THE CITY OF PROVIDENCE

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

RESOLUTION OF THE CITY COUNCIL

No. 527

Approved November 19, 1971

Resolved,

That the following named person, firm or corporation is hereby granted permission to erect, alter or use a building or structure at the location named herein for the sale of petroleum, kerosene, gasoline, coal oil and their products, compounds and components as described and shown in and on the application therefor and accompanying plat, all on file in the office of the Department of Building Inspection subject to the conditions that said person, firm or corporation shall not violate any of the laws of the State of Rhode Island or any of the Ordinances of the City of Providence relative to the erection, use or occupation of said structure and that said person, firm or corporation shall not allow petroleum, kerosene, gasoline, coal oil or their products, compounds or components, to be conveyed over or across any sidewalk by means of any pipe or hose, and upon such special conditions as are hereby enumerated and further provided that the Director of the Department of Building Inspection may authorize minor changes in the structural detail of plans on file, viz:

> PETROLANE, INC., Lessee of Lot 25, Plat 56; Increase from a 300,000 Barrel Propane Storage Tank to one of 400,000 Barrels, located at Sea View Drive and Field's Point, making a total storage capacity of 400,000 Barrels Refrigerated Propane Gas.

The erection or location of any buildings or structures not shown on the original plat on file with the Director of Department of Building Inspection, or any change in the location of buildings or structures from that shown on said plat shall be deemed a violation of this permit.

THE COMMITTEE ON

Approves Passage of
The Within Resolution

Nov. 16, 1971

IN CITY COUNCIL

NOV 18 1971

READ and PASSED

President

Clerk

APPROVED

NOV 18 1971

MAYOR

CITY OF PROVIDENCE
STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

PETITION TO THE CITY COUNCIL

TO THE HONORABLE CITY COUNCIL OF THE CITY OF PROVIDENCE:

The undersigned respectfully petitions your honorable body

for permission to increase from 300,000 barrel refrigerated propane storage tank, lot 25, plat 56 to 400,000 barrel refrigerated propane storage tank, lot 25, plat 56, located at Sea View Drive and Fields Point; making a total storage capacity of one 400,000 barrel refrigerated propane storage tank.

Petrolane, Inc., Lessee

W E Denny
Vice President

IN CITY
COUNCIL

OCT 21 1971

FIRST READING
REFERRED TO COMMITTEE ON
LICENSE

Vincent Vespia
CLERK

Councilman Johnson
and Councilman McKiernan, by request

PROVIDENCE, R.I.
CITY CLERK
OCT 8 1 37 PM '71

CITY OF PROVIDENCE

STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS

Copy

PETITION TO THE CITY COUNCIL

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Petrolane, Inc., Lessee

W. E. Denny

Vice President

BUREAU OF FIRE PREVENTION
WARREN R. KIRK
FIRE MARSHAL

209 FOUNTAIN STREET
PROVIDENCE, R. I. 02903

FIRE DEPARTMENT

November 1,1971

Mr. Peter Moran, Chairman
City Licensing Committee, City Hall
25 Dorrance Street
Providence, Rhode Island

Dear Sir:

I have been apprised of a request by Petrolane Incorporated for permission to increase the storage capability of their new facility, from the 300,000 barrels granted by The Building Board of Review, to the 400,000 barrels sought in their original petition, I am forwarding this written opinion, on the foregoing, as requested.

I can only reiterate my position taken on a previous occasion, and I assume a matter of record, before the Building Board of Review. I advocated approval of the original application for a 400,000 barrel storage facility; my approval was not given lightly, but was based upon considerable thought and research. Following, are some of the factors involved in that decision.

When initally contacted by Petrolane Incorporated, approximately a year and a half ago, I stipulated that any approval or rejection of their proposed installation by this office would be based on their capability and assurance of containing their product in an emergency. With the above stipulation as one of the motivating factors involved, several meetings were held; present at these meetings were the administrative personnel of Petrolane, The Stone and Webster Engineering Firm and The Providence Fire Department. The aftermath of the meetings was the adoption of the present safeguard system for the storage facility presently under construction. It will include:

A fifty-foot high retaining dike, surrounding the actual storage facility, and capable of containing one hundred and ten per cent of the product.

A built-in ignition system, surrounding the upper perimeter of the dike wall; said system to be remotely controlled and manually activated.

In effect, a dike to control the liquid product, and possibly the gas given off, dependent of course on the magnitude of the circumstance involved; a dike high enough to insure that radiated heat from any fire would be expended vertically rather than laterally, and enable the firefighters to utilize the surrounding hydrants to establish a protective water curtain for adjacent properties.Finally, if the damage to the storage facility were of catostrophic proportions, and the dike

proved incapable of containing the Propane gas, the ignition system could be activated and the product ignited at the source. This is a highly improbable occurrence, which obviously would result in the destruction of the facility itself.

Apart from the built-in safety features described, The Petrolane Corporation has agreed to the installation of an automatic "Sniffer" to detect any above-normal content of gas in the air. Portable fire extinguishers and fire protection equipment will also be provided in compliance with fire department directives. In my opinion, every conceivable precaution has been taken to insure the safety of the people of Providence and the surrounding communities.

I have found the personnel of Petrolane Incorporated to be extremely cooperative and amenable to all of our stringent fire safety requirements regardless of the cost factor involved. In my opinion, the additional 100,000 barrel storage increase sought, will not materially increase the hazard of fire extension; It may add to the duration of any fire in which the total product was involved, but can be as effectively contained as the 300,000 barrel storage presently approved.

Yours truly,

Warren R. Kirk

WARREN R. KIRK
Fire Marshal
Providence Fire Department

CURRAN, ROGERS AND PARISEAULT

Attorneys at Law

725 HOWARD BUILDING
PROVIDENCE, R. I. 02903

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CHARLES J. ROGERS, JR.
ROBERT G. PARISEAULT
ANTHONY J. BUCCI
FRANCIS J. RAO
CHARLES E. JOYCE, JR.
BERGE GREGIAN
BRIAN J. SARAULT

November 10, 1971

Mr. Peter Moran
Chairman
City License Committee
City Hall
Providence, Rhode Island

Re: Petrolane, Inc.

Dear Pete:

Enclosed please find for your perusal Memorandum of Law which I have this day submitted to the City Solicitor's Office.

Sincerely yours,

Anthony J. Bucci

AJB:ec

Nov. 12, 1971
Called Councilman Moran
V

IN RE:

PETITION OF PETROLANE, INC.

MEMORANDUM

Petrolane, Inc. filed an application before the Building Board of Review for an exception to the Building Code, Section 407.3 which in effect does not allow a liquified petroleum facility in fire district No. 1 but which exists in an M-2 heavy industrial zone. In its application, Petrolane, Inc. also filed for a permit to store 400,000 barrels of liquified petroleum.

After hearing the Building Board of Review granted the exception to 407.3 and allowed Petrolane, Inc. to erect the liquified petroleum facility in fire district No. 1. However, as a condition to the granting of the exception and permit to build, the Building Board of Review restricted the storage quantity to 300,000 barrels. Whereupon a permit was issued for the storage of 300,000 barrels.

Five months later Petrolane, Inc. filed a petition with the Providence City Council requesting an increase in the storage capacity from 300,000 barrels to 400,000 barrels. The Providence City Council referred the matter to the City Council's License Committee, and after hearing from expert fire safety people, engineers, technicians and correspondence from the Chief Fire Marshall of the City of Providence, the License Committee unanimously voted on November 8, 1971 to approve the increase in storage from 300,000 barrels to 400,000 barrels of LPG.

The questions present here are:

1. Whether or not the Building Board of Review had the legal right to restrict the storage facility under the powers granted to that Board.

2. Whether or not the Providence City Council has the legal right to issue permits for the storage of LPG.

The Charter of the City of Providence, Article I, Chapter 2 grants to the City Council all powers vested by law unto said City and all legislative powers shall be possessed and exercised by the City Council.

The Building Board of Review is a creature of the City Council of the City of Providence and was created under the legislative power of the City Council to enforce the powers granted unto it by the Providence Building Ordinances. 23-36-1 of the General Laws of Rhode Island, 1956 as amended entitled Ordinances- regulating manufacturing and handling of explosives and flammables - license, specifically sets forth that the City Council may from time to time make and ordain all ordinances and regulations in the City and a license for storage of petroleum products and the like must be first obtained from the City Council. Obviously the legislature of the State of Rhode Island intended that the City Council have the power to issue licenses or permits for the storage of petroleum products and the like.

The limiting of the storage capacity to 300,000 barrels by the Board was arbitrary and an unlawful exercise of its authority. The Building Board of Review has no jurisdiction, power or duty under the building code to restrict the storage capacity of any applicant and to do otherwise would be an unlawful delegation of legislative authority by the Providence City Council.

In examining the building code of the City of Providence and the powers granted to the Building Board of Review, there is no provision granting to the

Board the power or unrestricted authority to increase or decrease, or to permit the storing of petroleum or its allied products. Obviously the enabling act--23-36-1-- grants to the City Council solely the right to issue licenses and permits for the storing of petroleum products. 14-8 of the Ordinances of the City of Providence as amended entitled-Petroleum Products- specifically sets forth that any person, or other legal entity, storing petroleum products in bulk shall pay to the Bureau of Licenses of the City annual fees for permits granted by the City Council. Furthermore, Section 62.1(V) of the zoning ordinances of the City of Providence unequivocally states that there is no limit as to the amount of petroleum products which can be stored in an M-2 zone.

In Rhode Island Refining Corporation vs the Town of Tiverton, 92 RI 88 the Supreme Court of Rhode Island held that 23-36-1 vested the authority to regulate storage in the Town Council of Tiverton. See also Baileyv Zoning Board of Review of Warwick, 94 R.I. 168. Moreover should the Building Board of Review have unrestricted power with uncontrolled discretion, it would be an abdication by the City Council of the power which the legislature delegated to it under 23-36-1.

The legislature of the State of Rhode Island never intended to permit the Board to be clothed with the blanket authority to exercise the legislative power which had been delegated to the City Council by the enabling act. See Adams v Zoning Board of Review, 86 RI 396; Noonan v Zoning Board of Review, 90 RI 466;

There is no ordinance authorizing the Building Board of Review to limit or restrict the storage of petroleum products. Undoubtedly the City Council is the only body that has been so authorized and for the Board of Review

to limit or restrict the storing capacity of the petitioner was arbitrary, capricious and unlawful and a usurpation of the prerogatives reserved solely to the Providence City Council. See Messier v s City Council of Central Falls, 90 RI 127.

It is questionable whether or not the Building Board of Review had the power to grant the exception to 407.3. It is the contention of Petrolane, Inc. that a good case could be made that the Director of Public Buildings has the authority to allow this type of storage facility in fire district No. 1. See Section 108 of the Building Code.

The restriction or limitation imposed by the Building Board of Review is not one authorized by law. Therefore its action was arbitrary and unlawful and deprives petitioner of the lawful use of its property.

By virtue of the enabling act (23-36-1) and the pertinent ordinances the City Council undoubtedly has the power to regulate with relation to the storing of liquified petroleum gas products. The exercise of the unlimited power which the Building Board of Review applied in restricting the storage capacity of Petrolane, Inc. was an abuse of power. See Flynn v Zoning Board of Review of the City of Pawtucket, 77 RI 118. The only power or authority that the Building Board of Review had, if indeed it had, was its confinement to the issue of whether or not to allow the storage facility to be constructed in a No. 1 fire district zone in accordance with 407.3. Beyond that it could not exercise any of the legislative powers accorded the City Council by the enabling act. The only issue that the Board initially should have, or could have, considered was whether or not it would allow

a liquified petroleum gas storage facility, which under the building and fire code was excepted from being allowed in a fire district No. 1. Once this issue was determined, then, in such event, no law or ordinance or any of the powers delegated to the Board allowed it to restrict the gallonage of the facility. Furthermore, being a creature of the City Council the Board of Review without authority arbitrarily enlarged its own powers and abused the discretion allowed by law. See Harrison v Zoning Board of Review, 74 RI 135; Jacques v Zoning Board of Review, 64 RI 284; Heffernan v Zoning Board of Review, 49 RI 238; East Providence Mills, Inc. v Zoning Boar d of Review, 51 RI 428; Costantino v Zoning Board of Review, 74 RI 316.

Without question, the action of the Building Board of Review was an improper application of the power granted to it by the Providence City Council and its ordinances.

In M C & S Realty, Inc. v City Council of the City of Cranston, 88 RI138 the Supreme Court of the State of Rhode Island held that a land owner is entitled to the beneficial use of the land for any lawful purpose subject to reasonable regulation by the municipality in the exercise of police power. The unlimited storage granted to a land owner in an M-2 zone (see 62-1(v) of the zoning ordinances of the City of Providence), prohibits any municipal body from denying any land owner the beneficial use of his property. See also Walter I. Sundlun v Zoning Board of Review of Pawtucket, 50 RI 108; Holgate v Zoning Board of Review of Pawtucket, 74 RI 333; Tillotson v City Council of the City of Cranston, 61 RI 293.

Any denial of the beneficial use of a land owner's property to the landowner is clearly unconstitutional and in violation of Article I, Section I of the United States Constitution.

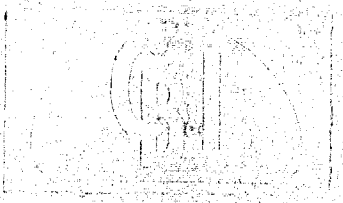
Therefore, for all the foregoing reasons the petitioner respectfully submits that the restrictive action of the Building Board of Review was arbitrary, capricious, illegal and void and unconstitutional and the action of the Providence City Council on November 8, 1971 is legal and proper.

400 MB PROPANE TERMINAL

FOR

PETROLANE, INCORPORATED

PROVIDENCE,
RHODE ISLAND



Chicago Bridge & Iron Company

400 MB PROPANE TERMINAL

FOR

PETROLANE, INCORPORATED

PROVIDENCE,
RHODE ISLAND

April 13, 1971

TABLE OF CONTENTS

Section 1

1.0 INTRODUCTION

This document is prepared to describe the facility proposed for Petrolane, Incorporated for a 400,000-barrel refrigerated propane storage facility with associated receiving and sendout facilities. The facility is designed to receive propane from a refrigerated ship and keep this propane refrigerated for storage at approximately atmospheric pressure in a large, well-insulated storage tank. It meets the requirements as we understand them for the facility required by Petrolane in Providence, Rhode Island.

CB&I has designed and fabricated many low temperature and cryogenic refrigeration systems on a turnkey basis, including ammonia, propane, butane, ethylene and LNG over a period of the last thirteen years. During the course of this time, CB&I has obtained a large number of basic patents with regard to unique refrigeration systems and storage concepts. The installation of many turnkey facilities has also lead to the development of CB&I expertise in the design procurement and construction of receiving and sendout systems. Petrolane will receive full benefit of CB&I's experience. In preparing this proposal, CB&I investigated alternative cycle designs and facility components and believe that our experience in this type of work has helped us to come up with a very complete, easily operated and maintained facility with a simple efficient cycle which will provide many years of useful service.

The following sections of this proposal provide detailed technical information for use in evaluating this proposal. We understand the information herein will be kept confidential.

Section 2

2.0 SCOPE OF WORK

2.1 General Scope of Work

This technical proposal covers the design, engineering, furnishing of material and construction by Chicago Bridge & Iron Company, hereinafter called "Contractor" or "CB&I", of the propane storage and terminal facility to be built for Petrolane, Incorporated, hereinafter called "Owner", at Providence, Rhode Island. The facility shall include a 400,000-barrel refrigerated, aboveground, double-wall tank and its associated receiving, refrigeration, pumpout and product heating systems. This facility, as outlined in subsequent sections, is proposed on a turnkey basis with CB&I accepting "single responsibility" for the entire project with the exception of items to be provided by Owner or others under Section 2.3.

All work shall be designed and constructed in accordance with the provisions of the current API Standard 2510, except where property line clearances are as stipulated and agreed upon by and between Petrolane and Providence regulatory agencies. Designs, drawings and specifications are presented in this proposal as typical information. CB&I, at its option, may make changes or substitutions which do not impair the guaranteed performance of the facility or structural adequacy of any part thereof. After an award of the contract, CB&I will continue to improve and make adjustments in the plant design to insure that the facility will perform as guaranteed.

Important: The following sections include the assumptions on which our price is based. If the actual conditions encountered vary from the assumptions, changes resulting from same shall be for the account of the Owner.

2.2 Work by CB&I

Specifically, CB&I shall furnish and/or perform the following:

1. Design and engineering services, drawings, bills of material and specifications for the entire project.

2. Purchasing, expediting and all shop inspection services.

3. All materials, equipment and supplies, including transportation to the site for the propane facility as described in this proposal, except the material and equipment to be supplied by the company as described under "Work by Owner."

4. Civil work to include initial grading, final grading, drainage ditches or swales to edge of property, dikes, construction of permanent roadways and fencing, excavation, foundations and backfill associated with the tank, equipment and building foundations. It has been assumed that all fill for diking or grading will be available on the site and all stripped or excess soil will remain on the site.

5. Reasonable amount of engineering assistance in connection with applications for permits and hearings for regulatory approvals.

6. All construction labor, supervision and field engineering except as described under "Work by Owner"; temporary construction facilities and supplies; construction equipment, tools and operating

supplies, except necessary water, natural gas, propane and electricity.

7. Electric power distribution from the substation including a lighting system for the tank, pipeways, process area, truck loading and interior of the building.

8. Initial charge of any lubricating oils, greases, filter cartridges, desiccants, methanol and glycol water required for startup and performance testing.

9. Purging of the tank, piping system and process vessels, including all consumables for purging and testing except nitrogen, natural gas, propane and water.

10. Procedures and supervision, including all engineering services, for complete startup and performance testing of all systems, including instruction to assigned operating personnel prior to turning over the plant.

11. External painting of all tanks, equipment, piping and structural supports, not insulated.

12. Four sets of contract drawings, operating instructions and equipment manuals, provided in a metal cabinet.

13. Odorizing and metering at truckloading stations.

14. Dry chemical fire extinguishers limited to the quantity shown on the plot plan.

15. Final grading of the site with a fence enclosing the plant area.

In general, all material, labor, equipment and services necessary for the complete and operable plant will be provided, guaranteed and performance tested, to demonstrate that the facility meets the design basis, with the exception as specifically indicated in this proposal.

2.3 Work by Owner

The following items shall be furnished and/or performed by Petrolane, Incorporated at no cost to CB&I:

1. A clear and reasonably level site adequately drained to property perimeter, drainage ditches or storm sewers, and without any above or below ground obstructions. The entire area within the dike area is assumed to have no underground piping or other means of draining possible propane spills from the dike area to areas outside of the dike.

2. Soil with a minimum bearing value of 3500 PSF on undisturbed soil at 1' below grade with no dewatering or rock removal required.

3. Adequate soils investigation and recommendations for the tank and process area.

4. Provide suitable quantities and quality of water for hydrostatic testing of the tank and suitable means for disposal of the water. The schedule requires the tank to be filled, tested and emptied in no more than four (4) weeks. This allows ten (10) days each for filling and then emptying the tank.

5. The company is to furnish and install power to the electric power substation. The company shall furnish and install the substation with pad, fencing, disconnects and any metering.

6. The installation of other utilities to the edge of the property will be the responsibility of the Company. It is believed the current available potable and fire protection water, sanitary sewers and natural gas are adequate to serve the facility. However, should there be additional expense in obtaining adequate quantities, this shall be for the account of Company.

7. Recent topographic drawings showing benchmarks, elevation and locating property lines, roads and fire hydrant locations.

8. Building permits and certificates of approval from all local and state agencies having jurisdiction over the work.

9. All operating labor, propane, utilities, supplies and expenses for cooling down and subsequent operation of the storage facility.

10. All necessary water and natural gas for CB&I during construction.

11. All necessary electrical power at no cost to CB&I during construction.

12. Disposal of sewage. Sanitary sewer containing domestic sewage from the washroom shall terminate at the property line.

13. Communication facilities and systems for voice and telemetering signals if required. Furniture, equipment, tools and supplies for offices and shops.

14. Recommended spare parts.

15. Safety equipment for startup and operation. This includes all safety protection and supervision from the time when product is first brought into the plant and for any other condition when products or facilities are under the control of those other than contractor.

3.0 STORAGE

3.1 General

Propane will be stored in a flat bottom tank having nominal capacity of 400MB at about -50°F. The double wall (DW) vessel is as shown on the sketch included in Section 9 under Drawings. The vessel will be insulated as described in Section 3.9. The tank will be designed for an internal pressure of 1.5 psig. It will be protected from overpressure by pressure and vacuum relief valves.

3.2 Design

3.2.1 The storage vessel will be designed in accordance with API Standard 620 Appendix R. The outer vapor barrier of the DW tank will be a CB&I proprietary design. Where the term "tank" is used in this write-up, it refers to the Code-stamped inner tank.

3.2.2 An overfill indicator pipe will be provided as a warning in the event the electronic alarm and shutdowns fail to operate. The top of the indicator will be set at a maximum design liquid level in the tank. The total height to the deck includes an additional 6" above the indicator to avoid the possibility of product contacting the suspended insulation deck in the event of an earthquake causing waves in a full tank.

3.2.3 The shell plates have been designed for the internal pressure plus the static head due to the weight of the product. The product head has been computed using the height of the overflow. The stress has been computed at the bottom of each ring.

3.2.4 The roof will be a self-supporting roof of proprietary design by CB&I, designed under the rules of Paragraph 3.01.1 of API 620. The inner tank shell will be stiffened to resist the external pressure exerted by the flexible blanket and perlite insulation.

3.2.5 One-quarter-inch (1/4") thick bottom segmental plates, butt welded from both sides, will be used immediately beneath the shell. The remainder of the bottom will be 3/16" thick, single-lap welded, with two passes.

3.2.6 Anchor bars (embedded in a concrete foundation) are provided to transmit the tank uplift loads to the foundation. The bars will not be welded to the shell. They will be attached by means of a bracket which will allow for take-up of any slack or settlement which might occur during the water test. Anchor bar materials will be the same as the shell material or better.

3.2.7 All steel plate used in the primary components, as described in API Standard 620, Appendix R will be in accordance with Table R2.2 or Table R2.3 of that standard. Base steel will be firebox quality. Quenched steel and flange quality steel will not be used.

3.2.8 All materials used in the secondary components as described in API Standard 620, Appendix R will be in accordance with Table R.2.4 of that standard except that the outer vapor barrier of the DW tank will be a CB&I proprietary design.

3.3 Accessories

3.3.1 All fittings will be designed per API Standard 620. This includes nozzle reinforcing plates, flanges, covers and

bolts. Fittings penetrating both the inner shell and the outer vapor barrier will be designed with adequate provision for the differential movement of the inner and outer vapor barrier due to a thermal gradient. Distance pieces are provided on all nozzles to avoid high local stress at the intersection of the fitting and the outer vapor barrier.

3.3.2 The following accessories are provided:

1) Nozzles:
   a) One 8"ϕ roof nozzle for pressure vacuum vent.
   b) One 4"ϕ nozzle for overfill indicator.
   c) One 12"ϕ fill nozzle in roof.
   d) One 3"ϕ pump vent nozzle in roof with deflector.
   e) One 2"ϕ level gauge connection.
   f) One 8"ϕ vapor suction nozzle.
   g) One 2"ϕ purge nozzle located at the top of the roof.
   h) 12"ϕ pumpout connection.

2) One Shand & Jurs (S&J) 92006 liquid level gauge with magnetic drive and with a high level alarm switch.

3) One 24"ϕ shell manhole with welded cover and one 24"ϕ roof manhole with bolted cover.

The following relief valves are furnished:

4) One 8"ϕ S&J 94020 pallet-type or Anderson Greenwood Series 90 pressure relief valve, 1.5 psi internal pressure.

5) One 8"ϕ S&J 94020 vacuum relief valves set to open at .865" H_2O vacuum.

6) One 4"ϕ pallet-type pressure relief valve for overfill indicator - S&J 94128.

3.3.3 The following additional accessories are provided for the outer vapor barrier:

1) Nozzles:
   a) One 1"ϕ outer vapor barrier gas make-up connection.
   b) One 4"ϕ outer vapor barrier nozzle for pressure-vacuum vent.
   c) One 20"ϕ outer vapor barrier nozzle for the emergency manhole.

The following relief devices are furnished for the outer vapor barrier:

2) One 4"ϕ outer vapor barrier pallet-type pressure-vacuum relief valve (S&J 94020) set to open at 0.865" H_2O vacuum and 2" H_2O internal pressure.

3) One 20"ϕ outer vapor barrier emergency manhole - S&J 94200.

3.3.4 Stairway

Standard CB&I spiral stairway with a top platform located at the roof-to-shell junction is provided. The roof fittings will be located near the platform and will be accessible from it.

3.4 Construction

Excessive hammering or cold working of the tank material that will come in contact with the liquid will not be permitted. The tank will be constructed with extreme care to avoid notches which may result in stress focal points. All temporary erection material made of regular carbon steel will be removed from the inner tank. Attachment welds for such devices will be chipped and ground smooth and inspected for crater cracks and undercuts. Any undercuts or crevices will be "picked up" and ground smooth.

3.5 Welding

3.5.1 All welders assigned to manual welding or welding operators assigned to automatic welding will have successfully passed the tests conducted by CB&I as prescribed for Welder Qualifications in Section IX of the ASME Boiler and Pressure Vessel Code. This is as specified in API 620. All welding will be done with special CB&I-formulated procedures designed to insure notch tough welds for low temperature applications. The restrictions on welding procedures apply to all attachments of stiffeners, lugs and reinforcements, as well as to the main joints in the shell and bottom of the tank. Each temporary attachment (fit-up devices) which will be removed after construction will be welded using a qualified procedure.

3.5.2 The welding procedure will be qualified as outlined in API 620, Appendix R, Paragraph R.6. The test specimen(s) will be sent immediately to our metallurgical laboratory for inspection and testing. One set of test plates will be welded in the laboratory for qualifications of the automatic girth weld procedure. Charpy V-notch impacts will be taken on the weld metal and the heat-affected zone at a temperature of -60°F.

3.6 Inspection and Tests

3.6.1 A qualified welding supervisor will be furnished full time. This person will supervise the welding to insure that the tank is constructed in accordance with the approved procedures, Codes and CB&I standards. In addition, he will be responsible for quality control. This includes vacuum box testing, magnetic particle testing and X-rays. He will inspect the completed tank to insure that there are no notches and to see that all "pick-ups" have been properly made.

3.6.2 Our proposal is based on the assumption that the Purchaser will provide the necessary inspection to enable certification and stamping of the tank under API 620. Qualifications for an inspector are described in Paragraph 5 of API 620.

3.6.3 All tank shell seams will be checked by spot X-ray as required under API Standard 620. No trepanned plugs or other destructive weld tests are permitted.

On all tank shell rings designed for 100% joint efficiency, the vertical joint, including 3" on each side of the intersection with the longitudinal seams, will be completely X-rayed as prescribed in API Standard 620, Paragraph 3.26.

3.6.4 Butt welds in the bottom sketch plates extending under the shell will be inspected their full length by the magnetic particle method, and at least two spot X-rays will be taken from the butt weld joints of the compression bar.

3.6.5 All bottom fillet welds will be checked by applying soap film to the joint and pulling a partial vacuum by means of a special vacuum box. The welds of the fittings to the

shell will be inspected both inside and outside by the magnetic particle method. The shell to bottom weld will be checked with liquid penetrant.

3.6.6 The completed tank will be filled with water or to a height sufficient to stress the bottom shell ring to a minimum of 1.25 times its maximum liquid stress during service. Hydrostatic overload testing serves the added advantage of relieving some of the residual welding stresses in bottom shell rings and fittings.

3.6.7 A pneumatic pressure of 1.875 psi will be imposed on the vessel. The pressure will then be lowered to the design pressure at which time the roof and all shell seams above the water level, not previously checked with liquid penetrant, will be soap film tested. The water will then be withdrawn from the vessel and the design gas pressure will be applied to check the anchorage and also the pressure vent setting.

3.7 Cleaning and Painting

3.7.1 After completing the tests, the tank will be emptied of water. All free water will be removed. The inside of the tank will be left broom clean.

3.7.2 Exterior surfaces of plate, structural, nozzles, etc., which are not insulated will be shop pickled or thoroughly field cleaned using wire brushes and solvents. Sandblasting is not included. These surfaces will be painted with one coat of red lead (Type II) and two coats of long oil alkyd tank white paint.

3.8 Foundation

3.8.1 The tank foundation will be designed on the basis of soils investigations and recommendations provided by Owner and prepared by Haley and Aldrich.

3.8.2 An electric foundation heating system is provided. The system is automatically controlled to maintain an average temperature of approximately +40°F under the tank. The heating system will be in accordance with CB&I Specification C-03, a copy of which is attached.

3.9 Tank Insulation

3.9.1 Bottom Insulation

The double wall tank will have an outer steel vapor barrier. This includes a double bottom arrangement wherein the load bearing insulation is installed between the two bottoms. The bottom insulation will be 5" of Foamglas. The area around the periphery of the inner tank which supports the shell and roof of the tank is designed such that the insulation will not be crushed. A thermal barrier is provided to limit heat flow through this special load bearing detail.

3.9.2 Shell Insulation

The shell of the tank will be insulated with 21" of loose fill perlite insulation and 3" of fiberglass. The fiberglass blanket is attached to the outside of the tank shell and controls perlite compaction. Without this fiberglass (resilient) blanket, as the tank shell moves due to the thermal or pressure cycling over the years, the perlite would tend to compact thus increasing the external pressure on the shell. This build-up in external pressure would cause buckling in the shell and eventually a failure. The flexible blanket concept is covered by CB&I's U.S. Patent No. 3,147,878.

