pipeline. India's oil minister, Mr Satish Sharma, met his Iranian counterpart, Mr Gholam Aghazadeh, in Iran recently, after which both parties expressed their support for the project. Exports of Iranian oil were also discussed, along with other joint oil-industry projects. ●

**... and Iran-India  
gas pipeline**

It has been confirmed that Qatar is negotiating with Israel to supply it with gas, either by pipeline or by surface transport. The Qatari foreign minister, Sheikh al-Thani, had a meeting in London with Israel's foreign and energy ministers, Mr Shimon Peres and Mr Moshe Shahal, in late January, at which the subject was discussed. Three proposals for the export of Qatari gas emerged: a gas pipeline from Qatar to the port of Ashkelon, on the Mediterranean in southern Israel; shipping gas by tanker to the port of Eilat, and thence transmitting it by pipeline to Ashkelon; and - considered to be even more far-sighted - construction of a pipeline under the Mediterranean from Ashkelon to Europe, to supply Qatari gas to European consumers.

**Qatar-Israel gas  
pipeline?**

A \$1-million feasibility study is to be funded by Qatar, whose government is already said to have pledged to supply Israel with gas for 25 years. ●

A system designed to support deep-water pipelay was recently successfully tested by **Stena Offshore** at Loch Linnhe, Scotland in preparation for the start of a contract with **Petrobras** in the *Marlim* field, Brazil, which will involve estimated pipelaying depths of 900m.

**Pipeline-recovery  
system**

The system, developed in-house by Stena, features the company's remotely-operated vehicle (ROV), the *MRV4*, a diamond-impregnated wire loop for cutting pipe, and a ball-grab device for pipe handling.

Designed to allow pipelines to be retrieved from the seabed without the need for diver intervention, it is considered cheaper than conventional methods of pipeline recovery and is intended for water depths of over 1000m.

The diamond wire cutter is separately deployed as part of a package developed by the company, to which the ROV attaches itself prior to pipe retrieval. The system has its own valve pack, telemetry system, and surface-control panel, and only depends on the ROV for hydraulic power and signal conductors.

The pipeline-recovery connector was developed after a review of available concepts which led to the ball grip, designed and manufactured by **BSW Engineering**, which is separately lowered to the sea-bed but which can be delivered directly to the ROV.

Once a pipe has been cut and grabbed, a recovery wire is attached by a rigging hook or a smaller version of the ball-grab, and dewatering of the line is by pigging. All of this equipment is ROV-operated. ●

*Reader enquiry service no: 1323*

### **Pipe renovation joint-venture**

A joint-venture agreement has been signed between **Instituform Technologies** and **KA-TE Holding AG** to license the newly-formed **KA-TE Instituform AG** of Waldkirch in Switzerland to undertake the no-dig renovation of waste-water pipelines using the *Instituform* process.

The Swiss holding company, based in Zurich, launched a robotic system for sewer repair early in the 1980s, and the patented equipment is now used for all types of spot repair, such as protruding and recessed laterals, cracks and leaking joints in non man-entry sewers.

The Instituform group's contracting companies are provided with technical support from the European Support Centre and from Corporate headquarters in the USA, and have reportedly renovated over 6500km of sewer, water, and industrial pipeline in more than 40 countries. ●

*Reader enquiry service no: 1324*

### **Acoustic enclosure dampens noise**

An acoustic enclosure installed in the pipe-mould repair workshops at **Stanton plc** in Nottingham has reportedly reduced noise levels from 107dB(A) to 78dB(A).

Designed, manufactured, and installed by **Noise Control Systems Ltd** of Derby, the enclosure measures 26.2m x 4m, is 3m high, and is built around a pneumatically-operated peening machine. Whereas ear protectors were adequate for operators in close proximity to the machine on an intermittent basis, increased use of the machine necessitated improved protection. ●

