



REPAIR PROCEDURES : THE GOOD, THE BAD, AND THE UGLY

BILL KITTERMAN

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



INTRODUCTION TO BREMCO

- COMPANY STARTED IN 1976
- HAVE BEEN WORKING IN THE HRSG MARKET SINCE 1993
- ONE OF THE FIRST COMPANY'S TO HAVE THE ABILITY TO FIELD WELD "2205"
- SIGNIFICANT EXPERIENCE IN "91"
- NOW PART OF THE SVI INDUSTRIAL FAMILY AND LEVERAGING SYNERGIES TO PROVIDE TURNKEY PRODUCTS AND SERVICES ENGINEERED TO SUPPORT GAS PLANT OUTAGE WORK INCLUDING:
 - • GAS PATH UPGRADES (LINERS, PLENUMS, SILENCERS, STACKS)
 - • HRSG PRESSURE PART REPAIR AND REPLACEMENT INCLUDING P/T 91, 22 AND 11
 - • HRSG PIPING AND VALVE SERVICE
 - • HRSG CATALYST REPLACEMENT AND SCR UPGRADES
 - • INSTALLATION OF PENETRATION SEALS, STACK DAMPERS AND DUCT BURNERS

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

2

TUBE LEAK



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

TUBE LEAK II



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

THE GOOD



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

6/28/2022

Bremco Inc, HRSG Forum July 2021

THE BAD



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

THE UGLY



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

THE UGLIER



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

THE UGLIEST



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



TUBE TO HEADER WELD DESIGNS

- STICK THRU WITH “J” BEVEL
- SOCKET SET
- SIDE STICK THRU
- SET ON
- SPOT FACE SET ON
- EXTRUDED HEADER

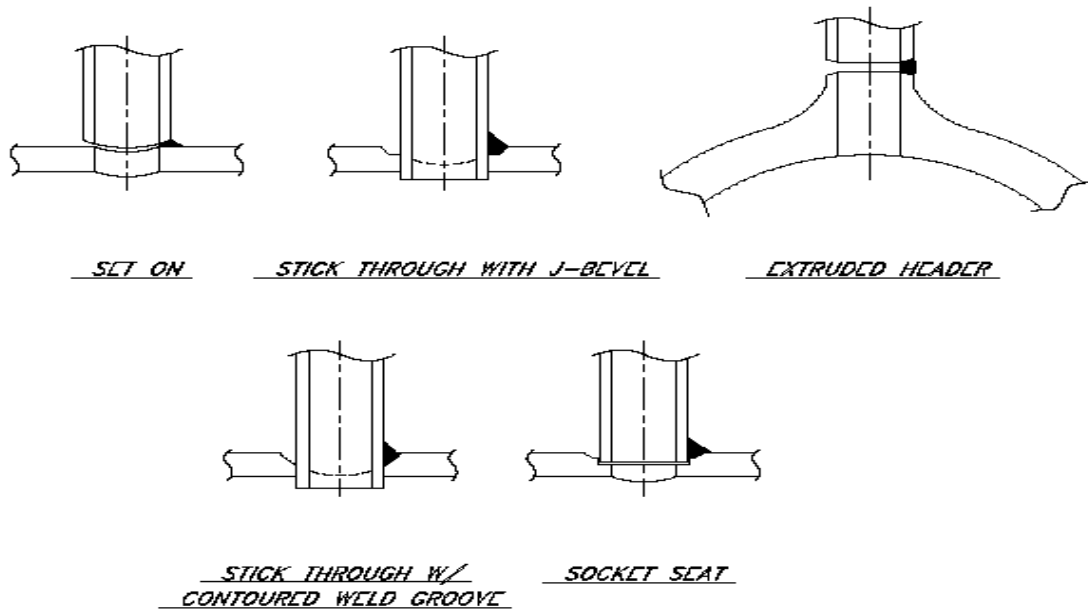
Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