Loose fill perlite is an inorganic material which is expanded from perlite ore and placed in the tank hot and dry. This type insulation can be installed any time of the year. Because of the outer vapor barrier, it is not affected by adverse weather conditions such as rain or high winds.

The shell and bottom insulation space is kept under a very slight positive pressure by admitting a small quantity of dry natural gas to the annular space. This slight positive pressure insures that the tank does not draw in moist air from the surrounding atmosphere, which would damage the insulation and lessen its efficiency.

3.9.3 Roof Insulation

The roof of the tank will be internally insulated with blown mineral wool or perlite. A false deck will be suspended from the tank roof to receive this insulating material. Nozzles through the deck provide free passage of gas so pressure across the insulation is equalized. Under normal operating conditions, the vapor space above the insulation will be filled with superheated gas. The suspended deck concept is covered by CB&I's U.S. Patent No. 3,352,443.

4.0 SYSTEMS

4.1 Design Bases

The conditions used for the design bases of this facility are as follows:

a. Storage: A 400,000-barrel capacity storage tank will be installed in this facility. The tank heat leak is based on the maximum ambient temperature of 90°F. The design pressure of the tank is 1.5 psig.

b. Product Delivery: Two product pumps will be installed in this facility such that product can be removed from the storage tank, heated to approximately 40°F and directed through hoses at two load stations at a rate of 300 gpm per truck.

c. Fill: The facility will be designed to receive liquid from a ship maintained at 0.5 psig equilibrium. The fill rate shall be a maximum of 17,000 tons per 30 hours. The liquid fill composition will consist predominately of propane with a maximum ethane content of 2.5 mol percentage. The system has been designed on the basis of fill from ship's pumps which deliver liquid at the battery limits at 65 psig and the design fill rate. It has been assumed that the ship's pumps will draw a maximum of 250 H.P. at these conditions.

d. Refrigeration System: A system is provided to reliquefy the vapors generated within the storage tank by tank heat leak.

4.2 Filling Operation

Prior to fill, a slow stream of liquid from the ship will be sent into the fill line for the purpose of cooling this line. The vapors generated by this operation will flow into the storage tank. Once the fill line is cooled down, the design fill rate can be achieved. Liquid from the ship will pass through a control valve located near the dock such that the rate of fill can be controlled. Should the tank pressure rise too rapidly during this operation, a control valve at the tank inlet will close automatically. The tank pressure shall be maintained automatically at 1.25 psig maximum such that the fill liquid will be allowed to reach an equilibrium temperature slightly higher than that maintained in the ship. Consideration for ship pump energy, fill line heat leak and vapor displacement in the tank have been taken into account. Some refrigeration will be required to maintain tank pressure during the fill operation.

4.3 Refrigeration System

During the holding and filling operations, refrigeration will be accomplished by utilization of a vapor compression-condensing system. During holding approximately half of this system is required for refrigeration of vapors generated by tank heat leak. The filling operation will utilize the refrigeration which has been provided for holding capacity standby.

The vapors formed within the tank will be drawn into a two-stage reciprocating, motor-driven compressor. The compressors shall be supplied with necessary pressure and temperature shutdowns for the protection of the machines. The high pressure propane discharged from the compressors will be de-superheated and condensed in an air-cooled exchanger. The liquid discharge from this condenser will be collected in a receiver vessel.

The reliquefied propane is returned automatically to the storage tank. A level controller is provided for this operation.

The plant is basically designed for attended operation, but the holding system is capable of running unattended for long periods of time.

4.4 Product Sendout

Product is withdrawn from the storage tank through a suction line common to both pumps. Each pump is provided to deliver 300 gpm. Each pump is provided with a foundation heating system which will maintain the pump foundation at a temperature above freezing. In the event that a pump "shuts in", a pressure controller will automatically bypass a minimum flow through the pumps back to the storage tank so that the pumps will remain cooled down and operating. Propane from the product heater will then flow through a header to one of two truck-loading stations. Each truck station is equipped with an odorizer and flow meter.

4.5 Plant Facilities

A standby generator will be installed and sized to accommodate the loads imposed by the refrigeration equipment required for holding. In addition, the standby generator would be used to operate necessary controls, area lighting and the instrument air system.

An instrument air system will be installed to provide the requirements for the pneumatic controls within the facility.

A small flare will be installed as a further standby in the event of high tank pressure.

5.0 PLANT FACILITIES

5.1 General

The proposed plant layout is shown on the Plot Plan Drawing 7.2 of this proposal. The layout provides adequate access to various sections of the plant and complies with equipment spacing suggested in API 2510. Truck parking areas have been provided and the roadwork has generous curves and waiting areas to alleviate congestion in the truck terminal.

5.2 Drainage and Earthwork

The dike is sized to contain 110% of the contents of a full tank. The final Plot Plan will be laid out so that any liquid spill will tend to drain away from the tank. If dike dewatering pump or pumps and discharge piping are required, this will be to the Company's account.

CB&I will also provide other earthwork necessary for the described turnkey facility. Included in this is roadwork with proper drainage, equipment and building foundations and pipe rack and walkway grading.

5.3 Building

One control building will be provided. The building will have four areas: a dispatcher's office with toilet, control room, product compressor room and an instrument air and motor control center utility room. The building will be furnished with doors, windows and other usual requirements. Heating is provided.

The control panel will be located in the control room. This will allow an operator to observe major plant functions from inside the control room.

5.4 Controls

The controls for the entire plant will consist primarily of the pneumatic type. The controls will be the PCI-type manufactured by the Foxboro Company. The control panel will have a semigraphic display to simplify plant operations. The plant will operate in an automatic fashion except that an operator is required to transfer product from ship and sendout operations, and operator attendance is required for occasional adjustment and inspection of machinery. Safety devices will shut down the plant automatically should a major operating upset occur. Annunciators will enable easy identification of trouble if a malfunction should occur.

The instrument air system will consist of two reciprocating, air-cooled compressors, each sized for 100% capacity. An air-cooled aftercooler, receiver, dryer and filter will be furnished. The dryer will be capable of drying air to a dew point of -40°F at 80 psig operating pressure. The entire system will be prefabricated on a skid and installed in the building.

5.5 Electrical

The area classification of the facility is in strict accordance with the latest draft of the American Gas Association publication entitled, "Classification of Utility Areas for Electrical Installations."

The 460-volt power feeds, substation, disconnect switches and any metering will be the responsibility of Petrolane, Incorporated. CB&I's responsibility will start with the lines leading from the substation into the motor control center.

Included in Section 8.0 of this proposal are two Chicago Bridge Specifications C-01 and C-03 to clarify the electrical requirements.

5.6 Lighting

CB&I will provide a plant lighting system. Incandescent lamps will provide the majority of the process lighting. These lamps will be 200 watt. Interior lighting of the control building will be of the fluorescent type. Wide area lighting such as parking lot and loadout stations will be furnished by twin 1000-watt mercury vapor floodlights. The mercury vapor lights are not explosion-proof, but they are mounted on 30-foot poles in nonhazardous locations.

5.7 Piping

CB&I will furnish a complete piping system. Piping, valving, etc. will be in accordance with the CB&I Specifications 521-2-1, Rev. 3, dated 9/17/65 which is included in Section 8.0. Piping tie-in into Petrolane-furnished utilities will be made by CB&I at the battery limits.

5.8 Roads and Walkways

The roadways, as shown on the Plot Plan, will be of the bituminous macadam one- or two-lane type. It will conform essentially to the present construction specification of the Asphalt Institute. Protection for truck-loading equipment will be provided in the area of the truck-trailer stations by curbs or 8"ϕ pipe embedded in concrete.

Walkways will be provided between areas of the plant which will be frequented by the operating personnel. This will include the product pump area and the process area.

5.9 Diking

A 250'ϕ by 52' high steel or reinforced concrete dike will be provided. The dike is sized to provide 440,000 barrels of storage or 110% of the maximum tank capacity.

If steel is used for the dike wall, low temperature, normalized, fine grain practice steel with guaranteed impacts at no less than -50°F will be used. Design stress will be the lower of 50% of the minimum ultimate strength or 80% of the minimum yield strength.

Section 6

6.0 FIRE PROTECTION SYSTEM

6.1 General

Chicago Bridge & Iron Company believes that the philosophy expressed in Oliver W. Johnson's memorandum entitled, "Safety in the Storage of Liquefied Natural Gas in Aboveground Atmospheric Pressure Tanks" is also the best approach to take in considering safety for storage of liquefied propane. Basically, safety requires that LPG be reliably contained; that means be available for control of small leaks which may occur during liquefaction, transfer and vaporization; that means for control or extinguishment of fires in such leaks be considered and provided; and that leaks or fire which might endanger neighboring properties must be evaluated.

6.2 Containment

Chicago Bridge & Iron Company represents many years of experience in designing and building low temperature and cryogenic storage facilities. The design basis has been very thoroughly worked out over the years. Construction details which cause undesirable stress concentrations are avoided. Properly designed foundations insure that minimum stress is transmitted to the shell of the tank. Very thorough quality control, utilizing inspectors who report to the regional manager rather than the job superintendent, is carried out in each aspect of the project. Materials are selected and tested for temperatures well below the design temperature of the liquid petroleum. Accurate information on soils conditions is obtained before the tank foundation is designed. Gauges and controls, some automatic, are designed into the system to insure that such things as overfilling and overpressuring of the system are recognized by alarms and automatically controlled or manually corrected after the alarm. Piping is carefully supported so

as to minimize continuous vibration which could be a source of failure.

While we believe that a properly designed tank will not fail catastrophically so as to release its entire contents, we recognize the fact that the equipment associated with the tank, notably liquid piping and some parts of the refrigerating plant, is subject to possible mechanical damage which could result in the escape of liquid and possible fire. We also recognize that liquid propane yields a vapor heavier than air and that released vapor or liquid could reach a source of ignition. For this reason, much care is taken in the laying out of the plant in regard to spacing, grading and diking. Grading of the area sharply away from the tank and particularly from the area in which connecting piping and pumps are located will insure that any spilled liquid will flow away from the equipment which could be most damaged if fire should result and will also increase the chances for effective action to control leaks. Proper grading also will avoid concentration of spilled liquid near property lines or around important facilities or points of control.

6.3 Control of Small Leaks

The control of small leaks is obtained not by extinguishment but by cutting off the supply of fuel. Even though a leak occurs, it is by no means assured that fire will follow. The liquid propane would tend to fall to the earth and flow to low places as would any other liquid. At the same time it will evaporate and chill all the earth with which it comes in contact, and the heat so absorbed will produce temporarily rapid boiling. Once a pool has been formed the boiling rate will subside. During this time extensive areas of ground level vapor clouds are produced. All evidence points to the importance of confinement of spills within the smallest, feasible, diked areas. A

tank valve located between the tank and the suction pumps, which can be operated remotely, provides a safeguard at this important point in the liquid handling system.

Hose houses equipped with fire hose and fog nozzles will be placed at strategically located fire hydrants around the tank area. These are not intended for extinguishing propane fires but rather to keep the tank and equipment cool in the event of a fire. They are also to be used for providing a water spray shield to enable personnel to reach shut-off valves and cut off flow of propane. Also located in the process area are dry chemical extinguishers located so as to be accessible for extinguishing small fires after the source has been cut off.

Petrolane will present to state and local fire marshals a layout that is satisfactory.

In conclusion, the safety of the plant depends not so much on the product which is handled as on the extent to which the characteristics of the product are realistically appraised and the facility designed with these characteristics in mind. Chicago Bridge & Iron Company has considered these characteristics in the design and layout of this LPG facility to be located in Providence, Rhode Island.

Section 7

7.0 QUALITY CONTROL, TESTING AND STARTUP

7.1 Quality Control

Quality of the completed project is something that cannot be achieved by "control" only. Quality begins with the design engineering effort, material selection and procedures and methods used in fabrication, erection and welding of the structure; it encompasses many details. Assurance of quality not only depends on experience and procedures but also the motivation of people, especially the construction forces involved in performing the work. The motivation from the "top" down to first line supervision is extremely important. CB&I has demonstrated its capability in this regard.

Sophisticated and expensive "inspection" alone will not guarantee quality throughout the completed project. CB&I believes, however, that careful quality control supervision is an important factor necessary to demonstrate or insure that the facility is completed in accordance with the highest possible obtainable standards. The overload testing of completed piping, vessels, exchangers, etc., is another basic demonstration of quality. CB&I has many years of experience with all methods of quality control inspection and has pioneered the use of most of the practical systems in use throughout the industry today. CB&I believes it can insure high quality standards for this turnkey facility because of the following principle reasons:

1. A complete understanding of every element of the system in design, engineering and construction techniques employed.

2. A thorough knowledge of all troublesome details and areas, based on actual experience with such details and their correction.

3. Experience with almost one hundred complete "turnkey" low temperature and cryogenic facilities.

4. A large reservoir of well-trained and experienced supervisory personnel with proven records of performance.

5. A quality control supervisory group specialized in study, application and supervision of quality control methods.

7.2 Testing

Inspection and testing of the mechanical, electrical and control equipment will begin at the manufacturers' plants. Responsibility will be placed on the manufacturers to provide equipment and components which fulfill CB&I's detail purchase specifications. Insofar as practical, equipment will be thoroughly inspected, checked and tested prior to shipment. For most major items of equipment, CB&I expediters and/or engineering inspectors will be present to witness prescribed tests.

After installation of equipment at the jobsite, all items will be thoroughly checked for missing or loose parts, proper lubrication, cooling leaks, alignment, safety devices, etc., in preparation for startup. All process lines will be mechanically tested in accordance with applicable codes; all lines will be cleaned before final connections are made; all power circuits will be checked for ground and amps drawn; all drives will be checked for rotation, alignment, vibration, lubrication, etc. Motors and drives will be started and stopped several times by automatic and manual control. The final inspection and checkout of all equipment, which will involve further testing, will be carried out by CB&I startup crews, as described in Paragraph 7.3.

The testing and inspection of the low temperature storage tank has been already described in Section 4.0.

7.3 Operator Training, Purge, Start-Up and Cooldown

Concurrent with design and engineering, Contractor will prepare a detailed operating manual. This manual will cover normal operation, normal shutdown, process descriptions and procedures for the start-up of the facility. This operating manual will be prepared for use by the Company operators and will be submitted to Company prior to start-up for use in operator training and other preparations for plant operations.

Contractor shall provide operator training for Company operators and will provide technical assistance for the Company staff to accomplish plant start-up. It is expected that between three to five days of combined classroom and on-site training will be sufficient before the facility is started up.

After completion of the tank, it will be purged with inert gas by the Contractor in preparation for cooldown. Major natural gas lines, vessels and equipment will be purged with inert gas prior to start-up.

Start-up is expected to be carried out over a one- to three-week period. The start-up period will include a final adjustment to equipment and instrumentation, simulation of plant operation, purging of equipment, initial operation of the liquefaction plant, cooldown of the storage tank and fine tuning of the facility for optimum performance. Contractor will provide technical assistance for the Company's operators until such time as the plant operations are stabilized. Contractor expects Company to assign operating personnel to spend a reasonable amount of time with the Contractor's start-up crew during inspection and checkout of the systems. Company's personnel

and Contractor's personnel will be integrated into one crew during actual start-up to insure that the operating procedures and methods are completely understood.

Initial LPG fill into the storage vessel will be vaporized until the bottom areas are sufficiently cooled down to sustain a liquid level. Cooldown and start-up are considered complete when there is evidence that liquid is accumulating in the bottom of the storage vessel. After cooldown and start-up are complete, the Company will accept full responsibility for operation of the facility. The Contractor's representative will be available at the site for advice and consultation for a maximum of five days after satisfactory operation, start-up and cooldown.

Start-up and cooldown are to take place immediately after completion, but in no event later than fifteen days after completion.

Rev. 1 1-17-61
Rev. 2 3-5-62
Rev. 3 9-17-65

PIPING SPECIFICATIONS

521-2-1

REFRIGERATED STORAGE FACILITIES FOR COMMERCIAL PROPANE FROM AMBIENT TEMPERATURE TO MINUS FIFTY DEGREES FAHRENHEIT

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Individual Piping Material Specifications

SPEC.	NOMINAL RATING	SERVICE:	SERVICE LIMITS
"A1"	300# R.F. Steel	Propane (Liquid & Vapor)	720#@-50°F to 720#@-21°F
"A2"	150# R.F. Steel	Propane (Liquid & Vapor)	275#@-50°F to 275#@-21°F
"B1"	300# R.F. Steel	Propane (Liquid & Vapor) High Pressure Steam (No Ball Valves) Lube Oil Underground Process Lines	720#@-20°F to 425#@750°F
"B2"	150# R.F. Steel	Propane Butane Freon (Liquid & Vapor) High Pressure Steam (No Ball Valves) Lube Oil Underground Process Lines	275#@-20°F to 110#@750°F
"C"	125# C.I. & Bronze	Cooling Water Low Pressure Steam Low Pressure Nitrogen Fuel Gas Underground Utility Lines	200#@100°F to 125#@350°F
"D"	125# C.I.	Instrument and Utility Air Potable Water	200#@100°F to 125#@350°F
"E"	Sewer Piping C.I. & Clay	Sewer Piping	

GENERAL PIPING SPECIFICATIONS

1.0 SCOPE

This piping specification has been prepared to form the basis for design, selection of material, fabrication, erection and testing of all the piping required to construct a refrigerated storage facility for commercial propane from ambient temperatures to minus 50°F and atmospheric pressure. It is based on engineering and construction experience, recognized codes and manufacturers' standards.

It is intended that this specification will serve as a guide and promote uniformity in matters of design, selection of materials and equipment, and preparation of plans and drawings. This specification presents preferred methods and should be followed closely. However, it is recognized that godd engineering judgment may dictate otherwise in some instances. Therefore, it is not presumed that this specification covers every condition or all material.

2.0 GENERAL

The design, fabrication and erection of piping shall be in accordance with applicable portions and latest revision of the following codes and standards:

ASA B31.1-1955	Code for Pressure Piping
ASA B31.3-1962	Petroleum Refining Piping
ASA B31.5-1962	Refrigeration Piping
ASME Section VIII-1962	Unfired Pressure Vessels
API Standard 2510-Latest Rev.	Liquefied-Petroleum-Gas, Installations
Chicago Bridge & Iron Company's Standards and Drawings	

Piping shall comply with applicable local, state or other government laws and codes. In cases of conflict with this specification, the more rigid code shall govern.

Chicago Bridge & Iron Company is referred to as CB&I in this specification.

3.0 DESIGN INFORMATION

3.1 Valves:

3.1.1 The valve type (gate, globe, check, etc.) shall be indicated on the flow diagrams by a valve symbol. Valve material shall be provided as specified on the assigned individual piping material

specification. Valves requiring special trims or other features not in agreement with the assigned individual piping material specification shall be noted on flow diagrams and drawings.

3.1.2 Valves shall not be installed with stems below the horizontal nor projecting into passageways. Position of stems of all flanged valves shall be indicated on the drawings.

3.1.3 All valves which require adjustment or operation during normal or emergency conditions shall be operable from grade, platform, or building floor. Valve handwheel extension stems or chain drops to within 3'-0" of the operating level are permissible. Chains shall not obstruct aisles or platforms.

3.1.4 Where practical, a valve shall be installed directly against the nozzles of tanks, pressure vessels, and other equipment to permit isolation.

3.1.5 All process valves against tanks shall be steel, regardless of pressure and temperature, except where process classification requires valves of special materials.

3.1.6 Globe valve shall be installed with the higher pressure against the bottom of the valve stem disc.

3.1.7 No shut off valve or shut off device shall be placed between the protected piping and relief valves unless absolutely necessary. If a valve is necessary it shall be car sealed in the open position .

3.1.8 Block valves in outdoor steam, air, or water service shall be installed in horizontal runs at high points in line so that water will tend to drain away from the valves.

3.1.9 Check valves shall be used at the following points:

(a) In discharge of centrifugal pumps where reversal of flow may occur. Locate between pump nozzle and block valve.

(b) In steam, air, or water lines connecting to process lines or vessels where possible back flow from process may occur.

3.1.9 (contd.)

(c) In steam trap discharge lines tieing into common condensate header.

(d) See flow diagram for other points of applications.

3.1.10 The flow diagram shall define the relief system to be provided. Relief valve body and trim material shall conform to the piping specification materials. Expansion relief valves shall be provided for the cold side of shell and tube units, for piping and other equipment operated under the following conditions:

(a) filled with liquid,
(b) subject to being blocked in,
(c) subject to temperature rise or heat source,
(d) without other means of pressure relief.

3.2 General Piping Construction:

3.2.1 The individual piping material specification shall be indicated by adding or tagging its letter classification to the lines appearing on the flow diagrams and drawings.

3.2.2 Piping that connects lines, systems, or equipment of different services shall conform with the specification of the higher process requirements up to and including the first block valve, not only as to material and pressure rating, but also as to flanged or screwed connections. Where a check valve is on the lower specification side of the block valve, the check valve also shall be of the higher specification.

3.2.3 Piping systems, valved at their extremities and incorporating a source of pressure shall be designed throughout for the maximum pressure rating involved, or be protected by suitable relief valves.

3.2.4 Above ground piping shall be grouped in pipeways and either run overhead on stanchions, or run on piers or sleepers close to grade. All piping shall be arranged, guided, and anchored to provide flexibility and prevent excessive forces on the pipe or equipment.

3.2.5 Line spacing shall be determined by the sum of the larger line flange radius, the smaller line pipe radius, the insulation thickness on either/or both lines and 1" minimum clearance.

3.2.6 Pipe sizes smaller than 1/2" and pipe sizes 1-1/4", 2-1/2", 3-1/2", and 5" shall not be used except as required by special equipment connections.

3.2.7 The minimum size for all process lines and utility headers shall be 1".

3.2.8 Piping shall be arranged to provide economy of pipe supports with the larger lines routed for flexibility and economy and the smaller lines following the route of the larger lines.

3.2.9 Lines subject to thermal expansion or contraction connected to equipment subject to thermal expansion or contraction shall be arranged to provide required flexibility. Excessive strains on equipment shall be avoided.

3.2.10 The following minimum clearances shall be observed for overhead piping:

(a) Within pump rooms or other confined areas 7'-0" to bottom of pipe.

(b) Over elevated walks or platform 7'-0" to bottom of pipe.

(c) In yard areas 9'-0" to bottom of pipe.

3.2.11 Lines on sleepers shall have a minimum of 8" clearance between the bottom of pipe and grade.

3.2.12 Buried lines shall have 1'-0" minimum cover over top of pipe. Clay sewer pipe shall have 2'-0" minimum cover over top of pipe.

3.2.13 The maximum distance to the center of an operating valve handwheel above the operating level without the use of extension stems or chains shall be 7'-3".

3.2.14 Clearances between bottom of control valves and floors, platforms, or grade shall be a minimum of 1'-0".

3.2.15 The minimum width of passageway between sets of pumps and other equipment shall be 2'-6".

3.2.16 Hot lines requiring expansion loops shall be carried, where possible, at the highest level of the established pipe elevations. The loop shall not be carried in the same plane as the line, but at a higher level to avoid blocking the run of additional lines at the established elevation.

3.2.17 Expansion loops shall be used in preference to expansion joints in high pressure lines.

3.2.18 Bends may be used in lieu of ells on 2 in. and smaller piping. A minimum bend radius of 10 nominal diameter shall be used on piping operating below -20°F. A minimum of 5 nominal diameters shall be used on piping operating above -20°F. Bends shall be made in accordance with ASA B31.3-1962, Division 304 and 329. The field piping crew shall not attempt to hot bend pipe or stress relieve cold bends. Bends other than those indicated on the design drawings may be made when their use will not alter adjacent pipe spacing or routing. The approval of the CB&I resident engineer is required for each application.

3.2.19 Closed or all threaded nipples shall not be used except when specifically permitted by the CB&I resident engineer.

3.2.20 Street ells shall not be used.

3.2.21 Butt welding elbows shall be the long radius type (1-1/2 r) wherever possible. Short radius, or long tangent, types may be used where space limitations, or other design conditions, warrant their use.

3.2.22 Piping in racks shall change elevation with each change in direction except in isolated cases where all existing piping turns flat. This change in elevation shall conform to the existing piping, if any. In cases of laterals or piping turning out to equipment, the laterial elevation change shall equal one-half the vertical difference of the pipe levels or in the case of single level racks, 2'-0" shall be maintained.

3.2.23 Welding of pipe supports, brackets, or anchorage to pipe lines shall be avoided. If welding to piping is necessary, it shall conform to Division 321, ASA B31.3-1962.

3.2.24 Line size changes shall be made by using screwed reducers, welding reducers, swaged nipples or socket weld reducing insert. In general, bushings shall not be used in process lines except where they are necessary at instrument connections.

3.2.25 Control valves shall be provided with bypasses where indicated on the flow diagrams. Suitable vents and drains shall be provided for removal of the control valve.

3.2.26 In lines having orifice runs, sufficient clearance shall be provided for installation of orifice piping and instrument housing.

3.2.27 All valves adjacent to pumps shall be accessible for hand operation without the use of chains or extension stems.

3.2.28 Relief valve outlet lines connected to a common vent system or header shall drain from the valve outlet connection. Relief vent stacks to atmosphere shall have a 3/8" weep hole drilled in the bottom near the relief valve outlet connection. Relief vent stacks shall be equipped with rain caps or equivalent covers.

3.2.29 Individual piping material specifications shall govern the type of branch connections used.

3.2.30 Normally, on process and high pressure piping, welding tees shall be used for full size branch connections. Full couplings or weldolet type fitting shall be used for branch connections smaller than the header. Screwed couplings 1" and smaller shall be 6,000# rating, 1-1/2" and larger shall be 3,000# rating. In special cases, when indicated on the piping drawings, reinforcing pads or weldolet type fittings may be substituted for full size branch connections.

3.2.31 Full size unreinforced branch welding is permitted on air and water lines where line pressure and temperature conditions do not require reinforcement, per Division 304.3, ASA B31.3-1962.

3.3 Equipment Piping:

3.3.1 Pump suction lines shall be as direct as possible and drain towards the pump wherever possible. No pockets shall be permitted in which vapor or gas can collect. Elbows shall not be installed in the horizontal adjacent to pump suction nozzle. Where reduction is required on horizontal pump suction lines, use eccentric reducers or swages installed flat on top (belly down).

3.3.2 Generally speaking, when the pump suction nozzle is two sizes smaller than suction line size, the suction block valve shall be one size smaller than line size. When the pump suction nozzle is one size smaller than suction line size, the suction block valve will generally be line size. In all cases, the block valve shall be established by the NPSH requirements of the pump.

3.3.3 Temporary strainers shall be provided for all pumps and compressors and installed before starting up the pump or compressor. Strainers shall be installed in the first flanged joint between suction valve and pump or compressor.

3.3.4 Pump discharge piping shall be designed to withstand pump shut in pressure or a relief valve shall be installed between the pump and the first block valve to limit maximum pressure.

3.3.5 Pump discharge valves will, in general, be the same size as the pump nozzle, except where process considerations require the valves to be slightly larger.

3.3.6 Where necessary, spool pieces designed for easy removal shall be provided in piping at pumps and drivers to facilitate the removal of pump impeller or driver without dismantling piping or valves.

3.3.7 Exchanger piping shall be arranged so that exchanger can be removed as a unit and so the tube bundle can be pulled after disconnecting the channel piping. A block valve shall be provided on the cooling water inlet or outlet lines on exchangers in cooling or condensing service. Water outlet lines shall be arranged to keep the tubes submerged or full.

3.3.8 Equipment on vertical and horizontal vessels, which must be operated or serviced while unit is operating, shall be accessible from ladder, platform or portable ladder. Large overhead vapor lines off the top head of vertical vessels shall be provided with valved vent connections at the highest point.

3.3.9 Piping and nozzles carrying inlet streams shall be arranged to avoid impingement on the vessel wall, or against liquid level and gage glass connections.

3.3.10 Relief valve vent piping shall be supported so that valves can be removed without necessitating temporary supporting of vent line.

3.3.11 Compressor and high pressure reciprocating pump piping shall be anchored and guided to eliminate excessive vibrations in piping and supporting structure..

3.3.12 Piping around all equipment shall be arranged to permit access to equipment and to permit removal of equipment for maintenance and inspection.

3.4 Utility Piping:

3.4.1 The flow diagram shall indicate the extent of utility piping, such as compressed air, cooling water, steam, etc., to be furnished.

3.4.2 Branch utility lines shall leave the main supply headers off the top (preferably) or the side of the header.

3.4.3 Drain valves shall be provided at low points in condensate, air and water lines.

3.4.4 Sight flow indicators shall be provided in cooling water outlet piping from turbines, compressors, etc., on closed circuit type cooling systems.

3.4.5 Steam traps will be provided for the removal of condensate from drip leg type collection points on live and exhaust steam lines.

3.4.6 Dead end steam, water, or condensate lines are to be avoided to prevent freezing. Unavoidable water dead ends will be provided with winter circulation bypasses.

3.5 Instrument Piping:

3.5.1 Instrument and instrument take-off connections shall be accessible from grade, platform, ladder, or portable ladder at grade.

3.5.2 Instrument take-off piping shall be as straight and short as possible. This piping shall be braced when stress or vibration is anticipated.

3.5.3 Minimum size piping from take-off connection through the first block valve shall be 1/2".

3.5.4 Thermometers, pressure gages, and other local indicating instruments shall be located so that they may be read from operating level.

3.6 Sewer Piping:

3.6.1 Normally, sewer lines shall have a minimum slope of 5" per 100 feet.

3.6.2 All sewers shall have clean-out provisions. Main sewer lines shall be provided with traps.

3.6.3 Vitreous tile hub and spigot joints shall be made with one round of braided hemp per joint. The joint shall be sealed by filling with Portland cement until a tight joint is obtained. The completed joint should be covered immediately to help retain moisture and protect the joint while curing.