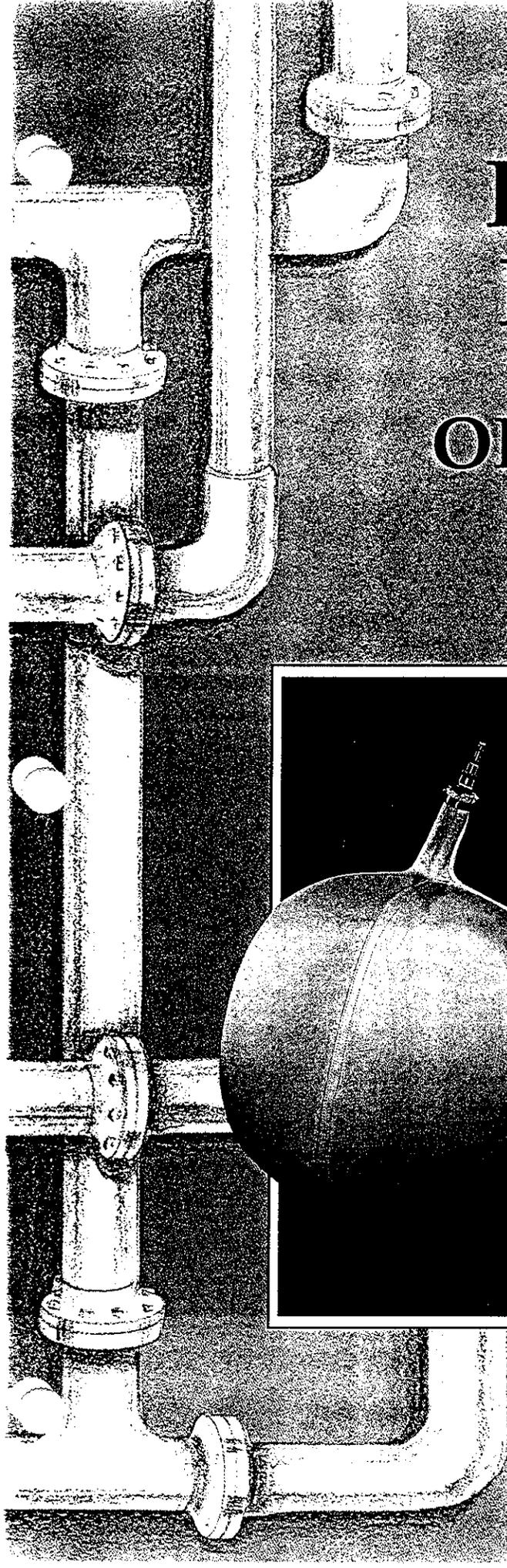
*Reader enquiry service no: 1325*

### **'Armada' project progress**

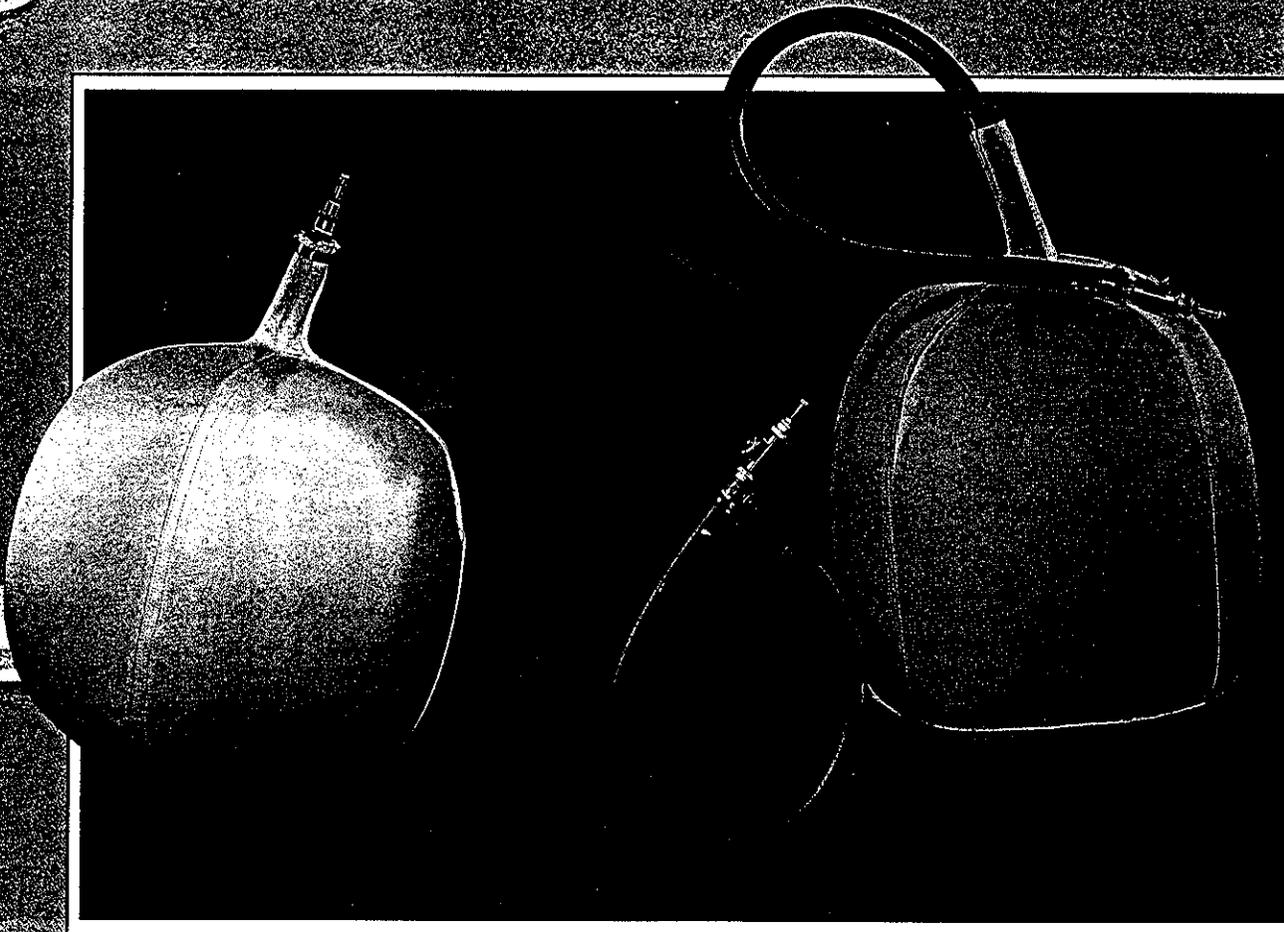
An engineering contract for the conceptual definition of a single platform and associated pipelines has been awarded to **Amec Engineering** by **British Gas** acting as operator of the *Armada* project. Contingent upon the outcome of this work and subsequent project approval, detailed design and procurement of the topside facilities will also be undertaken by the engineering company.

Situated 250km NE of Aberdeen in the Central North Sea, the *Armada* field has estimated recoverable reserves of 1.2tcf of sales gas plus associated liquids. The core of the complex, which spans five blocks north of the *Everest* field, is formed by the *Fleming*,

### **5.3.11 Perma-Type Rubber**



LOW PRESSURE  
**INFLATABLE  
PIPE PLUGS**  
FOR  
**OIL, GAS & WATER  
PIPELINES**



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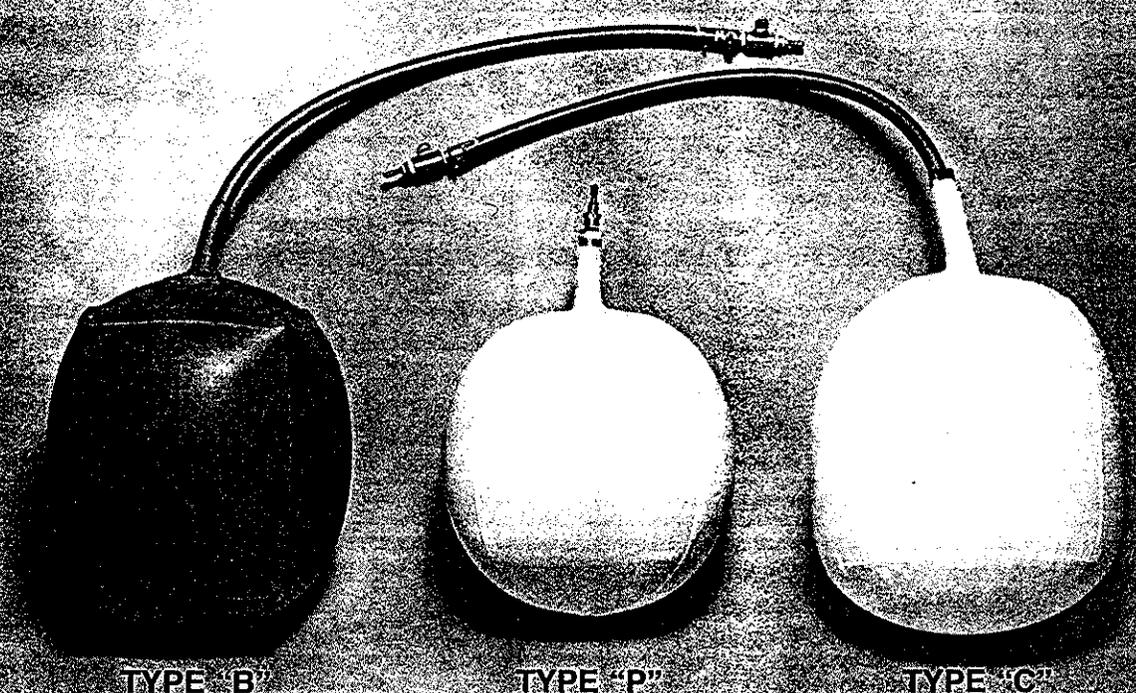
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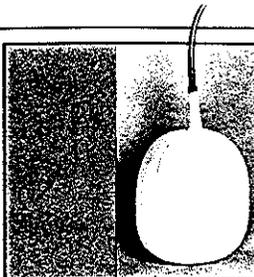
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TYPE "P"

TYPE "C"

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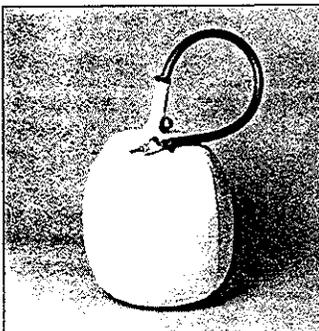
# NITRILE (BUNA-N) TYPE "C" (POLYESTER COVERED)