TUBE TO HEADER WELDS



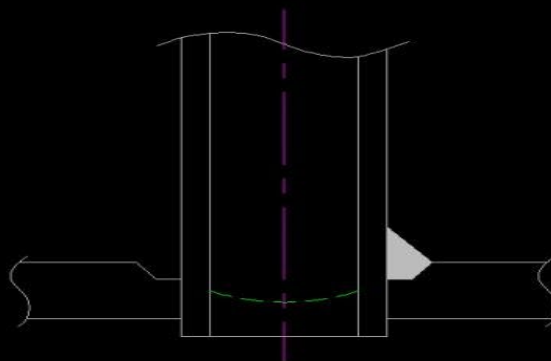
Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

“J” BEVEL



STICK THROUGH WITH J-BEVEL

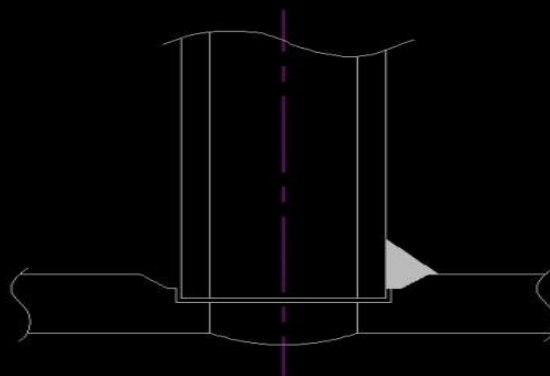
Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

SOCKET SET



SOCKET SEAT

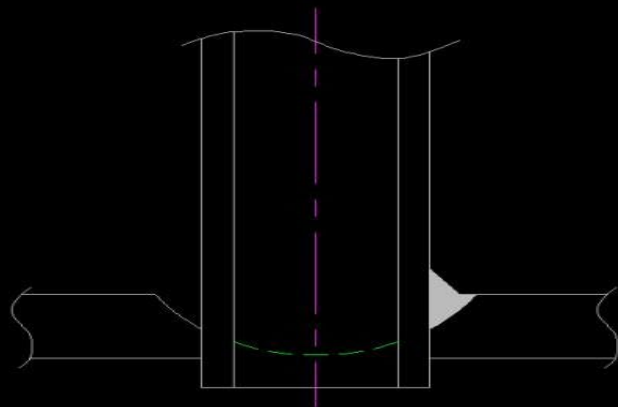
Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

STICK THROUGH



STICK THROUGH W/
CONTOURED WELD GROOVE

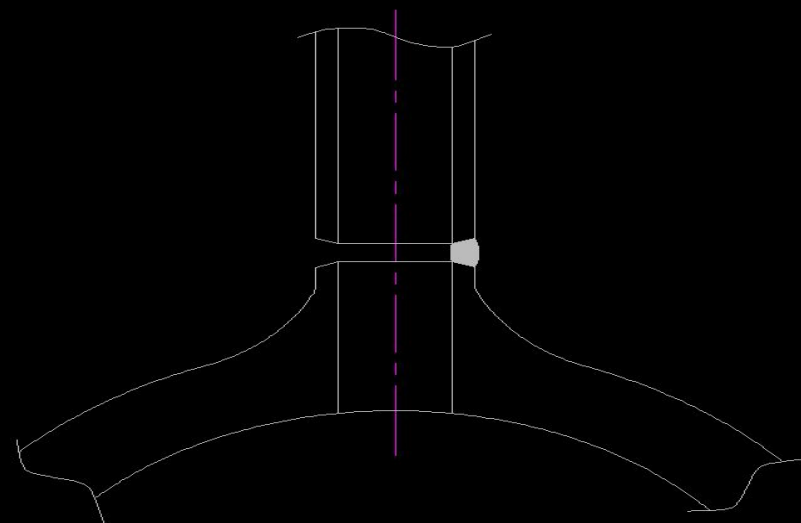
Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