3.6.4 Clay drain tile shall be laid with open joints and a piece of 15 pound felt shall be laid over the top of the joint before backfilling with earth.

3.6.5 Cast iron hub and spigot joints shall be made with two rounds of braided hemp, or jute, per joint. The joint shall be sealed with a self-caulking cast sulphur compound such as Atlas Mineralead. The compound must be heated slowly. If the compound burns, it shall not be used. Stir until the surface is smooth, without bubbles or froth. Each joint must be made in one pour while the compound is free flowing or watery. The joint shall be dry and wiped clean before pouring. The joints shall set until compound has completely solidified before removing pouring gate. Use a chisel in the slot of the pouring gate so that a clean break at the joint will be made. The pipe shall be covered with earth shortly after removing pouring gate.

3.7 Pipe Supports:

3.7.1 The piping shall be supported in accordance with Chapter II, Part 5 of the Code for Pressure Piping, ASA B31.3-1962.

3.7.2 When expansion joints are used, the piping shall be adequately anchored and guided. Piping should be routed within or near structures to obtain their maximum use for support.

3.7.3 Uninsulated piping shall rest on the supporting pier or structure. Insulated piping shall be raised above supporting pier or structure sufficiently to accommodate the insulation. Refer to insulation specifications for pipe insulation thickness at design temperatures.

3.8 Vents and Drains:

3.8.1 Except where otherwise specified, piping drains, vents, and sample connections shall be 1/2" minimum size. Sizes under 1/2" shall be used only where equipment connections cannot be made 1/2".

3.8.2 All high points of lines in pump suction service, lines requiring hydrostatic tests, or lines in liquid service that must be drained, shall be provided with valved vents to atmosphere. They shall, whenever possible, be placed in readily accessible location.

3.8.3 Valved drains to atmosphere shall be provided at all low points of the system as required to completely empty all equipment and lines after a test or shutdown.

3.8.4 Drains provided at the low point of control stations shall be located upstream of the control valve.

3.8.5 All drain and vent valves shall be provided with a steel plug for safety and thread protection. Vent and drain valves that are not insulated and are in low temperature lines shall be covered with a bitumastic type material for protection against corrosion due to sweating.

3.8.6 Unions and flanges which are part of the piping system may be used for vents and drains while testing the system.

3.9 Joints and Connections:

3.9.1 In general, a minimum of flanges shall be installed in welded lines. Flanges are to be located only at flanged equipment and valves. Fabricated pieces are to be welded in place whenever possible.

3.9.2 Flanged connections on equipment differing from those of the connecting piping shall have size, rating and facing indicated on arrangement drawings.

3.9.3 Flanges that bolt flat face or cast iron flanges shall be flat face.

3.9.4 Unions shall be located on the low pressure side of block valves except at vessels and tanks where the union shall be on the line side of the valve.

3.10 Materials:

The materials used shall be in accordance with the latest revisions of ASME, ASA, ASTM, API, AWWA, AWS, MSS, and AAR Standards. The individual piping specification classifications for the various services will indicate which of the above codes and standards are applicable.

4.0 FABRICATION

4.1 Welding:

4.1.1 All welding shall be performed in accordance with Chapter V ASA B31.3-1962 and other applicable codes. In addition, the following requirements shall be met:

4.1.2 Preparation of pipe ends shall be done preferably by machining or grinding. Flame or arc cut bevels are acceptable if the cut is reasonably smooth and is cleaned of all oxide and slag before welding. The bore of the fitting and the bore of the pipe shall match. End preparation shall be in accordance with Division 327.3, ASA B31.3-1962.

4.1.3 All welding shall be accomplished by the shielded arc process and/or the tungsten inert gas process (TIG).

4.1.4 The filler metal to be used for the shielded arc welding process shall be classification E6010, E7010 and/or E7018 electrodes to comply with ASTM A-233. The filler metal to be used for the tungsten inert gas process shall be Oxweld 65 or Page AS20.

4.1.5 The current used for welding shall be direct current reversed polarity (Electrode positive, work negative) for shielded arc welding and direct current straight polarity for tungsten inert gas welding.

4.1.6 All butt welded pipe and fittings 2" and smaller operating below minus 20°F shall have the first (or root) pass made using the tungsten inert gas process. The remaining passes may be made with the shielded metal arc process using coated electrodes in accordance with the filler metal requirements.

4.2 Qualifications:

4.2.1 Welders and welding procedures shall be qualified in accordance with the applicable paragraphs ASA B31.3-1962. All welding procedures shall be submitted 4 weeks prior to the time that actual pipe welding begins.

4.2.2 On process piping operating below -20°F, the weld metal and heat affected zones shall be impact tested in accordance with the applicable paragraphs ASA B31.3-1962.

4.2.3 When subcontracting is employed, the CB&I resident engineer will be the employer or code examinder for purpose of clarification of the code. The subcontractor shall qualify welders and submit qualified test reports of the weld metal and heat affected zone in accordance with paragraphs 4.2.1 and 4.2.2. In addition, after welding has started and during the first work week, the subcontractor shall provide CB&I with a typical welded joint in 3" and 6" low temperature pipe which has been welded in the horizontal fixed position under field conditions at the job site. All welding procedures, welder qualifications, certified test reports and welding samples shall be sent to the CB&I Regional Office for approval and tests.

4.3 Radiography:

4.3.1 All butt welds on all piping will be visually inspected. All process lines shall have 10% of the butt welded joints for each diameter x-rayed. The first butt weld on each pipe size for each welder shall be x-rayed.

4.3.2 The x-rays shall meet all the requirements for quality in accordance with paragraph 327.4.2 ASA B31.3-1962. The x-rays will be taken by CB&I personnel and graded in the field by the field weld supervisor. The graded film will be sent to the Regional Office on CB&I weekly x-ray report forms.

4.4 Postweld Heat Treatment:

Post heat treatment shall be performed only when required by paragraph 331.3 ASA B31.3-1962.

5.0 CLEANING AND FLUSHING

All piping will be cleaned per paragraph 120 and 420, ASA B31.1-1955 with the following addition:

Piping shall be flushed out with the same type of fluid that will be used to test the line. After flushing, and where it is practical, a "pig" (similar to that manufactured by Sweco, Incorporated of Houston, Texas) shall be pulled through the lines.

6.0 INSPECTION AND TESTING

6.1 Inspection:

Inspection will be made of all work to determine compliance with the codes and to determine good workmanship throughout to the satisfaction of the CB&I resident engineer. The inspection and tests by CB&I of any materials and/or construction as outlined herein, does not relieve the subcontractor from any responsibility regarding defects or other failures to meet the requirements of the subcontract, which may be discovered prior to final acceptance.

6.2 Testing:

6.2.1 Inspection and test shall conform to Chapter VI, ASA B31.3-1962.

6.2.2 All joints, including welds, are to be left uninsulated and exposed for examination during the tests. Vents, drains, and relief valves shall be utilized to prevent damage to the piping system due to freezing or thermal expansion during the test period.

6.2.3 Any test shall include a preliminary pneumatic check at not more than 25 psig.

6.2.4 The maximum operating pressure of each piece of equipment, including instruments, shall be checked against the test pressure of the piping system in which the piece of equipment is incorporated. If the test pressure of the piping system is greater than the maximum operating pressure of the equipment, the equipment shall be blanked off and tested separately. Refer to the line schedules for the test pressure of each line.

6.2.5 Process lines shall be hydrostatically or pneumatically tested. The line schedule shall indicate the type of test to be used on each line.

6.2.6 All piping which is hydrostatically tested shall be tested at a pressure of 1-1/2 times the maximum allowable pressure at 100°F. Minimum hydrostatic test pressure shall be 100 psig. Any leaks found during the test shall be repaired and retested to the satisfaction of the CB&I resident engineer.

6.2.7 All piping which is pneumatically tested, such as process piping, instrument air, plant air, and other low pressure piping, shall be tested at a pressure of 110 percent of the maximum allowable pressure. Any leaks found during the tests shall be repaired and retested to the satisfaction of the CB&I resident engineer.

6.2.8 Water may be used for hydrostatic testing of process lines provided special precautions are taken for draining and drying the lines.

6.2.9 All testing fluid, such as hydrocarbons, water, air, nitrogen, etc., shall be approved by the CB&I resident engineer before testing is started.

6.2.10 All expansion joints shall be guided, restricted, and protected during the test.

6.2.11 The subcontractor will furnish all testing equipment and testing fluid used.

7.0 DRYING

All piping, vessels, exchangers, etc., shall be completely drained of all testing fluid. Special precautions should be taken to insure the draining of all pockets where the testing fluid may be trapped.

All piping tested with water, in which water would be detrimental to the process operation, shall be thoroughly dried. This piping shall be blown down with air and air circulated through the piping until it has been determined that there are no trapped pockets of water and the piping is dry. The CB&I resident engineer shall determine when the piping is dry.

PROCESS PIPING SPECIFICATION "A1"

1.0	NOMINAL RATING:		300# R.F. Carbon Steel
2.0	SERVICE LIMITS:		720# @-50° to 720# @ -21°F (No Ball Valves) 520#@-50°F to 520#@-21°F (Ball Valves Limiting)
3.0	SERVICE:		Propane Liquid & Vapor
4.0	VALVES:		
	Gate:	2" & Smaller	600# F.S. or C.S. socket weld Pacific Fig.No. 3652-1 or equal.
		3" & Larger	300# C.S. R.F. flanged Pacific Fig. No. 350-1 or equal.
	Globe:	2" & Smaller	600# F.S. or C.S. socket weld Pacific Fig.No. 3662-1 or equal.
		3" & Larger	300# C.S. R.F. flanged Pacific Fig. No. 360-1 or equal.
	Check:	2" & Smaller	600# F.S. or C.S. socket weld Pacific Fig. No. 3682-1 or equal.
		3" & Larger	300# C.S. R.F. flanged Pacific Fig. No. 380-1 or equal.
	Ball:	2" & Smaller	600# F.S. or C.S. screwed Pacific Fig.No. 225-P5 or equal.
		3" thru 10"	300# C.S. R.F. flanged Pacific Fig. No. 3B10-P5 or equal.
	Needle:	1" & Smaller	3000# F.S.S. screwed Powell Fig. No. 1976 or equal.
	Butterfly:	1" thru 20"	150# Aluminum wafer type Center Line series "AL" & "AAL" or equal.

Butterfly valves shall have stainless steel disc, shaft, and bushing. Low temperature Buna-N CL-7 resilient seats. Lever lock handle or gear operator as indicated on the piping drawings. Not to be used in lines where pressure can exceed 150 psig. Companion flanges must be 150# F.S. R.F. weldneck flanges.

PROCESS PIPING SPECIFICATION "A1"

4.0	VALVES: (contd.)		All valve requisitions shall include design conditions as to temperature, pressure and flowing medium. Cast steel (C.S.) valve material shall be ASTM A-352 Grade LCB. Forged steel (F.S.) valve material shall be ASTM A-350 Grade LF1. Forged stainless steel (F.S.S.) valve material shall be ASTM A-182 Grade F304. Valve trim material shall be 11-13% chrome. Ball valve, butterfly valves, etc., shall have extension stems, where necessary to accommodate the required thickness of insulation. Valve packing shall be manufacturer's standard suitable for the pressure, temperature and flowing medium. Ball valve seals shall be Teflon.v
5.0	PIPE:	2" & Smaller	Schedule 80 seamless ASTM A-333 Grade 1.
		3" thru 10"	Schedule 40 seamless ASTM A-333 Grade 1.
		12" thru 20"	3/8" wall seamless ASTM A-333 Grade 1. ASTM A-106 Grade B pipe, Charpy impact tested at -50°F in accordance with Division 323.2.2., ASA B31.3-1962, may be substituted for ASTM A-333 Grade 1 pipe.
6.0	FITTINGS:	2" & Smaller	3000# F.S. socket weld ASTM A-350 Grade LF1.
		3" thru 10"	Schedule 40 butt welding ASTM A-420 Grade WPLO.

PROCESS PIPING SPECIFICATION "A1"

6.0	FITTINGS (Contd.)	12" thru 20"	3/8" wall butt welding ASTM A-420 Grade WPLO.
7.0	BRANCH CONNECTIONS:		Use welding tees for full size branches only.
			Use weldolet type fittings or full couplings for branches smaller than the header.
		2" & Smaller	3000# F.S. sockolet type fittings or socketweld full couplings ASTM A-350 Grade LF1.
		3" & Larger	Standard weight F.S. weldolet type fittings ASTM A-350 Grade LF1.
8.0	FLANGES:	2" & Smaller	300# F.S. R.F. socket weld ASTM A-350 Grade LF1.
		3" & Larger	300# F.S. R.F. Weldneck ASTM A-350 A-350 Grade LF1.
			Flanges shall be bored to the same I.D. as the pipe to which they are welded.
9.0	UNIONS:		Use flanges
			3000# F.S. socket weld unions with integral seats (ASTM A-350 Grade LF1) in sizes 2" and smaller may be used when indicated on the piping drawings.
10.0	GASKETS:		Spiral wound stainless steel with asbestos filler. Flexitallic Style "CG" or equal.
			Gasket dimension shall be in accordance with ASA B16.5-1961, Appendix E, Table 1, Figure 3.

PROCESS PIPING SPECIFICATION "A1"

11.0	BOLTING:	Alloy steel stud bolts ASTM A-193 Grade B7 with two semi-finished hex nuts ASTM A-194 Grade 2H.
12.0	THREAD COMPOUND:	Rectorseal No. 5 or equal. Screwed connections shall be made up dry and seal welded except at screwed equipment connections. Seal weld shall cover all exposed threads.
13.0	JOINTS:	All welded except at screwed equipment connections. Random lengths of pipe shall be butt welded together to make up pipe runs.
14.0	NIPPLES:	Schedule 80 seamless ASTM A-333 Grade 1.
15.0	SWAGES:	Schedule 80 seamless ASTM A-333 Grade 1. ASTM A-106 Grade B nipples and swages. Charpy impact tested at -50°F in accordance with Division 323.2.2, ASA B31.3-1962, may be substituted for ASTM A-333 Grade 1. nipples and swages.
16.0	PLUGS:	For socket weld valves use a pipe nipple one end plain, the other end threaded and with a screwed cap. For screwed connections use a round head forged solid steel plug ASTM A-350 Grade LF1.

PROCESS PIPING SPECIFICATION "A1"

17.0 GENERAL NOTES:

Pressure-temperature rating used in this specification are based on Class A rating for raised face flange joints, ASA B16.5-1961, Table 3.

Certification that all material conforms to the requirements of this specification is required.

Stainless steel fittings shall not be used in lieu of low temperature carbon steel welding fittings.

PROCESS PIPING SPECIFICATION "A2"

1.0	NOMINAL RATING:		150# R.F. Carbon Steel
2.0	SERVICE LIMITS:		275#@-50°F to 275#@-21°F
3.0	SERVICE:		Propane Liquid & Vapor
4.0	VALVES:		
	Gate:	2" & Smaller	600# F.S. or C.S. socket weld Pacific Figure No.3652-1 or equal.
		3" & Larger	150# C.S. R.F. flanged Pacific Figure No.150-1 or equal.
	Globe:	2" & Smaller	600# F.S. or C.S. socket weld Pacific Fig.No.3662-1 or equal.
		3" & Larger	150# C.S. R.F.flanged Pacific Fig.No. 160-1 or equal.
	Check:	2" & Smaller	600# F.S. or C.S. socket weld Pacific Fig.No. 3682-1 or equal.
		3" & Larger	150# C.S. R.F. flanged Pacific Fig. No. 180-1 or equal.
	Ball:	2" & Smaller	600# F.S. or C.S. screwed Pacific Fig. No. 225-P5 or equal.
		3" thru 10"	150# C.S. R.F. flanged Pacific Fig. No. 400-P5 or equal.
	Needle:	1" & Smaller	3000# F.S.S. screwed Powell Fig. No. 1976 or equal.
	Butterfly:	1" thru 20"	150# Aluminum wafer type Center Line Series "AL" & "AAL" or equal.

Butterfly valves shall have stainless steel disc, shaft, and bushing. Low temperature Buna-N CL-7 resilient seats. Lever lock handle or gear operator as indicated on the piping drawings. Not to be used in lines where pressure can exceed 150 psig. Companion flanges must be 150# F.S. R.F. weldneck flanges.

PROCESS PIPING SPECIFICATION "A2"

4.0	VALVES (Contd.)		All valve requisitions shall include design conditions as to temperature, pressure and flowing medium. Cast steel (C.S.) valve material shall be ASTM A-352 Grade LCB. Forged steel (F.S.) valve material shall be ASTM A-350 Grade LF1. Forged stainless steel (F.S.S.) valve material shall be ASTM A-182 Grade F304. Valve trim material shall be 11-13% chrome. Ball Valve, butterfly valves, etc., shall have extension stems, where necessary to accommodate the required thickness of insulation. Valve packing shall be manufacturer's standard suitable for the pressure, temperature and flowing medium. Ball valve seals shall be Teflon.
5.0	PIPE:	2" & Smaller	Schedule 80 seamless ASTM A-333 Grade 1.
		3" thru 10"	Schedule 40 seamless ASTM A-333 Grade 1.
		12" thru 20"	3/8" wall seamless ASTM A-333 Grade 1. ASTM A-106 Grade B pipe, Charpy impact tested at -50°F in accordance with Division 323.2.2, ASA B31.3-1962, may be substituted for ASTM A-333 Grade 1 pipe.
6.0	FITTINGS:	2" & Smaller	3000# F.S. socket weld ASTM A-350 Grade LF1.
		3" thru 10"	Schedule 40 butt welding ASTM A-420 Grade WPLO.

PROCESS PIPING SPECIFICATION "A2"

6.0	FITTINGS (Contd.)	12" thru 20"	3/8" Wall butt welding ASTM A-420 Grade WPLO.
7.0	BRANCH CONNECTIONS:		Use welding tees for full size branches only. Use weldolet type fittings or full couplings for branches smaller than the header.
		2" & Smaller	3000# F.S. sockolet type fittings or socketweld full couplings ASTM A-350 Grade LF1.
		3" & Larger	Standard weight F.S. weldolet type fittings ASTM A-350 Grade LF1.
8.0	FLANGES:	2" & Smaller	150# F.S. R.F. socket weld ASTM A-350 Grade LF1.
		3" & Larger	150# F.S. R.F. Weldneck ASTM A-350 Grade LF1. Flanges shall be bored to the same I.D. as the pipe to which they are welded.
9.0	UNIONS:		Use flanges. 3000# F.S. socket weld unions with integral seats (ASTM A-350 Grade LF1) in sizes 2" and smaller may be used when indicated on the piping drawings.
10.0	GASKETS:		Spiral wound stainless steel with asbestos filler. Flexitallic Style "CG" or equal. Gasket dimension shall be in accordance with ASA B16.5-1961, Appendix E, Table 1, Figure 3.
11.0	BOLTING:		Alloy steel stud bolts ASTM A-193 Grade B7 with two semi-finished hex nuts ASTM A-194 Grade 2H.

PROCESS PIPING SPECIFICATION "A2"

12.0	THREAD COMPOUND:	Rectorseal No. 5 or equal. Screwed connections shall be made up dry and seal welded except at screwed equipment connections. Seal weld shall cover all exposed threads.
13.0	JOINTS:	All welded except at screwed equipment connections. Random lengths of pipe shall be butt welded together to make up pipe runs.
14.0	NIPPLES:	Schedule 80 seamless ASTM A-333 Grade 1.
15.0	SWAGES:	Schedule 80 seamless ASTM A-333 Grade 1. ASTM A-106 Grade B nipples and swages. Charpy impact tested at -50 F in accordance with Division 323.2.2, ASA B31.3-1962, may be substituted for ASTM A-333 Grade 1 nipples and swages.
16.0	PLUGS:	For socket weld valves use a pipe nipple one end plain, the other end threaded and with a screwed cap. For screwed connections use a round head forged solid steel plug ASTM A-350 Grade LF1.
17.0	GENERAL NOTES:	Pressure-temperature rating used in this specification are based on Class A rating for raised face flange joints, ASA B16.5-1961, Table 2. Certification that all material conforms to the requirements of this specification is required. Stainless steel fittings shall not be used in lieu of low temperature carbon steel welding fittings.

PROCESS PIPING SPECIFICATION "B1"

1.0	NOMINAL RATING:		300# R.F. Carbon Steel
2.0	SERVICE LIMITS:		720#@-20°F to 425#@ 750°F (No Ball Valves) 520#@ -20° to 350#@ 220°F (Ball Valves Limiting)
3.0	SERVICE:		Propane (Liquid & Vapor) High Pressure Steam (No Ball Valves) Lube Oil Underground Process Lines
4.0	VALVES:		
	Gate:	2" & Smaller	600# F.S. or C.S. socket weld Pacific Figure No. 3652-1 or equal.
		3" & Larger	300# C.S. R.F. flanged Pacific Fig. No. 350-1 or equal.
	Globe:	2" & Smaller	600# F.S. or C.S. socket weld Pacific Figure No. 3662-1 or equal.
		3" & Larger	300# C.S. R.F. flanged Pacific Figure No. 360-1 or equal.
	Check:		
	Swing:	2" & Smaller	600# F.S. or C.S. socket weld Vogt Figure No. SW-4835-9 or equal.
		3" & Larger	300# C.S. R.F. flanged Pacific Fig. No. 380-1 or equal.
	Piston:	1" thru 10"	300# C.S. R.F. flanged Powell Fig. No. 3065 or equal.
	Ball:	2" & Smaller	600# F.S. or C.S. screwed Pacific Figure No. 225-P5 or equal.
		3" thru 10"	300# C.S. R.F. flanged Pacific Fig. No. 3B10-P5 or equal.
	Needle:	1" & Smaller	3000# C.S. screwed Powell Figure No. 675 or equal.

4.0 VALVES (Contd.)

Butterfly:	1" thru 20"	150# Aluminum wafer type Center Line Series "A", "AA", "AL" & "AAL" or equal.
		Butterfly valve shall have stainless steel disc, shaft, and bushings. Buna-N CL-1 resilient seats. Lever lock handle or gear operator as indicated on the piping drawings. Not to be used in lines where pressure can exceed 150 psig. Companion flanges must be 150# F.S. R.F. weldneck flanges.
		All valve requisitions shall include design conditions as to temperature, pressure and flowing medium.
		Cast steel (C.S.) valve material shall be ASTM A-216 Grade WCB.
		Forged steel (F.S.) valve material shall be ASTM A-105 Grade II.
		Valve trim material shall be 11-13% chrome.
		Ball valve, butterfly valves, etc. shall have extended stems where necessary to accommodate the required thickness of insulation.
		Valve packing shall be manufacturer's standard suitable for the pressure, temperature and flowing medium.
		Ball valve seals shall be Teflon.

5.0 PIPE:

2" & Smaller	Schedule 80 seamless ASTM A-53 Grade A.
3" thru 10"	Schedule 40 seamless ASTM A-53 Grade A.
12" thru 20"	3/8" Wall seamless ASTM A-53 Grade A.

PROCESS PIPING SPECIFICATION "B1"

6.0	FITTINGS:	2" & Smaller	3000# F.S. socket weld ASTM A-105 Grade II.
		3" thru 10"	Schedule 40 butt welding ASTM A-234 Grade WPA.
		12" thru 20"	3/8" Wall butt welding ASTM A-234 Grade WPA.
7.0	BRANCH CONNECTIONS:		Use welding tees for full size branches only.
			Use weldolet type fittings or full couplings for branches smaller than the header.
		2" & Smaller	3000# F.S. sockolet type fittings or socket weld full couplings ASTM A-105 Grade II.
		3" & Larger	Standard weight F.S. weldolet type fittings ASTM A-105 Grade II.
8.0	FLANGES:	2" & Smaller	300# F.S. R.F. socket weld ASTM A-181 Grade I.
		3" & Larger	300# F.S. R.F. Weldneck ASTM A-181 Grade I.
			Flanges shall be bored to the same I.D. as the pipe to which they are welded.
9.0	UNIONS:	2" & Smaller	3000# F.S. socket weld Vogt Figure No. B-2220 to B-2228 or equal. ASTM A-105 Grade II.
			Unions shall have integral seats.
10.0	GASKETS:		Spiral wound stainless steel with asbestos filler. Flexitallic style "CG" or equal.
			Gasket dimensions shall be in accordance with ASA B16.5-1961, Appendix E, Table 1, Figure 3.

PROCESS PIPING SPECIFICATION "B1"

11.0	BOLTING:	Alloy steel stud bolts ASTM A-193 Grade B7 with two semi-finished hex nuts ASTM A-194 Grade 2H.
12.0	THREAD COMPOUND:	Rectorseal No. 5 or equal.
13.0	JOINTS:	All welded except at screwed equipment connections. Random lengths of pipe shall be butt welded together to make up pipe runs.
14.0	NIPPLES:	Schedule 80 seamless ASTM A-53 Grade A.
15.0	SWAGES:	Schedule 80 seamless ASTM A-106 Grade B.
16.0	PLUGS:	For socket weld valves use a pipe nipple, one end plain, the other end threaded and with a screwed cap. For screwed connections, use a round head solid steel plug. ASTM A-105 Grade II.
17.0	UNDERGROUND SERVICE	
	MATERIAL:	Same as the above ground piping.
	JOINTS:	All welded except as noted on the piping drawings. Flanges and unions shall not be used underground unless noted on the piping drawings.
	COATING:	In accordance with CB&I Coating Specifications for Underground Pipe.
18.0	GENERAL NOTES:	Pressure-temperate rating used in this specification are based on Class "A" rating for raised face flanged joints, ASA B16.5-1961, Table 3.

PROCESS PIPING SPECIFICATION "B2"

1.0	NOMINAL RATING:		150# R.F. Carbon Steel
2.0	SERVICE LIMITS:		275#@-20°F to 110#@ 750°F
3.0	SERVICE:		Propane (Liquid & Vapor) Butane (Liquid & Vapor) Freon (Liquid & Vapor) High Pressure Steam (No Ball Valves) Lube Oil Underground Process lines
4.0	VALVES:		
	Gate:	2" & Smaller	600# F.S. or C.S. socket weld Pacific Fig. No. 3652-1 or equal.
		3" & Larger	150# C.S. R.F. flanged Pacific Fig. No. 150-1 or equal.
	Globe:	2" & Smaller	600# F.S. or C.S. socket weld Pacific Fig.No. 3662-1 or equal.
		3" & Larger	150# C.S. R.F. flanged Pacific Fig. No. 160-1 or equal.
	Check:		
	Swing:	2" & Smaller	600# F.S. or C.S. socket weld Vogt Fig. No. SW-4835-9 or equal.
		3" & Larger	150# C.S. R.F. flanged Pacific Fig. No. 180-1 or equal.
	Ball:	2" & Smaller	600# F.S. or C.S. screwed Pacific Fig. No. 225-P5 or equal.
		3" thru 10"	150# C.S. R.F. flanged Pacific Fig. No. 400-P5 or equal.
	Needle:	1" & Smaller	3000# C.S. screwed Powell Fig. No. 675 or equal.

4.0 VALVES (Contd.)

Butterfly:	1" thru 20"	150# Aluminum wafer type Center Line Series "A", "AA", "AL" & "AAL" or equal.

Butterfly valve shall have stainless steel disc, shaft, and bushings. Buna-N CL-1 resilient seats. Lever lock handle or gear operator as indicated on the piping drawings. Not to be used in lines where pressure can exceed 150 psig. Companion flanges must be 150# F.S. R.F. weldneck flanges.

All valve requisitions shall include design conditions as to temperature, pressure and flowing medium.

Cast steel (C.S.) valve material shall be ASTM A-216 Grade WCB.

Forged steel (F.S.)valve material shall be ASTM A-105 Grade II.

Valve trim material shall be 11-13% chrome.

Ball valve, butterfly valves, etc. shall have extended stems where necessary to accommodate the required thickness of insulation.

Valve packing shall be manufacturer's standard suitable for the pressure, temperature and flowing medium.

Ball valve seals shall be Teflon.

5.0	PIPE:	2" & Smaller	Schedule 80 seamless ASTM A-53 Grade A.
		3" thru 10"	Schedule 40 seamless ASTM A-53 Grade A.
		12" thru 20"	3/8" Wall seamless ASTM A-53 Grade A.

PROCESS PIPING SPECIFICATION "B2"

6.0	FITTINGS:	2" & Smaller	3000# F.S. socket weld ASTM A-105 Grade II.
		3" thru 10"	Schedule 40 butt welding ASTM A-234 Grade WPA.
		12" thru 20"	3/8" Wall butt welding ASTM A-234 Grade WPA.
7.0	BRANCH CONNECTIONS:		Use welding tees for full size branches only.
			Use weldolet type fittings or full couplings for branches smaller than the header.
		2" & Smaller	3000# F.S. sockolet type fittings or socket weld full couplings ASTM A-105 Grade II.
		3" & Larger	Standard weight F.S. weldolet type fittings ASTM A-105 Grade II.
8.0	FLANGES:	2" & Smaller	150# F.S. R.F. socket weld ASTM A-181 Grade I.
		3" & Larger	150# F.S. R.F. Weldneck ASTM A-181 Grade I.
			Flanges shall be bored to the same I.D. as the pipe to which they are welded.
9.0	UNIONS:	2" & Smaller	3000# F.S. socket weld Vogt Figure No. B-2220 to B-2228 or equal. ASTM A-105 Grade II.
			Unions shall have integral seats.
10.0	GASKETS:		Spiral wound stainless steel with asbestos filler. Flexitallic style "CG" or equal.
			Gasket dimensions shall be in accordance with ASA B16.5-1961, Appendix E, Table 1, Figure 3.