RESISTANT TO: OIL • KEROSENE • GASOLINE • HYDRAULIC OIL • HYDROCARBONS

• TYPE "C" STOPPERS WHEN INFLATED ARE SLIGHTLY CYLINDRICALLY SHAPED •

CATALOG NO.	INFLATED PLUG O.D. (INCHES)	INFLATED PLUG O.D. (MM)	MAXIMUM PRESSURE		INCHES OF WATER COLUMN	UNINFLATED DIMS.		TUBING I.D. (IN.)	TAP HOLE SIZE REQUIRED	APPROX. WEIGHT (WITH FITTING)
			IN PLUG (P.S.I.)	IN LINE (P.S.I.)		LENGTH (INCHES)	WIDTH (INCHES)			
PTRTCN02	2	51	15	1	27.71	4	1.5	.25	1"	9 oz.
PTRTCN03	3	76	15	1	27.71	5	2.56	.25	1"	10 oz.
PTRTCN04	4	101	15	1	27.71	6.5	3.50	.25	1.25"	12 oz.
PTRTCN05	5	127	15	1	27.71	7	4	.25	1.25"	14.5 oz.
PTRTCN06	6	152	15	1	27.71	9	5	.375	1.5"	1.25 lbs.
PTRTCN08	8	203	12	1	27.71	12	6	.375	2"	1.4 lbs.
PTRTCN10	10	254	10	3/4 lb.	20.78	15.5	7.5	.375	2"	1.5 lbs.
PTRTCN12	12	304	8	3/4 lb.	20.78	18	9	.375	2.5"	2.25 lbs.
PTRTCN14	14	355	6	1/2 lb.	13.86	19	10.5	.625	2.5"	4 lbs.
PTRTCN15	15	381	6	1/2 lb.	13.86	23	11.5	.625	3"	4.5 lbs.
PTRTCN16	16	406	6	1/2 lb.	13.86	24	12	.625	3"	4.75 lbs.
PTRTCN18	18	457	5	1/2 lb.	13.86	25	14	.625	3"	5.75 lbs.
PTRTCN20	20	508	5	1/2 lb.	13.86	32	15	.625	4"	7 lbs.
PTRTCN21	21	533	3	1/2 lb.	13.86	34	16	.625	4"	7.25 lbs.
PTRTCN22	22	558	3	1/2 lb.	13.86	36	17	.625	4"	7.5 lbs.
PTRTCN24	24	609	3	1/2 lb.	13.86	38	18	.625	4"	9 lbs.
PTRTCN26	26	660	3	1/4 lb.	6.93	39	21	.625	5"	12.5 lbs.
PTRTCN28	28	711	3	1/4 lb.	6.93	44	21.5	.625	5"	11.5 lbs.
PTRTCN30	30	762	3	1/4 lb.	6.93	48.5	22.5	.625	5"	13 lbs.
PTRTCN32	32	812	3	1/4 lb.	6.93	49	24.5	.625	5"	14.5 lbs.
PTRTCN34	34	863	3	1/4 lb.	6.93	53	25.5	.625	5"	15.5 lbs.
PTRTCN36	36	914	3	1/4 lb.	6.93	58	26	.625	5"	21 lbs.
PTRTCN40	40	1016	1	1/4 lb.	6.93	64	31	.625	6"	22 lbs.
PTRTCN42	42	1066	1	1/4 lb.	6.93	72	32	.625	6"	27 lbs.
PTRTCN44	44	1117	1	1/4 lb.	6.93	73	33	.625	6"	29.5 lbs.
PTRTCN48	48	1219	1	1/4 lb.	6.93	76	38	.625	6"	31 lbs.
PTRTCN54	54	1371	1	1/4 lb.	6.93	91	43	.625		40.25 lbs.
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★ TYPE "C" TUBING LENGTH IS APPROXIMATELY 3 FT. LONG ★



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SUGGESTION: SEE PAGE 10: "EXTENSION KIT." FOR ORDERING INFORMATION PLEASE SEE PRICE LIST.

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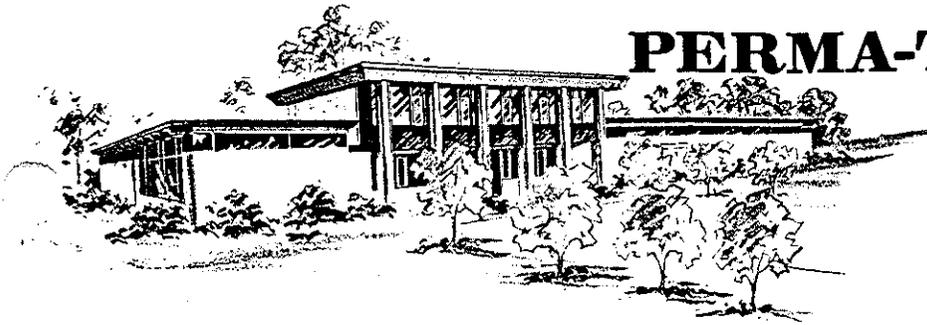
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AIR-PRESSURE  
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PLUGS CAN BE  
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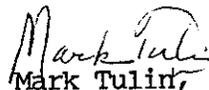
Dear Carl:

As per our telephone conversation today I am enclosing a copy of our Inflatable Pipe Plug Catalog for your evaluation. Please note that Page 6 of the catalog states the sizes that we would have you test for the various pressures. Would you please call me upon receipt.

Thank you.

Yours very truly,

PERMA-TYPE RUBBER

  
Mark Tulin,  
President

MT:f

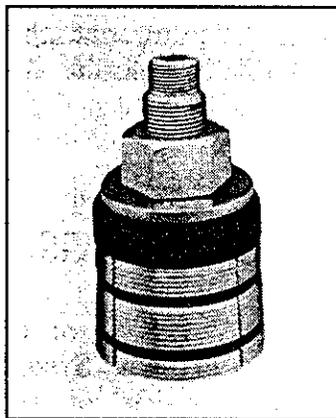
enc.



5.3.12 Thaxton, Inc.

## HYDROTEST STOPPER

**REVERSE PRESSURE** hydrotest stoppers simplify the testing of short sections of welded pipe, flange welds, and nozzles on pressure vessels. There is no need to fill long sections of pipe with water to hydrostatic test a particular weld or segment of pipe. Grips allow the unit to be installed manually anywhere — from a few inches to several feet from the weld to be tested.



As pressure increases, the grip forms a tighter seal. Made of heat treated, plated carbon steel, with neoprene or Buna-N seals, the stoppers are rated from  $-65^{\circ}\text{F}$  to  $+250^{\circ}\text{F}$ . Pressures to 3,000 psi are possible, and each unit is hydrotested prior to shipment. Sizes range from  $1\frac{1}{4}$  to 20 in. diameter and are stocked in sizes to 12-in. diameter.

**Thaxton Div., Hy-Tech Machine, 25 Leonburg Rd., Mars, PA 16046.**

◆ For More Information: Circle 52 on Reply Card ◆

**5.3.13 Petersen Products Co.**

# Petersen PRODUCTS COMPANY LLC

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April 26, 1994

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Dear Mr. Steck:

Thank you for your phone call requesting information on our plugs and stoppers for the oil industry.

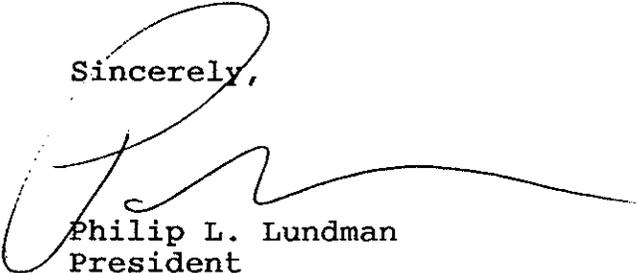
Our stoppers have been used for many years in stoppering for repairs, regulating flows, and permanent plugging.

To plug a pipeline or well, simply fill our stopper with grout and leave in place.

If our standard configurations do not fit the application, we will produce a stopper for your needs.

Thank you for your interest, we look forward to working with you in the future.