EXTRUDED HEADER



EXTRUDED HEADER

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

TEST JIG



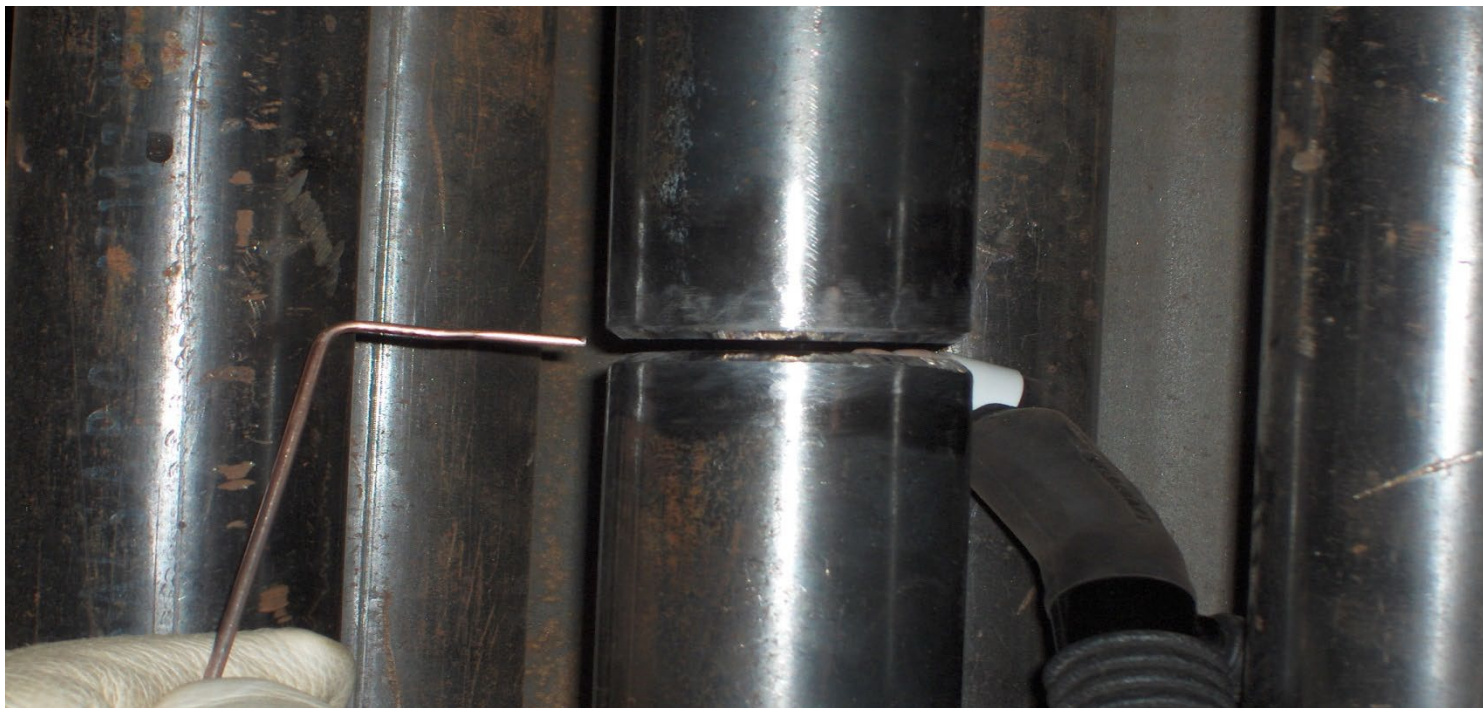
Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

MIRROR TEST



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



FINDING THE LEAK

- WHAT SECTION OF UNIT ?
- UPPER, LOWER, OR ELSEWHERE
- TUBE TO HEADER WELD
- HEADER LOCATION (IN A BUNDLE OR OPEN)