PROCESS PIPING SPECIFICATION "B2"

11.0	BOLTING:	Alloy steel stud bolts ASTM A-193 Grade B7 with two semi-finished hex nuts ASTM A-194 Grade 2H.
12.0	THREAD COMPOUND:	Rectorseal No. 5 or equal.
13.0	JOINTS:	All welded except at screwed equipment connections. Random lengths of pipe shall be butt welded together to make up pipe runs.
14.0	NIPPLES:	Schedule 80 seamless ASTM A-53 Grade A.
15.0	SWAGES:	Schedule 80 seamless ASTM A-106 Grade B.
16.0	PLUGS:	For socket weld valves use a pipe nipple, one end plain, the other end threaded and with a screwed cap. For screwed connections, use a round head solid steel plug. ASTM A-105 Grade II.
17.0	UNDERGROUND SERVICE	
	MATERIAL:	Same as the above ground piping.
	JOINTS:	All welded except as noted on the piping drawings. Flanges and unions shall not be used underground unless noted on the piping drawings.
	COATING:	In accordance with CB&I Coating Specifications for Underground Pipe.
18.0	GENERAL NOTES:	Pressure-temperating rating used in this specification are based on Class "A" rating for raised face flanged joints, ASA B16.5-1961, Table 2.

UTILITY PIPING SPECIFICATION "C"

1.0	NOMINAL RATING:		125# Cast Iron and Bronze
2.0	SERVICE LIMITS:		200# @ 100°F to 125# 350°F.
3.0	SERVICE:		Cooling Water Low Pressure Steam Low Pressure Nitrogen Fuel Gas Underground Utility Lines
4.0	VALVES:		
	Gate:	2" & Smaller	150# I.B.B.M. screwed Crane Figure 490 or equal.
		3" & Larger	125# I.B.B.M.F.F. flanged Crane Fig. No. 465½ or equal.
	Globe:	2" & Smaller	150# I.B.B.M. screwed Crane Fig. No. 350½ or equal.
		3" & Larger	125# I.B.B.M.F.F. flanged Crane Fig.No. 351 or equal.
	Check:	2" & Smaller	150# I.B.B.M. screwed Crane Fig. No. 366½ or equal.
		3" & Larger	125# I.B.B.M. F.F.flanged Crane Fig. No. 373.
	Needle:	1" & Smaller	3000# F.S. screwed Powell Fig. No. 675 or equal.
	Gas Cocks:	2" & Smaller	125# All Iron screwed Crane Fig. No. 320 or equal.
	Butterfly:	1" thru 20"	150# Malleable iron wafer type Center Line series "A" & "AA" or equal.

UTILITY PIPING SPECIFICATION "C"

4.0	Valves (Cont'd.)		Butterfly valves shall have carbon steel disc and shaft. Bronze bushings. Neoprene resilient seats. Lever lock handle or gear operator as indicated on the piping drawings.
			Cast iron valve material shall be ASTM A-126 Class B.
			Forged steel (F.S.) valve material shall be ASTM A-105 Grade II.
			Bronze valve material shall be ASTM B-62.
			Valve packing and trim material shall be manufacturer's standard.
5.0	PIPE:	10" & Smaller	Schedule 40 seamless ASTM A-53 Grade A.
		12" & Larger	Determine
6.0	FITTINGS:	2" & Smaller	150# Malleable iron screwed ASTM A-197.
		3" & Larger	Standard weight butt welding ASTM A-234 Grade WPA.
7.0	BRANCH CONNECTIONS:		Do not use welding tees. Use welded header and branch connections.
		1" & Smaller	2000# F.S. thredolet type fittings or 6000# F.S. screwed full couplings ASTM A-105 Grade II.
		1½" & Larger	2000# F.S. thredolet type fittings or 3000# F.S. screwed full coupling ASTM A-105 Grade II.
8.0	FLANGES:	2" & Smaller	Use Unions. Use threaded flanges to match 2" & smaller equipment flanges.

8.0	FLANGES (Contd.)	3" & Larger	150# F.S. R.F. weldneck ASTM A-181 Grade I. Weldneck flanges shall be bored to the same I.D. as the pipe to which they are welded. Flanges matching 125# cast iron flanges (including valves) shall be flat face.
9.0	UNIONS:	2" & Smaller	300# Malleable iron screwed ASTM A-197 Walworth No.7716 or equal.
10.0	GASKETS:		1/16" thick asbestos composition gasket JM-60 or equal. Use full face gaskets with flat face flanges.
11.0	BOLTING:		Regular unfinished carbon steel machine bolts with hex head and hex nut. ASTM A-307 Grade B.
12.0	THREAD COMPOUND:		Rectorseal No. 5 or equal.
13.0	JOINTS:		Welded and screwed. Random lengths of pipe shall be butt welded together to make up pipe runs.
14.0	NIPPLES:		Schedule 40 seamless ASTM A-53 Grade A.
15.0	SWAGES:		Schedule 40 seamless ASTM A-53 Grade A.
16.0	PLUGS:		Solid steel round head ASTM A-105 Grade II.
17.0	UNDERGROUND SERVICE:		
	MATERIAL:		Same as the above ground piping.
	JOINTS:		All welded except as noted on the piping drawings. Flanges and unions shall not be used underground unless noted on the piping drawings.
	COATING:		In accordance with CB&I Coating Specifications for Underground Pipe.

UTILITY PIPING SPECIFICATION "D"

1.0	NOMINAL RATING:		125# Cast Iron and Bronze
2.0	SERVICE LIMITS:		200# @ 100°F to 125# @ 350°F
3.0	SERVICE:		Instrument and Utility Air Potable Water (All pipe and fittings in potable water service to be galvanized.)
4.0	VALVES:		
	Gate:	2" & Smaller	200# Bronze screwed Crane Fig. No. 424 or equal.
		3" & Larger	125# I.B.B.M. F.F. flanged Crane Figure No. 465½ or equal.
	Globe:	2" & Smaller	200# Bronze screwed Crane Figure No. 212P or equal.
		3" & Larger	125# I.B.B.M. F.F. flanged Crane Figure No. 351 or equal.
	Check:	2" & Smaller	200# Bronze screwed Crane Figure No. 36 or equal.
	Needle:	1" & Smaller	3000# F.S. screwed Powell Figure No. 675 or equal.
			Cast iron valve material shall be ASTM A-126 Class B.
			Forged steel (F.S.) valve material shall be ASTM A-105 Grade II.
			Bronze valve material shall be ASTM B-62.
			Valve packing and trim shall be manufacturer's standard.

UTILITY PIPING SPECIFICATION "D"

5.0	PIPE:	10" & Smaller	Schedule 40 seamless ASTM A-53 Grade A.
		12" & Larger	Determine
6.0	FITTINGS:	2" & Smaller	150# Malleable iron screwed ASTM A-197.
		3" & Larger	Standard weight butt welding ASTM A-234 Grade WPA.
7.0	BRANCH CONNECTIONS:		Do not use welding tees. Use welded header and branch connections.
		1" & Smaller	2000# F.S. thredolet type fittings or 6000# F.S. screwed full coupling ASTM A-105 Grade II.
		1½" & Larger	2000# F.S. thredolet type fittings or 3000# F.S. screwed full coupling ASTM A-105 Grade II.
8.0	FLANGES:	2" & Smaller	Use unions. Use threaded flanges to match 2" and smaller equipment flanges.
		3" & Larger	150# F.S. R.F. weldneck ASTM A-181 Grade I.
			Weldneck flanges shall be bored to the same I.D. as the pipe to which they are welded. Flanges matching 125# cast iron flanges (including valves) shall be flat face.
9.0	UNIONS:		300# Malleable iron screwed ASTM A-197 Walworth Fig. No. 7716 or equal.
10.0	GASKETS:		1/16" thick asbestos composition gasket JM-60 or equal. Use full face gaskets with flat face flanges.

UTILITY PIPING SPECIFICATION "D"

11.0	BOLTING:	Regular unfinished carbon steel machine bolts with hex head and hex nut. ASTM A-307 Grade B.
12.0	THREAD COMPOUND:	Rectorseal No. 5 or equal.
13.0	JOINTS:	Welded and screwed. Random lengths of pipe shall be butt welded together to make up pipe runs.
14.0	NIPPLES:	Schedule 40 seamless ASTM A-53 Grade A.
15.0	SWAGES:	Schedule 80 seamless ASTM A-53 Grade A.
16.0	PLUGS:	Solid steel round head. ASTM A-105 Grade II.
17.0	TUBING:	1/4" O.D. x 0.030" wall dead soft, PVC covered, copper tubing.
18.0	TUBE FITTINGS:	Swagelok, brass, or equal.
19.0	TUBE VALVES:	1/4" diameter 3000# brass needle valve with integral tube ends. Hoke Figure No. 1193 or equal.

UTILITY PIPING SPECIFICATION "E"

1.0	NOMINAL RATING:	Type a	Sewer Piping (Cast Iron Pipe)
		Type b	Sewer Piping (Clay Pipe)
2.0	SERVICE CONDITIONS:		Atmospheric Conditions
3.0	SERVICE:	Type a	Hydrocarbons, Surface Water and Sanitary Sewers
		Type b	Sanitary Sewer from Septic Tank and Miscellaneous Drains (5'-0" min. from building).
4.0	PIPE:	Type a	2" thru 15" Service weight cast iron hub and spigot soil pipe.
		Type b	4" thru 10" Standard strength clay sewer pipe ASTM C-13.
			4" thru 10" Clay drain tile ASTM C-4.
5.0	FITTINGS:	Type a	2" thru 15" Service weight cast iron hub and spigot soil pipe.
		Type b	4" thru 10" Standard strength clay sewer pipe. ASTM C-13.
6.0	JOINTS:	Type a	Hub and spigot joints shall be made with braided hemp and mineralead or equal.
		Type b	Hub and spigot joints shall be made with braided hemp and Portland cement.

ELECTRICAL DESIGN AND INSTALLATION SPECIFICATIONS

(LPG, LNG, PETROLEUM PRODUCTS)

1.0 SCOPE

The purpose of this specification is to set forth, the electrical design and installation standards of Chicago Bridge & Iron Company for LPG and LNG refrigerated storage and petroleum product facilities.

Since these facilities are generally custom-designed and built, it should be understood that there may be sections of this general specification that will not apply specifically to a certain project and/or special requirements (customer or otherwise) that are not specifically mentioned herein. This specification will govern for electrical design and installation unless exceptions or revisions are specifically called out in the contract documents.

CB&I reserves the right to furnish other materials and concepts which are considered equivalent to those called for in these specs.

2.0 CODES AND STANDARDS

Applicable portions of the latest revisions of the following codes and standards shall serve as the minimum requirements throughout the electrical design and installation of the facility:

(a) National Electric Code (NFPA No. 70)
(b) National Fire Protection Association Bulletins 59 & 59A
(c) American Petroleum Institute Standard No. RP-500
(d) All state and local rules, regulations and codes

In the event of conflict between any of the above codes, the more rigid shall apply.

3.0 AREA CLASSIFICATION

The facility is classified in accordance with the requirements of the American Gas Association Inc. publication "Classification of Gas Utility Areas for Electrical Installations" (AGA#X-50765). The main equipment areas are classified as follows:

a. Non-Hazardous Areas

1. Control room separated from hazardous area room by sealed vapor-tight barrier.

2. Fired vaporizer or heater area.

3. General yard area and areas within the battery limits not classified hazardous.

b. Class I - Group D - Division 2 Hazardous Areas

1. Indoor compressor room with mechanically-induced ventilation.

2. Storage tank within dike area.

3. Indirect-heated vaporizer or heater area.

4. Area between 5 and 15 feet of fill connections in a gas loading or unloading area.

c. Class I - Group D - Division 1 Hazardous Areas

1. Sumps or trenches within Division 1 or Division 2 areas.

2. Areas within 5 ft of relief vents on storage tank, and within 5 ft of fill connections in a gas loading or unloading area.

In any case, this classification is subject to approval of code-enforcing authorities.

4.0 POWER PRIMARY DISTRIBUTION - OVER 600 VOLTS

4.1 Pole Line Construction

Construction of pole lines shall meet all state and local rules for overhead electric line construction.

4.1.1 Overhead electric lines shall be installed to maintain a minimum clearance of 20'-0" from grade to the lowest part of any conductor.

4.1.2 A minimum of Class 4 poles for main line work and Class 2 poles for corners and dead ends shall be provided. Poles shall be seasoned, reasonably straight, well proportioned, free from defects and creosoted over their full length.

4.1.3 Any poles supporting equipment which may require maintenance shall be equipped with pole steps spaced 1'-6" apart on alternate sides of the pole with the first step a minimum of 8'-0" above grade.

4.1.4 Cross arms shall be of the standard 4 or 6-pin size and shall be mounted with a minimum of 2'-6" vertical spacing. Double cross arms shall be used at all dead ends, corners and turns.

4.1.5 Guy wires shall be galvanized stranded steel, a minimum of 3/8" diameter. Strain insulators shall be mounted at least 10'-0" above grade in all guy wires with suitable anchors and anchor rods provided.

4.1.6 Conductors larger than #2 AWG shall be supported on saddle back or top groove insulators.

4.2 Substation Arrangement

Main power substations shall be located outdoors in non-hazardous areas. Load center substations shall be located indoors in non-hazardous areas.

4.2.1 Generally, the service drop from the power pole to the main power substation shall be made overhead with underground feeders running to indoor load center substations and/or secondary distribution equipment.

4.2.2 Substations shall be mounted on concrete foundations.

4.2.3 Fencing of substations shall not be provided.

4.3 Main Power Transformer

Main power transformers shall be furnished as part of outdoor main power substations.

4.3.1 Such transformers shall be oil-immersed, self-cooled type, sealed tank construction, suitable for use in outdoor locations.

4.3.2 Transformers shall be capable of maintaining 80% of normal rated voltage during any normal starting condition.

4.3.3 Transformers shall be provided with suitable externally operated no-load primary tap changers with two 2-1/2% taps above and two 2-1/2% taps below rated voltage.

4.3.4 Complete cooling equipment as required by the rating shall be provided.

4.3.5 Transformers shall be provided with an air-filled secondary terminal compartment suitable for terminating outgoing conduits.

4.3.6 Each transformer shall include oil level gage, oil thermometer, oil drain valves, and required ground connection.

4.4 Load Center Transformers

Load center transformers shall be furnished as part of indoor load center substations.

4.4.1 Such transformers shall be of the liquid-filled type or Class B insulated, air-cooled, ventilated type.

4.4.2 Transformers shall be capable of maintaining voltage levels specified in paragraph 4.3.2 above.

4.4.3 Transformers shall be provided with taps as specified in paragraph 4.3.3 above.

4.4.4 Complete cooling equipment as required by the rating shall be provided.

4.4.5 Transformers shall be provided with flanged throat enclosed terminals to permit bolting of throat to primary and/or secondary bus duct for connection to primary and/or secondary switchgear.

4.4.6 Each liquid-filled transformer shall include liquid level gage, liquid thermometer, liquid drain valve, and required ground connection.

4.5 Medium Voltage Motor Control

Motor control for medium voltage equipment shall be furnished as part of indoor load center substations.

4.5.1 Such motor controllers shall be full voltage, non-reversing starters employing current-limiting power fuses for high interrupting capacity, air break contactors, ambient-compensated overload relays, and instantaneous undervoltage protection for complete control and protection of equipment.

4.5.2 Such starters can be used as free-standing individual NEMA I controllers, or several may be lined up with a common feeder power bus to form a grouped-control installation, and, together with a transformer and low voltage motor control center, form an indoor load center substation.

5.0 POWER SECONDARY DISTRIBUTION - 600 VOLTS AND UNDER

5.1 Motor Control

Low voltage motor control centers shall be furnished in accordance with the type and classification of the area in which they will be used.

5.1.1 In indoor, non-hazardous areas, standard NEMA I Motor control center with Class I, Type B wiring shall be furnished. The horizontal bus shall be braced for 25,000 amp. short-circuit current. Such control centers shall contain the following equipment:

a. Main service disconnects.

b. Full voltage, circuit breaker type or fused disconnect combination starters, with two overload relays (for motors only), red (for running) indicating lights, and push-buttons, selector switches and auxiliary interlocks as required.

Control voltage for starters to be 120 volts which can be supplied in the following manner:

1. Individual 480/120V control transformers located within each starter unit.

2. One common transformer rated for all control circuits.

3. Combination of above items.

c. Distribution transformer, 480-120/208 volts 3-phase or 480-120/240 volts single phase with protection on the primary side.

d. Distribution panelboard with 20 amp single pole circuit breakers for lighting and 15 amp circuit breakers for auxiliary control. For each six circuits used, one spare circuit shall be provided.

e. Unit ground bus.

f. Compartment nameplates.

5.1.2 In outdoor, non-hazardous areas, NEMA-3 weather resistant non-walk-in enclosure shall be provided.

5.1.3 In indoor or outdoor, hazardous (Class 1, Division 2) areas, motor control equipment shall be rack-mounted, explosion-proof.

5.2 Low Voltage Distribution Transformer

Distribution transformers for lighting and control power shall be air-cooled, dry type, for indoor locations, and located in the low voltage motor control center.

6.0 EMERGENCY POWER (APPLICABLE ONLY IF SPECIFIED AS BEING FURNISHED)

An emergency electrical generator driven by a gas engine shall be furnished together with an automatic transfer switch which will, on normal power failure, start the emergency generator, transfer selected electrical loads from the normal power bus to the emergency power bus, retransfer these loads to the normal power bus when normal power has returned, and stop the engine-generator. The engine-generator will be equipped with the following features:

a. An automatic battery-operated starter

b. A battery charger

c. Self-regulating speed and voltage control device

Loads to be connected to the emergency power bus shall include the following:

a. At least one holding compressor with auxiliary electrical equipment.

b. The distribution transformer for 120-volt lighting and auxiliary control circuits.

c. Other essential equipment as required.

7.0 ELECTRICAL CONTROL

7.1 Compressors

Process compressors shall be controlled by individual three-position selector switches located on the motor control center, the control panel or locally. Running lights shall be located on the motor control center. Lock-out stop stations shall be furnished if required.

7.2 Product Pumps

Product pumps shall be controlled by pushbuttons (three-wire) located at the pumps. The local stop station shall have a lock-out feature. Running lights shall be located on the control panel.

7.3 Auxiliary Equipment

Other 3-phase motors shall be controlled either from the motor control center or locally.

7.4 Single-Phase Motors

Single-phase motors shall be controlled by local manual motor starters. Selector switches shall be provided if automatic control is required. Power for such equipment will be furnished from distribution panel 120-volt circuits in the motor control center.

7.5 Control Panel

The main control panel shall be located in an indoor non-hazardous area. Auxiliary panels will be located adjacent to equipment and with enclosures suitable for area classification.

7.5.1 All pushbuttons, selector switches, and indicating lights located on panels shall be heavy-duty, oil-tight units.

7.5.2 Control relays shall be 300 volt, industrial type.

7.5.3 Alarm horns shall be furnished in the main control panel. Alarm silence and lamp test pushbuttons shall be furnished on this panel. Alarm indication will be made only on the main control panel.

8.0 MOTORS

8.1 Classification

Motor classification according to voltage shall be as follows:

a. Over 200 HP - 2400 or 460 volt, 3 phase, 60 Hertz induction or synchronous.*

b. 200 HP to 1 HP - 460 volt, 3 phase, 60 Hertz induction.

c. Below 1 HP - 110 volt, 1 phase, 60 Hertz induction.

8.2 Synchronous Motors

Synchronous motors shall be engine type, drip-proof. Field excitation shall be static. In Class I, Group D, Division 2 areas, collector rings shall be enclosed in housings suitable for use in the hazardous area, or brushless-type machines may be used. In outdoor areas, NEMA Type I weather protection shall be furnished.

8.3 Induction Motors

Induction motors shall be furnished according to the classification of the area in which they are to be used.

8.3.1 In Class I, Group D, Division 1 areas, induction motors (1 & 3-phase) shall be TEFC, explosion-proof.

8.3.2 In indoor hazardous areas classified Class I, Group D, Division 2, induction motors (3-phase) shall be open drip-proof and single phase motor shall be TEFC, explosion-proof.

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* In general, synchronous motors shall be used for high horsepower-low speed applications. As a "rule of thumb," when the rating of the motor exceeds one horsepower per rpm, the synchronous motor and its control shall be used, mainly from the economic standpoints of both lower initial and lower operating costs.

8.3.3 In indoor non-hazardous areas, induction motors (1 & 3-phase) shall be open, drip-proof.

8.3.4 In ourdoor areas, hazardous (Class I, Group D, Division 2) or non-hazardous, 3-phase induction motors shall be one of the following:

(1) Open drip-proof with sealed windings
(2) NEMA Type I weather protected
(3) TEFC (Note: All single phase motors outdoors shall be TEFC)

9.0 STORAGE TANK FOUNDATION HEATING (NOT APPLICABLE IF STORAGE TANK IS CONSTRUCTED ON PILINGS)

Heat shall be supplied to the storage tank foundation with cable installed in conduit under the tank. Junction boxes will be provided externally on the ringwall. See Specification C-03.

10.0 LIGHTING AND AUXILIARIES

Lighting for compressor buildings, control rooms, process areas, pumpout areas, and storage tank stairways will be provided. Maintained average illumination levels shall be as follows:

Control Rooms	50 Footcandles
Compressor Rooms and Auxiliary Rooms	10 "
Process Areas and Pumpout Areas	5 "
Storage Tank Stairways and Building Doorways	Adequate for personnel safety

Lighting for areas inside the battery limits not containing process equipment will not be provided.

10.1 Fixtures

Lighting fixtures in Class I, Group D, Division 2 areas shall be vapor-tight. Floodlights will be used in conjunction with these fixtures in areas warranting their use. Lighting fixtures in control rooms (non-hazardous) shall be fluorescent.

10.2 Obstruction Lights

Obstruction lights on tall structures shall be provided when required by the Civil Aeronautics Administration. Such lights shall be electric-eye controlled and shall be on emergency circuits if available.

10.3 Convenience Receptacles

Convenience receptacles for 120-volt single-phase service shall be located as follows:

(1) In buildings, receptacles shall be located within 50 feet of equipment with a minimum of one to a room.

(2) In outdoor operating machinery areas, receptacles shall be located within 100 feet of machinery.

(3) In areas containing only pipeways, controls and vessels, no convenience receptacles will be furnished.

All receptacles shall meet the NEC requirements for that particular area classification. No welding receptacles will be furnished.

10.4 Switching

All lighting and convenience receptacles shall be switched from 20 amp, 120 volt circuit breakers on the distribution panel in the motor control center. In addition, building lighting may be switched from wall-mounted toggle switches. Three-way switches will be furnished where practical.

10.5 Circuit Loading

20 amp lighting circuits shall be designed for a maximum load of 1800 watts.

11.0 GROUNDING SYSTEM

A ground network or loop shall be installed throughout the jobsite area. This network shall consist of a main cable loop and branch cables from the main loop to the individual units or structures requiring grounding. The ground network shall be tied to ground to obtain a resistance to ground of 25 ohms or less, if practical, by one of the following:

(1) A metallic underground water-piping system will always be used as the grounding electrode if such a piping system is available.

(2) Piling or deep-well casings if available.

(3) 3/4"ϕ x 10 ft long copper-weld ground rods shall be used to obtain a suitable low resistance to ground.

11.1 Grounded Equipment

The following equipment shall be connected to the grounding system:

(a) Motor and generator frames

(b) Switchgear, motor control centers, instrument panels, control cabinets

(c) Storage tank

(d) Buildings

(e) Other vessels and steel structures

(f) Fences

11.2 Cable Size

Ground cable shall be stranded or solid bare copper, sized as follows:

(a) Main loop -- #2/0 AWG

(b) Motor frames (above 100 HP) -- #2/0 AWG

(c) Switchgear or control center ground bus -- #2/0 AWG

(d) Storage tank -- #2/0 AWG

(e) Other branch runs and motors 100 HP or less -- #2 AWG

11.3 Installation

All ground cables shall be directly buried. Wherever possible, ground cables shall be placed alongside underground conduit runs to minimize the amount of trenching required.

11.3.1 Ground cable shall be installed in conduit sleeves wherever it is necessary to protect it is necessary to protect it from mechanical injury. Across areas that are walked over, flat copper strap shall be used to connect the ground cable to a piece of equipment.

11.3.2 Ground cable connections to motors shall be made directly to motor frames using suitable grounding lugs.

11.3.3 Connections to equipment ground buses shall be made directly to the buses using suitable ground lugs. Connections to other equipment shall be made by brazing the ground cable to one of the anchor bolts supporting such equipment or with suitable connectors.

11.3.4 All conduits entering switchgear, motor control centers, instrument panels, auxiliary control panels, etc., shall be furnished with grounding bushings and tapes which shall be connected with suitable ground lugs to the ground bus of the unit.

11.3.5 Alternate method of Motor Grounding: Insulated ground cable shall be run with motor power feeds in conduit. Ground cables shall be the same size as motor power feeds, and shall be connected to ground system via motor control center ground bus.

12.0 CONDUIT SYSTEM

All conduit shall be rigid metal conduit except electrical metallic tubing (EMT) may be used on 120 volt lighting and auxiliary circuits inside buildings. Where practical, dissimilar metals in contact in the system shall be avoided to eliminate the possibility of galvanic action. Electrical fittings shall be Crouse-Hinds or equal quality. All such fittings shall meet NEC requirements for the type area in which they are to be used.

12.1 Length of Runs

Conduit runs shall not exceed 200 ft and shall not contain more than the equivalent of four 90° bends between pull points. In conduit runs exceeding 200 ft where the use of pull boxes would be impractical (such as in underground runs), conduit shall be oversized in proportion to the excess length of conduit and the maximum number of bends between pull points shall be reduced to the equivalent of three 90° bends.

12.2 Sizes

Conduit shall be sized to comply with NEC requirements on the size, quantity, and type of conductors capable of being installed, with the following additional restrictions:

(a) Minimum underground conduit size shall be 1".

(b) Minimum overhead conduit size on pipe racks shall be 3/4" except for connections to electrical fittings having 1/2" conduit openings, in which case 1/2" may be used.

12.3 Conduit for Power and Control

Power and control wiring may be run in the same conduit for motors 50 HP and smaller. For motors above 50 HP, power and control leads shall be in separate conduits. Thermocouple and small signal control, if shielded, can be run in the same conduit as 120 volt control wire.

12.4 Identification

All conduits entering switchgear, motor control center, instrument panels, or auxiliary control cabinets shall be provided with tags or permanent marking to identify the conduit as shown on contract drawings.

12.5 Seal Fittings

Seal fittings shall be furnished according to NEC requirements and manufacturer's recommendations.

12.6 Installation

Conduit may be run overhead on pipe racks, structural supports and building structures or may be run underground as required. Underground conduit shall be run at a minimum depth of 18" from grade, except conduit under concrete floor slabs which may be run with a minimum of 2" cover between bottom of slab and top of conduit. Underground conduit shall be laid such that the filling materials surrounding the conduit, to a thickness of 4", shall be free of stones or other material which may damage conduit. A minimum spacing of 1" for 1-1/2"ϕ conduit or smaller, and 2" for conduit larger than 1-1/2"ϕ shall be maintained between adjacent conduits in an underground trench.

12.6.1 Condouit requiring cutting shall be sawed square and reamed inside to remove all burrs. Rigid metal conduit shall be threaded with a minimum of five full threads. No "running threads" or split couplings shall be used. Threaded joints shall be made watertight by using a conductive non-seize thread lubricant/sealer. All conduit connections shall be made up tight to insure good mechanical and electrical connections. Elbows and bends may be formed with a hand or mechanical bender. In any case, all field bends shall be free from flat surfaces and kinks to the extent that the full inside cross-sectional area is maintained over the full length of the bend.

12.6.2 All aboveground conduit runs shall be run in straight lines at right angles to or parallel with pipe racks, pipe supports or conduit supports. These conduits shall be substantially supported with pipe straps, hanger, or clamps to provide a secure installation. As a minimum requirement, the conduit support spacing shall meet NEC article 346-12 and table 346-12. Conduit shall never be heated, welded or tacked.

12.6.3 All ends of conduits which are left open after installation shall be plugged or capped until the wire is installed. Such conduits shall be thoroughly swabbed out to remove any accumulated debris or moisture prior to installing the cables.

13.0 WIRE AND CABLE

13.1 Types

All wire and cable shall be copper conductors with insulation as follows:

(a) 12.5 KV Service - 15 KV grounded neutral, single conductor, rubber insulation with neoprene sheath.

(b) 4160 or 2400 Volt Service - 5 KV, single conductor, rubber insulation with neoprene sheath.

(c) 600 Volt and Below - 600 Volt, Type RHW or THW.

13.1.1 Conductors #6 AWG and larger shall be stranded. Conductors #8 AWG and smaller can be solid or stranded.

13.2 Sizes

Wire and cable shall be sized to comply with NEC requirements on allowable current carrying capacities.

13.3 Color Coding

Color coding will be in accordance with NEC requirements.

13.4 Installation

Cable shall be installed in conduit using equipment designed for cable pulling. Cable lubricant and pulling equipment as recommended by the cable manufacturer shall be employed.

13.5 Splicing

All conductors shall be continuous from box to box with no splices or sections of repaired insulation pulled into any conduit. Splices are permissible but the quantity of splices shall be held to a minimum. Splices in control wiring shall be made with pressure connectors and wrap-cap insulators. Splices in power wiring (including motor leads) shall be made with compression or bolted-type connectors and a minimum of two overlapping layers of insulating tape. Where wires make connections to terminal boards, fork-tongue connectors shall be used to connect the wires to the boards unless the boards are equipped with compression-type connectors.