Sincerely,



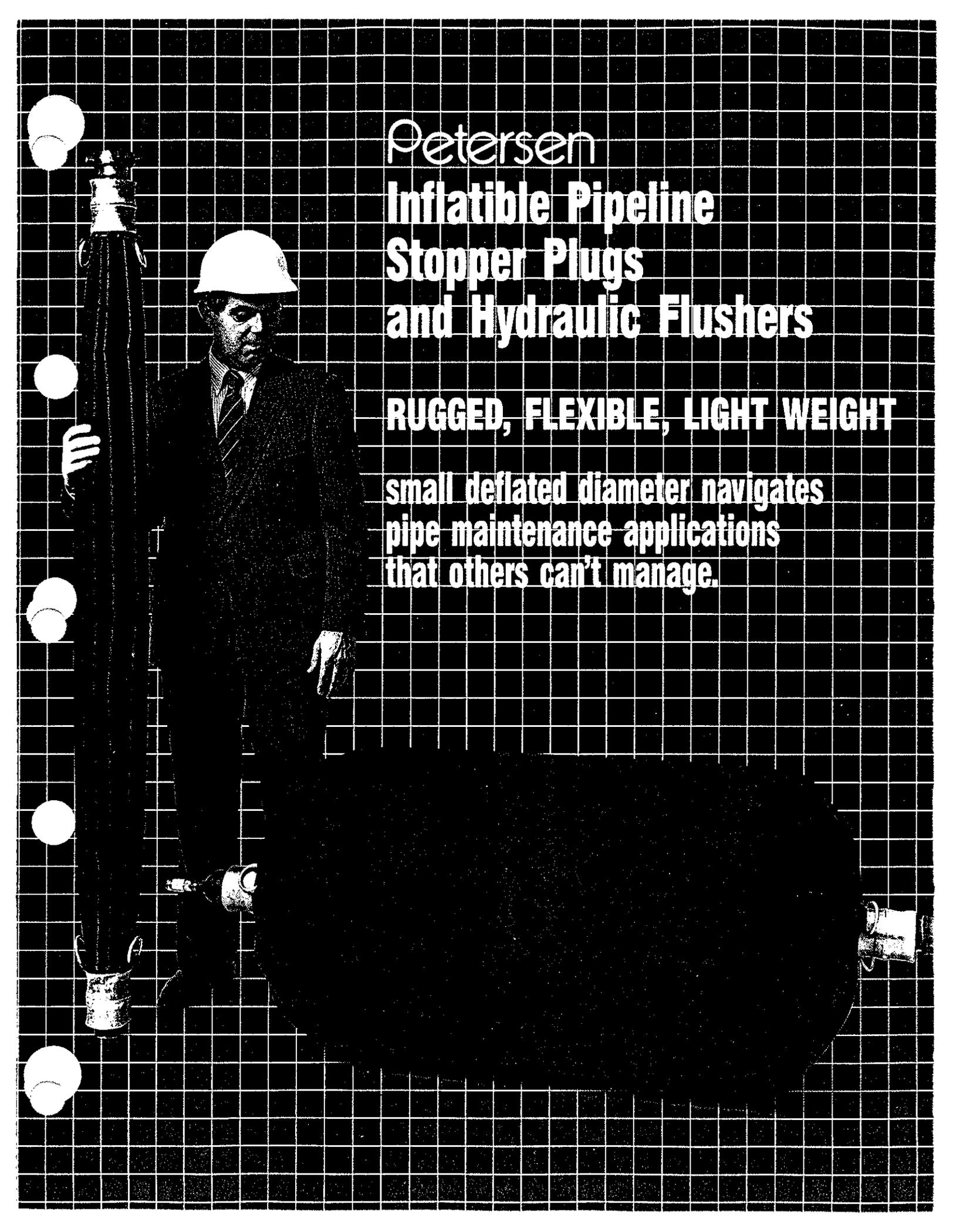
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A black and white advertisement featuring a man in a dark suit, white shirt, striped tie, and white hard hat. He is holding a long, thin, flexible pipe vertically. The pipe has several circular components or joints along its length. The background is a white grid pattern on a dark background. The text is positioned to the right of the man.

**Petersen  
Inflatable Pipeline  
Stopper Plugs  
and Hydraulic Flushers**

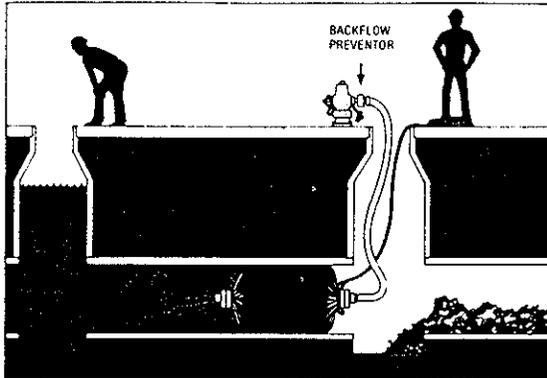
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Flusher design converts ordinary water into a powerful, directed force with jet action to loosen and flush pipeline clear. Ecologically safe, no chemicals or pipe-damaging tools required.



### CLEARING SAND AND HEAVY DEBRIS

1. Insert Flusher above debris with outlet nozzle pointing *upstream*.
2. Turn on water full force, allowing build-up. **CAUTION:** Never fill to cause overflow or backup into building laterals.
3. Turn off water, remove Flusher. Upstream force increases flow to flush sewer clean.

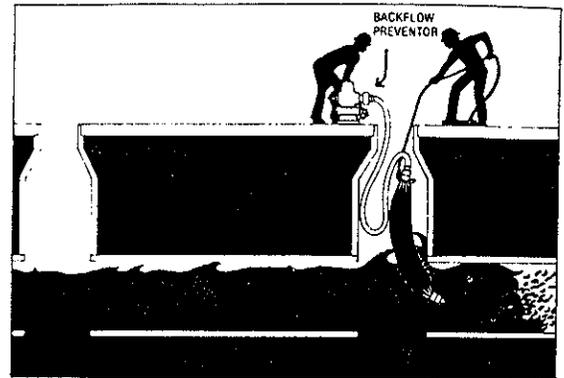
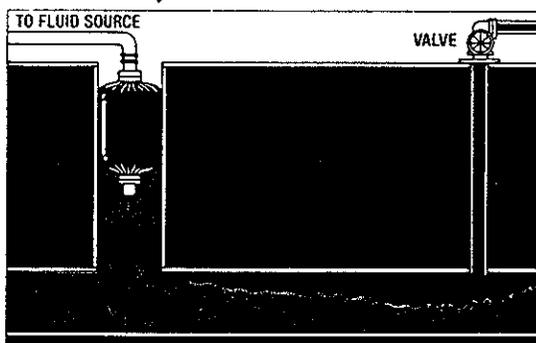
### OPENING CLOGGED SEWERS

1. Insert Flusher at a point where there are no branches or outlets between the Flusher and obstruction. ▶
2. Connect Flusher to water hose (hose diameter must be larger than outlet diameter of Flusher). Portable water pumps are often an effective pressure source for clearing sewers under highways or other remote locations.
3. Turn on water full force. The bag will inflate, blocking sewer to prevent backflow. Water force and jet action will flush pipeline clear.

**NOTE:** When blockage consists of roots, the roots should be cut with an auger before flushing clear. When sludge, paraffin or grease build-up block sewer, hot water improves flushing.

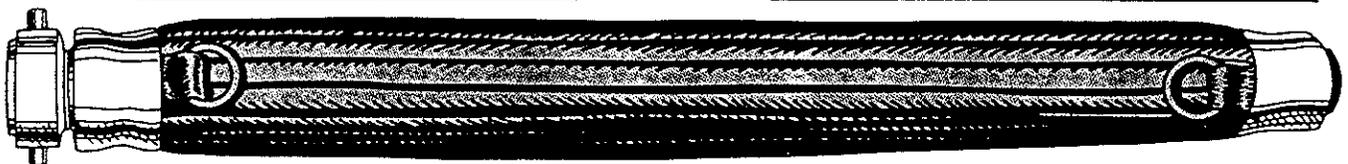
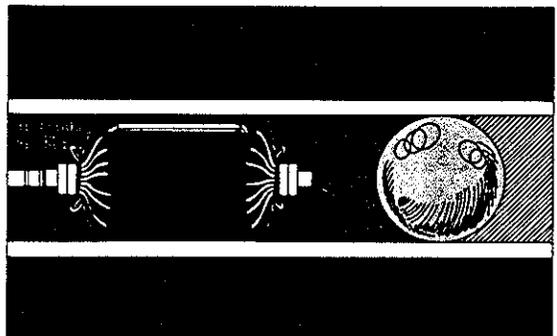
### PURGING WITH DISSIMILAR FLUIDS

Fill pipeline or holding tank to be purged with Flusher inserted into inlet pipe. If fluid to be removed is lighter than incoming fluid, bleed off at highest point or points within system. If it is heavier, bleed off at lowest point or points. ▼



### PURGING OR CLEANING PIPELINE WITH PIG OR SEPARATOR BALL

Insert separator ball or pig into pipeline. Apply fluid through flusher, forcing the separator through pipeline. ▼