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



CODE REPAIR CONCERNS

- NATIONAL BOARD
- STATE OR LOCAL JURISDICTIONS
- AI (AUTHORIZED INSPECTOR)
- INSURANCE REQUIREMENTS

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



IDENTIFYING REPAIR METHODS

- RAISE, LOWER PANEL (HARPS)
- JACK PANELS APART
- CUT YOUR WAY IN WELD YOUR WAY OUT
- PLUGGING

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



RAISING\LOWERING PANELS

- CUTTING JUMPER PIPING, DRAINS, ETC
- RESTRAINTS
- STRESS RELIVING (IF NECESSARY)
- RIGGING

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

RAISING PANEL FOR TUBE REPAIR



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

JUMPER PIPING



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



JACKING PANELS

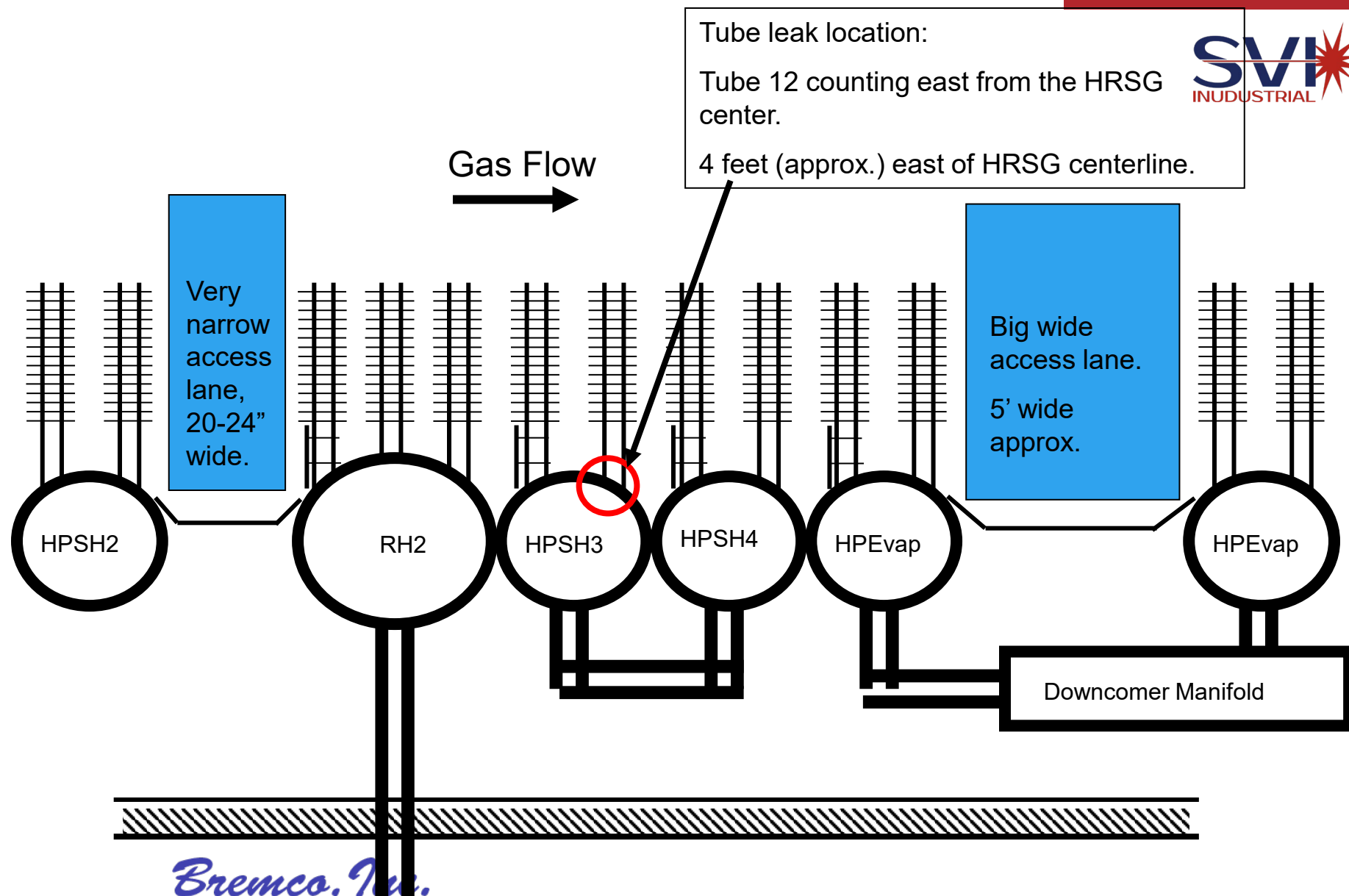
- CUTTING RESTRAINTS
- CUTTING DRAINS
- BLOCKING