13.6 Identification

Wiring in motor control centers, instrument panels, and other control cabinets shall be done in a neat and orderly manner with wires properly grouped, laced, supported and identified. All control circuit wiring shall be identified at each end and in junction boxes with cloth wire markers. Identification shall strictly correspond to that used on the contract drawings.

14.0 ARMORED OR METAL SHEATH CABLE

Armored or metal sheath cable may be used as an alternate to the conduit and wire system. All armored or metal sheath cable shall be fabricated and installed to meet NEC requirements.

14.1 Materials

All armored or metal sheath cable shall be NEC approved for use in each area classification. Cable type ALS, MI, MC, SE, USE and UF are approved and may be used as follows:

(a) In Class I Division 1 areas - Type MI cable

(b) In Class I Division 2 areas - Type MI, MC & ALS.

(c) In non-hazardous areas - Type MI, MC, ALS, SE, USE and UF.

14.2 Installation

Armored or metal sheath cable may be installed underground or overhead as required. Cable runs on pipe racks, structural supports or on building structural shall be supported with metal trays or ducts. In protected areas, such as against building or tunnel walls and ceilings, armored or metal sheath cable may be supported by brackets or straps attached to the walls or to cable supports. Underground cable for direct burial shall be protected from corrosion by a PVC coating or other suitable corrosion-resistant material. Cable connections into equipment or boxes shall be made with glands and/or seals suitable for area classification.

ELECTRICAL DESIGN AND INSTALLATION SPECIFICATIONS

FOR

FOUNDATION HEATING

FOR

SINGLE AND DOUBLE WALL

REFRIGERATED STORAGE TANKS

(BOTH STORAGE TANK FOUNDATION HEATING AND PROCESS BY CB&I)

ELECTRICAL DESIGN AND INSTALLATION SPECIFICATIONS (FOUNDATION HEATING)

TABLE OF CONTENTS

1.0 SCOPE

The purpose of this specification is to set forth, in general, the electrical design and installation standards of Chicago Bridge and Iron Company for foundation heating for single and double wall refrigerated storage tanks.

To maintain the storage tank foundation temperature at a value above freezing (+32 F), CB&I shall design, furnish and install a complete electrical heating system including heating cables in conduit, controls in conduit, power feeder, starter, and controlling instruments.

Since these facilities are generally custom designed and built, it should be understood that there may be sections of this general specification that will not apply specifically to a certain project and/or special requirements (customer or otherwise) that are not specifically mentioned herein. In any case, however, an attempt will be made to list exceptions on an individual proposal basis by addendums to this specification.

2.0 CODES AND STANDARDS

Applicable portions of the latest revisions of the following codes and standards shall serve as the minimum requirements throughout the electrical design and installation of the foundation heating system:

(a) National Electric Code (NFPA No. 70)
(b) National Board of Fire Underwriters
(c) National Electric Safety Code
(d) American Petroleum Institute Standard No. RP-500
(e) Agricultural Ammonia Institute Standards for the Storage and Handling of Anhydrous Ammonia
(f) All state and local rules, regulations and codes

In the event of conflict between any of the above codes, the more rigid shall apply.

3.0 AREA CLASSIFICATION

The storage tank area is classified in accordance with the following:

(a) National Electric Code (NFPA-70)
  1. Article 500 - "Hazardous locations"
  2. Article 501 - "Class 1 installations"
  3. Article 515 - "Bulk Storage Plants"

(b) American Gas Association Inc. Publication "Classification of Gas Utility Areas for Electrical Installations" (AGA #X-50765)

3.0 AREA CLASSIFICATION (Cont'd.)

Classifications of tank area is as follows:

(a) For LPG & LNG Storage Tanks - Class 1- Group D - Division 2
(b) For Anhydrous Ammonia Storage Tanks - Non-hazardous

4.0 DESIGN

4.1
General: Heat will be provided to the storage tank bottom electrically, using type XHHW, 600 volt insulated wire. Heating system will be connected as a 3-phase "Wye", 480 volts line to line, and installed in rigid conduit.

4.1.1 Quantity of such loops, sizes and lengths of conduits and cables, conduit centerline spacing, and quantity of heat supplied shall depend upon storage tank size and quantity and type of the load bearing insulation.

4.1.2 Since the system furnishes uniform heat distribution, no provision for modified zone heating or special heat regulation is required. The system shall be designed for strictly "On-Off" operation.

4.1.3 Power at 480 volt, 3 phase, 60 cycle shall be required at the ringwall at one point only. This power shall be switched by a 480 volt, 3 phase combination magnetic starter which, in turn, shall be operated automatically by the control system. The starter shall be located in the motor control center.

4.2 Conduit Layout: Conduits for both heating and control shall be installed under the load-bearing insulation.

4.2.1 Geometric configuration of the heating conduits shall be parallel chord type with spacing between conduits held to a maximum of 36". Where these conduits penetrate the ringwall, such penetrations shall be made radially and connected to a type FSAA conduit junction box encased within the concrete ringwall.

4.2.2 Geometric configuration of the control conduits shall also be parallel chord type. These conduits will be installed parallel to the heating cable condutis and extend the entire length of the chord. A "1" Ø Dia-P.V.C. pipe (2 ft. long) shall be installed between the chord and the last conduit length (approx. 10 ft. from outer ringwall). This length of P.V.C. pipe acts as an insulator to reduce ambient temperature effects.

Five equally spaced "1" Ø diameter control conduits shall be provided.

4.2.2 (Continued)

Control conduits shall be installed 2-1/2" lower than heating cable conduits within the sand bed.

Type FSCA conduit junction boxes shall be used with interconnecting conduits between junction boxes on the ringwall periphery.

4.2.3 Conduit and conduit fittings for both heating and control shall be rigid galvanized steel or rigid aluminum.

4.3 Control: The heating system shall be controlled by Fenwall Series 536 temperature control and Series 580 multipoint indicator. Control conduits contain themistor type probes that produce a large and rapid signal change with a very small temperature change.

4.3.1 The lowest temperature of the five temperature sensing points controls the "On-Off" operation of the heating system.

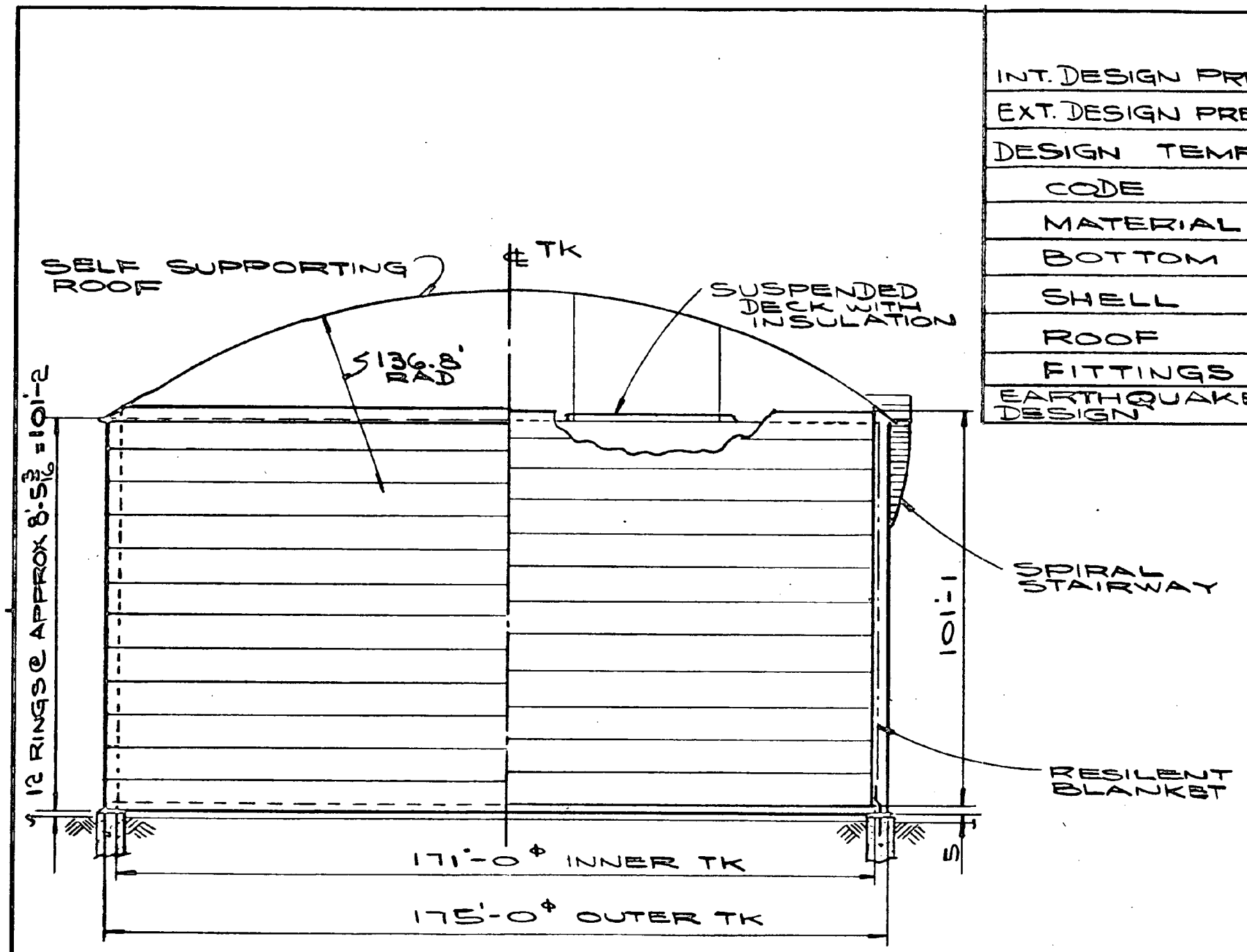
4.3.2 One thermistor probe shall be located in each of the control conduits. A rotary selector switch on the temperature indicator provides a means of monitoring each individual thermistor probe.

5.0 INSTALLATION

5.1 Conduit: Conduit requiring cutting shall be sawed square, reamed inside to remove all burrs, and threaded with a minimum of five full threads. No "running threads" or split couplings shall be used. Conduit couplings shall be made watertight. All conduit connections shall be made up tight to insure good mechanical and electrical connections. Elbows and bends (1" and below) may be formed with hand bender. In any case, all field bends shall be free from flat surfaces and kinks to the extent that the full inside cross sectional area is maintained over the full length of the bend. All ends of conduits which are left open after installation shall be plugged or capped until the heating cables are installed. Such conduits shall be thoroughly swabbed out to remove any accumulated debris or moisture prior to installing the cables.

5.2 Heating Cables: Cables shall be installed in conduit using equipment designed for cable pulling. Cable lubricant and pulling equipment as recommended by the cable manufacturer shall be employed. All conductors shall be continuous from box to box with no splices or sections of repaired insulation pulled into any conduit. Splices are permissible in the boxes but the quantity of splices shall be held to a minimum. Splices shall be made with crimp-type two way connectors, covered with glass cloth tape, and painted with Glyptal or equal. Each cable in each junction box where a splice occurs shall be permanently identified with Brady wire markers or equal.

5.3 Tests: Each cable shall be tested for short circuits, improper grounds and insulation resistance using an approved "Megger". Loop lengths shall have relatively equal resistances to assure balanced three-phase load. Resistance of each continuous loop length shall be measured with an ohmeter and recorded.



ELEVATION

	INNER TANK	OUTER TANK
INT. DESIGN PRESS	PRODUCT @ 36.6 #/FT³	
EXT. DESIGN PRESS	PERLITE FORCES AND 2" H_2O VACUUM	100 MPH WIND
DESIGN TEMP	-50°F	AMBIENT
CODE	API 620	CB&I STANDARD
MATERIAL:	ASTM	ASTM
BOTTOM	A516-60 MOD.	A283-C
SHELL	A537A, A537B A516-68	A283-C
ROOF	A131B	—
FITTINGS	A333GR1, A350GR LF1 OR EQUAL	
EARTHQUAKE-DESIGN	ZONE 1	

REMARKS

BY	CHKD	DATE

REVISIONS

CHICAGO BRIDGE & IRON COMPANY

DOUBLE WALL LPG TANK
400,000 BBL. CAPACITY
FOR
PETROLANE, INC.

PURCHASER'S NO. _____ CONTRACT NO. 71-2076

DRAWN BY LK DATE 4-7-71

CHECKED BY _____ DATE _____

ENGINEERING COORDINATOR _____ DWG NO. _____ REV

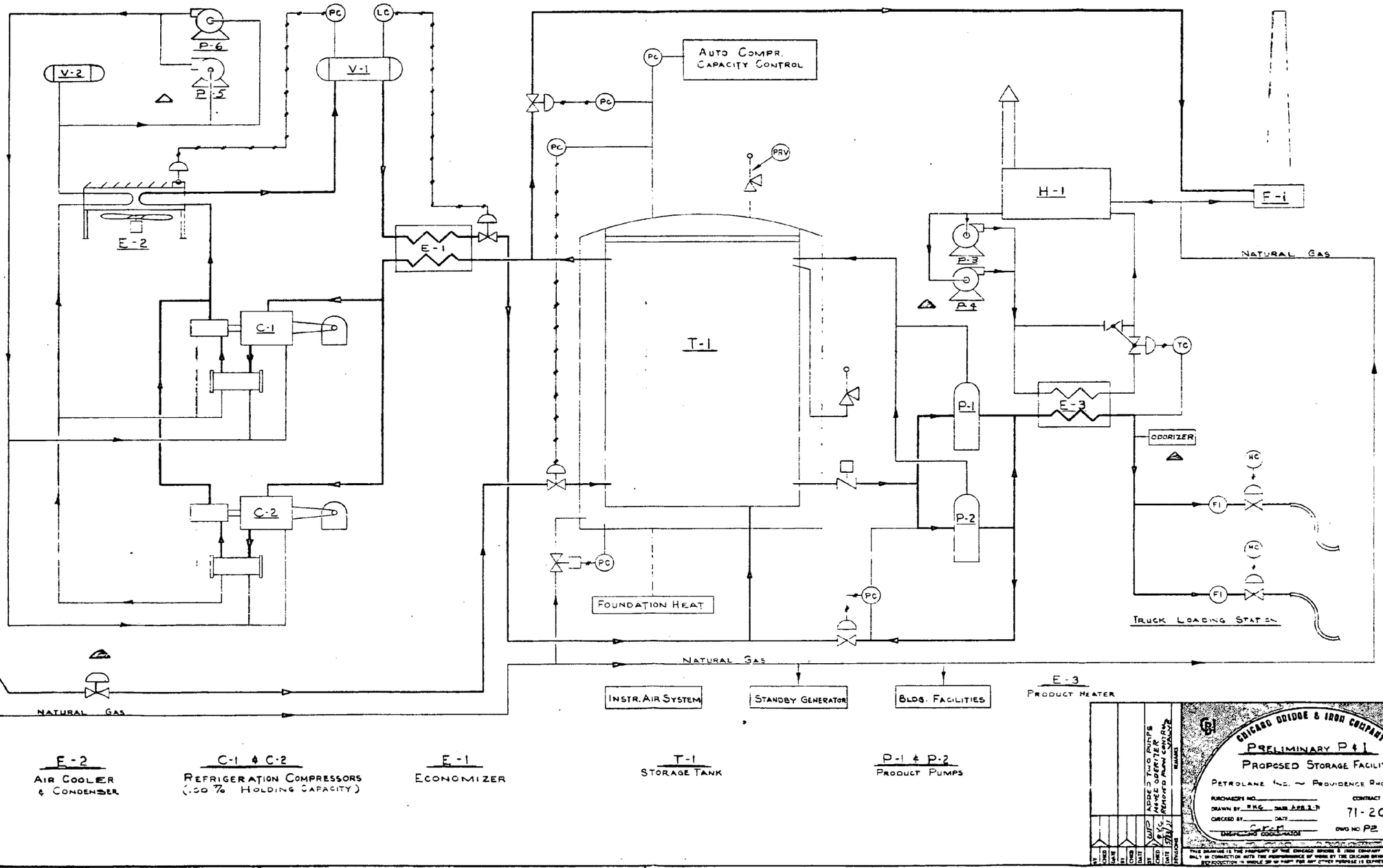
V-2
EXPANSION DRUM

V-1
RECEIVER

P-3
PRODUCT HEATER CIRCULATING PUMP

H-1
BOILER

F-1
FLARE STACK



E-2
AIR COOLER & CONDENSER

C-1 & C-2
REFRIGERATION COMPRESSORS (100% HOLDING CAPACITY)

E-1
ECONOMIZER

T-1
STORAGE TANK

P-1 & P-2
PRODUCT PUMPS

E-3
PRODUCT HEATER

ADDED 2 TWO PUMPS
MOVED ODERIZER
REVISED PLAN CONTROL VALVE
REMARKS

CHICAGO BRIDGE & IRON COMPANY

PRELIMINARY P & I

PROPOSED STORAGE FACILITY

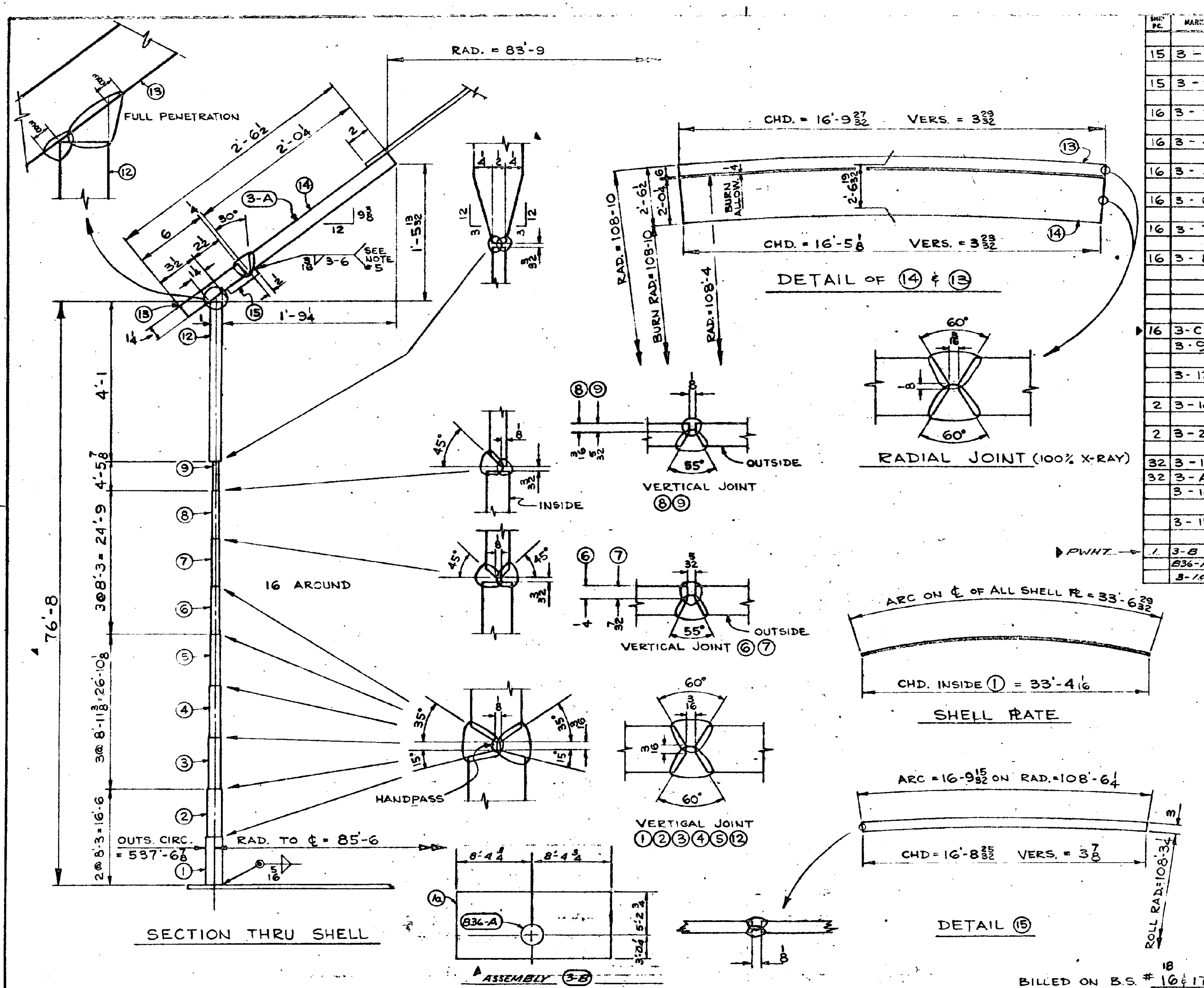
PETROLANE INC. — PROVIDENCE RHODE IS.

PURCHASER'S NO. _____ CONTRACT NO. 71-2075

DRAWN BY H.K.G. DATE APR 3 '71

CHECKED BY _____ DATE _____

ENGINEERING COORDINATOR _____ DWG NO. P2 REV 1



SHIP PC.	MARK	PCS. PC.	DESCRIPTION	LENGTH FT.	LENGTH IN.	SPEC.	WT.
15	3-1		PL 99 × 1.39 ×	33	6 29/32	3.1d	
			(C_F PL 100 × 1.39 × 33'-7⅞)				
15	3-2		PL 99 × 1 3/16 ×	33	6 29/32		
			(C_F PL 100 × 1 3/16 × 33'-7⅞)				
16	3-3		PL 107⅞ × 1.086 ×	33	6 29/32		
			(C_F PL 108⅜ × 1.086 × 33'-7⅞)				
16	3-4		PL 107⅞ × .975 ×	33	6 29/32		
			(C_F PL 108⅜ × .975 × 33'-7⅞)				
16	3-5		PL 107⅞ × .864 ×	33	6 29/32		
			(C_F PL 108⅜ × .864 × 33'-7⅞)				
16	3-6		PL 99 × ¾ ×	33	6 29/32		
			(C_F PL 99½ × ¾ × 33'-7½)				
16	3-7		PL 99 × .650 ×	33	6 29/32		
			(C_F PL 99½ × .650 × 33'-7½)				
16	3-8		PL 99 × .548 ×	33	6 29/32		
			(C_F PL 99½ × .548 × 33'-7½)				
16	3-C		TOP RING ASSY.				
	3-9	16	PL 53⅞ × .446	33	6 29/32		
			(C_F PL 99½ × .446 × 33'-7⅞)				
	3-12	16	PL 49 × 1" ×	33	6 29/32		
			(C_{2F} PL 100 × 1" × 33'-7⅞)				
2	3-1a		PL 99 × 1.39 ×	16	9 15/32		
			(C_{2F} PL 100 × 1.39 × 33'-7⅞)				
2	3-2a		PL 99 × 1 3/16 ×	16	9 15/32		
			(C_{2F} PL 100 × 1 3/16 × 33'-7⅞)				
32	3-13		PL SK × 1¼ (C_W 3-14)			3.1d	
32	3-A		COMPRESSION BAR ASSY.				
	3-14	32	PL SK × 1¼ (C_{6E} PL 97 × 1¼ ×	33	8⅝	3.1d	
			(C_2 ONLY F PL 65⅜ × 1¼ ×	16	10⅞		
	3-15	32	PL 3 × ¼ × (ROLL) FIN.	16	9 15/32	2.1	
			(C_{32F} PL 100 × ¼ × 16'-10)				
1	3-B		SHELL PL & MANWAY ASSEMBLY				
	B36-A	1	24 Ø MANWAY ASSEMBLY (SEE DWG			B36-1X)	
	3-1a	1	PL 99 × 1.39	16	9 15/32	3.1d	

PWHT.

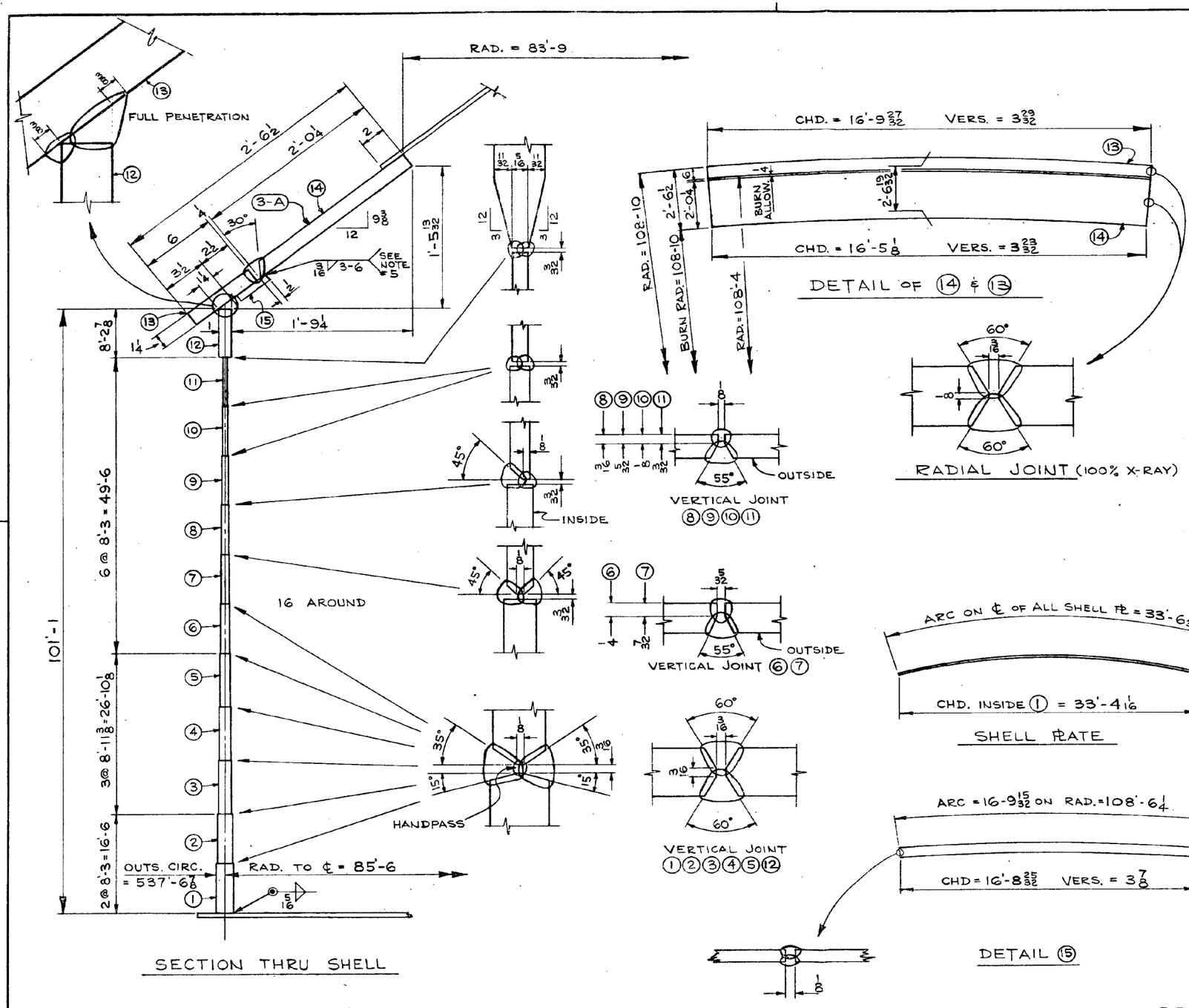
NOTES:
1. SHOP MARK ⅓ POINTS ON OUTS. 11'-2⅜ FROM ENDS OF SHELL PL'S.
2. SEE B.S. #1 FOR COMPLETE MAT'L. SPEC.
3. ALL VERT & GIRTH JOINTS TO BE SPOT X-RAYED PER A.P.I. 620, EXCEPT BOTTOM TO SHELL JOINT WHICH IS TO BE DYE PENETRANT INSPECTED OVER ENTIRE LENGTH.
4. MANUAL WELDS ARE TO BE 8018 C-1.
5. SHOP LEAVE 12" UNWELDED @ EACH END OF COMPRESSION RING SEGMENT. FIELD COMPLETE THE WELD.

FOR ONE TANK ~ ONE REQ'D.