**SIZES TO FIT YOUR NEEDS**  
Standard sizes from 4" to 66" diameter for every need.

**SMALL DEFLATED DIAMETERS**  
are easy to navigate in pipes with limited access.

**LIGHT WEIGHT**  
allows one-man application for most sizes.

**HEAVY DUTY BAG**  
specially treated industrial fabric and reinforced neoprene for maximum strength.

**COUPLINGS**  
machined from heavy duty castings to withstand frequent hard use.

**INLET 2½"**  
coupling can be removed exposing 2" male pipe thread.

**OUTLET** Male pipe thread allows various applications, including capping when unit is used as Stopper Plug.

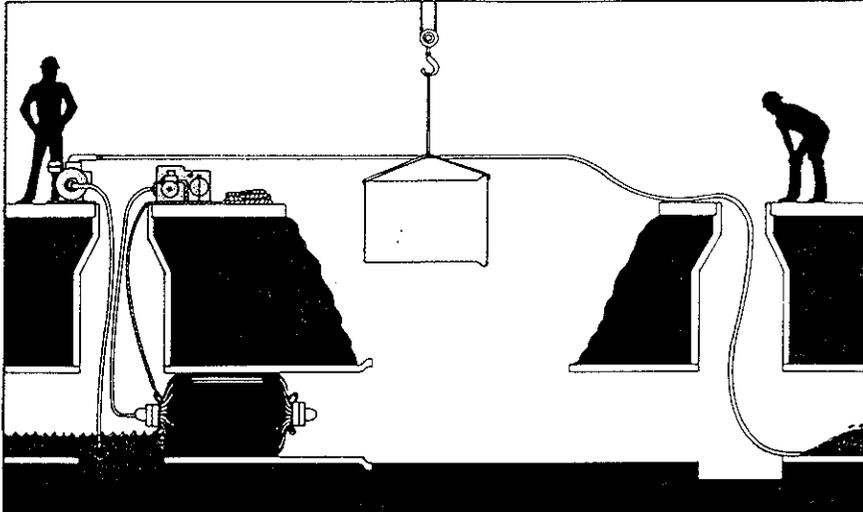
**PULL RINGS**  
Heavy duty steel rings for positioning and securing with pull rope or cable.

**END CLAMPS**  
Heavy aluminum end clamps.

# Petersen Inflatable Pipeline Stopper Plugs for Pipes 4" to 66" I.D.

## COMPACT DIAMETER INFLATES UP TO 8 TIMES FOR CONVENIENT PLUGGING OF PIPES WITH LIMITED ACCESS

Most sizes afford easy placement by one man. Flexibility and design enable unit to navigate through small hot tap or branch pipe into large pipeline; then inflate with air or water to temporarily stopper pipeline for maintenance.



### STOPPERING SEWER PIPE FOR REPAIRS

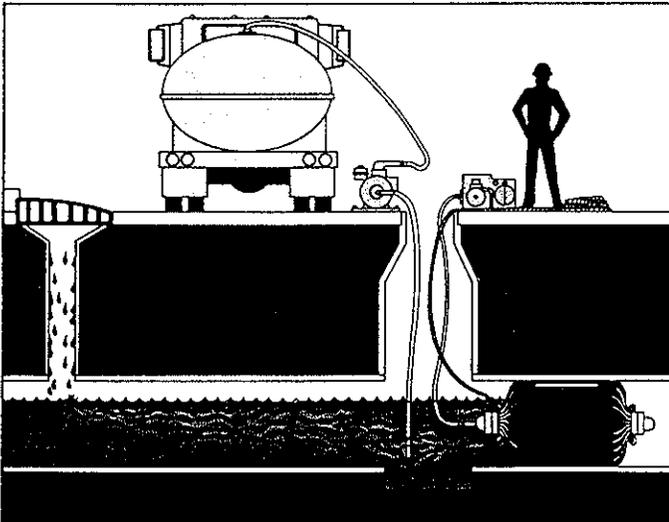
1. Insert Stopper Plug in downstream sewer outlet of manhole above repair area.
2. Inflate Stopper Plug with just enough pressure to stop flow. Maintain pressure with a regulated source to offset small amount of seepage through fabric.
3. Pump effluents from stoppered manhole into sewer downstream from repair area.

### CAUTION

Never stand in direct line with product ends. Never inflate with air where rupture may result in personal injury. Inflation with water is safer than inflation with air should the product burst or its ends come off.

### CLEAN UP HAZARDOUS WASTE SPILL

1. Insert Stopper Plug in downstream outlet of manhole below hazardous waste spill.
2. Inflate Stopper Plug with just enough pressure to stop flow. Maintain pressure with a regulated source to offset small amount of seepage through fabric.
3. Pump hazardous waste from stoppered manhole into waste tank authorized for such purposes.



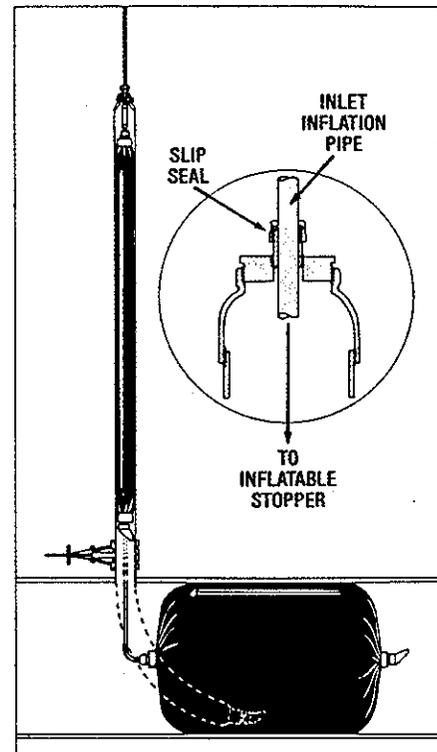
### SPECIAL CONFIGURATION

Special configurations in size, shape and pressure requirements are available on special order.

### INSERTING STOPPER PLUG THROUGH "HOT TAP"

The small deflated diameter of the Petersen Stopper Plug makes it ideal for use with a "hot tap" installed on larger diameter pipelines. The hot tap, including a gate valve sufficient to accommodate the deflated Stopper Plug, should be fitted with an extension pipe chamber long enough to accommodate Stopper Plug length, plus length of flexible hose and rigid inlet pipe which will double as an insertion plunger. Detailed examples of hot tap arrangements are available upon request from Petersen Products Co.

1. Insert deflated Stopper Plug in hot tap extension chamber with gate valve closed. Seal open end of extension chamber with cap, modified to seal rigid inlet pipe/plunger. NOTE: Rigid pipe/plunger should be long enough to reach at least halfway into large diameter pipeline through hot tap, valve and extension chamber.
2. Open gate valve. Slide Stopper Plug into large pipeline. If necessary, special "cornering" attachments are available from Petersen Products Co. to help bend Stopper Plug around corners.
3. With Stopper Plug in place, inflate with just enough pressure to stopper pipe. Maintain pressure with a regulated source to offset small amount of seepage through fabric.