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

*Bremco, Inc.*

JACKING PANELS



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



CUT YOUR WAY IN WELD YOUR WAY OUT

- AMOUNT OF TUBES NEEDED TO BE CUT OUT
- TUBE STOCK AVAILABILITY

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

TUBE PREP REPLACEMENT



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

COMPLETED TUBE REPLACEMENT



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



PLUGGING

- IN OUR EYES LEAST DESIRABLE METHOD
- STRONG CODE INVOLVEMENT
- HIGHEST SKILL LEVEL NEEDED
- STRONG POTENTIAL FOR STRESS RELIVING IN 2 AREAS (UPPER AND LOWER HEADERS)

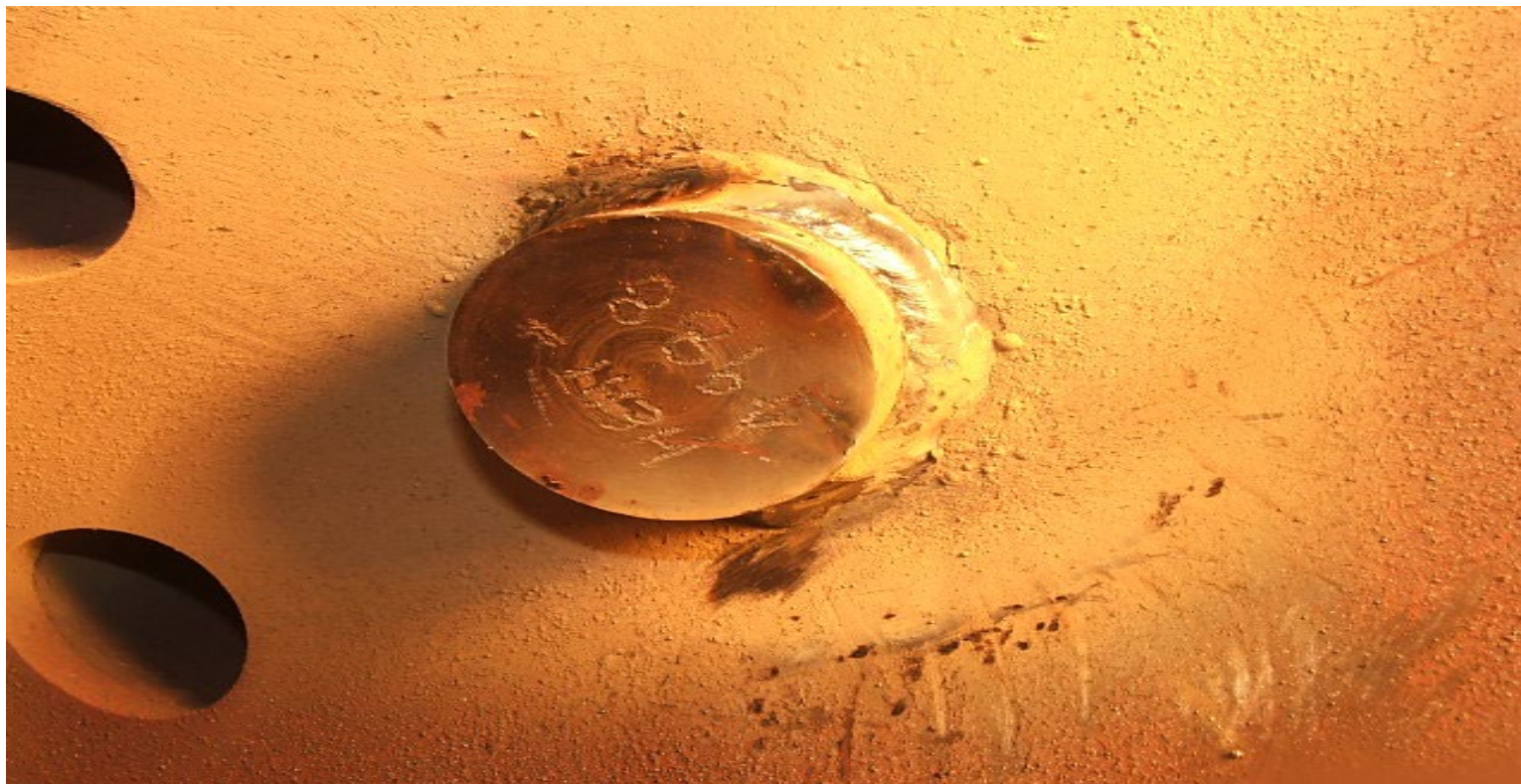
Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