BILLED ON B.S. # 16 & 17 18

REVISIONS		
DECREASE SHELL HT. ADD ASSY 3-B	GNS / RLH	8-3-71

CHICAGO BRIDGE & IRON COMPANY
INNER SHELL
171' Ø PROPANE TANK
PETROLANE INC.
PROVIDENCE, R.I.
DRAWN BY CMS DATE 6-1-71
CHECKED BY GNS DATE 8-2-71
H.H. JOHNSON, ENGINEERING COORDINATOR
CONTRACT NO. 71-2076
DWG NO. 3 REV. 1



SHOP PC.	MARK	ASSM. PC.	DESCRIPTION	LENGTH FT.	LENGTH IN.	SPEC.	WT.
15	3 – 1		℞ 99 x 1.39 x	33	6 29/32	3.1d	
			(C_F ℞ 100 x 1.39 x 33'-7 7/8)				
15	3 - 2		℞ 99 x 1 3/16 x	33	6 29/32		
			(C_F ℞ 100 x 1 3/16 x 33'-7 7/8)				
16	3 - 3		℞ 107 3/8 x 1.086 x	33	6 29/32		
			(C_F ℞ 108 3/8 x 1.086 x 33'-7 7/8)				
16	3 - 4		℞ 107 3/8 x .975 x	33	6 29/32		
			(C_F ℞ 108 3/8 x .975 x 33'-7 7/8)				
16	3 - 5		℞ 107 3/8 x .864 x	33	6 29/32		
			(C_F ℞ 108 3/8 x .864 x 33'-7 7/8)				
16	3 - 6		℞ 99 x 3/4 x	33	6 29/32		
			(C_F ℞ 99 3/4 x 3/4 x 33'-7½)				
16	3 - 7		℞ 99 x .650 x	33	6 29/32		
			(C_F ℞ 99½ x .650 x 33'-7½)				
16	3 - 8		℞ 99 x .548 x	33	6 29/32		
			(C_F ℞ 99½ x .548 x 33'-7½)				
16	3 - 9		℞ 99 x .446 x	33	6 29/32		
			(C_F ℞ 99½ x .446 x 33'-7 3/8)				
16	3 - 10		℞ 99 x 11/32 x	33	6 29/32		
			(C_F ℞ 99½ x 11/32 x 33'-7 3/8)				
16	3 - 11		℞ 99 x 5/16 x	33	6 29/32		
			(C_F ℞ 99 3/8 x 5/16 x 33'-7 3/8)				
16	3 - 12		℞ 98 7/8 x 1" x	33	6 29/32		
			(C_F ℞ 100 x 1" x 33'-7 3/8)				
2	3 - 1a		℞ 99 x 1.39 x	16	9 15/32		
			(C_2F ℞ 100 x 1.39 x 33'-7 7/8)				
2	3 - 2a		℞ 99 x 1 3/16 x	16	9 15/32		
			(C_2F ℞ 100 x 1 3/16 x 33'-7 7/8)				
32	3 - 13		℞ SK x 1¼ (C_W 3-14)			3.1d	
32	3 - A		COMPRESSION BAR ASSY.				
	3 - 14	32	℞ SK x 1¼ (C_6F ℞ 97 x 1¼ x	33	8 5/8	3.1d	
			(C_2 ONLY F ℞ 65 3/8 x 1¼ x	16	10 5/8		
	3 - 15	32	℞ 3 x ¼ x (ROLL) FIN.	16	9 15/32	2.1	
			(C_32F ℞ 100 x ¼ x 16'-10)				

NOTES:
1. SHOP MARK ⅓ POINTS ON OUTS. 11'-2⅜ FROM ENDS OF SHELL ℞'S.
2. SEE B.S. #1 FOR COMPLETE MAT'L. SPEC.
3. ALL VERT. JOINTS IN RINGS 1 THRU 10 ARE TO BE 100% X-RAYED. ALL VERT. TO GIRTH INTERSECTIONS IN RINGS 1 THRU 10 INCLUDING 10 TO 11 RING GIRTH JOINT ARE TO BE X-RAYED FOR A MIN. DISTANCE OF 3" EACH SIDE OF THE INTERSECTION. THE REMAINDER OF THE VERT. & GIRTH JOINTS TO BE SPOT X-RAYED PER A.P.I. 620, EXCEPT BOTTOM TO SHELL JOINT WHICH IS TO BE DYE PENETRANT INSPECTED OVER ENTIRE LENGTH.
4. MANUAL WELDS ARE TO BE 8018 C-1.
5. SHOP LEAVE 12" UNWELDED @ EACH END OF COMPRESSION RING SEGMENT. FIELD COMPLETE THE WELD.

FOR ONE TANK ~ ONE REQ'D.

BILLED ON B.S. # 16 & 17 18

REMARKS | BY | CHKD | DATE | REVISIONS

CHICAGO BRIDGE & IRON COMPANY

INNER SHELL

171'℄ PROPANE TANK
PETROLANE INC.
PROVIDENCE, R.I.

PURCHASER'S NO. CONTRACT NO. 71-2076
DRAWN BY CMS DATE 6-1-71
CHECKED BY SMS DATE
ENGINEERING COORDINATOR
DWG NO. 3 REV 0

PLANT NORTH

1053'-1 7/16"

428'-0"

5'-0"

10'-0"

FIELDS POINT DRIVE

FLARE STACK

133'-0"

61'-0"

115'-0"

5'-0"

100'-0"

100'-0"

℄ OF 15'-0 ROADWAY

H-1

BALLAST

E-3

E-2

V-1

WALKWAYS

DOORLEDGE

20'-0" WIDE ROADWAY.

25'-0

COMPRESSOR & CONTROL BLDG.

55'-0"

25'-0"

50'-0"

12

12

TRUCK LOADING STATIONS.

15' WIDE ROADWAY.

PARKING AREA

30'-0"

15' WIDE ROADWAY.

POWER & GAS STATION

18'-0"

UNDERGROUND FEEDS.

60'-0"

20'-0" WIDE ROADWAY.

5'-0"

℄ OF ROADWAY.

635'-0"

962'-7 13/16"

155'-0"

100'-0"

65'-0"

168'-0"

℄ FLARE STACK.

SEA VIEW DRIVE

℄ TANK

ROOF RAFTERS

WALKWAY

250'-0" ⌀

175'-0" ⌀

E-1

PRODUCT PUMPS

START OF SPIRAL STAIRWAY ON DIKE

START OF STAIRWAY ON TANK.

INLET LINE.

440'-10 7/16"

200'-0"

SCALE 1"=40'-0"

NOTES

⊕ - HYDRANT

■ - 30# DRY CHEMICAL

BY	CHKD	DATE	REMARKS
C.M.M.	E.P.L.	4/7/71	ADDED LOCATION OF SUB-STATION
C.M.M.	E.P.L.	4/7/71	CHANGED ROADWAY & LOADING STATIONS
C.M.M.	E.P.L.	5/10/71	GENERAL

REVISIONS

CHICAGO BRIDGE & IRON COMPANY

PRELIMINARY PLOT PLAN

PETROLANE INC.

PROVIDENCE RHODE ISLAND

PURCHASER'S NO.

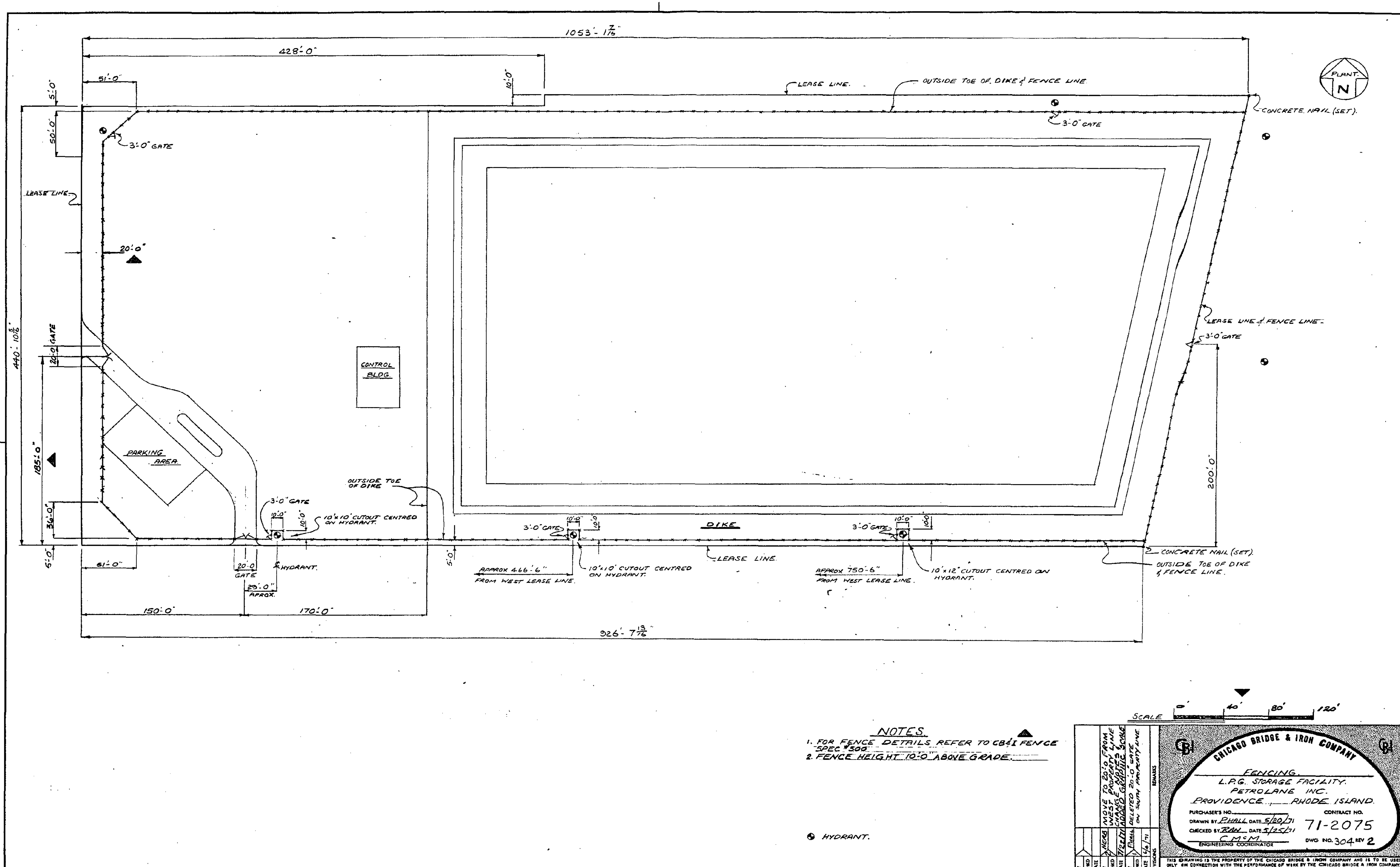
CONTRACT NO. 71-2075

DRAWN BY RAH DATE 4-6-71

CHECKED BY WJP DATE 4-6-71

C.M.M. ENGINEERING COORDINATOR

DWG NO. P1 REV 3


1053'-1 7/16"
428'-0"
51'-0"
10'-0"
5'-0"
50'-0"
LEASE LINE.
OUTSIDE TOE OF DIKE & FENCE LINE
CONCRETE NAIL (SET).
3'-0" GATE
PLANT N
LEASE LINE
20'-0"
440'-10 5/16"
20'-0" GATE
185'-0"
LEASE LINE & FENCE LINE
3'-0" GATE
CONTROL BLDG.
PARKING AREA
200'-0"
OUTSIDE TOE OF DIKE
3'-0" GATE
10'-0"
10'x10' CUTOUT CENTRED ON HYDRANT.
36'-0"
3'-0" GATE
DIKE
CONCRETE NAIL (SET).
OUTSIDE TOE OF DIKE & FENCE LINE.
5'-0"
61'-0"
20'-0" GATE
℄ HYDRANT.
25'-0" APPROX.
APPROX 466'-6" FROM WEST LEASE LINE.
10'x10' CUTOUT CENTRED ON HYDRANT.
LEASE LINE.
APPROX 750'-6" FROM WEST LEASE LINE.
10'x12' CUTOUT CENTRED ON HYDRANT.
150'-0"
170'-0"
926'-7 13/16"
SCALE 0' 40' 80' 120'
NOTES
1. FOR FENCE DETAILS REFER TO CB&I FENCE SPEC #500
2. FENCE HEIGHT 10'-0" ABOVE GRADE.
HYDRANT.
MOVE TO 20'-0 FROM WEST PROPERTY LINE
CHANGE NAMING & ADDED GRAPHIC SCALE
DELETED 20'-0 GATE ON SOUTH PROPERTY LINE
REMARKS
REVISIONS
CHICAGO BRIDGE & IRON COMPANY
FENCING
L.P.G. STORAGE FACILITY
PETROLANE INC.
PROVIDENCE, RHODE ISLAND.
PURCHASER'S NO.
CONTRACT NO. 71-2075
DRAWN BY P.HALL DATE 5/20/71
CHECKED BY RAH DATE 5/25/71
C.McM. ENGINEERING COORDINATOR
DWG NO. 304 REV 2
THIS DRAWING IS THE PROPERTY OF THE CHICAGO BRIDGE & IRON COMPANY AND IS TO BE USED ONLY IN CONNECTION WITH THE PERFORMANCE OF WORK BY THE CHICAGO BRIDGE & IRON COMPANY. REPRODUCTION IN WHOLE OR IN PART FOR ANY OTHER PURPOSE IS EXPRESSLY FORBIDDEN.

CHICAGO BRIDGE & IRON COMPANY
WELDING PROCEDURE SPECIFICATIONS
CONTRACT 71-2075/53
Double Wall Liquid Propane Tank
Storage and Terminal Facilities
Petrolane, Inc.
Providence, Rhode Island
(OUTER TANK)

PART I GENERAL

1. PROCESS:

The welding shall be accomplished by the Shielded Metal Arc and Submerged Arc Processes.

2. BASE METAL, FILLER METAL AND WELDING SPECIFICATION NUMBERS:

The base metal and filler metal shall be in accordance with the Table.

Base Metal	Filler Metal	CB&I Specification Number
SA283 Gr.C Together (ASME p-1)	E6010	198
	E6012	1142
	Linde 29 w/GR80 Flux	876
SA131 Gr. B Together (ASME p-1)	E6010	198
	E6012	1142
SA36 Together (ASME p-1)	E6010	198

3. POSITION:

The welding shall be performed in the Vertical, Horizontal, Overhead, and Downflat positions.

4. PREPARATION OF BASE METAL:

The edges or surfaces of parts to be joined by welding shall be prepared by chipping, grinding, shearing, flame burning, and/or arc-gouging.

5. WELDING TECHNIQUE AND CURRENT:

The welding technique such as electrode sizes, mean voltages, currents, etc., shall be substantially as shown on the attached sketches and data sheets.

(OUTER TANK)

6. CLEANING AND DEFECTS:

All slag or flux remaining on any bead of welding shall be removed before depositing the next successive bead of welding. Any defects that appear on any bead of welding shall be removed by chipping, grinding or arc gouging before depositing the next successive bead of welding.

7. PEENING:

In general, light peening shall be used as an aid to cleaning the weld beads.

8. TREATMENT OF BACKSIDE OF WELDING GROOVE:

None required.

9. PREHEAT:

None required.

10. POST WELD HEAT TREATMENT:

None required.

11. INSPECTION OF WELDS:

Inspection of welds shall be in accordance with special instructions issued by the Engineering Department of Chicago Bridge & Iron Company.

TENTATIVE-REVIEW REQUIRED

CHICAGO BRIDGE AND IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 198 DATE September 6, 1960

WELDING PROCESS Shielded Metal Arc MANUAL OR MACHINE Manual

MATERIAL SPECIFICATION A283-C

FLUX OR ATMOSPHERE

ASME P-NO. 1 TO ASME P-NO. 1 FLUX TRADE NAME OR COMPOSITION

THICKNESS (IF PIPE, DIA. AND WALL THICK.) 3/8" INERT GAS COMPOSITION

THICKNESS RANGE THIS TEST QUALIFIES 3/16" to 3/4" TRADE NAME FLOW RATE

FILLER METAL GROUP NO. F 3 IS BACKING STRIP USED? No

WELD METAL ANALYSIS NO. A 1 PREHEAT TEMPERATURE RANGE None

ASTM SPECIFICATION NO. A233 (SFA5.1) POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Overhead & Down

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE E6010 FILLER WIRE DIAMETER 5/32", 3/16"

TYPE OF BACKING None WELDING CURRENT D.C. Reverse Polarity

CONSULT PART III NON-ESSENTIAL VARIABLES FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
OD-1	0.740	0.328	0.2426	16,220	66,860	Ductile in Plate
OD-2	0.709	0.296	0.2098	13,660	65,110	Ductile in Plate

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
4 Side Bends	O.K.		

WELDER'S NAME Charles Neal SOCIAL SECURITY NO. 336-07-8359 WELDER'S SYMBOL

WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURER) DATE Sept. 6, 1960

LABORATORY TEST NO. 198 BY John Buzek

REMARKS:

WL 20D REV 4-66

TENTATIVE-REVIEW REQUIRED

CHICAGO BRIDGE AND IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 198 DATE September 6, 1960

WELDING PROCESS Shielded Metal Arc MANUAL OR MACHINE Manual

MATERIAL SPECIFICATION A283 Gr-C

FLUX OR ATMOSPHERE

ASME P-NO. 1 TO ASME P-NO. 1 FLUX TRADE NAME OR COMPOSITION

THICKNESS (IF PIPE, DIA. AND WALL THICK.) 3/8" INERT GAS COMPOSITION

THICKNESS RANGE THIS TEST QUALIFIES 3/16" to 3/4" TRADE NAME FLOW RATE

FILLER METAL GROUP NO. F 3 IS BACKING STRIP USED? No

WELD METAL ANALYSIS NO. A 1 PREHEAT TEMPERATURE RANGE None

ASTM SPECIFICATION NO. A233 (SFA5.1) POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Horizontal

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE E6010 FILLER WIRE DIAMETER 5/32", 3/16"

TYPE OF BACKING None WELDING CURRENT D.C. Reverse Polarity

CONSULT **PART III NON-ESSENTIAL VARIABLES** FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
H-1	0.725	0.345	0.2501	17,730	70,890	Ductile in Plate
H-2	0.775	0.323	0.2503	18,020	71,990	Ductile in Plate

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
4 Side Bends	O.K.		

WELDER'S NAME Charles Neal SOCIAL SECURITY NO. 336-07-8359 WELDER'S SYMBOL

WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURERS) DATE Sept. 6, 1960

LABORATORY TEST NO. 198 BY John Buzek John Buzek

REMARKS:

TENTATIVE-REVIEW REQUIRED

CHICAGO BRIDGE AND IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 198 — DATE September 6, 1960

WELDING PROCESS Shielded Metal Arc — MANUAL OR MACHINE Manual

MATERIAL SPECIFICATION A283-C

FLUX OR ATMOSPHERE

ASME P.NO. 1 TO ASME P.NO. 1 — FLUX TRADE NAME OR COMPOSITION

THICKNESS (IF PIPE, DIA. AND WALL THICK.) 3/8" — INERT GAS COMPOSITION

THICKNESS RANGE THIS TEST QUALIFIES 3/16" to 3/4" — TRADE NAME — FLOW RATE

FILLER METAL GROUP NO. F 3 — IS BACKING STRIP USED? No

WELD METAL ANALYSIS NO. A 1 — PREHEAT TEMPERATURE RANGE None

ASTM SPECIFICATION NO. A233 (SFA5.1) — POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple — SINGLE OR MULTIPLE ARC Single — POSITION OF GROOVE Vertical

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE E6010 — FILLER WIRE DIAMETER 3/16", 5/32"

TYPE OF BACKING None — WELDING CURRENT D.C. Reverse Polarity

CONSULT PART III NON-ESSENTIAL VARIABLES FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
V-1	0.751	0.322	0.2418	16,300	67,410	Ductile in Plate
V-2	0.717	0.328	0.2351	15,760	67,040	Ductile in Plate

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
4 Side Bends	O.K.		

WELDER'S NAME Charles Neal — SOCIAL SECURITY NO. 336-07-8359 — WELDER'S SYMBOL

WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURERS) DATE Sept. 6, 1960

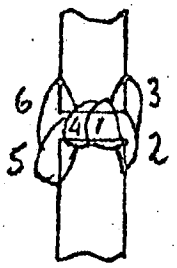
LABORATORY TEST NO. 198 — BY John Buzek John Buzek

REMARKS:

TENTATIVE-REVIEW REQUIRED

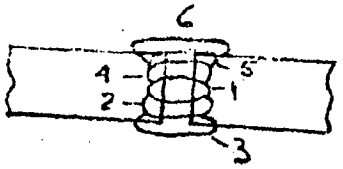
CHICAGO BRIDGE AND IRON COMPANY
WELDING PROCEDURE SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART III NON-ESSENTIAL VARIABLES



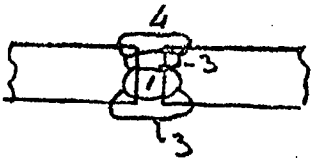
HORIZONTAL

	LAYER NUMBER	WIRE SIZE	AMPS	B.O.Rate xxxxx Sec/12"
	1,2,4,5	3/16	155-205	68-78
	3,6	3/16	140-190	73-83



VERTICAL

	LAYER NUMBER	WIRE SIZE	AMPS	B.O.Rate xxxxx Sec/12"
	1	5/32	130-170	50-60
	2,3	3/16	150-200	70-80
	4	5/32	130-170	50-60
	5,6	3/16	150-200	70-80



OVERHEAD & DOWN

	LAYER NUMBER	WIRE SIZE	AMPS	B.O.Rate xxxxx Sec/12"
	1	5/32	130-170	50-60
	2	3/16	150-200	70-80
	3	5/32	130-170	50-60
	4	3/16	150-200	70-80

TENTATIVE-REVIEW REQUIRED

Specification No. 198
Date Sept. 6, 1960

CHICAGO BRIDGE & IRON COMPANY
By John Buzek

CHICAGO BRIDGE AND IRON COMPANY
RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 1142 — DATE May 29, 1970
WELDING PROCESS Shielded Metal Arc — MANUAL OR MACHINE Manual
MATERIAL SPECIFICATION A283 C to 283C
ASME P-NO. P1 — TO ASME P-NO. P1
THICKNESS (IF PIPE, O.A. AND WALL THICK.) 3/8"
THICKNESS RANGE THIS TEST QUALIFIES 3/16"to 3/4"
FILLER METAL GROUP NO. F 2
WELD METAL ANALYSIS NO. A 1
ASTM SPECIFICATION NO A233 (SFA5.1)

FLUX OR ATMOSPHERE

FLUX TRADE NAME OR COMPOSITION -
INERT GAS COMPOSITION -
TRADE NAME - FLOW RATE -
IS BACKING STRIP USED? No
PREHEAT TEMPERATURE RANGE None
POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple — SINGLE OR MULTIPLE ARC Single — POSITION OF GROOVE Downflat

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE 6012 — FILLER WIRE DIAMETER 7/32ϕ
TYPE OF BACKING None — WELDING CURRENT D.C. Straight Polarity

CONSULT **PART III NON-ESSENTIAL VARIABLES** FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
1142-A	1.00"	.4"	.400	27,700	69,400	Base Metal
1142-B	1.010"	.4"	.404	27,800	69,000	Base Metal

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
4 Side	O.K.		

WELDER'S NAME C. Westfall — SOCIAL SECURITY NO. 316-52-6278 — WELDER'S SYMBOL
WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

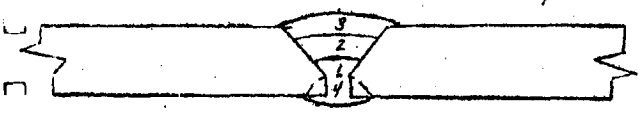
SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURERS) DATE 6-29-70
BY Louis Smith

LABORATORY TEST NO. 243 C
REMARKS: Tested by J. G. Silvester and Assoc.

TENTATIVE-REVIEW REQUIRED

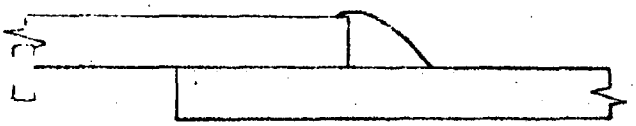
CHICAGO BRIDGE AND IRON COMPANY
WELDING PROCEDURE SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART III NON-ESSENTIAL VARIABLES



BUTT WELD

	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
	1	3/16"ø	200-210	20-22
	2 & 3	3/16"ø	222-240	20-22



LAP WELD

B.O. Rate Sec/12"	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
40-45	ALL	1/4"ø	250-350	24-26

	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS

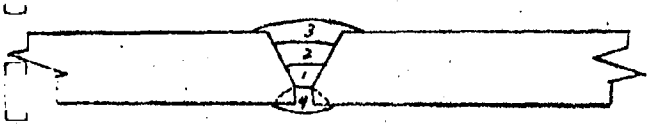
TENTATIVE-REVIEW REQUIRED

Specification No. 1142
Date 5/29/70
WI 10A

CHICAGO BRIDGE & IRON COMPANY
By Louis Smith

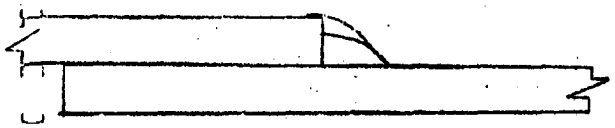
CHICAGO BRIDGE AND IRON COMPANY
WELDING PROCEDURE SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART III NON-ESSENTIAL VARIABLES



BUTT WELD

B.O. Rate Sec/12"	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
40-45	ALL	7/32"ϕ	230-300	24-26



LAP WELD

B.O.Rate Sec/12"	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
40-45	ALL	1/4"ϕ	250-350	24-26

	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS

TENTATIVE REVIEW REQUIRED

Specification No. 1142
Date 5/29/70

CHICAGO BRIDGE & IRON COMPANY
By Lorin Smith

CONTRACT 71-2075/76

CHICAGO BRIDGE AND IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 876 DATE October 4, 1968

WELDING PROCESS Submerged Metal Arc MANUAL OR MACHINE Machine

MATERIAL SPECIFICATION A285 to A285

FLUX OR ATMOSPHERE

ASME P-NO. 1 TO ASME P-NO. 1 FLUX TRADE NAME OR COMPOSITION Linde Grade 80

THICKNESS (IF PIPE, DIA. AND WALL THICK.) 3/4" INERT GAS COMPOSITION -

THICKNESS RANGE THIS TEST QUALIFIES 3/16" to 1½" TRADE NAME - FLOW RATE -

FILLER METAL GROUP NO. F 6 IS BACKING STRIP USED? No

WELD METAL ANALYSIS NO. A 1 PREHEAT TEMPERATURE RANGE None

ASTM SPECIFICATION NO. A558 (SFA5.1) POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Horizontal

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE Linde #29 FILLER WIRE DIAMETER 3/32"ϕ, 1/8"ϕ

TYPE OF BACKING None WELDING CURRENT D.C. Reversed Polarity

CONSULT PART III NON-ESSENTIAL VARIABLES FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
585-H-1	.696	1.500	1.044	67,700	68,846	Ductile in plate
585-H-2	.695	1.501	1.043	66,800	64,046	Ductile in plate

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
4 Side Bends	OK		

WELDER'S NAME W. R. Vincent SOCIAL SECURITY NO. 334-12-0340 WELDER'S SYMBOL

WAS BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURER) DATE 10-8-68

LABORATORY TEST NO. BY Alan L Dahlberg Alan L. Dahlberg

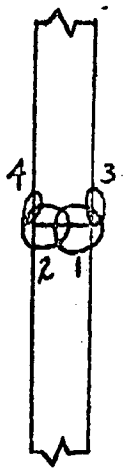
REMARKS:

20D REV 4-66

TENTATIVE-REVIEW REQUIRED

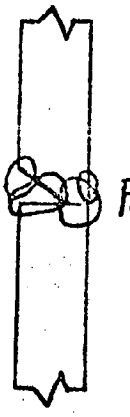
CHICAGO BRIDGE AND IRON COMPANY
WELDING PROCEDURE SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART III NON-ESSENTIAL VARIABLES



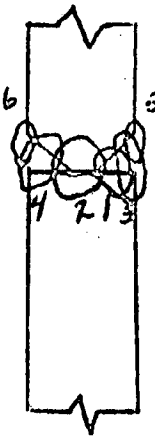
R 3/16" THRU 11/32"

Travel IPM	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
18-22	1,2	3/32"ϕ	400-440	26-28
25-30	3,4	3/32"ϕ	360-400	26-28



R 3/8" THRU 1/2"

Travel IPM	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
25-40	All	3/32"ϕ	400-500	26-28



R 17/32" AND OVER

Travel IPM	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
16-20 28-32	1 3	3/32"ϕ	400-500	26-28
16-20 28-32	2 4	1/8"ϕ	490-600	26-28
38-42	5	3/32"ϕ	320-400	24-28
38-42	6	1/8"ϕ	320-400	24-28

TENTATIVE-REVIEW REQUIRED

Specification No. 876
Date October 8, 1968

CHICAGO BRIDGE & IRON COMPANY
By Alan L Dahlberg

CHICAGO BRIDGE & IRON COMPANY

WELDING PROCEDURE SPECIFICATIONS
CONTRACT 71-2075/76
Double Wall Liquid Propane Tank
Storage and Terminal Facilities
Petrolane, Inc.
Providence, Rhode Island
(INNER TANK)

PART I GENERAL

1. PROCESS:

The welding shall be accomplished by the Shielded Metal Arc and Submerged Arc Process.

2. BASE METAL, FILLER METAL AND WELDING SPECIFICATION NUMBERS:

The base metal and filler metal shall be in accordance with the Table.

Base Metal	Filler Metal	CB&I Specification Number
SA537B SA537A SA516 Gr 60 SA131 Gr B SA36 (ASME P-1)	E8018 C1	744
	Speedalloy 75 w/Linde 80 flux	413
SA537A to SA240 Type 304 (ASME P-1 to P-8)	E309	914

3. POSITION:

The welding shall be performed in the Vertical, Horizontal, Overhead and Downflat Positions.

4. PREPARATION OF BASE METAL:

The edges or surfaces of parts to be joined by welding shall be prepared by chipping, grinding, flame burning, shearing, and/or arc gouging.

5. WELDING TECHNIQUE AND CURRENT:

The welding technique such as electrode sizes, meam voltages. currents, etc., shall be substantially as shown on the attached sketches and data sheets.

6. CLEANING AND DEFECTS:

All slag or flux remaining on any bead of welding shall be removed before depositing the next successive bead of welding. Any defects that appear on any bead of welding shall be removed by chipping, grinding or arc gouging before depositing the next successive bead of welding.

7. PEENING:

In general, light peening shall be used as an aid to cleaning the weld beads.

8. TREATMENT OF BACKSIDE OF WELDING GROOVE:

When the shielded metal arc process is utilized, in order to obtain complete fusion the backside of all double butt welded joints shall be prepared by chipping, grinding, and/or arc gouging to clean sound metal.