# Petersen Experience you can count on

## PRODUCT DATA

General				Hydraulic Pipeline Flushers					Pipeline Stopper Plugs			
Product No.	Pipe I.D. Inches	Deflated Length, Inches	Deflated Diameter, Inches	Inlet Size, Inches	Female Cplg. Thread	Outlet Pipe, Inches	Male Thread	Min. & Max. P.S.I. When Flushing	Stopper Plug Max P.S.I.	Thrust Max. Lbs.	Head Max. Ft.	Lbs./Ft. Head of Water
12-3041	4	26	2.5	1.5	SIPT	1.00	NPT	30 to 100 Lbs	60	754	139	5
12-3042	4	26	3.2	2.0	SIPT	1.25	NPT	30 to 100 Lbs	60	754	139	5
12-3043	4	26	5.0	2.5	NFH	1.50	NPT	30 to 100 Lbs	60	754	139	5
12-3061	6	29	2.5	1.5	SIPT	1.00	NPT	30 to 100 Lbs	60	1,696	139	12
12-3062	6	29	3.5	2.0	SIPT	1.25	NPT	30 to 100 Lbs	60	1,696	139	12
12-3063	6	29	5.0	2.5	NFH	1.50	NPT	30 to 100 Lbs	60	1,696	139	12
12-3081	8	32	2.7	1.5	SIPT	1.00	NPT	30 to 100 Lbs	60	3,014	139	22
12-3082	8	32	3.5	2.0	SIPT	1.25	NPT	30 to 100 Lbs	60	3,014	139	22
12-3083	8	32	5.0	2.5	NFH	1.50	NPT	30 to 100 Lbs	60	3,014	139	22
12-4102	10	40	4.5	2.0	SIPT	1.25	NPT	30 to 100 Lbs	60	4,710	139	34
12-4103	10	40	5.0	2.5	NFH	1.50	NPT	30 to 100 Lbs	60	4,710	139	34
12-4122	12	48	3.7	2.0	SIPT	1.25	NPT	30 to 100 Lbs	60	6,782	139	49
12-4123	12	48	5.0	2.5	NFH	1.50	NPT	30 to 100 Lbs	60	6,782	139	49
12-4153	15	60	5.0	2.5	NFH	2.00	NPT	30 to 100 Lbs	30	5,299	69	77
12-4183	18	72	5.0	2.5	NFH	2.00	NPT	30 to 80 Lbs	30	7,630	69	110
12-4203	20	76	5.0	2.5	NFH	2.00	NPT	30 to 80 Lbs	25	7,850	58	136
12-4223	22	80	5.0	2.5	NFH	2.00	NPT	30 to 80 Lbs	25	9,499	58	165
12-4243	24	84	5.0	2.5	NFH	2.00	NPT	30 to 70 Lbs	25	11,304	58	196
12-4263	26	88	5.0	2.5	NFH	2.00	NPT	30 to 70 Lbs	22	11,675	51	230
12-4283	28	92	5.2	2.5	NFH	2.00	NPT	30 to 70 Lbs	22	13,540	51	267
12-4303	30	96	5.3	2.5	NFH	2.00	NPT	30 to 60 Lbs	20	14,130	46	306
12-4333	33	102	5.5	2.5	NFH	2.00	NPT	30 to 60 Lbs	20	17,097	46	370
12-4363	36	108	5.7	2.5	NFH	2.00	NPT	30 to 60 Lbs	18	18,312	42	441
12-4423	42	120	6.0	2.5	NFH	2.00	NPT	30 to 50 Lbs	14	19,386	32	600
12-4483	48	132	6.2	2.5	NFH	2.00	NPT	30 to 50 Lbs	10	18,086	23	784
12-4543	54	144	7.0	2.5	NFH	2.00	NPT	30 to 50 Lbs	8	18,312	18	992
12-4603	60	156	7.6	2.5	NFH	2.00	NPT	30 to 45 Lbs	6	16,956	14	1224
12-4663	66	168	8.0	2.5	NFH	2.00	NPT	30 to 45 Lbs	5	17,097	12	1481

### TO ORDER INFLATABLE PIPELINE STOPPER PLUGS

To order with 2" male pipe thread inlet (2.5" coupling removed), change the last digit of the product number from "3" to "0."

### THREAD ABBREVIATIONS

SIPT — Straight Iron Pipe Thread (11.5 threads per inch)  
 NFH — National Fire Hose Thread (7.5 threads per inch, 3.0686" Basic I.D.)  
 NPT — National Pipe Tapered.

### WARNING:

The above inflation pressures and forces in the stoppered pipe are only estimates. Actual conditions will vary with each situation. Never use where failure will result in injury or property damage. Petersen Stopper Plugs are not an approved pressure vessel. Use only enough pressure to do the job.

Products illustrated in this folder have been inflated well below maximum pressure for size demonstration purposes only. NEVER STAND CLOSE TO AN INFLATED STOPPER PLUG OR FLUSHER.

### COMPLETE INSERTION

Completely enclose unit within pipe so that entire fabric area is supported. Fabric will rupture at less than recommended pressure when not supported.

### SHARP EDGES AND PROTRUSIONS

Position where there are no sharp edges or protrusions that may puncture fabric.

### USE PULL ROPE OR CABLE

Prevent damage to inlet hose by using rope or cable attached to Pull Rings when positioning, securing or removing.

### SLIPPAGE PREVENTION

When used as a Stopper Plug, it may be necessary to secure with cable attached to Pull Rings to prevent slippage.

1. Pressure Source must be regulated when used as a Stopper Plug to prevent pressure increases that might rupture the product.
2. When a potable water source is used, most plumbing codes require use of an approved backflow preventive device.

### LIMITED WARRANTY

Petersen warrants that at time of delivery the material furnished is free from defects in material and workmanship. In no event shall the seller be liable for any incidental, consequential or special damages. Before using, user shall determine the suitability of the product for his intended use and user assumes all risk and liability whatsoever in connection therewith. No statement or recommendation not contained herein shall have any force or effect unless in an agreement signed by officers of Petersen.

Petersen PRODUCTS CO. LLC

Fredonia, WI 53021 (414) 692-2416  
 Toll Free 1-800-926-1926  
 Telex 510 100 8566  
 Cable PETERSEN



# drainjet Professional Drain Flushers

**PRODUCT NO. 10-2002**  
FLUSHES DRAINS  
UP TO 2" DIAMETER

**drainjet**  
**Hydraulic Drain Flusher**

OPENS CLOGGED DRAINS WITH WATER PRESSURE AND POWERFUL JET ACTION

- 1.
- 2.
- 3.

• Flushes with water pressure and powerful jet action • Built-in backflow preventor • Ecologically safe • No chemicals needed

- LAVATORY
- LAUNDRY TUB
- PIPE CLEANOUT
- SWIMMING POOL
- SHOWER
- BATHTUB
- WASHING MACHINE DRAIN

Petersen PRODUCTS CO.  
Fredonia, WI 53021

**PRODUCT NO. 10-2004**  
FLUSHES DRAINS  
TO 4" DIAMETER

**drainjet**  
**Hydraulic Drain Flusher**

OPENS CLOGGED DRAINS WITH WATER PRESSURE AND POWERFUL JET ACTION

- 2.
- 3.

Flushes with water pressure and powerful jet action • Built-in backflow preventor • Ecologically safe • No chemicals needed

- FLOOR DRAIN
- PIPE CLEANOUT
- SEWER LATERAL
- RAIN GUTTER DOWNSPOUT
- DRAIN TILE & SOIL PIPE

Petersen PRODUCTS CO.  
Fredonia, WI 53021

## THE HYDRAULIC DRAIN FLUSHER FOR THE PROFESSIONAL

DrainJet design turns household water pressure into a powerful jet. Flushing force and sudden action break through toughest obstructions.

Competitive rubber bulb-type flushers require a pressure valve to maintain expansion which reduces flushing action. DrainJet Hydraulic Drain Flusher puts **all** the water pressure to work. Effective within a wide water pressure range: 30 to 100 psi. Backflow protection. Full year guarantee.

- **EASY TO USE** See easy 1-2-3 instructions and multiple application chart on back side.
- **CONSTRUCTED WITH STIFFENER SPRING** Expandable bag constructed of specially treated industrial fabric, neoprene reinforced for extra strength. Bronze stiffener spring (all models except 10-1002) allows "snaking" around pipe corners.
- **SIX MODELS TO FIT EVERY NEED** Six heavy duty DrainJet models for drains from 1-1/4" - 6" diameter. For larger flushers, to 66" diameter, ask about Petersen's Industrial Hydraulic Flushers.

## Dr. Fix It Economy Drain Flushers

**Dr. Fix It**  
**DRAIN FLUSHER**

**FLUSH DRAINS CLEAR**

OPENS CLOGGED DRAINS WITH WATER PRESSURE AND POWERFUL JET ACTION

- 1.
- 2.
- 3.

Flushes with water pressure and powerful jet action • Built-in backflow preventor • Ecologically safe • No chemicals needed

- FLOOR DRAIN IN HOME
- SEWER LATERAL
- DRAIN TILE
- RAIN GUTTER
- DRAIN PIPE CLEANOUT

**Dr. Fix It**  
**DRAIN FLUSHER**

**FLUSH DRAINS CLEAR**

OPENS CLOGGED DRAINS WITH WATER PRESSURE AND POWERFUL JET ACTION

- 1.
- 2.
- 3.

Flushes with water pressure and powerful jet action • Built-in backflow preventor • Ecologically safe • No chemicals needed

- FLOOR DRAIN IN HOME
- SEWER LATERAL
- DRAIN TILE
- RAIN GUTTER
- DRAIN PIPE CLEANOUT

## THE HYDRAULIC DRAIN FLUSHER FOR EVERY HOUSEHOLD

Dr. Fix It Drain Flushers work on same principle as heavier duty Petersen professional flushers within 30 to 95 psi water pressure range. Backflow protection. Full year guarantee.