TUBE PLUG THRU HEADER



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

COMPLETED HEADER TUBE PLUG



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



FERRITIC TUBE REPAIRS

- TRIALS AND TRIBULATIONS
- UNDERSTANDING “TRUE” DOWN TIMES
- WELDING DIFFERENCES
- REQUIREMENTS

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

CODE REQUIREMENTS STRESS RELIEVING

2004 SECTION I

TABLE PW-39

MANDATORY REQUIREMENTS FOR POSTWELD HEAT TREATMENT OF PRESSURE PARTS AND ATTACHMENTS (CONT'D)

Material	Minimum Holding Temperature, °F (°C)	Minimum Holding Time at Normal Temperature for Weld Thickness (Nominal)		
		Up to 2 in. (50 mm)	Over 2 in. (50 mm) to 5 in. (125 mm)	Over 5 in. (125 mm)
P-No. 5A Group No. 1 and P-No. 5B Group No. 1	1,250 (675)	1 hr/in. (2 min/mm), 15 min minimum	1 hr/in. (2 min/mm)	5 hr plus 15 min for each additional inch (25 mm) over 5 in. (125 mm)

NOTES:

- (1) Postweld heat treatment is not mandatory under the following conditions:
 - (a) for circumferential butt welds in pressure parts with all of the following conditions:
 - (1) a maximum specified chromium content of 3.0%
 - (2) DELETED
 - (3) a maximum thickness of $\frac{3}{8}$ in. (16 mm)
 - (4) a maximum specified carbon content (SA material specification carbon content, except when further limited by the Purchaser to a value within the specification limits) of not more than 0.15%
 - (5) a minimum preheat of 300°F (150°C)
 - (b) for fillet welds used on socket welding fittings conforming to the rules of PW-41, when the following conditions are met:
 - (1) a maximum specified chromium content of 3.0%
 - (2) a fillet weld throat thickness of $\frac{1}{2}$ in. (13 mm) or less, regardless of base metal thickness
 - (3) a maximum specified carbon content (SA material specification carbon content, except when further limited by the Purchaser to a value within the specification limits) of not more than 0.15%
 - (4) a minimum preheat of 300°F (150°C)
 - (c) for pipe and tube materials meeting the requirements of (a)(1), (a)(3), and (a)(4) above having fillet welds attaching nonpressure parts to them, provided the fillet weld has a throat thickness of $\frac{1}{2}$ in. (13 mm) or less and the material is preheated to 300°F (150°C) minimum; or combination groove and fillet welds attaching nonpressure parts to pressure parts, with a weld thickness of $\frac{1}{2}$ in. (13 mm) or less, and the material is preheated to a minimum of 300°F (150°C); or heat-absorbing surfaces and non-load-carrying studs attached to them, provided the material is preheated to 300°F (150°C) minimum. A lower preheating temperature may be used, provided specifically controlled procedures necessary to produce sound joints are used. Such procedures shall include but shall not be limited to the following:
 - (1) the maximum throat thickness of fillet welds shall be $\frac{1}{2}$ in. (13 mm)
 - (2) the maximum continuous length of fillet welds shall be not over 4 in. (100 mm)
 - (3) electrodes or filler metal shall be dry and shall provide a low-hydrogen weld deposit. Chromium-molybdenum filler metals shall have a maximum specified chromium content of not more than 2.50% and a maximum specified carbon content of not more than 0.05%
 - (4) the thickness of the test plate used in making the welding procedure qualification of Section IX shall not be less than that of the material to be welded
 - (d) for tubes or pressure retaining handhole and inspection plugs or fittings with a specified maximum chromium content of 6% that are secured by physical means (rolling, shoulder construction, machine threads, etc.) and seal welded, provided the seal weld has a throat thickness of $\frac{1}{2}$ in. (10 mm) or less, and preheat to a minimum temperature of 300°F (150°C) is applied when the thickness of either part exceeds $\frac{1}{2}$ in. (16 mm)
- (2) Postweld heat treatment is not mandatory for electric resistance welds used to attach extended heat-absorbing fins to pipe and tube materials, provided the following requirements are met:
 - (a) a maximum pipe or tube size of NPS 4 (DN 100)
 - (b) a maximum specified carbon content (SA material specification carbon content, except when further limited by the Purchaser to a value within the specification limits) of not more than 0.15%
 - (c) a maximum fin thickness of $\frac{1}{4}$ in. (3 mm)
 - (d) prior to using the welding procedure, the Manufacturer shall demonstrate that the heat affected zone does not encroach upon the minimum wall thickness
- (3) Note (1) does not apply to welds using the inertia and continuous drive friction welding processes. Postweld heat treatment is mandatory for all thicknesses of materials welded using inertia and continuous drive friction welding.