No treatment of the backside of the weld joint is required to obtain complete fusion when the submerged arc process is used.

9. PREHEAT:

No preheat other than to the extent necessary to drive surface moisture from the area to be welded is required.

10. POST WELD HEAT TREATMENT:

None required.

11. INSPECTION OF WELDS:

Inspection of welds shall be in accordance with special instructions issued by the Engineering Department of Chicago Bridge & Iron Company.

CHICAGO BRIDGE & IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

A537A

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 744-V — DATE September 6, 1967

WELDING PROCESS Shielded Metal Arc — MANUAL Manual

MATERIAL SPECIFICATION A537A — PREHEAT TEMPERATURE RANGE None

ASME P-NO. Similar P-1 TO ASME P-NO. Similar P-1 — POSTHEAT TREATMENT None

THICKNESS (IF PIPE, DIA. AND WALL THICK.) .970

THICKNESS RANGE THIS TEST QUALIFIES .1875" to 1.940"

FILLER METAL GROUP NO. F 4

WELD METAL ANALYSIS NO. A 3

ASTM SPECIFICATION NO. A316 (SFA5.5)

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple — SINGLE OR MULTIPLE ARC Single — POSITION OF GROOVE Vertical

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE E8018 C1 — FILLER WIRE DIAMETER 1/8" Ø

TYPE OF BACKING None — WELDING CURRENT D. C. Reverse Polarity

CONSULT PART III NON-ESSENTIAL VARIABLES FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
896-B-V-1	.812	1.439	1.168	94,400	80,821	Plate
B-V-2	.824	1.439	1.185	95,300	80,421	Plate

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
4 Side Bends	All OK		

WELDER'S NAME Marston Westfall — SOCIAL SECURITY NO. 334-24-1731 — WELDER'S SYMBOL

WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

Signed CHICAGO BRIDGE & IRON CO. DATE 9/6/67

LABORATORY TEST NO. 896A — BY Victor M. Yarbrough

REMARKS:

Full Size Charpy Vee Notch Impact Results at -60°F
H.A.Z. 95, 36, 24 ft-lbs.
W.M. 30, 34, 31 ft-lbs.

TENTATIVE REVIEW REQUIRED

CHICAGO BRIDGE & IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 744-H — DATE September 6, 1967

WELDING PROCESS Shielded Metal Arc — MANUAL Manual

MATERIAL SPECIFICATION A537A — PREHEAT TEMPERATURE RANGE None

ASME P-NO. Similar P-1 TO ASME P-NO. Similar P-1 — POSTHEAT TREATMENT None

THICKNESS (IF PIPE, DIA. AND WALL THICK.) .970

THICKNESS RANGE THIS TEST QUALIFIES .1875" to 1.940"

FILLER METAL GROUP NO. F 4

WELD METAL ANALYSIS NO. A 3

ASTM SPECIFICATION NO. A316 (SFA5.5)

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple — SINGLE OR MULTIPLE ARC Single — POSITION OF GROOVE Horizontal

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE E8018-C1 — FILLER WIRE DIAMETER 5/32"Ø & 3/16"Ø

TYPE OF BACKING None — WELDING CURRENT D. C. Reverse Polarity

CONSULT PART III NON-ESSENTIAL VARIABLES FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
896-B-H-1	.881	1.346	1.185	93,800	79,156	Plate
896-B-H-2	.880	1.339	1.178	94,300	80,050	Plate

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
4 Side Bends	All OK		

WELDER'S NAME Marston Westfall — SOCIAL SECURITY NO. 334-24-1731 — WELDER'S SYMBOL _____

WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

I CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

Signed CHICAGO BRIDGE & IRON CO. — DATE 9/6/67

LABORATORY TEST NO. 896B — BY Victor M. Yarbrough

REMARKS:

Full Size Charpy Vee Notch Impace Results @ -60°F
H.A.Z. 21, 27, 25 ft-lbs.
W. M. 74, 66, 91 ft-lbs.

TENTATIVE PETTER REQUIRED

CHICAGO BRIDGE & IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 744-OH — DATE September 6, 1967

WELDING PROCESS Shielded Metal Arc — MANUAL Manual

MATERIAL SPECIFICATION A537A — PREHEAT TEMPERATURE RANGE None

ASME P-NO. Similar P-1 TO ASME P-NO. Similar P-1 — POSTHEAT TREATMENT None

THICKNESS (IF PIPE, DIA. AND WALL THICK.) .970

THICKNESS RANGE THIS TEST QUALIFIES .1875" to 1.940

FILLER METAL GROUP NO. F 4

WELD METAL ANALYSIS NO. A 3

ASTM SPECIFICATION NO. A316 (SFA5.5)

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple — SINGLE OR MULTIPLE ARC Single — POSITION OF GROOVE Overhead & Down

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE E8018C1 — FILLER WIRE DIAMETER 1/8"Ø, 5/32"Ø, 3/16"Ø

TYPE OF BACKING None — WELDING CURRENT D. C. Reverse Polarity

CONSULT **PART III NON-ESSENTIAL VARIABLES** FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD,LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
896-OH-1	.828	1.489	1.232	101,300	82,224	Plate
896-OH-2	.827	1.487	1.229	102,100	83,075	Plate

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
4 Side Bends	All OK		

WELDER'S NAME Marston Westfall — SOCIAL SECURITY NO. 334-24-1731 — WELDER'S SYMBOL

WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

Signed CHICAGO BRIDGE & IRON CO. DATE 9/6/67

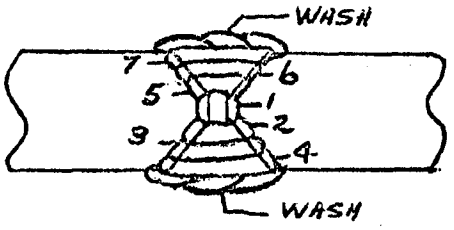
LABORATORY TEST NO. 896B — BY Victor M. Yarbrough

REMARKS:

Full Size Charpy Vee Notch Impact Results @ -60°F
W.M. 77, 69, 77 ft-lbs.
H.A.Z. 93, 79, 113 ft-lbs.

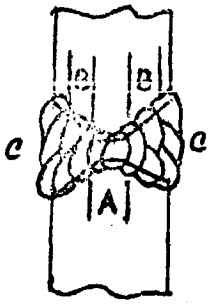
CHICAGO BRIDGE & IRON COMPANY
WELDING PROCEDURE SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART III NON-ESSENTIAL VARIABLES



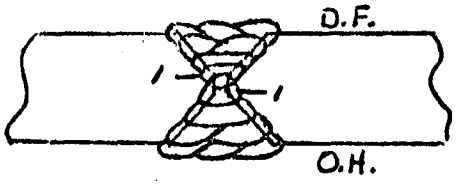
Vertical

	LAYER NUMBER	WIRE SIZE	AMPS	B.O.Rate Sec/12" VOLTS
Downhill	1	1/8"Ø	120-160	60-65
Uphill	2 thru 7	1/8"Ø	120-160	60-65
Downhill	wash	1/8"Ø	120-160	60-65



Horizontal

Both Sides	LAYER NUMBER	WIRE SIZE	AMPS	B.O.Rate Sec/12" VOLTS
Stringer	A	5/32"Ø	140-200	60-72
"	B	3/16"Ø	200-300	55-65
"	C	5/32"Ø	140-200	60-72



Overhead and Downflat

	LAYER NUMBER	WIRE SIZE	AMPS	B.O.Rate Sec/12" VOLTS
O.H.	1	1/8"Ø	120-160	60-65
O.H.	remainder	5/32"Ø	140-200	60-70
D.F.	1	5/32"Ø	140-200	55-65
D.F.	remainder	3/16"Ø	200-300	60-70

TENTATIVE REVIEW REQUIRED

Specification No. 744
Date 9/6/67
20Y REV 8-67

Signed CHICAGO BRIDGE & IRON CO.
By Victor M. Yarbrough

CHICAGO BRIDGE AND IRON COMPANY
RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 413 DATE August 11, 1964
WELDING PROCESS Submerged Arc MANUAL OR MACHINE Machine
MATERIAL SPECIFICATION Char-Pac(N) TO Char-Pac(N)
ASME P-NO. Similar P-1 TO ASME P-NO. Similar P-1
THICKNESS (IF PIPE, DIA. AND WALL THICK.) 1/2"
THICKNESS RANGE THIS TEST QUALIFIES 3/16" to 1"
FILLER METAL GROUP NO. F
WELD METAL ANALYSIS NO. A
ASTM SPECIFICATION NO.

FLUX OR ATMOSPHERE

FLUX TRADE NAME OR COMPOSITION Linde Grade 80
INERT GAS COMPOSITION -
TRADE NAME Linde FLOW RATE -
IS BACKING STRIP USED? No
PREHEAT TEMPERATURE RANGE None
POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Horizontal

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE Speedalloy 60* FILLER WIRE DIAMETER 7/64"ϕ
TYPE OF BACKING None WELDING CURRENT DC, Reverse Polarity

CONSULT PART III NON-ESSENTIAL VARIABLES FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
413-H-1	1.200	.406	.486	44,100	90,400	Ductile in plate
413-H-2	1.197	.406	.486	43,700	90,000	Ductile in plate

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
4 Side Bends	OK		

WELDER'S NAME R. E. Vincent SOCIAL SECURITY NO. 334-12-0340 WELDER'S SYMBOL
WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

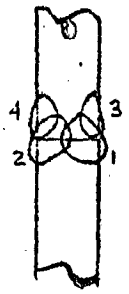
I CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURERS) DATE 8-11-64
BY A. N. Randall A. N. Randall

LABORATORY - TEST NO. 413-H
REMARKS: *Speedalloy 60 now designated Speedalloy 75 (Effective 4-23-65)

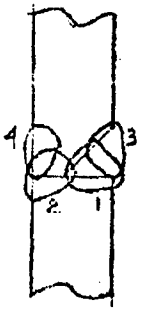
CHICAGO BRIDGE AND IRON COMPANY
WELDING PROCEDURE SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART III NON-ESSENTIAL VARIABLES



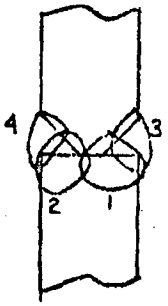
SQUARE BUTT

Travel in/min.	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
18-22	1,2	7/64"ϕ	400-440	26-28
25-30	3,4	7/64"ϕ	360-400	26-28



SINGLE BEVEL

Travel in/min.	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
16-20	1,2	7/64"ϕ	420-440	28-30
26-30	3,4	7/64"ϕ	390-410	28-30



DOUBLE BEVEL

Travel in/min.	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
18-20	1,2	7/64"ϕ	450-500	26-30
18-20	3,4	7/64"ϕ	400-420	28-30

TENTATIVE REVIEW REQUIRED

Specification No. 413
Date August 11, 1964

CHICAGO BRIDGE & IRON COMPANY
By C. F. Randall

WL 20A

CHICAGO BRIDGE AND IRON COMPANY
WELDING PROCEDURE SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART III NON-ESSENTIAL VARIABLES

IMPACT TEST RESULTS

Charpy Vee Notch impact tests were conducted upon the weld metal and heat affected zones of test plates welded using electrodes and procedures as set forth in Part I and Part II of this Welding Procedure Qualification Specification (Specification No. 413). The results of the tests are tabulated below:

Material	Char Pac (Norm)
Heat No.	851833 Slab No. 5-1A
Plate Thickness	1/2 inch
Specimen Size	Full Size
Specimen Type	Vee Notch
Test Temperature	Minus 60°F (-60°F)

WO 819

Results in ft.lbs.:

Weld Metal	25, 25, 20
Heat Affected Zone	11, 23, 22

Heat No.	2086 Slab No. 9W1
Plate Thickness	.705 inches
Specimen Size	Full Size
Specimen Type	Vee Notch
Test Temperature	Minus 60°F (-60°F)

WO 990

Results in ft. lbs.:

Weld Metal	23, 15, 20
Heat Affected Zone	14, 21, 17

TENTATIVE REVIEW REQUIRED

Specification No. 413

Date August 11, 1965

CHICAGO BRIDGE & IRON COMPANY

By A. J. Randall

WL 20E REV 10-64

CHICAGO BRIDGE AND IRON COMPANY
RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 914 DATE December 10, 1968
WELDING PROCESS Shielded Metal Arc MANUAL OR MACHINE Manual
MATERIAL SPECIFICATION SA516 Gr 70 to SA240 Gr TP304 **FLUX OR ATMOSPHERE**
ASME P-NO. 1 TO ASME P-NO. 8 FLUX TRADE NAME OR COMPOSITION -
THICKNESS (IF PIPE, DIA. AND WALL THICK.) 3/4" INERT GAS COMPOSITION -
THICKNESS RANGE THIS TEST QUALIFIES 3/16" to 1½" TRADE NAME - FLOW RATE -
FILLER METAL GROUP NO. F 5 IS BACKING STRIP USED? No
WELD METAL ANALYSIS NO. A 7 PREHEAT TEMPERATURE RANGE None
ASTM SPECIFICATION NO. SA298 (SFA5.4) POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Overhead & Down

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE E309 FILLER WIRE DIAMETER 1/8"ϕ & 5/32"ϕ
TYPE OF BACKING None WELDING CURRENT D.C. Reverse Polarity

CONSULT **PART III NON-ESSENTIAL VARIABLES** FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
914-OH-1	1.230	.701	.862	65,850	76,400	Ductile in plate
914-OH-2	1.228	.700	.860	65,500	76,200	" " "

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
2 Longitudinal Root Bends	Satisfactory	2 Longitudinal Face Bends	Satisfactory

WELDER'S NAME Marston Westfall SOCIAL SECURITY NO. 334-24-1731 WELDER'S SYMBOL MW
WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURERS) DATE 12-10-68
LABORATORY TEST NO. 914 BY A. N. Randall A. N. Randall
MARKS

TENTATIVE REVIEW REQUIRED

CHICAGO BRIDGE AND IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 914 DATE December 10, 1968

WELDING PROCESS Shielded Metal Arc MANUAL OR MACHINE Manual

MATERIAL SPECIFICATION SA516 Gr 70 to SA240 Gr TP304

ASME P-NO. 1 TO ASME P-NO. 8

THICKNESS (IF PIPE, DIA. AND WALL THICK.) 3/4"

THICKNESS RANGE THIS TEST QUALIFIES 3/16" to 1½"

FILLER METAL GROUP NO. F 5

WELD METAL ANALYSIS NO. A 7

ASTM SPECIFICATION NO. SA298 (SFA5.4)

FLUX OR ATMOSPHERE

FLUX TRADE NAME OR COMPOSITION -

INERT GAS COMPOSITION -

TRADE NAME - FLOW RATE -

IS BACKING STRIP USED? No

PREHEAT TEMPERATURE RANGE None

POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Horizontal

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE E309 FILLER WIRE DIAMETER 1/8"ϕ & 5/32"ϕ

TYPE OF BACKING None WELDING CURRENT D.C. Reverse Polarity

CONSULT **PART III NON-ESSENTIAL VARIABLES** FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
914-H-1	1.224	.700	.857	65,000	75,900	Ductile in plate
914-H-2	1.226	.701	.859	65,350	76,100	" " "

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
2 Longitudinal Root Bends	Satisfactory	2 Longitudinal Face Bends	Satisfactory

WELDER'S NAME Marston Westfall SOCIAL SECURITY NO. 334-24-1731 WELDER'S SYMBOL MW

WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURERS) DATE 12-10-68

LABORATORY TEST NO. 914 BY A. N. Randall

REMARKS:

TENTATIVE-REVIEW REQUIRED

CHICAGO BRIDGE AND IRON COMPANY
RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 914 DATE December 10, 1968
WELDING PROCESS Shielded Metal Arc MANUAL OR MACHINE Manual
MATERIAL SPECIFICATION SA516 Gr 70 to SA240 Gr TP304 **FLUX OR ATMOSPHERE**
ASME P-NO. 1 TO ASME P-NO. 8 FLUX TRADE NAME OR COMPOSITION -
THICKNESS (IF PIPE, DIA. AND WALL THICK.) 3/4" INERT GAS COMPOSITION -
THICKNESS RANGE THIS TEST QUALIFIES 3/16" to 1½" TRADE NAME - FLOW RATE -
FILLER METAL GROUP NO. F 5 IS BACKING STRIP USED? No
WELD METAL ANALYSIS NO. A 7 PREHEAT TEMPERATURE RANGE None
ASTM SPECIFICATION NO. SA298 (SFA5.4) POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Vertical

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE E309 FILLER WIRE DIAMETER 1/8"ϕ & 5/32"ϕ
TYPE OF BACKING None WELDING CURRENT D.C. Reverse Polarity

CONSULT **PART III NON-ESSENTIAL VARIABLES** FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
914-V-1	1.222	.701	.857	65,500	76,400	Ductile in plate
914-V-2	1.220	.698	.852	65,200	76,550	" " "

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
2 Longitudinal Root Bends	Satisfactory	2 Longitudinal Face Bends	Satisfactory

WELDER'S NAME Marston Westfall SOCIAL SECURITY NO. 334-24-1731 WELDER'S SYMBOL MW
WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

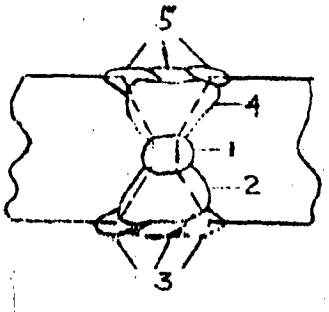
WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURER) DATE 12-10-68
LABORATORY TEST NO. 914 BY A.N.Randall
REMARKS:

TENTATIVE REVIEW REQUIRED

CHICAGO BRIDGE AND IRON COMPANY
WELDING PROCEDURE SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

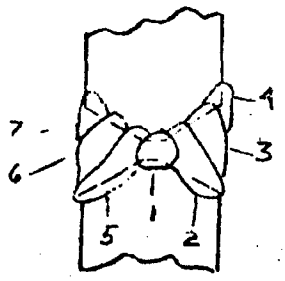
PART III NON-ESSENTIAL VARIABLES



VERTICAL

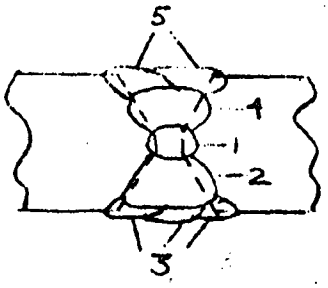
Layers 2 & 4
may be multipass

	LAYER NUMBER	WIRE SIZE	AMPS	BO Rate sec/12"
	1,3,5	1/8"ϕ	80-110	65-75
	2,4	5/32"ϕ	90-115	65-76



HORIZONTAL

	LAYER NUMBER	WIRE SIZE	AMPS	BO Rate sec/12"
	1,4,7	1/8"ϕ	80-95	65-75
	2,3,5,6	5/32"ϕ	95-120	60-70



OVERHEAD & DOWN

	LAYER NUMBER	WIRE SIZE	AMPS	BO Rate sec/12"
	1,3,5	1/8"ϕ	80-90	65-75
	2,4	5/32"ϕ	90-115	65-75

TENTATIVE REVIEW REQUIRED

Specification No. 914
Date December 10, 1968

CHICAGO BRIDGE & IRON COMPANY
By C. T. Randall

CHICAGO BRIDGE & IRON COMPANY
WELDING PROCEDURE SPECIFICATIONS
CONTRACT 71-2075~~76~~

Double Wall Liquid Propane Tank
Storage and Terminal Facilities
Petrolane, Inc.
Providence, Rhode Island
(PIPING SYSTEM)

PART I GENERAL

1. PROCESS:

The welding shall be accomplished by the Shielded Metal Arc and/or the Gas Tungston Arc Process.

2. BASE METAL, FILLER METAL AND WELDING SPECIFICATION NUMBERS:

The base metal and filler metal shall be in accordance with the Table.

Base Metal	Filler Metal	CB&I Specification No.
SA53, SA106B SA333 Gr.1 (ASME P-1 materials)	Linde Oxweld 65 W/Argon E7018	384
	Linde Oxweld 65 W/Argon	367

3. POSITION:

The welding shall be performed in the 2G and 5G positions.

4. PREPARATION OF BASE METAL:

The edges or surfaces of parts to be joined by welding shall be prepared by chipping, grinding, shearing, flame burning and/or arc gouging.

5. WELDING TECHNIQUE AND CURRENT:

The welding technique such as electrode sizes, mean voltages, currents, etc., shall be substantially as shown on the attached sketches and data sheets.

(PIPING SYSTEM)

6. CLEANING AND DEFECTS:

All slag or flux remaining on any bead of welding shall be removed before depositing the next successive bead of welding. Any defects that appear on any bead of welding shall be removed by chipping, grinding or arc gouging before depositing the next successive bead of welding.

7. PEENING:

In general, light peening shall be used as an aid to cleaning the weld beads.

8. TREATMENT OF BACKSIDE OF WELDING GROOVE:

None Required.

9. PREHEAT:

None Required.

10. POST WELD HEAT TREATMENT:

None Required.

11. INSPECTION OF WELDS:

Inspection of welds shall be in accordance with special instructions issued by the Engineering Department of Chicago Bridge & Iron Company.

CONTRACT 71-2075/76

CHICAGO BRIDGE AND IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 384 DATE February 19, 196

WELDING PROCESS TIG and Shielded Metal Arc MANUAL OR MACHINE Manual

MATERIAL SPECIFICATION A333 TO A333

ASME P-NO. 1 TO ASME P-NO. 1

FLUX OR ATMOSPHERE

FLUX TRADE NAME OR COMPOSITION -

THICKNESS (IF PIPE, DIA. AND WALL THICK.) 6"ϕ .280" thk. INERT GAS COMPOSITION Argon for TIG

THICKNESS RANGE THIS TEST QUALIFIES 1/16" to .560" TRADE NAME - FLOW RATE -

FILLER METAL GROUP NO. F 4 for E7018 IS BACKING STRIP USED? No

WELD METAL ANALYSIS NO. A 1 for E7018 PREHEAT TEMPERATURE RANGE None

ASTM SPECIFICATION NO. A233 (SFA5.1) POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Horizontal (2

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE Oxweld 65 (TIG) E7018 (Stick) FILLER WIRE DIAMETER 3/32"ϕ (TIG) 1/8"ϕ (E7018)

TYPE OF BACKING None WELDING CURRENT D.C. Straight Polarity (TIG)
D.C. Reverse Polarity (E7018)

CONSULT **PART III NON-ESSENTIAL VARIABLES** FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
503-2G-1	.761	.181	.138	9,050	65,600	Ductile in Pipe Mat'l.
503-2G-2	.764	.178	.136	9,100	66,900	Ductile in Pipe Mat'l.

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
2 Root Bends	Both OK	2 Face Bends	Both OK

WELDER'S NAME Marston Westfall SOCIAL SECURITY NO. 334-24-1731 WELDER'S SYMBOL

WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURERS) DATE February 19, 19

LABORATORY - TEST NO. 384/WO 503 BY A.N. Randall A.N.Randall

REMARKS: Impact Test Results:
Charpy Keyhole Specimens - Half Size
Test Temperature: -50°F
W.M. 32, 29, 28 ft.lbs.
H.A.Z. 28, 22, 28 ft.lbs.

WL 20D REV 10-64

TENTATIVE REVIEW REQUIRED

CONTRACT 71-2075/76

CHICAGO BRIDGE AND IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 384 DATE February 19, 196

WELDING PROCESS TIG and Shielded Metal Arc MANUAL OR MACHINE Manual

MATERIAL SPECIFICATION A333 TO A333

ASME P-NO. 1 TO ASME P-NO. 1

THICKNESS (IF PIPE, DIA. AND WALL THICK.) 6"ϕ .280" thk.

THICKNESS RANGE THIS TEST QUALIFIES 1/16" to .560"

FILLER METAL GROUP NO. F 4 for E7018

WELD METAL ANALYSIS NO. A 1 for E7018

ASTM SPECIFICATION NO. A233 (SFA5.1)

FLUX OR ATMOSPHERE

FLUX TRADE NAME OR COMPOSITION -

INERT GAS COMPOSITION Argon for TIG

TRADE NAME - FLOW RATE -

IS BACKING STRIP USED? No

PREHEAT TEMPERATURE RANGE None

POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Horizontal Fixed (5G)

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE Oxweld 65(TIG) E7018(Stick) FILLER WIRE DIAMETER 3/32"ϕ(TIG) 1/8"ϕ(E7018)

TYPE OF BACKING None WELDING CURRENT D.C.Straight Polarity(TIG) D.C.Reverse Polarity(E7018)

CONSULT PART III NON-ESSENTIAL VARIABLES FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD,LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
503-5G-1	.679	.217	.147	9,950	67,700	Ductile in pipe Mat'l.
503-5G-2	.679	.216	.147	10,025	68,200	Ductile in pipe Mat'l.

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
2 Root Bends	Both OK	2 Face Bends	Both OK

WELDER'S NAME Marston Westfall SOCIAL SECURITY NO 334-24-1731 WELDER'S SYMBOL

DO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURERS) DATE February 19, 1965

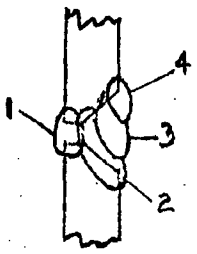
LABORATORY - TEST NO. 384/WO 503 BY A.N.Randall A.N.Randall

REMARKS: Impact Test Results:
Charpy Keyhole Specimens - Half Size
Test Temperature: -50°F
W.M. 23, 32, 24 ft.lbs.
H.A.Z. 28, 25, 29 ft.lbs.

TENTATIVE REVIEW REQUIRED

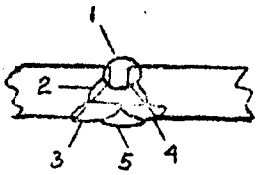
CHICAGO BRIDGE AND IRON COMPANY
WELDING PROCEDURE SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART III NON-ESSENTIAL VARIABLES



HORIZONTAL (2G)

	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
TIG	1	3/32"ϕ	165	15
E7018	2,3,4	1/8"ϕ	130	22-24



HORIZONTAL-FIXED (5G)

	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
TIG	1	3/32"ϕ	165	15
E7018	2,3,4,5	1/8"ϕ	130	22-24

	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS

TENTATIVE-REVIEW REQUIRED

Specification No. 384
Date February 19, 1964

CHICAGO BRIDGE & IRON COMPANY
By C. P. Randall

WL 20A

CHICAGO BRIDGE AND IRON COMPANY
RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 367 DATE December 18, 196
WELDING PROCESS Tungsten Inert Gas MANUAL OR MACHINE Manual
MATERIAL SPECIFICATION Similar A333 to Similar A333
ASME P-NO. 1 TO ASME P-NO. 1
THICKNESS (IF PIPE, DIA. AND WALL THICK.) 6"ϕ .280" thk.
THICKNESS RANGE THIS TEST QUALIFIES 1/16" to .560"
FILLER METAL GROUP NO. F
WELD METAL ANALYSIS NO. A 1
ASTM SPECIFICATION NO. A251 (SFA5.2)

FLUX OR ATMOSPHERE
FLUX TRADE NAME OR COMPOSITION -
INERT GAS COMPOSITION Argon
TRADE NAME - FLOW RATE 30-40 CF/hr
IS BACKING STRIP USED? No
PREHEAT TEMPERATURE RANGE None
POSTHEAT TREATMENT None

WELDING PROCEDURE
SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Horizontal 2

WELDING TECHNIQUE (FOR INFORMATION ONLY)
ELECTRODE Linde Oxweld 65 FILLER WIRE DIAMETER 3/32"ϕ
TYPE OF BACKING None WELDING CURRENT DC, Straight Polarity
CONSULT PART III NON-ESSENTIAL VARIABLES FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
502-2G-1	.645	.175	.113	7,450	65,900	Ductile in plate
502-2G-2	.670	.175	.117	7,100	60,700	Weld (non-fusion)

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
2 Root Bends	Both OK	2 Face Bends	Both OK

WELDER'S NAME Marston Westfall SOCIAL SECURITY NO. 334-24-1731 WELDER'S SYMBOL
WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURER) DATE 12-18-63
LABORATORY - TEST NO. 367-WO 502 BY A.N. Randall A.N.Randall

REMARKS:
Impact Test Results - Charpy Keyhole Specimens - Half Size
Test Temperature -50°F
Weld Metal 22, 26, 25 Heat Affected Zone 20, 27, 26

TENTATIVE-REVIEW REQUIRED

CHICAGO BRIDGE AND IRON COMPANY

RECORD OF WELDING PROCEDURE QUALIFICATION SPECIFICATION

TO A.S.M.E. SECTION IX LATEST EDITION

PART II ESSENTIAL VARIABLES

SPECIFICATION NO. 367 DATE December 18, 19

WELDING PROCESS Tungsten Inert Gas MANUAL OR MACHINE Manual

MATERIAL SPECIFICATION Similar A333 to Similar A333

ASME P-NO. 1 TO ASME P-NO. 1

THICKNESS (IF PIPE, DIA. AND WALL THICK.) 6"ϕ .280" thk.

THICKNESS RANGE THIS TEST QUALIFIES 1/16" to .560"

FILLER METAL GROUP NO. F

WELD METAL ANALYSIS NO. A 1

ASTM SPECIFICATION NO. A251 (SFA5.2)

FLUX OR ATMOSPHERE

FLUX TRADE NAME OR COMPOSITION -

INERT GAS COMPOSITION Argon

TRADE NAME - FLOW RATE 30-40 CF/hr.