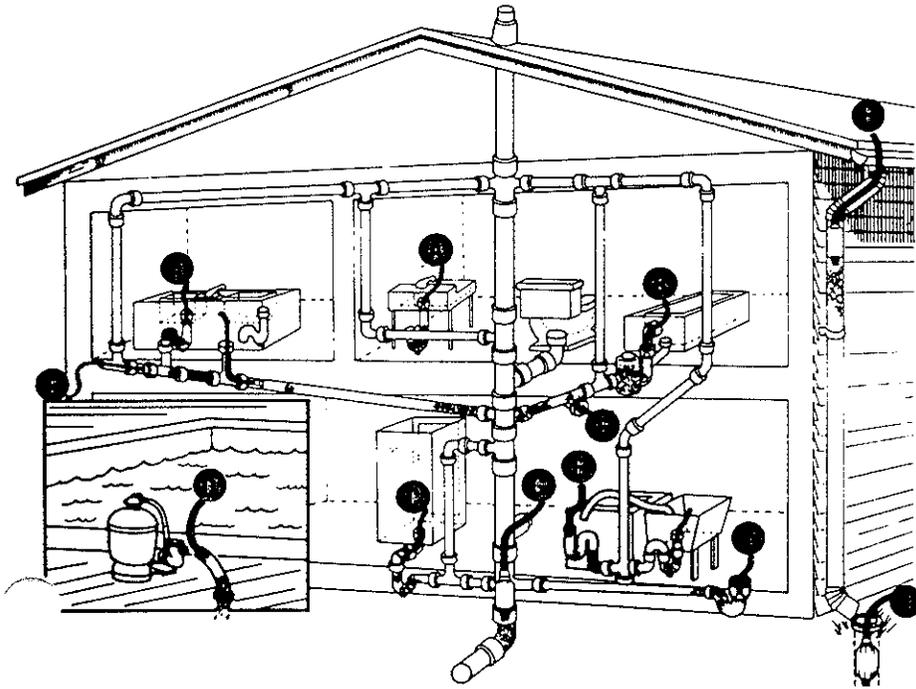
- **EASY TO USE** See easy 1-2-3 instructions and multiple application chart on back side.
- **TWO MODELS FIT ALL HOUSEHOLD NEEDS** Expandable, fast-acting flushers fit all household drains from 1-1/4" through 6".

The Original Flusher Manufacturer  
Supplying Professionals Since 1916

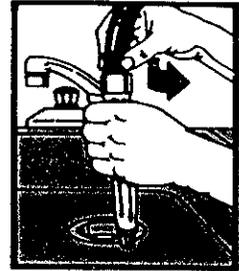
**Petersen PRODUCTS CO.**  
Fredonia, WI 53021 (414) 692-2416  
Out of State 1-800-926-1926  
Telex 510 100 8566  
Cable PETERSEN

# PETERSEN HYDRAULIC DRAIN FLUSHERS OPEN CLOGGED DRAINS WITH WATER PRESSURE AND POWERFUL JET ACTION:

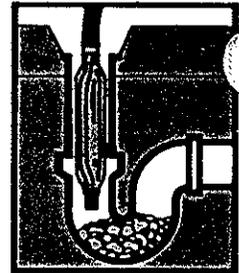
- **BACKFLOW PROTECTION** One-way valve protects potable water supply — prevents backflow.
- **FULL YEAR GUARANTEE** Petersen Products Co. will replace defective flusher within 1 year.
- **ECOLOGICALLY SAFE** No chemicals needed. Works with household water. Turns standard water pressure into a powerful jet. Keeps drains open safely without damaging pipes.



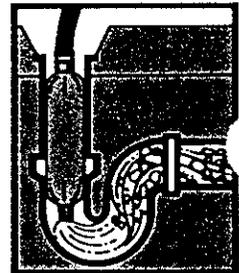
1. Connect Flusher to water hose.



2. Insert Flusher into drain.



3. Turn on water. Bag expands, locks flusher in pipe and flushes drain clear.

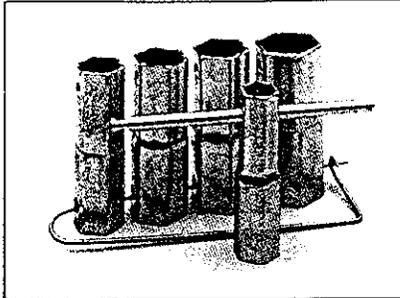


▼ Picture Reference Key	Flusher Size Needed	DrainJet Model No. 10-1062	DrainJet Model No. 10-2001	DrainJet Model No. 10-2002	DrainJet Model No. 10-2003	DrainJet Model No. 10-2004	DrainJet Model No. 10-2006
		1 1/4" - 2" Drains	1 1/2" Drains	2 1/2" Drains	3" Drains	4" Drains	6" Drains
<b>A SINK</b> — Remove stopper or screen and insert Flusher into drain. If this is not possible, remove trap below sink and insert into drainpipe.		●	●	●			
<b>B BATHTUB</b> — Remove stopper or screen and insert Flusher into drain. If this is not possible, remove overflow plate and insert into overflow pipe.		●	●	●			
<b>C SHOWER</b> — Remove drain screen and insert Flusher into drain.		●	●	●			
<b>D SWIMMING POOL</b> — Insert Flusher through skimmer. You can flush in same direction as normal flow or against direction of flow. Also use for priming pump by using flusher to fill inlet of pump with water.		●	●	●			
<b>E WASHING MACHINE DRAIN</b> — Remove hose from standpipe and insert Flusher into pipe.		●	●	●			
<b>F SMALL DRAIN CLEANOUT</b> — Remove cleanout plug and insert Flusher into pipe.				●	●		
<b>G MAIN DRAIN CLEANOUT</b> — Remove cleanout plug and insert Flusher into pipe.					●	●	●
<b>H RAIN GUTTER DOWNSPOUT</b> — Insert Flusher from top or bottom.					●	●	●
<b>I FLOOR DRAIN</b> — Remove strainer and insert Flusher into trap.						●	●
<b>J DRAIN TILES &amp; SOIL PIPES</b> — Insert Flusher into each end where possible.						●	●

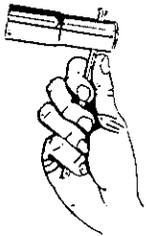
**PURGING A PIPELINE OR HOLDING TANK WITH DISSIMILAR FLUIDS** — Fill pipeline or holding tanks to be purged with Flusher inserted into inlet pipe. If fluid to be removed is lighter than incoming fluid, bleed off at the highest point or points within system. If it is heavier, bleed off at lowest point or points.

The Original Flusher Manufacturer  
Supplying Professionals Since 1916

## RX For Home Repair

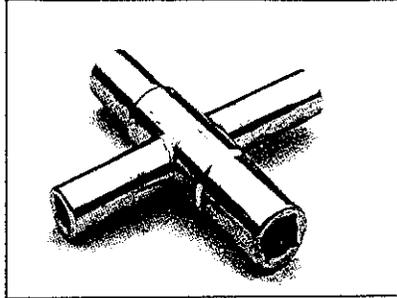


### 10 IN 1 SOCKET WRENCH SET



Ten popular socket sizes with bar handle for work in tight and recessed areas:  
 21/32" & 27/32",  
 29/32" & 1-1/32",  
 31/32" & 1-5/32",  
 1-3/32" & 1-9/32",  
 1-11/32" & 1-7/64".

MODEL 50-1010

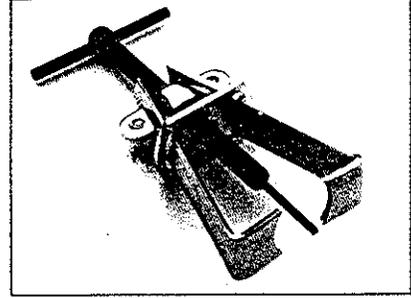


### 4-WAY VALVE AND FAUCET KEY

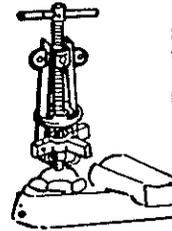


Fits square valve and faucet stems in popular sizes:  
 1/4", 9/32", 5/16",  
 11/32".