P/T 91

- BREMCO HAS MODIFIED IT'S 91 PROCEDURE 4 TIMES SINCE OUR INITIAL QUALIFICATION
 - MODIFICATIONS INCLUDED PRE-HEAT AND POST WELD HEAT TREAT REQUIREMENTS
 - TIGHTENING WELD WIRE REQUIREMENTS

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

35

KEY 91 WELD FEATURES

- PREHEAT TEMP 400 F (275 C)
- WRAPPING
- PROPER ROD SELECTION
- MAINTAIN INTERPASS TEMP
- POST WELD HEAT TREAT 1350 F – 1375 F (732 C-746 C)
- CONTROLLED COOL DOWN

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

36



HEAT TREAT/ STRESS RELIEVING

- UNDERSTAND AND MEET D-10.10 REQUIREMENTS
- ABILITY TO PROVIDE WRAP SPECS WITH DRAWINGS
- ABILITY TO MONITOR AND “FIX” AS NEEDED ON A 24 HOUR BASIS
- PROVIDE “TRUE” HEAT TREAT CHARTS
- BREMCO REQUIRES HT CONTRACTORS TO HAVE THE ABILITY TO PERFORM HARDNESS TESTING (BOTH PRE AND POST HEAT TREATMENT

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

37

CUTTING YOUR WAY IN



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

38

WELDING WAY OUT



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

39

POST WELD HEAT TREAT



Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

40



WELDING METHOD 6

- ALLOWS REPAIRS WITHOUT PWHT
- CAN BE USED FOR TUBES ONLY UP TO 13MM (.5") THICKNESS
- BUTT WELDS ONLY
- MINIMUM PREHEAT TEMP GTAW 100 C (200 F) SMAW 150 C (300F)
- FILLER METAL NEEDS TO BE AUSTENITIC NICKEL-BASED F-NO 43 AND MARTENSITIC IRON-BASED F-NO 4 OR F-NO 6 WITH SPECIFIC CONSUMABLES

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

41



SUPPLEMENT 8

- ALLOWS FOR REPAIRS WITHOUT PWHT
- CAN BE USED FOR THICKER PRESSURE PARTS HEADERS ETC
- WELD METAL AND PROCESSES MUST MEET THE SUPPLEMENT REQUIREMENTS AND WELDING TECHNIQUE
- MINIMUM PREHEAT IS 150C (300F)
- REQUIRES DOCUMENTED INSPECTION INTERVALS

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

42



REQUIREMENT BY NBIC

- R FORM, R1, R2 HOWEVER
- LARGE AMOUNT ON INFORMATION CAN BE GAINED FROM A “TRUE” CODE PACKAGE

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

43



STANDARD CODE PACKAGE

- JOB TRAVELER
- ITEM DATA REPORT (P3,P4,P6,U1A FORMS ETC.)
- WELD PROCEDURE
- WELDER QUALIFICATIONS WITH SUPPORTING CONTINUITY LOG.
- MATERIAL RECEIVING REPORT
- MAPPING AND/OR PHOTO DOCUMENTATION.
- PRESSURE TEST RECORD
- R-1, R-2 FORM

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022



THANK YOU FOR YOUR TIME

- BILL KITTERMAN
- BREMCO INC
- BKITTERMAN@BREMCO.COM

Bremco, Inc.

INDUSTRIAL CONTRACTORS FOR YOUR POWER GENERATION NEEDS
An SVI Industrial Company

Bremco Inc, HRSG Forum July 2021

6/28/2022

45