IS BACKING STRIP USED? No

PREHEAT TEMPERATURE RANGE None

POSTHEAT TREATMENT None

WELDING PROCEDURE

SINGLE OR MULTIPLE PASS Multiple SINGLE OR MULTIPLE ARC Single POSITION OF GROOVE Horizontal Fixed 5G

WELDING TECHNIQUE (FOR INFORMATION ONLY)

ELECTRODE Linde Oxweld 65 FILLER WIRE DIAMETER 3/32"ϕ

TYPE OF BACKING None WELDING CURRENT DC, Straight Polarity

CONSULT PART III NON-ESSENTIAL VARIABLES FOR JOINT DIMENSIONS AND WELDING CURRENT SETTINGS.

TEST RESULTS

REDUCED SECTION TENSILE RESULTS

SPECIMEN NO.	DIMENSIONS		AREA	ULTIMATE TOTAL LOAD, LB.	ULTIMATE UNIT STRESS, PSI	CHARACTER OF FAILURE AND LOCATION
	WIDTH	THICKNESS				
502-5G-1	.662	.171	.114	7,600	66,500	Ductile in plate
502-5G-2	.661	.175	.116	7,750	66,800	Ductile in plate

GUIDED BEND TEST

TYPE	RESULT	TYPE	RESULT
2 Root Bends	Both OK	2 Face Bends	Both OK

WELDER'S NAME Marston Westfall SOCIAL SECURITY NO. 334-24-1731 WELDER'S SYMBOL

WHO BY VIRTUE OF THESE TESTS MEETS WELDER PERFORMANCE REQUIREMENTS.

WE CERTIFY THAT THE STATEMENTS IN THIS RECORD ARE CORRECT AND THAT THE TEST WELDS WERE PREPARED, WELDED AND TESTED IN ACCORDANCE WITH THE REQUIREMENTS OF SECTION IX OF THE ASME CODE.

SIGNED CHICAGO BRIDGE & IRON COMPANY (MANUFACTURERS) DATE 12-18-63

LABORATORY - TEST NO. 367-WO 502 BY A. N. Randall

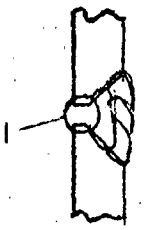
REMARKS:

Impact Test Results - Charpy Keyhole Specimens - Half Size
Test Temperature -50°F
Weld Metal 20, 22, 25 Heat Affected Zone 27, 28, 21

TENTATIVE REVIEW REQUIRED

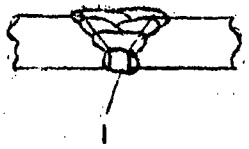
CHICAGO BRIDGE AND IRON COMPANY
WELDING PROCEDURE SPECIFICATION
TO A.S.M.E. SECTION IX LATEST EDITION

PART III NON-ESSENTIAL VARIABLES



HORIZONTAL (2G)

	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
	All	3/32"ϕ	170-180	



HORIZONTAL FIXED (5G)

	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS
	All	3/32"ϕ	170-180	

	LAYER NUMBER	WIRE SIZE	AMPS	VOLTS

TENTATIVE REVIEW REQUIRED

Specification No. 367
Date December 18, 1963

CHICAGO BRIDGE & IRON COMPANY
By A. N. Randall

WL DA

CERTIFICATE OF TESTS

CLASS | DIST. | CUST.

OUR ORDER NO.: THS 4713 | CUST. ORDER NO./DATE: 8453-1

ARMCO **Armco Steel Corporation**
P. O. Box 1367, Houston, Texas 77001

SHIPPED TO / SOLD TO

CHICAGO BRIDGE AND IRON CO.
P. O. BOX 40066
HOUSTON, TEXAS 77040

THE CHEMICAL, PHYSICAL OR MECHANICAL TESTS REPORTED HEREWITH ARE CORRECT AS CONTAINED IN THE RECORDS OF THE CORPORATION.

PREPAID - COLLECT	SHIPPED VIA / CAR INITIAL AND NO.	DATE MTR.	BY
	WM 2688	10-27-67	p 13

DATE SHIPPED	P.S. COMP.	SHIPPING LIST (RECAP) NO.	TARE	INSPECTION
10-13-67				

DESCRIPTION	TEST AND PI. NO.	NO. PCS.	YIELD POINT LBS./SQ. IN.	TENSILE LBS./SQ. IN.	% ELONG. 8"	BEND TEST	% ~~REDUCTION~~ Homogeneity	Full size charpy transv impacts v notch @ -75°f. 1	2	3	avg
ARMCO LOW TEMP PLATES FIREBOX QUALITY ASTM A-537-A TRANSV CHARPY V NOTCH PER CB&I STD 604-3 W/BASIC 15 FT LBS @ -75°F.											
HEAT 50737 .656" 115-7/8x390-3/16" NORMALIZING TEMP: 1650°F.	18t	1		74800		ok	ok	20	21	21	21
	b		54300	74500	29.0						
HEAT 16874 .656" 115-7/8x366-3/16" NORMALIZING TEMP: 1650°F.	3t	1		79000		ok	ok	30	34	35	33
	b		56700	79000	24.5						
HEAT 13675 .656" 115-7/8x366-3/16" NORMALIZING TEMP: 1650°F.	1t	1		78800		ok	ok	27	33	33	31
	b		58800	80400	26.0						
	2t	1		80400		ok	ok	22	25	27	25
	b		58600	79200	29.0						
HEAT 14089 .578" 115-7/8x366-3/16" NORMALIZING TEMP: 1650°F.	8t	1		77600		ok	ok	35	36	40	37
	b		55200	74700	30.0						
	6t	1		77000		ok	ok	29	35	36	33
	b		57900	75800	22.0						
	3t	1		77300		ok	ok	34	38	40	37
	b		53600	76400	28.0						
	7t	1		77600		ok	ok	22	27	28	26
	b		53900	77200	28.0						
	4t	1		77500		ok	ok	27	27	29	28
	b		54500	77000	29.0						
	11t	1		76700		ok	ok	32	32	34	33
	b		53700	76400	23.5						
HEAT 17273 .578" 115-7/8x366-3/16" NORMALIZING TEMP: 1650°F.	1t	1		80600		ok	ok	17	18	19	18
	b		57800	80400	28.0						

HEAT	C	MN	P	S	Si	CR	NI	MO	CU	TI	V	B	CB	AL
0737	.17	1.24	.010	.012	.24									
16874	.17	1.25	.012	.032	.36									
13675	.17	1.30	.012	.013	.34									
4089	.18	1.13	.015	.010	.31									
17273	.20	1.18	.025	.018	.27									

Cont on page 2

SIGNED _____ METALLURGICAL DEPT.

CERTIFICATE OF TESTS

CUST.

DATE | OUR ORDER NO. THS 4713 | CUST. ORDER NO./DATE

SHIPPED TO

- CHICAGO BRIDGE AND IRON
Page 2

SOLD TO

ARMCO Armco Steel Corporation
P. O. Box 1367, Houston, Texas 77001

THE CHEMICAL, PHYSICAL OR MECHANICAL TESTS REPORTED HEREWITH ARE CORRECT AS CONTAINED IN THE RECORDS OF THE CORPORATION.

PREPAID · COLLECT | SHIPPED VIA | CAR INITIAL AND NO. | DATE MTR. | BY

DATE SHIPPED | P.S. COMP. | SHIPPING LIST (RECAP) NO. | TARE | INSPECTION

DESCRIPTION	TEST AND PI. NO.	NO. PCS.	YIELD POINT LBS./ SQ. IN.	TENSILE LBS./ SQ. IN.	% ELONG. 8"	BEND TEST	% XXXXXX.	Full size charpy transv impacts v notch @		-75°f.	
SEE HEADING ON PAGE ONE.							Homo-geneity	1	2	3	avg
HEAT 18895 1/2" 115-7/8x366-3/16"	1t	1		81800		ok	ok	20	21	24	22
NORMALIZING TEMP: 1650°F.	b		61800	82500	24.5						
HEAT 17025 1/2" 115-7/8x366-3/16"	13t	1		77200		ok	ok	28	30	34	31
NORMALIZING TEMP: 1650°F.	b		55700	76600	27.0						
	11t	1		78600		ok	ok	18	21	23	21
	b		56900	78100	26.0						
	10t	1		78200		ok	ok	21	23	27	24
	b		59500	78000	28.0						
HEAT 17918 1/2" 115-7/8x366-3/16"	20t	1		77300		ok	ok	20	21	21	21
NORMALIZING TEMP: 1650°F.	b		56000	77700	28.0			3/4 size transv v notch		charpy	
HEAT 18019 5/16" 118-1/2x366-3/16"	1t	1		84200		ok	ok	18	19	20	19
NORMALIZING TEMP: 1650°F.	b		62000	84100	24.5						
	2t	1		84700		ok	ok	17	18	18	18
	b		62100	84300	25.5						
	3t	1		84900		ok	ok	17	17	18	17
	b		63000	84500	23.0						
HEAT 43594 5/16" 118-1/2x366-3/16"	39t	1		80200		ok	ok	18	20	20	19
NORMALIZING TEMP: 1650°F.	b		61000	79000	24.0						

HEAT	C	Mn	P	S	Si	Cr	Ni	Mo	Cu	Ti	V	B	Cb	Al
18895	.18	1.25	.017	.025	.27									
17025	.16	1.24	.012	.018	.38									
17918	.16	1.16	.013	.022	.35									
18019	.19	1.25	.016	.022	.34									
43594	.15	1.26	.012	.018	.37									

SIGNED [signature] METALLURGICAL DEPT.

CERTIFICATE OF TESTS

ST.	CLASS	TYPE	DIST.	CUST.		

OUR DATE	OUR ORDER NO.	CUST. ORDER NO./DATE
	THS 4713	8453-1

ARMCO **Armco Steel Corporation**
P. O. Box 1367, Houston, Texas 77001

SHIPPED TO

CHICAGO BRIDGE AND IRON CO.
P. O. BOX 40066
HOUSTON, TEXAS 77040

SOLD TO

THE CHEMICAL, PHYSICAL OR MECHANICAL TESTS REPORTED HEREWITH ARE CORRECT AS CONTAINED IN THE RECORDS OF THE CORPORATION.

PREPAID - COLLECT	SHIPPED VIA	CAR INITIAL AND NO.	DATE MTR.	BY
		SP 509253	10-16-67	p 12

TE SHIPPED	P.S. COMP.	SHIPPING LIST (RECAP) NO.	TARE	INSPECTION
10-11-67				

DESCRIPTION	TEST AND PI. NO.	NO. PCS.	YIELD POINT LBS./ SQ. IN.	TENSILE LBS./ SQ. IN.	% ELONG. 8"	BEND TEST	% XXXXXX Homo-geneity	Full size charpy transv impacts v notch @ -75°F. 1	2	3	AVG
ARMCO LO TEMP PLATES ASTM A-537-A FIREBOX QUALITY TRANSV CHARPY V NOTCH PER CB&I TD 604-3 W/BASIC 15 FT LBS @ -75°F.											
HEAT 18721 .656" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	3t	1		79700		ok	ok	23	28	30	27
	b		58300	79700	28.0						
HEAT 13675 .656" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	5t	1		79800		ok	ok	22	23	26	24
	b		58100	78500	28.0						
HEAT 54373 .656" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	11t	1		80100		ok	ok	32	33	38	34
	b		59400	79900	29.0						
HEAT 14089 .578" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	10t	1		77600		ok	ok	35	40	43	39
	b		53400	76900	28.5						
	5t	1		77000		ok	ok	35	36	38	36
	b		55200	77000	29.0						
HEAT 54373 1/2" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	12t	1		79400		ok	ok	17	19	19	18
	b		57500	79600	25.0						
	13t	1		80600		ok	ok	27	34	37	33
	b		58000	80400	27.0						
HEAT 17918 1/2" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	19t	1		77900		ok	ok	22	23	26	24
	b		58100	78300	27.0						

HEAT	C	Mn	P	S	Si	Cr	Ni	Mo	Cu	Ti	V	B	Cb	Al
18721	.16	1.35	.010	.017	.39									
13675	.17	1.30	.012	.013	.34									
54373	.18	1.16	.012	.016	.34									
14089	.18	1.13	.015	.010	.31									
17918	.16	1.16	.013	.020	.35									

Cont on page two

SIGNED [signature] METALLURGICAL DEPT.

CERTIFICATE OF TESTS

ST.	CLASS	TYPE	DIST.	CUST.		

OUR DATE	OUR ORDER NO.	CUST. ORDER NO./DATE
	THS 4713	

Armco Steel Corporation
P. O. Box 1367, Houston, Texas 77001

SHIPPED TO

CHICAGO BRIDGE AND IRON CO.
Page two

SOLD TO

THE CHEMICAL, PHYSICAL OR MECHANICAL TESTS REPORTED HEREWITH ARE CORRECT AS CONTAINED IN THE RECORDS OF THE CORPORATION.

PREPAID - COLLECT	SHIPPED VIA	CAR INITIAL AND NO.	DATE MTR.	BY

DATE SHIPPED	P.S. COMP.	SHIPPING LIST. (RECAP) NO.	TARE	INSPECTION

DESCRIPTION	TEST AND PI. NO.	NO. PCS.	YIELD POINT LBS./ SQ. IN.	TENSILE LBS./ SQ. IN.	% ELONG. 8"	BEND TEST	% XXXXXX	1	2	3	AV
SEE HEADING ON PAGE ONE.							Homo.				
HEAT 42200 1/2" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	15t	1		82500		ok	ok	30	31	32	31
	b		60200	81900	25.0						
HEAT 14089 .420" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	26t	1		78700		ok	ok	28	33	42	34
	b		56100	78500	27.0						
	27t	1		79000		ok	ok	40	40	40	40
	b		56400	78700	25.5						
	22t	1		78300		ok	ok	31	40	44	38
	b		57500	77600	26.0						
	24t	1		77100		ok	ok	30	31	31	31
	b		58100	77400	25.0						
	28t	1		78500		ok	ok	33	38	42	38
	b		57300	78400	27.0						
	21t	1		78600		ok	ok	30	31	32	31
	b		59800	78400	27.0						
	25t	1		78500		ok	ok	24	24	31	26
	b		57300	78700	23.0			3/4 size transv v		charpy notch	
HEAT 17281 .420" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	25t	1		84000		ok	ok	23	24	25	24
	b		62300	84100	24.0						
	24t	1		83700		ok	ok	25	25	25	25
	b		61100	83100	24.0						
HEAT 14089 .401" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	16t	1		77300		ok	ok	41	46	47	45
	b		57000	77700	28.0						
	19t	1		76800		ok	ok	40	44	51	45
	b		57200	75600	27.0						

HEAT	C	MN	P	S	Si	CR	Ni	Mo	Cu	Ti	V	B	CB	AL
42200	.19	1.27	.012	.020	.37									
17281	.18	1.34	.011	.021	.37									

ont on page three

R. L. Gist

CERTIFICATE OF TESTS

T.	CL.	DIST.	CUST.		
R DATE	OUR ORDER NO.		CUST. ORDER NO./DATE		
	THS 4713				

Armco Steel Corporation
P. O. Box 1367, Houston, Texas 77001

SHIPPED TO

CHICAGO BRIDGE AND IRON
Page three

SOLD TO

THE CHEMICAL, PHYSICAL OR MECHANICAL TESTS REPORTED HEREWITH ARE CORRECT AS CONTAINED IN THE RECORDS OF THE CORPORATION.

PAID - COLLECT	SHIPPED VIA	CAR INITIAL AND NO.	DATE MTR.	BY
DATE SHIPPED	P.S. COMP.	SHIPPING LIST (RECAP) NO.	TARE	INSPECTION

DESCRIPTION	TEST AND PI. NO.	NO. PCS.	YIELD POINT LBS./ SQ. IN.	TENSILE LBS./ SQ. IN.	% ELONG. 8"	BEND TEST	% XXXXXX	3/4 Size charpy impacts transv. 1	2	3	avg
SEE HEADING ON PAGE ONE.							Homo.				
EAT 14089 .401" 115-7/8x366-3/16" NORMALIZED @ 1650°F.	14t	1		78300		ok	ok	29	32	35	32
	b		57200	78100	26.0						
	12t	1		78200		ok	ok	28	30	49	36
	b		56100	78200	27.0						
	15t	1		77800		ok	ok	18	19	21	19
	b		56600	77600	30.5						
	18t	1		78400		ok	ok	30	34	39	34
	b		57400	78400	26.5						
EAT 18721 5/16" 118-1/2x 366-3/16" NORMALIZED @ 1650°F.	5t	1		79600		ok	ok	16	16	18	17
	b		58900	80000	23.0						
	6t	1		80900		ok	ok	18	20	21	20
	b		58500	80200	26.0						

HEAT	C	MN	P	S	Si	CR	Ni	Mo	CU	Ti	V	B	CB	AL

SIGNED [signature] METALLURGICAL DEPT.

CERTIFICATE OF TESTS

ST.	CLASS	TYPE	DIST.	CUST.		

OUR DATE	OUR ORDER NO.	CUST. ORDER NO./DATE
	HS 4714	8453 2

Armco Steel Corporation
P. O. Box 1367, Houston, Texas 77001

SHIPPED TO

SOLD TO

: CHICAGO BRIDGE AND IRON CO.
P O BOX 40066
HOUSTON, TEXAS 77040

THE CHEMICAL, PHYSICAL OR MECHANICAL TESTS REPORTED HEREWITH ARE CORRECT AS CONTAINED IN THE RECORDS OF THE CORPORATION.

PREPAID - COLLECT	SHIPPED VIA	CAR INITIAL AND NO.	DATE MTR.	BY
		SP 506582	1/10/68	lec 8

DATE SHIPPED	P.S. COMP.	SHIPPING LIST (RECAP) NO.	TARE	INSPECTION
1/8/68				HOMO- 1/4 SIZE

DESCRIPTION	TEST AND PI. NO.	NO. PCS.	YIELD POINT LBS./SQ. IN.	TENSILE LBS./SQ. IN.	% ELONG. 8"	BEND TEST	GENERALITY ~~HECXXX~~	TRANSVERSE CHARPY V NOTCH IMPACTS @ -40°F 1 2 3 AVG
H,R. CARBON STEEL PLATES FIREBOX QUALITY ASTM A 516 GR 60 .85/1.20 MANG TRANSVERSE CHARPY V NOTCH TESTS PER CB AND I STD 604-3 WITH BASIC 15 FT LB AT MINUS 40 DEG F API STD APPENDIX R MOD 3								
HEAT 46064 3/16" 90 x 357"	2T B	1	 56300	72600 71800	 23.0	OK	OK	11 12 12 12

HEAT	C	Mn	P	S	Si	Cr	Ni	Mo	Cu	Ti	V	B	Cb	Al
6064	.10	1.10	.010	.021	.22									

SIGNED R. L. Smith

TABLE 1 - DOUBLE WALL METAL LNG TANKS BUILT BY CB&I OR CB&I LICENSEES

NO. OF TANKS	DIMENSIONS DIAM.x HT. (Inner & Outer)	CAPACITY, EACH Liquid M Bbl	CAPACITY, EACH Equiv.Gas MMSCF	OWNER	LOCATION
1	142'ϕ x 105'7" 152'ϕ x 112''3"	290	1000	Atlanta Gas Light Co.	Riverdale, Georgia
1	184'ϕ x 132'3" 190'ϕ x 141'9"	600	2000	Distrigas Corp.	Everett, Massachusetts
2	182'ϕ x 56'11" 187'6"ϕ x 61'0"	290	1000	N.E.G.E.A.	Hopkinton, Massachusetts
2	142'ϕ x 107'0" 150'ϕ x 114'9"	290	1000	Peoples Gas Light & Coke Company	Fisher, Ill.
1	103'ϕ x 100'5" 111'ϕ x 107'0"	145	500	Iowa-Illinois Gas & Electric Company	Bettendorf, Iowa
1	76'ϕ x 74'11" 83'ϕ x 77'10"	58	200	Roanoke Gas Company	Roanoke, Virginia
1	130'ϕ x 100'0" 138'ϕ x 106'3"	225	775	Brockton Taunton Co.	Easton, Mass.
1	56'ϕ x 66'0" 66'ϕ x 70'10"	28.5	100	New Jersey Natural Gas Co.	Manahawkin, N.J.
1	150'ϕ x 125'0" 156'ϕ x 132'6"	374	1300	Distrigas Corp.	Everett, Mass.
1	150'ϕ x 111'4" 160'ϕ c 114'0"	350	1200	Philadelphia Electric Co.	West Conshocken, Penn.
1	146'ϕ x 105'0" 152'ϕ x 110'2"	331	1140	Boston Gas Company	Boston, Mass.
2	71'6"ϕ x 102'10" 79'6"ϕ x 108'0"	72	250	Baltimore Gas & Electric Co.	Baltimore, Maryland
1	35'4"ϕ Sphere 41'4"ϕ x 44'10"	4	14	Union Light Heat & Power Company	Erlanger, Ky.
1	48'3"ϕ Sphere 53'3"ϕ Sphere	10	35	Fort Hill Natural Gas Authority	Easley, So. Carolina
1	142'ϕ x 105'3" 149'ϕ x 109'3"	290	1000	Brooklyn Union Gas Company	Green Point, New York

TABLE 1 - DOUBLE WALL METAL LNG TANKS BUILT BY CB&I OR CB&I LICENSEES

No. OF TANKS	DIMENSIONS DIAM.x HT. (Inner & Outer)	CAPACITY, EACH Liquid M Bbl	Equiv.Gas MMSCF	OWNER	LOCATION
1	142'ϕ x 105'7" 152'ϕ x 112''3"	290	1000	Atlanta Gas Light Co.	Riverdale, Georgia
1	184'ϕ x 132'3" 190'ϕ x 141'9"	600	2000	Distrigas Corp.	Everett, Massachusetts
2	182'ϕ x 56'11" 187'6"ϕ x 61'0"	290	1000	N.E.G.E.A.	Hopkinton, Massachusetts
2	142'ϕ x 107'0" 150'ϕ x 114'9"	290	1000	Peoples Gas Light & Coke Company	Fisher, Ill.
4	103'ϕ x 100'5" 111'ϕ x 107'0"	145	500	Iowa-Illinois Gas & Electric Company	Bettendorf, Iowa
1	76'ϕ x 74'11" 83'ϕ x 77'10"	58	200	Roanoke Gas Company	Roanoke, Virginia
1	130'ϕ x 100'0" 138'ϕ x 106'3"	225	775	Brockton Taunton Co.	Easton, Mass.
1	56'ϕ x 66'0" 66'ϕ x 70'10"	28.5	100	New Jersey Natural Gas Co.	Manahawkin, N.J.
4	150'ϕ x 125'0" 156'ϕ x 132'6"	374	1300	Distrigas Corp.	Everett, Mass.
4	150'ϕ x 111'4" 160'ϕ c 114'0"	350	1200	Philadelphia Electric Co.	West Conshocken, Penn.
2	146'ϕ x 105'0" 152'ϕ x 110'2"	331	1140	Boston Gas Company	Boston, Mass.
2	71'6"ϕ x 102'10" 79'6"ϕ x 108'0"	72	250	Baltimore Gas & Electric Co.	Baltimore, Maryland
4	35'4"ϕ Sphere 41'4"ϕ x 44'10"	4	14	Union Light Heat & Power Company	Erlanger, Ky.
1	48'3"ϕ Sphere 53'3"ϕ Sphere	10	35	Fort Hill Natural Gas Authority	Easley, So. Carolina
1	142'ϕ x 105'3" 149'ϕ x 109'3"	290	1000	Brooklyn Union Gas Company	Green Point, New York

TABLE 1 - DOUBLE WALL METAL LNG TANKS BUILT BY CB&I OR CB&I LICENSEES

NO. OF TANKS	DIMENSIONS DIAM. x HT. (Inner & Outer)	CAPACITY, EACH Liquid M Bbl.	CAPACITY, EACH Equiv.Gas MMSCF	OWNER	LOCATION
1	118'ϕ x 91'0" 128'ϕ x 94'0"	175	600	Alabama Gas Corporation	Birmingham, Alabama
1	154'ϕ x 101'4" 160'ϕ x 105'5"	348	1200	San Diego Gas & Electric	Chula Vista, California
1	142'ϕ x 112'0" 151'ϕ x 114'9"	300	1000	Quebec Natural Gas	Montreal, Quebec
1	63'ϕ x 70'9" 73'ϕ x 74'0"	38	130	Northern States Power Company	LaCrosse, Wisconsin
1	78'ϕ x 93'5" 88'ϕ x 96'10"	79	270	Northern States Power Company	Eau Claire, Wisconsin
1	142'ϕ x 105'3" 149'ϕ x 109'5"	290	1000	Transcontinental Gas Pipe Line Co.	Carlstadt, New Jersey
3	142'ϕ x 80'3" 148'4"ϕ x 84'9"	225	775	Phillips Petroleum	Kenai, Alaska
1	142'ϕ x 105'3" 152'ϕ x 110'5"	300	1000	Boston Gas Company	Boston, Massachusetts
1	118'ϕ x 94' 128'ϕ x 95'2"	175	600	Northern & Central Gas Co. Ltd.	Hagar, Ontario
2	138'ϕ x 118' 144'ϕ x 123'0"	300	1035	Esso-Libya	Marsa el Brega, Libya
1	118'ϕ x 95'11" 128'ϕ x 98'1"	175	600	Northwest Natural Gas Co.	Portland, Oregon
1	118'ϕ x 91' 128'ϕ x 94'2"	175	600	Brooklyn Union Gas Company	Green Point, N.Y.
1	129'ϕ x 130'10" 137'ϕ x 135'	304	1050	Memphis Gas Division	Memphis, Tennessee
1	71'6"ϕ x 102'3" 81'6"ϕ x 105'6"	72	250	Wis.Natural Gas Company	Oak Creek, Wisconsin
1	111'ϕ x 98' 117'ϕ x 106'	175	600	San Diego Gas & Electric	Chula Vista, California
1	118'ϕ x 91' 128'ϕ x 94'2"	175	600	Alabama Gas Corp.	Birmingham, Alabama
1	67'ϕ x 56' 73'ϕ x 61'6"	35	120	Constock Liquid Methane Corp.	Lake Charles, Louisiana

TABLE 2 - REFRIGERATED LPG TANKS BUILT BY CB&I OR CB&I LICENSEES

NO. OF TANKS	DIMENSIONS	CAPACITY	OWNER	LOCATION
1	60'ϕ x 61'4"	35 MB	J.F.Pritchard & Company Illinois Power Company	Danville, Illinois
1	142'ϕ x 95'1" 146'ϕ x 95'6"	250 MB	VANGAS, Inc.	Elk Grove, Calif.
2	63'ϕ x 86'	45 MB	Bechtel/OX /Libya	Zueting, Libya
3	101'ϕ x 98'4"	135 MB	Hudson Eng./ Esso BHP	Long Island, Aust.
1	135'ϕ x 105'11"	250 MB	Sun Oil Co.	Bayo Grande, Venezuela
6	150'ϕ x 56'	165 MB	Iranian Oil Refining Co.	Bandor Mashur Iran
1		70 MB	British American O.I.	Montreal, Can.
1	79'ϕ x 68'	56 MB	Compania Shell de Venezuela	Puerto Miranda, Venezuela
1	111'ϕ x 70'1 115'ϕ x 71'7	120 MB	Gulf Oil	Puerta La Cruz, Venez.
1	63'ϕ x 82'3	47 MB	Applied Eng.	Northfolk, Va.
1	148'ϕ x 75'9 152'ϕ x 81'	250 MB	Tidewater Oil Company	Avon, Calif.
1	63'ϕ x 48' 68'ϕ x 50'2	26 MB	Esso	Trecate, Italy
1	78'ϕ x 48' 83'ϕ x 50'	40 MB	Esso	Trecate, Italy
1	124'ϕ x 56'6" 129'ϕ x 58'11"	120 MB	Northern States Power Company	Wescott, Minn.
2	125'ϕ x 48	103 MB	Hudson Eng.	Brooker, Fla.
1	101'2"ϕ x 84' 106'2"ϕ x 86'4"	120 MB	Minneapolis Gas Company	Minneapolis, Minn.

TABLE 2 - REFRIGERATED LPG TANKS BUILT BY CB&I OR CB&I LICENSEES

NO. OF TANKS	DIMENSIONS	CAPACITY	OWNER	LOCATION
3	108'ϕ x 49'	80 MB	ARAMCO	Ras Tanura, Saudi, Arabia
1	94'8"ϕ x 80' 99'8"ϕ x 82'3	100 MB	Kuwait Oil Company	Kuwait
5	70'ϕ x 40'	27 MB	Atlanta Gas Light	Riverdale, Georgia
1	33'8"ϕ x 44'8" 35'8"ϕ x 46'5"	7 MB	Chattanooga Gas Company	Chattanooga, Tenn.
2	86'10"ϕ x 100'0"	105 MB	Esso Pet. Co.	Fawley, Eng.
2	63'0"ϕ x 82'7"	45 MB	Shell Curacao, N.V.	Curacao, N.A.
1	104'ϕ x 80'0" 109'ϕ x 82'2"	120 MB	Kuwait Oil Co.	Kuwait
1	190'ϕ x 80'	400 MB	ARAMCO	Safaniva, Saudi Arabia
2	126'ϕ x 79' 130'ϕ x 81'	175'ϕ	Transmountain Oil Pipeline Company	Vancouver, B.C.
1	93'6"ϕ x 53'6"	65 MB	Montecatini, Edison	Priolo, Sicily
2	135'ϕ x 50'	240 MB	Esso Nederland	Botlek, Holland
3	79'ϕ x 62'7" 83'ϕ x 62'7"	50 MB	Fluor Common-wealth	Penuelas, Puerto Rico
3	101'ϕ x 98'4"	135 MB	Hudson Eng. for Esso BHP	Long Island, Australia