MODEL 50-1020

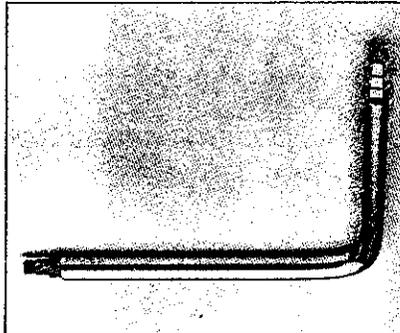


### FAUCET HANDLE PULLER

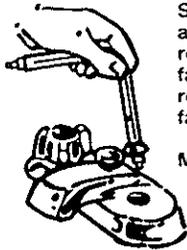


Pulls frozen or tight handles from all faucets and valves.

MODEL 50-1050

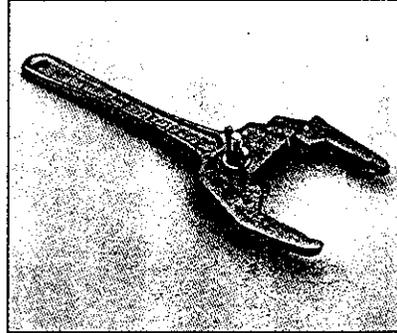


### FAUCET SEAT WRENCH

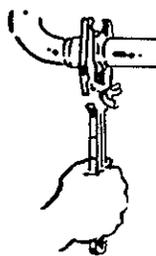


Six sizes, square and hex, for easy removing of old faucet seats, tight replacement of new faucet seats.

MODEL 50-1080

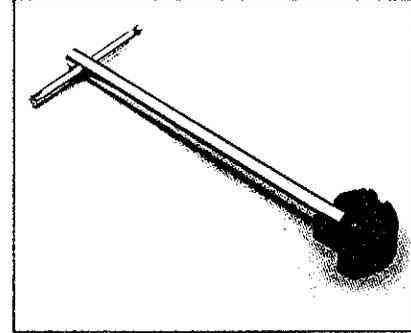


### COMBINATION WRENCH



Wide grip adjusts from 1" to 3" for sinks, strainers and all types of large nuts. Lock nut holds tool squarely for best grip.

MODEL 50-1090

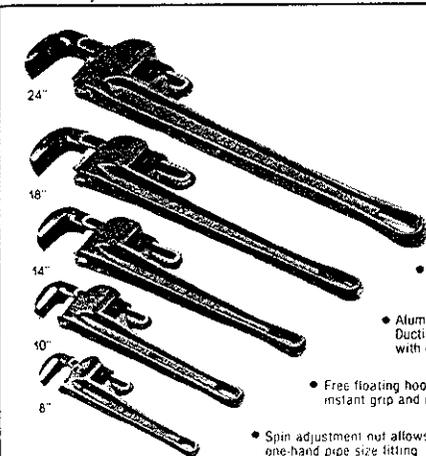


### FAUCET WRENCH



Reaches into tight spots to grip and unlock nuts . . . even smooth round pipes. Use for all jobs: plumbing, automotive and more. Forged steel jaws with automatic spring action.

MODEL 50-1110



## Professional Quality Pipe Wrenches Aluminum or Ductile Cast Iron

### STANDARD DUCTILE IRON

Model 60-0800 8-Inch Pipe Wrench  
 Model 60-1000 10-Inch Pipe Wrench  
 Model 60-1200 12-Inch Pipe Wrench  
 Model 60-1400 14-Inch Pipe Wrench  
 Model 60-1800 18-Inch Pipe Wrench  
 Model 60-2400 24-Inch Pipe Wrench

### ALUMINUM

Model 60-3010 14-Inch, 18-Inch, 24-Inch Set  
 Model 60-3140 14-Inch Pipe Wrench  
 Model 60-3180 18-Inch Pipe Wrench  
 Model 60-3240 24-Inch Pipe Wrench

• Spin adjustment nut allows fast, one-hand pipe size fitting

• Forged alloy steel jaws

• Aluminum or Ductile cast iron handles with comfort grip

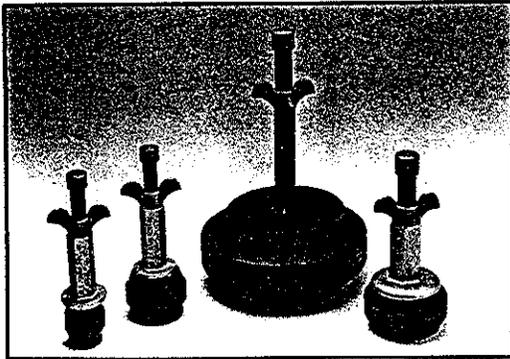
• Free floating hook jaws give instant grip and release

### Lifetime Warranty

Petersen's superior products are a result of engineering excellence and precision quality control. This allows us to offer a **LIFETIME WARRANTY** against defects in materials and workmanship. To take advantage of this warranty, the tool must be returned prepaid to Petersen or place of purchase. Repair or replacement will be made at our option.

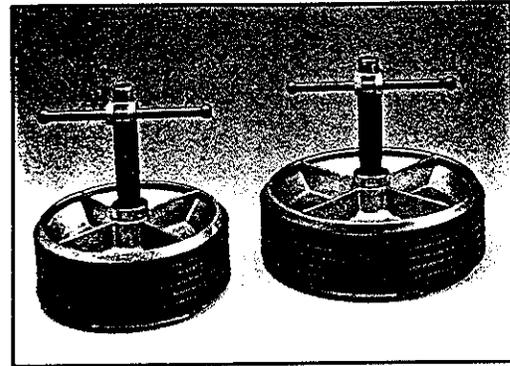
## Petersen ShurLok Test Plugs

### SINGLE TEST PLUGS



1-1/2" - 8" Diameter

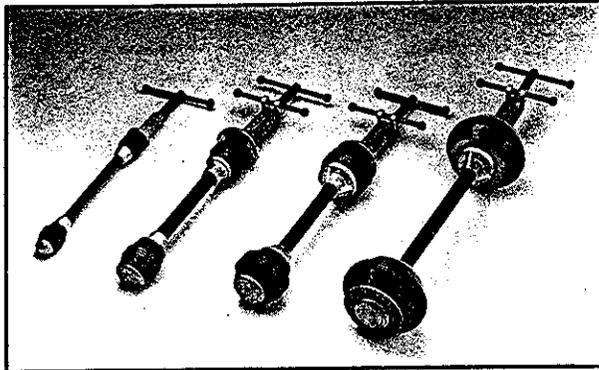
Easy to use for testing or sealing a variety of pipes and fittings. Short, hollow stems allow easier turning in pipes and permit filling or draining without removing the plug.



10" and 12" Diameter

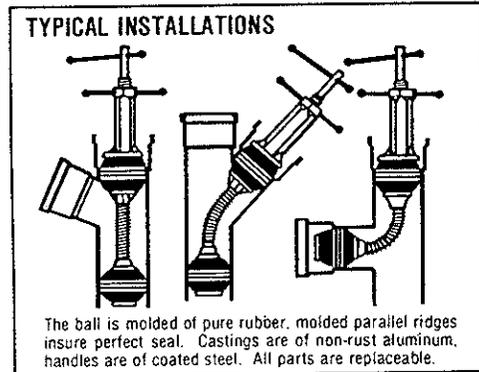
Designed with a lever-type handle for easily expanding the molded rubber sealing ring. Hollow stems allow filling or draining without removing the plug.

### FLEXIBLE DOUBLE TEST PLUG



1-1/2" - 2" Diameter Plugs are 11" Center to Center  
3" - 8" Diameter Plugs are 12" Center to Center  
Other Center to Center Distances Available to 96"

Unique, economical plug does the work of three plugs in one for quicker, easier, and more efficient testing. Both balls on the 1-1/2" and 2" plugs release with the same handle; the lower ball, however, releases before the upper ball. The 3" - 8" sizes have



two handles so each ball can be released separately. Blowouts and water damage are prevented because the plug allows the system to be drained prior to its removal. The flexible spring bends to any angle to effectively test from any type fitting.